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PHASE 1 DETAILED SHALLOW SOIL ENGINEERING GEOLOGICAL INVESTIGATION CONDUCTED ON ERF 1305 OF THE FARM RIETGAT 611-JR, SOSHANGUVE-M, GAUTENG PROVINCE, SOUTH AFRICA

(Phase 1 Detailed Shallow Soil Engineering Geological Investigation)

Client: **Govhani Student Accommodation**

Project number: **RS17001**

5 April 2017

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Notes:	This report serves as a Phase 1 detailed shallow soil engineering geological investigation guided by SANS634:2012. 21 TLB test pits were excavated in the accessible areas in order to assess the on-site conditions.

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LIST OF ABBREVIATIONS OR ACRONYMS

AASHTO	American Association of State Highway and Transportation Officials
AM	Appointed Manager or Appointed Responsible Person
amsl	Above mean sea level
AO	Other development
ASTM	American Society for Testing and Materials
bgl	Below ground level
BH	Borehole
bngl	Below natural ground level
CBR	California Bearing Ratio
CMC	Compaction Moisture Content
COLTO	Committee of Land Transport Officials
Comp.	Compaction
Coord/s	Coordinate/s
DWA	Department of Water Affairs
E	East
EC	Electrical Conductivity
etc.	et cetera
Ext.	Extension
GI	Group Index
GM	Grading Modulus
GW	Groundwater
ha	Hectares
HRB	Highway Research Board
IN	Infrastructure and social facilities
ISRM	International Society for Rock Mechanics
km	Kilometers
Lat	Latitude
LL	Liquid Limit
Lon	Longitude
LS	Linear Shrinkage
m	Meters
m^2	Square meters
m3	Cubic meters
mamsl	Meters above mean sea level
Max.	Maximum
mbgl	Meters below ground level
mbngl	Meters below natural ground level
MDD	Maximum Dry Density
min	Minutes
Min.	Minimum
MOD or Mod.AASHTO	Modified AASHTO Compaction Effort
Mod.	Modified
N	North
NE	North-east
NW	North-west
OI	Oversize Index

OMC	Optimum Moisture Content
OWL	Original water level
PD	Permissible deviation
PER	Potential Expansiveness Rating
PI	Plasticity Index
RH	High rise dwelling units
RL	Low rise dwelling units
RN	Dwelling houses
RSC	RockSoil Consult (Pty) Ltd.
RV	Report version
S	South
SA	South Africa/n
SACNASP	South African Council for Natural Scientific Professions
SAIEG	South African Institute for Engineering Geologists
SANS	South African National Standards
SE	South-east
St	Standard
SW	South-west
TLB	Tractor Loader Backhoe
TP	Test Pit, Trial Pit or Evaluation Pit
TRH	Technical Recommendations for Highways
USCS	Unified Soil Classification System
USCS	Unified Soil Class
W	West
WL	Water level
WT	Weighted

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1. INTRODUCTION

RockSoil Consult (Pty) Ltd. (to be referred to as RSC) was appointed to conduct a Phase 1 detailed shallow soil engineering geological investigation for the proposed student accommodation on Erf 1305 of the Farm Rietgat 611-JR, Soshanguve-M, Gauteng Province, South Africa.

The request for quotation was for a Phase 1 GFSH2 investigation that is aligned with the Phase 1 Detailed Shallow Soil Investigation as per SANS634:2012. Two levels of investigation were provided for consideration namely 1) Phase 1 detailed (as per minimum SANS634:2012) and 2) Phase 1 more detailed (as per the RSC recommended level) investigation option taking into consideration the different land facets and expected variance in soil and geotechnical conditions across the site. The client opted for the more detailed Phase 1 RSC recommended level.

The site locality is depicted in **Figure 1**, **Figure 2** and **Figure 3**, **Appendix A**.

The investigation findings, laboratory test results and recommendations are provided in this report for planning and preliminary design purposes.

2. INVESTIGATION OBJECTIVES

The main objectives of the investigation as per the appointed level of investigation were to:

- Identify any potential hazards that may affect the proposed development;
- Define the ground conditions, including detailed soil profile and groundwater occurrences within the zone of influence of foundation work;
- Broadly classify the land which is to developed in accordance with the relevant site class designations for single-storey and double-storey type 1 masonry buildings;
- Provide the geotechnical basis for safe and appropriate land use planning, infrastructure design, housing unit design, and the formulation of precautionary measures and risk management procedures;
- Gather factual data which has a bearing on the determination of housing subsidy variations and the installation of township services;
- Provide suitable earthwork and/or foundation options;
- Comment on the way forward.

3. LIMITATIONS OF THE INVESTIGATION

The following limitations apply to this investigation:

- Localised areas of the site were not accessible by a TLB for excavation of trial holes due to steep slopes and/or large sized boulders or rock outcrop;
- No detailed site specific contour data was available during the writing of this report;
- No high definition aerial images were available to assist in zone refinement.

4. INFORMATION USED DURING THE STUDY

The following available information was used during the course of the investigation:

- Site locality map;
- 1:250 000-scale 2528 Pretoria Geological Sheet;
- 1:50 000-scale 2528CA Topographical Sheet;
- GoogleEarth satellite images;
- Aerial images, contour data and services positions as per Tshwane online database;
- Detailed soil profile descriptions obtained during the assessment;
- Laboratory tests conducted specifically for the purposes of this assessment;
- Local knowledge of the area.

5. INVESTIGATION METHODOLOGY

The investigation comprises:

- Desk study of available information, databases, reports and maps;
- Site visit and walkover survey;
- Excavation of 21 on-site evaluation trial pits with a TLB (Backhoe);
- Detailed soil profile descriptions guided by SANS633:2009;
- Soil profile and material photograph recordings;
- Selective soil sampling;
- Selective soil testing at an accredited soil laboratory;
- Evaluation of results;
- Identification of geotechnical constraints;
- Geotechnical soil classification and zonation;
- Material evaluation for general construction purposes;
- Reporting discussing constraints, design considerations, preliminary foundation options and suitability of material for general construction purposes.

6. SITE LOCALITY AND BASIC DESCRIPTION

The area of interest is situated adjacent to the south of Imphangele Street and adjacent to the north and east of Flower Street, Soshanguve-M, Gauteng Province. The site is known as Erf 1305 Rietgat 611-JR. Erf 1/1305 does not form part of the investigation as depicted in **Figure 4**, **Appendix A**.

The site approximate centre site coordinate is (WGS84, Decimal Degree):
Latitude: -25.533312°
Longitude: 28.090254°

The site locality is depicted in **Figure 1**, **Figure 2** and **Figure 3**, **Appendix A**.

The area of interest is approximately 4.43 ha in size.

Two prominent granophyre "ridges" or "koppies" are present towards the centre and in the south-eastern corner of the site with elevations of 1 320 and 1 323 mamsl respectively. The elevations are based on the 1 meter inferred Tshwane Metropolitan Municipality (TMM) GIS contour data as depicted in **Figure 4**, **Appendix A**. Abundant localised smaller "ridges" are also present across the site, however more concentrated towards the centre and southern half of the site. The two prominent "ridges" form a SE-NW striking divide that causes the site specific slope direction to drain in a north-western, western and south-western direction as depicted in **Figure 4**, **Appendix A**. The regional slope direction is towards the west.

The north western and north eastern corner of the site is expected to have slope angles of less than 4 degrees. The remainder of the site is expected to have slope angles of between 6 and 12 degrees with slope angles in excess of 12 degrees near the "ridge" areas. Detailed site specific contour data will be required for slope categorization as per SANS634:2012.

An existing informal residential dwelling is present towards the northern boundary of the site approximately 90 m west of the north-eastern corner of the site.

Evidence of burrowed and fill to surficial fill material consisting of uncompacted domestic waste and construction rubble are present towards the north-western, northern and south-eastern boundary of the site.

The surroundings are developed and the site is seemingly services with the usual municipal services including electricity, sewer and water reticulation.

The planners/designers should refer to the services report for detailed planning and design purposes.

The site is mainly covered with natural vegetation consisting of grass and small to medium size shrubs and trees. More densely vegetated shrubs and trees are concentrated towards the ridges.

The typical on site conditions are depicted in **Photograph 1**, **Photograph 2**, **Photograph 3** and **Photograph 4** and in **Appendix C.**

Photograph 1: Granophyre ridge in the background *(Photograph taken from test pit TP02 in a SE direction)*

Photograph 2: Abundant large granophyre boulders *(Photograph taken from test pit TP20 in a NE direction)*

Photograph 3: Granophyre outcrops *(Photograph taken near test pit TP09 in an E direction)*

Photograph 4: Uncontrolled fill material *(Photograph taken near test pit TP05 in a NE direction)*

7. CLIMATE

The climate is an important parameter in determining the climatic N-value, which is a function of the rainfall and evaporation rate (Eq. 1).

N= 12Ej/Pa Eq. 1

Where:

Ej= Evapotranspiration during January

Pa= Total annual precipitation

The N-value is used to determine the predominant mode of weathering that can be expected in a region. N=5 represents the boundary between physical and chemical weathering, meaning that for areas with an N-value of less than 5 chemical weathering will predominate, and for areas with an N-value greater than 5 physical weathering processes will be the most pronounced (Weinert, 1980).

According to the contour map of climatic N-values for Southern Africa (Weinert, 1980), the expected N-values for the area of study range between N=2 and N=3. The predominant form of weathering in the area would thus be chemical of nature.

The Pretoria area normally receives approximately 573 mm to 684 mm of rain per year, with most rainfall occurring during the months of November, December, January and February (SA Explorer and Meoweather). The typical monthly rainfall distribution in mm rainfall per month is depicted in **Chart 1**.

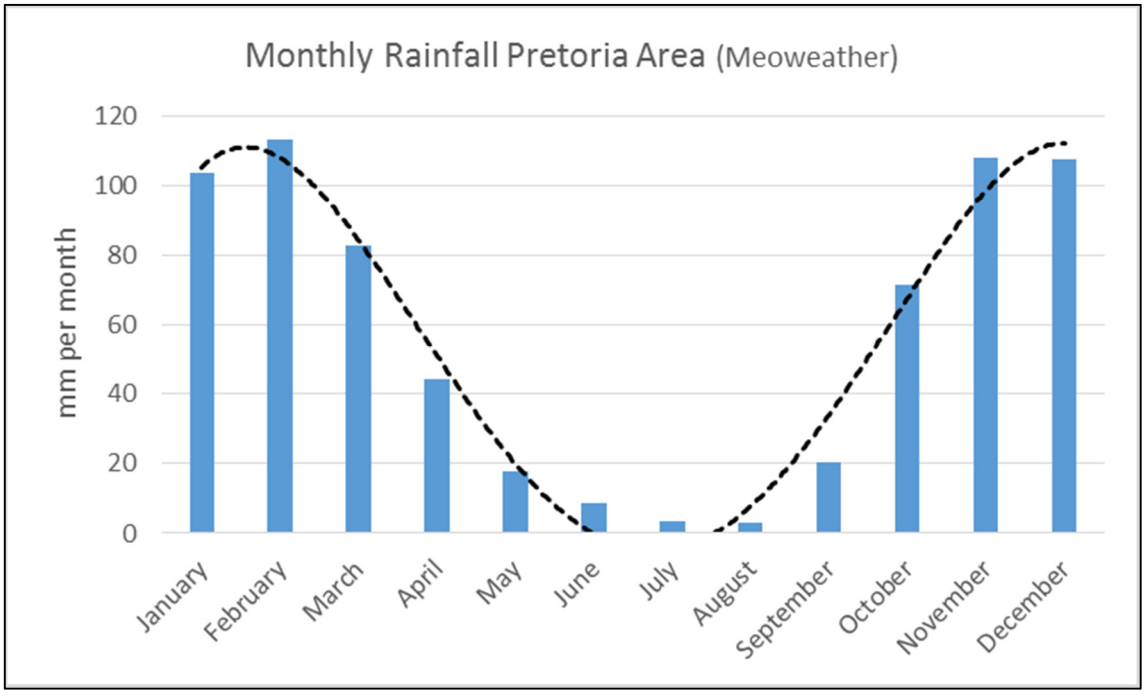

Chart 1: Rainfall for the Region per Month (Indicated in mm/month)

Average midday temperature for November/December/January/February is ~29 degrees Celsius and ~21 degrees Celsius for June and July.

8. GEOLOGY

8.1 Regional Geology and Economic Deposits

According to the 1:250 000-scale 2528 Pretoria Geological Sheet the region is mainly underlain by "**Mr**" with "**Mn**" towards the far north of the site.

The symbols represent the following formations:

- **Mr** → Granophyre, pseuogranophyre, microgranophyre; granite porphyry of the Rashoop Granophyre Suite from the Bushveld Igneous Complex.
- **Mn** → Grey to pink coarse-grained granite; medium-grained near top - Nebo Granites of the Lebowa Granite Suite from the Bushveld Igneous Complex.

The site is **not underlain** by potentially soluble rock formations such as dolomite and limestone. The site is considered **non-dolomitic** and a dolomite stability investigation is not required.

A prominent NS striking fault is situated approximately 800 m to the north of the site. No other prominent structural features such as shear zones, intrusions or lineaments are present in close proximity of the area of interest. A cropped section of the regional geology is depicted in **Figure 5**, **Appendix A**.

No known economically feasible mineral deposits that may influence the developability are present within close proximity of the site as depicted in **Figure 5**, **Appendix A**.

8.2 Site Specific Geology

The site-specific geology and conditions was evaluated by means of excavation and inspection of 21 test pits with a TLB (Backhoe) down to restricted refusal conditions. The test pit positions are depicted in **Figure 6**, **Appendix A**.

The detailed soil profile descriptions are provided in **Appendix B** with photographic recordings of the profiles and materials in **Appendix C**.

A simplified soil profile summary with horizon depths are provided in **Table E1**, **Appendix E**.

Burrowed fill and surficial material consisting of uncompacted domestic waste and construction rubble are present towards the north-western, northern and north-eastern boundary of the site as depicted in **Figure 7**, **Appendix A**. The natural soil profile is disturbed in these localised areas.

The 21 evaluation test pits confirmed that the site is covered with transported material consisting of coarser talus transported deposits. The transported material were underlain by residual granophyre in places and weathered granophyre.

The site is mainly covered with a thin **reworked topsoil and talus** horizon. The reworked topsoil and talus horizon was recorded down to between 0.12 and 0.55 mbgl. This horizon was described as dry to moist, dark to light brown, clayey silty gravelly sand to a coarser clast supported material with granophyre gravel to small boulders. The in-situ consistency was generally recorded as loose to medium dense at the prevailing dry to moist moisture content with a pinholed and open soil structure.

The upper reworked transported horizon was underlain by a **reworked residual granophyre** as encountered in only 5 of the 21 trial pits. This horizon was encountered down to between 0.50 and 2.50 mbgl where present. The horizon was generally described as dry to moist, dark brown to reddish-brown, clayey silty sandy GRAVEL with quartz and plagioclase fragments. The consistency of the material was generally described as medium dense to dense at the prevailing moisture content with an open soil structure with occasional voids.

The upper transported and/or residual granophyre horizon is underlain by **completely to medium weathered** granophyre. This horizon was generally encountered from as shallow as 0.12 mbg and from an average depth of ~0.33 m with a standard deviation of ~0.22 m. This horizon was generally described as dry to slightly, pinkish-brown to orange-brown speckled grey to black and stained, extremely close to closely jointed (10 to 500 mm spacing), completely to medium weathered granophyre with dry to moist, dark brown, clayey silty sand infill between the joints.

The hardness of the completely weathered granite/granophyre was generally recorded as extremely weak rock as per ISRM1981 “R0” hardness category with an approximate range of UCS of 0.25 to 0.75 MPa. Highly to medium weathered weak to medium strong rock granite/granophyre was locally encountered at termination depth as per ISRM1981 “R1” to “R3” classification with an approximate range of UCS of 1 to 25 MPa.

Undulating zones of slightly weathered granophyre were encountered in test pits TP07, TP12 and TP13 between 0.18 and 0.70 mbgl, 0.25 and 1.50 mbgl and 0.15 and 0.85 mbgl respectively. The hardness of the slightly weathered granophyre was generally recorded as strong rock as per ISRM1981 “R4” hardness category with an approximate range of UCS of 50 to 75 MPa.

Numerous “koppies” and rock outcrop are present across the site ad mainly towards the centre portion. The areas of outcrop should be refined during the detailed site survey.

The shallow soil profile photographs are attached as **Appendix C**. Typical soil profiled encountered are depicted in **Photograph 5** and **Photograph 6**.

Photograph 5: Typical soil profile encountered (test pit TP10)

Photograph 6: Typical soil profile encountered (test pit TP12)

The planners/designers should refer to the individual soil profile descriptions for planning purposes.

9. GROUNDWATER

A detailed hydrogeological assessment falls outside the scope of this shallow soil engineering geological investigation. No groundwater or any shallow perched water tables was encountered during the fieldwork phase that was conducted on 26 January 2017.

The presence of seasonal perched seepage water conditions may be expected after heavy and/or continuous downpours as indicated by localised pedogenic formations and staining in the residual horizon. Minor short lasted seepage water is expected to occur mainly in, but not limited to the transported and reworked residuum. Minor seepage water may also be expected through the discontinuities within the weathered granophyre. Seepage are mainly expected during and immediately after heavy and/or continuous downpours.

The depth to the water table is not known.

10. GEOTECHNICAL EVALUATION

The geotechnical evaluation is based on the available information, visual observations, soil profile descriptions, field interpretations and laboratory test results conducted on the selectively retrieved samples obtained during this investigation. The soil profile descriptions are attached as **Appendix B** with the soil profile photographs as **Appendix C** and laboratory test results as **Appendix D**. The laboratory test results are summarized in the relevant tables attached in **Appendix E**.

10.1 General Engineering and Material Characteristics

The upper on-site soils and weathered granophyre sampled and tested classify as "**SC**", "**SM**" and "**GM**" as per the Unified Soil Classification system. The soil classifications represent the following soil types:

- **GM** → Course-grained soils (more than 50% retained on the 0.075 mm sieve), gravels (50 % or more of course fraction retained on the 4.75 mm sieve), gravel with fines, silty gravels, gravel-sand-silt mixtures.
- **SC** → Course-grained soils (more than 50% retained on the 0.075mm sieve), sands (50% or more of course fraction passes the 4.75mm sieve), sands with fines, clayey sands, sand-clay mixtures.
- **SM** → Course-grained soils (more than 50% retained on the 0.075 mm sieve), sands (50 % or more of course fraction passes the 4.75 mm sieve, sands with fines, silty sands, sand-silt mixtures.

Typical material characteristics based on the USC can be provided as:

- The material classifying as "**GM**" are expected to be excellent for use as subgrade, good for use as subbase and fair to good for base courses in road construction. The material is expected to be semi-pervious when compacted. The in-situ material may have a slight in-situ compressibility with a low compressibility once compacted. The material is expected to be reasonable stable as embankment material when compacted with a fair workability and good compaction characteristics.
- The material classifying as "**SC**" are generally fair for use as subgrade, poor for use as subbase and not suitable for base courses in roads. The material is expected to be fairly impervious when compacted. The in-situ material may have a medium in-situ compressibility with a low compressibility and good to fair shear strength when properly compacted. The material is expected to be reasonable stable as embankment material when compacted with good workability rating and good to fair compaction characteristics.
- The material classifying as "**SM**" are generally fair to good for use as subgrade, poor too good for use as subbase and poor to not suitable for base courses in roads. The material is expected to be semi pervious to practically impervious when compacted. The in-situ material may have a medium in-situ compressibility with a low compressibility and good shear strength when compacted. The material is expected to be reasonable stable as embankment material when compacted with a fair workability rating and good compaction characteristics.

The upper and lower bound limits of the different classes as per this classification system are provided in the relevant reference tables, **Appendix F**.

The soils generally classify as "**A-1-b (0)**", "**A-2-4**" and "**A-2-6**" as per the H.R.B (also referred to as AASHTO) Classification system which represent the following soil types:

A-1 → Stone fragments gravel sand.
A-2 → Silty or clayey gravel, sand.

The upper and lower bound limits of the different classes as per this classification system are provided in the relevant reference tables, **Appendix F**.

The soils tested classify as "G5", "G6" and "G7" as per the THR14 and COLTO classification system. The upper and lower bound limits/properties of the different classes as per this classification system is provided in the TRH14 document. The material broadly represents the following material types:

G5/G6 → Natural gravel, specifications as per TRH14)
G7/G8 → Gravel-soil, specifications as per TRH14)

Typical material properties for the different soil classes encountered on site are provided in the relevant reference tables attached in **Appendix F**.

10.2 Soil Collapse and Compressibility

The thin upper transported and residual soils generally have a highly voided/pinholed soil structure with a **high collapse potential**. Taking into consideration the soil structure, in-situ density and percentage of fines (silt and clay) the upper soils are expected have a **slight consolidation/collapse potential** in the in-situ (natural uncompacted state) with induced loads and increase in moisture content of the soils.

A collapse and/or consolidation as per SAICE class "**C1**" soils are expected for foundations placed in the thicker upper in-situ soils (uncompacted state) with an estimated total settlement of **5 to 10 mm** with an assumed differential settlement of 75% of the total settlement. The aforementioned will obviously be foundation and position specific. Areas Foundation precautionary measures will thus be essential in order to prevent structural damage to foundations and/or masonry. Refer to **Table SAICE-1** and **Table SAICE-4**, **Appendix F**.

The lower completely weathered granodiorite is expected to have a negligible collapse and consolidation potential, however needs to be confirmed during the open excavation inspections.

Collapse/settlement are expected to be negligible if founded in/on intact highly to medium weathered rock.

10.3 Soil Heave

No materials with significant soil heave was identified nor expected to be present on site. Soil heave are considered negligible. The aforementioned is supported by the low recorded swell measured on the compacted samples, swell prediction based on PI and clay fraction of the samples (Van der Merwe's method) and the visual observations and interpretations. The swell potential chart is depicted in **Chart 2**.

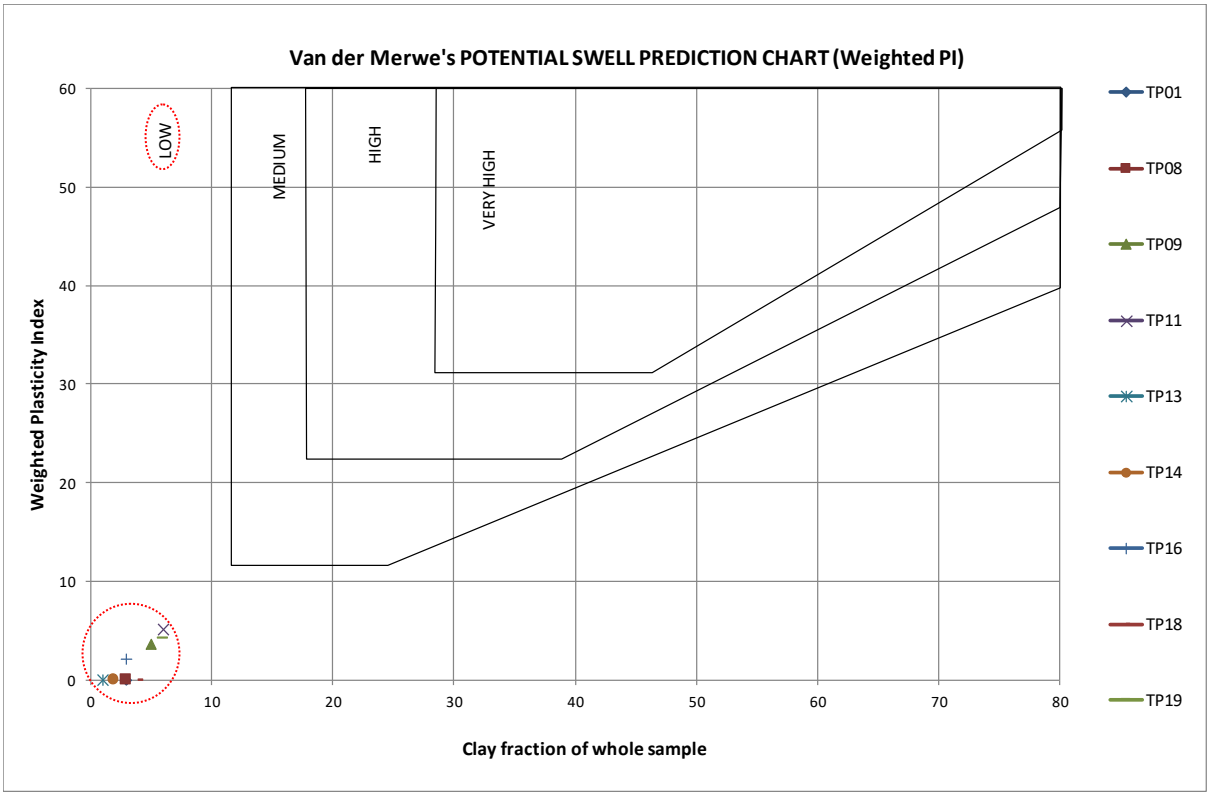

Chart 2: Van der Merwe's Swell Prediction Chart

All of the materials encountered and tested indicate a low soil heave potential.

10.4 Material Excavatability

The excavatability of the on-site materials were evaluated by means of 21 test pits excavated with a CAT 428F TLB (Backhoe). The excavation conditions encountered are summarized in **Table E1**, **Appendix E** and described in the detailed soil profile descriptions provided in **Appendix B**.

The test pits were terminated between 0.55 m and 2.50 mbgl in, restricted refusal conditions. The test pits were excavated down to an average depth of 1.14 mbgl with a standard deviation of 0.51 m (Not taking into consideration the numerous outcrop areas). The depth to completely to highly weathered granite/granophyre varies fairly significantly across the site, however are mostly in the region of ~0.5 m to ~1.0 mbgl.

Soft excavation conditions were experienced down to refusal depths. Intermediate to hard excavation conditions as per SANS excavation classes were experienced in all the test pits at TLB restricted refusal conditions. It is expected that the highly weathered very closely to closely jointed granophyre might be excavatable/rippable with a larger excavator and/or dozer in unconfined excavation conditions (Possibly for an additional 1m where highly jointed materials exist).

Abundant slightly weathered rock outcrop ridges (up to 10 m in diameter) and/or significant surface boulders (up to 2 m in diameter) were identified on site to the western, centre and southern portions of the site.

Excavatability are considered a major constraint and the use of pneumatic equipment and blasting for excavation of service trenches and foundation platforms will be a reality.

The design engineer should refer to the individual soil profile descriptions in combination with the detailed site specific survey data still to be conducted for the site for planning and/or design purposes.

10.5 Compaction Characteristics

Five compaction tests were conducted on soils retrieved from the shallow test pits. The results are attached as **Appendix D** with summary tables in **Appendix E**.

The CBR values increase from ~16/25 at 90 % Mod.AASHTO compaction effort to ~30/60 at 95 % and ~62/141 at 100 % compaction efforts at an optimum moisture content of between 7.8 % and 13.3 %. The maximum dry density of the material tested varied between 1 840 and 2 005 kg/m^3. The material classifies as "G5" to "G7" as per the TRH14 classification. The increase in CBR values with an increase in compaction effort (Modified AASHTO compaction effort) are visually illustrated in **Chart 3**.

