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GEOTECHNICAL INVESTIGATION REPORT FOR THE PROPOSED NEW IKAGENG POLICE STATION IN NORTHWEST, SOUTH AFRICA.

LC012-23. R01

19 JULY 2023

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Reg. 2016 / 073744 / 07

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Approval of Document		
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TABLE OF ABBREVIATIONS

AASHTO	American Association of State Highway and Transportation
begl	Below existing ground level
CBR	California Bearing Ratio
DCP	Dynamic Cone Penetrometer Test
E	East
GM	grading modulus
IMC	insitu moisture content
kN/m^2	kilonewtons per metre square
kPa	Kilopascals
LL	liquid limit
LS	linear shrinkage
Luhlaza	Luhlaza Advisory and Consulting Pty Ltd
m	metre (s)
MDD	maximum dry density
mm	Millimetre
Mpa	MegaPascal
mS/m	Millisiemens per meter
No.	Number
N	North
OMC	optimum moisture content
PI	plasticity index
SANS	South African National Standards
S	South
TLB	Tractor Loader Backhoe
TP	Test Pits
TRH	Technical Recommendations for Highways (1985)

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1 TERMS OF AGREEMENT AND SCOPE OF SERVICES

Luhlaza Advisory and Consulting (Pty) Ltd was requested by Ukuza Consulting (Pty) Ltd to carry out a geotechnical investigation for the proposed new police station at Ikageng in North West Province.

Luhlaza has carried out the following:

a) A site reconnaissance survey.
b) Excavation of inspection pits dug to 3.0m using a TLB machine.
c) Dynamic cone penetration tests to 3.0m.
d) Laboratory testing of soil and rock samples.
e) Prepare a geotechnical report.

The geotechnical report referenced LC012-23.R01 provides the results of the site investigation as well as foundation, slope stability, excavatability, earthworks, groundwater seepage, stormwater drainage and material usage and NHBRC Classification.

2 CODES OF PRACTICE AND STANDARDS

The field investigation and the report were carried out in accordance with the current level of geotechnical standards practiced by professionals in South Africa.

The document referenced for use is "*Site Investigation Code of Practice, 1st Edition, South African Institution of Civil Engineering – Geotechnical Division, January 2010*".

The nature of geotechnical engineering is such that variations in soil conditions may occur even where sites seem to be consistent. It is essential that all important development stages, including but not limited to excavations, be inspected by a competent person who is suitably skilled and experienced because construction may disclose deviations from what is detailed here. This is to ensure that conditions at variance with those predicted do not occur and to undertake an interpretation of the facts supplied in this report.

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It is possible that certain indications of ground stability, contamination, or groundwater levels were latent or otherwise not visible. Opinions are based on what was visible at the time the investigation was conducted.

3 INFORMATION SOURCES

The following maps and plans were available and were used in this report.

a) A regional geological map titled “2626 West Rand”, prepared by the Council for Geoscience to a scale of 1:250 000,
b) Low-resolution satellite imagery sourced from Google Earth (2023).

4 DESCRIPTION OF THE STUDY AREA

The project area (Proposed Police Station) is situated in Ikageng which is approximately 12 km southwest of Potchefstroom in the Northwest Province (Figure 1). It is located within the Dr Kenneth Kaunda District Municipality. The project area is approximately 3.12 hectares, and it is covered by grass and shrubs (Figure 2). The site can be accessed via the N14 and Mogolodi Street. The central coordinates of the site are [26.739135°S;27.015390°E].

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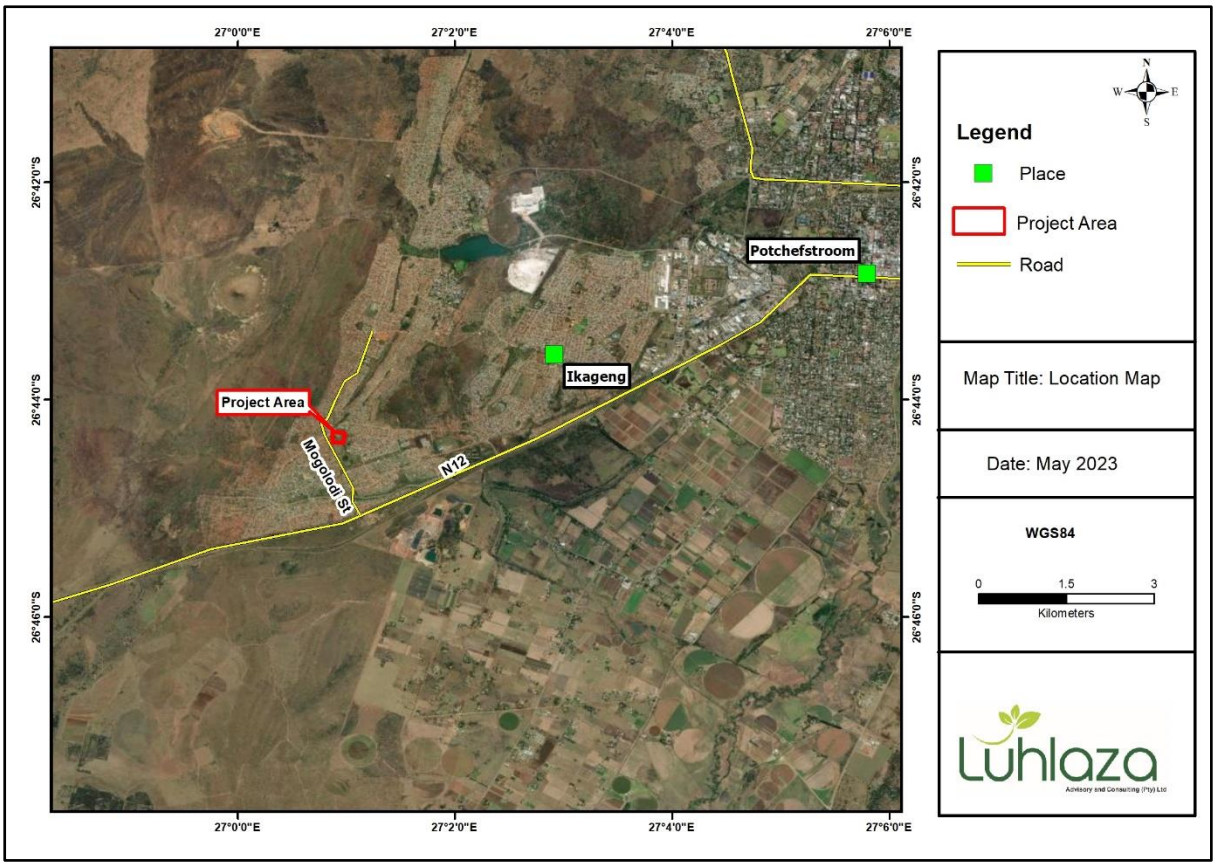

Figure 1: Location Map of the proposed Police Station depicted by the red on the Map.

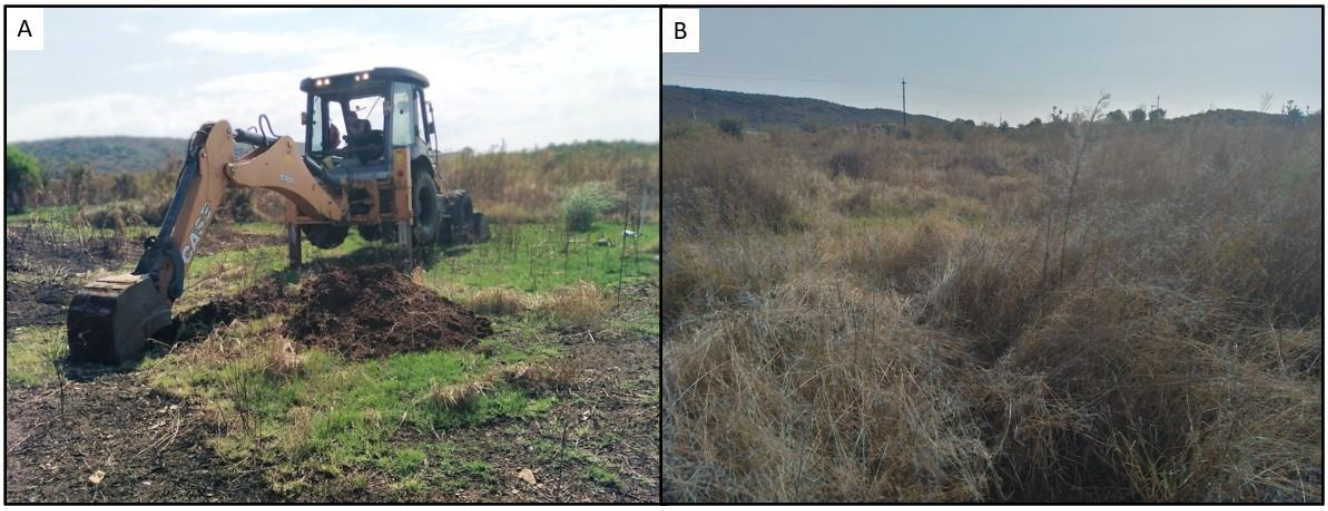

Figure 2: General site condition, with (A) showing TLB excavation and (B) showing a general site view with bushes and grass.

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5 INVESTIGATION ACTIVITIES

The site investigation was carried out from the 5th to the 6th of May 2023, which included:

a) Excavation of test pits using a TLB excavation tools.
b) Dynamic Cone Penetrometer (DCP) testing.
c) Collection of soil and rock samples for laboratory testing.

5.1 Test Pitting and Profiling

Twenty-four test pits (TP01 to TP24) were excavated at preselected points as indicated in Figure 3. The different soil horizons encountered in the test pits were described using the moisture, color, consistency, structure, soil type and origin (MCCSSO classification system), standard descriptors. The test pits were excavated into the weathered bedrock to an approximate depth ranging from 1.4m to 3.0m below existing ground level (begl) (Table 1).

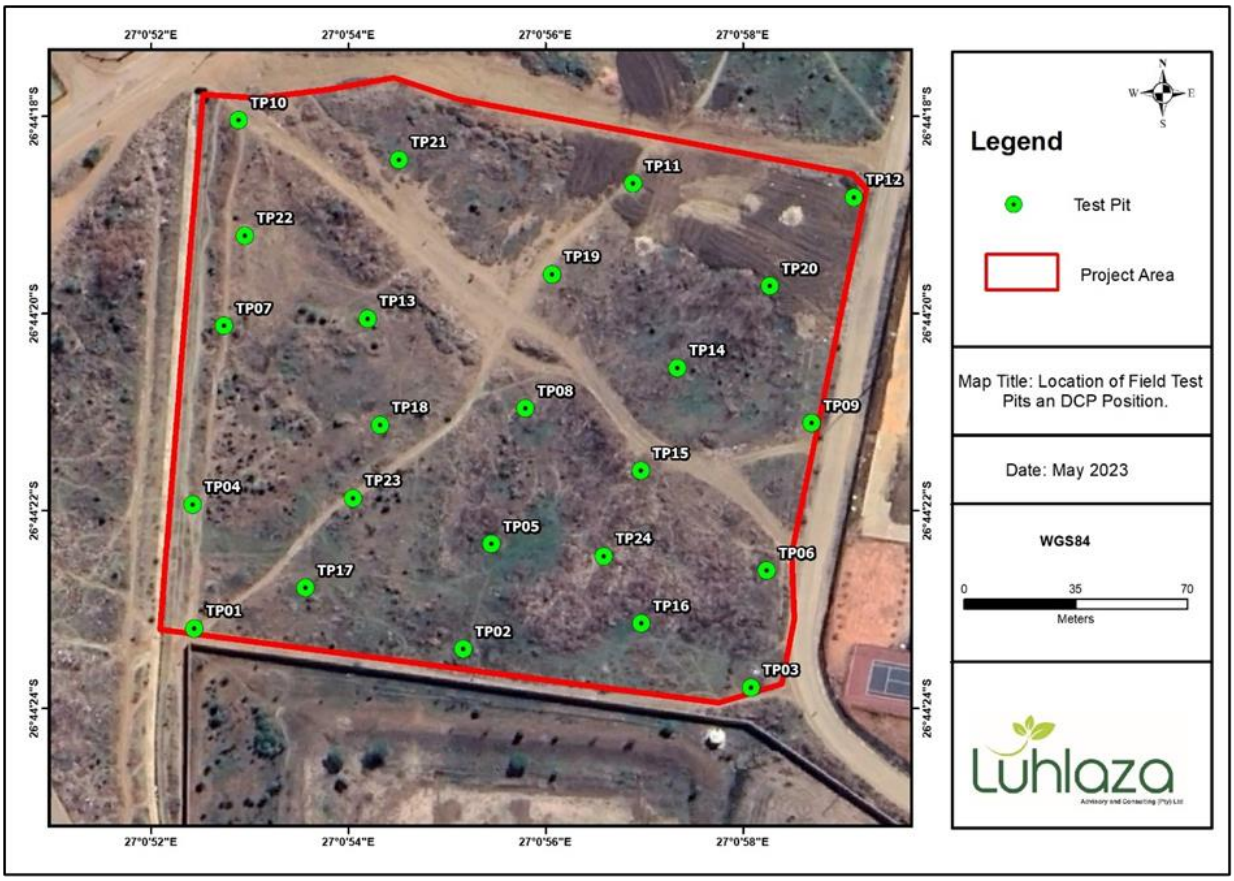

Figure 3: Location of the Field Test Pit and DCP relative to the proposed site.

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Table 1: Summary of the Test Pit and DCP Positions.

TP	Latitude (South)	Longitude (East)	Elevation (mamsl)	Depth of TP (m begl)	Depth of DCP (m begl)
01 (DCP01)	26.739775°	27.014566°	1381	1.5	1.5
02 (DCP02)	26.739833°	27.015324°	1384	1.6	0.8
03 (DCP03)	26.739941°	27.016136°	1386	1.9	0.7
04 (DCP04)	26.739426°	27.014562°	1381	1.9	1.2
05 (DCP05)	26.739537°	27.015403°	1379	1.6	1.5
06 (DCP06)	26.739612°	27.016180°	1380	2.1	0.6
07 (DCP07)	26.738923°	27.014650°	1380	2.7	1.8
08 (DCP08)	26.739156°	27.015499°	1381	1.5	1.6
09 (DCP09)	26.739197°	27.016306°	1382	1.8	0.7
10 (DCP10)	26.738345°	27.014691°	1389	3	0.6
11 (DCP11)	26.738523°	27.015803°	1380	1.5	0.7
12 (DCP12)	26.738562°	27.016426°	1387	2.2	1.5
13 (DCP13)	26.738903°	27.015055°	1376	1.6	0.7
14 (DCP14)	26.739042°	27.015928°	1381	1.8	0.7
15 (DCP15)	26.739331°	27.015824°	1375	2.6	1.7
16 (DCP16)	26.739761°	27.015826°	1382	1.9	0.5
17 (DCP17)	26.739661°	27.014879°	1382	1.4	0.8
18 (DCP18)	26.739202°	27.015090°	1372	1.7	1.7
19 (DCP19)	26.738778°	27.015575°	1382	1.5	0.8
20 (DCP20)	26.738811°	27.016188°	1382	2	1
21 (DCP21)	26.738456°	27.015143°	1384	2.1	1.2
22 (DCP22)	26.738669°	27.014709°	1387	2	0.7
23 (DCP23)	26.739408°	27.015013°	1382	1.6	0.4
24 (DCP23)	26.739572°	27.015720°	1390	1.7	0.8

The test pits were profiled in accordance with the South African Geoterminology Guidelines (Brink and Bruin, 2002). The test pit profiles are provided in Appendix A.

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5.2 DCP Testing

A DCP test is carried out in order to determine the consistency of the respective soil horizons (Figure 4). At each test pit a DCP test was conducted in close proximity. In total twenty-four DCP tests were conducted at preselected points (Table 1).

Figure 4: DCP testing conducted on site at TP08.

The DCP tests extended to an approximate depth ranging from 0.4 to 1.8m. The DCP test results are provided in Appendix B.

The co-ordinates of the test pits and DCP's were recorded using the handheld GPS device "Garmin GPS Map 62". Table 1 provides a summary of the test pit and DCP positions.

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6 GENERAL GEOLOGY OF THE SITE

The geological map “2626 West Rand” (1:250 000; Figure 5), illustrates that the project area is underlain by shale of the Timeball Hill Formation of the Pretoria Group which forms part of the Transvaal Supergroup.

Based on the geology map of the area, the project area is not subject to the formation of sinkholes and subsidence due to the presence of water-soluble rock types (such as dolomite or limestone). The project area is therefore classified as ‘non-dolomitic.’

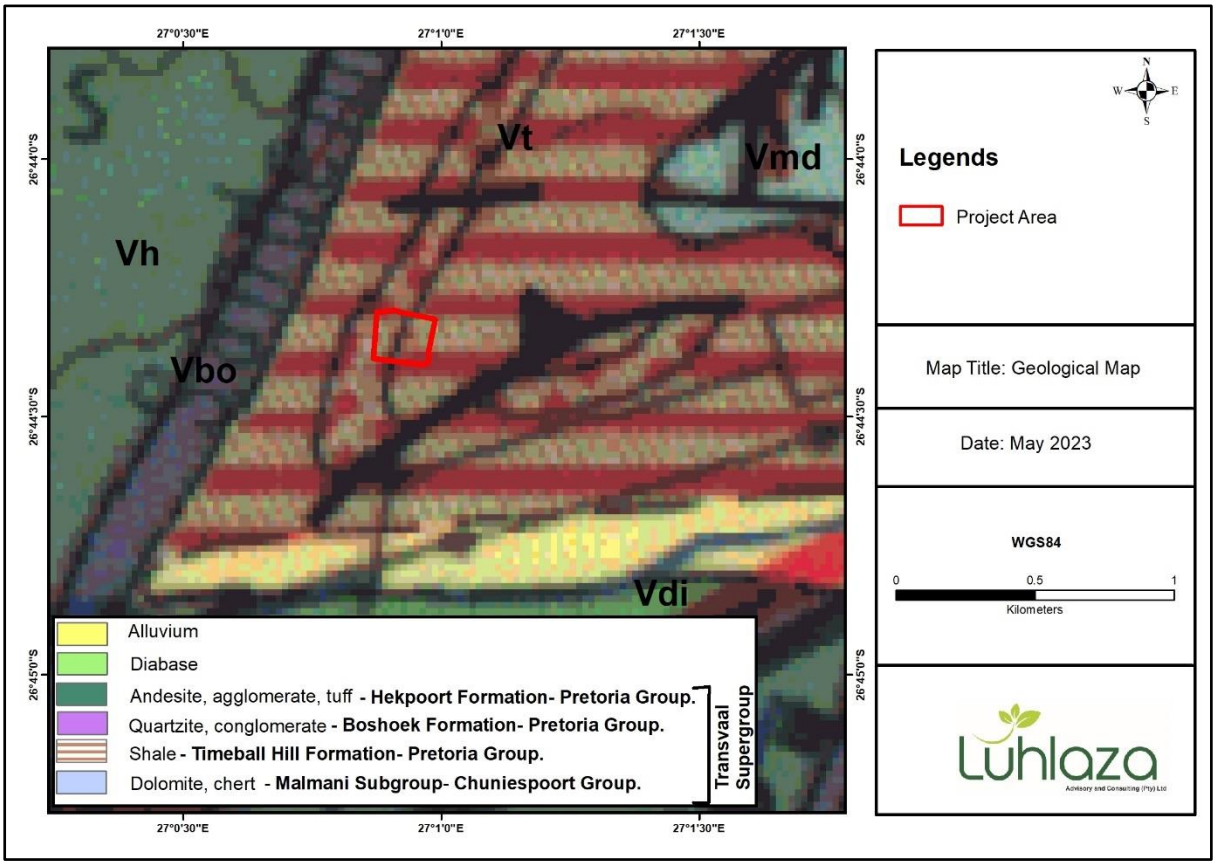

Figure 5: Geology Map of the area “2626 West Rand” highlighted in red, Scale 1:250 000.

The available geological information does not indicate any geological structures (i.e., faults) in the direct vicinity of the project area. As such there is no impact of any geological anomalies in the investigation area.

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7 TOPOGRAPHY

The topography of the investigated area (Figure 6) is generally characterized by a gentle slope with a minimum and maximum elevations of 1376m and 1377m above mean sea level (AMSL) respectively.

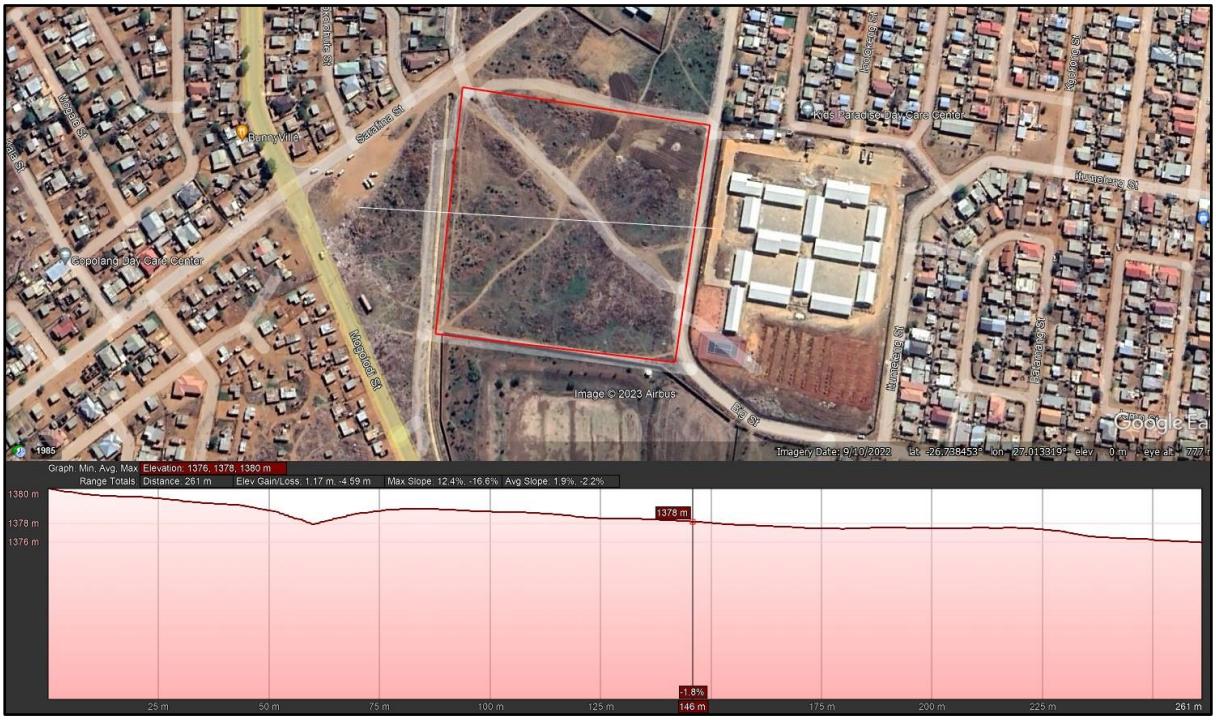

Figure 6: A topographical cross section site from west-east direction Google Earth Maps.

8 INVESTIGATION RESULTS

8.1 Soil Profiles

The test pit positions investigated (Figure 7 and Table 3) comprised of fill, colluvium, residual mudrock, residual quartzite, weathered quartzite, and weathered mudrock. The material profiled, is briefly discussed below, and summarized in Table 2.

a) **Fill** – Material may be described as slightly moist, dark brown to black, loose to dense, medium grained, clayey SAND with roots and plastics. The fill material was encountered in test pits TP01, TP04, TP07 – TP08, TP11 – TP12, TP14, TP20 and TP24 and extended to an approximate depth ranging from 0m to 0.9m begl. (Refer to test pit profiles for detailed descriptions at Appendix “A”).

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b) **Colluvium** – Material may be described as slightly moist, dark brown, medium dense to dense, intact, fine to medium grained, clayey SAND with cobbles and roots. The colluvium material was encountered in test pits TP02 – TP03, TP05 – TP06, TP08 – TP10, TP13 and TP15 – TP23 and extended to an approximate depth ranging from 0m to 1.1m begl. (Refer to test pit profiles for detailed descriptions at Appendix “A”).

c) **Residual Quartzite** – Material may be described as slightly moist, light reddish brown, dense to very dense, intact, fine to medium grained, silty SAND. The residual material was encountered in TP01, TP04, TP07, TP11 – TP12 and TP20, and it extended to an approximate depth ranging from 0.2m to 1.7m begl. (Refer to test pit profiles for detailed descriptions at Appendix “A”).

d) **Residual Mudrock** – Material may be described as slightly moist, dark reddish brown, very stiff, intact, fine grained, CLAY. The residual material was encountered in TP02 – TP03, TP05 – TP06, TP08 – TP10, TP13 – TP19 and TP21 – TP24, and it extended to an approximate depth ranging from 0.2m to 2.0m begl. (Refer to test pit profiles for detailed descriptions at Appendix “A”).

e) **Weathered Quartzite** – The weathered soft to medium hard rock can be described as light yellowish brown speckled white mottled black, highly to moderately weathered, medium grained, highly fractured, soft to medium hard rock - quartzite. The soft to medium hard rock was encountered in test pits TP01, TP03 – TP04, TP07, TP09 – TP12, TP15 – TP16 and TP20 – TP21 and extended to an approximate depth ranging from 0.8m to 3.0m begl. (Refer to test pit profiles for detailed descriptions at Appendix “A”).

f) **Weathered Mudrock** – The weathered soft rock can be described as maroon to olive green, highly weathered, fine grained, highly fractured, soft rock - mudrock. The soft rock was encountered in TP03, TP05 – TP06, TP08 – TP10, TP13 – TP19 and TP21 – TP24 and extended to an approximate depth ranging from 0.6m to 2.9m begl. (Refer to test pit profiles for detailed descriptions at Appendix “A”).

The general soil profiles encountered across the site are depicted in Figure 7.

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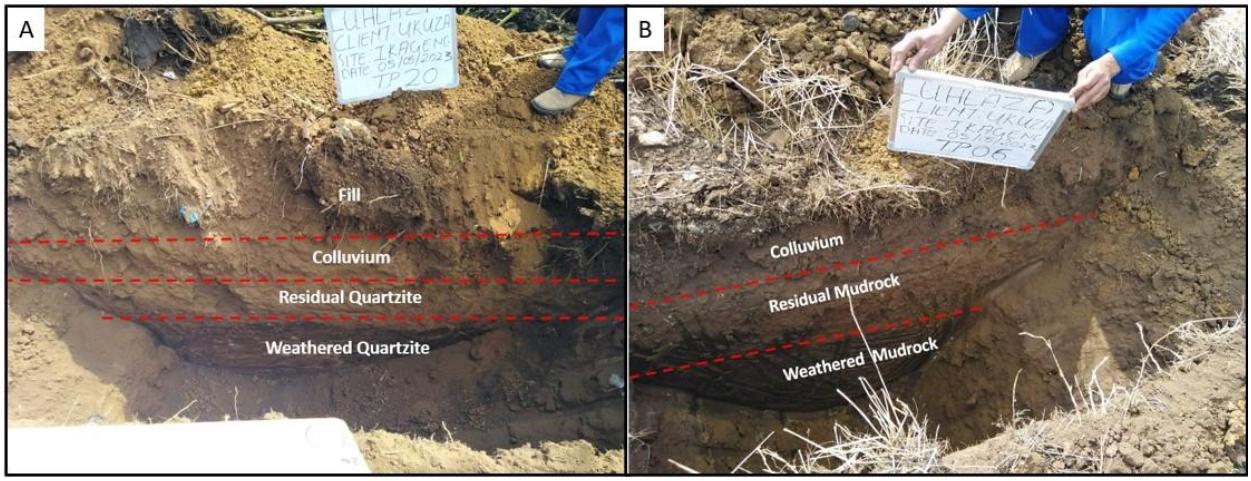

Figure 7: Soil Profile **A** showing materials encountered in TP20 and **B** showing materials encountered in TP06.

Table 2: Summary of the depths of the various layers encountered during profiling.

Test Pit	Latitude (South)	Longitude (East)	Elevation (mamsl)	Fill	Colluvium	Residual Quartzite	Weathered Quartzite	Residual Mudrock	Weathered Mudrock	Depth of Test Pit
TP01	26.739775°	27.014566°	1381	0 - 0.2	-	0.2 - 1.1	1.1 - 1.5	-	-	1.5
TP02	26.739833°	27.015324°	1384	-	0 - 0.5	-	-	0.5 - 1.3	-	1.6
TP03	26.739941°	27.016136°	1386	-	0 - 0.5	-	1.7 - 1.9	0.5 - 1.1	1.1 - 1.7	1.9
TP04	26.739426°	27.014562°	1381	0 - 0.6	-	0.6 - 1.5	1.5 - 1.9	-	-	1.9
TP05	26.739537°	27.015403°	1379	-	0 - 0.4	-	-	0.4 - 0.9	0.9 - 1.6	1.6
TP06	26.739612°	27.016180°	1380	-	0 - 0.4	-	-	0.4 - 1.7	1.7 - 2.1	2.1
TP07	26.738923°	27.014650°	1380	0 - 0.6	-	0.6 - 0.8	0.8 - 2.7	-	-	2.7
TP08	26.739156°	27.015499°	1381	0 - 0.2	0.2 - 0.4	-	-	0.4 - 0.9	0.9 - 1.5	1.5
TP09	26.739197°	27.016306°	1382	-	0 - 0.4	-	1.6 - 1.8	0.4 - 1.3	1.3 - 1.6	1.8
TP10	26.738345°	27.014691°	1389	-	0 - 0.6	-	2.9 - 3	0.6 - 2	2 - 2.9	3
TP11	26.738523°	27.015803°	1380	0 - 0.4	-	0.4 - 1.2	1.2 - 1.5	-	-	1.5
TP12	26.738562°	27.016426°	1387	0- 0.8	-	0.8 - 1.6	1.6 - 2.2	-	-	2.2
TP13	26.738903°	27.015055°	1376	-	0 - 0.6	-	-	0.6 - 1.1	1.1 - 1.6	1.6
TP14	26.739042°	27.015928°	1381	0 - 0.7	-	-	-	0.7 - 1.5	1.5 - 1.8	1.8
TP15	26.739331°	27.015824°	1375	-	0 - 0.3	-	1.6 - 2.6	0.3 - 0.9	0.9 - 1.6	2.6
TP16	26.739761°	27.015826°	1382	-	0 - 0.3	-	1.6 - 1.9	0.3 - 0.9	0.9 - 1.6	1.9
TP17	26.739661°	27.014879°	1382	-	0 - 0.2	-	-	0.2 - 0.7	0.7 - 1.4	1.4
TP18	26.739202°	27.015090°	1372	-	0 - 0.9	-	-	0.4 - 1.4	1.4 - 1.7	1.7
TP19	26.738778°	27.015575°	1382	-	0 - 0.5	-	-	0.5 - 0.9	0.9 - 1.5	1.5
TP20	26.738811°	27.016188°	1382	0 - 0.9	0.9 - 1.1	1.1 - 1.7	1.7 - 2	-	-	2
TP21	26.738456°	27.015143°	1384	-	0 - 0.5	-	1.6 - 2.1	0.5 - 0.7	0.7 - 1.6	2.1
TP22	26.738669°	27.014709°	1378	-	0 - 0.5	-	-	0.5 - 0.8	0.8 - 2	2
TP23	26.739408°	27.015013°	1382	-	0 - 0.4	-	-	0.4 - 0.6	0.6 - 1.6	1.6
TP24	26.739572°	27.015720°	1390	0 - 0.6	-	-	-	0.6 - 1.2	1.2 - 1.7	1.7

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8.2 DCP Test Results

The results of the DCP tests are displayed graphically in (Appendix B). DCP tests were planned but due to the stiffness of the material encountered on site, premature refusal was encountered. The DCP test results have been summarized for the fill, transported materials (colluvium), residual quartzite residual mudrock, weathered quartzite and weathered mudrock rocks (Table 3). The DCP test results were correlated with the consistency described during test pit soil profiling.

The area is underlain by fill, transported materials (colluvium), residual quartzite, residual mudrock, weathered quartzite and weathered mudrock. There is no undrained strength for sandy material, however, this can be correlated to the friction angle of sand assuming a cohesion of zero. The shear strength of the soil based on the results from the DCP are summarized in Table 3.

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Table 3: Summary of DCP Results.

