A PHASE ONE GEOTECHNICAL INVESTIGATION REPORT FOR THE PROPOSED TOWNSHIP ESTABLISHMENT OF A NEW TOWNSHIP IN LETHABO PARK, KIMBERLEY

Report Number: 2019/J004/MAC

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EXECUTIVE SUMMARY

Multiple portions of land were investigated by means of a phase one geotechnical investigation for the proposed expansion of Lethabo Park. No fundamental flaws were identified from a geotechnical perspective which prohibits development of the study area. In brief, the following applies:

- *Geology*: The study area is underlain by a dolerite intrusion in the east and the Prince Albert Formation in the west. The geology was verified by bedrock materials encountered in trial holes.
- *Soil Profile*: The profiles on site are variable, as is to be expected considering the size of the study area. The profiles hosted aeolian deposits, colluvium, residual shale, residual dolerite and an array of calcrete deposits. Surficial fill was also found in places and extensive rubble dumping has occurred throughout the study area.
- *Hydrology*: No perched water or seepage water was encountered on site, though surface water ponding was found where water services were reportedly leaking.
- *Conditions of Excavation*: A minimum proven depth of excavation by backhoe was established at 300mm, though the majority of the trial holes exceeded 1500mm when excavated with the aid of a backhoe. In general, in situ materials make for conditions of intermediate to difficult excavation.
- *Geotechnical Classification*: The site is divided into nine separate geotechnical zones. An additional zoning map was supplied indicating other problems encountered on site that are not necessarily of a geotechnical origin.
- *Soil Corrossivity*: All soil materials tested proved to be extremely corrosive on account of high soil conductivity.
- *Seismicity*: A 10% probability exists that an earthquake with Peak Ground Acceleration of 0.16g to 0.20g may take place once in 50 years. Tremors in this area are likely to be mining-related rather than naturally occurring.
- *Chemical Soil Heave*: There are indications that certain materials found on site are similar to those previously investigated due to severe heave associated with chemical expansion.
- *Construction and Development*: Preliminary recommendations were given for development, depending on the soil classification of zoned areas across the site.

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A PHASE ONE GEOTECHNICAL INVESTIGATION REPORT FOR THE PROPOSED TOWNSHIP ESTABLISHMENT OF A NEW TOWNSHIP IN LETHABO PARK, KIMBERLEY

1 INTRODUCTION

1.1 Appointment

Soilkraft cc was appointed by Macroplan Town and Regional Planners to undertake a geotechnical investigation for the proposed township establishment of a new township in Lethabo Park, Kimberley. In accordance with the request, a phase one geotechnical investigation was undertaken, as described by SANS 634.

2 AVAILABLE INFORMATION

The following sources of information were consulted:

- 1: 250 000 scale geological map: 2824 Kimberley, published in 1993.
- 1: 50 000 scale topographical map: 2824DA Barkly West, published in 2000.
- Existing geotechnical investigations conducted in the Kimberley area.

3 SITE DESCRIPTION

3.1 Site Location

The area under consideration is situated on the north western, northern and north eastern periphery

of the existing Lethabo Park neighbourhood, some 10km due north west of Kimberley. The study area consisted of erf 15089 (±10ha) and the remainder of the farm Roodepan 70 (±75ha) in Lethabo Park. It was initially indicated that erf 17725 would also form part of the investigation; however, on the first day of the investigation this erf was left out as it came to light that it had already been investigated previously. As a result, the total area investigated measured some 85ha.

The site can be accessed from all sides of Lethabo Park. Alternatively, access can be gained via the existing service road of the railway line, which forms the north eastern boundary of the study area.

Figure 1 : Locality Plan shows the position of the site.

3.2 Land Utilisation

The properties investigated constituted open, vacant land at the time of the investigation. The only exception to this was localised parts on the north eastern side of the remainder of the farm Roodepan 70, where new shacks had been erected in weeks preceding the investigation, which encroached on the study area.

No municipal services have been installed to the proposed erven as yet; however, municipal services are available in parts of Lethabo Park. These include water, sewerage reticulation and electricity. From site observations it appears that there is a water pump station at the boundary at the northern boundary of erf 15089.

Photo 1 illustrates site conditions encountered on the north western part of the site (i.e. remainder of the farm Roodepan 70), while Photo 2 shows conditions encountered on erf 15089, to the east.

3.3 Climate

The site is located in an area with an approximate Weinert N-value of 10 and a Thornthwaite Moisture Index between -20 and -40. Climatically the area may thus be described semi-arid, which signifies that mechanical weathering will likely be the dominant method of weathering. However, this does not mean that chemical weathering (i.e. decomposition) should be disregarded as climatic conditions change with time and may have varied over the geological history of this area. Minerals such as amphiboles, pyroxenes and olivine are particularly susceptible to chemical weathering.

4 METHOD OF INVESTIGATION

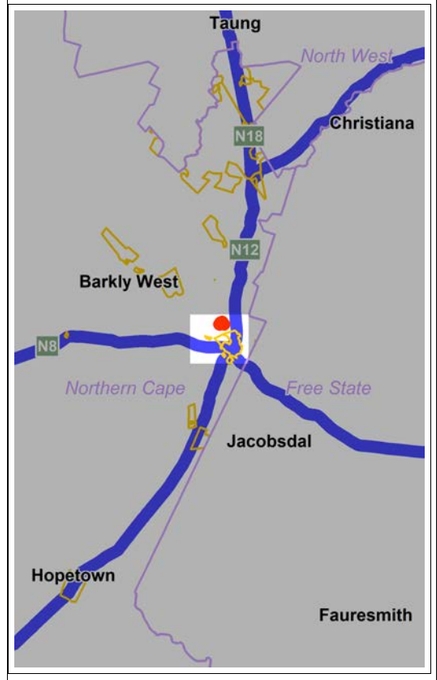
4.1 Trial Holes

For the purposes of the investigation, a total of 55 trial holes were originally planned. The position of

FIGURE 1

Legend

Study Area



SOIL KRAFT

TAAK: JOB NAME:	**LETHABO PARK**
KLIËNT: CLIENT:	**MACROPLAN**
TEKENING NO: DRWING NO:	**LOCALITY PLAN**
DATUM: DATE:	**23 FEBRUARY 2019**

SOIL KRAFT

SITE CONDITIONS

PHOTO 1

SOIL KRAFT

SITE CONDITIONS

PHOTO 2

the trial holes were determined prior to the site work being undertaken to ensure that trial holes are distributed evenly across the study area. However, on the first day of the investigation, it was revealed that erf 17725 had already been investigated previously and was excluded from the investigation at hand. As such, trial holes 1 through 8 – which were planned for this erf – were discarded.

The remainder of the trial holes were excavated between 21 and 22 February 2019. The trial holes were excavated with the aid of a Caterpillar 422F backhoe, supplied by Big Five Construction. The machine was found to be in an excellent condition. Trial holes were excavated, inspected, sampled (where suitable) and profiled by a professional engineering geologist according to the standard profiling parameters of SAICE[Reference 8.1]. These parameters are summarised in the attached Table 1. The trial hole soil profiles are included in Appendix A of this report and the exact coordinates for each trial hole are included on respective log sheets (provided in WGS84 format).

Figure 2 shows the placement of trial holes across the site.

4.2 Soil Tests

Samples of the in situ soil materials were retrieved for material test analyses. Material samples were delivered to Specialised Testing Laboratory (STL) in Pretoria for test analyses. STL is a SANAS accredited geotechnical laboratory. The following tests were performed:

- Foundation indicator tests were done to determine the general geotechnical properties of materials. This test includes a grading (and hydrometer) analysis and the determination of Atterberg Limits. The grading (i.e. hydrometer) results and Atterberg Limits are used to derive the materials' potential to heave empirically.
- Soil chemistry tests included soil paste pH and conductivity determinations. The tests were done to determine the corrossivity of in situ materials towards buried steel objects (e.g. utilities).
- Limited undisturbed samples were retrieved to assess conditions of settlement. Both consolidation and collapse potential tests were performed on block monsters taken from the soil profiles.

The results of the soil tests can be found in Appendix B. For easy reference, Table 2 summarises the foundation indicator test results.

5 DISCUSSION

5.1 Geology

Regional geological information shows that the study area is underlain by the Prince Albert Formation (Ecca Group, Karoo Supergroup) as well as a dolerite intrusion. Quaternary aged deposits also occur.

TABLE 1: SOIL PROFILING PARAMETERS

CONSISTENCY : GRANULAR SOILS

SPT N	GRAVELS & SANDS Generally free draining soils		DRY DENSITY (kg/m^3)
<4	Very loose	Crumbles very easily when scraped with geological pick.	<1450
4-10	Loose	Small resistance to penetration by sharp pick point.	1450-1600
10-30	Medium dense	Considerable resistance to penetration by sharp pick point.	1600-1750
30-50	Dense	Very high resistance to penetration by sharp pick point. Requires many blows by pick point for excavation.	1750-1925
>50	Very dense	High resistance to repeated blows of geological pick. Requires power tools for excavation.	>1925

CONSISTENCY : COHESIVE SOILS

SPT N	SILTS & CLAYS and combinations with SANDS, Generally slow draining soils		UCS (kPa)
<2	Very soft	Pick point easily pushed in 100mm. Easily moulded by fingers.	<50
2-4	Soft	Pick point easily pushed in 30mm to 40mm. Moulded by fingers with some pressure.	50-125
4-8	Firm	Pick point penetrates to 10mm. Very difficult to mould with fingers.	125-250
8-15	Stiff	Slight indentation by pick point. Cannot be moulded by fingers. Penetrated by thumb nail.	250-500
15-30	Very stiff	Slight indentation by blow of pick point. Requires power tools for excavation.	500-1000

SOIL TYPE

SOIL TYPE	PARTICLE SIZE (mm)
Clay	<0.002
Silt	0.002-0.06
Sand	0.06-2.0
Gravel	2.0-60.0
Cobbles	60.0-200.0
Boulders	>200.0

MOISTURE CONDITION

Dry	No water detectable
Slightly moist	Water just discernible
Moist	Water easily discernible
Very moist	Water can be squeezed out
Wet	Generally below water table

COLOUR

Speckled	Very small patches of colour <2mm
Mottled	Irregular patches of colour 2-6mm
Blotched	Large irregular patches 6-20mm
Banded	Approximately parallel bands of varying colours
Streaked	Randomly orientated streaks of colour
Stained	Local colour variations : Associated with discontinuity surfaces

SOIL STRUCTURE

Intact	No structure present.
Fissured	Presence of discontinuities, possibly cemented.
Slickensided	Very smooth, glossy, often striated discontinuity planes.
Shattered	Presence of open fissures. Soil break into gravel size blocks.
Micro shattered	Small scale shattering, very closely spaced open fissures. Soil breaks into sand size crumbs.
Residual structures	Residual bedding, laminations, foliations etc.

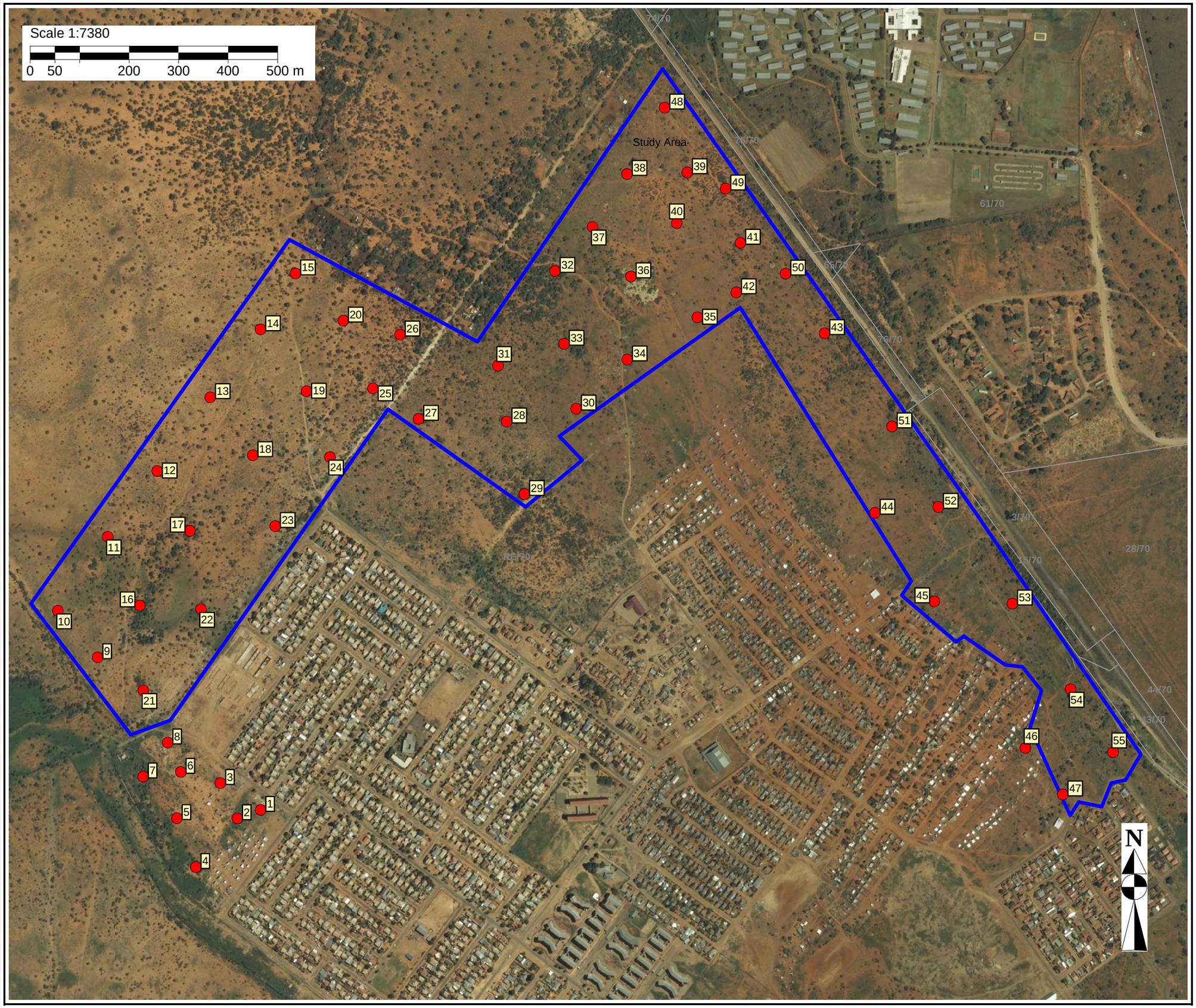
ORIGIN

Transported	Alluvium, hill wash, talus etc.
Residual	Weathered from parent rock e.g. residual granite
Pedocretes	Ferricrete, silcrete, calcrete etc.

DEGREE OF CEMENTATION OF PEDOCRETES

TERM	DESCRIPTION	UCS (MPa)
Very weakly cemented	Some material can be crumbled between finger and thumb. Disintegrates under knife blade to a friable state.	0.1-0.5
Weakly cemented	Cannot be crumbled between strong fingers. Some material can be crumbled by strong pressure between thumb and hard surface. Under light hammer blows disintegrate to a friable state.	0.5-2.0
Cemented	Material crumbles under firm blows of sharp pick point. Grains can be dislodged with some difficulty by a knife blade.	2.0-5.0
Strongly cemented	Firm blows of sharp pick point on hand-held specimen show 1-3mm indentations. Grains cannot be dislodged by knife blade.	5.0-10.0
Very strongly cemented	Hand-held specimen can be broken by single firm blow of hammer head. Similar appearance to concrete.	10.0-25.0

FIGURE 2



Legend

- Study Area
- Trial Hole

SOIL KRAFT

TAAK: JOB NAME:	**LETHABO PARK**
KLIËNT: CLIENT:	**MACROPLAN**
TEKENING NO: DRWING NO:	**SITE LAYOUT**
DATUM: DATE:	**23 FEBRUARY 2019**

TABLE 2 : SUMMARY OF SOIL TESTS

TRIAL HOLE NO	SAMPLE NO	DEPTH (mm)	SOIL ORIGIN	SOIL TYPE	GM	PI	LL	% ACTIVE CLAY	ACTIVITY CLASS	pH	CONDUC-TIVITY (S/m)	SOIL CLASS	
												PRA	UNIFIED
9	SKT-71-635	900 - 2300	Residual shale 1	Gravelly sand	1.31	19	40	10	Low	9.4	0.198	A-6	SC
11	SKT-71-636	0 - 500	Colluvium 2	Silty sand	0.62	10	22	15	Low			A-4	SC
13	SKT-71-637	700 - 1400	Powder calcrete	Sandy clay	0.51	17	34	37	Medium	8.6	0.209	A-6	CL
14	SKT-71-638	1100 - 2300	Residual shale 2	Silty clay	0.34	35	58	51	Very high			A-7-6	CH
17	SKT-71-639	0 - 800	Colluvium 3	Clayey sand	0.56	15	28	20	Medium			A-6	SC
20	SKT-71-640	600 - 1600	Powder calcrete	Clayey sand	0.84	18	48	25	Medium	8.9	0.029	A-7-5	ML
24	SKT-71-641	400 - 1100	Powder calcrete	Clayey silt	0.41	14	36	33	Medium	9.0	0.207	A-6	CL
26	SKT-71-642	1200 - 1700	Residual shale 2	Silty sand	0.63	14	31	20	Low to medium			A-6	CL

TABLE 2 : SUMMARY OF SOIL TESTS (CONTINUED)

TRIAL HOLE NO	SAMPLE NO	DEPTH (mm)	SOIL ORIGIN	SOIL TYPE	GM	PI	LL	% ACTIVE CLAY	ACTIVITY CLASS	pH	CONDUC-TIVITY (S/m)	SOIL CLASS	
												PRA	UNIFIED
29	SKT-71-643	1100 - 2000	Residual shale 2	Silty sand	0.90	32	58	20	Medium to high	9.2	0.234	A-7-6	CH
30	SKT-71-644	700 - 1600	Residual dolerite	Sandy gravel	2.29	7	29	2	Low	8.6	0.031	A-2-4	SW-SC
33	SKT-71-645	900 - 1700	Powder calcrete	Sandy gravel	1.93	15	42	4	Low			A-2-7	SC
35	SKT-71-646	1100 - 1900	Residual dolerite	Sandy gravel	2.59	SP	0	1	Low	8.7	0.033	A-1-a	GW
37	SKT-71-648	0 - 700	Aeolian deposit	Silty sand	0.69	7	20	11	Low			A-2-4	SC-SM
40	SKT-71-649	0 - 700	Aeolian deposit	Silty sand	0.75	SP	0	8	Low			A-2-4	SM
43	SKT-71-651	0 - 600	Aeolian deposit	Sand	0.86	SP	0	4	Low	7.8	0.041	A-2-4	SM
46	SKT-71-652	800 - 1300	Nodular calcrete	Gravelly sand	1.68	7	22	5	Low			A-2-4	SC-SM

TABLE 2 : SUMMARY OF SOIL TESTS (CONTINUED)

TRIAL HOLE NO	SAMPLE NO	DEPTH (mm)	SOIL ORIGIN	SOIL TYPE	GM	PI	LL	% ACTIVE CLAY	ACTIVITY CLASS	pH	CONDUC-TIVITY (S/m)	SOIL CLASS	
												PRA	UNIFIED
48	SKT-71-653	1100 - 1800	Residual shale 1	Sandy gravel	2.59	8	22	2	Low	8.4	0.039	A-2-4	GP-GC
49	SKT-71-654	300 - 1900	Residual shale 1	Sandy gravel	2.39	SP	0	1	Low			A-1-a	GW-GM
52	SKT-71-655	1000 - 2000	Residual dolerite	Sandy gravel	2.05	10	27	2	Low			A-2-4	SP-SC
54	SKT-71-656	600 - 900	Residual dolerite	Gravelly sand	1.96	7	20	2	Low	8.1	0.031	A-2-4	SP-SC

The Prince Albert Formation (Ppr) consists primarily of shale bedrock. Johnson *et. al.* [Reference 8.2] reported that the Formation consists of micaceous shale or silty shale. Arenite and wacke also occur, along with sandstone in the western parts of the Karoo basin. At the same time, dolerite (Jd) of a Jurassic age has intruded the region extensively and erratically, cutting through the older Karoo sedimentary rocks. Lastly, quaternary aged aeolian sands (Qs) are indicated in the north eastern parts of the study and as suggested by the name, the material largely consists of sand deposits.

No fault lines are indicated in the vicinity of the study area and Figure 3 : Regional Geology Map allows an overview of the geology of the area. Trial hole data was used to compile a site geology map – reflected in Figure 4 – showing the bedrock types encountered.

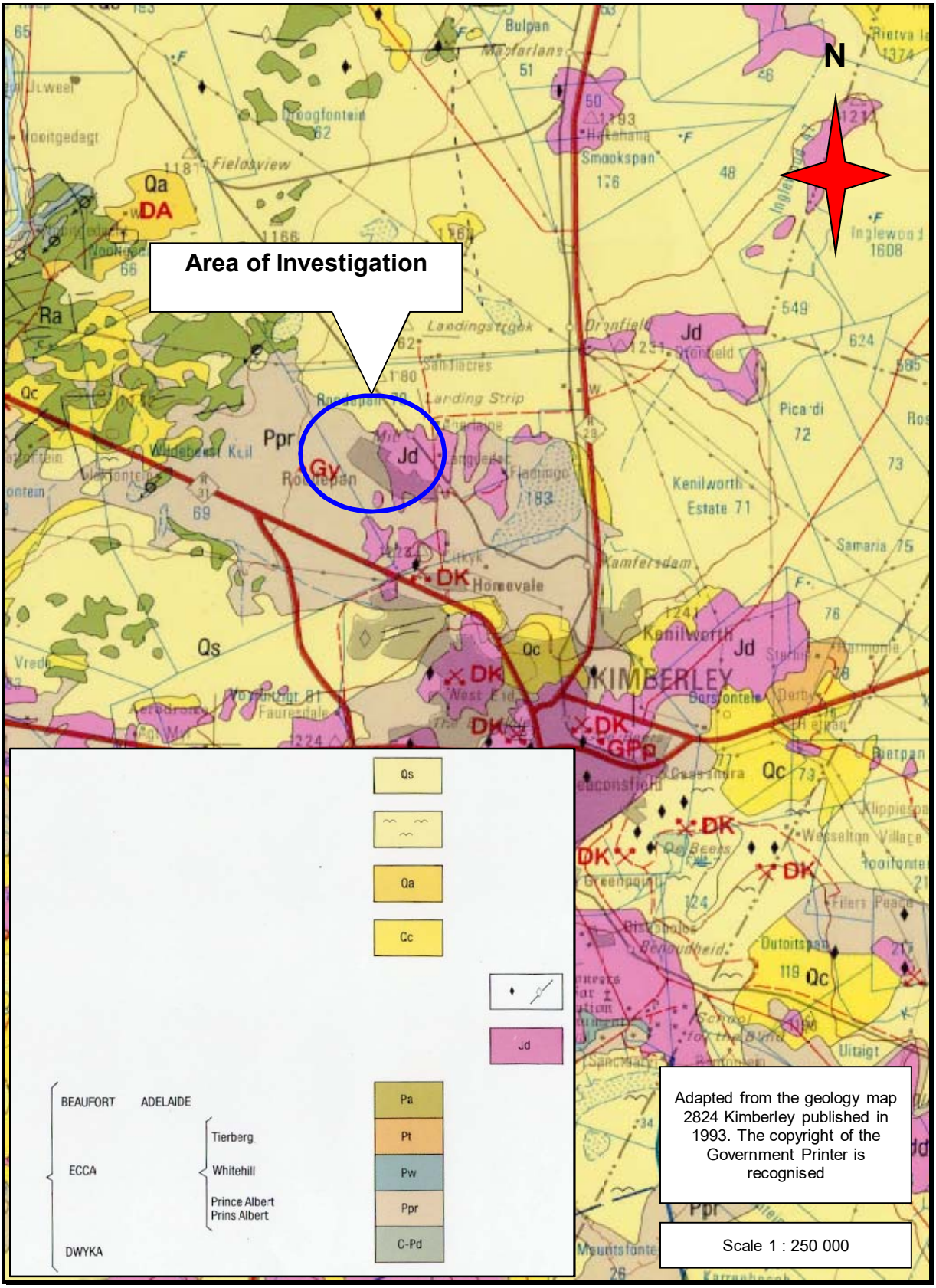
5.2 Groundwater

- *Perched Water*: No perched water or seepage was encountered in any of the trial holes and no signs or evidence of ferruginisation was noted. As such, it is unlikely that perched or seepage water will occur on this site under normal conditions.
- *Permanent Groundwater*: Vegter [Reference 8.3] indicates the probability of drilling successfully for water in the area to be less than 40%. In addition, should water be encountered, the chances are between 20% and 30% that the yield of such a borehole will exceed 2l/s. Groundwater in the area is usually encountered at depths exceeding fifteen metres, occurring in compact, dominantly argillaceous strata.

5.3 Soil Profiles

Prior to making any recommendations, it is important to distinguish between different materials encountered in the study area. Table 3 summarises the distribution of the materials discussed below. The profiles encountered during the investigation revealed the following materials:

- *Fill / Made Ground:* Surficial fill materials were encountered rare in trial hole profiles; however household refuse, litter and construction rubble were encountered extensively throughout the study area. In trial holes the fill horizon did not exceed 300mm and mostly consisted of soil materials containing foreign objects (e.g. plastic). Physical properties of the horizon such as its matrix composition and consistency were also variable and as a result, the fill was not samples.
- *Colluvium 1:* The first colluvial horizon was encountered on few occasions and the horizon was largely restricted to the eastern most parts of the site. The horizon was characterised by silty sand material with red brown colour, a loose to medium dense consistency and an intact structure. Due to its limited (and largely surficial) distribution, the horizon was not sampled.



SOIL KRAFT

REGIONAL GEOLOGY

FIGURE 3

FIGURE 4

LEGEND :

- TP1 — TRIAL HOLE
- INFERRED BOUNDARY
- SHALE (Prince Albert Formation)
- DOLERITE

FOR ILLUSTRATIVE PURPOSES ONLY

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TAAK: JOB NAME:	Lethabo Park
KLIËNT: CLIENT:	Marcoplan
TEKENING NO: DRAWING NO:	Site Geology
DATUM: DATE:	23 February 2019

100m 300m 500m
0m 200m 400m

Table 3: Distribution of Materials

Horizon	Trial Holes	Vertical Thickness (mm)
Fill Material	36, 54	100 – 300
Aeolian Deposits	15, 20, 26, 30, 32 – 43, 47 – 50	100 – 1100
Colluvium 1	45, 46, 51 – 55	300 – 1200
Colluvium 2	9, 11 – 16, 21, 31	300 – 800
Colluvium 3	1, 10, 17 – 19, 21 – 25, 27 – 29	300 – 1000
Powder Calcrete	9 – 15, 17 – 20, 24 – 29, 31 – 33, 37, 42, 48	200 – 1400
Nodular Calcrete	30, 38, 43, 46, 52	200 – 500
Hardpan Calcrete	33	400
Residual Dolerite	30, 34, 35, 45 – 47, 51 – 54	300 – 1100
Residual Shale 1	1, 9, 10, 12, 13, 16, 22, 23, 32, 37, 39, 41, 43, 48 – 50	100 – 1700
Residual Shale 2	14, 15, 18 – 21, 24 – 29, 31, 38	400 - 1200

- *Colluvium 2:* The second colluvial horizon discerned was mostly found on the western side of the study area. While the colour of the horizon varied somewhat, in general the horizon consisted of silty sand with a medium dense consistency and intact structure. The inclusion of rare calcrete nodules was also noted periodically. Test results showed that the horizon is not expansive, with results recording active clay content and a plasticity index of 15% and 10%, respectively. The sample tested had a grading modulus of 0.62 and was awarded a PRA classification of A-4.
- *Colluvium 3:* The third colluvial horizon typically consisted of clayey sand with an intact or slickensided structure. The latter is a good indication of expansive soil. The material colour also varied depending on its position on the site, but for the most part grey brown or dark brown colour was common, and so too a medium dense consistency. A single sample was tested and proved to be moderately expansive. The material contained 20% active clay and had a plasticity index of 15%. The sample also had a grading modulus of 0.56 and was awarded a PRA classification of A-6.
- *Aeolian Deposits:* Quaternary aged aeolian deposits were noted across the central and northern parts of the study area, mostly consisting of distinctive red brown sandy material. The aeolian sands had intact or voided structures and material consistencies ranged from very loose to medium dense, suggesting that some self-compaction may have occurred. As is to be expected, the aeolian sand was not expansive and contained between 4% and 11% active clay, with associated plasticity indices below 7%. Two of the samples analysed were proven to be semi-plastic. The calculated grading moduli were between 0.69 and 0.86, while a PRA classification of A-2-4 was awarded to all test samples. In addition, consolidation test analyses revealed that the aeolian material is very susceptible to settlement and further testing revealed that the material is in fact also very susceptible to collapse settlement, which likely constitutes that major portion of settlement incurred.

