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GEOTECHNICAL INVESTIGATION FOR THE PROPOSED SCHOOL BUILDING STRUCTURES IN SEDIKO PRIMARY SCHOOL, KLERKSDORP, NORTH WEST PROVINCE

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TITLE: GEOTECHNICAL INVESTIGATION FOR THE PROPOSED SCHOOL BUILDING STRUCTURES IN SEDIKO PRIMARY SCHOOL, KLERKSDORP, NORTH WEST PROVINCE

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Executive summary

Mamadi & Company was appointed to conduct a geotechnical investigation for the proposed school building structures in Sediko Primary School situated in Jouberton Township in Klerksdorp, North West.

This report addresses the findings of the undertaken geotechnical study for the extension of the school buildings, and it is intended solely for the associated applications of the proposed structural development.

The area under investigation is underlain by sedimentary rocks belonging to the Kameeldoorns Formation of the Platberg Group, Ventersdorp Supergroup. The Lithology comprises sandstones, shale, tuff, breccia, limestone and conglomerate. At local scale, fine-grained arkosic and grey-colored sandstones were encountered as bedrock. According to the published 1:250 000 geological map sheet 2626 West Rand geological series, no dolomite terrane is anticipated on the site.

The test pits generally indicated the following soil profiles to prevail at the site:

- ***Transported colluvium***
  – Slightly moist, brown, moderately loose, pin-holed, intact, silty SAND;
  – Slightly moist, reddish brown, slightly dense, fine gravels of ferricrete within silty SAND matrix with occasional sandstone cobbles
- ***Bed Rock***
  – *Slightly moist, maroon speckled orange, very dense, slightly weathered fine-grained arkosic SANDSTONE*
  – *Slightly moist, grey speckled red, very dense, slightly weathered fine-grained SANDSTONE*

There was no occurrence of groundwater seepage in all test pits.

Shallow bed rock may result to difficulty in excavation during construction.

The site is suitable for the proposed development provided recommendations are adhered to.

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1. INTRODUCTION

1.1. BACKGROUND

Mamadi & Company was appointed to conduct a geotechnical investigation for the proposed school building structures in Sediko Primary School situated in Jouberton Township in Klerksdorp, North West Province.

This report addresses the findings of the undertaken geotechnical study for the extension of the site, and it is intended solely for the associated applications of the proposed structural development.

1.2. SCOPE OF WORK

The geotechnical investigation included the following key components:

- *Desktop study and literature review*
- *Field investigation including:*
- *Test pitting*
- *Dynamic Cone Penetrometer (DCP) tests and*
- *Preparation of an interpretative geotechnical report*

1.3. OBJECTIVES

The objectives of this geotechnical investigation were to:

- *Assess the exposure and vulnerability of the site with respect to Geo-hazards*
- *Define the ground conditions and provide Site Classifications*
- *Establish possibility of existence or non-existence of any groundwater and abnormal water table level challenges*
- *Provide the geotechnical basis for safe and appropriate land use planning, infrastructure design, housing unit design*
- *Characterize the suitability of the area for residential development*
- *Recommend suitable foundation designs for the structures*

By default, the following form part of the Geotechnical Investigation:

- *Specific geology of the site and potential geotechnical restraining factors*
- *Excavation conditions*
- *Presence and proximity of groundwater.*
- *Source of Information*
- *The following were studied prior to the field investigation:*
- *A 1:250 000 geological map sheets 2626 West Rand*
- *The Geology of South Africa textbook*
- *Google Earth Satellite Imagery and online published literature with the site information*

2. SITE DESCRIPTION

2.1. SITE LOCATION & BOUNDARIES

The proposed building structures are located inside Sediko Primary School which is situated in Jouberton Township, approximately 8 km southwest of Klerksdorp Town central, North West Province. The proposed development area of the site covers a surface area of about 3.5 hectares. Figure 1 shows the locality of the site.

The site is accessible via Phuthaditshaba Street which joins from R30 Oliver Tambo Road. The central coordinates of the site is latitude -26.902888° longitude 26.595959° with an elevation from mean sea level of about 1362 m.

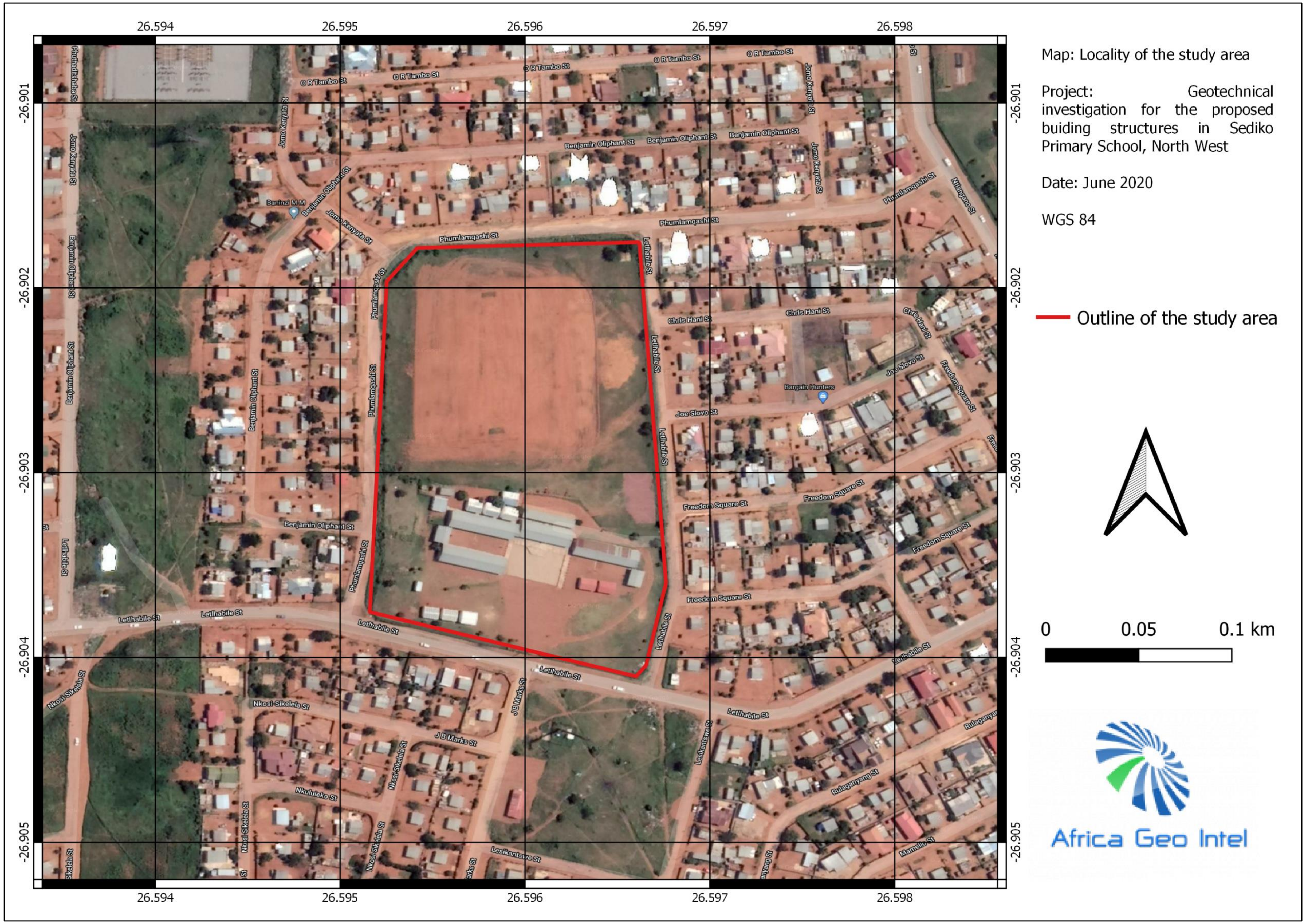

Figure 1 Locality of the proposed development area, Jouberton Township, North West Province.

2.2. TOPOGRAPHY

An extrapolation assessment of the site topography was conducted with Google earth sourced elevations. It is worth noting that the topography heights are only for relative height differences and cannot be concluded as survey standard survey heights. Topographically, the area is characterized flat topography. The land surface slopes very gently towards the west, with a gradient of approximatelyof 3.4%. The highest elevation point and lowest elevation point are 1356.5 and 1363 meters above sea level with a 5 meter margin of error, respectively. The elevation map of the area is indicated by Figure 2.

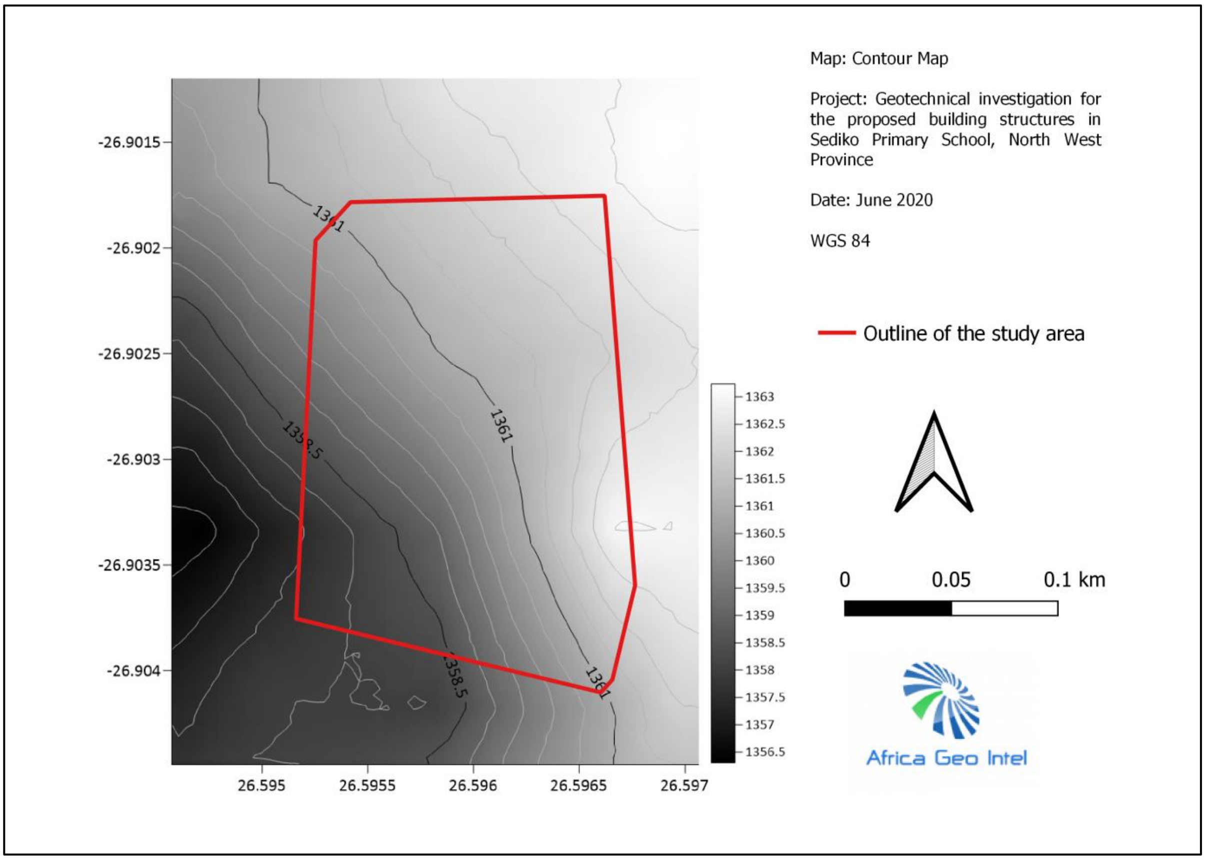

Figure 2 Elevation map covering the site investigation area and surroundings

2.3. CLIMATE

The average summer and winter daytime temperatures are 22.5°C and 8.8 °C, respectively. There is not much rainfall in this region. Klerksdorp normally receives an average of 603 mm of rainfall per year. Precipitation is the highest in January (102 mm); whilst, July precipitation receives its lowest precipitation of 5 mm.

2.4. WEATHERING

Weinert (1980) developed the N-value to differentiate between regions that have similar weathering characteristic namely physical or chemical weathering. The N-value is defined by:

Equation 1

$$N_w = \frac{12\mathrm{E}_j}{\mathrm{P}_a}$$

Whereby N_w is the Weinert N-value, E_j is the total evaporation for the warmest month and P_a is the total annual precipitation. The differentiated weathering mechanisms influenced by climate are described below under Figure 3.

