



- Site Investigations
- Slope Stability
- Rock Mechanics
- Soil Mechanics
- Foundations
- Borrow Pits and Materials
- Roads
- Groundwater
- NHBRC
- Geotechnical Instrumentation

***Rapid Land Release Program: NHBRC Phase 1
Geotechnical Investigation for Portions 79, 91, 96, 321
and 322 of the farm Hekpoort 504 JQ, Mogale City
LM: Final Report***

Client: Glad Africa & GDHS

Reference: 19-0866.08R03

Dated: 16 October 2019

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Rapid Land Release Program: NHBRC Phase 1 Geotechnical Investigation for Portions 79, 91, 96, 321 and 322 of the farm Hekpoort 504 JQ, Mogale City LM: Final Report

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EXECUTIVE SUMMARY

This report presents the findings of a NHBRC Phase 1 geotechnical investigation for the proposed Agri-village development on portions 79, 91, 96, 321 and 322 of the farm Hekpoort 504JQ, Mogale City LM, and presents the conclusions and recommendations for excavations, foundations and earthworks.

The most important consideration in relation to the proposed development is the presence of potentially collapsible aeolian sand and potentially expansive topsoil and residuum. Groundwater supply may also be a constraint in terms of irrigation.

Based on the 1:250 000 Geological Map titled "2628 West-Rand (1986)", the site can be seen to be underlain by shale of the Silverton Shale Formation and intruded by numerous east-west oriented diabase dykes. The soil cover has been described as colluvium derived from the adjacent mountain ranges.

The materials on site generally classify as SOFT excavation (SABS 1200 D) to between 1.1 and 2.8 m at an average depth of 2.0 m. Below this depth, intermediate to hard excavation is to be anticipated.

*The site has provisionally been classified as **C2/H2-H3 in Hekpoort A and H1-H3 in Hekpoort B** according to NHBRC guidelines. The following foundation options are proposed for the various site classes on site:*

Hekpoort A:

NHBRC Site Class	Foundation Options
C2	<ul style="list-style-type: none"> • Stiffened strip footings • RC raft with articulation joints or solid lightly reinforced masonry • Compaction of in situ soils beneath individual footings • Soil raft
C2-H2	<ul style="list-style-type: none"> • RC raft • Piled construction • Soil raft
C2/H2-H3	<ul style="list-style-type: none"> • RC raft • Piled construction • Soil raft

Hekpoort B:

NHBRC Site Class	Foundation Options
H1	<ul style="list-style-type: none"> • Modified normal • Soil raft
H2	<ul style="list-style-type: none"> • RC raft with articulation joints or solid lightly reinforced masonry • Piled construction • Split construction • Soil raft
H3	<ul style="list-style-type: none"> • RC raft • Piled construction • Soil raft

Finally, the ground conditions described in this report refer specifically to those encountered at the test positions advanced on site. It is therefore possible that conditions at variance with those discussed above may be encountered elsewhere on the site. In this regard it is critical that the NHBRC Phase 2 geotechnical investigation be commissioned and completed to assist the subsidy variation process.

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Definitions and Abbreviations

Commercial:**GCS Geotechnical** GCS Geotechnical (Pty.) Ltd.Technical:

CH	Chainage (metres)
mbgl	metres below ground level
masl	metres above sea level
NGL	Natural Ground Level
FL	Foundation Level
BH	Borehole
SPT	Standard Penetration Test
N	SPT N value (blows per 300 mm)
TLB	Tractor-mounted Loader Backhoe
TP	Test Pit
DCP	Dynamic Cone Penetrometer
EABC	Estimated Allowable Bearing Capacity
G1-G10	Standard classification of natural road building materials (TRH 14)
CBR	California Bearing Ratio
MDD	Maximum Dry Density (kg/m ³)
MADD	Modified AASHTO Dry Density
OMC	Optimum moisture Content (%)
PI	Plasticity Index
LL	Liquid Limit
LS	Linear Shrinkage
RMR	Rock Mass Rating
GSI	Geological Strength Index
mi	Hoek-Brown Constant (origin & texture dependent)
RQD	Rock Quality Designation (%)
FF	Fracture frequency
UCS	Unconfined Compressive Strength (MPa)
C (c')	Cohesion (kPa) – total stress and (effective stress)
Φ (Φ')	Friction Angle (degrees) – total stress and (effective stress)
K _v	Modulus of Subgrade Reaction (MN/mm or kPa/mm)
CFA	Continuous Flight Auger (pile type)
DCI	Driven Cast In situ (pile type)
C _v	Coefficient of Consolidation (m ² /yr)
M _v	Modulus of Compressibility (m ² /MN)
MC1	Moisture Content Before Test (%)
MC2	Moisture Content After Test (%)
ρ	Dry Density (kg/m ³)
VSR	Very soft rock
SR	Soft rock
MHR	Medium hard rock
HR	Hard rock
VHR	Very hard rock

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1. INTRODUCTION & TERMS OF REFERENCE

At the request of Nivendra Moodley of Glad Africa (and on behalf of the Gauteng Department of Human Settlements), **GCS Geotechnical** (hereafter referred to as GCS) was asked to provide a proposal and cost estimate quotation for the undertaking of a Phase 1 NHBRC geotechnical investigation for the proposed Agri-village development to be located on erven 79, 91, 96, 321 and 322 of the farm Hekpoort 504 JQ, Mogale City LM.

2. AVAILABLE INFORMATION

The following information was drawn upon for the purposes of the investigation:

- The 1:250 000 Geological Map titled “2628 West Rand” as compiled by the South African Geological Survey, 1986,
- Google Earth Imagery,
- SABS 1200 D – Earthworks, and
- Report titled “*RLRP: Desk Study Geotechnical Report for Hekpoort*”, referenced 19-0866.08R01, written by GCS in 2019.
- Report titled “*RLRP: Preliminary Geotechnical Report for Hekpoort*”, referenced 19-0866.08R02, written by GCS in 2019.

The table below shows the available published physiographical information on the site.

Table 2: Summary of Available Desk Study Information

Parameter	Value	Reference
Development	NHBRC Phase 1 Housing Dev.	Glad Africa & GDHS
Site coordinates	25°52'59.33"S / 27°36'59.85"E	
Weinerts N-value	2-5	Weinert (1974)
Climatic Region	Moderate	TRH 2 (1978)
Rainfall	600-650 mm	2526 Johannesburg (1999) 1:500 000 scale
Temperature	0.1 °C - 27.5°C	after DWAF (1986)
Evaporation	1670 mm	After DWAF (1986)
Water Balance	Deficit	Schulze (1985)
Weathering Type	Slight disintegration, moderate decomposition with frost action & very slight weathering.	Fookes et al (1971)
Geology	Shale of the Silverton Shale Formation with diabase dykes.	Geological Map Series: West Rand-2628 (1986) 1:250 000 scale
Soil Cover	Narrowly graded fersiallitic sands and loams, aeolian sand, mainly red.	Brink (1985)
Origin	Transported and residual soils	Brink (1985)
Topography	1:61 or 1.6% to NE	Garmap SA Topo & Rec 2012.1
Drainage	Not well defined	Garmap SA Topo & Rec 2012.1
Drainage Region	Quaternary Catchment: A21	DWAF (1999)
Hydrogeology	D3: Intergranular & fractured / 0.5-2 l	1:500 000 scale
Groundwater depth	35 mbgl	DWAF-WRC (1995) & pers., comm.
Erodibility Index	16-20 – Low	WRC (1992)
Seismic Intensity	VI (MMS)	Fernandez et al (1972)
Liquefaction	Likely (100-200 cm/s ²)	Welland (2002)

3. SITE DESCRIPTION

The site is located to the north (Hekpoort A) and south (Hekpoort B) of the R560 and east of the intersection with the R563 in the Mogale City LM.

The total site area is approximately 74.4 Ha in size.

Topographically, the site is fairly flat at 1:61 or 1.6% towards the north-west and drains into the Magalies River. The site is currently used for farming and cattle grazing and sparsely vegetated with thorn bush.

No services were identified on the site except for numerous boreholes and a reticulation pipeline along the eastern boundary of Hekpoort A.

No drainage paths were noted on site.

The far northern perimeter of Hekpoort A was not accessible due to a cut-off trench.

4. GEOLOGY

Based on the 1:250 000 Geological Map titled “2628 West-Rand (1986)”, the site can be seen to be underlain by shale of the Silverton Formation, Pretoria Group.

Further, more detailed mapping at 1:50 000 shows the shale bedrock to be intruded by east-west trending diabase dykes. The surficial deposits comprise transported soils (scree, colluvium, talus) derived from the erosion of the two low mountain ranges to the north and south.

5. FIELDWORK

TLB-excavated test pits were conducted on site, in order to ascertain and better understand the general engineering properties and parameters of the subsurface materials.

5.1 TLB-Excavated Trial Pits

Fourteen test pits were excavated over the 74 Ha site (roughly 50% of the required minimum according to guidelines of GFSH-2 of 2002), in order to better understand the engineering properties of the subsurface soil / rock conditions.

The results of the test pits indicated refusal depths ranging between 1.1 m and 2.8 m below existing ground level, refusing at an average depth of 2.0 m. Typically the ground conditions comprised a thin veneer of topsoil and hillwash or colluvium with some evidence of aeolian sand. These layers have been ferriginised and cemented to varying degrees. A summary of the soil profiles across the site are given below in Table 6.1a to 6.1b.

Table 5.1a: Summary of Soil Layers in Test Pits Hekpoort A (North)

TP No.	Topsoil	Aeolian	Ferricrete
11	0-0.5	0.5-1.2	1.2-2.1
12		0-1.6	
13		0-1.6	
14	0-0.3		0.3-1.8
Ave	0.4	1.3	1.2

Table 5.1b: Summary of Soil Layers in Test Pits Hekpoort B (South)

TP No.	Topsoil	PM/Talus	Residuum	Ferricrete	CWR Saprolite	VSR-SR Shale
1	0-0.6	0.8-1.5		0.6-0.8		
2	0-0.6			0.6-1.2		
3	0-0.5		0.5-1.7		1.7-2.1	2.1-2.5
4	0-0.6			0.6-1.7	1.7-2.2	
5	0-0.5	0.5-1.1				
6		0-0.5	0.5-1.6		1.6-2.6	
7		0-0.5	0.5-1.3		1.3-2.1	
8	0-0.6			0.6-1.8	1.8-2.1	
9	0-0.3			0.3-1.2	1.2-1.8	1.8-1.9
10	0-0.3			0.3-2.0	2.0-2.8	
Ave	0.5	0.6	1.0	1.0	0.6	2.0+

Table 5.1c: Summary of Soil Profile Hekpoort A (North)

Depth		Description	EABC (kPa)	Kv (kPa/mm)	E (MPa)	c (kPa)
From (m)	To (m)					
Topsoil						
0	0.4	Dry to slightly moist, red brown to grey brown, STIFF to VERY STIFF, shattered, clayey sandy SILT to SILT/CLAY with roots.	N/A	N/A	N/A	N/A
Aeolian						
0.4	1.7	Slightly moist, red brown to red orange brown, MEDIUM DENSE or STIFF, silty clayey fine SAND with roots.	100-150	<25	<3	18-72
Ferricrete						
0.8	2.0	Slightly moist, red brown to yellow grey brown speckled black, MEDIUM DENSE or STIFF, bioturbated and voided in places, sandy CLAY/SILT with scattered ferricrete nodules.	100-150	25-40	15-25	72+-

EABC = estimated allowable bearing capacity (ignoring collapse potential)

Kv = modulus of subgrade reaction

E = elastic modulus

Table 5.1d: Summary of Soil Profile Hekpoort B (South)

Depth		Description	EABC (kPa)	Kv (kPa/mm)	E (MPa)	c (kPa)
From (m)	To (m)					
Topsoil						
0	0.5	Dry to slightly moist, red brown to grey brown, FIRM to STIFF, shattered, clayey sandy SILT to SILT/CLAY with roots.	N/A	N/A	N/A	N/A
Pebble Marker/Talus						
0.3	0.9	MEDIUM DENSE, COBBLE GRAVEL and BOULDERS (up to 800 mm) of hard rock shale or quartzite in a matrix of slightly moist, red brown speckled black, FIRM to STIFF, sandy clayey SILT with ferricrete nodules.	100-150	50-80	3-10	18-72
Residuum						
0.5	1.1	Dry to slightly moist, grey brown, FIRM to STIFF, SILT/CLAY.	100-150	25-40	15-25	72+-
Ferricrete						
0.5	1.5	Slightly moist to moist, red brown speckled black, FIRM, CLAY/SILT with scattered ferricrete nodules.	40-80	80-100	25+	18-72
Completely Weathered Saprolite						
1.6	2.2	Slightly moist, yellow brown speckled black, FIRM to STIFF, SILT/CLAY to VERY SOFT ROCK.	300+	80-100+	25+	150+
Very Soft Rock Shale or dolerite						
0.8	2.0+	Highly weathered, grey speckled black, friable or jointed, VERY SOFT ROCK to MEDIUM HARD ROCK DOLERITE or SHALE	500+	150+	50+	400+

EABC = estimated allowable bearing capacity (ignoring collapse potential)

Kv = modulus of subgrade reaction

E = elastic modulus

6. GROUNDWATER

No groundwater seepage occurred on site in any of the test pits, although during summer months and during times of prolonged or heavy rainfall, it may be assumed that a perched groundwater table may be present at relatively shallow depths over the site.

The site resides in the A21 Tertiary drainage region in an area that appears to be fair in terms of borehole yield (0.5 to 2.0 l/hr) and this increases towards the north at the river to 2.0 to 5.0 l/hr. The groundwater level has been reported at between 10 and 25 mbgl (Barnard, 2000) but may have been compromised since 2000.

Personal communications with the local farmers indicated that groundwater has been encountered in a number of boreholes at about 35 mbgl but that the yield has been compromised by over-utilisation of the groundwater aquifers in the Tarlton area and subsequently reducing the yield to less than 5,000 l/hr.

7. LABORATORY TESTING

Laboratory tests were scheduled and completed on soil samples recovered from the site. The following tests were carried out:

- Four foundation indicator tests (particle size distribution, hydrometer, moisture content, and Atterberg Limits).
- Collapse potential tests.
- Chemical tests (pH and conductivity).

The detailed laboratory test results are provided in Appendix B, while summaries of these results are presented below as in Tables 7a to 7d:

Table 7a: Summary of Foundation Indicators

TP	Depth (m-m)	LL	PI	GM	PE*	CBR* (%)	Classifications		
							TRH14	PRA	USCS
<i>Topsoil</i>									
1	0-0.8	37	17	0.74	M	10	G9+	A.6	CL-OL
2	0-0.5	50	27	0.24	H	4	G10	A.7.6	CH-OH
14	0-0.3	27	13	0.40	M	11	G8	A.6	CL-OL
<i>Aeolian</i>									
11	1.0	41	13	0.78	L	14	G7+	A.7.6	SC
<i>Ferricrete</i>									
14	0.3-1.8	44	22	0.78	M	8	G9	A.7.6	CL-OL
<i>Residuum</i>									
2	1.5	53	28	0.56	M	5	G10	A.7.6	CH-OH
3	1.7-2.1	60	34	0.28	VH	3	G10	A.7.6	CH-OH

*CBR estimated from PI-GM relationship.