- *Powder Calcrete:* The first pedogenic material identified was powder calcrete which was found across most parts of the site except the eastern parts of the site. The powder calcrete was characterised by a distinctive white colour and generally had a medium dense or dense consistency and intact structure. Of interest, the powder calcrete proved to be moderately expansive on most accounts tested. The material had active clay content between 4% and 37%, with associated plasticity indices between 14% and 18%. Grading moduli were between 0.41 and 1.93 while PRA classifications included A-2-7, A-6 and A-7-5. The material requires more scrutiny due to peculiar properties and will be discussed in more detail in section 5.8.
- *Nodular Calcrete:* Nodular calcrete was encountered in only five trial holes and sampled in only one. The nodular calcrete consisted of gravelly sand with light grey or grey white colour and minor discolourations. The horizon also had a medium dense to dense consistency and was described as intact. The test sample had a plasticity index of 7% and contained 5% active clay. A PRA classification of A-2-4 was awarded and a grading modulus of 1.68 was calculated.
- *Hardpan Calcrete:* The hardpan calcrete was only found in trial hole 33 and consisted of white sandy gravel with a dense consistency and intact structure. Due to its isolated occurrence, the material was not sampled.
- *Residual Dolerite:* The residual dolerite was concentrated in the eastern side of the project area. Whereas residual dolerite is often known for its clayey and expansive nature, in this case the material was entire granular and consisted of sandy gravel or gravelly sand which showed the tendency to grade into bedrock. The samples tested were not expansive and had limited active clay content between 1% and 2%, as well as plasticity indices below 10%. At least one sample proved to be semi-plastic. The grading moduli were between 1.96 and 2.59, while PRA classifications included A-1-a and A-2-4.
- *Residual Shale 1:* The first type of residual shale found, often showed the tendency to grade into bedrock. As such, the horizon had a notable coarse fraction (e.g. gravel). For the most part the material proved to constitute sandy gravel or gravelly sand with an intact structure. The material consistency ranged from loose to dense and test results proved that the horizon is not expansive. Active clay contents were between 1% and 10%, with associated plasticity indices lower than 19%. At least one sample proved to be semi-plastic and grading moduli ranged from 1.31 to 2.59. PRA classifications included A-1-a, A-2-4 and A-6.
- *Residual Shale 2:* The second shale material was described as silty clay with firm or stiff consistency; or silty sand with a medium dense to dense consistency. The horizon mostly had an intact or laminated structure, while colours varied. Material test analyses revealed that the samples had varying degrees of expansiveness, ranging from medium to very high. The clay contents were between 20% and 51%, with plasticity indices between 14% and 35%. The material was awarded PRA classifications of A-6 and A-7-6, while grading moduli were between 0.34 and 0.90. All things considered, estimating heave in profiles where this material occurs should be done with caution due to the varying degree to which it is expansive and its changing vertical thickness.

5.4 General Soil Movements

Considering the discussion above, the following foundation conditions are expected on this site:

- *Conditions of Heave:* Material test results showed that the residual shale 2 horizon, the colluvium 3 horizon and the powder calcrete horizon are all expansive to some extent. As such, it is clear that conditions of heave characterises some parts of the study area. The method proposed by van der Merwe [Reference 8.4] was applied using RAFT software – developed by the CSIR – and unrestrained heave was calculated. Variable amounts of heave were estimated for different portions of the site and will be discussed in more detail later. An additional discussion about conditions of severe chemical heave documented in the Roodepan area will also be discussed in section 5.8.
- *Conditions of Settlement:* Conditions of settlement are largely restricted to surficial soils, such a certain colluvial horizons. Also, the aeolian materials were proven to be susceptible to settlement, and susceptibility to collapse settlement was proven to be severe.
- *Fill / Made Ground:* The fill materials that were found on site were typically of surficial distribution.
- *Shallow Bedrock:* Shallow bedrock occurred in few trial holes, though bedrock outcrop was not encountered.
- *Disturbed Ground:* Numerous, localised areas were found where past diggings had been undertaken, leaving behind disturbed soil conditions. These will be discussed separately in a later section of the report.

Considering the above, the study area can be divided into multiple geotechnical zones, as summarised in Table 4, while the extent of the various zones are shown in Figure 5. In addition to the conventional geotechnical zoning, certain areas were identified during the investigation that are characterised by potential problems which are not necessarily related to geotechnical conditions. These are illustrated in Figure 6 and can be summarised as follows:

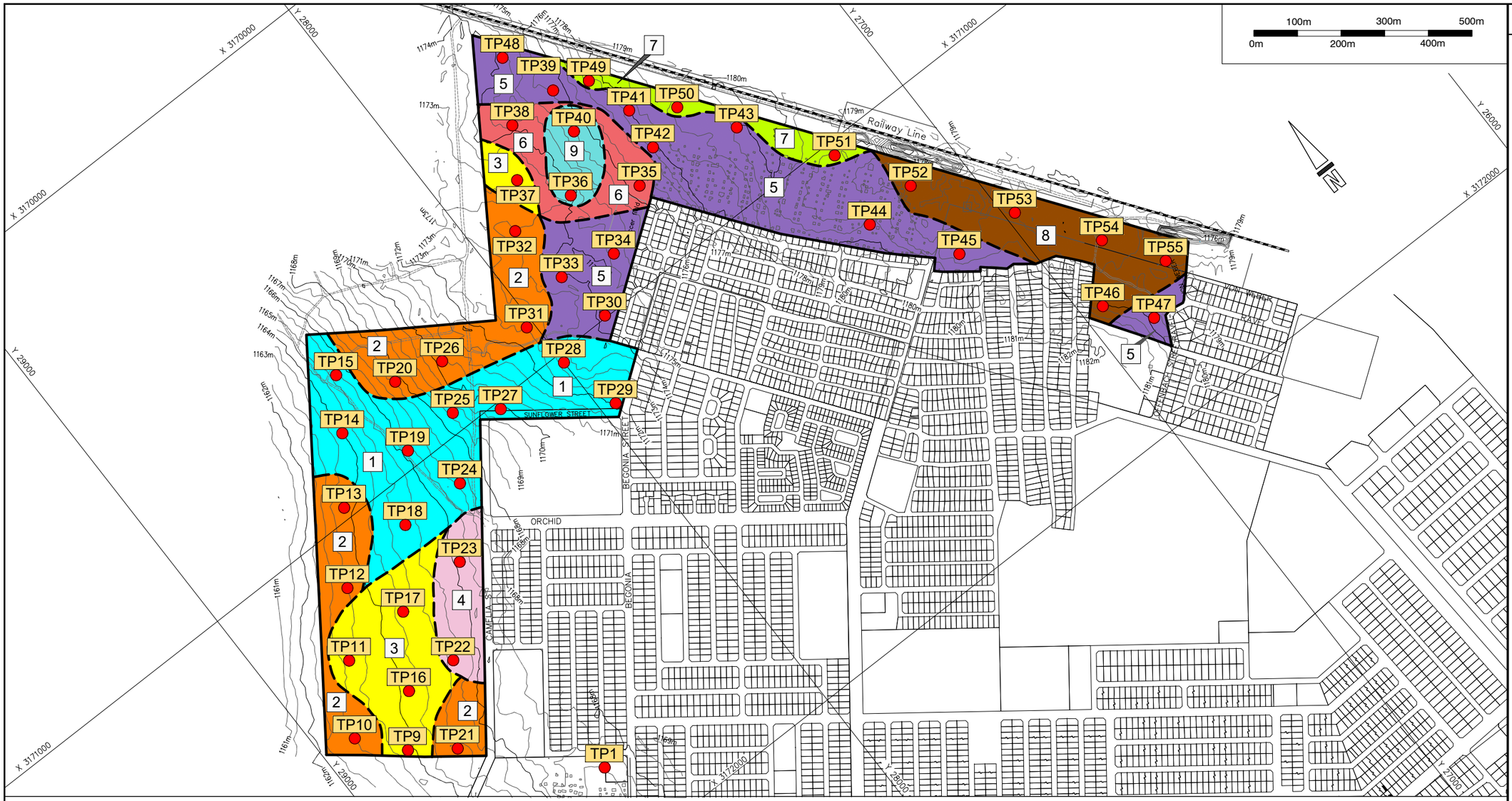
- *Surface Rubble:* Extensive rubble and refuse dumping had occurred over large portions of the study area. The rubble included an array of materials ranging from construction rubble to general household waste. The severity and extent of the dumping as such that is poses a health risk to future development, as well as current properties neighbouring the study area.
- *Digging and Rubble:* Areas were identified where diggings or excavation had been undertaken in the past. The purpose of the digging is unknown, but it is likely that sand was excavated for use in construction. In many cases the diggings had been filled with rubble and other waste. A trench was also found along the eastern boundary of the site. Such conditions clearly do not comply with the geotechnical zoning properties.
- *Water Leakages:* The area between trial holes 45 and 52 hosted a large, saturated area where water was ponding on surface. According to local residents, this water originates from leaking water infrastructure. Similar leakages occur west of the study area.

TABLE 4 : FOUNDATION DESIGN, BUILDING PROCEDURES AND PRECAUTIONARY MEASURES

GEOTECHNICAL ZONE	GEOTECHNICAL CLASS	% OF TOTAL AREA	ESTIMATED SOIL MOVEMENT	SOIL PROFILE	DEVELOPMENT POTENTIAL	CONSTRUCTION TYPE	FOUNDATION DESIGN	ASSOCIATED PROBLEMS
1	**H3**	19.9%	Soil heave exceeding 30mm	Multiple horizons of expansive colluvium, calcrete and residual shale.	Intermediate	Modified	Reinforced concrete raft	Corrosive soils Surface rubble and waste
2	**H2 – C1/H2**	17.7%	Soil heave of up to 30mm; collapse settlement of up to 10mm in places	Multiple horizons of expansive colluvium, calcrete and residual shale. Aeolian deposits in places.	Intermediate	Modified	Reinforced concrete raft	Corrosive soils Surface rubble and waste
3	**H1 - H1/R - H1/C1**	10.7%	Soil heave of up to 15mm; collapse settlement of up to 10mm in places	Expansive colluvium overlying expansive calcrete and residual shale; aeolian sand in places.	Intermediate	Modified	Reinforced strip footings OR Strip footings on bedrock	Corrosive soils Shallow bedrock in places Surface rubble and waste
4	**H/R**	4.1%	Soil heave of up to 7.5mm	Expansive colluvium overlying residual shale and shale bedrock	Intermediate	Normal	Strip footings on bedrock	Corrosive soils Shallow bedrock Surface rubble and waste
5	**C1 - C1/H**	26.1%	Collapse settlement of up to 10mm; heave of up to 7.5mm in places	Aeolian deposits overlying calcrete and/or residual dolerite	Intermediate	Modified	Reinforced strip footings	Corrosive soils Surface rubble and waste

TABLE 4 : FOUNDATION DESIGN, BUILDING PROCEDURES AND PRECAUTIONARY MEASURES (CONTINUED)

GEOTECHNICAL ZONE	GEOTECHNICAL CLASS	% OF TOTAL AREA	ESTIMATED SOIL MOVEMENT	SOIL PROFILE	DEVELOPMENT POTENTIAL	CONSTRUCTION TYPE	FOUNDATION DESIGN	ASSOCIATED PROBLEMS
6	**C2 - C2/H**	5.3%	Collapse settlement of exceeding 10mm; heave of up to 7.5mm in places	Aeolian deposits overlying calcrete and residual dolerite/shale	Intermediate	Modified	Reinforced strip footings OR Reinforced concrete raft	Corrosive soils Surface rubble and waste
7	**S1-S1/C**	3.1%	Settlement of up to 20mm; sometimes with collapse settlement of less than 5mm	Colluvium or aeolian deposits overlying residual dolerite	Intermediate	Modified	Reinforced strip footings OR Soil replacement raft	Corrosive soils
8	**S-S/R**	10.3%	Settlement of up to 10mm	Colluvium overlying residual dolerite and dolerite bedrock	Intermediate	Normal	Strip footings on bedrock	Corrosive soils Shallow bedrock Surface rubble and waste Boulders and corestones
9	**C/R**	2.8%	Collapse settlement of up to 5mm	Limited aeolian deposits overlying bedrock	Intermediate	Normal	Strip footings on bedrock	Corrosive soils Shallow bedrock



FOUNDATION DESIGN, BUILDING PROCEDURES AND PRECAUTIONARY MEASURES

ZONE	GEOTECHNICAL CLASS	% OF TOTAL AREA	ESTIMATED SOIL MOVEMENT	SOIL PROFILE	DEVELOPMENT POTENTIAL	CONSTRUCTION TYPE	FOUNDATION DESIGN	ASSOCIATED PROBLEMS
1	H3	19,9	Soil heave exceeding 30mm	Multiple horizons of expansive colluvium, calcrete and residual shale	Intermediate	Modified	Reinforced concrete raft	Corrosive soils Surface rubble and waste
2	H2-C1/H2	17,7	Soil heave of up to 30mm; collapse settlement of up to 10mm in places	Multiple horizons of expansive colluvium, calcrete and residual shale. Aeolian deposits in places.	Intermediate	Modified	Reinforced concrete raft	Corrosive soils Surface rubble and waste
3	H1-H1/R-H1/C1	10,7	Soil heave of up to 15mm; collapse settlement of up to 10mm in places	Expansive colluvium overlying expansive calcrete and residual shale; aeolian sand in places.	Intermediate	Modified	Reinforced strip footings OR Strip footings on bedrock	Corrosive soils Shallow bedrock in places Surface rubble and waste
4	H/R	4,1	Soil heave of up to 7,5mm	Expansive colluvium overlying residual shale and shale bedrock	Intermediate	Normal	Strip footings on bedrock	Corrosive soils Shallow bedrock Surface rubble and waste
5	C1-C1/H	26,1	Collapse settlement of up to 10mm; heave of up to 7,5mm in places	Aeolian deposits overlying calcrete and/or residual dolerite	Intermediate	Modified	Reinforced strip footings	Corrosive soils Surface rubble and waste
6	C2-C2/H	5,3	Collapse settlement of exceeding 10mm; heave of up to 7,5mm in places	Aeolian deposits overlying calcrete and residual dolerite/shale	Intermediate	Modified	Reinforced strip footings OR Reinforced concrete raft	Corrosive soils Surface rubble and waste
7	S1-S1/C	3,1	Settlement of up to 20mm; sometimes with collapse settlement of less than 5mm	Colluvium or aeolian deposits overlying residual dolerite	Intermediate	Modified	Reinforced strip footings OR Soil replacement raft	Corrosive soils
8	S-S/R	10,3	Settlement of up to 10mm	Colluvium overlying residual dolerite and dolerite bedrock	Intermediate	Normal	Strip footings on bedrock	Corrosive soils Shallow bedrock Surface rubble and waste Boulders and corestone
9	C/R	2,8	Collapse settlement of up to 5mm	Limited aeolian deposits overlying bedrock	Intermediate	Normal	Strip footings on bedrock	Corrosive soils Shallow bedrock

FIGURE 5

LEGEND :

TP1 TRIAL HOLE

INFERRED BOUNDARY

FOR ILLUSTRATIVE PURPOSES ONLY

SOIL KRAFT
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Website: www.soilkraft.co.za
P.O. Box 73478, Lynnwood Ridge, 0040

TAAK: / JOB NAME: Lethabo Park

KLIËNT: / CLIENT: Marcoplan

TEKENING NO: / DRAWING NO: Geotechnical Zoning

DATUM: / DATE: 26 February 2019

FIGURE 6

LEGEND :

- TP1 — TRIAL HOLE
- INFERRED BOUNDARY
- SURFACE RUBBLE DUMPS
- DIGGINGS, EXCAVATIONS AND RUBBLE
- WATER LEAKAGES AND SURFACE PONDING

FOR ILLUSTRATIVE PURPOSES ONLY

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E-Mail: izak@soilkraft.co.za
Website: www.soilkraft.co.za

P.O. Box 73478, Lynnwood Ridge, 0040

TAAK: JOB NAME:	Lethabo Park
KLIËNT: CLIENT:	Marcoplan
TEKENING NO: DRAWING NO:	Problem Areas
DATUM: DATE:	26 February 2019

Y 29000 Y 28000 Y 27000

X 3171000 X 3172000

0m 100m 200m 300m 400m 500m

5.5 Conditions of Excavation

The conditions of excavation encountered during the investigation can be summarised as follows:

- *Fill:* The fill materials encountered were excavatible by backhoe with little to moderate effort. However, cognisance must be taken of the large volume of surface rubble which is associated with the fill materials. Removal of the rubble materials will likely require a substantial clean-up and disposal operation.
- *Colluvium:* The colluvial materials were excavatible by backhoe with moderate effort.
- *Aeolian Deposits:* Aeolian deposits appeared to have been compacted to a notable extent. While the sandy material occasionally occurred as loose-lying surface soils, at depth it sometimes had a medium dense or even dense consistency. Despite this, excavation with the aid of a backhoe proved viable.
- *Calcrete:* The powder calcrete required significant effort to excavate due to its medium dense or dense consistency. Machine excavation was possible but in some instances persistence was required to excavate the horizon. Both the nodular calcrete and the hardpan calcrete were also machine excavatible with persistence and notable effort; however the hardpan calcrete induced gradual refusal of excavation.
- *Residual Dolerite:* The residual dolerite itself was excavatible by backhoe; however the material's tendency to grade into weathered bedrock presented a challenge to excavation and the latter generally caused refusal of excavation. In addition, the inclusion of dolerite cobbles (i.e. corestones) also impeded excavation, often inducing instant refusal when a corestone was intercepted.
- *Residual Shale 1:* This horizon was machine excavatible, but only to a limited extent, also due to its tendency to grade into bedrock material. As a result, it was sometimes entirely machine excavatible and on other occasions it was only partially machine excavatible when using a backhoe.
- *Residual Shale 2:* The second residual shale material was excavatible by backhoe, but with some effort. Also, the cohesive nature of the material suggests that it will make for clayey, cohesive excavation in the unlikely event that the material is found in a very moist or wet condition.
- *Dolerite Bedrock:* Though no unweathered dolerite was found in trial holes, it is expected that such a material will make for conditions of difficult excavation, as the bedrock is likely to constitute very hard rock material.
- *Shale Bedrock:* The shale bedrock encountered in trial holes had variable excavation properties. In some cases the bedrock was weathered to the extent that it resembles gravel which was excavatible to a large extent. On other occasions, the shale bedrock induced refusal of excavation and constituted very soft to medium hard rock material.
- *Depth of Excavation*: Excavatible depths by backhoe varied between 300mm and 2600mm, with the majority of trial holes exceeding 1500mm.

- *Corestones*: Corestones were observed on surface and proven in trial holes on the eastern parts of the site. It was found on site that the dolerite corestones likely induced refusal of excavation on a number of occasions. Removing these corestones with the use of a backhoe is therefore largely considered unsuccessful.
- *Sidewall Stabilities*: Excavations proved stable during the investigation, except where highly unstable fill materials were encountered.
- *Seepage*: No seepage water was encountered in any of the trial holes.

5.6 Soil Corrossivity

When discussing soil corrossivity, it is applicable to consider the guidelines as proposed by Evans [Reference 8.5]. The corrossivity of a soil towards buried, exposed, metallic surfaces is dependent on the following properties of the soil:

- Electrical conductivity
- Chemical properties of the soil
- Ability of the soil to support sulphate reducing bacteria
- Heterogeneity of the soil

The pH of a soil gives an indication of potential acid related problems. If the soil pH is less than 6.0, corrosion may take place and if the pH should be less than 4.50, the problem of corrosion may be serious. If the conductivity of the soil is less than 0.001S/m, corrossivity is generally not a problem. However, the corrosion potential of the soil increases with an increase in conductivity. Should the conductivity of the soil exceed 0.005S/m, the soil can be regarded as very corrosive. Should exposed metal pipes pass from argillaceous soils to arenaceous soils or vice versa, electrochemical cells are set up due to the different rates of oxygen diffusion of the soils. Sulphate reducing bacteria is usually present under anaerobic conditions, that is, typically saturated or waterlogged clays.

Samples collected from various horizons revealed the following:

- *Aeolian Deposits:* Aeolian material was sampled on one occasion. Results reported that the material had a pH of 7.8, making in slightly alkaline and therefore not corrosive as far as acidity is concerned. In addition, the material had a soil conductivity result of 0.041S/m, indicating that it is corrosive in this regard.
- *Calcrete:* Calcrete samples were tested on three occasions. The material proved to be non-corrosive on account of acidity, as pH levels were between 8.6 and 9.0. However, in contrast to this, the same materials reported conductivity results between 0.029S/m and 0.209S/m. The latter is indicative of an extremely corrosive material.
- *Residual Dolerite:* The residual dolerite had similar properties to preceding materials. The

samples had pH values between 8.1 and 8.7, suggesting a non-corrosive nature on account of acidity. However, conductivity readings were between 0.031S/m and 0.033S/m, indicating a corrosive material.

- *Residual Shale:* The residual shale was sampled on multiple occasions and continued the trend observed thus far. The materials are not considered corrosive on account of acidity, as pH values are between 8.4 and 9.4. However, once again high conductivity readings – between 0.039S/m and 0.234S/m – indicate an extremely corrosive material.

All things considered, conditions of extremely corrosive soil must be anticipated on this site.

In order to supplement the corrossivity tests, additional soluble salt and soluble sulphate tests were performed. The soluble sulphate test results reported a maximum of 0.069% soluble sulphate. At the same time, soluble salt contents were between 0.1% and 1.0%.

5.7 Seismicity

Kijko [Reference 8.6] indicates the annual probability for an earthquake with intensity of 5.5 on the Modified Mercalli Scale to occur in the area to be less than 10^{-1} and with an intensity of 8.5 to occur the probability is 10^{-4}. A 10% probability exists that an earthquake with Peak Ground Acceleration of 0.16g to 0.20g may take place once in 50 years. Tremors in this area are likely to be mining-related rather than naturally occurring.

To put the above information into perspective, Table 5 : Earthquake and Magnitude and Intensity, is attached to this report.

5.8 Chemical Soil Heave

Conditions of extreme soil heave have been encountered in the Roodepan area historically and formed the basis of investigative research work undertaken to assess the origin and nature of the heave. These studies were undertaken by Williams in 1980 (Reference 8.7) and a follow-up article was again published in 1991 (reference 8.8).

Williams discussed the effects of chemical heave in materials in Roodepan where calcrete and gypsum occurred and produced extreme amounts of soil heave (i.e. up to 600mm) which was not identifiable by conventional means. Materials and conditions similar to those described by Williams were found on site. The material described as “powder calcrete” appeared to have uncharacteristic properties and was classified as being moderately expansive by the empirical method proposed by van der Merwe which is commonly used in South Africa. This raised concern as such materials are generally not known to be expansive.

TABLE 5 : EARTHQUAKE MAGNITUDE AND INTENSITY

MODIFIED MERCALLI INTENSITY SCALE	INTENSITY	DESCRIPTION	RICHTER SCALE MAGNITUDE	RADIUS OF PERCEPTIBILITY (km)
I	Instrumental	Detected only by seismography		
II	Feeble	Noted only by sensitive people	3.5 to 4.2	3 to 24
III	Slight	Like the vibrations due to a passing lorry. Felt by people at rest, especially on upper floors		
IV	Moderate	Felt by people while walking. Rocking of loose objects, including vehicles	4.3 to 4.8	24 to 48
V	Rather strong	Felt generally ; most sleepers are awakened and bells ring		
VI	Strong	Trees sway and suspended objects swing ; damage by overturning and flling of loose objects	4.9 to 5.4	48 to 112
VII	Very strong	General public alarm ; walls crack ; plaster falls	5.5 to 6.1	110 to 200
VIII	Destructive	Car drivers seriously disturbed; masonry fissured ; buildings damaged	6.2 to 6.9	200 to 400
IX	Ruinous	Houses collapse ; pipes break		
X	Disasterous	Ground cracks badly ; buildings destroyed ; railway lines bent ; landslides on steep slopes	7.0 to 7.3	400 to 700
XI	Very disasterous	Few buildings remain standing; bridges destroyed ; all services out of action ; great landslides and floods	7.4 to 8.1	400 to 700
XII	Catastrophic	Total destruction ; objects thrown into the air; ground rises and falls in waves	>8.1	400 to 700

It is important to realise that the heave predicted by the van der Merwe method is only for a mechanism of mechanical swell and does not consider the effects of chemical heave. Nevertheless, the fact that the calcrete did prove expansive during conventional foundation indicator tests, warrants additional investigation to make sure that problematic conditions are not encountered, as this would have severe financial repercussions.

6 CONCLUSIONS

The following are the main conclusions that can be made from the discussion above:

- *Geology*: The study area is underlain by a dolerite intrusion in the east and the Prince Albert Formation in the west. The geology was verified by bedrock materials encountered in trial holes.
- *Soil Profile*: The profiles on site are variable, as is to be expected considering the size of the study area. The profiles hosted aeolian deposits, colluvium, residual shale, residual dolerite and an array of calcrete deposits. Surficial fill was also found in places and extensive rubble dumping has occurred throughout the study area.
- *Hydrology*: No perched water or seepage water was encountered on site, though surface water ponding was found where water services were reportedly leaking.
- *Conditions of Excavation*: A minimum proven depth of excavation by backhoe was established at 300mm, though the majority of the trial holes exceeded 1500mm when excavated with the aid of a backhoe. In general, in situ materials make for conditions of intermediate to difficult excavation.
- *Geotechnical Classification*: The site is divided into nine separate geotechnical zones. An additional zoning map was supplied indicating other problems encountered on site that are not necessarily of a geotechnical origin.
- *Soil Corrossivity*: All soil materials tested proved to be extremely corrosive on account of high soil conductivity.
- *Seismicity*: A 10% probability exists that an earthquake with Peak Ground Acceleration of 0.16g to 0.20g may take place once in 50 years. Tremors in this area are likely to be mining-related rather than naturally occurring.
- *Chemical Soil Heave*: There are indications that certain materials found on site are similar to those previously investigated due to severe heave associated with chemical expansion. This risk warrants additional work to be undertaken.

7 RECOMMENDATIONS

7.1 Proposals for Founding and Construction

Recommendations below are given as general guidelines to single storey structures of masonry design, in accordance with guidelines proposed by the NHBRC. *It is essential that the reader and end-users of this report also take note of the discussion in section 7.4*.

7.1.1 Geotechnical Zone 1: **H3**

Construction in this zone may be done by means of a reinforced raft or soil replacement raft. The exact amount of heave to be accommodated must be determined during the stand-specific phase two geotechnical investigation. The superstructure should also have reinforced masonry and articulation joints, as per the engineering design. Provision should also be made to clear extensive rubble materials deposited on site.

7.1.2 Geotechnical Zone 2: ***H2 – C1/H2***

Assuming founding is done at a depth of 600mm, the effects of collapsible soil will be limited in this zone. Consequently founding in this zone may therefore be done by means of a reinforced raft or soil replacement raft. The superstructure should also have reinforced masonry and articulation joints, as per the engineering design. As with zone 1, provision should also be made to clear extensive rubble materials deposited on site.

7.1.3 Geotechnical Zone 3: ***H1-H1/R-H1/C1***

While bedrock does occur in parts of this zone, it is expected that the state of the bedrock will not be considered competent for founding. Unless proven otherwise by a competent person, it is therefore recommended that founding in this zone be done by means of reinforced strip footings, capable of accommodating up to 15mm unrestrained heave. The superstructure must be modified to include articulation joints at all internal and external doors and openings, and masonry must be lightly reinforced.

Alternatively a soil replacement raft may be considered. As before, founding at a depth of 600mm will limit the effect of collapsible surface soils.

7.1.4 Geotechnical Zone 4: ***H/R***

As bedrock is relatively shallow in this zone, it is recommended that founding be done directly on suitable bedrock, pointed out by a competent person; however all expansive materials must be removed from the structure footprint to at least 1.5m beyond the building parameter. Founding may be done by normal strip footings, founded directly on competent bedrock, while the superstructure may be constructed normally.

