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Report on a Phase 1 Geotechnical Site Investigation on Portion 124 of the farm Diepsloot 388-JR, Johannesburg, Gauteng Province.

Prepared for: CENTURY PROPERTY DEVELOPMENTS

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REPORT ON A PHASE 1 GEOTECHNICAL SITE INVESTIGATION ON PORTION 124 OF THE FARM DIEPSLOOT 388-JR, JOHANNESBURG, GAUTENG PROVINCE.

1. INTRODUCTION

A Phase 1 Geotechnical Site Investigation was undertaken at the request of Johann Jordaan of Century Property Development for township establishment on Portion 124 of the farm Diepsloot 388-JR, Johannesburg, Gauteng Province.

The investigation was undertaken according to the Guidelines for Urban Engineering Geological Investigations (SAIEG & SAICE, 1997) for urban development on sites smaller than 10 hectares.

The objectives of the investigation were to:
1. To determine the geology and the relevant mechanical properties of the soil and rock horizons present on site.
2. To zone the site according to development suitability and to provide the NHBRC classification for each zone.
3. To give general foundation recommendations.
4. To comment on the excavation characteristics and possible uses of the materials underlying the site for installation of services as well as for use in layer works in paving and roads.
5. To comment on site water management aspects particularly pertaining to shallow groundwater or seepage.

2. AVAILABLE INFORMATION

At the time of the investigation the 1: 250 000 Geological Sheet 2528 Pretoria, 1:50 000 Geological Sheet 2528CC Lyttelton, 1:50 000 topocadastral map 2528CC Centurion, site locality and a satellite image were available.

Investigation results from previous investigations in the vicinity were also perused.

The guideline and specification documents by the South African Institute of Engineering and Environmental Geologists and South African Institution for Civil Engineers (1997), the National Department of Housing (2002), Draft SANS 634-2007 and the National Home Builders Registration Council (1999) were used in the execution of the investigation.

3. SITE DESCRIPTION

The investigated holding is located on the R511, William Nicol Drive between Zeven Street and Rose Road in Diepsloot Agricultural Holdings (Figure 1, Appendix A).

The holding is presently used as a golf driving range with local changes to topography

where the driving tees and sand bunkers were constructed. A clubhouse and restaurant occupies the western area with living quarters in the south-western corner.
The largest part of the holding is covered with cut grass and lawns.

The site slopes east and west, towards the central depression formed by a small drainage channel flowing north into the Diepsloot Spruit.
A small earth wall on the southern boundary with Holding 185, road crossings and another earth wall further to the north obstruct the drainage channel.

Evidence of surface seepage from the lower slopes on both sides of the drainage feature is evident.
The shallow stream area and driving tees are prone to marshy conditions.

The site elevation is between 1 400 and 1 380 m above mean sea level with the general gradient between 2° and 6°.

No rock outcrops or core stones were observed during the site walkover.

The surrounding area is serviced by tarred and dirt roads with limited municipal services and a sewerage servitude occurs in the eastern part of the site.

The climatic N-value (Weinert, 1980) of the region is less than 5, which implies that chemical weathering is dominant.

4. METHOD OF INVESTIGATION

The fieldwork, entailing a site walkover, trial pitting and profile descriptions, was conducted on 17 March 2011. Five trial pits were excavated using a CAT 416 TLB provided by the client.

The test pits were excavated in accessible positions and are deemed representative of the sub-surface conditions prevailing on this holding. The number of test pits (nine) and laboratory tests are not in accordance with the draft SANS 634 guideline due to the availability of detailed data points from the two adjacent properties.

The test pit positions from this investigation as well as those available from adjacent investigations on Holding 185 to the south and the Remainder of Portion 11 of the farm Diepsloot to the north, are also indicated on the site plan (Figure 2, Appendix A).
Parts of the site were not accessible to the TLB due to wet surface conditions.

A registered Engineering Geologist inspected the test pits and recorded the soil profiles using the standard procedures as recommended by AEG/SAIEG/SAICE (2002). The soil profiles are included in Appendix B and photographs of each test pit are attached in Appendix C.

Five disturbed soil samples were retrieved from selected layers and submitted to Soillab (Pty) Ltd. of Pretoria for testing. Foundation indicator tests were performed on these samples to determine the particle size distribution and plasticity of the soil. The material was tested for foundation purposes and therefore the grading was carried out to 0,002 mm.
The pH and electrical conductivity was also determined to assess the corrosivity of the soils and one sample was tested for the compaction characteristics of the soils.
Four test results from the holding to the north are also included in the site assessment.

The laboratory test results are included in Appendix D.

5. GEOLOGY

5.1 GENERAL
According to the 1:50 000 geological sheet 2528CC Lyttelton and 1:250 000 sheet 2528 Pretoria, the site is underlain by granite-gneiss and granite of the Johannesburg Granite Dome and consists of poorly exposed biotite tonalite, trondjhemite, granodiorite and migmatite varieties.

This site is not underlain by dolomitic bedrock and a surface stability investigation is therefore not required.

According to the geological maps and accompanied explanation no specific mineral deposits are present on the site.

A linear structure, inferred from a surface magnetic survey, is indicated to the north of the site where the Diepsloot Spruit occurs and may be due to an intrusive dyke or shearing. No evidence of any intrusive material was seen during the site investigation.

5.2 SOIL PROFILE
A brief description of the various soil horizons encountered during this investigation and soil profiles described directly adjacent to the site on the northern as well as southern holdings, are given below with a summary in Table 1.

Due to site modifications in the area and specifically on Holding 124 as well as adjacent holdings the natural profiles are somewhat disturbed in the upper parts. The levelling of the driving tees is just one such example.
One test pit, TP4, was excavated in the servitude of the sewerage line and is not representative of the natural profiles.

The profiles on the higher lying southern Holding 185 are also modified with the assumed removal of much of the topsoil for construction material purposes.

Table 1: Test pit summary: Encountered depths of different materials (m)

Test Pit	Topsoil	Pebble Marker	Ferruginized residuum	Residual granite	Test pit depth
Test Pits from present investigation					
TP01	0 - 0.60	0.60 - 0.72	0.72 - 1.30	0.65 - 0.95	0.95*
TP02	0 - 0.30		0.30 - 0.97	0.97 - 1.76	1.76
TP03	0 - 0.45	0.45 - 0.80		0.80 - 1.50	1.50
TP04	0 - 0.11			0.11 - 1.40	1.40
TP05	0 - 0.10	0.10 - 0.32	0.32 - 1.65		1.65
Test Pits from Portion Re/11					
TP2	0 - 0.16	0.16 - 0.40	0.40 - 0.93	0.93 - 1.76	1.76*
TP4	0 - 0.23	0.23 - 0.40		0.40 - 0.85	0.85
TP6	0 - 0.16	0.16 - 0.60	0.60 - 1.00	1.00 - 1.70	1.70*
TP7	0 - 0.14	0.14 - 0.40	0.40 - 1.30	1.30 - 1.60	1.60*
Test Pits from Portion 185					
TP7	0 - 0.15			0.15 - 0.50	0.50**
TP8	0 - 0.14			0.14 - 0.50	0.50**
TP9	0 - 0.13			0.13 - 0.30	0.30**

*Near refusal of TLB; **Refusal of TLB

The parts of the holding where little surface modification took place are covered by transported soils with an average thickness of 0,3 m.

