



May 2017

ESKOM HOLDINGS SOC

Tutuka Ash Disposal Facility Extension Geotechnical Investigation Report

Submitted to:

Elijah Kisaame
EDWL & LDE: Civil
Dams, Waterways & Hydro Design CoE
Plant Engineering | Group Technology
Megawatt Park
Sunninghill
Building B, 2nd Floor

REPORT



Report Number: 1658666-310335-1

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1.0 INTRODUCTION

Golder Associates Africa (Pty) Ltd (Golder) was appointed by Zitholele Consulting (Pty) Ltd (Zitholele) to subcontract for the geotechnical investigation for the assessment of the feasibility of the proposed ground locations as a new Ash Disposal Facility (ADF) at the Tutuka Power Station (TPS) near Standerton town; eMalahleni Province – Eskom Project Reference 684 – Tutuka Ash Dump Increase Project.

The significance of the geotechnical investigation owes to its findings which shall be integrated as part of the basic design of the ADF at the proposed area at the Tutuka Power Station. The areas where the associate structures of the ADF were also evaluated to inform the design and construction. These include:

- New Ash Disposal Facility;
- Pollution Control Dam (2); and
- Runoff Return Dam (1).

1.1 Project Background

Tutuka Power Station is a six unit coal fired power plant that produces a total of 3654 MW of electricity. The first unit was connected to the national grid in 1985 and the last unit was connected in 1990. Tutuka Power Station has been in operation for a period of 30 years and it disposes of burnt boiler Ash in a dry format by means of conveyors and spreaders at the Ash Disposal Facility.

The Power Station is facing a problem of depleting ashing space and the existing area where the ash is currently dumped is not lined. The new Environmental Legislation now requires Eskom to provide a liner to avoid pollution of the ground water. The station applied for a period of 4 years from 2016 - 2019 to continue dumping Ash without a liner, while the design and construction of the facilities take place.

Tutuka Ash dump Volume Increase Project has to follow the formal Project Life Cycle Model (PLCM) to achieve the project objective of extending the Ash dump space and provide an Ash dump liner.

As part of the Environmental Impact Assessment (EIA) process a concept design was completed. The basic and detail design of the civil works which must be done in the (Definition Review Approval) DRA phase of the project. Construction of the works will be covered in the (Execution Review Approval) ERA phase.

1.2 Project Objectives

The objectives of the geotechnical investigation are as follows:

- Conduct geotechnical investigations of the subsurface soil and rock conditions within the depth limit of the field investigation;
- Provide information on the nature, distribution and engineering properties of the sub-surface soils and/or rocks, within the depth limitations of the field investigations, as they affect the proposed key infrastructure items;
- Assess the ground conditions and suitability of the in situ soils/rock in respect of founding for the proposed infrastructure;
- Assess shallow groundwater conditions encountered during the investigation and their potential engineering impact on the proposed development;
- Review and evaluate all of the field and laboratory test data, and provide the soil parameters, construction material properties and general founding recommendations over key structures; and
- Provide comment on suitability of the on-site materials for use during construction.



1.3 Previous Studies

The following reports were provided to Golder for the purposes of the background data:

- Tutuka Power Station Ash Disposal Operating Manual, Report MI.3155, prepared by Steffen, Robertson and Kirsten (SRK) in November 1984;
- Report on the Probability of Side Slope Failure of the Dry Ash Dump, Report Number: 225906/1 prepared by Steffen, Robertson and Kirsten (SRK) in December 1996;
- Hydrology and Geohydrology of the Ash Dump, Report Number: RVN/2/14 Tutuka Power Station, prepared by Rudolph, Van Niekerk and Associates in October 1993.

2.0 SITE DESCRIPTION

2.1 Location and Access

The investigated area at the Tutuka Power Station (Eskom) is located at approximately 21 km north-east of Standerton town; eMalahleni province. The absolute location of the site can be referenced from coordinates - 26.7852205°S; 29.3975115°E. Accessibility to the site can be gained along road R546 which adjoins to N3 via R23. A site locality plan is presented in APPENDIX A.

2.2 Topography and Drainage

The site is generally characterised by a slightly undulating topographical profile in which the surface elevations range between 1600 masl to 1640 masl and has an average surface slope of 2%. The site also comprises of a gully channel and numerous water containment dam structures, particular towards the south (see locality map; APPENDIX A). Generally, the site is characterised by a poor surface drainage due to the enveloping clay soil mixtures.

2.3 Climate

The investigated area has a subtropical climate; wherein the summer seasons are characterised by hot, humid and wet weather conditions whilst the winter seasons experience low temperatures and dry conditions. The average annual temperature is ~20 °C and approximately 740 mm precipitation falls annually. Monthly precipitation and temperature levels reach their peak in the December/January at approximately 130 mm, whilst June has the driest and coldest conditions. The winds are usually north-westerly; are gusty and strong during thunderstorms which are frequent between October and March. There is normally an intense fog weather conditions between March and August.

2.4 Geology

According to Map 2628 East Rand 1:250 000 scale geological sheet, the regional lithostratigraphy in reference to the Tutuka Power Station is defined by the Permian-age Vryheid Formation, Ecca Group; Karoo Super group. The constituents of these sedimentary formations are described as fine to coarse grained sandstone, shale and coal seams. The Vryheid formation was intruded by Karoo Dolerite of Jurassic age. This is described as a network of dolerite sills, sheets and dykes. As can be seen from the Geology map; APPENDIX A, dolerite sills are spread over the site, though concentrated toward the south and central portions of the site, whilst the Vryheid formation surrounds the dolerite.

3.0 FIELD INVESTIGATION

3.1 Overview

The geotechnical field investigation was conducted between the 10th of November 2016 and 24th November 2016. The scope of work included:

- Test-pitting by means of TLB over the footprint of the proposed site in order to assess the ground profile;



- Rotary core drilling at three selected positions on the footprint of the proposed ash disposal facility as well as wash-boreholes at five positions on the existing ash disposal facility. The boreholes on natural ground were advanced into competent material and were used to collect core samples, as well as collect undisturbed Shelby Tube samples and conduct Standard Penetration Tests (SPT's);
- Soil profiling of pits and logging of borehole core was conducted by specialist engineering geologists, using Southern African profiling guidelines, and representative samples of the soils were collected for laboratory testing;
- Field testing using a Dynamic Probe Super Heavy (DPSH) rig and Dynamic Cone Penetrometer (DCP) over the footprint of the sites in order to determine the machine refusal depth and infer the subsoil consistency; and
- Laboratory testing of selected samples to determine the general engineering properties of significant horizons in the ground profile succession.

Geopractica (Pty) Ltd were the subcontracted for the test pits (TLB), drilling of the boreholes on site as well as for conducting the DPSH testing.

3.2 Rotary Core Drilling

Three boreholes, numbered BH01, BH02, and BH03, were drilled using the rotary core drilling technique and HQ sized coring equipment at the footprint of the proposed ash dump. Five borehole positions were washed at the existing ash dump facility. Standard Penetration Tests (SPT's) were performed in order to determine the in-situ material consistency/density. Shelby's were also collected for laboratory tests. These were mainly focused at the proposed ash dump although an SPT was also conducted at BH05 at a specific depth (24 m).

The core retrieved was profiled by an Engineering Geologist according to the Guidelines for Soil and Rock Logging in South Africa, (Brink, A.B.A and Bruin, R.M.H, 2002) and the samples retrieved from the SPT testing were profiled according to the prescribed terminology of Jennings *et al.*, (1973).

A test location plan is presented in APPENDIX A. Summary tables are presented in APPENDIX B, whilst the borehole profiles are presented in APPENDIX C.

3.3 Test Pits

Test pitting was undertaken between 10th of November 2016 and the 24th of November 2016 by means of a Tractor Loader Backhoe (TLB) in order to determine the ground conditions within the depth limit of the investigation.

These were excavated to the depth limit of the machine and in accordance with Golder Health and Safety requirements. No test pits deeper than 1.2m were entered for profiling, unless appropriately battered back to a safe angle. The test pits were excavated to 1.2m entered into and profiled in-situ by a geotechnical specialist and then excavated further to their full depth and profiled from spoil thereafter. The positions of all test pits were recorded using either a Garmin eTrex20 hand held GPS, accurate to within about 5m horizontally.

A test location plan is presented in APPENDIX A, whilst the test pit profiles are presented in APPENDIX C.

3.4 Dynamic Probe Super-Heavy (DPSH) Testing

The fieldwork also included Dynamic Probe Super Heavy (DPSH) testing and Dynamic Cone Penetrometers (DCP's) to ascertain and complement the consistency determined from soil profiling of the test pits.

The DPSH utilises a 63.5 kg hammer which is repeatedly dropped over a distance of 760 mm along a guide rail onto an anvil, driving a string of rods with a cone attached at the end. The cone has a diameter of 50.5mm and an apex angle of 60 °. A total of forty-four (No.44) DPSH tests were performed across the footprint of the ADF and four (No.4) within the runoff return dam area.



The number of blow counts per 30 cm intervals was then used to empirically derive the in-situ SPT 'N' value and consistency. The test results were used to determine the in-situ consistencies of the subsoil materials and also assist when determining the excavatability of the in-situ material. In order to ascertain a better relationship between the DPSH penetration rates and the in-situ subsoil consistency, the DPSH N counts were converted to Equivalent SPT N values, after the equation by (MacRobert C., Kalumba D. and Beales P., 2011):

$$\text{Equivalent SPT } N = \frac{N30SB}{0.02 \times N30SB + 0.8}$$

The DPSH test results are presented in APPENDIX D.

3.5 Dynamic Cone Penetration (DCP) Tests

The in-situ DCP tests were included as part of the field investigation and were conducted adjacent to the corresponding test pits. This in-situ test use an 8 kg hammer drop from height of 575 mm and blow counts which were recorded.

Twelve DCP tests were conducted on site; this data was generated within the ADF to measure the bearing capacity and ascertain the consistency of the soil materials as described from test pitting.

3.6 Piezometers and Thermal Sensors

Piezometers were installed in all of the boreholes drilled, at the bottom of each borehole. The purpose of the installations was to measure the perched water-table and the permeability of the in-situ materials. In addition, thermal heat sensors were installed to measure the heat/temperatures of the ash deposits at specific depth. The table below shows the depth where these were installed.

Table 1: Depth of Installations for Thermal Sensors

Borehole Name	Sensor Depth (m)
BH01	13.2
BH02	20.4
BH03	23.0
BH04	23.0
BH05	23.0
BH05	28.0

4.0 GENERAL ASSESSMENT OF GROUND CONDITIONS

4.1 Site Soils

4.1.1 Topsoil / Alluvium

Transported Topsoil/ Alluvium was encountered in 62 % of the test pits. The average thickness of the topsoil is 0.4 m and its geotechnical character generally describes as:

- Slightly moist, dark brown/grey, soft, slightly-medium shattered silty CLAY.

A soil horizon table indicating the depth to base of each of the horizons described is presented in APPENDIX B.



4.1.2 Sheetwash

Transported Sheetwash was encountered in 84 % of the test pits. This is a fine grained transported colluvial material typically underlying the topsoil and with a thickness commonly of 0.6 m. Its material properties may generally be described as follows:

- Slightly moist to moist, (dark) olive, soft to firm, medium shattered, silty CLAY. These soil horizons are cohesive and often characterised by slicken sided structures.

4.1.3 Residual Shale, Residual Sandstone and Residual Dolerite

The soil horizons mark the transitions between the transported soils and the underlying in situ soil material, comprised of decomposed rocks. They are cohesive in nature and intensely structured. A high moisture content caused side wall collapse in some test pits e.g. test pits RRD 18 and RRD 14. The general description of these soil is as follows:

- Slightly moist, olive, soft to firm, shattered and slicken sided, silty CLAYS.

The residual dolerites tend to contain some sand material. There are very localised areas of residual sandstone, these are mainly characterised by silty sand with traces of clay and correspond with the areas underlain by sandstone rock.

4.2 Site Rocks

The test pitting and drilling conducted on site proved that the investigated areas are predominantly underlain by the Ecca Group rocks which are intruded by the Jurassic-aged dolerites. Structure of the rock is normally not easily visible within the test pitting owing to excavation action but similar properties are assumed for the same rocks as profiled from drilling rock cores. Shale is the main rock formation found at shallow depths across the site, encountered in 52 % of the test pits, usually defined by olive, very fine grained, closely jointed, highly weathered becoming unweathered, soft becoming very hard rock at depths. A thin layer of light yellow brown medium grained sandstone formation underlies the shale rocks, and which was encountered in 5 % of the test pits. In places, the sandstones are in turn underlain by the very thinly bedded and closely jointed siltstone rocks which are normally banded light and dark grey.

The fine to medium grained dolerites intrudes into the Karoo successions and are also found at shallow depths or near the surface displaying closely sub-vertical jointing and onion-skin weathering. Dolerite rock was encountered in 31 % of the test pits across the site.

4.3 Borehole and Test Pit Summary

Table below summarises the ground profile as intersected during the investigation at the proposed ash dump facility. Boreholes BH06, BH07, and BH08 were drilled within the footprint of the ADF whilst BH01 - BH 05 are wash boreholes at the existing ash dump and did not generally extend into the natural soil.

Table 2: Summary of Borehole Profiles (Depth to Base of Horizon)

BH No.	Sheetwash	Residual Shale	Shale	Sandstone	Siltstone	Dolerite
BH06	1.25	2.20	5.20	6.10	7.10	12.60
BH07	0.50	2.30	8.70	-	11.90	12.40
BH08	1.30	4.10	8.00	8.60	10.74	12.18



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Table 3: Summary of Test Pit Profiles

	Depth of Test Pit (m)	Depth to Base of Unit (m)							
		Topsoil / Alluvium	Sheet-wash	Residual Shale	Shale Rock	Residual Dolerite	Dolerite Rock	Residual Sand-stone	Sand-stone Rock
All Test Pits									
Min	0.80	0.20	0.35	0.90	1.30	0.60	0.80	0.70	1.30
Max	3.60	0.60	2.60	3.15	3.60	3.00	3.30	2.50	3.20
Median	2.35	0.40	0.80	1.50	2.40	1.55	1.75	0.95	2.85
Count	98	60	82	43	51	20	30	3	5
% Encountering	-	61%	84%	44%	52%	20%	31%	3%	5%
ADF Footprint									
Min	0.85	0.20	0.35	0.90	1.30	0.70	0.85	0.70	1.30
Max	3.60	0.60	2.60	3.05	3.60	2.60	3.00	2.50	3.20
Median	2.40	0.40	0.78	1.53	2.45	1.45	1.60	0.95	2.78
Count	66	47	56	32	44	7	11	3	4
% Encountering	-	71%	85%	48%	67%	11%	17%	5%	6%
Pollution Control Dam									
Min	1.00	0.30	0.50	0.90	1.40	0.60	1.00	-	-
Max	3.30	0.40	1.10	3.00	3.30	3.00	3.00	-	-
Median	2.40	0.35	0.78	1.40	2.45	1.75	2.00	-	-
Count	15	4	14	5	4	10	8	0	0
% Encountering	-	27%	93%	33%	27%	67%	53%	0	0



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Runoff Return Dam

Min	0.80	0.20	0.50	1.10	1.50	1.10	0.80	0.00	3.10
Max	3.30	0.50	1.60	3.15	3.00	1.80	3.30	0.00	3.10
Median	2.05	0.30	0.90	2.80	2.10	1.50	1.70	-	3.10
Count	17	9	12	6	3	3	11	0	1
% Encountering	-	53%	71%	35%	18%	18%	65%	0%	6%

For summary of the depth to top of horizon, depth to base of horizon and thickness of horizon for each area, reference is made to APPENDIX B.



Table 4: Typical Ground Profile - All Test Pits*

Horizon	% Encountering	From (m)	To (m)
Topsoil / Alluvium	61	0.00	0.35
Sheetwash	84	0.35	0.80
Residual Shale (below Sheetwash)	44	0.80	1.35
Shale Rock	52	1.35	2.40
Residual Dolerite (below Sheetwash)	20	0.73	1.175
Dolerite Rock	31	1.175	1.75
Residual Sandstone (below Sheetwash)	3	0.6	1.375
Sandstone Rock	5	1.375	2.85

*As encountered

The median depth to the top of the most common rock units are:

- Ash Dump: Shale at a depth of 1.2m in 67 % of test pits;
- Pollution Control Dam: Dolerite at a depth of a 1.5m in 53 % of test pits; and
- Return Runoff Dam: Dolerite at a depth of 0.8 m in 65 % of test pits.

5.0 LABORATORY TESTING AND RESULTS

The following laboratory tests were conducted for the Tutuka Power Station geotechnical investigation; the purpose of which was to ascertain the geotechnical properties of the soil materials on across the site:

- Grading, double hydrometer and Atterberg limits tests;
- Natural moisture content analysis;
- Specific gravity tests;
- Consolidated undrained triaxle testing;
- Optimum moisture/maximum density relationship tests (Standard Proctor);
- Optimum moisture/maximum density relationship tests (Modified AASHTO);
- Standard Oedometer tests;
- Direct shear tests;
- Falling Head Permeability tests;
- Flexible wall permeability tests;
- Chemical tests including Basson index, pH and conductivity;
- Free Swell tests;
- Emerson crumb tests;
- Swell pressure tests; and
- Unconfined Compressive Strength tests.



5.1 Index Laboratory Test Results by Material Horizon

A summary of the laboratory test results with respect to the individual horizons on site is included in APPENDIX B.

An analysis of the laboratory results according is provided below:

5.1.1 Topsoil / Alluvium

The laboratory test results indicates that the topsoil is relatively uniform, with the percentage of 0 % to 4 % gravel (median 0 %), 25 % to 39 % sand (median 30 %) and 61 % to 75% fines (median 70 %). Fines is comprised of all of the cohesive (silt and clay) fractions.

The liquid limit varies from 41% to 60% (median 49 %) and plasticity index is very high, varying from 23 % to 41% (median 29%). This indicates that the USCS of the material varies from low plasticity clay (USCS classification of CL) to high plasticity clay (CH). The swell potential (activity) of the clay as described by van der Merwe varies from Medium to Very High.

The linear shrinkage test varied from 9.5 % to 12.5 % (median of 12 %).

The material classifies as A-7-6, which is the lowest grading in the TRH14 classification system.

5.1.2 Sheetwash

The laboratory test results indicates that the sheetwash is very similar to the topsoil, and is also relatively uniform, with the percentage of 0% to 4% gravel (median 0 %), 16 % to 40% sand (median 30 %) and 60 % to 84 % fines (median 70 %).

The liquid limit varies from 40% to 82% (median 63%) and plasticity index is very high, varying from 18% to 57% (median 39%). This indicates that the USCS of the material is typically CH (high plasticity clay), with about 15% of CL (low plasticity clay).

The swell potential (activity) of the clay as described by van der Merwe varies from Medium to Very High, and is typically Very High. Free swell testing (in the oedometer) indicated swell values varying from 3.8 % to 11 %. The linear shrinkage test varied from 6.5 % to 18.5 % (median of 13.5 %).

The limited compaction testing indicates a Proctor maximum dry density (MDD) of 1344 kg/m³ at an OMC of 20.4%.

The chemical character of the horizon was evaluated by pH and conductivity which showed pH varying from an average of 7.0 to 8.3 (median 8.3) with a conductivity varying from 0.126 S/m to 0.237 S/m (median 0.15 S/m).

The sheetwash material proved non-dispersive when tested for pinhole and crumb test.

The material classifies generally as A-7-6, which is the lowest grading in the TRH14 classification system. About 15% of the results classify as A-6 and A-7-5.

5.1.3 Residual Shale/Siltstone

The laboratory test results indicates that the Residual Shale/Siltstone is more variable. The percentage of gravel varied from 0 % to 19 % (median 0 %), 17 % to 40 % sand (median 30 %) and 60 % to 83 % fines (median 70 %).

The liquid limit varies from 33% to 89% (median 60%) and plasticity index is very high, varying from 15% to 59 % (median 37 %). This indicates that the USCS of the material is generally CH (high plasticity clay), with about 15 % CL (low plasticity clay).

The swell potential (activity) of the clay as described by van der Merwe varies from Low to Very High. The linear shrinkage test varied from 7.5 % to 15.5 % (median of 13 %).



The limited compaction testing indicates an average Proctor maximum dry density (MDD) of 1354 kg/m³ at an OMC of 22.4 %.

The material also proved non-dispersive when tested for pinhole test.

5.1.4 Residual Dolerite

The laboratory test results indicates that the Residual Dolerite is more variable. The percentage of gravel varied from 0 % to 18 % (median 4 %), 29 % to 52 % sand (median 35 %) and 48 % to 71 % fines (median 66 %).

The liquid limit varies from 44 % to 59 % (median 51 %) and plasticity index is very high, varying from 22 % to 37 % (median 32 %). This indicates that the USCS of the material is variable, including CL (low plasticity clay), CH (high plasticity clay) and SC (clayey sand). CH was the dominant classification.

The swell potential (activity) of the clay as described by van der Merwe varies from Low to Very High. The linear shrinkage test varied from 10 % to 16 % (median of 12 %).

The limited compaction testing indicates a Proctor maximum dry density (MDD) of 1478 kg/m³ at an OMC of 20.1 %.

The material also proved non-dispersive when tested for pinhole test.

5.1.5 Residual Sandstone

Limited testing was conducted of the Residual Sandstone. The percentage of gravel varied from 6 % to 18 % (median 12 %), 35 % to 58 % sand (median 47 %) and 42 % to 65 % fines (median 54 %).

The liquid limit varies from 42 % to 55 % (median 49 %) and plasticity index is high, varying from 17 % to 34 % (median 26 %). The UCS of the material varied from SC (clayey sand) to CH (high plasticity clay).

The swell potential (activity) of the clay as described by van der Merwe varies from Low to High. The linear shrinkage test varied from 9 % to 13.5 % (median of 12 %).

5.2 Shear Strength Laboratory Test Results

Table 5: Summary of Triaxial and Shear Box Test Results

Location	Depth	Horizon	Type	c' (kPa)	φ' (deg)
BH 06	1.5 - 2.05	Residual Shale	Triaxial CU (undisturbed)	7	20
BH 07	0.5 - 1.05		Triaxial CU (undisturbed)	9	23
BH 08	0.5 - 1.05	Sheetwash	Triaxial CU (undisturbed)	9	20
AD 22	0.6 - 0.85		Shear Box (undisturbed)	5	22



5.3 Soil Stiffness Laboratory Test Results

Table 6: Summary of Soil Stiffness Test Results

Location	Depth	Horizon	Mv (undisturbed)*					
			50 kPa	100 kPa	200 kPa	400 kPa	800 kPa	1600 kPa
AD 11	0.25 - 0.55	Sheetwash	0.343	0.284	0.244	0.172	0.102	0.049
AD 58	0.7 - 0.8		0.3984	0.3916	0.328	0.2149	0.1021	0.0626
BH 06	1.5 - 2.05	Residual Shale	0.6254	0.5235	0.4147	0.29	0.1736	0.0821
BH 08	1.5 - 2.05		0.4082	0.4191	0.4297	0.2588	0.1518	0.0847

* Constrained modulus (M), is the resistance to one-dimensional compression and is the inverse of the coefficient of volume compressibility m_v , calculated in the oedometer.

5.4 DPSH Testing

The DPSH test results have been interpreted to an equivalent SPT 'N' value. The results are plotted in Figure 1 below, together with the median values. It can be seen that the interpreted SPT blow counts generally increase with depth, but mostly reach a maximum of 30 (derived from the DPSH termination blow count of 100) at a depth of about 1.2 m to 2.4 m.

An empirical correlation using the Guidelines for Soil and Rock Logging in South Africa (2002) is presented on the figure which indicated that in general, the clay consistency median profile is as presented in Table 7.

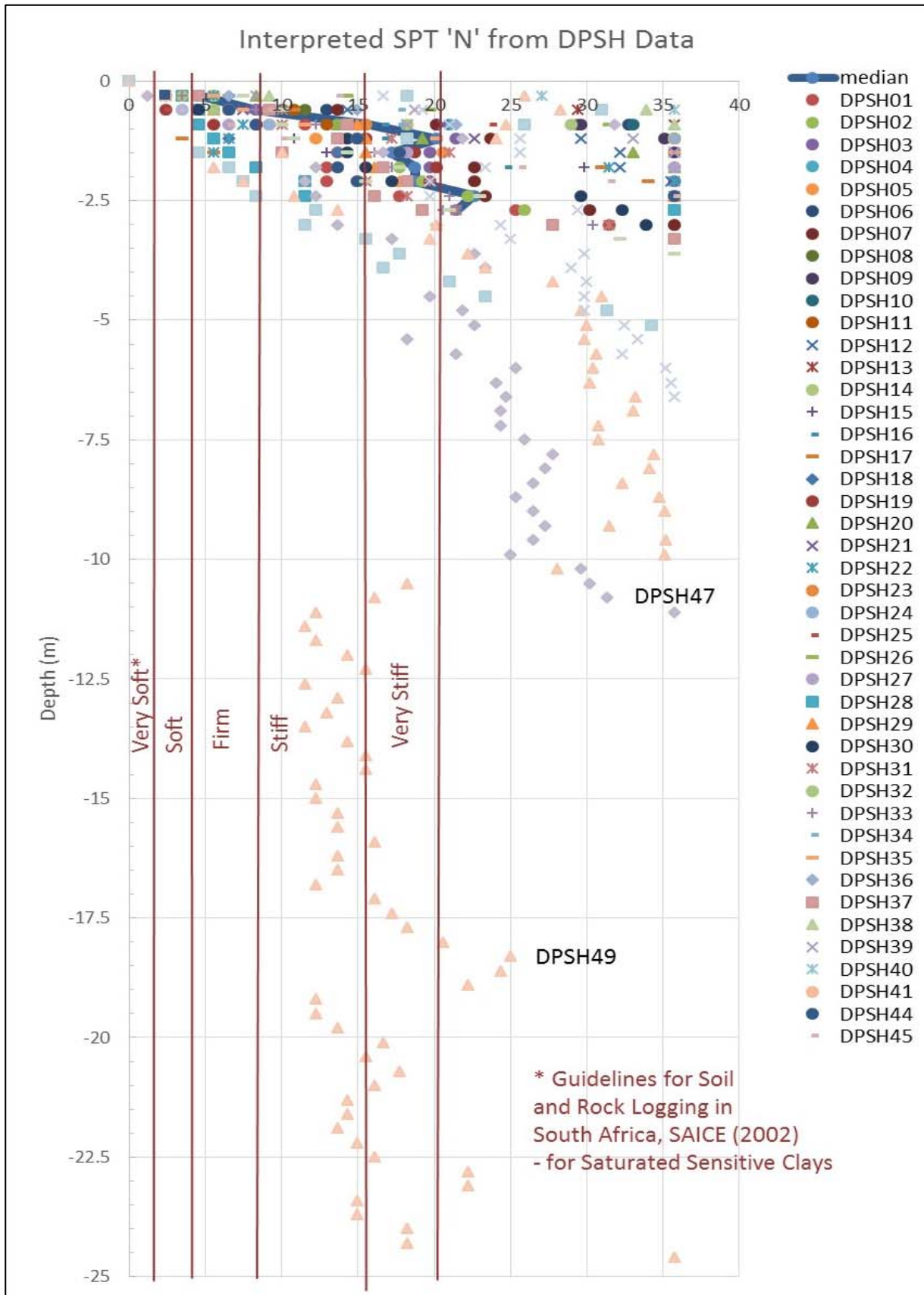


Figure 1: Interpreted of SPT Blow Counts from DPSH Testing against depth below NGL



Table 7: Median Ground Profile Interpreted from DPSH Data (entire site)*

Depth (m)	Strength
0.0-0.6	Firm
0.6-0.9	Stiff
0.9-2.1	Very Stiff
>2.1	Weathered Rock

* 0.3m depth increments recorded in the DPSH

A significant outlier to the above profile is DPSH49 which reached a depth of 24.6 m, and which generally indicated the profile in Table 7 above, however a very stiff layer was encountered from 10.5 m to the refusal depth at 24.6 m.

5.5 Permeability

The permeability of the soils was determined in the laboratory methods as follows:

- Falling head permeability test carried out at remoulded ratios and moisture levels of MDD as indicated.
- Flexible wall permeability tests carried out at 100kPa consolidation pressure in the triaxial cell on undisturbed samples.

The results of the falling head permeability testing have been summarised in Table 8.

Table 8: Summary of Laboratory Permeability Test Results

Location	Depth (m)	Origin	Coefficient of Permeability, k (cm/s)		
			Flexible Wall Permeability	Falling Head Permeability	
				Undisturbed	Remoulded
AD 05	1.9 - 2.1	Sheetwash	-	3.75E-8	98.4% of MDD, OMC +3.3%
AD 38	1.4 - 1.6		-	3.83E-6	97.2% of MDD, OMC +3.5%
AD 58	0.7 - 0.8		1.30E-8	-	-
AD 58	0.5 - 0.6		-	4.24E-8	101.8% of MDD, OMC -0.2%
AD 44	1.2 - 1.3	Residual Shale/Siltstone	-	6.42E-8	99.5% of MDD, OMC +1.2%
RRD 14	1.3 - 2.0		-	8.55E-8	99.6% of MDD, OMC +1.4%
AWRD 14	0.9 - 2.5	Residual Dolerite	-	2.51E-8	99.8% of MDD, OMC +2.7%



5.6 Shrink/Swell

Results of the van der Merwe swell potential assessment (based on Atterberg limit data), Linear Shrinkage testing during drying, and the free swell testing during saturation and consolidation testing are provided in Table 9 below.

Table 9: Summary of Laboratory Shrink/Swell Testing

Hole No	Depth (m)	Origin	Consol: Freeswell (undisturbed, 10kPa) (%)	Linear Shrinkage (%)			
				Topsoil	Sheetwash	Residual Shale	Residual Dolerite
Freeswell							
AD 11	0.25 - 0.55	Sheetwash	5.8	-			
AD 22	0.6 - 0.85		3.83	-			
AD 58	0.7 - 0.8		10.99	-			
Van der Mere Swell Potential							
Min	-		M-H	L	L	L-M	
Max	-		VH	VH	VH	VH	
Mode	-		M-H	VH	VH	H-VH	
Linear Shrinkage							
Min	-		9.5	6.5	7.5	10	
Max	-		12.5	18.5	15.5	16	
Median	-		11.75	13.5	12.75	12	

The testing indicates that the materials are highly active, with a high potential for shrink and swell. Slickensiding noted in the test pit profiles is further evidence of shrink/swell movement occurring during seasonal moisture changes.

5.7 Corrosivity

Results of the detailed chemical testing (BRE Aggressiveness Index). pH and conductivity testing are presented in Table 10 below.

Table 10: Summary of Corrosivity Test Results

Hole No	Depth (m)	Origin	pH	Conductivity (mS/m)	BRE Chemical	
					Basson Aggressivity Index (N _c)	Corrosivity Ratio
AD 58	0.7 - 0.8	Sheetwash	7.04	126	-	-
AWRD 16	0.9 - 3.0		8.25	148	-	-
RRD 02	0.6 - 1.3		8.26	237	-	-
AD 44	1.2 - 1.3	Residual Shale / Siltstone	7.68	1199	1458	3.4
RRD 08	0.95 - 1.15		8.56	158	-	-
RRD 14	1.3 - 2.0		7.62	96	992	1.0



- The pH of the materials range from 7.0 to 8.6, which is interpreted as non-corrosive to buried steel and concrete (Australian Standard AS2159);
- Based on the BRE Basson Aggressivity Index (Nc), the materials are interpreted to have a High to Very High aggressiveness;
- Based on the BRE Corrosivity Ratio, the materials are considered to be Corrosive towards metals; and
- Based on the conductivity test results, the material is Corrosive to Very Corrosive (British Standard DD81 (1982)).

5.8 Dispersivity

Results of the Dispersivity testing is presented in Table 11 below:

Table 11: Summary of Dispersivity Test Results

Hole No	Depth (m)	Origin	Crumb Test		Pinhole Test
			Water	NaOH	
AD 39	0.8 - 0.9	Sheetwash	-	-	Non-Dispersive
AD 58	0.7 - 0.8		Non-Dispersive	Non-Dispersive	Non-Dispersive
AD 44	1.2 - 1.3	Residual Shale / Siltstone	-	-	Non-Dispersive
RRD 14	1.3 - 2.0		Non-Dispersive	Non-Dispersive	Non-Dispersive
AWRD 14	0.9 - 2.5	Residual Dolerite	-	-	Non-Dispersive
RRD 10	0.3 - 1.0		-	-	Non-Dispersive

Based on the Crumb Test and Pinhole Test results, all materials tested are Non-Dispersive.

5.9 Rock Strength

Laboratory testing comprising Uniaxial Compressive Strength (UCS) testing was carried out on rock samples retrieved from the boreholes, with the results presented in Table 12 below.

Table 12: Summary of UCS Rock Strength Test Results

Hole No	Depth (m)	Rock Type	UCS (MPa)	Rock Hardness*
BH06	6.2-6.4	Siltstone	39.4	Hard Rock
BH07	3.2-3.4	Shale	22.6	Medium Hard Rock
BH08	7.4-7.6		157.3	Very Hard Rock

* SANS 633 (2007)



6.0 GEOTECHNICAL APPRAISAL

6.1 ADF Footprint

6.1.1 Ground Profile

Table 13: Typical Ground Profile (ADF Footprint)*

Horizon	% Encountering	From (m)	To (m)	Thickness (m)
Topsoil / Alluvium	73	0.00	0.375	0.38
Sheetwash	83	0.375	0.7875	0.41
Residual Shale (below Sheetwash)	48	0.7875	1.35	0.56
Shale Rock	67	1.35	-	-
Residual Dolerite (below Sheetwash)	11	0.7	1.025	0.33
Dolerite Rock	17	1.025	-	-
Residual Sandstone (below Sheetwash)	5	0.6	1.25	0.65
Sandstone Rock	6	1.25	-	-

* As encountered. These values are calculated using an average of the median lower depth of upper horizon and median upper depth of lower horizon.

6.1.2 General Suitability

The analysis of the field observations indicate that the site is suitable for the construction of the proposed ash disposal facility provided that certain design considerations are adhered to. The evaluations made herein are based on the limits of the field findings complemented with the in-situ field tests and laboratory tests conducted to ascertain their geotechnical properties.

6.1.3 Material Utilization

The general soil succession on the proposed ADF indicates transported horizons of topsoil and sheetwash comprising soft, silty clay with rootlets in the upper 0.4 m interval. These horizons are underlain by shattered and slickensided silty CLAYS which are residual materials from the underlain shales and dolerite formations.

Large silt and clay (fines) content with a median of 70 % were confirmed from the laboratory testing, and this provides an indication of the suitability of these materials for use as a low permeability liner material.

Most of the remoulded permeability values from the sheetwash and residual shale/siltstone/dolerite values of less than 9×10^{-8} cm/s, and are thus considered suitable for use as a clay liner material when re-compacted to about 98 % of MDD.

Due to the high shrink/swell properties of the materials, caution should be exercised in their use. They should be enclosed within a covering layer. It is noted that changes in moisture content will cause swelling and shrinkage, which will affect the permeability of the material.

The typically high plasticity soils (sheetwash and residual soils) are devoid of any gravels, have a relatively low MDD of between 1344 kg/m^3 and 1478 kg/m^3 . The results of the triaxial CU testing indicate material with a low drained cohesion, albeit with a reasonably high effective friction angle.

All material types tested (transported and residual material) have a typical Transportation Research Board (TRB) material classification of A-7-6 material. Whilst the CBR was not tested, this TRB classification indicates that a CBR of less than 5 % and a Technical Recommendations for Highways (TRH) 14 classification of G10 can be expected of this material.

The sheetwash is thus considered to have poor suitability for use as embankment fill materials, whilst the residual soils (residual shale, siltstone, dolerite and to a less extent the residual sandstone) are expected to have poor to fair suitability for use as embankment fills. None of the residual or transported soils are considered suitable for use below footings.



6.1.4 Dynamic Probe Super Heavy (DPSH) Test

Thirty-eight (No.38) DPSH points were assessed within the boundaries of the expansion of the TSF. The purpose of the exercise was to determine and confirm the density and consistency of the subsoil horizons. Refusal was considered to be reached at 100 blows or more within a single 300 mm interval. The depth of refusal for the tests conducted within the proposed ADF footprint commonly ranges between 1.4-1.9 m. A significant outlier is DPSH49 which reached a depth of 24.6 m, and which generally indicated a very stiff layer from 10.5m to the refusal depth at 24.6m.

An empirical correlation from all DPSH tests over the site and using the Guidelines for Soil and Rock Logging in South Africa (2002) indicated that in general, the clay consistency is as per Table 14 below:

Table 14: Median Ground Profile Interpreted from DPSH Data (ADF Footprint)*

Table with 2 columns: Depth (m) and Strength. Rows include depth ranges like 0.0-0.6 (Firm), 0.6-0.9 (Stiff), 0.9-2.1 (Very Stiff), and >2.1 (Weathered Rock).

* 0.3m depth increments recorded in the DPSH

6.1.5 Excavation

Assessment of the excavatability has been made in accordance with the excavation done during test-pitting. The evaluation is based on the National Standard Construction Specification referenced from the SANS 1200D: Earthworks, (1998) summarised below:

- Soft Excavation is material that can be efficiently removed without prior ripping by 22 t bulldozer (such as Cat D7) or front end loader;
Intermediate Excavation is material that can be efficiently ripped by a 35 t bulldozer (such as Cat D8) with a single ripping type;
Hard Rock Excavation is material that cannot be efficiently ripped by 35 t bulldozer (such as Cat D8), and requires blasting or splitting; and
Boulder Excavation contains greater than 40 % of boulders larger than 0.03 m³ in size (Class A), or contains less than 40 % boulders larger than 0.03 m³ in size but requires blasting to remove (Class B). This excludes rock, which should be classified as Soft to Hard Rock Excavation.

General soil profiles of the ADF mainly display the following units: topsoil, sheetwash, residual shales overlying weathered rock. The rock excavatability ranges between the depths of 0.9-3 m. The application of the above mentioned standard on the material succession is as follows:

Table 15: Generalised Excavatability for Successions over ADF Footprint

Table with 2 columns: Horizon and Excavation Class. Rows include Topsoil, Sheetwash, Residual shale, Shales, Dolerite, Sandstone, Siltstone, and Residual sandstone/quartzites.



6.1.6 Groundwater

Groundwater ingress was noted in 4 test pits (AD 12, AD 16, AD 46 and AD47) within the ADF footprint, these are all positioned towards the north. The observed very slow to slow groundwater seepage was observed between 0.5-1.2 m north-east of the proposed new ash dump. The recorded groundwater seepage could be an indication of groundwater water-level fluctuation or shallow water-level within the proposed ADF footprint.

6.2 Pollution Control Dam

Table 16: Typical Ground Profile (PCD Footprint)*

Horizon	% Encountering	From (m)	To (m)	Thickness (m)
Topsoil / Alluvium	27	0.00	0.18	0.18
Sheetwash	93	0.18	0.71	0.54
Residual Shale (below Sheetwash)	33	0.71	1.38	0.66
Shale Rock	27	1.38	-	-
Residual Dolerite (below Sheetwash)	67	0.71	1.63	0.91
Dolerite Rock	53	1.63	-	-

* As encountered. These values are calculated using an average of the median lower depth of upper horizon and median upper depth of lower horizon.

6.2.1 General Suitability

The observations made during the field investigation indicate that the site is suitable for the construction of the proposed pollution control dam provided that certain design considerations are adhered to. The evaluations presented herein are based on the limits of the investigation and are subject to change in the final geotechnical report.

6.2.2 Material Utilization

The investigated test pits within the confines of the area delineated for pollution control dam can generally be described by a soil succession which comprises of soft, shattered silty clay of sheetwash origin, which is underlain by shattered, soft silty clay of residual dolerite origin. In more than 50 % of the test pits, a fine grained, closely jointed, soft dolerite rock was encountered, whilst shale rock was encountered in about 25 % of the test pits, with similar properties to over the remainder of the ADF.

The cohesive sheetwash material and residual dolerites have high silt-clay content. Where needed, they are suitable for use within a liner system, as per the commentary provided for the ADF above.

The transported and residual materials suitability for use as (homogeneous) embankment materials is considered relatively poor, and are expected to have poor shear strength when compacted and saturated. The material classifies as an A-7-6 material.

6.2.3 Dynamic Probe Super Heavy (DPSH) Test

Three DPSH points were assessed within the areas delineated for the pollution control dam (DPSH 20, 21 and 45). The purpose of the exercise was to determine and confirm the density and consistency of the subsoil horizons. Refusal was considered to be reached at 100 blows or more within a single 300 mm interval. The maximum depth of refusal reached was 2.4 m.

An empirical correlation from all DPSH tests over the site and using the Guidelines for Soil and Rock Logging in South Africa (2002) indicated that in general, the clay consistency is as per Table 17 below:



Table 17: Median Ground Profile Interpreted from DPSH Data (PCD)*

Depth (m)	Strength
0.0-0.6	Firm
0.6-0.9	Stiff
0.9-1.2	Very Stiff
>1.2*	Weathered Rock

* 0.3m depth increments recorded in the DPSH

6.2.4 Excavation

Generally, *Soft Excavation* can be expected for the transported and residual horizons. At certain depths where dolerite intrusive rocks are intersected, intermediate and hard rock excavation is expected, and with the possibility of boulder class excavation on first intersection.

Table 18: Generalised Excavatability for Successions within Pollution Control Dam

Horizon	Excavation Class
Sheetwash	Soft Excavation Class
Residual Dolerite/Shale	Soft Excavation Class
Rock	Boulder, Intermediate to Hard Rock Excavation Class

6.2.5 Groundwater

Groundwater seepage was noted in test-pits excavated within these PCD areas, these include AWRD 01, AWRD 08 and AWRD 10. This may be indicative of a shallow or perched water-table. The presence of nearby water in the existing dam indicates that water seepage can be expected.

6.3 Runoff-Return Dam

Table 19: Typical Ground Profile (Runoff-Return Dam Footprint)*

Horizon	% Encountering	From (m)	To (m)	Thickness (m)
Topsoil / Alluvium	53	0.00	0.15	0.15
Sheetwash	71	0.15	0.91	0.76
Residual Shale (below Sheetwash)	35	0.91	1.95	1.04
Shale Rock	18	1.95	-	-
Residual Dolerite (below Sheetwash)	18	0.91	1.15	0.24
Dolerite Rock	65	1.15	-	-

* As encountered. These values are calculated using an average of the median lower depth of upper horizon and median upper depth of lower horizon.

6.3.1 General Suitability

The observations made during the field investigation indicate that the site is feasible for the construction of the proposed runoff return dam provided that certain design considerations are complied with. The evaluations presented herein are based on the field investigation and are subject to change in the final geotechnical report.



6.3.2 Material Utilization

The investigated test pits within the confines of the area delineated for the runoff return dam can generally be described by a soil succession which comprises of soft, shattered silty clay of sheetwash origin which is underlain by shattered, soft silty clay of residual dolerite. The bottom of the excavation are normally defined by a fine grained, closely jointed, weathered dolerite rocks.

For lining purposes, the sheetwash material and residual dolerites textural constituents are mainly silt-clay mixture which are characterised by a high plasticity. These physical attributes contributes to its low permeability which indicates suitability for engineering use as a liner material, where this is required. Reference is made to the commentary on permeability provided for the ADF footprint.

The transported and residual materials suitability for use as (homogeneous) embankment materials is considered relatively poor, and they are expected to have poor shear strength when compacted and saturated. The material classifies as an A-7-6 material.

6.3.3 Dynamic Probe Super Heavy (DPSH) Test

Only two DPSH points were evaluated within the areas delineated for Return Runoff Dam (DPSH 40 and 44). The purpose of the exercise was to determine and confirm the density and consistency of the subsoil horizons.

The two DPSH test results varied significantly, with DPSH40 refusing at 0.6 m and DPSH44 refusing at 2.4 m. As such, no statistically relevant typical DPSH profile can be produced. Reference is made to the results of the test pitting, which indicated median weathered rock from about 1.15 m.

6.3.4 Excavation

Generally, *Soft Excavation* is the expected excavation classification for transported and residual horizons. The medium-hard shale rocks may require blasting and splitting.

Table 20: Generalised Excavatability for Successions within Pollution Control Dam

Horizon	Excavation Class
Sheetwash	Soft Excavation Class
Residual Shale	Soft Excavation Class
Rock	Boulder, Intermediate to Hard Rock Excavation Class (dependent on depth)

6.3.5 Groundwater

Groundwater seepage was not noted in any of the test pits excavated within these return runoff dam area, although the presence of nearby water naturally indicates that water seepage can be expected.

7.0 CONCLUSIONS AND RECOMMENDATIONS

Based on the analysis and interpretations of the geotechnical data from the field findings, in situ tests conducted and laboratory based results, the following conclusions were reached.

7.1.1 General

The ground profile over the site was found to comprise transported and residual high plasticity clays to a depth of about 1.3m, overlying weathered rock. The clays are found to have a low permeability, however a high potential for shrink and swell and a low consolidated drained cohesion. As such, other than as a clay liner material, they are generally considered to be unsuitable for use as construction materials.



Any structure constructed over the materials should be carefully checked for stability and strength adequacy. Over areas where moderate strength is required or marginal stability issues are possible, it is considered prudent that the overlying transported and residual soils are stripped and the structure founded on weathered rock or on approved backfill.

7.1.2 Groundwater, Drainage and Site Preparation

- Saturated ground conditions can be expected within near flat or areas of poor drainage across the site during the wet season. Any soft or over-wet clayey materials within these areas should be stripped. Due to the high plasticity and high fines content of the surface materials, these stripped materials are unlikely to be suitable for replacement and re-compacted, unless they contain greater than 30% sand.
- Slow groundwater seepage was recorded in some test pits within the proposed ADF footprint. Even though it's not foreseen that bulk of the excavation will intersect the observed groundwater, there is potential for groundwater rise during rainy periods or where groundwater rise.

As such, appropriate measures need to be applied to cater for constructability and serviceability of the proposed infrastructure particularly during the initial ground preparation. These may include:

- Pre-drainage measures which will be exacerbated if construction commences during the wet season;
- Sub-surface and cut-off drains to be constructed in advance of the main earthworks operations;
- Trafficking and preparation of work areas / access routes for earthmoving and other construction;
- Equipment may prove difficult in sectors bordering on the margins of the alluvial floodplains; and
- Importation of pioneering layers (and possible geotextile separation layers) in areas where aforementioned mitigation proves to be inadequate or need to be supplemented.

In general, the site materials are not considered suitable for founding of movement sensitive civil structures. It is recommended that necessary subgrade treatment of the in-situ soils be undertaken after topsoil stripping and vegetation removal to ensure the integrity of raised civil structures. Such footings would require subgrade preparation as follows:

- Stripping of all transported and weathered soils;
- Grading of the subgrade exposed surface to ensure adequate subsoil drainage;
- Proof rolling; and
- Placement of imported approved granular fill materials as needed in order to bring the area up to the design grade.



8.0 CLOSING

Your attention is drawn to APPENDIX F, entitled "Document Limitations". The statements presented in this appendix are intended to advise you of what your realistic expectations of this report should be. The statements presented in this appendix are not intended to reduce the level of responsibility accepted by Golder, but rather to ensure that all parties who may rely on this report are aware of the responsibilities each assumes in so doing.

GOLDER ASSOCIATES AFRICA (PTY) LTD.

Sandile Nkosi
Engineering Geologist

Simon Owens-Collins
Senior Engineering Geologist, Associate

SN-SOC/SOC/mfb

Reg. No. 2002/007104/07

Directors: RGM Heath, MQ Mokulubete, SC Naidoo, GYW Ngoma

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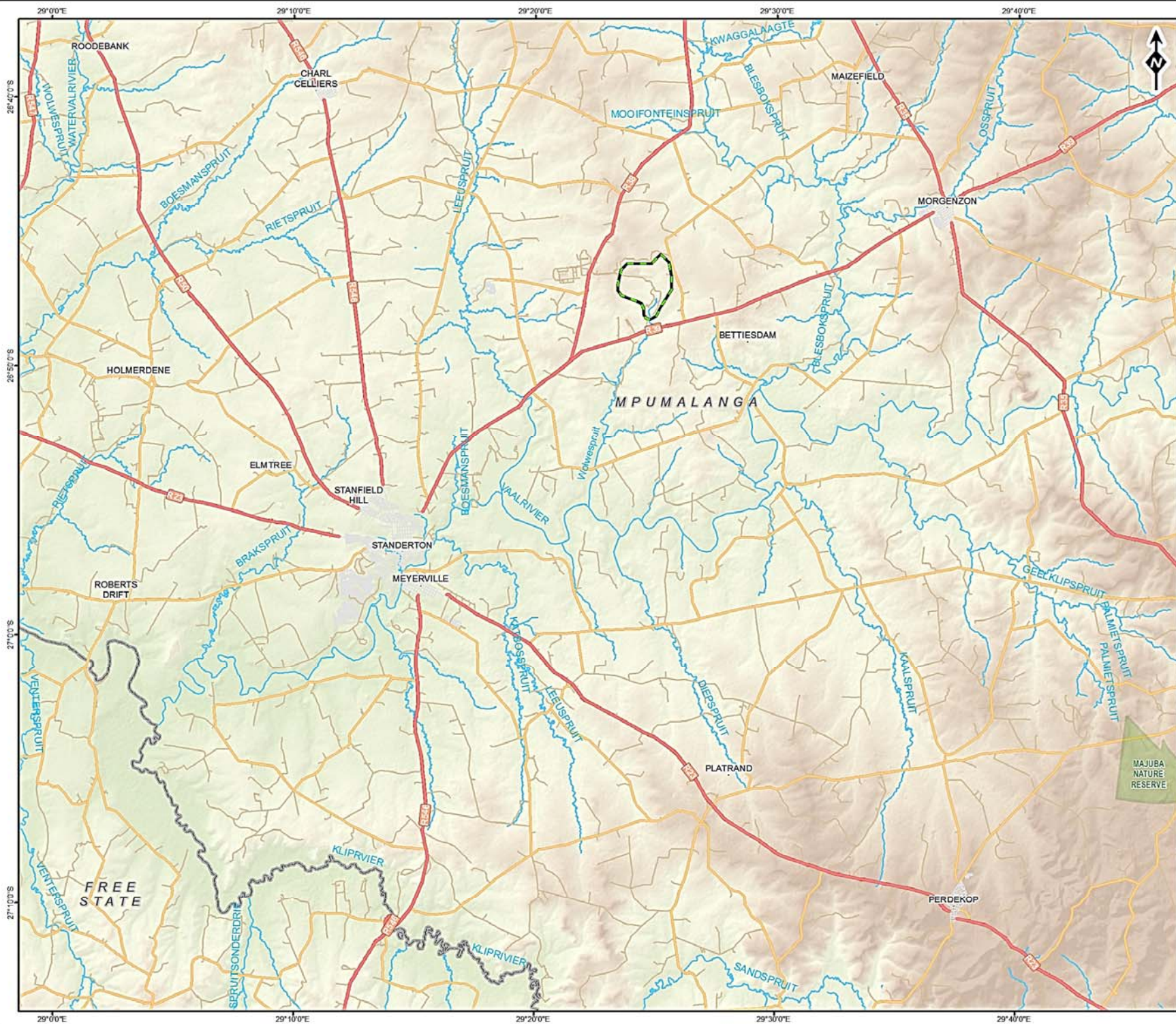
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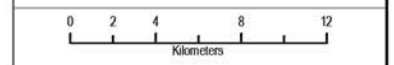
APPENDIX A

Maps and Figures

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- LEGEND**
- Site Boundary
 - Protected
 - Main road
 - Secondary road
 - Access road
 - Street
 - Towns - intermediate
 - Provincial Boundary
 - Rivers - Perennial



REFERENCE
Coordinate System: WGS Lo29

PROJECT
TUTUKA GEOTECHNICAL INVESTIGATION

TITLE

LOCALITY

PROJECT No. 1658666	REV 1
SCALE 1:250 000	A3
GIS	TS 13/12/2016
CHECK	SN 13/12/2016
REVIEW	NR 13/12/2016



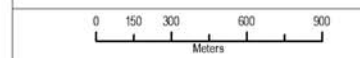


- LEGEND**
- Ash Dump
 - Borehole
 - Dynamic Cone Penetration
 - Dynamic Probe Super Heavy
 - Pollution Control Dams
 - Runoff Return Dams
- RSA250k_Litho_Chronostratigr...

Lithology

J-d: Karoo Dolerite; Network of dolerite sills, sheets and dykes, mainly intrusive into the Karoo Supergroup

Pv: Vryheid; Fine- to coarse-grained sandstone, shale, coal seams



REFERENCE
 Coordinate System: WGS Lo29
 Imagery: CD.NGI 2008-2012

PROJECT
 TUTUKA GEOTECHNICAL INVESTIGATION

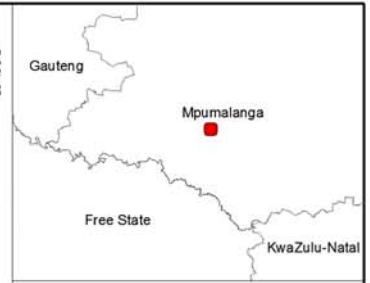
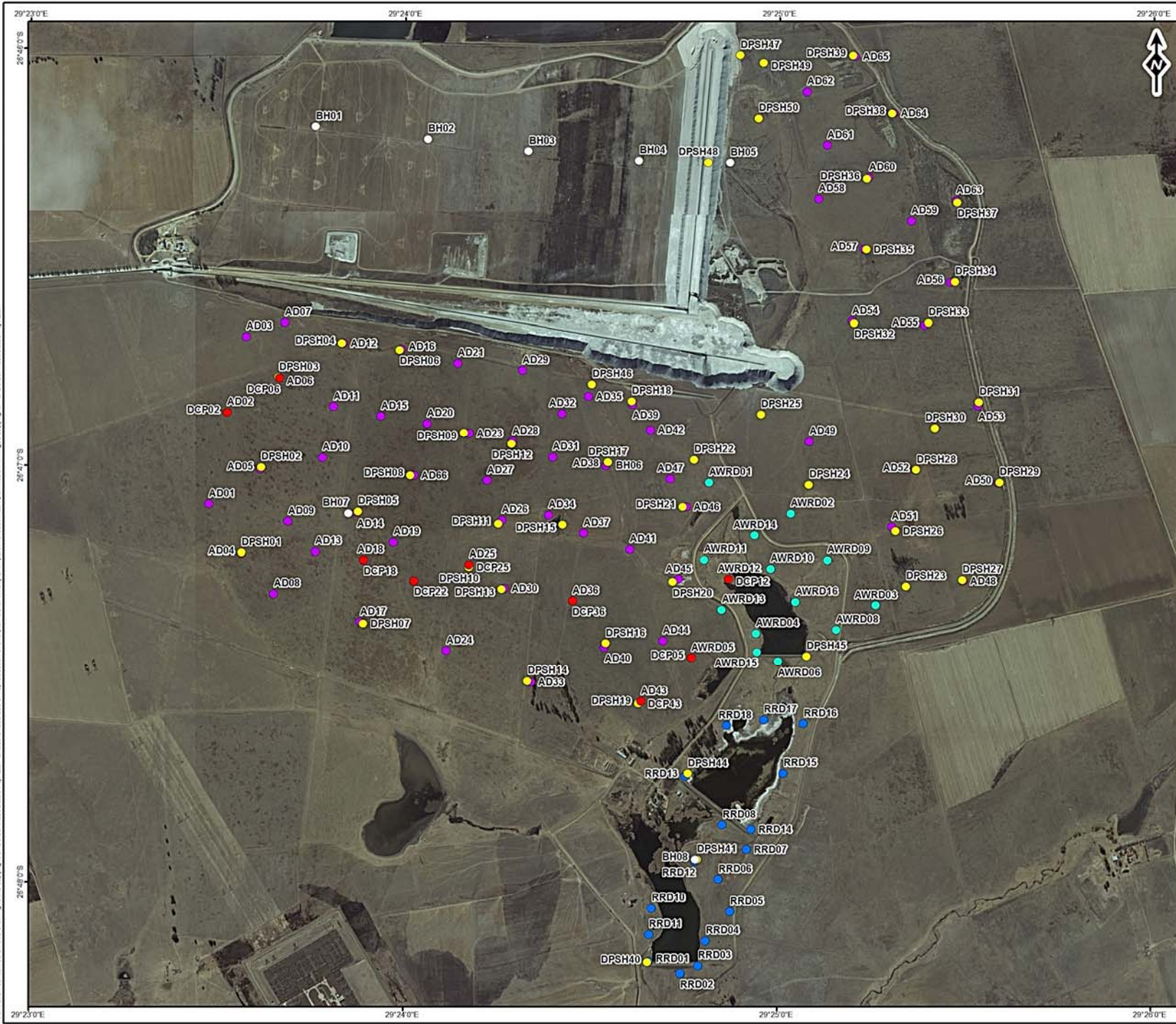
TITLE

GEOLOGY

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SCALE 1:20 000	A3
GIS	TS 13/12/2016
CHECK	SN 13/12/2016
REVIEW	NR 13/12/2016



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LEGEND

- Ash Dump
- Borehole
- Dynamic Cone Penetration
- Dynamic Probe Super Heavy
- Pollution Control Dams
- Runoff Return Dams

0 150 300 600 900
Meters

REFERENCE
 Coordinate System: WGS Lo29
 Imagery: CD.NGI 2008-2012

PROJECT
 TUTUKA GEOTECHNICAL INVESTIGATION

TITLE

SITE MAP

PROJECT No. 1658666	REV 1
SCALE 1:16 000	A3
GIS	TS 13/12/2016
CHECK	SN 13/12/2016
REVIEW	NR 13/12/2016



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APPENDIX B

Summary Tables

Hole No	Depth (m)	Origin	Activity	Van Der Merwe Activity	Casagrande A-Line	USCS	TRB	G _s	Triaxial (CU undisturbed)		Shear Box (undisturbed)		Std Proctor		Oedometer (Mv) (undisturbed)						pH	Conductivity (S/m)	BRE Chemical		Flexible Wall Permeability (m/s)	Falling Head Permeability (m/s)		Compaction and OMC								
									c' (kPa)	φ' (deg)	c' (kPa)	φ' (deg)	MDD (kg/m ³)	OMC (%)	50 kPa	100 kPa	200 kPa	400 kPa	800 kPa	1600 kPa			Basson Aggressivity Index (Nc)	Corrosivity Ratio		Undisturbed	Remoulded									
AD 15	0.2 - 0.3	Topsoil	0.9	VH	Clay	CH	A-7-6																													
AD 23	0.2 - 0.5	Topsoil	0.8	H	Clay	CL	A-7-6	2.405																												
AD 26	0.0 - 0.2	Topsoil	1.2	M-H	Clay	CL	A-7-6																													
AD 40	0.3 - 0.5	Topsoil	0.7	M-H	Clay	CL	A-7-6																													
Min			0.7					2.405																												
Max			1.2					2.405																												
Median			0.85					2.405																												
Average			0.9					2.405																												
Count			4					1																												
AD 01	0.3 - 0.5	Sheetwash	0.9	VH	Clay	CH	A-7-6	2.361																												
AD 05	1.9 - 2.1	Sheetwash	1.2	VH	Clay	CH	A-7-6	2.351																												
AD 11	0.25 - 0.55	Sheetwash	1	H-VH	Clay	CH	A-7-6	2.549																												
AD 12	0.5 - 0.7	Sheetwash	0.9	M	Clay	CL	A-6																													
AD 14	1.0 - 1.2	Sheetwash	1	VH	Clay	CH	A-7-6																													
AD 22	0.6 - 0.85	Sheetwash	0.5	L	Silt/Clay	CL	A-7-6	2.604																												
AD 22	0.4 - 0.6	Sheetwash	0.7	M-H	Clay	CL	A-7-6																													
AD 38	1.4 - 1.6	Sheetwash	0.8	H-VH	Clay	CH	A-7-6																													
AD 39	0.8 - 0.9	Sheetwash	1.2	VH	Clay	CH	A-7-6																													
AD 49	0.4 - 0.6	Sheetwash	1	VH	Clay	CH	A-7-6																													
AD 58	0.7 - 0.8	Sheetwash	0.7	H	Silt	MH	A-7-5	2.583																												
AD 58	0.5 - 0.6	Sheetwash	0.8	VH	Clay	CH	A-7-6	2.314																												
AWRD 01	0.5 - 0.8	Sheetwash	1	VH	Clay	CH	A-7-6																													
AWRD 13	0.0 - 1.0	Sheetwash	1.1	VH	Clay	CH	A-7-6	2.510																												
AWRD 16	0.9 - 3.0	Sheetwash	0.9	VH	Clay	CH	A-7-6																													
BH 08	0.5 - 1.05	Sheetwash						2.410	9	20																										
RRD 02	0.6 - 1.3	Sheetwash	1.3	VH	Clay	CH	A-7-6																													
RRD 08	0.5 - 0.7	Sheetwash	1.5	VH	Clay	CH	A-7-6																													
RRD 16	0.3 - 0.6	Sheetwash	1	H-VH	Clay	CH	A-7-6																													
Min			0.5					2.314	9	20	5	22	1344	20.4	0.343	0.284	0.244	0.172	0.102	0.049	7.04	0.1259			1.3E-10	3.75E-10										
Max			1.5					2.604	9	20	5	22	1344	20.4	0.3984	0.3916	0.328	0.2149	0.1021	0.0626	8.26	0.237			1.3E-10	3.83E-08										
Median			1					2.46	9	20	5	22	1344	20.4	0.3707	0.3378	0.286	0.19345	0.10205	0.0558	8.25	0.148			1.3E-10	4.24E-10										
Average			0.97222222					2.46025	9	20	5	22	1344	20.4	0.3707	0.3378	0.286	0.19345	0.10205	0.0558	7.85	0.1703			1.3E-10	1.3033E-08										
Count			18					8	1	1	1	1	1	1	2	2	2	2	2	2	3	3			1	3										
AD 03	1.0 - 1.1	Residual Shale	1.7	H	Clay	CH	A-7-6																													
AD 43	0.6 - 0.8	Residual Siltstone	1	VH	Clay	CH	A-7-6																													
AD 44	1.2 - 1.3	Residual Siltstone	0.7	H	Clay	CH	A-7-6																													
AD 48	0.3 - 0.8	Residual Shale	0.9	H-VH	Clay	CH	A-7-6	2.549																												
AD 50	1.3 - 1.5	Residual Shale	0.8	H-VH	Clay	CH	A-7-6																													
AD 52	0.95 - 1.15	Residual Shale	0.7	H-VH	Clay	CH	A-7-6																													
AD 61	0.5 - 0.6	Residual Shale	0.5	L	Clay	CL	A-6																													
AD 63	1.7 - 1.8	Residual Shale	0.8	VH	Clay	CH	A-7-6																													
BH 06	1.5 - 2.05	Residual Shale	1.2	H	Clay	CH	A-7-6	2.531	7	20																										
BH 07	0.5 - 1.05	Residual Shale	0.5	M	Clay	CL	A-7-6	2.449	9	23																										
BH 08	1.5 - 2.05	Residual Shale	1.2	VH	Clay	CH	A-4	2.463																												
RRD 08	0.95 - 1.15	Residual Shale	1.2	VH	Clay	CH	A-7-6																													
RRD 14	1.3 - 2.0	Residual Shale	0.9	VH	Clay	CH	A-7-6																													
RRD 15	0.9 - 1.3	Residual Shale	0.9	VH	Clay	CH	A-7-6																													
Min			0.5					2.449	7	20																										
Max			1.7					2.549	9	23																										
Median			0.9					2.497	8	21.5																										
Average			0.92857143					2.498	8	21.5																										
Count			14					4	2	2																										
AWRD 08	0.5 - 1.4	Residual Dolerite	1.1	H-VH	Clay	CH	A-7-6	2.438																												

Hole No	Depth (m)	Origin	Double Oedometer (Mv) (1/Mpa)												Consol: Freeswell (undistur)	Crumb Test			Rock UCS (Mpa)	
			NMC 50 kPa	NMC 100 kPa	NMC 200 kPa	NMC 400 kPa	NMC 800 kPa	NMC 1600 kPa	Soaked 50 kPa	Soaked 100 kPa	Soaked 200 kPa	Soaked 400 kPa	Soaked 800 kPa	Soaked 1600 kPa		Water	NaOH	Pinhole Test		
AD 15	0.2 - 0.3	Topsoil																		
AD 23	0.2 - 0.5	Topsoil																		
AD 26	0.0 - 0.2	Topsoil																		
AD 40	0.3 - 0.5	Topsoil																		
Min																				
Max																				
Median																				
Average																				
Count																				
AD 01	0.3 - 0.5	Sheetwash																		
AD 05	1.9 - 2.1	Sheetwash																		
AD 11	0.25 - 0.55	Sheetwash														5.8				
AD 12	0.5 - 0.7	Sheetwash																		
AD 14	1.0 - 1.2	Sheetwash																		
AD 22	0.6 - 0.85	Sheetwash	0.397	0.23	0.15	0.079	0.052	0.04	0.324	0.274	0.223	0.176	0.091	0.058		3.83				
AD 22	0.4 - 0.6	Sheetwash																		
AD 38	1.4 - 1.6	Sheetwash																		
AD 39	0.8 - 0.9	Sheetwash																		Non-Dispersive
AD 49	0.4 - 0.6	Sheetwash																		
AD 58	0.7 - 0.8	Sheetwash																		
AD 58	0.5 - 0.6	Sheetwash																		
AWRD 01	0.5 - 0.8	Sheetwash																		
AWRD 13	0.0 - 1.0	Sheetwash																		
AWRD 16	0.9 - 3.0	Sheetwash																		
BH 08	0.5 - 1.05	Sheetwash																		
RRD 02	0.6 - 1.3	Sheetwash																		
RRD 08	0.5 - 0.7	Sheetwash																		
RRD 16	0.3 - 0.6	Sheetwash																		
Min			0.397	0.23	0.15	0.079	0.052	0.04	0.324	0.274	0.223	0.176	0.091	0.058		3.83				
Max			0.397	0.23	0.15	0.079	0.052	0.04	0.324	0.274	0.223	0.176	0.091	0.058		10.99				
Median			0.397	0.23	0.15	0.079	0.052	0.04	0.324	0.274	0.223	0.176	0.091	0.058		5.8				
Average			0.397	0.23	0.15	0.079	0.052	0.04	0.324	0.274	0.223	0.176	0.091	0.058		6.87333				
Count			1	1	1	1	1	1	1	1	1	1	1	1		3				
AD 03	1.0 - 1.1	Residual Shale																		
AD 43	0.6 - 0.8	Residual Siltstone																		
AD 44	1.2 - 1.3	Residual Siltstone																		
AD 48	0.3 - 0.8	Residual Shale																		
AD 50	1.3 - 1.5	Residual Shale																		
AD 52	0.95 - 1.15	Residual Shale																		
AD 61	0.5 - 0.6	Residual Shale																		
AD 63	1.7 - 1.8	Residual Shale																		
BH 06	1.5 - 2.05	Residual Shale																		
BH 07	0.5 - 1.05	Residual Shale																		
BH 08	1.5 - 2.05	Residual Shale																		
RRD 08	0.95 - 1.15	Residual Shale																		
RRD 14	1.3 - 2.0	Residual Shale																		Non-Dispersive
RRD 15	0.9 - 1.3	Residual Shale																		Non-Dispersive
Min																				
Max																				
Median																				
Average																				
Count																				
AWRD 08	0.5 - 1.4	Residual Dolerite																		
AWRD 09	1.2 - 1.8	Residual Dolerite																		
AWRD 14	0.9 - 2.5	Residual Dolerite																		Non-Dispersive
RRD 10	0.3 - 1.0	Residual Dolerite																		Non-Dispersive
Min																				
Max																				
Median																				
Average																				
Count																				
AD 57	1.2 - 1.3	Residual Sandstone																		
AD 59	0.4 - 07	Residual Sandstone																		
Min																				
Max																				
Median																				
Average																				
Count																				
BH06	6.2-6.4	rock																		39.4
BH07	3.2-3.4	rock																		22.6
BH08	7.4-7.6	rock																		157.3
Min																				22.6
Max																				157.3
Median																				39.4
Average																				73.1
Count																				3

Test Pit Number	Depth of Test Pit (m)	Depth (m) to the Top of										Depth (m) to the Base of						Thickness (m)									
		Topsoil	Sheetwash	Residual Shale	Shale Rock	Residual Dolerite	Dolerite Rock	Residual Sandstone	Sandstone Rock	Topsoil	Sheetwash	Residual Shale	Shale Rock	Residual Dolerite	Dolerite Rock	Residual Sandstone	Sandstone Rock	Topsoil	Sheetwash	Residual Shale	Shale Rock	Residual Dolerite	Dolerite Rock	Residual Sandstone	Sandstone Rock		
Ash Disposal Facility Extension Footprint																											
AD01	3.00	0.00	0.30		0.50	1.50					0.30	0.50	1.50	3.00					0.30	0.20	1.00	1.50					
AD02	3.05	0.00	0.40			0.75					0.40	0.75		3.05					0.40	0.35		2.30					
AD03	2.30		0.00		0.90	1.10						0.90	1.10	2.30						0.90	0.20	1.20					
AD04	3.25	0.00	0.30		0.60	1.40					0.30	0.60	1.40	3.25					0.30	0.30	0.80	1.85					
AD05	3.60	0.00	0.45			2.60					0.45	2.60		3.60					0.45	2.15		1.00					
AD06	2.40	0.00	0.40			1.80					0.40	1.80		2.40					0.40	1.40		0.60					
AD07	2.20	0.00	0.40		0.80	1.10					0.40	0.80	1.10	2.20					0.40	0.40	0.30	1.10					
AD08	3.05	0.00	0.40		0.80	1.60					0.40	0.80	1.60	3.05					0.40	0.40	0.80	1.45					
AD09	3.05	0.00	0.25			0.60					0.25	0.60		3.05					0.25	0.35		2.45					
AD10	2.90	0.00	0.45		1.10	2.20					0.45	1.10	2.20	2.90					0.45	0.65	1.10	0.70					
AD11	2.80		0.00		0.40	0.90						0.40	0.90	2.80						0.40	0.50	1.90					
AD12	2.00	0.00	0.40			1.10					0.40	1.10		2.00					0.40	0.70		0.90					
AD13	3.05	0.00	0.50		0.80	2.05					0.50	0.80	2.05	3.05					0.50	0.30	1.25	1.00					
AD14	2.10	0.00	0.40		1.10	1.30					0.40	1.10	1.30	2.10					0.40	0.70	0.20	0.80					
AD15	1.30	0.00	0.30		0.60	1.00					0.30	0.60	1.00	1.30					0.30	0.30	0.40	0.30					
AD16	3.00		0.00			0.85						0.85		3.00						0.85		2.15					
AD17	3.00	0.00	0.50			1.10					0.50	1.10		3.00					0.50	0.60		1.90					
AD18	2.50	0.00	0.35				0.75	1.45			0.35	0.75			1.45	2.50			0.35	0.40			0.70	1.05			
AD19	1.70	0.00	0.30			1.10					0.30	1.10		1.70					0.30	0.80		0.60					
AD20	1.60	0.00				0.60						0.60		1.60					0.60			1.00					
AD21	1.70	0.00	0.40		0.70	1.00					0.40	0.70	1.00	1.70					0.40	0.30	0.30	0.70					
AD22	2.20		0.00		0.80	1.15						0.80	1.15	2.20						0.80	0.35	1.05					
AD23	2.50	0.00	0.40			0.70					0.40	0.70		2.50					0.40	0.30		1.80					
AD24	3.15	0.00	0.40		0.75	2.30					0.40	0.75	2.30	3.15					0.40	0.35	1.55	0.85					
AD25	2.60		0.00				0.55					0.55			2.60					0.55		2.05					
AD26	0.90	0.00						0.00			0.40									0.00			0.90				
AD27	1.30		0.00			0.90						0.90		1.30						0.90		0.40					
AD28	3.30		0.00		0.90	2.50						0.90	2.50	3.30						0.90	1.60	0.80					
AD29	0.85	0.00						0.30			0.30					0.85				0.30				0.55			
AD30	1.60	0.00	0.35					0.55			0.35	0.55				1.60			0.35	0.20				1.05			
AD31	2.60	0.00	0.30				0.60				0.30	0.60			2.60				0.30	0.30			2.00				
AD32	1.40		0.00			0.60						0.60		1.40						0.60		0.80					
AD33	1.10		0.00				0.55					0.55			1.10					0.55		0.55					
AD34	1.32	0.00	0.40					1.15			0.40	1.15			1.32				0.40	0.75				0.15			
AD35	1.55		0.00		0.65							0.65	1.55							0.65	0.90						
AD36	2.20		0.00			0.60						0.60		2.20						0.60		1.60					
AD37	2.15	0.00	0.40			1.20					0.40	1.20		2.15					0.40	0.80		0.95					
AD38	2.85	0.00	0.50			1.90					0.50	1.90		2.85			2.85		0.50	1.40		0.25				0.70	
AD39	2.50	0.00	0.40		1.60	1.80					0.40	1.60	1.80	2.50					0.40	1.20	0.20	0.70					
AD40	3.00	0.00	0.50		0.90	1.75					0.50	0.90	1.75	3.00					0.50	0.40	0.85	1.25					
AD41	1.80	0.00					0.40				0.40								0.40					1.40			
AD42	3.20		0.00					0.35	0.95			0.35				0.95	3.20			0.35			0.60	2.25			
AD43	3.05		0.00		0.55	1.30						0.55	1.30	3.05						0.55	0.75	1.75					
AD44	3.00	0.00	0.40		1.00						0.40	1.00	3.00						0.40	0.60	2.00						
AD45	2.00		0.00				0.60					0.60			2.00					0.60			1.40				
AD46	3.00		0.00				0.65					0.65			3.00					0.65			2.35				
AD47	3.20	0.00					0.60					0.60			3.20					0.60			2.40				
AD48	2.40	0.00			0.00		1.20				0.30		1.20		2.40					0.30		1.20					
AD49	1.50	0.00			0.00	0.90					0.30		0.90	1.50					0.30		0.90	0.60					
AD50	2.85	0.00	0.40		1.00	2.30					0.40	1.00	2.30	2.85					0.40	0.60	1.30	0.55					
AD51	1.20		0.00					0.20				0.20				1.20				0.20			1.00				
AD52	3.20		0.00		0.95	2.40						0.95	2.40	3.20						0.95	1.45	0.80					
AD53	3.00	0.00	0.50		1.30	1.90					0.50	1.30	1.90	3.00					0.50	0.80	0.60	1.10					
AD54	1.40	0.00	0.25		0.70	1.00					0.25	0.70	1.00	1.40					0.25	0.45	0.30	0.40					
AD55	3.20	0.00	0.40		1.00	2.50					0.40	1.00	2.50	3.20					0.40	0.60	1.50	0.70					
AD56	2.30	0.00	0.40		0.75	1.40					0.40	0.75	1.40	2.30					0.40	0.35	0.65	0.90					
AD57	2.70	0.00						0.40	2.50	0.40						2.50	2.70			0.40				2.10	0.20		
AD58	2.50	0.00	0.50		1.00	1.60					0.50	1.00	1.60	2.50					0.50	0.50	0.60	0.90					
AD59	1.30	0.00						0.40	0.70	0.40						0.70	1.30			0.40			0.30	0.60			
AD60	1.80	0.00	0.40		0.60	0.90					0.40	0.60	0.90	1.80					0.40	0.20	0.30	0.90					
AD61	2.00		0.00		0.50	1.00						0.5	1	2						0.50	0.50	1.00					
AD62	1.35	0.00	0.30			0.70					0.30	0.70		1.35					0.30	0.40		0.65					
AD63	3.00	0.00	0.40		0.70	1.90					0.40	0.70	1.90	3.00					0.40	0.30	1.20	1.10					
AD64	1.32	0.00					0.25	0.70				0.25				0.70	1.32			0.25			0.45	0.50			
AD65	1.50	0.00	0.40			1.00					0.40	1.00		1.50					0.40			0.50					
AD66	1.80		0.00			1.00						1.00		1.80						1.00		0.80					
Min	0.85	0.00	0.00		0.00	0.60	0.25	0.00	0.35	0.70	0.20	0.35	0.90	1.30	0.70	0.85	0.70	1.30	0.20	0.00	0.20	0.25	0.45	0.15	0.30	0.20	
Max	3.60	0.00	0.50		1.60	2.60	1.20	1.45	0.40	2.50	0.60	2.60	3.05	3.60	2.60	3.00	3.20	3.20	0.60	2.15	2.45	2.30	2.05	2.40	2.10	2.25	
Median	2.40	0.00	0.35		0.78	1.18	0.60	0.60	0.40	1.55	0.40	0.80	1.53	2.45	1.45	1.60	0.95	2.78	0.40	0.58	0.80	0.90	0.80	1.05	0.60	0.65	
Average	2.31	0.00	0.26		0.77	1.40	0.64	0.60	0.38																		

All Test Pits

	(m)	Depth of Test Pit (m)	Topsoil	Sheetwash	Shale Rock	Residual Dolerite	Dolerite Rock	Residual Sandstone	Sandstone Rock
Min	Depth to Top of Unit	0.80	0.00	0.00	0.20	0.25	0.00	0.35	0.70
Max		3.60	0.00	0.50	2.60	1.20	2.60	0.40	2.50
Median		2.35	0.00	0.30	1.20	0.65	0.80	0.40	1.80
Count		98	61	81	51	20	30	3	5
% Encountering			62%	83%	52%	20%	31%	3%	5%
Min	Depth to Base of Unit		0.20	0.35	1.30	0.60	0.80	0.70	1.30
Max			0.60	2.60	3.60	3.00	3.30	2.50	3.20
Median			0.40	0.80	2.40	1.55	1.75	0.95	2.85
Min	Thickness of Unit		0.20	0.00	0.25	0.15	0.10	0.30	0.20
Max			0.60	2.15	2.30	2.30	2.40	2.10	2.25
Median			0.40	0.60	0.90	0.85	0.65	0.60	0.70

Ash Footprint

	(m)	Depth of Test Pit (m)	Topsoil	Sheetwash	Shale Rock	Residual Dolerite	Dolerite Rock	Residual Sandstone	Sandstone Rock
Min	Depth to Top of Unit	0.85	0.00	0.00	0.60	0.25	0.00	0.35	0.70
Max		3.60	0.00	0.50	2.60	1.20	1.45	0.40	2.50
Median		2.40	0.00	0.35	1.18	0.60	0.60	0.40	1.55
Count		66	48	55	44	7	11	3	4
% Encountering			73%	83%	67%	11%	17%	5%	6%
Min	Depth to Base of Unit		0.20	0.35	1.30	0.70	0.85	0.70	1.30
Max			0.60	2.60	3.60	2.60	3.00	2.50	3.20
Median			0.40	0.80	2.45	1.45	1.60	0.95	2.78
Min	Thickness of Unit		0.20	0.00	0.25	0.45	0.15	0.30	0.20
Max			0.60	2.15	2.30	2.05	2.40	2.10	2.25
Median			0.40	0.58	0.90	0.80	1.05	0.60	0.65

Pollution Control Dam

	(m)	Shale Rock	Residual Dolerite	Dolerite Rock	Sandstone Rock
Min	Depth to Top of Unit	0.90	0.30	0.60	
Max		1.50	1.00	2.50	
Median		1.35	0.78	1.50	
Count		4	10	8	
% Encountering		27%	67%	53%	
Min	Depth to Base of Unit	1.40	0.60	1.00	
Max		3.30	3.00	3.00	
Median		2.45	1.75	2.00	
Min	Thickness of Unit	0.50	0.15	0.10	
Max		1.80	2.30	1.60	
Median		1.10	1.00	0.45	

Return Runoff Dam - RRD

	(m)	Depth of Test Pit (m)	Topsoil	Sheetwash	Shale Rock	Residual Dolerite	Dolerite Rock		Sandstone Rock
Min	Depth to Top of Unit	0.80	0.00	0.00	0.20	0.30	0.40		1.80
Max		3.30	0.00	0.50	1.30	1.20	2.60		1.80
Median		2.05	0.00	0.00	1.10	0.30	0.80		1.80
Count		17	9	12	3	3	11		1
% Encountering			53%	71%	18%	18%	65%		6%
Min	Depth to Base of Unit		0.20	0.50	1.50	1.10	0.80		3.10
Max			0.50	1.60	3.00	1.80	3.30		3.10
Median			0.30	0.90	2.10	1.50	1.70		3.10
Min	Thickness of Unit		0.20	0.40	0.40	0.60	0.10		1.30
Max			0.50	1.60	1.90	1.20	1.30		1.30
Median			0.30	0.80	1.70	0.80	0.60		1.30



APPENDIX C

Borehole and Test Pit Logs



TEST PIT PROFILE

CLIENT: Eskom Holdings SOC
PROJECT: Tutuka Ash Dump Extension
LOCATION: Standerton, Mpumalanga
PROJECT NO: 1658666

HOLE No: AD01

X COORD: 737744.00
Y COORD: 7035156.00
DATUM: 35s
ELEVATION:

Page 1 of 1

Scale	Legend	Depth	Description
		0.00	Moist, dark brown, soft, shattered, silty CLAY with traces of rootlets. TOPSOIL.
		0.30	
		0.50	Moist, dark grey becoming olive, firm, slickensided and shattered, silty CLAY. SHEETWASH.
0.5			
			Slightly moist, light olive, firm, shattered, silty CLAY with minor sand. RESIDUAL SHALE.
1.0			
		1.50	
1.5			Olive, highly weathered to medium weathered, very fine grained, laminated and fissile, <u>very soft to soft rock</u> SHALE.
2.0			
2.5			
3.0		3.00	
			No Refusal
			End of log
3.5			

- NOTES: 1: End of Hole at 3.0 m
2: No groundwater seepage
3: Foundation indicator sample taken at 0,3-0,5 m

Golder Associates Africa (Pty) Ltd.
Maxwell Office Park, Midrand
Gauteng, 0001
Telephone: [+27] (11) 254 4800
Fax: [+27] 086 582 1561

CONTRACTOR: Phezulu Projects
MACHINE: TLB 580T CASE
PIT LxB: 1.5x2.5
FILE REF: TP'S.GPJ

DATE EXCAVATED: 2016/11/16
DATE PROFILED: 2016/11/16
PROFILED BY: PM
CHECKED BY: SG





TEST PIT IMAGES

Table 1: AD01

Description	Photo
AD01 Total depth is 3 m	 A photograph showing a cross-section of a test pit. The soil is dark and appears to be composed of several distinct layers or horizons. The top layer is dark and somewhat crumbly, while the lower layers are more uniform in color and texture. Some sparse vegetation is visible on the right side of the pit.
AD01 Material from 0 to 3 m	 A photograph showing an orange excavator with "CASE" written on its arm, dumping a large pile of dark, moist soil. The soil is piled up in the foreground, and the background shows a green field under a blue sky with scattered clouds.



TEST PIT PROFILE

CLIENT: Eskom Holdings SOC
PROJECT: Tutuka Ash Dump Extension
LOCATION: Standerton, Mpumalanga
PROJECT NO: 1658666

HOLE No: AD02

X COORD: 737830.00
Y COORD: 7035562.00
DATUM: 35s
ELEVATION:

Page 1 of 1

Scale	Legend	Depth	Description
		0.00	Moist, dark brown, <u>soft</u> , shattered, silty CLAY with traces of rootlets. TOPSOIL.
0.5		0.40	Slightly moist, dark grey, <u>firm</u> , shattered, gravelly silty CLAY. SHEETWASH.
1.0		0.75	Brownish mottled olive grey, medium weathered, very fine grained, laminated and fissile, <u>soft rock</u> SHALE.
1.5			
2.0			
2.5			
3.0		3.05	No Refusal
3.5			End of log

- NOTES: 1: End of Hole at 3.05 m
2: No groundwater seepage
3: No sample taken
4: DCP conducted

Golder Associates Africa (Pty) Ltd.
Maxwell Office Park, Midrand
Gauteng, 0001
Telephone: [+27] (11) 254 4800
Fax: [+27] 086 582 1561

CONTRACTOR: Phezulu Projects
MACHINE: TLB 580T CASE
PIT LxB: 1.5x2.5
FILE REF: TP'S.GPJ

DATE EXCAVATED: 2016/11/16
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TEST PIT IMAGES

Table 2: AD02

Description	Photo
<p>AD02 Total depth is 3.05 m</p>	 A photograph showing a cross-section of a test pit. The soil is dark and appears to be composed of several distinct layers. The top layer is dark and silty, followed by a lighter, more sandy layer, and then a darker, more silty layer at the bottom. The pit is dug into a grassy area, and some grass is visible on the left side.
<p>AD02 Material from 0 to 3.05 m</p>	 A photograph showing an orange CASE excavator dumping a large pile of material into a test pit. The material is a mix of soil and small rocks. The excavator's arm and bucket are visible, and the background shows a green field under a blue sky.



TEST PIT PROFILE

CLIENT: Eskom Holdings SOC
 PROJECT: Tutuka Ash Dump Extension
 LOCATION: Standerton, Mpumalanga
 PROJECT NO: 1658666

HOLE No: AD03

X COORD: 737922.00
 Y COORD: 7035896.00
 DATUM: 35s
 ELEVATION:

Scale	Legend	Depth	Description
0.5		0.00	Moist, dark brown to grey, <u>firm</u> , shattered, silty CLAY. ALLUVIUM.
1.0		0.70	Moist, dark brown becoming grey, <u>stiff</u> , shattered, silty CLAY with minor sand. SHEETWASH.
1.5		0.90	Slightly moist, light yellowish brown, <u>stiff</u> , shattered and slickensided, silty CLAY with minor sand. RESIDUAL SHALE.
2.0		1.10	Yellowish brown, medium weathered, very fine grained, laminated and fissile, closely jointed, <u>soft rock</u> SHALE.
2.5		2.30	Refusal at 2.3 m
3.0			End of log
3.5			

- NOTES: 1: End of Hole at 2.3 m
 2: No groundwater seepage
 3: No sample taken

Golder Associates Africa (Pty) Ltd.
 Maxwell Office Park, Midrand
 Gauteng, 0001
 Telephone: [+27] (11) 254 4800
 Fax: [+27] 086 582 1561

CONTRACTOR: Phezulu Projects
 MACHINE: TLB 580T CASE
 PIT LxB: 1.5x2.5
 FILE REF: TP'S.GPJ



DATE EXCAVATED: 2016/11/10
 DATE PROFILED: 2016/11/10
 PROFILED BY: PM
 CHECKED BY: SG





TEST PIT IMAGES



Table 3: AD03

Description	Photo
<p>AD03 Total depth is 2.3 m</p>	 A photograph of a test pit showing soil layers. The top layer is dark brown, followed by a lighter brown layer, and then a darker, more textured layer at the bottom. The pit is dug into the ground, and some vegetation is visible around the edges.
<p>AD03 Material from 0 to 2.3 m</p>	 A photograph of a pile of rocks of various sizes, ranging from small pebbles to larger boulders. A red and blue measuring tape is placed on the rocks in the center of the frame for scale.



TEST PIT IMAGES

Table 4: AD04

Description	Photo
<p>AD04 Total depth is 3.25 m</p>	
<p>AD04 Material from 0 to 3.25 m</p>	



TEST PIT PROFILE

CLIENT: Eskom Holdings SOC
PROJECT: Tutuka Ash Dump Extension
LOCATION: Standerton, Mpumalanga
PROJECT NO: 1658666

HOLE No: AD05

X COORD: 737973.00
Y COORD: 7035308.00
DATUM: 35s
ELEVATION:

Page 1 of 1

Scale	Legend	Depth	Description
		0.00	Moist, dark brown, <u>soft to firm</u> , shattered, silty CLAY with traces of rootlets. SHEETWASH.
0.5		0.45	Moist becoming slightly moist, grey olive, <u>firm to stiff</u> , shattered and slickensided, silty CLAY with minor sand. SHEETWASH.
1.0			
1.5			
2.0			
2.5		2.60	Light yellowish brown, completely weathered to highly weathered, very fine grained, laminated and fissile, <u>very soft to soft rock</u> SHALE.
3.0			
3.5		3.60	
			No Refusal

End of log

- NOTES: 1: End of Hole at 3.6 m
2: No groundwater seepage
3: Bulk sample taken from depth 1.9 - 2.1 m

Golder Associates Africa (Pty) Ltd.
Maxwell Office Park, Midrand
Gauteng, 0001
Telephone: [+27] (11) 254 4800
Fax: [+27] 086 582 1561

CONTRACTOR: Phezulu Projects
MACHINE: TLB 580T CASE
PIT LxB: 1.5x2.5
FILE REF: TP'S.GPJ

DATE EXCAVATED: 2016/11/16
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TEST PIT IMAGES

Table 5: AD05

Description	Photo
<p>AD05 Total depth is 3.60 m</p>	 A vertical photograph showing the interior wall of a test pit. The soil is dark brown and appears to be a silty clay or loam. There are some horizontal layering or bedding planes visible. A concrete curb or edge is visible on the left side of the pit.
<p>AD05 Material from 0 to 3.60 m</p>	 A photograph showing a yellow CASE excavator in a field. The excavator's bucket is dumping a load of dark, silty soil onto a large pile. The background shows a green field under a blue sky with some clouds.



TEST PIT PROFILE

CLIENT: Eskom Holdings SOC
PROJECT: Tutuka Ash Dump Extension
LOCATION: Standerton, Mpumalanga
PROJECT NO: 1658666

HOLE No: AD06

X COORD: 738066.00
Y COORD: 7035711.00
DATUM: 35s
ELEVATION:

Page 1 of 1

Scale	Legend	Depth	Description
		0.00	Moist, dark brown, <u>soft to firm</u> , shattered, silty CLAY with traces of rootlets. ALLUVIUM.
0.5		0.40	Slightly moist, dark grey, <u>very stiff</u> , shattered, silty CLAY with minor sand. SHEETWASH.
1.0			
1.5		1.80	
2.0			Light yellowish brown, highly weathered, very fine grained, laminated and fissile, very closely jointed, <u>soft rock</u> SHALE.
		2.40	
2.5			Refusal at 2.4 m
3.0			End of log
3.5			

NOTES: 1: End of Hole at 2.4 m
2: No groundwater seepage
3: Bulk sample taken from 1.4 -1.5 m

Golder Associates Africa (Pty) Ltd.
Maxwell Office Park, Midrand
Gauteng, 0001
Telephone: [+27] (11) 254 4800
Fax: [+27] 086 582 1561

CONTRACTOR: Phezulu Projects
MACHINE: TLB 580T CASE
PIT LxB: 1.5x2.5
FILE REF: TP'S.GPJ

DATE EXCAVATED: 2016/11/10
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TEST PIT IMAGES

Table 6: AD06

Description	Photo
<p>AD06 Total depth is 2.40 m</p>	 A photograph showing a cross-section of a test pit. The top layer is dark, rich soil. Below it is a lighter, sandy layer. At the bottom, there is a layer of dark, rocky material. The pit is dug into a grassy area.
<p>AD06 Material from 0 to 2.40 m</p>	 A photograph showing a large pile of soil and rocks, likely the material excavated from the test pit. The pile is composed of dark, rocky material and is situated in a grassy field. In the background, there are some industrial structures.



TEST PIT PROFILE

CLIENT: Eskom Holdings SOC
 PROJECT: Tutuka Ash Dump Extension
 LOCATION: Standerton, Mpumalanga
 PROJECT NO: 1658666

HOLE No: AD07

X COORD: 738093.00
 Y COORD: 7035956.00
 DATUM: 35s
 ELEVATION:

Page 1 of 1

Scale	Legend	Depth	Description
		0.00	Moist, dark brown to grey, <u>soft to firm</u> , shattered, silty CLAY with traces of rootlets. TOPSOIL.
0.5		0.40	Slightly moist, greyish, <u>stiff</u> , shattered and slickensided, silty CLAY with minor sand. SHEETWASH.
		0.80	with some fine grained gravels
1.0		1.10	Slightly moist, light brown, <u>stiff</u> , slickensided, silty CLAY. RESIDUAL SHALE.
1.5		2.20	Light olive grey, medium weathered, very fine grained, laminated and fissile, closely jointed, <u>soft to medium hard rock</u> SHALE.
2.0			Refusal at 2.2 m
2.5			End of log
3.0			
3.5			

NOTES: 1: End of hole at 2.2 m
 2: No groundwater seepage
 3: No sample taken

Golder Associates Africa (Pty) Ltd.
 Maxwell Office Park, Midrand
 Gauteng, 0001
 Telephone: [+27] (11) 254 4800
 Fax: [+27] 086 582 1561

CONTRACTOR: Phezulu Projects
 MACHINE: TLB 580T CASE
 PIT LxB: 1.5x2.5
 FILE REF: TP'S.GPJ

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TEST PIT IMAGES

Table 7: AD07

Description	Photo
<p>AD07 Total depth is 2.20 m</p>	 A photograph of a test pit excavation. The soil is dark brown and appears to be a silty clay or loam. There is a distinct horizontal layer of lighter-colored, possibly sandy or silty material, located approximately 1.5 to 2.0 meters below the surface. The pit is surrounded by green grass.
<p>AD07 Material from 0 to 2.20 m</p>	 A photograph of a large pile of excavated material, consisting of dark, angular rocks and soil fragments. The pile is situated on a grassy area. A shovel is visible at the top of the pile, indicating recent excavation.