7.1.5 Geotechnical Zone 5: ***C1-C1/H***

Movement in this zone is limited to 10mm collapse settlement, possibly with heave of up to 7.5mm. It is therefore recommended that founding be done by means of reinforced strip footings, capable of accommodating the soil movement. Founding pressures should not exceed 50kPa. The superstructure must be modified to include articulation joints at all internal and external doors and openings, and masonry must be lightly reinforced.

As an alternative, a soil replacement raft solution may be considered.

Care must be taken in this zone as the soil profile has in places been disturbed by past diggings, excavations and extensive rubble dumping. Rehabilitation may be required in parts of this zone to render it suitable for development.

7.1.6 Geotechnical Zone 6: ***C2-C2/H***

Two construction options are available for this zone. Founding and construction by means of either reinforced concrete rafts or stiffened strip footings may be considered. Foundations and fabric pressures should not exceed 50kPa. The building superstructures should contain articulation joints and solid, lightly reinforced masonry.

7.1.7 Geotechnical Zone 7: ***S1-S1/C***

Founding in this zone may be done with the aid of reinforced strip footings, capable of accommodating up to 20mm settlement. The superstructure must be modified to include articulation joints at all internal and external doors and openings, and masonry must be lightly reinforced. Founding pressures should be limited to 50kPa.

Alternatively a soil replacement raft may be considered and as before, founding at a depth of 600mm will limit the effect of collapsible aeolian materials, if/when they are present.

7.1.8 Geotechnical Zone 8: ***S-S/R***

As bedrock is relatively shallow in this zone, it is recommended that founding be done directly on suitable bedrock, pointed out by a competent person. Remaining areas are expected to be suitable for conventional foundations. Founding may be done by normal strip footings, founded directly on competent bedrock (where available), while the superstructure may be constructed normally.

7.1.9 Geotechnical Zone 9: ***C/R***

As with zone 4, bedrock in this zone is relatively shallow, but is not always in a good state, suitable for hosting foundations. As a result, it is recommended that founding may be done by normal strip footings, while the superstructure may be constructed normally. Where suitable bedrock is identified by a competent person, foundations may be hosted directly on bedrock.

7.1.10 General Measures

It is critical that site drainage and storm water be planned carefully to ensure efficient drainage. No storm water or surface runoff should accumulate or pond within 1.5m of the structures. Services and plumbing precautions must be put in place to ensure that underground services are not disrupted by the heaving action of expansive in situ soils.

7.2 Conditions of Excavation

As far as conditions of excavation are concerned, the following is recommended:

- *Fill:* All fill materials may be considered machine excavatible. Considering the volume of rubble and waste encountered on site, it is recommended that provision be made to remove these materials prior to development.
- *Colluvium:* The colluvial materials are machine excavatible. While hand excavation is possible, this will be challenging where the colluvium has a cohesive nature and is therefore not advised.
- *Aeolian Deposits:* Aeolian materials may be excavated by hand or by machine. The latter is recommended, though, as loose-lying surface deposits of this material may be susceptible to instability and collapse into excavations, thereby posing a safety risk.
- *Calcrete:* The calcrete materials are generally machine excavatible, but with notable effort. Hand excavation is not recommended and in fact, excavation may be optimised using larger excavation equipment (e.g. excavators). Only the hardpan calcrete induced refusal of excavation and may require the use of a breaker or pecker to facilitate excavation.
- *Residual Dolerite:* The residual dolerite is only partially machine excavatible. Even when using an excavator, it is likely that the material will induce refusal of excavation as it grades into bedrock.
- *Residual Shale 1:* This material will be best excavated using an excavator. When planning deep excavations, provision should also be made for some aids, such as a rock bucket, to help remove the material from the profile.
- *Residual Shale 2:* The second residual shale material should also be excavated using excavation equipment, as opposed to excavation by hand. Provision should also be made for clayey, cohesive excavation in the unlikely event that the material is found in a very moist to wet state.
- *Dolerite Bedrock:* Though no unweathered dolerite was found in trial holes, it is expected that the

material will require physical or chemical blasting to be removed from the profile. The unweathered dolerite bedrock will likely constitute very hard rock material.

- *Shale Bedrock:* The shale bedrock consisted of very soft to medium hard rock material. Excavation using an excavator may be partially successful and may be enhanced by using a rock bucket or pneumatic breaking equipment. Blasting may be required to remove medium hard rock shale materials.
- *Depth of Excavation*: Excavatible depths by backhoe varied between 300mm and 2600mm, with the majority of trial holes exceeding 1500mm.
- *Corestones*: Considering site observations and the fact that a backhoe could not effectively manage all corestones encountered, it is recommended that provision be made for small scale blasting or demolition of corestones. The use of an excavator would also be beneficial when removing the corestones from the profile.
- *Sidewall Stabilities*: Excavations proved stable during the investigation, except where highly unstable fill materials or loose lying aeolian sands were encountered.
- *Seepage*: No seepage water was encountered in any of the trial holes.
- *General*: The safety of all persons working in or near open excavations must be ensured.

7.3 Soil Corrossivity

Considering the extremely corrosive nature of prevailing soil materials, it is recommended that precautionary measures be taken to protect steel objects buried and exposed to soil materials (e.g. steel piping, joints, etc.). The use of protectively coated steel piping or cathodic protection may be considered.

7.4 Further Work

The findings of the geotechnical investigations warrants further, more detailed work to investigate the expansive nature of certain materials encountered during the investigation. Existing literature by William [Reference 8.8] showed that peculiar conditions of chemical heave have occurred in the Roodepan area historically and certain materials encountered during this site investigation suggest that similar conditions may occur in the project area (though to a less severe extent as the offending horizons are not as thick as those encountered in adjacent areas). This potential problem was identified during the phase one geotechnical investigation, but investigating such a scenario itself falls beyond the scope of the phase one investigation.

With the above in mind, additional work is strongly recommended in order to assess the potential problem material and prove or disprove whether it is in fact problematic. Secondly, the additional investigation must determine the severity of the soil heave and estimated heave that may be generated by the material, if chemical heave does occur.

It is recommended that such an investigation should be undertaken using “dry” methods of investigation (e.g. trial hole excavation) as opposed to wet methods (e.g. drilling with lubricating fluids), as the introduction of moisture will affect the outcome of laboratory tests. Supplementary investigation work should be undertaken by a competent geotechnical engineer or engineering geologist.

It is important that the end-user of this report understand that the findings of such an additional assessment may supersede the findings of the report at hand and that geotechnical zoning and preliminary structural recommendations may need to be revised.

8 SOURCES OF REFERENCE

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8.8 Williams, A.A.B (1991): *The extraordinary phenomenon of chemical heaving and its effects of buildings and roads.* 10th Regional Conference for Africa on Soil Mechanics and Foundation Engineering Maseru, Lesotho, Volume 1, pp 91 – 98.

IJ Breytenbach (Pr. Sci. Nat.)
4 March 2019
For Soilkraft cc

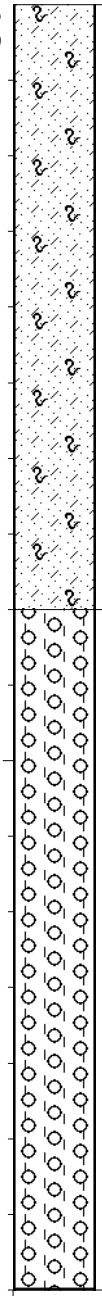
APPENDIX A: SOIL PROFILE LOG SHEETS

Macroplan
Lethabo Park

HOLE No: 1
Sheet 1 of 1

JOB NUMBER: 2019/J004/MAC

Scale 1:10



0.00 Dry, light grey brown, dense, slickensided and voided. clayey sand. Colluvium containing roots.

0.80 Slightly moist, dark green grey, dense, partially laminated, silty gravel. Residual shale.

1.70

NOTES

1) Gradual refusal of excavation.

2) No seepage.

CONTRACTOR : Big Five Construction
MACHINE : Cat 422F
DRILLED BY : Petrus
PROFILED BY : Izak Breytenbach

INCLINATION :
DIAM : 700mm
DATE :
DATE : 21-22/01/2019

ELEVATION :
X-COORD : 28° 39 42.1S
Y-COORD : 24° 42 28.8E

TYPE SET BY : Izak Breytenbach
SETUP FILE : STANDARD.SET

DATE : 22/02/2019 13:34
TEXT : ..Kimberley\TPProfiles.txt

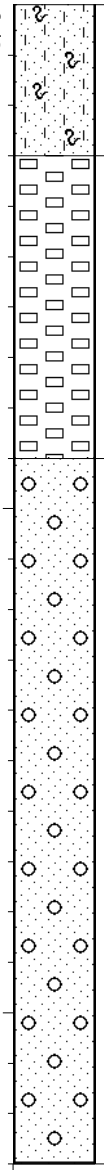
HOLE No: 1
Geotechnical Investigation

Macroplan
Lethabo Park

HOLE No: 9
Sheet 1 of 1

JOB NUMBER: 2019/J004/MAC

Scale 1:15



0.00 Dry, light grey brown, medium dense, intact, silty sand containing rare calcrete nodules. Colluvium containing roots.

0.30 Dry, white, medium dense to dense, intact, silty sand. Powder calcrete containing scattered nodules.

0.90 Slightly moist, dark purple brown laminated orange and streaked white, dense, intact, gravelly sand. Residual shale tending to weathered bedrock.

2.30

NOTES

1) Gradual refusal of excavation.
2) Disturbed Sample SKT-71-635: 1.60m.
3) No seepage.

CONTRACTOR : Big Five Construction
MACHINE : Cat 422F
DRILLED BY : Petrus
PROFILED BY : Izak Breytenbach

INCLINATION :
DIAM : 700mm
DATE :
DATE : 21-22/01/2019

ELEVATION :
X-COORD : 28° 39 32.0S
Y-COORD : 24° 42 18.4E

TYPE SET BY : Izak Breytenbach
SETUP FILE : STANDARD.SET

DATE : 22/02/2019 13:34
TEXT : ..Kimberley\TPProfiles.txt

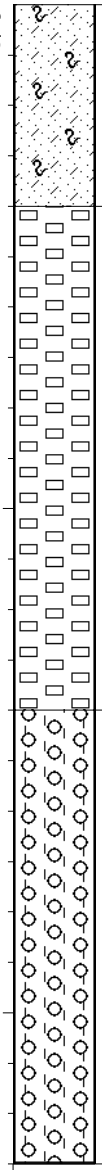
HOLE No: 9
Geotechnical Investigation

Macroplan
Lethabo Park

HOLE No: 10
Sheet 1 of 1

JOB NUMBER: 2019/J004/MAC

Scale 1:15



0.00 Dry, grey brown, medium dense, intact, clayey sand. Colluvium containing roots.

0.40 Dry, white, medium dense to dense, intact, silty sand. Powder calcrete containing scattered nodules.

1.40 Dry, light grey laminated white, loose to medium dense, intact, silty gravel. Residual shale tending to bedrock.

2.30

NOTES

1) No refusal of excavation.

2) No seepage.

CONTRACTOR : Big Five Construction
MACHINE : Cat 422F
DRILLED BY : Petrus
PROFILED BY : Izak Breytenbach

INCLINATION :
DIAM : 700mm
DATE :
DATE : 21-22/01/2019

ELEVATION :
X-COORD : 28° 39 29.0S
Y-COORD : 24° 42 15.5E

HOLE No: 10
Geotechnical Investigation

TYPE SET BY : Izak Breytenbach
SETUP FILE : STANDARD.SET

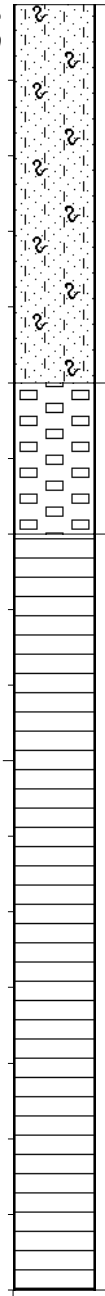
DATE : 22/02/2019 13:34
TEXT : ..Kimberley\TPProfiles.txt

Macroplan
Lethabo Park

HOLE No: 11
Sheet 1 of 1

JOB NUMBER: 2019/J004/MAC

Scale 1:10



0.00

Dry, red brown, medium dense, intact, silty sand containing rare calcrete nodules. Colluvium containing roots.

0.50

Dry, white, medium dense to dense, intact, silty sand. Powder calcrete containing scattered nodules.

0.70

Light blue grey, laminated, very fine grained, slightly weathered, very closely jointed, soft to very soft rock: SHALE. Material resembles coarse gravel.

1.70

NOTES

1) Refusal of excavation.

2) Disturbed Sample SKT-71-636: 0.25m.

3) No seepage.

CONTRACTOR : Big Five Construction
MACHINE : Cat 422F
DRILLED BY : Petrus
PROFILED BY : Izak Breytenbach

TYPE SET BY : Izak Breytenbach
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM : 700mm
DATE :
DATE : 21-22/01/2019

DATE : 22/02/2019 13:34
TEXT : ..Kimberley\TPProfiles.txt

ELEVATION :
X-COORD : 28° 39 24.1S
Y-COORD : 24° 42 19.2E

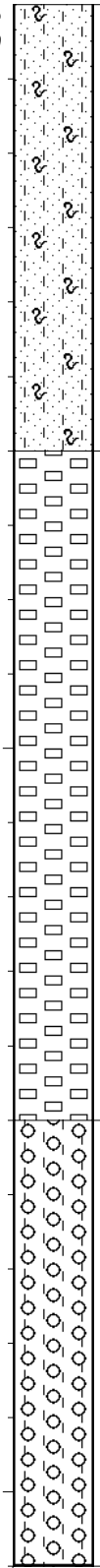
HOLE No: 11
Geotechnical Investigation

Macroplan
Lethabo Park

HOLE No: 12
Sheet 1 of 1

JOB NUMBER: 2019/J004/MAC

Scale 1:10



0.00

Dry, light grey brown, medium dense, intact, silty sand containing rare calcrete nodules. Colluvium containing roots.

0.60

Dry, white, medium dense to dense, intact, silty sand. Powder calcrete containing scattered nodules.

1.50

Dry, light grey laminated white, loose to medium dense, intact, silty gravel. Residual shale tending to bedrock.

2.10

NOTES

1) Gradual refusal of excavation.

2) No seepage.

CONTRACTOR : Big Five Construction
MACHINE : Cat 422F
DRILLED BY : Petrus
PROFILED BY : Izak Breytenbach

INCLINATION :
DIAM : 700mm
DATE :
DATE : 21-22/01/2019

ELEVATION :
X-COORD : 28° 39 19.8S
Y-COORD : 24° 42 22.9E

HOLE No: 12
Geotechnical Investigation

TYPE SET BY : Izak Breytenbach
SETUP FILE : STANDARD.SET

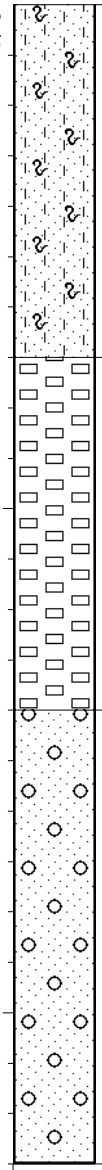
DATE : 22/02/2019 13:34
TEXT : ..Kimberley\TPProfiles.txt

Macroplan
Lethabo Park

HOLE No: 13
Sheet 1 of 1

JOB NUMBER: 2019/J004/MAC

Scale 1:15



0.00 Dry, light grey brown, medium dense, intact, silty sand containing rare calcrete nodules. Colluvium containing roots.

0.70 Dry, white, firm, intact, sandy clay. Powder calcrete containing scattered nodules.

1.40 Slightly moist, dark purple brown laminated orange and streaked white, dense, intact, gravelly sand. Residual shale tending to weathered bedrock.

2.30

NOTES

1) No refusal of excavation.
2) Disturbed Sample SKT-71-637: 1.05m.
3) No seepage.

CONTRACTOR : Big Five Construction
MACHINE : Cat 422F
DRILLED BY : Petrus
PROFILED BY : Izak Breytenbach

TYPE SET BY : Izak Breytenbach
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM : 700mm
DATE :
DATE : 21-22/01/2019

DATE : 22/02/2019 13:34
TEXT : ..Kimberley\TPProfiles.txt

ELEVATION :
X-COORD : 28° 39 15.0S
Y-COORD : 24° 42 26.8E

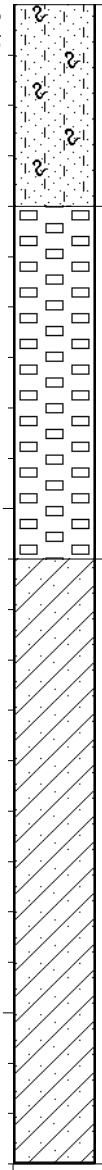
HOLE No: 13
Geotechnical Investigation

Macroplan
Lethabo Park

HOLE No: 14
Sheet 1 of 1

JOB NUMBER: 2019/J004/MAC

Scale 1:15



0.00 Dry, light grey brown, medium dense, intact, silty sand containing rare calcrete nodules. Colluvium containing roots.

0.40 Dry, white, firm, intact, sandy clay. Powder calcrete containing scattered nodules.

1.10 Slightly moist, dark green grey streaked orange, dense, partially laminated, sandy clay. Residual shale.

2.30

NOTES

1) No refusal of excavation.
2) Disturbed Sample SKT-71-638: 1.70m.
3) No seepage.

CONTRACTOR : Big Five Construction
MACHINE : Cat 422F
DRILLED BY : Petrus
PROFILED BY : Izak Breytenbach

INCLINATION :
DIAM : 700mm
DATE :
DATE : 21-22/01/2019

ELEVATION :
X-COORD : 28° 39 10.5S
Y-COORD : 24° 42 30.6E

TYPE SET BY : Izak Breytenbach
SETUP FILE : STANDARD.SET

DATE : 22/02/2019 13:34
TEXT : ..Kimberley\TPProfiles.txt

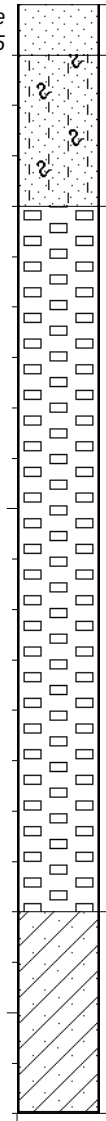
HOLE No: 14
Geotechnical Investigation

Macroplan
Lethabo Park

HOLE No: 15
Sheet 1 of 1

JOB NUMBER: 2019/J004/MAC

Scale 1:15



0.00	Dry, red brown, very loose, intact, fine sand. Aeolian deposit.
0.10	Dry, red brown, medium dense, intact, silty sand containing rare calcrete nodules. Colluvium containing roots.
0.40	Dry, white, medium dense to dense, intact, silty sand. Powder calcrete containing scattered nodules.
1.80	Slightly moist, dark green grey streaked orange, dense, partially laminated, sandy clay. Residual shale.
2.20	

NOTES

1) No refusal of excavation.

2) No seepage.

CONTRACTOR : Big Five Construction
MACHINE : Cat 422F
DRILLED BY : Petrus
PROFILED BY : Izak Breytenbach

TYPE SET BY : Izak Breytenbach
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM : 700mm
DATE :
DATE : 21-22/01/2019

DATE : 22/02/2019 13:34
TEXT : ..Kimberley\TPProfiles.txt

ELEVATION :
X-COORD : 28° 39 06.9S
Y-COORD : 24° 42 33.2E

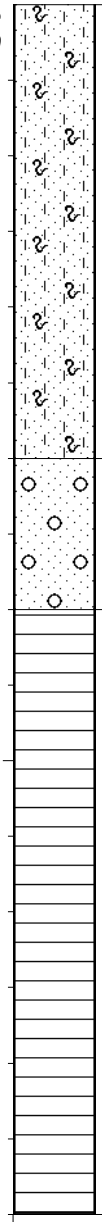
HOLE No: 15
Geotechnical Investigation

Macroplan
Lethabo Park

HOLE No: 16
Sheet 1 of 1

JOB NUMBER: 2019/J004/MAC

Scale 1:10



0.00 Dry, light grey brown, medium dense, intact, silty sand containing rare calcrete nodules. Colluvium containing roots.

0.60 Slightly moist, grey brown laminated light grey, loose, intact, gravelly sand. Residual shale.

0.80 Light grey laminated orange brown, very fine grained, slightly to moderately weathered, very closely jointed, very soft to soft rock: SHALE. Material resembles gravel.

1.60

NOTES

1) Gradual refusal of excavation.

2) No seepage.

CONTRACTOR : Big Five Construction
MACHINE : Cat 422F
DRILLED BY : Petrus
PROFILED BY : Izak Breytenbach

INCLINATION :
DIAM : 700mm
DATE :
DATE : 21-22/01/2019

ELEVATION :
X-COORD : 28° 39 28.6S
Y-COORD : 24° 42 21.6E

TYPE SET BY : Izak Breytenbach
SETUP FILE : STANDARD.SET

DATE : 22/02/2019 13:34
TEXT : ..Kimberley\TPProfiles.txt

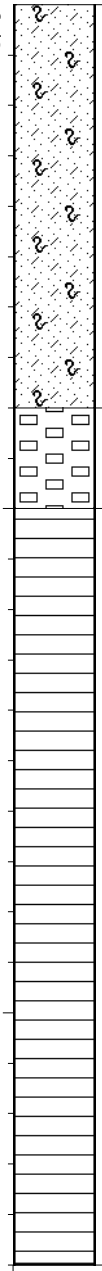
HOLE No: 16
Geotechnical Investigation

Macroplan
Lethabo Park

HOLE No: 17
Sheet 1 of 1

JOB NUMBER: 2019/J004/MAC

Scale 1:15



0.00 Dry, light grey brown, medium dense, intact, clayey sand containing rare calcrete nodules. Colluvium containing roots.

0.80 Dry, white, medium dense to dense, intact, silty sand. Powder calcrete containing scattered nodules.

1.00 Light blue grey, laminated, very fine grained, slightly weathered, very closely jointed, soft to very soft rock: SHALE. Material resembles coarse gravel.

2.50

NOTES

1) Gradual refusal of excavation.
2) Disturbed Sample SKT-71-639: 0.40m.
3) No seepage.

CONTRACTOR : Big Five Construction
MACHINE : Cat 422F
DRILLED BY : Petrus
PROFILED BY : Izak Breytenbach

INCLINATION :
DIAM : 700mm
DATE :
DATE : 21-22/01/2019

ELEVATION :
X-COORD : 28° 39 23.7S
Y-COORD : 24° 42 25.3E

TYPE SET BY : Izak Breytenbach
SETUP FILE : STANDARD.SET

DATE : 22/02/2019 13:34
TEXT : ..Kimberley\TPProfiles.txt

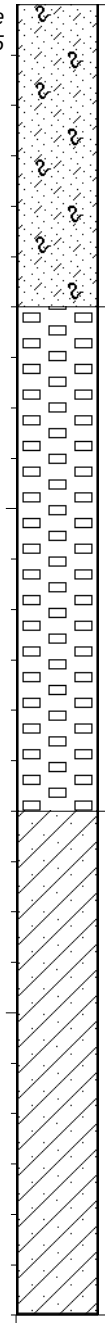
HOLE No: 17
Geotechnical Investigation

Macroplan
Lethabo Park

HOLE No: 18
Sheet 1 of 1

JOB NUMBER: 2019/J004/MAC

Scale 1:15



0.00

Dry, grey brown, medium dense, intact, clayey sand. Colluvium containing roots.

0.60

Dry, white, dense, intact, silty sand. Powder calcrete containing scattered nodules.

1.60

Slightly moist, dark green grey streaked orange, dense, partially laminated, sandy clay. Residual shale.

2.60

NOTES

1) No refusal of excavation.

2) No seepage.

CONTRACTOR : Big Five Construction
MACHINE : Cat 422F
DRILLED BY : Petrus
PROFILED BY : Izak Breytenbach

INCLINATION :
DIAM : 700mm
DATE :
DATE : 21-22/01/2019

ELEVATION :
X-COORD : 28° 39 18.8S
Y-COORD : 24° 42 30.0E

TYPE SET BY : Izak Breytenbach
SETUP FILE : STANDARD.SET

DATE : 22/02/2019 13:34
TEXT : ..Kimberley\TPProfiles.txt

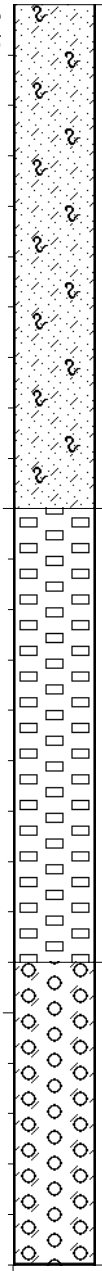
HOLE No: 18
Geotechnical Investigation

Macroplan
Lethabo Park

HOLE No: 19
Sheet 1 of 1

JOB NUMBER: 2019/J004/MAC

Scale 1:15



0.00 Slightly moist, grey brown mottled white, medium dense, intact, clayey sand containing calcrete nodules. Calcified colluvium containing roots.

1.00 Dry, white, medium dense to dense, intact, silty sand. Powder calcrete containing scattered nodules.

1.90 Slightly moist, light grey, medium dense, laminated, clayey gravel. Residual shale tending to bedrock.

2.50

NOTES

1) No refusal of excavation.

2) No seepage.

CONTRACTOR : Big Five Construction
MACHINE : Cat 422F
DRILLED BY : Petrus
PROFILED BY : Izak Breytenbach

TYPE SET BY : Izak Breytenbach
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM : 700mm
DATE :
DATE : 21-22/01/2019

DATE : 22/02/2019 13:34
TEXT : ..Kimberley\TPProfiles.txt

ELEVATION :
X-COORD : 28° 39 14.6S
Y-COORD : 24° 42 34.0E

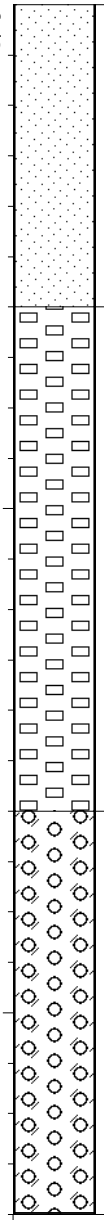
HOLE No: 19
Geotechnical Investigation

Macroplan
Lethabo Park

HOLE No: 20
Sheet 1 of 1

JOB NUMBER: 2019/J004/MAC

Scale 1:15



0.00 Dry, red brown, loose, intact, fine sand. Aeolian deposit.

0.60 Dry, white, medium dense to dense, intact, clayey sand. Powder calcrete containing scattered nodules.

1.60 Slightly moist, light grey, medium dense, laminated, clayey gravel. Residual shale tending to bedrock.

2.40

NOTES

1) No refusal of excavation.

2) Disturbed Sample SKT-71-640: 1.10m.

3) No seepage.

CONTRACTOR : Big Five Construction
MACHINE : Cat 422F
DRILLED BY : Petrus
PROFILED BY : Izak Breytenbach

INCLINATION :
DIAM : 700mm
DATE :
DATE : 21-22/01/2019

ELEVATION :
X-COORD : 28° 39 10.0S
Y-COORD : 24° 42 36.7E

HOLE No: 20
Geotechnical Investigation

TYPE SET BY : Izak Breytenbach
SETUP FILE : STANDARD.SET

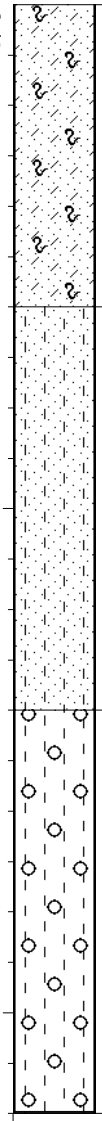
DATE : 22/02/2019 13:34
TEXT : ..Kimberley\TPProfiles.txt

Macroplan
Lethabo Park

HOLE No: 21
Sheet 1 of 1

JOB NUMBER: 2019/J004/MAC

Scale 1:15



0.00 Dry, grey brown, medium dense, voided, clayey sand. Colluvium containing roots.

0.60 Dry, light grey brown mottled white, dense, intact, silty sand. Calcified colluvium.

1.40 Slightly moist, dark purple brown streaked orange and light grey, laminated, firm, gravelly silty. Residual shale.

2.20

NOTES

1) No refusal of excavation.

2) No seepage.

