

**BIRCHLEIGH NORTH, EXTENSION 4:  
GEOTECHNICAL INVESTIGATIONS**

**GHS1018**

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**GHS1018**

**23 NOVEMBER 2018**

## **BIRCHLEIGH NORTH EXTENSION 4: GEOTECHNICAL INVESTIGATIONS**

### **SUMMARY**

This report presents the results of a design stage soils investigation carried out on various (totalling 25) stands in Birchleigh North Extension 4. This investigation had been undertaken to comply with the requirements of GFSH-2 Generic Specification (2002) and SAICE (1995).

The northern portion of the site is indicated to be underlain by dolomite land, however boreholes drilled by City of Ekurhuleni in 2011 confirm the presence of granodiorite and weathered soil derivatives of the Johannesburg Dome (Archaean Granitoid intrusion, Kaapvaal Craton).

The fieldwork component of the soils investigations were conducted in October 2018 over a period of 5 days. A total of forty-four test pits were excavated with an excavator and profiled to evaluate the geotechnical properties of the various soil horizons encountered in test pits.

Disturbed samples were submitted to Soillab to determine the geotechnical characteristics of the various soil horizons. Laboratory tests included 29 small disturbed samples submitted for foundation indicator tests, 9 samples for pH and conductivity tests, 3 samples for compaction tests and 5 undisturbed block samples submitted for consolidation testing.

No groundwater was intercepted in any of the test pits excavated.

The typical soil horizons identified are colluvium, pebble marker, reworked residual granite, and residual granite. The horizons are often ferruginised, occasionally forming honeycomb or even hardpan ferricrete.

<b>Horizon</b>	<b>Thickness in m</b>
Colluvium	0.4-3.4
Pebble Marker	0-1.2
Pedogenic	0-0.9
Reworked residual granite	0-5.1
Residual granite	0-4.8
Granite	0-0.05

Typically, no refusal occurred with the use of an excavator during this study. As is characteristic of the granite profile variations may occur over short distances, including refusal and near refusal on granite boulders and or granite rock.

In the north-easternmost area of the township (Stand 542) two existing test pits indicate the presence of Black Reef Formation quartzite rock at 0.6m to 1.4m depth.

Based on the geology, soil profiles and laboratory test results all the stands are classified as H/C2/S1-S2 in terms of the NHBRC Soil Classification. The exceptions are Stands 528 (Finalised Stand No. 2246), 539 (Finalised Stand No. 2263) and 542 (Finalised Stand No. 2271) that is classified as (H/C2/S1-S2) R3 in terms of the NHBRC Soil Classification.

Foundation recommendations for the various proposed structures are provided in the report.

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## BIRCHLEIGH NORTH EXTENSION 4: GEOTECHNICAL INVESTIGATIONS

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TEST PIT LOCATION, DEPTH OF EXCAVATION	GHS1018/1
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**APPENDICES**

TEST PIT PROFILES	1
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## 1. INTRODUCTION

This report presents the results of a near-surface soils investigation carried out on 25 stands in Birchleigh North Extension 4.

## 2. TERMS OF REFERENCE AND SCOPE OF WORK

Geohazard Solutions is appointed by Lebash Consortium to undertake a geotechnical investigation. Budget and cost proposals were submitted to the firm in proposal number GHS1018P.

## 3. INFORMATION SOURCES

- **Geological Map, 1: 250 000 Scale Series:** published by the Geological Survey of South Africa (Council for Geoscience):

Sheet Name	Reference
EAST RAND	2628

- **The Geology of South Africa:** by MR Johnson, CR Anhaeusser, RJ Thomas, 2006.
- South African National Standard **SANS 10160-4: 2011**, Seismic Actions and General Requirements for Buildings, Edition 1.1 (ISBN 978-0-626-26421-4).
- South African National Standard **SANS 634: 2012**, Edition 1 (ISBN 978-00626-27636-2), Geotechnical investigations for township development.
- **Site Investigation Code of Practice**, SAICE Geotechnical Division, January 2010.
- **NHBRC Home Building Manual**, Parts 1 and 2, Revision 1, dated February 1999 & 2015 (ISBN: 978-0-620-68292-3).
- South African Bureau of Standards, Standardized Specification For Civil Engineering Construction: Bedding (Pipes), **SABS 1200 LB-1983**, UDC 624(083.75).
- **Soil Survey for Engineering**, Brink, Partridge and Williams (1982) pp 20-21.
- **Engineering Geology of Southern Africa**, Volume 1, Brink, A.B.A. (1979) 319pp.
- South African Bureau of Standards SABS 1200 LB-1983, **Standardized Specification for Civil Engineering Construction: Bedding (Pipes)**, UDC 624(083.75).
- TRH14, **Guidelines for Road Construction Material**. Committee of State Road Authorities, Pretoria South Africa, dated 1985.
- **Intraconsult report**, dated 29 October 1999, numbered IR369R, titled "A Geotechnical Report to Esselen Park Developments on Portions of Land Surrounding the Esselen Park College for Proclamation Purposes And NHBRC Enrolment".
- VGIconsult Report, number VGI3355 WO312, dated 19 January 2011, titled "Gauteng: Ekurhuleni Metropolitan Municipality: Esselen Park: Portion 63 And Remainder Of Portion 39 Witfontein 15 IR: Geotechnical Investigation"

- **Crossman Pape & Associates report**, number 13/123/VH, dated September 2013 “NHBRC Phase 1 Geotechnical Investigation for Proposed Esselen Park Housing Development: Portions 63 & 39 Witfontein 15-IR”.

#### 4. DESCRIPTION OF THE STUDY AREA

##### 4.1. Locality

The locality of the site within the region is indicated below. The site is situated south of Tembisa, east of Birchleigh North and west of Esselen Park Extension 1, in the Ekurhuleni Metropolitan Municipality.

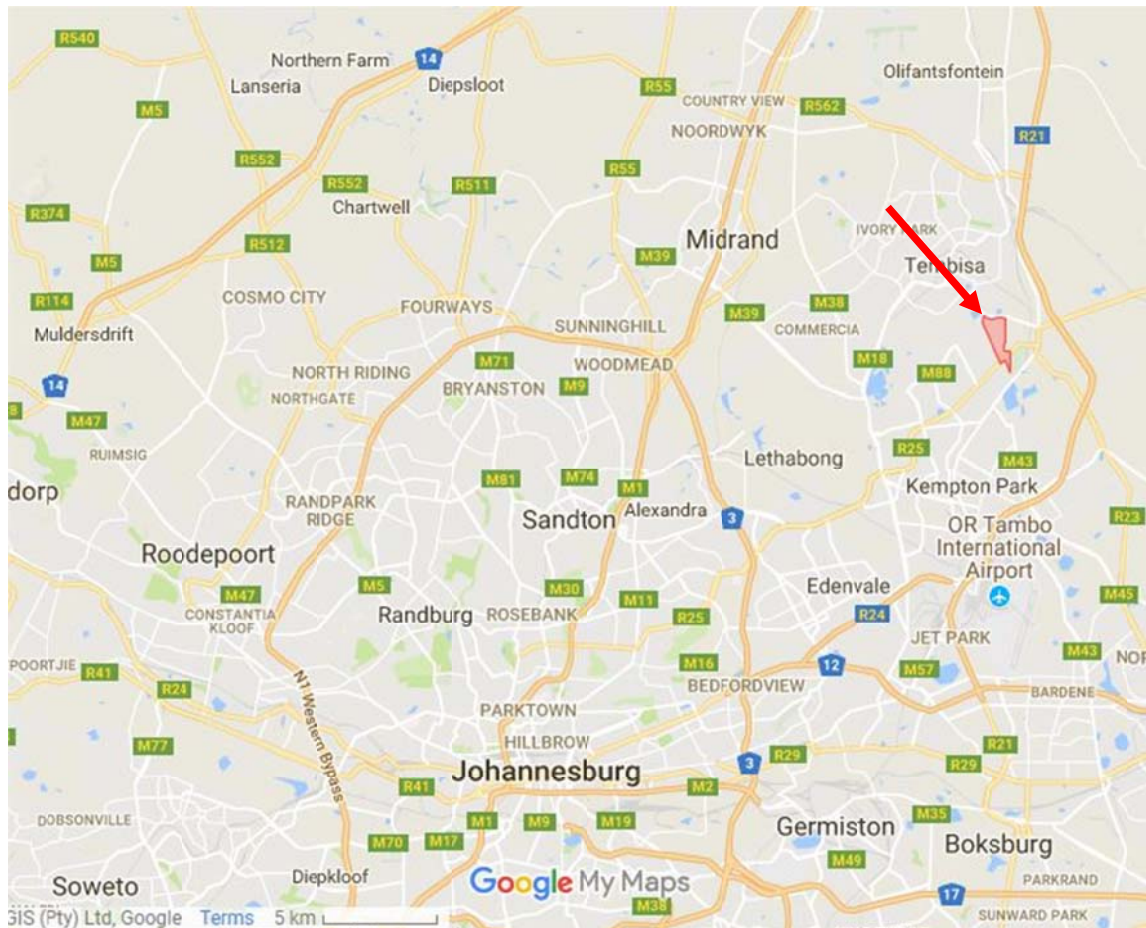


Figure 1: Location of the site (Google Maps)

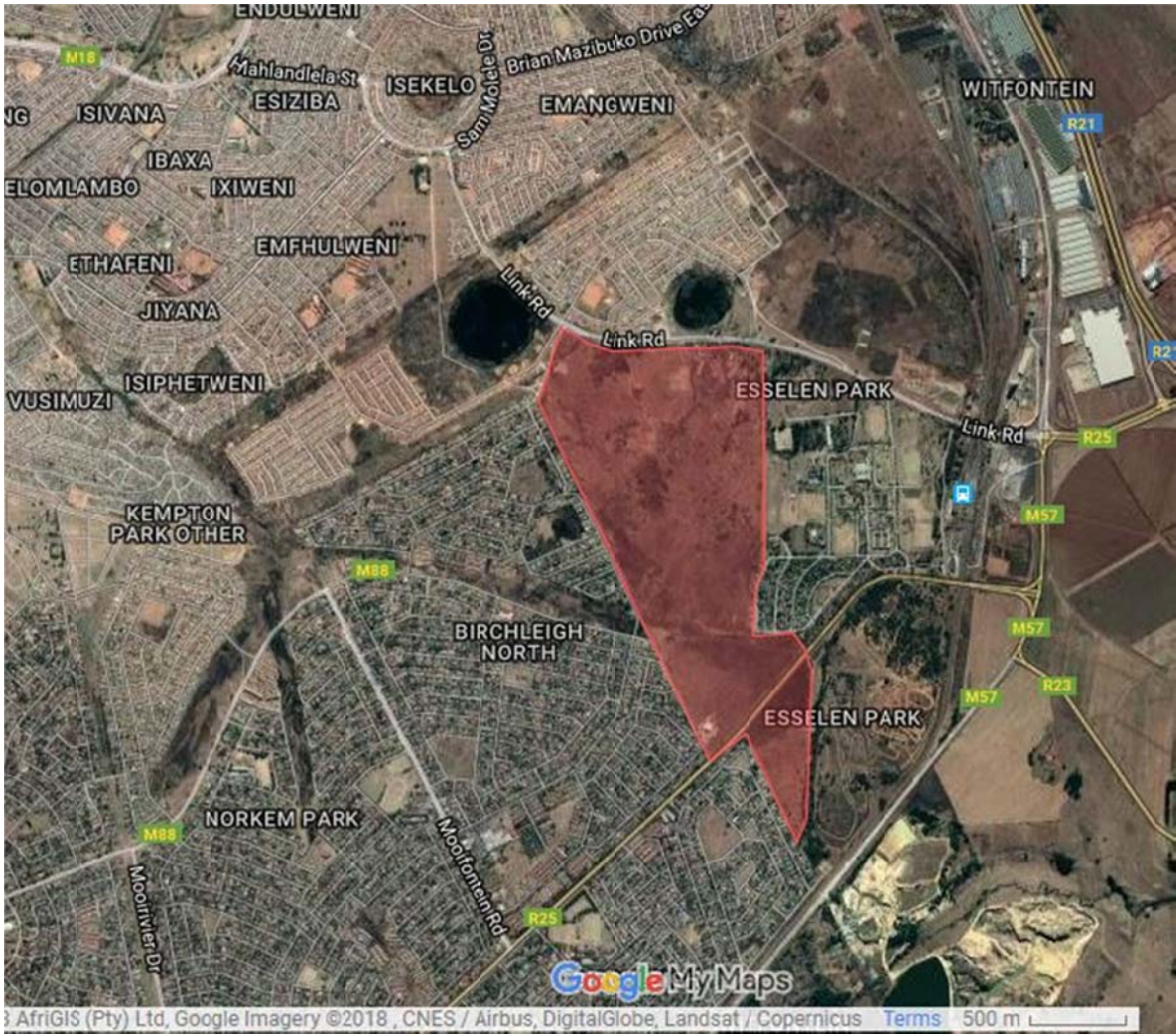


Figure 2: Google Earth Aerial Photo of the site



## 4.2. Site Description

The Land Use Framework for the site is displayed below:



The site is to comprise 25 stands earmarked for high density housing/walk ups.

The following stands form part of the study:

Stand Numbers	Total	Area	Land Use Type
519 to 523	5 stands	8.2 ha	Res 2
524 to 528	5 stands	4,2 ha	Res 4
529 to 537	9 stands	12,73 ha	Res 4
538 to 543	6 stands	12,2 ha	Res 4

## 5. PROCEDURES USED IN THIS STUDY

### 5.1. Test Pits

The site investigation consisted of the excavation of 44 test pits (GHS1018 TP1 to TP44) on the site using a CAT (110kW) excavator with a maximum reach of 6m. The soil profile of each test pit was described by an engineering geologist using the visual and tactile procedures advocated by Jennings et al (1973). Detailed descriptions of the test pits conducted during the current investigation are provided in Appendix 1 of this report and a summary of the test pits is given in Table 1. The positions of all test pits are given in Drawing GHS1018/1.

According to the Intraconsult and Crossman Pape reports, the following test pits were excavated on relevant stands, currently under investigation:

Stand Number	Test Pit Number
519	J13, TP14, TP32, TP78
520	K13
521	TP59
523	TH I9
527	TP65
528	TP83
531	J14, TP31, TP40, TP79
532	K12
535	TP81
537	TP25
538	TP15 & TP60
540	J12 & TP33
542	TP38, TP76, TP88 & TP89
543	TP82

### 5.2. Soil Sampling and Testing

Twenty-nine disturbed small bag samples were taken of representative soil horizons and submitted to Soillab Laboratory for foundation indicator tests and nine of these samples were also submitted for pH and conductivity testing. Five undisturbed block samples were submitted for consolidation tests and three disturbed bulk samples were submitted for compaction tests.

The existing laboratory test results available from the CP and Intra Consult Reports were incorporated into the current study, including six foundation indicator tests, two collapse potential tests and one compaction test.

Table 2 summarises the results of the laboratory tests and the detailed test results are contained in the Appendix.

### 5.3. Geotechnical Near-surface Soils Classification

Geotechnical Category and Designation	Geotechnical Characteristics
Active soils (heave/shrink)	Expected range of total movement at surface:
H	< 7.5 mm
H1	7.5 – 15 mm
H2	15 – 30 mm
H3	> 30 mm

<b>Geotechnical Category and Designation</b>	<b>Geotechnical Characteristics</b>
Collapsible soils C C1 C2	Expected range of total movement at surface: <5 mm 5 – 10 mm > 10 mm
Compressible soils S S1 S2	Expected range of total movement at surface: < 5 mm 5 -15 mm > 15 mm
Inundated Areas W	Wet areas, drainage line, seepage zone
T	Steep Slope (>15 degrees)
P	Dolomitic Areas
E	Abandoned borrow areas, dump rock, waste pits and uncontrolled fill.
R R1 R2 R3	Rock Rock outcrop Rock scattered outcrop Rock sub outcrop (surface to minus 1.5 m)

#### 5.4. Potential Erosion and Piping (Dispersive Soils)

Sodium-based clay minerals are susceptible to erosion or piping in the in situ soil profile. The electrical conductivity (EC) of the soil paste provides an indicator of the salinity and potential dispersive behaviour.

#### 5.5. Potential Aggressiveness of Interparticulated Groundwater

According to industry guidelines pH and electrical conductivity (EC) should be measured in selected samples.

pH is a measure of the acidity of the soil based on its hydrogen ion concentration and is mathematically defined as the negative logarithm of the hydrogen ion concentration, or  $\text{pH} = -\log[\text{H}^+]$ . The pH of a material ranges on a logarithmic scale from 1-14, where pH 1-6 are acidic, pH 7 is neutral, and pH 8-14 are basic. Lower pH corresponds with higher  $[\text{H}^+]$ , while higher pH is associated with lower  $[\text{H}^+]$ .

Electrical conductivity (EC) is the ability of the material to conduct electrical current through it. EC is measured in Siemens per unit area (e.g. Siemens per metre). The higher the dissolved material in soil sample, the higher the EC of the soil. The electrical conductivity of soils varies depending on the amount of moisture held by soil particles. Sands have a low conductivity, silts have a medium conductivity, and clays have a high conductivity. Consequently, EC correlates strongly to soil particle size and texture.

Soil resistivity is a function of soil moisture and the concentrations of ionic soluble salts and is considered to be most comprehensive indicator of a soil's corrosivity.

Typically, the lower the resistivity, the higher will be the corrosivity as indicated in the following Table:

<b>Soil Resistivity (Ohm/m)</b>	<b>Corrosivity Rating</b>
> 200	Essentially non-corrosive
100 to 200	Mildly corrosive

Soil Resistivity (Ohm/m)	Corrosivity Rating
50 to 100	Moderately corrosive
30 to 50	Corrosive
10 to 30	Highly corrosive
< 10	Extremely corrosive

### 5.6. Earthworks Classifications for Service Trenches

The ease of excavation is a critical financial factor when installing underground services and placement of foundations. The excavatability of material can be grouped into the following three categories according to SABS 1200D:

- Soft excavation (Class A) requires mechanical equipment
- Intermediate excavation (Class B) requires ripping equipment
- Hard rock excavation (Class C) requires blasting or pneumatic rock breaking equipment

### 5.7. Re-usability of Spoil

Material excavated from the pipe trench may be re-used as fill material if it meets the requirements of SABS 1200LB, as follows:

- **Selected Granular Fill**
  - Granular
  - Non-cohesive
  - 0,6mm to 19mm particle size
  - Free-draining
  - Compactibility factor <0,4
- **Selected Fill**
  - Plasticity Index (PI) < 6
  - No lumps or stones >30mm diameter
  - No vegetation
- **Backfill**
  - Little or no organic material
  - Stones >150mm in diameter
  - Less than 10% of rocks >50mm in diameter
  - No large clay lumps

### 5.8. Seismic Hazard

In accordance with SANS 10160 (2012) structures in seismic zones shall, as a minimum, be designed and constructed to resist the effects of seismic ground motions. This standard provides strategies and rules for the design of buildings subject to earthquake actions primarily to safeguard against major catastrophic structural failures and loss of life, not to prevent damage or to maintain function.

Figure 1 of SANS 10160-4 presents the seismic zones of South Africa. Two zones are identified, namely:

- a) Zone I: Natural seismic activity and
- b) Zone II: Regions of mining-induced and natural seismic activity.

SANS 10160-4, Table 3 presents classes of buildings relevant to seismic hazard:

Importance Class	Buildings	Importance Factor ( $\gamma$ )
I	Buildings of minor importance for public safety, e.g. agricultural buildings etc.	0.8
II	Ordinary buildings, not belonging to the other categories	1.0
III	Buildings for which seismic resistance is of importance in view of the consequences associated with collapse, e.g. schools, assembly halls, cultural institutions etc.	1.2
IV	Buildings for which integrity during earthquakes is of vital importance for protection e.g. hospitals, fire stations, power plants etc.	1.4

Note:

- The numbering of importance classes differ from those in the Eurocode where from the definitions were taken.
- Buildings of Importance Class I, II and III in Zone II need only comply with clause 5 and with the minimum requirements for structural and non-structural components and with the requirements for ties, continuity and anchorage, all as detailed in clause 9.
- Buildings of Importance Class IV in Zone II shall be treated as buildings located in Zone 1.

## 6. GEOLOGY

### 6.1. Regional Geological Setting

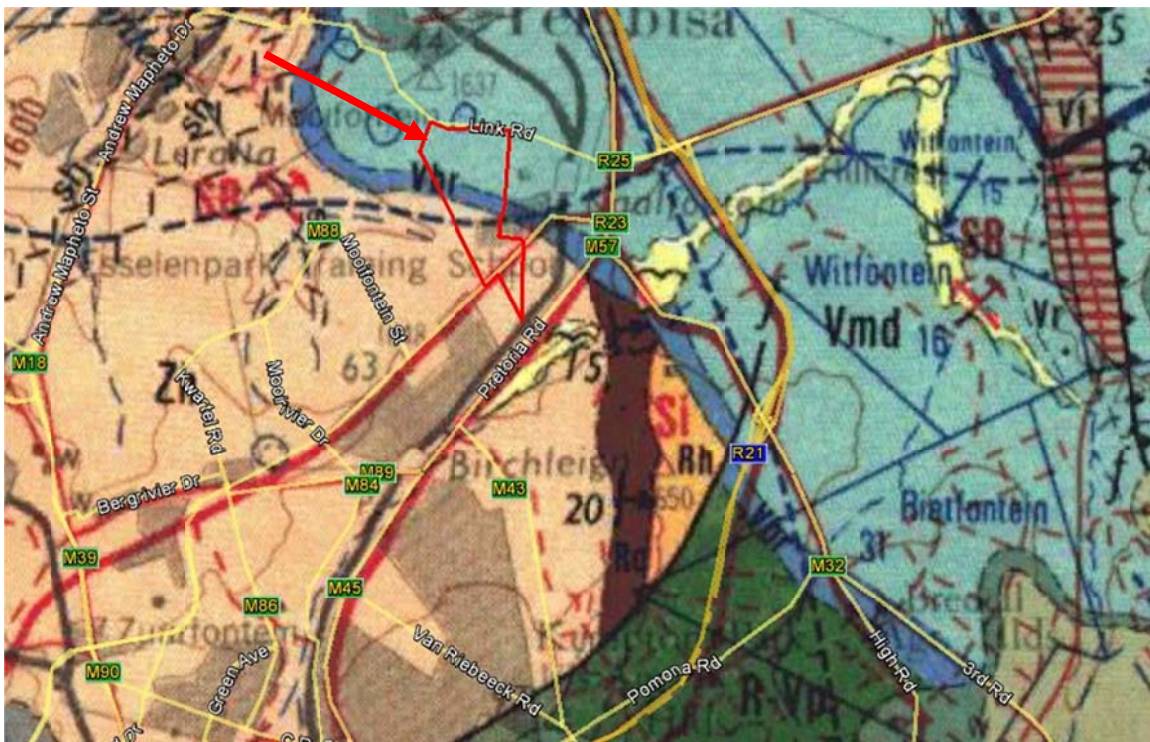


Figure 3: Regional Geological Setting (1:250 000 scale geological map & Google Earth data)

According to the published geological map, the site is directly underlain by chert and dolomite of the Malmani Sub-Group, Chuniespoort Group of the Transvaal Supergroup, shale and quartzite of the Black Reef Formation and granitoids of the Johannesburg Dome.

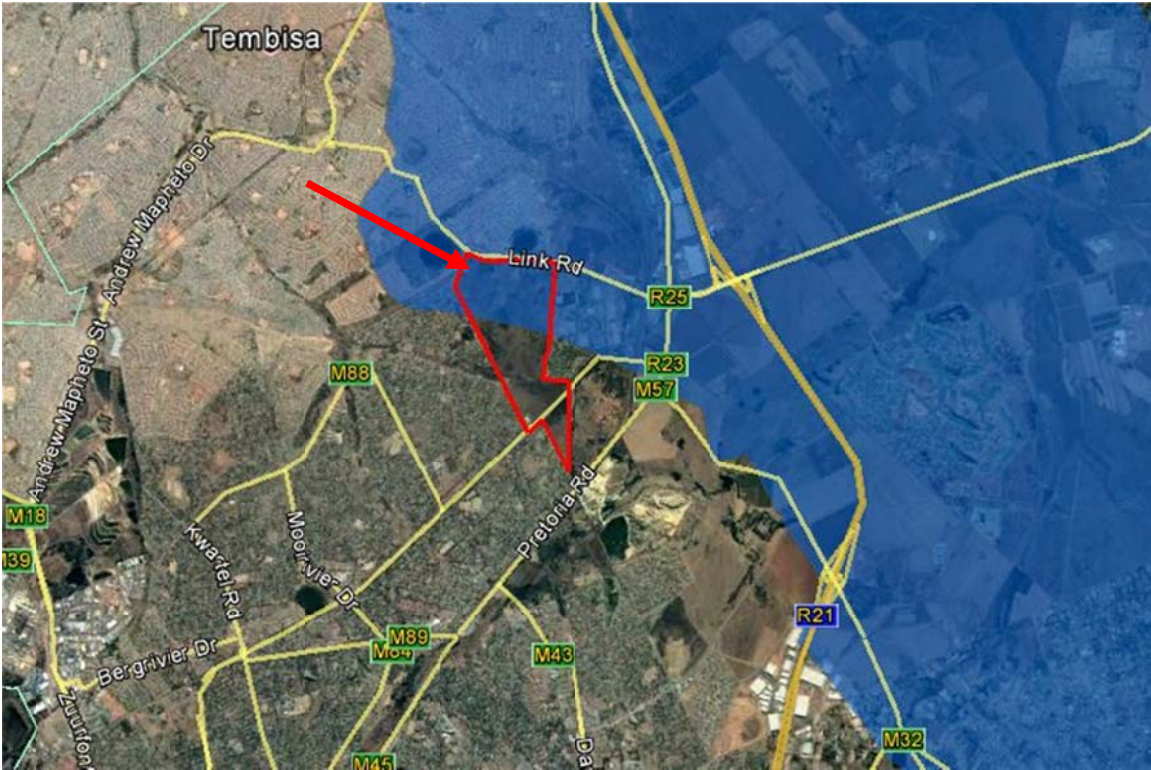


Figure 4: Dolomite Land Distribution of Gauteng and Google Earth data

Unconsolidated materials deemed to be various recent deposits (most likely 24 Ma [Miocene Epoch] and younger) are anticipated to mantle the hard rock geology (and residual product thereof). The material varies in thickness, sedimentological- and geotechnical properties:

Post-Gondwana Deposits	
Colluvium: Talus (Course Colluvium) or Hillwash	Soils of clayey and silty composition or gravels
Pedocretes (cemented soils)	e.g. calcrete (cemented or replaced by carbonates), ferricrete (cemented or replaced by iron oxides), silcrete (cemented or replaced by silica), manganocrete (cemented or replaced by manganese oxides)

**6.2. Site Specific Geology**

The VGIconsult report VGI3355 WO312, dated 19 January 2011, titled “Gauteng: Ekurhuleni Metropolitan Municipality: Esselen Park: Portion 63 and Remainder of Portion 39 Witfontein 15 IR” refers. Ten (10) boreholes were drilled within the area identified as dolomitic.

The boreholes confirm the presence of **granodiorite and gneiss** and weathered soil derivatives of the Johannesburg Dome (Archaean Granitoid intrusion, Central Kaapvaal Craton).

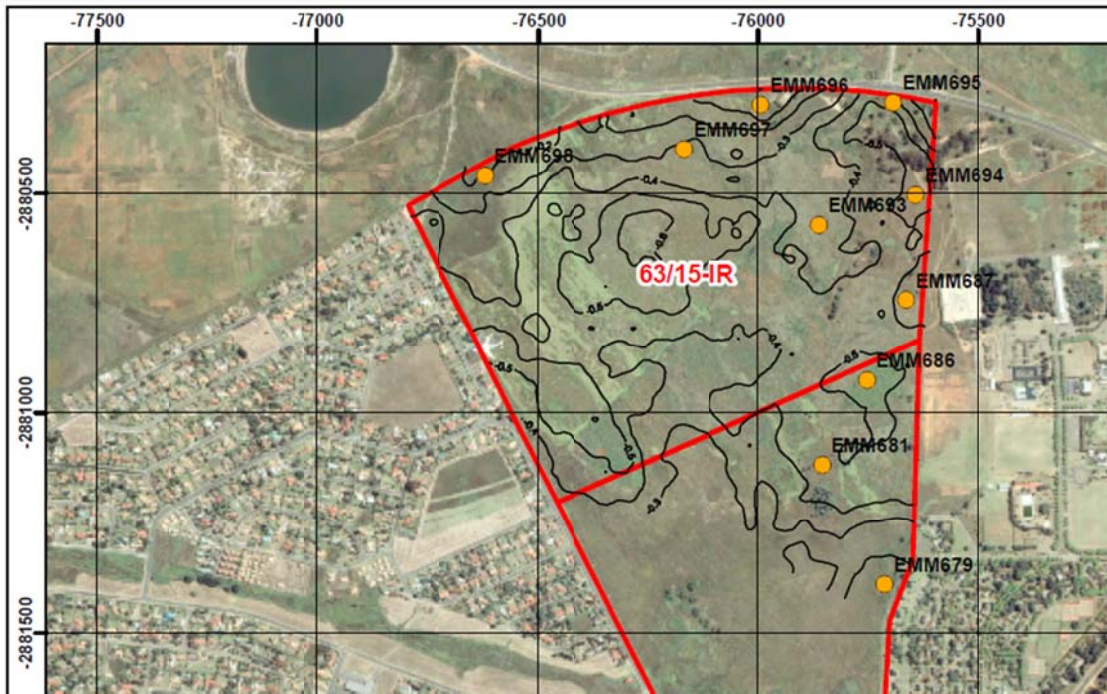


Figure 5: Excerpt from Drawing 1 of WO312, indicating borehole drilling positions

### 6.3. Near-surface Conditions in Test Pits

The soil horizons identified within the test pits excavated indicate layer thickness ranges as follows:

Horizon	Thickness in m
Colluvium	0.4-3.4
Pebble Marker	0-1.2
Pedogenic	0-0.9
Reworked residual granite	0-5.1
Residual granite	0-4.8
Granite	0-0.05

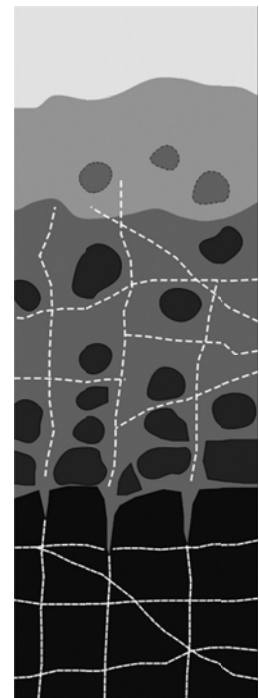
Typically transported material blankets a pebble marker, which may be ferruginised in places. Occasionally the transported material is underlain by a pedogenic horizon (nodular or honeycombed) The transported horizon overlies reworked residual granite, which may be ferruginised in places and/or residual granite, in turn underlain by weathered granite.

Granite corestones may occur, as well as granite weathered rock.

The typical soil profile encountered in test pits on the site can be summarized as follows (refer to Table 1, Drawing GHS1018/1 and Appendix 1):

- A layer of **colluvium** is encountered at surface comprising loose to medium dense (dense in subareas) pinhole voided silty sand. This layer is intercepted from surface extending to an anticipated maximum depth of 0.4m and 3.4m in all the test pits. A layer of **ferruginised colluvium** is intercepted in scattered locations, summarised as follows (the horizon ranges from medium dense to very dense):

Test Pit	Depth of occurrence (m-m)
1018-TP27	0.4-1.0



Test Pit	Depth of occurrence (m-m)
1018-TP29	1.8-3.5
1018-TP30	1.8-2.6
1018-TP31	1.2-2.7
1018-TP44	0.2-0.9
TP65	0.6-0.9
TP78	0.8-1.6
J14	1.2-1.75
K12	0.85-1.0
K13	1.5-1.8

- A **pebble marker layer** is encountered the majority of test pits excavated during the current investigation. The layer typically comprises loose to medium dense pinhole voided clayey silty sand with various percentages quartz gravel and cobbles. This layer is intercepted from a minimum depth of 0.4 and 3.5m below ground surface extending to an anticipated maximum depth of 0.5m and 3.6m. A **ferruginised pebble marker** layer is intercepted in scattered locations, summarised as follows (loose to dense in composition):

Test Pit	Depth of occurrence (m-m)
1018-TP13	0.7-0.9
1018-TP14	0.6-0.8
1018-TP15	0.5-0.8
1018-TP18	1.0-1.7
1018-TP19	1.4-1.9
1018-TP20	0.9-1.2
1018-TP31	2.7-3.8
1018-TP37	0.7-0.8
1018-TP38	0.7-0.8
1018-TP39	0.8-1.0
1018-TP40	1.0-1.2
1018-TP41	1.3-1.6
1018-TP42	0.7-1.3
1018-TP43	0.5-1.5

- A layer of **honeycomb ferricrete** is encountered in 7 of the 67 test pits on the site. The horizon typically comprises medium dense to dense gravelly silty sand. This layer is intercepted from a minimum depth of 0.35m and 0.9m below ground surface extending to an anticipated maximum depth of 0.93m and 2.1m. A layer of **strongly cemented hardpan ferricrete** is observed in Test Pit J14 from 1.7m to 2m depth (with very dense composition).
- A layer of **reworked granite** is encountered in the majority of test pits comprising medium dense to very dense with loose patches in subareas (pinhole voided) clayey silty sand with quartz gravel in subareas. This layer is intercepted from a minimum depth of 0.4m and 3.6m below ground surface extending to an anticipated maximum depth of 1.1m and 5.5m. A layer of **ferruginised reworked residual granite** is occasionally intercepted in scattered locations as follows (with typical medium dense composition):

Test Pit	Depth of occurrence (m-m)
1018-TP34	0.93-3.1
1018-TP41	1.6-3.65
TP31	1.7-3.0
TP40	1.2-2.0
TP60	1.8-3.0
J12	2.00-2.1

- A layer of **residual granite** is encountered in 35 of the 67 test pits on site. The layer comprises medium dense (to loose in subareas) to dense, pinhole voided clayey silty



sand, with medium to highly weathered granite cobbles in subareas. This layer is intercepted from a minimum depth of 0.7m and 4.2m below ground surface extending to an anticipated maximum depth of 1.2m and 6m. A layer of **ferruginised residual granite**, comprising medium dense to dense, occasionally voided, clayey silty SAND with Fe&Mn nodules is intercepted from 1.1m and 2.6m to a maximum depth of 1.95m and 5.5m (test Pits TP8 and TP24).

- A layer of **residual quartzite** was encountered in Test Pit 76 in the north-eastern most corner of the site comprising medium dense, and loose in places silty sand. This layer is intercepted at 0.9m to 1.4m, refusing at 1.4m on quartzite rock.
- Highly weathered **soft rock granite** is intercepted in Test Pit TP40 also in the north-eastern most corner of the site, comprising highly to completely weathered soft rock granite from 1.2m to 1.25m depth.

### 6.3.1. Refusal

A maximum reach of 5m to 6m was encountered with the excavator in most of the test pits excavated with the exception of the below mentioned.

Refusal occurred on granite rock, honeycomb ferricrete, ferruginised/reworked residual granite at depths of between 0.6m and 3.8m during the current investigation with the use of an excavator.

Test Pit Number	Refusal Depth in m	Material At The Base Of Test Pit
1018-TP17	2.1	Honeycomb ferricrete
1018-TP24	1.95	Medium to completely weathered granite
1018-TP36	1.5	Medium weathered granite
1018-TP38	4.2 Near Refusal	Medium dense residual granite
1018-TP40	1.25	Soft rock granite
1018-TP41	3.05 near Refusal	Highly weathered granite
1018-TP42	3.8 Near Refusal	Dense residual granite

Refusal occurred on ferruginised residual granite, reworked residual granite, residual granite, soft rock quartzite, and pedogenic material with use of a TLB as follows:

Test Pit Number	Refusal Depth in m	Material At The Base Of Test Pit
TP25	0.6	Very dense strongly cemented reworked residual granite
TP32	1.2	Very dense ferruginised residual granite
TP33	2.3	Very dense ferruginised reworked residual granite
TP38	1.9	Very dense ferruginised reworked residual granite
TP40	2.3	Very soft rock granite
TP65	1.8	Very dense reworked residual granite
TP78	2.6	Very dense residual granite
TP82	2.2	Very dense ferruginised reworked residual granite
TP83	1.1	Very dense reworked residual granite
TP88	1.1	Very dense strongly ferruginised reworked residual granite
TP89	0.6	Very soft rock quartzite
I9	1.2	Medium and fine sand
J14	2.0	Hardpan ferricrete
K12	2.0	Very dense ferruginised reworked residual granite

### 6.3.2. Groundwater conditions

Groundwater was typically not intercepted in the test pits. Test Pit I9 recorded a perched groundwater level at 1.2m in weakly cemented clayey, silty sand (residual granite) at the base of the test pit.

Perched groundwater should be anticipated seasonally on the contact between the soil and rock interface or soil and pedocrete.

## 7. NEAR SURFACE GEOTECHNICAL EVALUATION

### 7.1. Previous Evaluations

The following zones were identified in the 1999 Intraconsult investigation for the entire Esselen Park site, as summarized in their report:

#### **2W(H/C2/S1)**

**Variable thicknesses of hillwash over reworked residual granite, water seepage at shallow depth. Sub-Area has to be drained before development. Potentially collapsible and compressible profiles on individual stands.**

#### **2(H/C2/S1)**

**Variable thicknesses of hillwash (moderately ferruginised in places) over reworked residual granite. Potentially collapsible and compressible profiles on individual stands.**

#### **2(H/C2/S)**

**Variable thicknesses of hillwash over residual granite or hardpan ferricrete. Potentially collapsible profiles on individual stands.**

#### **2W(H/C2/S)**

**As above for 2(H/C2/S) but with water seepage at shallow depth. Sub-Area has to be drained before development.**

#### **3W(H2/C/S1)**

**Wet area, not recommended for development.**

The stands under investigation currently are located in the zones in bold typeface above.

The following zones were identified in the 2013 Crossman Pape and Associates investigation for the entire Esselen Park site, as summarized in their report:

#### **Zone C**

**Near surface hillwash / pebble marker overlying nodular ferricrete and/or hardpan ferricrete or overlying reworked residual granite or reworked residual quartzite, overlying granite or quartzite bedrock.**

#### **Zone C1**

**Near surface hillwash / pebble marker / nodular ferricrete overlying reworked residual granite / quartzite**

#### **Zone C2**

**Thick near surface hillwash / pebble marker / nodular ferricrete overlying reworked residual granite of poor consistency**

#### **Zone H1/H2**

**Transported hillwash / alluvium overlying expansive alluvial soils.**

## Zone P/C2

Uncontrolled fill material overlying reworked residual granite soils of poor consistency.

The stands under investigation currently are located in the zones in bold typeface above.

The geotechnical evaluation of the near surface soil horizons and their properties on the site are based on the interpretation of the geology, the soil profiles and the laboratory test results.

## 7.2. Engineering Properties and Material Characteristics

### 7.2.1. Activity (swelling/shrinking - H) or Expansive Potential<sup>1</sup>

Based on the previous investigations conducted by Crossman Pape and Intraconsult the colluvium, reworked residual granite and residual quartzite have a low potential expansiveness.

The foundation indicator test results indicate that all the soil layers (colluvium, pebble marker, ferruginised pebble marker, reworked residual granite and residual granite intercepted during the current investigation have a low potential expansiveness (<7,5mmm).

#### Colluvium:

TP	LL	PI	LS	Expansiveness	USC	Clay content	Gravel content
TP17	-	NP	0	LOW	SM	6%	6%
TP30	32	9	4.5	LOW	CL	26%	4%
TP31	27	11	5.5	LOW	CL	27%	5%
J12	31.5	9.4	4	LOW	CL	27%	2.2%

#### Pebble Marker and Ferruginised Pebble Marker:

TP	LL	PI	LS	Expansiveness	USC	Material	Clay content	Gravel content
TP26	30	8	4	LOW	SC	Ferruginised Pebble Marker	10%	14%
TP18	37	14	7	LOW	SC	Pebble Marker	16%	41%
TP30	37	12	5	LOW	SM	Pebble Marker	12%	26%

#### Reworked Residual Granite (ferruginised):

TP	LL	PI	LS	Expansiveness	USC	Clay content	Gravel content
TP34	35	12	5	LOW	SC	14%	5%
TP42	32	9	4	LOW	SC	10%	29%

#### Reworked Residual Granite:

TP	LL	PI	LS	Expansiveness	USC	Clay content	Gravel content
TP10	34	12	6	LOW	SC	17%	9%
TP11	32	11	4	LOW	SC	15%	9%
TP13	39	14	7	LOW	SC	16%	11%
TP20	34	11	5	LOW	SC	15%	13%
TP23	33	14	6.5	LOW	CL	16%	10%
TP37	34	10	5	LOW	SM	16%	17%
TP60	32	11	6	LOW	SC	9%	26%

<sup>1</sup> of soils within 3.0m from natural ground level

TP	LL	PI	LS	Expansiveness	USC	Clay content	Gravel content
TP79	32	9	5	LOW	SC	4%	18%
TP82	35	8	4	LOW	SM	6%	26%

#### Residual Granite:

TP	LL	PI	LS	Expansiveness	USC	Clay content	Gravel content
TP01	25	4	1.5	LOW	SM/SC	11%	3%
TP03	33	10	3.5	LOW	SC	17%	7%
TP03	29	7	2	LOW	SM/SC	16%	5%
TP07	25	7	2	LOW	SM/SC	12%	9%
TP25	33	9	3	LOW	SM	22%	3%
TP26	30	13	5	LOW	SC	18%	6%
TP28	36	13	5.5	LOW	SC	17%	5%
TP30	33	14	5.5	LOW	SC	12%	8%
TP34	29	7	2.5	LOW	SM & SC	14%	5%
TP39	29	8	3	LOW	SC	11%	5%
TP41	26	6	3	LOW	SM/SC	11%	12%

#### Residual Granite (ferruginised):

TP	LL	PI	LS	Expansiveness	USC	Clay content	Gravel content
TP24	24	7	2	LOW	SM/SC	9%	21%
TP08	47	16	6	LOW	SM	14%	18%

The Pedogenic horizon was not tested.

#### 7.2.2. Potentially Collapsible Soils (C)<sup>1</sup> and Compressible (S)<sup>1</sup> Soils

The colluvial layer was sampled and tested during the Feasibility Stage investigation Crossman Pape (Test Pit 31 at a depth of 0.3m). The sample indicated a collapse potential of 15%, indicating 'severe trouble'. The material is described as loose silty sand (colluvium).

The pebble marker and (reworked) residual granite (including horizons described as ferruginised) are described as exhibiting a pinhole voided structure and comprise low density material indicative of collapsible material.

Collapse/settlement can therefore be expected if structures are placed within or on these layers or if the moisture content is increased under load, especially where these soil layers exhibit a loose to medium dense consistency.

The consolidation test (TP11 at 3m) conducted on the reworked residual granite revealed settlements of 1mm (minimum layer thickness of 0,1m) and 39mm (maximum layer thickness of 4,25m) if placed under an external load of 80kPa (double storey structure); settlements of 2mm (layer thickness of 0,1m) and 78mm (layer thickness of 4,25m) if placed under an external load of 120kPa (three storey structure); and settlements of 2mm (layer thickness of 0,1m) and 104mm (layer thickness of 4,25m) if placed under an external load of 150kPa.

The consolidations tests (TP3 at 3m; TP8 at 4m, TP25 at 3,8m and TP26 at 1,95m) conducted on the residual granite revealed settlements of <1mm to 8mm (layer thickness of 0,3m) and 5mm to 115mm (layer thickness of 4,2m) if placed under an external load of 80kPa (double storey structure); settlements of <1mm to 14mm (layer thickness of 0,3m) and 6mm to 196mm

(layer thickness of 4,2m) if placed under an external load of 120kPa (three storey structure); and settlements of 1mm to 16mm (layer thickness of 0,3m) and 15mm to 230mm (layer thickness of 4,2m) if placed under an external load of 150kPa.

The colluvium, pebble marker, (reworked) residual granite (including horizons described as ferruginised) will be compressible under loads of 80kPa (double storey)-120kPa (3 storey)-150kPa (4 storey) as indicated in the consolidation and collapse potential tests.

### 7.2.3. Potential Aggressiveness of Interparticulated Groundwater

Our assessment of the pH- values is as follows:

Test Pit No.	Sample Depth	Material origin	pH: natural soil	Descriptor: natural soil
TP3	1.6-4.5	Residual granite	7.64	Slightly Alkaline
TP7	1.8-2.8	Ferruginised Pebble Marker	6.99	Slightly Acidic
TP24	1.1-1.95	Ferruginised Residual Granite	7.51	Slightly Alkaline
TP26	2.6-4.7	Residual Granite	8.67	Mod. Alkaline
TP39	3.6-5.2	Residual Granite	7.76	Slightly Alkaline
TP42	1.3-3.5	Ferruginised Reworked Residual Granite	6.54	Slightly Acidic
TP30	0.5-1.8	Colluvium	5.32	Mod. Acidic
TP34	0.93-3.1	Reworked residual granite	5.76	Mod. Acidic
TP17	0.76-1.6	Colluvium	7.35	Slightly Alkaline

The samples submitted for pH testing indicate that the colluvium, pebble marker and (reworked) residual granite are slightly to moderately alkaline, occasionally tending to slightly/moderately acidic.

The potential exist for aggressiveness of materials, encountered within profile, towards steel.

### 7.2.4. Potential Erosion and Piping (Dispersive Soils)<sup>2</sup>

Our assessment of the conductivity results values is as follows:

Test Pit No.	Sample Depth	Soil Origin	Conductivity (S.m)	Dispersive characteristics <sup>1</sup>
TP3	1.6-4.5	Residual granite	0.0049	None
TP7	1.8-2.8	Ferruginised Pebble Marker	0.0046	None
TP24	1.1-1.95	Ferruginised Residual Granite	0.0086	None
TP26	2.6-4.7	Residual Granite	0.0350	None
TP39	3.6-5.2	Residual Granite	0.0037	None
TP42	1.3-3.5	Ferruginised Reworked Residual Granite	0.0045	None
TP30	0.5-1.8	Colluvium	0.0038	None
TP34	0.93-3.1	Reworked residual granite	0.0056	None
TP17	0.76-1.6	Colluvium	0.0038	None

<sup>1</sup> Conductivities in excess of 0.5 S.m. may be associated with dispersive characteristics in soil units

<sup>2</sup> when soil types are subjected to a hydraulic gradient

### 7.2.5. Seepage (W)

No groundwater was intercepted in the test pits excavated during this study. A seasonal or perched groundwater level can be expected on the soil/rock contact as well as soil/pedogenic horizon.

### 7.3. Natural Slope Stability (T)

The site will not present slope stability problems.

All excavation slopes must, however, be inspected regularly by a competent person during construction to assess stability and to recommend stabilizing measures, where required.

### 7.4. Erosion

The fine nature of the upper soil unit encountered during investigations is such that after removal of natural cover they present a potential erosion problem during periods of heavy rain and also dust removal by high winds during the dry season.

### 7.5. Earthworks Classifications for Service Trenches (R)

A maximum reach of 5m to 6m was encountered with the excavator in most of the test pits excavated with the exception of 5 of the 44 test pits during the current investigation. Typically, refusal occurred on very dense hardpan ferricrete, ferruginised/reworked residual granite or soft rock granite.

The excavatability categories of materials identified from test pits (to a depth of 5.5m) are as follows:

- Soft Excavation (Class A): All soils (i.e. colluvium, pebble marker, pedogenic layer, residual granite).
- Intermediate excavation (Class B): On granite boulders and soft rock granite.
- Hard rock Excavation (Class C): not encountered.

In the table below the refusal depth is indicated (using an excavator) and in instances where a TLB was used (the tabulation is marked (TLB), > indicates no refusal:

Test Pit Number	Refusal Depth In m with excavator	Material At The Base Of Test Pit
1018-TP01	>5.5	Medium dense residual granite
1018-TP02	>5	Medium dense residual granite
1018-TP03	>5.8	Medium dense residual granite
1018-TP04	>6	Medium dense residual granite
1018-TP05	> 5.5	Medium dense residual granite
1018-TP06	>5	Medium dense residual granite
1018-TP07	> 4.5	Dense residual granite
1018-TP08	> 5.5	Medium dense residual granite
1018-TP09	> 5.5	Medium dense residual granite
1018-TP10	> 5.5	Medium dense slightly reworked residual granite
1018-TP11	>5.5	Medium dense residual granite
1018-TP12	>5.4	Dense reworked residual granite
1018-TP13	> 5.1	Medium dense reworked residual granite
1018-TP14	>5.1	Medium dense residual granite

Test Pit Number	Refusal Depth In m with excavator	Material At The Base Of Test Pit
1018-TP15	>5.5	Medium dense residual granite
1018-TP16	>5.5	Medium dense residual granite
1018-TP17	2.1	Refusal on Honeycomb ferricrete
1018-TP18	>5.5	Medium dense residual granite
1018-TP19	>5.3	Medium dense residual granite
1018-TP20	>5.2	Medium dense residual granite
1018-TP21	>5.2	Medium dense slightly reworked residual granite
1018-TP22	>5.3	Medium dense residual granite
1018-TP23	>5	Medium dense residual granite with cobbles, pinnacle
1018-TP24	1.95	Medium to completely weathered granite
1018-TP25	>5.5	Medium dense residual granite
1018-TP26	>4.7	Medium dense residual granite
1018-TP27	>5.5	Dense reworked residual granite
1018-TP28	>5.2	Medium dense residual granite
1018-TP29	>5.2	Medium dense slightly reworked residual granite
1018-TP30	>5.2	Medium dense slightly reworked residual granite
1018-TP31	>5.3	Medium dense reworked residual granite
1018-TP32	>5.2	Medium dense reworked residual granite
1018-TP33	>5.5	Medium dense reworked residual granite
1018-TP34	>5.3	Medium dense residual granite
1018-TP35	>5.8	Medium dense residual granite
1018-TP36	1.5	Medium weathered granite?
1018-TP37	>5	Medium dense residual granite
1018-TP38	>4.2 near refusal	Medium dense residual granite
1018-TP39	>5.2	Medium dense residual granite
1018-TP40	1.25	Soft rock granite
1018-TP41	3.05 near refusal	Highly weathered granite
1018-TP42	3.8 near refusal	Dense residual granite
1018-TP43	>5.8	Medium dense reworked residual granite
1018-TP44	>5.3	Medium dense residual granite
TP25	0.6 (TLB)	very dense strongly cemented reworked residual granite
TP31	Maximum reach with TLB	Medium dense ferruginised reworked residual granite
TP32	1.2 (TLB)	very dense ferruginised residual granite
TP33	2.3 (TLB)	very dense ferruginised reworked residual granite
TP38	1.9 (TLB)	very dense ferruginised reworked residual granite
TP40	2.3 (TLB)	very soft rock granite
TP59	Maximum reach with TLB	very soft rock consistency hardpan ferricrete

Test Pit Number	Refusal Depth In m with excavator	Material At The Base Of Test Pit
TP60	Maximum reach with TLB	medium dense ferruginised silty sand with scattered zones of residual granite
TP65	1.8 (TLB)	Very dense reworked residual granite
TP78	2.6 (TLB)	very dense residual granite
TP79	Maximum reach with TLB	Reworked residual granite
TP81	Maximum reach with TLB	Reworked residual granite
TP82	2.2 (TLB)	very dense ferruginised reworked residual granite
TP83	1.1 (TLB)	very dense reworked residual granite
TP88	1.1 (TLB)	very dense strongly ferruginised reworked residual granite
TP89	0.6 (TLB)	very soft rock quartzite
I9	1.2 (TLB)	medium and fine sand
J12	Maximum reach with TLB	Slightly ferruginised residual granite
J13	Maximum reach with TLB	Residual granite
J14	2 (TLB)	Hardpan ferricrete
K12	2 (TLB)	very dense ferruginised reworked residual granite
K13	Maximum reach with TLB	dense to very dense ferruginised hillwash

#### 7.6. Abandoned Borrow areas, Dump Rock, Waste Pits and Uncontrolled Fill (E)

Uncontrolled backfill was not intercepted in the test pits excavated during this study. However survey data indicates various sites of sand heaps and rubble etc., these are shown on Drawing 1.

#### 7.7. Seismic Activity

In terms of SANS 10160 (2012) and the seismic hazard map contained therein the site is not located in a Seismic Zone.

#### 7.8. Compaction Characteristics

Test Pit No.	Sample Depth	Soil Origin	MDD	OMC	COLTO Classification
TP25	2.1-5.5	Residual Granite	1962	10.9	>G9
TP26	2.6-4.7	Residual Granite	2028	9.2	G9
TP37	0.8-4.2	Ferruginised Reworked Residual Granite	1984	11.2	G6

Bulk soil samples were taken from the residual granite horizon (see table above) for CBR and Modified AASHTO compaction tests. The compaction test indicates that the Modified AASHTO maximum dry density (MDD) is 1962-2028kg/m<sup>3</sup> at 9.2-11.2% optimum moisture content (OMC). The residual granite has been classified as G9 (or greater) material and is not suitable for use in road layer works or earth mattresses.

The ferruginised, reworked granite (described as moist dark red blotched yellow-orange mottled black speckled white and black dense clayey silty SAND) has good compaction characteristics and classifies as G6 material. The G6-quality material may be used for sub-base in road layer works as well as the construction of engineered soil mattresses.



## 7.9. Re-Usability of Spoil: Bedding Material and Earthworks

- Selected Granular Bedding – i.e. naturally occurring non-cohesive, free draining, singularly graded gravel-soils between 0.6mm and 19.0mm particle size are not available on this site and will need to be imported.
- Selected Fill – the laboratory tests results confirm that natural soils with a PI less than 6% and/or a stones content of <30mm are available on this site.
- General Backfill –materials recovered from trench excavation works may be considered for general backfill purposes after removal or reduction of all the larger cobble and boulder size fractions.

## 8. CONCLUSIONS

### 8.1. Stand 519 (2255), 2 Storeys (Test Pits 1018-TP01, 1018-TP02, J13, TP32, TP78)

The surficial layer consists of colluvium, comprising loose to medium dense pinhole voided silty SAND. This horizon is encountered from depth of 0m extending to depth ranges of 0.5m to 0.95m with a layer thickness varying between 0.5m and 0.95m. This horizon is indicated to have a severe potential for collapse, as indicated by the collapse potential test and major settlements are anticipated if a structure is place on or within this layer.

The pebble marker comprises loose to medium dense pinhole voided silty SAND with quartzite gravel, ferricrete and manganese nodules. This horizon is encountered from depth ranges of 0.5m to 0.95m extending to depth ranges of 0.6m to 1.6m with a layer thickness varying between 0.1m and 0.8m. Experience indicates that this horizon too may be subject to settlement upon wetting and under load.

The reworked residual granite comprises loose to dense pinhole voided silty SAND with occasional ferruginization. This horizon is encountered from depth ranges of 0.6m to 1.6m extending to depth ranges of 1.2m to 2.9m with a layer thickness varying between 0.1m and 1.8m. Settlements of 5mm to 14mm can be expected upon wetting and under load.

The residual granite comprising medium dense to very dense pinhole voided silty SAND. This horizon is encountered from depth ranges of 1.2m to 2.9m extending to depth ranges of 2.4m to 5.55m with a layer thickness varying between 0.8m and 3.25m. Settlements of 1mm to 79mm can be expected upon wetting and under load.

All the above mentioned soil layers (colluvium, pebble marker, reworked residual granite and residual granite) presents a low expansiveness potential (<7.5mm).

Maximum reach of 5m to 5.5m was obtained with the excavator during the current investigation in medium dense, pinhole voided residual granite (1018 TP1 and 1018 TP2). Maximum reach of 3.0m was obtained with the use of a TLB in some test pits (TP60 and J13) in medium dense ferruginised silty sand with scattered zones of residual granite and refusal was encountered at a depth of 1.2m (TP32) and 2.6m (TP78) on very dense ferruginised residual granite and very dense residual granite.

### 8.2. Stand 520 (2256), 2 storeys (Test Pits 1018-TP03, 1018-TP04, K13)

The surficial layer consists of colluvium comprising loose to medium dense pinhole voided silty SAND with patches of ferruginization. This horizon is encountered from depth of 0m extending to depth ranges of 0.28m to 1.8m with a layer thickness varying between 0.28m and 1.8m. This horizon is indicated to have a severe potential for collapse, as indicated by the collapse potential test.

The pebble marker comprises loose pinhole voided silty SAND with quartzite gravel, ferricrete and manganese nodules. This horizon is encountered from depth ranges of 0.28m to 0.8m extending to depth ranges of 0.5m to 1.0m with a layer thickness varying between 0.2m and 0.22m. Experience indicates that this horizon too may be subject to settlement upon wetting and under load.

The reworked residual granite comprises loose to dense pinhole voided silty SAND with occasional ferruginization. This horizon is encountered from depth ranges of 0.5m to 1.0m extending to depth ranges of 1.6m to 2.1m with a layer thickness of 1.1m. Settlements of 5mm to 14mm can be expected upon wetting and under load.

The residual granite comprises medium dense to dense pinhole voided silty SAND. This horizon is encountered from depth ranges of 1.6m to 2.1m extending to depth ranges of 5.8m to 6.0m with a layer thickness varying between 3.9m and 4.2m. Settlements of 2mm to 60mm can be expected upon wetting and under load.

All the above mentioned soil layers (colluvium, pebble marker, reworked residual granite and residual granite) presents a low expansiveness potential (<7.5mm).

Maximum reach of 5.8m to 6.0m was obtained with the excavator during the current investigation in medium dense, pinhole voided residual granite (1018 TP3 and 1018 TP4). Maximum reach of 3.0m was obtained with the use of a TLB (K13) in dense to very dense ferruginised colluvium.

### **8.3. Stand 521 (2264), 2 storeys (Test Pits 1018-TP05, 1018-TP06, TP59)**

The surficial layer consists of colluvium comprising loose to medium dense pinhole voided silty SAND. This horizon is encountered from depth of 0m extending to depth ranges of 0.3m to 0.8m with a layer thickness varying between 0.3m and 0.8m. This horizon is indicated to have a severe potential for collapse, as indicated by the collapse potential test.

The pebble marker comprises medium dense pinhole voided silty SAND with quartzite gravel, ferricrete and manganese nodules. This horizon is encountered from depth ranges of 0.6m to 0.8m extending to depth ranges of 0.86m to 0.9m with a layer thickness varying between 0.1m and 0.26m. Experience indicates that this horizon too may be subject to settlement upon wetting and under load.

Isolated areas of pedogenic material with very dense honeycomb are encountered at a depth of 0.9m with layer thickness of 0.1m and refusal occurred on hardpan ferricrete at 0.3m.

The reworked residual granite comprises dense pinhole voided silty SAND with occasional ferruginization. This horizon is encountered from depth ranges of 0.86m to 1.0m extending to depth ranges of 2.4m to 3.7m with a layer thickness varying between 1.54m and 2.7m. Settlements of 7mm to 9mm can be expected upon wetting and under load.

The residual granite comprises medium dense to dense pinhole voided silty SAND. This horizon is encountered from depth ranges of 2.4m to 3.7m extending to depth ranges of 5.0m to 5.5m with a layer thickness varying between 2.3m and 3.1m. Settlements of 3mm to 98mm can be expected upon wetting and under load.

All the above mentioned soil layers (colluvium, pebble marker, reworked residual granite and residual granite) presents a low expansiveness potential (<7.5mm).

Maximum reach of 5m to 5.5m was obtained with the excavator during the current investigation in medium dense, pinhole voided residual granite (1018 TP5 and 1018 TP6). Maximum reach of 3.0m was obtained with the use of a TLB (TP59) very soft rock consistency hardpan ferricrete.

#### 8.4. Stand 522 (2261), 2 storeys (Test Pits 1018-TP07, 1018-TP08)

The surficial layer consists of colluvium comprising loose to dense pinhole voided silty SAND. This horizon is encountered from depth of 0m extending to depth ranges of 0.5m to 1.3m with a layer thickness varying between 0.5m and 1.3m. This horizon is indicated to have a severe potential for collapse, as indicated by the collapse potential test.

The pebble marker comprises medium dense pinhole voided silty SAND with quartzite gravel, ferricrete and manganese nodules. This horizon is encountered from depth ranges of 0.5m to 1.3m extending to depth ranges of 0.7m to 1.5m with a layer thickness of 0.2m. Experience indicates that this horizon too may be subject to settlement upon wetting and under load.

The reworked residual granite comprises medium dense to dense pinhole voided silty SAND with occasional ferruginization. This horizon is encountered from depth ranges of 0.7m to 1.5m extending to depth ranges of 2.6m to 2.8m with a layer thickness varying between 1.3m and 1.9m. Settlements of 6mm to 14mm can be expected upon wetting and under load.

The residual granite comprises dense pinhole voided silty SAND. This horizon is encountered from depth ranges of 2.6m to 2.8m extending to depth ranges of 4.5m to 5.5m with a layer thickness varying between 1.7m and 2.9m. Settlements of 3mm to 76mm can be expected upon wetting and under load.

All the above mentioned soil layers (colluvium, pebble marker, reworked residual granite and residual granite) presents a low expansiveness potential (<7.5mm).

Maximum reach of 4.5m to 5.5m was obtained with the excavator during the current investigation in medium dense to dense, pinhole voided residual granite (1018 TP7 and 1018 TP8).

#### 8.5. Stand 523 (2291), 2 storeys (Test Pits 1018-TP09, 1018-TP10, I9)

The surficial layer consists of colluvium comprising loose to medium dense pinhole voided silty SAND. This horizon is encountered from depth of 0m extending to depth ranges of 0.3m to 1.8m with a layer thickness varying between 0.35m and 1.8m. This horizon is indicated to have a severe potential for collapse, as indicated by the collapse potential test.

An isolated pebble marker comprises loose silty SAND with quartzite gravel and ferricrete nodules. This horizon is encountered from depth ranges of 0.45m extending to depth of 0.6m with a layer thickness of 1.5m. Experience indicates that this horizon too may be subject to settlement upon wetting and under load.

An isolated area of pedogenic material with very dense honeycomb is encountered at depth of 0.35m with layer thickness of 0.63 was encountered at TP10.

The reworked residual granite comprises medium dense to dense pinhole voided silty SAND with occasional ferruginization. This horizon is encountered from depth ranges of 0.6m to 1.8m extending to depth ranges of 1.2m to 5.5m with a layer thickness varying between 0.6m and 4.52m. Settlements of 5mm to 16mm can be expected upon wetting and under load.

The residual granite comprises medium dense pinhole voided silty SAND. This horizon is encountered from depth of 2.9m extending to depth of 5.5m with a layer thickness of 2.6m. Settlements of 4mm to 80mm can be expected upon wetting and under load.

All the above mentioned soil layers (colluvium, pebble marker, reworked residual granite and residual granite) presents a low expansiveness potential (<7.5mm).

Maximum reach of 5.5m was obtained with the excavator during the current investigation in medium dense, pinhole voided residual granite and slightly reworked residual granite (1018 TP9 and 1018 TP10). Refusal occurred with the use of a TLB on very dense reworked residual granite at 1.2m (Test Pit I9).

#### **8.6. Stand 524 (1889), 3 storeys (Test Pits 1018-TP12, 1018-TP11)**

The surficial layer consists of colluvium comprising loose to medium dense pinhole voided silty SAND. This horizon is encountered from depth of 0m extending to depth of 1.05m with a layer thickness of 1.05m. This horizon is indicated to have a severe potential for collapse, as indicated by the collapse potential test.

The pebble marker comprises loose to medium dense pinhole voided silty SAND with quartzite gravel, ferricrete and manganese nodules. This horizon is encountered from depth of 1.05m extending to depth ranges of 1.25m to 1.3m with a layer thickness varying between 0.2m and 0.25m. Experience indicates that this horizon too may be subject to settlement upon wetting and under load.

The reworked residual granite comprises loose to dense pinhole voided silty SAND with occasional ferruginization. This horizon is encountered from depth ranges of 1.25m to 1.3m extending to depth ranges of 3.8m to 5.4m with a layer thickness varying between 2.55m and 4.1m. Settlements of 11mm to 27mm can be expected upon wetting and under load.

The residual granite comprising medium dense pinhole voided silty SAND. This horizon is encountered from depth of 3.8m extending to depth of 5.5m with a layer thickness of 1.7m. Settlements of 5mm to 104mm can be expected upon wetting and under load.

All the above mentioned soil layers (colluvium, pebble marker, reworked residual granite and residual granite) presents a low expansiveness potential (<7.5mm).

Maximum reach of 5.4m and 5.5m was obtained with the excavator during the current investigation in medium dense and dense, pinhole voided residual granite and slightly reworked residual granite (1018 TP11 and 1018 TP12).

#### **8.7. Stand 525 (2051), 3 storeys (Test Pits 1018-TP13, 1018-TP14)**

The surficial layer consists of colluvium comprising loose to medium dense pinhole voided silty SAND. This horizon is encountered from depth of 0m extending to depth ranges of 0.6m to 0.7m with a layer thickness varying between 0.6m and 0.7m. This horizon is indicated to have a severe potential for collapse, as indicated by the collapse potential test.

The pebble marker comprises loose pinhole voided silty SAND with quartzite gravel, ferricrete and manganese nodules. This horizon is encountered from depth ranges of 0.6m to 0.7m extending to depth ranges of 0.8m to 0.9m with a layer thickness 0.2m. Experience indicates that this horizon too may be subject to settlement upon wetting and under load.

The reworked residual granite comprises medium dense to dense pinhole voided silty SAND with occasional ferruginization. This horizon is encountered from depth ranges of 0.8m to 0.9m extending to depth ranges of 4.1m to 5.1m with a layer thickness varying between 3.3m and 4.1m. Settlements of 18mm to 20mm can be expected upon wetting and under load.

The residual granite comprises medium dense pinhole voided silty SAND. This horizon is encountered from depth of 4.1m extending to depth of 5.1m with a layer thickness of 1.0m. Settlements of 31mm to 190mm can be expected upon wetting and under load.

All the above mentioned soil layers (colluvium, pebble marker, reworked residual granite and residual granite) presents a low expansiveness potential (<7.5mm).

Maximum reach of 5.1m was obtained with the excavator during the current investigation in medium dense and dense, pinhole voided residual granite and slightly reworked residual granite (1018 TP13 and 1018 TP14).

#### **8.8. Stand 526 (2053), 3 storeys (Test Pit 1018-TP15)**

The surficial layer consists of colluvium comprising loose to medium dense pinhole voided silty SAND. This horizon is encountered from depth of 0m extending to depth of 0.5m with a layer thickness 0.5m. This horizon is indicated to have a severe potential for collapse, as indicated by the collapse potential test.

The pebble marker comprises loose pinhole voided silty SAND with quartzite gravel, ferricrete and manganese nodules. This horizon is encountered from depth of 0.5m extending to depth of 0.8m with a layer thickness 0.2m. Experience indicates that this horizon too may be subject to settlement upon wetting and under load.

The reworked residual granite comprises medium dense to dense pinhole voided silty SAND with occasional ferruginization. This horizon is encountered from depth of 0.8m extending to depth of 2.1m with a layer thickness of 1.3m. Settlements of 17mm can be expected upon wetting and under load.

The residual granite comprises medium dense pinhole voided silty SAND. This horizon is encountered from depth of 2.1m extending to depth of 5.5m with a layer thickness of 3.4m. Settlements of 16mm to 99mm can be expected upon wetting and under load.

All the above mentioned soil layers (colluvium, pebble marker, reworked residual granite and residual granite) presents a low expansiveness potential (<7.5mm).

Maximum reach of 5.5m was obtained with the excavator during the current investigation in medium dense, pinhole voided residual granite (1018 TP15).

#### **8.9. Stand 527 (2112), 3 storeys (Test Pits 1018-TP16, TP65)**

The surficial layer consists of colluvium comprising loose to medium dense pinhole voided silty SAND. This horizon is encountered from depth of 0m extending to depth of 0.9m with a layer thickness 0.9m. This horizon is indicated to have a severe potential for collapse, as indicated by the collapse potential test.

Honeycomb ferricrete is intercepted in one of the test pits and described as dense to medium dense clayey silty SAND. This horizon is encountered from depth of 0.9m extending to depth of 1.8m with a layer thickness 0.9m.

The reworked residual granite comprises medium dense to dense pinhole voided silty SAND with occasional ferruginization. This horizon is encountered from depth of 0.9m extending to depth of 1.8m and 1.8m to 2.9m with a layer thickness of 0.9m to 1.1m. Settlements of 20mm can be expected upon wetting and under load.

The residual granite comprises medium dense pinhole voided silty SAND. This horizon is encountered from depth of 2.9m extending to depth of 5.5m with a layer thickness of 2.6m. Settlements of 22mm to 135mm can be expected upon wetting and under load.

All the above mentioned soil layers (colluvium, reworked residual granite and residual granite) presents a low expansiveness potential (<7.5mm).

Maximum reach of 5.5m was obtained with the excavator during the current investigation in medium dense, pinhole voided residual granite (1018 TP16). Refusal was attained at 1.8m

with a TLB on very dense ferruginised reworked residual granite, indicating a potentially highly variable granite rock topography.

#### **8.10. Stand 528 (2246), 3 storeys (Test Pits 1018-TP17, TP83)**

The surficial layer consists of colluvium comprising loose to medium dense pinhole voided silty SAND. This horizon is encountered from depth of 0m extending to depths of 0.7m and 0.8m. TP17 indicates a ferruginised colluvium from 0.7m to 2.1m depth. This horizon is indicated to have a severe potential for collapse, as indicated by the collapse potential test.

Reworked residual granite was encountered in Test Pit 83 and comprises medium dense weakly cemented and ferruginised silty SAND. This horizon is encountered from depth of 0.8m extending to a depth of 1.1m (0.3m thick layer). Settlements of 18mm can be expected upon wetting and under load.

All the above mentioned soil layers (colluvium, and reworked residual granite) presents a low expansiveness potential (<7.5mm).

Refusal was attained at 2.1m with the excavator during the current investigation in honeycomb ferricrete (1018 TP17).

Refusal was attained at 1.1m with a TLB on very dense reworked residual granite.

#### **8.11. Stand 529 (1816), 4 storeys (Test Pit 1018-TP18)**

The surficial layer consists of colluvium comprising loose to medium dense pinhole voided silty SAND. This horizon is encountered from depth of 0m extending to depth of 0.45m with a layer thickness 0.45m. This horizon is indicated to have a severe potential for collapse, as indicated by the collapse potential test.

The pebble marker comprises loose to medium dense pinhole voided silty SAND with quartzite gravel, ferricrete and manganese nodules. This horizon is encountered from depth of 0.45m extending to depth of 1.7m with a layer thickness 1.25m. Experience indicates that this horizon too may be subject to settlement upon wetting and under load.

The reworked residual granite comprises loose to dense pinhole voided silty SAND with occasional ferruginization. This horizon is encountered from depth of 1.7m extending to depth of 4.7m with a layer thickness of 3m. Settlements of 50mm can be expected upon wetting and under load.

The residual granite comprises medium dense pinhole voided silty SAND. This horizon is encountered from depth of 4.7m extending to depth of 5.5m with a layer thickness of 0.8m. Settlements of 66mm to 257mm can be expected upon wetting and under load.

All the above mentioned soil layers (colluvium, pebble marker, reworked residual granite and residual granite) presents a low expansiveness potential (<7.5mm).

Maximum reach of 5.5m was obtained with the excavator during the current investigation in medium dense, pinhole voided residual granite (1018 TP18).

#### **8.12. Stand 530 (1887), 4 storeys (Test Pits 1018-TP19, 1018-TP20, 1018-TP21)**

The surficial layer consists of colluvium comprising loose pinhole voided silty SAND. This horizon is encountered from depth of 0m extending to depths of 0.4m to 0.9m. This horizon is indicated to have a severe potential for collapse, as indicated by the collapse potential test.

The pebble marker comprises medium dense pinhole voided clayey silty SAND with quartzite

gravel, granite cobbles, ferricrete and manganese nodules. This horizon is encountered from depth of 0.4m to 0.9m extending to depth of 1.2m to 1.9m with a layer thickness range of 0.3m to 0.9m. Experience indicates that this horizon too may be subject to settlement upon wetting and under load.

The reworked residual granite comprises medium dense voided clayey silty SAND with occasional ferruginization. This horizon is encountered from depth of 1.2m to 1.9m extending to depths of 4.7m to 6.2m with a layer thickness range of 3m to 4.9m. Settlements of 35mm to 55mm can be expected upon wetting and under load.

The residual granite comprises medium dense intact clayey silty SAND. This horizon is encountered from depth of 4.7m to 4.9m extending to depth of 6.2m to 6.3m with a layer thickness range of 1.5m to 1.5m. Settlements of 67mm to 268mm can be expected upon wetting and under load.

All the above mentioned soil layers (colluvium, pebble marker, reworked residual granite and residual granite) presents a low expansiveness potential (<7.5mm).

Maximum reach of 5.2m to 5.3m was obtained with the excavator during the current investigation in medium dense, pinhole voided residual granite and slightly reworked residual granite (1018 TP19,- TP20, and -TP21).

#### **8.13. Stand 531 (2250), 4 storeys (Test pits 1018-TP23, 1018-TP24, 1018-TP25, J14, TP31, TP40, TP79)**

The surficial layer consists of colluvium comprising loose pinhole voided silty SAND. This horizon is encountered from surface extending to depths of 0.5m to 1.75m. This horizon is indicated to have a severe potential for collapse, as indicated by the collapse potential test.

The pebble marker comprises medium dense to dense pinhole voided silty SAND with quartzite gravel, granite cobbles, ferricrete and manganese nodules. This horizon is encountered from depth of 0.5m to 1.0m extending to depths of 0.7m to 1.6m with a layer thickness range of 0.1m to 0.6m. In sub-areas the pebble marker may even be absent. Experience indicates that this horizon too may be subject to settlement upon wetting and under load.

In sub-areas a horizon of dense honeycomb ferricrete occurs, as indicated in Test Pits TP24 and TP25. The horizon is intercepted at 0.7m to 0.9m extending to a depth of 1.1m. With the TLB refusal occurred on this horizon at 2m (TP J14).

The reworked residual granite comprises loose to medium dense voided clayey silty SAND. This horizon is encountered from depth of 0.65m to 1.6m extending to depths of 1.0m to 3m with a layer thickness range of 1.05m to 1.4m. Settlements of 17mm to 76mm can be expected upon wetting and under load.

The residual granite comprises medium dense intact clayey silty SAND. This horizon is encountered from depth of 1.1m to 2.3m extending to depth of 1.95m to 5.3m with a layer thickness range of 0.3m to 3.4m. Settlements of 28mm to 290mm can be expected upon wetting and under load.

All the above mentioned soil layers (colluvium, pebble marker, reworked residual granite and residual granite) presents a low expansiveness potential (<7.5mm).

Maximum reach of 5.0m to 5.5m was obtained with the excavator during the current investigation in medium dense, pinhole voided residual granite (1018 TP23- TP25). Refusal was recorded at 1.95m with an excavator in Test Pit TP24 at 1.95m on medium to completely weathered granite. Refusal was recorded at 2.4m with a TLB on soft rock granite. This

suggests quite a variable bedrock/hard rock profile over the stand.

#### **8.14. Stand 532 (2267), 4 storeys (Test Pits 1018-TP26, K12)**

The surficial layer consists of colluvium comprising loose pinhole voided silty SAND. This horizon is encountered from surface extending to depth of 1.0m. This horizon is indicated to have a severe potential for collapse, as indicated by the collapse potential test.

The pebble marker comprises medium dense to dense pinhole voided silty SAND with quartzite gravel, granite cobbles, ferricrete and manganese nodules. This horizon is encountered from a depth of 1.0m to a depth 1.3m. In sub-areas the pebble marker may even be absent.

The residual granite comprises medium dense to dense clayey silty SAND. This horizon is encountered from depth of 1.0m to 1.3m extending to depth of 3.7m to 4.7m with a layer thickness range of 1m to 2.6m. Settlements of 14mm to 71mm can be expected upon wetting and under load.

All the above mentioned soil layers (colluvium, pebble marker, and residual granite) presents a low expansiveness potential (<7.5mm).

Maximum reach of 4.7m was obtained with the excavator during the current investigation in medium dense, pinhole voided residual granite (1018 TP26. Refusal was recorded at 2.0m with a TLB in Test Pit K12 on very dense ferruginised reworked residual granite.

#### **8.15. Stand 533 (2280), 4 storeys (Test Pit 1018-TP27)**

The surficial layer consists of colluvium comprising loose pinhole voided slightly clayey silty SAND. This horizon is encountered from surface extending to depth of 1.0m. This horizon is indicated to have a severe potential for collapse, as indicated by the collapse potential test.

The ferruginised pebble marker comprises medium dense to dense pinhole voided clayey silty SAND with quartzite gravel, granite cobbles, ferricrete and manganese nodules. This horizon is encountered from a depth of 1.0m to a depth 1.28m. While the material is described as dense, the pinhole voided nature suggests collapse potential exists.

The reworked residual granite comprises dense clayey silty SAND. This horizon is encountered from depth of 1.28m to 5.5m with a layer thickness of 4.2m. Settlements of 37mm can be expected upon wetting and under load.

All the above mentioned soil layers (colluvium pebble marker, reworked residual granite) presents a low expansiveness potential (<7.5mm).

Maximum reach of 5.5m was obtained with the excavator during the current investigation in dense, reworked residual granite (1018 TP27).

#### **8.16. Stand 534 (2279), 4 storeys (Test Pit 1018-TP28)**

The surficial layer consists of colluvium comprising loose to medium dense pinhole voided silty SAND. This horizon is encountered from surface extending to depth of 2.0m, continuing to 2.5m with a slightly clayey composition, a loose consistency and ferruginised, thereafter to 2.4m with a dense consistency. This horizon is indicated to have a severe potential for collapse, as indicated by the collapse potential test.

The ferruginised pebble marker comprises dense pinhole voided clayey silty SAND with quartzite gravel, granite cobbles, ferricrete and manganese nodules. This horizon is encountered from a depth of 3.4m to 3.9m with a layer thickness of 0.5m. While the material



is described as dense, the pinhole voided nature suggests collapse potential exists.

The residual granite comprises medium dense clayey silty SAND. This horizon is encountered from depth of 3m to 5.2m with a layer thickness of 2.2m. Settlements of 42mm to 164mm can be expected upon wetting and under load.

All the above mentioned soil layers (colluvium, pebble marker, residual granite) presents a low expansiveness potential (<7.5mm).

Maximum reach of 5.2m was obtained with the excavator during the current investigation in medium dense, pinhole voided residual granite (1018 TP28).

#### **8.17. Stand 535 (2276), 4 storeys (Test Pits 1018-TP29, TP81)**

The surficial layer consists of colluvium comprising loose pinhole voided silty SAND. This horizon is encountered from surface extending to depth of 0.75m, continuing to 1.8m with a slightly clayey composition and a loose consistency, thereafter to 3.5m with a loose to dense consistency with depth. This horizon is indicated to have a severe potential for collapse, as indicated by the collapse potential test.

The ferruginised pebble marker comprises dense pinhole voided clayey silty SAND with quartzite gravel, granite cobbles, ferricrete and manganese nodules. This horizon is encountered from a depth of 3.5m to 3.6m with a layer thickness of 0.1m. While the material is described as dense, the pinhole voided nature suggests collapse potential exists.

The slightly reworked residual granite comprises medium dense clayey silty SAND. This horizon is encountered from depth of 3.6mm to 5.2m with a layer thickness of 1.6m. Settlements of 104mm can be expected upon wetting and under load.

All the above mentioned soil layers (colluvium, pebble marker and reworked residual granite) presents a low expansiveness potential (<7.5mm).

Maximum reach of 5.2m was obtained with the excavator during the current investigation in medium dense, slightly reworked residual granite (1018 TP29). Test Pit TP81 excavated with a TLB indicates a thinner colluvial horizon (1.6m) over a 0.6m thick pebble marker, blanketing medium dense reworked residual granite to 3m, with no refusal.

#### **8.18. Stand 536 (2273), 4 storeys (Test Pits TP81, 1018-TP30, 1018-TP31)**

The surficial layer consists of colluvium to a depth of 3.8m. This horizon comprises layers of material varying in consistency from loose to dense at the base, pinhole voided, clayey silty sand and from 1.2m and 1.8m comprises quartzite gravel, granite cobbles, ferricrete and manganese nodules. This horizon is indicated to have a severe potential for collapse, as indicated by the collapse potential test.

The reworked residual granite comprises medium dense to dense clayey silty SAND. This horizon is encountered from depth of 3.8m to 5.3m. Settlements of 109mm can be expected upon wetting and under load.

All the above mentioned soil layers (colluvium and reworked residual granite) presents a low expansiveness potential (<7.5mm).

Maximum reach of 5.2m to 5.3m was obtained with the excavator during the current investigation in medium dense, reworked residual granite (1018 TP30, and –TP31). Maximum reach was attained with a TLB in Test Pit TP81 at 3m on medium dense reworked residual granite.

#### **8.19. Stand 537 (2290), 4 storeys (Test Pits 1018-TP32, 1018-TP33, TP25)**

The surficial layer consists of colluvium to a depth of 1.25m to 1.45m. This horizon comprises layers of material varying in consistency from loose to dense at the base, pinhole voided, silty sand and a basal pebble marker comprising quartz pebbles or very dense reworked and ferruginised residual granite. This horizon is indicated to have a severe potential for collapse, as indicated by the collapse potential test.

The reworked residual granite comprises medium dense clayey silty SAND. This horizon is encountered from depth of 1.25m to 1.45m to a depth of 5.2m to 5.5m (maximum reach of excavator). Settlements of 36mm to 42mm can be expected upon wetting and under load.

All the above mentioned soil layers (colluvium and reworked residual granite) presents a low expansiveness potential (<7.5mm).

Maximum reach of 5.2m to 5.5m was obtained with the excavator during the current investigation in medium dense, reworked residual granite (1018 TP32, and –TP33). Test Pit 25 excavated with a TLB indicates a thinner colluvial horizon (0.4m) over a 0.2m thick very dense strongly cemented reworked residual granite and refusal recorded at 0.6m very dense strongly cemented reworked residual granite.

#### **8.20. Stand 538 (2273), 4 storeys (Test Pits 1018-TP34, 1018-TP35, TP15, TP60)**

The surficial layer consists of colluvium comprising loose to medium dense pinhole voided silty SAND. This horizon is encountered from surface extending to depths of 0.6m to 0.8m. This horizon is indicated to have a severe potential for collapse, as indicated by the collapse potential test.

The pebble marker comprises medium dense to dense pinhole voided silty SAND with quartzite gravel, granite cobbles, ferricrete and manganese nodules. This horizon is encountered from depth of 0.6m to 0.8m extending to depths of 0.7m to 1.25m with a layer thickness range of 0.1m to 0.4m.

In sub-areas a horizon of medium to very dense honeycomb ferricrete occurs, as indicated in Test Pit TP34. The horizon is intercepted at 0.7m extending to a depth of 0.9m.

The reworked residual granite comprises dense voided clayey silty SAND. This horizon is encountered from depth of 0.9m to 1.25m extending to depths of 3.1m to 4.4m with a layer thickness range of 2.2m to 3.15m. In Test Pit TP35 the horizon becomes medium dense to 5.5m.

The residual granite comprises medium dense voided clayey silty SAND. This horizon is encountered from depth of 3.1m to 5.5m extending to depth of 5.3m to 5.8m with a layer thickness range of 0.5m to 2.4m. Settlements of 44mm to 300mm can be expected upon wetting and under load.

All the above mentioned soil layers (colluvium, pebble marker, reworked residual granite and residual granite) presents a low expansiveness potential (<7.5mm).

The excavator did not experience refusal to 5.3m and 5.8m depth and ended in medium dense residual granite. Test Pits 15 and 60 excavated with a TLB indicate a colluvial horizon from surface to 0.5m and 0.7m over a pebble marker to 0.7m and 1.1m, in turn overlying reworked (ferruginised) residual granite to 1.7m and 1.8m depth becoming medium dense to dense and increasingly ferruginised to 3m (maximum reach of TLB).

#### **8.21. Stand 539 (2263), 4 storeys (Test Pit 1018-TP36)**

The surficial layer consists of colluvium comprising loose to medium dense pinhole voided

slightly clayey silty SAND. This horizon is encountered from surface extending to depth of 0.7m. This horizon is indicated to have a severe potential for collapse, as indicated by the collapse potential test.

The ferruginised pebble marker comprises medium dense pinhole voided clayey silty SAND with quartzite gravel, granite cobbles, ferricrete and manganese nodules. This horizon is encountered from a depth of 0.7m to a depth 0.8m. Experience indicates that this horizon too may be subject to settlement upon wetting and under load.

The reworked residual granite comprises dense clayey silty SAND. This horizon is encountered from depth of 0.8m to 1.15m with a layer thickness of 0.7m becoming very dense and ferruginised to 1.5m at which depth refusal is encountered with the excavator on hardpan ferricrete, or possibly weathered granite. Settlements of 23mm to 33mm can be expected upon wetting and under load.

All the above mentioned soil layers (colluvium, pebble marker, reworked residual granite) presents a low expansiveness potential (<7.5mm).

Refusal was attained with the excavator during the current investigation in medium weathered granite (1018 TP36).

#### **8.22. Stand 540 (2266), 4 storeys (Test Pits 1018-TP37, 1018-TP38, TH J12, TP33)**

The surficial layer consists of colluvium comprising loose pinhole voided silty SAND. This horizon is encountered from surface extending to depth of 0.3m, continuing to 0.7m with a slightly clayey composition and a medium dense consistency. This horizon is indicated to have a severe potential for collapse, as indicated by the collapse potential test.

The ferruginised pebble marker comprises medium dense pinhole voided clayey silty SAND with quartzite gravel, granite cobbles, ferricrete and manganese nodules. This horizon is encountered from a depth of 0.7m to 0.8m with a layer thickness of 0.1m. Experience indicates that this horizon too may be subject to settlement upon wetting and under load.

The slightly ferruginised reworked residual granite comprises dense clayey silty SAND. This horizon is encountered from depth of 0.8m 4.2m with a layer thickness of 2.6m. Settlements of 23mm to 127mm can be expected upon wetting and under load.

The underlying residual granite is medium dense and pinhole voided comprising a clayey silty SAND, which in places becomes dense leading to near refusal of the excavator (Test Pit TP38) at 4.2m or maximum reach to 5m. Settlements of 42mm to 164mm can be expected upon wetting and under load.

All the above mentioned soil layers (colluvium, pebble marker, reworked residual granite and residual granite) presents a low expansiveness potential (<7.5mm).

Maximum reach of 5.0m was attained with the excavator during the current investigation in medium dense, residual granite (1018 TP37) while 1018-TP38 experienced near refusal at 4.2m in medium dense residual granite. Test Pits J12 and TP33 excavated with a TLB indicate a thicker colluvial horizon (1.63m to 1.5m) over a 0.1m to 0.4m thick pebble marker, blanketing reworked residual granite to 2.1m and 2.3m. Test Pit TP33 refused at 2.3m on very dense ferruginised reworked residual granite.

#### **8.23. Stand 541 (2269), 4 storeys (Test Pit 1018-TP39)**

The surficial layer consists of colluvium comprising loose to medium dense pinhole voided silty SAND. This horizon is encountered from surface extending to depth of 0.8m. This horizon is indicated to have a severe potential for collapse, as indicated by the collapse

potential test.

The ferruginised pebble marker comprises medium dense pinhole voided clayey silty SAND with quartzite gravel, granite cobbles, ferricrete and manganese nodules. This horizon is encountered from a depth of 0.8m to a depth 1.0m. Experience indicates that this horizon too may be subject to settlement upon wetting and under load.

