REPORT

TO

LTE CONSULTING

ON A

DOLOMITIC STABILITY & GEOTECHNICAL INVESTIGATION

FOR THE PROPOSED EXTENSIONS TO SPRINGS FRESH PRODUCE MARKET

EKURHULENI, GAUTENG

Report No. 3546 October 2017

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3546/MP/ndl
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For the attention of
Mr. S. Maharaj

Dear Sir,

REPORT TO LTE CONSULTING ON A DOLOMITIC STABILITY AND GEOTECHNICAL INVESTIGATION FOR THE PROPOSED EXTENSIONS TO SPRINGS FRESH PRODUCE MARKET

We have pleasure in submitting this preliminary report for the above-mentioned project.

We trust that this will meet your requirements in this matter.

Yours faithfully,
MICHAEL PAVLAKIS & ASSOCIATES

DR. M. PAVLAKIS

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Project Ref No. 3546 – 10 October 2017

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1. INTRODUCTION AND TERMS OF REFERENCE

1.1 Michael Pavlakis & Associates were appointed by LTE Consulting to carry out a Geotechnical Investigation for the proposed extensions to the existing Springs Fresh Produce Market.

1.2 The purpose of the investigation was to establish the subsoil and founding conditions within the site and provide recommendations for the design of the building foundations and earthworks.

1.3 Because the site is underlain by dolomitic formations at depth, it was also deemed necessary that a basic dolomite investigation be carried out to confirm the results at the planning stage, which had suggested that the dolomites are present at depths well in excess of 70 m and are covered by a protective non-dolomitic cover of Karoo shale and intrusive rocks.

1.4 The initial exploratory work was carried out in February 2017, and comprised the drilling of 3 deep boreholes, while the near-surface investigation was carried out in June 2017. A preliminary report was issued on the 30th June 2017.

1.5 Following the completion of the laboratory testing program, we now have the pleasure of submitting this final report with design recommendations.

2. INFORMATION SUPPLIED

2.1 During the course of the investigation the following information was provided by LTE Consulting:

2.1.1 A set of undated drawings (PDF) prepared by Liefa Architects and titled:

- Springs Fresh Produce Market - Option B (Plan)
- Springs Fresh Produce Market - Sections
- Springs Fresh Produce Market - Elevations.

2.1.2 An Auto-Cad drawing with drawing number 16-015-02-01, titled Springs Fresh Produce Market, “LAYOUT”, received 29.05.2017

2.1.3 Drawing No. 16-015-00-01 titled Springs Fresh Produce Market dated 25/07/2017 showing a revised layout of the project.

2.2 The following additional information on previous work carried out was obtained:

2.2.1 A report titled: "Springs Stadsraad, Springs nasional Varsproduktemark, 'n Geotegniese verslag oor die bodemtoestande met die oog op strukturele en plaveisel uitbreiding aan die suiderlike kant van die marksaal", carried out by AMB, dated April 1996.

2.2.2 A report titled: "Dolomite Stability Investigation of Springs Fresh Produce market, Springs, by GeoBuro, dated January 2016

3. SITE DESCRIPTION

3.1 The site is situated immediately to the east of the existing development and comprises even terrain sloping gently towards the south and covered by grass. The southern-most section is covered by tall veld grass and is close the railway line.

4. THE STRUCTURES

4.1 The extensions will amount to virtually doubling the existing market facilities.

4.2 The new Market and Agro Processing structures comprise 11,3 m high and 20 m wide buildings with an arched structural steel roof truss, supported on concrete columns, with brick infill / dividing walls some 8 m high above floor level.

4.3 New shops are to be constructed to the north of the new Market comprising 4 m high band load bearing brickwork structures.

4.4 To the east of the new Market and Agro Processing buildings, additional smaller structures are to be constructed including new stores, electrical rooms, waste plants, and storage facilities. All of these are deemed to be single storey loadbearing brickwork structures.

5. SITE GEOLOGY

5.1 Published geological maps indicate that the site is underlain by the dolomites of the Chuniespoort Group, Transvaal Supergroup. These are shown to be overlain by shales of the Karoo Supergroup.

5.2 The results of drilling work also indicated that the above-mentioned formations have been intruded by a dolerite sill and, in the case of borehole BH.A2, some quartzite, probably of the Witwatersrand Group.

6. DOLOMITE STABILITY INVESTIGATION

6.1 Desktop Study

6.1.1 The results of a desktop study showed that the thickness of the non-dolomitic strata overlying the dolomites that underlie the site at depth is likely to be of the order of 70 m or more.

6.1.2 The results of drilling work carried out within the northern section of the existing Springs fresh produce market, referenced BH.A1 and BH.A2 on the attached site plan, Figure 2, showed that non-dolomitic formations are present down to the depth of 60 m.

6.2 Field Exploratory Work: Deep Drilling

6.2.1 In order to establish the deep subsoil conditions and dolomitic stability of the site to be occupied by the proposed market extensions, 3 boreholes, referenced BH.1 - BH.3, were drilled to cover the site. Their position is shown on the attached satellite image, Figure (i) and 3(a) and the Site Plan, Figure 3 (b). The chip samples recovered were subsequently logged in detail and the results are shown in the borehole logs, Figures 4 - 6.

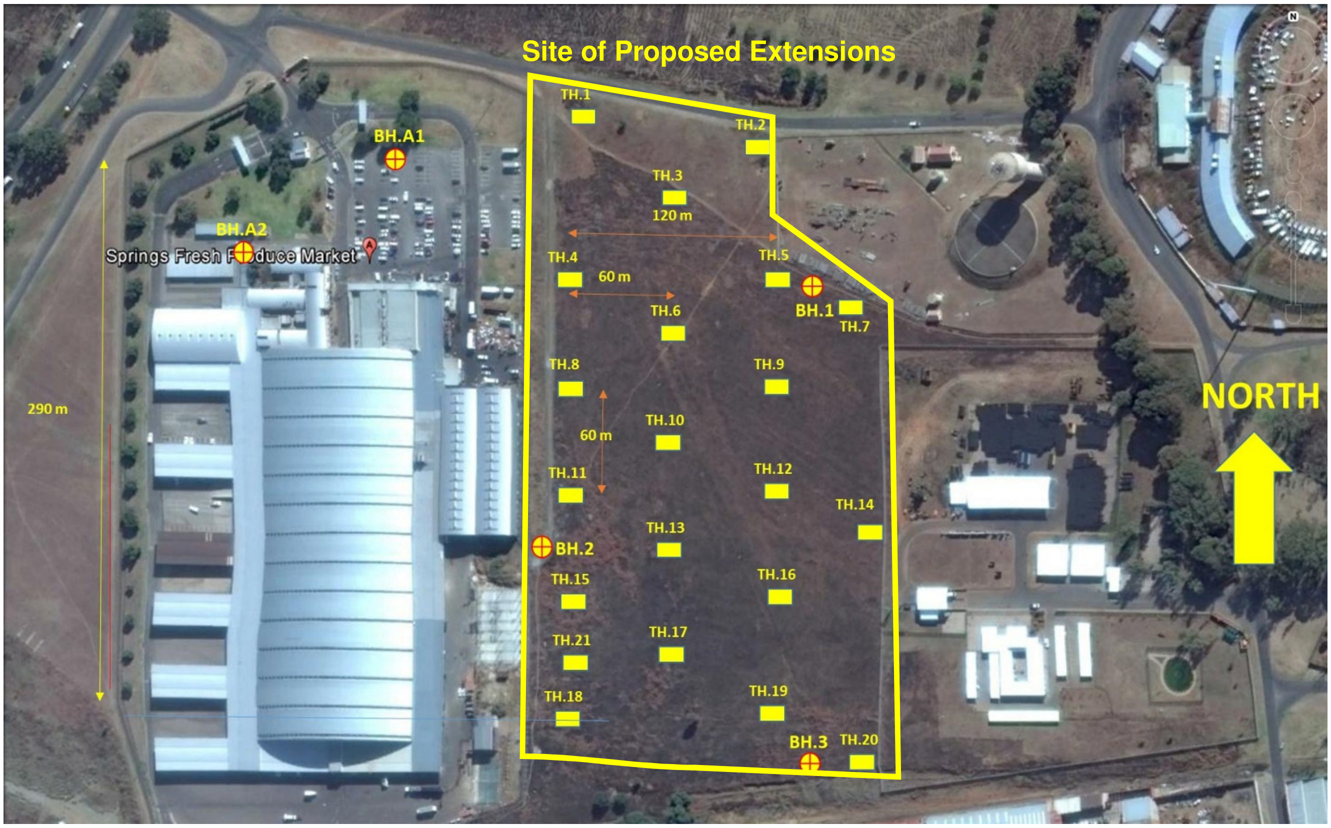


Figure. (i): Satellite Image Showing Positions of Boreholes and Trial Holes

6.2.2 The boreholes indicated that non dolomitic formations are present down to the maximum depth drilled of 60 m. The results of the drilling work, together with these obtained from the drilling of the previous borehole, are summarised in Table 1 below.

6.2.3 The ground water table is shallow, present at the depths of 2,8 - 4,2 m. These depths are similar to the ground water levels observed within the exploratory trial holes, reviewed in Section 7.

TABLE 1: Summary of Borehole Data

BH.No	Transported m	Shale m	Dolerite m	Quartzite m	Wad m	Cavities m	Dolomite Bedrock m	Air Loss m	Samples Loss m	Ground Water Rest Depth, m
BH.P1	-	0-11 30-60	11-30	-	-	-	>60	-	-	4.2
BH.P2	-	0-11	11-53	53-60	-	-	>60	-	-	3.4
BH.1	0-2	2-12	12-60	-	-	-	>60	S 21-22	-	3.6
BH.2	0-2	2-14 33-60	14-33	-	-	-	>60	-	-	2.8
BH.3	0-1	1-4	4-60	-	-	-	>60	S 31-41 M 42-43	-	Mud

* S = Slight M= Medium

6.3 Dolomitic Stability of Site

6.3.1 A total of 5 boreholes covering the site of the proposed extensions indicated that presence of non-dolomitic formations, namely Karoo shale, dolerite intrusion and some quartzite, down to the depth of 60 m below existing ground surface.

6.3.2 Taking into account that the area is situated in a non-dewatered compartment it is considered that it is associated with a low risk of any size sinkhole/subsidence occurring under conditions of both continuous water ingress and water table drawdown and is thus assigned an Inherent Hazard Class of IHC 1//1.

6.4 Dolomitic Designation of Site

6.4.1 In terms of the proposed usage of the site and the provisions of SANS 1936-1, the site is assigned a dolomitic designation “non dolomitic”. The conditions for development are indicated in Table 2 below.

TABLE 2: Summary of Borehole Data

Dolomitic Zone	Dolomitic Designation	Conditions for Development as per SANS 1936-1
Entire area for Market Extensions	Non-Dolomitic (But D2 for Implementation of Precautionary Measures)	Due to the presence of dolomite at depth, it is recommended that general precautionary measures, in accordance with the requirements of SANS 1936-3, that are intended to prevent the concentrated ingress of water into the ground, are required. The measures to be taken should correspond to D2 Dolomitic Designation.

6.4.2 All precautionary requirements relating to D2 designation, as indicated in SANS 1936-3 must be implemented.

7. NEAR SURFACE GEOTECHNICAL INVESTIGATION

7.1 Exploratory Trial Holes

7.1.1 The near-surface field exploratory work was carried out during the period from 1-2 June 2017, and comprised the excavation, detailed examination and sampling of 21 exploratory trial holes at the positions referenced TH.1 – TH.21 and on the attached site plan Figure 3. A powerful Sumitomo excavator was used for this purpose.

7.1.2 It should be noted that the trial holes were excavated in accordance with the original project layout, which has since changed.

7.1.3 Each of the holes was examined in detail immediately after excavation and the resulting trial hole logs are shown in Figures 7 - 27 of this report.

7.2 Subsoil Conditions

7.2.1 Transported Soils - Topsoil & Hillwash

a) The entire site is underlain by a 0,2 - 0,3 m thick grey brown loose clayey silty sand, topsoil, containing abundant roots.

b) A generally orange brown clayey/silty sand, Hillwash, follows below and extends to depths varying from 0,7 - 1,9 m below existing ground surface, but mostly within the 1,2 - 1,6 m range. This soil is generally of loose or loose to medium dense consistency and is associated with high compressibility and significant collapse potential.

7.2.2 Slightly Ferruginised Hillwash

a) The incompetent hillwash is underlain by similar clayey/silty sands containing ferruginous nodules and are deemed to have undergone variable, but generally moderate ferruginisation. This layer varies in consistency from loose to medium dense and is occasionally more gravelly and medium dense to dense. It is thus, also, deemed to be a generally incompetent founding medium except for lightly loaded structures. It was found to be present at depths of 1,0 m or less within trial holes TH.4, 6, 8 - 10, 16 - 18 and 20 – 21. Within the remaining trial holes it is generally present at the depths of mostly 1,3 – 1,9 m.

7.2.3 Ferricrete

a) The above-mentioned mostly incompetent soil horizons are followed by a competent ferricrete of mostly dense to very dense consistency. The ferricrete comprises mostly dark orange brown, reddish brown and maroon cemented and ferruginised clayey/gravelly silty sands becoming more clayey with depth.

b) Depths to the competent ferricrete layer vary mostly within the 1,5 - 2,5 m depth range.

7.2.4 Reworked/Residual Dolerite

a) Where the ferricrete could be penetrated it was found that it is underlain by generally stiff to very stiff clayey silty sand and sandy/silty clays deriving mostly from the in-situ decomposition and subsequent reworking of dolerite and shale rocks. The clayey soils extended to the bottom of the trial holes at the depth of 3,6 - 4,5 m below existing ground surface.

7.3 Ground Water Conditions

7.3.1 A shallow ground water table is present throughout the site at depths varying mostly within the 3,8 - 4,0 m depth range. These are in broad agreement with standing water levels measured within boreholes BH.1 - BH.3 of 2,8 - 3,6 m. Ground water depths at the individual trial hole positions are listed in Table 3 below.

TABLE 3: Depths of Ground Water Seepage and Ground Water Standing within Trial Holes.

Trial Hole No	Hole Depth, m	Depth of Ground Water		Comment
		Seepage	Standing	
TH.1	1.70	-	-	-
TH.2	1.80	-	-	-
TH.3	1.60	-	-	-
TH.4	3.90	-	3.90	-
TH.5	4.40	-	4.05	-
TH.6	3.40	-	-	-
TH.7	4.50	-	4.40	-
TH.8	4.30	3.80	4.25	Slow seepage
TH.9	4.35	-	4.25	-
TH.10	3.00	-	-	-
TH.11	4.40	-	4.00	-
TH.12	4.30	-	4.05	-
TH.13	4.00	-	3.80	-
TH.14	3.60	-	-	-
TH.15	4.00	-	3.20	-
TH.16	4.10	3.90	4.05	Slow seepage
TH.17	4.40	-	3.95	-
TH.18	3.90	3.40	3.60	Moderate
TH.19	3.70	-	3.55	-
TH.20	3.80	-	-	-
TH.21	4.00	-	3.90	-

7.3.2 It is noted that the auger holes drilled at the southern section of the existing development some 20 years ago showed water seepage depth of 1,2 - 2,0 m, which is shallower than those observed in this investigation. It appears, therefore, that the ground water table may have dropped slightly over this period.

8. LABORATORY TESTING

8.1 Particle Size Distribution & Atterberg Limit tests, Oedometer Collapse and Swell tests, Modified AASHTO Compaction and CBR tests and Bulk Density and pH & Conductivity tests were carried out on representative soil samples. The results of the tests are shown in Appendix B and are summarised in Tables 4 to 9 of this report.

TABLE 4: Summary of Results of Index Tests

HOLE NO	DEPTH m	SOIL TYPE & ORIGIN	LL	PI	LS	%< 425μ	(PI) ws	%< 2μ	G.M.	UCS	PE
TH.1	0.50-1.10	Abundant gravels and ferruginous nodules in clayey silty sand. Partly ferruginised hillwash.	39	14	6.5	42	6	13	1.70	SC	L
TH.2	0.30-0.70	Silty Sand. Hillwash.	25	10	4.5	88	9	14	0.67	SC	L
	0.70-1.40	Abundant gravels and ferruginous nodules in clayey silty sand.	35	12	5.5	39	5	10	1.83	SC	L
TH.3	0.20-0.80	Clayey silty sand. Hillwash.	30	12	5.5	75	9	25	0.90	CL	L
	0.90-1.40	Gravelly clayey silty sand. Hillwash with gravels.	31	13	6	43	6	13	1.70	SC	L
TH.4	0.20-1.20	Clayey silty sand. Hillwash.	29	12	6	86	11	29	0.59	CL	L
	0.90-1.10	Clayey silty sand. Hillwash.	29	12	6	91	11	32	0.50	CL	L
	1.90-2.20	Clayey sandy silt with abundant ferruginous nodules. Weakly ferruginised hillwash.	34	15	6.5	62	9	18	1.17	SC	L/M
	3.10-3.40	Gravelly clayey sand with abundant ferruginous nodules. Moderately ferruginised residual shale.	34	16	6.5	48	8	11	1.66	SC	L
TH.5	1.00-1.20	Gravelly silty sand. Slightly ferruginised hillwash.	36	16	7	45	7	11	1.69	SC	L
	1.40-1.60	Clayey sandy silt. Possibly residual dolerite with ferruginous nodules.	37	18	8	65	11	20	1.15	SC	L/M
	2.30-2.50	Clayey silt. Possible residual dolerite.	37	14	6.5	89	12	12	0.46	CL	M
TH.6	1.20-1.40	Clayey sandy silt. Hillwash.	33	13	6.5	88	12	33	0.51	CL	M
TH.7	3.20-3.60	Silty clay. Possibly residual dolerite.	51	20	8.5	88	18	45	0.43	MH	M
	4.10-4.40	Clayey silt. Possibly residual dolerite.	52	18	8	95	17	45	0.23	MH	M
TH.8	0.80-1.10	Clayey sandy silt. Hillwash.	31	9	4.5	90	8	23	0.47	CL	L
TH.9	4.00-4.35	Sandy silty clay. Residual dolerite.	42	21	8.5	81	17	38	0.71	CL	M
TH.10	1.40-1.70	Clayey sandy silt. Hillwash with gravels.	32	15	6.5	56	8	13	1.32	SC	L
	2.20-2.60	Gravelly silty sand. Ferricrete.	34	13	6	47	6	12	1.63	SC	L
TH.11	0.80-1.10	Abundant gravels in silty sand. Possibly ferruginous hillwash.	35	9	4.5	38	3	8	1.92	SC	L
	1.50-1.70	Gravelly clayey silty sand. Possibly partially ferruginised slightly reworked residual dolerite.	35	12	5.5	63	7	15	1.24	SC	L
	2.30-2.70	Silty sand. Possibly residual dolerite.	31	12	5.5	84	10	14	0.73	SC	L

NOTE :

LL = LIQUID LIMIT
PI = PLASTICITY INDEX
LS = LINEAR SHRINKAGE
G.M = GRADING MODULUS
UCS = UNIFIED CLASSIFICATION SYSTEM
PE = POTENTIAL EXPANSIVENESS

TABLE 4: Summary of Results of Index Tests (continued)

HOLE NO	DEPTH m	SOIL TYPE & ORIGIN	LL	PI	LS	%< 425µ	(PI) ws	%< 2µ	G.M.	UCS	PE
TH.12	0.20-0.80	Clayey sandy silt. Hillwash.	28	9	4.5	71	6	21	1.02	SC	L
	0.45-0.60	Clayey sandy silt. Hillwash.	27	10	4.5	89	8	32	0.53	CL	L
	1.50-2.50	Gravelly silty sand. Ferricrete.	32	13	6	48	6	9	1.65	SC	L
	3.40-3.60	Sandy silt. Possible residual dolerite.	28	14	5.5	89	13	18	0.74	SC	M
TH.13	2.85-3.10	Clayey silty gravel. Weak ferricrete.	37	17	8	76	13	30	0.81	CL	M
TH.14	0.45-0.90	Gravelly silty sand. Slightly gravelly hillwash.	36	13	6	56	7	18	1.34	SC	L
	1.90-2.20	Gravelly silty sand. Ferricrete.	36	14	6.5	59	8	19	1.24	SC	L
	2.90-3.30	Silty clay. Possibly residual dolerite.	44	22	9.5	90	20	42	0.46	CL	M
TH.15	0.80-1.10	Gravelly silty sand. Fine colluvium.	35	15	6.5	41	6	13	1.80	SC	L
	1.70-2.10	Gravelly silty sand. Ferricrete.	34	18	7.5	37	7	13	1.91	SC	L
	2.80-3.10	Clayey sandy silt. Possibly residual dolerite.	40	20	8.5	48	10	18	1.67	SC	L
TH.16	1.00-1.30	Clayey silty sand. Hillwash.	31	8	4.5	77	6	19	0.82	ML	L
	1.70-2.05	Mixture of Clayey silty sand with abundant gravels and ferruginous nodules. Hillwash and ferruginised hillwash.	31	11	5	71	7	17	1.01	CL	L
	2.70-3.10	Gravelly clayey sand. Ferricrete.	29	11	5.5	49	5	13	1.58	SC	L
	3.30-3.70	Gravelly sandy clay. Ferricrete.	40	16	6.5	32	5	15	2.08	SC	L
TH.17	1.00-1.30	Clayey silty sand. Hillwash with gravels.	32	12	5.5	73	9	19	0.95	CL	L
	1.70-3.00	Gravelly silty sand. Ferruginised hillwash.	37	16	7.5	52	8	16	1.25	SC	L
	3.50-3.80	Clayey sandy silt. Possible residual dolerite.	39	16	7.5	77	13	31	0.81	CL	M
TH.18	2.20-2.40	Sandy gravel. Ferruginised Hillwash.	34	14	6	43	6	13	1.76	SC	L
	3.20-3.40	Clayey sandy gravel. Ferricrete.	35	15	6.5	62	10	25	1.26	SC	L
TH.19	1.00-1.70	Sandy silt. Possible residual shale.	36	12	6	70	8	21	1.02	ML	L
	2.10-2.40	Clayey sandy silt. Possible residual shale.	37	17	8	79	13	34	0.75	CL	L/M
TH.20	1.50-1.80	Abundant gravels and ferruginous nodules in silty sand. Weakly ferruginised fine colluvium.	38	13	6	31	4	7	2.07	SC	L
TH.21	1.05-2.30	Abundant ferruginous nodules in clayey silty sand. Ferruginised hillwash.	34	10	5	29	3	7	2.15	SC	L
	1.20-1.80	Abundant ferruginous nodules in clayey silty sand. Ferruginised hillwash.	31	9	3.5	34	3	8	1.98	SC	L

NOTE :

LL = LIQUID LIMIT
PI = PLASTICITY INDEX
LS = LINEAR SHRINKAGE
G.M = GRADING MODULUS
UCS = UNIFIED CLASSIFICATION SYSTEM
PE = POTENTIAL EXPANSIVENESS

TABLE 5: Summary of Results of Oedometer Tests on Undisturbed Block Samples

HOLE NO.	DEPTH m	SOIL TYPE AND ORIGIN	ρ_d kg/m^3	NMC %	e_0	S_r %	P_c kPa	Ps kPa	C_e	C_c	% COLL @ 50 kPa	% Swell @ 10 kPa
TH.4	0.90-1.10	Clayey silty sand. Hillwash.	1372	20.2	0.953	57	50	-	0.200	0.415	3.69	-
TH.5	2.30-2.50	Clayey silt. Possible residual dolerite.	1493	25.5	0.774	87	70	-	0.012	0.098	-	-
TH.6	1.20-1.40	Clayey sandy silt. Hillwash.	1385	20.5	0.945	57	50	-	0.130	0.392	2.62	-
TH.7	4.10-4.40	Clayey silt. Possibly residual dolerite.	1376	36.6	0.926	105		95	0.013	0.066	-	0.78
TH.8	0.80-1.10	Clayey sandy silt. Hillwash.	1487	21.1	0.811	70	85	-	0.064	0.259	0.72	-
TH.12	0.45-0.60	Clayey sandy silt. Hillwash.	1357	16.6	0.963	46	60	-	0.126	0.415	2.45	-
TH.13	2.65-3.10	Clayey silty gravel. Weak ferricrete.	1756	19.2	0.509	100	55	-	0.010	0.040	-	-
TH.16	1.00-1.30	Clayey silty sand. Hillwash.	1486	18.9	0.754	65	80	-	0.082	0.296	1.43	-
TH.16	1.70-2.05	Mixture of Clayey silty sand with abundant gravels and ferruginous nodules. Hillwash and ferruginised hillwash.	1557	20.6	0.678	79	85	-	0.023	0.219	0.20	-

NOTE :

ρd = NATURAL DRY DENSITY
NMC = NATURAL MOISTURE CONTENT
Sr = DEGREE OF SATURATION
P0 = OVERBURDEN PRESSURE
Ps = SWELL PRESSURE

Pc = PRECONSOLIDATION PRESSURE
Ce = EXPANSION INDEX
Cc = VIRGIN COMPRESSION INDEX
ME = CONSTRAINED MODULUS

TABLE 6: Summary of Results of Oedometer Tests on Compacted Soils

HOLE NO.	DEPTH m	SOIL ORIGIN	ρ_d kg/m^3	NMC %	SG	e_0	S_r %	P_c kPa	ME 10kPa-200kPa (MPa)	C_e	C_c
TH.4	0.20-1.20	Hillwash Compacted to 93% Mod AASHTO	1689	15	2.667	0.579	70	220	9.1	0.009	0.246
	0.20-1.20	Hillwash Compacted to 95% Mod AASHTO	1755	15	2.677	0.520	77	225	8.8	0.010	0.206
TH.12	0.20-0.80	Hillwash Compacted to 93% Mod AASHTO	1797	14	2.679	0.485	79	125	3.8	0.013	0.176
	0.20-0.80	Hillwash Compacted to 95% Mod AASHTO	1842	15	2.679	0.449	91	215	8.3	0.009	0.160
TH.21	1.20-1.80	Ferr. Hillwash Compacted to 93% Mod AASHTO	1933	9	2.677	0.462	52	218	7.5	0.016	0.173
	1.20-1.80	Ferr. Hillwash Compacted to 95% Mod AASHTO	1978	10	2.677	0.428	60	255	8.0	0.010	0.166

NOTE :

ρd = NATURAL DRY DENSITY
NMC = NATURAL MOISTURE CONTENT
Sr = DEGREE OF SATURATION
P0 = OVERBURDEN PRESSURE

PC = PRECONSOLIDATION PRESSURE
Ce = EXPANSION INDEX
Cc = VIRGIN COMPRESSION INDEX
ME = CONSTRAINED MODULUS (UNCORRECTED)

TABLE 7: Summary of Mod AASHTO Compaction and CBR Tests

HOLE NO.	DEPTH m	SOIL TYPE AND ORIGIN	(ρ_d) max kg/m³	OMC %	Max Swell %	CBR at Degree of Compaction				TRH.14 Class
						90%	93%	95%	98%	
TH.1	0.50-1.10	Abundant gravels and ferruginous nodules in clayey silty sand. Partly ferruginised hillwash.	1871	11.7	0.2	11	14	17	22	G8
TH.2	0.30-0.70	Silty Sand. Hillwash.	1853	12.5	0.3	3.4	5.2	6.9	11	G10
	0.70-1.40	Abundant gravels and ferruginous nodules in clayey silty sand.	1914	11.1	0.2	16	27	38	62	G6
TH.3	0.20-0.80	Clayey silty sand. Hillwash.	1843	13.5	0.3	5.8	7.8	9.4	13	G9
	0.90-1.40	Gravelly clayey silty sand. Hillwash with gravels.	1846	12.2	0.3	13	17	19	24	G7
TH.4	0.20-1.20	Clayey silty sand. Hillwash.	1825	15.5	0.4	6	7.9	9.4	12	G9
TH.10	2.20-2.60	Gravelly silty sand. Ferricrete.	2002	11.6	0.2	5.9	9	12	18	G9
TH.12	0.20-0.80	Clayey sandy silt. Hillwash.	1913	15.1	0.2	8	12	15	23	G8
TH.21	1.20-1.80	Abundant ferruginous nodules in clayey silty sand. Ferruginised hillwash.	2082	9.8	0.2	14	22	32	53	G7

NOTE : **(ρd) max** = MAXIMUM DRY DENSITY **OMC** = OPTIMUM MOISTURE CONTENT
CBR = CALIFORNIA BEARING RATIO

TABLE 8: Summary of Bulk Density Tests

HOLE NO.	DEPTH, m	SOIL TYPE & ORIGIN	MOISTURE CONTENT %	DRY DENSITY kg/m³	BULK DENSITY kg/m³
TH.4	0.90-1.10	Clayey silty sand. Hillwash.	17.7	1344	1582
	3.10-3.40	Gravelly clayey sand with abundant ferruginous nodules. Moderately ferruginised residual shale.	12.4	2055	2310
TH.5	2.30-2.50	Clayey silt. Possible residual dolerite.	26	1487	1874
TH.6	1.20-1.40	Clayey sandy silt. Hillwash.	19.4	1328	1586
TH.7	4.10-4.40	Clayey silt. Possibly residual dolerite.	31	1426	1868
TH.12	0.45-0.60	Clayey sandy silt. Hillwash.	16.9	1402	1639
	1.50-2.50	Gravelly silty sand. Ferricrete.	13.9	1963	2236
TH.13	2.85-3.10	Clayey silty gravel. Weak ferricrete.	16	1777	2061
TH.16	1.00-1.30	Clayey silty sand. Hillwash.	20.4	1379	1660
	1.70-2.05	Mixture of Clayey silty sand with abundant gravels and ferruginous nodules. Hillwash and ferruginised hillwash.	20.7	1574	1900

TABLE 9: Summary of Conductivity and pH Tests

HOLE NO.	DEPTH m	SOIL TYPE & ORIGIN	pH Value	Conductivity mS/cm
TH.4	0.90-1.10	Clayey silty sand. Hillwash.	5.8	0.0183
	3.10-3.40	Gravelly clayey sand with abundant ferruginous nodules. Moderately ferruginised residual shale.	12.4	0.0090
TH.7	4.10-4.40	Clayey silt. Possibly residual dolerite.	6.4	0.0249
TH.12	3.40-3.60	Sandy silt. Possible residual dolerite.	6.5	0.0060
TH.16	3.30-3.70	Gravelly sandy clay. Ferricrete.	6.8	0.0105
TH.17	3.50-3.80	Clayey sandy silt. Possible residual dolerite.	6.7	0.0110
TH.18	3.20-3.40	Clayey sandy gravel. Ferricrete.	6.9	0.0162

9. DISCUSSION OF RESULTS

9.1 Dolomitic Stability Of Site

9.1.1 The drilling of 3 deep boreholes at the site of the proposed extensions to supplement 2 deep boreholes that had been drilled previously at the northern section of the existing development revealed that no dolomitic formations are present down to the depth of a least 60m below existing ground surface.