DCP	Soil Horizon	Depth of DCP (m begl)	mm per blow (min – max)	Infered Consistency	Shear Strength (°)	Shear Strength (kPa)
DCP01	Fill	0 - 0.2	2 - 3	Loose	30°	-
	Residual Quartzite	0.2 - 1.1	2 - 8	Loose - medium dende	30 - 35°	-
	Weathered Quartzite	1.1 - 1.5	7 - 23	Medium dense - dense	34 - 38°	-
DCP02	Colluvium	0 - 0.5	5 - 22	Medium dense - dense	32 - 38°	-
	Residual Mudrock	0.5 - 0.7	20 - 24	Stiff - very stiff	-	38 - 150
	Weathered Mudrock	0.7 - 0.8	24 - 28	Very stiff	-	150
DCP03	Colluvium	0 - 0.5	3 - 20	Loose - dense	30 - 38°	-
	Residual Mudrock	0.5 - 0.7	24 - 29	Very stiff	-	150
DCP04	Colluvium	0 - 0.6	5 - 13	Medium dense - dense	32 - 37°	-
	Residual Quartzite	0.6 - 1.2	13 - 25	Dense - very dense	37 - 38°	-
DCP05	Colluvium	0 - 0.4	2 - 9	Loose - medium dense	30 - 35°	-
	Residual Mudrock	0.4 - 0.9	10 - 13	Stiff	-	85 - 100
	Weathered Mudrock	0.9 - 1.5	11 -26	Stiff - very stiff	-	90 - 150
DCP06	Colluvium	0 - 0.4	4 - 24	Medium dense - dense	30 - 38°	-
	Residual Mudrock	0.5 - 0.6	24 - 28	Very stiff	-	150
DCP07	Fill	0 - 0.6	5 - 16	Medium dense - dense	32 - 37°	-
	Residual Quartzite	0.6 - 0.8	16- 18	Dense	37°	-
	Weathered Quartzite	0.8 - 1.8	13- 24	Dense	37 - 38°	-
DCP08	Fill	0 - 0.2	1- 2	Very loose - loose	29 - 30°	-
	Colluvium	0.2 - 0.4	1- 13	Very loose - dense	29 - 37°	-
	Residual Mudrock	0.4 - 0.9	5- 12	Firm	-	36 - 65
	Weathered Mudrock	0.9 - 1.6	5- 20	Firm - very stiff	-	40 - 150
DCP09	Colluvium	0 - 0.4	4 - 14	Medium dense - dense	30 - 37°	-
	Residual Mudrock	0.4 - 0.7	16 - 23	Stiff - very stiff	-	130 - 150
DCP10	Colluvium	0 - 0.6	13 - 28	Dense - very dense	37 - 38°	-
DCP11	Fill	0 - 0.4	3 - 16	Loose - dense	30 - 38°	-
	Residual Quartzite	0.4 - 0.7	24 - 26	Dense - very dense	38°	-
DCP12	Fill	0 - 0.8	2 - 8	Loose - medium dense	30 - 35°	-
	Residual Quartzite	0.8 - 1.5	6 - 24	Medium dense - dense	34 - 38°	-
DCP13	Colluvium	0 - 0.6	2 - 11	Loose - medium dense	30 - 36°	-
	Residual Mudrock	0.6 - 0.7	11- 12	Stiff	-	90 - 100
DCP14	Fill	0 - 0.7	2- 12	Loose - dense	30 - 36°	-
DCP15	Colluvium	0 - 0.3	2 - 7	Loose - medium dense	30 - 34°	-
	Residual Mudrock	0.3 - 0.9	5 - 9	Firm - stiff	-	34 - 75
	Weathered Mudrock	0.9 - 1.6	5 - 15	Firm - stiff	-	40- 125
	Weathered Quartzite	1.7	23	Dense	38°	-
DCP16	Colluvium	0 - 0.3	10 - 19	Medium dense - dense	36 - 37°	-
	Residual Mudrock	0.3 - 0.5	24 - 28	Very stiff	-	150
DCP17	Colluvium	0 - 0.2	3 - 6	Loose - medium dense	30 - 33°	-
	Residual Mudrock	0.2 - 0.7	9 - 18	Stiff	-	75 - 150
	Weathered Mudrock	0 . 7 - 0.8	17 - 24	Stiff	-	140 - 150
DCP18	Colluvium	0 - 0.9	3 - 24	Loose - dense	30 - 38°	-
	Residual Mudrock	0.9 - 1.4	24	Stiff	-	150
	Weathered Mudrock	1.4 - 1.7	24	Stiff	-	150
DCP19	Colluvium	0 - 0.5	4 - 22	Loose - dense	30 - 38°	-
	Residual Mudrock	0.5 - 0.8	21 - 26	Stiff - very stiff	-	150
DCP20	Fill	0 - 0.9	6 - 26	Medium dense - dense	32 - 38°	-
	Colluvium	0.9 - 1.0	26 - 27	Very dense	38°	-
DCP21	Colluvium	0 - 0.5	4 - 18	Medium dense - dense	30 - 37°	-
	Residual Mudrock	0.5 - 0.7	20 - 21	Very stiff	-	150
	Weathered Mudrock	0.7 - 1.2	20 - 27	Very stiff	-	150
DCP22	Colluvium	0 - 0.5	14 - 20	Dense	37 - 38°	-
	Residual Mudrock	0.5 - 0.7	28	Very Stiff	-	150
DCP23	Colluvium	0 - 0.4	2 - 25	Loose - dense	30 - 38°	-
DCP24	Fill	0 - 0.6	2 - 17	Loose - dense	30 - 32°	-
	Residual Mudrock	0.6 - 0.8	17 - 24	Very stiff	-	37 - 150

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9 GROUNDWATER

During the investigation, groundwater seepage was not encountered in all the test pits excavated on site. The groundwater activity is generally expected across the entire site on an intermittent / periodic basis and is also likely to fluctuate as a result of seasonal rainfall patterns.

10 SOIL LABORATORY RESULTS

The following tests were carried out on insitu soil samples to determine the engineering properties:

a) Foundation Indicators (Grading Analyses, Atterberg Limits Determination)
b) Road Indicators (Grading Analyses, Atterberg Limits Determination)
c) Maximum Dry Density and Optimum Moisture Content (MDD)
d) California Bearing Ratio (CBR)
e) Natural Moisture Content
f) Ph and Electric Conductivity
g) Double odometer

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Table 4: Summary of Laboratory Results.

TP No.	Depth (m)	Description	Particle Size %					Atterberg Limits %			Heave Potential	GM	Moisture (%)	Compaction			Consolidation						CBR						Soil Classification		Ph-Value	Electrical Conductivity (mS/m)
																	NMC			Soaked												
			Clay	Silt	Fines (clay + silt)	Sand	Gravel	LL	PI	LS				IMC(OMC) (%)	MDD (kg/m3)	%Swell	DD (kg/m3)	MC (%)	Void Ratio (%)	DD (kg/m3)	MC (%)	Void Ratio (%)	100	98	97	95	93	90	USC	H.R.B		
COLLUVIUM																																
TP20	0.9 - 1.1	Clayey Sand	-	-	-	-	-	-	-	-	-	-	14.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
RESIDUAL MUDROCK																																
TP02	0.5 - 0.7	Sandy Clay	-	-	-	-	-	-	-	-	-	-	0.2	17.2	1687	-	-	-	-	-	-	-	5	4	3	2	2	1	-	-	6.6	12
TP03	0.5 - 1.1	Sandy Clay	-	-	-	-	-	-	-	-	-	-	15.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP06	0.4 - 1.7	Sandy Clay	35.5	23.9	59.4	36.5	4.1	36	16	8	Low	0.49	14.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	CL	A-6 (8)	-	-
TP10	0.6 - 2.0	Sandy Clay	43.2	23.2	66.4	28.7	4.9	41	20	10	Low	0.47	15.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	CL	A-7-6 (11)	-	-
TP13	0.6 - 1.1	Sandy Clay	41.5	26.1	67.6	29.4	3.1	44	18	9.5	Low	0.41	16.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	CL	A-7-6 (11)	-	-
TP14	0.7 - 1.5	Sandy Clay	33.3	23.7	57	37.4	5.7	45	15	7.5	Low	0.53	14.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	ML	A-7-5 (8)	-	-
TP16	0.3 - 0.9	Sandy Clay	-	-	-	-	-	-	-	-	-	-	15.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP17	0.2 - 0.7	Sandy Clay	38.5	20.9	59.4	38.4	2.1	42	17	8	Low	0.44	17.8	16.1	1758	-	-	-	-	-	-	-	-	-	-	-	-	-	CL	A-7-6 (9)	-	-
TP17	0.2 - 0.8	Sandy Clay	-	-	45	25	31	34	16	7.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	CL	A-6	-	-
TP24	0.6 - 1.2	Sandy Clay	26.3	26.3	52.6	44.5	2.9	37	12	6.5	Low	0.52	12.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	ML	A-6 (6)	7.0	21
RESIDUAL QUARTZITE																																
TP04	0.6 - 1.5	Sandy Clay	-	-	59	32	9	32	16	7	-	1.59	-	12.4	1812	-	-	-	-	-	-	-	-	-	-	-	-	-	CS	A-6	-	-
TP06	0.6 - 0.8	Clayey Sand	25.8	23.9	49.7	44.4	5.9	32	12	6	Low	0.68	14.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	CL	A-6 (5)	-	-
TP07	0.6 - 0.8	Sandy Clay	-	-	-	-	-	-	-	-	-	-	14.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
WEATHERED MUDROCK																																
TP05	0.9 - 1.6	Soft Rock	42.8	24	66.8	29	4.2	52	22	11	Medium	0.35	15.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	MH	A-7-5(15)	-	-
TP06	1.7 - 2.1	Soft Rock	-	-	80	16	4	42	20	10	-	-	-	18	1747	-	-	-	-	-	-	-	-	-	-	-	-	-	CL	A-7-6	-	-
TP09	1.3 - 1.6	Soft Rock	-	-	-	-	-	-	-	-	-	-	-	15.7	1759	1.3	-	-	-	-	-	-	1	1	1	1	1	1	-	-	6.9	14
TP15	0.9 - 1.6	Soft Rock	41	25.8	66.8	29.6	3.6	48	18	9	Low	0.44	16.3	-	-	-	1594	20.1	0.764	1517	23.4	0.853	-	-	-	-	-	-	ML	A-7-5 (11)	7.6	16
TP18	1.4 - 1.7	Soft Rock	-	-	-	-	-	-	-	-	-	-	16.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6.75	25
TP19	0.9 - 1.5	Soft Rock	-	-	67	27	6	35	14	6.5	-	-	-	16.4	1748	-	-	-	-	-	-	-	-	-	-	-	-	-	CL	A-6	-	-
TP22	0.8 - 2.0	Soft Rock	-	-	-	-	-	-	-	-	-	-	-	17.3	1709	0.3	-	-	-	-	-	-	2	2	2	2	1	1	-	-	-	-
TP23	0.6 - 1.6	Soft Rock	-	-	-	-	-	-	-	-	-	-	15.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7.04	12
WEATHERED QUARTZITE																																
TP11	1.2 - 1.5	Soft Rock	-	-	-	-	-	-	-	-	-	-	-	12.9	1941	0.1	-	-	-	-	-	-	2	1	1	1	1	0	-	-	-	-
TP21	1.6 - 2.1	Soft Rock	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6.89	3

LL - Liquid Limit GM - Grading Modulus PI - Plasticity Index

G8 - COLTO Classification LS - Linear Shrinkage A-4 - AASHTO Classification

USC - Unified Soil Classification CBR - California Bearing Ratio ML - CL - Silt/Clay of low Plasticity.

Based on the table 4 above, the results indicate the following:

For more accurate identification and classification purposes, particle size distribution and Atterberg Limits tests we carried out. The results indicate that in general the colluvium, residual mudrock, residual quartzite and weathered quartzite material on site are of low plasticity. While the weathered mudrock is of medium plasticity. This indicates that the potential expansiveness of material on site is therefore low to medium with a low to medium grading modulus. The materials on site are therefore heaving in nature and compressible based on their clay percentage and liquid limit (LL) values which ranges between 32 – 52%.

Atterberg limits test results indicate that the residual mudrock, residual quartzite, weathered mudrock and weathered quartzite can be problematic in terms of expansiveness and compressibility if saturated under load.

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Unified Soil Classification systems classified the the residual mudrock as clay and silt of low plasticity (CL – ML) and the residual quartzite as sandy clay and clay of low plasticity (CS – CL). While it classified the weathered mudrock as clay and silt of low plasticity and silt of high plasticity (CL - ML and MH). The AASHTO classification systems classified the residual mudrock, residual quartzite and weathered mudrock material as moderately compressible (A-6, A-7-5 and A-7-6). This material is regarded as poor subgrade material.

The compaction test indicates that the residual mudrock has a maximum dry density ranging between 1687 – 1758kg/m^3 at an optimum moisture content ranging between 16.1–17.2% and the residual quartzite has a maximum dry density of 1812kg/m^3 at an optimum moisture content of 12.4%. While the weathered mudrock has a maximum dry density ranging between 1709 – 1759kg/m^3 at an optimum moisture content ranging between 15.7–17.3% and weathered quartzite has a maximum dry density of 1941kg/m^3 at an optimum moisture content of 12.9%. Hence the material on site indicates a very poor CBR with values of 1–2% at 95% and 1–2% at 93% MOD AASHTO.

The aim of the oedometer test was to determine the stiffness of the soil sample subjected to different loads. The double oedometer consolidation test indicates that the material in TP15 has a moderate insitu dry density ranging between 1594–1517kg/m3, high insitu moisture content ranging between 20.1–23.4% and a high insitu void ratio ranging between 0.764–0.853%. Thus, this indicates that the material is expected to compress when subjected to foundation load.

The electrical conductivity and the acidity of the soil influences the aggressiveness of the soil towards buried metallic and cementirerous objects. The material on site indicates that the residual mudrock has pH values ranging between 6.6–7.0 and an electrical conductivity ranging between 12–21mS.m^{-1}. The weathered mudrock has pH values ranging between 6.75–7.04 and an electrical conductivity ranging between 12 - 25mS.m^{-1}. While the weathered quartzite has a pH value of 6.89 and an electrical conductivity of 3mS.m^{-1}. This indicates that the materials in the area are slightly acidic and mildly corrosive to corrosive. Therefore, the materials in the area are regarded as aggressive and will corrode the metallic and cementirerous objects (Refer to Table 5 and 6).

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Table 5: Guideline values for interpretation of soil conductivity (Duligal, E., 1996. Significance of Soil Resistivity on Corrosivity. Unpublished report compiled for Africon).

Soil Conductivity (mS/m)	Degree of Corrosiveness
More than 50	Extremely corrosive
25 – 50	Very corrosive
20 – 25	Corrosive
21 – 25	Mildy corrosive
Less than 10	Not generally corrosive

Table 6: Interpretation of conductivity tests (Duligal, E., 1996. Significance of Soil Resistivity on Corrosivity. Unpublished report compiled for Africon).

pH	Degree of Acidity
< 4.0	Extremely acidic
4 - 5.4	Strongly acidic
5.5 - 6.4	Moderately Acidic
6.5 - 7.0	Slightly Acidic
7.1 - 7.4	Slightly Alkaline
7.5 - 8.5	Moderately Alkaline
>8.4	Strongly Alkaline

The laboratory results are included as Appendix C.

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11 DISCUSSION

11.1 Proposed Development

Information supplied to Luhlaza by the Ukuza Consulting (Pty) Ltd indicates that a new police station is proposed for the site.

Detailed designs of the structures are not known at this stage and it is recommended that this be discussed with a geotechnical specialist once finalized.

11.2 Site Stability

No signs of inherent ground instability such as slip scars, tension cracks or major sloughing of the mantle of transported soils were evident during the fieldwork. In addition, no known landslides were noted to occur on the site at the time of the investigation.

During the site geotechnical investigation, the embankments of test pits were generally stable, but Luhlaza recommend that all excavations exceeding 1.5m in depth should be stabilized by means of a 1:2 slope (1.0m vertical should have a side slope of 2.0m horizontal) to ensure slope stability during development phase as per SANS 1200.

It is imperative that all excavations are regularly (daily) inspected and approved by a geotechnical practitioner to detect any potentially unstable areas during the construction phase. The recommendations given in this report should be followed for the stability assessment to be valid.

11.3 General Earthworks

Earthwork activities will need to be carried out strictly in accordance with the current SANS 1200 guidelines to ensure safe working procedures and maintain stability of the site.

Where possible, the lowering of ground levels is to be avoided to reduce the risk of encountering problematic shallow groundwater seepage. Where this is not feasible, allowance is to be made for suitable subsoil drainage to engineer's detail. Placement of fill layers should be undertaken in layers not exceeding 150mm thick. When placed loose and compacted using

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suitable compaction plant to achieve 93% of Modified AASHTO maximum dry density. (Engineer may opt for 95% or 98% Modified AASHTO, depending on the proposed designs). If natural ground slopes are steeper than 9 degrees, the fill must be benched into the slope.

Terraces should be graded to direct water away from the fill edges, and small earth bands should be constructed along the crests of fills, to prevent overtopping and erosion of fill embankment slopes.

Acceptance and process density control testing of placed fill material should be undertaken at regular intervals during fill construction as part of process and acceptance quality assurance monitoring.

Regardless of the foundation solutions, an open excavation is likely to be formed to construct the proposed structure. Vertical sidewalls of this excavation are likely to be unstable and will need to be battered back to at least 26° or shored. It is strongly advised that adequate measures be implemented as collapsing sidewalls was observed during the investigation.

It should be noted that the presence of mudrock in the soil horizons when exposed to air, may become brittle in nature. As such this layer should not be let exposed to the natural elements for more than a day.

Steeper batters can be considered but will need to be inspected and approved by the geotechnical professional on site during construction. Alternatively, excavations will require shoring to engineer's detail particularly where there is groundwater seepage.

Cut and fill slopes should not exceed the recommended slope batters given in TRH9 and TRH10 i.e. cut and fill batters of 26° (1 Vertical in 2 horizontal) in soils. Where excavations intersect or approach the water table, the sidewalls will tend to become unstable and need to be drained and laterally supported or battered back at slopes of the order of 1v in 5h.

Workers should not enter any excavations deeper than 1.5m that are not shored or battered back as described above, as sidewalls in the low strength soils resembling those encountered on site will be prone to collapse. All excavations must be inspected daily by a competent person and records must be kept. It remains the responsibility of the Contractor/Developer to comply with the current requirements of the Occupational Health and Safety Act.

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11.4 The Trenchability/Excavatability on Site

The excavations have been assessed based on SANS 1200D (Refer to Table 10), DA and DB (Latest version). Based on the results of the field investigation, it is inferred that the subsurface material encountered in TP01 – TP24 classifies as soft to intermediate excavation down to the final depths of the tests pits (Table 7). Machinery such as TLB can be used on soft to intermediate excavation. (TP and DCP results, and Appendix D).

Table 7: Classification of Material for Machinery Excavation (SANS 1200 D).

CLASSIFICATION	DESCRIPTION
Soft	Material which can be efficient removed by a back-acting excavator of fly wheel power > 0,10Kw for each mm of tined bucket width.
Intermediate	Material which can be removed by a back-acting excavator having fly wheel power > 0,10kW for each mm of tined-bucket width or with the use of pneumatic tools before removal by a machine capable of removing material.
Hard Rock	Material cannot be removed without blasting or wedging and splitting.

Due to likely geological variations, it is also possible that hard excavations may be encountered at a shallower depth. Therefore, a contingency amount is recommended in the construction budget.

11.5 Classification of Material and Recommended Usage

The subgrade materials underlying the existing site have been classified in terms of their suitability for use in construction based on the field observations and laboratory testing in accordance with the proposed design.

The residual mudrock material classifies as A-6 to A-7-6 which can be classified as poor subgrade material and poor subbase material and not suitable for use as base course in roads pavement layers.

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The residual quartzite material classifies as A-6 which can be classified as poor subgrade material and poor subbase material and not suitable for use as base course in roads pavement layers.

The weathered mudrock material classifies as A-6 to A-7-6 which can be classified as poor subgrade material and poor subbase material and not suitable for use as base course in roads pavement layers.

Material such as G5/G6 or better quality will need to be imported to the site.

It must be noted that limited samples were extracted for laboratory testing, hence it is recommended that additional testing be carried out on site during construction to confirm the material quality and volumes available.

The above should be used as a guideline only and should be confirmed by further testing on site during construction as part of process and acceptance control monitoring, prior to the material being considered for use in construction.

11.6 General Subgrade layer works Guidelines.

The design of the pavement layer works has not been finalised at the time of this report and should be discussed with Luhlaza Advisory and Consulting (Pty) Ltd when available.

The following is a general guideline:

- If materials that are considered to be poor in quality are encountered on site, the material will need to be undercut and replaced by suitable granular material meeting the design engineer's requirements.
- Soils that meet the design engineer's requirements maybe ripped to the specified depth and recompacted to 93% Modified AASHTO maximum dry density to ±2% Optimum Moisture Content (OMC).
- Should the subgrade comprise weathered bedrock, it is recommended that the weathered bedrock be ripped to a minimum depth as prescribed by the engineer and recompacted to at least 93 % Modified AASHTO dry density.

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- The pavement formation layer for the proposed roads and parking areas should be designed taking into account anticipated traffic loads, volumes and design life of the parking area and roads.

The COLTO and SANRAL documents are good guidelines to assist with the design of pavements.

11.7 Founding Characteristics of the Site

According to the test pit excavations, the founding conditions encountered on site are inferred to comprise the following:

a) Soils capable of compressional / consolidation movements which may result in significant differential settlement.
b) Soils that are potentially expansive and compressible by nature.
c) Rock was encountered at depths in the range of 0.4m to 3.0m begl for test pits.

11.8 NHBRC Class Designation

The following Table extracted from the Home Building Manual (HBM) of the National Home Builders Registration Council (NHBRC) is used to guide the engineer with the soil properties and expected differential movements beneath the site.

According to guidelines provided in Part 1, Section 2, Table 1 of the HBM of the NHBRC, the following site classes are given for the site:

- **P (Colluvium/Fill)** – Areas underlain by colluvium and fill material.
- **H2/S2** – Areas that are underlain by residual mudrock and residual quartzite.

Then the area is classified as **P/H2/S2.**

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Accordingly, the parameters as set down by the NHBRC are given in Table 8 and Figure 8.

Table 8: Residential Site Class Designations (NHBRC HBM, Part 1, Section 2, Table 1).

TYPICAL FOUNDING MATERIAL	CHARACTER OF FOUNDING MATERIAL	EXPECTED RANGE OF TOTAL SOIL MOVEMENTS (mm)	ASSUMED DIFFERENTIAL MOVEMENT (% OF TOTAL)	SITE CLASS
Rock (excluding mud rocks which may exhibit swelling to some depth	STABLE	NEGLIGIBLE	-	R
Fine grained soils with moderate to very high plasticity (clays, silty clays, clayey silts and sandy clays)	**EXPANSIVE SOILS**	**<7,5 7,5-15 15 - 30 >30**	**50% 50% 50% 50%**	**H H1 H2 H3**
Silty sands, sands, sandy and gravely soils	COMPRESSIBLE AND POTENTIALLY COLLAPSIBLE SOILS	<5 5-10 >10	75% 75% 75%	C C1 C2
Fine grained soils (clayey silts and clayey sands of low plasticity), sands, sandy and gravely soils	**COMPRESSIBLE SOILS**	**<10 10-20 >20**	**50% 50% 50%**	**S S1 S2**
Contaminated soils, Controlled fill, Dolomitic areas, Landslip, Landfill, Marshy areas Mine waste fill, mining subsidence Reclaimed areas, Uncontrolled fill, Very soft silts/silty clays	**VARIABLE**	**VARIABLE**		**P**

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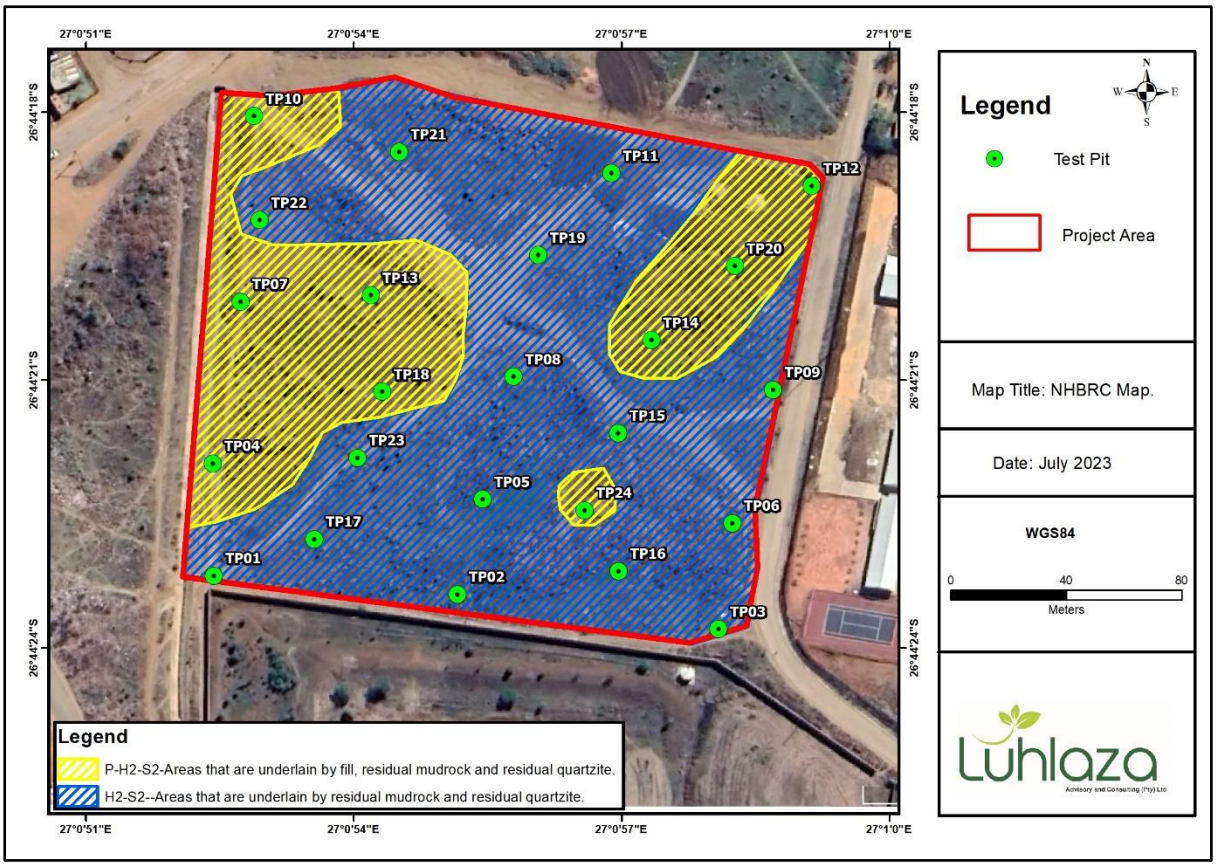

Figure 8: Map showing the different site classes according to NHBRC.

11.9 Foundation Recommendations for Structures

Based on the results of the geotechnical investigation, it is concluded that the suitable foundation option available for the site is the raft foundation on weathered mudrock and quartzite.

11.9.1 Raft Foundation on Weathered Rock

All foundations should be taken down through the in-situ material and placed on the weathered soft rock where an approximate net allowable bearing pressures between 100 kPa (100 kN/m2) to 150 kPa (150 kN/m2) is considered applicable. However, mudrock are known to breakdown when exposed to atmospheric conditions, it is then recommended that the foundation base should be cleaned immediately, and the foundation should be reinforced to resist some heave. Total settlement is likely to be between 15mm and 30m mm with differential settlement taken as 50%.

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It is a requirement that all foundations are inspected and approved by a geotechnical specialist such as Luhlaza Advisory and Consulting (Pty) Ltd.

All foundations will need to be designed strictly to engineer's detail and adequately reinforced taking into consideration the founding conditions of the site.

A provision for possible movements between floors and walls should be allowed for in the design e.g. provision of construction joints and use of appropriate softboard between walls and floors as per structural engineer's detail. All brickwork and foundations will need to be reinforced to resist heave repetition. The use of movement joints should also be considered.

Therefore, it must be noted that the above foundation recommendations are based on the results of the field investigation. Thus, the above is only to guide the engineers with preliminary design.

11.10 Drainage and Stormwater Guidelines

To maintain stability of the site, it is important to control the movement of both surface and groundwater. Adequate drainage measures need to be implemented to prevent any ponding occurring within the site during and post construction.

On all road curves, the outer shoulder should be lined with upright kerbs to deflect water run-off back into the road stormwater system. Experience with the erodible soils indicates that unlined dish (half round) drains adjacent to the roads are virtually ineffective and will soon give way to the formation of large and deep dongas (erosion gulley). Subsequent damage of road prisms may be expected.

The need for subsoil drainage will have to be assessed on site during construction in consultation with the geotechnical professional.

Owing to the highly erodible nature of the in-situ soils on-site if subject to poor stormwater runoff controls, due caution is permanently required to prevent slope damage and property maintenance arising from erosion due to uncontrolled runoff of surface water, particularly during periods of heavy rain.

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All stormwater issues arising from the roof and paved areas are to be piped to either discharge off-site into a municipal stormwater connection facility, if available. If this is not available, the feasibility of piping all stormwater from the completed development into an on-site stormwater subsoil percolation disposal system to engineer's detail is to be confirmed in consultation with the geotechnical professional as part of a supplementary geotechnical investigation.

As good practice, to limit maintenance and to promote foundation stability, the finished ground surfaces should be graded away from the structures to facilitate drainage of surface water runoff rapidly and effectively away from the building perimeter.

12 CONCLUDING COMMENTS

This geotechnical report provides a summary of the subsurface conditions and provides recommendations for foundation design for the proposed new police station at Ikageng, North West Province.

The site is underlain by subsoil comprising of fill, colluvium, residual quartzite, residual mudrock, weathered mudrock and weathered quartzite of the Pretoria Group of the Transvaal Supergroup.

Groundwater seepage was not encountered in all the test pits excavated on site. However, it is generally expected across the entire site on an intermittent / periodic basis and is also likely to fluctuate as a result of seasonal rainfall patterns. Therefore, it is advised that a contingency plan be developed to manage the groundwater risk at the site. The engineer's drainage design should account for this to prevent any issues that may arise.

Earthwork activities will need to be carried out strictly in accordance with the current SANS 1200 guidelines to ensure safe working procedures and maintain stability of the site.

Trenchability and excavability comments are provided in Section 11.4. In general, soft to intermediate excavations are possible down to final depths of the test pits.

Foundation solutions are discussed in Section 11.7 to 11.9.

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13 REFERENCES

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Appendix A: Test Pits

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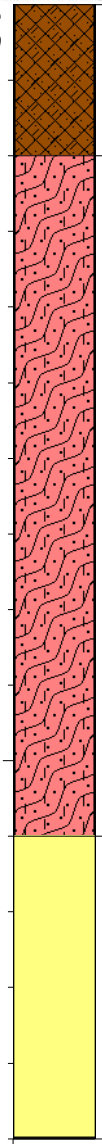
Ukuza
Ikageng Geotechnical Investigation

HOLE No: TP01
Sheet 1 of 1

JOB NUMBER: LC0012-23

Scale 1:10



0.00 Slightly moist, dark brown, loose, intact, fine grained, clayey SAND with roots- FILL.

0.20 Slightly moist, light reddish brown, intact, loose to medium dense, medium grained, silty SAND- RESIDUAL QUARTZITE.

1.10 Light yellowish brown speckled white mottled black, moderately weathered, medium grained, moderately fractured, hard rock, FERRUGENISED QUARTZITE- TIMEBALL HILL FM - PRETORIA GROUP - TRANSVAAL SUPERGROUP.

1.50

NOTES

1) End of hole at 1.5m.
2) Bedrock Refusal at 1.5m.
3) No groundwater seepage encountered.
4) No sample bags taken.
5) Side walls stable.

CONTRACTOR :
MACHINE : TLB Excavation
DRILLED BY :
PROFILED BY : Queen (Checked by Mbulungeni)
TYPE SET BY : Queen
SETUP FILE : STANDARD.SET

INCLINATION : Vertical
DIAM :
DATE :
DATE : 05 May 2023
DATE : 15/05/2023 09:58
TEXT : ..Logs\IkagengSiteLogs.TXT

ELEVATION : 1381m
X-COORD : 27.014566´°
Y-COORD : 26.739775´°

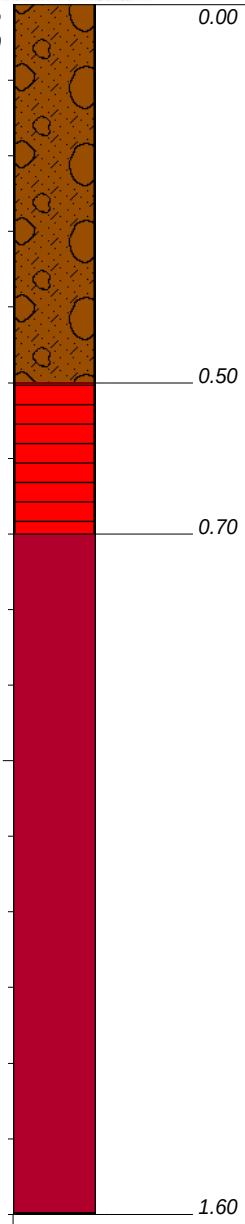
HOLE No: TP01

Ukuza
Ikageng Geotechnical Investigation

HOLE No: TP02
Sheet 1 of 1

JOB NUMBER: LC0012-23

Scale 1:10



0.00 — Slightly moist, dark brown, medium dense to dense, intact, fine grained, clayey SAND with cobbles and roots- COLLUVIUM.

0.5m

0.50 — Slightly moist, dark reddish brown, very stiff, intact, fine grained, CLAY- RESIDUAL MUDROCK.

0.7m

0.70 — Maroon, highly weathered, fine grained, highly fractured, soft rock, MUDROCK- TIMEBALL HILL FM - PRETORIA GROUP - TRANSVAAL SUPERGROUP.

1.60

NOTES

1) End of hole at 1.6m.
2) Excavation stopped at 1.6m on soft rock Mudrock.
3) No groundwater seepage encountered.
4) Sample bags at 0.5m -- 0.7m.
5) Side walls stable.

CONTRACTOR :
MACHINE : TLB Excavation
DRILLED BY :
PROFILED BY : Queen (Checked by Mbulungeni)
TYPE SET BY : Queen
SETUP FILE : STANDARD.SET

INCLINATION : Vertical
DIAM :
DATE :
DATE : 05 May 2023
DATE : 15/05/2023 09:58
TEXT : ..Logs\IkagengSiteLogs.TXT

ELEVATION : 1384m
X-COORD : 27.015324´°
Y-COORD : 26.739833´°

HOLE No: TP02

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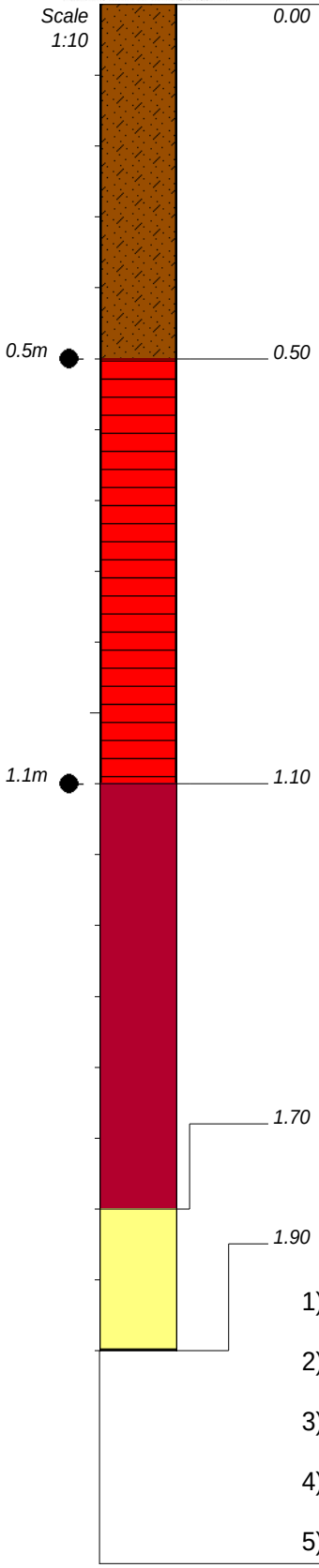
Ukuza
Ikageng Geotechnical Investigation

HOLE No: TP03
Sheet 1 of 1

JOB NUMBER: LC0012-23



0.00 Slightly moist, light brown, loose to very dense, intact, fine to medium grained, clayey SAND with roots- COLLUVIUM.

