

# GEOTECHNICAL CONDITIONS ON ERVEN 1, 45 AND 47 OF WEGDRAAI: A REPORT FOR THE EXPANSION AND FORMALISATION OF WEGDRAAI COMMUNITY

2020/J09/MCP\_01



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## EXECUTIVE SUMMARY

### **1 INTRODUCTION**

*It is envisaged to develop some 43 hectare of land on Erven 1, 45 and 47 of Wegdraai as an expansion and formalization of the existing Wegdraai community. For this purpose Cedar Land Geotechnical Consult (Pty) Ltd was appointed as sub consultant to Macroplan to conduct a geotechnical investigation on the property.*

### **2 SITE DESCRIPTION**

#### **2.1 Site Location**

*The village of Wegdraai is located some one kilometer to the west of the Orange River and the National Route 10 between Upington and Groblershoop in the Northern Cape. Access to Wegdraai is from Kleinbegin Road. Wegdraai is some 15 km from Groblershoop. The size of the area of investigation is 43 hectare.*

#### **2.2 Topography and Drainage**

*The land investigated is located between 854,0mamsl and 874,0mamsl. Topographical it can be described as generally sloping from west to east in a very low and undulating topography. Drainage takes place by means of surface sheetwash. The sheetwash is disposed of towards the northwest by means of several small non-perennial streams. The drainage courses are contained in narrow, steeply sloping and well defined gullies.*

#### **2.3 Vegetation and Landscape**

*The area of investigation is referred to as Bushmanland Arid Grassland. The landscape features are described as consisting of extensive to irregular plains on a slightly sloping plateau sparsely vegetated by grassland dominated by white grasses giving this vegetation type the character of semi-desert steppe. On site it was found that in the areas where natural vegetation is present it consists of a sparse stand of *Acacia melliflora* and *Prosopis glandula*.*

#### **2.4 Climatic Conditions**

*The area is located in a summer-rainfall region with mean annual precipitation between 70mm to 200mm ; mean maximum summer temperature of 38°C and mean minimum winter temperature of -0,6°C. Frost incidence varies between 10 and 35 days per year. The development of whirl winds are*

common on hot summer days. The Thornthwaite moisture index is less than -40 ; and the Weinert N value approximately 35. The climate can thus be described as arid.

## **2.5 Existing Facilities**

The area is characterized by the widespread presence of waste material, consisting of domestic waste, stockpiles of gravels and human waste. An excavation to dispose of waste is present in the western part of the site, but it is not used. Numerous trenches, presumably to obtain calcrete gravels for construction, are present in the northern parts of the site.

The area can be divided into two zones as follows :

### **2.5.1 Informal Housing**

Informal housing consisting of galvanized iron structures and some reed structures is present on the perimeter of the existing village. Electricity is provided by overhead power lines. Some residents have created small vegetable and flower gardens on the stands.

### **2.5.2 Vacant Land**

Vacant, undeveloped land extends from the existing village to the limits of the area of investigation in all wind directions.

## **3 NATURE OF INVESTIGATION**

### **3.1 Test Pitting**

On 8 July 2020 31 test pits were excavated with a Bell 315SK TLB on hire from ALS Plant Rentals. The TLB was equipped with a 600mm wide bucket. All test pits were excavated to refusal. The test pits were profiled by a professionally registered geotechnical engineer.

### **3.2 Materials Testing**

Soil testing was undertaken by Roadlab in Upington. Due to general limited vertical extent of the soil profile and coarse nature thereof, it was not feasible to retrieve undisturbed samples to determine properties of settlement or collapse fairly accurately.

Soil testing consisted of the following :

- Conductivity and pH determinations on five samples of the in-situ materials to determine the corrosivity thereof.
- Foundation indicator testing on ten samples of the in-situ materials to determine possible conditions of heave or settlement.
- CBR and road indicator testing on three samples to determine the suitability of the in-situ materials to be utilized as road layerworks.

## **4 SITE GEOLOGY, SOIL PROFILES AND GEOHYDROLOGY**

### **4.1 Site Geology**

The available information shows that the area of investigation is located on a subduction zone dating approximately 1000 million years old. The zone is located between the lithology of the Kaapvaal Craton and the Namaqua-Natal mobile belt. The remains of the original geology in the area are referred to as the Kaaien Terrane and the site is located on the Groblershoop Formation of the Brulpan Group. The quartz-muscovite schist is described as pale white mottled light green, intensely laminated, closely jointed, soft rock becoming hard rock with depth. While the laminations are generally closed smooth and clean ; the condition of the joints may vary from closed, smooth and clean to open smooth and containing fine, white calcareous sand.

### **4.2 Soil Profile**

#### **4.2.1 Colluvium**

On site colluvium as surface deposit was found in all the test pits except TP's 12, 24, 27 and 31. The matrix of the colluvium consists light brown fine sand and clasts of gravels and cobbles of quartz and some calcrete. With an increase in clasts from matrix supported to clast supported the consistency of the colluvium improves from loose to medium dense. The horizon of colluvium was between 100mm and 600mm thick in the test pits.

#### **4.2.2 Mokalanen Formation**

##### **4.2.2(i) Hardpan Calcrete**

Very dense hardpan calcrete was encountered in TP's 1, 2, 5 to 16, 20, 23 to 29 and 31. It is present dirty white, very fine grained, very dense hardpan calcrete. Small pockets and lenses of red sand may be contained in the pedocretic matrix. The calcrete was present as outcrops in TP's 12, 24, 27 and 31. Elsewhere it underlies the colluvium, occurring from depths between 150mm and 600mm minimum, extending to 200mm to 1000mm maximum.

#### 4.2.2(ii) Boulder Calcrete

Very dense boulder calcrete was encountered in TP's 3, 4, 17, 18 and 30. It is present tightly packets cobbles and boulders up to 500mm in diameter of calcrete in a matrix of light red sand. dirty white, very fine grained, very dense hardpan calcrete. Small pockets and lenses of red sand may be contained in the pedocretic matrix. It underlies the colluvium, occurring from depths between 100mm and 400mm minimum, extending to 300mm to 1000mm maximum.

#### 4.2.3 Residual Quartz-muscovite Schist

Residual quartz-muscovite schist was encountered in TP 19 only. It underlies the colluvium from a depth of 200mm extending to 700mm at which bedrock was encountered. The residual quartz-muscovite schist is described as abundant clast supported, coarse angular gravels of schist in a matrix of dark red brown fine sand. The consistency is dense.

### 4.3 Groundwater

#### 12.3.1 Perched Water

Perched groundwater was not encountered in any of the test pits excavated for this investigation. It is anticipated that perched water will generally not prove problematic on the site.

#### 12.3.2 Permanent Groundwater

The probability for drilling successfully for water in the area is between 40% and 60%, and the probability that such a borehole will yield more than 2l/s is between 10% and 20%. Groundwater is expected to occur at depths less than 15 meters in compact, argillaceous strata.

## 5 CONDITIONS OF EXCAVATION

On average over the entire site bedrock or refusal of excavation on very dense hardpan calcrete or quartz-muscovite schist occurred in all the test pits at depths varying between 200mm and 1000mm, averaging 570mm. The implication of this is that should trenches require excavated depths to 1000mm, 43% of the excavation may be classified as hard, requiring drilling and blasting. Should the required depth of excavation increase to 1500mm, 62% of the excavation may be classified as hard.

## 6 SITE CLASS DESIGNATION

The land can be divided into three geotechnical zones as follows :

### **6.1 Geotechnical Zone I**

*The zone is classed as R, meaning that the proposed horizon for founding is stable and negligible soil movement is expected. The distribution thereof encompasses 95% of the proposed area for development. Slope across the land is less than 2%. Two foundation design alternatives are applicable to the zone, namely conventional strip foundations or slab-on-the-ground foundations placed directly on bedrock or very dense pedoconcrete.*

### **6.2 Geotechnical Zone II**

*The zone is classed as S, meaning that the proposed horizon for founding is slightly compressible and rapid settlement less than 10mm is expected. The distribution thereof encompasses 2% of the proposed area for development. Slope across the land is less than 2%. Two foundation design alternatives are applicable to the zone, namely conventional strip foundations or slab-on-the-ground foundations placed directly on medium dense terrace gravels.*

### **6.3 Geotechnical Zone III**

*The zone is classed as S, meaning that the proposed horizon for founding is slightly compressible and rapid settlement less than 10mm is expected. The distribution thereof encompasses 3% of the proposed area for development. Slope across the land is between 2% and 6%. Two foundation design alternatives are applicable to the zone, namely conventional strip foundations or slab-on-the-ground foundations placed directly on medium dense terrace gravels. The more viable foundation alternative therefore remains founding by conventional strip foundations.*

## **7 LAND SLOPE**

*The average slope across the larger part of the land is less than 2%. Only in Geotechnical Zones III does the slope exceed 2%, that is over 3% of the site. This slope of less than 2% has a detrimental influence on especially the design of a stormwater disposal system depending on gravity to dissipate of the surface water due to downpours. The land slope also affects the design of the sewerage disposal but to a lesser extent as the gradient of the pipes can be adjusted according to design requirements.*

## **8 AREAS SUBJECT TO FLOODING**

*The non-perennial water courses on site are contained in well-defined, narrow gullies and may be regarded as being of lesser importance, requiring no additional precautionary measures to ensure the safety of the population against flooding.*

## **9 MATERIALS UTILIZATION**

- *Trench Backfilling : None of the materials are suitable for selected fill or pipe bedding. With exception of the hardpan calcrete all materials can be used for normal backfill.*
- *Layerworks for Paved or Segmental Block Paving : The residual soils are suitable for the construction of subbase and base course construction for lightly trafficked roads.*
- *Wearing Course for Gravel Roads in Urban Areas : None of the soil materials are 100% suitable for this purpose, but calcrete is the most suitable present. The use of these materials will generally result in a road surface subject to raveling and corrugations.*

## **10 OTHER CONSIDERATIONS**

- *Undermining : The area is not subject to undermining.*
- *Seismic Activity : The Peak Ground Acceleration expected in 50 years is 0,06g. A low risk for the development of earth tremors therefore exist.*
- *Soil Corrosivity : The in-situ soils and pedocretes are not corrosive due to acidic properties, but corrosive due to high soluble salts contents.*
- *Dolomite : The area of investigation is not subject to any restrictions due to the presence of dolomite. Bedrock of dolomite does not occur in the area of investigation.*

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## GEOTECHNICAL CONDITIONS ON ERVEN 1, 45 AND 47 OF WEGDRAAI : A REPORT FOR THE EXPANSION AND FORMALISATION OF WEGDRAAI COMMUNITY

### 1 INTRODUCTION

It is envisaged to develop some 43 hectare of land on Erven 1, 45 and 47 of Wegdraai as an expansion and formalization of the existing Wegdraai community. For this purpose Cedar Land Geotechnical Consult (Pty) Ltd was appointed as sub consultant to Macroplan as per the minutes of the start-up meeting of the project held in the offices of Macroplan on 20 May 2020 to conduct a geotechnical investigation on the property.

### 2 TERMS OF REFERENCE

The requirements of the following documents were adhered to in the conduct of the investigation and reporting of the project :

- The document *Geotechnical Site Investigations for Housing Developments (Generic Specification GFSH-2)*, issued by the National Department of Housing in September 2002.
- The document *SANS 634-1 : Geotechnical Investigations for Township Development*, issued by SABS in February 2012.

### 3 AVAILABLE INFORMATION

The following source of available information recording available data obtained in the larger Upington to Groblershoop area have been consulted for background information :

- *Breytenbach FJ* : Contract NRA N010-110-2012/1F : Geotechnical Investigation for Four

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**Directors : FJ Breytenbach (Pr Eng) B Eng (Civ) NDT (Geology); M Breytenbach M Sc (Mathematical Statistics)**

Bridge Widenings on the National Route 10 Section 11 between Groblershoop (km 0,0) and Lambrechtsdrift (km 61,1), issued by Soilkraft cc on behalf of Bvi Engineers on 8 March 2012.

## **4 SITE DESCRIPTION**

### **4.1 Site Location**

The village of Wegdraai is located some one kilometer to the west of the Orange River and the National Route 10 between Upington and Groblershoop in the Northern Cape. Access to Wegdraai is from Kleinbegin Road. Wegdraai is some 15 km from Groblershoop. The area of investigation consisting of Erven 1, 45 and 47 Wegdraai, is located on the perimeter of the village, on the northern, western, eastern and southern sides thereof. The size of the area of investigation is 43 hectare.

Refer to the attached Figure 1 : Locality Plan.

### **4.2 Topography and Drainage**

The land investigated is located between 854,0mamsl and 874,0mamsl. Topographical it can be described as generally sloping from west to east in a very low and undulating topography.

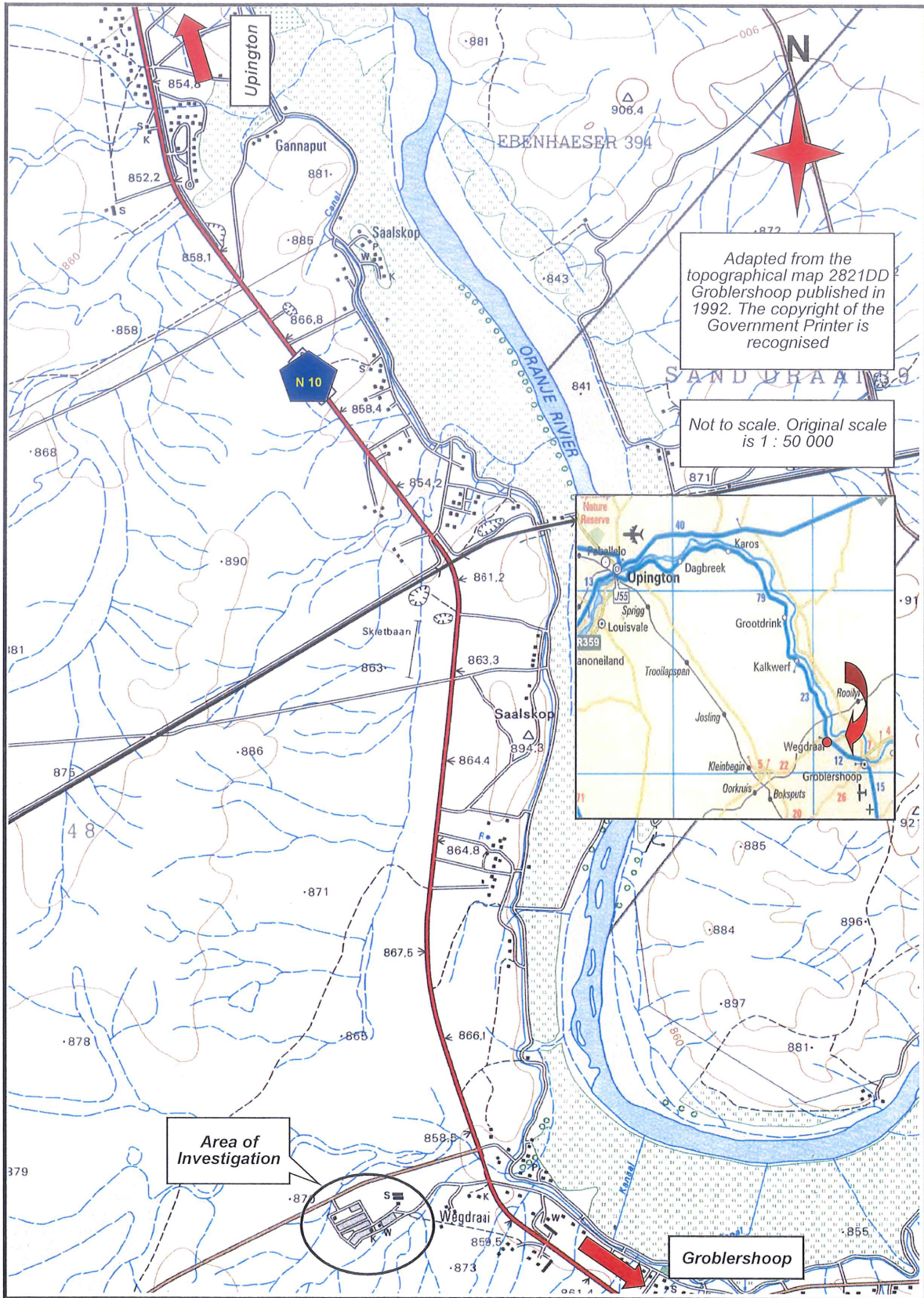
Drainage takes place by means of surface sheetwash. The sheetwash is disposed of towards the northwest by means of several small non-perennial streams. The drainage courses are contained in narrow, steeply sloping and well defined gullies.

### **4.3 Vegetation and Landscape**

Based on the work done by Mucina<sup>Reference 14.1</sup> the area of investigation is referred to as Bushmanland Arid Grassland. The landscape features are described as consisting of extensive to irregular plains on a slightly sloping plateau sparsely vegetated by grassland dominated by white grasses giving this vegetation type the character of semi-desert steppe. In places low shrubs change the vegetation structure. In years of abundant rainfall rich displays of annual herbs can be expected. On site it was found that in the areas where natural vegetation is present it consists of a sparse stand of *Acacia melliflora* and *prosopis glandula*.

### **4.4 Climatic Conditions**

The area is located in a summer-rainfall region with mean annual precipitation between 70mm



LOCALITY PLAN

FIGURE 1

to 200mm ; mean maximum summer temperature of 38°C and mean minimum winter temperature of -0,6°C. Frost incidence varies between 10 and 35 days per year. The development of whirl winds are common on hot summer days. The Thornthwaithe moisture index is less than -40 ; and the Weinert N value approximately 35. The climate can thus be described as arid. The importance of this is that mechanical breakdown of bedrock will take place rather than chemical decomposition, limiting the formation of secondary minerals such as expansive montmorillonite clay.

#### **4.5 Existing Facilities**

Site conditions are illustrated on Photo 1 : Site Conditions. The area is characterized by the widespread presence of waste material, consisting of domestic waste, stockpiles of gravels and human waste. An excavation to dispose of waste is present in the western part of the site, but it is not used. Numerous trenches, presumably to obtain calcrete gravels for construction, are present in the northern parts of the site.

The area can be divided into two zones as follows :

##### **4.5.1 Informal Housing**

Informal housing consisting of galvanized iron structures and some reed structures is present on the perimeter of the existing village. Electricity is provided by overhead power lines. Some residents have created small vegetable and flower gardens on the stands.

##### **4.5.2 Vacant Land**

Vacant, undeveloped land extends from the existing village to the limits of the area of investigation in all wind directions.

### **5 NATURE OF INVESTIGATION**

#### **5.1 Test Pitting**

In compliance with the requirements of SANS 634 and GFSH-2 test pitting was conducted to provide applicable geotechnical information. On 8 July 2020 31 test pits were excavated with a Bell 315SK TLB on hire from ALS Plant Rentals. The TLB was equipped with a 600mm wide bucket. All test pits were excavated to refusal.



HOUSEHOLD WASTE IN THE VILLAGE



UNUSED EXCAVATION FOR WASTE DISPOSAL



CONDITIONS IN THE VILLAGE



COLLUVIAL DEPOSITS OF COARSE GRAVELS AND COBBLES



ABANDONED TRENCH EXCAVATIONS



QUARTZ-MUSCOVITE SCHIST OUTCROPS THROUGH SURFACE CALCRETE



CONDITIONS IN WEGDRAAI VILLAGE

The test pits were profiled by a professionally registered geotechnical engineer. For the benefit of the non-geotechnical reader of this document, the guidelines for test pit profiling are summarized in the attached Table 1 : Soil Profiling Parameters. The profiles of the test pits may be found in Addendum A to this report. The positions of the test pits are indicated on the attached Figure 2 : Site Plan. Provisional co-ordinates for property beacons A to AAV are indicated on this figure. Due to access restrictions TP 15 had to be relocated from its original position.

**TABLE 1 : SOIL PROFILING PARAMETERS**

CONSISTENCY : GRANULAR SOILS

CONSISTENCY : COHESIVE SOILS

SPT N	GRAVELS & SANDS Generally free draining soils			DRY DENSITY (kg/m <sup>3</sup> )	SPT N	SILTS & CLAYS and combinations with SANDS Generally slow draining soils		UCS (kPa)
<4	Very loose	Crumbles very easily when scraped with geological pick. Requires power tools for		<1450	<2	Very soft	Pick point easily pushed in 100mm. Easily moulded by fingers.	<50
4-10	Loose	Small resistance to penetration by sharp pick point. requires many blows by pick point		1450- 1600	2-4	Soft	Pick point easily pushed in 30mm to 40mm. Moulded by fingers with some pressure.	50- 125
10-30	Medium dense	Considerable resistance to penetration by sharp pick point.		1600- 1750	4-8	Firm	Pick point penetrates to 10mm. Very difficult to mould with fingers.	125- 250
30-50	Dense	Very high resistance to penetration by sharp pick point. Requires many blows by pick point for excavation.		1750- 1925	8- 15	Stiff	Slight indentation by pick point. Cannot be moulded by fingers. Penetrated by thumb nail.	250- 500
>50	Very dense	High resistance to repeated blows of geological pick. Requires power tools for excavation.		>1925	15-30	Very stiff	Slight indentation by blow of pick point. Requires power tools for excavation.	500- 1000

SOIL TYPE

SOIL TYPE	PARTICLE SIZE(mm)
Clay	<0,002
Silt	0,002-0,06
Sand	0,06-2,0
Gravel	2,0-60,0
Cobbles	60,0-200,0
Boulders	>200,0

MOISTURE CONDITION

Dry	No water detectable
Slightly moist	Water just discernable
Moist	Water easily discernable
Very moist	Water can be squeezed out
Wet	Generally below water table

SOIL STRUCTURE

COLOUR		Intact	No structure present
Speckled	Very small patches of colour <2mm	Fissured	Presence of discontinuities, possibly cemented.
Mottled	Irregular patches of colour 2-6mm	Slickensided	Very smooth, glossy, often striated discontinuity planes.
Blotched	Large irregular patches 6-20mm	Shattered	Presence of open fissures. Soil break into gravel size blocks.
Banded	Approximately parallel bands of varying colours	Micro shattered	Small scale shattering, very closely spaced open fissures. Soil breaks into sand size crumbs.
Streaked	Randomly orientated streaks of colour	Residual structures	Residual bedding, laminations, foliations etc.
Stained	Local colour variations : Associated with discontinuity surfaces		

ORIGIN

Transported	Alluvium, hillwash, talus etc.
Residual	Weathered from parent rock, eg residual granite
Pedocretes	Emcrete, sicrete, calcicrete etc.

DEGREE OF CEMENTATION OF PEDOCRETES

TERM	DESCRIPTION	UCS (MPa)
Very weakly cemented	Some material can be crumbled between finger and thumb. Disintegrates under knife blade to a friable state.	0,1-0,5
Weakly cemented	Cannot be crumbled between strong fingers. Some material can be crumbled by strong pressure between thumb and hard surface. Under light hammer blows disintegrate to a friable state.	0,5-2,0
Cemented	Material crumbles under firm blows of sharp pick point. Grains can be dislodged with some difficulty by a knife blade.	2,0-5,0
Strongly cemented	Firm blows of sharp pick point on hand-held specimen show 1-3mm indentations. Grains cannot be dislodged by knife blade.	5,0- 10,0
Very strongly cemented	Hand-held specimen can be broken by single firm blow of hammer head. Similar appearance to concrete.	10,0-25

## 5.2 Materials Testing

Soil testing was undertaken by Roadlab in Upington. As a matter of quality control duplicate samples were sent to the Roadlab branch in Germiston for independent testing to verify the

COORDINATES – WEGDRAAI		
System: WGS84 GW21		
Point	Y	X
A	-83356.574	3191885.920
B	-83710.756	3191707.939
C	-83829.565	3191648.200
D	-83869.135	3191726.896
E	-83766.620	3191778.407
F	-83782.023	3191808.905
G	-83739.575	3191830.393
H	-83725.876	3191804.344
J	-83727.722	3191797.724
K	-83709.102	3191793.821
L	-83752.919	3191877.774
M	-83784.106	3191924.927
N	-83861.307	3192073.792
P	-83954.417	3192021.694
Q	-83968.536	3192004.443
R	-84063.620	3192082.321
S	-83537.415	3192328.712
T	-83851.920	3191637.014
U	-84211.636	3191459.865
V	-84495.144	3191378.309
W	-84515.878	3191450.386
X	-84302.587	3191511.633
Y	-84359.863	3191621.660
Z	-84248.849	3191696.523
AA	-84200.542	3191722.795
AB	-84113.821	3191550.176
AC	-83869.872	3191672.746
AD	-84760.348	3191302.036
AE	-84888.943	3191265.051

COORDINATES – WEGDRAAI		
System: WGS84 GW21		
Point	Y	X
AF	-84907.86	3191332.900
AG	-84856.320	3191373.470
AH	-84817.720	3191424.300
AJ	-84802.700	3191438.360
AK	-84780.129	3191450.378
AL	-84764.094	3191394.636
AM	-84785.234	3191388.556
AN	-84926.312	3191405.270
AP	-85024.260	3191357.460
AQ	-85094.530	3191387.840
AR	-85138.760	3191529.800
AS	-85185.448	3191623.605
AT	-85097.897	3191676.211
AU	-85136.859	3191740.863
AV	-84461.030	3191930.970
AW	-84429.829	3191876.815
AX	-84337.196	3191789.409
AY	-84454.154	3191714.674
AZ	-84578.665	3191671.094
AAA	-84612.347	3191625.046
AAB	-84619.276	3191624.041
AAC	-84709.262	3191692.636
AAD	-84690.473	3191717.284

COORDINATES – WEGDRAAI		
System: WGS84 GW21		
Point	Y	X
AAE	-84734.454	3191751.330
AAF	-84779.296	3191709.328
AAG	-84824.088	3191759.597
AAH	-84850.808	3191736.913
AAJ	-84843.054	3191727.766
AAK	-84952.248	3191647.497
AAL	-84973.750	3191634.408
AAM	-85054.034	3191585.536
AAN	-85035.876	3191555.832
AAP	-85053.963	3191543.349
AAQ	-85071.601	3191561.284
AAR	-85092.317	3191545.192
AAS	-85078.470	3191528.069
AAT	-85066.777	3191534.423
AAU	-85048.196	3191513.779
AAV	-85024.931	3191538.369

Adapted from Project : Wegdraai, Dated June 2020.  
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FIGURE 2 :  
SITE PLAN

**LEGEND**

-  TEST PIT POSITION
-  RUBBLE
-  WASTE DISPOSAL SITE
-  TRENCHES





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TAAK: Expansion and Formalisation of Wegdraai Community  
 IOB NAME: Erven 1, 45 and 47 of Wegdraai  
 KLIENT: IKheis Municipality  
 TEKENING NO: Figure 2 : Site Plan  
 DRAWING NO:  
 DATUM: 10 September 2020

results. Due to general limited vertical extent of the soil profile and coarse nature thereof, it was not feasible to retrieve undisturbed samples to determine properties of settlement or collapse fairly accurately.

Soil testing consisted of the following :

- Conductivity and pH determinations on five samples of the in-situ materials to determine the corrosivity thereof.
- Foundation indicator testing on ten samples of the in-situ materials to determine possible conditions of heave or settlement.
- CBR and road indicator testing on three samples to determine the suitability of the in-situ materials to be utilized as road layerworks.

The results of the soil testing may be found in Addendum B. However, for easy reference, these results are summarized in the attached Table 2 : Summary of Soil Testing. The data sheets contained in Addendum B are copies of the originals, which are available from Roadlab.

## **6 SITE GEOLOGY AND GEOHYDROLOGY**

The geology of the area between Upington and Groblershoop appears to consist of granitoid rock in the north, grading into metamorphic rocks towards Groblershoop, but it is in fact highly complex and from a stratigraphical viewpoint provides complicated formation. As a background to the site geology an effort is made in this subparagraph to provide a simplified explanation of the regional geology of the area. For this purpose publications by McCarthy<sup>Reference 14.2</sup>, Cornell<sup>Reference 14.3</sup> and Moen<sup>Reference 14.4</sup> were consulted. Of these three references, the latter two can be regarded as site specific. However, there is disagreement between the two sources regarding the stratigraphic classification of the major subdivisions of the Namaqua-Natal province. As the work produced by Cornell is regarded as the reference document, his approach is adopted for this report.

Some concepts must be identified :

- *Craton* : A craton is a block of ancient crust, formed 3000 million years ago and its rocks have essentially remained unchanged. Cratons form the larger parts of the land-building mass.
- *Province* : A tectono-stratigraphic province is defined as a large area of contiguous structural fabric with well-defined boundaries which formed during a particular, geochronologically defined, tectono-metamorphic event. A province is further subdivided in sub-provinces and sub-provinces into terranes.