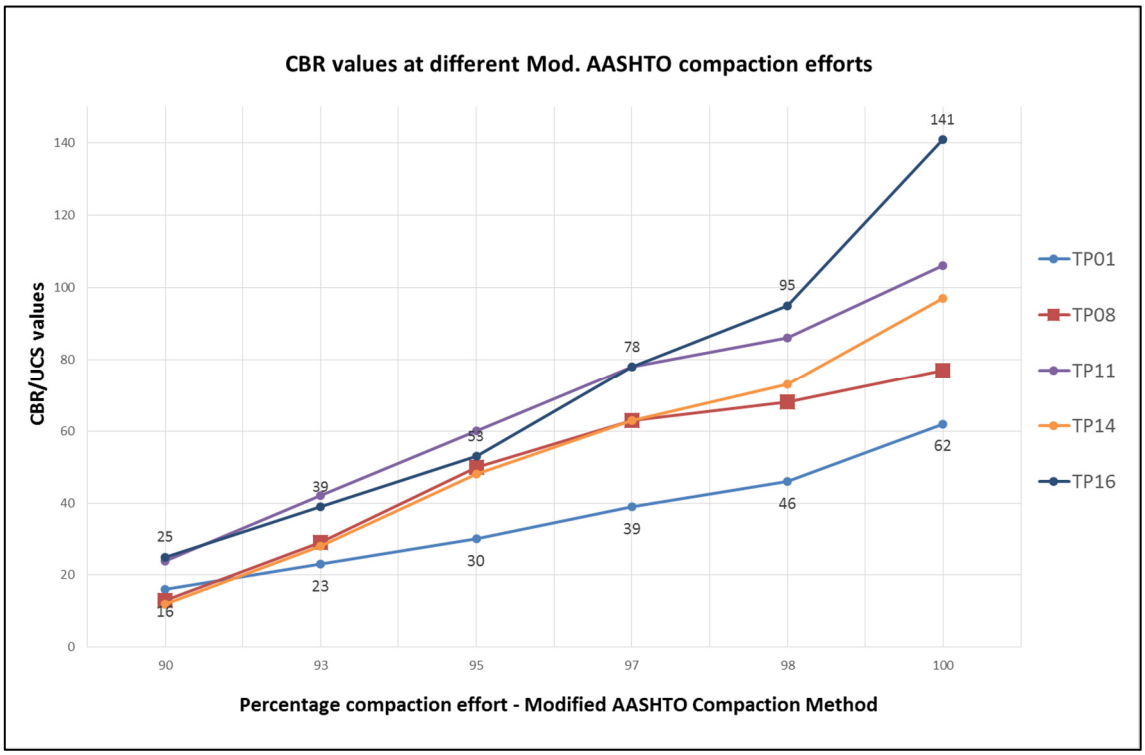

Chart 3: Increase in CBR values with Increase in Compaction Effort (Mod.AASHTO)

The topsoil and talus material retrieved from test pit TP14 and TP16 display good to excellent compaction characteristics. The weathered granophyre material retrieved from test pit TP01, TP08 and TP11 display good compaction characteristics.

10.6 Slope Stability and Erosion

Given the nature of the materials, shallow bedrock and overall slope angle no historic landslides or natural unstable slopes exist on site. Natural slope instability is not expected.

The slopes of the confined vertical inspection trenches were stable during the short period of investigation (+/- 8 hours) with no indications of bulging/toppling/ravelling. It should however be emphasised that although trench instability is unlikely that instability may **possibly** be expected in unconfined and confined conditions with an increase in moisture conditions as expected during the wet season. Any excavations should be inspected by a competent person. Any manned excavations should be inspected and approved by a competent person as per the health and safety regulations.

The general safety regulations (GSR13), which stated that no employer may require or permit any person to and no person shall, work in an excavation more than 1.5 m deep and which has not been adequately shored or braced if there is a danger of the sides of the excavation have a potential for collapse, **no longer apply**.

Regulation 13(2)(b) state that no work in unbraced excavations will be allowed unless:

1. Battered to angle of repose or
2. In stable material, **and**
    a. permission in writing by competent person and where uncertain,
    b. professional assessment in writing.

A competent person (suitably qualified and experienced preferably geotechnical engineer or and/or engineering geologist) should inspect any excavations to be entered:

1. Daily, prior to each shift;
2. After every blasting operation;
3. After an unexpected fall of ground;
4. After substantial damage to any supports; and
5. After any rain event.

Permission to enter any excavation should be granted in writing by the competent person daily and before/after the events as listed above for each separate pipeline section or excavation. The above is essential in order to evaluate the safety of the excavation to ensure the safety of persons working and around the trenches/excavations. The inspections are to be recorded in a register kept on site and made available to an inspector, client, client's agent, contractor or employee on request.

The excavation work requirements as per the Construction Regulations should be implemented by the client/agent/principal contractor/contractor as stipulated in the regulations or as otherwise specified in writing by the responsible engineer.

Overall slope angles of 2V:1H or less are deemed maximum slope angles for temporary works with ideally 1V:1: slopes. Permanent slopes should ideally be battered to 1V:1H for slope heights less than 3 m. Permanent slope angles are subject to erosion protection and control measures.

Slope stability analysis should be conducted for slopes in excess of 3.0 m and for slopes that has a surcharge at the top within 2.5 times the slope height.

All excavations should be inspected by a competent person in order to identify signs of possible seasonal seepage water conditions and to make adaptations to the angles recommended in this section.

Proper surface protection and drainage measures should be implemented to prevent saturation and excessive erosion that may potentially de-stabilise any slopes.

The upper soils are considered to have an i**ntermediate to high** susceptibility to erosion once exposed and subject to concentrated water flow. Surface water management will be required to avoid or limit excessive soil erosion.

10.7 Soil Corrosiveness

The potential corrosiveness rating categorization is summarized in **Table R1**. The laboratory test results are provided in **Appendix D**.

Table R1: Soil Corrosiveness Rating Based on Soil/Water Paste Conductivity **[6]**

Conductivity Range (mS/m)	Corrosiveness Rating	Recommendation
>50	Extremely corrosive	Cathodic protection required
25 – 50	Very corrosive	Cathodic protection required
20 – 25	Corrosive	Cathodic protection required
10 – 20	Mildly corrosive	Cathodic protection optional
<10	Not generally corrosive	Cathodic protection optional

Based on the pH and conductivity correlations the on-site soils are expected to be “mildly corrosive” to “not generally corrosive” towards ferrous metals that is in direct contact with the soil or soil/water interface.

Basson Index tests were also conducted on the transported and weathered granophyre material retrieved from sample TP05 (0.00-0.20 m) and TP15 (0.20-1.00 m). The results are not available at the time of writing this report. The results will be distributed to the client upon receival.

Corrosion and aggressiveness protection are deemed necessary.

11. MAJOR GEOTECHNICAL CONSTRAINTS

The geotechnical constraints identified during this investigation can be summarized as (SANS634:2012 Geotechnical Constraints in Urban Development):

- Thin to localised thick upper collapsible and compressible soil horizons;
- Expected minor shallow seasonal seepage water conditions and/or saturated soil profiles mainly during and immediately after rainfall events;
- **Severe shallow excavation difficulty;**
- Upper soils with an intermediate to high susceptibility to erosion if exposed and subject to concentrated water flow;
- **Intermediate (6 to 12°) to localised areas of least favourable slope angles (>12°).**

Other geotechnical constraints identified are:

- Localised fill that are expected to result in composite founding conditions;
- Large-size boulders and undulating bedrock that are expected to result in composite founding conditions;
- Localised areas of possible water ponding;
- Soils with a "mildly corrosive" corrosiveness rating towards ferrous metals based on soil/water paste conductivity measurements;
- Presence of localised trees with root systems that may affect the soils negatively if removed.

12. GEOTECHNICAL SITE CLASS DESIGNATION

Based on the encountered and expected constraints the site is preliminary considered one broad geotechnical zone namely (SAICE:1995 // SANS634:2012):

Zone I: P (Uncontrolled Fill & Steep Slopes)-C1-R // 1-2AD 2B 2-3FEI

Where C, P and R before the / refer to (SAICE, 1995):

- C - Collapse settlement;
- P - Constraint of concern as indicated;
- R - Shallow rock.

The A-B-D-E-F-I after the / refer to (SANS634, 2012):

- A - Collapse settlement;
- B - Seasonal shallow seepage water or saturated soil conditions;
- D - Consolidation settlement;
- E - Erodability of the soil horizons;
- F - Localised possible excavation difficulty;
- I - Steep slopes.

The areas of significant rock outcrop and different slope categories as per SANS634:2012 should be delineated once the detailed site survey and contour data are available.

13. CONSTRUCTION MATERIALS

The construction material evaluations are based on the visual assessment, typical soil classification correlations/performances and results obtained from the basic tests conducted on the selectively retrieved samples. No cement and/or lime stabilisation was conducted on the materials tested. Depending on foundation considerations the design engineer may conduct additional testing as deemed necessary.

Typical material properties and engineering suitability ratings for the soils encountered during the investigation are provided in the relevant reference tables attached in **Appendix E** and **Appendix F** for guideline purposes.

13.1 Soil Mattress Material

The compaction characteristics are discussed in the relevant report section.

The basic concept behind soil mattresses is that that material should be:

- Workable;
- Have a low/tolerable compressibility once compacted;
- Have a low/tolerable heave once compacted;
- Have suitable bearing capacity for the proposed foundation loads.

The materials will be workable if close to optimum moisture content. "**SC**" and "**SM**" materials generally have a medium in-situ compressibility, however expected to have a low compressibility once properly compacted at or near OMC.

Swell are considered negligible for the on-site soils.

The "**SC**", "**SM**" and "**GM**" materials will have fair shear strength characteristics when compacted and bearing are not expected to be problematic for the low expected induced loads. It will however be recommended that bearing capacity calculations be conducted by a competent person for any foundations in excess of 50 kPa and also especially for shallow thin strip foundations.

The on-site soils and soils are deemed suitable for general fill and mattress construction, provided that the material is sufficiently compacted at +/-1 % of OMC generally to 93 % of maximum Mod.AASHTO density in layers specified by the design engineer. Generally maximum uncompacted fill layers of 150 mm are specified, however can vary depending on the compaction methodology to be used during the earthwork preparation.

13.2 Road Pavement Material

The design of the road pavement will depend on the expected induced loads, volumes and overall pavement design with reference to type of materials, horizon thicknesses to be incorporated into the pavement and the drainage precautionary measures.

The design engineer should thus evaluate the suitability of the on-site soils taking into consideration the required parameters.

The compaction characteristics and CBR values measured at the different Mod.AASHTO compaction efforts are provided for evaluation purposes.

"**SC**" and "**G7/G8**" is generally considered fair for use as subgrade and selected layer, poor for used as subbase, and generally not suitable for upper road pavement construction.

"**SM**" and "**G5/G6**" is generally considered fair to good for use as subgrade and selected layer, fair to good for used as subbase, and generally not suitable for upper road pavement construction.

The materials classifying as "**GM**" have a "Good" rating for use in subgrade construction, "Fair" rating for the use in subbase construction and considered poor to not suitable for base construction.

Based on the TRH14 document materials classifying as G5 of G6 are generally considered suitable for subbase construction. The G5 and G6 material may be considered for base construction depending on the traffic loads/volumes and overall pavement design.

Based on the TRH14 document materials classifying as G7 and G8 are generally considered suitable for selected layer in pavement construction. The G7 material may however possibly be considered for subbase construction depending on the traffic loads/volumes and overall pavement design.

The design engineer should evaluate the materials based on the expected induced loads/volumes and overall pavement design.

13.3 Pipe Bedding and Backfill

Department Water Affairs developed a relaxed bedding specification especially for areas where materials with specifications as per SANS cannot be obtained. The specifications are summarized in **Table R2**.

Table R2: Relaxed Pipe Bedding Specifications (DWA) **[3]**

Material Description	**Percentage by Mass Passing Sieve Size (mm)**				**Atterberg Limits Shall Not Exceed (%)**		
	9,5	**4,75**	**0,425**	**0,002**	**LL***	**PI***	**LS***
Finely Graded A	100	100	80 - 100	0 - 45	30	15	5
Medium Graded B	100	80 - 100	60 - 80	0 - 40	35	18	7,5
Granular C	100	70 - 100	30 - 60	0 - 35	40	20	10

*Notes: * LL, PI and LS on material passing the 0,425mm sieve.*

The design engineer can select pipe bedding material as per the relaxed DWA specification if deemed appropriate based on the pipe and manufacturers requirements. The majority of the on-site material are considered suitable for **Finely Graded A** and in some cases Medium Graded B pipe bedding as per the DWA relaxed specifications, providing that stones in excess of 10 mm are sieved from especially the 75 mm of material immediately surrounding the pipe.

Refer to the laboratory test results in **Appendix D** for evaluation purposes.

13.4 Fine Aggregate for Mortar and Plaster

Construction material evaluation falls outside the scope of this appointment. It is expected that fine aggregate for mortar and plaster will be imported from the nearest local commercial source.

13.5 Coarse Aggregate for Concrete

Granophyre rock outcrop and medium to large-size boulders are present across the site which can be considered for crusher aggregated for concrete. Testing will be recommended if the materials are considered. It is however expected that suitable material will be imported from a local commercial source.

14. EARTHWORKS AND FOUNDATION RECOMMENDATIONS AND CONSIDERATIONS

Based on the conditions encountered and expected cut-to-fill-to-level preparation, one or a combination of the following foundation options can be recommended (SAICE 1995), providing proper fill and platform compaction were implemented:

1. Deep strip foundations (placement of foundations on highly to medium weathered competent granophyre).
2. Soil raft with lightly reinforced strip footings and light reinforcement in masonry.
3. Stiffened strip footings, stiffened or cellular raft.
4. Normal foundations (if placed in highly to slightly weathered granophyre or on outcrop).

Soil raft construction will occur during platform preparation if properly compacted as specified in the report.

Deep strip foundations (areas of shallow highly to medium weathered granophyre):

- Normal construction with drainage requirements.
- Founding on a competent horizon below the problem horizon.

Soil raft with lightly reinforced strip footings and light reinforcement in masonry:

- Remove in situ material to 1,0 m beyond perimeter of building to a depth and width of 1,5 times the widest foundation or to a competent horizon and replace with inert material (on-site soils are considered inert) compacted to at least 93 % MOD AASHTO density at –1 % to +2 % of optimum moisture content.
- Normal construction with lightly reinforced strip footings and light reinforcement in masonry.

Stiffened strip footings, stiffened or cellular raft:

- Stiffened strip footing or stiffened or cellular raft with articulation joints or solid lightly reinforced masonry.
- Bearing pressure not to exceed 50kPa.
- Fabric reinforcement in floor slabs.
- Site drainage and service/plumbing precautions.

Normal foundations (placed in highly to slightly weathered granophyre or on outcrop):

- Normal construction (strip footing or slab-on-the-ground foundations).
- Good site drainage.

Any other suitable foundation option/s as recommended by the design engineer can be considered.

It is expected that a cut-to-fill-to-level approach will be adopted for this site with expected cuts of ~0.5 to ~2.0 m and fill thicknesses of the same range. Cut-to-fill-to level preparation will result in composite founding conditions with completely to medium weathered granophyre generally exposed in the cut sections with transported, residuum and weathered granophyre in the fill sections.

Proper of the entire fill portions will be essential in order to provide uniform founding conditions and in order to limit differential movement/settlement between the cut and fill portions. Proper compaction of the in-situ and all of the fill material are deemed essential.

The material should ideally be compacted to a minimum density of at least 93% Mod.AASHTO density at -1% to +2 % of optimum moisture content in layers to be specified by the design engineer depending on the compaction equipment to be used for the site. The moisture content will be critical in order to ensure that the clay bridges between the sand grains resulting in the collapsible/compressible voided soil structure is breaked down.

Uniform compaction should be achieved below the platforms/foundations to minimize differential settlement.

Site drainage and plumbing/service precautionary measures should be implemented to prevent localised saturation “wet-spots” adjacent, below or under foundations that may cause localised settlement and unwanted differential settlement below the structures.

Proper overall site drainage and damp proofing of floors/slabs/masonry should be incorporated into the design. Toe drains or subsurface drains can be considered.

Proper compaction quality control measures should be implemented in order to ensure that the specified densities of the fill are achieved uniformly across the platform area in order to limit differential settlement. A combination of sand (or water)-replacement and nuclear surface moisture-density gauge testing can be considered.

The sand replacement and/or nuclear tests can be alternated with dynamic cone penetrometer testing (DCP) provided that the fill does not contain more than 10% gravel of size greater than 10mm or cobbles/boulders that may result in cone refusal. The on-site soils are suitable for DCP testing.

Maximum penetration rates of ~15 mm/blow (thus penetration rates of ≤15 mm/blow) should be obtained (as for upper penetration rates for "Dense" material and ideally 5 mm/blow as for the lower typical penetration rate for Dense/Very Dense material). The aforementioned are typical values that can be expected, however the required penetration rate should be determined on-site for the fill material based on actual sand/water-replacement densities. Typical penetration rates as for cohesive and non-cohesive soils for the achieved densities are provided in **Table R3** for guideline purposes.

Table R3: Typical DCP Penetration Rates with Correlated Material Consistencies

Penetration Rate (mm/blow)	Material Consistency (Non-cohesive Materials)	Penetration Rate (mm/blow)	Material Consistency (Cohesive Materials)
> 75	Very loose	> 110	Very soft
30 – 75	Loose	55 – 110	Soft
15 – 30	Medium dense	30 – 55	Firm
5 – 15	Dense	15 – 30	Stiff
< 5	Very dense	< 15	Very Stiff

15. CONCLUSIONS

The site is deemed suitable for the proposed development as from a geotechnical perspective, provided that the necessary design precautionary measures are implemented.

Rock outcrop to shallow rock are present that provide good founding conditions as from a bearing capacity perspective, however difficult conditions as from platform creation, installation of services and placement of structures. The rock outcrop, rock "koppies" and unfavourable slopes resulting from the outcrop/ridges are considered the major on-site geotechnical constraint.

The geotechnical constraints identified during this investigation can be summarized as (SANS634:2012 Geotechnical Constraints in Urban Development):

- Thin to localised thick upper collapsible and compressible soil horizons;
- Expected minor shallow seasonal seepage water conditions and/or saturated soil profiles mainly during and immediately after rainfall events;
- **Severe shallow excavation difficulty;**
- Upper soils with an intermediate to high susceptibility to erosion if exposed and subject to concentrated water flow;

- **Intermediate (6 to 12°) to localised areas of least favourable slope angles (>12°).**

Other geotechnical constraints identified are:

- Localised fill that are expected to result in composite founding conditions;
- Large-size boulders and undulating bedrock that are expected to result in composite founding conditions;
- Localised areas of possible water ponding;
- Soils with a “mildly corrosive” corrosiveness rating towards ferrous metals based on soil/water paste conductivity measurements;
- Presence of localised trees with root systems that may affect the soils negatively if removed.

The on-site soils generally classify as “SC”, “SM” and as “GM” as per the USCS. The on-site soils are deemed suitable for soil mattress construction.

The majority on-site soils are considered suitable for bedding and backfill material as per the DWA specifications, provided the courser fragments/stones are removed.

The majority on-site soils are considered suitable for subgrade to subbase material in road pavement construction. Selective material may be suitable for base construction depending on the required specifications based on the overall pavement design, traffic loads and nature of the loads.

Based on the conditions encountered and expected cut-to-fill-to-level preparation, one or a combination of the following foundation options can be recommended (SAICE 1995), providing proper fill and platform compaction were implemented:

1. Deep strip foundations (placement of foundations on highly to medium weathered competent granophyre).
2. Soil raft with lightly reinforced strip footings and light reinforcement in masonry.
3. Stiffened strip footings, stiffened or cellular raft.
4. Normal foundations (if placed in highly to slightly weathered granophyre or on outcrop).

Proper compaction quality control will be essential in order to limit differential settlement across the cut-to-fill-to-level platforms. The mattress construction should be certified by a competent person appointed by the client or alternatively the responsible design engineer.

The material properties and general recommendations are discussed in the relevant report sections. The design engineer should laisse with the engineering geologist if there are any uncertainty or if any additional specific input is required.

The slope stability of any significant cuts and/or excavations should be evaluated.

Proper drainage and damp proofing are deemed good practice in order to prevent concentrated water flow and erosion that may result in undercutting of structures and potential moisture damage to the foundations/floors and masonry.

Proper rehabilitation such as backfill and compaction should be implemented the burrowed and uncompacted fill material areas.

The necessary safety precautionary measures should be implemented for all manned excavations or trenches and should be signed off by a competent person during the construction period as guided by the regulations.

This investigation serves a Phase 1 detailed shallow soil investigation and should be supplemented by a Phase 2 investigation as per SANS634:2012. The Phase 2 investigation comprise an open service and foundation trench and excavation inspection to identify any variation in conditions as provided in this report and to confirm the suitability of the proposed foundation for the specific structures.

16. WAY FORWARD

A detailed site survey should be conducted for 1) refinement of the slope categorization and 2) identification and refinement of the rock outcrop/ridges and rock “koppies” that are expected to affect the development layout.

This investigation should be supplemented with a Phase 2 investigation (construction report) as per SANS634:2012 in order to confirm and refine the geotechnical conditions together with the necessary changes in earthwork, foundation options and/or general precautionary measures if deemed necessary. The Phase 2 report is generally conducted during installation of services, preparation of foundation platforms and open foundation/service trench inspections.

It is highly recommended that limit state evaluations are conducted for the proposes structures once the structure details and nature of the loads of the foundations on the soils/mattresses are known. The limit state evaluation should satisfy 1) the maximum allowable settlement based on the structure tolerances and 2) the bearing capacity of the soils/mattresses. The engineering geologist can evaluate the settlement/bearing upon request.

The design engineer should laisse with the engineering geologist if there are any uncertainty or if any additional specific input is required.

17. REPORT PROVISIONS

It is assumed that the necessary environmental impact assessments were conducted for this site especially from a “ridge area” and “aesthetic value” perspective. The environmental impact assessments are deemed obligatory.

While every effort was made during this basic site investigation to identify the different geological materials, areas subject to a perched water table, hydrogeological conditions, areas of poor drainage and to estimate their distribution, it is impossible to guarantee that isolated zones of significantly different conditions have not been missed. For this reason, this investigation has sought to highlight the significant issues regarding the influence of the proposed development on the geological environment to provide prior warning to the developer and to suggest precautionary measures.

Proper compaction should be implemented in areas where trees with large roots systems were removed, areas of uncontrolled backfill, areas of potential existing foundations and/or areas disturbed by possible underground services such as septic tanks, french drains and/or soak away systems. Pesticide control measures will be recommended below and immediately surrounding planned foundations and/or mattresses.

It is recommended that a competent person is present during material selection, placement and compaction of the fill and mattresses.

The design engineer should notify the engineering geologist if any significantly different soil conditions are encountered during the earthwork or foundation preparation phase so that the materials/conditions can be assessed and that proper precautionary measures can be recommended/implemented.

The report may only be distributed in its full context. RockSoil Consult (Pty) Ltd. and/or any of its employees or sub-contractors will not be held liable for any damages caused due to miss-interpretation of the findings and/or recommendations due to selective data presentation or distribution.

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Engineering Geologist
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JI Roux
Engineering Geologist

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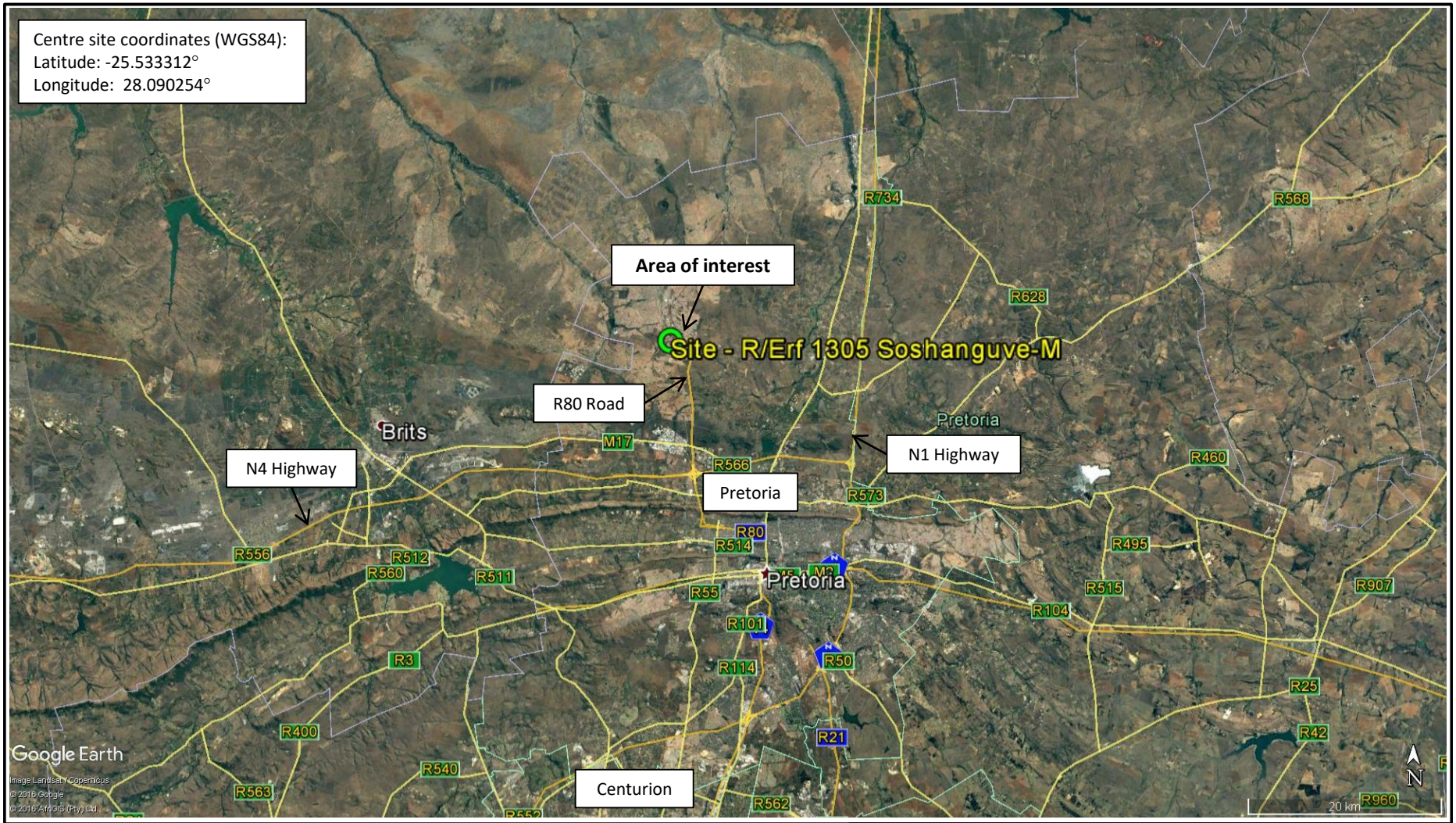
APPENDIX A

(Figures)



Project Description: Erf 1305 Soshanguve-M Gauteng Province
Investigation Type: Phase 1 Detailed Engineering Geological Investigation (SANS634:2012)
Figure 1: Locality Map 1

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Project no: RS17001

Project Description: Erf 1305 Soshanguve-M Gauteng Province
Investigation Type: Phase 1 Detailed Engineering Geological Investigation (SANS634:2012)
Figure 2: Locality Map 2

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Project no: RS17001

Project Description: Erf 1305 Soshanguve-M Gauteng Province
Investigation Type: Phase 1 Detailed Engineering Geological Investigation (SANS634:2012)
Figure 3: Locality Map 3

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Project no: RS17001

Project Description: Erf 1305 Soshanguve-M Gauteng Province
Investigation Type: Phase 1 Detailed Engineering Geological Investigation (SANS634:2012)
Figure 4: Regional Topographical Map – Tshwane Database (1m contours)