0.50 Slightly moist, dark reddish brown, very stiff, intact, fine grained, CLAY- RESIDUAL MUDROCK.

1.10 Maroon, highly weathered, fine grained, highly fractured, soft rock, MUDROCK- TIMEBALL HILL FM - PRETORIA GROUP - TRANSVAAL SUPERGROUP.

1.70 Light yellowish brown mottled black, highly weathered, medium grained, highly fractured, soft rock, FERRUGENISED QUARTZITE- TIMEBALL HILL FM - PRETORIA GROUP - TRANSVAAL SUPERGROUP.

1.90 NOTES

1) End of hole at 1.9m.
2) Excavation stopped at 1.9m on soft rock Quartzite.
3) No groundwater seepage encountered.
4) Sample bag at 0.5m -- 1.1m.
5) Side walls stable.

CONTRACTOR :
MACHINE : TLB Excavation
DRILLED BY :
PROFILED BY : Queen (Checked by Mbulungeni)

TYPE SET BY : Queen
SETUP FILE : STANDARD.SET

INCLINATION : Vertical
DIAM :
DATE :
DATE : 05 May 2023

DATE : 15/05/2023 09:58
TEXT : ..Logs\IkagengSiteLogs.TXT

ELEVATION : 1386m
X-COORD : 27.016136´°
Y-COORD : 26.739941´°

HOLE No: TP03

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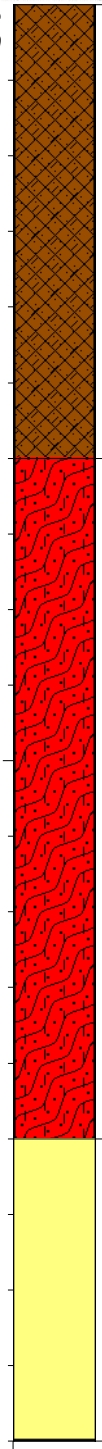
Ikageng Geotechnical Investigation

HOLE No: TP04
Sheet 1 of 1

JOB NUMBER: LC0012-23

Scale 1:10



0.00 Slightly moist, dark brown, medium dense to dense, intact, fine to medium grained, clayey SAND with roots- FILL.

0.6m

0.60 Slightly moist, light reddish brown, dense to very dense, intact, fine to medium grained, silty SAND- RESIDUAL QUARTZITE.

1.5m

1.50 Light yellowish brown speckled white mottled black, highly weathered, medium grained, highly fractured, soft rock, FERRUGENISED QUARTZITE- TIMEBALL HILL FM - PRETORIA GROUP - TRANSVAAL SUPERGROUP.

1.90

NOTES

1) End of hole at 1.9m.
2) Excavation stopped at 1.9m on soft rock Quartzite.
3) No groundwater seepage encountered.
4) Sample bags at 0.6m -- 1.5m.
5) Side walls stable.

CONTRACTOR :
MACHINE : TLB Excavation
DRILLED BY :
PROFILED BY : Queen (Checked by Mbulungeni)
TYPE SET BY : Queen
SETUP FILE : STANDARD.SET

INCLINATION : Vertical
DIAM :
DATE :
DATE : 05 May 2023
DATE : 15/05/2023 09:58
TEXT : ..Logs\IkagengSiteLogs.TXT

ELEVATION : 1381m
X-COORD : 27.014562´°
Y-COORD : 26.739426´°

HOLE No: TP04

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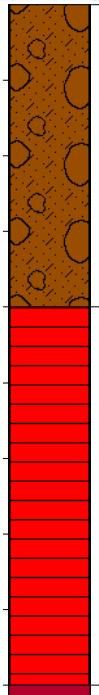
Ikageng Geotechnical Investigation

HOLE No: TP05
Sheet 1 of 1

JOB NUMBER: LC0012-23

Scale 1:10



0.00 Slightly moist, dark brown, loose to medium dense, intact, fine grained, clayey SAND with cobbles and roots- COLLUVIUM.

0.40 Slightly moist, dark reddish brown, stiff, intact, fine grained, CLAY- RESIDUAL MUDROCK.

0.9m

0.90 Maroon, highly weathered, fine grained, highly fractured, soft rock, MUDROCK- TIMEBALL HILL FM - PRETORIA GROUP - TRANSVAAL SUPERGROUP.

1.6m

1.60

NOTES

1) End of hole at 1.6m.
2) Excavation stopped at 1.6m on soft rock Mudrock.
3) No groundwater seepage encountered.
4) Sample bags at 0.9m -- 1.6m.
5) Side walls stable.

CONTRACTOR :
MACHINE : TLB Excavation
DRILLED BY :
PROFILED BY : Queen (Checked by Mbulungeni)
TYPE SET BY : Queen
SETUP FILE : STANDARD.SET

INCLINATION : Vertical
DIAM :
DATE :
DATE : 05 May 2023
DATE : 15/05/2023 09:58
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ELEVATION : 1379m
X-COORD : 27.015403´°
Y-COORD : 26.739537´°

HOLE No: TP05

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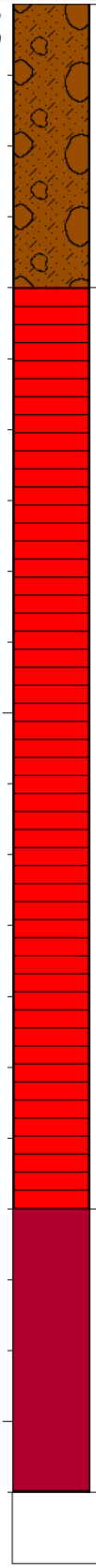
HOLE No: TP06
Sheet 1 of 1

JOB NUMBER: LC0012-23

Scale 1:10



0.00 Slightly moist, dark brown, medium dense to dense, intact, fine grained, clayey SAND with cobbles and roots- COLLUVIUM.

0.40 Slightly moist, dark reddish brown, very stiff, intact, fine grained, CLAY-RESIDUAL MUDROCK.

1.70 Maroon to olive green, highly weathered, fine grained, highly fractured, soft rock, MUDROCK- TIMEBALL HILL FM - PRETORIA GROUP - TRANSVAAL SUPERGROUP.

2.10

NOTES

1) End of hole at 2.1m.
2) Excavation stopped at 2.1m on soft rock Mudrock.
3) No groundwater seepage encountered.
4) Sample bag at 0.4 -- 1.7m.
5) Sample bags at 1.7m -- 2.1m.
6) Side walls stable.

CONTRACTOR :
MACHINE : TLB Excavation
DRILLED BY :
PROFILED BY : Queen (Checked by Mbulungeni)

INCLINATION : Vertical
DIAM :
DATE :
DATE : 05 May 2023

ELEVATION : 1380m
X-COORD : 27.016180´°
Y-COORD : 26.739612´°

HOLE No: TP06

TYPE SET BY : Queen
SETUP FILE : STANDARD.SET

DATE : 15/05/2023 09:58
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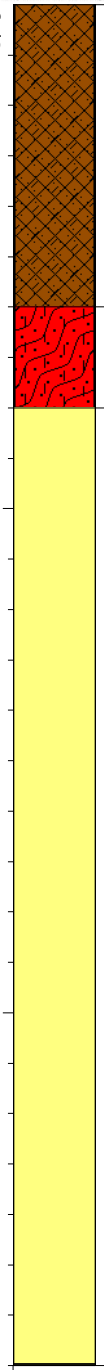
HOLE No: TP07
Sheet 1 of 1

JOB NUMBER: LC0012-23

Scale 1:15



0.6m
0.8m

0.00 Slightly moist, dark brown, medium dense to dense, intact, fine to medium grained, clayey SAND with roots- FILL.

0.60 Slightly moist, light reddish brown, dense, intact, fine to medium grained, silty SAND- RESIDUAL QUARTZITE.

0.80 Light yellowish brown speckled white mottled black, highly weathered, medium grained, highly fractured, soft rock, FERRUGENISED QUARTZITE- TIMEBALL HILL FM - PRETORIA GROUP - TRANSVAAL SUPERGROUP.

2.70

NOTES

1) End of hole at 2.7m.
2) Excavation stopped at 2.7m on soft rock Quartzite.
3) No groundwater seepage encountered.
4) Sample bags at 0.6m -- 0.8m.
5) Side walls stable.

CONTRACTOR :
MACHINE : TLB Excavation
DRILLED BY :
PROFILED BY : Queen (Checked by Mbulungeni)

TYPE SET BY : Queen
SETUP FILE : STANDARD.SET

INCLINATION : Vertical
DIAM :
DATE :
DATE : 05 May 2023

DATE : 15/05/2023 09:58
TEXT : ..Logs\IkagengSiteLogs.TXT

ELEVATION : 1380m
X-COORD : 27.014650´°
Y-COORD : 26.738923´°

HOLE No: TP07

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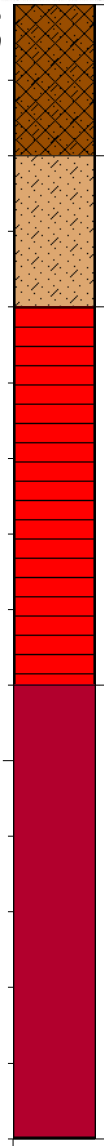
HOLE No: TP08
Sheet 1 of 1

JOB NUMBER: LC0012-23

Scale 1:10



0.00 Slightly moist, dark brown, very loose to loose, intact, fine grained, clayey SAND with roots- FILL.

0.20 Slightly moist, light yellowish brown, very loose to dense, intact, medium grained, clayey SAND with roots- COLLUVIUM.

0.40 Slightly moist, light reddish brown, firm to stiff, intact, medium dense, fine grained, CLAY- RESIDUAL MUDROCK.

0.90 Maroon, highly weathered, fine grained, highly fractured, soft rock, MUDROCK- TIMEBALL HILL FM - PRETORIA GROUP - TRANSVAAL SUPERGROUP.

1.50

NOTES

1) End of hole at 1.5m.
2) Excavation stopped at 1.5m on soft rock Mudrock.
3) No groundwater seepage encountered.
4) No sample taken.
5) Side walls stable.

CONTRACTOR :
MACHINE : TLB Excavation
DRILLED BY :
PROFILED BY : Queen (Checked by Mbulungeni)
TYPE SET BY : Queen
SETUP FILE : STANDARD.SET

INCLINATION : Vertical
DIAM :
DATE :
DATE : 05 May 2023
DATE : 15/05/2023 09:58
TEXT : ..Logs\IkagengSiteLogs.TXT

ELEVATION : 1381m
X-COORD : 27.015499´°
Y-COORD : 26.739156´°

HOLE No: TP08

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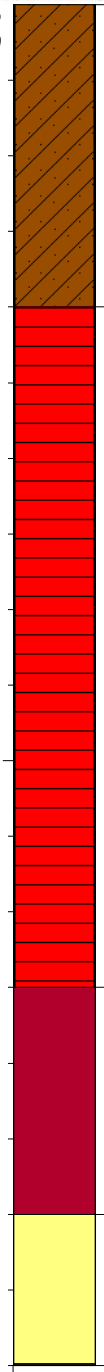
HOLE No: TP09
Sheet 1 of 1

JOB NUMBER: LC0012-23

Scale 1:10



0.00 Slightly moist, dark brown, medium dense to dense, intact, fine grained, sandy CLAY with roots- COLLUVIUM.

0.40 Slightly moist, dark reddish brown, stiff to very stiff, intact, fine grained, CLAY- RESIDUAL MUDROCK.

1.3

1.30 Maroon, highly weathered, fine grained, highly fractured, soft rock, MUDROCK- TIMEBALL HILL FM - PRETORIA GROUP - TRANSVAAL SUPERGROUP.

1.60 Light yellowish brown blotched white mottled black, highly to moderately weathered, medium grained, highly fractured, medium hard rock, FERRUGENISED QUARTZITE- TIMEBALL HILL FM - PRETORIA GROUP - TRANSVAAL SUPERGROUP.

1.6m

1.80

NOTES

1) End of hole at 1.8m.
2) Excavation stopped at 1.8m on medium hard rock Quartzite.
3) No groundwater seepage encountered.
4) Sample bags at 1.3 -- 1.6m.
5) Side walls stable.

CONTRACTOR :
MACHINE : TLB Excavation
DRILLED BY :
PROFILED BY : Queen (Checked by Mbulungeni)
TYPE SET BY : Queen
SETUP FILE : STANDARD.SET

INCLINATION : Vertical
DIAM :
DATE :
DATE : 05 May 2023
DATE : 15/05/2023 09:58
TEXT : ..Logs\IkagengSiteLogs.TXT

ELEVATION : 1382m
X-COORD : 27.016306´°
Y-COORD : 26.739197´°

HOLE No: TP09

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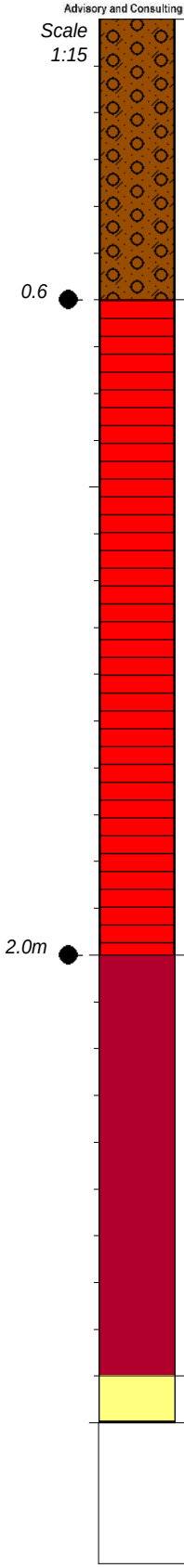
HOLE No: TP10
Sheet 1 of 1

JOB NUMBER: LC0012-23



0.00

Slightly moist, dark brown, dense to very dense, intact, fine grained, clayey SAND with gravels and roots- COLLUVIUM.

0.60

Slightly moist, dark reddish brown, very stiff, slickensided, fine grained, CLAY- RESIDUAL MUDROCK.

2.00

Maroon, highly weathered, fine grained, highly fractured, soft to medium hard rock, MUDROCK- TIMEBALL HILL FM - PRETORIA GROUP - TRANSVAAL SUPERGROUP.

2.90

Light yellowish brown blotched white mottled black, highly to moderately weathered, medium grained, highly fractured, medium hard rock, FERRUGENISED QUARTZITE- TIMEBALL HILL FM - PRETORIA GROUP - TRANSVAAL SUPERGROUP.

3.00

NOTES

1) End of hole at 3.0m.
2) No groundwater seepage encountered.
3) Sample bags at 0.6 -- 2.0m.
4) Side walls stable.

CONTRACTOR :
MACHINE : TLB Excavation
DRILLED BY :
PROFILED BY : Queen (Checked by Mbulungeni)
TYPE SET BY : Queen
SETUP FILE : STANDARD.SET

INCLINATION : Vertical
DIAM :
DATE :
DATE : 05 May 2023
DATE : 15/05/2023 09:58
TEXT : ..Logs\IkagengSiteLogs.TXT

ELEVATION : 1389m
X-COORD : 27.014691´°
Y-COORD : 26.738345´°

HOLE No: TP10

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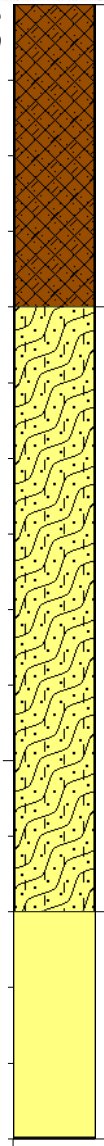
Ikageng Geotechnical Investigation

HOLE No: TP11
Sheet 1 of 1

JOB NUMBER: LC0012-23

Scale 1:10



0.00 Moist, dark brown, loose to dense, intact, fine grained, clayey SAND with roots- FILL.

0.40 Moist, light yellowish brown streaked black, dense to very dense, intact, medium grained, silty SAND- RESIDUAL QUARTZITE.

1.2 1.20 Light yellowish brown speckled red mottled black, highly weathered, medium grained, highly fractured, soft rock, FERRUGENISED QUARTZITE- TIMEBALL HILL FM - PRETORIA GROUP - TRANSVAAL SUPERGROUP.

1.5m 1.50

NOTES

1) End of hole at 1.5m.
2) Excavation stopped at 1.5m on soft rock Quartzite.
3) No groundwater seepage encountered.
4) Sample bags at 1.2 -- 1.5m.
5) Side walls stable.

CONTRACTOR :
MACHINE : TLB Excavation
DRILLED BY :
PROFILED BY : Queen (Checked by Mbulungeni)
TYPE SET BY : Queen
SETUP FILE : STANDARD.SET

INCLINATION : Vertical
DIAM :
DATE :
DATE : 05 May 2023
DATE : 15/05/2023 09:58
TEXT : ..Logs\IkagengSiteLogs.TXT

ELEVATION : 1380m
X-COORD : 27.015803´°
Y-COORD : 26.738523´°

HOLE No: TP11

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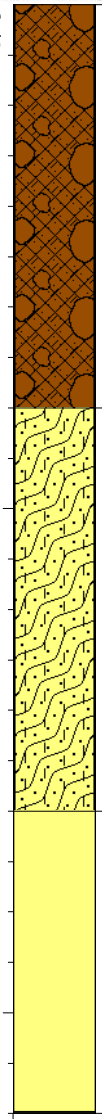
Ukuza
Ikageng Geotechnical Investigation

HOLE No: TP12
Sheet 1 of 1

JOB NUMBER: LC0012-23

Scale 1:15



0.00 Moist, black, loose to medium dense, intact, fine grained, clayey SAND with cobbles and roots- FILL.

0.8 ●

0.80 Moist, light yellowish brown streaked black, medium dense to dense, intact, medium grained, silty SAND- RESIDUAL QUARTZITE.

1.6m ●

1.60 Light yellowish brown speckled grey mottled black, highly weathered, medium grained, highly fractured, soft rock, FERRUGENISED QUARTZITE- TIMEBALL HILL FM - PRETORIA GROUP - TRANSVAAL SUPERGROUP.

2.20

NOTES

1) End of hole at 2.2m.
2) Excavation stopped at 2.2m on soft rock Quartzite.
3) No groundwater seepage encountered.
4) Sample bags at 0.8 -- 1.6m.
5) Side walls stable.

CONTRACTOR :
MACHINE : TLB Excavation
DRILLED BY :
PROFILED BY : Queen (Checked by Mbulungeni)
TYPE SET BY : Queen
SETUP FILE : STANDARD.SET

INCLINATION : Vertical
DIAM :
DATE :
DATE : 05 May 2023
DATE : 15/05/2023 09:58
TEXT : ..Logs\IkagengSiteLogs.TXT

ELEVATION : 1387m
X-COORD : 27.016426´°
Y-COORD : 26.738562´°

HOLE No: TP12

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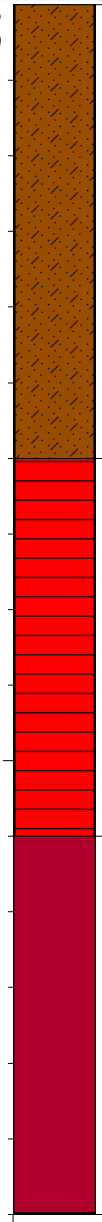
Ukuza
Ikageng Geotechnical Investigation

HOLE No: TP13
Sheet 1 of 1

JOB NUMBER: LC0012-23

Scale 1:10



0.00

Slightly moist, dark brown, loose to dense, intact, fine grained, clayey SAND with roots- COLLUVIUM.

0.6m

0.60

Slightly moist, dark reddish brown, stiff, intact, fine grained, CLAY- RESIDUAL MUDROCK.

1.1m

1.10

Maroon, highly weathered, fine grained, highly fractured, soft rock, MUDROCK- TIMEBALL HILL FM - PRETORIA GROUP - TRANSVAAL SUPERGROUP.

1.60

NOTES

1) End of hole at 1.6m.
2) Excavation stopped at 1.6m on soft rock Mudrock.
3) No groundwater seepage encountered.
4) Sample bags at 0.6m -- 1.1m.
5) Side walls stable.

CONTRACTOR :
MACHINE : TLB Excavation
DRILLED BY :
PROFILED BY : Queen (Checked by Mbulungeni)
TYPE SET BY : Queen
SETUP FILE : STANDARD.SET

INCLINATION : Vertical
DIAM :
DATE :
DATE : 05 May 2023
DATE : 15/05/2023 09:58
TEXT : ..Logs\IkagengSiteLogs.TXT

ELEVATION : 1376m
X-COORD : 27.015055´°
Y-COORD : 26.738903´°

HOLE No: TP13

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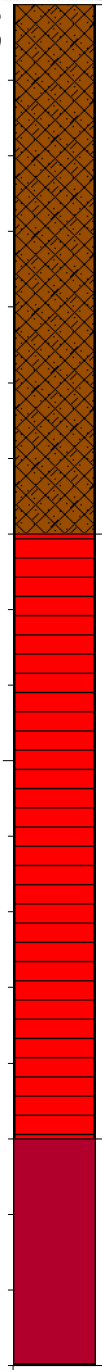
Advisory and Consulting (Pty) Ltd

Ukuza
Ikageng Geotechnical Investigation

HOLE No: TP14
Sheet 1 of 1

JOB NUMBER: LC0012-23

Scale 1:10



0.00 Slightly moist, black, loose to dense, intact, fine grained, clayey SAND with roots- FILL.

0.7m

0.70 Slightly moist, light reddish brown, stiff, intact, fine grained, CLAY- RESIDUAL MUDROCK.

1.5m

1.50 Maroon to olive green, highly weathered, fine grained, highly fractured, soft rock, MUDROCK- TIMEBALL HILL FM - PRETORIA GROUP - TRANSVAAL SUPERGROUP.

1.80

NOTES

1) End of hole at 1.8m.
2) Excavation stopped at 1.8m on soft rock Mudrock.
3) No groundwater seepage encountered.
4) Sample bags at 0.7m -- 1.5m.
5) Side walls stable.

CONTRACTOR :
MACHINE : TLB Excavation
DRILLED BY :
PROFILED BY : Queen (Checked by Mbulungeni)
TYPE SET BY : Queen
SETUP FILE : STANDARD.SET

INCLINATION : Vertical
DIAM :
DATE :
DATE : 05 May 2023
DATE : 15/05/2023 09:58
TEXT : ..Logs\IkagengSiteLogs.TXT

ELEVATION : 1381m
X-COORD : 27.015928´°
Y-COORD : 26.739042´°

HOLE No: TP14

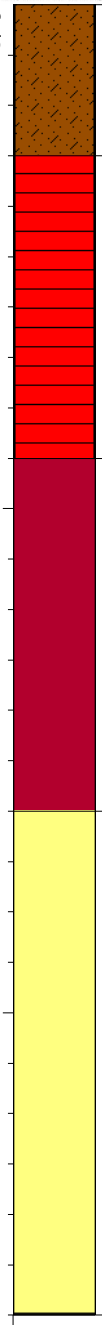
Luhlaza
Advisory and Consulting (Pty) Ltd

Ukuza
Ikageng Geotechnical Investigation

HOLE No: TP15
Sheet 1 of 1

JOB NUMBER: LC0012-23

Scale 1:15



0.9m

1.6m

0.00 Moist, dark brown, loose to dense, intact, fine grained, clayey SAND with roots- COLLUVIUM.

0.30 Moist, dark reddish brown, firm, intact, fine grained, CLAY- RESIDUAL MUDROCK.

0.90 Maroon to olive green, highly weathered, fine grained, highly fractured, soft rock, MUDROCK- TIMEBALL HILL FM - PRETORIA GROUP - TRANSVAAL SUPERGROUP.

1.60 Light yellowish brown blotched white mottled black, highly to moderately weathered, medium grained, highly fractured, soft rock, FERRUGENISED QUARTZITE- TIMEBALL HILL FM - PRETORIA GROUP - TRANSVAAL SUPERGROUP.

2.60

NOTES

1) End of hole at 2.6m.
2) Excavation stopped at 2.6m on soft rock Quartzite.
3) No groundwater seepage encountered.
4) Sample bags at 0.9m -- 1.6m.
5) Side walls stable.

CONTRACTOR :
MACHINE : TLB Excavation
DRILLED BY :
PROFILED BY : Queen (Checked by Mbulungeni)

TYPE SET BY : Queen
SETUP FILE : STANDARD.SET

INCLINATION : Vertical
DIAM :
DATE :
DATE : 05 May 2023

DATE : 15/05/2023 09:58
TEXT : ..Logs\IkagengSiteLogs.TXT

ELEVATION : 1375m
X-COORD : 27.015824´°
Y-COORD : 26.739331´°

HOLE No: TP15

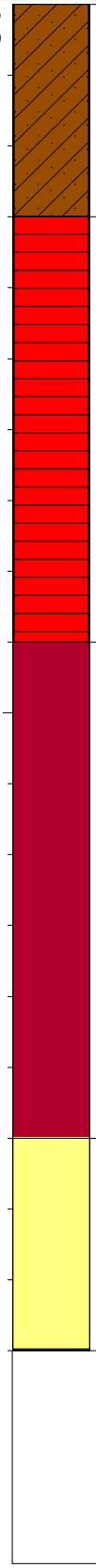
Luhlaza
Advisory and Consulting (Pty) Ltd

Ukuza
Ikageng Geotechnical Investigation

HOLE No: TP16
Sheet 1 of 1

JOB NUMBER: LC0012-23

Scale 1:10



0.00 Moist, dark brown, dense to very dense, intact, fine grained, sandy CLAY with roots- COLLUVIUM.

0.3m

0.30 Moist, dark reddish brown, very stiff, intact, fine grained, CLAY- RESIDUAL MUDROCK.

0.9m

0.90 Maroon to olive green, highly weathered, fine grained, highly fractured, soft rock, MUDROCK- TIMEBALL HILL FM - PRETORIA GROUP - TRANSVAAL SUPERGROUP.

1.60 Light yellowish brown blotched white mottled black, highly to moderately weathered, medium grained, highly fractured, soft rock, FERRUGENISED QUARTZITE- TIMEBALL HILL FM - PRETORIA GROUP - TRANSVAAL SUPERGROUP.

1.90

NOTES

1) End of hole at 1.9m.
2) Excavation stopped at 1.9m on soft rock Quartzite.
3) No groundwater seepage encountered.
4) Sample bags at 0.3m -- 0.9m.
5) Side walls stable.

CONTRACTOR :
MACHINE : TLB Excavation
DRILLED BY :
PROFILED BY : Queen (Checked by Mbulungeni)

TYPE SET BY : Queen
SETUP FILE : STANDARD.SET

INCLINATION : Vertical
DIAM :
DATE :
DATE : 05 May 2023

DATE : 15/05/2023 09:58
TEXT : ..Logs\IkagengSiteLogs.TXT

ELEVATION : 1382m
X-COORD : 27.015826´°
Y-COORD : 26.739761´°

HOLE No: TP16

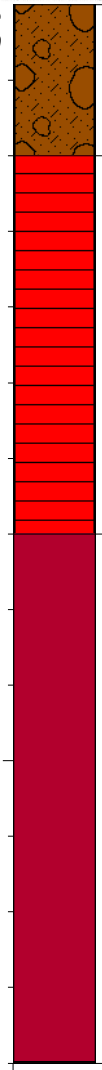
Luhlaza
Advisory and Consulting (Pty) Ltd

Ukuza
Ikageng Geotechnical Investigation

HOLE No: TP17
Sheet 1 of 1

JOB NUMBER: LC0012-23

Scale 1:10



0.00 Slightly moist, dark brown, loose to medium dense, intact, fine grained, clayey SAND with cobbles and roots- COLLUVIUM.

0.2m

0.20 Slightly moist, dark reddish brown, firm to stiff, intact, fine grained, CLAY- RESIDUAL MUDROCK.

0.7m

0.70 Maroon, highly weathered, fine grained, highly fractured, soft rock, MUDROCK- TIMEBALL HILL FM - PRETORIA GROUP - TRANSVAAL SUPERGROUP.

1.40

NOTES

1) End of hole at 1.4m.
2) Excavation stopped at 1.4m on soft rock Mudrock.
3) No groundwater seepage encountered.
4) Sample bags at 0.2m -- 0.7m.
5) Side walls stable.

CONTRACTOR :
MACHINE : TLB Excavation
DRILLED BY :
PROFILED BY : Queen (Checked by Mbulungeni)
TYPE SET BY : Queen
SETUP FILE : STANDARD.SET

INCLINATION : Vertical
DIAM :
DATE :
DATE : 05 May 2023
DATE : 15/05/2023 09:58
TEXT : ..Logs\IkagengSiteLogs.TXT

ELEVATION : 1382m
X-COORD : 27.014879´°
Y-COORD : 26.739661´°

HOLE No: TP17

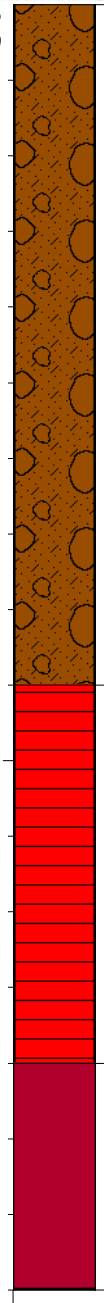
Luhlaza
Advisory and Consulting (Pty) Ltd

Ukuza
Ikageng Geotechnical Investigation

HOLE No: TP18
Sheet 1 of 1

JOB NUMBER: LC0012-23

Scale 1:10



0.00 Slightly moist, dark to light reddish brown, loose to dense, intact, fine grained, clayey SAND with cobbles and roots- COLLUVIUM.

0.90 Slightly moist, dark reddish brown, very stiff, intact, fine grained, CLAY- RESIDUAL MUDROCK.

1.4m

1.40 Maroon, highly weathered, fine grained, highly fractured, soft rock, MUDROCK- TIMEBALL HILL FM - PRETORIA GROUP - TRANSVAAL SUPERGROUP.

1.7m

1.70

NOTES

1) End of hole at 1.7m.
2) Excavation stopped at 1.7m on soft rock Mudrock.
3) No groundwater seepage encountered.
4) Sample bags at 1.4m -- 1.7m.
5) Side walls stable.

CONTRACTOR :
MACHINE : TLB Excavation
DRILLED BY :
PROFILED BY : Queen (Checked by Mbulungeni)
TYPE SET BY : Queen
SETUP FILE : STANDARD.SET

INCLINATION : Vertical
DIAM :
DATE :
DATE : 05 May 2023
DATE : 15/05/2023 09:58
TEXT : ..Logs\IkagengSiteLogs.TXT

ELEVATION : 1372m
X-COORD : 27.015090´°
Y-COORD : 26.739202´°

HOLE No: TP18

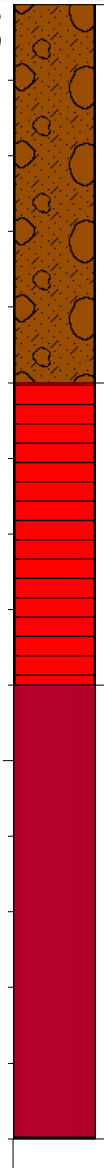
Luhlaza
Advisory and Consulting (Pty) Ltd

Ukuza
Ikageng Geotechnical Investigation

HOLE No: TP19
Sheet 1 of 1

JOB NUMBER: LC0012-23

Scale 1:10



0.00 Slightly moist, dark to light reddish brown, medium dense to dense, intact, fine grained, clayey SAND with cobbles and roots- COLLUVIUM.

0.50 Slightly moist, light yellowish green, firm to stiff, intact, fine grained, CLAY- RESIDUAL MUDROCK.

0.9m

0.90 Maroon to olive green, highly weathered, fine grained, highly fractured, soft rock, MUDROCK- TIMEBALL HILL FM - PRETORIA GROUP - TRANSVAAL SUPERGROUP.

1.5m

1.50

NOTES

1) End of hole at 1.5m.
2) Excavation stopped at 1.5m on soft rock Mudrock.
3) No groundwater seepage encountered.
4) Sample bags at 0.9m -- 1.5m.
5) Side walls stable.

CONTRACTOR :
MACHINE : TLB Excavation
DRILLED BY :
PROFILED BY : Queen (Checked by Mbulungeni)
TYPE SET BY : Queen
SETUP FILE : STANDARD.SET

INCLINATION : Vertical
DIAM :
DATE :
DATE : 05 May 2023
DATE : 15/05/2023 09:58
TEXT : ..Logs\IkagengSiteLogs.TXT

ELEVATION : 1382m
X-COORD : 27.015575´°
Y-COORD : 26.738778´°

HOLE No: TP19

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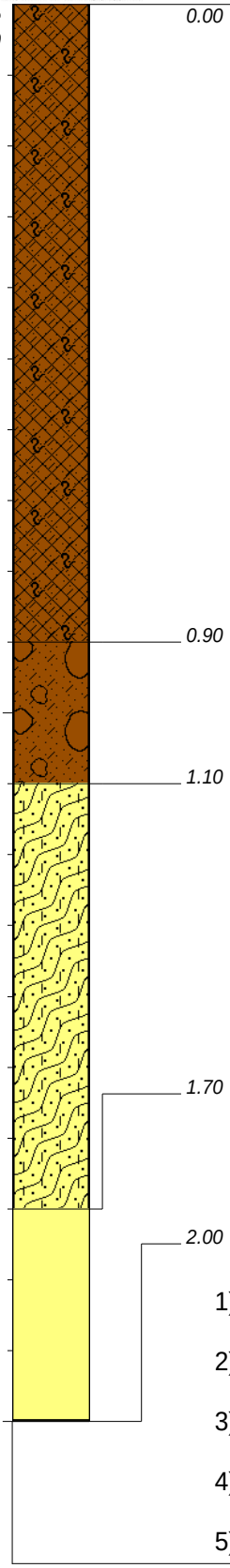
Ukuza
Ikageng Geotechnical Investigation

HOLE No: TP20
Sheet 1 of 1

JOB NUMBER: LC0012-23

Scale 1:10



0.00 Slightly moist, light brown, medium dense to very dense, intact, fine to medium grained, clayey SAND with roots and plastics- FILL.

0.9 — 0.90 Slightly moist, dark to light reddish brown, very dense, intact, fine grained, clayey SAND with cobbles and roots- COLLUVIUM.

1.1m — 1.10 Slightly moist, light reddish brown, medium dense, intact, medium grained, silty SAND- RESIDUAL QUARTZITE.

1.70 Light yellowish brown speckled grey mottled black, highly weathered, medium grained, highly fractured, soft rock, FERRUGENISED QUARTZITE- TIMEBALL HILL FM - PRETORIA GROUP - TRANSVAAL SUPERGROUP.

2.00

NOTES

1) End of hole at 2.0m.
2) Excavation stopped at 2.0m on soft rock Quartzite.
3) No groundwater seepage encountered.
4) Sample bags at 0.9 -- 1.1m.
5) Side walls stable.

CONTRACTOR :
MACHINE : TLB Excavation
DRILLED BY :
PROFILED BY : Queen (Checked by Mbulungeni)

TYPE SET BY : Queen
SETUP FILE : STANDARD.SET

INCLINATION : Vertical
DIAM :
DATE :
DATE : 05 May 2023

DATE : 15/05/2023 09:58
TEXT : ..Logs\IkagengSiteLogs.TXT

ELEVATION : 1382m
X-COORD : 27.016188´°
Y-COORD : 26.738811´°

HOLE No: TP20

Luhlaza
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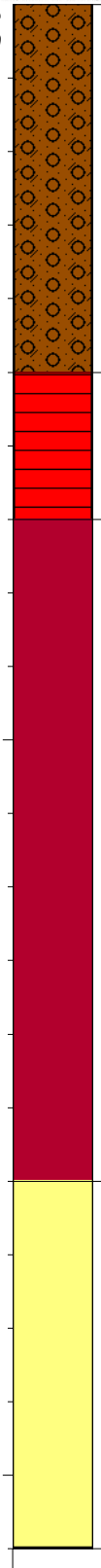
Ukuza
Ikageng Geotechnical Investigation

HOLE No: TP21
Sheet 1 of 1

JOB NUMBER: LC0012-23

Scale 1:10



0.00 Slightly moist, dark brown, medium dense to dense, intact, fine grained, clayey SAND with gravels and roots- COLLUVIUM.

0.50 Slightly moist, dark reddish brown, stiff to very stiff, slickensided, fine grained, CLAY- RESIDUAL MUDROCK.

0.70 Maroon, highly weathered, fine grained, highly fractured, soft to medium hard rock, MUDROCK- TIMEBALL HILL FM - PRETORIA GROUP - TRANSVAAL SUPERGROUP.

1.60 Light yellowish brown blotched white mottled black, highly weathered, medium grained, highly fractured, soft rock, FERRUGENISED QUARTZITE- TIMEBALL HILL FM - PRETORIA GROUP - TRANSVAAL SUPERGROUP.

2.10

NOTES

1) End of hole at 2.1m.
2) Excavation stopped at 2.1m on soft rock Quartzite.
3) No groundwater seepage encountered.
4) Sample bags at 1.6 -- 2.1m.
5) Side walls stable.

CONTRACTOR :
MACHINE : TLB Excavation
DRILLED BY :
PROFILED BY : Queen (Checked by Mbulungeni)

TYPE SET BY : Queen
SETUP FILE : STANDARD.SET

INCLINATION : Vertical
DIAM :
DATE :
DATE : 05 May 2023

DATE : 15/05/2023 09:58
TEXT : ..Logs\IkagengSiteLogs.TXT

ELEVATION : 1384m
X-COORD : 27.015143´°
Y-COORD : 26.738456´°

HOLE No: TP21

Luhlaza
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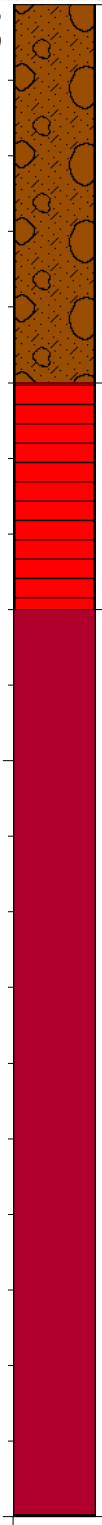
Ukuza
Ikageng Geotechnical Investigation

HOLE No: TP22
Sheet 1 of 1

JOB NUMBER: LC0012-23

Scale 1:10



0.00 Slightly moist, dark brown, dense, intact, fine grained, clayey SAND with cobbles and roots- COLLUVIUM.

0.50 Slightly moist, dark reddish brown, intact, very stiff, fine grained, CLAY- RESIDUAL MUDROCK.

0.80 Maroon, highly weathered, fine grained, highly fractured, soft rock, MUDROCK- TIMEBALL HILL FM - PRETORIA GROUP - TRANSVAAL SUPERGROUP.

2.00

NOTES

1) End of hole at 2.0m.
2) Excavation stopped at 2.0m on soft rock Mudrock.
3) No groundwater seepage encountered.
4) Sample bags at 0.8m -- 2.0m.
5) Side walls stable.

CONTRACTOR :
MACHINE : TLB Excavation
DRILLED BY :
PROFILED BY : Queen (Checked by Mbulungeni)

TYPE SET BY : Queen
SETUP FILE : STANDARD.SET

INCLINATION : Vertical
DIAM :
DATE :
DATE : 05 May 2023

DATE : 15/05/2023 09:58
TEXT : ..Logs\IkagengSiteLogs.TXT

ELEVATION : 1378m
X-COORD : 27.014709´°
Y-COORD : 26.738669´°

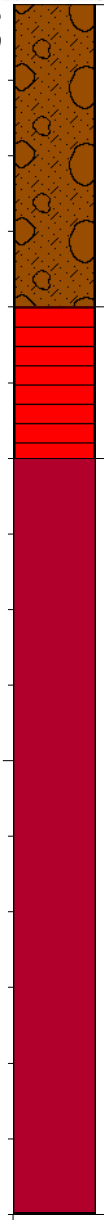
HOLE No: TP22

Ukuza
Ikageng Geotechnical Investigation

HOLE No: TP23
Sheet 1 of 1

JOB NUMBER: LC0012-23

Scale 1:10



0.00 Slightly moist, dark brown, loose to dense, intact, fine grained, clayey SAND with cobbles and roots- COLLUVIUM.

0.40 Slightly moist, dark reddish brown, very stiff, intact, fine grained, CLAY- RESIDUAL MUDROCK.

0.6m

0.60 Maroon, highly weathered, fine grained, highly fractured, soft rock, MUDROCK- TIMEBALL HILL FM - PRETORIA GROUP - TRANSVAAL SUPERGROUP.

1.6m

1.60

NOTES

1) End of hole at 1.6m.
2) Excavation stopped at 1.6m on soft rock Mudrock.
3) No groundwater seepage encountered.
4) Sample bags at 0.6m -- 1.6m.
5) Side walls stable.

CONTRACTOR :
MACHINE : TLB Excavation
DRILLED BY :
PROFILED BY : Queen (Checked by Mbulungeni)
TYPE SET BY : Queen
SETUP FILE : STANDARD.SET

INCLINATION : Vertical
DIAM :
DATE :
DATE : 05 May 2023
DATE : 15/05/2023 09:58
TEXT : ..Logs\IkagengSiteLogs.TXT

ELEVATION : 1382m
X-COORD : 27.015013´°
Y-COORD : 26.739408´°

HOLE No: TP23

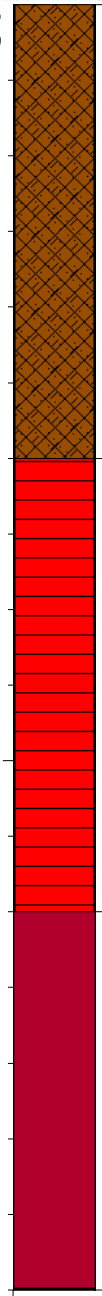
Luhlaza
Advisory and Consulting (Pty) Ltd

Ukuza
Ikageng Geotechnical Investigation

HOLE No: TP24
Sheet 1 of 1

JOB NUMBER: LC0012-23

Scale 1:10



0.00 Slightly moist, black, loose to dense , intact, fine grained, clayey SAND with roots- FILL.

0.6 ● 0.60

Slightly moist, light reddish brown, very stiff, intact, fine grained, CLAY-RESIDUAL MUDROCK.

1.2m ● 1.20

Maroon, highly weathered, fine grained, highly fractured, soft rock, MUDROCK- TIMEBALL HILL FM - PRETORIA GROUP - TRANSVAAL SUPERGROUP.

1.70

NOTES

1) End of hole at 1.7m.
2) Excavation stopped at 1.7m on soft rock Mudrock.
3) No groundwater seepage encountered.
4) Sample bags at 0.6 -- 1.2m.
5) Side walls stable.

CONTRACTOR :
MACHINE : TLB Excavation
DRILLED BY :
PROFILED BY : Queen (Checked by Mbulungeni)
TYPE SET BY : Queen
SETUP FILE : STANDARD.SET

INCLINATION : Vertical
DIAM :
DATE :
DATE : 05 May 2023
DATE : 15/05/2023 09:58
TEXT : ..Logs\IkagengSiteLogs.TXT

ELEVATION : 1390m
X-COORD : 27.015720´°
Y-COORD : 26.739572´°

HOLE No: TP24

Luhlaza
Advisory and Consulting (Pty) Ltd

Ukuza
Ikageng Geotechnical Investigation

LEGEND
Sheet 1 of 1

JOB NUMBER: LC0012-23

	GRAVELS	{SA02}
	SAND	{SA04}
	SANDY	{SA05}
	SILTY	{SA07}
	CLAY	{SA08}
	CLAYEY	{SA09}
	MUDROCK	{SA12}
	QUARTZITE	{SA15}
	FILL	{SA32}
Name ●	DISTURBED SAMPLE	{SA38}
	ROOTS	{SA40}
	COBBLES	{SA58}

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY :

INCLINATION :
DIAM :
DATE :
DATE :

ELEVATION :
X-COORD :
Y-COORD :

TYPE SET BY : Queen
SETUP FILE : STANDARD.SET

DATE : 15/05/2023 09:58
TEXT : ..Logs\IkagengSiteLogs.TXT

LEGEND
SUMMARY OF SYMBOLS

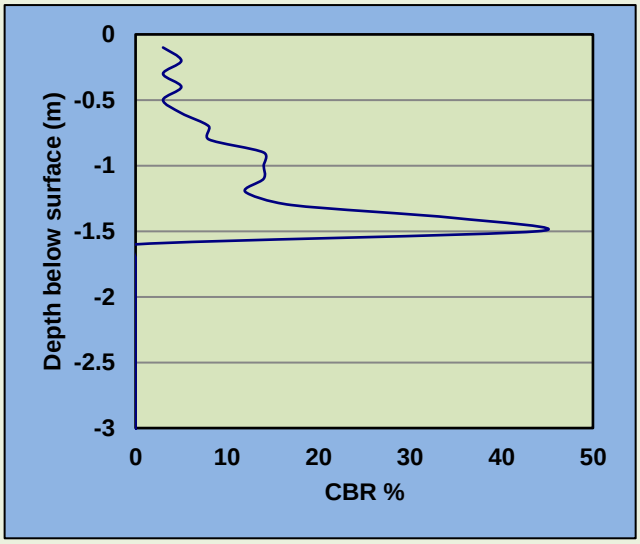
Appendix B: DCP

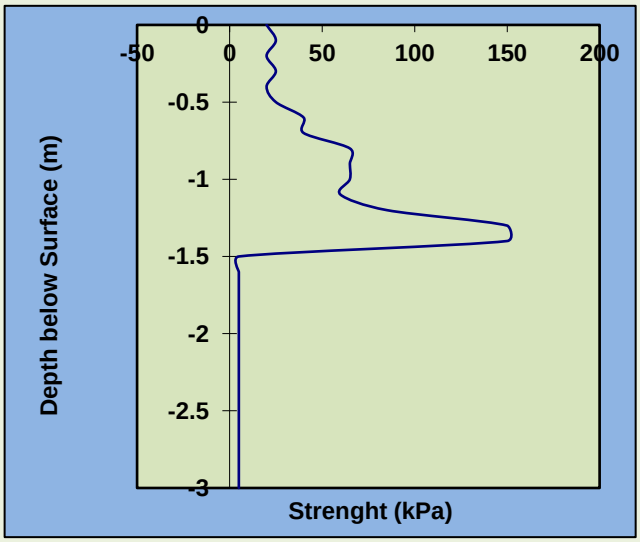
info@luhlazaconsulting.co.za
+27 63 769 4305
+27 63 769 4305
www.luhlazaconsulting.co.za

Luhlaza Advisory and Consulting (Pty) Ltd	**Client Name**	Ukuza
	Reference:	LC012-23
	Project:	Ikageng Geotechnical Investigation
	Date:	05-May-23
	DCP No.:	TP 1
	Final Depth:	*1.5 m*

The shear strength values are based on empirical calculations and should be used as a guide only

Depth (m)	Blows/ 0.1m	Inferred Consistency	Shear Strength
0			
0.1	2	Loose	30 deg
0.2	3	Loose	30 deg
0.3	2	Loose	30 deg
0.4	3	Loose	30 deg
0.5	2	Loose	30 deg
0.6	3	Loose	30 deg
0.7	5	Med.Dense	32 deg
0.8	5	Med.Dense	32 deg
0.9	8	Med.Dense	35 deg
1	8	Med.Dense	35 deg
1.1	8	Med.Dense	35 deg
1.2	7	Med.Dense	34 deg
1.3	10	Med.Dense	36 deg
1.4	19	Dense	37 deg
1.5	23	Dense	38 deg
	REF		



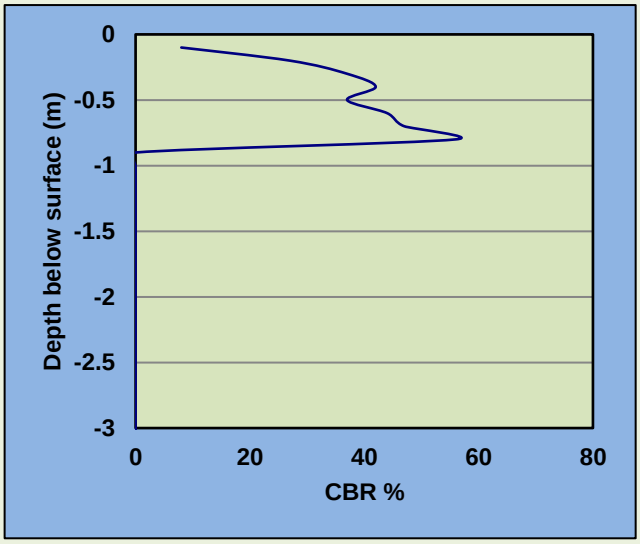


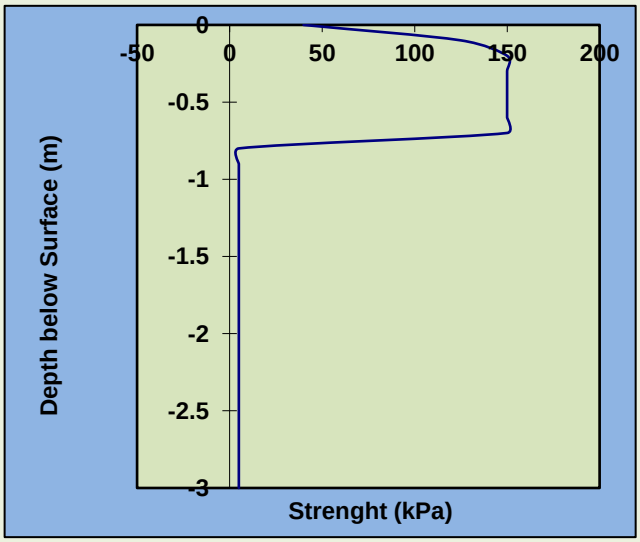
The results shown here are based on calculations using the DCP test. These are classified as indicative values and need to be verified by other testing methods.

Luhlaza Advisory and Consulting (Pty) Ltd	**Client Name**	Ukuza
	Reference:	LC012-23
	Project:	Ikageng Geotechnical Investigation
	Date:	05-May-23
	DCP No.:	TP 2
	Final Depth:	*0.8 m*

The shear strength values are based on empirical calculations and should be used as a guide only

Depth (m)	Blows/ 0.1m	Inferred Consistency	Shear Strength
0			
0.1	5	Med.Dense	32 deg
0.2	15	Dense	37 deg
0.3	20	Dense	38 deg
0.4	22	Dense	38 deg
0.5	20	Dense	38 deg
0.6	23	Very Stiff	150 kPa
0.7	24	Very Stiff	150 kPa
0.8	28	Very Stiff	150 kPa
	REF		



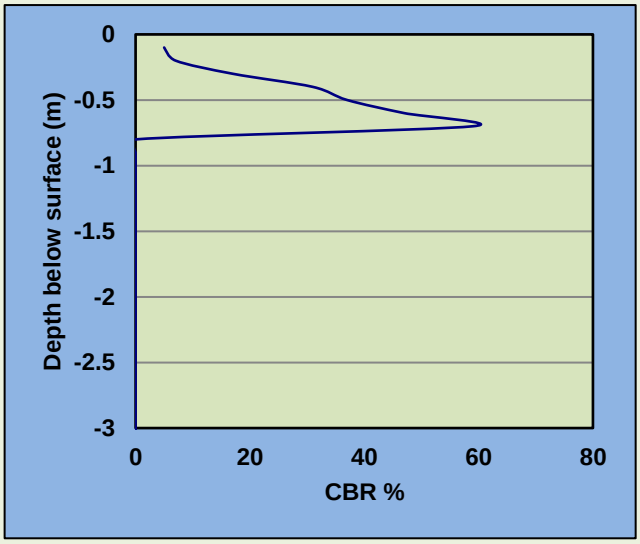


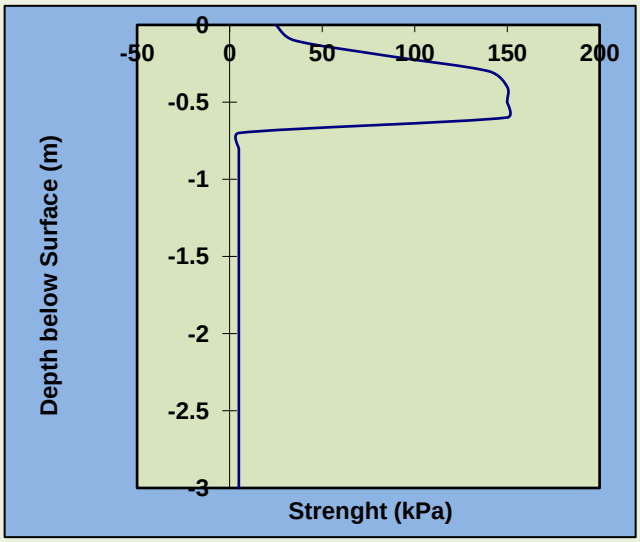
The results shown here are based on calculations using the DCP test. These are classified as indicative values and need to be verified by other testing methods.

Luhlaza Advisory and Consulting (Pty) Ltd	**Client Name**	Ukuza
	Reference:	LC012-23
	Project:	Ikageng Geotechnical Investigation
	Date:	05-May-23
	DCP No.:	TP 3
	Final Depth:	*0.7 m*

The shear strength values are based on empirical calculations and should be used as a guide only

Depth (m)	Blows/ 0.1m	Inferred Consistency	Shear Strength
0			
0.1	3	Loose	30 deg
0.2	4	Med.Dense	30 deg
0.3	10	Med.Dense	36 deg
0.4	17	Dense	37 deg
0.5	20	Dense	38 deg
0.6	24	Very Stiff	150 kPa
0.7	29	Very Stiff	150 kPa
	REF		



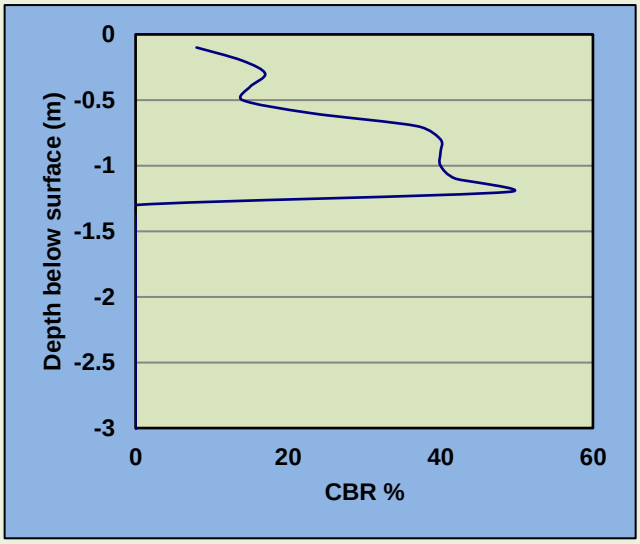


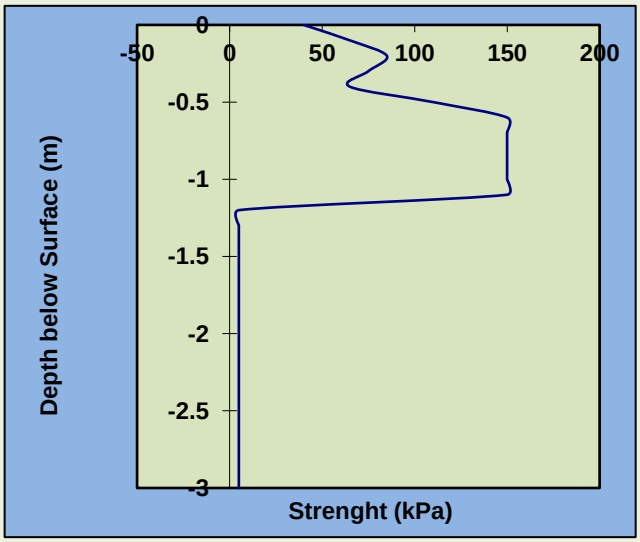
The results shown here are based on calculations using the DCP test. These are classified as indicative values and need to be verified by other testing methods.

Luhlaza Advisory and Consulting (Pty) Ltd	**Client Name**	Ukuza
	Reference:	LC012-23
	Project:	Ikageng Geotechnical Investigation
	Date:	05-May-23
	DCP No.:	TP 4
	Final Depth:	*1.2 m*

The shear strength values are based on empirical calculations and should be used as a guide only

Depth (m)	Blows/ 0.1m	Inferred Consistency	Shear Strength
0			
0.1	5	Med.Dense	32 deg
0.2	8	Med.Dense	35 deg
0.3	10	Med.Dense	36 deg
0.4	9	Med.Dense	35 deg
0.5	8	Med.Dense	35 deg
0.6	13	Dense	37 deg
0.7	20	Dense	38 deg
0.8	21	Dense	38 deg
0.9	21	Dense	38 deg
1	21	Dense	38 deg
1.1	22	Dense	38 deg
1.2	25	Very Dense	38 deg
	REF		



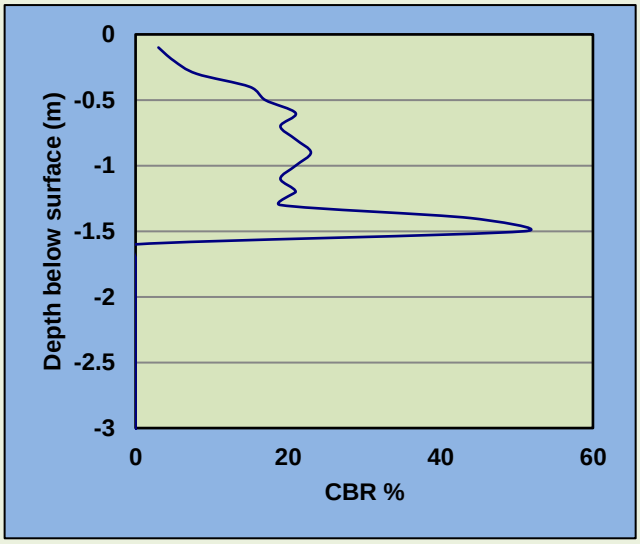


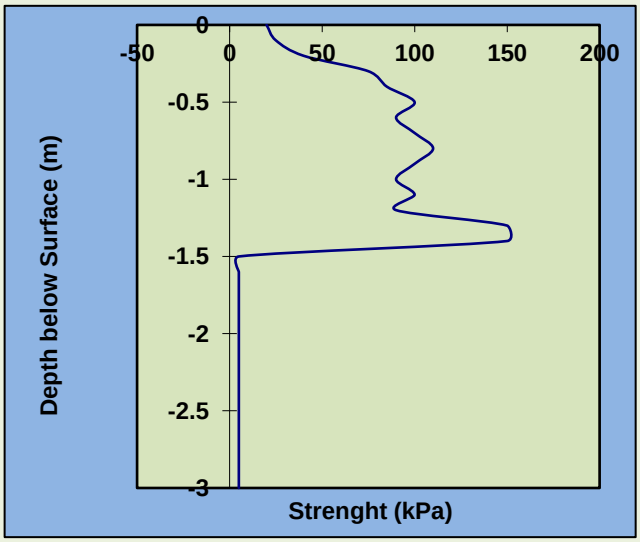
The results shown here are based on calculations using the DCP test. These are classified as indicative values and need to be verified by other testing methods.

Luhlaza Advisory and Consulting (Pty) Ltd	**Client Name**	Ukuza
	Reference:	LC012-23
	Project:	Ikageng Geotechnical Investigation
	Date:	05-May-23
	DCP No.:	TP 5
	Final Depth:	*1.5 m*

The shear strength values are based on empirical calculations and should be used as a guide only

Depth (m)	Blows/ 0.1m	Inferred Consistency	Shear Strength
0			
0.1	2	Loose	30 deg
0.2	3	Loose	30 deg
0.3	5	Med.Dense	32 deg
0.4	9	Med.Dense	35 deg
0.5	10	Stiff	85 kPa
0.6	12	Stiff	100 kPa
0.7	11	Stiff	90 kPa
0.8	12	Stiff	100 kPa
0.9	13	Stiff	110 kPa
1	12	Stiff	100 kPa
1.1	11	Stiff	90 kPa
1.2	12	Stiff	100 kPa
1.3	11	Stiff	90 kPa
1.4	23	Very Stiff	150 kPa
1.5	26	Very Stiff	150 kPa
	REF		



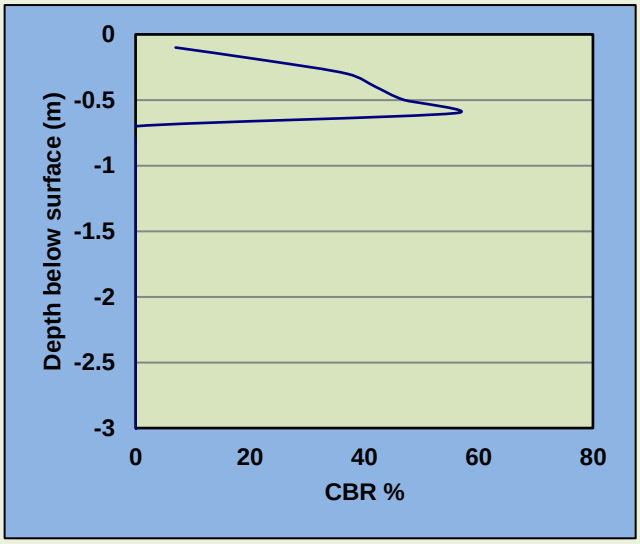


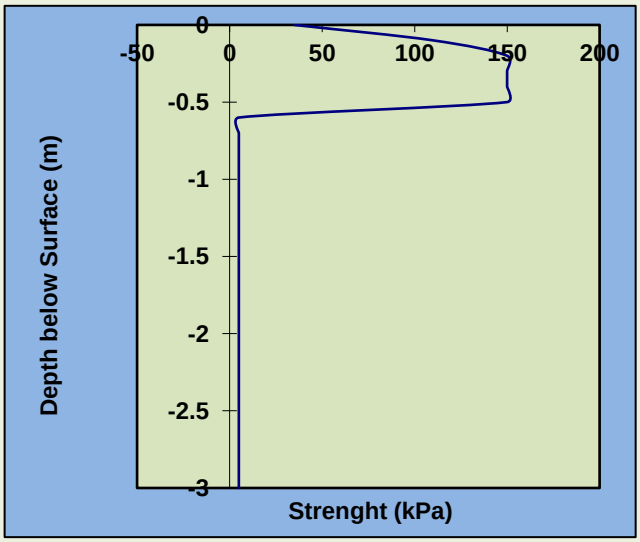
The results shown here are based on calculations using the DCP test. These are classified as indicative values and need to be verified by other testing methods.

Luhlaza Advisory and Consulting (Pty) Ltd	**Client Name**	Ukuza
	Reference:	LC012-23
	Project:	Ikageng Geotechnical Investigation
	Date:	05-May-23
	DCP No.:	TP 6
	Final Depth:	*0.6 m*

The shear strength values are based on empirical calculations and should be used as a guide only

Depth (m)	Blows/ 0.1m	Inferred Consistency	Shear Strength
0			
0.1	4	Med.Dense	30 deg
0.2	13	Dense	37 deg
0.3	20	Dense	38 deg
0.4	22	Dense	38 deg
0.5	24	Very Stiff	150 kPa
0.6	28	Very Stiff	150 kPa
	REF		



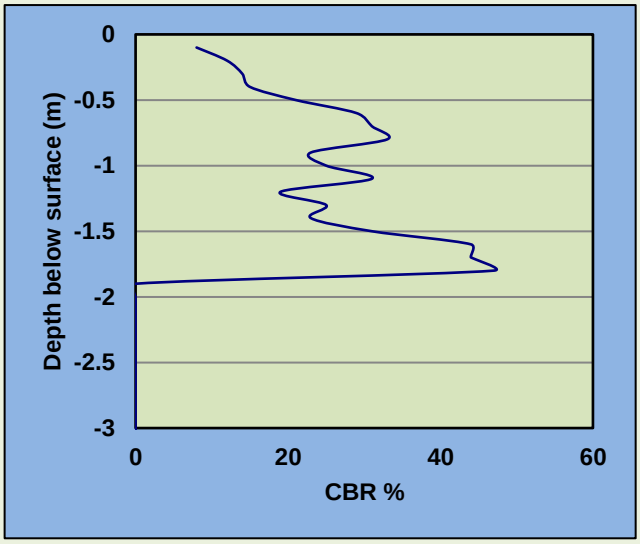


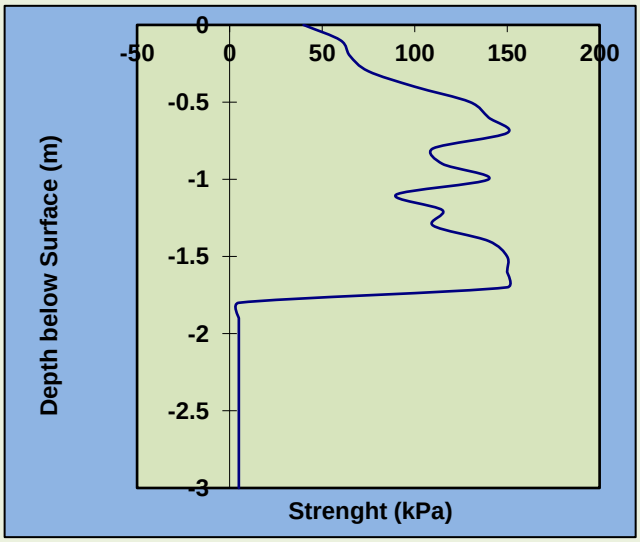
The results shown here are based on calculations using the DCP test. These are classified as indicative values and need to be verified by other testing methods.