*PE – Potential Expansiveness; L=low; M=medium; H=high; VH=very high

Table 7b: Summary of Collapse Potential Test Results

TP	Depth (m)	MCb (%)	MCA (%)	Yd (kg/m ³)	e ₀	CP (%)	Settlement (mm)
<i>Aeolian</i>							
11	1.0	21.83	24.61	1288	1.02	10.7	125-150
<i>Ferruginised Hillwash</i>							
14	0.3-1.8	15.25	22.29	1192	1.21	6.0	50-75

Table 7c: Summary of Corrosivity Test Results

TP	Depth (m-m)	pH	EC (μS/cm)	Res (Ohm/cm)	Corrosivity
<i>Topsoil</i>					
1	0-0.8	5.6	281	3559	Very
2	0-0.5	5.3	466	2146	Very
14	0-0.3	6.3	367	2725	Very
<i>Aeolian</i>					
11	1.0	6.8	326	3067	Very
<i>Ferricrete</i>					
14	0.3-1.8	6.8	360	2778	Very
<i>Residuum</i>					
2	1.5	6.2	360	2778	Very

Table 7d: Materials Classification and Recommended Usage

Material Description	Classification	Anticipated Recommended Usage
Topsoil	PI = 13-27 GM = 0.24-0.74 Classification: A.6; G8-10; CL-CH	G8-G10 (subgrade to selected layers)
Aeolian	PI = 13 GM = 0.78 Classification: A.7.6; G7+; SC	G7+ (upper selected subgrade)
Ferricrete	PI = 22 GM = 0.78 Classification: A.7.6; G9; CL-OL	G9 (lower selected subgrade)
Residuum	PI = 28-34 GM = 0.28-0.56 Classification: A.7.6; G10; CH-OH	G10 (subgrade only)

8. DEVELOPMENT RECOMMENDATIONS

8.1 Materials Usage

The soils include hillwash, pebble marker/talus and residuum. These layers are underlain by completely to highly weathered shale or dolerite.

Based on visual and tactile means, together with the limited laboratory results, the materials on site may be assumed to be used as follows:

- **Topsoil**

This layer is assumed to qualify as G8-10 and is to be cut and carted off site or stockpiled for landscaping.

- **Aeolian**

This layer is assumed to qualify as G7+ (and therefore could be re-used as selected layer).

- **Ferricrete**

This layer qualifies as G9 and can potentially only be used as subgrade or low-grade fill.

- **Residuum**

This layer is generally too deep and will only be encountered in service trenches. The material is fine-grained and rates as G10 and should be carted to spoil.

8.2 NHBRC Classification

Prior to obtaining laboratory results in order to quantify the effects of soil movement beneath the site, **GCS Geotechnical** has classified the site based on general experience in similar geological environments.

The site is underlain by potentially expansive topsoil and residuum (H1-H3) with limited potentially collapsible hillwash (C2) in Hekpoort A to the north, which is underlain by a localised pebble marker/talus, saprolite and weathered bedrock in places. These assumptions coupled with the layer thickness have led to the suggestion that this site can be represented by NHBRC classification: **C2/H2-H3 for Hekpoort A to the north and H1-H3 for Hekpoort B to the south**. This signifies a cumulative potential collapse of up to 175 mm and potential ground heave of between 7 and 85 mm.

8.3 Foundations

The NHBRC Site Classification based on test pit logs excavated over the site can be mitigated by the following foundation options:

Table 8.3a: Summary of foundation Options for Hekpoort A

<i>NHBRC Site Class</i>	<i>Foundation Options</i>
<i>C2</i>	<ul style="list-style-type: none"> • <i>Stiffened strip footings</i> • <i>RC raft with articulation joints or solid lightly reinforced masonry</i> • <i>Compaction of in situ soils beneath individual footings</i> • <i>Soil raft</i>
<i>C2-H2</i>	<ul style="list-style-type: none"> • <i>RC raft</i> • <i>Piled construction</i> • <i>Soil raft</i>
<i>C2/H2-H3</i>	<ul style="list-style-type: none"> • <i>RC raft</i> • <i>Piled construction</i> • <i>Soil raft</i>

Table 8.3b: Summary of Foundation Options for Hekpoort B

<i>NHBRC Site Class</i>	<i>Foundation Options</i>
<i>H1</i>	<ul style="list-style-type: none"> • <i>Modified normal</i> • <i>Soil raft</i>
<i>H2</i>	<ul style="list-style-type: none"> • <i>RC raft with articulation joints or solid lightly reinforced masonry</i> • <i>Piled construction</i> • <i>Split construction</i> • <i>Soil raft</i>
<i>H3</i>	<ul style="list-style-type: none"> • <i>RC raft</i> • <i>Piled construction</i> • <i>Soil raft</i>

8.4 Excavatability & Earthworks

All materials on site classify as SOFT excavation (SABS 1200 D) to depths ranging between 1.1 m and 2.8 m with an average depth of around 2.0 m. Below this depth, intermediate to hard excavation is to be anticipated due to weathered granite bedrock which has been identified along the western and eastern boundaries.

8.5 Drainage

For the promotion of a stable site, with no soil movement-related issues (settlement and/or heave), it is extremely important that adequate drainage, both surface and subsurface, be constructed so that no water ingress into the subsurface soils in and around foundation bases is possible. Drainage should be such that any rainfall is diverted to the nearest stormwater drainage system. Areas of potential pooling or damming of rainfall on site should be carefully designed and sloped so as to remove this water away from the foundations.

9. CONCLUSIONS & RECOMMENDATIONS

General

- This report presents the findings of a NHBRC Phase 1 geotechnical investigation for the proposed Agri-village development on portions 79, 91, 96, 321 and 322 of the farm Hekpoort 504 JQ and provides the conclusions and recommendations for excavations, foundations and earthworks.
- The most important consideration in relation to the proposed development is the presence of potentially expansive transported soils and residuum and isolated potentially collapsible aeolian sand.

Geology & Ground Conditions

- Based on the 1:250 000 Geological Map titled “2628 West-Rand (1986)”, the site can be seen to be underlain by shale of the Silverton Formation with diabase dykes.

Excavatability

- All materials on site classify as SOFT excavation (SABS 1200 D) to depths ranging between 1.1 m and 2.8 m with an average depth of around 2.0 m. Below this depth, intermediate to hard excavation is to be anticipated.

Foundations

- The site has provisionally been classified as C2/H2-H3 in Hekpoort A to the north and H1-H3 in Hekpoort B to the south according to NHBRC guidelines. The following foundation recommendations are proposed for the site:

Hekpoort A:

<i>NHBRC Site Class</i>	<i>Foundation Options</i>
<i>C2</i>	<ul style="list-style-type: none"> • <i>Stiffened strip footings</i> • <i>RC raft with articulation joints or solid lightly reinforced masonry</i> • <i>Compaction of in situ soils beneath individual footings</i> • <i>Soil raft</i>
<i>C2-H2</i>	<ul style="list-style-type: none"> • <i>RC raft</i> • <i>Piled construction</i> • <i>Soil raft</i>
<i>C2/H2-H3</i>	<ul style="list-style-type: none"> • <i>RC raft</i> • <i>Piled construction</i> • <i>Soil raft</i>

Hekpoort B:

<i>NHBRC Site Class</i>	<i>Foundation Options</i>
<i>H1</i>	<ul style="list-style-type: none"> • <i>Modified normal</i> • <i>Soil raft</i>
<i>H2</i>	<ul style="list-style-type: none"> • <i>RC raft with articulation joints or solid lightly reinforced masonry</i> • <i>Piled construction</i> • <i>Split construction</i> • <i>Soil raft</i>
<i>H3</i>	<ul style="list-style-type: none"> • <i>RC raft</i> • <i>Piled construction</i> • <i>Soil raft</i>

Further Investigations

-
- Finally, the ground conditions described in this report refer specifically to those encountered at the test positions advanced on site. It is therefore possible that conditions at variance with those discussed above may be encountered elsewhere on the site. In this regard it is critical that the NHBRC Phase 2 geotechnical investigation be commissioned and completed to assist the subsidy variation process.



N Welland: Pr.Eng. / Pr.Sci.Nat



Dale Franklin

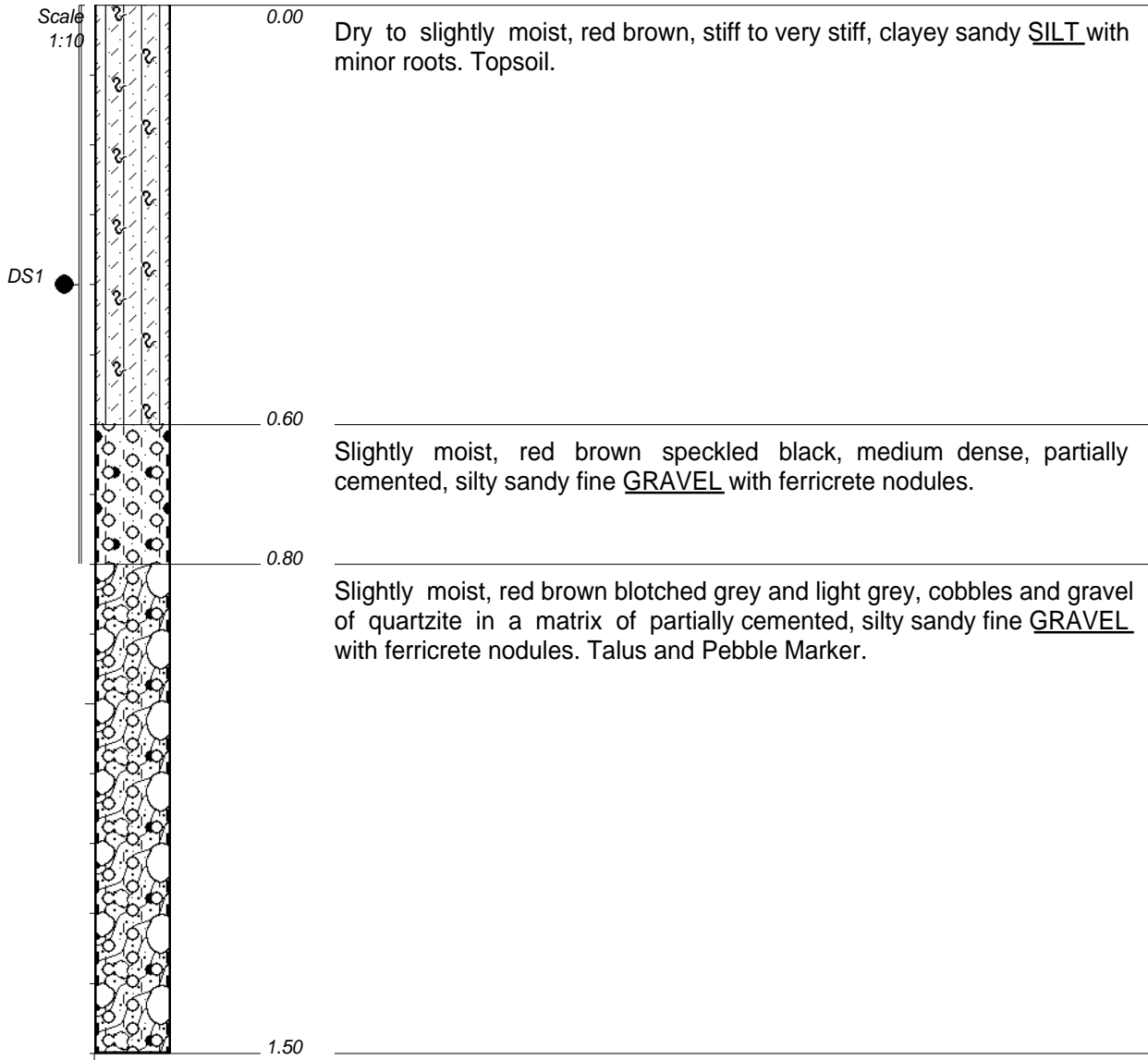
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APPENDIX A

TLB-Excavated Trial Pit Profiles



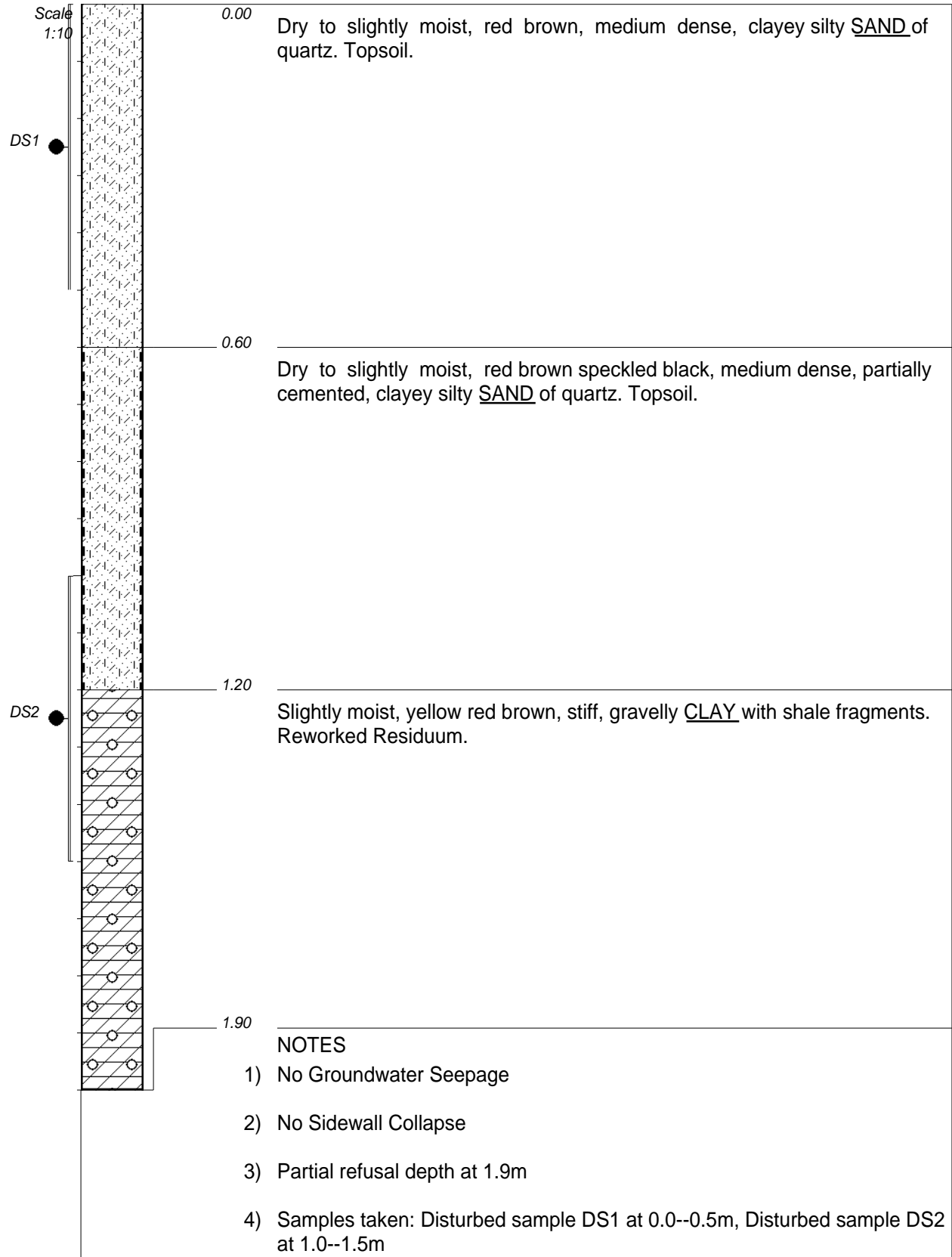
NOTES

- 1) No Groundwater Seepage
- 2) No Sidewall Collapse
- 3) Partial refusal depth at 1.5m
- 4) Samples taken: Disturbed sample DS1 at 0.0--0.8m

CONTRACTOR : N/A
 MACHINE : CAT 428E
 DRILLED BY : -
 PROFILED BY : Dale Franklin
 TYPE SET BY : Dale Franklin
 SETUP FILE : STANDARD.SET

INCLINATION : -
 DIAM : N/A
 DATE : -
 DATE : 18/09/2019
 DATE : 16/10/2019 10:32
 TEXT : ..866.08HekpoortTPLogs.TXT