The ferruginised reworked residual granite comprises dense pinhole voided clayey silty SAND. This horizon is encountered from depth of 1.0m to 3.6m with a layer thickness of 2.6m. Settlements of 28mm can be expected upon wetting and under load.

The residual granite comprises medium dense pinhole voided clayey silty SAND. This horizon is encountered from depth of 3.6m to 5.2m with a layer thickness of 1.6m. Settlements of 51mm to 197mm can be expected upon wetting and under load.

All the above mentioned soil layers (colluvium, pebble marker, reworked residual granite and residual granite) presents a low expansiveness potential (<7.5mm).

Maximum reach of 5.2m was attained with the excavator during the current investigation in medium dense, residual granite (1018 TP39).

#### **8.24. Stand 542, (2271), 4 storeys (Test Pits 1018-TP40, 1018-TP41, 1018-TP42, TP38, TP76, TP88, TP89)**

The surficial layer consists of colluvium comprising medium dense pinhole voided silty SAND. This horizon is encountered from surface extending to depth of 0.3m to 0.4m, continuing to 0.7m and 1.3m with a loose consistency, and in subareas deeper from 0.8m to 1m with a medium dense consistency again. This horizon is indicated to have a severe potential for collapse, as indicated by the collapse potential test.

The ferruginised pebble marker comprises medium dense (in places loose) pinhole voided clayey silty SAND with quartzite gravel, granite cobbles, ferricrete and manganese nodules. This horizon is encountered from a depth of 1.0m and 1.5m to 1.2m to 1.6m with a layer thickness range of 0.1m to 0.2m. Experience indicates that this horizon too may be subject to settlement upon wetting and under load.

The ferruginised reworked residual granite comprises dense to very dense clayey silty SAND. This horizon is encountered from depth of 1.3m 3.6m with a layer thickness of 1.2m to 2m. In Test Pit TP40 the pebble marker is directly over medium to soft rock granite at 1.2m with refusal at 1.25m and near refusal at 3.6m in Test Pit TP41.

Test Pit TP42 indicates a dense voided clayey silty SAND (residual granite) from 3.5m to 3.8m (layer thickness of 0.3m) with near refusal at 3.8m with the excavator.

Test Pits TP76 and TP89 excavated with a TLB indicate a colluvial horizon (ground surface to 0.4m to 0.6m) over a 0.3m to 0.4m thick pebble marker, blanketing reworked residual quartzite from 0.9m to 1.4m. Test Pit TP76 refused at 1.4m on very soft rock quartzite and Test Pit 89 at 0.6m. No contact between granite and quartzite is visible on surface.

Test Pits TP38 and TP88 excavated with a TLB indicate a colluvial horizon (ground surface to 1.0m or 0.6m) over a 0.3m to 0.5m thick pebble marker, blanketing reworked residual granite to 1.9m (i.e. a 0.6m thick layer) or refusing at 1.1m on strongly ferruginised reworked residual granite, while refusing at 1.9m in very dense ferruginised reworked residual granite at Test Pit TP38.

All the above mentioned soil layers (colluvium, pebble marker, reworked residual granite) presents a low expansiveness potential (<7.5mm).

## 8.25. Stand 543 (2295), 4 storeys (Test Pits 1018-TP43, 1018-TP44, TP82)

The surficial layer consists of colluvium comprising loose (becoming medium dense with depth) pinhole voided silty SAND. This horizon is encountered from surface extending to depth of 0.5m to 0.9m. This horizon is indicated to have a severe potential for collapse, as indicated by the collapse potential test.

The ferruginised pebble marker comprises medium dense to dense pinhole voided clayey silty SAND with quartzite gravel, granite cobbles, ferricrete and manganese nodules. This horizon is encountered to 1.2m to 1.5m depth with a layer thickness range of 0.3m to 1m.

The reworked residual granite comprises dense and medium dense clayey silty SAND. This horizon is encountered from depth of 1.2m and 1.5m to 3.6m and 5.3m with a layer thickness range of 2m to 2.4m. Settlements of 35mm to 43mm can be expected upon wetting and under load.

The underlying residual granite in Test Pit TP44 is medium dense and pinhole voided comprising a clayey silty SAND to maximum reach (5.5m). Settlements of 51mm to 197mm can be expected upon wetting and under load.

All the above mentioned soil layers (colluvium, pebble marker, reworked residual granite and residual granite) presents a low expansiveness potential (<7.5mm).

Maximum reach of 5.3m to 5.8m was attained with the excavator during the current investigation in medium dense, residual granite (1018 TP43, and –TP33). Test Pit TP82 excavated with a TLB indicates a colluvial horizon (0.6m) over a 0.4m thick pebble marker, blanketing reworked residual granite to 2.2m, refusing on very dense reworked residual granite.

## 9. RECOMMENDATIONS

### 9.1. Geotechnical Soil Classification

The following sub-surface horizons occur on site:

1. Colluvium.
2. Pebble marker.
3. Pedogenic horizon (sub-areas)
4. Reworked/residual granite.
5. Residual granite.
6. Weathered granite.

The soils classification for each stand is as follows:

Stand No.	Finalised Stand No. (storeys)	Comments & Material refused on	NHBRC Soil Class	Depth of refusal and maximum reach in m	NHBRC Rock Class
519	2255 (2)	Residual granite (no refusal)	H/C2/S1-S2	>5.5	-
520	2256 (2)	Residual granite (no refusal)	H/C2/S1-S2	>6	-
521	2264 (2)	Residual granite (no refusal)	H/C2/S1-S2	>5.5	-
522	2261 (2)	Residual granite (no refusal)	H/C2/S1-S2	>5.5	-

Stand No.	Finalised Stand No. (storeys)	Comments & Material refused on	NHBRC Soil Class	Depth of refusal and maximum reach in m	NHBRC Rock Class
523	2291 (2)	Residual granite (no refusal)	H/C2/S1-S2	>5.5 (or 1.2 with TLB)	-
524	1889 (3)	Residual granite (no refusal)	H/C2/S1-S2	>5.5	-
525	2051 (3)	Residual granite (no refusal)	H/C2/S1-S2	>5.1	-
526	2053 (3)	Residual granite (no refusal)	H/C2/S1-S2	>5.5	-
527	2112 (3)	Residual granite (no refusal)	H/C2/S1-S2	>5.5 (or 1.8m with TLB)	-
528	2246 (3)	Residual granite	H/C2/S1-S2	1.1-2.1	R3
529	1816 (4)	Residual granite (no refusal)	H/C2/S1-S2	>5.5	-
530	1887 (4)	Residual granite (no refusal)	H/C2/S1-S2	>6.2	-
531	2250 (4)	Ferruginised residual reworked granite	H/C2/S1-S2	1.95->5.3 (or 2.4m with TLB)	-
532	2267 (4)	Reworked residual granite	H/C2/S1-S2	>4.7 (or 2m with TLB)	-
533	2280 (4)	Residual granite (no refusal)	H/C2/S1-S2	>5.5	-
534	2279 (4)	Residual granite (no refusal)	H/C2/S1-S2	>5.2	-
535	2276 (4)	Residual granite (no refusal)	H/C2/S1-S2	>5.2	-
536	2273 (4)	Residual granite (no refusal)	H/C2/S1-S2	>5.3	-
537	2290 (4)	Residual granite (no refusal)	H/C2/S1-S2	>5.5 (or 0.6m with a TLB)	-
538	2273 (4)	Residual granite (no refusal)	H/C2/S1-S2	>5.5	-
539	2263 (4)	Hardpan Ferricrete	H/C2/S1-S2	1.5	R3
540	2266 (4)	Residual granite (no refusal)	H/C2/S1-S2	4.2m ->5.5 (or 1.5-1.6m with TLB)	-
541	2269 (4)	Residual granite (no refusal)	H/C2/S1-S2	>5.2	-
542	2271 (4)	Residual granite (near refusal) and quartzite (geological contact not visible at ground surface)	H/C2/S1-S2	1.2-3.6 (or 1.1-1.9 with TLB)	R3
543	2295 (4)	Residual granite (no refusal)	H/C2/S1-S2	>5.5 (or 2.2m with TLB)	-
<b>Active soils (heave/shrink)</b>			<b>Expected range of total movement at surface:</b>		
H			< 7.5 mm		
H1			7.5 – 15 mm		
H2			15 – 30 mm		
H3			> 30 mm		
<b>Collapsible soils</b>			<b>Expected range of total movement at surface:</b>		
C			<5 mm		
C1			5 – 10 mm		
C2			> 10 mm		
<b>Compressible soils</b>			<b>Expected range of total movement at surface:</b>		
S			< 5 mm		
S1			5 -15 mm		
S2			> 15 mm		
R3: rock at 1.5m or shallower *soils classes to be finalised during construction-completion phase					

No groundwater or perched groundwater level was intercepted in any of the test pits excavated during this investigation.

## 9.2. Foundation Recommendations

Problematic soils and conditions were identified within the footprints of the proposed structures. The footprints are underlain by loose to medium dense and dense collapsible

materials mostly extending to depths of between 4.5m to 6m below ground surface that will cause major settlements if placed under an external load or with an increase in moisture content.

Variable subsurface conditions were encountered, with most of the test pits excavated to depths of between 4,5m to 6m without refusal with the excavator, ending in medium dense or dense residual granite. Out of the 44 test pits excavated with the excavator only 6 test pits (14%) refused or neared refusal on honeycomb ferricrete (at 2.1m), on soft rock granite (at 1.25m to 3.05m) and dense residual granite (at 3.8m to 4.2m).

Based on the existing test pits excavated with a TLB, refusal was encountered at a depth of 0.6m to 2.6m on very dense honeycomb ferricrete, very dense reworked residual granite (also ferruginised), very dense residual granite (also ferruginised) and soft rock granite in 14 of the 22 test pits excavated (64%).

The foundation recommendations are based mainly on the findings of the current investigation, as medium dense consistency soil layers were encountered below dense consistency soil layers (causing refusal of a TLB) to a maximum depth of 6m in soil profile with the excavator.

#### 9.2.1 Double Storey Structures

Double storey structures are proposed on Stands 519 to 523. A bearing capacity of approximately 80kPa is required for a double storey structure.

The use of a rationally designed stiffened reinforced concrete raft foundation is recommended. A differential settlement of 20mm related to the underlying soils should be taken into account in the design of the foundations.

The engineered earth mattress below the concrete raft foundation shall involve the removal of all in situ materials to a depth of 2m in footprint areas and up to 2m beyond the edges of the proposed foundation areas; rip and compaction of the foundation floor area to at least 95% compaction effort at optimum moisture content; backfilling in maximum 150mm thick layers with imported G5 quality material; each layer compacted to at least 98% of Modified AASHTO maximum dry density at optimum moisture content. Strict quality control of earth works is required. Records of all testing to be kept.

or Alternatively

To reduce the costs on footprint excavations and foundation design the compaction of the foundation floor area and up to 2m beyond the edges of the proposed foundation floor area by means of the Dynamic Compaction (DC) Method is recommended, after the removal of the upper 0,5m loose colluvial material. The DC programme will induce loss in soil volume. Upon completion of the DC work, rip and compact the excavation floor area to 95% compaction effort at optimum moisture content, backfilling in maximum 150mm thick layers of G5-quality material, each layer compacted to 98% of Modified AASHTO maximum dry density at optimum moisture content with conventional compaction techniques, up to the required level before placing of the raft foundation. The DC Contractor is to guarantee achievement of desired densities to a depth of 3m below natural ground level. The specification for the DC work should be performance-based with the specialist contractor appointed to undertake the works providing verification of meeting the performance requirements.

Performance requirements:

- Bearing value of at least 80kPa
- Less than 10mm of differential settlement at the applied load
- The structural engineer is to confirm that the applied loads will be within the proposed bearing value or provide alternative appropriate performance requirements

Final layer works are then to be placed as required to accommodate the RC raft foundation as per engineer's final specification.

Strict quality control of earthworks is essential.

The DC contractor should verify that there is no danger posed to the surrounding structures or infrastructure through energy transfer. Where necessary energy dissipation measures should be introduced.

#### 9.2.2 Three Storey Structures

A bearing capacity of approximately 150kPa is required for a three storey structure. Three storey structures are proposed on Stands 524 to 528.

The use of a rationally designed stiffened reinforced concrete raft foundation is recommended. The raft foundation should be placed on a 3m thick engineered earth mattress. The raft foundation should be designed to cater for at least 20mm differential settlement related to the underlain soils.

The engineered earth mattress below the concrete raft foundation shall involve the removal of all in situ materials to a depth of 3m in footprint area and up to 3m beyond the edges of the proposed foundation area; rip and compaction of the foundation floor to at least 95% compaction effort at optimum moisture content; backfilling in maximum 150mm thick layers with imported G5 quality material; each layer compacted to at least 98% of Modified AASHTO maximum dry density at optimum moisture content. Strict quality control of earth works is required. Records of all testing to be kept.

or Alternatively

To reduce the costs on footprint excavations and foundation design the compaction of the foundation floor area and up to 3m beyond the edges of the proposed foundation floor area by means of the Dynamic Compaction (DC) Method is recommended, after the removal of the upper 1.5m of material. The DC programme will induce loss in soil volume. Upon completion of the DC work, rip and compact the excavation floor area to 95% compaction effort at optimum moisture content, backfilling in maximum 150mm thick layers of G5-quality material, each layer compacted to 98% of Modified AASHTO maximum dry density at optimum moisture content with conventional compaction techniques, up to the required level before placing of the raft foundation. The DC Contractor is to guarantee achievement of desired densities to a depth of 6m below natural ground level. The specification for the DC work should be performance-based, with the specialist contractor appointed to undertake the work providing a guarantee for the DC areas to support structural foundations (150kPa) with acceptable settlement to the satisfaction of the structural engineer.

Performance requirements:

- Bearing value of at least 150kPa
- Less than 10mm of differential settlement at the applied load
- The structural engineer is to confirm that the applied loads will be within the proposed bearing value or provide alternative appropriate performance requirements

Final layer works are then to be placed as required to accommodate the RC raft foundation as per engineer's final specification.

Strict quality control of earthworks is essential.

The DC contractor should verify that there is no danger posed to the surrounding structures or infrastructure through energy transfer. Where necessary energy dissipation measures should



be introduced.

### 9.2.3 Four Storey Structures

A bearing capacity of approximately 200kPa is required for a four storey structure. Four storey structures are proposed on Stands 529 to 543.

The use of a rationally designed stiffened reinforced concrete raft foundation is recommended. The raft foundation should be placed on a 3.5m thick engineered earth mattress. The raft foundation should be designed to cater for 20mm differential settlement related to the underlain soils.

The engineered earth mattress below the concrete raft foundation shall involve the removal of all in situ materials to a depth of 3.5m in footprint areas and up to 3.5m beyond the edges of the proposed foundation area; rip and compaction of the foundation floor to at least 95% compaction effort at optimum moisture content; backfilling in maximum 150mm thick layers with imported G5 quality material; each layer compacted to at least 98% of Modified AASHTO maximum dry density at optimum moisture content. Strict quality control of earth works is required. Records of all testing to be kept.

or Alternatively

To reduce the costs on footprint excavations and foundation design the compaction of the foundation floor area and up to 3m beyond the edges of the proposed foundation floor area by means of the Dynamic Compaction (DC) Method is recommended, after the removal of the upper 1,5m of material. The DC programme will induce loss in soil volume. Upon completion of the DC work, rip and compact the excavation floor area to 95% compaction effort at optimum moisture content, backfilling in maximum 150mm thick layers of G5-quality material, each layer compacted to 98% of Modified AASHTO maximum dry density at optimum moisture content with conventional compaction techniques, up to the required level before placing of the raft foundation. The DC Contractor is to guarantee achievement of desired densities to a depth of 6m below natural ground level. The specification for the DC work should be performance-based, with the specialist contractor appointed to undertake the work providing a guarantee for the DC areas to support structural foundations (200kPa) with acceptable settlement to the satisfaction of the structural engineer. The raft foundations should be designed to cater for 10mm differential settlement related to the underlain soils in the event that it is decided to use the DC method to improve soil conditions to a depth of at least 6m below natural ground level. The specification for the DC work should be performance-based, with the specialist contractor appointed to undertake the work providing a guarantee for the DC areas to support structural foundations (200kPa) with acceptable settlement to the satisfaction of the structural engineer.

Performance requirements:

- Bearing value of at least 200kPa
- Less than 10mm of differential settlement at the applied load
- The structural engineer is to confirm that the applied loads will be within the proposed bearing value or provide alternative appropriate performance requirements

Final layer works are then to be placed as required to accommodate the RC raft foundation as per engineer's final specification.

Strict quality control of earthworks is essential.

The DC contractor should verify that there is no danger posed to the surrounding structures or infrastructure through energy transfer. Where necessary energy dissipation measures should be introduced.

It is recommended that an experienced geotechnical engineer or engineering geologist inspect the excavated foundation floor areas prior to the placing of earth mattresses and foundations to ensure that suitable foundations have been reached. Where it is found that a suitable founding medium had not been reached, deeper excavation may be recommended for certain building footprint areas. This measure will be decided on during the inspection of the base of excavations.

### 9.3. **Materials for Construction Purposes: Roadworks and Earthworks**

The **ferruginised, reworked granite** (Test Pit TP37, between 0,8m to 4,2m) has good compaction characteristics and classifies as G6-quality material. The G6-quality material may be used for sub-base in road layer works as well as the construction of engineered soil mattresses. This material can potential be improved to a G5-quality material by adding approximately 40% gravel. In the event that it is decided to use this material for construction purposes, more compaction tests will be required on this material to define the area comprising G6-quality material.

The residual granite, however classifies as G9 or higher (TP25 and TP26). The G9-quality material can only be considered for fill in road layer works.

### 9.4. **Earthworks Classifications for Service Trenches**

Excavatability problems are not anticipated to a depth of 3m with the use of an excavator for the placing of wet services.

**Shoring will be required in all open workings deeper than 1,5m.** The Resident Engineer is to inspect all shallower open works and decide on the need for shoring. Where uncertain concerning sidewall stability the geotechnical specialist should be consulted.

### 9.5. **Re-usability of Spoil for Pipe Bedding Material**

Materials recovered from trench excavation works may be considered for general backfill purposes after removal or reduction of all the larger cobble and boulder size fractions.

The residual granite may be used as selected fill where the soils have a PI less than 6% but will require removal or reduction of all the larger cobble and boulder size fractions.

The materials tested in this investigation do not comply with the SABS 1200LB criteria for selected granular bedding.

### 9.6. **Corrosion and Pipe Material**

Provision against corrosion should be made in the selection of materials to be used for wet services placed below ground surface. uPVC and HDPE pipes are not subject to corrosion however where pipes utilise steel fittings at valve and air valve chambers, corrosion protection is required to avoid compromising the lifetime of the pipeline.

### 9.7. **Trench Sidewall Stability**

Shoring may be required in trenches deeper than 1m, as specified in terms of safety requirements for excavations. In the event that there is uncertainty with respect to shoring requirements in trenches deeper than 1m, a competent person should be consulted.

All excavation slopes must be inspected by a competent person during construction to assess stability and recommended stabilizing measures, where required.

## 9.8. Additional Site Recommendations

It is generally accepted good practice to avoid any accumulation of surface waters near buildings by appropriate surface drainage design. Design should also include (minimum) 150mm freeboard, i.e. top of floor slab to top of ground level and proper attention to 'damp course' provisions. It is anticipated that structures may be negatively impacted on by 'rising damp' in service. Special attention must be paid to introducing membrane/dampcourse measures (for example, the use of 'waterproof' concretes in slab/raft foundation designs).

Structures should be articulated at strategic positions to cater for any differential movement as specified by a structural engineer.

It is recommended that a competent engineer or engineering geologist inspect the excavated footprint areas before commencing with backfilling or placing of reinforcement and concrete in order to verify anticipated conditions and to confirm a suitable founding medium had been reached for structures. The base of the excavations is to be inspected and approved by the Engineer.

Implementation of a stormwater management plan, including erosion control measures, is recommended to ensure effective and efficient removal of stormwater run-off from the site.

The use of flexible couplings for wet services at the entrance of buildings is recommended.

## 10. GENERAL

The findings in this report are based upon our interpretation of the data recovered during these investigations. While every effort has been made, within the limits of the project budget, time and present-day insight, to determine overall ground conditions on this site, poorer sub-areas may have been missed. For this reason, it is recommended that a competent specialist is always invited to inspect open works on this site in order to further confirm the findings described in this report.

# TABLES

SUMMARISED TEST PIT PROFILES	TABLE 1
SUMMARISED LABORATORY TEST RESULTS	TABLE 2

TEST PIT NUMBER	DEPTH OF SOIL HORIZONS (M) – (M)						ROCK	MATERIAL AT THE BASE OF TEST PIT
	SOIL							
	COLLUVIUM/HILLWASH (FERRUGINISED*)	PEBBLE MARKER\ (FERRUGINISED*)	PEDOGENIC (NODULAR OR HONEYCOMB)	REWORKED RESIDUAL GRANITE (FERRUGINISED*)	RESIDUAL GRANITE (FERRUGINISED*)	RESIDUAL QUARTZITE (REWORKED)		
1018-TP01	0-0.8	0.8-0.95*	-	0.95-2.3	2.3-5.5	-	-	Medium dense residual granite
1018-TP02	0-0.95	0.95-1.1*	-	1.1-2.3* 2.3-2.9	2.9-5.0	-	-	Medium dense residual granite
1018-TP03	0-0.28	0.28-0.5	-	0.5-1 1-1.6*	1.6-5.8	-	-	Medium dense residual granite
1018-TP04	0-0.8	0.8-1.0	-	1.0-2.1*	2.1-6.0	-	-	Medium dense residual granite
1018-TP05	0-0.6	0.6-0.85*	-	0.85-2.4*	2.4-5.5	-	-	Medium dense residual granite
1018-TP06	0-0.8	0.8-0.9*	0.9-1.0	1-3.7*	3.7-5	-	-	Medium dense residual granite
1018-TP07	0-1.3	1.3-1.5 1.5-1.8*	-	1.8-2.8*	2.8-4.5	-	-	Dense residual granite
1018-TP08	0-0.5	0.5-0.7	-	1.5-2.6	0.7-1.5 2.6-5.5*	-	-	Medium dense residual granite
1018-TP09	0-0.63 0.63-1.8*	-	-	1.8-2.9	2.9-5.5	-	-	Medium dense residual granite
1018-TP10	0-0.17 0.17-0.35*	-	0.35-0.98	0.98-1.9* 1.9-5.5	-	-	-	Medium dense slightly reworked residual granite
1018-TP11	0-1.05	1.05-1.25	-	1.25-1.75* 1.75-3.8	3.8-5.5	-	-	Medium dense residual granite
1018-TP12	0-1.05	1.05-1.3	-	1.3-2.0* 2.0-5.4	-	-	-	Dense reworked residual granite
1018-TP13	0-0.7	0.7-0.9*	-	0.9-1.2* 1.2-5.1	-	-	-	Medium dense reworked residual granite
1018-TP14	0-0.6	0.6-0.8*	-	0.8-1.1* 1.1-4.1	4.1-5.1	-	-	Medium dense residual granite
1018-TP15	0-0.5	0.5-0.8*	-	0.8-1.2* 1.2-2.1	2.1-5.5	-	-	Medium dense residual granite
1018-TP16	0-0.9	-	0.9-1.88	1.88-2.9	2.9-5.5	-	-	Medium dense residual granite
1018-TP17	0-0.55 0.55-2.1*	-	+2.1R	-	-	-	-	Refusal on Honeycomb ferricrete

**TABLE 1: SUMMARISED TEST PIT PROFILES**

Note: MR – Maximum Reach  
R – Refusal  
NR – No Refusal (Webb & Partners, 1986)  
PR – Partial Refusal (Webb & Partners, 1986)

TEST PIT NUMBER	DEPTH OF SOIL HORIZONS (M) – (M)						ROCK	MATERIAL AT THE BASE OF TEST PIT
	SOIL						GRANITE	
	COLLUVIUM/HILLWASH (FERRUGINISED*)	PEBBLE MARKER\ (FERRUGINISED*)	PEDOGENIC (NODULAR OR HONEYCOMB)	REWORKED RESIDUAL GRANITE (FERRUGINISED*)	RESIDUAL GRANITE (FERRUGINISED*)	RESIDUAL QUARTZITE (REWORKED)		
1018-TP18	0-1.0	1.0-1.7*	-	1.7-2.1* 2.1-4.7	4.7-5.5	-	-	Medium dense residual granite
1018-TP19	0-1.4	1.4-1.9*	-	1.9-4.9	4.9-5.3	-	-	Medium dense residual granite
1018-TP20	0-0.9	0.9-1.2*	-	1.2-2.2* 2.2-4.7	4.7-5.2	-	-	Medium dense residual granite
1018-TP21	0-0.4	0.4-1.3*	-	1.3-5.2	-	-	-	Medium dense slightly reworked residual granite
1018-TP22	0-1.0	1.0-1.5*	-	1.5-2.0 2.0-3.0*	3.0-5.3	-	-	Medium dense residual granite
1018-TP23	0-0.75	0.75-1.05	-	1.05-2.3	2.3-5.0	-	-	Medium dense residual granite with cobbles, pinnacle
1018-TP24	0-0.5	0.5-0.7*	0.7-1.1	-	1.1-1.95*	-	-	Medium to completely weathered granite
1018-TP25	0.0-0.6	0.6-0.9*	0.9-1.1	1.1-2.1	2.1-5.5	-	-	Medium dense residual granite
1018-TP26	0-1.0	1.1.3*	-	-	1.3-4.7	-	-	Medium dense residual granite
1018-TP27	0-0.4 0.4-1.0*	1.0-1.28*	-	1.28-5.5	-	-	-	Dense reworked residual granite
1018-TP28	0-2.0 2.0-3.4*	3.4-3.9*	-	-	3.9-5.2	-	-	Medium dense residual granite
1018-TP29	0-1.8 1.8-3.5*	3.5-3.6*	-	3.6-5.2	-	-	-	Medium dense slightly reworked residual granite
1018-TP30	0-1.8 1.8-2.6*	2.6-3.8*	-	3.8-5.2	-	-	-	Medium dense slightly reworked residual granite
1018-TP31	0-1.2 1.2-2.7*	2.7-3.8*	-	3.8-5.3	-	-	-	Medium dense reworked residual granite
1018-TP32	0-1.1	1.1-1.25	-	1.25-5.2	-	-	-	Medium dense reworked residual granite

**TABLE 1: SUMMARISED TEST PIT PROFILES**

Note: MR – Maximum Reach  
R – Refusal  
NR – No Refusal (Webb & Partners, 1986)  
PR – Partial Refusal (Webb & Partners, 1986)

TEST PIT NUMBER	DEPTH OF SOIL HORIZONS (M) – (M)						ROCK	MATERIAL AT THE BASE OF TEST PIT
	SOIL						GRANITE	
	COLLUVIUM/HILLWASH (FERRUGINISED*)	PEBBLE MARKER (FERRUGINISED*)	PEDOGENIC (NODULAR OR HONEYCOMB)	REWORKED RESIDUAL GRANITE (FERRUGINISED*)	RESIDUAL GRANITE (FERRUGINISED*)	RESIDUAL QUARTZITE (REWORKED)		
1018-TP33	0-0.4	-	-	0.4-1.45* 1.45-5.5	-	-	-	Medium dense reworked residual granite
1018-TP34	0-0.6	0.6-0.7	0.7-0.93	0.93-3.1*	3.1-5.3	-	-	Medium dense residual granite
1018-TP35	0-0.8	0.8-1.25	-	1.25-5.5	5.5-5.8	-	-	Medium dense residual granite
1018-TP36	0-0.7	0.7-0.8	-	0.8-1.15	1.15-1.5R	-	-	Medium weathered granite?
1018-TP37	0-0.7	0.7-0.8*	-	0.8-4.2	4.2-5.0	-	-	Medium dense residual granite
1018-TP38	0-0.7	0.7-0.8*	-	0.8-3.0*	3.0-4.2NR	-	-	Medium dense residual granite
1018-TP39	0-0.8	0.8-1.0*	-	1.0-3.6*	3.6-5.2	-	-	Medium dense residual granite
1018-TP40	0-1.0	1-1.2*	-	-	-	-	1.2-1.25R	Soft rock granite
1018-TP41	0-1.3	1.3-1.6*	-	1.6-3.65*NR	-	-	-	Highly weathered granite
1018-TP42	0-0.7	0.7-1.3*	-	1.3-3.5*	3.5-3.8NR	-	-	Dense residual granite
1018-TP43	0-0.5	0.5-1.5*	-	1.5-5.5	-	-	-	Medium dense reworked residual granite
1018-TP44	0-0.2 0.2-0.9*	0.9-1.2*	-	1.2-3.6	3.6-5.3	-	-	Medium dense residual granite
<b>CP TEST PITS</b>								
TP25	0.0-0.4	-	-	0.4-0.6R	-	-	-	very dense strongly cemented reworked residual granite
TP31	0-0.8	-	-	0.8-1.7 1.7-3.0*	-	-	-	Medium dense ferruginised reworked residual granite
TP32	0-0.9	0.9-1.1	-	1.1-1.2R	-	-	-	very dense ferruginised residual granite

**TABLE 1: SUMMARISED TEST PIT PROFILES**

Note: MR – Maximum Reach  
R – Refusal  
NR – No Refusal (Webb & Partners, 1986)  
PR – Partial Refusal (Webb & Partners, 1986)

TEST PIT NUMBER	DEPTH OF SOIL HORIZONS (M) – (M)						ROCK	MATERIAL AT THE BASE OF TEST PIT
	SOIL						GRANITE	
	COLLUVIUM/HILLWASH (FERRUGINISED*)	PEBBLE MARKER (FERRUGINISED*)	PEDOGENIC (NODULAR OR HONEYCOMB)	REWORKED RESIDUAL GRANITE (FERRUGINISED*)	RESIDUAL GRANITE (FERRUGINISED*)	RESIDUAL QUARTZITE (REWORKED)		
TP33	0-1.5	1.5-1.9	-	1.9-2.3R	-	-	-	very dense ferruginised reworked residual granite
TP38	0-1	1.1.3	-	1.3-1.9R	-	-	-	very dense ferruginised reworked residual granite
TP40	0-0.5	0.5-0.65	-	0.65-1.2 1.2-2*	2-2.3R	-	-	very soft rock granite
TP59	0-0.3	-	-	-	-	-	-	very soft rock consistency hardpan ferricrete
TP60	0-0.5	0.5-0.7	-	0.7-1.8 1.8-3*	-	-	-	medium dense ferruginised silty sand with scattered zones of residual granite
TP65	0-0.6 0.6-0.9*	-	-	0.9-1.8R	-	-	-	Very dense reworked residual granite
TP76	0-0.6	0.6-0.9	-	-	-	0.9-1.4R	-	very soft rock quartzite
TP78	0-0.8 0.8-1.6*	1.6-2.4	-	2.4-2.6R	-	-	-	very dense residual granite
TP79	0-1	1-1.6	-	1.6-3	-	-	-	Reworked residual granite
TP81	0-1.6	1.6-2.2	-	2.2-3	-	-	-	Reworked residual granite
TP82	0-0.6	0.6-1	-	1-2.2R	-	-	-	very dense ferruginised reworked residual granite
TP83	0-0.8	-	-	0.8-1.1R	-	-	-	very dense reworked residual granite
TP88	0-0.6	0.6-1.1R	-	-	-	-	-	very dense strongly

**TABLE 1: SUMMARISED TEST PIT PROFILES**

Note: MR – Maximum Reach  
R – Refusal  
NR – No Refusal (Webb & Partners, 1986)  
PR – Partial Refusal (Webb & Partners, 1986)



TEST PIT NUMBER	DEPTH OF SOIL HORIZONS (M) – (M)						ROCK	MATERIAL AT THE BASE OF TEST PIT
	SOIL						GRANITE	
	COLLUVIUM/HILLWASH (FERRUGINISED*)	PEBBLE MARKER\ (FERRUGINISED*)	PEDOGENIC (NODULAR OR HONEYCOMB)	REWORKED RESIDUAL GRANITE (FERRUGINISED*)	RESIDUAL GRANITE (FERRUGINISED*)	RESIDUAL QUARTZITE (REWORKED)		
								ferruginised reworked residual granite
TP89	0-0.4	0.4-0.6R	-	-	-	-		very soft rock quartzite
<b>INTRACONSULT TEST PITS-</b>								
I9	0-0.45	0-45-0.6	-	-	0.6-1.2R	-	-	medium and fine sand
J12	0-1.3	1.3-1.45	-	1.45-2.00 2.00-2.1*	-	-	-	Slightly ferruginised residual granite
J13	0-0.5	0.5-0.6	-	0.6-1.6*	1.6-2.4	-	-	Residual granite
J14	0-0.3 0.3-1.2 1.2-1.75*	-	1.75-2.0R	-	-	-	-	Hardpan ferricrete
K12	0-0.85 0.85-1*	-	-	1-2*NR	-	-	-	very dense ferruginised reworked residual granite
K13	0-0.3 0.3-1.5 1.5-1.8*NR	-	-	-	-	-	-	dense to very dense ferruginised hillwash

**TABLE 1: SUMMARISED TEST PIT PROFILES**

Note: MR – Maximum Reach  
R – Refusal  
NR – No Refusal (Webb & Partners, 1986)  
PR – Partial Refusal (Webb & Partners, 1986)

TEST PIT No.	SAMPLE DEPTH (m)	GRADING (% PASSING)				ATTERBERG LIMITS			POTENTIAL EXPANSIVENESS	USC	GM	CBR AT % COMPACTION			MODIFIED AASHTO COMPACTION		ORIGIN
		SIEVE SIZE (mm)				LL						95	97	98	MDD (kg/m³)	OMC (%)	
		2,0	0,425	0,075	0,002	LL (%)	PI (%)	LS (%)									
TP01	2.3-5.5	97	57	32	4	25	4	1.5	LOW	SM/SC						Residual granite	
TP03	1.6-4.5	93	55	38	12	33	10	3.5	LOW	SC						Residual granite	
TP03	4.5-5.8	95	55	36	9	29	7	2	LOW	SM/SC						Residual granite	
TP07	1.8-2.8	91	64	43	6	31	11	4.5	LOW	SC						Reworked residual granite	
TP07	2.8-4.5	91	52	27	7	25	7	2	LOW	SM/SC						Residual granite	
TP08	2.6-5.5	82	69	48	10	47	16	6	LOW-MEDIUM	SM						Ferruginised residual granite	
TP10	1.9-5.50	91	50	34	15	34	12	6	LOW	SC						Reworked Residual granite	
TP11	2.45-3.80	91	56	34	8	32	11	4	LOW	SC						Reworked Residual granite	
TP13	1.90-3.30	89	51	39	11	39	14	7	LOW	SC						Reworked residual granite	
TP17	0.76-1.60	94	56	33	4	-	NP	0	LOW	SM						Colluvium	
TP18	1.00-2.10	59	45	36	14	37	14	7	LOW	SC						Pebble Marker	
TP20	3.40-4.70	87	53	39	10	34	11	5	LOW	SC						Reworked residual granite	
TP23	1.05-2.3	90	68	52	15	33	14	6.5	LOW	CL						Reworked residual granite	
TP24	1.1-1.95	79	46	29	6	24	7	2	LOW	SM/SC						Ferruginised residual granite	
TP25	2.1-5.5	97	64	46	12	33	9	3	LOW	SM	0.93	3	3	4	1962	10.9	Residual granite
TP26	1.3-2.6	86	59	44	9	30	8	4	LOW	SC							Ferruginised Pebble Marker
TP26	2.6-4.7	94	49	30	13	30	13	5	LOW	SC	1.27	13	20	26	2028	9.2	Residual granite
TP28	3.90-5.20	95	50	34	11	36	13	5.5	LOW	SC							Residual granite
TP30	0.50-1.80	96	76	57	25	32	9	4.5	LOW	CL							Colluvium

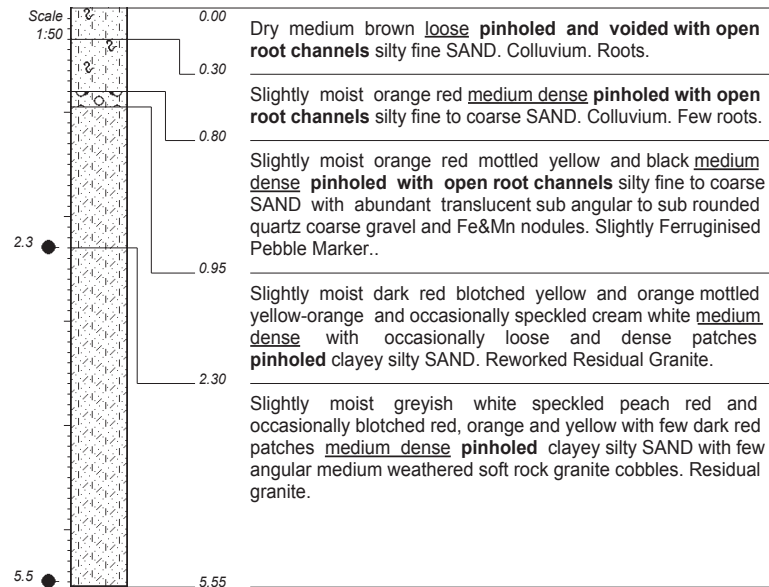
**TABLE 2: SUMMARISED LABORATORY TEST RESULTS**

LL	: Liquid Limit	OMC	: Optimum Moisture Content
PI	: Plasticity Index	CBR	: California Bearing Ratio
LS	: Linear Shrinkage	GC	: Clayey Gravels
GM	: Grading Modulus	SC	: Clayey Sands
USC	: Unified Soil Classification	CL	: Sandy Clays
MDD	: Maximum Dry Density	ML	: Clayey Silts

TEST PIT No.	SAMPLE DEPTH (m)	GRADING (% PASSING)				ATTERBERG LIMITS			POTENTIAL EXPANSIVE-NESS	USC	GM	CBR AT % COMPACTION			MODIFIED AASHTO COMPACTION		ORIGIN
		SIEVE SIZE (mm)				(%)						95	97	98	MDD (kg/m³)	OMC (%)	
		2,0	0,425	0,075	0,002	LL (%)	PI (%)	LS (%)									
TP30	3.80-5.20	92	52	36	8	33	14	5.5	LOW	SC						Residual granite	
TP30	2.30-3.80	74	53	40	10	37	12	5	LOW	SM						Pebble Marker	
TP34	0.93-3.10	92	69	42	15	35	12	5	LOW	SC						Ferruginised Reworked Residual granite	
TP34	3.10-5.30	95	53	33	6	29	7	2.5	LOW	SM & SC						Residual granite	
TP37	0.8-4.2	83	62	48	15	34	10	5	LOW	SM	1.08	30	46	58	1984	11.2	Reworked residual granite
TP39	3.6-5.2	95	48	30	6	29	8	3	LOW	SC						Residual granite	
TP41	0.3-5.2	88	64	37	10	26	6	3	LOW	SM/SC						Residual granite	
TP42	1.3-3.5	71	56	34	7	32	9	4	LOW	SC						Ferruginised reworked residual granite	
TP43	1.50-2.90	88	57	41	10	37	12	5.5	LOW	SM						Reworked Residual granite	
<b>Existing laboratory work</b>																	
TP31	0.3-0.5	95	71	51	27	27	11	5.5	LOW	CL						Colluvium	
TP60	0,7-1.8	74	62	47	9	32	11	6	LOW	SC						Reworked residual granite	
TP76	0.9-1.4	69	43	21	3	31	8	5	LOW	SC						Residual quartzite	
TP79	1.6-3.0	82	45	27	4	32	9	5	LOW	SC						Reworked residual granite	
TP82	1.0-2.2	98	74	47	6	35	8	4	LOW	SM						Reworked residual granite	
J12	1.0	98	76	56	27	31.5	9.4	4	LOW	CL						Colluvium	

# **APPENDICES**

TEST PIT PROFILES  
LABORATORY TEST RESULTS



NOTES

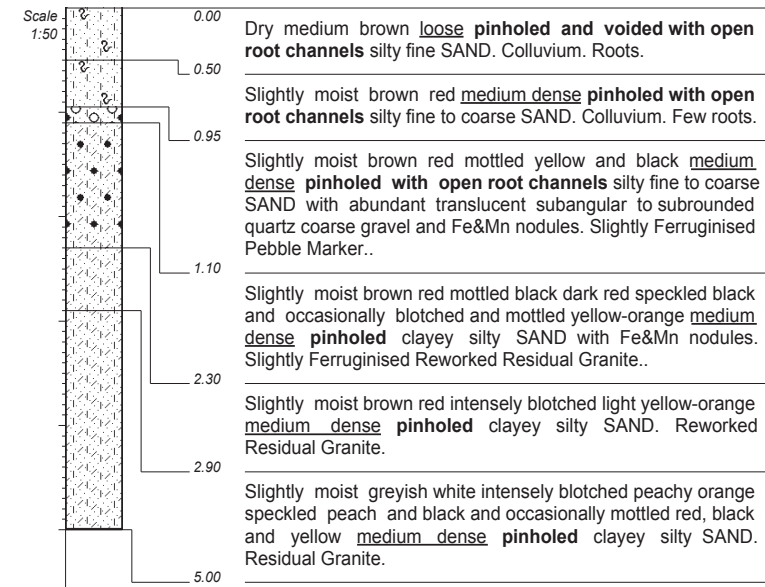
- 1) Small bag sample taken between 2.3 m to 5.5 m
- 2) Stable sidewalls
- 3) No groundwater intercepted
- 4) Lo 29 E (+ is west of Lo and - east of Lo), positions determined in ARC GIS

CONTRACTOR : RIVIERA PLANT HIRE  
MACHINE : CAT 320D L (110 kW) excavator† SIZE : TRENCH  
ELEVATION : 1639 m AMSL  
X-COORD : 2880434  
Y-COORD : 76099

PROFILED BY : D. SWART DATE : 2018/09/26  
TYPE SET BY : N. TROLLIP DATE : 05/11/18 09:07  
SETUP FILE : TESTPITS.SET TEXT : ..C:\DOTFILES\201811~1.TXT

HOLE No: TP01

D055 DBB dot.PLOT 5006 J&W



NOTES

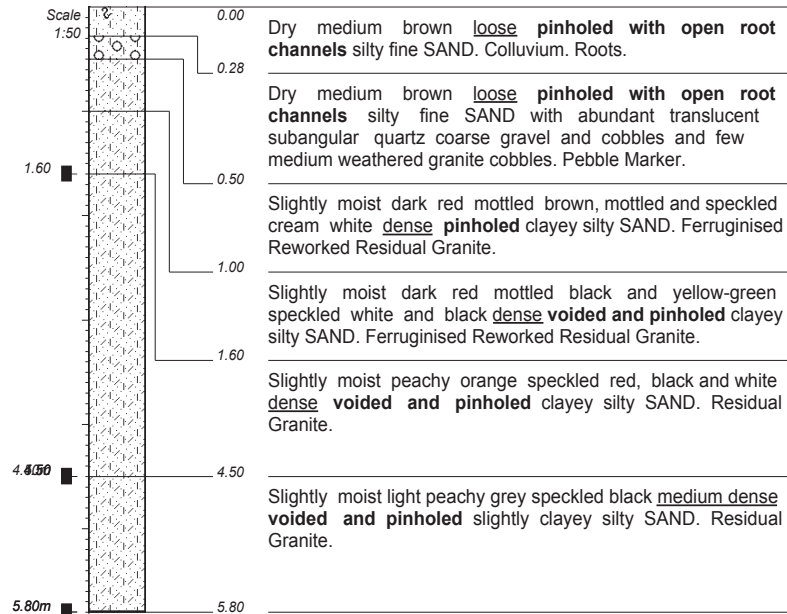
- 1) No samples
- 2) Stable sidewalls
- 3) No groundwater intercepted
- 4) Lo 29 E (+ is west of Lo and - east of Lo), positions determined in ARC GIS

CONTRACTOR : RIVIERA PLANT HIRE  
MACHINE : CAT 320D L (110 kW) excavator† SIZE : TRENCH  
ELEVATION : 1640 m AMSL  
X-COORD : 2880422  
Y-COORD : 76004

PROFILED BY : D. SWART DATE : 2018/09/26  
TYPE SET BY : N. TROLLIP DATE : 05/11/18 09:07  
SETUP FILE : TESTPITS.SET TEXT : ..C:\DOTFILES\201811~1.TXT

HOLE No: TP02

D055 DBB dot.PLOT 5006 J&W



NOTES

- 1) Small bag sample 1.60 - 4.50m and 4.50 - 5.80m, undisturbed sample 4.50 - 5.80m
- 2) Stable sidewalls
- 3) No groundwater intercepted
- 4) Lo 29 E (+ is west of Lo and - east of Lo), positions determined in ARC GIS

CONTRACTOR : RIVIERA PLANT HIRE  
MACHINE : CAT 320D L (110 kW) excavator†

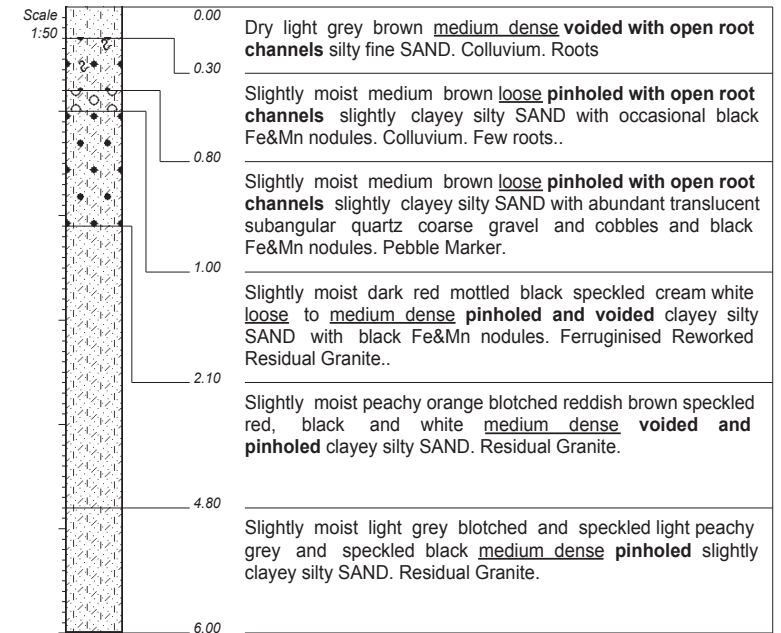
SIZE : TRENCH

ELEVATION : 1643 m AMSL  
X-COORD : 2880453  
Y-COORD : 75902

PROFILED BY : D. SWART  
TYPE SET BY : N. TROLLIP  
SETUP FILE : TESTPITS.SET

DATE : 2018/09/25  
DATE : 05/11/18 09:07  
TEXT : ..C:\DOTFILES\201811~1.TXT

HOLE No: TP03



NOTES

- 1) No samples taken
- 2) Stable sidewalls
- 3) No groundwater intercepted
- 4) Lo 29 E (+ is west of Lo and - east of Lo), positions determined in ARC GIS

CONTRACTOR : RIVIERA PLANT HIRE  
MACHINE : CAT 320D L (110 kW) excavator†

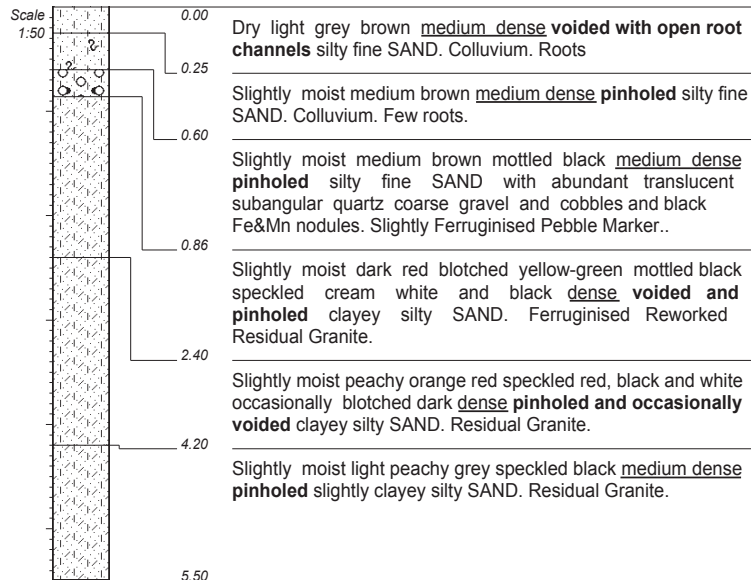
SIZE : TRENCH

ELEVATION : 1642 m AMSL  
X-COORD : 2880391  
Y-COORD : 75851

PROFILED BY : D. SWART  
TYPE SET BY : N. TROLLIP  
SETUP FILE : TESTPITS.SET

DATE : 2018/09/25  
DATE : 05/11/18 09:07  
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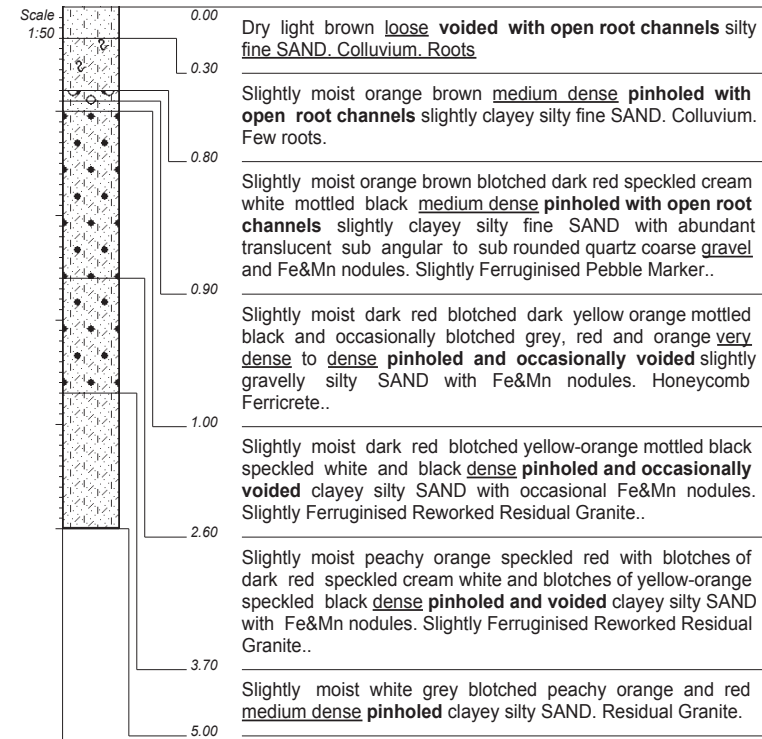
HOLE No: TP04



NOTES

- 1) No sample taken
- 2) Stable sidewalls
- 3) No groundwater intercepted
- 4) Lo 29 E (+ is west of Lo and - east of Lo), positions determined in ARC GIS

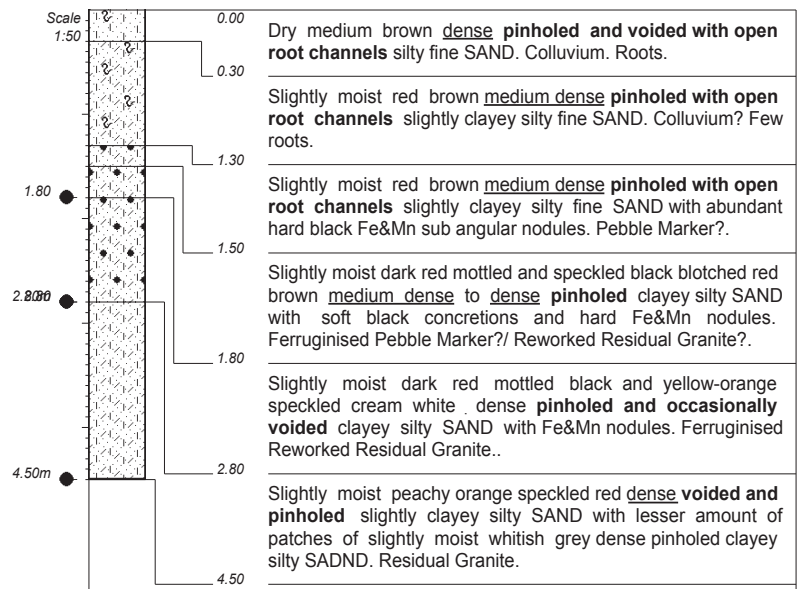
CONTRACTOR : RIVIERA PLANT HIRE  
MACHINE : CAT 320D L (110 kW) excavator† SIZE : TRENCH  
ELEVATION : 1643 m AMSL  
X-COORD : 2880541  
Y-COORD : 75863  
PROFILED BY : D. SWART DATE : 2018/09/25  
TYPE SET BY : N. TROLLIP DATE : 05/11/18 09:07  
SETUP FILE : TESTPITS.SET TEXT : ..C:\DOTFILES\201811~1.TXT  
HOLE No: TP05  
D055 DBB dot.PLOT 5006 J&W



NOTES

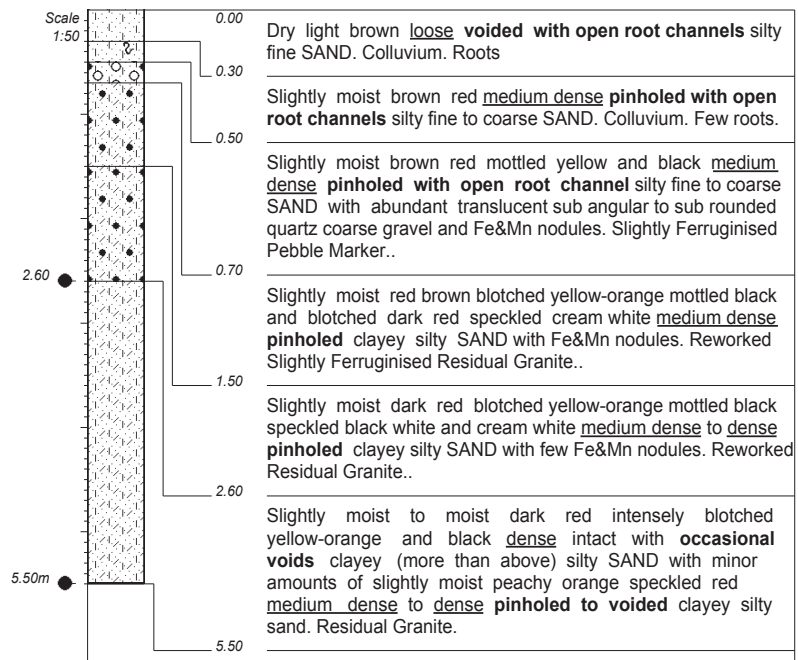
- 1) No sample taken
- 2) Stable sidewalls
- 3) No groundwater intercepted
- 4) Lo 29 E (+ is west of Lo and - east of Lo), positions determined in ARC GIS

CONTRACTOR : RIVIERA PLANT HIRE  
MACHINE : CAT 320D L (110 kW) excavator† SIZE : TRENCH  
ELEVATION : 1643 m AMSL  
X-COORD : 2880576  
Y-COORD : 75918  
PROFILED BY : D. SWART DATE : 2018/09/26  
TYPE SET BY : N. TROLLIP DATE : 05/11/18 09:07  
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HOLE No: TP06  
D055 DBB dot.PLOT 5006 J&W



NOTES

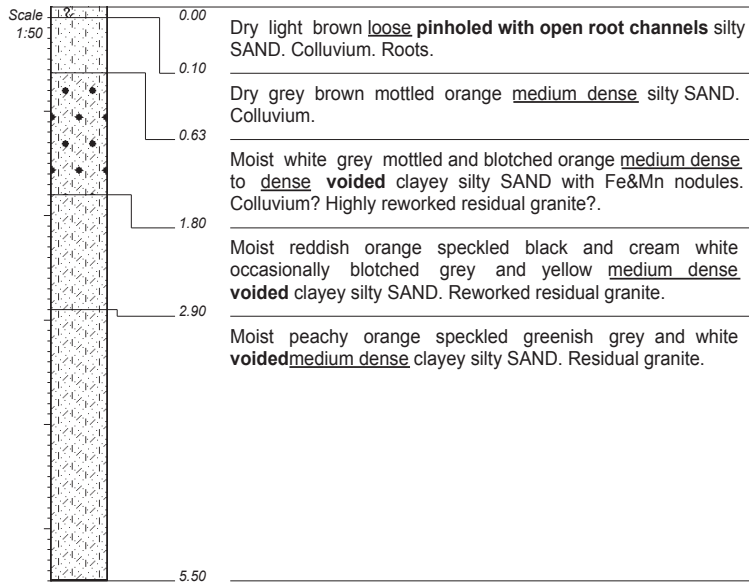
- 1) Small bag sample 2.80 - 4.50m and 1.80 - 2.80m
- 2) Stable sidewalls
- 3) No groundwater intercepted
- 4) Lo 29 E (+ is west of Lo and - east of Lo), positions determined in ARC GIS



NOTES

- 1) Small bag sample 2.60 - 5.50m
- 2) Stable sidewalls
- 3) No groundwater intercepted
- 4) Lo 29 E (+ is west of Lo and - east of Lo), positions determined in ARC GIS





NOTES

- 1) No sample
- 2) Stable sidewalls
- 3) No groundwater intercepted
- 4) Lo 29 E (+ is west of Lo and - east of Lo), positions determined in ARC GIS

CONTRACTOR : RIVIERA PLANT HIRE  
MACHINE : CAT 320D L (110 kW) excavator†

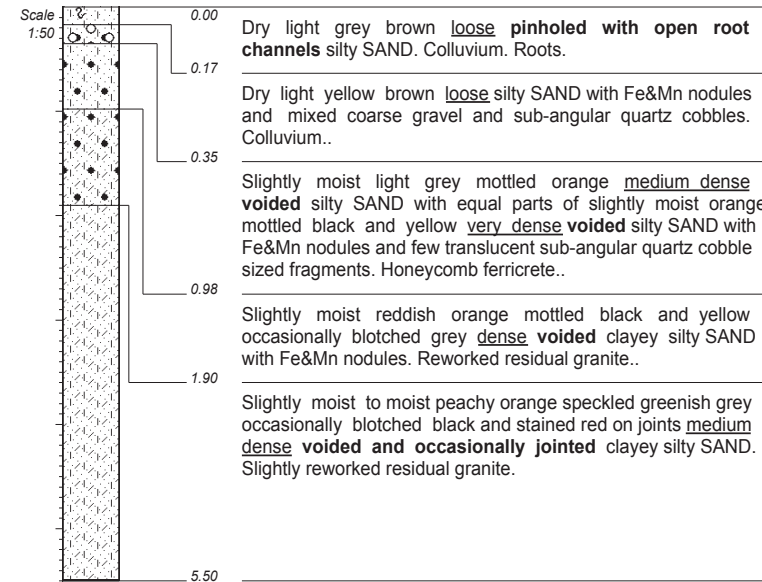
SIZE : TRENCH

ELEVATION : 1630 m AMSL  
X-COORD : 2881270  
Y-COORD : 75841

PROFILED BY : D. SWART  
TYPE SET BY : N. TROLLIP  
SETUP FILE : TESTPITS.SET

DATE : 2018/10/30  
DATE : 05/11/18 09:07  
TEXT : ..C:\DOTFILES\201811~1.TXT

HOLE No: TP09



NOTES

- 1) No sample
- 2) Stable sidewalls
- 3) No groundwater intercepted
- 4) Lo 29 E (+ is west of Lo and - east of Lo), positions determined in ARC GIS

CONTRACTOR : RIVIERA PLANT HIRE  
MACHINE : CAT 320D L (110 kW) excavator†

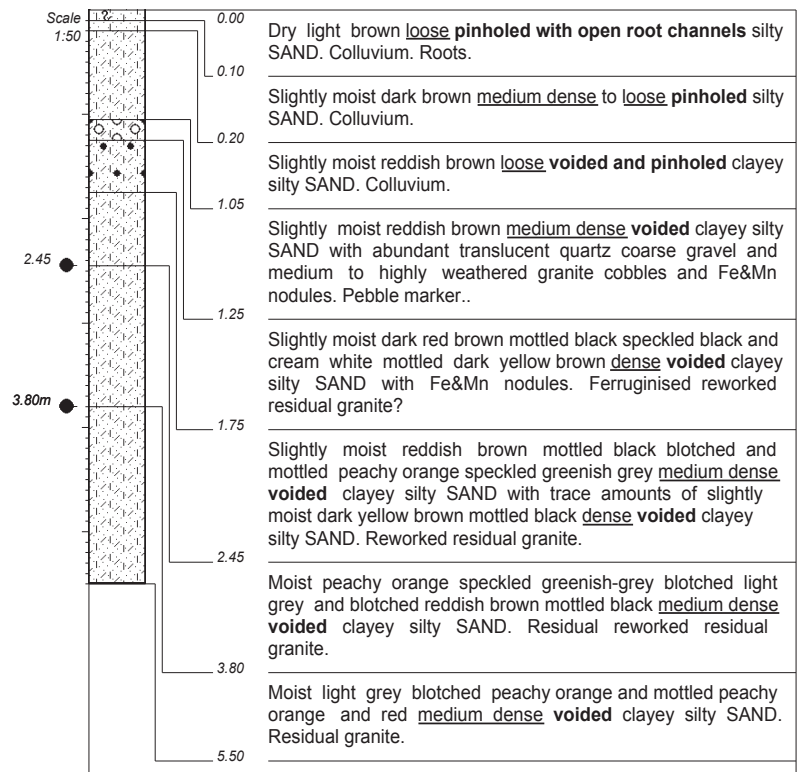
SIZE : TRENCH

ELEVATION : 1625 m AMSL  
X-COORD : 2881346  
Y-COORD : 75873

PROFILED BY : D. SWART  
TYPE SET BY : N. TROLLIP  
SETUP FILE : TESTPITS.SET

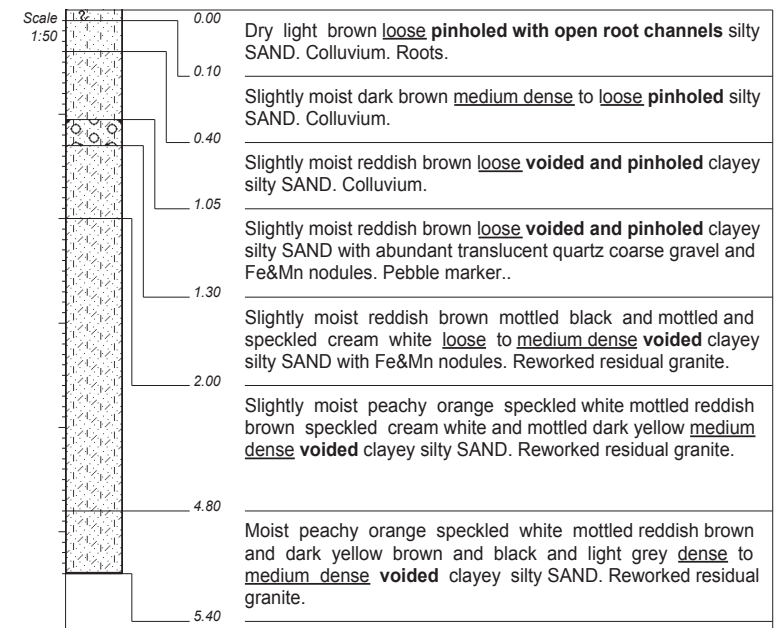
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DATE : 05/11/18 09:07  
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HOLE No: TP10



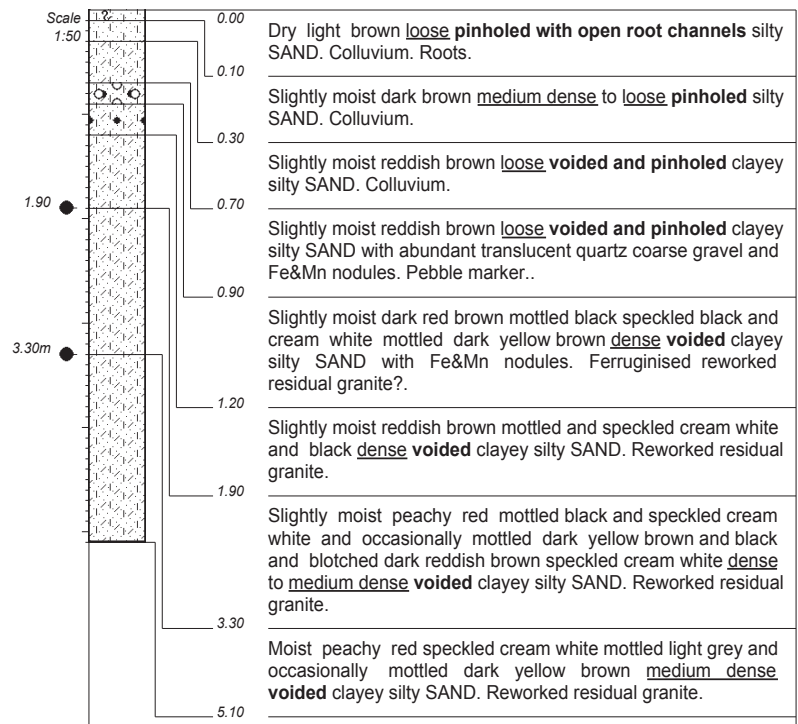
- NOTES
- 1) Maximum reach
  - 2) Block sample at 2.45 - 3.80m
  - 3) Small bag sample at 2.45 - 3.80m
  - 4) Stable sidewalls
  - 5) No groundwater intercepted
  - 6) Lo 29 E (+ is west of Lo and - east of Lo), positions determined in ARC GIS

CONTRACTOR : RIVIERA PLANT HIRE  
MACHINE : CAT 320D L (110 kW) excavator† SIZE : TRENCH  
ELEVATION : 1631 m AMSL  
X-COORD : 2880802  
Y-COORD : 76341  
PROFILED BY : D. SWART DATE : 2018/10/24  
TYPE SET BY : N. TROLLIP DATE : 05/11/18 09:07  
SETUP FILE : TESTPITS.SET TEXT : ..C:\DOTFILES\201811~1.TXT  
HOLE No: TP11  
D055 DBB dot.PLOT 5006 J&W



- NOTES
- 1) Maximum reach
  - 2) No sample
  - 3) Stable sidewalls
  - 4) No groundwater intercepted
  - 5) Lo 29 E (+ is west of Lo and - east of Lo), positions determined in ARC GIS

CONTRACTOR : RIVIERA PLANT HIRE  
MACHINE : CAT 320D L (110 kW) excavator† SIZE : TRENCH  
ELEVATION : 1630 m AMSL  
X-COORD : 2880848  
Y-COORD : 76320  
PROFILED BY : D. SWART DATE : 2018/10/24  
TYPE SET BY : N. TROLLIP DATE : 05/11/18 09:07  
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HOLE No: TP12  
D055 DBB dot.PLOT 5006 J&W



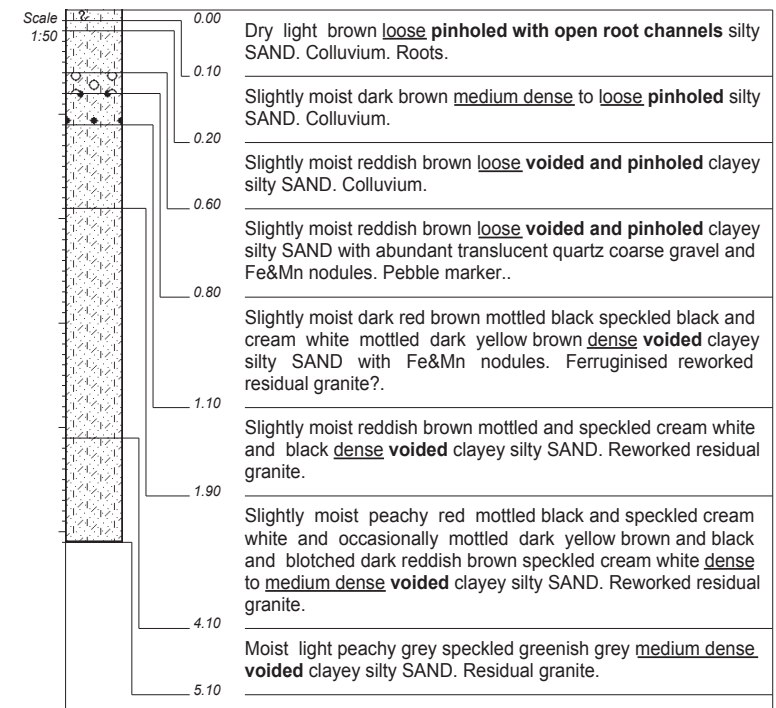
NOTES

- 1) Maximum reach
- 2) Small bag sample at 1.90 - 3.30m
- 3) Stable sidewalls
- 4) No groundwater intercepted
- 5) Lo 29 E (+ is west of Lo and - east of Lo), positions determined in ARC GIS

CONTRACTOR : RIVIERA PLANT HIRE  
MACHINE : CAT 320D L (110 kW) excavator† SIZE : TRENCH  
ELEVATION : 1630 m AMSL  
X-COORD : 2880921  
Y-COORD : 76278  
HOLE No: TP13

PROFILED BY : D. SWART DATE : 2018/10/24  
TYPE SET BY : N. TROLLIP DATE : 05/11/18 09:07  
SETUP FILE : TESTPITS.SET TEXT : ..C:\DOTFILES\201811~1.TXT

D055 DBB dot.PLOT 5006 J&W



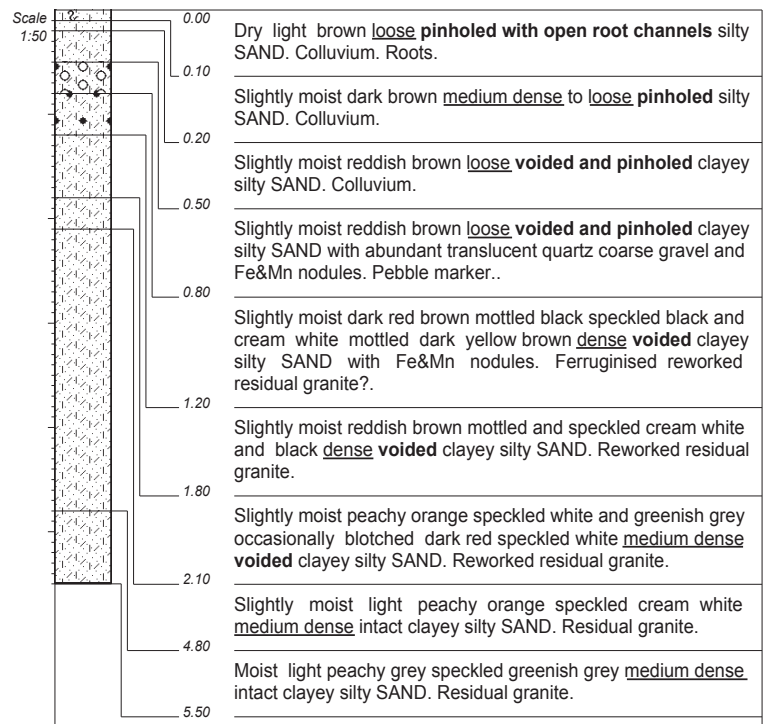
NOTES

- 1) Maximum reach
- 2) No sample
- 3) Stable sidewalls
- 4) No groundwater intercepted
- 5) Lo 29 E (+ is west of Lo and - east of Lo), positions determined in ARC GIS

CONTRACTOR : RIVIERA PLANT HIRE  
MACHINE : CAT 320D L (110 kW) excavator† SIZE : TRENCH  
ELEVATION : 1631 m AMSL  
X-COORD : 2880967  
Y-COORD : 76258  
HOLE No: TP14

PROFILED BY : D. SWART DATE : 2018/10/24  
TYPE SET BY : N. TROLLIP DATE : 05/11/18 09:07  
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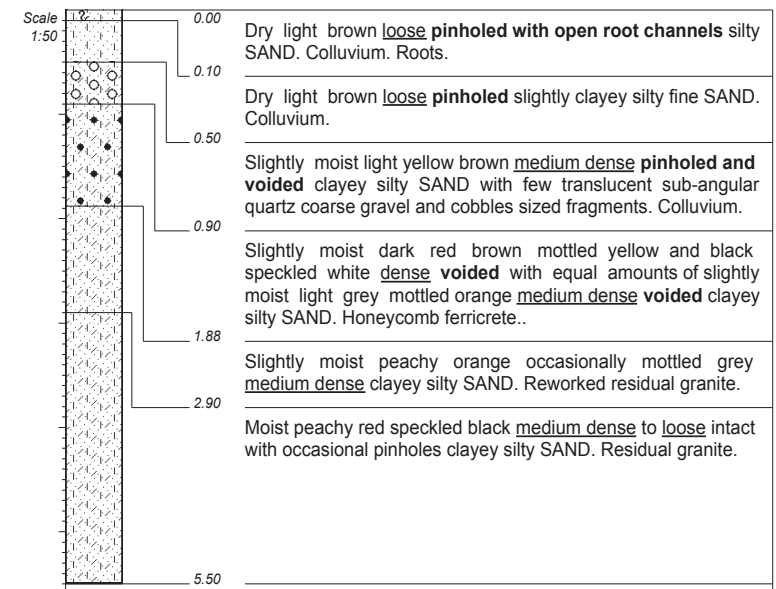
D055 DBB dot.PLOT 5006 J&W



NOTES

- 1) No sample
- 2) Stable sidewalls
- 3) No groundwater intercepted
- 4) Lo 29 E (+ is west of Lo and - east of Lo), positions determined in ARC GIS

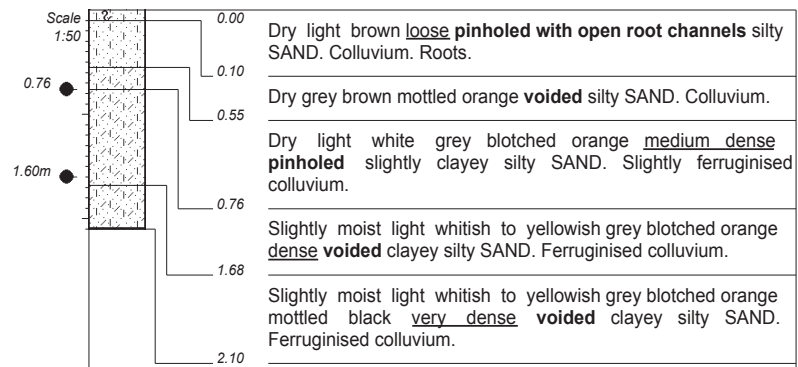
CONTRACTOR : RIVIERA PLANT HIRE  
MACHINE : CAT 320D L (110 kW) excavator† SIZE : TRENCH  
ELEVATION : 1631 m AMSL  
X-COORD : 2881038  
Y-COORD : 76268  
PROFILED BY : D. SWART DATE : 2018/10/30  
TYPE SET BY : N. TROLLIP DATE : 05/11/18 09:07  
SETUP FILE : TESTPITS.SET TEXT : ..C:\DOTFILES\201811~1.TXT  
HOLE No: TP15  
D055 DBB dot.PLOT 5006 J&W



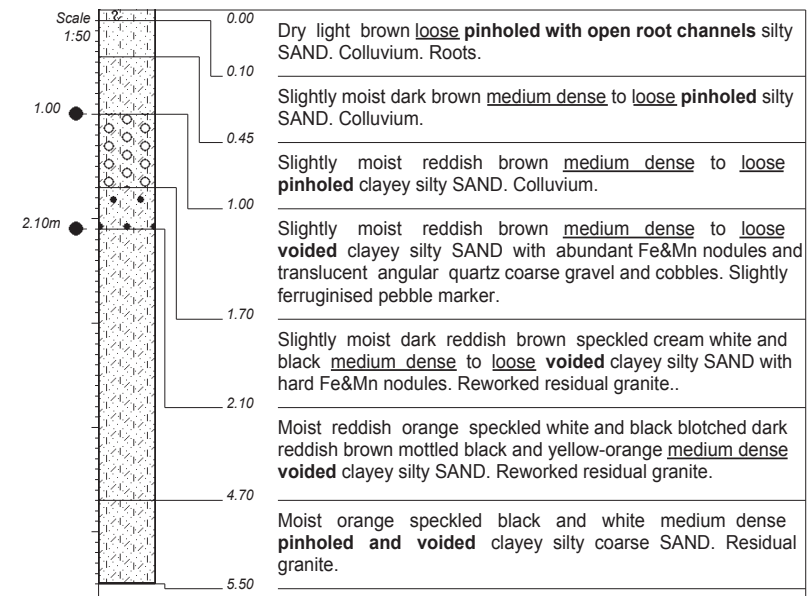
NOTES

- 1) No sample
- 2) Stable sidewalls
- 3) No groundwater intercepted
- 4) Lo 29 E (+ is west of Lo and - east of Lo), positions determined in ARC GIS

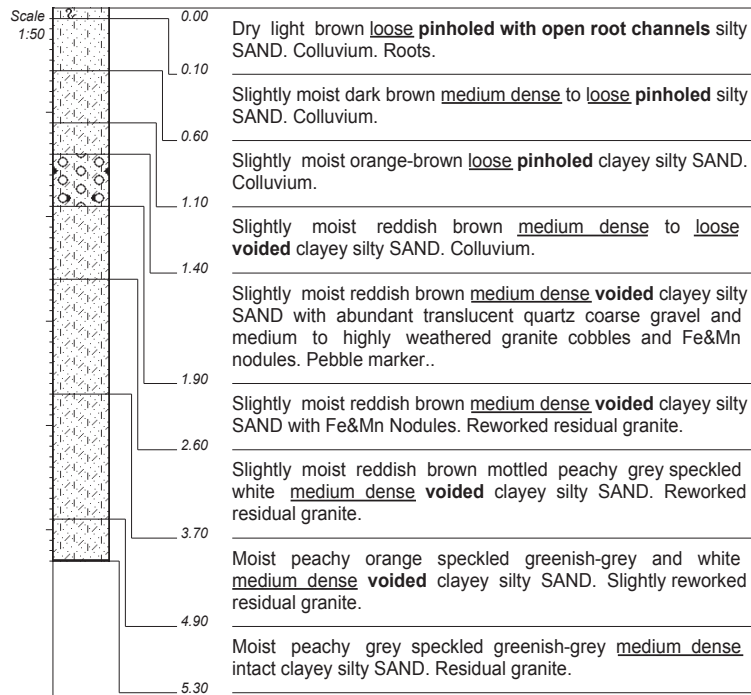
CONTRACTOR : RIVIERA PLANT HIRE  
MACHINE : CAT 320D L (110 kW) excavator† SIZE : TRENCH  
ELEVATION : 1627 m AMSL  
X-COORD : 2881131  
Y-COORD : 76173  
PROFILED BY : D. SWART DATE : 2018/10/30  
TYPE SET BY : N. TROLLIP DATE : 05/11/18 09:07  
SETUP FILE : TESTPITS.SET TEXT : ..C:\DOTFILES\201811~1.TXT  
HOLE No: TP16  
D055 DBB dot.PLOT 5006 J&W



- NOTES
- 1) Refusal on above material.
  - 2) Small bag sample 0.76 - 1.60m
  - 3) Stable sidewalls
  - 4) No groundwater intercepted
  - 5) Lo 29 E (+ is west of Lo and - east of Lo), positions determined in ARC GIS



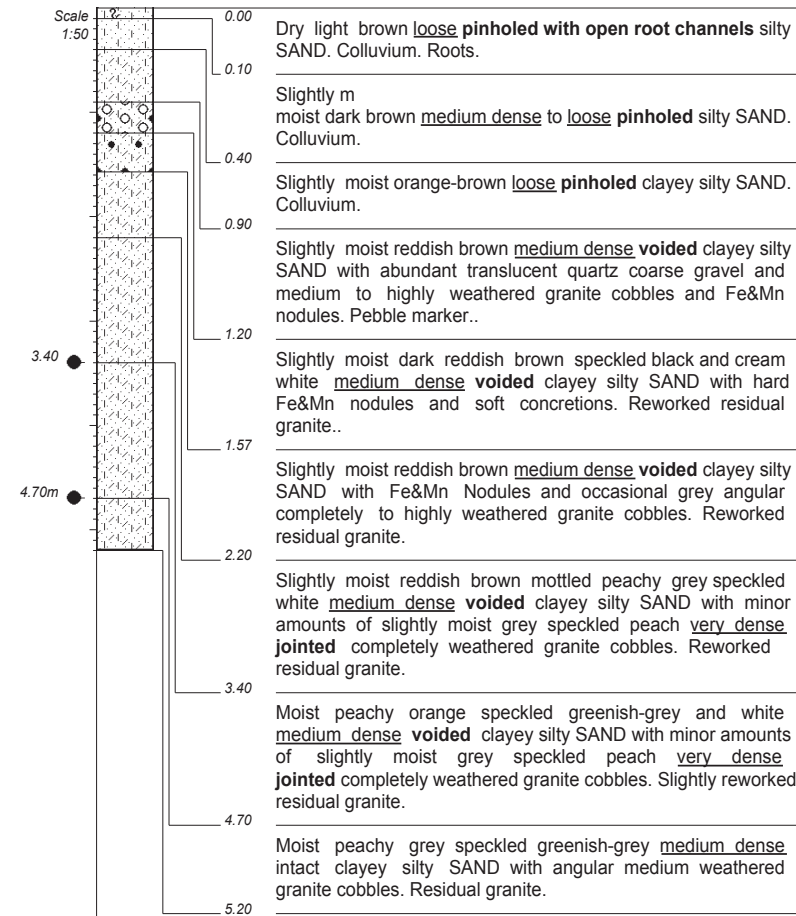
- NOTES
- 1) Big bag sample 1,00 - 2,10m
  - 2) Stable sidewalls
  - 3) No groundwater intercepted
  - 4) Lo 29 E (+ is west of Lo and - east of Lo), positions determined in ARC GIS



NOTES

- 1) No sample
- 2) Stable sidewalls
- 3) No groundwater intercepted
- 4) Lo 29 E (+ is west of Lo and - east of Lo), positions determined in ARC GIS

CONTRACTOR : RIVIERA PLANT HIRE  
MACHINE : CAT 320D L (110 kW) excavator† SIZE : TRENCH  
ELEVATION : 1633 m AMSL  
X-COORD : 2880654  
Y-COORD : 76414  
PROFILED BY : D. SWART DATE : 2018/10/24  
TYPE SET BY : N. TROLLIP DATE : 05/11/18 09:08  
SETUP FILE : TESTPITS.SET TEXT : ..C:\DOTFILES\201811~1.TXT  
D055 DBB dot.PLOT 5006 J&W

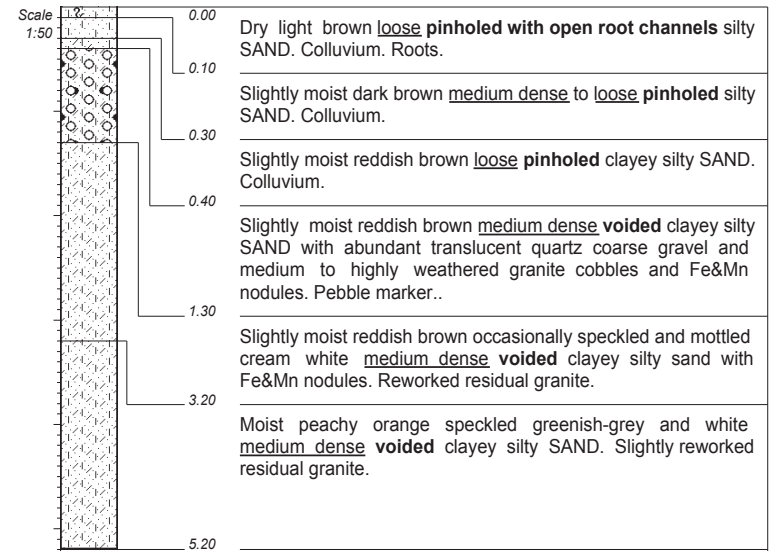


NOTES

- 1) Small bag sample 3.40 - 4.70m
- 2) Pinnacle in test pit. Stable sidewalls
- 3) No groundwater intercepted
- 4) Lo 29 E (+ is west of Lo and - east of Lo), positions determined in ARC GIS

CONTRACTOR : RIVIERA PLANT HIRE  
MACHINE : CAT 320D L (110 kW) excavator† SIZE : TRENCH  
PROFILED BY : D. SWART DATE : 2018/10/24  
TYPE SET BY : N. TROLLIP DATE : 05/11/18 09:08  
SETUP FILE : TESTPITS.SET TEXT : ..C:\DOTFILES\201811~1.TXT  
D055 DBB

ELEVATION : 1632 m AMSL  
X-COORD : 2880686  
Y-COORD : 76399  
HOLE No: TP20  
dot.PLOT 5006 J&W

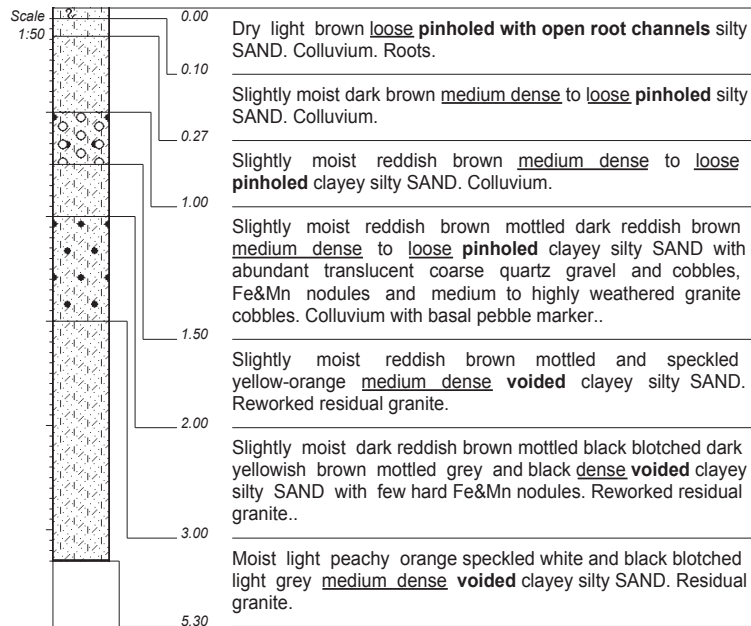


NOTES

- 1) No sample
- 2) Stable sidewalls
- 3) No groundwater intercepted
- 4) Lo 29 E (+ is west of Lo and - east of Lo), positions determined in ARC GIS

CONTRACTOR : RIVIERA PLANT HIRE  
MACHINE : CAT 320D L (110 kW) excavator† SIZE : TRENCH  
PROFILED BY : D. SWART DATE : 2018/10/24  
TYPE SET BY : N. TROLLIP DATE : 05/11/18 09:08  
SETUP FILE : TESTPITS.SET TEXT : ..C:\DOTFILES\201811~1.TXT  
D055 DBB

ELEVATION : 1632 m AMSL  
X-COORD : 2880713  
Y-COORD : 76385  
HOLE No: TP21  
dot.PLOT 5006 J&W



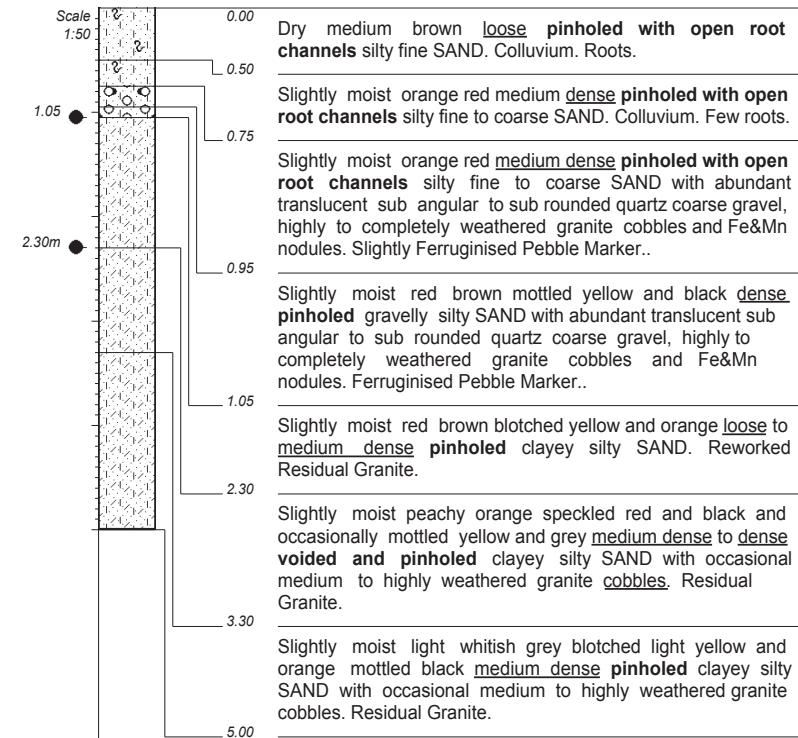
NOTES

- 1) No sample
- 2) Stable sidewalls
- 3) No groundwater intercepted
- 4) Lo 29 E (+ is west of Lo and - east of Lo), positions determined in ARC GIS