N-value	Mode of weathering	Weathering characteristics	Principle secondary minerals
>10	Mainly disintegration	Thin weathering layer, No secondary minerals	Almost none
5-10		Few secondary minerals	Hydromica, illite
2-5	Mainly decomposition	Weathering profile deepens towards N=2, significant secondary minerals	Kaolinite, Montmorillonite
<2		Montmorillonite changes to Kaolinite in top soil layers, deep weathering profile	Kaolinite, Montmorillonite
<1		Montmorillonite and kaolinite change to sesquioxides, very deep weathering profiles	Kaolinite, Sesquioxides

Figure 3 Weinert defined weathering characteristics as influenced by climate (Weinert, 1980).

The Weinert's N-value for this area is calculated to be **4.8** which indicate that mechanical disintegration of rocks will not be dominant over chemical decomposition. According to Thornthwaite's moisture index the area is between -20 and 0 (Figure 4) which indicates sub-humid environment (Weinert, 1980).

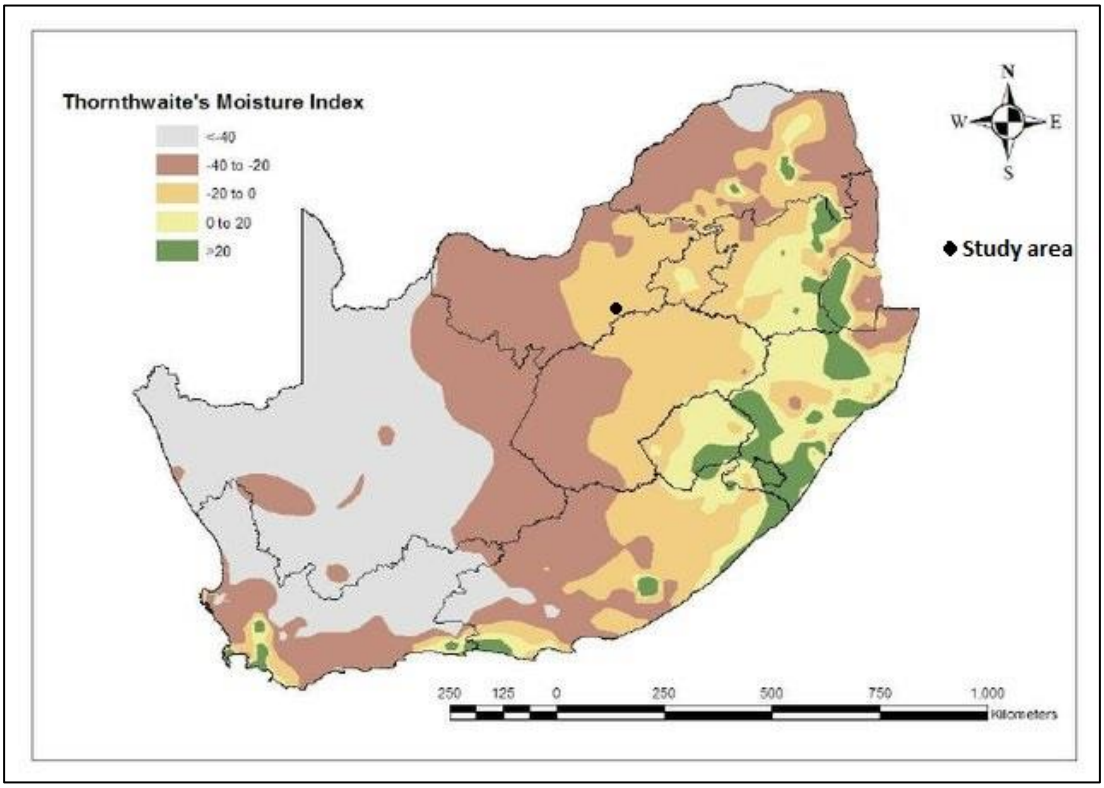

Figure 4 Thornthwaite's moisture index

2.5. VEGETATION

According to the 1: 1000 000 SANBI Vegetation map (2018), the site is regionally characterized by the Dry Sandy Highveld Grassland. The vegetation observed on site is dominantly grass.

2.6. LAND USE

The site under investigation is currently used as an active institutional land, with school building structures and sports fields (Figure 5).

Figure 5 Site condition and land use

3. GEOLOGY

3.1. REGIONAL GEOLOGY

According to the published 1:250 000 geological map sheet 2626 West Rand geological series, the investigation area lies on the sedimentary rocks belonging to the Kameeldoorns Formation which forms the base of Platberg Group of the Ventersdorp Supergroup (Figure 6). Kameeldoorns Formation is confined mainly to fault troughs (Visser, 1989), and its lithology includes shale, sandstone, tuff, limestone, conglomerate and breccia. At a regional scale, there are also amygdoidal lava and tuff of the Rietgat Formation overlying the sedimentary sequence. There are no soluble rocks (e.g. dolomite) underlying the site.

During fieldwork grey fine grained sandstone and maroon arkosic sandstone were encountered in the study area. Superficial deposits include colluvium covering the lithology.

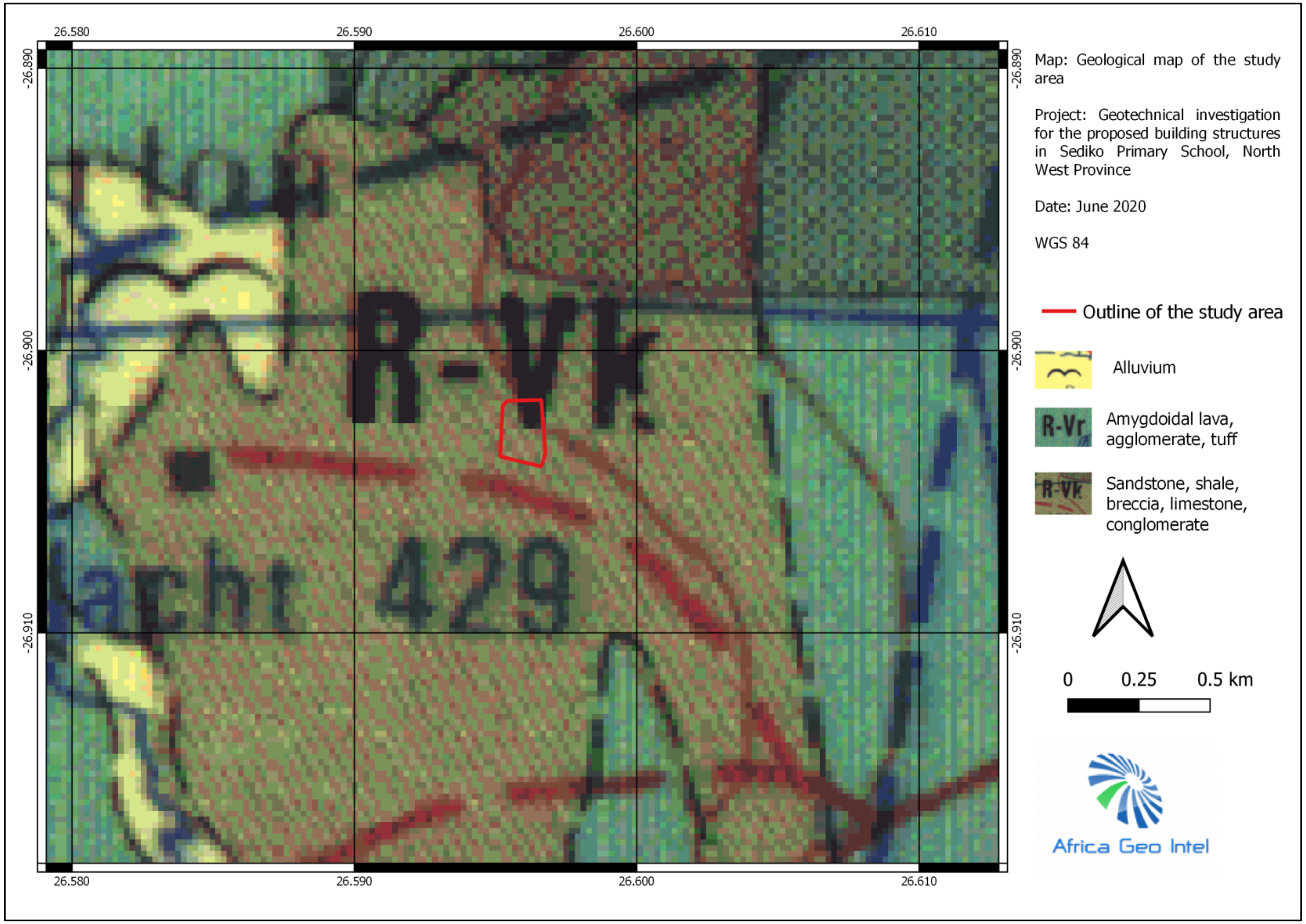

Figure 6 Regional geological map

3.2. REGIONAL HYDROGEOLOGY

Subterranean water in the study area is mainly associated with sedimentary rocks of Kameeldoorns Formation. These often undergo brittle deformation, resulting in numerous fracture structures enhancing the development of secondary porosity in these formations. These can therefore be classified as fractured aquifers. According to the published aquifer classification map (Department of water Affairs, 2012); the aquifer type in the study area can be classified as a minor aquifer, which is a moderately yielding system. In general these aquifers produce ≤ 2 ℓ/s in boreholes.

4. GEO – HAZARDS POTENTIALS

4.1. UNDER MINING

Based on the SANS 634 Geotechnical Investigation for Township Development, favorable conditions in aspect of undermining are regarded as areas with underground mining beyond 200 m depth from surface and the least favorable are those areas whereby underground mining is below less than 200 m from surface.

There are no immediate signs of mining activity within vicinity of the site area. However, there are historic and active mines within a 10 km radius from the study area.

4.2. DOLOMITE DISSOLUTION

Dissolution of dolomites or limestone rock over millions of years (karstification), results in the formation of sub-terrain caves and bedrock voids. These ultimately connect with the overburden (completely weathered bedrock, residual & colluvial soils), leading to the manifestation of sinkholes on surface.

The site geology is not susceptible to dissolution related subsidence or sinkhole formation as it is not characterized by dolomite.

4.3. SLOPE INSTABILITY

Slope stability is a function of slope height, slope face angle, soil and rock shear and cohesive properties (affected by water content), presence of unfavorably oriented discontinuities (joints, faults), plus external influences such as seismic accelerations, crest loading and toe erosion (rivers, sea waves, man-made excavations). Once the resisting forces of material land/or discontinuity shear strength are overcome, due to slope steepness and/or a critical reduction in material strength, movement will occur. There are numerous categories of slope failure, from wedge and planar type rock failures to landslides and earth flows.

The site area is located on a flat plain with ~ 4% slope gradient surrounded by flat lying area with gradient <6% steep. No landslip is expected specifically at the site.

4.4. SEISMIC HAZARDS

Seismic-hazard can be described as being the physical effects of an earthquake or earth tremor. (Kijko A et al, 2004). Earthquakes and mining activity are the common cause for seismic activity in South Africa. Kijko A et al define seismic hazards in South Africa as follows:

- *Earthquakes – the probability of tectonic-event occurrence has been estimated for different Modified Mercalli Scale intensity intervals, as well as for various peak ground accelerations.*
- *Mining Activities – the daily probability of occurrence of rock bursts in deep level gold and platinum mines.*

The peak ground acceleration (PGA) is the maximum acceleration of the ground shaking during an earthquake.

The seismic hazard map of South Africa (Kijko et al, 2003), indicates that site lies within an area where there is a 10% probability that Peak Ground Accelerations of **0.20 – 0.24 g** will be exceeded in 50 years (Figure 7).

There is high level of hazards in the vicinity of the area, and this is due to underground mining activities taking place in Klerksdorp.

