A SUPPLEMENTARY PHASE ONE GEOTECHNICAL REPORT FOR THE PROPOSED ESTABLISHMENT OF ROOSBOOM EXTENSION ONE ON PORTION 502 OF THE FARM ROOSBOOM 1102 GS IN LADYSMITH, KWAZULU-NATAL

Report Number: 2019/J011/SSS

FINAL REPORT
30 April 2019

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Table of Contents

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1 INTRODUCTION

1.1 Appointment

Soilkraft cc was appointed by Mr Silver Shalonga on behalf of SSS Invest (Pty) Ltd to undertake a supplementary phase one geotechnical investigation on portion 502 of the farm Roosboom 1102 GS as part of the requirements for the proposed establishment of Roosboom Extension One, near Ladysmith, KwaZulu-Natal.

The purpose of the investigation was to:

- assess the suitability of the site for the proposed township establishment
- identify possible relevant geotechnical constraints
- propose preliminary and general recommendations regarding the founding of structures
- comment on any matters related to the geotechnical conditions

1.2 Scope of the Investigation

This report serves as a supplementary report to a similar investigation done in 2017, after portion 502 of the farm Roosboom 1102 GS was added to the proposed development. This supplementary report is also compiled in such a way that it comprises a phase one investigation, as described by the SANS634 specification for residential township establishment. The investigation therefore does not constitute a phase two, structure-specific or stand-specific investigation.

2 AVAILABLE INFORMATION

The following sources of information were consulted:

- 1 : 50 000 scale topographical map: 2829DA Spioenkop, published in 2002
- 1 : 250 000 scale geological map: 2828 Harrismith, published in 1998
- The report *A phase one geotechnical report for the proposed establishment of Roosboom Extension one on portion 437 of the farm Roosboom 1102 GS in Ladysmith, KwaZulu-Natal,* issued on 5 July 2017 on behalf of SSS Invest (Pty) Ltd

3 SITE DESCRIPTION

3.1 Site Location

The area investigated as part of this supplementary investigation is located on portion 502 of the farm Roosboom 1102 GS. Portion 502 lies to the south of portion 437 which was previously investigated. The area lies on the outskirts of the existing Roosboom settlement, approximately 12km south west of Ladysmith, and measured some 8.2ha in total size.

The site was accessed via the unpaved road network surrounding Roosboom, leading from unpaved district road D637. This road leads back to provincial road R103. From the main unpaved road the study area was reached via existing tracks.

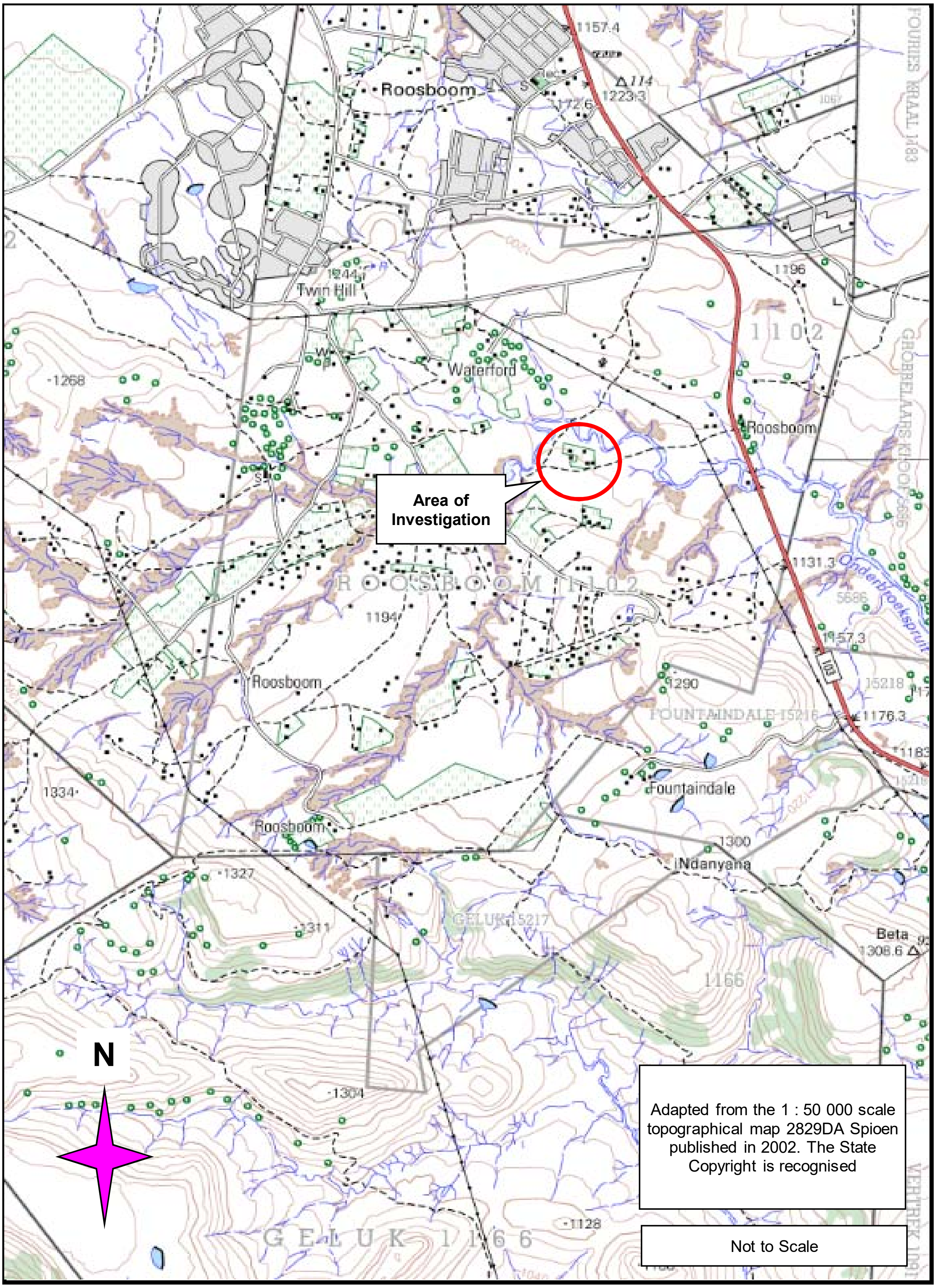
Figure 1 illustrates the approximate position of the study area.

3.2 Topography and Drainage

Based on the regional topographical map, the site is situated at an elevation of approximately 1140m above mean sea level. The study area lies on the banks of a water course and sees a fairly gentle increase in elevation towards the south west. The exception to this is the terraced ground levels immediately adjacent to the water course.

Site drainage takes place by means of sheet wash and infiltration. Excess surface runoff is destined to drain in accordance with the prevailing gradient and will likely join the non-perennial stream which forms the northern boundary of the site.

Gully erosion and soil pipes occur on this site or in its immediate vicinity and hence it is clear that the area is highly susceptible to erosion.



Adapted from the 1 : 50 000 scale topographical map 2829DA Spioen published in 2002. The State Copyright is recognised

Not to Scale

SOIL KRAFT

LOCALITY PLAN

FIGURE 1

3.3 Vegetation

Regional vegetation on the site complies with the editorial summary provided by Mucina and Rutherford $^{\text{Reference 9.1}}$. The vegetation forms part of the so-called KwaZulu-Natal Highland Thornveld, which is dominated by grassland and savannoid woodlands. The vegetation is described as least threatened. Certain parts of the study area had been cleared of regional vegetation to make room for cultivation and agriculture.

3.4 Climate and Weather Conditions

Average rainfall in the region is estimated by Mucina and Rutherford $^{\text{Reference 9.1}}$ at 752mm, along with a mean annual temperature of 16.5ºC. The site is located in an area with an approximate Weinert N-value of 2.2 and a Thornthwaite Moisture Index very close to 0. Climatically the area may thus be described sub-humid. This signifies that chemical weathering of rock material will take place, rather than mechanical breakdown thereof, resulting in the formation of active clays if suitable parent material is available. Minerals such as amphiboles, pyroxenes and olivine are particularly susceptible to this type of weathering. That being stated, the effects of mechanical weathering cannot be disregarded, particularly where brittle materials are involved.

4 EXISTING FACILITIES

At the time of the investigation, the study area hosted a number of rural residences. These mostly consisted of residences practicing subsistence farming. A single overhead electrical power line was noted in the area, but no other services or utilities were observed.

Photo 1: Site Conditions shows typical site conditions at the time of the site investigation.

5 SITE INVESTIGATION

5.1 Trial Holes

The area was investigated by means of conventional backhoe-excavated trial holes. Trial holes were excavated on 22 March 2019 with the aid of a JCB 3CX backhoe, supplied by World Impact Suppliers. Some eight trial holes were excavated in accordance with specification.

Trial holes were entered, inspected, profiled and (where suitable) sampled by a professionally registered engineering geologist. For the non-geotechnical reader, these guidelines are summarised in the attached Table 1 and the trial hole profile descriptions are included in Appendix A. The profile descriptions reflect the impressions created by the pedological conditions and may vary from the results of the soil tests. The placement of trial holes is illustrated in Figure 2.

SITE CONDITIONS

PHOTO 1

TABLE 1: SOIL PROFILING PARAMETERS

CONSISTENCY : GRANULAR SOILS

CONSISTENCY : COHESIVE SOILS

SPT N	GRAVELS & SANDS Generally free draining soils		DRY DENSITY (kg/m^3)	SPT N	SILTS & CLAYS and combinations with SANDS. Generally slow draining soils		UCS (kPa)
<4	Very loose	Crumbles very easily when scraped with geological pick.	<1450	<2	Very soft	Pick point easily pushed in 100mm. Easily moulded by fingers.	<50
4-10	Loose	Small resistance to penetration by sharp pick point.	1450-1600	2-4	Soft	Pick point easily pushed in 30mm to 40mm. Moulded by fingers with some pressure.	50-125
10-30	Medium dense	Considerable resistance to penetration by sharp pick point.	1600-1750	4-8	Firm	Pick point penetrates to 10mm. Very difficult to mould with fingers.	125-250
30-50	Dense	Very high resistance to penetration by sharp pick point. Requires many blows by pick point for excavation.	1750-1925	8-15	Stiff	Slight indentation by pick point. Cannot be moulded by fingers. Penetrated by thumb nail.	250-500
>50	Very dense	High resistance to repeated blows of geological pick. Requires power tools for excavation.	>1925	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.

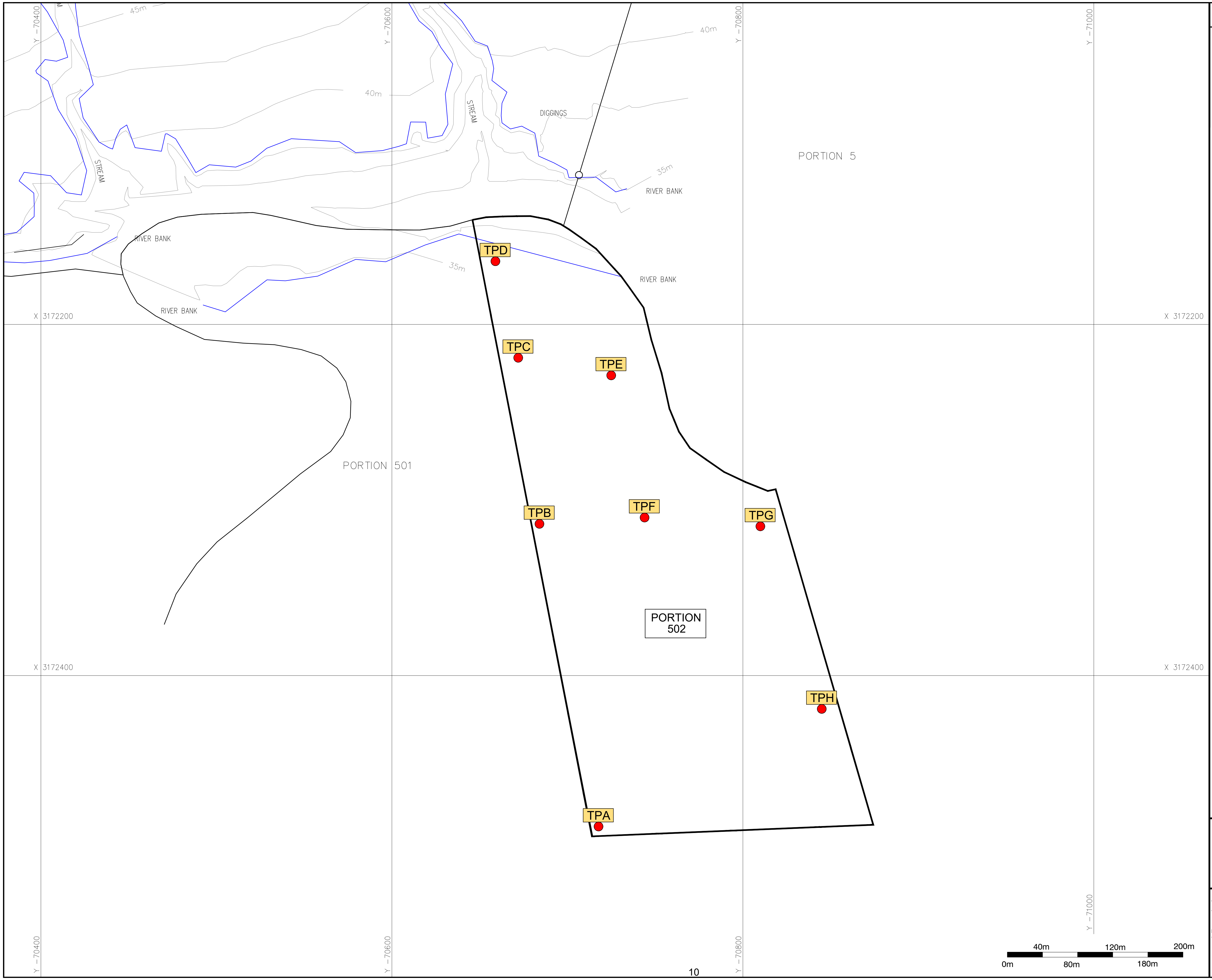
ORIGIN

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 :

TPA ● TRIAL HOLE

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TAAK: JOB NAME:	Portion 502 of the Farm Roosboom 1102 GS
KLIëNT: CLIENT:	SSS Invest (Pty) Ltd
TEKENING NO: DRAWING NO:	Site Layout Plan
DATUM: DATE:	30 April 2019

5.2 Materials Tests

Material soil samples were taken from trial holes across the entire site in a representative fashion. The samples were delivered to Specialised Testing Laboratory (Pty) Ltd in Pretoria for analyses. STL is a SANAS accredited geotechnical laboratory. The tests performed as part of this investigation included the following:

- Foundation indicator tests were performed to determine the general geotechnical properties of soil materials. The test includes a grading analysis, hydrometer analysis and the determination of Atterberg Limits. Results are also used to estimate the materials' expansiveness.
- Soil chemistry tests were done by assessing the soil paste acidity (i.e. pH) and conductivity. This is done to determine the corrossivity of soil materials, as it may affect the rate of corrosion of metallic services and utilities installed below ground level (e.g. pipes, joins, anchor poles, etc.).
- Undisturbed block samples were not collected as in situ materials were not conducive to this.

The results of the soil tests may be found in Appendix B to this report. For easy reference the foundation indicator test results are summarised in the attached Table 2: Results of Soil Tests.

6 DISCUSSION

6.1 Regional Geology

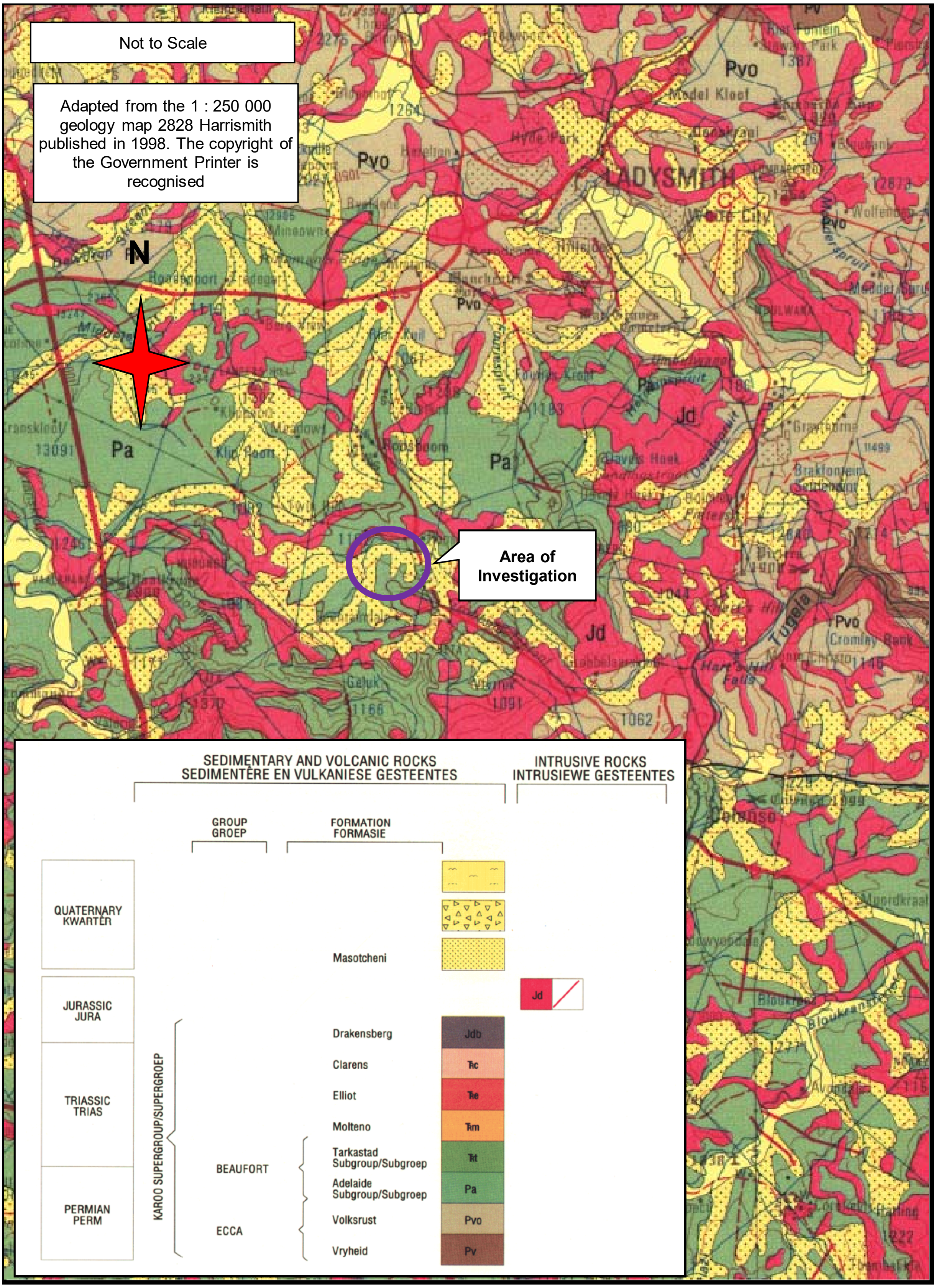
The regional geology was previously described in the 2017 report and will be reiterated here. Regional geological information indicates that the project area is underlain by three main geological units. In chronological order these include:

- *Quaternary Deposits:* Fine grained sediments and silcrete deposits are depicted on the study area dotted yellow. These deposits typically occur in lower-lying areas near the study area.
- *Dolerite:* Dolerite (Jd) intrusions are marked across the entire region and are erratic in distribution. The dolerite was previously found on the adjacent study area (i.e. portion 437). The dolerite is geologically younger than the sedimentary bedrock materials in the region and intruded through said materials. Where intrusion occurred, the sedimentary host materials often get baked by thermal, contact metamorphism effectively hardening the sedimentary bedrock.
- *Adelaide Subgroup:* The Adelaide Subgroup (Pa) forms part of the Beaufort Group of the Karoo Supergroup. The Subgroup is indicated over much of the original study area and regional information suggests that bedrock materials consist of grey mudstone, dark grey shale, siltstone and sandstone.

The attached Figure 3: Regional Geology Map allows an overview of the geology of the area.

TABLE 2 : SUMMARY OF SOIL TESTS

TRIAL HOLE NO	SAMPLE NO	DEPTH (mm)	SOIL ORIGIN	SOIL TYPE	GM	PI	LL	% CLAY (<0,002 mm)	ACTIVITY CLASS	pH	CON-DUCTIVITY (S/m)	SOIL CLASS	
												PRA	UNIFIED
A	SKT-78-690	600 - 1500	Residual shale	Silty clay	0.34	21	48	43	Medium	8.4	0.143	A-7-6	CL
C	SKT-78-691	300 - 900	Alluvium	Clayey sand	0.38	18	36	32	Medium			A-6	CL
E	SKT-78-692	0 - 700	Alluvium	Silty sand	0.46	15	31	22	Medium			A-6	CL
F	SKT-78-693	300 - 700	Alluvium	Clayey silt	0.42	23	42	30	Medium	8.5	0.111	A-7-6	ML
H	SKT-78-694	0 - 500	Colluvium	Silty sand	0.65	SP	SP	7	Low			A-4	ML



Adapted from the 1 : 250 000 geology map 2828 Harrismith published in 1998. The copyright of the Government Printer is recognised

REGIONAL GEOLOGY

FIGURE 3

No fault zones are indicated in the vicinity of the study area. Also, no bedrock materials were encountered in trial holes, however, residual soil materials and bedrock exposed in the adjacent water course suggests that the site is underlain by the Adelaide Subgroup.

6.2 Soil Profiles

Prior to discussing the geotechnical zoning of the land, it is important to distinguish between the different materials present on site. As the study area is fairly small, only a limited number of soil horizons were identified, namely:

- *Colluvium:* A surface colluvial horizon was identified in trial holes A, B, C, D and H. The horizon was between 300mm and 600mm in vertical thickness and had variable composition. The material was described as silty sand or clayey sand with light or dark grey colour. An intact or slickensided structure characterised this horizon, which also had a loose or medium dense consistency. While the observed slickensided structure suggests that the material may be expansive in places, the horizon is generally of limited vertical thickness and occurs above conventional founding depths. Nevertheless, a sample of the silty sand colluvium was collected and proved to be non-expansive. The material had a semi-plastic nature and contained only 7% active clay content. A grading modulus of 0.65 was calculated and a PRA classification of A-4 awarded.
- *Alluvium:* Alluvial materials occurred in all trial holes, except trial hole A. The alluvium mostly had light grey brown or dark grey colour, often with white or orange discolourations (presumably due to ferruginisation and leaching). The horizon was described as being medium dense to very dense (when granular) or very stiff (when cohesive), while a slickensided structure was common. Though the base of the horizon was not always encountered before refusal of excavation was encountered, vertical thicknesses were between 200mm and 1500mm. Laboratory analyses confirmed that all samples of the alluvium are moderately expansive. Active clay contents ranged from 22% to 32%, with associated plasticity indices between 15% and 23%. The samples had grading moduli between 0.38 and 0.46 and were awarded PRA classifications of A-6 or A-7-6.
- *Residual Shale:* The residual shale horizon was found in trial holes A and B, at higher lying parts of the site. The silty clay had light grey brown or orange brown colour, sometimes with black and light grey discolourations due to ferruginisation. A firm or very stiff consistency was recorded for this horizon, as well as a slickensided structure. Test results showed that this material is also moderately expansive with active clay content and a plasticity index of 43% and 21%, respectively. The test sample had a grading modulus of 0.34 and was awarded a PRA classification of A-7-6.

6.3 Groundwater

- *Perched Water*: No seepage water was encountered in any of the trial holes excavated during the investigation. However, in trial hole H the colluvial horizon was described as very moist to wet.

This combined with evidence of occasional ferruginisation in the soil profiles suggest that seasonal seepage water may occur within founding depths. It must also be taken into account that perched groundwater is a strongly seasonal phenomenon which is most dominant between the middle and end of the rainy season, while mostly being absent during the dry season. The likelihood and severity of such a condition must be established during a groundwater or geohydrological investigation. The outcome of such an investigation may also affect the recommendation of the investigation hand.

- *Permanent Water*: Vegter[Reference 9.2] indicates the probability for drilling successfully for water in the area to be more than 60% but the probability that such a borehole will yield more than 2l/s is between 10% and 20%. Groundwater is expected to occur at depths between ten and twenty metres in compact, dominantly argillaceous strata.

6.4 Geotechnical Zoning

The references contained in this section are applicable to township establishment only and describe general conditions encountered. Determining the geotechnical zoning is challenging in light of the fact that fairly shallow refusal of excavation was encountered in places. Nevertheless, it is important to keep the following issues in mind:

- *Properties of Heave*: Material test results proved that all soil materials sampled – except one colluvial sample – are moderately expansive. Using the results of the soil tests in the parametric heave calculation method as proposed by Van der Merwe[Reference 9.3], free heave was calculated for the soil profiles.
- *Properties of Settlement*: Conditions of soil settlement on this site are limited and dominated by conditions of unrestrained heave. Consequently, properties of settlement are not considered particularly problematic.
- *Flood Plains*: Lower lying parts of the study area proved to fall within the non-perennial stream's river terrace and as such, may be susceptible to periodic flooding. At the time of report compilation, the flood lines were yet to be established.
- *Perched Water and Seepage*: It is expected that much of the study area will experience seasonally perched water or shallow groundwater ingress.
- *Erosion and Dispersive Soils*: Erosion channels were abundant in the vicinity of the study area, with one particular example found adjacent to the study area being illustrated in Photo 2. A small soil pipe was also found in the study area, which manifested on surface near trial hole D. The feature is shown in Photo 3.

The geotechnical classification of the property is in accordance with the guidelines of the NHBRC[Reference 9.4]. In light of the fact that very stiff, expansive horizons induced refusal of excavation on numerous accounts, a conservative approach was adopted with regard to the geotechnical zoning. For this reason the entire study area is classified as **H2-H3**, indicating that unrestrained heave of up to and exceeding 30mm may occur. The zone is also susceptible to erosion, soil piping and it is

SOIL EROSION AND DISPERSIVE SOILS ADJACENT TO STUDY AREA

PHOTO 2

SOIL PIPING ADJACENT TO TRIAL HOLE D

PHOTO 3

expected that a substantial portion of the site may fall below the flood line. Perched water or shallow seepage water within founding depths may also occur seasonally.

The zonation is illustrated in Figure 4: Geotechnical Zoning. It is essential that the zoning be refined during the phase two investigation. *The zoning may also be reviewed once flood line assessments and a groundwater study had been undertaken.*

6.5 Conditions of Excavation

Conditions of excavation encountered during the site investigation can be summarised as follows:

- *Colluvium:* The colluvial materials varied in excavatibility due to the material's consistency. Despite this, the colluvium was fairly easy to excavate using a backhoe and offered little resistance to penetration.
- *Alluvium:* The alluvial horizons presented significant resistance to excavation due to the material's consistency and cohesive nature. The alluvium induced gradual refusal of excavation on six occasions. In addition, it is expected that the material will make for conditions of clayey excavation if it is found in a very moist or wet state. Overall then, the material is considered challenging to excavate, even when using a backhoe.
- *Residual Shale:* Residual shale induced gradual refusal of excavation on one occasion. The material had a very stiff consistency where refusal was encountered and as with the alluvial horizon, it is considered clayey or cohesive to excavate. The material will therefore also become even more challenging to excavate when in a very moist or wet state.
- *Bedrock:* No bedrock materials were encountered in any of the trial holes prior to encountering refusal of excavation.
- *Corestones:* No corestones were encountered in any of the trial holes. Considering that igneous bedrock was not noted in this additional study area, the occurrence of corestones is unlikely.
- *Excavation Stability:* Excavations made during the course of the investigation mostly proved to be stable. It is expected that perched or seepage water – if present – will severely detract from the excavation stability.
- *Wet Excavation:* Depending on the outcome of a groundwater study, it may be required to make provision for wet excavation on a seasonal basis.
- *General Comments:* Excavation by backhoe proved viable to depths between 700mm and 2200mm. Gradual refusal of excavation was encountered in all trial holes, except trial hole B (where refusal of excavation was not encountered).
- *Slope Stabilities*: No natural slope instabilities were observed during the investigation.

6.6 Seismicity

Kijko [Reference 9.5] 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} while the chances of a quake with intensity of

FIGURE 4

LEGEND :

TPA ● TRIAL HOLE

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FOUNDATION DESIGN, BUILDING PROCEDURES AND PRECAUTIONARY MEASURES

AREA	GEOTECHNICAL CLASS	% OF TOTAL AREA	ESTIMATED SOIL MOVEMENT	SOIL PROFILE	DEVELOPMENT POTENTIAL	CONSTRUCTION TYPE	FOUNDATION DESIGN	ASSOCIATED PROBLEMS
1	H2-H3	100,0%	Unrestrained heave of up to or exceeding 30mm	Colluvium overlying alluvium and/or residual shale	Intermediate	Modified	Reinforced raft OR Soil replacement raft	Corrosive soils Possible seasonal groundwater Risk of flooding Dispersive soils Erosion dongas

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TAAK:
JOB NAME: Portion 502 of the Farm Roosboom 1102 GS

KLIëNT:
CLIENT: SSS Invest (Pty) Ltd

TEKENING NO:
DRAWING NO: Zoning Plan

DATUM:
DATE: 30 April 2019

8.8 are 10^{-3}. A 10% probability exists that an earthquake with Peak Ground Acceleration of 0.06g to 0.10g may take place once in 50 years.

To put the above information into perspective, Table 3 is attached to this report.

6.7 Soil Corrossivity

When discussing soil corrossivity, it is applicable to consider the guidelines as proposed by Evans[Reference 9.6]. 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. Should the soil pH be less than 6.0, corrosion may take place and should the pH be less than 4.50, the problem of corrosion may be serious. If the conductivity of the soil is less than 0.1mS/cm, 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 0.5mS/cm, 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 were collected from the residual shale and alluvial horizons, as these are most likely to hosted services and utilities installed below ground level. Results can be summarised as follows:

- *Alluvium:* The alluvium sample had a pH of 8.5 and a soil paste conductivity reading of 0.111S/m. The material is therefore considered non-corrosive on account of acidity, but simultaneously it is considered extremely corrosive on account of its soil conductivity.
- *Residual Shale*: The residual shale had similar properties to the alluvium and proved non-corrosive on account of its acidity, with a pH of 8.4. As before, a conductivity result of 0.143S/m indicates that the residual shale is an extremely corrosive soil material.
- *Seepage Water*: Cognisance must be taken of the fact that any seepage water will have an oxidising effect on metal objects (e.g. utilities) installed below surface.

All things considered, the in situ materials are considered to be extremely corrosive on account of high soil conductivity.

TABLE 3 : 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 fllinging 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	Disastrous	Ground cracks badly ; buildings destroyed ; railway lines bent ; landslides on steep slopes	7.0 to 7.3	400 to 700
XI	Very disastrous	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

6.8 Other Considerations

- *Historic Monuments*: To the author's knowledge there are no historic monuments on the site.
- *Undermining*: The area is not subject to undermining.
- *Cemetery Sites*: No graves or cemeteries were noted during the investigation.
- *Soil Piping*: Soil piping was noted on at least one occasion.

7 CONCLUSIONS

Based on the findings of this investigation, the following issues must be taken into account:

- *Geology*: The study area appears to be underlain by the Adelaide Subgroup (Beaufort Group, Karoo Supergroup), based on residual materials encountered in profiles and rock materials exposed in the stream channel adjacent to the study area. No bedrock was found on this site or within excavatible depths.
- *Soil Profiles*: Soil profiles across the site typically consist of surficial colluvium overlying alluvial deposits and/or residual shale.
- *Groundwater*: Perched groundwater or seepage water was not encountered in trial holes, but it is expected that such water may occur on a seasonal basis and affect the proposed development adversely. The possibility and extent of such conditions remain to be verified by specialist studies.
- *Founding Conditions*: The entire study area is classified as **H2-H3**, though zoning was complicated by the fact that excavations were only of a limited depth due to material consistencies. The zoning must also be revisited once flood line and groundwater assessments have been completed.
- *Conditions of Excavation*: Conditions of difficult, cohesive excavation characterise most of the soil profiles on this site. Gradual refusal of excavation by backhoe was encountered in all but one trial holes.
- *Corrossivity:* Alluvial and residual shale materials are considered extremely corrosive on account of elevated soil conductivity. The corrosive nature of the soils may be further exacerbated by seasonal groundwater influx.
- *Historic Monuments*: To the author's knowledge there are no historic monuments on the site.
- *Undermining*: The area is not subject to undermining.
- *Dolomite Stability*: The area is not subject to dolomite related instabilities.
- *Seismicity*: A 10% probability exists that an earthquake with Peak Ground Acceleration of 0.06g to 0.10g may take place once in 50 years.
- *Cemetery Sites*: No graves or cemeteries were encountered.
- *Erosion and Dispersive Soils:* Erosion dongas and soil piping was noted on the site or in its immediate vicinity.

8 RECOMMENDATIONS

8.1 Proposed Development and Structural Recommendations

Taking into consideration the findings of the geotechnical investigation, the following general recommendations can be given as guidelines:

8.1.1 Geotechnical Zone 1: ***H2-H3***

Founding in this zone must be done by means of a reinforced raft capable of accommodating unrestrained heave exceeding 30mm. The exact amount of heave must be determine for each stand during the phase 2 geotechnical investigation, but as a guideline, maximum unrestrained heave of up to 45mm is expected. The superstructure must contain articulation joints and masonry must be lightly reinforced. Floor slabs must be fabric reinforced.

In areas where soil piping is common or frequently found, founding should preferably be done by means of a soil replacement raft, as designed by a suitably qualified structural engineer.

It is essential that zoning and individual stand zoning be verified during a phase two geotechnical investigation in accordance with SANS634. Also, the zoning as discussed above may be altered based on the outcome of a flood line assessment and groundwater study.

8.1.2 General Remarks

Site drainage of this area must be planned carefully and no storm water or surface water should be allowed to accumulate within 1.5m of individual structures. Also, cognisance must be taken of the expansive nature of in situ soils which may disrupt services installed below surface. Adequate measures must be put in place to ensure that such services are not damaged by the heave action of the expansive soil materials.

The anticipated soil movements, geotechnical zoning and proposed foundation precautions are summarised in the attached Table 4: Foundation Design, Building Procedures and Precautionary Measures.

8.2 Conditions of Excavation

Considering the parameters of “Conditions of Excavation” as per SANS 1200, one must allow amongst others the following for the prevailing site conditions:

- *Colluvium:* The colluvial materials are considered excavatible by hand or by machine. Due to its occasional clayey nature, machine excavation is recommended.

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	**H2-H3**	100.0%	Unrestrained heave of up to or exceeding 30mm	Colluvium overlying alluvium and/or residual shale	Intermediate	Modified	Reinforced raft OR Soil replacement raft	Corrosive soils Possible seasonal groundwater Risk of flooding Dispersive soils Erosion dongas

- *Alluvium:* Conditions of cohesive, difficult soil excavation must be anticipated in the alluvial horizon. Machine excavation will be essential and the use of an excavator is recommended for extensive or deep excavations, as a backhoe proved only partially successful in excavating the alluvium.
- *Residual Shale:* Machine excavation is again recommended due to the cohesive nature and difficult soil excavation encountered in this horizon. The use of an excavator is recommended above a backhoe.
- *Excavation Stability:* Excavations made during the course of the investigation largely proved to be stable. It is expected that perched or seepage water – if present – will severely detract from the excavation stability and would necessitate remedial steps (e.g. pumping dry excavations).
- *Wet Excavation:* Depending on the outcome of a groundwater study, it may be required to make provision for wet excavation on a seasonal basis.
- *General Comments:* Excavation by backhoe proved viable to depths between 700mm and 2200mm. Gradual refusal of excavation was encountered in all trial holes except one.
- *Safety:* The safety of all persons working in or near open excavations must be ensured.

8.3 Seismicity

The guidelines of the National Housing Board [Reference 9.7] indicate the level of seismicity of the area to be within acceptable limits. In terms of seismicity the development potential of the area is regarded as favourable.

8.4 Soil Corrossivity

Provision must be made to protect metallic objects (e.g. services, utilities, anchoring cables, etc.) which are buried below ground level from extremely corrosive soils and possible exposure to seasonal groundwater. It is recommended that protective coating be considered for piping. Alternatively, the use of PVC pipes may be considered.

8.5 Other Recommendations

As with the 2017 geotechnical investigation on the adjacent portion 437, it is recommended that the following additional matters be considered and/or investigated:

- *Flood Lines:* It is essential that a flood line assessment be undertaken for this property to ensure that no stands are set out below the applicable flood line. Once this is available, the geotechnical zoning should also be revised accordingly. The flood line assessment should be supplemented by a wetland review to identify a suitable buffer to be devoid of development, where applicable.
- *Groundwater Study:* It is essential that a groundwater study be undertaken to assess the possibility, severity and extent of expected seasonal groundwater (i.e. perched water level)

fluctuations. Based on the outcome of such a report, a decision must be taken whether additional measured (e.g. sub-surface drains, etc.) will be required to manage any seepage water.

9 SOURCES OF REFERENCE

9.1 Mucina L. and Rutherford M.C. (eds): *The Vegetation of South Africa, Lesotho and Swaziland*, page 335, published in 2006 by SANBI

9.2 Vegter, J.R. (1995): *An Explanation of a Set of National Ground Water Maps*, published by the Water Research Commission.

9.3 Van der Merwe, D (1964).: *The Prediction of Heave from the Plasticity Index and Percentage Clay Fraction of Soils*, published in the Civil Engineer in South Africa, pages 103 to 107.

9.4 NHBRC (1999): *Home Building Manual Part 1 & 2*, Revision 1, page 18, published by the National Home Builders Registration Counsel, Pretoria.

9.5 Kijko A., Graham, G., Bejaichund, D.L., Roblin, D.L. and Brandt, M.B.C. (2003): *Probabilistic Peak Ground Acceleration and Spectral Seismic Hazard Maps for South Africa*, Report 2003-0053, Council for Geoscience.

9.6 Evans, U.R. (1971): *The Corrosion and Oxidation of Metals*, published by Edward Arnold.

9.7 National Department of Housing (2002): Geotechnical Site Investigations for Housing Developments – Generic Specifications GFSH-2, pages 9 and 10.

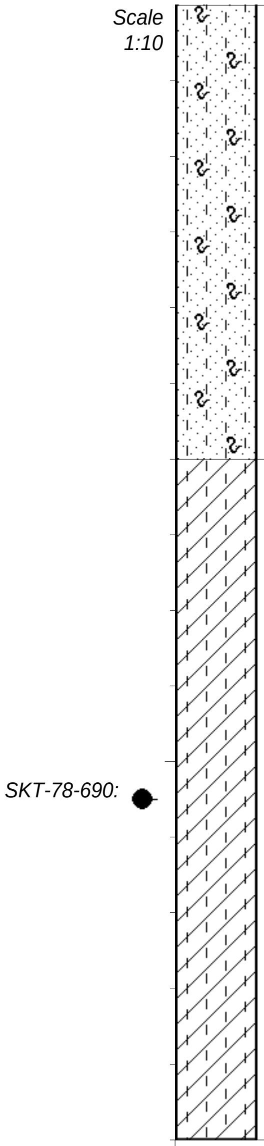
IJ Breytenbach (Pr. Sci. Nat.)
30 April 2019
For Soilkraft cc

APPENDIX A: TRIAL HOLE LOG SHEETS

SSS Invest
Roosboom

HOLE No: A
Sheet 1 of 1

JOB NUMBER: 2019/J011/SSS



0.00

Very moist, light grey, loose, intact, silty sand. Colluvium containing roots.

0.60

Moist, light grey brown, very stiff, slickensided, silty clay. Slightly ferruginised residual shale.

1.50

NOTES

1) Gradual refusal of excavation.
2) No seepage.
3) Disturbed Sample SKT-78-690: 1.05m.

CONTRACTOR : World Impact Suppliers
MACHINE : JCB 3CX
DRILLED BY : Joseph
PROFILED BY : Izak Breytenbach

INCLINATION :
DIAM : 700mm
DATE :
DATE : 22/03/2019

ELEVATION :
X-COORD : 28° 39 58.3S
Y-COORD : 29° 43 23.8E

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

DATE : 30/04/2019 08:38
TEXT : ..Roosboom2\TPProfiles.txt

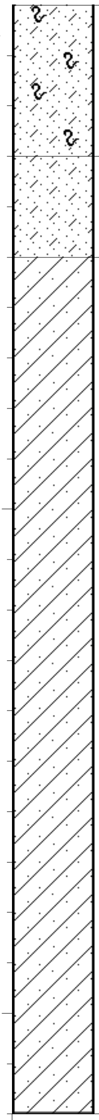
HOLE No: A
Geotechnical Investigation

SSS Invest
Roosboom

HOLE No: B
Sheet 1 of 1

JOB NUMBER: 2019/J011/SSS

Scale
1:15



0.00	Very moist, dark grey, medium dense, slickensided, clayey sand. Colluvium containing roots.
0.30	Very moist, light grey brown, medium dense, intact, clayey coarse sand. Alluvium.
0.50	Very moist, orange brown blotched light grey speckled black, firm, slickensided, sandy clay. Ferruginised residual shale.
2.20	

NOTES

1) No refusal of excavation.

2) No seepage.

CONTRACTOR : World Impact Suppliers
MACHINE : JCB 3CX
DRILLED BY : Joseph
PROFILED BY : Izak Breytenbach

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

INCLINATION :
DIAM : 700mm
DATE :
DATE : 22/03/2019

DATE : 30/04/2019 08:38
TEXT : ..Roosboom2\TPProfiles.txt

ELEVATION :
X-COORD : 28° 39 52.7S
Y-COORD : 29° 43 22.7E

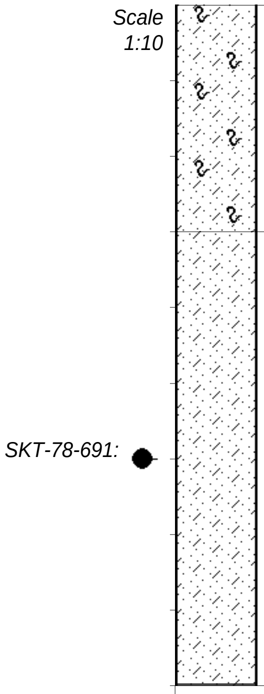
HOLE No: B
Geotechnical Investigation

SSS Invest
Roosboom

HOLE No: C
Sheet 1 of 1

JOB NUMBER: 2019/J011/SSS

Scale
1:10



0.00	Dry, light grey, medium dense, shattered, clayey sand. Colluvium containing roots.
0.30	Slightly moist, light grey brown, very dense, slickensided, clayey sand. Alluvium.
0.90	

NOTES

1) Gradual refusal of excavation.
2) No seepage.
3) Disturbed Sample SKT-78-691: 0.60m.

CONTRACTOR : World Impact Suppliers
MACHINE : JCB 3CX
DRILLED BY : Joseph
PROFILED BY : Izak Breytenbach

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

INCLINATION :
DIAM : 700mm
DATE :
DATE : 22/03/2019

DATE : 30/04/2019 08:38
TEXT : ..Roosboom2\TPProfiles.txt

ELEVATION :
X-COORD : 28° 39 49.6S
Y-COORD : 29° 43 22.6E

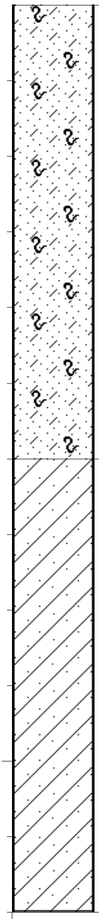
HOLE No: C
Geotechnical Investigation

SSS Invest
Roosboom

HOLE No: D
Sheet 1 of 1

JOB NUMBER: 2019/J011/SSS

Scale
1:10



0.00	Slightly moist, dark grey brown, dense, shattered and voided, clayey sand. Colluvium containing roots.
0.60	Slightly moist, dark grey brown mottled white and orange, very stiff, slickensided, sandy clay. Alluvium.
1.20	

NOTES

1) Gradual refusal of excavation.

2) No seepage.

3) Risk of flooding.

4) Soil piping.

CONTRACTOR : World Impact Suppliers
MACHINE : JCB 3CX
DRILLED BY : Joseph
PROFILED BY : Izak Breytenbach

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

INCLINATION :
DIAM : 700mm
DATE :
DATE : 22/03/2019

DATE : 30/04/2019 08:38
TEXT : ..Roosboom2\TPProfiles.txt

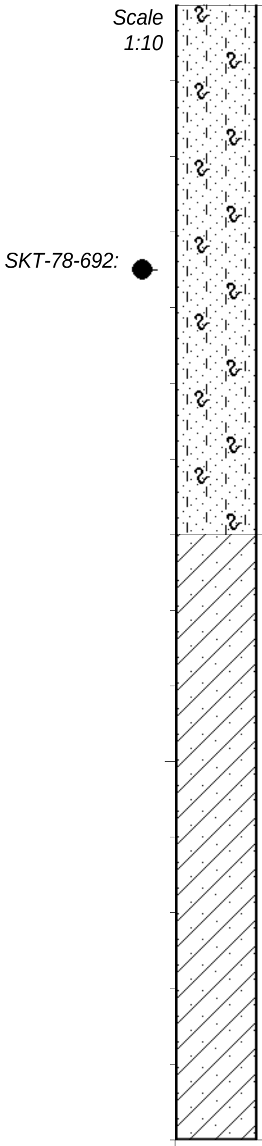
ELEVATION :
X-COORD : 28° 39 47.8S
Y-COORD : 29° 43 22.2E

HOLE No: D
Geotechnical Investigation

SSS Invest
Roosboom

HOLE No: E
Sheet 1 of 1

JOB NUMBER: 2019/J011/SSS



0.00

Very moist, light grey brown, medium dense, shattered, silty sand. Alluvium containing roots.

0.70

Slightly moist, light grey brown, very stiff, slickensided, sandy clay. Alluvium.

1.50

NOTES

1) Gradual refusal of excavation.
2) No seepage.
3) Disturbed Sample SKT-78-692: 0.35m.

CONTRACTOR : World Impact Suppliers
MACHINE : JCB 3CX
DRILLED BY : Joseph
PROFILED BY : Izak Breytenbach

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

INCLINATION :
DIAM : 700mm
DATE :
DATE : 22/03/2019

DATE : 30/04/2019 08:38
TEXT : ..Roosboom2\TPProfiles.txt

ELEVATION :
X-COORD : 28° 39 49.9S
Y-COORD : 29° 43 24.6E

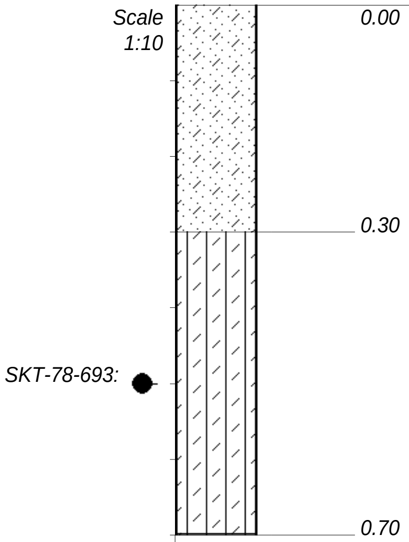
HOLE No: E
Geotechnical Investigation

SSS Invest
Roosboom

HOLE No: F
Sheet 1 of 1

JOB NUMBER: 2019/J011/SSS

Scale
1:10



Depth	Description
0.00	Slightly moist, brown grey, shattered and voided, medium dense, clayey sand. Alluvium.
0.30	Slightly moist, light grey brown, very stiff, slickensided, clayey silt. Alluvium.
0.70	

NOTES

1) Gradual refusal of excavation.

2) No seepage.

3) Disturbed Sample SKT-78-693: 0.50m.

CONTRACTOR : World Impact Suppliers
MACHINE : JCB 3CX
DRILLED BY : Joseph
PROFILED BY : Izak Breytenbach

INCLINATION :
DIAM : 700mm
DATE :
DATE : 22/03/2019

ELEVATION :
X-COORD : 28° 39 52.6S
Y-COORD : 29° 43 25.3E

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

DATE : 30/04/2019 08:38
TEXT : ..Roosboom2\TPProfiles.txt

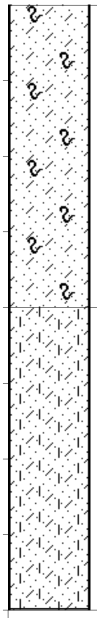
HOLE No: F
Geotechnical Investigation

SSS Invest
Roosboom

HOLE No: G
Sheet 1 of 1

JOB NUMBER: 2019/J011/SSS

Scale
1:10



0.00

Dry, grey white, very dense, intact, clayey sand. Alluvium containing roots.

0.40

Slightly moist, brown grey, very dense, intact, clayey silty sand. Alluvium.

0.80

NOTES

1) Gradual refusal of excavation.

2) No seepage.

CONTRACTOR : World Impact Suppliers
MACHINE : JCB 3CX
DRILLED BY : Joseph
PROFILED BY : Izak Breytenbach

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

INCLINATION :
DIAM : 700mm
DATE :
DATE : 22/03/2019

DATE : 30/04/2019 08:38
TEXT : ..Roosboom2\TPProfiles.txt

ELEVATION :
X-COORD : 28° 39 52.7S
Y-COORD : 29° 43 27.7E

HOLE No: G
Geotechnical Investigation

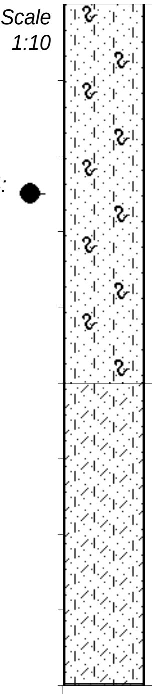
SSS Invest
Roosboom

HOLE No: H
Sheet 1 of 1

JOB NUMBER: 2019/J011/SSS

Scale
1:10

SKT-78-694:



0.00	Very moist to wet, grey, very loose, intact, silty sand. Colluvium containing roots.
0.50	Slightly moist, brown grey, very dense, intact, clayey silty sand. Alluvium.
0.90	

NOTES

1) Gradual refusal of excavation.

2) No seepage.

3) Disturbed Sample SKT-78-694: 0.25m.

CONTRACTOR : World Impact Suppliers
MACHINE : JCB 3CX
DRILLED BY : Joseph
PROFILED BY : Izak Breytenbach

INCLINATION :
DIAM : 700mm
DATE :
DATE : 22/03/2019

ELEVATION :
X-COORD : 28° 39 56.1S
Y-COORD : 29° 43 29.1E

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

DATE : 30/04/2019 08:38
TEXT : ..Roosboom2\TPProfiles.txt

HOLE No: H
Geotechnical Investigation

SOIL KRAFT

SSS Invest
Roosboom

LEGEND
Sheet 1 of 1

JOB NUMBER: 2019/J011/SSS

	░	SAND	{SA04}
	⁘	SANDY	{SA05}
	▥	SILT	{SA06}
	¦	SILTY	{SA07}
	▨	CLAY	{SA08}
	⁄	CLAYEY	{SA09}
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 : 30/04/2019 08:38
TEXT : ..Roosboom2\TPProfiles.txt

LEGEND
SUMMARY OF SYMBOLS

APPENDIX B: MATERIAL TEST RESULTS

Client Name: Soilkraft
Project Name: Roosboom
Job Number: SKT-78
Date: 05-Apr-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 A	TH C	TH E	TH F	TH H			
Depth (mm)	600 - 1500	300 - 900	0 - 700	300 - 700	0 - 500			
Lab No	SKT-78-690	SKT-78-691	SKT-78-692	SKT-78-693	SKT-78-694			
53.0	**100**	**100**	**100**	**100**	**100**			
37.5	**100**	**100**	**100**	**100**	**100**			
26.5	**100**	**100**	**100**	**100**	**100**			
19.0	**100**	**100**	**100**	**100**	**100**			
13.2	**100**	**99**	**97**	**100**	**100**			
9.5	**100**	**98**	**97**	**98**	**100**			
6.7	**100**	**98**	**96**	**97**	**99**			
4.75	**99**	**98**	**96**	**96**	**98**			
2.00	**97**	**97**	**95**	**94**	**94**			
1.00	**96**	**97**	**95**	**93**	**92**			
0.425	**92**	**96**	**94**	**92**	**85**			
0.250	**88**	**95**	**86**	**90**	**82**			
0.150	**84**	**88**	**78**	**84**	**74**			
0.075	**77**	**69**	**65**	**72**	**56**			
0.060	**71**	**61**	**54**	**65**	**36**			
0.050	**68**	**57**	**50**	**61**	**31**			
0.035	**63**	**49**	**42**	**54**	**23**			
0.020	**57**	**45**	**37**	**45**	**17**			
0.006	**49**	**38**	**29**	**36**	**11**			
0.002	**43**	**32**	**22**	**30**	**7**			
GM	**0.34**	**0.38**	**0.46**	**0.42**	**0.65**			

Atterberg Limits

LL (%)	**48**	**36**	**31**	**42**	**-**			
PI (%)	**21**	**18**	**15**	**23**	**SP**			
LS (%)	**9.5**	**9.0**	**7.0**	**10.0**	**0.5**			

pH & Conductivity

pH	**8.4**			**8.5**				
EC (S/m)	**0.143**			**0.111**				

MDD / OMC

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

CBR

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

UCS (MPa)

100%								
97%								
90%								

COLTO Classification

Remarks:

Client Name: Soilkraft
Project Name: Roosboom
Job Number: SKT-78
Date: 2019-04-05
Method: SANS 3001 GR1, GR3, GR10 GR12 & BS 1377 (where applicable)

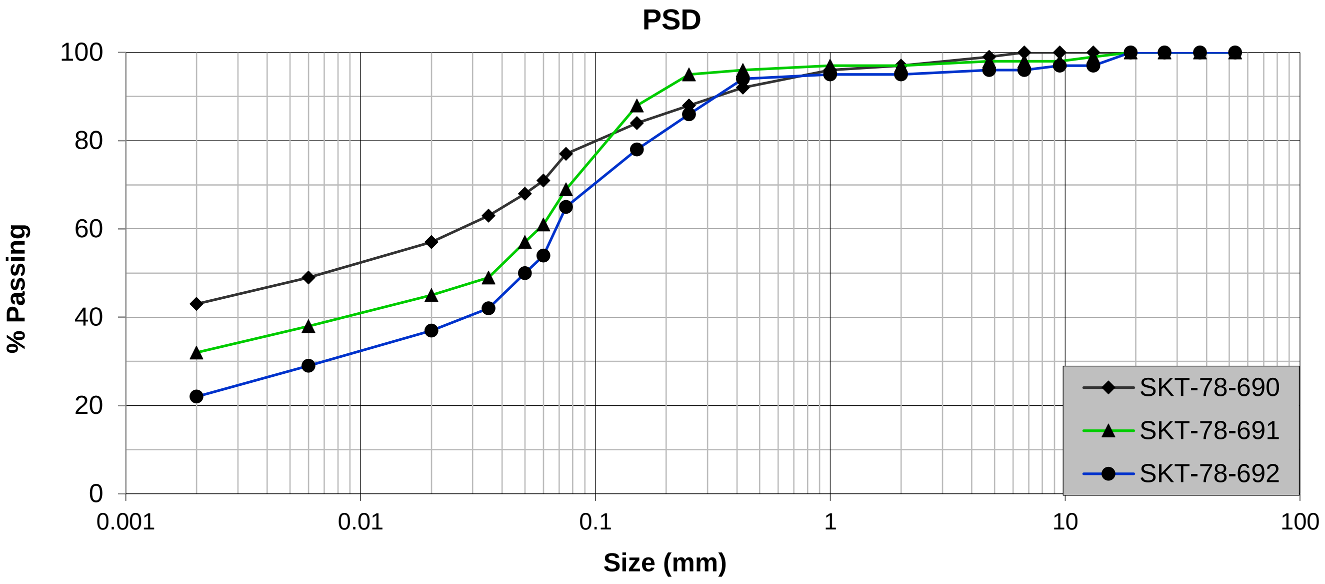
FOUNDATION INDICATOR

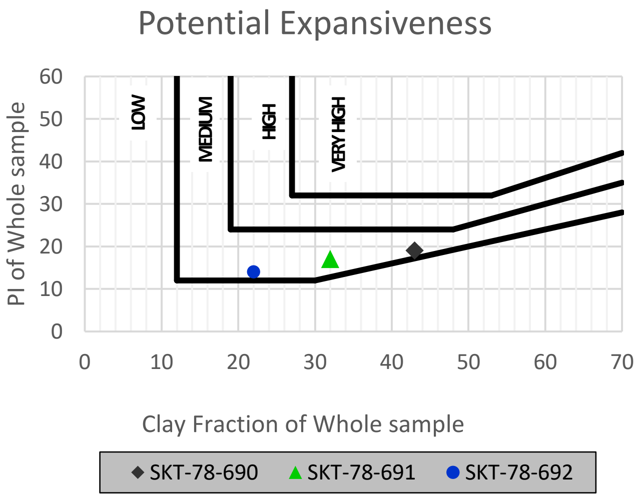
Grading & Hydrometer Analysis (Particle Size (mm) & % Passing)				**Atterberg Limits & Classification**			
Sample	TH A	TH C	TH E	Sample	TH A	TH C	TH E
Depth (m)	600 - 1500	300 - 900	0 - 700	Depth (m)	600 - 1500	300 - 900	0 - 700
Lab No	SKT-78-690	SKT-78-691	SKT-78-692	Lab No	SKT-78-690	SKT-78-691	SKT-78-692
53.0	**100**	**100**	**100**	Liquid Limit (%)	**48**	**36**	**31**
37.5	**100**	**100**	**100**	Plastic Limit (%)	**27**	**18**	**16**
26.5	**100**	**100**	**100**	Plasticity Index (%)	**21**	**18**	**15**
19.0	**100**	**100**	**100**	Linear Shrinkage (%)	**9.5**	**9.0**	**7.0**
13.2	**100**	**99**	**97**	PI of whole sample	**19**	**17**	**14**
9.5	**100**	**98**	**97**				
6.7	**100**	**98**	**96**	% Gravel	**3**	**3**	**5**
4.75	**99**	**98**	**96**	% Sand	**26**	**36**	**41**
2.00	**97**	**97**	**95**	% Silt	**28**	**29**	**32**
1.00	**96**	**97**	**95**	% Clay	**43**	**32**	**22**
0.425	**92**	**96**	**94**	Activity	**0.5**	**0.6**	**0.7**
0.250	**88**	**95**	**86**				
0.150	**84**	**88**	**78**	% Soil Mortar	**97**	**97**	**95**
0.075	**77**	**69**	**65**				
0.060	**71**	**61**	**54**	Grading Modulus	**0.34**	**0.38**	**0.46**
0.050	**68**	**57**	**50**	Moisture Content (%)	**N / T**	**N / T**	**N / T**
0.035	**63**	**49**	**42**	Relative Density (SG)*	**2.65**	**2.65**	**2.65**
0.020	**57**	**45**	**37**				
0.006	**49**	**38**	**29**	Unified (ASTM D2487)	**CL**	**CL**	**CL**
0.002	**43**	**32**	**22**	AASHTO (M145-91)	**A - 7 - 6**	**A - 6**	**A - 6**

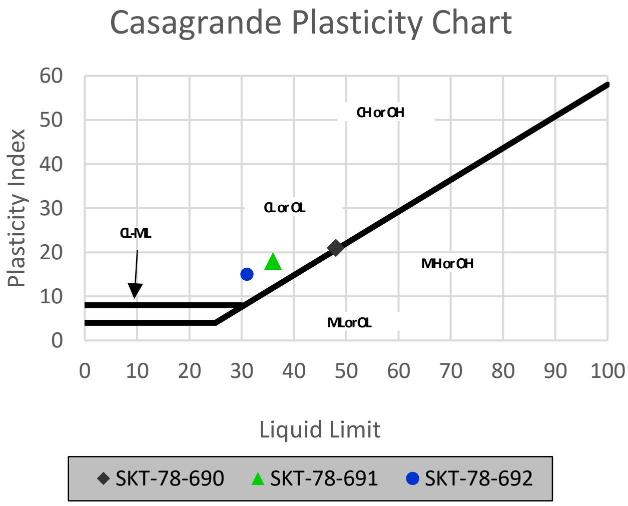
Remarks: *: Assumed
N / T: Not Tested

Client Name:	Soilkraft
Project Name:	Roosboom
Job Number:	SKT-78
Date:	2019-04-05
Method:	SANS 3001 GR1, GR3, GR10 GR12 & BS 1377 (where applicable)

FOUNDATION INDICATOR


PSD


Potential Expansiveness


Casagrande Plasticity Chart

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: Roosboom
Job Number: SKT-78
Date: 2019-04-05
Method: SANS 3001 GR1, GR3, GR10 GR12 & BS 1377 (where applicable)

FOUNDATION INDICATOR

Grading & Hydrometer Analysis
(Particle Size (mm) & % Passing)

Sample	TH F	TH H	
Depth (m)	300 - 700	0 - 500	
Lab No	SKT-78-693	SKT-78-694	
53.0	**100**	**100**	
37.5	**100**	**100**	
26.5	**100**	**100**	
19.0	**100**	**100**	
13.2	**100**	**100**	
9.5	**98**	**100**	
6.7	**97**	**99**	
4.75	**96**	**98**	
2.00	**94**	**94**	
1.00	**93**	**92**	
0.425	**92**	**85**	
0.250	**90**	**82**	
0.150	**84**	**74**	
0.075	**72**	**56**	
0.060	**65**	**36**	
0.050	**61**	**31**	
0.035	**54**	**23**	
0.020	**45**	**17**	
0.006	**36**	**11**	
0.002	**30**	**7**	

Atterberg Limits & Classification

Sample	TH F	TH H	
Depth (m)	300 - 700	0 - 500	
Lab No	SKT-78-693	SKT-78-694	
Liquid Limit (%)	**42**	**-**	
Plastic Limit (%)	**19**	**-**	
Plasticity Index (%)	**23**	**SP**	
Linear Shrinkage (%)	**10.0**	**0.5**	
PI of whole sample	**21**	**-**	
% Gravel	**6**	**6**	
% Sand	**29**	**58**	
% Silt	**35**	**29**	
% Clay	**30**	**7**	
Activity	**0.8**	**0.0**	
% Soil Mortar	**94**	**94**	
Grading Modulus	**0.42**	**0.65**	
Moisture Content (%)	**N / T**	**N / T**	
Relative Density (SG)*	**2.65**	**2.65**	
Unified (ASTM D2487)	**ML**	**ML**	
AASHTO (M145-91)	**A - 7 - 6**	**A - 4**	

Remarks: *: Assumed
N / T: Not Tested

Client Name:	Soilkraft
Project Name:	Roosboom
Job Number:	SKT-78
Date:	2019-04-05
Method:	SANS 3001 GR1, GR3, GR10 GR12 & BS 1377 (where applicable)

FOUNDATION INDICATOR