The topsoil is *moist, dark brown, loose, intact clayey silty sand with coarse quartz gravel.*

The typical pebble marker, regarded as the boundary between the transported upper end deeper residual materials, is only present in test pits TP1, TP3 and TP5. This is probably due to some reworked of the natural soil profiles to obtain materials for fill.
The pebble marker is generally *moist, light brown to grey, clayey silty sand with coarse quartz gravel and Fe and Mn* nodules.

The residual granite profile, occurring from an average depth of 0,5 m, is *slightly to very moist, grey to greyish brown mottled orange and black, medium dense intact clayey sand with Fe and Mn nodules.*

The profiles in the eastern parts (also those occurring to the north) show strong ferruginization in the upper horizons with abundant ferricrete concretions and less weathered and jointed granite from 1,3 m and deeper.
The profiles on the higher lying Holding 185 has thin topsoil with leached granite from 0,14 m and the machine refused around 0,5 m below surface.

5.3 GROUNDWATER
Groundwater seepage was only encountered in one of the test pits, namely TP3 on the southern boundary. This test pit is on the highest elevated part of the site in the west produced some water seepage as did test pit TP3 in the shallow drainage channel.

Similar seepage conditions occurred on the lower lying Holding Re/11 to the south. Average seepage depth was 0,6 m indicating semi-impervious conditions on the residual granite horizons.
Seepage also occurred into the test pits on the western part of the holding to the south from between 0,6 m and 0,8 m below surface.
The zone within and adjacent to the drainage channel was also wet at the time of the fieldwork.

The consistent ferruginization and/or mottling in the transported and residual profiles are also good indicators of seasonal saturation of the profile with possible seasonal perching of percolating groundwater.

Perched water tables may therefore be expected during the wet months and the perched water table may fluctuate depending on the season and amount of precipitation experienced.
Surface seepage can also be expected in surface cuts/excavations, the gulley head area and where drainage fields of septic tanks occur.

Surface runoff and groundwater flow will be towards the low-lying gulley area and eventually emerge as surface seepage or percolating groundwater in the floodplain of the Diepsloot Spruit to the north.

The regional groundwater in this area occurs in inter-granular and fractured aquifers with an average depth to the regional groundwater table of between 10 and 20 m. Groundwater depth could be significantly shallower within the stream area.

6. GEOTECHNICAL EVALUATION

The geotechnical appraisal is based on the field observations, local knowledge of the area, interpretations on site and available laboratory test results obtained during this

and investigations on the two adjacent holdings. Information from previous investigations in the vicinity have also been used.

6.1 ENGINEERING AND MATERIAL CHARACTERISTICS

The foundation indicator test results conducted on the bulk samples retrieved from the various test pits are summarised in Table 2. Results from Holding Re/11 to the north are also included. These test results only reflects the properties of the in situ soils excluding the materials in the fills and backfilled trenches.

Table 2: Indicator test results

Test pit	Depth (m)	Description	Soil composition				Atterberg Limits		LS %	GM	Activity	AASHTO / Unified classification
			Clay %	Silt %	Sand %	Gravel %	LL %	PI %				
Results from present investigation												
TP1	0.2-0.6	Colluvium	8	20	**66**	6	20	6	3.0	1.12	Low	A-2/SM&SC
TP2	0.5-0.6	Residuum	30	17	**52**	1	39	14	6.5	1.03	Low	A-6/CL
TP2	1.0-1.5	Residuum	36	16	**48**	0	45	14	6.5	0.74	Low	A-7/ML
TP3	1.0-1.5	Residuum	17	14	**67**	3	38	12	6.0	1.13	Low	A-2/SM
TP5	0.75-1.0	Fer residuum	4	21	**62**	12	17	4	2.0	1.31	Low	A-2/SM&SC
Results from Portion RE/11												
TP2	0-0.16	Colluvium	0	12	**59**	29	-	NP	0.0	1.67	Low	A-1/SM
TP2	0.93-1.5	Residuum	4	13	**50**	33	25	11	4.5	1.78	Low	A-2/SC
TP6	0-0.6	Colluvium	0	7	35	**58**	-	NP	0.0	2.22	Low	A1/GW&GM
TP6	0.7-1.0	Fer residuum	2	16	**45**	37	15	3	1.5	1.76	Low	A-1/SM

LL - Liquid limit; PI - Plasticity index; LS - Linear shrinkage; GM - grading modulus; SP - slightly plastic; NP - non plastic

The test results on the soil samples indicate the following:

- The **topsoil, pebble marker and ferruginized residual granite** grade as clayey silty sand with relatively high gravel content, especially where Fe and Mn nodules and quartz gravel are concentrated.
- These materials are slightly or non-plastic with low linear shrinkage and low to medium grading modulus values.
- The potential expansiveness, based on the whole sample PI and percentage clay, is also low.
- According to the Unified Soil Classification and the PRA classification the soils, falling in the "SM & SC" groups may be fair to good subgrade material, poor subbase and not suitable for base course in roads. The soils may have slight to medium compressibility/expansiveness, but low when compacted. Drainage will be poor to practically impervious when compacted and the material will be reasonably stable for the use in embankments. The soils have fair shear strength when compacted and saturated with CBR values of between 5 and 20 at OMC of 10 - 11 %.
- The **residual granite** contains varying clay percentages with relatively high clay content below 1,0 m in TP2 and TP3. The material grades as silty clayey sand with little gravel.
- Linear shrinkage is moderate to high, slightly plastic, but with low potential expansiveness.
- According to the Unified Soil Classification and the PRA classification the soils, falling in the "CL & ML" groups, may be fair to good subgrade material and not suitable for subbase or base course in roads. The soils may have slight to medium compressibility/expansiveness, but low when compacted. Drainage will be practically impervious when compacted and the material will not be stable in embankments.

The soils have fair shear strength when compacted and saturated with CBR values of less than 15 at OMC of 24 - 12 %.

The results are in accordance with those from adjacent sites.

The site soils are extremely corrosive due to high electrical conductivity.

The Californian Bearing Ratio (CBR) test results on a bulk sample from the transported horizons on Holding Re/11 (TP07) are summarised in Table 3.

Table 3. Compaction test results

Depth (m)	Material type	OMC (%)	MDD (kg/m³)	Swell (%)	CBR At various densities				TRH 14
					90%	93%	95%	97%	
TP7 0-1.3 Holding Re/11	Transported & residuum	6.2	2 100	0.0	23	35	46	62	G5

OMC = Optimum moisture content
MDD = Maximum dry density (Mod AASHTO)
Swell = soaked at 100% Mod AASHTO compaction

- The maximum dry density is 2 100 kg/m³ at optimum moisture content of 6,2 %.
- The ferruginized, gravelly transported soils classify as G5 road construction material and will only be suitable for use up to subbase when not stabilized.
- Although it was not determined the material will improved with cement stabilization and may be suitable for base course.
- It has good compaction characteristics and will be suitable for use as platform material for structures.