TEST PIT PROFILE

CLIENT: Eskom Holdings SOC
 PROJECT: Tutuka Ash Dump Extension
 LOCATION: Standerton, Mpumalanga
 PROJECT NO: 1658666

HOLE No: AD08

X COORD: 738024.00
 Y COORD: 7034755.00
 DATUM: 35s
 ELEVATION:

Page 1 of 1

Scale	Legend	Depth	Description
		0.00	Moist, dark brown, <u>very soft to soft</u> , shattered, silty CLAY with traces of rootlets. SHEETWASH.
0.5		0.40	Moist, dark grey becoming speckled black, <u>firm to stiff</u> , shattered and moderately slickensided, silty CLAY. SHEETWASH.
1.0		0.75	Slightly moist, olive grey speckled black, <u>stiff</u> , shattered and slickensided, silty CLAY with minor sand. RESIDUAL SHALE.
1.5		1.60	Greenish, highly weathered, very fine grained, laminated and fissile, closely jointed, <u>very soft to soft rock</u> SHALE.
2.0		2.0	
2.5		2.5	
3.0		3.0	
		3.05	No Refusal
3.5			End of log

NOTES: 1: End of Hole at 3.05 m
 2: No groundwater seepage
 3: No sample taken

Golder Associates Africa (Pty) Ltd.
 Maxwell Office Park, Midrand
 Gauteng, 0001
 Telephone: [+27] (11) 254 4800
 Fax: [+27] 086 582 1561

CONTRACTOR: Phezulu Projects
 MACHINE: TLB 580T CASE
 PIT LxB: 1.5x2.5
 FILE REF: TP'S.GPJ



DATE EXCAVATED: 2016/11/17
 DATE PROFILED: 2016/11/17
 PROFILED BY: PM
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TEST PIT IMAGES

Table 8: AD08

Description	Photo
<p>AD08 Total depth is 3.05 m</p>	 A vertical cross-section of a test pit. The top layer is dark, almost black, soil. Below this is a thick, uniform layer of light brown, silty soil. At the bottom, there is a thin, dark, and more textured layer. The pit is surrounded by a gravelly or rocky ground surface.
<p>AD08 Material from 0 – 3.05 m</p>	 An orange CASE excavator is shown from the side, dumping a large pile of dark, clumpy soil onto a green grassy field. The excavator's arm and bucket are visible, and the word 'CASE' is printed on the side of the boom. The background shows a clear blue sky and a flat horizon.



TEST PIT PROFILE

CLIENT: Eskom Holdings SOC
 PROJECT: Tutuka Ash Dump Extension
 LOCATION: Standerton, Mpumalanga
 PROJECT NO: 1658666

HOLE No: AD09

X COORD: 738092.00
 Y COORD: 7035074.00
 DATUM: 35s
 ELEVATION:

Page 1 of 1

Scale	Legend	Depth	Description
		0.00	Moist, dark brown, shattered and slickensided, <u>soft</u> , silty CLAY with rootlets. Topsoil.
		0.25	Moist, dark grey, shattered and slickensided, <u>firm</u> , silty CLAY. Sheetwash.
0.5		0.60	Slightly moist to moist, olive grey, shattered, <u>firm becoming stiff</u> , silty CLAY. Residual Shale.
1.0			
1.5			
2.0			
2.5			
3.0		3.05	No refusal
3.5			End of log

NOTES: 1: End of hole at 3.05 m
 2: No groundwater seepage
 3: No sample taken

Golder Associates Africa (Pty) Ltd.
 Maxwell Office Park, Midrand
 Gauteng, 0001
 Telephone: [+27] (11) 254 4800
 Fax: [+27] 086 582 1561

CONTRACTOR: Phezulu Projects
 MACHINE: TLB 580T CASE
 PIT LxB: 1.5x2.5
 FILE REF: TP'S.GPJ



DATE EXCAVATED: 2016/11/16
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TEST PIT IMAGES

Table 9: AD09

Description	Photo
<p>AD09 Total depth is 3.05 m</p>	
<p>AD09 Material from 0 to 3.05 m</p>	



TEST PIT PROFILE

CLIENT: Eskom Holdings SOC
 PROJECT: Tutuka Ash Dump Extension
 LOCATION: Standerton, Mpumalanga
 PROJECT NO: 1658666

HOLE No: AD10

X COORD: 738251.00
 Y COORD: 7035355.00
 DATUM: 35s
 ELEVATION:

Page 1 of 1

Scale	Legend	Depth	Description
		0.00	Moist, dark brown, <u>firm</u> , shattered, silty CLAY with traces of rootlets. TOPSOIL.
0.5		0.45	Slightly moist, light grey, <u>firm becoming stiff</u> , slickensided and shattered, silty CLAY. SHEETWASH.
1.0		1.10	Slightly moist, light brown, <u>stiff</u> , slickensided and shattered, silty CLAY. RESIDUAL SHALE.
1.5		2.20	Yellowish brown, highly weathered to medium weathered, very fine grained, laminated and fissile, closely jointed, <u>soft to medium hard rock</u> SHALE.
2.0		2.90	Refusal at 2.9 m
2.5			End of log
3.0			
3.5			

NOTES: 1: End of Hole at 2.9 m
 2: No groundwater seepage
 3: No sample taken

Golder Associates Africa (Pty) Ltd.
 Maxwell Office Park, Midrand
 Gauteng, 0001
 Telephone: [+27] (11) 254 4800
 Fax: [+27] 086 582 1561

CONTRACTOR: Phezulu Projects
 MACHINE: TLB 580T CASE
 PIT LxB: 1.5x2.5
 FILE REF: TP'S.GPJ

DATE EXCAVATED: 2016/11/10
 DATE PROFILED: 2016/11/10
 PROFILED BY: PM
 CHECKED BY: SG





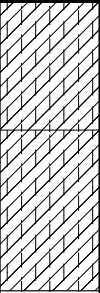


TEST PIT PROFILE

CLIENT: Eskom Holdings SOC
PROJECT: Tutuka Ash Dump Extension
LOCATION: Standerton, Mpumalanga
PROJECT NO: 1658666

HOLE No: AD11

X COORD: 738303.00
Y COORD: 7035581.00
DATUM: 35s
ELEVATION:

Page 1 of 1

Scale	Legend	Depth	Description
		0.00	Moist, dark brown becoming grey, <u>soft to firm</u> , shattered, silty CLAY. ALLUVIUM.
0.5		0.40	Slightly moist, light grey becoming yellowish brown, <u>stiff</u> , shattered and slickensided, silty CLAY. RESIDUAL SHALE.
1.0		0.90	Yellowish brown, medium weathered, very fine grained, laminated and fissile, <u>medium hard rock</u> , iron oxide staining SHALE.
2.0			
2.5			
2.80			
3.0			Refusal at 2.8 m
3.5			End of log

NOTES: 1: End of Hole at 2.8 m
2: No groundwater seepage
3: Bulk sample taken from 0,30 - 0,55 m

Golder Associates Africa (Pty) Ltd.
Maxwell Office Park, Midrand
Gauteng, 0001
Telephone: [+27] (11) 254 4800
Fax: [+27] 086 582 1561

CONTRACTOR: Phezulu Projects
MACHINE: TLB 580T CASE
PIT LxB: 1.5x2.5
FILE REF: TP'S.GPJ

DATE EXCAVATED: 2016/11/10
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TEST PIT IMAGES

Table 10: AD11

Description	Photo
<p>AD11 Total depth is 2.90 m</p>	 A photograph showing a cross-section of a test pit. The top layer is dark, rich soil. Below it is a lighter, sandy layer with visible horizontal layering. The pit is surrounded by green grass and some weeds.
<p>AD11 Material from 0 to 2.90 m</p>	 A photograph of an orange CASE excavator bucket dumping a large pile of light-colored, rocky material. The material consists of many small, angular stones and pebbles. The excavator is positioned on a grassy field.



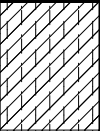
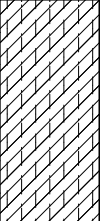

TEST PIT PROFILE

CLIENT: Eskom Holdings SOC
PROJECT: Tutuka Ash Dump Extension
LOCATION: Standerton, Mpumalanga
PROJECT NO: 1658666

HOLE No: AD12

X COORD: 738350.00
Y COORD: 7035861.00
DATUM: 35s
ELEVATION:

Page 1 of 1

Scale	Legend	Depth	Description
		0.00	Moist, dark brown, <u>soft to firm</u> , shattered, silty CLAY with traces of rootlets. TOPSOIL.
▼ 0.5		0.40	Moist to slightly moist, dark grey, <u>firm</u> , shattered and slickensided, silty CLAY. SHEETWASH.
1.0		1.10	Dark grey becoming mottled olive, medium weathered, very fine grained, laminated and fissile, <u>soft rock</u> SHALE.
1.5		2.00	Refusal at 2.0 m.
2.0			End of log
2.5			
3.0			
3.5			

NOTES: 1: End of Hole at 2.0 m
2: Groundwater seepage at 0,5 m
3: Disturbed sample taken from 0,5 - 0,7 m

Golder Associates Africa (Pty) Ltd.
Maxwell Office Park, Midrand
Gauteng, 0001
Telephone: [+27] (11) 254 4800
Fax: [+27] 086 582 1561

CONTRACTOR: Phezulu Projects
MACHINE: TLB 580T CASE
PIT LxB: 1.5x2.5
FILE REF: TP'S.GPJ

DATE EXCAVATED: 2016/11/16
DATE PROFILED: 2016/11/16
PROFILED BY: PM
CHECKED BY: SG





TEST PIT IMAGES

Table 11: AD12

Description	Photo
<p>AD12 Total depth is 2.0 m</p>	 A photograph showing a cross-section of a test pit. The top edge is covered with dry, light-colored grasses and roots. Below the surface, the soil is dark and appears to be a silty or clayey material. There are some horizontal layers or cracks visible in the soil. The bottom of the pit is not clearly visible, but it appears to be a similar material.
<p>AD12 Material from 0 to 2.0 m</p>	 A photograph of a large pile of excavated material. The material consists of dark, silty soil mixed with numerous angular, light-colored rocks and stones of various sizes. The pile is situated in an open field with a clear blue sky and a green hill in the background.



TEST PIT PROFILE

CLIENT: Eskom Holdings SOC
PROJECT: Tutuka Ash Dump Extension
LOCATION: Standerton, Mpumalanga
PROJECT NO: 1658666

HOLE No: AD13

X COORD: 738211.00
Y COORD: 7034938.00
DATUM: 35s
ELEVATION:

Page 1 of 1

Scale	Legend	Depth	Description
		0.00	Moist, dark brown, <u>soft</u> , moderately shattered, silty CLAY with traces of rootlets. TOPSOIL.
0.5		0.50	Moist, dark grey becoming light grey, <u>firm</u> , shattered, silty CLAY. SHEETWASH.
		0.80	
1.0			Slightly moist, mottled olive grey, <u>firm to stiff</u> , slightly shattered and slickensided, silty CLAY with minor sand. RESIDUAL SHALE.
1.5			
2.0		2.05	
			Light yellowish brown, highly weathered to medium weathered, very fine grained, laminated and fissile, <u>very soft to medium hard rock</u> SHALE.
2.5			
3.0		3.05	
			No Refusal
3.5			End of log

NOTES: 1: End of Hole at 3.05 m
2: No groundwater seepage
3: Disturbed sample taken from 0,4 - 0,6 m

Golder Associates Africa (Pty) Ltd.
Maxwell Office Park, Midrand
Gauteng, 0001
Telephone: [+27] (11) 254 4800
Fax: [+27] 086 582 1561

CONTRACTOR: Phezulu Projects
MACHINE: TLB 580T CASE
PIT LxB: 1.5x2.5
FILE REF: TP'S.GPJ

DATE EXCAVATED: 2016/11/16
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TEST PIT IMAGES

Table 12: AD13

Description	Photo
<p>AD13 Total depth is 3.05</p>	
<p>AD13 Material from 0 to 3.05 m</p>	



TEST PIT PROFILE

CLIENT: Eskom Holdings SOC
PROJECT: Tutuka Ash Dump Extension
LOCATION: Standerton, Mpumalanga
PROJECT NO: 1658666

HOLE No: AD14

X COORD: 738399.00
Y COORD: 7035108.00
DATUM: 35s
ELEVATION:

Page 1 of 1

Scale	Legend	Depth	Description
		0.00	Moist, dark brown becoming grey, <u>soft to firm</u> , shattered, silty CLAY with traces of rootlets.
		0.40	TOPSOIL.
0.5			Slightly moist, greyish, <u>stiff</u> , shattered and slickensided, silty CLAY with traces of sand.
		1.10	SHEETWASH.
1.0			Slightly moist, light brown, <u>stiff</u> , shattered, silty CLAY.
		1.30	RESIDUAL SHALE.
1.5			Yellowish brown, medium weathered to slightly weathered, very fine grained, laminated and fissile, closely jointed, <u>soft rock</u>
		2.10	SHALE.
			Refusal at 2.1 m
2.5			End of log
3.0			
3.5			

NOTES: 1: End of Hole at 2.1 m
2: No groundwater seepage
3: Disturbed sample taken from 1.0 -1.2 m

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Gauteng, 0001
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Fax: [+27] 086 582 1561

CONTRACTOR: Phezulu Projects
MACHINE: TLB 580T CASE
PIT LxB: 1.5x2.5
FILE REF: TP'S.GPJ

DATE EXCAVATED: 2016/11/10
DATE PROFILED: 2016/11/10
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CHECKED BY: SG



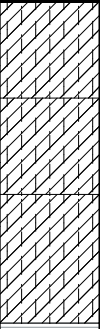


TEST PIT PROFILE

CLIENT: Eskom Holdings SOC
 PROJECT: Tutuka Ash Dump Extension
 LOCATION: Standerton, Mpumalanga
 PROJECT NO: 1658666

HOLE No: AD15

X COORD: 738512.00
 Y COORD: 7035535.00
 DATUM: 35s
 ELEVATION:

Scale	Legend	Depth	Description
		0.00	Moist, light brown, <u>soft</u> , shattered, silty CLAY with traces of rootlets. TOPSOIL.
		0.30	
0.5		0.60	Moist becoming slightly moist, greyish, <u>firm</u> , shattered and slickensided, silty CLAY. SHEETWASH.
1.0		1.00	Slightly moist, dark grey and mottled brown, <u>stiff</u> , slickensided and shattered, silty CLAY with traces of sand. RESIDUAL SHALE.
1.5			Olive grey, medium weathered, very fine grained, laminated and fissile, closely jointed, <u>medium hard rock</u> SHALE.
			Refusal at 1.3 m
			End of log
2.0			
2.5			
3.0			
3.5			

- NOTES: 1: End of Hole at 1.3 m
 2: No groundwater seepage
 3: Disturbed sample taken from 0.2 - 0.3 m

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 Telephone: [+27] (11) 254 4800
 Fax: [+27] 086 582 1561

CONTRACTOR: Phezulu Projects
 MACHINE: TLB 580T CASE
 PIT LxB: 1.5x2.5
 FILE REF: TP'S.GPJ

DATE EXCAVATED: 2016/11/10
 DATE PROFILED: 2016/11/10
 PROFILED BY: PM
 CHECKED BY: SG





TEST PIT IMAGES

Table 13: AD15

Description	Photo
<p>AD15 Total depth is 1.30 m</p>	 A photograph of a test pit showing soil layers. The top layer is dark brown, followed by a lighter brown layer, and then a layer of reddish-brown soil. The pit is surrounded by grass and some dry vegetation.
<p>AD15 Material from 0 to 1.30 m</p>	 A photograph of a pile of soil material, likely from the test pit, sitting on a grassy area. The soil is dark brown and appears to contain some small rocks or debris. A portion of an orange excavator is visible in the background.

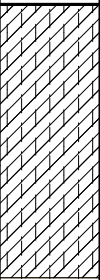
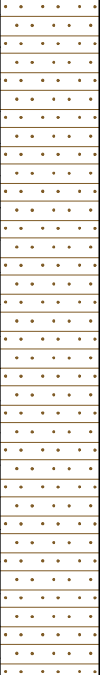


TEST PIT PROFILE

CLIENT: Eskom Holdings SOC
 PROJECT: Tutuka Ash Dump Extension
 LOCATION: Standerton, Mpumalanga
 PROJECT NO: 1658666

HOLE No: AD16

X COORD: 738608.00
 Y COORD: 7035830.00
 DATUM: 35s
 ELEVATION:

Scale	Legend	Depth	Description
0.00		0.00	Very moist to moist, dark brown to grey, <u>stiff to firm</u> , shattered, silty CLAY with traces of rootlets. ALLUVIUM.
0.5			
0.85		0.85	
1.0			Brownish becoming mottled orange red, highly weathered to medium weathered, fine to medium grained, <u>soft to medium hard rock</u> SANDSTONE.
1.5			
2.0			
2.5			
3.0		3.00	
			No Refusal
			End of log
3.5			

- NOTES: 1: End of Hole at 3.0 m
 2: Groundwater seepage at 1.20 m
 3: No sample taken

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 Telephone: [+27] (11) 254 4800
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CONTRACTOR: Phezulu Projects
 MACHINE: TLB 580T CASE
 PIT LxB: 1.5x2.5
 FILE REF: TP'S.GPJ

DATE EXCAVATED: 2016/11/16
 DATE PROFILED: 2016/11/16
 PROFILED BY: PM
 CHECKED BY: SG





TEST PIT IMAGES

Table 14: AD16

Description	Photo
<p>AD16 Total depth is 3.0 m</p>	 A photograph of a test pit showing soil layers. The top layer is dark brown/black, followed by a lighter brown layer, and then a darker layer at the bottom. The pit is surrounded by grass.
<p>AD16 Material from 0 to 3.0 m</p>	 A photograph of a large pile of excavated soil, showing a mix of dark brown and black material. The pile is situated in a grassy field, and the back of an excavator is visible on the right side.



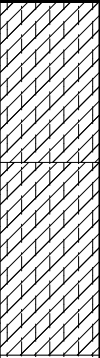
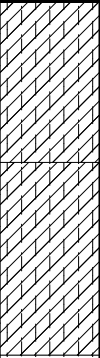


TEST PIT PROFILE

CLIENT: Eskom Holdings SOC
 PROJECT: Tutuka Ash Dump Extension
 LOCATION: Standerton, Mpumalanga
 PROJECT NO: 1658666

HOLE No: AD17

X COORD: 738404.00
 Y COORD: 7034624.00
 DATUM: 35s
 ELEVATION:

Page 1 of 1

Scale	Legend	Depth	Description
0.5		0.00	Moist, dark brown, <u>soft to firm</u> , shattered, silty CLAY with traces of rootlets. ALLUVIUM.
1.0		0.50	Moist to slightly moist, dark brown grey, <u>firm becoming stiff</u> , shattered and moderately slickensided, silty CLAY. SHEETWASH.
1.5		1.10	Olive, very fine grained, highly weathered, jointed, fissile and laminated, <u>soft rock</u> SHALE.
2.0		3.00	No Refusal
3.0			End of log
3.5			

NOTES: 1: End of Hole at 3.0 m
 2: No groundwater seepage
 3: No sample taken

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 Telephone: [+27] (11) 254 4800
 Fax: [+27] 086 582 1561

CONTRACTOR: Phezulu Projects
 MACHINE: TLB 580T CASE
 PIT LxB: 1.5x2.5
 FILE REF: TP'S.GPJ

DATE EXCAVATED: 2016/11/17
 DATE PROFILED: 2016/11/17
 PROFILED BY: PM
 CHECKED BY: SG





TEST PIT IMAGES

Table 15: AD17

Description	Photo
<p>AD17 Total depth is 3.0 m</p>	
<p>AD17 Material from 0 to 3.0 m</p>	



TEST PIT PROFILE

CLIENT: Eskom Holdings SOC
PROJECT: Tutuka Ash Dump Extension
LOCATION: Standerton, Mpumalanga
PROJECT NO: 1658666

HOLE No: AD18

X COORD: 738425.00
Y COORD: 7034897.00
DATUM: 35s
ELEVATION:

Page 1 of 1

Scale	Legend	Depth	Description
		0.00	Moist, dark brown, <u>soft</u> , shattered, silty CLAY with traces of rootlets. TOPSOIL.
0.5		0.35	Moist, dark brown becoming light grey, <u>firm</u> , shattered and moderately slickensided, silty CLAY. SHEETWASH.
1.0		0.75	Slightly moist, grey, <u>stiff to very stiff</u> , shattered and slickensided, silty CLAY. RESIDUAL DOLERITE.
1.5		1.45	Dark brown speckled olive blue, medium weathered, fine to medium grained, closely jointed, <u>medium hard rock</u> DOLERITE.
2.0		2.50	Refusal at 2.5 m
2.5			End of log
3.0			
3.5			

NOTES: 1: End of Hole at 2.5 m
2: No groundwater seepage
3: No sample taken
4: DCP conducted

CONTRACTOR: Phezulu Projects
MACHINE: TLB 580T CASE
PIT LxB: 1.5x2.5
FILE REF: TP'S.GPJ

DATE EXCAVATED: 2016/11/17
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Gauteng, 0001
Telephone: [+27] (11) 254 4800
Fax: [+27] 086 582 1561





TEST PIT IMAGES

Table 16: AD18

Description	Photo
<p>AD18 Total depth is 2.50 m</p>	
<p>AD18 Material from 0 to 2.50 m</p>	



TEST PIT PROFILE

CLIENT: Eskom Holdings SOC
PROJECT: Tutuka Ash Dump Extension
LOCATION: Standerton, Mpumalanga
PROJECT NO: 1658666

HOLE No: AD19

X COORD: 738558.00
Y COORD: 7034974.00
DATUM: 35s
ELEVATION:

Page 1 of 1

Scale	Legend	Depth	Description
		0.00	Very moist, dark brownish grey, <u>very soft rock</u> , shattered, silty CLAY with traces of rootlets.
		0.30	TOPSOIL.
0.5			
			Moist, dark grey becoming mottled dark olive, <u>soft to firm</u> , slickensided and shattered, silty CLAY.
			SHEETWASH.
1.0			
		1.10	
			Dark olive grey, medium weathered to slightly weathered, overlain by a completely weathered 200 mm gravel layer, <u>soft to medium hard rock</u>
			SHALE.
1.5			
		1.70	
			Refusal at 1.7 m
2.0			
			End of log
2.5			
3.0			
3.5			

NOTES: 1: End of Hole at 1.7 m
2: No groundwater seepage
3: No sample taken

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Gauteng, 0001
Telephone: [+27] (11) 254 4800
Fax: [+27] 086 582 1561

CONTRACTOR: Phezulu Projects
MACHINE: TLB 580T CASE
PIT LxB: 1.5x2.5
FILE REF: TP'S.GPJ

DATE EXCAVATED: 2016/11/14
DATE PROFILED: 2016/11/14
PROFILED BY: PM
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TEST PIT IMAGES

Table 17: AD19

Description	Photo
<p>AD19 Total depth is 1.70 m</p>	
<p>AD19 Material from 0 to 1.70 m</p>	

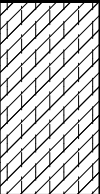



TEST PIT PROFILE

CLIENT: Eskom Holdings SOC
 PROJECT: Tutuka Ash Dump Extension
 LOCATION: Standerton, Mpumalanga
 PROJECT NO: 1658666

HOLE No: AD20

X COORD: 738716.00
 Y COORD: 7035498.00
 DATUM: 35s
 ELEVATION:

Scale	Legend	Depth	Description
0.00		0.00	Moist, dark brown becoming grey, <u>firm</u> , shattered, silty CLAY with traces of rootlets. TOPSOIL.
0.5		0.60	
1.0		1.60	Light grey becoming dark brown trace of white staining, highly weathered to medium weathered, very fine grained, laminated and fissile, closely jointed, <u>soft to medium hard rock</u> SHALE.
1.5			
2.0			Refusal at 1.6 m
2.5			
3.0			
3.5			
			End of log

- NOTES: 1: End of Hole at 1.6 m
 2: No groundwater seepage
 3: Disturbed sample taken from 0.2 - 0.3 m

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 Telephone: [+27] (11) 254 4800
 Fax: [+27] 086 582 1561

CONTRACTOR: Phezulu Projects
 MACHINE: TLB 580T CASE
 PIT LxB: 1.5x2.5
 FILE REF: TP'S.GPJ

DATE EXCAVATED: 2016/11/10
 DATE PROFILED: 2016/11/10
 PROFILED BY: PM
 CHECKED BY: SG





TEST PIT IMAGES

Table 18: AD20

Description	Photo
<p>AD20 Total depth is 1.60 m</p>	 A photograph of a test pit showing soil layers. The top layer is dark brown, topsoil-like soil. Below it is a lighter, tan-colored soil layer. The pit is surrounded by green grass.
<p>AD20 Material from 0 to 1.60 m</p>	 A photograph of a large pile of excavated material, consisting of dark, fragmented rock or soil. A yellow excavator bucket is visible on the right side of the pile. The background shows green grass.



TEST PIT PROFILE

CLIENT: Eskom Holdings SOC
 PROJECT: Tutuka Ash Dump Extension
 LOCATION: Standerton, Mpumalanga
 PROJECT NO: 1658666

HOLE No: AD21

X COORD: 738857.00
 Y COORD: 7035764.00
 DATUM: 35s
 ELEVATION:

Page 1 of 1

Scale	Legend	Depth	Description
		0.00	Moist, dark brown, <u>firm</u> , shattered, silty CLAY with traces of rootlets. TOPSOIL.
0.5		0.40	Slightly moist, dark greyish becoming light olive, <u>stiff</u> , slightly shattered and fissured, silty CLAY.
		0.70	SHEETWASH.
1.0		1.00	Slightly moist to dry, olive brownish, <u>stiff to very stiff</u> , shattered, silty CLAY with some rock fragments. RESIDUAL SHALE.
1.5		1.70	Brown speckled blue, medium weathered, very fine grained, Olive, very fine grained, highly weathered, jointed, <u>soft rock</u> SHALE. , <u>medium hard to hard rock</u> SHALE.
2.0			Refusal at 1.7 m
2.5			End of log
3.0			
3.5			

NOTES: 1: End of Hole at 1.7 m
 2: No groundwater seepage
 3: Bulk sample taken from 0.5 - 0.7 m

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 Telephone: [+27] (11) 254 4800
 Fax: [+27] 086 582 1561

CONTRACTOR: Phezulu Projects
 MACHINE: TLB 580T CASE
 PIT LxB: 1.5x2.5
 FILE REF: TP'S.GPJ

DATE EXCAVATED: 2016/11/15
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 PROFILED BY: PM
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TEST PIT IMAGES

Table 19: AD21

Description	Photo
<p>AD21 Total depth is 1.72 m</p>	
<p>AD21 Material from 0 to 1.70 m</p>	



TEST PIT PROFILE

CLIENT: Eskom Holdings SOC
PROJECT: Tutuka Ash Dump Extension
LOCATION: Standerton, Mpumalanga
PROJECT NO: 1658666

HOLE No: AD22

X COORD: 738646.00
Y COORD: 7034802.00
DATUM: 35s
ELEVATION:

Page 1 of 1

Scale	Legend	Depth	Description
		0.00	Moist, dark brown, <u>soft to firm</u> , moderately shattered and shattered, silty CLAY. TOPSOIL.
0.5		0.50	Moist becoming slightly moist, dark brown becoming dark grey, <u>firm</u> , shattered, silty CLAY.
		0.80	SHEETWASH.
1.0		1.15	Slightly moist, dark grey olive, <u>firm becoming stiff</u> , shattered, silty CLAY. RESIDUAL SHALE.
1.5			Light brownish, medium weathered, very fine grained, laminated and fissile, closely jointed, <u>medium hard rock</u> SHALE.
2.0		2.20	
2.5			Refusal at 2.2 m
3.0			
3.5			
			End of log

- NOTES: 1: End of Hole at 2.2 m
2: No groundwater seepage
3: Disturbed sample taken from 0,4 - 0,6 m & Block sample taken from 0,6 - 0,85 m

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Telephone: [+27] (11) 254 4800
Fax: [+27] 086 582 1561

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MACHINE: TLB 580T CASE
PIT LxB: 1.5x2.5
FILE REF: TP'S.GPJ

DATE EXCAVATED: 2016/11/17
DATE PROFILED: 2016/11/17
PROFILED BY: PM
CHECKED BY: SG





TEST PIT IMAGES

Table 20: AD22

Description	Photo
<p>AD22 Total depth is 2.20 m</p>	 A photograph showing a cross-section of a test pit. The soil is dark brown and appears to be composed of several distinct layers or horizons. The top layer is relatively loose, while the lower layers are more compact and show some horizontal layering. The pit is surrounded by dry grass and some green vegetation.
<p>AD22 Material from 0 to 2.20 m</p>	 A photograph showing an excavator bucket dumping a pile of material. The material is a mix of dark soil and light-colored rocks or gravel. The pile is situated in a grassy field under a clear blue sky. The excavator's arm and bucket are visible in the upper right corner of the frame.



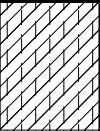
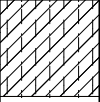
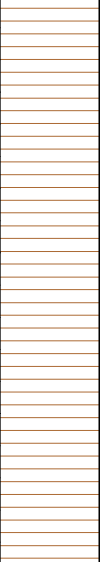
TEST PIT PROFILE

CLIENT: Eskom Holdings SOC
PROJECT: Tutuka Ash Dump Extension
LOCATION: Standerton, Mpumalanga
PROJECT NO: 1658666

HOLE No: AD23

X COORD: 738902.00
Y COORD: 7035451.00
DATUM: 35s
ELEVATION:

Page 1 of 1

Scale	Legend	Depth	Description
		0.00	Moist, dark brown, <u>soft to firm</u> , shattered, silty CLAY with traces of rootlets. TOPSOIL.
0.5		0.40	Moist, dark grey, <u>firm to stiff</u> , shattered and slickensided, silty CLAY. SHEETWASH.
1.0		0.70	Light yellowish brown, highly weathered to medium weathered, very fine grained, laminated and fissile, closely jointed, <u>soft to medium hard rock</u> , residual SHALE.
2.5		2.50	Refusal at 2.5 m
3.0			End of log
3.5			

NOTES: 1: End of hole at 2.5 m
2: No groundwater seepage
3: Disturbed sample taken from 0.2 - 0.7 m

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Maxwell Office Park, Midrand
Gauteng, 0001
Telephone: [+27] (11) 254 4800
Fax: [+27] 086 582 1561

CONTRACTOR: Phezulu Projects
MACHINE: TLB 580T CASE
PIT LxB: 1.5x2.5
FILE REF: TP'S.GPJ

DATE EXCAVATED: 2016/11/10
DATE PROFILED: 2016/11/10
PROFILED BY: PM
CHECKED BY: SG





TEST PIT IMAGES

Table 21: AD23

Description	Photo
<p>AD23 Total depth is 2.50 m</p>	 A photograph showing a cross-section of a test pit. The soil is dark brown and appears to be composed of several distinct layers. The top layer is dark and moist, while the lower layers are lighter and more granular. The pit is surrounded by dry grass and soil.
<p>AD23 Material from 0 to 2.50 m</p>	 A close-up photograph of soil material. The soil is yellowish-brown and appears to be composed of small, angular particles. A white marker with a black tip is placed on the soil for scale. The soil is piled up, and a yellow excavator bucket is visible in the background.



TEST PIT PROFILE

CLIENT: Eskom Holdings SOC
 PROJECT: Tutuka Ash Dump Extension
 LOCATION: Standerton, Mpumalanga
 PROJECT NO: 1658666

HOLE No: AD24

X COORD: 738785.00
 Y COORD: 7034490.00
 DATUM: 35s
 ELEVATION:

Scale	Legend	Depth	Description
		0.00	Moist, dark brown, <u>soft to firm</u> , shattered and shattered, silty CLAY with traces of rootlets. TOPSOIL.
0.5		0.40	Moist to slightly moist, dark brown grey, <u>firm becoming stiff</u> , shattered and slickensided, silty CLAY. SHEETWASH.
1.0		0.75	Slightly moist, dark grey becoming light grey, <u>stiff</u> , shattered and slickensided, silty CLAY. RESIDUAL SHALE.
1.5		1.65	Slightly moist, light yellowish brown, <u>stiff to very stiff</u> , slickensided and shattered, silty CLAY with traces of sand. RESIDUAL SHALE.
2.0		2.30	Mottled yellowish brown trace of blue, highly weathered to medium weathered, very fine grained, laminated and fissile, closely jointed, <u>soft to medium hard rock</u> SHALE.
2.5		3.15	No Refusal
3.0			End of log
3.5			

- NOTES: 1: End of Hole
 2: No groundwater seepage
 3: Bulk sample taken from 0,35 - 0,55 m

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 Telephone: [+27] (11) 254 4800
 Fax: [+27] 086 582 1561

CONTRACTOR: Phezulu Projects
 MACHINE: TLB 580T CASE
 PIT LxB: 1.5x2.5
 FILE REF: TP'S.GPJ

DATE EXCAVATED: 2016/11/17
 DATE PROFILED: 2016/11/17
 PROFILED BY: PM
 CHECKED BY: SG





TEST PIT PROFILE

CLIENT: Eskom Holdings SOC
 PROJECT: Tutuka Ash Dump Extension
 LOCATION: Standerton, Mpumalanga
 PROJECT NO: 1658666

HOLE No: AD25

X COORD: 738892.00
 Y COORD: 7034870.00
 DATUM: 35s
 ELEVATION:

Scale	Legend	Depth	Description
0.00		0.00	Very moist becoming moist, dark brown, <u>soft</u> , slightly shattered, silty CLAY with traces of rootlets. TOPSOIL.
0.5		0.55	Brown mottled olive and blue, highly weathered to medium weathered, very fine grained, <u>soft to medium hard rock</u> DOLERITE.
1.0			
1.5			
2.0			
2.5		2.60	Refusal at 2.6 m
3.0			End of log
3.5			

- NOTES: 1: End of Hole at 2.6 m
 2: No groundwater seepage
 3: No sample taken
 4: DCP conducted

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 Gauteng, 0001
 Telephone: [+27] (11) 254 4800
 Fax: [+27] 086 582 1561

CONTRACTOR: Phezulu Projects
 MACHINE: TLB 580T CASE
 PIT LxB: 1.5x2.5
 FILE REF: TP'S.GPJ

DATE EXCAVATED: 2016/11/17
 DATE PROFILED: 2016/11/17
 PROFILED BY: PM
 CHECKED BY: SG





TEST PIT IMAGES

Table 22: AD25

Description	Photo
<p>AD25 Total depth is 2.60 m</p>	
<p>AD25 Material from 0 to 2.60 m</p>	



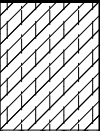

TEST PIT PROFILE

CLIENT: Eskom Holdings SOC
 PROJECT: Tutuka Ash Dump Extension
 LOCATION: Standerton, Mpumalanga
 PROJECT NO: 1658666

HOLE No: AD26

X COORD: 739041.00
 Y COORD: 7035064.00
 DATUM: 35s
 ELEVATION:

Page 1 of 1

Scale	Legend	Depth	Description
		0.00 0.40	Moist, dark brown, <u>firm</u> , shattered, silty CLAY. TOPSOIL.
0.5			Light brown becoming dark greyish green, medium weathered to slightly weathered, medium, <u>medium hard rock</u> DOLERITE.
1.0		0.90	Refusal at 0.9 m
1.5			End of log
2.0			
2.5			
3.0			
3.5			

- NOTES: 1: End of Hole at 0.9 m
 2: No groundwater seepage
 3: Disturbed sample taken from depth 0 - 0.2 m

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 Maxwell Office Park, Midrand
 Gauteng, 0001
 Telephone: [+27] (11) 254 4800
 Fax: [+27] 086 582 1561

CONTRACTOR: Phezulu Projects
 MACHINE: TLB 580T CASE
 PIT LxB: 1.5x2.5
 FILE REF: TP'S.GPJ

DATE EXCAVATED: 2016/11/14
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TEST PIT IMAGES

Table 23: AD26

Description	Photo
<p>AD26 Total depth is 0.90 m</p>	
<p>AD26 Material from 0 to 0.90 m</p>	



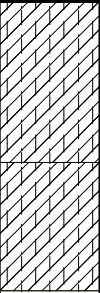
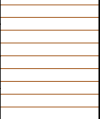
TEST PIT PROFILE

CLIENT: Eskom Holdings SOC
PROJECT: Tutuka Ash Dump Extension
LOCATION: Standerton, Mpumalanga
PROJECT NO: 1658666

HOLE No: AD27

X COORD: 738979.00
Y COORD: 7035241.00
DATUM: 35s
ELEVATION:

Page 1 of 1

Scale	Legend	Depth	Description
		0.00	Moist, dark brown, <u>soft</u> , shattered, silty CLAY. SHEETWASH.
0.5		0.50	Slightly moist, greyish, <u>firm</u> , slickensided, silty CLAY. SHEETWASH.
1.0		0.90	Light yellowish brown, highly weathered, very fine grained, laminated and fissile, closely jointed, <u>very soft to soft rock</u> SHALE.
		1.30	Refusal at 1.3 m
1.5			End of log
2.0			
2.5			
3.0			
3.5			

NOTES: 1: End of Hole at 1.3 m
2: No groundwater seepage
3: Foundation indicator sample taken at 0,6-0,7 m

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Maxwell Office Park, Midrand
Gauteng, 0001
Telephone: [+27] (11) 254 4800
Fax: [+27] 086 582 1561

CONTRACTOR: Phezulu Projects
MACHINE: TLB 580T CASE
PIT LxB: 1.5x2.5
FILE REF: TP'S.GPJ



DATE EXCAVATED: 2016/11/10
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TEST PIT IMAGES

Table 24: AD27

Description	Photo
<p>AD27 Total depth is 1.30 m</p>	
<p>AD27 Material from 0 to 1.30 m</p>	



TEST PIT PROFILE

CLIENT: Eskom Holdings SOC
PROJECT: Tutuka Ash Dump Extension
LOCATION: Standerton, Mpumalanga
PROJECT NO: 1658666

HOLE No: AD28

X COORD: 739093.00
Y COORD: 7035414.00
DATUM: 35s
ELEVATION:

Page 1 of 1

Scale	Legend	Depth	Description
0.00		0.00	Moist, dark brown (organic rich), <u>firm</u> , shattered, silty CLAY with traces of rootlets. SHEETWASH.
0.5			
1.0		0.90	Slightly moist, yellowish brown, <u>firm to stiff</u> , fissured and slightly intact, silty CLAY. RESIDUAL SHALE.
1.5			
2.0			
2.5		2.50	Mottled olive grey, highly weathered to medium weathered, very fine grained, laminated and fissile, closely jointed, <u>soft to medium hard rock</u> SHALE.
3.0			
3.30		3.30	
3.5			Refusal at 3.3 m End of log

NOTES: 1: End of Hole at 3.3 m
2: No groundwater seepage
3: Bulk sample taken from 1.0 - 1.3 m

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Gauteng, 0001
Telephone: [+27] (11) 254 4800
Fax: [+27] 086 582 1561

CONTRACTOR: Phezulu Projects
MACHINE: TLB 580T CASE
PIT LxB: 1.5x2.5
FILE REF: TP'S.GPJ

DATE EXCAVATED: 2016/09/11
DATE PROFILED: 2016/09/11
PROFILED BY: PM
CHECKED BY: SG





TEST PIT IMAGES

Table 25: AD28

Description	Photo
<p>AD28 Total depth is 3.30 m</p>	 A vertical photograph showing the interior of a test pit. The soil is dark brown and appears to be a silty clay or similar fine-grained material. The pit is roughly circular and has been excavated into the ground. Some roots and debris are visible at the top edge of the pit.
<p>AD28 Material from 3.30 m</p>	 A photograph showing a large pile of soil material. The soil is a mix of brown and greyish tones, with some larger clumps and what appears to be some organic matter or roots. The pile is situated outdoors on a grassy area. In the background, a portion of a yellow excavator or similar heavy machinery is visible.



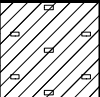

TEST PIT PROFILE

CLIENT: Eskom Holdings SOC
PROJECT: Tutuka Ash Dump Extension
LOCATION: Standerton, Mpumalanga
PROJECT NO: 1658666

HOLE No: AD29

X COORD: 739143.00
Y COORD: 7035728.00
DATUM: 35s
ELEVATION:

Page 1 of 1

Scale	Legend	Depth	Description
		0.00 0.30	Moist, dark brown, <u>soft</u> , shattered, silty CLAY with traces of rootlets. TOPSOIL.
0.5		0.85	Light brownish mottled olive, slightly weathered, medium to coarse grained, thinly, <u>medium hard to hard rock</u> DOLERITE.
1.0			Refusal at 0.85 m
1.5			End of log
2.0			
2.5			
3.0			
3.5			

NOTES: 1: End of Hole at 0.85 m
2: No groundwater seepage
3: No sample taken

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Maxwell Office Park, Midrand
Gauteng, 0001
Telephone: [+27] (11) 254 4800
Fax: [+27] 086 582 1561

CONTRACTOR: Phezulu Projects
MACHINE: TLB 580T CASE
PIT LxB: 1.5x2.5
FILE REF: TP'S.GPJ



DATE EXCAVATED: 2016/11/15
DATE PROFILED: 2016/11/15
PROFILED BY: PM
CHECKED BY: SG





TEST PIT IMAGES

Table 26: AD29

Description	Photo
<p>AD29 Total depth is 0.85 m</p>	 A photograph showing a cross-section of a test pit. The soil is dark brown and appears to be composed of various layers, including what looks like a silty clay layer and a more sandy or silty layer. There is some vegetation on the right side of the pit.
<p>AD29 Material from 0 to 0.85 m</p>	 A photograph showing a large pile of soil material, likely the material from the test pit. The soil is dark brown and appears to be composed of various layers. A yellow excavator bucket is visible in the background, and there is a large rock or piece of debris on top of the pile. The background shows a green field.



TEST PIT PROFILE

CLIENT: Eskom Holdings SOC
 PROJECT: Tutuka Ash Dump Extension
 LOCATION: Standerton, Mpumalanga
 PROJECT NO: 1658666

HOLE No: AD30

X COORD: 739047.00
 Y COORD: 7034762.00
 DATUM: 35s
 ELEVATION:

Page 1 of 1

Scale	Legend	Depth	Description
0.00		0.00	Moist, dark brown, <u>soft</u> , shattered and moderately shattered, silty CLAY with traces of rootlets.
0.35		0.35	TOPSOIL.
0.55		0.55	Moist, dark brown grey, <u>firm to soft</u> , shattered, silty CLAY.
1.0			SHEETWASH.
1.5			Dark grey olive, medium weathered, fine to medium grained, thinly banded, closely jointed, <u>medium hard to hard rock</u>
1.60		1.60	DOLERITE.
2.0			Refusal at 1.6 m
2.5			End of log
3.0			
3.5			

NOTES: 1: End of Hole at 1.6 m
 2: No groundwater seepage
 3: No sample taken

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 Maxwell Office Park, Midrand
 Gauteng, 0001
 Telephone: [+27] (11) 254 4800
 Fax: [+27] 086 582 1561

CONTRACTOR: Phezulu Projects
 MACHINE: TLB 580T CASE
 PIT LxB: 1.5x2.5
 FILE REF: TP'S.GPJ

DATE EXCAVATED: 2016/11/17
 DATE PROFILED: 2016/11/17
 PROFILED BY: PM
 CHECKED BY: SG





TEST PIT IMAGES

Table 27: AD30

Description	Photo
<p>AD30 Total depth is 1.60 m</p>	 A photograph showing a cross-section of a test pit. The soil is dark brown and appears to be composed of several distinct layers or horizons. The top layer is relatively loose and contains some roots. Below it, there are more compact layers with varying textures and colors, ranging from dark brown to a lighter, more silty appearance. The bottom of the pit is visible, showing a more uniform, lighter-colored soil layer.
<p>AD30 Material from 0 to 1.60 m</p>	 A photograph showing a large pile of excavated soil. The soil is dark brown and appears to be composed of several distinct layers or horizons. The top layer is relatively loose and contains some roots. Below it, there are more compact layers with varying textures and colors, ranging from dark brown to a lighter, more silty appearance. The bottom of the pile is visible, showing a more uniform, lighter-colored soil layer.



TEST PIT PROFILE

CLIENT: Eskom Holdings SOC
 PROJECT: Tutuka Ash Dump Extension
 LOCATION: Standerton, Mpumalanga
 PROJECT NO: 1658666

HOLE No: AD31

X COORD: 739270.00
 Y COORD: 7035340.00
 DATUM: 35s
 ELEVATION:

Scale	Legend	Depth	Description
		0.00	Moist, dark brown, <u>firm</u> , shattered, silty CLAY with traces of rootlets. TOPSOIL.
		0.30	
0.5		0.60	Slightly moist, dark brown, <u>firm to stiff</u> , shattered, silty CLAY. SHEETWASH.
1.0			Slightly moist, yellowish brown, <u>stiff</u> , shattered and fissured, silty CLAY with traces of sand. RESIDUAL DOLERITE.
1.5			
2.0			
2.5		2.60	Refusal at 2.6 m
3.0			End of log
3.5			

- NOTES: 1: End of Hole at 2.6 m
 2: No groundwater seepage
 3: No sample taken

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 Maxwell Office Park, Midrand
 Gauteng, 0001
 Telephone: [+27] (11) 254 4800
 Fax: [+27] 086 582 1561

CONTRACTOR: Phezulu Projects
 MACHINE: TLB 580T CASE
 PIT LxB: 1.5x2.5
 FILE REF: TP'S.GPJ

DATE EXCAVATED: 2016/09/11
 DATE PROFILED: 2016/09/11
 PROFILED BY: PM
 CHECKED BY: SG





TEST PIT IMAGES

Table 28: AD31

Description	Photo
<p>AD31 Total depth is 2.60 m</p>	 A photograph showing a cross-section of a test pit. The soil is dark brown/black at the top, transitioning to a lighter, yellowish-brown layer. The pit is surrounded by sparse, dry vegetation.
<p>AD31 Material from 0 to 2.60 m</p>	 A photograph showing a large pile of excavated soil, primarily yellowish-brown, with some dark patches. A yellow excavator bucket is visible on the right side, and the background shows a green field under a clear sky.



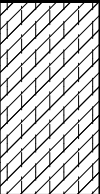
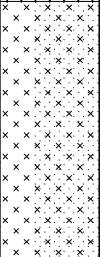
TEST PIT PROFILE

CLIENT: Eskom Holdings SOC
PROJECT: Tutuka Ash Dump Extension
LOCATION: Standerton, Mpumalanga
PROJECT NO: 1658666

HOLE No: AD32

X COORD: 739314.00
Y COORD: 7035534.00
DATUM: 35s
ELEVATION:

Page 1 of 1

Scale	Legend	Depth	Description
0.00		0.00	Moist, very dark brown becoming grey, <u>soft</u> , slickensided and shattered, silty CLAY. TOPSOIL.
0.5		0.60	
1.0		1.40	Brownish mottled orange, medium weathered, fine grained, thickly, <u>soft to medium hard rock</u> DOLERITE.
1.5			Refusal at 1.4 m
2.0			
2.5			
3.0			
3.5			
			End of log

NOTES: 1: End of Hole at 1.4 m
2: No groundwater seepage
3: No sample taken

Golder Associates Africa (Pty) Ltd.
Maxwell Office Park, Midrand
Gauteng, 0001
Telephone: [+27] (11) 254 4800
Fax: [+27] 086 582 1561

CONTRACTOR: Phezulu Projects
MACHINE: TLB 580T CASE
PIT LxB: 1.5x2.5
FILE REF: TP'S.GPJ

DATE EXCAVATED: 2016/11/15
DATE PROFILED: 2016/11/15
PROFILED BY: PM
CHECKED BY: SG





TEST PIT IMAGES

Table 29: AD32

Description	Photo
<p>AD32 Total depth is 1.40 m</p>	
<p>AD32 Material from 0 to 1.40 m</p>	



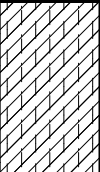
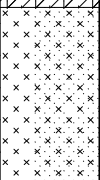
TEST PIT PROFILE

CLIENT: Eskom Holdings SOC
PROJECT: Tutuka Ash Dump Extension
LOCATION: Standerton, Mpumalanga
PROJECT NO: 1658666

HOLE No: AD33

X COORD: 739157.00
Y COORD: 7034344.00
DATUM: 35s
ELEVATION:

Page 1 of 1

Scale	Legend	Depth	Description
		0.00	Moist, dark brown, <u>soft firm</u> , shattered and slickensided, silty CLAY with some gravels. ALLUVIUM.
0.5		0.55	Dark becoming light greenish, medium weathered to slightly weathered, fine to medium grained, thinly bedded, closely jointed, <u>medium hard to hard rock</u> DOLERITE.
1.0		1.10	Refusal at 1.1 m
1.5			End of log
2.0			
2.5			
3.0			
3.5			

NOTES: 1: End of Hole at 1.1 m
2: No groundwater seepage
3: No sample taken

Golder Associates Africa (Pty) Ltd.
Maxwell Office Park, Midrand
Gauteng, 0001
Telephone: [+27] (11) 254 4800
Fax: [+27] 086 582 1561

CONTRACTOR: Phezulu Projects
MACHINE: TLB 580T CASE
PIT LxB: 1.5x2.5
FILE REF: TP'S.GPJ

DATE EXCAVATED: 2016/11/17
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PROFILED BY: PM
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TEST PIT IMAGES

Table 30: AD33

Description	Photo
<p>AD33 Total depth is 1.10 m</p>	
<p>AD33 Material from 0 to 1.10 m</p>	



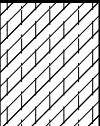
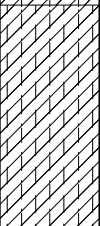

TEST PIT PROFILE

CLIENT: Eskom Holdings SOC
PROJECT: Tutuka Ash Dump Extension
LOCATION: Standerton, Mpumalanga
PROJECT NO: 1658666

HOLE No: AD34

X COORD: 739248.00
Y COORD: 7035083.00
DATUM: 35s
ELEVATION:

Page 1 of 1

Scale	Legend	Depth	Description
		0.00	Very moist, dark brownish grey, <u>soft to firm</u> , shattered, silty CLAY with traces of rootlets.
		0.40	TOPSOIL.
0.5			Moist, greyish becoming light grey, <u>firm</u> , shattered, silty CLAY.
			SHEETWASH.
1.0		1.15	
		1.30	Dark olive grey, medium weathered to slightly weathered, jointed, <u>soft to medium hard rock</u>
1.5			DOLERITE.
			Refusal at 1.3 m
2.0			
2.5			
3.0			
3.5			

End of log

NOTES: 1: End of Hole at 1.3 m
2: No groundwater seepage
3: Disturbed sample taken from 0,9 - 1,1 m

Golder Associates Africa (Pty) Ltd.
Maxwell Office Park, Midrand
Gauteng, 0001
Telephone: [+27] (11) 254 4800
Fax: [+27] 086 582 1561

CONTRACTOR: Phezulu Projects
MACHINE: TLB 580T CASE
PIT LxB: 1.5x2.5
FILE REF: TP'S.GPJ

DATE EXCAVATED: 2016/11/14
DATE PROFILED: 2016/11/14
PROFILED BY: PM
CHECKED BY: SG





TEST PIT IMAGES

Table 31: AD34

Description	Photo
<p>AD34 Total depth is 1.32 m</p>	
<p>AD34 Material from 0 to 1.32 m</p>	



TEST PIT PROFILE

CLIENT: Eskom Holdings SOC
 PROJECT: Tutuka Ash Dump Extension
 LOCATION: Standerton, Mpumalanga
 PROJECT NO: 1658666

HOLE No: AD35

X COORD: 739433.00
 Y COORD: 7035607.00
 DATUM: 35s
 ELEVATION:

Scale	Legend	Depth	Description
0.00		0.00	Moist, dark grey brown, <u>soft to firm</u> , shattered, silty CLAY. TOPSOIL.
0.5		0.65 0.75	Slightly moist, light yellow brown, <u>loose to medium dense</u> , intact, silty CLAY with rock fragments. RESIDUAL SHALE.
1.0		1.55	Olive grey mottled black, completely weathered, fine to medium grained, laminated and fissile, <u>soft to medium hard rock</u> SHALE.
1.5		1.55	Refusal at 1.55 m
2.0			End of log
2.5			
3.0			
3.5			

- NOTES: 1: End of Hole at 1.55 m
 2: No groundwater seepage
 3: Disturbed sample taken at depth 0.65 - 0.75 m

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 Maxwell Office Park, Midrand
 Gauteng, 0001
 Telephone: [+27] (11) 254 4800
 Fax: [+27] 086 582 1561

CONTRACTOR: Phezulu Projects
 MACHINE: TLB 580T CASE
 PIT LxB: 1.5x2.5
 FILE REF: TP'S.GPJ

DATE EXCAVATED: 2016/11/15
 DATE PROFILED: 2016/11/15
 PROFILED BY: RvdW
 CHECKED BY: SG





TEST PIT IMAGES

Table 32: AD35

Description	Photo
<p>AD35 Total depth is 1.55 m</p>	 A photograph showing a cross-section of a test pit. The soil is dark brown and appears to be composed of several distinct layers. The top layer is dark and contains some roots. Below it is a lighter, more uniform layer. The bottom layer is darker and appears to be more compact. The pit is surrounded by sparse vegetation and grass.
<p>AD35 Material from 0 to 1.55 m</p>	 A photograph showing an orange CASE excavator loading soil into a large pile. The excavator's bucket is positioned over the pile, and the soil is being dumped. The background shows a green field and a hillside under a cloudy sky.



TEST PIT PROFILE

CLIENT: Eskom Holdings SOC
PROJECT: Tutuka Ash Dump Extension
LOCATION: Standerton, Mpumalanga
PROJECT NO: 1658666

HOLE No: AD36

X COORD: 739347.00
Y COORD: 7034703.00
DATUM: 35s
ELEVATION:

Page 1 of 1

Scale	Legend	Depth	Description
0.00		0.00	Moist, dark brown, <u>soft to firm</u> , shattered and shattered, <u>silty clay</u> . SHEETWASH.
0.5		0.60	
1.0			Mottled brown yellowish, highly weathered to medium weathered, fine grained, laminated and fissile, <u>medium hard rock</u> SHALE.
1.5			
2.0		2.20	
2.5			Refusal at 2.2 m
3.0			
3.5			
			End of log

- NOTES: 1: End of Hole at 2.2 m
2: No groundwater seepage
3: No sample taken

Golder Associates Africa (Pty) Ltd.
Maxwell Office Park, Midrand
Gauteng, 0001
Telephone: [+27] (11) 254 4800
Fax: [+27] 086 582 1561

CONTRACTOR: Phezulu Projects
MACHINE: TLB 580T CASE
PIT LxB: 1.5x2.5
FILE REF: TP'S.GPJ

DATE EXCAVATED: 2016/11/17
DATE PROFILED: 2016/11/17
PROFILED BY: PM
CHECKED BY: SG





TEST PIT IMAGES

Table 33: AD36

Description	Photo
<p>AD36 Total depth is 2.20 m</p>	 A photograph of a test pit excavation. The pit is rectangular and shows several distinct soil layers. The top layer is dark brown, followed by a lighter brown layer, and then a darker, more textured layer at the bottom. Some roots are visible hanging down from the top edge of the pit.
<p>AD36 Material from 0 to 2.20 m</p>	 A photograph showing an orange excavator bucket dumping a large pile of soil. The soil is a mix of brown earth and small rocks. The background shows a grassy field under a blue sky.



TEST PIT PROFILE

CLIENT: Eskom Holdings SOC
 PROJECT: Tutuka Ash Dump Extension
 LOCATION: Standerton, Mpumalanga
 PROJECT NO: 1658666

HOLE No: AD37

X COORD: 739401.00
 Y COORD: 7035000.00
 DATUM: 35s
 ELEVATION:

Scale	Legend	Depth	Description
		0.00	Very moist, dark brown becoming grey, <u>very soft to soft</u> , shattered, silty CLAY with traces of rootlets. TOPSOIL.
0.5		0.40	Very moist becoming moist, dark greyish becoming greenish olive, <u>soft</u> , shattered, silty CLAY. RESIDUAL SHALE.
1.0		1.20	
1.5		1.50	Dark grey, medium weathered, very fine grained, laminated and fissile, <u>medium hard rock</u> SHALE.
2.0		2.15	
2.5			Refusal at 2.15 m
3.0			End of log
3.5			

- NOTES: 1: End of Hole at 2.15 m
 2: No groundwater seepage
 3: No sample taken

Golder Associates Africa (Pty) Ltd.
 Maxwell Office Park, Midrand
 Gauteng, 0001
 Telephone: [+27] (11) 254 4800
 Fax: [+27] 086 582 1561

CONTRACTOR: Phezulu Projects
 MACHINE: TLB 580T CASE
 PIT LxB: 1.5x2.5
 FILE REF: TP'S.GPJ

DATE EXCAVATED: 2016/11/14
 DATE PROFILED: 2016/11/14
 PROFILED BY: PM
 CHECKED BY: SG





TEST PIT IMAGES

Table 34: AD37

Description	Photo
<p>AD37 Total depth is 2.15 m</p>	
<p>AD37 Material from 0 to 2.15 m</p>	



TEST PIT PROFILE

CLIENT: Eskom Holdings SOC
 PROJECT: Tutuka Ash Dump Extension
 LOCATION: Standerton, Mpumalanga
 PROJECT NO: 1658666

HOLE No: AD38

X COORD: 739507.00
 Y COORD: 7035297.00
 DATUM: 35s
 ELEVATION:

Scale	Legend	Depth	Description
0.00		0.00	Very moist, dark brown grey, <u>soft to firm</u> , shattered, silty CLAY with traces of rootlets. TOPSOIL.
0.5		0.50	Moist to slightly moist, dark grey, <u>soft to firm</u> , slickensided and moderately shattered, silty CLAY. SHEETWASH.
1.0		1.90	Mottled dark olive grey, medium weathered to slightly weathered, very fine grained, laminated and fissile, <u>soft to medium hard rock</u> SHALE.
1.5		2.15	Mottled light brownish orange, medium weathered, fine grained, massive, <u>soft to medium hard rock</u> SANDSTONE.
2.0		2.85	Refusal at 2.85 m
2.5			End of log
3.0			
3.5			

- NOTES:
- 1: End of Hole at 2.85 m
 - 2: No groundwater seepage
 - 3: Bulk sample taken from depth 1.4 - 1.6 m
 - 4: DCP Conducted

Golder Associates Africa (Pty) Ltd.
 Maxwell Office Park, Midrand
 Gauteng, 0001
 Telephone: [+27] (11) 254 4800
 Fax: [+27] 086 582 1561

CONTRACTOR: Phezulu Projects
 MACHINE: TLB 580T CASE
 PIT LxB: 1.5x2.5
 FILE REF: TP'S.GPJ

DATE EXCAVATED: 2016/11/14
 DATE PROFILED: 2016/11/14
 PROFILED BY: PM
 CHECKED BY: SG





TEST PIT IMAGES

Table 35: AD38

Description	Photo
<p>AD38 Total depth is 2.85 m</p>	
<p>AD38 Material from 0 to 2.85 m</p>	



TEST PIT PROFILE

CLIENT: Eskom Holdings SOC
PROJECT: Tutuka Ash Dump Extension
LOCATION: Standerton, Mpumalanga
PROJECT NO: 1658666

HOLE No: AD39

X COORD: 739628.00
Y COORD: 7035569.00
DATUM: 35s
ELEVATION:

Page 1 of 1

Scale	Legend	Depth	Description
		0.00	Very moist, dark brown becoming dark grey organic rich, <u>soft to firm</u> , shattered, silty CLAY.
		0.40	ALLUVIUM.
0.5			Moist, dark brown grey, <u>soft to firm</u> , slickensided and shattered, silty CLAY.
			SHEETWASH.
1.0			
1.5		1.60	
		1.80	Slightly moist, light brownish olive, <u>firm to stiff</u> , moderately shattered and slickensided, silty CLAY with rock fragments.
			RESIDUAL SHALE.
2.0			Dark olive becoming grey, medium weathered to slightly weathered, very fine grained, laminated and fissile, <u>soft to medium hard rock</u>
			SHALE.
2.5		2.50	Refusal at 2.5 m
			End of log
3.0			
3.5			

NOTES: 1: End of Hole at 2.5 m
2: No groundwater seepage
3: Disturbed sample taken from depth 0.8 - 0.9 m

Golder Associates Africa (Pty) Ltd.
Maxwell Office Park, Midrand
Gauteng, 0001
Telephone: [+27] (11) 254 4800
Fax: [+27] 086 582 1561

CONTRACTOR: Phezulu Projects
MACHINE: TLB 580T CASE
PIT LxB: 1.5x2.5
FILE REF: TP'S.GPJ

DATE EXCAVATED: 2016/11/15
DATE PROFILED: 2016/11/15
PROFILED BY: PM
CHECKED BY: SG





TEST PIT IMAGES

Table 36: AD39

Description	Photo
<p>AD39 Total depth 2.50 m</p>	 A photograph showing a cross-section of a test pit. The soil is dark brown and appears to be a silty clay. There are some roots and small plants growing on the left side of the pit. The pit is about 2.5 meters deep.
<p>AD39 Material from 0 to 2.50 m</p>	 A photograph showing a bulldozer pushing a large pile of soil and rocks from a test pit. The soil is dark brown and appears to be a silty clay. The bulldozer is blue and yellow. The background shows a grassy field under a clear sky.



TEST PIT PROFILE

CLIENT: Eskom Holdings SOC
 PROJECT: Tutuka Ash Dump Extension
 LOCATION: Standerton, Mpumalanga
 PROJECT NO: 1658666

HOLE No: AD40

X COORD: 739486.00
 Y COORD: 7034493.00
 DATUM: 35s
 ELEVATION:

Page 1 of 1

Scale	Legend	Depth	Description
0.00		0.00	Moist, dark brown, <u>soft to firm</u> , shattered and shattered, silty CLAY with traces of rootlets. ALLUVIUM.
0.5		0.50	Moist becoming slightly moist, dark grey, <u>firm</u> , slickensided and shattered, silty CLAY. SHEETWASH.
1.0		0.90	Slightly moist, light grey becoming olive, <u>stiff</u> , shattered and slickensided, silty CLAY. RESIDUAL SHALE.
1.5		1.75	Mottled olive and light grey, highly weathered to medium weathered, very fine grained, laminated and fissile, <u>soft to medium hard rock</u> SHALE.
2.0		2.0	
2.5		2.5	
3.0		3.00	No Refusal
3.5			End of log

- NOTES: 1: End of Hole at 3.0 m
 2: No groundwater seepage
 3: Foundation indicator sample taken at 0,3-0,5 m

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 Maxwell Office Park, Midrand
 Gauteng, 0001
 Telephone: [+27] (11) 254 4800
 Fax: [+27] 086 582 1561

CONTRACTOR: Phezulu Projects
 MACHINE: TLB 580T CASE
 PIT LxB: 1.5x2.5
 FILE REF: TP'S.GPJ

DATE EXCAVATED: 2016/11/17
 DATE PROFILED: 2016/11/17
 PROFILED BY: PM
 CHECKED BY: SG





TEST PIT IMAGES

Table 37: AD40

Description	Photo
<p>AD40 Total depth is 3.0 m</p>	
<p>AD40 Material from 0 to 3.0 m</p>	



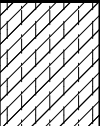
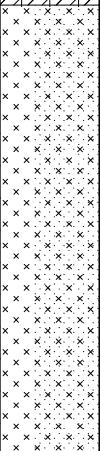
TEST PIT PROFILE

CLIENT: Eskom Holdings SOC
PROJECT: Tutuka Ash Dump Extension
LOCATION: Standerton, Mpumalanga
PROJECT NO: 1658666

HOLE No: AD41

X COORD: 739605.00
Y COORD: 7034925.00
DATUM: 35s
ELEVATION:

Page 1 of 1

Scale	Legend	Depth	Description
		0.00	Moist, very dark brown, <u>soft to firm</u> , silty CLAY with traces of rootlets. TOPSOIL.
0.5		0.40	Brownish becoming dark brown with olivish unweathered colour, medium weathered, medium grained, medium, <u>medium hard rock</u> DOLERITE.
1.0			
1.5			
1.80			Refusal at 1.8 m
2.0			End of log
2.5			
3.0			
3.5			

NOTES: 1: End of Hole at 1.8 m
2: No groundwater seepage
3: No sample taken

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Maxwell Office Park, Midrand
Gauteng, 0001
Telephone: [+27] (11) 254 4800
Fax: [+27] 086 582 1561

CONTRACTOR: Phezulu Projects
MACHINE: TLB 580T CASE
PIT LxB: 1.5x2.5
FILE REF: TP'S.GPJ

DATE EXCAVATED: 2016/11/15
DATE PROFILED: 2016/11/15
PROFILED BY: PM
CHECKED BY: SG





TEST PIT IMAGES

Table 38: AD41

Description	Photo
<p>AD41 Total depth is 1.80 m</p>	
<p>AD41 Material from 0 to 1.80 m</p>	

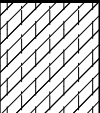
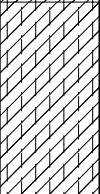



TEST PIT PROFILE

CLIENT: Eskom Holdings SOC
 PROJECT: Tutuka Ash Dump Extension
 LOCATION: Standerton, Mpumalanga
 PROJECT NO: 1658666

HOLE No: AD42

X COORD: 739706.00
 Y COORD: 7035454.00
 DATUM: 35s
 ELEVATION:

Scale	Legend	Depth	Description
		0.00	Moist, dark brown grey, <u>firm</u> , shattered, silty CLAY. TOPSOIL.
0.5		0.35	Slightly moist, dark grey becoming olive, <u>stiff</u> , shattered, silty CLAY with some very fine sand. RESIDUAL SANDSTONE.
1.0		0.95	Light brown to orange, highly weathered, medium to coarse grained, medium, <u>soft rock</u> SANDSTONE.
1.5			
2.0			
2.5			
3.0			
		3.20	No Refusal
3.5			End of log

- NOTES: 1: End of Hole at 3.2 m
 2: No groundwater seepage
 3: Disturbed sample taken from 1.0 - 1.1 m

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 Maxwell Office Park, Midrand
 Gauteng, 0001
 Telephone: [+27] (11) 254 4800
 Fax: [+27] 086 582 1561

CONTRACTOR: Phezulu Projects
 MACHINE: TLB 580T CASE
 PIT LxB: 1.5x2.5
 FILE REF: TP'S.GPJ

DATE EXCAVATED: 2016/11/15
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 PROFILED BY: PM
 CHECKED BY: SG





TEST PIT IMAGES

Table 39: AD42

Description	Photo
<p>AD42 Total depth is 3.20 m</p>	
<p>AD42 Material from 0 to 3.20 m</p>	



TEST PIT PROFILE

CLIENT: Eskom Holdings SOC
 PROJECT: Tutuka Ash Dump Extension
 LOCATION: Standerton, Mpumalanga
 PROJECT NO: 1658666

HOLE No: AD43

X COORD: 739643.00
 Y COORD: 7034250.00
 DATUM: 35s
 ELEVATION:

Page 1 of 1

Scale	Legend	Depth	Description
0.00		0.00	Moist, dark brown, <u>soft</u> , shattered, silty CLAY with traces of rootlets. ALLUVIUM.
0.5		0.55	Moist, dark brown becoming greyish, <u>firm to stiff</u> , shattered and slickensided, silty CLAY. RESIDUAL SHALE.
1.0		0.90	Slightly moist, light grey mottled olive, <u>stiff to very stiff</u> , shattered and slickensided, silty CLAY. RESIDUAL SHALE.
1.5		1.30	Light yellowish brown, highly weathered to medium weathered, very fine grained, laminated and fissile, closely jointed, <u>soft to medium hard rock</u> SHALE.
2.0			
2.5			
3.0		3.05	No Refusal
3.5			End of log

- NOTES: 1: End of hole at 3.05 m
 2: No groundwater seepage
 3: Foundation indicator sample taken at 0,6-0,8 m

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 Gauteng, 0001
 Telephone: [+27] (11) 254 4800
 Fax: [+27] 086 582 1561

CONTRACTOR: Phezulu Projects
 MACHINE: TLB 580T CASE
 PIT LxB: 1.5x2.5
 FILE REF: TP'S.GPJ

DATE EXCAVATED: 2016/11/18
 DATE PROFILED: 2016/11/18
 PROFILED BY: PM
 CHECKED BY: SG





TEST PIT IMAGES

Table 40: AD43

Description	Photo
<p>AD43 Total depth is 3.05 m</p>	 A photograph showing a cross-section of a test pit. The soil is dark brown and appears to be composed of several distinct layers. The top layer is relatively loose, while the lower layers are more compact and show some horizontal stratification. There are some roots visible in the upper part of the soil.
<p>AD43 Material from 0 to 3.05 m</p>	 A photograph showing a large pile of excavated soil and rocks. The material is a mix of brown soil and light-colored rocks. In the background, a yellow CASE excavator is visible, and the scene is set in a grassy field under a cloudy sky.



TEST PIT PROFILE

CLIENT: Eskom Holdings SOC
PROJECT: Tutuka Ash Dump Extension
LOCATION: Standerton, Mpumalanga
PROJECT NO: 1658666

HOLE No: AD44

X COORD: 739745.00
Y COORD: 7034518.00
DATUM: 35s
ELEVATION:

Page 1 of 1

Scale	Legend	Depth	Description
		0.00	Moist, dark brown, <u>very soft to soft</u> , shattered, silty CLAY with traces of rootlets. ALLUVIUM.
0.5		0.40	Moist becoming slightly moist, dark brown becoming grey, <u>firm to stiff</u> , shattered and slickensided, silty CLAY. SHEETWASH.
1.0		1.00	Slightly moist, light grey with olive, <u>stiff</u> , shattered and slickensided, silty CLAY. RESIDUAL SHALE.
1.5		1.50	
2.0		2.00	
2.5		2.50	
3.0		3.00	
			No Refusal
3.5			End of log

NOTES: 1: End of Hole at 3.0 m
2: No groundwater seepage
3: Bulk sample taken from 1.2 - 1.4 m

CONTRACTOR: Phezulu Projects
MACHINE: TLB 580T CASE
PIT LxB: 1.5x2.5
FILE REF: TP'S.GPJ

DATE EXCAVATED: 2016/11/18
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Maxwell Office Park, Midrand
Gauteng, 0001
Telephone: [+27] (11) 254 4800
Fax: [+27] 086 582 1561





TEST PIT IMAGES

Table 41: AD44

Description	Photo
<p>AD44 Total depth is 3.0 m</p>	 A photograph showing a cross-section of a test pit. The soil is dark brown and appears to be composed of several distinct layers. The top layer is relatively loose, while the lower layers are more compact and show some horizontal stratification. The pit is surrounded by grass and some small plants.
<p>AD44 Material from 0 to 3.0 m</p>	 A photograph showing a yellow CASE excavator loading a large pile of dark, rocky soil. The excavator's bucket is positioned over the pile, and its arm is extended. The background shows a grassy field under a cloudy sky, with a utility pole visible in the distance.



TEST PIT PROFILE

CLIENT: Eskom Holdings SOC
 PROJECT: Tutuka Ash Dump Extension
 LOCATION: Standerton, Mpumalanga
 PROJECT NO: 1658666

HOLE No: AD45
 X COORD: 739820.00
 Y COORD: 7034790.00
 DATUM: 35s
 ELEVATION:

Scale	Legend	Depth	Description
0.5		0.00	Moist, dark brown, <u>soft to firm</u> , shattered and slickensided, silty CLAY with minor gravels and rootlets. SHEETWASH.
1.0		0.60	Brownish becoming mottled greenish black, highly weathered to medium weathered, fine to medium grained, medium jointed, <u>soft to medium hard rock</u> DOLERITE.
2.0		2.00	Refusal at 2.0 m
2.5			End of log
3.0			
3.5			

NOTES: 1: End of Hole at 2.0 m
 2: No groundwater seepage
 3: No sample taken

Golder Associates Africa (Pty) Ltd.
 Maxwell Office Park, Midrand
 Gauteng, 0001
 Telephone: [+27] (11) 254 4800
 Fax: [+27] 086 582 1561

CONTRACTOR: Phezulu Projects
 MACHINE: TLB 580T CASE
 PIT LxB: 1.5x2.5
 FILE REF: TP'S.GPJ

DATE EXCAVATED: 2016/11/18
 DATE PROFILED: 2016/11/18
 PROFILED BY: PM
 CHECKED BY: SG





TEST PIT IMAGES

Table 42: AD45

Description	Photo
<p>AD45 Total depth is 2.0 m</p>	
<p>AD45 Material from 0 to 2.0 m</p>	



TEST PIT PROFILE

CLIENT: Eskom Holdings SOC
PROJECT: Tutuka Ash Dump Extension
LOCATION: Standerton, Mpumalanga
PROJECT NO: 1658666

HOLE No: AD46

X COORD: 739858.00
Y COORD: 7035110.00
DATUM: 35s
ELEVATION:

Page 1 of 1

Scale	Legend	Depth	Description
0.5		0.00	Very moist to moist, dark brown (organic rich), <u>soft</u> , shattered, silty CLAY with traces of rootlets. SHEETWASH.
1.0		0.65	Yellowish brown and speckled black, medium weathered, fine to medium grained, <u>very soft rock</u> DOLERITE.
3.0		3.00	No Refusal
3.5			End of log

NOTES: 1: End of Hole at 3.0 m
2: Groundwater seepage at 2.9 m
3: No sample taken

Golder Associates Africa (Pty) Ltd.
Maxwell Office Park, Midrand
Gauteng, 0001
Telephone: [+27] (11) 254 4800
Fax: [+27] 086 582 1561

CONTRACTOR: Phezulu Projects
MACHINE: TLB 580T CASE
PIT LxB: 1.5x2.5
FILE REF: TP'S.GPJ

DATE EXCAVATED: 2016/11/18
DATE PROFILED: 2016/11/18
PROFILED BY: PM
CHECKED BY: SG





TEST PIT IMAGES

Table 43: AD46

Description	Photo
<p>AD46 Total depth is 3.0 m</p>	 A photograph showing a cross-section of a test pit. The soil is dark brown and appears to be a mix of silt and clay. There are some roots visible in the upper part of the soil. The pit is approximately 3.0 meters deep.
<p>AD46 Material from 0 to 3.0 m</p>	 A photograph showing an orange CASE excavator loading soil into a large metal container. The soil is dark brown and appears to be a mix of silt and clay. The excavator is positioned on a grassy field. The background shows a green field and a cloudy sky.



TEST PIT PROFILE

CLIENT: Eskom Holdings SOC
PROJECT: Tutuka Ash Dump Extension
LOCATION: Standerton, Mpumalanga
PROJECT NO: 1658666

HOLE No: AD47

X COORD: 739789.00
Y COORD: 7035236.00
DATUM: 35s
ELEVATION:

Page 1 of 1

Scale	Legend	Depth	Description
0.5		0.00 0.60	Very moist to moist, dark brown (organic rich), <u>soft</u> , shattered and shattered, silty CLAY with traces of rootlets. SHEETWASH.
1.0 1.5 2.0 2.5 3.0		3.20	Yellowish brown speckled black, completely weathered to highly weathered, fine to medium grained, medium, <u>very soft to soft rock</u> DOLERITE.
3.5			No Refusal End of log

NOTES: 1: End of Hole at 3.2 m
2: Groundwater seepage at 3.2 m
3: Disturbed sample from 0,4 - 0,6 m

CONTRACTOR: Phezulu Projects
MACHINE: TLB 580T CASE
PIT LxB: 1.5x2.5
FILE REF: TP'S.GPJ

DATE EXCAVATED: 2016/11/18
DATE PROFILED: 2016/11/18
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Gauteng, 0001
Telephone: [+27] (11) 254 4800
Fax: [+27] 086 582 1561





TEST PIT IMAGES

Table 44: AD47

Description	Photos
<p>AD47 Total depth is 3.20 m</p>	
<p>AD47 Material from 0 to 3.20 m</p>	



TEST PIT PROFILE

CLIENT: Eskom Holdings SOC
 PROJECT: Tutuka Ash Dump Extension
 LOCATION: Standerton, Mpumalanga
 PROJECT NO: 1658666

HOLE No: AD48

X COORD: 741078,00
 Y COORD: 7034763,00
 DATUM: 35s
 ELEVATION:

Scale	Legend	Depth	Description
		0.00	Moist, dark brown, <u>soft</u> , medium shattered, silty CLAY with rootlets. Topsoil.
		0.30	Moist, dark olive, <u>very soft to soft</u> , highly shattered, silty CLAY. Residual shale.
0.5		0.80	Moist, olive, <u>soft</u> , highly shattered and slickensided, silty CLAY. Residual shale.
1.0		1.20	Olive, very fine grained, jointed, laminated and fissile, highly weathered, <u>soft rock</u> SHALE.
1.5		2.0	
2.0		2.40	
2.5			Refusal at 2.4 m
3.0			End of log
3.5			

- NOTES: 1: End of hole at 2.4 m
 2: No groundwater seepage
 3: Foundation indicator sample taken at 0,3-0,8 m

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 Maxwell Office Park, Midrand
 Gauteng, 0001
 Telephone: [+27] (11) 254 4800
 Fax: [+27] 086 582 1561

CONTRACTOR: Phezulu Projects
 MACHINE: TLB 580T CASE
 PIT LxB: 1.5x2.5
 FILE REF: TP'S.GPJ

DATE EXCAVATED: 2016/11/21
 DATE PROFILED: 2016/11/21
 PROFILED BY: SN
 CHECKED BY: SG





TEST PIT PROFILE

CLIENT: Eskom Holdings SOC
PROJECT: Tutuka Ash Dump Extension
LOCATION: Standerton, Mpumalanga
PROJECT NO: 1658666

HOLE No: AD49

X COORD: 740408.00
Y COORD: 7035392.00
DATUM: 35s
ELEVATION:

Page 1 of 1

Scale	Legend	Depth	Description
		0.00	Moist, dark brown, medium shattered, <u>soft to firm</u> , silty CLAY with rootlets. Topsoil.
		0.30	
		0.50	Moist, <u>soft becoming stiff</u> , olive brown, medium shattered, silty CLAY. Sheetwash.
		0.90	
		1.00	Olive, fine grained, <u>soft rock becoming medium-hard rock</u> , highly weathered, jointed, laminated and fissile SHALE.
		1.50	
		1.50	Refusal at 1.5 m
		2.00	
		2.50	
		3.00	
		3.50	

End of log

NOTES: 1: End of hole at 1.5 m
2: No groundwater seepage
3: Foundation indicator sample taken at 0,4-0,6 m

Golder Associates Africa (Pty) Ltd.
Maxwell Office Park, Midrand
Gauteng, 0001
Telephone: [+27] (11) 254 4800
Fax: [+27] 086 582 1561

CONTRACTOR: Phezulu Projects
MACHINE: TLB 580T CASE
PIT LxB: 1.5x2.5
FILE REF: TP'S.GPJ

DATE EXCAVATED: 2016/11/21
DATE PROFILED: 2016/11/21
PROFILED BY: RvdW
CHECKED BY: SG





TEST PIT IMAGES

Table 46: AD49

Description	Photo
<p>AD49 Total depth is 1.50 m</p>	
<p>AD49 Material from 0 to 1.50 m</p>	



TEST PIT IMAGES

Table 45: AD48

Description	Photo
<p>AD48 Total depth is 2.40 m</p>	 A photograph showing a cross-section of a test pit. The soil is dark brown and appears to be composed of several distinct layers. The top layer is relatively thin and contains some roots. Below it is a thicker layer of dark, silty soil. The bottom of the pit is not clearly visible. The pit is surrounded by green grass and some dry vegetation.
<p>AD48 Material from 0 to 2.40 m</p>	 A photograph showing an orange CASE excavator loading a pile of material. The material is a mix of soil and rocks, appearing to be the material from the test pit. The excavator's bucket is positioned over the pile, and its arm is extended. The background shows a flat, grassy field under a cloudy sky. A power line tower is visible in the distance.



TEST PIT PROFILE

CLIENT: Eskom Holdings SOC
PROJECT: Tutuka Ash Dump Extension
LOCATION: Standerton, Mpumalanga
PROJECT NO: 1658666

HOLE No: AD50

X COORD: 741244.00
Y COORD: 7035193.00
DATUM: 35s
ELEVATION:

Page 1 of 1

Scale	Legend	Depth	Description
		0.00	Slightly moist to moist, dark brown, medium shattered, <u>soft</u> , silty CLAY with rootlets. Topsoil.
0.5		0.40	Moist, dark olive, medium shattered, soft to firm, silty CLAY. Sheetwash.
1.0		1.00	Moist, light olive brown, shattered, <u>firm</u> , silty CLAY with minor sand. Residual shale.
1.5			
2.0			
2.5		2.30	Olive brown, fine grained, highly weathered, very thin bedded, <u>very soft to soft rock</u> SHALE.
		2.85	
3.0			End of log
3.5			

CONTRACTOR: Phezulu Projects
MACHINE: TLB 580T CASE
PIT LxB: 1.5x2.5
FILE REF: TP'S.GPJ

DATE EXCAVATED: 2016/11/21
DATE PROFILED: 2016/11/21
PROFILED BY: RvdW
CHECKED BY: SG

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Maxwell Office Park, Midrand
Gauteng, 0001
Telephone: [+27] (11) 254 4800
Fax: [+27] 086 582 1561





TEST PIT IMAGES

Table 47: AD50

Description	Photo
AD50 Total depth is	
AD50 Material from	



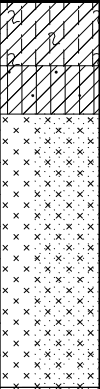
TEST PIT PROFILE

CLIENT: Eskom Holdings SOC
PROJECT: Tutuka Ash Dump Extension
LOCATION: Standerton, Mpumalanga
PROJECT NO: 1658666

HOLE No: AD51

X COORD: 740766.00
Y COORD: 7035006.00
DATUM: 35s
ELEVATION:

Page 1 of 1

Scale	Legend	Depth	Description
		0.00 0.20 0.35	Moist, blackish speckled dusky red, <u>very soft</u> , medium shattered, clayey SILT with rootlets. Topsoil .
0.5 1.0			Moist, dark yellow brown mottled dark purple, <u>loose</u> , medium shattered, sandy SILT with minor clay. Completely weathered. Grey weathered reddish brown, fine grained, jointed, highly weathered becoming medium weathered, <u>soft becoming medium-hard rock</u> DOLERITE .
1.20			Refusal at 1.2 m
1.5 2.0 2.5 3.0 3.5			End of log

NOTES: 1: End of hole at 1.2 m
2: No groundwater seepage
3: No sample taken

Golder Associates Africa (Pty) Ltd.
Maxwell Office Park, Midrand
Gauteng, 0001
Telephone: [+27] (11) 254 4800
Fax: [+27] 086 582 1561

CONTRACTOR: Phezulu Projects
MACHINE: TLB 580T CASE
PIT LxB: 1.5x2.5
FILE REF: TP'S.GPJ

DATE EXCAVATED: 2016/11/21
DATE PROFILED: 2016/11/21
PROFILED BY: SN
CHECKED BY: SG





TEST PIT IMAGES

Table 48: AD51

Description	Photo
<p>AD51 Total depth is 1.20 m</p>	
<p>AD51 Material from 0 to 1.20 m</p>	



TEST PIT PROFILE

CLIENT: Eskom Holdings SOC
 PROJECT: Tutuka Ash Dump Extension
 LOCATION: Standerton, Mpumalanga
 PROJECT NO: 1658666

HOLE No: AD52

X COORD: 740878,00
 Y COORD: 7035256,00
 DATUM: 35s
 ELEVATION:

Scale	Legend	Depth	Description
		0.00	Moist, dark brown, medium shattered, <u>soft</u> , clayey SILT. Sheetwash.
0.5		0.45	Moist, grey brown, shattered and slickensided, <u>soft</u> , silty CLAY. Sheetwash.
1.0		0.95	Moist, olive, medium shattered, silty CLAY and rock fragments, <u>firm</u> . Residual shale.
1.5			
2.0			
2.5		2.40	Olive brown, very fine grained, highly weathered, laminated and fissile, <u>soft rock</u> SHALE.
3.0			
		3.20	No refusal
3.5			End of log

- NOTES: 1: End of hole at 3.2 m
 2: No groundwater seepage
 3: Foundation indicator sample at 0,95-1,15 and bulk sample at 2,1-2,3 m

Golder Associates Africa (Pty) Ltd.
 Maxwell Office Park, Midrand
 Gauteng, 0001
 Telephone: [+27] (11) 254 4800
 Fax: [+27] 086 582 1561

CONTRACTOR: Phezulu Projects
 MACHINE: TLB 580T CASE
 PIT LxB: 1.5x2.5
 FILE REF: TP'S.GPJ

DATE EXCAVATED: 2016/11/21
 DATE PROFILED: 2016/11/21
 PROFILED BY: SN
 CHECKED BY: SG





TEST PIT IMAGES

Table 49: AD52

Description	Photo
<p>AD52 Total depth is 3.20 m</p>	
<p>AD52 Material from 0 to 3.20 m</p>	



TEST PIT PROFILE

CLIENT: Eskom Holdings SOC
 PROJECT: Tutuka Ash Dump Extension
 LOCATION: Standerton, Mpumalanga
 PROJECT NO: 1658666

HOLE No: AD53

X COORD: 741158.00
 Y COORD: 7035538.00
 DATUM: 35s
 ELEVATION:

Scale	Legend	Depth	Description
0.00		0.00	Moist, dark olive and yellowish brown, <u>very soft to soft</u> , shattered, silty CLAY with traces of rootlets. TOPSOIL.
0.50		0.50	Moist, dark olive, <u>soft</u> , shattered, silty CLAY. SHEETWASH.
1.00		1.30	Moist, light olive mottled yellowish towards the bottom, shattered and slickensided, silty CLAY. RESIDUAL SHALE.
1.50		1.90	Olive with yellowish, highly weathered, laminated and fissile, closely jointed, <u>very soft to soft rock</u>
2.00		2.00	
2.50		2.50	
3.00		3.00	No Refusal
3.50			End of log

- NOTES: 1: End of Hole at 3.0 m
 2: No groundwater seepage
 3: Disturbed sample taken at 0,7-0,9 m

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 Telephone: [+27] (11) 254 4800
 Fax: [+27] 086 582 1561

CONTRACTOR: Phezulu Projects
 MACHINE: TLB 580T CASE
 PIT LxB: 1.5x2.5
 FILE REF: TP'S.GPJ

DATE EXCAVATED: 2016/11/18
 DATE PROFILED: 2016/11/18
 PROFILED BY: SN
 CHECKED BY: SG





TEST PIT IMAGES

Table 50: AD53

Description	Photo
<p>AD53 Total depth is 3 m</p>	 A photograph showing a cross-section of a test pit. The soil profile is visible, showing a dark top layer, a lighter middle layer, and a darker bottom layer. The pit is dug into a slope.
<p>AD53 Material from 0 to 3 m</p>	 A photograph showing a large pile of excavated soil. The soil is dark brown and appears to be composed of clumps and small rocks. An excavator bucket is visible on the left side of the pile.



TEST PIT PROFILE

CLIENT: Eskom Holdings SOC
PROJECT: Tutuka Ash Dump Extension
LOCATION: Standerton, Mpumalanga
PROJECT NO: 1658666

HOLE No: AD54

X COORD: 740607.00
Y COORD: 7035922.00
DATUM: 35s
ELEVATION:

Page 1 of 1

Scale	Legend	Depth	Description
		0.00	Moist, dark brown, <u>soft</u> , slightly shattered, silty CLAY with traces of rootlets.
		0.25	TOPSOIL.
0.5			Moist, dark grey becoming olive, <u>very soft to soft</u> , shattered, silty CLAY.
		0.70	SHEETWASH.
1.0		1.00	Moist, light olive, <u>soft</u> , shattered, silty CLAY.
			RESIDUAL SHALE.
		1.40	Olive, highly weathered, laminated and fissile, closely jointed, <u>soft rock</u>
			SHALE.
1.5			Refusal at 1.4 m
2.0			
2.5			
3.0			
3.5			
			End of log

NOTES: 1: End of Hole at 1.4 m
2: No groundwater seepage
3: No sample taken

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Telephone: [+27] (11) 254 4800
Fax: [+27] 086 582 1561

CONTRACTOR: Phezulu Projects
MACHINE: TLB 580T CASE
PIT LxB: 1.5x2.5
FILE REF: TP'S.GPJ

DATE EXCAVATED: 2016/11/18
DATE PROFILED: 2016/11/18
PROFILED BY: SN
CHECKED BY: SG





TEST PIT IMAGES

Table 51: AD54

Description	Photo
<p>AD54 Total depth is 1.40 m</p>	 A photograph showing a cross-section of a test pit. The soil is dark and appears to be composed of fine-grained material with some larger clumps. The pit is surrounded by green grass and some small plants.
<p>AD54 Material from 0 to 1.40 m</p>	 A photograph showing an excavator bucket dumping a large amount of dark, moist soil onto a pile. The soil is dark and appears to be composed of fine-grained material. The background shows green grass and a clear sky.