9.1.2 Taking into account that the site is situated in a non-dewatered compartment, it has been assigned an Inherent Hazard Class of “Non-Dolomitic”.

9.1.3 However, cognizance will have to be taken of the fact that dolomites are still underlying the site, albeit at great depths, and therefore, some precautions will have to be taken to prevent concentrated water ingress into the ground. The implementation of precautions corresponding to a D2 Dolomitic Designation, according SANS 1936:2012 is recommended.

9.2 Near-Surface Founding Conditions

The near-surface investigation, comprising the excavation detailed examination and sampling of 21 trial holes down to a maximum depth of 4,50 m, and the results of extensive laboratory testing on representative soil samples indicate the following:

9.2.1 Below a 0,2 - 0,3 m thick topsoil, containing vegetable matter, the site is underlain by an orange brown clayey silty sand, hillwash down to the depths of 0,7 - 1,9 m but mostly within the 1,2 - 1,6 m range. The hillwash was found to be a low density, partly saturated soil of relatively moderate plasticity, but of significant compressibility and collapse potential. Collapse tests indicated that it undergoes collapse settlements varying mostly from 1,40% to 3,70% at the moderate effective stress of 50 kPa and that, beyond this stress level, it is associated with a high compression index of mostly within the 0,20 - 0,40 range. It is evident, therefore, that this soil is unsuitable for supporting significant foundation loads, including heavily loaded floors. Some form of foundation treatment is, therefore, required to be carried out to protect the structure from detrimental total and differential settlements.

9.2.2 The lower section of the hillwash has been ferruginised and comprises abundant ferruginous nodules in a clayey/silty sand matrix. This is deemed to be somewhat more competent and mostly of firm or medium dense consistency and of moderate plasticity. However, it is occasionally soft and incompetent.

9.2.3 The dense or very dense ferricrete, which is present within most of the site within the depth range of 1,1 - 2,8 m, but mostly within the 1,4 - 2,4 m range, is deemed to be a competent founding medium and can support significant foundation loads with little consequent deformation. It's thickness, however, is limited and frequently relatively thin. In these areas foundation stresses will be required to be reduced to suit the underlying less competent soils. The latter comprise mostly clayey/sandy silts, residual dolerite or shale which vary in consistency from “firm” to “very stiff”. These have also been found to be of significant plasticity and of medium swelling/shrinkage potential. The thickness of these clayey soils has not been established as they extend beyond the limit of reach of the excavator.

9.2.4 Information from deep drilling carried out at the immediate vicinity of the market, indicates that the clayey horizons can extend to large depths, of the order of 4,0-12 m or more and can be of high plasticity and high swelling/shrinkage potential. Their effect on the stability of the proposed structure is, however, likely to be small due to the mitigating effects of the high ground water table and the presence of the hard ferricrete.

9.2.5 Ground water was encountered within the trial holes at depths varying from 3,4 - 4,4 m below existing ground surface. The 3 deep boreholes drilled within the site, however, within which the ground water was allowed to stabilize for at least 24 hours, the ground water table level was slightly shallower varying from 2,8 - 3,6 m in two of the 3 boreholes.

9.2.6 Modified AASHTO Compaction and CBR tests carried out on representative samples of near surface soils indicate the following

a) The near surface clayey silty sand, hillwash, constitutes a low quality fill and classifies as mostly a G9 material, and occasionally, G10, in terms of TRH.14.

b) The ferruginised hillwash (abundant ferruginous nodules in clayey silty sand matrix) has been found to be more competent and classifies as a G7 - G6 material.

9.2.7 Oedometer tests carried out on compacted specimens of the near surface hillwash soils at degrees of compaction of 93 - 95% Mod AASHTO dry density at optimum moisture content indicated that their compressibility at the compacted state is improved with the Constraint Modulus varying mostly within the 8 - 9 MPa range. Further analyses of the results, however, suggested that the Constrained Modulus is improved to an average of 10 and 15 MPa corresponding to degrees of compaction of 93% and 95%, respectively, or greater values.

10. DESIGN RECOMMENDATIONS

10.1 Earthworks

10.1.1 Before any earthworks operations are carried out, the upper 150 mm section of the topsoil should be stripped to spoil, or to stockpile if needed for landscaping purposes.

10.1.2 Due to the relatively heavily loaded floors and the load imposed by the fill to be placed to raise floor levels to at least 1,0 m above natural ground, the incompetent hillwash covering the entire site will be required to be treated in order to limit the settlement and consequential cracking of the ground floors. This can be achieved either by;

a) The in-situ densification of the hillwash soils by impact rolling from the surface (or alternatively, by rapid impact compaction) or

b) By the removal of the incompetent soils, and their re-compaction to a minimum of 93% Mod AASHTO dry density, at optimum moisture content (O.M.C.).

10.1.3 Impact rolling can be decided upon only after an appropriate in-situ testing programme, involving impact rolling test strips and measuring the resulting densification and improvement in compressibility, has been carried out.

10.1.4 Before proceeding with any dynamic compaction (impact rolling or rapid impact compaction), the possible effects of the resulting vibrations on existing structures must be considered.

10.1.5 The fill required to be placed over the compacted hillwash to raise the floor levels 1m above existing ground surfaces, should comprise minimum G6 quality fill, compacted to 95% Mod AASHTO dry density at O.M.C in maximum 150 mm thick layers.

10.2 Foundation Design: Main Buildings

10.2.1 Column Foundations: Pad Footings

a) Heavily loaded columns should be supported on normal pad footings taken through the fill and compacted hillwash, and supported on the dense ferricrete present mostly at the depths of 1,3 - 2,5 m with an average of 1,9 m below existing ground surface. A maximum allowable foundation bearing pressure of 250 kPa can be used for foundation design purposes with a minimum foundation width of 1,2 m. The permissible bearing pressure has been reduced to allow for the fact that the ferricrete is often thin and underlain by less competent soils.

b) Within certain areas where the ferricrete is not present the foundations can be supported on top of the dense and dense to very dense residual dolerite.

c) Within trial hole TH.5 no ferricrete nor competent residual dolerite was encountered. Instead a firm clayey silt, residual dolerite is present below 1,7 m extending to the depth of 4,4 m. This horizon was found to be relatively compressible and considered unsuitable to support heavily loaded foundations.

The following foundation treatment should be carried in this and similar areas:

i. The foundation should be designed on the basis of a maximum allowable bearing pressure of 150 kPa.

ii. The foundation excavation should be at least 1,5 x the footing width and should be extended to the depth below the underside of the footing of 1,5 times the footing width.

iii. The excavation below the underside of the footing should then be backfilled with G5 quality gravel fill, placed in 150 m thick layers and compacted to 95% Mod AASHTO dry density at optimum moisture content.

iv. The footing can then be constructed centrally on top of the compacted engineered fill.

d) The conditions encountered within trial hole TH.5 are anomalous, and do not correlate with any of the surrounding trial holes. Because it is possible for similar conditions to occur anywhere within the site it will, therefore, be necessary for a geotechnical engineer to inspect and approve of all foundation excavations prior to casting of concrete.

e) Depths of founding corresponding to the positions of the various trial holes, are listed in Table 10.

TABLE 10: Anticipated Founding Levels at Various Trial Hole Positions

TH. No.	**Fonding Medium**	**Heavily Loaded Structures**	
		Founding Depth (m below GL)	**Allowable Bearing Pressure (kPa)**
TH.4	Ferricrete	2.30	250
TH.5	Engineered Fill.	Engineered fill under foundations to 1,5x foundation width designed using maximum allowable bearing pressure of 150 kPa.	
TH.6	Ferricrete	2.50	250
TH.7		1.10	250
TH.8		1.95	200
TH.9		1.95	250
TH.10		1.90	250
TH.11	Residual dolerite.	1.80	250
TH.12	Ferricrete	1.50	250
TH.13		1.50	250
TH.14		1.30	200
TH.15		1.60	200
TH.16		2.30	250
TH.17		2.20	150
TH.18		2.40	250
TH.19		2.80	250
TH.20		2.00	200
TH.21		2.30	250

10.2.2 Wall Foundations: Strip Footings and/or Ground Beams

a) If, as indicated in Section 10.1 (Earthworks) the incompetent hillwash soils underlying the site are densified by in-situ dynamic compaction and the fill to raise floor levels to 1,0 m above ground has been constructed as indicated in Section 10.1.5, it will be possible to support the up to 7,5 m high brick walls on reinforced concrete strip footings founded within the engineered fill at nominal depths (0,6 m below top of floor level).

b) Under these conditions the footings can be designed using a maximum allowable bearing pressure of 100 kPa with a minimum foundation width of 0,8 m. The walls should be provided with joints at suitable spacings to increase their flexibility.

c) If the natural ground is not densified, or, if deemed to be more economical, the brick walls can be supported on ground beams spanning in between columns. If the latter are far apart intermediate supports can be added. These should be designed as pad footings or piers founded within the dense ferricrete and designed as per the recommendations of Section 10.2.1.

10.2.3 Loading Bay Foundations

a) The loading bay retaining walls should be supported within the in-situ densified or otherwise densified soils at the minimum depth of 0,6 m. A maximum allowable bearing pressure of 75 MPa can be used for design purposes with a minimum foundation width of 0,60 m.

b) If the near-surface incompetent soils are not densified it will be necessary for the walls to be extended down to the medium dense ferruginous gravel present within the depth range of 0,5 – 1,0 m below existing ground surface within trial holes TH.4, 6, 8 - 10, 16 - 18, 20 and 21 and 1,05 - 1,95 m within the remaining trial holes.

10.2.4 Single Storey Structures

For smaller single storey lightly loaded structures which are constructed at ground level it may be possible to construct the foundations at nominal depths within the compacted hillwash soils and designed using a maximum allowable bearing pressure of 150 kPa instead of extending into the ferricrete. In this case the following excavation and replacement procedure should be followed.

- The foundation trenches should be excavated to a width of 1.5 times the footing width and to a depth below underside of footings also equal to 1.5 times the footing width.
- Approved engineered fill of at least G6 quality should then be placed within the trench, in maximum 150 mm thick layers and compacted to 95% Mod AASHTO dry density at optimum moisture content (OMC), up to the underside of footing level.
- The proposed building can be supported on minimum 750 mm wide strip footings constructed centrally within the trench and designed using a maximum allowable bearing pressure of 100 kPa.

Loading bay retaining walls can be supported within the compacted hillwash soils using a maximum allowable edge pressure of 100 kPa.

10.2.5 Potential Clay Heave/Shrinkage Movements

a) This investigation has showed that the reworked/residual soils underlying the site and, occasionally, the ferricrete itself, are significant plasticity and can be of significant swell/shrinkage potential.

b) The clays under the ferricrete are generally present at depths of mostly 2,5 - 4,0 m and are close to or below the ground water table. Because of this, and the protective action of the ferricrete, it is considered unlikely that any significant heave movements will be generated from these clays. Should the ground water drop, however, and the clay is allowed to dry out, significant clay shrinkage and consequent foundations and floor settlements and consequent distress can occur.

c) In areas where the ferruginous soils are not present (TH.5) some moderate heave is possible, of the order of 15 mm taking into account the clayey soils marginally classify of being of medium potential expansiveness (although no heave was experienced in an oedometer test or an undisturbed black sample).

10.3 Ground Floors

10.3.1 Ground floors will be required to be designed to support heavy imposed stacking/storage loads as well as wheel loads from forklift trucks. Floor elevations will be approximately 1,0 m above existing ground surface.

10.3.2 In order to ensure long term stability it will be necessary to density all near-surface hillwash soils underlying the site, as indicated in Section 10.1.2 and to subsequently place minimum G6 quality fill compacted to 95% Mod AASHTO dry density at optimum moisture content as indicated in section 10.1.5.

10.3.3 The layerworks immediately below the floor will be dependent on the manner of the design of the floor and nature and magnitude of applied loads.

10.3.4 Particular attention should be paid to the design of the floor supporting large fridges. Taking into account the relatively shallow ground water table and the possibility that it can rise further, a suitably designed insulation should be provided under all fridges in order to prevent the freezing of the possibly saturated ground and consequent large heave of the floors that is likely to occur.

10.4 Roads and Parking

10.4.1 All roads and parking should be designed bearing in mind the presence of the near surface hillwash soils which classify mostly as G9, and occasionally G10 quality materials in terms of TRH.14.

10.4.2 For long term stability it is considered advisable to densify these soils with impact rolling, as recommended for the remaining site.

10.5 Water Bearing Services and Stormwater Drainage

10.5.1 All water bearing infrastructure and provisions for stormwater drainage should be designed in accordance with the provisions of SANS 1936 for a D2 dolomitic designation of the site.

10.5.2 The entire area should be provided with suitable surface drainage to ensure the speedy disposal of stormwater away from it as per SANS 1936.

10.6 Influence Of Ground Water

10.6.1 A shallow ground water table was observed to be present with the trial holes at depths varying mostly within the 3,8 - 4,0 m depth range. The deep boreholes, however, showed that after 24 h the ground water table rises to 2,6 – 3,8 m.

10.6.2 It should be noted that it is possible for a perched ground water table to develop on top of the relatively shallow ferruginised horizons and possibly even over the compacted hillwash horizon overlying it if densified during periods of prolonged rainfall.

10.6.3 Structures should be provided with suitable waterproofing to avoid damage due to moisture rising into the buildings. All fridges to be provided with suitable insulation as discussed in Section 10.3.5.

10.7 Excavation Classification

10.7.1 All excavations are classified as “soft” sown to the depths of 1,5 - 2,5 m where the dense to very dense ferricrete is present.

10.7.2 Excavations within the ferricrete can classify as “intermediate” in areas where the ferricrete is well cemented and very dense.

10.7.3 Excavation conditions below the ferricrete are classified as “soft”.

10.8 Stability of Excavations

10.8.1 Excavations for foundations and pipeline trenches are expected to be stable in the short term. Nevertheless, all excavations will be required to be evaluated for stability and all precautions are required to be taken to ensure safe working conditions at all times.

10.9 Surface Water

10.9.1 Adequate storm water drainage as well as a minimum 1,5 wide apron slab along the perimeter of the structures should be allowed for to ensure no water is allowed to pond close to the building.

10.10 Stability of Trenches

10.10.1 All trenches excavated to the depth of about 1,50 to 2,0 m are expected to be stable when cut vertical for short periods. It should be noted if trenches are left open for long periods of time, sidewall collapse may occur. In these cases, the trenches should be adequately sloped back and proper stability evaluations and supervision should be carried out, depending on their depth.

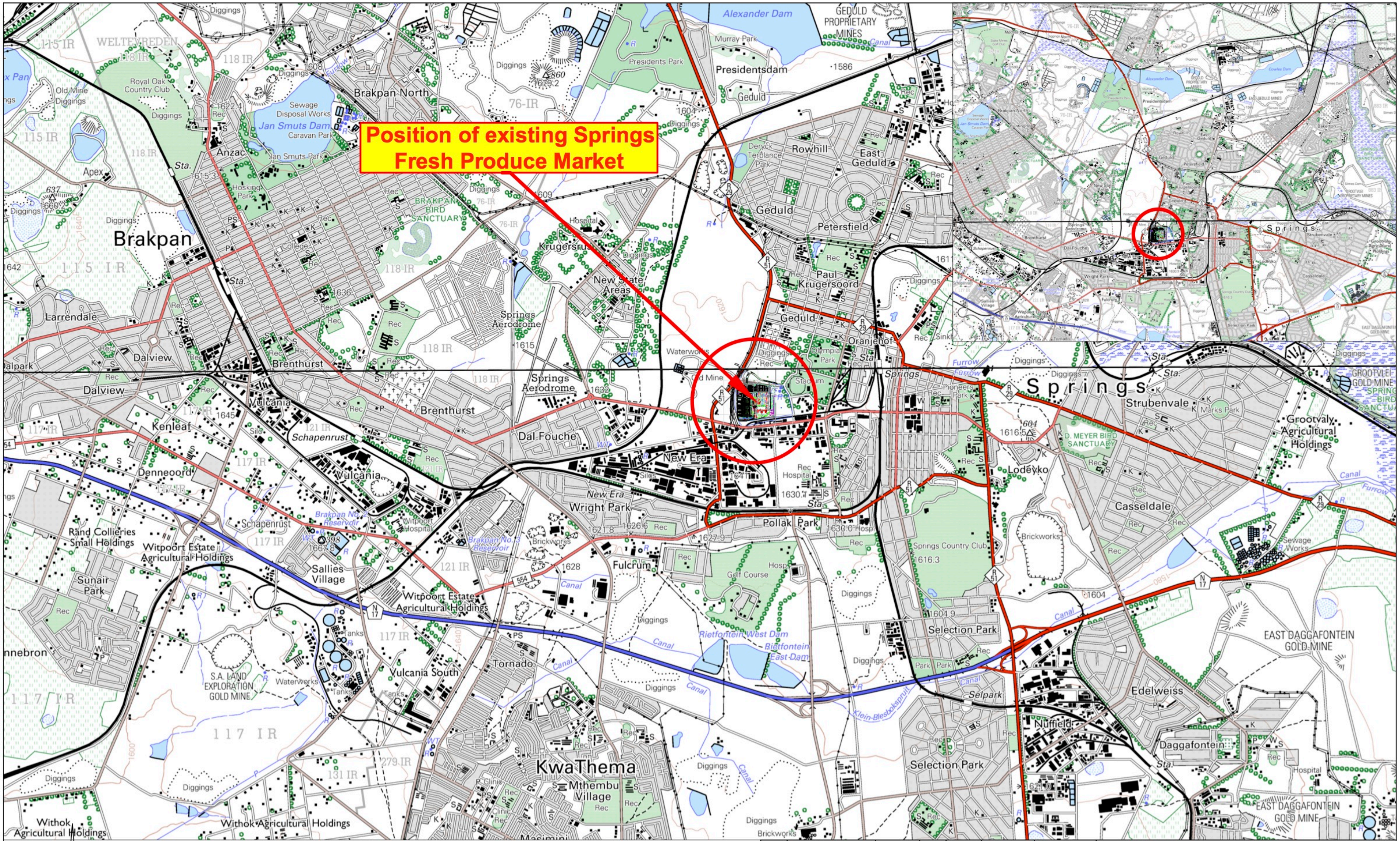
10.10.2 The trenches should at all times remain dry, and adequate care must be taken to avoid any surface water flow into the trenches during rainy periods.

10.11 General

10.11.1 The relatively shallow ground water table present with the site has a protective influence on the dolomitic stability of the development. For these reasons, the ground water table should be kept at constant levels by avoiding pumping from boreholes, both within the site as well as from surrounding ones.

10.11.2 Due to significant variations in subsoil conditions it is necessary that all foundation excavations be inspected and approval by a geotechnical engineer before blinding.

10.11.3 Strict compaction control is required during earthworks to ensure compliance with specifications.



TOPOGRAPHICAL MAP SHOWING THE POSITION OF THE EXISTING SPRINGS FRESH PRODUCE MARKET

SCALE 1:40 000

REV NO.	DESCRIPTION	CHK.	APPR.
00	FINAL REPORT	JP	MP

SCALE As Shown A3

LTE CONSULTING
Geotechnical Investigation For The
Proposed Springs Fresh Produce Market -
Springs

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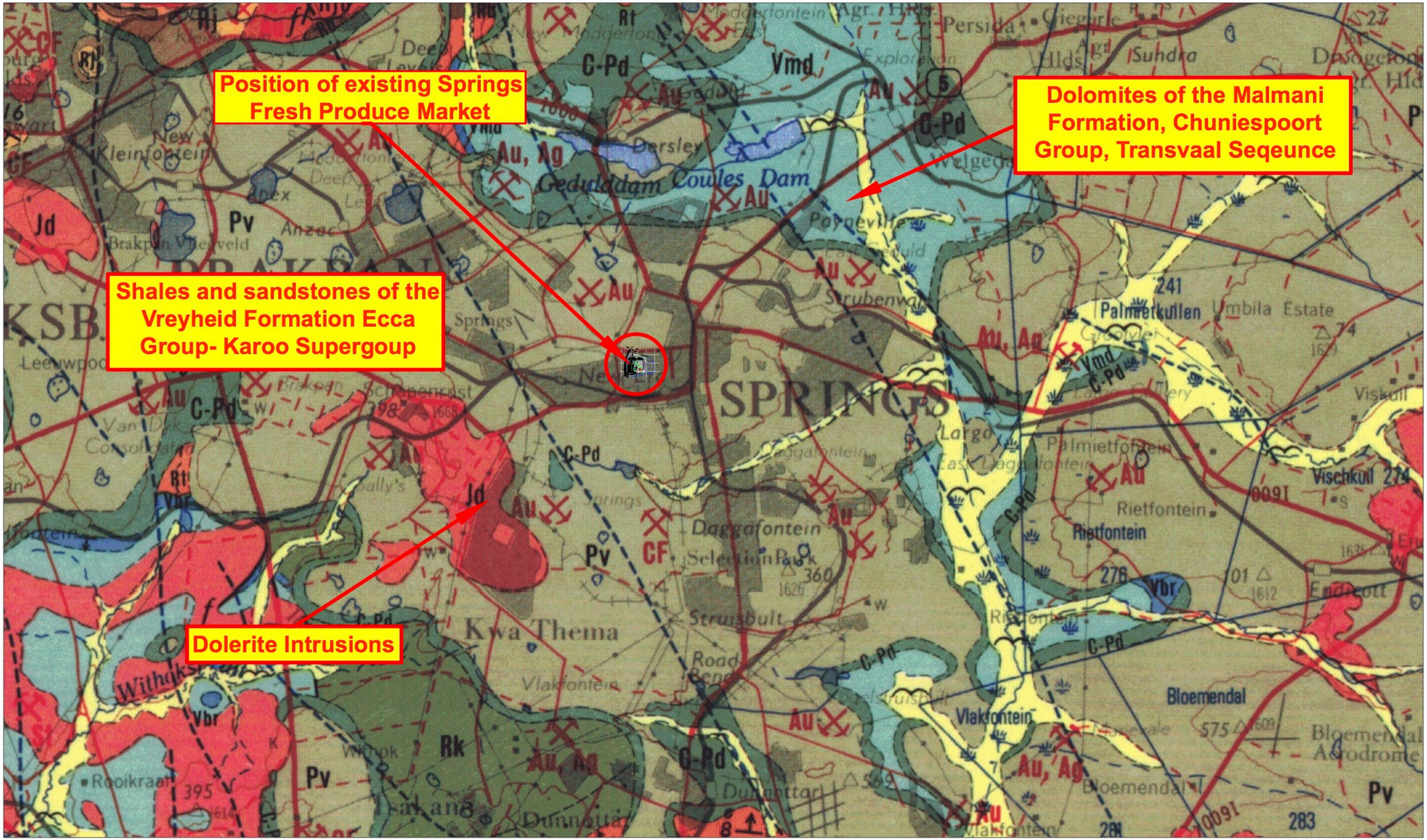
DRG. NO. 3546/1
FIG NO. 1
REV NO. 00