**TABLE 2 : SUMMARY OF SOIL TESTING**

TEST PIT NO	SAMPLE NO (CLG)	DEPTH (mm)	SOIL ORIGIN	SOIL TYPE	GMI	PI	LL	ACTIVITY	pH	CONDUCTIVITY (S <sup>m</sup> <sup>-1</sup> )	% < 0.002mm	OMC	MOD	SOIL CLASS		
														COLTO	PRA UNIFIED	
TP 1	U9267	0-300	Colluvium	Sandy gravel	1,90	1,0	14	Low			1,7				A-1-b(0)	SC
TP 6	U9268	0-400	Hardpan calcrete	Sandy gravel	2,00	2,0	17	Low	7,64	0,13	0,5				A-1-b(0)	GC
TP 12	U9269	400-800	Hardpan calcrete	Sandy gravel	2,10	2,0	21	Low			0,7	10,5	1922	65	A-1-b(0)	SC
TP 16	U9270	0-300	Colluvium	Sandy gravel	2,00	2,0	21	Low	7,80	0,09	1,0				A-1-b(0)	GC
TP 17	U9271	500-900	Bedrock schist	Rock fragments	2,20	7,0	33	Low			0,7	9,2	1932	66	A-2-4(0)	GW-GM
TP 21	U9272	0-400	Colluvium	Sandy gravel	2,10	3,0	18	Low	7,75	0,10	1,3				A-1-b(0)	GC
TP 23	U9273	100-400	Hardpan calcrete	Sandy gravel	2,10	8,0	27	Low	7,87	0,09	1,1				A-2-4(0)	GC
TP 26	U9274	200-600	Hardpan calcrete	Sandy gravel	2,10	2,0	19	Low			0,5				A-1-b(0)	SW-SC
TP 30	U9275	200-1000	Boulder calcrete	Sandy gravel	2,30	7,0	24	Low			1,1	7,5	2153	66	A-2-4(0)	GW-GM-GC
TP 31	U9276	0-300	Hardpan calcrete	Sandy gravel	1,90	8,0	27	Low	7,81	0,07	1,6				A-2-4(0)	GC

- *Terrane* : A terrane is a term for a tectonostratigraphic unit, which is a fragment of crustal material formed on, or broken off from, one tectonic plate and accreted or "sutured" to crust lying on another plate. The crustal block or fragment preserves its own distinctive geologic history, which is different from that of the surrounding areas.

## 6.1 Regional Geology

The geological processes by which the area under consideration was shaped, initiated some 1000 million years ago with the formation of the supercontinent Rodinia. A mountain chain of global extent formed along the boundaries, underlain by metamorphic rocks that have since then been exposed due to erosion. Metamorphic rocks of this age formed across South Africa to the south and west of the Kaapvaal Craton, known as the Namaqua-Natal Province. The Namaqua-Natal Province can be divided into five tectonostratigraphic subprovinces and terranes, based on marked changes in the lithostratigraphy across structural discontinuities. The five domains so recognized are the Richtersveld Subprovince, the Bushmanland Terrane, Kakamas Terrane, Areachap Terrane and Kaaien Terrane. The tectonic subdivision as proposed on Figure 2 (Cornell) is reproduced in this document as Figure 3.

The process of landforming can be described as compatible to the modern concept of plate tectonics. In this case the Namaqua plate became buried beneath the Kaapvaal Craton in a subduction zone. Considering the forces involved it can be regarded as a violent process, resulting in the breaking up of the landmass into the five domains as described above, associated with the intrusion of recycled rock material from the subduction zone. What is important for this report is that in the case of the Kaaien terrane, the formation of metaquartzites, deformed early Namaquan volcano-sedimentary rocks and deformed, but thermally metamorphosed bimodal volcanic rocks resulted, amongst others. These rocks are at present referred to amongst others as the Groblershoop Formation Brulpan Group, on which Wegdraai is located. There is controversy about the age of the Brulpan Group, but is estimated between 1710Ma to 1780Ma, underlying the Wilgenhoutsdrif Group.

The regional geology is indicated on Figure 4 : Regional Geology.

## 6.2 Site Geology

The site geology is illustrated on Figure 5. The soil, but especially the pedocretes form an ubiquitous and well developed cover over bedrock with only localized exposures in areas of thin and less dense pedocretic cover, thus hampering field investigations. The inferred material boundaries must be accepted as indicative of the actual conditions only.

Bedrock on site occurs as quartz-muscovite schist of the Groblershoop Formation, Brulpan Group. The strata of the Groblershoop Formation are intensely foliated on site, dipping between zero and 45°, striking randomly. On site the quartz-muscovite schist was exposed in TP's 17 to 19, 21 and 22, but elsewhere covered by a very dense horizon of hardpan calcrete. The quartz-muscovite schist is described as pale white mottled light green, intensely laminated, closely jointed, soft rock becoming hard rock with depth. While the laminations are generally closed smooth and clean ; the condition of the joints may vary from closed, smooth and clean to open smooth and containing fine, white calcareous sand.

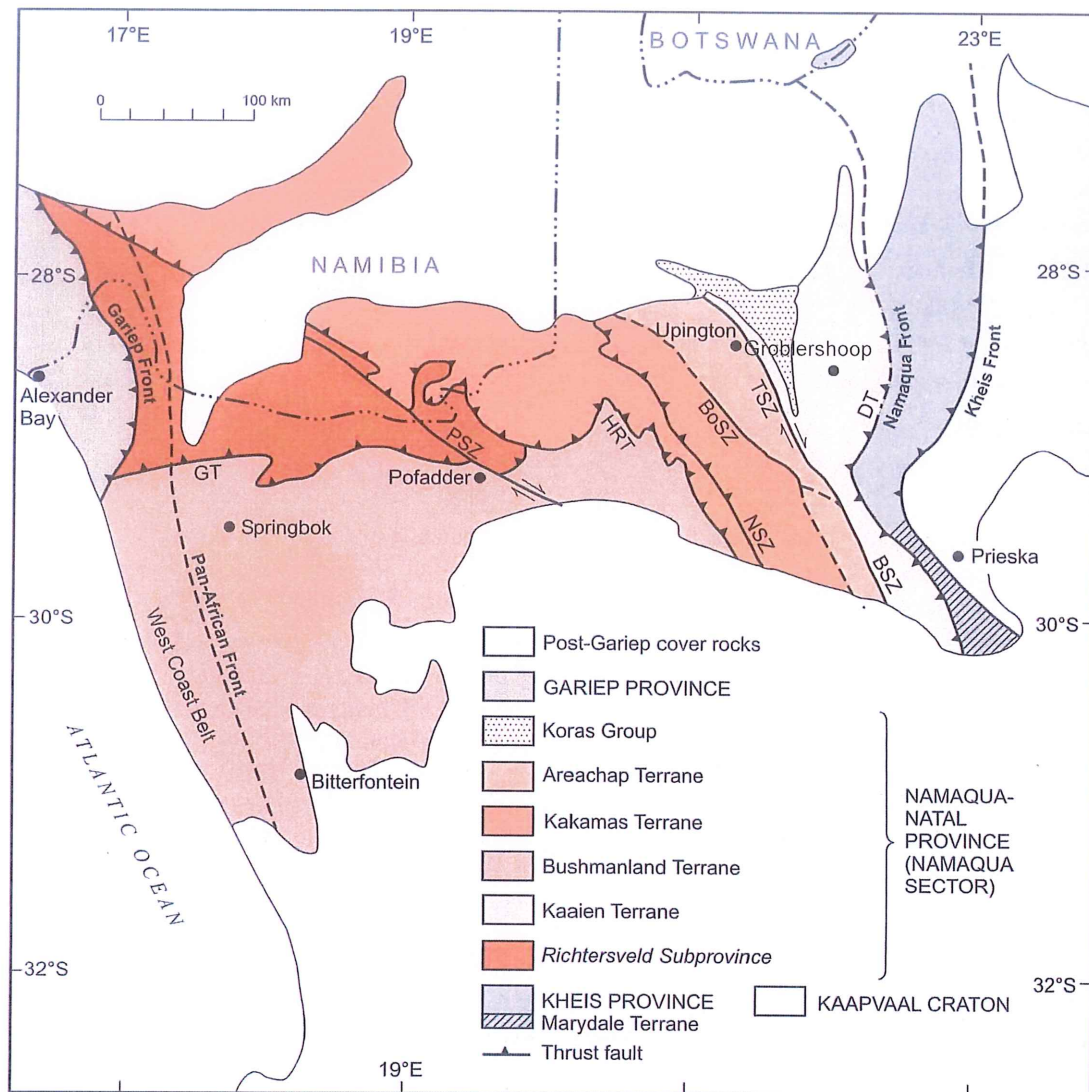
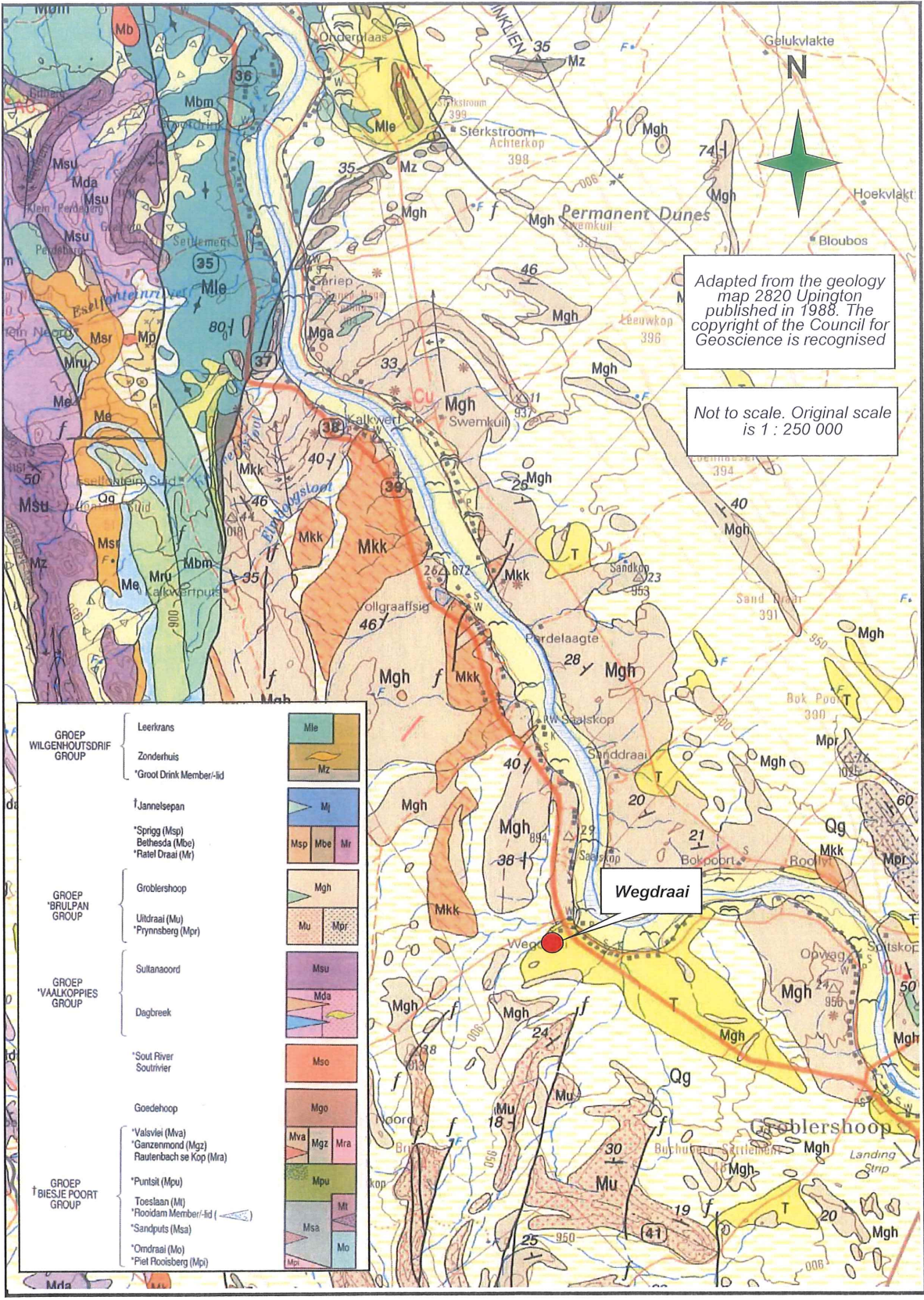


FIGURE 3 : TECTONIC SUBDIVISION OF THE NAMAQUA SECTOR

### 6.3 Soil Profile

#### 6.3.1 Colluvium

Although the surface soil deposits may easily be regarded as alluvial sands transported by the



**WEGDRAAI : REGIONAL GEOLOGY**

**FIGURE 4**

Adapted from Project : Topline, Dated June 2020.  
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is recognised



FIGURE 5 :  
SITE GEOLOGY

**LEGEND**

- TP1 TEST PIT POSITION
- RUBBLE
- WASTE DISPOSAL SITE
- TRENCHES
- INFERRED MATERIAL BOUNDARY



Lithology	Formation	Group
C Calcrete	Mokolanen	Kalahari
G Quartz-muscovite schist	Groblersthoop	Brulpan

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TAASK: Expansion and Formalisation of Wegdraai Community  
 JOBNAME: Erven 1, 45 and 47 of Wegdraai  
 LIGGING: Erven 1, 45 and 47 of Wegdraai  
 SITE:  
 KLIENT: !Kheis Municipality  
 CLIENT:  
 TEKENING NO: Figure 5 : Site Geology  
 DRAWING NO:  
 DATUM: 10 September2020

Orange River, this is not the case. Moen (Reference 14.4 page 149) describes the presence of alluvium and terrace gravels associated with the Orange River as being present on the northeastern banks of the river in the area between Grootdrink and Groblershoop.

On site colluvium as surface deposit was found in all the test pits except TP's 12, 24, 27 and 31. The colluvium is not a homogenous material on site due to a variable gravel content thereof. The matrix of the colluvium consists light brown fine sand and clasts of gravels and cobbles of quartz and some calcrete. With an increase in clasts from matrix supported to clast supported the consistency of the colluvium improves from loose to medium dense. The matrix of the colluvium remains intact throughout. The horizon of colluvium was between 100mm and 600mm thick in the test pits.

### 6.3.3 Mokalanen Formation

Calcrete of the Mokalanen Formation, Kalahari Group, is present as an ubiquitous surface duricrust on site. Again there is a difference in opinion between Moen (Reference 14.4 page 147) and Partridge<sup>Reference 14.5</sup> regarding the origin of the calcrete. Moen regards the calcrete as being of Tertiary age, but some doubt exists whether the outcrops are of the same age and in some localities it may still be in the process of forming. Partridge describes the age of the calcrete as straddling the boundary between the Pliocene and Quaternary, making it some 2,6 to 2,8 million years old. It was deposited under arid conditions and possibly reflects a climatic interval of global aridification.

The engineering properties of calcrete may differ widely for samples taken from the same locality. It is therefore important to provide some background in this regard to aid in the understanding of these conditions.

Brink<sup>Reference 14.6</sup> states that during pedocrete development, clay and silt become flocculated and cemented into larger silt to gravel-sized complexes of varying strength and porosity. These particles and aggregations may or may not break down during laboratory testing and under compaction. The mineralogy of the cementing material and of the clay fraction is different from those of normal, temperate zone soils on which current specifications for soil testing and classification is based. Calcrete can therefore be expected to exhibit differences in behaviour from those of traditional soil materials.

Whereas in traditional soil mechanics it is assumed that all the water is outside the particles, calcrete aggregates retain moisture and this affects conventional moisture content and Atterberg limit determinations. Palygorskite which is the dominant clay in calcrete has approximately the same plasticity index as some smectites, which can be regarded as highly expansive. However, the palygorskite has a non-expansive lattice and a hollow, needle-like

shape instead of the usual flaky particle shape of most other clays. It has the lowest shrinkage limit and dry density and the highest optimum moisture content and shear strength of all clays.

Be it as it may, calcrete was encountered as the dominant lithic material on site, in virtually a continuous cover over the quartz-muscovite schist, with the schist outcropping occasionally only in limited areas of localized extent. Moen reports the calcrete to be up to five meters thick in the area.

The calcrete is present as follows :

#### *6.3.3(i) Hardpan Calcrete*

Very dense hardpan calcrete was encountered in TP's 1, 2, 5 to 16, 20, 23 to 29 and 31. It is present as dirty white, very fine grained, very dense hardpan calcrete. Small pockets and lenses of red sand may be contained in the pedocretic matrix. The calcrete was present as outcrops in TP's 12, 24, 27 and 31. Elsewhere it underlies the colluvium, occurring from depths between 150mm and 600mm minimum, extending to 200mm to 1000mm maximum, at which stage refusal of excavation occurred or bedrock of quartz-muscovite schist was encountered.

#### *6.3.3(ii) Boulder Calcrete*

Very dense boulder calcrete was encountered in TP's 3, 4, 17, 18 and 30. It is present tightly packed cobbles and boulders up to 500mm in diameter of calcrete in a matrix of light red sand. Small pockets and lenses of red sand may be contained in the pedocretic matrix. It underlies the colluvium, occurring from depths between 100mm and 400mm minimum, extending to 300mm to 1000mm maximum, at which stage refusal of excavation occurred or bedrock of quartz-muscovite schist was encountered.

#### **6.3.4 Residual Quartz-muscovite Schist**

Residual quartz-muscovite schist was encountered in TP 19 only. It underlies the colluvium from a depth of 200mm extending to 700mm at which bedrock was encountered. The residual quartz-muscovite schist is described as abundant clast supported, coarse angular gravels of schist in a matrix of dark red brown fine sand. The consistency is dense.

#### **6.3.5 Fill**

Areas of stockpiled material were encountered randomly across the site, but especially to the

west of the existing village. The most important of these stockpiles of waste are indicated on the site plans and illustrated on the photo sheet. However, large areas of the land was littered with waste consisting of quartz gravels, soil, all types of household waste and builders' rubble. Test pit 14 was excavated through such waste. The waste can be described as consisting of dry, light brown sand containing ash, paper, bones, glass, plastic and decaying household matter. The waste extended to a depth of 300mm in the test pit, prior to encountering colluvium.

## **6.4 Groundwater**

### **6.4.1 Perched Water**

Perched groundwater was not encountered in any of the test pits excavated for this investigation. Considering the climate of the area and the nature of in situ materials, it is anticipated that perched water will generally not prove problematic on the site, except in the lesser drainage courses of the site after events of inundation. Even if it did occur, the grading of in-situ materials is such that dispersal will take place fairly rapidly. Furthermore, it is expected that perched water and/or surface seepage may occur shortly after precipitation events and in years of excessive rain only.

### **6.4.2 Permanent Groundwater**

Vegter<sup>Reference 14.7</sup> indicates the probability for drilling successfully for water in the area to be between 40% and 60%, and the probability that such a borehole will yield more than 2l/s is between 10% and 20%. Groundwater is expected to occur at depths less than 15 meters in compact, argillaceous strata.

## **7 GEOTECHNICAL EVALUATION**

The engineering properties of the in-situ materials are summarized in Table 3 : Summary of Engineering Properties. The characterizations have been derived based on the Unified materials classifications as reported by literature studies.

### **7.1 Engineering and Material Characteristics**

#### **7.1.1 Properties of Heave**

The results of the materials testing as reported in Table 2 indicate the in-situ materials are not expansive. Any future structures will thus not be subject to heave. The content of active clay,



TABLE 3 : SUMMARY OF ENGINEERING PROPERTIES

TEST PIT NO	SAMPLE NO	DEPTH (mm)	SOIL ORIGIN	SOIL TYPE	SOIL CLASS		COHESION <sup>1</sup> (kNm <sup>-2</sup> )	FRICTION ANGLE (°) <sup>1</sup>	COMPRESSIBILITY <sup>2</sup>	EROSION RESISTANCE <sup>2+5</sup>	PERMEABILITY <sup>2</sup> k (cms <sup>-1</sup> )	SPECIFICATIONS FOR UNPAVED ROADS <sup>3</sup>					SUITABILITY FOR ROAD CONSTRUCTION <sup>4</sup>	
					PRA	UNIFIED						MAXIMUM SIZE	OVERSIZE INDEX (I <sub>o</sub> )	GRADING COEFFICIENT (G <sub>o</sub> )	SHRINKAGE PRODUCT (S <sub>p</sub> )	CBR @ 95% MOD	PAVED	UNPAVED
TP 1	U9267	0-300	Colluvium	Sandy gravel	A-1-b(0)	SC	5 to 10	30° to 35°	Low	5	(3±2)X10 <sup>-7</sup>	28,0	0	24,8	20,0			Ravels & corrugates
TP 6	U9268	0-400	Hardpan calcrete	Sandy gravel	A-1-b(0)	GC	<5	28° to 35°	Very low	3	>3X10 <sup>-7</sup>	37,5	7	17,9	39,0			Ravels & corrugates
TP 12	U9269	400-800	Hardpan calcrete	Sandy gravel	A-1-b(0)	SC	5 to 10	30° to 35°	Low	5	(3±2)X10 <sup>-7</sup>	50,0	4	20,3	55,5	64	Base & subbase	Ravels & corrugates
TP 16	U9270	0-300	Colluvium	Sandy gravel	A-1-b(0)	GC	<5	28° to 35°	Very low	3	>3X10 <sup>-7</sup>	28,0	0	20,7	41,0			Ravels & corrugates
TP 17	U9271	500-900	Bedrock schist	Rock fragments	A-2-4(0)	GW-GM	<5	30° to 40°	Negligible	1 to 4	(2,7±1,3)X10 <sup>-2</sup>	63,0	7	19,3	70,0	22	Subbase	Ravels & corrugates
TP 21	U9272	0-400	Colluvium	Sandy gravel	A-1-b(0)	GC	<5	28° to 35°	Very low	3	>3X10 <sup>-7</sup>	37,5	4	22,1	68,0			Ravels & corrugates
TP 23	U9273	100-400	Hardpan calcrete	Sandy gravel	A-2-4(0)	GC	<5	28° to 35°	Very low	3	>3X10 <sup>-7</sup>	50,0	15	14,3	119,0			Erodible
TP 26	U9274	200-600	Hardpan calcrete	Sandy gravel	A-1-b(0)	SW-SC	1 to 10	30° to 38°	Negligible to low	5 to 6	(3±2)X10 <sup>-7</sup>	50,0	4	21,7	37,0			Ravels & corrugates
TP 30	U9275	200-1000	Boulder calcrete	Sandy gravel	A-2-4(0)	GW-GM-GC	<5	28° to 40°	Negligible to very low	3 to 4	2,7X10 <sup>-6</sup> to 5X10 <sup>-7</sup>	63,0	13	15,6	67,5	35	Subbase	Ravels & corrugates
TP 31	U9276	0-300	Hardpan calcrete	Sandy gravel	A-2-4(0)	GC	<5	28° to 35°	Very low	3	>3X10 <sup>-7</sup>	50,0	6	16,7	154,0			Good

1 Obrzud RF and Truty A : The Hardening Soil Model - A Practical Guidebook, 2018 edition, revised 21 October 2018.

2 Brink ABA et al : Soil Survey for Engineering, published in 1982.

3 The Structural Design, Construction and Maintenance of Unpaved Roads (Draft TRH 20), Committee of State Road Authorities 1990.

4 Structural Design of Flexible Pavements for Interurban and Rural Roads (Draft TRH 4), Committee of State Road Authorities 1996.

5 Erosion resistance : 1 is best 10 is poor.

that is the material smaller than 0,002mm in diameter, was less than 2% for all the samples tested.

## 7.1.2 Properties of Settlement

### 7.1.2(i) *Colluvium*

On site colluvium as surface deposit was found in all the test pits except TP's 12, 24, 27 and 31. The colluvium is not a homogenous material on site due to a variable gravel content. The matrix of the colluvium consists light brown fine sand and clasts of gravels and cobbles of quartz and some calcrete. With an increase in clasts from matrix supported to clast supported the consistency of the colluvium improves from loose to medium dense. The horizon of colluvium was between 100mm and 600mm thick in the test pits. The consistency cannot be described as very loose, and voided soil matrices were not encountered in the colluvial horizons. The properties of the colluvium are thus such that it does not tend to excessive settlement.

### 7.1.2(ii) *Residual Quartz-muscovite Schist*

Residual quartz-muscovite schist was encountered in TP 19 only. It underlies the colluvium from a depth of 200mm extending to 700mm at which bedrock was encountered. The residual quartz-muscovite schist is described as abundant clast supported, coarse angular gravels of schist in a matrix of dark red brown fine sand. The consistency is dense. It can thus accommodate stresses imposed by conventional housing structures without undue settlement. Only limited – if any – settlement can thus be expected for structures such as single storey units of masonry construction.

### 7.1.2(iii) *Pedocretes*

Very dense hardpan calcrete underlying the colluvium was encountered in TP's 1, 2, 5 to 16, 20, 23 to 29 and 31. The calcrete was present as outcrops in TP's 12, 24, 27 and 31. It is present as dirty white, very fine grained, very dense hardpan calcrete. Small pockets and lenses of red sand may be contained in the pedocretic matrix. It occurs to depths of 150mm and 600mm minimum, extending to 200mm to 1000mm maximum, at which stage refusal of excavation occurred or bedrock of quartz-muscovite schist was encountered. Both materials are of very dense consistency. It can thus accommodate stresses imposed by conventional housing structures without undue settlement. Only limited – if any – settlement can thus be expected for structures such as single storey units of masonry construction.

### 7.1.3 Corrosivity

When discussing soil corrosivity, it is applicable to consider the guidelines as proposed by EvansReference<sup>14.8</sup>. The corrosivity of a soil towards buried, exposed, metallic surfaces is dependent on the following properties of the soil :

- Electrical conductivity.
- Chemical properties of the soil.
- Ability of the soil to support sulphate reducing bacteria.
- Heterogeneity of the soil.

The tests carried out for the compilation of this report must be considered as indicative of the corrosivity of the soils only. The pH of a soil gives an indication of potential acid related problems. Should the soil pH be less than 6,0, corrosion may take place ; and should the pH be less than 4,50, the problem of corrosion may be serious. If the conductivity of the soil is less than  $0,01\text{Sm}^{-1}$ , corrosiveness is generally not a problem. However, the potential for corrosivity of the soil increases with an increase in conductivity. Should the conductivity of the soil exceed  $0,05\text{Sm}^{-1}$ , the soil can be regarded as very corrosive. Should exposed metal pipes pass from argillaceous soils to arenaceous soils or vice versa, electrochemical cells are set up due to the different rates of oxygen diffusion of the soils. Sulphate reducing bacteria is usually present under anaerobic conditions, that is, typically saturated or waterlogged clays.

The results of the chemical testing carried out for this report indicate the following :

- *Acidity* : The pH of the samples of material tested varied between 7,6 and 8,9. The soils are thus regarded as not corrosive due to the acidity there of.
- *Water Soluble Salts Content* : The conductivity of the samples of material tested varied between  $0,07\text{Sm}^{-1}$  to  $0,13\text{Sm}^{-1}$  for the calcrete ; and between  $0,09\text{Sm}^{-1}$  to  $0,10\text{Sm}^{-1}$  for the colluvium. The high soluble salt content does therefore results in all materials to be corrosive.

Other considerations are :

- *Heterogeneity of the Soil* : Conditions of corrosive soils due to a heterogeneous soil profile do not occur on the property.
- *Water Logged Soils* : Conditions of water logged soils were encountered in TP's 3 and 35 in the unlined stormwater course.

#### 7.1.4 Materials Utilisation

##### *7.1.4(i) Backfilling of Service Trenches*

The hardpan calcrete is not suitable to be used for any type of backfill due to its tendency to break into boulder and cobble sized fragments on excavation. Such fragments cannot be compacted properly on backfilling.

The colluvium can be used for normal backfilling of services trenches. However, due to the coarse granular composition thereof these materials are not suitable for pipe bedding or selected backfill around pipes.

##### *7.1.4(ii) Construction of Paved or Segmental Block Streets*

Only provisional indicators for future guidance of development are provided as far as material quality for road construction is concerned, complying with the requirements applicable to the level of investigation.

The results of the compaction testing on soil samples show the in-situ materials to be generally of G5 to G6 quality and therefore suitable for purposes of paved road or segmental block road construction. This proposal is applicable to access roads to townships and may be used successfully for subbase and base course construction.

##### *7.1.4(iii) Wearing Course for Urban Gravel Roads*

The properties to provide guidance for the use of soil materials for the structural design of a wearing course for urban gravel roads are contained in the various sub-columns of the column "Specifications for Unpaved Roads" in Table 3. The various parameters are colour-coded : Green = suitable ; red = unsuitable. The two sub-columns with a light yellow-brown background contain the parameters on which the physical behaviour of the wearing is course is determined.

From the table it is clear that none of the in-situ materials comply in all aspects to the requirements for a gravel wearing course. In most cases the use of these materials will result in a wearing course subject to raveling and corrugations. This can be attributed the non-cohesive character of most of the materials. Calcrete appears to be the material more suitable for gravel wearing course construction, although experience has taught that if a calcrete with a high PI is used for this purpose, the road surface can become slippery in wet conditions.

### 7.1.5 Other Considerations

The properties discussed in this subsection of the report were obtained from literature reported values based on studies done by the US Army Corps of Engineers as reported by Brink<sup>Reference 14.8</sup> for compacted material. This approach is followed as the arenaceous character of the in-situ materials that did not allow the retrieval of undisturbed sampling. The typical soil properties associated with the Unified classifications of the materials are thus reported.

#### 7.1.5(i) Compressibility

The compressibility of the material can be regarded as a necessary input to pavement design as well as lesser important supporting information for geotechnical classification for site class designation.

- *Colluvium* : The colluvium is regarded as very low compressible with cohesion ( $c_0$ ) of less than  $5,0\text{kNm}^{-2}$  and the effective stress envelope approximately  $28^\circ$  to  $35^\circ$ .
- *Hardpan Calcrete* : The hardpan calcrete is regarded as negligible to low compressible with cohesion ( $c_0$ ) of zero to  $22\text{kNm}^{-2}$  and the effective stress envelope approximately  $28^\circ$  to  $38^\circ$ .
- *Boulder Calcrete* : The boulder calcrete is regarded as negligible to very low compressible with cohesion ( $c_0$ ) less than  $5\text{kNm}^{-2}$  and the effective stress envelope approximately  $28^\circ$  to  $40^\circ$ .
- *Quartz-muscovite Schist Fragments* : Fragments of bedrock quartz-muscovite schist is regarded as negligibly compressible with cohesion ( $c_0$ ) of less than  $5\text{kNm}^{-2}$  and the effective stress envelope approximately  $30^\circ$  to  $40^\circ$ .

#### 7.1.5(ii) Permeability

Permeability is an important parameter in the design of surface drainage and seepage drains. As such indicators in this regard are provided.