CONTRACTOR : Big Five Construction
MACHINE : Cat 422F
DRILLED BY : Petrus
PROFILED BY : Izak Breytenbach

INCLINATION :
DIAM : 700mm
DATE :
DATE : 21-22/01/2019

ELEVATION :
X-COORD : 28° 39 34.2S
Y-COORD : 24° 42 21.8E

TYPE SET BY : Izak Breytenbach
SETUP FILE : STANDARD.SET

DATE : 22/02/2019 13:34
TEXT : ..Kimberley\TPProfiles.txt

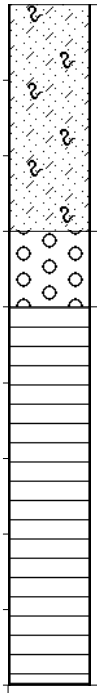
HOLE No: 21
Geotechnical Investigation

Macroplan
Lethabo Park

HOLE No: 22
Sheet 1 of 1

JOB NUMBER: 2019/J004/MAC

Scale 1:10



0.00 Dry, dark brown, medium dense, slickensided, clayey sand. Colluvium containing roots.

0.30 Dry, light grey, loose, intact, gravel. Residual shale.

0.40 Light grey, very fine grained, slightly weathered, very closely jointed, medium hard rock: baked SHALE.

0.90

NOTES

1) Refusal of excavation.

2) No seepage.

CONTRACTOR : Big Five Construction
MACHINE : Cat 422F
DRILLED BY : Petrus
PROFILED BY : Izak Breytenbach

INCLINATION :
DIAM : 700mm
DATE :
DATE : 21-22/01/2019

ELEVATION :
X-COORD : 28° 39 28.9S
Y-COORD : 24° 42 26.1E

HOLE No: 22
Geotechnical Investigation

TYPE SET BY : Izak Breytenbach
SETUP FILE : STANDARD.SET

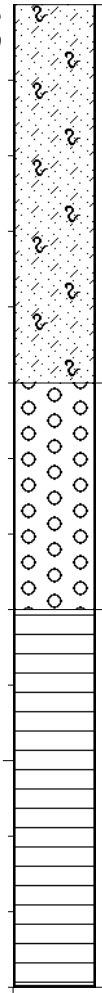
DATE : 22/02/2019 13:34
TEXT : ..Kimberley\TPProfiles.txt

Macroplan
Lethabo Park

HOLE No: 23
Sheet 1 of 1

JOB NUMBER: 2019/J004/MAC

Scale 1:10



0.00 Dry, dark brown, medium dense, slickensided, clayey sand. Colluvium containing roots.

0.50 Dry, light grey, loose, intact, gravel. Residual shale.

0.80 Light grey, very fine grained, slightly weathered, very closely jointed, medium hard rock: SHALE.

1.30

NOTES

1) Refusal of excavation.

2) No seepage.

CONTRACTOR : Big Five Construction
MACHINE : Cat 422F
DRILLED BY : Petrus
PROFILED BY : Izak Breytenbach

INCLINATION :
DIAM : 700mm
DATE :
DATE : 21-22/01/2019

ELEVATION :
X-COORD : 28° 39 23.4S
Y-COORD : 24° 42 31.7E

TYPE SET BY : Izak Breytenbach
SETUP FILE : STANDARD.SET

DATE : 22/02/2019 13:34
TEXT : ..Kimberley\TPProfiles.txt

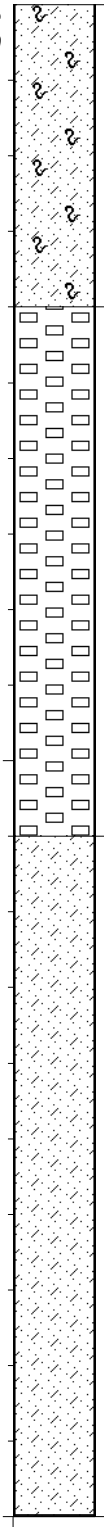
HOLE No: 23
Geotechnical Investigation

Macroplan
Lethabo Park

HOLE No: 24
Sheet 1 of 1

JOB NUMBER: 2019/J004/MAC

Scale 1:10



0.00 Dry, red brown, medium dense, slickensided, clayey sand. Colluvium containing roots.

0.40 Slightly moist, white grey, stiff, intact, clayey silt. Powder calcrete containing scattered nodules.

1.10 Slightly moist, pale green grey, dense, shattered, clayey sand. Calcified residual shale.

2.00

NOTES

1) No refusal of excavation.
2) Disturbed Sample SKT-71-641: 0.75m.
3) No seepage.

CONTRACTOR : Big Five Construction
MACHINE : Cat 422F
DRILLED BY : Petrus
PROFILED BY : Izak Breytenbach

INCLINATION :
DIAM : 700mm
DATE :
DATE : 21-22/01/2019

ELEVATION :
X-COORD : 28° 39 18.9S
Y-COORD : 24° 42 35.7E

TYPE SET BY : Izak Breytenbach
SETUP FILE : STANDARD.SET

DATE : 22/02/2019 13:34
TEXT : ..Kimberley\TPProfiles.txt

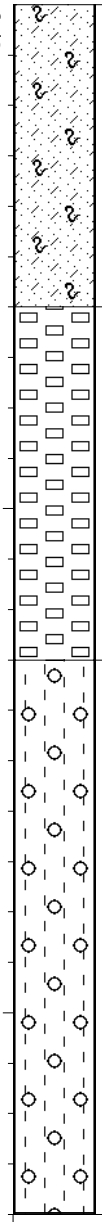
HOLE No: 24
Geotechnical Investigation

Macroplan
Lethabo Park

HOLE No: 25
Sheet 1 of 1

JOB NUMBER: 2019/J004/MAC

Scale 1:15



0.00 Dry, dark brown, medium dense, slickensided, clayey sand. Colluvium containing roots.

0.60 Slightly moist, white grey, stiff, intact, clayey silt. Powder calcrete containing scattered nodules.

1.30 Slightly moist, dark purple brown streaked orange and light grey, laminated, firm, gravelly silty. Residual shale.

2.40

NOTES

1) No refusal of excavation.

2) No seepage.

CONTRACTOR : Big Five Construction
MACHINE : Cat 422F
DRILLED BY : Petrus
PROFILED BY : Izak Breytenbach

INCLINATION :
DIAM : 700mm
DATE :
DATE : 21-22/01/2019

ELEVATION :
X-COORD : 28° 39 14.4S
Y-COORD : 24° 42 39.0E

TYPE SET BY : Izak Breytenbach
SETUP FILE : STANDARD.SET

DATE : 22/02/2019 13:34
TEXT : ..Kimberley\TPProfiles.txt

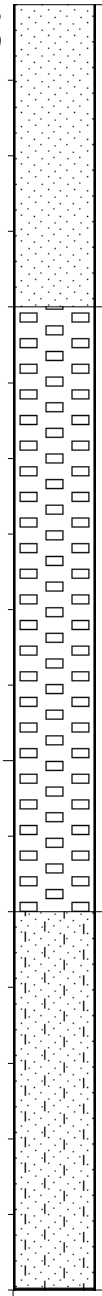
HOLE No: 25
Geotechnical Investigation

Macroplan
Lethabo Park

HOLE No: 26
Sheet 1 of 1

JOB NUMBER: 2019/J004/MAC

Scale 1:10



0.00 Dry, brown red, very loose to medium dense, intact, fine sand. Aeolian deposit.

0.40 Slightly moist, white grey, stiff, intact, clayey silt. Powder calcrete containing scattered nodules.

1.20 Slightly moist, pale green grey, dense, shattered, silty sand. Calcified residual shale.

SKT-71-642:

1.70

NOTES

1) No refusal of excavation.

2) Disturbed Sample SKT-71-642: 1.45m.

3) No seepage.

CONTRACTOR : Big Five Construction
MACHINE : Cat 422F
DRILLED BY : Petrus
PROFILED BY : Izak Breytenbach

INCLINATION :
DIAM : 700mm
DATE :
DATE : 21-22/01/2019

ELEVATION :
X-COORD : 28° 39 10.9S
Y-COORD : 24° 42 41.0E

TYPE SET BY : Izak Breytenbach
SETUP FILE : STANDARD.SET

DATE : 22/02/2019 13:34
TEXT : ..Kimberley\TPProfiles.txt

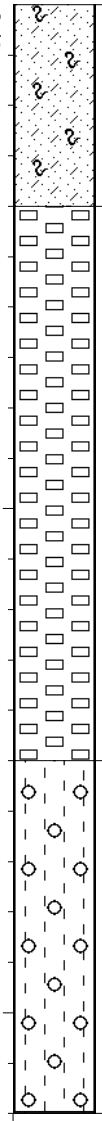
HOLE No: 26
Geotechnical Investigation

Macroplan
Lethabo Park

HOLE No: 27
Sheet 1 of 1

JOB NUMBER: 2019/J004/MAC

Scale 1:15



0.00

Dry, dark brown, medium dense, slickensided, clayey sand. Colluvium containing roots and scattered calcrete concretions.

0.40

Slightly moist, white grey, stiff, intact, clayey silt. Powder calcrete containing scattered nodules.

1.50

Slightly moist, dark purple brown streaked orange and light grey, laminated, firm, gravelly silty. Residual shale containing lenses of powder calcrete.

2.20

NOTES

1) No refusal of excavation.

2) No seepage.

CONTRACTOR : Big Five Construction
MACHINE : Cat 422F
DRILLED BY : Petrus
PROFILED BY : Izak Breytenbach

TYPE SET BY : Izak Breytenbach
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM : 700mm
DATE :
DATE : 21-22/01/2019

DATE : 22/02/2019 13:34
TEXT : ..Kimberley\TPProfiles.txt

ELEVATION :
X-COORD : 28° 39 16.4S
Y-COORD : 24° 42 42.3E

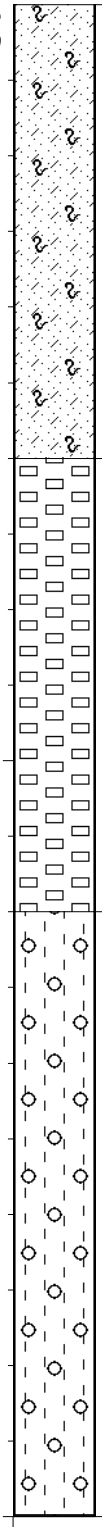
HOLE No: 27
Geotechnical Investigation

Macroplan
Lethabo Park

HOLE No: 28
Sheet 1 of 1

JOB NUMBER: 2019/J004/MAC

Scale 1:10



0.00

Dry, dark brown, medium dense, slickensided, clayey sand containing abundant calcrete concretions. Calcified colluvium containing roots.

0.60

Slightly moist, white grey, stiff, intact, clayey silt. Powder calcrete containing scattered nodules.

1.20

Slightly moist, dark purple brown streaked orange and light grey, laminated, firm, gravelly silty. Residual shale.

2.00

NOTES

1) Gradual refusal of excavation.

2) No seepage.

CONTRACTOR : Big Five Construction
MACHINE : Cat 422F
DRILLED BY : Petrus
PROFILED BY : Izak Breytenbach

INCLINATION :
DIAM : 700mm
DATE :
DATE : 21-22/01/2019

ELEVATION :
X-COORD : 28° 39 16.6S
Y-COORD : 24° 42 48.9E

HOLE No: 28
Geotechnical Investigation

TYPE SET BY : Izak Breytenbach
SETUP FILE : STANDARD.SET

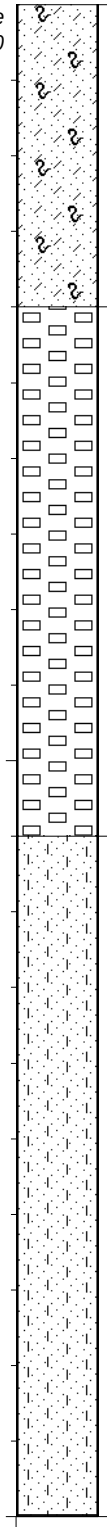
DATE : 22/02/2019 13:34
TEXT : ..Kimberley\TPProfiles.txt

Macroplan
Lethabo Park

HOLE No: 29
Sheet 1 of 1

JOB NUMBER: 2019/J004/MAC

Scale 1:10



0.00 Dry, dark brown, medium dense, voided, clayey sand. Calcified colluvium containing roots.

0.40 Slightly moist, white grey, stiff, intact, clayey silt. Powder calcrete containing scattered nodules.

1.10 Slightly moist, dark purple brown streaked orange and light grey, laminated, firm, silty sand. Residual shale.

2.00

NOTES

1) No refusal of excavation.
2) Disturbed Sample SKT-71-643: 1.55m.
3) No seepage.

CONTRACTOR : Big Five Construction
MACHINE : Cat 422F
DRILLED BY : Petrus
PROFILED BY : Izak Breytenbach

INCLINATION :
DIAM : 700mm
DATE :
DATE : 21-22/01/2019

ELEVATION :
X-COORD : 28° 39 21.3S
Y-COORD : 24° 42 50.2E

HOLE No: 29
Geotechnical Investigation

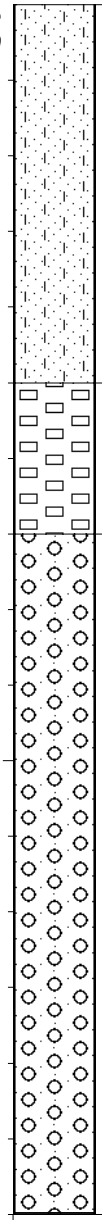
TYPE SET BY : Izak Breytenbach
SETUP FILE : STANDARD.SET
DATE : 22/02/2019 13:34
TEXT : ..Kimberley\TPProfiles.txt

Macroplan
Lethabo Park

HOLE No: 30
Sheet 1 of 1

JOB NUMBER: 2019/J004/MAC

Scale 1:10



0.00 Slightly moist, red brown, very loose to medium dense, pinhole voided, silty fine sand. Aeolian deposit.

0.50 Dry, white, dense, intact, sandy gravel. Nodular calcrete.

0.70 Dry, pale grey speckled black and dark green, dense, intact, sandy gravel. Residual dolerite grading into bedrock.

1.60

NOTES

1) Gradual refusal of excavation.
2) Disturbed Sample SKT-71-644: 1.05m.
3) No seepage.

CONTRACTOR : Big Five Construction
MACHINE : Cat 422F
DRILLED BY : Petrus
PROFILED BY : Izak Breytenbach

INCLINATION :
DIAM : 700mm
DATE :
DATE : 21-22/01/2019

ELEVATION :
X-COORD : 28° 39 15.7S
Y-COORD : 24° 42 54.1E

TYPE SET BY : Izak Breytenbach
SETUP FILE : STANDARD.SET

DATE : 22/02/2019 13:34
TEXT : ..Kimberley\TPProfiles.txt

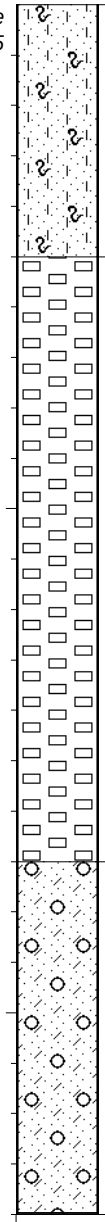
HOLE No: 30
Geotechnical Investigation

Macroplan
Lethabo Park

HOLE No: 31
Sheet 1 of 1

JOB NUMBER: 2019/J004/MAC

Scale 1:15



0.00	Dry, red brown, loose to medium dense, intact, silty fine sand containing scattered calcrete nodules. Aeolian deposits containing roots.
0.50	Dry, white, dense, intact, silty fine sand containing scattered calcrete concretions. Powder calcrete.
1.70	Slightly moist, pale green mottled white, dense, intact, clayey gravelly sand. Calcified residual shale.
2.40	

NOTES

1) No refusal of excavation.

2) No seepage.

CONTRACTOR : Big Five Construction
MACHINE : Cat 422F
DRILLED BY : Petrus
PROFILED BY : Izak Breytenbach

INCLINATION :
DIAM : 700mm
DATE :
DATE : 21-22/01/2019

ELEVATION :
X-COORD : 28° 39 12.9S
Y-COORD : 24° 42 48.3E

TYPE SET BY : Izak Breytenbach
SETUP FILE : STANDARD.SET

DATE : 22/02/2019 13:34
TEXT : ..Kimberley\TPProfiles.txt

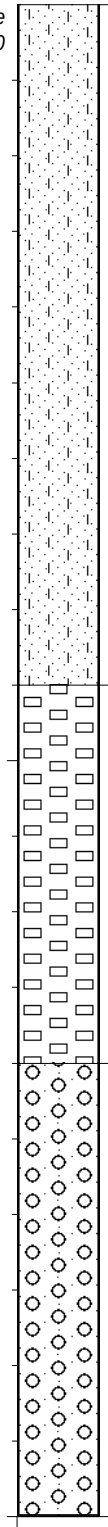
HOLE No: 31
Geotechnical Investigation

Macroplan
Lethabo Park

HOLE No: 32
Sheet 1 of 1

JOB NUMBER: 2019/J004/MAC

Scale 1:10



0.00 Slightly moist, red brown, very loose to medium dense, pinhole voided, silty fine sand. Aeolian deposit.

0.90 Dry, white, dense, intact, silty fine sand containing scattered calcrete concretions. Powder calcrete.

1.40 Dry, light green grey, dense, intact, sandy gravel. Residual shale tending to weathered bedrock.

2.00

NOTES

1) Gradual refusal of excavation.
2) No seepage.
3) Rubble dumping in vicinity of trial hole.

CONTRACTOR : Big Five Construction
MACHINE : Cat 422F
DRILLED BY : Petrus
PROFILED BY : Izak Breytenbach

INCLINATION :
DIAM : 700mm
DATE :
DATE : 21-22/01/2019

ELEVATION :
X-COORD : 28° 39 06.7S
Y-COORD : 24° 42 52.5E

HOLE No: 32
Geotechnical Investigation

TYPE SET BY : Izak Breytenbach
SETUP FILE : STANDARD.SET

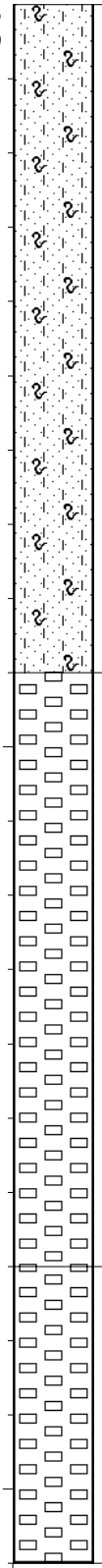
DATE : 22/02/2019 13:34
TEXT : ..Kimberley\TPProfiles.txt

Macroplan
Lethabo Park

HOLE No: 33
Sheet 1 of 1

JOB NUMBER: 2019/J004/MAC

Scale 1:10



0.00

Dry, red brown, loose to medium dense, intact, silty fine sand containing scattered calcrete nodules. Aeolian deposits containing roots.

0.90

Dry, white, dense, intact, sandy gravel containing scattered calcrete concretions. Powder calcrete.

SKT-71-645:

1.70

Dry, white grey, very dense, intact, sandy gravel. Hardpan calcrete.

2.10

NOTES

1) Gradual refusal of excavation.

2) Disturbed Sample SKT-71-645: 1.30m.

3) No seepage.

CONTRACTOR : Big Five Construction
MACHINE : Cat 422F
DRILLED BY : Petrus
PROFILED BY : Izak Breytenbach

TYPE SET BY : Izak Breytenbach
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM : 700mm
DATE :
DATE : 21-22/01/2019

DATE : 22/02/2019 13:34
TEXT : ..Kimberley\TPProfiles.txt

ELEVATION :
X-COORD : 28° 39 11.5S
Y-COORD : 24° 42 53.2E

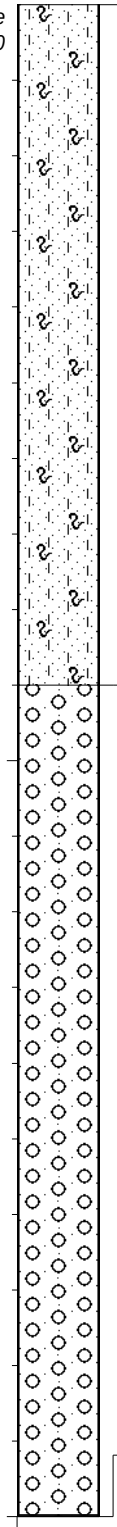
HOLE No: 33
Geotechnical Investigation

Macroplan
Lethabo Park

HOLE No: 34
Sheet 1 of 1

JOB NUMBER: 2019/J004/MAC

Scale 1:10



0.00 Slightly moist, red brown, very loose to medium dense, pinhole voided, silty fine sand. Aeolian deposit containing fine roots.

0.90 Dry, pale grey speckled black and dark green, dense, intact, sandy gravel. Residual dolerite grading into bedrock.

2.00

NOTES

1) Gradual refusal of excavation.

2) No seepage.

3) Diggings and excavations in surrounding area.

CONTRACTOR : Big Five Construction
MACHINE : Cat 422F
DRILLED BY : Petrus
PROFILED BY : Izak Breytenbach

INCLINATION :
DIAM : 700mm
DATE :
DATE : 21-22/01/2019

ELEVATION :
X-COORD : 28° 39 12.5S
Y-COORD : 24° 42 57.9E

TYPE SET BY : Izak Breytenbach
SETUP FILE : STANDARD.SET

DATE : 22/02/2019 13:34
TEXT : ..Kimberley\TPProfiles.txt

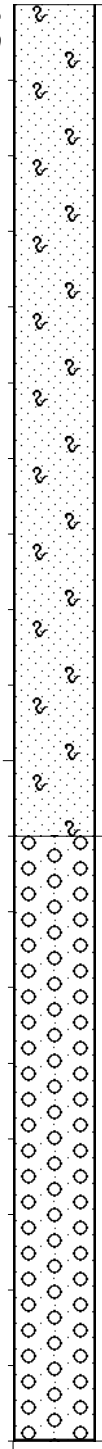
HOLE No: 34
Geotechnical Investigation

Macroplan
Lethabo Park

HOLE No: 35
Sheet 1 of 1

JOB NUMBER: 2019/J004/MAC

Scale 1:10



0.00 Dry, red brown, dense, voided, fine sand. Aeolian deposit containing roots.

1.10 Dry, light green grey speckled black and dark grey, dense, intact, sandy gravel. Residual dolerite tending to bedrock.

SKT-71-646:

1.90

NOTES

1) Gradual refusal of excavation.

2) No seepage.

3) Disturbed Sample SKT-71-646: 1.50m.

CONTRACTOR : Big Five Construction
MACHINE : Cat 422F
DRILLED BY : Petrus
PROFILED BY : Izak Breytenbach

INCLINATION :
DIAM : 700mm
DATE :
DATE : 21-22/01/2019

ELEVATION :
X-COORD : 28° 39 09.7S
Y-COORD : 24° 43 03.1E

TYPE SET BY : Izak Breytenbach
SETUP FILE : STANDARD.SET

DATE : 22/02/2019 13:34
TEXT : ..Kimberley\TPProfiles.txt

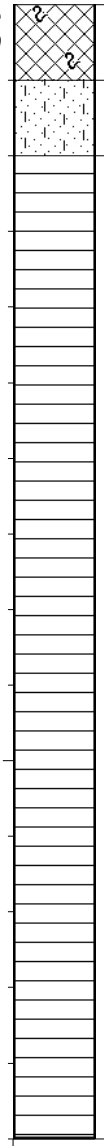
HOLE No: 35
Geotechnical Investigation

Macroplan
Lethabo Park

HOLE No: 36
Sheet 1 of 1

JOB NUMBER: 2019/J004/MAC

Scale 1:10



0.00 Dry, dark grey, medium dense, clayey sand containing plastic. Fill material. Roots.

0.10 Slightly moist, red brown, very loose to medium dense, pinhole voided, silty fine sand. Aeolian deposit.

0.20 Light grey laminated yellow and dark grey, very fine grained, very closely jointed, very soft rock: SHALE. Material resembles gravel.

1.50

NOTES

1) Gradual refusal of excavation.
2) No seepage.
3) Diggings in the vicinity.

CONTRACTOR : Big Five Construction
MACHINE : Cat 422F
DRILLED BY : Petrus
PROFILED BY : Izak Breytenbach

TYPE SET BY : Izak Breytenbach
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM : 700mm
DATE :
DATE : 21-22/01/2019

DATE : 22/02/2019 13:34
TEXT : ..Kimberley\TPProfiles.txt

ELEVATION :
X-COORD : 28° 39 07.1S
Y-COORD : 24° 42 58.2E

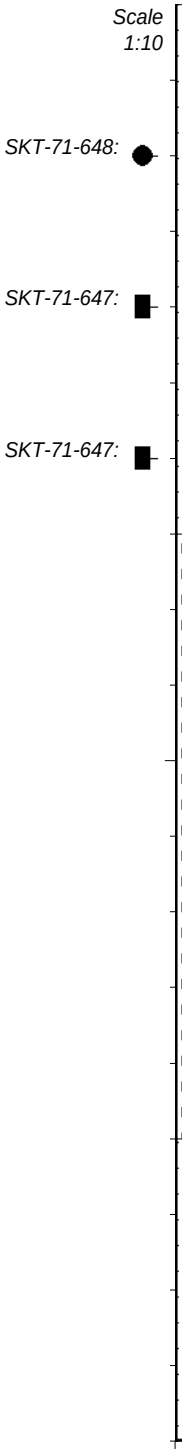
HOLE No: 36
Geotechnical Investigation

Macroplan
Lethabo Park

HOLE No: 37
Sheet 1 of 1

JOB NUMBER: 2019/J004/MAC

Scale 1:10



0.00 Slightly moist, red brown, very loose to medium dense, pinhole voided, silty fine sand. Aeolian deposit.

0.70 Dry, white, dense, intact, silty fine sand containing scattered calcrete concretions. Powder calcrete.

1.50 Dry, light green grey, dense, intact, sandy gravel. Residual shale tending to weathered bedrock.

1.90

NOTES

1) Refusal of excavation.
2) No seepage.
3) Disturbed Sample SKT-71-648: 0.20m.
4) Undisturbed Sample SKT-71-647: 0.40m.
5) Undisturbed Sample SKT-71-647: 0.60m.

CONTRACTOR : Big Five Construction
MACHINE : Cat 422F
DRILLED BY : Petrus
PROFILED BY : Izak Breytenbach

INCLINATION :
DIAM : 700mm
DATE :
DATE : 21-22/01/2019

ELEVATION :
X-COORD : 28° 39 03.8S
Y-COORD : 24° 42 55.3E

HOLE No: 37
Geotechnical Investigation

TYPE SET BY : Izak Breytenbach
SETUP FILE : STANDARD.SET

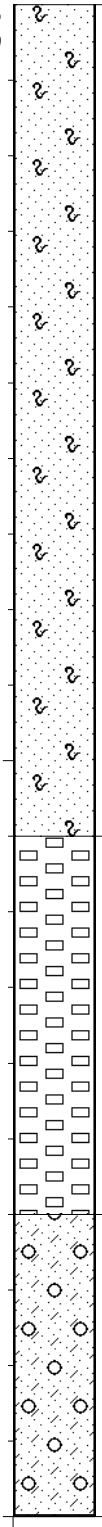
DATE : 22/02/2019 13:34
TEXT : ..Kimberley\TPProfiles.txt

Macroplan
Lethabo Park

HOLE No: 38
Sheet 1 of 1

JOB NUMBER: 2019/J004/MAC

Scale 1:10



0.00 Dry, red brown, medium dense, voided, fine sand. Aeolian deposit containing roots.

1.10 Dry, white, dense, intact, silty fine sand containing scattered calcrete concretions. Nodular calcrete.

1.60 Slightly moist, pale green mottled white, dense, intact, clayey gravelly sand. Calcified residual shale.

2.00

NOTES

1) Gradual refusal of excavation.

2) No seepage.

CONTRACTOR : Big Five Construction
MACHINE : Cat 422F
DRILLED BY : Petrus
PROFILED BY : Izak Breytenbach

INCLINATION :
DIAM : 700mm
DATE :
DATE : 21-22/01/2019

ELEVATION :
X-COORD : 28° 39 00.3S
Y-COORD : 24° 42 57.9E

TYPE SET BY : Izak Breytenbach
SETUP FILE : STANDARD.SET

DATE : 22/02/2019 13:34
TEXT : ..Kimberley\TPProfiles.txt

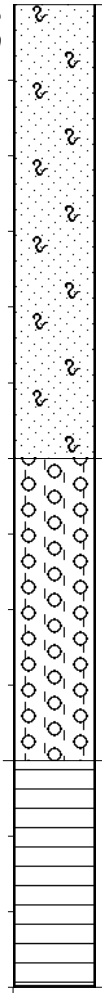
HOLE No: 38
Geotechnical Investigation

Macroplan
Lethabo Park

HOLE No: 39
Sheet 1 of 1

JOB NUMBER: 2019/J004/MAC

Scale 1:10



0.00

Dry, red brown, medium dense, voided, fine sand. Aeolian deposit containing roots.