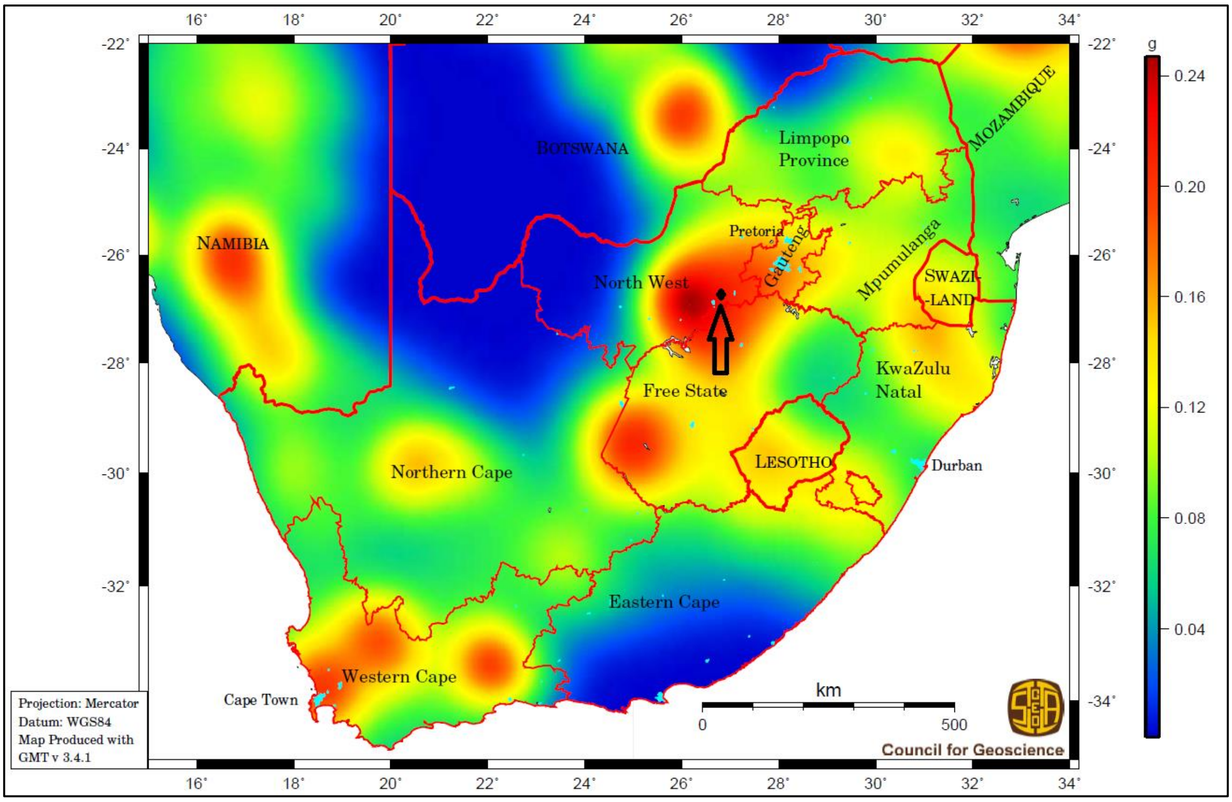

Figure 7 Peak ground acceleration (g) with a 10 % probability of being exceeded in a 50 year period.

4.5. Drainage & Flood Line

The proposed development area is located within the Middle Vaal Water Management Area. Drainage pattern surrounding the site resembles that of braid plain; however, no drainage channels intersect the site.

Surface runoff from the site is directed by natural gradient towards the west to eventually join Jagspruit which is a tributary to the Vaal River. Installed municipal storm water channels may divert runoff into dedicated drainage systems.

A 1:100 year flood line implies that an area below that line has a high probability of being flooded at least once in every hundred-year period. A similar contextual definition applies for the 1:50 year flood line. By law, residential developments below the 1:50 year flood line areas (Class $P_{(\text{flood zone})}$) are prohibited. This is due to the risk of flooding leading to property damage, health risks and possible injury or death.

There is not visible potential flood line within vicinity of the site / within 100 m radial distance.

5. SITE INVESTIGATION METHODS

The approach adopted was to plan the geotechnical site investigation in accordance with the published Site Investigation Code of Practice, published by The Geotechnical Division of the South African Institution of Civil Engineering (SAICE, 2008). The GFSH-2 and SANS 634 were also consulted.

5.1. DESKTOP STUDY

Desktop studies have entailed the examination of available published geological maps, a study of site geomorphology using satellite imagery and the reading of any existing engineering geological and geohydrological reports and/or web-sourced technical reports, within the immediate area.

5.2. SOIL PROFILING AND SAMPLING

Fieldwork was conducted on the 1st of June 2020. A total of four (4) shallow test pits were excavated across the site by means of a New Holland at a frequency not less than prescribed in the GFSH-2. The exposed soil horizons in each of the pits were identified and described comprehensively applying the MCCSSO technique as advocated by Jennings *et al*. (1973). The acronym – MCCSSO – stands for Moisture, Color, Consistency, Structure, Soil Type, and Origin (Appendix I). Note that due to erratic GPS satellite signal reception, the coordinates and elevations recorded will have an accuracy of only +/- 5 m.

5.3. DYNAMIC CONE PENETROMETER

A total of four (4) DCP tests were conducted adjacent to each test pit to obtain an indication of the in-situ CBR values for the subsoil. Measurements were taken at depths varying from the surface down to maximum of up to 150mm below surface due to refusal. Full DCP reports are presented in Appendix II.

5.4. LABORATORY

Disturbed soil samples were collected from selected soil horizons and test pits across the site for further analysis. The following tests were undertaken by a SANAS accredited commercial laboratory in order to assess the geotechnical properties of the founding soil strata and their suitability for use as backfill materials during construction.

- ***Foundation Indicator Tests** – used to establish the soil type, its potential for heave and give an indication of its suitability for use in pavement layers. The sample used to conduct tests was from a disturbed sample*
- ***California Bearing Ratio –** used to evaluate the strength/resistance of the material*
- ***pH and conductivity chemical Test –** to characterize the environment*

6. FIELDWORK RESULTS

6.1. SOIL PROFILING

The excavation of four (4) test pits across the site was conducted (Figure 8). The test pits generally indicated the following soil profiles to prevail at the site:

- ***Transported colluvium***
  - *Slightly moist, brown, slightly dense to moderately loose, intact, fine to coarse gravels of quartz and ferricrete within silty SAND matrix, cobbles of sandstone were also observed in KTP 4;*
  - *Slightly moist reddish brown mottled black, slightly dense, fine to medium gravels of well-rounded ferricrete within a silty SAND matrix*
- ***Bedrock***
  - *Dry, maroon speckled orange, very dense, fine-grained, slightly weathered arkosic SANDSTONE*
  - *Slightly moist, grey speckled red, very dense, fine-grained, slightly weathered SANDSTONE*

The soils encountered best describe by moderately loose to slightly dense, brown silty SAND material (in KTP 1, 2 and 4) with depth from surface ranging from 0 – (between 0.32 - 0.37 m). The material deposition mechanisms is of transported colluvium type deposition. This material is underlain by reddish brown mottled black silty sand, in KTP3 the reddish brown soil overlies the brown soil. At the bottom of the profiles, two types of sandstones were encountered; fine-grained grey sandstone and maroon arkosic sandstone. Figure 9 displays typical soil profiles encountered at the site; Table 1 shows a summary of the test pit profiles at the proposed site.

No seepage was encountered at the excavated pits. There was difficulty of excavation between 1 and 1.3m due to shallow bedrock.

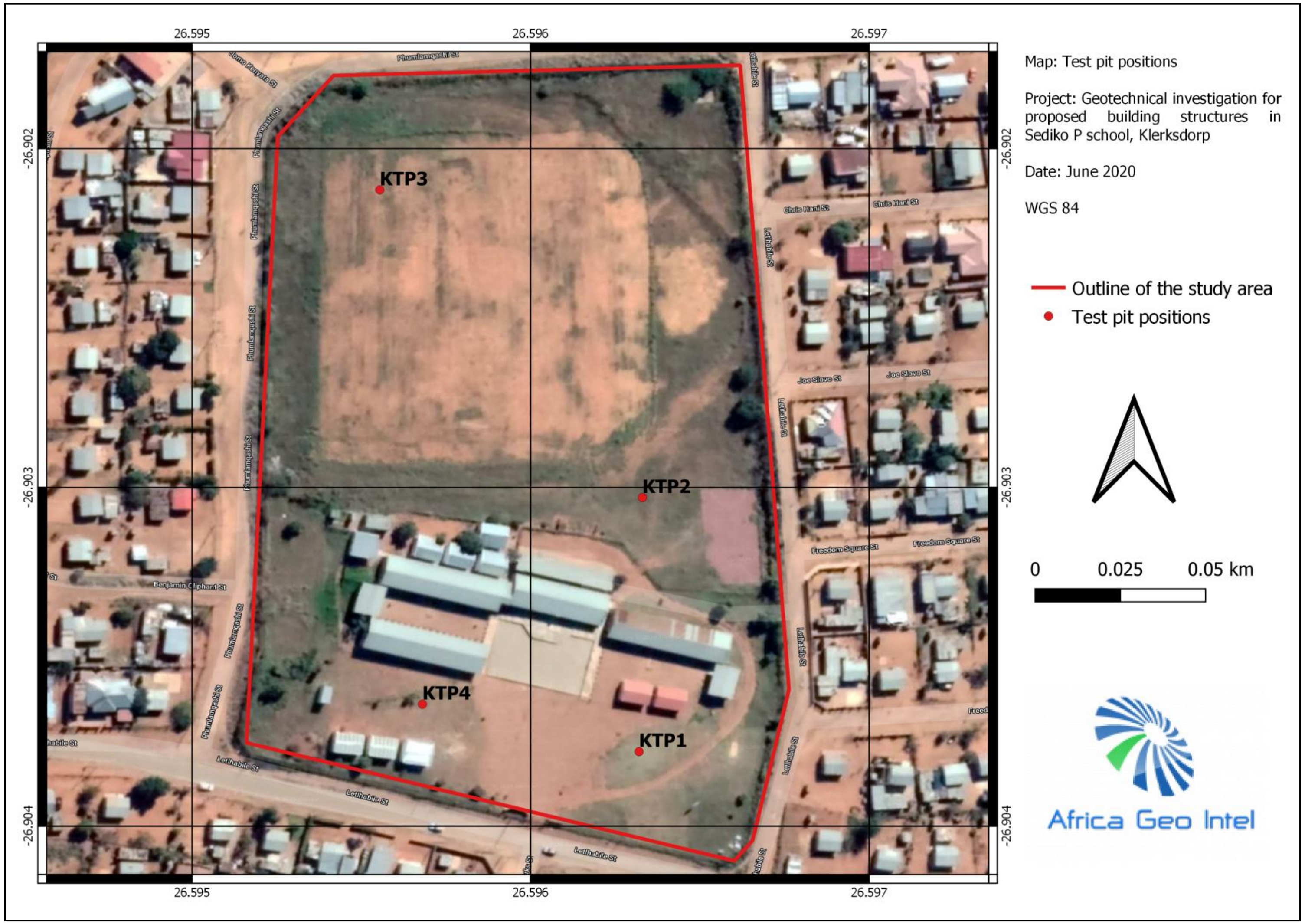

Figure 8 Test pit locations

Table 1 summary of test pit profiles

Test Pit number	x	y	Thickness of layers (m)			End of Pit (m)	Seepage depth (m)
			Transported colluvium	**Transported Colluvium**	**Bedrock**		
			Brown silty SAND with gravels quartz and ferricrete and cobbles of sandstone	***Reddish brown, fine to medium silty sand with ferricrete gravels***	***Fine-grained Sandstone***		
KTP1	26.59632°	-26.90378°	0-0.37	0.37-0.94	0.94-1.3	1.3	-
KTP2	26.59633°	-26.90303°	0-0.35	0.35-0.67	0.67-1	1	-
KTP3	26.59557°	-26.90211°	0.43-0.70	0-0.43	0.70-1.1	1.1	-
KTP4	26.59565°	-26.90364°	0-0.32	0.32-0.56	0.56-1.32	1.32	-