- *Colluvium* : The colluvium is regarded as impervious. The soil permeability coefficient exceeds  $3 \times 10^{-7} \text{cms}^{-1}$ .
- *Hardpan Calcrete* : The permeability of the hardpan calcrete is highly variable depending on the mode of deposition and regarded as pervious to impervious. The soil permeability coefficient varies between  $(3 \pm 2) \times 10^{-7} \text{cms}^{-1}$ .
- *Boulder Calcrete* : The boulder calcrete is regarded as impervious. The soil permeability coefficient varies between  $2,7 \times 10^{-6}$  to  $5 \times 10^{-7} \text{cms}^{-1}$ .

### 7.1.5(iii) Erosion Potential

All soil materials encountered during the investigation can be regarded as moderately to highly resistant against erosion. The aspect of erosion potential is important in the area.

## 7.2 Properties of Bedrock

The TLB used to excavate the test pits did not penetrate hardpan calcrete or bedrock of schist to any significant extent and refusal of excavation occurred within millimeters after encountering these materials. It is not customary to penetrate bedrock in the case of a geotechnical investigation for purposes of a residential development. Refusal of excavation on hard rock is accepted as suitable. One can thus accept bedrock to be hard tending to very hard once refusal of excavation was encountered.

### 7.2.1 Calcrete

The results of the materials testing on samples of the hardpan calcrete approach that of the nodular calcrete. However, it must be borne in mind that in in-situ conditions the properties of intact hardpan calcrete approach that of soft rock rather than a gravelly sand. The grading modulus of the samples of hardpan calcrete fragments varied between 1,90 and 2,10 ; plasticity index between 1,0 and 8,0 ; and clay content less than 2%. The activity of the hardpan calcrete is described as low. The PRA classification of the calcrete is A-2-4(0) to A-1-b(0) ; and the Unified classification is SC to GC. Based on these properties and material classification the hardpan calcrete is regarded as non-expansive and no consolidation settlement and no collapse settlement can thus be expected for structures such as single storey units of masonry construction.

The test results of the samples of the hardpan calcrete reflect the properties of excavated fragments of material and not the intact mass of hardpan calcrete. It is therefore accepted that the properties of the very dense calcrete can be considered as tending towards soft rock to medium hard rock, limestone.

Brink (Reference 14.6) reports an average UCS of 32MPa for intact samples of hardpan calcrete from the Kalahari region. Using this as input to parametric calculations with Roclab software results for very dense calcrete tending to widely jointed, slightly weathered, medium hard rock, limestone result in the following properties :

- Cohesion : 1,08MPa
- Friction Angle : 24°
- Tensile Strength : 0,018MPa

- Uni-axle Compressive Strength : 550kPa
- Young's Modulus : 2340MPa

All which show a sound pedocrete, not compressible, not permeable nor subject to erosion.

### 7.2.2 Quartz-muscovite Schist

Parametric calculations with Roclab software results for slightly weathered, very closely jointed, very intensely laminated, medium hard rock result in the following properties :

- Cohesion : 3,4MPa
- Friction Angle : 29,0°
- Tensile Strength : 0,07MPa
- Uni-axle Compressive Strength : 2,5MPa
- Young's Modulus : 8082,4MPa

The above calculations are for schists dipping at 90° with the horizontal plane. Should the angle of dip change the tensile strength, UCS and Young's modulus may change accordingly.

## 7.3 Excavation Classification with Respect to Services

### 7.3.1 Hand Excavation

#### 7.3.1(i) Colluvium

The colluvium can be considered as suitable to be excavated by swing tools.

#### 7.3.1(ii) Pedogenic Deposits

The nodular and hardpan calcrete are of very dense consistency. Such material cannot be considered as suitable to be manually excavated and may as minimum require the use of a 55kW TLB, but preferably a 30 ton excavator to remove it on an economical basis.

#### 7.3.1(iii) Bedrock

Bedrock of quartz-muscovite schist cannot be excavated manually successfully.

### 7.3.2 Classification of Material for Machine Excavation

In terms of Table 5 of SANS 634 : 2012 the following is applicable :

### 7.3.2(i) Restricted Excavation

- *Soft Excavation* : The colluvium and residual quartz-muscovite schist can be regarded as soft excavation. The thickness of this stratum varied between 100mm and 700mm in the test pits, averaging 250mm prior to encountering conditions of intermediate or hard rock excavation.
- *Intermediate Excavation* : Refusal of excavation with a TLB occurred in most cases soon once very dense, hardpan calcrete or slightly weathered to unweathered rock was encountered. However, some penetration into the hardpan calcrete or quartz-muscovite schist was possible and can be regarded as intermediate excavation. It was possible to penetrate between 100mm and 800mm into the hardpan calcrete and quartz-muscovite schist, averaging 320mm thick, prior to encountering hard rock excavation.
- *Hard Rock Excavation* : Refusal of excavation with the TLB occurred on conditions of hard rock excavation in all the test pits at depths varying between 200mm and 1000mm, averaging 570mm on quartz-muscovite schist or hardpan calcrete.

From the above it is clear that the transition of conditions of excavation is rapid from soft to hard rock excavation with virtually no intermediate excavation.

### 7.3.2(ii) Non-restricted Excavation

The classification as per subparagraph 7.3.2(i) : Restricted Excavation as above is also applicable for non-restricted excavation.

## 7.4 Seismicity

A 10% probability of an event with magnitude less than  $100\text{cms}^{-2}$  to take place once in 50 years is regarded as favourable ; and a natural seismic activity with magnitude exceeding  $100\text{cms}^{-2}$  is regarded as unfavourable. Based on a report compiled by Kijko<sup>Reference 14.10</sup> a 10% probability exists that an earthquake with Peak Ground Acceleration exceeding of 0,06g may take place once in 50 years in Wegdraai.

The closest source of seismic measurements to Wegdraai under control of the Council for Geoscience is Tontelbos at  $31^{\circ} 10' 12''\text{S}$  and  $20' 30' 00''\text{E}$ .

- The annual probability for an earthquake with intensity of 4,5 on the Modified Mercalli Scale to occur in the area is less than  $10^{-0.7}$  ; and with an intensity of 8,5 to occur the probability is  $10^{-3.8}$ .



- The annual probability for an earthquake with an acceleration of  $10^{-1.9}g$  to occur in the area is less than  $10^{-0.7}$  ; and with an acceleration of  $10^{-0.75}g$  to occur in the area is less than  $10^{-3.8}$ .

To put the above information into perspective, Table 4 : Earthquake and Magnitude and Intensity, is attached to this report.

### **7.5 Undermining**

The area of investigation is not undermined.

### **7.6 Dolomite Stability**

The area of investigation is not subject to dolomite related instabilities.

## **8 SITE CLASS DESIGNATIONS**

Based on the above discussions the property can be divided into four zones as per the guidelines posted by SANS 10400 : Section H<sup>Reference 14.11</sup> . The zonation is indicated on Figure 6 : Site Class Designation.

### **8.1 Geotechnical Zone I**

This zone comprises 95% of the area investigated. It is characterized by the materials profile of TP's 1 to 7, 9, 10, 12 to 16 and 20 to 31. It consists of a superficial horizon less than 400mm thick comprising of colluvium, residual quartz-muscovite schist and very dense calcrete less than 400mm thick overlying bedrock of quartz-muscovite schist. Several outcrops of calcrete occur in the area. Slope across the land is less than 2%. Foundation stresses induced by conventional strip foundations for single and double storey structures will result in almost negligible settlement if founded directly on the slightly weathered and unweathered hard rock to very hard rock, or on the very dense calcrete. The area is thus zoned as "R" and regarded as stable.

### **8.2 Geotechnical Zone II**

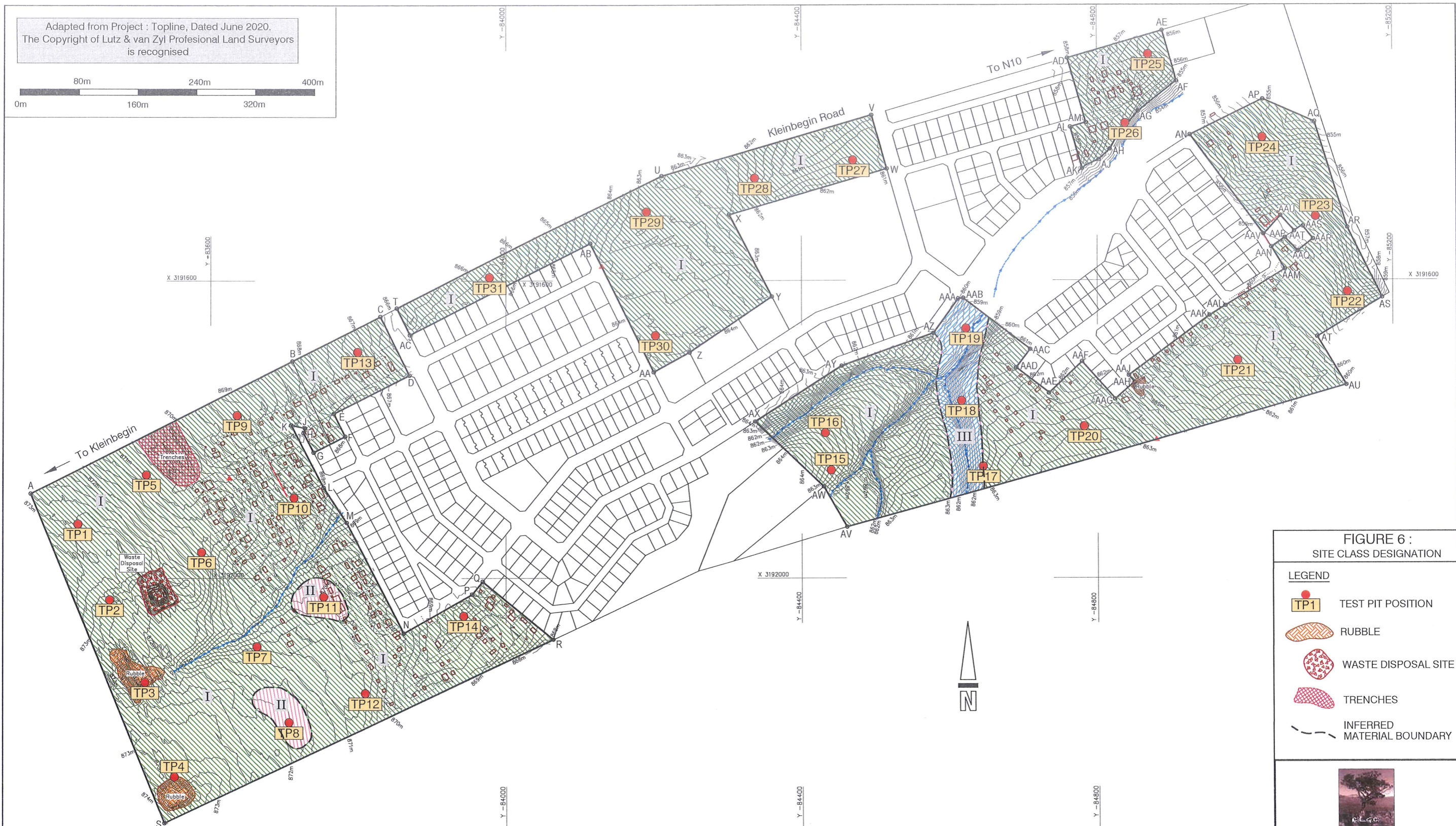
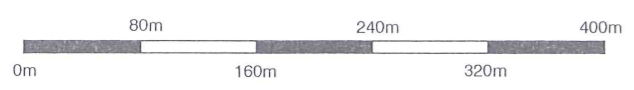
This zone comprises 2% of the area investigated. The zone is present in two separate areas in the south western section of the property. It is characterized by the materials profiles of TP's 8 and 11. It consists of a horizon of colluvium exceeding 400mm thick overlying to very dense hardpan calcrete and at depth bedrock of quartz-muscovite schist. Slope across the land is less than 2%. Foundation stresses induced by conventional strip foundations for single

and double storey structures will result in limited compression settlement less than 10mm if founded directly on the medium dense colluvium. As per the materials profile encountered in the test pits the thickness of the horizon of colluvium and underlying calcrete soil is sufficient to dissipate the stresses induced by the foundations effectively. The area is thus zoned as “S” and the materials strata can be regarded as compressible to a maximum of 10mm.

**TABLE 4 : EARTHQUAKE MAGNITUDE AND INTENSITY**

MODIFIED MERCALLI INTENSITY SCALE	INTENSITY	DESCRIPTION	RICHTER SCALE MAGNITUDE	RADIUS OF PERCEPTIBILITY (km)
I	Instrumental	Detected only by seismography		
II	Feeble	Noted only by sensitive people	3.5 to 4.2	3 to 24
III	Slight	Like the vibrations due to a passing lorry. Felt by people at rest, especially on upper floors		
IV	Moderate	Felt by people while walking. Rocking of loose objects, including vehicles	4.3 to 4.8	24 to 48
V	Rather strong	Felt generally ; most sleepers are awakened and bells ring		
VI	Strong	Trees sway and suspended objects swing ; damage by overturning and fling of loose objects	4.9 to 5.4	48 to 112
VII	Very strong	General public alarm ; walls crack ; plaster falls	5.5 to 6.1	110 to 200
VIII	Destructive	Car drivers seriously disturbed; masonry fissured ; buildings damaged	6.2 to 6.9	200 to 400
IX	Ruinous	Houses collapse ; pipes break		
X	Disasterous	Ground cracks badly ; buildings destroyed ; railway lines bent ; landslides on steep slopes	7.0 to 7.3	400 to 700
XI	Very disasterous	Few buildings remain standing; bridges destroyed ; all services out of action ; great landslides and floods	7.4 to 8.1	400 to 700
XII	Catastrophic	Total destruction ; objects thrown into the air; ground rises and falls in waves	>8.1	400 to 700

Adapted from Project : Topline, Dated June 2020.  
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**FIGURE 6 :  
SITE CLASS DESIGNATION**

**LEGEND**

- TP-1** TEST PIT POSITION
- RUBBLE
- WASTE DISPOSAL SITE
- TRENCHES
- INFERRED MATERIAL BOUNDARY



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**FOUNDATION DESIGN, BUILDING PROCEDURES AND PRECAUTIONARY MEASURES**

AREA	AREA OF PROPERTY (%)	GEOTECHNICAL CLASS	ESTIMATED SOIL MOVEMENT(mm)	SOIL PROFILE	CONSTRUCTION TYPE	FOUNDATION DESIGN	ASSOCIATED PROBLEMS	DEVELOPMENT POTENTIAL
I	95,57	R	Negligible	Less than 400mm of colluvium and residual soil overlying bedrock and pedogenic deposits	Normal	Normal construction (strip footing or slab-on-the-ground) foundation. Founding to take place on very dense pedocretes or bedrock	Conditions of hard rock excavation. Landslope less than 2% favours slab-on-the-ground foundations. Stormwater disposal negatively effected by limited slope across the land Large volumes of waste need to be cleared away.	Intermediate
II	1,55	S	0mm to 10mm compressible settlement	More than 400mm of colluvium and residual soil overlying bedrock and pedogenic deposits	Normal	Normal construction (strip footing or slab-on-the-ground) foundation. Founding to take place on dense to very dense pedocretes or residual soil. Foundation bearing pressure not to exceed 50kPa. Good site drainage	Conditions of hard rock excavation. Landslope less than 2% favours slab-on-the-ground foundations. Stormwater disposal negatively effected by limited slope across the land	Intermediate
III	2,88	S	0mm to 10mm compressible settlement	More than 400mm of colluvium and residual soil overlying bedrock and pedogenic deposits	Normal	Normal construction (strip footing or slab-on-the-ground) foundation. Founding to take place on dense to very dense pedocretes or residual soil. Foundation bearing pressure not to exceed 50kPa. Good site drainage	Conditions of hard rock excavation Landslope between 2% and 6% favours strip foundations Proximity of non-perennial stream limits development	Intermediate

TAAK: Expansion and Formalisation of Wegdraai Community  
 JOB NAME:  
 LIGGING SITE: Erven 1, 45 and 47 of Wegdraai  
 KLIJNT: IKheis Municipality  
 CLIENT:  
 TEKENING NO: Figure 6 :  
 DRAWING NO: Site Class Designation  
 DATUM: 10 September 2020  
 DATE:

### **8.3 Geotechnical Zone III**

This zone comprises 3% of the area investigated. The zone is present in a narrow strip of land extending from the southern limit of investigation northwards along a non-perennial water course. The very dense hardpan calcrete has been removed by the seasonal presence of flood water, exposing residual quartz-muscovite schist and dense boulder calcrete. It is characterized by the materials profiles of TP's 17 to 19. It consists of a horizon of colluvium overlying residual quartz-muscovite schist and boulder calcrete exceeding 400mm thick, overlying bedrock of quartz-muscovite schist. Slope across the land is between 2% and 6%. Foundation stresses induced by conventional strip foundations for single and double storey structures will result in limited compression settlement less than 10mm if founded directly on the medium dense terrace gravels. As per the materials profile encountered in the test pits the thickness of the horizon of terrace gravels and underlying calcrete soil is sufficient to dissipate the stresses induced by the foundations effectively. The area is thus zoned as "S" and the materials strata can be regarded as compressible to a maximum of 10mm.

As this narrow zone encompasses a non-perennial stream, it is unlikely that residential development will take place in it.

### **8.4 Other Considerations**

The contents of this subparagraph 8.4 largely fall outside the scope of a geotechnical investigation and refer to the widespread presence of various types of waste as described briefly in subsections 4.5 and 6.3.4 of this document. However, it is given in good faith in an effort to find a solution to the presence of waste in the area. To implement these measures will require inputs from both the local municipal authorities as well as the community of Wegdraai.

An excavation for waste disposal in the area is already in existence. Based on current regulations this excavation may not be used as waste disposal site due to its proximity to the village. However, it may be backfilled or partially backfilled by the stockpiles of soil and gravels on site as a measure of land rehabilitation, thereby reducing the danger of injuries or death to children. Similarly can the series of trenches on the northern perimeter of the site between TP's 5 and 9 be backfilled, making the land suitable for the construction of residences.

In the village and immediate surroundings thereof it was clear that household waste is present in extreme distribution over the entire area. Based on a visual appraisal of the conditions the "dirty" content of this waste renders the proposal of separating and recycling as not viable and it needs to be removed to a suitable waste disposal site.

## 9 FOUNDATION RECOMMENDATIONS AND SOLUTIONS

The foundation design alternatives and ancillary issues as discussed in subparagraphs 9.1 and 9.4 below are summarized in Table 5 : Foundation Design, Building Procedures and Precautionary Measures. In some cases more than one foundation solution is offered in the discussion below. Whichever option is used, the design must adhere strictly on the proposals of SANS 10400H. As geotechnical conditions favour the use of both alternatives, the decision of which option to use must be based on financial and practical considerations. In all cases service trenches shall not be excavated parallel to buildings within 1500mm of the building perimeter.

### 9.1 Geotechnical Zone I

The zone is classed as R, meaning that the proposed horizon for founding is stable and negligible soil movement is expected. Considering the limited slope across the land of less than 2% only and the favourable geotechnical site classification as per Section 8 above, two foundation design alternatives are applicable to the zone.

#### 9.1.1 Strip Foundations

Foundations of 400mm wide placed directly on the very dense hardpan calcrete may be used. Should the areas of the proposed dwellings not exceed 200m<sup>2</sup> foundations for internal non-loadbearing walls may consist of thickened floorslabs. Should this option be adopted the floorslabs shall be reinforced steel mesh.

#### 9.1.2 Slab-on-the-ground Foundations

This is the preferred method of founding. The solution of slab-on-the-ground foundations may only be used for dwellings less than 200m<sup>2</sup> in area. Edge beams shall be placed directly on the very dense hardpan calcrete.

Foundations for internal non-loadbearing walls shall consist of thickened floorslabs. The foundations shall not contain any changes in surface levels with steps exceeding 400mm and do not support any chimneys or walls which support concrete roofs.

### 9.2 Geotechnical Zone II

The zone is classed as S, meaning that less than 10mm of compression settlement may occur. Considering the slope across the land is less than 2% and the stable geotechnical site

TABLE 5 : FOUNDATION DESIGN, BUILDING PROCEDURES AND PRECAUTIONARY MEASURES

AREA	AREA OF PROPERTY (%)	GEOTECHNICAL CLASS	ESTIMATED SOIL MOVEMENT (mm)	SOIL PROFILE	CONSTRUCTION TYPE	FOUNDATION DESIGN AND BUILDING PROCEDURES	ASSOCIATED PROBLEMS	DEVELOPMENT POTENTIAL
I		R	Negligible	Less than 400mm of colluvium and residual soil overlying bedrock and pedogenic deposits	Normal	Normal construction (strip footing or slab-on-the-ground) foundation. Founding to take place on very dense pedocretes or bedrock	Conditions of hard rock excavation Landslope less than 2% favours slab-on-the-ground foundations. Stormwater disposal negatively effected by limited slope across the land Large volumes of waste need to be cleared away.	Intermediate
II		S	0mm to 10mm compression settlement	More than 400mm of colluvium and residual soil overlying bedrock and pedogenic deposits	Normal	Normal construction (strip footing or slab-on-the-ground) foundation. Founding to take place on dense to very dense pedocretes or residual soil Foundation bearing pressure not to exceed 50kPa Good site drainage	Conditions of hard rock excavation Landslope less than 2% favours slab-on-the-ground foundations. Stormwater disposal negatively effected by limited slope across the land	Intermediate
III		S	0mm to 10mm compression settlement	More than 400mm of colluvium and residual soil overlying bedrock and pedogenic deposits	Normal	Normal construction (strip footing or slab-on-the-ground) foundation. Founding to take place on dense to very dense pedocretes or residual soil Foundation bearing pressure not to exceed 50kPa Good site drainage	Conditions of hard rock excavation Landslope between 2% and 6% favours strip foundations Proximity of non-perennial stream limits development	Intermediate

classification as per Section 8 above, two foundation design alternatives are applicable to the zone.

#### 9.2.1 Strip Foundations

Foundations of 400mm wide placed directly on the very dense hardpan calcrete may be used. Should the areas of the proposed dwellings not exceed 200m<sup>2</sup> foundations for internal non-loadbearing walls may consist of thickened floorslabs. Should this option be adopted the floorslabs shall be reinforced steel mesh.

#### 9.2.2 Slab-on-the-ground Foundations

This is the preferred method of founding. The solution of slab-on-the-ground foundations may only be used for dwellings less than 200m<sup>2</sup> in area. Edge beams shall be placed directly on the very dense hardpan calcrete.

Foundations for internal non-loadbearing walls shall consist of thickened floorslabs. The foundations shall not contain any changes in surface levels with steps exceeding 400mm and do not support any chimneys or walls which support concrete roofs.

### **9.3 Geotechnical Zone III**

The zone is classed as S, meaning that less than 10mm of compression settlement may occur. Cognizance must be taken of the proximity of the non-perennial stream central to this area. Considering the slope across the land of approximately 2% to 6% and the stable geotechnical site classification as per Section 8 above, two foundation design alternatives are applicable to the zone.

#### 9.3.1 Strip Foundations

This is the preferred method of founding. Foundations of 400mm wide placed directly on the medium dense terrace gravels may be used. Should the areas of the proposed dwellings not exceed 200m<sup>2</sup> foundations for internal non-loadbearing walls may consist of thickened floorslabs. Should this option be adopted the floorslabs shall be reinforced steel mesh.

#### 9.3.2 Slab-on-the-ground Foundations

The solution of slab-on-the-ground foundations may only be used for dwellings less than 200m<sup>2</sup> in area. Edge beams shall be placed directly on the medium dense terrace gravels. Foundations for internal non-loadbearing walls shall consist of thickened floorslabs. The

foundations shall not contain any changes in surface levels with steps exceeding 400mm and do not support any chimneys or walls which support concrete roofs.

## **10 DRAINAGE**

The water courses on site are contained in narrow and well-defined gullies of such extent that they do not influence the various geotechnical site class designations. They are therefore not zoned separately. However, the presence of these water courses must be taken into account and infrastructure established only in a safe distance from these features.

The slope of less than 2% in certain areas of the land is regarded as marginal and may result in problems with the design of stormwater and sewerage disposal systems depending on dissipation by gravity.

## **11 SPECIAL PRECAUTIONARY MEASURES**

No extraordinary features requiring special precautionary measures to decrease the impact thereof are present on site, except that waste and litter are present abundantly and need to be cleared up.

## **12 CONCLUSIONS**

The property is regarded as being of intermediate suitability for residential development. Founding conditions can be defined as R and S. The only factors that reduce the suitability of the land for development are :

- The presence of hard rock and very dense hardpan calcrete close to the surface. The presence thereof will result in conditions of hard excavation. On the other hand it provides conditions favouring conventional methods of founding.
- The limited slope of less than 2% in Geotechnical Zones I and II will have a detrimental influence on the design of stormwater disposal systems and sewerage reticulation.
- The presence of waste material need to be addressed.

The conclusions as based on the site conditions are summarized in Table 6 : Influence of Constraints per Geotechnical Zoning. This classification is based on the proposals of the document *Geotechnical Site Investigations for Housing Developments (Generic Specification GFSH-2)*, issued by the National Department of Housing in September 2002.



**TABLE 6 : INFLUENCE OF CONSTRAINTS PER GEOTECHNICAL ZONING**

CONSTRAINT	KEY TO CLASSIFICATION			CLASSIFICATION PER GEOTECHNICAL ZONE		
	MOST FAVOURABLE (1)	INTERMEDIATE (2)	LEAST FAVOURABLE (3)	I	II	III
Collapsible soil	Any collapsible horizon or consecutive horizons totalling a depth of less than 750mm in thickness	Any collapsible horizon or consecutive horizons with a depth of more than 750mm in thickness	A least favourable situation for this constraint does not occur			
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			
Active soil	Low soil heave potential anticipated	Moderate soil heave potential anticipated	High soil heave potential anticipated			
Highly compressible soil	Low soil compressibility anticipated	Moderate soil compressibility anticipated	High soil compressibility anticipated			
Erodibility of Soil	Low	Intermediate	High			
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			
Undermined ground	Undermining at a depth greater than 240m below surface, except where total extraction mining has not occurred	Old undermined areas to a depth of 90m to 240m below surface where stope closure has ceased	Mining within less than 90m to 240m of surface or where total extraction mining has taken place			
Dolomite and limestone stability	Possibly stable. Areas of dolomite overlain by Karoo rocks or intruded by sills. Areas of Black Reef rocks. Anticipated Inherent Risk Class 1	Potentially characterised by instability. Anticipated Inherent Risk Classes 2 to 5	Known sinkholes and dolines. Anticipated Inherent Risk Classes 6 to 8			
Steep slopes*	Between 2° and 6° in 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)			
Areas of unstable natural slopes*	Low risk	Intermediate risk	High risk (Especially in areas subject to seismic activity)			
Areas subject to seismic activity	10% probability of an event less than 100cms <sup>-2</sup> within 50 years	Mining induced seismic activity more than 100cms <sup>-2</sup>	Natural seismic activity more than 100cms <sup>-2</sup>			
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 with a known drainage channel or floodplain			

## 12.1 Stratigraphy

The available information shows that the area of investigation is located on a subduction zone dating approximately 1000 million years old. The zone is located between the lithology of the Kaapvaal Craton and the Namaqua-Natal mobile belt. The remains of the original geology in the area are referred to as the Kaaien Terrane and the site is located on the Groblershoop Formation of the Brulpan Group. The quartz-muscovite schist is described as pale white mottled light green, intensely laminated, closely jointed, soft rock becoming hard rock with depth. While the laminations are generally closed smooth and clean ; the condition of the joints may vary from closed, smooth and clean to open smooth and containing fine, white calcareous sand.

## 12.2 Soil Profile

### 12.2.1 Colluvium

On site colluvium as surface deposit was found in all the test pits except TP's 12, 24, 27 and 31. The colluvium is not a homogenous material on site due to a variable gravel content. The matrix of the colluvium consists light brown fine sand and clasts of gravels and cobbles of quartz and some calcrete. With an increase in clasts from matrix supported to clast supported the consistency of the colluvium improves from loose to medium dense. The matrix of the colluvium remains intact throughout. The horizon of colluvium was between 100mm and 600mm thick in the test pits.

### 12.2.2 Mokalanen Formation

#### 12.2.2(i) *Hardpan Calcrete*

Very dense hardpan calcrete was encountered in TP's 1, 2, 5 to 16, 20, 23 to 29 and 31. It is present dirty white, very fine grained, very dense hardpan calcrete. Small pockets and lenses of red sand may be contained in the pedocretic matrix. The calcrete was present as outcrops in TP's 12, 24, 27 and 31. Elsewhere it underlies the colluvium, occurring from depths between 150mm and 600mm minimum, extending to 200mm to 1000mm maximum.

#### 12.2.2(ii) *Boulder Calcrete*

Very dense boulder calcrete was encountered in TP's 3, 4, 17, 18 and 30. It is present tightly packets cobbles and boulders up to 500mm in diameter of calcrete in a matrix of light red sand. dirty white, very fine grained, very dense hardpan calcrete. Small pockets and lenses of red

sand may be contained in the pedocretic matrix. It underlies the colluvium, occurring from depths between 100mm and 400mm minimum, extending to 300mm to 1000mm maximum.

### 12.2.3 Residual Quartz-muscovite Schist

Residual quartz-muscovite schist was encountered in TP 19 only. It underlies the colluvium from a depth of 200mm extending to 700mm at which bedrock was encountered. The residual quartz-muscovite schist is described as abundant clast supported, coarse angular gravels of schist in a matrix of dark red brown fine sand. The consistency is dense.