TEST PIT PROFILE

CLIENT: Eskom Holdings SOC
 PROJECT: Tutuka Ash Dump Extension
 LOCATION: Standerton, Mpumalanga
 PROJECT NO: 1658666

HOLE No: AD55

X COORD: 740929.00
 Y COORD: 7035899.00
 DATUM: 35s
 ELEVATION:

Scale	Legend	Depth	Description
		0.00	Moist, dark brownish grey, <u>firm</u> , shattered, silty CLAY with traces of rootlets. TOPSOIL.
0.5		0.40	Slightly moist, light grey, <u>firm to stiff</u> , shattered and slickensided, silty CLAY. SHEETWASH.
1.0		1.00	Slightly moist, light brown and speckled yellow, <u>stiff</u> , slickensided and shattered, silty CLAY. RESIDUAL SHALE.
1.5			
2.0			
2.5		2.50	Blotched light yellowish brown, completely weathered to medium weathered, very fine grained, laminated and fissile, <u>very soft to soft rock</u> SHALE.
3.0		3.20	
3.5			No Refusal End of log

- NOTES: 1: End of Hole
 2: No groundwater seepage
 3: No sample taken

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 Gauteng, 0001
 Telephone: [+27] (11) 254 4800
 Fax: [+27] 086 582 1561

CONTRACTOR: Phezulu Projects
 MACHINE: TLB 580T CASE
 PIT LxB: 1.5x2.5
 FILE REF: TP'S.GPJ

DATE EXCAVATED: 2016/11/11
 DATE PROFILED: 2016/11/11
 PROFILED BY: PM
 CHECKED BY: SG



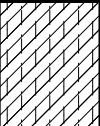
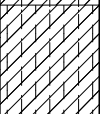
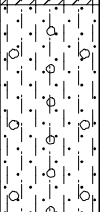
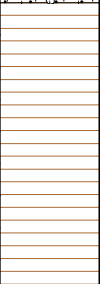


TEST PIT PROFILE

CLIENT: Eskom Holdings SOC
 PROJECT: Tutuka Ash Dump Extension
 LOCATION: Standerton, Mpumalanga
 PROJECT NO: 1658666

HOLE No: AD56

X COORD: 741044.00
 Y COORD: 7036086.00
 DATUM: 35s
 ELEVATION:

Scale	Legend	Depth	Description
		0.00	Moist, dark brown, <u>firm</u> , shattered, silty CLAY with traces of rootlets. TOPSOIL.
0.5		0.40	Slightly moist, dark grey, <u>firm to stiff</u> , shattered, silty CLAY. RESIDUAL SHALE.
1.0		0.75	Speckled light grey with black, completely weathered to highly weathered, very fine grained, laminated and fissile, <u>very soft to soft rock</u> , mudstones with sills and bends of silty clays SHALE.
1.5		1.40	Greyish brown, highly weathered, fine grained, laminated and fissile, closely jointed, <u>soft rock</u> SHALE.
2.0		2.30	Refusal at 2.3 m
2.5			End of log
3.0			
3.5			

- NOTES: 1: End of Hole at 2.3m
 2: No groundwater seepage
 3: No sample taken

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 Gauteng, 0001
 Telephone: [+27] (11) 254 4800
 Fax: [+27] 086 582 1561

CONTRACTOR: Phezulu Projects
 MACHINE: TLB 580T CASE
 PIT LxB: 1.5x2.5
 FILE REF: TP'S.GPJ

DATE EXCAVATED: 2016/11/11
 DATE PROFILED: 2016/11/11
 PROFILED BY: RvdW
 CHECKED BY: SG





TEST PIT IMAGES

Table 52: AD56

Description	Photo
<p>AD56 Total depth is 2.30 m</p>	
<p>AD56 Material from 0 to 2.30 m</p>	



TEST PIT PROFILE

CLIENT: Eskom Holdings SOC
 PROJECT: Tutuka Ash Dump Extension
 LOCATION: Standerton, Mpumalanga
 PROJECT NO: 1658666

HOLE No: AD57

X COORD: 740664.00
 Y COORD: 7036240.00
 DATUM: 35s
 ELEVATION:

Scale	Legend	Depth	Description
		0.00	Moist, dark brown, <u>firm</u> , shattered, silty CLAY with traces of rootlets. ALLUVIUM.
		0.40	
0.5			Moist, brown becoming grey, <u>firm</u> , shattered, gravelly silty SAND. RESIDUAL SANDSTONE.
1.0		1.00	
1.5			Slightly moist, light yellow brown, <u>loose to medium dense</u> , slightly shattered, clayey silty SAND. RESIDUAL SANDSTONE.
2.0			
2.5		2.50	
		2.70	Mottled light brownish orange, completely weathered, very fine grained, very thinly, <u>very soft to soft rock</u> , residual SANDSTONE.
3.0			No Refusal
3.5			End of log

- NOTES: 1: End of Hole at 2.7 m
 2: No groundwater seepage
 3: Bulk sample taken at 1.2-1.3 m

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 Telephone: [+27] (11) 254 4800
 Fax: [+27] 086 582 1561

CONTRACTOR: Phezulu Projects
 MACHINE: TLB 580T CASE
 PIT LxB: 1.5x2.5
 FILE REF: TP'S.GPJ

DATE EXCAVATED: 2016/11/11
 DATE PROFILED: 2016/11/11
 PROFILED BY: RvdW
 CHECKED BY: SG





TEST PIT IMAGES

Table 53: AD57

Description	Photo
<p>AD57 Total depth is 2.70 m</p>	
<p>AD57 Material from 0 to 2.70 m</p>	



TEST PIT PROFILE

CLIENT: Eskom Holdings SOC
 PROJECT: Tutuka Ash Dump Extension
 LOCATION: Standerton, Mpumalanga
 PROJECT NO: 1658666

HOLE No: AD58

X COORD: 740467.00
 Y COORD: 7036468.00
 DATUM: 35s
 ELEVATION:

Scale	Legend	Depth	Description
0.00		0.00	Moist, dark brown, <u>soft</u> , shattered and shattered, silty CLAY with traces of rootlets. TOPSOIL.
0.5		0.50	Moist to slightly moist, greyish, <u>firm to stiff</u> , shattered and slickensided, silty CLAY. SHEETWASH.
1.0		1.00	Slightly moist, light brown, <u>stiff to very stiff</u> , fissured, silty CLAY. RESIDUAL SHALE.
1.5		1.60	Light brown, highly weathered to medium weathered, fine grained, laminated and fissile, closely jointed, <u>soft to medium hard rock</u> SHALE.
2.0		2.50	Refusal at 2.5 m
2.5			End of log
3.0			
3.5			

- NOTES: 1: End of Hole at 2.5 m
 2: No groundwater seepage
 3: Bulk sample taken from 0.5 - 0.6 m

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 Gauteng, 0001
 Telephone: [+27] (11) 254 4800
 Fax: [+27] 086 582 1561

CONTRACTOR: Phezulu Projects
 MACHINE: TLB 580T CASE
 PIT LxB: 1.5x2.5
 FILE REF: TP'S.GPJ

DATE EXCAVATED: 2016/11/11
 DATE PROFILED: 2016/11/11
 PROFILED BY: PM
 CHECKED BY: SG





TEST PIT IMAGES

Table 54: AD58

Description	Photo
<p>AD58 Total depth is 2.50 m</p>	 A vertical cross-section of a test pit. The top layer is dark, moist soil. Below it is a lighter, sandy layer. The bottom part of the pit shows a more heterogeneous material with some darker clumps and lighter soil.
<p>AD58 Material from 0 to 2.50 m</p>	 A close-up view of the soil material from the test pit. It consists of a mixture of fine soil and small, angular rocks. A small red and blue marker is placed on the surface for scale.



TEST PIT PROFILE

CLIENT: Eskom Holdings SOC
 PROJECT: Tutuka Ash Dump Extension
 LOCATION: Standerton, Mpumalanga
 PROJECT NO: 1658666

HOLE No: AD59

X COORD: 740875.00
 Y COORD: 7036362.00
 DATUM: 35s
 ELEVATION:

Page 1 of 1

Scale	Legend	Depth	Description
		0.00	Moist, dark reddish brown, <u>firm</u> , shattered, silty CLAY with traces of rootlets. TOPSOIL.
0.5		0.40	Slightly moist, dark brown, <u>medium dense to dense</u> , slightly shattered, clayey silty sand. RESIDUAL SANDSTONE.
1.0		0.70	Light yellowish brown, highly weathered to medium weathered, fine grained, thinly, <u>soft to medium hard rock</u> , residual SANDSTONE.
1.5		1.30	Refusal at 1.3 m
2.0			End of log
2.5			
3.0			
3.5			

NOTES: 1: End of Hole at 1.3 m
 2: No groundwater seepage
 3: Disturbed sample taken from 0.4 - 0.7 m

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 Maxwell Office Park, Midrand
 Gauteng, 0001
 Telephone: [+27] (11) 254 4800
 Fax: [+27] 086 582 1561

CONTRACTOR: Phezulu Projects
 MACHINE: TLB 580T CASE
 PIT LxB: 1.5x2.5
 FILE REF: TP'S.GPJ

DATE EXCAVATED: 2016/11/11
 DATE PROFILED: 2016/11/11
 PROFILED BY: PM
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TEST PIT IMAGES

Table 55: AD59

Description	Photo
<p>AD59 Total depth is 1.30 m</p>	
<p>AD59 Material from 0 to 1.30 m</p>	



TEST PIT PROFILE

CLIENT: Eskom Holdings SOC
 PROJECT: Tutuka Ash Dump Extension
 LOCATION: Standerton, Mpumalanga
 PROJECT NO: 1658666

HOLE No: AD60

X COORD: 740691.00
 Y COORD: 7036559.00
 DATUM: 35s
 ELEVATION:

Scale	Legend	Depth	Description
		0.00	Moist, dark reddish brown, <u>soft to firm</u> , shattered, silty CLAY with traces of rootlets. TOPSOIL.
		0.30	
0.5		0.60	Moist, light brown becoming greyish, <u>firm</u> , shattered, silty CLAY. SHEETWASH.
1.0		0.90	Slightly moist, light brown, <u>stiff</u> , slickensided and shattered, silty CLAY. RESIDUAL SHALE.
1.5		1.80	Olive brown trace of white staining, medium weathered, very fine grained, laminated and fissile, closely jointed, <u>soft to medium hard rock</u> SHALE.
2.0			Refusal at 1.8 m
2.5			End of log
3.0			
3.5			

- NOTES: 1: End of Hole at 1.8 m
 2: No groundwater seepage
 3: Disturbed sample taken from 0,5 - 0,85 m

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 Maxwell Office Park, Midrand
 Gauteng, 0001
 Telephone: [+27] (11) 254 4800
 Fax: [+27] 086 582 1561

CONTRACTOR: Phezulu Projects
 MACHINE: TLB 580T CASE
 PIT LxB: 1.5x2.5
 FILE REF: TP'S.GPJ

DATE EXCAVATED: 2016/11/11
 DATE PROFILED: 2016/11/11
 PROFILED BY: PM
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TEST PIT IMAGES

Table 56: AD60

Description	Photo
<p>AD60 Total depth is 1.80 m</p>	
<p>AD60 Material from 0 to 1.80 m</p>	



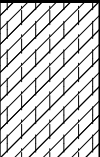

TEST PIT PROFILE

CLIENT: Eskom Holdings SOC
PROJECT: Tutuka Ash Dump Extension
LOCATION: Standerton, Mpumalanga
PROJECT NO: 1658666

HOLE No: AD61

X COORD: 740510.00
Y COORD: 7036704.00
DATUM: 35s
ELEVATION:

Page 1 of 1

Scale	Legend	Depth	Description
		0.00	Moist, dark reddish brown, <u>firm</u> , shattered, silty CLAY. TOPSOIL.
0.5		0.50	Slightly moist, light brown, <u>stiff</u> , slickensided and fissured, silty CLAY. RESIDUAL SHALE.
1.0		1.00	Dark grey, medium weathered, very fine grained, laminated and fissile, closely jointed, <u>soft to medium hard rock</u> , iron oxide staining SHALE.
1.5			
2.0		2.00	Refusal at 2.0 m
2.5			End of log
3.0			
3.5			

NOTES: 1: End of Hole ate 2.0 m
2: No groundwater seepage
3: Disturbed sample taken from 0,5 - 0,6 m

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Maxwell Office Park, Midrand
Gauteng, 0001
Telephone: [+27] (11) 254 4800
Fax: [+27] 086 582 1561

CONTRACTOR: Phezulu Projects
MACHINE: TLB 580T CASE
PIT LxB: 1.5x2.5
FILE REF: TP'S.GPJ

DATE EXCAVATED: 2016/11/11
DATE PROFILED: 2016/11/11
PROFILED BY: PM
CHECKED BY: SG





TEST PIT IMAGES

Table 57: AD61

Description	Photo
<p>AD61 Total depth is 2.0 m</p>	
<p>AD61 Material from 0 to 2.0 m</p>	



TEST PIT PROFILE

CLIENT: Eskom Holdings SOC
 PROJECT: Tutuka Ash Dump Extension
 LOCATION: Standerton, Mpumalanga
 PROJECT NO: 1658666

HOLE No: AD62

X COORD: 740423.00
 Y COORD: 7036940.00
 DATUM: 35s
 ELEVATION:

Scale	Legend	Depth	Description
		0.00	Moist, dark brown, <u>soft</u> , shattered, clayey SILT with traces of rootlets. SHEETWASH.
		0.30	
0.5		0.70	Moist, greyish brown, <u>soft becoming firm</u> , shattered, silty CLAY. SHEETWASH.
1.0		1.35	Olive grey, highly weathered to medium weathered, very fine grained, laminated and fissile, closely jointed, <u>soft rock</u> SHALE.
1.5			Refusal at 1.35 m
2.0			End of log
2.5			
3.0			
3.5			

- NOTES: 1: End of Hole at 1.35 m
 2: No groundwater seepage
 3: No sample taken

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 Gauteng, 0001
 Telephone: [+27] (11) 254 4800
 Fax: [+27] 086 582 1561

CONTRACTOR: Phezulu Projects
 MACHINE: TLB 580T CASE
 PIT LxB: 1.5x2.5
 FILE REF: TP'S.GPJ

DATE EXCAVATED: 2016/11/18
 DATE PROFILED: 2016/11/18
 PROFILED BY: RvdW
 CHECKED BY: SG





TEST PIT IMAGES

Table 58: AD62

Description	Photo
<p>AD62 Total depth is 1.35 m</p>	
<p>AD62 Material from 0 to 1.35 m</p>	



TEST PIT PROFILE

CLIENT: Eskom Holdings SOC
 PROJECT: Tutuka Ash Dump Extension
 LOCATION: Standerton, Mpumalanga
 PROJECT NO: 1658666

HOLE No: AD63

X COORD: 741076.00
 Y COORD: 7036450.00
 DATUM: 35s
 ELEVATION:

Scale	Legend	Depth	Description
		0.00	Moist, light yellowish to blotched light brown, <u>very soft to soft</u> , shattered, silty CLAY with traces of rootlets. ALLUVIUM.
0.5		0.40	
		0.70	Very moist, light brown, <u>stiff to very stiff</u> , shattered and slickensided, gravelly silty. SHEETWASH.
1.0			Slightly moist, brown, <u>medium dense</u> , intact. RESIDUAL SHALE.
1.5			
2.0		1.90	Light yellow, highly weathered to medium weathered, very fine grained, laminated and fissile, <u>soft to medium hard rock</u> SHALE.
2.5			
3.0		3.00	No Refusal
3.5			End of log

- NOTES: 1: End of Hole at 3.0 m
 2: No groundwater seepage
 3: Disturbed sample taken from 1.7 - 1.8 m

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 Maxwell Office Park, Midrand
 Gauteng, 0001
 Telephone: [+27] (11) 254 4800
 Fax: [+27] 086 582 1561

CONTRACTOR: Phezulu Projects
 MACHINE: TLB 580T CASE
 PIT LxB: 1.5x2.5
 FILE REF: TP'S.GPJ

DATE EXCAVATED: 2016/11/11
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 CHECKED BY: SG





TEST PIT IMAGES

Table 59: AD63

Description	Photo
AD63 Total depth is 3.0 m	
AD63 Material from 0 to 3.0 m	



TEST PIT PROFILE

CLIENT: Eskom Holdings SOC
 PROJECT: Tutuka Ash Dump Extension
 LOCATION: Standerton, Mpumalanga
 PROJECT NO: 1658666

HOLE No: AD64

X COORD: 740805.00
 Y COORD: 7036842.00
 DATUM: 35s
 ELEVATION:

Scale	Legend	Depth	Description
		0.00	Slightly moist to moist, dark brown, <u>soft</u> , slightly shattered, silty CLAY with some fine sands and traces of rootlets.
		0.25	TOPSOIL.
0.5			Moist, olive brown becoming light olive, <u>soft to very stiff</u> , moderately shattered, silty CLAY.
		0.70	RESIDUAL DOLERITE.
1.0			Grey brown on the outside, highly weathered, fine grained, very closely jointed, <u>soft rock</u>
		1.20, 2.0	DOLERITE.
1.5			Refusal at 1.2 m
2.0			
2.5			
3.0			
3.5			
			End of log

- NOTES: 1: End of Hole at 1.2 m
 2: No groundwater seepage
 3: No sample taken

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 Maxwell Office Park, Midrand
 Gauteng, 0001
 Telephone: [+27] (11) 254 4800
 Fax: [+27] 086 582 1561

CONTRACTOR: Phezulu Projects
 MACHINE: TLB 580T CASE
 PIT LxB: 1.5x2.5
 FILE REF: TP'S.GPJ

DATE EXCAVATED: 2016/11/18
 DATE PROFILED: 2016/11/18
 PROFILED BY: SN
 CHECKED BY: SG





TEST PIT IMAGES

Table 60: AD64

Description	Photo
<p>AD64 Total depth is 1.32 m</p>	 A photograph showing a cross-section of a test pit. The soil is dark brown and appears to be a mix of clay and silt. There are some roots visible in the lower part of the pit. The top of the pit is level with the ground surface.
<p>AD64 Material from 0 to 1.32 m</p>	 A photograph showing a large pile of dark brown soil material. The pile is situated in a grassy area. In the background, there is a piece of heavy machinery, possibly a bulldozer or excavator, partially visible. The soil appears to be the same material as shown in the test pit above.



TEST PIT PROFILE

CLIENT: Eskom Holdings SOC
PROJECT: Tutuka Ash Dump Extension
LOCATION: Standerton, Mpumalanga
PROJECT NO: 1658666

HOLE No: AD65

X COORD: 740640.00
Y COORD: 7037092.00
DATUM: 35s
ELEVATION:

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Scale	Legend	Depth	Description
		0.00	Slightly moist, dark brown, <u>soft</u> , shattered, clayey SILT with traces of rootlets. TOPSOIL.
0.5		0.40	Moist, greyish brown, <u>soft becoming very stiff</u> , shattered, silty CLAY. SHEETWASH.
1.0		1.00	Olive brown, highly weathered, very fine grained, laminated and fissile, closely jointed, <u>soft rock</u> SHALE.
1.5		1.50	Refusal at 1.5 m
2.0			End of log
2.5			
3.0			
3.5			

NOTES: 1: End of hole at 1.5 m
2: No groundwater seepage
3: No sample taken

Golder Associates Africa (Pty) Ltd.
Maxwell Office Park, Midrand
Gauteng, 0001
Telephone: [+27] (11) 254 4800
Fax: [+27] 086 582 1561

CONTRACTOR: Phezulu Projects
MACHINE: TLB 580T CASE
PIT LxB: 1.5x2.5
FILE REF: TP'S.GPJ

DATE EXCAVATED: 2016/11/18
DATE PROFILED: 2016/11/18
PROFILED BY: RvdW
CHECKED BY: SG





TEST PIT IMAGES

Table 61: AD65

Description	Photo
<p>AD65 Total depth is 1.50 m</p>	
<p>AD65 Material from 0 to 1.50 m</p>	



TEST PIT IMAGES

Table 61: AD65

Description	Photo
<p>AD65 Total depth is 1.50 m</p>	
<p>AD65 Material from 0 to 1.50 m</p>	



TEST PIT PROFILE

CLIENT: Eskom Holdings SOC
PROJECT: Tutuka Ash Dump Extension
LOCATION: Standerton, Mpumalanga
PROJECT NO: 1658666

HOLE No: AD66

X COORD: 738654.00
Y COORD: 7035269.00
DATUM: 35s
ELEVATION:

Page 1 of 1

Scale	Legend	Depth	Description
		0.00	Moist, dark brown, <u>firm</u> , shattered, silty CLAY. ALLUVIUM.
0.5		0.50	Slightly moist, greyish, <u>stiff</u> , slickensided and fissured, silty CLAY. SHEETWASH.
1.0		1.00	Mottled olive grey, medium weathered, very fine grained, laminated and fissile, closely jointed, <u>medium hard rock</u> SHALE.
1.5		1.80	
2.0			Refusal at 1.8 m
2.5			End of log
3.0			
3.5			

NOTES: 1: End of Hole at 1.8 m
2: No groundwater seepage
3: No sample taken

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Maxwell Office Park, Midrand
Gauteng, 0001
Telephone: [+27] (11) 254 4800
Fax: [+27] 086 582 1561

CONTRACTOR: Phezulu Projects
MACHINE: TLB 580T CASE
PIT LxB: 1.5x2.5
FILE REF: TP'S.GPJ

DATE EXCAVATED: 2016/11/10
DATE PROFILED: 2016/11/10
PROFILED BY: PM
CHECKED BY: SG





TEST PIT IMAGES

Table 62: AD66

Description	Photo
<p>AD66 Total depth is 1.80 m</p>	
<p>AD66 Material from 0 to 1.80 m</p>	



TEST PIT PROFILE

CLIENT: Eskom Holdings SOC
PROJECT: Tutuka Ash Dump Extension
LOCATION: Standerton, Mpumalanga
PROJECT NO: 1658666

HOLE No: AWRD01

X COORD: 739961.00
Y COORD: 7035216.00
DATUM: 35s
ELEVATION:

Page 1 of 1

Scale	Legend	Depth	Description
0.00			Slightly moist to moist, dark grey, highly shattered, <u>very soft</u> , silty CLAY. Sheetwash.
0.5			
1.0			
1.10		1.10	Moist, olive, shattered and slickensided, <u>very soft to soft</u> , silty CLAY. Residual Shale.
1.5		1.50	Olive, very fine grained, highly weathered, laminated and fissile, soft rock SHALE.
2.0			
2.5			
3.0			
3.30		3.30	
3.5			No refusal
			End of log

- NOTES: 1: End of hole at 3.3 m
2: Very slow groundwater seepage at 1.8 m
3: Foundation indicator sample taken at 0.5-0.8 m

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Gauteng, 0001
Telephone: [+27] (11) 254 4800
Fax: [+27] 086 582 1561

CONTRACTOR: Phezulu Projects
MACHINE: TLB 580T CASE
PIT LxB: 1.5x2.5
FILE REF: TP'S.GPJ

DATE EXCAVATED: 2016/11/22
DATE PROFILED: 2016/11/22
PROFILED BY: SN
CHECKED BY: SG





TEST PIT IMAGES

Table 63: AWRD01

Description	Photo
<p>AWRD01 Total depth is 3.30 m</p>	
<p>AWRD01 Material from 0 to 3.30 m</p>	



TEST PIT PROFILE

CLIENT: Eskom Holdings SOC
PROJECT: Tutuka Ash Dump Extension
LOCATION: Standerton, Mpumalanga
PROJECT NO: 1658666

HOLE No: AWRD02

X COORD: 740320.00

Y COORD: 7035073.00

DATUM: 35s

ELEVATION:

Page 1 of 1

Scale	Legend	Depth	Description
		0.00	Slightly moist to moist, dark brown, medium shattered, silty CLAY with very fine gravels and sand, <u>soft</u> . Topsoil .
		0.30	Moist, dark and light olive, <u>firm</u> , medium shattered, silty CLAY with very fine gravels and sand. Residual dolerite .
		0.60	Grey weathered reddish brown, highly weathered, fine grained, jointed, soft becoming medium-hard rock DOLERITE .
0.5			
1.0			
1.30			
1.5			Refusal at 1.3 m
2.0			
2.5			
3.0			
3.5			
			End of log

NOTES: 1: End of hole at 1.3 m
2: No groundwater seepage
3: No sample taken

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Maxwell Office Park, Midrand
Gauteng, 0001
Telephone: [+27] (11) 254 4800
Fax: [+27] 086 582 1561

CONTRACTOR: Phezulu Projects
MACHINE: TLB 580T CASE
PIT LxB: 1.5x2.5
FILE REF: TP'S.GPJ

DATE EXCAVATED: 2016/11/21
DATE PROFILED: 2016/11/21
PROFILED BY: SN
CHECKED BY: SG





TEST PIT IMAGES

Table 64: AWRD02

Description	Photo
<p>AWRD02 Total depth is 1.30 m</p>	
<p>AWRD02 Material from 0 to 1.30 m</p>	



TEST PIT PROFILE

CLIENT: Eskom Holdings SOC
PROJECT: Tutuka Ash Dump Extension
LOCATION: Standerton, Mpumalanga
PROJECT NO: 1658666

HOLE No: AWRD03

X COORD: 740691.00
Y COORD: 7034661.00
DATUM: 35s
ELEVATION:

Page 1 of 1

Scale	Legend	Depth	Description
		0.00	Moist, dark brown, <u>soft</u> , medium shattered, silty CLAY. Topsoil .
0.5		0.40	Moist, dark olive, shattered and slickensided, <u>soft</u> , silty CLAY. Sheetwash .
		0.65	Moist, olive, <u>soft to firm</u> , slightly shattered, silty clay with rock fragments. Residual shale .
1.0		0.90	Moist, olive brown, very fine to fine grained, highly weathered, laminated and fissile, jointed, soft rock SHALE .
1.5		1.40	Refusal at 1.4 m
			End of log
2.0			
2.5			
3.0			
3.5			

NOTES: 1: End of hole at 1.4 m
2: No groundwater seepage
3: No sample taken

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Gauteng, 0001
Telephone: [+27] (11) 254 4800
Fax: [+27] 086 582 1561

CONTRACTOR: Phezulu Projects
MACHINE: TLB 580T CASE
PIT LxB: 1.5x2.5
FILE REF: TP'S.GPJ

DATE EXCAVATED: 2016/11/21
DATE PROFILED: 2016/11/21
PROFILED BY: RvdW
CHECKED BY: SG





TEST PIT IMAGES

Table 65: AWRD03

Description	Photo
<p>AWRD03 Total depth is 1.40 m</p>	
<p>AWRD03 Material from 0 to 1.40 m</p>	



TEST PIT PROFILE

CLIENT: Eskom Holdings SOC
 PROJECT: Tutuka Ash Dump Extension
 LOCATION: Standerton, Mpumalanga
 PROJECT NO: 1658666

HOLE No: AWRD04

X COORD: 740158,00
 Y COORD: 7034545,00
 DATUM: 35s
 ELEVATION:

Scale	Legend	Depth	Description
0.00		0.00	Slightly moist to moist, dark brown, shattered, silty CLAY, <u>very soft to soft</u> . Topsoil.
0.30		0.30	Slightly moist to moist, dark olive, highly shattered, <u>very soft</u> , silty CLAY. Sheetwash.
0.60		0.60	Slightly moist to moist, olive, medium shattered, <u>soft becoming firm</u> , silty CLAY. Residual shale.
1.0		1.0	●
1.30		1.30	Olive, highly weathered, jointed, very fine grained, laminated and fissile, <soft rock <u>SHALE.</u> >>
1.5		1.5	
2.0		2.0	
2.20		2.20	Refusal at 2.2 m
2.5		2.5	End of log
3.0		3.0	
3.5		3.5	

- NOTES: 1: End of hole at 2.2 m
 2: No groundwater seepage
 3: Foundation indicator sample taken at 0,6-1,3 m

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 Maxwell Office Park, Midrand
 Gauteng, 0001
 Telephone: [+27] (11) 254 4800
 Fax: [+27] 086 582 1561

CONTRACTOR: Phezulu Projects
 MACHINE: TLB 580T CASE
 PIT LxB: 1.5x2.5
 FILE REF: TP'S.GPJ

DATE EXCAVATED: 2016/11/21
 DATE PROFILED: 2016/11/21
 PROFILED BY: SN
 CHECKED BY: SG





TEST PIT IMAGES

Table 66: AWRD04

Description	photo
<p>AWRD04 Total depth is 2.20 m</p>	
<p>AWRD04 Material from 0 to 2.20 m</p>	



TEST PIT PROFILE

CLIENT: Eskom Holdings SOC
PROJECT: Tutuka Ash Dump Extension
LOCATION: Standerton, Mpumalanga
PROJECT NO: 1658666

HOLE No: AWRD05

X COORD: 739869.00
Y COORD: 7034441.00
DATUM: 35s
ELEVATION:

Page 1 of 1

Scale	Legend	Depth	Description
0.5		0.00	Slightly moist, dark olive brown, shattered and slickensided, <u>soft</u> , silty CLAY. Sheetwash.
1.0		0.90	Slightly moist, olive, shattered and slickensided, <u>firm becoming stiff</u> , silty CLAY. Residual Shale.
1.5		3.00	No refusal
2.0			End of log
2.5			
3.0			
3.5			

NOTES: 1: End of hole at 3 m
2: No groundwater seepage
3: Bulk sample taken at 0.9-3 m

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Maxwell Office Park, Midrand
Gauteng, 0001
Telephone: [+27] (11) 254 4800
Fax: [+27] 086 582 1561

CONTRACTOR: Phezulu Projects
MACHINE: TLB 580T CASE
PIT LxB: 1.5x2.5
FILE REF: TP'S.GPJ

DATE EXCAVATED: 2016/11/24
DATE PROFILED: 2016/11/24
PROFILED BY: SN
CHECKED BY: SG





TEST PIT IMAGES

Table 67: AWRD05

Description	Photo
AWRD05 Total depth is 3.0 m	 A photograph of a test pit excavation. The pit is approximately 3.0 meters deep. The soil profile shows several distinct layers: a top layer of dark, moist soil with some roots; a middle layer of lighter, brownish soil; and a bottom layer of darker, more compact soil. The pit is surrounded by green grass and some dry vegetation.



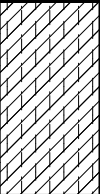
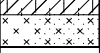
TEST PIT PROFILE

CLIENT: Eskom Holdings SOC
PROJECT: Tutuka Ash Dump Extension
LOCATION: Standerton, Mpumalanga
PROJECT NO: 1658666

HOLE No: AWRD06

X COORD: 740254.00
Y COORD: 7034418.00
DATUM: 35s
ELEVATION:

Page 1 of 1

Scale	Legend	Depth	Description
		0.00	Slightly moist, dark brown, medium shattered, <u>soft</u> , silty CLAY. Sheetwash.
0.5		0.60	Slightly moist, olive, medium shattered, soft, silty CLAY. Residual Dolerite.
		0.90	
1.0		1.00	Olive, highly weathered, jointed, fined grained, <u>very soft becoming soft rock</u> DOLERITE.
			Refusal at 1.0 m
1.5			End of log
2.0			
2.5			
3.0			
3.5			

NOTES: 1: End of hole at 1.0 m
2: No groundwater seepage
3: No sample taken

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Maxwell Office Park, Midrand
Gauteng, 0001
Telephone: [+27] (11) 254 4800
Fax: [+27] 086 582 1561

CONTRACTOR: Phezulu Projects
MACHINE: TLB 580T CASE
PIT LxB: 1.5x2.5
FILE REF: TP'S.GPJ

DATE EXCAVATED: 2016/11/23
DATE PROFILED: 2016/11/23
PROFILED BY: SN
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TEST PIT IMAGES

Table 68: AWRD06

Description	Photo
AWRD06 Total depth is 1.0 m	 A photograph of a test pit excavation. The pit is approximately 1.0 meter deep. The soil profile shows several distinct layers: a top layer of dark, moist soil with some roots; a middle layer of lighter brown, silty soil; and a bottom layer of darker, more compact soil. The right side of the pit is bordered by a grassy slope. The overall appearance is that of a natural soil profile exposed by excavation.



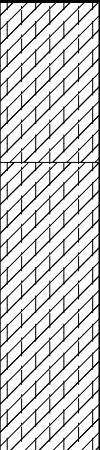

TEST PIT PROFILE

CLIENT: Eskom Holdings SOC
PROJECT: Tutuka Ash Dump Extension
LOCATION: Standerton, Mpumalanga
PROJECT NO: 1658666

HOLE No: AWRD08

X COORD: 740515.00
Y COORD: 7034555.00
DATUM: 35s
ELEVATION:

Page 1 of 1

Scale	Legend	Depth	Description
		0.00	Slightly moist, dark brown, <u>soft</u> , medium shattered, silty CLAY. Sheetwash.
0.5		0.50	Slightly moist, olive, <u>soft to firm</u> , slightly shattered, silty CLAY. Residual Dolerite.
1.0		1.40	Olive, completely weathered becoming highly weathered, <u>very soft becoming soft rock</u> , jointed, DOLERITE.
1.5			
2.0			
2.5			
3.0		3.00	Refusal at 3.0 m
3.5			End of log

NOTES: 1: End of hole at 3.0 m
2: Groundwater seepage at 3 m
3: Foundation indicator sample at 0,5-1,4 m

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Maxwell Office Park, Midrand
Gauteng, 0001
Telephone: [+27] (11) 254 4800
Fax: [+27] 086 582 1561

CONTRACTOR: Phezulu Projects
MACHINE: TLB 580T CASE
PIT LxB: 1.5x2.5
FILE REF: TP'S.GPJ

DATE EXCAVATED: 2016/11/23
DATE PROFILED: 2016/11/23
PROFILED BY: SN
CHECKED BY: SG





TEST PIT IMAGES

Table 69: AWRD08

Description	Photo
<p>AWDR08 Total depth is 3.0 m</p>	
<p>AWDR08 Material from 0 to 3.0 m</p>	



TEST PIT PROFILE

CLIENT: Eskom Holdings SOC
PROJECT: Tutuka Ash Dump Extension
LOCATION: Standerton, Mpumalanga
PROJECT NO: 1658666

HOLE No: AWRD09

X COORD: 740480.00
Y COORD: 7034864.00
DATUM: 35s
ELEVATION:

Page 1 of 1

Scale	Legend	Depth	Description
0.00			Slightly moist, dark brown, medium shattered, <u>soft</u> , silty CLAY. Sheetwash.
0.5			
0.70			Slightly moist, olive, shattered and slickensided, <u>firm to stiff</u> , silty CLAY. Residual Dolerite.
1.0			
1.5			
1.90			Yellow brown, fine grained, highly weathered, jointed, <u>soft rock</u> DOLERITE.
2.0			
2.10			Refusal at 2.1 m
2.5			End of log
3.0			
3.5			

NOTES: 1: End of hole at 2.1 m
2: No groundwater seepage
3: Foundation indicator sample taken 0.7-1.9 m

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Maxwell Office Park, Midrand
Gauteng, 0001
Telephone: [+27] (11) 254 4800
Fax: [+27] 086 582 1561

CONTRACTOR: Phezulu Projects
MACHINE: TLB 580T CASE
PIT LxB: 1.5x2.5
FILE REF: TP'S.GPJ

DATE EXCAVATED: 2016/11/24
DATE PROFILED: 2016/11/24
PROFILED BY: SN
CHECKED BY: SG





TEST PIT IMAGES

Table 70: AWRD09

Description	Photo
<p>AWRD09 Total depth is 2.10 m</p>	 A photograph of a soil test pit. The top layer consists of dark, moist soil with some roots and green grass. Below this is a thicker, more uniform layer of dark soil. At the bottom, there is a distinct, lighter-colored layer, possibly sand or a different soil type, with some roots extending down to it. The pit is surrounded by green grass and some dry, brown roots.



TEST PIT PROFILE

CLIENT: Eskom Holdings SOC
PROJECT: Tutuka Ash Dump Extension
LOCATION: Standerton, Mpumalanga
PROJECT NO: 1658666

HOLE No: AWRD10

X COORD: 740228.00

Y COORD: 7034830.00

DATUM: 35s

ELEVATION:

Page 1 of 1

Scale	Legend	Depth	Description
0.00		0.00	Slightly moist, dark brown, medium shattered, <u>soft</u> , silty CLAY. Sheetwash.
0.5		0.70	Slightly moist, olive, shattered and slickensided, <u>firm to stiff</u> , silty CLAY. Residual Dolerite.
1.0		2.30	Slightly moist, yellow brown mottled black, shattered, <u>soft</u> , silty CLAY with minor sand. Completely weathered dolerite.
1.5		3.00	No refusal
2.0			End of log
2.5			
3.0			
3.5			

- NOTES: 1: End of hole at 3 m
2: Slow groundwater seepage at 2.4 m
3: No sample taken

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Gauteng, 0001
Telephone: [+27] (11) 254 4800
Fax: [+27] 086 582 1561

CONTRACTOR: Phezulu Projects
MACHINE: TLB 580T CASE
PIT LxB: 1.5x2.5
FILE REF: TP'S.GPJ

DATE EXCAVATED: 2016/11/24
DATE PROFILED: 2016/11/24
PROFILED BY: SN
CHECKED BY: SG





TEST PIT IMAGES

Table 71: AWRD10

Description	Photos
<p>AWRD10 Total depth is 3.0 m</p>	
<p>AWRD10 Material from 0 to 3.0 m</p>	



TEST PIT PROFILE

CLIENT: Eskom Holdings SOC
PROJECT: Tutuka Ash Dump Extension
LOCATION: Standerton, Mpumalanga
PROJECT NO: 1658666

HOLE No: AWRD11

X COORD: 739935.00
Y COORD: 7034875.00
DATUM: 35s
ELEVATION:

Page 1 of 1

Scale	Legend	Depth	Description
		0.00	Moist, dark brown, medium shattered, <u>soft</u> , silty clay. Topsoil .
		0.40	Moist, dark brown, <u>soft to firm</u> , medium shattered, silty CLAY. Sheetwash .
0.5		0.85	Moist, <u>firm</u> , clayey SILT with gravel sized to cobble sized rock fragments, light grey mottled yellow brown. Residual dolerite .
1.0		1.00	Grey, fine to medium grained, thinly bedded, highly weathered, <u>soft becoming medium-hard rock</u> DOLERITE .
1.5		1.60	Refusal at 1.6 m
2.0			End of log
2.5			
3.0			
3.5			

NOTES: 1: End of hole at 1.6 m
2: No groundwater seepage
3: No sample taken

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Maxwell Office Park, Midrand
Gauteng, 0001
Telephone: [+27] (11) 254 4800
Fax: [+27] 086 582 1561

CONTRACTOR: Phezulu Projects
MACHINE: TLB 580T CASE
PIT LxB: 1.5x2.5
FILE REF: TP'S.GPJ

DATE EXCAVATED: 2016/11/21
DATE PROFILED: 2016/11/21
PROFILED BY: RvdW
CHECKED BY: SG





TEST PIT IMAGES

Table 72: AWRD11

Description	Photo
<p>AWRD11 Total depth is 1.60 m</p>	
<p>AWRD11 Material from 0 to 1.60 m</p>	



TEST PIT PROFILE

CLIENT: Eskom Holdings SOC
PROJECT: Tutuka Ash Dump Extension
LOCATION: Standerton, Mpumalanga
PROJECT NO: 1658666

HOLE No: AWRD12

X COORD: 740041.00
Y COORD: 7034789.00
DATUM: 35s
ELEVATION:

Page 1 of 1

Scale	Legend	Depth	Description
0.00		0.00	Slightly moist, dark brown, medium shattered, <u>soft</u> , silty CLAY. Sheetwash.
0.5			
1.0		0.90	Slightly moist, olive, shattered and slickensided, <u>firm to stiff</u> , silty CLAY. Residual Dolerite.
1.5			
2.0			
2.5			
3.0		3.00	No refusal
3.5			End of log

NOTES: 1: End of hole at 3 m
2: No groundwater seepage
3: Bulk sample taken at 0.9-3.0 m

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Gauteng, 0001
Telephone: [+27] (11) 254 4800
Fax: [+27] 086 582 1561

CONTRACTOR: Phezulu Projects
MACHINE: TLB 580T CASE
PIT LxB: 1.5x2.5
FILE REF: TP'S.GPJ

DATE EXCAVATED: 2016/11/24
DATE PROFILED: 2016/11/24
PROFILED BY: SN
CHECKED BY: SG





TEST PIT IMAGES

Table 73: AWRD12

Description	Photo
<p>AWRD12 Total depth is 3.0 m</p>	 A photograph showing a cross-section of a test pit. The soil is dark and appears to be composed of several distinct layers. The top layer is relatively loose, while the middle layer is more compact and shows some horizontal layering. The bottom layer is also dark and appears to be a different soil type. There is some green grass visible on the left side of the pit.
<p>AWRD12 Material from 0 to 3.0 m</p>	 A photograph showing a large pile of dark, excavated soil. The soil is dark grey to black and appears to be composed of several distinct layers. The pile is situated on a grassy area. In the background, the tires of a piece of heavy machinery are visible.



TEST PIT PROFILE

CLIENT: Eskom Holdings SOC
 PROJECT: Tutuka Ash Dump Extension
 LOCATION: Standerton, Mpumalanga
 PROJECT NO: 1658666

HOLE No: AWRD13

X COORD: 740008.00
 Y COORD: 7034652.00
 DATUM: 35s
 ELEVATION:

Scale	Legend	Depth	Description
0.00			Slightly moist to moist, dark grey, highly shattered, <u>very soft</u> , silty CLAY. Sheetwash.
0.5			
1.0		1.00	Moist, olive, medium shattered, <u>soft</u> , silty CLAY. Residual Dolerite.
1.5		1.60	
		1.90	Grey weathered yellow brown, highly weathered, jointed, fine grained, <u>soft</u> DOLERITE.
2.0			Refusal at 1.9 m
2.5			End of log
3.0			
3.5			

- NOTES: 1: End of hole at 1.9 m
 2: No groundwater seepage
 3: Foundation indicator sample taken at

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 Gauteng, 0001
 Telephone: [+27] (11) 254 4800
 Fax: [+27] 086 582 1561

CONTRACTOR: Phezulu Projects
 MACHINE: TLB 580T CASE
 PIT LxB: 1.5x2.5
 FILE REF: TP'S.GPJ

DATE EXCAVATED: 2016/11/23
 DATE PROFILED: 2016/11/23
 PROFILED BY: SN
 CHECKED BY: SG





TEST PIT IMAGES

Table 74: AWRD13

Description	Photo
AWRD13 Total depth is 1.90 m	 A photograph of a test pit excavation. The pit is rectangular and shows several distinct soil layers. The top layer is dark brown, moist soil with some roots. Below it is a lighter, more granular layer. The bottom layer is a dark, silty material. The pit is surrounded by green grass and some dry, brown vegetation. The lighting is natural, suggesting an outdoor setting.



TEST PIT PROFILE

CLIENT: Eskom Holdings SOC
 PROJECT: Tutuka Ash Dump Extension
 LOCATION: Standerton, Mpumalanga
 PROJECT NO: 1658666

HOLE No: AWRD14

X COORD: 740159.00
 Y COORD: 7034978.00
 DATUM: 35s
 ELEVATION:

Scale	Legend	Depth	Description
0.00		0.00	Moist, dark grey, highly shattered, <u>very soft</u> , silty CLAY with roots. Sheetwash.
0.5		0.90	Moist, olive, very highly shattered, <u>very soft to soft</u> , silty CLAY. Residual Dolerite.
1.0		1.5	
2.0		2.50	Olive, very fine grained, highly weathered, jointed, <u>soft</u> , DOLERITE.
2.5		3.00	
3.0			No refusal
3.5			End of log

- NOTES: 1: End of hole at 3 m
 2: No groundwater seepage
 3: Bulk sample taken at 0.9-2.5 m

Golder Associates Africa (Pty) Ltd.
 Maxwell Office Park, Midrand
 Gauteng, 0001
 Telephone: [+27] (11) 254 4800
 Fax: [+27] 086 582 1561

CONTRACTOR: Phezulu Projects
 MACHINE: TLB 580T CASE
 PIT LxB: 1.5x2.5
 FILE REF: TP'S.GPJ

DATE EXCAVATED: 2016/11/23
 DATE PROFILED: 2016/11/23
 PROFILED BY: SN
 CHECKED BY: SG





TEST PIT IMAGES

Table 75: AWRD14

Description	Photo
<p>AWRD14 Total depth is 3.0 m</p>	 A vertical photograph showing the interior of a test pit. The soil profile is visible, starting with a top layer of dark, loose soil and some sparse vegetation. Below this is a thicker, more uniform layer of dark, silty soil. At the bottom of the pit, there is a distinct, darker, and more layered soil structure, possibly representing a different geological stratum or a highly eroded surface. The overall appearance is that of a natural soil profile exposed in a test pit.



TEST PIT PROFILE

CLIENT: Eskom Holdings SOC
PROJECT: Tutuka Ash Dump Extension
LOCATION: Standerton, Mpumalanga
PROJECT NO: 1658666

HOLE No: AWRD15

X COORD: 740162.00
Y COORD: 7034462.00
DATUM: 35s
ELEVATION:

Page 1 of 1

Scale	Legend	Depth	Description
0.00		0.00	Slightly moist, dark olive brown, shattered and slickensided, <u>soft</u> , silty CLAY. Sheetwash.
0.5		0.60	Slightly moist, olive, shattered and slickensided, <u>firm</u> , silty CLAY. Residual Shale.
1.0		1.40	Olive, highly weathered, very fine grained, jointed, laminated and fissile, <u>very soft to soft rock</u> SHALE.
1.5		2.70	Refusal at 2.7 m
2.0			End of log
2.5			
3.0			
3.5			

NOTES: 1: End of hole at 2.7 m
2: No groundwater seepage
3: No sample taken

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Maxwell Office Park, Midrand
Gauteng, 0001
Telephone: [+27] (11) 254 4800
Fax: [+27] 086 582 1561

CONTRACTOR: Phezulu Projects
MACHINE: TLB 580T CASE
PIT LxB: 1.5x2.5
FILE REF: TP'S.GPJ


DATE EXCAVATED: 2016/11/24
DATE PROFILED: 2016/11/24
PROFILED BY: SN
CHECKED BY: SG





TEST PIT IMAGES

Table 76: AWRD15

Description	Photo
AWRD15 Total depth is 2.70 m	 A photograph of a test pit excavation. The pit is rectangular and shows several distinct soil layers. The top layer is dark brown, followed by a lighter, more silty layer, and then a darker, more textured layer. The bottom of the pit is uneven and appears to be composed of loose soil and some roots. The surrounding area is grassy.



TEST PIT PROFILE

CLIENT: Eskom Holdings SOC
PROJECT: Tutuka Ash Dump Extension
LOCATION: Standerton, Mpumalanga
PROJECT NO: 1658666

HOLE No: AWRD16

X COORD: 740334.00
Y COORD: 7034682.00
DATUM: 35s
ELEVATION:

Page 1 of 1

Scale	Legend	Depth	Description
0.00		0.00	Slightly moist to moist, olive, shattered, <u>soft</u> , silty CLAY with rootlets. Sheetwash.
0.5			
0.90		0.90	Slightly moist to moist, olive, shattered, <u>soft to firm</u> , silty CLAY. Residual Dolerite.
1.0			
1.5			
2.00		2.00	Yellow brown, highly weathered, fine grained, <u>soft rock</u> DOLERITE.
2.0			
2.40		2.40	Refusal at 2.4 m
2.5			End of log
3.0			
3.5			

NOTES: 1: End of hole at 2.4 m
2: No groundwater seepage
3: Foundation indicator sample taken at 0,9-2,0 m

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Gauteng, 0001
Telephone: [+27] (11) 254 4800
Fax: [+27] 086 582 1561

CONTRACTOR: Phezulu Projects
MACHINE: TLB 580T CASE
PIT LxB: 1.5x2.5
FILE REF: TP'S.GPJ

DATE EXCAVATED: 2016/11/23
DATE PROFILED: 2016/11/23
PROFILED BY: SN
CHECKED BY: SG





TEST PIT IMAGES

Table 77: AWRD16

Description	Photo
AWRD16 Total depth is 2.40 m	 A photograph showing a rectangular test pit dug into the ground. The pit is approximately 2.40 meters deep. The soil is dark brown and appears to be a mix of clay and silt. There are some roots and debris visible on the surface around the pit. The pit is surrounded by grass and other vegetation.



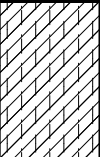

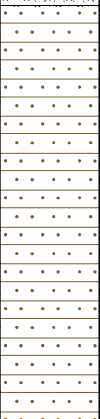
TEST PIT PROFILE

CLIENT: Eskom Holdings SOC
PROJECT: Tutuka Ash Dump Extension
LOCATION: Standerton, Mpumalanga
PROJECT NO: 1658666

HOLE No: RRD01

X COORD: 739661.00
Y COORD: 7033098.00
DATUM: 35s
ELEVATION:

Page 1 of 1

Scale	Legend	Depth	Description
		0.00	Slightly moist to moist, dark gray, medium shattered, <u>soft becoming firm</u> , silty CLAY. Sheetwash.
0.5		0.50	Olive and blackish, highly weathered, <u>soft rock</u> , very fine to fine grained, jointed, DOLERITE.
1.0			
1.5			
1.80		1.80	
2.0			Yellow brown, <u>soft rock</u> , fine grained, intensely bedded SANDSTONE.
2.5			
3.0			
3.10		3.10	
			No refusal
3.5			End of log

NOTES: 1: End of hole at 3.1 m
2: No groundwater seepage
3: No sample taken

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Maxwell Office Park, Midrand
Gauteng, 0001
Telephone: [+27] (11) 254 4800
Fax: [+27] 086 582 1561

CONTRACTOR: Phezulu Projects
MACHINE: TLB 580T CASE
PIT LxB: 1.5x2.5
FILE REF: TP'S.GPJ

DATE EXCAVATED: 2016/11/22
DATE PROFILED: 2016/11/22
PROFILED BY: SN
CHECKED BY: SG





TEST PIT IMAGES

Table 78: RRD01

Description	Photo
<p>RRD01 Total depth is 3.10 m</p>	 A photograph showing a cross-section of a test pit. The soil is dark brown and appears to be composed of several distinct layers. The top layer is dark and silty, followed by a lighter, more sandy layer, and then a darker, more silty layer at the bottom. The pit is surrounded by green grass and some dry vegetation.
<p>RRD01 Material from 0 to 3.10 m</p>	 A photograph showing a large pile of soil material, likely the material from the test pit. The pile is conical and composed of dark brown soil. The background shows a green field under a blue sky with a few trees in the distance.



TEST PIT PROFILE

CLIENT: Eskom Holdings SOC
PROJECT: Tutuka Ash Dump Extension
LOCATION: Standerton, Mpumalanga
PROJECT NO: 1658666

HOLE No: RRD02
X COORD: 739799.00
Y COORD: 7033044.00
DATUM: 35s
ELEVATION:

Page 1 of 1

Scale	Legend	Depth	Description
0.00			Slightly moist, yellow brown, slightly shattered, <u>loose</u> , clayey SILT with some sand and gravels. Hillwash.
0.30			Slightly moist to moist, dark gray, shattered and slickensided, <u>very soft to soft</u> , silty CLAY. Sheetwash.
0.5			
1.0			
1.20			Moist, olive, shattered and slickensided, silty clay, <u>very soft to soft</u> , silty CLAY. Residual Shale.
1.5			
1.80			Grey, highly to medium weathered, fine grained, closely jointed, <u>soft</u> DOLERITE.
2.0			
2.40			
2.5			Refusal at 2.1 m
3.0			End of log
3.5			

- NOTES: 1: End of hole at 2.4 m
2: Slow groundwater seepage at 2.1 m
3: Foundation indicator sample taken at 0,3-2,12 m

Golder Associates Africa (Pty) Ltd.
Maxwell Office Park, Midrand
Gauteng, 0001
Telephone: [+27] (11) 254 4800
Fax: [+27] 086 582 1561

CONTRACTOR: Phezulu Projects
MACHINE: TLB 580T CASE
PIT LxB: 1.5x2.5
FILE REF: TP'S.GPJ

DATE EXCAVATED: 2016/11/22
DATE PROFILED: 2016/11/22
PROFILED BY: SN
CHECKED BY: SG





TEST PIT IMAGES

Table 79: RRD02

Description	photo
<p>RRD02 Total depth is 2.40 m</p>	 A photograph showing a cross-section of a test pit. The soil is dark and appears to be composed of several distinct layers. At the bottom of the pit, there is a small pool of water. The surrounding area is covered with green grass and some dry, brownish vegetation.
<p>RRD02 Material from 0 to 2.40 m</p>	 A photograph showing a large pile of dark, rocky material. A yellow excavator is visible in the background, with its arm extended over the pile. The material appears to be a mix of soil and rocks. The background shows a green field under a clear sky.



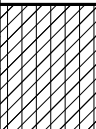
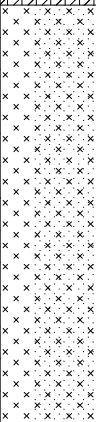
TEST PIT PROFILE

CLIENT: Eskom Holdings SOC
PROJECT: Tutuka Ash Dump Extension
LOCATION: Standerton, Mpumalanga
PROJECT NO: 1658666

HOLE No: RRD03

X COORD: 739878,00
Y COORD: 7033076,00
DATUM: 35s
ELEVATION:

Page 1 of 1

Scale	Legend	Depth	Description
		0.00	Slightly moist, dark grey, medium shattered, <u>soft</u> , silty CLAY. Sheetwash.
0.5		0.40	Grey, highly to medium weathered, fine grained, closely jointed, <u>soft rock</u> DOLERITE.
1.0			
1.5			
		1.70	Refusal at 1.7 m
2.0			End of log
2.5			
3.0			
3.5			

NOTES: 1: End of hole at 1.7 m
2: No groundwater seepage
3: No sample taken

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Maxwell Office Park, Midrand
Gauteng, 0001
Telephone: [+27] (11) 254 4800
Fax: [+27] 086 582 1561

CONTRACTOR: Phezulu Projects
MACHINE: TLB 580T CASE
PIT LxB: 1.5x2.5
FILE REF: TP'S.GPJ

DATE EXCAVATED: 2016/11/22
DATE PROFILED: 2016/11/22
PROFILED BY: SN
CHECKED BY: SG





TEST PIT IMAGES

Table 80: RRD03

Description	Photo
<p>RRD03 Total depth is 1.70 m</p>	 A photograph showing a cross-section of a test pit. The soil is dark brown and appears to be a heavy clay or silt. The pit is surrounded by green grass and some dry vegetation. The soil surface is uneven and shows signs of being recently excavated.
<p>RRD03 Material from 0 to 1.70 m</p>	 A photograph showing a large pile of soil material, likely the material from the test pit. The soil is dark brown and appears to be a heavy clay or silt. The pile is surrounded by green grass. In the background, a yellow excavator is visible, suggesting the soil was recently excavated.



TEST PIT PROFILE

CLIENT: Eskom Holdings SOC
PROJECT: Tutuka Ash Dump Extension
LOCATION: Standerton, Mpumalanga
PROJECT NO: 1658666

HOLE No: RRD04

X COORD: 739914.00
Y COORD: 7033184.00
DATUM: 35s
ELEVATION:

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Scale	Legend	Depth	Description
0.5		0.00	Slightly moist to moist, dark grey, <u>very soft</u> , highly shattered, silty CLAY with coarse gravels towards the bottom of the horizon. Sheetwash.
1.0		0.80	Grey weathered yellow brown, highly weathered, soft, jointed DOLERITE.
1.5		1.20	Refusal at 1.2 m
2.0			End of log
2.5			
3.0			
3.5			

NOTES: 1: End of hole at 1.2 m
2: No groundwater seepage
3: No sample taken

Golder Associates Africa (Pty) Ltd.
Maxwell Office Park, Midrand
Gauteng, 0001
Telephone: [+27] (11) 254 4800
Fax: [+27] 086 582 1561

CONTRACTOR: Phezulu Projects
MACHINE: TLB 580T CASE
PIT LxB: 1.5x2.5
FILE REF: TP'S.GPJ

DATE EXCAVATED: 2016/11/22
DATE PROFILED: 2016/11/22
PROFILED BY: SN
CHECKED BY: SG





TEST PIT IMAGES

Table 81: RRD04

Description	Photo
<p>RRD04 Total depth is 1.0 m</p>	 A photograph showing a cross-section of a test pit. The soil is dark and appears to be composed of several layers, including a top layer of dark, silty soil, followed by a layer of lighter, sandy soil, and then a layer of dark, rocky soil. The pit is surrounded by green grass.
<p>RRD04 Material from 0 to 1.0 m</p>	 A photograph showing an excavator loading material from a test pit into a large pile. The material is dark and rocky. In the background, there is a body of water and a grassy field under a blue sky.



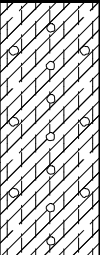
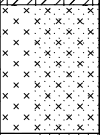
TEST PIT PROFILE

CLIENT: Eskom Holdings SOC
PROJECT: Tutuka Ash Dump Extension
LOCATION: Standerton, Mpumalanga
PROJECT NO: 1658666

HOLE No: RRD05

X COORD: 740025.00
Y COORD: 7033312.00
DATUM: 35s
ELEVATION:

Page 1 of 1

Scale	Legend	Depth	Description
0.00			
0.5			Slightly moist, dark grey, highly shattered, <u>very soft</u> , silty CLAY with coarse gravels at the bottom of the layer. Sheetwash.
0.80			
1.0			Grey weathered yellow brown, fine grained, highly weathered, jointed, <u>soft rock</u> DOLERITE.
1.20			
1.5			Refusal at 1.2 m
2.0			
2.5			
3.0			
3.5			
			End of log

NOTES: 1: End of hole at 1.2 m
2: No groundwater seepage
3: No sample taken

Golder Associates Africa (Pty) Ltd.
Maxwell Office Park, Midrand
Gauteng, 0001
Telephone: [+27] (11) 254 4800
Fax: [+27] 086 582 1561

CONTRACTOR: Phezulu Projects
MACHINE: TLB 580T CASE
PIT LxB: 1.5x2.5
FILE REF: TP'S.GPJ



DATE EXCAVATED: 2016/11/22
DATE PROFILED: 2016/11/22
PROFILED BY: SN
CHECKED BY: SG





TEST PIT IMAGES

Table 82: RRD05

Description	Photo
<p>RRD05 Total depth is 1.20 m</p>	
<p>RRD05 Material from 0 to 1.20 m</p>	



TEST PIT PROFILE

CLIENT: Eskom Holdings SOC
 PROJECT: Tutuka Ash Dump Extension
 LOCATION: Standerton, Mpumalanga
 PROJECT NO: 1658666

HOLE No: RRD06
 X COORD: 739973.00
 Y COORD: 7033457.00
 DATUM: 35s
 ELEVATION:

Scale	Legend	Depth	Description
0.00		0.00	Moist, dark olive, medium shattered, <u>very soft to soft</u> , silty CLAY. Topsoil.
0.30		0.30	Moist, dark olive, shattered and slickensided, <u>very soft to soft</u> , silty CLAY with traces of rock fragments. Residual Dolerite.
0.50		0.50	Moist, dark olive, slightly shattered, <u>soft to firm</u> , silty CLAY with sand and rock fragments. Residual Dolerite.
1.0		1.10	Gray weathered orange brown, highly weathered, fine grained, jointed, DOLERITE.
1.5		2.05	Refusal at 2.05 m
2.0			End of log
2.5			
3.0			
3.5			

- NOTES: 1: End of hole at 2.05 m
 2: No groundwater seepage
 3: No sample taken

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 Gauteng, 0001
 Telephone: [+27] (11) 254 4800
 Fax: [+27] 086 582 1561

CONTRACTOR: Phezulu Projects
 MACHINE: TLB 580T CASE
 PIT LxB: 1.5x2.5
 FILE REF: TP'S.GPJ

DATE EXCAVATED: 2016/11/22
 DATE PROFILED: 2016/11/22
 PROFILED BY: SN
 CHECKED BY: SG





TEST PIT IMAGES

Table 83: RRD06

Description	photo
<p>RRD06 Total depth is 2.05 m</p>	 A photograph showing a cross-section of a test pit. The soil is dark brown and appears to be composed of several distinct layers. The top layer is relatively smooth, while the lower layers show more texture and some small rocks. The pit is surrounded by sparse, dry vegetation.
<p>RRD06 Material from 0 to 2.05 m</p>	 A photograph showing an excavator with a yellow bucket loading a large pile of dark brown soil. The soil is piled up in a grassy field. The excavator's arm and bucket are visible in the upper right corner of the frame.



TEST PIT PROFILE

CLIENT: Eskom Holdings SOC
PROJECT: Tutuka Ash Dump Extension
LOCATION: Standerton, Mpumalanga
PROJECT NO: 1658666

HOLE No: RRD07

X COORD: 740101.00
Y COORD: 7033587.00
DATUM: 35s
ELEVATION:

Page 1 of 1

Scale	Legend	Depth	Description
		0.00	Slightly moist, to moist, dark olive, shattered, <u>soft</u> , clayey SILT. Topsoil.
		0.30	
		0.50	Moist, dark grey, medium shattered, <u>soft</u> , silty CLAY. Sheetwash.
		0.70	
		0.80	Grey weathered orange brown, moderately weathered, jointed, fine grained, <u>soft to medium-hard rock</u> DOLERITE.
1.0			Refusal at 0.8 m
			End of log
1.5			
2.0			
2.5			
3.0			
3.5			

NOTES: 1: End of hole at 0.8 m
2: No groundwater seepage
3: No sample taken

Golder Associates Africa (Pty) Ltd.
Maxwell Office Park, Midrand
Gauteng, 0001
Telephone: [+27] (11) 254 4800
Fax: [+27] 086 582 1561

CONTRACTOR: Phezulu Projects
MACHINE: TLB 580T CASE
PIT LxB: 1.5x2.5
FILE REF: TP'S.GPJ

DATE EXCAVATED: 2016/11/22
DATE PROFILED: 2016/11/22
PROFILED BY: RvdW
CHECKED BY: SG





TEST PIT PROFILE

CLIENT: Eskom Holdings SOC
PROJECT: Tutuka Ash Dump Extension
LOCATION: Standerton, Mpumalanga
PROJECT NO: 1658666

HOLE No: RRD08

X COORD: 739995,00
Y COORD: 7033699,00
DATUM: 35s
ELEVATION:

Page 1 of 1

Scale	Legend	Depth	Description
		0.00	Moist, brown, shattered, <u>soft to firm</u> , clayey SILT with sand and gravels. Topsoil.
0.5		0.50	Moist, dark olive, slightly shattered, <u>soft to firm</u> , silty CLAY. Sheetwash.
1.0		0.95	Moist, olive, slightly shattered, <u>soft to firm</u> , silty CLAY. Residual Shale.
1.5			
2.0			
2.5			
3.0		3.00	No refusal
3.5			End of log

- NOTES: 1: End of hole at 3.0 m
2: No groundwater seepage
3: Foundation indicator samples taken at 0,5-0,7 m and 0,95-1,15 m

CONTRACTOR: Phezulu Projects
MACHINE: TLB 580T CASE
PIT LxB: 1,5x2,5
FILE REF: TP'S.GPJ

DATE EXCAVATED: 2016/11/22
DATE PROFILED: 2016/11/22
PROFILED BY: RvdW
CHECKED BY: SG

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Maxwell Office Park, Midrand
Gauteng, 0001
Telephone: [+27] (11) 254 4800
Fax: [+27] 086 582 1561





TEST PIT IMAGES

Table 85: RRD08

Description	Photo
<p>RRD08 Total depth is 3.0 m</p>	 A photograph showing a cross-section of a test pit. The pit is filled with dark, layered soil and rock material, showing distinct horizontal strata. The surrounding area is grassy.
<p>RRD08 Material from 0 to 3.0 m</p>	 A photograph showing a large pile of excavated material, likely soil and rock, in an open field. A yellow CASE excavator is visible in the background, with its arm and bucket raised. The ground is grassy.



TEST PIT PROFILE

CLIENT: Eskom Holdings SOC
PROJECT: Tutuka Ash Dump Extension
LOCATION: Standerton, Mpumalanga
PROJECT NO: 1658666

HOLE No: RRD10
X COORD: 739676.00
Y COORD: 7033333.00
DATUM: 35s
ELEVATION:

Page 1 of 1

Scale	Legend	Depth	Description
		0.00	Slightly moist to moist, dark brown, slightly shattered, <u>soft to firm</u> , silty CLAY. Topsoil.
		0.30	
0.5			Slightly moist to moist, olive brown, slightly shattered, <u>soft</u> , silty CLAY with minor sand. Residual Dolerite.
		1.10	
1.0			Moist, bluish green, medium to highly shattered, <u>soft</u> , silty CLAY. Residual Dolerite.
		1.50	
1.5			Blueish green and yellow, highly weathered, fine grained, jointed, <u>soft rock</u> DOLERITE.
		1.80	
2.0			Refusal at 1.8 m
			End of log
2.5			
3.0			
3.5			

NOTES: 1: End of hole at 1.8 m
2: Moderate groundwater seepage at 1,9 m
3: Foundation indicator sample taken at 0,3-1 m

Golder Associates Africa (Pty) Ltd.
Maxwell Office Park, Midrand
Gauteng, 0001
Telephone: [+27] (11) 254 4800
Fax: [+27] 086 582 1561

CONTRACTOR: Phezulu Projects
MACHINE: TLB 580T CASE
PIT LxB: 1.5x2.5
FILE REF: TP'S.GPJ

DATE EXCAVATED: 2016/11/24
DATE PROFILED: 2016/11/24
PROFILED BY: SN
CHECKED BY: SG





TEST PIT IMAGES

Table 86: RRD10

Description	Photo
RRD10 Total depth is 1.80 m	 A photograph of a test pit excavation. The pit is rectangular and shows several distinct soil layers. The top layer is dark brown, moist soil with some green grass growing on the surface. Below this is a lighter, more silty layer. At the bottom of the pit, there is a pool of greyish, turbid water, which is the groundwater level. The water surface is slightly rippled. The pit is surrounded by green grass and soil.



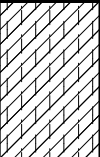

TEST PIT PROFILE

CLIENT: Eskom Holdings SOC
PROJECT: Tutuka Ash Dump Extension
LOCATION: Standerton, Mpumalanga
PROJECT NO: 1658666

HOLE No: RRD11

X COORD: 739664.00
Y COORD: 7033217.00
DATUM: 35s
ELEVATION:

Page 1 of 1

Scale	Legend	Depth	Description
		0.00	Very coarse to cobble-sized, rounded, GRAVELS with moist, dark grey, silty clay. <u>Loose</u> , Hillwash.
0.5		0.50	Grey weathered yellow brown, highly weathered, fine grained, jointed, <u>soft</u> DOLERITE.
1.0		1.40	Refusal at 1.4 m
1.5			End of log
2.0			
2.5			
3.0			
3.5			

NOTES: 1: End of hole at 1.4 m
2: No groundwater seepage
3: No sample taken

Golder Associates Africa (Pty) Ltd.
Maxwell Office Park, Midrand
Gauteng, 0001
Telephone: [+27] (11) 254 4800
Fax: [+27] 086 582 1561

CONTRACTOR: Phezulu Projects
MACHINE: TLB 580T CASE
PIT LxB: 1.5x2.5
FILE REF: TP'S.GPJ


DATE EXCAVATED: 2016/11/24
DATE PROFILED: 2016/11/24
PROFILED BY: SN
CHECKED BY: SG





TEST PIT IMAGES

Table 87: RRD11

Description	Photo
RRD11 Total depth is 1.40 m	 A vertical photograph of a test pit. The top layer shows dark, moist soil with a dense network of roots. Below this is a layer of lighter-colored, more granular soil. The bottom portion of the pit is filled with numerous dark, angular rocks of various sizes, some embedded in a sandy matrix.



TEST PIT PROFILE

CLIENT: Eskom Holdings SOC
 PROJECT: Tutuka Ash Dump Extension
 LOCATION: Standerton, Mpumalanga
 PROJECT NO: 1658666

HOLE No: RRD12
 X COORD: 739873.00
 Y COORD: 7033538.00
 DATUM: 35s
 ELEVATION:

Scale	Legend	Depth	Description
0.00		0.00	Moist, dark olive, medium shattered, <u>very soft</u> , silty CLAY. Topsoil.
0.30		0.30	Moist, dark olive, shatterede and slickensided, <u>very soft</u> , silty CLAY. Sheetwash.
0.90		0.90	Moist, olive, medium shattered, <u>very soft to soft</u> , silty CLAY. Residual shale.
1.0		1.0	
1.5		1.5	
2.0		2.0	
2.5		2.5	
3.0		3.0	
3.15		3.15	
3.5			No refusal
			End of log

- NOTES: 1: End of hole at 3.15 m
 2: No groundwater seepage
 3: Bulk sample taken at 1.1-1.3 m

Golder Associates Africa (Pty) Ltd.
 Maxwell Office Park, Midrand
 Gauteng, 0001
 Telephone: [+27] (11) 254 4800
 Fax: [+27] 086 582 1561

CONTRACTOR: Phezulu Projects
 MACHINE: TLB 580T CASE
 PIT LxB: 1.5x2.5
 FILE REF: TP'S.GPJ

DATE EXCAVATED: 2016/11/22
 DATE PROFILED: 2016/11/22
 PROFILED BY: SN
 CHECKED BY: SG





TEST PIT IMAGES

Table 88: RRD12

Description	Photo
<p>RRD12 Total depth is 3.15 m</p>	
<p>RRD12 Material from 0 to 3.15 m</p>	



TEST PIT PROFILE

CLIENT: Eskom Holdings SOC
PROJECT: Tutuka Ash Dump Extension
LOCATION: Standerton, Mpumalanga
PROJECT NO: 1658666

HOLE No: RRD13

X COORD: 739833,00
Y COORD: 7033915,00
DATUM: 35s
ELEVATION:

Page 1 of 1

Scale	Legend	Depth	Description
0.00			
0.5			Moist, very dark olive, <u>very soft</u> , highly shattered, silty CLAY. Sheetwash.
0.90			
1.0			Grey weathered yellow brown, highly weathered, fine grained, jointed, <u>very soft becoming soft rock</u> DOLERITE.
1.50			
1.5			Refusal at 1.5 m
2.0			
2.5			
3.0			
3.5			
			End of log

NOTES: 1: End of hole at 1.5 m
2: No groundwater seepage
3: No sample taken

Golder Associates Africa (Pty) Ltd.
Maxwell Office Park, Midrand
Gauteng, 0001
Telephone: [+27] (11) 254 4800
Fax: [+27] 086 582 1561

CONTRACTOR: Phezulu Projects
MACHINE: TLB 580T CASE
PIT LxB: 1.5x2.5
FILE REF: TP'S.GPJ


DATE EXCAVATED: 2016/11/23
DATE PROFILED: 2016/11/23
PROFILED BY: SN
CHECKED BY: SG





TEST PIT IMAGES

Table 89: RRD13

Description	Photo
RRD13 Total depth is 1.5 m	 A vertical photograph of a test pit excavation. The soil profile shows a top layer of dark, moist soil with visible roots and some organic matter. Below this is a layer of lighter, brownish soil, followed by a layer of dark, silty soil. The bottom of the pit is composed of dark, silty soil with some small rocks and debris. The pit is surrounded by dry, yellowish grass and some green plants at the edges.



TEST PIT PROFILE

CLIENT: Eskom Holdings SOC
 PROJECT: Tutuka Ash Dump Extension
 LOCATION: Standerton, Mpumalanga
 PROJECT NO: 1658666

HOLE No: RRD14
 X COORD: 740122.00
 Y COORD: 7033676.00
 DATUM: 35s
 ELEVATION:

Scale	Legend	Depth	Description
0.00		0.00	Moist, very dark olive, highly slickensided and shattered, <u>very soft</u> , silty CLAY. Sheetwash.
0.5		1.30	Moist, olive, very highly shattered and slickensided, <u>very soft to soft</u> , silty CLAY. Residual Shale.
1.0		2.60	Grey weathered yellow brown, <u>soft rock</u> , highly weathered, fine grained, jointed DOLERITE.
1.5		3.30	Refusal at 3.3 m
2.0			End of log
2.5			
3.0			
3.5			

- NOTES: 1: End of hole at 3.3 m
 2: No groundwater seepage
 3: Bulk sample taken at 1.3-2.0 m

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 Maxwell Office Park, Midrand
 Gauteng, 0001
 Telephone: [+27] (11) 254 4800
 Fax: [+27] 086 582 1561

CONTRACTOR: Phezulu Projects
 MACHINE: TLB 580T CASE
 PIT LxB: 1.5x2.5
 FILE REF: TP'S.GPJ


DATE EXCAVATED: 2016/11/23
 DATE PROFILED: 2016/11/23
 PROFILED BY: SN
 CHECKED BY: SG





TEST PIT IMAGES

Table 90: RRD14

Description	Photo
RRD14 Total depth is 3.30 m	 A photograph of a test pit (RRD14) showing a cross-section of soil. The top layer is dark, moist soil with some roots. Below this is a layer of lighter, more granular soil. The bottom of the pit shows a layer of dark, silty soil. The pit is approximately 3.30 m deep.



TEST PIT PROFILE

CLIENT: Eskom Holdings SOC
PROJECT: Tutuka Ash Dump Extension
LOCATION: Standerton, Mpumalanga
PROJECT NO: 1658666

HOLE No: RRD15

X COORD: 740269.00
Y COORD: 7033921.00
DATUM: 35s
ELEVATION:

Page 1 of 1

Scale	Legend	Depth	Description
0.5		0.00	Slightly moist, to moist, dark olive, shattered, <u>very soft</u> , silty CLAY. Sheetwash.
1.0		0.90	Slightly moist, olive, slightly shattered, <u>firm</u> , silty CLAY with traces of rock fragments. Residual Shale.
1.5		1.30	Dark olive, very fine grained, highly becoming medium weathered, laminated and fissile, <u>soft rock</u> , jointed SHALE.
2.0			
2.5			
3.0		3.00	Slight refusal at 3.0 m
3.5			End of log

NOTES: 1: End of hole at 3.0 m
2: No groundwater seepage
3: Foundation indicator sample taken at 0,9-1,3 m

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Maxwell Office Park, Midrand
Gauteng, 0001
Telephone: [+27] (11) 254 4800
Fax: [+27] 086 582 1561

CONTRACTOR: Phezulu Projects
MACHINE: TLB 580T CASE
PIT LxB: 1.5x2.5
FILE REF: TP'S.GPJ

DATE EXCAVATED: 2016/11/23
DATE PROFILED: 2016/11/23
PROFILED BY: SN
CHECKED BY: SG





TEST PIT IMAGES

Table 91: RRD15

Description	Photo
<p>RRD15 Total depth is 3.0 m</p>	 A photograph showing a vertical cross-section of a test pit. The soil is dark brown to black, with visible horizontal layering and some vertical cracks. There is some dry, light-colored vegetation or roots on the left side of the pit.



TEST PIT PROFILE

CLIENT: Eskom Holdings SOC
PROJECT: Tutuka Ash Dump Extension
LOCATION: Standerton, Mpumalanga
PROJECT NO: 1658666

HOLE No: RRD16

X COORD: 740362.00

Y COORD: 7034140.00

DATUM: 35s

ELEVATION:

Page 1 of 1

Scale	Legend	Depth	Description
0.00			Slightly moist, to moist, dark grey, shattered, <u>soft</u> , silty CLAY. Sheetwash.
0.5			
0.70			Slightly moist, olive, slightly shattered, <u>firm</u> , silty CLAY. Residual Shale.
1.0			
1.10			Olive, highly weathered, very fine, jointed, laminated and fissile, <u>soft rock</u> SHALE.
1.50			Refusal at 1.5 m
2.0			End of log
2.5			
3.0			
3.5			

NOTES: 1: End of hole at 1.5 m
2: No groundwater seepage
3: Foundation indicator sample taken at 0,3-0,6 m

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Maxwell Office Park, Midrand
Gauteng, 0001
Telephone: [+27] (11) 254 4800
Fax: [+27] 086 582 1561

CONTRACTOR: Phezulu Projects
MACHINE: TLB 580T CASE
PIT LxB: 1.5x2.5
FILE REF: TP'S.GPJ


DATE EXCAVATED: 2016/11/23
DATE PROFILED: 2016/11/23
PROFILED BY: SN
CHECKED BY: SG





TEST PIT IMAGES

Table 92: RRD16

Description	Photo
<p>RRD16 Total depth is 1.50 m</p>	 A vertical photograph of a test pit. The top of the pit shows dark, rich soil with some green grass and roots. Below this is a layer of lighter, more silty soil. At the bottom, there is a distinct, wavy, brownish layer, possibly representing a different soil type or a root zone. The pit is approximately 1.50 m deep.



TEST PIT PROFILE

CLIENT: Eskom Holdings SOC
 PROJECT: Tutuka Ash Dump Extension
 LOCATION: Standerton, Mpumalanga
 PROJECT NO: 1658666

HOLE No: RRD17
 X COORD: 740187.00
 Y COORD: 7034160.00
 DATUM: 35s
 ELEVATION:

Scale	Legend	Depth	Description
0.00		0.00	Slightly moist to moist, dark grey, medium to highly shattered, <u>very soft</u> , silty CLAY. Sheetwash.
0.5			
1.0			
1.5			
1.60		1.60	Moist, olive, highly shattered, <u>very soft</u> , silty CLAY. Residual Shale.
2.0			
2.5			
2.60		2.60	Moist, bluish green, highly shattered, <u>very soft</u> , silty CLAY with minor sand. Completely weathered shale.
3.0		3.00	No refusal
3.5			End of log

- NOTES: 1: End of hole at 3.0 m
 2: No groundwater seepage
 3: Bulk sample taken at 1.0-1.4 m

Golder Associates Africa (Pty) Ltd.
 Maxwell Office Park, Midrand
 Gauteng, 0001
 Telephone: [+27] (11) 254 4800
 Fax: [+27] 086 582 1561

CONTRACTOR: Phezulu Projects
 MACHINE: TLB 580T CASE
 PIT LxB: 1.5x2.5
 FILE REF: TP'S.GPJ


DATE EXCAVATED: 2016/11/23
 DATE PROFILED: 2016/11/23
 PROFILED BY: SN
 CHECKED BY: SG





TEST PIT IMAGES

Table 93: RRD17

Description	Photo
<p>RRD17 Total depth is 3.0 m</p>	 A vertical photograph of a test pit. The soil profile shows several distinct layers. At the top, there is a thin layer of light-colored, silty soil. Below this is a thicker layer of dark brown, silty soil. The middle section consists of a layer of reddish-brown soil with some horizontal layering. The bottom portion of the pit is filled with dark, fragmented material, likely rock or highly weathered soil, with some green vegetation growing at the base.





TEST PIT PROFILE

CLIENT: Eskom Holdings SOC
PROJECT: Tutuka Ash Dump Extension
LOCATION: Standerton, Mpumalanga
PROJECT NO: 1658666

HOLE No: RRD18

X COORD: 740022.00
Y COORD: 7034137.00
DATUM: 35s
ELEVATION:

Page 1 of 1

Scale	Legend	Depth	Description
		0.00	Slightly moist, reddish brown, intact, <u>very soft to soft</u> , silty CLAY with sand. Hillwash.
		0.20	
0.5			Olive and yellow brown, highly weathered, very soft becoming soft rock , very fine, laminated and fissile, jointed SHALE .
1.0			
1.5			
2.0		2.10	
			Refusal at 2.1 m
2.5			End of log
3.0			
3.5			

NOTES: 1: End of hole at 2.1 m
2: No groundwater seepage
3: No sample taken

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Maxwell Office Park, Midrand
Gauteng, 0001
Telephone: [+27] (11) 254 4800
Fax: [+27] 086 582 1561

CONTRACTOR: Phezulu Projects
MACHINE: TLB 580T CASE
PIT LxB: 1.5x2.5
FILE REF: TP'S.GPJ

DATE EXCAVATED: 2016/11/23
DATE PROFILED: 2016/11/23
PROFILED BY: SN
CHECKED BY: SG





TEST PIT IMAGES

Table 94: RRD18

Description	Photo
RRD18 Total depth is 2.10 m	 A photograph showing a cross-section of a test pit. The soil is dark, almost black, and appears to be composed of volcanic ash or similar material. There are several large, dark rocks scattered throughout the pit. The surrounding area is covered with green grass and some small, leafy plants. The pit is located in a grassy field.



CORE BOREHOLE LOG

CLIENT: Eskom
 PROJECT: Tutuka Power Station
 LOCATION: Thuthukani, Standerton; MP Province
 PROJECT NO: 1658666

HOLE No: BH06

X COORD: 739516.80
 Y COORD: 7035312.50
 DATUM: 35J
 ELEVATION:

Sample Type	Mat.Recov. (m)	% Mat.Recov.	% Core Recov.	% RQD	No. Fractures	SPT - N value	Water	Legend	Legend	Depth (m)	Description
NQ	0.53	35	0	0						0.00	Slightly moist to moist, dark brown to grey, soft, shattered, <u>silty clay</u> with some sand. Sheetwash.
SH	0.5		0	0						1.0	
NQ	0.63	42	0	0						1.25	
SH	0.5		0	0						2.0	Moist, olive green blotched dark brown, <u>soft</u> , slickensided and shattered, silty clays. Residual shales.
SPT	0.13		0	0		REF				2.20	
NQ	1.5	100	100	35						3.0	Light olive, very fine, jointed and intensely bedded, medium to slight weathered, soft to medium-hard SHALE.
										4.0	
NQ	1.5	100	100	57						5.0	
										5.20	
NQ	1.6	107	107	73						6.0	Light yellow brown, slightly to unweathered, medium to course grained, massive, very hard SANDSTONE.
										6.10	
										7.0	Banded light grey and dark grey, unweathered, intensely bedded, very fine to fine grained, hard SILTSTONE.
NQ	1.57	105	105	82						7.10	
										8.0	Dark grey, unweathered, jointed, medium grained, very hard DOLERITE.
										9.0	
NQ	1.38	92	92	8						10.0	
										11.0	
NQ	1.53	102	102	0						12.0	
										12.60	
										13.0	Borehole drilled up to 12.6 m
										14.0	End of log

- NOTES: 1: End of hole at 12.6 m
 2: Piezometer installed at 12.6 m
 3: SPT's conducted at 2.05-2.2 m, Shelby samples taken at 0.5-1.05 m and 1.5-2.2 m

Golder Associates Africa (Pty) Ltd.
 Maxwell Office Park, Midrand
 Gauteng, 0001
 Telephone: [+27] (11) 254 4800
 Fax: [+27] 086 582 1561

CONTRACTOR: Geopractica
 MACHINE: Wireline Rotary Core
 INCLINATION: Vertical
 FILE REF: 1658666_BOREHOLE LOGS.GPJ

DRILLING DATE: 2016/11/11
 DATE PROFILED: 2016/11/13
 PROFILED BY: SN
 CHECKED BY: SOC



Client	Eskom
Site/ Project Name	Tutuka Power Station
BH Number	BH 06
Core Box Number	Box 01 to Box 02
Drill Run Length	0.00-9.6 m
Drilling Contractor	Geopractica Drilling
Date Drilled	11-11-2016 to 13-11-2016



Client	Eskom
Site/ Project Name	Tutuka Power Station
BH Number	BH 06
Core Box Number	Box 03
Drill Run Length	9.6-12.6 m
Drilling Contractor	Geopractica Drilling
Date Drilled	11-11-2016 to 13-11-2016





CORE BOREHOLE LOG

CLIENT: Eskom
 PROJECT: Tutuka Power Station
 LOCATION: Thuthukani, Standerton; MP Province
 PROJECT NO: 1658666

HOLE No: BH07
 X COORD: 738363.78
 Y COORD: 7035228.44
 DATUM: 35L
 ELEVATION:

Sample Type	Mat.Recov. (m)	% Mat.Recov.	% Core Recov.	% RQD	No. Fractures	SPT - N value	Water	Legend	Legend	Depth (m)	Description
NQ	0.5	33	0	0						0.00	Slightly moist to moist, dark brown, <u>soft</u> , shattered, silty clay with some sand, Sheetwash .
SH	0.55	37	0	0						0.50	
SPT	0.33	22	0	0		53				1.0	Moist, olive, silty clay with minor sand, <u>soft becoming stiff</u> , shattered and slickensided. Residual Shale .
SH	0.05	3	0	0						2.0	
NQ	0.9	60	40	30						2.30	Olive, very fine, very intensely bedded and jointed, unweathered, hard to very hard SHALE .
NQ	1.5	100	100	35						3.0	
NQ	1.5	100	100	21						4.0	
NQ	1.5	100	100	21						5.0	
NQ	1.5	100	100	21						6.0	
NQ	1.5	100	100	21						7.0	
NQ	1.5	100	100	87						8.0	
NQ	1.5	100	100	87						8.70	Banded light and dark gray, very fine to fine, closely to moderately jointed and intensely bedded, unweathered, very hard, SILTSTONE .
NQ	1.5	100	100	87						9.0	
NQ	1.5	100	100	87						10.0	
NQ	1.4	93	93	64						11.0	Greyish, fine, jointed, unweathered, very hard DOLERITE .
										11.90	
										12.0	DOLERITE .
										12.40	
										13.0	Borehole drilled up to 12.4 m
										14.0	End of log

- NOTES: 1: End of hole at 12.4 m
 2: Piezometer installed at 12.4 m
 3: SPT tests conducted at 1,05-1,5 m and Shelby samples taken at 0,5-1,05 m and 1,55-2,05 m

Golder Associates Africa (Pty) Ltd.
 Maxwell Office Park, Midrand
 Gauteng, 0001
 Telephone: [+27] (11) 254 4800
 Fax: [+27] 086 582 1561

CONTRACTOR: Geopractica
 MACHINE: Wireline Rotary Core
 INCLINATION: Vertical
 FILE REF: 1658666_BOREHOLE LOGS.GPJ

DRILLING DATE: 2016/11/14
 DATE PROFILED: 2016/11/16
 PROFILED BY: SN
 CHECKED BY: SOC



Client	Eskom
Site/ Project Name	Tutuka Power Station
BH Number	BH 07
Core Box Number	Box 01 to Box 02
Drill Run Length	0.00-9.6 m
Drilling Contractor	Geopractica Drilling
Date Drilled	14-11-2016 to 17-11-2016





CORE BOREHOLE LOG

CLIENT: Eskom
 PROJECT: Tutuka Power Station
 LOCATION: Thuthukani, Standerton; MP Province
 PROJECT NO: 1658666

HOLE No: BH08

X COORD: 739873.44
 Y COORD: 7033538.24
 DATUM: 35L
 ELEVATION:

Sample Type	Mat.Recov. (m)	% Mat.Recov.	% Core Recov.	% RQD	No. Fractures	SPT - N value	Water	Legend	Legend	Depth (m)	Description
NQ	0.6	40	0	0						0.00	Slightly moist, dark grey, <u>very soft to soft</u> , shattered, silty clay. Sheetwash.
SH	0.5		0	0						1.0	
NQ	0.5	33	0	0						1.30	Slightly moist to moist, olive, <u>soft</u> , shattered and slickensided, silty clay. Residual Shale.
SH	0.55		0	0						2.0	
NQ	0.45	30	0	0						2.0	
SPT	0.29		0	0		11				3.0	
NQ	0.56	37	0	0						3.0	
NQ	0.7	47	27	0						4.0	Olive, very fine, highly weathered, <u>very soft to soft rock</u> , intensely bedded and jointed. SHALE.
NQ	0.26	17	17	0						5.0	
NQ	0.34	23	23	0						5.0	
NQ	0.54	36	36	0						6.0	
NQ	1.5	100	100	33						7.0	
NQ	1.61	107	107	19						8.0	Light yellow brown, medium grained, highly weathered becoming slightly weathered, medium jointed, <u>soft becoming hard rock</u> . SANDSTONE.
NQ	1.32	88	88	17						8.60	Light brown banded light grey, very fine to fine grained, intensely bedded and very closely bedded, highly to medium weathered, <u>soft to medium hard rock</u> . SILTSTONE.
NQ	1.44	96	96	21						10.74	Grey, fine grained, closely jointed, medium becoming unweathered, <u>medium hard becoming very hard rock</u> . DOLERITE.
										12.0	
										12.18	Borehole drilled up to 12.18 m
										13.0	End of log
										14.0	

NOTES: 1: End of hole at 12.18 m
 2: SPT test conducted at 2.55-3.00 m and Shelby samples taken at 0.5-1.05 m and 1.55-2.05 m
 3: Piezometer installed at 12.18 m

Golder Associates Africa (Pty) Ltd.
 Maxwell Office Park, Midrand
 Gauteng, 0001
 Telephone: [+27] (11) 254 4800
 Fax: [+27] 086 582 1561

CONTRACTOR: Geopractica
 MACHINE: Wireline Rotary Core
 INCLINATION: Vertical
 FILE REF: 1658666_BOREHOLE LOGS.GPJ

DRILLING DATE: 2016/11/14
 DATE PROFILED: 2016/11/17
 PROFILED BY: SN
 CHECKED BY: SOC



Client	Eskom
Site/ Project Name	Tutuka Power Station
BH Number	BH 07
Core Box Number	Box 03
Drill Run Length	9.6-12.4 m
Drilling Contractor	Geopractica Drilling
Date Drilled	14-11-2016 to 17-11-2016



Client	Eskom
Site/ Project Name	Tutuka Power Station
BH Number	BH 08
Core Box Number	Box 01 to Box 02
Drill Run Length	0.00-10.74 m
Drilling Contractor	Geopractica Drilling
Date Drilled	14-11-2016 to 18-11-2016



Client	Eskom
Site/ Project Name	Tutuka Power Station
BH Number	BH 08
Core Box Number	Box 03
Drill Run Length	10.74-12.18 m
Drilling Contractor	Geopractica Drilling
Date Drilled	14-11-2016 to 17-11-2016





APPENDIX D

Dynamic Probe Super Heavy (DPSH) and Dynamic Cone Penetration (DCP) Results

IN-SITU CBR

Job Name Tutuka Geotechnical Investigation

8kg Hammer

20mm point

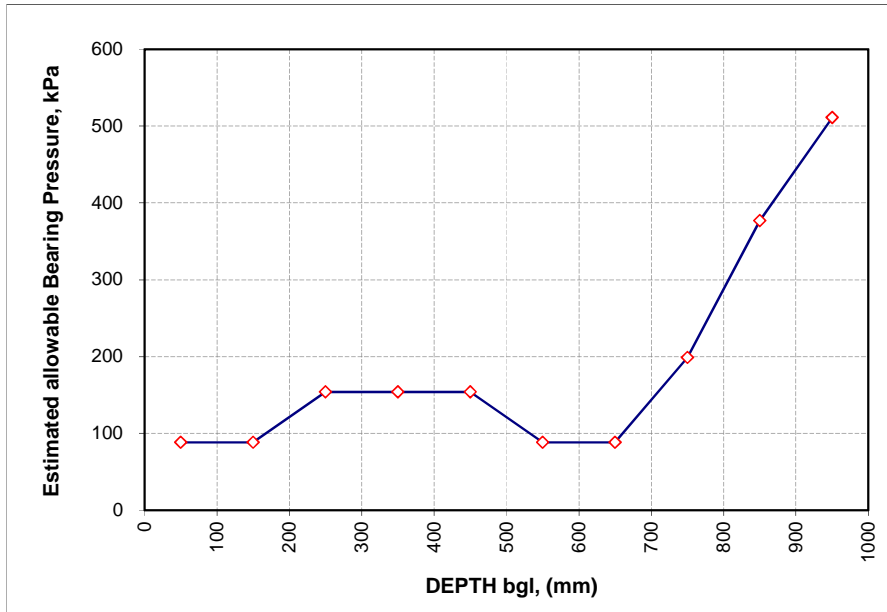
File No: AD36

Job No: 1658666

Date of Test:

16/11/2016

DCP No: **AD02** Location: **Tutuka Power Station** 1499
 note: **EASBP** from **Terzaghi** & Peck p4 for 25mm settlement



SPT mm/blow	DCP DN	Consistency
< 5	132-210	Very Dense
5 - 10	78-132	Dense
10 - 30	25-78	Med Dense
30 - 75	10 25	Loose
75 -100	<10	Very Loose

NOTE :
 Stated consistencies do not apply to cohesive materials. Describe using "stiff or firm or soft".

Depth of hole in which DCP was taken :				0	mm below NGL				
Applied Factor :		1	times Terzaghi's value				SPT = 1.2 DN		
Remarks : DCP by Golder, light hammer									
Reading No.	Layer From	Layer To	Layer thickness	DCP Blows	Level Below NGL mm	DCP DN	Equiv. SPT N Value	Approx In-situ CBR	Approx EASBP kPa
1	0	100	100	2	50	6	7	3	88
2	100	200	100	2	150	6	7	3	88
3	200	300	100	3	250	9	11	5	154
4	300	400	100	3	350	9	11	5	154
5	400	500	100	3	450	9	11	5	154
6	500	600	100	2	550	6	7	3	88
7	600	700	100	2	650	6	7	3	88
8	700	800	100	4	750	12	14	7	199
9	800	900	100	8	850	24	29	17	377
10	900	1000	100	11	950	33	40	26	511

IN-SITU CBR

Job Name Tutuka Geotechnical Investigation

8kg Hammer

20mm point

File No:

Job No: 1658666

Date of Test:

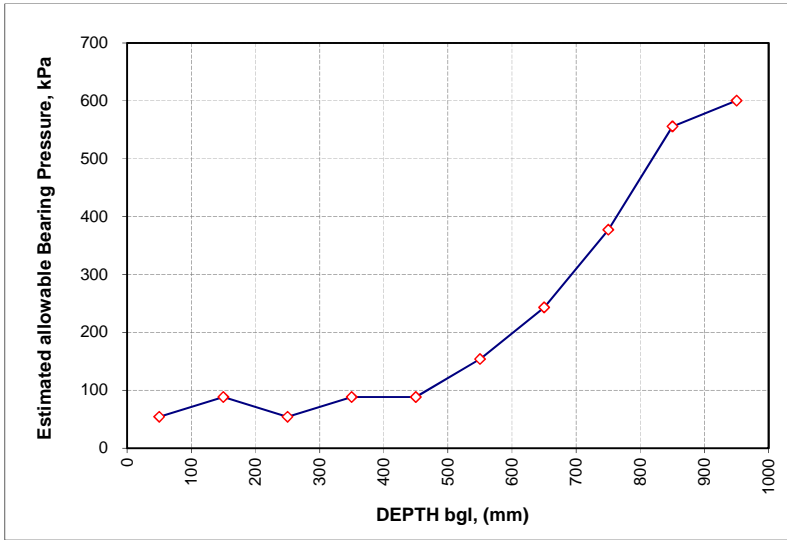
18/11/2016

DCP No: AD18

Location: Tutuka Power Station

1499

note: EASBP from Terzaghi & Peck p4 for 25mm settlement



Penetration Guide		
SPT mm/blow	DCP DN	Consistency
< 5	132-210	Very Dense
5 - 10	78-132	Dense
10 - 30	25-78	Med Dense
30 - 75	10 - 25	Loose
75 - 100	<10	Very Loose

NOTE :
Stated consistencies do not apply to cohesive materials. Describe using "stiff or firm or soft".