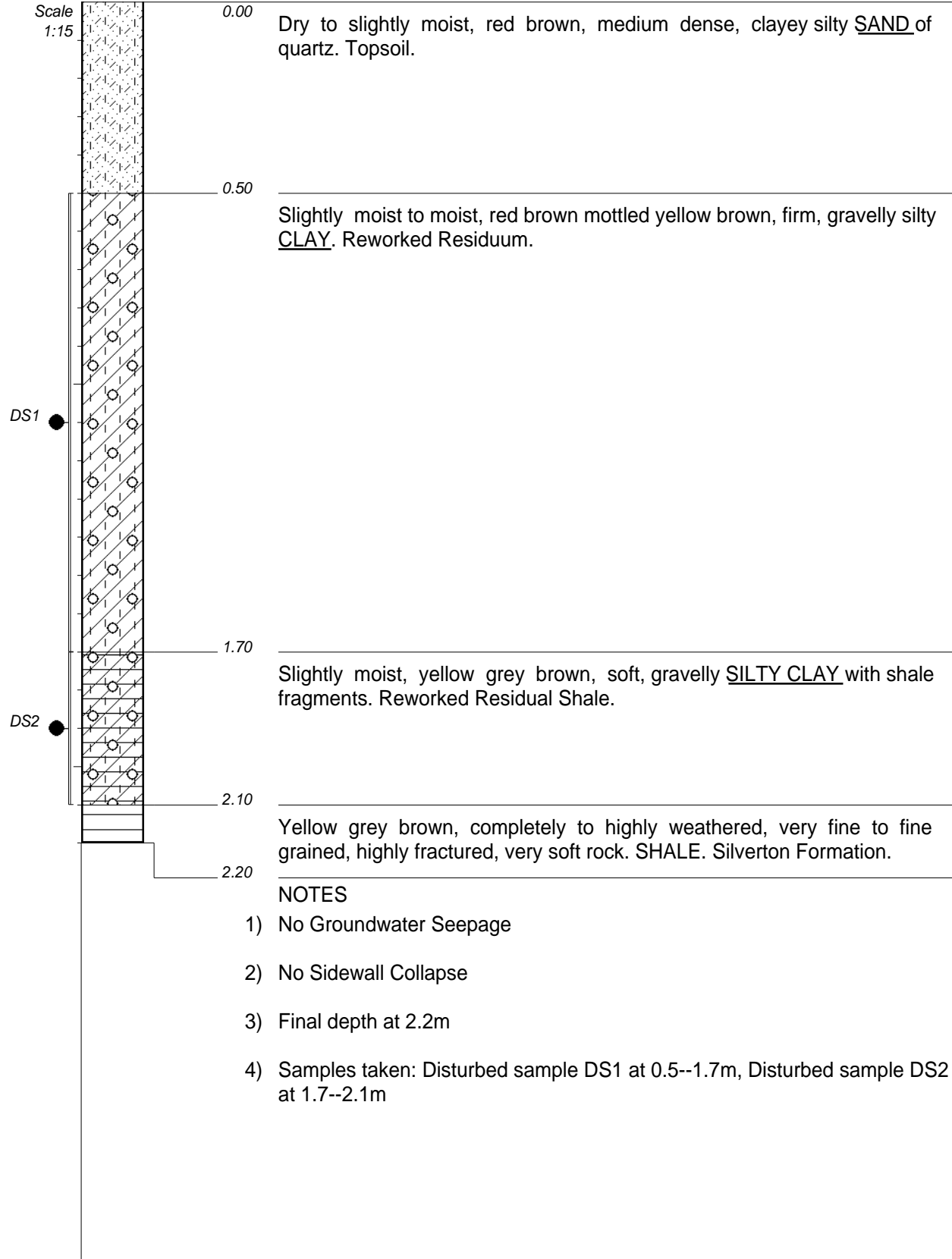
ELEVATION : N/A
 X-COORD : 27 36 51.48"E
 Y-COORD : 25 53 07.90"S



CONTRACTOR : N/A
 MACHINE : CAT 428E
 DRILLED BY : -
 PROFILED BY : Dale Franklin
 TYPE SET BY : Dale Franklin
 SETUP FILE : STANDARD.SET

INCLINATION : -
 DIAM : N/A
 DATE : -
 DATE : 18/09/2019
 DATE : 16/10/2019 10:32
 TEXT : ..866.08HekpoortTPLogs.TXT

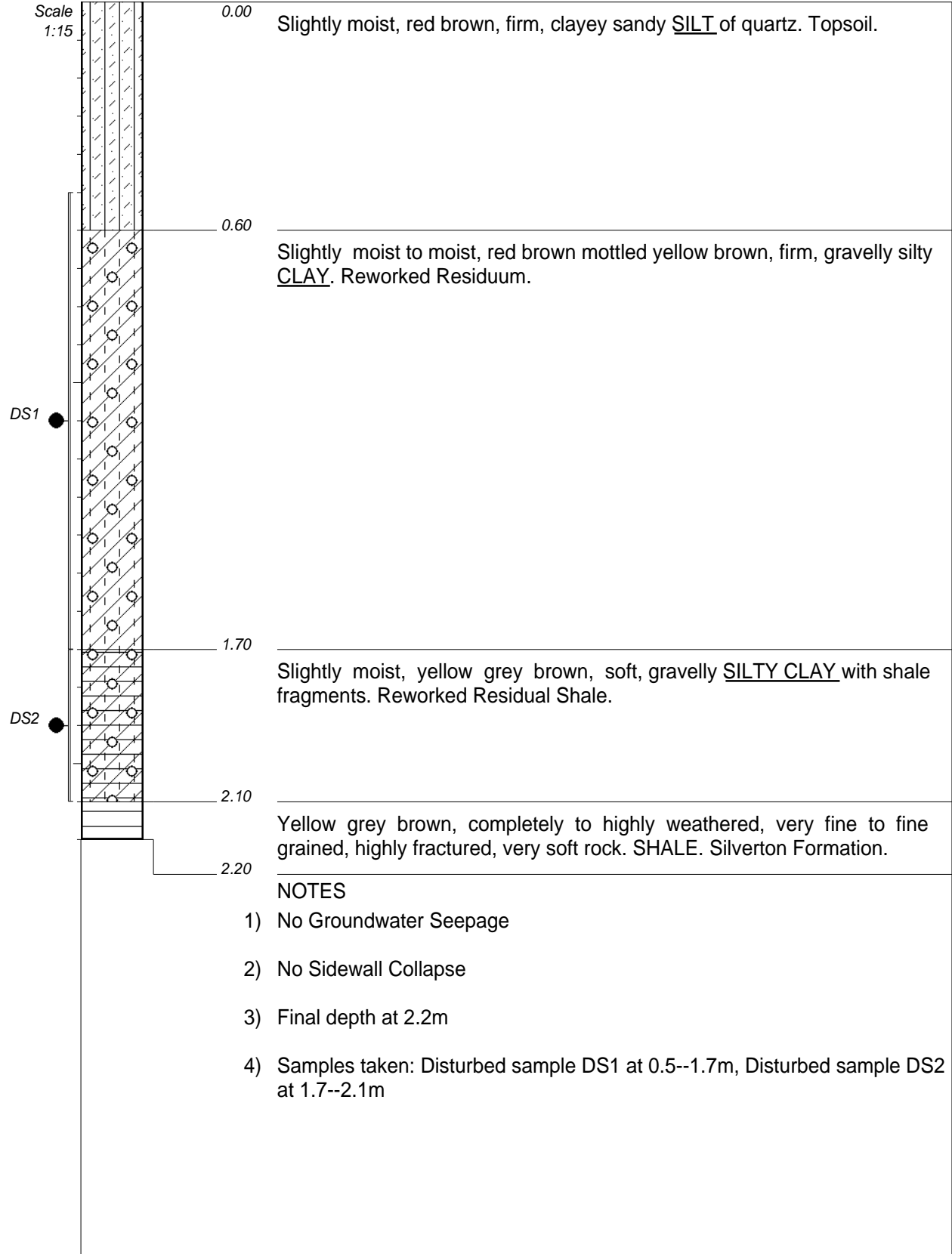
ELEVATION : N/A
 X-COORD : 27 37 08.40"E
 Y-COORD : 25 53 26.64"S



CONTRACTOR : N/A
 MACHINE : CAT 428E
 DRILLED BY : -
 PROFILED BY : Dale Franklin
 TYPE SET BY : Dale Franklin
 SETUP FILE : STANDARD.SET

INCLINATION : -
 DIAM : N/A
 DATE : -
 DATE : 18/09/2019
 DATE : 16/10/2019 10:32
 TEXT : ..866.08HekpoortTPLogs.TXT

ELEVATION : N/A
 X-COORD : 27 37 16.30"E
 Y-COORD : 25 53 15.00"S



- NOTES**
- 1) No Groundwater Seepage
 - 2) No Sidewall Collapse
 - 3) Final depth at 2.2m
 - 4) Samples taken: Disturbed sample DS1 at 0.5--1.7m, Disturbed sample DS2 at 1.7--2.1m

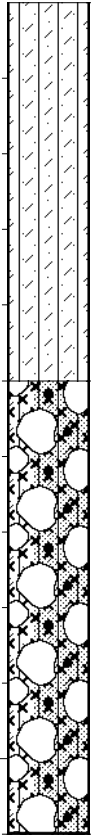
CONTRACTOR : N/A
 MACHINE : CAT 428E
 DRILLED BY : -
 PROFILED BY : Dale Franklin
 TYPE SET BY : Dale Franklin
 SETUP FILE : STANDARD.SET

INCLINATION : -
 DIAM : N/A
 DATE : -
 DATE : 18/09/2019
 DATE : 16/10/2019 10:32
 TEXT : ..866.08HekpoortTPLogs.TXT

ELEVATION : N/A
 X-COORD : 27 37 08.22"E
 Y-COORD : 25 53 04.63"S



Scale
1:10



0.00

Slightly moist, red brown, firm, clayey sandy SILT of quartz. Topsoil.

0.50

Boulders of hard subrounded dolerite up to 0.8 m diameter, in a matrix of slightly moist, red brown speckled black, stiff, sandy clayey SILT with scattered ferricrete nodules. Talus.

1.10

NOTES

- 1) No Groundwater Seepage
- 2) No Sidewall Collapse
- 3) Refusal on boulders at 1.1m
- 4) No Samples taken

CONTRACTOR : N/A
MACHINE : CAT 428E
DRILLED BY : -
PROFILED BY : Dale Franklin
TYPE SET BY : Dale Franklin
SETUP FILE : STANDARD.SET

INCLINATION : -
DIAM : N/A
DATE : -
DATE : 18/09/2019
DATE : 16/10/2019 10:32
TEXT : ..866.08HekpoortTPLogs.TXT

ELEVATION : N/A
X-COORD : 27 36 57.17"E
Y-COORD : 25 53 03.90"S

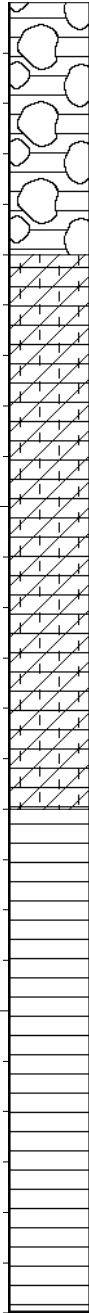


Glad Africa
Hekpoort - B

HOLE No: TP06
Sheet 1 of 1

JOB NUMBER: 19.0866.08

Scale
1:15



0.00

Cobbles and boulders up to 0.8m diameter of hard shale in a minor highly weathered matrix. Talus and Pebble marker.

0.50

Slightly moist, red brown, stiff, SILTY CLAY. Residual Shale.

1.60

Olive grey stained red orange brown, highly weathered, very fine to fine grained, highly jointed, very soft rock. SAPROLITIC SHALE. Silverton Formation.

2.60

NOTES

- 1) No Groundwater Seepage
- 2) No Sidewall Collapse
- 3) Final depth at 2.6m
- 4) No Samples taken

CONTRACTOR : N/A
 MACHINE : CAT 428E
 DRILLED BY : -
 PROFILED BY : Dale Franklin
 TYPE SET BY : Dale Franklin
 SETUP FILE : STANDARD.SET

INCLINATION : -
 DIAM : N/A
 DATE : -
 DATE : 18/09/2019
 DATE : 16/10/2019 10:32
 TEXT : ..866.08HekpoortTPLogs.TXT

ELEVATION : N/A
 X-COORD : 27 36 57.66"E
 Y-COORD : 25 53 20.13"S

HOLE No: TP06

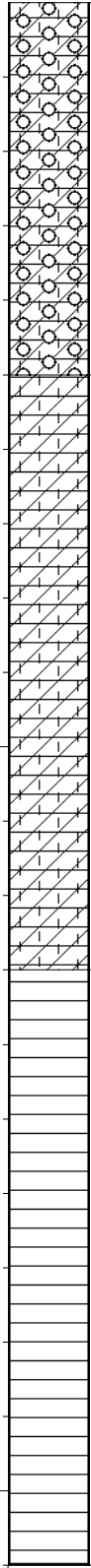


Glad Africa
Hekpoort - B

HOLE No: TP07
Sheet 1 of 1

JOB NUMBER: 19.0866.08

Scale
1:10



0.00

Slightly moist, grey brown, shattered, stiff, silty CLAY with abundant dense subangular gravel of hard quartz and shale. Talus.

0.50

Slightly moist, red brown, firm to stiff, SILTY CLAY with fragments of shale.

1.30

Moderately weathered, very fine to fine grained, highly jointed, medium hard rock. SAPROLITIC SILTSTONE. Silverton Formation.

2.10

- NOTES
- 1) No Groundwater Seepage
 - 2) No Sidewall Collapse
 - 3) Partial refusal at 2.1m
 - 4) No Samples taken

CONTRACTOR : N/A
MACHINE : CAT 428E
DRILLED BY : -
PROFILED BY : Dale Franklin
TYPE SET BY : Dale Franklin
SETUP FILE : STANDARD.SET

INCLINATION : -
DIAM : N/A
DATE : -
DATE : 18/09/2019
DATE : 16/10/2019 10:32
TEXT : ..866.08HekpoortTPLogs.TXT

ELEVATION : N/A
X-COORD : 27 37 05.31"E
Y-COORD : 25 53 13.82"S

HOLE No: TP07

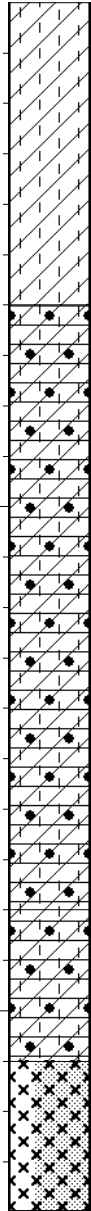


Glad Africa
Hekpoort - B

HOLE No: TP08
Sheet 1 of 1

JOB NUMBER: 19.0866.08

Scale
1:15



0.00 Slightly moist, grey brown, firm, SILTY CLAY. Topsoil.

0.60 Slightly moist, red brown, stiff, SILTY CLAY with scattered ferricrete nodules. Residual Ferriginised Shale.

1.80 Slightly moist, pale yellow brown, stiff, SILTY CLAY with scattered ferricrete nodules. Residual Saprolitic Shale.

2.10 Completely weathered, very soft rock. DOLERITE.

2.40

NOTES

- 1) No Groundwater Seepage
- 2) No Sidewall Collapse
- 3) Refusal depth at 2.4m
- 4) No Samples taken

CONTRACTOR : N/A
 MACHINE : CAT 428E
 DRILLED BY : -
 PROFILED BY : Dale Franklin
 TYPE SET BY : Dale Franklin
 SETUP FILE : STANDARD.SET

INCLINATION : -
 DIAM : N/A
 DATE : -
 DATE : 18/09/2019
 DATE : 16/10/2019 10:32
 TEXT : ..866.08HekpoortTPLogs.TXT

ELEVATION : N/A
 X-COORD : 27 37 12.69"E
 Y-COORD : 25 53 08.38"S

HOLE No: TP08

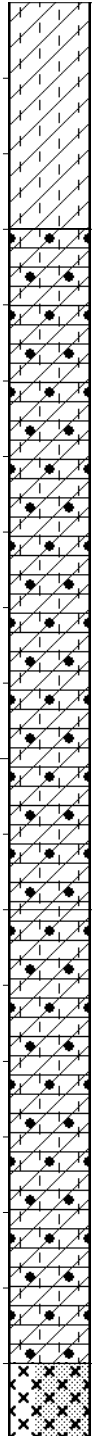


Glad Africa
Hekpoort - B

HOLE No: TP09
Sheet 1 of 1

JOB NUMBER: 19.0866.08

Scale
1:10



0.00 Slightly moist, grey brown, shattered, firm to stiff, SILTY CLAY. Topsoil.

0.30 Slightly moist, red brown, firm, SILTY CLAY with scattered ferricrete nodules. Residual Ferriginised Shale.

1.20 Slightly moist, red brown becoming yellow speckled black, firm, SILTY CLAY with scattered ferricrete nodules. Residual Ferriginised Shale.