0.60

Slightly moist, light grey, medium dense, intact, silty gravel. Residual shale.

1.00

Light grey laminated yellow and dark grey, very fine grained, very closely jointed, very soft rock: SHALE. Material resembles gravel.

1.30

NOTES

1) Gradual refusal of excavation.

2) No seepage.

CONTRACTOR : Big Five Construction
MACHINE : Cat 422F
DRILLED BY : Petrus
PROFILED BY : Izak Breytenbach

INCLINATION :
DIAM : 700mm
DATE :
DATE : 21-22/01/2019

ELEVATION :
X-COORD : 28° 39 00.2S
Y-COORD : 24° 43 02.3E

TYPE SET BY : Izak Breytenbach
SETUP FILE : STANDARD.SET

DATE : 22/02/2019 13:34
TEXT : ..Kimberley\TPProfiles.txt

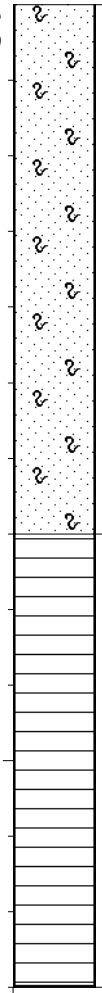
HOLE No: 39
Geotechnical Investigation

Macroplan
Lethabo Park

HOLE No: 40
Sheet 1 of 1

JOB NUMBER: 2019/J004/MAC

Scale 1:10



0.00

Dry, red brown, medium dense, voided, fine sand. Aeolian deposit containing roots.

0.70

Light grey laminated yellow and dark grey, very fine grained, very closely jointed, soft rock: SHALE. Material resembles gravel.

1.30

NOTES

1) Refusal of excavation.

2) No seepage.

3) Disturbed Sample SKT-71-649: 0.35m.

CONTRACTOR : Big Five Construction
MACHINE : Cat 422F
DRILLED BY : Petrus
PROFILED BY : Izak Breytenbach

TYPE SET BY : Izak Breytenbach
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM : 700mm
DATE :
DATE : 21-22/01/2019

DATE : 22/02/2019 13:34
TEXT : ..Kimberley\TPProfiles.txt

ELEVATION :
X-COORD : 28° 39 03.6S
Y-COORD : 24° 43 01.6E

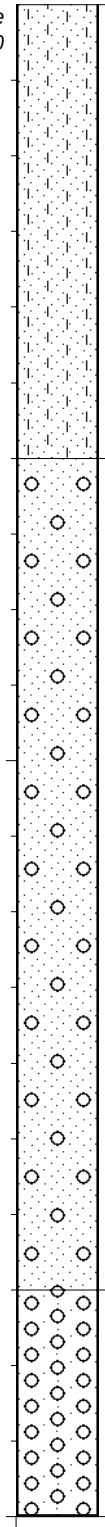
HOLE No: 40
Geotechnical Investigation

Macroplan
Lethabo Park

HOLE No: 41
Sheet 1 of 1

JOB NUMBER: 2019/J004/MAC

Scale 1:10



0.00 Dry, red brown, loose to medium dense, intact, silty fine sand. Aeolian deposit.

0.60 Dry, light grey blotched white, medium dense, intact, gravelly sand. Calcified residual shale.

1.70 Slightly moist, light grey, loose, laminated, sandy gravel. Residual shale grading into bedrock.

2.00

NOTES

1) Gradual refusal of excavation.

2) No seepage.

CONTRACTOR : Big Five Construction
MACHINE : Cat 422F
DRILLED BY : Petrus
PROFILED BY : Izak Breytenbach

INCLINATION :
DIAM : 700mm
DATE :
DATE : 21-22/01/2019

ELEVATION :
X-COORD : 28° 39 04.9S
Y-COORD : 24° 43 06.3E

TYPE SET BY : Izak Breytenbach
SETUP FILE : STANDARD.SET

DATE : 22/02/2019 13:34
TEXT : ..Kimberley\TPProfiles.txt

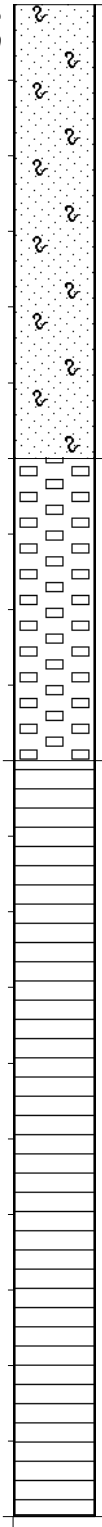
HOLE No: 41
Geotechnical Investigation

Macroplan
Lethabo Park

HOLE No: 42
Sheet 1 of 1

JOB NUMBER: 2019/J004/MAC

Scale 1:10



0.00

Dry, red brown, medium dense, voided, fine sand. Aeolian deposit containing roots.

0.60

Dry, white, dense, intact, silty fine sand containing scattered calcrete concretions. Powder calcrete.

1.00

Light grey laminated yellow and dark grey, very fine grained, very closely jointed, very soft rock: SHALE. Material resembles gravel.

2.00

NOTES

1) Gradual refusal of excavation.

2) No seepage.

CONTRACTOR : Big Five Construction
MACHINE : Cat 422F
DRILLED BY : Petrus
PROFILED BY : Izak Breytenbach

INCLINATION :
DIAM : 700mm
DATE :
DATE : 21-22/01/2019

ELEVATION :
X-COORD : 28° 39 08.1S
Y-COORD : 24° 43 06.0E

TYPE SET BY : Izak Breytenbach
SETUP FILE : STANDARD.SET

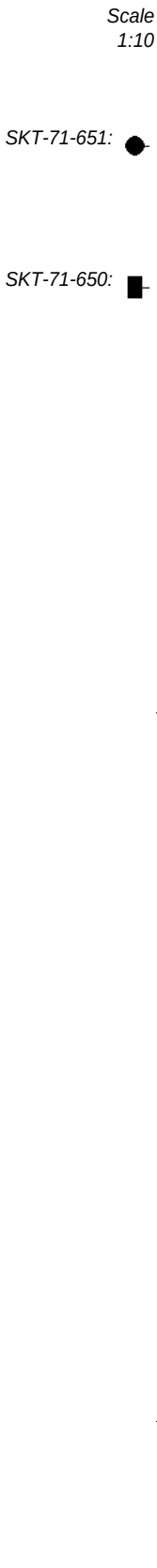
DATE : 22/02/2019 13:34
TEXT : ..Kimberley\TPProfiles.txt

HOLE No: 42
Geotechnical Investigation

Macroplan
Lethabo Park

HOLE No: 43
Sheet 1 of 1

JOB NUMBER: 2019/J004/MAC



0.00 Dry, red brown, loose to medium dense, intact, fine sand. Aeolian deposit.

0.60 Dry, white, dense. Intact, sandy gravel. Nodular calcrete.

0.80 Dry, light grey blotched white, medium dense, intact, gravelly sand. Calcified residual shale.

2.00

NOTES

1) Gradual refusal of excavation.
2) Disturbed Sample SKT-71-651: 0.20m.
3) Undisturbed Sample SKT-71-650: 0.40m.
4) No seepage.

CONTRACTOR : Big Five Construction
MACHINE : Cat 422F
DRILLED BY : Petrus
PROFILED BY : Izak Breytenbach

INCLINATION :
DIAM : 700mm
DATE :
DATE : 21-22/01/2019

ELEVATION :
X-COORD : 28° 39 10.8S
Y-COORD : 24° 43 12.6E

TYPE SET BY : Izak Breytenbach
SETUP FILE : STANDARD.SET

DATE : 22/02/2019 13:34
TEXT : ..Kimberley\TPProfiles.txt

HOLE No: 43
Geotechnical Investigation

Macroplan
Lethabo Park

HOLE No: 44
Sheet 1 of 1

JOB NUMBER: 2019/J004/MAC

Scale 1:10

0.00 No trial holes.

0.00

NOTES

1) Area inhabited by shacks.

CONTRACTOR : Big Five Construction
MACHINE : Cat 422F
DRILLED BY : Petrus
PROFILED BY : Izak Breytenbach

TYPE SET BY : Izak Breytenbach
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM : 700mm
DATE :
DATE : 21-22/01/2019

DATE : 22/02/2019 13:34
TEXT : ..Kimberley\TPProfiles.txt

ELEVATION :
X-COORD : 28° 39 22.6S
Y-COORD : 24° 43 16.3E

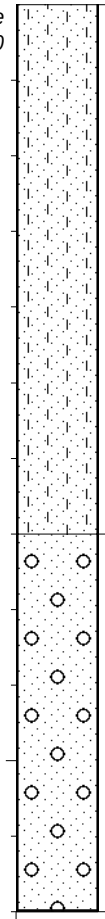
HOLE No: 44
Geotechnical Investigation

Macroplan
Lethabo Park

HOLE No: 45
Sheet 1 of 1

JOB NUMBER: 2019/J004/MAC

Scale 1:10



0.00 Dry, red brown, dense, intact, silty fine sand. Colluvium.

0.70 Dry, light grey speckled dark green, medium dense to dense, intact, gravelly sand. Calcified residual dolerite grading into bedrock.

1.20

NOTES

1) Gradual refusal of excavation.

2) No seepage.

CONTRACTOR : Big Five Construction
MACHINE : Cat 422F
DRILLED BY : Petrus
PROFILED BY : Izak Breytenbach

INCLINATION :
DIAM : 700mm
DATE :
DATE : 21-22/01/2019

ELEVATION :
X-COORD : 28° 39 28.4S
Y-COORD : 24° 43 20.8E

TYPE SET BY : Izak Breytenbach
SETUP FILE : STANDARD.SET

DATE : 22/02/2019 13:34
TEXT : ..Kimberley\TPProfiles.txt

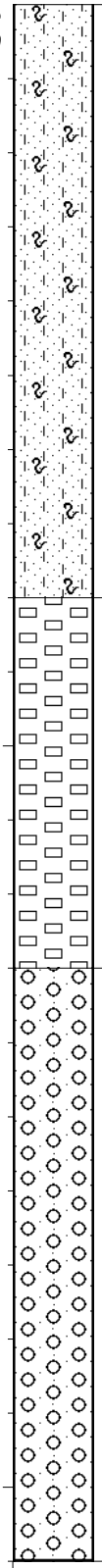
HOLE No: 45
Geotechnical Investigation

Macroplan
Lethabo Park

HOLE No: 46
Sheet 1 of 1

JOB NUMBER: 2019/J004/MAC

Scale 1:10



0.00 Dry, grey brown, loose, intact, silty sand. Colluvium containing roots.

0.80 Dry, white, medium dense to dense, intact, gravelly sand. Nodular calcrete containing boulder-sized concretions.

1.30 Dry, dark green grey, dense to very dense, intact, sandy gravel. Calcified residual dolerite tending to bedrock containing corestones.

2.10

NOTES

1) No refusal of excavation.
2) Disturbed Sample SKT-71-652: 1.05m.
3) No seepage.

CONTRACTOR : Big Five Construction
MACHINE : Cat 422F
DRILLED BY : Petrus
PROFILED BY : Izak Breytenbach

INCLINATION :
DIAM : 700mm
DATE :
DATE : 21-22/01/2019

ELEVATION :
X-COORD : 28° 39 38.0S
Y-COORD : 24° 43 27.5E

TYPE SET BY : Izak Breytenbach
SETUP FILE : STANDARD.SET

DATE : 22/02/2019 13:34
TEXT : ..Kimberley\TPProfiles.txt

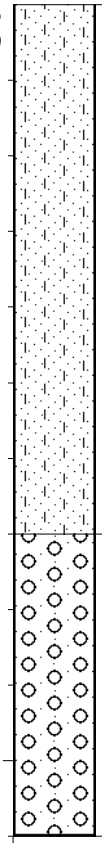
HOLE No: 46
Geotechnical Investigation

Macroplan
Lethabo Park

HOLE No: 47
Sheet 1 of 1

JOB NUMBER: 2019/J004/MAC

Scale 1:10



0.00

Dry, red brown, loose to medium dense, intact, silty fine sand. Aeolian deposit.

0.70

Dry, dark green grey, dense to very dense, intact, sandy gravel. Residual dolerite tending to bedrock containing corestones.

1.10

NOTES

1) Instant refusal of excavation, presumably on corestone.

2) No seepage.

CONTRACTOR : Big Five Construction
MACHINE : Cat 422F
DRILLED BY : Petrus
PROFILED BY : Izak Breytenbach

TYPE SET BY : Izak Breytenbach
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM : 700mm
DATE :
DATE : 21-22/01/2019

DATE : 22/02/2019 13:34
TEXT : ..Kimberley\TPProfiles.txt

ELEVATION :
X-COORD : 28° 39 41.0S
Y-COORD : 24° 43 30.3E

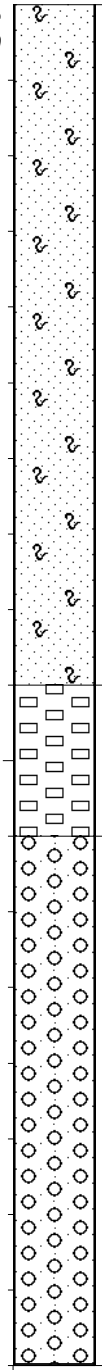
HOLE No: 47
Geotechnical Investigation

Macroplan
Lethabo Park

HOLE No: 48
Sheet 1 of 1

JOB NUMBER: 2019/J004/MAC

Scale 1:10



0.00

Dry, red brown, medium dense, voided, fine sand. Aeolian deposit containing roots.

0.90

Dry, white, dense, intact, silty fine sand containing scattered calcrete concretions. Powder calcrete.

1.10

Dry, light grey, dense, laminated, sandy gravel. Residual shale grading into bedrock.

SKT-71-653:

1.80

NOTES

1) Gradual refusal of excavation.

2) Disturbed Sample SKT-71-653: 1.45m.

3) No seepage.

CONTRACTOR : Big Five Construction
MACHINE : Cat 422F
DRILLED BY : Petrus
PROFILED BY : Izak Breytenbach

TYPE SET BY : Izak Breytenbach
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM : 700mm
DATE :
DATE : 21-22/01/2019

DATE : 22/02/2019 13:34
TEXT : ..Kimberley\TPProfiles.txt

ELEVATION :
X-COORD : 28° 38 56.0S
Y-COORD : 24° 43 00.7E

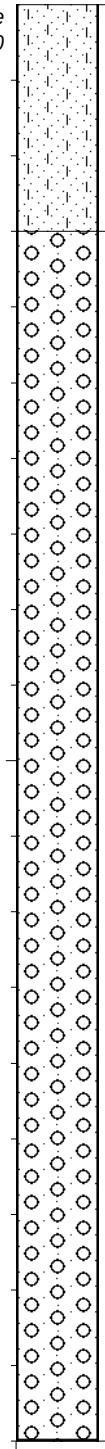
HOLE No: 48
Geotechnical Investigation

Macroplan
Lethabo Park

HOLE No: 49
Sheet 1 of 1

JOB NUMBER: 2019/J004/MAC

Scale 1:10



0.00 Dry, red brown, loose to medium dense, intact, silty fine sand. Aeolian deposit.

0.30 Slightly moist, light grey, loose, laminated, sandy gravel. Residual shale grading into bedrock.

1.90

NOTES

1) No refusal of excavation.
2) Disturbed Sample SKT-71-654: 1.10m.
3) No seepage.

CONTRACTOR : Big Five Construction
MACHINE : Cat 422F
DRILLED BY : Petrus
PROFILED BY : Izak Breytenbach

INCLINATION :
DIAM : 700mm
DATE :
DATE : 21-22/01/2019

ELEVATION :
X-COORD : 28° 39 01.3S
Y-COORD : 24° 43 05.2E

TYPE SET BY : Izak Breytenbach
SETUP FILE : STANDARD.SET

DATE : 22/02/2019 13:34
TEXT : ..Kimberley\TPProfiles.txt

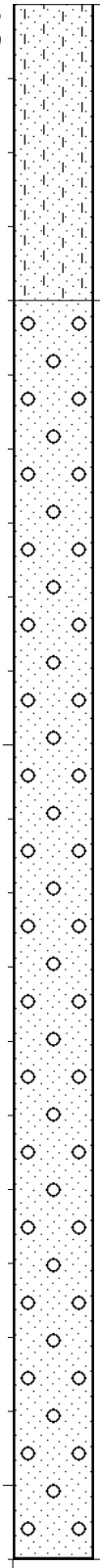
HOLE No: 49
Geotechnical Investigation

Macroplan
Lethabo Park

HOLE No: 50
Sheet 1 of 1

JOB NUMBER: 2019/J004/MAC

Scale 1:10



0.00 Dry, red brown, loose to medium dense, intact, silty fine sand. Aeolian deposit.

0.40 Dry, light grey blotched white, medium dense, intact, gravelly sand. Calcified residual shale.

2.10

NOTES

1) No refusal of excavation.

2) No seepage.

CONTRACTOR : Big Five Construction
MACHINE : Cat 422F
DRILLED BY : Petrus
PROFILED BY : Izak Breytenbach

INCLINATION :
DIAM : 700mm
DATE :
DATE : 21-22/01/2019

ELEVATION :
X-COORD : 28° 39 06.9S
Y-COORD : 24° 43 09.7E

TYPE SET BY : Izak Breytenbach
SETUP FILE : STANDARD.SET

DATE : 22/02/2019 13:34
TEXT : ..Kimberley\TPProfiles.txt

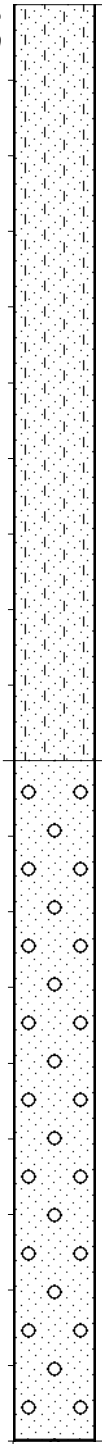
HOLE No: 50
Geotechnical Investigation

Macroplan
Lethabo Park

HOLE No: 51
Sheet 1 of 1

JOB NUMBER: 2019/J004/MAC

Scale 1:10



0.00 Dry, red brown, loose to medium dense, intact, silty sand. Colluvium.

1.00 Dry, light grey speckled dark green, medium dense to dense, intact, gravelly sand. Residual dolerite grading into bedrock.

1.90

NOTES

1) Gradual refusal of excavation.

2) No seepage.

CONTRACTOR : Big Five Construction
MACHINE : Cat 422F
DRILLED BY : Petrus
PROFILED BY : Izak Breytenbach

TYPE SET BY : Izak Breytenbach
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM : 700mm
DATE :
DATE : 21-22/01/2019

DATE : 22/02/2019 13:34
TEXT : ..Kimberley\TPProfiles.txt

ELEVATION :
X-COORD : 28° 39 16.9S
Y-COORD : 24° 43 17.6E

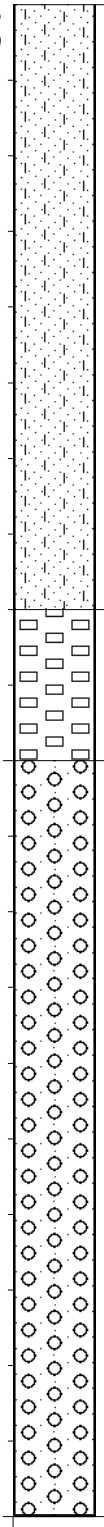
HOLE No: 51
Geotechnical Investigation

Macroplan
Lethabo Park

HOLE No: 52
Sheet 1 of 1

JOB NUMBER: 2019/J004/MAC

Scale 1:10



0.00 Dry, red brown, loose to medium dense, intact, silty sand. Colluvium.

0.80 Dry, white, dense. Intact, sandy gravel. Nodular calcrete.

1.00 Dry, light grey speckled dark green, medium dense to dense, intact, sandy gravel. Residual dolerite grading into bedrock.

2.00

NOTES

1) Gradual refusal of excavation.
2) Disturbed Sample SKT-71-655: 1.50m.
3) No seepage.

CONTRACTOR : Big Five Construction
MACHINE : Cat 422F
DRILLED BY : Petrus
PROFILED BY : Izak Breytenbach

INCLINATION :
DIAM : 700mm
DATE :
DATE : 21-22/01/2019

ELEVATION :
X-COORD : 28° 39 22.2S
Y-COORD : 24° 43 21.0E

HOLE No: 52
Geotechnical Investigation

TYPE SET BY : Izak Breytenbach
SETUP FILE : STANDARD.SET

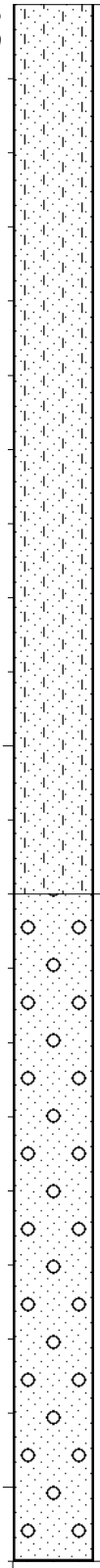
DATE : 22/02/2019 13:34
TEXT : ..Kimberley\TPProfiles.txt

Macroplan
Lethabo Park

HOLE No: 53
Sheet 1 of 1

JOB NUMBER: 2019/J004/MAC

Scale 1:10



0.00 Dry, red brown, medium dense, intact, silty sand. Colluvium.

1.20 Dry, light grey speckled dark green, medium dense to dense, intact, gravelly sand. Calcified residual dolerite grading into bedrock.

2.10

NOTES

1) Gradual refusal of excavation.

2) No seepage.

CONTRACTOR : Big Five Construction
MACHINE : Cat 422F
DRILLED BY : Petrus
PROFILED BY : Izak Breytenbach

INCLINATION :
DIAM : 700mm
DATE :
DATE : 21-22/01/2019

ELEVATION :
X-COORD : 28° 39 28.5S
Y-COORD : 24° 43 26.5E

TYPE SET BY : Izak Breytenbach
SETUP FILE : STANDARD.SET

DATE : 22/02/2019 13:34
TEXT : ..Kimberley\TPProfiles.txt

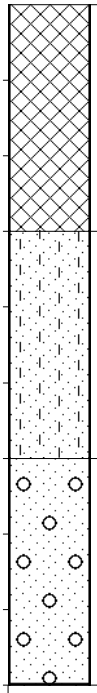
HOLE No: 53
Geotechnical Investigation

Macroplan
Lethabo Park

HOLE No: 54
Sheet 1 of 1

JOB NUMBER: 2019/J004/MAC

Scale 1:10



0.00 Dry, dark brown, medium dense, voided, silty sand. Fill material.

0.30 Dry, red brown, loose to medium dense, intact, silty sand. Colluvium.

0.60 Dry, dark green grey, dense to very dense, intact, gravelly sand. Residual dolerite tending to bedrock.

SKT-71-656:

0.90

NOTES

1) Gradual refusal of excavation.
2) Disturbed Sample SKT-71-656: 0.75m.
3) No seepage.

CONTRACTOR : Big Five Construction
MACHINE : Cat 422F
DRILLED BY : Petrus
PROFILED BY : Izak Breytenbach

INCLINATION :
DIAM : 700mm
DATE :
DATE : 21-22/01/2019

ELEVATION :
X-COORD : 28° 39 34.1S
Y-COORD : 24° 43 30.9E

TYPE SET BY : Izak Breytenbach
SETUP FILE : STANDARD.SET

DATE : 22/02/2019 13:34
TEXT : ..Kimberley\TPProfiles.txt

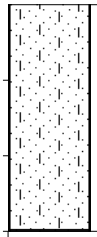
HOLE No: 54
Geotechnical Investigation

Macroplan
Lethabo Park

HOLE No: 55
Sheet 1 of 1

JOB NUMBER: 2019/J004/MAC

Scale 1:10



0.00 Dry, red brown, loose to medium dense, intact, silty sand. Colluvium.

0.30

NOTES

1) Instant refusal, presumably on dolerite corestone.

2) No seepage.

CONTRACTOR : Big Five Construction
MACHINE : Cat 422F
DRILLED BY : Petrus
PROFILED BY : Izak Breytenbach

TYPE SET BY : Izak Breytenbach
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM : 700mm
DATE :
DATE : 21-22/01/2019

DATE : 22/02/2019 13:34
TEXT : ..Kimberley\TPProfiles.txt

ELEVATION :
X-COORD : 28° 39 38.3S
Y-COORD : 24° 43 34.0E

HOLE No: 55
Geotechnical Investigation

Macroplan
Lethabo Park

LEGEND
Sheet 1 of 1

JOB NUMBER: 2019/J004/MAC

	GRAVEL	{SA02}
	GRAVELLY	{SA03}
	SAND	{SA04}
	SANDY	{SA05}
	SILTY	{SA07}
	CLAY	{SA08}
	CLAYEY	{SA09}
	SHALE	{SA12}
	CALCRETE	{SA26}
	FILL	{SA32}
Name	UNDISTURBED SAMPLE	{SA37}
Name	DISTURBED SAMPLE	{SA38}
	ROOTS	{SA40}

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY :

INCLINATION :
DIAM :
DATE :
DATE :

ELEVATION :
X-COORD :
Y-COORD :

TYPE SET BY : Izak Breytenbach
SETUP FILE : STANDARD.SET

DATE : 22/02/2019 13:34
TEXT : ..Kimberley\TPProfiles.txt

LEGEND
SUMMARY OF SYMBOLS

APPENDIX B: MATERIAL TEST RESULTS

Specialised Testing Laboratory (Pty) Ltd
Asphalt | Aggregate | Bitumen | Geotechnical
Quality | Excellence | On Time

Unit 1, 13 Bloubokkie Street, Koedoespoort 0186
Roelof | 072 674 6343 | roelof@stlab.co.za
Gerrie | 082 309 4448 | gerrie@stlab.co.za
www.stlab.co.za

Client Name: Soilkraft
Project Name: Lethabo Park
Job Number: SKT-71
Date: 21-Feb-19
Method: SANS 3001 GR1, GR3 GR10, GR12 GR20, GR30, GR31, GR40, GR50, GR53, GR54 & BS 1377 (where applicable)

SUMMARY OF TEST DATA

Grading & Hydrometer Analysis (% Passing)

Sample	TH 9	TH 11	TH 13	TH 14	TH 17	TH 20	TH 24	TH 26
Depth (mm)	900 - 2300	0 - 500	700 - 1400	1100 - 2300	0 - 800	600 - 1600	400 - 1100	1200 - 1700
Lab No	SKT-71-635	SKT-71-636	SKT-71-637	SKT-71-638	SKT-71-639	SKT-71-640	SKT-71-641	SKT-71-642
53.0	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**
37.5	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**
26.5	**99**	**100**	**100**	**100**	**100**	**100**	**100**	**99**
19.0	**88**	**100**	**100**	**100**	**100**	**100**	**100**	**95**
13.2	**86**	**99**	**100**	**100**	**100**	**99**	**100**	**95**
9.5	**84**	**99**	**99**	**100**	**100**	**97**	**99**	**95**
6.7	**81**	**99**	**99**	**99**	**99**	**94**	**99**	**95**
4.75	**78**	**99**	**98**	**99**	**99**	**92**	**98**	**95**
2.00	**70**	**99**	**95**	**96**	**99**	**84**	**96**	**94**
1.00	**65**	**98**	**93**	**95**	**98**	**80**	**94**	**93**
0.425	**61**	**96**	**89**	**93**	**96**	**76**	**91**	**92**
0.250	**55**	**91**	**83**	**89**	**91**	**71**	**85**	**82**
0.150	**49**	**71**	**75**	**83**	**73**	**65**	**79**	**69**
0.075	**38**	**43**	**65**	**77**	**49**	**56**	**72**	**51**
0.060	**31**	**35**	**64**	**75**	**39**	**48**	**70**	**41**
0.050	**29**	**33**	**63**	**74**	**37**	**47**	**69**	**41**
0.035	**26**	**29**	**61**	**72**	**33**	**45**	**66**	**39**
0.020	**21**	**26**	**58**	**68**	**31**	**43**	**63**	**37**
0.006	**16**	**21**	**50**	**61**	**26**	**35**	**53**	**31**
0.002	**10**	**15**	**37**	**51**	**20**	**25**	**33**	**20**
GM	**1.31**	**0.62**	**0.51**	**0.34**	**0.56**	**0.84**	**0.41**	**0.63**