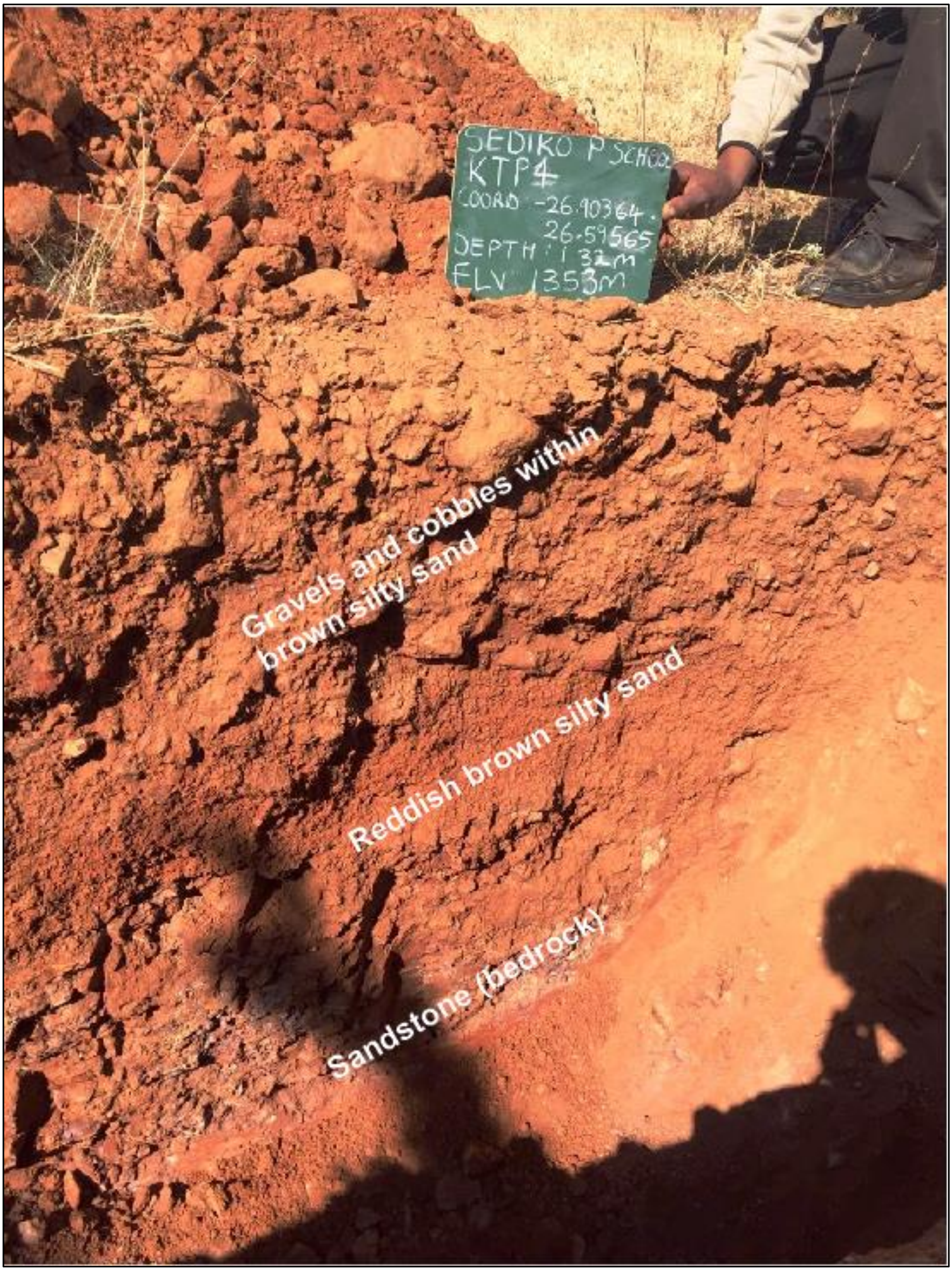

Figure 9 Typical soil profile encountered in site (KTP4)

6.2. DYNAMIC CONE PENETROMETER (DCP) TESTING

A total of four (4) DCP tests were conducted at each test pit in order to determine in-situ soil consistency and associated California Bearing Ratios (CBR). Measurements were taken at depths varying from the surface to 150 mm below ground level, most likely due du refusal at cobbles that are associated with the topsoil layer. The results should however only be used by an experienced foundation designer who appreciates the limitations of the test, especially with respect to the moisture content of the material being tested. The full comprehensive DCP results may be viewed under APPENDIX II.

6.3. LABORATORY TESTING

A total of four disturbed soil samples recovered from representative soil horizon in various test pits across the site were collected for further analysis. The laboratory tests included:

- *Foundation indicators: Sieve analyses, Atterberg limits, Hydrometer analyses*
- *California Bearing Ratio*
- *pH and electric conductivity*

7. SITE GEOTECHNICAL EVALUATION

7.1. GENERAL ASSESSMENTS

The purpose of this section is to evaluate the likely geotechnical properties of the project area against the typical geotechnical constraints for development as identified by Partridge et al (1993). Only those constraints identified as likely to affect development are evaluated in more detail below. A summary of site conditions compared to typical geotechnical constraints for development is shown in

Table 3. Collapsible soils are expected to be **medium** at the site, and the soil activity/heave potential is expected to be **low** due to lack of presence of fine clay fraction and the parent material of the soils. The compressibility of the soils at the site has not been tested but assessment from test pit profiling suggests low to moderate compressibility. The erodibility may be regarded as low due to adjacent slopes with a gradient of ≤4%. Some problems regarding excavatability can be expected on the site due to relatively shallow bedrock. No known underground mines were noted and the site is not underlain by a dolomitic terrane, hence no soluble rock is expected. No seepage or the presence of perennial fluctuations of ground water was encountered on site. The proposed specific site is not on steep slopes but rather on a relatively flat area of ≤4% gradient. The probability of flooding is remote for the site due to the natural gradient being above 1%.

7.2. POTENTIAL EXPANSIVE OR SWELLING SOILS

Damage to structures erected on potentially active soils occurs where the expansiveness has not been determined and necessary remedial measures not employed. The potential expansiveness of a soil depends upon its clay content, the type of clay mineral present, its chemical composition and mechanical character.

The method of Van der Merwe (1964) was used to determine the potential heave of soil samples. In addition to van der Merwe’s method, the plasticity index and linear shrinkage of soil samples were used to indicate the soils potential expansiveness.

Based on fieldwork and laboratory results, the potential expansiveness for soils encountered on site is **low**. This is due to the amount and type of clay/silt content for the material. As a result, the possibility of structural distress resulting from cyclic drying shrinkage in dry seasons and swell after wetting is regarded to be **low.**

7.3. SETTLEMENT AND COLLAPSE POTENTIAL

Collapsible soils can withstand relatively large imposed stresses with small settlements at low in situ moisture content, but this can increase rapidly when saturation wetting occurs under loaded (house) conditions. Such soils need to be subjected to an imposed pressure greater than their overburden pressure before collapse will take place. The volume change is associated with a change in the structure of the soil. It can occur in any open textured, clayey to silty sandy soils, with a high void ratio and generally low in-situ dry density.

Based on the encountered soil profiles, silty sand with gravels was dominant in the soil profiles; therefore compressibility and collapse are possible due to the material type and thickness. The potential soil settlement due to consolidation of soils resulting from imposed loads has **MEDIUM** probability at the site (Table 3). For normal single-storey class rooms, differential settlement of the building is only expected to be minor. However for double-storey school building structures, precautionary measures must be put into place.

7.4. DISPERSIVE SOILS

Dispersion can occur in any given soil with a high percentage of exchangeable sodium percentage (ESP). A dispersive soil is prone to desegregation or separation of clay particles from the soil mass upon contact with water. These soils can be identified in the field by the presence of erosion gullies, soil piping and areas of stunted growth and ponds of milky to cloudy water.

Although no dispersivity indicator tests were undertaken on any site soils, it is apparent from site observation that the soils may be classified as low dispersive.

7.5. SOIL AGGRESSIVENESS

Aggressiveness is the propensity of a soil to dissolve cement structures. This is mostly a function of total salt load, the sulphate level and the acidity.

Corrosion is most commonly the conversion of a metal to its oxide and consequent loss of strength and function. The most familiar form of corrosion is rust, which is a mixture of oxides of iron. Other metals can also become corroded, but rust is the biggest problem, both because iron is the commonest construction metal and because of the way iron rusts: Iron oxides take up more room than iron, and so rust expands, cracking structures.

The pH and electric conductivity of the soil indicate that they are alkaline with moderately low electric conductivity (Table 2). Problems associated with corrosion of buried structures are not anticipated at this site.

Table 2: Summary table for pH and electric conductivity

Sample	Depth (m)	pH	Electric conductivity ($S.m^{-1}$)
KTP 1	0.37-0.94	7.9	0.014

7.6. Excavatability

Excavatability is a high cost factor for development when installing underground services and foundations. The excavatability of materials across the site has been evaluated according to the South African Bureau of Standards' Standardized Specification for Civil Engineering Construction classification for earthworks. The site is dominantly characterized by transported material underlain by bed rock.

In terms of the above standard, the site can be classified as moderately soft excavation from surface up to depths of between 1 – 1.32m; and based on soil profiling; hard rock excavation is anticipated for all parts of the site at bedrock from depths of 1m. The following are two (2) classes of excavations anticipated on this site:

- ***Soft excavation****: Material which can be efficiently removed by a back-acting excavator of flywheel power > 0, 10 kW for each mm of tined-bucket width.*
- ***Hard excavation****: Material that cannot be efficiently ripped by a bulldozer having an approximate mass of 35 ton and a flywheel power of 220 kW.*

Table 3 Preliminary Geotechnical Classification of the site (Partridge *et al. 1993)*

CONSTRAINT		Most Favorable (1)	Intermediate (2)	Least favorable (3)
A	**Collapsible Soil**	Any collapsible horizon or consecutive horizons totaling a depth of less than 750mm in thickness.*	Any collapsible horizon or consecutive horizons with a depth of more than 750 mm in thickness.	A least favorable* situation for this constraint does not occur.
B	**Seepage**	Permanent or perched water table more than 1,5m below ground surface	Permanent or perched water table less than 1,5m below ground surface.	Swamps and marshes
C	**Active Soil**	Low soil-heave potential predicted*	Moderate soil heave potential predicted.	High soil heave potential predicted
D	**Highly compressible Soil**	Low soil compressibility expected *	Moderate soil compressibility expected	High soil compressibility expected
E	**Erodibility of soil**	Low	Intermediate	High
F	**Difficulty of excavation to 1.5m depth**	Scattered or occasional boulders less than 10% of the total volume	Rock or hardpan pedocretes between 10 and 40% of the total volume	Rock or hardpan pedocretes more than 40% of the total volume.
G	**Undermined ground –**	Undermining at a depth greater than 100m below surface	Old undermined areas to a depth of 100m below surface where stope closure has ceased	Mining within less than 100m of surface or where extraction mining total has taken place.
H	**Instability in areas of soluble rock –**	Possibly unstable	Probably unstable	Known sinkholes and dolines
I	**Steep slopes**	Between 2 and 6 degrees (all regions)	Slopes between 6 and 18 degrees and less than 2 degrees (Natal and Western Cape). Slopes between 6 and 12 degrees and less than 2 degrees	More than 18 degrees (Natal and Western Cape) More than 12 degrees (all other regions)
J	**Areas of unstable natural slope**	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 100cm/s²	Natural seismic activity more than 100 cm/s²
L	**Areas subject to flooding**	A “most favorable” 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.

Table 4 Summary of foundation indicator test

FOUNDATION INDICATOR											
Test Pit No.	**Sample Depth** (m)	**Particle Size (%)**				**Atterberg Limits (%)**			**GM**	**Vd Merwe PE**	**AASHTO /PRA/H.R.B.**
		Clay	***Silt***	***Fine Sand***	***Coarse Sand***	***LL***	***PI***	***LS***			
KTP 1	0-0.37	5	15	39	41			1.5	1.75	Low	
KTP 1	0.37-0.94	3	5	14	78	28	14	6	2.55	Low	A-2-6(0)
KTP 3	0.43-0.70 (small bag)	8	13	39	40	20	7	3.7	1.73	Low	A-2-4(0)
KTP 3	0.43-0.70 (big bag)	5	4	19	72	21	9	4	2.4	Low	A-2-4(0)
KTP 4	0.32-0.56	6	8	18	68	25	10	4	2.29	Low	A-2-4(0)

Table 5 Summary of California Bearing Ratio

CALIFORNIA BEARING RATIO										
Test Pit No.	Sample Depth (m)	Moisture Density Relationship		TRH 14	CBR @ 90% Mod. AASHTO	CBR @ 93% Mod. AASHTO	CBR @ 95% Mod. AASHTO	CBR @ 97% Mod. AASHTO	CBR @ 98% Mod. AASHTO	CBR @ 100% Mod. AASHTO
		Dry Density (kg/m3)	Optimum Moisture Content (%)							
KTP 1	0.37-0.94	2093	10.6	G6	28.4	33.2	37	41.1	43.3	48.2
KTP 3	0.47-0.70	2182	7.5	G6	26.6	31.4	35.1	39.2	41.4	46.2

7.7. SITE CLASSIFICATION & FOUNDATION RECOMMENDATION

The aim of this geotechnical investigation report is to determine the different engineering geological properties of the surface and subsurface soils in accordance with geotechnical practices. The intention is to be able to recommend for the foundation designs of single and/or double storey school building structures. Individual pits and their constituent horizons have been examined and the dominant geotechnical property assessed. The soil profiles of the site are similar; therefore recommendations apply to the whole studied area.