CONTRACTOR : RIVIERA PLANT HIRE  
MACHINE : CAT 320D L (110 kW) excavator† SIZE : TRENCH  
ELEVATION : 1639 m AMSL  
X-COORD : 2880342  
Y-COORD : 76213  
HOLE No: TP22

PROFILED BY : D. SWART DATE : 2018/10/24  
TYPE SET BY : N. TROLLIP DATE : 05/11/18 09:08  
SETUP FILE : TESTPITS.SET TEXT : ..C:\DOTFILES\201811~1.TXT

D055 DBB dot.PLOT 5006 J&W



NOTES

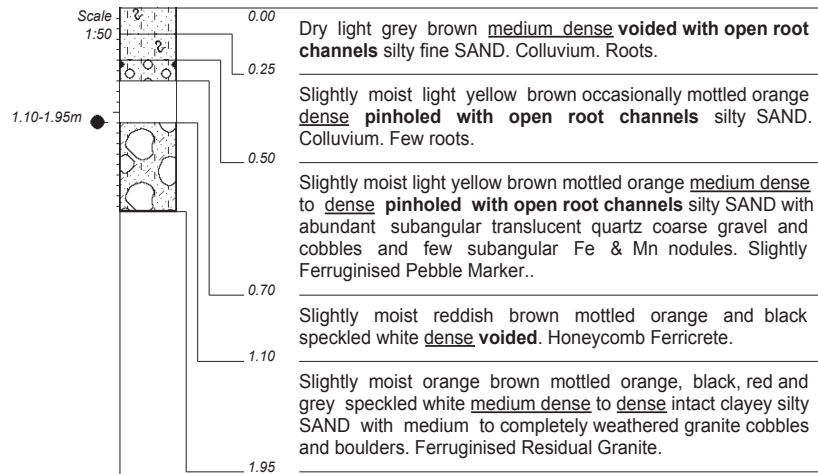
- 1) Small bag sample 1.05 - 2.30m
- 2) Pinnacle in test pit. Stable sidewalls
- 3) No groundwater intercepted
- 4) Lo 29 E (+ is west of Lo and - east of Lo), positions determined in ARC GIS

CONTRACTOR : RIVIERA PLANT HIRE  
MACHINE : CAT 320D L (110 kW) excavator† SIZE : TRENCH  
ELEVATION : 1637 m AMSL  
X-COORD : 2880321  
Y-COORD : 76110  
HOLE No: TP23

PROFILED BY : D. SWART DATE : 2018/09/26  
TYPE SET BY : N. TROLLIP DATE : 05/11/18 09:08  
SETUP FILE : TESTPITS.SET TEXT : ..C:\DOTFILES\201811~1.TXT

D055 DBB dot.PLOT 5006 J&W





NOTES

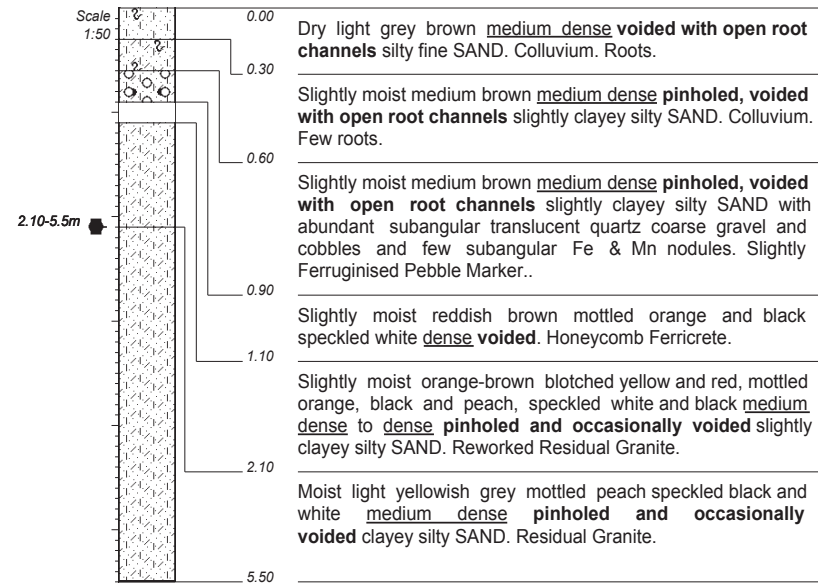
- 1) Refusal on medium to completely weathered granite
- 2) Small bag sample 1.10-1.95m
- 3) Pinnacle in trial pit
- 4) Stable sidewalls
- 5) No groundwater intercepted
- 6) Lo 29 E (+ is west of Lo and - east of Lo), positions determined in ARC GIS

CONTRACTOR : RIVIERA PLANT HIRE  
MACHINE : CAT 320D L (110 kW) excavator† SIZE : TRENCH  
ELEVATION : 1637 m AMSL  
X-COORD : 2880302  
Y-COORD : 76012

PROFILED BY : D. SWART DATE : 2018/09/25  
TYPE SET BY : N. TROLLIP DATE : 05/11/18 09:08  
SETUP FILE : TESTPITS.SET TEXT : ..C:\DOTFILES\201811~1.TXT

HOLE No: TP24

D055 DBB dot.PLOT 5006 J&W



NOTES

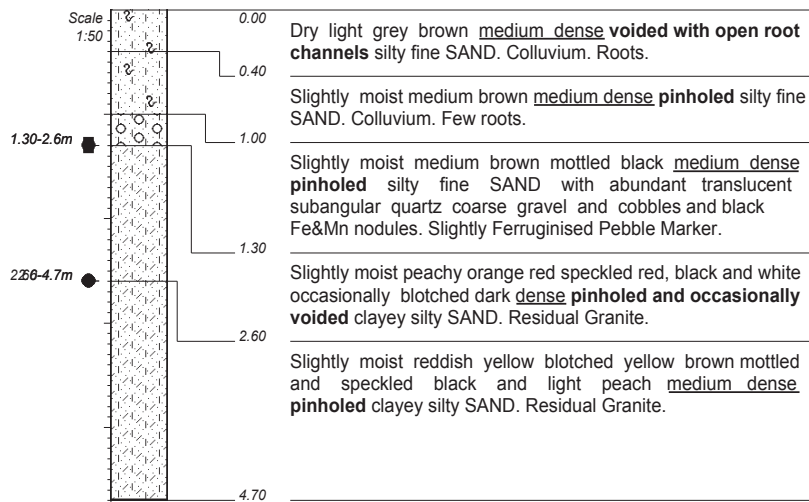
- 1) Maximum reach
- 2) Small bag sample 2.10-5.5m
- 3) Large bag sample 2.10-5.5m
- 4) Undisturbed sample 2.10-5.5m
- 5) Stable sidewalls
- 6) No groundwater intercepted
- 7) Lo 29 E (+ is west of Lo and - east of Lo), positions determined in ARC GIS

CONTRACTOR : RIVIERA PLANT HIRE  
MACHINE : CAT 320D L (110 kW) excavator† SIZE : TRENCH  
ELEVATION : 1638 m AMSL  
X-COORD : 2880299  
Y-COORD : 75888

PROFILED BY : D. SWART DATE : 2018/09/25  
TYPE SET BY : N. TROLLIP DATE : 05/11/18 09:08  
SETUP FILE : TESTPITS.SET TEXT : ..C:\DOTFILES\201811~1.TXT

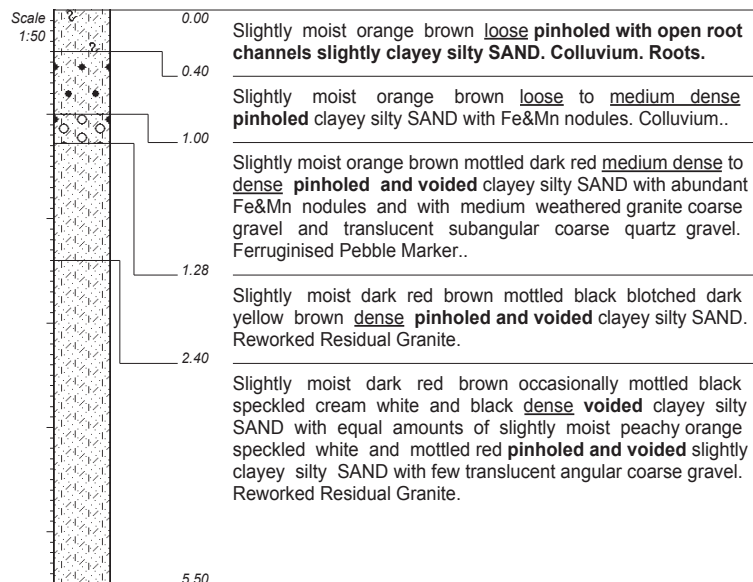
HOLE No: TP25

D055 DBB dot.PLOT 5006 J&W



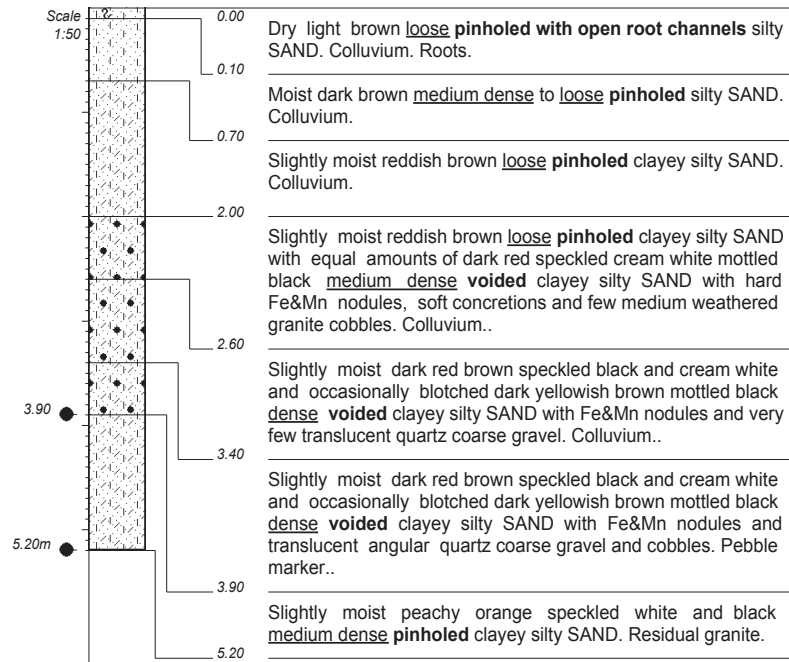
NOTES

- 1) Maximum reach
- 2) Small bag sample 1.30-2.6m and 2.6-4.7m
- 3) Large bag sample 2.60-4.7m
- 4) Undisturbed sample 1.30-2.6m
- 5) Stable sidewalls
- 6) No groundwater intercepted
- 7) Lo 29 E (+ is west of Lo and - east of Lo), positions determined in ARC GIS



NOTES

- 1) No sample
- 2) Stable sidewalls
- 3) No groundwater intercepted
- 4) Lo 29 E (+ is west of Lo and - east of Lo), positions determined in ARC GIS



NOTES

- 1) Small bag sample 3.90 - 5.20m
- 2) Stable sidewalls
- 3) No groundwater intercepted
- 4) Lo 29 E (+ is west of Lo and - east of Lo), positions determined in ARC GIS

CONTRACTOR : RIVIERA PLANT HIRE  
MACHINE : CAT 320D L (110 kW) excavator†

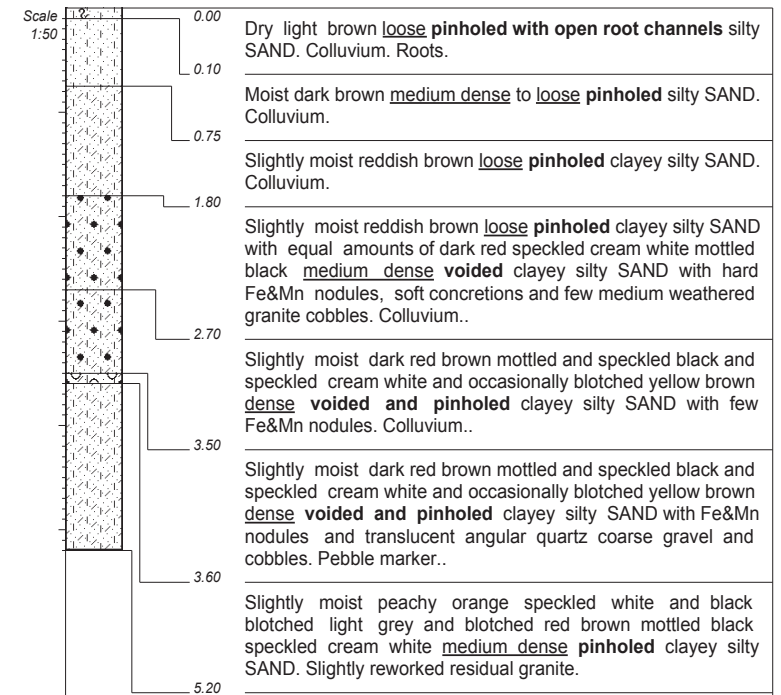
SIZE : TRENCH

ELEVATION : 1641 m AMSL  
X-COORD : 2880780  
Y-COORD : 75938

PROFILED BY : D. SWART  
TYPE SET BY : N. TROLLIP  
SETUP FILE : TESTPITS.SET

DATE : 2018/10/23  
DATE : 05/11/18 09:08  
TEXT : ..C:\DOTFILES\201811~1.TXT

HOLE No: TP28



NOTES

- 1) No sample
- 2) Stable sidewalls
- 3) No groundwater intercepted
- 4) Lo 29 E (+ is west of Lo and - east of Lo), positions determined in ARC GIS

CONTRACTOR : RIVIERA PLANT HIRE  
MACHINE : CAT 320D L (110 kW) excavator†

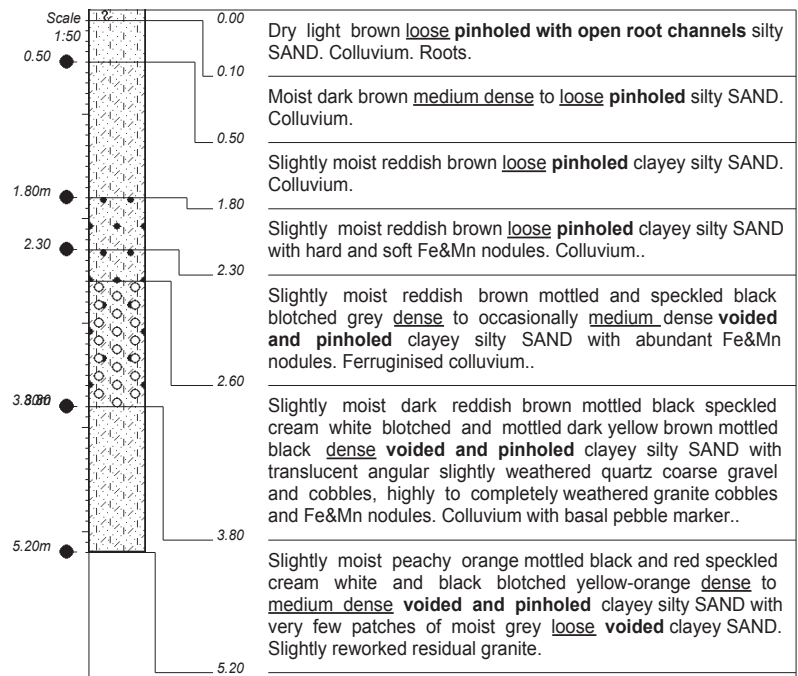
SIZE : TRENCH

ELEVATION : 1639 m AMSL  
X-COORD : 2880821  
Y-COORD : 76014

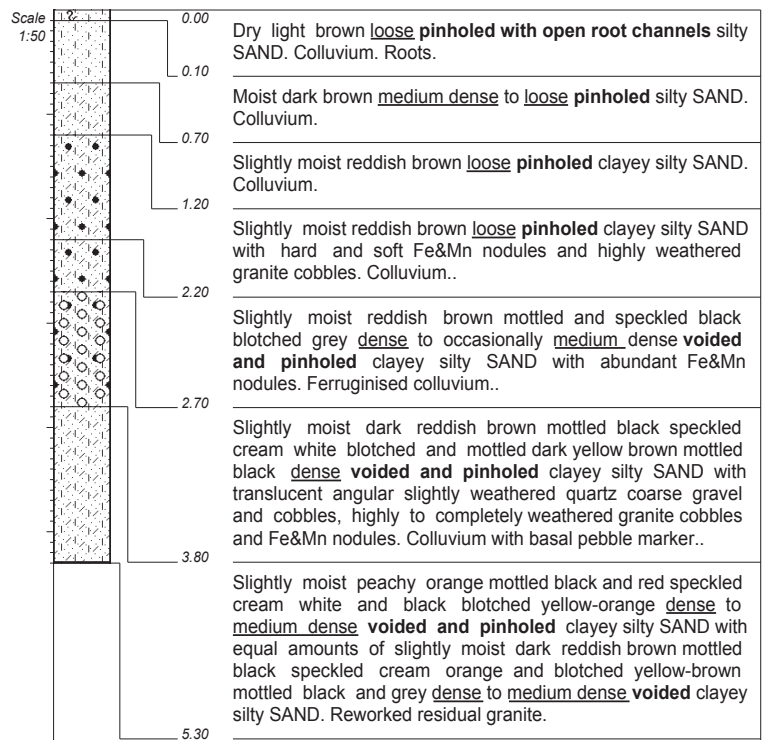
PROFILED BY : D. SWART  
TYPE SET BY : N. TROLLIP  
SETUP FILE : TESTPITS.SET

DATE : 2018/10/23  
DATE : 05/11/18 09:08  
TEXT : ..C:\DOTFILES\201811~1.TXT

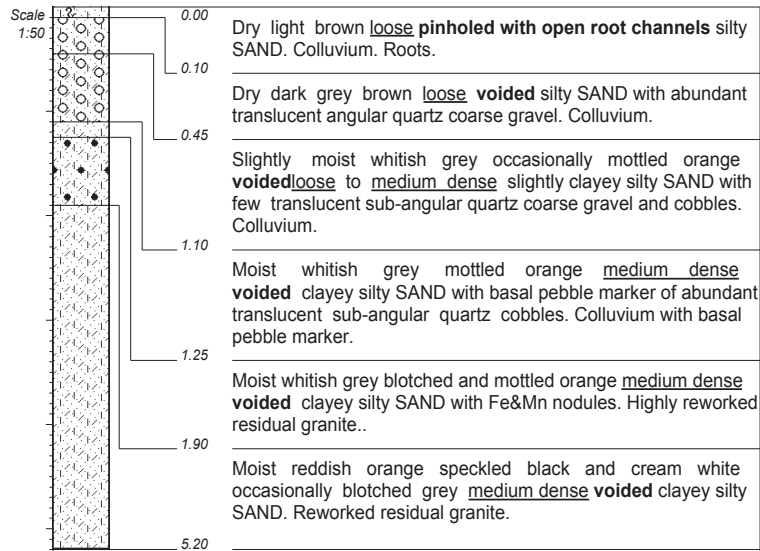
HOLE No: TP29



- NOTES
- 1) Small bag sample 0.50 - 1.80m and 3.80 - 5.20m
  - 2) Big bag sample 2.30 - 3.80m
  - 3) Stable sidewalls
  - 4) No groundwater intercepted
  - 5) Lo 29 E (+ is west of Lo and - east of Lo), positions determined in ARC GIS

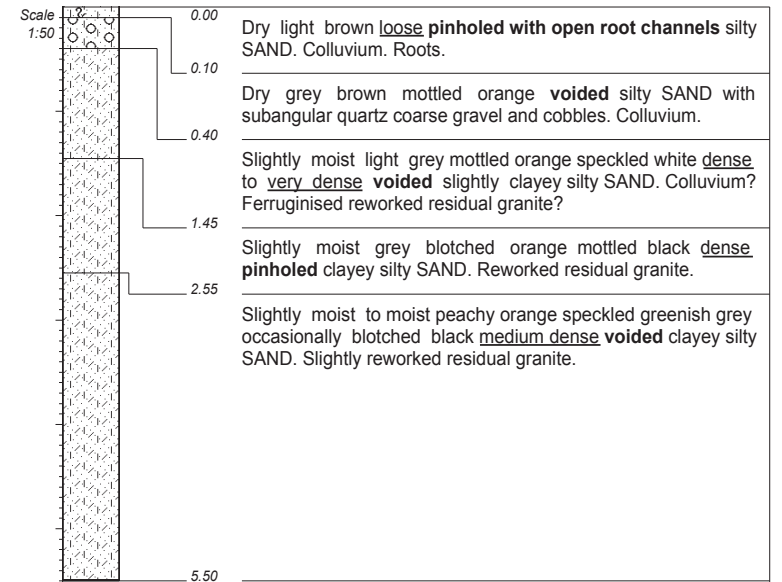


- NOTES
- 1) No sample
  - 2) Stable sidewalls
  - 3) No groundwater intercepted
  - 4) Lo 29 E (+ is west of Lo and - east of Lo), positions determined in ARC GIS



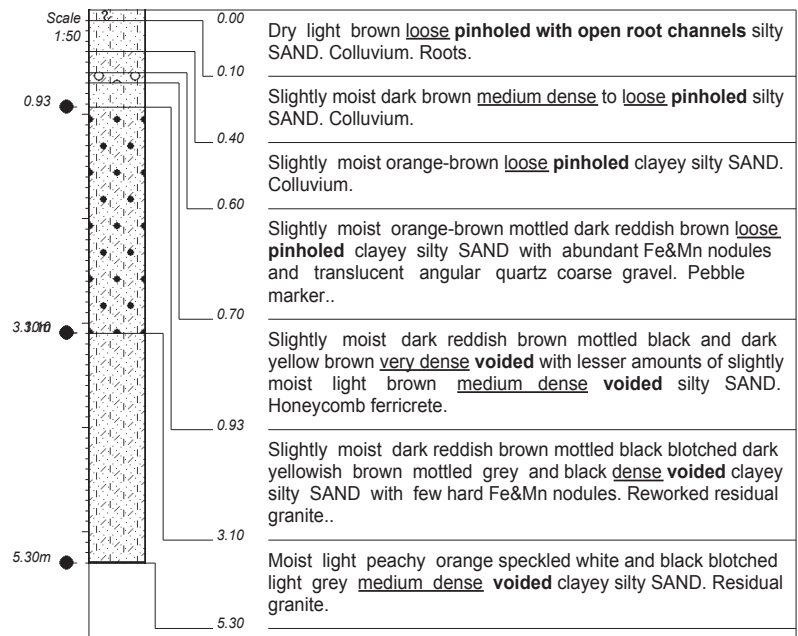
NOTES

- 1) No sample
- 2) Stable sidewalls
- 3) No groundwater intercepted
- 4) Lo 29 E (+ is west of Lo and - east of Lo), positions determined in ARC GIS

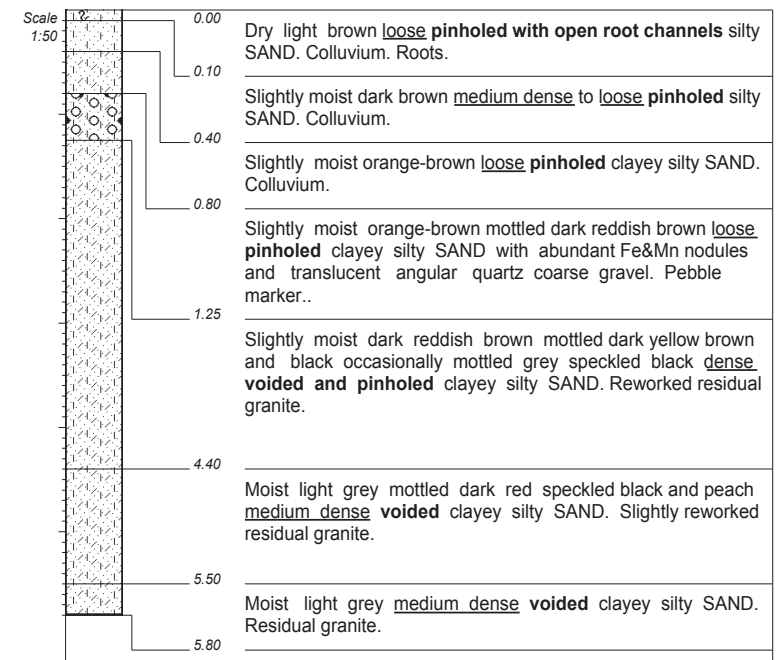


NOTES

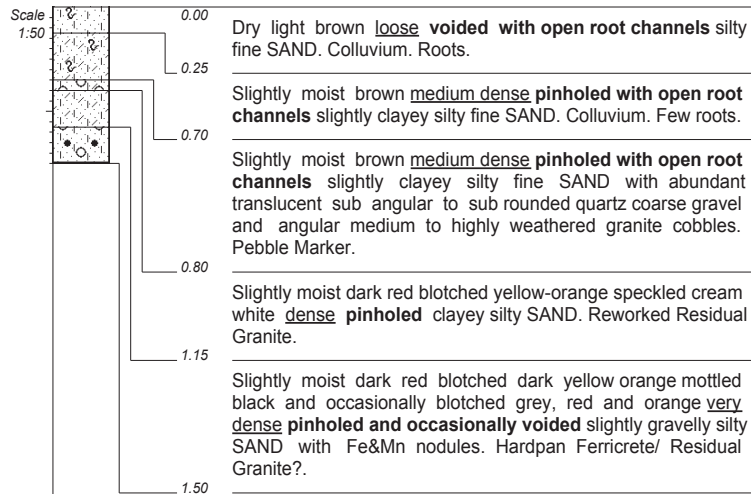
- 1) No sample
- 2) Stable sidewalls
- 3) No groundwater intercepted
- 4) Lo 29 E (+ is west of Lo and - east of Lo), positions determined in ARC GIS



- NOTES
- 1) Small bag sample 0,93 - 3,10m and 3,10 - 5,30m
  - 2) Stable sidewalls
  - 3) No groundwater intercepted
  - 4) Lo 29 E (+ is west of Lo and - east of Lo), positions determined in ARC GIS



- NOTES
- 1) No sample
  - 2) Stable sidewalls
  - 3) No groundwater intercepted
  - 4) Lo 29 E (+ is west of Lo and - east of Lo), positions determined in ARC GIS



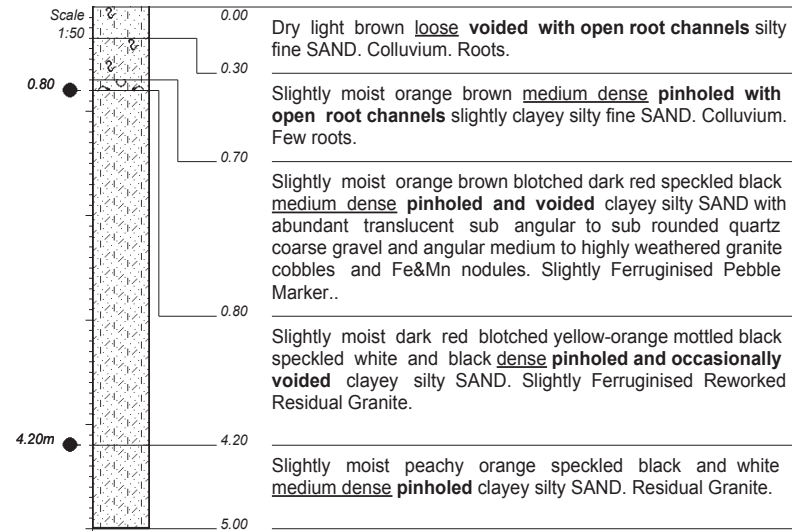
NOTES

- 1) Refusal on hardpan ferricrete / medium weathered granite
- 2) No sample
- 3) Stable sidewalls
- 4) No groundwater intercepted
- 5) Lo 29 E (+ is west of Lo and - east of Lo), positions determined in ARC GIS

CONTRACTOR : RIVIERA PLANT HIRE  
MACHINE : CAT 320D L (110 kW) excavator† SIZE : TRENCH  
ELEVATION : 1642 m AMSL  
X-COORD : 2880653  
Y-COORD : 76010  
HOLE No: TP36

PROFILED BY : D. SWART DATE : 2018/09/26  
TYPE SET BY : N. TROLLIP DATE : 05/11/18 09:08  
SETUP FILE : TESTPITS.SET TEXT : ..C:\DOTFILES\201811~1.TXT

D055 DBB dot.PLOT 5006 J&W



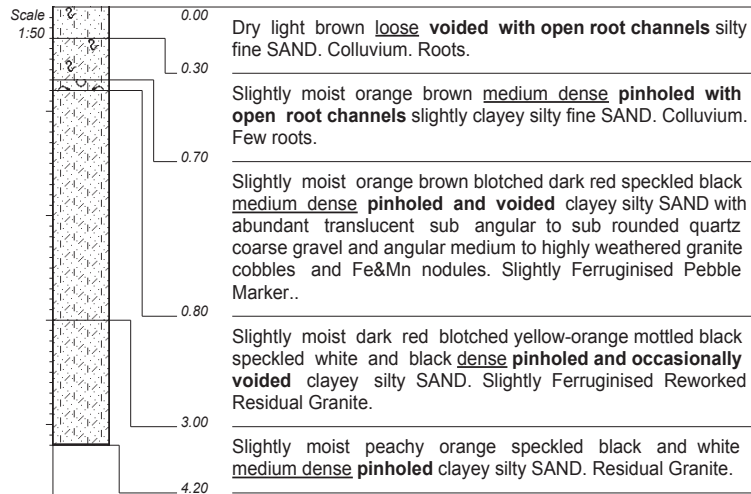
NOTES

- 1) Maximum reach
- 2) Small bag sample at 0.80 - 4.20m
- 3) Big bag sample at 0.80 - 4.20m
- 4) Stable sidewalls
- 5) No groundwater intercepted
- 6) Lo 29 E (+ is west of Lo and - east of Lo), positions determined in ARC GIS

CONTRACTOR : RIVIERA PLANT HIRE  
MACHINE : CAT 320D L (110 kW) excavator† SIZE : TRENCH  
ELEVATION : 1642 m AMSL  
X-COORD : 2880658  
Y-COORD : 75919  
HOLE No: TP37

PROFILED BY : D. SWART DATE : 2018/09/26  
TYPE SET BY : N. TROLLIP DATE : 05/11/18 09:08  
SETUP FILE : TESTPITS.SET TEXT : ..C:\DOTFILES\201811~1.TXT

D055 DBB dot.PLOT 5006 J&W



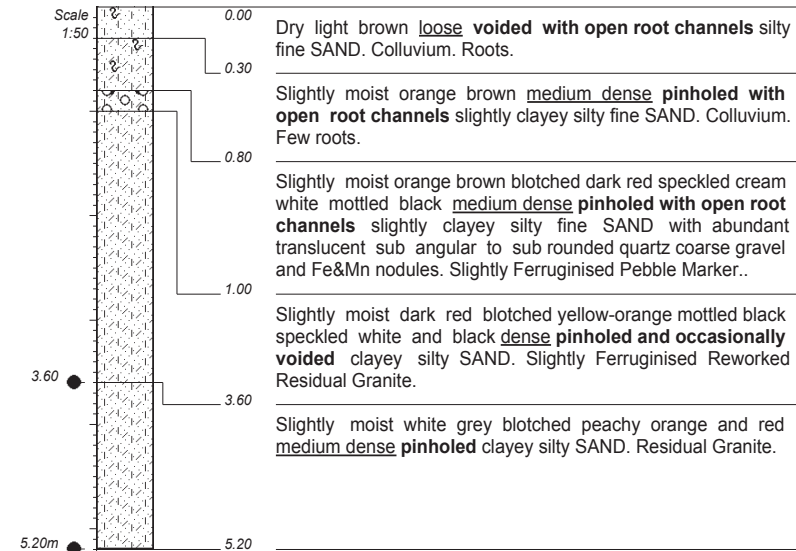
NOTES

- 1) Slow going
- 2) No sample
- 3) Stable sidewalls
- 4) No groundwater intercepted
- 5) Lo 29 E (+ is west of Lo and - east of Lo), positions determined in ARC GIS

CONTRACTOR : RIVIERA PLANT HIRE  
MACHINE : CAT 320D L (110 kW) excavator† SIZE : TRENCH  
ELEVATION : 1642 m AMSL  
X-COORD : 2880661  
Y-COORD : 75884  
HOLE No: TP38

PROFILED BY : D. SWART DATE : 2018/09/26  
TYPE SET BY : N. TROLLIP DATE : 05/11/18 09:08  
SETUP FILE : TESTPITS.SET TEXT : ..C:\DOTFILES\201811~1.TXT

D055 DBB dot.PLOT 5006 J&W



NOTES

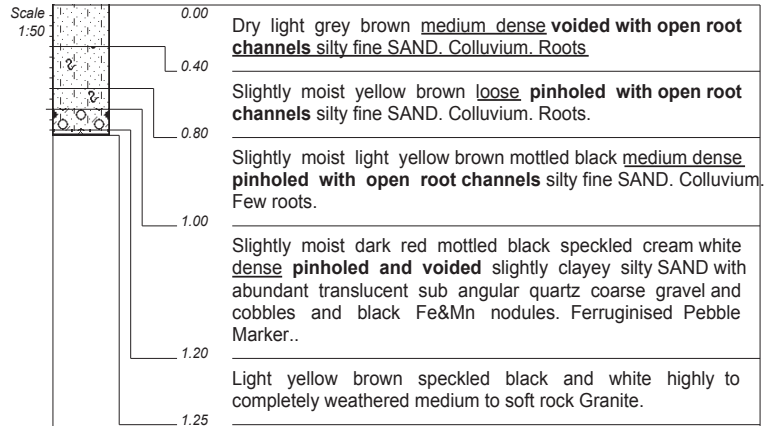
- 1) Maximum reach
- 2) Small bag sample at 3.60 - 5.20m
- 3) Stable sidewalls
- 4) No groundwater intercepted
- 5) Lo 29 E (+ is west of Lo and - east of Lo), positions determined in ARC GIS

CONTRACTOR : RIVIERA PLANT HIRE  
MACHINE : CAT 320D L (110 kW) excavator† SIZE : TRENCH  
ELEVATION : 1643 m AMSL  
X-COORD : 2880667  
Y-COORD : 75791  
HOLE No: TP39

PROFILED BY : D. SWART DATE : 2018/09/26  
TYPE SET BY : N. TROLLIP DATE : 05/11/18 09:08  
SETUP FILE : TESTPITS.SET TEXT : ..C:\DOTFILES\201811~1.TXT

D055 DBB dot.PLOT 5006 J&W

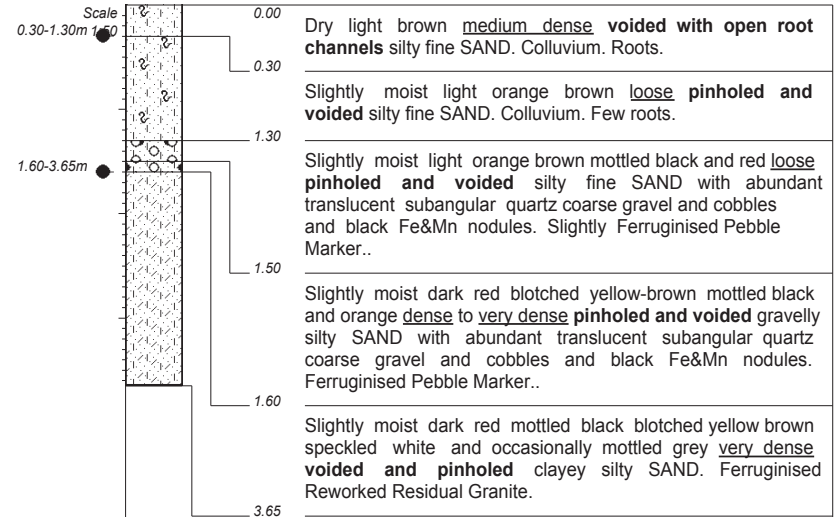




NOTES

- 1) Refusal on medium to highly weathered granite
- 2) No sample
- 3) Stable sidewalls
- 4) No groundwater intercepted
- 5) Lo 29 E (+ is west of Lo and - east of Lo), positions determined in ARC GIS

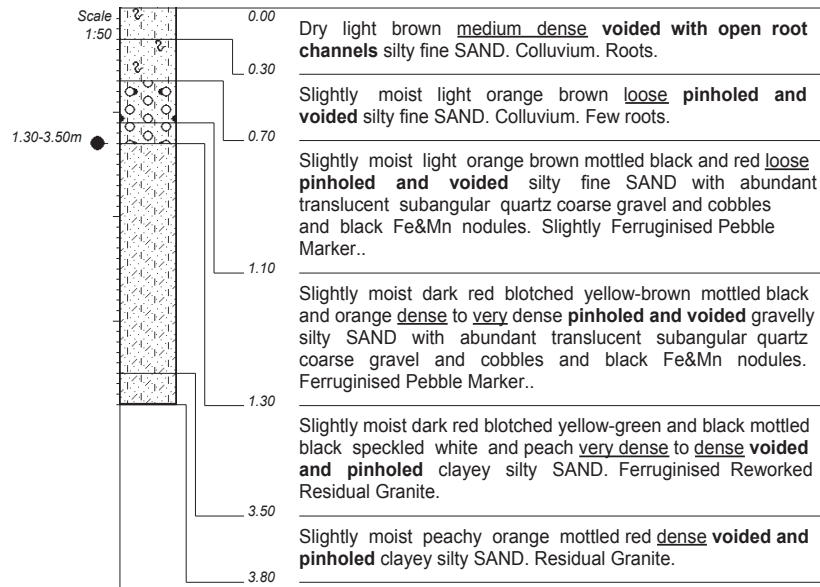
CONTRACTOR : RIVIERA PLANT HIRE  
MACHINE : CAT 320D L (110 kW) excavator† SIZE : TRENCH  
ELEVATION : 1643 m AMSL  
X-COORD : 2880433  
Y-COORD : 75657  
PROFILED BY : D. SWART DATE : 2018/09/25  
TYPE SET BY : N. TROLLIP DATE : 05/11/18 09:08  
SETUP FILE : TESTPITS.SET TEXT : ..C:\DOTFILES\201811~1.TXT  
D055 DBB dot.PLOT 5006 J&W



NOTES

- 1) Approaching refusal on highly weathered granite
- 2) Small bag samples at 0.30-1.30m and 1.60-3.65m
- 3) Stable sidewalls
- 4) No groundwater intercepted
- 5) Lo 29 E (+ is west of Lo and - east of Lo), positions determined in ARC GIS

CONTRACTOR : RIVIERA PLANT HIRE  
MACHINE : CAT 320D L (110 kW) excavator† SIZE : TRENCH  
ELEVATION : 1643 m AMSL  
X-COORD : 2880540  
Y-COORD : 75663  
PROFILED BY : D. SWART DATE : 2018/09/25  
TYPE SET BY : N. TROLLIP DATE : 05/11/18 09:08  
SETUP FILE : TESTPITS.SET TEXT : ..C:\DOTFILES\201811~1.TXT  
D055 DBB dot.PLOT 5006 J&W



NOTES

- 1) Slow going
- 2) Small bag sample at 1.30-3.50m
- 3) Stable sidewalls
- 4) No groundwater intercepted
- 5) Lo 29 E (+ is west of Lo and - east of Lo), positions determined in ARC GIS

CONTRACTOR : RIVIERA PLANT HIRE  
MACHINE : CAT 320D L (110 kW) excavator†

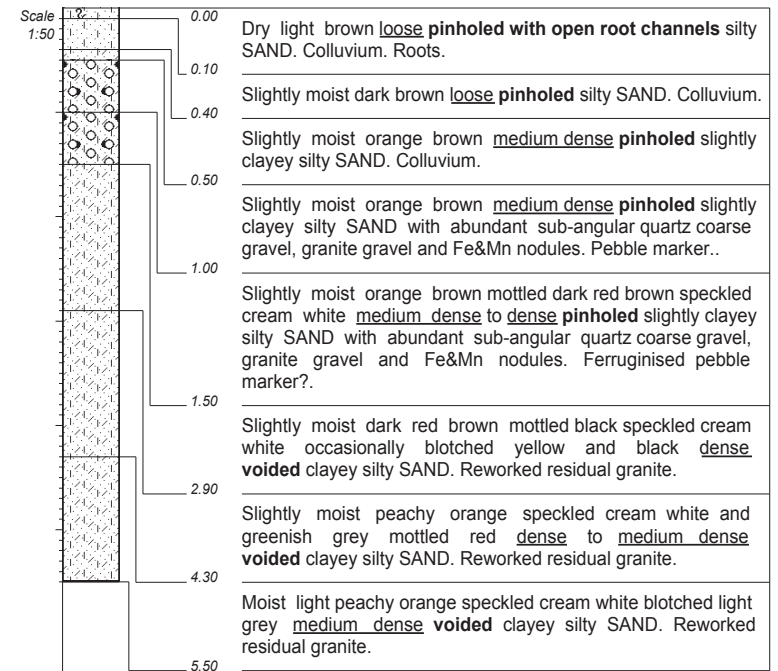
SIZE : TRENCH

ELEVATION : 1642 m AMSL  
X-COORD : 2880654  
Y-COORD : 75670

PROFILED BY : D. SWART  
TYPE SET BY : N. TROLLIP  
SETUP FILE : TESTPITS.SET

DATE : 2018/09/25  
DATE : 05/11/18 09:08  
TEXT : ..C:\DOTFILES\201811~1.TXT

HOLE No: TP42



NOTES

- 1) Maximum reach
- 2) No sample
- 3) Stable sidewalls
- 4) No groundwater intercepted
- 5) Lo 29 E (+ is west of Lo and - east of Lo), positions determined in ARC GIS

CONTRACTOR : RIVIERA PLANT HIRE  
MACHINE : CAT 320D L (110 kW) excavator†

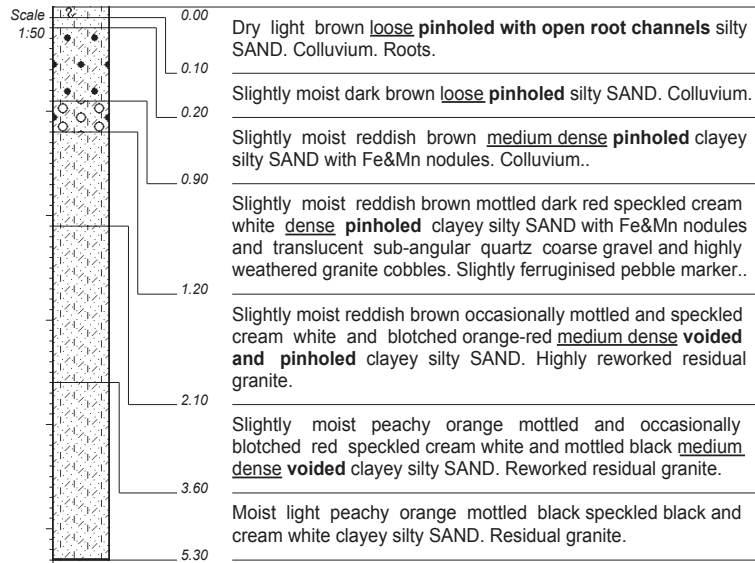
SIZE : TRENCH

ELEVATION : 1635 m AMSL  
X-COORD : 2881050  
Y-COORD : 75698

PROFILED BY : D. SWART  
TYPE SET BY : N. TROLLIP  
SETUP FILE : TESTPITS.SET

DATE : 2018/10/30  
DATE : 05/11/18 09:08  
TEXT : ..C:\DOTFILES\201811~1.TXT

HOLE No: TP43



NOTES

- 1) Maximum reach
- 2) No sample.
- 3) Stable sidewalls
- 4) No groundwater intercepted
- 5) Lo 29 E (+ is west of Lo and - east of Lo), positions determined in ARC GIS

CONTRACTOR : RIVIERA PLANT HIRE  
MACHINE : CAT 320D L (110 kW) excavator†

SIZE : TRENCH

ELEVATION : 1633 m AMSL  
X-COORD : 2881163  
Y-COORD : 75706

PROFILED BY : D. SWART  
TYPE SET BY : N. TROLLIP  
SETUP FILE : TESTPITS.SET

DATE : 2018/10/30  
DATE : 05/11/18 09:08  
TEXT : ..C:\DOTFILES\201811~1.TXT

	Boulders	{SA01}
	Gravel	{SA02}
	Gravelly	{SA03}
	Sand	{SA04}
	Silty	{SA07}
	Clayey	{SA09}
	Granite	{SA17}{SA44}
	SPARSE FERRICRETE NODULES/occasional ferricrete nodu....	{SA25}
	UNDISTURBED SAMPLE	{SA37}
	DISTURBED SAMPLE	{SA38}
	ROOTS	{SA40}

CONTRACTOR :  
MACHINE :

SIZE :

ELEVATION :  
X-COORD :  
Y-COORD :

PROFILED BY :  
TYPE SET BY : N. TROLLIP  
SETUP FILE : TESTPITS.SET

DATE :  
DATE : 05/11/18 09:08  
TEXT : ..C:\DOTFILES\201811~1.TXT

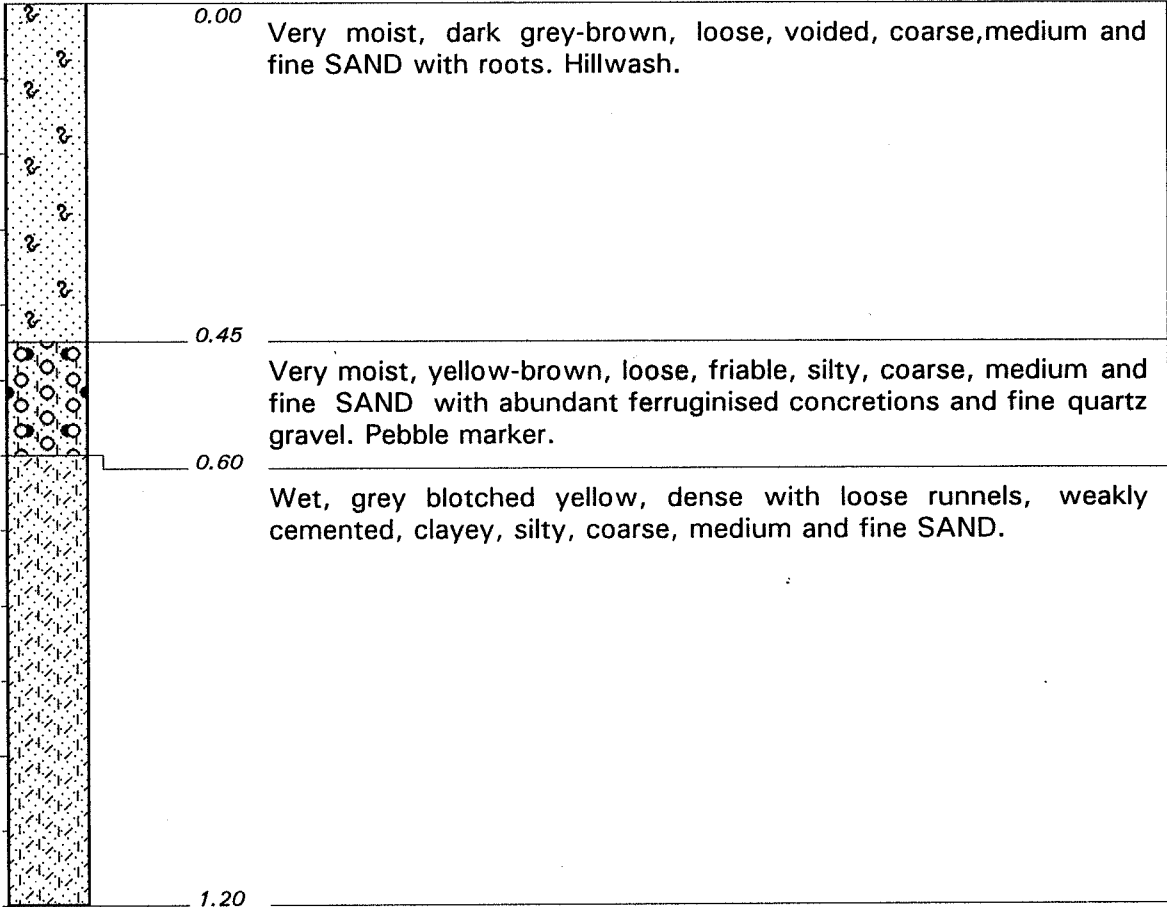
**INTRACONSULT CC**  
Consulting Engineers & Geologists  
Tel: (011) 465-8706  
Fax: (011) 465-0772

ESSELEN PARK

**HOLE No: 19**  
**Sheet 1 of 1**

**JOB NUMBER: IR 369**

Scale  
1:10



**NOTES**

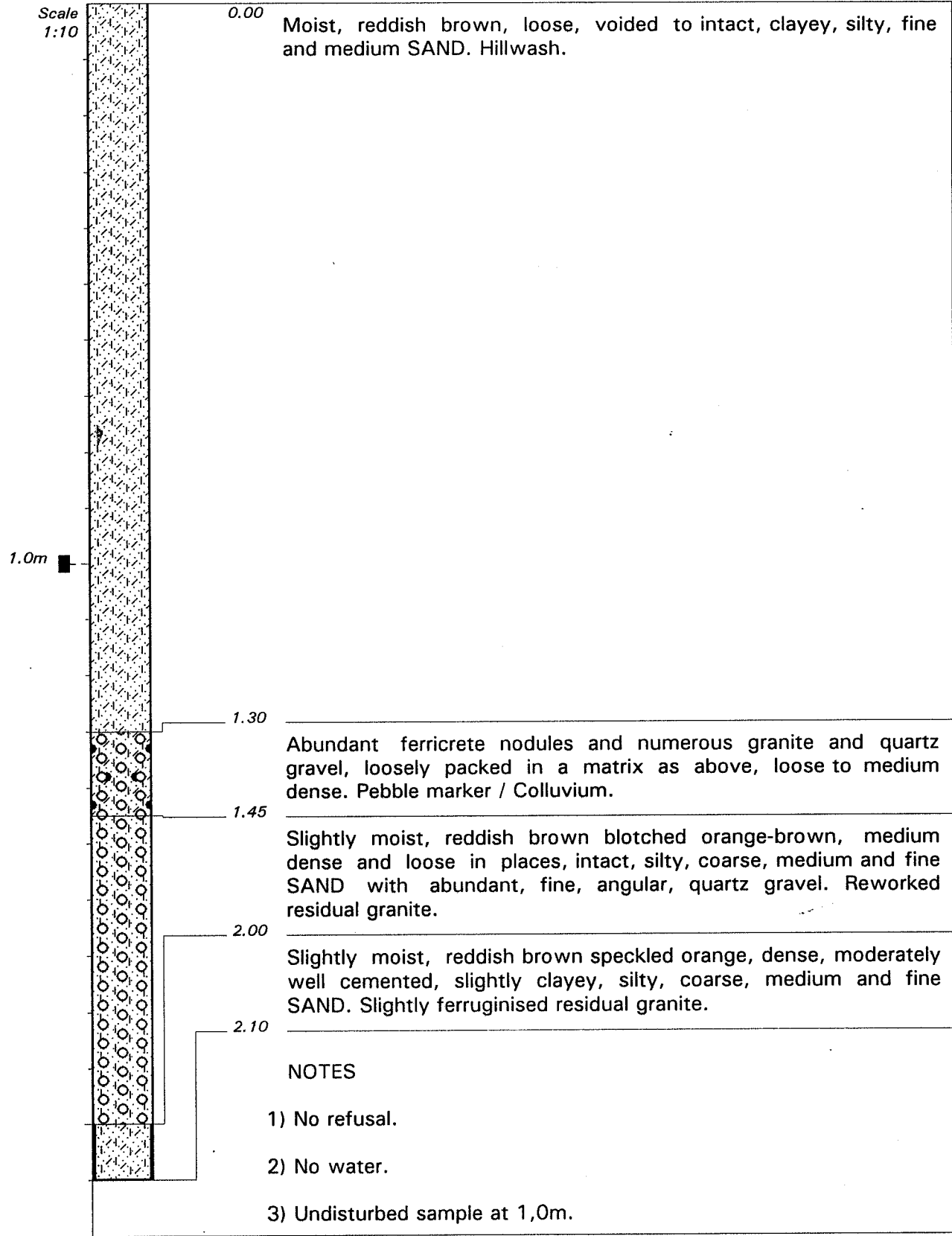
- 1) Refusal on very dense as above at 1,6m.
- 2) Water standing at 1,2m.

CONTRACTOR : PAUL HESLOP  
MACHINE : CAT 416  
DRILLED BY :  
PROFILED BY : BRB  
TYPE SET BY :  
SETUP FILE : STANDARD.SET

INCLINATION :  
DIAM :  
DATE :  
DATE :  
DATE : 12/10/99 09:37  
TEXT : C:\profiles\ESSELEN.TXT

ELEVATION :  
X-COORD :  
Y-COORD :

**HOLE No: 19**



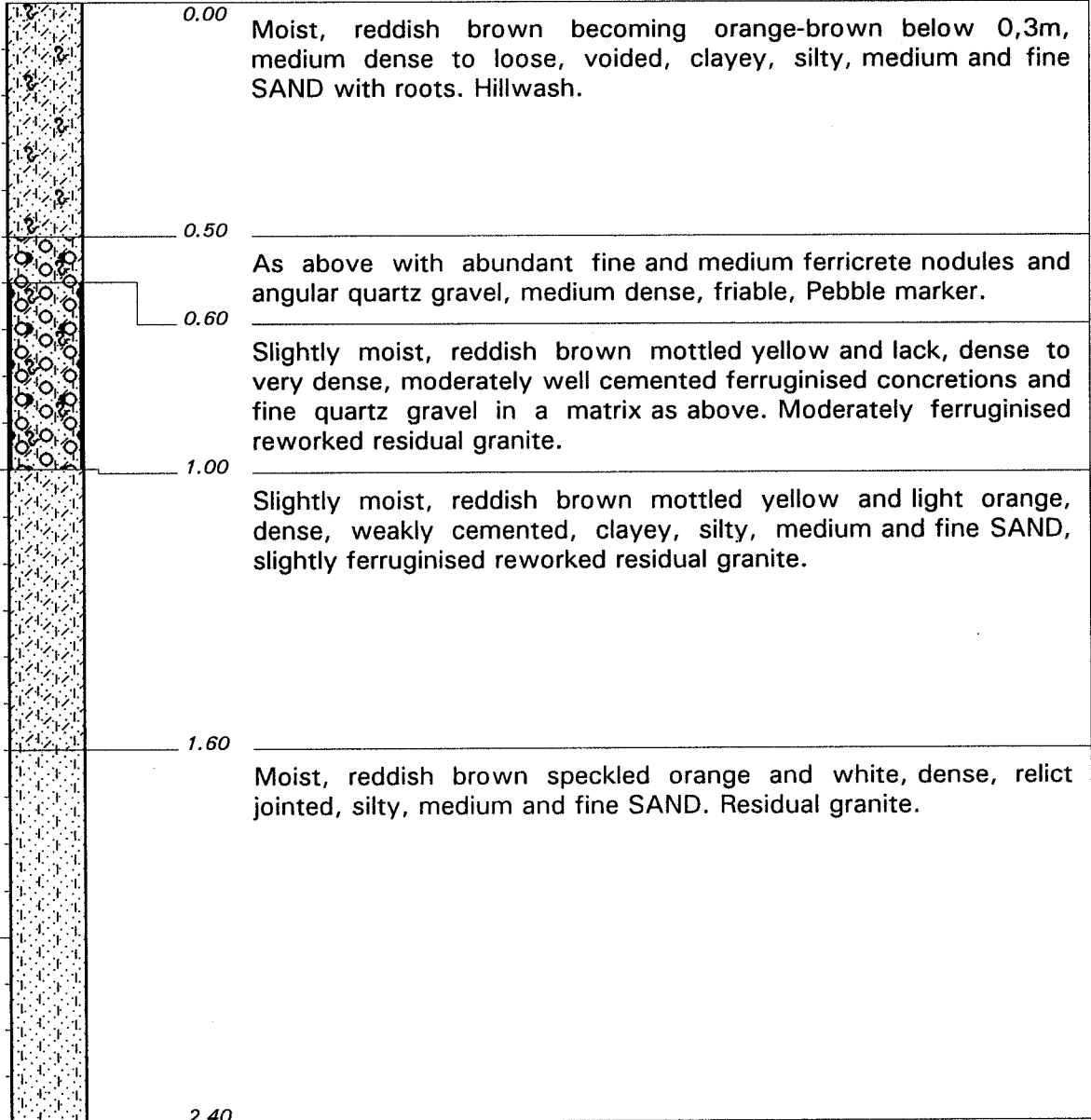
**CONTRACTOR : PAUL HESLOP**  
**MACHINE : CAT 416**  
**DRILLED BY :**  
**PROFILED BY : BRB**  
**TYPE SET BY :**  
**SETUP FILE : STANDARD.SET**

**INCLINATION :**  
**DIAM :**  
**DATE :**  
**DATE :**  
**DATE : 12/10/99 09:40**  
**TEXT : C:\profiles\ESSELEN.TXT**

**ELEVATION :**  
**X-COORD :**  
**Y-COORD :**

**HOLE No: J12**

Scale  
 1:15



**NOTES**

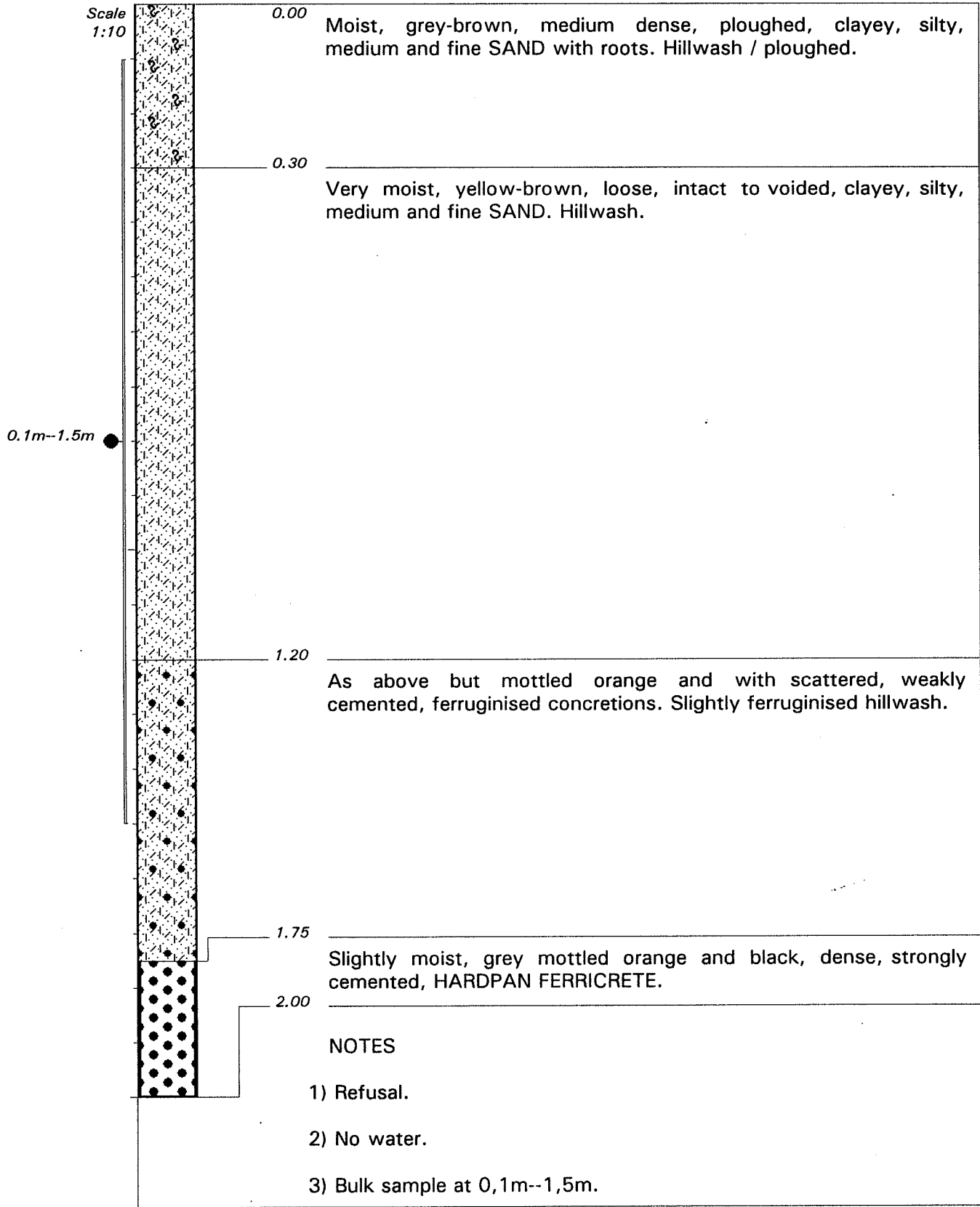
- 1) No refusal.
- 2) No water.

**CONTRACTOR : PAUL HESLOP**  
**MACHINE : CAT 416**  
**DRILLED BY :**  
**PROFILED BY : BRB**  
**TYPE SET BY :**  
**SETUP FILE : STANDARD.SET**

**INCLINATION :**  
**DIAM :**  
**DATE :**  
**DATE :**  
**DATE : 12/10/99 09:40**  
**TEXT : C:\profiles\ESSELEN.TXT**

**ELEVATION :**  
**X-COORD :**  
**Y-COORD :**

**HOLE No: J 13**

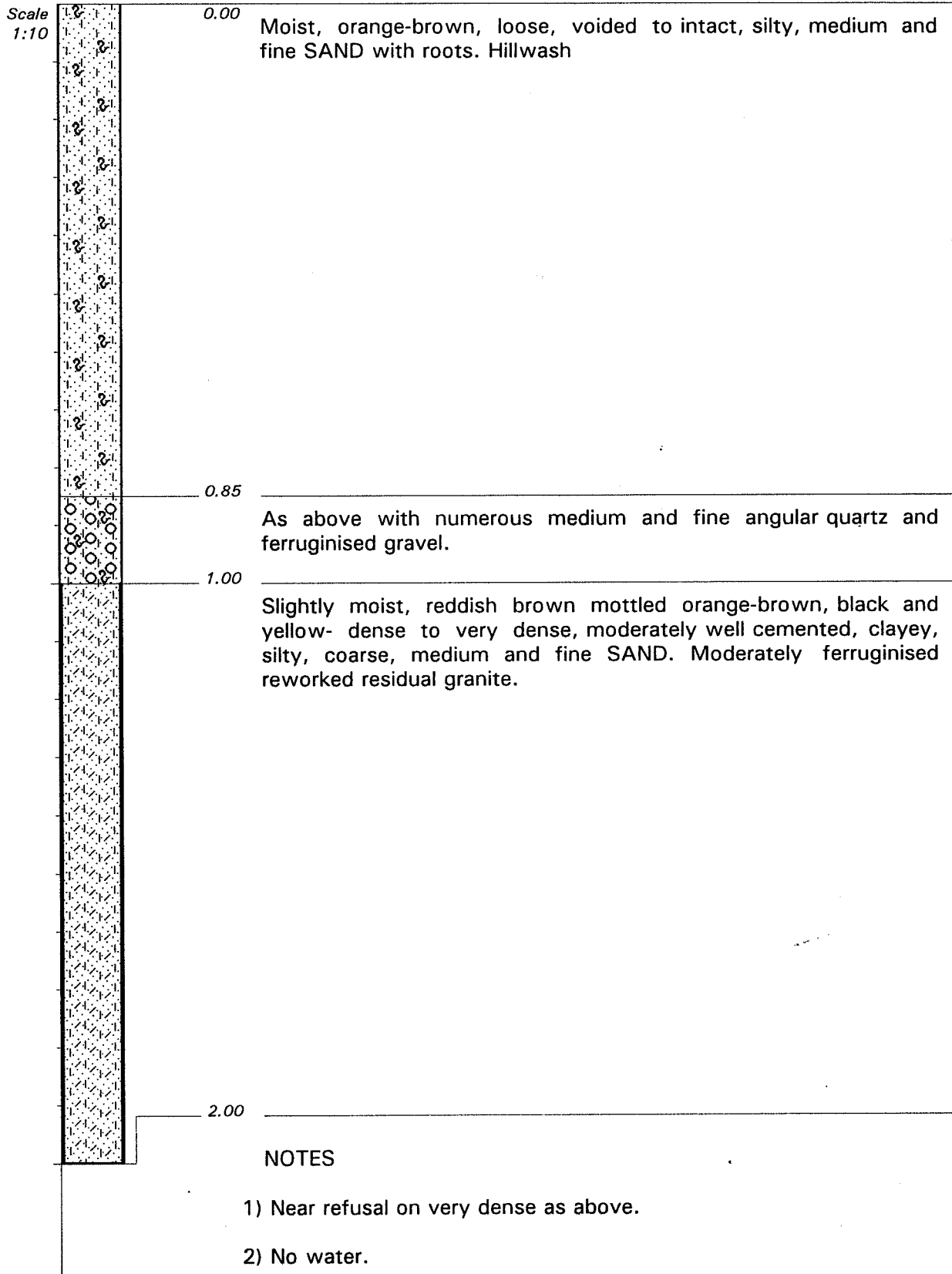


CONTRACTOR : PAUL HESLOP  
 MACHINE : CAT 416  
 DRILLED BY :  
 PROFILED BY : BRB  
 TYPE SET BY :  
 SETUP FILE : STANDARD.SET

INCLINATION :  
 DIAM :  
 DATE :  
 DATE :  
 DATE : 12/10/99 09:40  
 TEXT : C:\profiles\ESSELEN.TXT

ELEVATION :  
 X-COORD :  
 Y-COORD :

**HOLE No: J14**



CONTRACTOR : PAUL HESLOP  
MACHINE : CAT 416  
DRILLED BY :  
PROFILED BY : BRB  
TYPE SET BY :  
SETUP FILE : STANDARD.SET

INCLINATION :  
DIAM :  
DATE :  
DATE :  
DATE : 12/10/99 09:40  
TEXT : C:\profiles\ESSELEN.TXT

ELEVATION :  
X-COORD :  
Y-COORD :



Scale  
1:10



0.00 Slightly moist, brown, medium dense, voided and ploughed, clayey, silty, medium and fine SAND with roots. Hillwash.

0.30 Moist, orange-brown, loose, voided to intact, silty, medium and fine SAND with roots. Hillwash.

1.50 Moist, reddish brown mottled brown, orange and black, medium dense to dense, weakly cemented, clayey, silty, medium and fine SAND with abundant ferruginised concretions. Nodular ferruginised hillwash.

1.80

**NOTES**

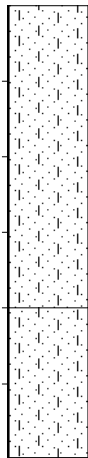
- 1) Near refusal on dense to very dense as above.
- 2) No water.

CONTRACTOR : PAUL HESLOP  
MACHINE : CAT 416  
DRILLED BY :  
PROFILED BY : BRB  
TYPE SET BY :  
SETUP FILE : STANDARD.SET

INCLINATION :  
DIAM :  
DATE :  
DATE :  
DATE : 12/10/99 09:41  
TEXT : C:\profiles\ESSELEN.TXT

ELEVATION :  
X-COORD :  
Y-COORD :

Scale  
1:10



0.00

Slightly moist to moist grey brown loose intact silty sand. Hillwash. Also contains abundant roots in upper 0,15m.

0.40

Moist grey brown mottled orange brown dense strongly cemented and weakly ferruginised silty sand. Reworked residual granite.

0.60

**NOTES**

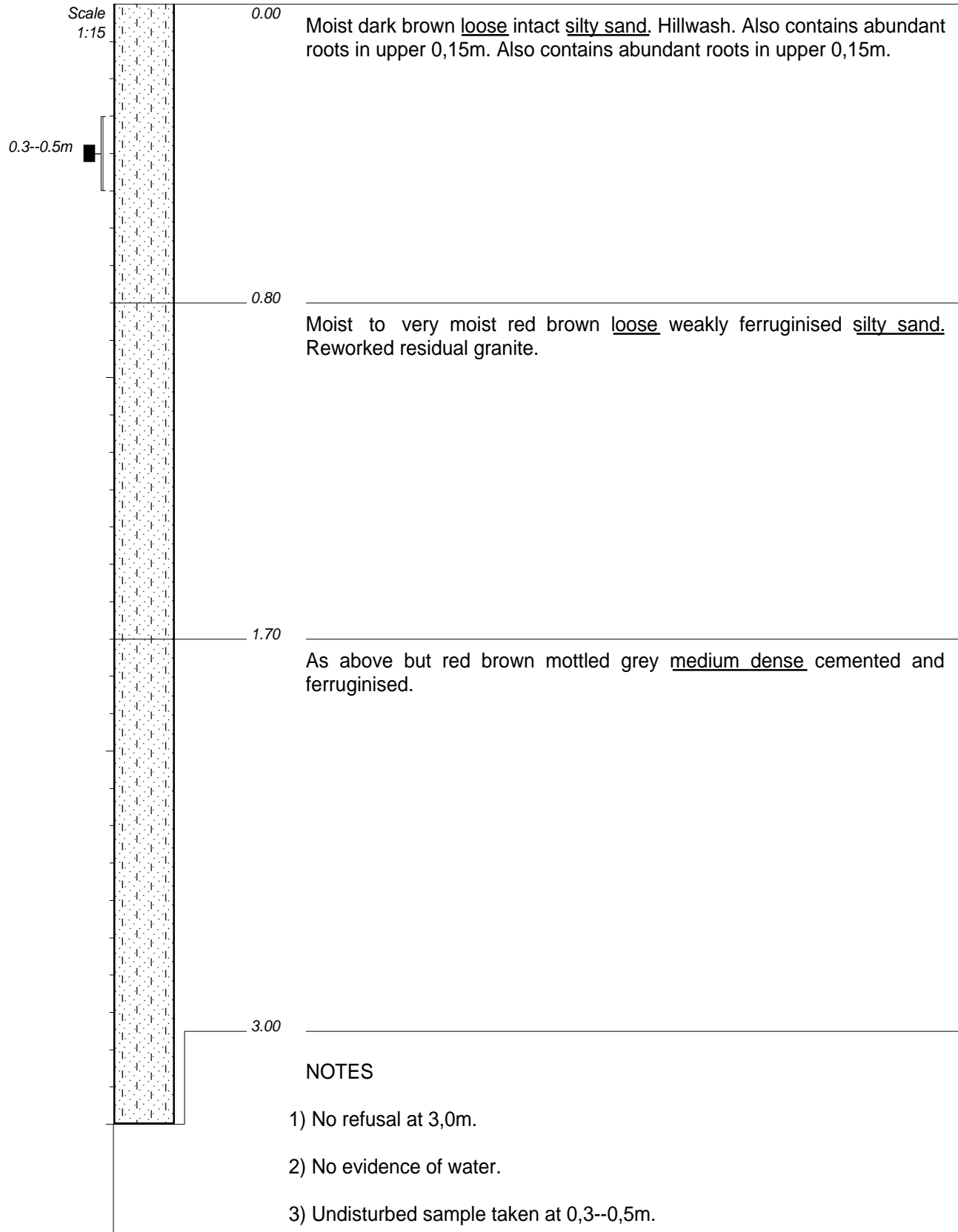
- 1) Refusal at 0,6m on very dense strongly cemented reworked residual granite.
- 2) No evidence of water.

CONTRACTOR :  
MACHINE : Cat 422E  
DRILLED BY :  
PROFILED BY : J van Huyssteen  
TYPE SET BY : Gisela  
SETUP FILE : STANDARD.SET

INCLINATION :  
DIAM :  
DATE :  
DATE : 23/08/2013  
DATE : 27/09/2013 08:37  
TEXT : ..s\13123TPEsselenPark.txt

ELEVATION :  
X-COORD :  
Y-COORD :

HOLE No: TP25

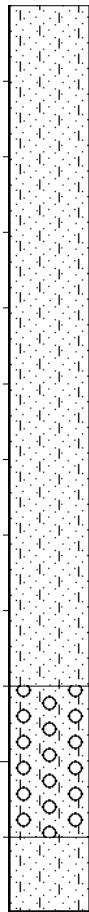


CONTRACTOR :  
MACHINE : Cat 422E  
DRILLED BY :  
PROFILED BY : J van Huyssteen  
TYPE SET BY : Gisela  
SETUP FILE : STANDARD.SET

INCLINATION :  
DIAM :  
DATE :  
DATE : 23/08/2013  
DATE : 27/09/2013 08:37  
TEXT : ..s\13123TPEsselenPark.txt

ELEVATION :  
X-COORD :  
Y-COORD :

Scale  
1:10



0.00

Moist light red brown loose intact silty sand. Hillwash. Also contains abundant roots in upper 0,15m.

0.90

As above but loose to medium dense and contains scattered fine to coarse quartz gravel. Pebble marker.

1.10

Moist red brown mottled off white medium dense to dense ferruginised silty sand. Reworked residual granite.

1.20

NOTES

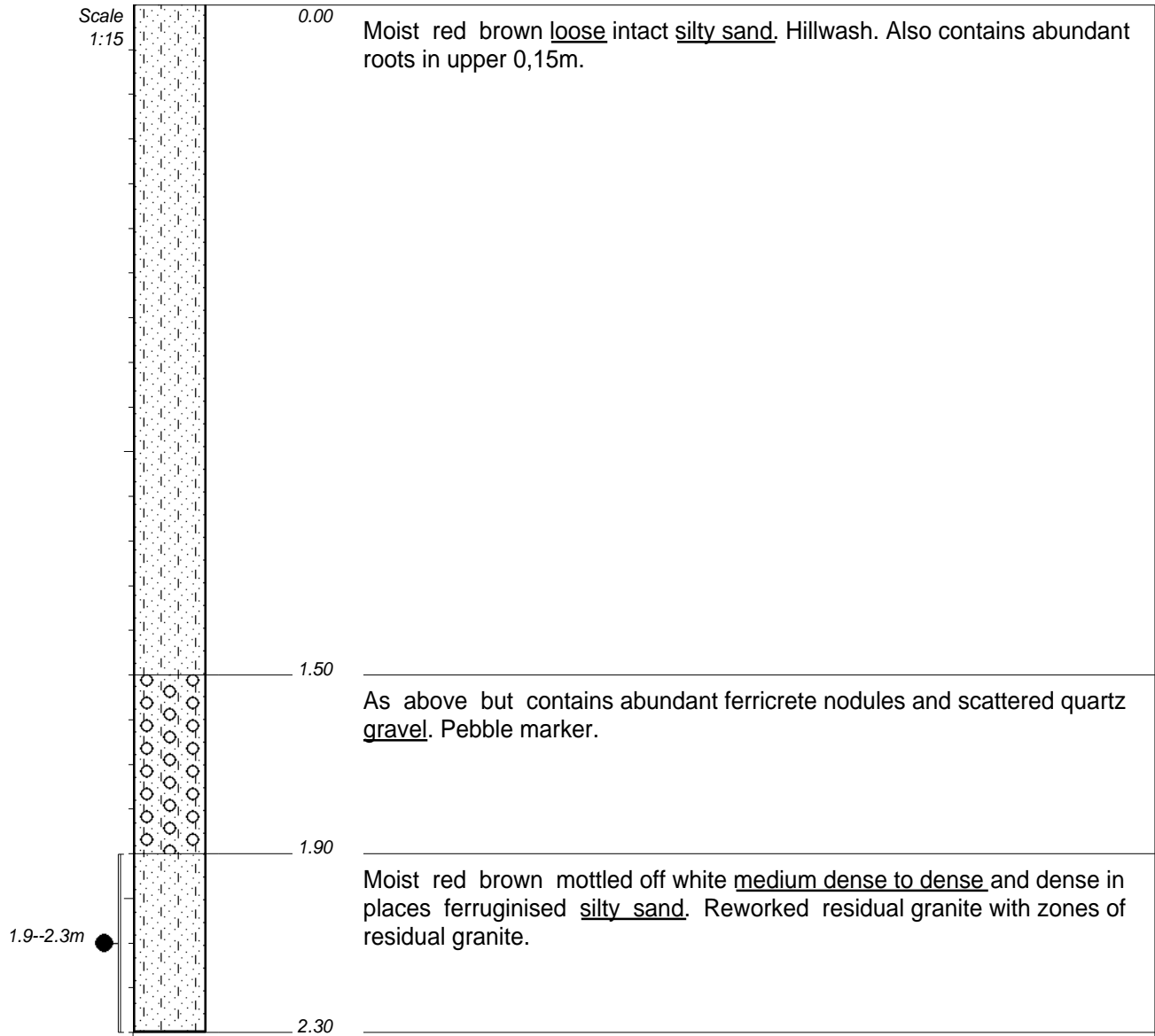
- 1) Refusal at 1,2m on very dense ferruginised residual granite.
- 2) No evidence of water.

CONTRACTOR :  
MACHINE : Cat 422E  
DRILLED BY :  
PROFILED BY : J van Huyssteen  
TYPE SET BY : Gisela  
SETUP FILE : STANDARD.SET

INCLINATION :  
DIAM :  
DATE :  
DATE : 23/08/2013  
DATE : 27/09/2013 08:37  
TEXT : ..s\13123TPEsselenPark.txt

ELEVATION :  
X-COORD :  
Y-COORD :

HOLE No: TP32



**NOTES**

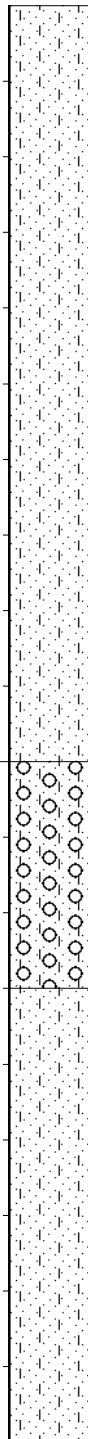
- 1) Refusal at 2,3m on very dense ferruginised reworked residual granite.
- 2) No evidence of water.
- 3) Disturbed sample taken at 1,9--2,3m.

CONTRACTOR :  
MACHINE : Cat 422E  
DRILLED BY :  
PROFILED BY : J van Huyssteen  
TYPE SET BY : Gisela  
SETUP FILE : STANDARD.SET

INCLINATION :  
DIAM :  
DATE :  
DATE : 23/08/2013  
DATE : 27/09/2013 08:37  
TEXT : ..s\13123TPEsselenPark.txt

ELEVATION :  
X-COORD :  
Y-COORD :

Scale  
1:10



0.00

Slightly moist to moist grey brown loose to medium dense intact silty sand. Hillwash. Also contains abundant roots in upper 0,15m.

1.00

As above but contains abundant ferricrete nodules and scattered quartz gravel. Pebble marker.

1.30

Moist grey brown mottled red and black dense and very dense in places ferruginised silty sand. Reworked residual granite.

1.90

**NOTES**

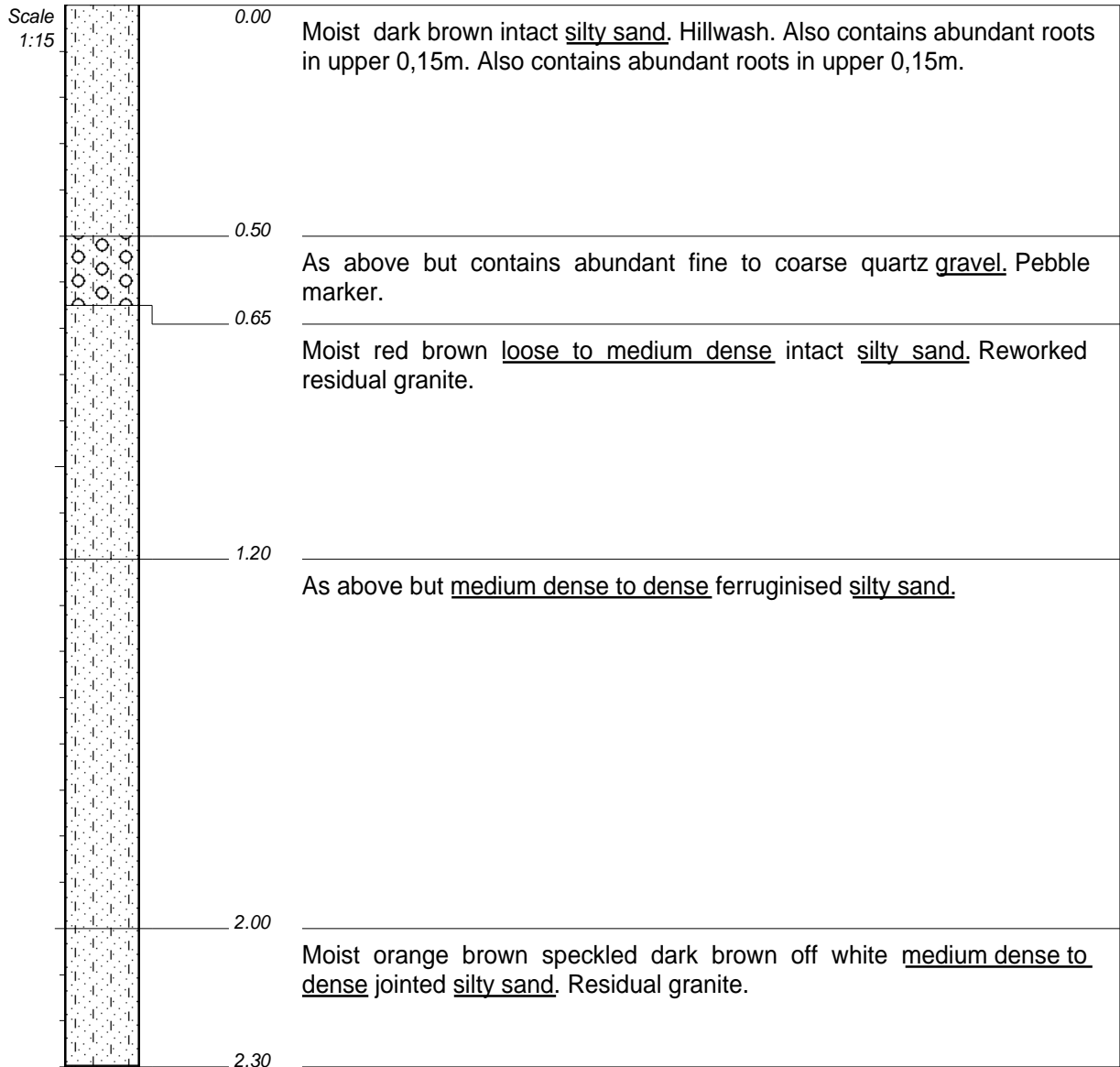
- 1) Refusal at 0,9m on very dense ferruginised reworked residual granite.
- 2) No evidence of water.

CONTRACTOR :  
MACHINE : Cat 422E  
DRILLED BY :  
PROFILED BY : J van Huyssteen  
TYPE SET BY : Gisela  
SETUP FILE : STANDARD.SET

INCLINATION :  
DIAM :  
DATE :  
DATE : 23/08/2013  
DATE : 27/09/2013 08:37  
TEXT : ..s\13123TPEsselenPark.txt

ELEVATION :  
X-COORD :  
Y-COORD :

HOLE No: TP38



**NOTES**

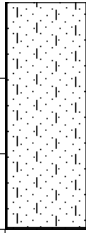
- 1) Refusal at 2,4m on very soft rock granite.
- 2) No evidence of water.

CONTRACTOR :  
MACHINE : Cat 422E  
DRILLED BY :  
PROFILED BY : J van Huyssteen  
TYPE SET BY : Gisela  
SETUP FILE : STANDARD.SET

INCLINATION :  
DIAM :  
DATE :  
DATE : 23/08/2013  
DATE : 27/09/2013 08:37  
TEXT : ..s\13123TPEsselenPark.txt

ELEVATION :  
X-COORD :  
Y-COORD :

Scale  
1:10



0.00

Moist light brown loose intact silty sand. Hillwash. Also contains abundant roots in upper 0,15m.

0.30

NOTES

- 1) Refusal at 0,3m on very soft rock consistency hardpan ferricrete.
- 2) No evidence of water.