N

GEOLOGICAL SETTING SHOWING THE POSITION OF THE EXISTING SPRINGS FRESH PRODUCE MARKET

SCALE 1:100 000

REV NO.	DESCRIPTION	CHK.	APPR.			
00	FINAL REPORT	JP	MP	SCALE	As Shown	A3

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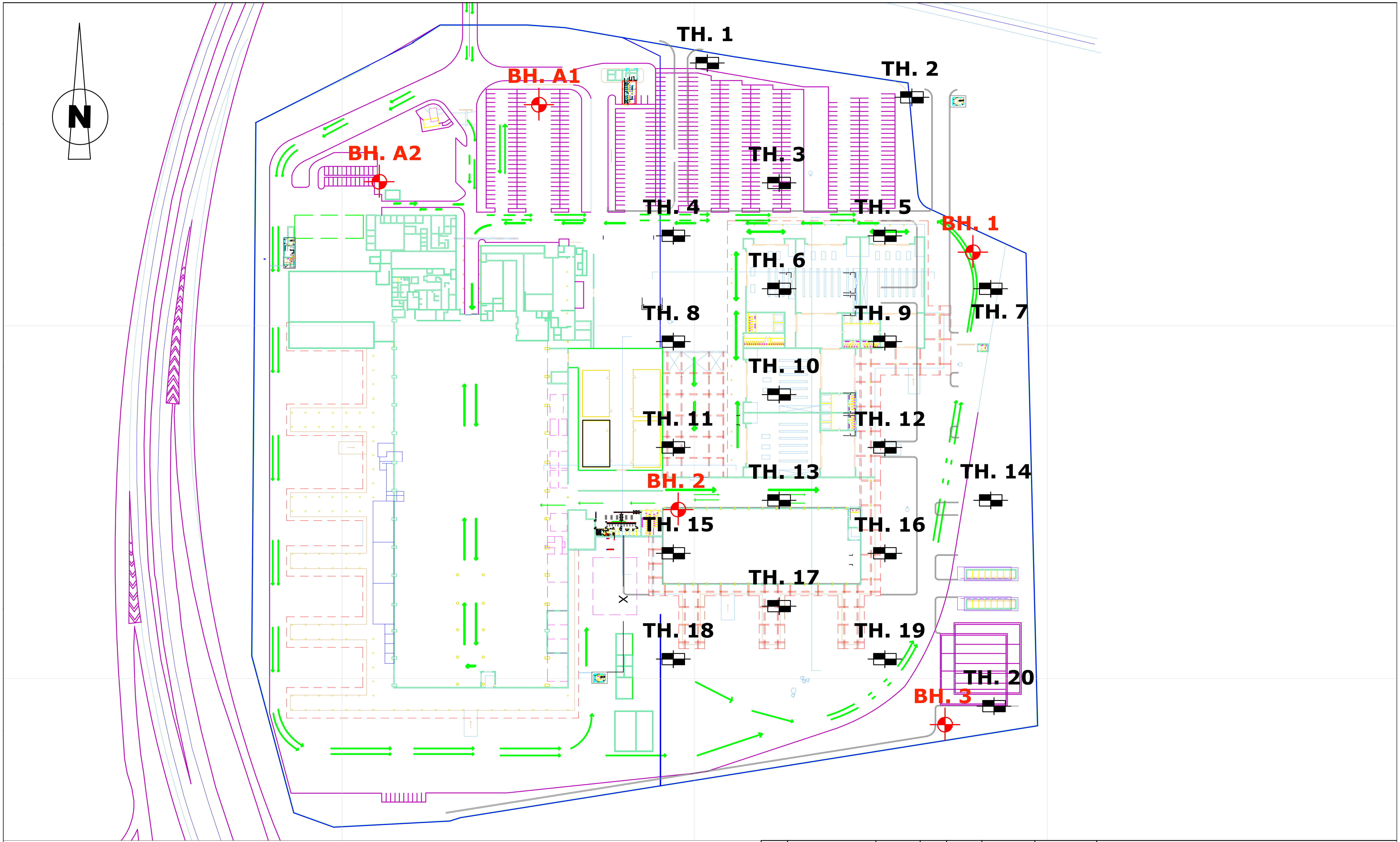
DRG. NO. 3546/2
FIG NO. 2
REV NO. 00



SITE PLAN SHOWING THE POSITION OF BOREHOLES AND TRIAL HOLES

SCALE 1:2 000 (A3)

TH. 1

Position of Trial holes

BH. A1

Position of previously drilled Bore Holes

BH. 1

Position of New Bore Holes

REV NO.	DESCRIPTION	CHK.	APPR.			
00	FINAL REPORT	JP	MP	SCALE	As Shown	A3

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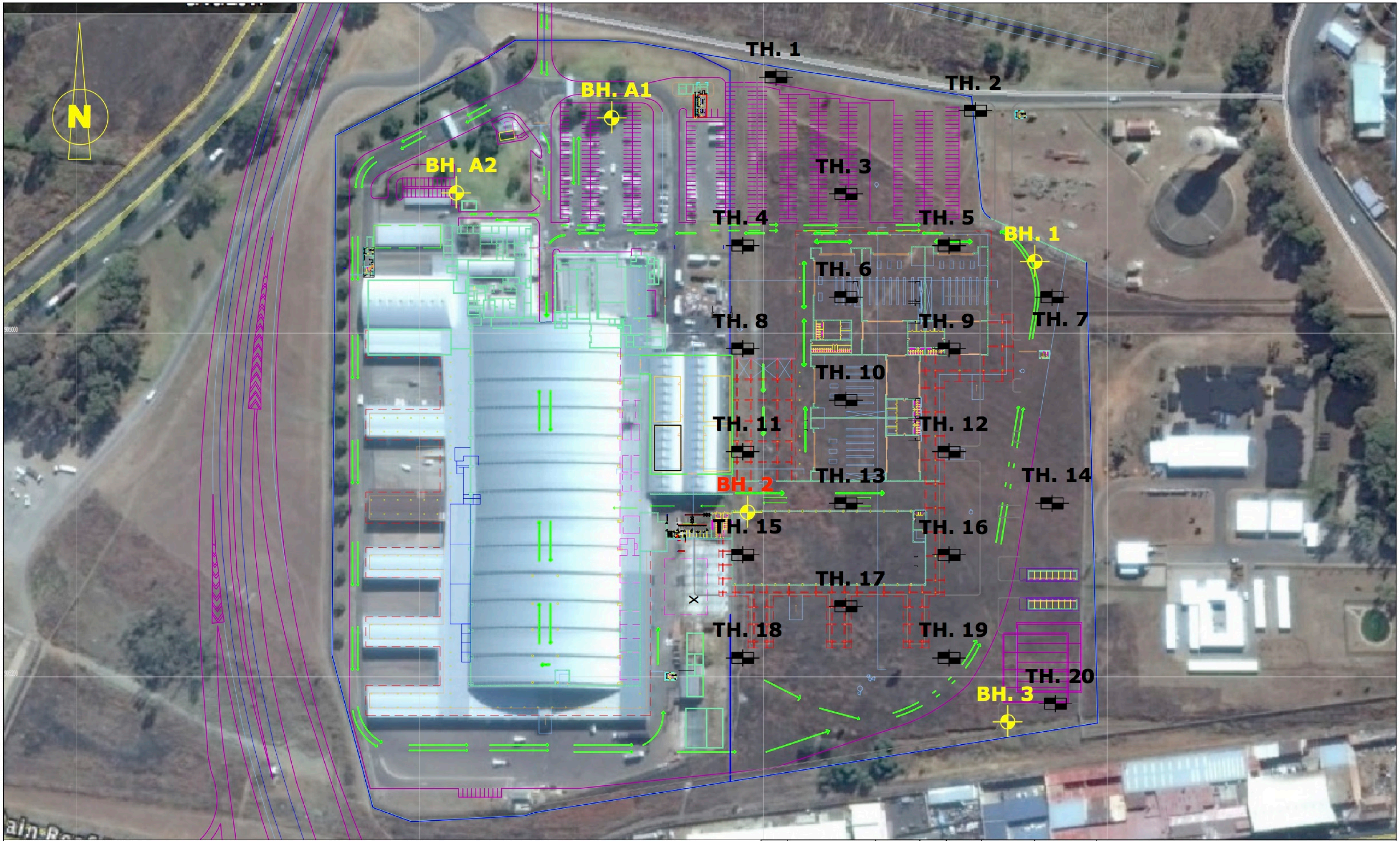
DRG. NO. 3546/3A
FIG NO. 3A
REV NO. 00



TH. 1	Position of Trial holes
BH. A1	Position of previously drilled Bore Holes
BH. 1	Position of New Bore Holes

SITE PLAN SHOWING THE POSITION OF BOREHOLES AND TRIAL HOLES

SCALE 1:2 000 (A3)

REV NO.	DESCRIPTION	CHK.	APPR.			
00	FINAL REPORT	JP	MP	SCALE	As Shown	A3

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DRG. NO. 3546/3B
FIG NO. 3B
REV NO. 00

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PERCUSSION BOREHOLE PROFILE

Borehole No..
BH.1

CONTRACTOR: HENNIE ERWEE
DRILLER: Japhta
DMACHINE: SUPER ROCK 1000

LOGGED BY: MC
DRILLING STARTED: 02.02.2017
DRILLING COMPLETED: 02.02.2017

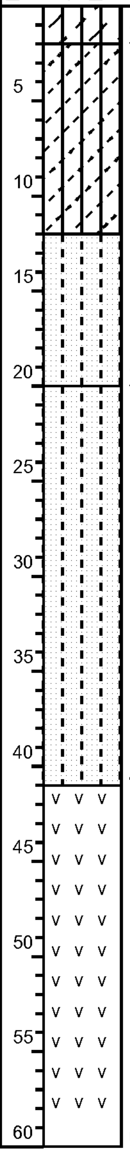
LOCATION: X= m; Y= m
ORIENTATION: Vertical
ELEVATION: AMSL

DRILLING METHOD & SIZE: 3.60 ▽ 165 mm DIA. DOWN THE HOLE HAMMER-PRESSURE=19 BAR

PENETRATION RATE (min/m)	HAMMER TEMPO	AIR LOSS
0.40	R	N
1.13	R	N
0.44	R	N
0.39	R	N
0.46	R	N
0.41	R	N
0.29	R	N
0.18	I	N
0.15	I	N
0.22	R	N
0.25	R	N
0.36	R	N
0.59	R	N
0.40	R	N
0.45	R	N
0.39	R	N
0.39	R	N
0.34	R	N
0.55	R	N
0.45	R	N
0.39	R	N
0.12	I	S
1.03	I	S
1.10	R	N
1.09	R	N
0.28	I	N
0.31	I	N
1.15	R	N
1.00	R	N
1.10	R	N
1.26	R	N
1.03	R	N
1.10	R	N
1.15	R	N
1.22	R	N
1.29	R	N
1.22	R	N
1.36	R	N
1.17	R	N
1.56	R	N
1.53	R	N
1.28	R	N
1.34	R	N
1.29	R	N
1.23	R	N
1.34	R	N
1.20	R	N
1.31	R	N
1.22	R	N
1.29	R	N
1.30	R	N
1.36	R	N
1.40	R	N
1.55	R	N
1.41	R	N
1.12	R	N
1.31	R	N
1.41	R	N
1.36	R	N
1.22	R	N

DRILLER'S REMARKS

ORIGIN



Scale 1: 400

	DESCRIPTION
0	
2.00	Dark orange brown, **SANDY CLAYEY SILT** with ferruginus fine gravels. *Transported soils.*
	Dark orange brown, mottled greenish grey, **CLAYEY SILT**. *Residual shale*. Ecca Group Karoo Sequence
12.00	Becomes dark orange brown, mottled and speckled yellow brown below 4 m. Becomes dark yellow brown, below 9 m.
20.00	Orange, reddish brown and greenish grey, very **SILTY SAND**. *Possibly Residual intrusive syenite.*
	Light orange brown and fawn brown, fine **SILTY SAND**. *Possibly Residual intrusive syenite.* Contains minor greenish grey & pinkish brown, soft fine gravels and comprise syenite and shale. Possible weathered syenite rock from 27 m.
41.00	Dark greenish grey, slightly clayey sand with minor greenish grey, hard crystalline fine gravel up to 25 mm in size. *Possibly weathered **SYENITE** rock.*
60.00	

NOTES

1. Bottom of borehole at 60 m.
2. Borehole dipped on 03.02.2017. Ground water stood at 3,60 m.
3. Slight air loss between 21 - 23 m.

▽ Ground Water Standing

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The Proposed New Upgrades To
Springs Fresh Produce Market

Dwg. No.
3546/4

Fig. No.
4

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PERCUSSION BOREHOLE PROFILE

Borehole No..
BH.2

CONTRACTOR:	HENNIE ERWEE	LOGGED BY:	MC	LOCATION:	X= m; Y= m
DRILLER:	Japhta	DRILLING STARTED:	07.02.2017	ORIENTATION:	Vertical
DMACHINE:	SUPER ROCK 1000	DRILLING COMPLETED:	07.02.2017	ELEVATION:	AMSL

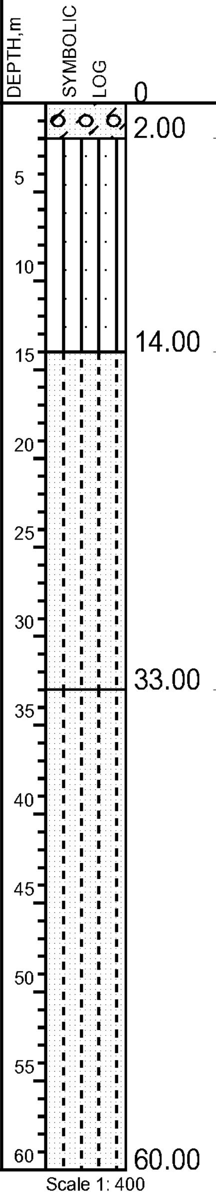
DRILLING METHOD & SIZE: 165 mm DIA. DOWN THE HOLE HAMMER-PRESSURE=19 BAR

2.80 ▽

DRILLER'S REMARKS

ORIGIN

PENETRATION RATE (min/m)	HAMMER TEMPO	AIR LOSS
0.36	R	N
0.54	R	N
0.30	C	N
0.26	C	N
0.58	C	N
0.44	C	N
0.46	C	N
0.44	C	N
0.37	C	N
0.33	C	N
0.40	C	N
0.32	C	N
0.30	C	N
0.28	C	N
0.31	C	N
0.40	C	N
0.46	C	N
0.55	C	N
0.04	C	N
0.41	C	N
0.48	C	N
0.57	C	N
1.00	C	N
1.04	C	N
0.40	R	N
0.36	R	N
0.31	R	N
0.41	R	N
1.13	R	N
1.15	R	N
0.50	R	N
0.46	R	N
0.54	R	N
0.49	I	N
0.46	R	N
0.39	R	N
0.58	R	N
0.47	R	N
0.45	R	N
0.44	R	N
0.43	R	N
0.46	R	N
0.50	R	N
0.52	R	N
0.48	R	N
0.57	R	N
0.55	R	N
0.58	R	N
0.48	R	N
0.54	R	N
0.52	R	N
0.47	R	N
0.44	R	N
0.55	R	N
0.51	R	N
0.50	R	N
0.48	R	N
0.58	R	N
0.54	R	N
0.56	R	N



DESCRIPTION

Abundant, reddish and orange brown, medium soft, fine **GRAVELS** up to 10 mm in diameter in a matrix of minor, slightly **CLAYEY SAND**.
Ferruginous Transported soils.

Light orange brown, fine **SANDY SILT**.
Residual shale Ecca Group Karoo Sequence.

Becomes dark orange brown, clayey silt below 6 m.
Becomes light yellow, mottled orange brown, below 11,0 m.

Abundant, dark yellow brown, becoming dark brown, speckled yellow brown and dark bluish grey, hard crystalline, fine gravels, 2-15 mm in size in a minor matrix of dark yellow brown and greenish grey, **SILTY SAND**. *Possibly Residual intrusive syenite*. Contains possible bands of weathered syenite rock.

Abundant, dark bluish grey, laminated weathered, shale fragments with minor **SILTY SAND**.
Residual carbonaceous shale.

NOTES
1. Bottom of borehole at 60 m.
2. Borehole dipped on 09.02.2017 and ground water stood at 2.80 m.
3. No air or sample loss
4. Ground water strike at 15 m.

▽ Ground Water Standing

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Dwg. No.
3546/5

Fig. No.
5

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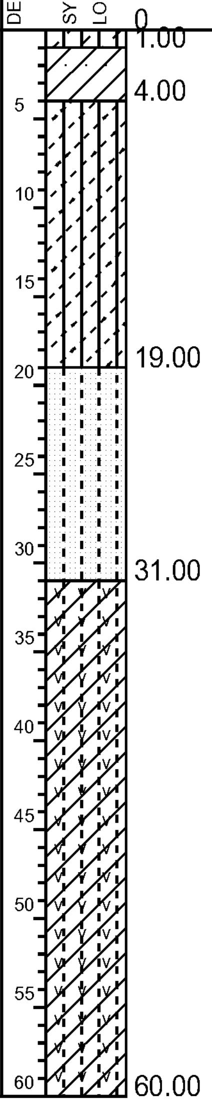
PERCUSSION BOREHOLE PROFILE

Borehole No..
BH.3

CONTRACTOR:	HENNIE ERWEE	LOGGED BY:	MC	LOCATION:	X= m; Y= m
DRILLER:	Japhta	DRILLING STARTED:	02.02.2017	ORIENTATION:	Vertical
DMACHINE:	SUPER ROCK 1000	DRILLING COMPLETED:	02.02.2017	ELEVATION:	AMSL

DRILLING METHOD & SIZE: 165 mm DIA. DOWN THE HOLE HAMMER-PRESSURE=19 BAR

PENETRATION RATE (min/m)	HAMMER TEMPO	AIR LOSS	DRILLER'S REMARKS	ORIGIN
0.21	I	N		
0.24	C	N		
0.23	C	N		
0.22	C	N		
0.26	C	N		
0.31	C	N		
0.35	C	N		
0.29	C	N		
0.19	C	N		
0.18	C	N		
0.22	C	N		
0.31	C	N		
0.29	R	N		
0.26	R	N		
0.37	R	N		
0.39	R	N		
0.48	R	N		
1.03	R	N		
1.10	R	N		
1.01	R	N		
0.51	I	N		
0.58	R	N		
0.41	R	N		
0.51	R	N		
0.49	R	N		
0.43	R	N		
0.38	R	N		
0.40	R	N		
0.59	R	N		
0.50	R	N		
1.18	R	S		
1.09	R	S		
1.18	R	S		
1.41	R	S		
1.36	R	S		
1.49	R	S		
1.56	R	S		
1.44	R	S		
1.52	R	S		
1.31	R	S		
1.39	R	S		
1.50	R	M		
2.03	R	M		
1.58	R	N		
1.56	R	N		
1.55	R	N		
1.18	R	N		
1.31	R	N		
1.41	R	N		
1.51	R	N		
1.37	R	N		
1.20	R	N		
1.38	R	N		
1.37	R	N		
1.22	R	N		
1.40	R	N		
1.56	I	N		
2.03	R	N		
2.18	R	N		
2.59	R	N		



Scale 1: 400

DESCRIPTION

Dark orange brown, banded dark grey brown, **CLAYEY SILT**. *Transported soils.*

Light grey brown, **SANDY CLAY** containing minor orange brown and yellow brown, fine, medium, hard gravels, 2-5 mm in size.
Possibly Weakly ferruginised residual shale.

Abundant, orange brown, yellow brown and greenish grey, very fine gravels, 2-3 mm in size in a matrix of dark yellow brown, speckled greenish grey, **CLAYEY SILT**. *Possibly residual syenite.*

Abundant, orange brown and greenish grey, very fine gravels 2-3 mm in size, in a matrix of yellow brown and greenish grey, **SILTY SAND**.
Residual intrusive syenite.

Dark greenish grey, **SILTY CLAY** containing minor orange brown, yellow brown and greenish grey, very fine gravels 2-3 mm in size.
Possibly Weathered ***SYENITE*** *rock.*

NOTES
1. Bottom of borehole at 60 m.
2. Borehole dipped on 03.02.2017 and found to have mud.
3. Slight air loss between 31 - 41 m.
4. Medium air loss between 42 - 43 m.

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Fig. No.
6

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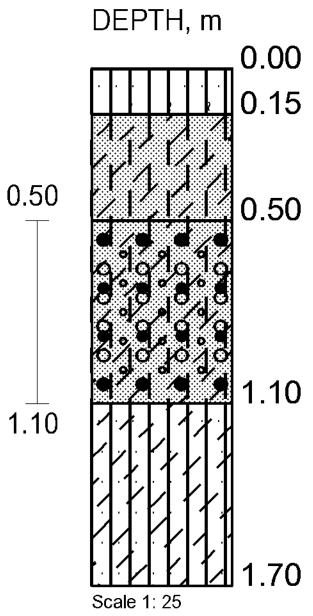
TRIAL HOLE PROFILE

Hole No.
TH.1



Slightly moist, grey brown, loose, **SANDY SILT** with fine roots. *Topsoil.*

Moist, dark grey brown, firm to stiff, slightly **CLAYEY SILTY SAND**. *Hillwash.*

Becomes dark reddish brown below 0,30 m.

Abundant, fine to medium **GRAVELS** and **FERRUGINOUS NODULES** in a matrix of dark orange and reddish brown, speckled light grey brown and black, medium dense, slightly **CLAYEY SILTY SAND**. *Partly ferruginised hillwash.*

Moist to very moist, dark orange brown, speckled light grey brown and occasionally black, soft, **CLAYEY SANDY SILT**. *Possibly residual dolerite.*

NOTES
1. Bottom of hole at 1,70 m.
2. Not to refusal of Sumitomo excavator.
3. No water.

⌶ Disturbed Sample

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Fig. No.
7

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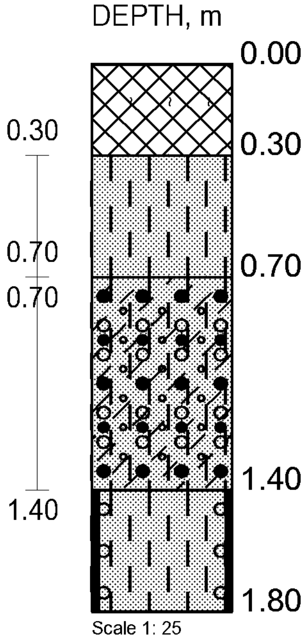
TRIAL HOLE PROFILE

Hole No.
TH.2



Slightly moist, greenish grey, speckled orange brown, loose, silty sand containing fine roots. **FILL**.

Slightly moist to moist, dark grey brown, medium dense, very **SILTY SAND**. *Hillwash*.

Abundant, fine to medium **GRAVELS** and **FERRUGINOUS NODULES** in a dark orange brown and greenish grey, speckled dark yellow brown and black, medium dense, slightly **CLAYEY SILTY SAND**.

Moist, dark orange, maroon and yellow brown, dense to very dense, fine to medium **GRAVELLY SILTY SAND**.
Moderately cemented and ferruginised ferricrete

NOTES
1. Bottom of hole at 1,80 m.
2. Not to refusal of Sumitomo excavator.
3. No water.

⌶ Disturbed Sample

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3546/8

Fig. No.
8

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TRIAL HOLE PROFILE

Hole No.
TH.3

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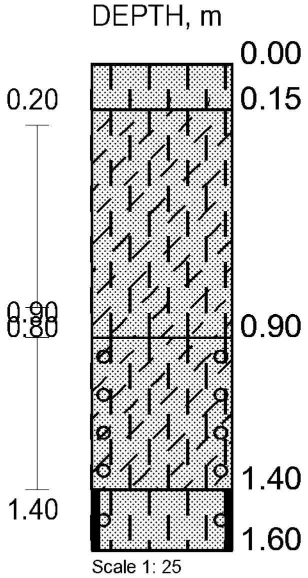

Slightly moist, grey brown, <u>loose</u>, **SILTY SAND** with fine roots. *Hillwash.*

Slightly moist, dark grey brown, <u>firm</u>, intact, slightly **CLAYEY SILTY SAND**. *Hillwash.*

Becomes moist and dark reddish brown below 0,40 m.

Moist, dark reddish brown, speckled light grey brown and black, <u>medium dense</u>, fine to medium **GRAVELLY** slightly **CLAYEY SILTY SAND**. *Hillwash with gravels.*

Moist, dark orange brown, mottled dark maroon brown and dark yellow brown, <u>dense</u>, moderately ferruginised, fine to medium, well cemented, **GRAVELLY SILTY SAND**. *Ferricrete.*

NOTES

1. Bottom of hole at 1,60 m.
2. Not to refusal of Sumitomo excavator.
3. No water.

⌶ Disturbed Sample

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Fig. No.
9

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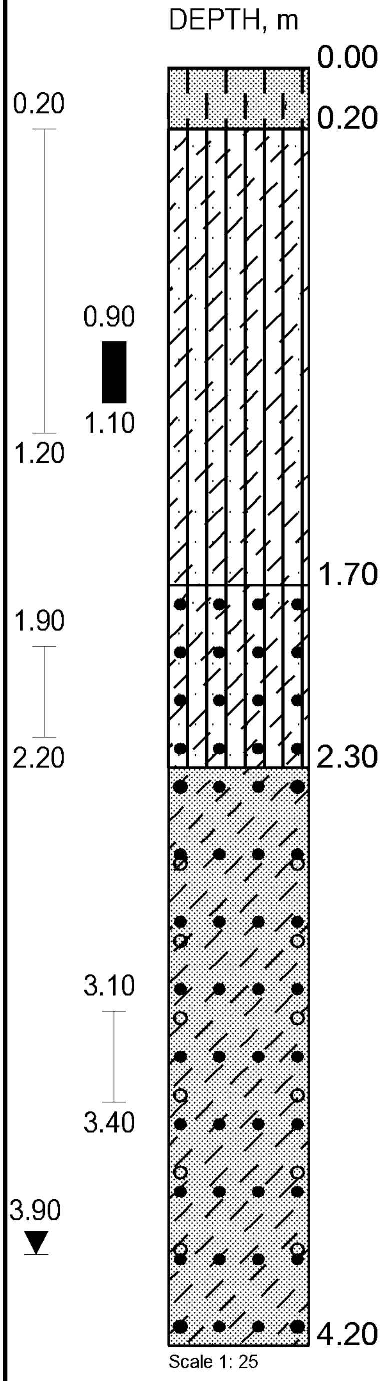
TRIAL HOLE PROFILE

Hole No.
TH.4



Slightly moist to moist, dark reddish brown, <u>loose</u>, **SILTY SAND** with abundant roots. *Topsoil.*

Slightly moist to moist, dark reddish brown, <u>soft</u>, intact, **CLAYEY SANDY SILT**. *Hillwash.*

Becomes moist below 0,70 m.

Moist, dark reddish brown, <u>soft</u>, **CLAYEY SANDY SILT** containing abundant medium gravel sized **FERRUGINOUS NODULES**. *Weakly ferruginised Hillwash.*

Moist, khaki brown, mottled dark maroon brown, speckled black, <u>dense to very dense</u>, moderately ferruginised, fine **GRAVELLY** slightly **CLAYEY SAND** containing abundant **FERRUGINOUS NODULES**. *Moderately ferruginised residual shale.*

NOTES
1. Bottom of hole at 4,20 m.
2. Semi refusal of Sumitomo excavator. Very slow penetration rates.
3. Ground water standing at 3,90 m.