Atterberg Limits

LL (%)	**40**	**22**	**34**	**58**	**28**	**48**	**36**	**31**
PI (%)	**19**	**10**	**17**	**35**	**15**	**18**	**14**	**14**
LS (%)	**9.5**	**5.0**	**8.0**	**24.0**	**8.0**	**9.0**	**7.5**	**7.5**

pH & Conductivity

pH	**9.4**		**8.6**			**8.9**	**9.0**	
EC (S/m)	**0.198**		**0.209**			**0.029**	**0.207**	

MDD / OMC

MDD (kg/m^3)								
OMC (%)								

CBR

100%								
98%								
97%								
95%								
93%								
90%								
Swell (%)								

UCS (MPa)

100%								
97%								
90%								

COLTO Classification

Remarks:

Specialised Testing Laboratory (Pty) Ltd
Asphalt | Aggregate | Bitumen | Geotechnical
Quality | Excellence | On Time

Unit 1, 13 Bloubokkie Street, Koedoespoort 0186
Roelof | 072 674 6343 | roelof@stlab.co.za
Gerrie | 082 309 4448 | gerrie@stlab.co.za
www.stlab.co.za

Client Name: Soilkraft
Project Name: Lethabo Park
Job Number: SKT-71
Date: 21-Feb-19
Method: SANS 3001 GR1, GR3 GR10, GR12 GR20, GR30, GR31, GR40, GR50, GR53, GR54 & BS 1377 (where applicable)

SUMMARY OF TEST DATA

Grading & Hydrometer Analysis (% Passing)

Sample	TH 29	TH 30	TH 33	TH 35	TH 37	TH 40	TH 43	TH 46
Depth (mm)	1100 - 2000	700 - 1600	900 - 1700	1100 - 1900	0 - 700	0 - 700	0 - 600	800 - 1300
Lab No	SKT-71-643	SKT-71-644	SKT-71-645	SKT-71-646	SKT-71-648	SKT-71-649	SKT-71-651	SKT-71-652
53.0	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**
37.5	**100**	**97**	**100**	**86**	**100**	**100**	**100**	**100**
26.5	**96**	**85**	**93**	**68**	**100**	**100**	**100**	**91**
19.0	**89**	**76**	**86**	**59**	**100**	**100**	**100**	**83**
13.2	**89**	**72**	**79**	**49**	**100**	**100**	**100**	**82**
9.5	**89**	**67**	**73**	**43**	**100**	**100**	**100**	**79**
6.7	**87**	**60**	**66**	**38**	**100**	**100**	**100**	**74**
4.75	**86**	**55**	**60**	**34**	**100**	**99**	**100**	**71**
2.00	**82**	**40**	**49**	**24**	**100**	**97**	**100**	**62**
1.00	**79**	**30**	**45**	**18**	**100**	**97**	**99**	**58**
0.425	**75**	**22**	**40**	**13**	**98**	**94**	**96**	**53**
0.250	**69**	**17**	**34**	**10**	**83**	**81**	**81**	**46**
0.150	**63**	**14**	**26**	**7**	**59**	**54**	**45**	**31**
0.075	**53**	**9**	**18**	**4**	**33**	**34**	**18**	**17**
0.060	**43**	**6**	**14**	**3**	**23**	**18**	**11**	**13**
0.050	**42**	**6**	**12**	**3**	**21**	**16**	**10**	**12**
0.035	**39**	**4**	**9**	**2**	**18**	**11**	**7**	**10**
0.020	**34**	**3**	**8**	**1**	**15**	**10**	**6**	**8**
0.006	**28**	**2**	**6**	**1**	**13**	**9**	**5**	**6**
0.002	**20**	**2**	**4**	**1**	**11**	**8**	**4**	**5**
GM	**0.90**	**2.29**	**1.93**	**2.59**	**0.69**	**0.75**	**0.86**	**1.68**

Atterberg Limits

LL (%)	**58**	**29**	**42**	**0**	**20**	**0**	**0**	**22**
PI (%)	**32**	**7**	**15**	**SP**	**7**	**SP**	**SP**	**7**
LS (%)	**21.0**	**4.0**	**7.0**	**1.0**	**3.0**	**0.5**	**0.5**	**3.5**

pH & Conductivity

pH	**9.2**	**8.6**		**8.7**			**7.8**	
EC (S/m)	**0.234**	**0.031**		**0.0330**			**0.041**	

MDD / OMC

MDD (kg/m^3)								
OMC (%)								

CBR

100%								
98%								
97%								
95%								
93%								
90%								
Swell (%)								

UCS (MPa)

100%								
97%								
90%								

COLTO Classification

Remarks:

Specialised Testing Laboratory (Pty) Ltd
Asphalt | Aggregate | Bitumen | Geotechnical
Quality | Excellence | On Time

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Client Name: Soilkraft
Project Name: Lethabo Park
Job Number: SKT-71
Date: 21-Feb-19
Method: SANS 3001 GR1, GR3 GR10, GR12 GR20, GR30, GR31, GR40, GR50, GR53, GR54 & BS 1377 (where applicable)

SUMMARY OF TEST DATA

Grading & Hydrometer Analysis (% Passing)

Sample	TH 48	TH 49	TH 52	TH 54				
Depth (mm)	1100 - 1800	300 - 1900	1000 - 2000	600 - 900				
Lab No	SKT-71-653	SKT-71-654	SKT-71-655	SKT-71-656				
53.0	**100**	**100**	**100**	**100**				
37.5	**86**	**100**	**100**	**100**				
26.5	**78**	**95**	**92**	**95**				
19.0	**70**	**89**	**78**	**90**				
13.2	**61**	**75**	**75**	**88**				
9.5	**49**	**64**	**72**	**85**				
6.7	**40**	**52**	**67**	**81**				
4.75	**33**	**45**	**64**	**76**				
2.00	**22**	**32**	**50**	**57**				
1.00	**17**	**26**	**41**	**44**				
0.425	**14**	**22**	**33**	**35**				
0.250	**11**	**16**	**27**	**29**				
0.150	**8**	**12**	**18**	**20**				
0.075	**5**	**7**	**12**	**12**				
0.060	**3**	**5**	**8**	**8**				
0.050	**3**	**4**	**7**	**7**				
0.035	**3**	**3**	**5**	**6**				
0.020	**2**	**2**	**4**	**5**				
0.006	**2**	**2**	**3**	**3**				
0.002	**2**	**1**	**2**	**2**				
GM	**2.59**	**2.39**	**2.05**	**1.96**				

Atterberg Limits

LL (%)	**22**	**0**	**27**	**20**				
PI (%)	**8**	**SP**	**10**	**7**				
LS (%)	**4.5**	**1.0**	**4.5**	**3.5**				

pH & Conductivity

pH	**8.4**			**8.1**				
EC (S/m)	**0.039**			**0.0310**				

MDD / OMC

MDD (kg/m^3)								
OMC (%)								

CBR

100%								
98%								
97%								
95%								
93%								
90%								
Swell (%)								

UCS (MPa)

100%								
97%								
90%								

COLTO Classification

Remarks:

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Quality | Excellence | On Time

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Client Name: Soilkraft
Project Name: Lethabo Park
Job Number: SKT-71
Date: 2019-02-21
Method: SANS 3001 GR1, GR3, GR10 GR12 & BS 1377 (where applicable)

FOUNDATION INDICATOR

Grading & Hydrometer Analysis (Particle Size (mm) & % Passing)				Atterberg Limits & Classification			
Sample	TH 9	TH 11	TH 13	Sample	TH 9	TH 11	TH 13
Depth (mm)	900 - 2300	0 - 500	700 - 1400	Depth (mm)	900 - 2300	0 - 500	700 - 1400
Lab No	SKT-71-635	SKT-71-636	SKT-71-637	Lab No	SKT-71-635	SKT-71-636	SKT-71-637
53.0	**100**	**100**	**100**	Liquid Limit (%)	**40**	**22**	**34**
37.5	**100**	**100**	**100**	Plastic Limit (%)	**21**	**12**	**17**
26.5	**99**	**100**	**100**	Plasticity Index (%)	**19**	**10**	**17**
19.0	**88**	**100**	**100**	Linear Shrinkage (%)	**9.5**	**5.0**	**8.0**
13.2	**86**	**99**	**100**	PI of whole sample	**12**	**10**	**15**
9.5	**84**	**99**	**99**				
6.7	**81**	**99**	**99**	% Gravel	**30**	**1**	**5**
4.75	**78**	**99**	**98**	% Sand	**39**	**64**	**31**
2.00	**70**	**99**	**95**	% Silt	**21**	**20**	**27**
1.00	**65**	**98**	**93**	% Clay	**10**	**15**	**37**
0.425	**61**	**96**	**89**	Activity	**1.9**	**0.7**	**0.5**
0.250	**55**	**91**	**83**				
0.150	**49**	**71**	**75**	% Soil Mortar	**70**	**99**	**95**
0.075	**38**	**43**	**65**				
0.060	**31**	**35**	**64**	Grading Modulus	**1.31**	**0.62**	**0.51**
0.050	**29**	**33**	**63**	Moisture Content (%)	**N / T**	**N / T**	**N / T**
0.035	**26**	**29**	**61**	Relative Density (SG)*	**2.65**	**2.65**	**2.65**
0.020	**21**	**26**	**58**				
0.006	**16**	**21**	**50**	Unified (ASTM D2487)	**SC**	**SC**	**CL**
0.002	**10**	**15**	**37**	AASHTO (M145-91)	**A - 6**	**A - 4**	**A - 6**

Remarks: *: Assumed
N / T: Not Tested

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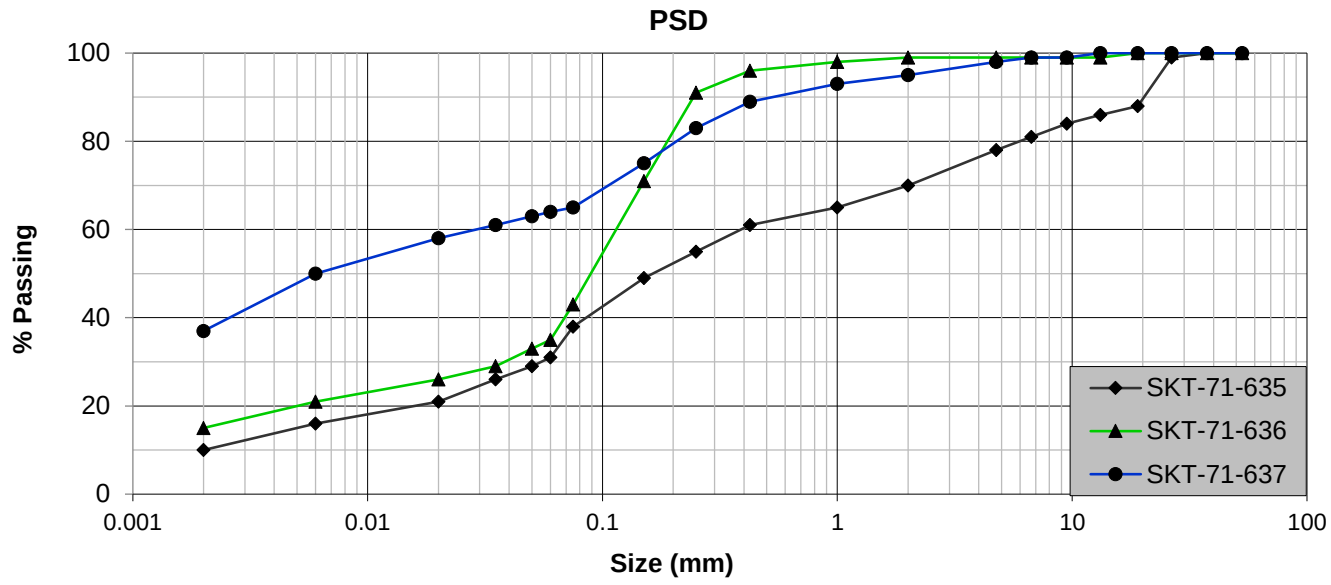
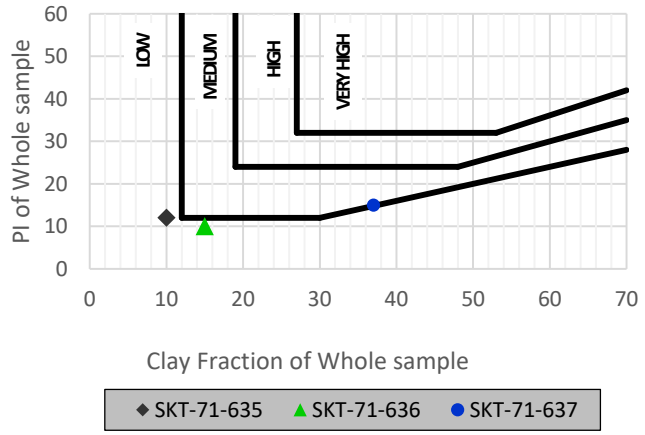
Project Name: Lethabo Park
Job Number: SKT-71
Date: 2019-02-21
Method: SANS 3001 GR1, GR3, GR10 GR12 & BS 1377 (where applicable)

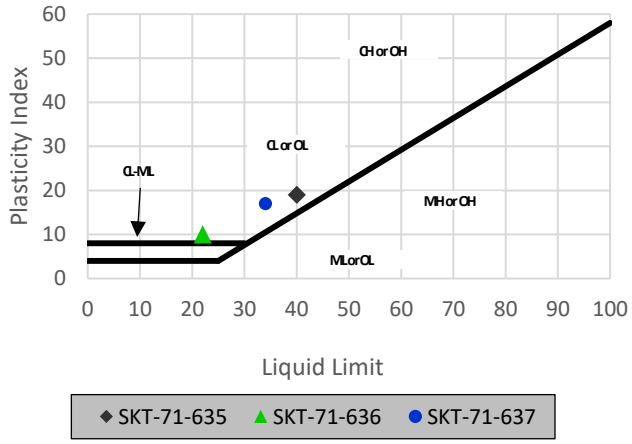
FOUNDATION INDICATOR



Potential Expansiveness



Casagrande Plasticity Chart



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FOUNDATION INDICATOR

Grading & Hydrometer Analysis (Particle Size (mm) & % Passing)				Atterberg Limits & Classification			
Sample	TH 14	TH 17	TH 20	Sample	TH 14	TH 17	TH 20
Depth (mm)	1100 - 2300	0 - 800	600 - 1600	Depth (mm)	1100 - 2300	0 - 800	600 - 1600
Lab No	SKT-71-638	SKT-71-639	SKT-71-640	Lab No	SKT-71-638	SKT-71-639	SKT-71-640
53.0	**100**	**100**	**100**	Liquid Limit (%)	**58**	**28**	**48**
37.5	**100**	**100**	**100**	Plastic Limit (%)	**23**	**13**	**30**
26.5	**100**	**100**	**100**	Plasticity Index (%)	**35**	**15**	**18**
19.0	**100**	**100**	**100**	Linear Shrinkage (%)	**24.0**	**8.0**	**9.0**
13.2	**100**	**100**	**99**	PI of whole sample	**33**	**14**	**14**
9.5	**100**	**100**	**97**				
6.7	**99**	**99**	**94**	% Gravel	**4**	**1**	**16**
4.75	**99**	**99**	**92**	% Sand	**21**	**60**	**36**
2.00	**96**	**99**	**84**	% Silt	**24**	**19**	**23**
1.00	**95**	**98**	**80**	% Clay	**51**	**20**	**25**
0.425	**93**	**96**	**76**	Activity	**0.7**	**0.8**	**0.7**
0.250	**89**	**91**	**71**				
0.150	**83**	**73**	**65**	% Soil Mortar	**96**	**99**	**84**
0.075	**77**	**49**	**56**				
0.060	**75**	**39**	**48**	Grading Modulus	**0.34**	**0.56**	**0.84**
0.050	**74**	**37**	**47**	Moisture Content (%)	**N / T**	**N / T**	**N / T**
0.035	**72**	**33**	**45**	Relative Density (SG)*	**2.65**	**2.65**	**2.65**
0.020	**68**	**31**	**43**				
0.006	**61**	**26**	**35**	Unified (ASTM D2487)	**CH**	**SC**	**ML**
0.002	**51**	**20**	**25**	AASHTO (M145-91)	**A - 7 - 6**	**A - 6**	**A - 7 - 5**

Remarks: *: Assumed
N / T: Not Tested

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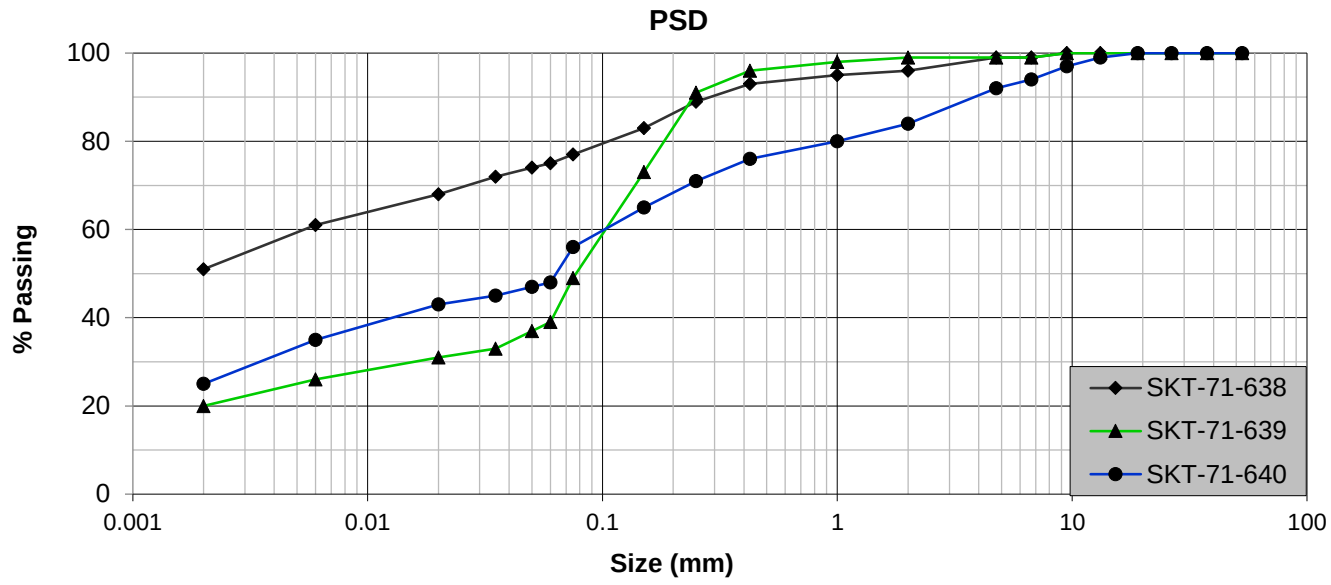
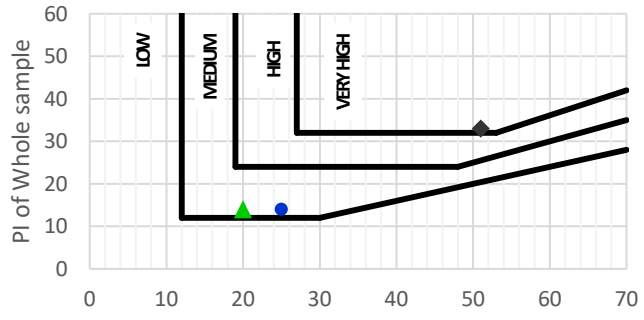
Project Name: Lethabo Park
Job Number: SKT-71
Date: 2019-02-21
Method: SANS 3001 GR1, GR3, GR10 GR12 & BS 1377 (where applicable)

FOUNDATION INDICATOR

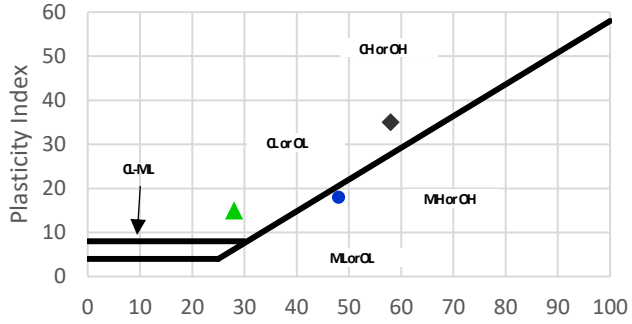


Potential Expansiveness



◆ SKT-71-638 ▲ SKT-71-639 ● SKT-71-640

Casagrande Plasticity Chart



◆ SKT-71-638 ▲ SKT-71-639 ● SKT-71-640

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Job Number: SKT-71
Date: 2019-02-21
Method: SANS 3001 GR1, GR3, GR10 GR12 & BS 1377 (where applicable)

FOUNDATION INDICATOR

Grading & Hydrometer Analysis (Particle Size (mm) & % Passing)				Atterberg Limits & Classification			
Sample	TH 24	TH 26	TH 29	Sample	TH 24	TH 26	TH 29
Depth (mm)	400 - 1100	1200 - 1700	1100 - 2000	Depth (mm)	400 - 1100	1200 - 1700	1100 - 2000
Lab No	SKT-71-641	SKT-71-642	SKT-71-643	Lab No	SKT-71-641	SKT-71-642	SKT-71-643
53.0	**100**	**100**	**100**	Liquid Limit (%)	**36**	**31**	**58**
37.5	**100**	**100**	**100**	Plastic Limit (%)	**22**	**17**	**26**
26.5	**100**	**99**	**96**	Plasticity Index (%)	**14**	**14**	**32**
19.0	**100**	**95**	**89**	Linear Shrinkage (%)	**7.5**	**7.5**	**21.0**
13.2	**100**	**95**	**89**	PI of whole sample	**13**	**13**	**24**
9.5	**99**	**95**	**89**				
6.7	**99**	**95**	**87**	% Gravel	**4**	**6**	**18**
4.75	**98**	**95**	**86**	% Sand	**26**	**53**	**39**
2.00	**96**	**94**	**82**	% Silt	**37**	**21**	**23**
1.00	**94**	**93**	**79**	% Clay	**33**	**20**	**20**
0.425	**91**	**92**	**75**	Activity	**0.4**	**0.7**	**1.6**
0.250	**85**	**82**	**69**				
0.150	**79**	**69**	**63**	% Soil Mortar	**96**	**94**	**82**
0.075	**72**	**51**	**53**				
0.060	**70**	**41**	**43**	Grading Modulus	**0.41**	**0.63**	**0.90**
0.050	**69**	**41**	**42**	Moisture Content (%)	**N / T**	**N / T**	**N / T**
0.035	**66**	**39**	**39**	Relative Density (SG)*	**2.65**	**2.65**	**2.65**
0.020	**63**	**37**	**34**				
0.006	**53**	**31**	**28**	Unified (ASTM D2487)	**CL**	**CL**	**CH**
0.002	**33**	**20**	**20**	AASHTO (M145-91)	**A - 6**	**A - 6**	**A - 7 - 6**

Remarks: *: Assumed
N / T: Not Tested

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Quality | Excellence | On Time

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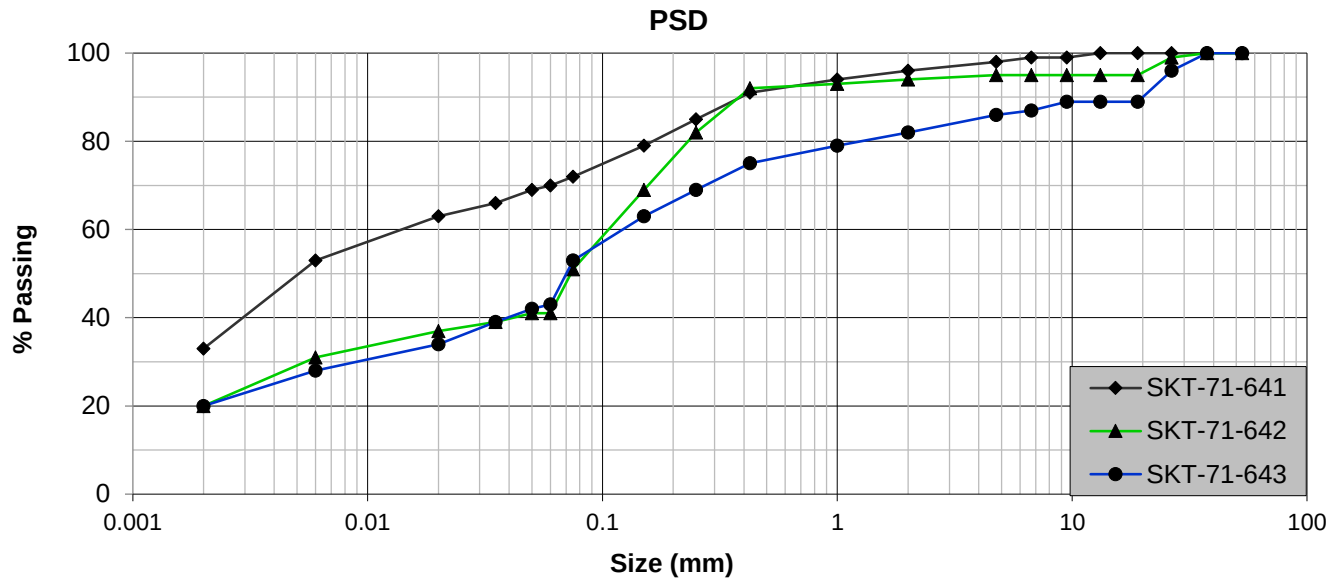
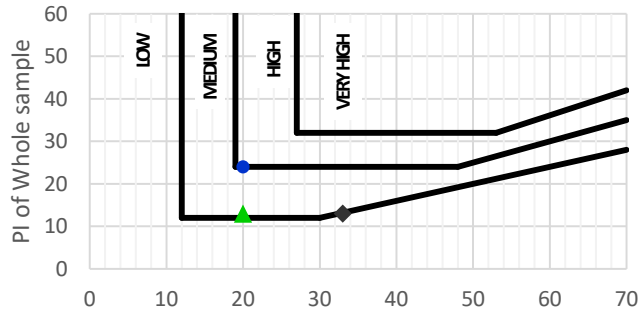
Client Name: Soilkraft
Project Name: Lethabo Park
Job Number: SKT-71
Date: 2019-02-21
Method: SANS 3001 GR1, GR3, GR10 GR12 & BS 1377 (where applicable)

FOUNDATION INDICATOR

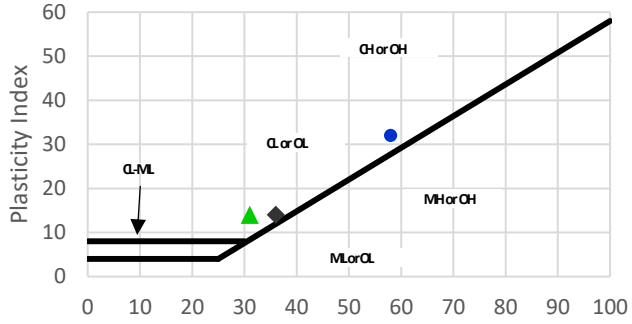


Potential Expansiveness



◆ SKT-71-641 ▲ SKT-71-642 ● SKT-71-643

Casagrande Plasticity Chart



◆ SKT-71-641 ▲ SKT-71-642 ● SKT-71-643

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Date: 2019-02-21
Method: SANS 3001 GR1, GR3, GR10 GR12 & BS 1377 (where applicable)

FOUNDATION INDICATOR

Grading & Hydrometer Analysis (Particle Size (mm) & % Passing)				Atterberg Limits & Classification			
Sample	TH 30	TH 33	TH 35	Sample	TH 30	TH 33	TH 35
Depth (mm)	700 - 1600	900 - 1700	1100 - 1900	Depth (mm)	700 - 1600	900 - 1700	1100 - 1900
Lab No	SKT-71-644	SKT-71-645	SKT-71-646	Lab No	SKT-71-644	SKT-71-645	SKT-71-646
53.0	**100**	**100**	**100**	Liquid Limit (%)	**29**	**42**	**0**
37.5	**97**	**100**	**86**	Plastic Limit (%)	**22**	**27**	**0**
26.5	**85**	**93**	**68**	Plasticity Index (%)	**7**	**15**	**SP**
19.0	**76**	**86**	**59**	Linear Shrinkage (%)	**4.0**	**7.0**	**1.0**
13.2	**72**	**79**	**49**	PI of whole sample	**2**	**6**	**0**
9.5	**67**	**73**	**43**				
6.7	**60**	**66**	**38**	% Gravel	**60**	**51**	**76**
4.75	**55**	**60**	**34**	% Sand	**34**	**35**	**21**
2.00	**40**	**49**	**24**	% Silt	**4**	**10**	**2**
1.00	**30**	**45**	**18**	% Clay	**2**	**4**	**1**
0.425	**22**	**40**	**13**	Activity	**3.5**	**3.8**	**0.0**
0.250	**17**	**34**	**10**				
0.150	**14**	**26**	**7**	% Soil Mortar	**40**	**49**	**24**
0.075	**9**	**18**	**4**				
0.060	**6**	**14**	**3**	Grading Modulus	**2.29**	**1.93**	**2.59**
0.050	**6**	**12**	**3**	Moisture Content (%)	**N / T**	**N / T**	**N / T**
0.035	**4**	**9**	**2**	Relative Density (SG)*	**2.65**	**2.65**	**2.65**
0.020	**3**	**8**	**1**				
0.006	**2**	**6**	**1**	Unified (ASTM D2487)	**SW-SC**	**SC**	**GW**
0.002	**2**	**4**	**1**	AASHTO (M145-91)	**A - 2 - 4**	**A - 2 - 7**	**A - 1 - a**