Luhlaza Advisory and Consulting (Pty) Ltd	**Client Name**	Ukuza
	Reference:	LC012-23
	Project:	Ikageng Geotechnical Investigation
	Date:	05-May-23
	DCP No.:	TP 7
	Final Depth:	*1.8 m*

The shear strength values are based on empirical calculations and should be used as a guide only

Depth (m)	Blows/ 0.1m	Inferred Consistency	Shear Strength
0			
0.1	5	Med.Dense	32 deg
0.2	7	Med.Dense	34 deg
0.3	8	Med.Dense	35 deg
0.4	9	Med.Dense	35 deg
0.5	12	Dense	36 deg
0.6	16	Dense	37 deg
0.7	17	Dense	37 deg
0.8	18	Dense	37 deg
0.9	13	Dense	37 deg
1	14	Dense	37 deg
1.1	17	Dense	37 deg
1.2	11	Dense	36 deg
1.3	14	Dense	37 deg
1.4	13	Dense	37 deg
1.5	17	Dense	37 deg
1.6	23	Dense	38 deg
1.7	23	Dense	38 deg
1.8	24	Dense	38 deg
	REF		



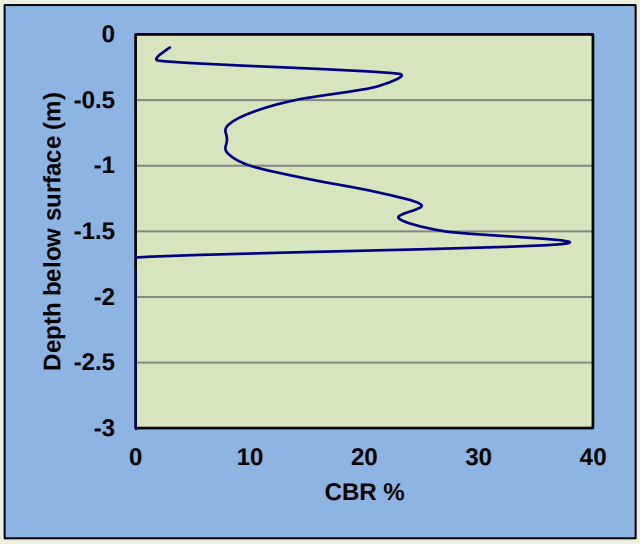


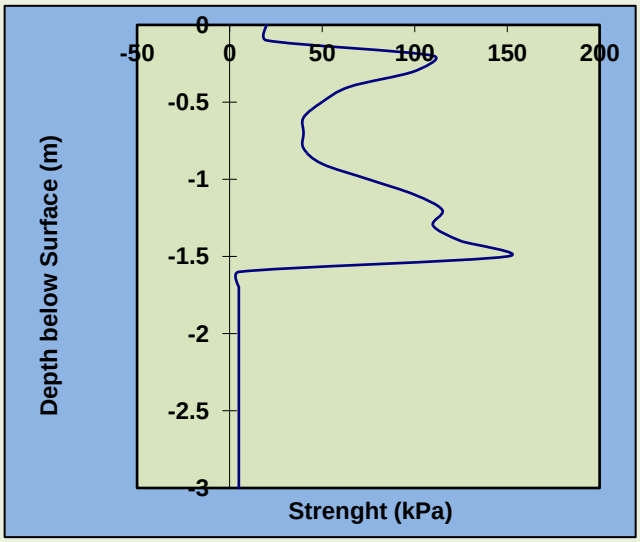
The results shown here are based on calculations using the DCP test. These are classified as indicative values and need to be verified by other testing methods.

Luhlaza Advisory and Consulting (Pty) Ltd	**Client Name**	Ukuza
	Reference:	LC012-23
	Project:	Ikageng Geotechnical Investigation
	Date:	05-May-23
	DCP No.:	TP 8
	Final Depth:	*1.6 m*

The shear strength values are based on empirical calculations and should be used as a guide only

Depth (m)	Blows/ 0.1m	Inferred Consistency	Shear Strength
0			
0.1	2	Loose	30 deg
0.2	1	Very Loose	29 deg
0.3	13	Dense	37 deg
0.4	12	Dense	36 deg
0.5	8	Firm	65 kPa
0.6	6	Firm	50 kPa
0.7	5	Firm	40 kPa
0.8	5	Firm	40 kPa
0.9	5	Firm	40 kPa
1	6	Firm	50 kPa
1.1	9	Stiff	75 kPa
1.2	12	Stiff	100 kPa
1.3	14	Stiff	115 kPa
1.4	13	Stiff	110 kPa
1.5	15	Stiff	125 kPa
1.6	20	Very Stiff	150 kPa
	REF		



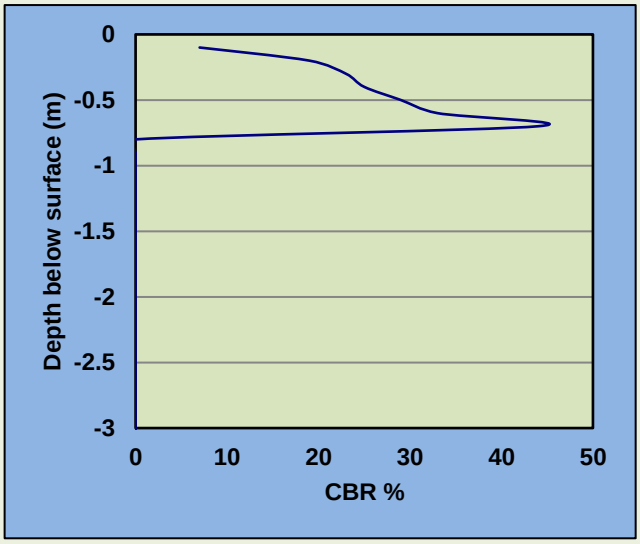


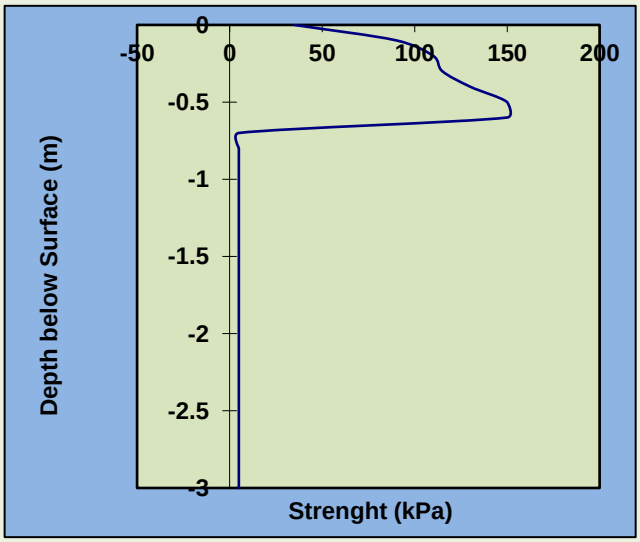
The results shown here are based on calculations using the DCP test. These are classified as indicative values and need to be verified by other testing methods.

Luhlaza Advisory and Consulting (Pty) Ltd	Client Name	Ukuza
	Reference:	LC012-23
	Project:	Ikageng Geotechnical Investigation
	Date:	05-May-23
	DCP No.:	TP 9
	Final Depth:	*0.7 m*

The shear strength values are based on empirical calculations and should be used as a guide only

Depth (m)	Blows/ 0.1m	Inferred Consistency	Shear Strength
0			
0.1	4	Med.Dense	30 deg
0.2	11	Dense	36 deg
0.3	13	Dense	37 deg
0.4	14	Dense	37 deg
0.5	16	Stiff	130 kPa
0.6	18	Stiff	150 kPa
0.7	23	Very Stiff	150 kPa
	REF		
	REF		



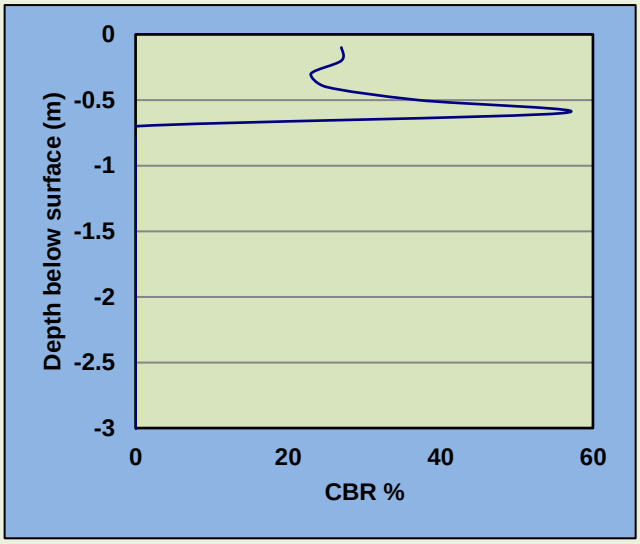


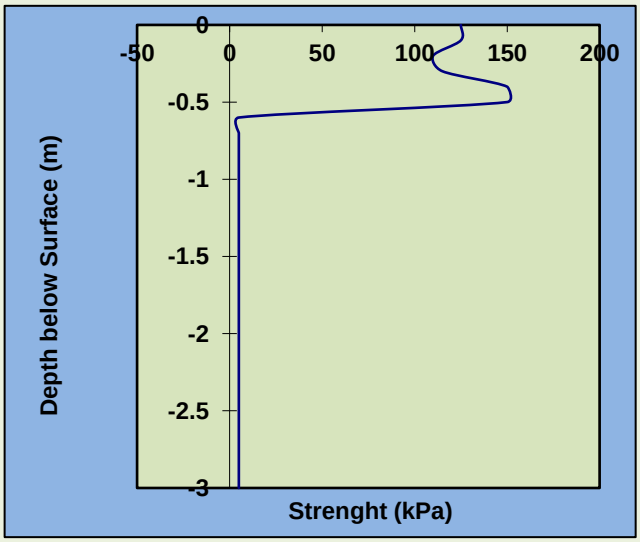
The results shown here are based on calculations using the DCP test. These are classified as indicative values and need to be verified by other testing methods.

Luhlaza Advisory and Consulting (Pty) Ltd	**Client Name**	Ukuza
	Reference:	LC012-23
	Project:	Ikageng Geotechnical Investigation
	Date:	05-May-23
	DCP No.:	TP 10
	Final Depth:	*0.6 m*

The shear strength values are based on empirical calculations and should be used as a guide only

Depth (m)	Blows/ 0.1m	Inferred Consistency	Shear Strength
0			
0.1	15	Dense	37 deg
0.2	15	Dense	37 deg
0.3	13	Dense	37 deg
0.4	14	Dense	37 deg
0.5	20	Dense	38 deg
0.6	28	Very Dense	38 deg
	REF		



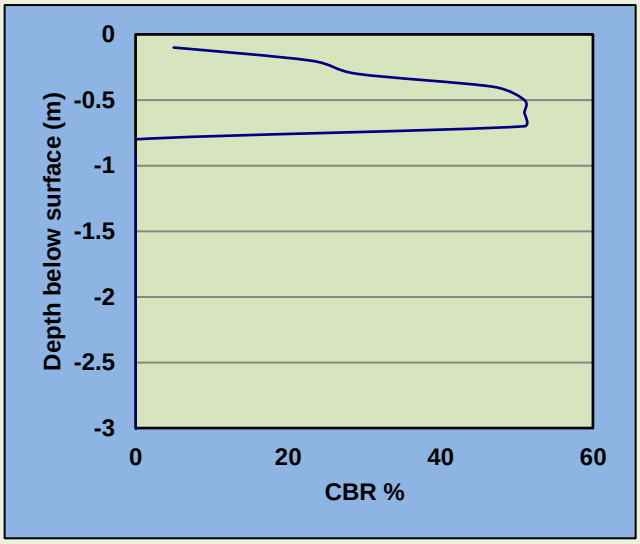


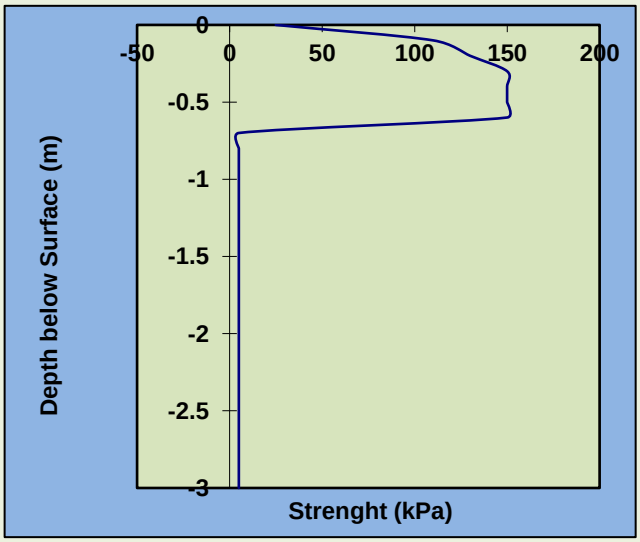
The results shown here are based on calculations using the DCP test. These are classified as indicative values and need to be verified by other testing methods.

Luhlaza Advisory and Consulting (Pty) Ltd	**Client Name**	Ukuza
	Reference:	LC012-23
	Project:	Ikageng Geotechnical Investigation
	Date:	05-May-23
	DCP No.:	TP 11
	Final Depth:	*0.7 m*

The shear strength values are based on empirical calculations and should be used as a guide only

Depth (m)	Blows/ 0.1m	Inferred Consistency	Shear Strength
0			
0.1	3	Loose	30 deg
0.2	13	Dense	37 deg
0.3	16	Dense	37 deg
0.4	24	Dense	38 deg
0.5	26	Very Dense	38 deg
0.6	26	Very Dense	38 deg
0.7	26	Very Dense	38 deg
	REF		



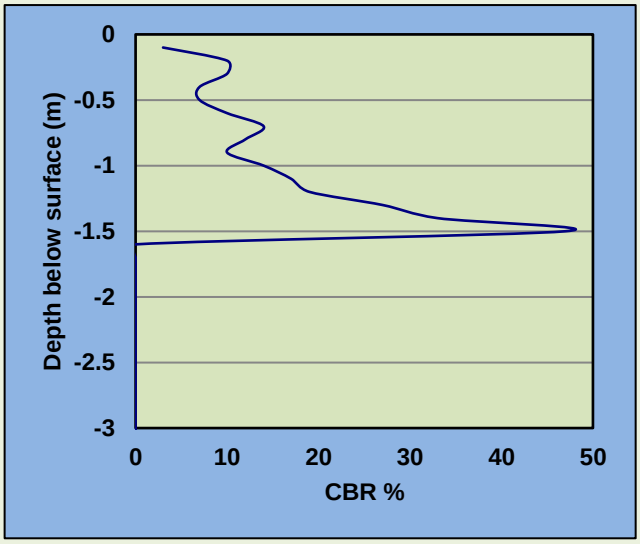


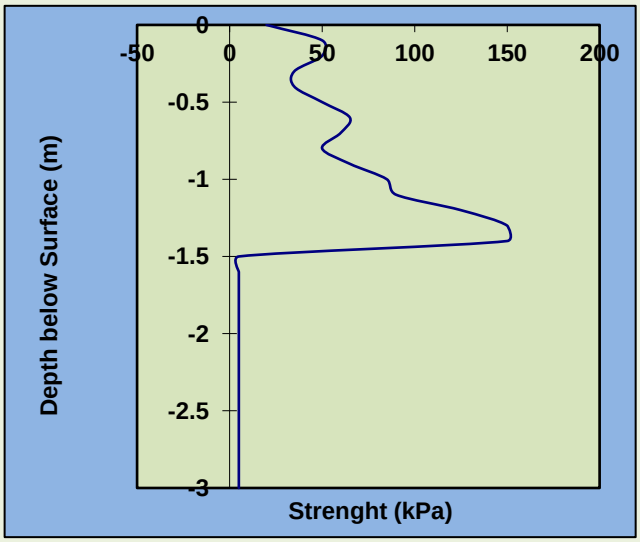
The results shown here are based on calculations using the DCP test. These are classified as indicative values and need to be verified by other testing methods.

Luhlaza Advisory and Consulting (Pty) Ltd	**Client Name**	Ukuza
	Reference:	LC012-23
	Project:	Ikageng Geotechnical Investigation
	Date:	05-May-23
	DCP No.:	TP 12
	Final Depth:	*1.5 m*

The shear strength values are based on empirical calculations and should be used as a guide only

Depth (m)	Blows/ 0.1m	Inferred Consistency	Shear Strength
0			
0.1	2	Loose	30 deg
0.2	6	Med.Dense	33 deg
0.3	6	Med.Dense	33 deg
0.4	4	Med.Dense	30 deg
0.5	4	Med.Dense	30 deg
0.6	6	Med.Dense	33 deg
0.7	8	Med.Dense	35 deg
0.8	7	Med.Dense	34 deg
0.9	6	Med.Dense	33 deg
1	8	Med.Dense	35 deg
1.1	10	Med.Dense	36 deg
1.2	11	Dense	36 deg
1.3	15	Dense	37 deg
1.4	18	Dense	37 deg
1.5	24	Dense	38 deg
	REF		



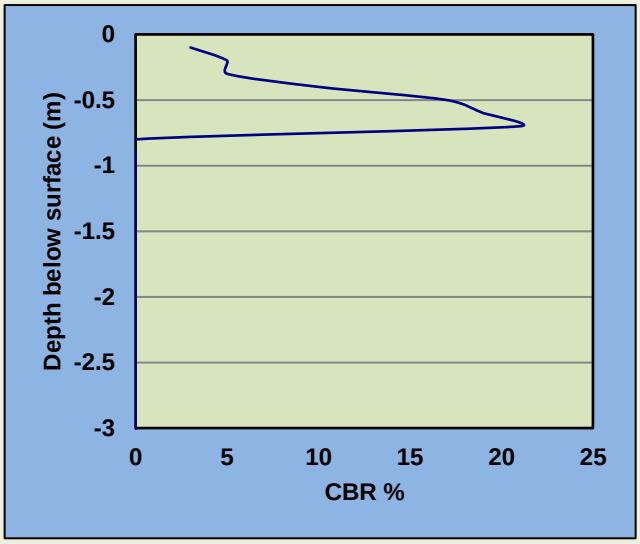


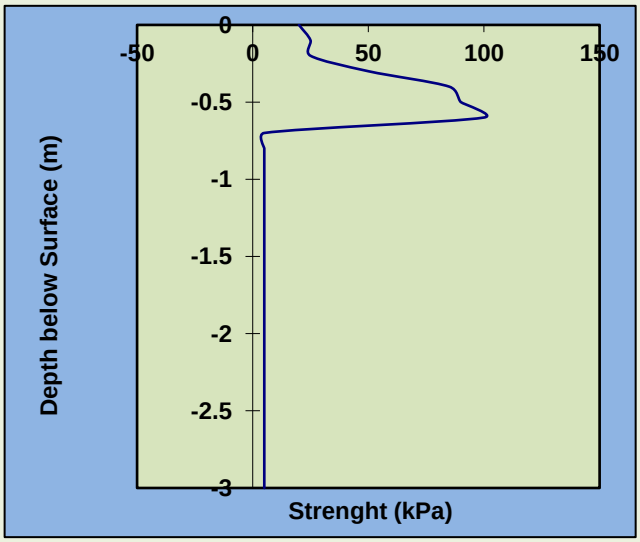
The results shown here are based on calculations using the DCP test. These are classified as indicative values and need to be verified by other testing methods.

Luhlaza Advisory and Consulting (Pty) Ltd	**Client Name**	Ukuza
	Reference:	LC012-23
	Project:	Ikageng Geotechnical Investigation
	Date:	05-May-23
	DCP No.:	TP 13
	Final Depth:	*0.7 m*

The shear strength values are based on empirical calculations and should be used as a guide only

Depth (m)	Blows/ 0.1m	Inferred Consistency	Shear Strength
0			
0.1	2	Loose	30 deg
0.2	3	Loose	30 deg
0.3	3	Loose	30 deg
0.4	6	Med.Dense	33 deg
0.5	10	Med.Dense	36 deg
0.6	11	Stiff	90 kPa
0.7	12	Stiff	100 kPa
	REF		



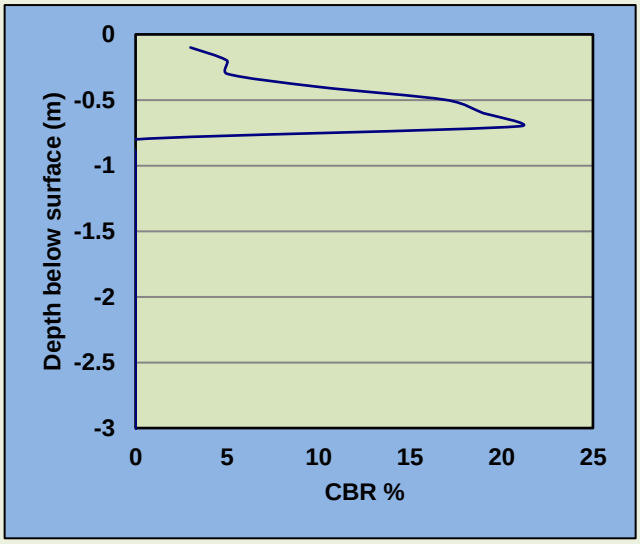


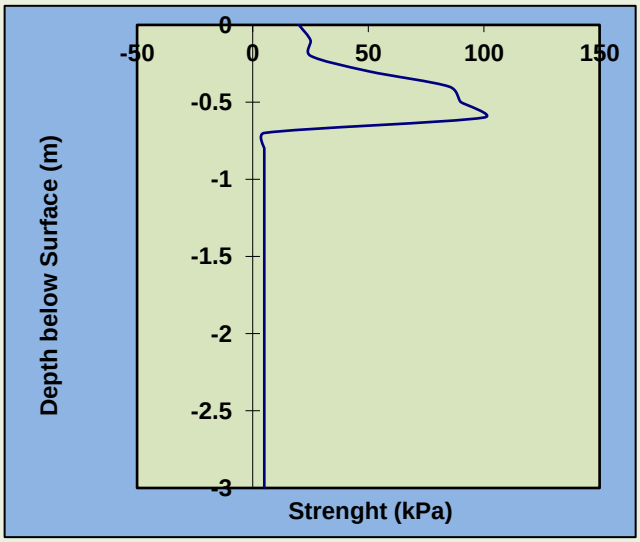
The results shown here are based on calculations using the DCP test. These are classified as indicative values and need to be verified by other testing methods.

Luhlaza Advisory and Consulting (Pty) Ltd	**Client Name**	Ukuza
	Reference:	LC012-23
	Project:	Ikageng Geotechnical Investigation
	Date:	05-May-23
	DCP No.:	TP 14
	Final Depth:	*0.7 m*

The shear strength values are based on empirical calculations and should be used as a guide only

Depth (m)	Blows/ 0.1m	Inferred Consistency	Shear Strength
0			
0.1	2	Loose	30 deg
0.2	3	Loose	30 deg
0.3	3	Loose	30 deg
0.4	6	Med.Dense	33 deg
0.5	10	Med.Dense	36 deg
0.6	11	Dense	36 deg
0.7	12	Dense	36 deg
	REF		



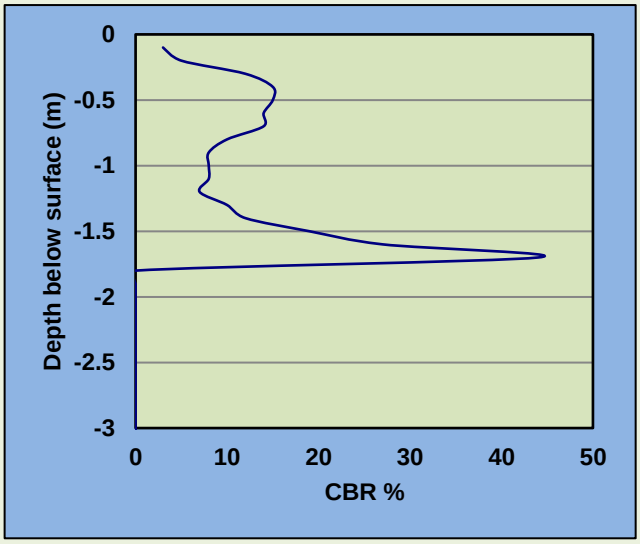


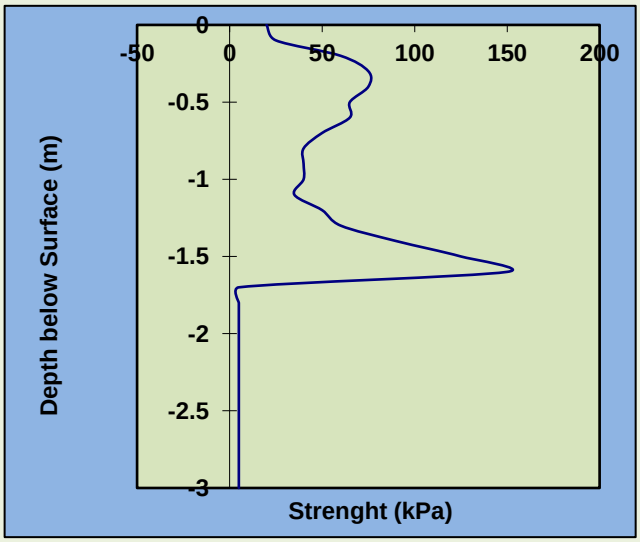
The results shown here are based on calculations using the DCP test. These are classified as indicative values and need to be verified by other testing methods.

Luhlaza Advisory and Consulting (Pty) Ltd	**Client Name**	Ukuza
	Reference:	LC012-23
	Project:	Ikageng Geotechnical Investigation
	Date:	05-May-23
	DCP No.:	TP 15
	Final Depth:	*1.7 m*

The shear strength values are based on empirical calculations and should be used as a guide only

Depth (m)	Blows/ 0.1m	Inferred Consistency	Shear Strength
0			
0.1	2	Loose	30 deg
0.2	3	Loose	30 deg
0.3	7	Med.Dense	34 deg
0.4	9	Stiff	75 kPa
0.5	9	Stiff	75 kPa
0.6	8	Firm	65 kPa
0.7	8	Firm	65 kPa
0.8	6	Firm	50 kPa
0.9	5	Firm	40 kPa
1	5	Firm	40 kPa
1.1	5	Firm	40 kPa
1.2	4	Soft	35 kPa
1.3	6	Firm	50 kPa
1.4	7	Firm	60 kPa
1.5	11	Stiff	90 kPa
1.6	15	Stiff	125 kPa
1.7	23	Dense	38 deg
	REF		



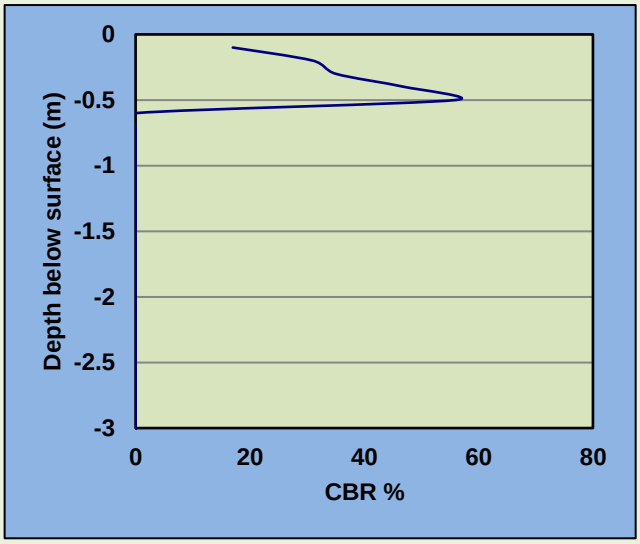


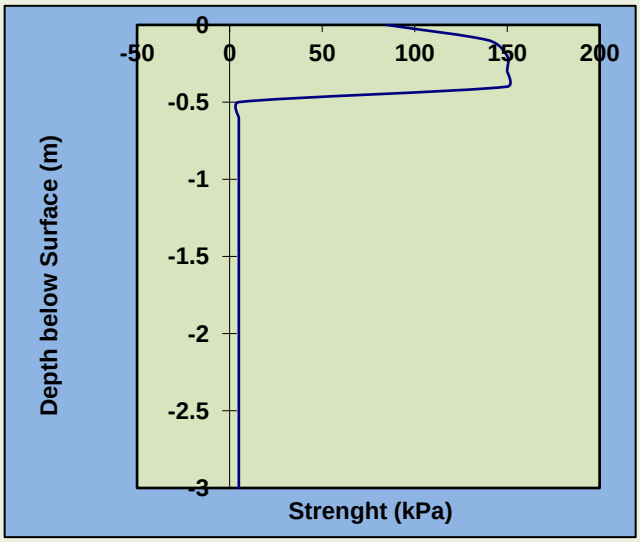
The results shown here are based on calculations using the DCP test. These are classified as indicative values and need to be verified by other testing methods.

Luhlaza Advisory and Consulting (Pty) Ltd	**Client Name**	Ukuza
	Reference:	LC012-23
	Project:	Ikageng Geotechnical Investigation
	Date:	05-May-23
	DCP No.:	TP 16
	Final Depth:	*0.5 m*

The shear strength values are based on empirical calculations and should be used as a guide only

Depth (m)	Blows/ 0.1m	Inferred Consistency	Shear Strength
0			
0.1	10	Med.Dense	36 deg
0.2	17	Dense	37 deg
0.3	19	Dense	37 deg
0.4	24	Very Stiff	150 kPa
0.5	28	Very Stiff	150 kPa
	REF		



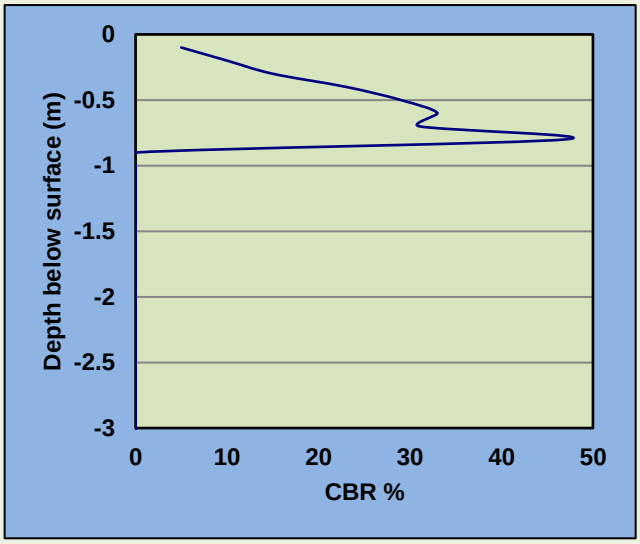


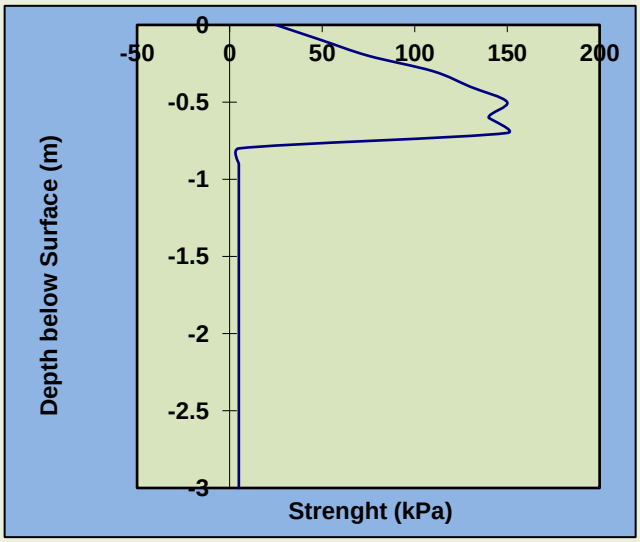
The results shown here are based on calculations using the DCP test. These are classified as indicative values and need to be verified by other testing methods.

Luhlaza Advisory and Consulting (Pty) Ltd	**Client Name**	Ukuza
	Reference:	LC012-23
	Project:	Ikageng Geotechnical Investigation
	Date:	05-May-23
	DCP No.:	TP 17
	Final Depth:	*0.8 m*

The shear strength values are based on empirical calculations and should be used as a guide only

Depth (m)	Blows/ 0.1m	Inferred Consistency	Shear Strength
0			
0.1	3	Loose	30 deg
0.2	6	Med.Dense	33 deg
0.3	9	Stiff	75 kPa
0.4	13	Stiff	110 kPa
0.5	16	Stiff	130 kPa
0.6	18	Stiff	150 kPa
0.7	17	Stiff	140 kPa
0.8	24	Very Stiff	150 kPa
	REF		



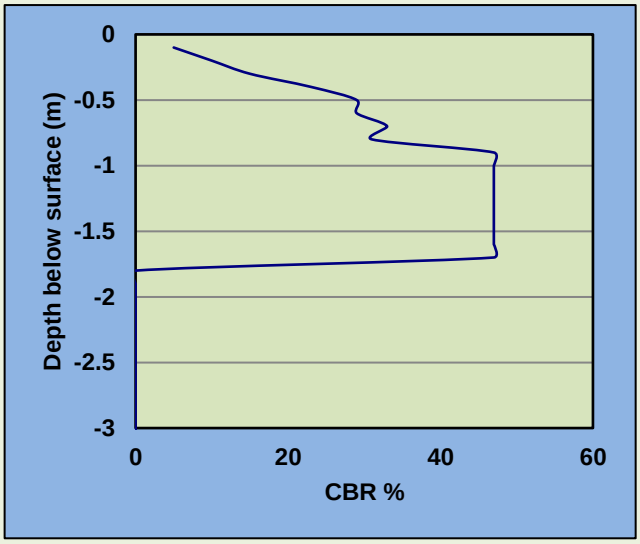


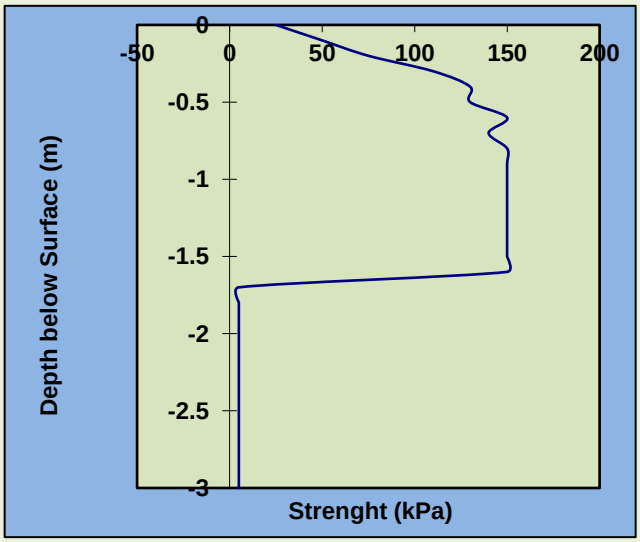
The results shown here are based on calculations using the DCP test. These are classified as indicative values and need to be verified by other testing methods.