1.80 Grey speckled black, highly weathered, highly fractured, friable, very soft rock. DOLERITE.

1.90 NOTES

- 1) No Groundwater Seepage
- 2) No Sidewall Collapse
- 3) Refusal depth at 1.9m
- 4) No Samples taken

CONTRACTOR : N/A
 MACHINE : CAT 428E
 DRILLED BY : -
 PROFILED BY : Dale Franklin
 TYPE SET BY : Dale Franklin
 SETUP FILE : STANDARD.SET

INCLINATION : -
 DIAM : N/A
 DATE : -
 DATE : 18/09/2019
 DATE : 16/10/2019 10:32
 TEXT : ..866.08HekpoortTPLogs.TXT

ELEVATION : N/A
 X-COORD : 27 36 58.56"E
 Y-COORD : 25 53 11.31"S

HOLE No: TP09

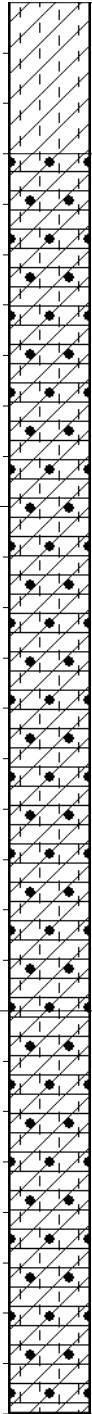


Glad Africa
Hekpoort - B

HOLE No: TP10
Sheet 1 of 1

JOB NUMBER: 19.0866.08

Scale
1:15



0.00 Slightly moist, grey brown, shattered, firm to stiff, SILTY CLAY. Topsoil.

0.30 Slightly moist, red brown, firm, SILTY CLAY with scattered ferricrete nodules. Residual Ferriginised Shale.

2.00 Slightly moist, red brown becoming yellow speckled black, firm, SILTY CLAY with scattered ferricrete nodules. Residual Ferriginised Shale.

- 2.80
- NOTES**
- 1) No Groundwater Seepage
 - 2) No Sidewall Collapse
 - 3) Final depth at 2.8m
 - 4) No Samples taken

CONTRACTOR : N/A
MACHINE : CAT 428E
DRILLED BY : -
PROFILED BY : Dale Franklin
TYPE SET BY : Dale Franklin
SETUP FILE : STANDARD.SET

INCLINATION : -
DIAM : N/A
DATE : -
DATE : 18/09/2019
DATE : 16/10/2019 10:32
TEXT : ..866.08HekpoortTPLogs.TXT

ELEVATION : N/A
X-COORD : 27 36 58.56"E
Y-COORD : 25 53 11.31"S

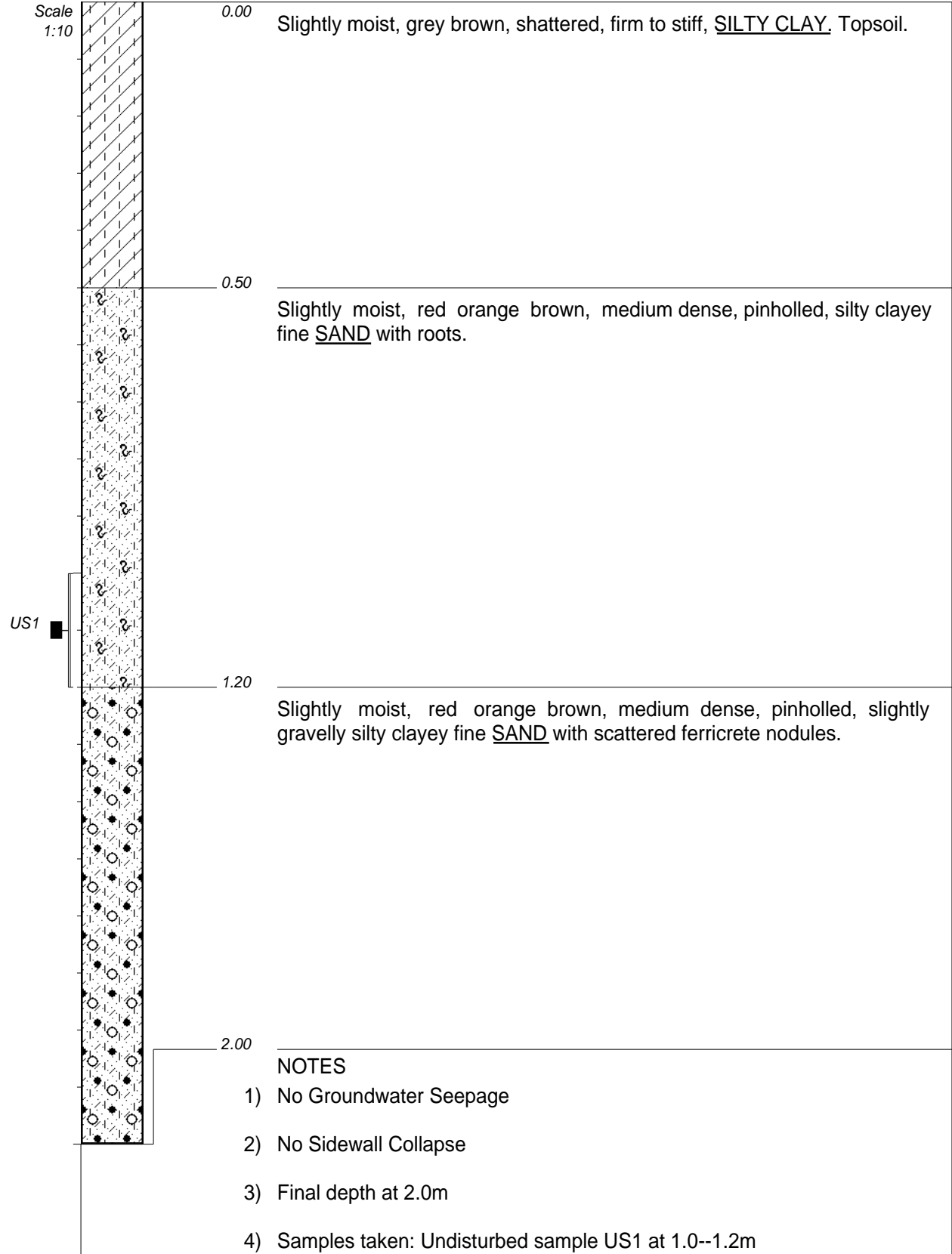
HOLE No: TP10



Glad Africa
Hekpoort - A

HOLE No: TP11
Sheet 1 of 1

JOB NUMBER: 19.0866.08



CONTRACTOR : N/A
 MACHINE : CAT 428E
 DRILLED BY : -
 PROFILED BY : Dale Franklin
 TYPE SET BY : Dale Franklin
 SETUP FILE : STANDARD.SET

INCLINATION : -
 DIAM : N/A
 DATE : -
 DATE : 18/09/2019
 DATE : 16/10/2019 10:32
 TEXT : ..866.08HekpoortTPLogs.TXT

ELEVATION : N/A
 X-COORD : 27 36 55.98"E
 Y-COORD : 25 52 52.98"S

HOLE No: TP11

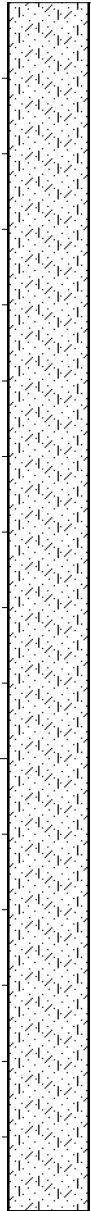


Glad Africa
Hekpoort - A

HOLE No: TP12
Sheet 1 of 1

JOB NUMBER: 19.0866.08

Scale
1:10



0.00

Slightly moist, red brown, medium dense, pinholled, silty clayey fine SAND. Alluvial Deposits.

1.60

NOTES

- 1) No Groundwater Seepage
- 2) No Sidewall Collapse
- 3) Final depth at 1.6m
- 4) No Samples taken

CONTRACTOR : N/A
MACHINE : CAT 428E
DRILLED BY : -
PROFILED BY : Dale Franklin
TYPE SET BY : Dale Franklin
SETUP FILE : STANDARD.SET

INCLINATION : -
DIAM : N/A
DATE : -
DATE : 18/09/2019
DATE : 16/10/2019 10:32
TEXT : ..866.08HekpoortTPLogs.TXT

ELEVATION : N/A
X-COORD : 27 36 32.66"E
Y-COORD : 25 52 30.68"S

HOLE No: TP12

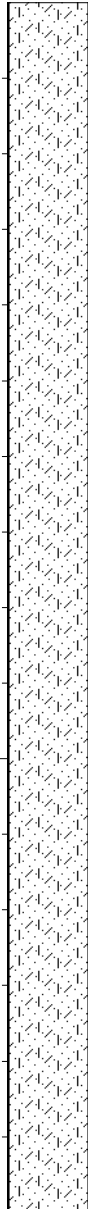


Glad Africa
Hekpoort - A

HOLE No: TP13
Sheet 1 of 1

JOB NUMBER: 19.0866.08

Scale
1:10



0.00

Slightly moist, red brown, medium dense, pinholled, silty clayey fine SAND. Alluvial Deposits.

1.60

NOTES

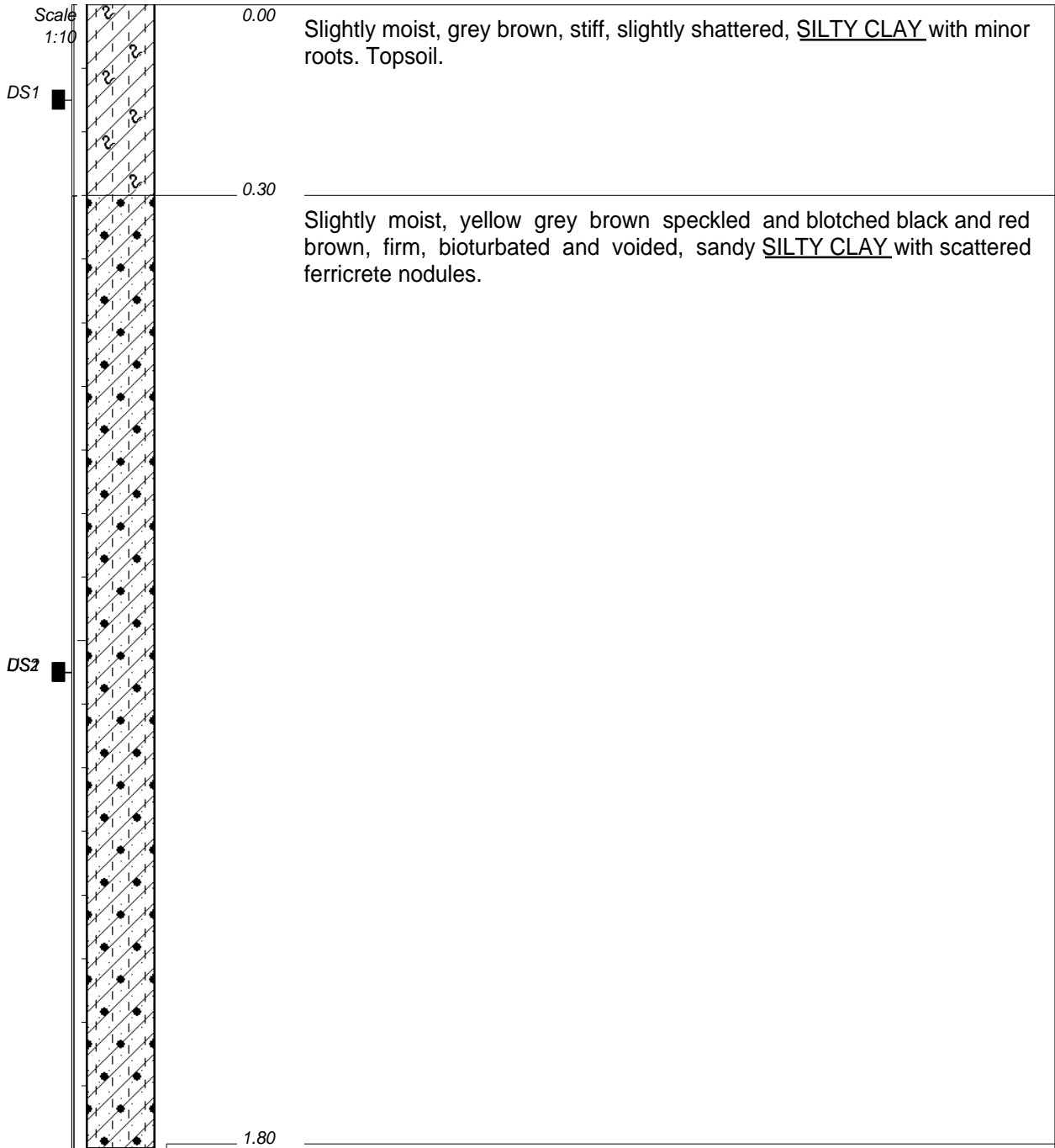
- 1) No Groundwater Seepage
- 2) No Sidewall Collapse
- 3) Final depth at 1.6m
- 4) No Samples taken

CONTRACTOR : N/A
MACHINE : CAT 428E
DRILLED BY : -
PROFILED BY : Dale Franklin
TYPE SET BY : Dale Franklin
SETUP FILE : STANDARD.SET

INCLINATION : -
DIAM : N/A
DATE : -
DATE : 18/09/2019
DATE : 16/10/2019 10:32
TEXT : ..866.08HekpoortTPLogs.TXT

ELEVATION : N/A
X-COORD : 27 36 37.27"E
Y-COORD : 25 52 38.88"S

HOLE No: TP13



NOTES

- 1) No Groundwater Seepage
- 2) No Sidewall Collapse
- 3) Final depth at 1.8m
- 4) Samples taken: Disturbed sample DS1 at 0.0--0.3m, Disturbed sample DS2 at 0.3--1.8m, Undisturbed sample US1 at 0.3--1.8m

CONTRACTOR : N/A
 MACHINE : CAT 428E
 DRILLED BY : -
 PROFILED BY : Dale Franklin
 TYPE SET BY : Dale Franklin
 SETUP FILE : STANDARD.SET

INCLINATION : -
 DIAM : N/A
 DATE : -
 DATE : 18/09/2019
 DATE : 16/10/2019 10:32
 TEXT : ..866.08HekpoortTPLogs.TXT

ELEVATION : N/A
 X-COORD : 27 36 48.73"E
 Y-COORD : 25 52 42.28"S



	BOULDERS	{SA01}
	GRAVEL	{SA02}
	GRAVELLY	{SA03}
	SAND	{SA04}
	SANDY	{SA05}
	SILT	{SA06}
	SILTY	{SA07}
	CLAY	{SA08}
	CLAYEY	{SA09}
	SHALE/siltstone	{SA12}
	QUARTZITE	{SA15}
	DOLERITE	{SA18}{SA42}
	FERRICRETE NODULES	{SA24}
	SCATTERED FERRICRETE NODULES	{SA25}
	PARTIALLY CEMENTED	{SA30}
	UNDISTURBED SAMPLE	{SA37}
	DISTURBED SAMPLE	{SA38}
	ROOTS	{SA40}
	COBBLES	{SA58}