Depth of hole in which DCP was taken :				0	mm below NGL				
Applied Factor :				1	times Terzaghi's value			SPT = 1.2 DN	
Remarks : DCP by Golder, light hammer									
Reading No.	Layer From	Layer To	Layer thickness	DCP Blows	Level Below NGL mm	DCP DN	Equiv. SPT N Value	Approx In-situ CBR	Approx EASBP kPa
1	0	100	100	1	50	3	4	0	54
2	100	200	100	2	150	6	7	3	88
3	200	300	100	1	250	3	4	0	54
4	300	400	100	2	350	6	7	3	88
5	400	500	100	2	450	6	7	3	88
6	500	600	100	3	550	9	11	5	154
7	600	700	100	5	650	15	18	9	243
8	700	800	100	8	750	24	29	17	377
9	800	900	100	12	850	36	43	29	556
10	900	1000	100	13	950	39	47	32	600

IN-SITU CBR

Job Name Tutuka Geotechnical Investigation

8kg Hammer

20mm point

File No:

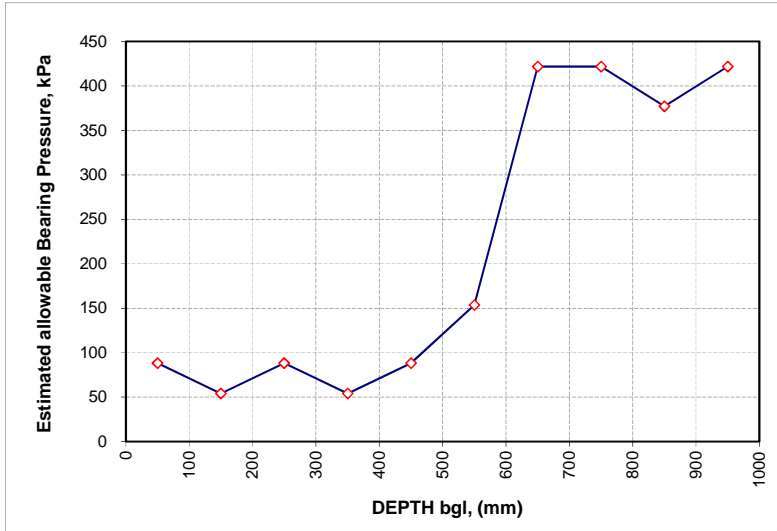
Job No: 1658666

Date of Test:

17/11/2016

DCP No: AD22 Location: Tutuka Power Station 1499

note: EASBP from Terzaghi & Peck p4 for 25mm settlement



Penetration Guide		
SPT mm/blow	DCP DN	Consistency
< 5	132-210	Very Dense
5 - 10	78-132	Dense
10 - 30	25-78	Med Dense
30 - 75	10 - 25	Loose
75 -100	<10	Very Loose

NOTE :
Stated consistencies do not apply to cohesive materials. Describe using "stiff or firm or soft".

Depth of hole in which DCP was taken :				0	mm below NGL					
Applied Factor :				1	times Terzaghi's value				SPT = 1.2 DN	
Remarks : DCP by Golder, light hammer										
Reading No.	Layer From	Layer To	Layer thickness	DCP Blows	Level Below NGL mm	DCP DN	Equiv. SPT N Value	Approx In-situ CBR	Approx EASBP kPa	
1	0	100	100	2	50	6	7	3	88	
2	100	200	100	1	150	3	4	0	54	
3	200	300	100	2	250	6	7	3	88	
4	300	400	100	1	350	3	4	0	54	
5	400	500	100	2	450	6	7	3	88	
6	500	600	100	3	550	9	11	5	154	
7	600	700	100	9	650	27	32	20	422	
8	700	800	100	9	750	27	32	20	422	
9	800	900	100	8	850	24	29	17	377	
10	900	1000	100	9	950	27	32	20	422	

IN-SITU CBR

Job Name Tutuka Geotechnical Investigation

8kg Hammer

20mm point

File No:

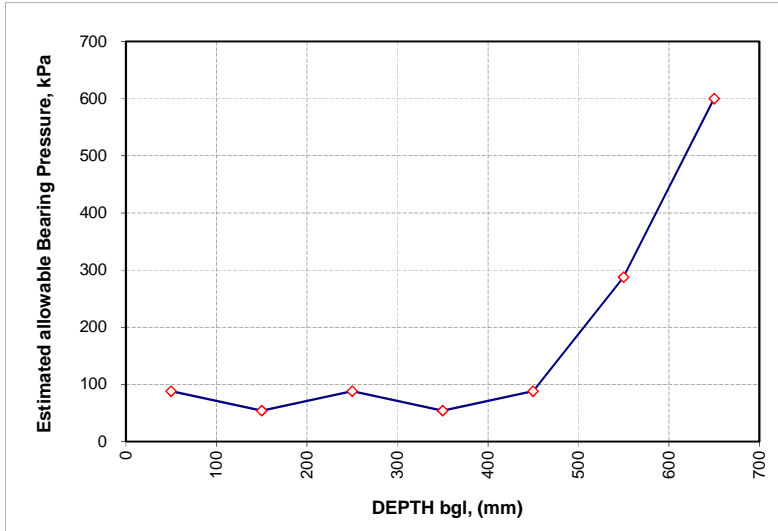
Job No: 1658666

Date of Test:

17/11/2016

DCP No: **AD25** Location: **Tutuka Power Station** 1499

note: **EASBP** from **Terzaghi** & Peck p4 for 25mm settlement



Penetration Guide		
SPT mm/blow	DCP DN	Consistency
< 5	132-210	Very Dense
5 - 10	78-132	Dense
10 - 30	25-78	Med Dense
30 - 75	10 - 25	Loose
75 -100	<10	Very Loose

NOTE :
Stated consistencies do not apply to cohesive materials. Describe using "stiff or firm or soft".

Depth of hole in which DCP was taken :				0	mm below NGL					
Applied Factor :				1	times Terzaghi's value				SPT = 1.2 DN	
Remarks : DCP by Golder, light hammer										
Reading No.	Layer From	Layer To	Layer thickness	DCP Blows	Level Below NGL mm	DCP DN	Equiv. SPT N Value	Approx In-situ CBR	Approx EASBP kPa	
1	0	100	100	2	50	6	7	3	88	
2	100	200	100	1	150	3	4	0	54	
3	200	300	100	2	250	6	7	3	88	
4	300	400	100	1	350	3	4	0	54	
5	400	500	100	2	450	6	7	3	88	
6	500	600	100	6	550	18	22	12	288	
7	600	700	100	13	650	39	47	32	600	

IN-SITU CBR

Job Name Tutuka Geotechnical Investigation
 File No: AD36 Job No: 1658666

8kg Hammer

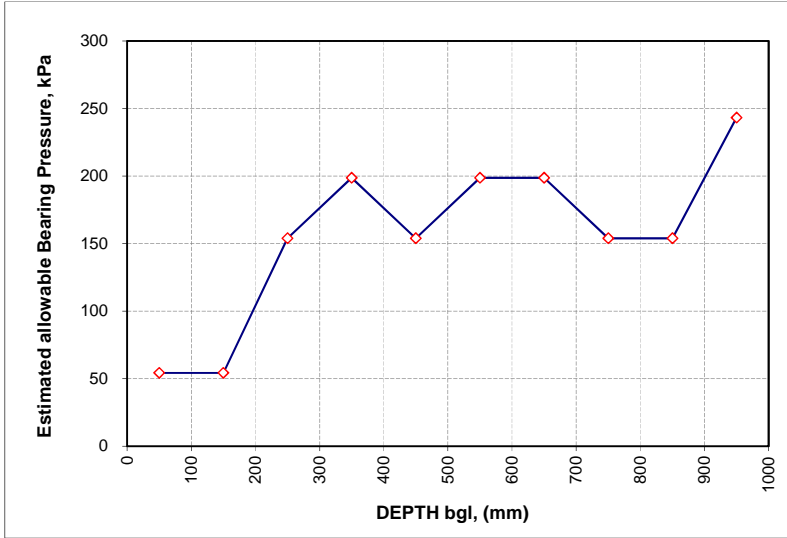
20mm point

Date of Test:

22/11/2016

DCP No: **AWRD12** Location: **Tutuka Power Station** 1499

note: **EASBP** from **Terzaghi** & Peck p4 for 25mm settlement



Penetration Guide		
SPT mm/blow	DCP DN	Consistency
< 5	132-210	Very Dense
5 - 10	78-132	Dense
10 - 30	25-78	Med Dense
30 - 75	10 25	Loose
75 - 100	<10	Very Loose

NOTE :
 Stated consistencies do not apply to cohesive materials. Describe using "stiff or firm or soft".

Depth of hole in which DCP was taken :			0	mm below NGL					
Applied Factor :			1	times Terzaghi's value				SPT = 1.2 DN	
Remarks : DCP by Golder, light hammer									
Reading No.	Layer From	Layer To	Layer thickness	DCP Blows	Level Below NGL mm	DCP DN	Equiv. SPT N Value	Approx In-situ CBR	Approx EASBP kPa
1	0	100	100	1	50	3	4	0	54
2	100	200	100	1	150	3	4	0	54
3	200	300	100	3	250	9	11	5	154
4	300	400	100	4	350	12	14	7	199
5	400	500	100	3	450	9	11	5	154
6	500	600	100	4	550	12	14	7	199
7	600	700	100	4	650	12	14	7	199
8	700	800	100	3	750	9	11	5	154
9	800	900	100	3	850	9	11	5	154
10	900	1000	100	5	950	15	18	9	243

IN-SITU CBR

Job Name Tutuka Geotechnical Investigation

8kg Hammer

20mm point

File No:

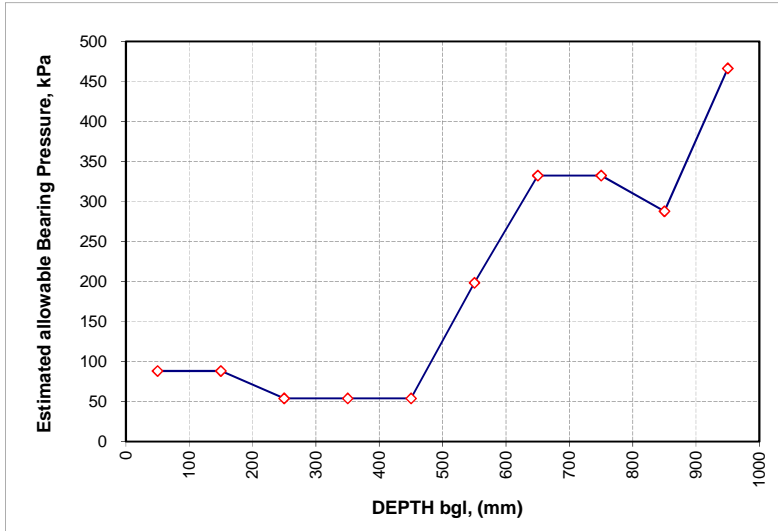
Job No: 1658666

Date of Test:

22/11/2016

DCP No: **AD43** Location: **Tutuka Power Station** 1499

note: **EASBP** from **Terzaghi** & Peck p4 for 25mm settlement



Penetration Guide		
SPT mm/blow	DCP DN	Consistency
< 5	132-210	Very Dense
5 - 10	78-132	Dense
10 - 30	25-78	Med Dense
30 - 75	10 25	Loose
75 -100	<10	Very Loose

NOTE :
Stated consistencies do not apply to cohesive materials. Describe using "stiff or firm or soft".

Depth of hole in which DCP was taken :				0	mm below NGL				
Applied Factor :				1	times Terzaghi's value				SPT = 1.2 DN
Remarks : DCP by Golder, light hammer									
Reading No.	Layer From	Layer To	Layer thickness	DCP Blows	Level Below NGL mm	DCP DN	Equiv. SPT N Value	Approx In-situ CBR	Approx EASBP kPa
1	0	100	100	2	50	6	7	3	88
2	100	200	100	2	150	6	7	3	88
3	200	300	100	1	250	3	4	0	54
4	300	400	100	1	350	3	4	0	54
5	400	500	100	1	450	3	4	0	54
6	500	600	100	4	550	12	14	7	199
7	600	700	100	7	650	21	25	14	332
8	700	800	100	7	750	21	25	14	332
9	800	900	100	6	850	18	22	12	288
10	900	1000	100	10	950	30	36	23	466

IN-SITU CBR

Job Name Tutuka Geotechnical Investigation

8kg Hammer

20mm point

File No:

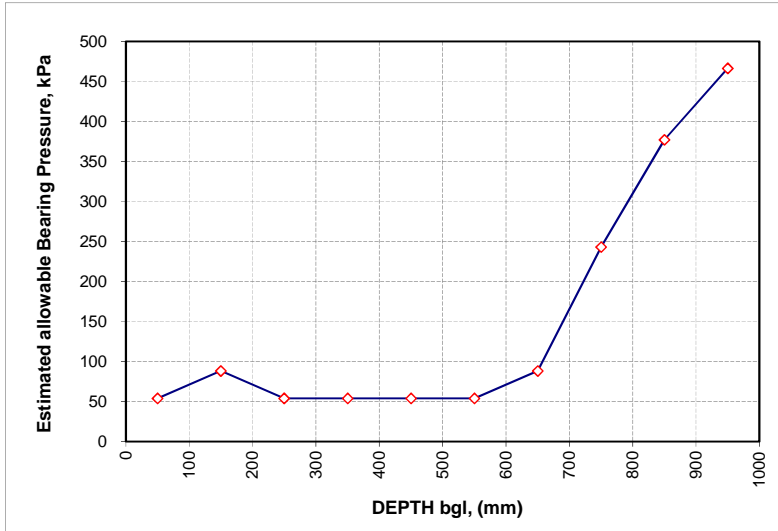
Job No: 1658666

Date of Test:

22/11/2016

DCP No: **AWRD05** Location: **Tutuka Power Station** 1499

note: **EASBP** from **Terzaghi** & Peck p4 for 25mm settlement



Penetration Guide		
SPT mm/blow	DCP DN	Consistency
< 5	132-210	Very Dense
5 - 10	78-132	Dense
10 - 30	25-78	Med Dense
30 - 75	10 25	Loose
75 -100	<10	Very Loose

NOTE :
Stated consistencies do not apply to cohesive materials. Describe using "stiff or firm or soft".

Depth of hole in which DCP was taken :				0	mm below NGL				
Applied Factor :				1	times Terzaghi's value				SPT = 1.2 DN
Remarks : DCP by Golder, light hammer									
Reading No.	Layer From	Layer To	Layer thickness	DCP Blows	Level Below NGL mm	DCP DN lows/300m	Equiv. SPT N Value	Approx In-situ CBR	Approx EASBP kPa
1	0	100	100	1	50	3	4	0	54
2	100	200	100	2	150	6	7	3	88
3	200	300	100	1	250	3	4	0	54
4	300	400	100	1	350	3	4	0	54
5	400	500	100	1	450	3	4	0	54
6	500	600	100	1	550	3	4	0	54
7	600	700	100	2	650	6	7	3	88
8	700	800	100	5	750	15	18	9	243
9	800	900	100	8	850	24	29	17	377
10	900	1000	100	10	950	30	36	23	466

IN-SITU CBR

8kg Hammer

20mm point

Job Name Tutuka Geotechnical Investigation

File No: AWRD12

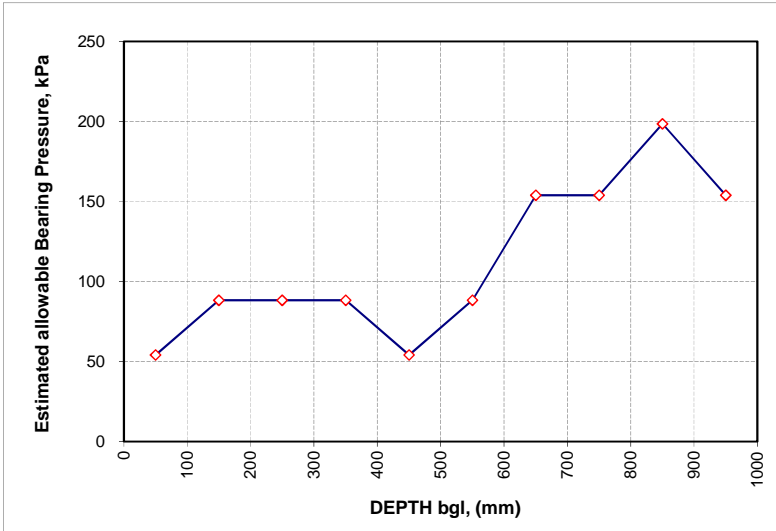
Job No: 1658666

Date of Test:

22/11/2016

DCP No: AWRD12 Location: Tutuka Power Station 1499

note: **EASBP** from **Terzaghi** & Peck p4 for 25mm settlement



Penetration Guide		
SPT mm/blow	DCP DN	Consistency
< 5	132-210	Very Dense
5 - 10	78-132	Dense
10 - 30	25-78	Med Dense
30 - 75	10 - 25	Loose
75 -100	<10	Very Loose

NOTE :
Stated consistencies do not apply to cohesive materials. Describe using "stiff or firm or soft".

Depth of hole in which DCP was taken :				0	mm below NGL					
Applied Factor :				1	times Terzaghi's value				SPT = 1.2 DN	
Remarks : <u>DCP by Golder, light hammer</u>										
Reading No.	Layer From	Layer To	Layer thickness	DCP Blows	Level Below NGL mm	DCP DN	Equiv. SPT N Value	Approx In-situ CBR	Approx EASBP kPa	
1	0	100	100	1	50	3	4	0	54	
2	100	200	100	2	150	6	7	3	88	
3	200	300	100	2	250	6	7	3	88	
4	300	400	100	2	350	6	7	3	88	
5	400	500	100	1	450	3	4	0	54	
6	500	600	100	2	550	6	7	3	88	
7	600	700	100	3	650	9	11	5	154	
8	700	800	100	3	750	9	11	5	154	
9	800	900	100	4	850	12	14	7	199	
10	900	1000	100	3	950	9	11	5	154	

IN-SITU CBR

Job Name Tutuka Geotechnical Investigation

8kg Hammer

20mm point

File No:

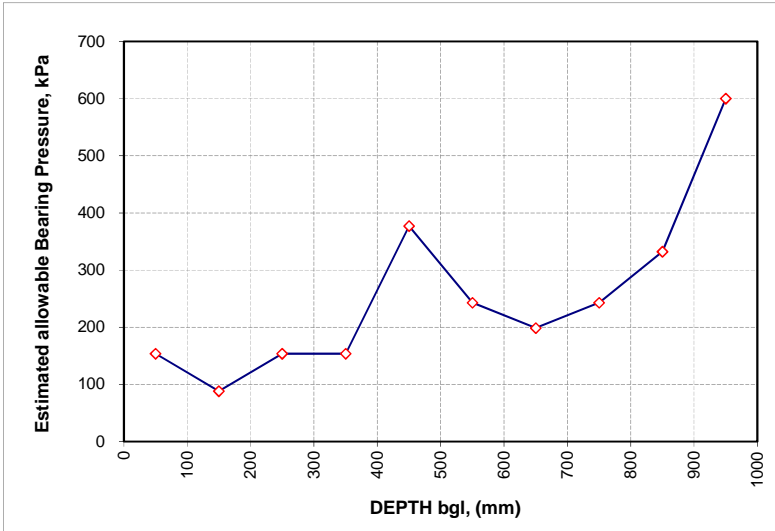
Job No: 1658666

Date of Test:

22/11/2016

DCP No: **RRD01** Location: **Tutuka Power Station** 1499

note: **EASBP** from **Terzaghi** & Peck p4 for 25mm settlement



Penetration Guide		
SPT mm/blow	DCP DN	Consistency
< 5	132-210	Very Dense
5 - 10	78-132	Dense
10 - 30	25-78	Med Dense
30 - 75	10 25	Loose
75 -100	<10	Very Loose

NOTE :
Stated consistencies do not apply to cohesive materials. Describe using "stiff or firm or soft".

Depth of hole in which DCP was taken :				0	mm below NGL					
Applied Factor :		1	times Terzaghi's value				SPT = 1.2 DN			
Remarks : DCP by Golder, light hammer										
Reading No.	Layer From	Layer To	Layer thickness	DCP Blows	Level Below NGL mm	DCP DN	Equiv. SPT N Value	Approx In-situ CBR	Approx EASBP kPa	
1	0	100	100	3	50	9	11	5	154	
2	100	200	100	2	150	6	7	3	88	
3	200	300	100	3	250	9	11	5	154	
4	300	400	100	3	350	9	11	5	154	
5	400	500	100	8	450	24	29	17	377	
6	500	600	100	5	550	15	18	9	243	
7	600	700	100	4	650	12	14	7	199	
8	700	800	100	5	750	15	18	9	243	
9	800	900	100	7	850	21	25	14	332	
10	900	1000	100	13	950	39	47	32	600	

IN-SITU CBR

Job Name Tutuka Geotechnical Investigation

8kg Hammer

20mm point

File No:

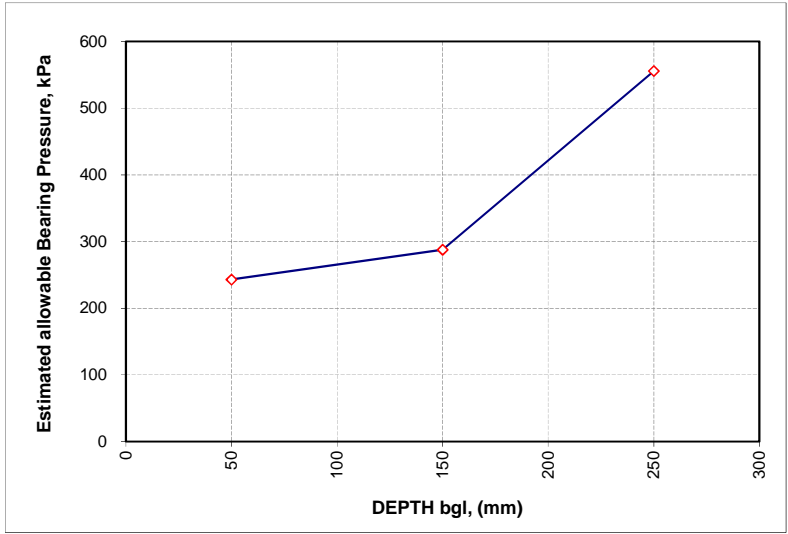
Job No: 1658666

Date of Test:

22/11/2016

DCP No: **RRD03** Location: **Tutuka Power Station** 1499

note: **EASBP** from **Terzaghi** & Peck p4 for 25mm settlement



Penetration Guide		
SPT mm/blow	DCP DN	Consistency
< 5	132-210	Very Dense
5 - 10	78-132	Dense
10 - 30	25-78	Med Dense
30 - 75	10 25	Loose
75 -100	<10	Very Loose

NOTE :
Stated consistencies do not apply to cohesive materials. Describe using "stiff or firm or soft".

Depth of hole in which DCP was taken :				0	mm below NGL					
Applied Factor :		1	times Terzaghi's value				SPT = 1.2 DN			
Remarks : DCP by Golder, light hammer										
Reading	Layer	Layer	Layer	DCP	Level	DCP	Equiv.	Approx	Approx	
No.	From	To	thickness	Blows	Below NGL	DN	SPT N	In-situ	EASBP	
					mm	blows/300m	Value	CBR	kPa	
1	0	100	100	5	50	15	18	9	243	
2	100	200	100	6	150	18	22	12	288	
3	200	300	100	12	250	36	43	29	556	

IN-SITU CBR

8kg Hammer

20mm point

Job Name Tutuka Geotechnical Investigation

File No:

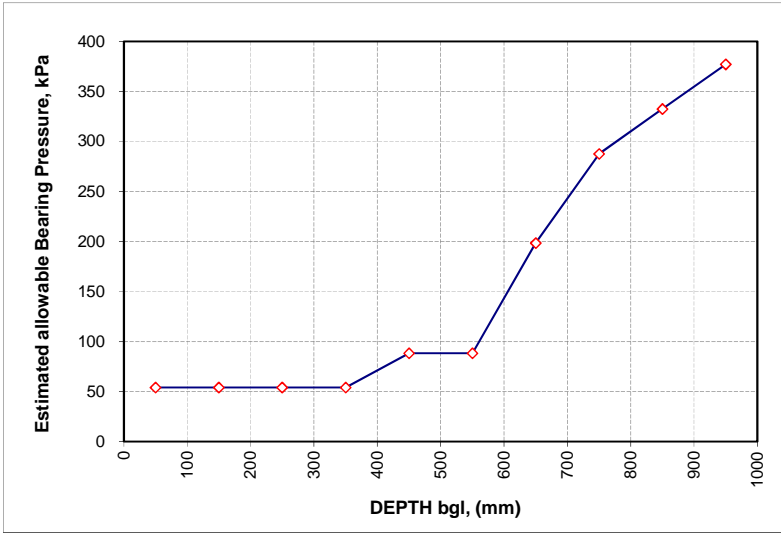
Job No: 1658666

Date of Test:

22/11/2016

DCP No: **RRD02** Location: **Tutuka Power Station** 1499

note: **EASBP** from **Terzaghi** & Peck p4 for 25mm settlement



Penetration Guide		
SPT mm/blow	DCP DN	Consistency
< 5	132-210	Very Dense
5 - 10	78-132	Dense
10 - 30	25-78	Med Dense
30 - 75	10 - 25	Loose
75 - 100	<10	Very Loose

NOTE :
Stated consistencies do not apply to cohesive materials. Describe using "stiff or firm or soft".

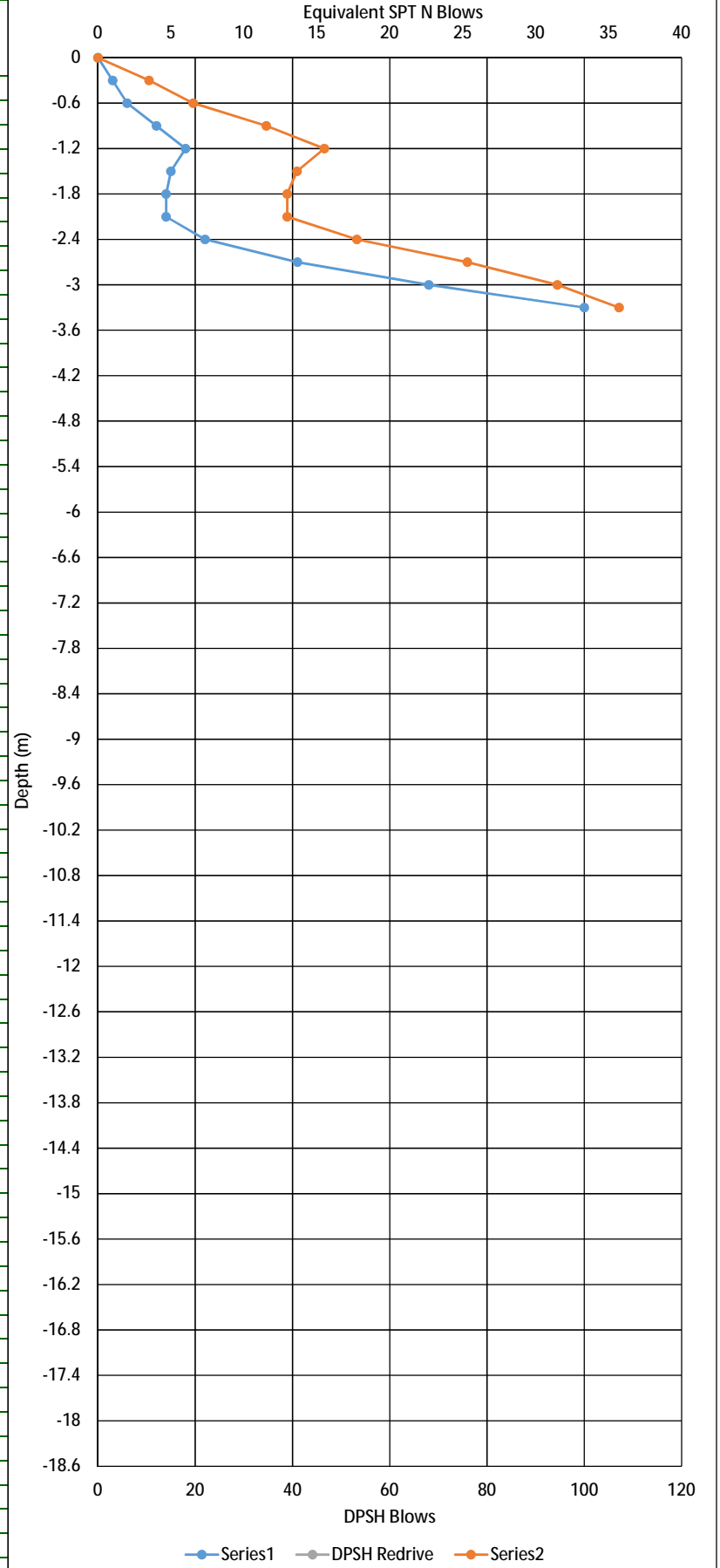
Depth of hole in which DCP was taken :				0	mm below NGL					
Applied Factor :				1	times Terzaghi's value				SPT = 1.2 DN	
Remarks : DCP by Golder, light hammer										
Reading No.	Layer From	Layer To	Layer thickness	DCP Blows	Level Below NGL mm	DCP DN lows/300m	Equiv. SPT N Value	Approx In-situ CBR	Approx EASBP kPa	
1	0	100	100	1	50	3	4	0	54	
2	100	200	100	1	150	3	4	0	54	
3	200	300	100	1	250	3	4	0	54	
4	300	400	100	1	350	3	4	0	54	
5	400	500	100	2	450	6	7	3	88	
6	500	600	100	2	550	6	7	3	88	
7	600	700	100	4	650	12	14	7	199	
8	700	800	100	6	750	18	22	12	288	
9	800	900	100	7	850	21	25	14	332	
10	900	1000	100	8	950	24	29	17	377	

Project No	1658666	DPSH ID	DPSH 01
Description	1658666l Ash Dump Extension	Location	Dump Footprint



Depth (m)	DPSH Blows	Equivalent SPT N ^[1]	Horizon Average SPT N ^[1]	Redrive Number of Blows
0	0	0.0	1.7	
-0.3	3	3.5		
-0.6	6	6.5		
-0.9	12	11.5	11.8	
-1.2	18	15.5		
-1.5	15	13.6		
-1.8	14	13.0		
-2.1	14	13.0		
-2.4	22	17.7	22.7	
-2.7	41	25.3		
-3	68	31.5		
-3.3	100	35.7		

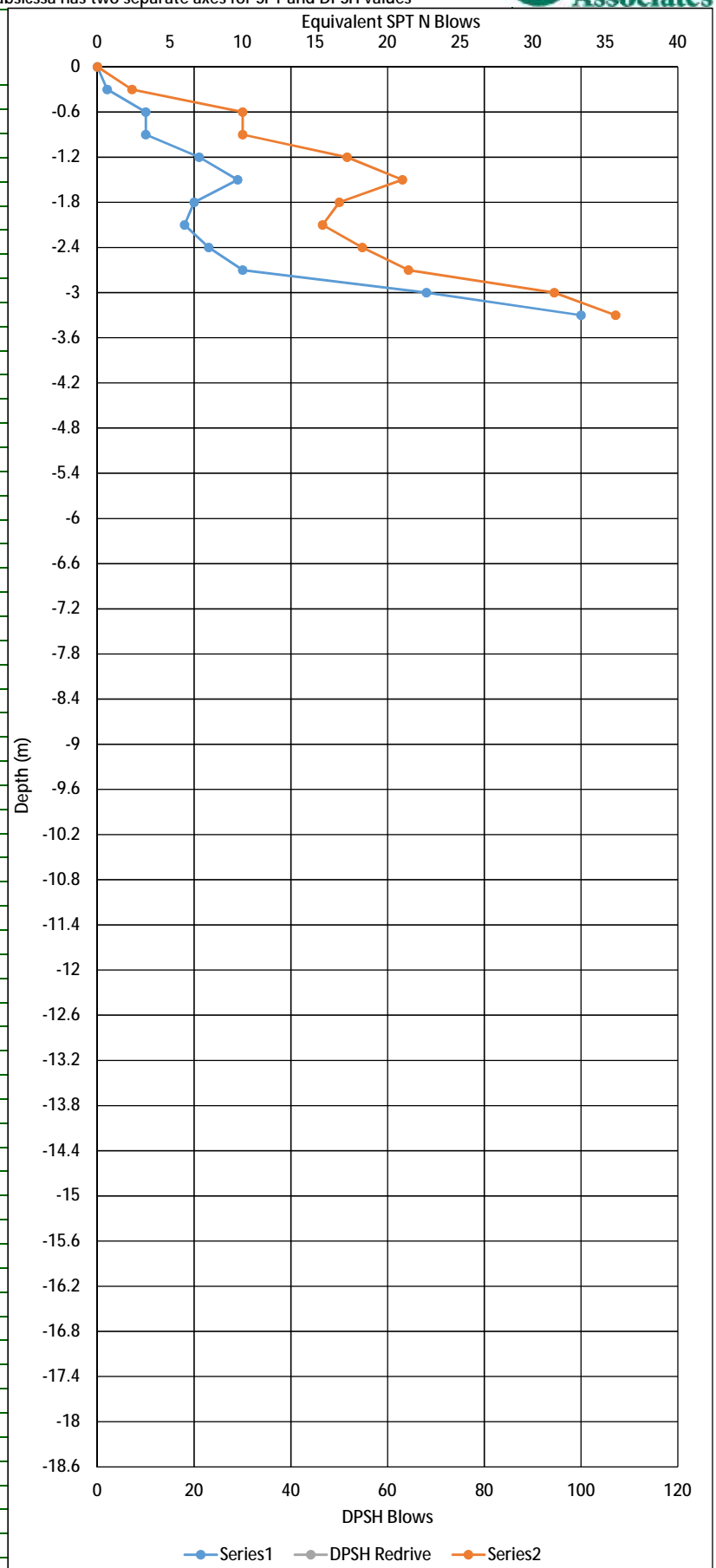
NOTE: The abscissa has two separate axes for SPT and DPSH values



Project No	1658666		DPSH ID	DPSH 31			
Description	Tutukal Ash Dump Extension		Location	Dump Footprint			



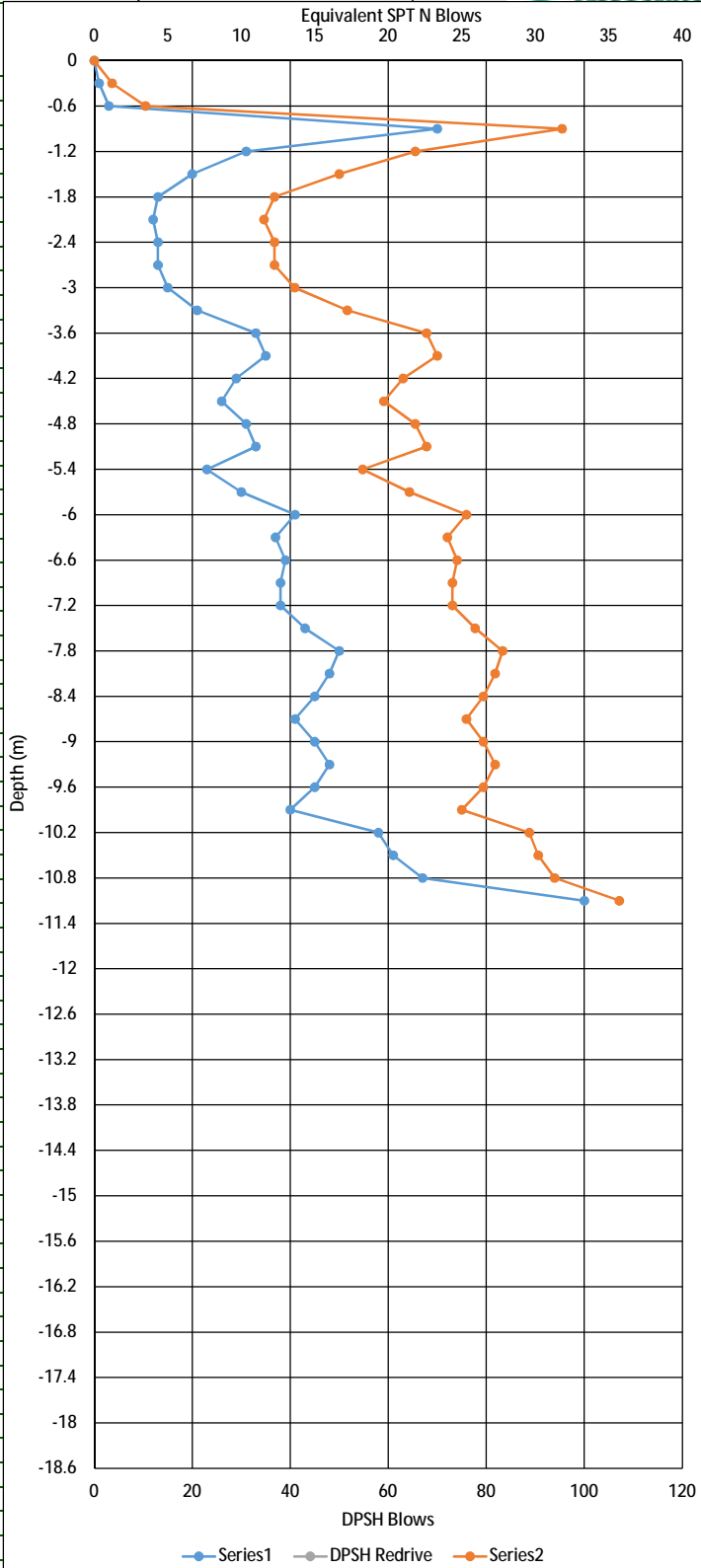
Refusal Depth (m)	3.3			NOTE: The abscissa has two separate axes for SPT and DPSH values
Depth (m)	DPSH Blows	Equivalent SPT N ^[1]	Average Horizon SPT N ^[1]	Redrive Number of Blows
0	0	0.0		
-0.3	2	2.4	2.38	
-0.6	10	10.0	10.00	
-0.9	10	10.0		
-1.2	21	17.2		
-1.5	29	21.0	16.08	
-1.8	20	16.7		
-2.1	18	15.5		
-2.4	23	18.3		
-2.7	30	21.4		
-3	68	31.5		
-3.3	100	35.7		



Project No	1658666		DPSH ID	DPSH 47			
Description	Tutukal Ash Dump Extension		Location	Dump Footprint			
Refusal Depth (m)	11.1		NOTE: The abscissa has two separate axes for SPT and DPSH values				



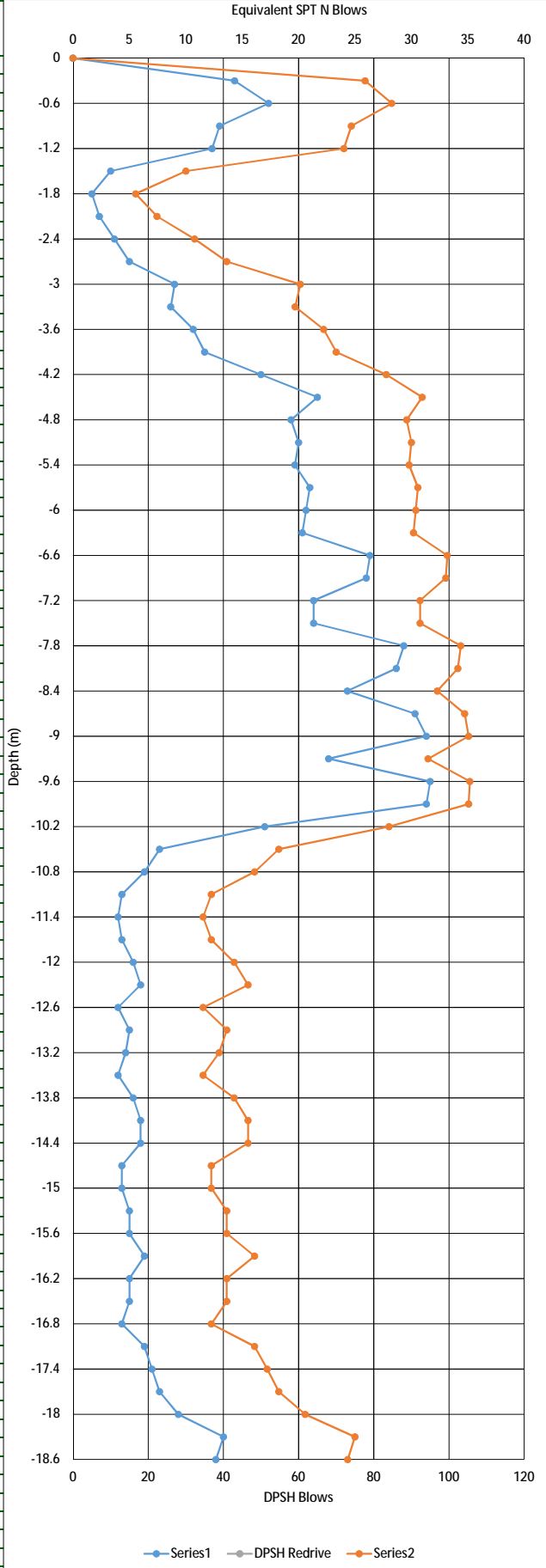
Depth (m)	DPSH Blows	Equivalent SPT N ⁽¹⁾	Redrive Depth (m)	Redrive Number of Blows
0	0	0.0		
-0.3	1	1.2		
-0.6	3	3.5		
-0.9	70	31.8		
-1.2	31	21.8		
-1.5	20	16.7		
-1.8	13	12.3		
-2.1	12	11.5		
-2.4	13	12.3		
-2.7	13	12.3		
-3	15	13.6		
-3.3	21	17.2		
-3.6	33	22.6		
-3.9	35	23.3		
-4.2	29	21.0		
-4.5	26	19.7		
-4.8	31	21.8		
-5.1	33	22.6		
-5.4	23	18.3		
-5.7	30	21.4		
-6	41	25.3		
-6.3	37	24.0		
-6.6	39	24.7		
-6.9	38	24.4		
-7.2	38	24.4		
-7.5	43	25.9		
-7.8	50	27.8		
-8.1	48	27.3		
-8.4	45	26.5		
-8.7	41	25.3		
-9	45	26.5		
-9.3	48	27.3		
-9.6	45	26.5		
-9.9	40	25.0		
-10.2	58	29.6		
-10.5	61	30.2		
-10.8	67	31.3		
-11.1	100	35.7		



Project No	1658666	DPSH ID	DPSH 49
Description	Tutukal Ash Dump Extension	Location	Dump Footprint
Refusal Depth (m)	24.6	NOTE: The abscissa has two separate axes for SPT and DPSH values	



Depth (m)	DPSH Blows	Equivalent SPT N ⁽¹⁾	Redrive Depth (m)	Redrive Number of Blows
0	0	0.0		
-0.3	43	25.9		
-0.6	52	28.3		
-0.9	39	24.7		
-1.2	37	24.0		
-1.5	10	10.0		
-1.8	5	5.6		
-2.1	7	7.4		
-2.4	11	10.8		
-2.7	15	13.6		
-3	27	20.1		
-3.3	26	19.7		
-3.6	32	22.2		
-3.9	35	23.3		
-4.2	50	27.8		
-4.5	65	31.0		
-4.8	58	29.6		
-5.1	60	30.0		
-5.4	59	29.8		
-5.7	63	30.6		
-6	62	30.4		
-6.3	61	30.2		
-6.6	79	33.2		
-6.9	78	33.1		
-7.2	64	30.8		
-7.5	64	30.8		
-7.8	88	34.4		
-8.1	86	34.1		
-8.4	73	32.3		
-8.7	91	34.7		
-9	94	35.1		
-9.3	68	31.5		
-9.6	95	35.2		
-9.9	94	35.1		
-10.2	51	28.0		
-10.5	23	18.3		
-10.8	19	16.1		
-11.1	13	12.3		
-11.4	12	11.5		
-11.7	13	12.3		
-12	16	14.3		
-12.3	18	15.5		
-12.6	12	11.5		
-12.9	15	13.6		
-13.2	14	13.0		
-13.5	12	11.5		
-13.8	16	14.3		
-14.1	18	15.5		
-14.4	18	15.5		
-14.7	13	12.3		
-15	13	12.3		
-15.3	15	13.6		
-15.6	15	13.6		
-15.9	19	16.1		
-16.2	15	13.6		
-16.5	15	13.6		
-16.8	13	12.3		
-17.1	19	16.1		
-17.4	21	17.2		
-17.7	23	18.3		
-18	28	20.6		
-18.3	40	25.0		
-18.6	38	24.4		
-18.9	32	22.2		
-19.2	13	12.3		
-19.5	13	12.3		
-19.8	15	13.6		
-20.1	20	16.7		
-20.4	18	15.5		
-20.7	22	17.7		
-21	19	16.1		
-21.3	16	14.3		
-21.6	16	14.3		
-21.9	15	13.6		
-22.2	17	14.9		
-22.5	19	16.1		
-22.8	32	22.2		
-23.1	32	22.2		
-23.4	17	14.9		
-23.7	17	14.9		
-24	23	18.3		
-24.3	23	18.3		
-24.6	100	35.7		





APPENDIX E

Laboratory Tests Results

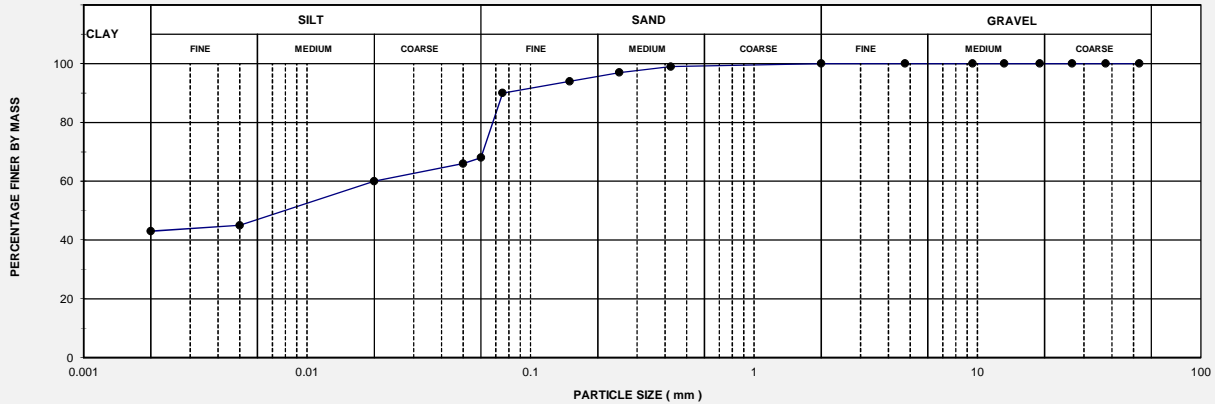


FOUNDATION INDICATOR TEST RESULTS - REP COM 7

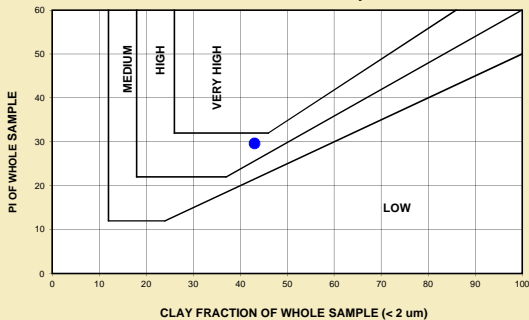
Client: Golder Associates	Source/Location:	Job No: 2016-C-1779
Project Name: Tutuka Ash Increase	Layer:	Sample No: 6/13705
Project No: 1658666	Lane:	Date: 15/03/2017
Hole/TP No: AD 58	Stabilizing Agent:	Test Method: TMH1 A1, A5 & ASTM D422
Depth (m): 0.7 - 0.8	Section:	Client Ref No:
Description:	Chainage:	GPS X:
Additional Info:	Offset:	GPS Y:

SIEVE ANALYSIS				ATTERBERG LIMITS		SOIL CLASSIFICATION	
Sieve (mm)	% Passing	Sieve (mm)	% Passing				
75.0	100	0.425	99	Liquid Limit (%)	65	% Gravel	0
63.0	100	0.250	97	Plastic Limit (%)	35	% Sand	32
53.0	100	0.150	94	Plasticity Index (%)	30	% Silt	25
37.5	100	0.075	90	Weighted PI (%)	29.7	% Clay	43
26.5	100	0.060	68	Linear Shrinkage (%)	15.5	Activity	0.7
19.0	100	0.050	66	Grading Modulus	0.11	% Soil Mortar	100
13.2	100	0.020	60	Uniformity coefficient	10	Coarse Sand Ratio	0.01
9.5	100	0.005	45	Coefficient of curvature	0.1	TRB Classification	A - 7 - 5
4.75	100	0.002	43			Unified Classification	MH
2.00	100			Remarks:			

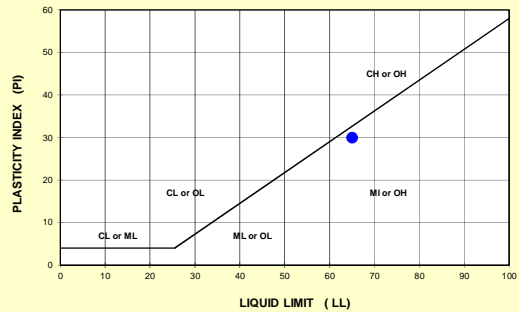
PARTICLE SIZE DISTRIBUTION



POTENTIAL EXPANSIVENESS Van der Merwe's Activity Chart



CASAGRANDE 'A' LINE



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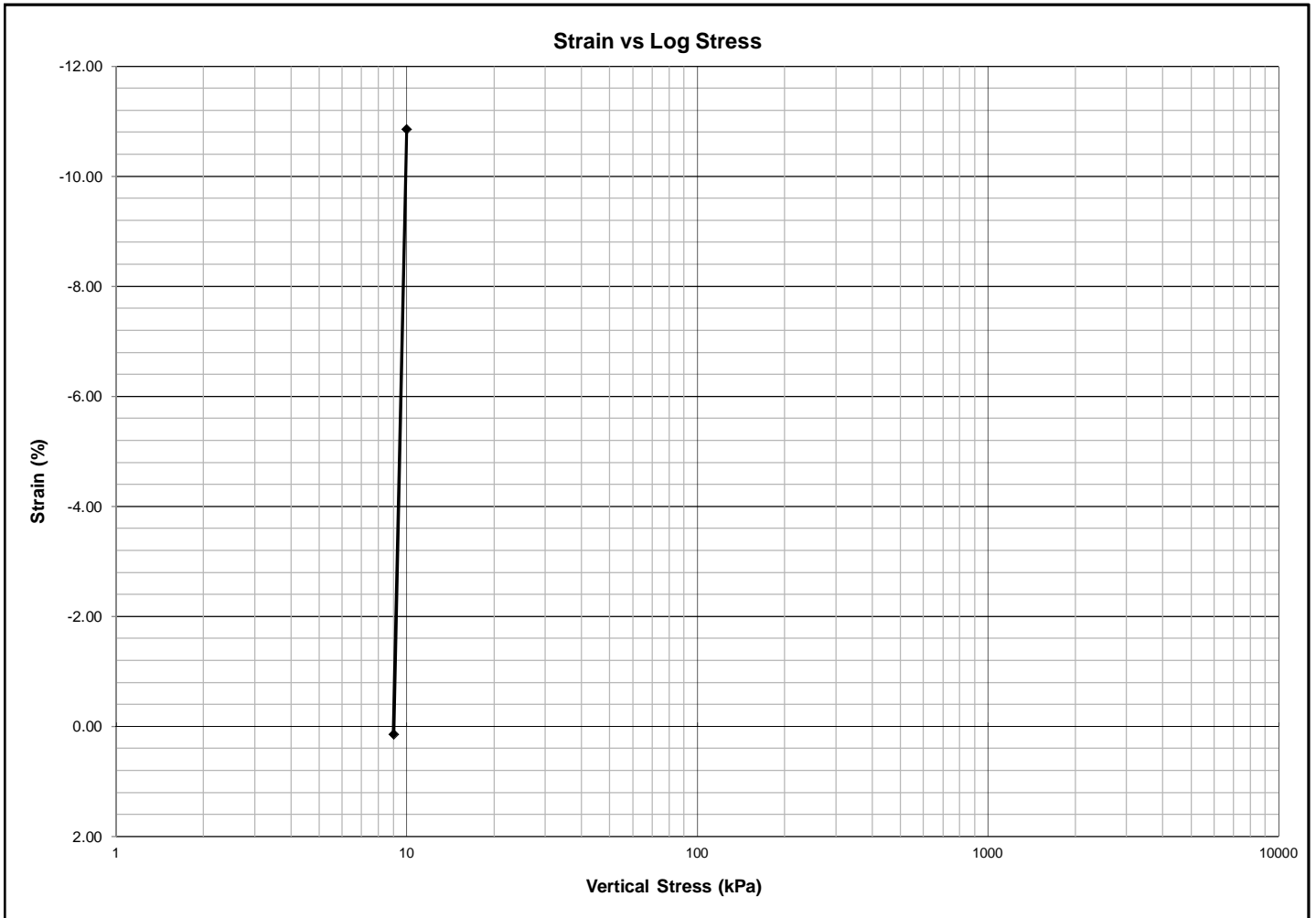
CONSOLIDATION TESTS: FREESWELL

**BS 1377
Part 5**

Client Golder Associates	Project Tutuka Ash Increase	Job no 2016-C-1779
Sample no AD58	Depth (m) 0.7-0.8	Date 2/28/2017
Lab no 6/13705		

Sample Parameters	Unit	Value	Remarks	Test Remarks	
Moisture Content	Before Test	%	27.0	Complete test specimen	Undisturbed
	After Test	%	38.9	Complete test specimen	Soaked @ 10 kPa
Dry Density	Kg/m ³	1448			Swell: 10.99%
Void Ratio	-	0.830			
Degree of Saturation	%	86.1			
Initial Specimen Height	mm	25.4			
Relative Density (SG)	-	2.650	Assumed		

Test Parameters													
Vertical Stress	kPa	9	10										
Time Elapsed	hr	1	48										
H ₁₀₀	mm	25.364	28.157										
Strain	%	0.142	-10.856										
Void Ratio	-	0.827	1.028										
Mv (1/Mpa)	-	-	-										



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CONSOLIDATION TESTS: FREESWELL

**BS 1377
Part 5**

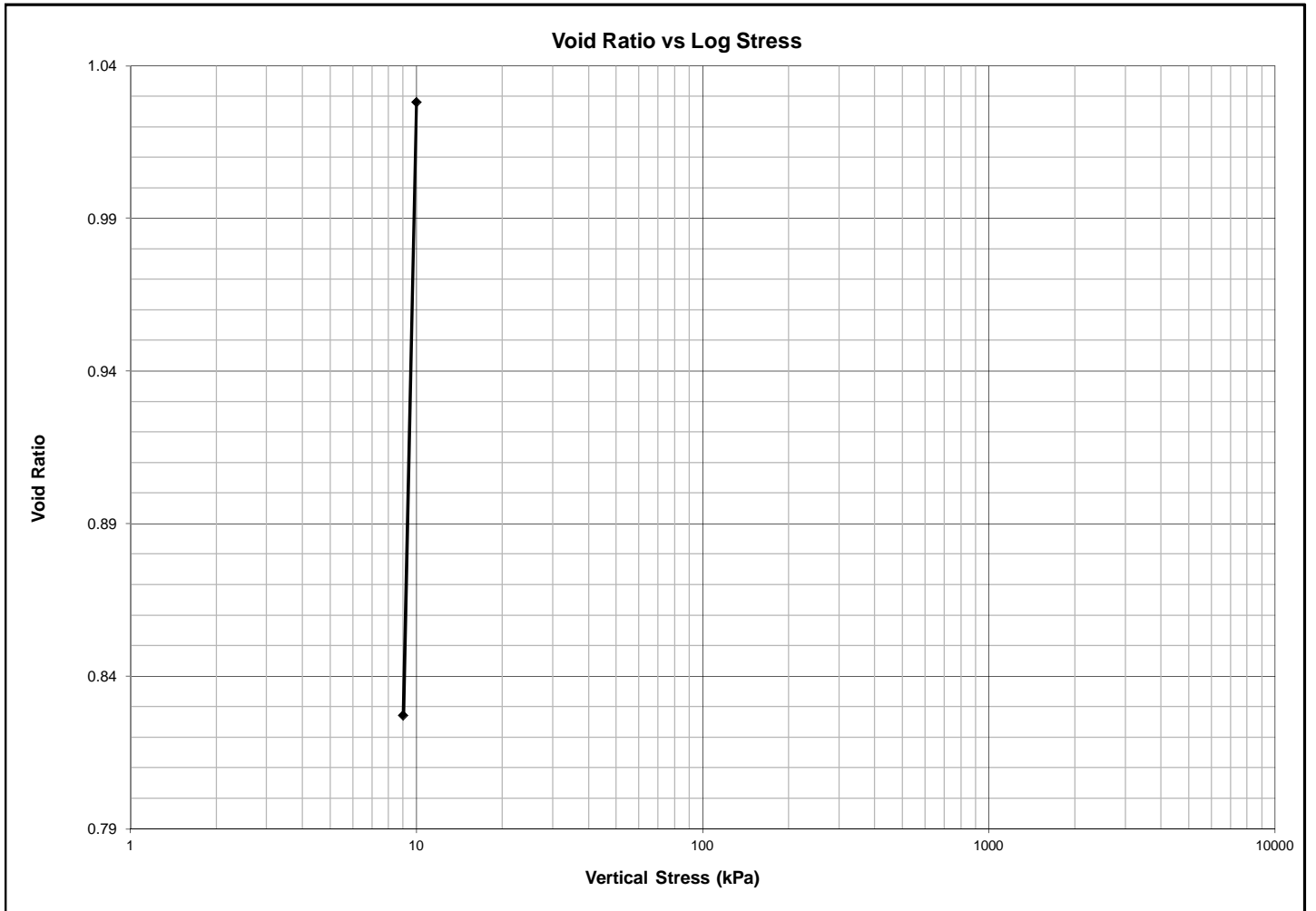
Client Golder Associates
Sample no AD58
Lab no 6/13705

Project Tutuka Ash Increase
Depth (m) 0.7-0.8

Job no 2016-C-1779
Date 2/28/2017

Sample Parameters	Unit	Value	Remarks	Test Remarks
Moisture Content	Before Test	27.0	Complete test specimen	Undisturbed
	After Test	38.9		Soaked @ 10 kPa
Dry Density	Kg/m ³	1448		Swell: 10.99%
Void Ratio	-	0.830		
Degree of Saturation	%	86.1		
Initial Specimen Height	mm	25.4		
Relative Density (SG)	-	2.650		

Test Parameters											
Vertical Stress	kPa	9	10								
Time Elapsed	hr	1	48								
H ₁₀₀	mm	25.364	28.157								
Strain	%	0.142	-10.856								
Void Ratio	-	0.827	1.028								
Mv (1/Mpa)	-	-	-								



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CONSOLIDATION TESTS: FREESWELL

**BS 1377
Part 5**

Client Golder Associates
Sample no AD58
Lab no 6/13705

Project Tutuka Ash Increase
Depth (m) 0.7-0.8

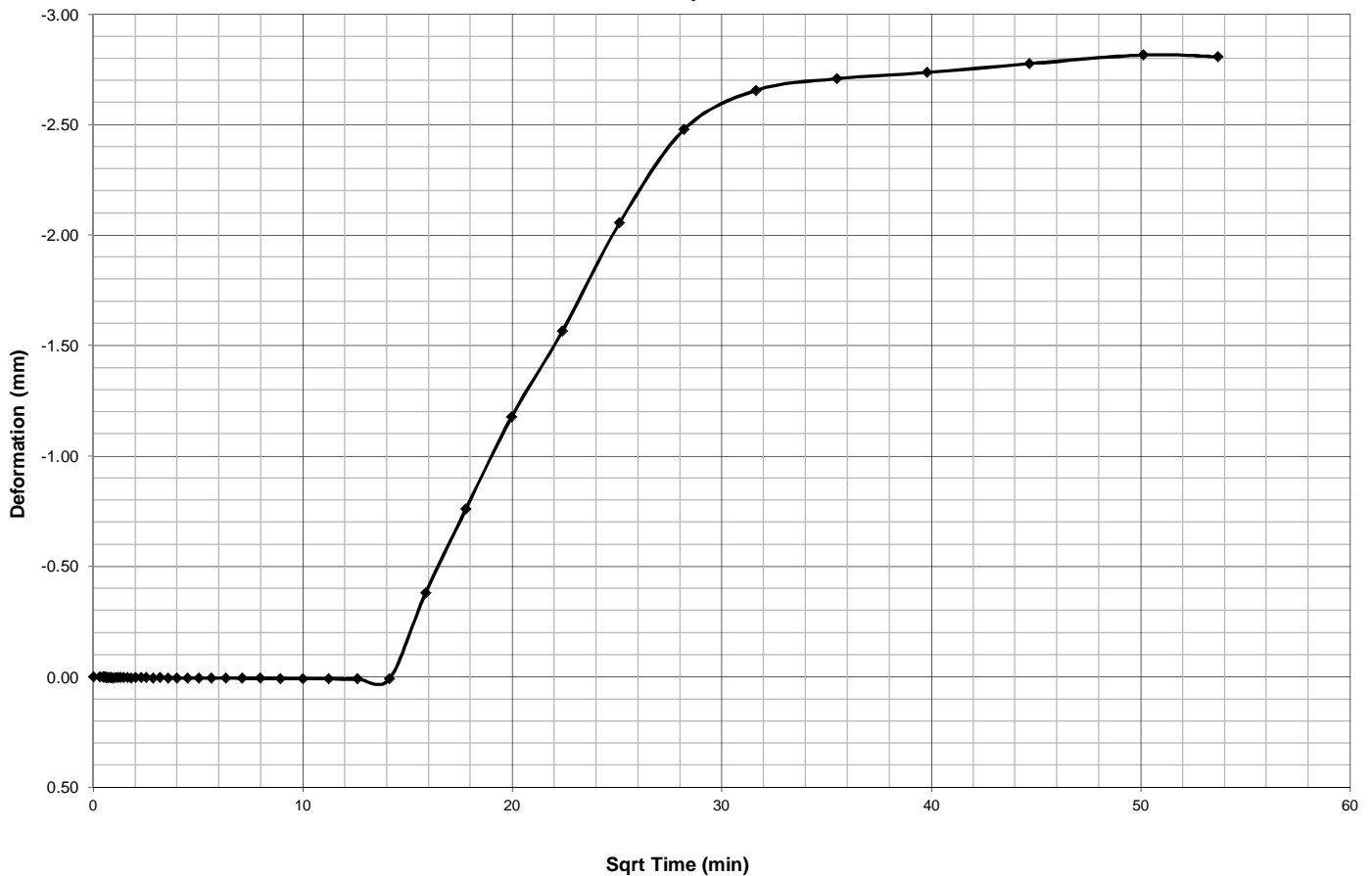
Job no 2016-C-1779
Date 2/28/2017

Sample Parameters	Unit	Value	Remarks	Test Remarks	
Moisture Content	Before Test	%	27.0	Complete test specimen	Undisturbed
	After Test	%	38.9	Complete test specimen	Soaked @ 10 kPa
Dry Density	Kg/m ³	1448			Swell: 10.99%
Void Ratio	-	0.830			
Degree of Saturation	%	86.1			
Initial Specimen Height	mm	25.4			
Relative Density (SG)	-	2.650	Assumed		

Test Parameters

		9	10										
Vertical Stress	kPa												
Time Elapsed	hr	1	48										
H ₁₀₀	mm	25.364	28.157										
Strain	%	0.142	-10.856										
Void Ratio	-	0.827	1.028										
Mv (1/Mpa)	-	-	-										

Swell vs Sqrt Time





Flexible Wall Permeability Test

**BS 1377
Part 6**

Client Golder Associates
Sample no AD58
Lab no 6/13705

Project Tutuka Ash Increase
Depth (m) 0.7 - 0.8

Job no 2016-C-1779
Date 04-04-2017

Initial Sample Parameters		
Sample Condition	-	Undisturbed Sample
MDD (Mod. AASHTO)	kg / m ³	-
OMC	%	-
Consolidation Pressure	kPa	100
Pressure Difference	kPa	10

Test Information			
Moisture Content	Before	%	24.4
	After	%	35.7
Dry Density		Kg/m ³	1443
Initial Void Ratio		-	0.790
Relative Density (SG)		-	2.583 - Determined
Initial Degree of Saturation		%	79.7
Final B Parameter		-	0.94
Co-efficient of Permeability	Min.	m/s	1.0E-10
	Max.	m/s	1.6E-10
	Ave.	m/s	1.3E-10



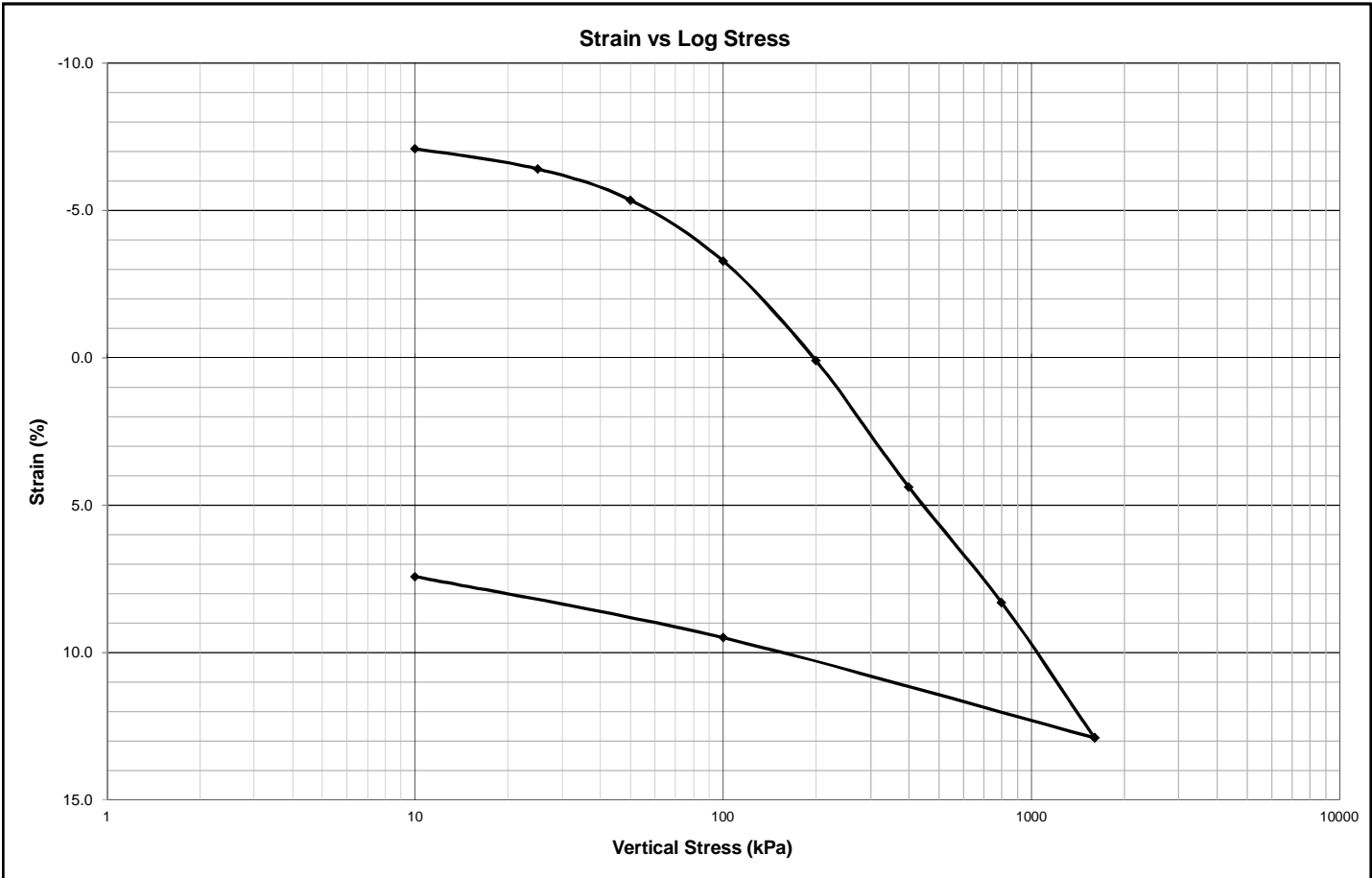
CONSOLIDATION TESTS: STANDARD OEDOMETER

**BS 1377
Part 5**

Client Golder Associates	Project Tutuka Ash Increase	Job no: 2016-C-1779
Sample no AD58	Depth (m) 0.7-0.8	Date 09/03/2017
Lab no 6/13705		

Sample Parameters	Unit	Value	Remarks	Test Remarks
Moisture Content	Before Test	26.7	Complete test specimen	Undisturbed sample
	After Test	35.8		
Dry Density	Kg/m ³	1353		
Void Ratio	-	0.959		
Degree of Saturation	%	73.6		
Initial Specimen Height	mm	25.4		
Relative Density (SG)	-	2.650	Assumed	

Test Parameters													
Vertical Stress	kPa	10	25	50	100	200	400	800	1600	100	10		
Time Elapsed	hr	24	24	24	24	24	24	24	24	2	2		
H ₁₀₀	mm	27.203	27.026	26.757	26.233	25.372	24.282	23.291	22.125	22.986	23.512		
Strain	%	-7.097	-6.401	-5.341	-3.279	0.109	4.402	8.305	12.895	9.503	7.432		
Void Ratio	-	1.098	1.085	1.064	1.023	0.957	0.873	0.797	0.707	0.773	0.814		
Mv (1/Mpa)	-	-	0.433	0.3984	0.3916	0.328	0.2149	0.1021	0.0626	0.026	0.2543		



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CONSOLIDATION TESTS: STANDARD OEDOMETER

**BS 1377
Part 5**

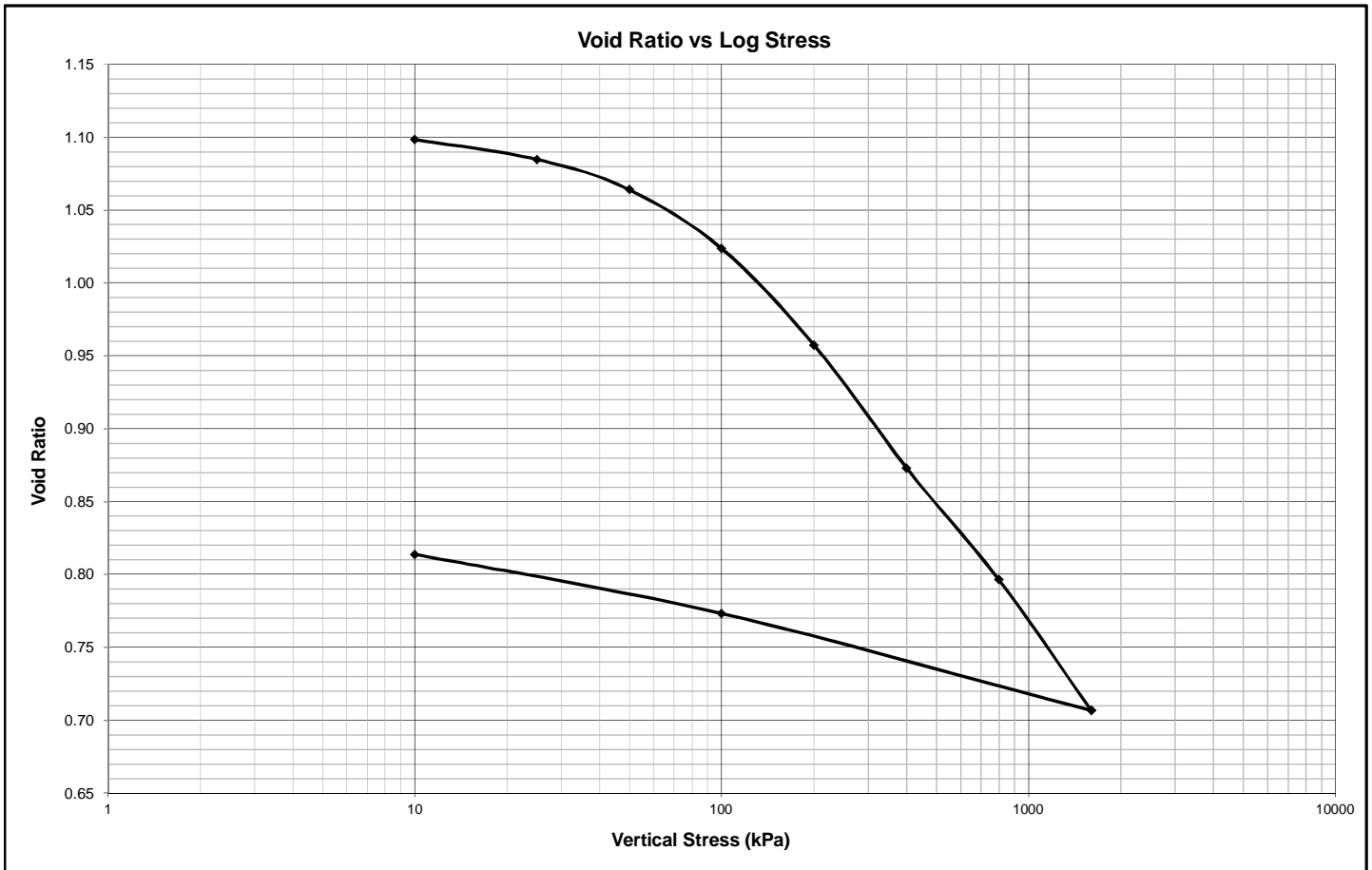
Client Golder Associates
Sample no AD58
Lab no 6/13705

Project Tutuka Ash Increase
Depth (m) 0.7-0.8

Job no: 2016-C-1779
Date 09/03/2017

Sample Parameters	Unit	Value	Remarks	Test Remarks	
Moisture Content	Before Test	%	26.7	Complete test specimen	Undisturbed sample
	After Test	%	35.8		
Dry Density	Kg/m ³	1353			
Void Ratio	-	0.959			
Degree of Saturation	%	73.6			
Initial Specimen Height	mm	25.4			
Relative Density (SG)	-	2.650	Assumed		

Test Parameters												
Vertical Stress	kPa	10	25	50	100	200	400	800	1600	100	10	
Time Elapsed	hr	24	24	24	24	24	24	24	24	2	2	
H ₁₀₀	mm	27.203	27.026	26.757	26.233	25.372	24.282	23.291	22.125	22.986	23.512	
Strain	%	-7.097	-6.401	-5.341	-3.279	0.109	4.402	8.305	12.895	9.503	7.432	
Void Ratio	-	1.098	1.085	1.064	1.023	0.957	0.873	0.797	0.707	0.773	0.814	
Mv (1/Mpa)	-	-	0.433	0.3984	0.3916	0.328	0.2149	0.1021	0.0626	0.026	0.2543	



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T0023

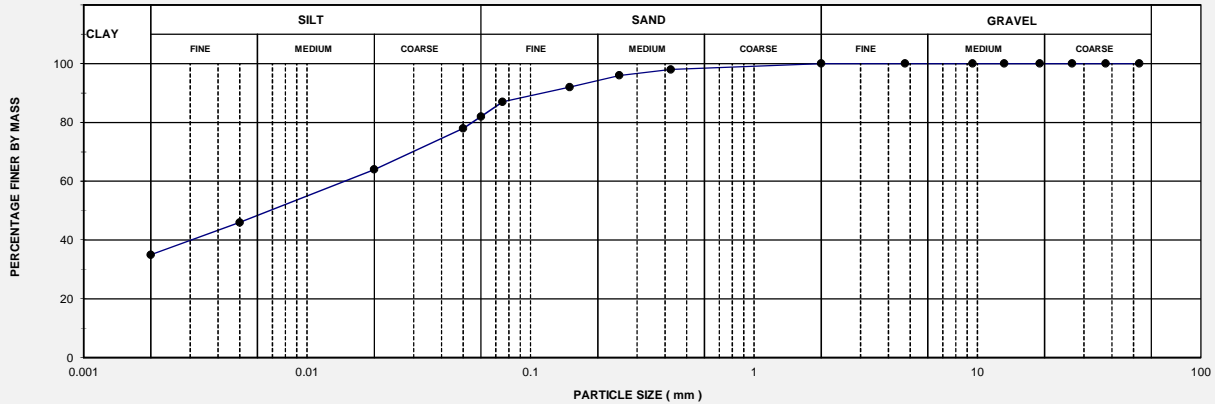


FOUNDATION INDICATOR TEST RESULTS - REP COM 7

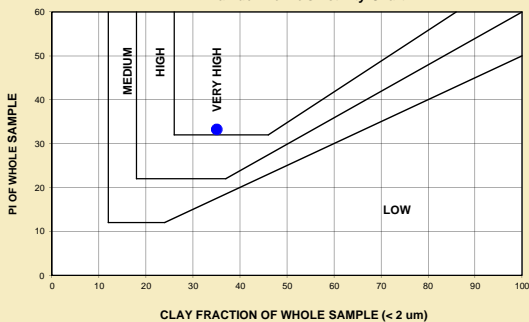
Client: Golder Associates	Source/Location:	Job No: 2016-C-1779
Project Name: Tutuka Ash Increase	Layer:	Sample No: 6/13706
Project No: 1658666	Lane:	Date: 03/02/2017
Hole/TP No: AD 11	Stabilizing Agent:	Test Method: TMH1 A1, A5 & ASTM D422
Depth (m): 0.25 - 0.55	Section:	Client Ref No:
Description:	Chainage:	GPS X:
Additional Info:	Offset:	GPS Y:

SIEVE ANALYSIS				ATTEBERG LIMITS		SOIL CLASSIFICATION	
Sieve (mm)	% Passing	Sieve (mm)	% Passing				
75.0	100	0.425	98	Liquid Limit (%)	54	% Gravel	0
63.0	100	0.250	96	Plastic Limit (%)	20	% Sand	18
53.0	100	0.150	92	Plasticity Index (%)	34	% Silt	47
37.5	100	0.075	87	Weighted PI (%)	33.3	% Clay	35
26.5	100	0.060	82	Linear Shrinkage (%)	11.5	Activity	1.0
19.0	100	0.050	78	Grading Modulus	0.15	% Soil Mortar	100
13.2	100	0.020	64	Uniformity coefficient	8	Coarse Sand Ratio	0.02
9.5	100	0.005	46	Coefficient of curvature	0.1	TRB Classification	A - 7 - 6
4.75	100	0.002	35			Unified Classification	CH
2.00	100			Remarks:			

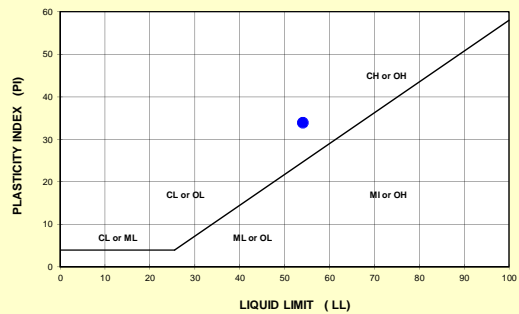
PARTICLE SIZE DISTRIBUTION



POTENTIAL EXPANSIVENESS Van der Merwe's Activity Chart



CASAGRANDE 'A' LINE



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CONSOLIDATION TESTS: STANDARD OEDOMETER

**BS 1377
Part 5**

Client Golder Associates	Project Tutuka Ash Increase	Job no 2016-C-1779
Sample no AD11	Depth (m) 0.25 - 0.55	Date 42774
Lab no 6/13706		

Sample Parameters	Unit	Value	Remarks	Test Remarks
Moisture Content	Before Test	22.3	Complete test specimen	
	After Test	26.3	Complete test specimen	
Dry Density	Kg/m ³	1591		
Void Ratio	-	0.602		
Degree of Saturation	%	94.7		
Initial Specimen Height	mm	25.4		
Relative Density (SG)	-	2.549	Determined	

Test Parameters														
Vertical Stress	kPa	10	25	50	100	200	400	800	1600	400	100	10		
Time Elapsed	hr	24	24	24	24	24	24	24	24	2	2	3		
H ₁₀₀	mm	26.341	26.228	26.010	25.649	25.028	24.154	23.113	22.114	22.643	23.065	23.591		
Strain	%	-3.703	-3.259	-2.402	-0.980	1.464	4.905	9.002	12.938	10.853	9.194	7.123		
Void Ratio	-	0.661	0.653	0.639	0.616	0.577	0.522	0.460	0.402	0.432	0.455	0.486		
Mv (1/Mpa)	-	-	0.296	0.343	0.284	0.244	0.172	0.102	0.049	0.017	0.055	0.23		



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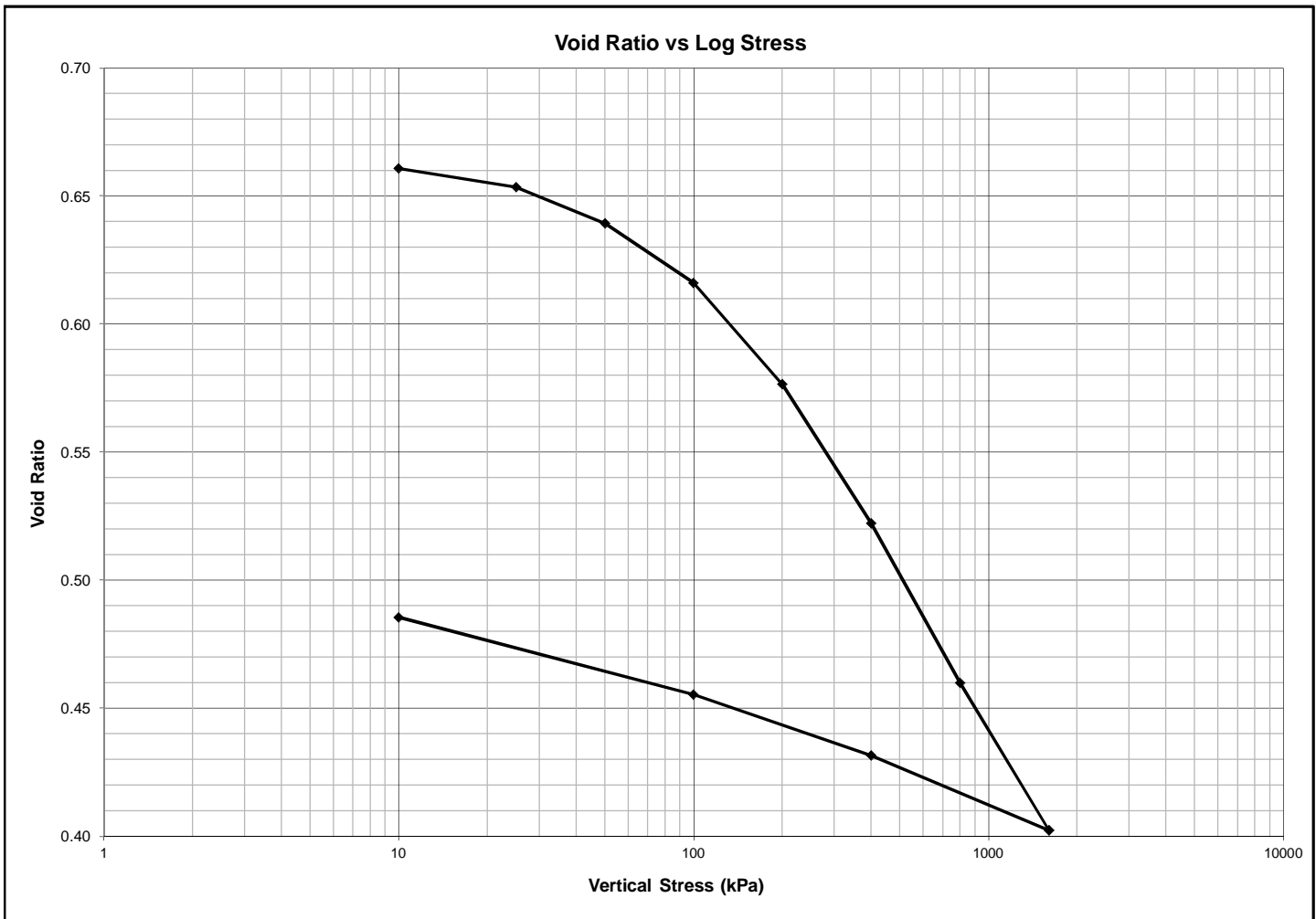
CONSOLIDATION TESTS: STANDARD OEDOMETER

**BS 1377
Part 5**

Client Golder Associates	Project Tutuka Ash Increase	Job no 2016-C-1779
Sample no AD11	Depth (m) 0.25 - 0.55	Date 42774
Lab no 6/13706		

Sample Parameters	Unit	Value	Remarks	Test Remarks
Moisture Content	Before Test	22.3	Complete test specimen	
	After Test	26.3	Complete test specimen	
Dry Density	Kg/m ³	1591		
Void Ratio	-	0.602		
Degree of Saturation	%	94.7		
Initial Specimen Height	mm	25.4		
Relative Density (SG)	-	2.549	Determined	

Test Parameters														
Vertical Stress	kPa	10	25	50	100	200	400	800	1600	400	100	10		
Time Elapsed	hr	24	24	24	24	24	24	24	24	2	2	3		
H ₁₀₀	mm	26.341	26.228	26.010	25.649	25.028	24.154	23.113	22.114	22.643	23.065	23.591		
Strain	%	-3.703	-3.259	-2.402	-0.980	1.464	4.905	9.002	12.938	10.853	9.194	7.123		
Void Ratio	-	0.661	0.653	0.639	0.616	0.577	0.522	0.460	0.402	0.432	0.455	0.486		
M _v (1/Mpa)	-	-	0.296	0.343	0.284	0.244	0.172	0.102	0.049	0.017	0.055	0.230		



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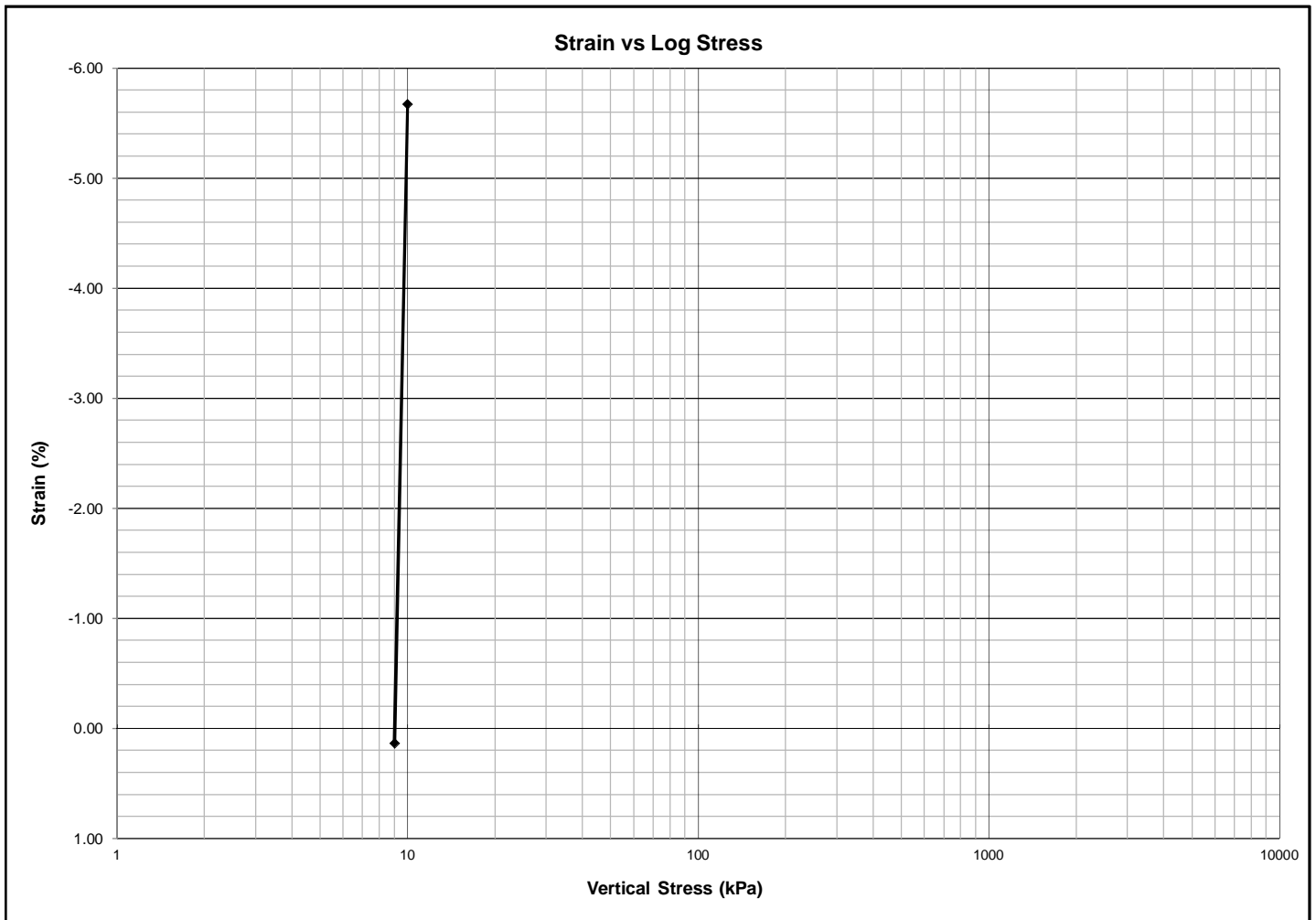
CONSOLIDATION TESTS: FREESWELL

**BS 1377
Part 5**

Client Golder Associates	Project Tutuka-Ash Increase	Job no 2016-C-1779
Sample no AD11	Depth (m) 0.25 - 0.55	Date 2/2/2017
Lab no 6/13706		

Sample Parameters	Unit	Value	Remarks	Test Remarks	
Moisture Content	Before Test	%	22.2	Complete test specimen	Undisturbed
	After Test	%	30.6	Complete test specimen	Soaked @ 10 kPa
Dry Density	Kg/m ³	1580			Swell: 5.8%
Void Ratio	-	0.613			
Degree of Saturation	%	92.3			
Initial Specimen Height	mm	25.4			
Relative Density (SG)	-	2.549	Determined		

Test Parameters													
Vertical Stress	kPa	9	10										
Time Elapsed	hr	1	48										
H ₁₀₀	mm	25.365	26.841										
Strain	%	0.137	-5.673										
Void Ratio	-	0.611	0.704										
Mv (1/Mpa)	-	-	-										



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CONSOLIDATION TESTS: FREESWELL

**BS 1377
Part 5**

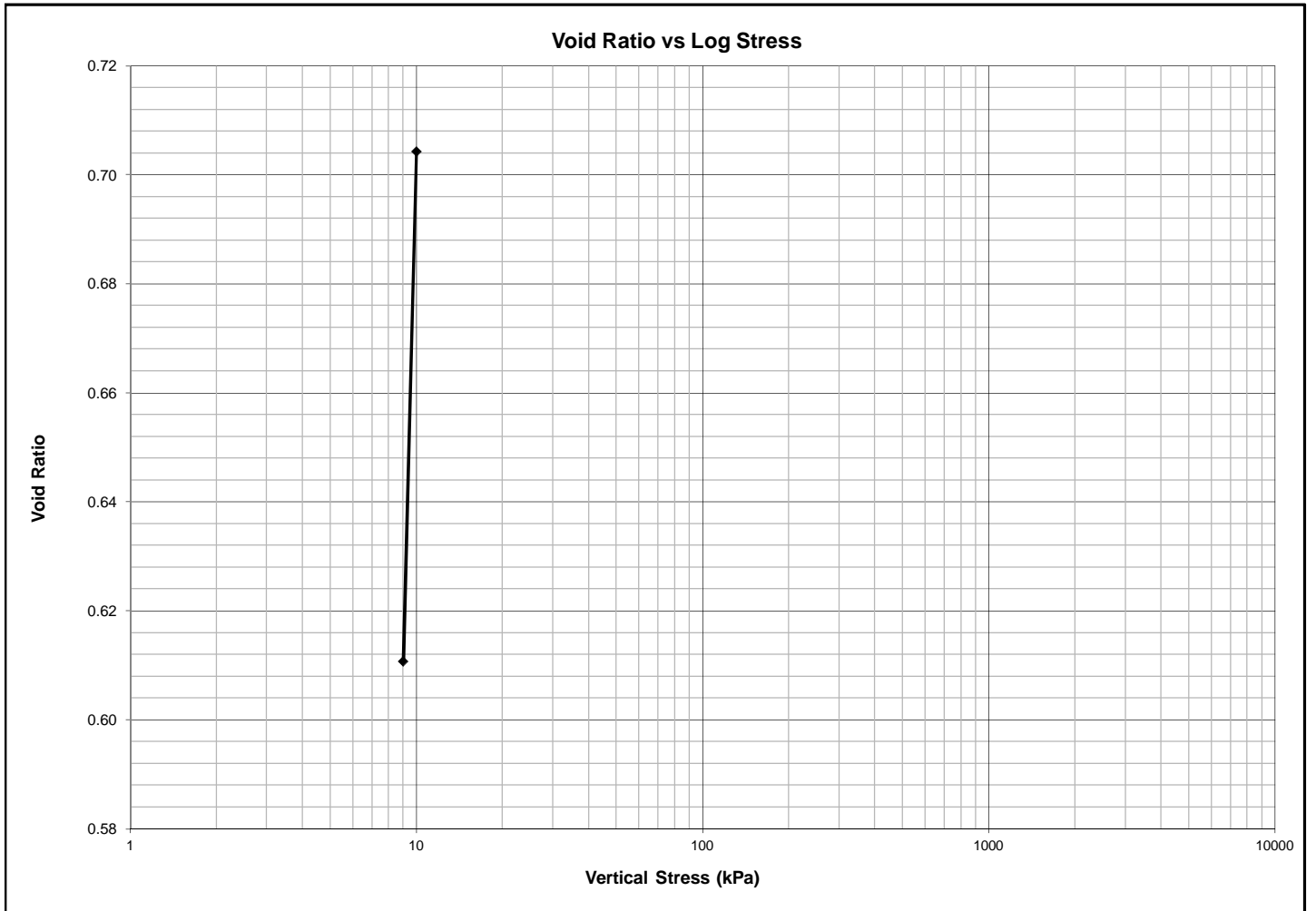
Client Golder Associates
Sample no AD11
Lab no 6/13706