6.2 SLOPE STABILITY AND EROSION

The slope gradients are typically between 2° and 6° to the east and west with a slight gradient towards the north.
Natural slope instabilities are not expected on this site.

Due to the site gradient cut to fill site preparation are expected and care must be taken to prevent differential settlements from occurring across the cut and fill parts of platforms. There is presently a number of fill platforms on site.

It will be essential to implement good and effective surface and groundwater management practice to prevent wet soil profile conditions, perched groundwater tables and surface seepage. This will especially important closer to the drainage channel. Concentrated runoff will also cause erosion, especially after the vegetation has been cleared.

6.3 EXCAVATION CLASSIFICATION WITH RESPECT TO SERVICES

No rock outcrop or corestones were seen during the walkover survey and the test pits were terminated deeper than 1,5 m below surface.

The material on site may therefore be classified as soft in the upper 1,5 m below surface (SANS 1200D, 1988) based on the trial pit excavations.
Refusal occurred on adjacent holdings in hardpan ferricrete horizons that may also occur sporadically on this site.

Due to the ferruginization the site soils they may be unsuitable for use as bedding and/or backfill in pipelines.

6.4 IMPACT OF THE GEOTECHNICAL CHARACTER OF THE SITE ON HOUSING DEVELOPMENTS

The impact of the geotechnical constraints on housing development may be evaluated according to Table 4, which is a summary of the general geotechnical constraints relevant to urban development (Partridge, Wood and Brink, 1993). The Class column indicates the severity of the specific constraints for this site.

Table 4. Geological classification for urban development

	CONSTRAINT	SITE CONDITION	CLASS
A	Collapsible soil	Any collapsible horizon or consecutive horizons with a depth of less than 750 mm in thickness.	1
B	Seepage	Permanent or perched water table less than 1,5 m below ground surface Swamps & marshes in drainage channel	2 3
C	Active soil	Low soil heave potential expected.	1
D	Highly compressible soil	Moderate soil compressibility expected.	2
E	Erodability of soil	Intermediate	2
F	Difficulty of excavation to 1,5m depth	Scattered or occasional boulders less than 10% of the total volume.	1
G	Undermined ground	No known undermined areas	1
H	Instability in areas of soluble rock	Soluble rocks not present	1
I	Steep slopes	Slopes between 2 and 6 degrees.	1
J	Areas of unstable natural slopes	Low risk.	1
K	Areas subject to seismic activity	This area is not a known natural seismic active zone. Induced seismicity may occur.	1
L	Areas subject to flooding	Areas within known drainage channel or floodplain	3

Class: 1 - Most favourable, 2 - Intermediate, 3 - Least favourable

The main expected geotechnical constraints for this site are:

- Thin collapsible/compressible soil horizons.
- Seasonal shallow perched groundwater tables and/or surface seepage.
- Intermediate erodability of surficial soil horizons.
- Flooding in the gulley running through the eastern part of the investigated site.

7. SITE CLASSIFICATION AND FOUNDATION RECOMMENDATIONS

The site has been classified into two Site Class Designation zones (Figure 2), based on the above constraints and the criteria as set out in the NHBRC (1999) guideline document of which the appropriate tables have been included in Appendix A. The classification and foundation recommendations are based on results from this and other nearby investigations.

ZONE I: Site Class Designation S-C1/2BDE

This zone covers most of the holding, but excludes the gulley area.
Slight soil collapse and compressibility is expected due to localised open soil structure in surficial soil horizons.
Shallow (<1.0 m) perched groundwater tables are present and seasonally wet surface conditions may also occur in cuts and on lower lying areas.
Surficial soils are expected to be erodible.

One of the following foundation options is recommended depending on the type of structure to be erected on site and the foundation depth as outlined within this report

(SAICE, 1995):

Modified normal.
Compaction of in situ soils below individual footings
Deep strip foundations
Soil raft.

ZONE II: Site Class Designation P(flooding; marshy area)/3BL
This zone covers the area in the existing drainage channel. The scope of this report did not include the determination of flood lines and should be determined by a competent civil engineer.
No residential development should be allowed in this zone without appropriate storm water management measures.

The above foundation recommendations are according to the Joint Structural Division (SAICE, 1995) code of practice for single storey masonry structures founded below the loose upper horizons (Tables 5 to 8, Appendix A).

It is recommended that the structural engineers calculate the best economical foundation option for the proposed development based on the type of structure and the different available construction methods.

The boundary between Zones I and II, as depicted on Figure 2 (Appendix A), is based on the visual topographic changes and must be finalized by a suitably qualified professional.

8. SPECIAL PRECAUTIONARY MEASURES

The upper loose colluvium has a low bearing capacity and may be compressible. The ferruginized residual granite profile exhibits localized, slightly open structure and slight collapse potential may occur. The recommended foundation precautionary measures needs to be implemented to limit damage due to additional settlements under load and saturation of the profile.

Good site drainage will be necessary as a seasonal perched water table will occur and wet surface conditions will prevail in cut faces and levelled areas.
This may cause problems with dampness in surface structures and with installation of services. The saturation of the soil profile will also need special site drainage methods as this may lead to additional settlements under load.

Areas of termite and other biotic activity are present and additional foundation modifications to prevent damage to single-storey structures due to differential settlements may be necessary across these features. The biotic activity is generally limited to the upper soil horizons. Thick (> 0,5 m) organic soils occur within the drainage channel area.

The test pits were positioned to cover the accessible parts in order to zone the site. The pits were backfilled by the TLB without proper compaction in layers. If structures are to be positioned over or across these pits proper compaction must be executed to prevent differential settlements from taking place. The same will apply to development across previous excavations, root areas of removed trees, septic tanks, waste pits and uncontrolled fill areas where levelling took place.

It is assumed that the development will be serviced by the usual municipal services and no recommendations are made on on-site sanitation, waste disposal, and storm water reticulation services.

The soils are extremely corrosive and it will be good practice to use plastic pipes rather than steel pipes for services.

9. CONCLUSIONS

Appropriate foundation design and building procedures should be implemented as listed in this report and the NHBRC Home Builders Manual.

The major geological factors that may influence residential development are the following:

- Slightly collapsible/compressible soil horizons.
- Seasonal shallow perched groundwater tables and surface wet conditions.
- Flooding and surface seepage in the gulley area.

The colluvium and residuum may exhibit settlements due to slightly collapsible upper soils, especially when loading and saturated. Special drainage measures will be necessary to prevent surface wet conditions, flooding in the gulley and damage due to rising damp.

The site soils may not be suitable as fill and bedding for pipelines due to the coarse fraction and will be suitable for subgrade and lower road layers and in embankments.