According to the unified soil classification system, the soils encountered on site can be classified as SC-SM (silty sand, sand-silt mixtures and sand-clay mixture) and GP-GC (Poorly graded gravels and clayey gravels). Based on this classification, these are expected to have Atterberg/consistency limits below A-line or plastic index less than 4 on the soil plasticity chart.

The site is characterized by silty sand which can be classified as potentially collapsing soils (C1), shallow bedrock (R) and by silty SAND material with low heave potential. Thus, the site in its entirety can be classified as C1, we recommend additional collapse potential tests conducted during construction phase on exposed foundations (Watermeyer and Tromp, 1992). The respective definitions of these site classes are available under APPENDIX IV. Collapsible soils confirmed during construction may be removed (0 – 1m) where feasible and if impractical, structures placed collapsible soils must consider strip footing / slab on the ground type of foundations. The foundation trenches must be well compacted to 95 Mod AASHTO and good site drainage designed for.

The character of the founding material is stable due to shallow bedrock <1.5 m below surface. However difficulties associated with excavation may be expected to 1.5m depth on site, therefore, additional provision for trench excavation should be considered.

The net bearing capacity may be problematic without pre-compaction of the material in order to reduce the expected potential primary settlements to some extent. Foundation pressures should not exceed the estimated allowable bearing capacities for the materials underlying the site. Based on the laboratory results, the soils underlying the study area can be classified as natural gravel (G6) according to TRH14 classification system. Therefore the estimated safe bearing capacities for colluvium and weathered sandstone are 250 kPa and 150-300 kPa, respectively.

There is no dolomite occurrence in the investigation area, therefore, no stability investigation is required.

The site contains potentially compressible and collapsible soils. Hence problems due to collapse potential of soil profiles under load may be anticipated, unless suitable precautionary measures are put in place. The following recommendations are proposed:

- Bearing pressure not to exceed 150kPa within 0 – 1 m depth and weathered sandstone profiles. Greater bearing capacities are expected on competent sandstone bedrock.
- Compaction of in-situ soils below individual footings
- compacted to 95% Mod AASHTO density at -1% to +2% of optimum moisture content.
- Normal construction with lightly reinforced strip foundation and light reinforcement in masonry.
- Foundation must be made in a way that will ensure adequate drainage system to prevent the accumulation of water next to building structures.

8. CONCLUSIONS

Based on the field and lab results, the overall conditions of the site are suitable for the proposed school building structures, provided that recommendations are adhered to. It is also important to note that comments and recommendations contained within this report are based on a limited number of test pits conducted. It is, therefore also recommended that all excavations and foundation trenches be inspected by a geotechnical engineer or engineering geologist to verify that the founding conditions are not at variance with those described in this report.

9. REFERENCES

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10. APPENDICES

APPENDIX I:

SOIL PROFILES

APPENDIX II

DYNAMIC CONE PENETROMETER (DCP)

APPENDIX III:

LABORATORY TESTS RESULTS

APPENDIX IV:

SITE CLASSIFICATION TABLES

APPENDIX I: SOIL PROFILES

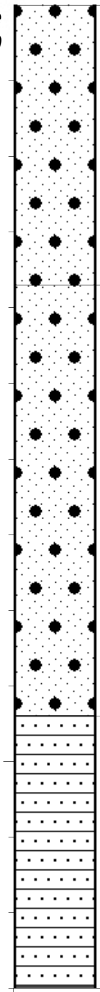
Africa Geo Intel

Mamadi & Company
GEOTECH INVESTIGATION: Sediko P School

HOLE No: KTP 1
Sheet 1 of 1

JOB NUMBER: 2020-053

Scale 1:10



Sample	Depth (m)	Description
	0.00	Slightly moist, brown, moderately loose, intact, gravels of ferricrete within silty SAND matrix with visible roots, sandstone cobbles also occur within this layer **Transported Colluvium**
0.37-0.94	0.37	Slightly moist, reddish brown mottled black, slightly dense, dominant medium gravels of ferricrete and occasional sandstone cobbles within silty SAND matrix, **TRANSPORTED COLLUVIUM**
	0.94	Slightly moist, maroon speckled orange, very dense, laminated, highly weathered SANDSTONE (arkose) **BEDROCK**
	1.30	

NOTES

1) No groundwater seepage

2) Machine refusal at 1.3m

3) sample at 0-0.37 & 0.37-0.94

CONTRACTOR :
MACHINE : Bell Hydraulic 2000
DRILLED BY :
PROFILED BY : Boniswa Magwaza

TYPE SET BY : Boniswa Magwaza
SETUP FILE : STANDARD.SET

INCLINATION : Vertical
DIAM :
DATE :
DATE : 01/06/20

DATE : 23/06/2020 13:47
TEXT : ..rp\SoilProfiles\KTP1.txt

ELEVATION : 1357m
X-COORD : 26.59632
Y-COORD : -26.90378

HOLE No: KTP 1

Africa Geo Intel

Mamadi & Company
GEOTECH INVESTIGATION: Sediko P School

LEGEND
Sheet 1 of 1

JOB NUMBER: 2020-053

	SAND	{SA04}
	SANDSTONE	{SA11}
	FERRICRETE	{SA24}
Name	DISTURBED SAMPLE	{SA38}

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY :

INCLINATION :
DIAM :
DATE :
DATE :

ELEVATION :
X-COORD :
Y-COORD :

TYPE SET BY : Boniswa Magwaza
SETUP FILE : STANDARD.SET

DATE : 23/06/2020 13:47
TEXT : ..rp\SoilProfiles\KTP1.txt

LEGEND
SUMMARY OF SYMBOLS

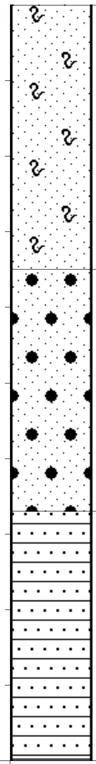
Africa Geo Intel

Mamadi & Company
GEOTECH INVESTIGATION: Sediko P School

HOLE No: KTP 2
Sheet 1 of 1

JOB NUMBER: 2020-053

Scale
1:10



0.00

Slightly moist, brown, moderately loose, pin-holed, intact, silty SAND with visible roots, **TRANSPORTED COLLUVIUM**

0.35

Slightly moist, reddish brown, slightly dense, fine gravels of ferricrete within silty SAND matrix with occasional sandstone cobbles **TRANSPORTED COLLUVIUM**

0.67

Slightly moist, grey speckled red, very dense, slightly weathered fine-grained SANDSTONE **BEDROCK**

1.00

NOTES

1) No groundwater seepage

2) Machine refusal at 1.0m

3) No Sample

CONTRACTOR :
MACHINE : Bell Hydraulic 2000
DRILLED BY :
PROFILED BY : Boniswa Magwaza

TYPE SET BY : Boniswa Magwaza
SETUP FILE : STANDARD.SET

INCLINATION : Vertical
DIAM :
DATE :
DATE : 01/06/20

DATE : 23/06/2020 13:43
TEXT : ..rp\SoilProfiles\KTP2.txt

ELEVATION : 1350m
X-COORD : 26.59633
Y-COORD : -26.90303

HOLE No: KTP 2

Mamadi & Company
GEOTECH INVESTIGATION: Sediko P School

LEGEND
Sheet 1 of 1

JOB NUMBER: 2020-053

Symbol	Description	Code
	SAND	{SA04}
	SANDSTONE	{SA11}
	FERRICRETE	{SA24}
	ROOTS	{SA40}

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY :
TYPE SET BY : Boniswa Magwaza
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE :
DATE : 23/06/2020 13:43
TEXT : ..rp\SoilProfiles\KTP2.txt

ELEVATION :
X-COORD :
Y-COORD :

LEGEND
SUMMARY OF SYMBOLS

Africa Geo Intel

Mamadi & Company
GEOTECH INVESTIGATION: Sediko P School

HOLE No: KTP 4
Sheet 1 of 1

JOB NUMBER: 2020-053

Scale 1:10

Depth (m)	Description
0.00 – 0.43	Slightly moist, <u>reddish</u> brown, slightly dense, intact, fine to medium <u>gravels</u> of ferricrete within silty SAND matrix with occasional sandstone cobbles **TRANSPORTED COLLUVIUM**
0.43 – 0.70	Slightly moist, <u>brown</u>, slightly dense, medium to coarse <u>gravels</u> of ferricrete and <u>cobbles</u> of sandstone within silty SAND matrix **TRANSPORTED COLLUVIUM**
0.70 – 1.00	Slightly moist, <u>maroon</u> speckled orange, very dense, slightly weathered fine-grained SANDSTONE (arkose) **BEDROCK**

Sample: *0.43-0.70*

NOTES

1) No groundwater seepage

2) Machine refusal at 1.0m

3) Samples at 0-0.43 & 0.43-0.70

CONTRACTOR :
MACHINE : Bell Hydraulic 2000
DRILLED BY :
PROFILED BY : Boniswa Magwaza

TYPE SET BY : Boniswa Magwaza
SETUP FILE : STANDARD.SET

INCLINATION : Vertical
DIAM :
DATE :
DATE : 01/06/20

DATE : 23/06/2020 13:47
TEXT : ..rp\SoilProfiles\KTP3.txt

ELEVATION : 1356m
X-COORD : 26.59557
Y-COORD : -26.90211

HOLE No: KTP 4

Mamadi & Company
GEOTECH INVESTIGATION: Sediko P School

LEGEND
Sheet 1 of 1

JOB NUMBER: 2020-053

	SAND	{SA04}
	SANDSTONE	{SA11}
	FERRICRETE	{SA24}
Name	DISTURBED SAMPLE	{SA38}

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY :
TYPE SET BY : Boniswa Magwaza
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE :
DATE : 23/06/2020 13:47
TEXT : ..rp\SoilProfiles\KTP3.txt

ELEVATION :
X-COORD :
Y-COORD :

LEGEND
SUMMARY OF SYMBOLS

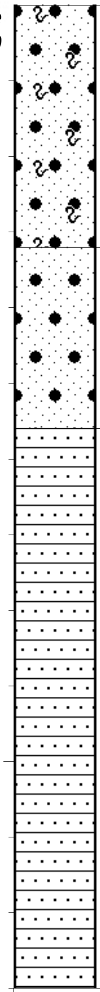
Africa Geo Intel

Mamadi & Company
GEOTECH INVESTIGATION: Sediko P School

HOLE No: KTP 4
Sheet 1 of 1

JOB NUMBER: 2020-053

Scale 1:10



Depth	Description
0.00	Slightly moist, brown, moderately dense, intact, coarse gravels of quartz and well-rounded fine ferricrete gravels within silty SAND matrix with visible roots, sandstone cobbles also occasionally occur within this layer **Transported Colluvium**
0.32	Slightly moist, maroon speckled black, moderately loose, rounded finr gravels of ferricrete within silty SAND matrix, **TRANSPORTED COLLUVIUM**
0.56	Dry, maroon speckled orange, very dense, fine-grained weathered SANDSTONE (arkose) **BEDROCK**
1.30	

0.32-0.56 (sample)

NOTES

1) No groundwater seepage

2) Machine refusal at 1.32m

3) sample at 0.32-0.56

CONTRACTOR :
MACHINE : Bell Hydraulic 2000
DRILLED BY :
PROFILED BY : Boniswa Magwaza

