REPORT
ON
THE ENGINEERING GEOLOGICAL INVESTIGATION
FOR
THE PROPOSED FILLING STATION
SITUATED
ON
STAND 1869
CAPITAL PARK

LOUIS KRUGER GEOTECHNICS CC
PO BOX 90093
Garsfontein
0042
Tel 082 651 4819
Fax 086 671 1684

SEPTEMBER 2014

Client

EXDEV

REPORT ON THE ENGINEERING GEOLOGICAL INVESTIGATION FOR THE PROPOSED FILLING STATION SITUATED ON STAND 1869 CAPITAL PARK

CONTENTS Page

REPORT ON THE ENGINEERING GEOLOGICAL INVESTIGATION FOR THE PROPOSED FILLING STATION SITUATED ON STAND 1869 CAPITAL PARK

1. INTRODUCTION

Louis Kruger Geotechnics CC was appointed to do an engineering geological investigation for the proposed filling station situated on Stand 1869 Capital Park. The investigation was undertaken according to the normal requirements to assess the suitability of the site (SANS 634: Geotechnical Investigations For Township Development, SANS 633: Profiling, and Percussion and Core Borehole Logging In Southern Africa for Engineering Purposes, Home Building Manual Part 1 & 2", National Home Builders Registration Council, 1999) and Guidelines for Urban Engineering Geological Investigations 1997). The following aspects are addressed in this report:

- Geology and Soil profile
- Geohydrology
- Foundation conditions
- Construction material

2. TERMS OF REFERENCE

The appointment was to do an engineering geological investigation for the proposed filling station situated on Stand 1869 Capital Park. The following aspects were to be addressed:

- The geotechnical characteristics of the site
- Geotechnical constraints
- Geohydrology
- Founding conditions
- NHBRC Zoning

The locality of the site is shown on Figure 1.

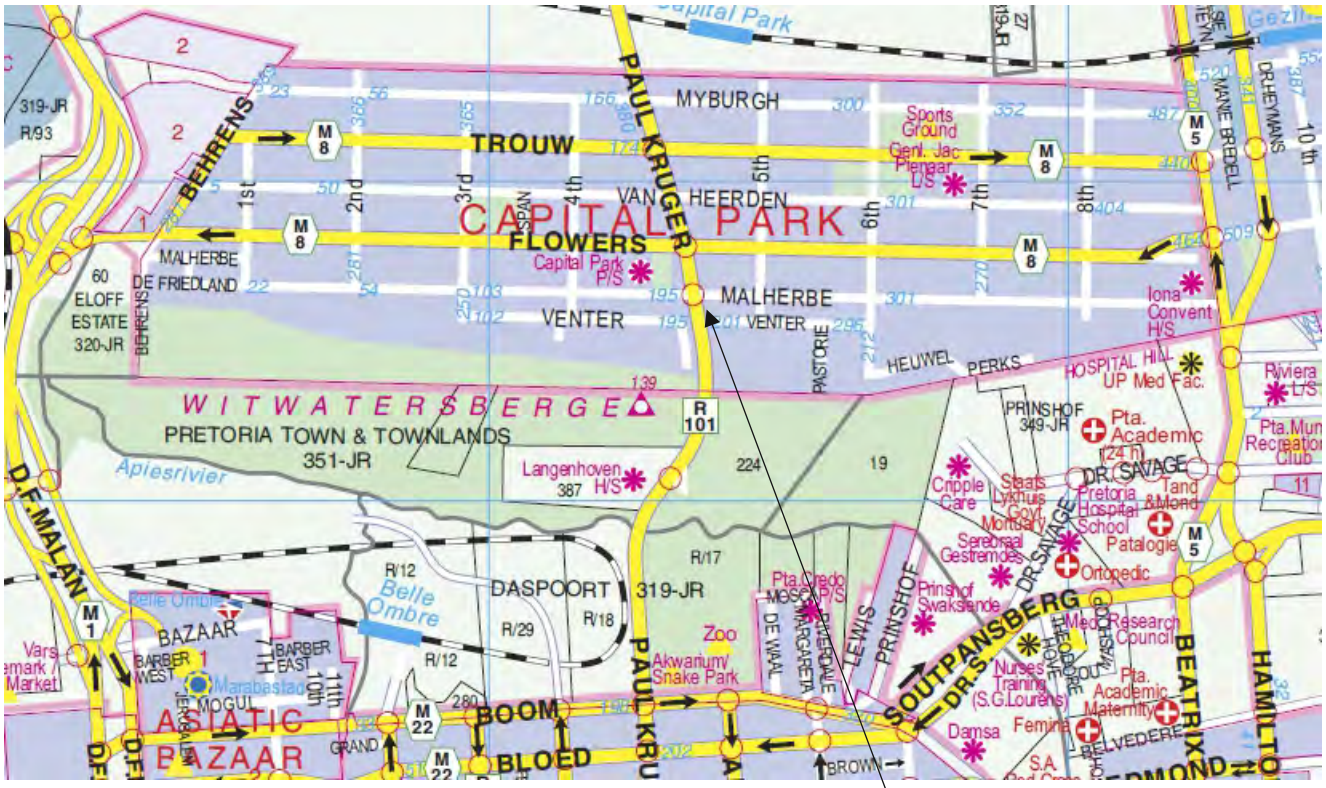
3. AVAILABLE INFORMATION

The following information was available:

- 1 : 50 000 Geological Map 2528CA Pretoria
- 1 : 50 000 Topographical Map
- Aerial photographs
- "Hydrocensus Survey Report: Proposed Capital Park Filling Station", Strategic Environmental Focus (Pty) Ltd, April 2014

4. LOCALITY

The proposed site is situated on Stand 1869 Capital Park. The site is bounded by Malherbe Street in the north and by Paul Kruger Street in the west. The locality of the site is shown on Figure 1.



LOCALITY	FIGURE 1 NTS

5. TOPOGRAPHY AND DRAINAGE

No topographical information was available. According to the available information the site slopes gently towards the west at approximately 2%. Surface water drains by means of sheet wash in the same direction into the municipal storm water system. According to the available information the site is not affected by flood lines.