Name

Name

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY :

INCLINATION :
DIAM :
DATE :
DATE :

ELEVATION :
X-COORD :
Y-COORD :

TYPE SET BY : Dale Franklin
SETUP FILE : STANDARD.SET

DATE : 16/10/2019 10:32
TEXT : ..866.08HekpoortTPLogs.TXT

APPENDIX B

Laboratory Test Results

**COLLAPSE POTENTIAL at 200 kPa**

Client	GCS GEOTECHNICAL ENGINEERING		
Location	HEKPOORT.	IP 11 @ 1,0m	
Date	08 OCTOBER 2019	Test No	3107
Job No	19281	Checked By	EB

Sample Height (mm)	20	Sample Diameter (mm)	64	Sample Specific Gravity	2.603
--------------------	----	----------------------	----	-------------------------	-------

Sample Preparation	NMC
--------------------	-----

Effective Stress (kPa)	Time (mins)	Consolidation Reading	Voids Ratio	Strain (%)
10	60	1067	1.020	0.00
10	90	1068	1.019	0.05
33	130	1072	1.015	0.25
65	190	1079	1.008	0.60
127	310	1105	0.982	1.90
200	1750	1126	0.961	2.95
200	3190	1339	0.745	13.60
498	3430	1437	0.646	18.50
993	3670	1510	0.573	22.15
1868	5110	1575	0.507	25.40
743	5230	1572	0.510	25.25
118	5350	1560	0.522	24.65
10	5470	1543	0.539	23.80

Moisture Content Calculations

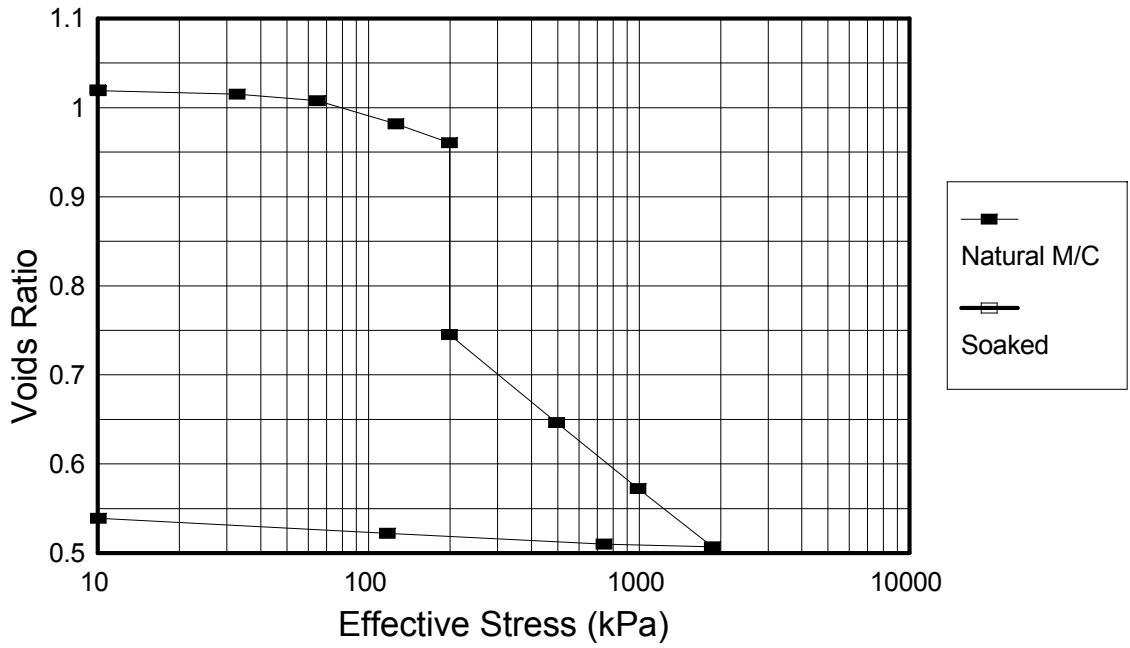
Mass wet sample plus ring before test (gms)	313.00
Mass wet sample plus ring after test (gms)	315.30
Mass dry sample plus ring (gms)	294.90
Mass ring (gms)	212.00
Moisture content before test (%)	21.83
Moisture content after test (%)	24.61

Other Data

Initial Dry Density (kg/m ³)	1288
Initial Void Ratio	1.02

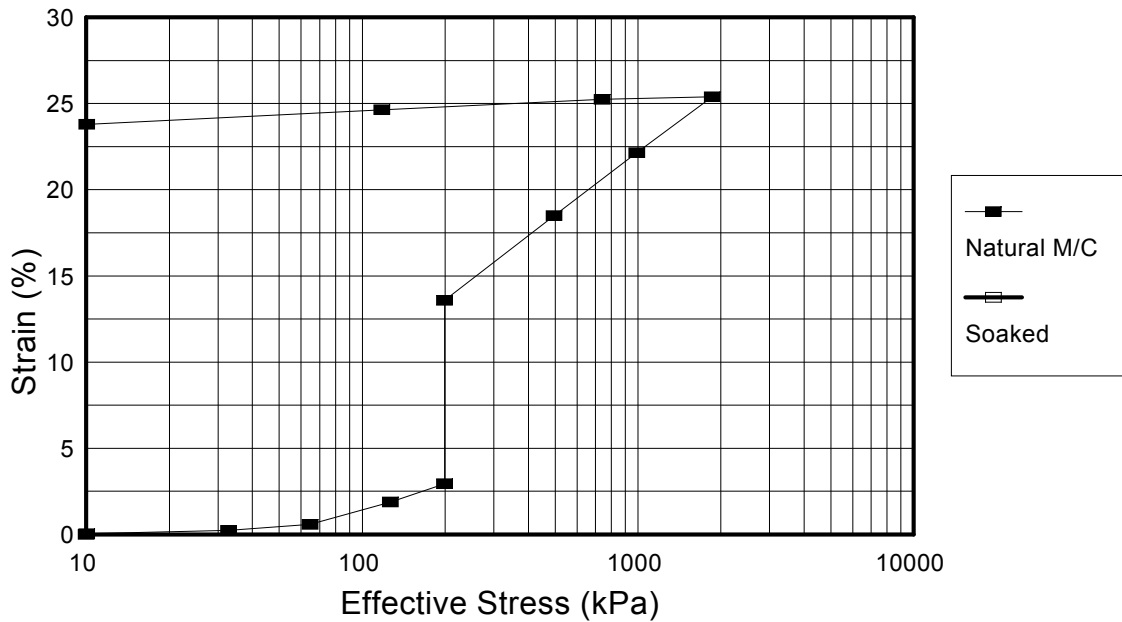
VOIDS RATIO v EFFECTIVE STRESS

Test No: 3107



STRAIN v EFFECTIVE STRESS

Test No: 3107



FOUNDATION INDICATOR

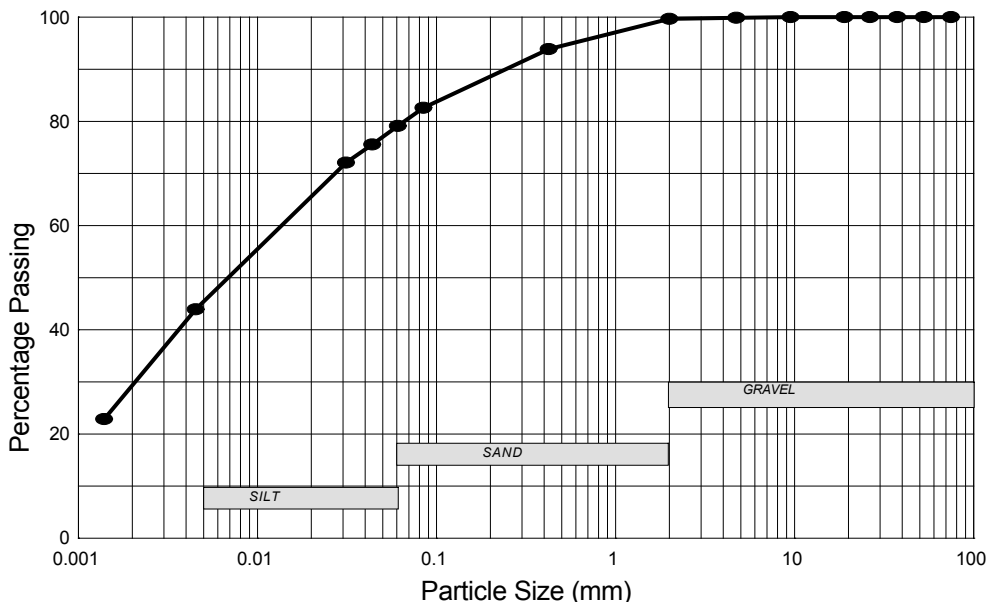
Client	GCS GEOTECHNICAL ENGINEERING		
Location	HEKPOORT	IP 2 @ 0,0 - 0,5m	
Date	07 OCTOBER 2019	Test No	3103
Job No	19281	Checked By	EB

GRADING ANALYSIS

SIEVE ANALYSIS

Values are expressed as a percentage of total sample

Sieve Size (mm)	Total Passing (%)
75.00	100.00
53.00	100.00
37.50	100.00
26.50	100.00
19.00	100.00
9.50	100.00
4.75	99.92
2.00	99.70
0.425	93.89



HYDROMETER ANALYSIS

Values are expressed as a percentage of total sample

Sieve Size (mm)	Total Passing (%)
0.0847	82.64
0.0609	79.13
0.0437	75.61
0.0314	72.09
0.0045	43.96
0.0014	22.86

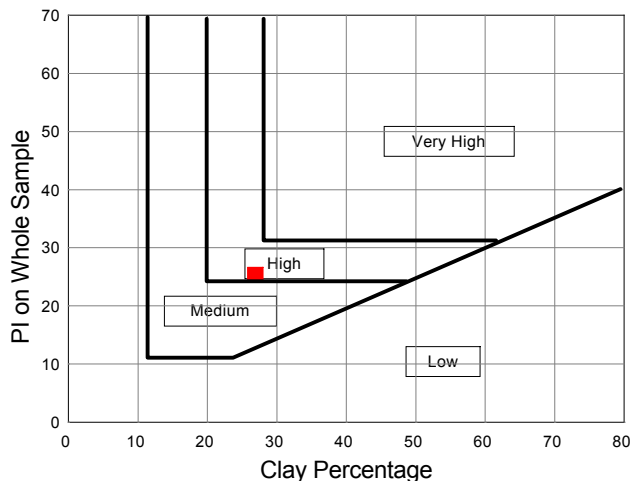
ATTERBERG LIMITS & OTHER VALUES

Liquid Limit	50
Plastic Limit	23
Plastic Index	27
Linear Shrinkage	13
Grading Modulus	0.24
Moisture Content	8.59
PI on Whole Sample	26
PRA Classification	A.7.6
Unified Classification	See Plasticity Chart

ESTIMATED COMPOSITION (As BS 1377)

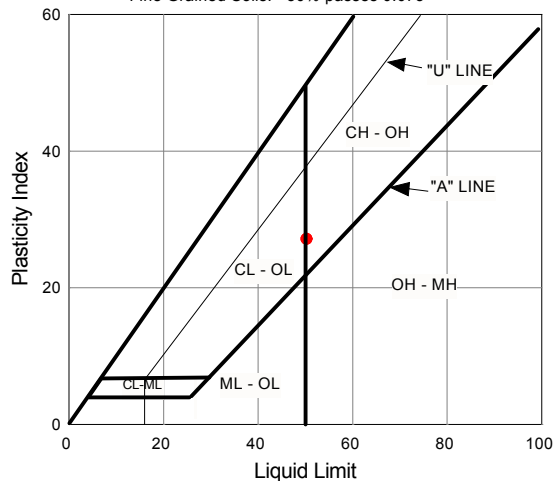
Clay (<0.002)	26.92
0.002 < Silt < 0.06	52.04
0.06 < Sand < 2.0	20.75
Gravel > 2.0	0.30
% less than 0.075	81.22

ACTIVITY CHART



PLASTICITY CHART

Fine Grained Soils: >50% passes 0.075



FOUNDATION INDICATOR

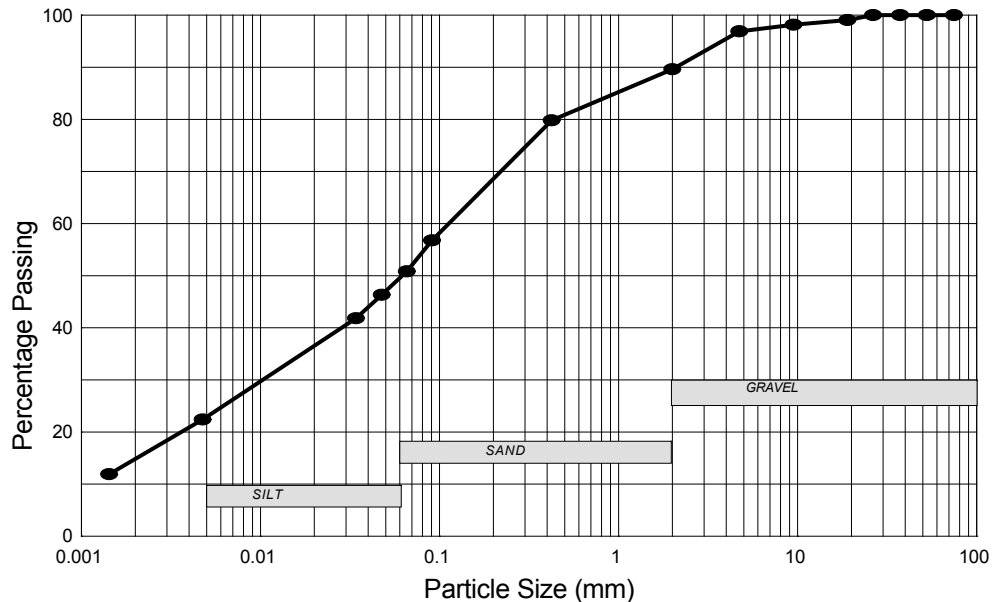
Client	GCS GEOTECHNICAL ENGINEERING		
Location	HEKPOORT	IP 1 @ 0,0 - 0,8m	
Date	07 OCTOBER 2019	Test No	3102
Job No	19281	Checked By	EB

GRADING ANALYSIS

SIEVE ANALYSIS

Values are expressed as a percentage of total sample

Sieve Size (mm)	Total Passing (%)
75.00	100.00
53.00	100.00
37.50	100.00
26.50	100.00
19.00	99.05
9.50	98.20
4.75	96.92
2.00	89.63
0.425	79.84



HYDROMETER ANALYSIS

Values are expressed as a percentage of total sample

Sieve Size (mm)	Total Passing (%)
0.0908	56.82
0.0660	50.84
0.0476	46.35
0.0343	41.87
0.0048	22.43
0.0014	11.96

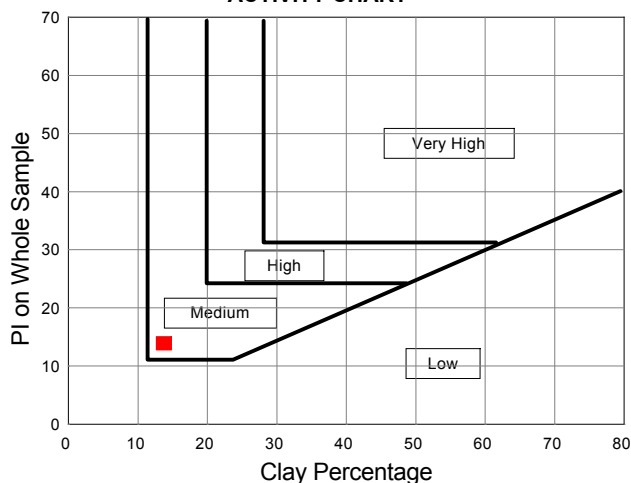
ATTERBERG LIMITS & OTHER VALUES

Liquid Limit	37
Plastic Limit	19
Plastic Index	17
Linear Shrinkage	9
Grading Modulus	0.74
Moisture Content	10.94
PI on Whole Sample	14
PRA Classification	A.6
Unified Classification	See Plasticity Chart