Luhlaza Advisory and Consulting (Pty) Ltd	**Client Name**	Ukuza
	Reference:	LC012-23
	Project:	Ikageng Geotechnical Investigation
	Date:	05-May-23
	DCP No.:	TP 18
	Final Depth:	*1.7 m*

The shear strength values are based on empirical calculations and should be used as a guide only

Depth (m)	Blows/ 0.1m	Inferred Consistency	Shear Strength
0			
0.1	3	Loose	30 deg
0.2	6	Med.Dense	33 deg
0.3	9	Med.Dense	35 deg
0.4	13	Dense	37 deg
0.5	16	Dense	37 deg
0.6	16	Dense	37 deg
0.7	18	Dense	37 deg
0.8	17	Dense	37 deg
0.9	24	Dense	38 deg
1	24	Very Stiff	150 kPa
1.1	24	Very Stiff	150 kPa
1.2	24	Very Stiff	150 kPa
1.3	24	Very Stiff	150 kPa
1.4	24	Very Stiff	150 kPa
1.5	24	Very Stiff	150 kPa
1.6	24	Very Stiff	150 kPa
1.7	24	Very Stiff	150 kPa
	REF		



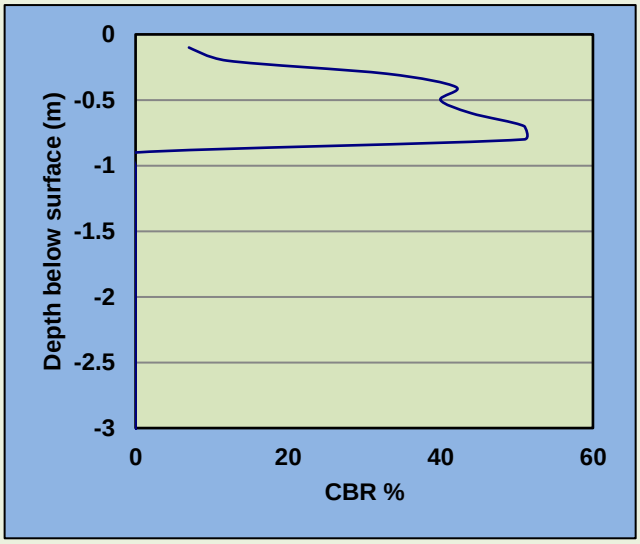


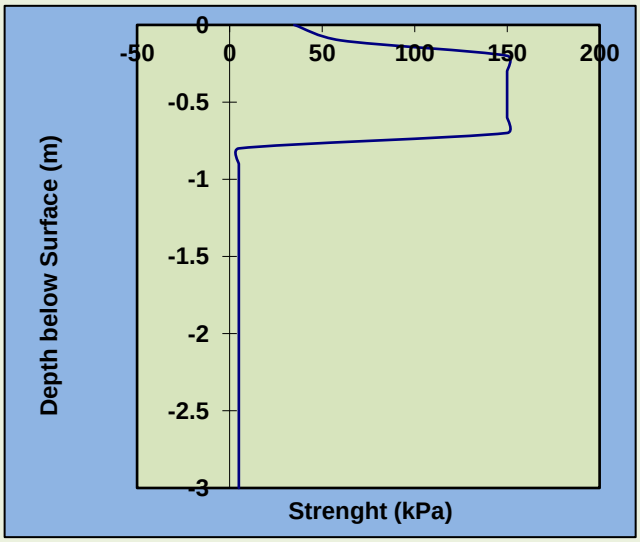
The results shown here are based on calculations using the DCP test. These are classified as indicative values and need to be verified by other testing methods.

Luhlaza Advisory and Consulting (Pty) Ltd	**Client Name**	Ukuza
	Reference:	LC012-23
	Project:	Ikageng Geotechnical Investigation
	Date:	05-May-23
	DCP No.:	TP 19
	Final Depth:	*0.8 m*

The shear strength values are based on empirical calculations and should be used as a guide only

Depth (m)	Blows/ 0.1m	Inferred Consistency	Shear Strength
0			
0.1	4	Med.Dense	30 deg
0.2	7	Med.Dense	34 deg
0.3	18	Dense	37 deg
0.4	22	Dense	38 deg
0.5	21	Dense	38 deg
0.6	23	Very Stiff	150 kPa
0.7	26	Very Stiff	150 kPa
0.8	26	Very Stiff	150 kPa
	REF		



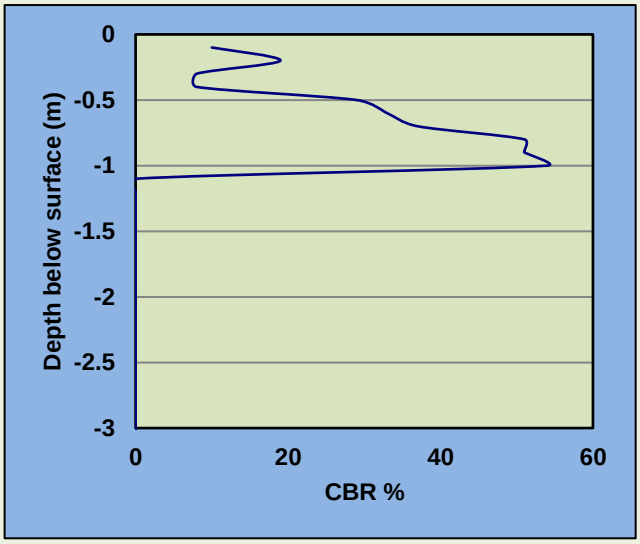


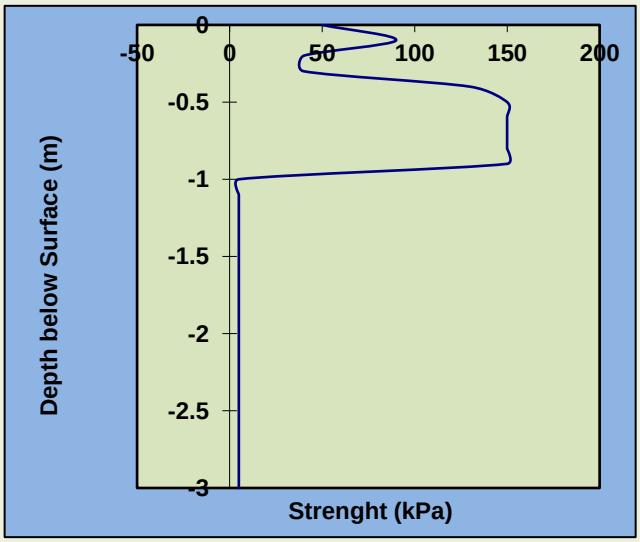
The results shown here are based on calculations using the DCP test. These are classified as indicative values and need to be verified by other testing methods.

Luhlaza Advisory and Consulting (Pty) Ltd	Client Name	Ukuza
	Reference:	LC012-23
	Project:	Ikageng Geotechnical Investigation
	Date:	05-May-23
	DCP No.:	TP 20
	Final Depth:	*1 m*

The shear strength values are based on empirical calculations and should be used as a guide only

Depth (m)	Blows/ 0.1m	Inferred Consistency	Shear Strength
0			
0.1	6	Med.Dense	33 deg
0.2	11	Dense	36 deg
0.3	5	Med.Dense	32 deg
0.4	5	Med.Dense	32 deg
0.5	16	Dense	37 deg
0.6	18	Dense	37 deg
0.7	20	Dense	38 deg
0.8	26	Very Dense	38 deg
0.9	26	Very Dense	38 deg
1	27	Very Dense	38 deg
	REF		



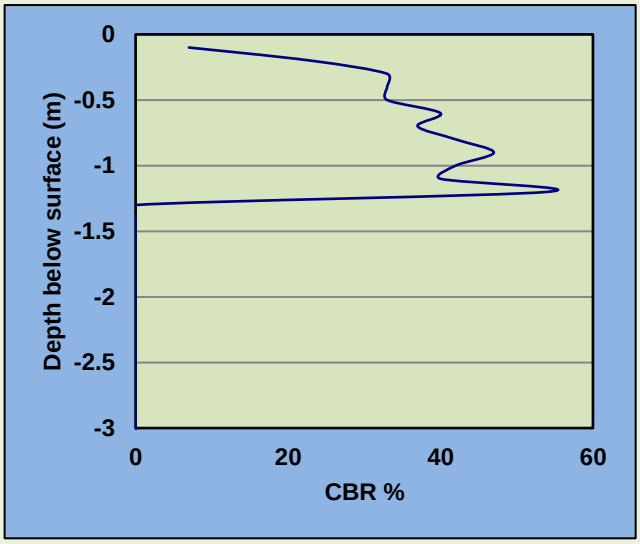


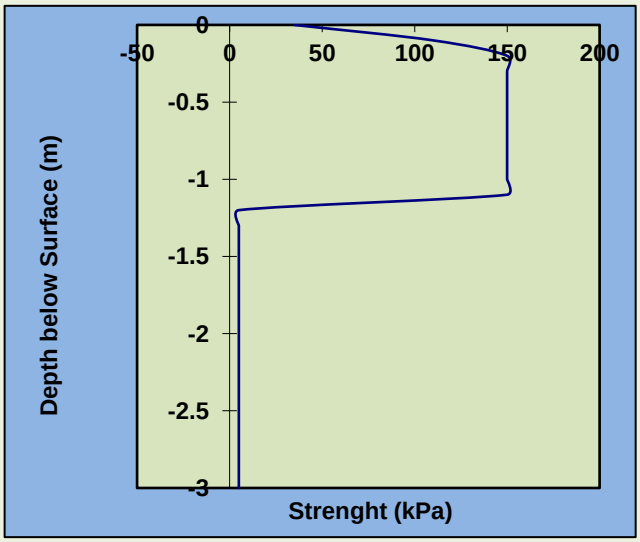
The results shown here are based on calculations using the DCP test. These are classified as indicative values and need to be verified by other testing methods.

Luhlaza Advisory and Consulting (Pty) Ltd	**Client Name**	Ukuza
	Reference:	LC012-23
	Project:	Ikageng Geotechnical Investigation
	Date:	05-May-23
	DCP No.:	TP 21
	Final Depth:	*1.2 m*

The shear strength values are based on empirical calculations and should be used as a guide only

Depth (m)	Blows/ 0.1m	Inferred Consistency	Shear Strength
0			
0.1	4	Med.Dense	30 deg
0.2	13	Dense	37 deg
0.3	18	Dense	37 deg
0.4	18	Dense	37 deg
0.5	18	Dense	37 deg
0.6	21	Very Stiff	150 kPa
0.7	20	Very Stiff	150 kPa
0.8	22	Very Stiff	150 kPa
0.9	24	Very Stiff	150 kPa
1	22	Very Stiff	150 kPa
1.1	21	Very Stiff	150 kPa
1.2	27	Very Stiff	150 kPa
	REF		



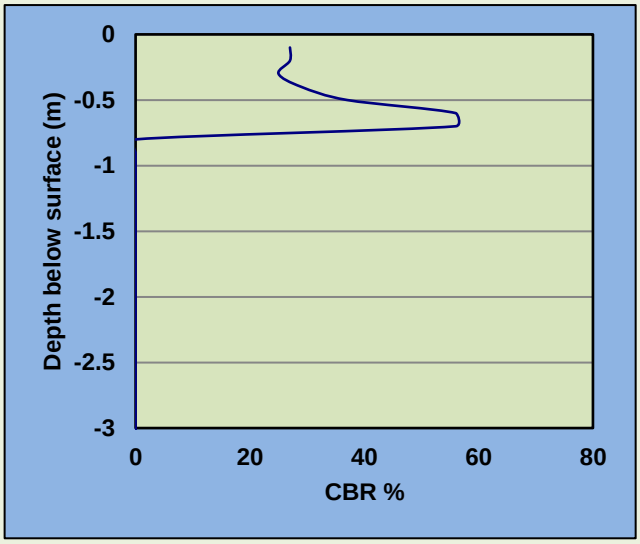


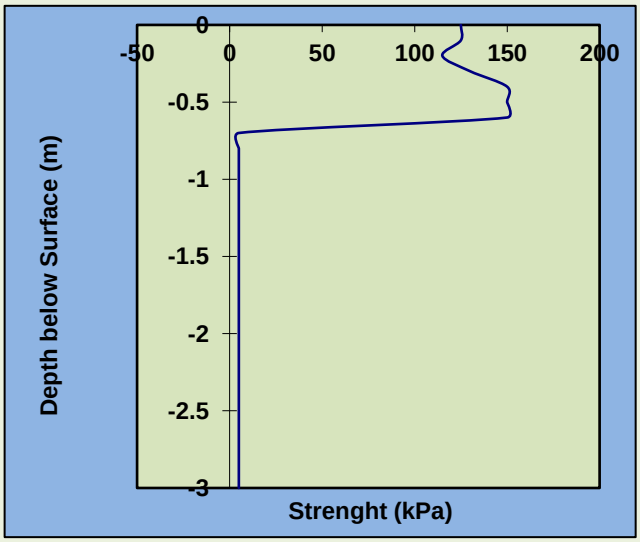
The results shown here are based on calculations using the DCP test. These are classified as indicative values and need to be verified by other testing methods.

Luhlaza Advisory and Consulting (Pty) Ltd	**Client Name**	Ukuza
	Reference:	LC012-23
	Project:	Ikageng Geotechnical Investigation
	Date:	05-May-23
	DCP No.:	TP 22
	Final Depth:	*0.7 m*

The shear strength values are based on empirical calculations and should be used as a guide only

Depth (m)	Blows/ 0.1m	Inferred Consistency	Shear Strength
0			
0.1	15	Dense	37 deg
0.2	15	Dense	37 deg
0.3	14	Dense	37 deg
0.4	16	Dense	37 deg
0.5	20	Dense	38 deg
0.6	28	Very Stiff	150 kPa
0.7	28	Very Stiff	150 kPa
	REF		



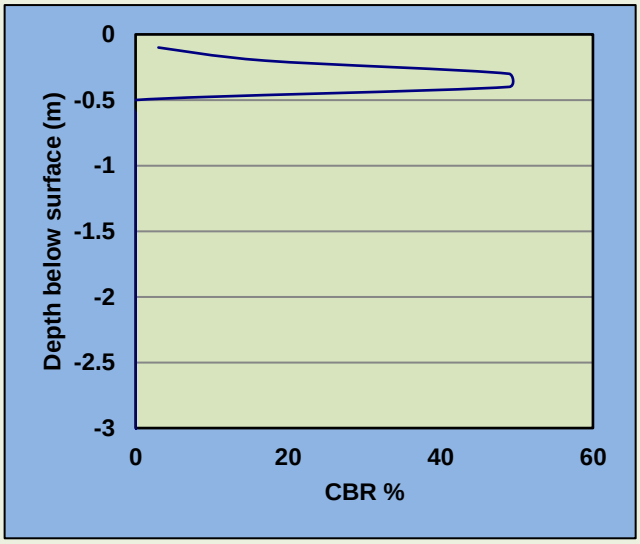


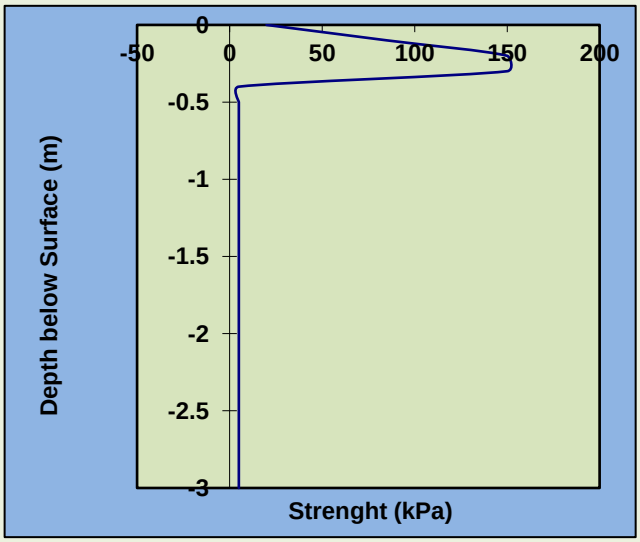
The results shown here are based on calculations using the DCP test. These are classified as indicative values and need to be verified by other testing methods.

Luhlaza Advisory and Consulting (Pty) Ltd	Client Name	Ukuza
	Reference:	LC012-23
	Project:	Ikageng Geotechnical Investigation
	Date:	05-May-23
	DCP No.:	TP 23
	Final Depth:	*0.4 m*

The shear strength values are based on empirical calculations and should be used as a guide only

Depth (m)	Blows/ 0.1m	Inferred Consistency	Shear Strength
0			
0.1	2	Loose	30 deg
0.2	10	Med.Dense	36 deg
0.3	25	Very Dense	38 deg
0.4	25	Dense	38 deg
	REF		



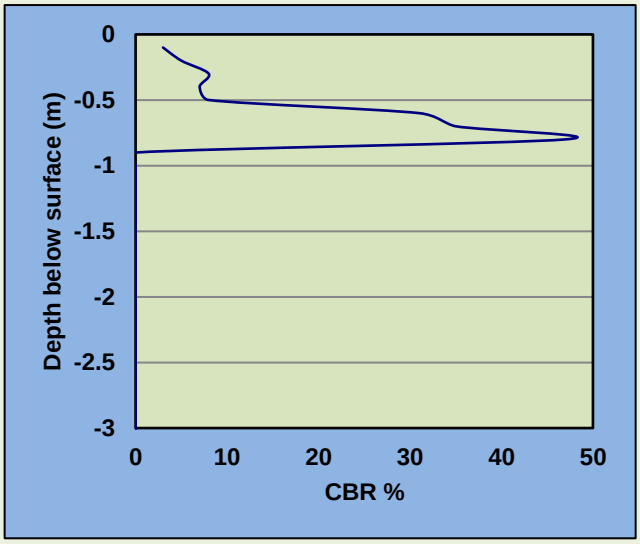


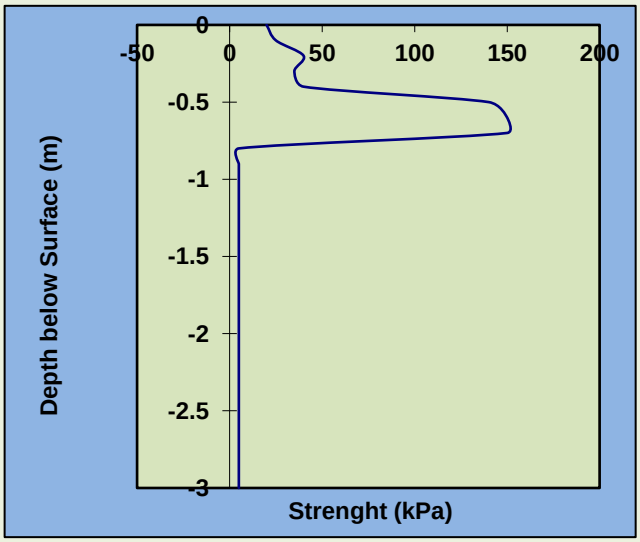
The results shown here are based on calculations using the DCP test. These are classified as indicative values and need to be verified by other testing methods.

Luhlaza Advisory and Consulting (Pty) Ltd	**Client Name**	Ukuza
	Reference:	LC012-23
	Project:	Ikageng Geotechnical Investigation
	Date:	05-May-23
	DCP No.:	TP 24
	Final Depth:	*0.8 m*

The shear strength values are based on empirical calculations and should be used as a guide only

Depth (m)	Blows/ 0.1m	Inferred Consistency	Shear Strength
0			
0.1	2	Loose	30 deg
0.2	3	Loose	30 deg
0.3	5	Med.Dense	32 deg
0.4	4	Med.Dense	30 deg
0.5	5	Med.Dense	32 deg
0.6	17	Dense	37 deg
0.7	19	Very Stiff	150 kPa
0.8	24	Very Stiff	150 kPa
	REF		





The results shown here are based on calculations using the DCP test. These are classified as indicative values and need to be verified by other testing methods.

Appendix C: Laboratory Results

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Business Reg No: 2019/410066/07

Luhlaza Consulting and Advisory (PTY) Ltd

Blairgowrie Plaza Office Park,

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Office 128 & 126, Level One,

Randburg,

2194.Fax + 27 865452720/ Cell +27 72 598 8809 / Mbulungeni@luhlazaconsulting.co.za

Attention: Mbulungeni Ramudzuli

Ikageng: C968

Moisture / pH / Conductivity

Sample ID	Depth(m)	Moisture	pH	Conductivity (s/m)
TP02	0.5 – 0.7		6.60	0.012
TP03	0.5 - 1.1	15.4		
TP05	0.9 - 1.6	15.7		
TP07	0.6 - 0.8	14.2		
TP09	1.3 – 1.6		6.90	0.014
TP12	0.8 – 1.6		6.90	0.013
TP15	0.9 - 1.6	16.3	7.60	0.016
TP16	0.3 - 0.9	15.6		
TP18	1.4 - 1.7	16.6	6.75	0.025
TP20	0.9 - 1.1	14.2		
TP21	1.6 – 2.1		6.89	0.030
TP23	0.6 - 1.6	15.1	7.04	0.012
TP24	0.6 – 1.2		7.00	0.021

Martinus Schwartz (Reporting)

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Business Reg No: 2019/410066/07

GRAVEL, SOIL AND SAND TEST REPORT : Maximum Dry Density & OMC

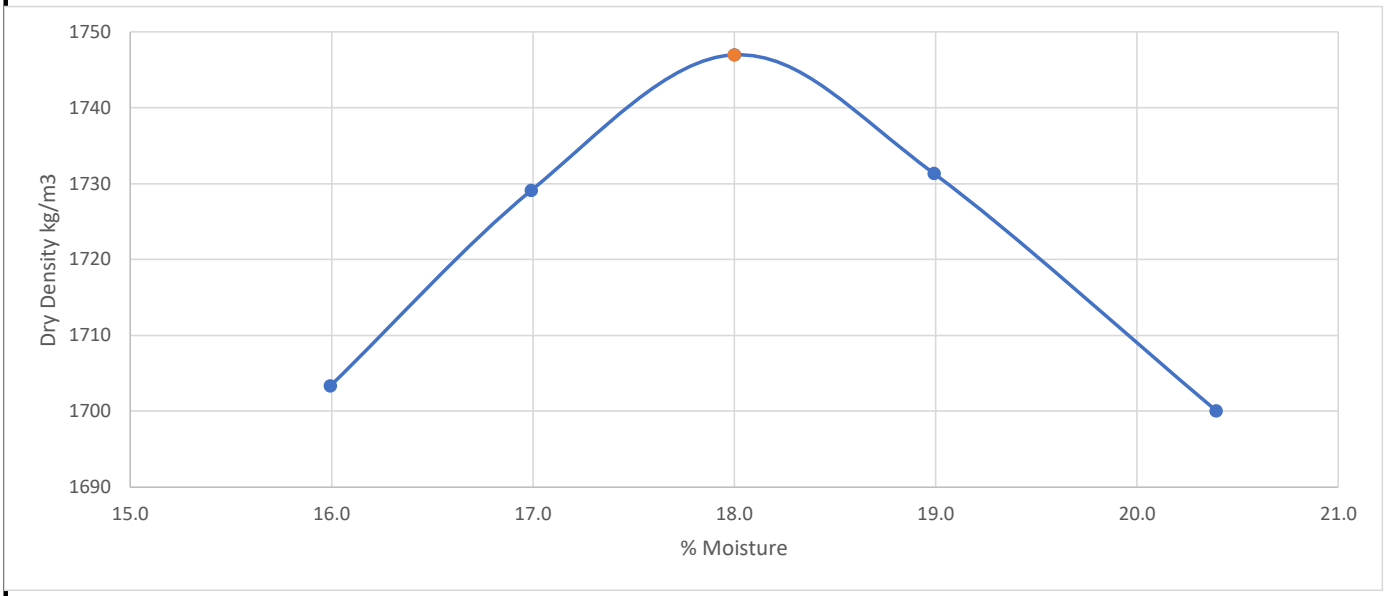
SANS 3001
Method GR30

Client:	**Luhlaza Consulting and Advisory (PTY) Ltd**	Date Sampled:	**-**
Address:	**Blairgowrie Plaza Office Park**	Date Received:	**09-May-23**
Contract:	**Ikageng**	Date Tested :	**13-May-23**
Description:	**TP06: 1.7 - 2.1**	**Sample No:**	**C968-1**

Doc No.	CL0004		Rev 1		Date updated 26/07/2022

Maximum dry density =	**1747**	kg/m³
Optimum moisture content =	**18.0**	%
Preparation method used:	Scalping	

	1	2	3	4	5
Wet Density	1976	2023	2061	2060	2047
Moisture Content	16.0	17.0	18.0	19.0	20.4
Dry Density	1703	1729	1747	1731	1700



REMARKS *

Please note that this sample was compacted with 55 blows per layer to achieve the Maximum Dry Density

Date Issued: 2023/06/28 *Technical signatory (Name) :* Martinus Schwartz (Reporting) *Signature:*

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GRAVEL, SOIL AND SAND TEST REPORT : Maximum Dry Density & OMC

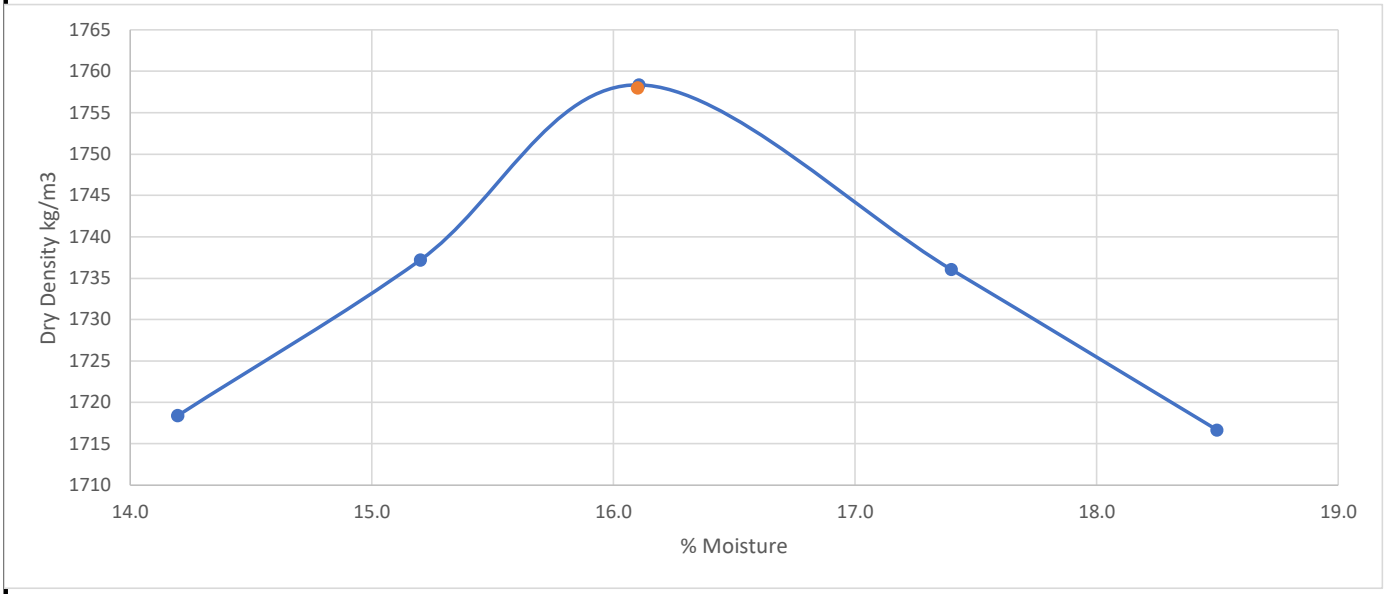
SANS 3001
Method GR30

Client:	**Luhlaza Consulting and Advisory (PTY) Ltd**	Date Sampled:	**-**
Address:	**Blairgowrie Plaza Office Park**	Date Received:	**09-May-23**
Contract:	**Ikageng**	Date Tested :	**13-May-23**
Description:	**TP17: 0.2 - 0.7**	**Sample No:**	**C968-2**

Doc No.	CL0004		Rev 1	Date updated	26/07/2022

Maximum dry density =	**1758**	kg/m³
Optimum moisture content =	**16.1**	%
Preparation method used:	Scalping	

	1	2	3	4	5
Wet Density	1962	2001	2042	2038	2034
Moisture Content	14.2	15.2	16.1	17.4	18.5
Dry Density	1718	1737	1758	1736	1717



REMARKS *

Please note that this sample was compacted with 55 blows per layer to achieve the Maximum Dry Density

Date Issued: 2023/06/28 *Technical signatory (Name) :* Martinus Schwartz (Reporting) *Signature:*

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Business Reg No: 2019/410066/07

GRAVEL, SOIL AND SAND TEST REPORT : Maximum Dry Density & OMC

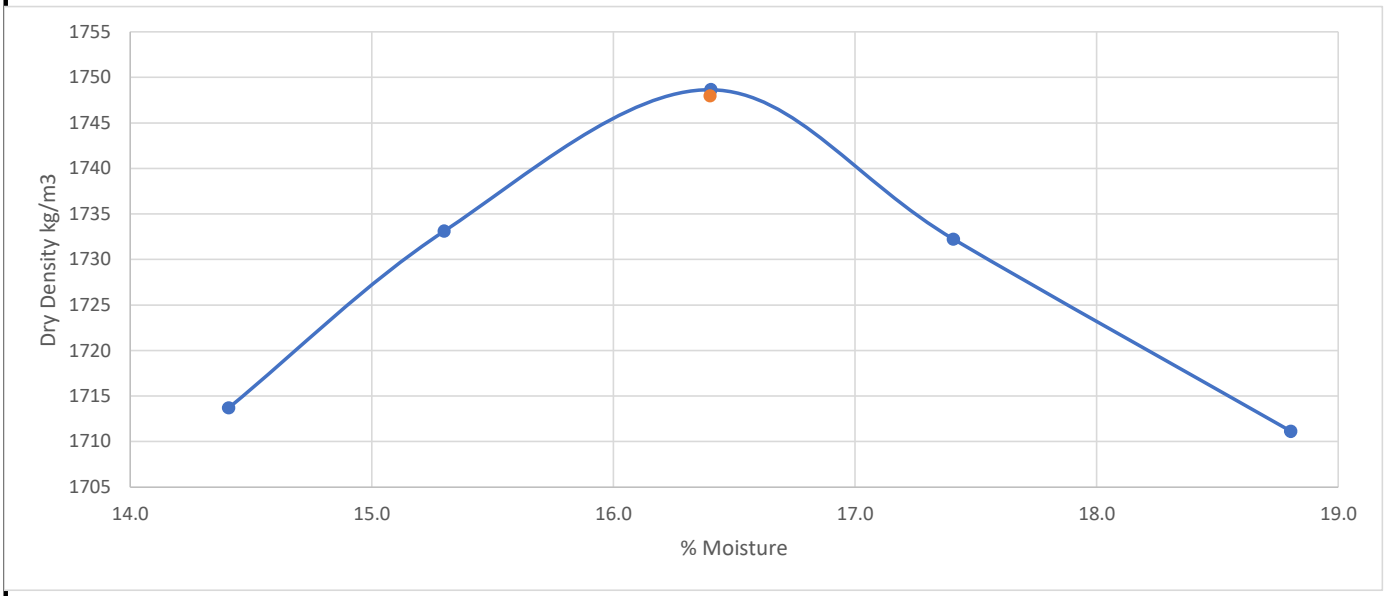
SANS 3001
Method GR30

Client:	**Luhlaza Consulting and Advisory (PTY) Ltd**	Date Sampled:	**-**
Address:	**Blairgowrie Plaza Office Park**	Date Received:	**09-May-23**
Contract:	**Ikageng**	Date Tested :	**13-May-23**
Description:	**TP19: 0.9 - 1.5**	**Sample No:**	**C968-3**

Doc No.	CL0004		Rev	1	Date updated 26/07/2022

Maximum dry density =	**1748**	kg/m³
Optimum moisture content =	**16.4**	%
Preparation method used:	Scalping	

	1	2	3	4	5
Wet Density	1961	1998	2035	2034	2033
Moisture Content	14.4	15.3	16.4	17.4	18.8
Dry Density	1714	1733	1749	1732	1711



REMARKS *

Please note that this sample was compacted with 55 blows per layer to achieve the Maximum Dry Density

Date Issued: 2023/06/28 *Technical signatory (Name) :* Martinus Schwartz (Reporting) *Signature:*

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GRAVEL, SOIL AND SAND TEST REPORT

SANS 3001 Methods
GR1, GR5, GR10, GR20, GR30 & GR40

Doc No. CL0001		Rev 1		Date updated 26/07/2022	

Client : Luhlaza — Doc No: C968-4(i)

Address: Blairgowrie Plaza Office Park

Contract : Ikageng

Description : TP05

Date Sampled : -
Date Recieved: **09-May-23**
Date Tested : **18-May-23**

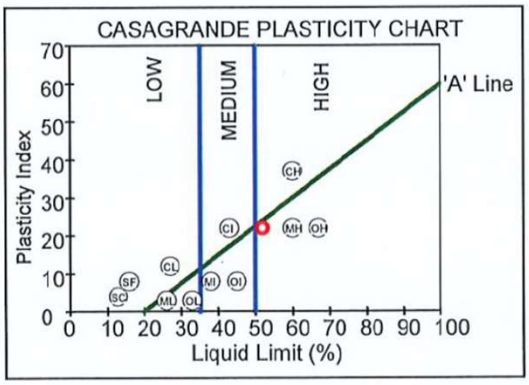
Sample No	C968-4
Depth (m)	0.9 - 1.6

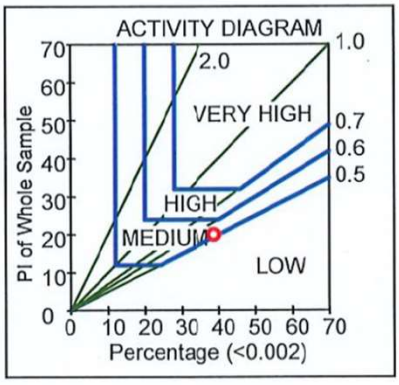
Sample No.	: L4524
Hole No.	: TP05
Depth	: 900-1600
Liquid Limit (%)	: 52
Plasticity Index	: 22
Linear Shrinkage (%)	: 11.0
PI of Whole Sample	: 20
P.R.A. Classification	: A-7-5(15)
Unified Soil Classificati	: MH
Activity	: 0.51
Heave Classification	: MEDIUM
Grading Modulus	: 0.35
Percentage (<0.002)	: 39.0
Moisture Content (%)	: 17.4