10. REPORT PROVISIONS

While every effort is made during the fieldwork phase to identify the different soil horizons, areas subject to a perched water table, areas of poor drainage, areas underlain by hard rock and to estimate their distribution, it is impossible to guarantee that isolated zones of poorer foundation materials, or harder rock have not been missed.

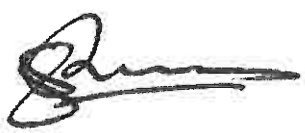
For this reason this investigation has sought to highlight areas of potential foundation, groundwater and excavation problems, to provide prior warning to the developer.

A competent person should inspect foundation excavations for future structures at the time of construction or the open service trenches, to determine the variance from the above assessment of the site.

It is recommended that a Phase II Geotechnical Site Investigation be conducted to determine any variation in the material properties and zoning described in this report. NHBRC enrolment of the site can only be completed once this Phase II Geotechnical Site Investigation has been executed.

The determination of flood lines and delineation of wetland areas were not part of this investigation and should be addressed by suitably competent professionals prior to the final site development plan is compiled.

The present site zoning is based on the NHBRC Manual with the guideline site class designation specifically for single-storey masonry residential units.



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11. REFERENCES

Brink, A B A, 1979. Engineering Geology of Southern Africa. Volume 1. Building Publications. Silverton.

Guidelines for soil and rock logging in South Africa. 2nd Impression 2002, eds. A.B.A, Brink and R.M.H. Bruin, Proceedings, Geoterminology Workshop organized by AEG, SAICE and SAIEG. 1990.

Jennings, J.E.B., Brink, A.B.A., Williams, A.A.B., 1973. Revised guide to Soil Profiling for Civil Engineering Purposes in Southern Africa. The Civil Engineer in SA. p3-12. January 1973.

Jennings, JE., & Knight, KA., 1975. A guide to construction on or with materials exhibiting additional settlement due to 'collapse' of grain structure. Proc. 6th Regional Conf. for Africa on SM & FE., Durban. Vol. 1, pp 99-105.

Partridge, T.C., Wood, C.K., Brink, A.B.A., 1993. Priorities for urban expansion within the PWV metropolitan region: The primacy of geotechnical constraints. South African Geographical Journal, Vol 75, pp9-13.

Stiff, et al, 1997. Guidelines for Urban Engineering Geological Investigations. South African Institute for Engineering and Environmental Geologists and the South African Institution of Civil Engineers.

SAICE. 1995. Code of Practice: Foundations and superstructures for single storey residential buildings of masonry construction. Joint Structural Division, Johannesburg. First edition.

Weinert, H.H., 1980. The natural road construction materials of southern Africa. Academica. Cape Town.

APPENDIX A: FIGURES AND REFERENCE TABLES

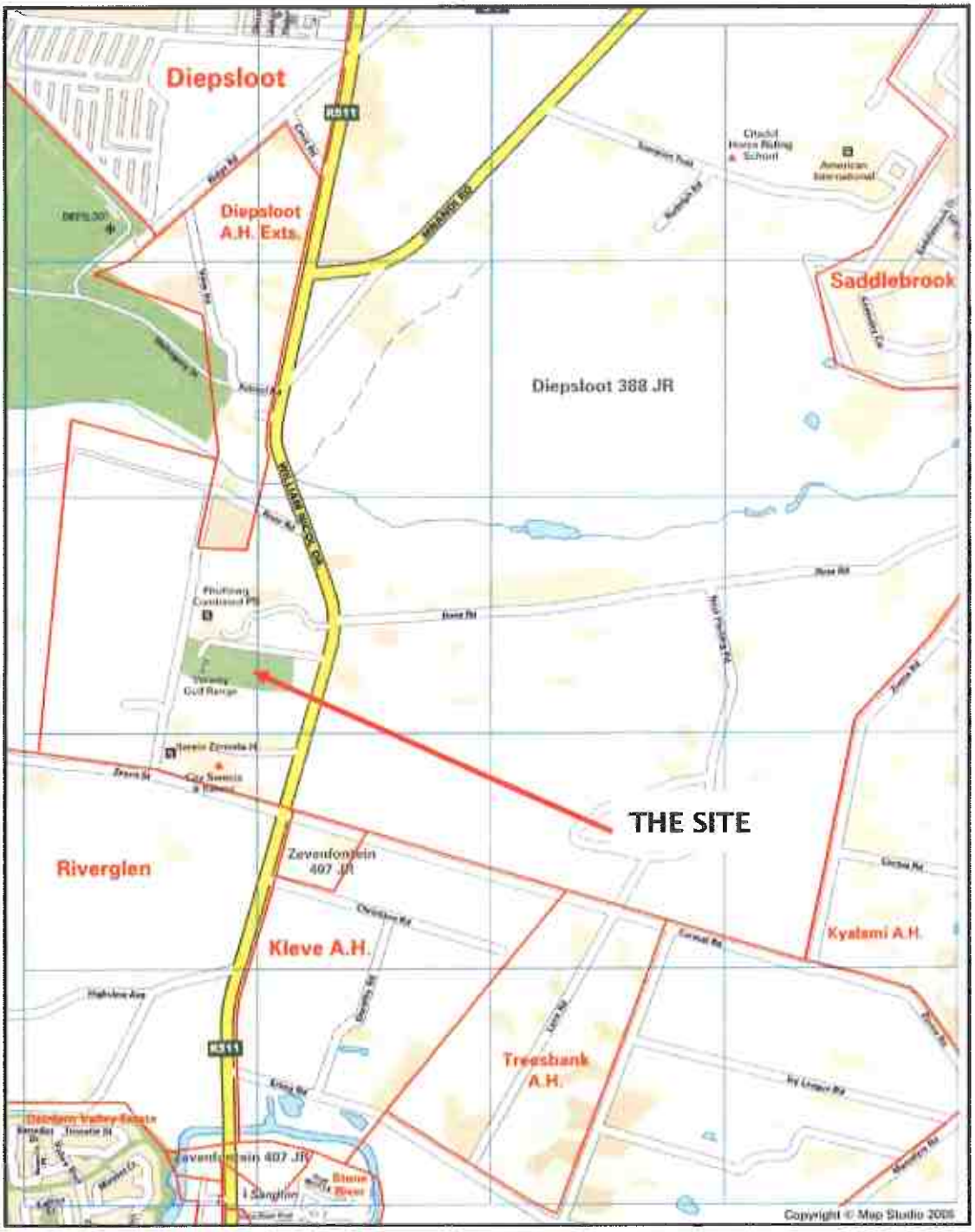


Figure 1: Locality Plan Portion 124; Diepsloot 388-JR, Midrand.