▮ Undisturbed Block Sample
⌶ Disturbed Sample
▼ Ground Water Standing

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3546/10

Fig. No.
10

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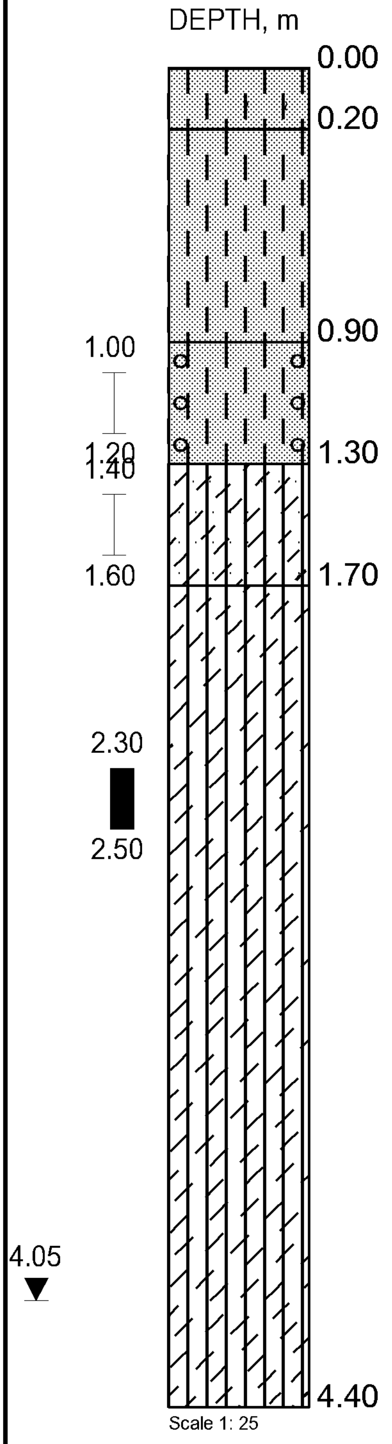
TRIAL HOLE PROFILE

Hole No.
TH.5



0.00–0.20: Slightly moist, dark grey brown, loose, **SILTY SAND** with abundant roots. *Topsoil.*

0.20–0.90: Slightly moist, dark grey brown and dark reddish brown, generally medium dense, with occasional medium dense to dense pockets, **SILTY SAND**. Contains frequent fine gravels below 0,7 m. *Hillwash.*

0.90–1.30: Slightly moist to moist, dark reddish brown, mottled dark grey brown, speckled black, generally dense, with scattered medium dense to dense pockets, very weakly ferruginised, fine to medium **GRAVELLY SILTY SAND**. *Slightly ferruginised hillwash.*

1.30–1.70: Moist, dark reddish brown, mottled dark grey brown, speckled black, firm, **CLAYEY SANDY SILT** containing many ferruginous nodules. *Possibly residual dolerite with ferruginous nodules.*

1.70–4.40: Moist to very moist, dark orange brown, mottled dark greenish grey, speckled yellow brown, firm, slightly relict, fissured **CLAYEY SILT**. *Possible residual dolerite.*

NOTES
1. Bottom of hole at 4,40 m.
2. Not to refusal of Sumitomo excavator.
3. Ground water standing at 4,05 m.

▮ Undisturbed Block Sample
I Disturbed Sample
▼ Ground Water Standing

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Dwg. No.
3546/11

Fig. No.
11

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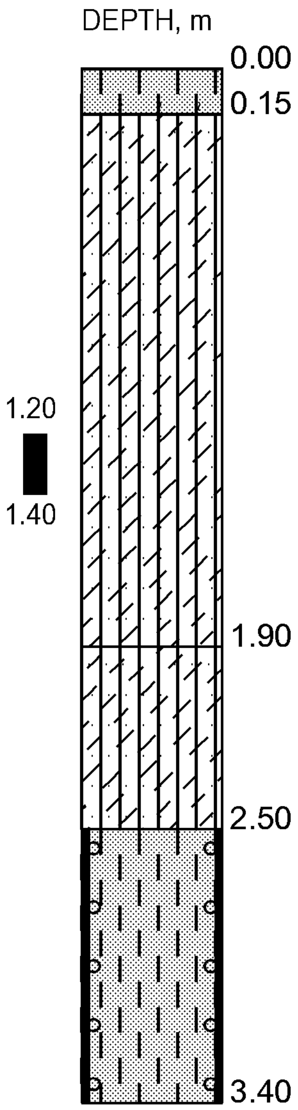
TRIAL HOLE PROFILE

Hole No.
TH.6



Scale 1: 25

Slightly moist, grey brown, <u>loose</u>, **SILTY SAND** with abundant roots. *Topsoil.*

Slightly moist, grey brown, <u>firm</u>, intact, slightly **CLAYEY SANDY SILT**. *Hillwash.*

Becomes moist below 0,60 m and becomes dark reddish brown below 0,5 m. Becomes <u>soft to firm</u> below 1,10 m.

Moist to very moist, dark reddish brown, speckled light grey brown and black, <u>firm</u>, slightly **CLAYEY SANDY SILT** containing many fine to medium gravels. *Hillwash with gravels.*

Moist, dark reddish brown, mottled dark maroon brown and dark yellow brown, speckled black, <u>very dense</u>, well cemented and ferruginised, fine to medium **GRAVELLY SILTY SAND**. *Ferricrete.*

NOTES
1. Refusal of Sumitomo excavator at 3,40 m on very dense Ferricrete.
2. No water.

▮ Undisturbed Block Sample

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Dwg. No.
3546/12

Fig. No.
12

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TRIAL HOLE PROFILE

Hole No.
TH.7

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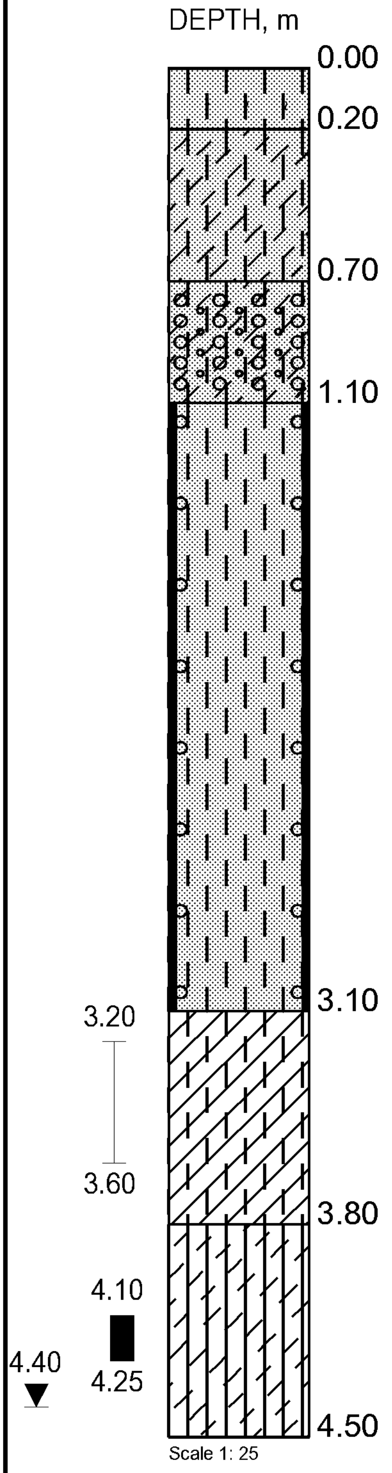

Slightly moist, grey brown, loose, **SILTY SAND** with abundant roots. *Topsoil.*

Slightly moist to moist, reddish brown, medium dense, intact, slightly **CLAYEY SILTY SAND**. *Hillwash.*

Abundant, fine to medium **GRAVELS** in matrix of dark reddish brown, specked light grey brown and black, medium dense, slightly **CLAYEY SILTY SAND**. *Hillwash containing gravels.*

Slightly moist, dark maroon brown, mottled dark yellow and reddish brown, very dense, well cemented and ferruginised, fine to medium **GRAVELLY SILTY SAND**. *Ferricrete.*

Moist, reddish brown, stiff to very stiff, intact, **SILTY CLAY**. *Possibly residual dolerite.*

Moist, orange brown, mottled dark maroon brown and dark yellow brown, firm, slightly relict, fissured, **CLAYEY SILT**.
Possibly residual dolerite.
Becomes wet below 4,3 m.

NOTES

1. Bottom of hole at 4,50 m.
2. Not to refusal of Sumitomo excavator.
3. Ground water standing at 4,40 m.

■ Undisturbed Block Sample

⌶ Disturbed Sample

▼ Ground Water Standing

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Dwg. No.
3546/13

Fig. No.
13

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TRIAL HOLE PROFILE

Hole No.
TH.8

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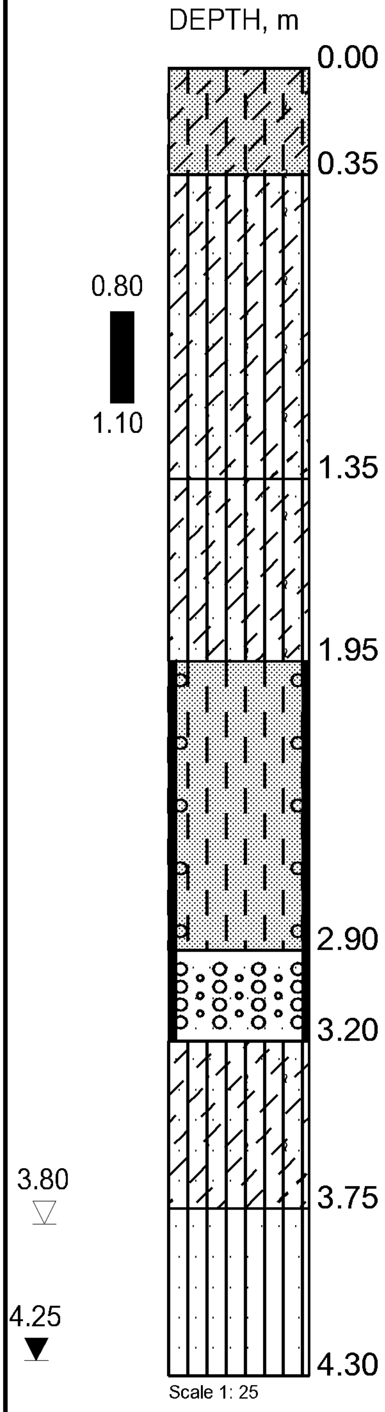

Moist, dark greyish brown, <u>firm</u>, **CLAYEY SILTY SAND** with many fine roots. *Topsoil/Fill.*

Moist, orange brown, <u>loose to medium dense</u>, **CLAYEY SANDY SILT** with fine roots. *Hillwash.*

Becomes <u>loose</u> below 0,75 m.

Abundant, 2 - 10 mm, <u>loose to medium dense</u>, soft ferruginous nodules and very occasional 30 mm rounded quartz pebbles in matrix (+-50%) of orange brown, **CLAYEY SANDY SILT** as above with fine roots. *Ferruginised Hillwash.*

Slightly moist, pinkish and reddish orange brown, streaked yellow and greenish grey, mottled black, <u>dense to very dense</u>, weakly cemented, weakly ferruginised, 2 - 5 mm and occasional 10 mm ferruginised **GRAVELLY SILTY SAND**. *Ferricrete.*

Becomes <u>very dense</u> below 2,5 m and becomes dark mottled brown with depth.

Slightly moist, dark reddish brown, <u>dense</u>, weakly cemented, weakly ferruginised, 2 - 15 mm **SANDY GRAVEL** and up to 30 mm rounded quartzitic pebbles. *Probably ferruginised pebble marker.*

Moist, dark reddish/pinkish brown, <u>stiff</u>, micaceous, very **CLAYEY SANDY SILT** with occasional fine roots. *Reworked dolerite.*

Moist, light pinkish red, specked white, <u>dense</u>, jointed, micaceous, **SANDY SILT** with red stains at joints. *Possibly residual dolerite.*

NOTES
1. Refusal of Sumitomo excavator at 4,30 m.
2. Slow ground water seepage at 3,80 m.
3. Ground water standing at 4,25 m after 1 h.

▮ Undisturbed Block Sample
▽ Ground Water Seepage
▼ Ground Water Standing

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Dwg. No.
3546/14

Fig. No.
14

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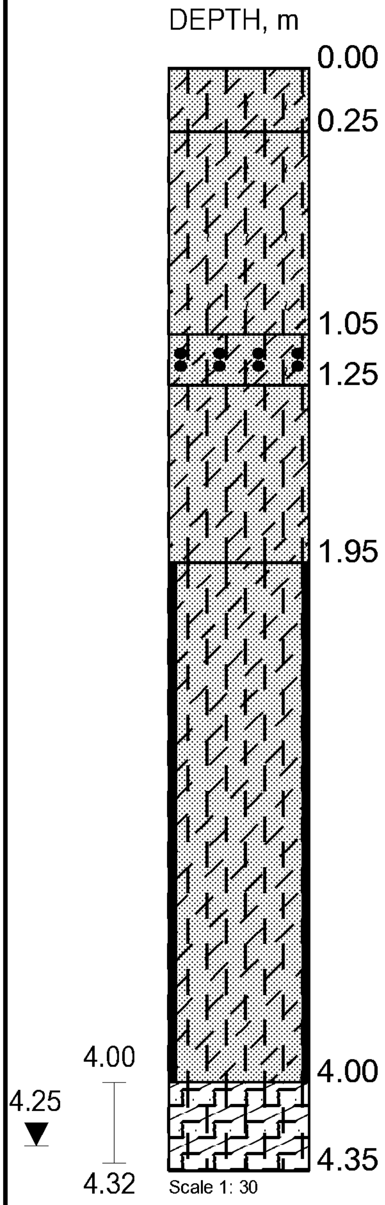
TRIAL HOLE PROFILE

Hole No.
TH.9



Slightly moist, grey brown, <u>loose</u>, **CLAYEY SILTY SAND** with abundant roots. *Topsoil.*

Moist, dark reddish brown, <u>loose</u>, very **CLAYEY SILTY SAND** with fine roots and occasional brown pockets. *Hillwash.*

Abundant, 2 - 5 mm well rounded, <u>loose</u>, **FERRUGINOUS NODULES** in matrix of dark reddish brown **CLAYEY SILTY SAND** as above with fine roots.

Moist, dark reddish brown, <u>loose to medium dense</u>, 5 - 20 mm ferruginous nodules in matrix of dark reddish brown, **CLAYEY SILTY SAND**. *Slightly ferruginised hillwash..*

Slightly moist, dark reddish brown, mottled bluish grey and yellow, weakly cemented, weak ferruginised, <u>dense</u>, **CLAYEY SILTY SAND** or sandy silt. *Ferricrete.*

Becomes well ferruginised and <u>very dense</u> below 2,90 m.
Scattered angular gravels (+-2 - 5 mm) between 2,80 - 3,30 m.
10 mm rounded gravel at 3,30 m.

Moist, reddish orange brown, <u>stiff</u>, shattered **SANDY/SILTY CLAY**. *Residual dolerite.*

NOTES

1. Bottom of hole at 4,35 m.
2. Near refusal of Sumitomo excavator. Very slow penetration rates.
2. Ground water standing at 4,25 m.

I	Disturbed Sample
▼	Ground Water Standing

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Dwg. No.
3546/15

Fig. No.
15

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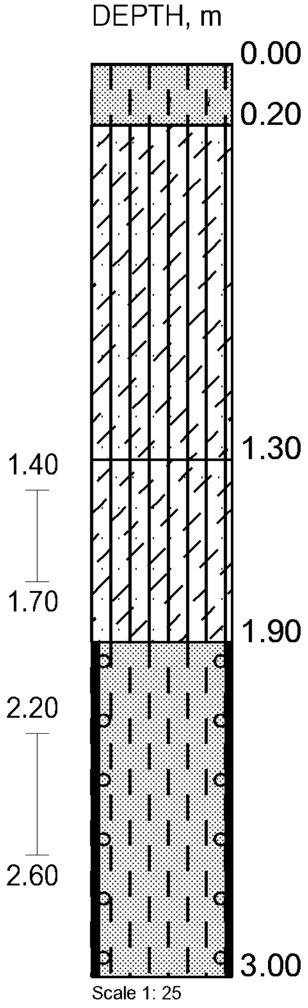
TRIAL HOLE PROFILE

Hole No.
TH.10



Slightly moist, grey brown, <u>loose</u>, **SILTY SAND** with abundant roots. *Topsoil.*

Slightly moist, grey brown, <u>firm</u>, intact, slightly **CLAYEY SANDY SILT**. *Hillwash.*

Becomes moist, dark reddish brown and <u>soft to firm</u> below 0,5 m.

Moist, dark reddish brown, speckled light grey brown and black, <u>soft to firm</u>, slightly **CLAYEY SANDY SILT** containing many fine to medium gravels and scattered ferricrete nodules. *Hillwash with gravels.*

Moist, dark reddish brown, mottled dark greenish grey, <u>very dense</u>, well cemented and ferruginised, fine to medium **GRAVELLY SILTY SAND**. *Ferricrete.*

NOTES
1. Refusal of Sumitomo excavator at 3,00 m on very dense Ferricrete.
2. No water.

Ɪ Disturbed Sample

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3546/16

Fig. No.
16

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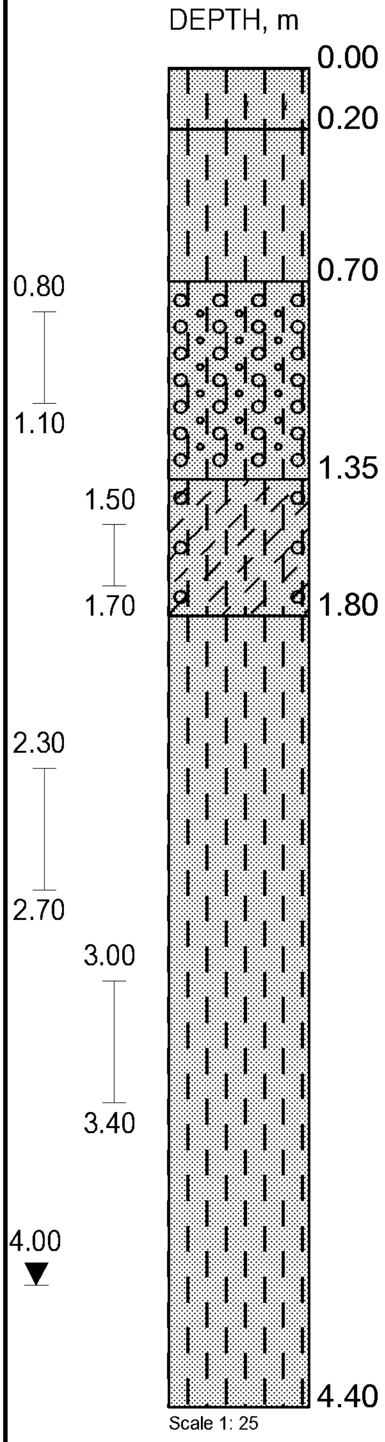
TRIAL HOLE PROFILE

Hole No.
TH.11



Slightly moist, grey brown, loose, **SILTY SAND** with abundant roots. *Topsoil.*

Slightly moist, dark grey brown, intact, medium dense, **SILTY SAND** containing scattered fine gravels. *Hillwash.*

Becomes moist below 0,4 m.

Abundant, angular, fine to medium ferruginous **GRAVELS** in a matrix of moist, dark orange brown, speckled black, medium dense to dense, **SILTY SAND**. *Possibly ferruginous hillwash.*

Moist, dark orange brown, mottled khaki brown, speckled black, firm, fine **GRAVELLY CLAYEY SILTY SAND**. Contains frequent ferruginous nodules.
Possibly partially ferruginised, slightly reworked residual dolerite.

Moist, orange brown, mottled greenish grey, dark yellow brown and dark maroon brown, dense, slightly relict, fissured, **SILTY SAND**. *Possibly residual dolerite.*

Becomes dense to very dense below 2,2 m.
Becomes wet below 4,0 m.

NOTES
1. Bottom of hole at 4,40 m.
2. Not to refusal of Sumitomo excavator. Very slow penetration rates.
3. Ground water standing at 4,00 m.

I	Disturbed Sample
▼	Ground Water Standing

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Dwg. No.
3546/17

Fig. No.
17

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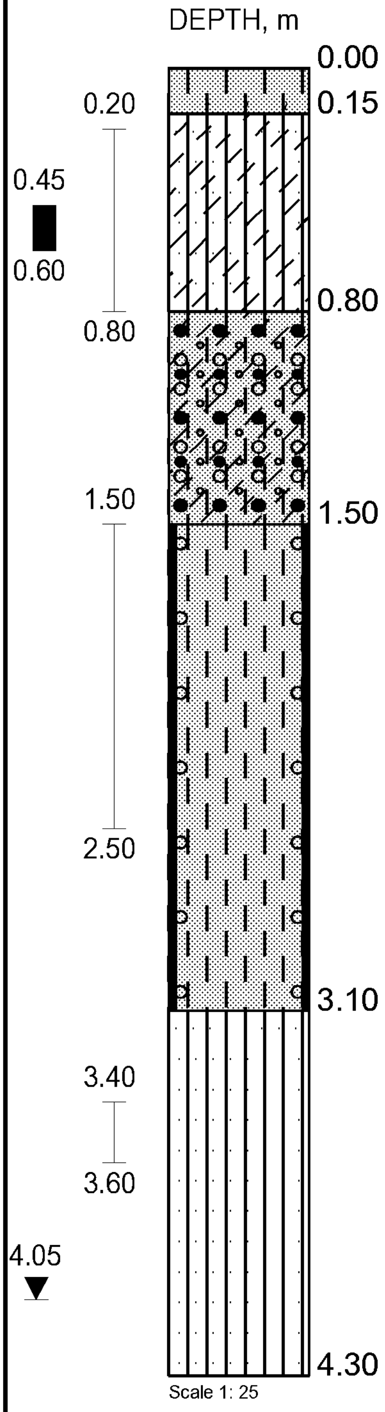
TRIAL HOLE PROFILE

Hole No.
TH.12



Slightly moist, grey brown, **SILTY SAND** with abundant roots. *Topsoil.*

Moist, dark brown, reddish brown, firm, intact, **CLAYEY SANDY SILT**. *Hillwash.*

Abundant, angular, fine to medium **GRAVELS** and **FERRUGINOUS NODULES** in a matrix of moist, dark reddish brown, speckled yellow brown and black, firm, **CLAYEY SILTY SAND**. *Ferruginised Hillwash.*

Moist, dark maroon brown, mottled dark yellow brown, speckled black, well cemented and ferruginised, very dense, fine to medium **GRAVELLY SILTY SAND**. *Ferricrete.*

Moist, orange brown, mottled dark yellow brown, stiff, micaceous, **SANDY SILT**. *Possible residual dolerite.*

NOTES
1. Bottom of hole at 4,30 m.
2. Not to refusal of Sumitomo excavator. Very slow penetration rates.
3. Ground water standing at 4,05 m.

▮ Undisturbed Block Sample
I Disturbed Sample
▼ Ground Water Standing

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Dwg. No.
3546/18

Fig. No.
18

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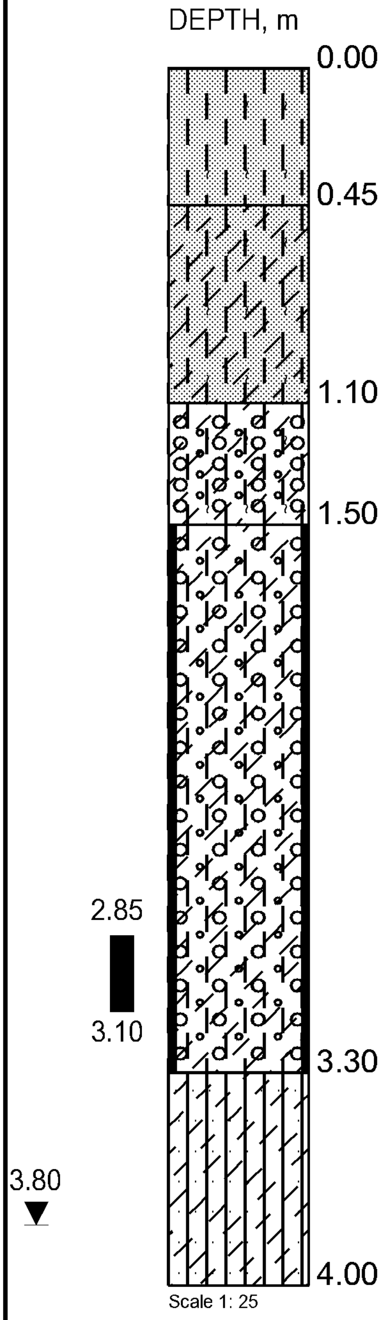
TRIAL HOLE PROFILE

Hole No.
TH.13



Moist, dark brown, loose, **SILTY SAND** with abundant roots. *Topsoil.*

Moist, light orange brown, mottled brown, loose, 2 - 5 mm ferruginous nodules in matrix of **CLAYEY SILTY SAND** and with some fine roots. *Nodular ferricrete*

Moist, dark reddish orange and yellow, mottled black, **CLAYEY SILTY GRAVEL** comprising ferruginous nodules with occasional roots. Overall consistency medium dense.

Moist, dark reddish brown, heavily mottled yellow and black, weakly cemented, weakly ferruginised, dense to very dense, **CLAYEY SILTY GRAVEL** comprising 2 - 15 mm sub-rounded to rounded ferruginous nodules. *Weak ferricrete.*

Large pockets of stiff, micaceus clayey sandy silt below 2,70 m.

Moist, dark pinkish brown, speckled yellow, stiff, micaceous, slightly **CLAYEY SANDY SILT**. *Possibly residual dolerite*

NOTES
1. Bottom of hole at 4,00 m.
2. Semi-refusal of Sumitomo excavator. Very slow penetration rates.
3. Ground water standing at 3,80 m.

▮ Undisturbed Block Sample
▼ Ground Water Standing

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Dwg. No.
3546/19

Fig. No.
19

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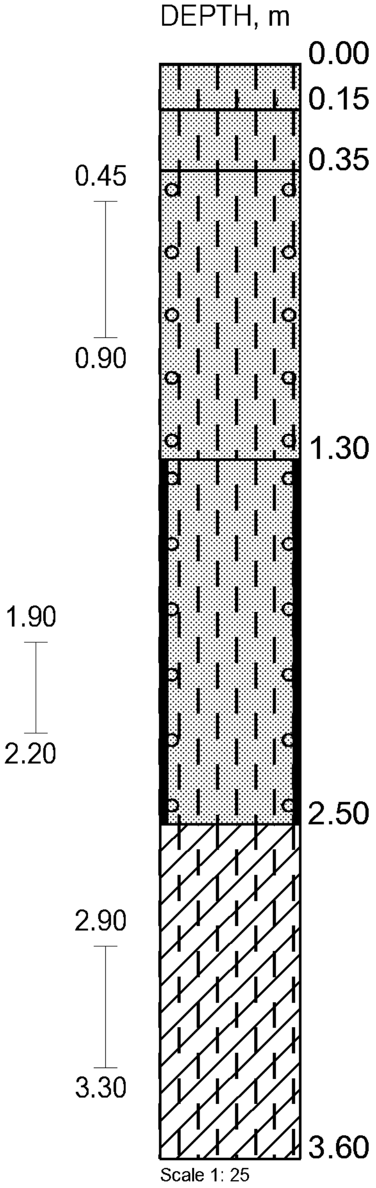
TRIAL HOLE PROFILE

Hole No.
TH.14



Slightly moist, grey brown, <u>loose</u>, **SILTY SAND** with abundant roots. *Topsoil.*

Slightly moist, dark reddish brown, <u>medium dense</u>, intact, **SILTY SAND**. *Hillwash.*

Slightly moist to moist, dark reddish brown, <u>medium dense to dense</u> slightly firm to medium **GRAVELLY SILTY SAND**.
Slightly gravelly hillwash.

Becomes <u>dense</u> below 1,1 m.

Moist, dark reddish brown, mottled dark yellow brown, speckled light grey and black, well cemented and ferruginised, <u>very dense</u>, fine to medium **GRAVELLY SILTY SAND**. *Ferricrete.*

Moist, dark reddish brown, intact, <u>very stiff</u>, **SILTY CLAY**.
Possibly residual dolerite.