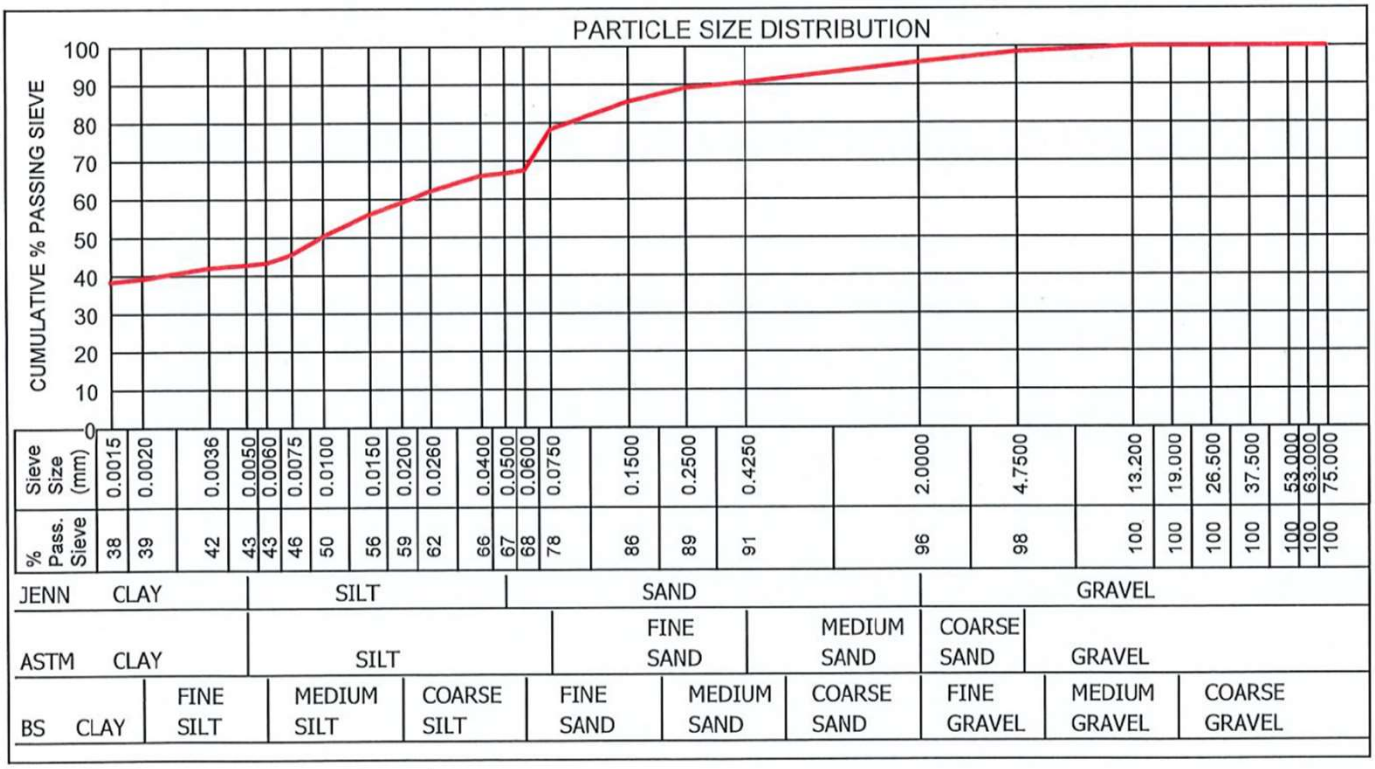
FOUNDATION INDICATOR (ASTM: D422)

Material Description : DK BR SILTY CLAY

	Clay (%)	Silt (%)	Sand (%)	Gravel (%)	Classification
Jennings	42.8	24.0	29.0	4.2	SANDY CLAY
Astm	42.8	35.5	20.2	1.5	SILTY CLAY
British Standard	39.2	28.4	28.2	4.2	SILTY CLAY







Sieve Size (mm)	0.0015	0.0020	0.0036	0.0050	0.0060	0.0075	0.0100	0.0150	0.0200	0.0260	0.0400	0.0500	0.0600	0.0750	0.1500	0.2500	0.4250	2.0000	4.7500	13.200	19.000	26.500	37.500	53.000	63.000	75.000
% Pass. Sieve	38	39	42	43	43	46	50	56	59	62	66	67	68	78	86	89	91	96	98	100	100	100	100	100	100	100

JENN	CLAY	SILT		SAND			GRAVEL			
ASTM	CLAY	SILT		FINE SAND	MEDIUM SAND	COARSE SAND	GRAVEL			
BS	CLAY	FINE SILT	MEDIUM SILT	COARSE SILT	FINE SAND	MEDIUM SAND	COARSE SAND	FINE GRAVEL	MEDIUM GRAVEL	COARSE GRAVEL

Date Issued: 2023/06/28 *Technical signatory (Name) :* **Martinus Schwartz (Reporting)** *Signature:*

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GRAVEL, SOIL AND SAND TEST REPORT

SANS 3001 Methods
GR1, GR5, GR10, GR20, GR30 & GR40

Doc No. CL0001		Rev 1		Date updated 26/07/2022	

Client : Luhlaza — Doc No: C968-5(i) — Date Sampled : -

Address: Blairgowrie Plaza Office Park — Date Recieved: **09-May-23**

Contract : Ikageng — Date Tested : **18-May-23**

Description : TP06

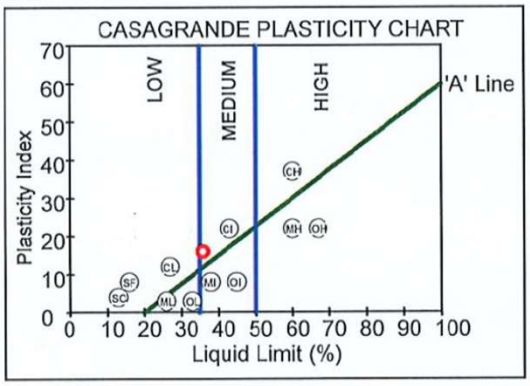
Sample No	C968-5
Depth (m)	0.4 - 1.7

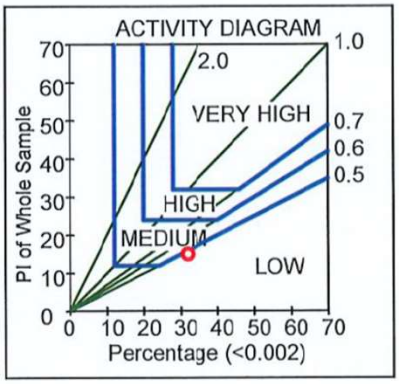
Sample No.	: L4525
Hole No.	: TP06
Depth	: 400-1700
Liquid Limit (%)	: 36
Plasticity Index	: 16
Linear Shrinkage (%)	: 8.0
PI of Whole Sample	: 15
P.R.A. Classification	: A-6(8)
Unified Soil Classificati	: CL
Activity	: 0.47
Heave Classification	: LOW
Grading Modulus	: 0.49
Percentage (<0.002)	: 32.0
Moisture Content (%)	: 14.6

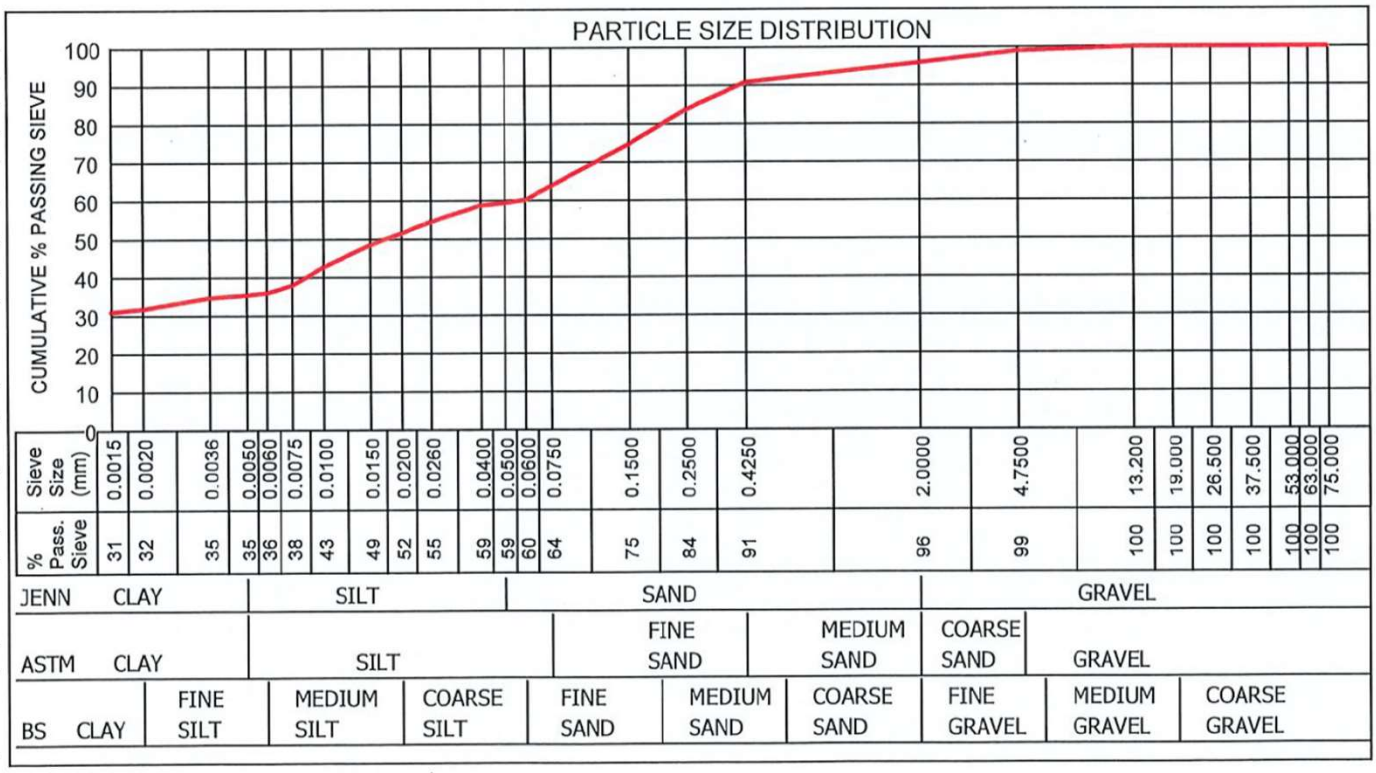
FOUNDATION INDICATOR (ASTM: D422)

Material Description : DK BR SANDY CLAY

	Clay (%)	Silt (%)	Sand (%)	Gravel (%)	Classification
Jennings	35.5	23.9	36.5	4.1	SANDY CLAY
Astm	35.5	28.2	35.2	1.1	SANDY CLAY
British Standard	31.8	28.3	35.8	4.1	SANDY CLAY







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GRAVEL, SOIL AND SAND TEST REPORT

SANS 3001 Methods
GR1, GR5, GR10, GR20, GR30 & GR40

Doc No. CL0001		Rev 1		Date updated 26/07/2022	

Client : Luhlaza — Doc No: C968-6(i) — Date Sampled : -

Address: Blairgowrie Plaza Office Park — Date Recieved: **09-May-23**

Contract : Ikageng — Date Tested : **18-May-23**

Description : TP07

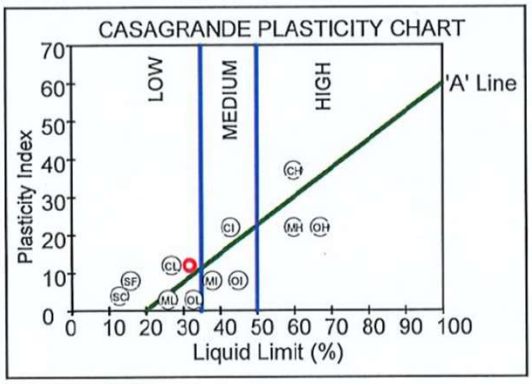
Sample No	C968-6
Depth (m)	0.6 - 0.8

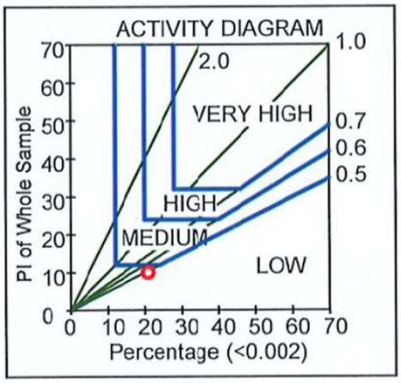
Sample No.	: L4526
Hole No.	: TP07
Depth	: 600-800
Liquid Limit (%)	: 32
Plasticity Index	: 12
Linear Shrinkage (%)	: 6.0
PI of Whole Sample	: 10
P.R.A. Classification	: A-6(5)
Unified Soil Classificati	: CL
Activity	: 0.48
Heave Classification	: LOW
Grading Modulus	: 0.68
Percentage (<0.002)	: 21.0
Moisture Content (%)	: 14.2

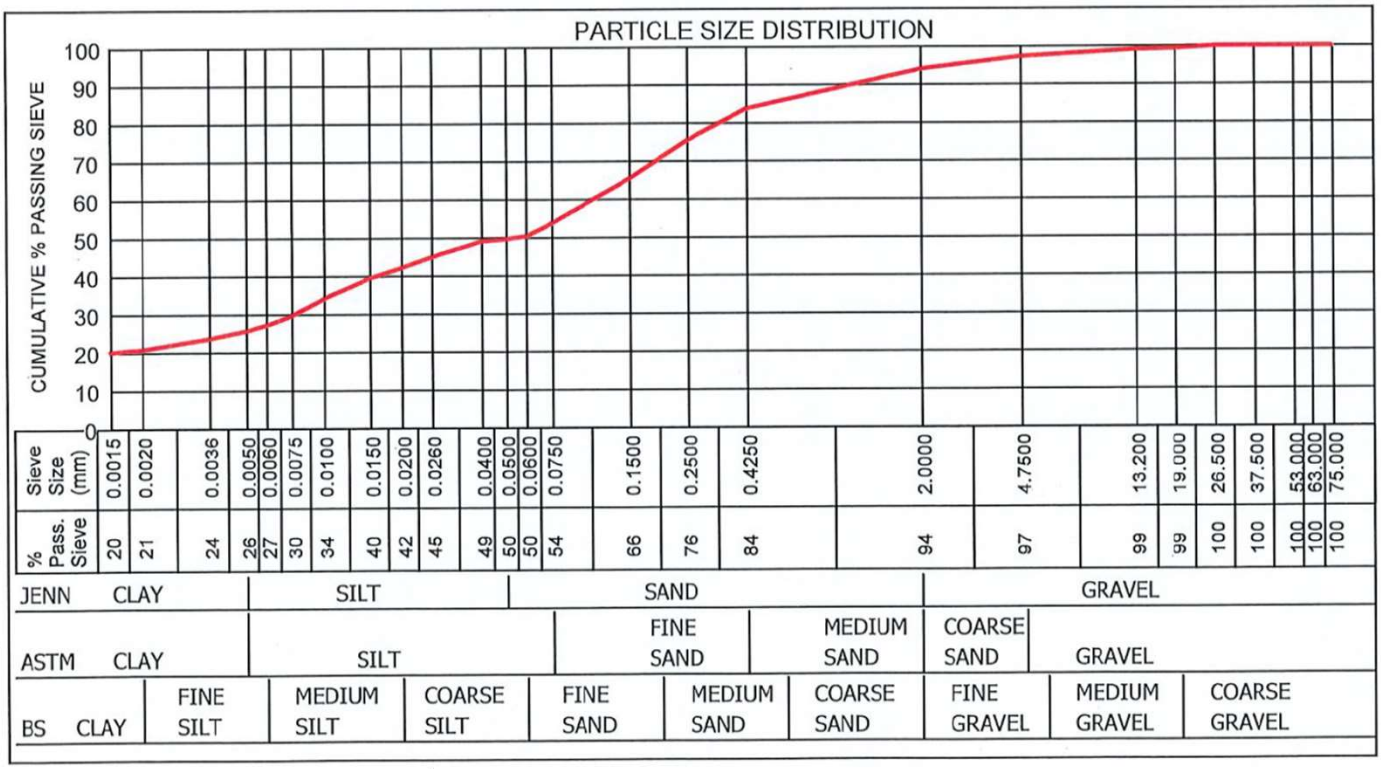
FOUNDATION INDICATOR (ASTM: D422)

Material Description : DK BR CLAYEY SAND

	Clay (%)	Silt (%)	Sand (%)	Gravel (%)	Classification
Jennings	25.8	23.9	44.4	5.9	CLAYEY SAND
Astm	25.8	28.0	43.5	2.7	CLAYEY SAND
British Standard	20.9	29.5	43.7	5.9	CLAYEY SAND







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GRAVEL, SOIL AND SAND TEST REPORT

SANS 3001 Methods
GR1, GR5, GR10, GR20, GR30 & GR40

Doc No. CL0001		Rev 1		Date updated 26/07/2022	

Client : Luhlaza — Doc No: C968-7(i)

Address: Blairgowrie Plaza Office Park

Contract : Ikageng

Description : TP10

Date Sampled : -
Date Recieved: **09-May-23**
Date Tested : **18-May-23**

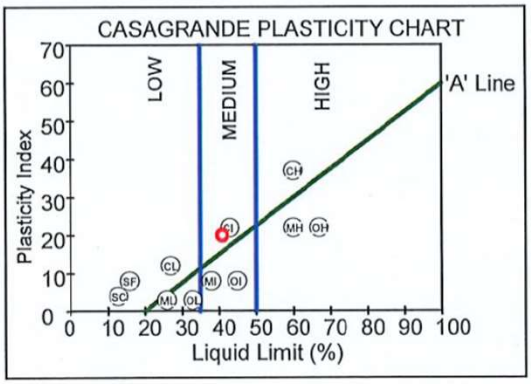
Sample No	C968-7
Depth (m)	0.6 - 2.0

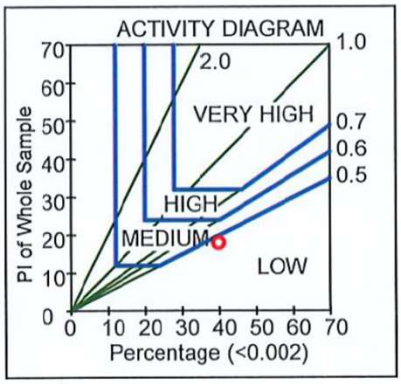
Sample No.	: L4527
Hole No.	: TP10
Depth	: 600 - 2000
Liquid Limit (%)	: 41
Plasticity Index	: 20
Linear Shrinkage (%)	: 10.0
PI of Whole Sample	: 18
P.R.A. Classification	: A-7-6(11)
Unified Soil Classificati	: CL
Activity	: 0.45
Heave Classification	: LOW
Grading Modulus	: 0.47
Percentage (<0.002)	: 40.0
Moisture Content (%)	: 15.8

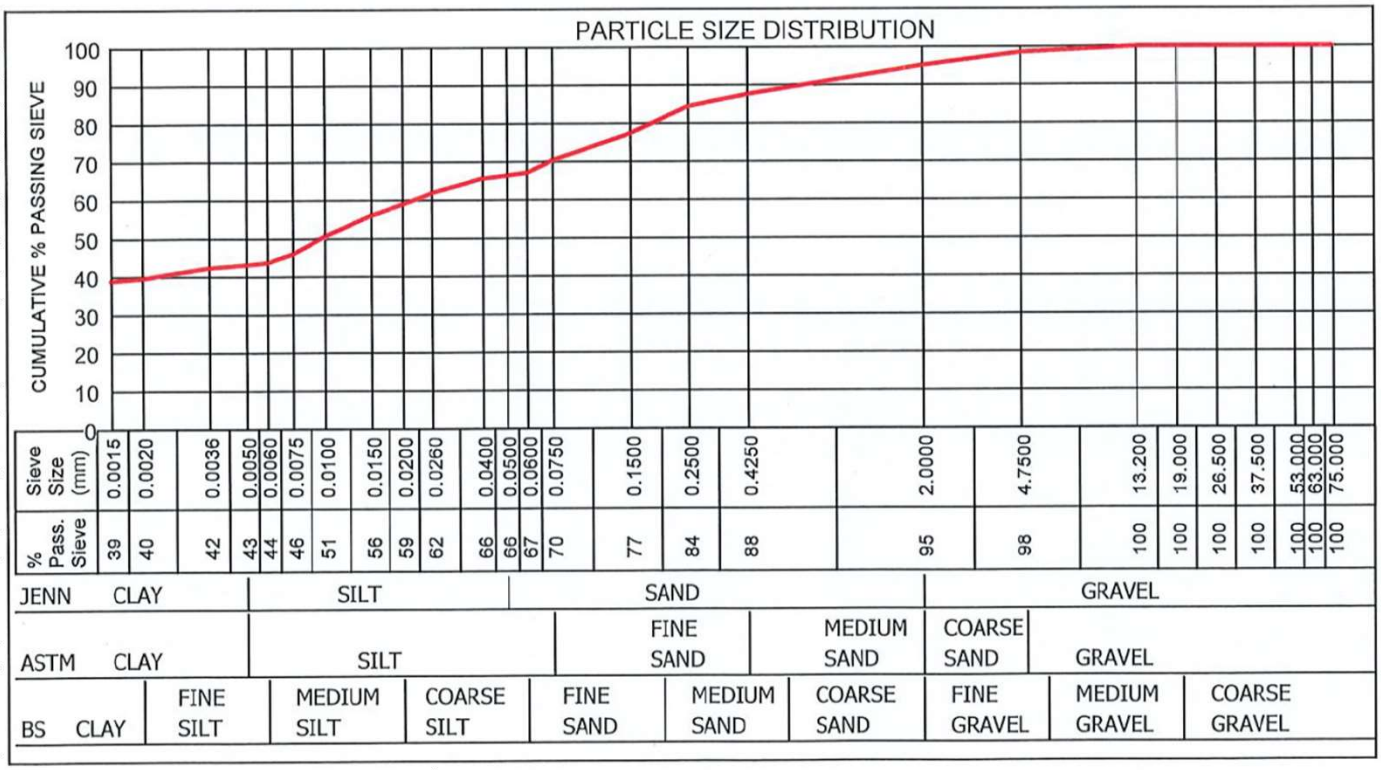
FOUNDATION INDICATOR (ASTM: D422)

Material Description : DK YL BR SILTY CLAY

	Clay (%)	Silt (%)	Sand (%)	Gravel (%)	Classification
Jennings	43.2	23.2	28.7	4.9	SANDY CLAY
Astm	43.2	27.2	28.1	1.5	SILTY CLAY
British Standard	39.7	27.4	28.0	4.9	SILTY CLAY







Sieve Size (mm)	0.0015	0.0020	0.0036	0.0050	0.0060	0.0075	0.0100	0.0150	0.0200	0.0260	0.0400	0.0500	0.0600	0.0750	0.1500	0.2500	0.4250	2.0000	4.7500	13.200	19.000	26.500	37.500	53.000	63.000	75.000
% Pass. Sieve	39	40	42	43	44	46	51	56	59	62	66	66	67	70	77	84	88	95	98	100	100	100	100	100	100	100

JENN	CLAY	SILT		SAND			GRAVEL			
ASTM	CLAY	SILT		FINE SAND	MEDIUM SAND	COARSE SAND	GRAVEL			
BS	CLAY	FINE SILT	MEDIUM SILT	COARSE SILT	FINE SAND	MEDIUM SAND	COARSE SAND	FINE GRAVEL	MEDIUM GRAVEL	COARSE GRAVEL

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GRAVEL, SOIL AND SAND TEST REPORT

SANS 3001 Methods
GR1, GR5, GR10, GR20, GR30 & GR40

Doc No. CL0001		Rev 1		Date updated 26/07/2022	

Client : Luhlaza — Doc No: C968-8(i) — Date Sampled : -

Address: Blairgowrie Plaza Office Park — Date Recieved: **09-May-23**

Contract : Ikageng — Date Tested : **18-May-23**

Description : TP13

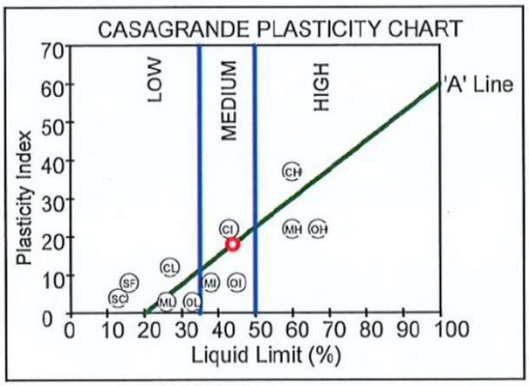
Sample No	C968-8
Depth (m)	0.6 - 1.1

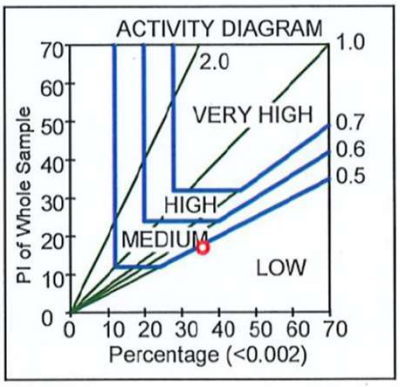
Sample No.	: L4528
Hole No.	: TP13
Depth	: 600 - 1100
Liquid Limit (%)	: 44
Plasticity Index	: 18
Linear Shrinkage (%)	: 9.5
PI of Whole Sample	: 17
P.R.A. Classification	: A-7-6(11)
Unified Soil Classificati	: CL
Activity	: 0.47
Heave Classification	: LOW
Grading Modulus	: 0.41
Percentage (<0.002)	: 36.0
Moisture Content (%)	: 16.8

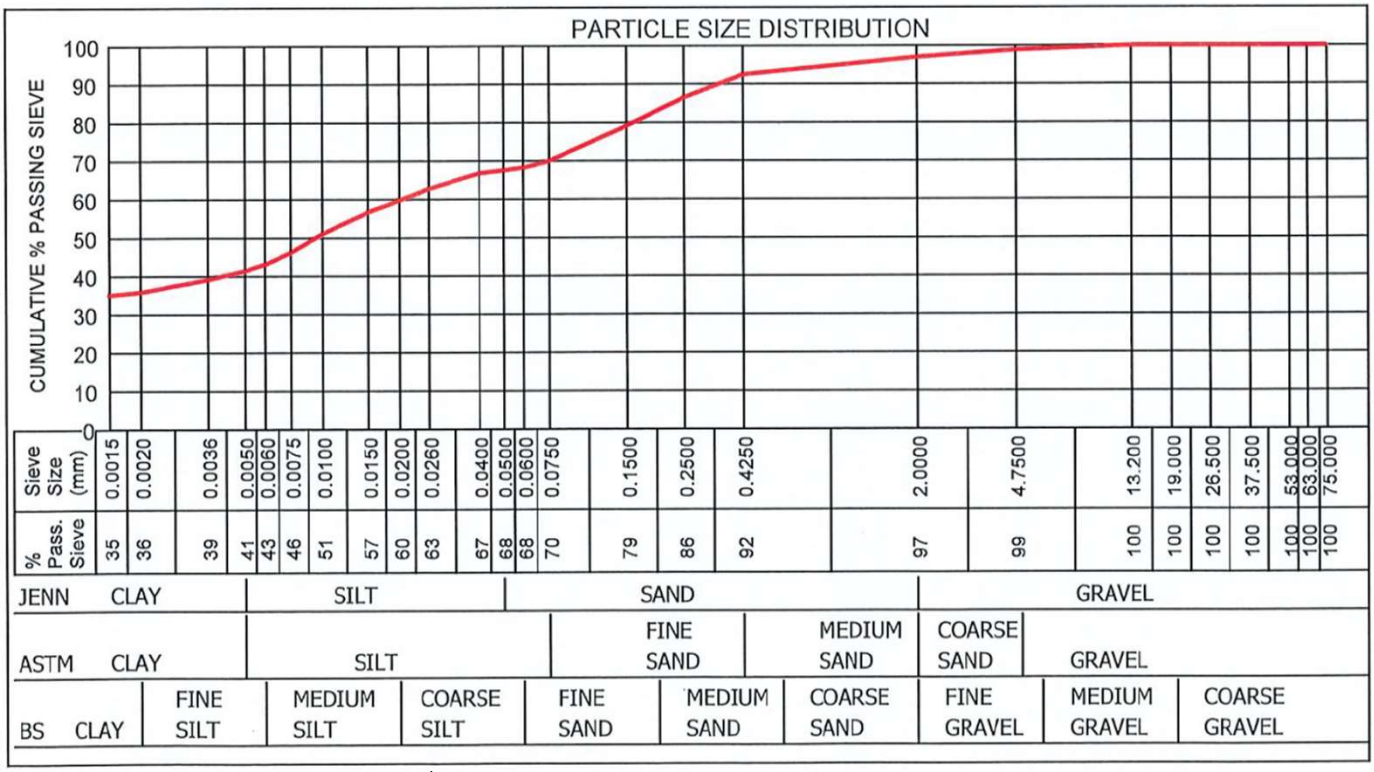
FOUNDATION INDICATOR (ASTM: D422)

Material Description : DK BR SILTY CLAY

	Clay (%)	Silt (%)	Sand (%)	Gravel (%)	Classification
Jennings	41.5	26.1	29.4	3.1	SANDY CLAY
Astm	41.5	28.5	28.9	1.2	SILTY CLAY
British Standard	35.9	32.4	28.6	3.1	SILTY CLAY







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GRAVEL, SOIL AND SAND TEST REPORT : Maximum Dry Density & OMC

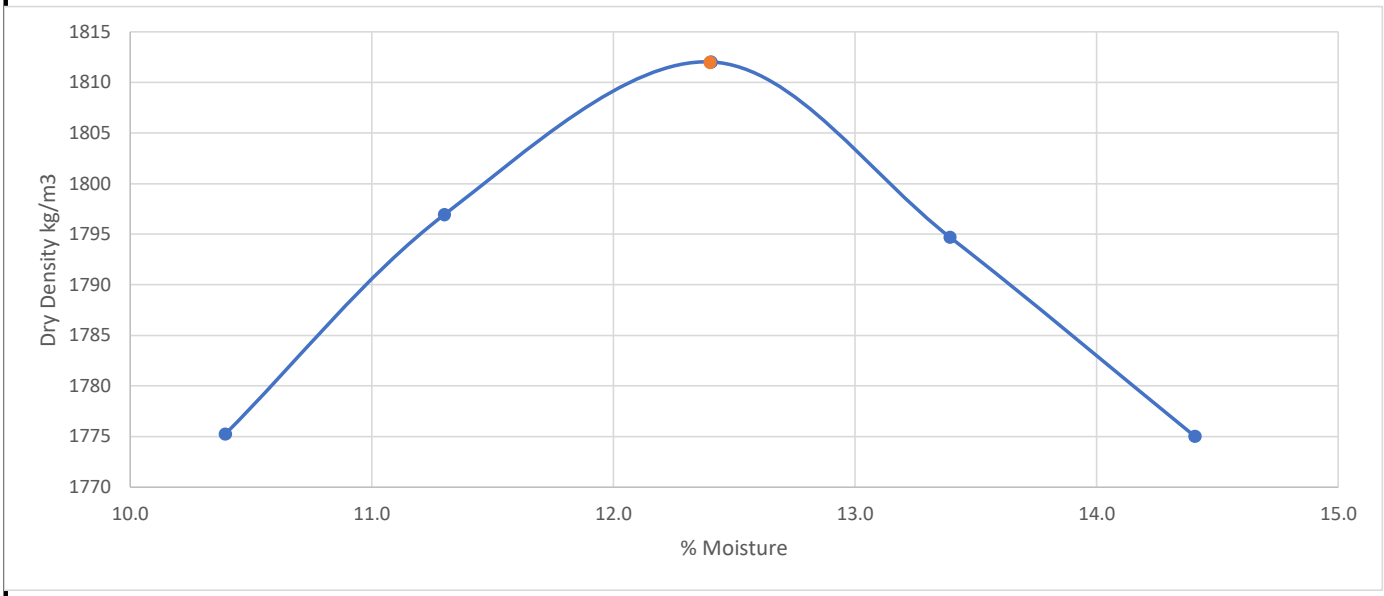
SANS 3001
Method GR30

Client:	**Luhlaza Consulting and Advisory (PTY) Ltd**	Date Sampled:	**-**
Address:	**Blairgowrie Plaza Office Park**	Date Received:	**09-May-23**
Contract:	**Ikageng**	Date Tested :	**13-May-23**
Description:	**TP04: 0.6 - 1.5**	**Sample No:**	**C968-9**

Doc No.	CL0004		Rev 1		Date updated 26/07/2022

Maximum dry density =	**1812**	kg/m³
Optimum moisture content =	**12.4**	%
Preparation method used:	Scalping	

	1	2	3	4	5
Wet Density	1960	2000	2037	2035	2031
Moisture Content	10.4	11.3	12.4	13.4	14.4
Dry Density	1775	1797	1812	1795	1775



REMARKS *

Please note that this sample was compacted with 55 blows per layer to achieve the Maximum Dry Density

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GRAVEL, SOIL AND SAND TEST REPORT