Figure 2: Test Pit positions & Geotechnical Zoning Ptn 124 Diepsloot 388-JR Midrand

Table 5. RESIDENTIAL SITE CLASS DESIGNATIONS (SAICE, 1995)

TYPICAL FOUNDATION MATERIAL	CHARACTER OF FOUNDING MATERIAL	EXPECTED RANGE OF TOTAL SOIL MOVEMENTS (mm)	ASSUMED DIFFERENTIA MOVEMENT (% OF TOTAI
Rock (excluding mud rocks which exhibit swelling to some depth)	STABLE	NEGLIGIBLE	-
Fine-grained soils with moderate to very high plasticity (clays, silty clays, clayey silts and sandy clays)	EXPANSIVE SOILS	< 7,5 7,5 – 15 15 – 30 > 30	50% 50% 50% 50%
Silty sands, sands, sandy and gravelly soils	COMPRESSIBLE AND POTENTIALLY COLLAPSIBLE SOILS	< 5,0 5,0 – 10 > 10	75% 75% 75%
Fine-grained soils (clayey silts and clayey sands of low plasticity), sands, sandy and gravelly soils	COMPRESSIBLE SOIL	< 10 10 – 20 > 20	50% 50% 50%
Contaminated soils Controlled fill Dolomitic areas Land fill Marshy areas Mine waste fill Mining subsidence Reclaimed areas Very soft silt/silty clays Uncontrolled fill	VARIABLE	VARIABLE	

NOTES:

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

Table 6. **FOUNDATION DESIGN, BUILDING PROCEDURES AND PRECAUTIONARY MEASURES FOR SINGLE-STOREY RESIDENTIAL BUILDINGS FOUNDED ON HORIZONS SUBJECT TO BOTH CONSOLIDATION AND COLLAPSE SETTLEMENT**
(SAICE, 1995)

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

NOTES:

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

Table 7. FOUNDATION DESIGN, BUILDING PROCEDURES AND PRECAUTIONARY MEASURES FOR SINGLE-STOREY RESIDENTIAL BUILDINGS FOUNDED ON HORIZONS SUBJECT TO CONSOLIDATION SETTLEMENT (SAICE, 1995)

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

NOTES:

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

Table 8. **FOUNDATION DESIGN, BUILDING PROCEDURES AND PRECAUTIONARY MEASURES FOR SINGLE-STOREY RESIDENTIAL BUILDINGS FOUNDED ON EXPANSIVE SOIL** (SAICE, 1995)

SITE CLASS	ESTIMATED TOTAL SETTLEMENT (mm)	CONSTRUCTION TYPE	FOUNDATION DESIGN AND BUILDING PROCEDURES
H	<7,5	Normal	- Normal construction (strip footing or slab-on-the-ground foundations) - Site drainage and service/plumbing precautions recommended
H1	7,5 – 15	Modified normal	- Reinforced strip footings - Articulation joints at all internal/external doors and openings - Light reinforcement in masonry - Site drainage and service/plumbing precautions
		Soil raft	- Remove all or part of expansive horizon to 1,0 m beyond the perimeter of the structure and replace with inert backfill, compacted to 93% MOD AASHTO density at –1% to +2% of optimum moisture content. - Normal construction with lightly reinforced strip footings and light reinforcement in masonry if residual movements are 7,5mm, or construction type appropriate to residual movements. - Site drainage and service/plumbing precautions.
H2	15 – 30	Stiffened or cellular raft	- Stiffened or cellular raft with articulation joints or lightly reinforced masonry. - Site drainage and service/plumbing precautions.
		Piled construction	- Piled foundations with suspended floor slabs with or without ground beams. - Site drainage and service/plumbing precautions.
		Split construction	- Combination of reinforced brickwork/block work and full movement joints. - Suspended floors of fabric-reinforced ground slabs acting independently from structure. - Site drainage and service/plumbing precautions.
		Soil raft	- As for H1.
H3	> 30	Stiffened or cellular raft	- As for H2
		Piled construction	- As for H2
		Soil raft	- As for H1

NOTES:

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

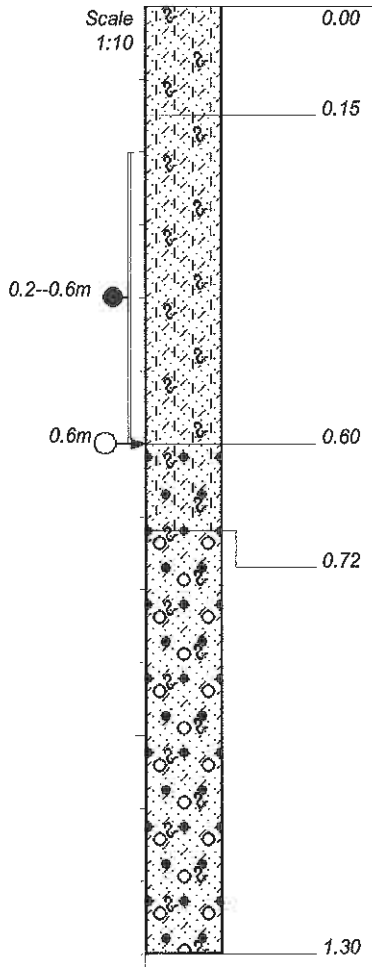
APPENDIX B: SOIL PROFILES

J LOUIS VAN ROOY
Pr.Sci.Nat. PhD(Pret) FSAIEG MGSSA
Engineering Geologist

Century Property
Ptn 124 Diepsloot 388-JR

HOLE No: TP01
Sheet 1 of 1

JOB NUMBER: 1107



Moist dark brown loose intact clayey silty fine SAND. Topsoil. Abundant roots.

Very moist light yellowish brown loose intact clayey silty fine SAND. Colluvium. Roots.

Wet light yellowish brown loose intact clayey silty fine SAND with abundant angular translucent coarse quartz gravel and Fe and Mn nodules. Pebble Marker. Roots.

Very moist light greyish brown mottled orange & black medium dense to dense intact gravelly clayey fine SAND with Fe & Mn concretions and coarse weathered granite gravel. Ferruginized reworked residual granite. Roots.

NOTES

1) Hole stopped.

2) Water seepage from 0.6m.

3) Disturbed sample at 0.2--0.6m.

4) Some sidewall collapse.

CONTRACTOR : Century Properties
MACHINE : CAT 416
DRILLED BY :
PROFILED BY : JL van Rooy
TYPE SET BY :
SETUP FILE : LOUIS.SET

INCLINATION :
DIAM :
DATE :
DATE : 17/03/2011
DATE : 30/04/11 17:41
TEXT : ..C:\DOT5000\1107DP.TXT

ELEVATION :
X-COORD : S25 57 49.83
Y-COORD : E28 00 51.19

HOLE No: TP01

D04E J.Louis van Rooy

dot.PLOT 5005 J&W

J LOUIS VAN ROOY
Pr.Sci.Nat. PhD(Pret) FSAIEG MGSSA
Engineering Geologist

Century Property
Ptn 124 Diepsloot 388-JR

HOLE No: TP02
Sheet 1 of 1

JOB NUMBER: 1107

0.00

Moist dark brown loose intact clayey silty fine SAND with scattered sub-rounded translucent coarse quartz gravel. Topsoil. Abundant roots.