## 12.3 Groundwater

### 12.3.1 Perched Water

Perched groundwater was not encountered in any of the test pits excavated for this investigation. It is anticipated that perched water will generally not prove problematic on the site.

### 12.3.2 Permanent Groundwater

The probability for drilling successfully for water in the area is between 40% and 60%, and the probability that such a borehole will yield more than 2l/s is between 10% and 20%. Groundwater is expected to occur at depths less than 15 meters in compact, argillaceous strata.

## 12.4 Conditions of Excavation

On average over the entire site bedrock or refusal of excavation on very dense hardpan calcrete or quartz-muscovite schist occurred in all the test pits at depths varying between 200mm and 1000mm, averaging 570mm. The implication of this is that should trenches require excavated depths to 1000mm, 43% of the excavation may be classified as hard, requiring drilling and blasting. Should the required depth of excavation increase to 1500mm, 62% of the excavation may be classified as hard.

Irrespective of which method of excavation is considered, the most important issue is that across the entire site the depth to bedrock and hardpan calcrete can be regarded as hard rock excavation that is variable as follows :

#### 12.4.1 Geotechnical Zone I

This zone is classified as R. The average depth to bedrock or very dense pedocrete is 220mm. Refusal of excavation occurred at an average depth of 510mm. The implication of this is that should trenches require excavated depths to 1000mm, 49% of the excavation may be classified as hard, requiring drilling and blasting. Should the required depth of excavation increase to 1500mm, 67% of the excavation may be classified as hard.

#### 12.4.2 Geotechnical Zones II and III

These zones are classified as S. The average depth to bedrock is 520mm. Refusal of excavation occurred at an average depth of 860mm. The implication of this is that should trenches require excavated depths to 1000mm, 86% of the excavation may be classified as soft, suitable for TLB excavation. Should the required depth of excavation increase to 1500mm, 43% of the excavation may be classified as hard, requiring drilling and blasting.

### **12.5 Site Class Designation**

It is concluded that the entire area is regarded as suitable for residential development as follows :

#### 12.5.1 Geotechnical Zone I

The zone is classed as R, meaning that the proposed horizon for founding is stable and negligible soil movement is expected. The distribution thereof encompasses 95% of the proposed area for development. Slope across the land is less than 2%. Considering the limited slope and the stable geotechnical site classification, two foundation design alternatives are applicable to the zone, namely conventional strip foundations or slab-on-the-ground foundations placed directly on bedrock or very dense pedocrete.

Geotechnical conditions related to foundation design can be regarded as favourable, but the conditions of hard rock excavation close to the surface and slope less than 2% detract from the suitability of establishing services and overall the development potential is regarded as intermediate only.

#### 12.5.2 Geotechnical Zone II

The zone is classed as S, meaning that the proposed horizon for founding is slightly compressible and rapid settlement less than 10mm is expected. The distribution thereof encompasses 2% of the proposed area for development. Slope across the land is less than

2%. Considering the limited slope and the favourable geotechnical site classification, two foundation design alternatives are applicable to the zone, namely conventional strip foundations or slab-on-the-ground foundations placed directly on medium dense terrace gravels.

Geotechnical conditions related to foundation design can be regarded as favourable, but the conditions of hard rock excavation close to the surface and slope less than 2% detract from the suitability of establishing services and overall the development potential is regarded as intermediate only.

### 12.5.3 Geotechnical Zone III

The zone is classed as S, meaning that the proposed horizon for founding is slightly compressible and rapid settlement less than 10mm is expected. The distribution thereof encompasses 3% of the proposed area for development. Slope across the land is between 2% and 6%. Considering the limited slope and the favourable geotechnical site classification, two foundation design alternatives are applicable to the zone, namely conventional strip foundations or slab-on-the-ground foundations placed directly on medium dense terrace gravels. The more viable foundation alternative therefore remains founding by conventional strip foundations.

Geotechnical conditions related to foundation design can be regarded as favourable, but the conditions of hard rock excavation close to the surface detracts from the suitability of establishing services and overall the development potential is regarded as intermediate only.

## 12.6 Land Slope

The average slope across the larger part of the land is less than 2%. Only in Geotechnical Zones III does the slope exceed 2%, that is over 3% of the site. This slope of less than 2% has a detrimental influence on especially the design of a stormwater disposal system depending on gravity to dissipate of the surface water due to downpours. The land slope also affects the design of the sewerage disposal but to a lesser extent as the gradient of the pipes can be adjusted according to design requirements.

No steep slopes are present on the property.

## 12.7 Areas Subject to Flooding

The non-perennial water courses on site are contained in well-defined, narrow gullies and

may be regarded as being of lesser importance, requiring no additional precautionary measures to ensure the safety of the population against flooding.

### **12.8 Materials Utilization**

- *Trench Backfilling* : None of the materials are suitable for selected fill or pipe bedding. With exception of the hardpan calcrete all materials can be used for normal backfill.
- *Layerworks for Paved or Segmental Block Paving* : The residual soils are suitable for the construction of subbase and base course construction for lightly trafficked roads.
- *Wearing Course for Gravel Roads in Urban Areas* : None of the soil materials are 100% suitable for this purpose, but calcrete is the most suitable present. The use of these materials will generally result in a road surface subject to raveling and corrugations.

### **12.9 Other Considerations**

- *Undermining* : The area is not subject to undermining.
- *Seismic Activity* : The Peak Ground Acceleration expected in 50 years is 0,06g. A low risk for the development of earth tremors therefore exist.
- *Soil Corrosivity* : The in-situ soils and pedocretes are not corrosive due to acidic properties, but corrosive due to high soluble salts contents.
- *Dolomite* : The area of investigation is not subject to any restrictions due to the presence of dolomite. Bedrock of dolomite does not occur in the area of investigation.

## **13 RECOMMENDATIONS**

### **13.1 Foundation and Structural Design**

Section 9 of this document provides guidelines for foundation and structural design. These guidelines are based strictly on the contents of SANS 10400H and the NHBRC Home Owners Manual published in 2015. It is recommended that development take place strictly according to these guidelines. More than one founding solution is applicable on the site, and the property developer can base his choice on financial constraints.

### **13.2 Materials Utilization**

- *Trench Backfill* : With exception of the hardpan calcrete, the in-situ materials may be used for normal backfill of trenches. The hardpan calcrete shall be spoilt and not used at all for this purpose. Material for pipe bedding and selected backfill shall be obtained from commercial sources.

- *Layerworks for Paved or Segmental Block Paving* : Material for subbase and base construction may be obtained from excavated calcrete and colluvium. It is recommended that a centerline investigation consisting of test pitting and soil sampling be conducted to allow the consulting engineer to produce suitable pavement designs for the project.
- *Wearing Course for Gravel Roads in Urban Areas* : The calcrete can be used for the construction of a gravel wearing course.

#### **13.4 Conditions of Excavation**

Although manual excavation is possible through the colluvium, residual soil and to some extent through the calcrete, it is considered as not an economic proposition, mostly due to the consistency and composition of the soil. Excavation through these soils shall require the use of a TLB rated at 55kW minimum, or preferably a 30 ton excavator of the very dense pedocretes need to be removed. It is recommended that adequate provision be made for hard rock excavation.

#### **13.5 Land Slope**

Slope across the 97% of the land is less than 2%. This is regarded as being of intermediate suitability for urban development only. This has an influence on especially the stormwater disposal system but to a lesser extent on the waste water design. In theory the slope of 2% to 6% on 2% of the land can be regarded as favourable for urban development, but the combination of the slope and presence of rock outcrops result in conditions less desirable for development.

### **14 SOURCES OF REFERENCE**

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14.2 McCarthy T and Rubidge B : *The Story of Earth and Life*, pages 156 to 161, funded by Exxaro and published in 2006 by Struik Nature.

14.3 Cornell DH et al : *Section 16 The Namaqua-Natal Province, pages 325 to 380, as contained in the Geology of South Africa*, under editorship of MR Johnson, published by the Council for Geoscience in 2006.

14.4 Moen HFG : *The Geology of the Upington Area*, pages 72 to 87, published by the Council for Geoscience in 2007.

14.5 Partridge TC et al : *Section 29 Cenozoic Deposits of the Interior, pages 585 to 593, as contained in the Geology of South Africa*, under editorship of MR Johnson, published by the Council for Geoscience in 2006.

14.6 Brink ABA : *Engineering Geology of Southern Africa, Volume 4, pages 294 to 295*, published in 1985 by Building Publications, Pretoria.

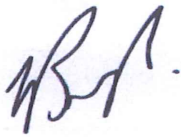
14.7 Vegter JR : *An Explanation of a Set of National Ground Water Maps*, published by the Water Research Commission, in August 1995.

14.8 Evans UR : *The Corrosion and Oxidation of Metals*, published by Edward Arnold in 1971.

14.9 Brink ABA et al : *Soil Survey for Engineering*, pages 38 to 39, published by Clarendon Press in 1982.

14.10 Kijko A et al : *Probabilistic Peak Ground Acceleration and Spectral Seismic Hazard Maps for South Africa*, Report 2003-0053 by the Council for Geoscience.

14.11 SANS 10400 : Section H Edition 3 pages 14 to 28.



FJ Breytenbach, Pr Eng  
For Cedar Land Geotechnical Consult (Pty) Ltd

11 September 2020



**GEOTECHNICAL CONDITIONS ON ERVEN 1, 45 AND  
47 OF WEGDRAAI: A REPORT FOR THE EXPANSION  
AND FORMALISATION OF WEGDRAAI COMMUNITY**

2020/J09/MCP\_01

**ADDENDUM A: TEST PIT PROFILES**

**TRIAL HOLE: 1**

**PROJECT:** EXPANSION AND FORMALISATION OF WEGDRAAI COMMUNITY

**LOGGED BY:** FJB

**SITE:** ERVEN 1, 45 AND 47 OF WEGDRAAI

**DATE LOGGED:** 8/7/2020

**CLIENT:** IKHEIS MUNICIPALITY

**LOCATION:** 28°50'26,9" S 21°51'17,3" E

*Cedar Land Geotechnical*

*Consult (Pty) Ltd*

**P O Box 607**

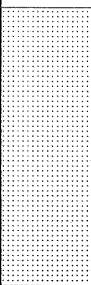


**Ceres**

**6835**

**Cell: 082 570 2767**

**Email:**

**cedarland.frans@breede.co.za**

Depth (m)	Legend	PROFILE	SAMPLE			Remarks
			Number	Type	Symbol	
0.00		Ground Surface				<b>NOTES:</b> 1 Refusal of excavation at 400 mm on very dense hardpan calcrete.
0.20		Dry, light brown, loose, intact, fine SAND and matrix supported, medium coarse, subangular, gravels of quartz and cobbles of calcrete. Colluvium.	U9267	0-0,3		
0.40		Dirty white, very fine grained, very dense, hardpan CALCRETE with pockets of dry, light red, fine sand. Pedogenic deposits.				
0.60						▽ Water encountered ▼ Water level ▾ Bottom of hole --- Approximate material change • Disturbed sample ■ Undisturbed sample
0.80						
1.00						

**Contractor:** ALS Plant Hire

**Date Drilled:** 8/7/2020

**Machine:** Bell 315SK

**Hole Diameter:** 600 mm

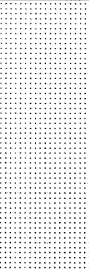

**Water Depth:**

**Sheet:** 1 of 1







**SOIL PROFILE:** TEST PIT 1

**FIGURE:** A1

<b>TRIAL HOLE: 2</b>	<i>Cedar Land Geotechnical</i>
PROJECT: EXPANSION AND FORMALISATION OF WEGDRAAI COMMUNITY	<i>Consult (Pty) Ltd</i>
LOGGED BY: FJB	P O Box 607
SITE: ERVEN 1, 45 AND 47 OF WEGDRAAI	Ceres
	6835
	Cell: 082 570 2767
	Email:
CLIENT: !KHEIS MUNICIPALITY	cedarland.frans@breede.co.za
DATE LOGGED: 8/7/2020	
LOCATION: 28°50'30,2" S 21°51'18,9" E	

Depth (m)	Legend	PROFILE	SAMPLE			Remarks
			Number	Type	Symbol	
0.00		Ground Surface				<b>NOTES:</b> 1 Refusal of excavation at 400 mm on very dense hardpan calcrete.
0.20		Dry, light red brown, loose, intact, fine SAND and matrix supported, medium coarse, subrounded and subangular, gravels of quartz. Colluvium.				
0.40		Dirty white, very fine grained, very dense, hardpan CALCRETE with minor inclusions of quartz-muscovite schist. Pedogenic deposits.				
0.60						
0.80						
1.00						

Contractor: ALS Plant Hire Date Drilled: 8/7/2020 Machine: Bell 315SK	Hole Diameter: 600 mm Water Depth: Sheet: 1 of 1
SOIL PROFILE: TEST PIT 2	FIGURE: A2

-  Water encountered
-  Water level
-  Bottom of hole
-  Approximate material change
-  Disturbed sample
-  Undisturbed sample

**TRIAL HOLE: 3**

**PROJECT:** EXPANSION AND FORMALISATION OF WEGDRAAI COMMUNITY

**LOGGED BY:** FJB

**SITE:** ERVEN 1, 45 AND 47 OF WEGDRAAI

**DATE LOGGED:** 8/7/2020

**CLIENT:** !KHEIS MUNICIPALITY

**LOCATION:** 28°50'33,8" S 21°51'20,7" E

*Cedar Land Geotechnical*

*Consult (Pty) Ltd*

P O Box 607

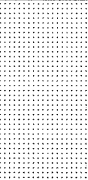
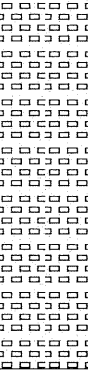
Ceres

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Depth (m)	Legend	PROFILE	SAMPLE			Remarks
			Number	Type	Symbol	
0.00		Ground Surface				<b>NOTES:</b> 1 Refusal of excavation at 700 mm on very dense boulder calcrete.
		Dry, light red brown, loose, intact, fine SAND. Colluvium.				
0.20		Dry, light red brown, loose, intact, fine SAND and matrix supported, medium coarse, subrounded and subangular, gravels of quartz. Colluvium.				
0.40		Abundant, clast supported, boulders (± 500 mm in diameter) of calcrete in a matrix of dry, red brown, fine sand, boulder CALCRETE. Overall consistency is very dense. Pedogenic deposits.				
0.60						
0.80						√ Water encountered T Water level r Bottom of hole --- Approximate material change • Disturbed sample ■ Undisturbed sample
1.00						

**Contractor:** ALS Plant Hire

**Date Drilled:** 8/7/2020

**Machine:** Bell 315SK

**Hole Diameter:** 600 mm

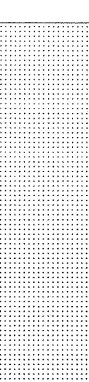
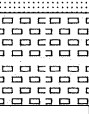
**Water Depth:**

**Sheet:** 1 of 1

**SOIL PROFILE:** TEST PIT 3

**FIGURE:** A3

<b>TRIAL HOLE: 4</b>	<i>Cedar Land Geotechnical Consult (Pty) Ltd P O Box 607 Ceres 6835 Cell: 082 570 2767 Email: cedarland.frans@breede.co.za</i>
PROJECT: EXPANSION AND FORMALISATION OF WEGDRAAI COMMUNITY	
LOGGED BY: FJB	
SITE: ERVEN 1, 45 AND 47 OF WEGDRAAI	
CLIENT: !KHEIS MUNICIPALITY	
DATE LOGGED: 8/7/2020	
LOCATION: 28°50'37,9" S 21°51'22,2" E	

Depth (m)	Legend	PROFILE	SAMPLE			Remarks
			Number	Type	Symbol	
0.00		Ground Surface				<b>NOTES:</b> 1 Refusal of excavation at 500 mm on very dense boulder calcrete.
0.20		Dry, light red brown, loose, intact, fine SAND and matrix supported, medium coarse, subrounded and subangular, gravels of quartz. Colluvium.				
0.40		Abundant, clast supported, boulders (± 500 mm in diameter) of calcrete in a matrix of dry, red brown, fine sand, boulder CALCRETE. Overall consistency is very dense. Pedogenic deposits.				
0.60						
0.80						
1.00						

Contractor: ALS Plant Hire Date Drilled: 8/7/2020 Machine: Bell 315SK	Hole Diameter: 600 mm Water Depth: Sheet: 1 of 1
SOIL PROFILE: TEST PIT 4	FIGURE: A4

- ∇ Water encountered
- ▼ Water level
- └ Bottom of hole
- - - Approximate material change
- Disturbed sample
- Undisturbed sample

**TRIAL HOLE: 5**

**PROJECT:** EXPANSION AND FORMALISATION OF WEGDRAAI COMMUNITY

**LOGGED BY:** FJB

**SITE:** ERVEN 1, 45 AND 47 OF WEGDRAAI

**DATE LOGGED:** 8/7/2020

**CLIENT:** !KHEIS MUNICIPALITY

**LOCATION:** 28°50'24,7" S 21°51'20,7" E

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*Consult (Pty) Ltd*

**P O Box 607**

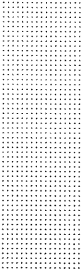
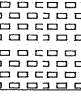
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



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Depth (m)	Legend	PROFILE	SAMPLE			Remarks
			Number	Type	Symbol	
0.00		Ground Surface				<b>NOTES:</b> 1 Refusal of excavation at 400 mm on very dense hardpan calcrete.
0.20		Dry, light red brown, loose, intact, fine SAND and matrix supported, medium coarse, angular gravels of calcrete and angular to subangular, medium coarse, gravels of quartz. Colluvium.				
0.40		Dirty white, very fine grained, very dense, hardpan CALCRETE with pockets of dry, light red, fine sand. Pedogenic deposits.				
0.60						
0.80						
1.00						

-  Water encountered
-  Water level
-  Bottom of hole
-  Approximate material change
-  Disturbed sample
-  Undisturbed sample

<b>Contractor:</b> ALS Plant Hire <b>Date Drilled:</b> 8/7/2020 <b>Machine:</b> Bell 315SK	<b>Hole Diameter:</b> 600 mm <b>Water Depth:</b> <b>Sheet:</b> 1 of 1
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<b>SOIL PROFILE:</b> TEST PIT 5	<b>FIGURE:</b> A5
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**TRIAL HOLE: 6**

**PROJECT:** EXPANSION AND FORMALISATION OF WEGDRAAI COMMUNITY

**LOGGED BY:** FJB

**SITE:** ERVEN 1, 45 AND 47 OF WEGDRAAI

**DATE LOGGED:** 8/7/2020

**CLIENT:** !KHEIS MUNICIPALITY

**LOCATION:** 28°50'28,1" S 21°51'23,5" E

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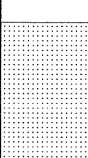
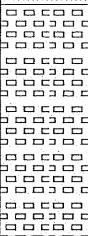

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**Email:**

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Depth (m)	Legend	PROFILE	SAMPLE			Remarks
			Number	Type	Symbol	
0.00		Ground Surface				<b>NOTES:</b> 1 Refusal of excavation at 400 mm on very dense hardpan calcrete.
		Dry, light red brown, loose, intact, fine SAND and matrix supported, medium coarse, subangular gravels of quartz and cobbles of calcrete. Colluvium.				
0.20		Dirty white, very fine grained, very dense, hardpan CALCRETE with pockets of dry, light red, fine sand. Pedogenic deposits.	U9268	0-0.4		
0.40						
0.60						
0.80						
1.00						

-  Water encountered
-  Water level
-  Bottom of hole
-  Approximate material change
-  Disturbed sample
-  Undisturbed sample

**Contractor:** ALS Plant Hire

**Date Drilled:** 8/7/2020

**Machine:** Bell 315SK

**Hole Diameter:** 600 mm

**Water Depth:**

**Sheet:** 1 of 1

**SOIL PROFILE:** TEST PIT 6

**FIGURE:** A6

**TRIAL HOLE: 7**

**PROJECT:** EXPANSION AND FORMALISATION OF WEGDRAAI COMMUNITY

**LOGGED BY:** FJB

**SITE:** ERVEN 1, 45 AND 47 OF WEGDRAAI

**DATE LOGGED:** 8/7/2020

**CLIENT:** !KHEIS MUNICIPALITY

**LOCATION:** 28°50'32,2" S 21°51'26,3" E

*Cedar Land Geotechnical*

*Consult (Pty) Ltd*

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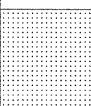
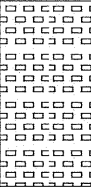
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Depth (m)	Legend	PROFILE	SAMPLE			Remarks
			Number	Type	Symbol	
0.00		Ground Surface				<b>NOTES:</b> 1 Refusal of excavation at 400 mm on very dense hardpan calcrete.
0.20		Dry, light red brown, loose, intact, fine SAND and matrix supported, medium coarse, subangular gravels of quartz and cobbles of calcrete. Colluvium.				
0.40		Dirty white, very fine grained, very dense, hardpan CALCRETE with pockets of dry, light red, fine sand. Pedogenic deposits.				
0.60						
0.80						
1.00						

- ∇ Water encountered
- ⊥ Water level
- ⊥ Bottom of hole
- - - Approximate material change
- Disturbed sample
- Undisturbed sample

**Contractor:** ALS Plant Hire

**Date Drilled:** 8/7/2020

**Machine:** Bell 315SK

**Hole Diameter:** 600 mm

**Water Depth:**

**Sheet:** 1 of 1

**SOIL PROFILE:** TEST PIT 7

**FIGURE:** A7



<b>TRIAL HOLE: 8</b>	<i>Cedar Land Geotechnical Consult (Pty) Ltd</i>
PROJECT: EXPANSION AND FORMALISATION OF WEGDRAAI COMMUNITY	P O Box 607
LOGGED BY: FJB	Ceres
SITE: ERVEN 1, 45 AND 47 OF WEGDRAAI	6835
	Cell: 082 570 2767
CLIENT: !KHEIS MUNICIPALITY	Email: cedarland.frans@breede.co.za
DATE LOGGED: 8/7/2020	
LOCATION: 28°50'35,5" S 21°51'27,9" E	

Depth (m)	Legend	PROFILE	SAMPLE			Remarks
			Number	Type	Symbol	
0.00		Ground Surface				<b>NOTES:</b> 1 Refusal of excavation at 900 mm on very dense hardpan calcrete.
0.20		Abundant, clast supported, medium coarse to coarse, subrounded and rounded GRAVELS of quartz and singular COBBLES of quartz in a matrix of dry, light red, fine sand. Overall consistency is medium dense. Colluvium.				
0.40						
0.60		Dirty white mottled light grey stained light brown, very fine grained, very dense, hardpan CALCRETE. Pedogenic deposits.				
0.80						
1.00						

Contractor: ALS Plant Hire	Hole Diameter: 600 mm
Date Drilled: 8/7/2020	Water Depth:
Machine: Bell 315SK	Sheet: 1 of 1

SOIL PROFILE: TEST PIT 8	FIGURE: A8
--------------------------	------------

- ∇ Water encountered
- ▼ Water level
- ⊥ Bottom of hole
- Approximate material change
- Disturbed sample
- Undisturbed sample

**TRIAL HOLE: 9**

**PROJECT:** EXPANSION AND FORMALISATION OF WEGDRAAI COMMUNITY

**LOGGED BY:** FJB

**SITE:** ERVEN 1, 45 AND 47 OF WEGDRAAI

**DATE LOGGED:** 8/7/2020

**CLIENT:** !KHEIS MUNICIPALITY

**LOCATION:** 28°50'22,1" S 21°51'25,2" E

*Cedar Land Geotechnical*

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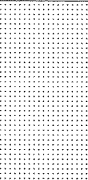
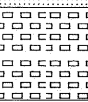
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

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Depth (m)	Legend	PROFILE	SAMPLE			Remarks
			Number	Type	Symbol	
0.00		Ground Surface				<b>NOTES:</b> 1 Refusal of excavation at 300 mm on very dense hardpan calcrete.
		Dry, light red brown, loose, intact, fine SAND and matrix supported, medium coarse, angular gravels of calcrete and angular to subangular, medium coarse, gravels of quartz. Colluvium.				
0.20		Dirty white, very fine grained, very dense, hardpan CALCRETE with pockets of dry, light red, fine sand. Pedogenic deposits.				
0.40						
0.60						
0.80						
1.00						

-  Water encountered
-  Water level
-  Bottom of hole
-  Approximate material change
-  Disturbed sample
-  Undisturbed sample

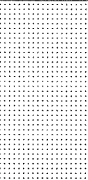
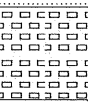
**Contractor:** ALS Plant Hire  
**Date Drilled:** 8/7/2020  
**Machine:** Bell 315SK







**Hole Diameter:** 600 mm  
**Water Depth:**  
**Sheet:** 1 of 1

**SOIL PROFILE:** TEST PIT 9

**FIGURE:** A9

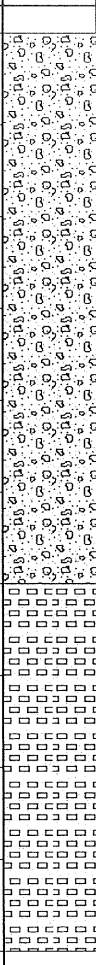
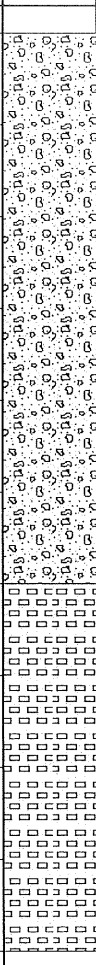
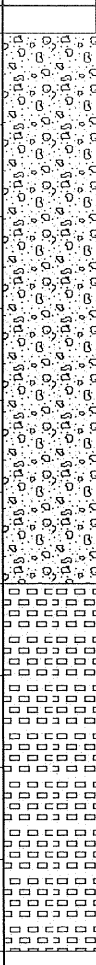
<b>TRIAL HOLE: 10</b>	<i>Cedar Land Geotechnical Consult (Pty) Ltd</i>
PROJECT: EXPANSION AND FORMALISATION OF WEGDRAAI COMMUNITY	P O Box 607
LOGGED BY: FJB	Ceres
SITE: ERVEN 1, 45 AND 47 OF WEGDRAAI	6835
	Cell: 082 570 2767
DATE LOGGED: 8/7/2020	Email:
CLIENT: !KHEIS MUNICIPALITY	cedarland.frans@breede.co.za
LOCATION: 28°50'25,7" S 21°51'28,1" E	

Depth (m)	Legend	PROFILE	SAMPLE			Remarks
			Number	Type	Symbol	
0.00		Ground Surface				<b>NOTES:</b> 1 Refusal of excavation at 300 mm on very dense hardpan calcrete.
		Dry, light red brown, loose, intact, fine SAND and matrix supported, medium coarse, angular gravels of calcrete and angular to subangular, medium coarse, gravels of quartz. Colluvium.				
0.20		Dirty white, very fine grained, very dense, hardpan CALCRETE with pockets of dry, light red, fine sand. Pedogenic deposits.				
0.40						
0.60						
0.80						
1.00						

-  Water encountered
-  Water level
-  Bottom of hole
-  Approximate material change
-  Disturbed sample
-  Undisturbed sample

Contractor: ALS Plant Hire Date Drilled: 8/7/2020 Machine: Bell 315SK	Hole Diameter: 600 mm Water Depth: Sheet: 1 of 1
SOIL PROFILE: TEST PIT 10	FIGURE: A10

<b>TRIAL HOLE: 11</b>	<i>Cedar Land Geotechnical Consult (Pty) Ltd</i>
<b>PROJECT:</b> EXPANSION AND FORMALISATION OF WEGDRAAI COMMUNITY	P O Box 607
<b>LOGGED BY:</b> FJB	<b>Ceres</b>
<b>SITE:</b> ERVEN 1, 45 AND 47 OF WEGDRAAI	<b>6835</b>
<b>DATE LOGGED:</b> 8/7/2020	<b>Cell: 082 570 2767</b>
<b>CLIENT:</b> IKHEIS MUNICIPALITY	<b>Email:</b> cedarland.frans@breede.co.za
<b>LOCATION:</b> 28°50'30,0" S 21°51'29,6" E	

Depth (m)	Legend	PROFILE	SAMPLE			Remarks
			Number	Type	Symbol	
0.00		Ground Surface				<b>NOTES:</b> 1 Refusal of excavation at 1000 mm on very dense hardpan calcrete.
0.20		Abundant, clast supported, medium coarse to coarse, subrounded and rounded <b>GRAVELS</b> of quartz and singular <b>COBBLES</b> of quartz in a matrix of dry, light red, fine sand. Overall consistency is medium dense. Colluvium.				
0.40						
0.60		Dirty white mottled light grey stained light brown, very fine grained, very dense, hardpan <b>CALCRETE</b> . Pedogenic deposits.				
0.80						<ul style="list-style-type: none"> <li>∇ Water encountered</li> <li>▼ Water level</li> <li>⌒ Bottom of hole</li> <li>- - - Approximate material change</li> <li>• Disturbed sample</li> <li>■ Undisturbed sample</li> </ul>
1.00						

<b>Contractor:</b> ALS Plant Hire	<b>Hole Diameter:</b> 600 mm
<b>Date Drilled:</b> 8/7/2020	<b>Water Depth:</b>
<b>Machine:</b> Bell 315SK	<b>Sheet:</b> 1 of 1
<b>SOIL PROFILE:</b> TEST PIT 11	<b>FIGURE:</b> A11