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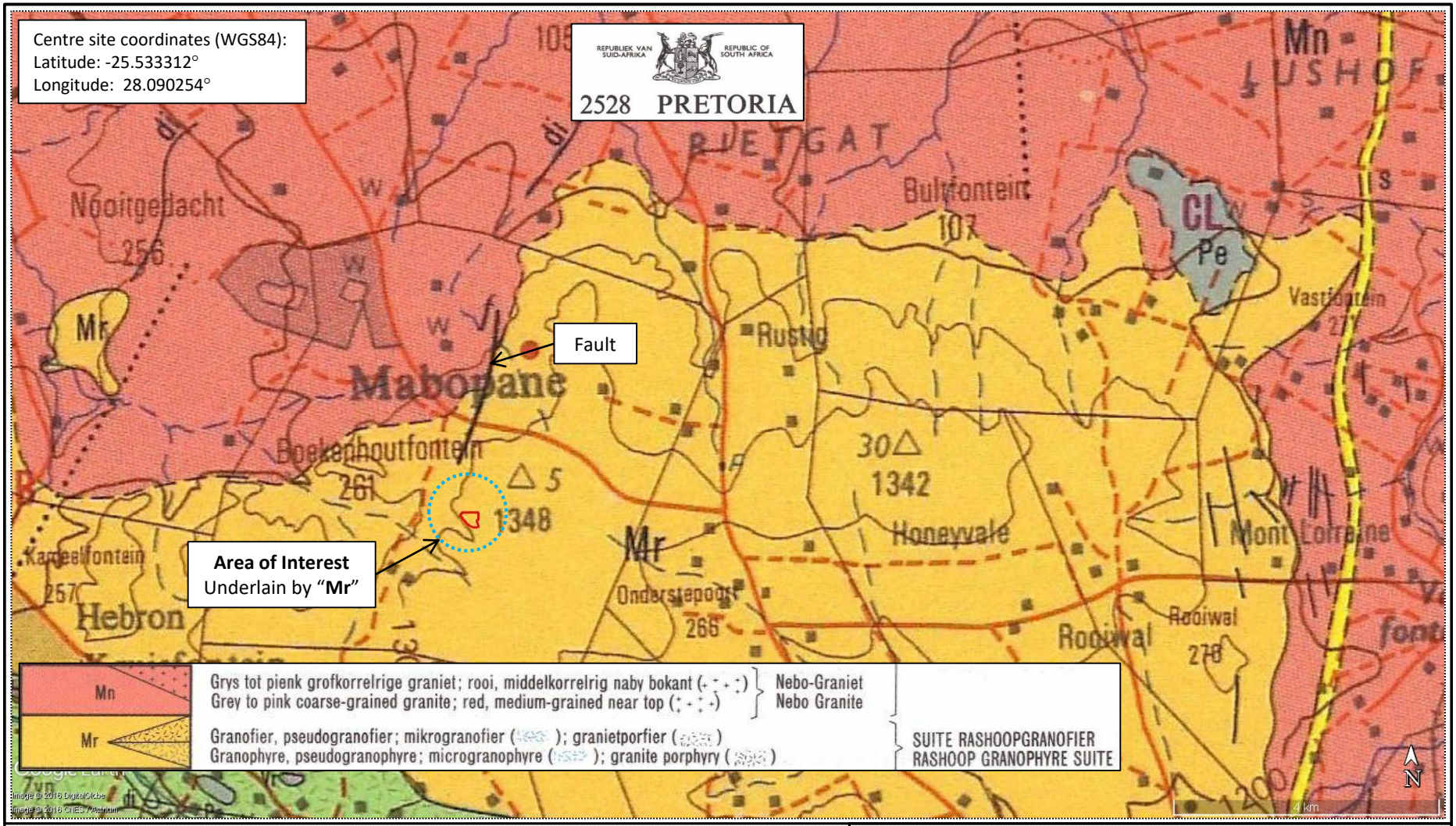

Project Description: Erf 1305 Soshanguve-M Gauteng Province
Investigation Type: Phase 1 Detailed Engineering Geological Investigation (SANS634:2012)
Figure 5: Regional Geological Map – 1:50 000-scale 2528 Pretoria

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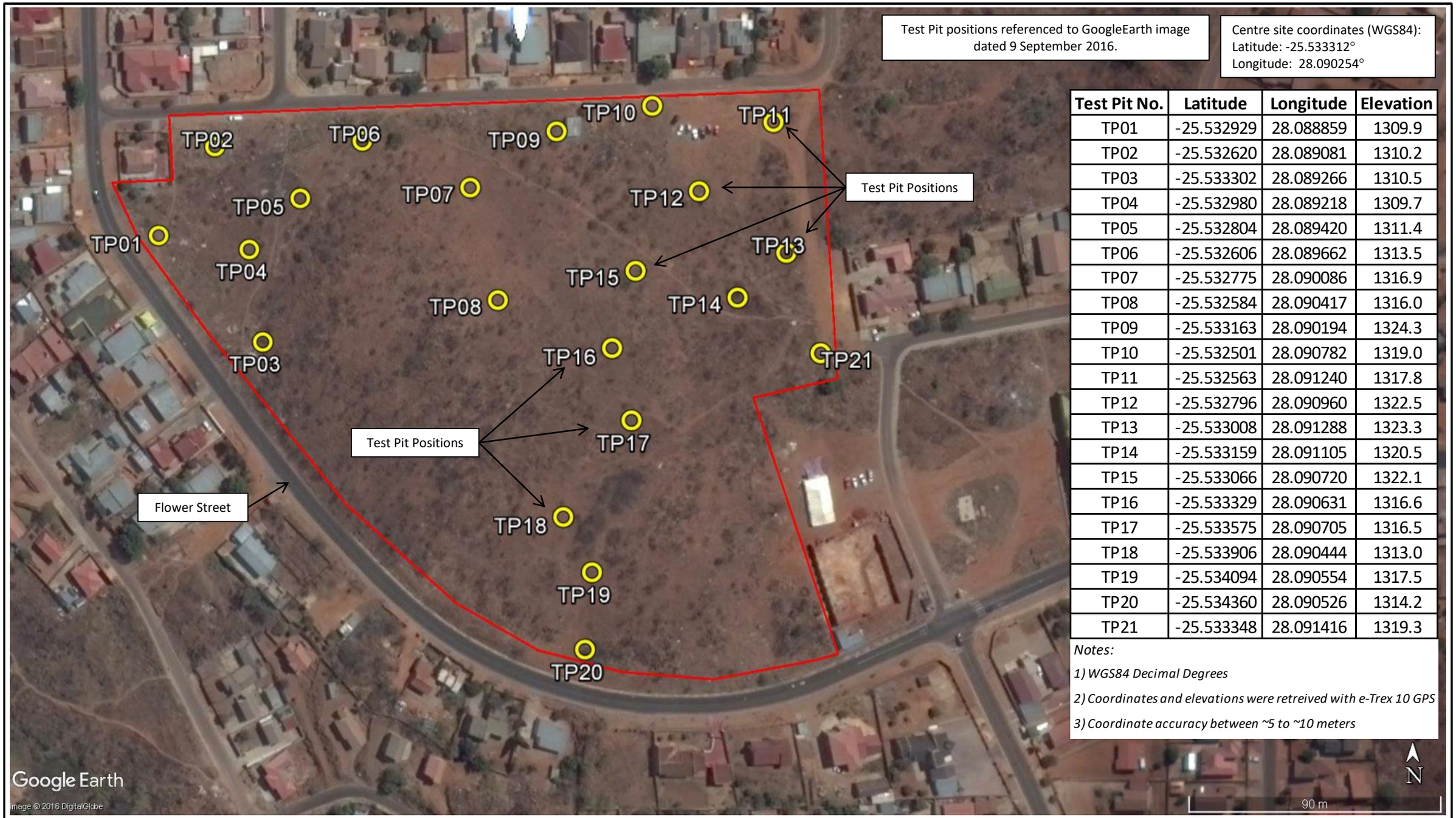
The Government Printer

Project no: RS17001



Test Pit No.	Latitude	Longitude	Elevation
TP01	-25.532929	28.088859	1309.9
TP02	-25.532620	28.089081	1310.2
TP03	-25.533302	28.089266	1310.5
TP04	-25.532980	28.089218	1309.7
TP05	-25.532804	28.089420	1311.4
TP06	-25.532606	28.089662	1313.5
TP07	-25.532775	28.090086	1316.9
TP08	-25.532584	28.090417	1316.0
TP09	-25.533163	28.090194	1324.3
TP10	-25.532501	28.090782	1319.0
TP11	-25.532563	28.091240	1317.8
TP12	-25.532796	28.090960	1322.5
TP13	-25.533008	28.091288	1323.3
TP14	-25.533159	28.091105	1320.5
TP15	-25.533066	28.090720	1322.1
TP16	-25.533329	28.090631	1316.6
TP17	-25.533575	28.090705	1316.5
TP18	-25.533906	28.090444	1313.0
TP19	-25.534094	28.090554	1317.5
TP20	-25.534360	28.090526	1314.2
TP21	-25.533348	28.091416	1319.3

Notes:

1) WGS84 Decimal Degrees

2) Coordinates and elevations were retreived with e-Trex 10 GPS

3) Coordinate accuracy between ~5 to ~10 meters

Project Description: Erf 1305 Soshanguve-M Gauteng Province

Investigation Type: Phase 1 Detailed Engineering Geological Investigation (SANS634:2012)

Figure 6: Test Pit Positions

Notes:

1) Test pit positions taken with hand-held GPS in clear-sky conditions with expected accuracy of between 5 to 10 m.

Project no: RS17001
Compiled by: RockSoil Consult (Pty) Ltd.
GoogleEarth image date: 9 September 2016
Date compiled: 2017-04-03
Drawing version: V1.0

Approved by: JI Roux

Project no: RS17001

ROCKSOIL CONSULT

Construction rubble and domestic waste material

Test Pit positions referenced to GoogleEarth image dated 9 September 2016.

Centre site coordinates (WGS84):
Latitude: -25.533312°
Longitude: 28.090254°

Outcrop

Localised outcrop and large boulders

Construction rubble and domestic waste material

Localised outcrop and large boulders

Large boulders

Construction rubble and domestic waste material

Outcrop and large boulders

Google Earth

image © 2016 DigitalGlobe

N

80 m

Project Description: Erf 1305 Soshanguve-M Gauteng Province

Investigation Type: Phase 1 Detailed Engineering Geological Investigation (SANS634:2012)

Figure 7: Outcrops with Large Boulders and Uncontrolled Fill Material Areas

Notes:

1) Preliminary zone boundaries that should be refined upon availability of site-specific survey and contour data.

Project no: RS17001
Compiled by: RockSoil Consult (Pty) Ltd.
GoogleEarth image date: 9 September 2016
Date compiled: 2017-04-03
Drawing version: V1.0

Approved by: JI Roux

Project no: RS17001

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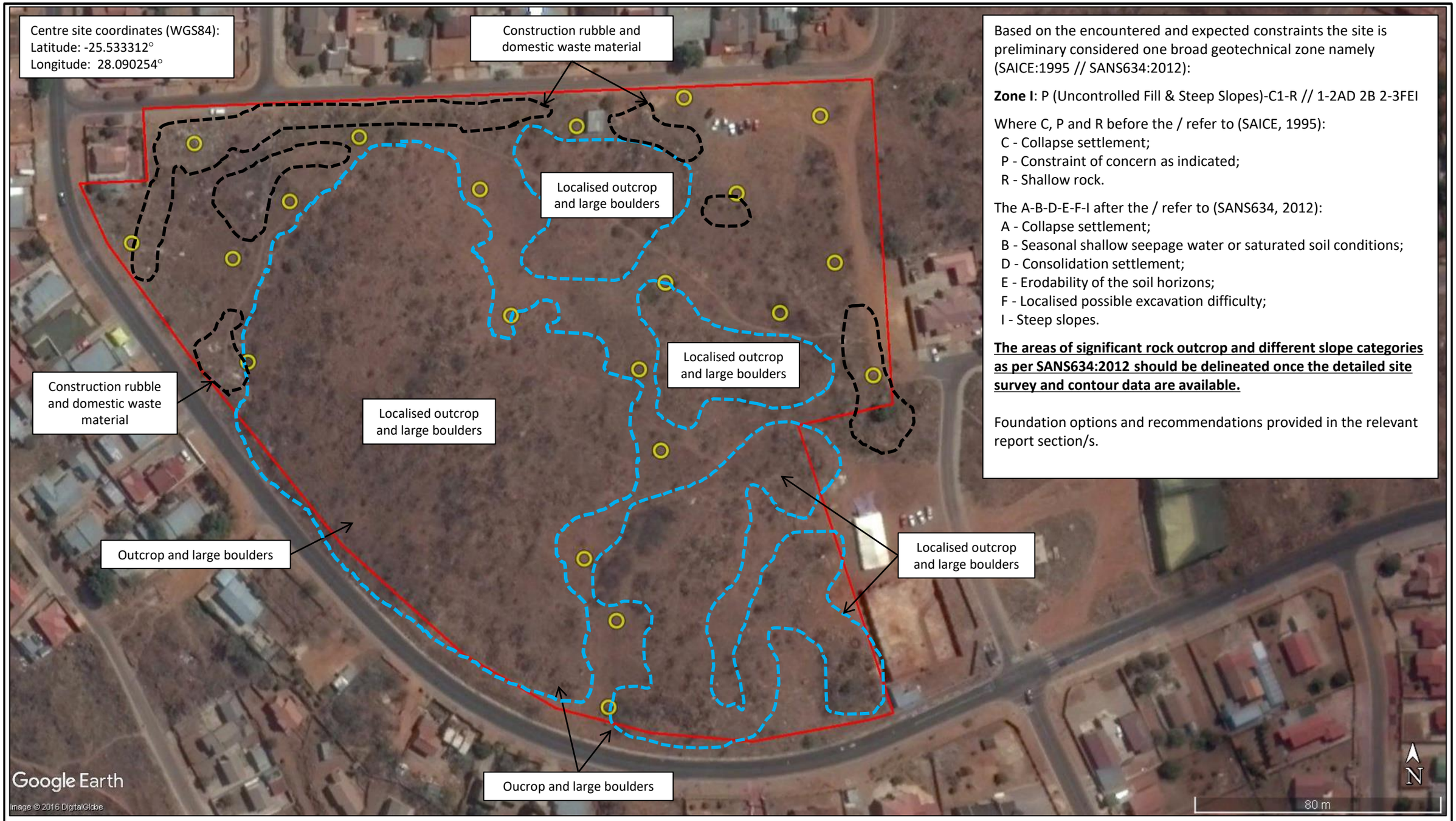

Based on the encountered and expected constraints the site is preliminary considered one broad geotechnical zone namely (SAICE:1995 // SANS634:2012):

Zone I: P (Uncontrolled Fill & Steep Slopes)-C1-R // 1-2AD 2B 2-3FEI

Where C, P and R before the / refer to (SAICE, 1995):
- C - Collapse settlement;
- P - Constraint of concern as indicated;
- R - Shallow rock.

The A-B-D-E-F-I after the / refer to (SANS634, 2012):
- A - Collapse settlement;
- B - Seasonal shallow seepage water or saturated soil conditions;
- D - Consolidation settlement;
- E - Erodability of the soil horizons;
- F - Localised possible excavation difficulty;
- I - Steep slopes.

The areas of significant rock outcrop and different slope categories as per SANS634:2012 should be delineated once the detailed site survey and contour data are available.

Foundation options and recommendations provided in the relevant report section/s.

Project Description: Erf 1305 Soshanguve-M Gauteng Province

Investigation Type: Phase 1 Detailed Engineering Geological Investigation (SANS634:2012)

Figure 8: Geotechnical Zonation

Notes:

1) Preliminary zone boundaries that should be refined upon availability of site-specific survey and contour data.

2) Slope categorization and areas of prominent rock outcrop should be defined upon availability of site-specific survey data.

Project no: RS17001
Compiled by: RockSoil Consult (Pty) Ltd.
GoogleEarth image date: 9 September 2016
Date compiled: 2017-04-03
Drawing version: V1.0

Approved by: JI Roux

Project no: RS17001

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APPENDIX B

(Soil Profile Descriptions)

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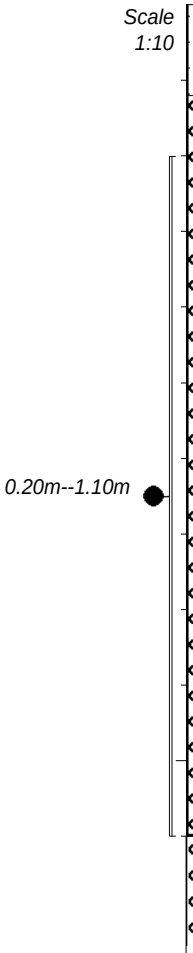
Govhani Student Accommodation
Erf 1305 Soshanguve-M Shallow Soil

HOLE No: TP01
Sheet 1 of 1

JOB NUMBER: RS17001



Slightly moist, dark brown speckled white and orange, medium dense to dense, **pinholed and voided**, clayey silty sandy GRAVEL with pinkish-brown to brown, angular to sub-angular granophyre gravel to cobbles and scattered domestic waste material. Interpreted as **TOPSOIL AND TALUS**. Termites and roots present. Undulating contact between horizons.

Dry to slightly moist, pinkish-brown to orange-brown speckled black to grey stained brown, **very closely to closely jointed and fractured**, completely to highly weathered granophyre with orange-brown, clayey silty fine SAND infilling between the joints. Interpreted as **COMPLETELY TO HIGHLY WEATHERED GRANOPHYRE** (ISRM 1981 class R0 to R1 extremely weak to very weak rock). Very few roots in joints.

Material properties:

USCS = SM, HRB class = A-1-b(0), Potential Expansiveness Rating = Low, Clay = 4%, Silt = 6%, Sand = 43%, Gravel = 47%, PI = SP, LL = 0, TRH14 class = G6, MDD =1 920 kgm3, Swell measured = 0.1%, OMC = 7.8%, CBR 93% Compaction Effort Mod.AASHTO = 23.

As above becoming more pinkish-brown and medium to highly weathered (ISRM 1981 class R1 to R2 very weak to weak rock)

NOTES

1) TLB refused at 1.10m.
2) No water seepage.
3) No sidewall instability.
4) Construction rubble and domestic waste in the vicinity of the test pit.
5) Intermediate excavatability conditions.
6) Disturbed sample taken from 0.20m--1.10m.

CONTRACTOR : Aganang Plant Hire
MACHINE : CAT 428F
DRILLED BY : RockSoil Consult (Pty) Ltd.
PROFILED BY : HG Human and JI Roux

INCLINATION : Vertical
DIAM : 600mm wide trench
DATE : 2017-01-26
DATE : 2017-01-26

ELEVATION :
X-COORD :
Y-COORD :

HOLE No: TP01

TYPE SET BY : JI Roux
SETUP FILE : STANDARD.SET

DATE : 05/04/2017 07:05
TEXT : ..0\Examples\RS17001SP.txt

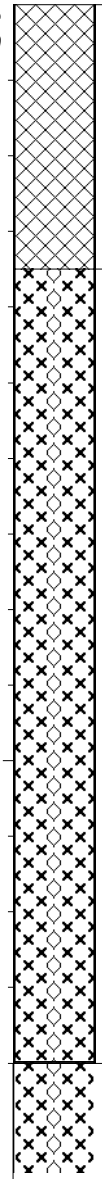
ROCKSOIL CONSULT

Govhani Student Accommodation
Erf 1305 Soshanguve-M Shallow Soil

HOLE No: TP02
Sheet 1 of 1

JOB NUMBER: RS17001

Scale 1:10



0.00 Slightly moist, dark brown speckled black, white and orange, loose to medium dense, **pinholed and open** clayey silty gravelly fine sand with abundant pinkish-orange to brown, angular to sub-angular granophyre gravel to small boulders with domestic waste and construction rubble. Interpreted as **FILL MATERIAL AND DOMESTIC WASTE**. Roots present. Undulating contact between horizons.

0.35 Dry to slightly moist, reddish-pink stained dark brown and pink, **very closely to closely jointed**, completely to medium weathered granophyre with slightly moist, dark brown to orange brown, clayey silty fine SAND infilling. Interpreted as **COMPLETELY TO MEDIUM WEATHERED GRANOPHYRE** (ISRM 1981 class R0 to R2 extremely weak to weak rock). Variable rock hardness in the horizon. Very few roots in joints.

1.40 As above becoming more pinkish-brown and medium to highly weathered (ISRM 1981 class R1 to R2 very weak to weak rock).

NOTES

1) TLB refused at 1.40m.
2) No water seepage.
3) No sidewall instability.
4) Abundant fill and domestic waste present in the vicinity.
5) Intermediate excavatability conditions.
6) No sample.

CONTRACTOR : Aganang Plant Hire
MACHINE : CAT 428F
DRILLED BY : RockSoil Consult (Pty) Ltd.
PROFILED BY : HG Human and JI Roux

INCLINATION :
DIAM : 600mm wide trench
DATE : 2017-01-26
DATE : 2017-01-26

ELEVATION :
X-COORD :
Y-COORD :

HOLE No: TP02

TYPE SET BY : JI Roux
SETUP FILE : STANDARD.SET

DATE : 05/04/2017 07:05
TEXT : ..0\Examples\RS17001SP.txt

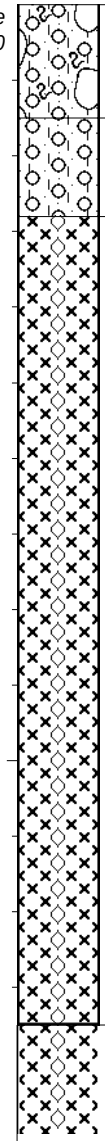
ROCKSOIL CONSULT

Govhani Student Accommodation
Erf 1305 Soshanguve-M Shallow Soil

HOLE No: TP03
Sheet 1 of 1

JOB NUMBER: RS17001

Scale 1:10



0.00 Slightly moist to moist, orange-brown, loose to medium dense, **pinholed and open** clayey silty fine sandy GRAVEL with abundant pinkish-brown to orange-brown, angular to sub-rounded granophyre gravel to boulders. Interpreted as **TOPSOIL AND TALUS**. Roots present. Undulating contact between horizons.

0.15 Slightly moist to moist, dark brown speckled white, medium dense, **highly pinholed and open** silty fine sandy GRAVEL with orange-brown to pinkish-brown, sub-angular to angular granophyre gravel to cobbles. Interpreted as **TALUS**. Abundant roots present. Undulating contact between horizons.

0.28 Dry to slightly moist, pinkish-brown to orange-brown speckled black to grey stained brown, **very closely to closely jointed and fractured**, completely to slightly weathered granophyre with dark brown, clayey silty fine SAND infilling between the joints. Interpreted as **MODERATELTLY TO COMPLETELY WEATHERED GRANOPHYRE** (ISRM 1981 class R0 to R2 extremely weak to weak rock). Very few roots in joints. Undulating zones of slightly weathered strong rock granophyre is also present in the sidewalls

1.35 As above becoming more pinkish-brown to reddish-pink, medium weathered (ISRM 1981 class R3 to R4 medium strong to strong rock).

NOTES

1) TLB refused at 1.35m.
2) No water seepage.
3) No sidewall instability.
4) Abundant domestic waste present in the vicinity of the test pit.
5) Intermediate to hard excavatability conditions.
6) Next to ridge.
7) Seemingly outcrop in the vicinity of the test pit.
8) No sample.

CONTRACTOR : Aganang Plant Hire
MACHINE : CAT 428F
DRILLED BY : RockSoil Consult (Pty) Ltd.
PROFILED BY : HG Human and Jl Roux

INCLINATION :
DIAM : 600mm wide trench
DATE : 2017-01-26
DATE : 2017-01-26

ELEVATION :
X-COORD :
Y-COORD :

HOLE No: TP03

TYPE SET BY : Jl Roux
SETUP FILE : STANDARD.SET

DATE : 05/04/2017 07:05
TEXT : ..0\Examples\RS17001SP.txt

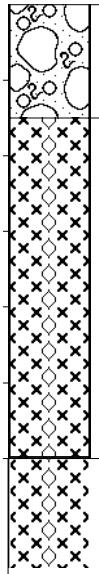
ROCKSOIL CONSULT

Govhani Student Accommodation
Erf 1305 Soshanguve-M Shallow Soil

HOLE No: TP04
Sheet 1 of 1

JOB NUMBER: RS17001

Scale 1:10



0.00 Slightly moist, dark brown speckled pink and white, medium dense, **pinholed and voided** clayey silty gravelly fine sand with abundant pinkish-orange to brown, angular to sub-angular granophyre gravel to boulders. Interpreted as **TOPSOIL AND TALUS**. Undulating bottom contact. Roots present.

0.15 Dry, pink speckled grey stained orange and brown, **closely jointed and fractured**, highly to medium weathered granophyre with dark brown, loose, clayey silty fine SAND infilling. Interpreted as **HIGHLY TO MEDIUM WEATHERED GRANOPHYRE** (ISRM 1981 class R1 to R3 very weak to medium strong rock). Very few roots in joints.

0.60 As above becoming more pinkish-brown to reddish-pink and medium weathered (ISRM 1981 class R3 to R4 medium strong to strong rock).

NOTES

1) TLB refused at 0.60m.
2) No water seepage.
3) No sidewall instability.
4) Construction rubble and domestic waste in the vicinity of the test pit.
5) Intermediate to hard excavatability conditions.
6) Boulders and outcrop in the vicinity of the test pit.
7) No sample.

CONTRACTOR : Aganang Plant Hire
MACHINE : CAT 428F
DRILLED BY : RockSoil Consult (Pty) Ltd.
PROFILED BY : HG Human and JI Roux

INCLINATION :
DIAM : 600mm wide trench
DATE : 2017-01-26
DATE : 2017-01-26

ELEVATION :
X-COORD :
Y-COORD :

HOLE No: TP04

TYPE SET BY : JI Roux
SETUP FILE : STANDARD.SET

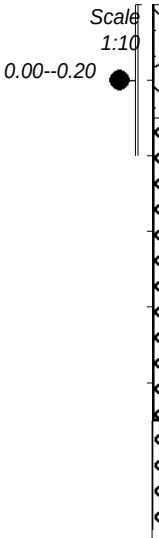
DATE : 05/04/2017 07:05
TEXT : ..0\Examples\RS17001SP.txt

ROCKSOIL CONSULT

Govhani Student Accommodation
Erf 1305 Soshanguve-M Shallow Soil

HOLE No: TP05
Sheet 1 of 1

JOB NUMBER: RS17001



0.00 Slightly moist, dark brown speckled pink and white, loose to medium dense, **pinholed and voided** clayey silty gravelly fine sand with abundant pinkish orange to brown, angular to sub-angular granophyre gravel to boulders. Interpreted as **TOPSOIL AND TALUS**. Roots and ants present.

0.15 Dry to slightly moist, pinkish-brown to orange-brown speckled black to grey stained brown, **closely jointed**, highly to medium weathered granophyre with slightly moist, dark brown, clayey silty fine SAND infilling between the joints. Interpreted as **HIGHLY TO MEDIUM WEATHERED GRANOPHYRE** (ISRM 1981 class R1 to R3 very weak to medium strong rock). Very few roots in joints. Ants present.

0.55 As above becoming more pinkish-brown to reddish-pink and medium to slightly weathered (ISRM 1981 class R3 to R4 medium strong to strong rock).

NOTES

1) TLB refused at 0.55m.
2) No water seepage.
3) No sidewall instability.
4) Construction rubble and domestic waste in the vicinity of the test pit.
5) Intermediate to hard excavatability conditions.
6) Outcrop and boulders up to 0.60m in the vicinity of the test pit.
7) Disturbed sample taken from 0.00--0.20 m.

CONTRACTOR : Aganang Plant Hire
MACHINE : CAT 428F
DRILLED BY : RockSoil Consult (Pty) Ltd.
PROFILED BY : HG Human and JI Roux

INCLINATION :
DIAM : 600mm wide trench
DATE : 2017-01-26
DATE : 2017-01-26

ELEVATION :
X-COORD :
Y-COORD :

HOLE No: TP05

TYPE SET BY : JI Roux
SETUP FILE : STANDARD.SET

DATE : 05/04/2017 07:05
TEXT : ..0\Examples\RS17001SP.txt

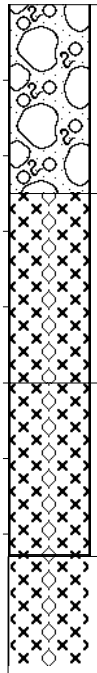
ROCKSOIL CONSULT

Govhani Student Accommodation
Erf 1305 Soshanguve-M Shallow Soil

HOLE No: TP06
Sheet 1 of 1

JOB NUMBER: RS17001

Scale 1:10



0.00 Slightly moist, dark brown speckled pink and white, loose to medium dense, **slightly pinholed** clayey silty gravelly fine sand with abundant pinkish-orange to brown, angular to sub-angular granophyre gravel to boulders an scattered domestic waste material. Interpreted as **TOPSOIL AND TALUS**. Fine roots and ants present.

0.25 Dry to slightly moist, pinkish-brown to orange-brown speckled black to grey stained brown, **very closely to closely jointed and fractured**, medium to highly weathered granophyre with slightly moist, dark brown, clayey silty fine SAND infilling between the joints. Interpreted as **MEDIUM TO HIGHLY WEATHERED GRANOPHYRE** (ISRM 1981 class R1 to R3 very weak to medium strong rock). Very few roots in joints.

0.50 Dry, pinkish-brown to orange-brown speckled black to grey stained brown, **closely jointed and fractured**, medium weathered granophyre. Interpreted as **MEDIUM WEATHERED GRANOPHYRE** (ISRM 1981 class R3 to R4 medium strong to strong rock).

0.73 As above becoming more pinkish-brown to reddish-pink and medium to slightly weathered (ISRM 1981 class R3 to R4 medium strong to strong rock).

NOTES

1) TLB refused at 0.73m.
2) No water seepage.
3) No sidewall instability.
4) Construction rubble and domestic waste in the vicinity of the test pit.
5) Intermediate to hard excavatability conditions.
6) Outcrop and boulders up to 1.0m in the vicinity of the test pit.
7) No sample.

CONTRACTOR : Aganang Plant Hire
MACHINE : CAT 428F
DRILLED BY : RockSoil Consult (Pty) Ltd.
PROFILED BY : HG Human and JI Roux

INCLINATION :
DIAM : 600mm wide trench
DATE : 2017-01-26
DATE : 2017-01-26

ELEVATION :
X-COORD :
Y-COORD :

HOLE No: TP06

TYPE SET BY : JI Roux
SETUP FILE : STANDARD.SET

DATE : 05/04/2017 07:05
TEXT : ..0\Examples\RS17001SP.txt

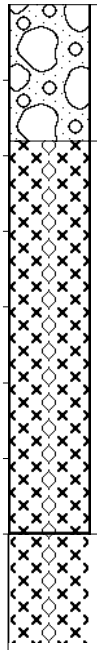
ROCKSOIL CONSULT

Govhani Student Accommodation
Erf 1305 Soshanguve-M Shallow Soil

HOLE No: TP07
Sheet 1 of 1

JOB NUMBER: RS17001

Scale 1:10



0.00 Dry to slightly moist, dark brown speckled pink and yellow, medium dense, **pinholed and open** clayey silty gravelly fine sand with abundant pinkish-orange to brown, angular to sub-angular granophyre gravel to boulders. Interpreted as **TOPSOIL AND TALUS**. Fine roots and ants present. Undulating contacts between horizons.

0.18 Dry to slightly moist, pinkish-brown to orange-brown speckled black to grey stained brown, **medium to closely jointed**, highly to medium weathered granophyre with dry, dark brown, clayey silty fine SAND infilling between the joints. Interpreted as **HIGHLY TO MEDIUM WEATHERED GRANOPHYRE** (ISRM 1981 class R1 to R3 very weak to medium strong rock). Slightly weathered strong rock granophyre is also present in the sidewalls. Very few roots in joints.

0.70 As above becoming more pinkish-brown to pink and medium weathered (ISRM 1981 class R3 to R4 medium strong to strong rock).

NOTES

1) TLB refused at 0.70m.
2) No water seepage.
3) No sidewall instability.
4) Outcrop and boulders up to 0.60m in the vicinity of the test pit.
5) Intermediate to hard excavatability conditions.
6) No sample.

CONTRACTOR : Aganang Plant Hire
MACHINE : CAT 428F
DRILLED BY : RockSoil Consult (Pty) Ltd.
PROFILED BY : HG Human and JI Roux

INCLINATION :
DIAM : 600mm wide trench
DATE : 2017-01-26
DATE : 2017-01-26

ELEVATION :
X-COORD :
Y-COORD :

HOLE No: TP07

TYPE SET BY : JI Roux
SETUP FILE : STANDARD.SET

DATE : 05/04/2017 07:05
TEXT : ..0\Examples\RS17001SP.txt

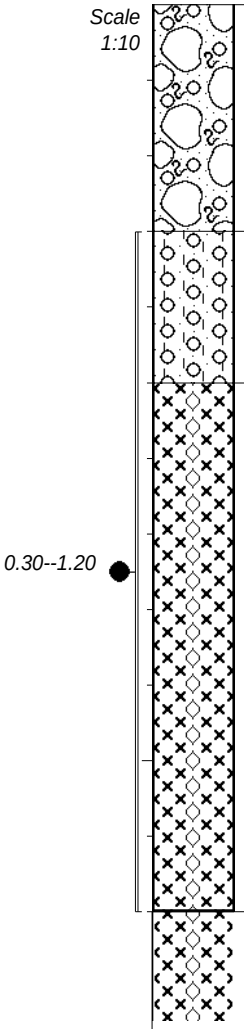
ROCKSOIL CONSULT

Govhani Student Accommodation
Erf 1305 Soshanguve-M Shallow Soil

HOLE No: TP08
Sheet 1 of 1

JOB NUMBER: RS17001

Scale 1:10



0.00

Slightly moist to moist, dark brown speckled pink and white, medium dense, **pinholed and voided**, clayey silty gravelly fine sand with abundant pinkish orange to brown, angular to sub-angular granophyre gravel to boulders. Interpreted as **TOPSOIL AND TALUS**. Fine roots and ants present. Undulating contact between horizons.

0.30

Moist, dark brown speckled orange and red, medium dense to dense, **open and voided in places**, clayey silty sandy GRAVEL with angular to sub-angular quartz and plagioclase fragments. Interpreted as **RESIDUAL TO COMPLETELY WEATHERED GRANOPHYRE**. Fine roots and termites present.

0.50

Dry to slightly moist, reddish-pink and whitish-pink stained brown and pink, **very closely to closely jointed**, highly to medium weathered granophyre with dry, dark brown, clayey silty fine SAND infilling between the joints. Interpreted as **HIGHLY TO MEDIUM WEATHERED GRANOPHYRE** (ISRM 1981 class R1 to R3 very weak to medium strong rock). Undulating bottom contact.

0.30--1.20

Material properties:

USCS = SM, HRB class = A-1-b(0), Potential Expansiveness Rating = Low, Clay = 4%, Silt = 8%, Sand = 46%, Gravel = 42%, PI = SP, LL = 0, TRH14 class = G5, MDD = 2 005kgm3, Swell measured = 0.1%, OMC = 9.1%, CBR 93% Compaction Effort Mod.AASHTO = 29.

1.20

As above becoming more pinkish-brown to pink and medium weathered (ISRM 1981 class R3 to R4 medium strong to strong rock).

NOTES

1) TLB refused at 1.20m.
2) No water seepage.
3) No sidewall instability.
4) Outcrop and boulders up to 1.20m in the vicinity of the test pit.
5) Intermediate to hard excavatability conditions.
6) Disturbed sample taken from 0.30--1.20 m.

CONTRACTOR : Aganang Plant Hire
MACHINE : CAT 428F
DRILLED BY : RockSoil Consult (Pty) Ltd.
PROFILED BY : HG Human and JI Roux

INCLINATION :
DIAM : 600mm wide trench
DATE : 2017-01-26
DATE : 2017-01-26

ELEVATION :
X-COORD :
Y-COORD :

TYPE SET BY : JI Roux
SETUP FILE : STANDARD.SET

DATE : 05/04/2017 07:05
TEXT : ..0\Examples\RS17001SP.txt

HOLE No: TP08

ROCKSOIL CONSULT

Govhani Student Accommodation
Erf 1305 Soshanguve-M Shallow Soil

HOLE No: TP09
Sheet 1 of 1

JOB NUMBER: RS17001

Scale 1:10

0.00

Pinkish-brown to orange-brown, medium to highly weathered granophyre cobbles to boulders set in a matrix of slightly moist to moist, dark brown speckled-pink and white, loose to medium dense, **pinholed and open**, clayey silty gravelly fine sand. Overall consistency of dense. Interpreted as **TOPSOIL AND TALUS**. Fine roots and ants present. Undulating contact between horizons.

0.55

0.55--0.80

Slightly moist, reddish-brown to orange-brown speckled grey to black, **very closely to closely jointed**, completely to highly weathered granophyre with slightly moist to moist, red to dark brown, clayey silty fine SAND infilling and residual partings between the joints. Interpreted as **COMPLETELY TO HIGHLY WEATHERED GRANOPHYRE**. (ISRM 1981 class R0 to R1 extremely weak to very weak rock). Very few roots in joints.

Material properties:

USCS = SC, HRB class = A-2-4(0), Potential Expansiveness Rating = Low, Clay = 6%, Silt = 9%, Sand = 40%, Gravel = 45%, PI = 9, LL = 27.

0.80

Refusal on pinkish-brown to pink and medium weathered (ISRM 1981 class R3 to R4 medium strong to strong rock).

NOTES

1) TLB refused at 0.80m.
2) No water seepage.
3) No sidewall instability.
4) Construction rubble and domestic waste in the vicinity of the test pit.
5) Outcrop and boulders up to 0.90m in the vicinity of the test pit.
6) Intermediate to hard excavatability conditions
7) Disturbed sample taken from 0.55--0.80 m.

CONTRACTOR : Aganang Plant Hire
MACHINE : CAT 428F
DRILLED BY : RockSoil Consult (Pty) Ltd.
PROFILED BY : HG Human and JI Roux

INCLINATION :
DIAM : 600mm wide trench
DATE : 2017-01-26
DATE : 2017-01-26

ELEVATION :
X-COORD :
Y-COORD :

TYPE SET BY : JI Roux
SETUP FILE : STANDARD.SET

DATE : 05/04/2017 07:05
TEXT : ..0\Examples\RS17001SP.txt

HOLE No: TP09

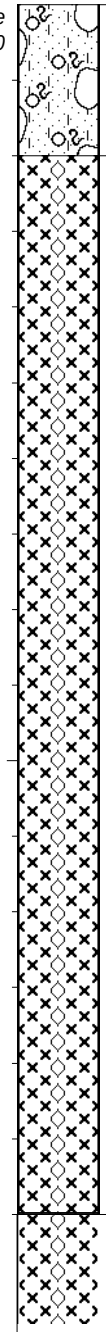
ROCKSOIL CONSULT

Govhani Student Accommodation
Erf 1305 Soshanguve-M Shallow Soil

HOLE No: TP10
Sheet 1 of 1

JOB NUMBER: RS17001

Scale 1:10



0.00

Dry to slightly moist, light brown, loose to medium dense, **pinholed**, clayey silty gravelly fine sand with abundant pinkish-brown, angular to sub-angular granophyre gravel to cobbles. Interpreted as **TOPSOIL and TALUS**. Roots and ants present. Undulating contact between horizons.

0.20

Dry to slightly moist, reddish-brown to pink-brown speckled black to grey, **very closely to closely jointed**, medium to completely weathered granophyre with slightly moist to moist, dark brown, clayey silty fine SAND infilling between the joints. Interpreted as **MEDIUM TO COMPLETELY WEATHERED GRANOPHYRE**. (ISRM 1981 class R0 to lower limit R3 extremely weak to medium strong rock). Very few roots in joints.

1.60

As above becoming more pinkish-brown to whitish-pink and medium to slightly weathered (ISRM 1981 class R3 to R4 medium strong to strong rock.

NOTES

1) TLB refused at 1.60m.
2) No water seepage.
3) No sidewall instability.
4) Intermediate to hard excavatability conditions.
5) No sample.

CONTRACTOR : Aganang Plant Hire
MACHINE : CAT 428F
DRILLED BY : RockSoil Consult (Pty) Ltd.
PROFILED BY : HG Human and JI Roux

INCLINATION :
DIAM : 600mm wide trench
DATE : 2017-01-26
DATE : 2017-01-26

ELEVATION :
X-COORD :
Y-COORD :

HOLE No: TP10

TYPE SET BY : JI Roux
SETUP FILE : STANDARD.SET

DATE : 05/04/2017 07:05
TEXT : ..0\Examples\RS17001SP.txt

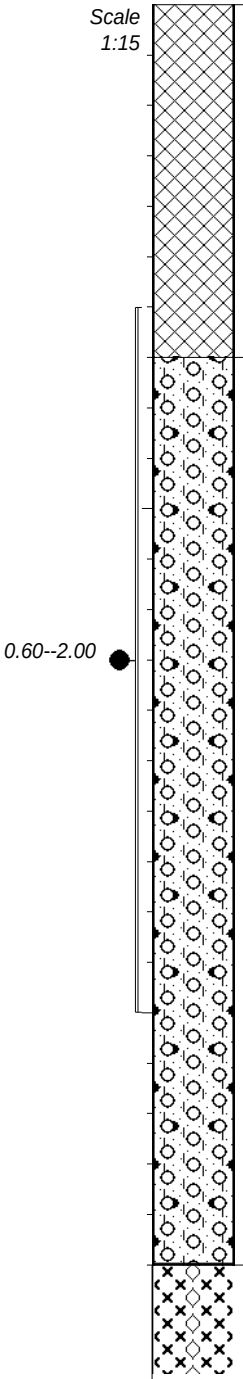
ROCKSOIL CONSULT

Govhani Student Accommodation
Erf 1305 Soshanguve-M Shallow Soil

HOLE No: TP11
Sheet 1 of 1

JOB NUMBER: RS17001

Scale 1:15



0.00 Slightly moist, reddish-brown to light brown speckled grey to orange, dense, **pinholed and open**, clayey silty fine sandy GRAVEL with sub-angular to rounded granophyre gravel of mixed origin and scattered domestic waste material. Interpreted as **IMPORTED FILL MATERIAL**. Fine roots present. Undulating contact between horizons.

0.70 Slightly moist to moist, reddish-brown to orange-brown speckled and streaked black and yellow, dense, **open and relict structured**, clayey silty gravelly sand with quartz and plagioclase gravel and weakly to medium cemented ferricrete. Interpreted as slightly ferruginised **RESIDUAL TO COMPLETELY WEATHERED GRANOPHYRE**. Occasional highly weathered granophyre partings present.

Material properties:

USCS = SC, HRB class = A-2-6(0), Potential Expansiveness Rating = Low, Clay = 8%, Silt = 7%, Sand = 54%, Gravel = 31%, PI = 13, LL = 32, TRH14 class = G7, MDD = 1 898kgm3, Swell measured = 0.1%, OMC = 10.3%, CBR 93% Compaction Effort Mod.AASHTO = 42.

0.60--2.00

2.50 Dry, reddish-brown to pink-brown speckled black to grey, **very closely to closely jointed**, medium weathered granophyre. Interpreted as **MEDIUM WEATHERED GRANOPHYRE**. (ISRM 1981 class R3 to R4 medium strong to strong rock). SA18]

NOTES

1) TLB refused at 2.50m.
2) No water seepage.
3) No sidewall instability.
4) Intermediate to hard excavatability conditions.
5) Disturbed sample taken from 0.60--2.00 m.

CONTRACTOR : Aganang Plant Hire
MACHINE : CAT 428F
DRILLED BY : RockSoil Consult (Pty) Ltd.
PROFILED BY : HG Human and JI Roux

INCLINATION :
DIAM : 600mm wide trench
DATE : 2017-01-26
DATE : 2017-01-26

ELEVATION :
X-COORD :
Y-COORD :

TYPE SET BY : JI Roux
SETUP FILE : STANDARD.SET

DATE : 05/04/2017 07:05
TEXT : ..0\Examples\RS17001SP.txt

HOLE No: TP11

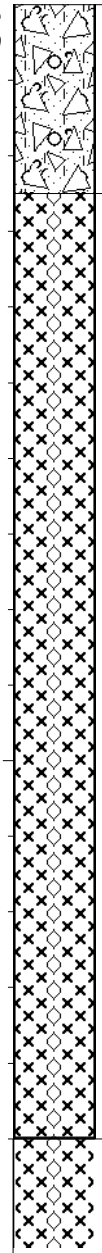
ROCKSOIL CONSULT

Govhani Student Accommodation
Erf 1305 Soshanguve-M Shallow Soil

HOLE No: TP12
Sheet 1 of 1

JOB NUMBER: RS17001

Scale 1:10



0.00 Slightly moist, light brown, loose to medium dense, **pinholed and open**, clayey silty gravelly sand with sub-angular to rounded granophyre gravel of mixed origin and scattered domestic waste material and construction rubble. Interpreted as **TALUS AND FILL MATERIAL**. Fine roots and termites present. Undulating contact between horizons.

0.25 Dry to slightly moist, reddish-brown to orange-brown speckled black, **very closely to closely jointed**, highly to medium weathered granophyre with dry, dark brown, clayey silty fine SAND infilling between the joints. Interpreted as **HIGHLY TO MEDIUM WEATHERED GRANOPHYRE** (ISRM 1981 class R1 to R3 very weak to medium strong rock). Localised areas slightly weathered strong rock granophyre. Undulating bottom contact.

1.50 As above becoming more pinkish-brown to pinkish-red and medium to slightly weathered (ISRM 1981 class R3 to R4 medium strong to strong rock).

NOTES

1) TLB refused at 1.50m.
2) No water seepage.
3) No sidewall instability.
4) Construction rubble and domestic waste in area.
5) Intermediate to hard excavatability conditions.
6) Boulders up to 0.50m in the vicinity of the test pit.
7) No sample.

CONTRACTOR : Aganang Plant Hire
MACHINE : CAT 428F
DRILLED BY : RockSoil Consult (Pty) Ltd.
PROFILED BY : HG Human and JI Roux

INCLINATION :
DIAM : 600mm wide trench
DATE : 2017-01-26
DATE : 2017-01-26

ELEVATION :
X-COORD :
Y-COORD :

HOLE No: TP12

TYPE SET BY : JI Roux
SETUP FILE : STANDARD.SET

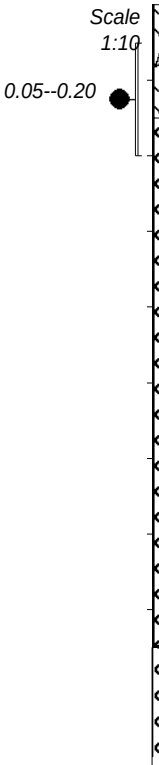
DATE : 05/04/2017 07:05
TEXT : ..0\Examples\RS17001SP.txt

ROCKSOIL CONSULT

Govhani Student Accommodation
Erf 1305 Soshanguve-M Shallow Soil

HOLE No: TP13
Sheet 1 of 1

JOB NUMBER: RS17001



0.00

Slightly moist to moist, light brown to brown, medium dense, **pinholed and open**, clayey silty gravelly fine sand with minor brown, angular to sub-angular granophyre gravel to cobbles. Interpreted as **TOPSOIL AND TALUS**. Roots and ants present. Undulating contact between horizons.

Material properties:

USCS = GM, HRB class = A-1-b(0), Potential Expansiveness Rating = Low, Clay = 3%, Silt = 6%, Sand = 35%, Gravel = 56%, PI = SP, LL = 0.

0.15

Dry to slightly moist, pinkish-brown to orange-brown speckled black, **very closely to closely jointed**, highly to medium weathered granophyre with moist, brown, clayey silty fine SAND infilling between the joints. Interpreted as **HIGHLY TO MEDIUM WEATHERED GRANOPHYRE** (ISRM 1981 class R1 to R3 very weak to medium strong rock). Localised areas slightly weathered strong rock granophyre. Undulating bottom contact.

0.85

As above becoming more pinkish-brown to pinkish-red and medium to slightly weathered (ISRM 1981 class R3 to R4 medium strong to strong rock).

NOTES

1) TLB refused at 0.85m.
2) No water seepage.
3) No sidewall instability.
4) Intermediate to hard excavatability conditions.
5) Small boulders in the vicinity of the test pit.
6) Disturbed sample taken from 0.05--0.20 m.

CONTRACTOR : Aganang Plant Hire
MACHINE : CAT 428F
DRILLED BY : RockSoil Consult (Pty) Ltd.
PROFILED BY : HG Human and JI Roux

INCLINATION :
DIAM : 600mm wide trench
DATE : 2017-01-26
DATE : 2017-01-26

ELEVATION :
X-COORD :
Y-COORD :

TYPE SET BY : JI Roux
SETUP FILE : STANDARD.SET

DATE : 05/04/2017 07:05
TEXT : ..0\Examples\RS17001SP.txt

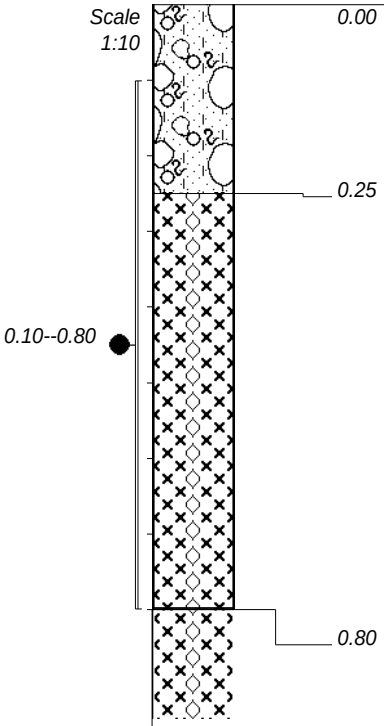
HOLE No: TP13

ROCKSOIL CONSULT

Govhani Student Accommodation
Erf 1305 Soshanguve-M Shallow Soil

HOLE No: TP14
Sheet 1 of 1

JOB NUMBER: RS17001



Dry to slightly moist, light brown to brown, loose to medium dense, **pinholed and open**, gravelly silty fine sand with minor brown, angular to sub-angular granophyre gravel to cobbles. Interpreted as **TOPSOIL AND TALUS**. Fine roots and ants present. Undulating contact between horizons.

Slightly moist, reddish-brown to orange-brown speckled black, **closely to very closely jointed and fractured**, completely to medium weathered granophyre with moist, red-brown, loose, clayey silty fine gravelly sand residual partings. Interpreted as highly undulating **COMPLETELY TO MEDIUM WEATHERED GRANOPHYRE** (ISRM 1981 class R0 to R3 lower limit extremely weak to medium strong rock). Very few roots in joints.

Material properties:

USCS = SM, HRB class = A-1-b(0), Potential Expansiveness Rating = Low, Clay = 4%, Silt = 5%, Sand = 44%, Gravel = 47%, PI = SP, LL = 0, TRH14 class = G5, MDD = 1 857kgm3, Swell measured = 0.0%, OMC = 13.3%, CBR 93% Compaction Effort Mod.AASHTO = 28.

As above becoming more pinkish-brown to pinkish-red and medium weathered (ISRM 1981 class R3 to R4 medium strong to strong rock).

NOTES

1) TLB refused at 0.80m.
2) No water seepage.
3) No sidewall instability.
4) Termite burrows and mounds present.
5) Outcrop and boulders up to 0.90m in the vicinity of the test pit.
6) Intermediate to hard excavatability conditions.
7) Disturbed sample taken from 0.10--0.80 m.

CONTRACTOR : Aganang Plant Hire
MACHINE : CAT 428F
DRILLED BY : RockSoil Consult (Pty) Ltd.
PROFILED BY : HG Human and JI Roux

INCLINATION :
DIAM : 600mm wide trench
DATE : 2017-01-26
DATE : 2017-01-26

ELEVATION :
X-COORD :
Y-COORD :

TYPE SET BY : JI Roux
SETUP FILE : STANDARD.SET

DATE : 05/04/2017 07:05
TEXT : ..0\Examples\RS17001SP.txt

HOLE No: TP14

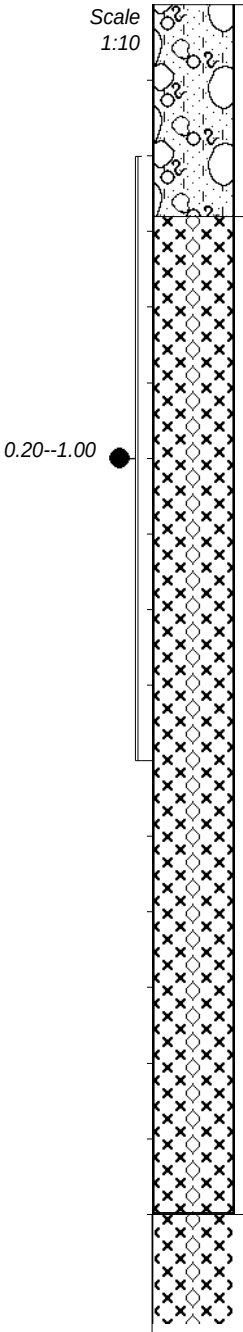
ROCKSOIL CONSULT

Govhani Student Accommodation
Erf 1305 Soshanguve-M Shallow Soil

HOLE No: TP15
Sheet 1 of 1

JOB NUMBER: RS17001

Scale 1:10



0.00

Slightly moist to moist, light brown to brown, loose to medium dense, **pinholed and open**, clayey silty gravelly fine sand with minor brown, angular to sub-angular granophyre gravel to cobbles. Interpreted as **TOPSOIL AND TALUS**. Roots and ants present. Undulating contact between horizons.

0.28

Slightly moist, reddish-brown to orange-brown speckled black, **closely to very closely jointed and fractured**, completely to medium weathered granophyre with moist, red-brown, loose, clayey silty fine gravelly sand residual partings. Interpreted as highly undulating **COMPLETELY TO MEDIUM WEATHERED GRANOPHYRE** (ISRM 1981 class R0 to R3 lower limit extremely weak to medium strong rock). Very few roots in joints.

1.60

As above becoming more pinkish-brown to pinkish-red and medium weathered (ISRM 1981 class R3 to R4 medium strong to strong rock).

NOTES

1) TLB refused at 1.60m.
2) No water seepage.
3) No sidewall instability.
4) Intermediate to hard excavatability conditions.
5) Outcrop and boulders up to 1.20m in the vicinity of the test pit.
6) Disturbed sample retrieved at 0.20--1.00 m.

CONTRACTOR : Aganang Plant Hire
MACHINE : CAT 428F
DRILLED BY : RockSoil Consult (Pty) Ltd.
PROFILED BY : HG Human and JI Roux

INCLINATION :
DIAM : 600mm wide trench
DATE : 2017-01-26
DATE : 2017-01-26

ELEVATION :
X-COORD :
Y-COORD :

TYPE SET BY : JI Roux
SETUP FILE : STANDARD.SET

DATE : 05/04/2017 07:05
TEXT : ..0\Examples\RS17001SP.txt

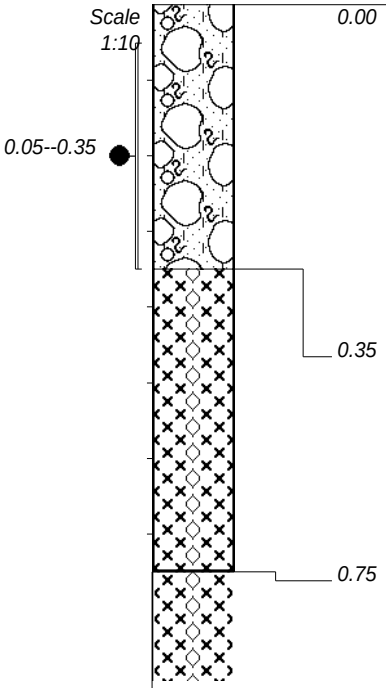
HOLE No: TP15

ROCKSOIL CONSULT

Govhani Student Accommodation
Erf 1305 Soshanguve-M Shallow Soil

HOLE No: TP16
Sheet 1 of 1

JOB NUMBER: RS17001



Slightly moist to moist, brown to light brown, loose to medium dense, **pinholed**, clayey gravelly silty fine sand with minor brown, angular to sub-angular granophyre gravel to boulders. Interpreted as **TOPSOIL AND TALUS**. Roots and ants present.

Material properties:
USCS = SM & SC, HRB class = A-2-4(0), Potential Expansiveness Rating = Low, Clay = 4%, Silt = 7%, Sand = 38%, Gravel = 51%, PI = 7, LL = 25, TRH14 class = G5, MDD = 1 840kgm3, Swell measured = 0.1%, OMC = 12.1%, CBR 93% Compaction Effort Mod.AASHTO = 39.

Dry to slightly moist, pinkish-brown to orange-brown speckled black and stained orange, **closely to very closely jointed**, medium to highly weathered granophyre with dry to slightly moist, dark brown, clayey silty fine SAND infilling between the joints. Interpreted as **MEDIUM TO HIGHLY WEATHERED GRANOPHYRE** (ISRM 1981 class R1 to R3 very weak to medium strong rock). Very few roots in joints.

As above becoming more pinkish-brown to pinkish-red and medium to slightly weathered (ISRM 1981 class R3 to R4 medium strong to strong rock).

NOTES

1) TLB refused at 0.75m.
2) No water seepage.
3) No sidewall instability.
4) Intermediate to hard excavatability conditions.
5) Outcrop in vicinity of the test pit.
6) Disturbed sample taken from 0.05--0.35 m.

CONTRACTOR : Aganang Plant Hire
MACHINE : CAT 428F
DRILLED BY : RockSoil Consult (Pty) Ltd.
PROFILED BY : HG Human and JI Roux

INCLINATION :
DIAM : 600mm wide trench
DATE : 2017-01-26
DATE : 2017-01-26

ELEVATION :
X-COORD :
Y-COORD :

HOLE No: TP16

TYPE SET BY : JI Roux
SETUP FILE : STANDARD.SET

DATE : 05/04/2017 07:05
TEXT : ..0\Examples\RS17001SP.txt

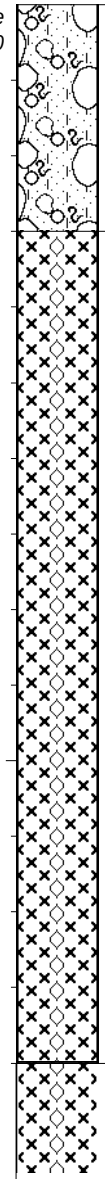
ROCKSOIL CONSULT

Govhani Student Accommodation
Erf 1305 Soshanguve-M Shallow Soil

HOLE No: TP17
Sheet 1 of 1

JOB NUMBER: RS17001

Scale 1:10



0.00

Slightly moist, dark brown to brown, loose to medium dense, **pinholed and open**, silty gravelly fine sand with minor brown, angular to sub-angular granophyre gravel to cobbles. Interpreted as **TOPSOIL AND TALUS**. Roots present. Undulating contact between horizons.

0.30

Dry to slightly moist, pinkish-brown to orange-brown speckled black to grey stained brown, **extremely closely to closely jointed and fractured**, medium to highly weathered granophyre with dry to slightly moist, dark brown, clayey silty fine SAND infilling between the joints. Interpreted as **MEDIUM TO HIGHLY WEATHERED GRANOPHYRE** (ISRM 1981 class R1 to R3 very weak to medium strong rock). Very few roots in joints.

1.40

As above becoming more pinkish-brown to pinkish-red and medium to slightly weathered (ISRM 1981 class R3 to R4 medium strong to strong rock).

NOTES

1) TLB refused at 1.40m.
2) No water seepage.
3) No sidewall instability.
4) Intermediate to hard excavatability conditions.
5) Outcrop and boulders up to 0.90m in the vicinity of the test pit.
6) No sample.

CONTRACTOR : Aganang Plant Hire
MACHINE : CAT 428F
DRILLED BY : RockSoil Consult (Pty) Ltd.
PROFILED BY : HG Human and JI Roux

INCLINATION :
DIAM : 600mm wide trench
DATE : 2017-01-26
DATE : 2017-01-26

ELEVATION :
X-COORD :
Y-COORD :

HOLE No: TP17

TYPE SET BY : JI Roux
SETUP FILE : STANDARD.SET

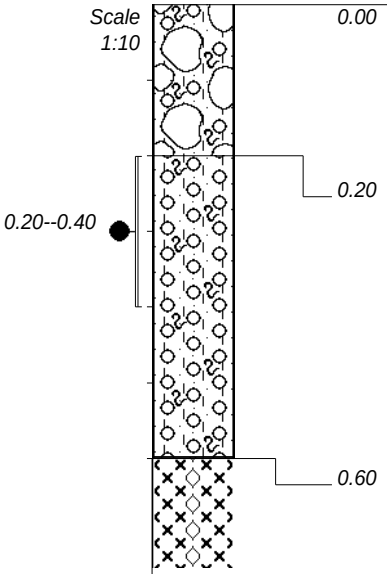
DATE : 05/04/2017 07:05
TEXT : ..0\Examples\RS17001SP.txt

ROCKSOIL CONSULT

Govhani Student Accommodation
Erf 1305 Soshanguve-M Shallow Soil

HOLE No: TP18
Sheet 1 of 1

JOB NUMBER: RS17001



Dry to slightly moist, dark brown to brown, loose to medium dense, **voided**, silty fine sandy gravel with abundant brown, angular to sub-angular granophyre gravel to small boulders (<30cm). Undulating Interpreted as **TOPSOIL AND TALUS**. Roots present. Undulating contact between horizons.

Slightly moist to moist, red-brown speckled orange and grey, medium dense, **pinholed and open** clayey silty sandy GRAVEL with angular to sub-angular quartz and plagioclase gravel. Interpreted as **REWORKED RESIDUAL GRANOPHYRE**. Scattered roots.

Material properties:

USCS = SM, HRB class = A-2-4(0), Potential Expansiveness Rating = Low, Clay = 6%, Silt = 13%, Sand = 69%, Gravel = 11%, PI = NP, LL = 0.

Dry, pinkish-brown to orange-brown speckled black to grey stained brown, **closely jointed and fractured**, slightly to medium weathered granophyre. Interpreted as **SLIGHTLY TO MEDIUM WEATHERED GRANOPHYRE** (ISRM 1981 class R3 to R4 medium strong to strong rock).

NOTES

1) TLB refused at 0.60m.
2) No water seepage.
3) No sidewall instability.
4) Intermediate to hard excavatability conditions.
5) Outcrop and boulders up to 0.50m in the vicinity of the test pit.
6) Disturbed sample taken from 0.20--0.40 m.

CONTRACTOR : Aganang Plant Hire
MACHINE : CAT 428F
DRILLED BY : RockSoil Consult (Pty) Ltd.
PROFILED BY : HG Human and JI Roux

INCLINATION :
DIAM : 600mm wide trench
DATE : 2017-01-26
DATE : 2017-01-26

ELEVATION :
X-COORD :
Y-COORD :

HOLE No: TP18

TYPE SET BY : JI Roux
SETUP FILE : STANDARD.SET

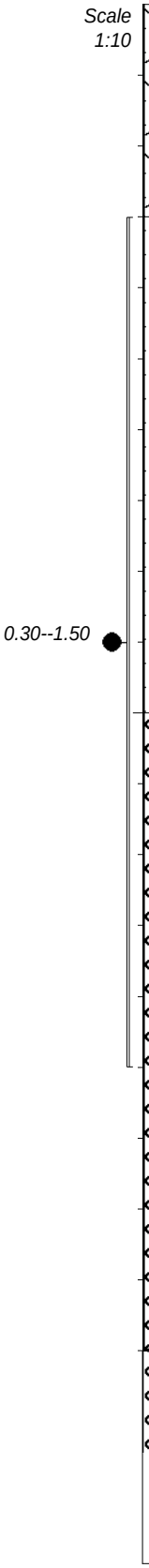
DATE : 05/04/2017 07:05
TEXT : ..0\Examples\RS17001SP.txt

ROCKSOIL CONSULT

Govhani Student Accommodation
Erf 1305 Soshanguve-M Shallow Soil

HOLE No: TP19
Sheet 1 of 1

JOB NUMBER: RS17001



0.00

Slightly moist, light brown to brown, loose to medium dense, **pinholed and open**, clayey silty gravelly fine sand with minor brown, angular to sub-angular granophyre gravel to small boulders. Interpreted as **TOPSOIL AND TALUS**. Roots and ants present. Undulating contact between horizons.

0.30

Dry to slightly moist, reddish-brown to orange-brown speckled black and white, dense, **open and relict structured**, clayey silty sandy gravel. Interpreted as **RESIDUAL TO COMPLETELY WEATHERED GRANOPHYRE**. Occasional highly weathered granophyre partings present.

Material properties:

USCS = SC, HRB class = A-2-4(0), Potential Expansiveness Rating = Low, Clay = 8%, Silt = 9%, Sand = 59%, Gravel = 24%, PI = 9, LL = 25.

1.00

Dry, reddish-brown to orange-brown speckled black and white stained brown, **very closely jointed and fractured**, completely to highly weathered granophyre. Interpreted as **COMPLETELY TO HIGHLY WEATHERED GRANOPHYRE** (ISRM 1981 class R0 to R1 extremely weak to lower limit very weak rock).

Material properties:

USCS = SC, HRB class = A-2-4(0), Potential Expansiveness Rating = Low, Clay = 8%, Silt = 9%, Sand = 59%, Gravel = 24%, PI = 9, LL = 25.

1.90

As above becoming more pinkish-brown and medium weathered (ISRM 1981 class R3 to R4 medium strong to strong rock).

NOTES

1) TLB refused at 1.90m.
2) No water seepage.
3) No sidewall instability.
4) Intermediate to hard excavatability conditions.
5) Outcrop and boulders in the vicinity of the test pit.
6) Disturbed sample taken from 0.30--1.50 m.

CONTRACTOR : Aganang Plant Hire
MACHINE : CAT 428F
DRILLED BY : RockSoil Consult (Pty) Ltd.
PROFILED BY : HG Human and JI Roux

INCLINATION :
DIAM : 600mm wide trench
DATE : 2017-01-26
DATE : 2017-01-26

ELEVATION :
X-COORD :
Y-COORD :

HOLE No: TP19

TYPE SET BY : JI Roux
SETUP FILE : STANDARD.SET

DATE : 05/04/2017 07:05
TEXT : ..0\Examples\RS17001SP.txt

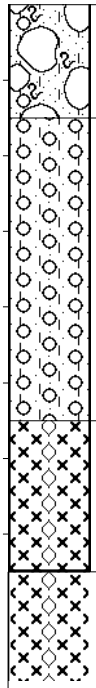
ROCKSOIL CONSULT

Govhani Student Accommodation
Erf 1305 Soshanguve-M Shallow Soil

HOLE No: TP20
Sheet 1 of 1

JOB NUMBER: RS17001

Scale 1:10



0.00 Slightly moist to moist, light brown to brown, loose to medium dense, **pinholed and open**, clayey silty gravelly fine sand with minor brown, angular to sub-angular granophyre gravel to boulders. Interpreted as **TOPSOIL AND TALUS**. Roots and ants present. Undulating contact between horizons.

0.15 Dry to slightly moist, reddish-brown to orange-brown speckled black and white, dense, **open and relict structured**, clayey silty sandy gravel. Interpreted as **RESIDUAL TO COMPLETELY WEATHERED GRANOPHYRE**. Occasional highly weathered granophyre partings present.

0.55 Dry, pinkish-brown to orange-brown speckled black and white stained brown, **very closely to closely jointed and fractured**, medium to slightly weathered granophyre. Interpreted as **MEDIUM TO SLIGHTLY WEATHERED GRANOPHYRE** (ISRM 1981 class R3 to R5 medium strong to lower limit very strong rock).

0.75 As above.

NOTES

1) TLB refused at 0.75m.
2) No water seepage.
3) No sidewall instability.
4) Intermediate to hard excavatability conditions.
5) Outcrop and boulders up to 2m in diameter in the vicinity of the test pit.
6) No sample.

CONTRACTOR : Aganang Plant Hire
MACHINE : CAT 428F
DRILLED BY : RockSoil Consult (Pty) Ltd.
PROFILED BY : HG Human and JI Roux

INCLINATION :
DIAM : 600mm wide trench
DATE : 2017-01-26
DATE : 2017-01-26

ELEVATION :
X-COORD :
Y-COORD :

HOLE No: TP20

TYPE SET BY : JI Roux
SETUP FILE : STANDARD.SET

DATE : 05/04/2017 07:05
TEXT : ..0\Examples\RS17001SP.txt

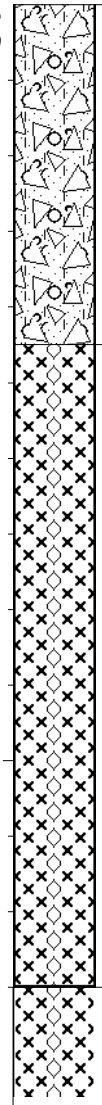
ROCKSOIL CONSULT

Govhani Student Accommodation
Erf 1305 Soshanguve-M Shallow Soil

HOLE No: TP21
Sheet 1 of 1

JOB NUMBER: RS17001

Scale 1:10



0.00

Slightly moist to moist, orange brown to brown speckled grey to yellow, medium dense, **pinholed and open**, clayey silty gravelly sand with sub-angular to rounded granophyre gravel to cobbles of mixed origin and scattered domestic waste material and construction rubble. Interpreted as **TALUS AND FILL MATERIAL**. Fine roots and termites present. Undulating contact between horizons.

0.45

Dry to slightly moist, reddish-brown to orange-brown speckled black, **very closely to closely jointed**, highly to medium weathered granophyre with dry, dark brown, clayey silty fine SAND infilling between the joints. Interpreted as **HIGHLY TO MEDIUM WEATHERED GRANOPHYRE** (ISRM 1981 class R1 to R3 very weak to medium strong rock). Undulating bottom contact.

1.30

As above becoming more pinkish-brown to pinkish-red and medium to slightly weathered (ISRM 1981 class R3 to R4 medium strong to strong rock).

NOTES

1) TLB refused at 1.30m.
2) No water seepage.
3) No sidewall instability.
4) Construction rubble and domestic waste in area.
5) Intermediate to hard excavatability conditions.
6) Boulders and outcrop in the vicinity of the test pit.
7) No sample.

CONTRACTOR : Aganang Plant Hire
MACHINE : CAT 428F
DRILLED BY : RockSoil Consult (Pty) Ltd.
PROFILED BY : HG Human and JI Roux

INCLINATION :
DIAM : 600mm wide trench
DATE : 2017-01-26
DATE : 2017-01-26

ELEVATION :
X-COORD :
Y-COORD :

HOLE No: TP21

TYPE SET BY : JI Roux
SETUP FILE : STANDARD.SET

DATE : 05/04/2017 07:05
TEXT : ..0\Examples\RS17001SP.txt

ROCKSOIL CONSULT

Govhani Student Accommodation
Erf 1305 Soshanguve-M Shallow Soil

LEGEND
Sheet 1 of 1

JOB NUMBER: RS17001

	BOULDERS	{SA01}
	SCATTERED BOULDERS/occasional boulders	{SA48}
	GRAVEL	{SA02}
	GRAVELLY	{SA03}
	SAND	{SA04}
	SANDY	{SA05}
	SILTY	{SA07}
	HYPABYSSAL/anorthosite/syenite aplite	{SA18}
	FREE QUARTZ/visible quartz	{SA44}
	SPARSE FERRICRETE NODULES/occasional ferricrete nodu....	{SA25}
	RUBBLE	{SA31}
	FILL	{SA32}
Name	DISTURBED SAMPLE	{SA38}
	ROOTS	{SA40}
	COBBLES	{SA58}

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY :

INCLINATION :
DIAM :
DATE :
DATE :

ELEVATION :
X-COORD :
Y-COORD :

LEGEND
SUMMARY OF SYMBOLS

TYPE SET BY : JI Roux
SETUP FILE : STANDARD.SET

DATE : 05/04/2017 07:05
TEXT : ..0\Examples\RS17001SP.txt

APPENDIX C

(Soil Profile and General Photographs)

Project reference number: RS17001
Project name: Phase 1 Geotech - Soshanguve Shallow Soil

Test Pit no: TP01  Notes: Profile down to 1.10 mbgl.	Test Pit no: TP01  Notes: Topsoil and talus material.
Test Pit no: TP01  Notes: Jointed completely to highly weathered granophyre.	Test Pit no: TP01  Notes: Scattered surficial domestic waste material.

Project reference number: RS17001
Project name: Phase 1 Geotech - Soshanguve Shallow Soil

Test Pit no: TP02  Notes: Profile down to 1.40 mbgl.	Test Pit no: TP02  Notes: Upper uncontrolled construction rubble and domestic waste material.
Test Pit no: TP02  Notes: Completely weathered granophyre.	Test Pit no: TP02  Notes: Mediumweathered granophyre.

Project reference number: RS17001
Project name: Phase 1 Geotech - Soshanguve Shallow Soil

Test Pit no: TP03

Notes: Profile down to 1.35 mbgl.

Test Pit no: TP03

Notes: Scattered cobbles to small boulders in upper transported material.

Test Pit no: TP03

Notes: Pinholed and open structured upper topsoil and talus horizon.

Test Pit no: TP03

Notes: Undulating completely to medium weathered granophyre zones.

Project reference number: RS17001
Project name: Phase 1 Geotech - Soshanguve Shallow Soil

ROCKSOIL CONSULT

Test Pit no: TP04

Notes: Profile down to 0.60 mbgl.

Test Pit no: TP04

Notes: Upper clayey silty gravelly fine sand topsoil and talus.

Test Pit no: TP04

Notes: Open structured upper soil.

Test Pit no: TP04

Notes: Jointed and fracture highly to medium weathered granophyre.

Project reference number: RS17001
Project name: Phase 1 Geotech - Soshanguve Shallow Soil

Test Pit no: TP05

Notes: Profile down to 0.55 mbgl.

Test Pit no: TP05

Notes: Refusal on slightly to medium weathered granophyre.

Test Pit no: TP05

Notes: Fractured highly to medium weathered granophyre.

Test Pit no: TP05

Notes: Medium weathered granophyre.

Project reference number: RS17001
Project name: Phase 1 Geotech - Soshanguve Shallow Soil

Test Pit no: TP06  Notes: Profile down to 0.73 mbgl.	Test Pit no: TP06  Notes: Very closely jointed and fractured medium to highly weathered granophyre.
Test Pit no: TP06  Notes: Slightly weathered granophyre.	Test Pit no: TP06  Notes: Refusal on medium strong to strong rock.

Project reference number: RS17001
Project name: Phase 1 Geotech - Soshanguve Shallow Soil

Test Pit no: TP07	Test Pit no: TP07
	
Notes: Profile down to 0.70 mbgl.	Notes: Completely weathered granophyre.
Test Pit no: TP07	Test Pit no: TP07
	
Notes: Slightly weathered strong rock granophyre (IRSM1981 class R4).	Notes: Highly to medium weathered granophyre material.

Project reference number: RS17001
Project name: Phase 1 Geotech - Soshanguve Shallow Soil

Test Pit no: TP08

Notes: Profile down to 1.20 mbgl.

Test Pit no: TP08

Notes: Termite burrows in the upper topsoil and talus horizon.

Test Pit no: TP08

Notes: Residual to completely weathered granophyre horizon.

Test Pit no: TP08

Notes: Medium strong moderately weathered granophyre.

Project reference number: RS17001
Project name: Phase 1 Geotech - Soshanguve Shallow Soil

Test Pit no: TP09	Test Pit no: TP09
	
Notes: Profile down to 0.80 mbgl.	Notes: Open structured upper clayey silty gravelly fine sand soil.
Test Pit no: TP09	Test Pit no: TP09
	
Notes: Boulders in topsoil and talus horizon.	Notes: Gravelly clayey silty sandy residual granophyre material.

Project reference number: RS17001
Project name: Phase 1 Geotech - Soshanguve Shallow Soil

Test Pit no: TP10

Notes: Profile down to 1.60 mbgl.

Test Pit no: TP10

Notes: Closely to very closely jointed and fractured granophyre.

Test Pit no: TP10

Notes: Medium weathered granophyre.

Test Pit no: TP10

Notes: Refusal on medium to slightly weathered granophyre.

Project reference number: RS17001
Project name: Phase 1 Geotech - Soshanguve Shallow Soil

Test Pit no: TP11  Notes: Profile down to 2.50 mbgl.	Test Pit no: TP11  Notes: Imported residual to completely weathered granophyre material.
Test Pit no: TP11  Notes: Weakly to moderately cemented ferricrete concretions.	Test Pit no: TP11  Notes: Refusal on medium weathered granophyre.

Project reference number: RS17001
Project name: Phase 1 Geotech - Soshanguve Shallow Soil

Test Pit no: TP12

Notes: Profile down to 1.50 mbgl.

Test Pit no: TP12

Notes: Construction rubble material.

Test Pit no: TP12

Notes: Very closely to closely jointed and fractured granophyre.

Test Pit no: TP12

Notes: Medium strong granophyre rock.

Project reference number: RS17001
Project name: Phase 1 Geotech - Soshanguve Shallow Soil

ROCKSOIL CONSULT

Test Pit no: TP13

Notes: Profile down to 0.85 mbgl.

Test Pit no: TP13

Notes: Pinholed an open structured clayey silty gravelly sandy soil.

Test Pit no: TP13

Notes: Highly weathered granophyre.

Test Pit no: TP13

Notes: Highly to medium weathered granophyre material excavated.

Project reference number: RS17001
Project name: Phase 1 Geotech - Soshanguve Shallow Soil

Test Pit no: TP14  Notes: Profile down to 0.80mbgl.	Test Pit no: TP14  Notes: Highly to medium weathered granophyre material excavated.
Test Pit no: TP15  Notes: Profile down to 1.60 mbgl.	Test Pit no: TP15  Notes: Very closely to closely jointed and fractured granophyre.

Project reference number: RS17001
Project name: Phase 1 Geotech - Soshanguve Shallow Soil

Test Pit no: TP15

Notes: Highly weathered granophyre.

Test Pit no: TP16

Notes: Profile down to 0.75 mbgl.

Test Pit no: TP16

Notes: Topsoil material.

Test Pit no: TP16

Notes: Outcrop next to test pit.

Project reference number: RS17001
Project name: Phase 1 Geotech - Soshanguve Shallow Soil

Test Pit no: TP17

Notes: Profile down to 1.40 mbgl.

Test Pit no: TP17

Notes: Silty gravelly sandy upper soil.

Test Pit no: TP17

Notes: Jointed and fractured granophyre.

Test Pit no: TP17

Notes: Highly to medium weathered granophyre material excavated.

Project reference number: RS17001
Project name: Phase 1 Geotech - Soshanguve Shallow Soil

Test Pit no: TP18

Notes: Profile down to 0.60 mbgl.

Test Pit no: TP18

Notes: Abundant roots.

Test Pit no: TP18

Notes: Reworked residual granophyre.

Test Pit no: TP18

Notes: Clayey silty sandy gravel reworked residual granophyre.

Project reference number: RS17001
Project name: Phase 1 Geotech - Soshanguve Shallow Soil

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Test Pit no: TP19

Notes: Profile down to 1.90 mbgl.

Test Pit no: TP19

Notes: Residual to completely weathered granophyre.

Test Pit no: TP20

Notes: Profile down to 0.75 mbgl.

Test Pit no: TP20

Notes: Abundant large boulders near the test pit.

Project reference number: RS17001
Project name: Phase 1 Geotech - Soshanguve Shallow Soil

Test Pit no: TP20  Notes: Medium weathered granophyre.	Test Pit no: TP20  Notes: Refusal on slightly weathered granophyre.
Test Pit no: TP21  Notes: Profile down to 1.30 mbgl.	Test Pit no: TP21  Notes: Scattered domestic waste.

Project reference number: RS17001
Project name: Phase 1 Geotech - Soshanguve Shallow Soil

Site Scenery – TP01

Notes: Typical on site conditions. Photograph taken from test pit TP01 in a south-easterly direction.

Site Scenery – TP01

Notes: Typical on site conditions. Photograph taken in a easterly direction. Ridge in the background.

Project reference number: RS17001
Project name: Phase 1 Geotech - Soshanguve Shallow Soil

Site Scenery – TP02

Notes: Typical on site conditions. Photograph taken from test pit TP02 in a south-westerly direction. Abundant domestic waste and construction rubble.

Site Scenery – TP02

Notes: Typical on site conditions. Photograph taken from test pit TP02 in a easterly direction. Imphangele Street to the left.

Project reference number: RS17001
Project name: Phase 1 Geotech - Soshanguve Shallow Soil

Site Scenery – TP03

Notes: Typical on site conditions. Photograph taken from test pit TP03 in an easterly direction. Prominent granophyre ridge and boulders.

Site Scenery – TP04

Notes: Typical on site conditions. Photograph taken in a north-westerly direction. Old burrows and uncontrolled fill near the test pit.

Project reference number: RS17001
Project name: Phase 1 Geotech - Soshanguve Shallow Soil

Site Scenery – TP05

Notes: Typical on site conditions. Photograph taken near test pit TP05 in an easterly direction. Old material burrows in the toe of the ridge.

Site Scenery – TP06

Notes: Typical on site conditions. Photograph taken in a westerly direction. Uncontrolled fill near the test pit.

Project reference number: RS17001
Project name: Phase 1 Geotech - Soshanguve Shallow Soil

Site Scenery – TP07

Notes: Typical on site conditions. Photograph taken near test pit TP07 in an easterly direction.

Site Scenery – TP07

Notes: Typical on site conditions. Photograph taken at test pit TP07 in a south-westerly direction. Outcrops and abundant boulders in the vicinity.

Project reference number: RS17001
Project name: Phase 1 Geotech - Soshanguve Shallow Soil

Site Scenery – TP08

Notes: Typical on site conditions. Photograph taken near test pit TP08 in a south-easterly direction. Outcrops and abundant boulders in the vicinity.

Site Scenery – TP08

Notes: Typical on site conditions. Photograph taken near test pit TP08 in a southerly direction. Outcrops and abundant boulders in the vicinity.

Project reference number: RS17001
Project name: Phase 1 Geotech - Soshanguve Shallow Soil

Site Scenery – TP09

Notes: Typical on site conditions. Photograph taken near test pit TP09 in an south-easterly direction. Outcrops in the vicinity.

Site Scenery – TP11

Notes: Typical on site conditions. Photograph taken near test pit TP11 in a southerly direction.

Project reference number: RS17001
Project name: Phase 1 Geotech - Soshanguve Shallow Soil

Site Scenery – TP11

Notes: Typical on site conditions. Photograph taken near test pit TP11 in a westerly direction.

Site Scenery – TP12

Notes: Typical on site conditions. Photograph taken at test pit TP12 in a southerly direction. Abundant boulders and domestic waste material in the vicinity.

Project reference number: RS17001
Project name: Phase 1 Geotech - Soshanguve Shallow Soil

Site Scenery – TP13

Notes: Typical on site conditions. Photograph taken near test pit TP13 in a easterly direction. Abundant boulders in the vicinity.

Site Scenery – TP15

Notes: Typical on site conditions. Photograph taken at test pit TP15 in a southerly direction. Abundant boulders and outcrops in the vicinity.

Project reference number: RS17001
Project name: Phase 1 Geotech - Soshanguve Shallow Soil

Site Scenery – TP16

Notes: Typical on site conditions. Photograph taken near test pit TP16 in a easterly direction. Granophyre outcrops.

Site Scenery – TP17

Notes: Typical on site conditions. Photograph taken near test pit TP17 in a northerly direction. Abundant boulders and outcrops in the vicinity.

Project reference number: RS17001
Project name: Phase 1 Geotech - Soshanguve Shallow Soil

Site Scenery – TP18

Notes: Typical on site conditions. Photograph taken near test pit TP18 in a south-westerly direction. Abundant boulders and outcrops in the vicinity.

Site Scenery – TP19

Notes: Typical on site conditions. Photograph taken at test pit TP19 in a southerly direction towards TP20.

Project reference number: RS17001
Project name: Phase 1 Geotech - Soshanguve Shallow Soil

Site Scenery – TP20

Notes: Typical on site conditions. Photograph taken near test pit TP20 in a north-westerly direction. Abundant boulders and outcrops in the vicinity.

Site Scenery – TP21

Notes: Typical on site conditions. Photograph taken near test pit TP21 in a south-easterly direction. Abundant boulders and domestic waste material in the vicinity.

Project reference number: RS17001
Project name: Phase 1 Geotech - Soshanguve Shallow Soil

Site Scenery – TP20

Notes: Typical on site conditions. Photograph taken near test pit TP20 in a southerly direction. Abundant boulders and outcrops in the vicinity.

Site Scenery – TP21

Notes: Typical on site conditions. Photograph taken near test pit TP21. Granophyre outcrop to the west of the test pit.

APPENDIX D

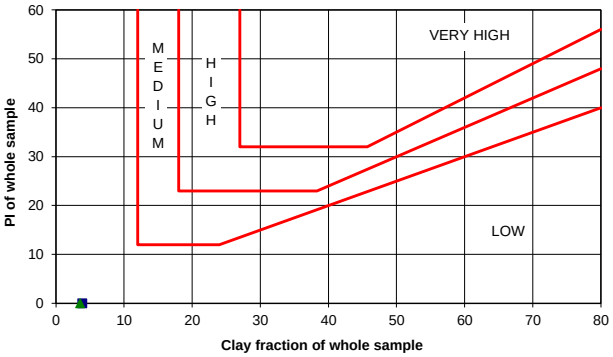
(Laboratory Test Results)

PARTICLE SIZE ANALYSIS

Sample No.	1	2
Soillab Sample No.	2017-S-0096-01	2017-S-0096-02
Depth (m)	0.20-1.10	0.30-1.20
Position	TP 01	TP 08
Material Description	DARK RED FERRICRETE SANDY GRAVEL	PALE RED FERRICRETE GRAVELLY SAND
Organic Material	YES	YES
Moisture (%) / Dispersion (%)		
SCREEN ANALYSIS (% PASSING) **(TMH 1 A1(a) & A5)**		
63.0 mm	96	92
53.0 mm	95	91
37.5 mm	92	86
26.5 mm	88	79
19.0 mm	84	73
13.2 mm	82	73
4.75 mm	69	67
2.00 mm	53	58
0.425 mm	32	44
0.075 mm	13	15
HYDROMETER ANALYSIS (% PASSING) **(TMH 1 A6)**		
0.040 mm	9	10
0.027 mm	8	8
0.013 mm	5	4
0.005 mm	4	4
0.002 mm	3	3
% Clay	4	4
% Silt	6	8
% Sand	43	46
% Gravel	47	42
ATTERBERG LIMITS **(TMH 1 A2 - A4)**		
Liquid Limit		
Plasticity Index	SP	SP
Linear Shrinkage (%)	1.0	1.0
Grading Modulus	2.01	1.83
Classification	A-1-b (0)	A-1-b (0)
Unified Classification	SM	SM
Chart Reference		

PROJECT : SOSHANGUVE SHALLOW SOIL
JOB No. : 2017-S-0096
DATE : 2017/01/30

POTENTIAL EXPANSIVENESS



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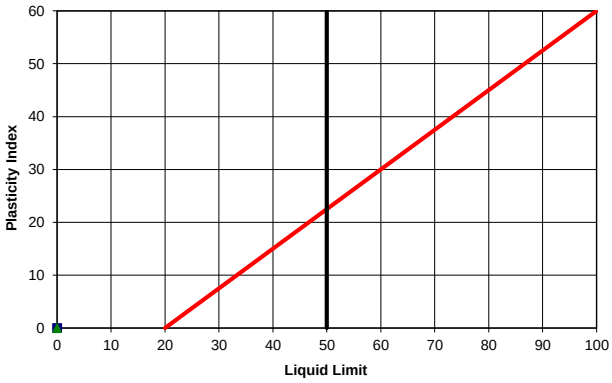

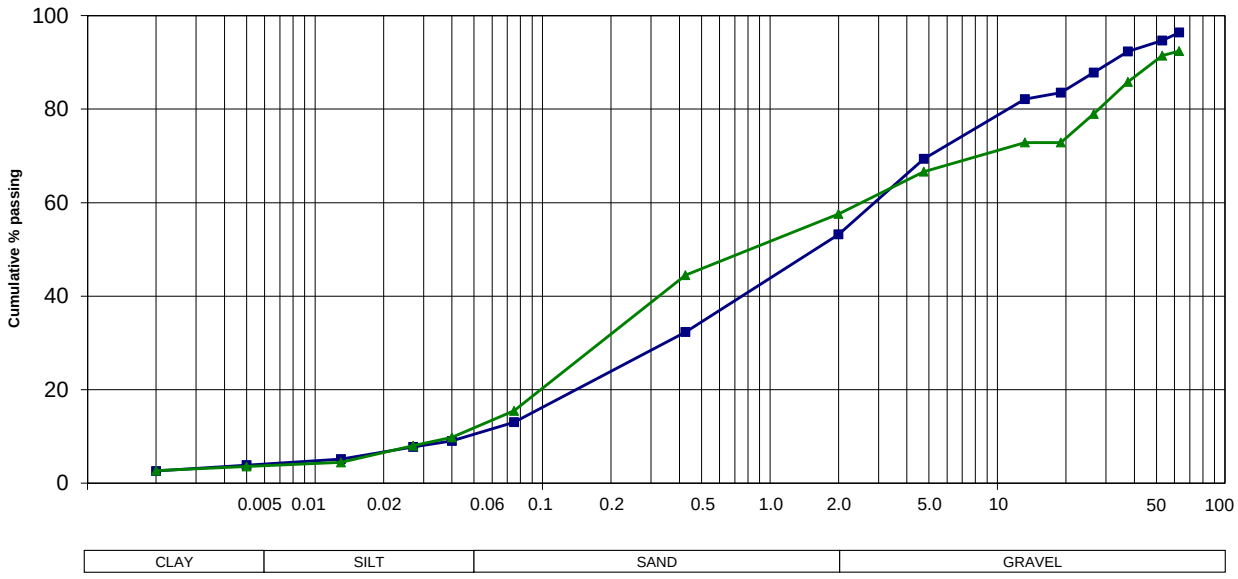

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PARTICLE SIZE ANALYSIS

Sample No.	3	4
Soillab Sample No.	2017-S-0096-03	2017-S-0096-04
Depth (m)	0.55-0.80	0.60-2.00
Position	TP 09	TP 11
Material Description	DARK RED FERRICRETE SANDY GRAVEL	LIGHT RED FERRICRETE GRAVELLY SAND
Organic Material	YES	
Moisture (%) / Dispersion (%)		
SCREEN ANALYSIS (% PASSING) **(TMH 1 A1(a) & A5)**		
63.0 mm	100	100
53.0 mm	100	100
37.5 mm	96	99
26.5 mm	90	97
19.0 mm	87	95
13.2 mm	85	95
4.75 mm	70	88
2.00 mm	55	69
0.425 mm	40	39
0.075 mm	20	22
HYDROMETER ANALYSIS (% PASSING) **(TMH 1 A6)**		
0.040 mm	14	13
0.027 mm	11	12
0.013 mm	9	10
0.005 mm	6	8
0.002 mm	5	6
% Clay	6	8
% Silt	9	7
% Sand	40	54
% Gravel	45	31
ATTERBERG LIMITS **(TMH 1 A2 - A4)**		
Liquid Limit	27	32
Plasticity Index	9	13
Linear Shrinkage (%)	4.0	6.5
Grading Modulus	1.85	1.70
Classification	A-2-4 (0)	A-2-6 (0)
Unified Classification	SC	SC
Chart Reference		

PROJECT : SOSHANGUVE SHALLOW SOIL
JOB No. : 2017-S-0096
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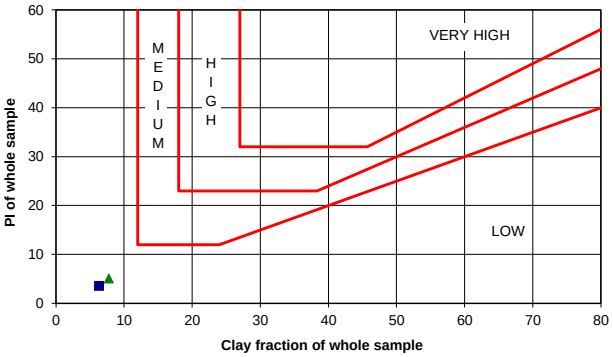
POTENTIAL EXPANSIVENESS



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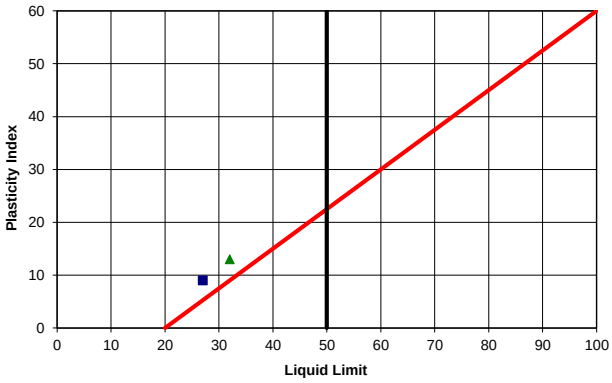

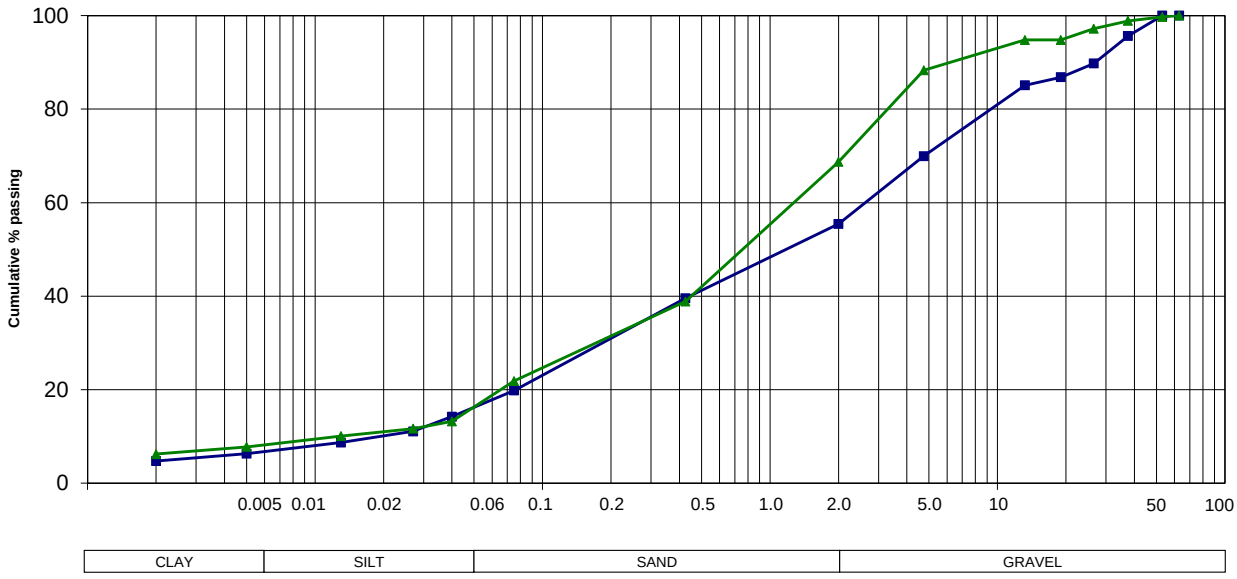

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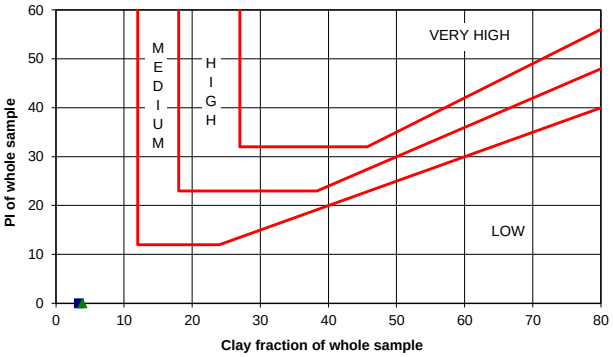
PARTICLE SIZE ANALYSIS

Sample No.	5	6
Soillab Sample No.	2017-S-0096-05	2017-S-0096-06
Depth (m)	0.05-0.20	0.10-0.80
Position	TP 13	TP 14
Material Description	PALE RED FERRICRETE SANDY GRAVEL	PALE RED FERRICRETE SANDY GRAVEL
Organic Material	YES	
Moisture (%) / Dispersion (%)		
SCREEN ANALYSIS (% PASSING) **(TMH 1 A1(a) & A5)**		
63.0 mm	100	95
53.0 mm	100	94
37.5 mm	92	88
26.5 mm	81	82
19.0 mm	73	77
13.2 mm	68	75
4.75 mm	52	63
2.00 mm	44	53
0.425 mm	34	39
0.075 mm	13	13
HYDROMETER ANALYSIS (% PASSING) **(TMH 1 A6)**		
0.040 mm	8	9
0.027 mm	6	6
0.013 mm	5	5
0.005 mm	3	4
0.002 mm	1	2
% Clay	3	4
% Silt	6	5
% Sand	35	44
% Gravel	56	47
ATTERBERG LIMITS **(TMH 1 A2 - A4)**		
Liquid Limit		
Plasticity Index	SP	SP
Linear Shrinkage (%)	1.0	1.0
Grading Modulus	2.09	1.95
Classification	A-1-b (0)	A-1-b (0)
Unified Classification	GM	SM
Chart Reference		

PROJECT : SOSHANGUVE SHALLOW SOIL
JOB No. : 2017-S-0096
DATE : 2017/01/30

POTENTIAL EXPANSIVENESS



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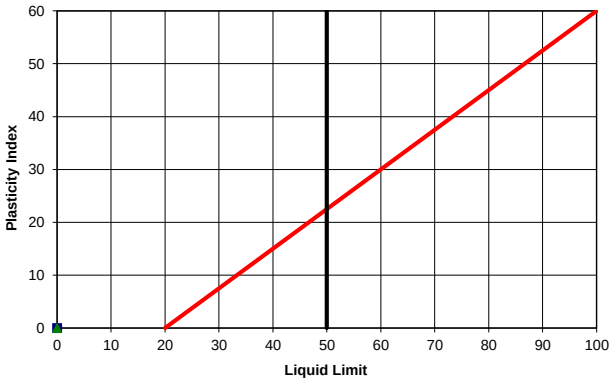

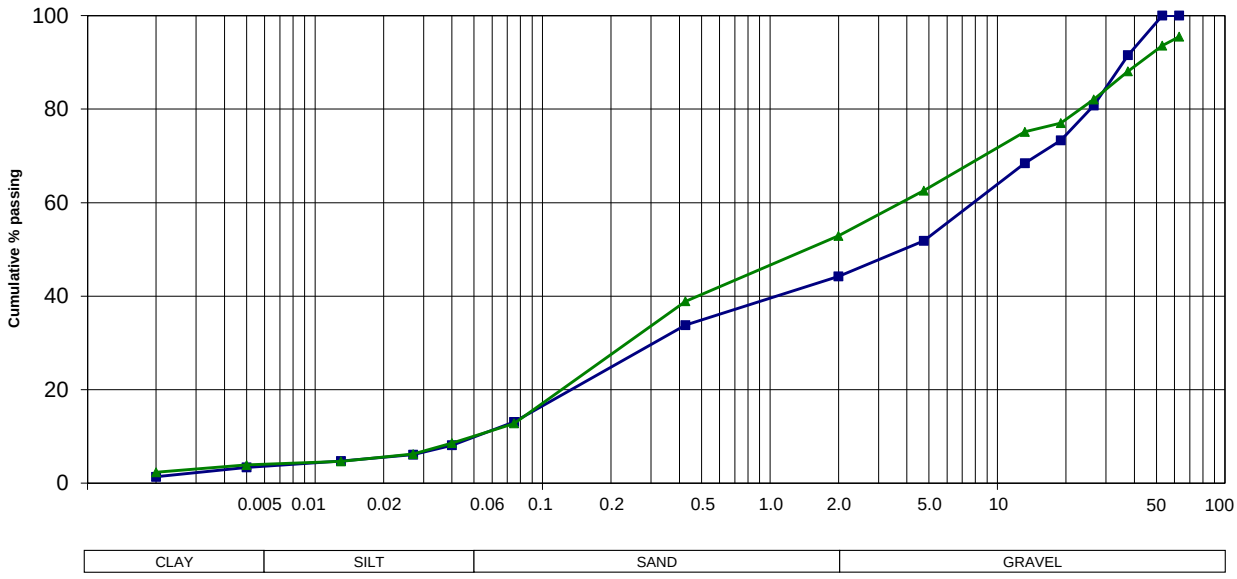

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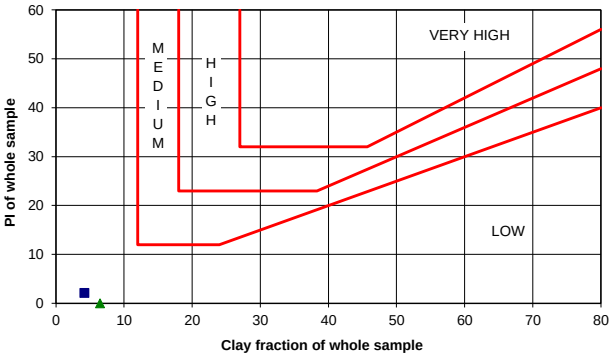
PARTICLE SIZE ANALYSIS

Sample No.	7	8
Soillab Sample No.	2017-S-0096-07	2017-S-0096-08
Depth (m)	0.05-0.35	0.20-0.40
Position	TP 16	TP 18
Material Description	LIGHT RED FERRICRETE SANDY GRAVEL	DARK RED FERRICRETE SILTY SAND
Organic Material		
Moisture (%) / Dispersion (%)		
SCREEN ANALYSIS (% PASSING) **(TMH 1 A1(a) & A5)**		
63.0 mm	95	100
53.0 mm	93	100
37.5 mm	86	100
26.5 mm	81	100
19.0 mm	77	100
13.2 mm	75	100
4.75 mm	63	98
2.00 mm	49	89
0.425 mm	30	65
0.075 mm	15	25
HYDROMETER ANALYSIS (% PASSING) **(TMH 1 A6)**		
0.040 mm	10	17
0.027 mm	8	13
0.013 mm	6	9
0.005 mm	4	6
0.002 mm	3	4
% Clay	4	6
% Silt	7	13
% Sand	38	69
% Gravel	51	11
ATTERBERG LIMITS **(TMH 1 A2 - A4)**		
Liquid Limit	25	
Plasticity Index	7	NP
Linear Shrinkage (%)	3.0	0.0
Grading Modulus	2.06	1.21
Classification	A-2-4 (0)	A-2-4 (0)
Unified Classification	SM & SC	SM
Chart Reference		

PROJECT : SOSHANGUVE SHALLOW SOIL
JOB No. : 2017-S-0096
DATE : 2017/01/30

POTENTIAL EXPANSIVENESS



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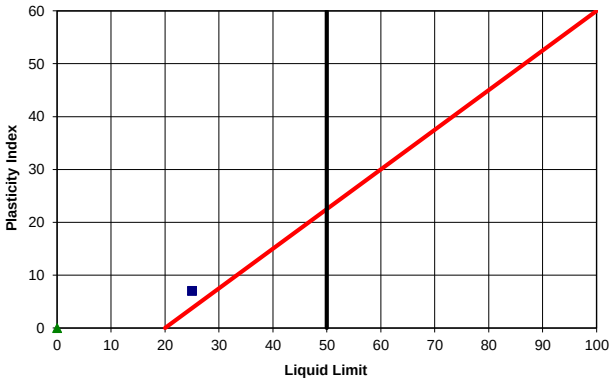

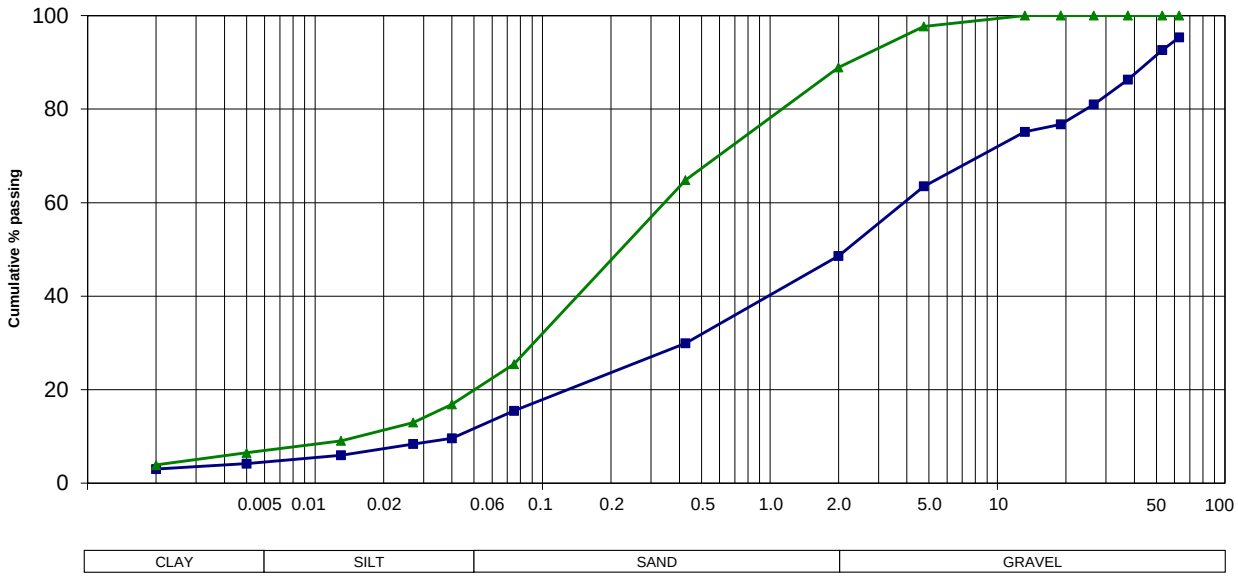

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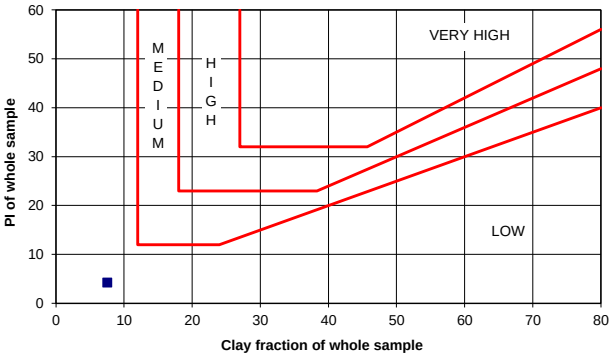
PARTICLE SIZE ANALYSIS

Sample No.	9	
Soillab Sample No.	2017-S-0096-09	
Depth (m)	0.30-1.50	
Position	TP 19	
Material Description	DARK RED FERRICRETE GRAVELLY SAND	
Organic Material		
Moisture (%) / Dispersion (%)		
SCREEN ANALYSIS (% PASSING) **(TMH 1 A1(a) & A5)**		
63.0 mm	100	
53.0 mm	100	
37.5 mm	100	
26.5 mm	100	
19.0 mm	99	
13.2 mm	99	
4.75 mm	93	
2.00 mm	76	
0.425 mm	47	
0.075 mm	25	
HYDROMETER ANALYSIS (% PASSING) **(TMH 1 A6)**		
0.040 mm	16	
0.027 mm	13	
0.013 mm	10	
0.005 mm	8	
0.002 mm	6	
% Clay	8	
% Silt	9	
% Sand	59	
% Gravel	24	
ATTERBERG LIMITS **(TMH 1 A2 - A4)**		
Liquid Limit	25	
Plasticity Index	9	
Linear Shrinkage (%)	4.0	
Grading Modulus	1.52	
Classification	A-2-4 (0)	
Unified Classification	SC	
Chart Reference		

PROJECT : SOSHANGUVE SHALLOW SOIL
JOB No. : 2017-S-0096
DATE : 2017/01/30

POTENTIAL EXPANSIVENESS



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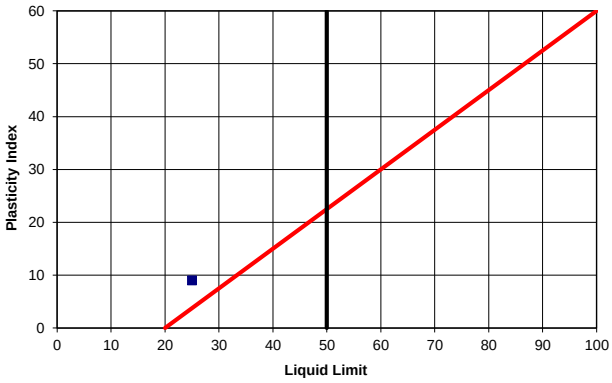

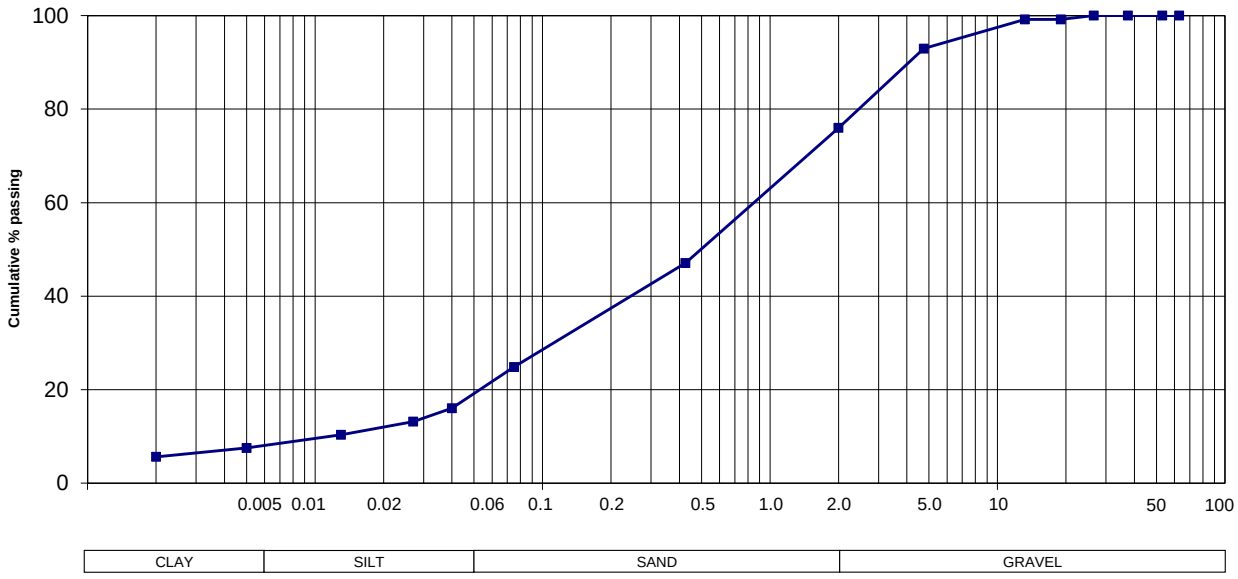

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SOIL ANALYSIS BY ..... : SOILLAB (Pty) Ltd
Lab reference No. ..... : 2017-S-0096

Date Printed : 2017-02-22

Customer ..... : ROCKSOIL CONSULT
Job Description ..... : SOSHANGUVE SHALLOW SOIL
Road Number ..... :

Job Number ..... : 2017-S-0096
Contract Number .... :
Date ..... : 2017-01-30

SAMPLE DESCRIPTION						
Sample Number	57754	57755	57756	57757	57758	57759
Sample Position	TP 01	TP 08	TP 09	TP 11	TP 13	TP 14
Sample Depth (mm)	200-1100	300-1200	550-800	600-2000	50-200	100-800
Material Description	DARK RED FERRICRETE SANDY GRAVEL	PALE RED FERRICRETE GRAVELLY SAND	DARK RED FERRICRETE SANDY GRAVEL	LIGHT RED FERRICRETE GRAVELLY SAND	PALE RED FERRICRETE GRAVEL	PALE RED FERRICRETE SANDY GRAVEL
Max size of boulder (mm)	-	-	-	-	-	-
SCREEN ANALYSIS (% PASS)						
75,00 mm	100	100	100	100	100	100
63,00 mm	96	92	100	100	100	95
53,00 mm	95	91	100	100	100	94
37,50 mm	93	86	79	99	92	88
26,50 mm	88	79	51	97	81	82
19,00 mm	84	73	37	95	73	77
13,20 mm	82	73	36	95	68	75
4,750 mm	70	67	30	88	52	63
2,000 mm	53	58	24	69	44	53
0,425 mm	32	44	17	39	34	39
0,075 mm	13	15	8	22	13	13
SOIL MORTAR						
Coarse Sand 2,000-0,425	39	23	29	43	24	26
Coarse Fine Sd 0,425-0,250	17	18	12	9	13	17
Medium Fine Sd 0,250-0,150	10	16	11	8	16	17
Fine Fine Sand 0,150-0,075	9	15	12	8	18	16
Material <0,075	25	28	36	32	29	24
CONSTANTS						
Grading Modulus	2.02	1.83	2.51	1.70	2.09	1.95
Liquid Limit			27	32		
Plasticity Index	SP	SP	9	13	SP	SP
Linear Shrinkage (%)	1.0	1.0	4.0	6.5	1.0	1.0
Sand Equivalent						
Classification - TRB	A-1-b (0)	A-1-b (0)	A-2-4 (0)	A-2-6 (0)	A-1-b (0)	A-1-b (0)
Classification - COLTO	G6	G5		G7		G5
CBR / UCS VALUES	CBR	CBR		CBR		CBR
MOD. AASHTO						
Max Dry Density (kg/m³)	1920	2005		1898		1857
Optimum Moisture Cont (%) ...	7.8	9.1		10.3		13.3
Moulding Moisture Cont (%) ...	7.7	9.3		10.1		13.3
Dry Density (kg/m³)	1923	2027		1908		1846
% of Max Dry Density	100.2	101.1		100.5		99.4
100% Mod CBR/UCS	64	83		112		89
% Swell	0.1	0.1		0.1		0.0
NRB						
Dry Density (kg/m³)	1837	1914		1817		1757
% of Max Dry Density	95.7	95.5		95.7		94.6
100% NRB CBR/UCS.....	32	57		68		45
% Swell	0.0	0.1		0.1		0.1
PROCTOR						
Dry Density (kg/m³)	1723	1844		1716		1698
% of Max Dry Density	89.7	92.0		90.4		91.4
100% Proc CBR/UCS	16	22		26		18
% Swell	0.0	0.1		0.1		0.1
CBR / UCS VALUES						
100% Mod AASHTO	62	77		106		97
98% Mod AASHTO	46	68		86		73
97% Mod AASHTO	39	63		78		63
95% Mod AASHTO	30	50		60		48
93% Mod AASHTO	23	29		42		28
90% Mod AASHTO	16	13		24		12
SOILLAB NR.	17-S-0096-01	17-S-0096-02	17-S-0096-03	17-S-0096-04	17-S-0096-05	17-S-0096-06

Customer ..... : ROCKSOIL CONSULT
Job Description ..... : SOSHANGUVE SHALLOW SOIL
Road Number ..... :

Job Number ..... : 2017-S-0096
Contract Number .... :
Date ..... : 2017-01-30

SAMPLE DESCRIPTION						
Sample Number	57760	57761	57762			
Sample Position	TP 16	TP 18	TP 19			
Sample Depth (mm)	50-350	200-400	300-1500			
Material Description	LIGHT RED FERRICRETE SANDY GRAVEL	DARK RED FERRICRETE SAND	DARK RED FERRICRETE SAND			
Max size of boulder (mm)	-	-	-			
SCREEN ANALYSIS (% PASS)						
75,00 mm	100	100	100			
63,00 mm	95	100	100			
53,00 mm	93	100	100			
37,50 mm	86	100	100			
26,50 mm	81	100	100			
19,00 mm	77	100	99			
13,20 mm	75	100	99			
4,750 mm	63	98	93			
2,000 mm	49	89	76			
0,425 mm	30	65	47			
0,075 mm	15	25	25			
SOIL MORTAR						
Coarse Sand 2,000-0,425	38	27	37			
Coarse Fine Sd 0,425-0,250	12	16	11			
Medium Fine Sd 0,250-0,150	8	15	9			
Fine Fine Sand 0,150-0,075	10	13	10			
Material <0,075	32	29	33			
CONSTANTS						
Grading Modulus	2.06	1.21	1.52			
Liquid Limit	25		25			
Plasticity Index	7	NP	9			
Linear Shrinkage (%)	3.0	0.0	4.0			
Sand Equivalent						
Classification - TRB	A-2-4 (0)	A-2-4 (0)	A-2-4 (0)			
Classification - COLTO	G5					
CBR / UCS VALUES	CBR					
MOD. AASHTO						
Max Dry Density (kg/m³)	1840					
Optimum Moisture Cont (%) ...	12.1					
Moulding Moisture Cont (%) ...	11.9					
Dry Density (kg/m³)	1816					
% of Max Dry Density	98.7					
100% Mod CBR/UCS	109					
% Swell	0.1					
NRB						
Dry Density (kg/m³)	1748					
% of Max Dry Density	95.0					
100% NRB CBR/UCS.....	53					
% Swell	0.1					
PROCTOR						
Dry Density (kg/m³)	1675					
% of Max Dry Density	91.0					
100% Proc CBR/UCS	29					
% Swell	0.1					
CBR / UCS VALUES						
100% Mod AASHTO	141					
98% Mod AASHTO	95					
97% Mod AASHTO	78					
95% Mod AASHTO	53					
93% Mod AASHTO	39					
90% Mod AASHTO	25					
SOILLAB NR.	17-S-0096-07	17-S-0096-08	17-S-0096-09			

Client:	ROCKSOIL CONSULT
Project:	SOSHANGUVE SHALLOW SOIL
Project No.:	2017-S-0096
Date:	2017-02-07

pH & CONDUCTIVITY - TMH 1 A20 & A21T

Soillab No.	Sample Position	Depth (m)	pH	Electrical Conductivity S/m
2017-S-0096-01	TP01	0.2-1.10	5.61	0.0052
2017-S-0096-02	TP08	0.3-1.20	5.84	0.0053
2017-S-0096-04	TP11	0.6-2.00	6.61	0.0061
2017-S-0096-05	TP13	0.05-0.20	6.28	0.0136
2017-S-0096-06	TP14	0.10-0.80	5.85	0.0050
2017-S-0096-07	TP16	0.05-0.35	5.74	0.0055
2017-S-0096-08	TP18	0.20-0.40	5.33	0.0106
2017-S-0096-09	TP19	0.30-1.50	6.60	0.0089

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APPENDIX E

(Summary, Evaluation and Correlation Tables)

Table E1: Simplified Soil Horizons and Conditions Encountered

Test Pit No.	Latitude	Longitude	Elevation e-Trex 10 GPS (mamsl)	Fill material		Topsoil and talus		Residual to completely weathered granophyre		Highly to moderately weathered granophyre		Termination depth	Excavatability down to termination depth	Generalised formation encountered at termination depth	TLB excavation conditions experienced termination depth	SANS expected excavatability classification at termidation depth	Some degree of pedogenic formation		Seepage at time of investigation	Seasonal shallow seepage or saturation expected
				From	To	From	To	From	To	From	To		Description	Description	Description	Description	From	To	Yes/No	Yes/No
TP01	-25.532929	28.088859	1310	-	-	0.00	0.12	-	-	0.12	1.10	1.10	Soft	Granophyre	Refusal	Intermediate to Hard	-	-	No	Yes
TP02	-25.532620	28.089081	1310	0.00	0.35	-	-	-	-	0.35	1.40	1.40	Soft	Granophyre	Refusal	Intermediate to Hard	-	-	No	Yes
TP03	-25.533302	28.089266	1310	-	-	0.00	0.28	-	-	0.28	1.35	1.35	Soft	Granophyre	Refusal	Intermediate to Hard	-	-	No	Yes
TP04	-25.532980	28.089218	1310	-	-	0.00	0.15	-	-	0.15	0.60	0.60	Soft	Granophyre	Refusal	Intermediate to Hard	-	-	No	Yes
TP05	-25.532804	28.089420	1311	-	-	0.00	0.15	-	-	0.15	0.55	0.55	Soft	Granophyre	Refusal	Intermediate to Hard	-	-	No	Yes
TP06	-25.532606	28.089662	1313	-	-	0.00	0.25	-	-	0.25	0.73	0.73	Soft	Granophyre	Refusal	Intermediate to Hard	-	-	No	Yes
TP07	-25.532775	28.090086	1317	-	-	0.00	0.18	-	-	0.18	0.70	0.70	Soft	Granophyre	Refusal	Intermediate to Hard	-	-	No	Yes
TP08	-25.532584	28.090417	1316	-	-	0.00	0.30	0.30	0.50	0.50	1.20	1.20	Soft	Granophyre	Refusal	Intermediate to Hard	-	-	No	Yes
TP09	-25.533163	28.090194	1324	-	-	0.00	0.55	-	-	0.55	0.80	0.80	Soft	Granophyre	Refusal	Intermediate to Hard	-	-	No	Yes
TP10	-25.532501	28.090782	1319	-	-	0.00	0.20	-	-	0.20	1.60	1.60	Soft	Granophyre	Refusal	Intermediate to Hard	-	-	No	Yes
TP11	-25.532563	28.091240	1318	0.00	0.70	-	-	0.70	2.50	-	-	2.50	Soft	Granophyre	Refusal	Intermediate to Hard	0.70	2.50	No	Yes
TP12	-25.532796	28.090960	1323	-	-	0.00	0.25	-	-	0.25	1.50	1.50	Soft	Granophyre	Refusal	Intermediate to Hard	-	-	No	Yes
TP13	-25.533008	28.091288	1323	-	-	0.00	0.15	-	-	0.15	0.85	0.85	Soft	Granophyre	Refusal	Intermediate to Hard	-	-	No	Yes
TP14	-25.533159	28.091105	1321	-	-	0.00	0.25	-	-	0.25	0.80	0.80	Soft	Granophyre	Refusal	Intermediate to Hard	-	-	No	Yes
TP15	-25.533066	28.090720	1322	-	-	0.00	0.28	-	-	0.28	1.60	1.60	Soft	Granophyre	Refusal	Intermediate to Hard	-	-	No	Yes
TP16	-25.533329	28.090631	1317	-	-	0.00	0.35	-	-	0.35	0.75	0.75	Soft	Granophyre	Refusal	Intermediate to Hard	-	-	No	Yes
TP17	-25.533575	28.090705	1317	-	-	0.00	0.30	-	-	0.30	1.40	1.40	Soft	Granophyre	Refusal	Intermediate to Hard	-	-	No	Yes
TP18	-25.533906	28.090444	1313	-	-	0.00	0.20	0.20	0.60	-	-	0.60	Soft	Granophyre	Refusal	Intermediate to Hard	-	-	No	Yes
TP19	-25.534094	28.090554	1317	-	-	0.00	0.30	0.30	1.00	1.00	1.90	1.90	Soft	Granophyre	Refusal	Intermediate to Hard	-	-	No	Yes
TP20	-25.534360	28.090526	1314	-	-	0.00	0.15	0.15	0.55	0.55	0.75	0.75	Soft	Granophyre	Refusal	Intermediate to Hard	-	-	No	Yes
TP21	-25.533348	28.091416	1319	0.00	0.45	-	-	-	-	0.45	1.30	1.30	Soft	Granophyre	Refusal	Intermediate to Hard	-	-	No	Yes

Min:	0.00	0.12	0.15	0.50	0.12	0.55	0.55	
Max:	0.00	0.55	0.70	2.50	1.00	1.90	2.50	
Average:	0.00	0.25	0.33	1.03	0.33	1.10	1.14	
Standard deviation:	0.00	0.13	0.17	0.59	0.22	0.51	0.51	

Min:	0.70	2.50
Max:	0.70	2.50
Average:	0.70	2.50
Standard deviation:	0.15	0.55

Notes:

1) Depths indicated in meters below ground level.

2) Elevations are based on GPS coordinates.

3) Coordinates retreived with an e-Trex 10 GPS.

Table E2: Foundation Indicator Test Results and Soil Classification Summary

Test Pit No.	Sample depth (mbgl)	Material description	Soil composition				Atterberg Limits		LS (%)	GM	Class (AASHTO)	Class (USCS) 1	Class (USCS) 2
			Clay (%)	Silt (%)	Sand (%)	Gravel (%)	LL (%)	PI (%)					
TP01	0.20-1.10	Completely to highly weathered granophyre	4	6	43	47	0	0	1.0	2.01	A-1-b (0)	SM	-
TP08	0.30-1.20	Residual to moderately weathered granophyre	4	8	46	42	0	SP	1.0	1.83	A-1-b (0)	SM	-
TP09	0.55-0.80	Completely to highly weathered granophyre	6	9	40	45	27	9	4.0	1.85	A-2-4 (0)	SC	-
TP11	0.60-2.00	Residual to completely weathered granophyre	8	7	54	31	32	13	6.5	1.70	A-2-6 (0)	SC	-
TP13	0.05-0.20	Topsoil and talus	3	6	35	56	0	SP	1.0	2.09	A-1-b (0)	GM	-
TP14	0.10-0.80	Talus and completely to moderately weathered granophyre	4	5	44	47	0	SP	1.0	1.95	A-1-b (0)	SM	-
TP16	0.05-0.35	Topsoil and talus	4	7	38	51	25	7	3.0	2.06	A-2-4 (0)	SM	SC
TP18	0.20-0.40	Residual granophyre	6	13	69	11	0	NP	0.0	1.21	A-2-4 (0)	SM	-
TP19	0.30-1.50	Residual to highly weathered gronophyre	8	9	59	24	25	9	4.0	1.52	A-2-4 (0)	SC	-

Notes:

1) This is only a basic summary for quick reference purposes.

2) Refer to the laboratory test results.

Table E3: Soil pH, Conductivity and Corrosiveness Rating

Test Pit No.	Sample depth (mbgl)	Material description	pH	Electrical conductivity of the soil paste (S/m)	Electrical conductivity of the soil paste (mS/cm)	Corrosiveness rating based on the electrical conductivity correlation
TP01	0.20-1.10	Completely to highly weathered granophyre	5.61	0.0052	0.052	Not generally corrosive
TP08	0.30-1.20	Residual to moderately weathered granophyre	5.84	0.0053	0.053	Not generally corrosive
TP11	0.60-2.00	Residual to completely weathered granophyre	6.61	0.0061	0.061	Not generally corrosive
TP13	0.05-0.20	Topsoil and talus	6.28	0.0136	0.136	Mildly corrosive
TP14	0.10-0.80	Talus and completely to moderately weathered granophyre	5.85	0.0050	0.050	Not generally corrosive
TP16	0.05-0.35	Topsoil and talus	5.74	0.0055	0.055	Not generally corrosive
TP18	0.20-0.40	Residual granophyre	5.33	0.0106	0.106	Mildly corrosive
TP19	0.30-1.50	Residual to highly weathered gronophyre	6.6	0.0089	0.089	Not generally corrosive

Notes:

1) This is only a basic summary for quick reference purposes.

2) Refer to the laboratory test results.

Table E4: Typical Compressibility Rating Correlations Based on Unified Soil Classification System (Well-Compacted State)

Test Pit No.	Sample depth (mbgl)	Material description	Unified Soil Classification System	Expected compressibility when properly compacted (USCS)
TP01	0.20-1.10	Completely to highly weathered granophyre	SM	Low
TP08	0.30-1.20	Residual to moderately weathered granophyre	SM	Low
TP09	0.55-0.80	Completely to highly weathered granophyre	SC	Low
TP11	0.60-2.00	Residual to completely weathered granophyre	SC	Low
TP13	0.05-0.20	Topsoil and talus	GM	Low
TP14	0.10-0.80	Talus and completely to moderately weathered granophyre	SM	Low
TP16	0.05-0.35	Topsoil and talus	SM	Low
TP18	0.20-0.40	Residual granophyre	SM	Low
TP19	0.30-1.50	Residual to highly weathered gronophyre	SC	Low

Notes:
1) The rating does not consider voided soil structure.

Table E5: Compaction and Typical Fill Rating Correlations Based on Unified Soil Classification System

Test Pit No.	Sample depth (mbgl)	Material description	Unified Soil Class	General compaction characteristics or rating based on USCS	Typical fill material rating based USCS
TP01	0.20-1.10	Completely to highly weathered granophyre	SM	Good	Average
TP08	0.30-1.20	Residual to moderately weathered granophyre	SM	Good	Average
TP09	0.55-0.80	Completely to highly weathered granophyre	SC	Good to fair	Average
TP11	0.60-2.00	Residual to completely weathered granophyre	SC	Good to fair	Average
TP13	0.05-0.20	Topsoil and talus	GM	Good to fair	Good
TP14	0.10-0.80	Talus and completely to moderately weathered granophyre	SM	Good	Average
TP16	0.05-0.35	Topsoil and talus	SM	Good	Average
TP18	0.20-0.40	Residual granophyre	SM	Good	Average
TP19	0.30-1.50	Residual to highly weathered gronophyre	SC	Good to fair	Average

Notes:
1) For guideline purposes only, refer to compaction test results if available.

Table E6: Material Properties and Compaction Test Results Summary

Test Pit No.	Sample depth (mbgl)	Material description	Constants				MOD. AASHTO			
			GM	LL	PI	LS	MDD (kg/m^3)	OMC (%)	CBR at 100% Mod.AASHTO	Swell Measured (%)
TP01	0.20-1.10	Completely to highly weathered granophyre	2.01	0	0	1.0	1920	7.8	64.0	0.1
TP08	0.30-1.20	Residual to moderately weathered granophyre	1.83	0	SP	1.0	2005	9.1	83.0	0.1
TP11	0.60-2.00	Residual to completely weathered granophyre	1.70	32	13	6.5	1898	10.3	112.0	0.1
TP14	0.10-0.80	Talus and completely to moderately weathered granophyre	1.95	0	SP	1.0	1857	13.3	89.0	0.0
TP16	0.05-0.35	Topsoil and talus	2.06	25	7	3.0	1840	12.1	109.0	0.1

Note: This is only a summary sheet for quick reference purposes. Refer to detailed laboratory test results for design purposes.
GM - Grading Modulus, LL - Liquid Limit, PI - Plasticity Index, LS - Linear Shrinkage, MDD - Maximum Dry Density, OMC - Optimum Moisture Content.

Table E7: CBR values at different Compaction Efforts, Soil Classifications and Swell Rating and Measurements

Test Pit No.	Sample depth (mbgl)	Material description	CBR / UCS VALUES at % Mod. AASHTO						Soil Classes			Swell (VDM Rating)	Swell Measured (%)
			90	93	95	97	98	100	USCS	AASHTO	TRH14		
TP01	0.20-1.10	Completely to highly weathered granophyre	16	23	30	39	46	62	SM	A-1-b (0)	G6	Low	0.1
TP08	0.30-1.20	Residual to moderately weathered granophyre	13	29	50	63	68	77	SM	A-1-b (0)	G5	Low	0.1
TP11	0.60-2.00	Residual to completely weathered granophyre	24	42	60	78	86	106	SC	A-2-6 (0)	G7	Low	0.1
TP14	0.10-0.80	Talus and completely to moderately weathered granophyre	12	28	48	63	73	97	SM	A-1-b (0)	G5	Low	0.0
TP16	0.05-0.35	Topsoil and talus	25	39	53	78	95	141	SM	A-2-4 (0)	G5	Low	0.1

Note: This is only a summary sheet for quick reference purposes. Refer to detailed laboratory test results for design purposes.
VDM - Van Der Merwe's Swell Prediction (PI and Clay Fraction).

Table E8: Typical Material Rating for Use as Road Construction Material

Test Pit No.	Sample depth (mbgl)	Material description	Soil Class (USCS)	Material typical road construction rating based on Unified Soil Classification System			Soil Class (AASHTO)	Material typical road construction rating based on AASHTO Soil Classification System	
				Subgrade	Subbase	Base		Subgrade	Significant Constituent Materials
TP01	0.20-1.10	Completely to highly weathered granophyre	SM	Fair to good	Fair to good	Poor to not suitable	A-1-b (0)	Excellent to Good	Stone fragments gravel sand
TP08	0.30-1.20	Residual to moderately weathered granophyre	SM	Fair to good	Fair to good	Poor to not suitable	A-1-b (0)	Excellent to Good	Stone fragments gravel sand
TP09	0.55-0.80	Completely to highly weathered granophyre	SC	Fair	Poor	Not suitable	A-2-4 (0)	Excellent to Good	Silty or clayey gravel sand
TP11	0.60-2.00	Residual to completely weathered granophyre	SC	Fair	Poor	Not suitable	A-2-6 (0)	Excellent to Good	Silty or clayey gravel sand
TP13	0.05-0.20	Topsoil and talus	GM	Good	Fair	Poor to not suitable	A-1-b (0)	Excellent to Good	Stone fragments gravel sand
TP14	0.10-0.80	Talus and completely to moderately weathered granophyre	SM	Fair to good	Fair to good	Poor to not suitable	A-1-b (0)	Excellent to Good	Stone fragments gravel sand
TP16	0.05-0.35	Topsoil and talus	SM	Fair to good	Fair to good	Poor to not suitable	A-2-4 (0)	Excellent to Good	Silty or clayey gravel sand
TP18	0.20-0.40	Residual granophyre	SM	Fair to good	Fair to good	Poor to not suitable	A-2-4 (0)	Excellent to Good	Silty or clayey gravel sand
TP19	0.30-1.50	Residual to highly weathered gronophyre	SC	Fair	Poor	Not suitable	A-2-4 (0)	Excellent to Good	Silty or clayey gravel sand

Notes:
1) Based on Unified Soil Classification System.
2) Refer to compaction test results and specific testing for detailed evaluation and selection purposes if available.
3) USCS - Unified Soil Classification System.

Table E9: Typical Material Rating for Use as General and Foundation Fill

Test Pit No.	Sample depth (mbgl)	Material description	Unified Soil Class	Typical rating for use as general fill material	Typical rating for use as fill for foundation purposes	Expected Dry Density (kg/m^3) (PROCTOR)
TP01	0.20-1.10	Completely to highly weathered granophyre	SM	Average	Good (density important)	1 830 +/- 20
TP08	0.30-1.20	Residual to moderately weathered granophyre	SM	Average	Good (density important)	1 830 +/- 20
TP09	0.55-0.80	Completely to highly weathered granophyre	SC	Average	Good (density important)	1 840 +/- 20
TP11	0.60-2.00	Residual to completely weathered granophyre	SC	Average	Good (density important)	1 840 +/- 20
TP13	0.05-0.20	Topsoil and talus	GM	Good	Excellent	> 1 830
TP14	0.10-0.80	Talus and completely to moderately weathered granophyre	SM	Average	Good (density important)	1 830 +/- 20
TP16	0.05-0.35	Topsoil and talus	SM	Average	Good (density important)	1 830 +/- 20
TP18	0.20-0.40	Residual granophyre	SM	Average	Good (density important)	1 830 +/- 20
TP19	0.30-1.50	Residual to highly weathered gronophyre	SC	Average	Good (density important)	1 840 +/- 20

Notes:

1) Based on Unified Soil Classification System.

2) The evaluator should refer to the compaction, consolidation and swell test results for detailed evaluation and selection purposes.

APPENDIX F

(Reference Tables)

ISRM – Table 3.1: Classification of rock and soil strengths (ISRM, 1981b)

Grade	Description	Field identification	Approx. range of uniaxial compressive strength (MPa)
R6	Extremely strong rock	Specimen can only be chipped with geological hammer. UCS testing required.	>250
R5	Very strong rock	Specimen requires many blows of geological hammer to fracture it. UCS testing required.	100-250
R4	Strong rock	Specimen requires more than one blow of geological hammer to fracture it. UCS testing required.	50-100
R3	Medium strong rock	Cannot be scraped or peeled with a pocket knife, specimen can be fractured with single firm blow of geological hammer.	25-50
R2	Weak rock	Can be peeled by a pocket knife with difficulty, shallow indentations made by firm blow with point of geological hammer.	5.0-25
R1	Very weak rock	Crumbles under firm blows with point of geological hammer and can be peeled by a pocket knife.	1.0-5.0
R0	Extremely weak rock	Indented by thumbnail.	0.25-1.0
S6	Hard clay	Indented with difficulty by thumbnail.	>0.5
S5	Very stiff clay	Readily indented by thumbnail.	0.25-0.50
S4	Stiff clay	Readily indented by thumb nail but penetrated only with great difficulty.	0.1-0.25
S3	Firm clay	Can be penetrated several inches by thumb with moderate effort.	0.05-0.1
S2	Soft clay	Easily penetrated several inches by thumb.	0.025-0.05
S1	Very soft clay	Easily penetrated several inches by fist.	<0.025

NOTES: Discontinuity wall strength will generally be characterized by grades R0-R6 (rock). Some rounding of strength values has been made when converting to SI units (ISRM, 1981b).

SAIEG 1990: Simplified Rock Hardness Classification (SAIEG-AEG-SAICE, 1990)

Classification	Field Test or Descriptor	Approximate UCS Range (MPa)
Very Soft Rock	Can be peeled with a knife, material crumbles under firm blows with the sharp end of a geological pick.	1 to 3
Soft Rock	Can just be scraped with a knife, indentations of 2 to 4 mm with firm blows of the pick point.	3 to 10
Medium Hard Rock	Cannot be scraped or peeled with a knife, handheld specimen breaks with firm blows of the pick point.	10 to 25
Hard Rock	These materials are usually only broken with some difficulty and ring when struck. Classification can be assessed by Schmidt hammer/point load test and verified by uniaxial compressive strength testing.	25 to 70
Very Hard Rock	These materials are usually only broken with some difficulty and ring when struck. Classification can be assessed by Schmidt hammer/point load test and verified by uniaxial compressive strength testing.	70 to 200
Extremely Hard Rock	These materials are usually only broken with some difficulty and ring when struck. Classification can be assessed by Schmidt hammer/point load test and verified by uniaxial compressive strength testing.	>200

Guidelines for Soil and Rock Logging in SA: Published and Sponsored jointly by: AEG, SAICE & SAIEG, 1990.

SAIEG 1990 – Table 2: Consistency of Granular Soils

Consistency	**Gravels and clean sands Generally free-draining (cohesionless materials)**	**Typical Dry Density (kg/m^3)**	**Saturated SPT Blow counts N**
Very loose	Crumbles very easily when scraped with geological pick.	<1450	<4
Loose	Small resistance to penetration by sharp end of geological pick.	1451 - 1600	4 - 10
Medium dense	Considerable resistance to penetration by sharp end of geological pick.	1601 - 1750	11 - 30
Dense	Very high resistance to penetration of sharp end of geological pick; requires many blows of pick for excavation.	1751 - 1925	31 - 50
Very dense	High resistance to repeated blows of geological pick; requires power tools for excavation.	>1925	>50

Reference:

Guidelines for Soil and Rock Logging in South Africa, 2nd Impression 2001, eds. A.B.A. Brink and R.M.H. Bruin, Proceedings, Geoterminology Workshop organised by AEG, SAICE and SAIEG, 1990.

SAIEG 1990 – Table 3: Consistency of Cohesive Soils

Consistency	**Silts and clays and combinations thereof with sand. Generally slow draining (cohesive materials) (M=0)**	**Unconfined Compressive Strength (kN/m^2)**	**Saturated SPT Blow counts. Sensitive silts and clays.**	**Saturated SPT Blow counts. Insensitive silts and clays.**
Very soft	Pick head can easily be pushed in to the shaft of handle; easily moulded by fingers.	<50	<2	<5
Soft	Easily penetrated by thumb; sharp end of pick can be pushed in 30 – 40 mm; moulded with some pressure.	50 to 125	2 – 4	5 – 10
Firm	Indented by thumb with effort; sharp end of pick can be pushed in up to 10 mm; very difficult to mould with fingers; can just be penetrated with an ordinary hand spade.	126 to 250	5 – 8	11 – 25
Stiff	Penetrated by thumb nail; slight indentation produced by pushing pick point into soil; cannot be moulded by fingers; requires hand pick for excavation.	251 to 500	9 – 15	26 – 50
Very stiff	Indented by thumb nail with difficulty; slight indentation produced by blow of pick point; requires power tools for excavation.	500 to 1000	16 – 20	51 – 80

Reference:

Guidelines for Soil and Rock Logging in South Africa, 2nd Impression 2001, eds. A.B.A. Brink and R.M.H. Bruin, Proceedings, Geoterminology Workshop organised by AEG, SAICE and SAIEG, 1990.

SANS633 – Table 1: Descriptors for moisture condition

Descriptors	Field identification
Dry	No moisture detectable.
Slightly moist	Moisture just discernible. Soil just below optimum moisture content.
Moist	Moisture easily discernible. Soil at or near optimum moisture content.
Very moist	Moisture above optimum moisture content. Soil close to saturation but no seepage evident.
Wet	Generally at or below water table. Soil saturated and usually with seepage.

Note 1: The moisture condition of the layer of soil is a necessary precursor to the assessment of consistency, which is largely influenced by the moisture content at the time of inspection.

Note 2: The interpretation of moisture condition in terms of approximate moisture content will depend on the grain size of the soil, e.g. sand with a moisture content of 5 % to 10 % will be observed to be wet, while clay at the same moisture content might be dry or only slightly moist.

SANS633 – Table 4: Descriptors of consistency of non-cohesive soils

Descriptor of consistency	Field identification
Very loose	Crumbles very easily when scraped with geological pick.
Loose	Small resistance to penetration by sharp end of geological pick.
Medium dense	Considerable resistance to penetration by sharp end of geological pick.
Dense	Very high resistance to penetration of sharp end of geological pick; requires many blows of pick for excavation.
Very dense	High resistance to repeated blows of geological pick; requires power tools for excavation.

SANS633 – Table 5: Descriptors of consistency of cohesive soils

Descriptor of consistency	Field identification
Very soft	Pick head can easily be pushed into the shaft of handle; easily moulded by fingers.
Soft	Easily penetrated by thumb; sharp end of pick can be pushed in 30 mm to 40 mm; moulded with some pressure.
Firm	Indented by thumb with effort; sharp end of pick can be pushed in up to 10 mm; very difficult to mould with fingers; can just be penetrated with an ordinary hand spade.
Stiff	Penetrated by thumbnail; slight indentation produced by pushing pick point into soil; cannot be moulded by fingers; requires hand pick for excavation.
Very stiff	Indented by thumbnail with difficulty; slight indentation produced by blow of pick point; requires power tools for excavation.