6. METHOD OF INVESTIGATION

Large pots for plants are being stored and sold on the site. Therefore there was limited space available for the digging of test pits. Two test pits were dug on the site with a TLB at predetermined positions. The soil profiles were described according to the standard method proposed by Jennings, Brink and Williams (1973). .Disturbed samples of the most prominent soil horizons were taken and submitted to a soils laboratory for foundation indicator tests. Due to the high gravel content and the limited thickness of the materials encountered on the site, no undisturbed samples were taken and no CBR tests were done.

Due to the presence of fill on the site, with a highly variable composition, no infiltration tests were done, the laboratory test results were used to give an indication of the permeability of the materials encountered on the site. Furthermore no tests were done to determine a base value for petroleum hydrocarbons since it is not known if the fill are to be removed.

7. GEOLOGY AND SOIL PROFILE

According to the 1 : 50 000 scale geological map, the site is underlain by shale of the Magaliesberg Stage of the Pretoria Series of the Transvaal Sequence. This was confirmed during the investigation, residual shale was encountered in the test pits. The test pit positions are shown on Figure 2 and are attached as Appendix A. The following materials were encountered on the site:

7.1 Fill

Fill, consisting of red brown, soft, gravely clayey sand with abundant ferricrete concretions and pipe fragments was encountered in all the test pits from surface up to a depth of 1,0 meters.

7.2 Nodular ferricrete

Slightly moist, red brown mottled yellow and black, stiff, silty, sandy, fine and medium gravel consisting of hard, round, intact, nodular ferricrete was encountered in all the test pits from an average depth of 1,0 meters up to an average depth 2,6 meters. The thickness of this material increases slightly towards the south.

7.3 Residual shale

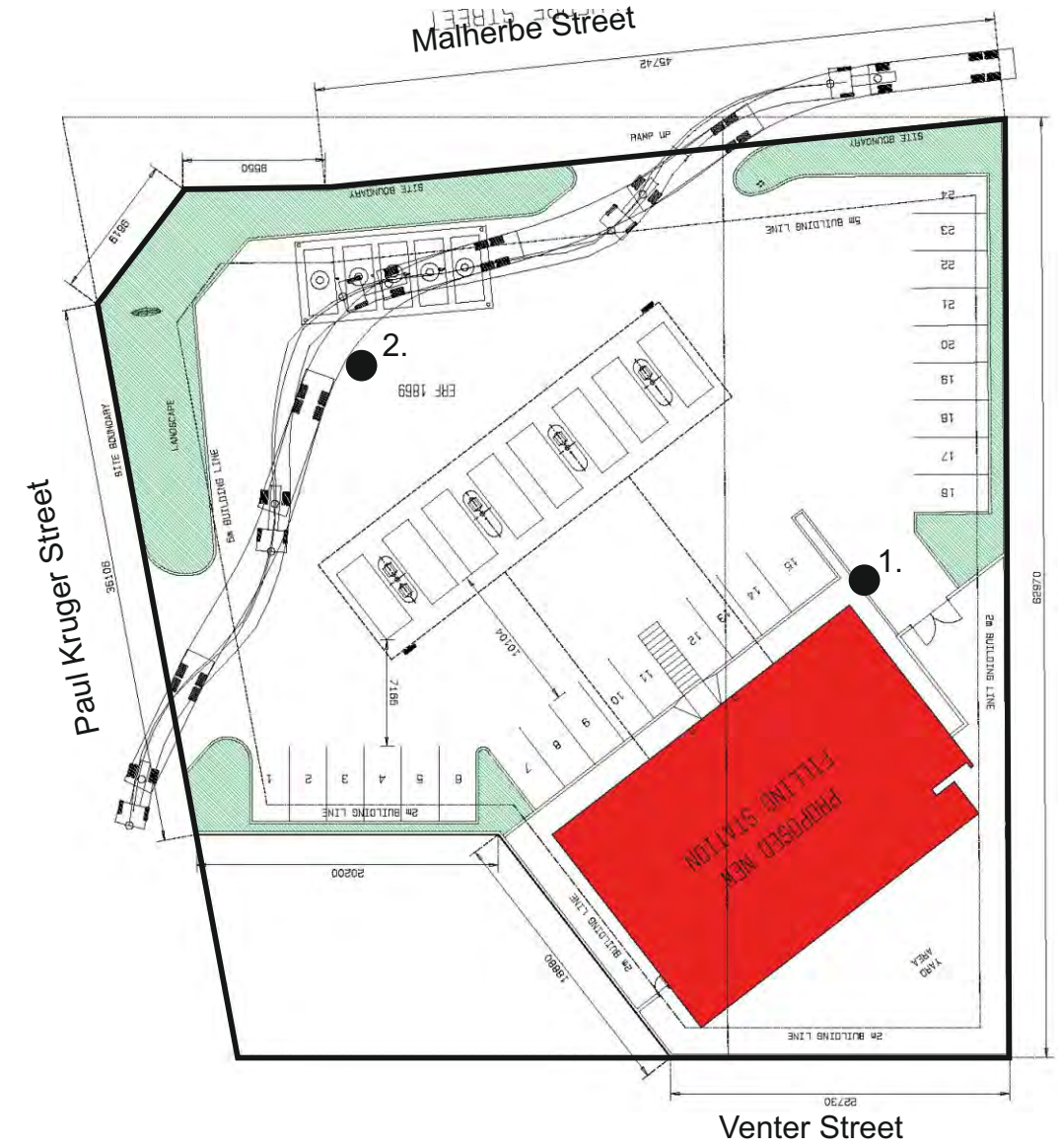
Slightly moist to moist, red brown mottled pink and yellow, soft, silty, clayey sand was encountered in both test pits from an average depth of 2,6 meters up to the maximum reach of the back actor.

8. GEOHYDROLOGY

8.1 Regional geohydrology

The regional geohydrology is discussed in detail in the report by Groundwater Strategic Environmental Focus (Pty) Ltd, and is summarized as follows:

- Three boreholes were located in the vicinity of the site. The boreholes were sealed; therefore ground water levels could not be obtained. Groundwater Strategic Environmental Focus obtained the following information from the WRC (2001) report concerning water levels of the study area; the mean depth to water level is 10-20mbgl and the standard deviation for water levels ranges from 15 to 25mbgl. It should be noted that these figures are regional values and not site specific



LAYOUT
and
TEST PIT POSITIONS

FIGURE 2

SCALE 1 : 500

.

- Site falls with the quaternary catchment A23E and the general surface and groundwater flow is towards the north-west to Apies River which eventual flow to the north

- The general usage for groundwater in the area is related to the irrigation of gardens and domestic use when no municipal water is available; Groundwater usage may increase during the dry season for garden/lawn irrigation. Estimated usage ranges from 0.8 to 2.7 l/s.

8.2 Site geohydrology

No ground water was encountered during the investigation. The presence of the pedogenic material however indicates that a perched water table could be present during and after periods of high rainfall. The Unified Soil Classification of the nodular ferricrete is SC, according to the Unified Soil Classification the expected permeability of the nodular ferricrete range from 10^{-3} cm/s to 10^{-5} cm/s. The Unified Soil Classification of the residual shale is SC, according to the Unified Soil Classification the expected permeability of this material range from 10^{-6} cm/s to 10^{-7} cm/s. It is recommended that a conservative approach be adopted and that a permeability of 10^{-3} cm/s be assigned to the materials on the site

9. LABORATORY TEST RESULTS

9.1 Indicator test results

The laboratory test results are attached as Appendix B and are summarized in the following table:

MATERIAL	TP	DEPTH (m)	PI	% Clay	% Silt	% Sand	% Gravel
Nodular ferricrete	1	2,1	13	7	14	38	40
Nodular ferricrete	2	1,8	13	8	13	47	32
Residual shale	1	2,8	19	32	22	44	3
Residual shale	2	2,8	22	32	22	43	4

The predominantly sandy- nature of the materials encountered on the site is clearly reflected by the laboratory test results. The difference between the nodular ferricrete and the residual shale is reflected by the lower clay- and higher gravel content of the nodular ferricrete. The laboratory test results furthermore clearly reflect the variation in the composition of the materials.

9.2 Potential expansiveness

The potential expansiveness of the materials encountered on the site was calculated according to the method proposed by Van der Merwe (1964). The following material characteristics are considered when applying this method:

- Plasticity index
- Clay fraction (< 0,002 mm)
- Thickness of expansive material
- Thickness of non - expansive material

Assuming the laboratory test results typify the material encountered on the site, the application of the method of Van der Merwe shows that the nodular ferricrete classifies as “Low” and that the residual shale classifies as “Medium” expansive. The calculated heave in the test pits is less than 7,5 mm.

9.3 Collapse potential

Due to the high gravel content of the materials encountered on the site, no undisturbed samples were taken.

9.4 CBR test results

Due to the presence of the fill no CBR tests were done.

9.5 Chemical test results

Due to the presence of the fill no chemical tests were done.

10. ENGINEERING GEOLOGICAL ZONING

The soil profile is fairly uniform; therefore the site was not divided into different engineering geological zones.

11. GEOTECHNICAL CONSIDERATIONS

The following geotechnical considerations, which could influence the proposed development, were identified:

11.1 Founding of structures

- The composition and consistency of the fill varies considerably, therefore it is not considered to be suitable founding material. If unadapted structures are founded on this material, and the moisture condition of the insitu material should vary, unacceptable differential movements, with resultant cracking, may occur in structure
- Although overall consistency of the nodular ferricrete is stiff, the consistency and composition vary considerably, and soft patches are present, therefore it is not considered suitable founding material. If unadapted structures are founded on this material, and the moisture condition of the insitu material should vary, unacceptable differential movements, with resultant cracking, may occur in structures
- The residual shale is potentially expansive, and classifies as “Medium”. Therefore, it is not considered suitable founding material. If unadapted structures are founded on this material, and the moisture condition of the insitu material should vary, unacceptable differential movements, with resultant cracking may occur in structures.
- The calculated heave is less than 7,5 mm

11.2 Excavatability

The test pits were dug to the maximum reach of the back actor.

11.3 Construction material

The nodular ferricrete classifies as A-2-6 and the residual shale classifies as A-6. The Plasticity Index and Grading Modulus were used to assess the suitability as construction material (TRH 14).

11.4 Groundwater

A periodical perched water table, which could cause the flooding of excavations, could be present during or after periods of high rainfall. This is confirmed by the presence of pedogenic material. Groundwater Strategic Environmental Focus (Pty) Ltd the regional ground water level is between 10 meters and 20 meters below surface.

11.5 Stability of excavations

Limited instability occurred in the sidewalls of the test pits.

12. GEOHYDROLOGICAL CONSIDERATIONS

12.1 Domestic water sources

A borehole census was done in a one kilometer radius around the proposed site, three boreholes that are used for the irrigation of gardens and domestic use when no municipal water is available was located. Two of these boreholes are up-gradient, the third is situated 300 meters down-gradient from the site. **Based on the available information and the report by Groundwater Simple Solutions it is concluded that the pollution threat to domestic water sources is considered to be low to medium.**

12.2 Soil permeabilities

According to the Unified Soil Classification the expected permeability of these materials range from 10^{-3} cm/s to 10^{-7} cm/s. It is recommended that a conservative approach be adopted and that a permeability of 10^{-3} cm/s be assigned to the materials on the site. According to Fisher the permeability of the materials should be in the order of 1×10^{-5} cm/s to prevent pollution of surface water sources. **Based on the available information it is concluded that the pollution threat to the non-perennial stream is medium *if no mitigating measures are implemented* on the site.**

12.3 Site drainage

Based on the available information it seems that surface water drains into the municipal storm water system. The construction of roads, parking areas and structures will increase the impermeable surface area on the site, leading to increased surface water runoff. **Based on the available information it is concluded that the pollution threat to the municipal storm water system is high if storm water is not managed effectively.**

12.4 Basal buffer zone

The basal buffer zone refers to the zone between the base of the fuel tanks and the water table. According to the available information the natural ground water level is situated between 10 meters and 20 meters below surface. Furthermore a periodical perched water table could be present during or after periods of high rainfall. This is confirmed by the presence of pedogenic material**. If no discontinuities that could act as zones of preferential infiltration to the ground water, the pollution potential of the natural ground water table is considered to be low to medium due to thickness and composition of the basal buffer zone. The pollution potential of the perched water table is considered to be high if no mitigating measures are implemented on the site.**

13. GEOTECHNICAL CLASSIFICATION

The site was classified according to the Geotechnical Classification for Urban Development (after Partridge, Wood and Brink 1993). The criteria for the classification are shown in the following table:

GEOTECHNICAL CLASSIFICATION FOR URBAN DEVELOPMENT (after Partridge, Wood and Brink 1993)

	CONSTRAINT	MOST FAVOURABLE (1)	INTERMEDIATE (2)	LEAST FAVOURABLE (3)
A	Collapsible soil	Any collapsible horizon or consecutive horizons totalling a depth of less than 750 mm in thickness	Any collapsible horizon or consecutive horizons totalling a depth of more than 750 mm in thickness	A least favourable situation for this constraint does not occur
B	Seepage	Permanent or perched water table more than 1,5 meters below surface	Permanent or perched water table less than 1,5 meters below surface	Swamps or marshes
C	Active soil	Low soil heave predicted	Moderate soil heave predicted	High soil heave predicted
D	Highly compressible soil	Low soil compressibility expected	Moderate soil compressibility expected	High soil compressibility expected
E	Erodibility of soil	Low	Intermediate	High
F	Difficulty of excavation to 1,5 m depth	Scattered or occasional boulders less than 10% of the total volume	Rock or hardpan pedocretes between 10 and 40% of the total volume	Rock or hardpan pedocretes more than 40% of total volume
G	Undermined ground	Undermining at a depth greater than 100 m below	Old undermined areas to a depth of 100 m below surface	Mining within less than 100 m of surface or where total

CONSTRAINT		MOST FAVOURABLE (1)	INTERMEDIATE (2)	LEAST FAVOURABLE (3)
		surface (except where total extraction mining has not occurred)	where stope closure has ceased	extraction mining has taken place
H	Instability in areas of soluble rock	Possibly unstable	Probably unstable	Known sinkholes and dolines
I	Steep slopes	Between 2 and 6 degrees (all regions)	Slopes between 6 and 18 degrees and less 2 degrees (Natal and Western Cape) Slopes between 6 and 12 degrees and less 2 degrees (all other regions)	More than 18 degrees (Natal and western Cape) More than 12 degrees (all other regions)
J	Areas of unstable natural slopes	Low risk	Intermediate risk	High risk (especially in areas subject to seismic activity)
K	Areas subject to seismic activity	10% probability of an event less than 100 cm/s^2 within 50 years	Mining induced seismic activity more than 100 cm/s^2	Natural seismic activity more than 100 cm/s^2
L	Areas subject to flooding	A "most favourable" situation for this constraint does not occur	Areas adjacent to a known drainage channel or floodplain with slope less than 1%	Areas within a known drainage channel or floodplain

Based on the above, the site is classified as 2A 1/2B 1/2C 2D 2E 1F 1I

14. NHBRC ZONING

Due to the variation in composition, and the overall consistency, collapse / settlement is expected in the nodular ferricrete if unadapted structures are founded on this material. The thickness of the potentially collapsible / compressible material exceeds two meter. The collapse / settlement of this material could not be quantified due to the variation in composition and consistency and the limited thickness. Therefore the site is zoned as C2-S2. The residual shale is potentially expansive and the calculated heave is less than 7,5, therefore the site is zoned as H. The presence of the periodical shallow perched water table is accommodated by adding a zoning of P(Perched water table).

The site is zoned as NHBRC Zone P(Perched water table)—C2-S2-H

It is important to note that since the zoning is based on the profiling of test pits and the interpolation of information between test pits, it is possible that variations from the expected conditions can occur. The zoning is shown on Figure 3*.*

15. CONCLUSIONS AND RECOMMENDATIONS

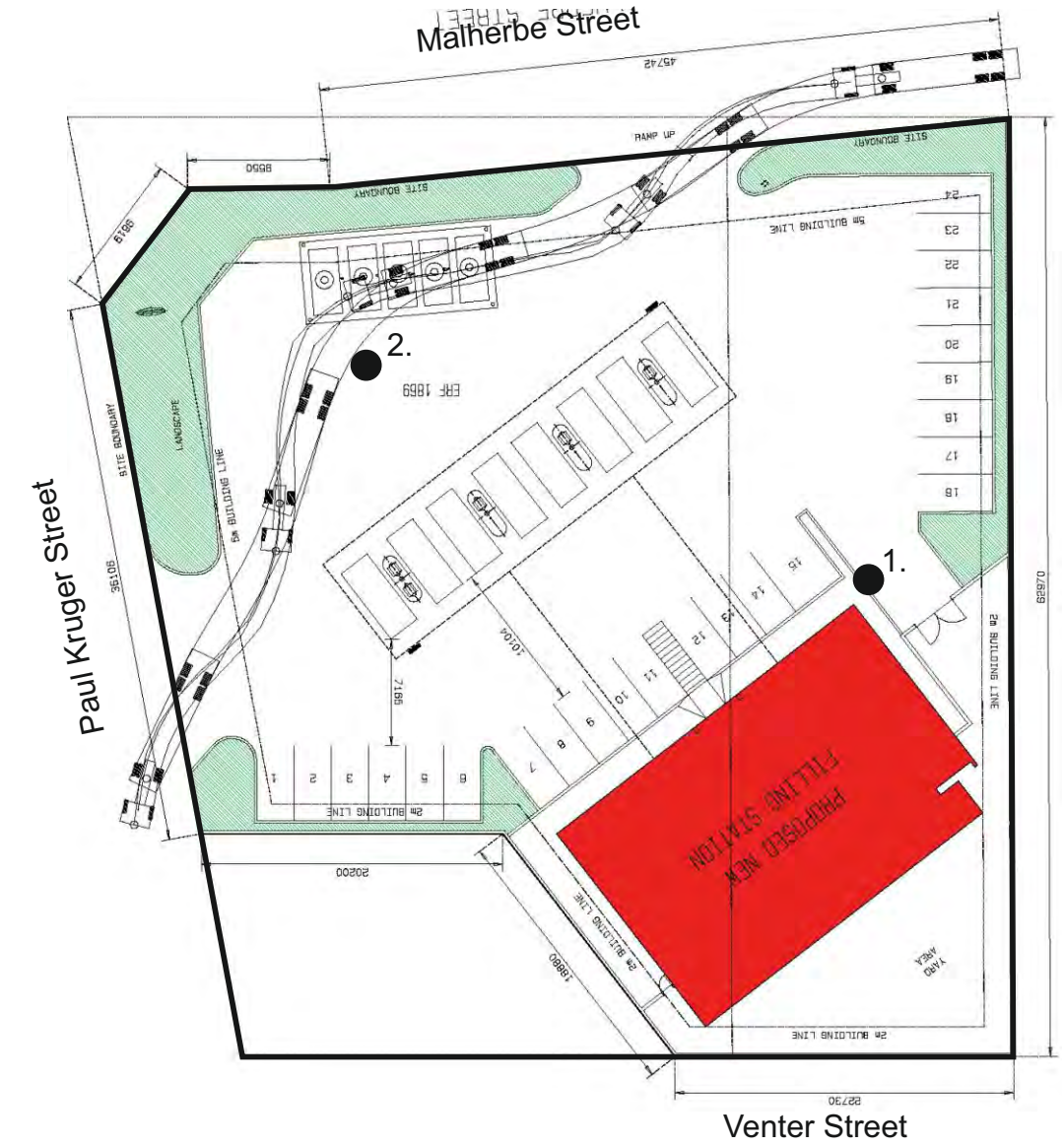
It is important to note that the recommendations are based on the profiling of test pits and the interpolation of information. It is therefore possible that variations from the expected conditions can occur.

15.1 Pollution Potential

The pollution threat to domestic water sources and the natural ground water is considered to be low to medium if no mitigating measures are implemented and the pollution potential of the municipal storm water system is considered to be high if storm water is not managed effectively, furthermore the pollution potential of the perched water table is considered to be high if preventative measures are not implemented.

However, the proposed development should not result in significant impacts provided that the following recommendations *and the recommendations listed in the report by Groundwater Strategic Environmental Focus (Pty) Ltd* are applied:

- In order to prevent pollution of municipal storm water system by surface water runoff from the site It is essential to ensure that storm water is controlled on the site by compiling and implementing a site specific storm water management plan according to the standards applicable to the management of runoff from petroleum filling stations*. It is important that surface water runoff during construction be addressed as well.*



THE ENTIRE SITE IS ZONED AS NHBRC ZONE P(Perched water table)-C2-S2-H

The zoning is based on the interpolation of information.
Therefore a conservative approach to the use of boundaries of the zones is recommended.

NHBRC ZONING	FIGURE 3 SCALE 1 : 500

- To prevent pollution of the perched water table it is recommended that the installation of underground tanks must be in line with the SABS guidelines, which include early warning systems, interceptor drain system and monitoring of potential hydrocarbon leakages and containment measures, thereby preventing any potential groundwater contamination. *Refer to the report by Groundwater Strategic Environmental Focus (Pty) Ltd: "The likely receptors of the possible pollution will be anticipated to be at the down-gradient of the site (i.e. intercepting boreholes in the preferential flow zone if any) and eventual the Apies river.* ***However, the installation of the underground tank storage will follow proper guidelines from The South African Bureau of Standards, SABS-089-3 (1999) which will help to avoid any possible escape of the leakage****"*

- It is recommended that soil samples be taken and tested to determine a base value for petroleum hydrocarbons once excavations have been made during construction of the filling station

The recommendations by Groundwater Strategic Environmental Focus (Pty) Ltd are discussed in detail in their report and is summarized as follows

- There is a need to verify groundwater levels from the boreholes identified by the hydrocensus through negotiations with owners in terms of creating access holes for the dip-meter (water level meter);

- At least three monitoring boreholes should be drilled around the underground fuel storage tanks. The boreholes need to be perforated as to capture LNAPLs;

- Groundwater monitoring programme/plan need to be developed for the groundwater management of the area to monitor the potential leakage of contaminants and spillages and it should include a remedial approach. Leak detection and sorbent material such as Drizit and Zorbit; and

- Monitoring boreholes to be drilled need to be perforated as to capture LNAPLs.

It is important though that in spite of the guidelines given above, inspection of excavations and the involvement of a competent engineer familiar with petrol filling stations are necessary. ***It is furthermore recommended that the trenches for services and excavations for the underground tanks be inspected and that a construction report be compiled for the development. The purpose of the construction report is to confirm or adapt the results of the investigations and to provide more accurate information regarding the structural geological- and geohydrological conditions.***

15.2 Foundations

The nodular ferricrete is expected to be potentially collapsible. Therefore this material is considered unsuitable in its natural state to act as a founding medium. This even applies for light structures with a foundation pressure of less than 100kPa. From the discussion foundation improvement and imparting flexibility in the brickwork are clearly required. The following alternatives are recommended:

- *Stiffened strip footings, stiffened or cellular raft:*
  Found structures on stiffened strip footings or a stiffened or cellular raft with lightly reinforced masonry. The bearing pressure should not exceed 50 kPa and floor slabs should be reinforced.

- *Compaction of insitu soil below footings:*
  Remove unsuitable material up to a depth and width of 1,5 times the foundation width, below normal founding depth. The loose material in the bottom of excavations should be compacted, and the excavations backfilled with suitable material, compacted in 150 mm layers to at least 93% of Mod AASHTO density at -1% to +2% of optimum moisture content. Structures can be founded on normal reinforced strip

footings on the backfill and should be provided with vertical movement joints, light reinforcement in the masonry and floor slabs should be provided with fabric reinforcement.

- *Soil raft:*
  Remove the collapsible material to 1,0 meters beyond the perimeter of the structure to at least a depth of 1,5 times the width of the widest foundation. The loose material in the bottom of excavations should be compacted, and the excavations backfilled with suitable material, compacted in 150 mm layers to at least 93% of Mod AASHTO density at -1% to +2% of optimum moisture content. Structures can be founded on normal reinforced strip footings on the backfill and should be provided with vertical movement joints and light reinforcement in the masonry.

- *Piled or pier foundations:*
  Found structures on piled or pier foundations with reinforced ground beams or solid slabs on piled or pier foundations. Due to the limited reach of the back actor, the piling depth could not be determined.

It is important though that in spite of the guidelines given above, inspection of foundation excavations and the involvement of a competent engineer familiar with structural founding are necessary. ***It is furthermore recommended that the trenches for services be profiled and that a construction report be compiled for the development. The purpose of the construction report is to confirm or adapt the zoning of the site, and to provide more accurate information regarding the founding conditions.***

15.3 Excavatability

The excavatability of the materials encountered on the site was evaluated according to the South African Bureau of Standards Standardized Specification for Civil Engineering Construction DB: Earthworks (Pipe Trenches. The excavatability is considered to classify as "soft to intermediate" up to an **average** depth of three meters. *It is important to note that the evaluation is based primarily on the profiling of test pits and the interpolation of information between test pits. It is therefore possible that variations from the expected conditions can occur.*

15.4 Geohydrology

All excavations should be provided with adequate drainage, specific attention should be given to the fuel tanks. Structures should be provided with damp proofing and provision should be made to prevent the ingress of water into– and below foundations.

15.5 Construction material

The laboratory test results show that the nodular ferricrete could be suitable as fill and selected subgrade and that the residual shale is not considered suitable as construction material. *It is recommended that the suitability of material that is to be used, be confirmed by detailed laboratory testing.*

15.6 Services

Due to the expected corrosivity, it is recommended that all services be protected.

15.7 Stability of excavations

It is recommended that all excavations be cut back or shored.

15.8 General recommendations

Water has a significant influence on the behaviour of the in-situ material. To reduce differential movements of structures it is necessary to maintain moisture equilibrium under the structures. Therefore it is recommended that the following measures regarding drainage around structures be implemented:

- No accumulation of surface water must be allowed around the perimeter of the structures and the entire development must be properly drained.
- Down pipes should discharge into a lined or precast furrow. This furrow should discharge the water 1,5 meters away from the foundation onto a paved or grassed surface sloping away from the building.
- Preferably, if no gutters or paving is to be provided around structures, a 1,5 meter wide sealed concrete apron should be cast along the perimeter of the structures the water must be channeled away from the foundation.
- Leaks in water bearing services should be attended to without undue delay.
- No large shrubs or trees should be planted closer to structures than the distances provided in the following Table:

DESCRIPTION	**MATURE HEIGHT OF TREE**		
	Up to 8m	**8m tot 15m**	**Over 15m**
Buildings other than single storey buildings of lightweight construction	-	0.5	1,2
Single storey buildings of lightweight construction (e.g. timber framed)	-	0.7	1,5
Free standing masonry walls	-	1,0[1] 0,5[2]	2,0[1] 1,0[2]
Drains and underground services • less than 1 meter deep • more than 1 meter deep	 0,5 -	 1,5 1,0	 3,0 2,0

Note:
1) These distances will generally avoid all direct damage
2) These distances assume that some movement and minor damage, which may be tolerated, might occur.
This table provides guidance on the acceptable proximity of young trees or new planting to allow for future growth. This table should not be taken to imply that construction work can occur at the specified distances from existing trees; as such work might damage the tree, or render it 1) dangerous, but refers to the potential for future growth, either of a young tree or of planting, occurring subsequent to construction

L.J Kruger Pr. Sci. Nat.

REFERENCES

- "Guidelines for Urban Engineering Geological Investigations", SAIEG & SAICE, 1995
- "Home Building Manual Part 1 & 2", National Home Builders Registration Council, 1999
- "Revised Guide to Soil Profiling for Civil Engineering Purposes in Southern Africa", Jennings Brink and Williams, The Civil Engineer in SA, 1973
- "The Prediction of Soil Heave from the Plasticity Index and Percentage Clay Fraction of Soils", D.H van der Merwe, The Civil Engineer in South Africa, 1964
- "A Guide to Construction on or with Materials Exhibiting Additional Settlement due to Collapse of Grain Structure", Jennings and Knight 1975
- "A Short Workshop on Suggested Interpretation Techniques of Soil Movement with Emphasis on Heave and Collapse Conditions": SAIEG, 1999
- "The Engineering Geology of Southern Africa", Volumes 1, 2 , 3 and 4, A.B.A Brink
- "Soil Survey for Engineering", Brink, Partridge & Williams
- South African Bureau of Standards Standardized Specification for Civil Engineering Construction DB: Earthworks (Pipe Trenches) SABS 1200 DB-1982
- Technical Recommendations for Highways, TRH 14 of 1985

APPENDIX A

SOIL PROFILE

PROJECT: Erf 1869

SITE: CAPITAL PARK

CLIENT: EXDEV

LOGGED BY: LJK

MACHINE: TLB

DATE: 27/07/2014

TEST PIT: 1.

SAMPLE / TEST	GROUND WATER	LEGEND	DESCRIPTION
			Fill, consisting of red brown, soft, gravely clayey sand with abundant ferricrete concretions and pipe fragments
		1,5	Slightly moist, red brown mottled yellow and black, stiff, silty, sandy, fine and medium gravel consisting of hard, round, intact, nodular ferricrete
		2,6	Slightly moist to moist, red brown mottled pink and yellow, soft, silty, clayey sand - Residual shale
		3,0	No Refusal No ground water

LOUIS KRUGER GEOTECHNICS PO BOX 90093 GARSFONTEIN TEL 082 651 4819

SOIL PROFILE

PROJECT: Erf 1869

SITE: CAPITAL PARK

CLIENT: EXDEV

LOGGED BY: LJK

MACHINE: TLB

DATE: 27/07/2014

TEST PIT: 2.

SAMPLE / TEST	GROUND WATER	LEGEND	DESCRIPTION
			Fill, consisting of red brown, soft, gravely clayey sand with abundant ferricrete concretions and medium gravel (used as surface covering)
		0,5	
			Slightly moist, red brown mottled yellow and black, stiff, silty, sandy, fine and medium gravel consisting of hard, round, intact, nodular ferricrete
		2,5	
			Slightly moist to moist, red brown mottled pink and yellow, soft, silty, clayey sand - Residual shale
		3,0	No Refusal
			No ground water

LOUIS KRUGER GEOTECHNICS PO BOX 90093 GARSFONTEIN TEL 082 651 4819

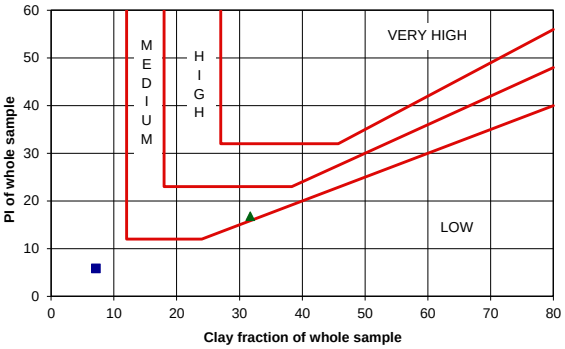
APPENDIX B

PARTICLE SIZE ANALYSIS

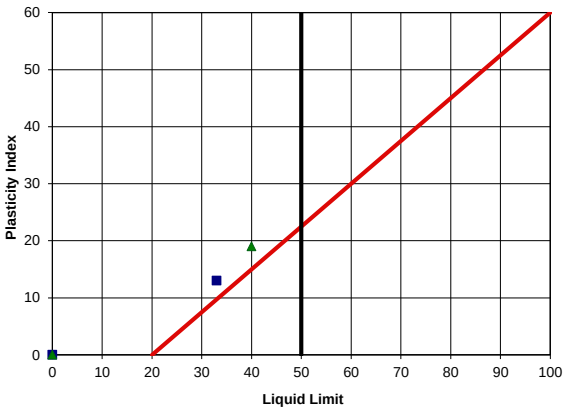
Sample No.	C 1	C 2
Soillab sample no.	S14-0838-1	S14-0838-2
Depth (m)		
Position		
Material Description	DARK RED FERRICRETE SANDY GRAVEL	DARK RED QUARTZITE CLAYEY SAND
Moisture (%)		
Dispersion (%)		
SCREEN ANALYSIS (% PASSING) **(TMH 1 A1(a) & A5)**		
63.0 mm	100	100
53.0 mm	100	100
37.5 mm	100	100
26.5 mm	100	100
19.0 mm	100	100
13.2 mm	100	100
4.75 mm	81	100
2.00 mm	60	97
0.425 mm	45	88
0.075 mm	25	56
HYDROMETER ANALYSIS (% PASSING) **(TMH 1 A6)**		
0.040 mm	16	49
0.027 mm	12	46
0.013 mm	10	41
0.005 mm	8	35
0.002 mm	7	32
% Clay	7	32
% Silt	14	22
% Sand	38	44
% Gravel	40	3
ATTERBERG LIMITS **(TMH 1 A2 - A4)**		
Liquid Limit	33	40
Plasticity Index	13	19
Linear Shrinkage (%)	5.5	9.0
Grading Modulus	1.71	0.58
Uniformity coefficient	145	-
Coefficient of curvature	0.5	-
Classification	A-2-6 (0)	A-6 (8)
Unified Classification	SC	CL
Chart Reference		

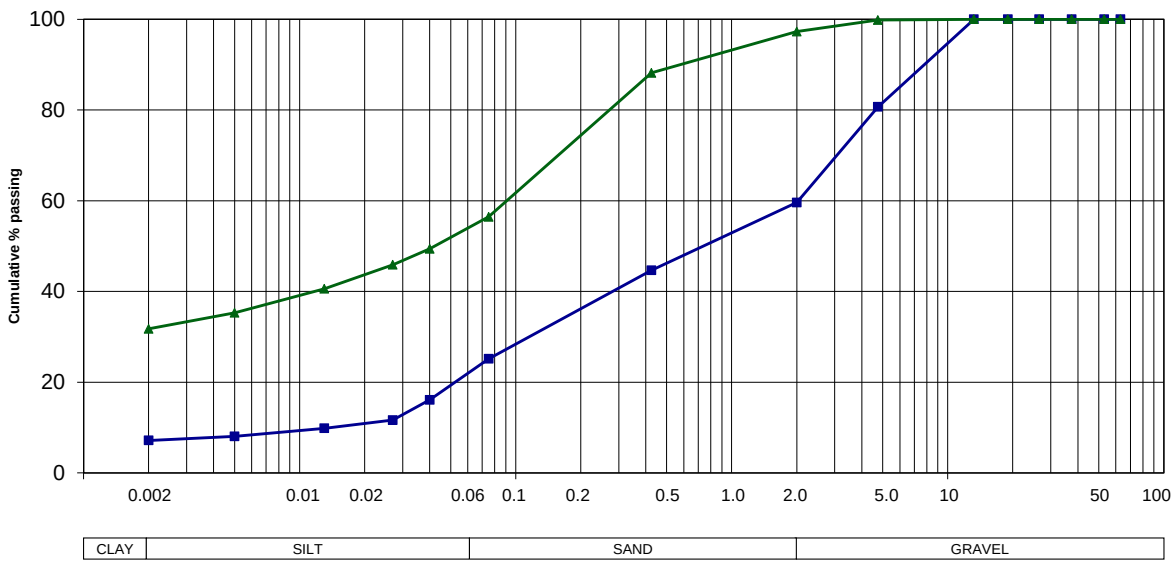
PROJECT : CAPITAL PARK
JOB No. : S14-0838
DATE : 02-08-2014

POTENTIAL EXPANSIVENESS



PLASTICITY CHART





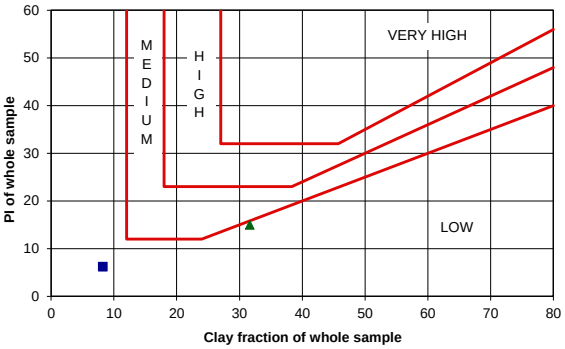
Engineering Materials Laboratory
T +27 12 813 4900 E info@soillab.co.za
Soillab Pretoria
www.soillab.co.za

PARTICLE SIZE ANALYSIS

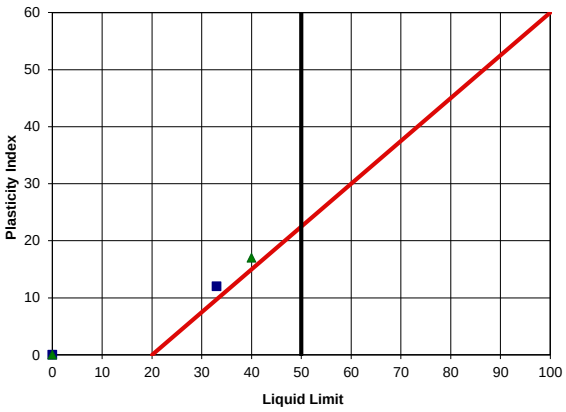
Sample No.	C 3	C 4
Soillab sample no.	S14-0838-3	S14-0838-4
Depth (m)		
Position		
Material Description	DARK RED FERRICRETE GRAVELLY SAND	DARK RED FERRICRETE CLAYEY SAND
Moisture (%)		
Dispersion (%)		
SCREEN ANALYSIS (% PASSING) **(TMH 1 A1(a) & A5)**		
63.0 mm	100	100
53.0 mm	100	100
37.5 mm	100	100
26.5 mm	100	100
19.0 mm	100	100
13.2 mm	100	100
4.75 mm	90	100
2.00 mm	68	96
0.425 mm	52	88
0.075 mm	24	56
HYDROMETER ANALYSIS (% PASSING) **(TMH 1 A6)**		
0.040 mm	18	49
0.027 mm	15	46
0.013 mm	13	40
0.005 mm	10	35
0.002 mm	8	32
% Clay	8	32
% Silt	13	22
% Sand	47	43
% Gravel	32	4
ATTERBERG LIMITS **(TMH 1 A2 - A4)**		
Liquid Limit	33	40
Plasticity Index	12	17
Linear Shrinkage (%)	5.0	8.0
Grading Modulus	1.57	0.60
Uniformity coefficient	218	-
Coefficient of curvature	3.0	-
Classification	A-2-6 (0)	A-6 (7)
Unified Classification	SC	CL
Chart Reference		

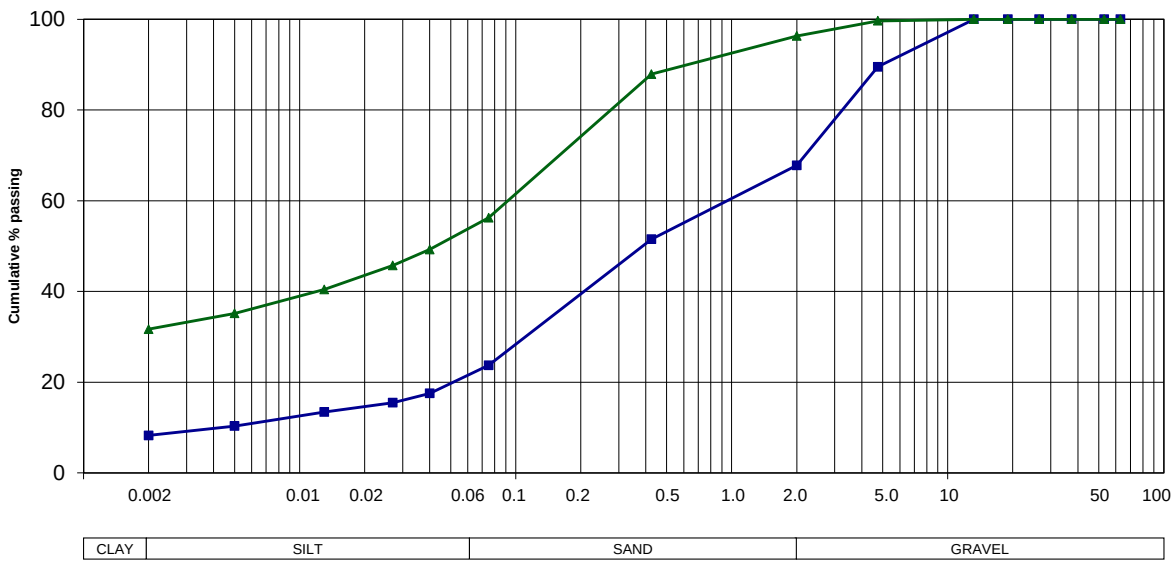
PROJECT : CAPITAL PARK
JOB No. : S14-0838
DATE : 02-08-2014

POTENTIAL EXPANSIVENESS



PLASTICITY CHART





Engineering Materials Laboratory
T +27 12 813 4900 E info@soillab.co.za
Soillab Pretoria
www.soillab.co.za

REPORT
ON
THE ENGINEERING GEOLOGICAL INVESTIGATION
FOR
THE PROPOSED FILLING STATION
SITUATED
ON
STAND 1869
CAPITAL PARK

LOUIS KRUGER GEOTECHNICS CC
PO BOX 90093
Garsfontein
0042
Tel 082 651 4819
Fax 086 671 1684

SEPTEMBER 2014

Client

EXDEV