SANS 3001 Methods
GR1, GR5, GR10, GR20, GR30 & GR40

Doc No. CL0001		Rev 1		Date updated 26/07/2022	

Client : Luhlaza — Doc No: C968-10(i) — Date Sampled : -

Address: Blairgowrie Plaza Office Park — Date Recieved: **09-May-23**

Contract : Ikageng — Date Tested : **18-May-23**

Description : TP14

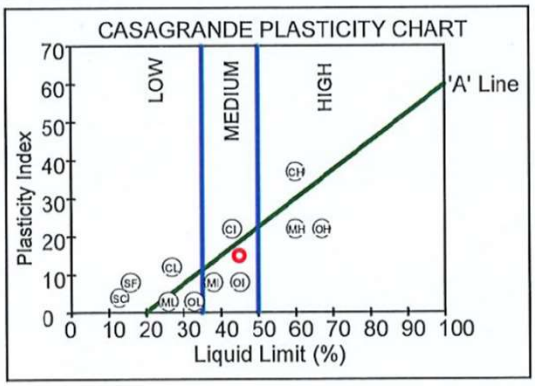
Sample No	C968-10
Depth (m)	0.7 - 1.5

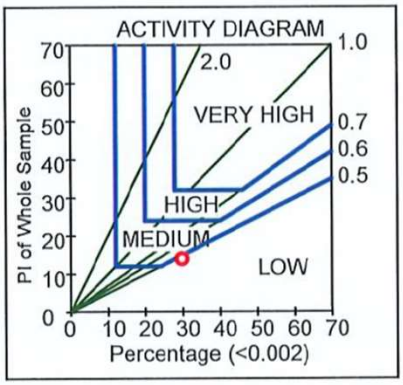
Sample No.	: L4529
Hole No.	: TP14
Depth	: 700-1500
Liquid Limit (%)	: 45
Plasticity Index	: 15
Linear Shrinkage (%)	: 7.5
PI of Whole Sample	: 14
P.R.A. Classification	: A-7-5(8)
Unified Soil Classificati	: ML
Activity	: 0.47
Heave Classification	: LOW
Grading Modulus	: 0.53
Percentage (<0.002)	: 30.0
Moisture Content (%)	: 14.8

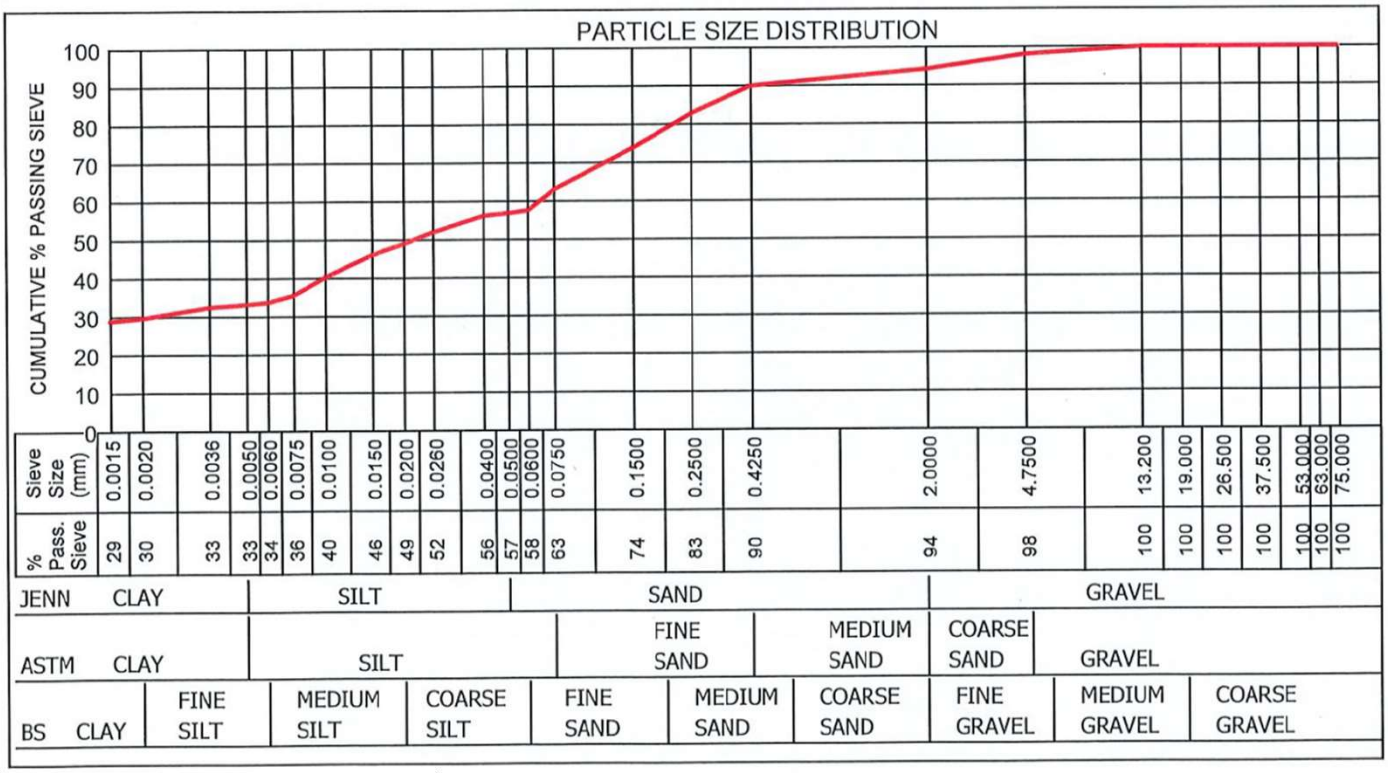
FOUNDATION INDICATOR (ASTM: D422)

Material Description : DK BR SANDY CLAY

	Clay (%)	Silt (%)	Sand (%)	Gravel (%)	Classification
Jennings	33.3	23.7	37.4	5.7	SANDY CLAY
Astm	33.3	29.7	35.1	1.9	SANDY CLAY
British Standard	29.7	28.0	36.6	5.7	SANDY CLAY







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GRAVEL, SOIL AND SAND TEST REPORT

SANS 3001 Methods
GR1, GR5, GR10, GR20, GR30 & GR40

Doc No. CL0001		Rev 1		Date updated 26/07/2022	

Client : Luhlaza — Doc No: C968-11(i) — Date Sampled : -

Address: Blairgowrie Plaza Office Park — Date Recieved: **09-May-23**

Contract : Ikageng — Date Tested : **18-May-23**

Description : TP15

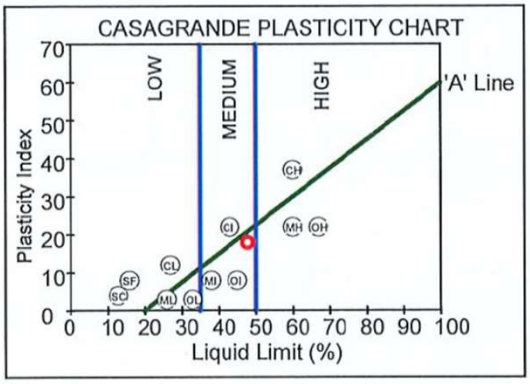
Sample No	C968-11
Depth (m)	0.9 - 1.6

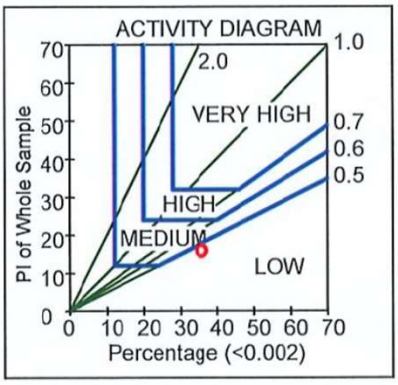
Sample No.	: L4530
Hole No.	: TP15
Depth	: 900-1600
Liquid Limit (%)	: 48
Plasticity Index	: 18
Linear Shrinkage (%)	: 9.0
PI of Whole Sample	: 16
P.R.A. Classification	: A-7-5(11)
Unified Soil Classificati:	ML
Activity	: 0.44
Heave Classification	: LOW
Grading Modulus	: 0.44
Percentage (<0.002)	: 36.0
Moisture Content (%)	: 17.7

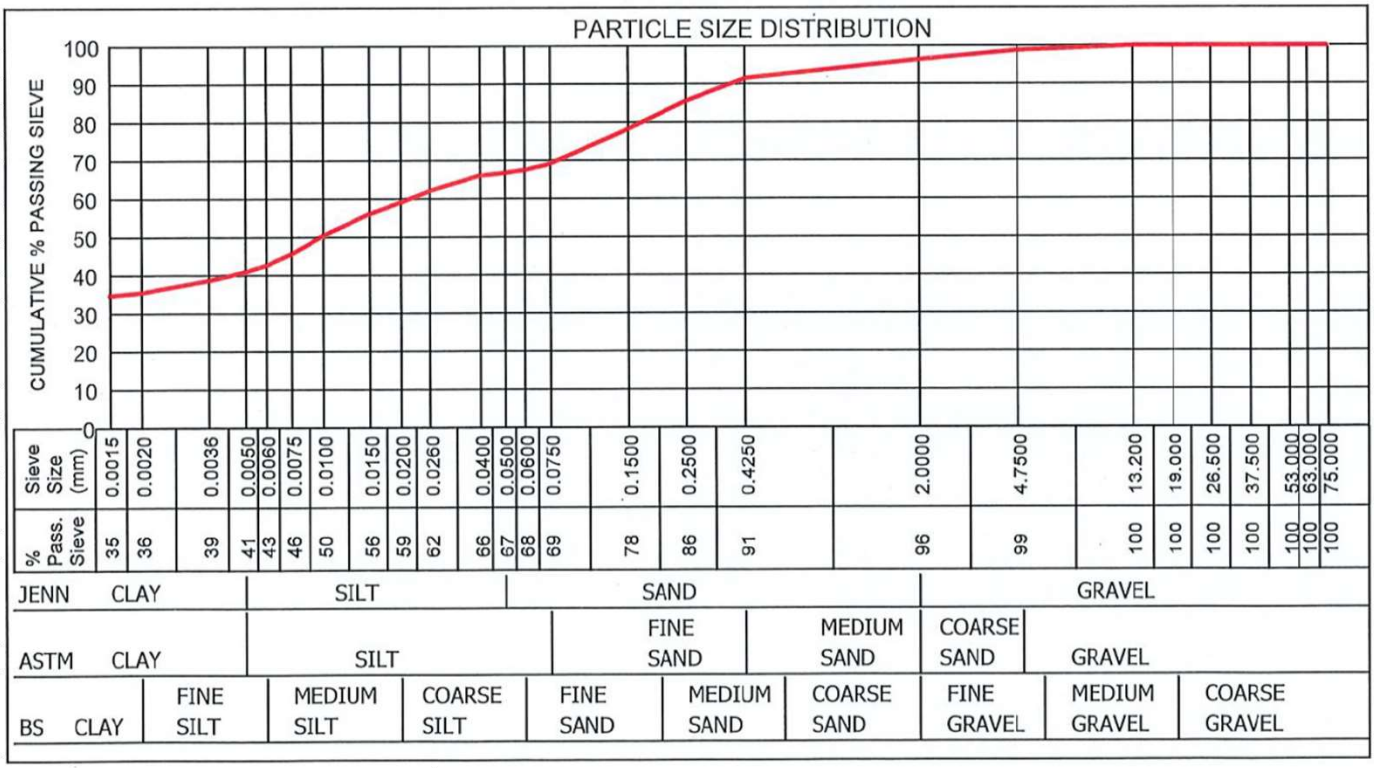
FOUNDATION INDICATOR (ASTM: D422)

Material Description : DK BR SILTY CLAY

	Clay (%)	Silt (%)	Sand (%)	Gravel (%)	Classification
Jennings	41.0	25.8	29.6	3.6	SANDY CLAY
Astm	41.0	28.1	29.6	1.3	SILTY CLAY
British Standard	35.5	32.1	28.8	3.6	SILTY CLAY







Sieve Size (mm)	0.0015	0.0020	0.0036	0.0050	0.0060	0.0075	0.0100	0.0150	0.0200	0.0260	0.0400	0.0500	0.0600	0.0750	0.1500	0.2500	0.4250	2.0000	4.7500	13.200	19.000	26.500	37.500	53.000	63.000	75.000
% Pass. Sieve	35	36	39	41	43	46	50	56	59	62	66	67	68	69	78	86	91	96	99	100	100	100	100	100	100	100

JENN	CLAY	SILT			SAND			GRAVEL			
ASTM	CLAY	SILT			FINE SAND	MEDIUM SAND	COARSE SAND	GRAVEL			
BS	CLAY	FINE SILT	MEDIUM SILT	COARSE SILT	FINE SAND	MEDIUM SAND	COARSE SAND	FINE GRAVEL	MEDIUM GRAVEL	COARSE GRAVEL	

Date Issued: 2023/06/28 *Technical signatory (Name) :* **Martinus Schwartz (Reporting)** *Signature:*

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Double Oedometer

BS 1377 Part 5

Doc No. CL0001		Rev 1		Date updated 26/07/2022	

Client : Luhlaza — Doc No: C968-22-A(i) — Date Sampled : -

Address: Blairgowrie Plaza Office Park — Date Recieved: **09-May-23**

Contract : Ikageng — Completed: **14-Jul-23**

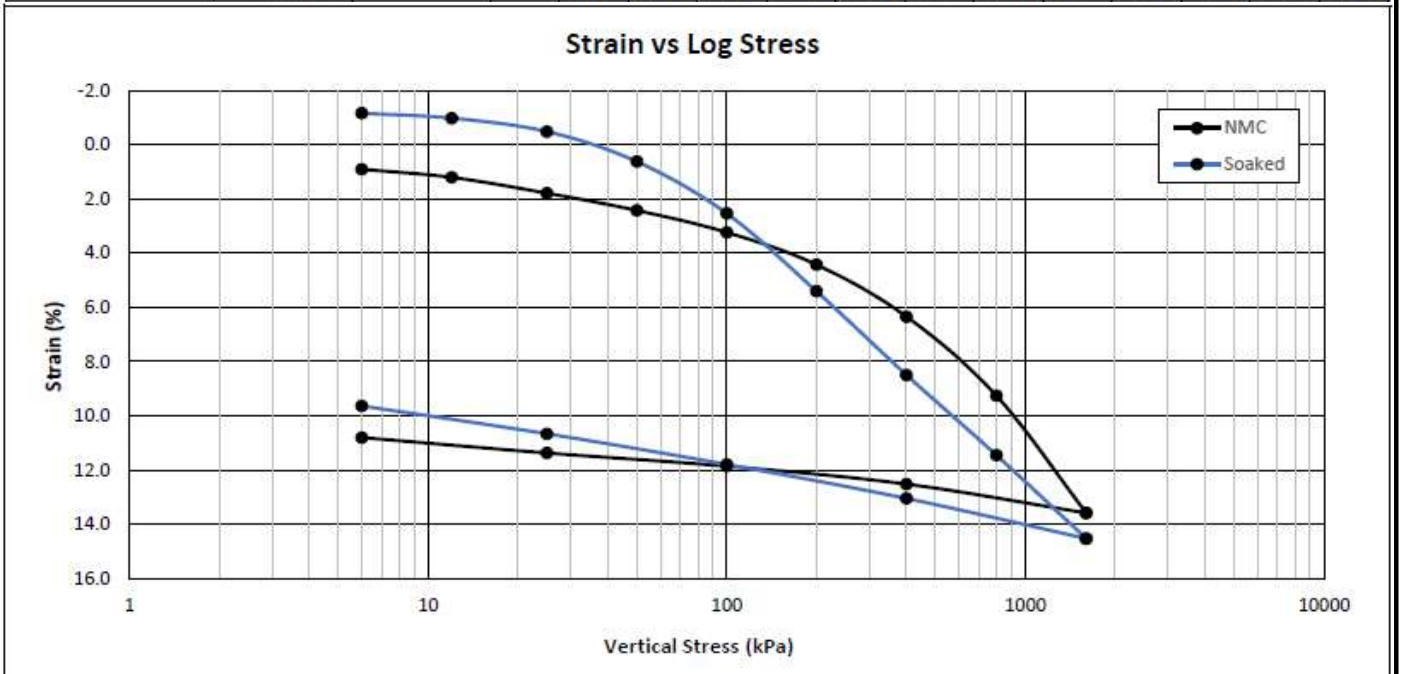
Description : TP15

Sample No	C968-22-A
Depth (m)	0.9 - 1.6

DOUBLE OEDOMETER

Sample Info		Unit	NMC	Soaked	Test Remarks:
Test Specimen Height		mm	25.4	25.4	Undisturbed
Moisture Content	Initial	%	20.7	20.9	
	Final	%	20.1	23.4	
Dry Density		kg/m³	1594	1517	
Void Ratio		-	0.764	0.853	
Degree of Saturation		%	76.1	68.8	
Relative Density (SG)		-	2.811		Determined

Vertical Stress Applied:		kPa	6	12	25	50	100	200	400	800	1600	400	100	25	6
Load applied for:		Hrs	24	24	24	24	24	24	24	24	24	3	3	3	3
Specimen Height	NMC	mm	25.17	25.09	24.94	24.78	24.58	24.28	23.79	23.05	21.95	22.22	22.39	22.51	22.66
	Soaked	mm	25.69	25.65	25.52	25.24	24.76	24.03	23.24	22.49	21.71	22.09	22.41	22.69	22.95
Total Strain	NMC	%	0.91	1.21	1.79	2.43	3.23	4.43	6.34	9.25	13.57	12.51	11.85	11.36	10.80
	Soaked	%	-1.15	-0.97	-0.48	0.63	2.54	5.41	8.49	11.44	14.52	13.04	11.79	10.66	9.63
Void Ratio	NMC	-	0.748	0.742	0.732	0.721	0.707	0.686	0.652	0.601	0.524	0.543	0.555	0.563	0.573
	Soaked	-	0.875	0.871	0.862	0.842	0.806	0.753	0.696	0.641	0.584	0.612	0.635	0.656	0.675
Mv (1/Mpa)	NMC	-	-	0.504	0.453	0.259	0.166	0.123	0.100	0.078	0.060	0.010	0.025	0.074	0.337
	Soaked	-	-	0.298	0.376	0.441	0.384	0.295	0.163	0.081	0.043	0.014	0.048	0.171	0.605



Date Issued: 2023/07/17 *Technical signatory (Name) :* **Martinus Schwartz (Reporting)** *Signature:*

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Double Oedometer

BS 1377 Part 5

Doc No. CL0001		Rev 1		Date updated 26/07/2022	

Client : Luhlaza — Doc No: C968-22-B(i) — Date Sampled : -

Address: Blairgowrie Plaza Office Park — Date Recieved: **09-May-23**

Contract : Ikageng — Completed: **14-Jul-23**

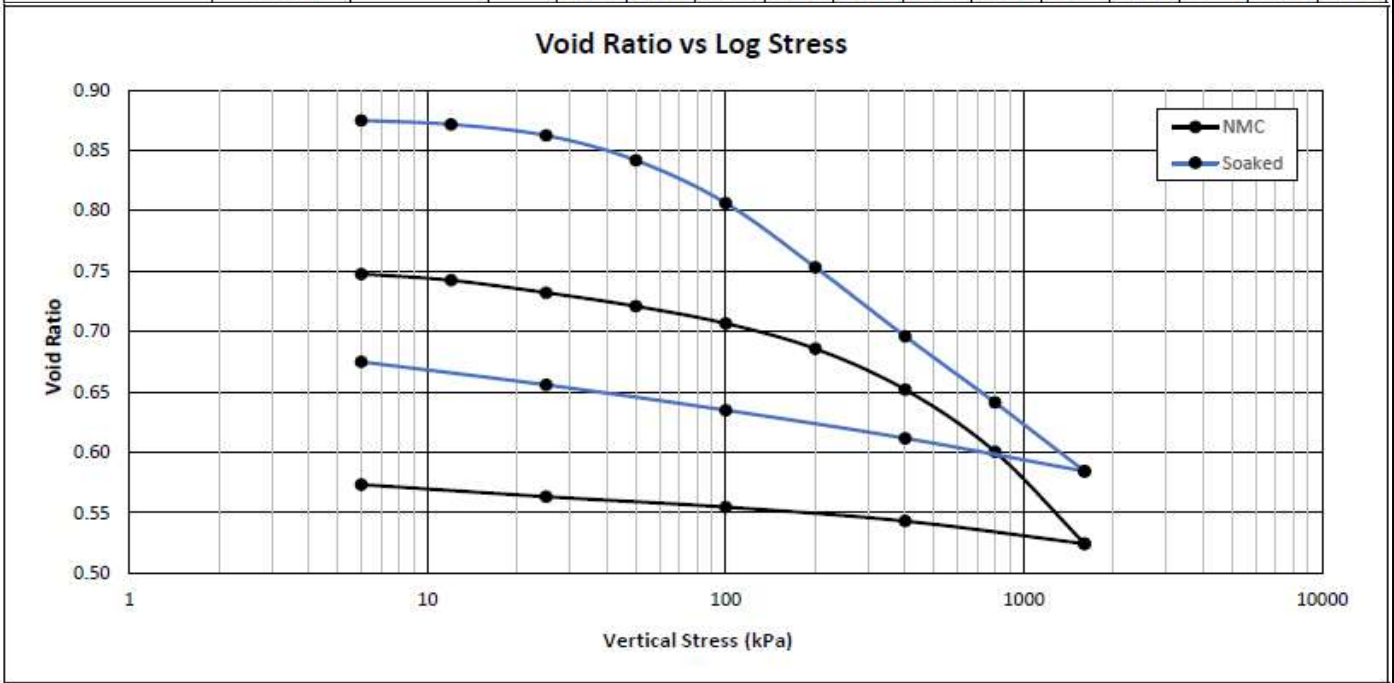
Description : TP15

Sample No	C968-22-B
Depth (m)	0.9 - 1.6

DOUBLE OEDOMETER

Sample Info		Unit	NMC	Soaked	Test Remarks:
Test Specimen Height		mm	25.4	25.4	Undisturbed
Moisture Content	Initial	%	20.7	20.9	
	Final	%	20.1	23.4	
Dry Density		kg/m³	1594	1517	
Void Ratio		-	0.764	0.853	
Degree of Saturation		%	76.1	68.8	
Relative Density (SG)		-	2.811		Determined

Vertical Stress Applied:		kPa	6	12	25	50	100	200	400	800	1600	400	100	25	6
Load applied for:		Hrs	24	24	24	24	24	24	24	24	24	3	3	3	3
Specimen Height	NMC	mm	25.17	25.09	24.94	24.78	24.58	24.28	23.79	23.05	21.95	22.22	22.39	22.51	22.66
	Soaked	mm	25.69	25.65	25.52	25.24	24.76	24.03	23.24	22.49	21.71	22.09	22.41	22.69	22.95
Total Strain	NMC	%	0.91	1.21	1.79	2.43	3.23	4.43	6.34	9.25	13.57	12.51	11.85	11.36	10.80
	Soaked	%	-1.15	-0.97	-0.48	0.63	2.54	5.41	8.49	11.44	14.52	13.04	11.79	10.66	9.63
Void Ratio	NMC	-	0.748	0.742	0.732	0.721	0.707	0.686	0.652	0.601	0.524	0.543	0.555	0.563	0.573
	Soaked	-	0.875	0.871	0.862	0.842	0.806	0.753	0.696	0.641	0.584	0.612	0.635	0.656	0.675
Mv (1/Mpa)	NMC	-	-	0.504	0.453	0.259	0.166	0.123	0.100	0.078	0.060	0.010	0.025	0.074	0.337
	Soaked	-	-	0.298	0.376	0.441	0.384	0.295	0.163	0.081	0.043	0.014	0.048	0.171	0.605



Date Issued: 2023/07/17 *Technical signatory (Name) :* **Martinus Schwartz (Reporting)** *Signature:*

Appendix D: Field Test Pit Photographs

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TP01


LUHLAZA
CLIENT UKUZA
SITE. IKAGENG
DATE 05/05/2023
TP 01


LUHLAZA
CLIENT UKUZA
SITE. IKAGENG
DATE 05/05/2023
TP 01

TP02


UHLAZA
CLIENT UKUZ
SITE IKAGENG
DATE 05/01/2023
TP02


UHLAZA
CLIENT UKUZ
SITE IKAGENG
DATE 05/01/2023
TP02

TP03


LUHLAZA
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SITE: IKAGENG
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TP03


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TP04


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TP 04


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TP05


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TP06


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TP07

TP08


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SITE. IKAGENG
DATE 05/05/2023
TP 08

TP09

TP10


UHLAZA
CLIENT UKUZA
SITE IKAGEM
DATE 05/05/202
TP10


UHLAZA
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SITE IKAGEM
DATE 05/05/202
TP10

TP12

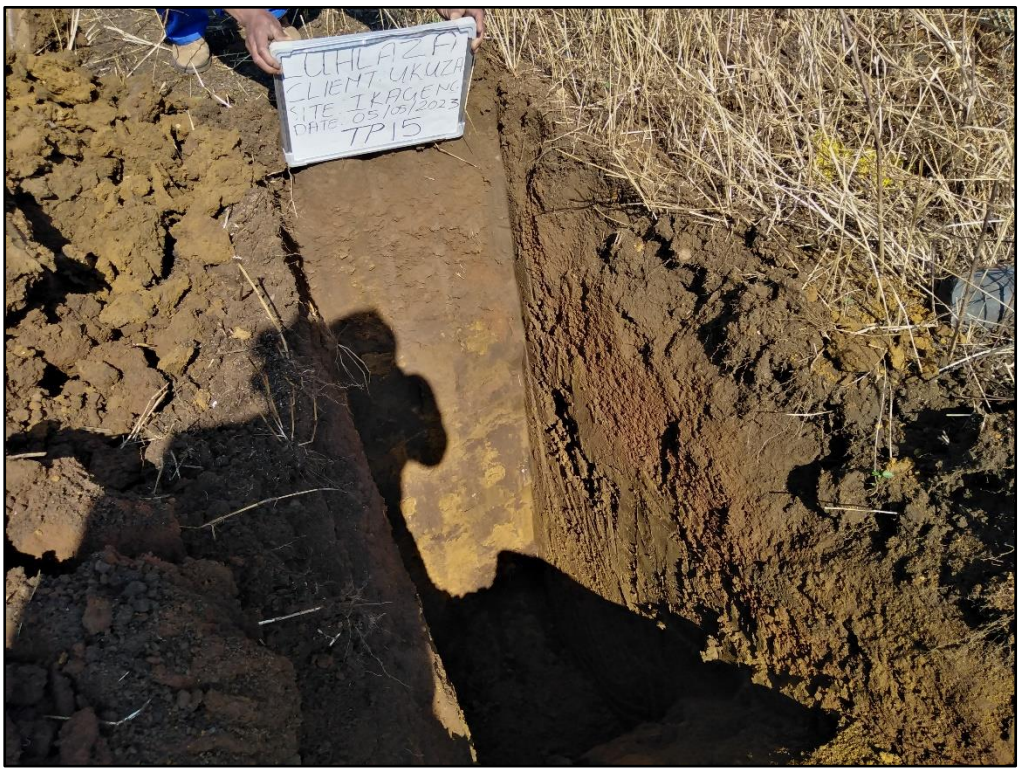
TP13


LUHLAZA
CLIENT UKUZA
SITE: IKAGENG
DATE: 05/05/2023
TP13


LUHLAZA
CLIENT UKUZA
SITE: IKAGENG
DATE: 05/05/2023
TP13

TP14

TP15



TP16

TP17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DATE: 05/05/2023
TP 17


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SITE: IKAGENG
DATE: 05/05/2023
TP 17

TP18


CLIENT UKUZA
SITE: IKAGENG
DATE: 05/05/2023
TP 18


CLIENT UKUZA
SITE: IKAGENG
DATE: 05/05/2023
TP 18

TP19

TP20

TP21

TP22


LUHLAZH
CLIENT UKUZA
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DATE 05/05/2023
TP 22


CLIENT UKUZA
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DATE 05/05/2023
TP 22

TP23


LUHLAZA
CLIENT UKUZ
SITE: TKAGENG
DATE: 05/5/2023
TP 23


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TP24


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TP 24


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TP 24

Appendix E: Summary of Standard Soil and Rock Profile Description Terminology

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SUMMARY OF SOIL STANDARD AND ROCK PROFILE DESCRIPTION

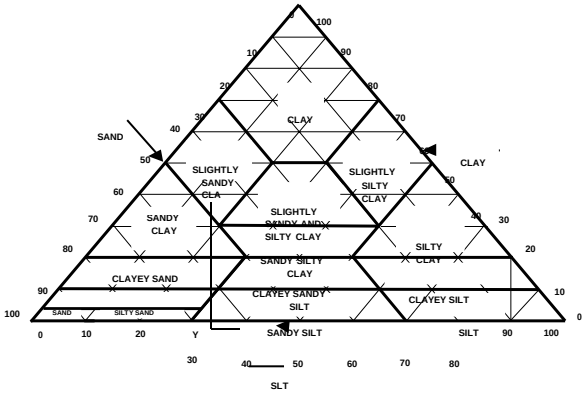
TERMINOLOGY

STANDARD DESCRIPTIONS USED IN SOIL PROFILING

1. MOISTURE CONDITION		2. COLOUR
Term	Description	The Predominant colours or colour combinations are described including secondary coloration described as banded, streaked, blotched, mottled, speckled or stained.
Dry		
Slightly moist	Requires addition of water to reach optimum moisture content for compaction	
Moist	Near optimum content	
Very Moist	Requires drying to attain optimum content	
Wet	Fully saturated and generally below water table	

3. CONSISTENCY			
3.1 Non-Cohesive Soils		3.2 Cohesive Soils	
Term	Description	Term	Description
Very Loose	Crumbles very easily when scraped with geological pick	Very soft	Easily penetrated by thumb. Sharp end of pick can be pushed in 30 - 40mm. Easily moulded by fingers.
Loose	Small resistance to penetration by sharp end of geological pick	Soft	Pick head can easily be pushed into the shaft of handle. Moulded by fingers with some pressure.
Medium Dense	Considerable resistance to penetration by sharp end of geological pick	Firm	Indented by thumb with effort. Sharp end of pick can be pushed in up to 10mm. Can just be penetrated with an ordinary spade.
Dense	Very high resistance to penetration to sharp end of geological pick. Requires many blows of hand pick for excavation.	Stiff	Penetrated by thumbnail. Slight indentation produced by pushing pick point into soil. Cannot be moulded by fingers. Requires hand pick for excavation.
Very Dense	High resistance to repeated blows of geological pick. Requires power tools for excavation	Very Stiff	Indented by thumbnail. Slight indentation produced by blow of pick point. Requires power tools for excavation.

4. STRUCTURE		**5. SOIL TYPE**	
		5.1 Particle Size	
Term	Description	Term	Size (mm)
Intact	Absence of fissures or joints	Boulder	>200
Fissured	Presence of closed joints	Pebbles	60 – 200
Shattered	Presence of closely spaced air filled joints giving cubical fragments	Gravel	60 – 2
Micro shattered	Small scale shattering with shattered fragments the size of sand grains	Sand	2 – 0,06
Slickensided	Polished planar surfaces representing shear movement in soil	Silt	0,06 – 0,002
Bedded Foliated	Many residual soils show structures of parent rock.	Clay	<0,002

6. ORIGIN		5.2 Soil Classification
6.1 Transported Soils		
Term	Agency of Transportation	
Colluvium	Gravity deposits	
Talus	Scree or coarse colluvium	
Hillwash	Fine colluvium	
Alluvial	River deposits	
Aeolian	Wind deposits	
Littoral	Beach deposits	
Estuarine	Tidal – river deposits	
Lacustrine	Lake deposits	
6.2 Residual soils		
These are products of in situ weathering of rocks and are described as e.g. Residual Shale		
6.3 Pedocretes		
Formed in transported and residual soils etc. calcrete, silcrete, manganocrete and ferricrete.		

SUMMARY OF DESCRIPTIONS USED IN ROCK CORE LOGGING

1. WEATHERING

Term	Symbol	Diagnostic Features
Residual Soil	W5	Rock is discoloured and completely changed to a soil in which original rock fabric is completely destroyed. There is a large change in volume.
Completely Weathered	W5	Rock is discoloured and changed to a soil but original fabric is mainly preserved. There may be occasional small corestones.
Highly Weathered	W4	Rock is discoloured, discontinuities may be open and have discoloured surfaces, and the original fabric of the rock near the discontinuities may be altered; alternation penetrates deeply inwards, but corestones are still present.
Moderately Weathered	W3	Rock is discoloured, discontinuities may be open and will have discoloured surfaces with alteration starting to penetrate inwards, intact rock is noticeably weaker than the fresh rock.
Slightly Weathered	W2	Rock may be slightly discoloured, particularly adjacent to discontinuities, which may be open and will have slightly discoloured surfaces, the intact rock is not noticeably weaker than the fresh rock.
Unweathered	W1	Parent rock showing no discolouration, loss of strength or any other weathering effects.

2. HARDNESS

Classification	Field Test	Compressive Strength Range MPa
Extremely Soft Rock	Easily peeled with a knife	<1
Very Soft Rock	Can be peeled with a knife. Material crumbles under firm blows with the sharp end of a geological pick.	1 to 3
Soft Rock	Can be scraped with a knife, indentation of 2 to 4 mm with firm blows of the pick point.	3 to 10
edium Hard Rock	Cannot be scraped or peeled with a knife. Hand held specimen breaks with firm blows of the pick.	10 to 25
Hard Rock	Point load tests must be carried out in order to distinguish between these classifications	25 - 70
ery Hard Rock	These results may be verified by uniaxial compressive strength tests on selected samples.	70 - 200
Extremely Hard Rock		>200

3. COLOUR

The predominant colours or colour combination are described including secondary colouration described as banded, streaked, blotched, mottled,

4. FABRIC

4.1 Grain Size

Term	Size (mm)
Very Coarse	>2,0

4.2 Discontinuity Spacing

Description for: Bedding, foliation, laminations	Spacing (mm)	Descriptions for joints, faults, etc.
Very Thickly Bedded	> 2000	Very Widely

Coarse	0,6 – 2,0	Thickly Bedded	600 – 2000	Widely
Medium	0,2 – 0,6	Medium Bedded	200 – 600	Medium
Fine	0,06 – 0,2	Thinly Bedded	60 – 200	Closely
Very Fine	< 0,06	Laminated	3 – 60	Very closely
		Thinly Laminated	<3	

5. ROCK NAME		6. STRATIGRAPHIC LAYER
Classified in terms of origin:		Identification of rock type in terms of stratigraphic layers.
IGNEOUS	Granite, Diorite, Gabbro, Syenite, , Dolerite, Trachyte, Andesite, Basalt.	
METAMORPHIC	Slate, Felsite, Gneiss, Schist, Quartzite	
SEDIMENTARY	Shale, Siltstone, Siltstone, Sandstone, Dolomite, Conglomerate, Tillite, Limestone.	