SANS633 – Table 8: Descriptors for degree of prominence of structure

Descriptor	Identification
Faint(ly)	Poorly formed, closed, barely observable until disturbed.
Distinct(ly)	Well formed and observable, but closed.
Very distinct(ly)	Well formed and open.

SANS633 – Table 9: Descriptors for degree of prominence of structure

Type	Sub-division	Particle size mm	Identification tests
Boulders	-	Over 200	Observed with naked eye.
Cobbles	-	60 to 200	
Gravel	Coarse	20 to 60	
	Medium	6 to 20	
	Fine	2 to 6	
Sand	Coarse	0,6 to 2	Particles are visible to the naked eye. Sand is clearly distinguishable by the presence of gritty particles which do not break down when rubbed with water on the palm of the hand.
	Medium	0,2 to 0,6	
	Fine	0,0006 to 0,2	Gritty feel on teeth
Silt	-	0,0002 to 0,0006	Silt particles are barely felt when rubbed on the palm of the hand with water. When a small quantity of the wetted soil is placed on the tongue, the particles can be felt grating against the enamel of the teeth. Chalky feel on teeth
Clay	-	Under 0,0002	In general the particles are flaky and when rubbed on the palm of the hand with water, have a soapy or greasy feel. There is no sensation of grittiness when placed between the tongue and teeth. Soils remain on hands. Shiny when wet.

NOTE: Most natural soils are a combination of one or more textures and, in describing a soil, the adjective is used to denote the lesser type, e.g. a silty clay is a clay with some silt. A silt-clay however has approximately equal proportions of silt and clay.

SANS633 – Table 15: Descriptors for the degree of weathering

Descriptor	Surface characteristics	Diagnostic feature				
		Discoloration extent	**Fracture condition**	**Surface characteristic**	**Original texture**	**Grain boundary condition**
Unweathered	No visible signs of alteration in the rock material but discontinuity planes might be stained.	None.	Closed or discoloured.	Unchanged.	Preserved.	Tight.
Slightly weathered	Discontinuities are stained or discoloured and might contain a thin filling of altered material. Unweathered rock colour is generally preserved. Discoloration might extend into the rock from the discontinuities.	<20 % of fracture spacing on both sides of fracture.	Discoloured. Might contain thin filling.	Partial discoloration.	Preserved.	Tight.
Medium weathered	Slight discolouration extends from discontinuities for a distance greater than 20 % of their spacing (ie. generally greater part of the rock). Discontinuities may contain filling of altered material. The surface of the core is not friable (except in the case of poorly cemented sedimentary rocks) and the original fabric of the rock has been preserved. Partial opening of grain boundaries might be observed.	>20 % of fracture spacing on both sides of fracture.	Discoloured. Might contain thick filling.	Partial to complete discoloration. Not friable except poorly cemented rocks.	Preserved.	Partial opening.
Highly weathered	Friable and possibly pitted. Discolouration extends throughout core. The surface of the core is friable and usually pitted due to washing out of highly altered minerals by drilling water. The original fabric of the rock has mainly been preserved but separation of grains has occurred. Not easily indented with knife, does not slake in water.	Throughout.	-	Friable and possibly pitted.	Mainly preserved.	Partial separation
Completely weathered	Resembles a soil. The core is totally discoloured though internally the rock fabric is partly preserved but grains have completely separated. Easily indented with knife, slakes in water.	Throughout.	-	Resembles a soil.	Partly preserved.	Complete separation.

NOTE: The boundary between soil and rock is defined in terms of strength or hardness and not in terms of weathering.

Table: Engineering suitability ratings based upon Unified Soil Classes

USCS group symbol	Typical description	Source of borrow			Resources	Suitability for:					
		Embankments		Fill	Clean sand / gravel	Road subgrade	Building foundations	Slope stability	Trenching/ tunneling	Septic tanks	Untreated roads
		Water retaining	None-water retaining								
GW	Well-graded gravels, gravel-sand mixtures, little or no fines.	Unsuitable	Excellent	Excellent	Good	Excellent	Excellent	Excellent	Shoring	Good	Average
GP	Poorly graded gravels, gravel-sand mixtures, little or no fines.	Unsuitable	Average	Excellent	Good	Excellent	Excellent	Average	Shoring	Excellent	Unsuitable
GM	Silty gravels, poorly graded gravel-sand-silt mixtures.	Unsuitable	Average	Good	Average	Excellent	Excellent	Average	Shoring	Average	Average
GC	Clayey gravels, poorly graded gravel-sand-clay mixtures.	Suitable	Average	Good	Poor	Excellent	Excellent	Average	Good	Unsuitable	Excellent
SW	Well-graded sands, gravelly sands, little or no fines.	Unsuitable	Excellent	Excellent	Good	Good	Excellent	Average	Shoring	Good	Average
SP	Poorly graded sands, gravelly sands, little or no fines.	Unsuitable	Average	Good	Good	Good	Excellent	Excellent	Shoring	Good	Unsuitable
SM	Silty sands, poorly graded silt-sand mixtures.	Suitable (with compaction)	Average	Average	Average	Average	Good (density important)	Average	Mostly good, but shoring may be required	Poor	Poor
SC	Clayey sands, poorly graded sand-clay mixtures.	Suitable	Average	Average	Poor	Average	Good (density important)	Average	Good	Unsuitable	Good
ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands with slight plasticity.	Unsuitable	Poor	Average	N/A	Average	Good (Liquifaction problem)	Average	Shoring	Average	Unsuitable
CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.	Suitable (erosion protection required)	Good	Average	N/A	Average	Average (Swell?)	Poor	Good	Unsuitable	Poor
OL	Organic silts and organic silt-clays of low plasticity	Unsuitable	Unsuitable	Poor	N/A	Average	Poor (Swell)	Good	Shoring	Poor	Unsuitable
MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic soils.	Unsuitable	Poor	Poor	N/A	Poor	Unsuitable (Swell?)	Unsuitable	Shoring	Average	Unsuitable
CH	Inorganic clays of high plasticity, fat clays, silty soils, elastic soils.	Suitable (erosion protection required)	Average	Unsuitable	N/A	Poor	Poor (Swell?)	Poor	Good	Unsuitable	Unsuitable
OH	Organic clays of medium to high plasticity.	Unsuitable	Unsuitable	Unsuitable	N/A	Unsuitable	Unsuitable (Swell?)	Average	Shoring	Unsuitable	Unsuitable
PT	Peat or other highly organic soils.	Unsuitable	Unsuitable	Unsuitable	N/A	Unsuitable	Unsuitable (Swell?)	Unsuitable	Shoring	Average	Unsuitable

Source: Finlayson (1982)

Note: These recommendations are based on the construction of earthworks with adequate access to compaction and engineering equipment. They are based solely on the USCS classification, which does not take account of the full effects of particle size, dispersion or the conditions under which soil conservation earthworks are constructed. This then in not a DLWC based set of recommendations for the construction of soil conservation earthworks.

TABLE: Material properties after NAVFAC DM7 (1971)

Group symbol	Soil type	Max yd	Optimum moisture (%)	Typical strength characteristics			
				Cu (kPa)	C` (kPa)	ϕ` (deg.)	tan ϕ`
GW	Well-graded clean gravels, gravel-sand mixtures	19.7-21.2	11-8	0	0	>38	>0.78
GC	Clayey gravels, poorly graded gravel-sand-clay	18.1-20.5	14-9	0	0	>31	>0.60
SM	Silty sands, poorly graded sand-silt mixtures	17.3-19.7	16-11	50	5	34	0.67
SC	Clayey sands poorly graded sand-clays	16.5-19.7	19-11	75	10	31	0.60
CL	Inorganic clays of low to medium plasticity	15.0-18.9	24-12	85	12	28	0.54
ML	Inorganic silts and clayey silts	15.0-18.9	24-12	65	10	32	0.62
CH	Inorganic clays of high plasticity	11.8-16.5	36-19	100	12	19	0.35

yd – Dry density; Cu – Undrained cohesion; C` - Drained cohesion; ϕ`(deg.) – Shearing resistance

Table SAICE-1: Residential Site Class Designations (SAICE, 1995)

Typical Founding Material	Character of Founding Material	Expected Range of Total Soil Movements (mm)	Assumed Differential Movement (% of total)	Site Class
Rock (excluding mud rocks which exhibit swelling to some depth)	Stable	NEGLIGIBLE	-	R
Fine-grained soils with moderate to very high plasticity (clays, silty clays, clayey silts and sandy clays)	Expansive Soils	< 7,5 7,5 – 15 15 – 30 > 30	50% 50% 50% 50%	H H1 H2 H3
Silty sands, sands, sandy and gravelly soils	Compressible and Potentially Collapsible Soils	< 5,0 5,0 – 10 > 10	75% 75% 75%	C C1 C2
Fine-grained soils (clayey silts and clayey sands of low plasticity), sands, sandy and gravelly soils	Compressible Soils	< 10 10 – 20 > 20	50% 50% 50%	S S1 S2
Contaminated soils Controlled fill Dolomitic areas Land fill Marshy areas Mine waste fill Mining subsidence Reclaimed areas Very soft silt/silty clays Uncontrolled fill	Variable	Variable		P

NOTES:

1. The classifications C, H, R and S are not intended for dolomitic area sites unless specific investigations are carried out to assess the stability (risk of sinkholes and doline formation) of the dolomites. Where this risk is found to be acceptable, the site shall be designated as Class P (dolomitic areas).
2. Site classes are based on the assumption that differential movements, experienced by single-storey residential buildings, expressed as a percentage of the total movements are equal to about 50% for soils that exhibit expansive or compressive characteristics and 75% for soils that exhibit both compressible and collapse characteristics. Where this assumption is incorrect or inappropriate, the total soil movements must be adjusted so that the resultant different movements implied by the table are equal to that which is expected in the field.
3. In some instances, it may be more appropriate to use a composite description to describe a site mote fully e.g. C1/H2 or S1 and/or H2. Composite Site Classes may lead to higher differential movements and result in design solutions appropriate to a higher range of differential movement e.g. a Class R/C1 site. Alternatively, a further site investigation may be necessary since the final design solution may depend on the location of the building on a particular site.
4. Where it is not possible to provide a single site designation and a composite description is inappropriate, sites may be given multiple descriptions to indicate the range of possible conditions e.g. H-H1-H2 or C1-C2.
5. Soft silts and clays usually exhibit high consolidation and low bearing characteristics. Structures founded on these horizons may experience high settlements and such sites should be designated as being Class S1 or S2 as relevant and appropriate.
6. Sites containing contaminated soils include those associated with reclaimed mine land, land down-slope of mine tailings and old land fills.
7. Where a site is designated as Class P, full particulars relating to the founding conditions on the site must be provided.
8. Where sites are designated as being Class P, the reason for such classification shall be placed in brackets immediately after the suffix – i.e. P(contaminated soils). Under certain circumstances, composite description may be more appropriate – e.g. P(dolomite areas)-C1.
9. Certain fills may contain contaminates which present a health risk. The nature of such fill should be evaluated and should be clearly demarcated as such.

Table SAICE-2: Foundation design, building procedures and precautionary measures for single-storey residential buildings founded on horizons subject to consolidation settlement (SAICE, 1995).

Site Class	Estimated Total Settlement	Construction Type	Foundation Design and Building Procedures
S	**<10** mm	Normal	- Normal construction (strip footing or slab-on-the-ground foundations) - Good site drainage
S1	**10-20** mm	Modified normal	- Reinforced strip footings - Articulation joints at some internal and all external doors - Light reinforcement in masonry - Site drainage and service/plumbing precautions - Foundation pressure not to exceed 50 kPa
		Compaction of in situ soils below individual footings	- Remove in situ material below foundations to a depth and width of 1,5 times the foundation width or to a competent horizon and replace with material compacted to 93% MOD AASHTO density at –1% to +2% of optimum moisture content. - Normal construction with lightly reinforced strip foundations and light reinforcement in masonry.
		Deep strip foundations	- Normal construction with drainage requirements. - Founding on a competent horizon below the problem horizon
		Soil raft	- Remove in situ material to 1,0m beyond perimeter of building to a depth and width of 1,5 times the widest foundation or to a competent horizon and replace with material compacted to 93% MOD AASHTO density at –1% to +2% of optimum moisture content. - Normal construction with lightly reinforced strip footings and light reinforcement in masonry.
S2	**>20** mm	Stiffened strip footings, stiffened or cellular raft	- Stiffened strip footing or stiffened or cellular raft with articulation joints or solid lightly reinforced masonry. - Bearing pressure not to exceed 50kPa. - Fabric reinforcement in floor slabs. - Site drainage and service/plumbing precautions.
		Deep strip foundations	- As for S1 but with fabric reinforcement in floor slabs
		Compaction of in-situ soils below individual footings	- As for S1.
		Piled or pier foundations	- Reinforced concrete ground beams or solid slabs on piled or pier foundations. - Ground slabs with fabric reinforcement. - Good site drainage.
		Soil raft	- As for S1.

Notes:

1. Differential settlement assumed to equal 50% of total settlement.
2. The relaxation of some of these requirements, e.g. the reduction or omission of steel or articulation joints, may result in a Category 2 level of expected damage.
3. Account must be taken on sloping site since differential fill heights may lead to greater differential settlements.
4. Settlements induced by loads imposed by deep filling beneath surface beds may necessitate the adoption of a construction type appropriate to a more severe site class.

Table SAICE-3: Foundation design, building procedures and precautionary measures for single-storey residential buildings founded on horizons subject to both consolidation and collapse settlement (SAICE, 1995)

Site Class	Estimated Total Settlement	Construction Type	Foundation Design and Building Procedures
C	**<5** mm	Normal	- Normal construction (strip footing or slab-on-the-ground foundations) - Good site drainage
C1	**5 – 10** mm	Modified normal	- Reinforced strip footings - Articulation joints at some internal and all external doors - Light reinforcement in masonry - Site drainage and service/plumbing precautions - Foundation pressure not to exceed 50 kPa
		Compaction of in situ soils below individual footings	- Remove in situ material below foundations to a depth and width of 1,5 times the foundation width or to a competent horizon and replace with material compacted to 93% MOD AASHTO density at –1% to +2% of optimum moisture content. - Normal construction with lightly reinforced strip foundations and light reinforcement in masonry.
		Deep strip foundations	- Normal construction with drainage requirements. - Founding on a competent horizon below the problem horizon
		Soil raft	- Remove in situ material to 1,0m beyond perimeter of building to a depth and width of 1,5 times the widest foundation or to a competent horizon and replace with material compacted to 93% MOD AASHTO density at –1% to +2% of optimum moisture content. - Normal construction with lightly reinforced strip footings and light reinforcement in masonry.
C2	**>10** mm	Stiffened strip footings, stiffened or cellular raft	- Stiffened strip footing or stiffened or cellular raft with articulation joints or solid lightly reinforced masonry. - Bearing pressure not to exceed 50kPa. - Fabric reinforcement in floor slabs. - Site drainage and service/plumbing precautions.
		Deep strip foundations	- As for C1 but with fabric reinforcement in floor slabs
		Compaction of in situ soils below individual footings	- As for C1.
		Piled or pier foundations	- Reinforced concrete ground beams or solid slabs on piled or pier foundations. - Ground slabs with fabric reinforcement. - Good site drainage.
		Soil raft	- As for C1.

Notes:

1. Differential settlement assumed to equal 75% of total settlement
2. The relaxation of some of these requirements, e.g. the reduction or omission of steel or articulation joints, may result in a Category 2 level of expected damage.

Table SAICE-4: Foundation design, building procedures and precautionary measures for single-storey residential buildings founded on expansive soil horizons (SAICE, 1995)

Site Class	Estimated Total Heave	Construction Type	Foundation Design and Building Procedures
H	**<7,5** mm	Normal	- Normal construction (strip footing or slab-on-the-ground foundations) - Good site drainage and service/plumbing precautions recommended.
H1	**7,5 – 15** mm	Modified normal	- Lightly reinforced strip footings - Articulation joints at all internal/external doors - Light reinforcement in masonry - Site drainage and service/plumbing precautions
		Soil raft	- Remove in situ material to 1,0m beyond perimeter of the structure and replace with inert backfill, compacted to 93% MOD AASHTO density at –1% to +2% of optimum moisture content. - Normal construction with lightly reinforced strip footings and light reinforcement in masonry if residual movements are <7,5mm, or construction type appropriate to residual movements. - Site drainage and plumbing/service precautions.
H2	**15-30** mm	Stiffened or cellular raft	- Stiffened or cellular raft with articulation joints or lightly reinforced masonry. - Site drainage and plumbing/service precautions.
		Piled construction	- Piled foundations with suspended floor slabs with or without ground beams. - Site drainage and plumbing/service precautions.
		Split construction	- Combination of reinforced brickwork/block work and full movement joints. - Suspended floors of fabric-reinforced ground slabs acting independently from the structure. - Site drainage and plumbing/service precautions.
		Soil raft	- As for H1.
H3	**>30** mm	Stiffened or cellular raft	- As for H2.
		Piled construction	- As for H2.
		Soil raft	- As for H1.

Notes:

1. Differential movement assumed to equal 50% of total heave.
2. The relaxation of some of these requirements, e.g. the reduction or omission of steel or articulation joints, may result in a Category 2 level of expected damage.

Table SANS634: Table 5 Classification of Material for Machine Excavation

1	2	3
Excavation	**Classification**	**Description**
Restricted	Soft	Material which can be efficiently removed by a back-acting excavator of flywheel power > 0,10 kW for each millimetre of tined bucket width.
	Intermediate	Material which can be removed by a back-acting excavator of flywheel power > 0,10 kW for each millimetre of tined bucket width, or with the use of pneumatic tools, before removal by a machine capable of removing soft material.
	Hard rock	Material that cannot be removed without blasting or wedging and splitting.
Non-restricted	Soft	Material which can be efficiently removed or loaded, without prior ripping, by any of the following: a) a bulldozer or a track-type front-end loader with an approximate mass of 22 tonnes and 145 kW flywheel power. b) a tractor-scraper unit with an approximate mass of 28 tonnes and 245 kW flywheel power, pushed during loading by a bulldozer equivalent to that described in (a) above.
	Intermediate	Material that can be efficiently ripped by a bulldozer with an approximate mass of 35 tonnes and 220 kW flywheel power.
	Hard rock	Material that cannot be efficiently ripped by a bulldozer with an approximate mass of 35 tonnes and 220 kW flywheel power.
	Boulder class A	Material containing more than a volume fraction of 40 % of boulders of size between 0,03 m^3 and 20 m^3, in a matrix of soft material or smaller boulders.
	Boulder class B	Material containing a volume fraction of 40 % or less of boulders of size between 0,03 m^3 and 20 m^3, in a matrix of soft material or smaller boulders.

Table SANS634-1: Geotechnical Constraints in Urban Development (SANS 634:2012 Edition 1)

1	2	3	4	5
Constraint		**Descriptor**		
Letter	**Description**	**1 (most favourable)**	**2 (intermediate)**	**3 (least favourable)**
A	Collapsible soil	Any collapsible horizon or consecutive horizons totalling a depth of less than 750 mm in thickness[a]	Any collapsible horizon or consecutive horizons with 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 m below ground below	Permanent or perched water table less than 1,5 m ground surface	Swamps and marshes
C	Active soil	Low soil-heave potential anticipated[a]	Moderate soil-heave potential anticipated	High soil-heave potential anticipated
D	Highly compressible soil	Low soil compressibility anticipated[a]	Moderate soil compressibility anticipated	High soil compressibility anticipated
E	Erodability 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[a]	Rock or hardpan pedocretes between 10 % and 40 % of the total volume	Rock or hardpan pedocretes more than 40 % of the total volume
G	Undermined ground	Undermining at a depth greater than 200 m below surface (except where total extraction mining has not occurred)	Old undermined areas to a depth of 200 m below surface where stope closure has ceased	Mining within less than 200 m of surface or where total extraction mining has taken place
H	Stability (dolomite land)	Possibly stable. Areas of dolomite overlain by Karoo rocks or intruded by sills. Areas of Black Reef rocks. Anticipated inherent hazard class 1 (see SANS 1936-2)	Potentially characterized by instability. Anticipated inherent classes 2 to 5 (see SANS 1936-2)	Known sinkholes and dolines. Anticipated inherent hazard classes 6 to 8 (see SANS 1936-2)
I	Steep slopes	Between 2° and 6° (all regions)	Slopes between 6° and 18° and less than 2° (Natal and Western Cape) Slopes between 6° and 12°and less than 2° (all other regions)	More than 18° (Natal and Western Cape) More than 12° (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/s² within 50 years	Mining-induced seismic activity more than 100 cm/s²	Natural seismic activity more than 100 cm/s²
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

Note 1: Areas should be designated by the numeral associated with the most appropriate descriptor in columns 3 to 5 followed by the letter associated with the constraint. For example, an area designated as Zone 2BF would be an intermediate class with anticipated seepage and excavation problems while an area designated as Zone 3B would be least favourable and not recommended for development due to surface water inundation.

Note 2: More detailed information on undermined land can be obtained from Stacey, T.R. and Bakker, D. The erection or construction of buildings and other structures on undermined ground. NOTE 3 Undermining assessments should be carried out by persons with expert knowledge of such conditions.

[a] *These areas are designated as 1A, 1C, 1D, or 1F where localized occurrences of the constraint might arise.*

Table: Soil Classification AASHTO System (from AASHTO M 145 or ASTM D3282)

General Classification	**Granular Materials (35% or less passing the 0.075 mm sieve)**							**Silt-Clay Materials (>35% passing the 0.075 mm sieve)**			
Group Classification	A-1		A-3	A-2				A-4	A-5	A-6	A-7
	A-1-a	A-1-b		A-2-4	A-2-5	A-2-6	A-2-7				A-7-5 A-7-6
Sieve Analysis (% passing)											
2.00 mm (No. 10)	50 max	-	-	-	-	-	-	-	-	-	-
0.425 (No. 40)	30 max	50 max	51 min	-	-	-	-	-	-	-	-
0.075 (No. 200)	15 max	25 max	10 max	35 max	35 max	35 max	35 max	36 min	36 min	36 min	36 min
Characteristics of fraction passing 0.425 mm (No. 40)											
Liquid Limit	-		-	40 max	41 min	40 max	41 min	40 max	41 min	40 max	41 min
Plasticity Index	6 max		N.P.	10 max	10 max	11 min	11 min	10 max	10 max	11 min	11 min*
Group index	0		0	0		4 max		8 max	12 max	16 max	20 max
Usual types of significant constituent materials	Stone fragments, gravel and sand		Fine sand	Silty or clayey gravel and sand				Silty soils		Clayey soils	
General rating as a subgrade	Excellent to Good							Fair to Poor			

* Plasticity index of A-7-5 subgroup is equal to or less than the LL - 30. Plasticity index of A-7-6 subgroup is greater than LL - 30

Table: Soil Classification Unified Soil Classification (from ASTM D 2487)

Major Divisions			Group Symbols	Typical Names
Course-Grained Soils More than 50% retained on the 0.075 mm (No. 4) sieve	**Gravels** 50% or more of course fraction retained on the 4.75 mm (No. 4) sieve	Clean Gravels	GW	Well-graded gravels and gravel-sand mixtures, little or no fines
			GP	Poorly graded gravels and gravel-sand mixtures, little or no fines
		Gravels (with Fines)	GM	Silty gravels, gravel-sand-silt mixtures
			GC	Clayey gravels, gravel-sand-clay mixtures
	Sands 50% or more of course fraction passes the 4.75 (No. 4) sieve	Clean Sands	SW	Well-graded sands and gravelly sands, little or no fines
			SP	Poorly graded sands and gravelly sands, little or no fines
		Sands (with Fines)	SM	Silty sands, sand-silt mixtures
			SC	Clayey sands, sand-clay mixtures
Fine-Grained Soils More than 50% passes the 0.075 mm (No. 200) sieve		**Silts and Clays** Liquid Limit 50% or less	ML	Inorganic silts, very fine sands, rock four, silty or clayey fine sands
			CL	Inorganic clays of low to medium plasticity, gravelly/sandy/silty/lean clays
			OL	Organic silts and organic silty clays of low plasticity
		Silts and Clays Liquid Limit greater than 50%	MH	Inorganic silts, micaceous or diatomaceous fine sands or silts, elastic silts
			CH	Inorganic clays or high plasticity, fat clays
			OH	Organic clays of medium to high plasticity
Highly Organic Soils			PT	Peat, muck, and other highly organic soils

Prefix: G = Gravel, S = Sand, M = Silt, C = Clay, O = Organic
Suffix: W = Well Graded, P = Poorly Graded, M = Silty, L = Clay, LL < 50%, H = Clay, LL > 50%

Note: These definitions are Unified Soil Classification system definitions and are slightly different than those of AASHTO.

TABLE: Typical Correlations Unified Soil Classification

Class:	Material description	Subgrade	Subbase	Base	Drainage when compacted	Compaction characteristics	Embankment material	Compressibility when compacted
GW	Well-graded gravel	Good to Excellent	Good	Fair to good	Excellent	Good	Reasonably stable	Low
GP	Poorly grade gravel (<5% fines)	Good to Excellent	Good	Fair to good	Excellent	Good	Reasonably stable	Low
GC	Clayey gravel (>12% fines)	Good	Fair	Poor to not suitable	Poor to practically impervious	Good to fair	Reasonably stable	Low
SP	Poorly graded sand (<5% fines)	Fair to good	Fair	Poor to not suitable	Excellent	Good	Reasonably stable	Low
SM	Silty sand (sand with fines PI<4)	Fair to good	Fair to good	Poor to not suitable	Fair to practically impervious to impervious	Good	Reasonably stable	Low
SC	Clayey sand (>12% fines PI>7)	Fair	Poor	Not suitable	Poor, impervious when compacted	Good to fair	Reasonably stable	Low
CL	Silts and clays (LL<50 & PI>7)	Fair to poor	Not suitable	Not suitable	Practically impervious	Good to fair	Good stability	Medium
ML	Silts and clays (LL<50 & PI<4)	Fair to poor	Not suitable	Not suitable	Semi-pervious to impervious	Good to poor	Poor stability	Medium
CH	Silts and clays (LL>50)	Poor to fair	Not suitable	Not suitable	Practically impervious	Fair to poor	Fair stability	Medium to high
MH	Silts and clays (LL>50)	Poor	Not suitable	Not suitable	Fair to poor, semi-pervious to pervious	Fair to poor	Poor stability	Medium to high

TABLE: Typical shear strength parameters for quick draining non-cohesive materials

Consistency	Rule of thumb Field identification	Approx CPT (MPa)	Approx SPT (N)	Approximate ϕ`	Typical Dry Density (kg/m^3)
Very loose	Crumbles very easily when scraped with geological pick	0 to 2	0 to 5	26 to 28	< 1450
Loose	Small resistance to penetration by sharp end of geological pick	2 to 4	5 to 10	28 to 30	1 450 to 1 600
Medium dense	Considerable resistance to penetration by sharp end of geological pick	4 to 9	10 to 30	30 to 35	1 600 to 1 750
Dense	Very high resistance to penetration of sharp end of geological pick. Requires many blows of pick for excavation	9 to 12.5	30 to 50	35 to 40	1 750 to 1 950
Very dense	High resistance to repeated blows of geological pick. Requires power tools for excavation	< 12.5	> 50	40 to 50	> 1 950

TABLE: Typical shear strength parameters for slow draining cohesive material

	Consistency	**Rule of thumb Field identification**	**Unconfined Compressive Strength (kN/m^2)**	**UCS (kPa) (COP4)**	**UCS (kPa) (Terz & Peck)**	**Approximate SPT (N)**
S.1	Very soft	Easily moulded by fingers. Full pick penetration	< 40	< 35	<25	<2
S.2	Soft	Easily penetrated by with thumb. Moulded with strong pressure. 30 to 40mm penetration	40 to 80	35 to 75	25 to 50	2 to 4
S.3	Firm	Indent by thumb with effort. Very difficult to mould with fingers. 10mm penetration	80 to 160	75 to 150	50 to 100	4 to 8
S.4	Stiff	Penetration by thumb nail. Cannot be moulded with fingers. Geologist pick (sharp end) makes slight indentation when pushed.	160 to 320	150 to 300	100 to 200	8 to 15
S.5	Very stiff	Indentation by thumb nail difficult. Slight indentation with blow of geologist pick. Power tools required for excavation.	320 to 1000	> 300	200 to 400	15 to 50