<b>TRIAL HOLE: 12</b>		<i>Cedar Land Geotechnical Consult (Pty) Ltd P O Box 607 Ceres 6835 Cell: 082 570 2767 Email: cedarland.frans@breede.co.za</i>
<b>PROJECT:</b> EXPANSION AND FORMALISATION OF WEGDRAAI COMMUNITY	<b>LOGGED BY:</b> FJB	
<b>SITE:</b> ERVEN 1, 45 AND 47 OF WEGDRAAI	<b>DATE LOGGED:</b> 8/7/2020	
<b>CLIENT:</b> IKHEIS MUNICIPALITY	<b>LOCATION:</b> 28°50'34,2" S 21°51'31,7" E	

Depth (m)	Legend	PROFILE	SAMPLE			Remarks
			Number	Type	Symbol	
0.00		Ground Surface				<b>NOTES:</b> 1 Refusal of excavation at 800 mm on very dense hardpan calcrete.
0.20		Abundant, clast supported, cobbles and boulders (± 400 mm in diameter) of <b>CALCRETE</b> in a matrix of dry, light brown, fine sand. Overall consistency is dense. Pedogenic deposits.				
0.40	Dirty white mottled light grey stained light brown, very fine grained, very dense, hardpan <b>CALCRETE</b> . Pedogenic deposits.					
0.60			U9269	0,4-0,8		
0.80						
1.00						

<b>Contractor:</b> ALS Plant Hire	<b>Hole Diameter:</b> 600 mm
<b>Date Drilled:</b> 8/7/2020	<b>Water Depth:</b>
<b>Machine:</b> Bell 315SK	<b>Sheet:</b> 1 of 1

<b>SOIL PROFILE:</b> TEST PIT 12	<b>FIGURE:</b> A12
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**TRIAL HOLE: 13**

**PROJECT:** EXPANSION AND FORMALISATION OF WEGDRAAI COMMUNITY

**LOGGED BY:** FJB

**SITE:** ERVEN 1, 45 AND 47 OF WEGDRAAI

**DATE LOGGED:** 8/7/2020

**CLIENT:** IKHEIS MUNICIPALITY

**LOCATION:** 28°50'19,3" S 21°51'31,2" E

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*Consult (Pty) Ltd*

**P O Box 607**


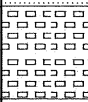
**Ceres**







**6835**

**Cell: 082 570 2767**

**Email:**

**cedarland.frans@breede.co.za**

Depth (m)	Legend	PROFILE	SAMPLE			Remarks
			Number	Type	Symbol	
0.00		Ground Surface				<b>NOTES:</b> 1 Refusal of excavation at 300 mm on very dense hardpan calcrete.
		Dry, light red brown, loose, intact, fine SAND and matrix supported, medium coarse, angular gravels of calcrete and angular to subangular, medium coarse, gravels of quartz. Colluvium.				
0.20		Dirty white, very fine grained, very dense, hardpan CALCRETE with pockets of dry, light red, fine sand. Pedogenic deposits.				
0.40						
0.60						
0.80						
1.00						

-  Water encountered
-  Water level
-  Bottom of hole
-  Approximate material change
-  Disturbed sample
-  Undisturbed sample

**Contractor:** ALS Plant Hire

**Date Drilled:** 8/7/2020

**Machine:** Bell 315SK

**Hole Diameter:** 600 mm

**Water Depth:**

**Sheet:** 1 of 1

**SOIL PROFILE:** TEST PIT 13

**FIGURE:** A13

**TRIAL HOLE: 14**

**PROJECT:** EXPANSION AND FORMALISATION OF WEGDRAAI COMMUNITY

**LOGGED BY:** FJB

**SITE:** ERVEN 1, 45 AND 47 OF WEGDRAAI

**DATE LOGGED:** 8/7/2020

**CLIENT:** !KHEIS MUNICIPALITY

**LOCATION:** 28°50'30,8" S 21°51'36,6" E

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*Consult (Pty) Ltd*

**P O Box 607**

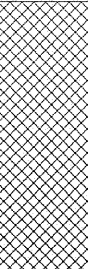
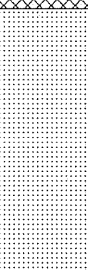

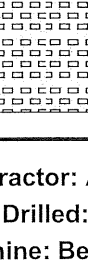

**Ceres**

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**Cell: 082 570 2767**

**Email:**

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Depth (m)	Legend	PROFILE	SAMPLE			Remarks
			Number	Type	Symbol	
0.00		Ground Surface <i>FILL</i> : consisting of dry, light brown sand containing ash, paper, bones, glass, plastic and decaying household matter. Overall consistency is very loose. Made ground.				<b>NOTES:</b> 1 Refusal of excavation at 1000 mm on very dense hardpan calcrete.
0.20		Slightly moist, light brown, loose, intact, fine <i>SAND</i> . Colluvium.				
0.40		Dirty white, very fine grained, very dense, hardpan <i>CALCRETE</i> with pockets of dry, light red, fine sand. Pedogenic deposits.				
0.60						∇ Water encountered ↓ Water level ⌋ Bottom of hole --- Approximate material change • Disturbed sample ■ Undisturbed sample
0.80						
1.00						

**Contractor:** ALS Plant Hire

**Date Drilled:** 8/7/2020

**Machine:** Bell 315SK

**Hole Diameter:** 600 mm

**Water Depth:**

**Sheet:** 1 of 1

**SOIL PROFILE:** TEST PIT 14

**FIGURE:** A14

**TRIAL HOLE: 15**

**PROJECT:** EXPANSION AND FORMALISATION OF WEGDRAAI COMMUNITY

**LOGGED BY:** FJB

**SITE:** ERVEN 1, 45 AND 47 OF WEGDRAAI

**DATE LOGGED:** 8/7/2020

**CLIENT:** !KHEIS MUNICIPALITY

**LOCATION:** 28°50'24,3" S 21°51'54,9" E

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Depth (m)	Legend	PROFILE	SAMPLE			Remarks
			Number	Type	Symbol	
0.00		Ground Surface				<b>NOTES:</b> 1 Refusal of excavation at 600 mm on very dense hardpan calcrete.
0.20		Abundant, clast supported, medium coarse to coarse, subrounded and rounded, GRAVELS of quartz and singular COBBLES of quartz in a matrix of dry, light red, fine sand. Overall consistency is medium dense. Colluvium.				
0.40		Pale light grey discoloured light green, very fine grained, very dense, hardpan CALCRETE. Pedogenic deposits.				
0.60						
0.80						
1.00						

- ∇ Water encountered
- ▼ Water level
- ⊥ Bottom of hole
- - - Approximate material change
- Disturbed sample
- Undisturbed sample

**Contractor:** ALS Plant Hire

**Date Drilled:** 8/7/2020

**Machine:** Bell 315SK

**Hole Diameter:** 600 mm

**Water Depth:**

**Sheet:** 1 of 1

**SOIL PROFILE:** TEST PIT 15

**FIGURE:** A15



**TRIAL HOLE: 16**

**PROJECT:** EXPANSION AND FORMALISATION OF WEGDRAAI COMMUNITY

**LOGGED BY:** FJB

**SITE:** ERVEN 1, 45 AND 47 OF WEGDRAAI

**DATE LOGGED:** 8/7/2020

**CLIENT:** !KHEIS MUNICIPALITY

**LOCATION:** 28°50'22,7" S 21°51'54,6" E

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Depth (m)	Legend	PROFILE	SAMPLE			Remarks
			Number	Type	Symbol	
0.00		Ground Surface				<b>NOTES:</b> 1 Refusal of excavation at 300 mm on very dense hardpan calcrete.
0.20		Abundant, clast supported, medium coarse to coarse, subrounded and rounded, <i>GRAVELS</i> of quartz and singular <i>COBBLES</i> of quartz in a matrix of dry, light red, fine sand. Overall consistency is medium dense. Colluvium.	U9270	0-0,3		
0.40		Pale light grey discoloured light brown, very fine grained, very dense, hardpan <i>CALCRETE</i> . Pedogenic deposits.				
0.60						
0.80						
1.00						

- Water encountered
- Water level
- Bottom of hole
- Approximate material change
- Disturbed sample
- Undisturbed sample

**Contractor:** ALS Plant Hire

**Date Drilled:** 8/7/2020

**Machine:** Bell 315SK

**Hole Diameter:** 600 mm

**Water Depth:**

**Sheet:** 1 of 1

**SOIL PROFILE:** TEST PIT 16

**FIGURE:** A16

**TRIAL HOLE: 17**

**PROJECT:** EXPANSION AND FORMALISATION OF WEGDRAAI COMMUNITY

**LOGGED BY:** FJB

**SITE:** ERVEN 1, 45 AND 47 OF WEGDRAAI

**DATE LOGGED:** 8/7/2020

**CLIENT:** !KHEIS MUNICIPALITY

**LOCATION:** 28°50'24,1" S 21°52'02,5" E

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Depth (m)	Legend	PROFILE	SAMPLE			Remarks
			Number	Type	Symbol	
0.00		Ground Surface				<b>NOTES:</b> 1 Refusal of excavation at 900 mm on hard rock, schist.
0.20		Abundant, clast supported, medium coarse to coarse, subrounded and rounded, <i>GRAVELS</i> of quartz and singular <i>COBBLES</i> of quartz in a matrix of dry, light red, fine sand. Overall consistency is medium dense. Colluvium.  Dirty white, very fine grained, lenses of calcrete ( $\pm$ 100 mm thick) in a matrix of dry, light brown, fine sand, boulder <i>CALCRETE</i> . Overall consistency is dense. Pedogenic deposits.				
0.40						
0.60		Pale white mottled light green, intensely laminated, closely jointed, slightly weathered, soft rock becoming hard rock at depth, <i>quartz-muscovite SCHIST</i> . Discontinuities are closed, smooth and clean. Discontinuities are orientated at 40° with the horizontal.				
			U9271	0,5-0,9		
0.80						√ Water encountered ↓ Water level ▾ Bottom of hole ~ Approximate material change • Disturbed sample ■ Undisturbed sample
1.00						

**Contractor:** ALS Plant Hire

**Date Drilled:** 8/7/2020

**Machine:** Bell 315SK

**Hole Diameter:** 600 mm

**Water Depth:**

**Sheet:** 1 of 1

**SOIL PROFILE:** TEST PIT 17

**FIGURE:** A17

**TRIAL HOLE: 18**

**PROJECT:** EXPANSION AND FORMALISATION OF WEGDRAAI COMMUNITY

**LOGGED BY:** FJB

**SITE:** ERVEN 1, 45 AND 47 OF WEGDRAAI

**DATE LOGGED:** 8/7/2020

**CLIENT:** !KHEIS MUNICIPALITY

**LOCATION:** 28°50'21,2" S 21°52'01,4" E

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*Consult (Pty) Ltd*

**P O Box 607**

**Ceres**

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**Cell: 082 570 2767**

**Email:**

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Depth (m)	Legend	PROFILE	SAMPLE			Remarks
			Number	Type	Symbol	
0.00		Ground Surface				<p><u>NOTES:</u></p> <p>1 Refusal of excavation at 500 mm on hard rock, schist.</p>
0.20		Abundant, clast supported, medium coarse to coarse, subrounded and rounded, <i>GRAVELS</i> of quartz and singular <i>COBBLES</i> of quartz in a matrix of dry, light red, fine sand. Overall consistency is medium dense. Colluvium.				
0.40		Dirty white, very fine grained, lenses of calcrete (± 100 mm thick) in a matrix of dry, light brown, fine sand, boulder <i>CALCRETE</i> . Overall consistency is dense. Pedogenic deposits.				
0.60		Pale white mottled light green, intensely laminated, closely jointed, slightly weathered, soft rock becoming hard rock at depth, <i>quartz-muscovite SCHIST</i> . Laminations are closed, smooth and clean. Joints open up to 1 cm and are filled with white, very fine grained, hard calcrete. Discontinuities are orientated at 40° with the horizontal.				
0.80						<p> Water encountered</p> <p> Water level</p> <p> Bottom of hole</p> <p> Approximate material change</p> <p> Disturbed sample</p> <p> Undisturbed sample</p>
1.00						

**Contractor:** ALS Plant Hire

**Date Drilled:** 8/7/2020

**Machine:** Bell 315SK

**Hole Diameter:** 600 mm

**Water Depth:**

**Sheet:** 1 of 1

**SOIL PROFILE:** TEST PIT 18

**FIGURE:** A18

**TRIAL HOLE: 19**

**PROJECT:** EXPANSION AND FORMALISATION OF WEGDRAAI COMMUNITY

**LOGGED BY:** FJB

**SITE:** ERVEN 1, 45 AND 47 OF WEGDRAAI

**DATE LOGGED:** 8/7/2020

**CLIENT:** !KHEIS MUNICIPALITY

**LOCATION:** 28°50'18,1" S 21°52'01,6" E

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Depth (m)	Legend	PROFILE	SAMPLE			Remarks
			Number	Type	Symbol	
0.00		Ground Surface				<b>NOTES:</b> 1 Refusal of excavation at 1000 mm on hard rock, schist.
0.20		Abundant, clast supported, medium coarse to coarse, subrounded and rounded, GRAVELS of quartz and singular COBBLES of quartz in a matrix of dry, light red, fine sand. Overall consistency is medium dense. Colluvium.				
0.40		Abundant, clast supported, coarse, angular GRAVELS of schist in a matrix of slightly moist, dark red brown, fine sand. Overall consistency is dense. Residual quartz-muscovite schist.				
0.80		Pale white mottled light green, intensely laminated, closely jointed, slightly weathered, soft rock becoming hard rock at depth, quartz-muscovite SCHIST. Discontinuities are closed, smooth and clean. Discontinuities are orientated at 40° with the horizontal.				√ Water encountered ↓ Water level ▾ Bottom of hole --- Approximate material change • Disturbed sample ■ Undisturbed sample
1.00						

**Contractor:** ALS Plant Hire

**Date Drilled:** 8/7/2020

**Machine:** Bell 315SK

**Hole Diameter:** 600 mm

**Water Depth:**

**Sheet:** 1 of 1

**SOIL PROFILE:** TEST PIT 19

**FIGURE:** A19

**TRIAL HOLE: 20**

**PROJECT:** EXPANSION AND FORMALISATION OF WEGDRAAI COMMUNITY

**LOGGED BY:** FJB

**SITE:** ERVEN 1, 45 AND 47 OF WEGDRAAI

**DATE LOGGED:** 8/7/2020

**CLIENT:** !KHEIS MUNICIPALITY

**LOCATION:** 28°50'22,3" S 21°52'07,5" E

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*Consult (Pty) Ltd*

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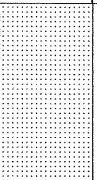
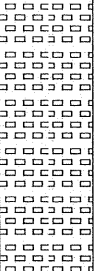
Ceres







6835

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Depth (m)	Legend	PROFILE	SAMPLE			Remarks
			Number	Type	Symbol	
0.00		Ground Surface				<b>NOTES:</b> 1 Refusal of excavation at 500 mm on very dense hardpan calcrete.
0.20		Dry, light red brown, loose, intact, fine SAND and matrix supported, medium coarse, angular gravels of calcrete and angular to subangular, medium coarse, gravels of quartz. Colluvium.				
0.40		Dirty white, very fine grained, very dense, hardpan CALCRETE with pockets of dry, light red, fine sand. Pedogenic deposits.				
0.60						
0.80						
1.00						

-  Water encountered
-  Water level
-  Bottom of hole
-  Approximate material change
-  Disturbed sample
-  Undisturbed sample

**Contractor:** ALS Plant Hire

**Date Drilled:** 8/7/2020

**Machine:** Bell 315SK

**Hole Diameter:** 600 mm




**Water Depth:**

**Sheet:** 1 of 1

**SOIL PROFILE:** TEST PIT 20

**FIGURE:** A20

<b>TRIAL HOLE: 21</b>	<i>Cedar Land Geotechnical Consult (Pty) Ltd</i>
PROJECT: EXPANSION AND FORMALISATION OF WEGDRAAI COMMUNITY	P O Box 607
LOGGED BY: FJB	Ceres
SITE: ERVEN 1, 45 AND 47 OF WEGDRAAI	6835
CLIENT: !KHEIS MUNICIPALITY	Cell: 082 570 2767
DATE LOGGED: 8/7/2020	Email: cedarland.frans@breede.co.za
LOCATION: 28°50'19,4" S 21°52'15,2" E	

Depth (m)	Legend	PROFILE	SAMPLE			Remarks
			Number	Type	Symbol	
0.00		Ground Surface				<b>NOTES:</b> 1 Refusal of excavation at 800 mm on hard rock, schist.
0.20		Abundant, clast supported, medium coarse to coarse, subrounded and rounded, GRAVELS of quartz and singular COBBLES of quartz in a matrix of dry, light red, fine sand. Overall consistency is medium dense. Colluvium.	U9272	0-0,4		
0.40		Pale white mottled light green, intensely laminated, closely jointed, slightly weathered, soft rock becoming hard rock at depth, quartz-muscovite SCHIST. Discontinuities are closed, smooth and clean. Discontinuities are horizontally orientated.				
0.80						▽ Water encountered ↓ Water level ▾ Bottom of hole --- Approximate material change • Disturbed sample ■ Undisturbed sample
1.00						

Contractor: ALS Plant Hire Date Drilled: 8/7/2020 Machine: Bell 315SK	Hole Diameter: 600 mm Water Depth: Sheet: 1 of 1
SOIL PROFILE: TEST PIT 21	FIGURE: A21

**TRIAL HOLE: 22**

**PROJECT:** EXPANSION AND FORMALISATION OF WEGDRAAI COMMUNITY

**LOGGED BY:** FJB

**SITE:** ERVEN 1, 45 AND 47 OF WEGDRAAI

**DATE LOGGED:** 8/7/2020

**CLIENT:** !KHEIS MUNICIPALITY

**LOCATION:** 28°50'16,4" S 21°52'20,6" E

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*Consult (Pty) Ltd*

**P O Box 607**

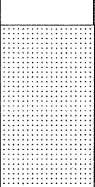
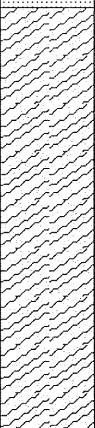
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Depth (m)	Legend	PROFILE	SAMPLE			Remarks
			Number	Type	Symbol	
0.00		Ground Surface				<b>NOTES:</b> 1 Refusal of excavation at 700 mm on hard rock, schist.
0.20		Dry, light red brown, loose, intact, fine SAND and matrix supported, medium coarse, angular gravels of calcrete and angular to subangular, medium coarse, gravels of quartz. Colluvium.				
0.40		Dark grey green, very closely jointed, very intensely laminated, very fine grained, slightly weathered, soft rock becoming hard rock with depth, quartz-muscovite SCHIST with lenses of very hard, light grey quartz. Discontinuities are open, smooth and filled with white, powdery calcrete. Discontinuities are orientated at 45° with the horizontal.				
0.60						
0.80						
1.00						

-  Water encountered
-  Water level
-  Bottom of hole
-  Approximate material change
-  Disturbed sample
-  Undisturbed sample

**Contractor:** ALS Plant Hire

**Date Drilled:** 8/7/2020

**Machine:** Bell 315SK

**Hole Diameter:** 600 mm

**Water Depth:**

**Sheet:** 1 of 1

**SOIL PROFILE:** TEST PIT 22

**FIGURE:** A22

**TRIAL HOLE: 23**

PROJECT: EXPANSION AND FORMALISATION OF WEGDRAAI COMMUNITY

LOGGED BY: FJB

SITE: ERVEN 1, 45 AND 47 OF WEGDRAAI

DATE LOGGED: 8/7/2020

CLIENT: !KHEIS MUNICIPALITY

LOCATION: 28°50'13,1" S 21°52'19,0" E

*Cedar Land Geotechnical*

*Consult (Pty) Ltd*

P O Box 607


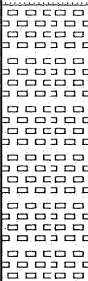

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Depth (m)	Legend	PROFILE	SAMPLE			Remarks
			Number	Type	Symbol	
0.00		Ground Surface				<b>NOTES:</b> 1 Refusal of excavation at 400 mm on very dense hardpan calcrete.
		Dry, light red brown, loose, intact, fine SAND and matrix supported, medium coarse, angular gravels of calcrete and angular to subangular, medium coarse, gravels of quartz. Colluvium.				
0.20		Dirty white, very fine grained, very dense, hardpan CALCRETE with pockets of dry, light brown, fine sand. Pedogenic deposits.	U9273	0,1-0,4		
0.40						
0.60						
0.80						
1.00						

-  Water encountered
-  Water level
-  Bottom of hole
-  Approximate material change
-  Disturbed sample
-  Undisturbed sample

Contractor: ALS Plant Hire

Date Drilled: 8/7/2020

Machine: Bell 315SK

Hole Diameter: 600 mm

Water Depth:

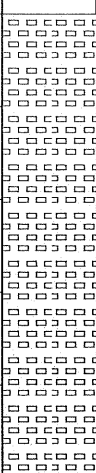
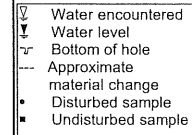






Sheet: 1 of 1

SOIL PROFILE: TEST PIT 23

FIGURE: A23

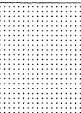












<b>TRIAL HOLE: 24</b>	<i>Cedar Land Geotechnical Consult (Pty) Ltd</i>
PROJECT: EXPANSION AND FORMALISATION OF WEGDRAAI COMMUNITY	P O Box 607
LOGGED BY: FJB	Ceres
SITE: ERVEN 1, 45 AND 47 OF WEGDRAAI	6835
	Cell: 082 570 2767
DATE LOGGED: 8/7/2020	Email:
CLIENT: !KHEIS MUNICIPALITY	cedarland.frans@breede.co.za
LOCATION: 28°50'09,7" S 21°52'16,3" E	

Depth (m)	Legend	PROFILE	SAMPLE			Remarks
			Number	Type	Symbol	
0.00		Ground Surface				<b>NOTES:</b> 1 Refusal of excavation at 500 mm on very dense hardpan calcrete.
0.20		Dirty white, very fine grained, dense becoming very dense with depth, hardpan CALCRETE with pockets of dry, light brown, fine sand. Pedogenic deposits.				
0.40						
0.60						
0.80						 <ul style="list-style-type: none"> <li> Water encountered</li> <li> Water level</li> <li> Bottom of hole</li> <li> Approximate material change</li> <li> Disturbed sample</li> <li> Undisturbed sample</li> </ul>
1.00						

Contractor: ALS Plant Hire Date Drilled: 8/7/2020 Machine: Bell 315SK	Hole Diameter: 600 mm Water Depth: Sheet: 1 of 1
SOIL PROFILE: TEST PIT 24	FIGURE: A24

<b>TRIAL HOLE: 25</b>	<i>Cedar Land Geotechnical Consult (Pty) Ltd</i>
PROJECT: EXPANSION AND FORMALISATION OF WEGDRAAI COMMUNITY	P O Box 607
LOGGED BY: FJB	Ceres
SITE: ERVEN 1, 45 AND 47 OF WEGDRAAI	6835
	Cell: 082 570 2767
CLIENT: !KHEIS MUNICIPALITY	Email: cedarland.frans@breede.co.za
DATE LOGGED: 8/7/2020	
LOCATION: 28°50'06,1" S 21°52'10,6" E	

Depth (m)	Legend	PROFILE	SAMPLE			Remarks
			Number	Type	Symbol	
0.00		Ground Surface				<b>NOTES:</b> 1 Refusal of excavation at 700 mm on very dense hardpan calcrete.
0.20		Dry, light red brown, loose, intact, fine SAND and matrix supported, medium coarse, angular gravels of calcrete and angular to subangular, medium coarse, gravels of quartz. Colluvium.				
0.40		Dirty white, very fine grained, very dense, hardpan CALCRETE with pockets of dry, light brown, fine sand. Pedogenic deposits.				
0.60						
0.80						
1.00						
						 Water encountered  Water level  Bottom of hole  Approximate material change  Disturbed sample  Undisturbed sample

Contractor: ALS Plant Hire	Hole Diameter: 600 mm
Date Drilled: 8/7/2020	Water Depth:
Machine: Bell 315SK	Sheet: 1 of 1
<b>SOIL PROFILE: TEST PIT 25</b>	<b>FIGURE: A25</b>

**TRIAL HOLE: 26**

**PROJECT:** EXPANSION AND FORMALISATION OF WEGDRAAI COMMUNITY

**LOGGED BY:** FJB

**SITE:** ERVEN 1, 45 AND 47 OF WEGDRAAI

**DATE LOGGED:** 8/7/2020

**CLIENT:** !KHEIS MUNICIPALITY

**LOCATION:** 28°50'09,1" S 21°52'09,5" E

*Cedar Land Geotechnical*

*Consult (Pty) Ltd*

P O Box 607

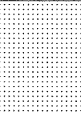


Ceres

6835

Cell: 082 570 2767

Email:

cedarland.frans@breede.co.za

Depth (m)	Legend	PROFILE	SAMPLE			Remarks
			Number	Type	Symbol	
0.00		Ground Surface				<b>NOTES:</b> 1 Refusal of excavation at 600 mm on very dense hardpan calcrete.
0.20		Dry, light red brown, loose, intact, fine SAND and matrix supported, medium coarse, angular gravels of calcrete and angular to subangular, medium coarse, gravels of quartz. Colluvium.				
0.40		Dirty white, very fine grained, very dense, hardpan CALCRETE with pockets of dry, light brown, fine sand. Pedogenic deposits.	U9274	0,2-0,6		
0.60						
0.80						√ Water encountered ↓ Water level ⌋ Bottom of hole ~ Approximate material change • Disturbed sample ■ Undisturbed sample
1.00						

**Contractor:** ALS Plant Hire

**Date Drilled:** 8/7/2020

**Machine:** Bell 315SK

**Hole Diameter:** 600 mm

**Water Depth:**

**Sheet:** 1 of 1

**SOIL PROFILE:** TEST PIT 26

**FIGURE:** A26

<b>TRIAL HOLE: 27</b>	<i>Cedar Land Geotechnical Consult (Pty) Ltd</i>
PROJECT: EXPANSION AND FORMALISATION OF WEGDRAAI COMMUNITY	P O Box 607
LOGGED BY: FJB	Ceres
SITE: ERVEN 1, 45 AND 47 OF WEGDRAAI	6835
CLIENT: !KHEIS MUNICIPALITY	Cell: 082 570 2767
DATE LOGGED: 8/7/2020	Email: cedarland.frans@breede.co.za
LOCATION: 28°50'10,7" S 21°51'55,9" E	

Depth (m)	Legend	PROFILE	SAMPLE			Remarks
			Number	Type	Symbol	
0.00		Ground Surface				<b>NOTES:</b> 1 Refusal of excavation at 200 mm on very dense hardpan calcrete.
0.20		Dirty white, very fine grained, very dense, hardpan CALCRETE with pockets of dry, light red, fine sand. Pedogenic deposits.				
0.40						
0.60						
0.80						▽ Water encountered ▼ Water level ▵ Bottom of hole --- Approximate material change • Disturbed sample ■ Undisturbed sample
1.00						

Contractor: ALS Plant Hire Date Drilled: 8/7/2020 Machine: Bell 315SK	Hole Diameter: 600 mm Water Depth: Sheet: 1 of 1
SOIL PROFILE: TEST PIT 27	FIGURE: A27

**TRIAL HOLE: 28**

**PROJECT:** EXPANSION AND FORMALISATION OF WEGDRAAI COMMUNITY

**LOGGED BY:** FJB

**SITE:** ERVEN 1, 45 AND 47 OF WEGDRAAI

**DATE LOGGED:** 8/7/2020

**CLIENT:** !KHEIS MUNICIPALITY

**LOCATION:** 28°50'11,6" S 21°51'51,0" E

*Cedar Land Geotechnical*

*Consult (Pty) Ltd*

**P O Box 607**

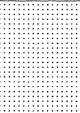

**Ceres**

**6835**

**Cell: 082 570 2767**

**Email:**

**cedarland.frans@breede.co.za**

Depth (m)	Legend	PROFILE	SAMPLE			Remarks
			Number	Type	Symbol	
0.00		Ground Surface				<b>NOTES:</b> 1 Refusal of excavation at 500 mm on very dense hardpan calcrete.
0.20		Dry, light red brown, loose, intact, fine SAND and matrix supported, medium coarse, angular gravels of calcrete and angular to subangular, medium coarse, gravels of quartz. Colluvium.				
0.40		Dirty white, very fine grained, very dense, hardpan CALCRETE with pockets of dry, light red, fine sand. Pedogenic deposits.				
0.60						
0.80						
1.00						

- ∇ Water encountered
- ▼ Water level
- ⊥ Bottom of hole
- - - Approximate material change
- Disturbed sample
- Undisturbed sample

**Contractor:** ALS Plant Hire  
**Date Drilled:** 8/7/2020  
**Machine:** Bell 315SK

**Hole Diameter:** 600 mm  
**Water Depth:**  
**Sheet:** 1 of 1

**SOIL PROFILE:** TEST PIT 28

**FIGURE:** A28

**TRIAL HOLE: 29**

**PROJECT:** EXPANSION AND FORMALISATION OF WEGDRAAI COMMUNITY

**LOGGED BY:** FJB

**SITE:** ERVEN 1, 45 AND 47 OF WEGDRAAI

**DATE LOGGED:** 8/7/2020

**CLIENT:** IKHEIS MUNICIPALITY

**LOCATION:** 28°50'13,1" S 21°51'45,6" E

*Cedar Land Geotechnical*

*Consult (Pty) Ltd*

P O Box 607

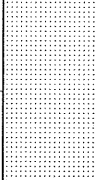

Ceres







6835

Cell: 082 570 2767

Email:

cedarland.frans@breede.co.za

Depth (m)	Legend	PROFILE	SAMPLE			Remarks
			Number	Type	Symbol	
0.00		Ground Surface				<b>NOTES:</b> 1 Refusal of excavation at 300 mm on very dense hardpan calcrete.
		Dry, light red brown, loose, intact, fine SAND and matrix supported, medium coarse, angular gravels of calcrete and angular to subangular, medium coarse, gravels of quartz. Colluvium.				
0.20		Dirty white, very fine grained, very dense, hardpan CALCRETE with pockets of dry, light red, fine sand. Pedogenic deposits.				
0.40						
0.60						
0.80						
1.00						

-  Water encountered
-  Water level
-  Bottom of hole
-  Approximate material change
-  Disturbed sample
-  Undisturbed sample

**Contractor:** ALS Plant Hire

**Date Drilled:** 8/7/2020

**Machine:** Bell 315SK

**Hole Diameter:** 600 mm

**Water Depth:**

**Sheet:** 1 of 1

**SOIL PROFILE:** TEST PIT 29

**FIGURE:** A29

**TRIAL HOLE: 30**

**PROJECT:** EXPANSION AND FORMALISATION OF WEGDRAAI COMMUNITY

**LOGGED BY:** FJB

**SITE:** ERVEN 1, 45 AND 47 OF WEGDRAAI

**DATE LOGGED:** 8/7/2020

**CLIENT:** IKHEIS MUNICIPALITY

**LOCATION:** 28°50'18,5" S 21°51'46,1" E

*Cedar Land Geotechnical*

*Consult (Pty) Ltd*

**P O Box 607**

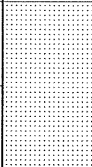
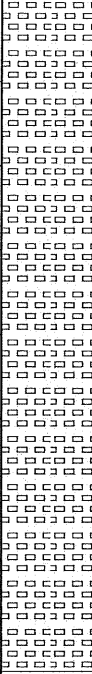

**Ceres**







**6835**

**Cell: 082 570 2767**

**Email:**

**cedarland.frans@breede.co.za**

Depth (m)	Legend	PROFILE	SAMPLE			Remarks
			Number	Type	Symbol	
0.00		Ground Surface				<b>NOTES:</b> 1 Refusal of excavation at 1000 mm on very dense boulder calcrete.
		Slightly moist, dark red brown, medium dense, intact, fine SAND. Colluvium.				
0.20		Tightly packed cobbles and boulders (300 mm - 500 mm in diameter) of calcrete in a matrix of dry, dark red brown, fine sand, boulder CALCRETE. Overall consistency is very dense. Pedogenic deposits.				
						