Remarks: *: Assumed
N / T: Not Tested

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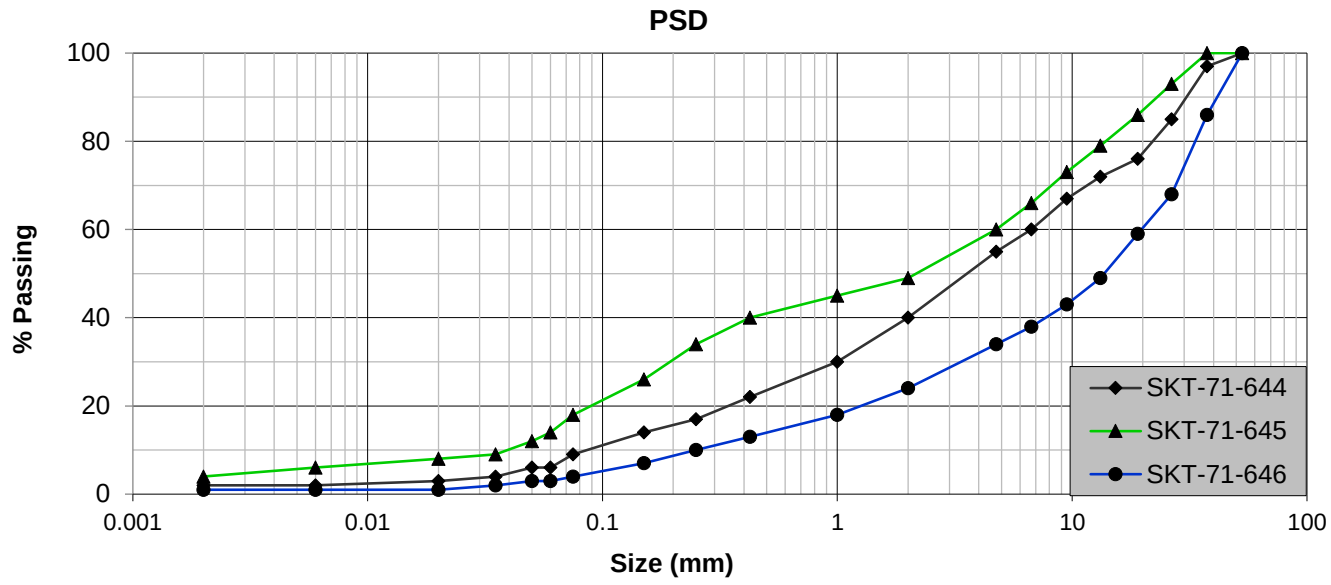
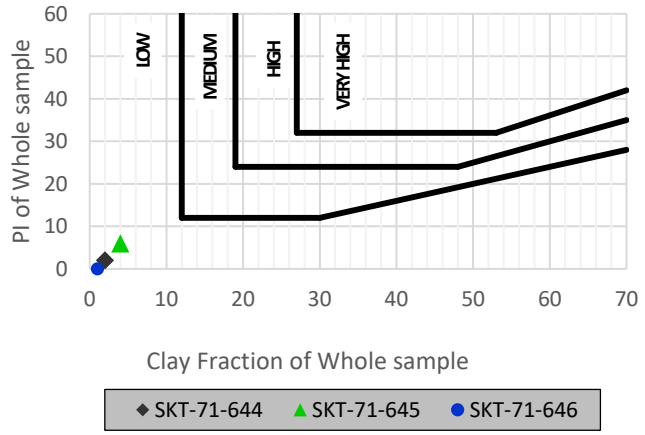
Method: SANS 3001 GR1, GR3, GR10 GR12 & BS 1377 (where applicable)

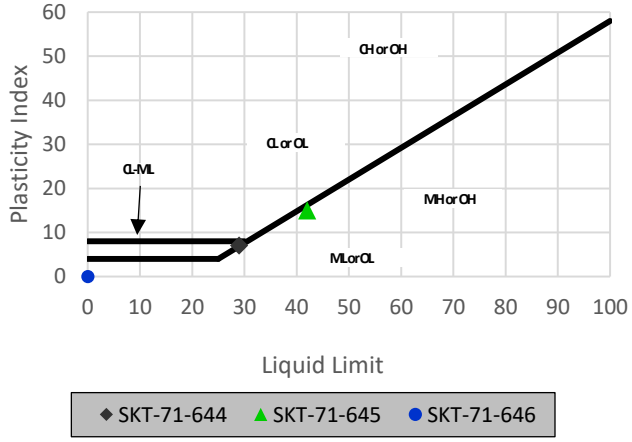
FOUNDATION INDICATOR



Potential Expansiveness



Casagrande Plasticity Chart



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Gerrie | 082 309 4448 | gerrie@stlab.co.za
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Client Name: Soilkraft
Project Name: Lethabo Park
Job Number: SKT-71
Date: 2019-02-21
Method: SANS 3001 GR1, GR3, GR10 GR12 & BS 1377 (where applicable)

FOUNDATION INDICATOR

Grading & Hydrometer Analysis (Particle Size (mm) & % Passing)				Atterberg Limits & Classification			
Sample	TH 37	TH 40	TH 43	Sample	TH 37	TH 40	TH 43
Depth (mm)	0 - 700	0 - 700	0 - 600	Depth (mm)	0 - 700	0 - 700	0 - 600
Lab No	SKT-71-648	SKT-71-649	SKT-71-651	Lab No	SKT-71-648	SKT-71-649	SKT-71-651
53.0	**100**	**100**	**100**	Liquid Limit (%)	**20**	**0**	**0**
37.5	**100**	**100**	**100**	Plastic Limit (%)	**13**	**0**	**0**
26.5	**100**	**100**	**100**	Plasticity Index (%)	**7**	**SP**	**SP**
19.0	**100**	**100**	**100**	Linear Shrinkage (%)	**3.0**	**0.5**	**0.5**
13.2	**100**	**100**	**100**	PI of whole sample	**7**	**0**	**0**
9.5	**100**	**100**	**100**				
6.7	**100**	**100**	**100**	% Gravel	**0**	**3**	**0**
4.75	**100**	**99**	**100**	% Sand	**77**	**79**	**89**
2.00	**100**	**97**	**100**	% Silt	**12**	**10**	**7**
1.00	**100**	**97**	**99**	% Clay	**11**	**8**	**4**
0.425	**98**	**94**	**96**	Activity	**0.6**	**0.0**	**0.0**
0.250	**83**	**81**	**81**				
0.150	**59**	**54**	**45**	% Soil Mortar	**100**	**97**	**100**
0.075	**33**	**34**	**18**				
0.060	**23**	**18**	**11**	Grading Modulus	**0.69**	**0.75**	**0.86**
0.050	**21**	**16**	**10**	Moisture Content (%)	**N / T**	**N / T**	**N / T**
0.035	**18**	**11**	**7**	Relative Density (SG)*	**2.65**	**2.65**	**2.65**
0.020	**15**	**10**	**6**				
0.006	**13**	**9**	**5**	Unified (ASTM D2487)	**SC-SM**	**SM**	**SM**
0.002	**11**	**8**	**4**	AASHTO (M145-91)	**A - 2 - 4**	**A - 2 - 4**	**A - 2 - 4**

Remarks: *: Assumed
N / T: Not Tested

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Quality | Excellence | On Time

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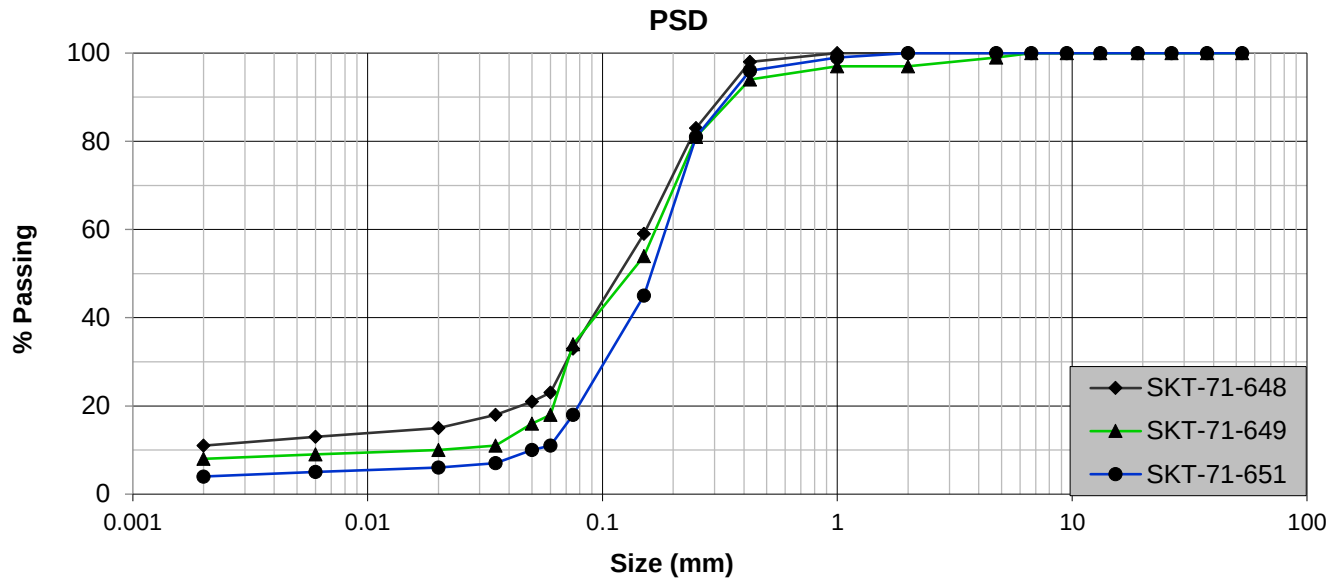
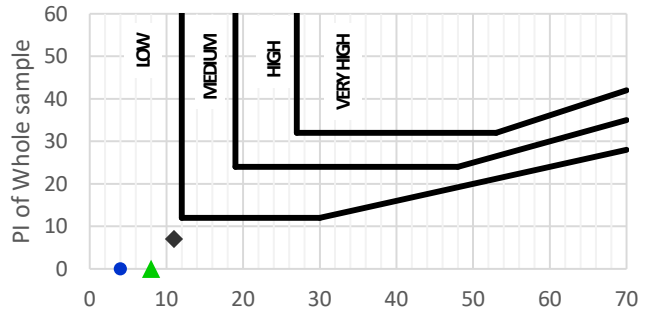
Project Name: Lethabo Park
Job Number: SKT-71
Date: 2019-02-21
Method: SANS 3001 GR1, GR3, GR10 GR12 & BS 1377 (where applicable)

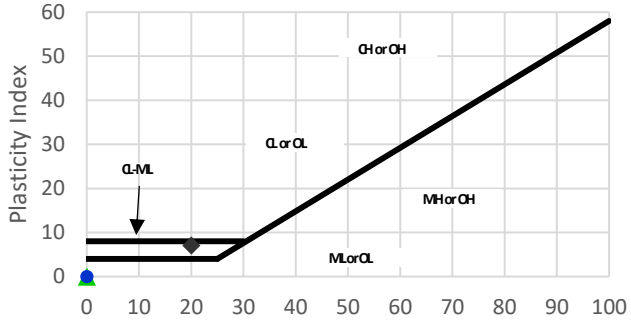
FOUNDATION INDICATOR



Potential Expansiveness



Casagrande Plasticity Chart



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Method: SANS 3001 GR1, GR3, GR10 GR12 & BS 1377 (where applicable)

FOUNDATION INDICATOR

Grading & Hydrometer Analysis (Particle Size (mm) & % Passing)				Atterberg Limits & Classification			
Sample	TH 46	TH 48	TH 49	Sample	TH 46	TH 48	TH 49
Depth (mm)	800 - 1300	1100 - 1800	300 - 1900	Depth (mm)	800 - 1300	1100 - 1800	300 - 1900
Lab No	SKT-71-652	SKT-71-653	SKT-71-654	Lab No	SKT-71-652	SKT-71-653	SKT-71-654
53.0	**100**	**100**	**100**	Liquid Limit (%)	**22**	**22**	**0**
37.5	**100**	**86**	**100**	Plastic Limit (%)	**15**	**14**	**0**
26.5	**91**	**78**	**95**	Plasticity Index (%)	**7**	**8**	**SP**
19.0	**83**	**70**	**89**	Linear Shrinkage (%)	**3.5**	**4.5**	**1.0**
13.2	**82**	**61**	**75**	PI of whole sample	**4**	**1**	**0**
9.5	**79**	**49**	**64**				
6.7	**74**	**40**	**52**	% Gravel	**38**	**78**	**68**
4.75	**71**	**33**	**45**	% Sand	**49**	**19**	**27**
2.00	**62**	**22**	**32**	% Silt	**8**	**1**	**4**
1.00	**58**	**17**	**26**	% Clay	**5**	**2**	**1**
0.425	**53**	**14**	**22**	Activity	**1.4**	**4.0**	**0.0**
0.250	**46**	**11**	**16**				
0.150	**31**	**8**	**12**	% Soil Mortar	**62**	**22**	**32**
0.075	**17**	**5**	**7**				
0.060	**13**	**3**	**5**	Grading Modulus	**1.68**	**2.59**	**2.39**
0.050	**12**	**3**	**4**	Moisture Content (%)	**N / T**	**N / T**	**N / T**
0.035	**10**	**3**	**3**	Relative Density (SG)*	**2.65**	**2.65**	**2.65**
0.020	**8**	**2**	**2**				
0.006	**6**	**2**	**2**	Unified (ASTM D2487)	**SC-SM**	**GP-GC**	**GW-GM**
0.002	**5**	**2**	**1**	AASHTO (M145-91)	**A - 2 - 4**	**A - 2 - 4**	**A - 1 - a**

Remarks: *: Assumed
N / T: Not Tested

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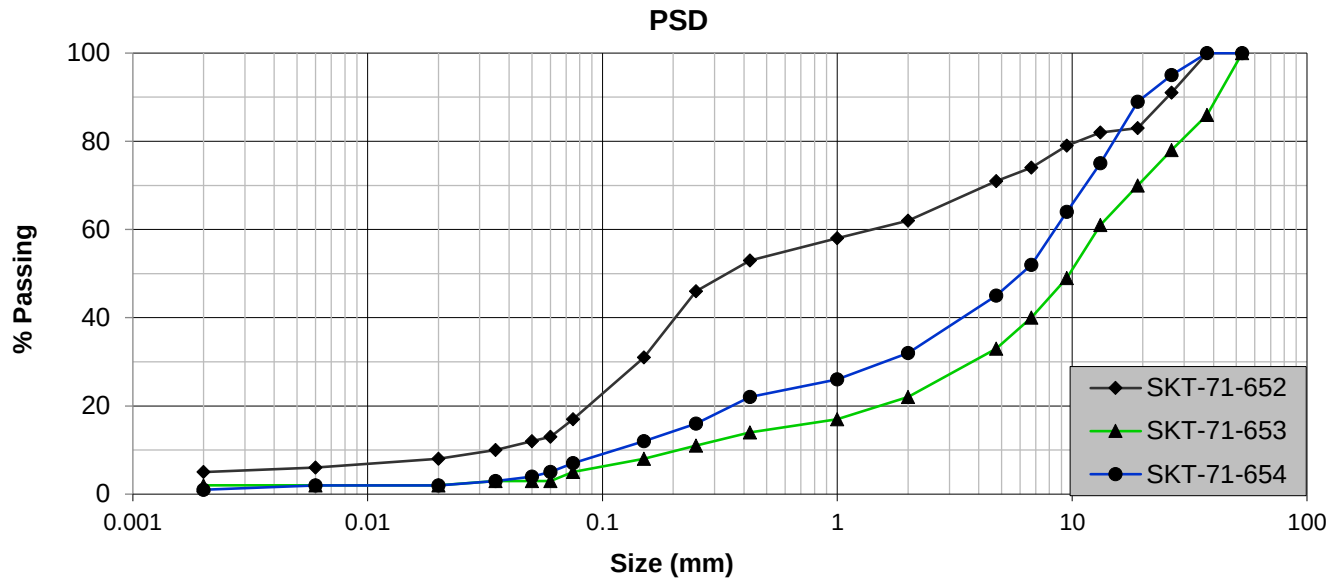
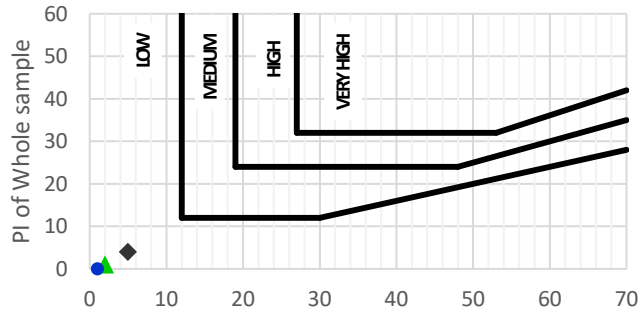
Project Name: Lethabo Park
Job Number: SKT-71
Date: 2019-02-21
Method: SANS 3001 GR1, GR3, GR10 GR12 & BS 1377 (where applicable)

FOUNDATION INDICATOR

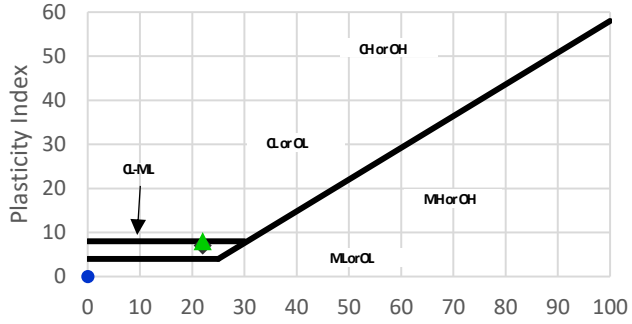


Potential Expansiveness



◆ SKT-71-652 ▲ SKT-71-653 ● SKT-71-654

Casagrande Plasticity Chart



◆ SKT-71-652 ▲ SKT-71-653 ● SKT-71-654

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Project Name: Lethabo Park
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Date: 2019-02-21
Method: SANS 3001 GR1, GR3, GR10 GR12 & BS 1377 (where applicable)

FOUNDATION INDICATOR

Grading & Hydrometer Analysis (Particle Size (mm) & % Passing)				Atterberg Limits & Classification			
Sample	TH 52	TH 54		Sample	TH 52	TH 54	
Depth (mm)	1000 - 2000	600 - 900		Depth (mm)	1000 - 2000	600 - 900	
Lab No	SKT-71-655	SKT-71-656		Lab No	SKT-71-655	SKT-71-656	
53.0	**100**	**100**		Liquid Limit (%)	**27**	**20**	
37.5	**100**	**100**		Plastic Limit (%)	**17**	**13**	
26.5	**92**	**95**		Plasticity Index (%)	**10**	**7**	
19.0	**78**	**90**		Linear Shrinkage (%)	**4.5**	**3.5**	
13.2	**75**	**88**		PI of whole sample	**3**	**2**	
9.5	**72**	**85**					
6.7	**67**	**81**		% Gravel	**50**	**43**	
4.75	**64**	**76**		% Sand	**42**	**49**	
2.00	**50**	**57**		% Silt	**6**	**6**	
1.00	**41**	**44**		% Clay	**2**	**2**	
0.425	**33**	**35**		Activity	**5.0**	**3.5**	
0.250	**27**	**29**					
0.150	**18**	**20**		% Soil Mortar	**50**	**57**	
0.075	**12**	**12**					
0.060	**8**	**8**		Grading Modulus	**2.05**	**1.96**	
0.050	**7**	**7**		Moisture Content (%)	**N / T**	**N / T**	
0.035	**5**	**6**		Relative Density (SG)*	**2.65**	**2.65**	
0.020	**4**	**5**					
0.006	**3**	**3**		Unified (ASTM D2487)	**SP-SC**	**SP-SC**	
0.002	**2**	**2**		AASHTO (M145-91)	**A - 2 - 4**	**A - 2 - 4**	

Remarks: *: Assumed
N / T: Not Tested

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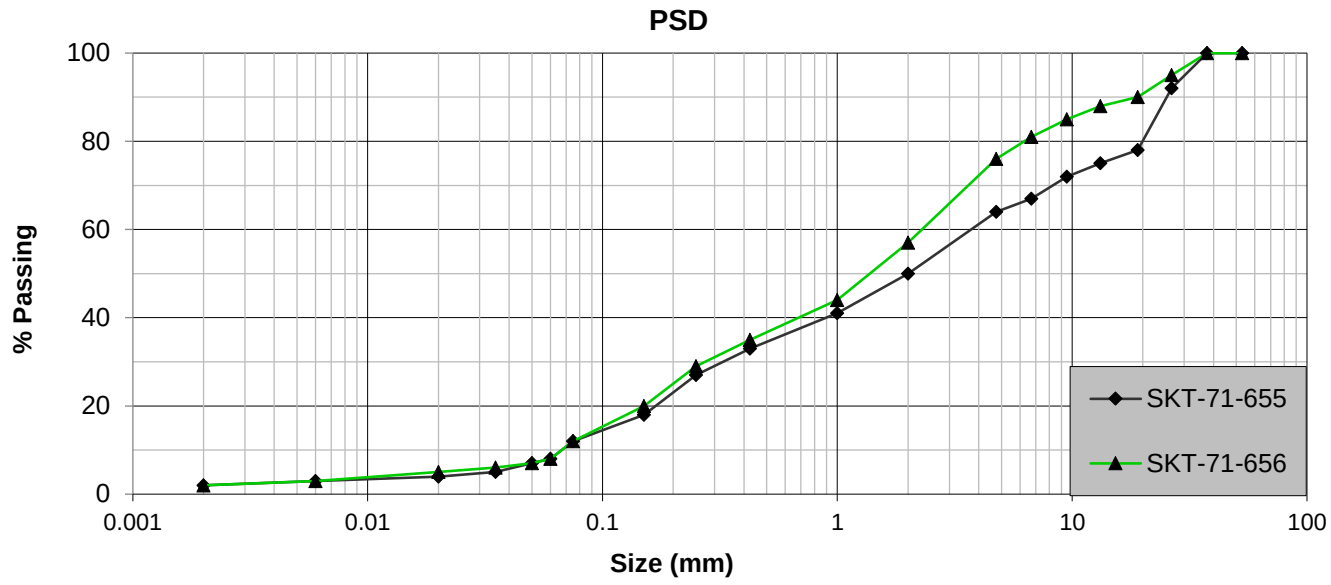
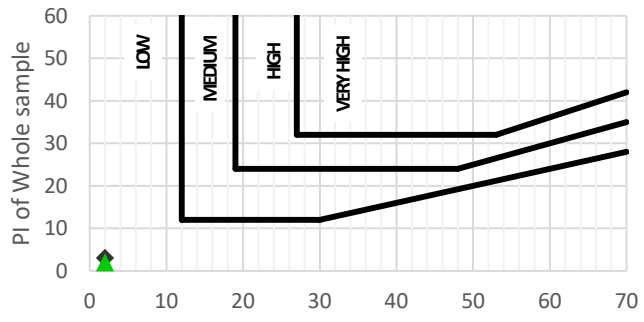
Client Name: Soilkraft
Project Name: Lethabo Park
Job Number: SKT-71
Date: 2019-02-21
Method: SANS 3001 GR1, GR3, GR10 GR12 & BS 1377 (where applicable)

FOUNDATION INDICATOR

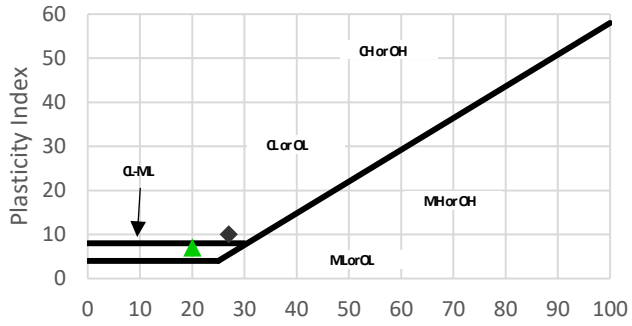


Potential Expansiveness



◆ SKT-71-655 ▲ SKT-71-656

Casagrande Plasticity Chart



◆ SKT-71-655 ▲ SKT-71-656

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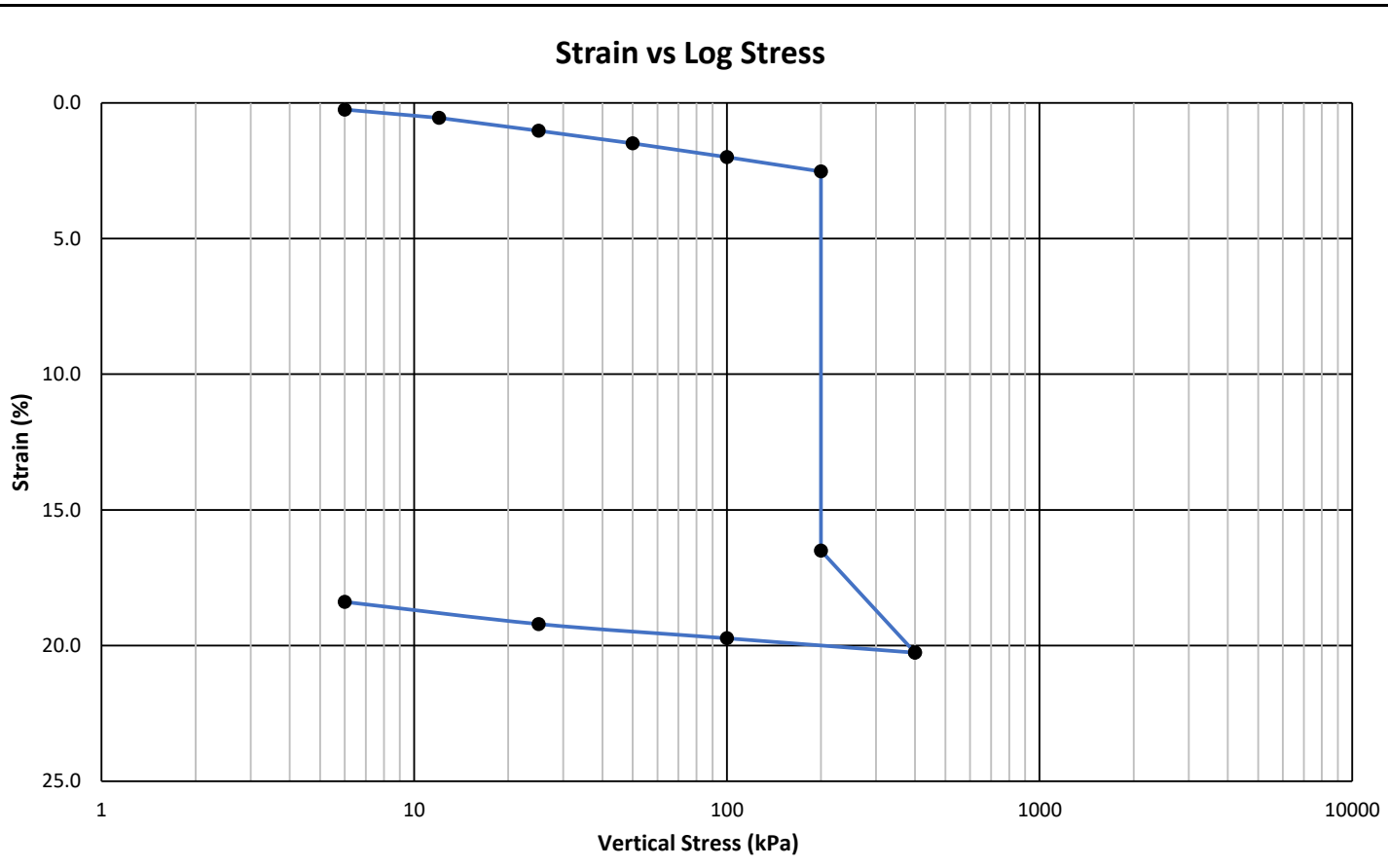
Client Name:	Soilkraft	**Job Number:**	SKT-71
Project Name:	Lethabo Park	**Lab Number:**	SKT-71-647
Sample:	TH 37	**Method:**	BS 1377 Part 5
Depth: (mm)	0 - 700	**Date:**	21-Feb-19