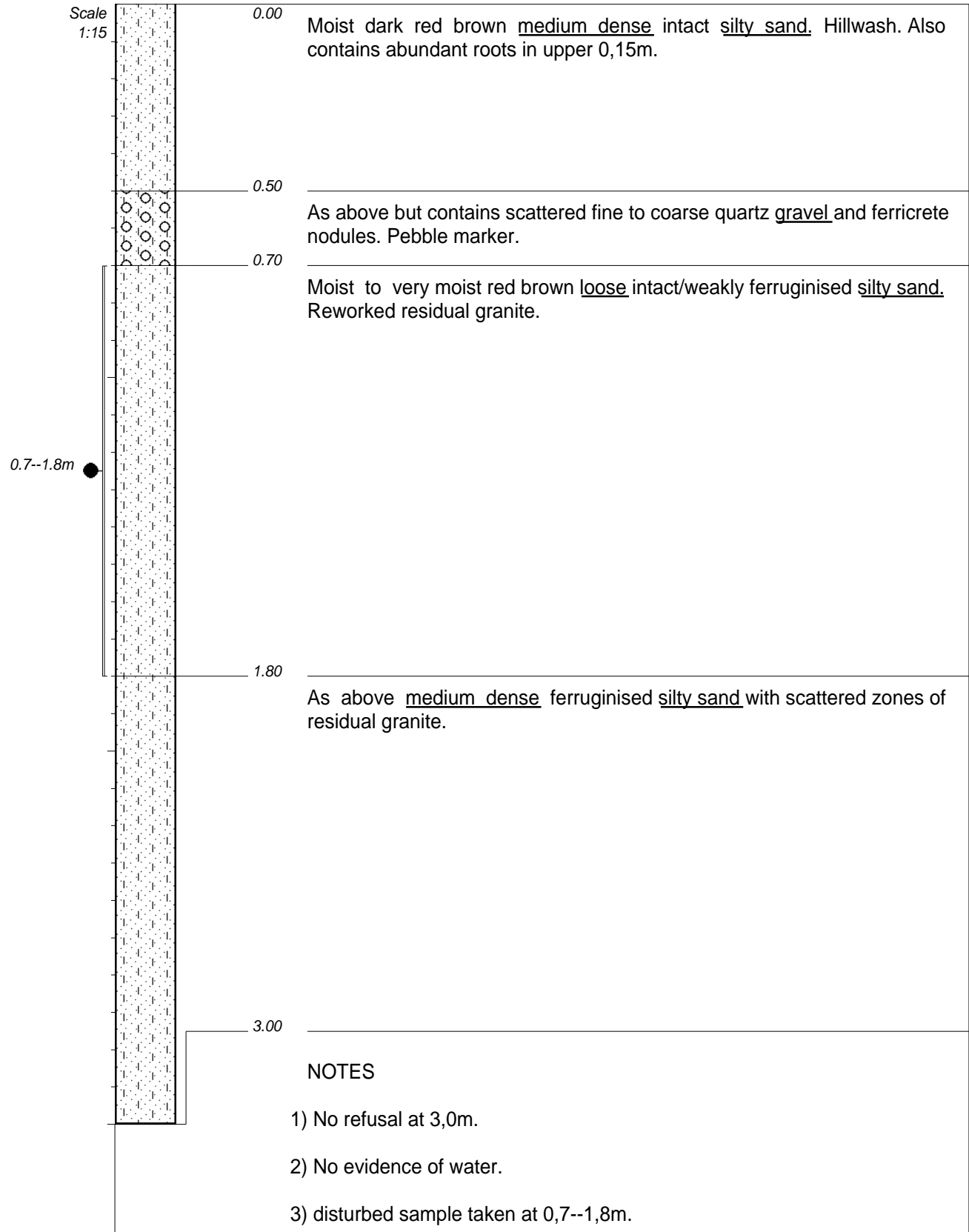
CONTRACTOR :  
MACHINE : Cat 422E  
DRILLED BY :  
PROFILED BY : J van Huyssteen  
TYPE SET BY : Gisela  
SETUP FILE : STANDARD.SET

INCLINATION :  
DIAM :  
DATE :  
DATE : 23/08/2013  
DATE : 27/09/2013 08:37  
TEXT : ..s\13123TPEsselenPark.txt

ELEVATION :  
X-COORD :  
Y-COORD :

HOLE No: TP59



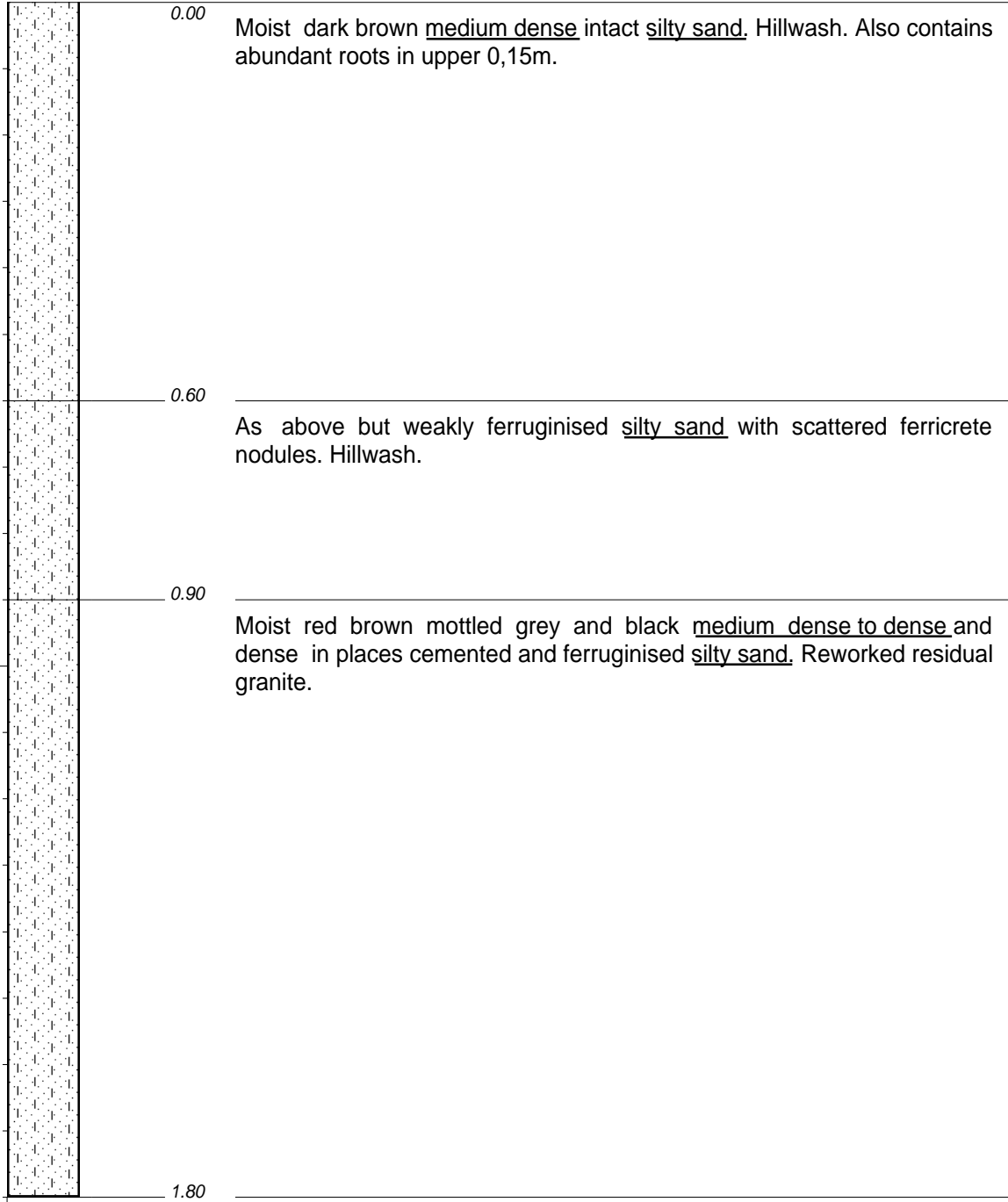


CONTRACTOR :  
MACHINE : Cat 422E  
DRILLED BY :  
PROFILED BY : J van Huyssteen  
TYPE SET BY : Gisela  
SETUP FILE : STANDARD.SET

INCLINATION :  
DIAM :  
DATE :  
DATE : 23/08/2013  
DATE : 27/09/2013 08:37  
TEXT : ..s\13123TPEsselenPark.txt

ELEVATION :  
X-COORD :  
Y-COORD :

Scale  
1:10



NOTES

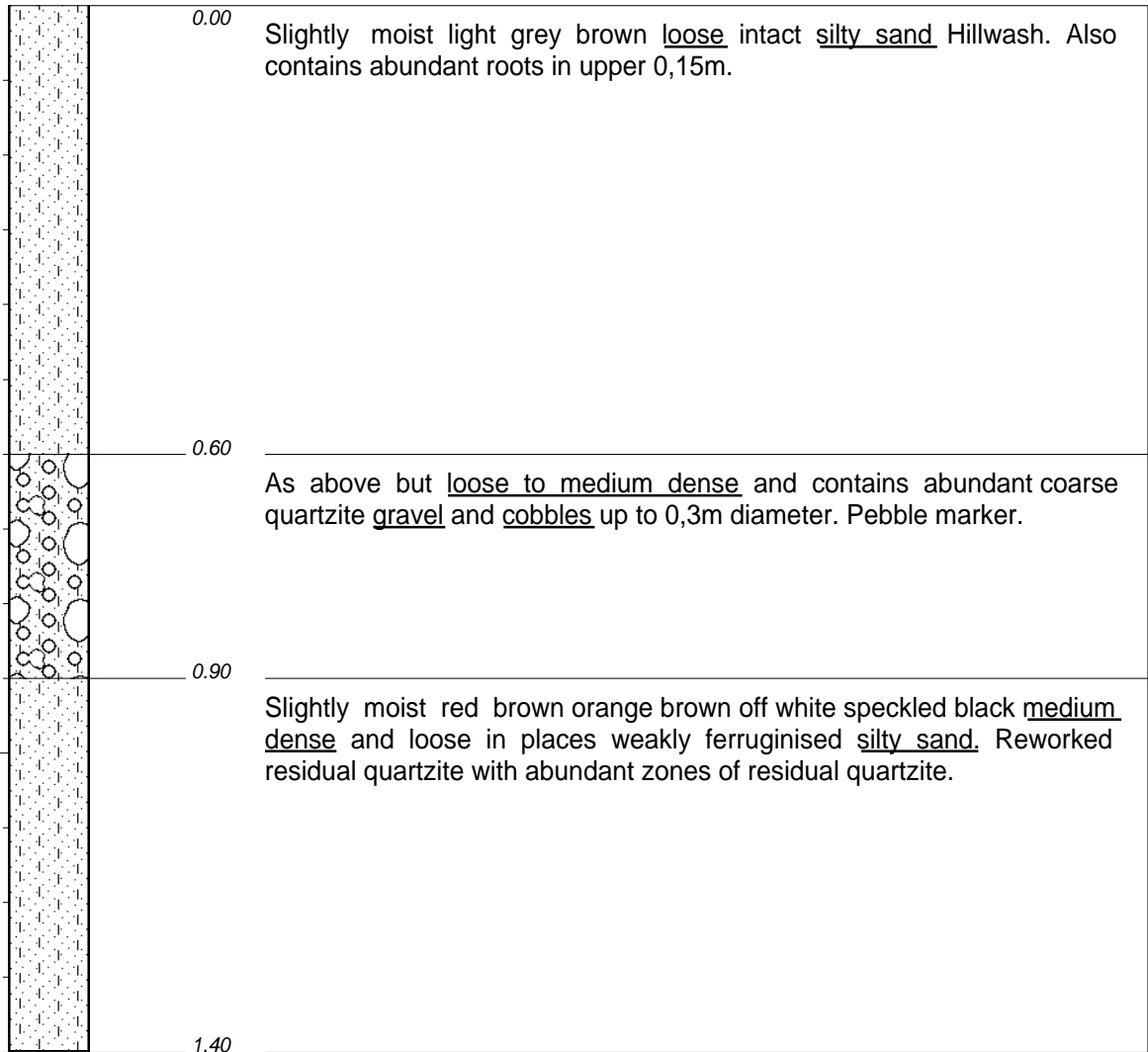
- 1) Refusal at 1,8m on very dense reworked residual granite.
- 2) No evidence of water.

CONTRACTOR :  
MACHINE : Cat 422E  
DRILLED BY :  
PROFILED BY : J van Huyssteen  
TYPE SET BY : Gisela  
SETUP FILE : STANDARD.SET

INCLINATION :  
DIAM :  
DATE :  
DATE : 23/08/2013  
DATE : 27/09/2013 08:37  
TEXT : ..s\13123TPEsselenPark.txt

ELEVATION :  
X-COORD :  
Y-COORD :

Scale  
1:10



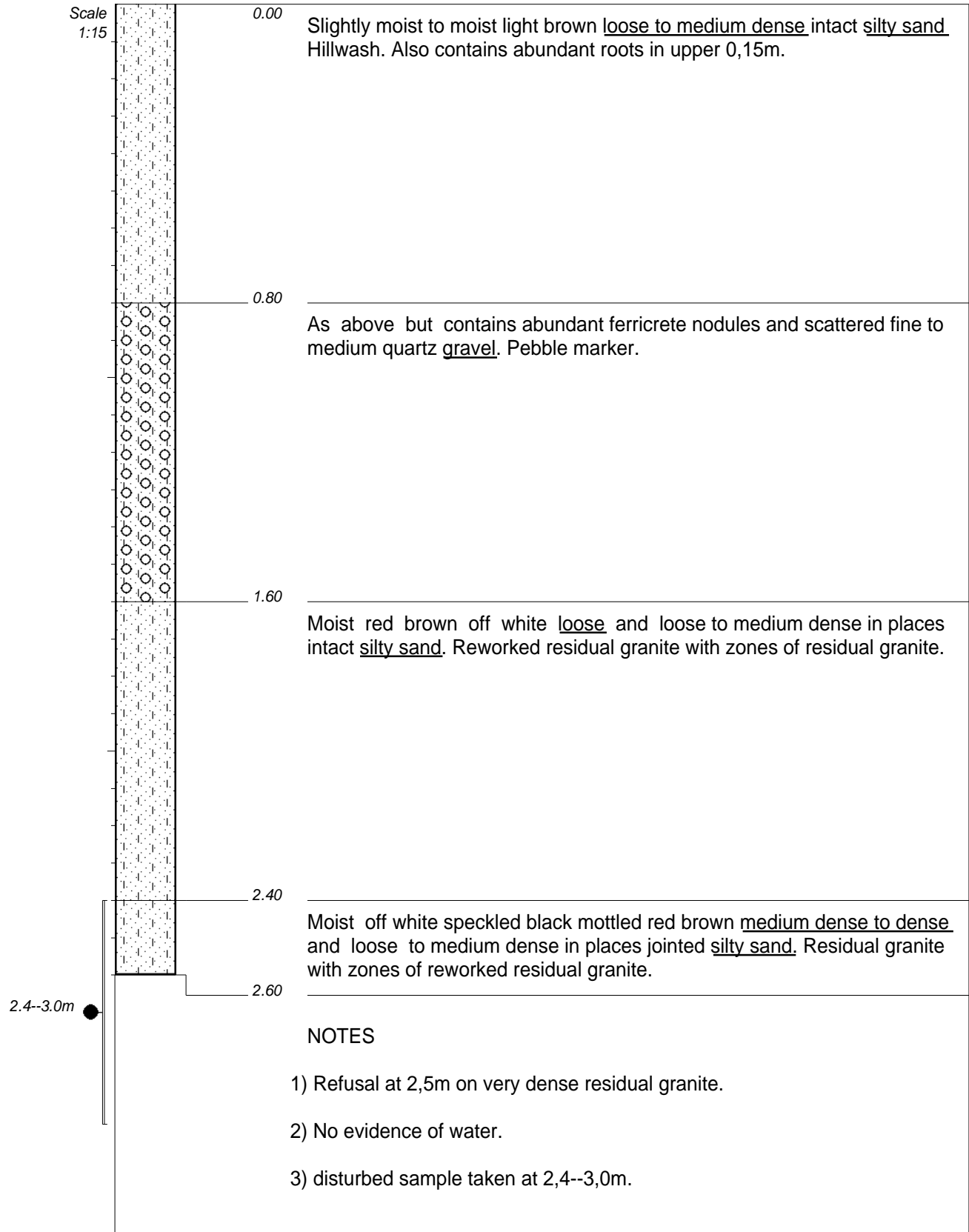
**NOTES**

- 1) Refusal at 1,4m on very soft rock quartzite.
- 2) No evidence of water.
- 3) Disturbed sample taken at -.9--1,4m.

CONTRACTOR :  
MACHINE : Cat 422E  
DRILLED BY :  
PROFILED BY : J van Huyssteen  
TYPE SET BY : Gisela  
SETUP FILE : STANDARD.SET

INCLINATION :  
DIAM :  
DATE :  
DATE : 23/08/2013  
DATE : 27/09/2013 08:37  
TEXT : ..s\13123TPEsselenPark.txt

ELEVATION :  
X-COORD :  
Y-COORD :

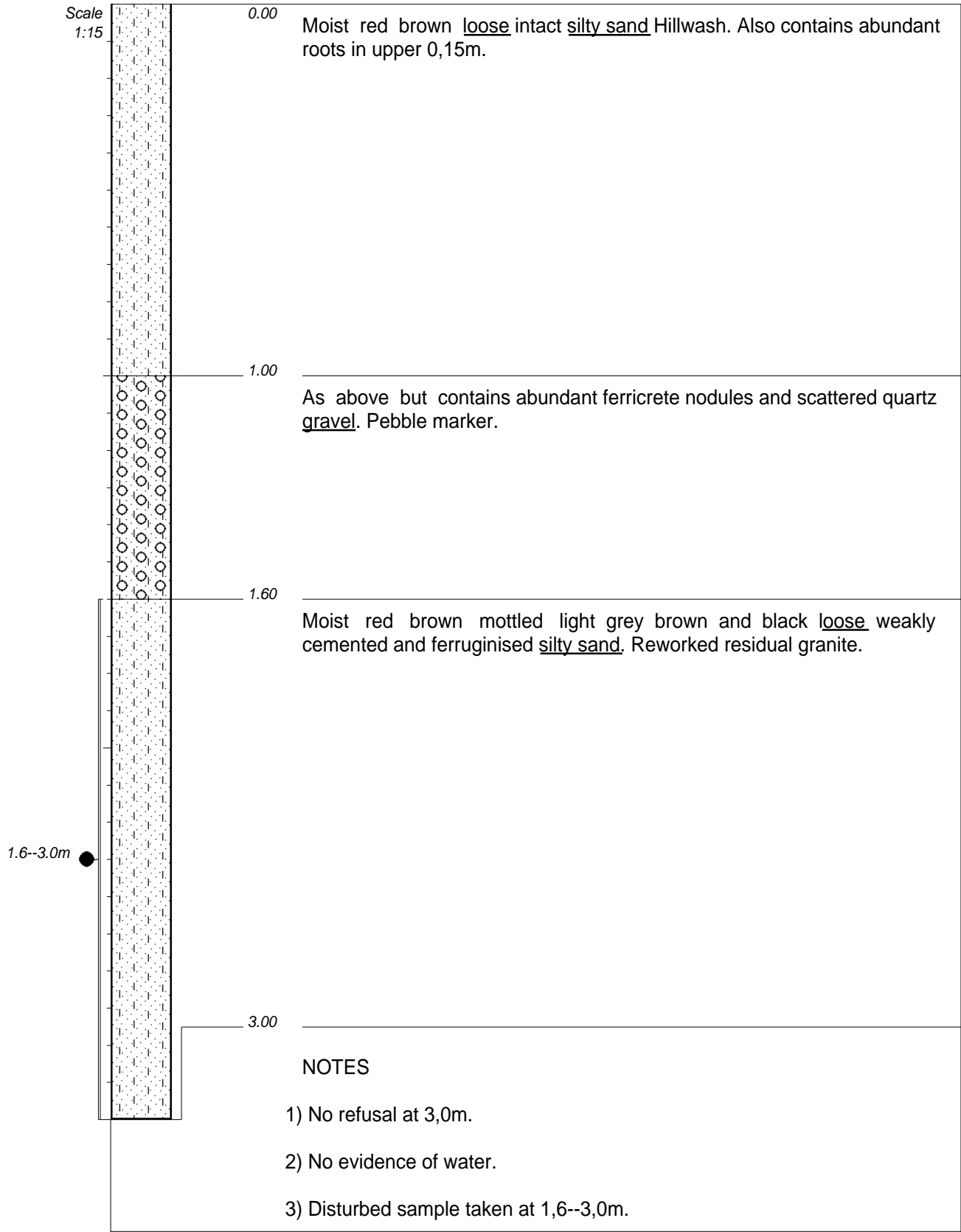


CONTRACTOR :  
MACHINE : Cat 422E  
DRILLED BY :  
PROFILED BY : J van Huyssteen  
TYPE SET BY : Gisela  
SETUP FILE : STANDARD.SET

INCLINATION :  
DIAM :  
DATE :  
DATE : 23/08/2013  
DATE : 27/09/2013 08:37  
TEXT : ..s\13123TPEsselenPark.txt

ELEVATION :  
X-COORD :  
Y-COORD :

HOLE No: TP78



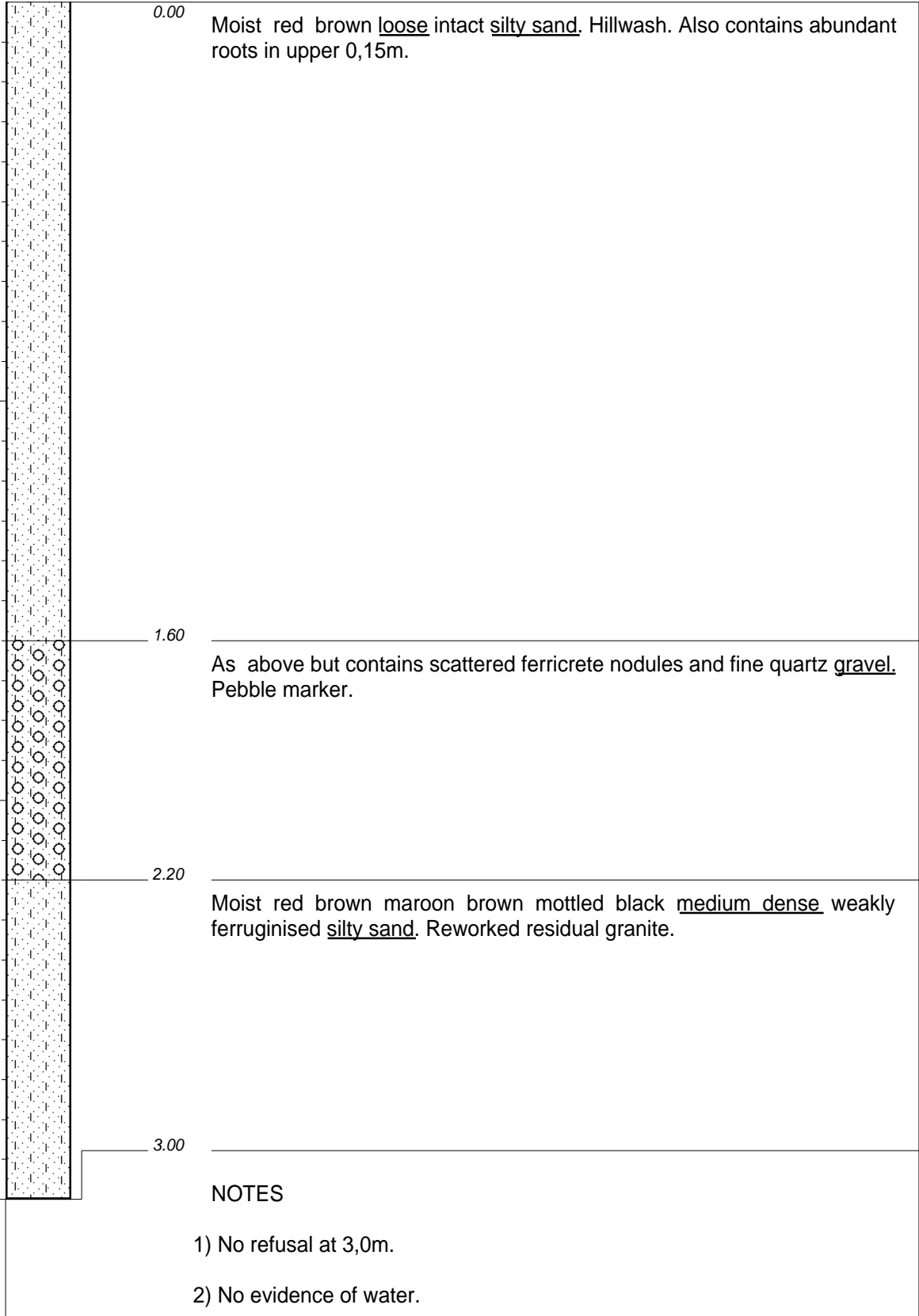
CONTRACTOR :  
MACHINE : Cat 422E  
DRILLED BY :  
PROFILED BY : J van Huyssteen  
TYPE SET BY : Gisela  
SETUP FILE : STANDARD.SET

INCLINATION :  
DIAM :  
DATE :  
DATE : 23/08/2013  
DATE : 27/09/2013 08:37  
TEXT : ..s\13123TPEsselenPark.txt

ELEVATION :  
X-COORD :  
Y-COORD :

HOLE No: TP79

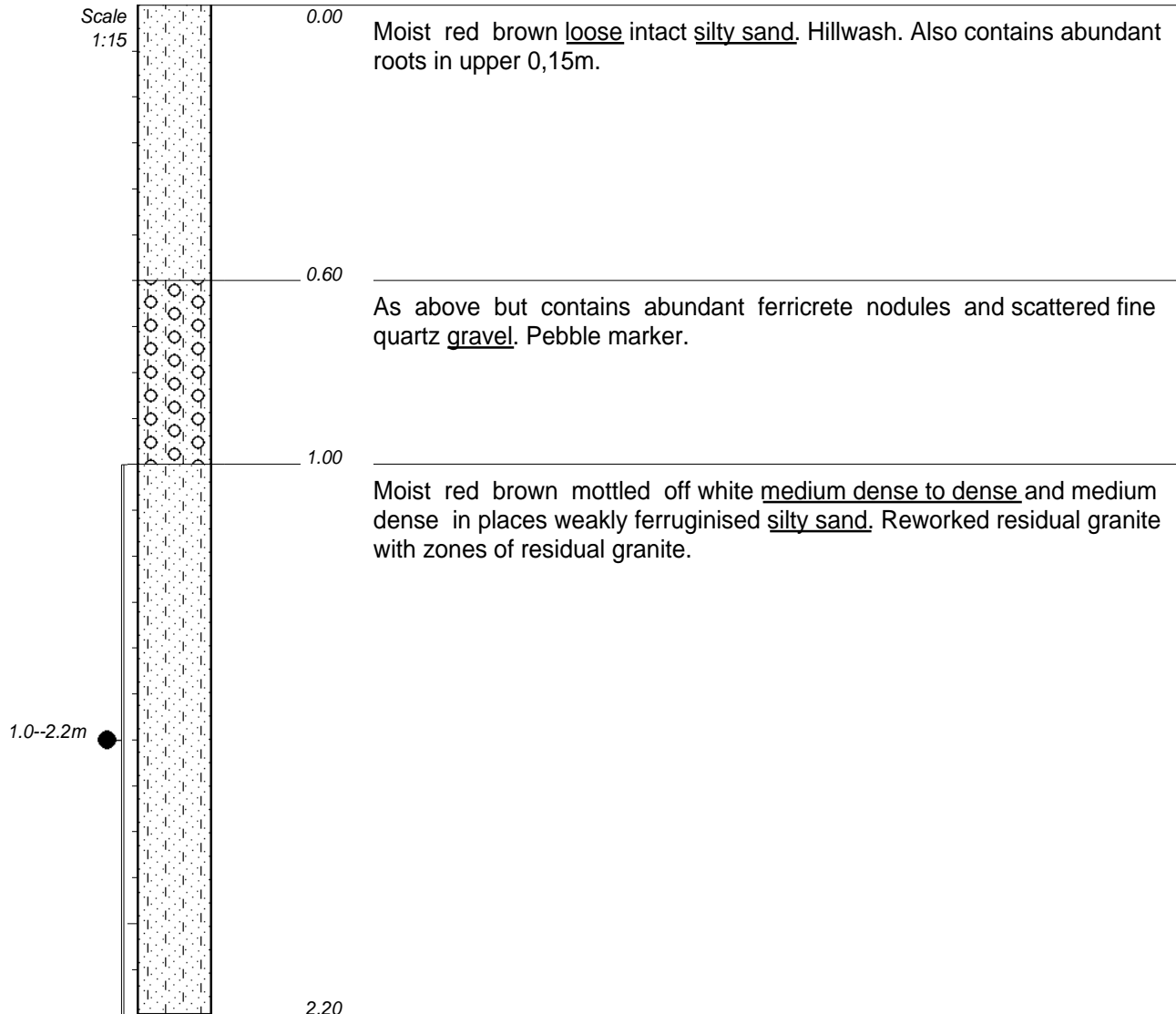
Scale  
1:15



CONTRACTOR :  
MACHINE : Cat 422E  
DRILLED BY :  
PROFILED BY : J van Huyssteen  
TYPE SET BY : Gisela  
SETUP FILE : STANDARD.SET

INCLINATION :  
DIAM :  
DATE :  
DATE : 23/08/2013  
DATE : 27/09/2013 08:37  
TEXT : ..s\13123TPEsselenPark.txt

ELEVATION :  
X-COORD :  
Y-COORD :



**NOTES**

- 1) Refusal at 2,2m on very dense ferruginised reworked residual granite.
- 2) No evidence of water.
- 3) Disturbed sample taken at 1,0--2,2m.

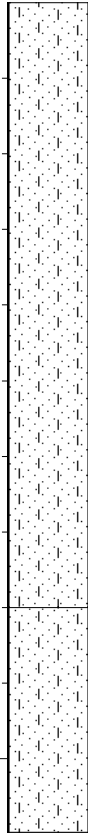
CONTRACTOR :  
MACHINE : Cat 422E  
DRILLED BY :  
PROFILED BY : J van Huyssteen  
TYPE SET BY : Gisela  
SETUP FILE : STANDARD.SET

INCLINATION :  
DIAM :  
DATE :  
DATE : 23/08/2013  
DATE : 27/09/2013 08:37  
TEXT : ..s\13123TPEsselenPark.txt

ELEVATION :  
X-COORD :  
Y-COORD :

HOLE No: TP82

Scale  
1:10



0.00

Slightly moist grey brown loose to medium dense intact silty sand. Hillwash. Also contains abundant roots in upper 0,15m.

0.80

Slightly moist to moist grey mottled beige brown red medium dense weakly cemented and ferruginised silty sand. Reworked residual granite.

1.10

NOTES

- 1) Refusal at 1,1m on very dense reworked residual granite.
- 2) No evidence of water.

CONTRACTOR :  
MACHINE : Cat 422E  
DRILLED BY :  
PROFILED BY : J van Huyssteen  
TYPE SET BY : Gisela  
SETUP FILE : STANDARD.SET

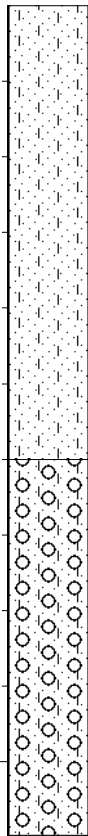
INCLINATION :  
DIAM :  
DATE :  
DATE : 23/08/2013  
DATE : 27/09/2013 08:37  
TEXT : ..s\13123TPEsselenPark.txt

ELEVATION :  
X-COORD :  
Y-COORD :

HOLE No: TP83



Scale  
1:10



0.00

Slightly moist dark green brown loose intact silty sand. Hillwash. Also contains abundant roots in upper 0,15m. Also contains abundant roots in upper 0,15m.

0.60

As above but medium dense and weakly ferruginised and contains scattered coarse quartzite gravel. Pebble marker.

1.10

**NOTES**

- 1) Refusal at 1,1m on very dense strongly ferruginised reworked residual granite.
- 2) No evidence of water.

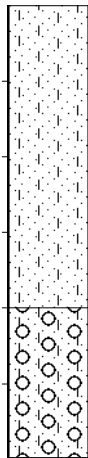
CONTRACTOR :  
MACHINE : Cat 422E  
DRILLED BY :  
PROFILED BY : J van Huyssteen  
TYPE SET BY : Gisela  
SETUP FILE : STANDARD.SET

INCLINATION :  
DIAM :  
DATE :  
DATE : 23/08/2013  
DATE : 27/09/2013 08:37  
TEXT : ..s\13123TPEsselenPark.txt

ELEVATION :  
X-COORD :  
Y-COORD :

HOLE No: TP88

Scale  
1:10



0.00

Slightly moist beige brown loose intact silty sand. Hillwash. Also contains abundant roots in upper 0,15m.

0.40

As above but medium dense and contains scattered coarse quartzite gravel. Pebble marker.

0.60

NOTES

- 1) Refusal at 0,6m on very soft rock quartzite.
- 2) No evidence of water.


CONTRACTOR :  
MACHINE : Cat 422E  
DRILLED BY :  
PROFILED BY : J van Huyssteen  
TYPE SET BY : Gisela  
SETUP FILE : STANDARD.SET

INCLINATION :  
DIAM :  
DATE :  
DATE : 23/08/2013  
DATE : 27/09/2013 08:37  
TEXT : ..s\13123TPEsselenPark.txt

ELEVATION :  
X-COORD :  
Y-COORD :

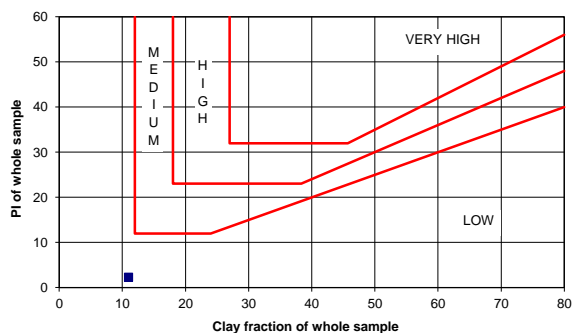
HOLE No: TP89

## PARTICLE SIZE ANALYSIS

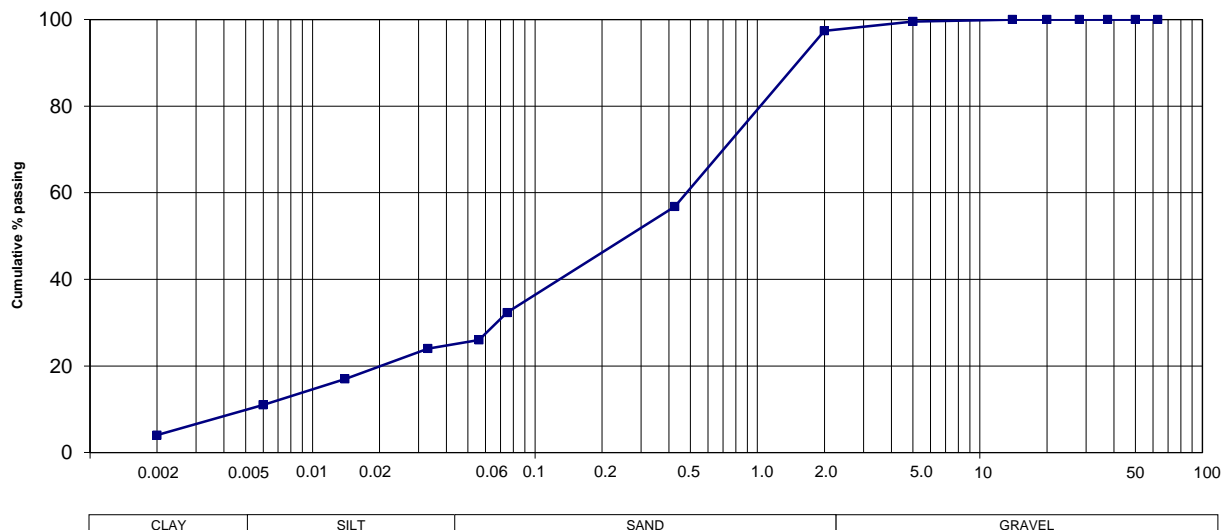
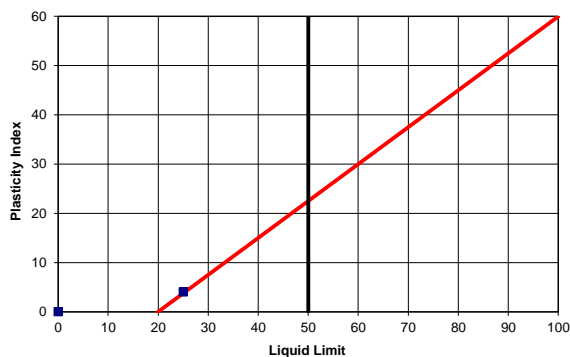
Sample No.	1								
Soillab Sample No.	S18-1898-01								
Depth (m)	2.3 - 5.55								
Position	TP 01								
Material Description	DARK YELLOW  SILTY SAND								
Relative density on < 2 mm (SANS 5844)	2.623								
Organic Material									
Moisture (%) / Dispersion (%)									
<b>SCREEN ANALYSIS (% PASSING) (SANS 3001:GR1)</b>									
63.0 mm	100								
50.0 mm	100								
37.5 mm	100								
28.0 mm	100								
20.0 mm	100								
14.0 mm	100								
5.0 mm	100								
2.00 mm	97								
0.425 mm	57								
0.075 mm	32								
<b>HYDROMETER ANALYSIS (% PASSING) (SANS 3001:GR3)</b>									
56 µm	26								
33 µm	24								
14 µm	17								
6 µm	11								
2 µm	4								
<table border="1" style="width: 100%;"> <tr> <td>% Clay</td> <td>11</td> </tr> <tr> <td>% Silt</td> <td>15</td> </tr> <tr> <td>% Sand</td> <td>71</td> </tr> <tr> <td>% Gravel</td> <td>3</td> </tr> </table>		% Clay	11	% Silt	15	% Sand	71	% Gravel	3
% Clay	11								
% Silt	15								
% Sand	71								
% Gravel	3								
<b>ATTERBERG LIMITS (SANS 3001:GR10)</b>									
Liquid Limit	25								
Plasticity Index	4								
Linear Shrinkage (%)	1.5								
Grading Modulus	1.13								
Classification	A-2-4 (0)								
Unified Classification	SM & SC								
Chart Reference									

PROJECT : ESSELEN PARK  
JOB No. : S18-1898  
DATE : 2018-10-09


### POTENTIAL EXPANSIVENESS



### PLASTICITY CHART

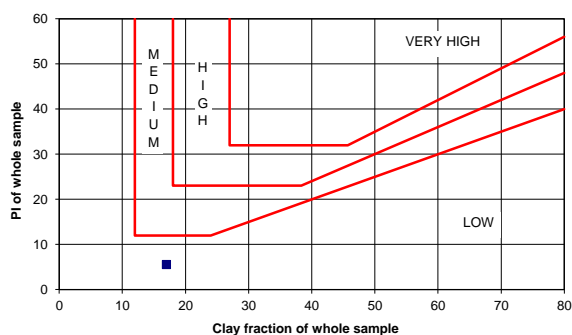


## PARTICLE SIZE ANALYSIS

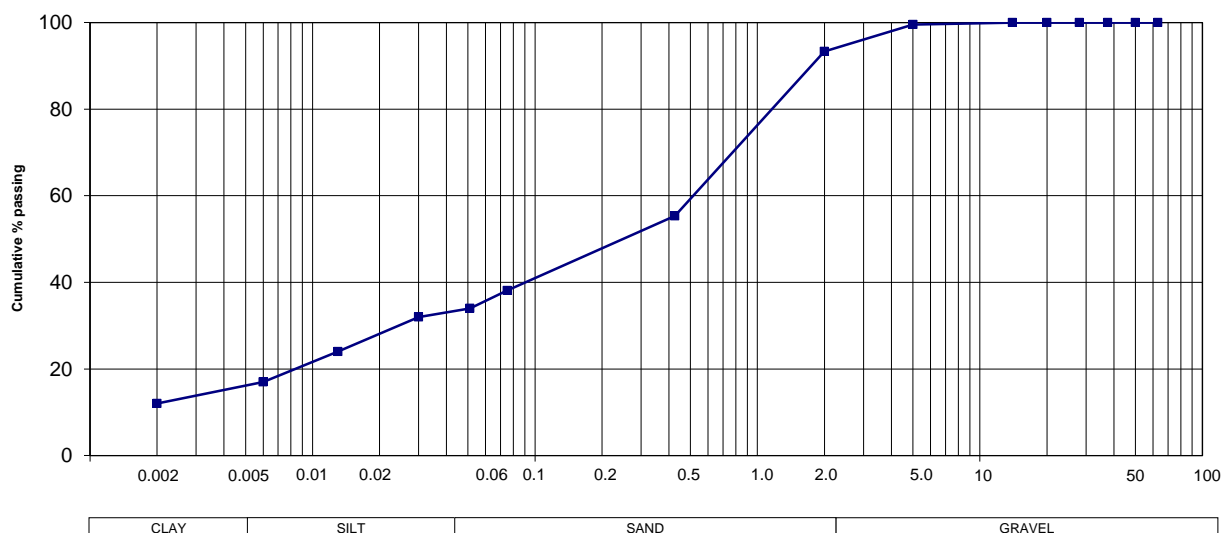
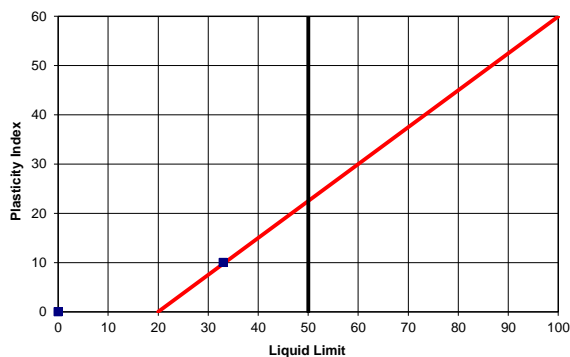
Sample No.	2
Soillab Sample No.	S18-1898-02
Depth (m)	1.60 - 4.50
Position	TP 03
Material Description	LIGHT REDDISH ORANGE CLAYEY SAND
Relative density on < 2 mm (SANS 5844)	2.702
Organic Material	
Moisture (%) / Dispersion (%)	
<b>SCREEN ANALYSIS (% PASSING) (SANS 3001:GR1)</b>	
63.0 mm	100
50.0 mm	100
37.5 mm	100
28.0 mm	100
20.0 mm	100
14.0 mm	100
5.0 mm	100
2.00 mm	93
0.425 mm	55
0.075 mm	38
<b>HYDROMETER ANALYSIS (% PASSING) (SANS 3001:GR3)</b>	
51 $\mu$ m	34
30 $\mu$ m	32
13 $\mu$ m	24
6 $\mu$ m	17
2 $\mu$ m	12
% Clay	17
% Silt	17
% Sand	59
% Gravel	7
<b>ATTERBERG LIMITS (SANS 3001:GR10)</b>	
Liquid Limit	33
Plasticity Index	10
Linear Shrinkage (%)	3.5
Grading Modulus	1.13
Classification	A-4 (0)
Unified Classification	SC
Chart Reference	

PROJECT : ESSELEN PARK  
JOB No. : S18-1898  
DATE : 2018-10-09

### POTENTIAL EXPANSIVENESS



### PLASTICITY CHART

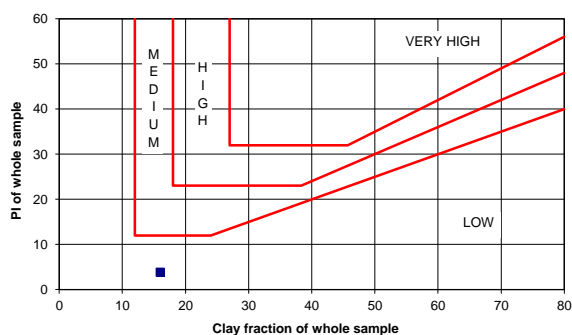


## PARTICLE SIZE ANALYSIS

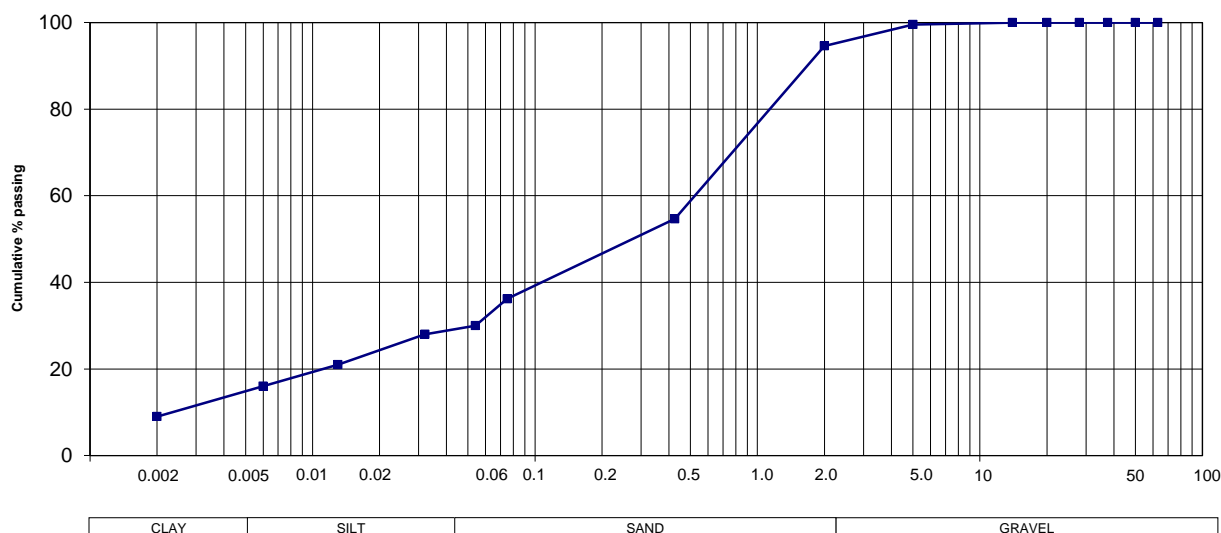
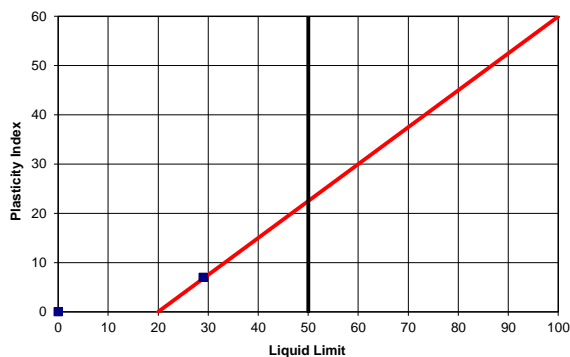
Sample No.	3
Soillab Sample No.	S18-1898-03
Depth (m)	4.50 - 5.80
Position	TP 03
Material Description	LIGHT REDDISH ORANGE CLAYEY SAND
Relative density on < 2 mm (SANS 5844)	2.637
Organic Material	
Moisture (%) / Dispersion (%)	
<b>SCREEN ANALYSIS (% PASSING) (SANS 3001:GR1)</b>	
63.0 mm	100
50.0 mm	100
37.5 mm	100
28.0 mm	100
20.0 mm	100
14.0 mm	100
5.0 mm	100
2.00 mm	95
0.425 mm	55
0.075 mm	36
<b>HYDROMETER ANALYSIS (% PASSING) (SANS 3001:GR3)</b>	
54 µm	30
32 µm	28
13 µm	21
6 µm	16
2 µm	9
% Clay	16
% Silt	14
% Sand	65
% Gravel	5
<b>ATTERBERG LIMITS (SANS 3001:GR10)</b>	
Liquid Limit	29
Plasticity Index	7
Linear Shrinkage (%)	2.0
Grading Modulus	1.15
Classification	A-4 (0)
Unified Classification	SM & SC
Chart Reference	■

PROJECT : ESSELEN PARK  
JOB No. : S18-1898  
DATE : 2018-10-09


### POTENTIAL EXPANSIVENESS



### PLASTICITY CHART

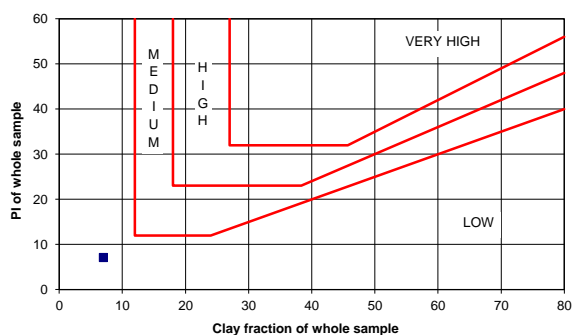


## PARTICLE SIZE ANALYSIS

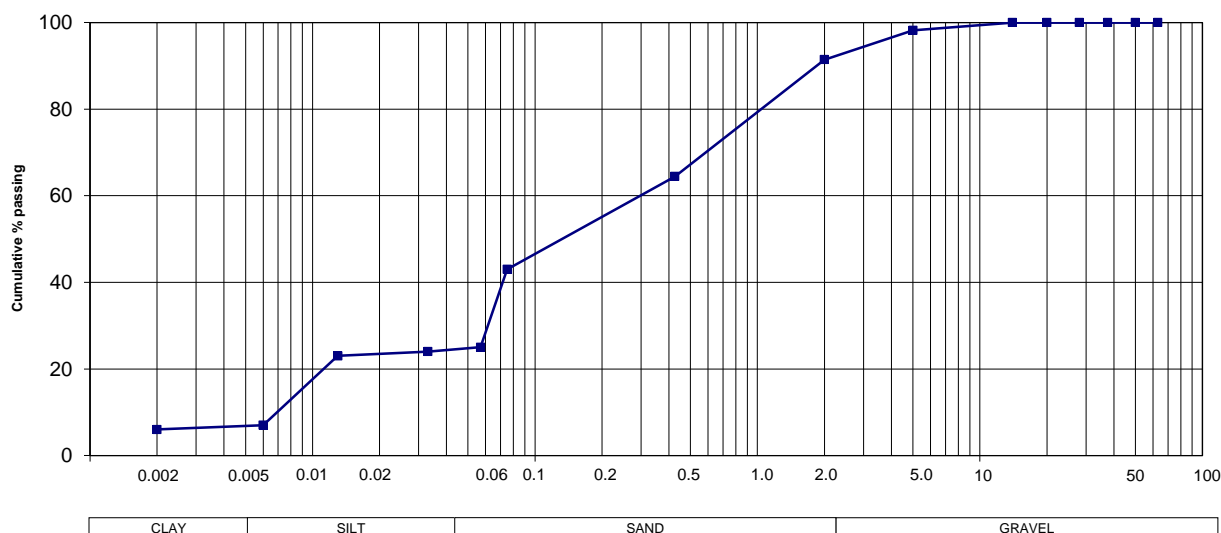
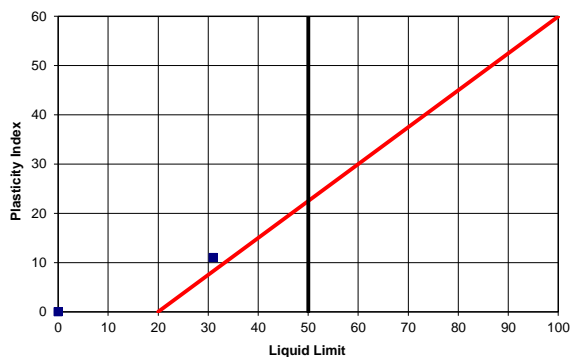
Sample No.	4
Soillab Sample No.	S18-1898-04
Depth (m)	1.80 - 2.80
Position	TP 07
Material Description	DUSKY RED FERRICRETE SILTY SAND
Relative density on < 2 mm (SANS 5844)	2.651
Organic Material	
Moisture (%) / Dispersion (%)	
<b>SCREEN ANALYSIS (% PASSING) (SANS 3001:GR1)</b>	
63.0 mm	100
50.0 mm	100
37.5 mm	100
28.0 mm	100
20.0 mm	100
14.0 mm	100
5.0 mm	98
2.00 mm	91
0.425 mm	64
0.075 mm	43
<b>HYDROMETER ANALYSIS (% PASSING) (SANS 3001:GR3)</b>	
57 µm	25
33 µm	24
13 µm	23
6 µm	7
2 µm	6
% Clay	7
% Silt	18
% Sand	66
% Gravel	9
<b>ATTERBERG LIMITS (SANS 3001:GR10)</b>	
Liquid Limit	31
Plasticity Index	11
Linear Shrinkage (%)	4.5
Grading Modulus	1.01
Classification	A-6 (2)
Unified Classification	SC
Chart Reference	

PROJECT : ESSELEN PARK  
JOB No. : S18-1898  
DATE : 2018-10-09


### POTENTIAL EXPANSIVENESS



### PLASTICITY CHART

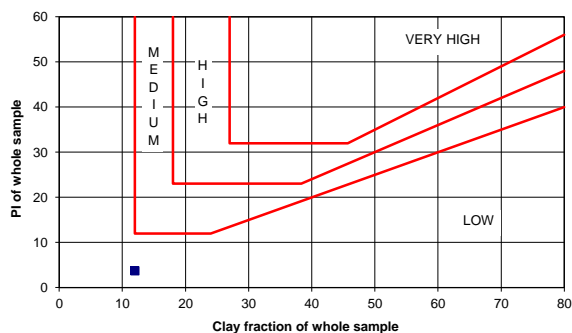


## PARTICLE SIZE ANALYSIS

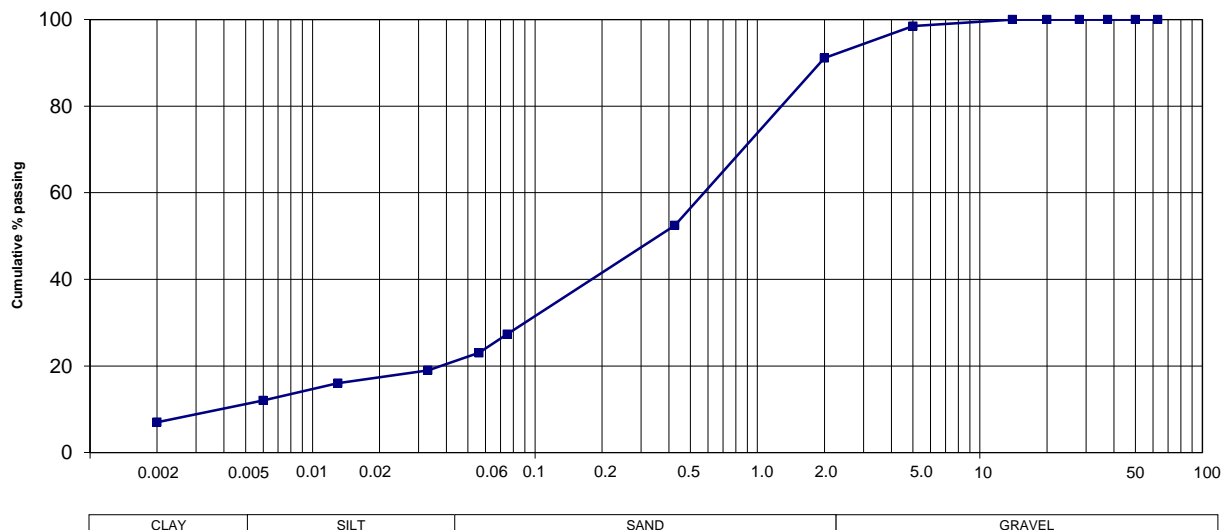
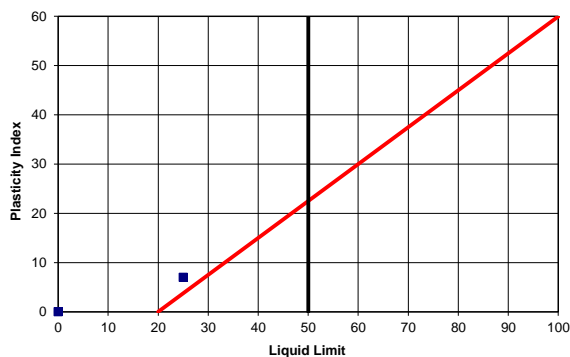
Sample No.	5								
Soillab Sample No.	S18-1898-05								
Depth (m)	2.80 - 4.50								
Position	TP 07								
Material Description	LIGHT REDDISH ORANGE FERRICRETE CLAYEY SAND								
Relative density on < 2 mm (SANS 5844)	2.651								
Organic Material									
Moisture (%) / Dispersion (%)									
<b>SCREEN ANALYSIS (% PASSING) (SANS 3001:GR1)</b>									
63.0 mm	100								
50.0 mm	100								
37.5 mm	100								
28.0 mm	100								
20.0 mm	100								
14.0 mm	100								
5.0 mm	98								
2.00 mm	91								
0.425 mm	52								
0.075 mm	27								
<b>HYDROMETER ANALYSIS (% PASSING) (SANS 3001:GR3)</b>									
56 µm	23								
33 µm	19								
13 µm	16								
6 µm	12								
2 µm	7								
<table border="1" style="width: 100%;"> <tr> <td>% Clay</td> <td>12</td> </tr> <tr> <td>% Silt</td> <td>11</td> </tr> <tr> <td>% Sand</td> <td>68</td> </tr> <tr> <td>% Gravel</td> <td>9</td> </tr> </table>		% Clay	12	% Silt	11	% Sand	68	% Gravel	9
% Clay	12								
% Silt	11								
% Sand	68								
% Gravel	9								
<b>ATTERBERG LIMITS (SANS 3001:GR10)</b>									
Liquid Limit	25								
Plasticity Index	7								
Linear Shrinkage (%)	2.0								
Grading Modulus	1.29								
Classification	A-2-4 (0)								
Unified Classification	SM & SC								
Chart Reference									

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
### POTENTIAL EXPANSIVENESS



### PLASTICITY CHART

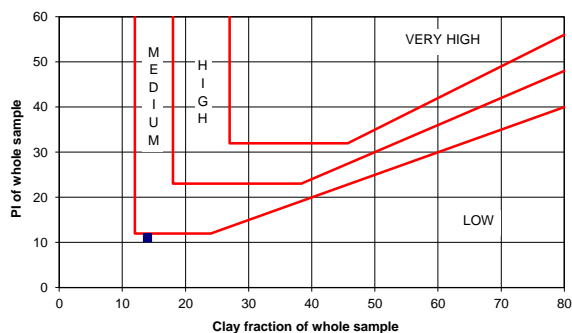


## PARTICLE SIZE ANALYSIS

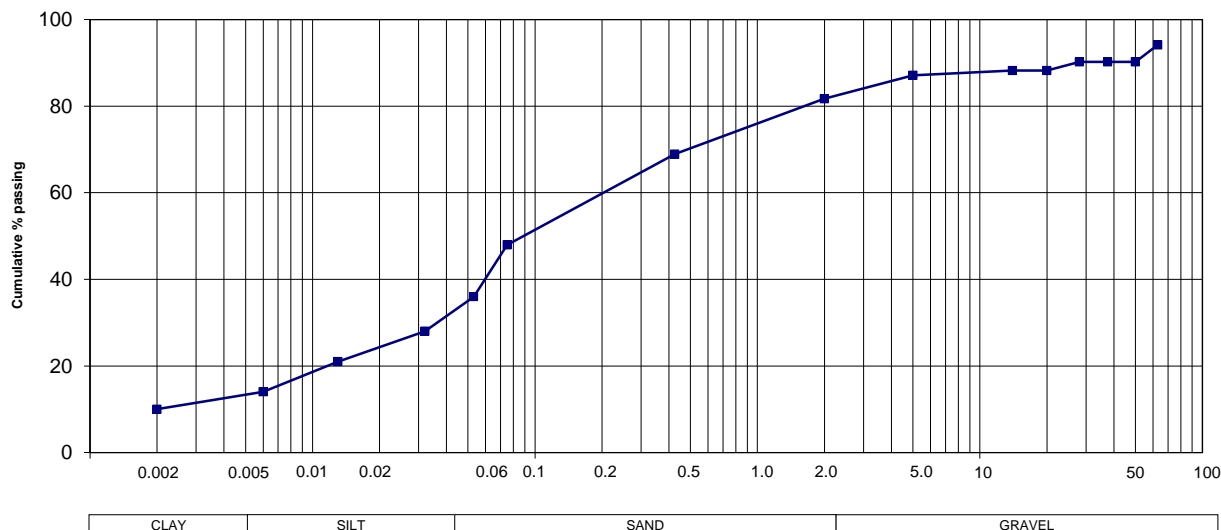
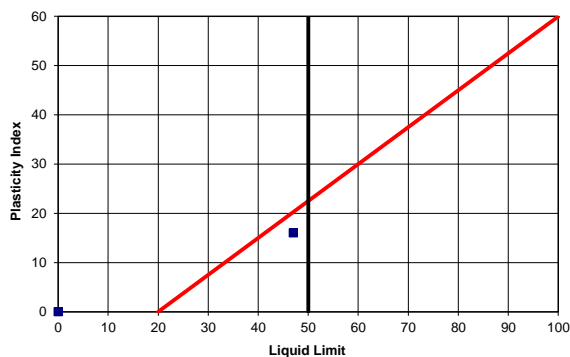
Sample No.	6								
Soillab Sample No.	S18-1898-06								
Depth (m)	2.60 - 5.50								
Position	TP 08								
Material Description	LIGHT RED FERRICRETE SILTY SAND								
Relative density on < 2 mm (SANS 5844)	2.702								
Organic Material									
Moisture (%) / Dispersion (%)									
<b>SCREEN ANALYSIS (% PASSING) (SANS 3001:GR1)</b>									
63.0 mm	94								
50.0 mm	90								
37.5 mm	90								
28.0 mm	90								
20.0 mm	88								
14.0 mm	88								
5.0 mm	87								
2.00 mm	82								
0.425 mm	69								
0.075 mm	48								
<b>HYDROMETER ANALYSIS (% PASSING) (SANS 3001:GR3)</b>									
53 µm	36								
32 µm	28								
13 µm	21								
6 µm	14								
2 µm	10								
<table border="1" style="width: 100%;"> <tr> <td>% Clay</td> <td>14</td> </tr> <tr> <td>% Silt</td> <td>22</td> </tr> <tr> <td>% Sand</td> <td>46</td> </tr> <tr> <td>% Gravel</td> <td>18</td> </tr> </table>		% Clay	14	% Silt	22	% Sand	46	% Gravel	18
% Clay	14								
% Silt	22								
% Sand	46								
% Gravel	18								
<b>ATTERBERG LIMITS (SANS 3001:GR10)</b>									
Liquid Limit	47								
Plasticity Index	16								
Linear Shrinkage (%)	6.0								
Grading Modulus	1.01								
Classification	A-7-5 (5)								
Unified Classification	SM								
Chart Reference									

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### POTENTIAL EXPANSIVENESS



### PLASTICITY CHART



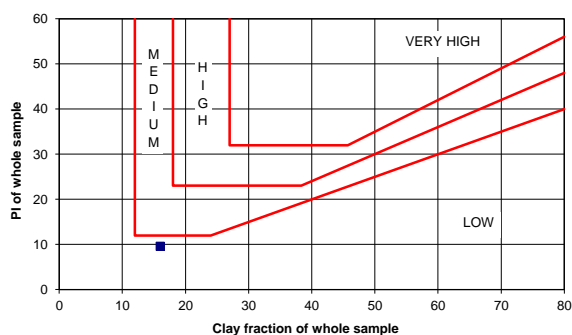


## PARTICLE SIZE ANALYSIS

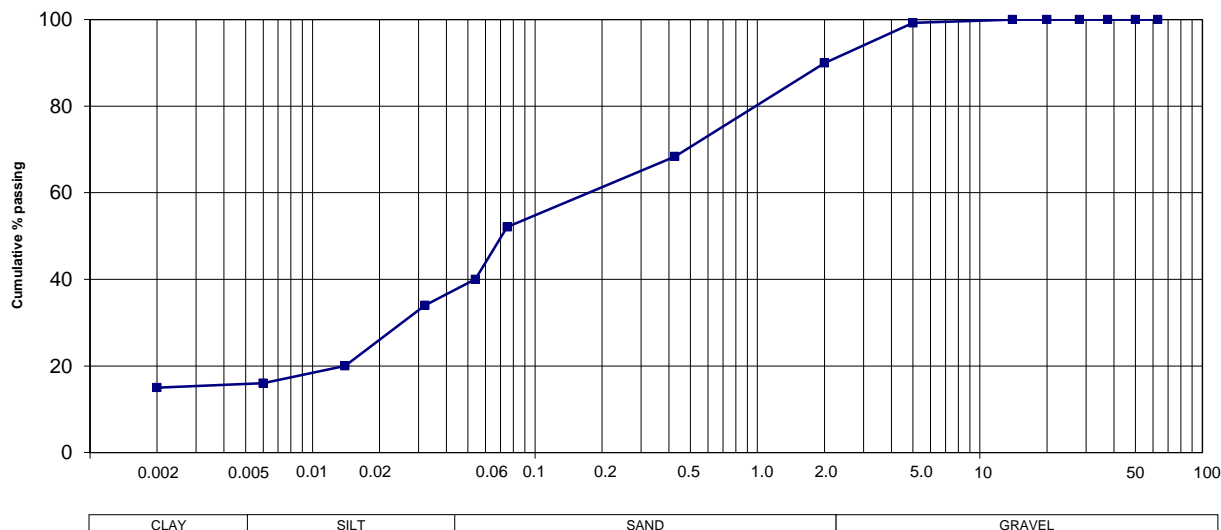
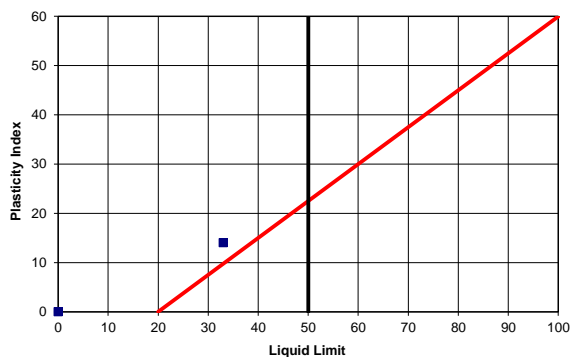
Sample No.	7								
Soillab Sample No.	S18-1898-07								
Depth (m)	1.05 - 2.30								
Position	TP 23								
Material Description	DUSKY RED FERRICRETE SILTY SAND								
Relative density on < 2 mm (SANS 5844)	2.644								
Organic Material									
Moisture (%) / Dispersion (%)									
<b>SCREEN ANALYSIS (% PASSING) (SANS 3001:GR1)</b>									
63.0 mm	100								
50.0 mm	100								
37.5 mm	100								
28.0 mm	100								
20.0 mm	100								
14.0 mm	100								
5.0 mm	99								
2.00 mm	90								
0.425 mm	68								
0.075 mm	52								
<b>HYDROMETER ANALYSIS (% PASSING) (SANS 3001:GR3)</b>									
54 µm	40								
32 µm	34								
14 µm	20								
6 µm	16								
2 µm	15								
<table border="1" style="width: 100%;"> <tr> <td>% Clay</td> <td>16</td> </tr> <tr> <td>% Silt</td> <td>24</td> </tr> <tr> <td>% Sand</td> <td>50</td> </tr> <tr> <td>% Gravel</td> <td>10</td> </tr> </table>		% Clay	16	% Silt	24	% Sand	50	% Gravel	10
% Clay	16								
% Silt	24								
% Sand	50								
% Gravel	10								
<b>ATTERBERG LIMITS (SANS 3001:GR10)</b>									
Liquid Limit	33								
Plasticity Index	14								
Linear Shrinkage (%)	6.5								
Grading Modulus	0.90								
Classification	A-6 (4)								
Unified Classification	CL								
Chart Reference									

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### POTENTIAL EXPANSIVENESS



### PLASTICITY CHART

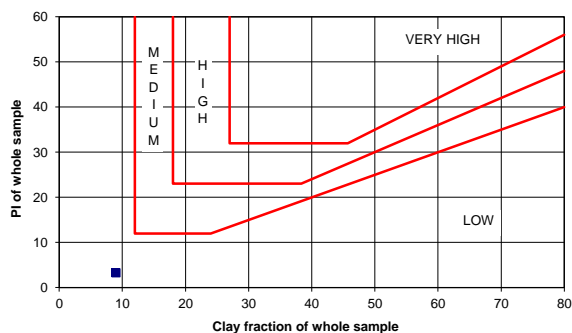


## PARTICLE SIZE ANALYSIS

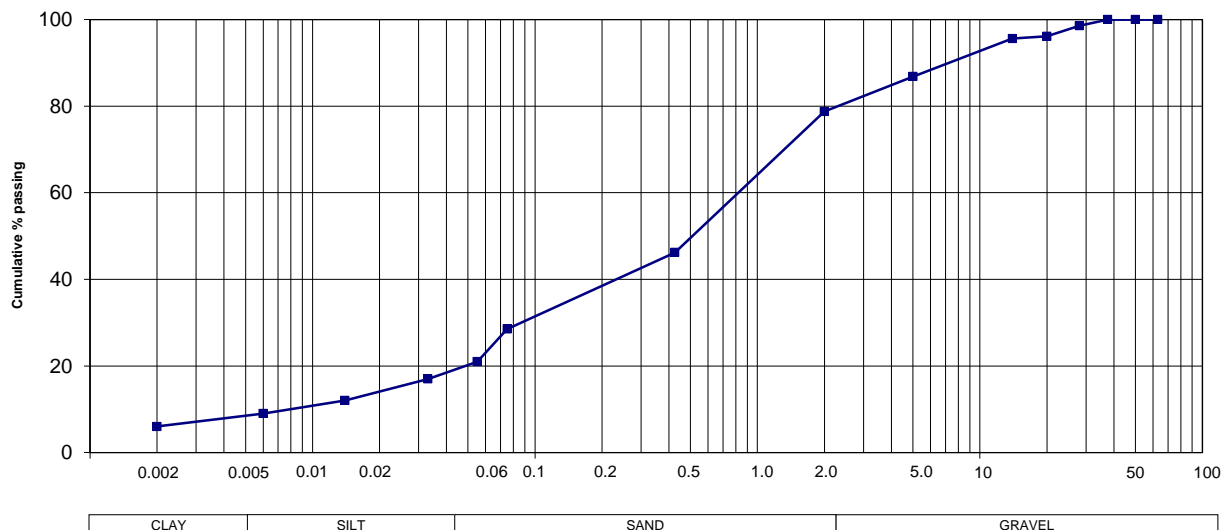
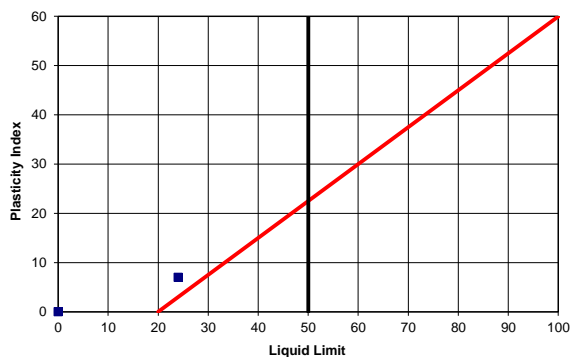
Sample No.	8								
Soillab Sample No.	S18-1898-08								
Depth (m)	1.10 - 1.95								
Position	TP 24								
Material Description	DARK YELLOW  GRAVELLY SAND								
Relative density on < 2 mm (SANS 5844)	2.673								
Organic Material									
Moisture (%) / Dispersion (%)									
<b>SCREEN ANALYSIS (% PASSING) (SANS 3001:GR1)</b>									
63.0 mm	100								
50.0 mm	100								
37.5 mm	100								
28.0 mm	99								
20.0 mm	96								
14.0 mm	96								
5.0 mm	87								
2.00 mm	79								
0.425 mm	46								
0.075 mm	29								
<b>HYDROMETER ANALYSIS (% PASSING) (SANS 3001:GR3)</b>									
55 µm	21								
33 µm	17								
14 µm	12								
6 µm	9								
2 µm	6								
<table border="1" style="width: 100%;"> <tr> <td>% Clay</td> <td>9</td> </tr> <tr> <td>% Silt</td> <td>12</td> </tr> <tr> <td>% Sand</td> <td>58</td> </tr> <tr> <td>% Gravel</td> <td>21</td> </tr> </table>		% Clay	9	% Silt	12	% Sand	58	% Gravel	21
% Clay	9								
% Silt	12								
% Sand	58								
% Gravel	21								
<b>ATTERBERG LIMITS (SANS 3001:GR10)</b>									
Liquid Limit	24								
Plasticity Index	7								
Linear Shrinkage (%)	2.0								
Grading Modulus	1.47								
Classification	A-2-4 (0)								
Unified Classification	SM & SC								
Chart Reference									

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### POTENTIAL EXPANSIVENESS



### PLASTICITY CHART

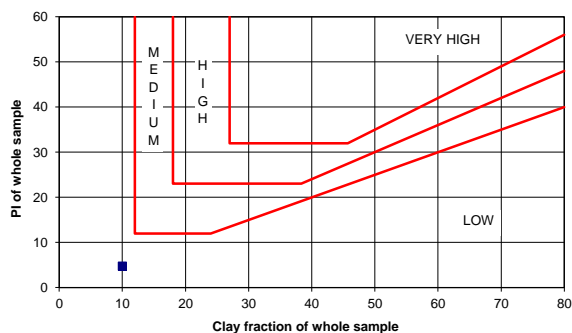


## PARTICLE SIZE ANALYSIS

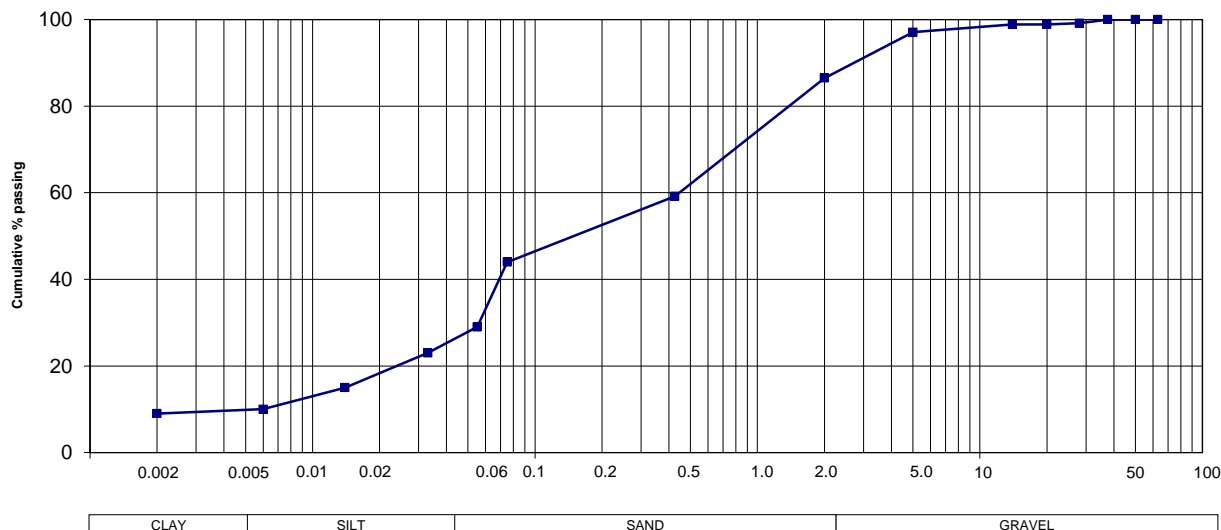
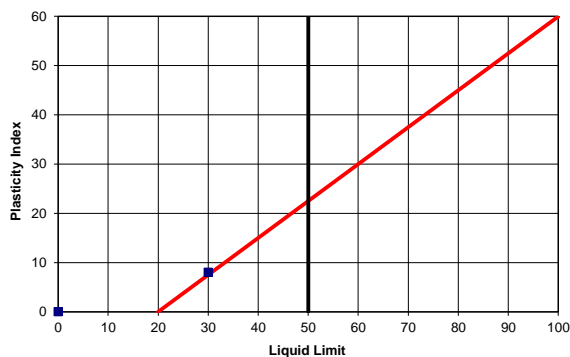
Sample No.	9								
Soillab Sample No.	S18-1898-09								
Depth (m)	1.30 - 2.60								
Position	TP 26								
Material Description	DUKSY RED  SILTY SAND								
Relative density on < 2 mm (SANS 5844)	2.666								
Organic Material									
Moisture (%) / Dispersion (%)									
<b>SCREEN ANALYSIS (% PASSING) (SANS 3001:GR1)</b>									
63.0 mm	100								
50.0 mm	100								
37.5 mm	100								
28.0 mm	99								
20.0 mm	99								
14.0 mm	99								
5.0 mm	97								
2.00 mm	86								
0.425 mm	59								
0.075 mm	44								
<b>HYDROMETER ANALYSIS (% PASSING) (SANS 3001:GR3)</b>									
55 µm	29								
33 µm	23								
14 µm	15								
6 µm	10								
2 µm	9								
<table border="1" style="width: 100%;"> <tr> <td>% Clay</td> <td>10</td> </tr> <tr> <td>% Silt</td> <td>19</td> </tr> <tr> <td>% Sand</td> <td>57</td> </tr> <tr> <td>% Gravel</td> <td>14</td> </tr> </table>		% Clay	10	% Silt	19	% Sand	57	% Gravel	14
% Clay	10								
% Silt	19								
% Sand	57								
% Gravel	14								
<b>ATTERBERG LIMITS (SANS 3001:GR10)</b>									
Liquid Limit	30								
Plasticity Index	8								
Linear Shrinkage (%)	4.0								
Grading Modulus	1.10								
Classification	A-4 (1)								
Unified Classification	SC								
Chart Reference									

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JOB No. : S18-1898  
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### POTENTIAL EXPANSIVENESS



### PLASTICITY CHART

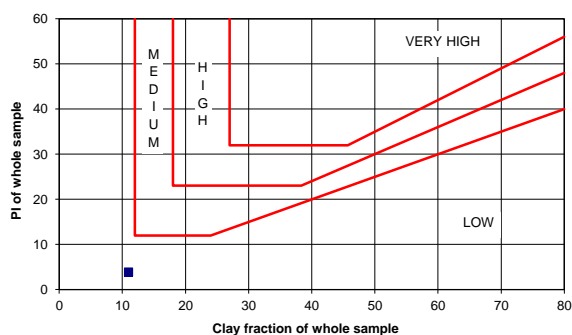


## PARTICLE SIZE ANALYSIS

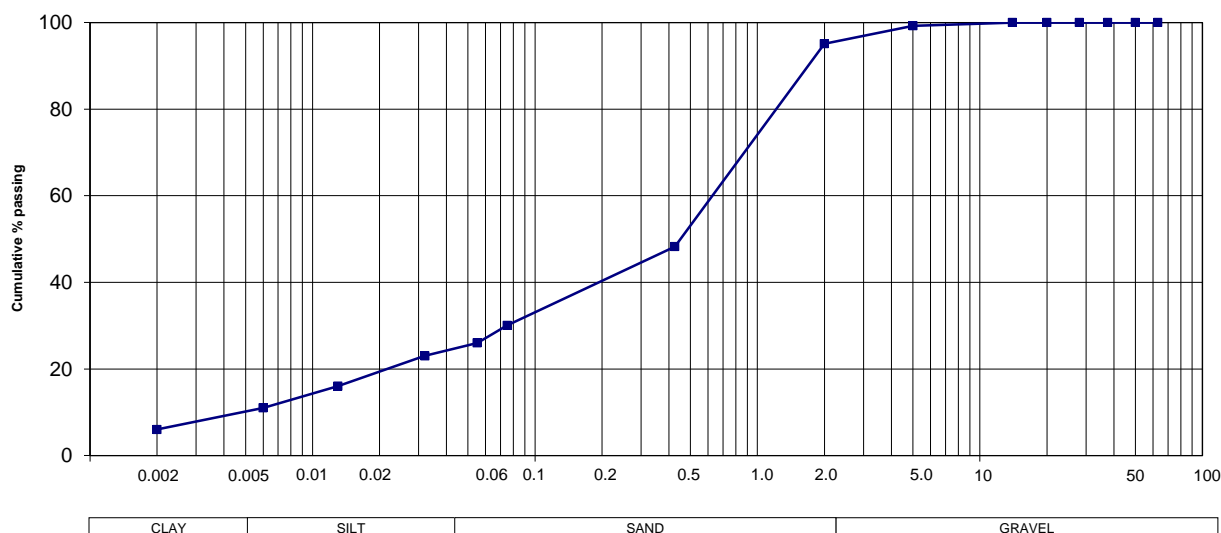
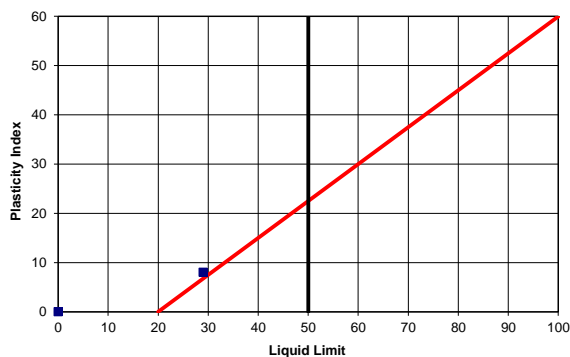
Sample No.	10								
Soillab Sample No.	S18-1898-10								
Depth (m)	3.60 - 5.20								
Position	TP 39								
Material Description	DARK YELLOW  SILTY SAND								
Relative density on < 2 mm (SANS 5844)	2.637								
Organic Material									
Moisture (%) / Dispersion (%)									
<b>SCREEN ANALYSIS (% PASSING) (SANS 3001:GR1)</b>									
63.0 mm	100								
50.0 mm	100								
37.5 mm	100								
28.0 mm	100								
20.0 mm	100								
14.0 mm	100								
5.0 mm	99								
2.00 mm	95								
0.425 mm	48								
0.075 mm	30								
<b>HYDROMETER ANALYSIS (% PASSING) (SANS 3001:GR3)</b>									
55 µm	26								
32 µm	23								
13 µm	16								
6 µm	11								
2 µm	6								
<table border="1" style="width: 100%;"> <tr> <td>% Clay</td> <td>11</td> </tr> <tr> <td>% Silt</td> <td>15</td> </tr> <tr> <td>% Sand</td> <td>69</td> </tr> <tr> <td>% Gravel</td> <td>5</td> </tr> </table>		% Clay	11	% Silt	15	% Sand	69	% Gravel	5
% Clay	11								
% Silt	15								
% Sand	69								
% Gravel	5								
<b>ATTERBERG LIMITS (SANS 3001:GR10)</b>									
Liquid Limit	29								
Plasticity Index	8								
Linear Shrinkage (%)	3.0								
Grading Modulus	1.27								
Classification	A-2-4 (0)								
Unified Classification	SC								
Chart Reference									

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### POTENTIAL EXPANSIVENESS



### PLASTICITY CHART

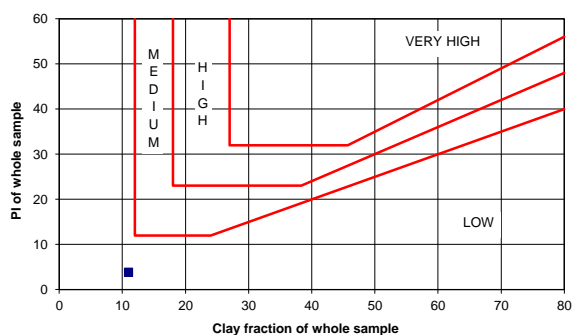


## PARTICLE SIZE ANALYSIS

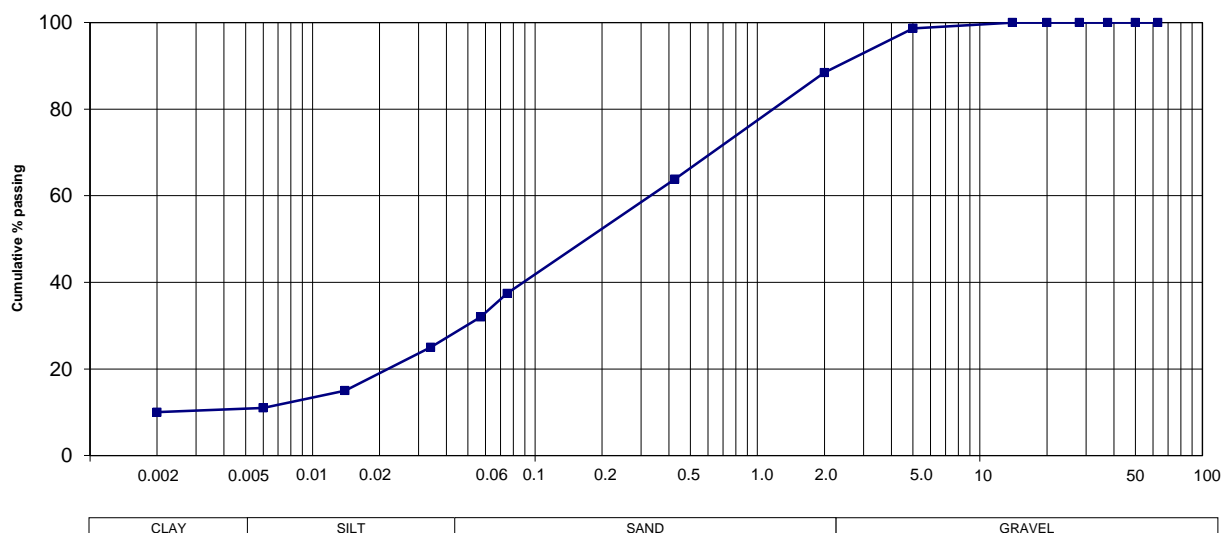
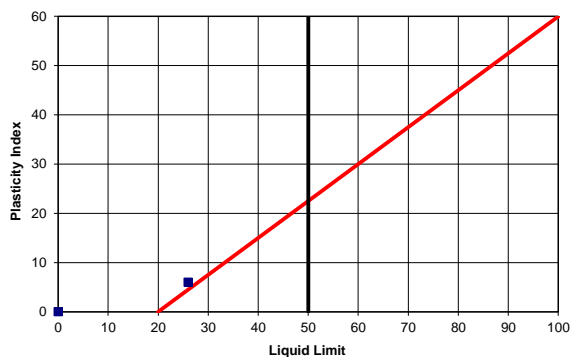
Sample No.	11								
Soillab Sample No.	S18-1898-11								
Depth (m)	0.3 - 5.2								
Position	TP 41								
Material Description	DARK REDDISH ORANGE FERRICRETE SILTY SAND								
Relative density on < 2 mm (SANS 5844)	2.617								
Organic Material									
Moisture (%) / Dispersion (%)									
<b>SCREEN ANALYSIS (% PASSING) (SANS 3001:GR1)</b>									
63.0 mm	100								
50.0 mm	100								
37.5 mm	100								
28.0 mm	100								
20.0 mm	100								
14.0 mm	100								
5.0 mm	99								
2.00 mm	88								
0.425 mm	64								
0.075 mm	37								
<b>HYDROMETER ANALYSIS (% PASSING) (SANS 3001:GR3)</b>									
57 µm	32								
34 µm	25								
14 µm	15								
6 µm	11								
2 µm	10								
<table border="1" style="width: 100%;"> <tr> <td>% Clay</td> <td>11</td> </tr> <tr> <td>% Silt</td> <td>21</td> </tr> <tr> <td>% Sand</td> <td>56</td> </tr> <tr> <td>% Gravel</td> <td>12</td> </tr> </table>		% Clay	11	% Silt	21	% Sand	56	% Gravel	12
% Clay	11								
% Silt	21								
% Sand	56								
% Gravel	12								
<b>ATTERBERG LIMITS (SANS 3001:GR10)</b>									
Liquid Limit	26								
Plasticity Index	6								
Linear Shrinkage (%)	3.0								
Grading Modulus	1.10								
Classification	A-4 (0)								
Unified Classification	SM & SC								
Chart Reference									

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
### POTENTIAL EXPANSIVENESS