0.60			U9275	0,2-1,0		
0.80						
1.00						

-  Water encountered
-  Water level
-  Bottom of hole
-  Approximate material change
-  Disturbed sample
-  Undisturbed sample

**Contractor:** ALS Plant Hire

**Date Drilled:** 8/7/2020

**Machine:** Bell 315SK

**Hole Diameter:** 600 mm

**Water Depth:**

**Sheet:** 1 of 1

**SOIL PROFILE:** TEST PIT 30

**FIGURE:** A30

<b>TRIAL HOLE: 31</b>	<i>Cedar Land Geotechnical Consult (Pty) Ltd</i>
<b>PROJECT:</b> EXPANSION AND FORMALISATION OF WEGDRAAI COMMUNITY	P O Box 607
<b>LOGGED BY:</b> FJB	Ceres
<b>SITE:</b> ERVEN 1, 45 AND 47 OF WEGDRAAI	6835
	Cell: 082 570 2767
<b>DATE LOGGED:</b> 8/7/2020	Email:
<b>CLIENT:</b> !KHEIS MUNICIPALITY	cedarland.frans@breede.co.za
<b>LOCATION:</b> 28°50'16,0" S 21°51'37,8" E	

Depth (m)	Legend	PROFILE	SAMPLE			Remarks
			Number	Type	Symbol	
0.00		Ground Surface				<b>NOTES:</b> 1 Refusal of excavation at 300 mm on very dense hardpan calcrete.
0.20		Dirty white, very fine grained, very dense, hardpan <i>CALCRETE</i> with pockets of dry, light red, fine sand. Pedogenic deposits.	U9276	0-0,3		
0.40						
0.60						
0.80						
1.00						

<b>Contractor:</b> ALS Plant Hire	<b>Hole Diameter:</b> 600 mm
<b>Date Drilled:</b> 8/7/2020	<b>Water Depth:</b>
<b>Machine:</b> Bell 315SK	<b>Sheet:</b> 1 of 1
<b>SOIL PROFILE:</b> TEST PIT 31	<b>FIGURE:</b> A31

- Water encountered
- Water level
- Bottom of hole
- Approximate material change
- Disturbed sample
- Undisturbed sample



**GEOTECHNICAL CONDITIONS ON ERVEN 1, 45 AND  
47 OF WEGDRAAI: A REPORT FOR THE EXPANSION  
AND FORMALISATION OF WEGDRAAI COMMUNITY**

2020/J09/MCP\_01

**ADDENDUM B: RESULTS OF MATERIALS TESTING**

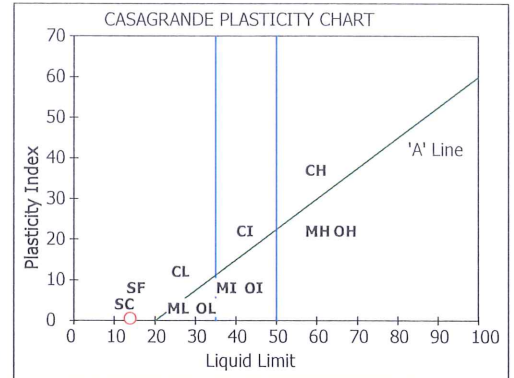
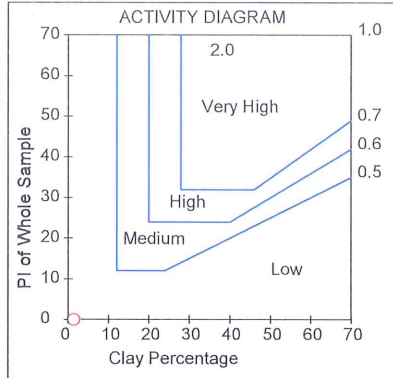
Job Request No.: RU3525  
 Ceder Land Geotechnical Consult (Pty) Ltd  
 PO Box 607  
 Ceres  
 6835  
 Attention : Frans Breytenbach

Date Reported : 2020-08-12

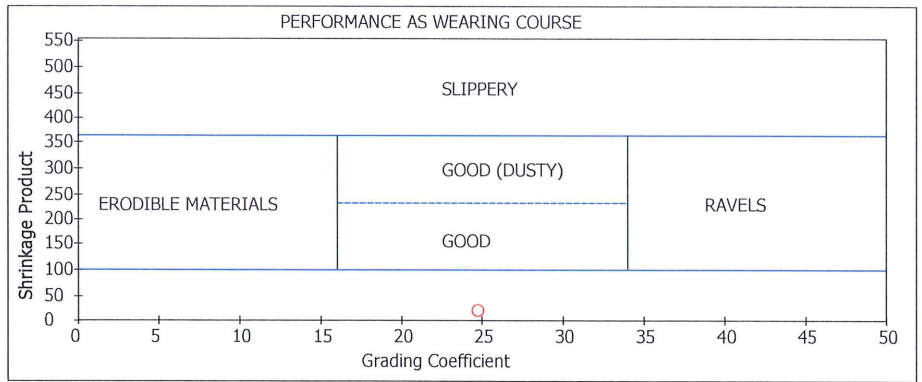
Project : Wegdraai Infrastructure Upgrade

Foundation Indicator Test Report SANS 3001 - GR1 / GR3 / GR10

Sample No.	: U9267
Position	: TP 1
Layer Type	: 0-300mm
Sample Colour	: Orange Brown Gravel
Sample Type	: Mix Quartzstone

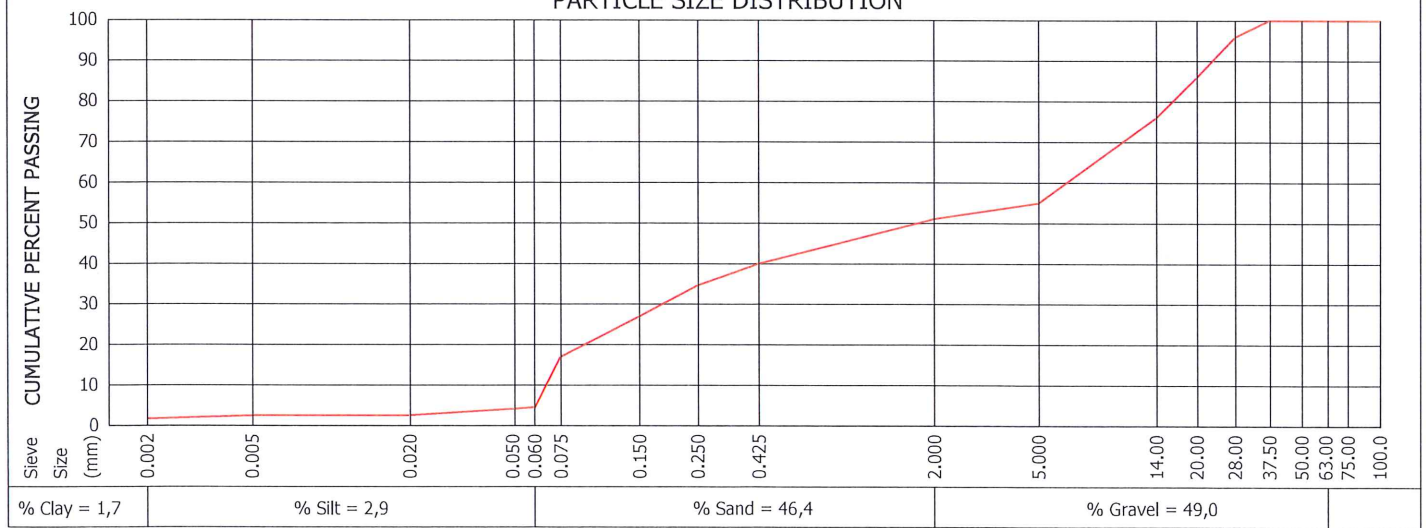


Sieve Size(mm)	% Passing	Soil Mortar		
2.000 - 0.425	22	Soil Mortar		
0.425 - 0.250	10			
0.250 - 0.150	15			
0.150 - 0.075	20			
< 0.075	33			
Effective Size	0,067			
Uniformity Coefficient	106,6			
Curvature Coefficient	0,1			
Oversize Index	0,0			
Shrinkage Product	20,0			
Grading Coefficient	24,8			
Grading Modulus	1,90			
		Atterberg Limits		
			Liquid Limit	14
			Plasticity Index	1.0
			Linear Shrinkage	0.5
		PI < 0.075		
		Unified Soil Classification	SC	
		US Highway Classification	A-1-b(0)	
0.002	1,7			



D10= 0,067 D30= 0,189 D60= 7,143

PARTICLE SIZE DISTRIBUTION



Deviation from Test Method :  
 Remarks and Notes :

Opinions and interpretations are not included in our scope of works. (T0296)  
 The samples were subjected to analysis according to (SANS)(TMH5)(DOT)(ASTM).  
 The test results reported relate to the samples tested.  
 Further use of the above information is not the responsibility or liability of Roadlab.  
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 Report compiled by : Juraine Okkies



D Juckers  
 Technical Signatory

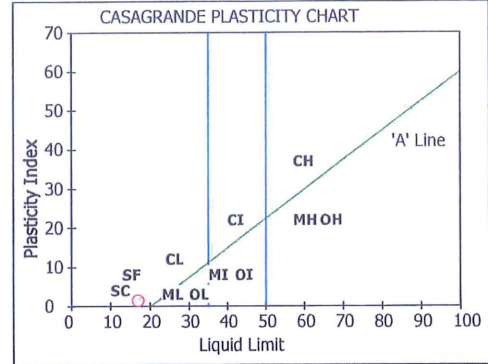
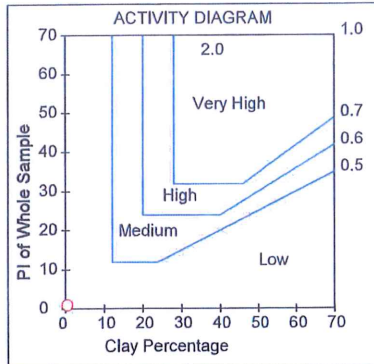
Job Request No.: RU3525  
 Ceder Land Geotechnical Consult (Pty) Ltd  
 PO Box 607  
 Ceres  
 6835  
 Attention : Frans Breytenbach

Date Reported : 2020-08-24

Project : Wegdraai Infrastructure Upgrade

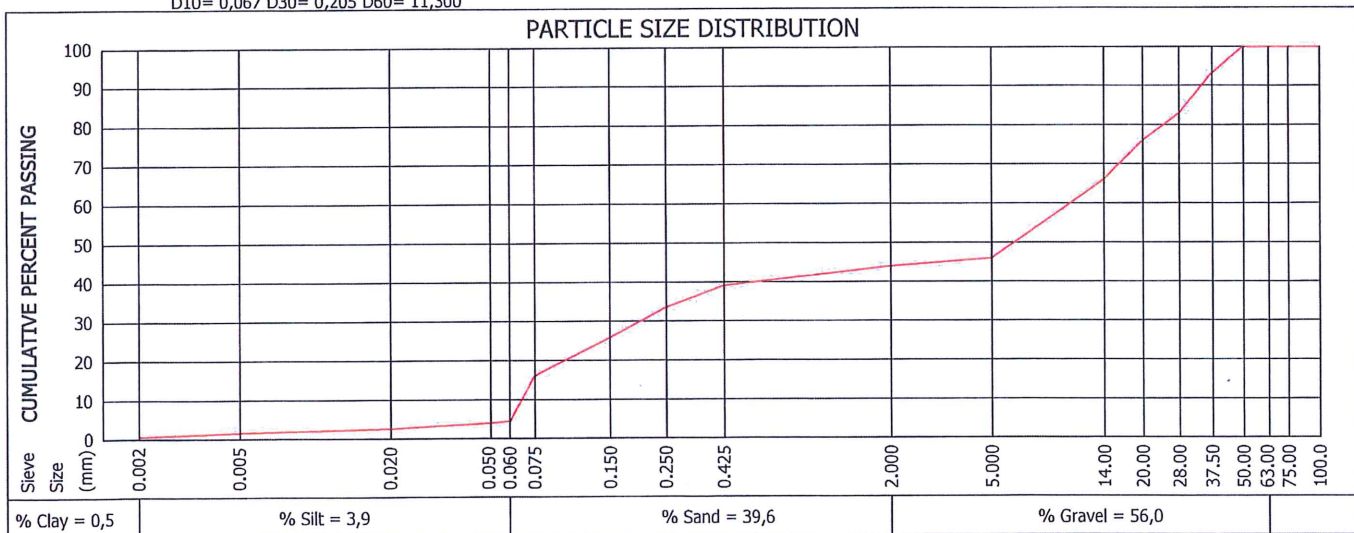
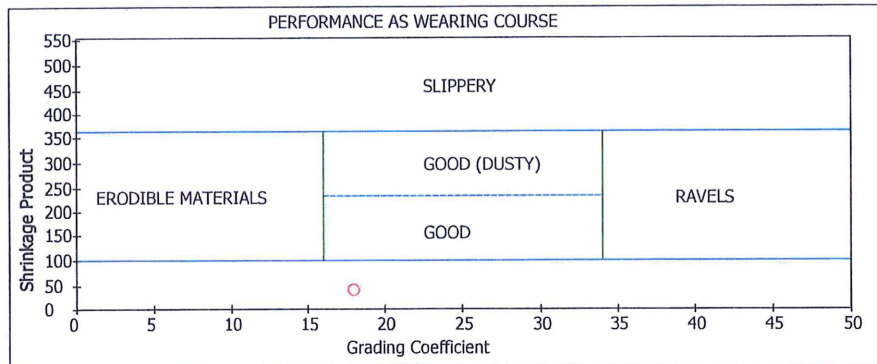
Foundation Indicator Test Report SANS 3001 - GR1 / GR3 / GR10

Sample No.	: U9268
Position	: TP 6
Layer Type	: 0-400mm
Sample Colour	: Orange Brown Gravel
Sample Type	: Mix Calcrete + Quart



Sieve Size (mm)	% Passing	Soil Mortar		
100.0	100	2.000 - 0.425	11	
75.00	100	0.425 - 0.250	13	
63.00	100	0.250 - 0.150	17	
50.00	100	0.150 - 0.075	22	
37.50	93	< 0.075	37	
28.00	83	Effective Size	0,067	
20.00	76	Uniformity Coefficient	168,7	
14.00	66	Curvature Coefficient	0,1	
5.000	46	Oversize Index	7,0	
2.000	44	Shrinkage Product	39,0	
0.425	39	Grading Coefficient	17,9	
0.250	33	Grading Modulus	2,00	
0.150	26	Atterberg Limits	Liquid Limit	17
0.075	16		Plasticity Index	2,0
0.060	4,4		Linear Shrinkage	1,0
0.050	3,9		PI < 0.075	
0.020	2,5	Unified Soil Classification	GC	
0.005	1,5	US Highway Classification	A-1-b(0)	
0.002	0,5			

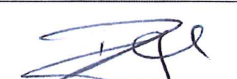
D10= 0,067 D30= 0,205 D60= 11,300



Deviation from Test Method :  
 Remarks and Notes : Chemistry: pH = 7.64 [SANS 5854] & Conductivity = 0.13 S/m [SANS 6240]

Opinions and interpretations are not included in our scope of works. (T0296)  
 The samples were subjected to analysis according to (SANS)(TMH5)(DOT)(ASTM).  
 The test results reported relate to the samples tested.  
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 Report compiled by : Juraine Okkies

**sanas**  
 Testing Laboratory  
 Accreditation No. T0296  
 Prog.ver 10.7 (2019/11/07)

  
 D Juckers  
 Technical Signatory

2... of ...

Job Request No.: RU3525  
 Ceder Land Geotechnical Consult (Pty) Ltd  
 PO Box 607  
 Ceres  
 6835  
 Attention : Frans Breytenbach

Date Reported : 2020-07-17

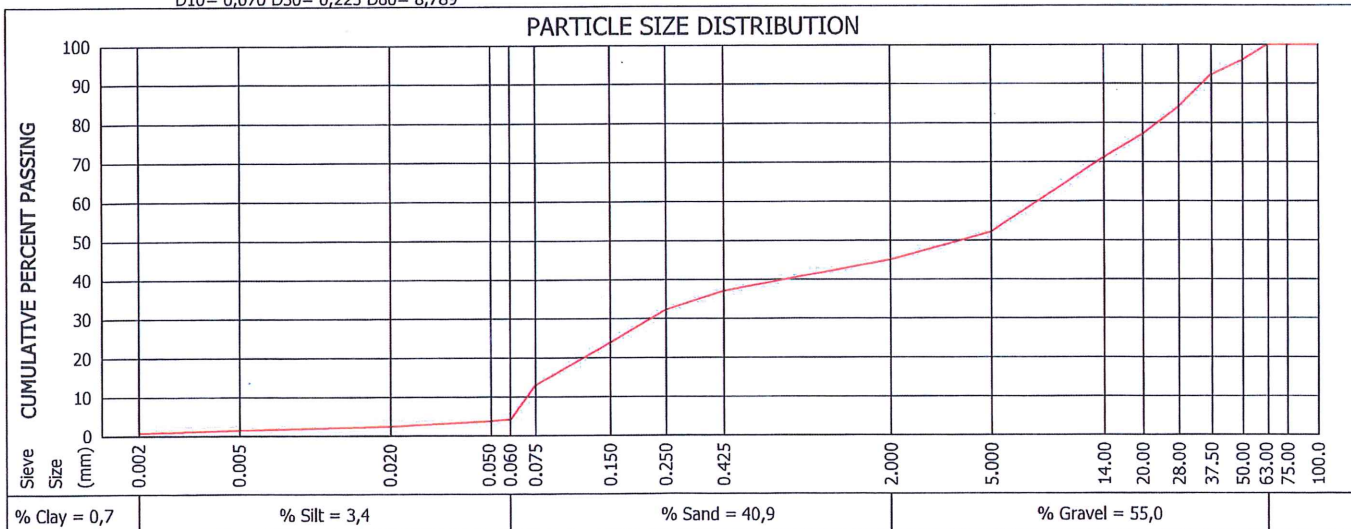
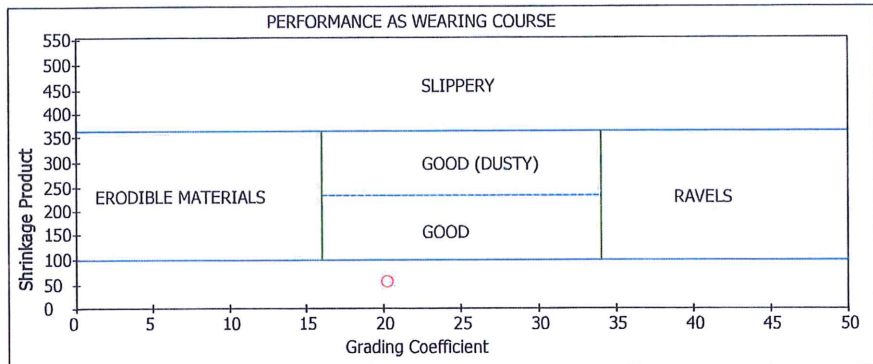
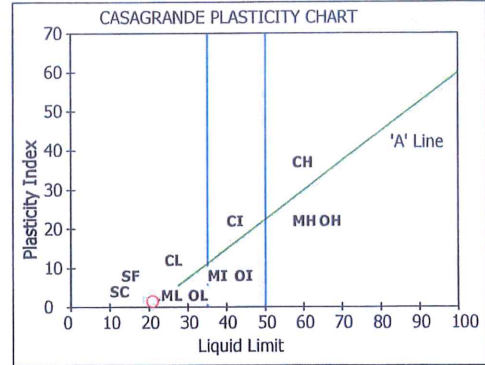
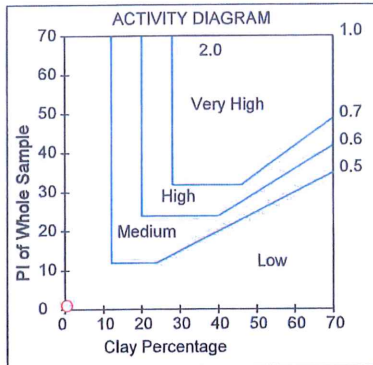
Project : Wegdraai Infrastructure Upgrade

Foundation Indicator Test Report SANS 3001 - GR1 / GR3 / GR10

Sample No.	: U9269
Position	: TP 12
Layer Type	: 400-800mm
Sample Colour	: Brown
Sample Type	: Mix Calcretestone


Sieve Size (mm)	% Passing	Soil Mortar		
100.0	100	2.000 - 0.425	17	
75.00	100	0.425 - 0.250	12	
63.00	100	0.250 - 0.150	19	
50.00	96	0.150 - 0.075	24	
37.50	92	< 0.075	29	
28.00	84	Effective Size	0,070	
20.00	77	Uniformity Coefficient	125,6	
14.00	71	Curvature Coefficient	0,1	
5.000	52	Oversize Index	4,0	
2.000	45	Shrinkage Product	55,5	
0.425	37	Grading Coefficient	20,3	
0.250	32	Grading Modulus	2,10	
0.150	24	Atterberg Limits	Liquid Limit	21
0.075	13		Plasticity Index	2.0
0.060	4,1		Linear Shrinkage	1.5
0.050	3,7		PI < 0.075	
0.020	2,3	Unified Soil Classification	SC	
0.005	1,4	US Highway Classification	A-1-b(0)	
0.002	0,7			

D10= 0,070 D30= 0,225 D60= 8,789




Deviation from Test Method :  
 Remarks and Notes :

Opinions and interpretations are not included in our scope of works. (T0296)  
 The samples were subjected to analysis according to (SANS)(TMH5)(DOT)(ASTM).  
 The test results reported relate to the samples tested.  
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 Report compiled by : Juraine Okkies



Accreditation No. T0296  
 Prog.ver 10.7 (2019/11/07)



D Juckers  
 Technical Signatory 5/18  
 ... of ...

Job Request No.: RU3525  
 Ceder Land Geotechnical Consult (Pty) Ltd  
 PO Box 607  
 Ceres  
 6835

Date Reported : 2020-07-24

Project : Wegdraai Infrastructure Upgrade

Attention : Frans Breytenbach  
 Determination of the California Bearing Ratio Test Report SANS 3001 - GR1 / GR2 / GR10 / GR20 / GR30 / GR40 / PR5

SAMPLE INFORMATION AND PROPERTIES

SAMPLE NO.	U9269
HOLE NO./ Km / CHAINAGE	TP12
ROAD NO./ NAME Line 1	S28° 50' 24,1"
ROAD NO./ NAME Line 2	E21° 52' 02,5"
LAYER TESTED/SAMPLED	400-800mm
SAMPLE DEPTH	400-800mm
DATE SAMPLED	2020-07-08
COLOUR OF SAMPLE	Brown
TYPE OF SAMPLE	Mix Calcrete Stone

SIEVE ANALYSIS - % PASSING SIEVES \*(SANS 3001-GR1:2010, SANS 3001-GR2:2010)

SIEVE ANALYSIS (GR 1) % PASSING	100.0 mm	
	75.0 mm	
	63.0 mm	100
	50.0 mm	96
	37.5 mm	92
	28.0 mm	84
	20.0 mm	77
	14.0 mm	71
	5.0 mm	52
	2.0 mm	45
0.425 mm	37	
0.075 mm	13	
GM %		2,1

SOIL MORTAR ANALYSIS (SANS 3001-PR5:2011)

COARSE SAND	2.000 - 0.425	17
COARSE FINE SAND	0.425 - 0.250	12
MEDIUM FINE SAND	0.250 - 0.150	19
FINE FINE SAND	0.150 - 0.075	24
SILT CLAY	0.075	29

ATTERBERG LIMITS ANALYSIS - \*(SANS 3001-GR10:2010)

ATTERBERG LIMITS (%) SANS GR10,GR11	LIQUID LIMIT	21
	PLASTICITY INDEX	1,7
	LINEAR SHRINKAGE	1,5
CLASSIFICATION	H.R.B.	A-1-b(0)
	COLTO	G5
	TRH 14	G5

CALIFORNIA BEARING RATIO - \*(SANS 3001-GR30:2010, SANS 3001-GR40:2010)

SANS GR30 MAX. DRY DENSITY	OMC %	10,5
	MDD (kg/m³)	1922
	COMP MC %	10,5
SWELL % @	MOD   NRB   PRO	0,00   0,01   0,02
	100 %	81
	98 %	70
C.B.R. SANS GR40	97 %	64
	95 %	55
	93 %	47
	90 %	38

STABILISER IN LAB	Not Applicable
TEST TYPE	CBR
SAMPLING METHOD	TMH 5
WEATHER WHEN SAMPLED	Cold

Deviation from Test Method :  
 Remarks and Notes :

Opinions and interpretations are not included in our scope of works. (T0296)  
 The samples were subjected to analysis according to (SANS)(TMH5)(DOT)(ASTM).  
 The test results reported relate to the samples tested.  
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 Report compiled by : Juraine Okkies

Job Request No.: RU3525  
 Ceder Land Geotechnical Consult (Pty) Ltd  
 PO Box 607  
 Ceres  
 6835  
 Attention : Frans Breytenbach

Date Reported : 2020-07-17

Project : Wegdraai Infrastructure Upgrade

Determination Maximum Dry Density & Optimum Moisture Content Test Report

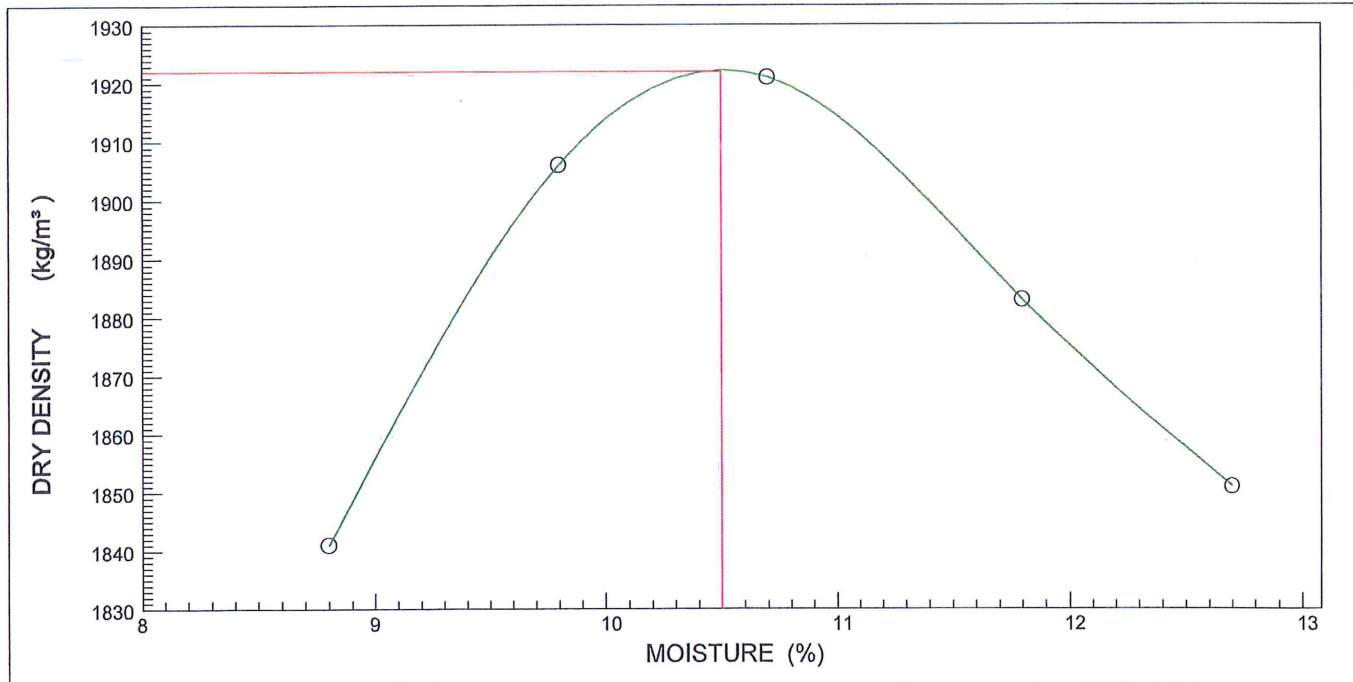
SANS 3001 - GR20/GR30

SAMPLE NO.	U9269
CONTAINER FOR SAMPLING	Black Bags
SIZE / APPROX. MASS OF SAMPLE	100kg
MOISTURE CONDITION OF SAMPLE	Moist
LAYER TESTED / SAMPLED FROM	400-800mm
MATERIAL DESCRIPTION	Mix Calcretestone
HOLE NO./ km / CHAINAGE	TP12
ROAD NO.	Not Specified
DATE RECEIVED	2020-07-09
DATE SAMPLED	2020-07-08
CLIENT MARKING	S28° 50' 24,1"; E21° 52' 02,5"
COLOUR AND TYPE	Brown Gravel