ONE DIMENSIONAL COLLAPSE POTENTIAL TEST

Sample Info		Unit	Initial	Test Remarks:
Test Specimen Height		mm	25.4	**Collapse Potential:** 13.98 %
Moisture Content	Initial	%	5.7	
	Final	%	16.7	
Dry Density		kg/m³	1503	
Void Ratio		-	0.762	
Degree of Saturation		%	19.8	
Relative Density (SG)		-	2.649	Determined

Vertical Stress Applied:	kPa	6	12	25	50	100	200	200	400	100	25	6		
Load applied for:	Hrs	1	1	1	1	1	1	24	1	1	1	1		
Height after increment	mm	25.34	25.26	25.14	25.02	24.89	24.76	21.21	20.25	20.39	20.52	20.73		
Total Strain	%	0.25	0.55	1.03	1.50	1.99	2.52	16.50	20.26	19.73	19.21	18.39		
Void Ratio	-	0.758	0.753	0.744	0.736	0.727	0.718	0.472	0.405	0.415	0.424	0.438		
Mv (1/Mpa)	-	-	0.505	0.375	0.187	0.101	0.054	-	0.225	0.022	0.087	0.532		



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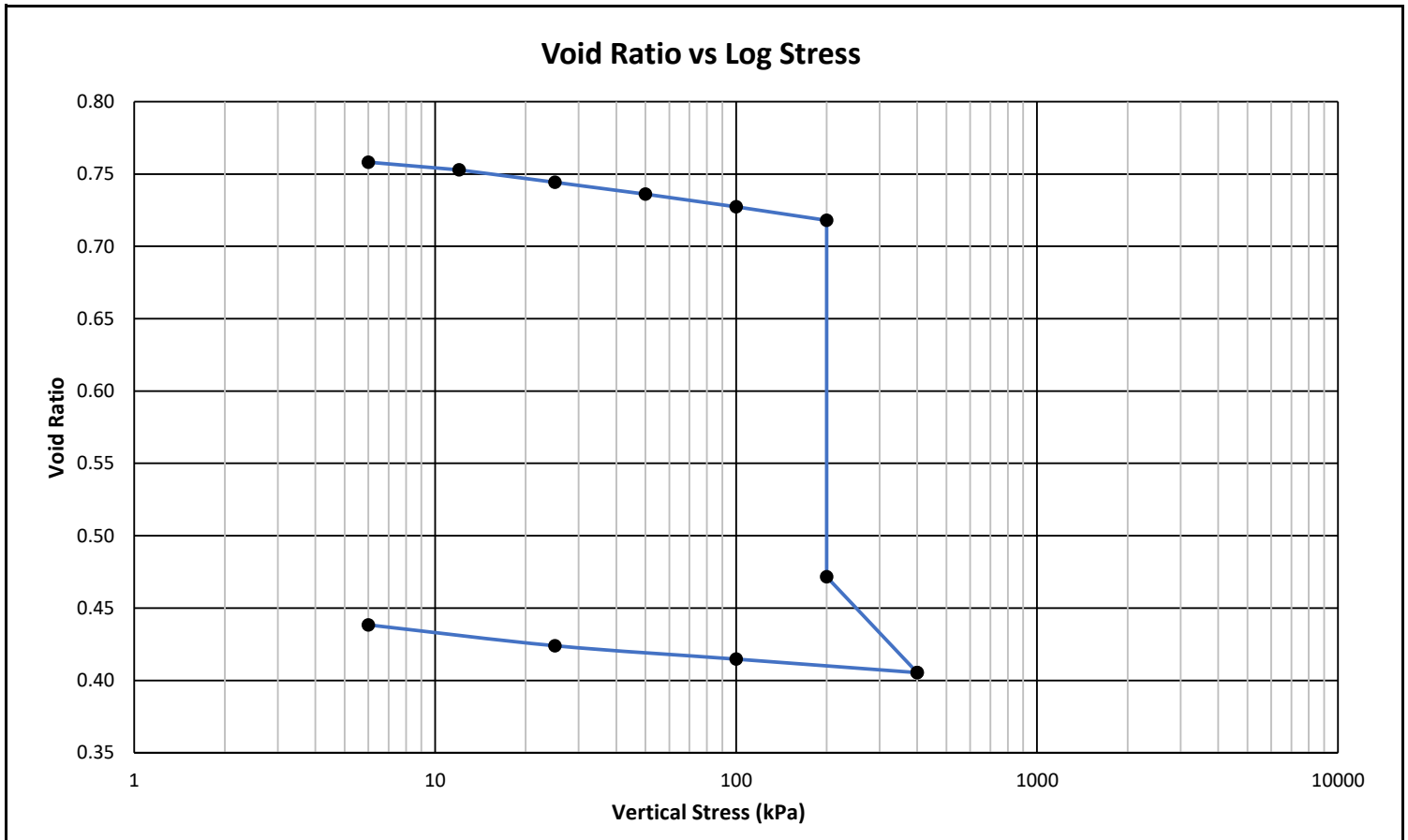
Client Name:	Soilkraft	**Job Number:**	SKT-71
Project Name:	Lethabo Park	**Lab Number:**	SKT-71-647
Sample:	TH 37	**Method:**	BS 1377 Part 5
Depth: (mm)	0 - 700	**Date:**	21-Feb-19

ONE DIMENSIONAL COLLAPSE POTENTIAL TEST

Sample Info		Unit	Initial	Test Remarks:
Test Specimen Height		mm	25.4	**Collapse Potential:** 13.98 %
Moisture Content	Initial	%	5.7	
	Final	%	16.7	
Dry Density		kg/m³	1503	
Void Ratio		-	0.762	
Degree of Saturation		%	19.8	
Relative Density (SG)		-	2.649	Determined

Vertical Stress Applied:	kPa	6	12	25	50	100	200	200	400	100	25	6		
Load applied for:	Hrs	1	1	1	1	1	1	24	1	1	1	1		
Height after increment	mm	25.34	25.26	25.14	25.02	24.89	24.76	21.21	20.25	20.39	20.52	20.73		
Total Strain	%	0.25	0.55	1.03	1.50	1.99	2.52	16.50	20.26	19.73	19.21	18.39		
Void Ratio	-	0.758	0.753	0.744	0.736	0.727	0.718	0.472	0.405	0.415	0.424	0.438		
Mv (1/Mpa)	-	-	0.505	0.375	0.187	0.101	0.054	-	0.225	0.022	0.087	0.532		



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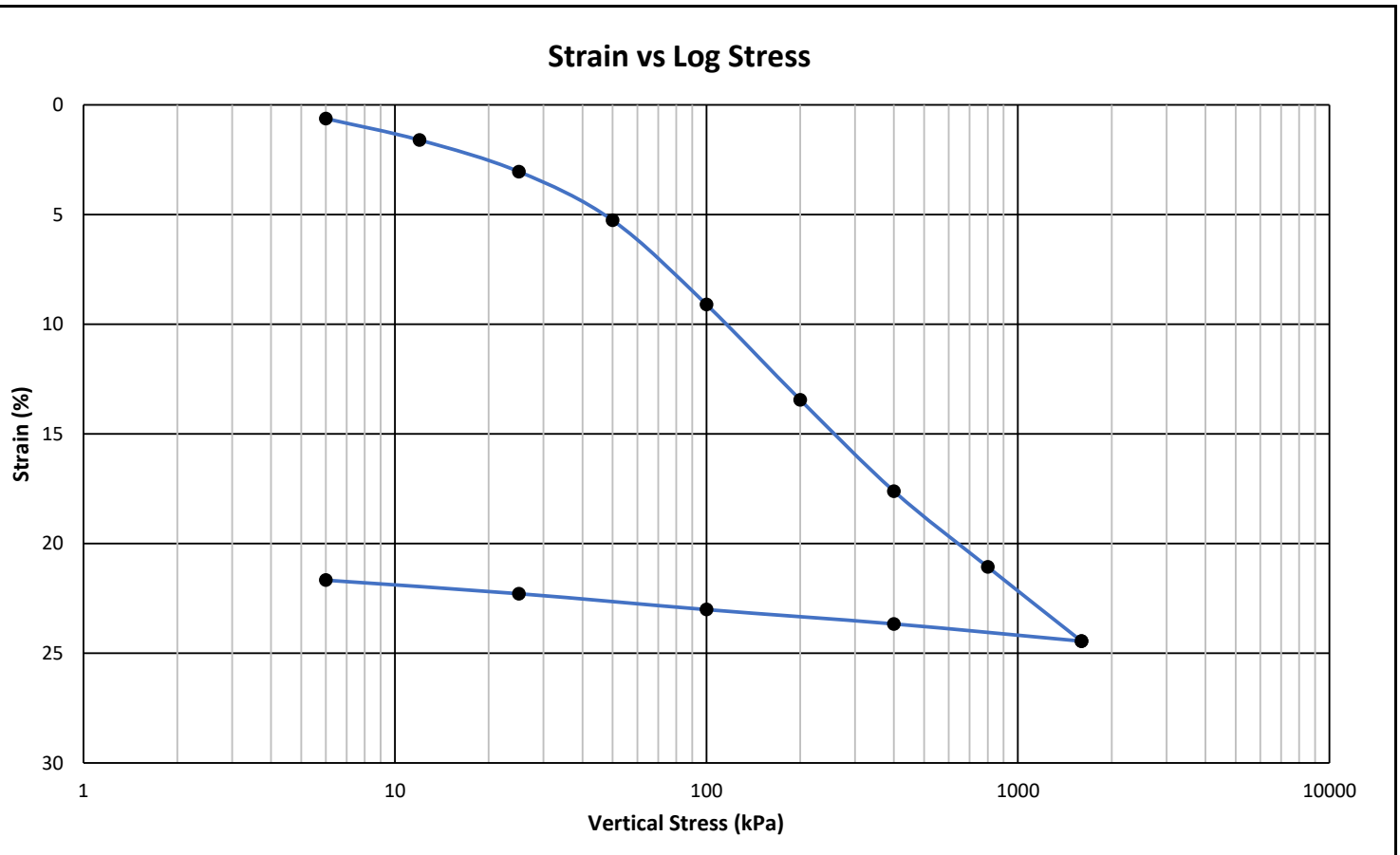
Client Name: Soilkraft
Project Name: Lethabo Park
Sample: TH 37
Depth: (mm) 0 - 700

Job Number: SKT-71
Lab Number: SKT-71-647
Method: BS 1377 Part 5
Date: 21/02/2019

ONE DIMENSIONAL CONSOLIDATION TEST

Sample Info		Unit	Initial	Test Remarks:
Test Specimen Height		mm	25.4	Undisturbed
Moisture Content	Initial	%	5.3	
	Final	%	14.0	
Dry Density		kg/m³	1543	
Void Ratio		-	0.717	
Degree of Saturation		%	19.6	
Relative Density (SG)		-	2.649	Determined

Vertical Stress Applied:	kPa	6	12	25	50	100	200	400	800	1600	400	100	25	6
Load applied for:	Hrs	12	12	12	12	12	12	12	12	12	3	3	3	3
Height after increment	mm	25.24	24.99	24.63	24.06	23.09	21.99	20.93	20.05	19.19	19.39	19.56	19.74	19.90
Total Strain	%	0.63	1.61	3.04	5.27	9.10	13.44	17.61	21.06	24.45	23.66	23.01	22.29	21.67
Void Ratio	-	0.706	0.689	0.665	0.627	0.561	0.486	0.415	0.355	0.297	0.311	0.322	0.334	0.345
Mv (1/Mpa)	-	-	1.642	1.125	0.916	0.810	0.478	0.241	0.105	0.054	0.009	0.029	0.125	0.417



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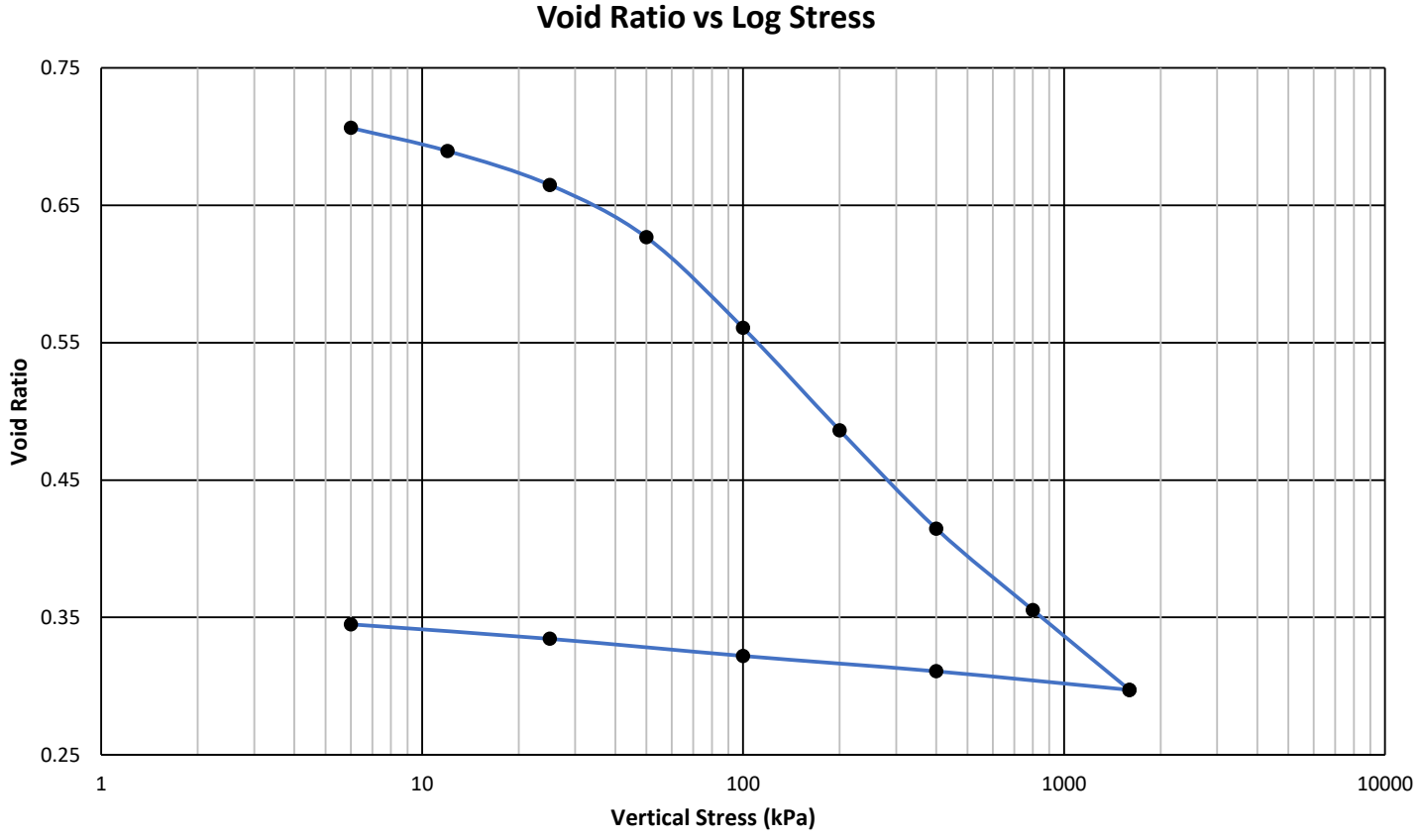
Client Name: Soilkraft
Project Name: Lethabo Park
Sample: TH 37
Depth: (m) 0 - 700

Job Number: SKT-71
Lab Number: SKT-71-647
Method: BS 1377 Part 5
Date: 21/02/2019

ONE DIMENSIONAL CONSOLIDATION TEST

Sample Info		Unit	Initial	Test Remarks:
Test Specimen Height		mm	25.4	Undisturbed
Moisture Content	Initial	%	5.3	
	Final	%	14.0	
Dry Density		kg/m³	1543	
Void Ratio		-	0.717	
Degree of Saturation		%	19.6	
Relative Density (SG)		-	2.649	Determined

Vertical Stress Applied:	kPa	6	12	25	50	100	200	400	800	1600	400	100	25	6
Load applied for:	Hrs	12	12	12	12	12	12	12	12	12	3	3	3	3
Height after increment	mm	25.24	24.99	24.63	24.06	23.09	21.99	20.93	20.05	19.19	19.39	19.56	19.74	19.90
Total Strain	%	0.63	1.61	3.04	5.27	9.10	13.44	17.61	21.06	24.45	23.66	23.01	22.29	21.67
Void Ratio	-	0.706	0.689	0.665	0.627	0.561	0.486	0.415	0.355	0.297	0.311	0.322	0.334	0.345
Mv (1/Mpa)	-	-	1.642	1.125	0.916	0.810	0.478	0.241	0.105	0.054	0.009	0.029	0.125	0.417



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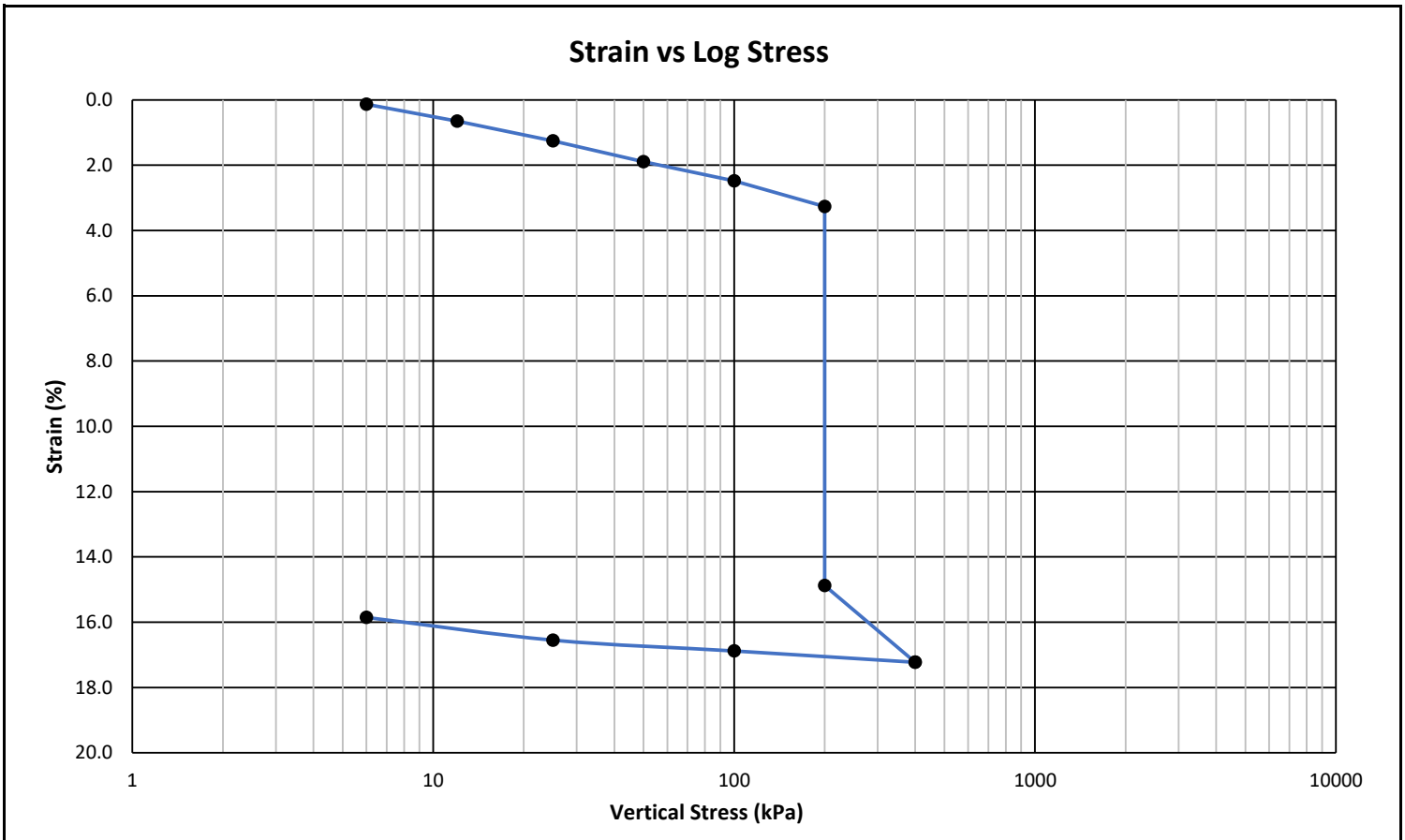
Client Name:	Soilkraft	**Job Number:**	SKT-71
Project Name:	Lethabo Park	**Lab Number:**	SKT-71-650
Sample:	TH 43	**Method:**	BS 1377 Part 5
Depth: (mm)	0 - 600	**Date:**	21-Feb-19

ONE DIMENSIONAL COLLAPSE POTENTIAL TEST

Sample Info		Unit	Initial	Test Remarks:
Test Specimen Height		mm	25.4	**Collapse Potential:** 11.61 %
Moisture Content	Initial	%	2.3	
	Final	%	17.6	
Dry Density		kg/m³	1459	
Void Ratio		-	0.816	
Degree of Saturation		%	7.5	
Relative Density (SG)		-	2.650	Assumed

Vertical Stress Applied:	kPa	6	12	25	50	100	200	200	400	100	25	6		
Load applied for:	Hrs	1	1	1	1	1	1	24	1	1	1	1		
Height after increment	mm	25.37	25.23	25.08	24.92	24.77	24.57	21.62	21.02	21.11	21.20	21.37		
Total Strain	%	0.13	0.65	1.26	1.89	2.48	3.26	14.88	17.23	16.88	16.55	15.85		
Void Ratio	-	0.813	0.804	0.793	0.781	0.771	0.756	0.546	0.503	0.509	0.515	0.528		
Mv (1/Mpa)	-	-	0.868	0.467	0.256	0.121	0.080	-	0.138	0.014	0.053	0.439		



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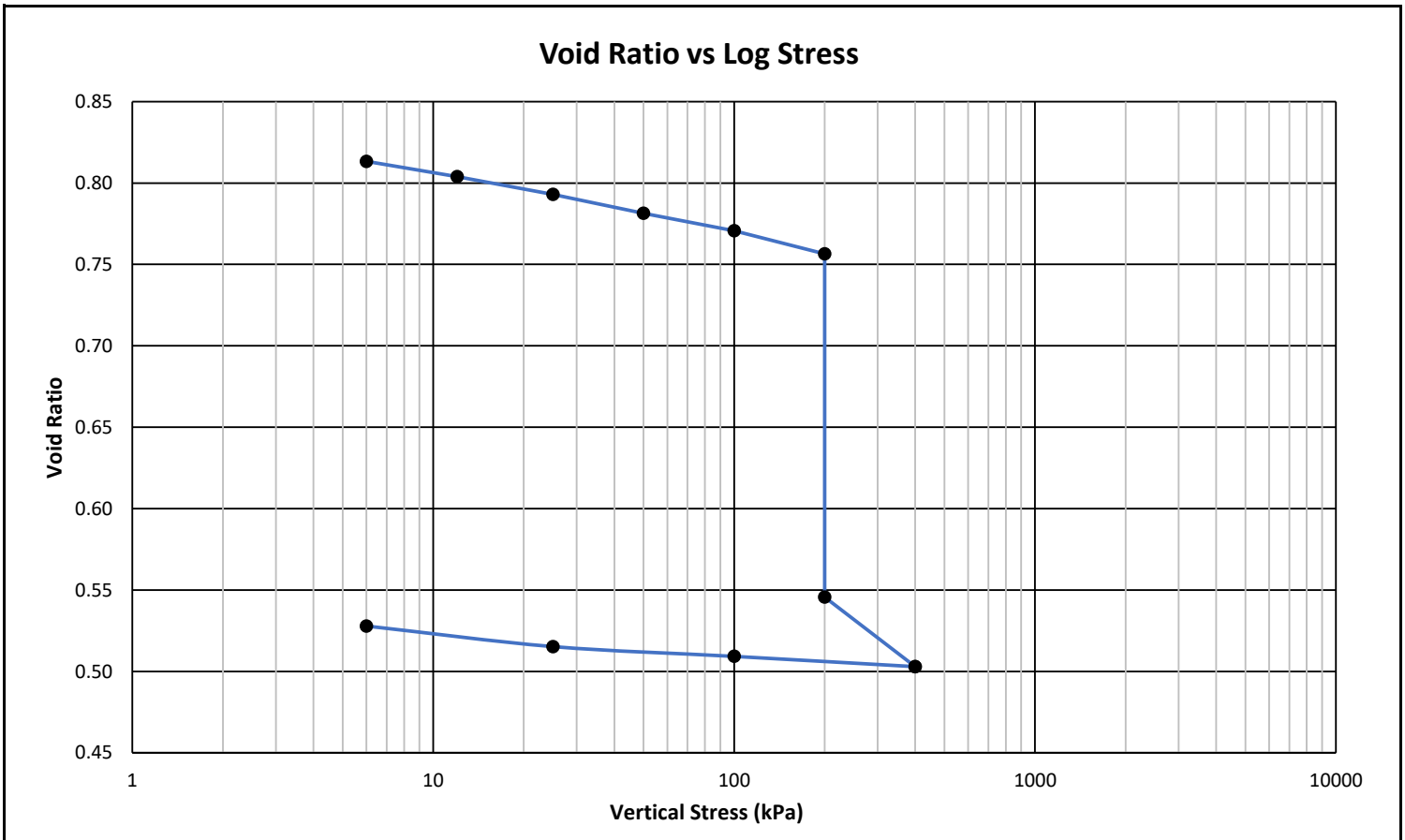
Client Name:	Soilkraft	**Job Number:**	SKT-71
Project Name:	Lethabo Park	**Lab Number:**	SKT-71-650
Sample:	TH 43	**Method:**	BS 1377 Part 5
Depth: (mm)	0 - 600	**Date:**	21-Feb-19

ONE DIMENSIONAL COLLAPSE POTENTIAL TEST

Sample Info		Unit	Initial	Test Remarks:
Test Specimen Height		mm	25.4	**Collapse Potential:** 11.61 %
Moisture Content	Initial	%	2.3	
	Final	%	17.6	
Dry Density		kg/m³	1459	
Void Ratio		-	0.816	
Degree of Saturation		%	7.5	
Relative Density (SG)		-	2.650	Assumed

Vertical Stress Applied:	kPa	6	12	25	50	100	200	200	400	100	25	6		
Load applied for:	Hrs	1	1	1	1	1	1	24	1	1	1	1		
Height after increment	mm	25.37	25.23	25.08	24.92	24.77	24.57	21.62	21.02	21.11	21.20	21.37		
Total Strain	%	0.13	0.65	1.26	1.89	2.48	3.26	14.88	17.23	16.88	16.55	15.85		
Void Ratio	-	0.813	0.804	0.793	0.781	0.771	0.756	0.546	0.503	0.509	0.515	0.528		
Mv (1/Mpa)	-	-	0.868	0.467	0.256	0.121	0.080	-	0.138	0.014	0.053	0.439		



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PROPERTIES OF AGGREGATE & SAND

Test Method(s) : SANS 3001-AG1 / AG2 / AG4 / AG5 / AG10 / AG14 / AG15 / AG20 / AG21 / AG22 SANS202 / 850 / 5833 / 5837 / 5839 / 5840 / 5846 / 5849 / 5850 / 5856 / 6243 / 5832 / TMH1 A20 / A21 (if applicable)

Sheet reference: R-STL-005

Client: Soilkraft | Project Name: Lethabo Park | Job Reference no: SKT-72

Source: | Project No: | Date: 04.03.2019

Lab no	Client ref no	Sieve Analysis (% Passing) per Sieve Size (mm)														Water Soluble Sulphates (%)	Water Soluble Salts (%)
		37.5	28	20	14	10	7.1	5	2	1	0.600	0.300	0.150	0.075	FM		
657	TH 13 / 700 - 1400mm															0.034	1.0
658	TH 20 / 600 - 1600mm															0.000	0.2
659	TH 24 / 400 - 1100mm															0.069	0.5
660	TH 33 / 900 - 1700mm															0.034	0.1

Remarks: