



# KWA THEMA SHOPPING CENTRE NEAR SPRINGS

## Geotechnical Investigation Report



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TITLE **KWA THEMA SHOPPING CENTRE  
Geotechnical Investigation Report**

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R0	18/11/2013	Madaleen Booyesen	Alan Parrock	Draft for comment

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## **SYNOPSIS**

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*A field investigation was conducted by Madaleen Booysen and Bronwen Klaas of ARQ (Pty) Ltd to assess the founding conditions for the new Kwa Thema Shopping centre near Springs, South Africa.*

*According to the 1:250 000 geological map 2628 EAST RAND the site is underlain by sandstone, shale and coal beds of the Vryheid Formation, Eccra Group and Karoo Supergroup.*

*The field investigation was carried out on the 10<sup>th</sup> and 11<sup>th</sup> of October 2013. Thirty (30) test pits were excavated by means of a tractor loader backactor (TLB) to an approximate depth of 3m or effective refusal conditions.*

*The test pits were profiled according to Brink and Bruin (2002).*

*Recommendations for the development are given in Section 7.*

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## LIST OF ABBREVIATIONS AND ACRONYMS

$\phi$	Angle of friction ( $^{\circ}$ )
$\gamma$	Bulk density ( $\text{kN/m}^3$ )
AASHTO	American Association of State Highway and Transportation Officials
ARQ	ARQ Consulting Engineers (Pty) Ltd
c	Cohesion (kPa)
CBR	California Bearing Ratio
COLTO	Committee of Land Transport Officials
GM	Grading Modules
GPS	Global Positioning System
MAD	Modified AASHTO Density
Mod	Modified
OMC	Optimum Moisture Content
PI	Plasticity Index
SABS	South African Bureau of Standards
SICOP	Site Investigation Code of Practice
TLB	Tractor Loader Backactor
TP	Test Pit

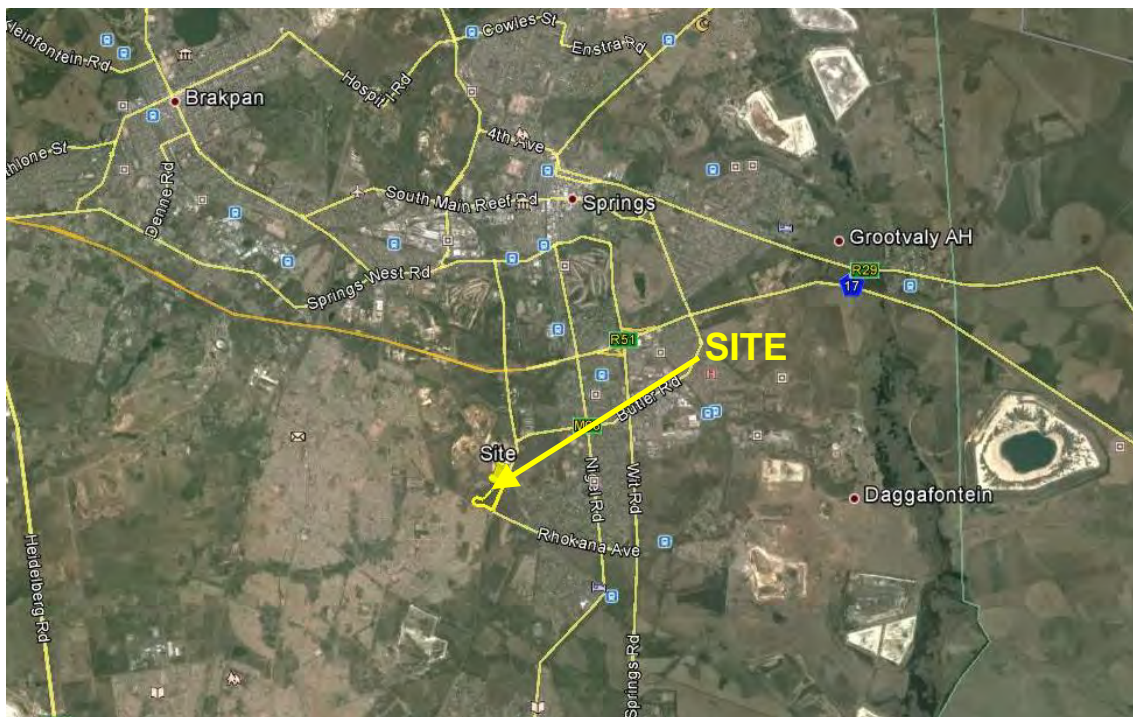
## 1. INTRODUCTION

ARQ (Pty) Ltd was requested by Mr Charles Gibbs of Mamphela Development Planners (Pty) Ltd to carry out a field investigation for the new Kwa Thema Shopping centre near Springs in Gauteng. The field portion of the work was carried out by Madaleen Booysen and Bronwen Klaas of ARQ on 10th and 11th of October 2013. The investigation was aimed at supplying information in terms of:

- Geology of the site,
- Engineering properties of materials excavated,
- Water table,
- Suitability of materials for use as fill/layer works materials,
- Bearing capacity/ suitability for founding in the in-situ soil/soft rock layers, and
- Potential expansiveness/collapsibility of the soils.

## 2. THE SITE

The site is located on the corner of Tonk Meter Road and Rhokana Avenue near Springs as shown in Figure 1.



**Figure 1: Site location.**

The site is relatively flat with no existing structures. However the site is currently vacant and has become the ideal place for the local community to dump unwanted possessions varying from domestic waste to animal remains. It is expected that the following will form part of the development:

- A shopping centre,
- A taxi rank,
- A KFC, and

- A Builders Warehouse.

### 3. METHOD OF INVESTIGATION

The investigation was carried out in accordance with Site Investigation Code of Practice (SICOP) (2010).

The investigation comprised the excavation of 30 test pits to a depth of 3m or until effective refusal conditions were encountered. The test pits were excavated using a Tractor Loader Backactor (TLB).

The test pits were profiled according to current methods and procedures (Brink and Bruin, 2002). Samples were taken and tested at an accredited soils laboratory. The following tests were conducted:

- Particle size distribution,
- Atterberg limits,
- MOD and CBR,
- pH and conductivity,
- Moisture content, and
- Collapse potential (via one – dimensional consolidation).

The positions of the test pits were determined prior to the field investigation to provide representative information of the entire site. No drawings of the proposed structures were made available to ARQ prior to the field investigation. The test pits positions were located on site using a hand-held GPS.

#### 3.1. INVESTIGATION POSITIONS

Figure 2 below shows the approximate position of the test pits which were investigated on the site.



Figure 2: Site layout showing the test pit positions.



Thirty four test pits were originally planned. However, due to time constrained only 30 test pits were excavated across the site to give an accurate representation of the entire site.

Co-ordinates and elevations noted on the profiles were taken using a GPS on site using the WGS 84 datum, hddd°mm'ss.s" grid.

See **Appendix C** for test pit co-ordinates.

## 4. GEOLOGY AND TYPICAL SOIL PROFILE

According to the 1:250 000 geological map 2628 EAST RAND the site is underlain by sandstone, shale and coal beds of the Vryheid Formation, Ecca Group, Karoo Supergroup.

Figure 2 below shows the geology of the area overlain in Google Earth.



Figure 3: Geology overlain in Google Earth.

### 4.1. SITE SPECIFIC GEOLOGY

A summary of the test pits is presented in Table 2, whilst the comprehensive soil profiles are contained in **Appendix A**. Most of the test pits indicate a very similar profile.

**Table 1: Summary of test pits.**

Test Pit	Soft to stiff (clayey, sandy, gravelly) silt	Medium dense to very dense (clayey, silty, sandy, ferruginous) gravel	Soft to firm (gravelly, sandy, silty) clay	Soft to firm clayey sand	Refusal
TP1	0.0-0.35 & 0.5 - 3.0	0.35 - 0.5			No
TP3	0.0 - 3.0				No
TP4	0.0 - 3.0				No
TP5	0.0 - 3.0				No
TP6	0.0 - 3.0				No
TP7	0.0 - 3.0				No
TP8	0.0 - 3.0				No
TP9	0.0 - 1.8	1.8 - 2.5			Yes
TP10	0.0 1.7	1.7 - 2.5			Yes
TP11	0.0 - 0.5		0.5 - 3.0		No
TP12	0.0 - 0.5	0.5 - 2.0			Yes
TP13	0.0 - 0.5 & 1.2 -1.8	1.8 -2.5		0.5 - 1.2	Yes
TP14	0.0 -0.8	0.8 - 2.2			Yes
TP16	0.0 - 1.5	1.5 -2.1			Yes
TP18	0.0 - 0.5	0.5 - 3.0			No
TP19	0.0 - 0.5	1.5 - 2.8	0.5 - 1.5		Yes
TP21	0.0 - 2.6				Yes
TP22	0.0 - 1.4	1.4 -2.5			Yes
TP23	0.0 -0.7 & 2.0 - 2.6	0.7 - 2.0			Yes
TP24	0.0 - 1.4	1.4 - 3.0			No
TP25	0.0 - 0.7	0.7 - 0.9			Yes
TP26	0.0 - 1.4	1.4 - 2.2			Yes
TP27	0.0 - 1.7		1.7 - 3.0		No
TP28	0.0 - 3.0				No
TP29	0.0 - 3.0				No
TP30	0.0 -2.5				Yes
TP31	0.0 - 2.1	2.1 - 3.0			No
TP32	0.5 - 1.7	1.7 - 3.0			No
TP33	0.0 - 2.7				Yes
TP34	0.0 - 0.8		0.8 - 3.0		No

## 5. MATERIAL PROPERTIES

Soil samples retrieved during the investigation were sent to an independent soil testing laboratory in Pretoria for the following tests:

- Foundation indicator,
- pH and Conductivity,
- MOD and CBR,
- Collapse, and
- Moisture content.

The laboratory results are presented in **Appendix B**. A summary of the soil tests are presented in Table 3, and discussed below.

**Table 2: Summary of Indicator test results.**

Sample No.	TP1	TP8	TP12
Depth (m)	0.5 - 2.7	0.4 - 3.0	0.5 - 2.0
Liquid Limit	27	24	22
Plasticity Index	11	10	8
Linear shrinkage	5.7	5.3	4
Grading modulus	0.49	0.39	0.87
% passing 0.425mm	91	93	74
Expansiveness rating	Low	Low	Low
AASTHO Classification	A-6(5)	A-4(7)	A-4(4)

### 5.1. EXPANSIVE SOILS

Expansive soils are generally not expected to be problematic on site, with the material tested showing a low expansiveness rating.

### 5.2. COLLAPSIBLE SOILS

Although a collapsible fabric was identified on site as a pinholed structure in the profile, it is not expected that collapse settlements will be problematic, provided the correct preventative measures are undertaken. These measures will be discussed further in section 7.

An undisturbed sample was taken from TP 34 (0.8 – 1.5m) and sent for collapse potential testing. The test indicated a collapse potential of 0.13% under a load of 200kPa. This ranks the collapse potential of the sample as “no problem”.

### 5.3. PH AND CORROSIVITY

The corrosivity of the material on site was classified as “mildly corrosive” and “very corrosive” with a slightly acidic pH that ranges from 6.00 to 6.22 (a pH of 7.0 indicates a completely neutral material). The electrical conductivity, pH and corrosivity of the soil are presented in Table 4. According to the criteria in Table C7 of the CSIR Report No: BOU/R9705, a conductivity of >0.050 S/m indicates a soil that is very corrosive.

**Table 3: pH and conductivity results.**

	pH values	Electrical Conductivity (S/m)	Corrosivity
TP1	6.00	0.076	Very corrosive
TP8	6.22	0.015	Mildly corrosive
TP12	6.08	0.057	Very corrosive

#### 5.4. MOISTURE CONTENT

**Table 4: Moisture content.**

	Wet weight (g)	Dry weight (g)	Moist weight	% Moist
TP1	2 043.30	1 770.10	273.20	15.43
TP8	2 102.7	1 856.1	246.6	13.29
TP12	2 050	1 836.7	213.3	11.61
TP43	2 016.1	1 765.6	25.5	14.19

Table 4 shows the moisture-density attributes of the material present on site. In order for the maximum density to be achieved in the soil, it should be compacted at moisture content equal to or slightly wet of, it's optimum moisture content.

#### 5.5. COMPACTION AND STRENGTH PROPERTIES

Representative samples on which CBR tests were conducted according to TMH1 (1986) were classified according to COLTO (1998). A summary of the strength and compaction properties of the material sampled are presented in **Table 5**.

**Table 5: Summary of Strength characteristics.**

TP No and Depth	Parameter	Recorded value	Classification (Colto)
TP1 (0.5 - 2.7m)	Optimum moisture content (%)	13.7	NC
	Max Dry Density (kg/m <sup>3</sup> )	1848	
	CBR @ 93% Mod AASHTO (%)	3.4	
	Max swell @ 100% Mod AASHTO (%)	0.07	
TP8 (0.4 - 3.0m)	Optimum moisture content (%)	16	NC
	Max Dry Density (kg/m <sup>3</sup> )	1771	
	CBR @ 93% Mod AASHTO (%)	7.7	
	Max swell @ 100% Mod AASHTO (%)	0.03	
TP12 (0.5 - 2.0m)	Optimum moisture content (%)	14.3	G10
	Max Dry Density (kg/m <sup>3</sup> )	1840	
	CBR @ 93% Mod AASHTO (%)	4.6	
	Max swell @ 100% Mod AASHTO (%)	0.33	

\*NC = non-classifiable. Due to low strength, GM < 0.77.

## **6. GEOTECHNICAL EVALUATION**

### **6.1. IN SITU MATERIAL**

Expansive soils are generally not expected to be problematic on site due to a low expansiveness rating.

A pinholed structure was identified on site in most of the test pits. This is indicative of some form of collapse potential.

The pinholed (voided) structure of the material must be destroyed. Loose and soft material will benefit from rolling as the density, stiffness and shear strength of the material is improved.

Collapse settlements and/or heave are therefore not deemed to be significant for foundations constructed on this material. Recommendations are given in Section 7 to mitigate any potential large settlements.

### **6.2. GROUNDWATER**

Some water seepage was encountered in TP 32. No groundwater was encountered in any of the other test pits excavated during the field visit. The depth to the water table is therefore unknown.

### **6.3. EXCAVATION CONDITIONS**

The TLB used for the field investigation was able to easily excavate most of the soil.

Based on SABS 1200, soft excavation conditions can be expected to at least a depth of 3.0m using a 20 ton excavator.

### **6.4. SLOPE SUPPORT**

An assessment of the safe slope angles was conducted first using chart 3 of the circular failure charts of Hoek & Bray (1981) and an 80% confidence limit on envisaged Mohr-Coulomb shear parameters as derived from Theyse et al (1996) using the following attributes for a G8 quality material:

- $c = 6 \text{ kPa}$ ,
- $\phi = 27^\circ$ ,
- $\gamma = 18 \text{ kN/m}^3$ ,
- $H = 3\text{m}$ , and
- $\text{FOS} = 1.5$

Based on this evaluation a slope batter angle of  $34^\circ$  or 1.5:1 (H:V) will be required to generate an  $\text{FOS} = 1.5$ .

If this batter angle is not possible on site due to space constraints and a vertical face is desired, a soil nail wall or other restraints will need to be designed.

## **7. RECOMMENDATIONS**

The recommendations contained in this report were made based on the near-surface geotechnical investigation conducted at the site. Visual observations of the in situ material, as well as laboratory test results, are used to provide meaningful recommendations.

### **7.1. SITE COMPACTION**

It is recommended that the following be used to ensure effective site compaction is achieved:

- The topsoil and all organic material must be removed to 300mm below natural ground level (NGL),
- Thereafter the site must be ripped and compacted using 20 passes of a 300kN centrifugal force pad foot roller operating in maximum amplitude vibrating mode so as to include an area extending 2m beyond the footprint boundary of any structure, and
- Import two layers of 150mm commercial G7 quality material placed and compact to 93% of Mod AASHTO density at 0 to +2% of the optimum moisture content (0+2 OMC) using the aforementioned roller. It is likely that some 20 passes will be required per layer.

### **7.2. FOUNDING OF STRUCTURES**

The client stated that the shopping centre will consist of a single storey building. As such recommendations contained in this report are only valid for a single story building with no basement excavations.

Conventional 2.0 x 2.0 m pad footings can be considered for loads (up to 130kPa). The pad footings must have a 1m embedment. Another possibility is 0.75m strip foundations for light loads (up to 90kPa/m). Compaction in base of footing excavations is imperative. Compaction at the base of footings can be achieved by ripping and re-compacting the area beneath the footing using a Wacker to 93% of Mod AASHTO density at 0 to +2% of the optimum moisture content (0+2 OMC).

### **7.3. FLOOR SLABS**

The area under the slab should be slightly moist and clear of all debris prior to the placement of concrete.

### **7.4. CONCRETE COVER**

A concrete cover over reinforcing should be a minimum of 50mm due to the mildly corrosive to very corrosive nature of the soil. In addition, admixtures may prove beneficial and economic. "Xypex" concrete waterproofing may be considered. ARQ can assist with these contact details if required.

### **7.5. ROADS AND PARKING AREAS**

The in situ material is sufficient for fill material, but not for layer works. Selected subgrade, sub base, base course and surfacing must be obtained from commercial sources. Block paving can also be considered but only if the sub base below the paving is stabilised.

## 7.6. DRAINAGE

It is essential that proper site drainage and plumbing/service precautions be taken, i.e., proper down pipes which eject away from the proposed structure must be installed in conjunction with a concrete or a paved apron with a width of at least 1m. Due to the pin holed structure that is evident in the in situ material, it is advised that all water be diverted away from the buildings. As good construction practice, damp-proofing measures should be incorporated into the foundations of the structures to prevent the ingress of water from the underlying material.

## 8. GENERAL

The comments and recommendations contained within this report are based on a limited number of test pits excavated which we believe are representative. Therefore, conditions at variance with those described in this report should not be overlooked.

## 9. REFERENCES

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**APPENDIX A**  
**SOIL PROFILES**

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**Test Pit: TP 01**

<b>Client:</b>	Dijalo Property Development
<b>Project:</b>	Kwa Thema shopping centre - 6796
<b>Date Profiled:</b>	2013/10/10
<b>Coordinates:</b>	26°18'14.70"S, 28°25'45.60"E
<b>Elevation:</b>	1635 m
<b>Profiled By:</b>	Bronwen & Madaleen .



Depth (m)	Sampling	Ground Water	Symbol	Description
0.1				<b>FIRM, CLAYEY SILT</b> Slightly moist, brown to red brown, firm, pinholed, clayey silt Fill (0.35 m)
0.2				
0.3				
0.4				<b>MEDIUM DENSE, SILTY GRAVEL</b> Dry, light grey with angular pebbles of all colours, medium dense, martrix supported, silty gravel Fill (0.5 m)
0.5				
0.6	D			<b>FIRM, FINE SANDY CLAYEY SILT WITH SLIGHT FERRUGINATION AT 1.9-2.1M</b> Slightly moist, redbrown mottled black, firm, pinholed, fine sandy clayey silt with slight ferrugination at 1.9-2.1m Transported (2.7 m)
0.7				
0.8				
0.9				
1.0				
1.1				
1.2				
1.3				
1.4				
1.5				
1.6				
1.7				
1.8				
2.7				<b>STIFF, GRAVELLY CLAYEY SILT</b> Slightly moist, orange brown mottled grey and red, stiff, intact, gravelly clayey silt Transported (3 m)
2.8				
2.9				
3.0				
3.1				
3.2				
3.3				
3.4				

<b>Excavation Method:</b>	TLB
<b>Refusal:</b>	None
<b>Water Table:</b>	None



**Test Pit: TP 03**

<b>Client:</b> Dijalo Property Development	
<b>Project:</b> Kwa Thema shopping centre - 6796	
<b>Date Profiled:</b> 2013/10/11	
<b>Coordinates:</b> 26°18'15.60"S, 28°25'43.80"E	
<b>Elevation:</b> 1636 m	
<b>Profiled By:</b> Madaleen Booysen	

Depth (m)	Sampling	Ground Water	Symbol	Description
0.1				<b>FIRM, CLAYEY SILT</b> Slightly moist, brown mottled black, firm, pinholed, clayey silt Transported
0.2				
0.3				
0.4				
0.5				
0.6				<b>FIRM TO SOFT, FINE SANDY CLAYEY SILT</b> Slightly moist, light brown slightly mottled black, firm to soft, pinholed, fine sandy clayey silt Transported
0.7				
0.8				
0.9				
1.0				
1.1				
1.2				
1.3				
1.4				
1.5				
2.0				<b>FIRM TO STIFF, FINE SANDY CLAYEY SILT</b> Slightly moist, redbrown mottled black, firm to stiff, pinholed, fine sandy clayey silt Residual shale
2.1				
2.2				
2.3				
2.4				
2.5				
2.6				
2.7				
2.8				
2.9				
3.0				
3.1				
3.2				
3.3				
3.4				

<b>Excavation Method:</b> TLB
<b>Refusal:</b> None
<b>Water Table:</b> None



**Test Pit: TP 04**

<b>Client:</b>	Dijalo Property Development
<b>Project:</b>	Kwa Thema shopping centre - 6796
<b>Date Profiled:</b>	2013/10/10
<b>Coordinates:</b>	26°18'17.60"S, 28°25'43.70"E
<b>Elevation:</b>	1635 m
<b>Profiled By:</b>	Bronwen & Madaleen .




Depth (m)	Sampling	Ground Water	Symbol	Description
0.1				<b>SOFT, FINE SANDY SILT</b> Dry, brown, soft, pinholed, fine sandy silt Transported (0.4 m)
0.2				
0.3				
0.4				
0.5				<b>FIRM, FINE SANDY SILT</b> Slightly moist, light brown, firm, pinholed, fine sandy silt Transported (1.3 m)
0.6				
0.7				
0.8				
0.9				
1.0				
1.1				
1.2				
1.3				
1.4				<b>FIRM, FINE SANDY CLAYEY SILT</b> Slightly moist, red brown mottled black, firm, pinholed, fine sandy clayey silt Transported (2.7 m)
1.5				
1.6				
1.7				
1.8				
1.9				
2.0				
2.1				
2.2				
2.3				
2.4				
2.5				
2.6				
2.7				
2.8				<b>STIFF, GRAVELLY SANDY SILT</b> Slightly moist, reddish brown mottled grey, black and yellow, stiff, pinholed, gravelly sandy silt Transported (3 m)
2.9				
3.0				
3.1				
3.2				
3.3				
3.4				

<b>Excavation Method:</b>	TLB
<b>Refusal:</b>	None
<b>Water Table:</b>	None



**Test Pit: TP 05**

<b>Client:</b> Dijalo Property Development	
<b>Project:</b> Kwa Thema shopping centre - 6796	
<b>Date Profiled:</b> 2013/10/11	
<b>Coordinates:</b> 26°18'17.70"S, 28°25'41.50"E	
<b>Elevation:</b> 1636 m	
<b>Profiled By:</b> Madaleen Booysen	

Depth (m)	Sampling	Ground Water	Symbol	Description
0.1				<b>FIRM, CLAYEY SILT</b> Slightly moist, brown, firm, pinholed, clayey silt Transported
0.2				
0.3				
0.4				
0.5				
0.6				<b>FIRM, SANDY SILT</b> Slightly moist, light brown to orange, firm, pinholed, sandy silt Transported
0.7				
0.8				
0.9				
1.0				
1.1				
1.2				
1.3				
1.4				
1.5				
1.6				<b>STIFF, CLAYEY SANDY SILT</b> Slightly moist, brown to yellow mottled black, stiff, pinholed, clayey sandy silt Transported
1.7				
1.8				
1.9				
2.0				
2.1				
2.2				
2.3				
2.4				
2.5				
2.6				
2.7				
2.8				
2.9				
3.0				(3 m)
3.1				
3.2				
3.3				
3.4				

<b>Excavation Method:</b> TLB
<b>Refusal:</b> None
<b>Water Table:</b> None



**Test Pit: TP 06**


<p><b>Client:</b> Dijalo Property Development  <b>Project:</b> Kwa Thema shopping centre - 6796  <b>Date Profiled:</b> 2013/10/11  <b>Coordinates:</b> 26°18'19.10"S, 28°25'43.40"E  <b>Elevation:</b> 1628 m  <b>Profiled By:</b> Madaleen Booysen</p>	
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Depth (m)	Sampling	Ground Water	Symbol	Description
0.1				<p><b>FIRM, CLAYEY SILT</b>                      Slightly moist, brown, firm, pinholed, clayey silt                      Transported</p>
0.2				
0.3				
0.4				
0.5				
0.6				<p><b>FIRM, CLAYEY SILT</b>                      Slightly moist, light brown mottled yellow, firm, pinholed, clayey silt                      Transported</p>
0.7				
0.8				
0.9				
1.0				
1.1				
1.2				
1.3				
1.4				
1.5				
1.6				
1.7				<p><b>FIRM TO STIFF, CLAYEY SANDY SILT WITH FERIGIUNOUS NODULES</b>                      Slightly moist, brown to yellow mottled black, firm to stiff, pinholed, clayey sandy silt with ferigiunous nodules                      Transported</p>
1.8				
1.9				
2.0				
2.1				
2.2				
2.3				
2.4				
2.5				
2.6				
2.7				
2.8				
2.9				
3.0				
3.1				
3.2				
3.3				
3.4				

<p><b>Excavation Method:</b> TLB  <b>Refusal:</b> None  <b>Water Table:</b> None</p>
--



**Test Pit: TP 07**

<b>Client:</b> Dijalo Property Development	
<b>Project:</b> Kwa Thema shopping centre - 6796	
<b>Date Profiled:</b> 2013/10/11	
<b>Coordinates:</b> 26°18'19.70"S, 28°25'41.20"E	
<b>Elevation:</b> 1633 m	
<b>Profiled By:</b> Madaleen Booysen	

Depth (m)	Sampling	Ground Water	Symbol	Description
0.1				<b>FIRM, CLAYEY SILT</b> Slightly moist, brown, firm, pinholed, clayey silt Transported
0.2				
0.3				
0.4				
0.5				
0.6				<b>FIRM, SANDY SILT</b> Slightly moist, light brown to orange, firm, pinholed, sandy silt Transported
0.7				
0.8				
0.9				
1.0				
1.1				
1.2				
1.3				
1.4				
1.5				
1.6				<b>FIRM TO STIFF, SANDY SILT WITH COBBLES OF QUARTZITE AND FERRUGINOUS</b> Slightly moist, light brown, firm to stiff, pinholed, sandy silt with cobbles of quartzite and ferruginous Residual shale
1.7				
1.8				
1.9				
2.0				
2.1				
2.2				
2.3				
2.4				
2.5				
2.6				
2.7				
2.8				
2.9				
3.0				
3.1				
3.2				
3.3				
3.4				

<b>Excavation Method:</b> TLB
<b>Refusal:</b> None
<b>Water Table:</b> None



**Test Pit: TP 08**

<b>Client:</b>	Dijalo Property Development
<b>Project:</b>	Kwa Thema shopping centre - 6796
<b>Date Profiled:</b>	2013/10/10
<b>Coordinates:</b>	26°18'18.70"S, 28°25'39.60"E
<b>Elevation:</b>	1632 m
<b>Profiled By:</b>	Bronwen & Madaleen .



Depth (m)	Sampling	Ground Water	Symbol	Description
0.1				<b>FIRM, SANDY SILT</b> Dry, brown, firm, pinholed, sandy silt Transported
0.2				
0.3				
0.4				
0.5	D			<b>FIRM TO STIFF, FINE SANDY SILT</b> Dry, light brown, firm to stiff, pinholed, fine sandy silt Transported
0.6				
0.7				
0.8				
0.9				
1.0				
1.1				
1.2				
1.3				
1.4				
1.5				
1.6				
1.7				
1.8				
1.9				
2.0				
2.1				
2.2				
2.3				
2.4				
2.5				
2.6				
2.7				
2.8				
2.9				
3.0				(3 m)
3.1				
3.2				
3.3				
3.4				

<b>Excavation Method:</b>	TLB
<b>Refusal:</b>	None
<b>Water Table:</b>	None



**Test Pit: TP 09**

<b>Client:</b> Dijalo Property Development	
<b>Project:</b> Kwa Thema shopping centre - 6796	
<b>Date Profiled:</b> 2013/10/11	
<b>Coordinates:</b> 26°18'20.80"S, 28°25'38.70"E	
<b>Elevation:</b> 1632 m	
<b>Profiled By:</b> Madaleen Booysen	

Depth (m)	Sampling	Ground Water	Symbol	Description
0.1				<b>FIRM, CLAYEY SILT</b> Slightly moist, brown, firm, pinholed, clayey silt Transported
0.2				
0.3				
0.4				
0.5				
0.6				<b>FIRM, SANDY SILT</b> Slightly moist, light brown to orange, firm, pinholed, sandy silt Transported
0.7				
0.8				
0.9				
1.0				
1.1				
1.2				
1.3				
1.4				
1.5				
1.8				<b>MEDIUM DENSE TO DENSE, SANDY SILTY GRAVEL</b> Dry, yellow brown mottled black, medium dense to dense, pinholed, sandy silty gravel Residual shale
1.9				
2.0				
2.1				
2.2				
2.3				
2.4				
2.5				
2.5				<b>Refused on: Ferruginous gravel</b>
2.6				
2.7				
2.8				
2.9				
3.0				
3.1				
3.2				
3.3				
3.4				

<b>Excavation Method:</b> TLB
<b>Refusal:</b> 2.5 m on Ferruginous
<b>Water Table:</b> None





**Test Pit: TP 10**

<b>Client:</b> Dijalo Property Development	
<b>Project:</b> Kwa Thema shopping centre - 6796	
<b>Date Profiled:</b> 2013/10/11	
<b>Coordinates:</b> 26°18'22.30"S, 28°25'40.30"E	
<b>Elevation:</b> 1627 m	
<b>Profiled By:</b> Madaleen Booysen	

Depth (m)	Sampling	Ground Water	Symbol	Description
0.1				<b>FIRM, CLAYEY SILT</b> Slightly moist, brown, firm, pinholed, clayey silt Transported
0.2				
0.3				
0.4				
0.5				
0.6				<b>FIRM, SANDY SILT</b> Slightly moist, light brown to orange, firm, pinholed, sandy silt Transported
0.7				
0.8				
0.9				
1.0				
1.1				
1.2				
1.3				
1.4				
1.5				
1.6				<b>MEDIUM DENSE TO DENSE, SANDY SILTY GRAVEL</b> Dry, yellow brown mottled black, medium dense to dense, pinholed, sandy silty gravel Residual shale
1.7				
1.8				
1.9				
2.0				
2.1				
2.2				
2.3				
2.4				
2.5				<b>Refused on: Residual shale</b>
2.6				
2.7				
2.8				
2.9				
3.0				
3.1				
3.2				
3.3				
3.4				

<b>Excavation Method:</b> TLB
<b>Refusal:</b> 2.5 m on Residual shale
<b>Water Table:</b> None



**Test Pit: TP 11**

<b>Client:</b>	Dijalo Property Development
<b>Project:</b>	Kwa Thema shopping centre - 6796
<b>Date Profiled:</b>	2013/10/11
<b>Coordinates:</b>	26°18'21.10"S, 28°25'42.90"E
<b>Elevation:</b>	1634 m
<b>Profiled By:</b>	Madaleen Booysen



Depth (m)	Sampling	Ground Water	Symbol	Description
0.1				<b>FIRM, CLAYEY SILT</b> Slightly moist, brown, firm, pinholed, clayey silt Transported
0.2				
0.3				
0.4				
0.5				
0.6				<b>SOFT TO FIRM, FINE SANDY SILTY CLAY</b> Slightly moist, light brown to yellowish, soft to firm, pinholed, fine sandy silty clay Transported
0.7				
0.8				
0.9				
1.0				
1.1				
1.2				
1.3				
1.4				
1.5				<b>SOFT, SILTY CLAY</b> Slightly moist, reddish brown mottled grey and black, soft, pinholed, silty clay Residual shale
1.6				
1.7				
1.8				
1.9				
2.0				
2.1				
2.2				
2.3				
2.4				
2.5				
2.6				
2.7				
2.8				
2.9				
3.0				
3.1				
3.2				
3.3				
3.4				

<b>Excavation Method:</b>	TLB
<b>Refusal:</b>	None
<b>Water Table:</b>	None



**Test Pit: TP 12**


<b>Client:</b> Dijalo Property Development <b>Project:</b> Kwa Thema shopping centre - 6796 <b>Date Profiled:</b> 2013/10/10 <b>Coordinates:</b> 26°18'23.50"S, 28°25'41.20"E <b>Elevation:</b> 1632 m <b>Profiled By:</b> Bronwen & Madaleen .	
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Depth (m)	Sampling	Ground Water	Symbol	Description
0.1				<b>FIRM, FINE SANDY SILT</b> Dry, brown, firm, pinholed, fine sandy silt Transported <span style="float: right;">(0.5 m)</span>
0.2				
0.3				
0.4				
0.5				
0.6	D			<b>MEDIUM DENSE BECOMING VERY DENSE, SANDY SILTY FERRUGINOUS GRAVEL</b> Dry, yellow brown, medium dense becoming very dense, pinholed, sandy silty ferruginous gravel Transported <span style="float: right;">(2 m)</span>
0.7				
0.8				
0.9				
1.0				
1.1				
1.2				
1.3				
1.4				
1.5				
1.6				
1.7				
1.8				
1.9				
2.0				
2.1				
2.2				
2.3				
2.4				
2.5				
2.6				
2.7				
2.8				
2.9				
3.0				
3.1				
3.2				
3.3				
3.4				

<b>Excavation Method:</b> TLB <b>Refusal:</b> 2 m on very dense <b>Water Table:</b> None
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**Test Pit: TP 13**

<b>Client:</b> Dijalo Property Development	
<b>Project:</b> Kwa Thema shopping centre - 6796	
<b>Date Profiled:</b> 2013/10/11	
<b>Coordinates:</b> 26°18'23.50"S, 28°25'38.30"E	
<b>Elevation:</b> 1625 m	
<b>Profiled By:</b> Madaleen Booysen	

Depth (m)	Sampling	Ground Water	Symbol	Description
0.1				<b>FIRM, CLAYEY SILT</b> Slightly moist, brown, firm, pinholed, clayey silt Transported <div style="text-align: right;">(0.5 m)</div>
0.2				
0.3				
0.4				
0.5				
0.6				<b>SOFT TO FIRM, CLAYEY SAND</b> Slightly moist, light brown, soft to firm, pinholed, clayey sand Transported <div style="text-align: right;">(1.2 m)</div>
0.7				
0.8				
0.9				
1.0				
1.1				
1.2				<b>FIRM, FINE SANDY CLAYEY SILT</b> Slightly moist, reddish brown, firm, pinholed, fine sandy clayey silt Transported <div style="text-align: right;">(1.8 m)</div>
1.3				
1.4				
1.5				
1.6				
1.7				
1.8				<b>MEDIUM DENSE, CLAYEY SILTY GRAVEL AND FERRICRETE NODULES</b> Slightly moist, brown mottled grey, yellow, red and black, medium dense, matrix supported, clayey silty gravel and ferricrete nodules Residual shale <div style="text-align: right;">(2.5 m)</div>
1.9				
2.0				
2.1				
2.2				
2.3				
2.4				
2.5				<b>Refused on: Residual shale</b>
2.6				
2.7				
2.8				
2.9				
3.0				
3.1				
3.2				
3.3				
3.4				

<b>Excavation Method:</b> TLB
<b>Refusal:</b> 2.5 m on Residual shale
<b>Water Table:</b> None



**Test Pit: TP 14**

<b>Client:</b>	Dijalo Property Development
<b>Project:</b>	Kwa Thema shopping centre - 6796
<b>Date Profiled:</b>	2013/10/11
<b>Coordinates:</b>	26°18'21.70"S, 28°25'36.30"E
<b>Elevation:</b>	1628 m
<b>Profiled By:</b>	Madaleen Booysen



Depth (m)	Sampling	Ground Water	Symbol	Description
0.1				<b>FIRM, CLAYEY SILT</b> Slightly moist, brown, firm, pinholed, clayey silt Transported
0.2				
0.3				
0.4				
0.5				
0.6				
0.7				
0.8				
0.9				<b>VERY DENSE, SANDY SILTY GRAVEL</b> Slightly moist, light brown, very dense, pinholed, sandy silty gravel Transported
1.0				
1.1				
1.2				
1.3				
1.4				
1.5				
1.6				
1.7				
1.8				
1.9				
2.0				
2.1				
2.2				
2.3				<b>Refused on: very dense sandy silty gravel</b>
2.4				
2.5				
2.6				
2.7				
2.8				
2.9				
3.0				
3.1				
3.2				
3.3				
3.4				

<b>Excavation Method:</b>	TLB
<b>Refusal:</b>	2.2 m on very dense sandy
<b>Water Table:</b>	None



**Test Pit: TP 16**

<b>Client:</b> Dijalo Property Development	
<b>Project:</b> Kwa Thema shopping centre - 6796	
<b>Date Profiled:</b> 2013/10/11	
<b>Coordinates:</b> 26°18'25.20"S, 28°25'36.40"E	
<b>Elevation:</b> 1631 m	
<b>Profiled By:</b> Bronwen & Madaleen .	

Depth (m)	Sampling	Ground Water	Symbol	Description
0.1				<b>STIFF, FINE SANDY SILT</b> Dry, brown, stiff, pinholed, fine sandy silt Transported <span style="float: right;">(0.3 m)</span>
0.2				
0.3				
0.4				<b>FIRM, FINE SANDY SILT</b> Dry, light brown, firm, pinholed, fine sandy silt Transported <span style="float: right;">(1.5 m)</span>
0.5				
0.6				
0.7				
0.8				
0.9				
1.0				
1.1				
1.2				
1.3				
1.4				
1.5				
1.6				<b>MEDIUM DENSE BECOMING VERY DENSE, SANDY SILTY FERRUGINOUS GRAVEL</b> Dry, yellow brown, medium dense becoming very dense, pinholed, sandy silty ferruginous gravel Transported <span style="float: right;">(2.1 m)</span>
1.7				
1.8				
1.9				
2.0				
2.1				
2.2				<b>Refused on: very dense ferruginous gravel</b>
2.3				
2.4				
2.5				
2.6				
2.7				
2.8				
2.9				
3.0				
3.1				
3.2				
3.3				
3.4				

<b>Excavation Method:</b> TLB
<b>Refusal:</b> 2.1 m on very dense
<b>Water Table:</b> None



**Test Pit: TP 18**

<p><b>Client:</b> Dijalo Property Development  <b>Project:</b> Kwa Thema shopping centre - 6796  <b>Date Profiled:</b> 2013/10/11  <b>Coordinates:</b> 26°18'27.00"S, 28°25'39.70"E  <b>Elevation:</b> 1627 m  <b>Profiled By:</b> Madaleen Booysen</p>	
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Depth (m)	Sampling	Ground Water	Symbol	Description
0.1				<p><b>FIRM, CLAYEY SILT</b>                      Slightly moist, brown, firm, pinholed, clayey silt                      Transported</p>
0.2				
0.3				
0.4				
0.5				
0.6				<p><b>MEDIUM DENSE, CLAYEY SILTY GRAVEL WITH FERRICRETE NODULES</b>                      Slightly moist, brown mottled grey, yellow, red and black, medium dense, pinholed, clayey silty gravel with ferricrete nodules                      Residual shale</p>
0.7				
0.8				
0.9				
1.0				
1.1				
1.2				
1.3				
1.4				
1.5				
1.6				
1.7				
1.8				
1.9				
2.0				
2.1				
2.2				
2.3				
2.4				
2.5				
2.6				
2.7				
2.8				
2.9				
3.0				
3.1				
3.2				
3.3				
3.4				

<p><b>Excavation Method:</b> TLB  <b>Refusal:</b> None  <b>Water Table:</b> None</p>
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**Test Pit: TP 19**

<b>Client:</b> Dijalo Property Development	
<b>Project:</b> Kwa Thema shopping centre - 6796	
<b>Date Profiled:</b> 2013/10/11	
<b>Coordinates:</b> 26°18'27.80"S, 28°25'36.90"E	
<b>Elevation:</b> 1635 m	
<b>Profiled By:</b> Madaleen Booysen	

Depth (m)	Sampling	Ground Water	Symbol	Description
0.1				<b>FIRM, CLAYEY SILT</b> Slightly moist, brown, firm, pinholed, clayey silt Transported <div style="text-align: right;">(0.5 m)</div>
0.2				
0.3				
0.4				
0.5				
0.6				<b>FIRM, SILTY GRAVELLY CLAY</b> Slightly moist, brown mottled orange and black, firm, pinholed, silty gravelly clay Residual shale <div style="text-align: right;">(1.5 m)</div>
0.7				
0.8				
0.9				
1.0				
1.1				
1.2				
1.3				
1.4				
1.5				
1.6				<b>MEDIUM DENSE, SILTY CLAYEY GRAVEL WITH FERRICRETE NODULES</b> Slightly moist, yellow brown mottled grey orange and black, medium dense, pinholed, silty clayey gravel with ferricrete nodules Residual shale <div style="text-align: right;">(2.8 m)</div>
1.7				
1.8				
1.9				
2.0				
2.1				
2.2				
2.3				
2.4				
2.5				
2.6				
2.7				
2.8				<b>Refused on: Residual shale</b>
2.9				
3.0				
3.1				
3.2				
3.3				
3.4				

<b>Excavation Method:</b> TLB
<b>Refusal:</b> 2.8 m on Residual shale
<b>Water Table:</b> None





**Test Pit: TP 21**

<b>Client:</b> Dijalo Property Development
<b>Project:</b> Kwa Thema shopping centre - 6796
<b>Date Profiled:</b> 2013/10/11
<b>Coordinates:</b> 26°18'27.00"S, 28°25'34.70"E
<b>Elevation:</b> 1628 m
<b>Profiled By:</b> Madaleen Booysen




Depth (m)	Sampling	Ground Water	Symbol	Description
0.1				<b>FIRM, CLAYEY SILT</b> Slightly moist, brown, firm, pinholed, clayey silt Transported
0.2				
0.3				
0.4				
0.5				
0.6				<b>FIRM, CLAYEY SILT</b> Slightly moist, yellow brown mottled black, firm, pinholed, clayey silt Transported
0.7				
0.8				
0.9				
1.0				
1.1				
1.2				
1.3				
1.4				
1.5				
1.6				<b>STIFF, GRAVELLY SILT</b> Slightly moist, yellow mottled red and grey, stiff, pinholed, gravelly silt Residual shale
1.7				
1.8				
1.9				
2.0				
2.1				
2.2				
2.3				
2.4				
2.5				
2.6				<b>Refused on: Residual shale</b>
2.7				
2.8				
2.9				
3.0				
3.1				
3.2				
3.3				
3.4				

<b>Excavation Method:</b> TLB
<b>Refusal:</b> 2.6 m on Residual shale
<b>Water Table:</b> None



**Test Pit: TP 22**

<b>Client:</b> Dijalo Property Development	
<b>Project:</b> Kwa Thema shopping centre - 6796	
<b>Date Profiled:</b> 2013/10/11	
<b>Coordinates:</b> 26°18'24.70"S, 28°25'33.80"E	
<b>Elevation:</b> 1627 m	
<b>Profiled By:</b> Madaleen Booysen	

Depth (m)	Sampling	Ground Water	Symbol	Description
0.1				<b>FIRM, CLAYEY SILT</b> Slightly moist, brown, firm, pinholed, clayey silt Transported (0.5 m)
0.2				
0.3				
0.4				
0.5				
0.6				<b>FIRM, CLAYEY SILT</b> Slightly moist, yellowish light brown mottled orange, firm, pinholed, clayey silt Residual shale (1.4 m)
0.7				
0.8				
0.9				
1.0				
1.1				
1.2				
1.3				
1.4				
1.5				<b>MEDIUM DENSE TO DENSE, SANDY SILT GRAVEL</b> Slightly moist, yellowish brown mottled red and grey, medium dense to dense, pinholed, sandy silt gravel Residual shale (2.5 m)
1.6				
1.7				
1.8				
1.9				
2.0				
2.1				
2.2				
2.3				
2.4				
2.5				<b>Refused on: Residual shale</b>
2.6				
2.7				
2.8				
2.9				
3.0				
3.1				
3.2				
3.3				
3.4				

<b>Excavation Method:</b> TLB
<b>Refusal:</b> 2.5 m on Residual shale
<b>Water Table:</b> None



**Test Pit: TP 23**

<b>Client:</b>	Dijalo Property Development
<b>Project:</b>	Kwa Thema shopping centre - 6796
<b>Date Profiled:</b>	2013/10/10
<b>Coordinates:</b>	26°18'26.10"S, 28°25'31.80"E
<b>Elevation:</b>	1628 m
<b>Profiled By:</b>	Bronwen & Madaleen .



Depth (m)	Sampling	Ground Water	Symbol	Description
0.1				<b>FIRM, SANDY SILT</b> Dry, brown, firm, pinholed, sandy silt Transported (0.5 m)
0.2				
0.3				
0.4				
0.5				
0.6				<b>FIRM TO STIFF, FINE SANDY SILT</b> Dry, light brown, firm to stiff, pinholed, fine sandy silt Transported (0.7 m)
0.7				
0.8				<b>MEDIUM DENSE BECOMING VERY DENSE, SANDY SILTY FERRUGINOUS GRAVEL</b> Dry, yellow brown, medium dense becoming very dense, pinholed, sandy silty ferruginous gravel Transported (2 m)
0.9				
1.0				
1.1				
1.2				
1.3				
1.4				
1.5				
1.6				
1.7				
1.8				
1.9				
2.0				<b>STIFF, GRAVELLY SANDY SILT</b> Slightly moist, reddish brown mottled grey, black and yellow, stiff, pinholed, gravelly sandy silt Transported (2.6 m)
2.1				
2.2				
2.3				
2.4				
2.5				<b>Refused on: Stiff gravelly sandy silt</b>
2.6				
2.7				
2.8				
2.9				
3.0				
3.1				
3.2				
3.3				
3.4				

<b>Excavation Method:</b>	TLB
<b>Refusal:</b>	2.6 m on Stiff gravelly
<b>Water Table:</b>	None



**Test Pit: TP 24**


<b>Client:</b> Dijalo Property Development	
<b>Project:</b> Kwa Thema shopping centre - 6796	
<b>Date Profiled:</b> 2013/10/11	
<b>Coordinates:</b> 26°18'27.70"S, 28°25'32.10"E	
<b>Elevation:</b> 1633 m	
<b>Profiled By:</b> Madaleen Booysen	

Depth (m)	Sampling	Ground Water	Symbol	Description
0.1				<b>FIRM, CLAYEY SILT</b> Slightly moist, brown, firm, pinholed, clayey silt Transported <div style="text-align: right;">(0.5 m)</div>
0.2				
0.3				
0.4				
0.5				
0.6				<b>FIRM, FINE SANDY SILT</b> Slightly moist, yellowish brown mottled black, firm, pinholed, fine sandy silt Transported <div style="text-align: right;">(1.4 m)</div>
0.7				
0.8				
0.9				
1.0				
1.1				
1.2				
1.3				
1.4				<b>MEDIUM DENSE TO DENSE, SANDY SILTY GRAVEL</b> Slightly moist, light brown mottled red, black and grey, medium dense to dense, pinholed, sandy silty gravel Residual shale <div style="text-align: right;">(3 m)</div>
1.5				
1.6				
1.7				
1.8				
1.9				
2.0				
2.1				
2.2				
2.3				
2.4				
2.5				
2.6				
2.7				
2.8				
2.9				
3.0				
3.1				
3.2				
3.3				
3.4				

<b>Excavation Method:</b> TLB
<b>Refusal:</b> None
<b>Water Table:</b> None



**Test Pit: TP 25**


<b>Client:</b> Dijalo Property Development	
<b>Project:</b> Kwa Thema shopping centre - 6796	
<b>Date Profiled:</b> 2013/10/11	
<b>Coordinates:</b> 26°18'31.10"S, 28°25'37.50"E	
<b>Elevation:</b> 1632 m	
<b>Profiled By:</b> Madaleen Booysen	

Depth (m)	Sampling	Ground Water	Symbol	Description
0.1				<b>FIRM, CLAYEY SILT</b> Slightly moist, brown, firm, pinholed, clayey silt Transported <span style="float: right;">(0.3 m)</span>
0.2				
0.3				
0.4				<b>STIFF, SILT</b> Slightly moist, light grey speckled dark grey, stiff, intact, silt Transported <span style="float: right;">(0.7 m)</span>
0.5				
0.6				
0.7				<b>DENSE, SILTY GRAVEL WITH FURRUGINOUS NODULES</b> Slightly moist, yellow brown mottled grey, orange and black, dense, pinholed, silty gravel with furruginous nodules Residual shale <span style="float: right;">(0.9 m)</span>
0.8				
0.9				
1.0				
1.1				
1.2				
1.3				
1.4				
1.5				
1.6				
1.7				
1.8				
1.9				
2.0				
2.1				
2.2				
2.3				
2.4				
2.5				
2.6				
2.7				
2.8				
2.9				
3.0				
3.1				
3.2				
3.3				
3.4				

<b>Excavation Method:</b> TLB	<b>Notes:</b> Test pit very close to coner roads crossing. Suspect the there might have been a road on this test pit.
<b>Refusal:</b> 0.9 m	
<b>Water Table:</b> None	



**Test Pit: TP 26**

<b>Client:</b> Dijalo Property Development	
<b>Project:</b> Kwa Thema shopping centre - 6796	
<b>Date Profiled:</b> 2013/10/10	
<b>Coordinates:</b> 26°18'29.40"S, 28°25'35.40"E	
<b>Elevation:</b> 1632 m	
<b>Profiled By:</b> Bronwen & Madaleen .	

Depth (m)	Sampling	Ground Water	Symbol	Description
0.1				<b>FIRM, SANDY SILT</b> Dry, brown, firm, pinholed, sandy silt Transported <div style="text-align: right;">(0.5 m)</div>
0.2				
0.3				
0.4				
0.5				
0.6				<b>FIRM, FINE SANDY SILT</b> Dry, light brown, firm, pinholed, fine sandy silt Transported <div style="text-align: right;">(1.4 m)</div>
0.7				
0.8				
0.9				
1.0				
1.1				
1.2				
1.3				
1.4				<b>MEDIUM DENSE BECOMING VERY DENSE, SANDY SILTY FERRUGINOUS GRAVEL</b> Dry, yellow brown, medium dense becoming very dense, pinholed, sandy silty ferruginous gravel Transported <div style="text-align: right;">(2.2 m)</div>
1.5				
1.6				
1.7				
1.8				
1.9				
2.0				
2.1				
2.2				
2.3				
2.4				
2.5				
2.6				
2.7				
2.8				
2.9				
3.0				
3.1				
3.2				
3.3				
3.4				

<b>Excavation Method:</b> TLB
<b>Refusal:</b> 2.2 m on very dense
<b>Water Table:</b> None



**Test Pit: TP 27**

<b>Client:</b> Dijalo Property Development	
<b>Project:</b> Kwa Thema shopping centre - 6796	
<b>Date Profiled:</b> 2013/10/11	
<b>Coordinates:</b> 26°18'29.50"S, 28°25'32.60"E	
<b>Elevation:</b> 1631 m	
<b>Profiled By:</b> Madaleen Booysen	

Depth (m)	Sampling	Ground Water	Symbol	Description
0.1				<b>FIRM, CLAYEY SILT</b> Slightly moist, brown, firm, pinholed, clayey silt Transported <div style="text-align: right;">(0.5 m)</div>
0.2				
0.3				
0.4				
0.5				
0.6				<b>FIRM, CLAYEY SILT</b> Slightly moist, reddish brown, firm, pinholed, clayey silt Transported <div style="text-align: right;">(1.7 m)</div>
0.7				
0.8				
0.9				
1.0				
1.1				
1.2				
1.3				
1.4				
1.5				
1.6				
1.7				
1.8				<b>FIRM TO SOFT, GRAVELLY CLAY</b> Slightly moist, yellowish brown mottled grey, red and black, firm to soft, pinholed, gravelly clay Residual shale <div style="text-align: right;">(3 m)</div>
1.9				
2.0				
2.1				
2.2				
2.3				
2.4				
2.5				
2.6				
2.7				
2.8				
2.9				
3.0				
3.1				
3.2				
3.3				
3.4				

<b>Excavation Method:</b> TLB
<b>Refusal:</b> None
<b>Water Table:</b> None



**Test Pit: TP 28**

<b>Client:</b> Dijalo Property Development <b>Project:</b> Kwa Thema shopping centre - 6796 <b>Date Profiled:</b> 2013/10/10 <b>Coordinates:</b> 26°18'27.80"S, 28°25'29.80"E <b>Elevation:</b> 1628 m <b>Profiled By:</b> Bronwen & Madaleen .	
--	--

Depth (m)	Sampling	Ground Water	Symbol	Description
0.1				<b>FIRM, SANDY SILT</b> Slightly moist, brown, firm, pinholed, sandy silt Transported <div style="text-align: right;">(0.6 m)</div>
0.2				
0.3				
0.4				
0.5				
0.6				
0.7				<b>FIRM, SANDY CLAYEY SILT</b> slightly moist, light orange brown, firm, pinholed, sandy clayey silt Transported <div style="text-align: right;">(1.6 m)</div>
0.8				
0.9				
1.0				
1.1				
1.2				
1.3				
1.4				
1.5				
1.6				
1.7				<b>FIRM, GRAVELLY SANDY SILT</b> Slightly moist, reddish brown mottled grey, black and yellow, firm, pinholed, gravelly sandy silt Transported <div style="text-align: right;">(3 m)</div>
1.8				
1.9				
2.0				
2.1				
2.2				
2.3				
2.4				
2.5				
2.6				
2.7				
2.8				
2.9				
3.0				
3.1				
3.2				
3.3				
3.4				

<b>Excavation Method:</b> TLB <b>Refusal:</b> None <b>Water Table:</b> None
---





**Test Pit: TP 29**

<b>Client:</b>	Dijalo Property Development
<b>Project:</b>	Kwa Thema shopping centre - 6796
<b>Date Profiled:</b>	2013/10/10
<b>Coordinates:</b>	26°18'25.90"S, 28°25'28.90"E
<b>Elevation:</b>	Not specified
<b>Profiled By:</b>	Bronwen & Madaleen .



Depth (m)	Sampling	Ground Water	Symbol	Description
0.1				<b>FIRM, SANDY SILT</b> Slightly moist, brown, firm, pinholed, sandy silt Transported  (0.6 m)
0.2				
0.3				
0.4				
0.5				
0.6				
0.7				<b>FIRM, SANDY CLAYEY SILT</b> Slightly moist, light orange brown, firm, pinholed, sandy clayey silt Transported  (1.5 m)
0.8				
0.9				
1.0				
1.1				
1.2				
1.3				
1.4				
1.5				
1.6				<b>STIFF, GRAVELLY SANDY SILT</b> Slightly moist, reddish brown mottled grey, black and yellow, stiff, pinholed, gravelly sandy silt Transported  (3 m)
1.7				
1.8				
1.9				
2.0				
2.1				
2.2				
2.3				
2.4				
2.5				
2.6				
2.7				
2.8				
2.9				
3.0				
3.1				
3.2				
3.3				
3.4				

<b>Excavation Method:</b>	TLB	<b>Notes:</b>	Raining
<b>Refusal:</b>	None		
<b>Water Table:</b>	None		



**Test Pit: TP 30**

<b>Client:</b> Dijalo Property Development
<b>Project:</b> Kwa Thema shopping centre - 6796
<b>Date Profiled:</b> 2013/10/10
<b>Coordinates:</b> 26°18'27.90"S, 28°25'26.90"E
<b>Elevation:</b> 1629 m
<b>Profiled By:</b> Bronwen & Madaleen .



Depth (m)	Sampling	Ground Water	Symbol	Description
0.1				<b>FIRM, SANDY SILT</b> Slightly moist, brown, firm, pinholed, sandy silt Transported
0.2				
0.3				
0.4				
0.5				
0.6				<b>SOFT, SANDY CLAYEY SILT</b> Slightly moist, light orange brown, soft, pinholed, sandy clayey silt Transported
0.7				
0.8				
0.9				
1.0				
1.1				
1.2				
1.3				
1.4				
1.5				
1.9				<b>STIFF, CLAYEY SILT WITH FERRUGINATION</b> Slightly moist, red brown, stiff, pinholed, clayey silt with ferrugination Transported
2.0				
2.1				
2.2				
2.3				
2.4				
2.5				
2.6				
2.7				
2.8				
2.9				
3.0				
3.1				
3.2				
3.3				
3.4				

<b>Excavation Method:</b> TLB
<b>Refusal:</b> None
<b>Water Table:</b> None



**Test Pit: TP 31**

<b>Client:</b>	Dijalo Property Development
<b>Project:</b>	Kwa Thema shopping centre - 6796
<b>Date Profiled:</b>	2013/10/10
<b>Coordinates:</b>	26°18'27.80"S, 28°25'25.00"E
<b>Elevation:</b>	1631 m
<b>Profiled By:</b>	Bronwen & Madaleen .




Depth (m)	Sampling	Ground Water	Symbol	Description
0.1				<b>FIRM, SANDY SILT</b> Slightly moist, brown, firm, pinholed, sandy silt Transported
0.2				
0.3				
0.4				
0.5				<b>FIRM, CLAYEY SILT</b> Slightly moist, redbrown, firm, pinholed, clayey silt Transported
0.6				
0.7				
0.8				
0.9				
1.0				
1.1				
1.2				
1.3				
1.4				
1.5				
1.6				
1.7				
1.8				
1.9				
2.0				
2.1				(0.4 m)
2.2				<b>VERY DENSE, SANDY SILTY FERRUGINOUS GRAVEL</b> Dry, yellow brown, very dense, pinholed, sandy silty ferruginous gravel Transported
2.3				
2.4				
2.5				
2.6				
2.7				
2.8				
2.9				
3.0				
3.1				
3.2				(2.1 m)
3.3				(3 m)
3.4				

<b>Excavation Method:</b>	TLB
<b>Refusal:</b>	None
<b>Water Table:</b>	None



**Test Pit: TP 32**


<b>Client:</b> Dijalo Property Development	
<b>Project:</b> Kwa Thema shopping centre - 6796	
<b>Date Profiled:</b> 2013/10/10	
<b>Coordinates:</b> 26°18'25.60"S, 28°25'26.20"E	
<b>Elevation:</b> 1626 m	
<b>Profiled By:</b> Madaleen Booysen	

Depth (m)	Sampling	Ground Water	Symbol	Description
0.1				<b>FIRM, SANDY SILT</b> Slightly moist, brown, firm, pinholed, sandy silt Transported
0.2				
0.3				
0.4				
0.5				
0.6				<b>SOFT, CLAYEY SILT</b> Slightly moist, red brown, soft, intact, clayey silt Transported
0.7				
0.8				
0.9				
1.0				
1.1				
1.2				
1.3				
1.4				
1.5				
1.6				
1.7				
1.8				<b>MEDIUM DENSE, SANDY SILTY FERRUGINOUS GRAVEL</b> Dry, yellow brown, medium dense, pinholed, sandy silty ferruginous gravel Transported
1.9				
2.0				
2.1				
2.2				
2.3				
2.4				
2.5				
2.6				
2.7				
2.8				
2.9				
3.0		▼		
3.1				
3.2				
3.3				
3.4				

<b>Excavation Method:</b> TLB	<b>Notes:</b> Minor seepage
<b>Refusal:</b> None	
<b>Water Table:</b> 3 m	



**Test Pit: TP 33**


<b>Client:</b> Dijalo Property Development	
<b>Project:</b> Kwa Thema shopping centre - 6796	
<b>Date Profiled:</b> 2013/10/10	
<b>Coordinates:</b> 26°18'29.40"S, 28°25'29.00"E	
<b>Elevation:</b> 1626 m	
<b>Profiled By:</b> Bronwen & Madaleen .	

Depth (m)	Sampling	Ground Water	Symbol	Description
0.1				<b>FIRM, CLAYEY SILT</b> Dry to slightly moist, brown, firm, pinholed, clayey silt Transported
0.2				
0.3				
0.4				
0.5				
0.6				
0.7				<b>FIRM, CLAYEY SILT</b> Slightly moist, orange brown mottled black, firm, pinholed, clayey silt Transported
0.8				
0.9				
1.0				
1.1				
1.2				
1.3				<b>FIRM, SANDY GRAVELLY SILT</b> Slightly moist, reddish brown mottled grey and black, firm, pinholed, sandy gravelly silt Transported
1.4				
1.5				
1.6				
1.7				
1.8				
1.9				<b>Refused on: firm sandy gravelly silt</b>
2.0				
2.1				
2.2				
2.3				
2.4				
2.5				<b>Refused on: firm sandy gravelly silt</b>
2.6				
2.7				
2.8				
2.9				
3.0				
3.1				<b>Refused on: firm sandy gravelly silt</b>
3.2				
3.3				
3.4				

<b>Excavation Method:</b> TLB
<b>Refusal:</b> 2.7 m on firm sandy
<b>Water Table:</b> None



**Test Pit: TP 34**

<b>Client:</b> Dijalo Property Development	
<b>Project:</b> Kwa Thema shopping centre - 6796	
<b>Date Profiled:</b> 2013/10/10	
<b>Coordinates:</b> 26°18'26.70"S, 28°25'28.70"E	
<b>Elevation:</b> 1626 m	
<b>Profiled By:</b> Madaleen Booysen	

Depth (m)	Sampling	Ground Water	Symbol	Description
0.1				<b>FIRM, CLAYEY SILT</b> Slightly moist, brown, firm, pinholed, clayey silt Transported  (0.8 m)
0.2				
0.3				
0.4				
0.5				
0.6				
0.7				
0.8				
0.9	U			<b>FIRM, SILTY CLAY</b> Slightly moist, red brown, firm, pinholed, silty clay Transported  (1.5 m)
1.0				
1.1				
1.2				
1.3				
1.4				
1.5				
1.6				
1.7				<b>FIRM, FINE SANDY SILTY CLAY</b> Slightly moist, reddish brown mottled grey and black, firm, pinholed, fine sandy silty clay Residual shale  (3 m)
1.8				
1.9				
2.0				
2.1				
2.2				
2.3				
2.4				
2.5				
2.6				
2.7				
2.8				
2.9				
3.0				
3.1				
3.2				
3.3				
3.4				

<b>Excavation Method:</b> TLB
<b>Refusal:</b> None
<b>Water Table:</b> None

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**APPENDIX B**  
**LABORATORY RESULTS**

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CIVIL ENGINEERING LABORATORY

**SNA CIVIL AND STRUCTURAL ENGINEERS (PTY) LTD**

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REG. NO. 2005/006128/07

"a SANAS Accredited  
Testing Laboratory, No.  
T0345"

## TEST REPORT

		REPORT NUMBER
<b>Client :</b>	ARQ	<b>14332</b>
<b>Address:</b>	P.O.BOX LYNNWOOD RIDGE 0040	
<b>Cell :</b>		
<b>Tel:</b>	123 486 669	
<b>Fax:</b>	123 486 668	
<b>ATTENTION:</b>	MADALEEN BOOYSEN	
<b>Project/Order:</b>	KWA THEMA	
<b>Brief :</b>	GRAD, PI, HYDRO, MDD, CBR, PH, COND, MOIST, COLLAPSE	

Date requested	14/10/2013
Date sampled	14/10/2013
Date received	14/10/2013
Test date/dates	15/11/2013
Location of sampling	KWA THEMA
Sampling method/methods# /	SAMPLED BY CLIENT
Sampled by	SAMPLED BY CLIENT
Sample number/numbers	REFER TO TEST SHEET
Sample Condition/Description	REFER TO TEST SHEET
Sampling Environmental condition	SAMPLED BY CLIENT
Test Method/Methods used	REFER TO TEST SHEET
<b>Test done at</b>	SNALAB

**Deviation to test methods :** NONE

**Tests marked # Not SANAS Accredited**

The results relate only to the items tested. Any opinions ,classifications , comments and interpretations do not fall within the scope of our SANAS accreditation.

Test/Tests marked # Not SANAS Accredited in this report are not included in the SANAS Schedule of Accreditation for this laboratory.

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If the report is referred to as an INTERIM REPORT it is not fit for publication.

Terms and conditions of business are contained on the reverse side of the report.

Hendrik Diederiks. Pr Tech Eng  
Laboratory Manager

15.11.2013

DATE:



	Project: KWA THEMA	Lab No: 14332	Client No: 7400	Date: 14/10/2013
	Rd/Sect/BP: Layer/Holes			

### INDICATORS

Methods:		TMH 1: Method A1 - A5										TMH 1: A2 + A3 and A4	TMH 1: A20	TMH 1: A21T	ELEC-TRIC CONDUCT. (S/m)	AASHTO Classification #			
		% PASSING																	
HOLE & / SAMPLE No. MATERIALS DESCRIPTION	DEPTH (m)	SOIL MORTAR ANAL vs # mm										ATTERBERG LIMITS (%)			pH				
		0.075	0.150	0.250	0.425	0.75	1.50	3.00	6.00	12.5	25.0	50.0	LL	LS		PI			
TP 1 RED BROWN SAND	0.5 - 2.7	100	100	100	99	91	61	8	7	13	11	62	0.49	27	5.7	11	6.00	0.076	A-6 ( 5 )
TP 8 RED BROWN SAND	0.4 - 3.0	100	100	100	99	93	70	7	5	9	9	70	0.39	24	5.3	10	6.22	0.015	A-4 ( 7 )
TP 12 YELLOW BROWN SAND	0.5 - 2.0	100	92	84	74	55	12	6	9	8	65	0.87	22	4.0	8	6.08	0.057	A-4 ( 4 )	
																			( ) ( 4 )
																			( ) ( 5 )
																			( ) ( 6 )
																			( ) ( 7 )
																			( ) ( 8 )
																			( ) ( 9 )
																			( ) ( 10 )

REMARKS:	TECH: <u>                    </u>
	DATE: 15-11-13



Project : KWA THEMA

Rd name / No : 14332

Section from : 7400

Client No : 15/10/2013

Date : 15/10/2013

Lab No: 14332

Client No: 7400

Date: 15/10/2013

**CBR / UCS / ITS**  
**TMH 1: METHODS A8 / A13T, A14, A16T**

Sample No.	Description Stabilising agent % and type	MDD / OMC ( MOD, AASHTO. )				Compaction							Summary			G- Classification COL TO SERIES 3400- Table 3402/#				
		Mc %	Wet kg/m <sup>3</sup>	Dry kg/m <sup>3</sup>	Density	Swell %	Comp MC %	Dry dens kg/m <sup>3</sup>	Rel Comp %	CBR % ( UCS ITS (kPa)	Cor. Factor % / (kPa)	CBR % ( UCS (kPa))	Rel comp %	CBR %	UCS kPa		ITS kPa			
TP 1	RED BROWN SAND 0.5-2.7	10.3	1968	1784						15.6	15.6	1852	100.2	16.0	0.37	16.4	100	15.6		NC
TP 8	RED BROWN SAND 0.4-3.0	14.3	2003	1752						0.03	16.2	1789	101.0	13.0	0.34	13.3	100	12.6		NC
TP 12	YELLOW BROWN GRAVEL 0.5-2.0	16.0	1771	1710						0.07	17.1	1675	94.6	9.0	0.22	9.2	100	25.3		NC
		14.3	1840	1712						0.14	17.2	1610	90.9	6.0	0.15	6.2	90	14.7		NC
		14.3	1840	1712						0.72	14.1	1630	88.6	3.0	0.07	3.1	90	11.2		NC
		14.3	1840	1712						AV/MC	13.9						1	4.6		
		14.3	1840	1712						AV/MC	13.9						1	3.5		

Sample No.	Description Stabilising agent % and type	MDD / OMC ( MOD, AASHTO. )				Compaction							Summary			G- Classification COL TO SERIES 3400- Table 3402/#				
		Mc %	Wet kg/m <sup>3</sup>	Dry kg/m <sup>3</sup>	Density	Swell %	Comp MC %	Dry dens kg/m <sup>3</sup>	Rel Comp %	CBR % ( UCS ITS (kPa)	Cor. Factor % / (kPa)	CBR % ( UCS (kPa))	Rel comp %	CBR %	UCS kPa		ITS kPa			
		10.3	1968	1784						15.6	15.6	1852	100.2	16.0	0.37	16.4	100	15.6		NC
		14.3	2003	1752						0.03	16.2	1789	101.0	13.0	0.34	13.3	100	12.6		NC
		16.0	1771	1710						0.07	17.1	1675	94.6	9.0	0.22	9.2	100	25.3		NC
		14.3	1840	1712						0.14	17.2	1610	90.9	6.0	0.15	6.2	90	14.7		NC
		14.3	1840	1712						0.72	14.1	1630	88.6	3.0	0.07	3.1	90	11.2		NC
		14.3	1840	1712						AV/MC	13.9						1	4.6		
		14.3	1840	1712						AV/MC	13.9						1	3.5		

Remarks :

Water added weighed and not measured by volume

TECH DATE



Project : KWA THEMA  
Rd/Sect/BP :  
Layer/Holes :

Lab No : 14332  
Client No : 7400  
Date : 14/10/2013

### HYDROMETER ANALYSIS # TMH 1: TM 6A (Modified) (Na<sub>4</sub>P<sub>2</sub>O<sub>7</sub>)

HOLE & / SAMPLE No	TP 1	TP 8	TP 12	-
Description	RED BROWN SAND	RED BROWN SAND	YELLOW BROWN SAND	-
Depth	0.5 - 2.7	0.4 - 3.0	0.5 - 2.0	-

#### GRADING ANALYSIS. (CUM % PASSING)

SIEVE # (mm)	(01-1)	(01-2)	(02-3)	(02-4)	(03-5)	-
106.0						
90.0						
75.0						
63.0						
53.0						
37.5						
26.5						
19.0						
13.2	100	100	100			
4.75	100	100	92			
2.00	99	99	84			
0.425	91	93	74			
0.075	61	70	55			
GRADING MODULUS GM	0.49	0.39	0.87			

#### ATTERBERG CONSTANTS.

LL	27	24	22			
PI	11	10	8			
LS	5.7	5.3	4.0			

(PI &lt; 20, use 100 g. PI &gt; 20 use 50 g)

#### HYDROMETER ANALYSIS

USED 50 / 100 g	100	100	100			
SOIL FINES						
STARTING TIME						
FINE SAND 18 sek.	56.0	60.0	58.0			
SILT 40 sek.	50.0	54.0	51.0			
CLAY 1 hr.	27.0	34.0	27.0			
EXPANSIVE CLAY 6 hrs.	24.0	30.0	23.0			
TEMPERATURE . ( 18 - 22 ) (°C)	21.0	21.0	21.0			
CORRECTION	0.4	0.4	0.4	NA	NA	NA

#### CORRECTED HYDROMETER READINGS

FINE SAND 18 sek.	56.4	60.4	58.4			
SILT 40 sek.	50.4	54.4	51.4			
CLAY 1 hrs.	27.4	34.4	27.4			
EXPANSIVE CLAY 6 hrs.	24.4	30.4	23.4			
SOIL FINES % OF TOTAL SAMPLE	0.075	51.4	55.9	43.3		
	0.05	46.0	50.4	38.1		

SOIL MORTAR ANALYSIS		PERCENTAGE OF SOIL MORTAR				
C.SAND	2,0 TO 0,425	7.9	6.5	12.3		
F.SAND	0,425 TO 0,05	45.7	42.6	42.6		
SILT	0,05 TO 0,005	21.2	18.7	21.0		
CLAY	0,005 TO 0,002	2.8	3.7	3.5		
EXP. CLAY (C)	< 0,002	22.5	28.4	20.5		
MORTAR CHECK SUM	= 100	100.0	100.0	100.0		
SILT-CLAY FRACT.	< 0.05	46.4	50.9	45.1		

ACTIVITY INDEX K		SUPPLEMENTARY INFORMATION.				
EXP. CLAY FRACT % = 0,4x C		9.0	11.4	8.2		
EFFECTIVE PI = % <sub>&lt;0,425</sub> x PI	(P)	9.7	8.9	5.9		
K = 5(( P-0,4C )(C-10 )) <sup>0,6</sup>		18				
ACTIVITY CLASSIFICATION*		LOW	LOW	LOW		

\* ACTIVITY CLASSIFICATION (&lt;50), LOW: (50-120), MED: (120-200), HIGH: (&gt;200), VERY HIGH, &amp; (where #NUM! = neg val), LOW.

ELECTRIC. CONDUCT. (S/m)	0.0763	0.015	0.0567			
pH	6.00	6.22	6.08			

REMARKS:	TECH:				
	DATE:	15-11-13			

W.I.4.0(b)24  
 Lab No: 14332  
 Client No: 7400  
 Date: 14/10/2013

Project: KWA THEMA  
 Rd name / No:  
 Section from:



**Moisture Content  
 TMH 1: METHOD A17**

Sample number	Description	Wet weight gram	Dry weight gram	Moist. weight	% Moist	Comments
TP 1	RED BEOWN SAND	2043.3	1770.1	273.2	15.43	
TP 8	RED BROWN SAND	2102.7	1856.1	246.6	13.29	
TP 12	YELLOW BROWN SAND	2050	1836.7	213.3	11.61	
TP 34	RED BROWN SAND	2016.1	1765.6	250.5	14.19	

*[Handwritten Signature]*

Remarks:

TECH  
 DATE

15.11.13



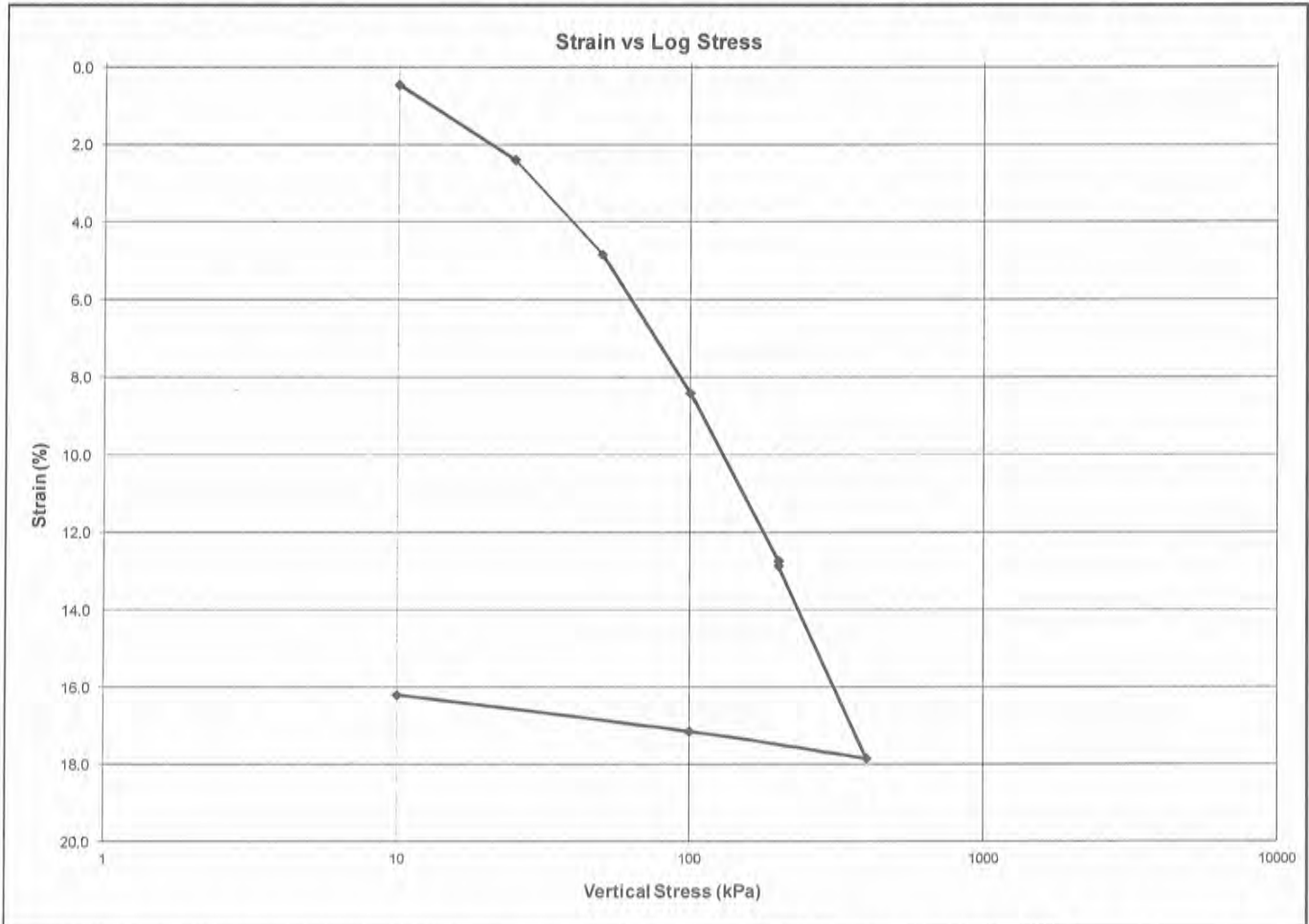
## CONSOLIDATION TESTS: COLLAPSE POTENTIAL

**BS 1377  
Part 5**

Client SNA Civil & Struct. Eng. Project Project 14332	Job no 2013-C-1402
Sample no TP 34	Date 04/11/2013
Lab no 3/10781	Depth (m) 0.8 - 1.5

Sample Parameters	Unit	Value	Remarks	Test Remarks
Moisture Content	Before Test	15.8	Complete test specimen	Soaked @ 200kPa
	After Test	22.6	Complete test specimen	Collapse Potential: 0.13%
Dry Density	Kg/m <sup>3</sup>	1369		
Void Ratio	-	0.936		
Degree of Saturation	%	44.7		
Initial Specimen Height	mm	25.4		
Relative Density (SG)	-	2.650	Assumed	

Test Parameters											
Vertical Stress	kPa	10	25	50	100	200	200	400	100	10	
Time Elapsed	hr	1	1	1	1	1	24	1	1	1	
H <sub>100</sub>	mm	25.284	24.792	24.171	23.263	22.166	22.132	20.867	21.046	21.285	
Strain	%	0.455	2.396	4.837	8.413	12.733	12.865	17.846	17.140	16.200	
Void Ratio	-	0.927	0.890	0.842	0.773	0.690	0.687	0.591	0.604	0.622	
Mv (1/Mpa)	-	-	1.3	1.001	0.751	0.472	-	0.286	0.029	0.126	



Everything possible is done to ensure that tests are representative and are performed accurately, and that reports and conclusions are quoted correctly. Geostrada or its officials can in no way be held liable for consequential damage or loss due to any error made in carrying out the tests, nor for any erroneous statement or opinion contained in a report based on such tests. If a test report is published or reproduced by the client, it will be done in full, without any omission.



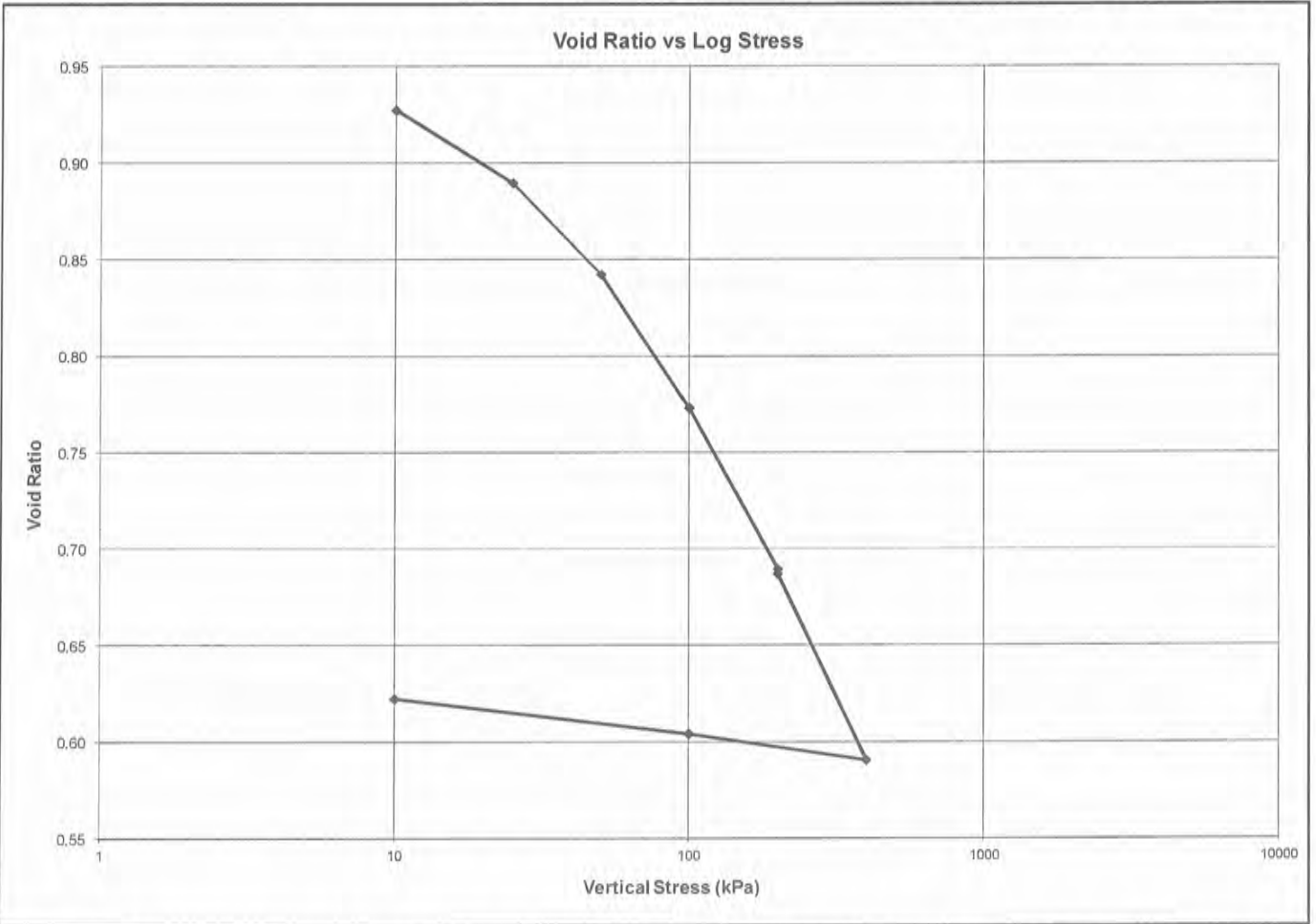
## CONSOLIDATION TESTS: COLLAPSE POTENTIAL

**BS 1377  
Part 5**

Client SNA Civil & Struct. Eng. Project Project 14332	Job no 2013-C-1402
Sample no TP 34	Depth (m) 0.8 - 1.5
Lab no 3/10781	Date 04/11/2013

Sample Parameters	Unit	Value	Remarks	Test Remarks	
Moisture Content	Before Test	%	15.8	Complete test specimen	Soaked @ 200kPa
	After Test	%	22.6	Complete test specimen	Collapse Potential: 0.13%
Dry Density	Kg/m <sup>3</sup>	1369			
Void Ratio	-	0.936			
Degree of Saturation	%	44.7			
Initial Specimen Height	mm	25.4			
Relative Density (SG)	-	2.650	Assumed		

Test Parameters											
Vertical Stress	kPa	10	25	50	100	200	200	400	100	10	
Time Elapsed	hr	1	1	1	1	1	24	1	1	1	
H <sub>100</sub>	mm	25.284	24.792	24.171	23.263	22.166	22.132	20.867	21.046	21.285	
Strain	%	0.455	2.396	4.837	8.413	12.733	12.865	17.846	17.140	16.200	
Void Ratio	-	0.927	0.890	0.842	0.773	0.690	0.687	0.591	0.604	0.622	
Mv (1/MPa)	-	-	1.3	1.001	0.751	0.472	-	0.2858	0.029	0.126	



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