ESTIMATED COMPOSITION (As BS 1377)

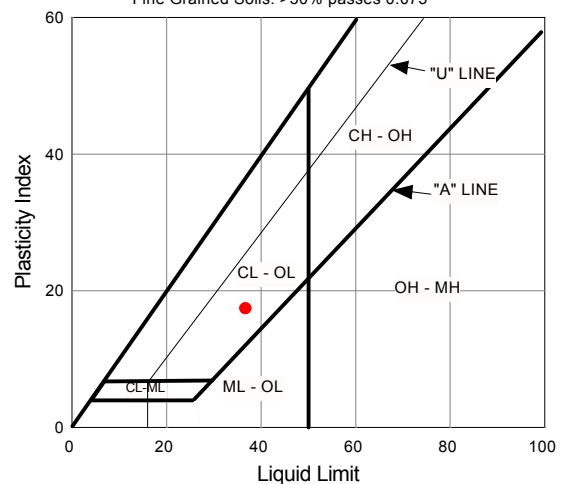
Clay (<0.002)	13.74
0.002 < Silt < 0.06	35.63
0.06 < Sand < 2.0	40.26
Gravel > 2.0	10.37
% less than 0.075	53.01

ACTIVITY CHART



PLASTICITY CHART

Fine Grained Soils: >50% passes 0.075



FOUNDATION INDICATOR

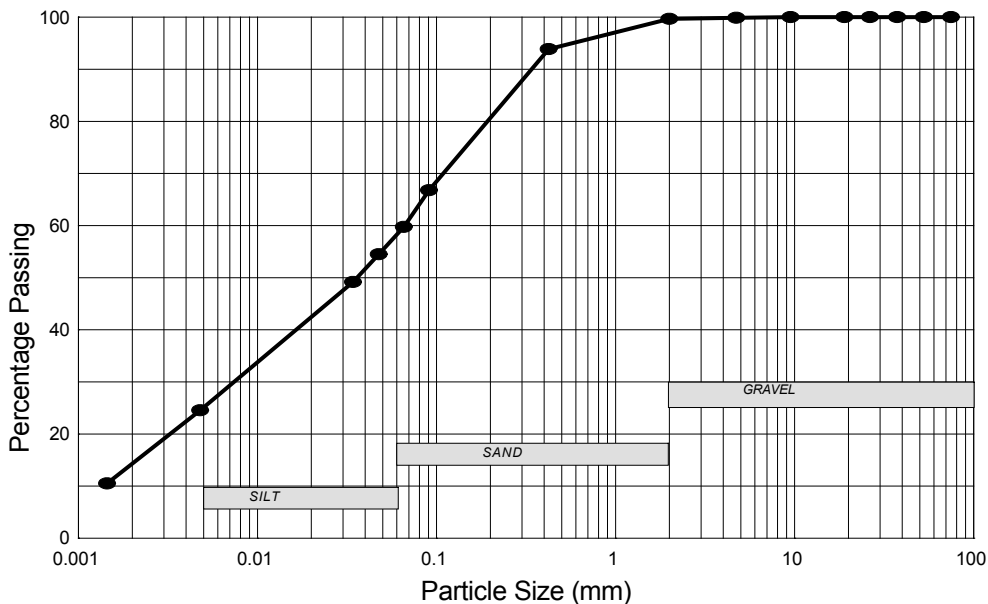
Client	GCS GEOTECHNICAL ENGINEERING		
Location	HEKPOORT	IP 14 @ 0,0 - 0,3m	
Date	07 OCTOBER 2019	Test No	3108
Job No	19281	Checked By	EB

GRADING ANALYSIS

SIEVE ANALYSIS

Values are expressed as a percentage of total sample

Sieve Size (mm)	Total Passing (%)
75.00	100.00
53.00	100.00
37.50	100.00
26.50	100.00
19.00	100.00
9.50	100.00
4.75	99.92
2.00	99.70
0.425	93.89



HYDROMETER ANALYSIS

Values are expressed as a percentage of total sample

Sieve Size (mm)	Total Passing (%)
0.0908	66.82
0.0660	59.79
0.0476	54.51
0.0343	49.23
0.0248	24.62
0.0014	10.55

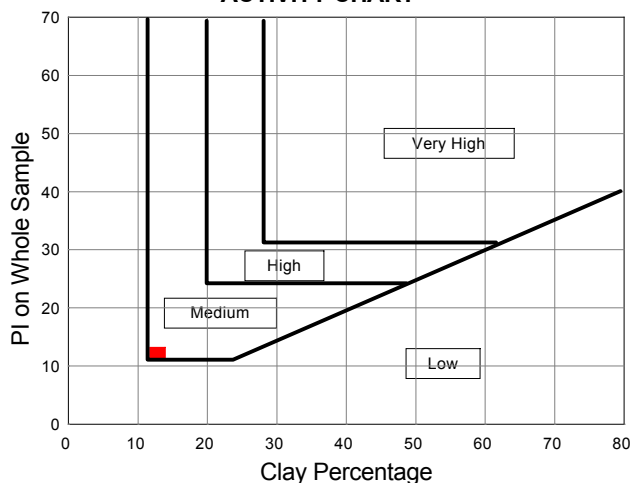
ATTERBERG LIMITS & OTHER VALUES

Liquid Limit	27
Plastic Limit	14
Plastic Index	13
Linear Shrinkage	7
Grading Modulus	0.40
Moisture Content	8.59
PI on Whole Sample	12
PRA Classification	A.6
Unified Classification	See Plasticity Chart

ESTIMATED COMPOSITION (As BS 1377)

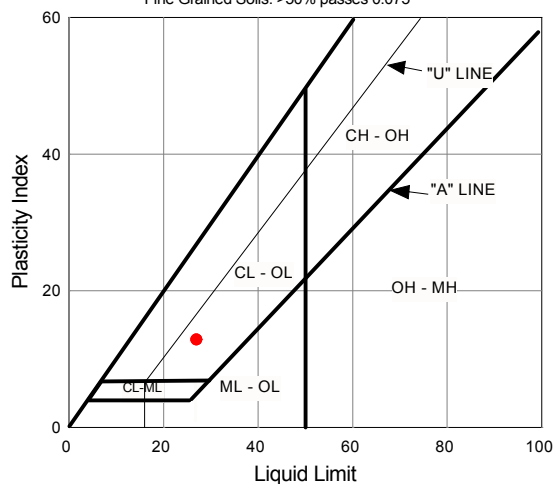
Clay (<0.002)	12.85
0.002 < Silt < 0.06	45.21
0.06 < Sand < 2.0	41.65
Gravel > 2.0	0.30
% less than 0.075	62.34

ACTIVITY CHART



PLASTICITY CHART

Fine Grained Soils: >50% passes 0.075



FOUNDATION INDICATOR

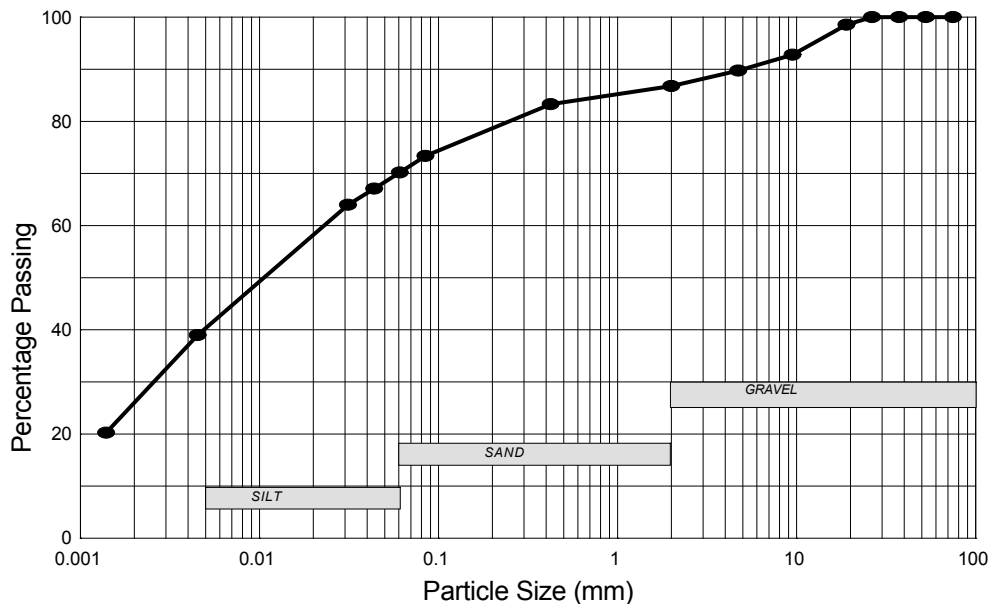
Client	GCS GEOTECHNICAL ENGINEERING		
Location	HEKPOORT	IP 2 @ 1,5m	
Date	07 OCTOBER 2019	Test No	3104
Job No	19281	Checked By	EB

GRADING ANALYSIS

SIEVE ANALYSIS

Values are expressed as a percentage of total sample

Sieve Size (mm)	Total Passing (%)
75.00	100.00
53.00	100.00
37.50	100.00
26.50	100.00
19.00	98.59
9.50	92.83
4.75	89.77
2.00	86.81
0.425	83.34



HYDROMETER ANALYSIS

Values are expressed as a percentage of total sample

Sieve Size (mm)	Total Passing (%)
0.0847	73.36
0.0609	70.23
0.0437	67.11
0.0314	63.99
0.0045	39.02
0.0014	20.29

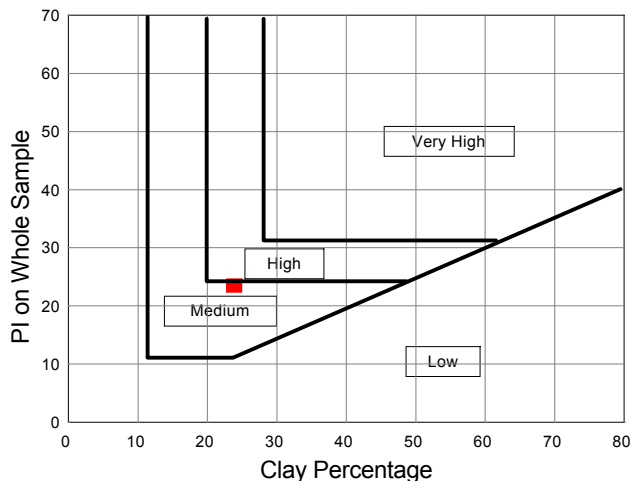
ATTERBERG LIMITS & OTHER VALUES

Liquid Limit	53
Plastic Limit	24
Plastic Index	28
Linear Shrinkage	14
Grading Modulus	0.56
Moisture Content	23.10
PI on Whole Sample	24
PRA Classification	A.7.6
Unified Classification	See Plasticity Chart

ESTIMATED COMPOSITION (As BS 1377)

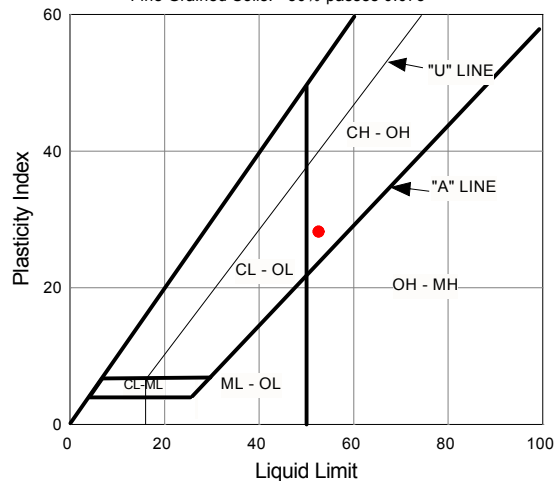
Clay (<0.002)	23.89
0.002 < Silt < 0.06	46.19
0.06 < Sand < 2.0	16.73
Gravel > 2.0	13.19
% less than 0.075	72.09

ACTIVITY CHART



PLASTICITY CHART

Fine Grained Soils: >50% passes 0.075



FOUNDATION INDICATOR

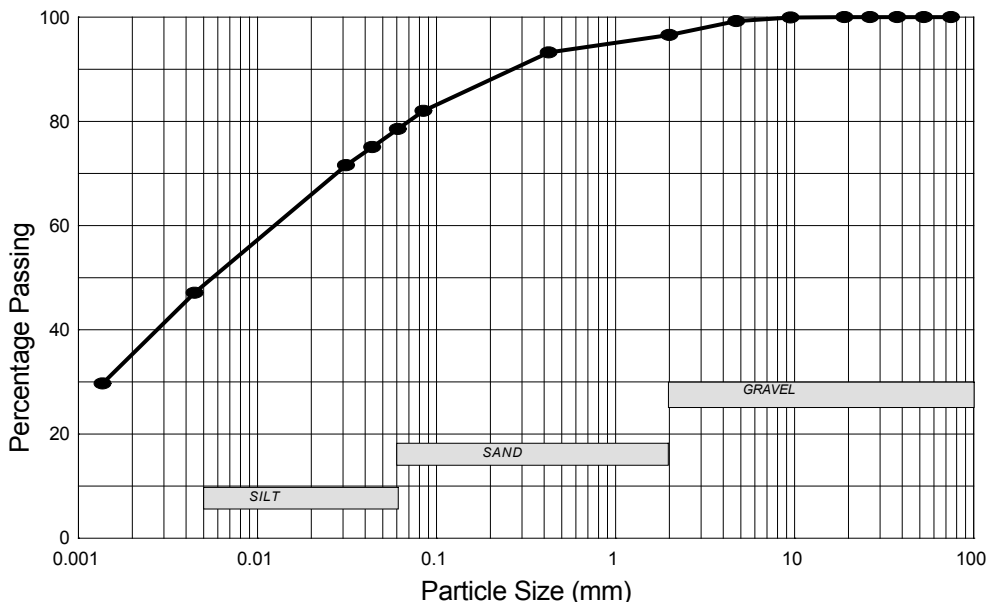
Client	GCS GEOTECHNICAL ENGINEERING		
Location	HEKPOORT	IP 3 @ 1,7 - 2,1m	
Date	07 OCTOBER 2019	Test No	3105
Job No	19281	Checked By	EB

GRADING ANALYSIS

SIEVE ANALYSIS

Values are expressed as a percentage of total sample

Sieve Size (mm)	Total Passing (%)
75.00	100.00
53.00	100.00
37.50	100.00
26.50	100.00
19.00	100.00
9.50	99.95
4.75	99.26
2.00	96.63
0.425	93.25



HYDROMETER ANALYSIS

Values are expressed as a percentage of total sample

Sieve Size (mm)	Total Passing (%)
0.0847	82.08
0.0609	78.58
0.0437	75.09
0.0314	71.60
0.0045	47.15
0.0014	29.69

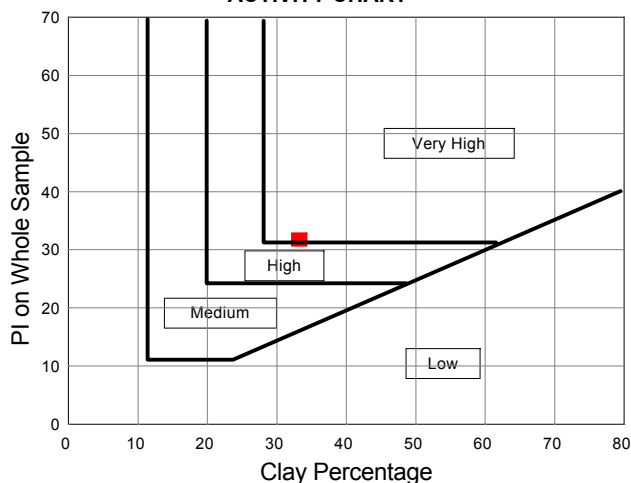
ATTERBERG LIMITS & OTHER VALUES

Liquid Limit	60
Plastic Limit	25
Plastic Index	34
Linear Shrinkage	17
Grading Modulus	0.28
Moisture Content	26.01
PI on Whole Sample	32
PRA Classification	A.7.6
Unified Classification	See Plasticity Chart