0.30

Moist light grey mottled orange medium dense **slightly pinholed** clayey silty fine and medium SAND. Reworked residual granite. Roots.

0.97

Moist light grey with orange patches medium dense intact silty clayey fine SAND. Reworked residual granite.

1.76

NOTES

1) Hole stopped.

2) No seepage.

3) Disturbed samples at 0.5--0.6m and 1.0--1.5m.

4) No sidewall collapse.

CONTRACTOR : Century Properties
MACHINE : CAT 416
DRILLED BY :
PROFILED BY : JL van Rooy

TYPE SET BY :
SETUP FILE : LOUIS.SET

INCLINATION :
DIAM :
DATE :
DATE : 17/03/2011

DATE : 30/04/11 17:41
TEXT : ..C:\DOT5000\1107DP.TXT

ELEVATION :
X-COORD : S25 57 54.39
Y-COORD : E28 00 56.97

HOLE No: TP02

J LOUIS VAN ROOY
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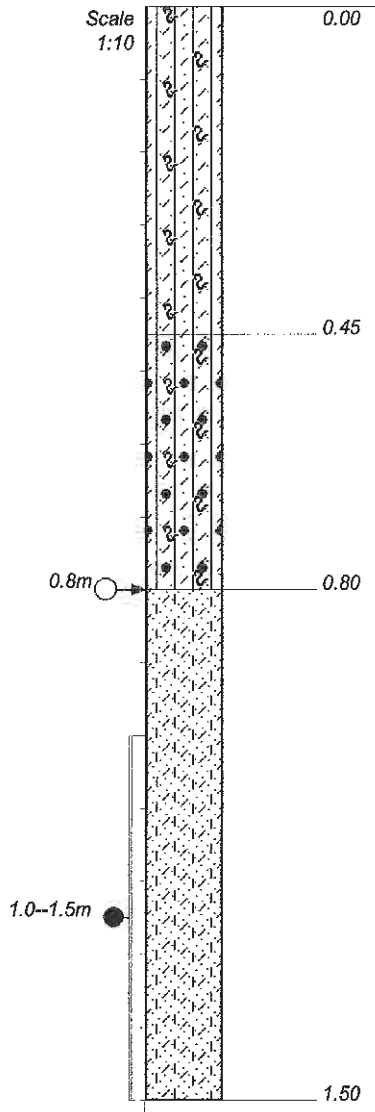
Engineering Geologist

Century Property
Ptn 124 Diepsloot 388-JR

HOLE No: TP03
Sheet 1 of 1

JOB NUMBER: 1107



0.00 – 0.45: Moist black firm intact fine sandy clayey SILT. Topsoil. Abundant roots.

0.45 – 0.80: Moist black firm intact fine sandy clayey SILT with abundant coarse quartz gravel and Fe and Mn nodules. Pebble Marker? Roots.

0.80 – 1.50: Very moist dark grey mottled black, grey & dark grey firm intact clayey silty fine to medium SAND. Residual granite.

NOTES

1) Hole stopped.

2) Water seepage from 0.8m (slight sewage smell).

3) Disturbed samples at 1.0--1.5m.

4) Significant sidewall collapse (profiled from surface).

CONTRACTOR : Century Properties
MACHINE : CAT 416
DRILLED BY :
PROFILED BY : JL van Rooy
TYPE SET BY :
SETUP FILE : LOUIS.SET

INCLINATION :
DIAM :
DATE :
DATE : 17/03/2011
DATE : 30/04/11 17:41
TEXT : ..C:\DOT5000\1107DP.TXT

ELEVATION :
X-COORD : S25 57 53.06
Y-COORD : E28 01 2.07

HOLE No: TP03

J LOUIS VAN ROOY
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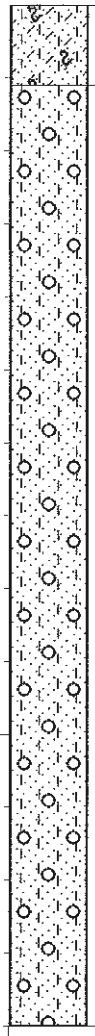
Engineering Geologist

Century Property
Ptn 124 Diepsloot 388-JR

HOLE No: TP04
Sheet 1 of 1

JOB NUMBER: 1107

Scale 1:10



0.00 Moist dark brown loose intact clayey silty fine SAND with scattered sub-rounded translucent coarse quartz gravel. Topsoil. Abundant roots.

0.11 Moist brown mottled orange and dark brown loose intact gravelly silty fine and coarse SAND with sub-rounded translucent coarse quartz gravel. Pipe backfill.

1.40

NOTES

1) Refusal on concrete manhole.

2) No seepage.

3) No sample.

4) Some sidewall collapse.

CONTRACTOR : Century Properties
MACHINE : CAT 416
DRILLED BY :
PROFILED BY : JL van Rooy
TYPE SET BY :
SETUP FILE : LOUIS.SET

INCLINATION :
DIAM :
DATE :
DATE : 17/03/2011
DATE : 30/04/11 17:41
TEXT : ..C:\DOT5000\1107DP.TXT

ELEVATION :
X-COORD : S25 57 50.42
Y-COORD : E28 01 4.27

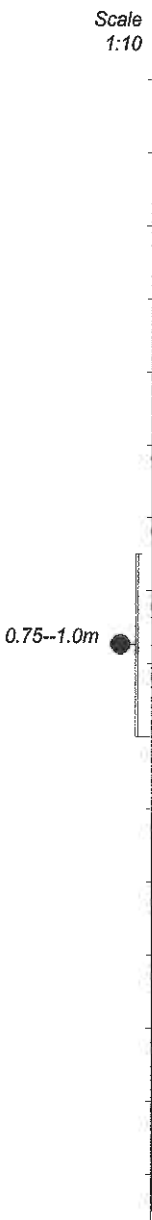
HOLE No: TP04

J LOUIS VAN ROOY
Pr.Sci.Nat. PhD(Pret) FSAIEG MGSSA
Engineering Geologist

Century Property
Ptn 124 Diepsloot 388-JR

HOLE No: TP05
Sheet 1 of 1

JOB NUMBER: 1107



0.00 – 0.10: Moist dark brown loose intact clayey silty fine SAND with scattered sub-rounded translucent coarse quartz gravel and Fe and Mn nodules & concretions. Topsoil. Abundant roots.

0.10 – 0.32: Moist grey mottled orange & black medium dense to dense intact clayey silty fine to coarse SAND with sub-rounded translucent coarse quartz gravel and abundant Fe and Mn nodules & concretions. Pebble Marker. Roots.

0.32 – 0.70: Moist greyish brown mottled orange & black medium dense intact clayey silty fine to coarse SAND with Fe & Mn concretions and nodules. Ferruginized residual granite. Roots.

0.70 – 1.65: Slightly moist to moist light grey mottled orange with black patches medium dense to dense intact clayey silty fine to coarse SAND with scattered Fe and Mn concretions. Ferruginized residual granite.

NOTES

1) Hole stopped.

2) No seepage.