### PLASTICITY CHART

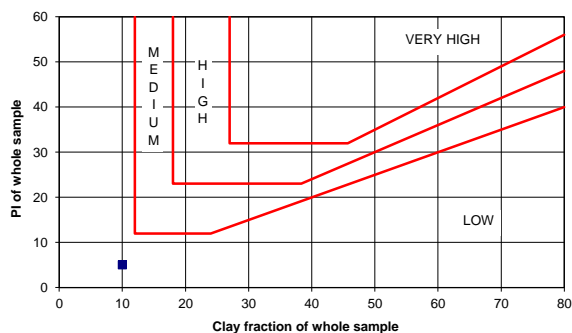


## PARTICLE SIZE ANALYSIS

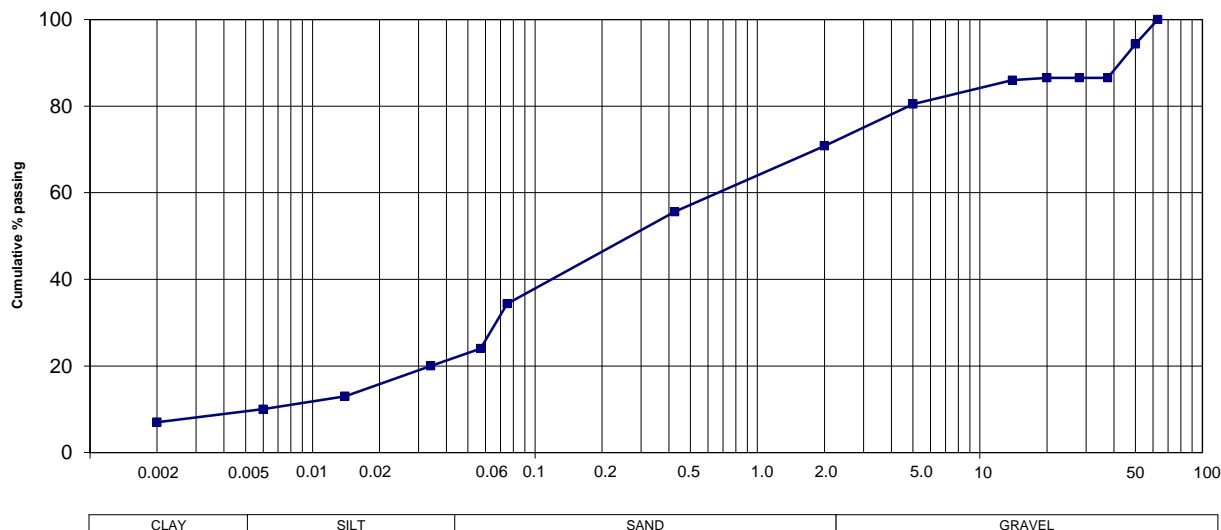
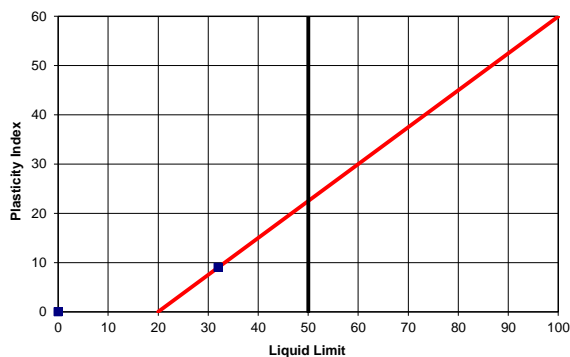
Sample No.	12								
Soillab Sample No.	S18-1898-12								
Depth (m)	1.30 - 3.50								
Position	TP 42								
Material Description	LIGHT REDDISH ORANGE FERRICRETE GRAVELLY SAND								
Relative density on < 2 mm (SANS 5844)	2.603								
Organic Material									
Moisture (%) / Dispersion (%)									
<b>SCREEN ANALYSIS (% PASSING) (SANS 3001:GR1)</b>									
63.0 mm	100								
50.0 mm	94								
37.5 mm	87								
28.0 mm	87								
20.0 mm	87								
14.0 mm	86								
5.0 mm	80								
2.00 mm	71								
0.425 mm	56								
0.075 mm	34								
<b>HYDROMETER ANALYSIS (% PASSING) (SANS 3001:GR3)</b>									
57 µm	24								
34 µm	20								
14 µm	13								
6 µm	10								
2 µm	7								
<table border="1" style="width: 100%;"> <tr> <td>% Clay</td> <td>10</td> </tr> <tr> <td>% Silt</td> <td>14</td> </tr> <tr> <td>% Sand</td> <td>47</td> </tr> <tr> <td>% Gravel</td> <td>29</td> </tr> </table>		% Clay	10	% Silt	14	% Sand	47	% Gravel	29
% Clay	10								
% Silt	14								
% Sand	47								
% Gravel	29								
<b>ATTERBERG LIMITS (SANS 3001:GR10)</b>									
Liquid Limit	32								
Plasticity Index	9								
Linear Shrinkage (%)	4.0								
Grading Modulus	1.39								
Classification	A-2-4 (0)								
Unified Classification	SC								
Chart Reference									

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
### POTENTIAL EXPANSIVENESS



### PLASTICITY CHART

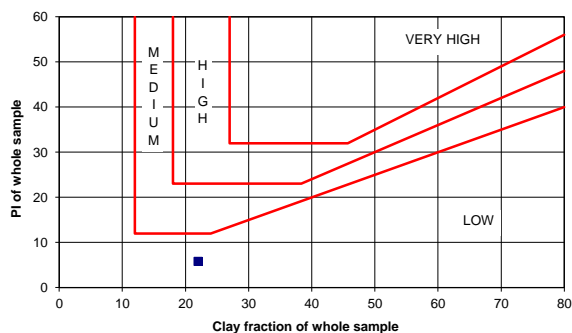


## PARTICLE SIZE ANALYSIS

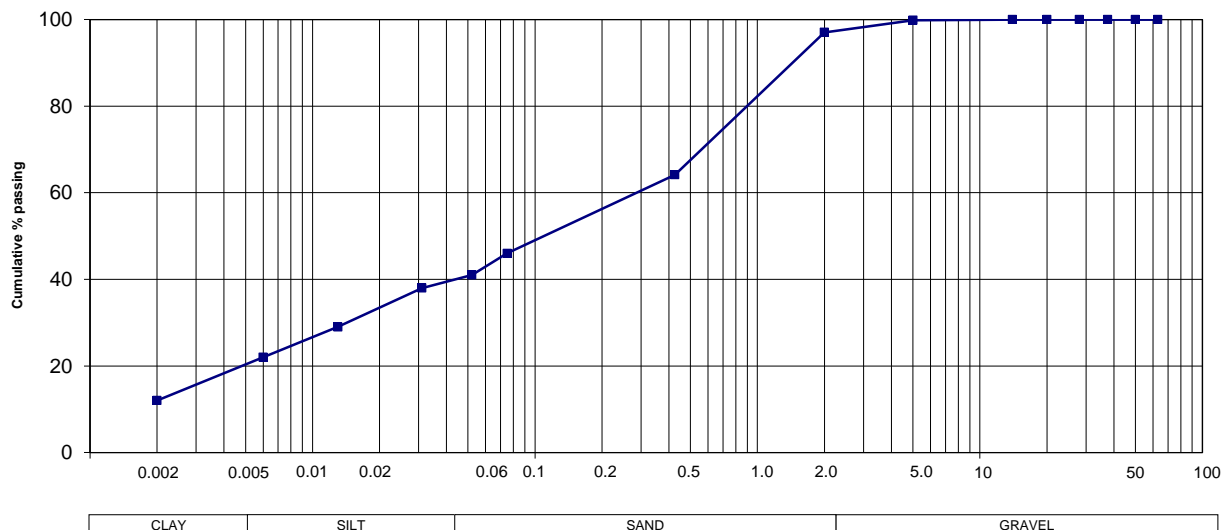
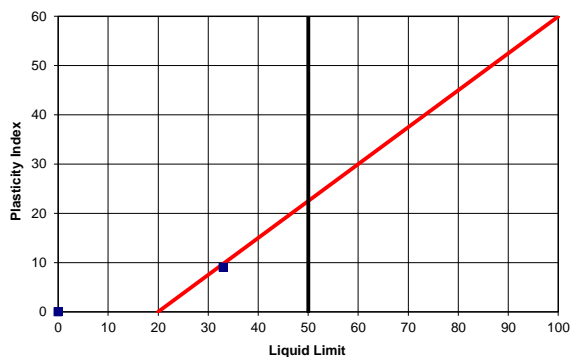
Sample No.	13								
Soillab Sample No.	S18-1898-13								
Depth (m)	2.10 - 5.5								
Position	TP 25								
Material Description	LIGHT REDDISH ORANGE  CLAYEY SAND								
Relative density on < 2 mm (SANS 5844)	2.694								
Organic Material									
Moisture (%) / Dispersion (%)									
<b>SCREEN ANALYSIS (% PASSING) (SANS 3001:GR1)</b>									
63.0 mm	100								
50.0 mm	100								
37.5 mm	100								
28.0 mm	100								
20.0 mm	100								
14.0 mm	100								
5.0 mm	100								
2.00 mm	97								
0.425 mm	64								
0.075 mm	46								
<b>HYDROMETER ANALYSIS (% PASSING) (SANS 3001:GR3)</b>									
52 µm	41								
31 µm	38								
13 µm	29								
6 µm	22								
2 µm	12								
<table border="1" style="width: 100%;"> <tr> <td>% Clay</td> <td>22</td> </tr> <tr> <td>% Silt</td> <td>19</td> </tr> <tr> <td>% Sand</td> <td>56</td> </tr> <tr> <td>% Gravel</td> <td>3</td> </tr> </table>		% Clay	22	% Silt	19	% Sand	56	% Gravel	3
% Clay	22								
% Silt	19								
% Sand	56								
% Gravel	3								
<b>ATTERBERG LIMITS (SANS 3001:GR10)</b>									
Liquid Limit	33								
Plasticity Index	9								
Linear Shrinkage (%)	3.0								
Grading Modulus	0.93								
Classification	A-4 (2)								
Unified Classification	SM								
Chart Reference									

PROJECT : ESSELEN PARK  
JOB No. : S18-1898  
DATE : 2018-10-09

### POTENTIAL EXPANSIVENESS



### PLASTICITY CHART

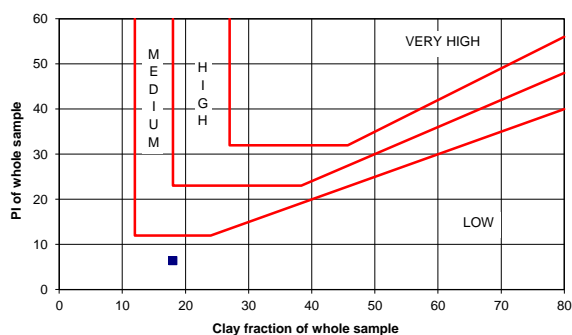


## PARTICLE SIZE ANALYSIS

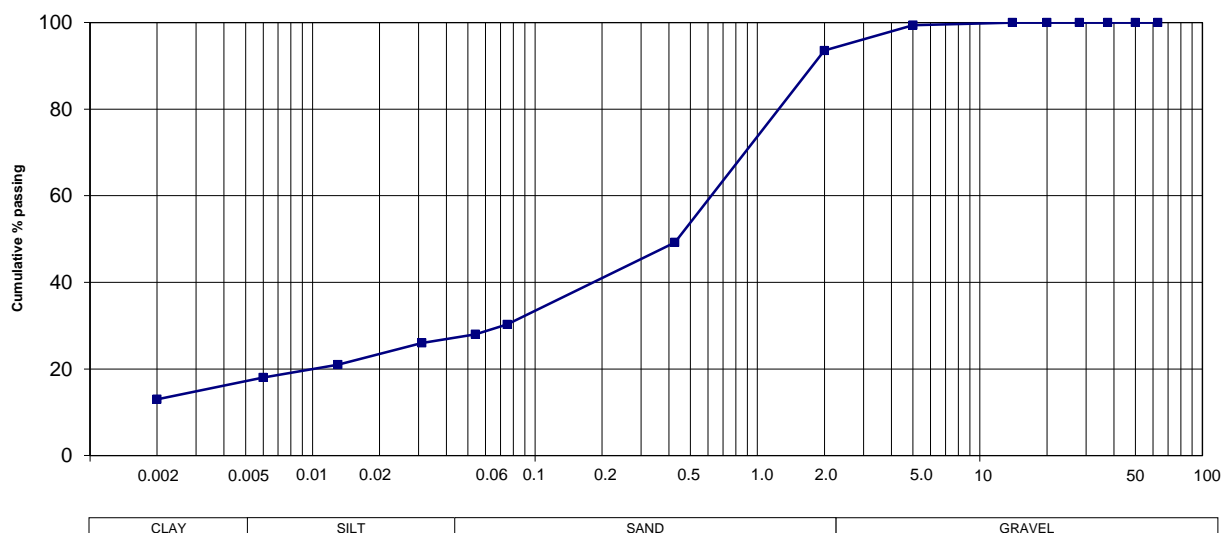
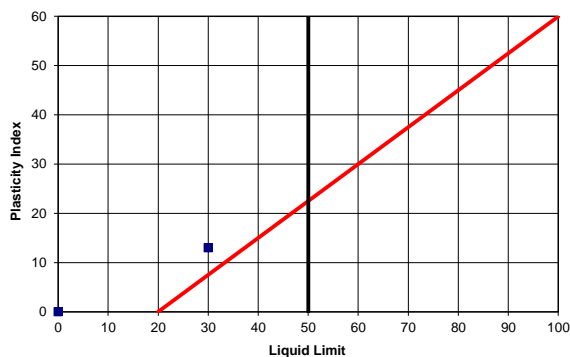
Sample No.	14								
Soillab Sample No.	S18-1898-14								
Depth (m)	2.6 - 4.7								
Position	TP 26								
Material Description	LIGHT REDDISH ORANGE  CLAYEY SAND								
Relative density on < 2 mm (SANS 5844)	2.68								
Organic Material									
Moisture (%) / Dispersion (%)									
<b>SCREEN ANALYSIS (% PASSING) (SANS 3001:GR1)</b>									
63.0 mm	100								
50.0 mm	100								
37.5 mm	100								
28.0 mm	100								
20.0 mm	100								
14.0 mm	100								
5.0 mm	99								
2.00 mm	94								
0.425 mm	49								
0.075 mm	30								
<b>HYDROMETER ANALYSIS (% PASSING) (SANS 3001:GR3)</b>									
54 µm	28								
31 µm	26								
13 µm	21								
6 µm	18								
2 µm	13								
<table border="1" style="width: 100%;"> <tr> <td>% Clay</td> <td>18</td> </tr> <tr> <td>% Silt</td> <td>10</td> </tr> <tr> <td>% Sand</td> <td>66</td> </tr> <tr> <td>% Gravel</td> <td>6</td> </tr> </table>		% Clay	18	% Silt	10	% Sand	66	% Gravel	6
% Clay	18								
% Silt	10								
% Sand	66								
% Gravel	6								
<b>ATTERBERG LIMITS (SANS 3001:GR10)</b>									
Liquid Limit	30								
Plasticity Index	13								
Linear Shrinkage (%)	5.0								
Grading Modulus	1.27								
Classification	A-2-6 (0)								
Unified Classification	SC								
Chart Reference									

PROJECT : ESSELEN PARK  
JOB No. : S18-1898  
DATE : 2018-10-09

### POTENTIAL EXPANSIVENESS




### PLASTICITY CHART



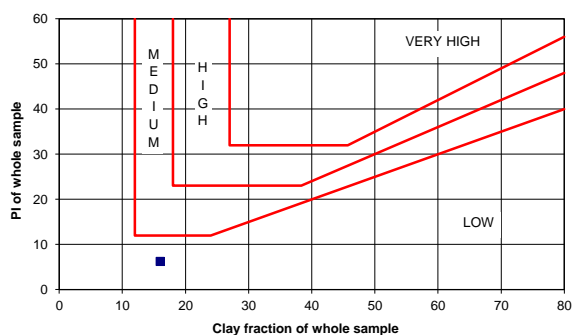


## PARTICLE SIZE ANALYSIS

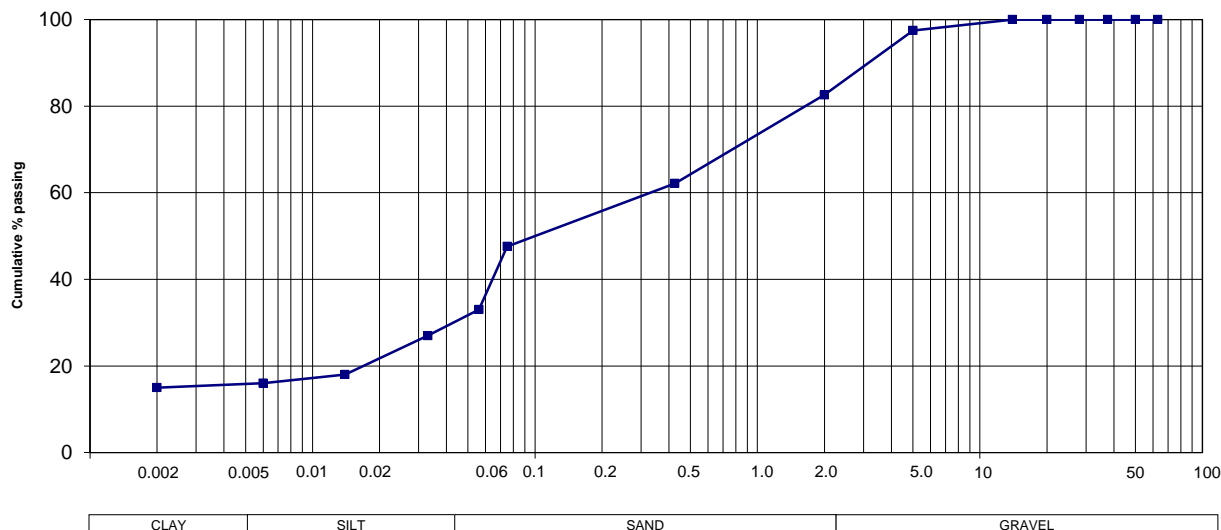
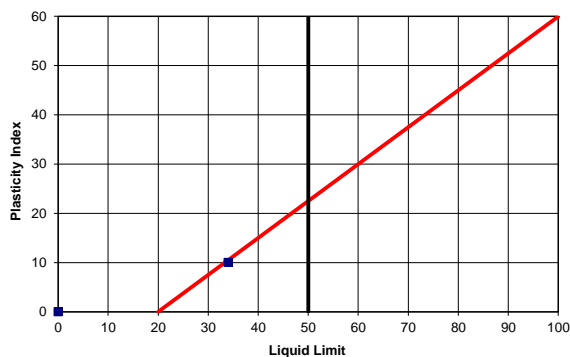
Sample No.	15								
Soillab Sample No.	S18-1898-15								
Depth (m)	0.8 - 4.20								
Position	TP 37								
Material Description	DUSKY RED FERRICRETE GRAVELLY SAND								
Relative density on < 2 mm (SANS 5844)	2.596								
Organic Material									
Moisture (%) / Dispersion (%)									
<b>SCREEN ANALYSIS (% PASSING) (SANS 3001:GR1)</b>									
63.0 mm	100								
50.0 mm	100								
37.5 mm	100								
28.0 mm	100								
20.0 mm	100								
14.0 mm	100								
5.0 mm	97								
2.00 mm	83								
0.425 mm	62								
0.075 mm	48								
<b>HYDROMETER ANALYSIS (% PASSING) (SANS 3001:GR3)</b>									
56 µm	33								
33 µm	27								
14 µm	18								
6 µm	16								
2 µm	15								
<table border="1" style="width: 100%;"> <tr> <td>% Clay</td> <td>16</td> </tr> <tr> <td>% Silt</td> <td>17</td> </tr> <tr> <td>% Sand</td> <td>50</td> </tr> <tr> <td>% Gravel</td> <td>17</td> </tr> </table>		% Clay	16	% Silt	17	% Sand	50	% Gravel	17
% Clay	16								
% Silt	17								
% Sand	50								
% Gravel	17								
<b>ATTERBERG LIMITS (SANS 3001:GR10)</b>									
Liquid Limit	34								
Plasticity Index	10								
Linear Shrinkage (%)	5.0								
Grading Modulus	1.08								
Classification	A-4 (2)								
Unified Classification	SM								
Chart Reference									

PROJECT : ESSELEN PARK  
JOB No. : S18-1898  
DATE : 2018-10-09

### POTENTIAL EXPANSIVENESS



### PLASTICITY CHART



### Project Description

Client:	GEOHAZARD SOLUTIONS	Soillab Job No.:	S18-1898
Job Description:	ESSELEN PARK	Contract Number:	
Date:	2018/10/09	Reference Number:	

### Sample Description

Soillab Sample No.:	S18-1898-13	S18-1898-14	S18-1898-15	
Sample Description:	TP 25	TP 26	TP 37	
Sample Depth:	2.10 - 5.5	2.6 - 4.70	0.8 - 4.20	
Material Description:	LIGHT REDDISH ORANGE	LIGHT REDDISH ORANGE	DUSKY RED FERRICRETE	

### Screen Analysis (% Passing) - SANS 3001-GR1

75,00 mm	100	100	100	
63,00 mm	100	100	100	
50,00 mm	100	100	100	
37,50 mm	100	100	100	
28,00 mm	100	100	100	
20,00 mm	100	100	100	
14,00 mm	100	100	100	
5,00 mm	100	99	97	
2,000 mm	97	94	83	
0,425 mm	64	49	62	
0,075 mm	46	30	48	

### Soil-mortar percentages - SANS 3001-PR5

Coarse Sand	2.000-0.425mm	34	47	25	
Coarse Fine Sand	0.425-0.250mm	10	12	6	
Medium Fine Sand	0.250-0.150mm	5	5	5	
Fine Fine Sand	0.150-0.075mm	4	4	7	
Silt and clay	<0.075mm	47	32	58	

### Constants

Grading Modulus	SANS 3001-PR5	0.93	1.27	1.08	
Liquid Limit		33	30	34	
Plasticity Index	SANS 3001-GR10	9	13	10	
Linear Shrinkage		3.0	5.0	5.0	

### MOD AASHTO - SANS 3001-GR30

Max Dry Density (kg/m <sup>3</sup> )	1962	2028	1984	
Optimum Moisture Content (%)	10.9	9.2	11.2	

### CBR - SANS 3001-GR40

<b>MOD AASHTO</b>				
Moulding Moisture Content (%)	11.0	9.2	11.3	
Dry Density (kg/m <sup>3</sup> )	1962	2043	1972	
% of Max Dry Density	100.0	100.7	99.4	
100% MOD CBR (%)	4	50	78	
% Swell	2.3	0.4	0.0	
<b>NRB</b>				
Dry Density (kg/m <sup>3</sup> )	1855	1926	1871	
% of Max Dry Density	94.5	95.0	94.3	
100% NRB CBR (%)	3	13	26	
% Swell	3.0	0.6	0.1	
<b>PROCTOR</b>				
Dry Density (kg/m <sup>3</sup> )	1768	1830	1775	
% of Max Dry Density	90.1	90.2	89.5	
100% PROCTOR CBR (%)	2	4	9	
% Swell	4.5	1.0	0.1	
<b>CBR (%)</b>				
100% Mod AASHTO	4	42	89	
98% Mod AASHTO	4	26	58	
97% Mod AASHTO	3	20	46	
95% Mod AASHTO	3	13	30	
93% Mod AASHTO	2	8	19	
90% Mod AASHTO	2	4	10	
<b>COLTO Classification:</b>	<b>&gt;G9</b>	<b>G9</b>	<b>G6</b>	



## Engineering Materials Laboratory

SMEC Building, 230 Albertus Street  
La Montagne, Pretoria, 0184

Tel: (+27) (12) 813 4900  
Email: info@soillab.co.za

PO Box 72928, Lynnwood Ridge,  
South Africa, 0040

Client: GEOHAZARD SOLUTIONS

Project: ESSELEN PARK

Project No.: S18-1898

Date: 2018/10/09

### pH & CONDUCTIVITY - TMH 1 A20 & A21T

Sample No	Sample Position	Depth (m)	pH	Electrical Conductivity S/m
S18-1898-02	TP 03	1.60-4.50	7.64	0.0049
S18-1898-04	TP 07	1.80-2.80	6.99	0.0046
S18-1898-08	TP 24	1.10-1.95	7.51	0.0086
S18-1898-10	TP 39	3.6-5.20	7.76	0.0037
S18-1898-12	TP 42	1.30-3.50	6.54	0.0045
S18-1898-14	TP 26	2.6-4.70	8.67	0.0350

Comments:

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Note: Items marked with a star (\*) is Not Accredited

Soillab is a SANAS accredited Testing Laboratory according to the Accreditation Scope

# Oedometer

## TMH 6 ST10

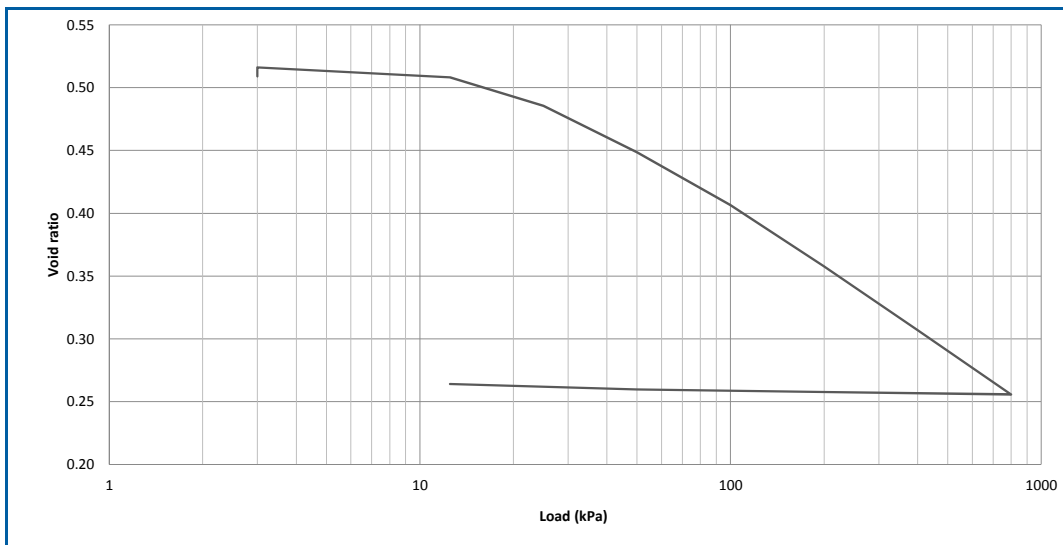
<b>Project:</b>	Esselen Park
<b>Client:</b>	Geohazard Solutions
<b>Geolab Job Nr:</b>	G18-237
<b>Test Method:</b>	TMH 6 ST10

<b>Sample Nr:</b>	TP26
<b>Sample Depth:</b>	1.30-2.60m
<b>Date:</b>	2018-10-30

Load kPa	Height mm	Void Ratio	$m_v$ MPa <sup>-1</sup>
3.0	20.110	0.509	
3.0	20.204	0.516	
12.5	20.1	0.508	0.542
25.0	19.796	0.485	1.210
50.0	19.305	0.449	0.992
100.0	18.745	0.407	0.580
200.0	18.094	0.358	0.347
400.0	17.416	0.307	0.187
800.0	16.736	0.256	0.098
200.0	16.763	0.258	
50.0	16.788	0.260	
12.5	16.845	0.264	

<b>Sampling Method:</b>	Block
<b>Disturbed/Undist:</b>	Undisturbed
<b>Remoulded To:</b>	-

	Initial	Final	
<b>Sample Height:</b>	20.11	16.85	mm
<b>Sample Mass:</b>	129.13	132.50	g
<b>Dry Density:</b>	1793	2140	kg/m <sup>3</sup>
<b>Density</b>	2018	2472	kg/m <sup>3</sup>
<b>Moisture Content:</b>	12.6	15.5	%
<b>Void Ratio:</b>	0.509	0.264	
<b>Specific Gravity:</b>	2.705		Mg/m <sup>3</sup>



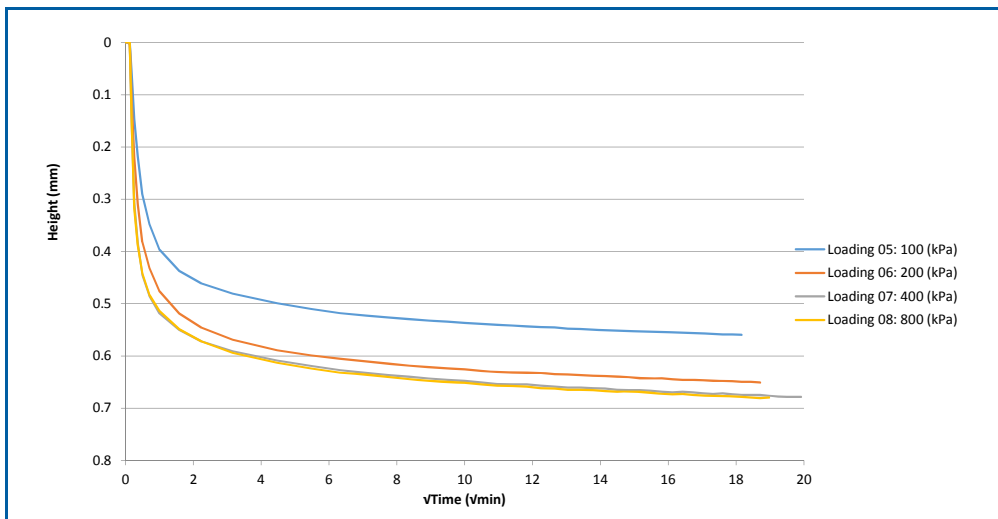
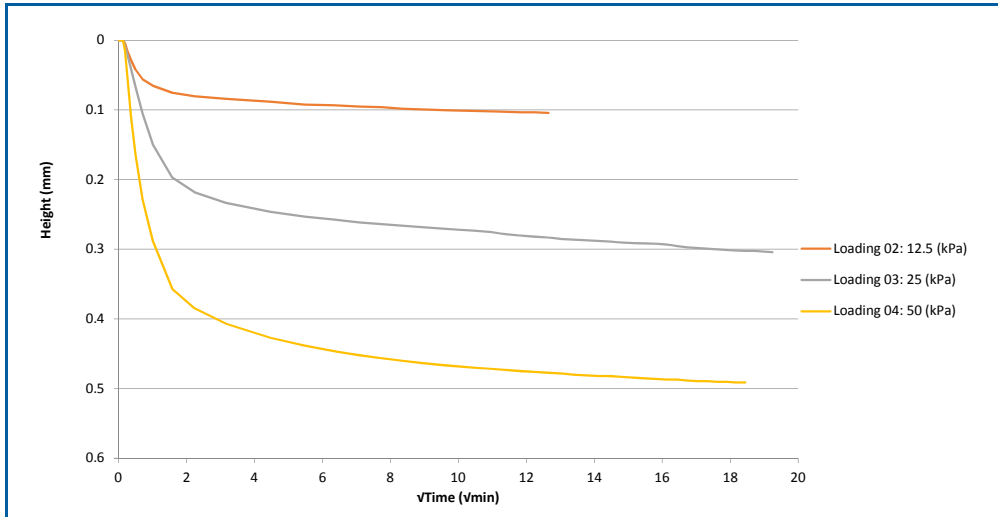
\* -  $m_v$  values provided are incremental and only valid for the specific load increment.

# Oedometer

## Time Readings

<b>Project:</b>	Esselen Park
<b>Client:</b>	Geohazard Solutions
<b>Geolab Job Nr:</b>	G18-237
<b>Test Method:</b>	TMH 6 ST10

<b>Sample Nr:</b>	TP26
<b>Sample Depth:</b>	1.30-2.60m
<b>Date:</b>	2018-10-30



# Oedometer

## TMH 6 ST10

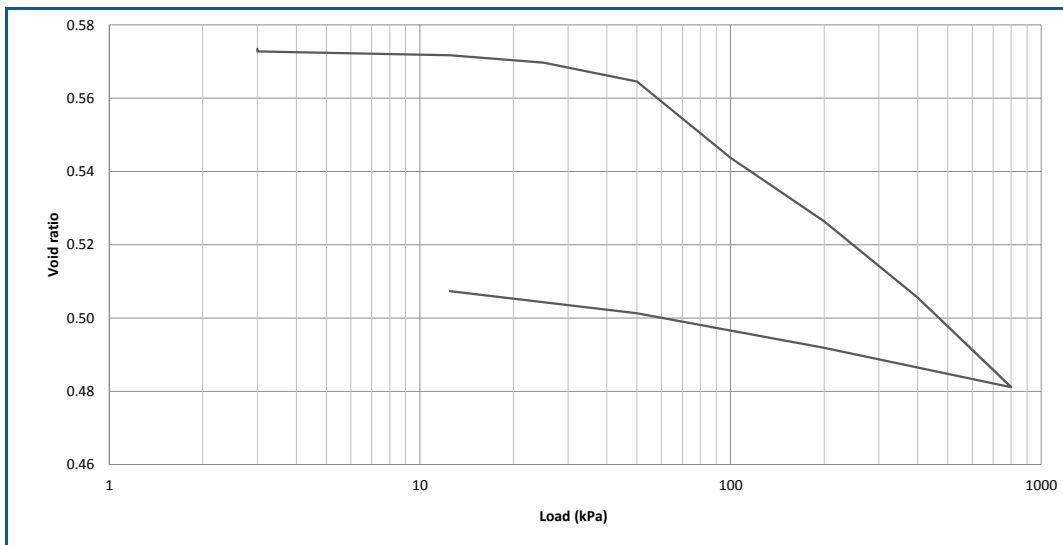
<b>Project:</b>	Esselen Park
<b>Client:</b>	Geohazard Solutions
<b>Geolab Job Nr:</b>	G18-237
<b>Test Method:</b>	TMH 6 ST10

<b>Sample Nr:</b>	TP25
<b>Sample Depth:</b>	2.10-5.50m
<b>Date:</b>	2018-10-30

Load kPa	Height mm	Void Ratio	$m_v$ MPa <sup>-1</sup>
3.0	20.170	0.573	
3.0	20.162	0.573	
12.5	20.148	0.572	0.073
25.0	20.122	0.570	0.103
50.0	20.056	0.565	0.131
100.0	19.79	0.544	0.265
200.0	19.567	0.526	0.113
400.0	19.3	0.506	0.068
800.0	18.987	0.481	0.041
200.0	19.125	0.492	
50.0	19.245	0.501	
12.5	19.323	0.507	

<b>Sampling Method:</b>	Block
<b>Disturbed/Undist:</b>	Undisturbed
<b>Remoulded To:</b>	-

	Initial	Final	
<b>Sample Height:</b>	20.17	19.32	mm
<b>Sample Mass:</b>	126.16	130.20	g
<b>Dry Density:</b>	1698	1773	kg/m <sup>3</sup>
<b>Density</b>	1964	2116	kg/m <sup>3</sup>
<b>Moisture Content:</b>	15.6	19.3	%
<b>Void Ratio:</b>	0.573	0.507	
<b>Specific Gravity:</b>	2.672		Mg/m <sup>3</sup>



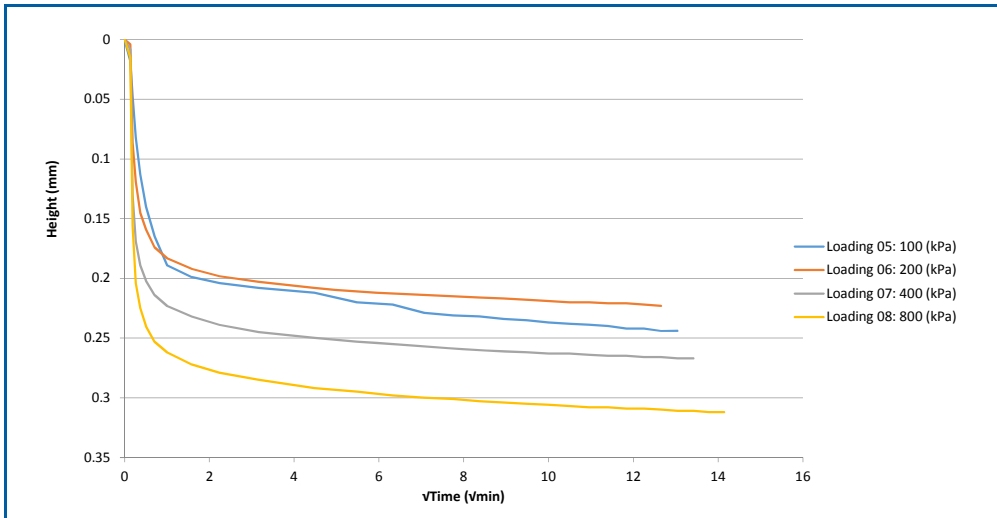
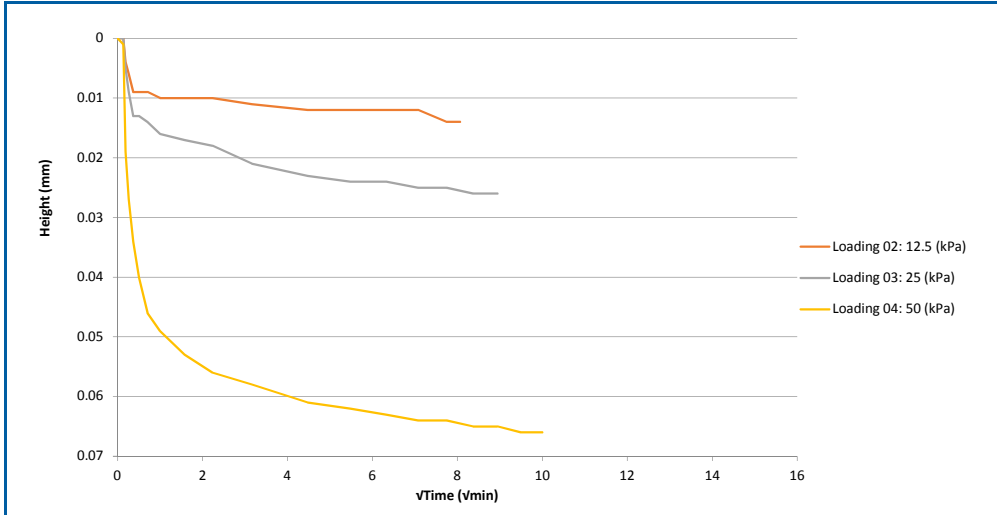
\* -  $m_v$  values provided are incremental and only valid for the specific load increment.

# Oedometer

## Time Readings

<b>Project:</b>	Esselen Park
<b>Client:</b>	Geohazard Solutions
<b>Geolab Job Nr:</b>	G18-237
<b>Test Method:</b>	TMH 6 ST10

<b>Sample Nr:</b>	TP25
<b>Sample Depth:</b>	2.10-5.50m
<b>Date:</b>	2018-10-30



# Oedometer

## TMH 6 ST10

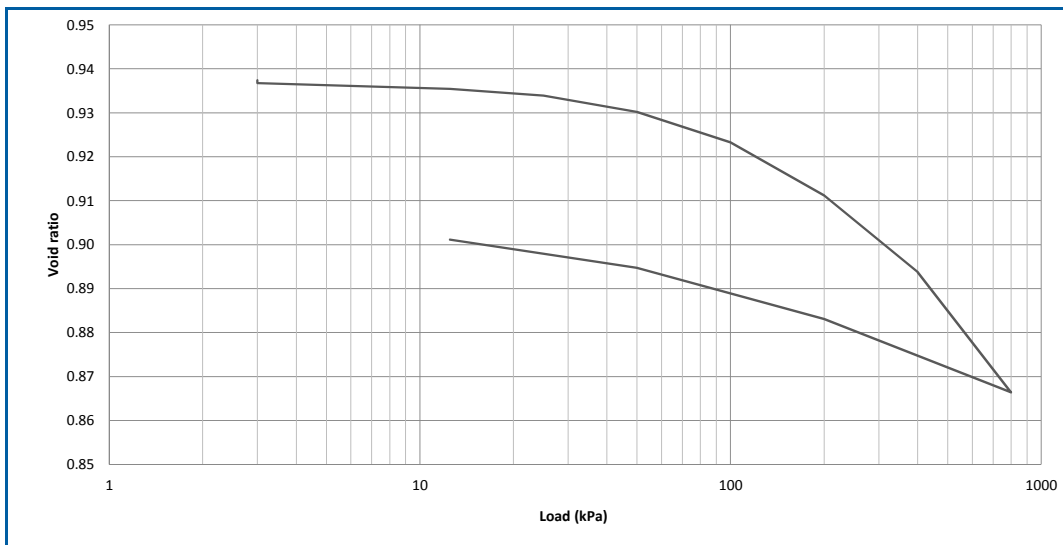
<b>Project:</b>	Esselen Park
<b>Client:</b>	Geohazard Solutions
<b>Geolab Job Nr:</b>	G18-237
<b>Test Method:</b>	TMH 6 ST10

<b>Sample Nr:</b>	TP08
<b>Sample Depth:</b>	2.6-5.5m
<b>Date:</b>	2018-10-31

Load kPa	Height mm	Void Ratio	$m_v$ MPa <sup>-1</sup>
3.0	20.170	0.937	
3.0	20.163	0.937	
12.5	20.15	0.935	0.068
25.0	20.134	0.934	0.064
50.0	20.095	0.930	0.077
100.0	20.023	0.923	0.072
200.0	19.897	0.911	0.063
400.0	19.716	0.894	0.045
800.0	19.431	0.866	0.036
200.0	19.605	0.883	
50.0	19.726	0.895	
12.5	19.793	0.901	

<b>Sampling Method:</b>	Block
<b>Disturbed/Undist:</b>	Undisturbed
<b>Remoulded To:</b>	-

	Initial	Final	
<b>Sample Height:</b>	20.17	19.79	mm
<b>Sample Mass:</b>	128.06	130.20	g
<b>Dry Density:</b>	1529	1558	kg/m <sup>3</sup>
<b>Density</b>	1993	2065	kg/m <sup>3</sup>
<b>Moisture Content:</b>	30.4	32.6	%
<b>Void Ratio:</b>	0.937	0.901	
<b>Specific Gravity:</b>	2.962		Mg/m <sup>3</sup>



\* -  $m_v$  values provided are incremental and only valid for the specific load increment.

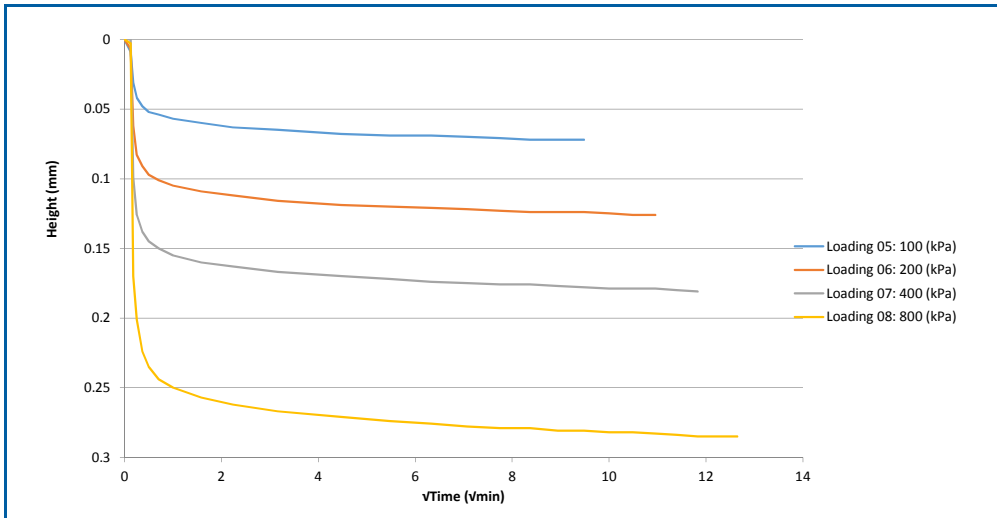
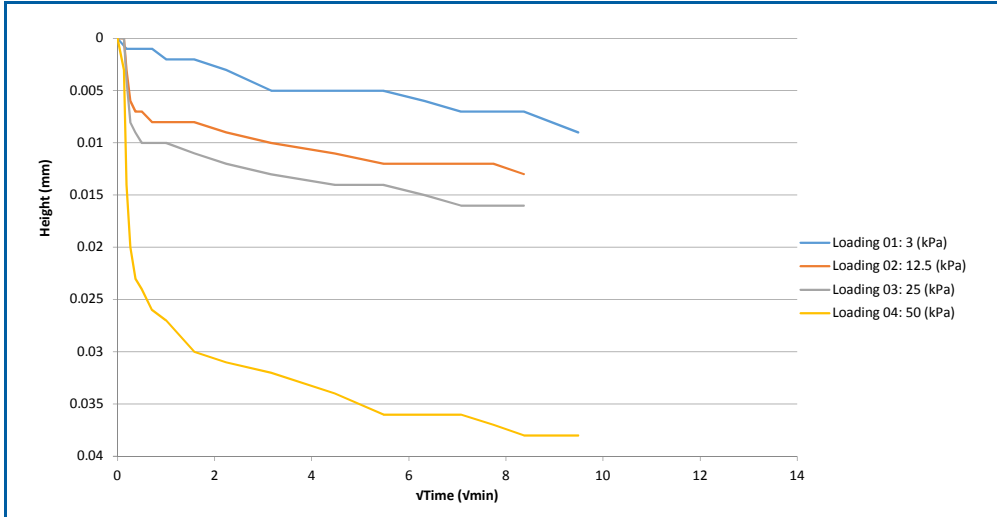


# Oedometer

## Time Readings

<b>Project:</b>	Esselen Park
<b>Client:</b>	Geohazard Solutions
<b>Geolab Job Nr:</b>	G18-237
<b>Test Method:</b>	TMH 6 ST10

<b>Sample Nr:</b>	TP08
<b>Sample Depth:</b>	2.6-5.5m
<b>Date:</b>	2018-10-31



# Oedometer

## TMH 6 ST10

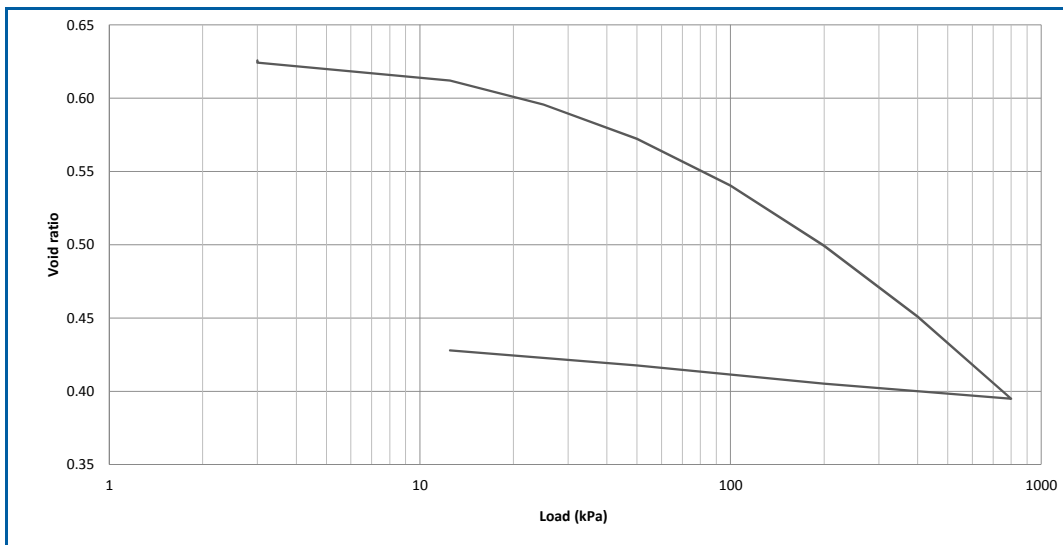
<b>Project:</b>	Esselen Park
<b>Client:</b>	Geohazard Solutions
<b>Geolab Job Nr:</b>	G18-237
<b>Test Method:</b>	TMH 6 ST10

<b>Sample Nr:</b>	TP03
<b>Sample Depth:</b>	1.60-4.50m
<b>Date:</b>	2018-10-30

Load kPa	Height mm	Void Ratio	$m_v$ MPa <sup>-1</sup>
3.0	19.110	0.626	
3.0	19.094	0.624	
12.5	18.951	0.612	0.788
25.0	18.758	0.596	0.815
50.0	18.483	0.572	0.586
100.0	18.107	0.540	0.407
200.0	17.626	0.499	0.266
400.0	17.054	0.451	0.162
800.0	16.397	0.395	0.096
200.0	16.518	0.405	
50.0	16.665	0.418	
12.5	16.785	0.428	

<b>Sampling Method:</b>	Block
<b>Disturbed/Undist:</b>	Undisturbed
<b>Remoulded To:</b>	-

	Initial	Final	
<b>Sample Height:</b>	19.11	16.79	mm
<b>Sample Mass:</b>	111.34	118.30	g
<b>Dry Density:</b>	1660	1891	kg/m <sup>3</sup>
<b>Density</b>	1830	2214	kg/m <sup>3</sup>
<b>Moisture Content:</b>	10.2	17.1	%
<b>Void Ratio:</b>	0.626	0.428	
<b>Specific Gravity:</b>	2.699		Mg/m <sup>3</sup>



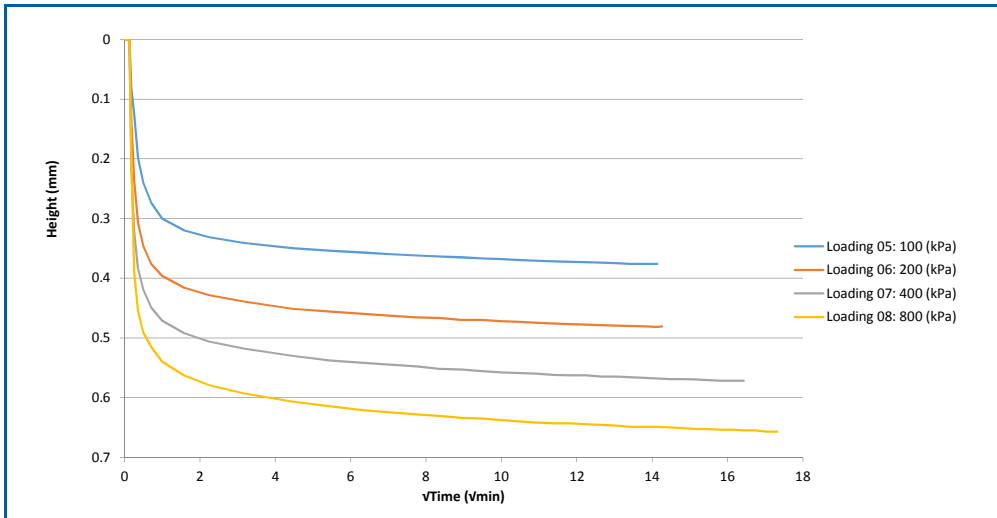
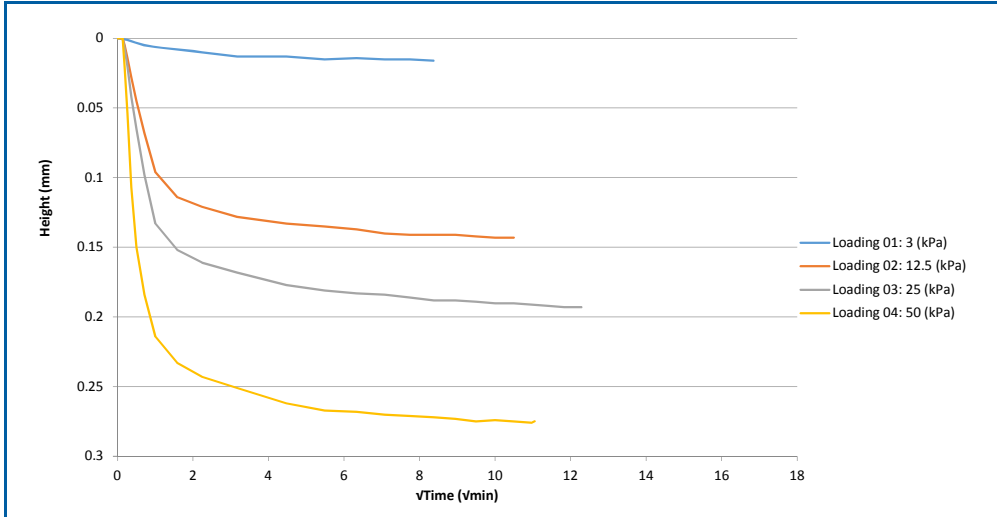
\* -  $m_v$  values provided are incremental and only valid for the specific load increment.

# Oedometer

## Time Readings

<b>Project:</b>	Esselen Park
<b>Client:</b>	Geohazard Solutions
<b>Geolab Job Nr:</b>	G18-237
<b>Test Method:</b>	TMH 6 ST10

<b>Sample Nr:</b>	TP03
<b>Sample Depth:</b>	1.60-4.50m
<b>Date:</b>	2018-10-30

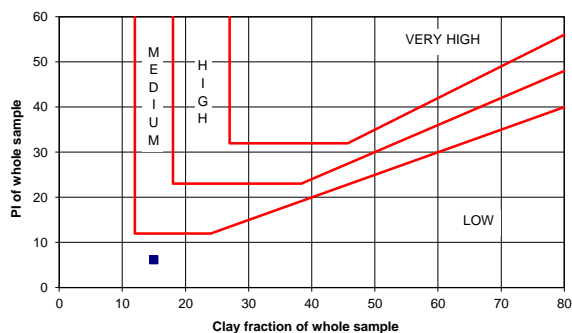


## PARTICLE SIZE ANALYSIS

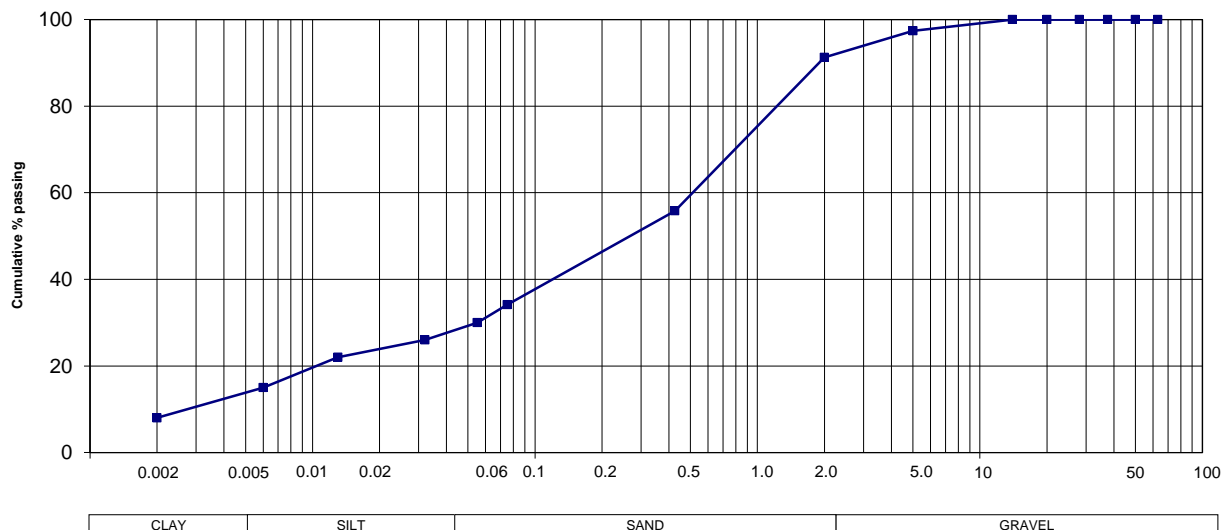
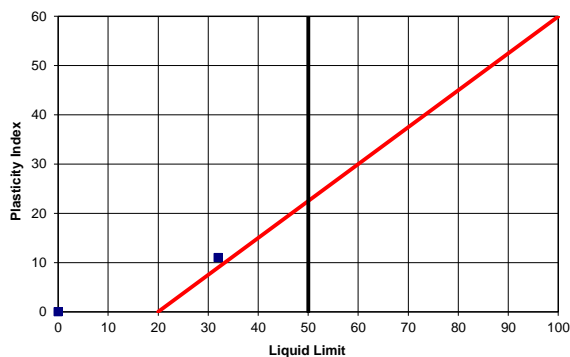
Sample No.	1								
Soillab Sample No.	S18-2073-01								
Depth (m)	2.45 - 3.80								
Position	TP 11								
Material Description	LIGHT REDDISH ORANGE CLAYEY SAND								
Relative density on < 2 mm (SANS 5844)	2.65								
Organic Material									
Moisture (%) / Dispersion (%)									
<b>SCREEN ANALYSIS (% PASSING) (SANS 3001:GR1)</b>									
63.0 mm	100								
50.0 mm	100								
37.5 mm	100								
28.0 mm	100								
20.0 mm	100								
14.0 mm	100								
5.0 mm	97								
2.00 mm	91								
0.425 mm	56								
0.075 mm	34								
<b>HYDROMETER ANALYSIS (% PASSING) (SANS 3001:GR3)</b>									
55 µm	30								
32 µm	26								
13 µm	22								
6 µm	15								
2 µm	8								
<table border="1" style="width: 100%;"> <tr> <td>% Clay</td> <td>15</td> </tr> <tr> <td>% Silt</td> <td>15</td> </tr> <tr> <td>% Sand</td> <td>61</td> </tr> <tr> <td>% Gravel</td> <td>9</td> </tr> </table>		% Clay	15	% Silt	15	% Sand	61	% Gravel	9
% Clay	15								
% Silt	15								
% Sand	61								
% Gravel	9								
<b>ATTERBERG LIMITS (SANS 3001:GR10)</b>									
Liquid Limit	32								
Plasticity Index	11								
Linear Shrinkage (%)	4.0								
Grading Modulus	1.19								
Classification	A-2-6 (0)								
Unified Classification	SC								
Chart Reference									

PROJECT : ESSELEN PARK  
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DATE : 2018-11-05


### POTENTIAL EXPANSIVENESS



### PLASTICITY CHART

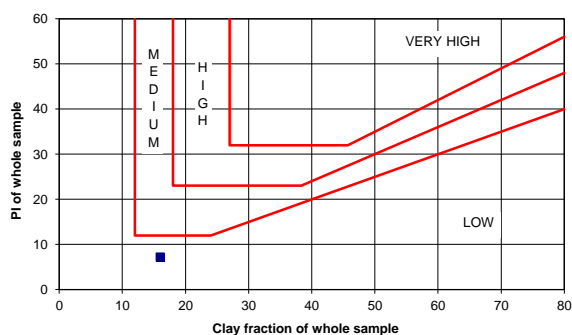


## PARTICLE SIZE ANALYSIS

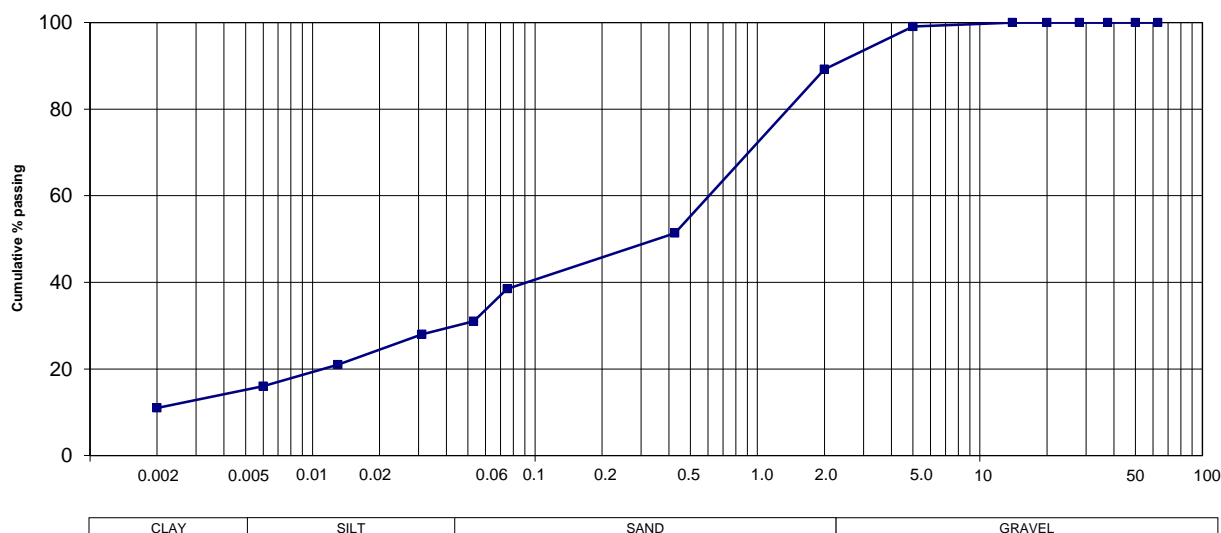
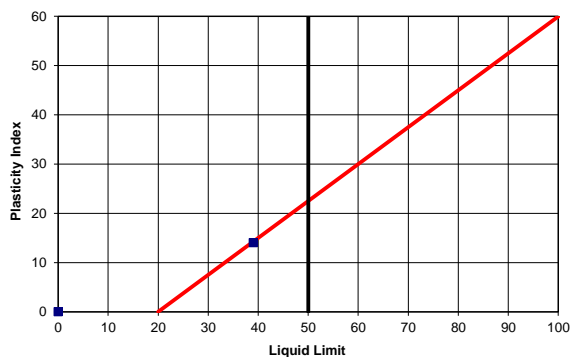
Sample No.	2								
Soillab Sample No.	S18-2073-02								
Depth (m)	1.90 - 3.30								
Position	TP 13								
Material Description	LIGHT REDDISH ORANGE CLAYEY SAND								
Relative density on < 2 mm (SANS 5844)	2.65								
Organic Material									
Moisture (%) / Dispersion (%)									
<b>SCREEN ANALYSIS (% PASSING) (SANS 3001:GR1)</b>									
63.0 mm	100								
50.0 mm	100								
37.5 mm	100								
28.0 mm	100								
20.0 mm	100								
14.0 mm	100								
5.0 mm	99								
2.00 mm	89								
0.425 mm	51								
0.075 mm	39								
<b>HYDROMETER ANALYSIS (% PASSING) (SANS 3001:GR3)</b>									
53 µm	31								
31 µm	28								
13 µm	21								
6 µm	16								
2 µm	11								
<table border="1" style="width: 100%;"> <tr> <td>% Clay</td> <td>16</td> </tr> <tr> <td>% Silt</td> <td>15</td> </tr> <tr> <td>% Sand</td> <td>58</td> </tr> <tr> <td>% Gravel</td> <td>11</td> </tr> </table>		% Clay	16	% Silt	15	% Sand	58	% Gravel	11
% Clay	16								
% Silt	15								
% Sand	58								
% Gravel	11								
<b>ATTERBERG LIMITS (SANS 3001:GR10)</b>									
Liquid Limit	39								
Plasticity Index	14								
Linear Shrinkage (%)	7.0								
Grading Modulus	1.21								
Classification	A-6 (2)								
Unified Classification	SC								
Chart Reference									

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### POTENTIAL EXPANSIVENESS



### PLASTICITY CHART

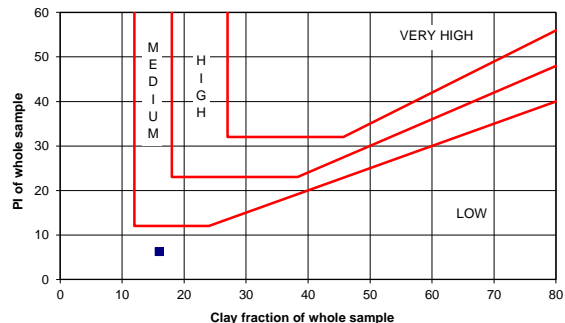


## PARTICLE SIZE ANALYSIS

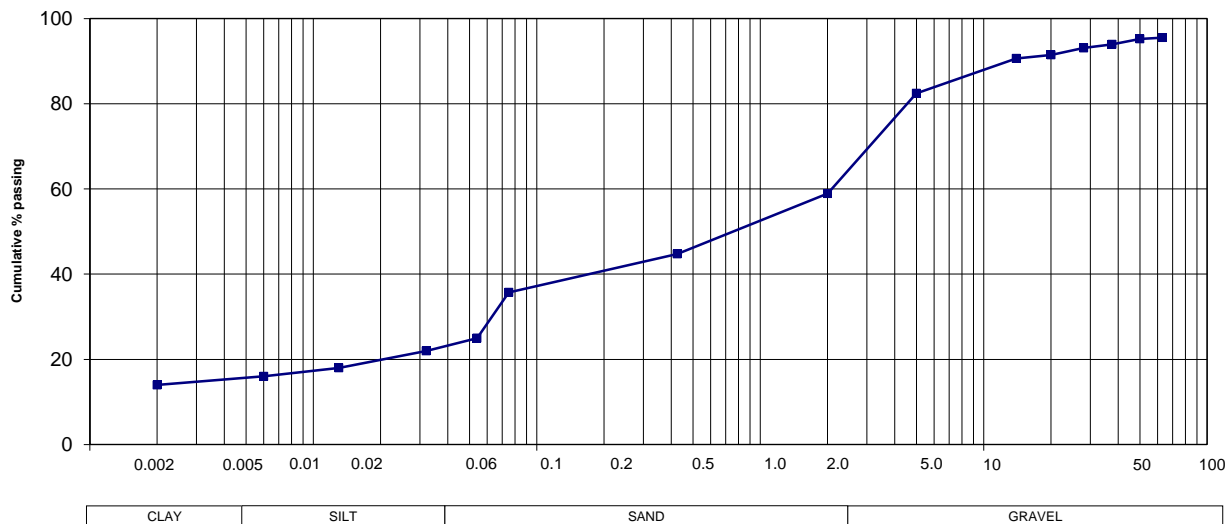
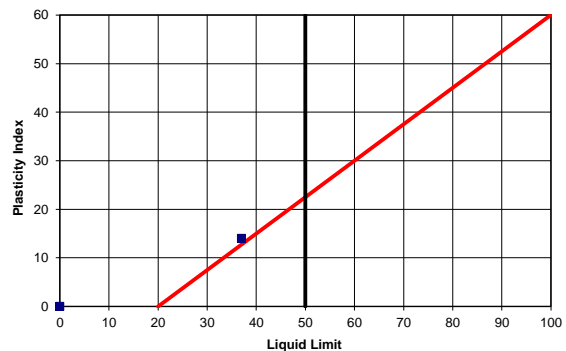
Sample No.	3
Soillab Sample No.	S18-2073-03
Depth (m)	1.00 - 2.10
Position	TP 18
Material Description	DUSKY RED QUARTZITE & FERRICRETE SANDY GRAVEL
Relative density on < 2 mm (SANS 5844)	2.65
Organic Material	
Moisture (%) / Dispersion (%)	
<b>SCREEN ANALYSIS (% PASSING) (SANS 3001:GR1)</b>	
63.0 mm	96
50.0 mm	95
37.5 mm	94
28.0 mm	93
20.0 mm	91
14.0 mm	91
5.0 mm	82
2.00 mm	59
0.425 mm	45
0.075 mm	36
<b>HYDROMETER ANALYSIS (% PASSING) (SANS 3001:GR3)</b>	
54 µm	25
32 µm	22
13 µm	18
6 µm	16
2 µm	14
% Clay	16
% Silt	9
% Sand	34
% Gravel	41
<b>ATTERBERG LIMITS (SANS 3001:GR10)</b>	
Liquid Limit	37
Plasticity Index	14
Linear Shrinkage (%)	7.0
Grading Modulus	1.61
Classification	A-6 (1)
Unified Classification	SC
Chart Reference	

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
### POTENTIAL EXPANSIVENESS



### PLASTICITY CHART

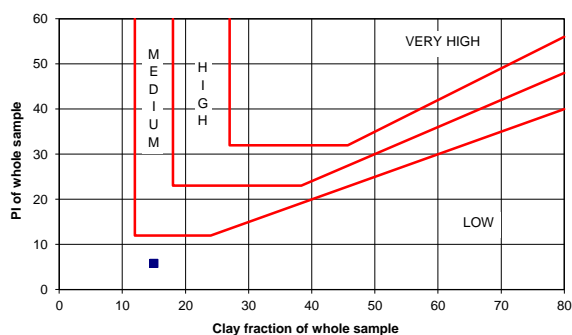


## PARTICLE SIZE ANALYSIS

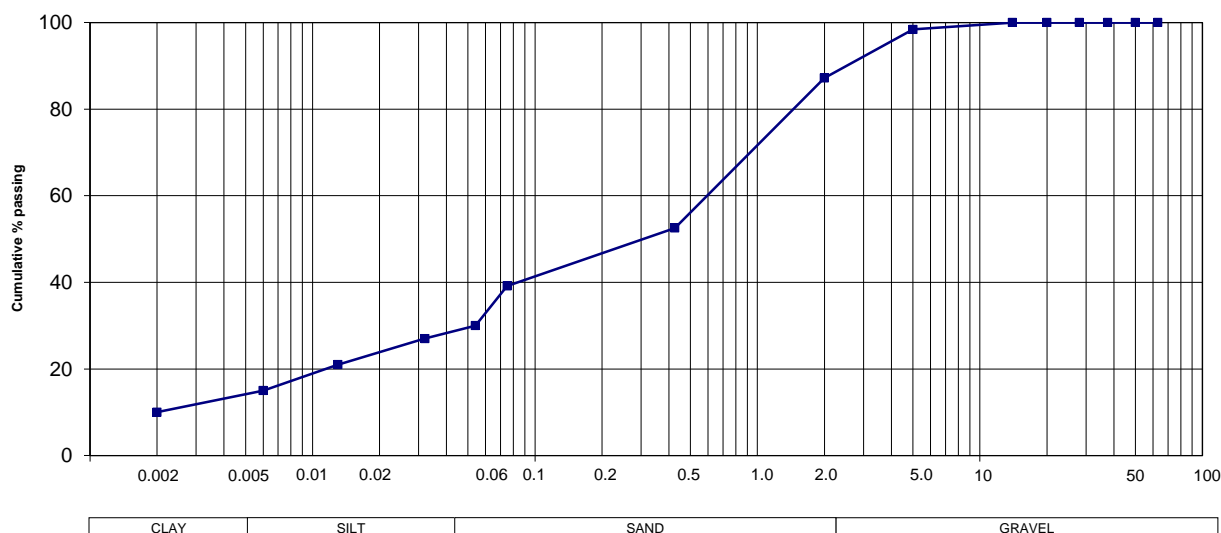
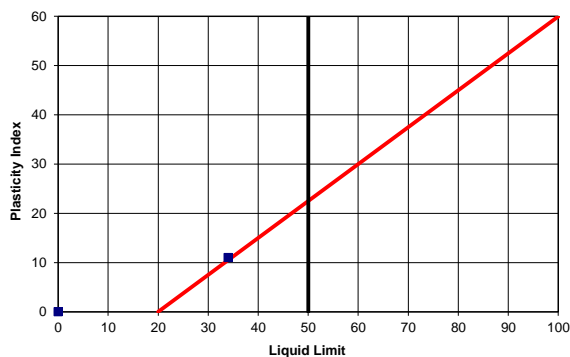
Sample No.	4
Soillab Sample No.	S18-2073-04
Depth (m)	3.40 - 4.70
Position	TP 20
Material Description	LIGHT REDDISH ORANGE FERRICRETE CLAYEY SAND
Relative density on < 2 mm (SANS 5844)	2.65
Organic Material	
Moisture (%) / Dispersion (%)	
<b>SCREEN ANALYSIS (% PASSING) (SANS 3001:GR1)</b>	
63.0 mm	100
50.0 mm	100
37.5 mm	100
28.0 mm	100
20.0 mm	100
14.0 mm	100
5.0 mm	98
2.00 mm	87
0.425 mm	53
0.075 mm	39
<b>HYDROMETER ANALYSIS (% PASSING) (SANS 3001:GR3)</b>	
54 µm	30
32 µm	27
13 µm	21
6 µm	15
2 µm	10
% Clay	15
% Silt	15
% Sand	57
% Gravel	13
<b>ATTERBERG LIMITS (SANS 3001:GR10)</b>	
Liquid Limit	34
Plasticity Index	11
Linear Shrinkage (%)	5.0
Grading Modulus	1.21
Classification	A-6 (1)
Unified Classification	SC
Chart Reference	

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
### POTENTIAL EXPANSIVENESS



### PLASTICITY CHART

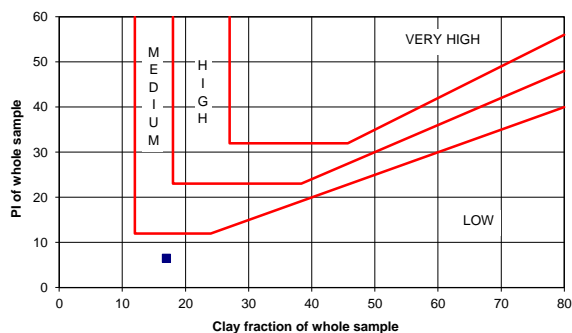


## PARTICLE SIZE ANALYSIS

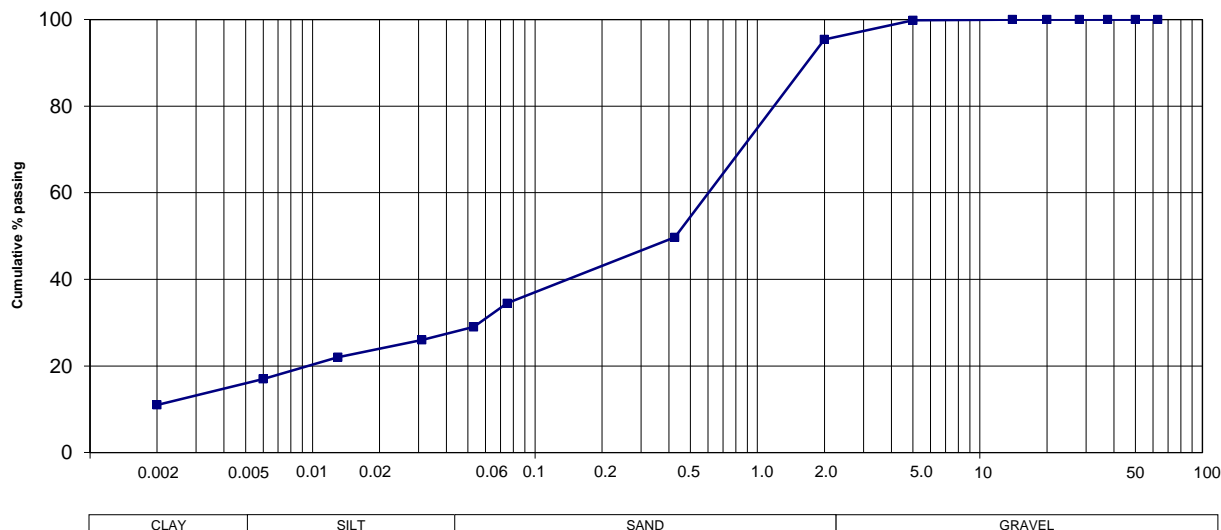
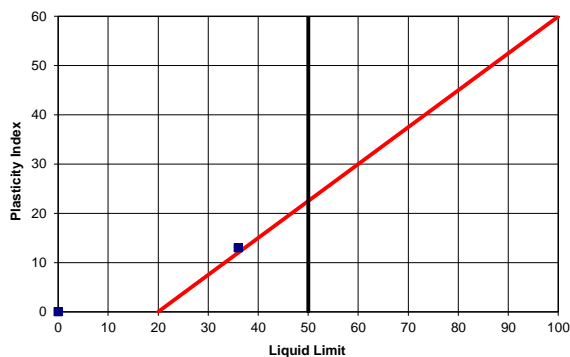
Sample No.	5
Soillab Sample No.	S18-2073-05
Depth (m)	3.90 - 5.20
Position	TP 28
Material Description	LIGHT REDDISH ORANGE CLAYEY SAND
Relative density on < 2 mm (SANS 5844)	2.65
Organic Material	
Moisture (%) / Dispersion (%)	
<b>SCREEN ANALYSIS (% PASSING) (SANS 3001:GR1)</b>	
63.0 mm	100
50.0 mm	100
37.5 mm	100
28.0 mm	100
20.0 mm	100
14.0 mm	100
5.0 mm	100
2.00 mm	95
0.425 mm	50
0.075 mm	34
<b>HYDROMETER ANALYSIS (% PASSING) (SANS 3001:GR3)</b>	
53 µm	29
31 µm	26
13 µm	22
6 µm	17
2 µm	11
% Clay	17
% Silt	12
% Sand	66
% Gravel	5
<b>ATTERBERG LIMITS (SANS 3001:GR10)</b>	
Liquid Limit	36
Plasticity Index	13
Linear Shrinkage (%)	5.5
Grading Modulus	1.20
Classification	A-2-6 (1)
Unified Classification	SC
Chart Reference	

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### POTENTIAL EXPANSIVENESS




### PLASTICITY CHART



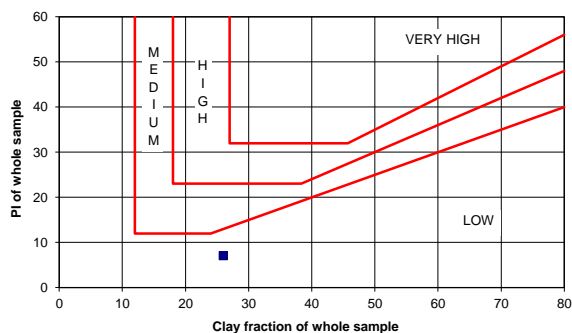


## PARTICLE SIZE ANALYSIS

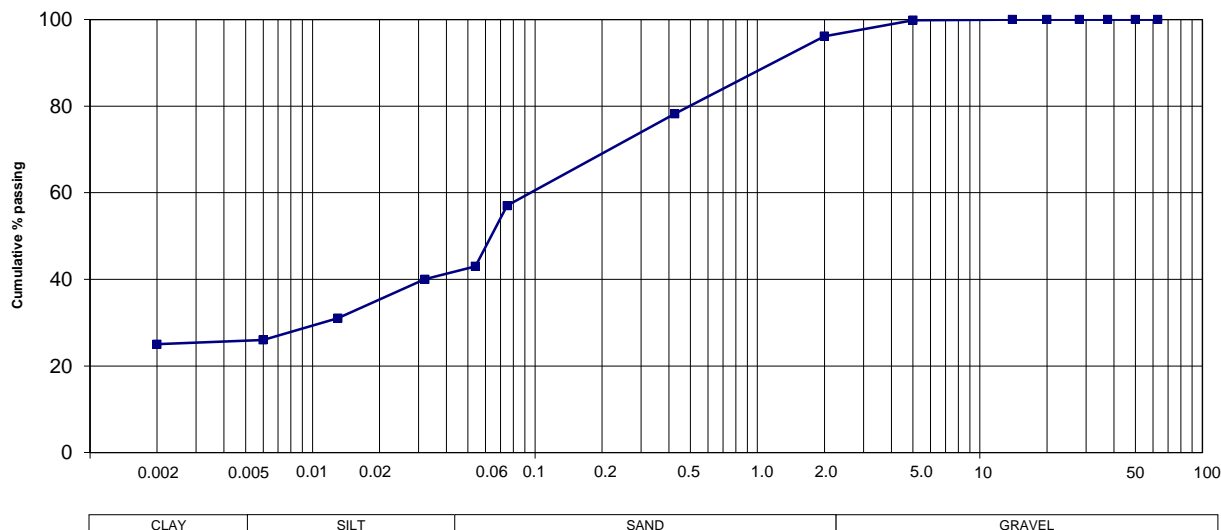
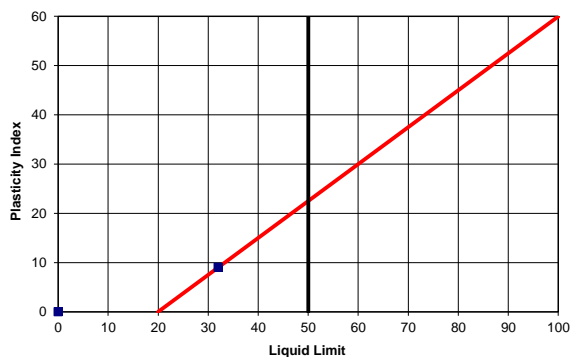
Sample No.	6								
Soillab Sample No.	S18-2073-06								
Depth (m)	0.50 - 1.80								
Position	TP 30								
Material Description	DUSKY RED  CLAYEY SAND								
Relative density on < 2 mm (SANS 5844)	2.65								
Organic Material									
Moisture (%) / Dispersion (%)									
<b>SCREEN ANALYSIS (% PASSING) (SANS 3001:GR1)</b>									
63.0 mm	100								
50.0 mm	100								
37.5 mm	100								
28.0 mm	100								
20.0 mm	100								
14.0 mm	100								
5.0 mm	100								
2.00 mm	96								
0.425 mm	78								
0.075 mm	57								
<b>HYDROMETER ANALYSIS (% PASSING) (SANS 3001:GR3)</b>									
54 µm	43								
32 µm	40								
13 µm	31								
6 µm	26								
2 µm	25								
<table border="1" style="width: 100%;"> <tr> <td>% Clay</td> <td>26</td> </tr> <tr> <td>% Silt</td> <td>17</td> </tr> <tr> <td>% Sand</td> <td>53</td> </tr> <tr> <td>% Gravel</td> <td>4</td> </tr> </table>		% Clay	26	% Silt	17	% Sand	53	% Gravel	4
% Clay	26								
% Silt	17								
% Sand	53								
% Gravel	4								
<b>ATTERBERG LIMITS (SANS 3001:GR10)</b>									
Liquid Limit	32								
Plasticity Index	9								
Linear Shrinkage (%)	4.5								
Grading Modulus	0.69								
Classification	A-4 (3)								
Unified Classification	CL								
Chart Reference									

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### POTENTIAL EXPANSIVENESS



### PLASTICITY CHART

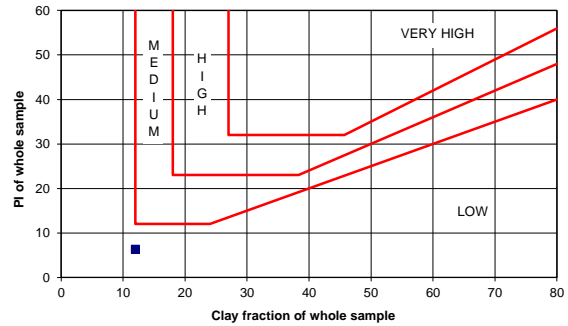


## PARTICLE SIZE ANALYSIS

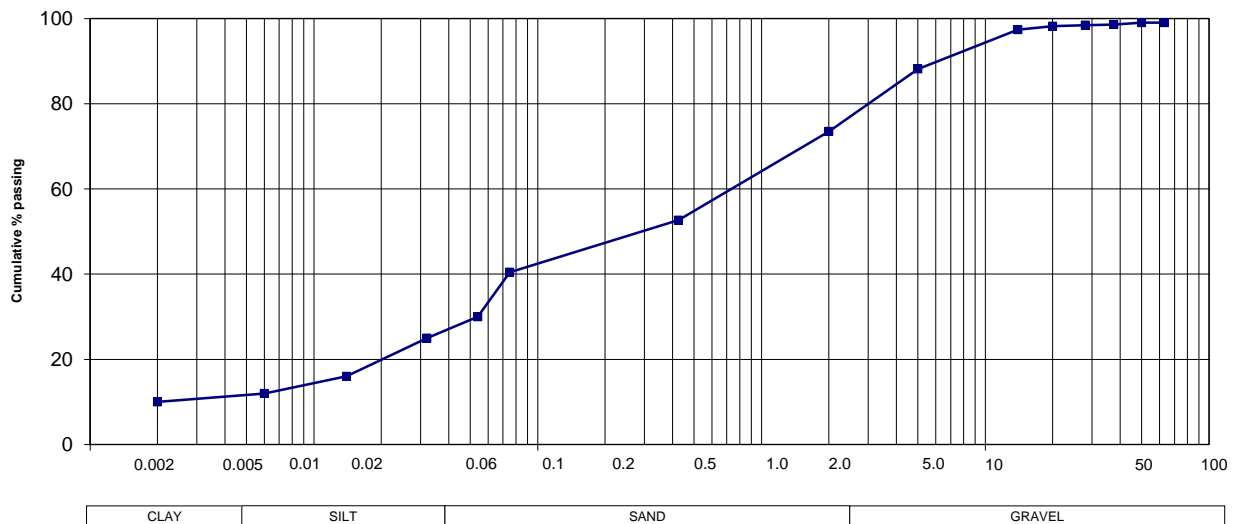
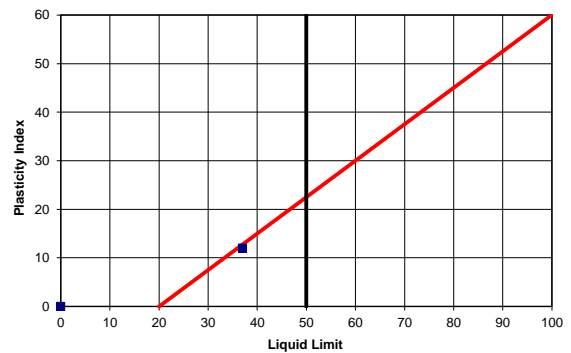
Sample No.	7
Soillab Sample No.	S18-2073-07
Depth (m)	2.30 - 3.80
Position	TP 30
Material Description	LIGHT REDDISH ORANGE FERRICRETE & QUARTZITE GRAVELLY SAND
Relative density on < 2 mm (SANS 5844)	2.65
Organic Material	
Moisture (%) / Dispersion (%)	
<b>SCREEN ANALYSIS (% PASSING) (SANS 3001:GR1)</b>	
63.0 mm	99
50.0 mm	99
37.5 mm	99
28.0 mm	98
20.0 mm	98
14.0 mm	97
5.0 mm	88
2.00 mm	74
0.425 mm	53
0.075 mm	40
<b>HYDROMETER ANALYSIS (% PASSING) (SANS 3001:GR3)</b>	
54 µm	30
32 µm	25
14 µm	16
6 µm	12
2 µm	10
% Clay	12
% Silt	18
% Sand	44
% Gravel	26
<b>ATTERBERG LIMITS (SANS 3001:GR10)</b>	
Liquid Limit	37
Plasticity Index	12
Linear Shrinkage (%)	5.0
Grading Modulus	1.33
Classification	A-6 (1)
Unified Classification	SM
Chart Reference	

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### POTENTIAL EXPANSIVENESS



### PLASTICITY CHART

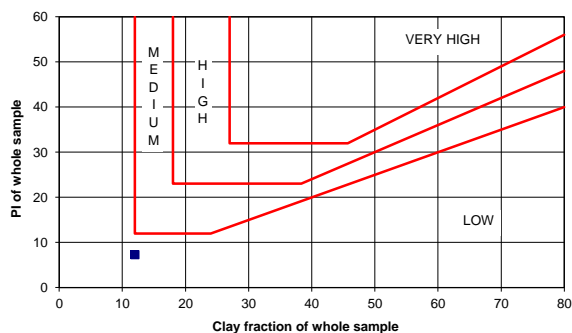


## PARTICLE SIZE ANALYSIS

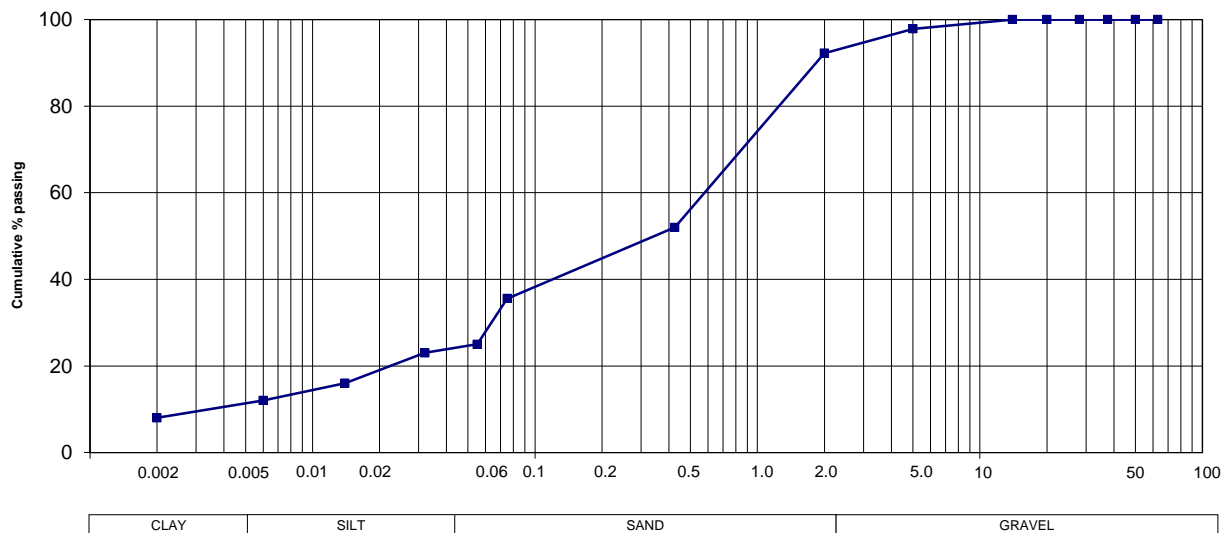
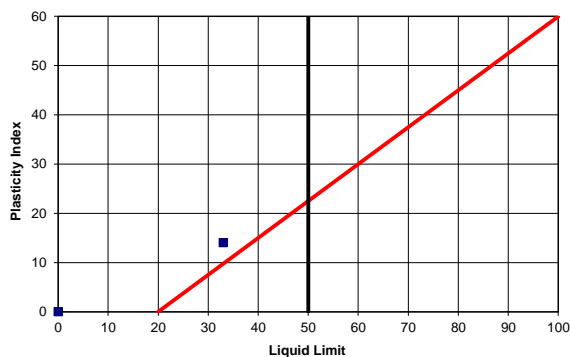
Sample No.	8								
Soillab Sample No.	S18-2073-08								
Depth (m)	3.80 - 5.20								
Position	TP 30								
Material Description	LIGHT REDDISH ORANGE SILTY SAND								
Relative density on < 2 mm (SANS 5844)	2.65								
Organic Material									
Moisture (%) / Dispersion (%)									
<b>SCREEN ANALYSIS (% PASSING) (SANS 3001:GR1)</b>									
63.0 mm	100								
50.0 mm	100								
37.5 mm	100								
28.0 mm	100								
20.0 mm	100								
14.0 mm	100								
5.0 mm	98								
2.00 mm	92								
0.425 mm	52								
0.075 mm	36								
<b>HYDROMETER ANALYSIS (% PASSING) (SANS 3001:GR3)</b>									
55 µm	25								
32 µm	23								
14 µm	16								
6 µm	12								
2 µm	8								
<table border="1" style="width: 100%;"> <tr> <td>% Clay</td> <td>12</td> </tr> <tr> <td>% Silt</td> <td>13</td> </tr> <tr> <td>% Sand</td> <td>67</td> </tr> <tr> <td>% Gravel</td> <td>8</td> </tr> </table>		% Clay	12	% Silt	13	% Sand	67	% Gravel	8
% Clay	12								
% Silt	13								
% Sand	67								
% Gravel	8								
<b>ATTERBERG LIMITS (SANS 3001:GR10)</b>									
Liquid Limit	33								
Plasticity Index	14								
Linear Shrinkage (%)	5.5								
Grading Modulus	1.20								
Classification	A-6 (1)								
Unified Classification	SC								
Chart Reference									