NOTES

1. Refusal of Sumitomo excavator at 3,60 m on very stiff, residual dolerite.
2. No water.

⌶ Disturbed Sample

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Dwg. No.
3546/20

Fig. No.
20

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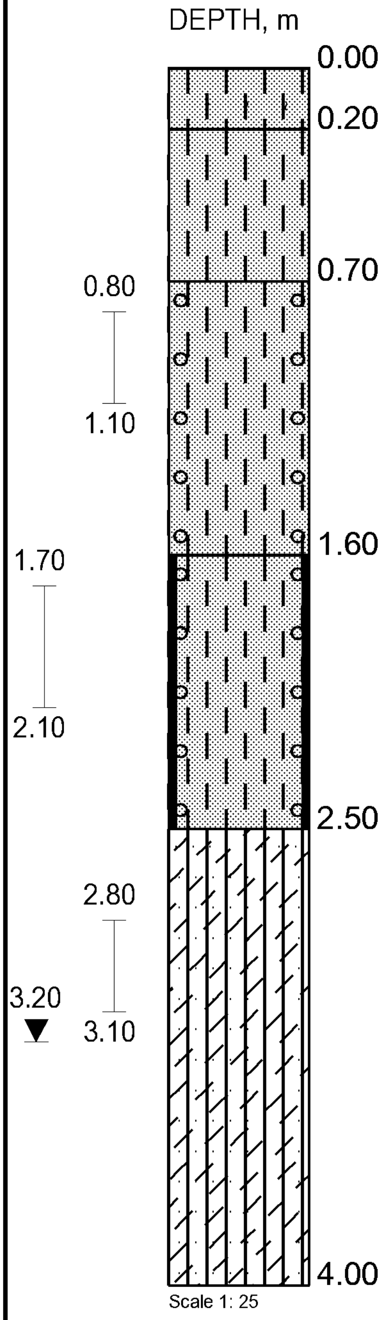
TRIAL HOLE PROFILE

Hole No.
TH.15



Slightly moist, dark grey, brown, loose, **SILTY SAND** with abundant roots. *Topsoil.*

Slightly moist, grey brown, loose to medium dense, **SILTY SAND**, containing frequent fine gravels below 0,6 m. *Hillwash*.

Becomes moist below 0,50 m.

Moist, dark yellow brown, medium dense, fine to medium **GRAVELLY SILTY SAND**. *Fine colluvium.*

Moist, dark maroon brown, mottled khaki brown and yellow brown, speckled black, very dense, moderately to well ferruginised and cemented **GRAVELLY SILTY SAND**. *Ferricrete*.

Moist, dark maroon brown, mottled orange brown, speckled yellow brown, stiff, fissured, slightly **CLAYEY SANDY SILT**. *Possibly residual dolerite*.

Becomes moist to wet below 3,20 m.

NOTES
1. Bottom of hole at 4,00 m.
2. Not to refusal of Sumitomo excavator. Very slow penetration rates.
3. Ground water standing at 3,20 m.

I	Disturbed Sample
▼	Ground Water Standing

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Dwg. No.
3546/21

Fig. No.
21

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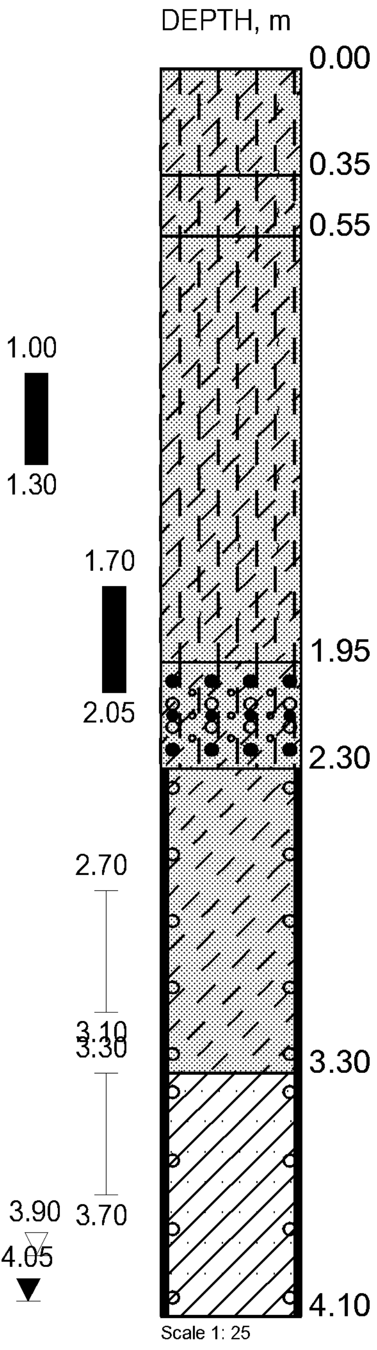
TRIAL HOLE PROFILE

Hole No.
TH.16



Slightly moist, grey brown, loose to medium dense, **CLAYEY SILTY SAND** with abundant roots. *Topsoil.*

Slightly moist, orange brown to brown, stiff, **CLAYEY SILTY SAND** with fine roots. *Hillwash.*

Moist, orange brown, loose, **CLAYEY SILTY SAND** with fine roots and occasional ferruginous nodules. *Hillwash.*

Abundant, 5 - 20 mm sub-angular to rounded **GRAVELS** and **FERRUGINOUS NODULES** in matrix of +-30% of orange brown, mottled greenish grey **CLAYEY SILTY SAND**.
Ferruginised Hillwash.

Very moist, orange brown and light bluish grey, mottled black, weakly cemented, weakly ferruginised very dense, **GRAVELLY** very **CLAYEY SAND**. *Ferricrete.*

Very moist, reddish orange, weakly cemented, weakly cemented and ferruginised, very dense, **GRAVELLY SANDY CLAY**. *Ferricrete.*

NOTES
1. Bottom of hole at 4,10 m.
2. Near refusal of Sumitomo excavator.
3. Slow ground water seepage at 3,90 m.
4. Ground water standing at 4,05 m.

■ Undisturbed Block Sample
I Disturbed Sample
∇ Ground Water Seepage
▼ Ground Water Standing

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Dwg. No.
3546/22

Fig. No.
22

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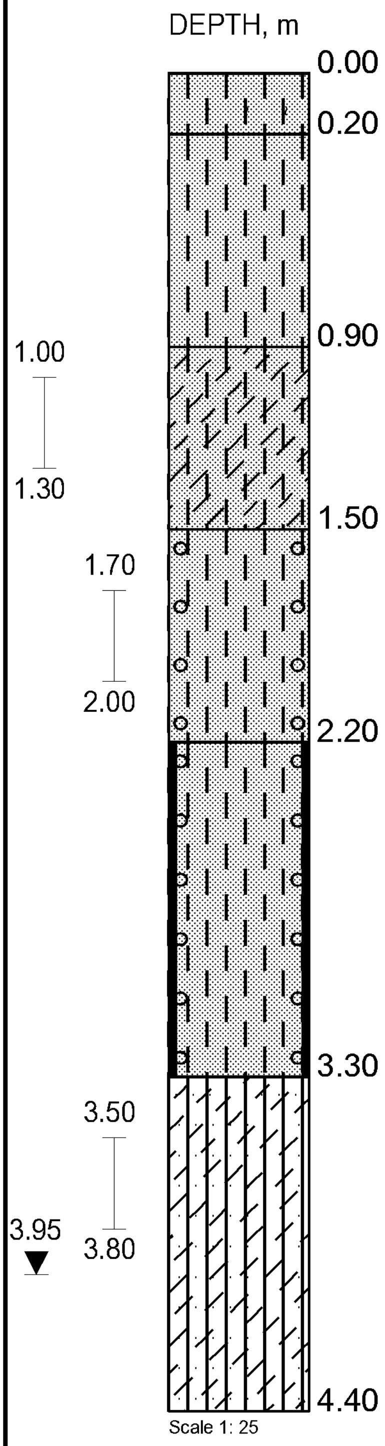
TRIAL HOLE PROFILE

Hole No.
TH.17



Slightly moist, grey brown, loose, **SILTY SAND** with abundant roots. *Topsoil.*

Slightly moist, grey brown, medium dense, intact, **SILTY SAND** with many fine gravels near base of horizon. *Hillwash.*

Becomes moist below 0,70 m.

Moist to very mist, yellow brown, speckled black, soft to firm, slightly **CLAYEY SILTY SAND** containing scattered fine gravels and occasional ferruginous nodules. *Hillwash with gravels.*

Very moist, yellow brown, mottled orange brown, speckled black, medium dense, moderately fine to medium **GRAVELLY SILTY SAND**. *Ferruginised Hillwash.*

Moist, dark olive brown, mottled light grey brown and dark yellow brown, speckled black, well cemented and ferruginised, very dense fine to medium **GRAVELLY SILTY SAND**. *Ferricrete.*

Very moist, dark maroon brown, mottled khaki brown and dark yellow brown, firm to stiff, slightly relict textured, **CLAYEY SANDY SILT**. *Possible residual dolerite.*

NOTES
1. Bottom of hole at 4,40 m.
2. Not to refusal of Sumitomo excavator. Slow penetration rates.
3. Ground water standing at 3,95 m.

Ⅰ	Disturbed Sample
▼	Ground Water Standing

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Dwg. No.
3546/23

Fig. No.
23

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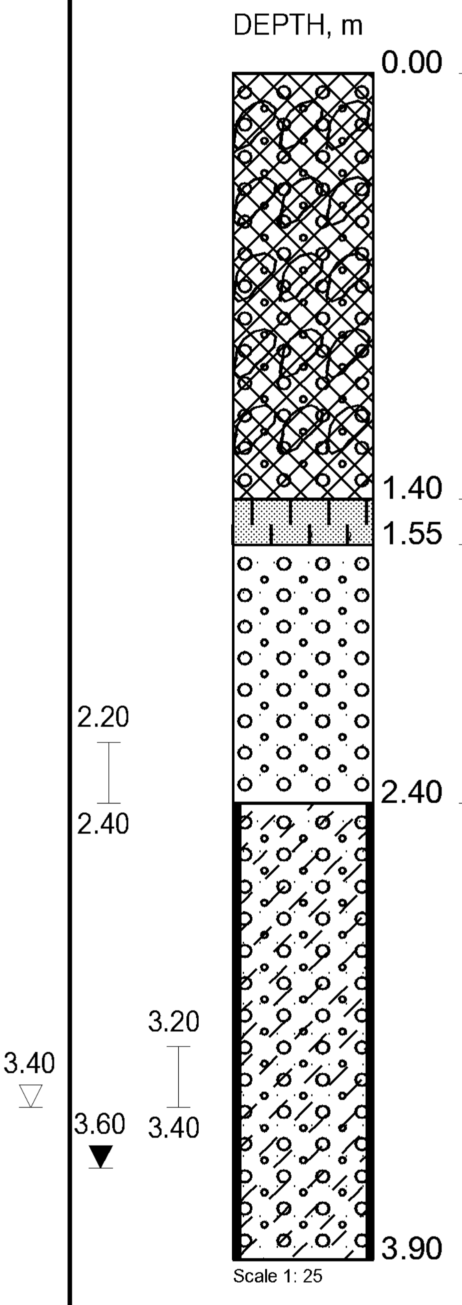
TRIAL HOLE PROFILE

Hole No.
TH.18



Slightly moist, dark grey brown, very loose, clayey silty sand with pockets of abundant 5 - 20 mm **GRAVELS** other coarser gravels and occasional hard **BOULDERS** and black plastic bags. **FILL**.
700 mm thick coarse gravel at the bottom of the layer.

Slightly moist, grey brown, loose to medium dense, **SILTY SAND** with fine roots. *Topsoil.*

Moist, dark reddish brown and greenish yellow, medium dense to dense, 2 - 5 mm **SANDY GRAVEL** comprising ferruginous nodules. *Ferruginised hillwash.*

Moist, dark reddish brown, mottled yellow and orange, weakly cemented, weakly ferruginised, dense to very dense, **CLAYEY SANDY GRAVEL** comprising 2 - 10 mm and occasional 20 mm rounded ferruginous nodules. *Ferricrete.*

Becomes dark reddish brown, mottled grey and less gravelly and more clayey at 3,20 m.

NOTES
1. Refusal of Sumitomo excavator at 3,90 m.
2. Moderate ground water seepage at south side of hole at 3,40 m.
3. Ground water standing at 3,60 m after 1 h.

Disturbed Sample
▽ Ground Water Seepage
▼ Ground Water Standing

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Dwg. No.
3546/24

Fig. No.
24

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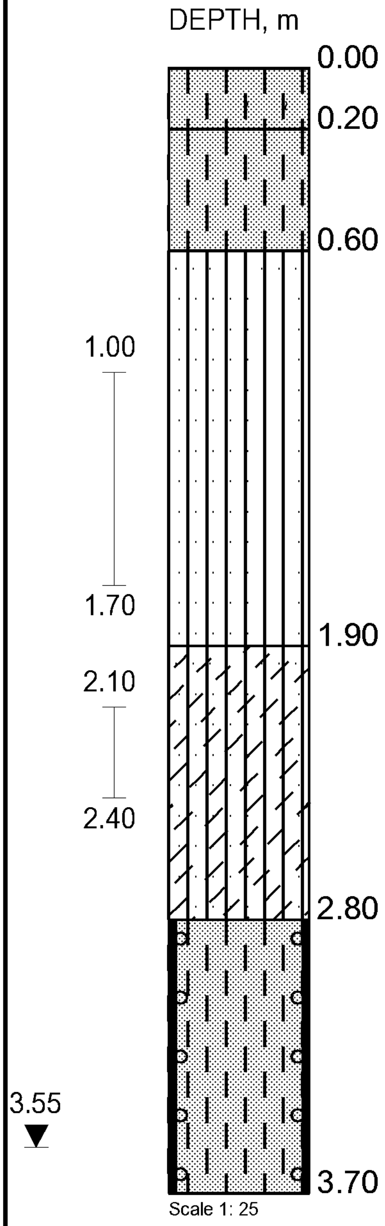
TRIAL HOLE PROFILE

Hole No.
TH.19



Slightly moist, grey brown, **SILTY SAND** with roots. *Topsoil.*

Slightly moist, grey brown, medium dense, intact, **SILTY SAND**. *Hillwash*.

Moist, dark yellow brown, mottled dark orange brown, generally firm, with firm to stiff zones, weakly relict bedded, **SANDY SILT**. *Possible residual shale*.

Contains many fine to medium ferruginous nodules. Frequency of nodules increases at base of horizon.

Very moist, dark yellow brown, mottled dark reddish brown, firm, weakly relict bedded, **CLAYEY SANDY SILT**. *Possible residual shale*.

Very moist, dark reddish and yellow brown, mottled light grey brown speckled black, dense to very dense, moderately ferruginised, and cemented fine to medium **GRAVELLY SILTY SAND**. *Ferricrete*.

NOTES
1. Bottom of hole at 3,70 m.
2. Semi refusal of Sumitomo excavator on very dense ferricrete.
3. Ground water standing at 3,55 m.

⌶ Disturbed Sample

▼ Ground Water Standing

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Dwg. No.
3546/25

Fig. No.
25

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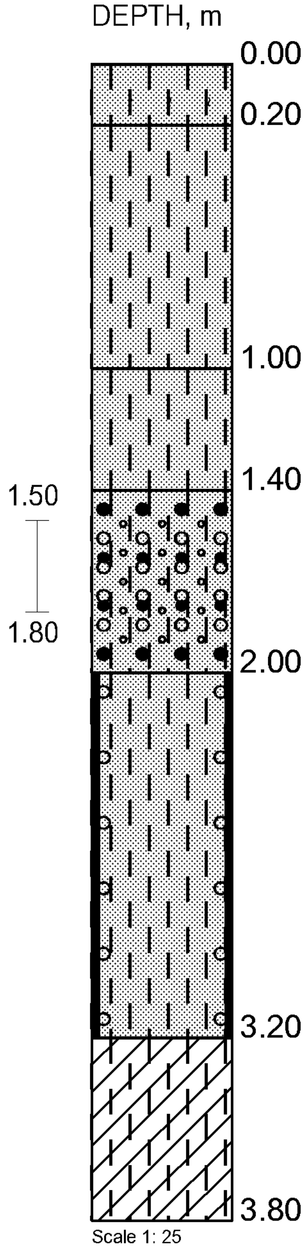
TRIAL HOLE PROFILE

Hole No.
TH.20



Slightly moist, grey brown, loose, **SILTY SAND** with abundant roots. *Topsoil.*

Slightly moist, grey brown, medium dense to dense, **SILTY SAND**. *Hillwash*.

Becomes moist and light reddish brown below 0,70 m.

Moist, dark yellow brown, occasionally speckled black, medium dense to dense, very **SILTY SAND** containing scattered fine gravels. *Hillwash.*

Abundant, fine to medium **GRAVELS** and **FERRUGINOUS NODULES** in matrix of moist, dark orange brown, mottled dark maroon brown and dark yellow brown, speckled light grey, brown, black, dense, weakly ferruginised **SILTY SAND**.
Weakly ferruginised fine colluvium.

Slightly moist to moist, dark orange and reddish brown, mottled dark yellow brown, speckled light yellow brown and black, very dense, well cemented and ferruginised, fine to medium **GRAVELLY SILTY SAND**. *Well cemented ferricrete*.

Moist, dark reddish brown, very stiff, intact, **SILTY CLAY**.
Possibly residual dolerite.

NOTES
1. Refusal of Sumitomo excavator at 3,80 m on very stiff, residual dolerite.
2. No water.

⌶ Disturbed Sample

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Dwg. No.
3546/26

Fig. No.
26

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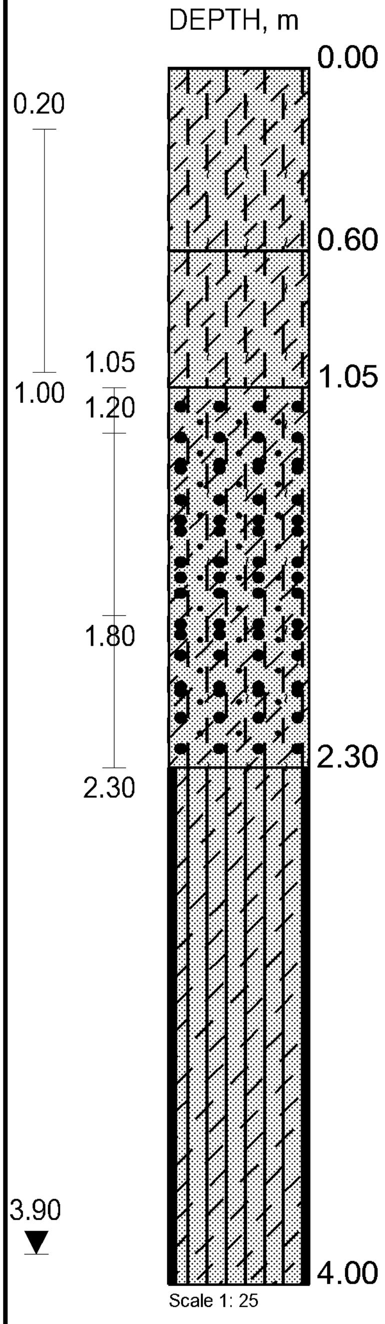
TRIAL HOLE PROFILE

Hole No.
TH.21



Moist, grey brown, loose, **CLAYEY SILTY SAND** with fine roots.
Topsoil

Becomes light grey brown below 0,90 m.

Very moist, yellow brown, loose to medium dense, **CLAYEY SILTY SAND** with fine roots. *Hillwash.*

Abundant, 2 - 20 mm **FERRUGINOUS NODULES** in matrix of moist, yellow **CLAYEY SILTY SAND** and occasional fine roots.
Ferruginised Hillwash.

Moist, dark reddish brown, weakly cemented, weakly ferruginised, dense to very dense, **CLAYEY SAND-SILT**.
Ferruginised Hillwash

NOTES
1. Refusal of Sumitomo excavator at 4,00 m.
2. Ground water standing at 3,90 m.

⊥	Disturbed Sample
▼	Ground Water Standing

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Dwg. No.
3546/27

Fig. No.
27

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PARTICLE SIZE DISTRIBUTION & ATTERBERG LIMITS TEST

TRIAL HOLE NO.
TH.1

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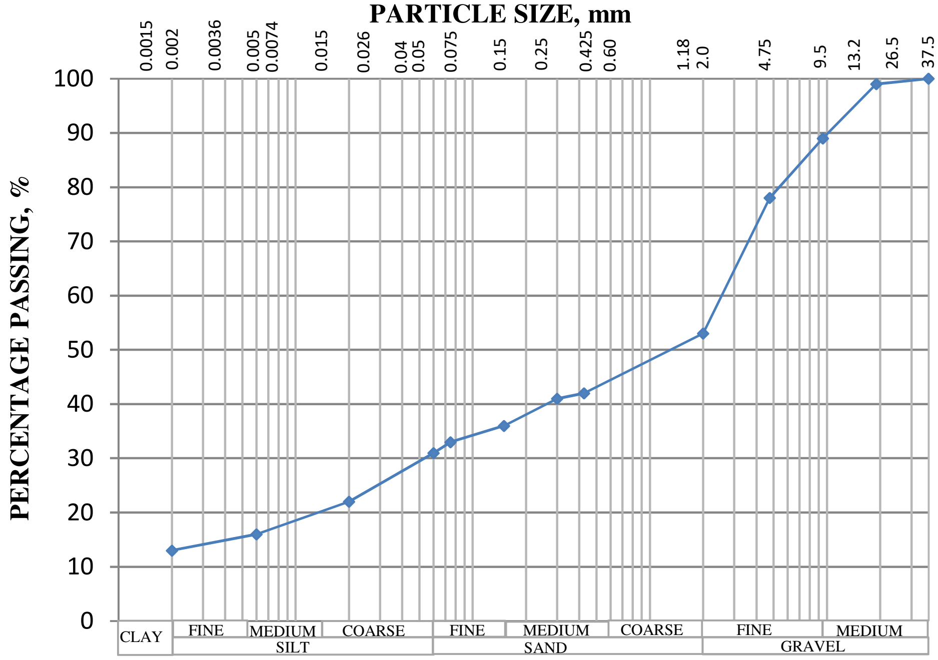

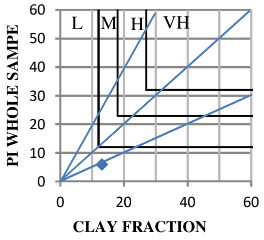

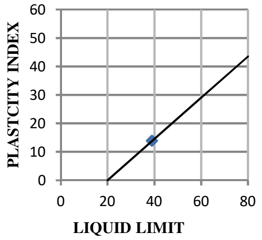

HOLE NO	SYMBOL	DEPTH, m	LIQUID LIMIT	PLASTICITY INDEX	LINEAR SHRINKAGE	%<0,425 mm	PI WHOLE SAMPLE	% CLAY	UCS CLASS
TH.1	◆	0.50-1.10	39	14	6.5	42	6	13	SC

SYMBOL	DESCRIPTION
◆	Abundant, fine to medium GRAVELS and FERRUGINOUS NODULES in matrix of dark orange and reddish brown, speckled light grey brown and black, medium dense, slightly CLAYEY SILTY SAND. Partly ferruginised hillwash.

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DWG. NO
3546/28

Fig. No.
28

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PARTICLE SIZE DISTRIBUTION & ATTERBERG LIMITS TEST

TRIAL HOLE NO.

TH.2

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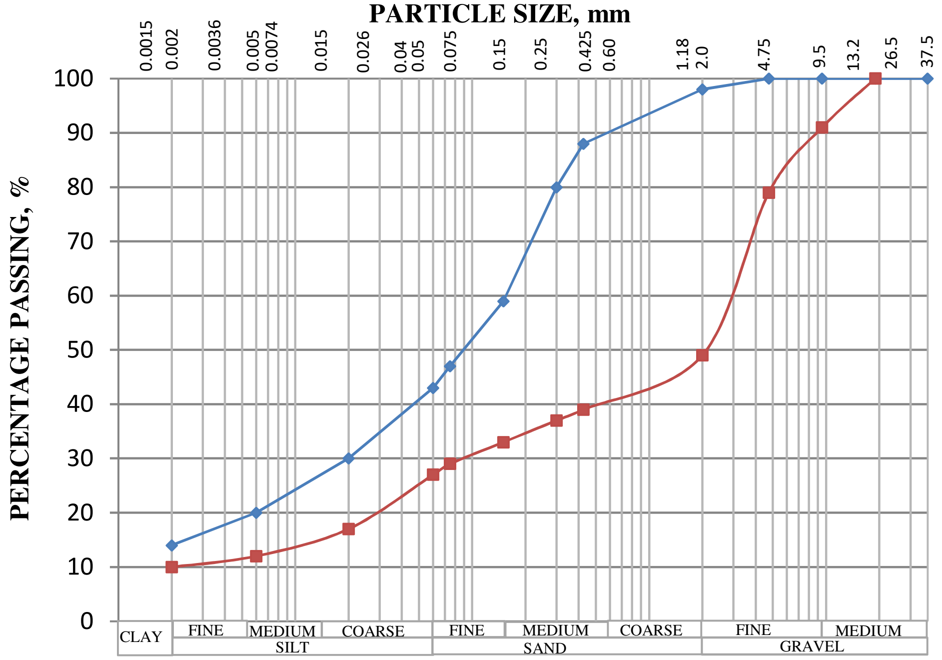

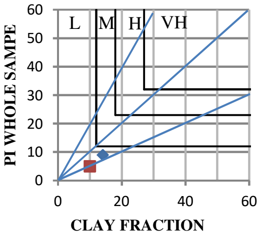

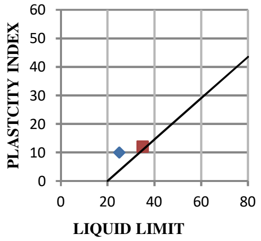

HOLE NO	SYMBOL	DEPTH, m	LIQUID LIMIT	PLASTICITY INDEX	LINEAR SHRINKAGE	%<0,425 mm	PI WHOLE SAMPLE	% CLAY	UCS CLASS
TH.2	◆	0.30-0.70	25	10	4.5	88	9	14	SC
TH.2	■	0.70-1.40	35	12	5.5	39	5	10	SC

SYMBOL	DESCRIPTION
◆	Slightly moist to moist, dark grey brown, medium dense, very SILTY SAND. Hillwash.
■	Abundant, fine to medium GRAVELS and FERRUGINOUS NODULES in dark orange brown and greenish grey, speckled dark yellow brown and black, medium dense, slightly CLAYEY SILTY SAND.

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DWG. NO
3546/29

Fig. No.
29

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PARTICLE SIZE DISTRIBUTION & ATTERBERG LIMITS TEST

TRIAL HOLE NO.

TH.3

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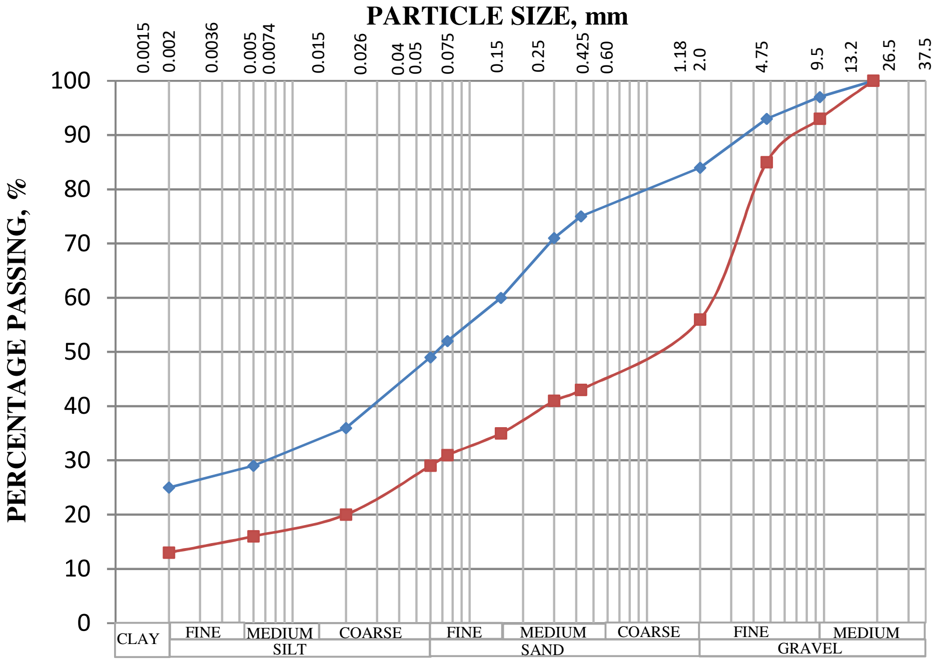

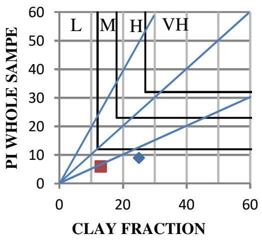

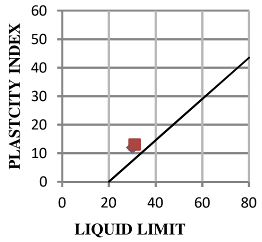

HOLE NO	SYMBOL	DEPTH, m	LIQUID LIMIT	PLASTICITY INDEX	LINEAR SHRINKAGE	%<0,425 mm	PI WHOLE SAMPLE	% CLAY	UCS CLASS
TH.3	◆	0.20-0.80	30	12	5.5	75	9	25	CL
TH.3	■	0.90-1.40	31	13	6.0	43	6	13	SC

SYMBOL	DESCRIPTION
◆	Slightly moist, dark grey brown, firm, intact, slightly CLAYEY SILTY SAND. Hillwash.
■	Moist, dark reddish brown, speckled light grey brown and black, medium dense, fine to medium GRAVELLY slightly CLAYEY SILTY SAND. Hillwash with gravels.

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DWG. NO
3546/30

Fig. No.
30

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PARTICLE SIZE DISTRIBUTION & ATTERBERG LIMITS TEST

TRIAL HOLE NO.

TH.4

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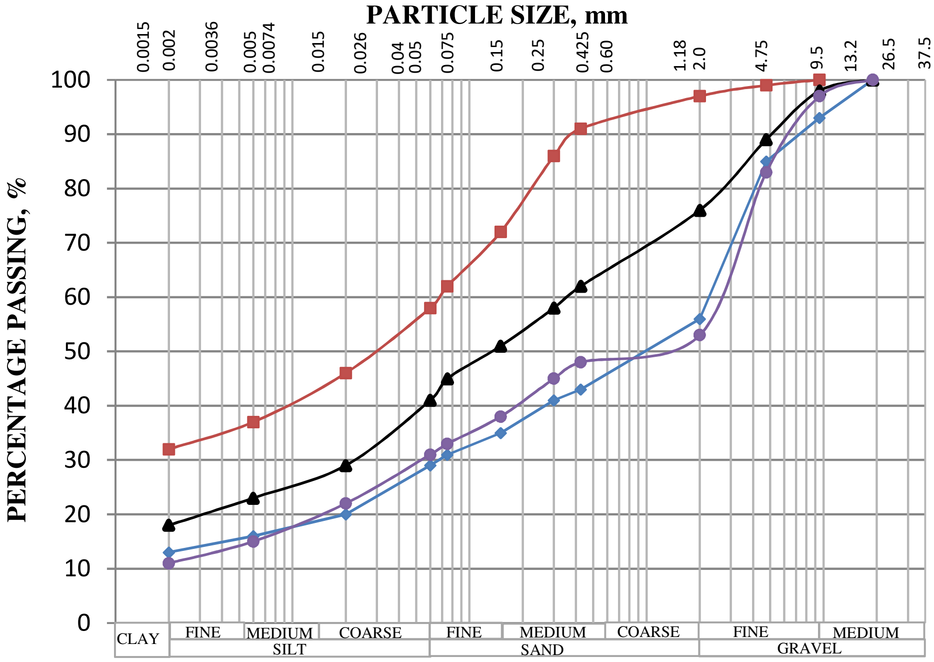
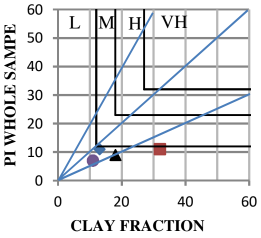
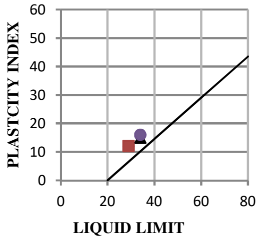
E-mail : mpavlaki@iafirca.com







HOLE NO	SYMBOL	DEPTH, m	LIQUID LIMIT	PLASTICITY INDEX	LINEAR SHRINKAGE	%<0,425 mm	PI WHOLE SAMPLE	% CLAY	UCS CLASS
TH.4	◆	0.20-1.20	29	12	6.0	43	11	13	CL
TH.4	■	0.90-1.10	29	12	6.0	91	11	32	CL
TH.4	▲	1.90-2.20	34	15	6.5	62	9	18	SC
TH.4	●	3.10-3.40	34	16	6.5	48	7	11	SC

SYMBOL	DESCRIPTION
◆	Slightly moist to moist, dark reddish brown, soft, intact, CLAYEY SANDY SILT. Hillwash.
■	Slightly moist to moist, dark reddish brown, soft, intact, CLAYEY SANDY SILT. Hillwash.
▲	Moist, dark reddish brown, soft CLAYEY SANDY SILT containing abundant medium gravel sized FERRUGINOUS NODULES. Weakly ferruginised hillwash.
●	Moist, khaki brown, mottled dark maroon brown, speckled black, dense to very dense, moderately ferruginised, fine GRAVELLY slightly CLAYEY SAND containing abundant FERRUGINOUS NODULES. Moderately ferruginised residual shale.

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DWG. NO
3546/31

Fig. No.
31

MICHAEL PAVLAKIS & ASSOCIATES
Consulting Geotechnical Engineers
Raadgewende Geotegniese Engineers

PARTICLE SIZE DISTRIBUTION & ATTERBERG LIMITS TEST

TRIAL HOLE NO.
TH.5

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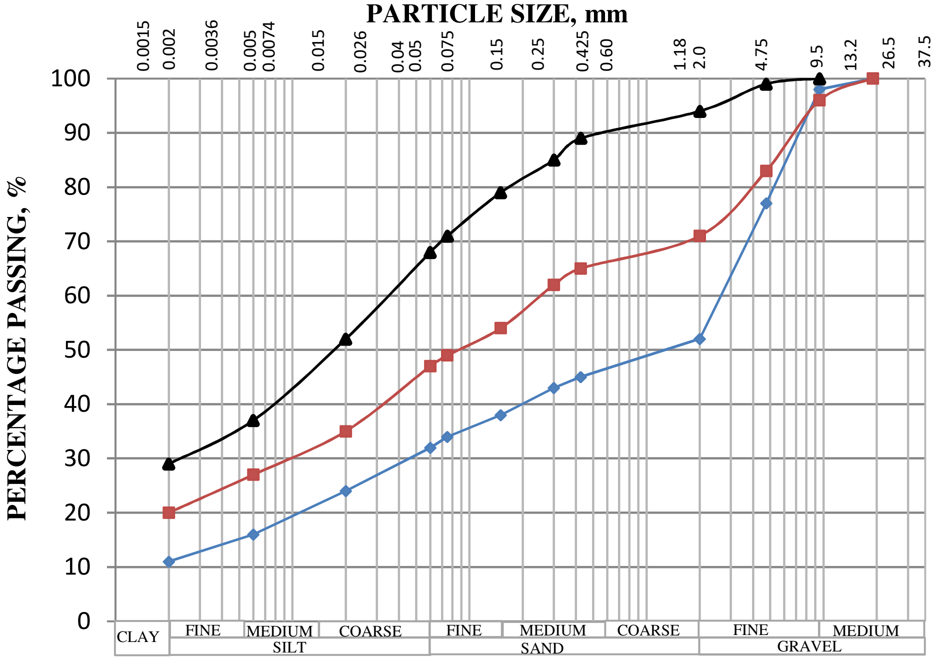

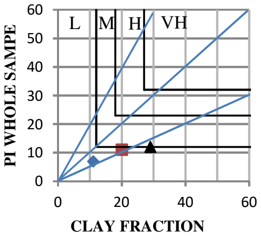

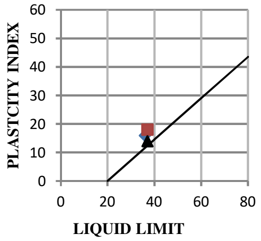

HOLE NO	SYMBOL	DEPTH, m	LIQUID LIMIT	PLASTICITY INDEX	LINEAR SHRINKAGE	%<0,425 mm	PI WHOLE SAMPLE	% CLAY	UCS CLASS
TH.5	◆	1.00-1.20	36	16	7.0	45	7	11	SC
TH.5	■	1.40-1.60	37	18	8.0	65	11	20	SC
TH.5	▲	2.30-2.50	37	14	6.5	89	12	29	CL

SYMBOL	DESCRIPTION
◆	Slightly moist to moist, dark reddish brown, mottled dark grey brown, speckled black, generally dense with scattered medium dense to dense pockets, very weakly ferruginised, fine to medium GRAVELLY SILTY SAND. Slightly ferruginised hillwash.
■	Moist, reddish brown, mottled dark grey brown, speckled black, firm, CLAYEY SANDY SILT containing many ferruginous nodules. Possibly residual syenite with ferruginous nodules.
▲	Moist to very moist, dark orange brown, mottled dark greenish grey, speckled yellow brown, firm, slightly relict, fissured CLAYEY SILT. Possible residual dolerite.

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DWG. NO
3546/32

Fig. No.
32

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Raadgewende Geotegniese Ingenieurs

PARTICLE SIZE DISTRIBUTION & ATTERBERG LIMITS TEST

TRIAL HOLE NO.

TH.6

Tel. (011) 888-7232 * Fax (011) 888-7428
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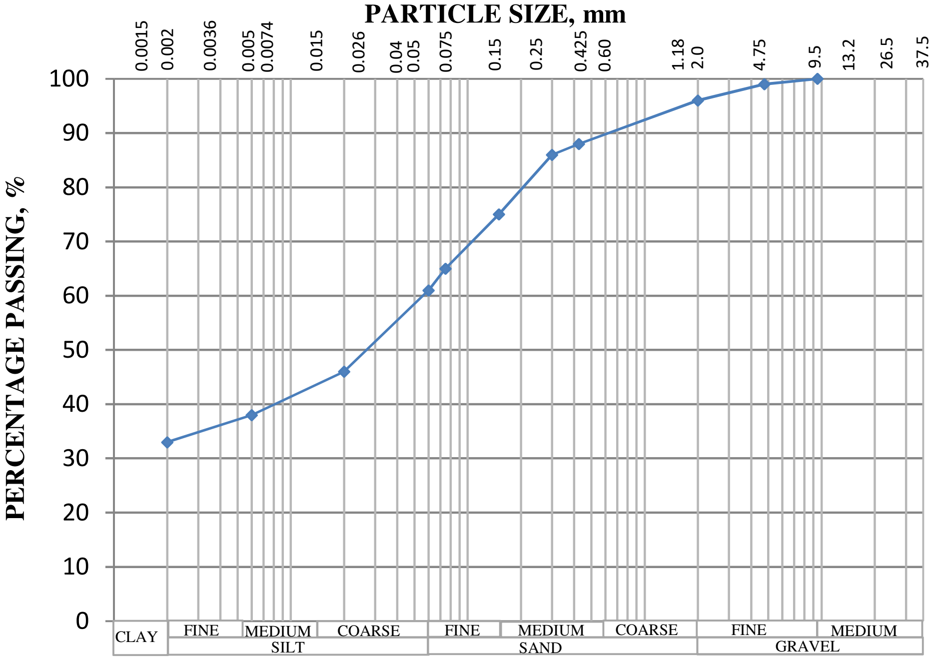

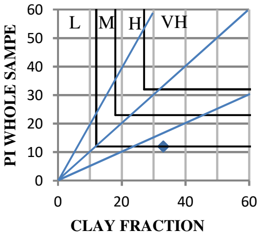

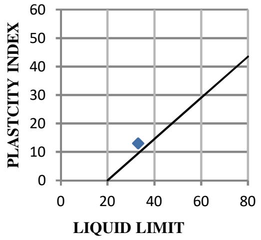

HOLE NO	SYMBOL	DEPTH, m	LIQUID LIMIT	PLASTICITY INDEX	LINEAR SHRINKAGE	%<0,425 mm	PI WHOLE SAMPLE	% CLAY	UCS CLASS
TH.6	◆	1.20-1.40	33	13	6.5	88	12	33	CL

SYMBOL	DESCRIPTION
◆	Moist, dark reddish brown, soft to firm, intact, slightly CLAYEY SANDY SILT. Hillwash.

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Springs Fresh Produce Market

DWG. NO
3546/33

Fig. No.
33

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Raadgewende Geotegniese Engineers

PARTICLE SIZE DISTRIBUTION & ATTERBERG LIMITS TEST

TRIAL HOLE NO.

TH.7

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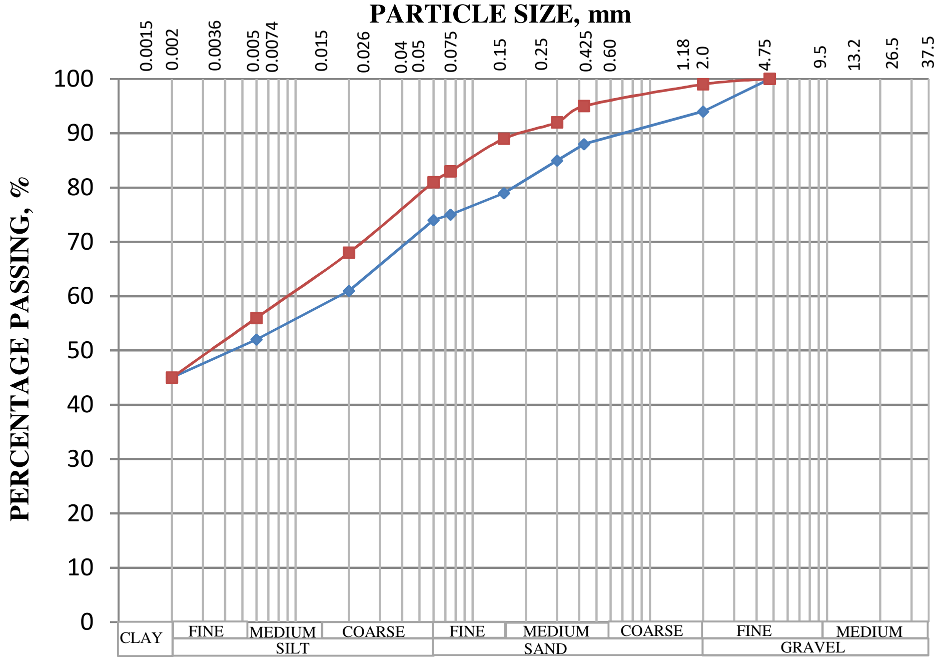

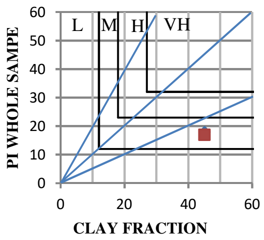

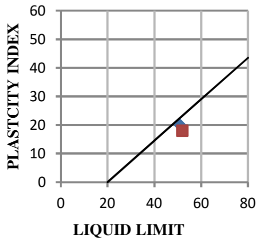

HOLE NO	SYMBOL	DEPTH, m	LIQUID LIMIT	PLASTICITY INDEX	LINEAR SHRINKAGE	%<0,425 mm	PI WHOLE SAMPLE	% CLAY	UCS CLASS
TH.7	◆	3.20-3.60	51	20	8.5	88	18	45	MH
TH.7	■	4.10-4.40	52	18	8.0	95	17	45	MH

SYMBOL	DESCRIPTION
◆	Moist, reddish brown, stiff to very stiff, intact, SILTY CLAY. Possibly residual dolerite.
■	Moist, orange brown, mottled dark maroon brown and dark yellow brown, firm, slightly relict, fissured, CLAYEY SILT. Possibly residual dolerite.

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DWG. NO
3546/34

Fig. No.
34

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Raadgewende Geotegniese Engineers

PARTICLE SIZE DISTRIBUTION & ATTERBERG LIMITS TEST

TRIAL HOLE NO.

TH.8

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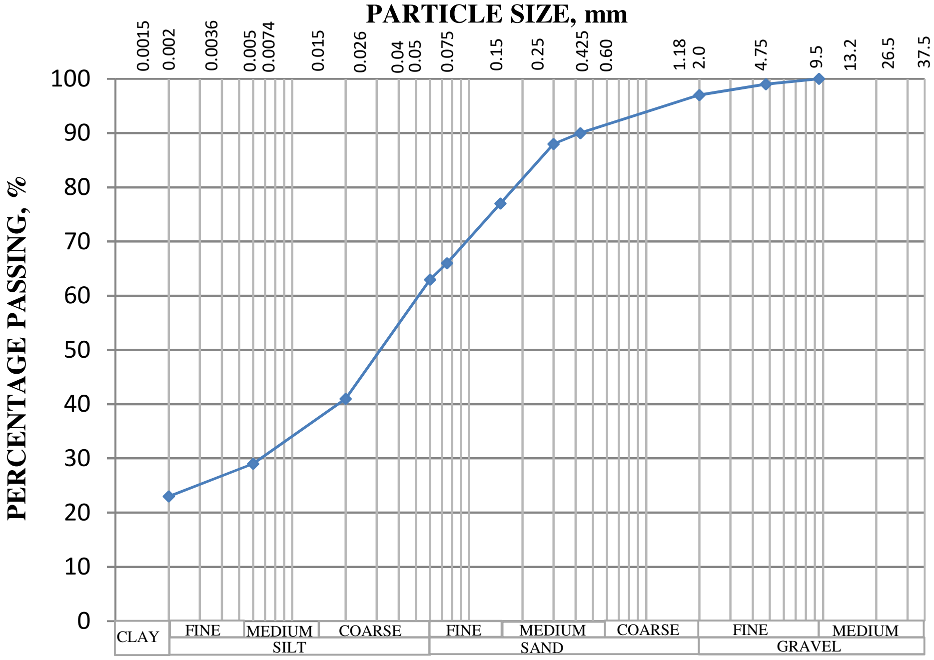

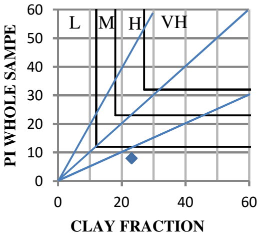

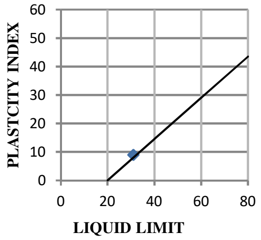

HOLE NO	SYMBOL	DEPTH, m	LIQUID LIMIT	PLASTICITY INDEX	LINEAR SHRINKAGE	%<0,425 mm	PI WHOLE SAMPLE	% CLAY	UCS CLASS
TH.8	◆	0.80-1.10	31	9	4.5	90	8	23	CL

SYMBOL	DESCRIPTION
◆	Moist, orange brown, loose, CLAYEY SANDY SILT with fine roots. Hillwash.

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Geotechnical Investigation For
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Springs Fresh Produce Market

DWG. NO
3546/35

Fig. No.
35

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PARTICLE SIZE DISTRIBUTION & ATTERBERG LIMITS TEST

TRIAL HOLE NO.

TH.9

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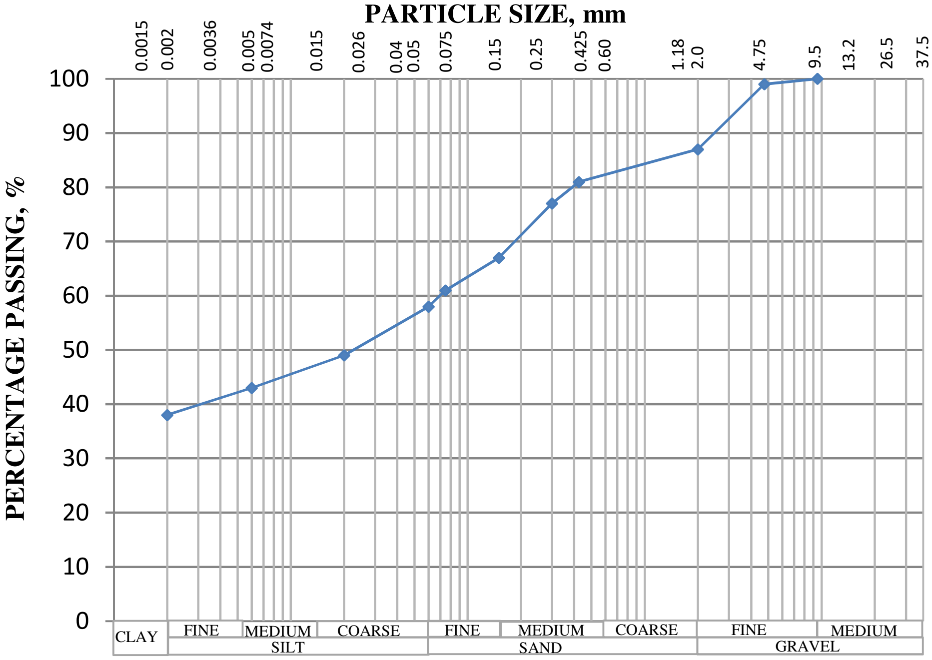

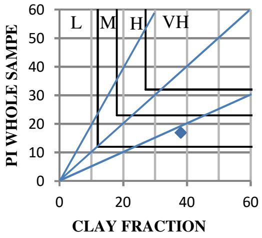

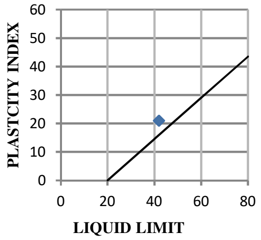

HOLE NO	SYMBOL	DEPTH, m	LIQUID LIMIT	PLASTICITY INDEX	LINEAR SHRINKAGE	%<0,425 mm	PI WHOLE SAMPLE	% CLAY	UCS CLASS
TH.9	◆	4.00-4.35	42	21	8.5	81	17	38	CL

SYMBOL	DESCRIPTION
◆	Moist, reddish orange brown, stiff, shattered SANDY/SILTY CLAY. Residual dolerite.

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Geotechnical Investigation For
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DWG. NO
3546/36

Fig. No.
36

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PARTICLE SIZE DISTRIBUTION & ATTERBERG LIMITS TEST

TRIAL HOLE NO.

TH.10

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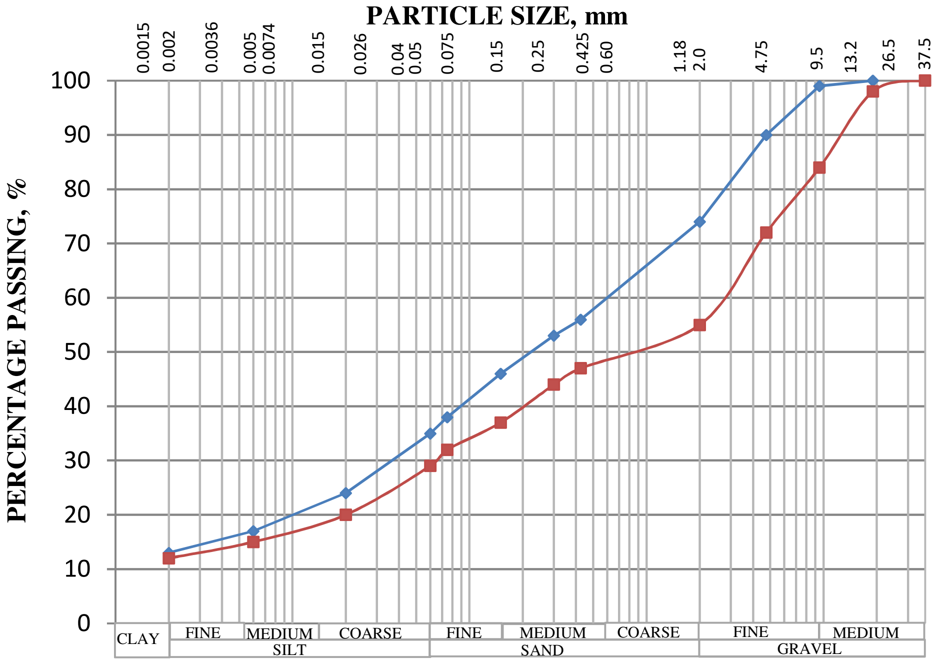

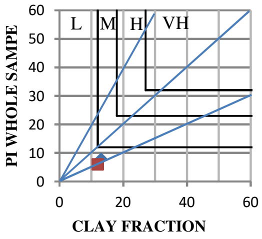

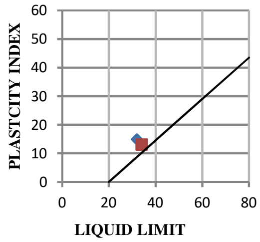

HOLE NO	SYMBOL	DEPTH, m	LIQUID LIMIT	PLASTICITY INDEX	LINEAR SHRINKAGE	%<0,425 mm	PI WHOLE SAMPLE	% CLAY	UCS CLASS
TH.10	◆	1.40-1.70	32	15	6.5	56	8	13	SC
TH.10	■	2.20-2.60	34	13	6.0	47	6	12	SC

SYMBOL	DESCRIPTION
◆	Moist, dark reddish brown, speckled light grey brown and black, soft to firm, slightly CLAYEY SANDY SILT containing many fine to medium gravels and scattered ferricrete nodules. Hillwash with gravels.
■	Moist, dark reddish brown, mottled dark greenish grey, very dense, well cemented and ferruginised, fine to medium GRAVELLY SILTY SAND. Ferricrete.

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Springs Fresh Produce Market

DWG. NO
3546/37

Fig. No.
37

MICHAEL PAVLAKIS & ASSOCIATES Consulting Geotechnical Engineers Raadgewende Geotegniese Engineers	PARTICLE SIZE DISTRIBUTION & ATTERBERG LIMITS TEST	TRIAL HOLE NO. TH.11

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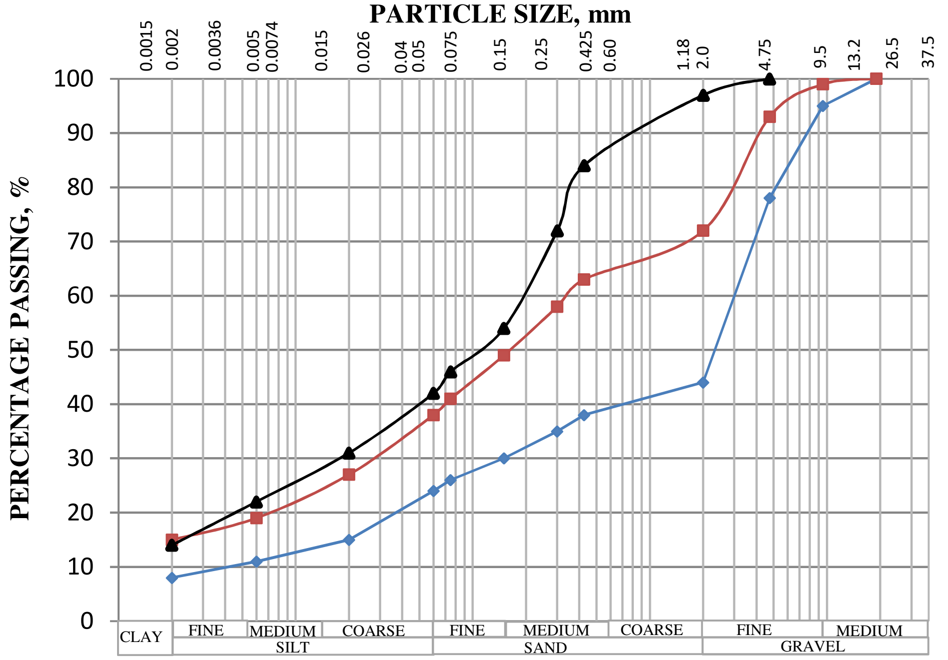

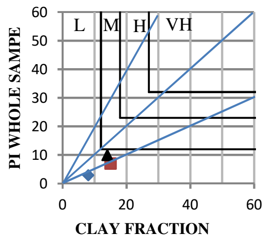

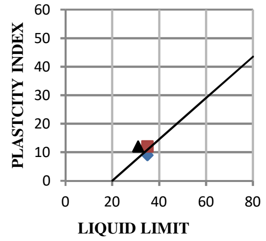

HOLE NO	SYMBOL	DEPTH, m	LIQUID LIMIT	PLASTICITY INDEX	LINEAR SHRINKAGE	%<0,425 mm	PI WHOLE SAMPLE	% CLAY	UCS CLASS
TH.11	◆	0.80-1.10	35	9	4.5	38	3	8	SC
TH.11	■	1.50-1.70	35	12	5.5	63	7	15	SC
TH.11	▲	2.30-2.70	31	12	5.5	84	10	14	SC

SYMBOL	DESCRIPTION
◆	Abundant, angular, fine to medium ferruginous GRAVELS in matrix of moist, dark orange brown, speckled black, medium dense to dense, SILTY SAND. Possibly ferruginous hillwash.
■	Moist, dark orange brown, mottled khaki brown, speckled black, firm, fine GRAVELLY CLAYEY SILTY SAND. Possibly partially ferruginised slightly reworked residual dolerite.
▲	Moist, orange brown, mottled greenish grey, dark yellow brown and dark marron brown, dense to very dense, slightly relict, fissured, SILTY SAND. Possibly residual dolerite.