3) Disturbed sample at 0.75--1.0m.

4) No sidewall collapse.

CONTRACTOR : Century Properties
MACHINE : CAT 416
DRILLED BY :
PROFILED BY : JL van Rooy
TYPE SET BY :
SETUP FILE : LOUIS.SET

INCLINATION :
DIAM :
DATE :
DATE : 17/03/2011
DATE : 30/04/11 17:41
TEXT : ..C:\DOT5000\1107DP.TXT

ELEVATION :
X-COORD : S25 57 51.68
Y-COORD : E28 01 6.9

HOLE No: TP05

APPENDIX C: SOIL PROFILE PHOTOGRAPHS

Soil profile TP01

Soil Profile TP02

Soil profile TP03

Soil profile TP04

Soil profile TP05

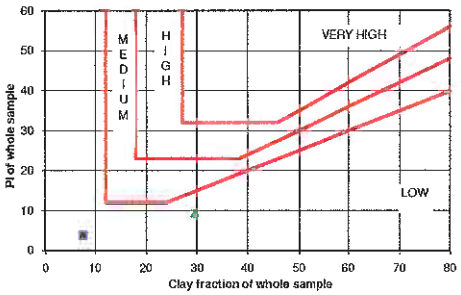
APPENDIX D: LABORATORY TEST RESULTS

PARTICLE SIZE ANALYSIS

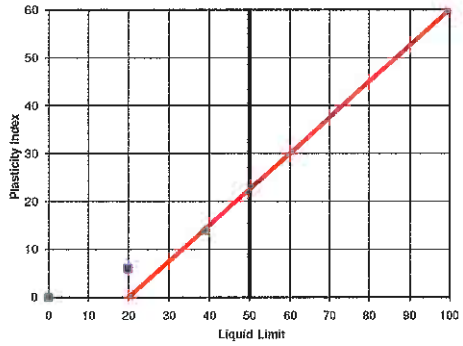
Sample No.		
Soillab sample no.	S11-0353-1	S11-0353-2
Depth (m)	0.2-0.6	0.5-0.6
Position	TP1	TP2
Material Description	LIGHT GREY QUARTZ SILTY SAND	LIGHT OLIVE CLAYEY SAND
Moisture (%)		
SG		
SCREEN ANALYSIS (% PASSING) (TMH 1 A1(a) & A5)		
63.0 mm	100	100
53.0 mm	100	100
37.5 mm	100	100
26.5 mm	100	100
19.0 mm	100	100
13.2 mm	99	100
4.75 mm	99	100
2.00 mm	94	99
0.425 mm	63	67
0.075 mm	31	51
HYDROMETER ANALYSIS (% PASSING) (TMH 1 A6)		
0.040 mm	24	42
0.027 mm	20	39
0.013 mm	14	36
0.005 mm	11	34
0.002 mm	8	30
% Clay	8	30
% Silt	20	17
% Sand	66	52
% Gravel	6	1
ATTERBERG LIMITS (TMH 1 A2 - A4)		
Liquid Limit	20	39
Plasticity Index	6	14
Linear Shrinkage (%)	3.0	6.5
Grading Modulus	1.12	1.03
Uniformity coefficient	99	-
Coefficient of curvature	3.7	-
Classification	A-2-4 (0)	A-6 (5)
Unified Classification	SM & SC	CL
Chart Reference		

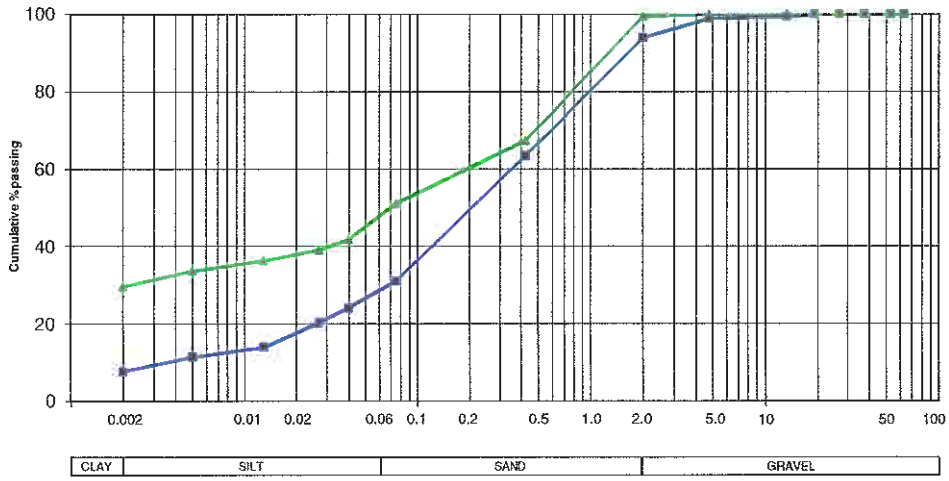
PROJECT : DIEPSLOOT
JOB No. : S11-0353
DATE : 2011-03-29

POTENTIAL EXPANSIVENESS



PLASTICITY CHART





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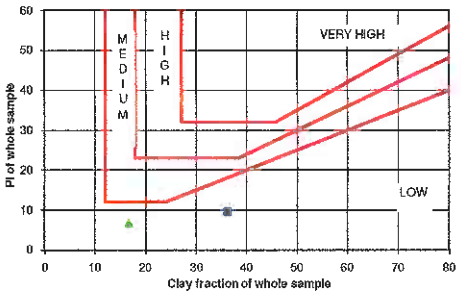
Reg No 1971/000112/07
230 Albertus Street
La Montagne 0184
Tel (012) 481-3999
P O Box 72928
Lynnwood Ridge 0040
Fax (012) 481-3812

PARTICLE SIZE ANALYSIS

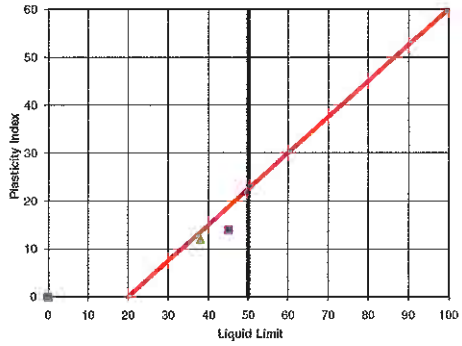
Sample No.		
Soillab sample no.	S11-0353-3	S11-0353-4
Depth (m)	1.0-1.5	1.0-1.5
Position	TP2	TP3
Material Description	LIGHT OLIVE CLAYEY SAND	DUSKY BLUE CALCRETE CLAYEY SAND
Moisture (%)		
SG		
SCREEN ANALYSIS (% PASSING) (TMH 1 A1(a) & A5)		
63.0 mm	100	100
53.0 mm	100	100
37.5 mm	100	100
26.5 mm	100	100
19.0 mm	100	100
13.2 mm	100	100
4.75 mm	100	100
2.00 mm	100	97
0.425 mm	70	56
0.075 mm	57	34
HYDROMETER ANALYSIS (% PASSING) (TMH 1 A6)		
0.040 mm	46	26
0.027 mm	43	23
0.013 mm	42	21
0.005 mm	40	19
0.002 mm	36	17
% Clay	36	17
% Silt	16	14
% Sand	48	67
% Gravel	0	3
ATTERBERG LIMITS (TMH 1 A2 - A4)		
Liquid Limit	45	38
Plasticity Index	14	12
Linear Shrinkage (%)	6.5	6.0
Grading Modulus	0.74	1.13
Uniformity coefficient	-	-
Coefficient of curvature	-	-
Classification	A-7-5 (7)	A-2-6 (0)
Unified Classification	ML	SM
Chart Reference		