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### POTENTIAL EXPANSIVENESS



### PLASTICITY CHART

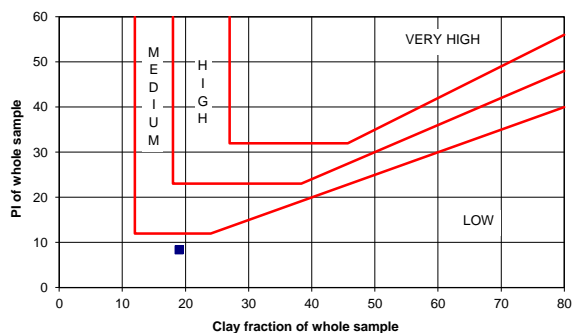


## PARTICLE SIZE ANALYSIS

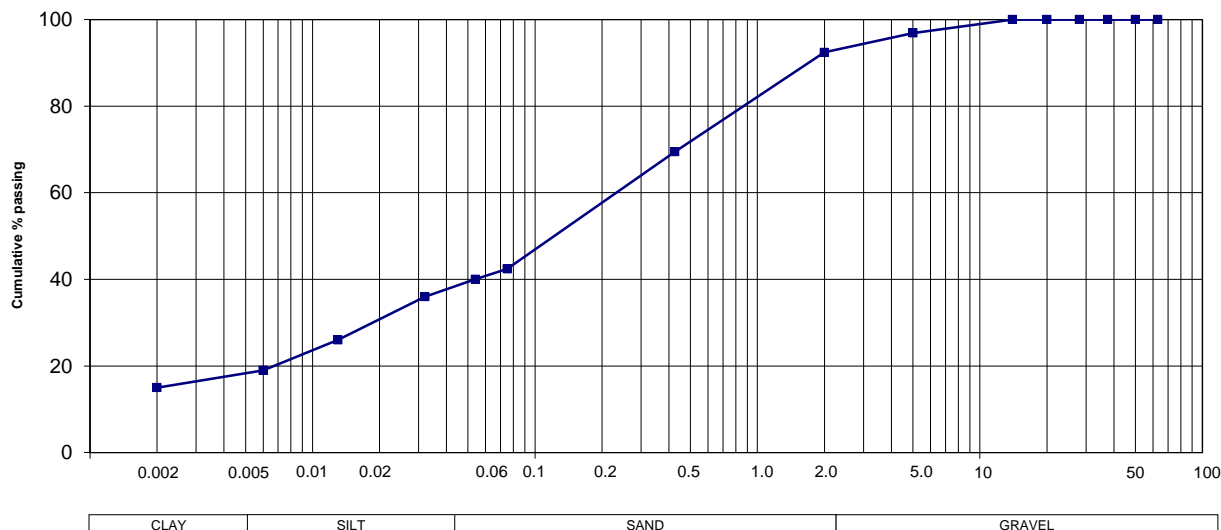
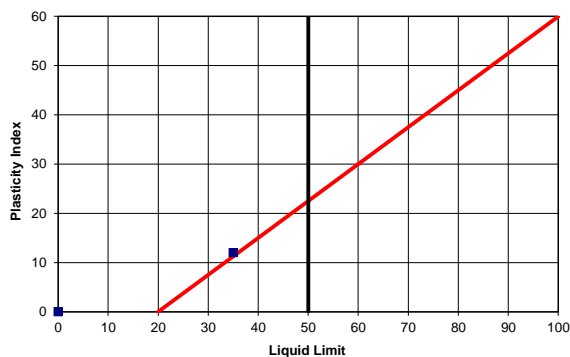
Sample No.	9								
Soillab Sample No.	S18-2073-09								
Depth (m)	0.93 - 3.10								
Position	TP 34								
Material Description	LIGHT REDDISH ORANGE SILTY SAND								
Relative density on < 2 mm (SANS 5844)	2.65								
Organic Material									
Moisture (%) / Dispersion (%)									
<b>SCREEN ANALYSIS (% PASSING) (SANS 3001:GR1)</b>									
63.0 mm	100								
50.0 mm	100								
37.5 mm	100								
28.0 mm	100								
20.0 mm	100								
14.0 mm	100								
5.0 mm	97								
2.00 mm	92								
0.425 mm	69								
0.075 mm	42								
<b>HYDROMETER ANALYSIS (% PASSING) (SANS 3001:GR3)</b>									
54 µm	40								
32 µm	36								
13 µm	26								
6 µm	19								
2 µm	15								
<table border="1" style="width: 100%;"> <tr> <td>% Clay</td> <td>19</td> </tr> <tr> <td>% Silt</td> <td>21</td> </tr> <tr> <td>% Sand</td> <td>52</td> </tr> <tr> <td>% Gravel</td> <td>8</td> </tr> </table>		% Clay	19	% Silt	21	% Sand	52	% Gravel	8
% Clay	19								
% Silt	21								
% Sand	52								
% Gravel	8								
<b>ATTERBERG LIMITS (SANS 3001:GR10)</b>									
Liquid Limit	35								
Plasticity Index	12								
Linear Shrinkage (%)	5.0								
Grading Modulus	0.96								
Classification	A-6 (2)								
Unified Classification	SC								
Chart Reference									

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### POTENTIAL EXPANSIVENESS



### PLASTICITY CHART

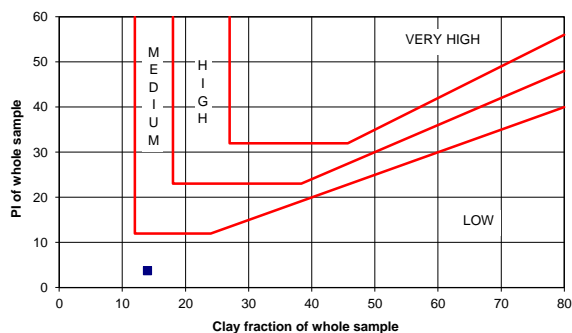


## PARTICLE SIZE ANALYSIS

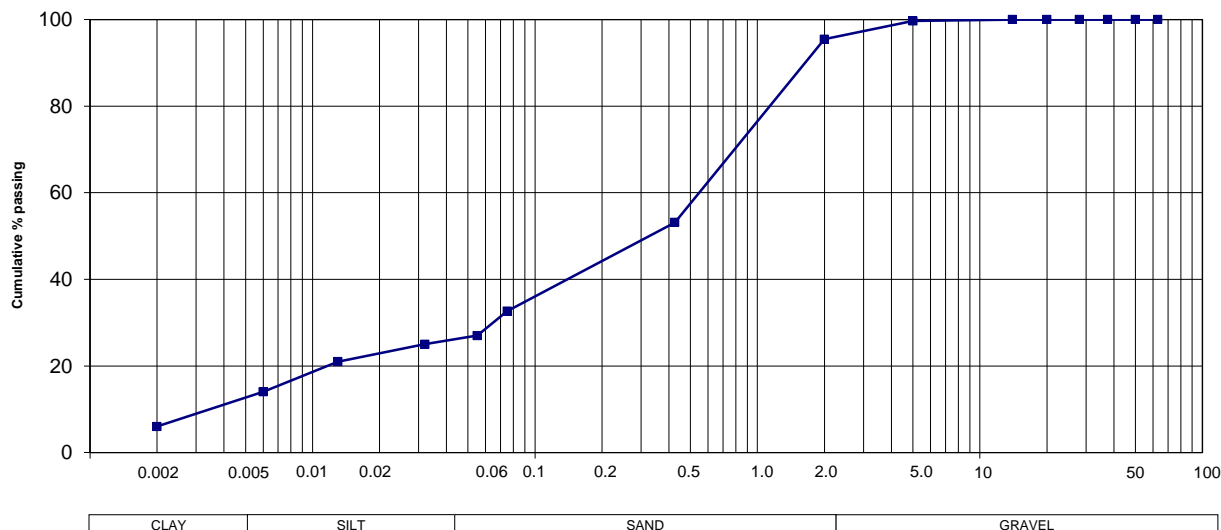
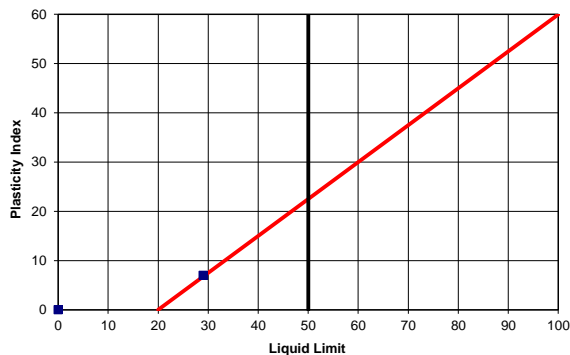
Sample No.	10
Soillab Sample No.	S18-2073-10
Depth (m)	3.10 - 5.30
Position	TP 34
Material Description	LIGHT REDDISH BROWN CLAYEY SAND
Relative density on < 2 mm (SANS 5844)	2.65
Organic Material	
Moisture (%) / Dispersion (%)	
<b>SCREEN ANALYSIS (% PASSING) (SANS 3001:GR1)</b>	
63.0 mm	100
50.0 mm	100
37.5 mm	100
28.0 mm	100
20.0 mm	100
14.0 mm	100
5.0 mm	100
2.00 mm	95
0.425 mm	53
0.075 mm	33
<b>HYDROMETER ANALYSIS (% PASSING) (SANS 3001:GR3)</b>	
55 µm	27
32 µm	25
13 µm	21
6 µm	14
2 µm	6
% Clay	14
% Silt	13
% Sand	68
% Gravel	5
<b>ATTERBERG LIMITS (SANS 3001:GR10)</b>	
Liquid Limit	29
Plasticity Index	7
Linear Shrinkage (%)	2.5
Grading Modulus	1.19
Classification	A-2-4 (0)
Unified Classification	SM & SC
Chart Reference	

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### POTENTIAL EXPANSIVENESS



### PLASTICITY CHART

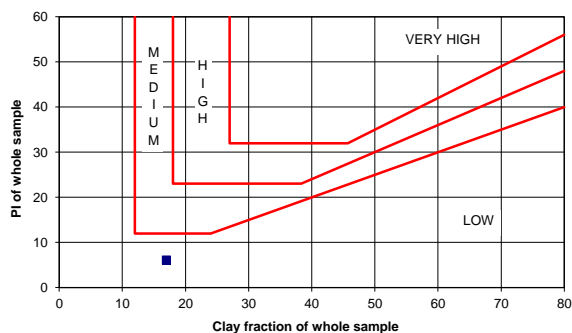


## PARTICLE SIZE ANALYSIS

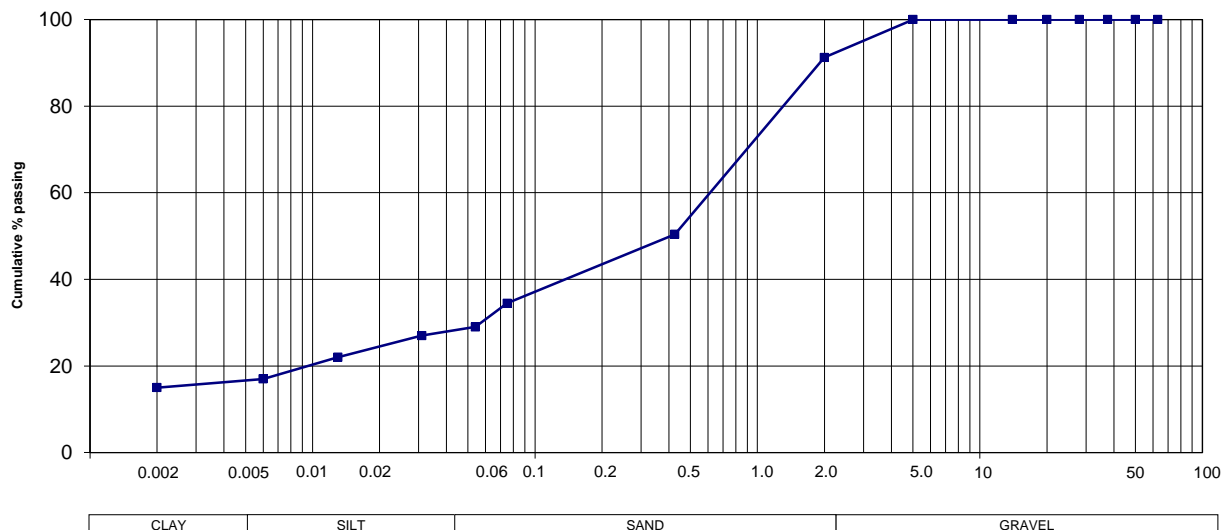
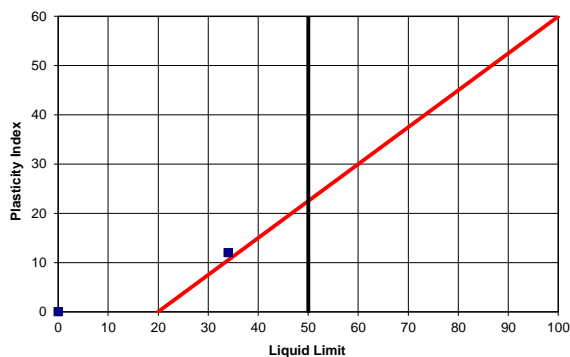
Sample No.	11								
Soillab Sample No.	S18-2073-11								
Depth (m)	1.90 - 5.50								
Position	TP 10								
Material Description	LIGHT REDDISH ORANGE CLAYEY SAND								
Relative density on < 2 mm (SANS 5844)	2.65								
Organic Material									
Moisture (%) / Dispersion (%)									
<b>SCREEN ANALYSIS (% PASSING) (SANS 3001:GR1)</b>									
63.0 mm	100								
50.0 mm	100								
37.5 mm	100								
28.0 mm	100								
20.0 mm	100								
14.0 mm	100								
5.0 mm	100								
2.00 mm	91								
0.425 mm	50								
0.075 mm	34								
<b>HYDROMETER ANALYSIS (% PASSING) (SANS 3001:GR3)</b>									
54 µm	29								
31 µm	27								
13 µm	22								
6 µm	17								
2 µm	15								
<table border="1" style="width: 100%;"> <tr> <td>% Clay</td> <td>17</td> </tr> <tr> <td>% Silt</td> <td>12</td> </tr> <tr> <td>% Sand</td> <td>62</td> </tr> <tr> <td>% Gravel</td> <td>9</td> </tr> </table>		% Clay	17	% Silt	12	% Sand	62	% Gravel	9
% Clay	17								
% Silt	12								
% Sand	62								
% Gravel	9								
<b>ATTERBERG LIMITS (SANS 3001:GR10)</b>									
Liquid Limit	34								
Plasticity Index	12								
Linear Shrinkage (%)	6.0								
Grading Modulus	1.24								
Classification	A-2-6 (0)								
Unified Classification	SC								
Chart Reference									

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### POTENTIAL EXPANSIVENESS



### PLASTICITY CHART

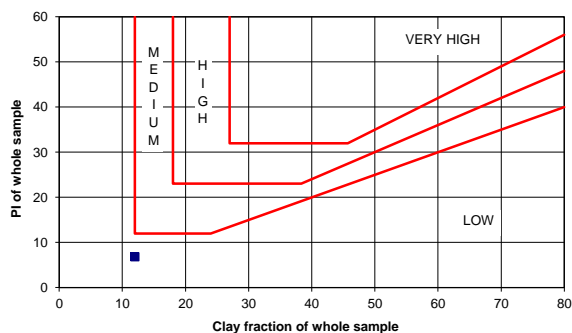


## PARTICLE SIZE ANALYSIS

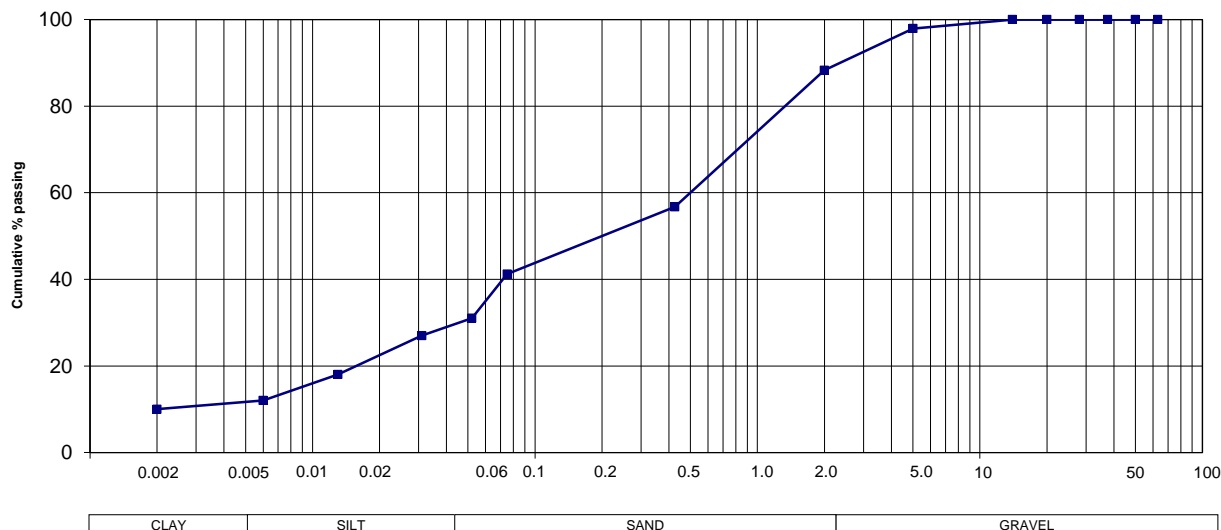
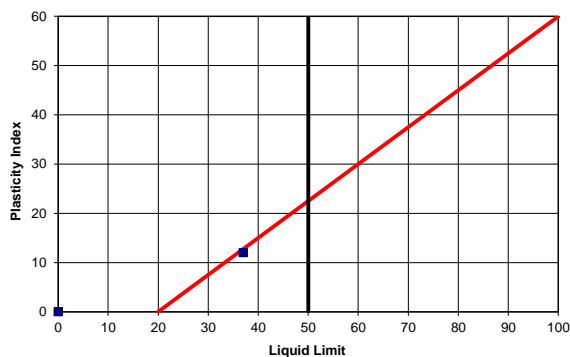
Sample No.	12								
Soillab Sample No.	S18-2073-12								
Depth (m)	1.50 - 2.90								
Position	TP 13								
Material Description	DUSKY RED FERRICRETE SILTY SAND								
Relative density on < 2 mm (SANS 5844)	2.65								
Organic Material									
Moisture (%) / Dispersion (%)									
<b>SCREEN ANALYSIS (% PASSING) (SANS 3001:GR1)</b>									
63.0 mm	100								
50.0 mm	100								
37.5 mm	100								
28.0 mm	100								
20.0 mm	100								
14.0 mm	100								
5.0 mm	98								
2.00 mm	88								
0.425 mm	57								
0.075 mm	41								
<b>HYDROMETER ANALYSIS (% PASSING) (SANS 3001:GR3)</b>									
52 µm	31								
31 µm	27								
13 µm	18								
6 µm	12								
2 µm	10								
<table border="1" style="width: 100%;"> <tr> <td>% Clay</td> <td>12</td> </tr> <tr> <td>% Silt</td> <td>19</td> </tr> <tr> <td>% Sand</td> <td>57</td> </tr> <tr> <td>% Gravel</td> <td>12</td> </tr> </table>		% Clay	12	% Silt	19	% Sand	57	% Gravel	12
% Clay	12								
% Silt	19								
% Sand	57								
% Gravel	12								
<b>ATTERBERG LIMITS (SANS 3001:GR10)</b>									
Liquid Limit	37								
Plasticity Index	12								
Linear Shrinkage (%)	5.5								
Grading Modulus	1.14								
Classification	A-6 (2)								
Unified Classification	SM								
Chart Reference									

PROJECT : ESSELEN PARK  
JOB No. : S18-2073  
DATE : 2018-11-05


### POTENTIAL EXPANSIVENESS



### PLASTICITY CHART

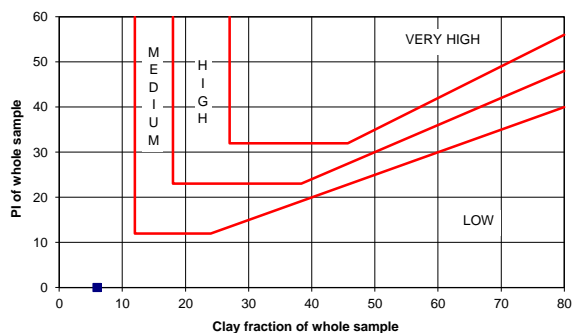


## PARTICLE SIZE ANALYSIS

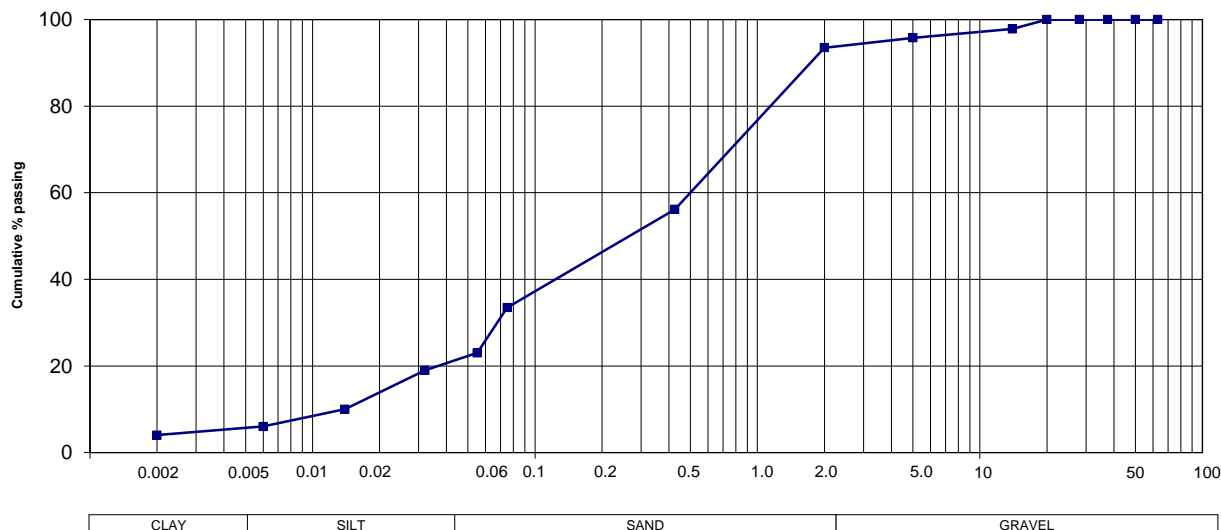
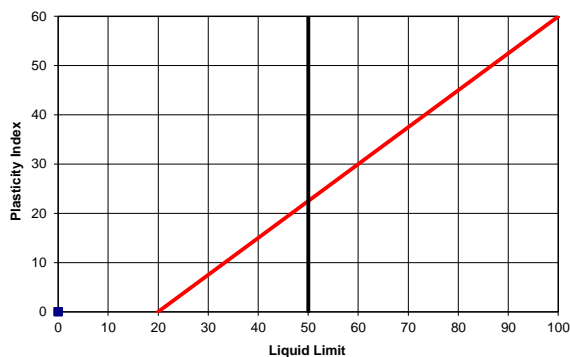
Sample No.	13
Soillab Sample No.	S18-2073-13
Depth (m)	0.76 - 1.60
Position	TP 17
Material Description	LIGHT OLIVE  SILTY SAND
Relative density on < 2 mm (SANS 5844)	2.65
Organic Material	
Moisture (%) / Dispersion (%)	
<b>SCREEN ANALYSIS (% PASSING) (SANS 3001:GR1)</b>	
63.0 mm	100
50.0 mm	100
37.5 mm	100
28.0 mm	100
20.0 mm	100
14.0 mm	98
5.0 mm	96
2.00 mm	94
0.425 mm	56
0.075 mm	33
<b>HYDROMETER ANALYSIS (% PASSING) (SANS 3001:GR3)</b>	
55 µm	23
32 µm	19
14 µm	10
6 µm	6
2 µm	4
% Clay	6
% Silt	17
% Sand	71
% Gravel	6
<b>ATTERBERG LIMITS (SANS 3001:GR10)</b>	
Liquid Limit	
Plasticity Index	NP
Linear Shrinkage (%)	0.0
Grading Modulus	1.17
Classification	A-2-4 (0)
Unified Classification	SM
Chart Reference	

PROJECT : ESSELEN PARK  
JOB No. : S18-2073  
DATE : 2018-11-05

### POTENTIAL EXPANSIVENESS



### PLASTICITY CHART





**Engineering Materials Laboratory**SMEC Building, 230 Albertus Street  
La Montagne, Pretoria, 0184Tel: (+27) (12) 813 4900  
Email: info@soillab.co.zaPO Box 72928, Lynnwood Ridge,  
South Africa, 0040

Client: GEOHAZARD SOLUTIONS

Project: ESSELEN PARK

Project No.: S18-2073

Date: 2018/11/07

**pH & CONDUCTIVITY - TMH 1 A20 & A21T**

Sample No	Sample Position	Depth (m)	pH	Electrical Conductivity S/m
S18-2073-06	TP 30	0.50-1.80	5.32	0.0038
S18-2073-09	TP 34	0.93-3.10	5.76	0.0056
S18-2073-13	TP 17	0.76-1.60	7.35	0.0038

Comments:

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Note: Items marked with a star (\*) is Not Accredited

Soillab is a SANAS accredited Testing Laboratory according to the Accreditation Scope

# Oedometer

## TMH 6 ST10

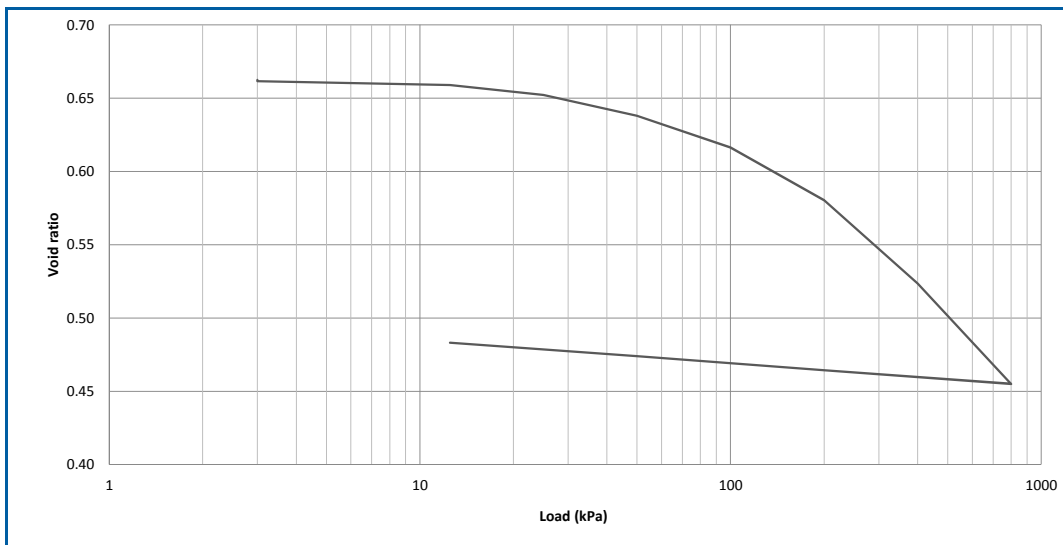
<b>Project:</b>	Esselen Park
<b>Client:</b>	Geohazard Solutions
<b>Geolab Job Nr:</b>	G18-237
<b>Test Method:</b>	TMH 6 ST10

<b>Sample Nr:</b>	TP11
<b>Sample Depth:</b>	2.45-3.80m
<b>Date:</b>	2018-11-08

Load kPa	Height mm	Void Ratio	$m_v$ MPa <sup>-1</sup>
3.0	20.110	0.662	
3.0	20.101	0.662	
12.5	20.069	0.659	0.168
25.0	19.986	0.652	0.331
50.0	19.814	0.638	0.344
100.0	19.552	0.616	0.264
200.0	19.116	0.580	0.223
400.0	18.43	0.524	0.179
800.0	17.601	0.455	0.112
200.0	17.713	0.464	
50.0	17.829	0.474	
12.5	17.942	0.483	

<b>Sampling Method:</b>	Block
<b>Disturbed/Undist:</b>	Undisturbed
<b>Remoulded To:</b>	-

	Initial	Final	
<b>Sample Height:</b>	20.11	17.94	mm
<b>Sample Mass:</b>	121.43	126.00	g
<b>Dry Density:</b>	1657	1857	kg/m <sup>3</sup>
<b>Density</b>	1898	2207	kg/m <sup>3</sup>
<b>Moisture Content:</b>	14.6	18.9	%
<b>Void Ratio:</b>	0.662	0.483	
<b>Specific Gravity:</b>	2.754		Mg/m <sup>3</sup>



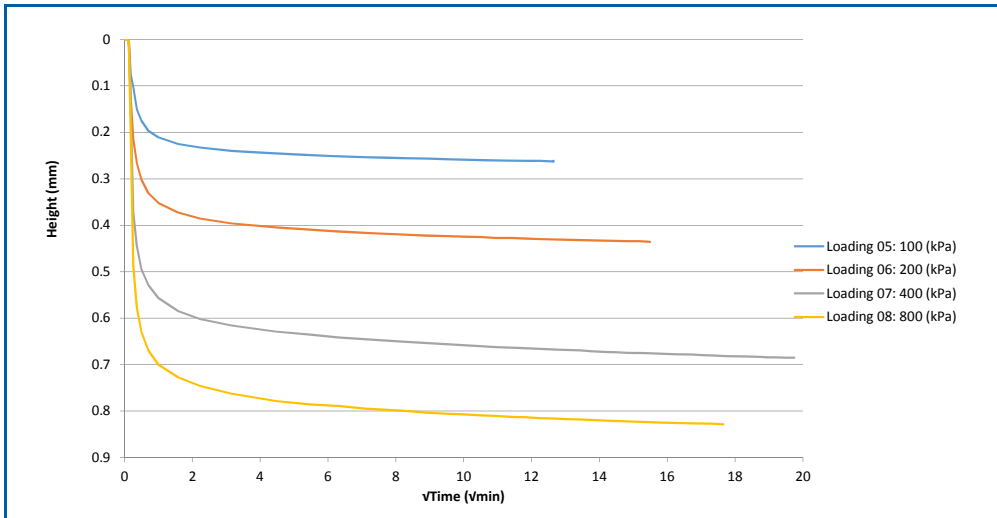
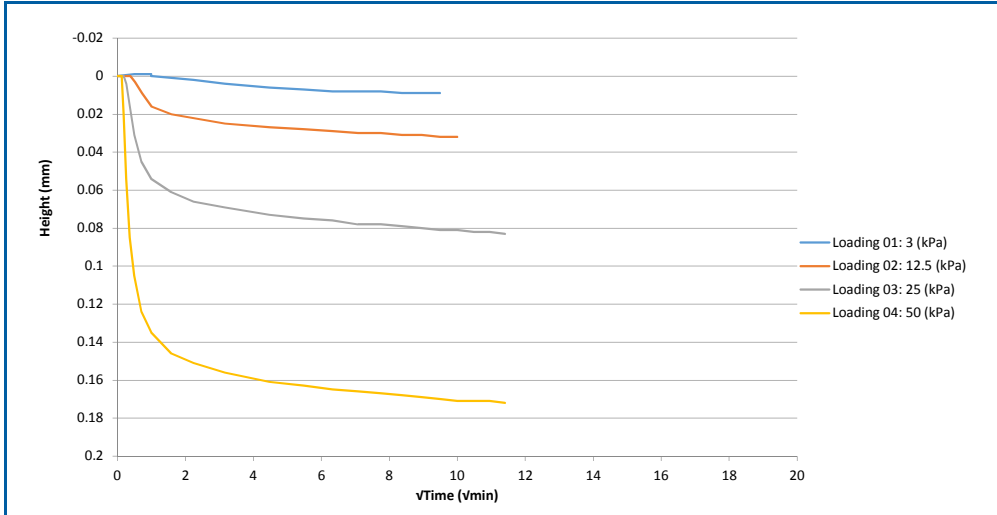
\* -  $m_v$  values provided are incremental and only valid for the specific load increment.

# Oedometer


## Time Readings

<b>Project:</b>	Esselen Park
<b>Client:</b>	Geohazard Solutions
<b>Geolab Job Nr:</b>	G18-237
<b>Test Method:</b>	TMH 6 ST10

<b>Sample Nr:</b>	TP11
<b>Sample Depth:</b>	2.45-3.80m
<b>Date:</b>	2018-11-08

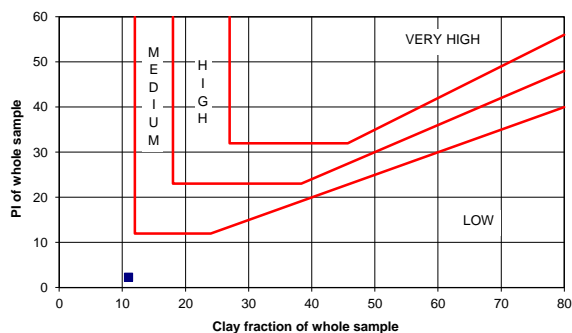


## PARTICLE SIZE ANALYSIS

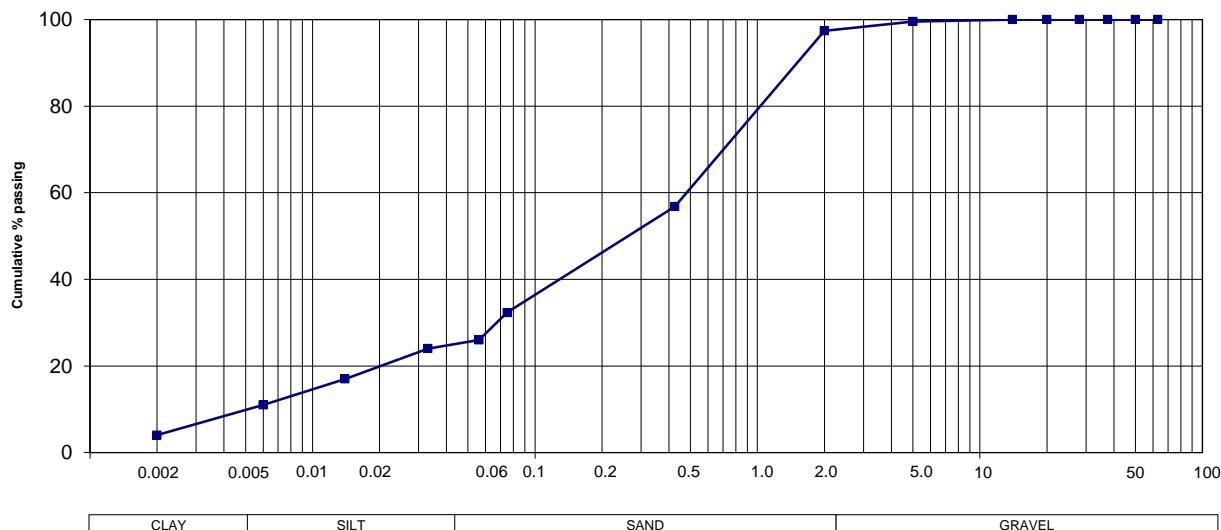
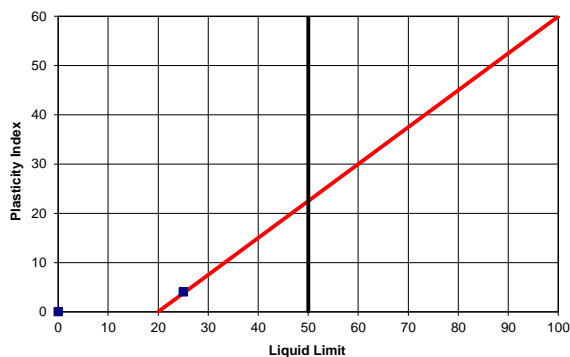
Sample No.	1								
Soillab Sample No.	S18-1898-01								
Depth (m)	2.3 - 5.55								
Position	TP 01								
Material Description	DARK YELLOW  SILTY SAND								
Relative density on < 2 mm (SANS 5844)	2.623								
Organic Material									
Moisture (%) / Dispersion (%)									
<b>SCREEN ANALYSIS (% PASSING) (SANS 3001:GR1)</b>									
63.0 mm	100								
50.0 mm	100								
37.5 mm	100								
28.0 mm	100								
20.0 mm	100								
14.0 mm	100								
5.0 mm	100								
2.00 mm	97								
0.425 mm	57								
0.075 mm	32								
<b>HYDROMETER ANALYSIS (% PASSING) (SANS 3001:GR3)</b>									
56 µm	26								
33 µm	24								
14 µm	17								
6 µm	11								
2 µm	4								
<table border="1" style="width: 100%;"> <tr> <td>% Clay</td> <td>11</td> </tr> <tr> <td>% Silt</td> <td>15</td> </tr> <tr> <td>% Sand</td> <td>71</td> </tr> <tr> <td>% Gravel</td> <td>3</td> </tr> </table>		% Clay	11	% Silt	15	% Sand	71	% Gravel	3
% Clay	11								
% Silt	15								
% Sand	71								
% Gravel	3								
<b>ATTERBERG LIMITS (SANS 3001:GR10)</b>									
Liquid Limit	25								
Plasticity Index	4								
Linear Shrinkage (%)	1.5								
Grading Modulus	1.13								
Classification	A-2-4 (0)								
Unified Classification	SM & SC								
Chart Reference									

PROJECT : ESSELEN PARK  
JOB No. : S18-1898  
DATE : 2018-10-09


### POTENTIAL EXPANSIVENESS



### PLASTICITY CHART

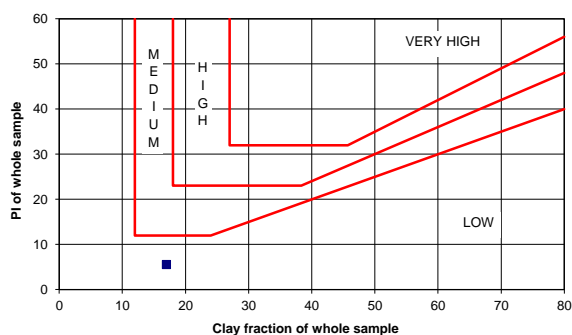


## PARTICLE SIZE ANALYSIS

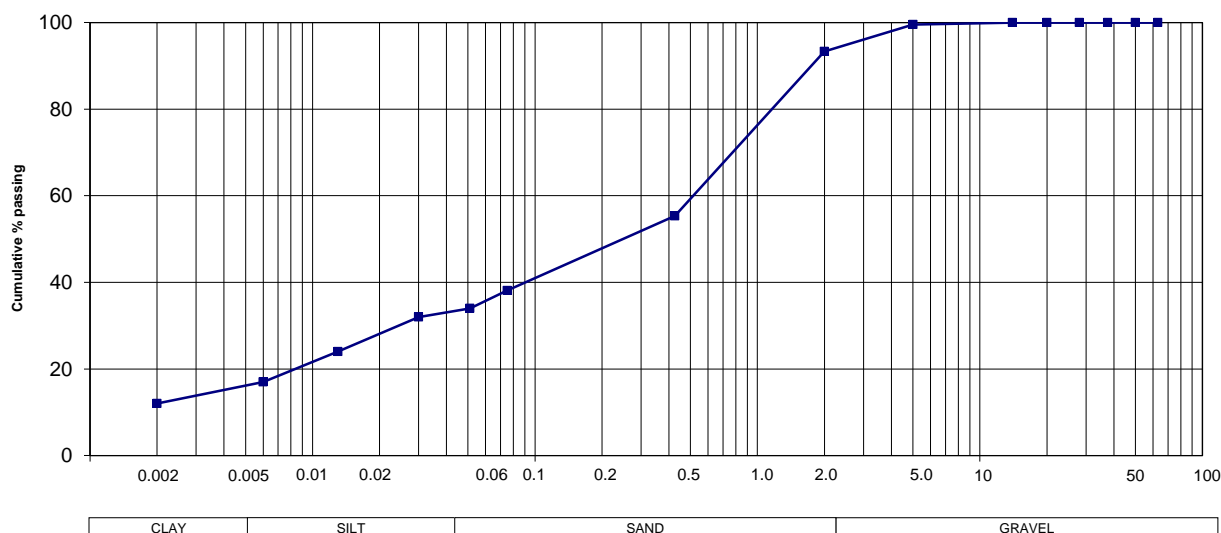
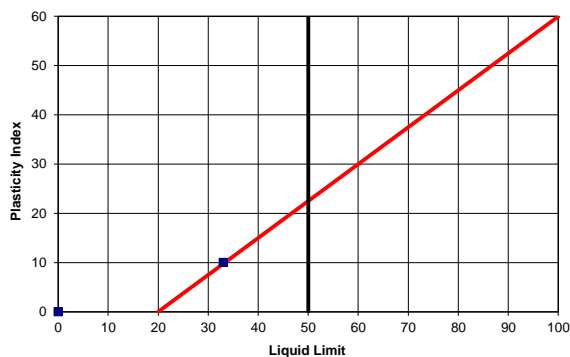
Sample No.	2
Soillab Sample No.	S18-1898-02
Depth (m)	1.60 - 4.50
Position	TP 03
Material Description	LIGHT REDDISH ORANGE CLAYEY SAND
Relative density on < 2 mm (SANS 5844)	2.702
Organic Material	
Moisture (%) / Dispersion (%)	
<b>SCREEN ANALYSIS (% PASSING) (SANS 3001:GR1)</b>	
63.0 mm	100
50.0 mm	100
37.5 mm	100
28.0 mm	100
20.0 mm	100
14.0 mm	100
5.0 mm	100
2.00 mm	93
0.425 mm	55
0.075 mm	38
<b>HYDROMETER ANALYSIS (% PASSING) (SANS 3001:GR3)</b>	
51 $\mu$ m	34
30 $\mu$ m	32
13 $\mu$ m	24
6 $\mu$ m	17
2 $\mu$ m	12
% Clay	17
% Silt	17
% Sand	59
% Gravel	7
<b>ATTERBERG LIMITS (SANS 3001:GR10)</b>	
Liquid Limit	33
Plasticity Index	10
Linear Shrinkage (%)	3.5
Grading Modulus	1.13
Classification	A-4 (0)
Unified Classification	SC
Chart Reference	

PROJECT : ESSELEN PARK  
JOB No. : S18-1898  
DATE : 2018-10-09


### POTENTIAL EXPANSIVENESS



### PLASTICITY CHART

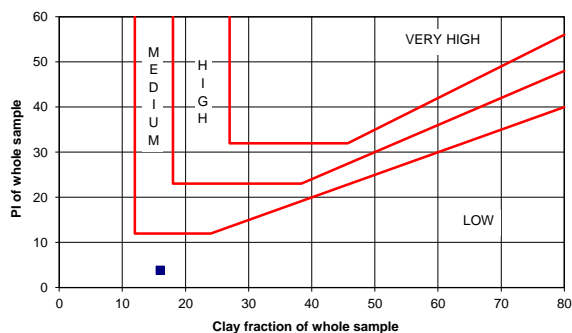


## PARTICLE SIZE ANALYSIS

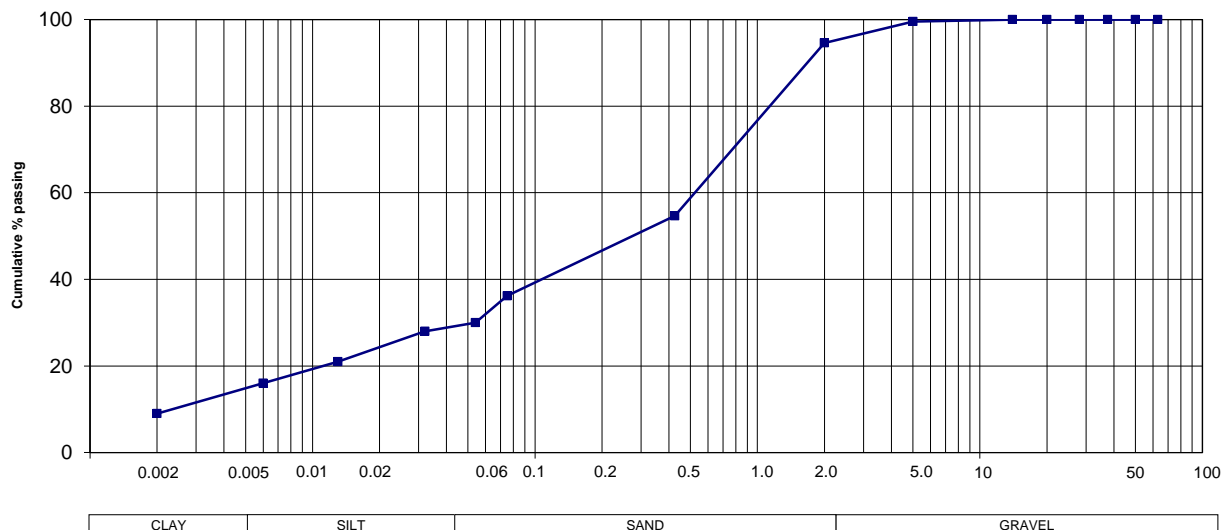
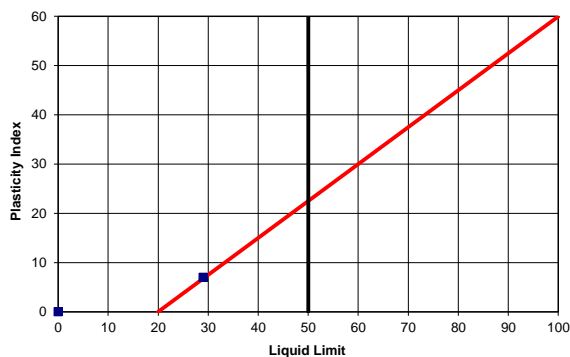
Sample No.	3								
Soillab Sample No.	S18-1898-03								
Depth (m)	4.50 - 5.80								
Position	TP 03								
Material Description	LIGHT REDDISH ORANGE CLAYEY SAND								
Relative density on < 2 mm (SANS 5844)	2.637								
Organic Material									
Moisture (%) / Dispersion (%)									
<b>SCREEN ANALYSIS (% PASSING) (SANS 3001:GR1)</b>									
63.0 mm	100								
50.0 mm	100								
37.5 mm	100								
28.0 mm	100								
20.0 mm	100								
14.0 mm	100								
5.0 mm	100								
2.00 mm	95								
0.425 mm	55								
0.075 mm	36								
<b>HYDROMETER ANALYSIS (% PASSING) (SANS 3001:GR3)</b>									
54 µm	30								
32 µm	28								
13 µm	21								
6 µm	16								
2 µm	9								
<table border="1" style="width: 100%;"> <tr> <td>% Clay</td> <td>16</td> </tr> <tr> <td>% Silt</td> <td>14</td> </tr> <tr> <td>% Sand</td> <td>65</td> </tr> <tr> <td>% Gravel</td> <td>5</td> </tr> </table>		% Clay	16	% Silt	14	% Sand	65	% Gravel	5
% Clay	16								
% Silt	14								
% Sand	65								
% Gravel	5								
<b>ATTERBERG LIMITS (SANS 3001:GR10)</b>									
Liquid Limit	29								
Plasticity Index	7								
Linear Shrinkage (%)	2.0								
Grading Modulus	1.15								
Classification	A-4 (0)								
Unified Classification	SM & SC								
Chart Reference									

PROJECT : ESSELEN PARK  
JOB No. : S18-1898  
DATE : 2018-10-09


### POTENTIAL EXPANSIVENESS



### PLASTICITY CHART

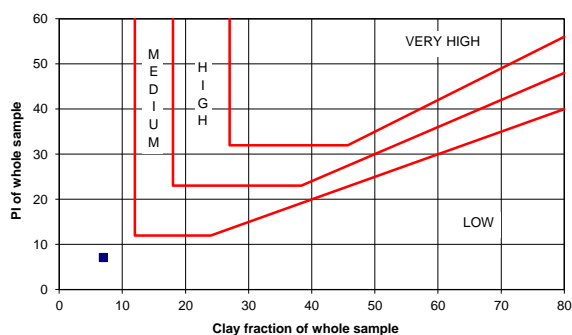


## PARTICLE SIZE ANALYSIS

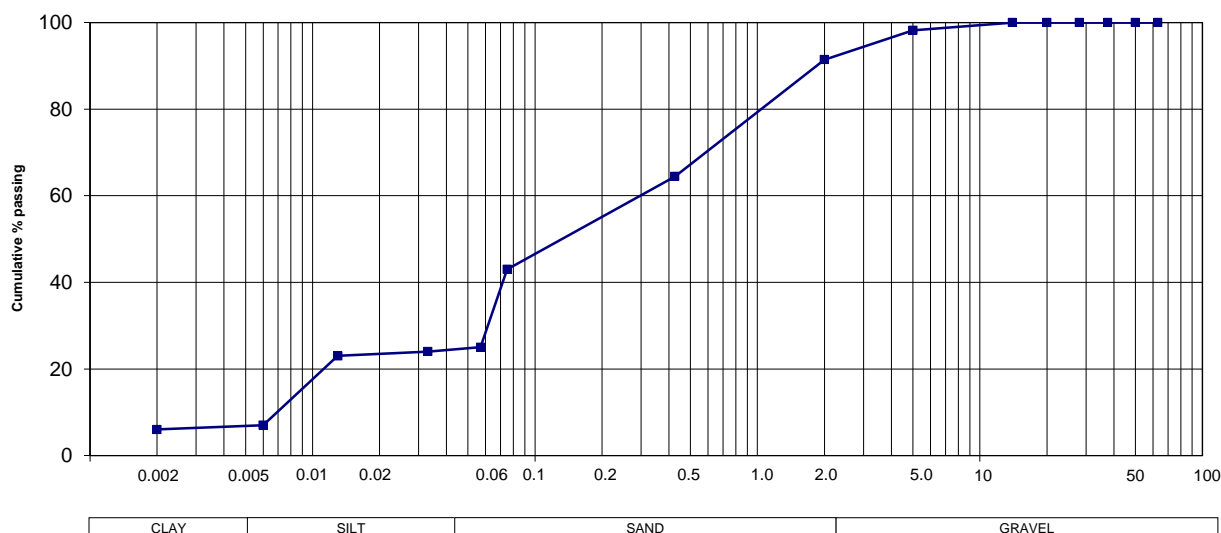
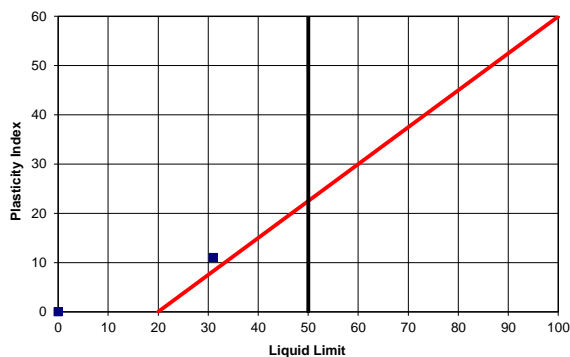
Sample No.	4
Soillab Sample No.	S18-1898-04
Depth (m)	1.80 - 2.80
Position	TP 07
Material Description	DUSKY RED FERRICRETE SILTY SAND
Relative density on < 2 mm (SANS 5844)	2.651
Organic Material	
Moisture (%) / Dispersion (%)	
<b>SCREEN ANALYSIS (% PASSING) (SANS 3001:GR1)</b>	
63.0 mm	100
50.0 mm	100
37.5 mm	100
28.0 mm	100
20.0 mm	100
14.0 mm	100
5.0 mm	98
2.00 mm	91
0.425 mm	64
0.075 mm	43
<b>HYDROMETER ANALYSIS (% PASSING) (SANS 3001:GR3)</b>	
57 µm	25
33 µm	24
13 µm	23
6 µm	7
2 µm	6
% Clay	7
% Silt	18
% Sand	66
% Gravel	9
<b>ATTERBERG LIMITS (SANS 3001:GR10)</b>	
Liquid Limit	31
Plasticity Index	11
Linear Shrinkage (%)	4.5
Grading Modulus	1.01
Classification	A-6 (2)
Unified Classification	SC
Chart Reference	

PROJECT : ESSELEN PARK  
JOB No. : S18-1898  
DATE : 2018-10-09


### POTENTIAL EXPANSIVENESS



### PLASTICITY CHART

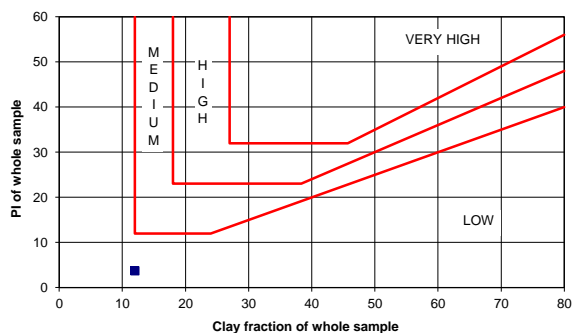


## PARTICLE SIZE ANALYSIS

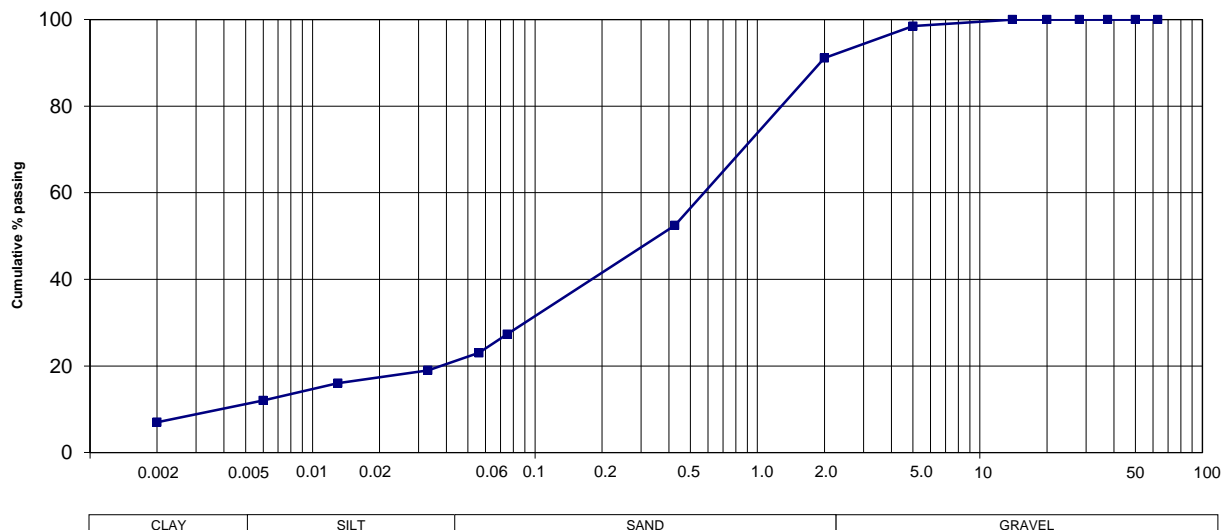
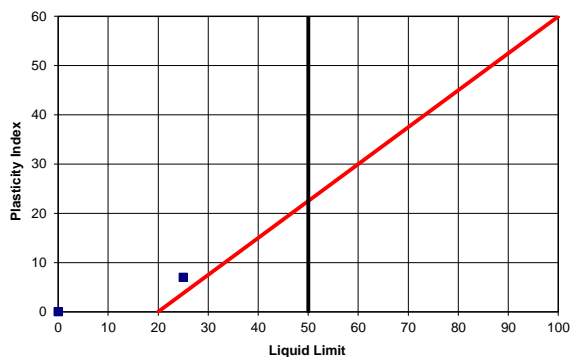
Sample No.	5								
Soillab Sample No.	S18-1898-05								
Depth (m)	2.80 - 4.50								
Position	TP 07								
Material Description	LIGHT REDDISH ORANGE FERRICRETE CLAYEY SAND								
Relative density on < 2 mm (SANS 5844)	2.651								
Organic Material									
Moisture (%) / Dispersion (%)									
<b>SCREEN ANALYSIS (% PASSING) (SANS 3001:GR1)</b>									
63.0 mm	100								
50.0 mm	100								
37.5 mm	100								
28.0 mm	100								
20.0 mm	100								
14.0 mm	100								
5.0 mm	98								
2.00 mm	91								
0.425 mm	52								
0.075 mm	27								
<b>HYDROMETER ANALYSIS (% PASSING) (SANS 3001:GR3)</b>									
56 µm	23								
33 µm	19								
13 µm	16								
6 µm	12								
2 µm	7								
<table border="1" style="width: 100%;"> <tr> <td>% Clay</td> <td>12</td> </tr> <tr> <td>% Silt</td> <td>11</td> </tr> <tr> <td>% Sand</td> <td>68</td> </tr> <tr> <td>% Gravel</td> <td>9</td> </tr> </table>		% Clay	12	% Silt	11	% Sand	68	% Gravel	9
% Clay	12								
% Silt	11								
% Sand	68								
% Gravel	9								
<b>ATTERBERG LIMITS (SANS 3001:GR10)</b>									
Liquid Limit	25								
Plasticity Index	7								
Linear Shrinkage (%)	2.0								
Grading Modulus	1.29								
Classification	A-2-4 (0)								
Unified Classification	SM & SC								
Chart Reference									

PROJECT : ESSELEN PARK  
JOB No. : S18-1898  
DATE : 2018-10-09

### POTENTIAL EXPANSIVENESS




### PLASTICITY CHART



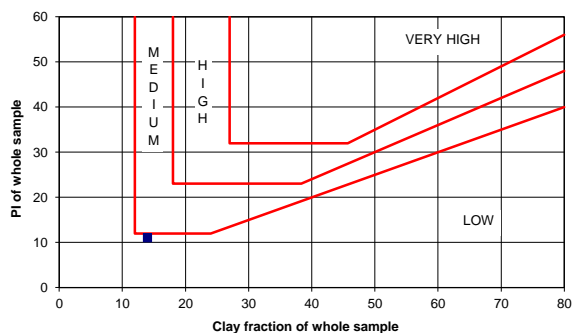


## PARTICLE SIZE ANALYSIS

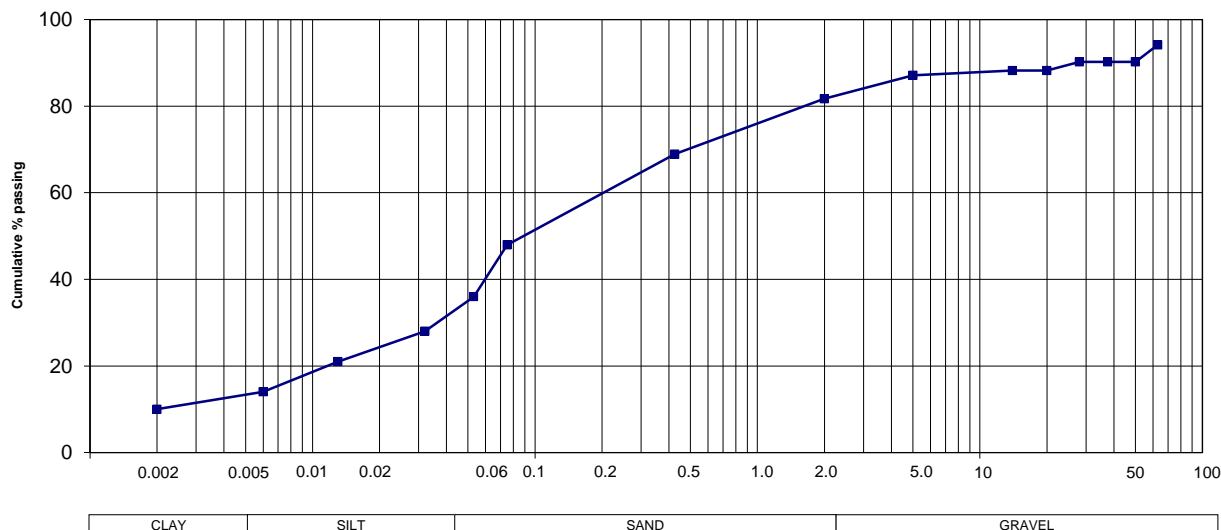
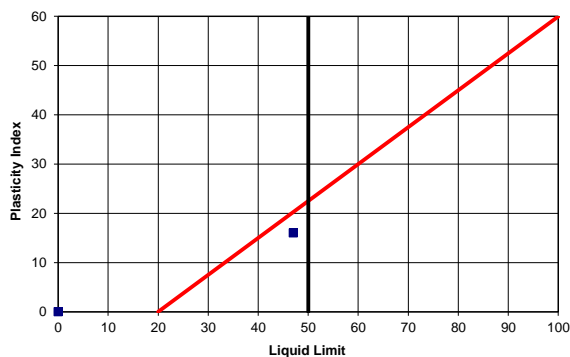
Sample No.	6								
Soillab Sample No.	S18-1898-06								
Depth (m)	2.60 - 5.50								
Position	TP 08								
Material Description	LIGHT RED FERRICRETE SILTY SAND								
Relative density on < 2 mm (SANS 5844)	2.702								
Organic Material									
Moisture (%) / Dispersion (%)									
<b>SCREEN ANALYSIS (% PASSING) (SANS 3001:GR1)</b>									
63.0 mm	94								
50.0 mm	90								
37.5 mm	90								
28.0 mm	90								
20.0 mm	88								
14.0 mm	88								
5.0 mm	87								
2.00 mm	82								
0.425 mm	69								
0.075 mm	48								
<b>HYDROMETER ANALYSIS (% PASSING) (SANS 3001:GR3)</b>									
53 µm	36								
32 µm	28								
13 µm	21								
6 µm	14								
2 µm	10								
<table border="1" style="width: 100%;"> <tr> <td>% Clay</td> <td>14</td> </tr> <tr> <td>% Silt</td> <td>22</td> </tr> <tr> <td>% Sand</td> <td>46</td> </tr> <tr> <td>% Gravel</td> <td>18</td> </tr> </table>		% Clay	14	% Silt	22	% Sand	46	% Gravel	18
% Clay	14								
% Silt	22								
% Sand	46								
% Gravel	18								
<b>ATTERBERG LIMITS (SANS 3001:GR10)</b>									
Liquid Limit	47								
Plasticity Index	16								
Linear Shrinkage (%)	6.0								
Grading Modulus	1.01								
Classification	A-7-5 (5)								
Unified Classification	SM								
Chart Reference									

PROJECT : ESSELEN PARK  
JOB No. : S18-1898  
DATE : 2018-10-09

### POTENTIAL EXPANSIVENESS



### PLASTICITY CHART

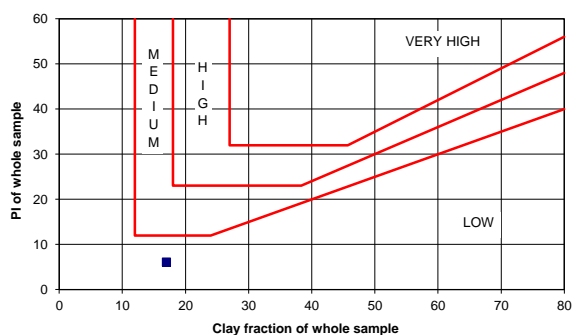


## PARTICLE SIZE ANALYSIS

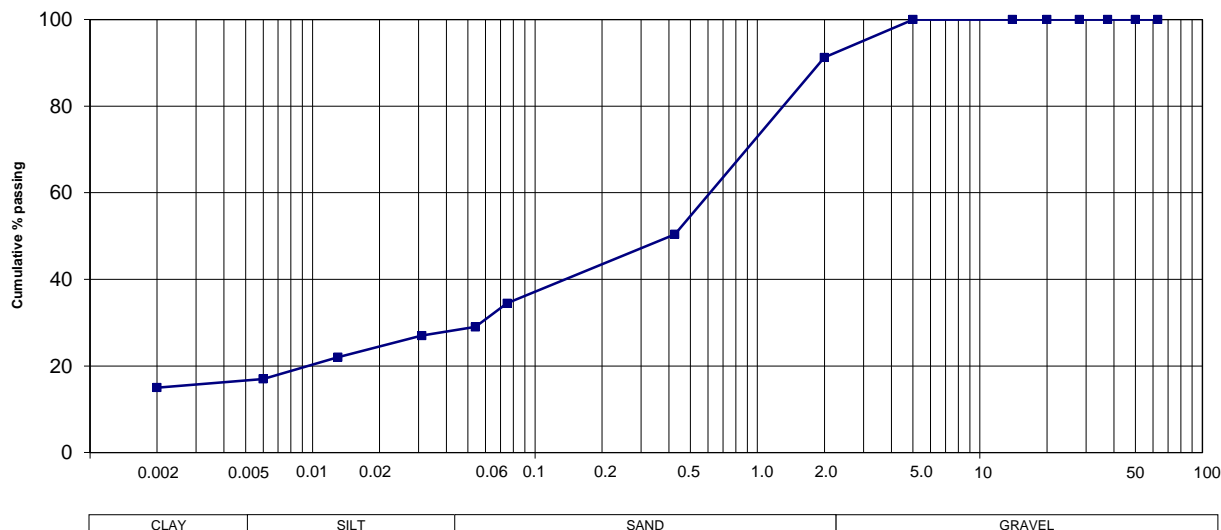
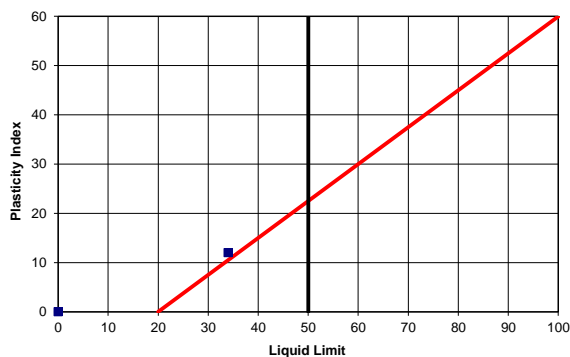
Sample No.	11								
Soillab Sample No.	S18-2073-11								
Depth (m)	1.90 - 5.50								
Position	TP 10								
Material Description	LIGHT REDDISH ORANGE CLAYEY SAND								
Relative density on < 2 mm (SANS 5844)	2.65								
Organic Material									
Moisture (%) / Dispersion (%)									
<b>SCREEN ANALYSIS (% PASSING) (SANS 3001:GR1)</b>									
63.0 mm	100								
50.0 mm	100								
37.5 mm	100								
28.0 mm	100								
20.0 mm	100								
14.0 mm	100								
5.0 mm	100								
2.00 mm	91								
0.425 mm	50								
0.075 mm	34								
<b>HYDROMETER ANALYSIS (% PASSING) (SANS 3001:GR3)</b>									
54 µm	29								
31 µm	27								
13 µm	22								
6 µm	17								
2 µm	15								
<table border="1" style="width: 100%;"> <tr> <td>% Clay</td> <td>17</td> </tr> <tr> <td>% Silt</td> <td>12</td> </tr> <tr> <td>% Sand</td> <td>62</td> </tr> <tr> <td>% Gravel</td> <td>9</td> </tr> </table>		% Clay	17	% Silt	12	% Sand	62	% Gravel	9
% Clay	17								
% Silt	12								
% Sand	62								
% Gravel	9								
<b>ATTERBERG LIMITS (SANS 3001:GR10)</b>									
Liquid Limit	34								
Plasticity Index	12								
Linear Shrinkage (%)	6.0								
Grading Modulus	1.24								
Classification	A-2-6 (0)								
Unified Classification	SC								
Chart Reference									

PROJECT : ESSELEN PARK  
JOB No. : S18-2073  
DATE : 2018-11-05

### POTENTIAL EXPANSIVENESS



### PLASTICITY CHART

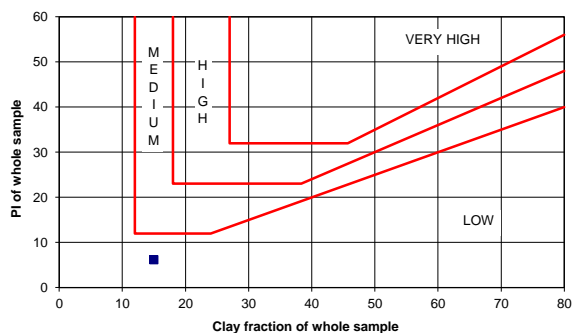


## PARTICLE SIZE ANALYSIS

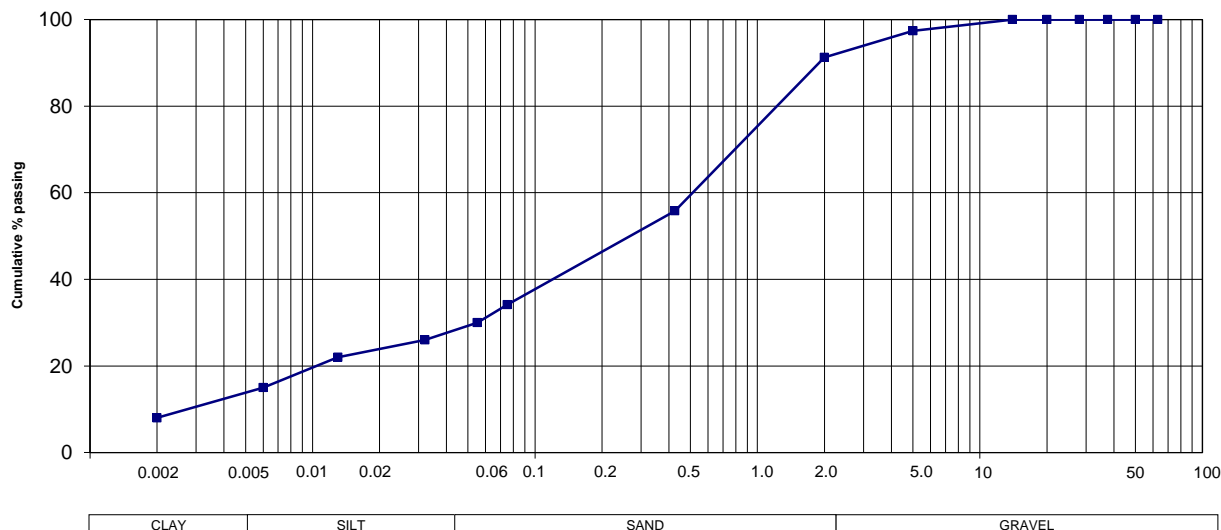
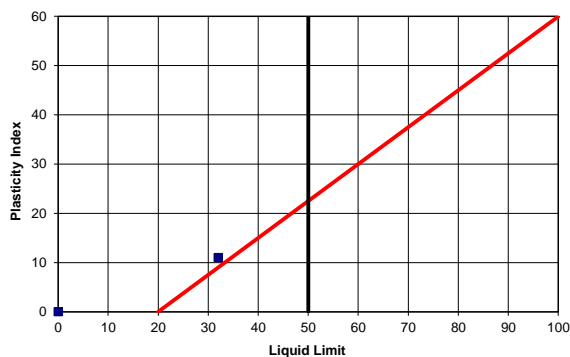
Sample No.	1								
Soillab Sample No.	S18-2073-01								
Depth (m)	2.45 - 3.80								
Position	TP 11								
Material Description	LIGHT REDDISH ORANGE CLAYEY SAND								
Relative density on < 2 mm (SANS 5844)	2.65								
Organic Material									
Moisture (%) / Dispersion (%)									
<b>SCREEN ANALYSIS (% PASSING) (SANS 3001:GR1)</b>									
63.0 mm	100								
50.0 mm	100								
37.5 mm	100								
28.0 mm	100								
20.0 mm	100								
14.0 mm	100								
5.0 mm	97								
2.00 mm	91								
0.425 mm	56								
0.075 mm	34								
<b>HYDROMETER ANALYSIS (% PASSING) (SANS 3001:GR3)</b>									
55 µm	30								
32 µm	26								
13 µm	22								
6 µm	15								
2 µm	8								
<table border="1" style="width: 100%;"> <tr> <td>% Clay</td> <td>15</td> </tr> <tr> <td>% Silt</td> <td>15</td> </tr> <tr> <td>% Sand</td> <td>61</td> </tr> <tr> <td>% Gravel</td> <td>9</td> </tr> </table>		% Clay	15	% Silt	15	% Sand	61	% Gravel	9
% Clay	15								
% Silt	15								
% Sand	61								
% Gravel	9								
<b>ATTERBERG LIMITS (SANS 3001:GR10)</b>									
Liquid Limit	32								
Plasticity Index	11								
Linear Shrinkage (%)	4.0								
Grading Modulus	1.19								
Classification	A-2-6 (0)								
Unified Classification	SC								
Chart Reference									

PROJECT : ESSELEN PARK  
JOB No. : S18-2073  
DATE : 2018-11-05

### POTENTIAL EXPANSIVENESS



### PLASTICITY CHART

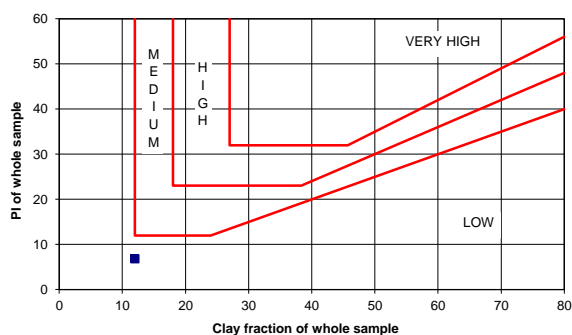


## PARTICLE SIZE ANALYSIS

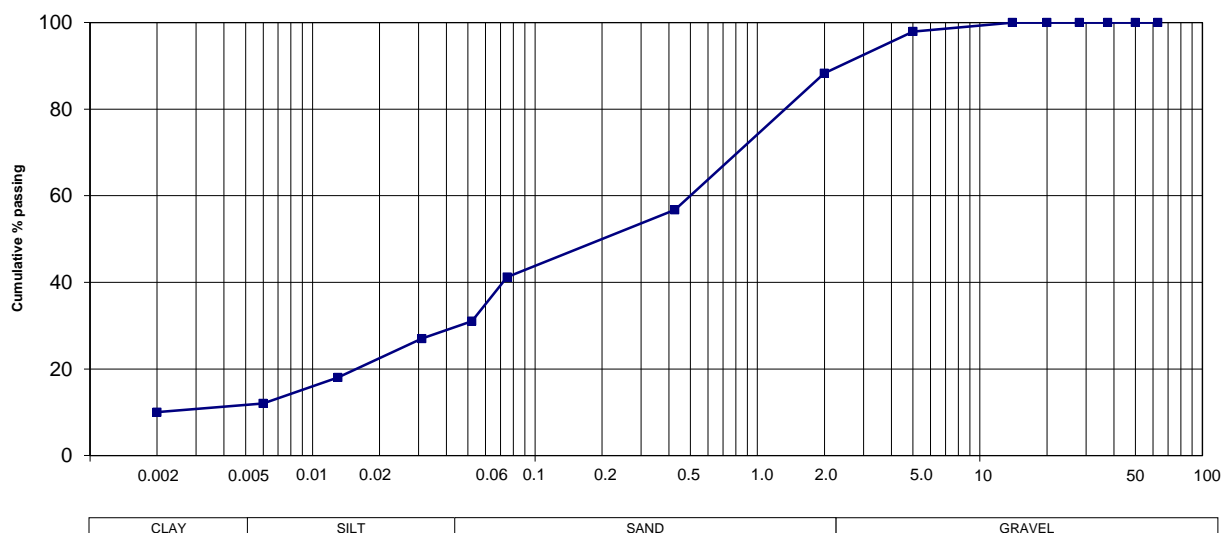
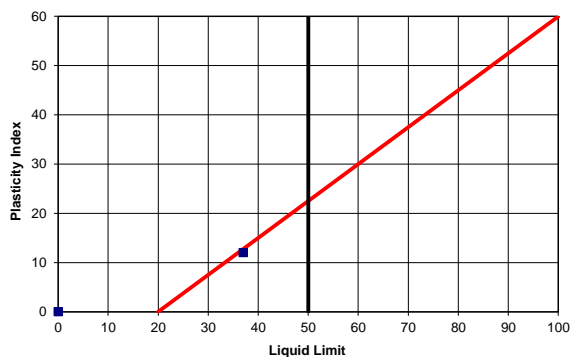
Sample No.	12								
Soillab Sample No.	S18-2073-12								
Depth (m)	1.50 - 2.90								
Position	TP 13								
Material Description	DUSKY RED FERRICRETE SILTY SAND								
Relative density on < 2 mm (SANS 5844)	2.65								
Organic Material									
Moisture (%) / Dispersion (%)									
<b>SCREEN ANALYSIS (% PASSING) (SANS 3001:GR1)</b>									
63.0 mm	100								
50.0 mm	100								
37.5 mm	100								
28.0 mm	100								
20.0 mm	100								
14.0 mm	100								
5.0 mm	98								
2.00 mm	88								
0.425 mm	57								
0.075 mm	41								
<b>HYDROMETER ANALYSIS (% PASSING) (SANS 3001:GR3)</b>									
52 µm	31								
31 µm	27								
13 µm	18								
6 µm	12								
2 µm	10								
<table border="1" style="width: 100%;"> <tr> <td>% Clay</td> <td>12</td> </tr> <tr> <td>% Silt</td> <td>19</td> </tr> <tr> <td>% Sand</td> <td>57</td> </tr> <tr> <td>% Gravel</td> <td>12</td> </tr> </table>		% Clay	12	% Silt	19	% Sand	57	% Gravel	12
% Clay	12								
% Silt	19								
% Sand	57								
% Gravel	12								
<b>ATTERBERG LIMITS (SANS 3001:GR10)</b>									
Liquid Limit	37								
Plasticity Index	12								
Linear Shrinkage (%)	5.5								
Grading Modulus	1.14								
Classification	A-6 (2)								
Unified Classification	SM								
Chart Reference									

PROJECT : ESSELEN PARK  
JOB No. : S18-2073  
DATE : 2018-11-05


### POTENTIAL EXPANSIVENESS



### PLASTICITY CHART

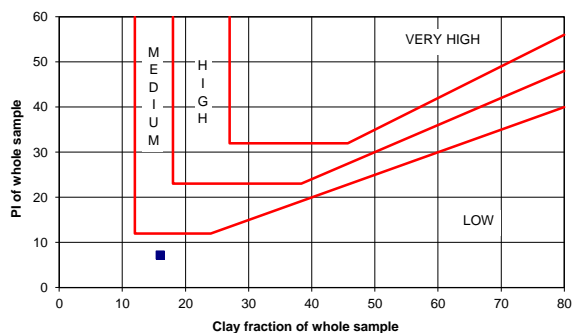


## PARTICLE SIZE ANALYSIS

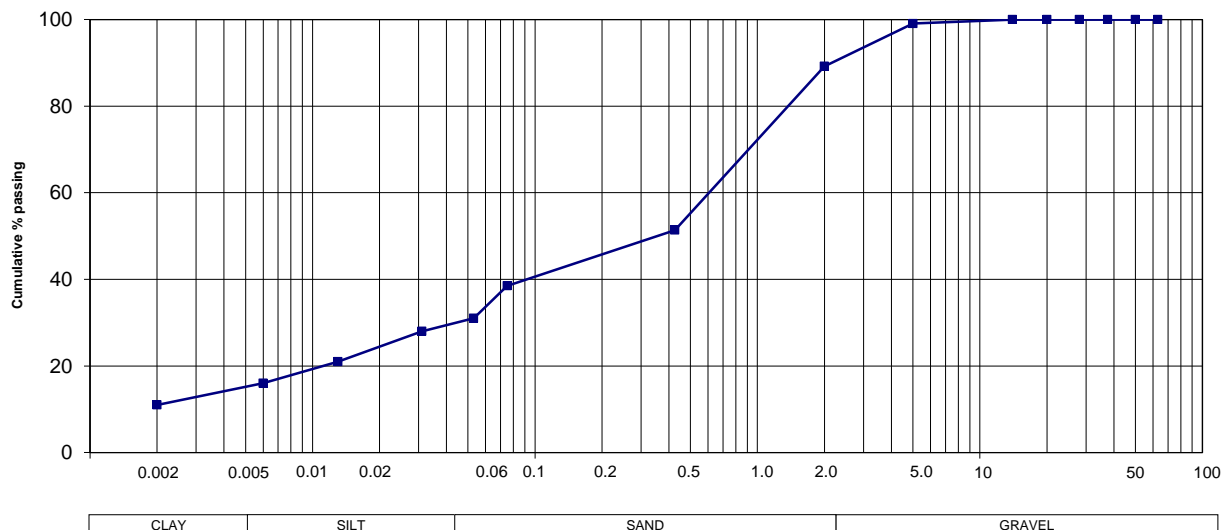
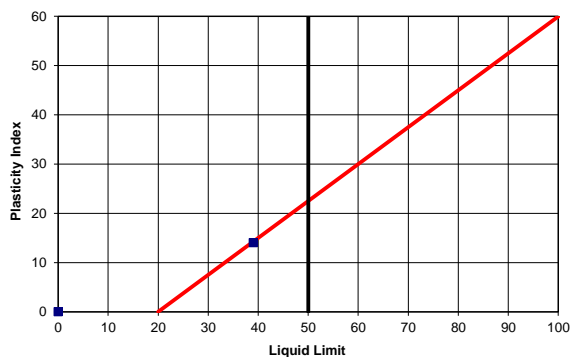
Sample No.	2								
Soillab Sample No.	S18-2073-02								
Depth (m)	1.90 - 3.30								
Position	TP 13								
Material Description	LIGHT REDDISH ORANGE CLAYEY SAND								
Relative density on < 2 mm (SANS 5844)	2.65								
Organic Material									
Moisture (%) / Dispersion (%)									
<b>SCREEN ANALYSIS (% PASSING) (SANS 3001:GR1)</b>									
63.0 mm	100								
50.0 mm	100								
37.5 mm	100								
28.0 mm	100								
20.0 mm	100								
14.0 mm	100								
5.0 mm	99								
2.00 mm	89								
0.425 mm	51								
0.075 mm	39								
<b>HYDROMETER ANALYSIS (% PASSING) (SANS 3001:GR3)</b>									
53 µm	31								
31 µm	28								
13 µm	21								
6 µm	16								
2 µm	11								
<table border="1" style="width: 100%;"> <tr> <td>% Clay</td> <td>16</td> </tr> <tr> <td>% Silt</td> <td>15</td> </tr> <tr> <td>% Sand</td> <td>58</td> </tr> <tr> <td>% Gravel</td> <td>11</td> </tr> </table>		% Clay	16	% Silt	15	% Sand	58	% Gravel	11
% Clay	16								
% Silt	15								
% Sand	58								
% Gravel	11								
<b>ATTERBERG LIMITS (SANS 3001:GR10)</b>									
Liquid Limit	39								
Plasticity Index	14								
Linear Shrinkage (%)	7.0								
Grading Modulus	1.21								
Classification	A-6 (2)								
Unified Classification	SC								
Chart Reference									

PROJECT : ESSELEN PARK  
JOB No. : S18-2073  
DATE : 2018-11-05


### POTENTIAL EXPANSIVENESS



### PLASTICITY CHART

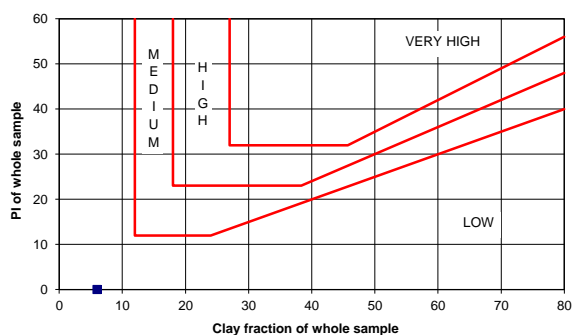


## PARTICLE SIZE ANALYSIS

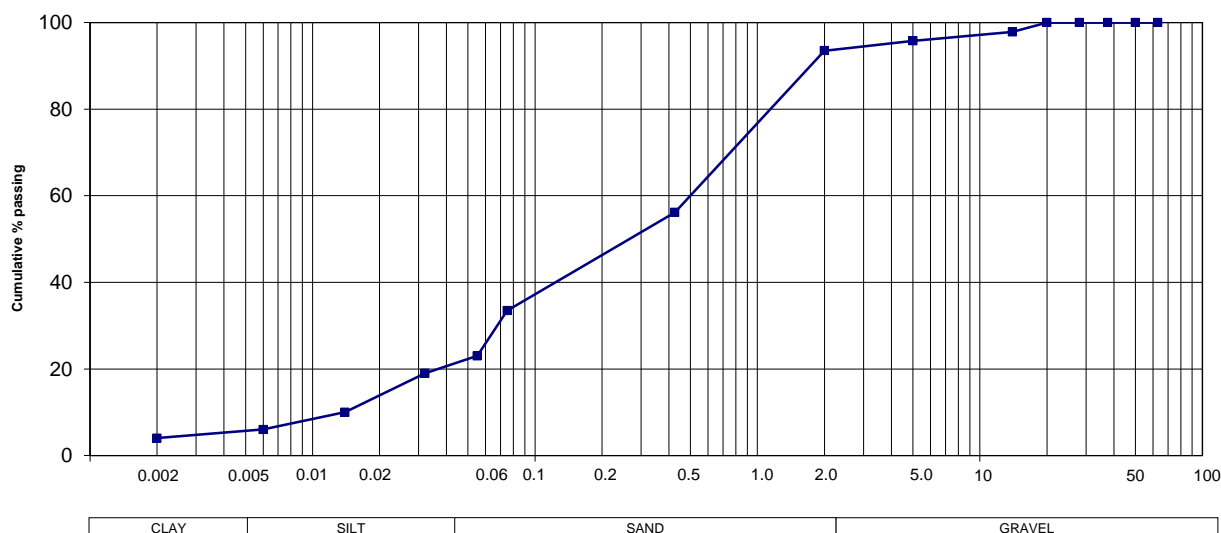
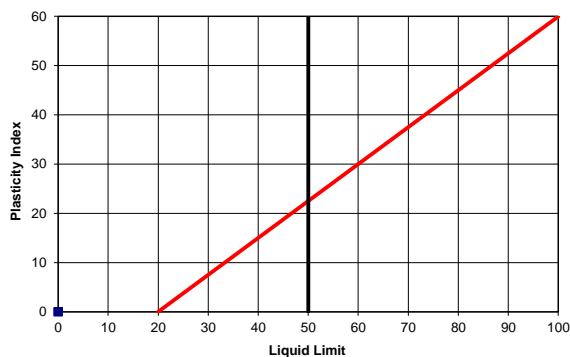
Sample No.	13
Soillab Sample No.	S18-2073-13
Depth (m)	0.76 - 1.60
Position	TP 17
Material Description	LIGHT OLIVE  SILTY SAND
Relative density on < 2 mm (SANS 5844)	2.65
Organic Material	
Moisture (%) / Dispersion (%)	
<b>SCREEN ANALYSIS (% PASSING) (SANS 3001:GR1)</b>	
63.0 mm	100
50.0 mm	100
37.5 mm	100
28.0 mm	100
20.0 mm	100
14.0 mm	98
5.0 mm	96
2.00 mm	94
0.425 mm	56
0.075 mm	33
<b>HYDROMETER ANALYSIS (% PASSING) (SANS 3001:GR3)</b>	
55 µm	23
32 µm	19
14 µm	10
6 µm	6
2 µm	4
% Clay	6
% Silt	17
% Sand	71
% Gravel	6
<b>ATTERBERG LIMITS (SANS 3001:GR10)</b>	
Liquid Limit	
Plasticity Index	NP
Linear Shrinkage (%)	0.0
Grading Modulus	1.17
Classification	A-2-4 (0)
Unified Classification	SM
Chart Reference	