Project Tutuka-Ash Increase
Depth (m) 0.25 - 0.55

Job no 2016-C-1779
Date 2/2/2017

Sample Parameters	Unit	Value	Remarks	Test Remarks
Moisture Content	Before Test	22.2	Complete test specimen	Undisturbed
	After Test	30.6		Soaked @ 10 kPa
Dry Density	Kg/m ³	1580		Swell: 5.8%
Void Ratio	-	0.613		
Degree of Saturation	%	92.3		
Initial Specimen Height	mm	25.4		
Relative Density (SG)	-	2.549		Determined

Test Parameters											
Vertical Stress	kPa	9	10								
Time Elapsed	hr	1	48								
H ₁₀₀	mm	25.365	26.841								
Strain	%	0.137	-5.673								
Void Ratio	-	0.611	0.704								
Mv (1/Mpa)	-	-	-								



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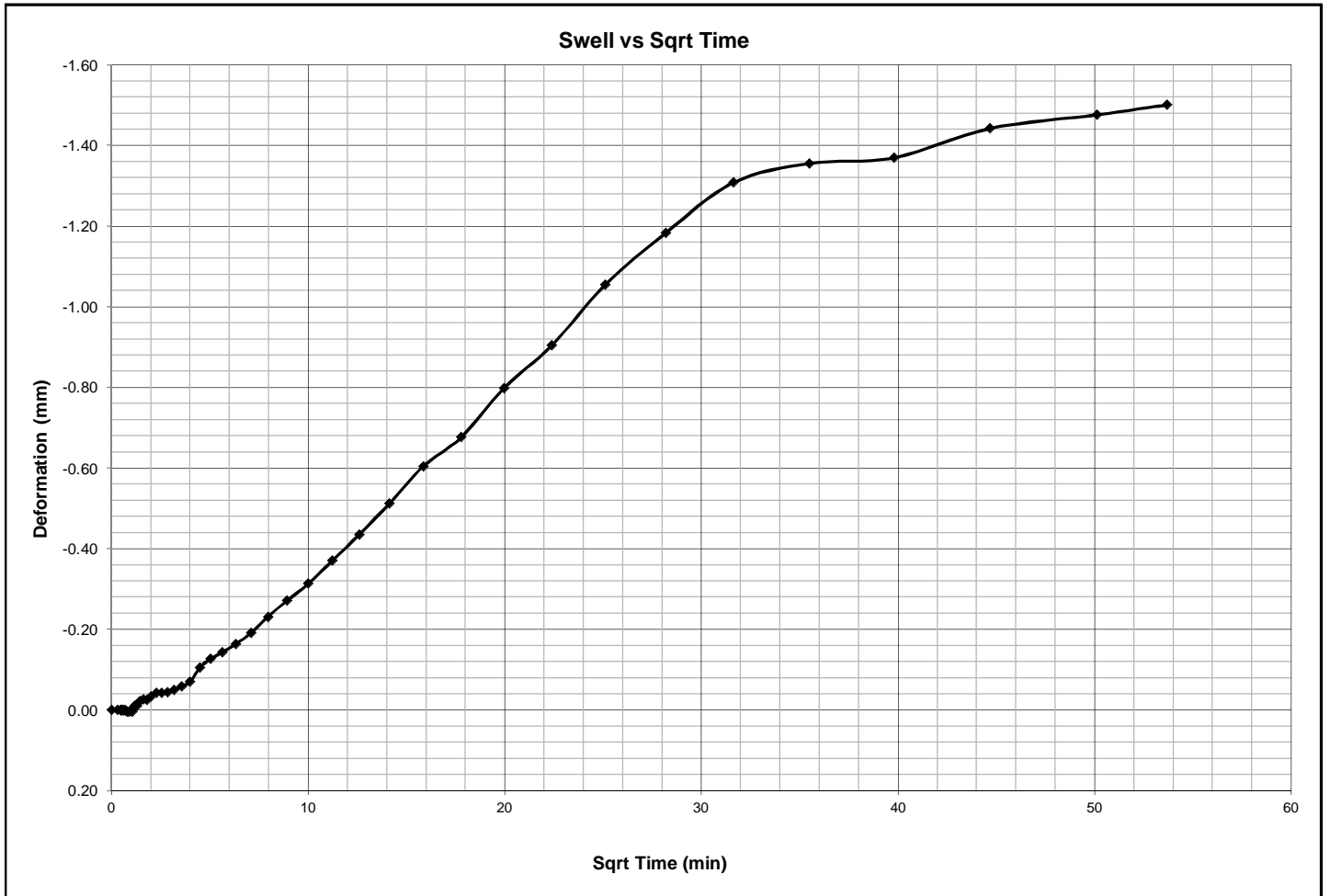
CONSOLIDATION TESTS: FREESWELL

**BS 1377
Part 5**

Client Golder Associates	Project Tutuka-Ash Increase	Job no 2016-C-1779
Sample no AD11	Depth (m) 0.25 - 0.55	Date 2/2/2017
Lab no 6/13706		

Sample Parameters	Unit	Value	Remarks	Test Remarks
Moisture Content	Before Test	22.2	Complete test specimen	Undisturbed
	After Test	30.6		
Dry Density	Kg/m ³	1580		Soaked @ 10 kPa Swell: 5.8%
Void Ratio	-	0.613		
Degree of Saturation	%	92.3		
Initial Specimen Height	mm	25.4		
Relative Density (SG)	-	2.549	Determined	

Test Parameters												
Vertical Stress	kPa	9	10									
Time Elapsed	hr	1	48									
H ₁₀₀	mm	25.365	26.841									
Strain	%	0.137	-5.673									
Void Ratio	-	0.611	0.704									
Mv (1/Mpa)	-	-	-									



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T0023

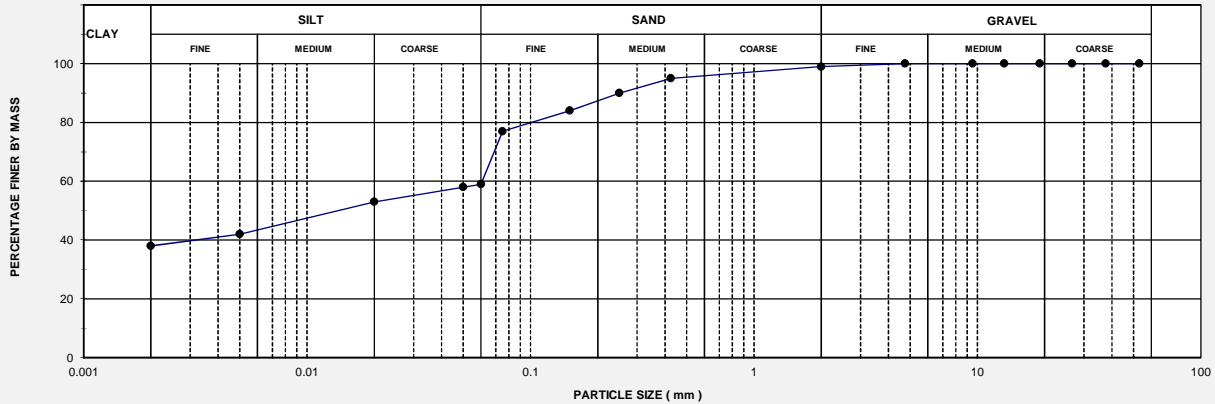


FOUNDATION INDICATOR TEST RESULTS - REP COM 7

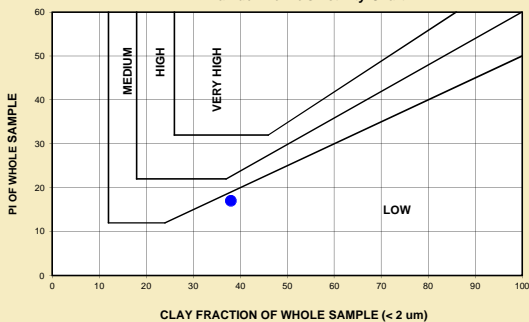
Client: Golder Associates	Source/Location:	Job No: 2016-C-1779
Project Name: Tutuka Ash Increase	Layer:	Sample No: 6/13707
Project No: 1658666	Lane:	Date: 15/03/2017
Hole/TP No: AD 22	Stabilizing Agent:	Test Method: TMH1 A1, A5 & ASTM D422
Depth (m): 0.6 - 0.85	Section:	Client Ref No:
Description:	Chainage:	GPS X:
Additional Info:	Offset:	GPS Y:

SIEVE ANALYSIS				ATTERBERG LIMITS		SOIL CLASSIFICATION	
Sieve (mm)	% Passing	Sieve (mm)	% Passing				
75.0	100	0.425	95	Liquid Limit (%)	44	% Gravel	1
63.0	100	0.250	90	Plastic Limit (%)	26	% Sand	40
53.0	100	0.150	84	Plasticity Index (%)	18	% Silt	21
37.5	100	0.075	77	Weighted PI (%)	17.1	% Clay	38
26.5	100	0.060	59	Linear Shrinkage (%)	9.5	Activity	0.5
19.0	100	0.050	58	Grading Modulus	0.29	% Soil Mortar	99
13.2	100	0.020	53	Uniformity coefficient	30	Coarse Sand Ratio	0.04
9.5	100	0.005	42	Coefficient of curvature	0.0	TRB Classification	A - 7 - 6
4.75	100	0.002	38			Unified Classification	CL
2.00	99			Remarks:			

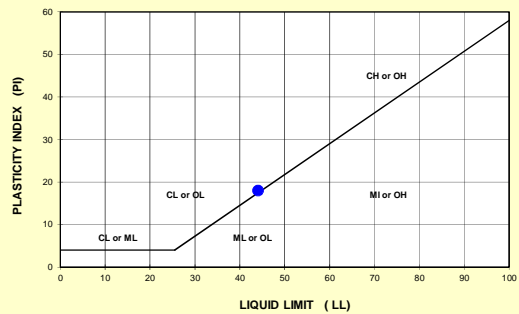
PARTICLE SIZE DISTRIBUTION



POTENTIAL EXPANSIVENESS Van der Merwe's Activity Chart



CASAGRANDE 'A' LINE



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SHEAR TESTS: BOX SHEAR

KH Head

Client Golder Associates
Sample no AD22
Lab no 6/13707

Project Tutuka Ash Increase
Depth (m) 0.6-0.85m

Job no 2016-C-1779
Date 28/2/2017

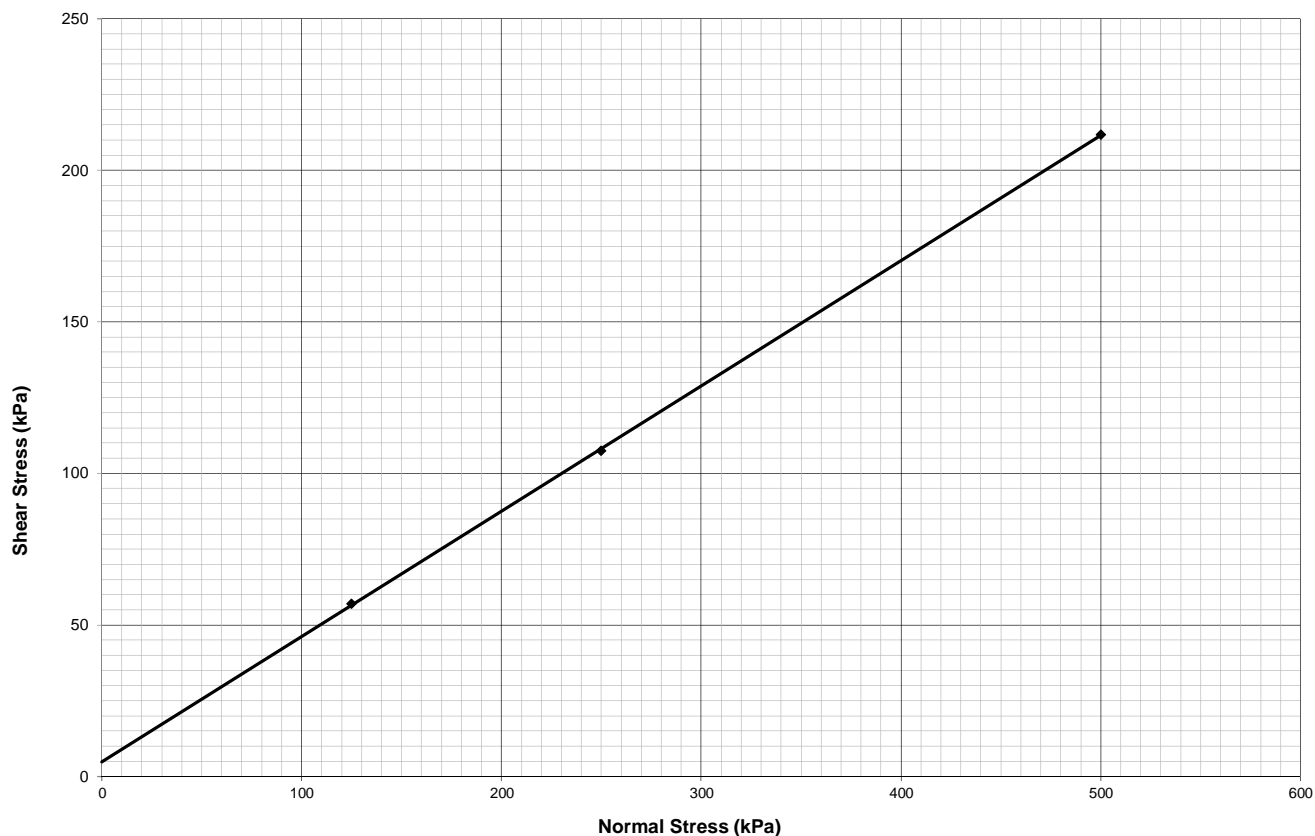
Test Information

Test Type	-	Slow Drained, saturated
Sample Condition	-	Remoulded by hand to estimated OMC
Normal Stresses	kPa	125, 250, 500
Rate of Strain	mm/min	0.0030

Initial Sample Parameters	Unit	Test 1	Test 2	Test 3	Remarks
Moisture Content	%	155.8	16.5	17.4	Complete test specimen
Dry Density	Kg/m ³	1763	1735	1759	
Void Ratio	-	0.503	0.527	0.506	
Degree of Saturation	%	820.3	83.2	91.0	
Relative Density (SG)	-	2.650			Assumed

Final Sample Parameters	Unit	Test 1	Test 2	Test 3	Remarks
Moisture Content	%	23.1	27.1	24.9	
Normal Stress	kPa	125	250	500	
Shear Stress	kPa	57	107	212	
Residual Stress	kPa	Not Tested	Not Tested	Not Tested	
Angle of Internal Friction	Deg.	22			Peak
Cohesion	kPa	5			Peak

Stress Plot



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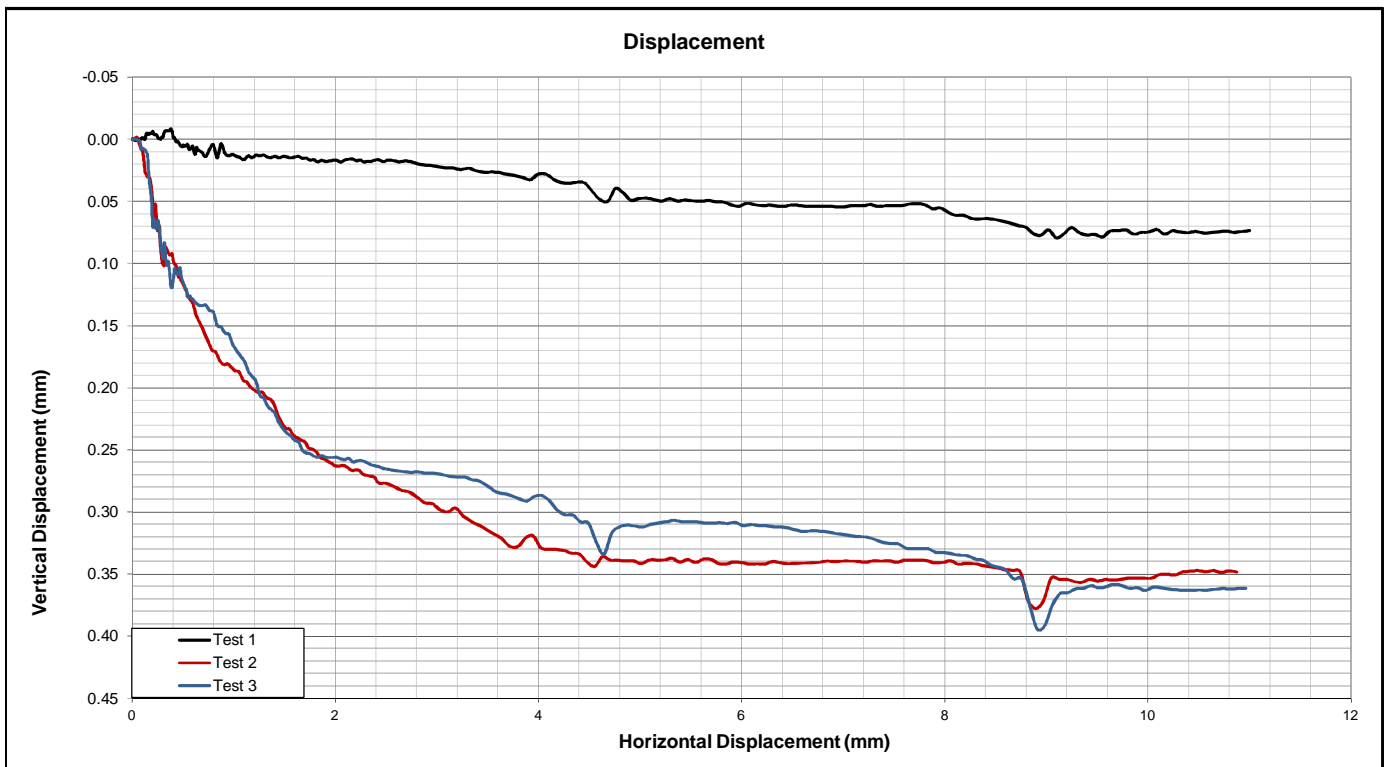
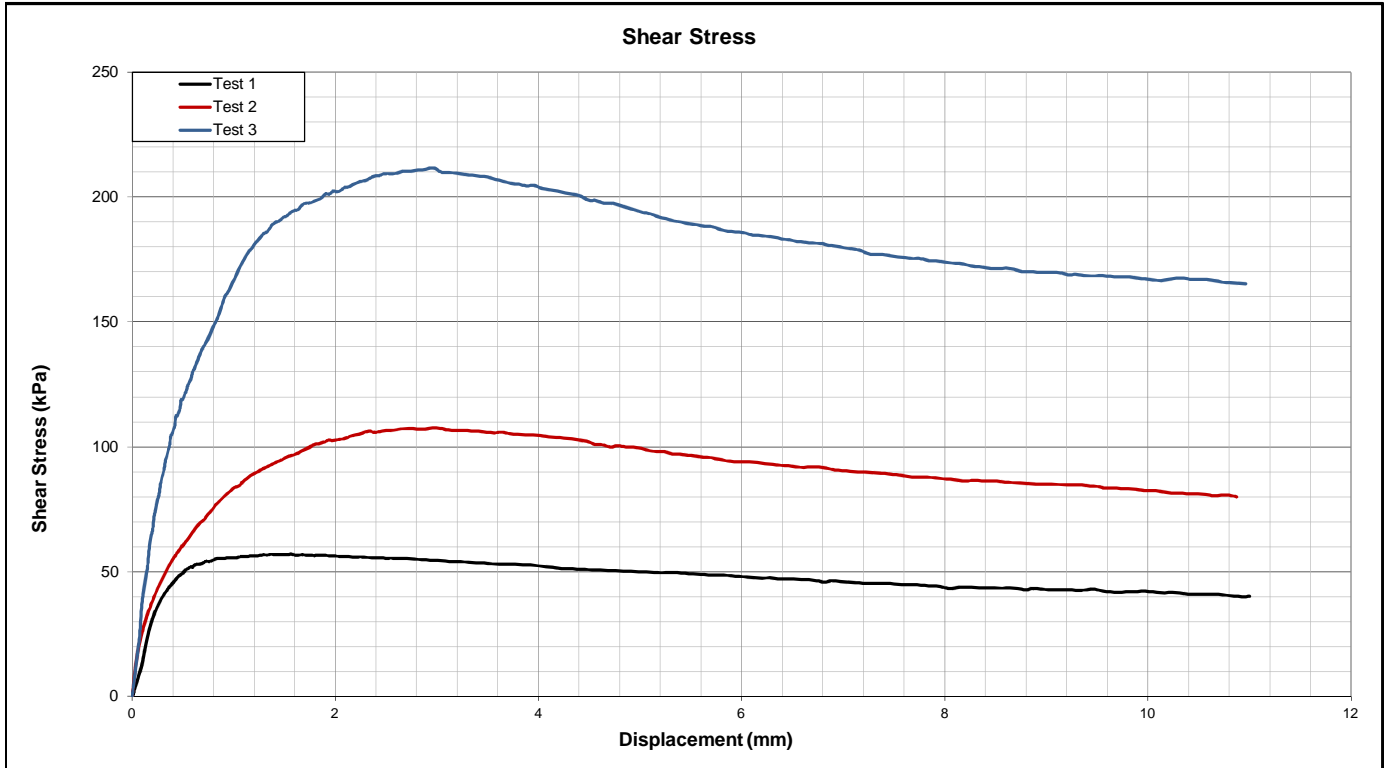
SHEAR TESTS: BOX SHEAR

KH Head

Client Golder Associates
Sample no AD22
Lab no 6/13707

Project Tutuka Ash Increase
Depth (m) 0.6-0.85m

Job no 2016-C-1779
Date 28/2/2017



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CONSOLIDATION TESTS: DOUBLE OEDOMETER

**BS 1377
Part 5**

Client Golder Associates
Sample no AD22
Lab no 6/13705

Project Tutuka Ash Increase
Depth (m) 0.6 - 0.85m

Job no 2016-C-1779
Date 2/28/2017

Sample Parameters		Unit	NMC	Soaked	Remarks
Moisture Content	Before Test	%	11.7	10.9	Complete test specimen
	After Test	%	8.5	15.6	Complete test specimen
Dry Density		Kg/m ³	1821	1738	
Void Ratio		-	0.430	0.498	
Degree of Saturation		%	71.1	56.8	
Initial Specimen Height		mm	25.4	25.4	
Relative Density (SG)		-	2.604		Determined

Test Parameters														
Vertical Stress	kPa	10	25	50	100	200	400	800	1600	400	100	10		
Time Elapsed	hr	24	24	24	24	24	24	24	24	2	2	3		
H ₁₀₀	NMC	mm	25.050	24.824	24.578	24.295	23.930	23.552	23.060	22.318	22.676	22.907	23.136	
	Soaked	mm	26.090	25.956	25.746	25.393	24.826	23.951	23.078	22.012	22.441	22.763	23.598	
Strain	NMC	%	1.377	2.268	3.238	4.352	5.789	7.277	9.215	12.133	10.725	9.816	8.914	
	Soaked	%	-2.717	-2.189	-1.361	0.028	2.259	5.706	9.142	13.337	11.651	10.383	7.094	
Void Ratio	NMC	-	0.410	0.397	0.384	0.368	0.347	0.326	0.298	0.256	0.276	0.289	0.302	
	Soaked	-	0.539	0.531	0.519	0.498	0.464	0.413	0.361	0.298	0.324	0.343	0.392	
Mv (1/Mpa)	NMC	-	-	0.602	0.397	0.230	0.150	0.079	0.052	0.040	0.013	0.034	0.111	
	Soaked	-	-	0.343	0.324	0.274	0.223	0.176	0.091	0.058	0.016	0.048	0.408	



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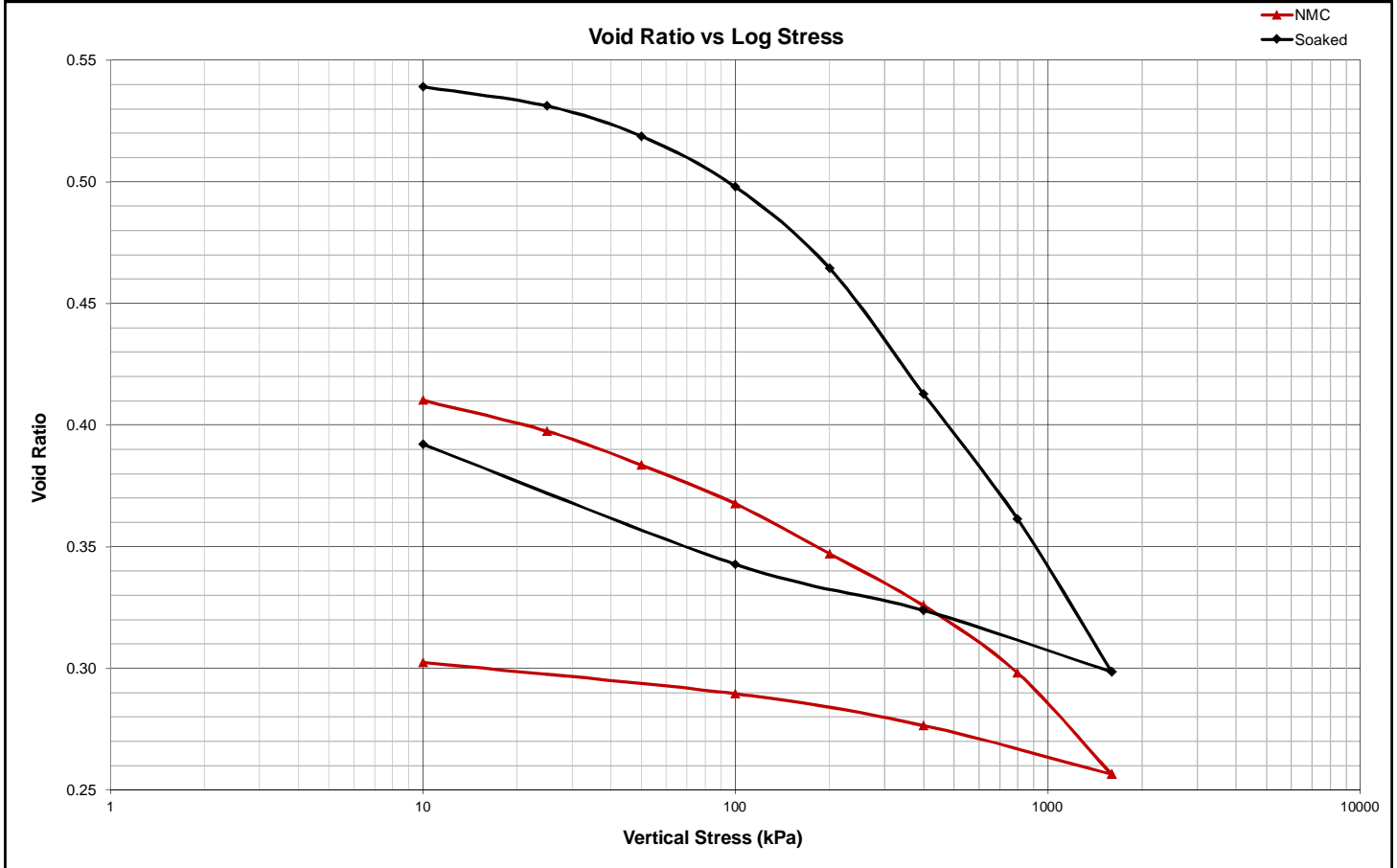
CONSOLIDATION TESTS: DOUBLE OEDOMETER

**BS 1377
Part 5**

Client Golder Associates	Project Tutuka Ash Increase	Job no 2016-C-1779
Sample no AD22	Depth (m) 0.6 - 0.85m	Date 2/28/2017
Lab no 6/13705		

Sample Parameters	Unit	NMC	Soaked	Remarks
Moisture Content Before Test	%	11.7	10.9	Complete test specimen
Moisture Content After Test	%	8.5	15.6	Complete test specimen
Dry Density	Kg/m ³	1821	1738	
Void Ratio	-	0.430	0.498	
Degree of Saturation	%	71.1	56.8	
Initial Specimen Height	mm	25.4	25.4	
Relative Density (SG)	-	2.604		Determined

Test Parameters														
Vertical Stress	kPa	10	25	50	100	200	400	800	1600	400	100	10		
Time Elapsed	hr	24	24	24	24	24	24	24	24	2	2	3		
H ₁₀₀	NMC	mm	25.050	24.824	24.578	24.295	23.930	23.552	23.060	22.318	22.676	22.907	23.136	
	Soaked	mm	26.090	25.956	25.746	25.393	24.826	23.951	23.078	22.012	22.441	22.763	23.598	
Strain	NMC	%	1.377	2.268	3.238	4.352	5.789	7.277	9.215	12.133	10.725	9.816	8.914	
	Soaked	%	-2.717	-2.189	-1.361	0.028	2.259	5.706	9.142	13.337	11.651	10.383	7.094	
Void Ratio	NMC	-	0.410	0.397	0.384	0.368	0.347	0.326	0.298	0.256	0.276	0.289	0.302	
	Soaked	-	0.539	0.531	0.519	0.498	0.464	0.413	0.361	0.298	0.324	0.343	0.392	
Mv	NMC	1/MPa	-	0.602	0.397	0.230	0.150	0.079	0.052	0.040	0.013	0.034	0.111	
	Soaked	1/MPa	-	0.343	0.324	0.274	0.223	0.176	0.091	0.058	0.016	0.048	0.408	



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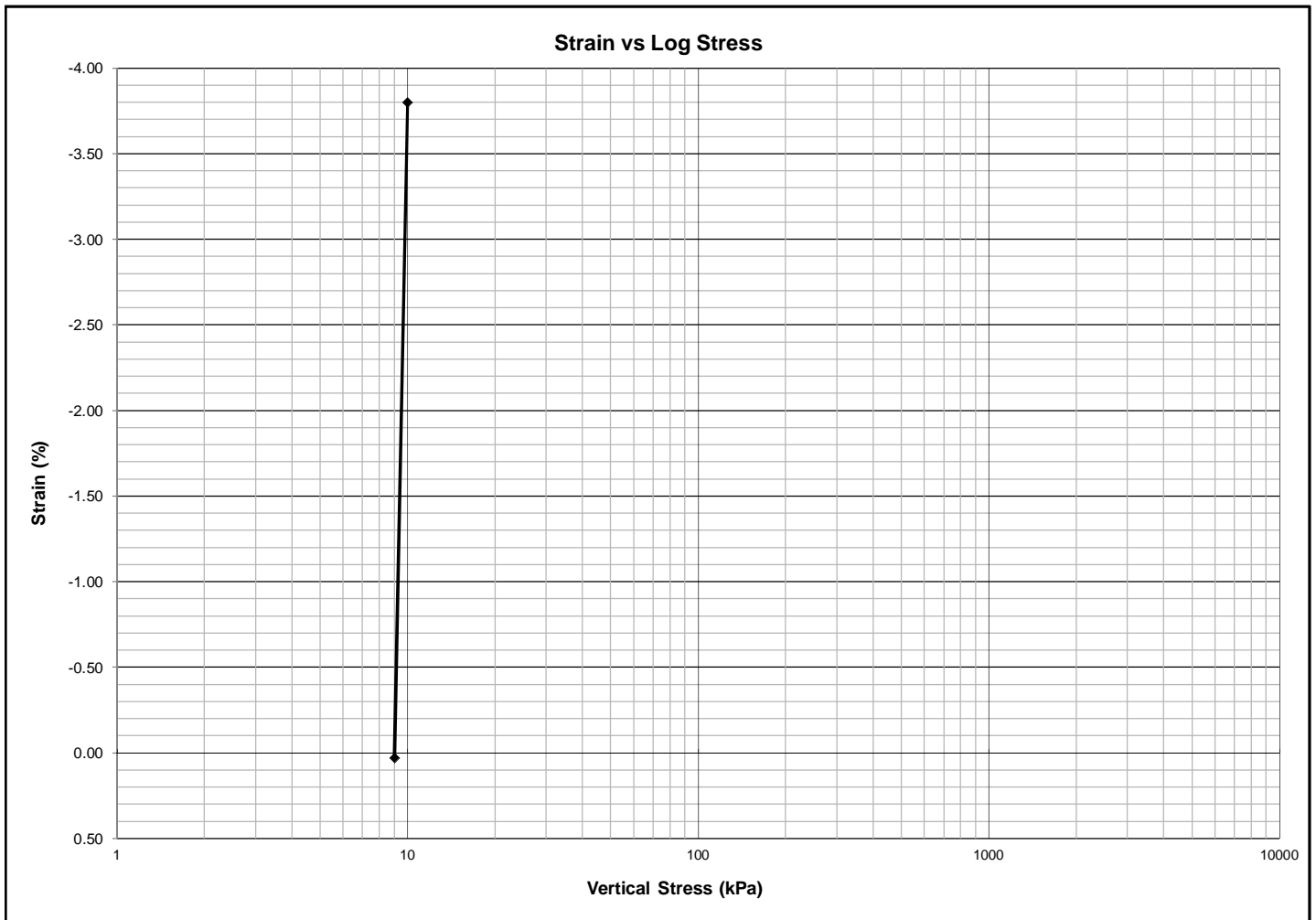
CONSOLIDATION TESTS: FREESWELL

**BS 1377
Part 5**

Client Golder Associates	Project Tutuka Ash Increase	Job no 2016-C-1779
Sample no AD22	Depth (m) 0.6-0.85	Date 2/28/2017
Lab no 6/13707		

Sample Parameters	Unit	Value	Remarks	Test Remarks	
Moisture Content	Before Test	%	15.6	Complete test specimen	Undisturbed
	After Test	%	26.2	Complete test specimen	Soaked @ 10 kPa
Dry Density	Kg/m ³	1630			Swell: 3.83%
Void Ratio	-	0.598			
Degree of Saturation	%	67.8			
Initial Specimen Height	mm	25.4			
Relative Density (SG)	-	2.604	Determined		

Test Parameters													
Vertical Stress	kPa	9	10										
Time Elapsed	hr	1	48										
H ₁₀₀	mm	25.393	26.365										
Strain	%	0.028	-3.800										
Void Ratio	-	0.597	0.658										
Mv (1/Mpa)	-	-	-										



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CONSOLIDATION TESTS: FREESWELL

**BS 1377
Part 5**

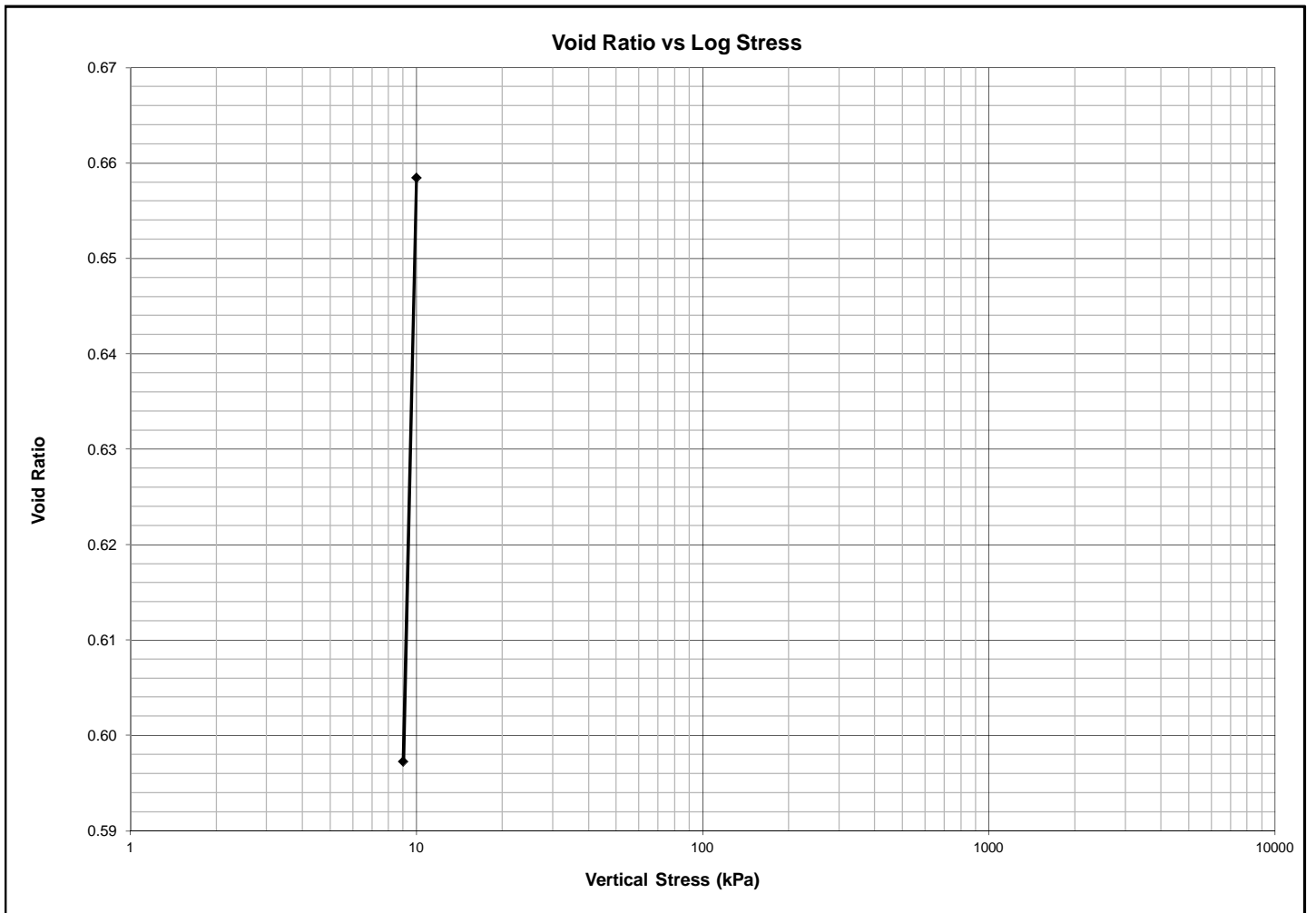
Client Golder Associates
Sample no AD22
Lab no 6/13707

Project Tutuka Ash Increase
Depth (m) 0.6-0.85

Job no 2016-C-1779
Date 2/28/2017

Sample Parameters	Unit	Value	Remarks	Test Remarks	
Moisture Content	Before Test	%	15.6	Complete test specimen	Undisturbed
	After Test	%	26.2	Complete test specimen	Soaked @ 10 kPa
Dry Density	Kg/m ³	1630			Swell: 3.83%
Void Ratio	-	0.598			
Degree of Saturation	%	67.8			
Initial Specimen Height	mm	25.4			
Relative Density (SG)	-	2.604	Determined		

Test Parameters													
Vertical Stress	kPa	9	10										
Time Elapsed	hr	1	48										
H ₁₀₀	mm	25.393	26.365										
Strain	%	0.028	-3.800										
Void Ratio	-	0.597	0.658										
Mv (1/Mpa)	-	-	-										



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CONSOLIDATION TESTS: FREESWELL

**BS 1377
Part 5**

Client Golder Associates
Sample no AD22
Lab no 6/13707

Project Tutuka Ash Increase
Depth (m) 0.6-0.85

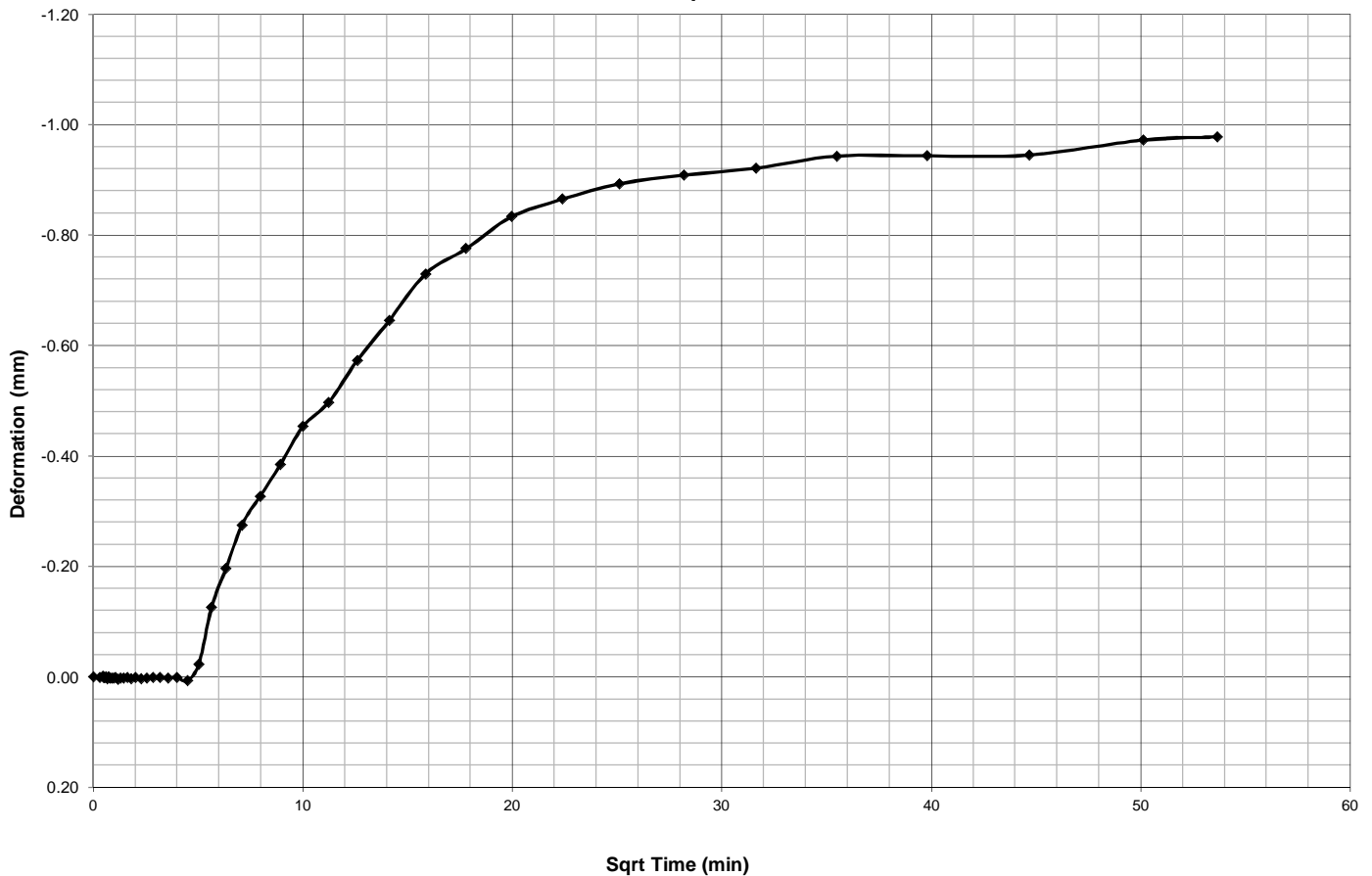
Job no 2016-C-1779
Date 2/28/2017

Sample Parameters	Unit	Value	Remarks	Test Remarks	
Moisture Content	Before Test	%	15.6	Complete test specimen	Undisturbed
	After Test	%	26.2	Complete test specimen	Soaked @ 10 kPa
Dry Density	Kg/m ³	1630			Swell: 3.83%
Void Ratio	-	0.598			
Degree of Saturation	%	67.8			
Initial Specimen Height	mm	25.4			
Relative Density (SG)	-	2.604	Determined		

Test Parameters

		9	10										
Vertical Stress	kPa	9	10										
Time Elapsed	hr	1	48										
H ₁₀₀	mm	25.393	26.365										
Strain	%	0.028	-3.800										
Void Ratio	-	0.597	0.658										
Mv (1/Mpa)	-	-	-										

Swell vs Sqrt Time





T0023

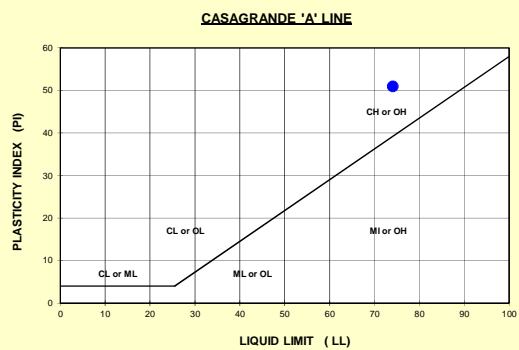
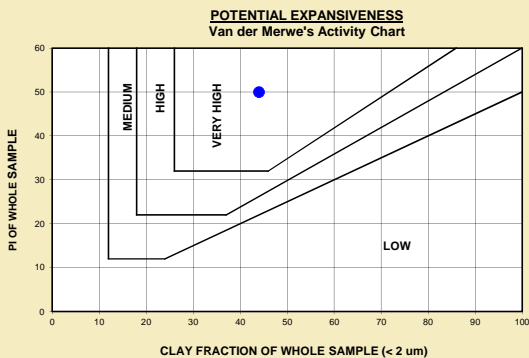
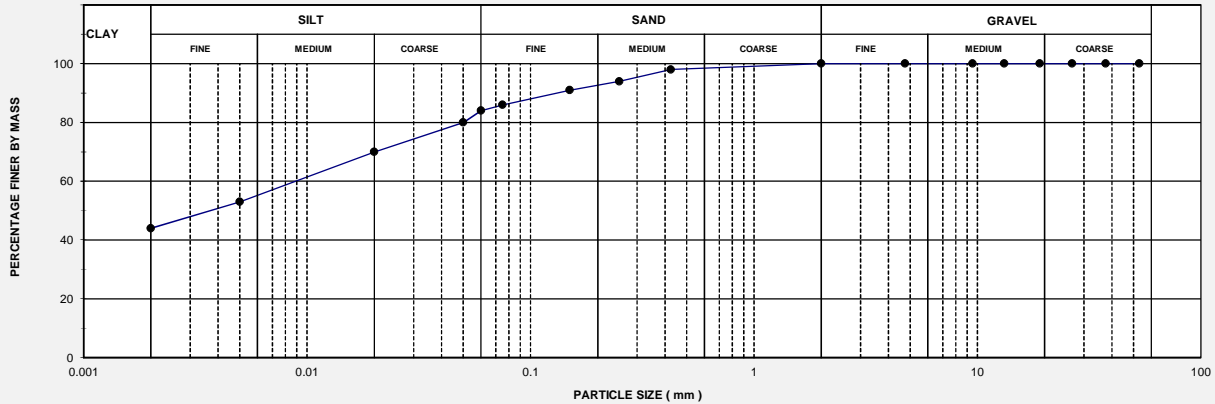


FOUNDATION INDICATOR TEST RESULTS - REP COM 7

Client: Golder Associates	Source/Location:	Job No: 2016-C-1779
Project Name: Tutuka Ash Increase	Layer:	Sample No: 6/13708
Project No: 1658666	Lane:	Date: 20/01/2017
Hole/TP No: AD 05	Stabilizing Agent:	Test Method: TMH1 A1, A5 & ASTM D422
Depth (m): 1.9 - 2.1	Section:	Client Ref No:
Description:	Chainage:	GPS X:
Additional Info:	Offset:	GPS Y:

SIEVE ANALYSIS				ATTEBERG LIMITS		SOIL CLASSIFICATION	
Sieve (mm)	% Passing	Sieve (mm)	% Passing				
75.0	100	0.425	98	Liquid Limit (%)	74	% Gravel	0
63.0	100	0.250	94	Plastic Limit (%)	23	% Sand	16
53.0	100	0.150	91	Plasticity Index (%)	51	% Silt	40
37.5	100	0.075	86	Weighted PI (%)	50.0	% Clay	44
26.5	100	0.060	84	Linear Shrinkage (%)	8.5	Activity	1.2
19.0	100	0.050	80	Grading Modulus	0.16	% Soil Mortar	100
13.2	100	0.020	70	Uniformity coefficient	6	Coarse Sand Ratio	0.02
9.5	100	0.005	53	Coefficient of curvature	0.2	TRB Classification	A - 7 - 6
4.75	100	0.002	44			Unified Classification	CH
2.00	100			Remarks:			

PARTICLE SIZE DISTRIBUTION



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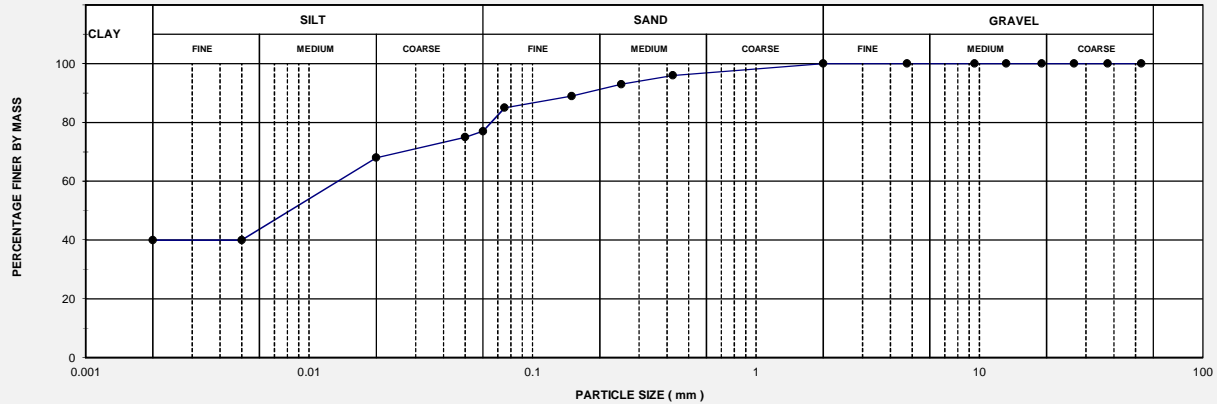


FOUNDATION INDICATOR TEST RESULTS - REP COM 7

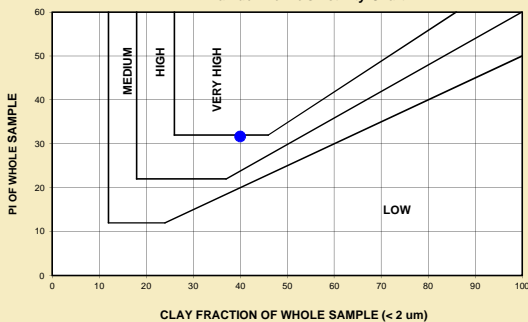
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Project Name: Tutuka Ash Increase	Layer:	Sample No: 6/13709
Project No: 1658666	Lane:	Date: 20/01/2017
Hole/TP No: AD 38	Stabilizing Agent:	Test Method: TMH1 A1, A5 & ASTM D422
Depth (m): 1.4 - 1.6	Section:	Client Ref No:
Description:	Chainage:	GPS X:
Additional Info:	Offset:	GPS Y:

SIEVE ANALYSIS				ATTERBERG LIMITS		SOIL CLASSIFICATION	
Sieve (mm)	% Passing	Sieve (mm)	% Passing				
75.0	100	0.425	96	Liquid Limit (%)	51	% Gravel	0
63.0	100	0.250	93	Plastic Limit (%)	18	% Sand	23
53.0	100	0.150	89	Plasticity Index (%)	33	% Silt	37
37.5	100	0.075	85	Weighted PI (%)	31.7	% Clay	40
26.5	100	0.060	77	Linear Shrinkage (%)	18.5	Activity	0.8
19.0	100	0.050	75	Grading Modulus	0.19	% Soil Mortar	100
13.2	100	0.020	68	Uniformity coefficient	8	Coarse Sand Ratio	0.04
9.5	100	0.005	40	Coefficient of curvature	0.1	TRB Classification	A - 7 - 6
4.75	100	0.002	40			Unified Classification	CH
2.00	100			Remarks:			

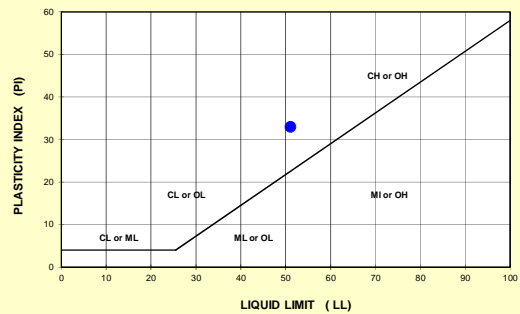
PARTICLE SIZE DISTRIBUTION



POTENTIAL EXPANSIVENESS Van der Merwe's Activity Chart



CASAGRANDE 'A' LINE





T0023

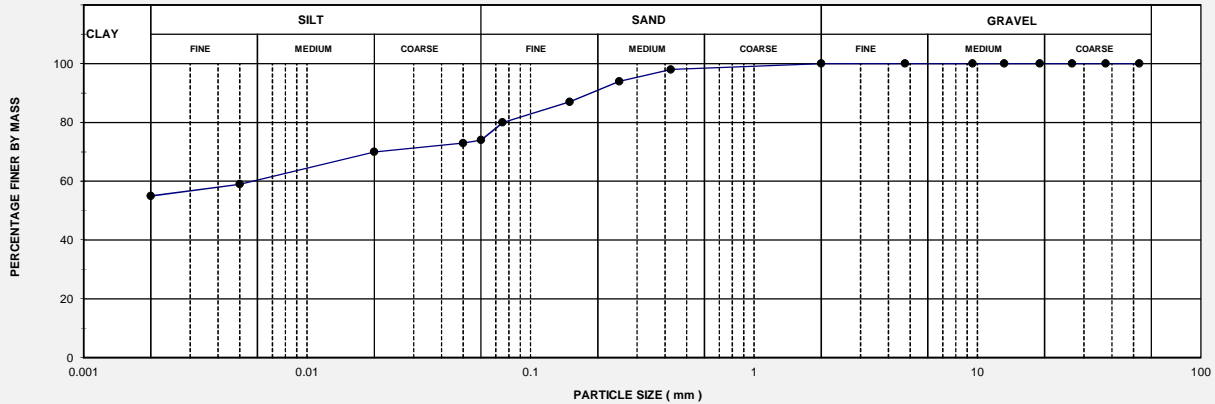


FOUNDATION INDICATOR TEST RESULTS - REP COM 7

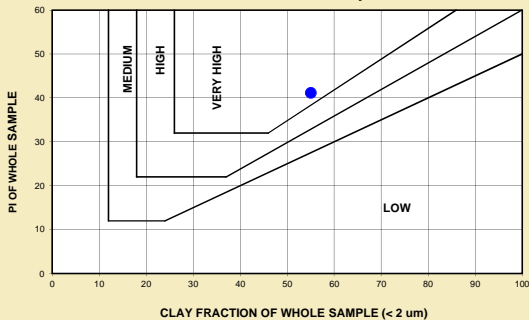
Client: Golder Associates	Source/Location:	Job No: 2016-C-1779
Project Name: Tutuka Ash Increase	Layer:	Sample No: 6/13710
Project No: 1658666	Lane:	Date: 17/02/2017
Hole/TP No: AD 58	Stabilizing Agent:	Test Method: TMH1 A1, A5 & ASTM D422
Depth (m): 0.5 - 0.6	Section:	Client Ref No:
Description:	Chainage:	GPS X:
Additional Info:	Offset:	GPS Y:

SIEVE ANALYSIS				ATTERBERG LIMITS		SOIL CLASSIFICATION	
Sieve (mm)	% Passing	Sieve (mm)	% Passing				
75.0	100	0.425	98	Liquid Limit (%)	67	% Gravel	0
63.0	100	0.250	94	Plastic Limit (%)	25	% Sand	26
53.0	100	0.150	87	Plasticity Index (%)	42	% Silt	19
37.5	100	0.075	80	Weighted PI (%)	41.2	% Clay	55
26.5	100	0.060	74	Linear Shrinkage (%)	14.0	Activity	0.8
19.0	100	0.050	73	Grading Modulus	0.22	% Soil Mortar	100
13.2	100	0.020	70	Uniformity coefficient	3	Coarse Sand Ratio	0.02
9.5	100	0.005	59	Coefficient of curvature	0.3	TRB Classification	A - 7 - 6
4.75	100	0.002	55			Unified Classification	CH
2.00	100			Remarks:			

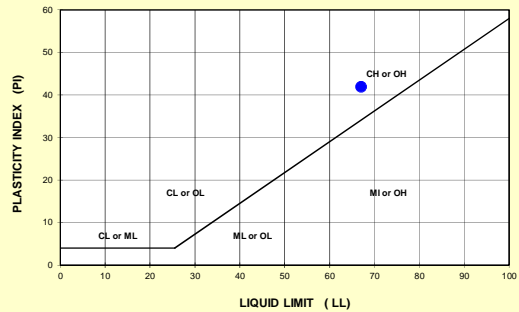
PARTICLE SIZE DISTRIBUTION



POTENTIAL EXPANSIVENESS Van der Merwe's Activity Chart



CASAGRANDE 'A' LINE



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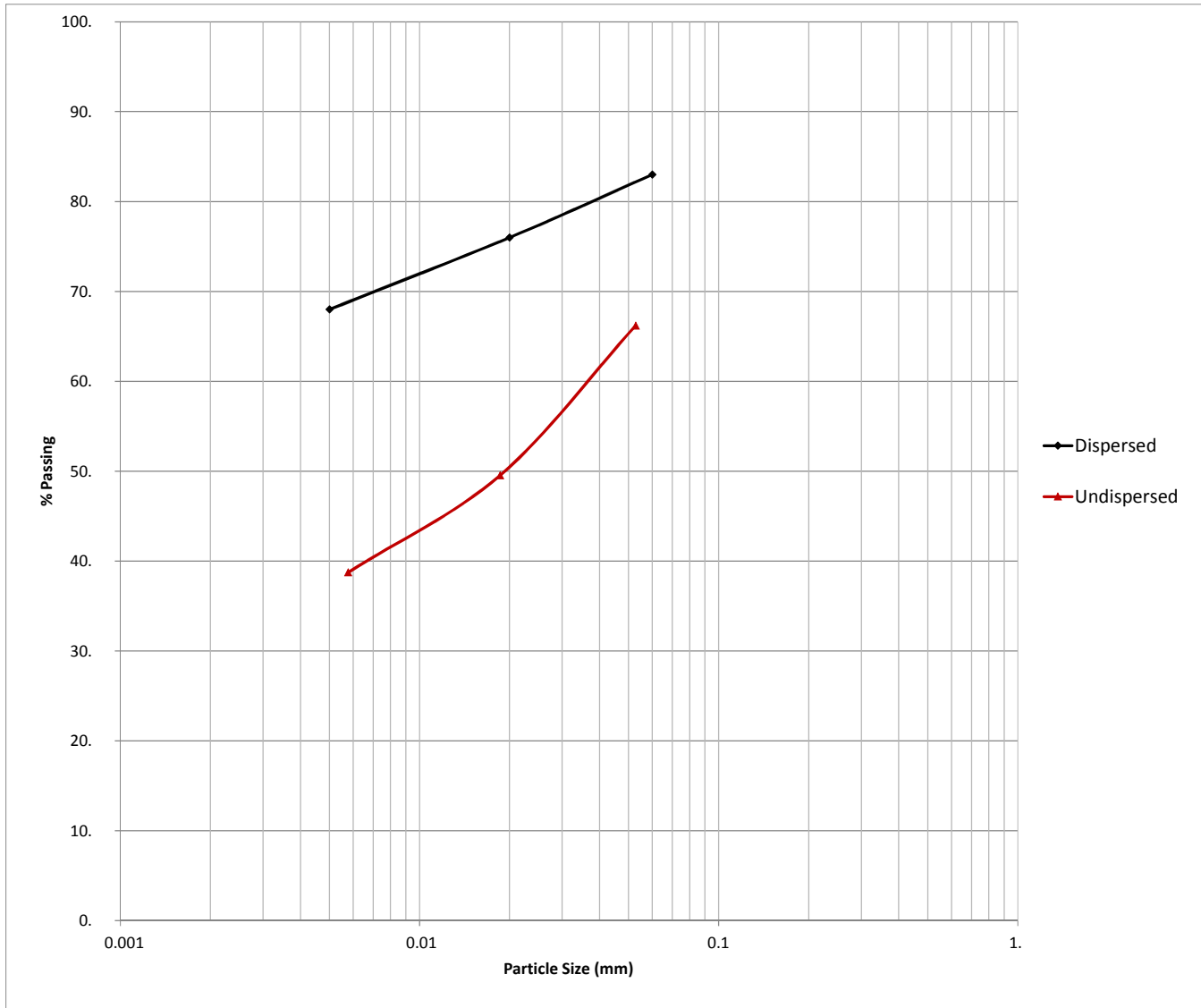
Double Hydrometer Test Result

ASTM
D4221

Client Golder Associates
Sample no RRD 14
Lab no 6/13711

Project Tutuka Ash Increase
Depth (m) 1.3 - 2.0

Job no 2016-C-1779
Date 02/02/2017



Dispersion:

57%

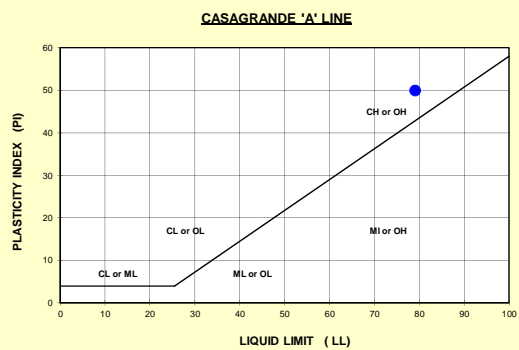
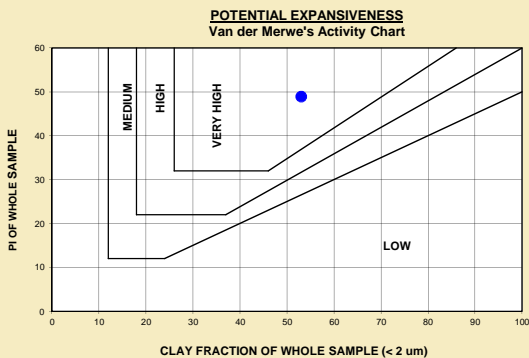
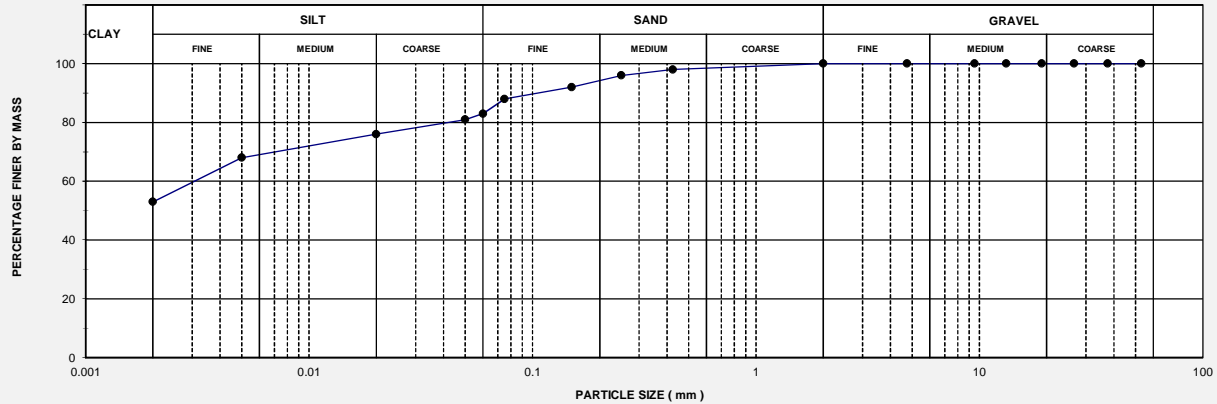


FOUNDATION INDICATOR TEST RESULTS - REP COM 7

Client: Golder Associates	Source/Location:	Job No: 2016-C-1779
Project Name: Tutuka Ash Increase	Layer:	Sample No: 6/13711
Project No: 1658666	Lane:	Date: 20/01/2017
Hole/TP No: RRD 14	Stabilizing Agent:	Test Method: TMH1 A1, A5 & ASTM D422
Depth (m): 1.3 - 2.0	Section:	Client Ref No:
Description:	Chainage:	GPS X:
Additional Info:	Offset:	GPS Y:

SIEVE ANALYSIS				ATTERBERG LIMITS		SOIL CLASSIFICATION	
Sieve (mm)	% Passing	Sieve (mm)	% Passing				
75.0	100	0.425	98	Liquid Limit (%)	79	% Gravel	0
63.0	100	0.250	96	Plastic Limit (%)	29	% Sand	17
53.0	100	0.150	92	Plasticity Index (%)	50	% Silt	30
37.5	100	0.075	88	Weighted PI (%)	49.0	% Clay	53
26.5	100	0.060	83	Linear Shrinkage (%)	15.5	Activity	0.9
19.0	100	0.050	81	Grading Modulus	0.14	% Soil Mortar	100
13.2	100	0.020	76	Uniformity coefficient	2	Coarse Sand Ratio	0.02
9.5	100	0.005	68	Coefficient of curvature	0.6	TRB Classification	A - 7 - 6
4.75	100	0.002	53			Unified Classification	CH
2.00	100			Remarks:			

PARTICLE SIZE DISTRIBUTION





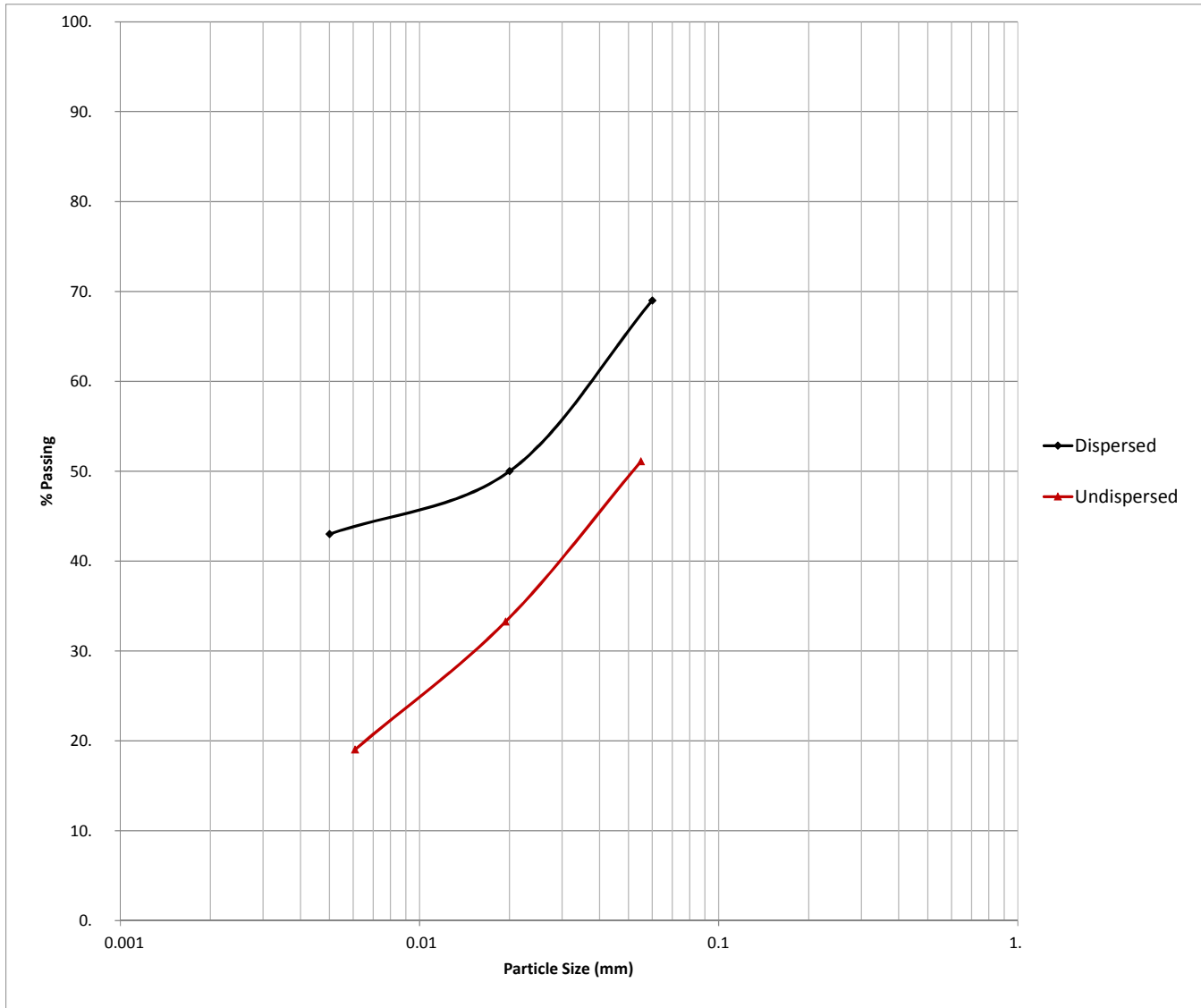
Double Hydrometer Test Result

ASTM
D4221

Client Golder Associates
Sample no AWRD 14
Lab no 6/13712

Project Tutuka Ash Increase
Depth (m) 0.9 - 2.5

Job no 2016-C-1779
Date 02/02/2017



Dispersion:

44%

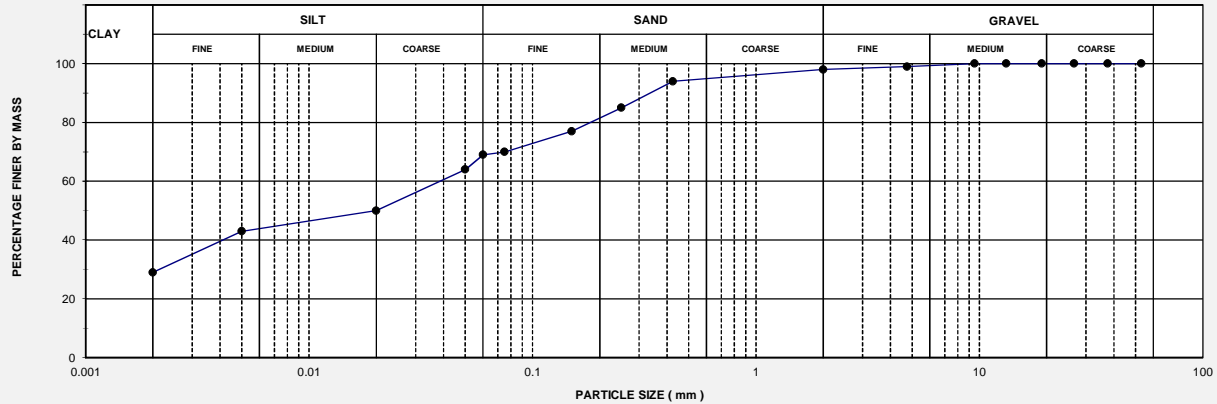


FOUNDATION INDICATOR TEST RESULTS - REP COM 7

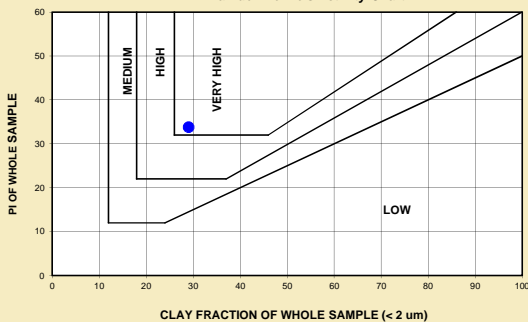
Client: Golder Associates	Source/Location:	Job No: 2016-C-1779
Project Name: Tutuka Ash Increase	Layer:	Sample No: 6/13712
Project No: 1658666	Lane:	Date: 20/01/2017
Hole/TP No: AWRD 14	Stabilizing Agent:	Test Method: TMH1 A1, A5 & ASTM D422
Depth (m): 0.9 - 2.5	Section:	Client Ref No:
Description:	Chainage:	GPS X:
Additional Info:	Offset:	GPS Y:

SIEVE ANALYSIS				ATTERBERG LIMITS		SOIL CLASSIFICATION	
Sieve (mm)	% Passing	Sieve (mm)	% Passing				
75.0	100	0.425	94	Liquid Limit (%)	57	% Gravel	2
63.0	100	0.250	85	Plastic Limit (%)	21	% Sand	29
53.0	100	0.150	77	Plasticity Index (%)	36	% Silt	40
37.5	100	0.075	70	Weighted PI (%)	33.8	% Clay	29
26.5	100	0.060	69	Linear Shrinkage (%)	16.0	Activity	1.2
19.0	100	0.050	64	Grading Modulus	0.38	% Soil Mortar	98
13.2	100	0.020	50	Uniformity coefficient	21	Coarse Sand Ratio	0.04
9.5	100	0.005	43	Coefficient of curvature	0.1	TRB Classification	A - 7 - 6
4.75	99	0.002	29			Unified Classification	CH
2.00	98			Remarks:			

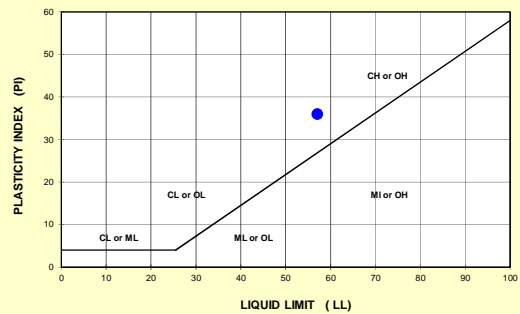
PARTICLE SIZE DISTRIBUTION



POTENTIAL EXPANSIVENESS Van der Merwe's Activity Chart



CASAGRANDE 'A' LINE



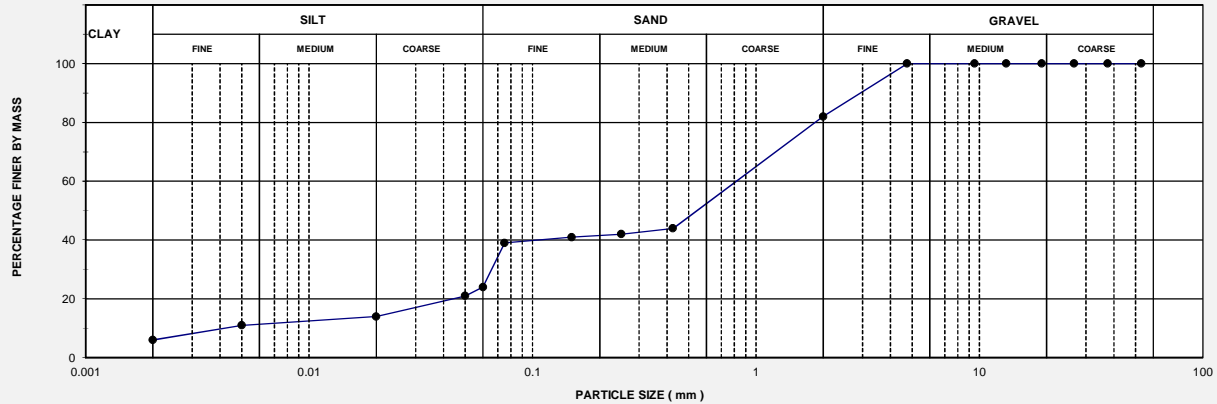


FOUNDATION INDICATOR TEST RESULTS - REP COM 7

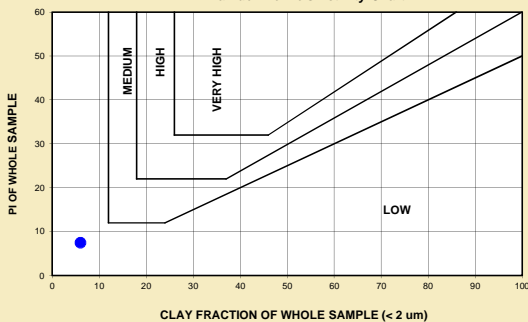
Client: Golder Associates	Source/Location:	Job No: 2016-C-1779
Project Name: Tutuka Ash Increase	Layer:	Sample No: 6/13713
Project No: 1658666	Lane:	Date: 20/01/2017
Hole/TP No: AD 57	Stabilizing Agent:	Test Method: TMH1 A1, A5 & ASTM D422
Depth (m): 1.2 - 1.3	Section:	Client Ref No:
Description:	Chainage:	GPS X:
Additional Info:	Offset:	GPS Y:

SIEVE ANALYSIS				ATTERBERG LIMITS		SOIL CLASSIFICATION	
Sieve (mm)	% Passing	Sieve (mm)	% Passing				
75.0	100	0.425	44	Liquid Limit (%)	42	% Gravel	18
63.0	100	0.250	42	Plastic Limit (%)	25	% Sand	58
53.0	100	0.150	41	Plasticity Index (%)	17	% Silt	18
37.5	100	0.075	39	Weighted PI (%)	7.5	% Clay	6
26.5	100	0.060	24	Linear Shrinkage (%)	9.5	Activity	2.8
19.0	100	0.050	21	Grading Modulus	1.35	% Soil Mortar	82
13.2	100	0.020	14	Uniformity coefficient	247	Coarse Sand Ratio	0.46
9.5	100	0.005	11	Coefficient of curvature	1.0	TRB Classification	A - 7 - 6
4.75	100	0.002	6			Unified Classification	SC
2.00	82			Remarks:			

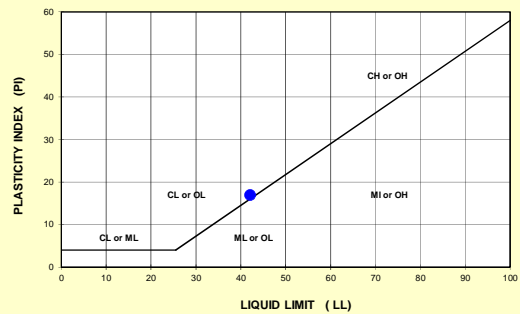
PARTICLE SIZE DISTRIBUTION



POTENTIAL EXPANSIVENESS Van der Merwe's Activity Chart



CASAGRANDE 'A' LINE





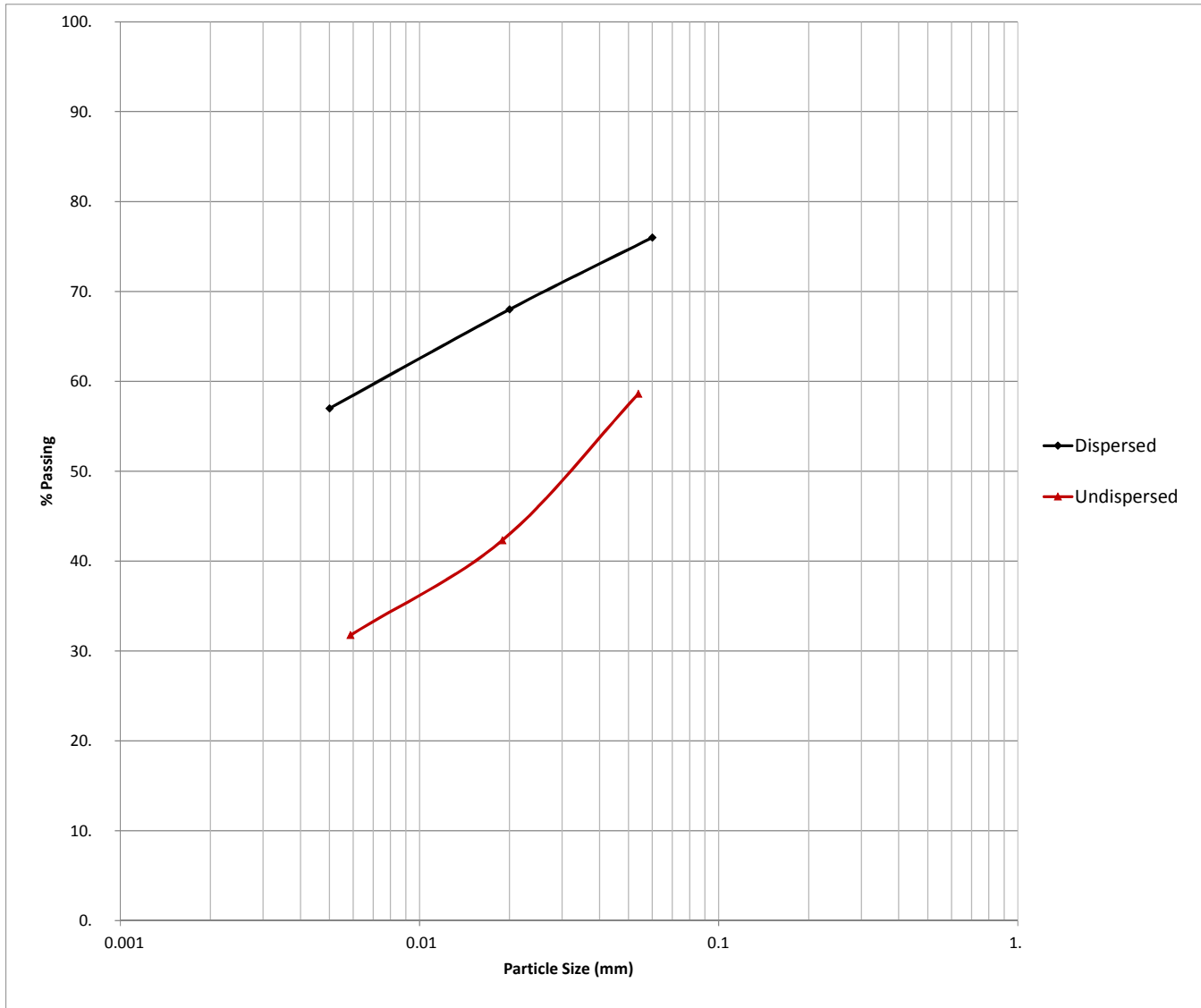
Double Hydrometer Test Result

ASTM
D4221

Client Golder Associates
Sample no AD44
Lab no 6/13714

Project Tutuka Ash Increase
Depth (m) 1.2 - 1.3

Job no 2016-C-1779
Date 02/02/2017



Dispersion:

56%



T0023

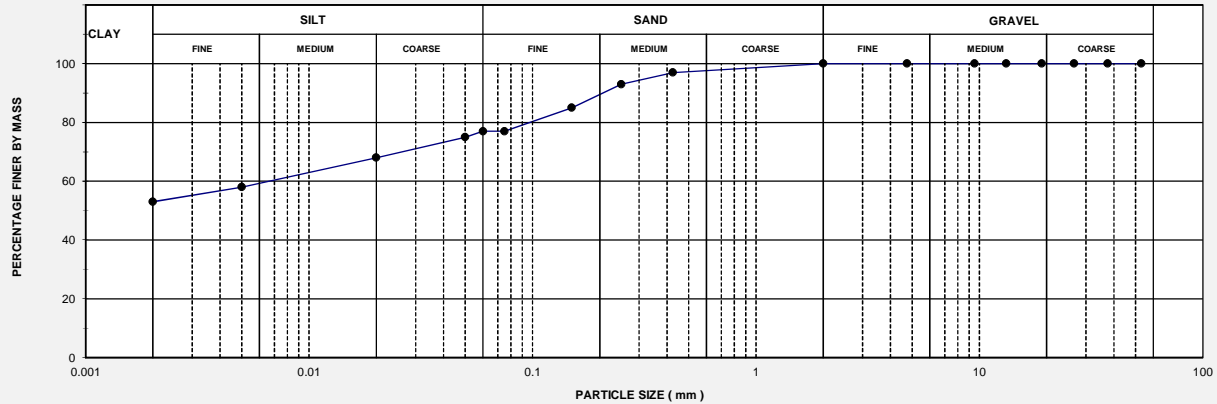


FOUNDATION INDICATOR TEST RESULTS - REP COM 7

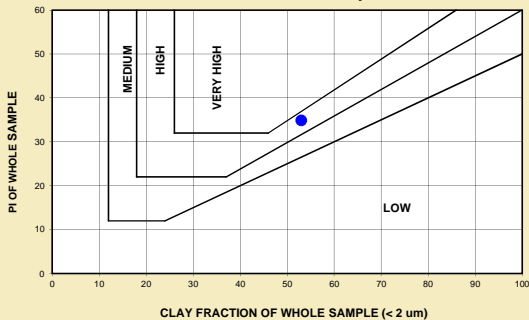
Client: Golder Associates	Source/Location:	Job No: 2016-C-1779
Project Name: Tutuka Ash Increase	Layer:	Sample No: 6/13714
Project No: 1658666	Lane:	Date: 20/01/2017
Hole/TP No: AD 44	Stabilizing Agent:	Test Method: TMH1 A1, A5 & ASTM D422
Depth (m): 1.2 - 1.3	Section:	Client Ref No:
Description:	Chainage:	GPS X:
Additional Info:	Offset:	GPS Y:

SIEVE ANALYSIS				ATTERBERG LIMITS		SOIL CLASSIFICATION	
Sieve (mm)	% Passing	Sieve (mm)	% Passing				
75.0	100	0.425	97	Liquid Limit (%)	61	% Gravel	0
63.0	100	0.250	93	Plastic Limit (%)	25	% Sand	23
53.0	100	0.150	85	Plasticity Index (%)	36	% Silt	24
37.5	100	0.075	77	Weighted PI (%)	34.9	% Clay	53
26.5	100	0.060	77	Linear Shrinkage (%)	14.5	Activity	0.7
19.0	100	0.050	75	Grading Modulus	0.26	% Soil Mortar	100
13.2	100	0.020	68	Uniformity coefficient	4	Coarse Sand Ratio	0.03
9.5	100	0.005	58	Coefficient of curvature	0.3	TRB Classification	A - 7 - 6
4.75	100	0.002	53			Unified Classification	CH
2.00	100			Remarks:			

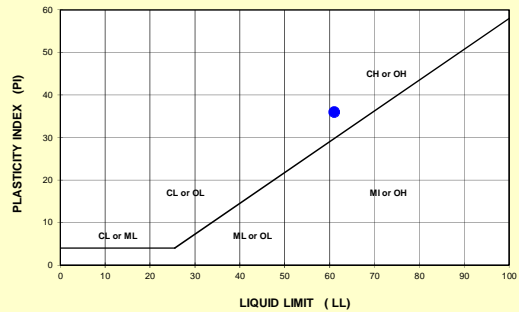
PARTICLE SIZE DISTRIBUTION



POTENTIAL EXPANSIVENESS Van der Merwe's Activity Chart



CASAGRANDE 'A' LINE



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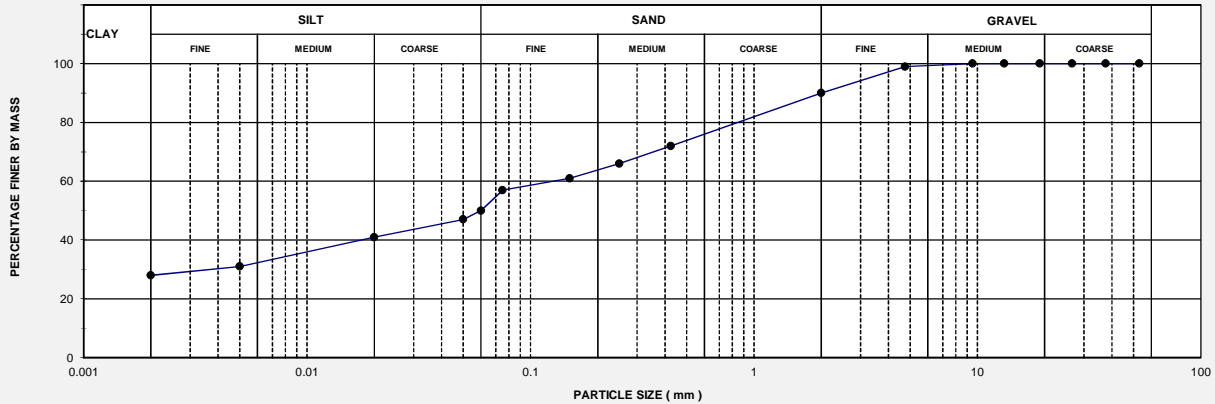


FOUNDATION INDICATOR TEST RESULTS - REP COM 7

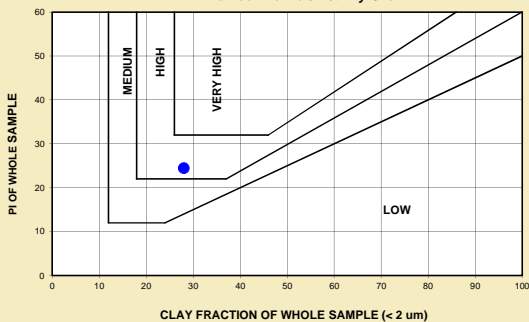
Client: Golder Associates	Source/Location:	Job No: 2016-C-1779
Project Name: Tutuka Ash Increase	Layer:	Sample No: 6/13715
Project No: 1658666	Lane:	Date: 2017/04/04
Hole/TP No: BH 06	Stabilizing Agent:	Test Method: TMH1 A1, A5 & ASTM D422
Depth (m): 1.5 - 2.05	Section:	Client Ref No:
Description:	Chainage:	GPS X:
Additional Info:	Offset:	GPS Y:

SIEVE ANALYSIS				ATTERBERG LIMITS		SOIL CLASSIFICATION	
Sieve (mm)	% Passing	Sieve (mm)	% Passing				
75.0	100	0.425	72	Liquid Limit (%)	56	% Gravel	10
63.0	100	0.250	66	Plastic Limit (%)	22	% Sand	40
53.0	100	0.150	61	Plasticity Index (%)	34	% Silt	22
37.5	100	0.075	57	Weighted PI (%)	24.5	% Clay	28
26.5	100	0.060	50	Linear Shrinkage (%)	12.0	Activity	1.2
19.0	100	0.050	47	Grading Modulus	0.81	% Soil Mortar	90
13.2	100	0.020	41	Uniformity coefficient	66	Coarse Sand Ratio	0.20
9.5	100	0.005	31	Coefficient of curvature	0.1	TRB Classification	A - 7 - 6
4.75	99	0.002	28			Unified Classification	CH
2.00	90			Remarks:			

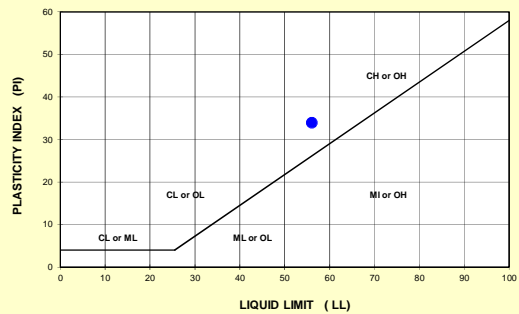
PARTICLE SIZE DISTRIBUTION



POTENTIAL EXPANSIVENESS Van der Merwe's Activity Chart



CASAGRANDE 'A' LINE





CONSOLIDATION TESTS: STANDARD OEDOMETER

**BS 1377
Part 5**

Client Golder	Project Tutuka Ash Increase	Job no: 2017-C-1779
Sample no BH06	Depth (m) 1.5-2.05m	Date 04-04-2017
Lab no 6/13715		

Sample Parameters	Unit	Value	Remarks	Test Remarks
Moisture Content	Before Test	33.5	Complete test specimen	Undisturbed sample
	After Test	26.4		
Dry Density	Kg/m ³	1349		
Void Ratio	-	0.876		
Degree of Saturation	%	96.6		
Initial Specimen Height	mm	25.4		
Relative Density (SG)	-	2.531	Determined	

Test Parameters														
Vertical Stress	kPa	10	25	50	100	200	400	800	1600	400	100	10		
Time Elapsed	hr	24	24	24	24	24	24	24	24	2	2	3		
H ₁₀₀	mm	25.261	24.830	24.442	23.802	22.815	21.492	19.999	18.686	19.192	19.626	20.212		
Strain	%	0.550	2.240	3.770	6.290	10.180	15.390	21.260	26.430	24.440	22.730	20.420		
Void Ratio	-	0.866	0.834	0.805	0.758	0.685	0.587	0.477	0.380	0.418	0.450	0.493		
Mv (1/Mpa)	-	-	1.1364	0.6254	0.5235	0.4147	0.29	0.1736	0.0821	0.0226	0.0753	0.3322		



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CONSOLIDATION TESTS: STANDARD OEDOMETER