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Geotechnical Investigation For
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Springs Fresh Produce Market

DWG. NO
3546/38

Fig. No.
38

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PARTICLE SIZE DISTRIBUTION & ATTERBERG LIMITS TEST

TRIAL HOLE NO.
TH.12

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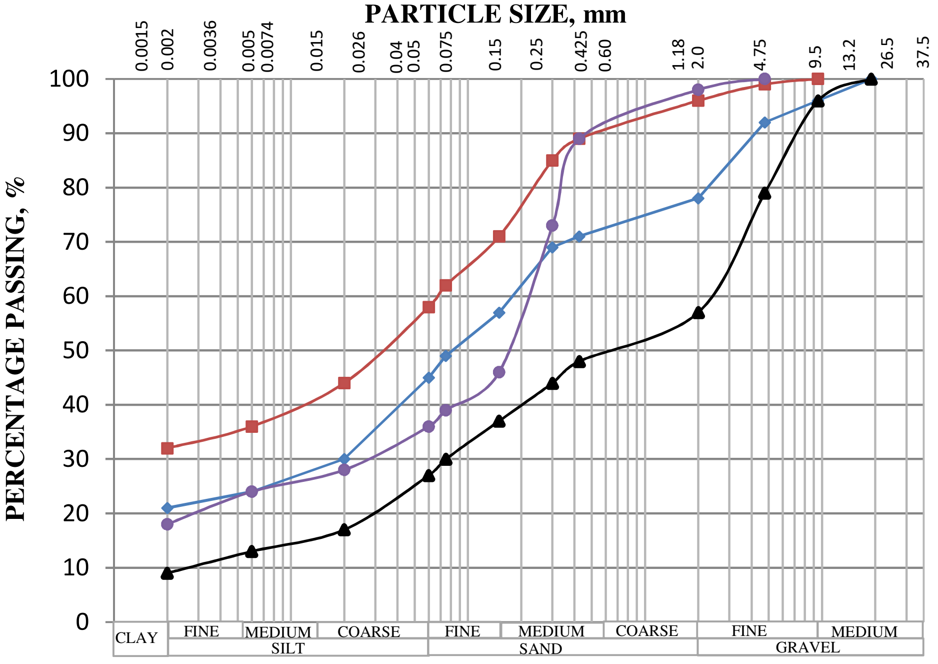

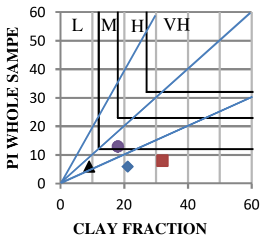

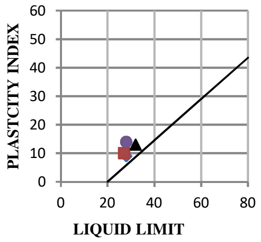

HOLE NO	SYMBOL	DEPTH, m	LIQUID LIMIT	PLASTICITY INDEX	LINEAR SHRINKAGE	%<0,425 mm	PI WHOLE SAMPLE	% CLAY	UCS CLASS
TH.12	◆	0.20-0.80	28	9	4.5	71	6	21	SC
TH.12	■	0.45-0.60	27	10	4.5	89	8	32	CL
TH.12	▲	1.50-2.50	32	13	6.0	48	6	9	SC
TH.12	●	3.40-3.60	28	14	5.5	89	13	18	SC

SYMBOL	DESCRIPTION
◆	Moist, dark brown, reddish brown, firm, intact, CLAYEY SANDY SILT. Hillwash.
■	Moist, dark brown, reddish brown, firm, intact, CLAYEY SANDY SILT. Hillwash.
▲	Moist, dark maroon brown, mottled dark yellow brown, speckled black, well cemented and ferruginised, very dense, fine to medium GRAVELLY SILTY SAND. Ferricrete.
●	Moist, orange brown, mottled dark yellow brown, stiff, micaceous, SANDY SILT. Possible residual dolerite.

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Geotechnical Investigation For
The Proposed New Upgrades To
Springs Fresh Produce Market

DWG. NO
3546/39

Fig. No.
39

MICHAEL PAVLAKIS & ASSOCIATES Consulting Geotechnical Engineers Raadgewende Geotegniese Engineers	PARTICLE SIZE DISTRIBUTION & ATTERBERG LIMITS TEST	TRIAL HOLE NO. **TH.13**

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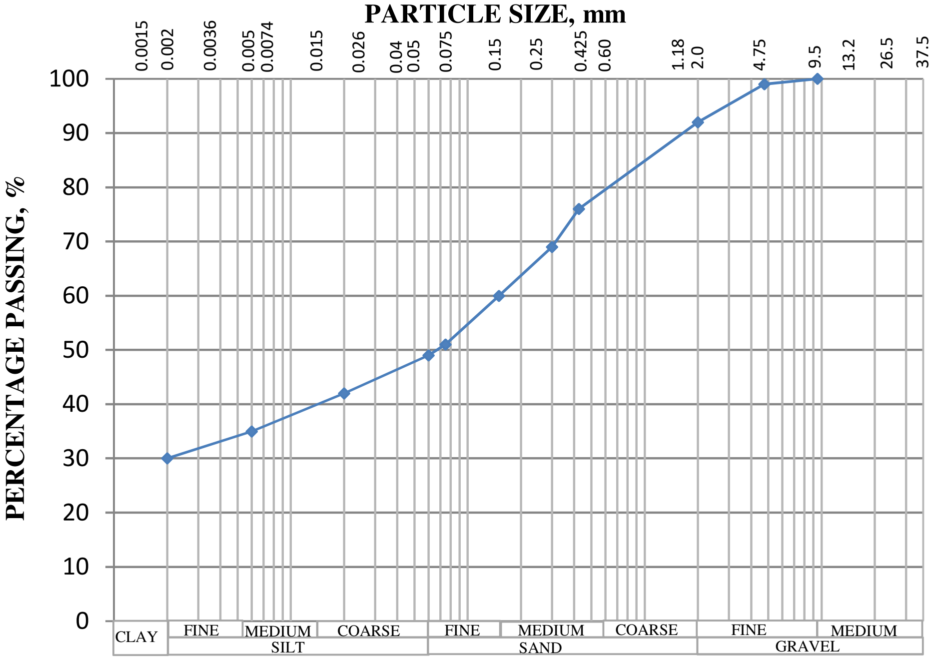

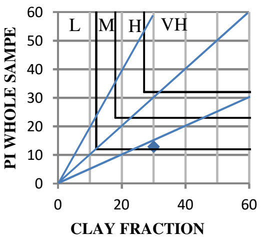

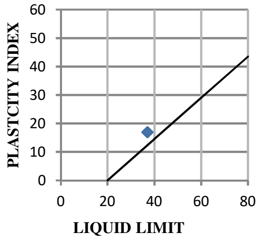

HOLE NO	SYMBOL	DEPTH, m	LIQUID LIMIT	PLASTICITY INDEX	LINEAR SHRINKAGE	%<0,425 mm	PI WHOLE SAMPLE	% CLAY	UCS CLASS
TH.13	◆	2.85-3.10	37	17	8.0	76	13	30	CL

SYMBOL	DESCRIPTION
◆	Moist, dark reddish brown, heavily mottled yellow and black, weakly cemented, weakly ferruginised, dense to very dense, CLAYEY SILTY GRAVEL. Weak ferricrete.

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Geotechnical Investigation For
The Proposed New Upgrades To
Springs Fresh Produce Market

DWG. NO
3546/40

Fig. No.
40

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PARTICLE SIZE DISTRIBUTION & ATTERBERG LIMITS TEST

TRIAL HOLE NO.

TH.14

Tel. (011) 888-7232 * Fax (011) 888-7428
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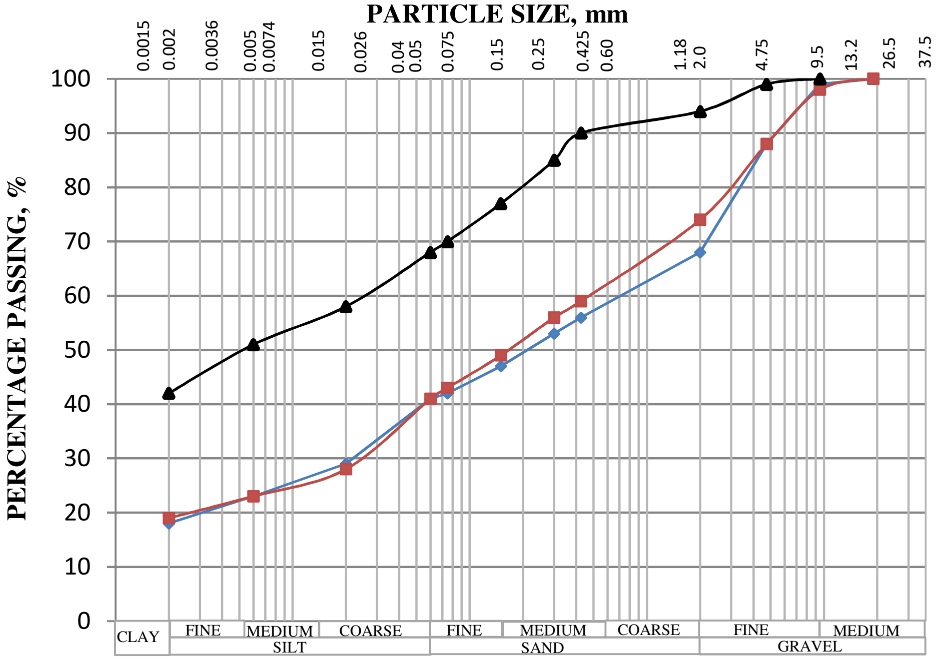

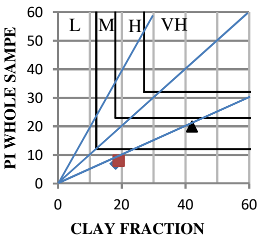

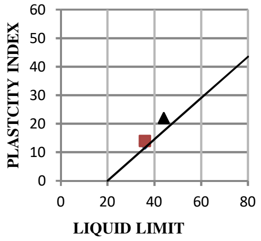

HOLE NO	SYMBOL	DEPTH, m	LIQUID LIMIT	PLASTICITY INDEX	LINEAR SHRINKAGE	%<0,425 mm	PI WHOLE SAMPLE	% CLAY	UCS CLASS
TH.14	◆	0.45-0.90	36	13	6.0	56	7	18	SC
TH.14	🟥	1.90-2.20	36	14	6.5	59	8	19	SC
TH.14	▲	2.90-3.30	44	22	9.5	90	20	42	CL

SYMBOL	DESCRIPTION
◆	Slightly moist to moist, dark reddish brown, medium dense to dense, slightly firm to medium GRAVELLY SILTY SAND. Slightly gravelly hillwash.
🟥	Moist, dark reddish brown, mottled dark yellow brown, speckled light grey and black, well cemented and ferruginised, very dense, fine to medium GRAVELLY SILTY SAND. Ferricrete.
▲	Moist, dark reddish brown, intact, very stiff, SILTY CLAY. Possibly residual dolerite.

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Geotechnical Investigation For
The Proposed New Upgrades To
Springs Fresh Produce Market

DWG. NO
3546/41

Fig. No.
41

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Consulting Geotechnical Engineers
Raadgewende Geotegniese Engineers

PARTICLE SIZE DISTRIBUTION & ATTERBERG LIMITS TEST

TRIAL HOLE NO.
TH.15

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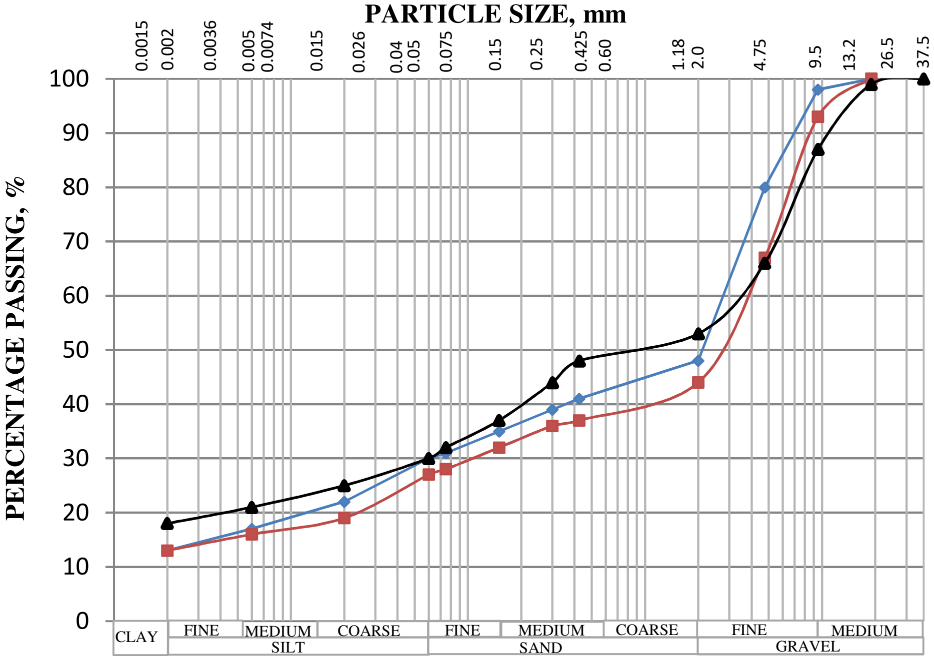

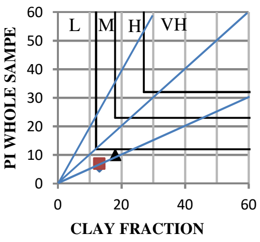

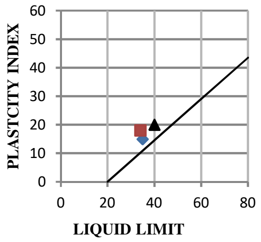

HOLE NO	SYMBOL	DEPTH, m	LIQUID LIMIT	PLASTICITY INDEX	LINEAR SHRINKAGE	%<0,425 mm	PI WHOLE SAMPLE	% CLAY	UCS CLASS
TH.15	◆	0.80-1.10	35	15	6.5	41	6	13	SC
TH.15	🟥	1.70-2.10	34	18	7.5	37	7	13	SC
TH.15	▲	2.80-3.10	40	20	8.5	48	10	18	SC

SYMBOL	DESCRIPTION
◆	Moist, dark yellow brown, medium dense, fine to medium GRAVELLY SILTY SAND. Fine colluvium.
🟥	Moist, dark maroon brown, mottled khaki brown and yellow brown, speckled black, very dense, moderately to well ferruginised and cemented GRAVELLY SILTY SAND. Ferricrete.
▲	Moist, dark maroon brown, mottled orange brown, speckled yellow brown, stiff, weakly fissured, slightly CLAYEY SANDY SILT. Possibly residual dolerite.

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DWG. NO
3546/42

Fig. No.
42

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PARTICLE SIZE DISTRIBUTION & ATTERBERG LIMITS TEST

TRIAL HOLE NO.

TH.16

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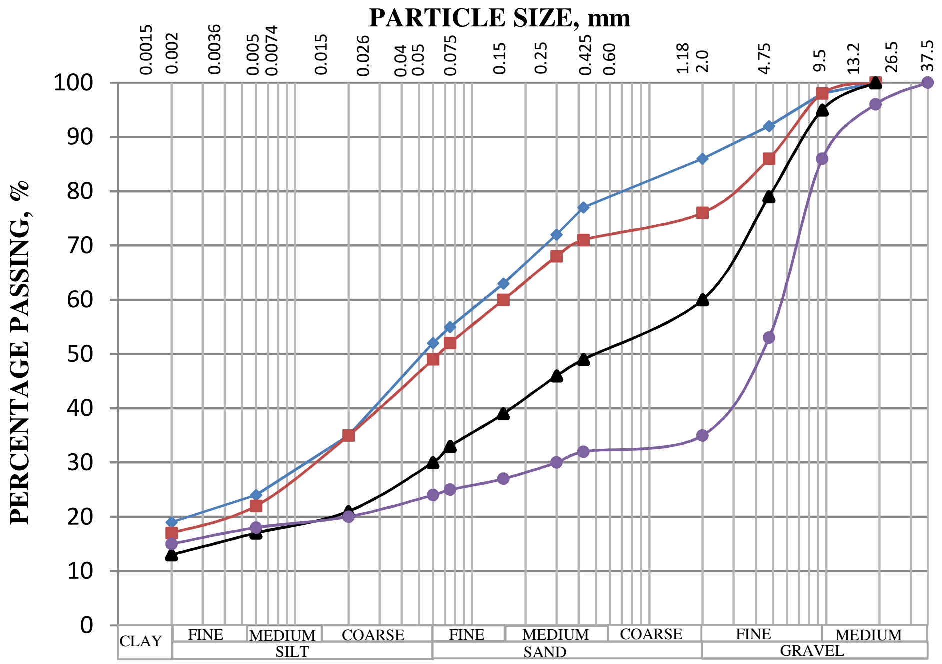

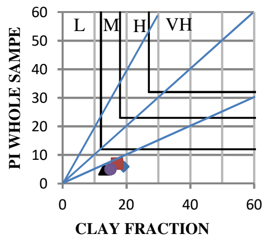

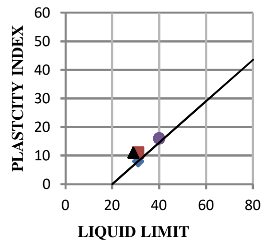

HOLE NO	SYMBOL	DEPTH, m	LIQUID LIMIT	PLASTICITY INDEX	LINEAR SHRINKAGE	%<0,425 mm	PI WHOLE SAMPLE	% CLAY	UCS CLASS
TH.16	◆	1.00-1.30	31	8	4.5	77	6	19	ML
TH.16	■	1.70-2.05	31	11	5.0	71	7	17	CL
TH.16	▲	2.70-3.10	29	11	5.5	49	5	13	SC
TH.16	●	3.30-3.70	40	16	6.5	32	5	15	SC

SYMBOL	DESCRIPTION
◆	Moist, orange brown, loose, CLAYEY SILTY SAND with fine roots and occasional ferruginous nodules. Hillwash.
■	Mixture of CLAYEY SILTY SAND with abundant GRAVELS and FERRUGINOUS NODULES. Hillwash & Ferruginised hillwash.
▲	Very moist, orange brown and light bluish grey, mottled black, weakly cemented, weakly ferruginised, very dense, GRAVELLY very CLAYEY SAND. Ferricrete.
●	Very moist, reddish orange, weakly cemented and ferruginised, very dense, GRAVELLY SANDY CLAY. Ferricrete.

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DWG. NO
3546/43

Fig. No.
43

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PARTICLE SIZE DISTRIBUTION & ATTERBERG LIMITS TEST

TRIAL HOLE NO.
TH.17

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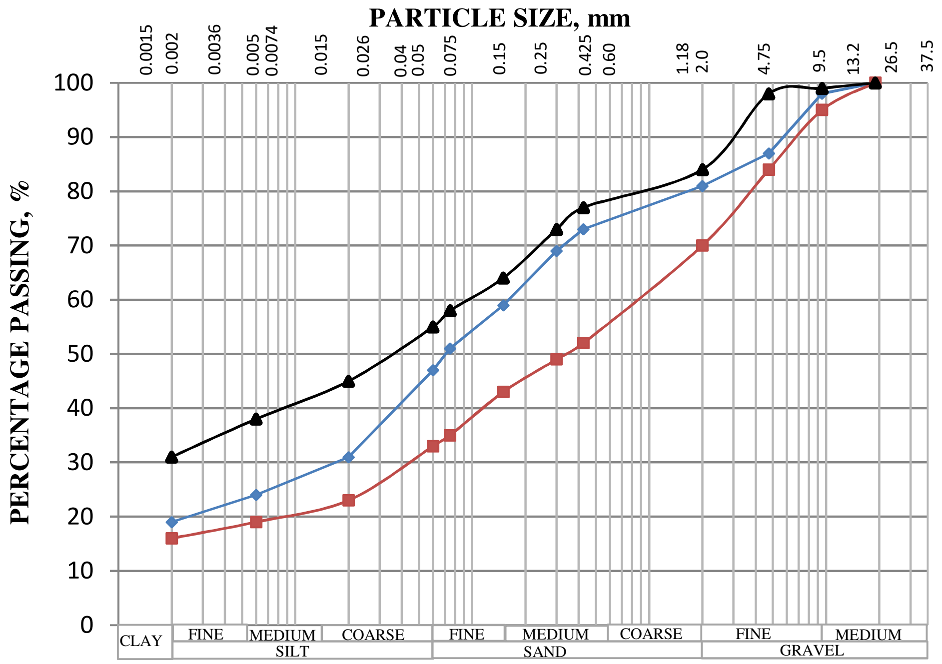

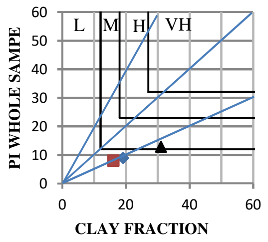

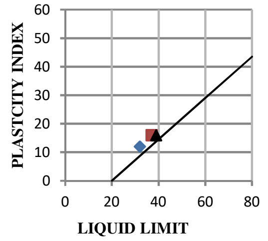

HOLE NO	SYMBOL	DEPTH, m	LIQUID LIMIT	PLASTICITY INDEX	LINEAR SHRINKAGE	%<0,425 mm	PI WHOLE SAMPLE	% CLAY	UCS CLASS
TH.17	◆	1.00-1.30	32	12	5.5	73	9	19	CL
TH.17	🟥	1.70-3.00	37	16	7.5	52	8	16	SC
TH.17	▲	3.50-3.80	39	16	7.5	77	13	31	CL

SYMBOL	DESCRIPTION
◆	Moist to very moist, yellow brown, speckled black, soft to firm, slightly CLAYEY SILTY SAND containing scattered fine gravels and occasional ferruginous nodules. Hillwash with gravels.
🟥	Very moist, yellow brown, mottled orange brown, speckled black, medium dense, moderately fine to medium GRAVELLY SILTY SAND. Ferruginised hillwash.
▲	Very moist, dark maroon, brown, mottled khaki brown and dark yellow brown, firm to stiff, slightly relict textured, CLAYEY SANDY SILT. Possible residual dolerite.

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DWG. NO
3546/44
Fig. No.
44

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PARTICLE SIZE DISTRIBUTION & ATTERBERG LIMITS TEST

TRIAL HOLE NO.

TH.18

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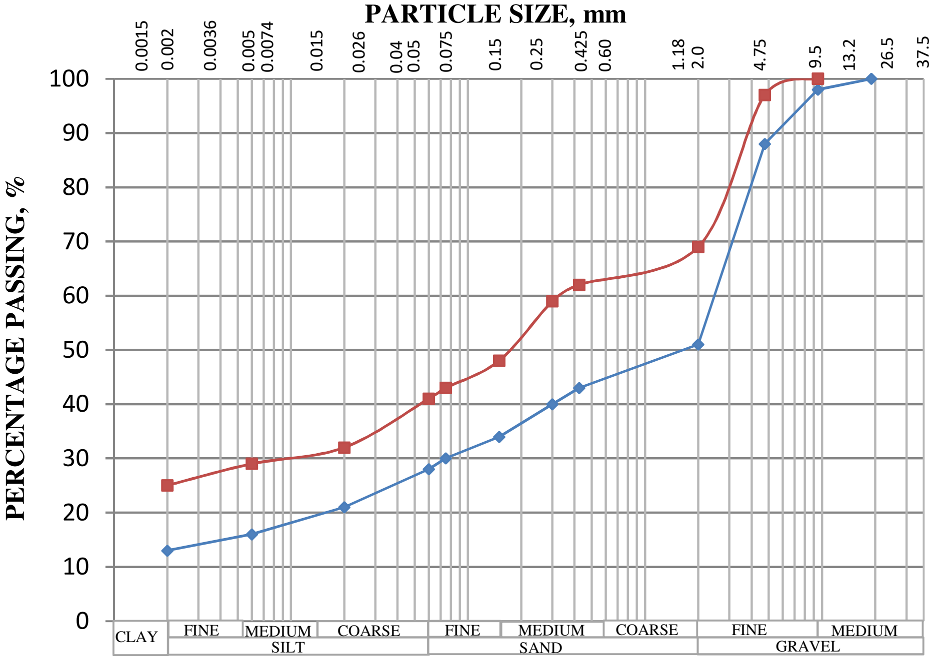

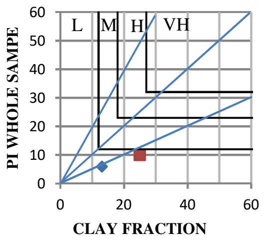

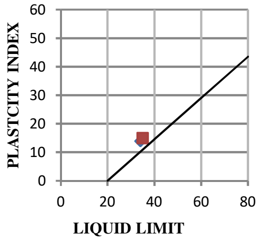

HOLE NO	SYMBOL	DEPTH, m	LIQUID LIMIT	PLASTICITY INDEX	LINEAR SHRINKAGE	%<0,425 mm	PI WHOLE SAMPLE	% CLAY	UCS CLASS
TH.18	◆	2.20-2.40	34	14	6.0	43	6	13	SC
TH.18	■	3.20-3.40	35	15	6.5	62	10	25	SC

SYMBOL	DESCRIPTION
◆	Moist, dark reddish brown and greenish yellow, medium dense to dense, 2-5 mm SANDY GRAVEL comprising ferruginous nodules. Ferruginised hillwash.
■	Moist, dark reddish brown, mottled grey, weakly cemented, weakly ferruginised, dense to very dense, CLAYEY SANDY GRAVEL. Ferricrete.