PROJECT : ESSELEN PARK  
JOB No. : S18-2073  
DATE : 2018-11-05

### POTENTIAL EXPANSIVENESS



### PLASTICITY CHART

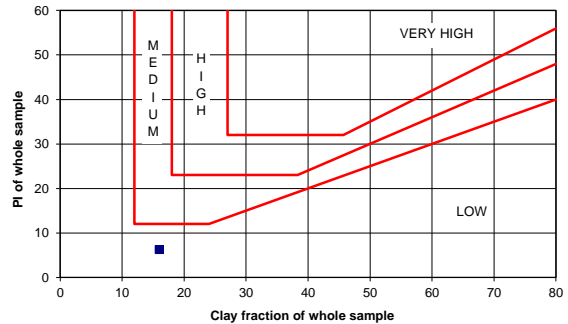


## PARTICLE SIZE ANALYSIS

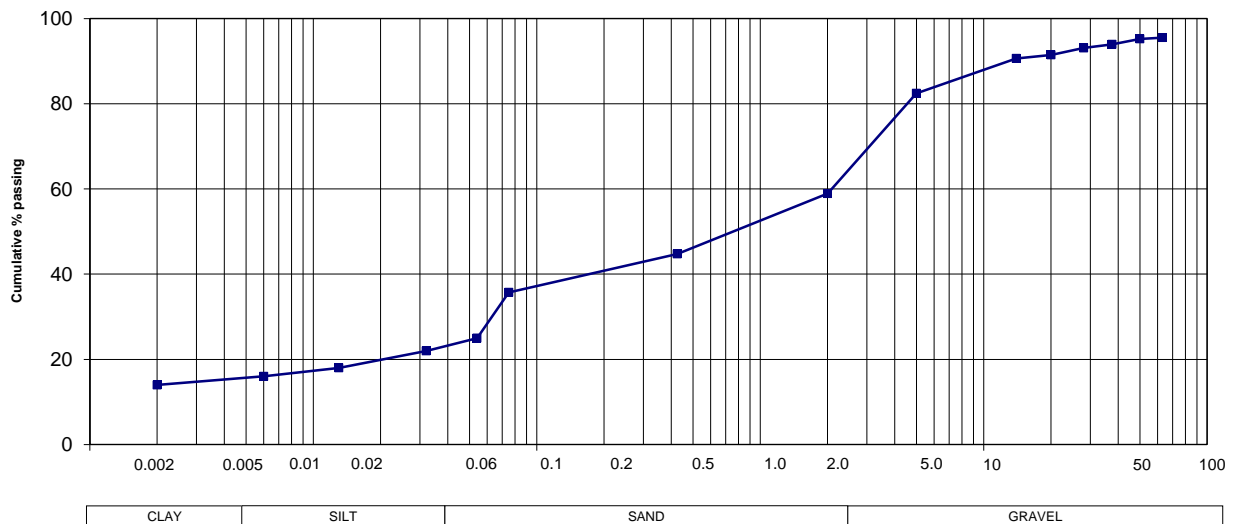
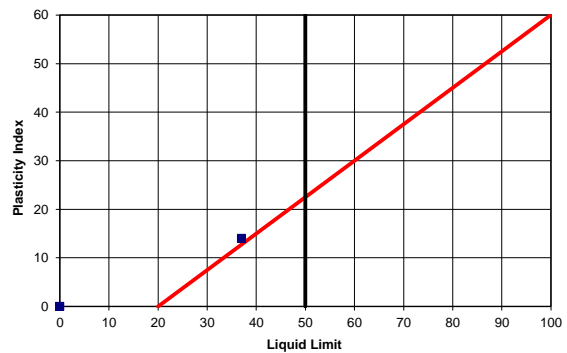
Sample No.	3
Soillab Sample No.	S18-2073-03
Depth (m)	1.00 - 2.10
Position	TP 18
Material Description	DUSKY RED QUARTZITE & FERRICRETE SANDY GRAVEL
Relative density on < 2 mm (SANS 5844)	2.65
Organic Material	
Moisture (%) / Dispersion (%)	
<b>SCREEN ANALYSIS (% PASSING) (SANS 3001:GR1)</b>	
63.0 mm	96
50.0 mm	95
37.5 mm	94
28.0 mm	93
20.0 mm	91
14.0 mm	91
5.0 mm	82
2.00 mm	59
0.425 mm	45
0.075 mm	36
<b>HYDROMETER ANALYSIS (% PASSING) (SANS 3001:GR3)</b>	
54 µm	25
32 µm	22
13 µm	18
6 µm	16
2 µm	14
% Clay	16
% Silt	9
% Sand	34
% Gravel	41
<b>ATTERBERG LIMITS (SANS 3001:GR10)</b>	
Liquid Limit	37
Plasticity Index	14
Linear Shrinkage (%)	7.0
Grading Modulus	1.61
Classification	A-6 (1)
Unified Classification	SC
Chart Reference	

PROJECT : ESSELEN PARK  
 JOB No. : S18-2073  
 DATE : 2018-11-05


### POTENTIAL EXPANSIVENESS



### PLASTICITY CHART

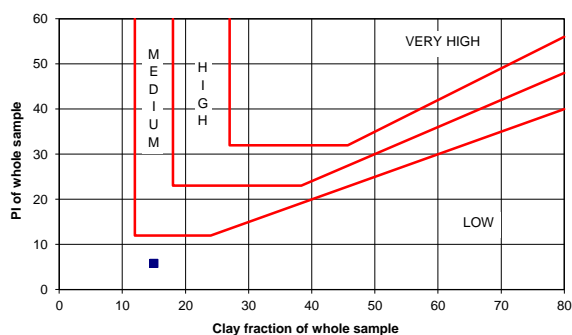


## PARTICLE SIZE ANALYSIS

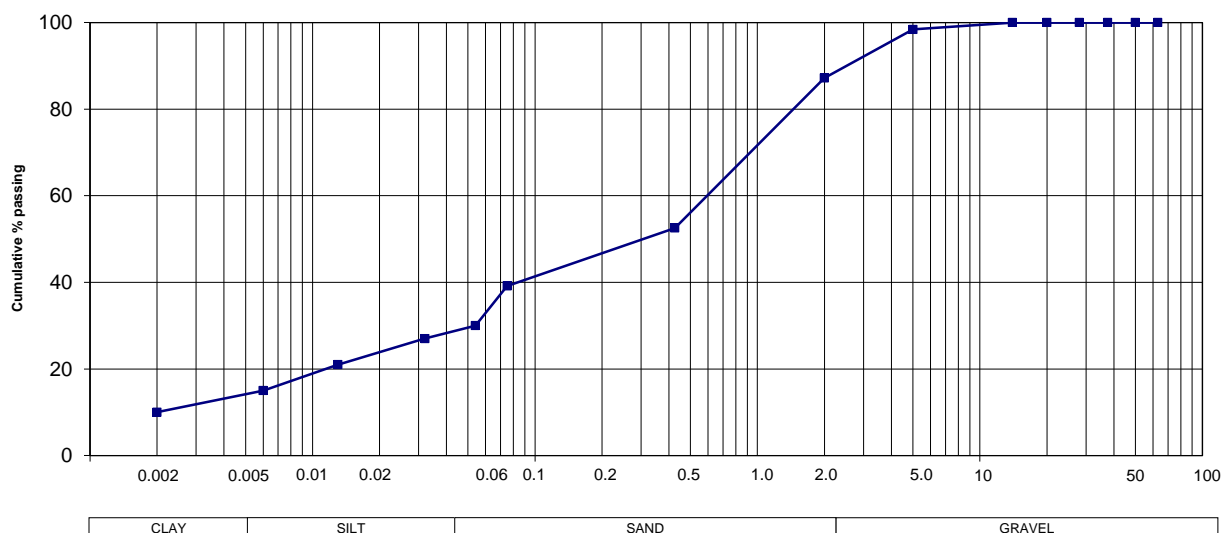
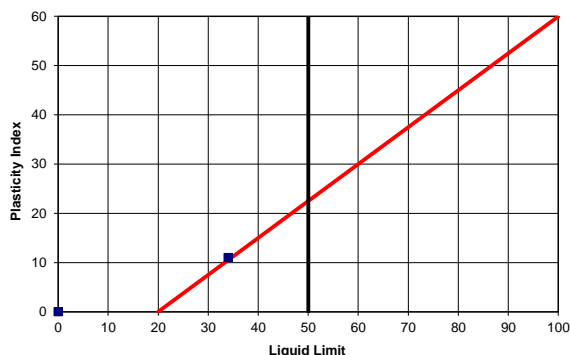
Sample No.	4
Soillab Sample No.	S18-2073-04
Depth (m)	3.40 - 4.70
Position	TP 20
Material Description	LIGHT REDDISH ORANGE FERRICRETE CLAYEY SAND
Relative density on < 2 mm (SANS 5844)	2.65
Organic Material	
Moisture (%) / Dispersion (%)	
<b>SCREEN ANALYSIS (% PASSING) (SANS 3001:GR1)</b>	
63.0 mm	100
50.0 mm	100
37.5 mm	100
28.0 mm	100
20.0 mm	100
14.0 mm	100
5.0 mm	98
2.00 mm	87
0.425 mm	53
0.075 mm	39
<b>HYDROMETER ANALYSIS (% PASSING) (SANS 3001:GR3)</b>	
54 µm	30
32 µm	27
13 µm	21
6 µm	15
2 µm	10
% Clay	15
% Silt	15
% Sand	57
% Gravel	13
<b>ATTERBERG LIMITS (SANS 3001:GR10)</b>	
Liquid Limit	34
Plasticity Index	11
Linear Shrinkage (%)	5.0
Grading Modulus	1.21
Classification	A-6 (1)
Unified Classification	SC
Chart Reference	

PROJECT : ESSELEN PARK  
JOB No. : S18-2073  
DATE : 2018-11-05

### POTENTIAL EXPANSIVENESS



### PLASTICITY CHART



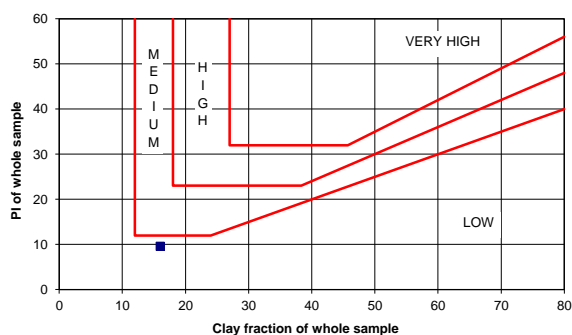


## PARTICLE SIZE ANALYSIS

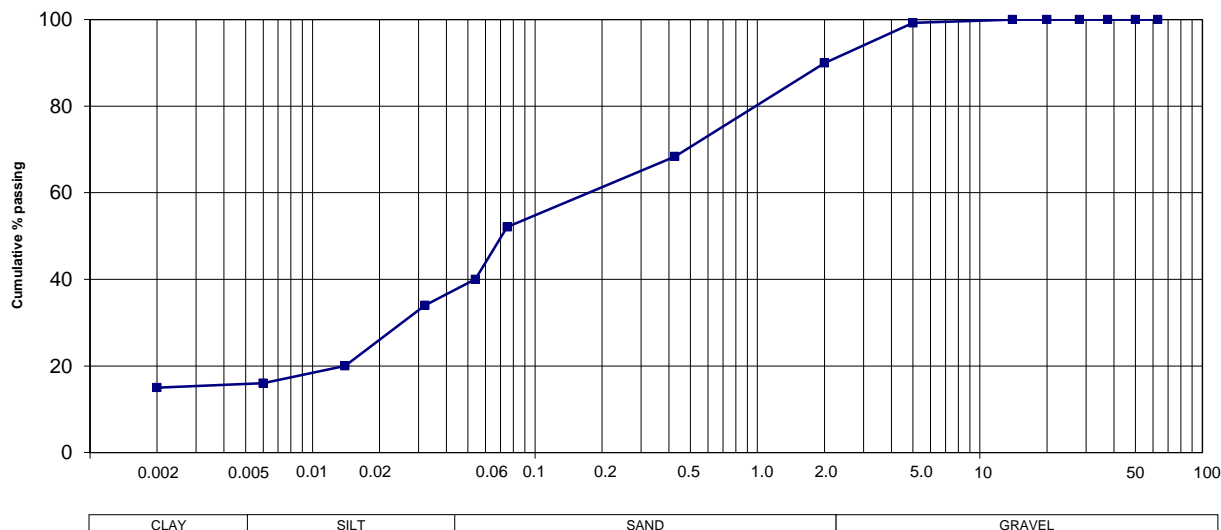
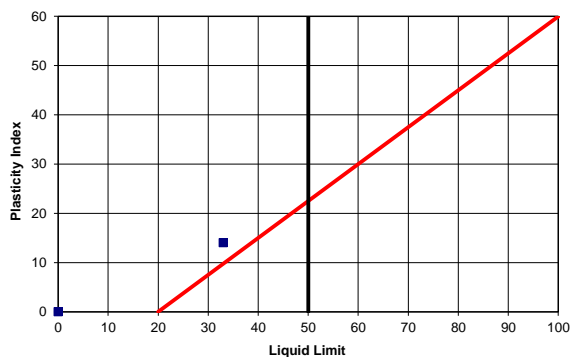
Sample No.	7								
Soillab Sample No.	S18-1898-07								
Depth (m)	1.05 - 2.30								
Position	TP 23								
Material Description	DUSKY RED FERRICRETE SILTY SAND								
Relative density on < 2 mm (SANS 5844)	2.644								
Organic Material									
Moisture (%) / Dispersion (%)									
<b>SCREEN ANALYSIS (% PASSING) (SANS 3001:GR1)</b>									
63.0 mm	100								
50.0 mm	100								
37.5 mm	100								
28.0 mm	100								
20.0 mm	100								
14.0 mm	100								
5.0 mm	99								
2.00 mm	90								
0.425 mm	68								
0.075 mm	52								
<b>HYDROMETER ANALYSIS (% PASSING) (SANS 3001:GR3)</b>									
54 µm	40								
32 µm	34								
14 µm	20								
6 µm	16								
2 µm	15								
<table border="1" style="width: 100%;"> <tr> <td>% Clay</td> <td>16</td> </tr> <tr> <td>% Silt</td> <td>24</td> </tr> <tr> <td>% Sand</td> <td>50</td> </tr> <tr> <td>% Gravel</td> <td>10</td> </tr> </table>		% Clay	16	% Silt	24	% Sand	50	% Gravel	10
% Clay	16								
% Silt	24								
% Sand	50								
% Gravel	10								
<b>ATTERBERG LIMITS (SANS 3001:GR10)</b>									
Liquid Limit	33								
Plasticity Index	14								
Linear Shrinkage (%)	6.5								
Grading Modulus	0.90								
Classification	A-6 (4)								
Unified Classification	CL								
Chart Reference									

PROJECT : ESSELEN PARK  
JOB No. : S18-1898  
DATE : 2018-10-09


### POTENTIAL EXPANSIVENESS



### PLASTICITY CHART

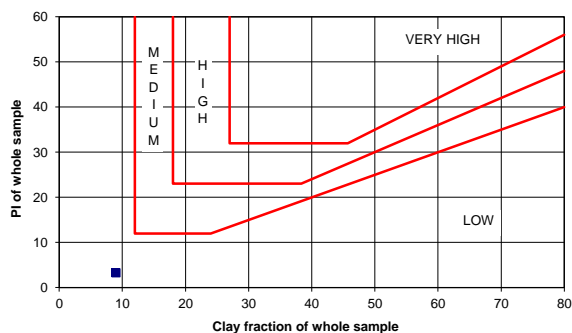


## PARTICLE SIZE ANALYSIS

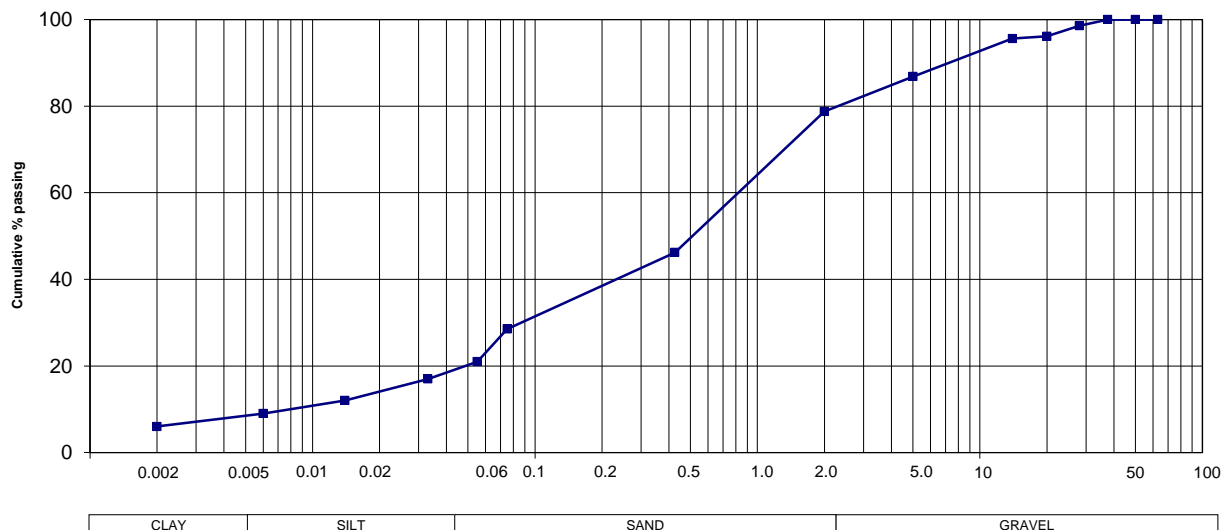
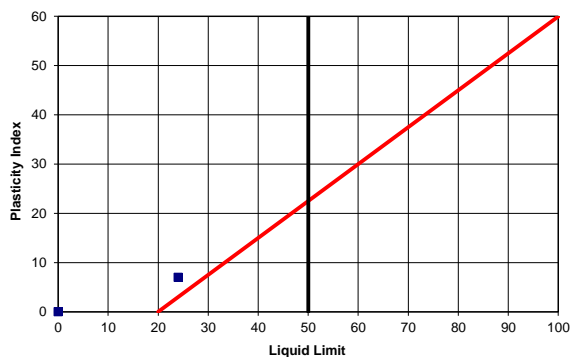
Sample No.	8								
Soillab Sample No.	S18-1898-08								
Depth (m)	1.10 - 1.95								
Position	TP 24								
Material Description	DARK YELLOW  GRAVELLY SAND								
Relative density on < 2 mm (SANS 5844)	2.673								
Organic Material									
Moisture (%) / Dispersion (%)									
<b>SCREEN ANALYSIS (% PASSING) (SANS 3001:GR1)</b>									
63.0 mm	100								
50.0 mm	100								
37.5 mm	100								
28.0 mm	99								
20.0 mm	96								
14.0 mm	96								
5.0 mm	87								
2.00 mm	79								
0.425 mm	46								
0.075 mm	29								
<b>HYDROMETER ANALYSIS (% PASSING) (SANS 3001:GR3)</b>									
55 µm	21								
33 µm	17								
14 µm	12								
6 µm	9								
2 µm	6								
<table border="1" style="width: 100%;"> <tr> <td>% Clay</td> <td>9</td> </tr> <tr> <td>% Silt</td> <td>12</td> </tr> <tr> <td>% Sand</td> <td>58</td> </tr> <tr> <td>% Gravel</td> <td>21</td> </tr> </table>		% Clay	9	% Silt	12	% Sand	58	% Gravel	21
% Clay	9								
% Silt	12								
% Sand	58								
% Gravel	21								
<b>ATTERBERG LIMITS (SANS 3001:GR10)</b>									
Liquid Limit	24								
Plasticity Index	7								
Linear Shrinkage (%)	2.0								
Grading Modulus	1.47								
Classification	A-2-4 (0)								
Unified Classification	SM & SC								
Chart Reference									

PROJECT : ESSELEN PARK  
JOB No. : S18-1898  
DATE : 2018-10-09


### POTENTIAL EXPANSIVENESS



### PLASTICITY CHART

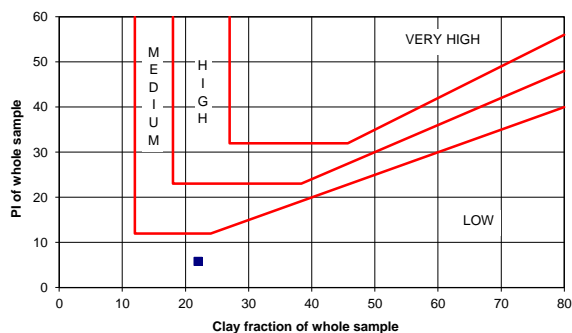


## PARTICLE SIZE ANALYSIS

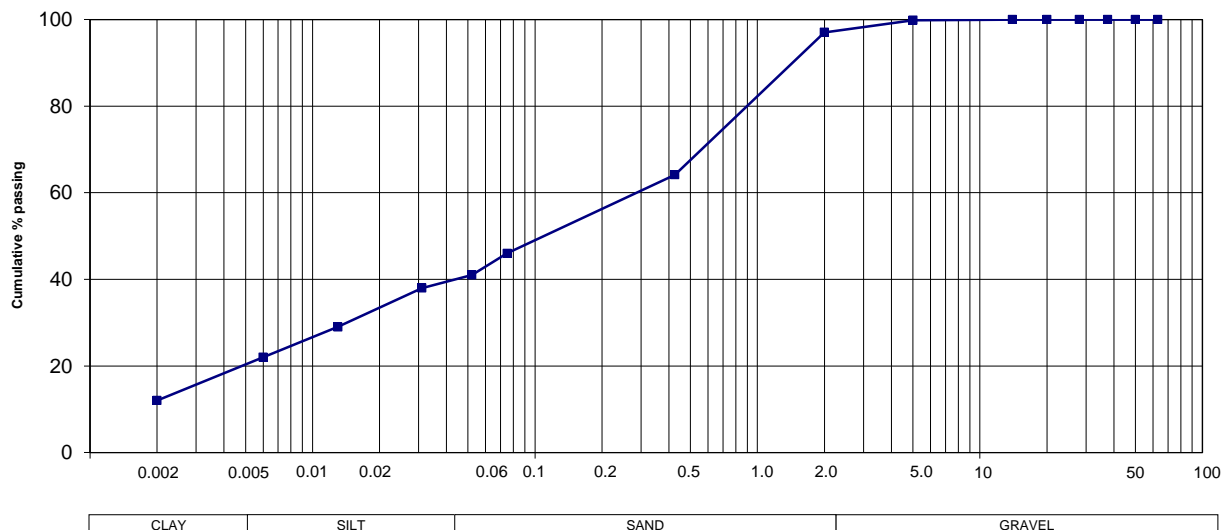
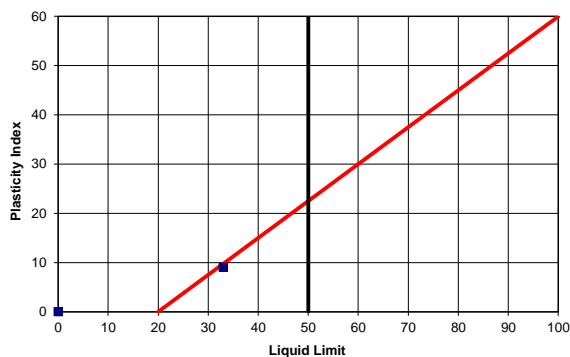
Sample No.	13								
Soillab Sample No.	S18-1898-13								
Depth (m)	2.10 - 5.5								
Position	TP 25								
Material Description	LIGHT REDDISH ORANGE  CLAYEY SAND								
Relative density on < 2 mm (SANS 5844)	2.694								
Organic Material									
Moisture (%) / Dispersion (%)									
<b>SCREEN ANALYSIS (% PASSING) (SANS 3001:GR1)</b>									
63.0 mm	100								
50.0 mm	100								
37.5 mm	100								
28.0 mm	100								
20.0 mm	100								
14.0 mm	100								
5.0 mm	100								
2.00 mm	97								
0.425 mm	64								
0.075 mm	46								
<b>HYDROMETER ANALYSIS (% PASSING) (SANS 3001:GR3)</b>									
52 µm	41								
31 µm	38								
13 µm	29								
6 µm	22								
2 µm	12								
<table border="1" style="width: 100%;"> <tr> <td>% Clay</td> <td>22</td> </tr> <tr> <td>% Silt</td> <td>19</td> </tr> <tr> <td>% Sand</td> <td>56</td> </tr> <tr> <td>% Gravel</td> <td>3</td> </tr> </table>		% Clay	22	% Silt	19	% Sand	56	% Gravel	3
% Clay	22								
% Silt	19								
% Sand	56								
% Gravel	3								
<b>ATTERBERG LIMITS (SANS 3001:GR10)</b>									
Liquid Limit	33								
Plasticity Index	9								
Linear Shrinkage (%)	3.0								
Grading Modulus	0.93								
Classification	A-4 (2)								
Unified Classification	SM								
Chart Reference									

PROJECT : ESSELEN PARK  
JOB No. : S18-1898  
DATE : 2018-10-09

### POTENTIAL EXPANSIVENESS



### PLASTICITY CHART

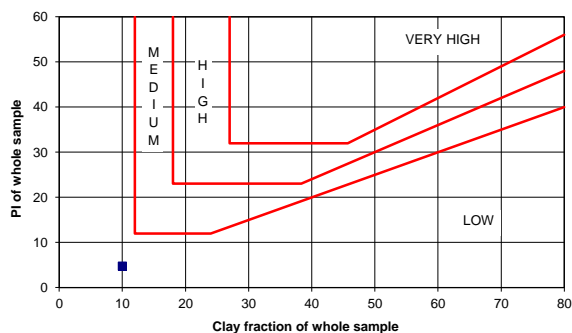


## PARTICLE SIZE ANALYSIS

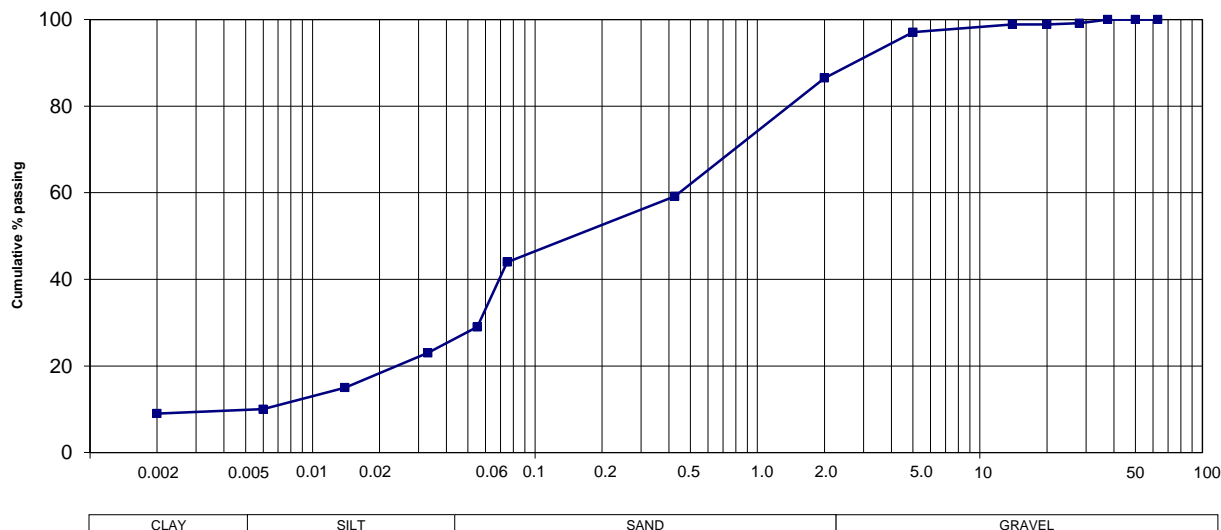
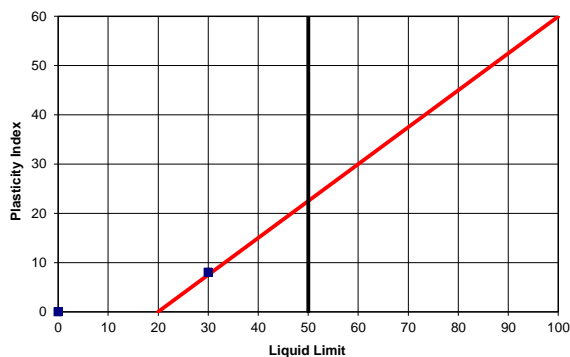
Sample No.	9								
Soillab Sample No.	S18-1898-09								
Depth (m)	1.30 - 2.60								
Position	TP 26								
Material Description	DUKSY RED  SILTY SAND								
Relative density on < 2 mm (SANS 5844)	2.666								
Organic Material									
Moisture (%) / Dispersion (%)									
<b>SCREEN ANALYSIS (% PASSING) (SANS 3001:GR1)</b>									
63.0 mm	100								
50.0 mm	100								
37.5 mm	100								
28.0 mm	99								
20.0 mm	99								
14.0 mm	99								
5.0 mm	97								
2.00 mm	86								
0.425 mm	59								
0.075 mm	44								
<b>HYDROMETER ANALYSIS (% PASSING) (SANS 3001:GR3)</b>									
55 µm	29								
33 µm	23								
14 µm	15								
6 µm	10								
2 µm	9								
<table border="1" style="width: 100%;"> <tr> <td>% Clay</td> <td>10</td> </tr> <tr> <td>% Silt</td> <td>19</td> </tr> <tr> <td>% Sand</td> <td>57</td> </tr> <tr> <td>% Gravel</td> <td>14</td> </tr> </table>		% Clay	10	% Silt	19	% Sand	57	% Gravel	14
% Clay	10								
% Silt	19								
% Sand	57								
% Gravel	14								
<b>ATTERBERG LIMITS (SANS 3001:GR10)</b>									
Liquid Limit	30								
Plasticity Index	8								
Linear Shrinkage (%)	4.0								
Grading Modulus	1.10								
Classification	A-4 (1)								
Unified Classification	SC								
Chart Reference									

PROJECT : ESSELEN PARK  
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### POTENTIAL EXPANSIVENESS



### PLASTICITY CHART

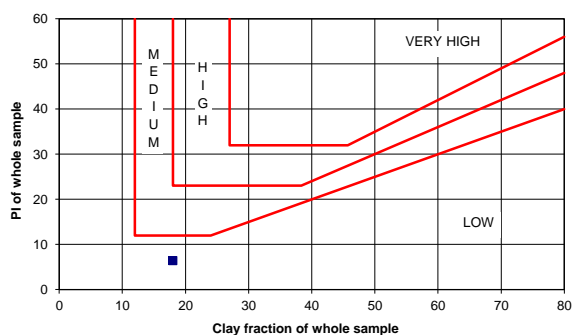


## PARTICLE SIZE ANALYSIS

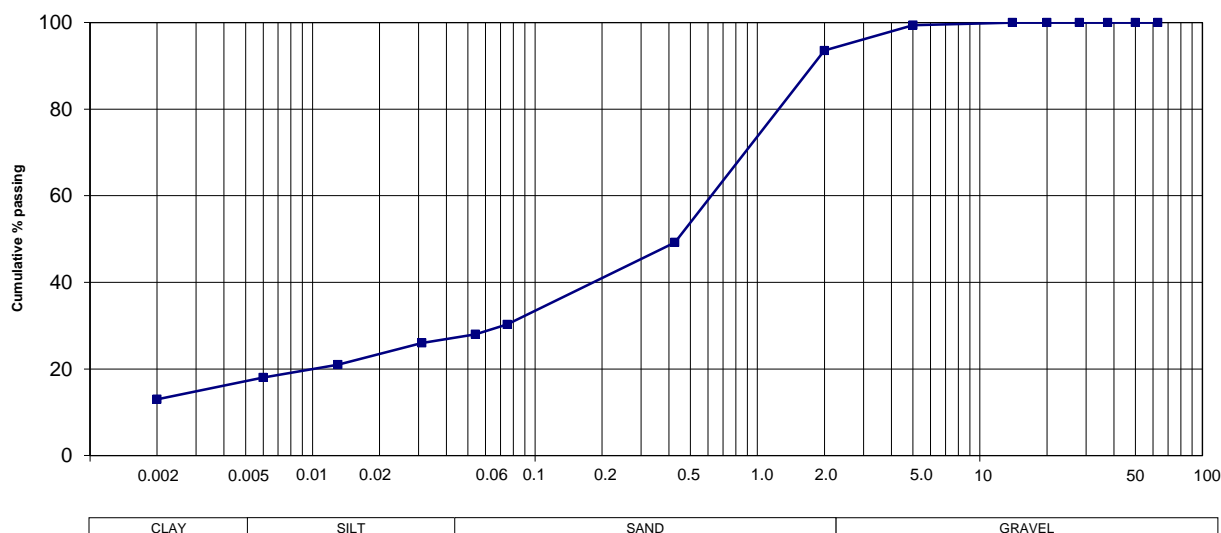
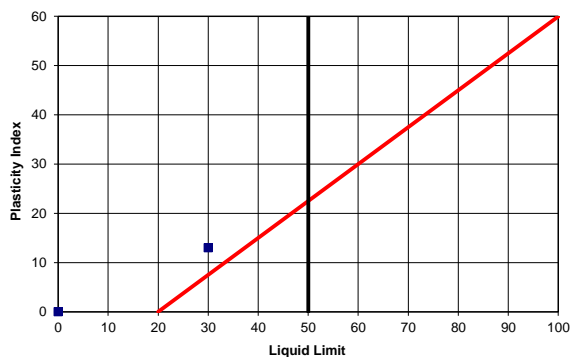
Sample No.	14								
Soillab Sample No.	S18-1898-14								
Depth (m)	2.6 - 4.7								
Position	TP 26								
Material Description	LIGHT REDDISH ORANGE  CLAYEY SAND								
Relative density on < 2 mm (SANS 5844)	2.68								
Organic Material									
Moisture (%) / Dispersion (%)									
<b>SCREEN ANALYSIS (% PASSING) (SANS 3001:GR1)</b>									
63.0 mm	100								
50.0 mm	100								
37.5 mm	100								
28.0 mm	100								
20.0 mm	100								
14.0 mm	100								
5.0 mm	99								
2.00 mm	94								
0.425 mm	49								
0.075 mm	30								
<b>HYDROMETER ANALYSIS (% PASSING) (SANS 3001:GR3)</b>									
54 µm	28								
31 µm	26								
13 µm	21								
6 µm	18								
2 µm	13								
<table border="1" style="width: 100%;"> <tr> <td>% Clay</td> <td>18</td> </tr> <tr> <td>% Silt</td> <td>10</td> </tr> <tr> <td>% Sand</td> <td>66</td> </tr> <tr> <td>% Gravel</td> <td>6</td> </tr> </table>		% Clay	18	% Silt	10	% Sand	66	% Gravel	6
% Clay	18								
% Silt	10								
% Sand	66								
% Gravel	6								
<b>ATTERBERG LIMITS (SANS 3001:GR10)</b>									
Liquid Limit	30								
Plasticity Index	13								
Linear Shrinkage (%)	5.0								
Grading Modulus	1.27								
Classification	A-2-6 (0)								
Unified Classification	SC								
Chart Reference									

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
### POTENTIAL EXPANSIVENESS



### PLASTICITY CHART

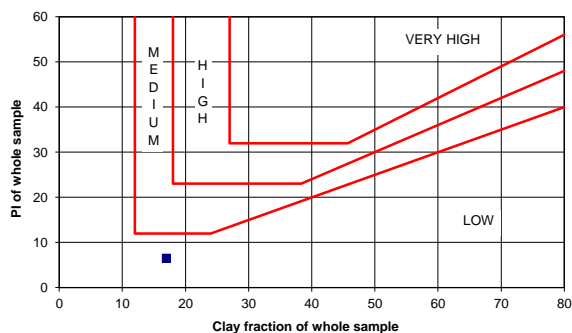


## PARTICLE SIZE ANALYSIS

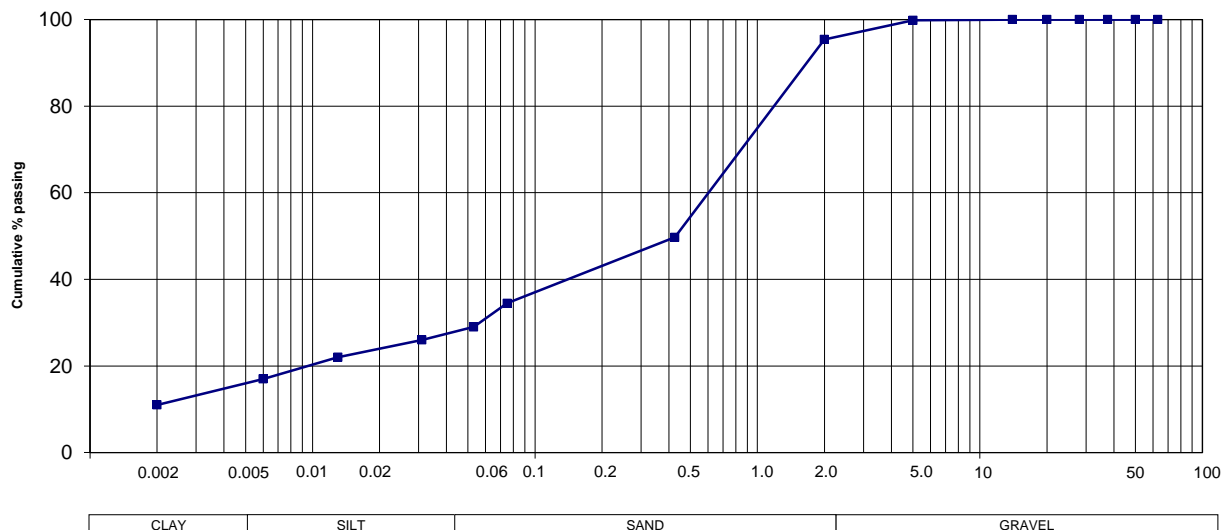
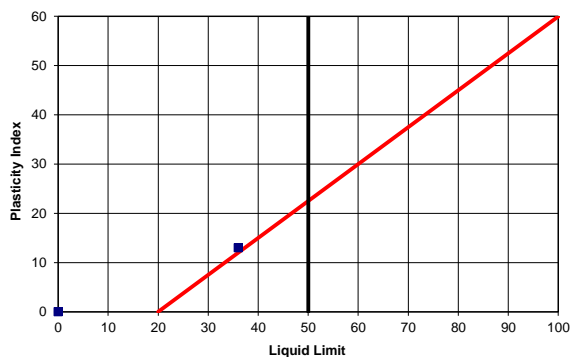
Sample No.	5
Soillab Sample No.	S18-2073-05
Depth (m)	3.90 - 5.20
Position	TP 28
Material Description	LIGHT REDDISH ORANGE CLAYEY SAND
Relative density on < 2 mm (SANS 5844)	2.65
Organic Material	
Moisture (%) / Dispersion (%)	
<b>SCREEN ANALYSIS (% PASSING) (SANS 3001:GR1)</b>	
63.0 mm	100
50.0 mm	100
37.5 mm	100
28.0 mm	100
20.0 mm	100
14.0 mm	100
5.0 mm	100
2.00 mm	95
0.425 mm	50
0.075 mm	34
<b>HYDROMETER ANALYSIS (% PASSING) (SANS 3001:GR3)</b>	
53 µm	29
31 µm	26
13 µm	22
6 µm	17
2 µm	11
% Clay	17
% Silt	12
% Sand	66
% Gravel	5
<b>ATTERBERG LIMITS (SANS 3001:GR10)</b>	
Liquid Limit	36
Plasticity Index	13
Linear Shrinkage (%)	5.5
Grading Modulus	1.20
Classification	A-2-6 (1)
Unified Classification	SC
Chart Reference	

PROJECT : ESSELEN PARK  
JOB No. : S18-2073  
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### POTENTIAL EXPANSIVENESS



### PLASTICITY CHART

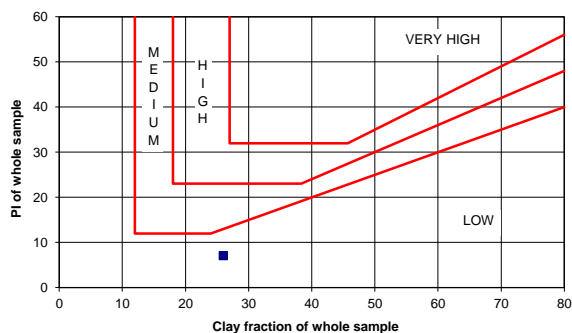


## PARTICLE SIZE ANALYSIS

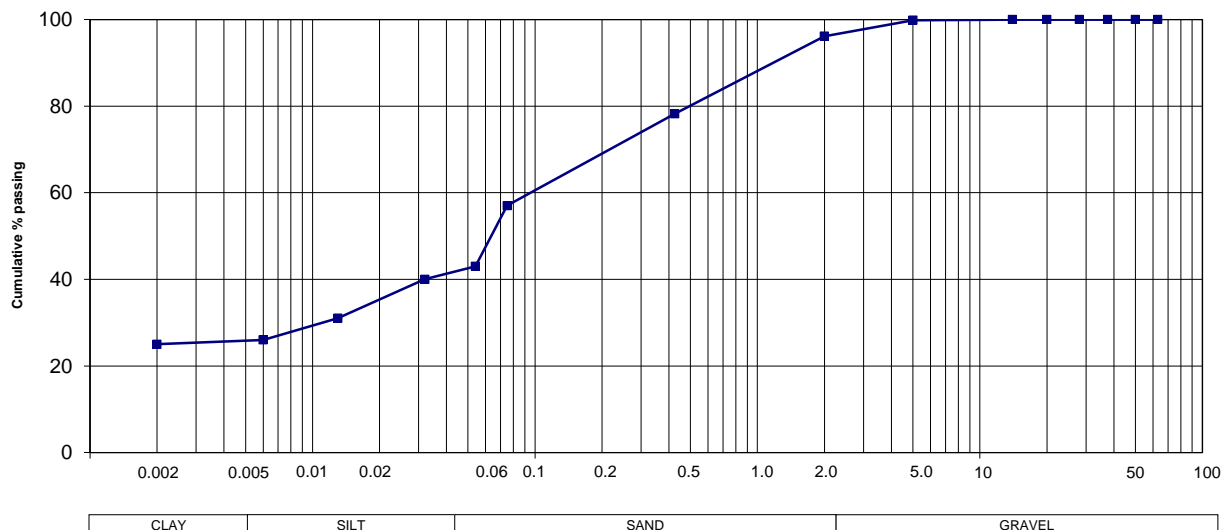
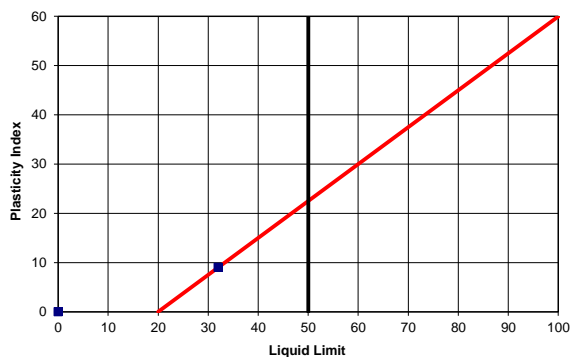
Sample No.	6
Soillab Sample No.	S18-2073-06
Depth (m)	0.50 - 1.80
Position	TP 30
Material Description	DUSKY RED  CLAYEY SAND
Relative density on < 2 mm (SANS 5844)	2.65
Organic Material	
Moisture (%) / Dispersion (%)	
<b>SCREEN ANALYSIS (% PASSING) (SANS 3001:GR1)</b>	
63.0 mm	100
50.0 mm	100
37.5 mm	100
28.0 mm	100
20.0 mm	100
14.0 mm	100
5.0 mm	100
2.00 mm	96
0.425 mm	78
0.075 mm	57
<b>HYDROMETER ANALYSIS (% PASSING) (SANS 3001:GR3)</b>	
54 µm	43
32 µm	40
13 µm	31
6 µm	26
2 µm	25
% Clay	26
% Silt	17
% Sand	53
% Gravel	4
<b>ATTERBERG LIMITS (SANS 3001:GR10)</b>	
Liquid Limit	32
Plasticity Index	9
Linear Shrinkage (%)	4.5
Grading Modulus	0.69
Classification	A-4 (3)
Unified Classification	CL
Chart Reference	

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### POTENTIAL EXPANSIVENESS



### PLASTICITY CHART

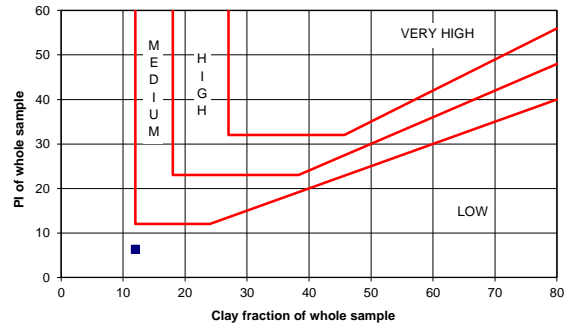


## PARTICLE SIZE ANALYSIS

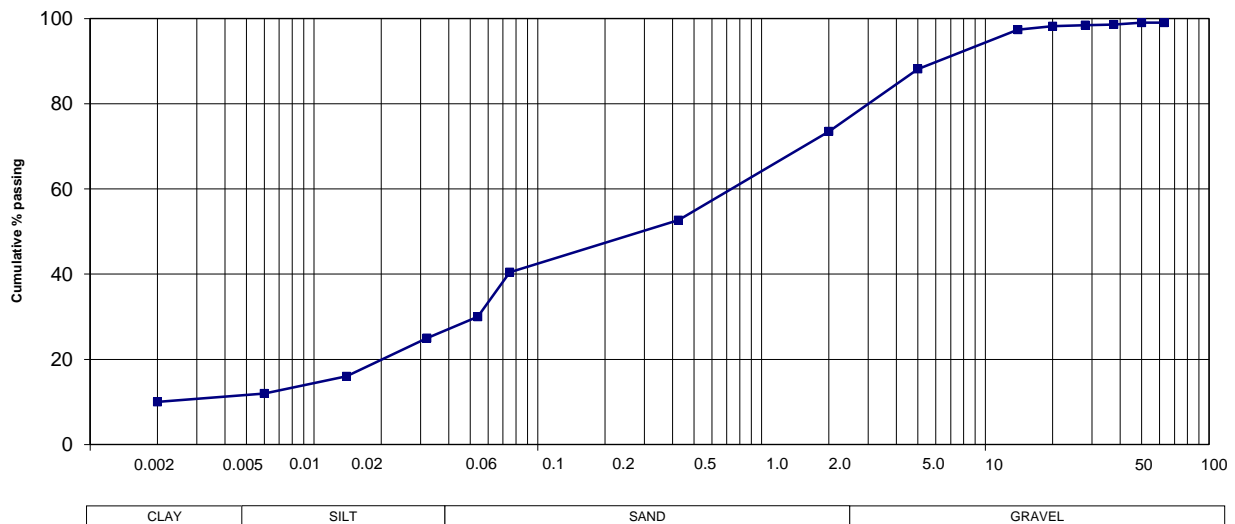
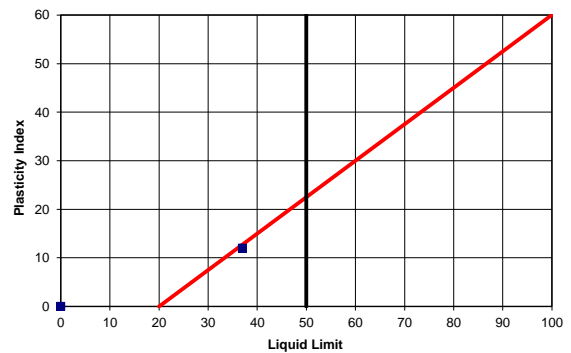
Sample No.	7
Soillab Sample No.	S18-2073-07
Depth (m)	2.30 - 3.80
Position	TP 30
Material Description	LIGHT REDDISH ORANGE FERRICRETE & QUARTZITE GRAVELLY SAND
Relative density on < 2 mm (SANS 5844)	2.65
Organic Material	
Moisture (%) / Dispersion (%)	
<b>SCREEN ANALYSIS (% PASSING) (SANS 3001:GR1)</b>	
63.0 mm	99
50.0 mm	99
37.5 mm	99
28.0 mm	98
20.0 mm	98
14.0 mm	97
5.0 mm	88
2.00 mm	74
0.425 mm	53
0.075 mm	40
<b>HYDROMETER ANALYSIS (% PASSING) (SANS 3001:GR3)</b>	
54 µm	30
32 µm	25
14 µm	16
6 µm	12
2 µm	10
% Clay	12
% Silt	18
% Sand	44
% Gravel	26
<b>ATTERBERG LIMITS (SANS 3001:GR10)</b>	
Liquid Limit	37
Plasticity Index	12
Linear Shrinkage (%)	5.0
Grading Modulus	1.33
Classification	A-6 (1)
Unified Classification	SM
Chart Reference	

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### POTENTIAL EXPANSIVENESS




### PLASTICITY CHART



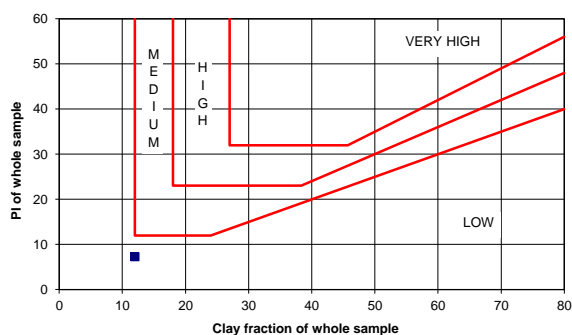


## PARTICLE SIZE ANALYSIS

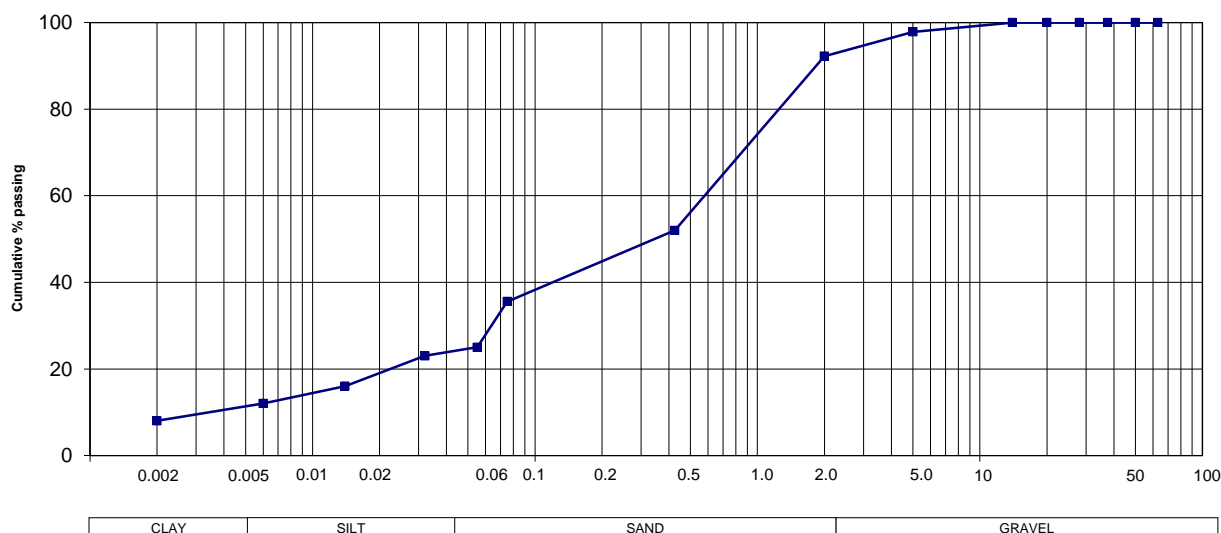
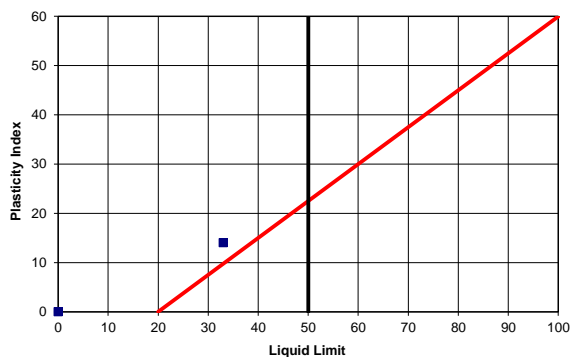
Sample No.	8								
Soillab Sample No.	S18-2073-08								
Depth (m)	3.80 - 5.20								
Position	TP 30								
Material Description	LIGHT REDDISH ORANGE SILTY SAND								
Relative density on < 2 mm (SANS 5844)	2.65								
Organic Material									
Moisture (%) / Dispersion (%)									
<b>SCREEN ANALYSIS (% PASSING) (SANS 3001:GR1)</b>									
63.0 mm	100								
50.0 mm	100								
37.5 mm	100								
28.0 mm	100								
20.0 mm	100								
14.0 mm	100								
5.0 mm	98								
2.00 mm	92								
0.425 mm	52								
0.075 mm	36								
<b>HYDROMETER ANALYSIS (% PASSING) (SANS 3001:GR3)</b>									
55 µm	25								
32 µm	23								
14 µm	16								
6 µm	12								
2 µm	8								
<table border="1" style="width: 100%;"> <tr> <td>% Clay</td> <td>12</td> </tr> <tr> <td>% Silt</td> <td>13</td> </tr> <tr> <td>% Sand</td> <td>67</td> </tr> <tr> <td>% Gravel</td> <td>8</td> </tr> </table>		% Clay	12	% Silt	13	% Sand	67	% Gravel	8
% Clay	12								
% Silt	13								
% Sand	67								
% Gravel	8								
<b>ATTERBERG LIMITS (SANS 3001:GR10)</b>									
Liquid Limit	33								
Plasticity Index	14								
Linear Shrinkage (%)	5.5								
Grading Modulus	1.20								
Classification	A-6 (1)								
Unified Classification	SC								
Chart Reference									

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DATE : 2018-11-05


### POTENTIAL EXPANSIVENESS



### PLASTICITY CHART

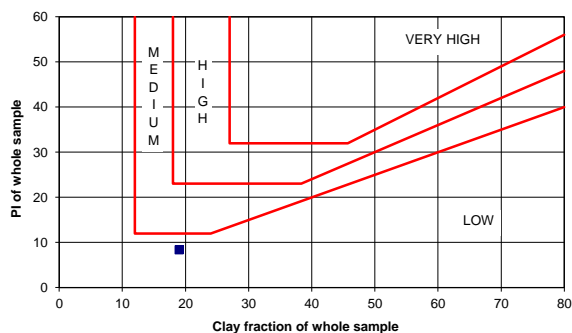


## PARTICLE SIZE ANALYSIS

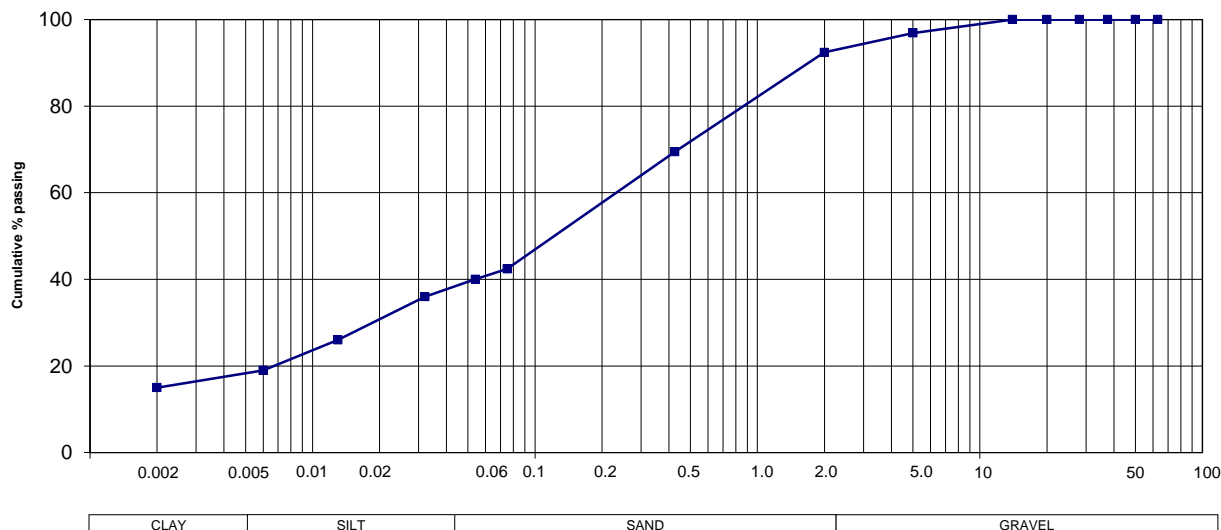
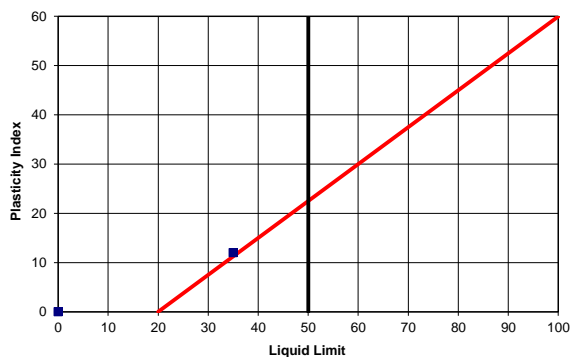
Sample No.	9								
Soillab Sample No.	S18-2073-09								
Depth (m)	0.93 - 3.10								
Position	TP 34								
Material Description	LIGHT REDDISH ORANGE SILTY SAND								
Relative density on < 2 mm (SANS 5844)	2.65								
Organic Material									
Moisture (%) / Dispersion (%)									
<b>SCREEN ANALYSIS (% PASSING) (SANS 3001:GR1)</b>									
63.0 mm	100								
50.0 mm	100								
37.5 mm	100								
28.0 mm	100								
20.0 mm	100								
14.0 mm	100								
5.0 mm	97								
2.00 mm	92								
0.425 mm	69								
0.075 mm	42								
<b>HYDROMETER ANALYSIS (% PASSING) (SANS 3001:GR3)</b>									
54 µm	40								
32 µm	36								
13 µm	26								
6 µm	19								
2 µm	15								
<table border="1" style="width: 100%;"> <tr> <td>% Clay</td> <td>19</td> </tr> <tr> <td>% Silt</td> <td>21</td> </tr> <tr> <td>% Sand</td> <td>52</td> </tr> <tr> <td>% Gravel</td> <td>8</td> </tr> </table>		% Clay	19	% Silt	21	% Sand	52	% Gravel	8
% Clay	19								
% Silt	21								
% Sand	52								
% Gravel	8								
<b>ATTERBERG LIMITS (SANS 3001:GR10)</b>									
Liquid Limit	35								
Plasticity Index	12								
Linear Shrinkage (%)	5.0								
Grading Modulus	0.96								
Classification	A-6 (2)								
Unified Classification	SC								
Chart Reference									

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### POTENTIAL EXPANSIVENESS



### PLASTICITY CHART

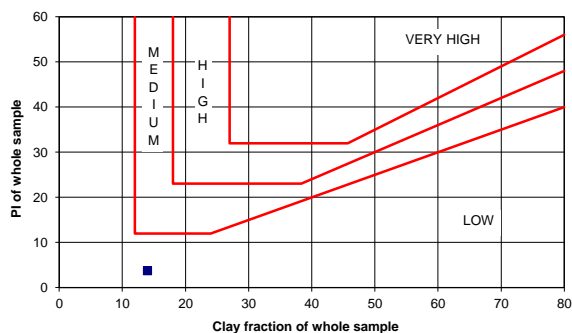


## PARTICLE SIZE ANALYSIS

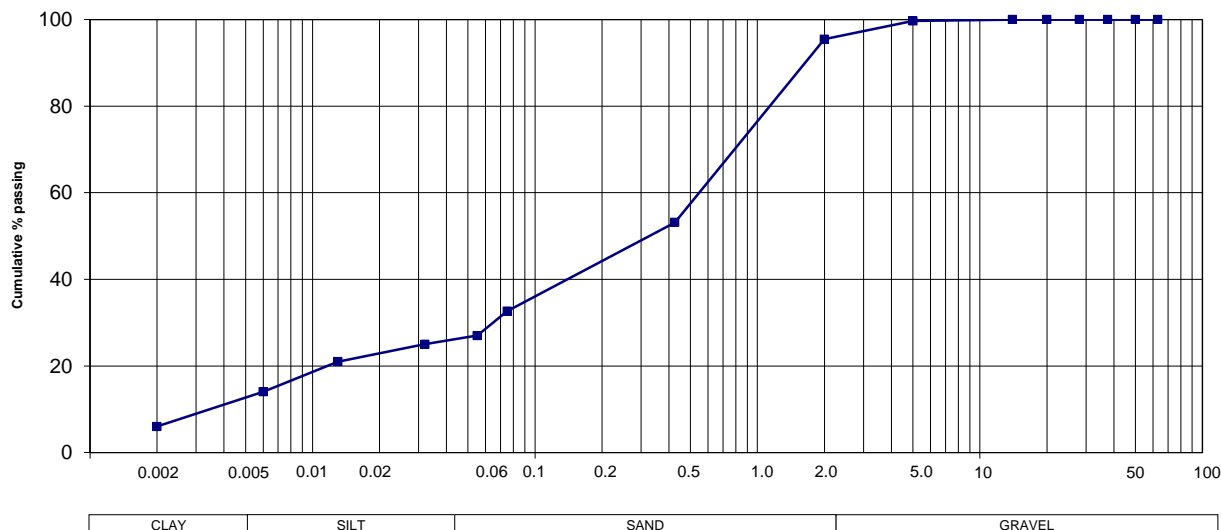
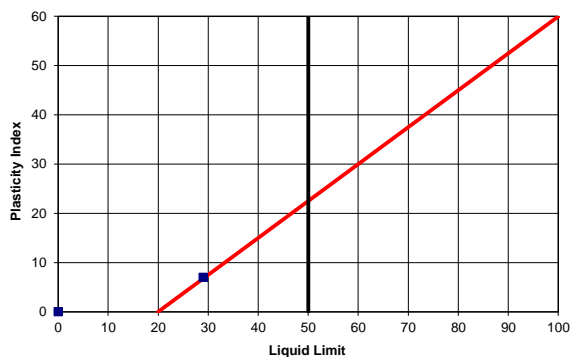
Sample No.	10
Soillab Sample No.	S18-2073-10
Depth (m)	3.10 - 5.30
Position	TP 34
Material Description	LIGHT REDDISH BROWN CLAYEY SAND
Relative density on < 2 mm (SANS 5844)	2.65
Organic Material	
Moisture (%) / Dispersion (%)	
<b>SCREEN ANALYSIS (% PASSING) (SANS 3001:GR1)</b>	
63.0 mm	100
50.0 mm	100
37.5 mm	100
28.0 mm	100
20.0 mm	100
14.0 mm	100
5.0 mm	100
2.00 mm	95
0.425 mm	53
0.075 mm	33
<b>HYDROMETER ANALYSIS (% PASSING) (SANS 3001:GR3)</b>	
55 µm	27
32 µm	25
13 µm	21
6 µm	14
2 µm	6
% Clay	14
% Silt	13
% Sand	68
% Gravel	5
<b>ATTERBERG LIMITS (SANS 3001:GR10)</b>	
Liquid Limit	29
Plasticity Index	7
Linear Shrinkage (%)	2.5
Grading Modulus	1.19
Classification	A-2-4 (0)
Unified Classification	SM & SC
Chart Reference	

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
### POTENTIAL EXPANSIVENESS



### PLASTICITY CHART

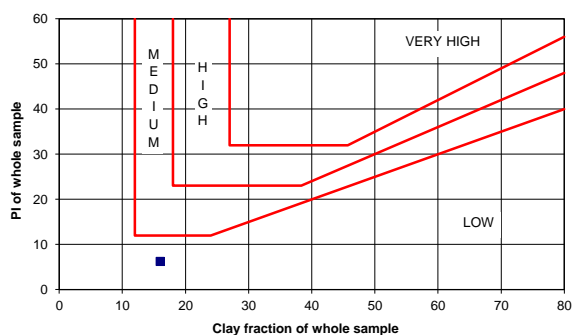


## PARTICLE SIZE ANALYSIS

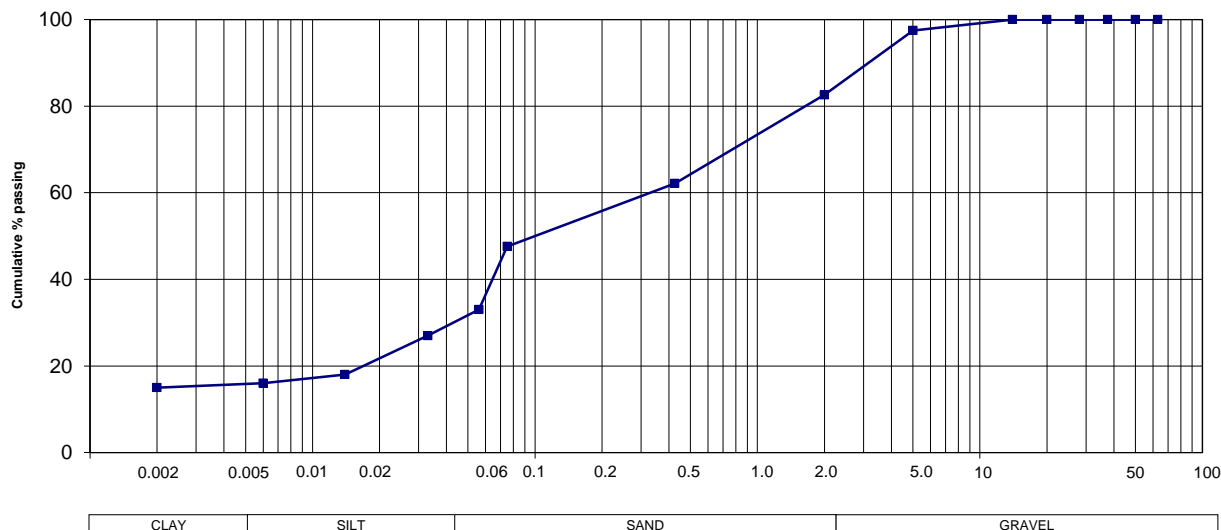
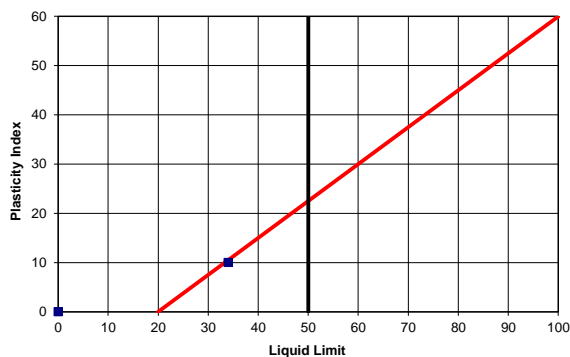
Sample No.	15								
Soillab Sample No.	S18-1898-15								
Depth (m)	0.8 - 4.20								
Position	TP 37								
Material Description	DUSKY RED FERRICRETE GRAVELLY SAND								
Relative density on < 2 mm (SANS 5844)	2.596								
Organic Material									
Moisture (%) / Dispersion (%)									
<b>SCREEN ANALYSIS (% PASSING) (SANS 3001:GR1)</b>									
63.0 mm	100								
50.0 mm	100								
37.5 mm	100								
28.0 mm	100								
20.0 mm	100								
14.0 mm	100								
5.0 mm	97								
2.00 mm	83								
0.425 mm	62								
0.075 mm	48								
<b>HYDROMETER ANALYSIS (% PASSING) (SANS 3001:GR3)</b>									
56 µm	33								
33 µm	27								
14 µm	18								
6 µm	16								
2 µm	15								
<table border="1" style="width: 100%;"> <tr> <td>% Clay</td> <td>16</td> </tr> <tr> <td>% Silt</td> <td>17</td> </tr> <tr> <td>% Sand</td> <td>50</td> </tr> <tr> <td>% Gravel</td> <td>17</td> </tr> </table>		% Clay	16	% Silt	17	% Sand	50	% Gravel	17
% Clay	16								
% Silt	17								
% Sand	50								
% Gravel	17								
<b>ATTERBERG LIMITS (SANS 3001:GR10)</b>									
Liquid Limit	34								
Plasticity Index	10								
Linear Shrinkage (%)	5.0								
Grading Modulus	1.08								
Classification	A-4 (2)								
Unified Classification	SM								
Chart Reference									

PROJECT : ESSELEN PARK  
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### POTENTIAL EXPANSIVENESS



### PLASTICITY CHART

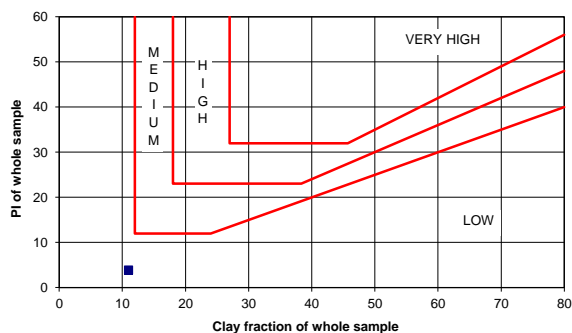


## PARTICLE SIZE ANALYSIS

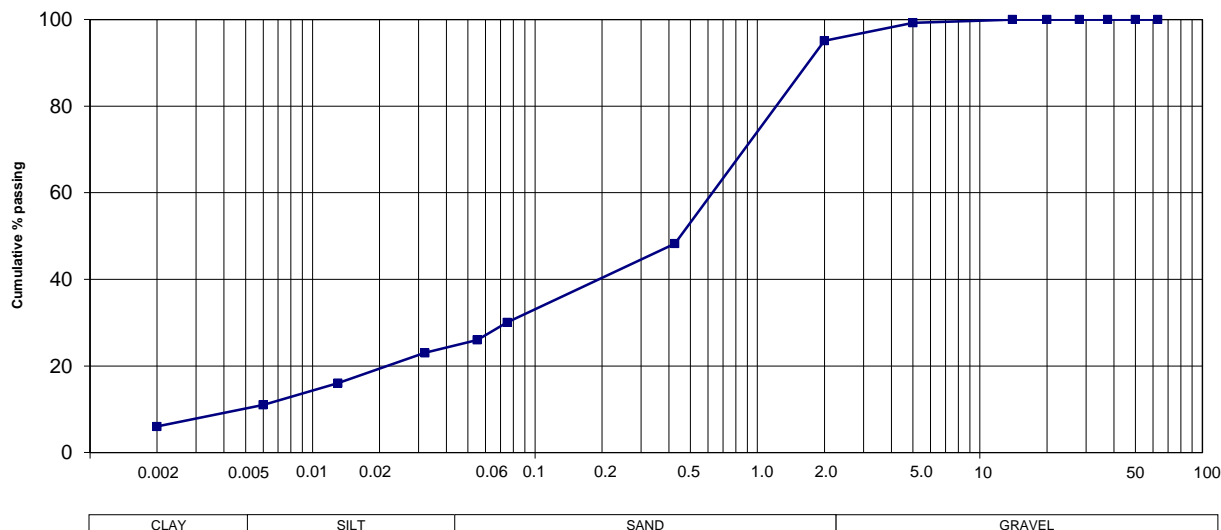
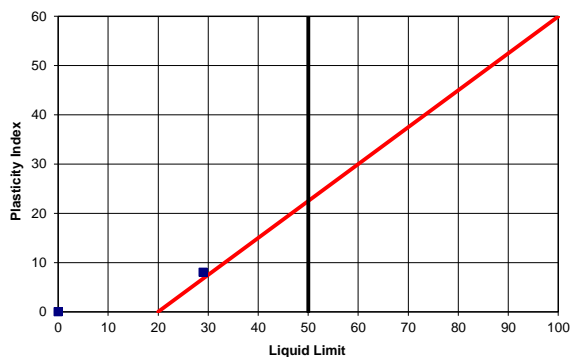
Sample No.	10								
Soillab Sample No.	S18-1898-10								
Depth (m)	3.60 - 5.20								
Position	TP 39								
Material Description	DARK YELLOW  SILTY SAND								
Relative density on < 2 mm (SANS 5844)	2.637								
Organic Material									
Moisture (%) / Dispersion (%)									
<b>SCREEN ANALYSIS (% PASSING) (SANS 3001:GR1)</b>									
63.0 mm	100								
50.0 mm	100								
37.5 mm	100								
28.0 mm	100								
20.0 mm	100								
14.0 mm	100								
5.0 mm	99								
2.00 mm	95								
0.425 mm	48								
0.075 mm	30								
<b>HYDROMETER ANALYSIS (% PASSING) (SANS 3001:GR3)</b>									
55 µm	26								
32 µm	23								
13 µm	16								
6 µm	11								
2 µm	6								
<table border="1" style="width: 100%;"> <tr> <td>% Clay</td> <td>11</td> </tr> <tr> <td>% Silt</td> <td>15</td> </tr> <tr> <td>% Sand</td> <td>69</td> </tr> <tr> <td>% Gravel</td> <td>5</td> </tr> </table>		% Clay	11	% Silt	15	% Sand	69	% Gravel	5
% Clay	11								
% Silt	15								
% Sand	69								
% Gravel	5								
<b>ATTERBERG LIMITS (SANS 3001:GR10)</b>									
Liquid Limit	29								
Plasticity Index	8								
Linear Shrinkage (%)	3.0								
Grading Modulus	1.27								
Classification	A-2-4 (0)								
Unified Classification	SC								
Chart Reference									

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JOB No. : S18-1898  
DATE : 2018-10-09

### POTENTIAL EXPANSIVENESS



### PLASTICITY CHART

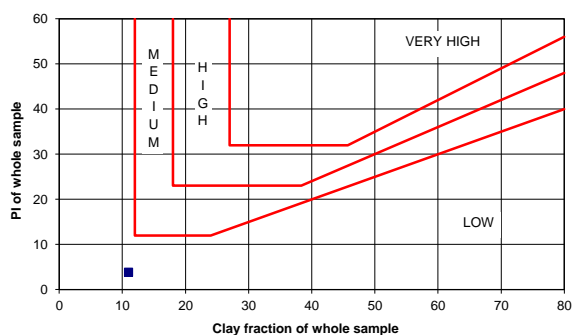


## PARTICLE SIZE ANALYSIS

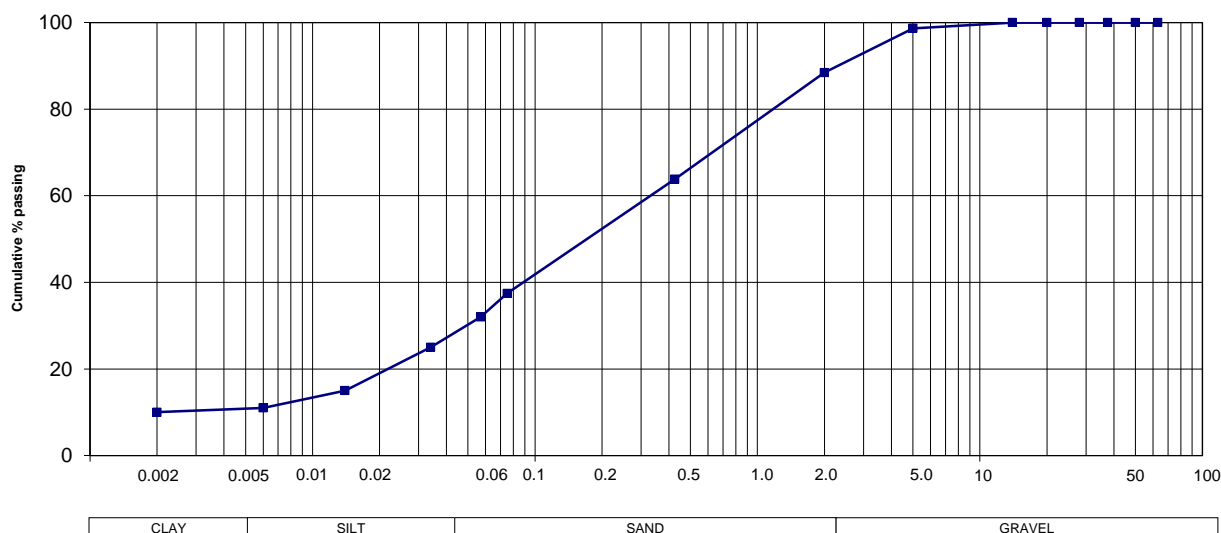
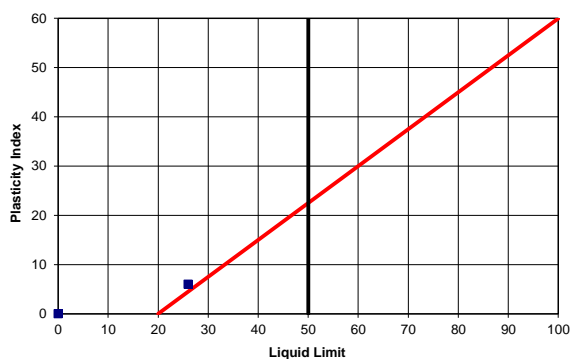
Sample No.	11								
Soillab Sample No.	S18-1898-11								
Depth (m)	0.3 - 5.2								
Position	TP 41								
Material Description	DARK REDDISH ORANGE FERRICRETE SILTY SAND								
Relative density on < 2 mm (SANS 5844)	2.617								
Organic Material									
Moisture (%) / Dispersion (%)									
<b>SCREEN ANALYSIS (% PASSING) (SANS 3001:GR1)</b>									
63.0 mm	100								
50.0 mm	100								
37.5 mm	100								
28.0 mm	100								
20.0 mm	100								
14.0 mm	100								
5.0 mm	99								
2.00 mm	88								
0.425 mm	64								
0.075 mm	37								
<b>HYDROMETER ANALYSIS (% PASSING) (SANS 3001:GR3)</b>									
57 µm	32								
34 µm	25								
14 µm	15								
6 µm	11								
2 µm	10								
<table border="1" style="width: 100%;"> <tr> <td>% Clay</td> <td>11</td> </tr> <tr> <td>% Silt</td> <td>21</td> </tr> <tr> <td>% Sand</td> <td>56</td> </tr> <tr> <td>% Gravel</td> <td>12</td> </tr> </table>		% Clay	11	% Silt	21	% Sand	56	% Gravel	12
% Clay	11								
% Silt	21								
% Sand	56								
% Gravel	12								
<b>ATTERBERG LIMITS (SANS 3001:GR10)</b>									
Liquid Limit	26								
Plasticity Index	6								
Linear Shrinkage (%)	3.0								
Grading Modulus	1.10								
Classification	A-4 (0)								
Unified Classification	SM & SC								
Chart Reference									

PROJECT : ESSELEN PARK  
JOB No. : S18-1898  
DATE : 2018-10-09

### POTENTIAL EXPANSIVENESS



### PLASTICITY CHART

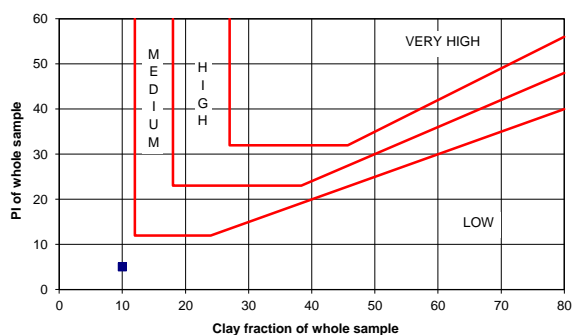


## PARTICLE SIZE ANALYSIS

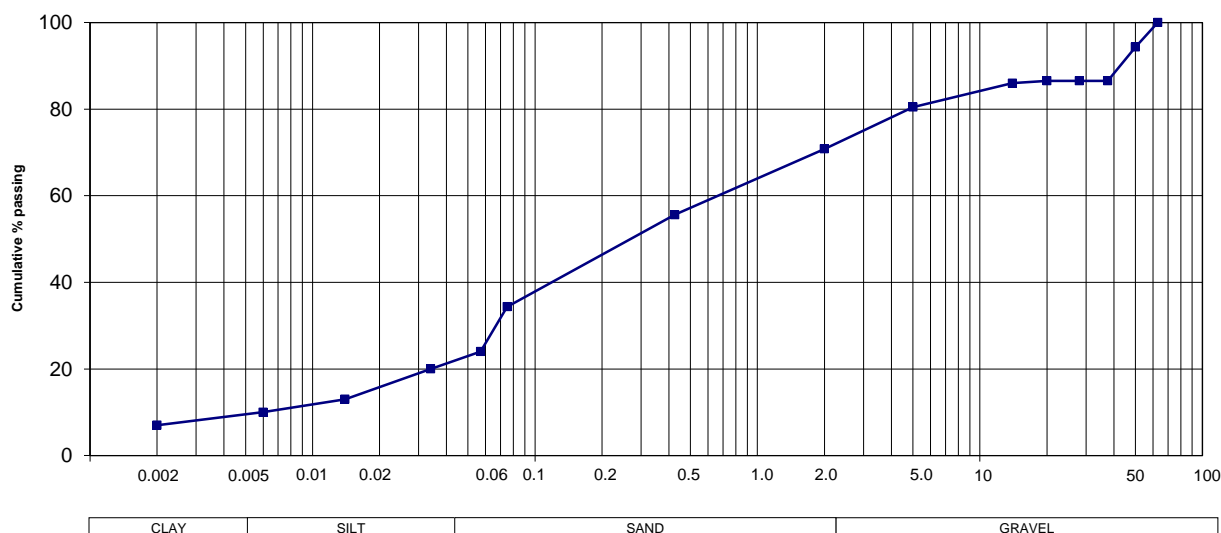
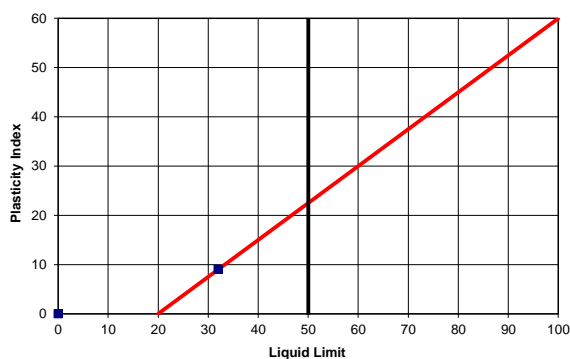
Sample No.	12								
Soillab Sample No.	S18-1898-12								
Depth (m)	1.30 - 3.50								
Position	TP 42								
Material Description	LIGHT REDDISH ORANGE FERRICRETE GRAVELLY SAND								
Relative density on < 2 mm (SANS 5844)	2.603								
Organic Material									
Moisture (%) / Dispersion (%)									
<b>SCREEN ANALYSIS (% PASSING) (SANS 3001:GR1)</b>									
63.0 mm	100								
50.0 mm	94								
37.5 mm	87								
28.0 mm	87								
20.0 mm	87								
14.0 mm	86								
5.0 mm	80								
2.00 mm	71								
0.425 mm	56								
0.075 mm	34								
<b>HYDROMETER ANALYSIS (% PASSING) (SANS 3001:GR3)</b>									
57 µm	24								
34 µm	20								
14 µm	13								
6 µm	10								
2 µm	7								
<table border="1" style="width: 100%;"> <tr> <td>% Clay</td> <td>10</td> </tr> <tr> <td>% Silt</td> <td>14</td> </tr> <tr> <td>% Sand</td> <td>47</td> </tr> <tr> <td>% Gravel</td> <td>29</td> </tr> </table>		% Clay	10	% Silt	14	% Sand	47	% Gravel	29
% Clay	10								
% Silt	14								
% Sand	47								
% Gravel	29								
<b>ATTERBERG LIMITS (SANS 3001:GR10)</b>									
Liquid Limit	32								
Plasticity Index	9								
Linear Shrinkage (%)	4.0								
Grading Modulus	1.39								
Classification	A-2-4 (0)								
Unified Classification	SC								
Chart Reference									

PROJECT : ESSELEN PARK  
JOB No. : S18-1898  
DATE : 2018-10-09

### POTENTIAL EXPANSIVENESS



### PLASTICITY CHART



### Project Description

Client:	GEOHAZARD SOLUTIONS	Soillab Job No.:	S18-1898
Job Description:	ESSELEN PARK	Contract Number:	
Date:	2018/10/09	Reference Number:	

### Sample Description

Soillab Sample No.:	S18-1898-13	S18-1898-14	S18-1898-15	
Sample Description:	TP 25	TP 26	TP 37	
Sample Depth:	2.10 - 5.5	2.6 - 4.70	0.8 - 4.20	
Material Description:	LIGHT REDDISH ORANGE	LIGHT REDDISH ORANGE	DUSKY RED FERRICRETE	

### Screen Analysis (% Passing) - SANS 3001-GR1

75,00 mm	100	100	100	
63,00 mm	100	100	100	
50,00 mm	100	100	100	
37,50 mm	100	100	100	
28,00 mm	100	100	100	
20,00 mm	100	100	100	
14,00 mm	100	100	100	
5,00 mm	100	99	97	
2,000 mm	97	94	83	
0,425 mm	64	49	62	
0,075 mm	46	30	48	

### Soil-mortar percentages - SANS 3001-PR5

Coarse Sand	2.000-0.425mm	34	47	25	
Coarse Fine Sand	0.425-0.250mm	10	12	6	
Medium Fine Sand	0.250-0.150mm	5	5	5	
Fine Fine Sand	0.150-0.075mm	4	4	7	
Silt and clay	<0.075mm	47	32	58	

### Constants

Grading Modulus	SANS 3001-PR5	0.93	1.27	1.08	
Liquid Limit		33	30	34	
Plasticity Index	SANS 3001-GR10	9	13	10	
Linear Shrinkage		3.0	5.0	5.0	

### MOD AASHTO - SANS 3001-GR30

Max Dry Density (kg/m <sup>3</sup> )	1962	2028	1984	
Optimum Moisture Content (%)	10.9	9.2	11.2	

### CBR - SANS 3001-GR40

<b>MOD AASHTO</b>				
Moulding Moisture Content (%)	11.0	9.2	11.3	
Dry Density (kg/m <sup>3</sup> )	1962	2043	1972	
% of Max Dry Density	100.0	100.7	99.4	
100% MOD CBR (%)	4	50	78	
% Swell	2.3	0.4	0.0	
<b>NRB</b>				
Dry Density (kg/m <sup>3</sup> )	1855	1926	1871	
% of Max Dry Density	94.5	95.0	94.3	
100% NRB CBR (%)	3	13	26	
% Swell	3.0	0.6	0.1	
<b>PROCTOR</b>				
Dry Density (kg/m <sup>3</sup> )	1768	1830	1775	
% of Max Dry Density	90.1	90.2	89.5	
100% PROCTOR CBR (%)	2	4	9	
% Swell	4.5	1.0	0.1	
<b>CBR (%)</b>				
100% Mod AASHTO	4	42	89	
98% Mod AASHTO	4	26	58	
97% Mod AASHTO	3	20	46	
95% Mod AASHTO	3	13	30	
93% Mod AASHTO	2	8	19	
90% Mod AASHTO	2	4	10	
<b>COLTO Classification:</b>	<b>&gt;G9</b>	<b>G9</b>	<b>G6</b>	



# Oedometer

## TMH 6 ST10

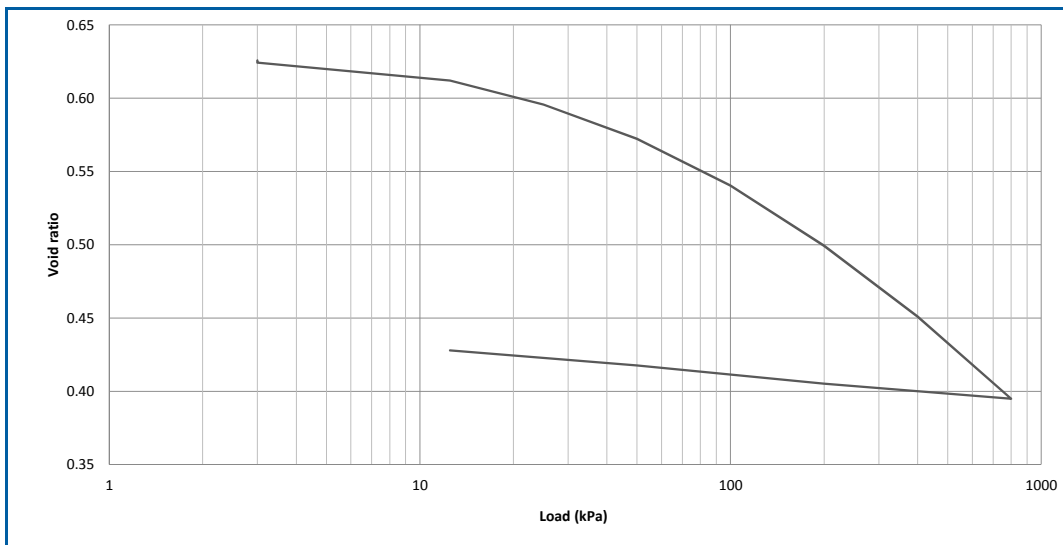
<b>Project:</b>	Esselen Park
<b>Client:</b>	Geohazard Solutions
<b>Geolab Job Nr:</b>	G18-237
<b>Test Method:</b>	TMH 6 ST10

<b>Sample Nr:</b>	TP03
<b>Sample Depth:</b>	1.60-4.50m
<b>Date:</b>	2018-10-30

Load kPa	Height mm	Void Ratio	$m_v$ MPa <sup>-1</sup>
3.0	19.110	0.626	
3.0	19.094	0.624	
12.5	18.951	0.612	0.788
25.0	18.758	0.596	0.815
50.0	18.483	0.572	0.586
100.0	18.107	0.540	0.407
200.0	17.626	0.499	0.266
400.0	17.054	0.451	0.162
800.0	16.397	0.395	0.096
200.0	16.518	0.405	
50.0	16.665	0.418	
12.5	16.785	0.428	

<b>Sampling Method:</b>	Block
<b>Disturbed/Undist:</b>	Undisturbed
<b>Remoulded To:</b>	-

	Initial	Final	
<b>Sample Height:</b>	19.11	16.79	mm
<b>Sample Mass:</b>	111.34	118.30	g
<b>Dry Density:</b>	1660	1891	kg/m <sup>3</sup>
<b>Density</b>	1830	2214	kg/m <sup>3</sup>
<b>Moisture Content:</b>	10.2	17.1	%
<b>Void Ratio:</b>	0.626	0.428	
<b>Specific Gravity:</b>	2.699		Mg/m <sup>3</sup>



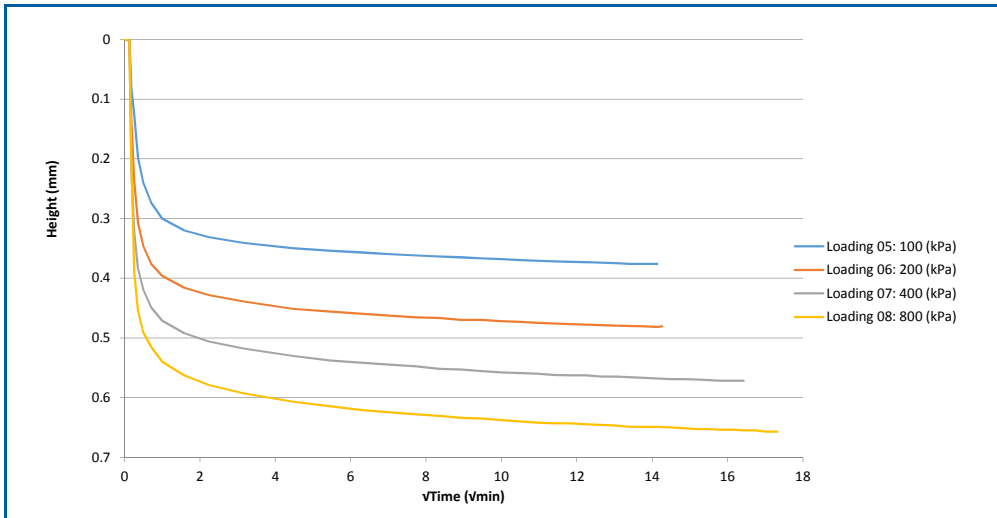
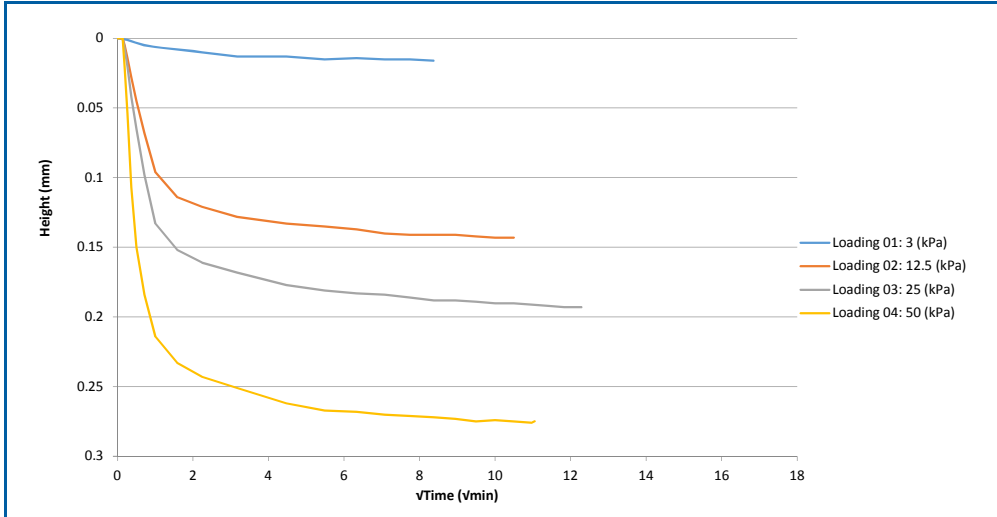
\* -  $m_v$  values provided are incremental and only valid for the specific load increment.