**BS 1377
Part 5**

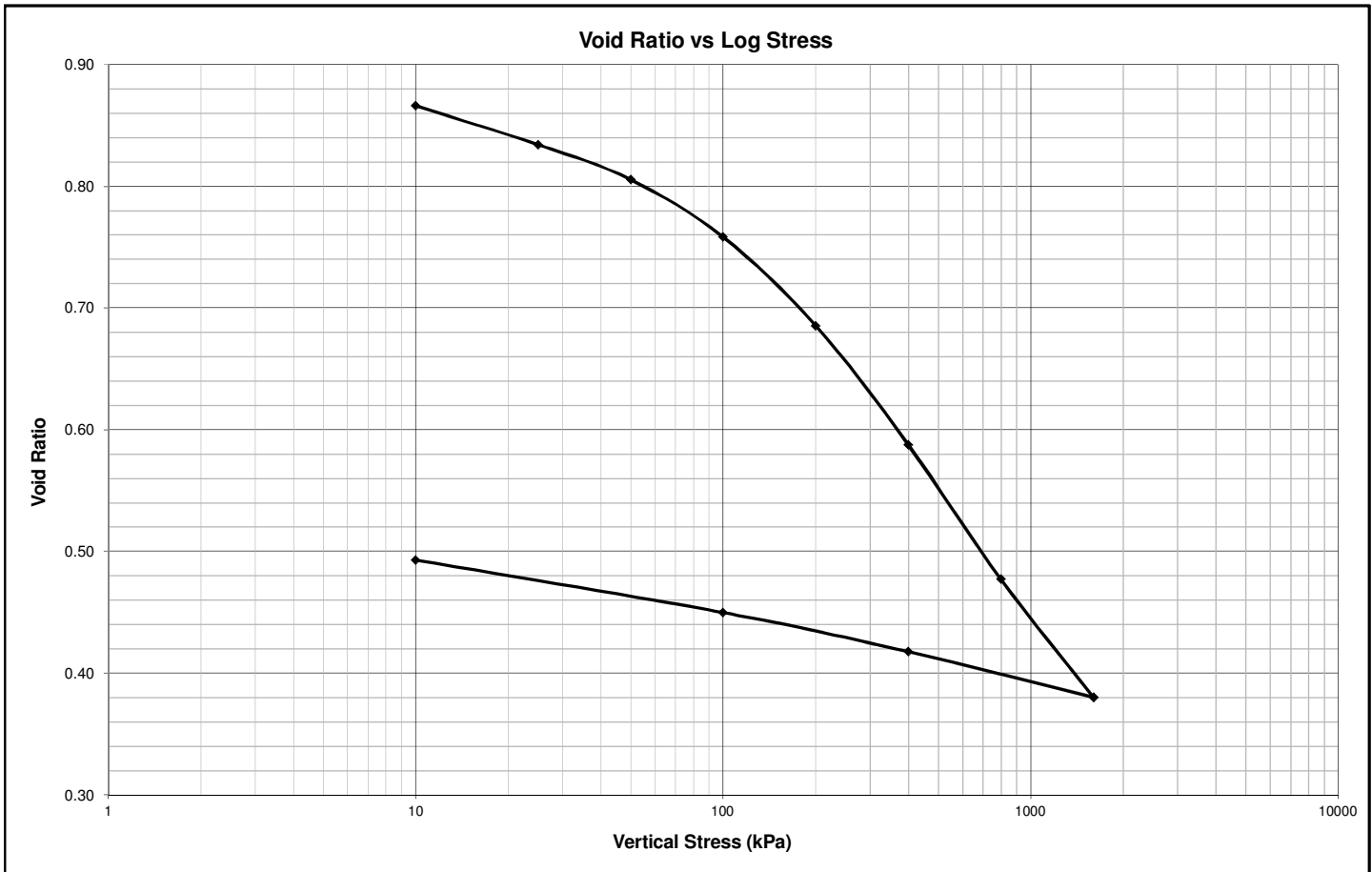
Client Golder
Sample no BH06
Lab no 6/13715

Project Tutuka Ash Increase
Depth (m) 1.5-2.05m

Job no: 2017-C-1779
Date 04-04-2017

Sample Parameters	Unit	Value	Remarks	Test Remarks	
Moisture Content	Before Test	%	33.5	Complete test specimen	Undisturbed sample
	After Test	%	26.4	Complete test specimen	
Dry Density	Kg/m ³	1349			
Void Ratio	-	0.876			
Degree of Saturation	%	96.6			
Initial Specimen Height	mm	25.4			
Relative Density (SG)	-	2.531	Determined		

Test Parameters														
Vertical Stress	kPa	10	25	50	100	200	400	800	1600	400	100	10		
Time Elapsed	hr	24	24	24	24	24	24	24	24	2	2	3		
H ₁₀₀	mm	25.261	24.830	24.442	23.802	22.815	21.492	19.999	18.686	19.192	19.626	20.212		
Strain	%	0.550	2.240	3.770	6.290	10.180	15.390	21.260	26.430	24.440	22.730	20.420		
Void Ratio	-	0.866	0.834	0.805	0.758	0.685	0.587	0.477	0.380	0.418	0.450	0.493		
Mv (1/Mpa)	-	-	1.1364	0.6254	0.5235	0.4147	0.29	0.1736	0.0821	0.0226	0.0753	0.3322		



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CONSOLIDATED UNDRAINED TRIAXIAL TEST

**BS 1377
Part 8**

Client Golder Associates
Sample no BH06
Lab no 6/13715

Project Tutuka Ash Increase
Depth (m) 1.5 - 2.05

Job no 2016-C-1779
Date 28-04-2017

Test Information		
Test Type	-	Consolidated Undrained with PWP measurements, saturated
Sample Condition	-	Undisturbed
Saturation Method		Increments of Cell- and Backpressure
Consolidation Pressures	kPa	125, 250, 500
Rate of Strain	%/min	0.0008
Failure Criterion	-	Maximum Deviator Stress
Side Drains Used	-	Yes
Drainage Conditions	-	To One End
Comments	-	-

Initial Sample Parameters	Unit	Test 1	Test 2	Test 3	Remarks
Moisture Content	%	16.8	20.1	41.0	Complete test specimen
Dry Density	Kg/m ³	1678	1628	1227	
Void Ratio	-	0.509	0.555	1.062	
Degree of Saturation	%	83.6	91.7	97.8	
Initial Height	cm	7.6	7.6	7.6	
Initial Diameter	cm	3.8	3.8	3.8	
Area (After Consolidation)	cm ²	10.928	10.821	9.838	Calculated
Relative Density (SG)	-		2.531		Determined

Final Sample Parameters	Unit	Test 1	Test 2	Test 3	Remarks	
Moisture Content	%	20.1	20.2	29.2	Complete test specimen	
Dry Density	Kg/m ³	1773	1745	1509		
Void Ratio	-	0.428	0.450	0.678		
Area	cm ²	12.688	12.603	10.904	Calculated	
Eff. Consolidation Pressures	kPa	123	244	498		
Total Backpressure used	kPa	170	170	170	Saturation	
Final B Parameter	-	0.97	0.97	0.98		
Cell Pressure	kPa	295	420	670	Consolidation & Shear	
Axial Strain at Max. Deviator Stress	%	13.82	14.08	7.61		
Volume Change	ml	4.6	5.8	16.1	During Consolidation	
Principal Stresses at Max. Deviator Stress	σ_1	kPa	247	427	815	Corrected
	σ_3	kPa	123	244	498	Corrected
	$\sigma_{1'}$	kPa	228	338	607	Corrected
	$\sigma_{3'}$	kPa	104	155	290	Corrected



CONSOLIDATED UNDRAINED TRIAXIAL TEST

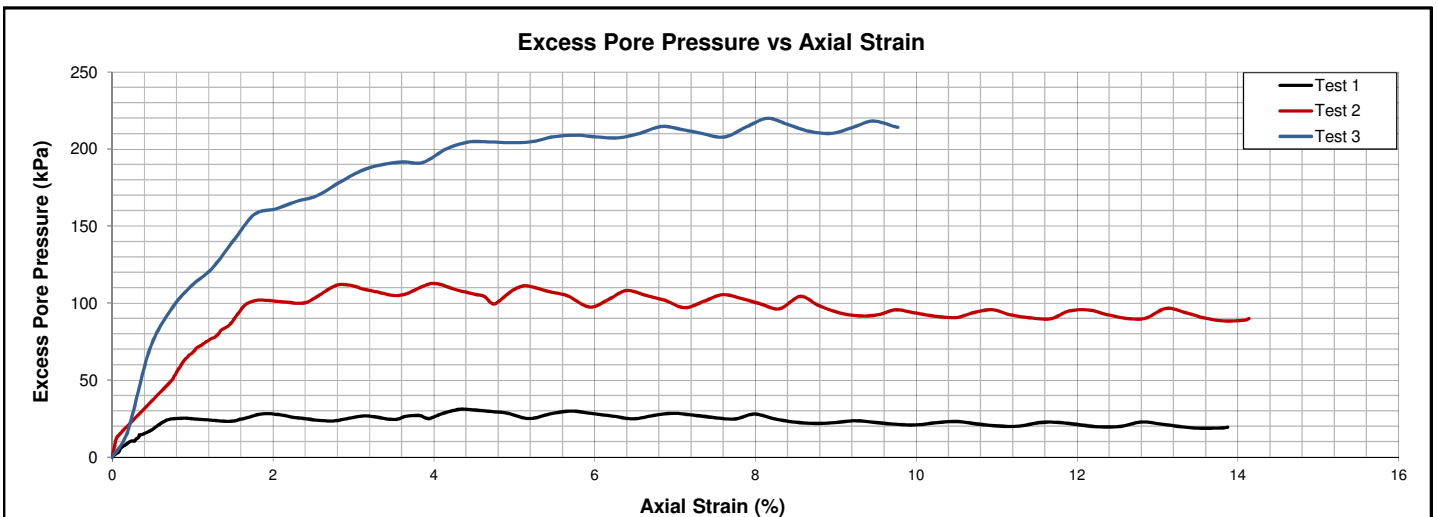
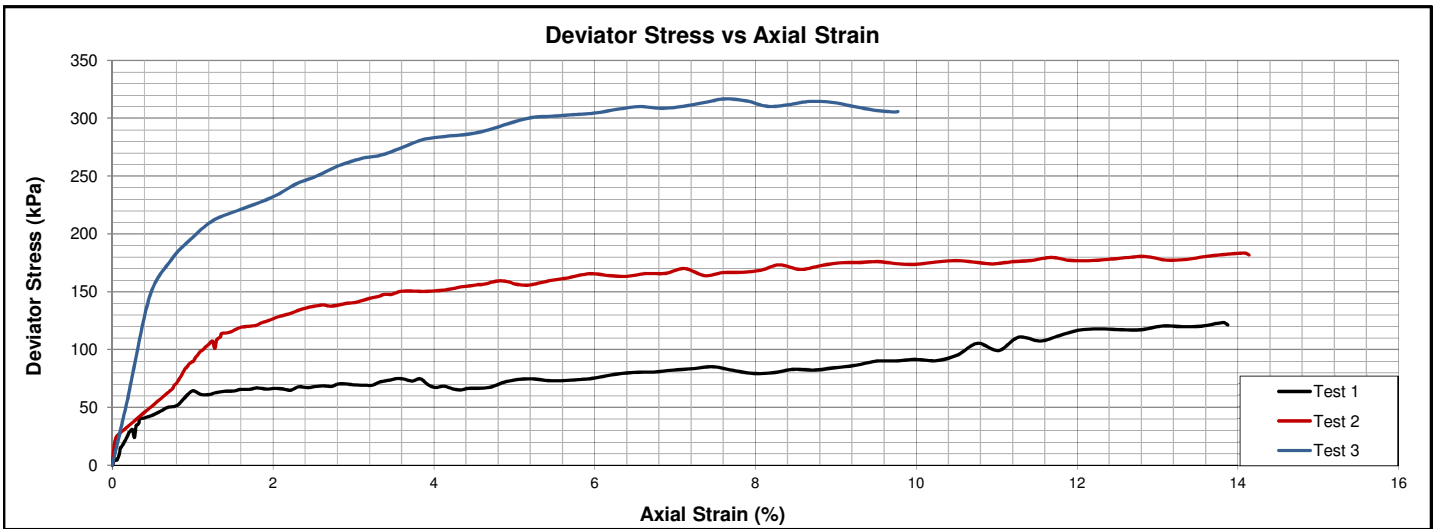
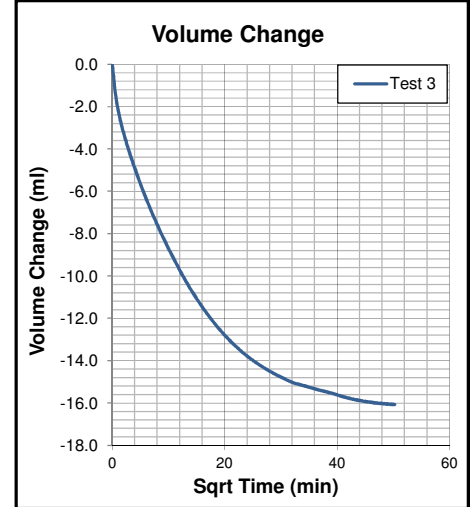
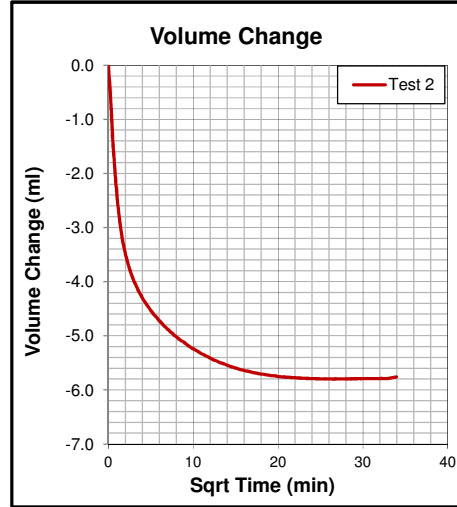
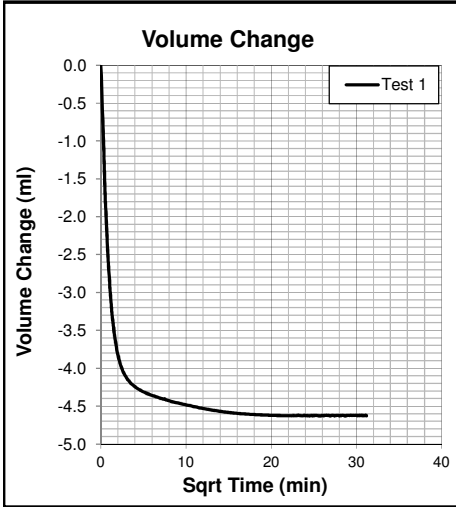
BS 1377
Part 8

Client Golder Associates
Sample no BH06
Lab no 6/13715

Project Tutuka Ash Increase
Depth (m) 1.5 - 2.05

Job no 2016-C-1779
Date 28-04-2017

Sample Condition: Undisturbed



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CONSOLIDATED UNDRAINED TRIAXIAL TEST

BS 1377
Part 8

Client Golder Associates
Sample no BH06
Lab no 6/13715

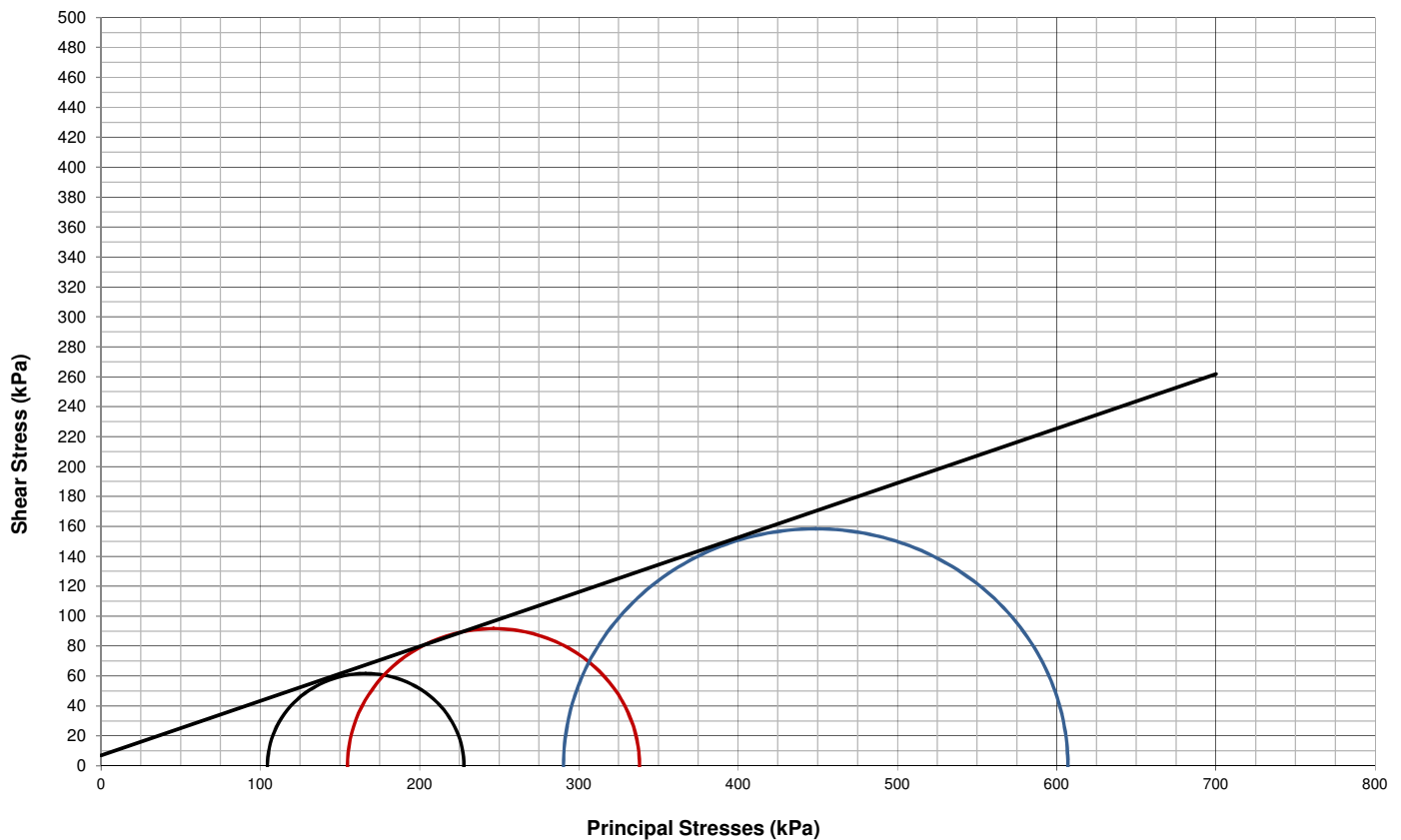
Project Tutuka Ash Increase
Depth (m) 1.5 - 2.05

Job no 2016-C-1779
Date 28-04-2017
Sample Condition: Undisturbed

Shear Parameters of Effective Stresses

Angle of Internal Friction	Deg.	20
Cohesion	kPa	7

Effective Shear Strength





CONSOLIDATED UNDRAINED TRIAXIAL TEST

BS 1377
Part 8

Client Golder Associates
Sample no BH06
Lab no 6/13715

Project Tutuka Ash Increase
Depth (m) 1.5 - 2.05

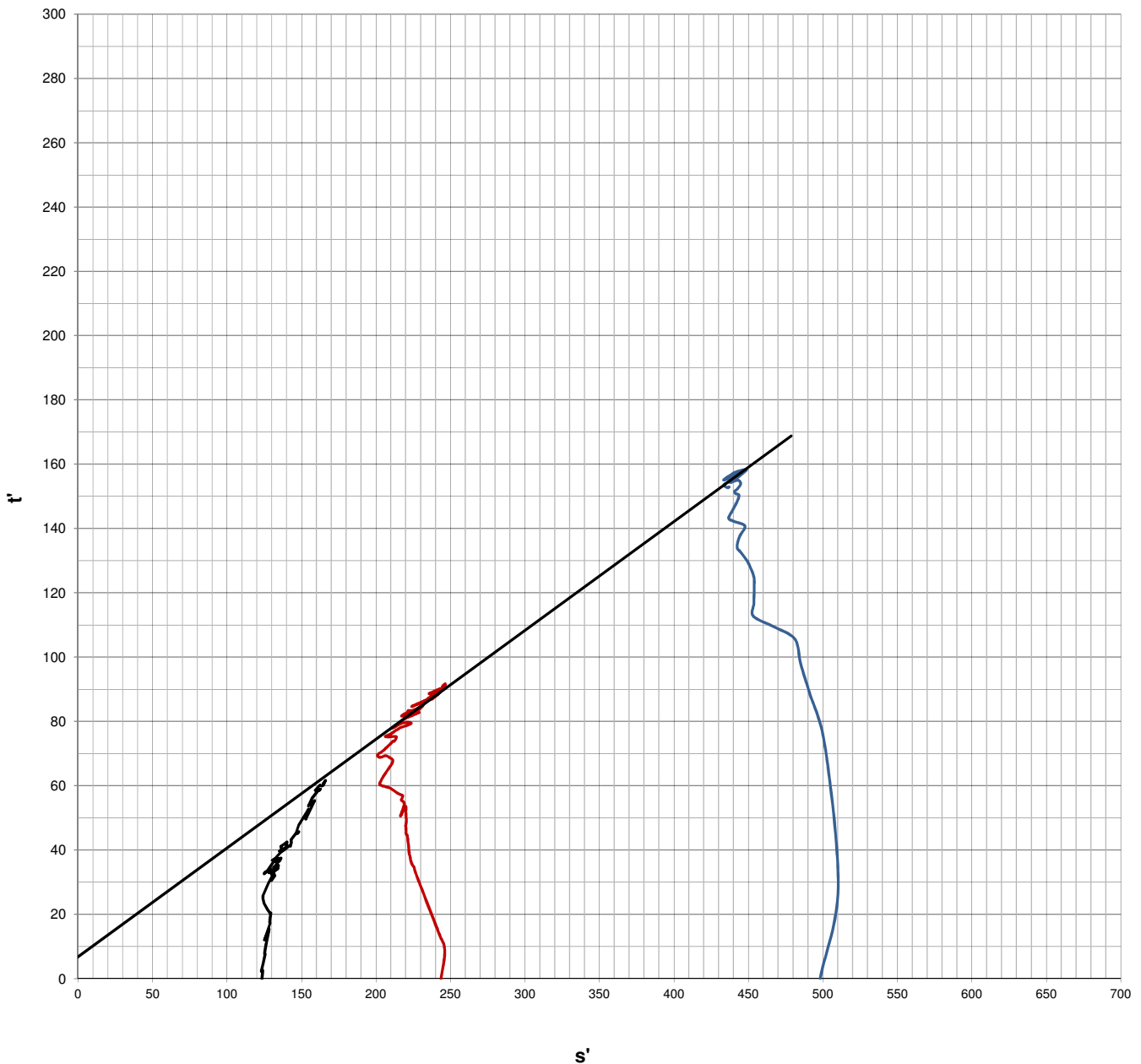
Job no 2016-C-1779
Date 28-04-2017

Sample Condition: Undisturbed

Shear Parameters at Failure

Angle of Internal Friction	Deg.	20
Cohesion	kPa	7

Stress Path Failure Envelope



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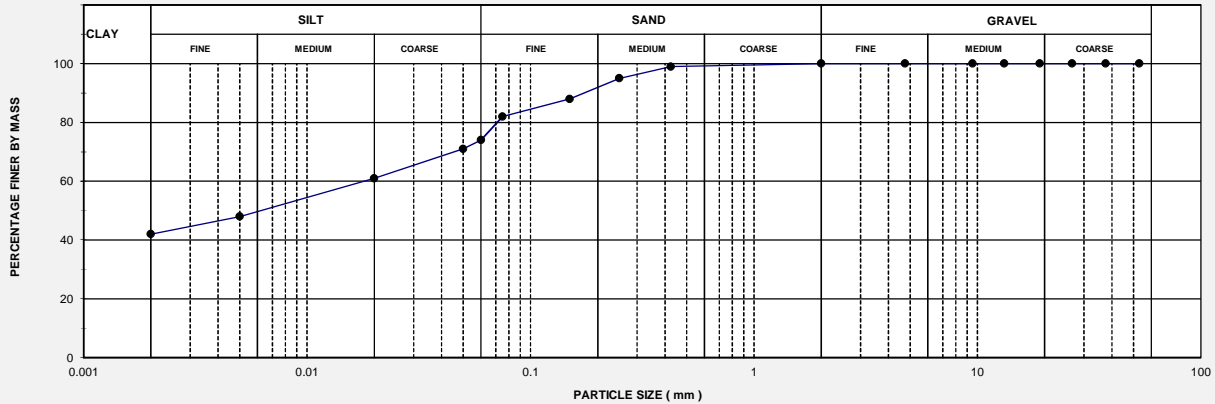


FOUNDATION INDICATOR TEST RESULTS - REP COM 7

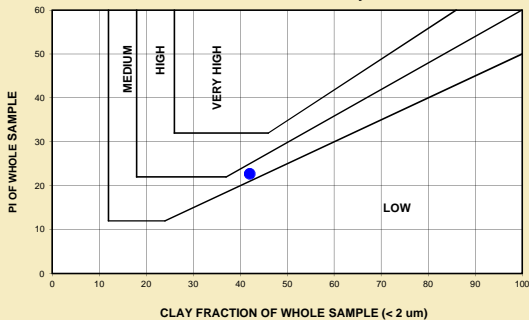
Client: Golder Associates	Source/Location:	Job No: 2016-C-1779
Project Name: Tutuka Ash Increase	Layer:	Sample No: 6/13716
Project No: 1658666	Lane:	Date: 20/01/2017
Hole/TP No: BH 07	Stabilizing Agent:	Test Method: TMH1 A1, A5 & ASTM D422
Depth (m): 0.5 - 1.05	Section:	Client Ref No:
Description:	Chainage:	GPS X:
Additional Info:	Offset:	GPS Y:

SIEVE ANALYSIS				ATTEBERG LIMITS		SOIL CLASSIFICATION	
Sieve (mm)	% Passing	Sieve (mm)	% Passing				
75.0	100	0.425	99	Liquid Limit (%)	43	% Gravel	0
63.0	100	0.250	95	Plastic Limit (%)	20	% Sand	26
53.0	100	0.150	88	Plasticity Index (%)	23	% Silt	32
37.5	100	0.075	82	Weighted PI (%)	22.8	% Clay	42
26.5	100	0.060	74	Linear Shrinkage (%)	13.5	Activity	0.5
19.0	100	0.050	71	Grading Modulus	0.19	% Soil Mortar	100
13.2	100	0.020	61	Uniformity coefficient	9	Coarse Sand Ratio	0.01
9.5	100	0.005	48	Coefficient of curvature	0.1	TRB Classification	A - 7 - 6
4.75	100	0.002	42			Unified Classification	CL
2.00	100			Remarks:			

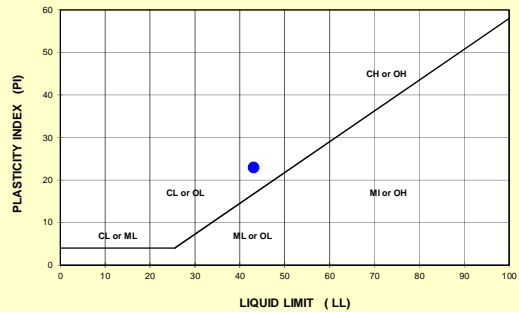
PARTICLE SIZE DISTRIBUTION



POTENTIAL EXPANSIVENESS Van der Merwe's Activity Chart



CASAGRANDE 'A' LINE





CONSOLIDATED UNDRAINED TRIAXIAL TEST

**BS 1377
Part 8**

Client Golder Associates
Sample no BH 07
Lab no 6/13716

Project Tutuka Ash Increase
Depth (m) 0.5 - 1.05

Job no 2016-C-1779
Date 28-03-2017

Test Information		
Test Type	-	Consolidated Undrained with PWP measurements, saturated
Sample Condition	-	Undisturbed
Saturation Method		Increments of Cell- and Backpressure
Consolidation Pressures	kPa	125, 250, 500
Rate of Strain	%/min	0.0008
Failure Criterion	-	Maximum Deviator Stress
Side Drains Used	-	Yes
Drainage Conditions	-	To One End
Comments	-	-

Initial Sample Parameters	Unit	Test 1	Test 2	Test 3	Remarks
Moisture Content	%	35.0	32.9	25.1	Complete test specimen
Dry Density	Kg/m ³	1369	1396	1560	
Void Ratio	-	0.789	0.755	0.569	
Degree of Saturation	%	108.7	106.8	108.1	
Initial Height	cm	7.6	7.6	7.6	
Initial Diameter	cm	3.8	3.8	3.8	
Area (After Consolidation)	cm ²	10.953	10.710	10.718	Calculated
Relative Density (SG)	-		2.449		Determined

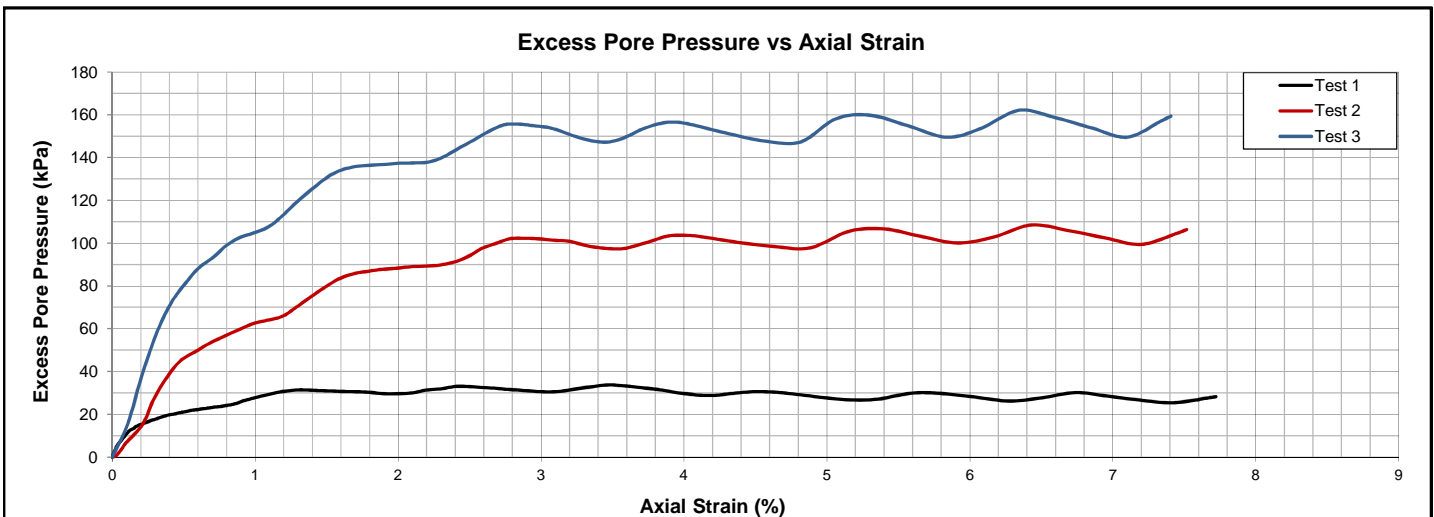
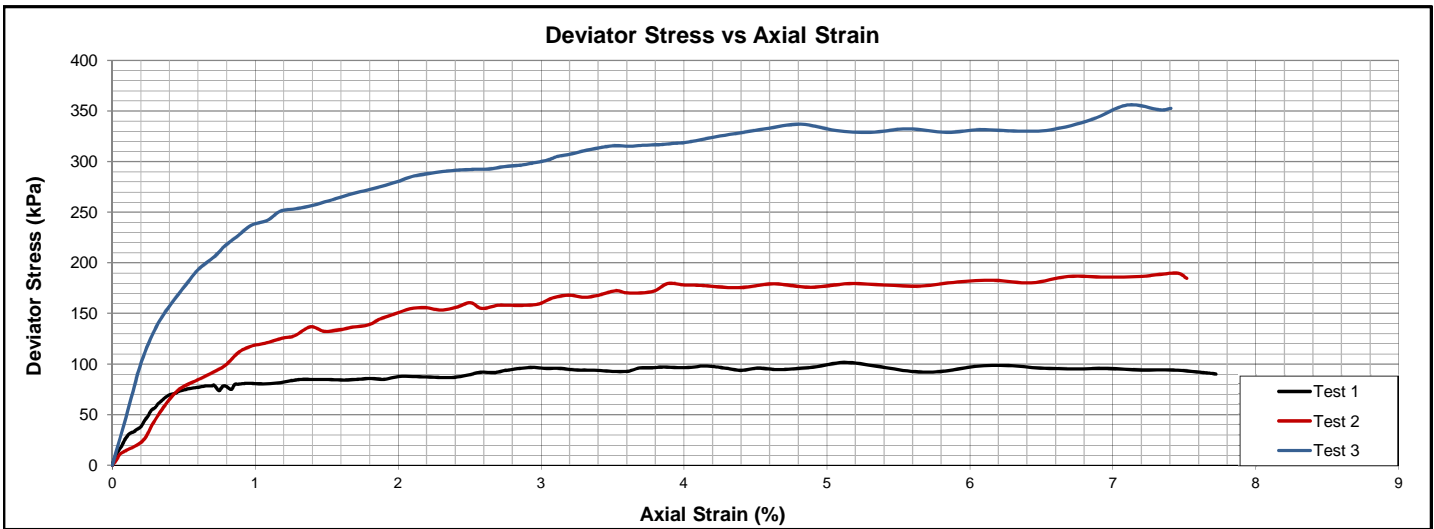
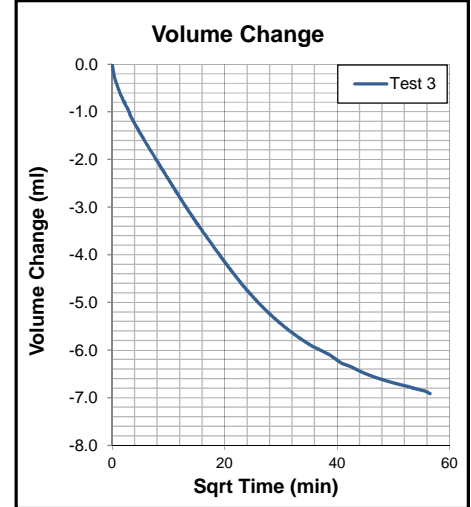
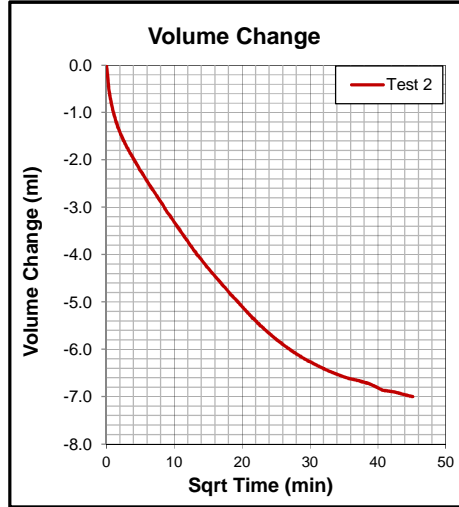
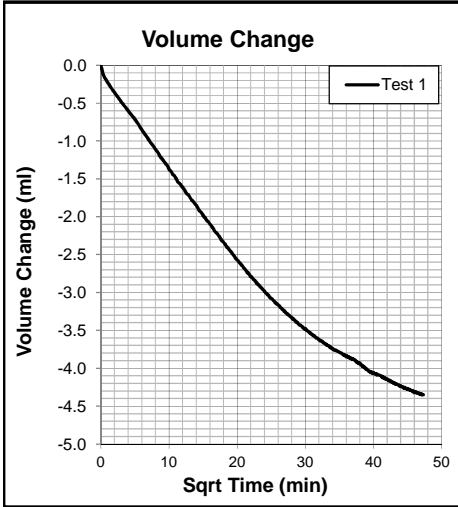
Final Sample Parameters	Unit	Test 1	Test 2	Test 3	Remarks	
Moisture Content	%	35.9	34.6	26.2	Complete test specimen	
Dry Density	Kg/m ³	1442	1519	1697		
Void Ratio	-	0.699	0.612	0.444		
Area	cm ²	11.870	11.581	11.575	Calculated	
Eff. Consolidation Pressures	kPa	84	229	402		
Total Backpressure used	kPa	120	170	120	Saturation	
Final B Parameter	-	0.97	0.97	0.98		
Cell Pressure	kPa	245	420	620	Consolidation & Shear	
Axial Strain at Max. Deviator Stress	%	5.12	7.45	7.10		
Volume Change	ml	4.3	7.0	6.9	During Consolidation	
Principal Stresses at Max. Deviator Stress	σ_1	kPa	186	419	758	Corrected
	σ_3	kPa	84	229	402	Corrected
	$\sigma_{1'}$	kPa	159	315	609	Corrected
	$\sigma_{3'}$	kPa	57	125	253	Corrected

Client Golder Associates
Sample no BH 07
Lab no 6/13716

Project Tutuka Ash Increase
Depth (m) 0.5 - 1.05

Job no 2016-C-1779
Date 28-03-2017

Sample Condition: Undisturbed



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CONSOLIDATED UNDRAINED TRIAXIAL TEST

BS 1377
Part 8

Client Golder Associates
Sample no BH 07
Lab no 6/13716

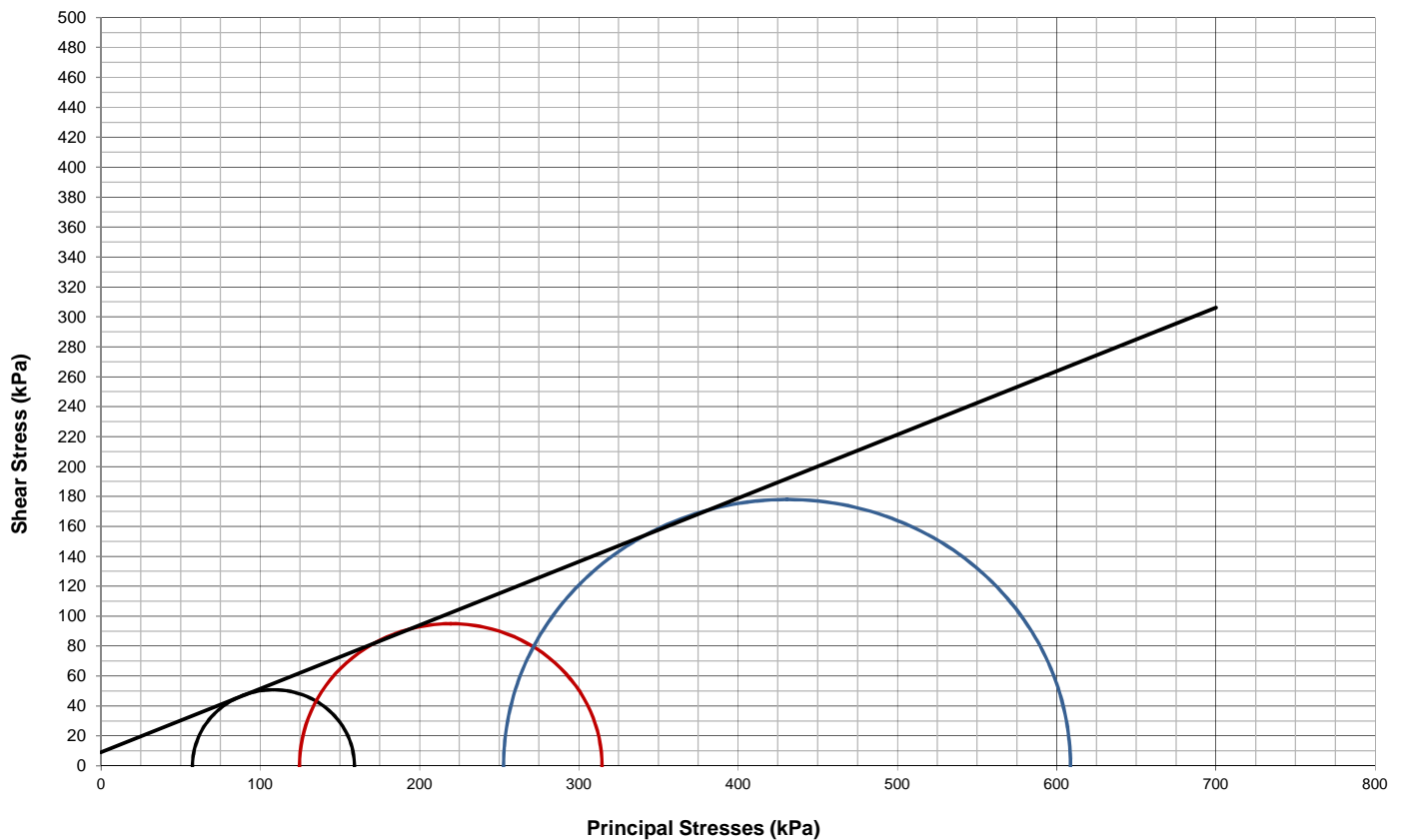
Project Tutuka Ash Increase
Depth (m) 0.5 - 1.05

Job no 2016-C-1779
Date 28-03-2017
Sample Condition: Undisturbed

Shear Parameters of Effective Stresses

Angle of Internal Friction	Deg.	23
Cohesion	kPa	9

Effective Shear Strength





CONSOLIDATED UNDRAINED TRIAXIAL TEST

BS 1377
Part 8

Client Golder Associates
Sample no BH 07
Lab no 6/13716

Project Tutuka Ash Increase
Depth (m) 0.5 - 1.05

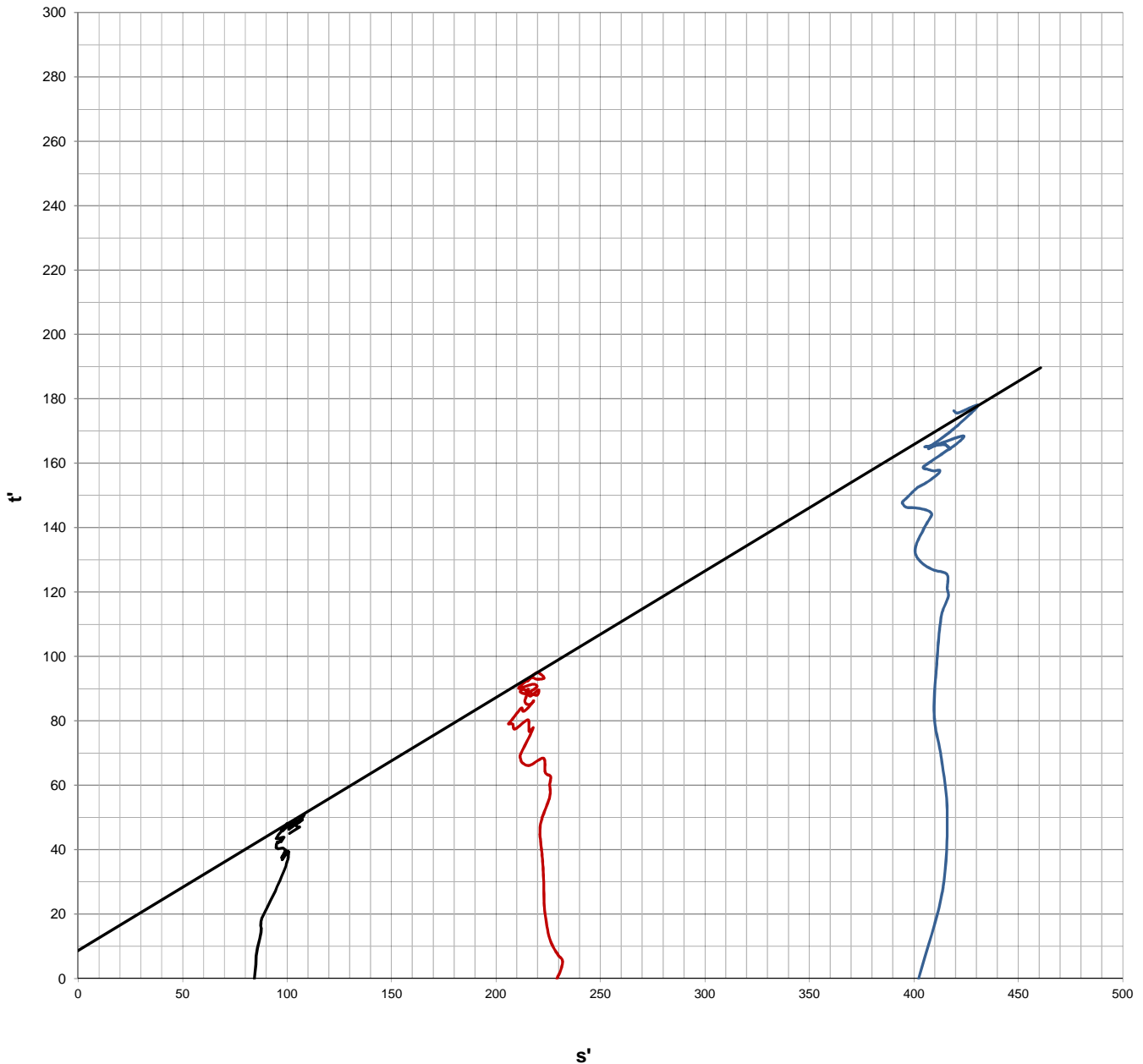
Job no 2016-C-1779
Date 28-03-2017

Sample Condition: Undisturbed

Shear Parameters at Failure

Angle of Internal Friction	Deg.	23
Cohesion	kPa	9

Stress Path Failure Envelope





CONSOLIDATED UNDRAINED TRIAXIAL TEST

**BS 1377
Part 8**

Client Golder Associates
Sample no BH08
Lab no 6/13717

Project Tutuka Ash Increase
Depth (m) 0.5 - 1.05

Job no 2016-C-1779
Date 05-04-2017

Test Information		
Test Type	-	Consolidated Undrained with PWP measurements, saturated
Sample Condition	-	Undisturbed
Saturation Method		Increments of Cell- and Backpressure
Consolidation Pressures	kPa	125, 250, 500
Rate of Strain	%/min	0.0008
Failure Criterion	-	Maximum Deviator Stress
Side Drains Used	-	Yes
Drainage Conditions	-	To One End
Comments	-	-

Initial Sample Parameters	Unit	Test 1	Test 2	Test 3	Remarks
Moisture Content	%	45.9	36.0	46.9	Complete test specimen
Dry Density	Kg/m ³	1157	1276	1214	
Void Ratio	-	1.083	0.888	0.986	
Degree of Saturation	%	102.2	97.7	114.7	
Initial Height	cm	7.6	7.6	7.6	
Initial Diameter	cm	3.8	3.8	3.8	
Area (After Consolidation)	cm ²	10.878	10.805	10.295	Calculated
Relative Density (SG)	-		2.410		Determined

Final Sample Parameters	Unit	Test 1	Test 2	Test 3	Remarks	
Moisture Content	%	45.0	32.0	39.9	Complete test specimen	
Dry Density	Kg/m ³	1231	1371	1398		
Void Ratio	-	0.958	0.758	0.723		
Area	cm ²	12.161	12.005	11.389	Calculated	
Eff. Consolidation Pressures	kPa	117	215	451		
Total Backpressure used	kPa	170	170	120	Saturation	
Final B Parameter	-	0.97	0.98	0.98		
Cell Pressure	kPa	295	420	620	Consolidation & Shear	
Axial Strain at Max. Deviator Stress	%	3.12	4.48	4.47		
Volume Change	ml	5.2	6.0	11.4	During Consolidation	
Principal Stresses at Max. Deviator Stress	σ_1	kPa	202	365	768	Corrected
	σ_3	kPa	117	215	451	Corrected
	$\sigma_{1'}$	kPa	142	266	591	Corrected
	$\sigma_{3'}$	kPa	57	116	274	Corrected



CONSOLIDATED UNDRAINED TRIAXIAL TEST

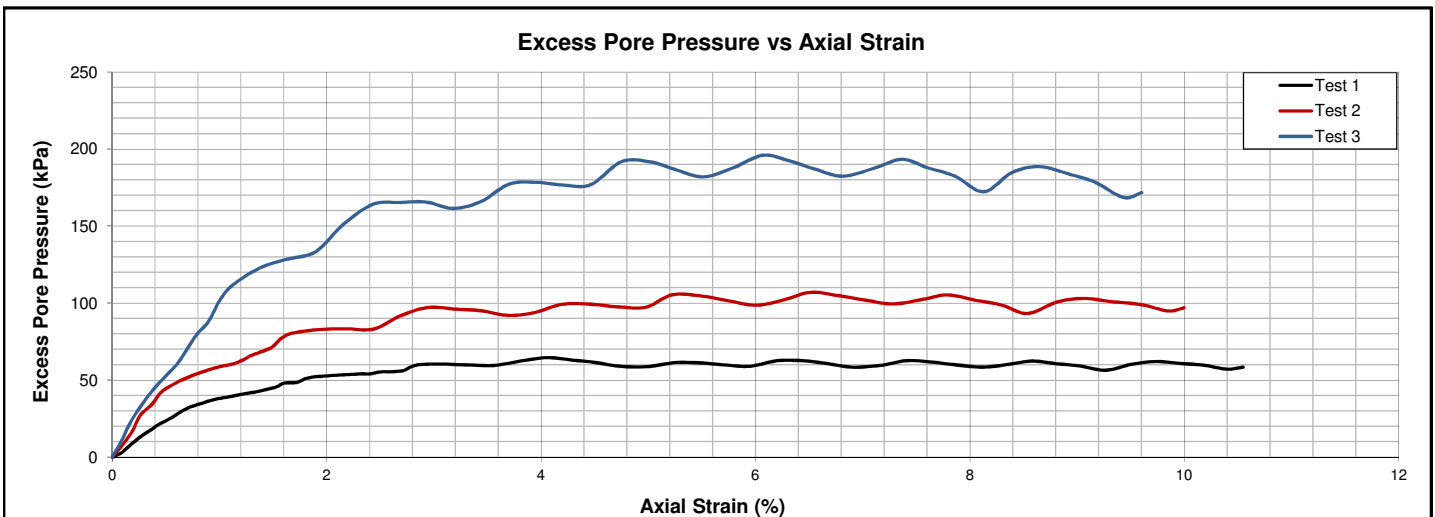
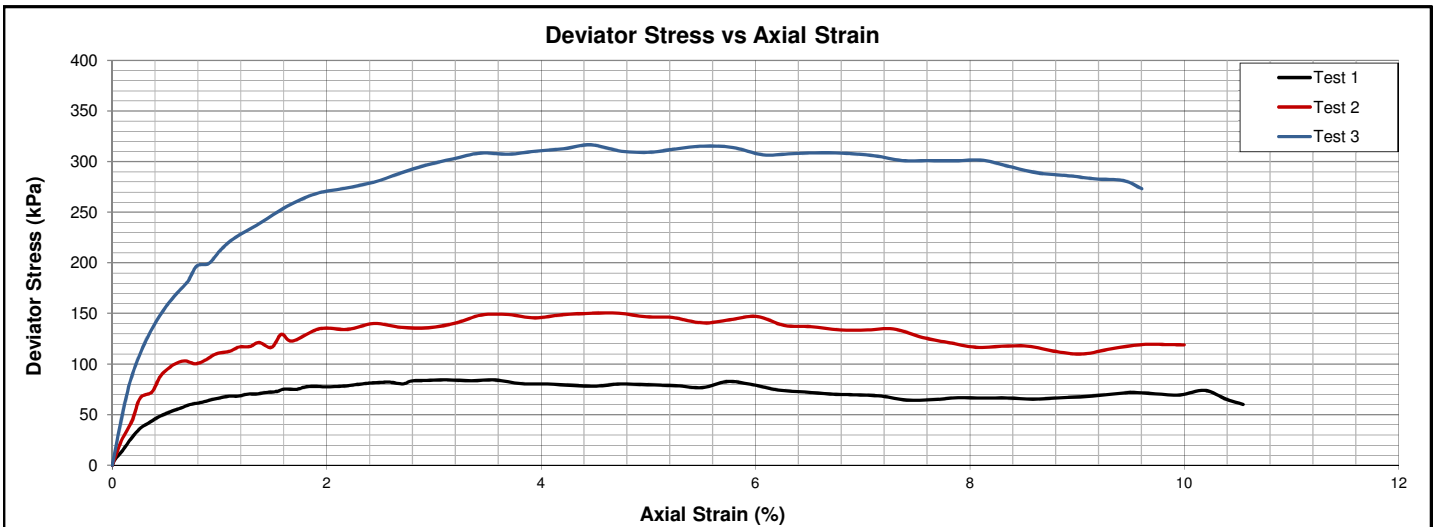
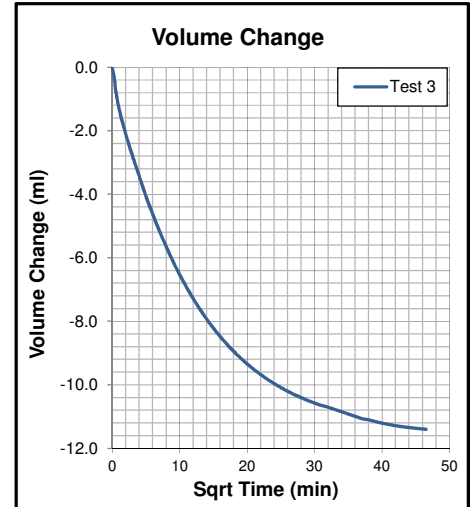
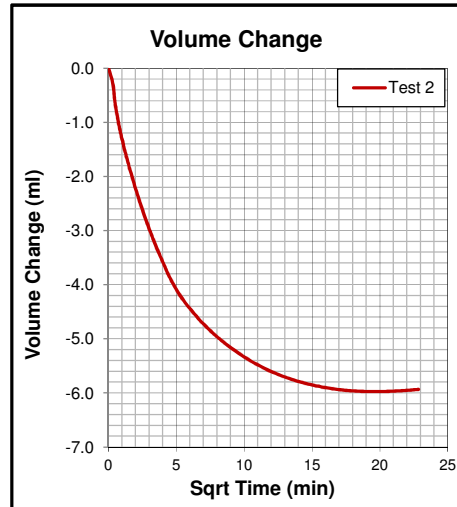
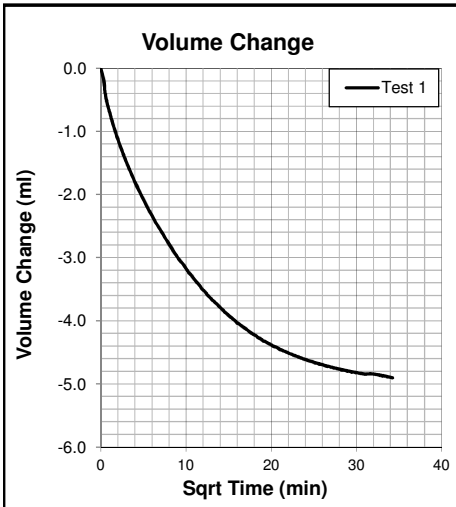
BS 1377
Part 8

Client Golder Associates
Sample no BH08
Lab no 6/13717

Project Tutuka Ash Increase
Depth (m) 0.5 - 1.05

Job no 2016-C-1779
Date 05-04-2017

Sample Condition: Undisturbed



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CONSOLIDATED UNDRAINED TRIAXIAL TEST

BS 1377
Part 8

Client Golder Associates
Sample no BH08
Lab no 6/13717

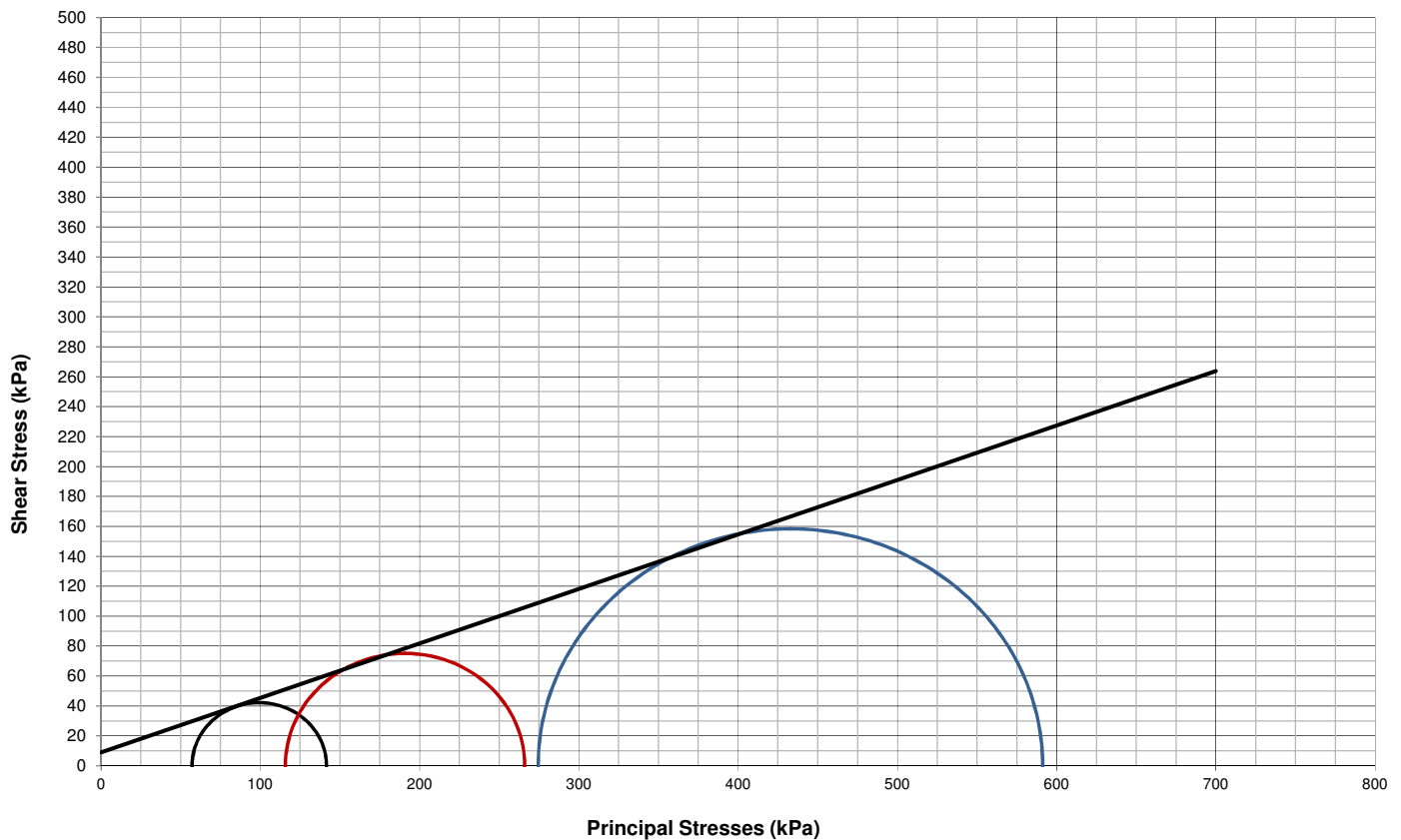
Project Tutuka Ash Increase
Depth (m) 0.5 - 1.05

Job no 2016-C-1779
Date 05-04-2017
Sample Condition: Undisturbed

Shear Parameters of Effective Stresses

Angle of Internal Friction	Deg.	20
Cohesion	kPa	9

Effective Shear Strength





CONSOLIDATED UNDRAINED TRIAXIAL TEST

BS 1377
Part 8

Client Golder Associates
Sample no BH08
Lab no 6/13717

Project Tutuka Ash Increase
Depth (m) 0.5 - 1.05

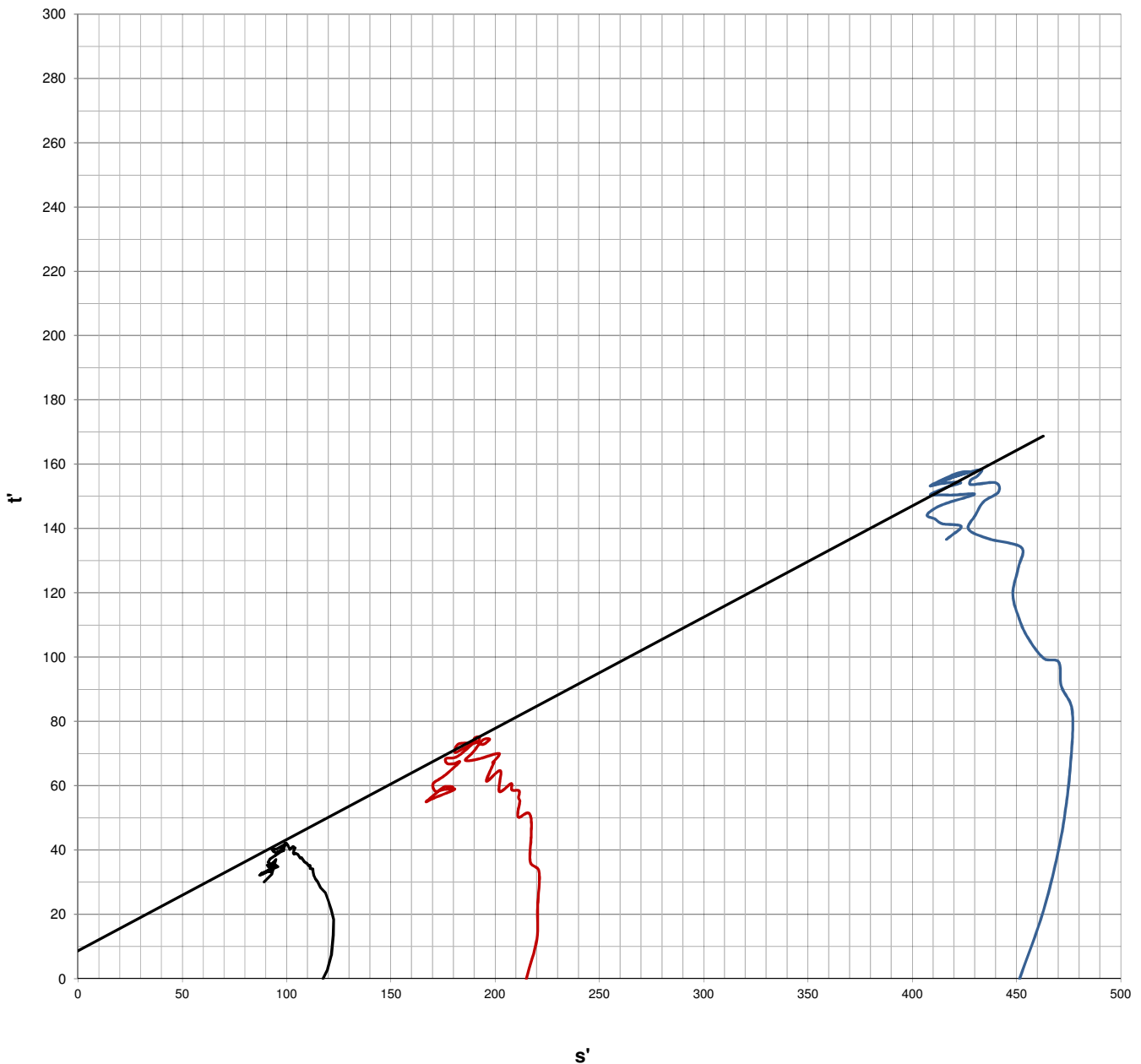
Job no 2016-C-1779
Date 05-04-2017

Sample Condition: Undisturbed

Shear Parameters at Failure

Angle of Internal Friction	Deg.	20
Cohesion	kPa	9

Stress Path Failure Envelope



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T0023

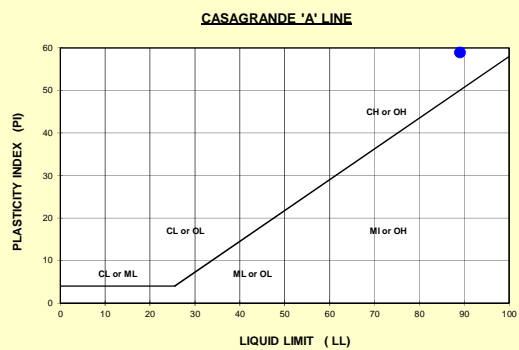
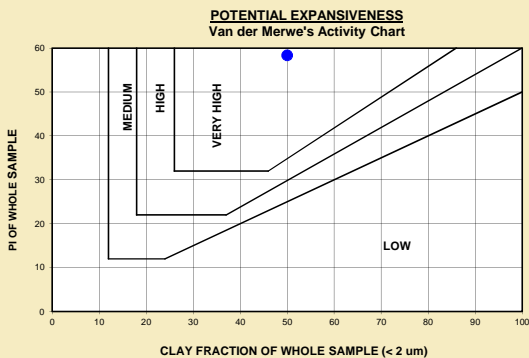
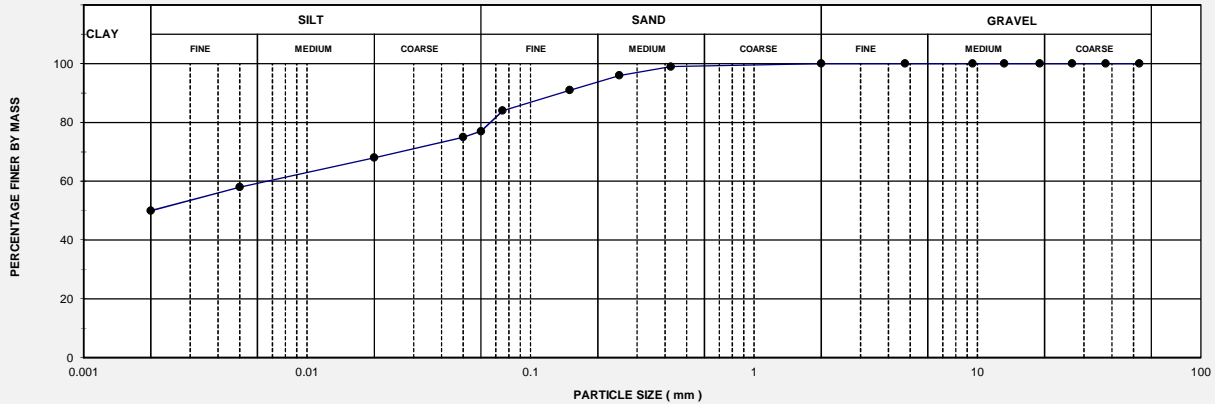


FOUNDATION INDICATOR TEST RESULTS - REP COM 7

Client: Golder Associates	Source/Location:	Job No: 2016-C-1779
Project Name: Tutuka Ash Increase	Layer:	Sample No: 6/13718
Project No: 1658666	Lane:	Date: 2017/04/04
Hole/TP No: BH 08	Stabilizing Agent:	Test Method: TMH1 A1, A5 & ASTM D422
Depth (m): 1.5 - 2.05	Section:	Client Ref No:
Description:	Chainage:	GPS X:
Additional Info:	Offset:	GPS Y:

SIEVE ANALYSIS				ATTERBERG LIMITS		SOIL CLASSIFICATION	
Sieve (mm)	% Passing	Sieve (mm)	% Passing				
75.0	100	0.425	99	Liquid Limit (%)	89	% Gravel	0
63.0	100	0.250	96	Plastic Limit (%)	30	% Sand	23
53.0	100	0.150	91	Plasticity Index (%)	59	% Silt	27
37.5	100	0.075	84	Weighted PI (%)	58.4	% Clay	50
26.5	100	0.060	77	Linear Shrinkage (%)	13.5	Activity	1.2
19.0	100	0.050	75	Grading Modulus	0.17	% Soil Mortar	100
13.2	100	0.020	68	Uniformity coefficient	4	Coarse Sand Ratio	0.01
9.5	100	0.005	58	Coefficient of curvature	0.3	TRB Classification	A - 4
4.75	100	0.002	50			Unified Classification	CH
2.00	100			Remarks:			

PARTICLE SIZE DISTRIBUTION



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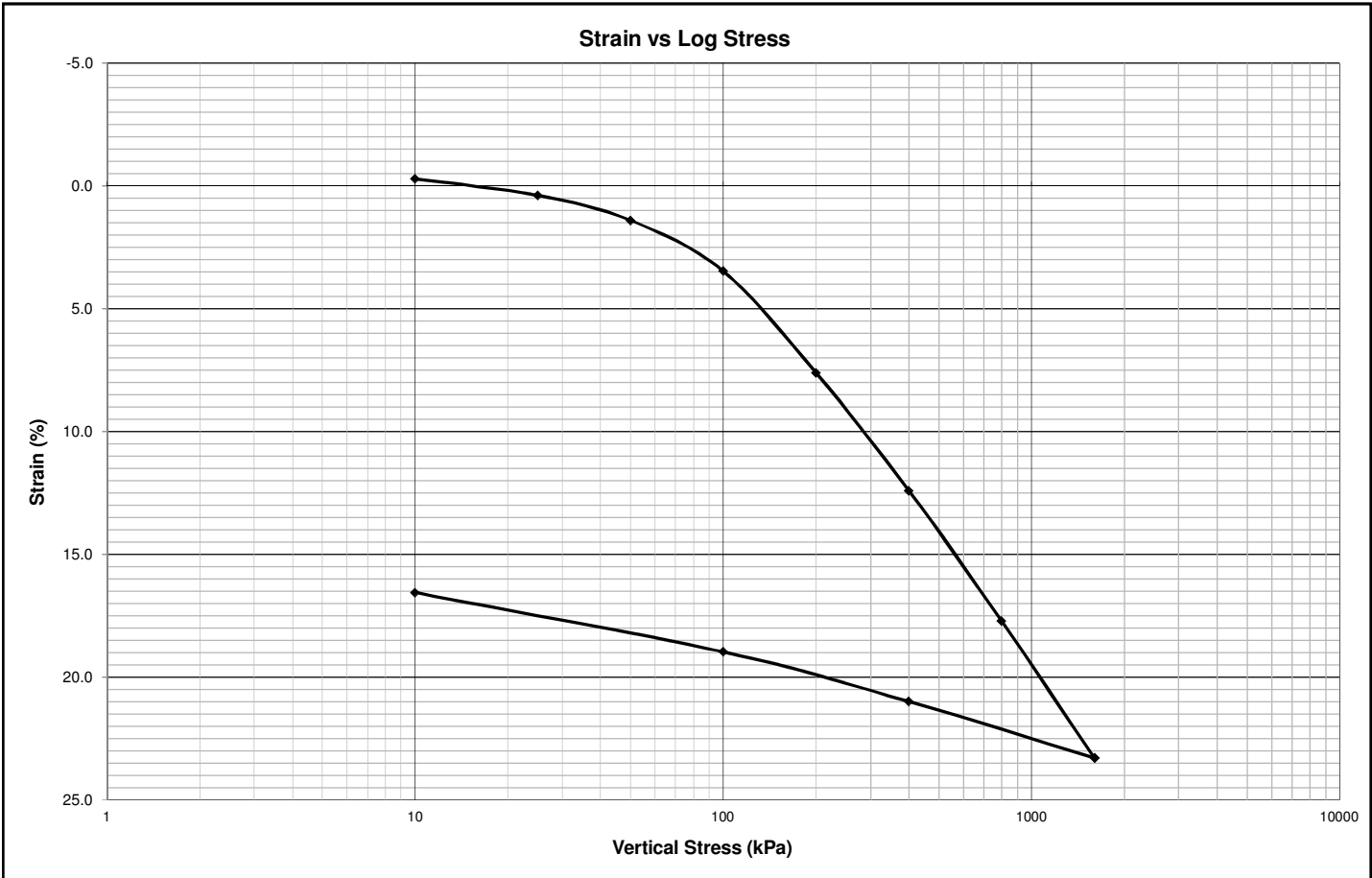
CONSOLIDATION TESTS: STANDARD OEDOMETER

**BS 1377
Part 5**

Client Golder Associates	Project Tutuka Ash Increase	Job no: 2017-C-1779
Sample no BH08	Depth (m) 1.5-2.05	Date 04-04-2017
Lab no 6/13718		

Sample Parameters	Unit	Value	Remarks	Test Remarks
Moisture Content	Before Test	46.4	Complete test specimen	Undisturbed sample
	After Test	44.5		
Dry Density	Kg/m ³	1155		
Void Ratio	-	1.133		
Degree of Saturation	%	100.9		
Initial Specimen Height	mm	25.4		
Relative Density (SG)	-	2.463	Determined	

Test Parameters														
Vertical Stress	kPa	10	25	50	100	200	400	800	1600	400	100	10		
Time Elapsed	hr	24	24	24	24	24	24	24	24	2	2	3		
H ₁₀₀	mm	25.472	25.300	25.042	24.517	23.464	22.249	20.898	19.482	20.066	20.580	21.194		
Strain	%	-0.280	0.390	1.410	3.480	7.620	12.410	17.730	23.300	21.000	18.980	16.560		
Void Ratio	-	1.139	1.124	1.103	1.059	0.970	0.868	0.755	0.636	0.685	0.728	0.779		
Mv (1/Mpa)	-	-	0.4507	0.4082	0.4191	0.4297	0.2588	0.1518	0.0847	0.025	0.0853	0.3316		



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CONSOLIDATION TESTS: STANDARD OEDOMETER

**BS 1377
Part 5**

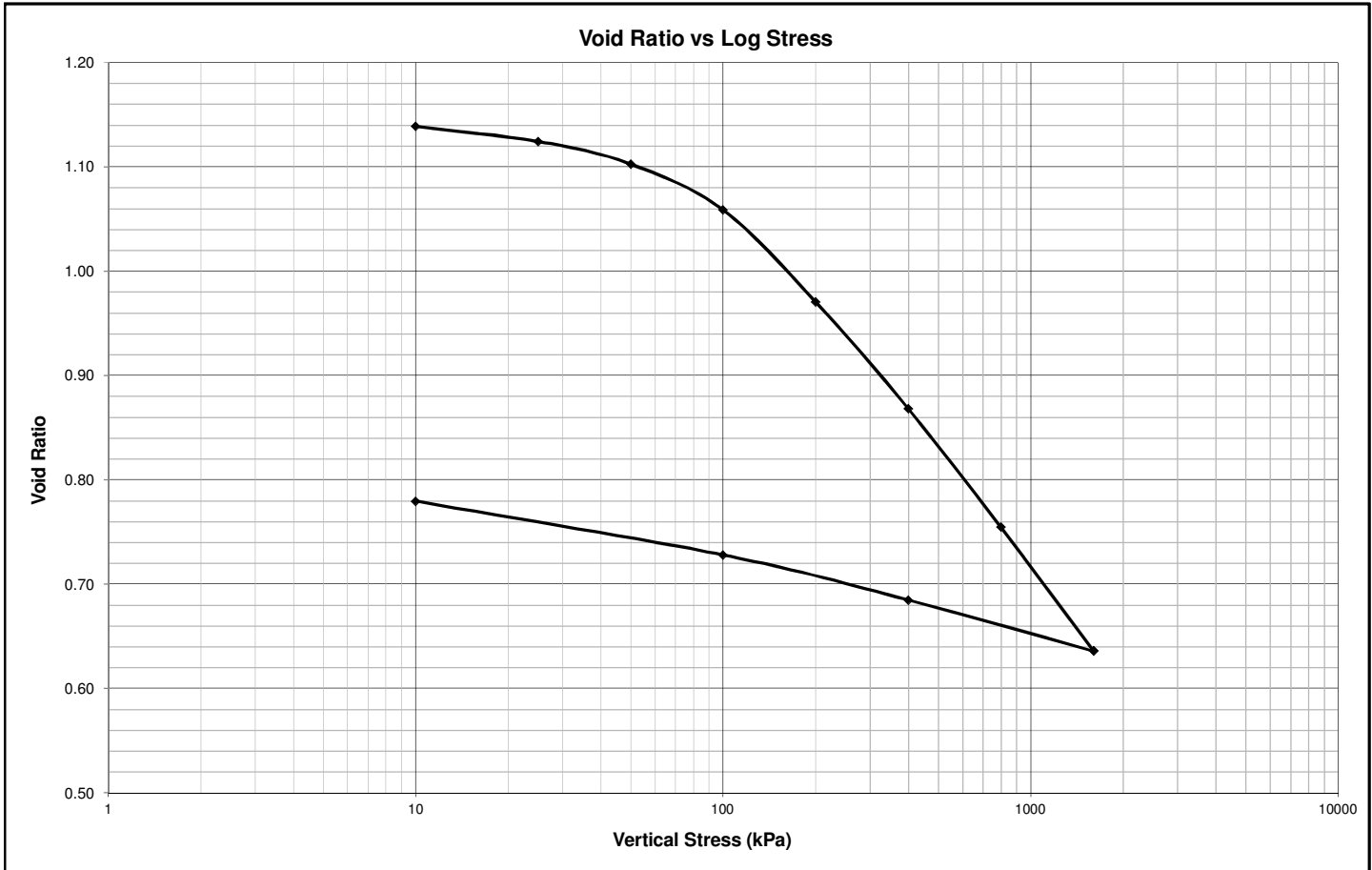
Client Golder Associates
Sample no BH08
Lab no 6/13718

Project Tutuka Ash Increase
Depth (m) 1.5-2.05

Job no: 2017-C-1779
Date 04-04-2017

Sample Parameters	Unit	Value	Remarks	Test Remarks	
Moisture Content	Before Test	%	46.4	Complete test specimen	Undisturbed sample
	After Test	%	44.5	Complete test specimen	
Dry Density	Kg/m ³	1155			
Void Ratio	-	1.133			
Degree of Saturation	%	100.9			
Initial Specimen Height	mm	25.4			
Relative Density (SG)	-	2.463	Determined		

Test Parameters														
Vertical Stress	kPa	10	25	50	100	200	400	800	1600	400	100	10		
Time Elapsed	hr	24	24	24	24	24	24	24	24	2	2	3		
H ₁₀₀	mm	25.472	25.300	25.042	24.517	23.464	22.249	20.898	19.482	20.066	20.580	21.194		
Strain	%	-0.280	0.390	1.410	3.480	7.620	12.410	17.730	23.300	21.000	18.980	16.560		
Void Ratio	-	1.139	1.124	1.103	1.059	0.970	0.868	0.755	0.636	0.685	0.728	0.779		
Mv (1/Mpa)	-	-	0.4507	0.4082	0.4191	0.4297	0.2588	0.1518	0.0847	0.025	0.0853	0.3316		



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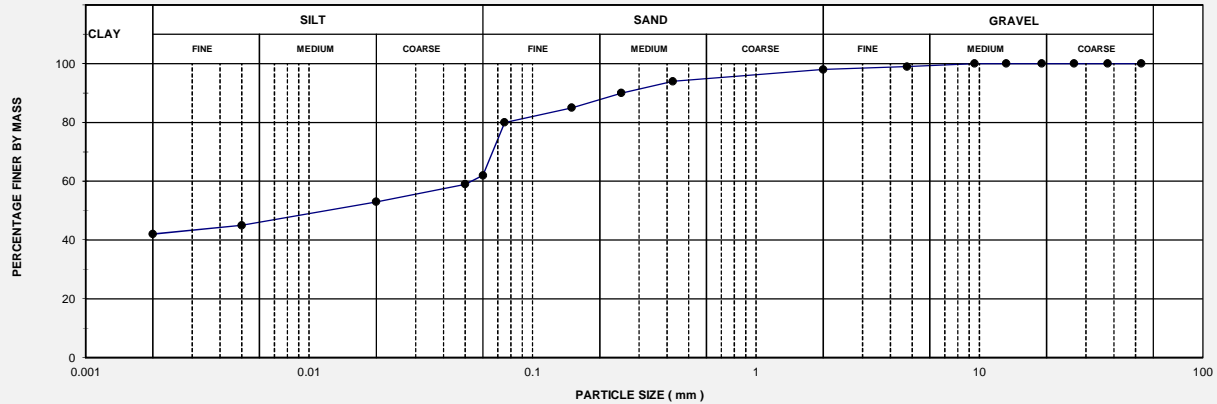


FOUNDATION INDICATOR TEST RESULTS - REP COM 7

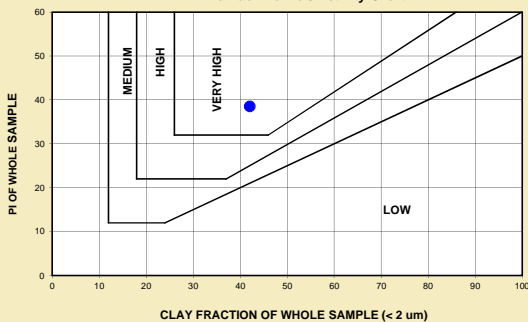
Client: Golder Associates	Source/Location:	Job No: 2016-C-1779
Project Name: Tutuka Ash Increase	Layer:	Sample No: 6/13719
Project No: 1658666	Lane:	Date: 20/01/2017
Hole/TP No: AD 49	Stabilizing Agent:	Test Method: TMH1 A1, A5 & ASTM D422
Depth (m): 0.4 - 0.6	Section:	Client Ref No:
Description:	Chainage:	GPS X:
Additional Info:	Offset:	GPS Y:

SIEVE ANALYSIS				ATTERBERG LIMITS		SOIL CLASSIFICATION	
Sieve (mm)	% Passing	Sieve (mm)	% Passing				
75.0	100	0.425	94	Liquid Limit (%)	60	% Gravel	2
63.0	100	0.250	90	Plastic Limit (%)	19	% Sand	36
53.0	100	0.150	85	Plasticity Index (%)	41	% Silt	20
37.5	100	0.075	80	Weighted PI (%)	38.5	% Clay	42
26.5	100	0.060	62	Linear Shrinkage (%)	15.0	Activity	1.0
19.0	100	0.050	59	Grading Modulus	0.28	% Soil Mortar	98
13.2	100	0.020	53	Uniformity coefficient	27	Coarse Sand Ratio	0.04
9.5	100	0.005	45	Coefficient of curvature	0.0	TRB Classification	A - 7 - 6
4.75	99	0.002	42			Unified Classification	CH
2.00	98			Remarks:			

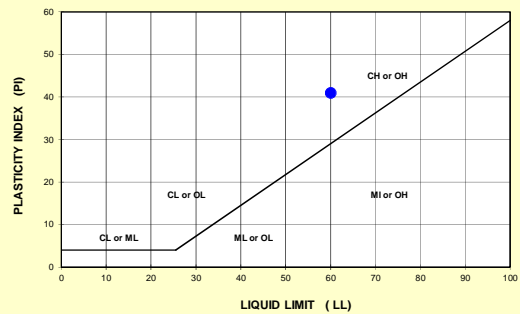
PARTICLE SIZE DISTRIBUTION



POTENTIAL EXPANSIVENESS Van der Merwe's Activity Chart



CASAGRANDE 'A' LINE



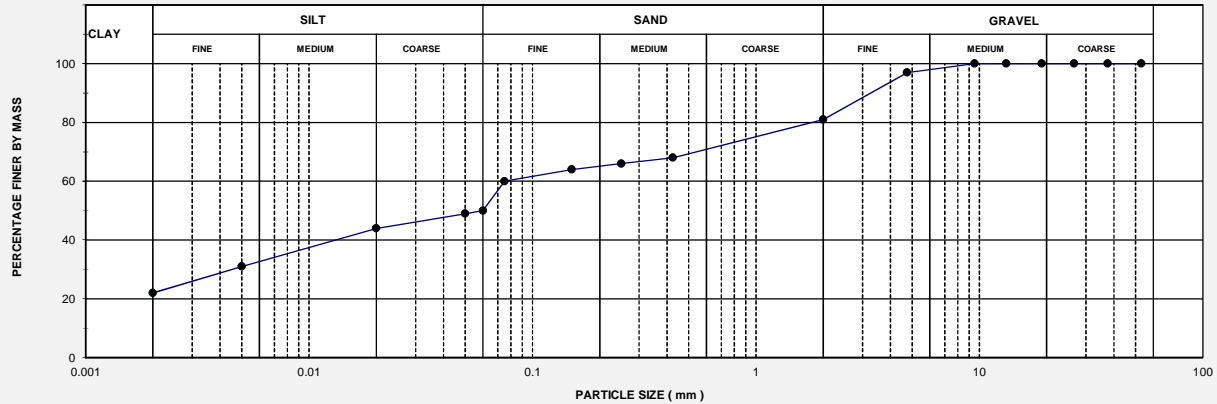


FOUNDATION INDICATOR TEST RESULTS - REP COM 7

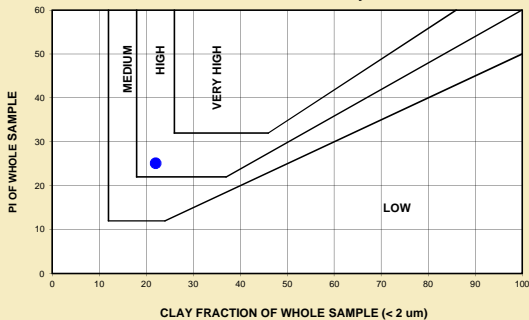
Client: Golder Associates	Source/Location:	Job No: 2016-C-1779
Project Name: Tutuka Ash Increase	Layer:	Sample No: 6/13720
Project No: 1658666	Lane:	Date: 20/01/2017
Hole/TP No: AD 03	Stabilizing Agent:	Test Method: TMH1 A1, A5 & ASTM D422
Depth (m): 1.0 - 1.1	Section:	Client Ref No:
Description:	Chainage:	GPS X:
Additional Info:	Offset:	GPS Y:

SIEVE ANALYSIS				ATTERBERG LIMITS		SOIL CLASSIFICATION	
Sieve (mm)	% Passing	Sieve (mm)	% Passing				
75.0	100	0.425	68	Liquid Limit (%)	60	% Gravel	19
63.0	100	0.250	66	Plastic Limit (%)	23	% Sand	31
53.0	100	0.150	64	Plasticity Index (%)	37	% Silt	28
37.5	100	0.075	60	Weighted PI (%)	25.2	% Clay	22
26.5	100	0.060	50	Linear Shrinkage (%)	14.5	Activity	1.7
19.0	100	0.050	49	Grading Modulus	0.91	% Soil Mortar	81
13.2	100	0.020	44	Uniformity coefficient	38	Coarse Sand Ratio	0.16
9.5	100	0.005	31	Coefficient of curvature	0.1	TRB Classification	A - 7 - 6
4.75	97	0.002	22			Unified Classification	CH
2.00	81			Remarks:			

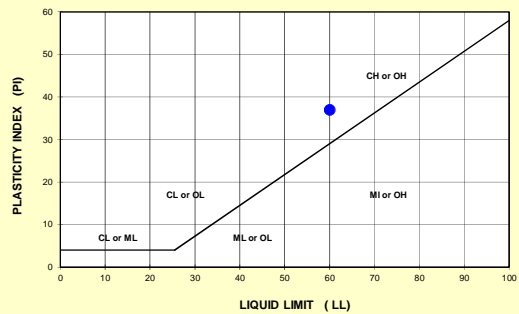
PARTICLE SIZE DISTRIBUTION



POTENTIAL EXPANSIVENESS Van der Merwe's Activity Chart



CASAGRANDE 'A' LINE





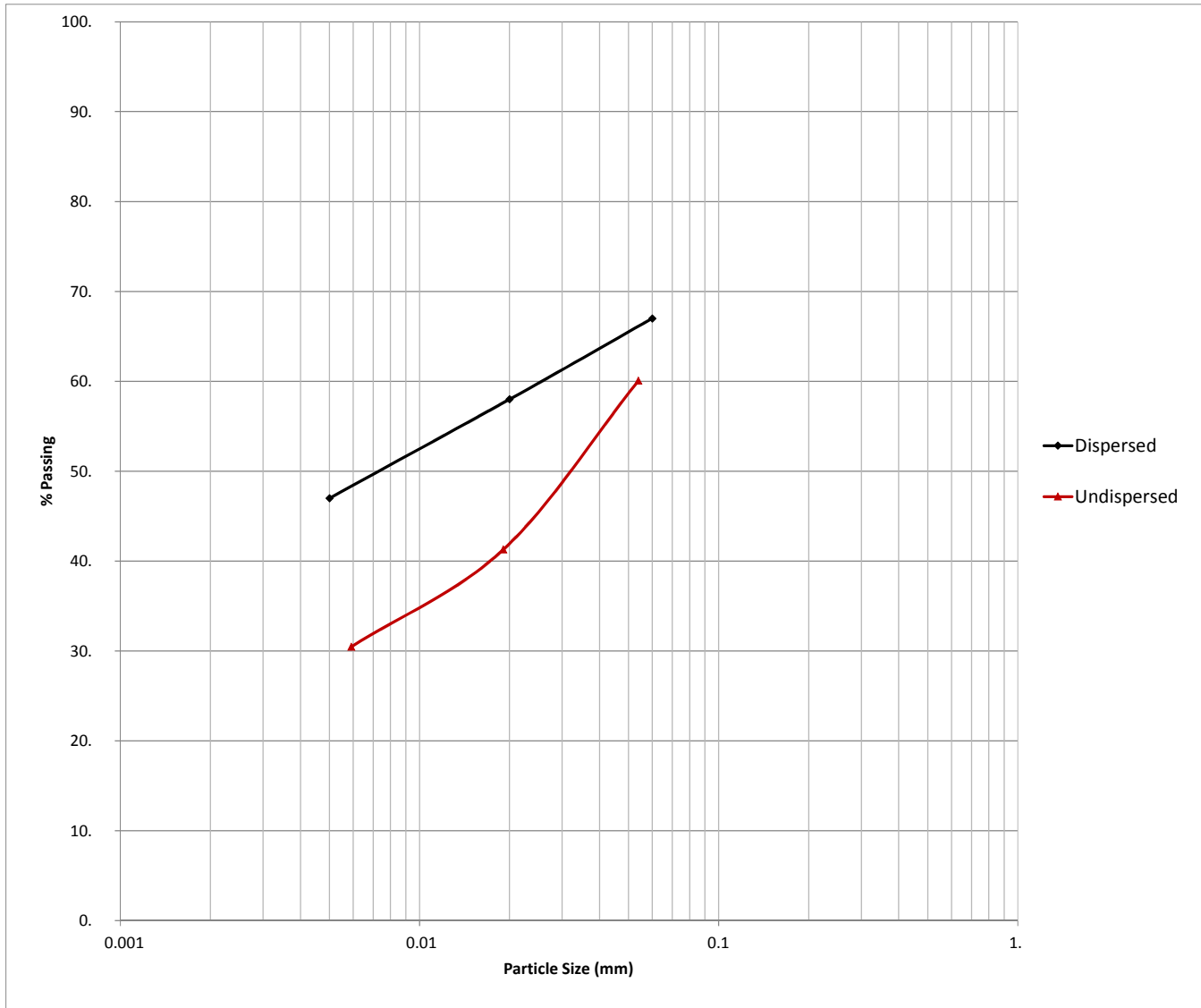
Double Hydrometer Test Result

ASTM
D4221

Client Golder Associates
Sample no AD39
Lab no 6/13721

Project Tutuka Ash Increase
Depth (m) 0.8 - 0.9

Job no 2016-C-1779
Date 02/02/2017



Dispersion:

65%



T0023

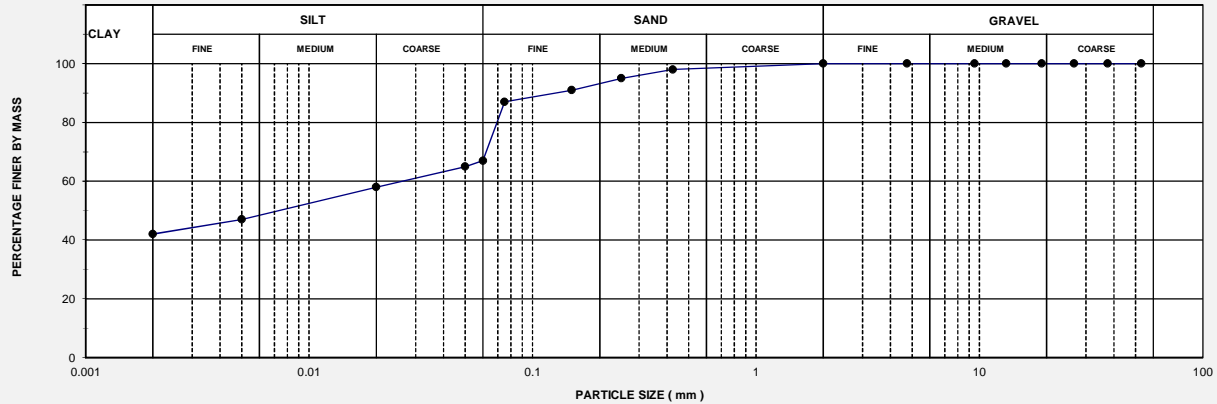


FOUNDATION INDICATOR TEST RESULTS - REP COM 7

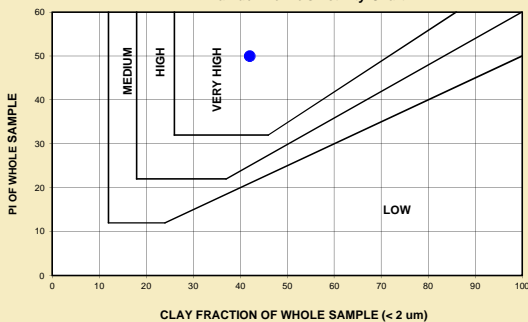
Client: Golder Associates	Source/Location:	Job No: 2016-C-1779
Project Name: Tutuka Ash Increase	Layer:	Sample No: 6/13721
Project No: 1658666	Lane:	Date: 20/01/2017
Hole/TP No: AD 39	Stabilizing Agent:	Test Method: TMH1 A1, A5 & ASTM D422
Depth (m): 0.8 - 0.9	Section:	Client Ref No:
Description:	Chainage:	GPS X:
Additional Info:	Offset:	GPS Y:

SIEVE ANALYSIS				ATTERBERG LIMITS		SOIL CLASSIFICATION	
Sieve (mm)	% Passing	Sieve (mm)	% Passing				
75.0	100	0.425	98	Liquid Limit (%)	74	% Gravel	0
63.0	100	0.250	95	Plastic Limit (%)	23	% Sand	33
53.0	100	0.150	91	Plasticity Index (%)	51	% Silt	25
37.5	100	0.075	87	Weighted PI (%)	50.0	% Clay	42
26.5	100	0.060	67	Linear Shrinkage (%)	12.5	Activity	1.2
19.0	100	0.050	65	Grading Modulus	0.15	% Soil Mortar	100
13.2	100	0.020	58	Uniformity coefficient	14	Coarse Sand Ratio	0.02
9.5	100	0.005	47	Coefficient of curvature	0.1	TRB Classification	A - 7 - 6
4.75	100	0.002	42			Unified Classification	CH
2.00	100			Remarks:			

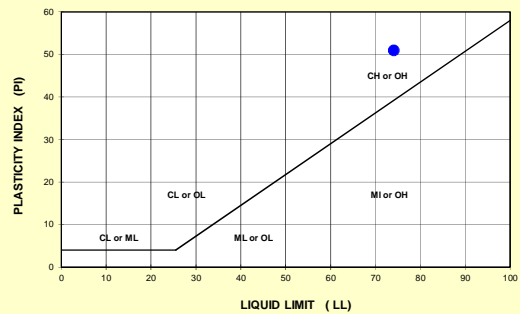
PARTICLE SIZE DISTRIBUTION



POTENTIAL EXPANSIVENESS Van der Merwe's Activity Chart



CASAGRANDE 'A' LINE



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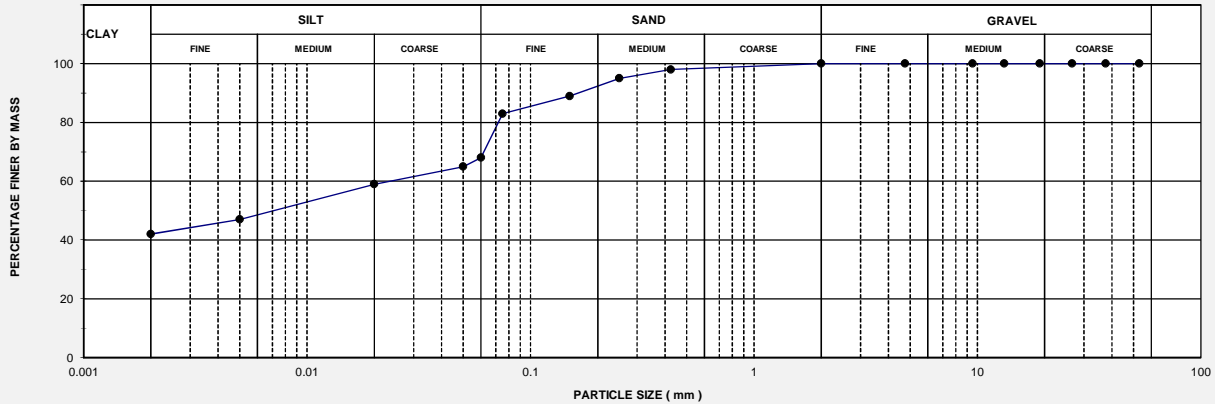


FOUNDATION INDICATOR TEST RESULTS - REP COM 7

Client: Golder Associates	Source/Location:	Job No: 2016-C-1779
Project Name: Tutuka Ash Increase	Layer:	Sample No: 6/13722
Project No: 1658666	Lane:	Date: 20/01/2017
Hole/TP No: AD 01	Stabilizing Agent:	Test Method: TMH1 A1, A5 & ASTM D422
Depth (m): 0.3 - 0.5	Section:	Client Ref No:
Description:	Chainage:	GPS X:
Additional Info:	Offset:	GPS Y:

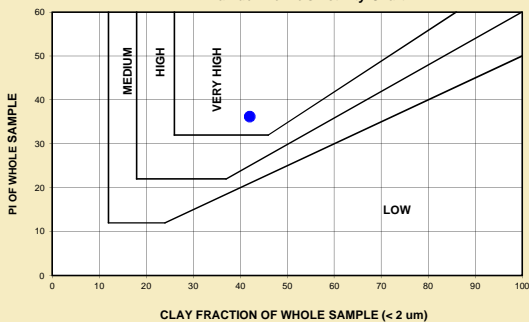
SIEVE ANALYSIS				ATTERBERG LIMITS		SOIL CLASSIFICATION	
Sieve (mm)	% Passing	Sieve (mm)	% Passing				
75.0	100	0.425	98	Liquid Limit (%)	59	% Gravel	0
63.0	100	0.250	95	Plastic Limit (%)	22	% Sand	32
53.0	100	0.150	89	Plasticity Index (%)	37	% Silt	26
37.5	100	0.075	83	Weighted PI (%)	36.3	% Clay	42
26.5	100	0.060	68	Linear Shrinkage (%)	10.5	Activity	0.9
19.0	100	0.050	65	Grading Modulus	0.19	% Soil Mortar	100
13.2	100	0.020	59	Uniformity coefficient	13	Coarse Sand Ratio	0.02
9.5	100	0.005	47	Coefficient of curvature	0.1	TRB Classification	A - 7 - 6
4.75	100	0.002	42			Unified Classification	CH
2.00	100			Remarks:			

PARTICLE SIZE DISTRIBUTION

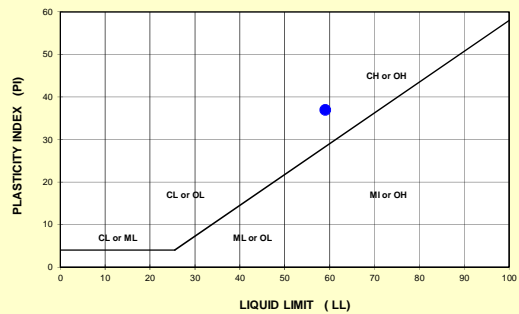


POTENTIAL EXPANSIVENESS

Van der Merwe's Activity Chart



CASAGRANDE 'A' LINE



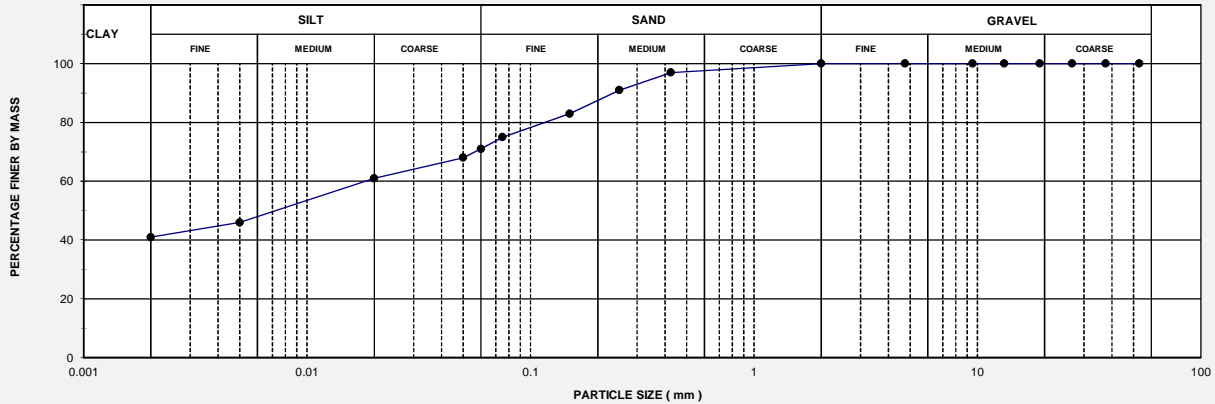


FOUNDATION INDICATOR TEST RESULTS - REP COM 7

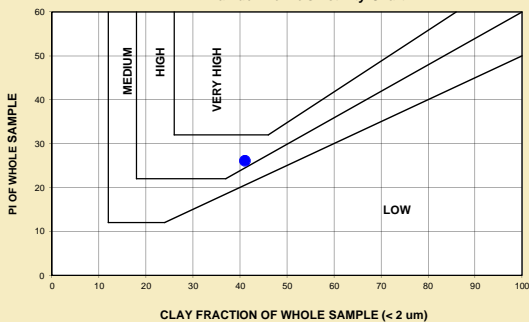
Client: Golder Associates	Source/Location:	Job No: 2016-C-1779
Project Name: Tutuka Ash Increase	Layer:	Sample No: 6/13723
Project No: 1658666	Lane:	Date: 20/01/2017
Hole/TP No: AD 22	Stabilizing Agent:	Test Method: TMH1 A1, A5 & ASTM D422
Depth (m): 0.4 - 0.6	Section:	Client Ref No:
Description:	Chainage:	GPS X:
Additional Info:	Offset:	GPS Y:

SIEVE ANALYSIS				ATTERBERG LIMITS		SOIL CLASSIFICATION	
Sieve (mm)	% Passing	Sieve (mm)	% Passing				
75.0	100	0.425	97	Liquid Limit (%)	49	% Gravel	0
63.0	100	0.250	91	Plastic Limit (%)	22	% Sand	29
53.0	100	0.150	83	Plasticity Index (%)	27	% Silt	30
37.5	100	0.075	75	Weighted PI (%)	26.2	% Clay	41
26.5	100	0.060	71	Linear Shrinkage (%)	9.5	Activity	0.7
19.0	100	0.050	68	Grading Modulus	0.28	% Soil Mortar	100
13.2	100	0.020	61	Uniformity coefficient	10	Coarse Sand Ratio	0.03
9.5	100	0.005	46	Coefficient of curvature	0.1	TRB Classification	A - 7 - 6
4.75	100	0.002	41			Unified Classification	CL
2.00	100			Remarks:			

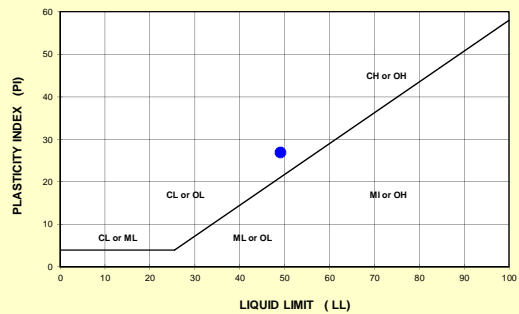
PARTICLE SIZE DISTRIBUTION



POTENTIAL EXPANSIVENESS Van der Merwe's Activity Chart



CASAGRANDE 'A' LINE





T0023

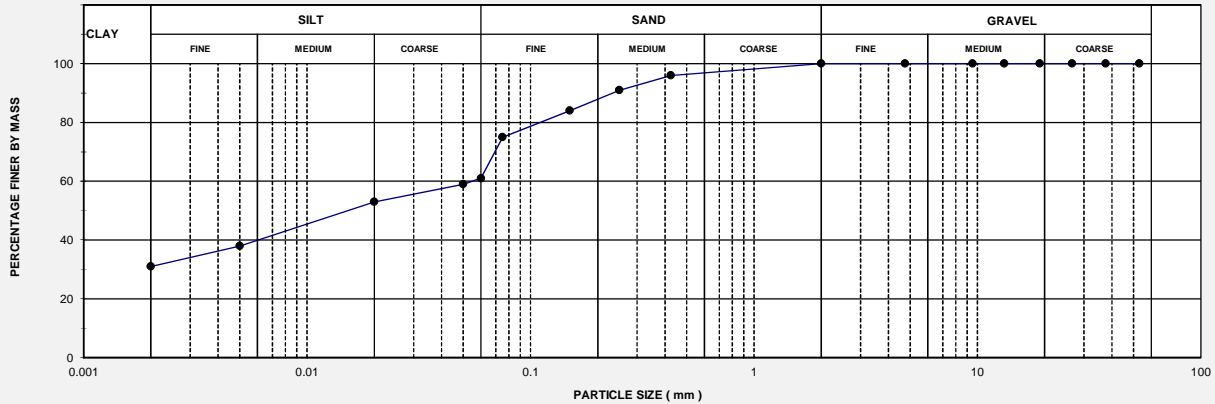


FOUNDATION INDICATOR TEST RESULTS - REP COM 7

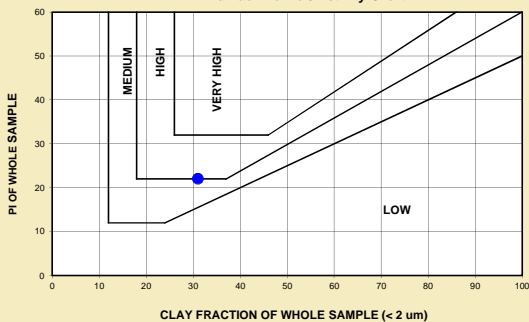
Client: Golder Associates	Source/Location:	Job No: 2016-C-1779
Project Name: Tutuka Ash Increase	Layer:	Sample No: 6/13724
Project No: 1658666	Lane:	Date: 20/01/2017
Hole/TP No: AD 40	Stabilizing Agent:	Test Method: TMH1 A1, A5 & ASTM D422
Depth (m): 0.3 - 0.5	Section:	Client Ref No:
Description:	Chainage:	GPS X:
Additional Info:	Offset:	GPS Y:

SIEVE ANALYSIS				ATTERBERG LIMITS		SOIL CLASSIFICATION	
Sieve (mm)	% Passing	Sieve (mm)	% Passing				
75.0	100	0.425	96	Liquid Limit (%)	41	% Gravel	0
63.0	100	0.250	91	Plastic Limit (%)	18	% Sand	39
53.0	100	0.150	84	Plasticity Index (%)	23	% Silt	30
37.5	100	0.075	75	Weighted PI (%)	22.1	% Clay	31
26.5	100	0.060	61	Linear Shrinkage (%)	11.5	Activity	0.7
19.0	100	0.050	59	Grading Modulus	0.29	% Soil Mortar	100
13.2	100	0.020	53	Uniformity coefficient	28	Coarse Sand Ratio	0.04
9.5	100	0.005	38	Coefficient of curvature	0.0	TRB Classification	A - 7 - 6
4.75	100	0.002	31			Unified Classification	CL
2.00	100			Remarks:			

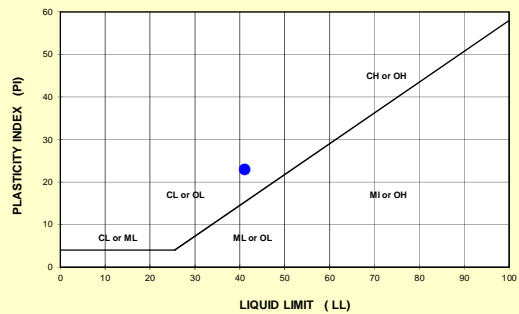
PARTICLE SIZE DISTRIBUTION



POTENTIAL EXPANSIVENESS Van der Merwe's Activity Chart



CASAGRANDE 'A' LINE



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T0023

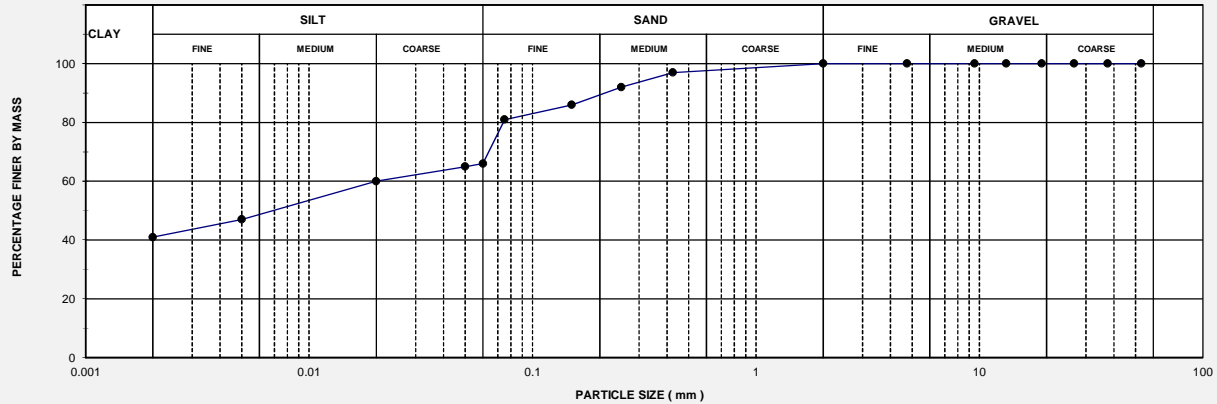


FOUNDATION INDICATOR TEST RESULTS - REP COM 7

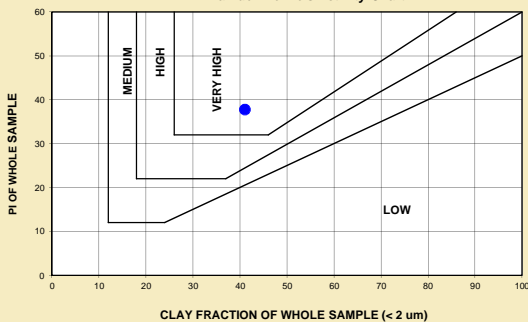
Client: Golder Associates	Source/Location:	Job No: 2016-C-1779
Project Name: Tutuka Ash Increase	Layer:	Sample No: 6/13725
Project No: 1658666	Lane:	Date: 20/01/2017
Hole/TP No: AD 43	Stabilizing Agent:	Test Method: TMH1 A1, A5 & ASTM D422
Depth (m): 0.6 - 0.8	Section:	Client Ref No:
Description:	Chainage:	GPS X:
Additional Info:	Offset:	GPS Y:

SIEVE ANALYSIS				ATTERBERG LIMITS		SOIL CLASSIFICATION	
Sieve (mm)	% Passing	Sieve (mm)	% Passing				
75.0	100	0.425	97	Liquid Limit (%)	59	% Gravel	0
63.0	100	0.250	92	Plastic Limit (%)	20	% Sand	34
53.0	100	0.150	86	Plasticity Index (%)	39	% Silt	25
37.5	100	0.075	81	Weighted PI (%)	37.8	% Clay	41
26.5	100	0.060	66	Linear Shrinkage (%)	11.5	Activity	1.0
19.0	100	0.050	65	Grading Modulus	0.22	% Soil Mortar	100
13.2	100	0.020	60	Uniformity coefficient	10	Coarse Sand Ratio	0.03
9.5	100	0.005	47	Coefficient of curvature	0.1	TRB Classification	A - 7 - 6
4.75	100	0.002	41			Unified Classification	CH
2.00	100			Remarks:			

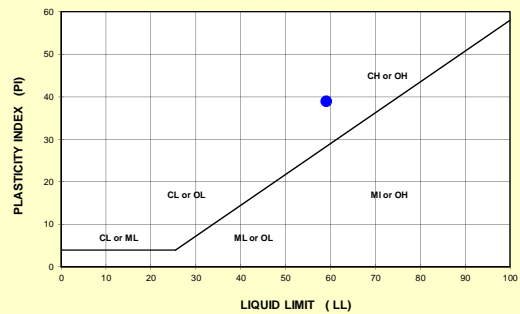
PARTICLE SIZE DISTRIBUTION



POTENTIAL EXPANSIVENESS Van der Merwe's Activity Chart



CASAGRANDE 'A' LINE



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T0023

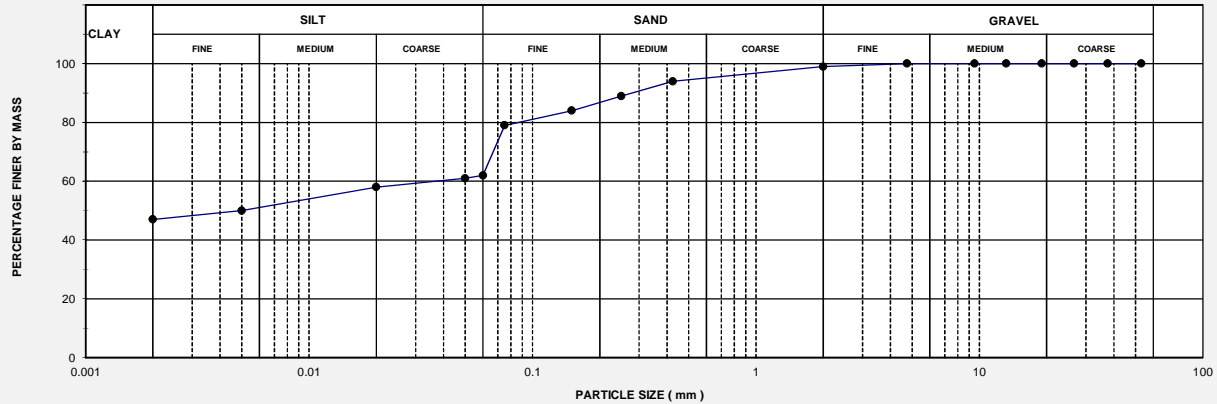


FOUNDATION INDICATOR TEST RESULTS - REP COM 7

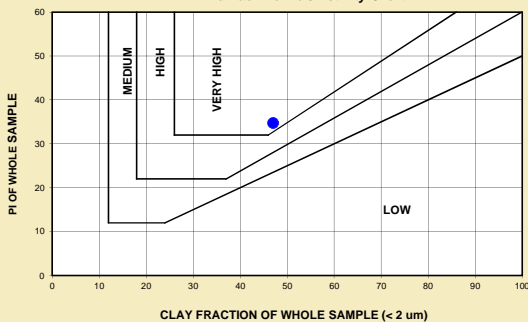
Client: Golder Associates	Source/Location:	Job No: 2016-C-1779
Project Name: Tutuka Ash Increase	Layer:	Sample No: 6/13726
Project No: 1658666	Lane:	Date: 17/02/2017
Hole/TP No: AD 63	Stabilizing Agent:	Test Method: TMH1 A1, A5 & ASTM D422
Depth (m): 1.7 - 1.8	Section:	Client Ref No:
Description:	Chainage:	GPS X:
Additional Info:	Offset:	GPS Y:

SIEVE ANALYSIS				ATTERBERG LIMITS		SOIL CLASSIFICATION	
Sieve (mm)	% Passing	Sieve (mm)	% Passing				
75.0	100	0.425	94	Liquid Limit (%)	60	% Gravel	1
63.0	100	0.250	89	Plastic Limit (%)	23	% Sand	37
53.0	100	0.150	84	Plasticity Index (%)	37	% Silt	15
37.5	100	0.075	79	Weighted PI (%)	34.8	% Clay	47
26.5	100	0.060	62	Linear Shrinkage (%)	12.0	Activity	0.8
19.0	100	0.050	61	Grading Modulus	0.28	% Soil Mortar	99
13.2	100	0.020	58	Uniformity coefficient	20	Coarse Sand Ratio	0.05
9.5	100	0.005	50	Coefficient of curvature	0.1	TRB Classification	A - 7 - 6
4.75	100	0.002	47			Unified Classification	CH
2.00	99			Remarks:			

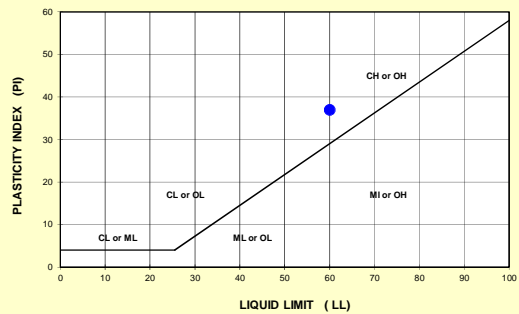
PARTICLE SIZE DISTRIBUTION



POTENTIAL EXPANSIVENESS
Van der Merwe's Activity Chart



CASAGRANDE 'A' LINE



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T0023

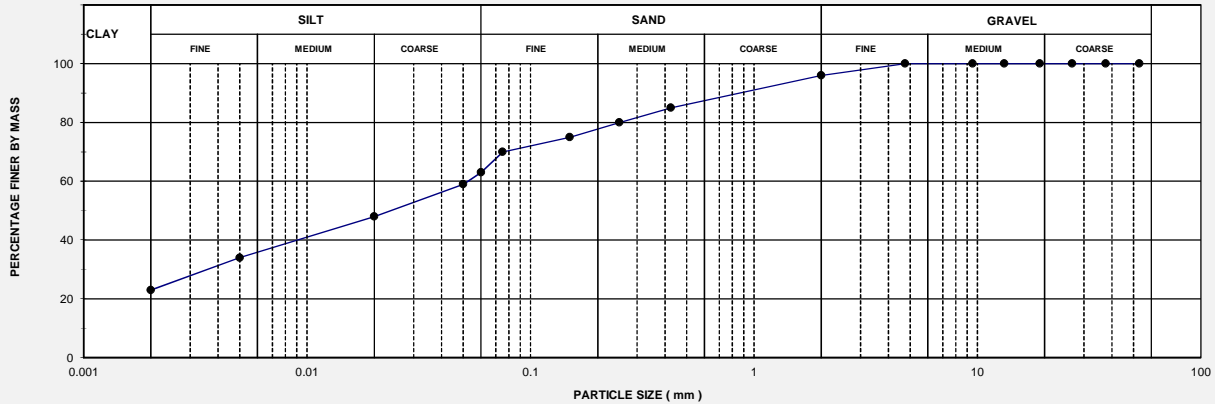


FOUNDATION INDICATOR TEST RESULTS - REP COM 7

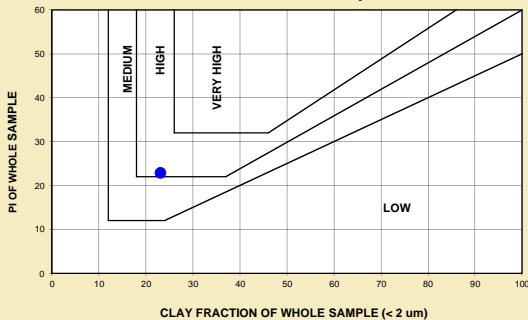
Client: Golder Associates	Source/Location:	Job No: 2016-C-1779
Project Name: Tutuka Ash Increase	Layer:	Sample No: 6/13727
Project No: 1658666	Lane:	Date: 20/01/2017
Hole/TP No: AD 26	Stabilizing Agent:	Test Method: TMH1 A1, A5 & ASTM D422
Depth (m): 0.0 - 0.2	Section:	Client Ref No:
Description:	Chainage:	GPS X:
Additional Info:	Offset:	GPS Y:

SIEVE ANALYSIS				ATTERBERG LIMITS		SOIL CLASSIFICATION	
Sieve (mm)	% Passing	Sieve (mm)	% Passing				
75.0	100	0.425	85	Liquid Limit (%)	48	% Gravel	4
63.0	100	0.250	80	Plastic Limit (%)	21	% Sand	33
53.0	100	0.150	75	Plasticity Index (%)	27	% Silt	40
37.5	100	0.075	70	Weighted PI (%)	23.0	% Clay	23
26.5	100	0.060	63	Linear Shrinkage (%)	12.5	Activity	1.2
19.0	100	0.050	59	Grading Modulus	0.49	% Soil Mortar	96
13.2	100	0.020	48	Uniformity coefficient	26	Coarse Sand Ratio	0.11
9.5	100	0.005	34	Coefficient of curvature	0.1	TRB Classification	A - 7 - 6
4.75	100	0.002	23			Unified Classification	CL
2.00	96			Remarks:			

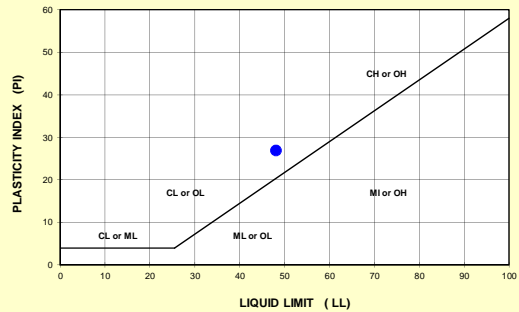
PARTICLE SIZE DISTRIBUTION



POTENTIAL EXPANSIVENESS Van der Merwe's Activity Chart



CASAGRANDE 'A' LINE



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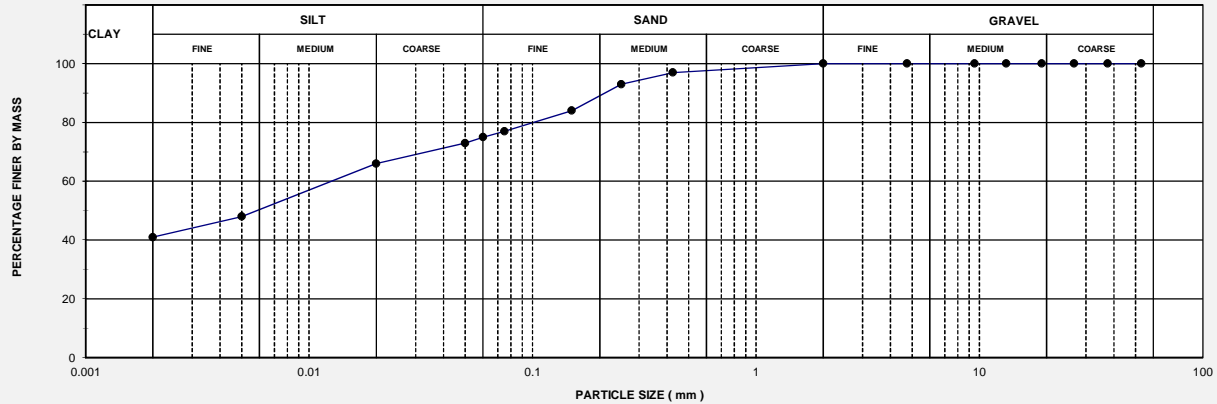


FOUNDATION INDICATOR TEST RESULTS - REP COM 7

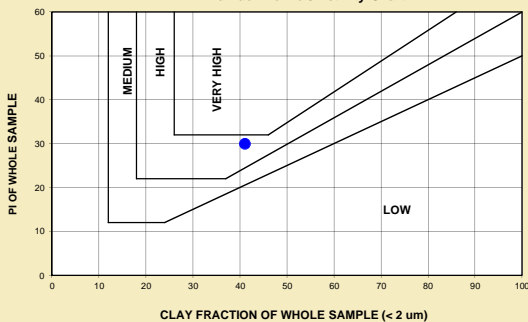
Client: Golder Associates	Source/Location:	Job No: 2016-C-1779
Project Name: Tutuka Ash Increase	Layer:	Sample No: 6/13728
Project No: 1658666	Lane:	Date: 20/01/2017
Hole/TP No: AD 23	Stabilizing Agent:	Test Method: TMH1 A1, A5 & ASTM D422
Depth (m): 0.2 - 0.5	Section:	Client Ref No:
Description:	Chainage:	GPS X:
Additional Info:	Offset:	GPS Y:

SIEVE ANALYSIS				ATTERBERG LIMITS		SOIL CLASSIFICATION	
Sieve (mm)	% Passing	Sieve (mm)	% Passing				
75.0	100	0.425	97	Liquid Limit (%)	50	% Gravel	0
63.0	100	0.250	93	Plastic Limit (%)	19	% Sand	25
53.0	100	0.150	84	Plasticity Index (%)	31	% Silt	34
37.5	100	0.075	77	Weighted PI (%)	30.1	% Clay	41
26.5	100	0.060	75	Linear Shrinkage (%)	9.5	Activity	0.8
19.0	100	0.050	73	Grading Modulus	0.26	% Soil Mortar	100
13.2	100	0.020	66	Uniformity coefficient	8	Coarse Sand Ratio	0.03
9.5	100	0.005	48	Coefficient of curvature	0.1	TRB Classification	A - 7 - 6
4.75	100	0.002	41			Unified Classification	CL
2.00	100			Remarks:			

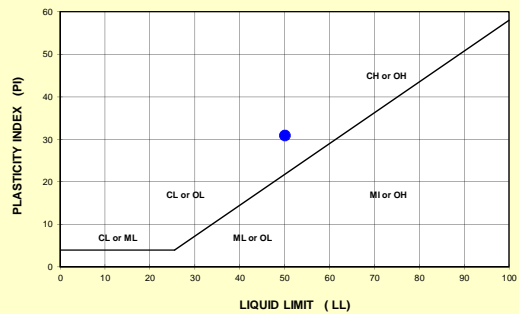
PARTICLE SIZE DISTRIBUTION



POTENTIAL EXPANSIVENESS Van der Merwe's Activity Chart



CASAGRANDE 'A' LINE



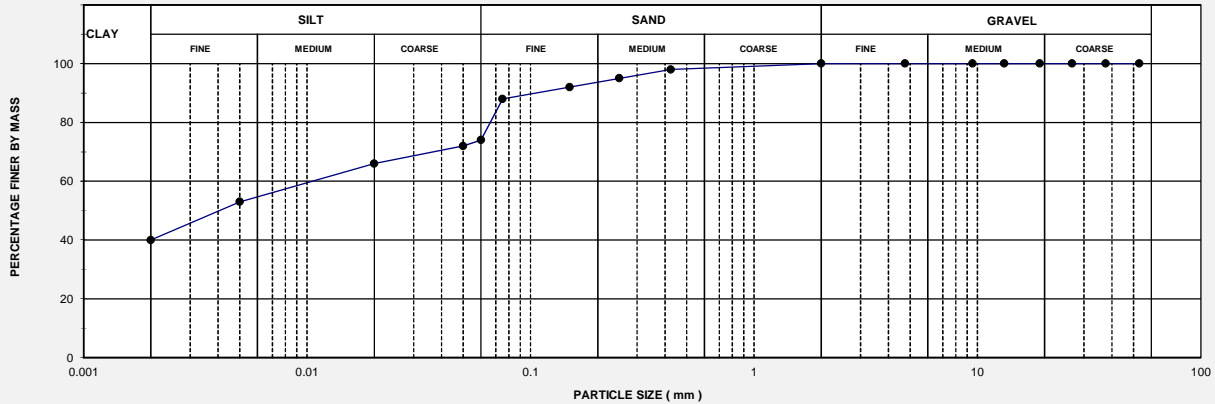


FOUNDATION INDICATOR TEST RESULTS - REP COM 7

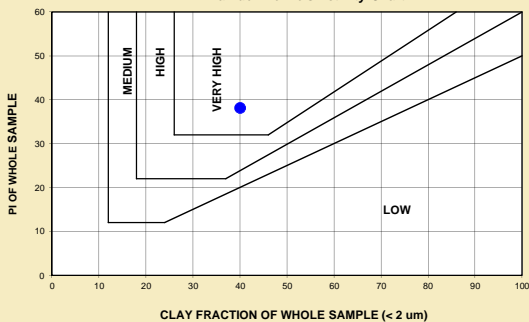
Client: Golder Associates	Source/Location:	Job No: 2016-C-1779
Project Name: Tutuka Ash Increase	Layer:	Sample No: 6/13729
Project No: 1658666	Lane:	Date: 20/01/2017
Hole/TP No: AD 14	Stabilizing Agent:	Test Method: TMH1 A1, A5 & ASTM D422
Depth (m): 1.0 - 1.2	Section:	Client Ref No:
Description:	Chainage:	GPS X:
Additional Info:	Offset:	GPS Y:

SIEVE ANALYSIS				ATTERBERG LIMITS		SOIL CLASSIFICATION	
Sieve (mm)	% Passing	Sieve (mm)	% Passing				
75.0	100	0.425	98	Liquid Limit (%)	60	% Gravel	0
63.0	100	0.250	95	Plastic Limit (%)	21	% Sand	26
53.0	100	0.150	92	Plasticity Index (%)	39	% Silt	34
37.5	100	0.075	88	Weighted PI (%)	38.2	% Clay	40
26.5	100	0.060	74	Linear Shrinkage (%)	6.5	Activity	1.0
19.0	100	0.050	72	Grading Modulus	0.14	% Soil Mortar	100
13.2	100	0.020	66	Uniformity coefficient	7	Coarse Sand Ratio	0.02
9.5	100	0.005	53	Coefficient of curvature	0.2	TRB Classification	A - 7 - 6
4.75	100	0.002	40			Unified Classification	CH
2.00	100			Remarks:			

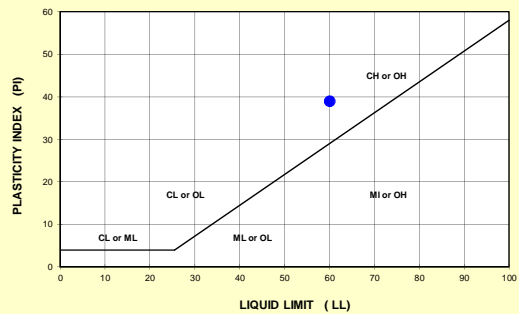
PARTICLE SIZE DISTRIBUTION



POTENTIAL EXPANSIVENESS Van der Merwe's Activity Chart



CASAGRANDE 'A' LINE



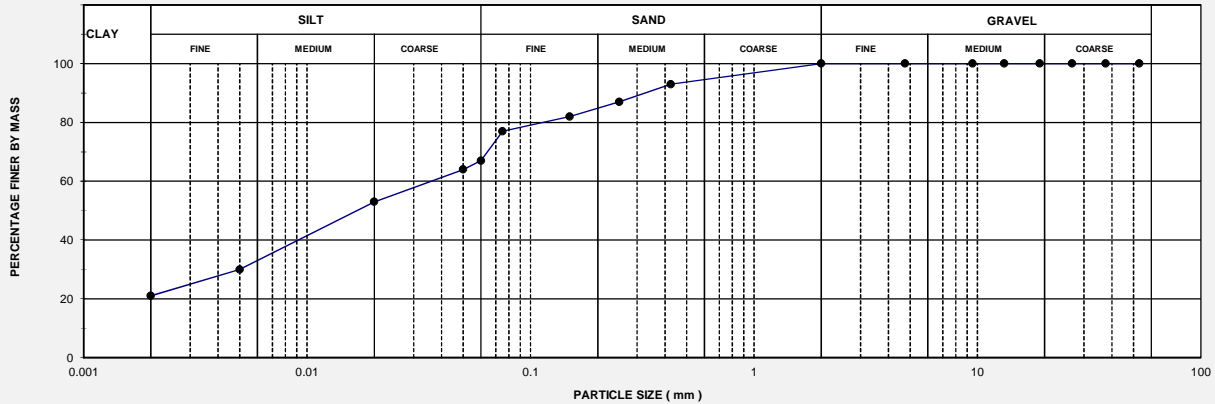


FOUNDATION INDICATOR TEST RESULTS - REP COM 7

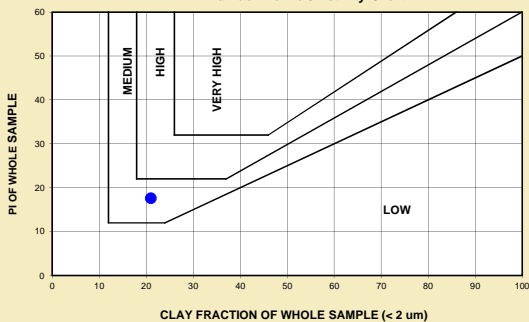
Client: Golder Associates	Source/Location:	Job No: 2016-C-1779
Project Name: Tutuka Ash Increase	Layer:	Sample No: 6/13730
Project No: 1658666	Lane:	Date: 20/01/2017
Hole/TP No: AD 12	Stabilizing Agent:	Test Method: TMH1 A1, A5 & ASTM D422
Depth (m): 0.5 - 0.7	Section:	Client Ref No:
Description:	Chainage:	GPS X:
Additional Info:	Offset:	GPS Y:

SIEVE ANALYSIS				ATTERBERG LIMITS		SOIL CLASSIFICATION	
Sieve (mm)	% Passing	Sieve (mm)	% Passing				
75.0	100	0.425	93	Liquid Limit (%)	40	% Gravel	0
63.0	100	0.250	87	Plastic Limit (%)	21	% Sand	33
53.0	100	0.150	82	Plasticity Index (%)	19	% Silt	46
37.5	100	0.075	77	Weighted PI (%)	17.7	% Clay	21
26.5	100	0.060	67	Linear Shrinkage (%)	7.5	Activity	0.9
19.0	100	0.050	64	Grading Modulus	0.30	% Soil Mortar	100
13.2	100	0.020	53	Uniformity coefficient	20	Coarse Sand Ratio	0.07
9.5	100	0.005	30	Coefficient of curvature	0.6	TRB Classification	A - 6
4.75	100	0.002	21			Unified Classification	CL
2.00	100			Remarks:			

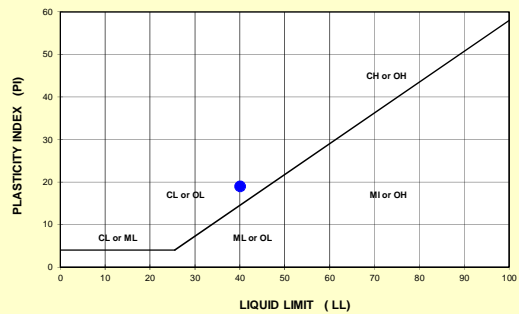
PARTICLE SIZE DISTRIBUTION



POTENTIAL EXPANSIVENESS Van der Merwe's Activity Chart



CASAGRANDE 'A' LINE





T0023

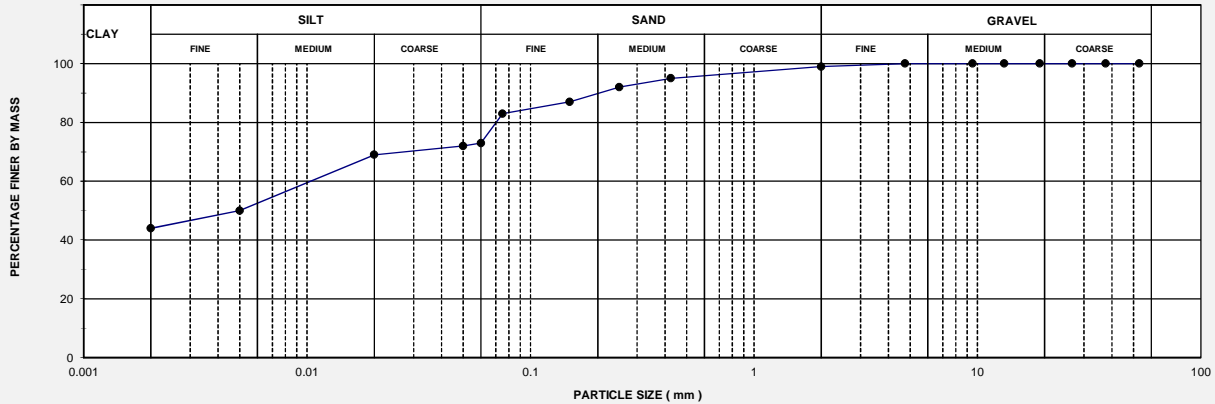


FOUNDATION INDICATOR TEST RESULTS - REP COM 7

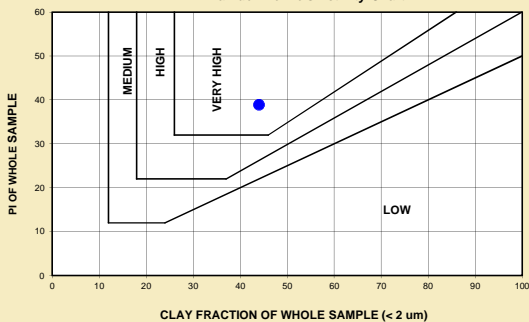
Client: Golder Associates	Source/Location:	Job No: 2016-C-1779
Project Name: Tutuka Ash Increase	Layer:	Sample No: 6/13731
Project No: 1658666	Lane:	Date: 20/01/2017
Hole/TP No: AD 15	Stabilizing Agent:	Test Method: TMH1 A1, A5 & ASTM D422
Depth (m): 0.2 - 0.3	Section:	Client Ref No:
Description:	Chainage:	GPS X:
Additional Info:	Offset:	GPS Y:

SIEVE ANALYSIS				ATTERBERG LIMITS		SOIL CLASSIFICATION	
Sieve (mm)	% Passing	Sieve (mm)	% Passing				
75.0	100	0.425	95	Liquid Limit (%)	60	% Gravel	1
63.0	100	0.250	92	Plastic Limit (%)	19	% Sand	26
53.0	100	0.150	87	Plasticity Index (%)	41	% Silt	29
37.5	100	0.075	83	Weighted PI (%)	39.0	% Clay	44
26.5	100	0.060	73	Linear Shrinkage (%)	12.0	Activity	0.9
19.0	100	0.050	72	Grading Modulus	0.23	% Soil Mortar	99
13.2	100	0.020	69	Uniformity coefficient	6	Coarse Sand Ratio	0.04
9.5	100	0.005	50	Coefficient of curvature	0.2	TRB Classification	A - 7 - 6
4.75	100	0.002	44			Unified Classification	CH
2.00	99			Remarks:			

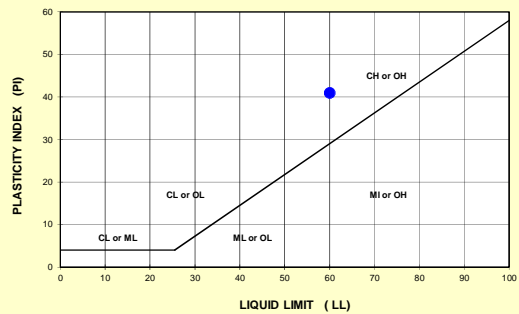
PARTICLE SIZE DISTRIBUTION



POTENTIAL EXPANSIVENESS
Van der Merwe's Activity Chart



CASAGRANDE 'A' LINE



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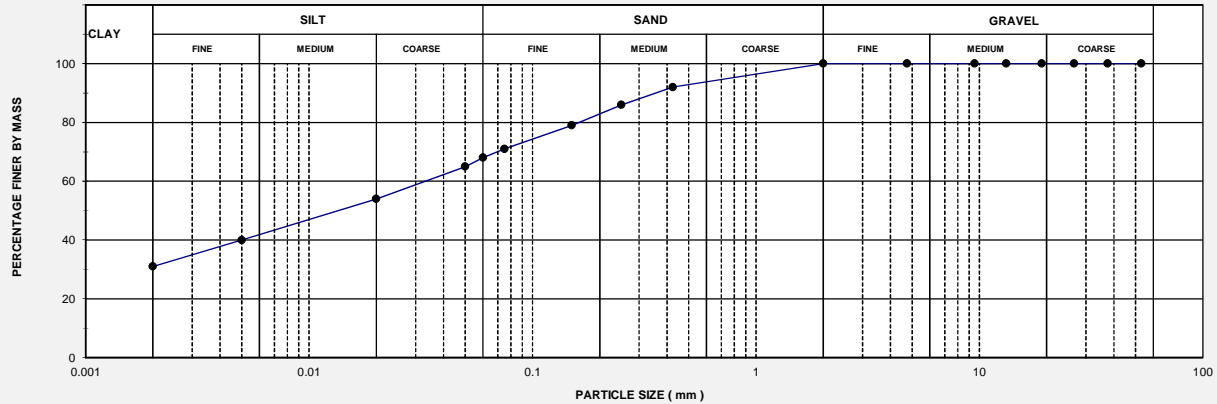


FOUNDATION INDICATOR TEST RESULTS - REP COM 7

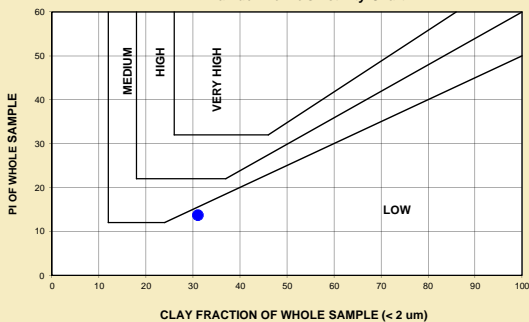
Client: Golder Associates	Source/Location:	Job No: 2016-C-1779
Project Name: Tutuka Ash Increase	Layer:	Sample No: 6/13732
Project No: 1658666	Lane:	Date: 20/01/2017
Hole/TP No: AD 61	Stabilizing Agent:	Test Method: TMH1 A1, A5 & ASTM D422
Depth (m): 0.5 - 0.6	Section:	Client Ref No:
Description:	Chainage:	GPS X:
Additional Info:	Offset:	GPS Y:

SIEVE ANALYSIS				ATTERBERG LIMITS		SOIL CLASSIFICATION	
Sieve (mm)	% Passing	Sieve (mm)	% Passing				
75.0	100	0.425	92	Liquid Limit (%)	33	% Gravel	0
63.0	100	0.250	86	Plastic Limit (%)	18	% Sand	32
53.0	100	0.150	79	Plasticity Index (%)	15	% Silt	37
37.5	100	0.075	71	Weighted PI (%)	13.8	% Clay	31
26.5	100	0.060	68	Linear Shrinkage (%)	7.5	Activity	0.5
19.0	100	0.050	65	Grading Modulus	0.37	% Soil Mortar	100
13.2	100	0.020	54	Uniformity coefficient	18	Coarse Sand Ratio	0.08
9.5	100	0.005	40	Coefficient of curvature	0.1	TRB Classification	A - 6
4.75	100	0.002	31			Unified Classification	CL
2.00	100			Remarks:			

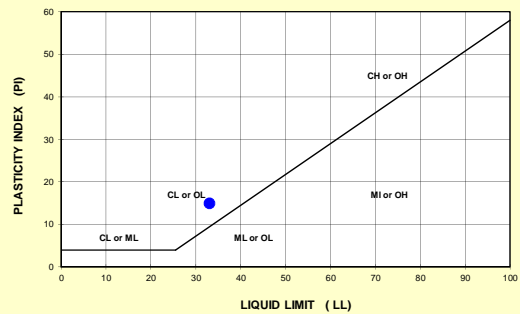
PARTICLE SIZE DISTRIBUTION



POTENTIAL EXPANSIVENESS Van der Merwe's Activity Chart



CASAGRANDE 'A' LINE



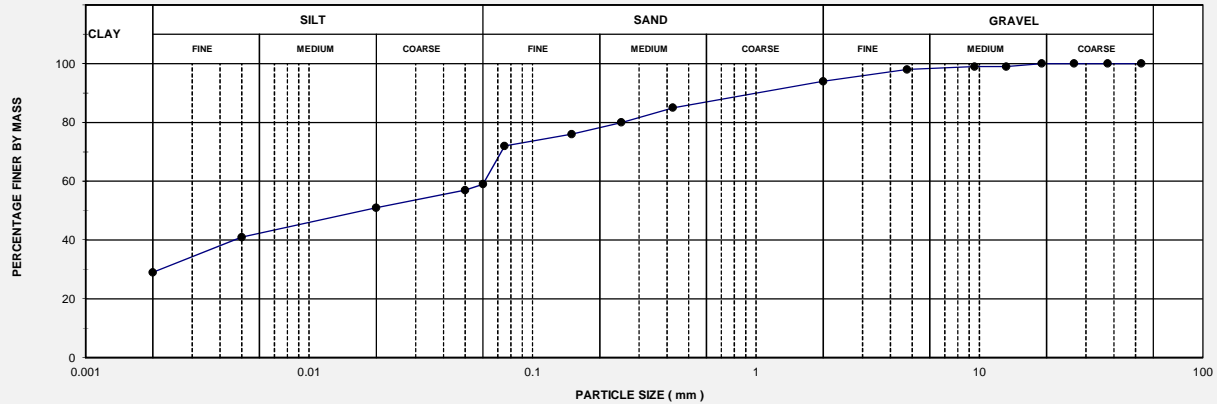


FOUNDATION INDICATOR TEST RESULTS - REP COM 7

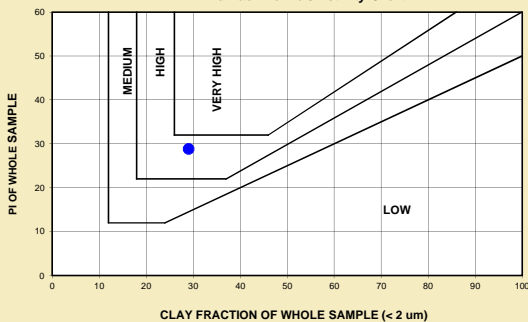
Client: Golder Associates	Source/Location:	Job No: 2016-C-1779
Project Name: Tutuka Ash Increase	Layer:	Sample No: 6/13733
Project No: 1658666	Lane:	Date: 20/01/2017
Hole/TP No: AD 59	Stabilizing Agent:	Test Method: TMH1 A1, A5 & ASTM D422
Depth (m): 0.4 - 0.7	Section:	Client Ref No:
Description:	Chainage:	GPS X:
Additional Info:	Offset:	GPS Y:

SIEVE ANALYSIS				ATTERBERG LIMITS		SOIL CLASSIFICATION	
Sieve (mm)	% Passing	Sieve (mm)	% Passing				
75.0	100	0.425	85	Liquid Limit (%)	55	% Gravel	6
63.0	100	0.250	80	Plastic Limit (%)	21	% Sand	35
53.0	100	0.150	76	Plasticity Index (%)	34	% Silt	30
37.5	100	0.075	72	Weighted PI (%)	28.9	% Clay	29
26.5	100	0.060	59	Linear Shrinkage (%)	13.5	Activity	1.2
19.0	100	0.050	57	Grading Modulus	0.49	% Soil Mortar	94
13.2	99	0.020	51	Uniformity coefficient	31	Coarse Sand Ratio	0.10
9.5	99	0.005	41	Coefficient of curvature	0.0	TRB Classification	A - 7 - 6
4.75	98	0.002	29			Unified Classification	CH
2.00	94			Remarks:			

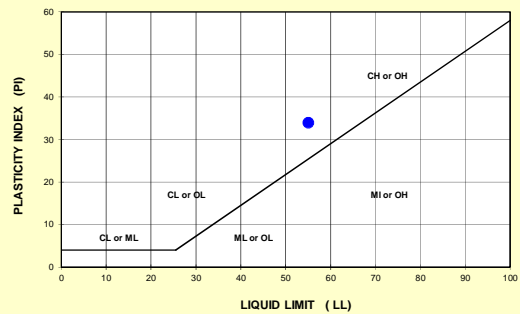
PARTICLE SIZE DISTRIBUTION



POTENTIAL EXPANSIVENESS Van der Merwe's Activity Chart



CASAGRANDE 'A' LINE



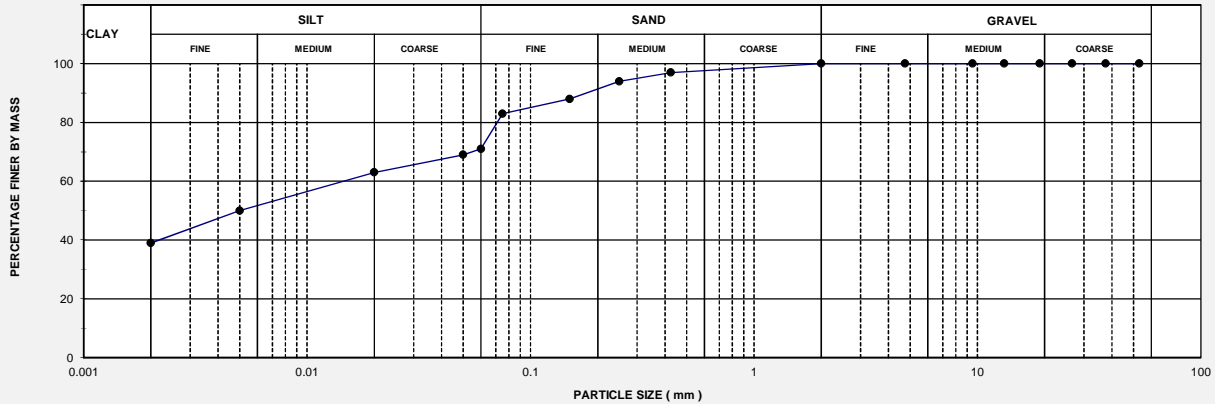


FOUNDATION INDICATOR TEST RESULTS - REP COM 7

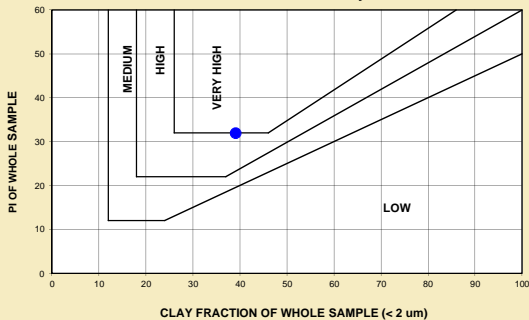
Client: Golder Associates	Source/Location:	Job No: 2016-C-1779
Project Name: Tutuka Ash Increase	Layer:	Sample No: 6/13734
Project No: 1658666	Lane:	Date: 20/01/2017
Hole/TP No: AD 50	Stabilizing Agent:	Test Method: TMH1 A1, A5 & ASTM D422
Depth (m): 1.3 - 1.5	Section:	Client Ref No:
Description:	Chainage:	GPS X:
Additional Info:	Offset:	GPS Y:

SIEVE ANALYSIS				ATTERBERG LIMITS		SOIL CLASSIFICATION	
Sieve (mm)	% Passing	Sieve (mm)	% Passing				
75.0	100	0.425	97	Liquid Limit (%)	52	% Gravel	0
63.0	100	0.250	94	Plastic Limit (%)	19	% Sand	29
53.0	100	0.150	88	Plasticity Index (%)	33	% Silt	32
37.5	100	0.075	83	Weighted PI (%)	32.0	% Clay	39
26.5	100	0.060	71	Linear Shrinkage (%)	10.0	Activity	0.8
19.0	100	0.050	69	Grading Modulus	0.20	% Soil Mortar	100
13.2	100	0.020	63	Uniformity coefficient	8	Coarse Sand Ratio	0.03
9.5	100	0.005	50	Coefficient of curvature	0.1	TRB Classification	A - 7 - 6
4.75	100	0.002	39			Unified Classification	CH
2.00	100			Remarks:			

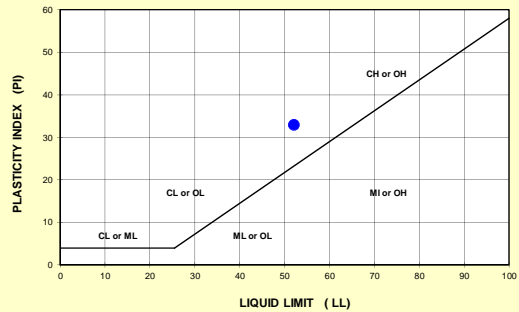
PARTICLE SIZE DISTRIBUTION



POTENTIAL EXPANSIVENESS Van der Merwe's Activity Chart



CASAGRANDE 'A' LINE



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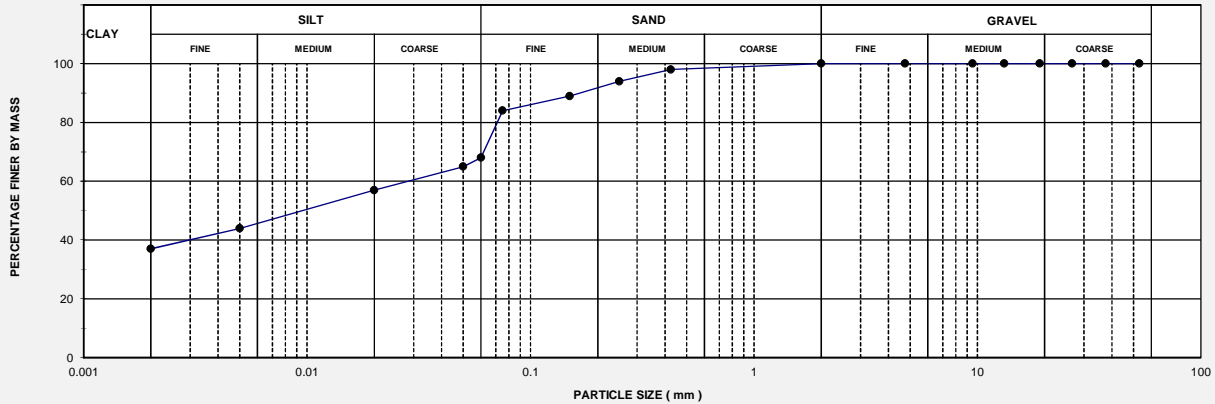


FOUNDATION INDICATOR TEST RESULTS - REP COM 7

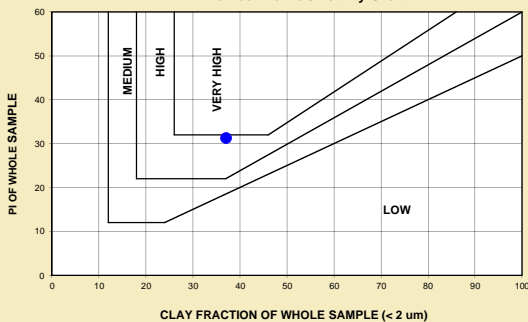
Client: Golder Associates	Source/Location:	Job No: 2016-C-1779
Project Name: Tutuka Ash Increase	Layer:	Sample No: 6/13735
Project No: 1658666	Lane:	Date: 20/01/2017
Hole/TP No: AD 48	Stabilizing Agent:	Test Method: TMH1 A1, A5 & ASTM D422
Depth (m): 0.3 - 0.8	Section:	Client Ref No:
Description:	Chainage:	GPS X:
Additional Info:	Offset:	GPS Y:

SIEVE ANALYSIS				ATTERBERG LIMITS		SOIL CLASSIFICATION	
Sieve (mm)	% Passing	Sieve (mm)	% Passing				
75.0	100	0.425	98	Liquid Limit (%)	57	% Gravel	0
63.0	100	0.250	94	Plastic Limit (%)	25	% Sand	32
53.0	100	0.150	89	Plasticity Index (%)	32	% Silt	31
37.5	100	0.075	84	Weighted PI (%)	31.4	% Clay	37
26.5	100	0.060	68	Linear Shrinkage (%)	10.5	Activity	0.9
19.0	100	0.050	65	Grading Modulus	0.18	% Soil Mortar	100
13.2	100	0.020	57	Uniformity coefficient	16	Coarse Sand Ratio	0.02
9.5	100	0.005	44	Coefficient of curvature	0.1	TRB Classification	A - 7 - 6
4.75	100	0.002	37			Unified Classification	CH
2.00	100			Remarks:			

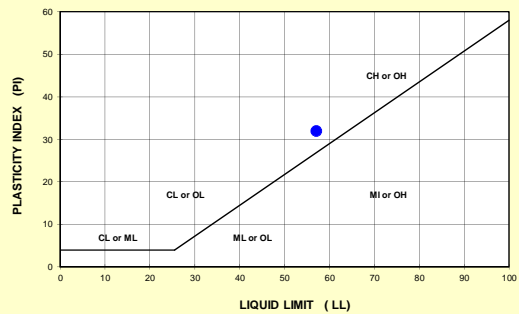
PARTICLE SIZE DISTRIBUTION



POTENTIAL EXPANSIVENESS Van der Merwe's Activity Chart



CASAGRANDE 'A' LINE





T0023

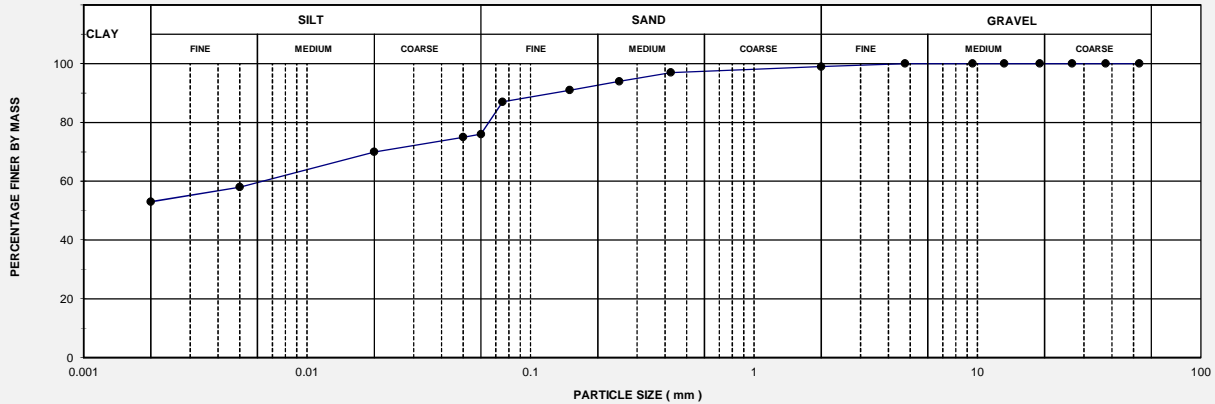


FOUNDATION INDICATOR TEST RESULTS - REP COM 7

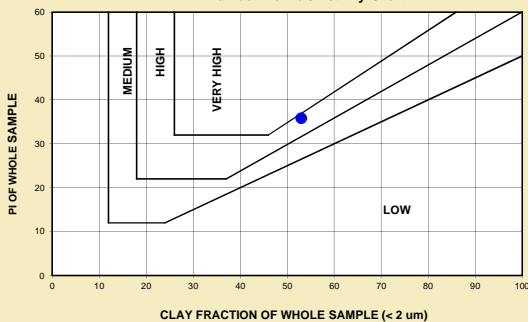
Client: Golder Associates	Source/Location:	Job No: 2016-C-1779
Project Name: Tutuka Ash Increase	Layer:	Sample No: 6/13736
Project No: 1658666	Lane:	Date: 20/01/2017
Hole/TP No: AD 52	Stabilizing Agent:	Test Method: TMH1 A1, A5 & ASTM D422
Depth (m): 0.95 - 1.15	Section:	Client Ref No:
Description:	Chainage:	GPS X:
Additional Info:	Offset:	GPS Y:

SIEVE ANALYSIS				ATTERBERG LIMITS		SOIL CLASSIFICATION	
Sieve (mm)	% Passing	Sieve (mm)	% Passing				
75.0	100	0.425	97	Liquid Limit (%)	60	% Gravel	1
63.0	100	0.250	94	Plastic Limit (%)	23	% Sand	23
53.0	100	0.150	91	Plasticity Index (%)	37	% Silt	23
37.5	100	0.075	87	Weighted PI (%)	35.9	% Clay	53
26.5	100	0.060	76	Linear Shrinkage (%)	8.5	Activity	0.7
19.0	100	0.050	75	Grading Modulus	0.17	% Soil Mortar	99
13.2	100	0.020	70	Uniformity coefficient	4	Coarse Sand Ratio	0.02
9.5	100	0.005	58	Coefficient of curvature	0.3	TRB Classification	A - 7 - 6
4.75	100	0.002	53			Unified Classification	CH
2.00	99			Remarks:			

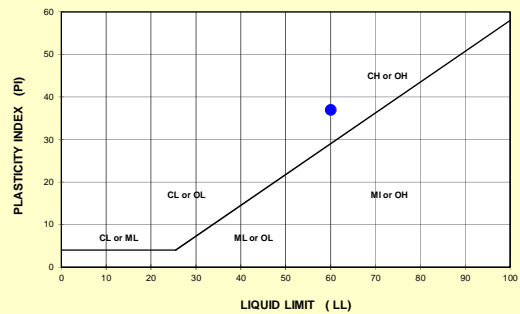
PARTICLE SIZE DISTRIBUTION



POTENTIAL EXPANSIVENESS Van der Merwe's Activity Chart



CASAGRANDE 'A' LINE



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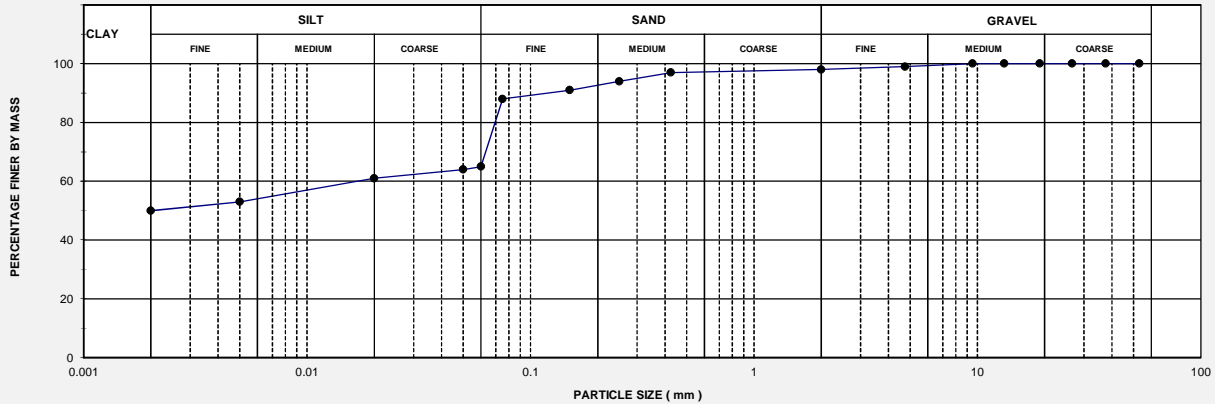


FOUNDATION INDICATOR TEST RESULTS - REP COM 7

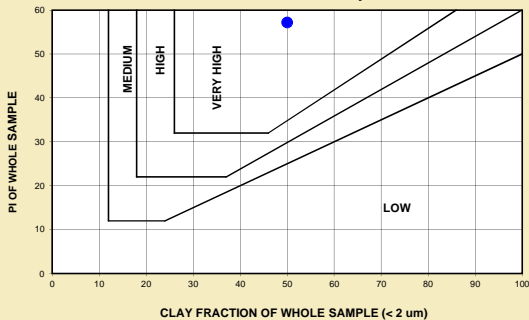
Client: Golder Associates	Source/Location:	Job No: 2016-C-1779
Project Name: Tutuka Ash Increase	Layer:	Sample No: 6/13737
Project No: 1658666	Lane:	Date: 20/01/2017
Hole/TP No: RRD 08	Stabilizing Agent:	Test Method: TMH1 A1, A5 & ASTM D422
Depth (m): 0.95 - 1.15	Section:	Client Ref No:
Description:	Chainage:	GPS X:
Additional Info:	Offset:	GPS Y:

SIEVE ANALYSIS				ATTEBERG LIMITS		SOIL CLASSIFICATION	
Sieve (mm)	% Passing	Sieve (mm)	% Passing				
75.0	100	0.425	97	Liquid Limit (%)	84	% Gravel	2
63.0	100	0.250	94	Plastic Limit (%)	25	% Sand	33
53.0	100	0.150	91	Plasticity Index (%)	59	% Silt	15
37.5	100	0.075	88	Weighted PI (%)	57.2	% Clay	50
26.5	100	0.060	65	Linear Shrinkage (%)	13.5	Activity	1.2
19.0	100	0.050	64	Grading Modulus	0.17	% Soil Mortar	98
13.2	100	0.020	61	Uniformity coefficient	9	Coarse Sand Ratio	0.01
9.5	100	0.005	53	Coefficient of curvature	0.1	TRB Classification	A - 7 - 6
4.75	99	0.002	50			Unified Classification	CH
2.00	98			Remarks:			

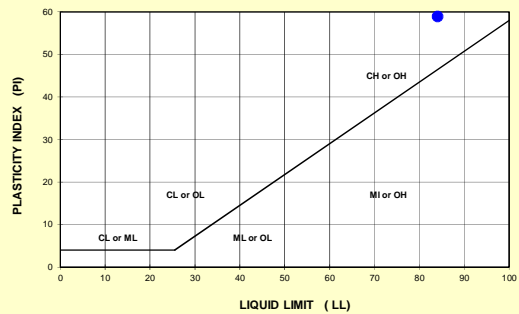
PARTICLE SIZE DISTRIBUTION



POTENTIAL EXPANSIVENESS Van der Merwe's Activity Chart



CASAGRANDE 'A' LINE





T0023

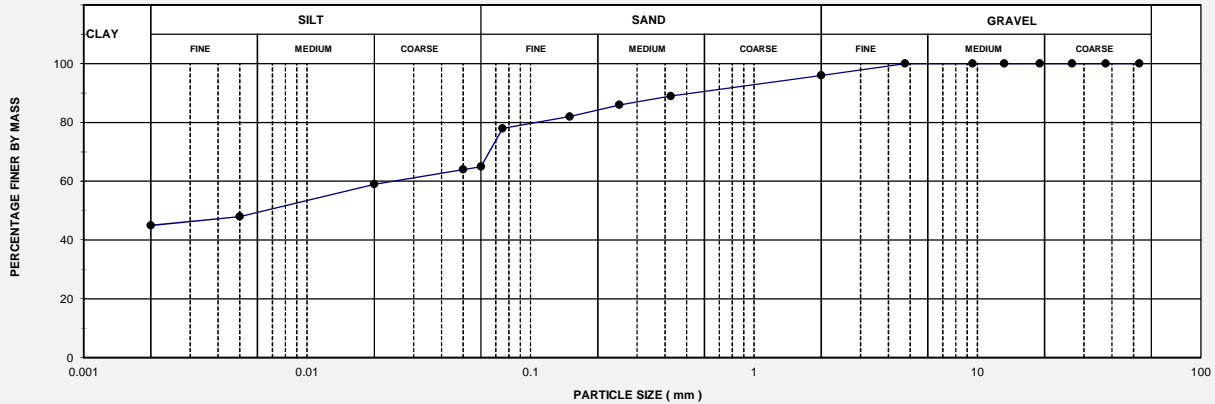


FOUNDATION INDICATOR TEST RESULTS - REP COM 7

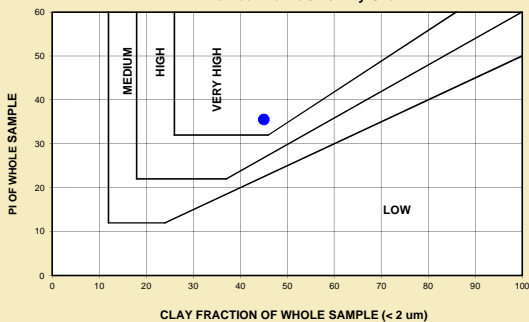
Client: Golder Associates	Source/Location:	Job No: 2016-C-1779
Project Name: Tutuka Ash Increase	Layer:	Sample No: 6/13738
Project No: 1658666	Lane:	Date: 20/01/2017
Hole/TP No: RRD 15	Stabilizing Agent:	Test Method: TMH1 A1, A5 & ASTM D422
Depth (m): 0.9 - 1.3	Section:	Client Ref No:
Description:	Chainage:	GPS X:
Additional Info:	Offset:	GPS Y:

SIEVE ANALYSIS				ATTERBERG LIMITS		SOIL CLASSIFICATION	
Sieve (mm)	% Passing	Sieve (mm)	% Passing				
75.0	100	0.425	89	Liquid Limit (%)	61	% Gravel	4
63.0	100	0.250	86	Plastic Limit (%)	21	% Sand	31
53.0	100	0.150	82	Plasticity Index (%)	40	% Silt	20
37.5	100	0.075	78	Weighted PI (%)	35.6	% Clay	45
26.5	100	0.060	65	Linear Shrinkage (%)	13.5	Activity	0.9
19.0	100	0.050	64	Grading Modulus	0.37	% Soil Mortar	96
13.2	100	0.020	59	Uniformity coefficient	13	Coarse Sand Ratio	0.07
9.5	100	0.005	48	Coefficient of curvature	0.1	TRB Classification	A - 7 - 6
4.75	100	0.002	45			Unified Classification	CH
2.00	96			Remarks:			

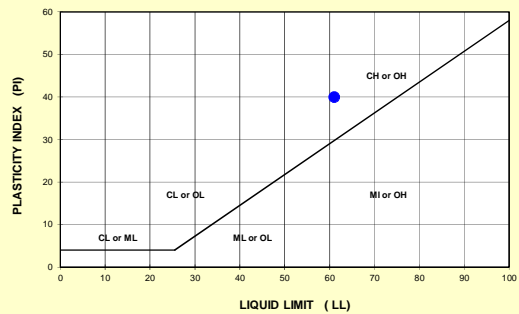
PARTICLE SIZE DISTRIBUTION



POTENTIAL EXPANSIVENESS Van der Merwe's Activity Chart



CASAGRANDE 'A' LINE



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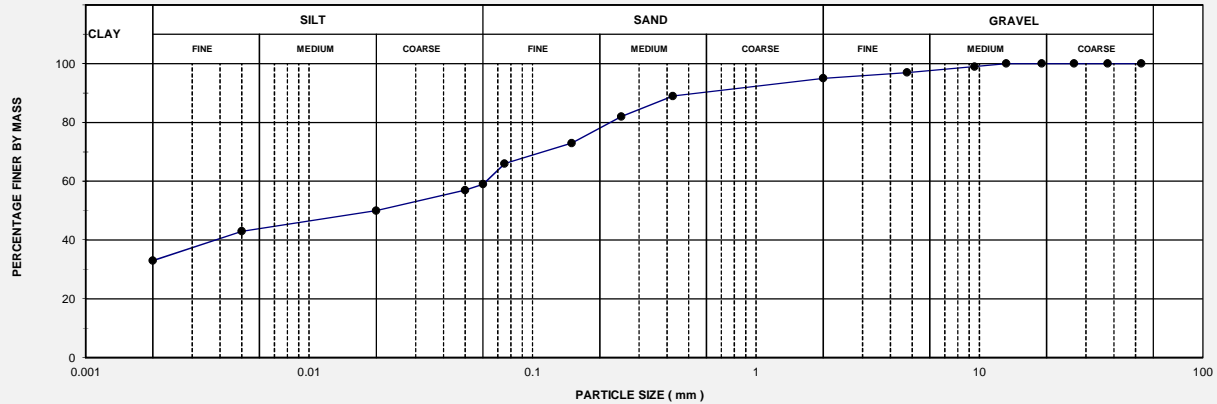


FOUNDATION INDICATOR TEST RESULTS - REP COM 7

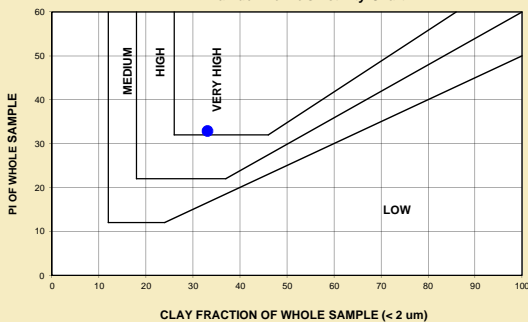
Client: Golder Associates	Source/Location:	Job No: 2016-C-1779
Project Name: Tutuka Ash Increase	Layer:	Sample No: 6/13739
Project No: 1658666	Lane:	Date: 20/01/2017
Hole/TP No: AWRD 08	Stabilizing Agent:	Test Method: TMH1 A1, A5 & ASTM D422
Depth (m): 0.5 - 1.4	Section:	Client Ref No:
Description:	Chainage:	GPS X:
Additional Info:	Offset:	GPS Y:

SIEVE ANALYSIS				ATTERBERG LIMITS		SOIL CLASSIFICATION	
Sieve (mm)	% Passing	Sieve (mm)	% Passing				
75.0	100	0.425	89	Liquid Limit (%)	59	% Gravel	5
63.0	100	0.250	82	Plastic Limit (%)	22	% Sand	36
53.0	100	0.150	73	Plasticity Index (%)	37	% Silt	26
37.5	100	0.075	66	Weighted PI (%)	32.9	% Clay	33
26.5	100	0.060	59	Linear Shrinkage (%)	13.5	Activity	1.1
19.0	100	0.050	57	Grading Modulus	0.50	% Soil Mortar	95
13.2	100	0.020	50	Uniformity coefficient	31	Coarse Sand Ratio	0.06
9.5	99	0.005	43	Coefficient of curvature	0.0	TRB Classification	A - 7 - 6
4.75	97	0.002	33			Unified Classification	CH
2.00	95			Remarks:			

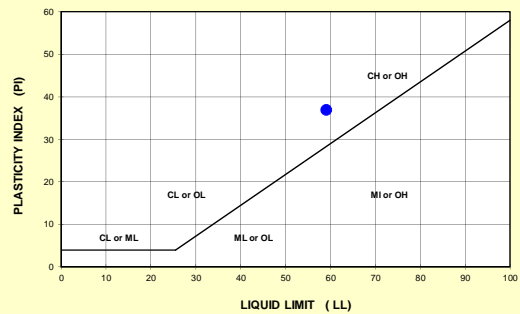
PARTICLE SIZE DISTRIBUTION



POTENTIAL EXPANSIVENESS Van der Merwe's Activity Chart



CASAGRANDE 'A' LINE



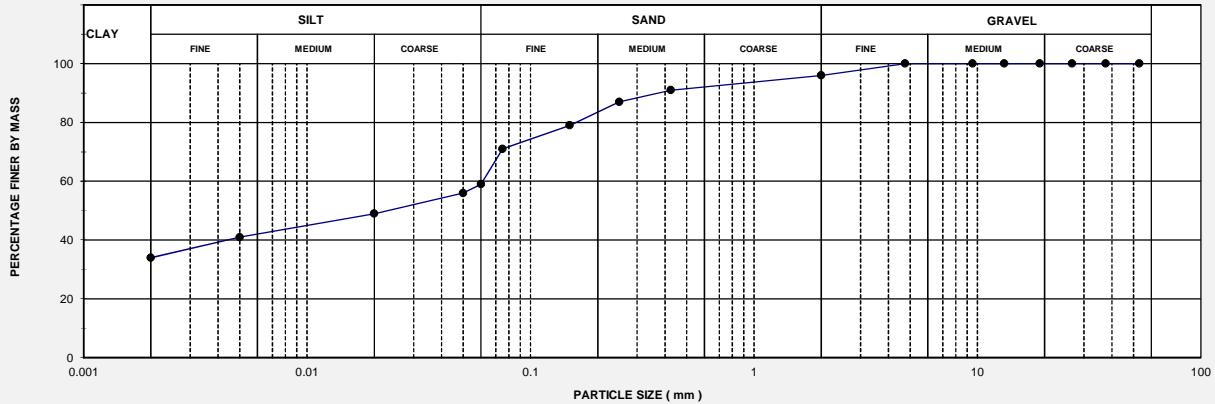


FOUNDATION INDICATOR TEST RESULTS - REP COM 7

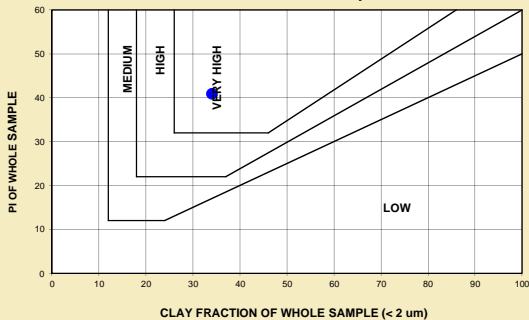
Client: Golder Associates	Source/Location:	Job No: 2016-C-1779
Project Name: Tutuka Ash Increase	Layer:	Sample No: 6/13740
Project No: 1658666	Lane:	Date: 20/01/2017
Hole/TP No: RRD 02	Stabilizing Agent:	Test Method: TMH1 A1, A5 & ASTM D422
Depth (m): 0.6 - 1.3	Section:	Client Ref No:
Description:	Chainage:	GPS X:
Additional Info:	Offset:	GPS Y:

SIEVE ANALYSIS				ATTERBERG LIMITS		SOIL CLASSIFICATION	
Sieve (mm)	% Passing	Sieve (mm)	% Passing				
75.0	100	0.425	91	Liquid Limit (%)	70	% Gravel	4
63.0	100	0.250	87	Plastic Limit (%)	25	% Sand	37
53.0	100	0.150	79	Plasticity Index (%)	45	% Silt	25
37.5	100	0.075	71	Weighted PI (%)	41.0	% Clay	34
26.5	100	0.060	59	Linear Shrinkage (%)	17.0	Activity	1.3
19.0	100	0.050	56	Grading Modulus	0.42	% Soil Mortar	96
13.2	100	0.020	49	Uniformity coefficient	31	Coarse Sand Ratio	0.05
9.5	100	0.005	41	Coefficient of curvature	0.0	TRB Classification	A - 7 - 6
4.75	100	0.002	34			Unified Classification	CH
2.00	96			Remarks:			

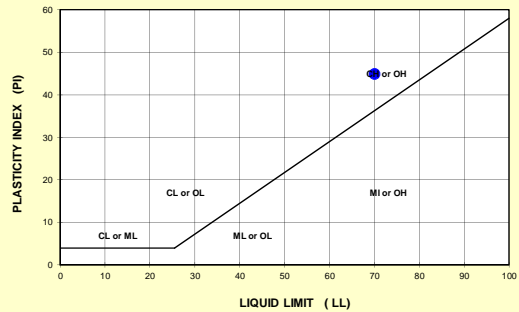
PARTICLE SIZE DISTRIBUTION



POTENTIAL EXPANSIVENESS Van der Merwe's Activity Chart



CASAGRANDE 'A' LINE





T0023

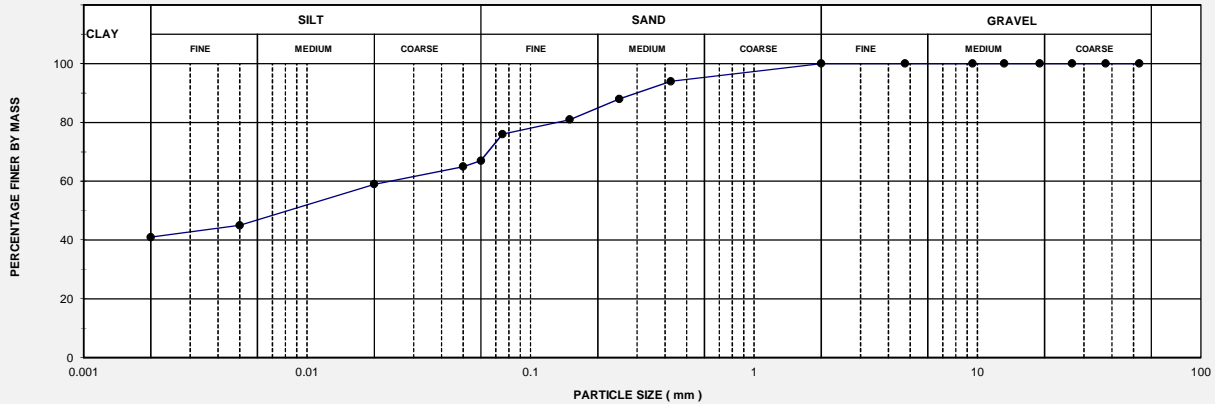


FOUNDATION INDICATOR TEST RESULTS - REP COM 7

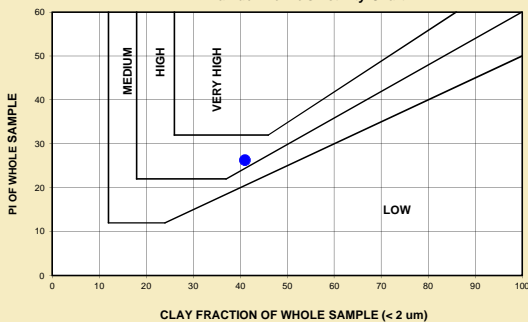
Client: Golder Associates	Source/Location:	Job No: 2016-C-1779
Project Name: Tutuka Ash Increase	Layer:	Sample No: 6/13742
Project No: 1658666	Lane:	Date: 20/01/2017
Hole/TP No: AWRD 09	Stabilizing Agent:	Test Method: TMH1 A1, A5 & ASTM D422
Depth (m): 1.2 - 1.8	Section:	Client Ref No:
Description:	Chainage:	GPS X:
Additional Info:	Offset:	GPS Y:

SIEVE ANALYSIS				ATTERBERG LIMITS		SOIL CLASSIFICATION	
Sieve (mm)	% Passing	Sieve (mm)	% Passing				
75.0	100	0.425	94	Liquid Limit (%)	44	% Gravel	0
63.0	100	0.250	88	Plastic Limit (%)	16	% Sand	33
53.0	100	0.150	81	Plasticity Index (%)	28	% Silt	26
37.5	100	0.075	76	Weighted PI (%)	26.3	% Clay	41
26.5	100	0.060	67	Linear Shrinkage (%)	10.0	Activity	0.7
19.0	100	0.050	65	Grading Modulus	0.30	% Soil Mortar	100
13.2	100	0.020	59	Uniformity coefficient	13	Coarse Sand Ratio	0.06
9.5	100	0.005	45	Coefficient of curvature	0.1	TRB Classification	A - 7 - 6
4.75	100	0.002	41			Unified Classification	CL
2.00	100			Remarks:			

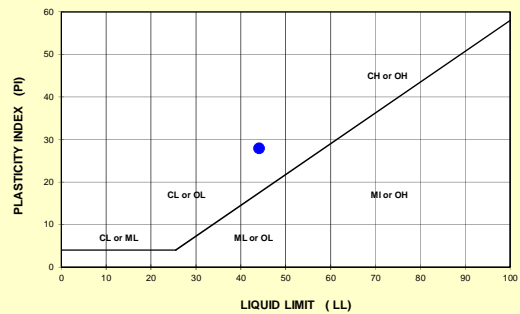
PARTICLE SIZE DISTRIBUTION



POTENTIAL EXPANSIVENESS Van der Merwe's Activity Chart



CASAGRANDE 'A' LINE



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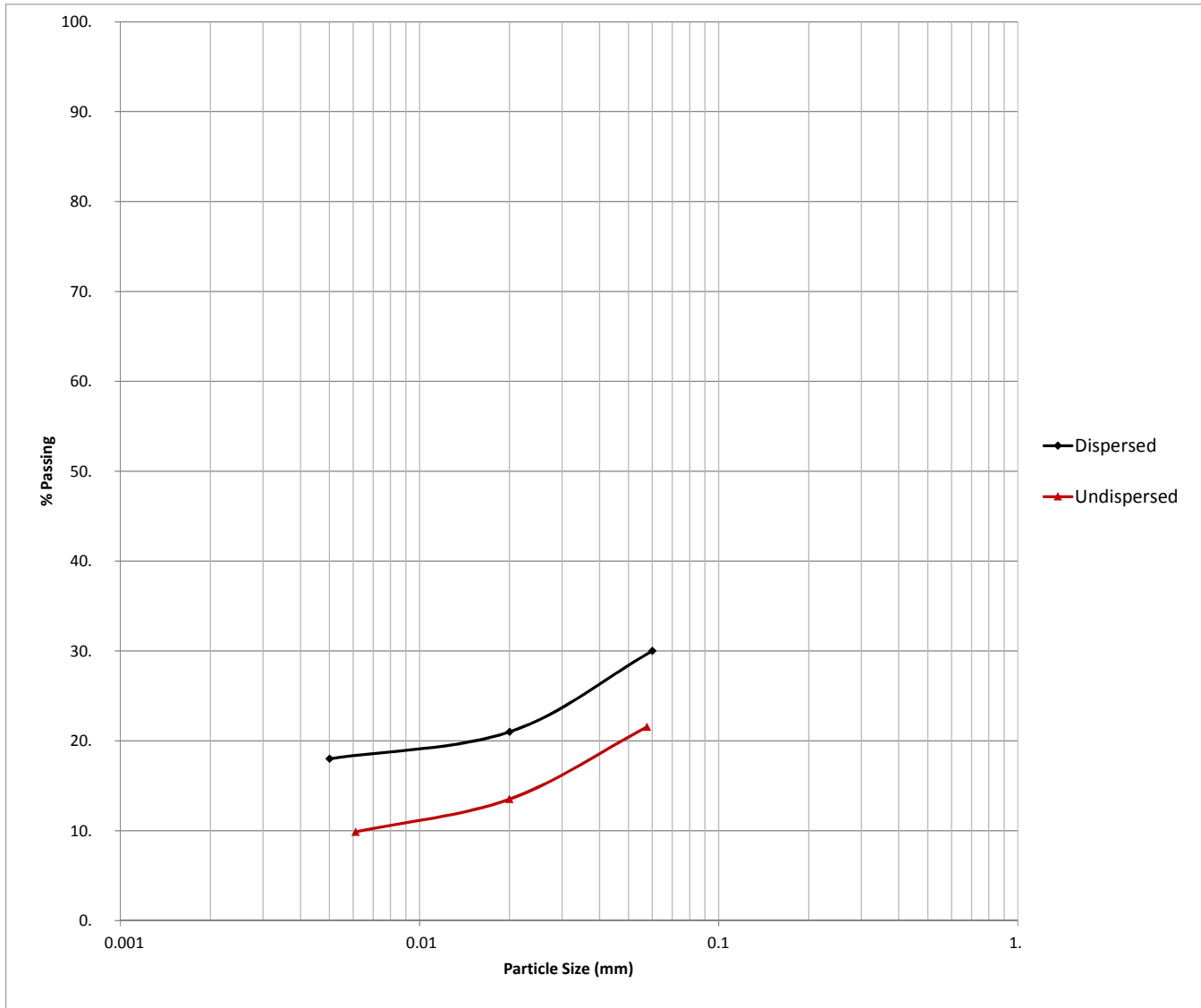
Double Hydrometer Test Result