POINT NO.	1	2	3	4	5			
DRY DENSITY (kg/m <sup>3</sup> )	1841	1906	1921	1883	1851			
MOISTURE (%)	8,8	9,8	10,7	11,8	12,7			

MAXIMUM DRY DENSITY (kg/m<sup>3</sup>) : 1922

OPTIMUM MOISTURE CONTENT (%) : 10,5



Deviation from Test Method :  
 Remarks and Notes :

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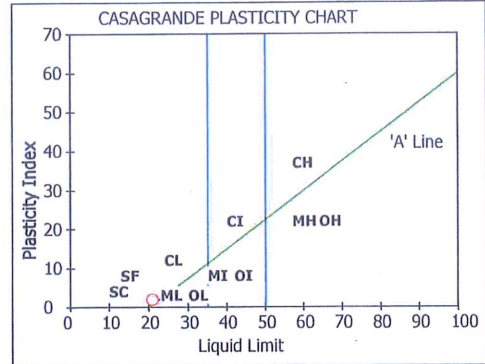
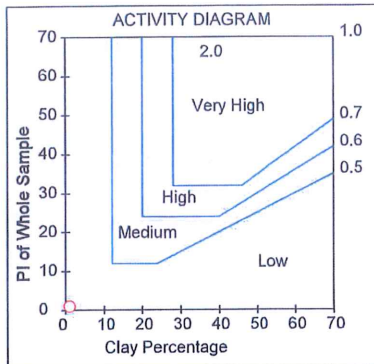
Job Request No.: RU3525  
 Ceder Land Geotechnical Consult (Pty) Ltd  
 PO Box 607  
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 6835  
 Attention : Frans Breytenbach

Date Reported : 2020-08-06

Project : Wegdraai Infrastructure Upgrade

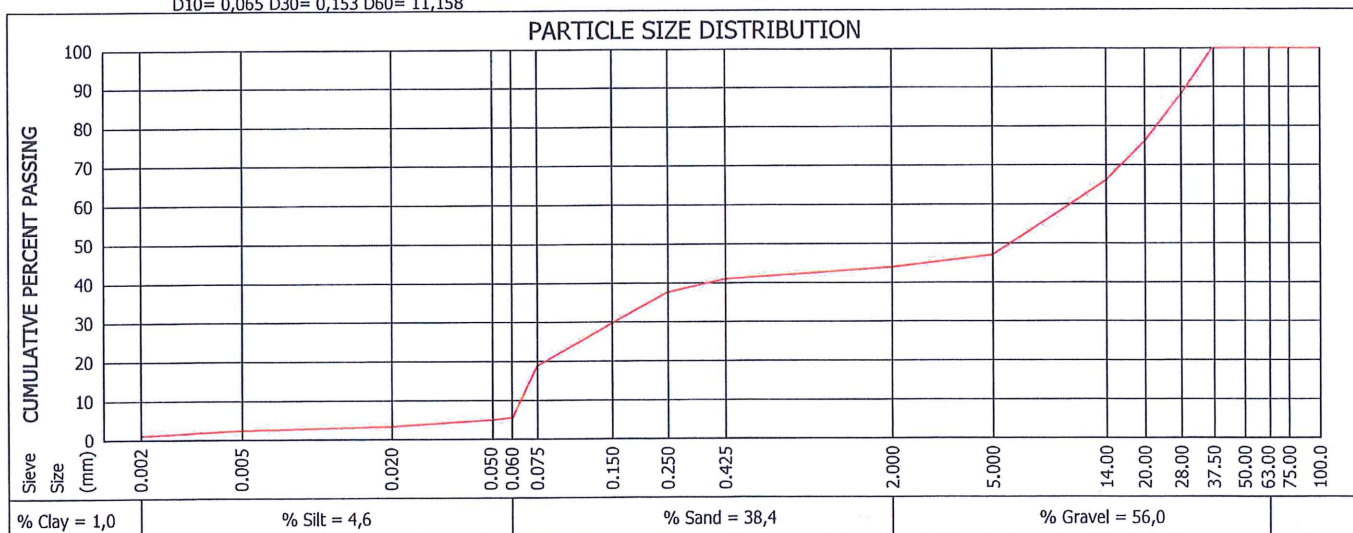
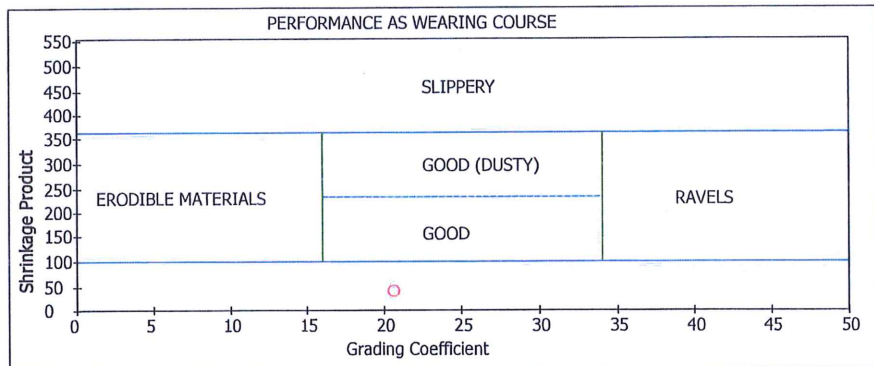
Foundation Indicator Test Report SANS 3001 - GR1 / GR3 / GR10

Sample No.	: U9270
Position	: TP 16
Layer Type	: 0-300mm
Sample Colour	: Light Red & Brown
Sample Type	: Fine Sand & Calcrete



Sieve Size(mm)	% Passing	Soil Mortar		
100.0	100	2.000 - 0.425	7	
75.00	100	0.425 - 0.250	8	
63.00	100	0.250 - 0.150	18	
50.00	100	0.150 - 0.075	25	
37.50	100	< 0.075	43	
28.00	88	Effective Size	0,065	
20.00	76	Uniformity Coefficient	171,7	
14.00	66	Curvature Coefficient	0,0	
5.000	47	Oversize Index	0,0	
2.000	44	Shrinkage Product	41,0	
0.425	41	Grading Coefficient	20,7	
0.250	38	Grading Modulus	2,00	
0.150	30	Atterberg Limits	Liquid Limit	21
0.075	19		Plasticity Index	2.0
0.060	5,6		Linear Shrinkage	1.0
0.050	5,0		PI < 0,075	
0.020	3,3	Unified Soil Classification	GC	
0.005	2,3	US Highway Classification	A-1-b(0)	
0.002	1,0			


D10= 0,065 D30= 0,153 D60= 11,158



Deviation from Test Method :  
 Remarks and Notes : Chemistry: pH = 7.80 [SANS 5854] & Conductivity = 0.09 S/m [SANS 6240]

Opinions and interpretations are not included in our scope of works. (T0296)  
 The samples were subjected to analysis according to (SANS)(TMH5)(DOT)(ASTM).  
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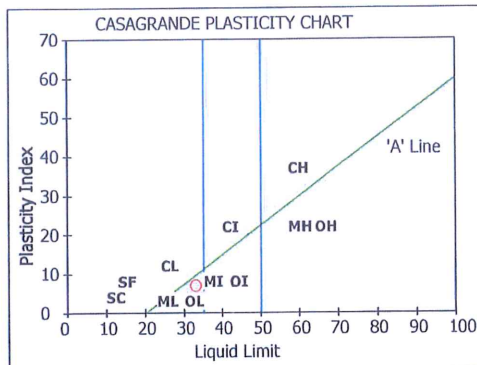
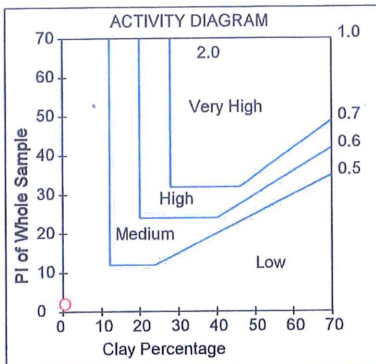
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 6835  
 Attention : Frans Breytenbach

Date Reported : 2020-07-17

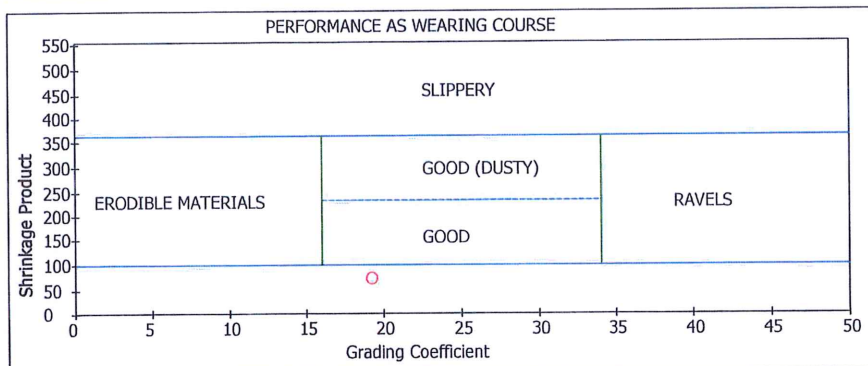
Project : Wegdraai Infrastructure Upgrade

Foundation Indicator Test Report SANS 3001 - GR1 / GR3 / GR10

Sample No.	: U9271
Position	: TP 17
Layer Type	: 500-900mm
Sample Colour	: Light Brown
Sample Type	: Mix Weathered Quartz

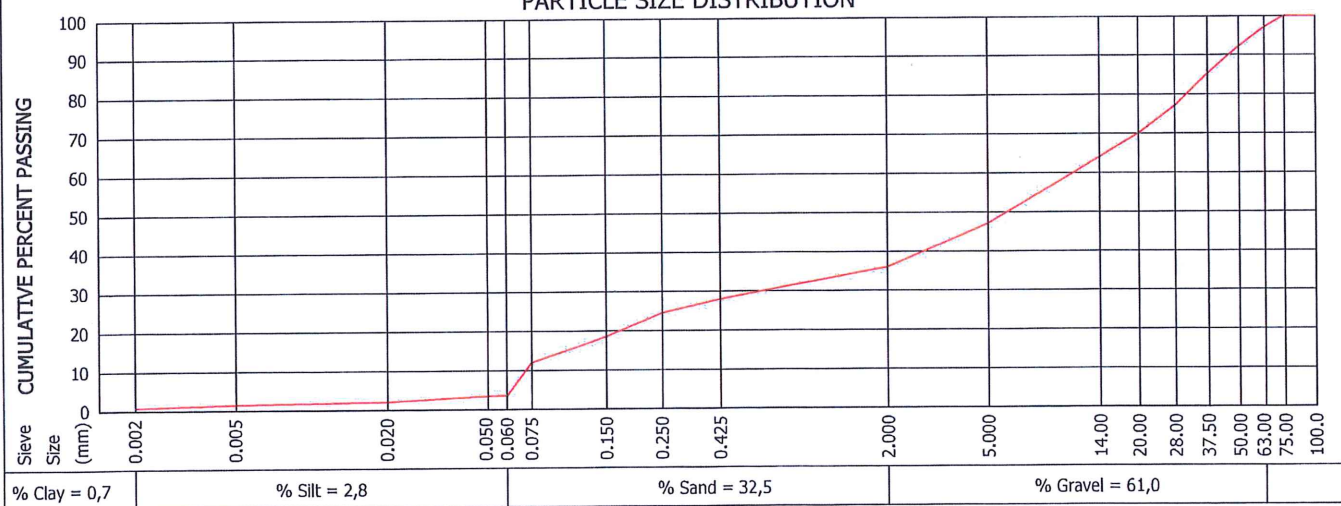


Sieve Size(mm)	% Passing	Soil Mortar		
2.000	22	2.000 - 0.425		22
0.425	11	0.425 - 0.250		11
0.250	16	0.250 - 0.150		16
0.150	18	0.150 - 0.075		18
< 0.075	33			33
Effective Size	0,071			
Uniformity Coefficient	167,4			
Curvature Coefficient	0,8			
Oversize Index	7,0			
Shrinkage Product	70,0			
Grading Coefficient	19,3			
Grading Modulus	2,20			
		Atterberg Limits	Liquid Limit	33
			Plasticity Index	7
			Linear Shrinkage	2.5
			PI < 0.075	
		Unified Soil Classification		GW-GM
		US Highway Classification		A-2-4(0)



D10= 0,071 D30= 0,819 D60= 11,882

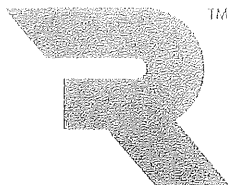
PARTICLE SIZE DISTRIBUTION



Deviation from Test Method :  
 Remarks and Notes :

Opinions and interpretations are not included in our scope of works. (T0296)  
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**ROADLAB**

Job Request No.: RU3525  
 Ceder Land Geotechnical Consult (Pty) Ltd  
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 8135

Roadlab Germiston  
 207 Rietfontein Road Primrose Germiston  
 1401  
 Tel: 011 828 0279 Fax: 011 828 0279  
 Email: info@roadlab.co.za  
 Web: www.roadlab.co.za

Date Reported : 2020-07-24

Project : Wegdraai Infrastructure Upgrade

Attention : Frans Breytenbach

Determination of the California Bearing Ratio Test Report SANS 3001 - GR1 / GR2 / GR10 / GR20 / GR30 / GR40 / PR5

**SAMPLE INFORMATION AND PROPERTIES**

SAMPLE NO.	U9271
HOLE NO./ Km / CHAINAGE	TP17
ROAD NO./ NAME Line 1	S28° 50' 24,1"
ROAD NO./ NAME Line 2	E21° 52' 02,5"
LAYER TESTED/SAMPLED	500-900mm
SAMPLE DEPTH	500-900mm
DATE SAMPLED	2020-07-08
COLOUR OF SAMPLE	Light Brown
TYPE OF SAMPLE	Mix WQuartz+Calcrete

**SIEVE ANALYSIS - % PASSING SIEVES \*(SANS 3001-GR1:2010, SANS 3001-GR2:2010)**

SIEVE ANALYSIS (GR 1) % PASSING	100.0 mm	100
	75.0 mm	97
	63.0 mm	92
	50.0 mm	85
	37.5 mm	77
	28.0 mm	70
	20.0 mm	64
	14.0 mm	47
	5.0 mm	38
	2.0 mm	28
	0.425 mm	12
GM %	2.2	

**SOIL MORTAR ANALYSIS (SANS 3001-PR5:2011)**

COARSE SAND	2.000 - 0.425	22
COARSE FINE SAND	0.425 - 0.250	11
MEDIUM FINE SAND	0.250 - 0.150	16
FINE FINE SAND	0.150 - 0.075	18
SILT CLAY	0.075	33

**ATTERBERG LIMITS ANALYSIS - \*(SANS 3001-GR10:2010)**

ATTERBERG LIMITS (%) SANS GR10,GR11	LIQUID LIMIT	33
	PLASTICITY INDEX	7
	LINEAR SHRINKAGE	2.5
CLASSIFICATION	H.R.B.	A-2-4(0)
	COLTO	G7
	TRH 14	G7

**CALIFORNIA BEARING RATIO - \*(SANS 3001-GR30:2010, SANS 3001-GR40:2010)**

SANS GR30 MAX. DRY DENSITY	OMC %	9.2
	MDD (kg/m³)	1932
	COMP MC %	9.2
SWELL % @	MOD   NRB   PRO	0.01   0.04   0.06
	100 %	54
C.B.R. SANS GR40	98 %	38
	97 %	32
	95 %	22
	93 %	15
	90 %	9

STABILISER IN LAB	Not Applicable
TEST TYPE	CBR
SAMPLING METHOD	TMH 5
WEATHER WHEN SAMPLED	Cold

Deviation from Test Method :  
 Remarks and Notes :

Opinions and interpretations are not included in our schedule of accreditation. (T0296)  
 The samples were subjected to analysis according to (SANS)(TMH5)(DOT)(ASTM)  
 The test results reported relate to the samples tested.  
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 Ceder Land Geotechnical Consult (Pty) Ltd  
 PO Box 607  
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 6835  
 Attention : Frans Breytenbach

Date Reported : 2020-07-23

Project : Wegdraai Infrastructure Upgrade

Determination Maximum Dry Density & Optimum Moisture Content Test Report

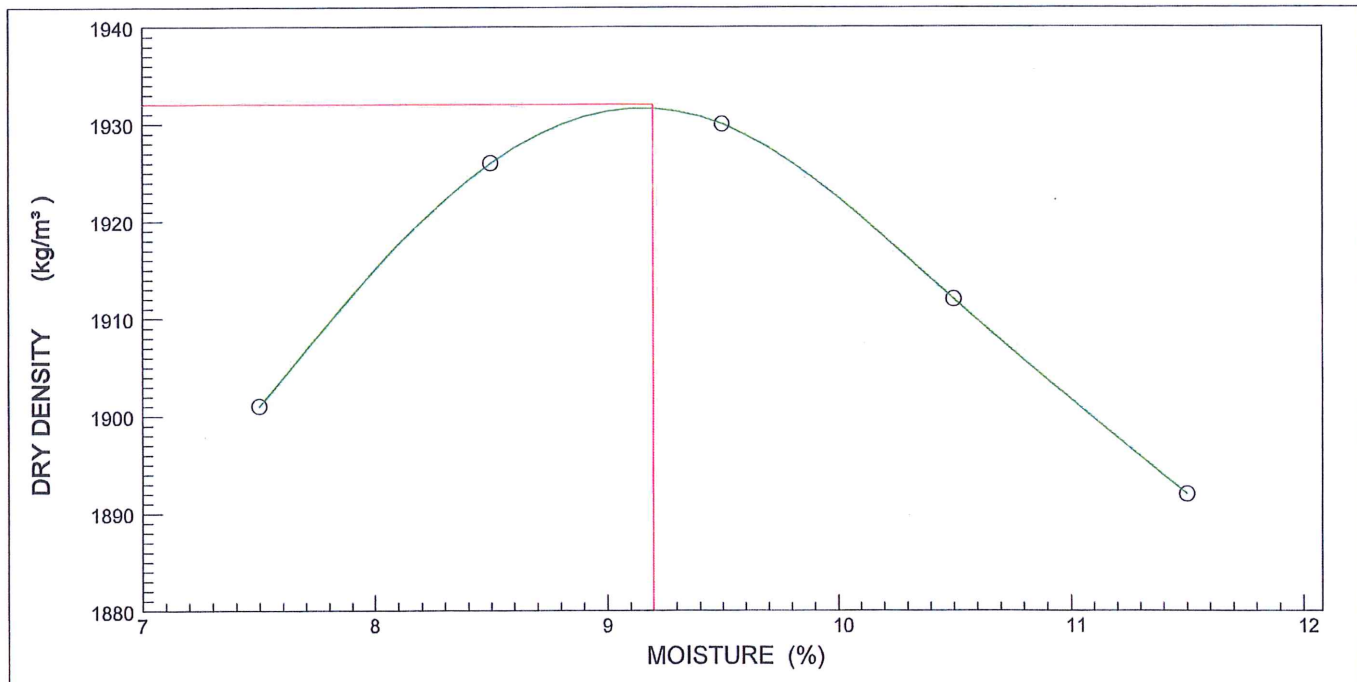
SANS 3001 - GR20/GR30

SAMPLE NO.	U9271
CONTAINER FOR SAMPLING	Black Bags
SIZE / APPROX. MASS OF SAMPLE	98kg
MOISTURE CONDITION OF SAMPLE	Moist
LAYER TESTED / SAMPLED FROM	500-900mm
MATERIAL DESCRIPTION	Mix Weathered Quartz + Calcrete
HOLE NO./ km / CHAINAGE	TP17
ROAD NO.	Not Specified
DATE RECEIVED	2020-07-09
DATE SAMPLED	2020-07-08
CLIENT MARKING	S28° 50' 24,1"; E21° 52' 02,5"
COLOUR AND TYPE	Light Brown Gravel

POINT NO.	1	2	3	4	5			
DRY DENSITY (kg/m <sup>3</sup> )	1901	1926	1930	1912	1892			
MOISTURE (%)	7,5	8,5	9,5	10,5	11,5			

MAXIMUM DRY DENSITY (kg/m<sup>3</sup>) : 1932

OPTIMUM MOISTURE CONTENT (%) : 9,2



Deviation from Test Method :  
 Remarks and Notes :

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 Attention : Frans Breytenbach

Date Reported : 2020-08-06

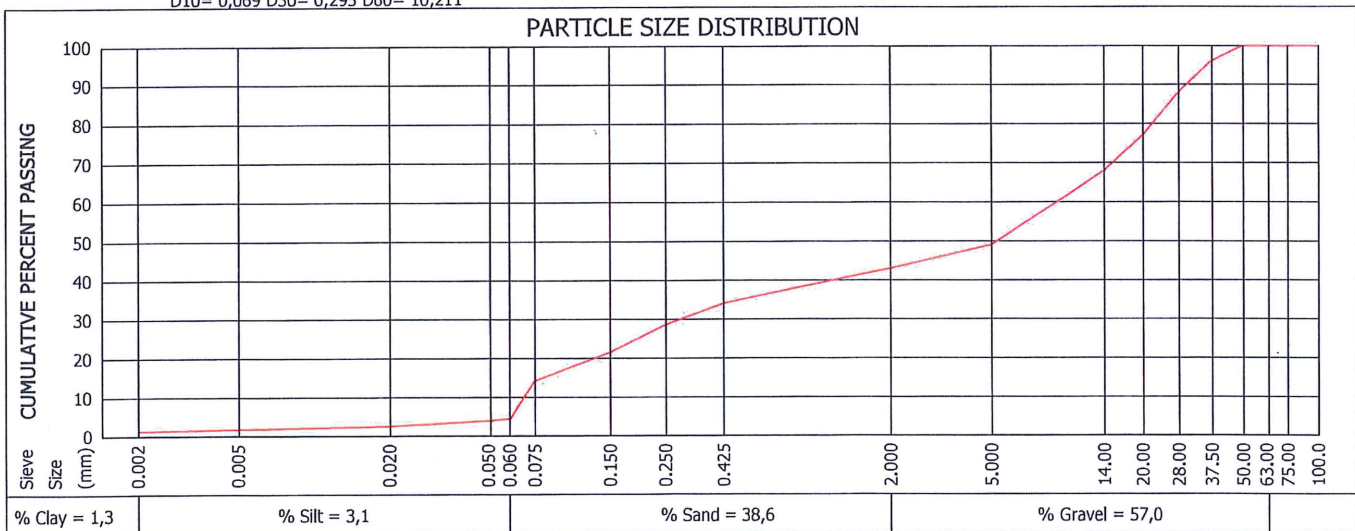
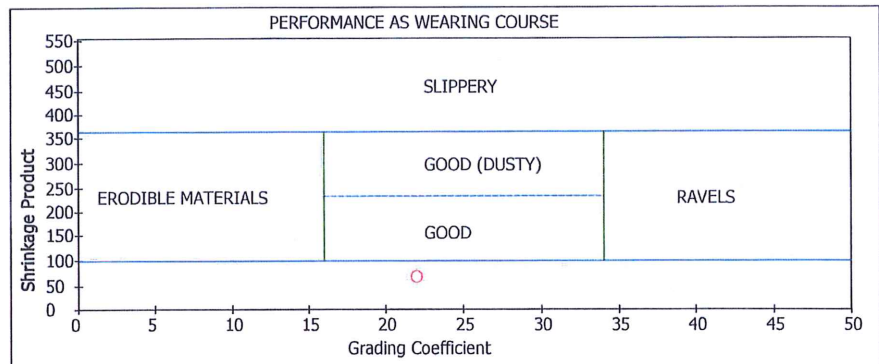
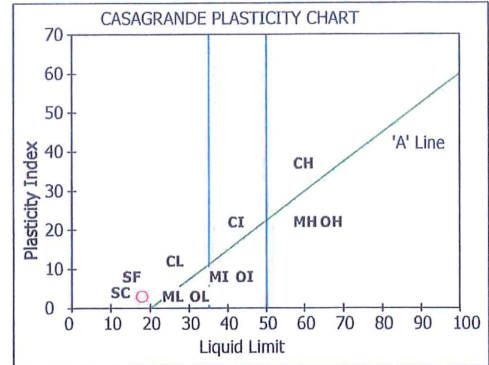
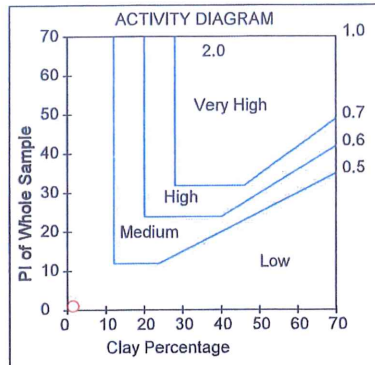
Project : Wegdraai Infrastructure Upgrade

Foundation Indicator Test Report SANS 3001 - GR1 / GR3 / GR10

Sample No.	: U9272
Position	: TP 21
Layer Type	: 0-400mm
Sample Colour	: Dark Brown Gravel
Sample Type	: Mix Quartzstone

Sieve Size(mm)	% Passing	Soil Mortar		
100.0	100	2.000 - 0.425	21	
75.00	100	0.425 - 0.250	13	
63.00	100	0.250 - 0.150	17	
50.00	100	0.150 - 0.075	17	
37.50	96	< 0.075	33	
28.00	88	Effective Size	0,069	
20.00	77	Uniformity Coefficient	148,0	
14.00	68	Curvature Coefficient	0,1	
5.000	49	Oversize Index	4,0	
2.000	43	Shrinkage Product	68,0	
0.425	34	Grading Coefficient	22,1	
0.250	29	Grading Modulus	2,10	
0.150	22	Atterberg Limits	Liquid Limit	18
0.075	14		Plasticity Index	3,0
0.060	4,4		Linear Shrinkage	2,0
0.050	3,9		PI < 0.075	
0.020	2,5	Unified Soil Classification	GC	
0.005	1,7	US Highway Classification	A-1-b(0)	
0.002	1,3			

D10= 0,069 D30= 0,295 D60= 10,211

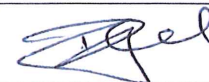


Deviation from Test Method :

Remarks and Notes : Chemistry: pH = 7.75 [SANS 5854] & Conductivity = 0.10 S/m [SANS 6240]

Opinions and interpretations are not included in our scope of works. (T0296)  
 The samples were subjected to analysis according to (SANS)(TMH5)(DOT)(ASTM).  
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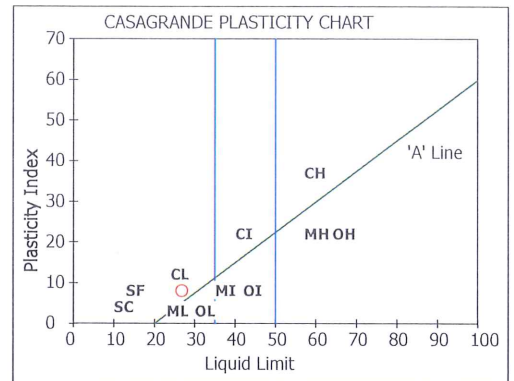
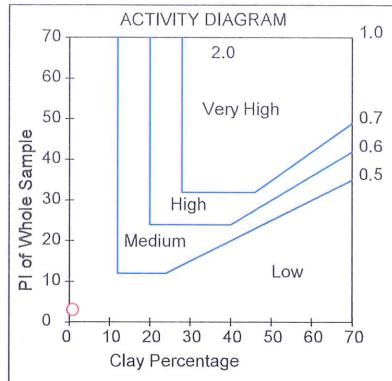
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 6835  
 Attention : Frans Breytenbach

Date Reported : 2020-08-12

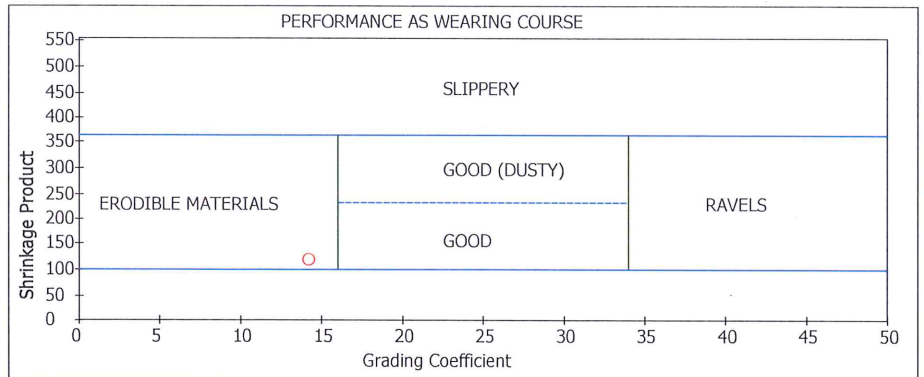
Project : Wegdraai Infrastructure Upgrade