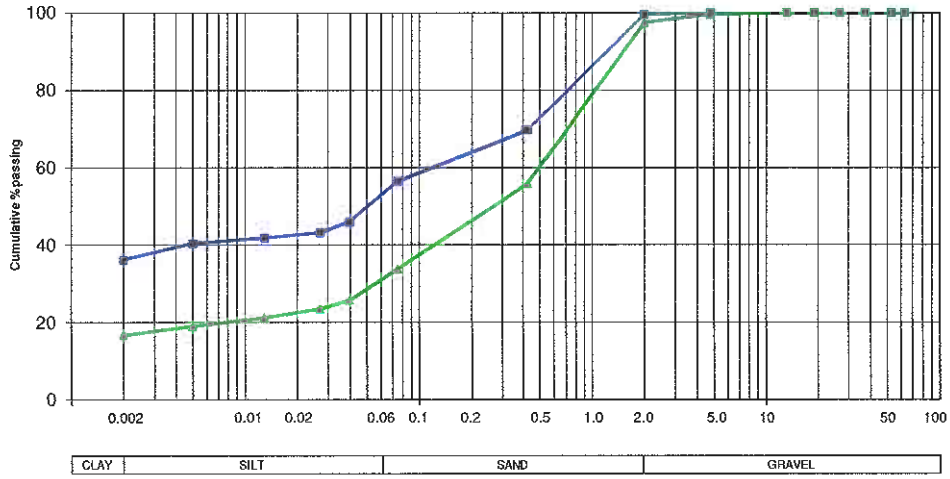
PROJECT : DIEPSLOOT
JOB No. : S11-0353
DATE : 2011-03-29

POTENTIAL EXPANSIVENESS



PLASTICITY CHART





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Lynnwood Ridge 0040
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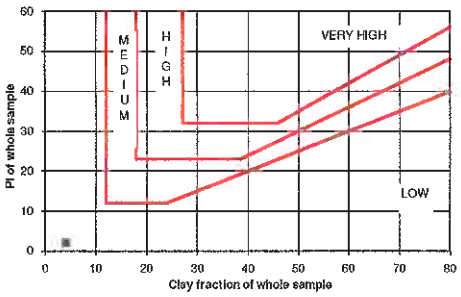
PARTICLE SIZE ANALYSIS

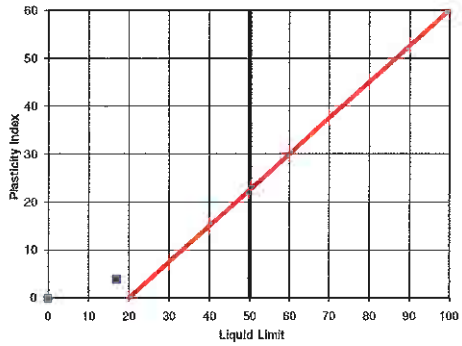
Sample No.		
Soillab sample no.	S11-0353-5	
Depth (m)	0.75-1.0	
Position	TP5	
Material Description	DARK RED ORANGE WEATHERED GRANITE SILTY SAND	
Moisture (%)		
SG		
SCREEN ANALYSIS (% PASSING) (TMH 1 A1(a) & A5)		
63.0 mm	100	
53.0 mm	100	
37.5 mm	100	
26.5 mm	100	
19.0 mm	100	
13.2 mm	100	
4.75 mm	97	
2.00 mm	88	
0.425 mm	53	
0.075 mm	28	
HYDROMETER ANALYSIS (% PASSING) (TMH 1 A6)		
0.040 mm	21	
0.027 mm	16	
0.013 mm	12	
0.005 mm	9	
0.002 mm	4	
% Clay	4	
% Silt	21	
% Sand	62	
% Gravel	12	
ATTERBERG LIMITS (TMH 1 A2 - A4)		
Liquid Limit	17	
Plasticity Index	4	
Linear Shrinkage (%)	2.0	
Grading Modulus	1.31	
Uniformity coefficient	74	
Coefficient of curvature	1.6	
Classification	A-2-4 (0)	
Unified Classification	SM & SC	
Chart Reference		

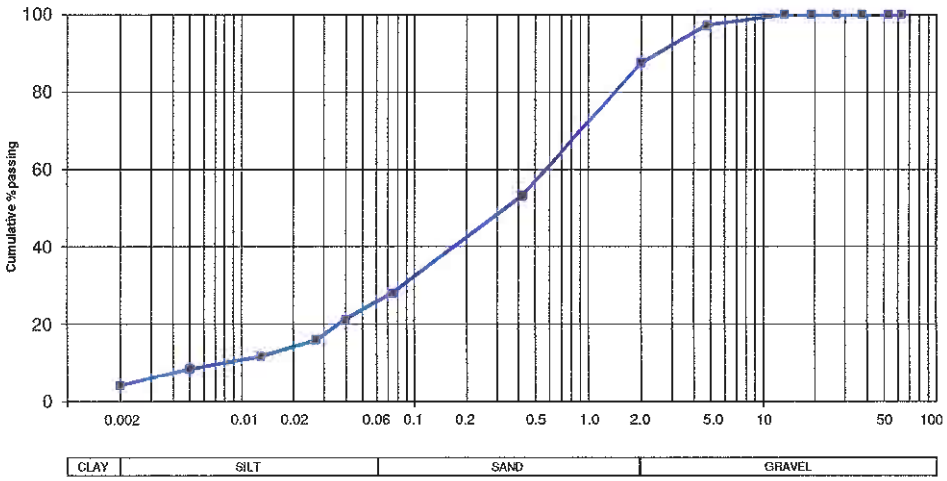
PROJECT : DIEPSLOOT
JOB No. : S11-0353
DATE : 2011-03-29

POTENTIAL EXPANSIVENESS



PLASTICITY CHART





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230 Albertus Street
La Montagne 0184
Tel (012) 481-3999
P O Box 72928
Lynnwood Ridge 0040
Fax (012) 481-3812

CLIENT : LOUIS VAN ROOY

PROJECT : DIEPSLOOT

PROJECT NO. : S11-0353

DATE : 2011-03-29

pH & CONDUCTIVITY - TMH 1 A20 & A21T

Soillab No	Sample Position	Sample Depth (m)	pH	Electrical Conductivity S/m
S11-0353-02	TP2	0.5-0.6	7.05	0.1780

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