TYPE SET BY : Boniswa Magwaza
SETUP FILE : STANDARD.SET

INCLINATION : Vertical
DIAM :
DATE :
DATE : 01/06/20

DATE : 23/06/2020 13:50
TEXT : ..rp\SoilProfiles\KTP4.txt

ELEVATION : 1353m
X-COORD : 26.59565
Y-COORD : -26.90364

HOLE No: KTP 4

Africa Geo Intel

Mamadi & Company
GEOTECH INVESTIGATION: Sediko P School

LEGEND
Sheet 1 of 1

JOB NUMBER: 2020-053

	SAND	{SA04}
	SANDSTONE	{SA11}
	FERRICRETE	{SA24}
Name	DISTURBED SAMPLE	{SA38}
	ROOTS	{SA40}

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY :

INCLINATION :
DIAM :
DATE :
DATE :

ELEVATION :
X-COORD :
Y-COORD :

TYPE SET BY : Boniswa Magwaza
SETUP FILE : STANDARD.SET

DATE : 23/06/2020 13:50
TEXT : ..rp\SoilProfiles\KTP4.txt

LEGEND
SUMMARY OF SYMBOLS

APPENDIX II: DYNAMIC CONE PENETROMETER (DCP)

Dynamic Cone Penetration Test 1

Project	:	Geotech for school building structures	Start Depth	0m
Client	:	Mamadi & Company	Operator	Boniswa
Location	:	DCP01	Instrument Type	Two metre DCP
Date Tested	:	01-06-2020	Date Processed	15/06/2020
Layer	:	**Insitu**		

No. of Blows	**Instrument Reading**	**Depth in mm**	**mm per blow**	**Comments**
	2000	0		
5	1980	20	4.0	
10	1960	40	8.0	
15	1950	50	10.0	
20	1920	80	16.0	
25	1910	90	18.0	
30	1900	100	20.0	
35	1890	110	22.0	
40	1890	110	22.0	
45	Refusal			Refusal is most likely due to abundant gravels and cobbles in places

Dynamic Cone Penetration Test 2

Project	:	Geotech for school building structures	Start Depth	0m
Client	:	Mamadi & Company	Operator	Boniswa
Location	:	DCP02	Instrument Type	Two metre DCP
Date Tested	:	01-06-2020	Date Processed	15/06/2020
Layer	:	**Insitu**		

No. of Blows	**Instrument Reading**	**Depth in mm**	**mm per blow**	**Comments**
	2000			
5	1970	30	6.0	
10	1920	80	16.0	
15	1900	100	20.0	
20	1890	110	22.0	
25	1860	140	28.0	
30	1850	150	30.0	
35	1850	150	30.0	
35	Refusal			Refusal is most likely due to abundant gravels and cobbles associated with the soil profiles

Dynamic Cone Penetration Test 3

Project	:	Geotech for school building structures	Start Depth	0m
Client	:	Mamadi & Company	Operator	Boniswa
Location	:	DCP03	Instrument Type	Two metre DCP
Date Tested	:	01-06-2020	Date Processed	15/06/2020
Layer	:	**Insitu**		

No. of Blows	**Instrument Reading**	**Depth in mm**	**mm per blow**	**Comments**
	2000			
5	1970	70	14.0	
10	1890	110	22.0	
15	1890	110	22.0	
20	1889	111	22.2	
25	1860	140	28.0	
29	Refusal			Refusal is most likely due to abundant gravels and cobbles associated with the soil profiles

Dynamic Cone Penetration Test 4

Project	:	Geotech for school building structures	Start Depth	0m
Client	:	Mamadi & Company	Operator	Boniswa
Location	:	DCP04	Instrument Type	Two metre DCP
Date Tested	:	01-06-2020	Date Processed	15/06/2020
Layer	:	**Insitu**		

No. of Blows	**Instrument Reading**	**Depth in mm**	**mm per blow**	**Comments**
	2000			
5	1970	40	8.0	
10	1930	70	14.0	
15	1910	90	18.0	
20	1900	100	20.0	
25	1900	100	20.0	
30	Refusal			Refusal is most likely due to abundant gravels and cobbles associated with the soil profiles

APPENDIX III:

SOIL LABORATORY TESTING RESUTLS

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E-mail: jhb@civilab.co.za•Website: www.civilab.co.za

sanas Testing Laboratory T0062

Civilab

Civil Engineering Testing Laboratories

Client : YAMI YAKHO T/A AFRICA GEO INTEL (COO)
Address : 8 HELIKON VILLA
: 28 HORINGBEK AVENUE
: HELIKON PARK

Client Reference :
Order No. : Melusi

Attention :
Facsimile :
E-mail : info@africageointel.co.za

Date Received : 08/06/2020
Date Tested : 08/06/2020 - 13/07/2020
Date Reported : 13/07/2020

Project : Klerksdorp to Mafikeng Geotech
Project No. : 2020-B-574

Report Status : Final
Page : 1 of 15

Herewith please find the test report(s) pertaining to the above project. All tests were conducted in accordance with prescribed test method(s). Information herein consists of the following:

Test(s) conducted / Item(s) measured	Qty.	Test Method(s)	Authorized By**	Page(s)
Moisture Density Relationship	4.000	SANS 3001 GR30	B Mvubu/S Pullen	10-13
pH of Soil *	2.000	TMH1 A20	S Pullen	2-3
Conductivity of saturated soil paste *	2.000	TMH1 A21T	S Pullen	2-3
Atterberg Limits <0.425mm	12.000	SANS 3001 GR10	S Pullen/B Mvubu	4-9, 14-15
Sieve Analysis 0.075mm	12.000	SANS 3001 GR1	S Pullen/B Mvubu	4-9, 14-15
California Bearing Ratio (CBR)	4.000	SANS 3001 GR40	S Pullen	14-15

Any test results contained in this report and marked with * in the table above are "not SANAS accredited" and are not included in the schedule of accreditation for this laboratory.

Any information contained in this test report pertain only to the areas and/or samples tested. Documents may only be reproduced or published in their full context.

While every care is taken to ensure that all tests are carried out in accordance with recognised standards, neither Civilab (Proprietary) Limited nor its employess shall be liable in any way whatsoever for any error made in the execution or reporting of tests or any erroneous conclusions drawn therefrom or for any consequences thereof.

All interpretations, Interpolations, Opinions and/or Classifications contained in this report falls outside our scope of accreditation.

The following parameters, where applicable, were excluded from the classification procedure: Chemical modifications, Additional fines, Fractured Faces, Soluble Salts, pH, Conductivity, Coarse Sand Ratio, Durability (COLTO: G4-G9).

The following parameters, where applicable, were assumed: Rock types were assumed to be of an Arenaceous nature with Siliceous cementing material.

Unless otherwise requested or stated, all samples will be discarded after a period of 3 months.

This report is completely confidential between the parties (Civilab and Civilab`s client) and shall not be disclosed to anybody else, unless agreed upon in writing or made publicly available by the client or required to make available by law.

Deviations in Test Methods:

Technical Signatory:	
Signature:	

**All results are authorized electronically by approved managers and/or technical signatories.

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sanas Testing Laboratory T0062

Civilab

Civil Engineering Testing Laboratories

Client	:	YAMI YAKHO T/A AFRICA GEO INTEL (COO)	Date Received:	08/06/2020
Project	:	Klerksdorp to Mafikeng Geotech	Date Reported:	13/07/2020
Project No	:	2020-B-574	Page No. :	3 of 15

AGGREGATE TEST REPORT

Laboratory Number		9
Field Number		KTP1
Client Reference		
Depth (m)		0.37-0.94
Position		
Coordinates	X	
	Y	
Description		
Additional Information		
Calcrete/Crushed		
Stabilizing Agent		

	% Passing		mm	
			mm	
			mm	
			mm	
			mm	
			mm	
			mm	
			mm	
			mm	
			mm	
			mm	
			mm	
			mm	
			mm	
			mm	
			mm	
			mm	
			mm	
			mm	
Sand Equivalent, Se				
pH				7.9
Relative Density of Soils				
Durability Mill Index				
Moisture Content			%	
Compactibility Factor				
Conductivity			$S.m^{-1}$	0.014
Total Water Soluble	Salts		%	
	Sulphates			
Soluble	Salts		%	
	Sulphates			
Soundness	Fine		%	
	Coarse			
	Fractions		No.	
Methylene Blue Absorption				
Soluble Deleterious Impurities			%	
Chloride Content			%	
Low Density Material			%	
Presence of Sugar				
Mill Abrasion				
Treton Value				
Vialit Adhesion @	5°C		%	
	25°C		%	

Finess Modulus				
Clay Content		SANS 3001 GR3	%	3
Organic Impurities			Ref.	
Flakiness Index	Total		%	
Average Least Dimension	Manual		mm	
	Machine			
	Computation			
Aggregate Crushing Value	Dry		%	
	Wet			
	Eth. Glycol			
10% Fines Aggregate Crushing Test (FACT)	Dry		kN	
	Wet			
	Eth. Glycol			
	Wet/Dry Ratio		%	
Bulk Density	Loose		kg/m^3	
	Compacted			
Water Absorption			%	
Bulk Particle Density			kg/m^3	
	Aggregate			
Apparent Particle Density			kg/m^3	
	Adjusted			
	Relative			
LA Abrasion	1000 Revs		%	
	500 Revs			
Riedel & Weber				
Akali Silica Reaction			%	
Drying Shrinkage			%	
Wetting Expansion			%	
Fractured Faces			%	
Coarse Sand Ratio			%	
Shape: Voids			%	
Shell Content			%	
Durability	Ballast			
Eth. Glycol	Concrete			
Durability on	Crushed			
_ Stone	Seal			

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T0062

Civilab

Civil Engineering Testing Laboratories

Client	:	YAMI YAKHO T/A AFRICA GEO INTEL (COO)	Date Received:	08/06/2020
Project	:	Klerksdorp to Mafikeng Geotech	Date Reported:	13/07/2020
Project No	:	2020-B-574	Page No. :	8 of 15

FOUNDATION INDICATOR

Laboratory Number		9 ◆	10 ■
Field Number		KTP1	KTP3
Client Reference			
Depth (m)		0.37-0.94	0.43-0.70
Position			
Coordinates	X		
	Y		
Description			
Aditional Information			
Calcrete / Crushed			
Stabilizing Agent			

Moisture Content & Relative Density SANS 3001 GR30

Moisture Content (%)		
Relative Density (S.G.)		

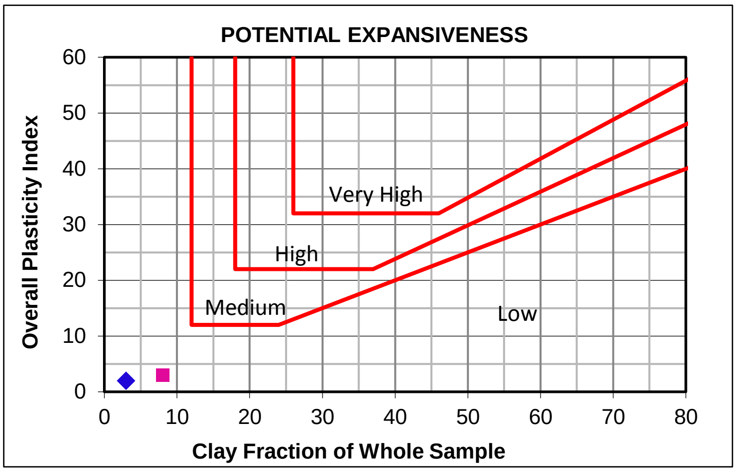
Sieve Analysis (Wet Prep) SANS 3001 GR1

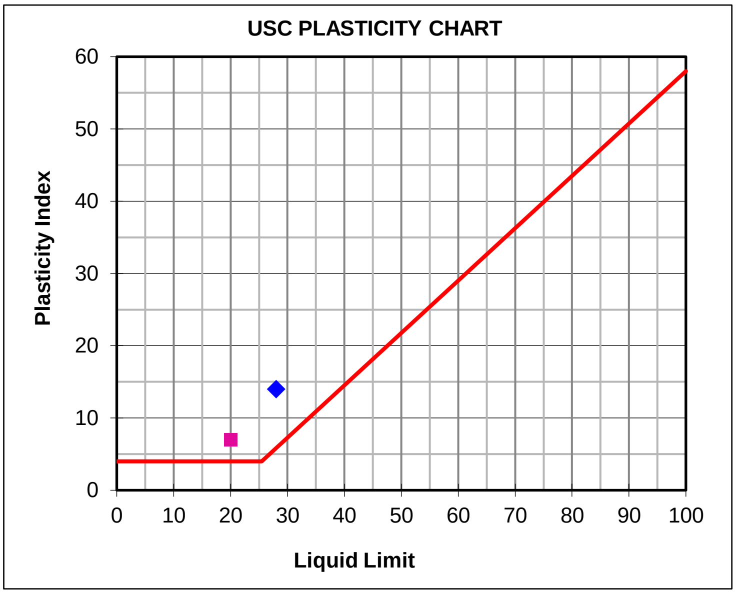
Percentage Passing	100 mm	100	100
	75 mm	93	100
	63 mm	84	100
	50 mm	79	100
	37.5 mm	76	100
	28 mm	76	100
	20 mm	76	100
	14 mm	56	89
	5 mm	35	74
	2 mm	22	60
	1 mm	18	53
	0.425 mm	13	43
	0.250 mm	12	39
	0.150 mm	12	35
	0.075 mm	10	24
Grading Modulus		2.55	1.73