ESTIMATED COMPOSITION (As BS 1377)

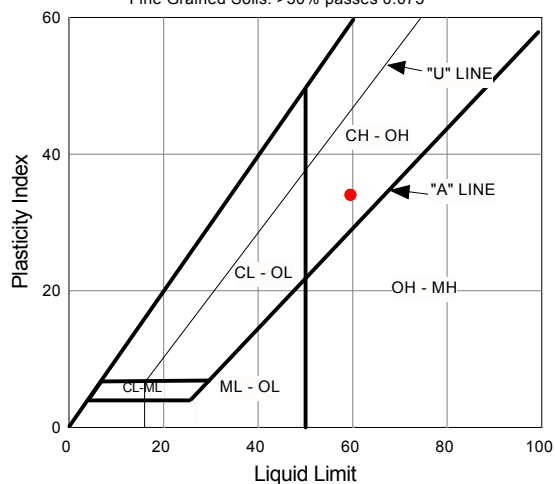
Clay (<0.002)	33.25
0.002 < Silt < 0.06	45.16
0.06 < Sand < 2.0	18.22
Gravel > 2.0	3.37
% less than 0.075	80.66

ACTIVITY CHART



PLASTICITY CHART

Fine Grained Soils: >50% passes 0.075





SOIL and MATERIAL TESTING
P.O. BOX 227
MARAISBURG 1700

TEL: (011) 674 1325
FAX: (011) 674 4513
e mail: satisfied@geopractica.co.za

SOIL pH and CONDUCTIVITY TEST RESULT

Client	GCS GEOTECHNICAL ENGINEERING		
Location	HEKPOORT.		
Date	07 OCTOBER 2019	Test No	
Job No	19281		MM

Sample Description	pH	Electrical Conductivity EC (µS/cm)	Total Dissolved Salts TDS (ppm)	Resistivity R (Ohms/cm)
TP 1 @ 0.0 - 0.8	5.6	281	141	3559
TP 2 @ 0.0 - 0.5	5.3	466	234	2146
TP 2 @ 1.5	6.2	360	180	2778
TP 3 @ 1.7 - 2.1	5.8	381	191	2625
TP 11 @ 1.0	6.8	326	163	3067
TP 14 @ 0.0 - 0.3	6.3	367	184	2725
TP 14 @ 0.3 - 1.8	6.8	360	180	2778
				ERR
				ERR
				ERR

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

Resistivity (Ohm/cm)	Degree of Corrosivity
0 - 2 000	Extremely Corrosive
2 000 - 4 000	Very Corrosive
4 000 - 5 000	Corrosive
5 000 - 6 000	Mildly Corrosive
>10 000	Not Generally Corrosive

FOUNDATION INDICATOR

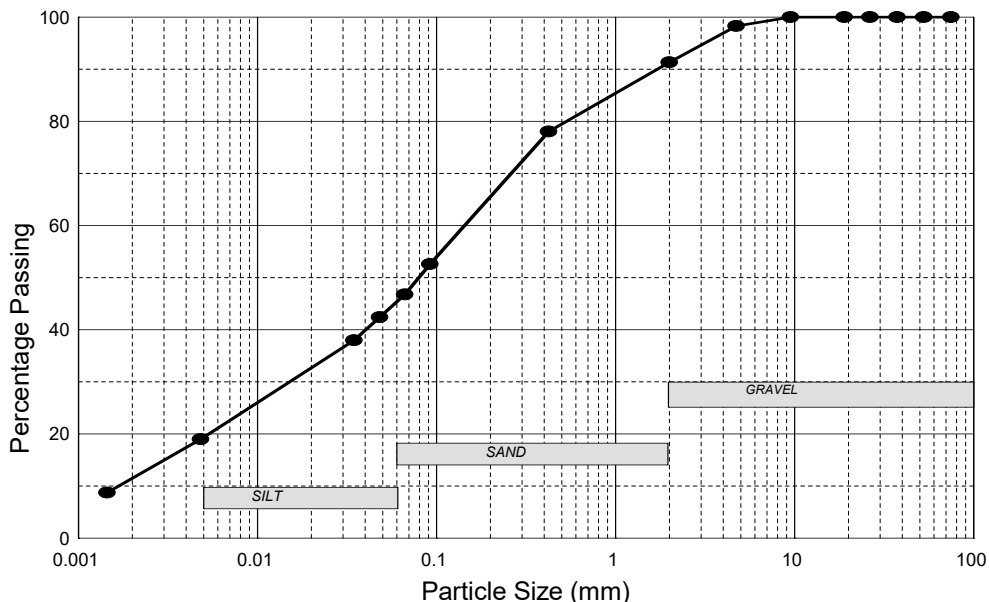
Client	GCS GEOTECHNICAL ENGINEERING		
Location	HEKPOORT	IP 11 @ 1,0m	
Date	07 OCTOBER 2019	Test No	3106
Job No	19281	Checked By	EB

GRADING ANALYSIS

SIEVE ANALYSIS

Values are expressed as a percentage of total sample

Sieve Size (mm)	Total Passing (%)
75.00	100.00
53.00	100.00
37.50	100.00
26.50	100.00
19.00	100.00
9.50	100.00
4.75	98.30
2.00	91.35
0.425	78.09



HYDROMETER ANALYSIS

Values are expressed as a percentage of total sample

Sieve Size (mm)	Total Passing (%)
0.0921	52.65
0.0669	46.80
0.0482	42.41
0.0348	38.02
0.0048	19.01
0.0014	8.77

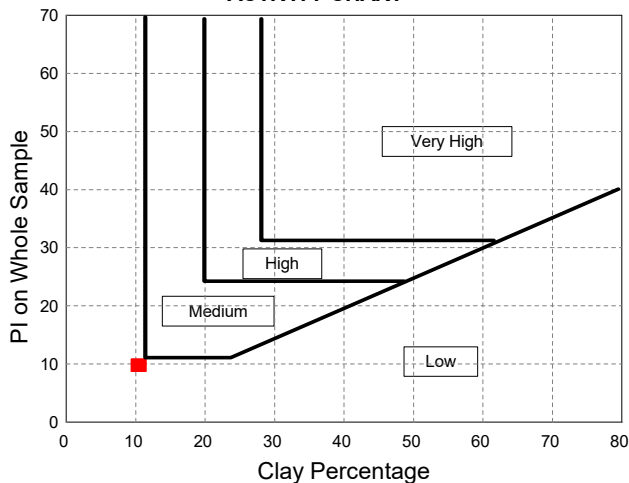
ATTERBERG LIMITS & OTHER VALUES

Liquid Limit	41
Plastic Limit	28
Plastic Index	13
Linear Shrinkage	7
Grading Modulus	0.78
Moisture Content	18.09
PI on Whole Sample	10
PRA Classification	A.7.6
Unified Classification	SC

ESTIMATED COMPOSITION (As BS 1377)

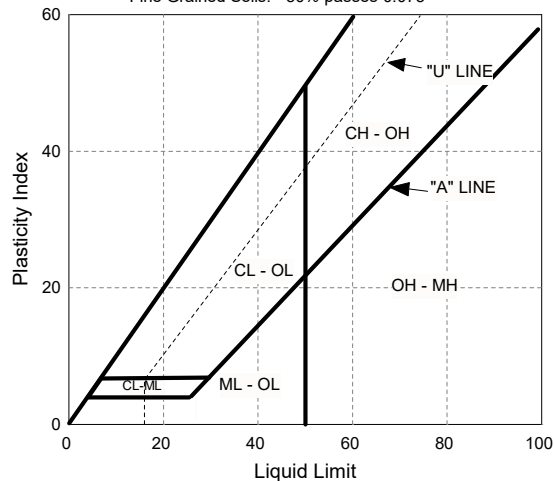
Clay (<0.002)	10.44
0.002 < Silt < 0.06	34.73
0.06 < Sand < 2.0	46.18
Gravel > 2.0	8.65
% less than 0.075	48.68

ACTIVITY CHART



PLASTICITY CHART

Fine Grained Soils: >50% passes 0.075



FOUNDATION INDICATOR

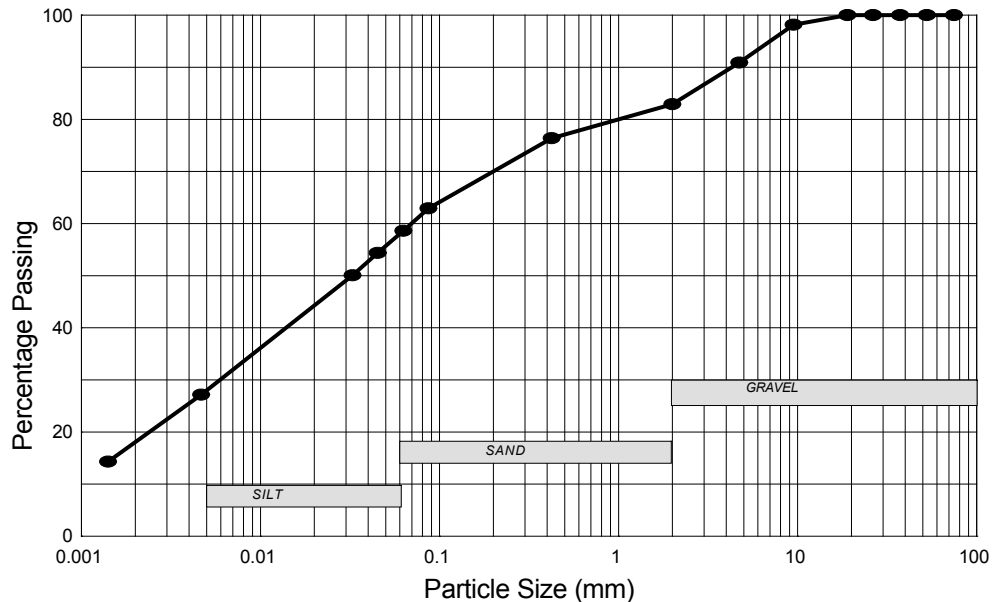
Client	GCS GEOTECHNICAL ENGINEERING		
Location	HEKPOORT	IP 14 @ 0,3 - 1,8m	
Date	07 OCTOBER 2019	Test No	3109
Job No	19281	Checked By	EB

GRADING ANALYSIS

SIEVE ANALYSIS

Values are expressed as a percentage of total sample

Sieve Size (mm)	Total Passing (%)
75.00	100.00
53.00	100.00
37.50	100.00
26.50	100.00
19.00	100.00
9.50	98.22
4.75	90.95
2.00	82.95
0.425	76.40



HYDROMETER ANALYSIS

Values are expressed as a percentage of total sample

Sieve Size (mm)	Total Passing (%)
0.0867	62.95
0.0628	58.66
0.0454	54.37
0.0328	50.08
0.0047	27.19
0.0014	14.31

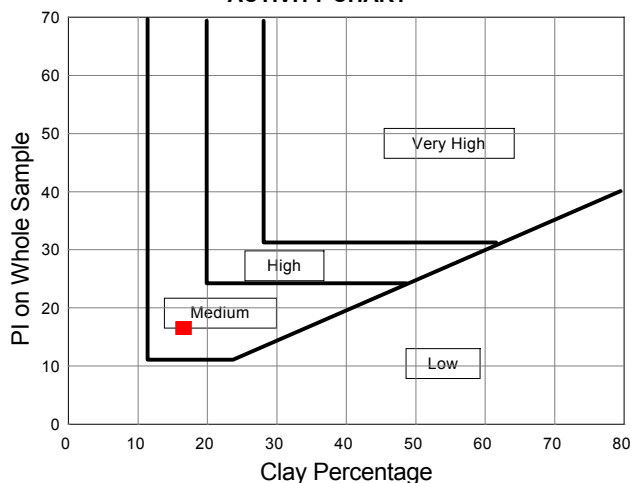
ATTERBERG LIMITS & OTHER VALUES

Liquid Limit	44
Plastic Limit	22
Plastic Index	22
Linear Shrinkage	11
Grading Modulus	0.78
Moisture Content	16.37
PI on Whole Sample	17
PRA Classification	A.7.6
Unified Classification	See Plasticity Chart

ESTIMATED COMPOSITION (As BS 1377)

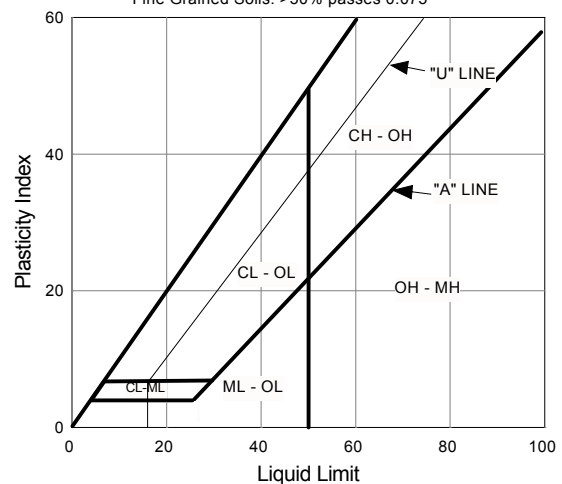
Clay (<0.002)	16.60
0.002 < Silt < 0.06	41.38
0.06 < Sand < 2.0	24.97
Gravel > 2.0	17.05
% less than 0.075	60.85

ACTIVITY CHART



PLASTICITY CHART

Fine Grained Soils: >50% passes 0.075



**COLLAPSE POTENTIAL at 200 kPa**

Client	GCS GEOTECHNICAL ENGINEERING		
Location	HEKPOORT	IP 14 @ 0,3 - 1,8m	
Date	08 OCTOBER 2019	Test No	3110
Job No	19281	Checked By	EB

Sample Height (mm)	20	Sample Diameter (mm)	64	Sample Specific Gravity	2.633
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Sample Preparation	NMC
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Effective Stress (kPa)	Time (mins)	Consolidation Reading	Voids Ratio	Strain (%)
10	60	807	1.209	0.00
10	90	808	1.208	0.05
33	130	812	1.203	0.25
65	190	818	1.197	0.55
127	310	831	1.182	1.20
200	1750	842	1.170	1.75
200	3190	962	1.038	7.75
498	3430	1053	0.937	12.30
993	3670	1130	0.852	16.15
1868	5110	1194	0.781	19.35
743	5230	1181	0.796	18.70
118	5350	1165	0.813	17.90
10	5470	1149	0.831	17.10