ASTM
D4221

Client Golder Associates
Sample no RRD 10
Lab no 6/13743

Project Tutuka Ash Increase
Depth (m) 0.3 - 1.0

Job no 2016-C-1779
Date 02/02/2017



Dispersion:

55%



T0023

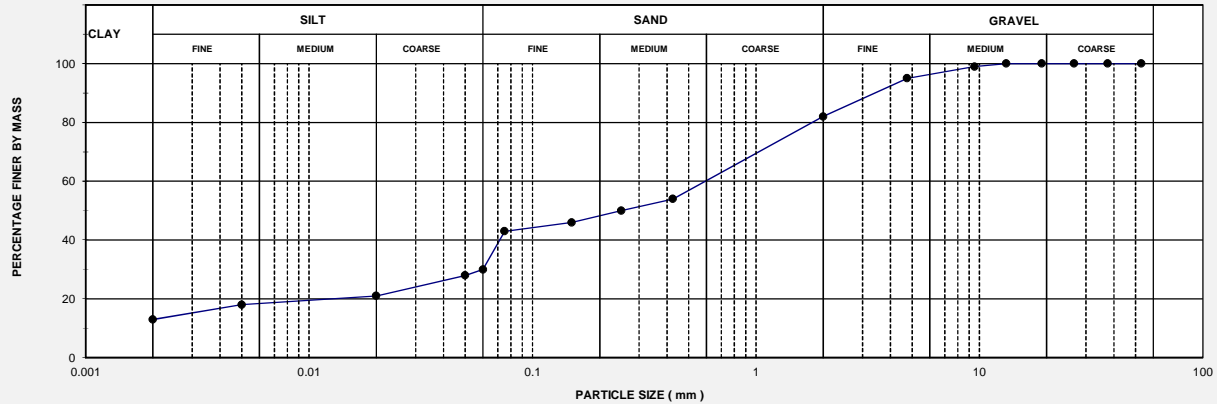


FOUNDATION INDICATOR TEST RESULTS - REP COM 7

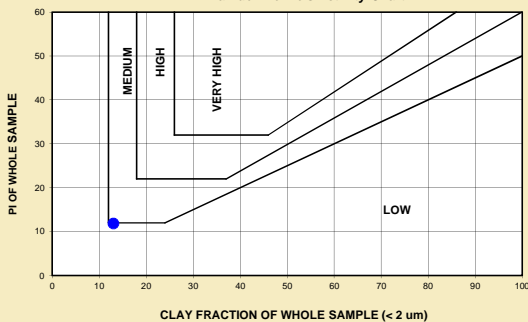
Client: Golder Associates	Source/Location:	Job No: 2016-C-1779
Project Name: Tutuka Ash Increase	Layer:	Sample No: 6/13743
Project No: 1658666	Lane:	Date: 20/01/2017
Hole/TP No: RRD 10	Stabilizing Agent:	Test Method: TMH1 A1, A5 & ASTM D422
Depth (m): 0.3 - 1.0	Section:	Client Ref No:
Description:	Chainage:	GPS X:
Additional Info:	Offset:	GPS Y:

SIEVE ANALYSIS				ATTERBERG LIMITS		SOIL CLASSIFICATION	
Sieve (mm)	% Passing	Sieve (mm)	% Passing				
75.0	100	0.425	54	Liquid Limit (%)	44	% Gravel	18
63.0	100	0.250	50	Plastic Limit (%)	22	% Sand	52
53.0	100	0.150	46	Plasticity Index (%)	22	% Silt	17
37.5	100	0.075	43	Weighted PI (%)	11.9	% Clay	13
26.5	100	0.060	30	Linear Shrinkage (%)	10.5	Activity	1.7
19.0	100	0.050	28	Grading Modulus	1.21	% Soil Mortar	82
13.2	100	0.020	21	Uniformity coefficient	381	Coarse Sand Ratio	0.34
9.5	99	0.005	18	Coefficient of curvature	2.5	TRB Classification	A - 7 - 6
4.75	95	0.002	13			Unified Classification	SC
2.00	82			Remarks:			

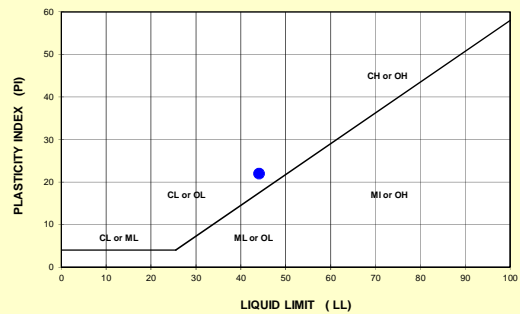
PARTICLE SIZE DISTRIBUTION



POTENTIAL EXPANSIVENESS Van der Merwe's Activity Chart



CASAGRANDE 'A' LINE



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T0023

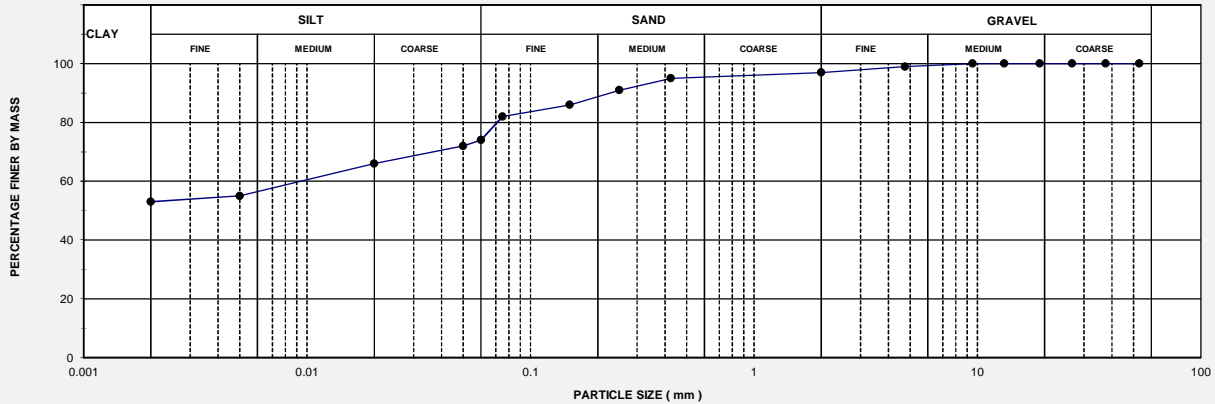


FOUNDATION INDICATOR TEST RESULTS - REP COM 7

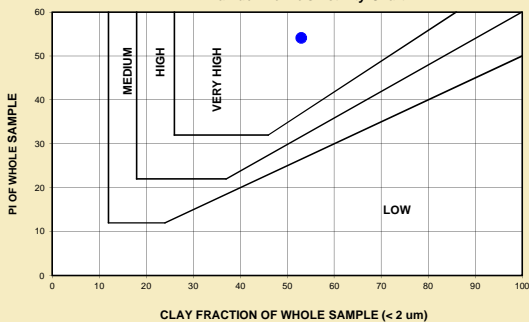
Client: Golder Associates	Source/Location:	Job No: 2016-C-1779
Project Name: Tutuka Ash Increase	Layer:	Sample No: 6/13744
Project No: 1658666	Lane:	Date: 17/02/2017
Hole/TP No: AWRD 13	Stabilizing Agent:	Test Method: TMH1 A1, A5 & ASTM D422
Depth (m): 0.0 - 1.0	Section:	Client Ref No:
Description:	Chainage:	GPS X:
Additional Info:	Offset:	GPS Y:

SIEVE ANALYSIS				ATTERBERG LIMITS		SOIL CLASSIFICATION	
Sieve (mm)	% Passing	Sieve (mm)	% Passing				
75.0	100	0.425	95	Liquid Limit (%)	82	% Gravel	3
63.0	100	0.250	91	Plastic Limit (%)	25	% Sand	23
53.0	100	0.150	86	Plasticity Index (%)	57	% Silt	21
37.5	100	0.075	82	Weighted PI (%)	54.2	% Clay	53
26.5	100	0.060	74	Linear Shrinkage (%)	15.5	Activity	1.1
19.0	100	0.050	72	Grading Modulus	0.26	% Soil Mortar	97
13.2	100	0.020	66	Uniformity coefficient	6	Coarse Sand Ratio	0.02
9.5	100	0.005	55	Coefficient of curvature	0.2	TRB Classification	A - 7 - 6
4.75	99	0.002	53			Unified Classification	CH
2.00	97			Remarks:			

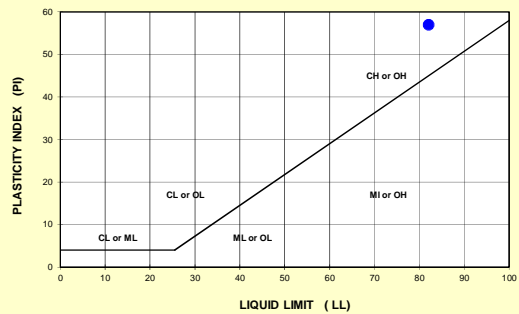
PARTICLE SIZE DISTRIBUTION



POTENTIAL EXPANSIVENESS Van der Merwe's Activity Chart



CASAGRANDE 'A' LINE



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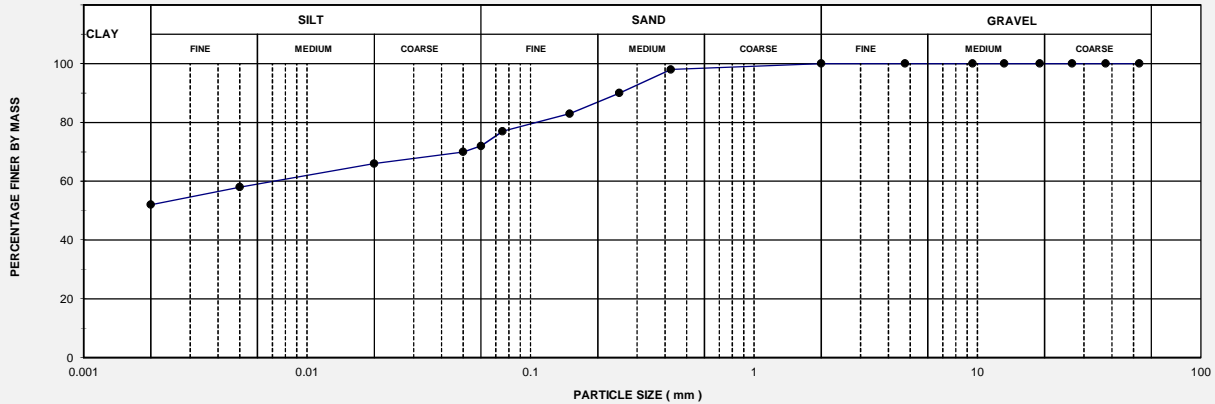


FOUNDATION INDICATOR TEST RESULTS - REP COM 7

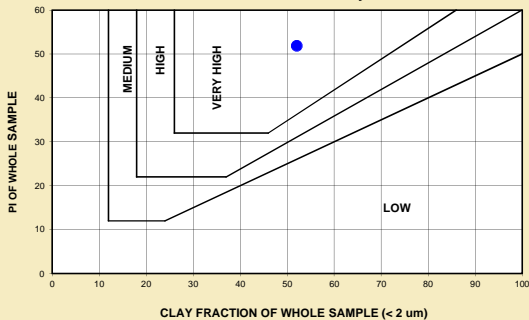
Client: Golder Associates	Source/Location:	Job No: 2016-C-1779
Project Name: Tutuka Ash Increase	Layer:	Sample No: 6/13745
Project No: 1658666	Lane:	Date: 17/02/2017
Hole/TP No: AWRD 01	Stabilizing Agent:	Test Method: TMH1 A1, A5 & ASTM D422
Depth (m): 0.5 - 0.8	Section:	Client Ref No:
Description:	Chainage:	GPS X:
Additional Info:	Offset:	GPS Y:

SIEVE ANALYSIS				ATTERBERG LIMITS		SOIL CLASSIFICATION	
Sieve (mm)	% Passing	Sieve (mm)	% Passing				
75.0	100	0.425	98	Liquid Limit (%)	81	% Gravel	0
63.0	100	0.250	90	Plastic Limit (%)	28	% Sand	28
53.0	100	0.150	83	Plasticity Index (%)	53	% Silt	20
37.5	100	0.075	77	Weighted PI (%)	51.9	% Clay	52
26.5	100	0.060	72	Linear Shrinkage (%)	14.5	Activity	1.0
19.0	100	0.050	70	Grading Modulus	0.25	% Soil Mortar	100
13.2	100	0.020	66	Uniformity coefficient	4	Coarse Sand Ratio	0.02
9.5	100	0.005	58	Coefficient of curvature	0.2	TRB Classification	A - 7 - 6
4.75	100	0.002	52			Unified Classification	CH
2.00	100			Remarks:			

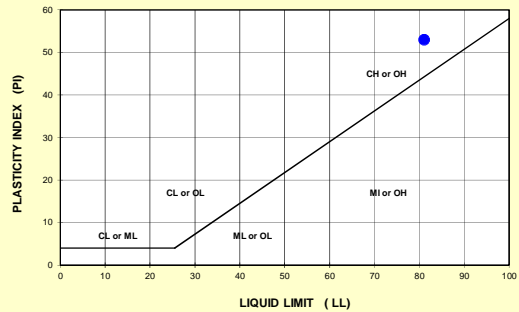
PARTICLE SIZE DISTRIBUTION



POTENTIAL EXPANSIVENESS Van der Merwe's Activity Chart



CASAGRANDE 'A' LINE



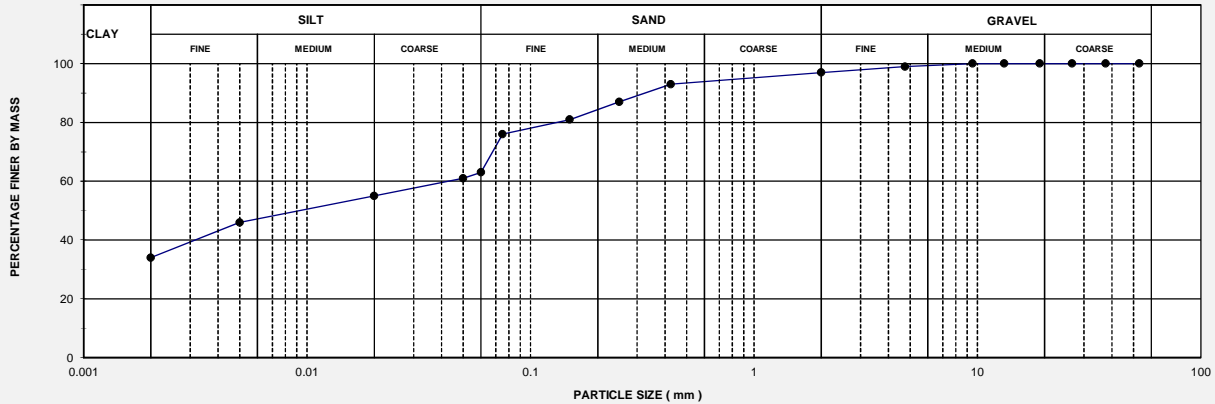


FOUNDATION INDICATOR TEST RESULTS - REP COM 7

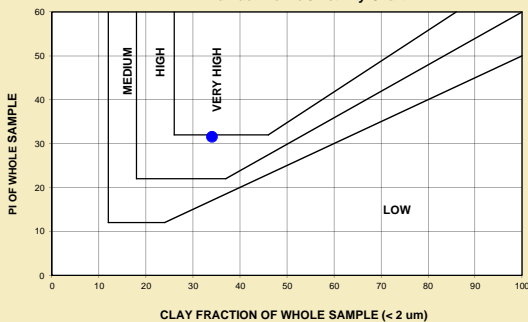
Client: Golder Associates	Source/Location:	Job No: 2016-C-1779
Project Name: Tutuka Ash Increase	Layer:	Sample No: 6/13746
Project No: 1658666	Lane:	Date: 20/01/2017
Hole/TP No: RRD 16	Stabilizing Agent:	Test Method: TMH1 A1, A5 & ASTM D422
Depth (m): 0.3 - 0.6	Section:	Client Ref No:
Description:	Chainage:	GPS X:
Additional Info:	Offset:	GPS Y:

SIEVE ANALYSIS				ATTERBERG LIMITS		SOIL CLASSIFICATION	
Sieve (mm)	% Passing	Sieve (mm)	% Passing				
75.0	100	0.425	93	Liquid Limit (%)	53	% Gravel	3
63.0	100	0.250	87	Plastic Limit (%)	19	% Sand	34
53.0	100	0.150	81	Plasticity Index (%)	34	% Silt	29
37.5	100	0.075	76	Weighted PI (%)	31.6	% Clay	34
26.5	100	0.060	63	Linear Shrinkage (%)	11.5	Activity	1.0
19.0	100	0.050	61	Grading Modulus	0.34	% Soil Mortar	97
13.2	100	0.020	55	Uniformity coefficient	23	Coarse Sand Ratio	0.04
9.5	100	0.005	46	Coefficient of curvature	0.0	TRB Classification	A - 7 - 6
4.75	99	0.002	34			Unified Classification	CH
2.00	97			Remarks:			

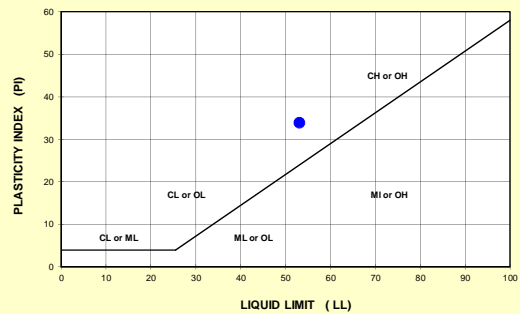
PARTICLE SIZE DISTRIBUTION



POTENTIAL EXPANSIVENESS Van der Merwe's Activity Chart



CASAGRANDE 'A' LINE



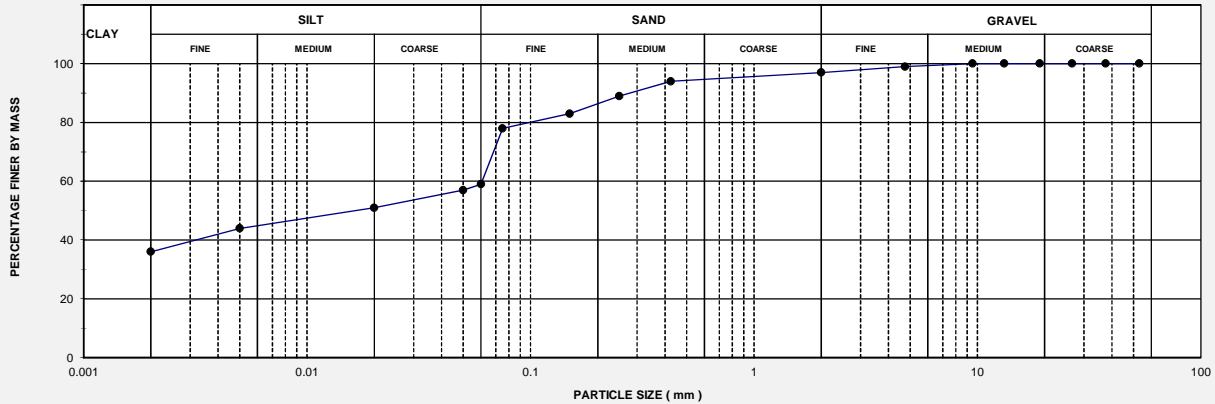


FOUNDATION INDICATOR TEST RESULTS - REP COM 7

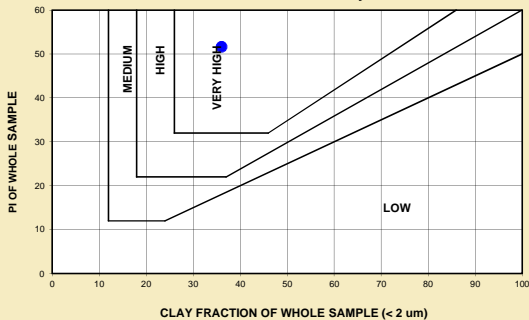
Client: Golder Associates	Source/Location:	Job No: 2016-C-1779
Project Name: Tutuka Ash Increase	Layer:	Sample No: 6/13747
Project No: 1658666	Lane:	Date: 20/01/2017
Hole/TP No: RRD 08	Stabilizing Agent:	Test Method: TMH1 A1, A5 & ASTM D422
Depth (m): 0.5 - 0.7	Section:	Client Ref No:
Description:	Chainage:	GPS X:
Additional Info:	Offset:	GPS Y:

SIEVE ANALYSIS				ATTERBERG LIMITS		SOIL CLASSIFICATION	
Sieve (mm)	% Passing	Sieve (mm)	% Passing				
75.0	100	0.425	94	Liquid Limit (%)	80	% Gravel	3
63.0	100	0.250	89	Plastic Limit (%)	25	% Sand	38
53.0	100	0.150	83	Plasticity Index (%)	55	% Silt	23
37.5	100	0.075	78	Weighted PI (%)	51.7	% Clay	36
26.5	100	0.060	59	Linear Shrinkage (%)	13.5	Activity	1.5
19.0	100	0.050	57	Grading Modulus	0.31	% Soil Mortar	97
13.2	100	0.020	51	Uniformity coefficient	30	Coarse Sand Ratio	0.03
9.5	100	0.005	44	Coefficient of curvature	0.0	TRB Classification	A - 7 - 6
4.75	99	0.002	36			Unified Classification	CH
2.00	97			Remarks:			

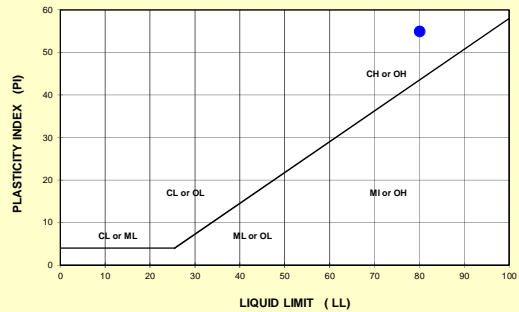
PARTICLE SIZE DISTRIBUTION



POTENTIAL EXPANSIVENESS Van der Merwe's Activity Chart



CASAGRANDE 'A' LINE





T0023

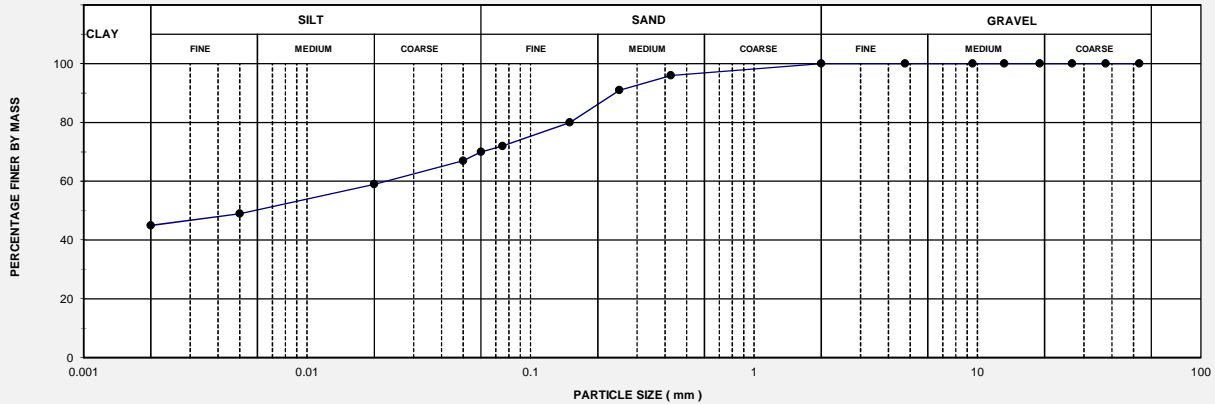


FOUNDATION INDICATOR TEST RESULTS - REP COM 7

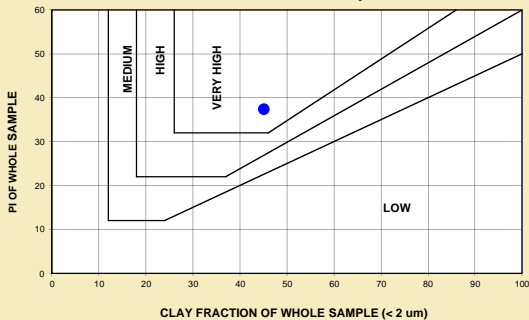
Client: Golder Associates	Source/Location:	Job No: 2016-C-1779
Project Name: Tutuka Ash Increase	Layer:	Sample No: 6/13748
Project No: 1658666	Lane:	Date: 20/01/2017
Hole/TP No: AWRD 16	Stabilizing Agent:	Test Method: TMH1 A1, A5 & ASTM D422
Depth (m): 0.9 - 3.0	Section:	Client Ref No:
Description:	Chainage:	GPS X:
Additional Info:	Offset:	GPS Y:

SIEVE ANALYSIS				ATTERBERG LIMITS		SOIL CLASSIFICATION	
Sieve (mm)	% Passing	Sieve (mm)	% Passing				
75.0	100	0.425	96	Liquid Limit (%)	63	% Gravel	0
63.0	100	0.250	91	Plastic Limit (%)	24	% Sand	30
53.0	100	0.150	80	Plasticity Index (%)	39	% Silt	25
37.5	100	0.075	72	Weighted PI (%)	37.4	% Clay	45
26.5	100	0.060	70	Linear Shrinkage (%)	14.0	Activity	0.9
19.0	100	0.050	67	Grading Modulus	0.32	% Soil Mortar	100
13.2	100	0.020	59	Uniformity coefficient	12	Coarse Sand Ratio	0.04
9.5	100	0.005	49	Coefficient of curvature	0.1	TRB Classification	A - 7 - 6
4.75	100	0.002	45			Unified Classification	CH
2.00	100			Remarks:			

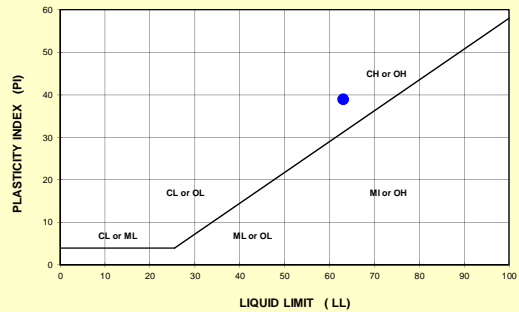
PARTICLE SIZE DISTRIBUTION



POTENTIAL EXPANSIVENESS Van der Merwe's Activity Chart



CASAGRANDE 'A' LINE



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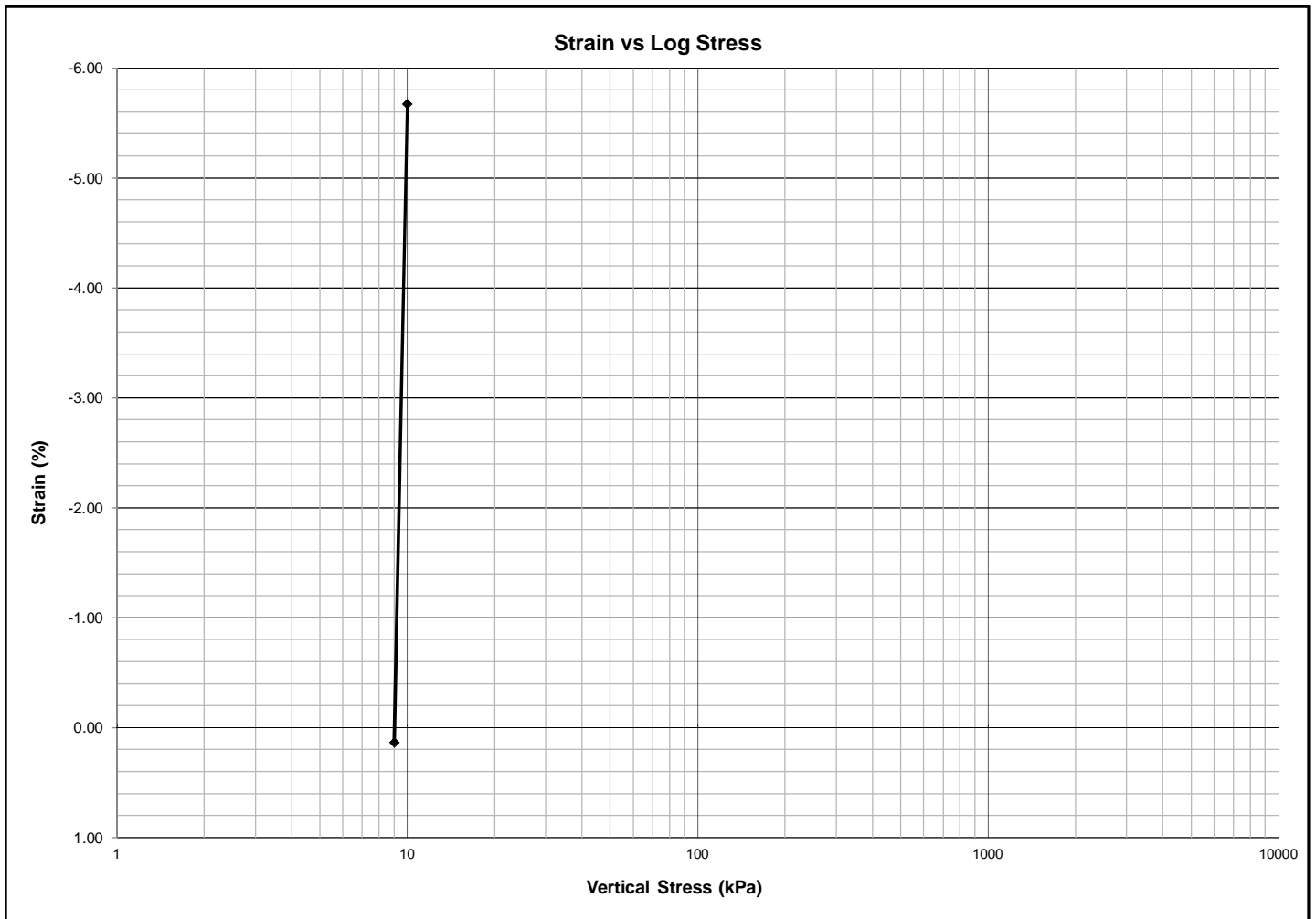
CONSOLIDATION TESTS: FREESWELL

**BS 1377
Part 5**

Client Golder Associates	Project Tutuka-Ash Increase	Job no 2016-C-1779
Sample no AD11	Depth (m) 0.25 - 0.55	Date 2/2/2017
Lab no 6/13706		

Sample Parameters	Unit	Value	Remarks	Test Remarks	
Moisture Content	Before Test	%	22.2	Complete test specimen	Undisturbed
	After Test	%	30.6	Complete test specimen	Soaked @ 10 kPa
Dry Density	Kg/m ³	1580			Swell: 5.8%
Void Ratio	-	0.613			
Degree of Saturation	%	92.3			
Initial Specimen Height	mm	25.4			
Relative Density (SG)	-	2.549	Determined		

Test Parameters													
Vertical Stress	kPa	9	10										
Time Elapsed	hr	24	24										
H ₁₀₀	mm	25.365	26.841										
Strain	%	0.137	-5.673										
Void Ratio	-	0.611	0.704										
Mv (1/Mpa)	-	-	-										



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CONSOLIDATION TESTS: FREESWELL

**BS 1377
Part 5**

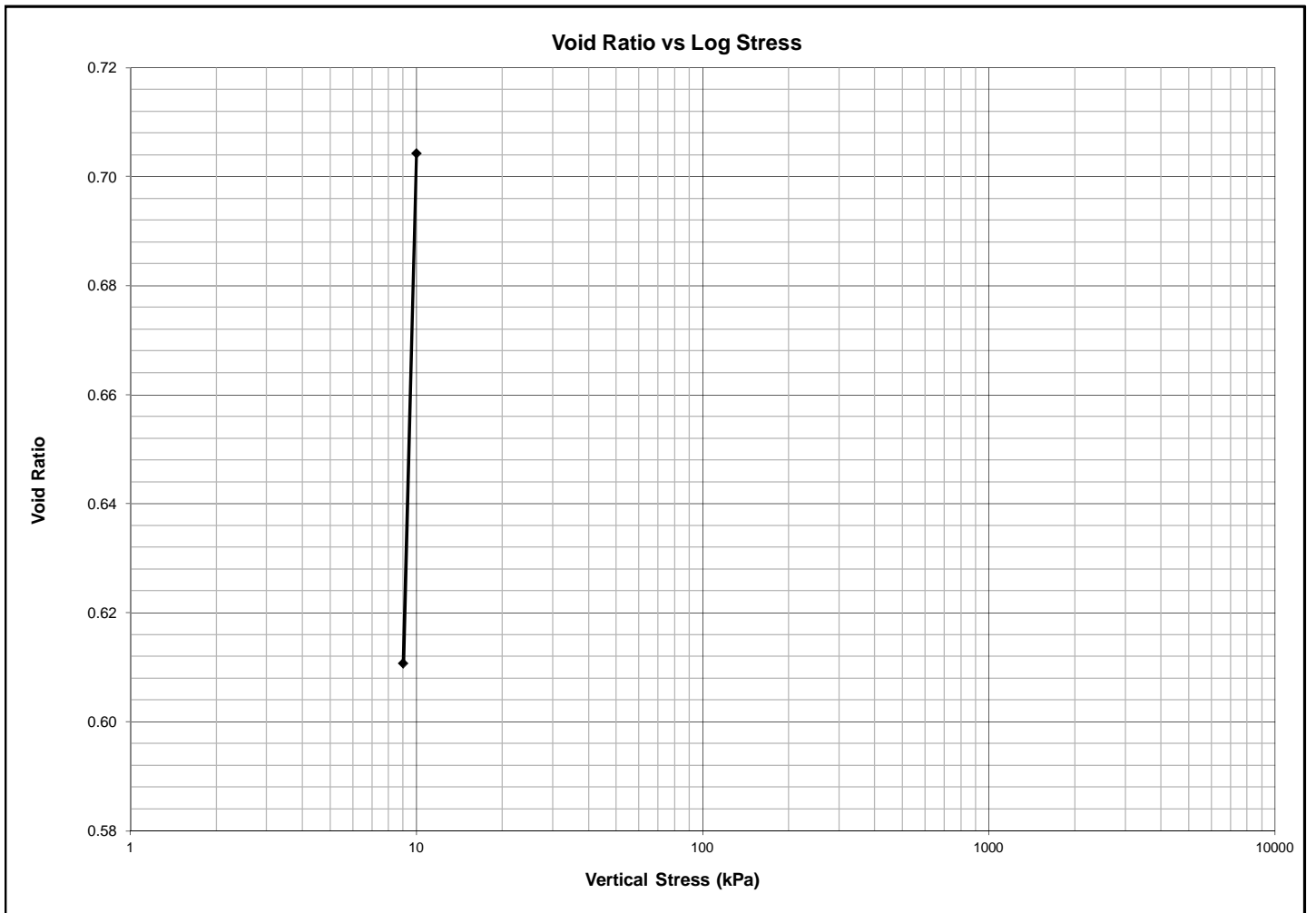
Client Golder Associates
Sample no AD11
Lab no 6/13706

Project Tutuka-Ash Increase
Depth (m) 0.25 - 0.55

Job no 2016-C-1779
Date 2/2/2017

Sample Parameters	Unit	Value	Remarks	Test Remarks
Moisture Content	Before Test	22.2	Complete test specimen	Undisturbed
	After Test	30.6		Soaked @ 10 kPa
Dry Density	Kg/m ³	1580		Swell: 5.8%
Void Ratio	-	0.613		
Degree of Saturation	%	92.3		
Initial Specimen Height	mm	25.4		
Relative Density (SG)	-	2.549		Determined

Test Parameters											
Vertical Stress	kPa	9	10								
Time Elapsed	hr	24	24								
H ₁₀₀	mm	25.365	26.841								
Strain	%	0.137	-5.673								
Void Ratio	-	0.611	0.704								
Mv (1/Mpa)	-	-	-								



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Civil Engineering

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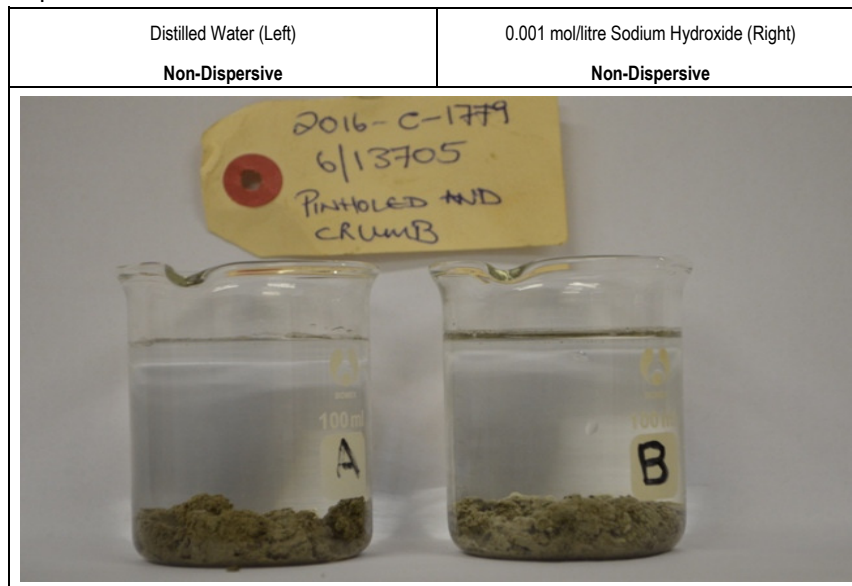
Tel/Fax 012 346 7586
Cell: 082 375 3003
bennie@geotesting.co.za

Client Name:	Geostrada	Date sampled/tested on site:	-
Client Contact:	Hennie Barnard	Sample Receive Date:	23-Jan-17
Project:	2016-C-1779	Laboratory Sample Number:	17/124
Order Number:	200.044	Report Revision:	Rev 0
Laboratory Project Number:	B656	Report Date:	28-Feb-17
Client Sample Number/Reference:	AD58	Tests:	Crumb Test (BS1377:Part 5:1990.6.3)
Sample Position/Depth:	0.7-0.8m	Remarks:	-

Elapsed Time: Zero Minutes



Result after Elapsed Time: 5 Minutes





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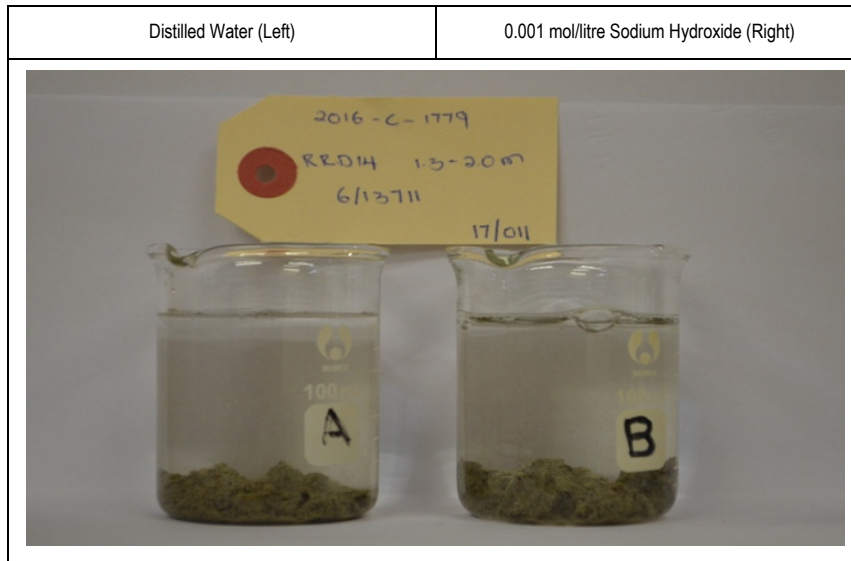
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Monument Park
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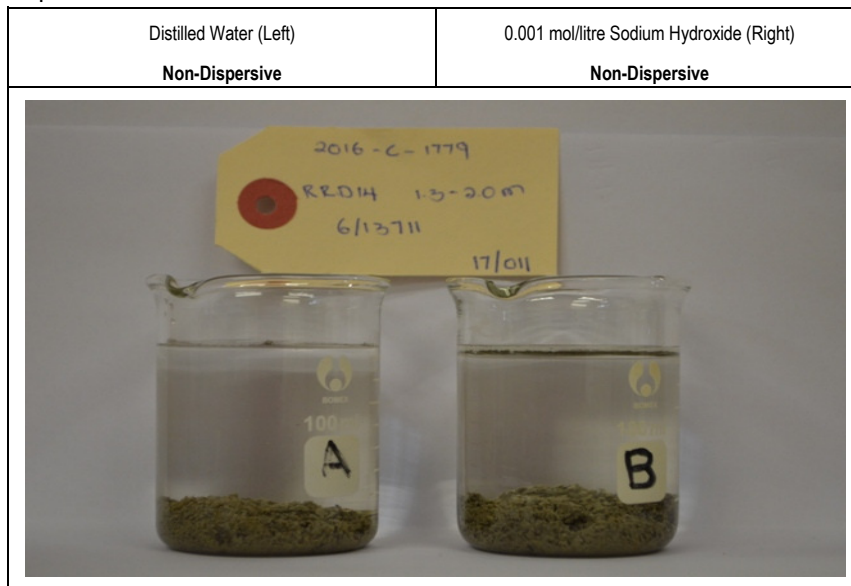
Tel/Fax 012 346 7586
Cell: 082 375 3003
bennie@geotesting.co.za

Client Name:	Geostrada	Date sampled/tested on site:	-
Client Contact:	Hennie Barnard	Sample Receive Date:	17-Jan-17
Project:	2016-C-1779	Laboratory Sample Number:	17/011
Order Number:	200.044	Report Revision:	Rev 0
Laboratory Project Number:	B656	Report Date:	03-Feb-17
Client Sample Number/Reference:	RRD14	Tests:	Crumb Test (BS1377:Part 5:1990:6.3)
Sample Position/Depth:	1.3-2.0m	Remarks:	-

Elapsed Time: Zero Minutes



Result after Elapsed Time: 5 Minutes





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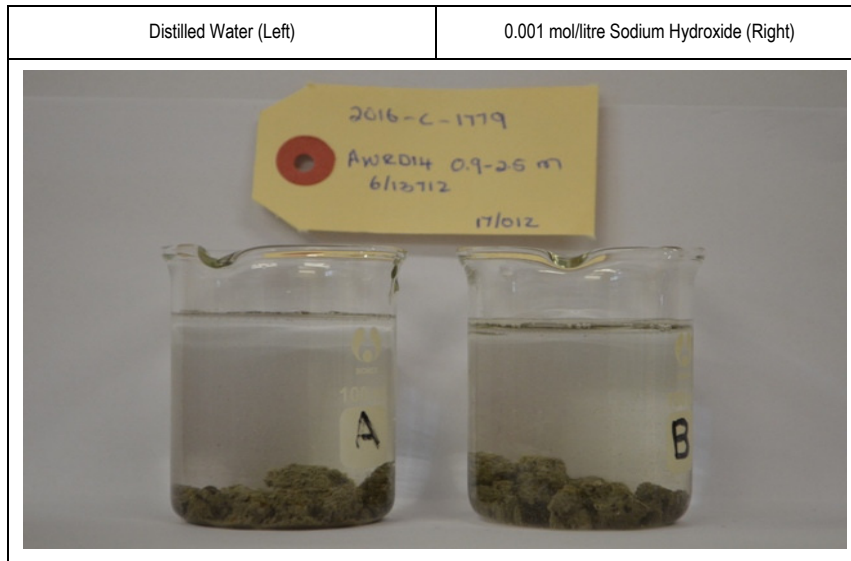
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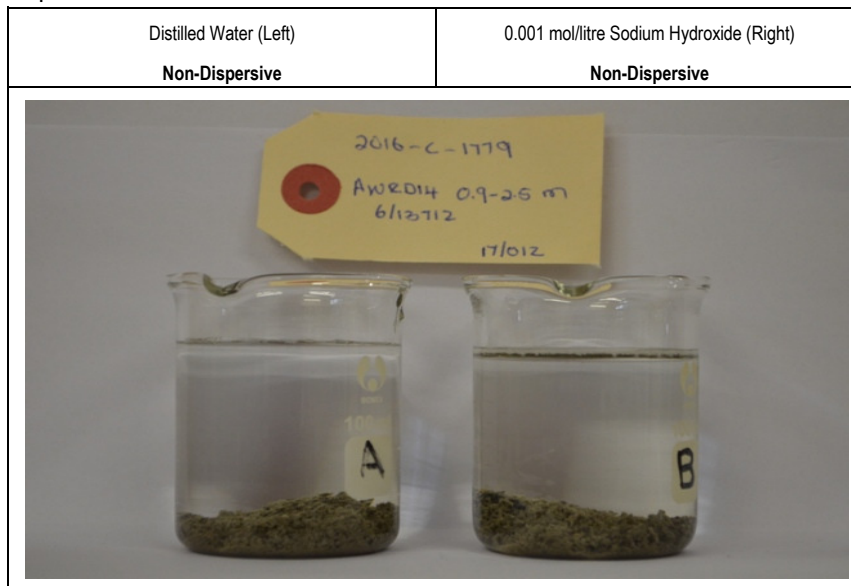
Tel/Fax 012 346 7586
Cell: 082 375 3003
bennie@geotesting.co.za

Client Name:	Geostrada	Date sampled/tested on site:	-
Client Contact:	Hennie Barnard	Sample Receive Date:	17-Jan-17
Project:	2016-C-1779	Laboratory Sample Number:	17/012
Order Number:	200.044	Report Revision:	Rev 0
Laboratory Project Number:	B656	Report Date:	03-Feb-17
Client Sample Number/Reference:	AWRD14	Tests:	Crumb Test (BS1377:Part 5:1990:6.3)
Sample Position/Depth:	0.9-2.5m	Remarks:	-

Elapsed Time: Zero Minutes



Result after Elapsed Time: 5 Minutes





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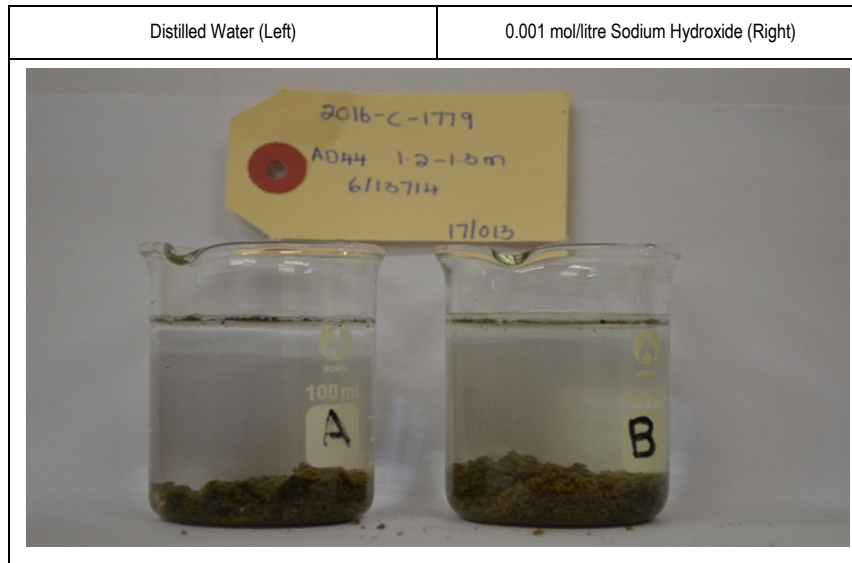
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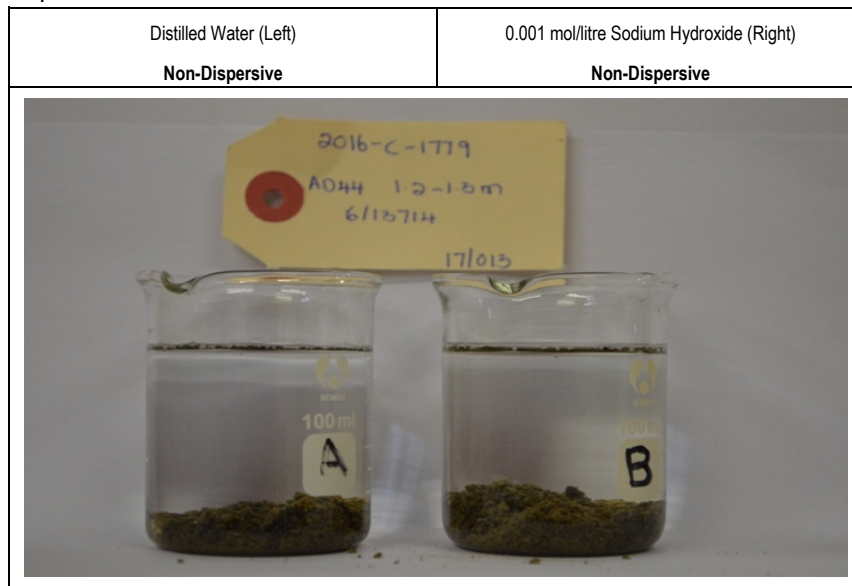
Tel/Fax 012 346 7586
Cell: 082 375 3003
bennie@geotesting.co.za

Client Name:	Geostrada	Date sampled/tested on site:	-
Client Contact:	Hennie Barnard	Sample Receive Date:	17-Jan-17
Project:	2016-C-1779	Laboratory Sample Number:	17/013
Order Number:	200.044	Report Revision:	Rev 0
Laboratory Project Number:	B656	Report Date:	03-Feb-17
Client Sample Number/Reference:	AD44	Tests:	Crumb Test (BS1377:Part 5:1990:6.3)
Sample Position/Depth:	1.2-1.3m	Remarks:	-

Elapsed Time: Zero Minutes



Result after Elapsed Time: 5 Minutes





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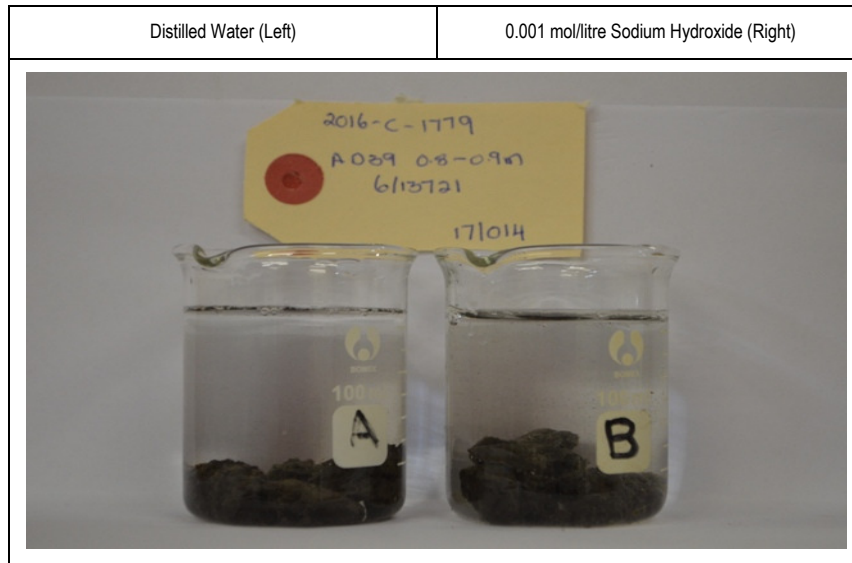
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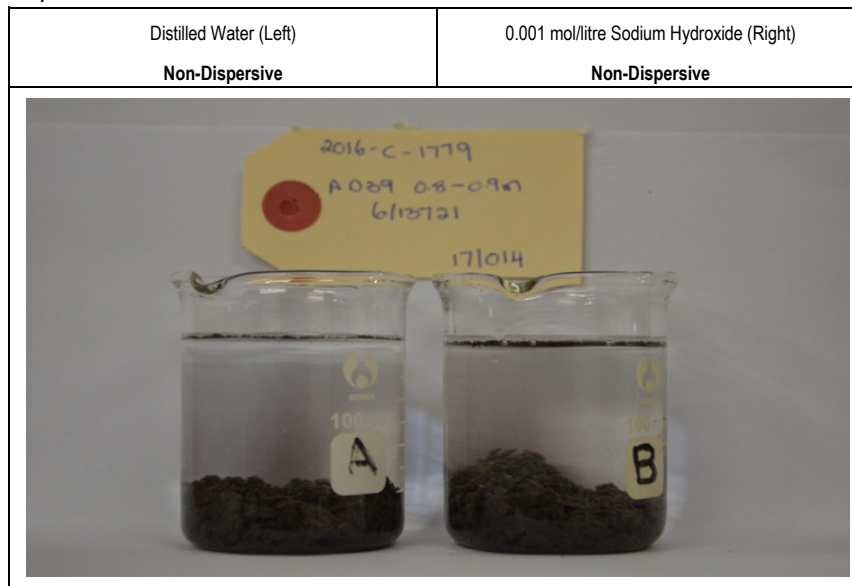
Tel/Fax 012 346 7586
Cell: 082 375 3003
bennie@geotesting.co.za

Client Name:	Geostrada	Date sampled/tested on site:	-
Client Contact:	Hennie Barnard	Sample Receive Date:	17-Jan-17
Project:	2016-C-1779	Laboratory Sample Number:	17/014
Order Number:	200.044	Report Revision:	Rev 0
Laboratory Project Number:	B656	Report Date:	03-Feb-17
Client Sample Number/Reference:	AD39	Tests:	Crumb Test (BS1377:Part 5:1990:6.3)
Sample Position/Depth:	0.8-0.9m	Remarks:	-

Elapsed Time: Zero Minutes



Result after Elapsed Time: 5 Minutes





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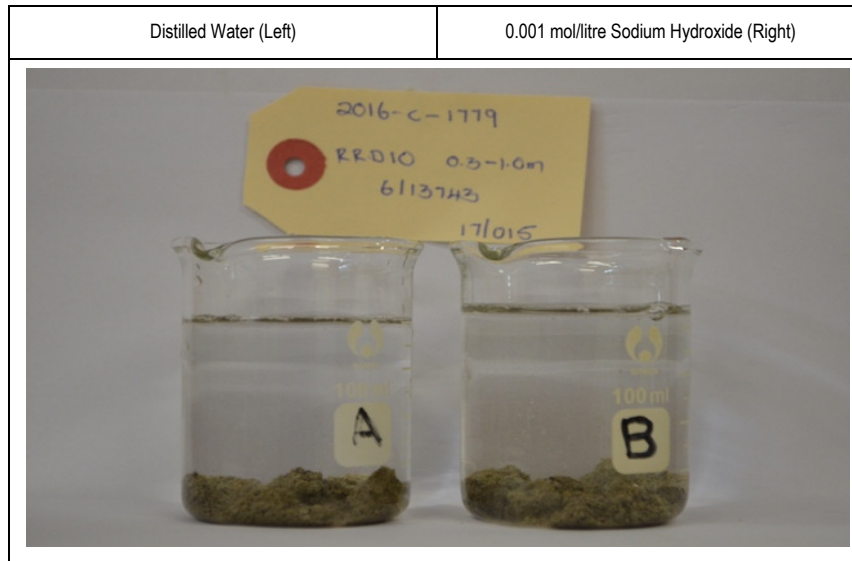
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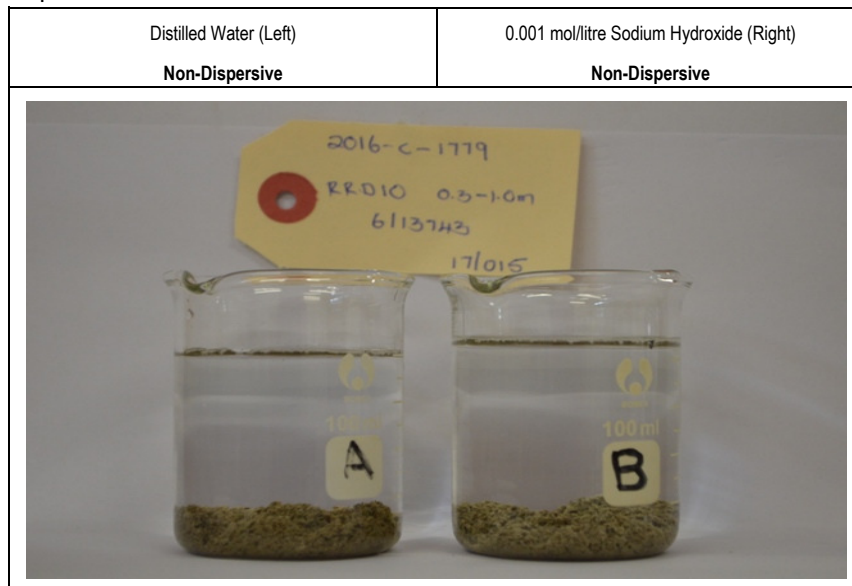
Tel/Fax 012 346 7586
Cell: 082 375 3003
bennie@geotesting.co.za

Client Name:	Geostrada	Date sampled/tested on site:	-
Client Contact:	Hennie Barnard	Sample Receive Date:	17-Jan-17
Project:	2016-C-1779	Laboratory Sample Number:	17/015
Order Number:	200.044	Report Revision:	Rev 0
Laboratory Project Number:	B656	Report Date:	03-Feb-17
Client Sample Number/Reference:	RRD10	Tests:	Crumb Test (BS1377:Part 5:1990.6.3)
Sample Position/Depth:	0.3-1.0m	Remarks:	-

Elapsed Time: Zero Minutes



Result after Elapsed Time: 5 Minutes



Project:	2016-C-1779	Test Type:	Permeameter Cell Falling Head Permeability
Sample No:	AD05	Sample Preparation:	Remoulded
Sample Position:	1.9-2.1m	Start Date:	Rev 0 20-Jan-17
Lab No.:	17/005		

Preparation:

Specified Dry Density (kg/m ³):	1317
Optimum Moisture Content (%):	20.4%
Target % of Dry Density (%):	100.0%
Target Dry Density (kg/m ³):	1317
Target Moisture Content (%):	21.4%
Specimen Length L (mm):	68.2
Specimen Diameter (mm):	64.5
Specimen Area A (mm ²):	3266.2
Specimen Vol. (cm ³):	222.7
Sample Mass (g):	357.2
Specimen Moisture Content(%):	23.7%
Specimen Bulk Density (kg/m ³):	1604
Specimen Dry Density (kg/m ³):	1296
Final % of Specified Dry Density (%):	98.4%
Particle Density:	<i>Assumed</i> 2.65
Vol. of Soil (V _s) (cm ³):	109.0
Initial Vol. of Voids (V _v) cm ³):	113.8
Initial Voids Ratio (e) (V _v /V _s):	1.04
Tube Area (a) (mm ²):	168.1
Soaking Tank Water Temperature (°C):	26.0
Temperature Correction Factor:	0.89

Time Readings and Permeability:

	Elapsed Time (min)	Height (h) above outlet (mm)	Height Ratio (h ₁ /h ₃ or h ₃ /h ₂)	k _T (m/s)	Averaged k _T :
Run 1	0.0	3540.0	1.04	5.02E-10	
	4030.0	3419.8			4.23E-10
	7080.0	3359.1	1.02	3.44E-10	

Permeability (K.H. Head Vol 2):

$$k_T = 3.84(aL/At)\log_{10}(h_1/h_2) \times 10^{-9} \text{ m/s}$$

Selected k_T: 4.23E-10

k_{T20} Temperature Correction: 3.75E-10

Permeability k_{T20} = 3.75E-10 m/s

Project: 2016-C-1779 Test Type: Permeameter Cell Falling Head Permeability
 Sample No: AD38 Sample Preparation: Remoulded
 Sample Position: 1.4-1.8m Start Date: Rev 0 20-Jan-17
 Lab No.: 17/006

Preparation:

Specified Dry Density (kg/m³): 1317
 Optimum Moisture Content (%): 20.4%
 Target % of Dry Density (%): 100.0%
 Target Dry Density (kg/m³): 1317
 Target Moisture Content (%): 21.4%
 Specimen Length L (mm): 63.5
 Specimen Diameter (mm): 63.1
 Specimen Area A (mm²): 3129.9
 Specimen Vol. (cm³): 198.7
 Sample Mass (g): 315.2
 Specimen Moisture Content(%): 23.9%
 Specimen Bulk Density (kg/m³): 1586
 Specimen Dry Density (kg/m³): 1280
 Final % of Specified Dry Density (%): 97.2%
 Particle Density: *Assumed* 2.65
 Vol. of Soil (V_s) (cm³): 96.0
 Initial Vol. of Voids (V_v) cm³): 102.8
 Initial Voids Ratio (e) (V_v/V_s): 1.07
 Tube Area (a) (mm²): 160.0
 Soaking Tank Water Temperature (°C): 26.0
 Temperature Correction Factor: 0.89

Time Readings and Permeability:

	Elapsed Time (min)	Height (h) above outlet (mm)	Height Ratio (h1/h3 or h3/h2)	kT (m/s)	Averaged k _T :
Run 1	0.0	3488.0	1.12	5.64E-08	
	105.0	3126.8			4.31E-08
	230.0	2918.0	1.07	2.99E-08	
Run 2	0.0	3488.0	1.11	4.18E-08	
	140.0	3130.5			4.81E-08
	225.0	2874.3	1.09	5.44E-08	
Run 3	0.0	3488.0	1.10	1.42E-07	
	35.0	3181.8			1.24E-07
	85.0	2885.5	1.10	1.06E-07	
Run 4	0.0	3488.0	1.08	1.60E-07	
	25.0	3239.3			1.32E-07
	90.0	2863.0	1.13	1.03E-07	
Run 5	0.0	3488.0	1.07	9.78E-08	
	35.0	3274.3			8.61E-08
	113.0	2941.8	1.11	7.43E-08	
Run 6	0.0	3488.0	1.05	5.02E-08	
	49.0	3333.0			6.67E-08
	114.0	3016.1	1.11	8.32E-08	
Run 7	0.0	3488.0	1.11	8.25E-08	
	67.0	3149.3			7.66E-08
	140.0	2863.0	1.10	7.07E-08	

$$k_T = 3.84(aL/At)\log_{10}(h_1/h_2) \times 10^{-9} \text{ m/s}$$

Selected k_T: 4.31E-08

k_{T20} Temperature Correction: 3.83E-08

Permeability k_{T20} = 3.83E-08 m/s



du Plessis
Civil Engineering

Req. No: cc 200004833323

250 ORION Ave
Monument Park
0181

PO Box 26272
Monument Park
0105

Tel/Fax 012 346 7586
Cell: 082 375 3003
bennie@geotesting.co.za

Project:	2016-C-1779	Test Type:	Permeameter Cell Falling Head Permeability
Sample No:	AD44	Sample Preparation:	Remoulded
Sample Position:	1.2-1.3m	Start Date:	Rev 0 06-Feb-17
Lab No.:	17/010		

Preparation:

Specified Dry Density (kg/m ³):	1395
Optimum Moisture Content (%):	20.9%
Target % of Dry Density (%):	100.0%
Target Dry Density (kg/m ³):	1395
Target Moisture Content (%):	22.9%
Specimen Length L (mm):	62.9
Specimen Diameter (mm):	63.5
Specimen Area A (mm ²):	3168.9
Specimen Vol. (cm ³):	199.4
Sample Mass (g):	338.2
Specimen Moisture Content(%):	22.1%
Specimen Bulk Density (kg/m ³):	1696
Specimen Dry Density (kg/m ³):	1389
Final % of Specified Dry Density (%):	99.5%
Particle Density:	<i>Assumed</i> 2.65
Vol. of Soil (V _s) (cm ³):	104.5
Initial Vol. of Voids (V _v) cm ³):	94.9
Initial Voids Ratio (e) (V _v /V _s):	0.91
Tube Area (a) (mm ²):	168.1
Soaking Tank Water Temperature (°C):	26.0
Temperature Correction Factor:	0.89

Time Readings and Permeability:

	Elapsed Time (min)	Height (h) above outlet (mm)	Height Ratio (h1/h3 or h3/h2)	kT (m/s)	Averaged k _T :
Run 1	0.0	3540.0	1.02	8.02E-10	
	1390.0	3469.8			7.24E-10
	2910.0	3409.1	1.02	6.46E-10	

Permeability (K.H. Head Vol 2):

$$k_T = 3.84(aL/At)\log_{10}(h_1/h_2) \times 10^{-9} \text{ m/s}$$

Selected k_T: 7.24E-10

k_{T20} Temperature Correction: 6.42E-10

Permeability k_{T20} = 6.42E-10 m/s



du Plessis
Civil Engineering

Req. No: cc 200004833323

250 ORION Ave
Monument Park
0181

PO Box 26272
Monument Park
0105

Tel/Fax 012 346 7586
Cell: 082 375 3003
bennie@geotesting.co.za

Project: 2016-C-1779
Sample No: AD58
Sample Position: 0.5-0.6m
Lab No.: 17/007

Test Type: Permeameter Cell Falling Head Permeability
Sample Preparation: Remoulded
Start Date: Rev 0 30-Jan-17

Preparation:

Specified Dry Density (kg/m³): 1317
Optimum Moisture Content (%): 20.4%
Target % of Dry Density (%): 100.0%
Target Dry Density (kg/m³): 1317
Target Moisture Content (%): 21.4%
Specimen Length L (mm): 67.9
Specimen Diameter (mm): 64.5
Specimen Area A (mm²): 3266.7
Specimen Vol. (cm³): 221.7
Sample Mass (g): 357.2
Specimen Moisture Content(%): 20.2%
Specimen Bulk Density (kg/m³): 1611
Specimen Dry Density (kg/m³): 1340
Final % of Specified Dry Density (%): 101.8%
Particle Density: *Assumed* 2.65
Vol. of Soil (V_s) (cm³): 112.1
Initial Vol. of Voids (V_v) cm³): 109.6
Initial Voids Ratio (e) (V_v/V_s): 0.98
Tube Area (a) (mm²): 168.1
Soaking Tank Water Temperature (°C): 22.3
Temperature Correction Factor: 0.97

Time Readings and Permeability:

	Elapsed Time (min)	Height (h) above outlet (mm)	Height Ratio (h1/h3 or h3/h2)	kT (m/s)	Averaged k _T :
Run 1	0.0	3540.0	1.02	6.92E-10	
	1311.0	3485.3			4.36E-10
	4205.0	3454.3	1.01	1.79E-10	

Permeability (K.H. Head Vol 2):

$$k_T = 3.84(aL/At)\log_{10}(h_1/h_2) \times 10^{-9} \text{ m/s}$$

Selected k_T: 4.36E-10

k_{T20} Temperature Correction: 4.24E-10

Permeability k_{T20} = 4.24E-10 m/s



BM du Plessis
Civil Engineering

Req. No: cc 200004833323

250 ORION Ave
Monument Park
0181

PO Box 26272
Monument Park
0105

Tel/Fax 012 346 7586
Cell: 082 375 3003
bennie@geotesting.co.za

Project:	2016-C-1779	Test Type:	Permeameter Cell Falling Head Permeability
Sample No:	AWDR14	Sample Preparation:	Remoulded
Sample Position:	0.9-2.5m	Start Date:	Rev 0 06-Feb-17
Lab No.:	17/009		

Preparation:

Specified Dry Density (kg/m ³):	1448.44
Optimum Moisture Content (%):	20.1%
Target % of Dry Density (%):	100.0%
Target Dry Density (kg/m ³):	1448.44
Target Moisture Content (%):	22.1%
Specimen Length L (mm):	68.2
Specimen Diameter (mm):	64.3
Specimen Area A (mm ²):	3251.5
Specimen Vol. (cm ³):	221.8
Sample Mass (g):	393.8
Specimen Moisture Content(%):	22.8%
Specimen Bulk Density (kg/m ³):	1776
Specimen Dry Density (kg/m ³):	1446
Final % of Specified Dry Density (%):	99.8%
Particle Density: <i>Assumed</i>	2.65
Vol. of Soil (V _s) (cm ³):	121.0
Initial Vol. of Voids (V _v) cm ³):	100.7
Initial Voids Ratio (e) (V _v /V _s):	0.83
Tube Area (a) (mm ²):	168.1
Soaking Tank Water Temperature (°C):	26.0
Temperature Correction Factor:	0.89

Time Readings and Permeability:

	Elapsed Time (min)	Height (h) above outlet (mm)	Height Ratio (h1/h3 or h3/h2)	kT (m/s)	Averaged k _T :
Run 1	0.0	3458.0	1.01	3.36E-10	
	1390.0	3430.6			2.82E-10
	2910.0	3410.4	1.01	2.29E-10	

Permeability (K.H. Head Vol 2):

$$k_T = 3.84(aL/At)\log_{10}(h_1/h_2) \times 10^{-9} \text{ m/s}$$

Selected k_T: 2.82E-10

k_{T20} Temperature Correction: 2.51E-10

Permeability k_{T20} = 2.51E-10 m/s



BM du Plessis
Civil Engineering

Req. No: cc 200004833323

250 ORION Ave
Monument Park
0181

PO Box 26272
Monument Park
0105

Tel/Fax 012 346 7586
Cell: 082 375 3003
bennie@geotesting.co.za

Project:	2016-C-1779	Test Type:	Permeameter Cell Falling Head Permeability
Sample No:	RRD14	Sample Preparation:	Remoulded
Sample Position:	1.3-2.0m	Start Date:	Rev 0 30-Jan-17
Lab No.:	17/008		

Preparation:

Specified Dry Density (kg/m ³):	1287
Optimum Moisture Content (%):	23.9%
Target % of Dry Density (%):	100.0%
Target Dry Density (kg/m ³):	1287
Target Moisture Content (%):	25.9%
Specimen Length L (mm):	63.2
Specimen Diameter (mm):	63.4
Specimen Area A (mm ²):	3160.7
Specimen Vol. (cm ³):	199.9
Sample Mass (g):	321.2
Specimen Moisture Content(%):	25.3%
Specimen Bulk Density (kg/m ³):	1607
Specimen Dry Density (kg/m ³):	1282
Final % of Specified Dry Density (%):	99.6%
Particle Density: <i>Assumed</i>	2.65
Vol. of Soil (V _s) (cm ³):	96.7
Initial Vol. of Voids (V _v) cm ³):	103.2
Initial Voids Ratio (e) (V _v /V _s):	1.07
Tube Area (a) (mm ²):	168.1
Soaking Tank Water Temperature (°C):	22.3
Temperature Correction Factor:	0.97

Time Readings and Permeability:

	Elapsed Time (min)	Height (h) above outlet (mm)	Height Ratio (h1/h3 or h3/h2)	kT (m/s)	Averaged k _T :
Run 1	0.0	3458.0	1.03	1.28E-09	
	1311.0	3355.7			8.79E-10
	4205.0	3274.7	1.02	4.73E-10	

Permeability (K.H. Head Vol 2):

$$k_T = 3.84(aL/At)\log_{10}(h_1/h_2) \times 10^{-9} \text{ m/s}$$

Selected k_T: 8.79E-10

k_{T20} Temperature Correction: 8.55E-10

Permeability k_{T20} = 8.55E-10 m/s



du Plessis
Civil Engineering

Reg. No: cc 20000483323

250 ORION Ave
Monument Park
0181

PO Box 26272
Monument Park
0105

Tel/Fax 012 346 7586
Cell: 082 375 3003
bennie@geotesting.co.za

Client Name:	Geostrada	Date sampled/tested on site:	-
Client Contact:	Hennie Barnard	Sample Receive Date:	16-Jan-17
Project:	2016-C-1779	Laboratory Sample Number:	17/014
Order Number:	200.044	Report Revision:	0
Laboratory Project Number:	B656	Report Date:	31-Jan-17
Client Sample Number/Reference:	AD39	Tests:	Pinhole Test (BS1377:Part 5:1990:6.3)
Sample Position/Depth:	0.8-0.9m	Remarks:	-

Preparation:

Specimen Initial Moisture (%):	32.4%
Specimen Dry Density (kg/m ³):	1658
Specimen After Test Moisture (%):	39.1%

Test Outcome: **Non-dispersive**

Pinhole Test Sequence

	Head (mm)	Steady Flow (ml/s)	Colour of Water collected	Test Stopped?	Continue test stage?	New Specimen?	Hole Diam. (mm)
Stage 1	50	0.26	Perfectly Clear	No	Yes	No	N/A
Stage 2	180	1.05	Perfectly Clear	No	Yes	No	N/A
Stage 3	380	1.88	Perfectly Clear	No	Yes	No	N/A
Stage 4	1020	3.56	Perfectly Clear	Yes	No	No	1.0

Pinhole Test Outcome

Selected Class	Dispersive Class	Head (mm)	Final Flow (ml/s)	Cloudiness of flow at end of test	Hole Size After Test
	D1	50	1.0 - 1.4	Dark	≥2
	D2	50	1.0 - 1.4	Moderately	>1.5
	ND4	50	0.8 - 1.0	Slightly Dark	≤1.5
>	ND3	180	1.4 - 2.7	Barely Visible	≥1.5
		380	1.8 - 3.2		
	ND2	1020	>3.0	Clear	<1.5
	ND1	1020	≤3.0	Perfectly Clear	1

Notes:



du Plessis
Civil Engineering

Reg. No: cc 20000483323

250 ORION Ave
Monument Park
0181

PO Box 26272
Monument Park
0105

Tel/Fax 012 346 7586
Cell: 082 375 3003
bennie@geotesting.co.za

Client Name:	Geostrada	Date sampled/tested on site:	-
Client Contact:	Hennie Barnard	Sample Receive Date:	16-Jan-17
Project:	2016-C-1779	Laboratory Sample Number:	17/013
Order Number:	200.044	Report Revision:	0
Laboratory Project Number:	B656	Report Date:	31-Jan-17
Client Sample Number/Reference:	AD44	Tests:	Pinhole Test (BS1377:Part 5:1990:6.3)
Sample Position/Depth:	1.2-1.3m	Remarks:	-

Preparation:

Specimen Initial Moisture (%):	31.7%
Specimen Dry Density (kg/m ³):	1518
Specimen After Test Moisture (%):	34.5%

Test Outcome: **Non-dispersive**

Pinhole Test Sequence

	Head (mm)	Steady Flow (ml/s)	Colour of Water collected	Test Stopped?	Continue test stage?	New Specimen?	Hole Diam. (mm)
Stage 1	50	0.30	Perfectly Clear	No	Yes	No	N/A
Stage 2	180	1.04	Perfectly Clear	No	Yes	No	N/A
Stage 3	380	2.13	Perfectly Clear	No	Yes	No	N/A
Stage 4	1020	2.56	Perfectly Clear	Yes	No	No	1.1

Pinhole Test Outcome

Selected Class	Dispersive Class	Head (mm)	Final Flow (ml/s)	Cloudiness of flow at end of test	Hole Size After Test
	D1	50	1.0 - 1.4	Dark	≥2
	D2	50	1.0 - 1.4	Moderately	>1.5
	ND4	50	0.8 - 1.0	Slightly Dark	≤1.5
>	ND3	180	1.4 - 2.7	Barely Visible	≥1.5
		380	1.8 - 3.2		
	ND2	1020	>3.0	Clear	<1.5
	ND1	1020	≤3.0	Perfectly Clear	1

Notes:



du Plessis
Civil Engineering

Reg. No: cc 20000483323

250 ORION Ave
Monument Park
0181

PO Box 26272
Monument Park
0105

Tel/Fax 012 346 7586
Cell: 082 375 3003
bennie@geotesting.co.za

Client Name:	Geostrada	Date sampled/tested on site:	-
Client Contact:	Hennie Barnard	Sample Receive Date:	23-Feb-17
Project:	2016-C-1779	Laboratory Sample Number:	17/124
Order Number:	200.044	Report Revision:	0
Laboratory Project Number:	B656	Report Date:	28-Feb-17
Client Sample Number/Reference:	AD58	Tests:	Pinhole Test (BS1377:Part 5:1990:6.3)
Sample Position/Depth:	0.7-0.8m	Remarks:	-

Preparation:

Specimen Initial Moisture (%):	26.4%
Specimen Dry Density (kg/m ³):	1448
Specimen After Test Moisture (%):	34.5%

Test Outcome: **Non-dispersive**

Pinhole Test Sequence

	Head (mm)	Steady Flow (ml/s)	Colour of Water collected	Test Stopped?	Continue test stage?	New Specimen?	Hole Diam. (mm)
Stage 1	50	0.42	Perfectly Clear	No	Yes	No	N/A
Stage 2	180	0.99	Perfectly Clear	No	Yes	No	N/A
Stage 3	380	1.89	Perfectly Clear	No	Yes	No	N/A
Stage 4	1020	2.35	Perfectly Clear	Yes	No	No	0.9

Pinhole Test Outcome

Selected Class	Dispersive Class	Head (mm)	Final Flow (ml/s)	Cloudiness of flow at end of test	Hole Size After Test
	D1	50	1.0 - 1.4	Dark	≥2
	D2	50	1.0 - 1.4	Moderately	>1.5
	ND4	50	0.8 - 1.0	Slightly Dark	≤1.5
>	ND3	180	1.4 - 2.7	Barely Visible	≥1.5
		380	1.8 - 3.2		
	ND2	1020	>3.0	Clear	<1.5
	ND1	1020	≤3.0	Perfectly Clear	1

Notes:



BM du Plessis
Civil Engineering

Reg. No: cc 20000483323

250 ORION Ave
Monument Park
0181

PO Box 26272
Monument Park
0105

Tel/Fax 012 346 7586
Cell: 082 375 3003
bennie@geotesting.co.za

Client Name:	Geostrada	Date sampled/tested on site:	-
Client Contact:	Hennie Barnard	Sample Receive Date:	16-Jan-17
Project:	2016-C-1779	Laboratory Sample Number:	17/012
Order Number:	200.044	Report Revision:	0
Laboratory Project Number:	B656	Report Date:	31-Jan-17
Client Sample Number/Reference:	AWRD14	Tests:	Pinhole Test (BS1377:Part 5:1990:6.3)
Sample Position/Depth:	0.9-2.5m	Remarks:	-

Preparation:

Specimen Initial Moisture (%):	24.0%
Specimen Dry Density (kg/m ³):	1424
Specimen After Test Moisture (%):	29.2%

Test Outcome: **Non-dispersive**

Pinhole Test Sequence

	Head (mm)	Steady Flow (ml/s)	Colour of Water collected	Test Stopped?	Continue test stage?	New Specimen?	Hole Diam. (mm)
Stage 1	50	0.23	Perfectly Clear	No	Yes	No	N/A
Stage 2	180	1.00	Perfectly Clear	No	Yes	No	N/A
Stage 3	380	1.25	Perfectly Clear	No	Yes	No	N/A
Stage 4	1020	3.50	Perfectly Clear	Yes	No	No	1.0

Pinhole Test Outcome

Selected Class	Dispersive Class	Head (mm)	Final Flow (ml/s)	Cloudiness of flow at end of test	Hole Size After Test
	D1	50	1.0 - 1.4	Dark	≥2
	D2	50	1.0 - 1.4	Moderately	>1.5
	ND4	50	0.8 - 1.0	Slightly Dark	≤1.5
	ND3	180	1.4 - 2.7	Barely Visible	≥1.5
		380	1.8 - 3.2		
>	ND2	1020	>3.0	Clear	<1.5
	ND1	1020	≤3.0	Perfectly Clear	1

Notes:



du Plessis
Civil Engineering

Reg. No: cc 20000483323

250 ORION Ave
Monument Park
0181

PO Box 26272
Monument Park
0105

Tel/Fax 012 346 7586
Cell: 082 375 3003
bennie@geotesting.co.za

Client Name:	Geostrada	Date sampled/tested on site:	-
Client Contact:	Hennie Barnard	Sample Receive Date:	16-Jan-17
Project:	2016-C-1779	Laboratory Sample Number:	17/015
Order Number:	200.044	Report Revision:	0
Laboratory Project Number:	B656	Report Date:	31-Jan-17
Client Sample Number/Reference:	RRD10	Tests:	Pinhole Test (BS1377:Part 5:1990:6.3)
Sample Position/Depth:	0.3-1.0m	Remarks:	-

Preparation:

Specimen Initial Moisture (%):	15.8%
Specimen Dry Density (kg/m ³):	1649
Specimen After Test Moisture (%):	18.4%

Test Outcome: **Non-dispersive**

Pinhole Test Sequence

	Head (mm)	Steady Flow (ml/s)	Colour of Water collected	Test Stopped?	Continue test stage?	New Specimen?	Hole Diam. (mm)
Stage 1	50	0.15	Perfectly Clear	No	Yes	No	N/A
Stage 2	180	0.51	Perfectly Clear	No	Yes	No	N/A
Stage 3	380	1.36	Perfectly Clear	No	Yes	No	N/A
Stage 4	1020	2.96	Perfectly Clear	Yes	No	No	1.0

Pinhole Test Outcome

Selected Class	Dispersive Class	Head (mm)	Final Flow (ml/s)	Cloudiness of flow at end of test	Hole Size After Test
	D1	50	1.0 - 1.4	Dark	≥2
	D2	50	1.0 - 1.4	Moderately	>1.5
	ND4	50	0.8 - 1.0	Slightly Dark	≤1.5
	ND3	180	1.4 - 2.7	Barely Visible	≥1.5
		380	1.8 - 3.2		
	ND2	1020	>3.0	Clear	<1.5
>	ND1	1020	≤3.0	Perfectly Clear	1

Notes:



du Plessis
Civil Engineering

Reg. No: cc 20000483323

250 ORION Ave
Monument Park
0181

PO Box 26272
Monument Park
0105

Tel/Fax 012 346 7586
Cell: 082 375 3003
bennie@geotesting.co.za

Client Name:	Geostrada	Date sampled/tested on site:	-
Client Contact:	Hennie Barnard	Sample Receive Date:	16-Jan-17
Project:	2016-C-1779	Laboratory Sample Number:	17/011
Order Number:	200.044	Report Revision:	0
Laboratory Project Number:	B656	Report Date:	31-Jan-17
Client Sample Number/Reference:	RRD14	Tests:	Pinhole Test (BS1377:Part 5:1990:6.3)
Sample Position/Depth:	1.3-2.0m	Remarks:	-

Preparation:

Specimen Initial Moisture (%):	29.5%
Specimen Dry Density (kg/m ³):	1277
Specimen After Test Moisture (%):	44.7%

Test Outcome: **Non-dispersive**

Pinhole Test Sequence

	Head (mm)	Steady Flow (ml/s)	Colour of Water collected	Test Stopped?	Continue test stage?	New Specimen?	Hole Diam. (mm)
Stage 1	50	0.09	Perfectly Clear	Yes	No	No	0
Stage 2	180	0.99	Perfectly Clear	No	Yes	Yes	N/A
Stage 3	380	1.50	Perfectly Clear	No	Yes	No	N/A
Stage 4	1020	3.33	Perfectly Clear	Yes	No	No	1.0

Pinhole Test Outcome

Selected Class	Dispersive Class	Head (mm)	Final Flow (ml/s)	Cloudiness of flow at end of test	Hole Size After Test
	D1	50	1.0 - 1.4	Dark	≥2
	D2	50	1.0 - 1.4	Moderately	>1.5
	ND4	50	0.8 - 1.0	Slightly Dark	≤1.5
	ND3	180	1.4 - 2.7	Barely Visible	≥1.5
		380	1.8 - 3.2		
>	ND2	1020	>3.0	Clear	<1.5
	ND1	1020	≤3.0	Perfectly Clear	1

Notes: Stage 1: Material swell, reduces outflow and eventually closes hole

Issued by:

ROCKLAB

(ROCK MECHANICS & EXCAVATION LABORATORIES)

230 ALBERTUS STREET

LA MONTAGNE 0184

PRETORIA

SOUTH AFRICA

TEL: +27 12 8134910

E-MAIL: CHENJ@ROCKLAB.CO.ZA

RESULTS OF ROCK PROPERTIES TESTS

Sampling Site:

BY

DR J. F. CHEN

Submitted to:

GEOSTRADA

12 JANUARY 2017

C O N T E N T S

TABLE 1 RESULTS OF UNIAXIAL COMPRESSIVE STRENGTH TESTS

APPENDIX 1 FAILURE CODES FOR ROCK COMPRESSION TEST

TABLE 1 RESULTS OF UNIAXIAL COMPRESSIVE STRENGTH TESTS



Client: GEOSTRADA

Sampling Site:

12-01-2017

SPECIMEN PARTICULARS				SPECIMEN DIMENSIONS					SPECIMEN TEST RESULTS				
Rocklab Specimen No.	Sample No	Depth		Rock Type	Diameter	Height	Ratio of Height to Diameter	Mass	Density	Failure Load	Strength (UCS)	Failure Code	Note
		From ..	To ..										
		m	m		mm	mm		g	g/cm ³	kN	MPa		
UCS-01	BH 06	6.2	6.4		51.60	122.1	2.4	623.51	2.44	82.3	39.4	3B	
UCS-02	BH 07	3.2	3.4		50.20	60.9	1.2	282.53	2.34	44.7	22.6	XB	
UCS-03	BH 08	7.4	7.6		52.39	94.8	1.8	531.27	2.60	339.2	157.3	2B	

Note: All tests were conducted according to the ISRM's (International Society for Rock Mechanics) specification.

APPENDIX 1

CLASSIFICATION OF ROCK SPECIMEN FAILURE MODE INFLUENCED / NOT INFLUENCED BY DISCONTINUITIES DURING COMPRESSION TESTING

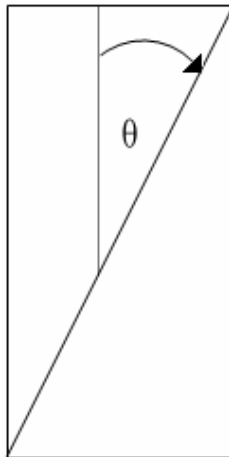
FAILURE NOT INFLUENCED BY DISCONTINUITIES (INTACT)

TYPE CODE	DESCRIPTION OF SUB CODES	
	A	B
X	SLIDING SHEAR FAILURE	COMPLETE CONE DEVELOPMENT
Y	SPLITTING	BREAKING INTO A LOT OF PIECES

FAILURE INFLUENCED BY DISCONTINUITIES

TYPE CODE	DESCRIPTION OF SUB CODES	
	A	B
	PARTIAL FAILURE ON DISCONTINUITY	FAILURE COMPLETELY ON DISCONTINUITY
1	AT 0-10° TO AXIS	AT 0-10° TO AXIS
2	AT 11-20° TO AXIS	AT 11-20° TO AXIS
3	AT 21-30° TO AXIS	AT 21-30° TO AXIS
4	AT 31-40° TO AXIS	AT 31-40° TO AXIS
5	AT 41-50° TO AXIS	AT 41-50° TO AXIS
6	AT 51-70° TO AXIS	AT 51-70° TO AXIS
7	AT 71-90° TO AXIS	AT 71-90° TO AXIS
0	Multiple Discontinuities	Multiple Discontinuities

Example: Failure Type3B: Failure completely on a discontinuity with an orientation of between 21° and 30° to the specimen axis.





WATERLAB

WATERLAB (PTY) LTD

23B De Havilland Crescent
Persekor Techno Park,
Meiring Naudé Road, Pretoria
P.O. Box 283, 0020

Telephone: +2712 – 349 – 1066
Facsimile: +2712 – 349 – 2064
Email: accounts@waterlab.co.za

**CERTIFICATE OF ANALYSES
BASSON INDEX & BRE**

Date received: 2017-01-17
Project number: 255

Report number: 64501

Date completed: 2017-02-14
Order number: 200,046

Client name: Geostrada
Address: P.O.Box 11126, Hatfield, 0028
Telephone: 012 432 0531
Fax: 012 430 3548

Contact person: Hennie Barnard
Contact person: Martinus Schwartz
Email: HennieB@geostrada.co.za
Email:
Martinus.Schwartz@aurecongroup.com
Cell: +27 83 785 0852

Analyses in mg/ℓ (Unless specified otherwise)	Sample Identification:	
	6/13711 RRD14 1.3 - 2.0	6/13714 AD44 1.2 - 1.3
Sample Number	26291	26292
Paste pH	7.8	7.5
pH Value at 25°C	8.0	7.6
pHs Value at 20°C (calc)	8.8	9.1
Electrical Conductivity in mS/m at 25°C	29.5	34.6
Total Dissolved Solids* (calc)	198	232
Total Alkalinity as CaCO ₃	72	36
Total Hardness as CaCO ₃ (calc)	47	46
Calcium Hardness as CaCO ₃ (calc)	22	25
Calcium as Ca	9	10
Magnesium as Mg	6	5
Free & Saline Ammonia	<0.1	<0.1
Ammonium as NH ₄ (calc)	<0.1	<0.1
Acid Soluble Sulphate	262	159
Sulphate as SO ₄	36	34
Chloride as Cl	23	62
Nitrate as N	0.35	<0.2
Total Sulphur (Leco) %	<0.01	<0.01
Langelier Index at 20°C (calc)	-0.8	-1.5
Ryznar Index at 20°C (calc)	9.6	10.5
Corrosivity Ratio (calc)	1.0	3.4
Leaching Index [LCSI] (calc)	987	1454
Spalling Index [SCSI] (calc)	5	4
Aggressiveness Index [N _c] (calc)	992	1458

*TDS Calculated EC X 6.7

2:1 Distilled Water : Soil Extract

E. Pelsler
Associate Geochemistry Project Manager

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23B De Havilland Crescent
Persequor Techno Park,
Meiring Naudé Road, Pretoria
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Email: HennieB@geostrada.co.za
Email:
Martinus.Schwartz@aurecongroup.com
Cell: +27 83 785 0852

Important notes (see table for corrections on p. 2-3):

1. The above aggressiveness index is only applicable for conditions of laminar flow at a mean annual temperature of 20°C.
2. For stagnant/turbulent conditions the aggressiveness index must be corrected.
3. For wet/dry cycling conditions (for example in tidal zones) the aggressiveness index must be corrected.
4. For mean annual temperatures lower/higher than 20°C the aggressiveness index must be corrected.

Guidelines for assessing overall aggressiveness (N_c):

N _c	Aggressiveness
Not greater than 300	None to mild
400-700	Mild to moderate
800-1000	High
= or > 1 100	Very high

Aggressiveness Towards Concrete and Fibre Cement Pipes			
Index	Aggressive	Neutral	Non- Aggressive
a) Stability pH (pHs)	>pH	= pH	<pH
b) Langelier Index	Neg. Value	Zero	Pos. Value
c) Ryznar Index	>7.5	6-7	<6

Corrosiveness Towards metals	
Corrosivity	>0.2

Sample Name	Sample Number	Corrosivity Indices	Basson Index
6/13711 RRD14 1.3 - 2.0	26291	Corrosive	Aggressive
6/13714 AD44 1.2 - 1.3	26292	Corrosive	Aggressive

E. Pelsler
Associate Geochemistry Project Manager

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WATERLAB (PTY) LTD

23B De Havilland Crescent
Persekor Techno Park,
Meiring Naudé Road, Pretoria
P.O. Box 283, 0020

Telephone: +2712 – 349 – 1066
Facsimile: +2712 – 349 – 2064
Email: accounts@waterlab.co.za

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Martinus.Schwartz@aurecongroup.com
Cell: +27 83 785 0852

To correct for:	Multiply	By: (see Notes 2 to 5 below)
Turbulence	LCSI	1.75
Stagnance	LCSI	0.5
Temperature	LCSI, SCSi, N7 Where N7=0.2 x Cl in mg/l	(1+ [0.05 x (T-20)])
Wet-dry cycles	SCSi	0.23 x 10 ⁻⁶ x TDS x DTF x CPA Where: DTF = Dry Time Fraction CPA = wet-dry cycles per annum

- Note 1:** Only if the concrete contains embedded steel.
Note 2: To preserve the correct logical relationships when dealing with the negative sub indices (ie LCSI or SCSi having minus values) they should be multiplied by the reciprocal of the relevant factor indicated in this column
Note 3: If more than one correction is required, multiply by the product of the individual correction factors
Note 4: Use subscript c to indicate that the index has been corrected, eg for turbulent conditions LCSI_c = LCSI x 1.75
Note 5: Round off corrected indices to the nearest 100.

E. Pelsler
Associate Geochemistry Project Manager

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APPENDIX F

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DOCUMENT LIMITATIONS

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Africa	+ 27 11 254 4800
Asia	+ 86 21 6258 5522
Australasia	+ 61 3 8862 3500
Europe	+ 44 1628 851851
North America	+ 1 800 275 3281
South America	+ 56 2 2616 2000

solutions@golder.com
www.golder.com

Golder Associates Africa (Pty) Ltd.
P.O. Box 6001
Halfway House, 1685
Building 1, Maxwell Office Park
Magwa Crescent West
Waterfall City
Midrand, 1685
South Africa
T: [+27] (11) 254 4800