Hydrometer Analysis SANS 3001 GR3

Percentage Passing	0.060 mm	8	21
	0.040 mm	6	16
	0.020 mm	5	13
	0.006 mm	4	11
	0.002 mm	3	8
Gravel	%	78	40
Sand	%	14	39
Silt	%	5	13
Clay	%	3	8

Note: An assumed S.G. may be used in Hydrometer Analysis calculations

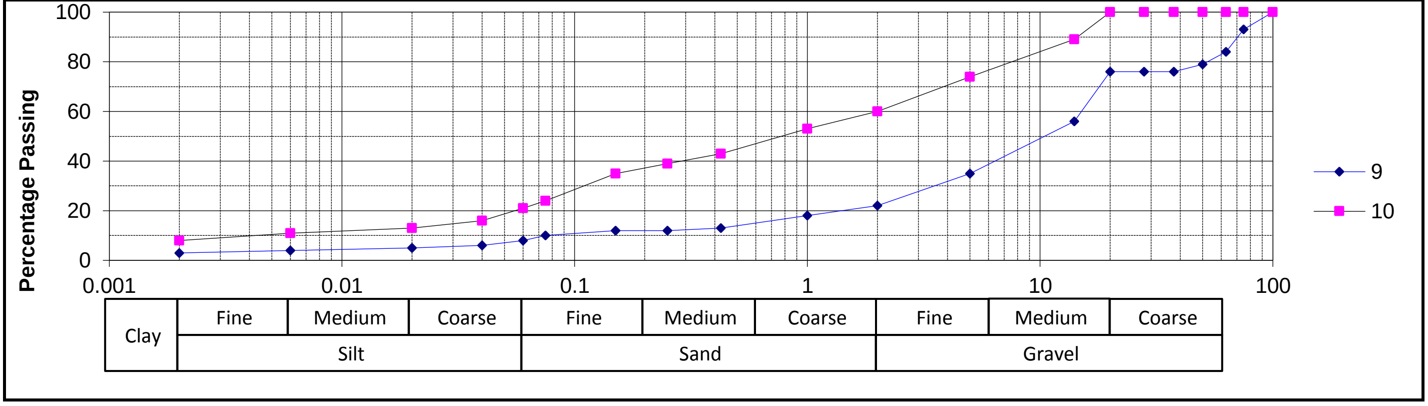




Laboratory Number		9 ◆	10 ■
Atterberg Limits -425µ		**SANS 3001 GR10**	
Liquid Limit	%	28	20
Plasticity Index	%	14	7
Linear Shrinkage	%	6.0	3.5
Overall PI	%	2	3

Classifications

HRB (AASHTO)	A-2-6(0)	A-2-4(0)
Unified (ASTM D2487)	GP-GC	SC-SM
Weston Swell @ 1 kPa		



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Client	:	YAMI YAKHO T/A AFRICA GEO INTEL (COO)	Date Received:	08/06/2020
Project	:	Klerksdorp to Mafikeng Geotech	Date Reported:	13/07/2020
Project No	:	2020-B-574	Page No. :	9 of 15

FOUNDATION INDICATOR

Laboratory Number		11	12
Field Number		KTP3	KTP4
Client Reference			
Depth (m)		0.47-0.70	0.35-0.56
Position			
Coordinates	X		
	Y		
Description			
Aditional Information			
Calcrete / Crushed			
Stabilizing Agent			

Moisture Content & Relative Density SANS 3001 GR30

Moisture Content (%)		
Relative Density (S.G.)		

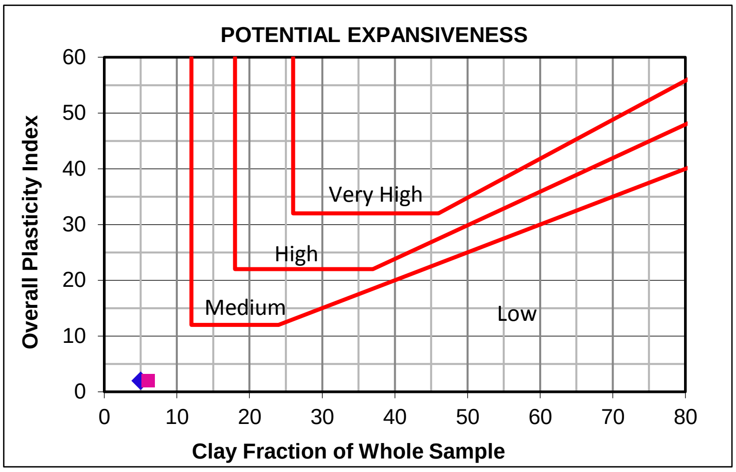
Sieve Analysis (Wet Prep) SANS 3001 GR1

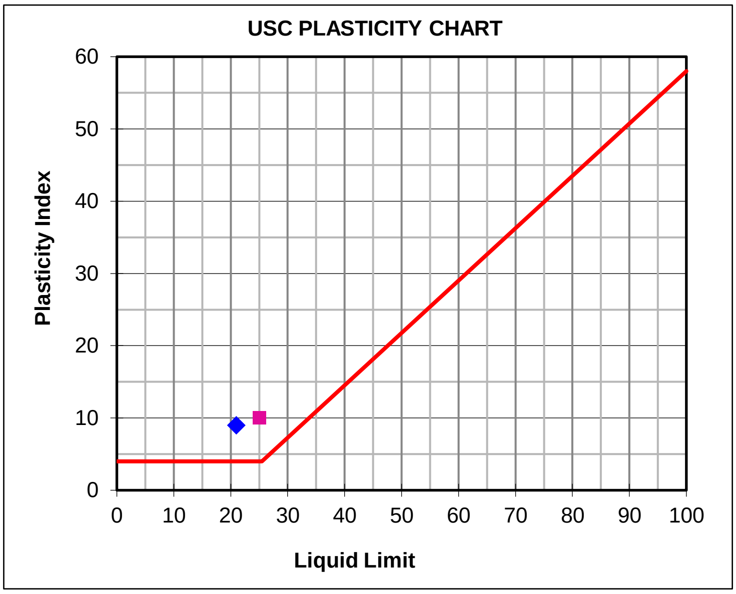
		11	12
Percentage Passing	100 mm	100	100
	75 mm	100	100
	63 mm	100	100
	50 mm	94	100
	37.5 mm	81	100
	28 mm	76	100
	20 mm	72	100
	14 mm	65	95
	5 mm	39	77
	2 mm	28	32
	1 mm	25	27
	0.425 mm	20	24
	0.250 mm	19	23
	0.150 mm	17	21
	0.075 mm	12	15
Grading Modulus		2.40	2.29

Hydrometer Analysis SANS 3001 GR3

		11	12
Percentage Passing	0.060 mm	9	14
	0.040 mm	8	10
	0.020 mm	7	9
	0.006 mm	6	7
	0.002 mm	5	6
Gravel	%	72	68
Sand	%	19	18
Silt	%	4	8
Clay	%	5	6

Note: An assumed S.G. may be used in Hydrometer Analysis calculations

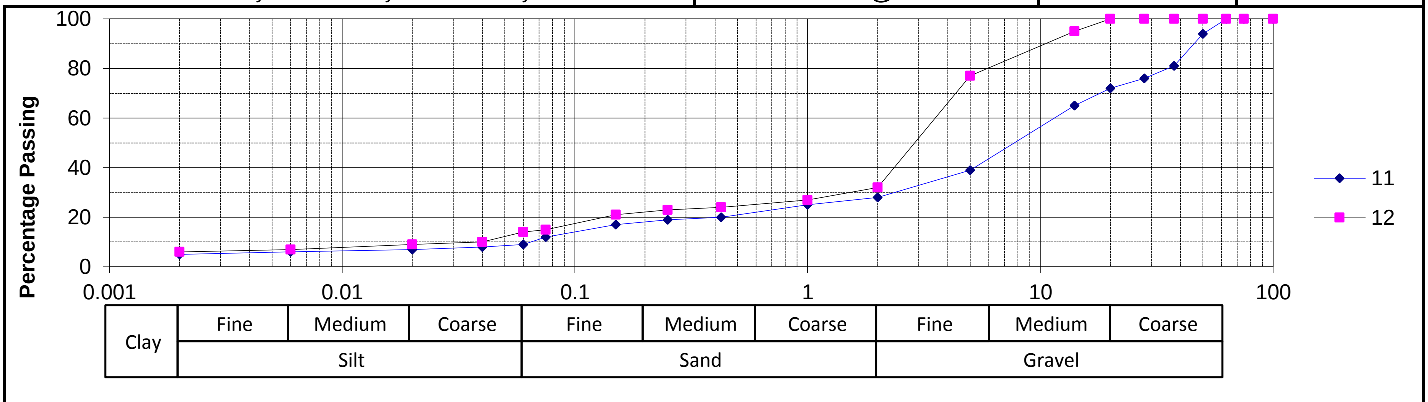




Laboratory Number		11	12
Atterberg Limits -425µ	**SANS 3001 GR10**		
Liquid Limit	%	21	25
Plasticity Index	%	9	10
Linear Shrinkage	%	4.0	4.0
Overall PI	%	2	2

Classifications

HRB (AASHTO)	A-2-4(0)	A-2-4(0)
Unified (ASTM D2487)	GP-GC	SC
Weston Swell @ 1 kPa		



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MOISTURE DENSITY RELATIONSHIP

Laboratory Number		9
Field Number		KTP1
Client Reference		
Depth (m)		0.37-0.94
Position		
Coordinates	X	
	Y	
Description		
Additional Information		
Calcrete / Crushed		
Stabilizing Agent		

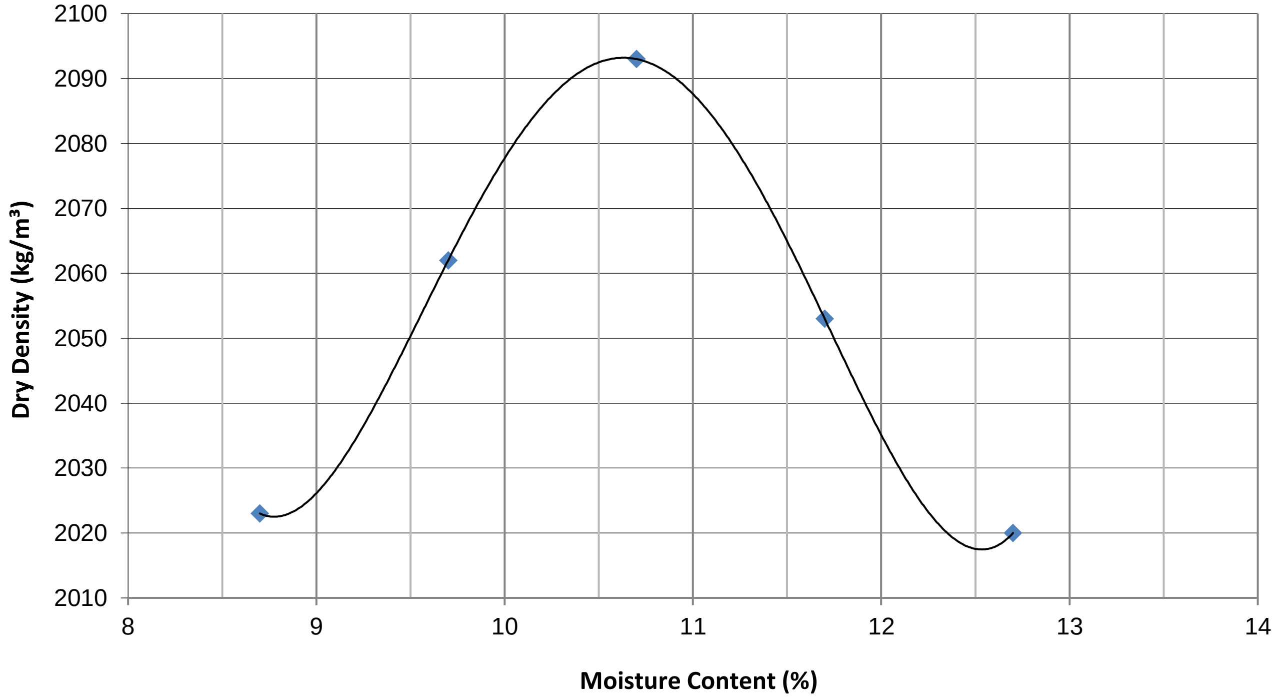
Maximum Dry Density & Optimum Moisture Content - SANS 3001 GR30

Compactive Effort:	Modified AASHTO

Dry Density	kg/m³	2023	2062	2093	2053	2020	
Moisture Content	%	8.7	9.7	10.7	11.7	12.7	

Max. Dry Density	kg/m³	2093
Optimum Moisture	%	10.6

NB! Air-Void curves might be based on assumend Specific Gravity values.