Moisture Content Calculations

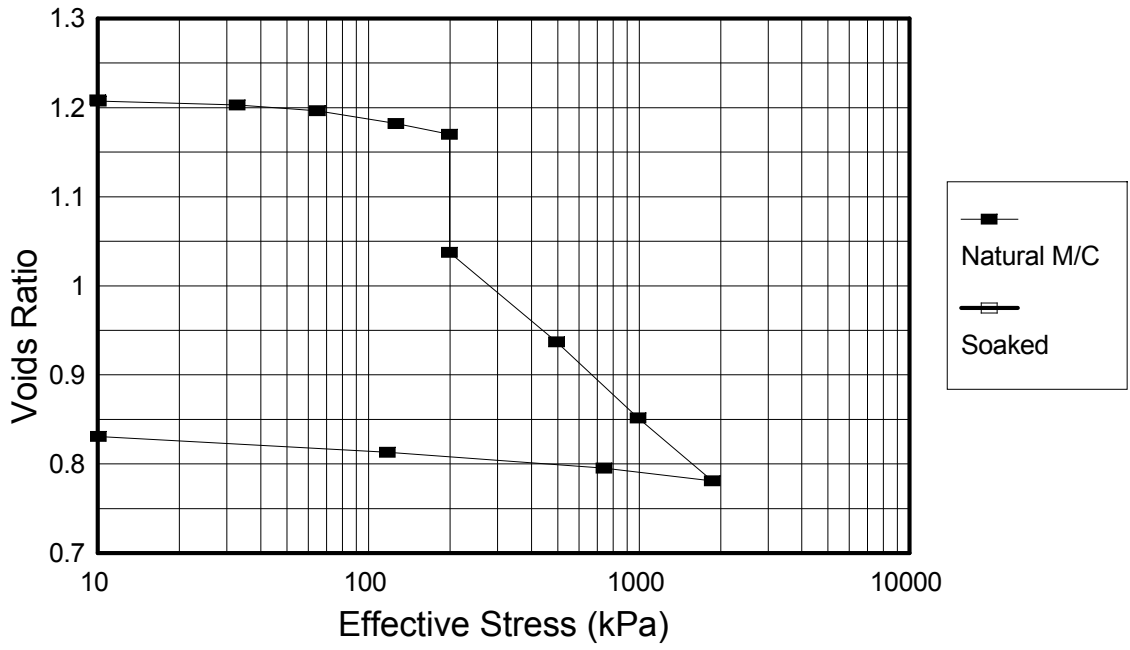
Mass wet sample plus ring before test (gms)	299.80
Mass wet sample plus ring after test (gms)	305.20
Mass dry sample plus ring (gms)	288.10
Mass ring (gms)	211.40
Moisture content before test (%)	15.25
Moisture content after test (%)	22.29

Other Data

Initial Dry Density (kg/m ³)	1192
Initial Void Ratio	1.21

VOIDS RATIO v EFFECTIVE STRESS

Test No: 3110



STRAIN v EFFECTIVE STRESS

Test No: 3110

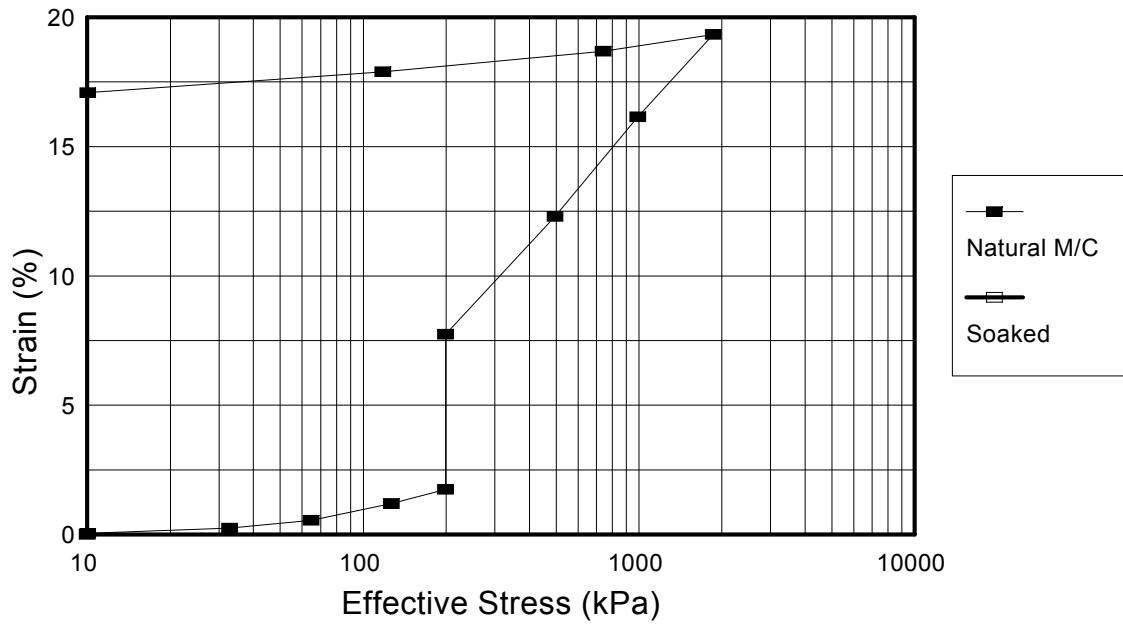
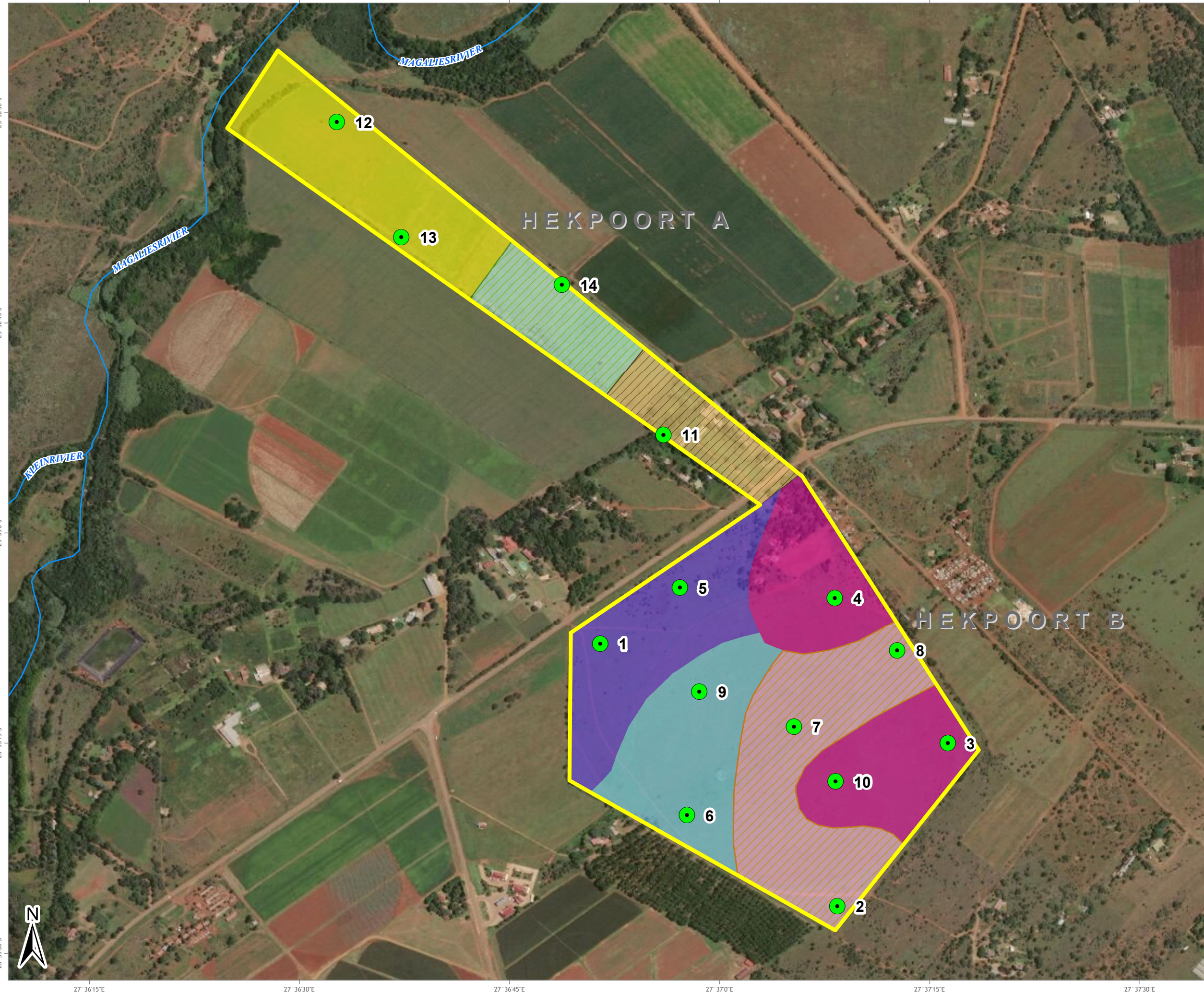


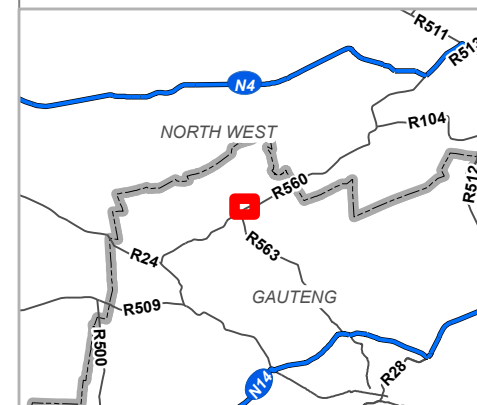
FIGURE 1
Site Plan

RAPID LAND RELEASE PROGRAM - HEKPOORT NHBRC CLASSIFICATIONS



LEGEND

- Test Pits
- Rivers and Streams**
- Perennial
- Hekpoort Site Boundary
- NHBRC**
- H2 - H3
- C2/H2 - H3
- C2 - H2
- H1 - Heave 7.5 - 15 mm
- H2 - Heave 15 - 30 mm
- H3 - Heave > 30 mm
- C2 - Collapsible Sand > 10 mm



Data Sources:
 ESRI Basemap 2019
 Data supplied by Specialist (N. Welland)

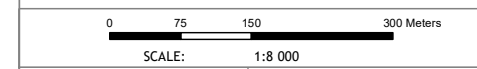
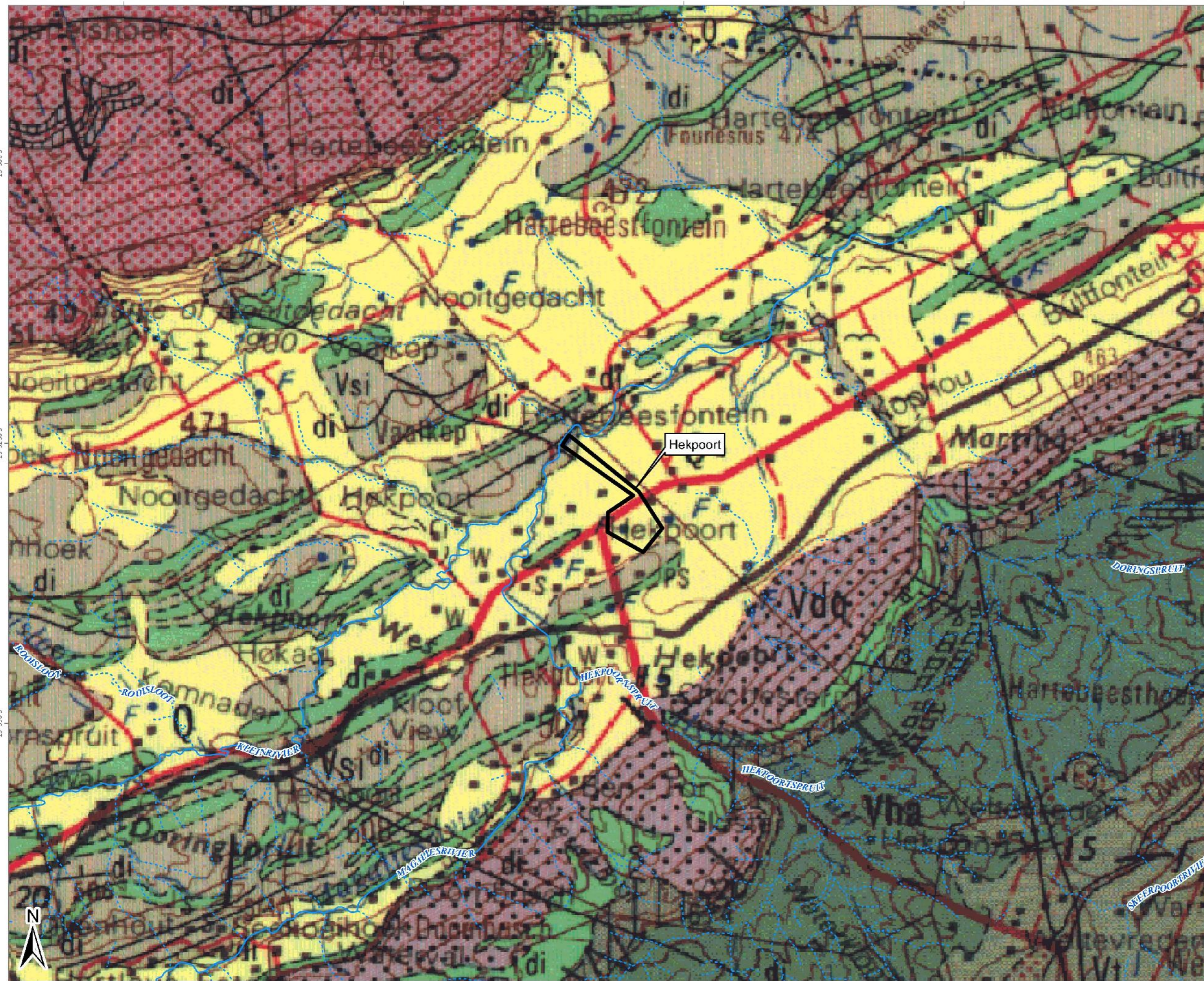


FIGURE NO.:	-	MAP NUMBER:	19-0866-16
DRAWN BY:	A LOVE GIS CONSULTANT	REVIEWED BY:	C BOTHA GIS SPECIALIST
DATUM:	WGS84	DATE:	26 SEPTEMBER 2019
PROJECTION:	GEOGRAPHIC		
PROJECT:	RAPID LAND RELEASE PROGRAM		
CLIENT:	GLAD AFRICA		

63 Wessel Road Woodmead
 PO Box 2597 Rivonia 2128
 South Africa
 Tel: +27 (0) 11 803 5726
 Fax: +27 (0) 11 803 5745
 E-mail: jhb@gcs-sa.biz
 www.gcs-sa.biz

FIGURE 2
Geological Plan

RAPID LAND RELEASE PROGRAM - HEKPOORT: GEOLOGY



LEGEND

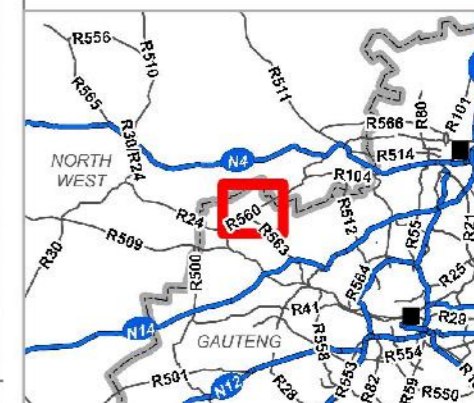
Rivers and Streams

- Non-Perennial
- Perennial

- Hekpoort

Lithology

- Surface deposits (undifferentiated)
- Diabase; hybrid diabase (---); diabase dyke (-.a)
- Vsi Slate, shale, hornfels, graphitic (-.-); with andalusite (-.-); quartzite (-.-)
- Vm Quartzite, minor hornfels (---)
- Vdq Quartzite
- Vha Andesite, basalt, tuff, agglomerate (-.-); shale (-.-); chert (-.a)
- Vt Shale, slate, with andalusite (-.-); ferruginous quartzite (-.-); quartzite; slate (-.-)



Data Sources:
Council for Geoscience
1:250 000 Geological Series: 2526



FIGURE NO.: MAP NUMBER: 19-066-04

DRAWN BY: N NAIDOO GIS CONSULTANT REVIEWED BY: C BOTHA GIS SPECIALIST

DATUM: WGS84 GEOGRAPHIC DATE: 12 SEPTEMBER 2019

PROJECT: RAPID LAND RELEASE PROGRAM CLIENT: GLAD AFRICA

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South Africa
Tel: +27 (0) 11 803 5726
Fax: +27 (0) 11 803 5745
E mail: jnb@gcs.co.za
www.gcs.co.za

27° 32' 30" E

27° 35' 0" E

27° 37' 30" E

27° 40' 0" E

25° 50' 0" S

25° 52' 30" S

25° 55' 0" S