Foundation Indicator Test Report SANS 3001 - GR1 / GR3 / GR10

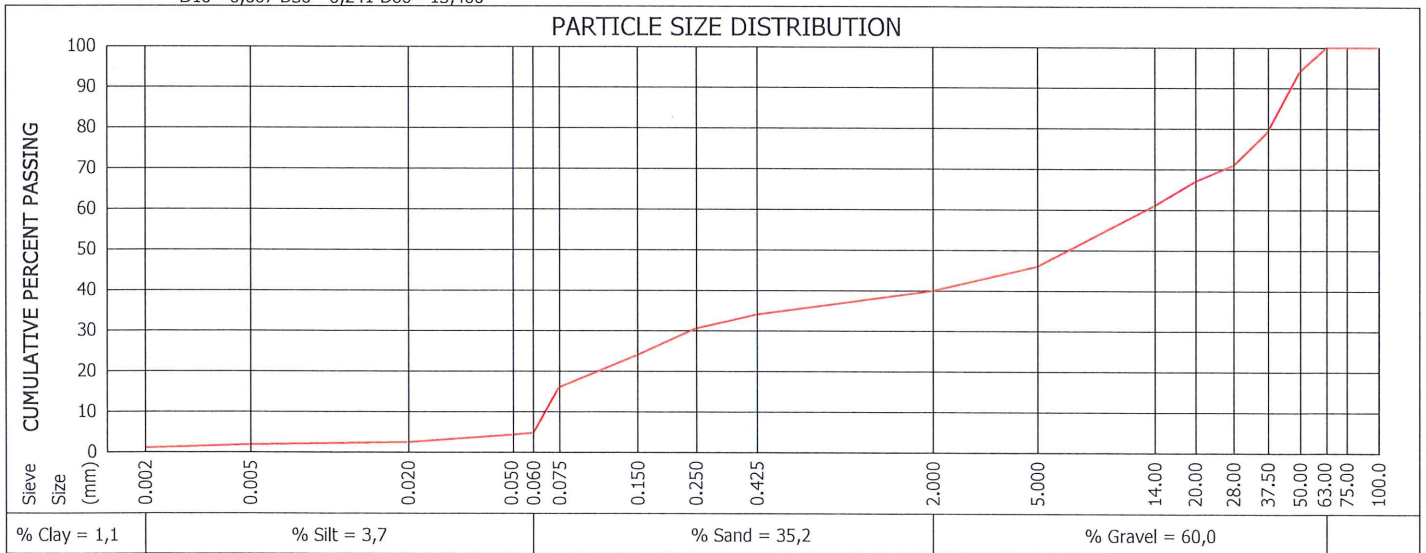
Sample No.	: U9273
Position	: TP 23
Layer Type	: 100-400mm
Sample Colour	: Brown Gravel
Sample Type	: Mix Calcrete+Quartz



Sieve Size(mm)	% Passing	Soil Mortar	2.000 - 0.425	15
100.0	100		0.425 - 0.250	10
75.00	100		0.250 - 0.150	16
63.00	100		0.150 - 0.075	20
50.00	94		< 0.075	40
37.50	79	Effective Size		0,067
28.00	71	Uniformity Coefficient		200,0
20.00	67	Curvature Coefficient		0,1
14.00	61	Oversize Index		15,0
5.000	46	Shrinkage Product		119,0
2.000	40	Grading Coefficient		14,3
0.425	34	Grading Modulus		2,10
0.250	31	Atterberg Limits	Liquid Limit	27
0.150	24		Plasticity Index	8
0.075	16		Linear Shrinkage	3.5
0.060	4,8		PI < 0.075	
0.050	4,3	Unified Soil Classification		GC
0.020	2,5	US Highway Classification		A-2-4(0)
0.005	1,9			
0.002	1,1			



D10= 0,067 D30= 0,241 D60= 13,400



Deviation from Test Method :  
 Remarks and Notes : Chemistry: pH = 7.87 [SANS 5854] & Conductivity = 0.09 S/m [SANS 6240]

Opinions and interpretations are not included in our scope of works. (T0296)  
 The samples were subjected to analysis according to (SANS)(TMH5)(DOT)(ASTM).  
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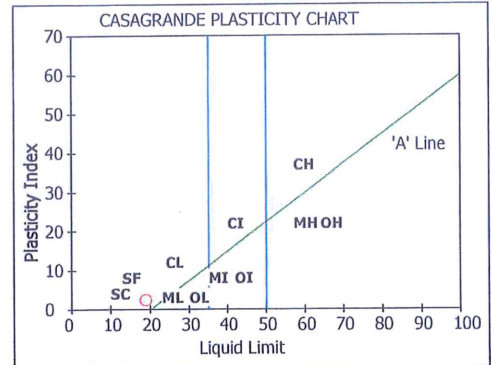
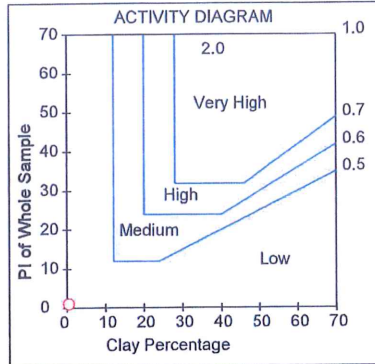
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 6835  
 Attention : Frans Breytenbach

Date Reported : 2020-08-05

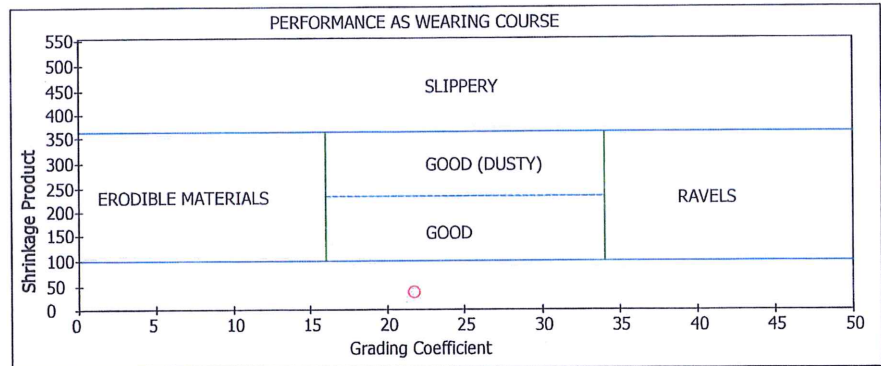
Project : Wegdraai

Foundation Indicator Test Report SANS 3001 - GR1 / GR3 / GR10

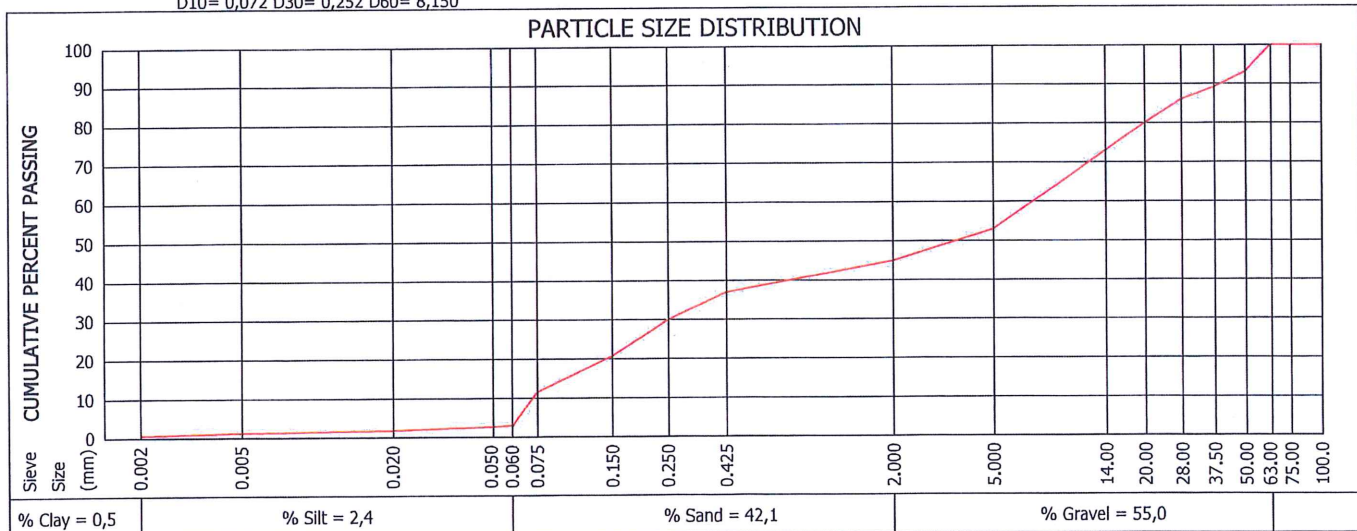
Sample No.	: U9274
Position	: TP 26
Layer Type	: 200-600mm
Sample Colour	: Brown Gravel
Sample Type	: Mix Calcrete+Quartz



Sieve Size(mm)	% Passing	Soil Mortar		
100.0	100	2.000 - 0.425	19	
75.00	100	0.425 - 0.250	15	
63.00	100	0.250 - 0.150	20	
50.00	93	0.150 - 0.075	19	
37.50	89	< 0.075	27	
28.00	86	Effective Size	0,072	
20.00	80	Uniformity Coefficient	113,2	
14.00	73	Curvature Coefficient	0,1	
5.000	53	Oversize Index	4,0	
2.000	45	Shrinkage Product	37,0	
0.425	37	Grading Coefficient	21,7	
0.250	30	Grading Modulus	2,10	
0.150	21	Atterberg Limits	Liquid Limit	19
0.075	12		Plasticity Index	2,0
0.060	2,9		Linear Shrinkage	1,0
0.050	2,6		PI < 0.075	
0.020	1,7	Unified Soil Classification	SW-SC	
0.005	1,2	US Highway Classification	A-1-b(0)	
0.002	0,5			



D10= 0,072 D30= 0,252 D60= 8,150



Deviation from Test Method :  
 Remarks and Notes :

Opinions and interpretations are not included in our scope of works. (T0296)  
 The samples were subjected to analysis according to (SANS)(TMH5)(DOT)(ASTM).  
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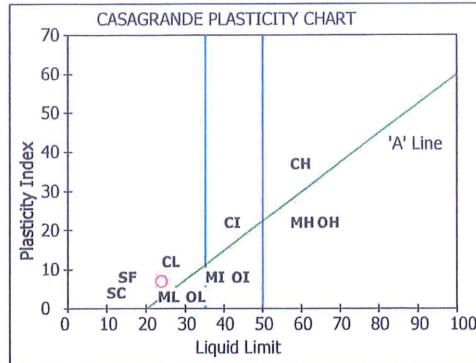
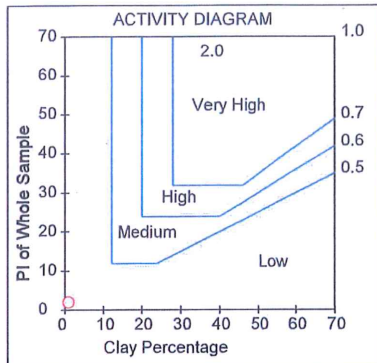
Job Request No.: RU3525  
 Ceder Land Geotechnical Consult (Pty) Ltd  
 PO Box 607  
 Ceres  
 6835  
 Attention : Frans Breytenbach

Date Reported : 2020-07-17

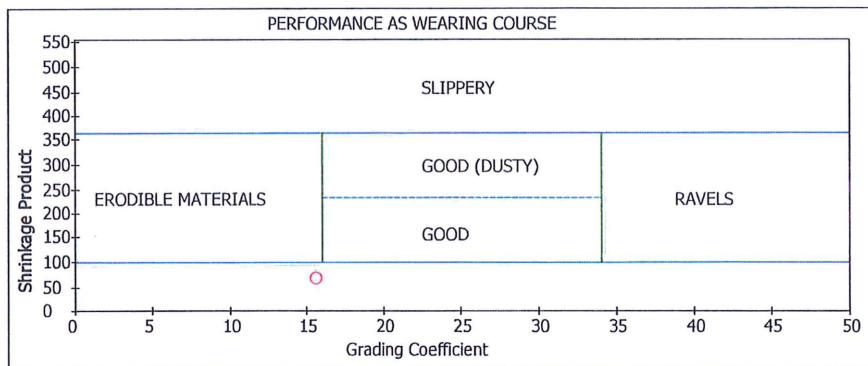
Project : Wegdraai Infrastructure Upgrade

Foundation Indicator Test Report SANS 3001 - GR1 / GR3 / GR10

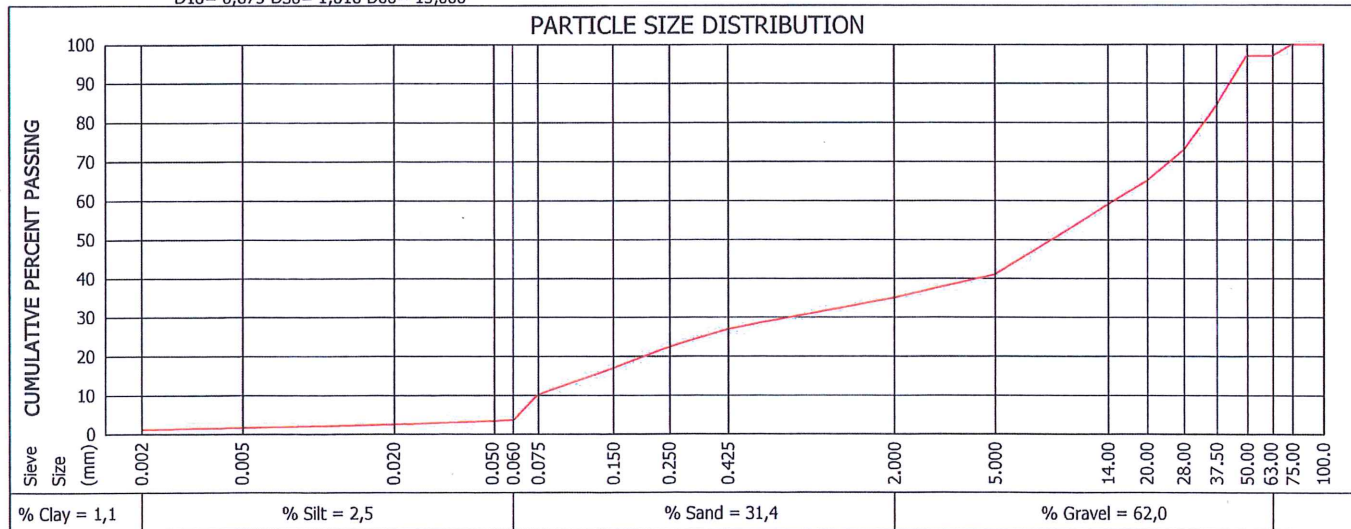
Sample No.	: U9275
Position	: TP 30
Layer Type	: 200-1000mm
Sample Colour	: Brown Gravel
Sample Type	: Mix Calcrete+Quartz



Sieve Size(mm)	% Passing	Soil Mortar		
100.0	100	2.000 - 0.425	22	
75.00	100	0.425 - 0.250	14	
63.00	97	0.250 - 0.150	16	
50.00	97	0.150 - 0.075	20	
37.50	84	< 0.075	29	
28.00	73	Effective Size	0,075	
20.00	65	Uniformity Coefficient	200,0	
14.00	59	Curvature Coefficient	0,9	
5.000	41	Oversize Index	13,0	
2.000	35	Shrinkage Product	67,5	
0.425	27	Grading Coefficient	15,6	
0.250	22	Grading Modulus	2,30	
0.150	17	Atterberg Limits	Liquid Limit	24
0.075	10		Plasticity Index	7
0.060	3,6		Linear Shrinkage	2.5
0.050	3,3		PI < 0.075	
0.020	2,4	Unified Soil Classification	GW-GM-GC	
0.005	1,6	US Highway Classification	A-2-4(0)	
0.002	1,1			



D10= 0,075 D30= 1,016 D60= 15,000



Deviation from Test Method :  
 Remarks and Notes :

Opinions and interpretations are not included in our scope of works. (T0296)  
 The samples were subjected to analysis according to (SANS)(TMH5)(DOT)(ASTM).  
 The test results reported relate to the samples tested.  
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Job Request No.: RU3525  
 Ceder Land Geotechnical Consult (Pty) Ltd  
 PO Box 607  
 Ceres  
 6835

Date Reported : 2020-08-04

Project : Wegdraai Infrastructure Upgrade

Attention : Frans Breytenbach

Determination of the California Bearing Ratio Test Report SANS 3001 - GR1 / GR2 / GR10 / GR20 / GR30 / GR40 / PR5

SAMPLE INFORMATION AND PROPERTIES

SAMPLE NO.	U9275
HOLE NO./ Km / CHAINAGE	TP30
ROAD NO./ NAME Line 1	S28° 50' 18,5"
ROAD NO./ NAME Line 2	E21° 51" 46,1"
LAYER TESTED/SAMPLED	200-1000mm
SAMPLE DEPTH	200-1000mm
DATE SAMPLED	2020-07-09
COLOUR OF SAMPLE	Brown
TYPE OF SAMPLE	Mix Calcrete+Quartz

SIEVE ANALYSIS - % PASSING SIEVES \*(SANS 3001-GR1:2010, SANS 3001-GR2:2010)

SIEVE ANALYSIS (GR 1) % PASSING	100.0 mm	
	75.0 mm	100
	63.0 mm	97
	50.0 mm	97
	37.5 mm	84
	28.0 mm	73
	20.0 mm	65
	14.0 mm	59
	5.0 mm	41
	2.0 mm	35
	0.425 mm	27
0.075 mm	10	
GM %		2,3

SOIL MORTAR ANALYSIS (SANS 3001-PR5:2011)

COARSE SAND	2.000 - 0.425	22
COARSE FINE SAND	0.425 - 0.250	14
MEDIUM FINE SAND	0.250 - 0.150	16
FINE FINE SAND	0.150 - 0.075	20
SILT CLAY	0.075	29

ATTERBERG LIMITS ANALYSIS - \*(SANS 3001-GR10:2010)

ATTERBERG LIMITS (%) SANS GR10,GR11	LIQUID LIMIT	24
	PLASTICITY INDEX	7
	LINEAR SHRINKAGE	2,5
CLASSIFICATION	H.R.B.	A-2-4(0)
	COLTO	G6
	TRH 14	G7

CALIFORNIA BEARING RATIO - \*(SANS 3001-GR30:2010, SANS 3001-GR40:2010)

SANS GR30 MAX. DRY DENSITY	OMC %	7,5
	MDD (kg/m³)	2153
	COMP MC %	7,7
SWELL % @	MOD   NRB   PRO	0,01   0,03   0,05
	100 %	100
	98 %	66
C.B.R. SANS GR40	97 %	53
	95 %	35
	93 %	23
	90 %	12

STABILISER IN LAB	Not Applicable
TEST TYPE	CBR
SAMPLING METHOD	TMH 5
WEATHER WHEN SAMPLED	Cold

Deviation from Test Method :  
 Remarks and Notes :

Opinions and interpretations are not included in our scope of works. (T0296)  
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 6835  
 Attention : Frans Breytenbach

Date Reported : 2020-08-04

Project : Wegdraai Infrastructure Upgrade -

Determination Maximum Dry Density & Optimum Moisture Content Test Report

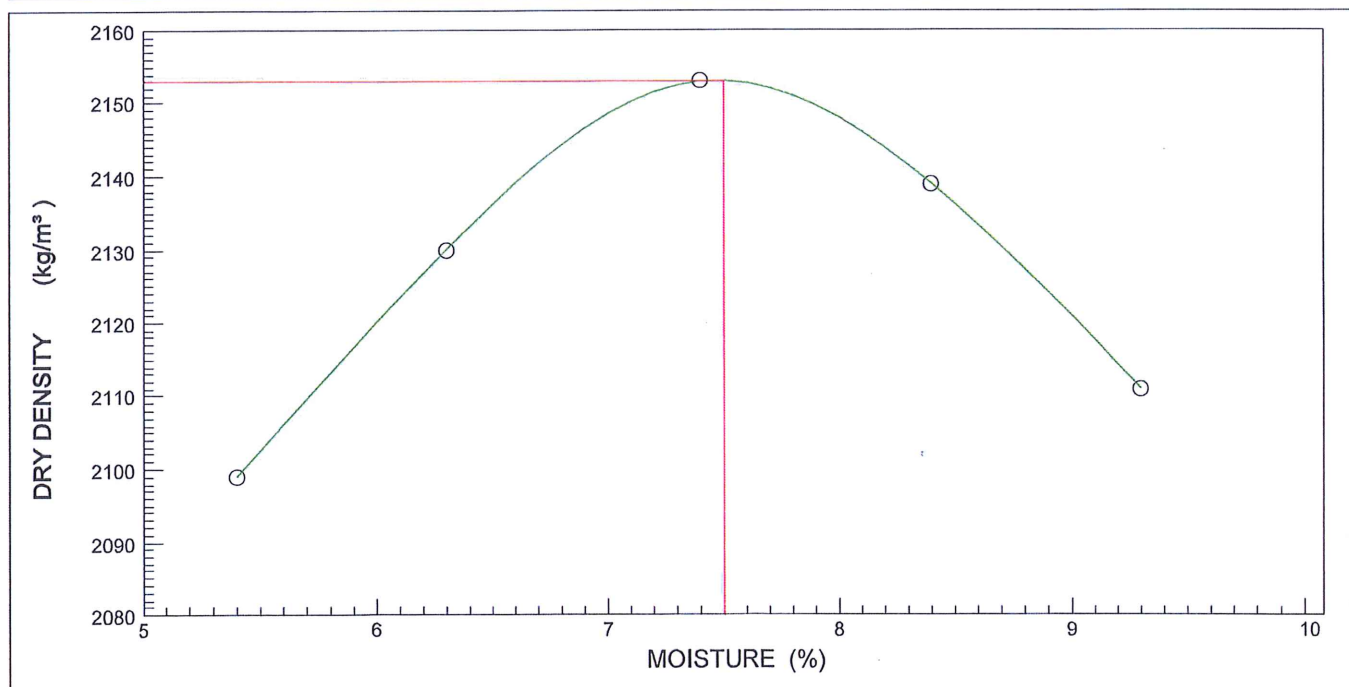
SANS 3001 - GR20/GR30

SAMPLE NO.	U9275
CONTAINER FOR SAMPLING	Black Bags
SIZE / APPROX. MASS OF SAMPLE	102kg
MOISTURE CONDITION OF SAMPLE	Moist
LAYER TESTED / SAMPLED FROM	200-1000mm
MATERIAL DESCRIPTION	Mix Calcrete + Quartzstone
HOLE NO./ km / CHAINAGE	TP30
ROAD NO.	Not Specified
DATE RECEIVED	2020-07-09
DATE SAMPLED	2020-07-13
CLIENT MARKING	S28° 50' 18,5"; E21° 51" 46,1
COLOUR AND TYPE	Brown Gravel

POINT NO.	1	2	3	4	5			
DRY DENSITY (kg/m <sup>3</sup> )	2099	2130	2153	2139	2111			
MOISTURE (%)	5,4	6,3	7,4	8,4	9,3			

MAXIMUM DRY DENSITY (kg/m<sup>3</sup>) : 2153

OPTIMUM MOISTURE CONTENT (%) : 7,5



Deviation from Test Method :  
 Remarks and Notes :

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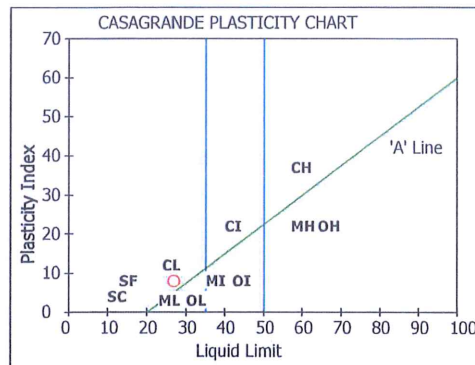
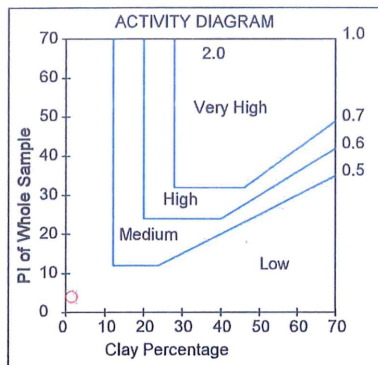
Job Request No.: RU3525  
 Ceder Land Geotechnical Consult (Pty) Ltd  
 PO Box 607  
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 6835  
 Attention : Frans Breytenbach

Date Reported : 2020-08-12

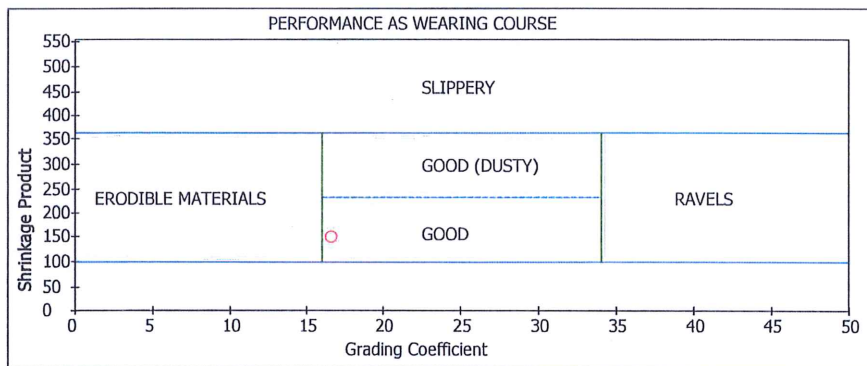
Project : Wegdraai Infrastructure Upgrade

Foundation Indicator Test Report SANS 3001 - GR1 / GR3 / GR10

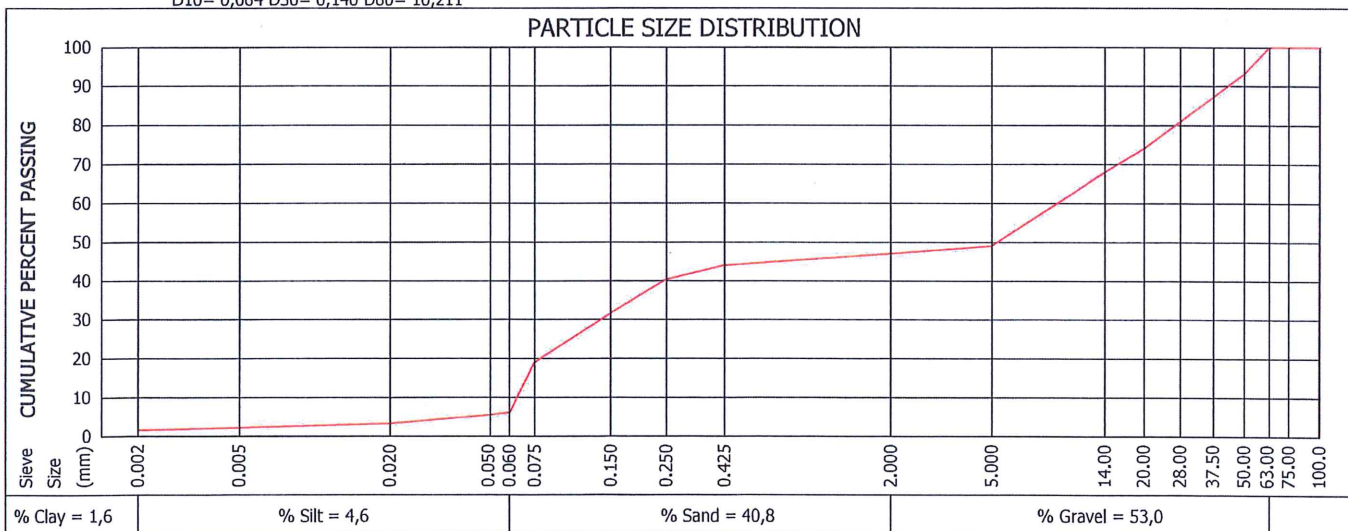
Sample No.	: U9276
Position	: TP 31
Layer Type	: 0-300mm
Sample Colour	: Light Reddish Brown
Sample Type	: Calcrete & Kalahari



Sieve Size (mm)	% Passing	Soil Mortar	2.000 - 0.425	6
100.0	100		0.425 - 0.250	9
75.00	100		0.250 - 0.150	19
63.00	100		0.150 - 0.075	27
50.00	93		< 0.075	40
37.50	87	Effective Size		0,064
28.00	81	Uniformity Coefficient		159,5
20.00	74	Curvature Coefficient		0,0
14.00	68	Oversize Index		6,0
5.000	49	Shrinkage Product		154,0
2.000	47	Grading Coefficient		16,7
0.425	44	Grading Modulus		1,90
0.250	40	Atterberg Limits	Liquid Limit	27
0.150	32		Plasticity Index	8
0.075	19		Linear Shrinkage	3.5
0.060	6,2		PI < 0.075	
0.050	5,5	Unified Soil Classification		GC
0.020	3,3	US Highway Classification		A-2-4(0)
0.005	2,2			
0.002	1,6			



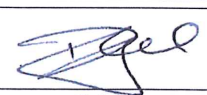
D10= 0,064 D30= 0,140 D60= 10,211



Deviation from Test Method :  
 Remarks and Notes : Chemistry: pH = 7.81 [SANS 5854] & Conductivity = 0.07 S/m [SANS 6240]

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