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Client :	YAMI YAKHO T/A AFRICA GEO INTEL (COO)	Date Received:	08/06/2020
Project :	Klerksdorp to Mafikeng Geotech	Date Reported:	13/07/2020
Project No:	2020-B-574	Page No. :	13 of 15

MOISTURE DENSITY RELATIONSHIP

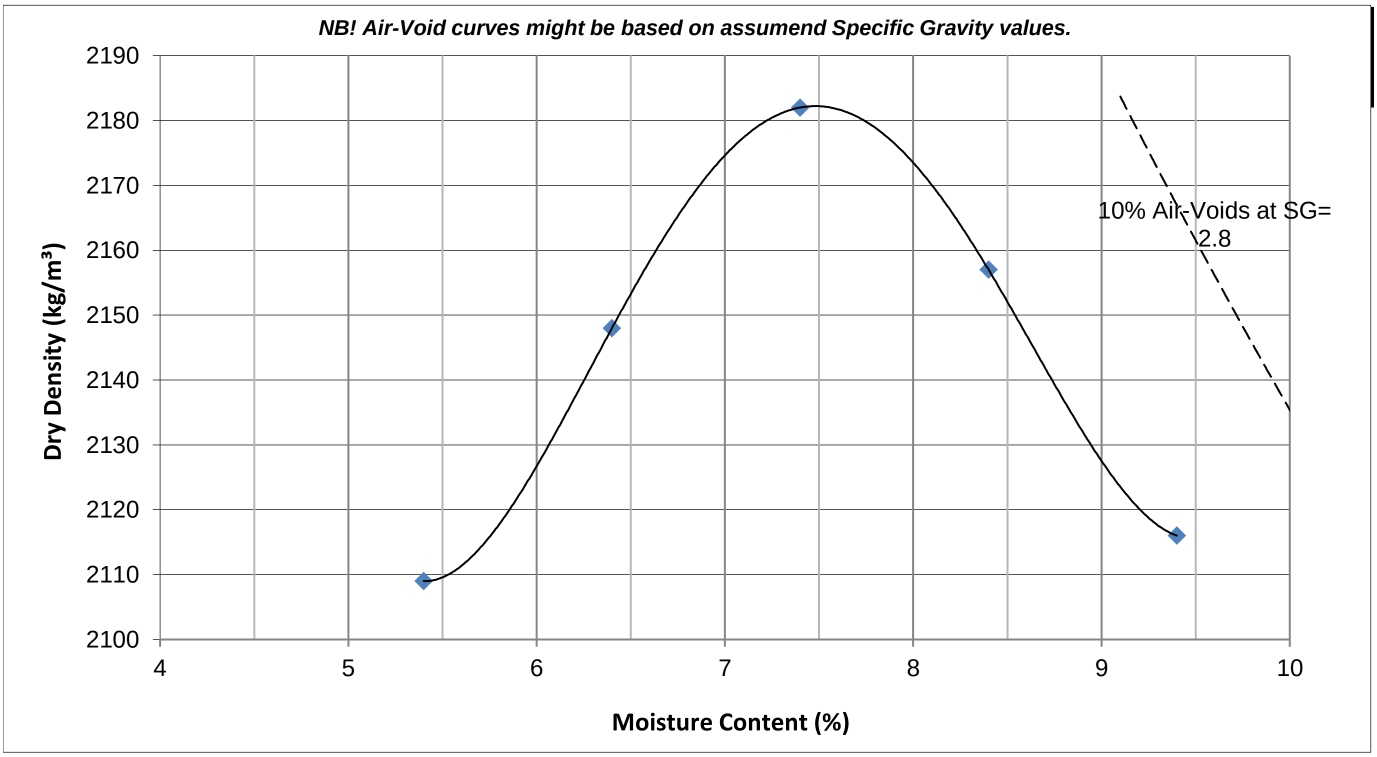
Laboratory Number		11
Field Number		KTP3
Client Reference		
Depth (m)		0.47-0.70
Position		
Coordinates	X	
	Y	
Description		
Additional Information		
Calcrete / Crushed		
Stabilizing Agent		

Maximum Dry Density & Optimum Moisture Content - SANS 3001 GR30

Compactive Effort:	

Dry Density	kg/m³	2109	2148	2182	2157	2116	
Moisture Content	%	5.4	6.4	7.4	8.4	9.4	

Max. Dry Density	kg/m³	2182
Optimum Moisture	%	7.5



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Client	:	YAMI YAKHO T/A AFRICA GEO INTEL (COO)	Date Received	:	08/06/2020
Project	:	Klerksdorp to Mafikeng Geotech	Date Reported	:	13/07/2020
Project No.	:	2020-B-574	Page No.	:	15 of 15

CALIFORNIA BEARING RATIO (CBR) & ROAD INDICATOR REPORT

Laboratory No.		9	11
Field Number		KTP1	KTP3
Client Reference			
Depth (m)		0.37-0.94	0.47-0.70
Position			
Coordinates	X		
	Y		
Description			
Additional information			
Calcrete/Crushed			
Stabilizing Agent			

Sieve Analysis (Wet preparation) SANS 3001 GR1

		9	11
Percentage Passing	100 mm	100	100
	75 mm	93	100
	63 mm	84	100
	50 mm	79	94
	37.5 mm	76	81
	28 mm	76	76
	20 mm	76	72
	14 mm	56	65
	5 mm	35	39
	2 mm	22	28
	1 mm	18	25
	0.425 mm	13	20
	0.250 mm	12	19
	0.150 mm	12	17
	0.075 mm	10	12
Grading Modulus		2.6	2.4

Soil Mortar Analysis

	9	11
Coarse Sand	41	29
Coarse Fine Sand	3	5
Medium Fine Sand	4	7
Fine Fine Sand	8	17
Silt and Clay	44	43

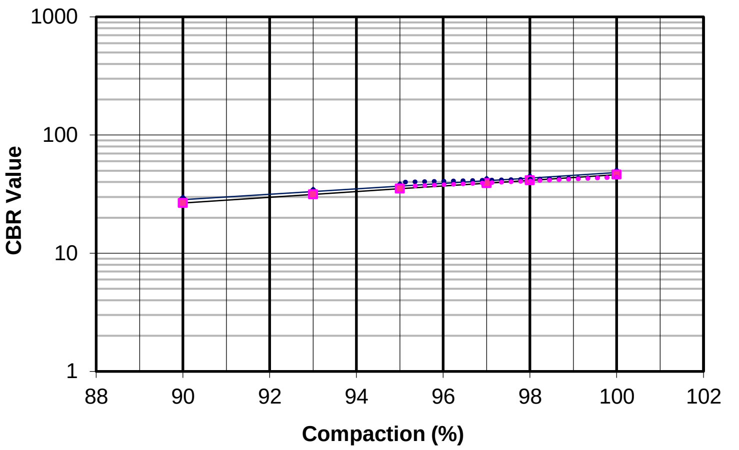
Atterberg Limits SANS 3001 GR10

	9	11
Liquid Limit (%)	28	21
Plasticity Index (%)	14	9
Linear Shrinkage (%)	6.0	4.0

Laboratory No.		9	11
Maximum Dry Density & Optimum Moisture Content			**SANS 3001 GR30**
MDD	kg/m^3	2093	2182
OMC	%	10.6	7.5

California Bearing Ratio **SANS 3001 GR40**

Compaction Data							
Moisture	%	10.3			7.5		
Dry Density	kg/m^3	2111	2007	1908	2212	2108	1997
Compaction	%	100.0	95.1	90.4	100.0	95.3	90.3
Penetration Data							
CBR at	2.50 mm	44	40	29	44	37	27
	5.00 mm	49	40	28	57	50	28
	7.50 mm	53	38	27	61	55	28
Swell	%	0.4	0.4	0.6	0.1	0.1	0.1
Final Moisture (%)		12.3	12.9	14	9	10.8	14.4

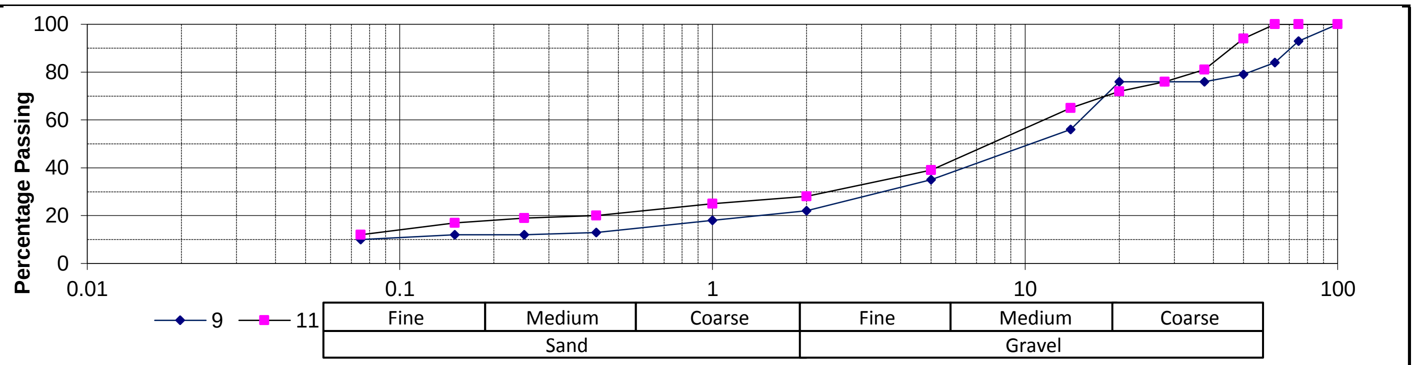


Interpolated CBR Data

		9	11
CBR Mod. AASHTO	@ 100%	48	46
	@ 98%	43	41
	@ 97%	41	39
	@ 95%	37	35
	@ 93%	33	31
	@ 90%	28	27
	@ SANS3001 Midpoint	42	41

Classifications

	9	11
HRB (AASHTO)	A-2-6(0)	A-2-4(0)
COLTO	G7	G6
TRH14	G6	G6



APPENDIX IV: SITE CLASSIFICATION TABLES (Watermeyer and Tromp, 1992)

Typical foundation material	Character of founding material	Expected range of total soil movements (mm)	Assumed differential movement (% of total)	Site class
Rock excluding mudrock which may exhibit swelling to some depth	*Stable*	*Neligible*	*-*	*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 sand, sand, sandy and gravely soils	*Compressible and potentially collapsible soils*	*<5* *5-10* *>10*	*75%* *75%* *75%*	*C* *C1* *C2*
Fine-grained soils (clayey silt and clayey sands of low plasticity, sands, sandy and gravelly soils	*Collapsible soils*	*<10* *10-20* *>20*	*50%* *50%* *50%*	*S* *S1* *S2*
Contaminated soils, controlled fills, dolomitic areas, landslip, *Landfill, marshy areas, mine waste fill, mining subsidence, reclaimed areas, uncontrolled fill, very soft silt/silty clays*	*Variable*	*Variable*		*P*