# Oedometer

## Time Readings

<b>Project:</b>	Esselen Park
<b>Client:</b>	Geohazard Solutions
<b>Geolab Job Nr:</b>	G18-237
<b>Test Method:</b>	TMH 6 ST10

<b>Sample Nr:</b>	TP03
<b>Sample Depth:</b>	1.60-4.50m
<b>Date:</b>	2018-10-30



# Oedometer

## TMH 6 ST10

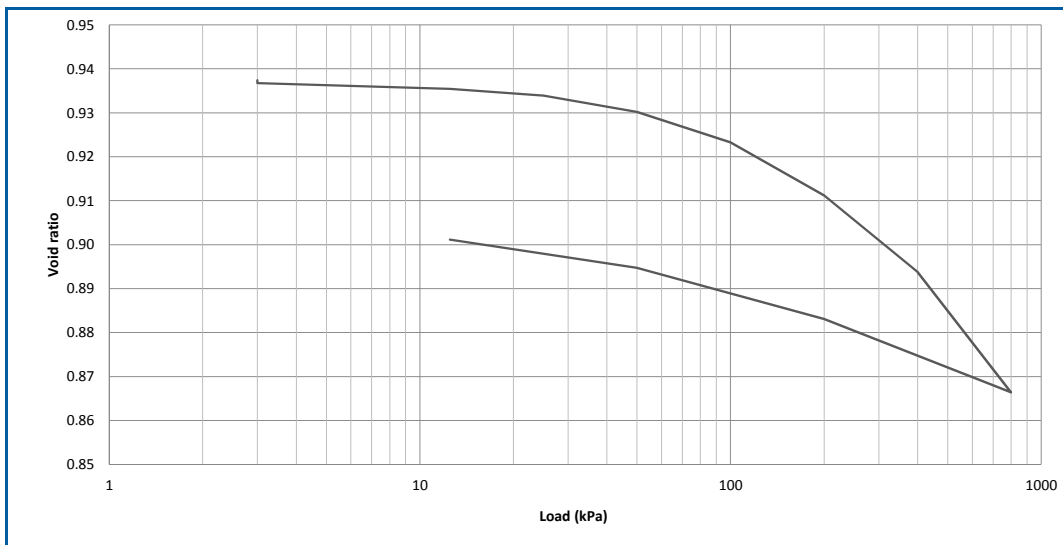
<b>Project:</b>	Esselen Park
<b>Client:</b>	Geohazard Solutions
<b>Geolab Job Nr:</b>	G18-237
<b>Test Method:</b>	TMH 6 ST10

<b>Sample Nr:</b>	TP08
<b>Sample Depth:</b>	2.6-5.5m
<b>Date:</b>	2018-10-31

Load kPa	Height mm	Void Ratio	$m_v$ MPa <sup>-1</sup>
3.0	20.170	0.937	
3.0	20.163	0.937	
12.5	20.15	0.935	0.068
25.0	20.134	0.934	0.064
50.0	20.095	0.930	0.077
100.0	20.023	0.923	0.072
200.0	19.897	0.911	0.063
400.0	19.716	0.894	0.045
800.0	19.431	0.866	0.036
200.0	19.605	0.883	
50.0	19.726	0.895	
12.5	19.793	0.901	

<b>Sampling Method:</b>	Block
<b>Disturbed/Undist:</b>	Undisturbed
<b>Remoulded To:</b>	-

	Initial	Final	
<b>Sample Height:</b>	20.17	19.79	mm
<b>Sample Mass:</b>	128.06	130.20	g
<b>Dry Density:</b>	1529	1558	kg/m <sup>3</sup>
<b>Density</b>	1993	2065	kg/m <sup>3</sup>
<b>Moisture Content:</b>	30.4	32.6	%
<b>Void Ratio:</b>	0.937	0.901	
<b>Specific Gravity:</b>	2.962		Mg/m <sup>3</sup>



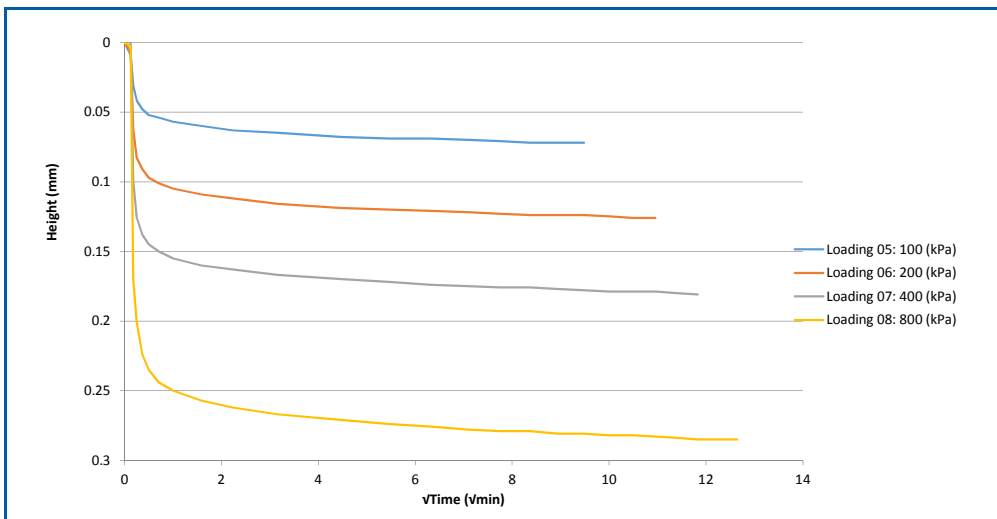
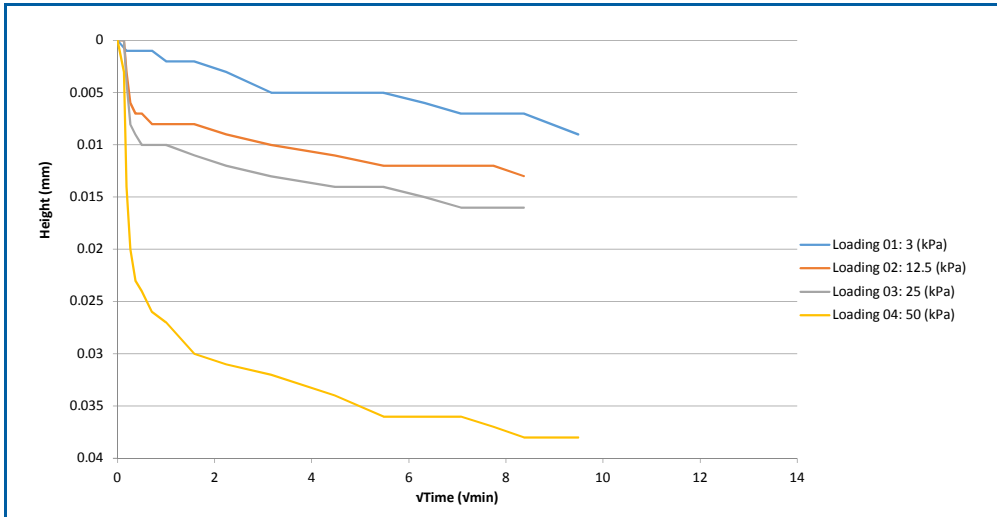
\* -  $m_v$  values provided are incremental and only valid for the specific load increment.

# Oedometer

## Time Readings

<b>Project:</b>	Esselen Park
<b>Client:</b>	Geohazard Solutions
<b>Geolab Job Nr:</b>	G18-237
<b>Test Method:</b>	TMH 6 ST10

<b>Sample Nr:</b>	TP08
<b>Sample Depth:</b>	2.6-5.5m
<b>Date:</b>	2018-10-31



# Oedometer

## TMH 6 ST10

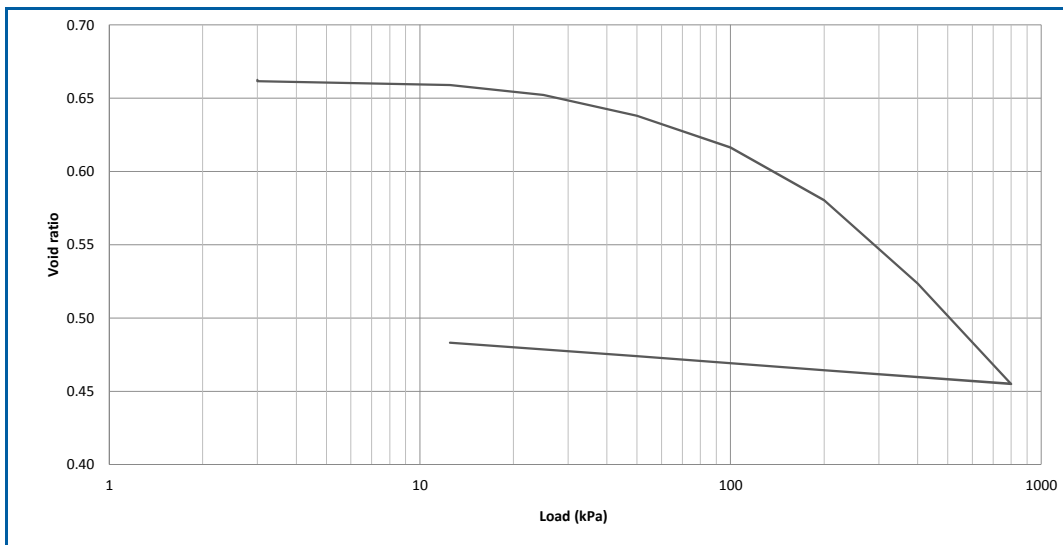
<b>Project:</b>	Esselen Park
<b>Client:</b>	Geohazard Solutions
<b>Geolab Job Nr:</b>	G18-237
<b>Test Method:</b>	TMH 6 ST10

<b>Sample Nr:</b>	TP11
<b>Sample Depth:</b>	2.45-3.80m
<b>Date:</b>	2018-11-08

Load kPa	Height mm	Void Ratio	$m_v$ MPa <sup>-1</sup>
3.0	20.110	0.662	
3.0	20.101	0.662	
12.5	20.069	0.659	0.168
25.0	19.986	0.652	0.331
50.0	19.814	0.638	0.344
100.0	19.552	0.616	0.264
200.0	19.116	0.580	0.223
400.0	18.43	0.524	0.179
800.0	17.601	0.455	0.112
200.0	17.713	0.464	
50.0	17.829	0.474	
12.5	17.942	0.483	

<b>Sampling Method:</b>	Block
<b>Disturbed/Undist:</b>	Undisturbed
<b>Remoulded To:</b>	-

	Initial	Final	
<b>Sample Height:</b>	20.11	17.94	mm
<b>Sample Mass:</b>	121.43	126.00	g
<b>Dry Density:</b>	1657	1857	kg/m <sup>3</sup>
<b>Density</b>	1898	2207	kg/m <sup>3</sup>
<b>Moisture Content:</b>	14.6	18.9	%
<b>Void Ratio:</b>	0.662	0.483	
<b>Specific Gravity:</b>	2.754		Mg/m <sup>3</sup>



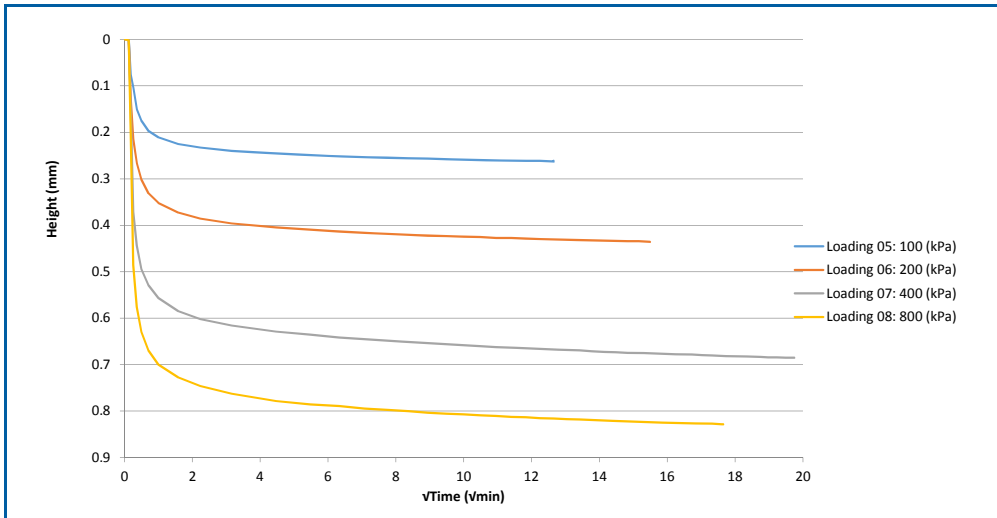
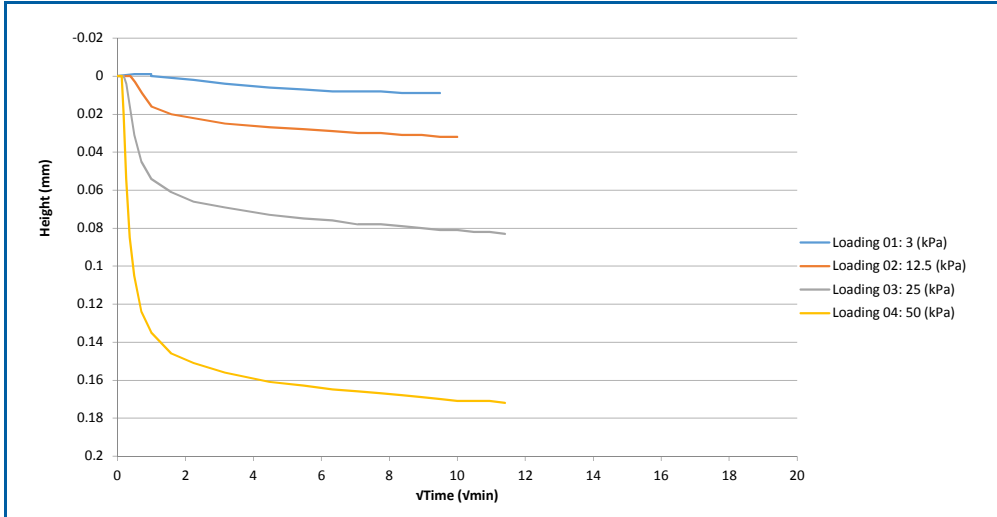
\* -  $m_v$  values provided are incremental and only valid for the specific load increment.

# Oedometer

## Time Readings

<b>Project:</b>	Esselen Park
<b>Client:</b>	Geohazard Solutions
<b>Geolab Job Nr:</b>	G18-237
<b>Test Method:</b>	TMH 6 ST10

<b>Sample Nr:</b>	TP11
<b>Sample Depth:</b>	2.45-3.80m
<b>Date:</b>	2018-11-08



# Oedometer

## TMH 6 ST10

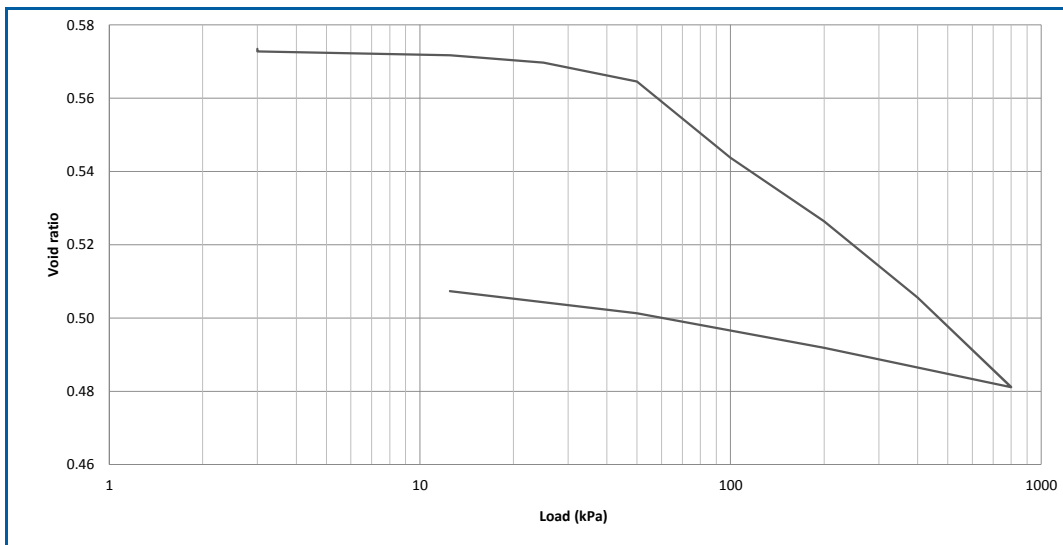
<b>Project:</b>	Esselen Park
<b>Client:</b>	Geohazard Solutions
<b>Geolab Job Nr:</b>	G18-237
<b>Test Method:</b>	TMH 6 ST10

<b>Sample Nr:</b>	TP25
<b>Sample Depth:</b>	2.10-5.50m
<b>Date:</b>	2018-10-30

Load kPa	Height mm	Void Ratio	$m_v$ MPa <sup>-1</sup>
3.0	20.170	0.573	
3.0	20.162	0.573	
12.5	20.148	0.572	0.073
25.0	20.122	0.570	0.103
50.0	20.056	0.565	0.131
100.0	19.79	0.544	0.265
200.0	19.567	0.526	0.113
400.0	19.3	0.506	0.068
800.0	18.987	0.481	0.041
200.0	19.125	0.492	
50.0	19.245	0.501	
12.5	19.323	0.507	

<b>Sampling Method:</b>	Block
<b>Disturbed/Undist:</b>	Undisturbed
<b>Remoulded To:</b>	-

	Initial	Final	
<b>Sample Height:</b>	20.17	19.32	mm
<b>Sample Mass:</b>	126.16	130.20	g
<b>Dry Density:</b>	1698	1773	kg/m <sup>3</sup>
<b>Density</b>	1964	2116	kg/m <sup>3</sup>
<b>Moisture Content:</b>	15.6	19.3	%
<b>Void Ratio:</b>	0.573	0.507	
<b>Specific Gravity:</b>	2.672		Mg/m <sup>3</sup>



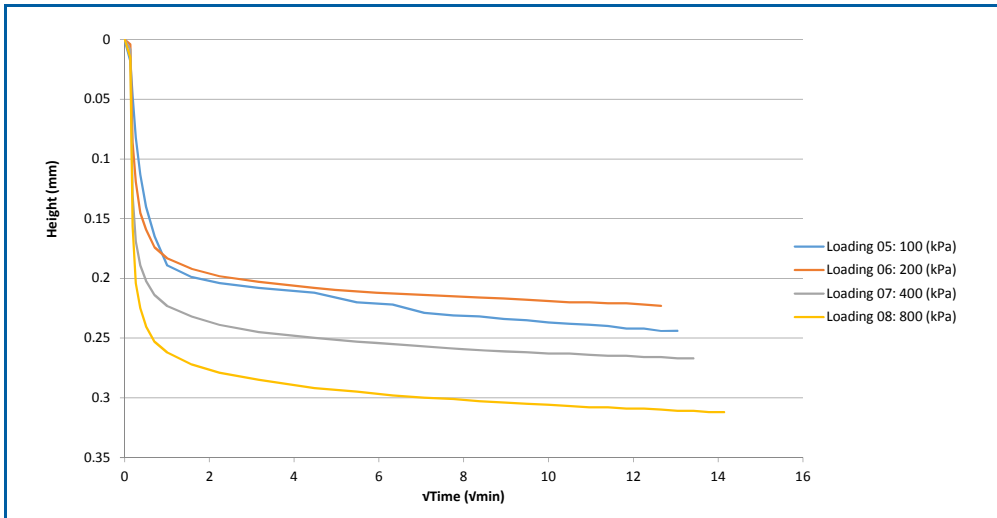
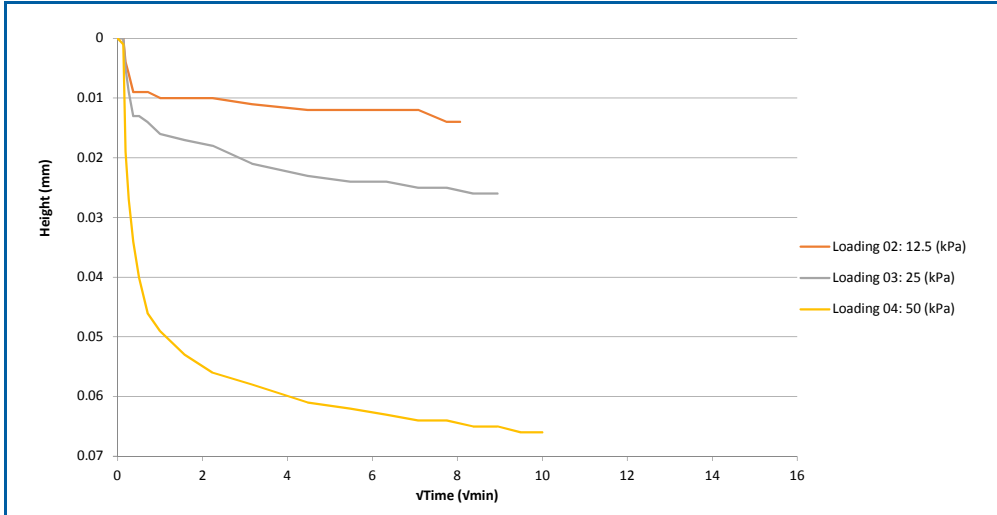
\* -  $m_v$  values provided are incremental and only valid for the specific load increment.

# Oedometer

## Time Readings

<b>Project:</b>	Esselen Park
<b>Client:</b>	Geohazard Solutions
<b>Geolab Job Nr:</b>	G18-237
<b>Test Method:</b>	TMH 6 ST10

<b>Sample Nr:</b>	TP25
<b>Sample Depth:</b>	2.10-5.50m
<b>Date:</b>	2018-10-30





# Oedometer

## TMH 6 ST10

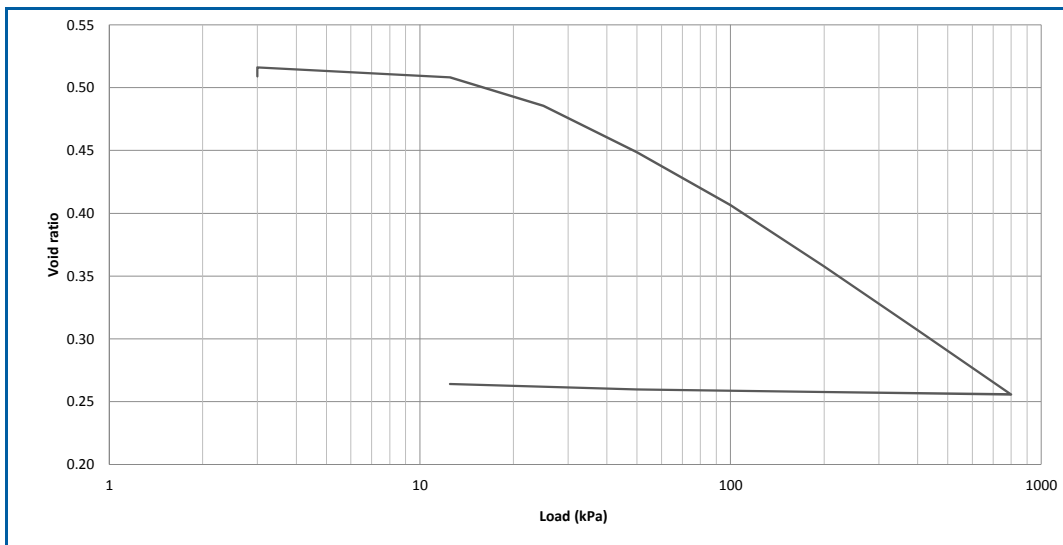
<b>Project:</b>	Esselen Park
<b>Client:</b>	Geohazard Solutions
<b>Geolab Job Nr:</b>	G18-237
<b>Test Method:</b>	TMH 6 ST10

<b>Sample Nr:</b>	TP26
<b>Sample Depth:</b>	1.30-2.60m
<b>Date:</b>	2018-10-30

Load kPa	Height mm	Void Ratio	$m_v$ MPa <sup>-1</sup>
3.0	20.110	0.509	
3.0	20.204	0.516	
12.5	20.1	0.508	0.542
25.0	19.796	0.485	1.210
50.0	19.305	0.449	0.992
100.0	18.745	0.407	0.580
200.0	18.094	0.358	0.347
400.0	17.416	0.307	0.187
800.0	16.736	0.256	0.098
200.0	16.763	0.258	
50.0	16.788	0.260	
12.5	16.845	0.264	

<b>Sampling Method:</b>	Block
<b>Disturbed/Undist:</b>	Undisturbed
<b>Remoulded To:</b>	-

	Initial	Final	
<b>Sample Height:</b>	20.11	16.85	mm
<b>Sample Mass:</b>	129.13	132.50	g
<b>Dry Density:</b>	1793	2140	kg/m <sup>3</sup>
<b>Density</b>	2018	2472	kg/m <sup>3</sup>
<b>Moisture Content:</b>	12.6	15.5	%
<b>Void Ratio:</b>	0.509	0.264	
<b>Specific Gravity:</b>	2.705		Mg/m <sup>3</sup>



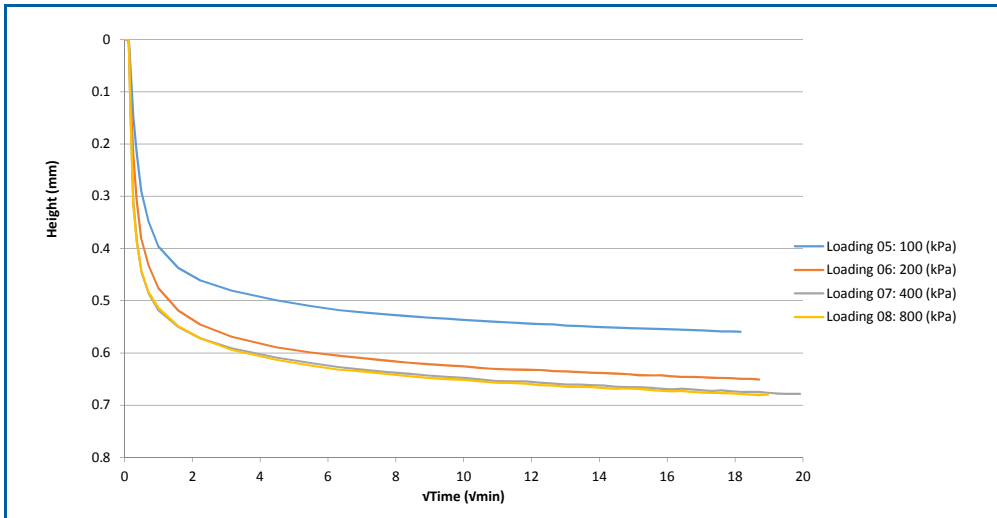
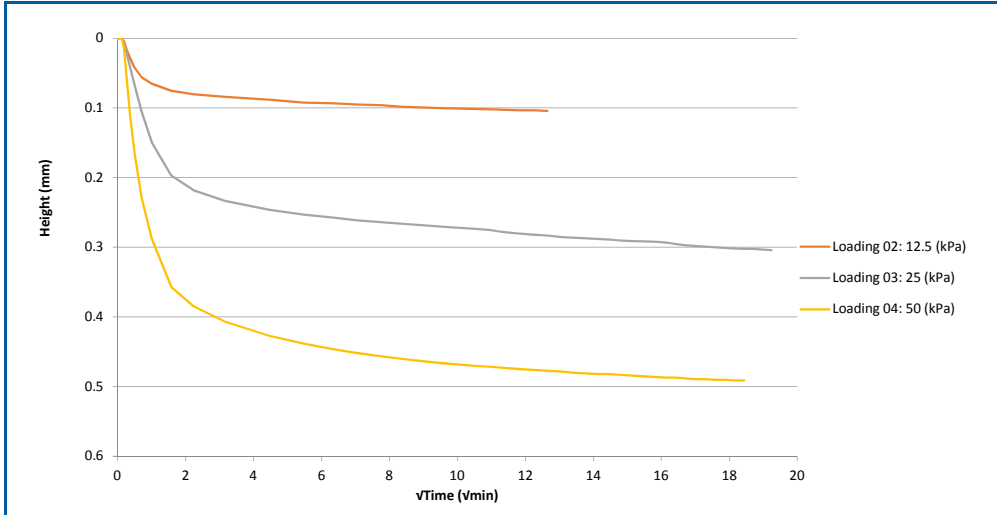
\* -  $m_v$  values provided are incremental and only valid for the specific load increment.

# Oedometer

## Time Readings

<b>Project:</b>	Esselen Park
<b>Client:</b>	Geohazard Solutions
<b>Geolab Job Nr:</b>	G18-237
<b>Test Method:</b>	TMH 6 ST10

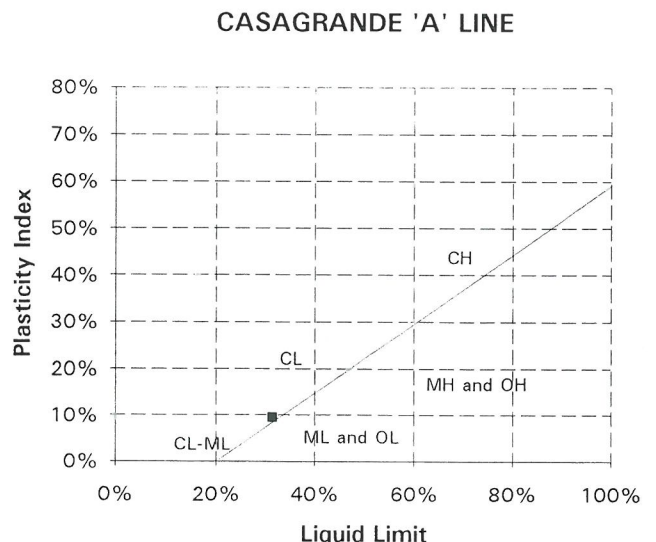
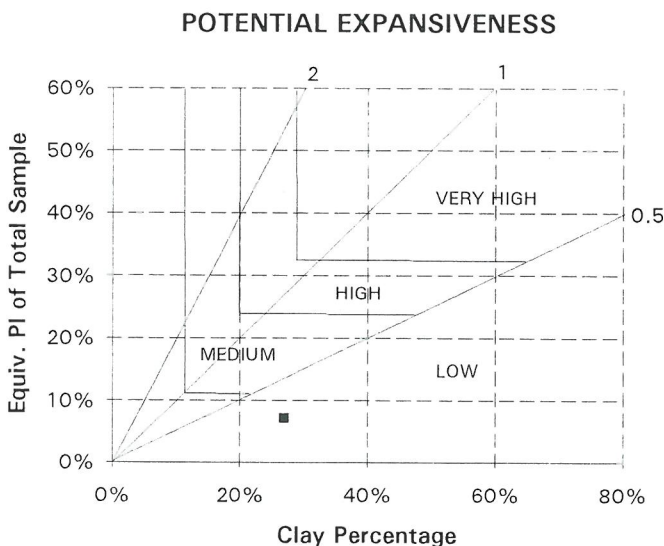
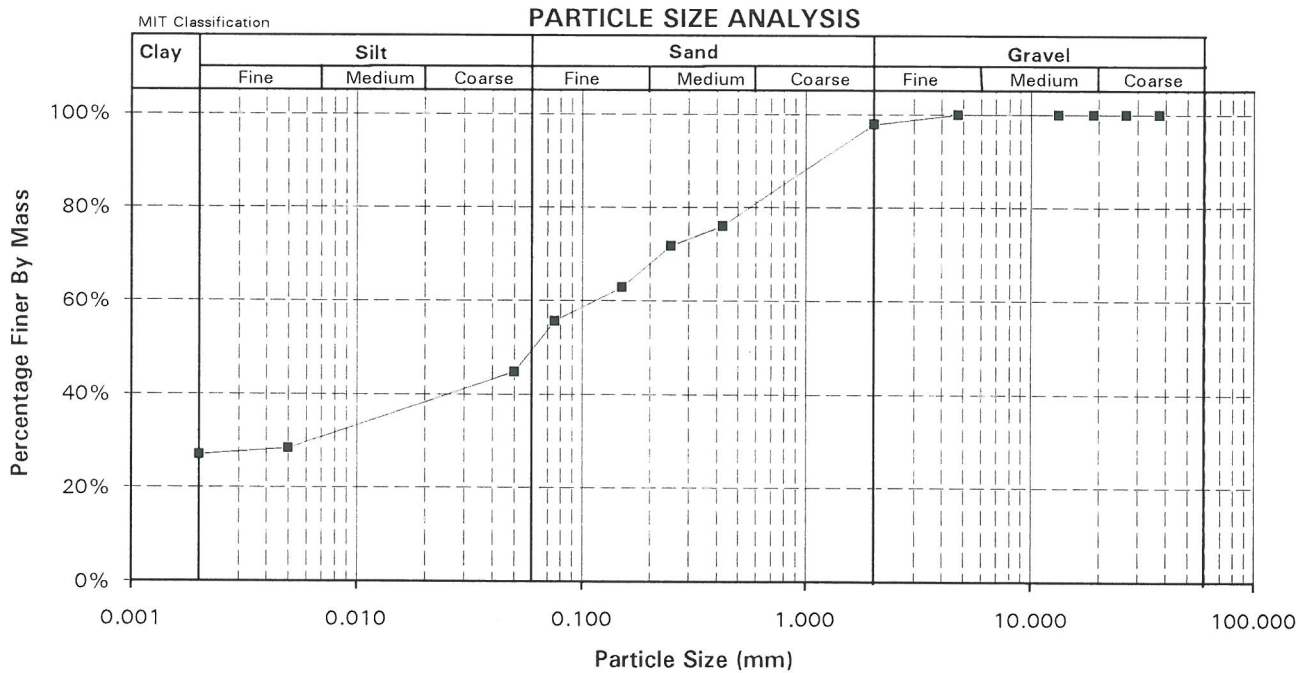
<b>Sample Nr:</b>	TP26
<b>Sample Depth:</b>	1.30-2.60m
<b>Date:</b>	2018-10-30





### FOUNDATION INDICATOR

Client	Intraconsult ( Acc No. IN001 )			Date	10/22/99	
Project Site	Ref. No. IR 369, Esselen Park			Job #	22158	
Test Pos Sample	J 12 Undisturbed			Depth	1,0	
SIEVE ANALYSIS				ATTERBERG LIMITS		
Sieve(mm)	% Passing	Sieve(mm)	% Passing		Test 1	Test 2
37.500	100%	0.250	72%	Liquid Limit	31.2%	31.8%
26.500	100%	0.150	63%	Average	31.5%	
19.000	100%	0.075	56%	Plastic Limit	21.9%	22.2%
13.200	100%	0.050	45%	Average	22.1%	
4.750	100%	0.005	28%	Plasticity Index (PI)	9.4%	
2.000	98%	0.002	27%	Linear Shrinkage	4.0%	
0.425	76%			Grading Modulus	0.70	
				PRA Classification	A-4 [4]	
				Unified Classification	CL	
				PI of whole sample	7.2%	
				% Gravel	2.2%	
				% Sand	48.2%	
				% Silt	22.7%	
				% Clay	27.0%	








CLIENT:- Intraconsult  
PROJECT:- IR 369,  
SITE:- Esselen Park

DAT 17/08/99  
JOB 22158

### CONDUCTIVITY & PH VALUES

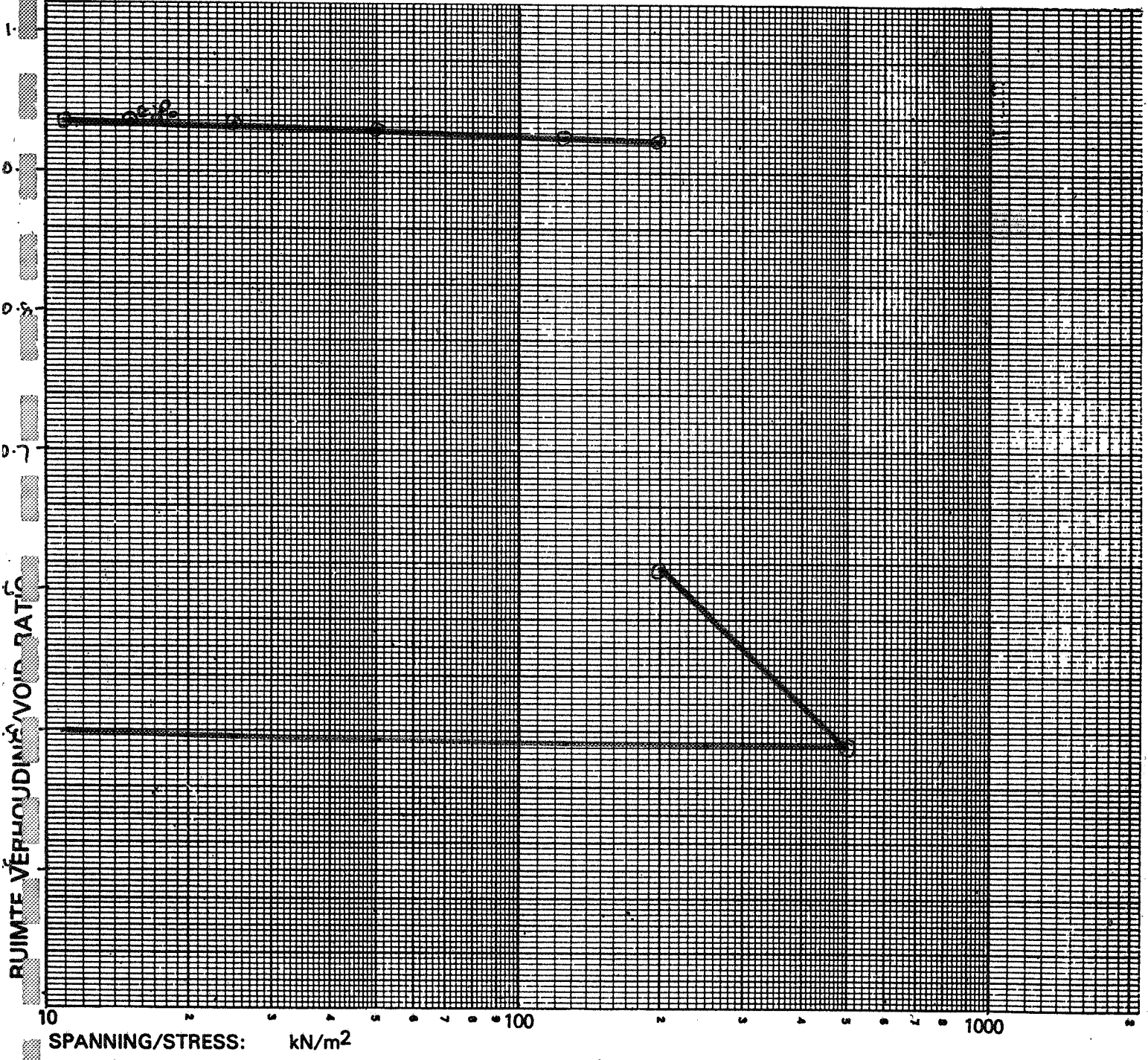
TEST HOLE NO.	DEPTH m	CONDUCTIVITY ( mS/cm )	PH VALUE
B 15	1,2	-	5,51
E 15	0,6	-	5.1
D 16	1,5	-	4,98
J 12	1,0	-	5,04
H 4	1,0	-	5,07

TEST DONE BY:- G. FRIEDRICH

CLIENT <i>Intraconsult</i>	DATE <i>15.10.99</i>	
PROJECT <i>Esselen Park</i>	JOB No	
SITE	TEST No <i>312</i>	

**KONSOLIDASIE TOETS – CONSOLIDATION TEST**

Diepte van Monster: Depth of Sample: <i>1 m</i>	Soortlike Gewig: Specific Gravity: <i>2.65</i>
Monster: Onversteurd: Sample: Undisturbed	Aanvanklike Droë Digtheid: <i>1769</i> kg/m <sup>3</sup> Initial Dry Density:
Monster Beskrywing: <i>CP<sub>200</sub>: 15.80%</i> Sample Description	Aanvanklike Voggehalte: <i>8.25</i> % Initial Moisture Content:
Opmerkings: Comments: <b>Soaked at 200 kpa</b>	Finale Voggehalte: <i>18.70</i> % Final Moisture Content:



CLIENT Intraconsult

DATE 15.10.99

PROJECT Esselen Park

JOB No

SITE

TEST No 312



**KONSOLIDASIE TOETS - CONSOLIDATION TEST**

Diepte van Monster: 1m  
Depth of Sample:

Opmerking: Soaked at 200 kpa  
Remarks:

Toets Nummer: 5  
Test Number:

Volgnummer: 1467  
Serial Number:

**TYD-VERSAKKINGS LESINGS  
TIME-SETTLEMENT READINGS**

Lading Load Load Korreksie Correction	kN/m <sup>2</sup>	25		50		125		200		500		1000		2000	
		1	7	2	11	3	16	4	20	5	29	6	7	6	6h
TYD Time	(mic - t)	Meter Lesing	Dial Reading	Meter Lesing	Dial Reading	Meter Lesing	Dial Reading	Meter Lesing	Dial Reading	Meter Lesing	Dial Reading	Meter Lesing	Dial Reading	Meter Lesing	Dial Reading
0.0	.00	7	19	78	70	54	1674	1654							
0.2	.02	17	20	58	78	58	2205	2176							
0.3	.09	14	21	59	79	59	2220	2201							
0.4	.16	14	21	60	80	60	2247	2218							
0.5	.25	14	22	60	81	61	2259	2230							
0.6	.36	14	22	61	82	62	2268	2239							
0.8	.64	15	22	62	83	63	2280	2251							
1.0	1.00	15	22	62	84	64	2288	2259							
1.5	2.25	16	22	62	85	65	2301	2272							
2.0	4.00	16	22	64	86	66	2308	2279							
2.5	6.25	16	22	65	87	67	2312	2284							
3.0	9.00	16	22	65	88	68	2316	2287							
3.5	12.25	17	22	66	89	69	2318	2289							
4.0	16.00	17	22	66	89	69	2320	2291							
5.0	25.00	17	22	67	90	70	2322	2294							
6.0	36.00	18	22	67	90	70	2325	2296							
7.0	49.00	18	22	67	91	71	2327	2298							
8.0	64.00	18	22	68	91	71	2328	2299							
9.0	81.00	18	22	68	92	72	2329	2300							
10.0	100.00	18	22	68	92	72	2330	2301							
15.0	225.00	19	22	69	92	72	2332	2304							
20.0	400.00	19	22	69	94	74	2335	2306							
30.0	900.00	19	22	70	94	74	2339	2310							
Final Cost			.024		.054		.108		.148						

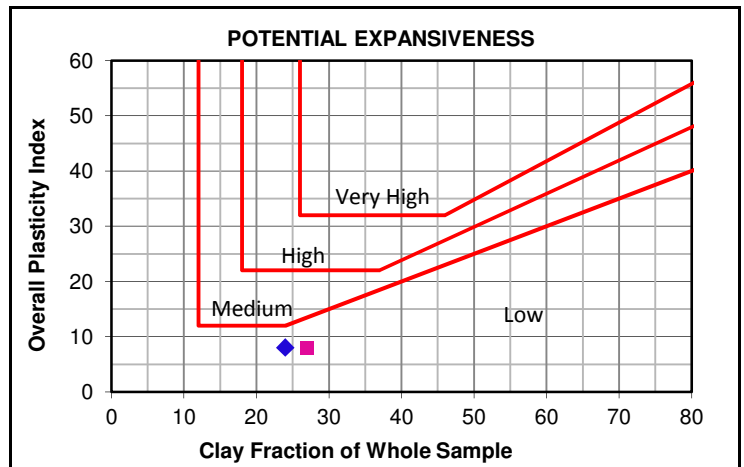
	11KR	(12)	25KR	(17)	50KR	(20)	125KR	(25)	200KR	(29)	400KR	(34)
Ontlaai/Rebound	2270	2287	2270	2201	2281	2316	2293	2278	2302			
Lading/Loading	2257											
Ontlaai/Rebound												

Client : CROSSMAN PAPE ASSOCIATES cc  
 Project : Esselan Park  
 Project No : 2013-B-2293

Date Received: 10/10/2013  
 Date Reported: 01/11/2013  
 Page No. : 2 of 5

### FOUNDATION INDICATOR

Laboratory Number	1 <span style="color:blue">◆</span>	2 <span style="color:magenta">■</span>
Field Number	TP 13	TP 31
Client Reference		
Depth (m)	1.8-2.0	0.3-0.5
Position		
Coordinates	X Y	
Description		
Additional Information		
Calcrete / Crushed Stabilizing Agent		

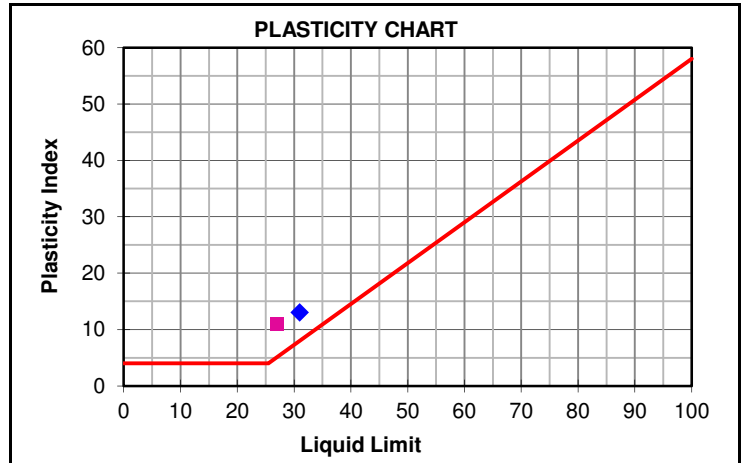


**Moisture Content & Relative Density-TMH1 Meted A12T**

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

**Sieve Analysis (Wet Preparation) - TMH1 Method A1(a)**

Percentage Passing	75.0 mm	100	100
	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	98	99
	2.00 mm	80	95
	0.425 mm	59	71
	0.075 mm	48	51
Grading Modulus	1.13	0.83	



**Hydrometer Analysis - ASTM Method D422**

Percentage Passing	0.060 mm	45	48
	0.040 mm	39	44
	0.020 mm	33	39
	0.006 mm	28	34
	0.002 mm	24	27
Gravel	%	20	5
Sand	%	35	47
Silt	%	21	21
Clay	%	24	27

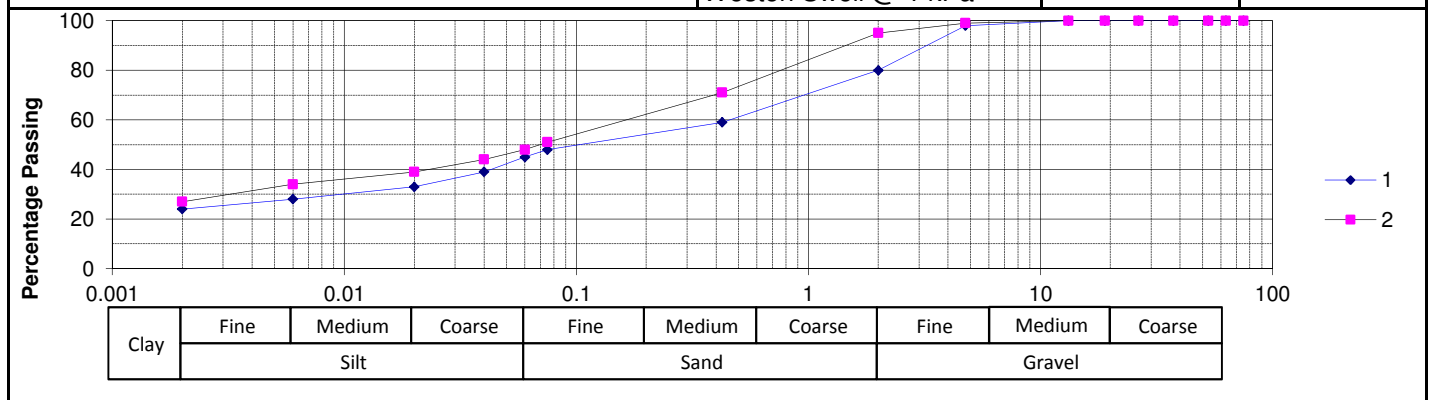
Laboratory Number	1 <span style="color:blue">◆</span>	2 <span style="color:magenta">■</span>
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**Atterberg Limits - TMH1 Method A2, A3 & A4**

Liquid Limit	%	31	27
Plasticity Index	%	13	11
Linear Shrinkage	%	7.5	5.5
Overall PI	%	8	8

**Classifications**

HRB	A-6(3)	A-6(3)
Unified	SC	CL
Weston Swell @ 1 kPa		







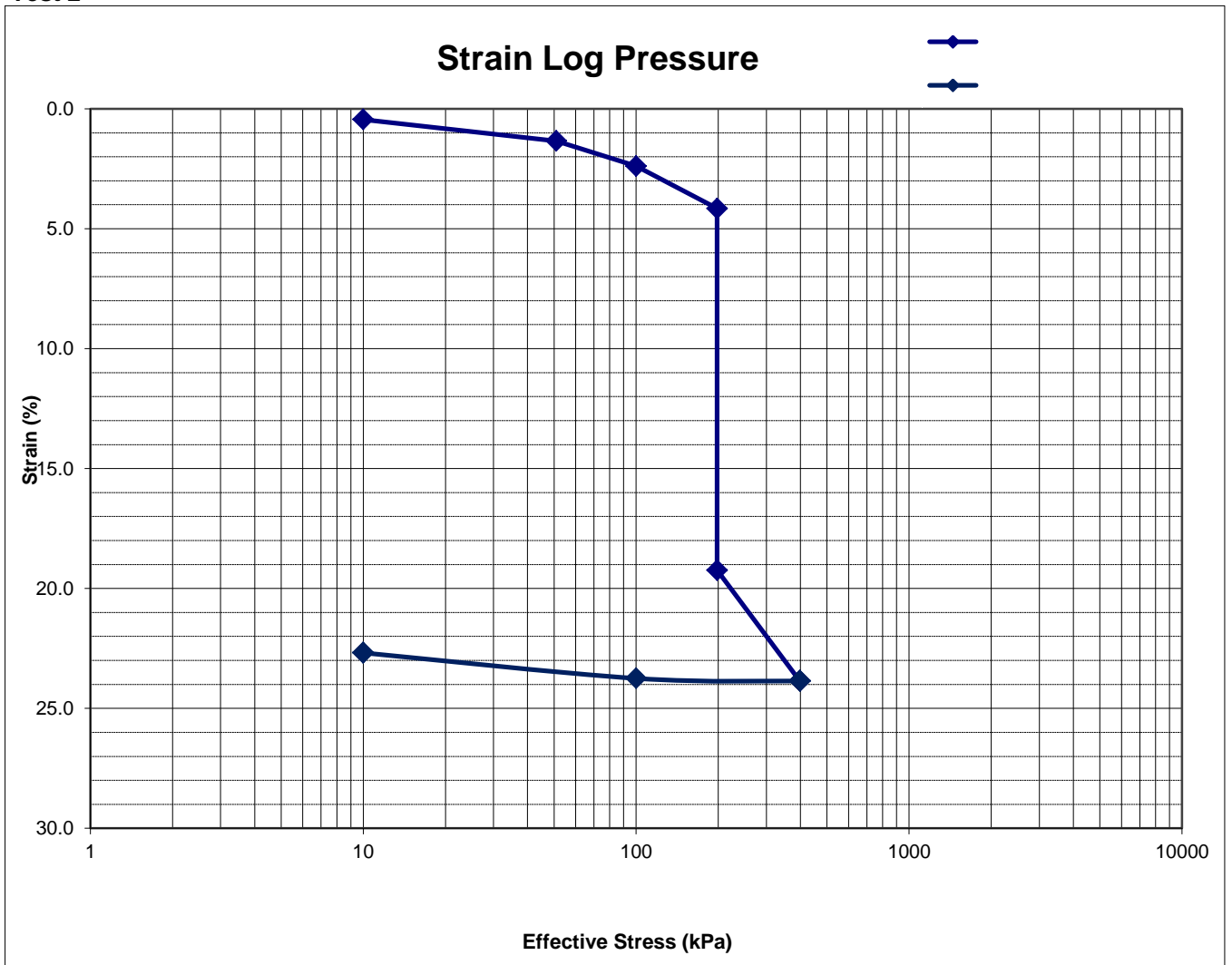
## Consolidation Tests

Project: ESSELAN PARK	
Project No.: 2013-B-2293	Sample No.: 2293-2
Borehole No: TP 31	Depth: 0.3 - 0.5
Date Received: 10/10/2013	Date Tested: 17/10/2013

### Test 1

Effect.Stress (kPa)	10	51	100	198	198	398	100	10			
Strain (%)	0.45	1.34	2.39	4.15	19.23	23.86	23.75	22.68			
Mv (1/MPa)		0.2172	0.2141	0.1801		0.2311	0.0037	0.1184			
Void Ratio	0.906	0.8889	0.8688	0.835	0.5463	0.4578	0.45986	0.4803			

### Test 2



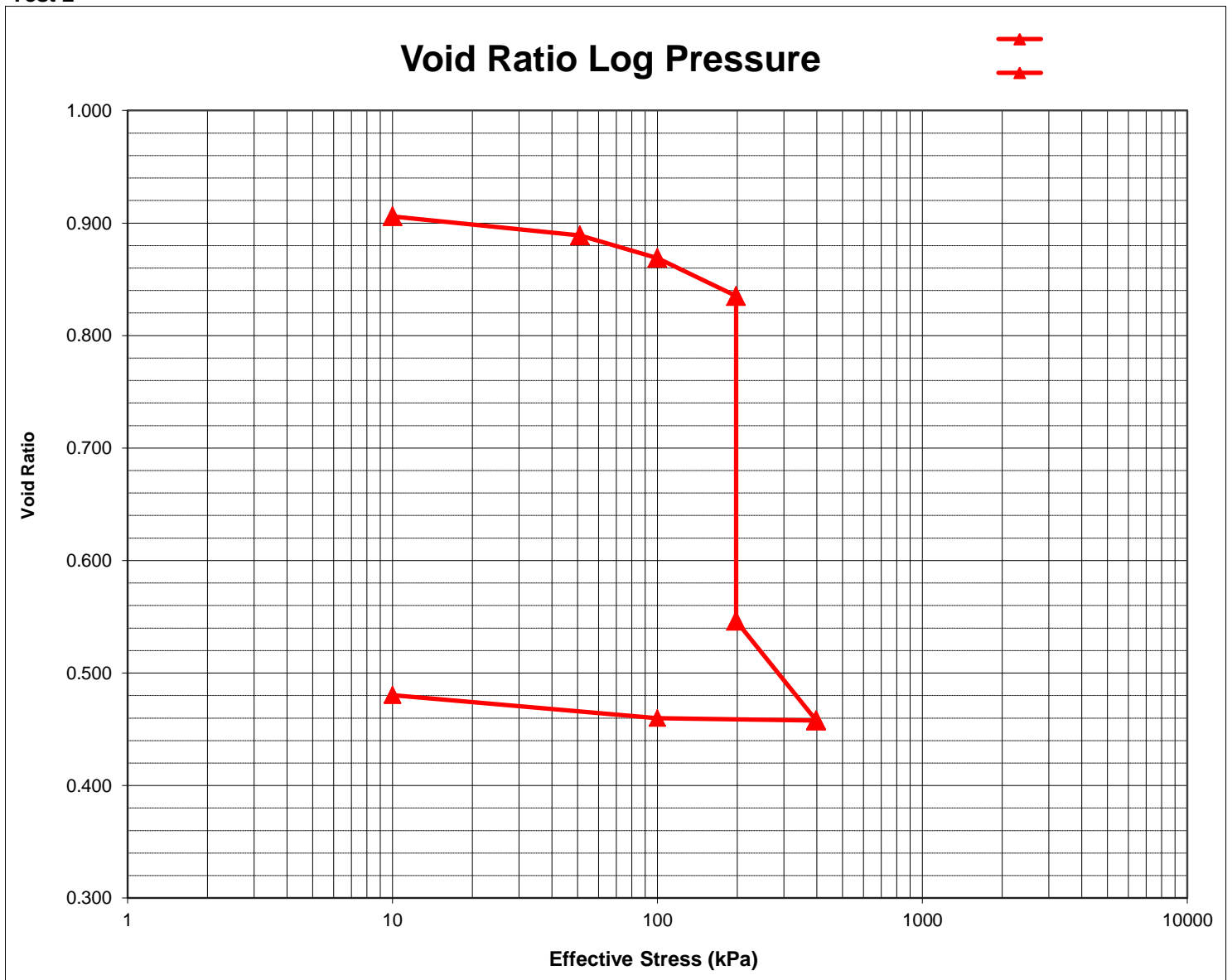
## Consolidation Tests

Project: ESSELAN PARK	
Project No.: 2013-B-2293	Sample No.: 2293-2
Borehole No: TP 31	Depth: 0.3 - 0.5
Date Received: 10/10/2013	Date Tested: 17/10/2013

### Test 1

Effect. Stress (kPa)	10	51	100	198	198	398	100	10			
Strain (%)	0.45	1.34	2.39	4.15	19.23	23.86	23.75	22.68			
Mv (1/MPa)		0.2172	0.2141	0.1801		0.2311	0.0037	0.1184			
Void Ratio	0.90596	0.88891	0.86882	0.83503	0.54628	0.45777	0.45986	0.48027			

### Test 2



<b>LABORATORY AND HEAD OFFICE ADDRESS:</b>	Reg.No.: 92/03145/07
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<b>HEAD OFFICE CONTACT INFO.:</b>	Tel.: +27(0) 31 266 0458      Fax: 086 689 5506 Mobile: +27(0) 82 784 0544      e-mail: <a href="mailto:geosure@iafrica.com">geosure@iafrica.com</a>
<b>WEBSITE:</b>	<a href="http://www.geosure.co.za">www.geosure.co.za</a>

<b>Client</b>	: Crossman, Pape and Associates	<b>Our Ref. :</b> 0104
<b>Project</b>	: Esselen Park	<b>Your Ref. :</b> -
		<b>Date Tested :</b> 10/09/2013
<b>Attention</b>	: Mr Justin Davel	<b>Date Reported :</b> 11/09/2013

<b>Sample No.</b>	T287	T288	T289	T290	T291
<b>Field No.</b>	TP41	TP60	TP72	TP2	TP63
<b>Position in Field</b>					
<b>Depth (m)</b>	1.0 - 0.5	0.7 - 1.8	1.1 - 3.0	0.7 - 1.2	0.1 - 1.2
<b>Material Description</b>	TP41	TP60	TP72	TP2	TP63

**Sieve Analysis ( ASTM - D422 )**

<b>% Passing</b>	<b>63.0 mm</b>	100	100	100	100	100
	<b>53.0 mm</b>	100	100	100	100	100
	<b>37.5 mm</b>	100	100	100	100	100
	<b>26.5 mm</b>	100	100	100	100	100
	<b>19.0 mm</b>	100	100	100	100	100
	<b>13.2 mm</b>	100	100	100	100	100
	<b>4.75 mm</b>	99	98	100	98	99
	<b>2.00 mm</b>	93	74	95	80	91
	<b>0.425 mm</b>	73	62	66	72	80
<b>0.075 mm</b>	35	47	49	51	55	

**Hydrometer Analysis ( ASTM - D422 )**

<b>% Passing</b>	<b>0.060 mm</b>	32	44	46	48	51
	<b>0.050 mm</b>	27	40	40	43	44
	<b>0.040 mm</b>	19	35	35	33	36
	<b>0.026 mm</b>	12	26	30	25	26
	<b>0.015 mm</b>	10	19	25	21	21
	<b>0.010 mm</b>	9	17	23	18	18
	<b>0.0074 mm</b>	7	13	21	16	13
	<b>0.0036 mm</b>	5	12	17	13	11
	<b>0.0020 mm</b>	4	9	15	11	10
<b>0.0015 mm</b>	4	8	14	10	10	

**Soil Mortar Analysis**

<b>Coarse Sand</b>	%	21	16	30	10	12
<b>Coarse Fine Sand</b>	%	15	8	8	12	12
<b>Medium Fine Sand</b>	%	15	7	5	6	10
<b>Fine Fine Sand</b>	%	11	5	5	8	5
<b>Silt &amp; Clay</b>	%	38	64	52	64	61
<b>Grading Modulus</b>		1.0	1.2	0.9	1.0	0.7

**Atterberg Limits and Classification**

<b>Liquid Limit</b>	%	21	32	27	30	28
<b>Plasticity Index</b>	%	10	11	6	8	10
<b>Linear Shrinkage</b>	%	5	6	3	4	5
<b>AASHTO Classification (Group Index)*</b>		A-2-4 (0)	A-6 (2)	A-4 (1)	A-4 (2)	A-4 (3)
<b>Unified Classification*</b>		SC	SC	SM-SC	CL	CL
<b>Moisture Content</b>	%					

<b>Remarks:</b>	Date Received: 27/08/2013
	Samples delivered by client
	*Opinions expressed herein fall outside the scope of SANAS accreditation.

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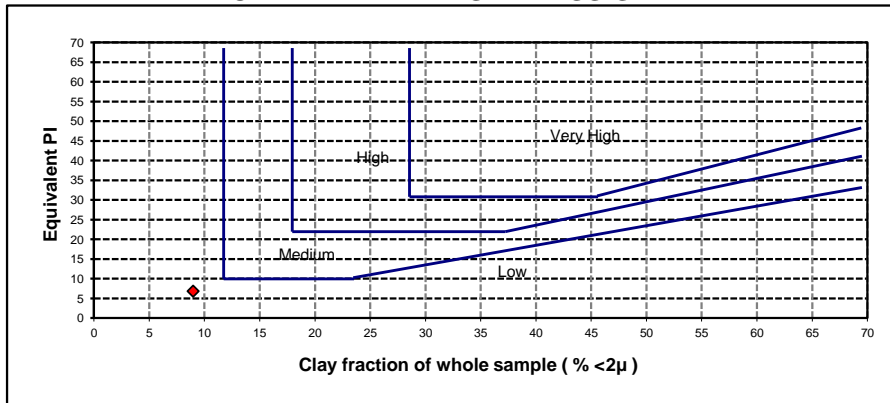


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	Mobile: +27(0) 82 784 0544	e-mail: <a href="mailto:geosure@iafrica.com">geosure@iafrica.com</a>
	<a href="http://www.geosure.co.za">www.geosure.co.za</a>	

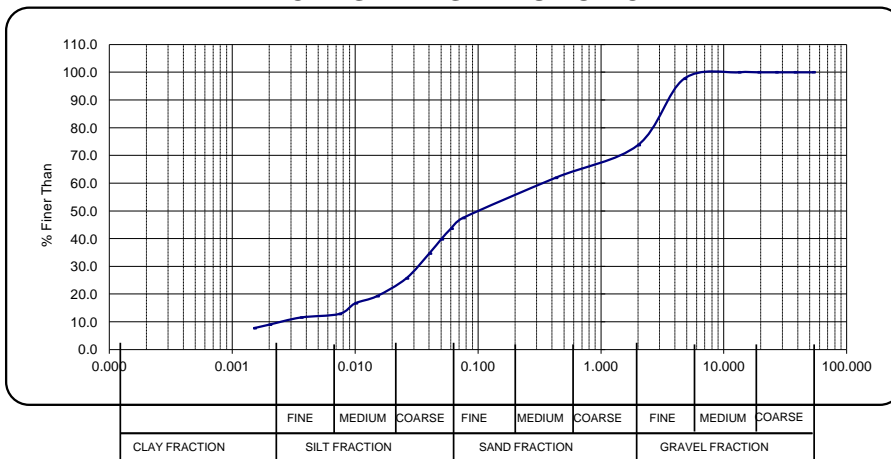
**Client** : Crossman, Pape and Associates **Job No.** : 0104  
**Project** : Esselen Park **Your Ref.No.** : -  
**Date Tested** : 10/09/2013  
**Attention** : Mr Justin Davel **Date Reported** : 11/09/2013

**Sample Number** : T288  
**Field No.** : TP60  
**Sample Description** : TP60  
**Equivalent PI** : 7 Clay fraction of whole sample (% <2μ) : 9

**POTENTIAL EXPANSIVENESS GRAPH**



**PARTICLE SIZE DISTRIBUTION CHART**



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<b>WEBSITE:</b>	<a href="http://www.geosure.co.za">www.geosure.co.za</a>	

**Client** : Crossman, Pape and Associates **Our Ref. : 0104**  
**Project** : Esselen Park **Your Ref. : -**  
**Date Tested : 27/08/2013**  
**Attention** : Mr Justin Davel **Date Reported : 13/09/2013**

<b>Sample No.</b>	T318	T328	T329	T330	T331
<b>Field No.</b>	TP18	TP54	TP54	TP7	TP79
<b>Position in Field</b>	[Patterned background]				
<b>Depth (m)</b>	0.4 - 0.7	0.5 - 1.1	1.1 - 3.0	0.4 - 0.7	1.6 - 3.0
<b>Material Description</b>	TP18	TP54	TP54	TP7	TP79

**Sieve Analysis ( ASTM - D422 )**

<b>% Passing</b>	63.0 mm	100	100	100	100	100
	53.0 mm	100	100	100	100	100
	37.5 mm	100	100	100	100	100
	26.5 mm	100	100	100	100	100
	19.0 mm	100	100	100	100	100
	13.2 mm	98	100	100	100	100
	4.75 mm	88	99	100	86	95
	2.00 mm	75	94	99	74	82
	0.425 mm	48	76	69	49	45
	0.075 mm	23	44	43	36	27

**Hydrometer Analysis ( ASTM - D422 )**

<b>% Passing</b>	0.060 mm	21	40	37	32	25
	0.050 mm	19	37	33	29	22
	0.040 mm	15	33	28	25	18
	0.026 mm	12	30	22	21	15
	0.015 mm	9	26	18	18	12
	0.010 mm	7	21	15	14	10
	0.0074 mm	4	18	12	11	8
	0.0036 mm	3	15	9	10	7
	0.0020 mm	2	12	6	7	4
	0.0015 mm	2	11	4	6	4

**Soil Mortar Analysis**

Coarse Sand	%	36	19	31	33	45
Coarse Fine Sand	%	12	13	8	8	12
Medium Fine Sand	%	11	14	12	3	5
Fine Fine Sand	%	10	8	5	8	5
Silt & Clay	%	31	46	44	48	33
Grading Modulus		1.5	0.9	0.9	1.4	1.5

**Atterberg Limits and Classification**

Liquid Limit	%	29	39	36	32	32
Plasticity Index	%	8	12	15	16	9
Linear Shrinkage	%	4	6	8	9	5
AASHTO Classification (Group Index)*		A-2-4 (0)	A-6 (1)	A-6 (3)	A-6 (1)	A-2-4 (0)
Unified Classification*		SC	SM	SC	SC	SC
Moisture Content	%	[Patterned background]				

<b>Remarks:</b>	Date Received: 27/08/2013
	Samples delivered by client
	*Opinions expressed herein fall outside the scope of SANAS accreditation.

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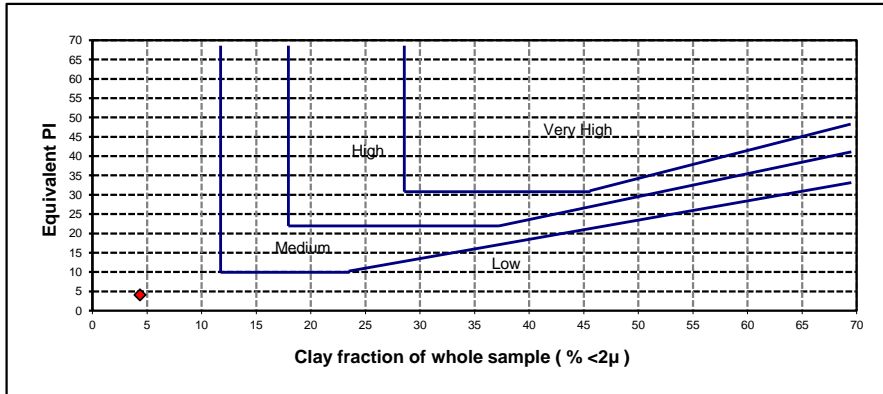
  
 for Geosure (Pty) Ltd.

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	Mobile: +27(0) 82 784 0544	e-mail: <a href="mailto:geosure@iafrica.com">geosure@iafrica.com</a>
	<a href="http://www.geosure.co.za">www.geosure.co.za</a>	

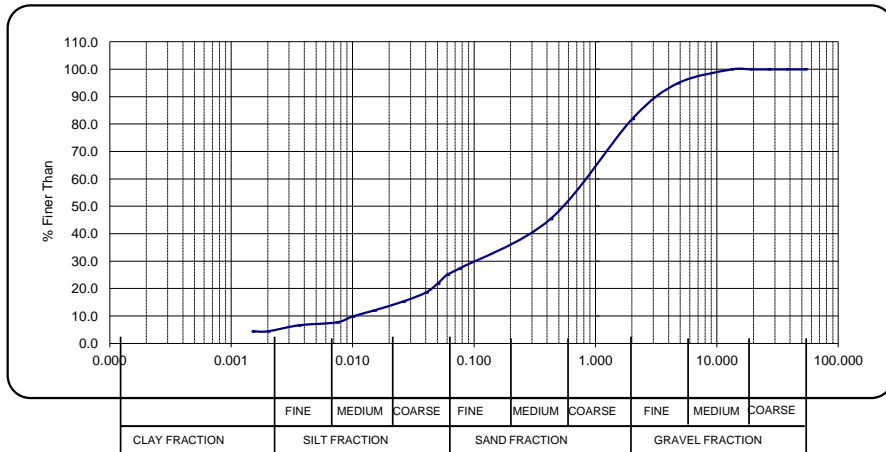
**Client** : Crossman, Pape and Associates **Job No.** : 0104  
**Project** : Esselen Park **Your Ref.No.** : -  
**Date Tested** : 27/08/2013  
**Attention** : Mr Justin Davel **Date Reported** : 13/09/2013

**Sample Number** : T331  
**Field No.** : TP79  
**Sample Description** : TP79  
**Equivalent PI** : 4 Clay fraction of whole sample (% <2μ) : 4

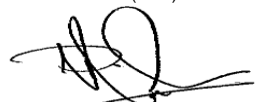
**POTENTIAL EXPANSIVENESS GRAPH**



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<b>HEAD OFFICE CONTACT INFO.:</b>		Mobile: +27(0) 83 377 6559	e-mail: <a href="mailto:gauteng@geosure.co.za">gauteng@geosure.co.za</a>
<b>WEBSITE:</b>		Tel.: +27(0) 31 266 0458	Fax: 086 689 5506
		Mobile: +27(0) 82 784 0544	e-mail: <a href="mailto:geosure@iafrica.com">geosure@iafrica.com</a>
		<a href="http://www.geosure.co.za">www.geosure.co.za</a>	

**Client** : Crossman, Pape and Associates **Our Ref. : 0104**  
**Project** : Esselen Park **Your Ref. : -**  
**Date Tested : 27/08/2013**  
**Attention** : Mr Justin Davel **Date Reported : 13/09/2013**

<b>Sample No.</b>	T332	T333	T334	T335	
<b>Field No.</b>	TP76	TP82	TP84	TP10	
<b>Position in Field</b>					
<b>Depth (m)</b>	0.9 - 1.4	1.0 - 2.2	1.8 - 2.3	1.2 - 1.6	
<b>Material Description</b>	TP76	TP82	TP84	TP10	

**Sieve Analysis ( ASTM - D422 )**

<b>% Passing</b>	<b>63.0 mm</b>	100	100	100	100	
	<b>53.0 mm</b>	100	100	100	100	
	<b>37.5 mm</b>	100	100	100	100	
	<b>26.5 mm</b>	100	100	100	100	
	<b>19.0 mm</b>	100	100	100	100	
	<b>13.2 mm</b>	99	98	100	100	
	<b>4.75 mm</b>	90	98	100	99	
	<b>2.00 mm</b>	69	74	90	76	
	<b>0.425 mm</b>	43	47	60	47	
	<b>0.075 mm</b>	21	24	46	9	

**Hydrometer Analysis ( ASTM - D422 )**

<b>% Passing</b>	<b>0.060 mm</b>	18	22	42	8	
	<b>0.050 mm</b>	15	20	38	6	
	<b>0.040 mm</b>	14	18	34	6	
	<b>0.026 mm</b>	12	15	28	4	
	<b>0.015 mm</b>	9	13	23	3	
	<b>0.010 mm</b>	7	11	18	2	
	<b>0.0074 mm</b>	6	9	15	1	
	<b>0.0036 mm</b>	5	7	11	1	
	<b>0.0020 mm</b>	3	6	8	1	
	<b>0.0015 mm</b>	3	5	7	1	

**Soil Mortar Analysis**

<b>Coarse Sand</b>	%	38	37	33	38	
<b>Coarse Fine Sand</b>	%	15	11	9	20	
<b>Medium Fine Sand</b>	%	8	11	4	13	
<b>Fine Fine Sand</b>	%	9	9	3	17	
<b>Silt &amp; Clay</b>	%	30	32	51	12	
<b>Grading Modulus</b>		1.7	1.6	1.0	1.7	

**Atterberg Limits and Classification**

<b>Liquid Limit</b>	%	31	35	35	NP	
<b>Plasticity Index</b>	%	8	8	13	NP	
<b>Linear Shrinkage</b>	%	5	4	7	0	
<b>AASHTO Classification (Group Index)*</b>		A-2-4 (0)	A-2-4 (0)	A-6 (3)	A-3 (0)	
<b>Unified Classification*</b>		SC	SM	SC	SP	
<b>Moisture Content</b>	%					

<b>Remarks:</b>	Date Received: 27/08/2013
	Samples delivered by client
	*Opinions expressed herein fall outside the scope of SANAS accreditation.

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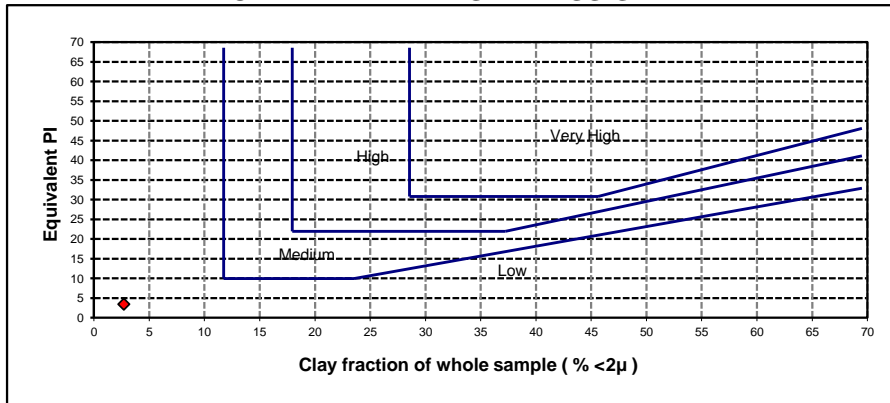
  
 for Geosure (Pty) Ltd.

<b>LABORATORY ADDRESS:</b>	<b>Reg.No.:</b> 92/03145/07	
<b>LABORATORY CONTACT INFO.:</b>	Unit B1, Tillbury Business Park, 1030 16th Road, Randjespark, Midrand	
<b>HEAD OFFICE CONTACT INFO.:</b>	Tel.: +27(0) 11 314 3148	Fax: +27 (0) 11 314 4278
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	Tel.: +27(0) 31 266 0458	Fax: 086 689 5506
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	<a href="http://www.geosure.co.za">www.geosure.co.za</a>	

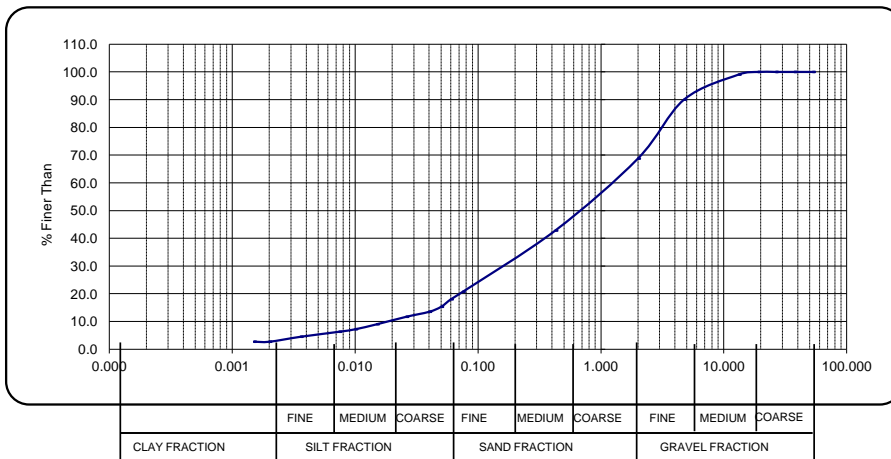
**Client** : Crossman, Pape and Associates **Job No.** : 0104  
**Project** : Esselen Park **Your Ref.No.** : -  
**Date Tested** : 27/08/2013  
**Attention** : Mr Justin Davel **Date Reported** : 13/09/2013

**Sample Number** : T332  
**Field No.** : TP76  
**Sample Description** : TP76  
**Equivalent PI** : 3 Clay fraction of whole sample (% <2μ) : 3

**POTENTIAL EXPANSIVENESS GRAPH**



**PARTICLE SIZE DISTRIBUTION CHART**



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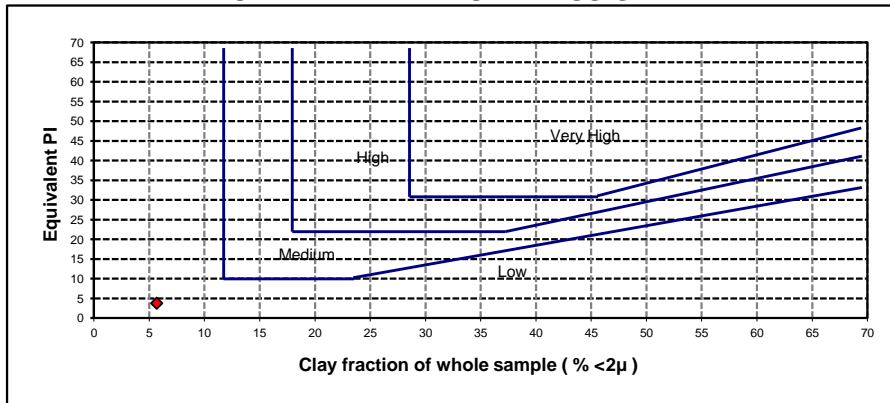


LABORATORY ADDRESS:	Reg.No.: 92/03145/07	
LABORATORY CONTACT INFO.:	Unit B1, Tillbury Business Park, 1030 16th Road, Randjespark, Midrand	
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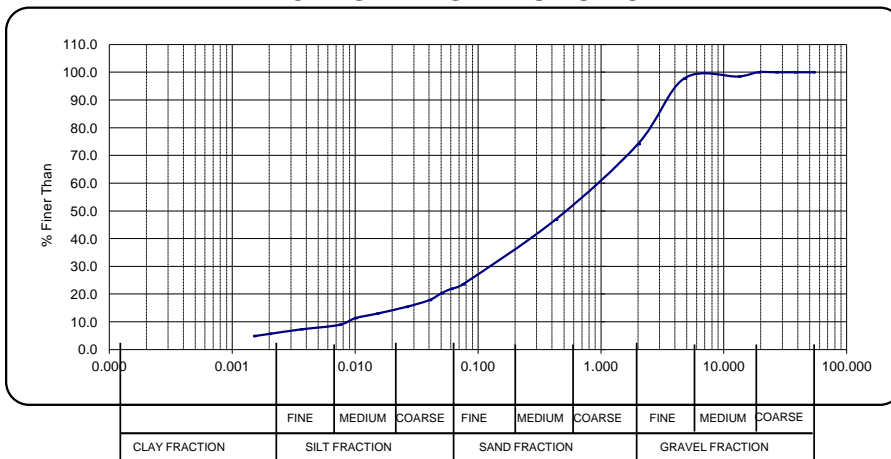
Client : Crossman, Pape and Associates Job No. : 0104  
 Project : Esselen Park Your Ref.No. : -  
 Attention : Mr Justin Davel Date Tested : 27/08/2013  
 Date Reported : 13/09/2013

Sample Number : T333  
 Field No. : TP82  
 Sample Description : TP82  
 Equivalent PI : **4** Clay fraction of whole sample (% <2µ) : **6**

**POTENTIAL EXPANSIVENESS GRAPH**



**PARTICLE SIZE DISTRIBUTION CHART**



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