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DWG. NO
3546/45

Fig. No.
45

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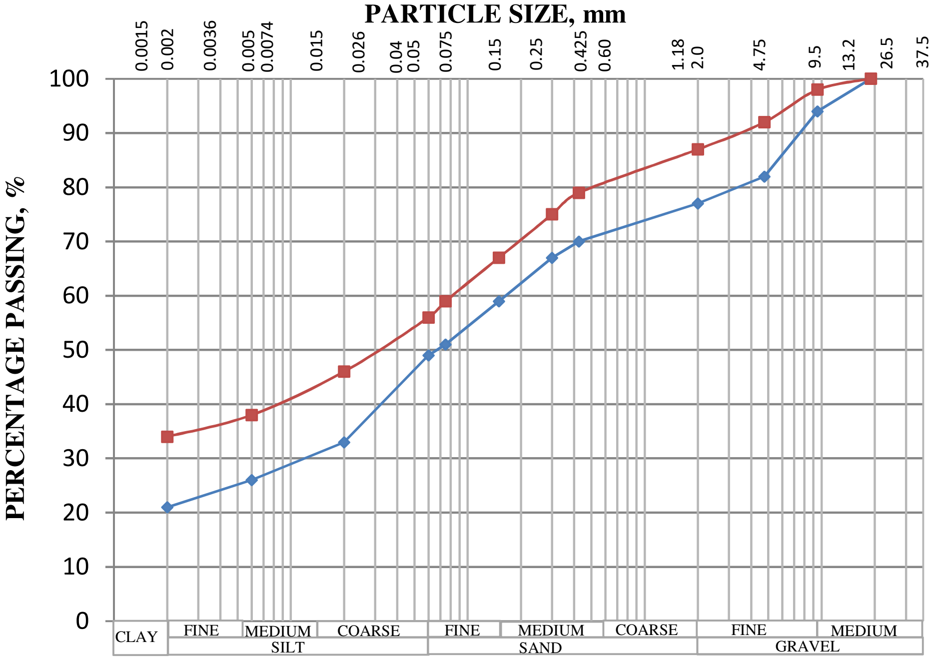
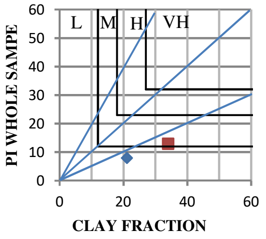
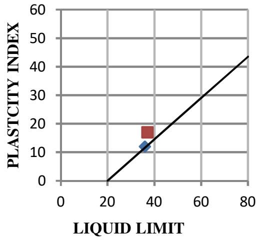
PARTICLE SIZE DISTRIBUTION & ATTERBERG LIMITS TEST

TRIAL HOLE NO.

TH.19







HOLE NO	SYMBOL	DEPTH, m	LIQUID LIMIT	PLASTICITY INDEX	LINEAR SHRINKAGE	%<0,425 mm	PI WHOLE SAMPLE	% CLAY	UCS CLASS
TH.19	◆	1.00-1.70	36	12	6.0	70	8	21	ML
TH.19	🟥	2.10-2.40	37	17	8.0	79	13	34	CL

SYMBOL	DESCRIPTION
◆	Moist, dark yellow brown, mottled dark orange brown, generally firm with firm to stiff zones, weakly relict bedded SANDY SILT. Possible residual shale.
🟥	Very moist, dark yellow brown, mottled dark reddish brown, firm, weakly relict bedded CLAYEY SANDY SILT. Possible residual shale.

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DWG. NO
3546/46

Fig. No.
46

PARTICLE SIZE DISTRIBUTION & ATTERBERG LIMITS TEST

TRIAL HOLE NO.

TH.20

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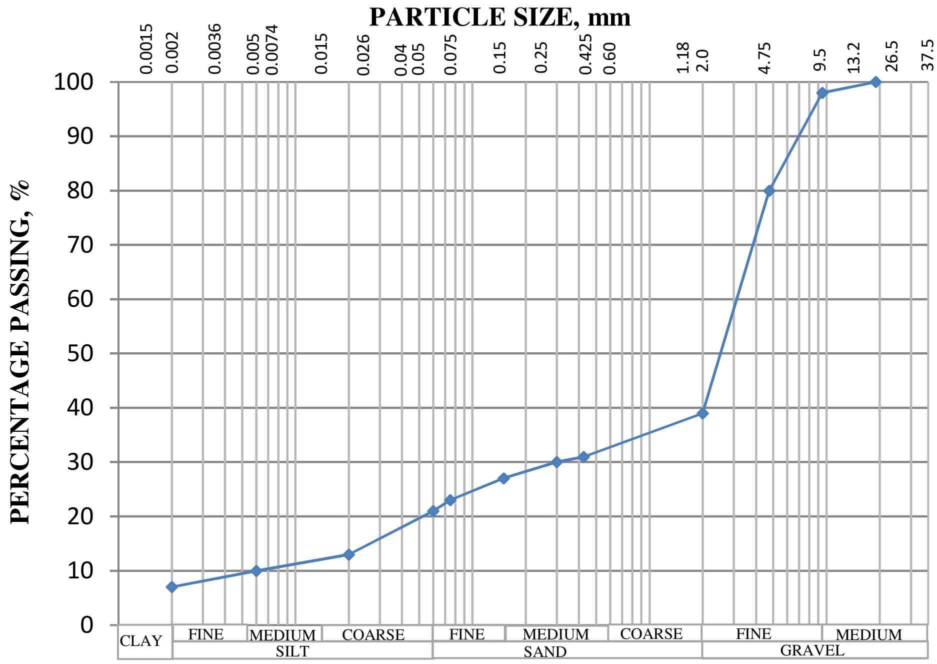

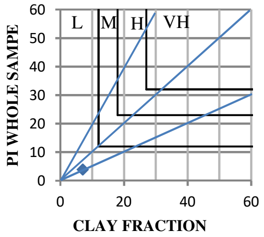

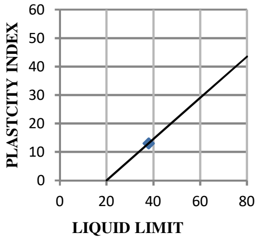

HOLE NO	SYMBOL	DEPTH, m	LIQUID LIMIT	PLASTICITY INDEX	LINEAR SHRINKAGE	%<0,425 mm	PI WHOLE SAMPLE	% CLAY	UCS CLASS
TH.20	◆	1.50-1.80	38	13	6.0	31	4	7	SC

SYMBOL	DESCRIPTION
◆	Abundant fine to medium GRAVELS and FERRUGINOUS NODULES in matrix of moist, dark orange brown, mottled dark maroon brown and dark yellow brown, speckled light grey brown, black, dense, weakly ferruginised SILTY SAND. Weakly ferruginised fine colluvium.

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DWG. NO
3546/47

Fig. No.
47

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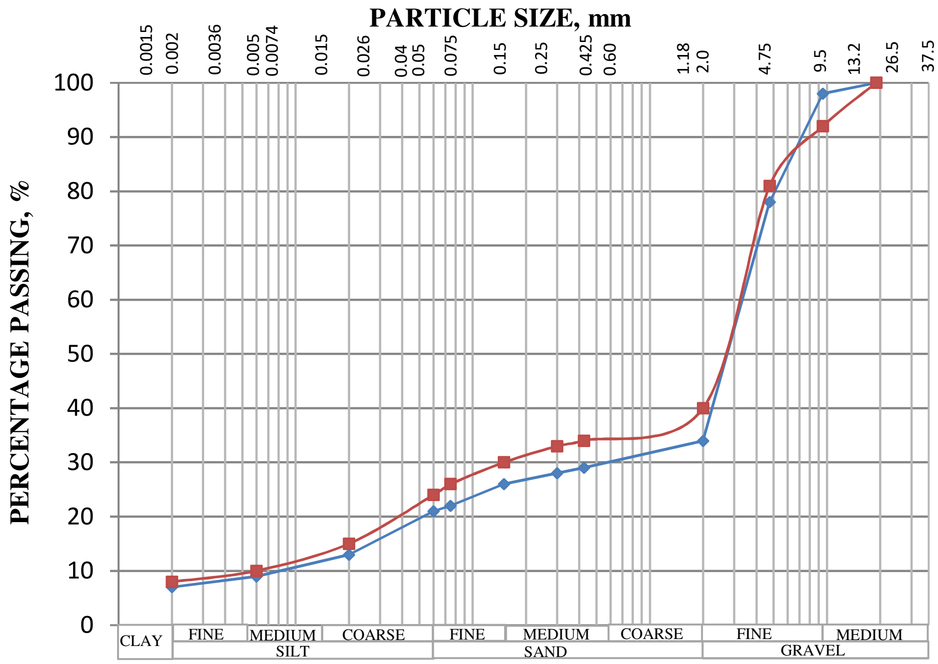
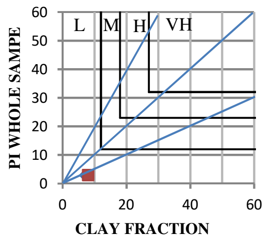
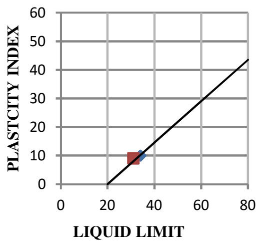
PARTICLE SIZE DISTRIBUTION & ATTERBERG LIMITS TEST

TRIAL HOLE NO.

TH.21







HOLE NO	SYMBOL	DEPTH, m	LIQUID LIMIT	PLASTICITY INDEX	LINEAR SHRINKAGE	%<0,425 mm	PI WHOLE SAMPLE	% CLAY	UCS CLASS
TH.21	◆	1.05-2.30	34	10	5.5	29	3	7	SC
TH.21	■	1.20-1.80	31	9	3.5	34	3	8	SC

SYMBOL	DESCRIPTION
◆	Abundant 2-20 mm FERRUGINOUS NODULES in matrix of moist, yellow, CLAYEY SILTY SAND and occasional fine roots. Ferruginised hillwash.
■	Abundant 2-20 mm FERRUGINOUS NODULES in matrix of moist, yellow, CLAYEY SILTY SAND and occasional fine roots. Ferruginised hillwash.

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Springs Fresh Produce Market

DWG. NO
3546/48

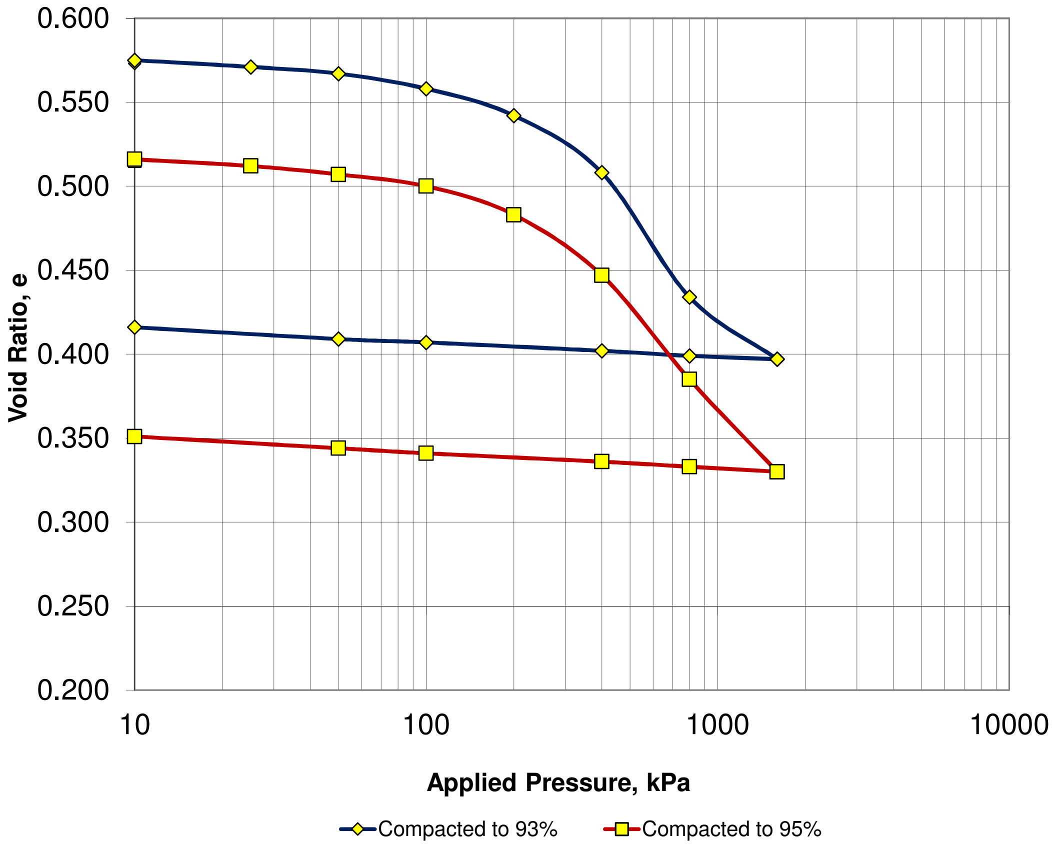
Fig. No.
48

OEDOMETER TEST

Hole. No.

TH. 4

Depth 0.20-1.20 m



APPLIED PRESSURE, kPa	VOID RATIO	APPLIED PRESSURE, kPa	VOID RATIO
10	0.573	800	0.434
10	0.575	1600	0.397
25	0.571	800	0.399
50	0.567	400	0.402
100	0.558	100	0.407
200	0.542	50	0.409
400	0.508	10	0.416

Sample Compacted to 93% Mod AASHTO Dry Density @ OMC

Dry Density kg/m³	1689
Moisture Content %	0.2
Degree of Saturation %	70%
Specific Gravity	2.667
Liquid Limit	29
Plasticity Index	12

Po, kPa	
Pc, kPa	
eo	0.579
ec	
ce	0.009
cc	0.246

APPLIED PRESSURE, kPa	VOID RATIO	APPLIED PRESSURE, kPa	VOID RATIO
10	0.520	800	0.385
10	0.515	1600	0.330
25	0.516	800	0.333
50	0.512	400	0.330
100	0.507	100	0.341
200	0.500	50	0.344
400	0.483	10	0.351

Sample Compacted to 95% Mod AASHTO Dry Density @ OMC

Dry Density kg/m³	1755
Moisture Content %	15%
Degree of Saturation %	77%
Specific Gravity	2.667
Liquid Limit	29
Plasticity Index	12

Po, kPa	
Pc, kPa	
eo	0.520
ec	
ce	0.010
cc	0.206

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Dwg. No.
3546/49

FIG. NO.
49

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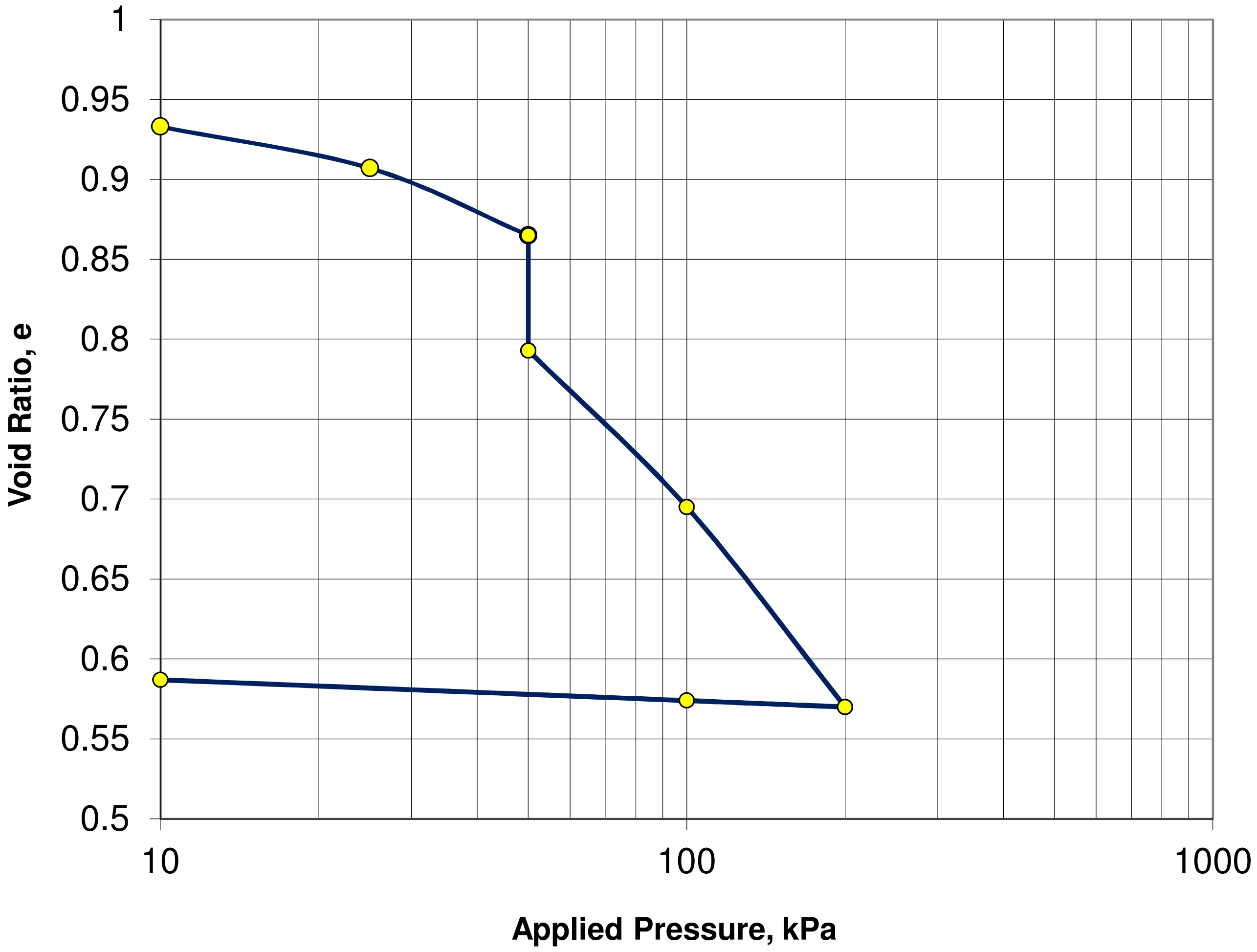
OEDOMETER TEST

Hole. No.
TH. 4

Depth 0.90-1.10 m



APPLIED PRESSURE, kPa	VOID RATIO	APPLIED PRESSURE, kPa	VOID RATIO
10	0.933	100	0.574
25	0.907	10	0.587
50	0.865		
50	0.793		
100	0.695		
200	0.570		

Undisturbed Sample Soaked @ 50kPa

Collapse at 50kPa = 3.69%

Dry Density kg/m³	1372
Moisture Content %	20%
Degree of Saturation %	57%
Specific Gravity	2.679
Liquid Limit	29
Plasticity Index	12

Po, kPa	13
Pc, kPa	
eo	0.953
ec	
ce	0.200
cc	0.415

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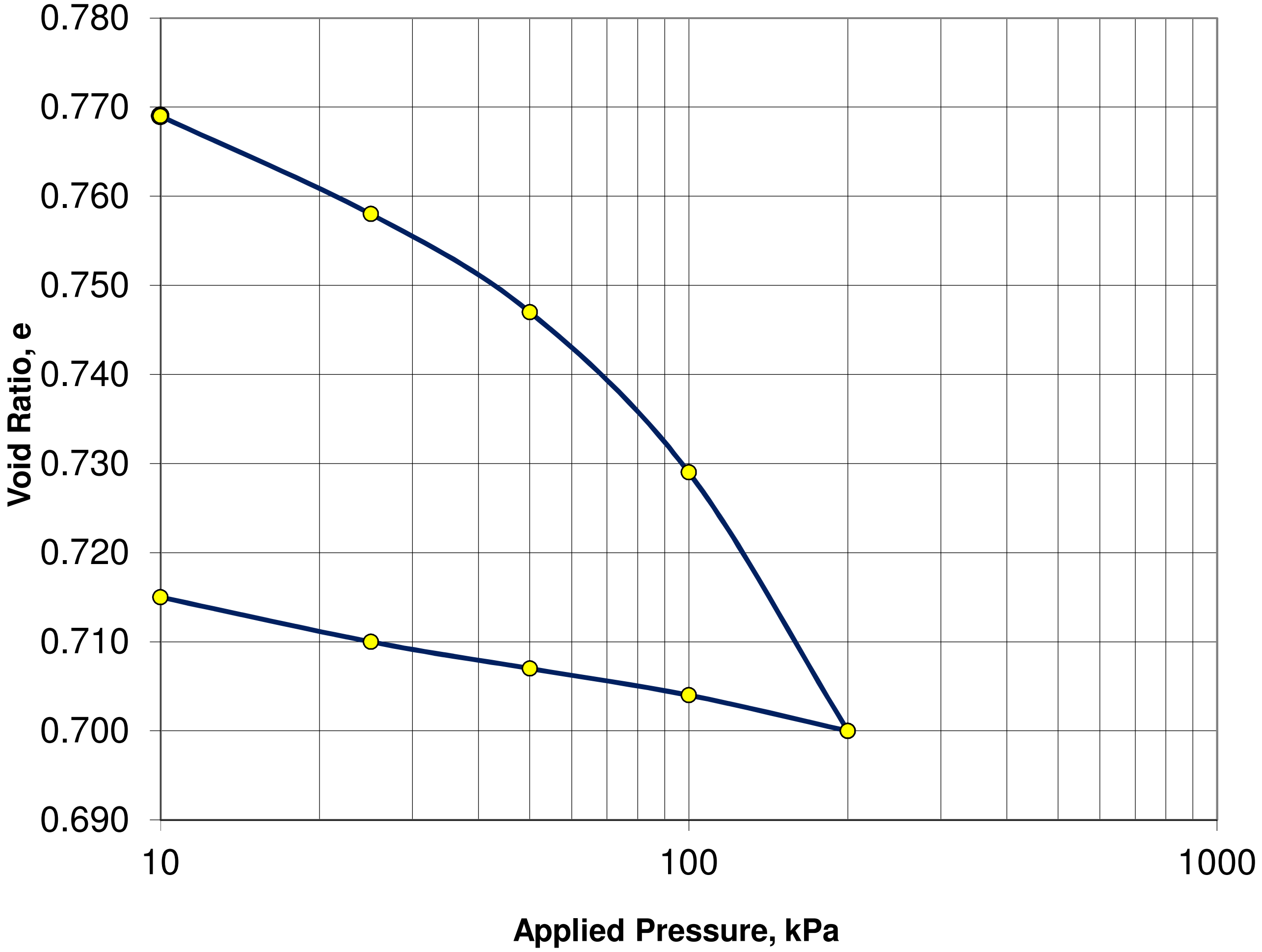
Dwg. No.
3546/50

FIG. NO.
50

OEDOMETER TEST

Hole. No.
TH.5

Depth 2.30-2.50 m



APPLIED PRESSURE, kPa	VOID RATIO	APPLIED PRESSURE, kPa	VOID RATIO
10	0.769	100	0.704
10	0.769	50	0.707
25	0.758	25	0.710
50	0.747	10	0.715
100	0.729		
200	0.700		

Undisturbed Sample Soaked @ 10kPa

Swell at 10kPa = -

Dry Density kg/m³	1493
Moisture Content %	25.5
Degree of Saturation %	87%
Specific Gravity	2.65
Liquid Limit	37
Plasticity Index	14

Po, kPa	44
Pc, kPa	
eo	0.774
ec	
ce	0.012
cc	0.096

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Dwg. No.
3546/51

FIG. NO.
51

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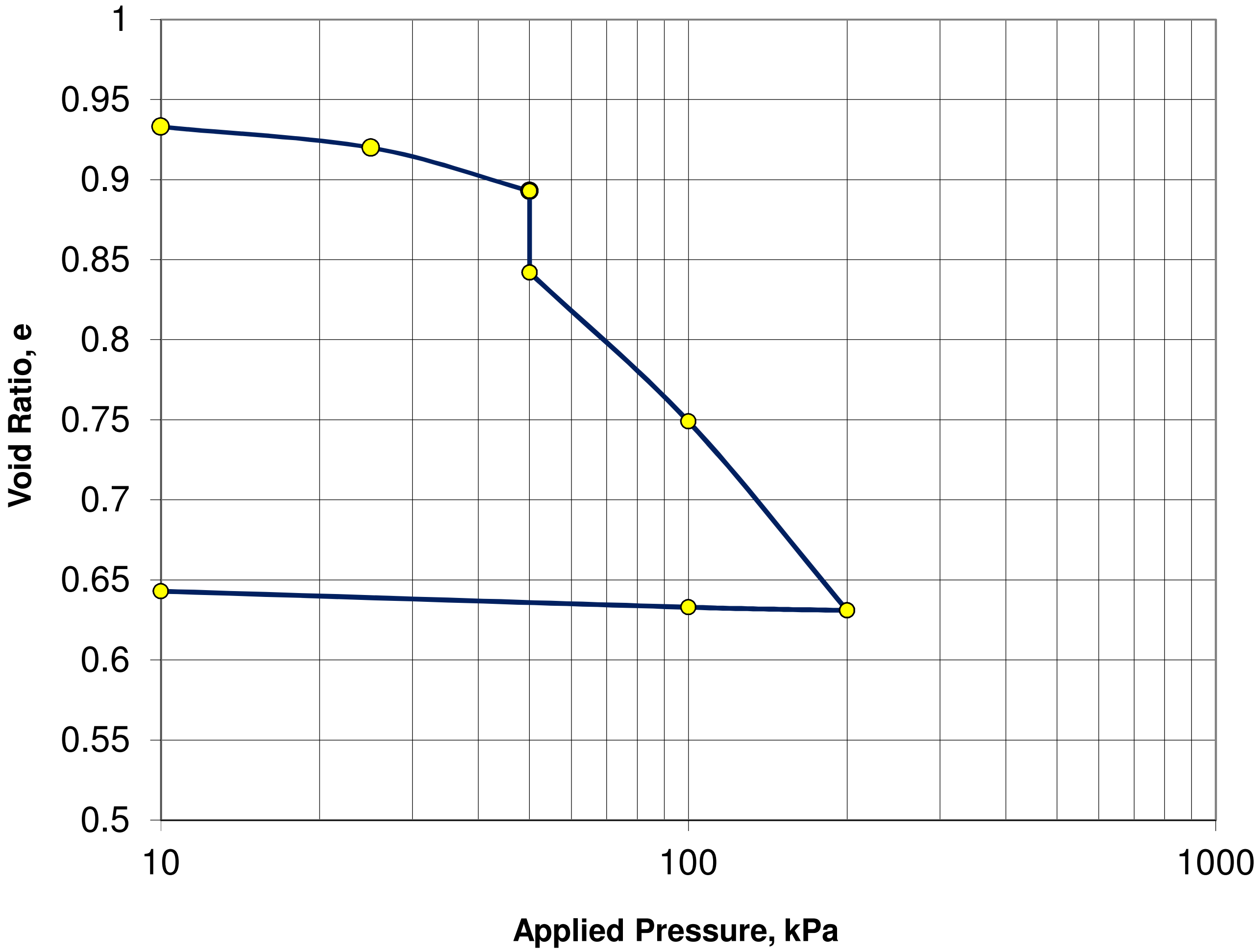
OEDOMETER TEST

Hole. No.
TH. 6

Depth 1.20-1.40 m



APPLIED PRESSURE, kPa	VOID RATIO	APPLIED PRESSURE, kPa	VOID RATIO
10	0.933	100	0.633
25	0.920	10	0.643
50	0.893		
50	0.842		
100	0.749		
200	0.631		

Undisturbed Sample Soaked @ 50kPa

Collapse at 50kPa = 2.62%

Dry Density kg/m³	1385
Moisture Content %	21%
Degree of Saturation %	58%
Specific Gravity	2.693
Liquid Limit	33
Plasticity Index	13

Po, kPa	18
Pc, kPa	
eo	0.945
ec	
ce	0.130
cc	0.392

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Dwg. No.
3546/52

FIG. NO.
52

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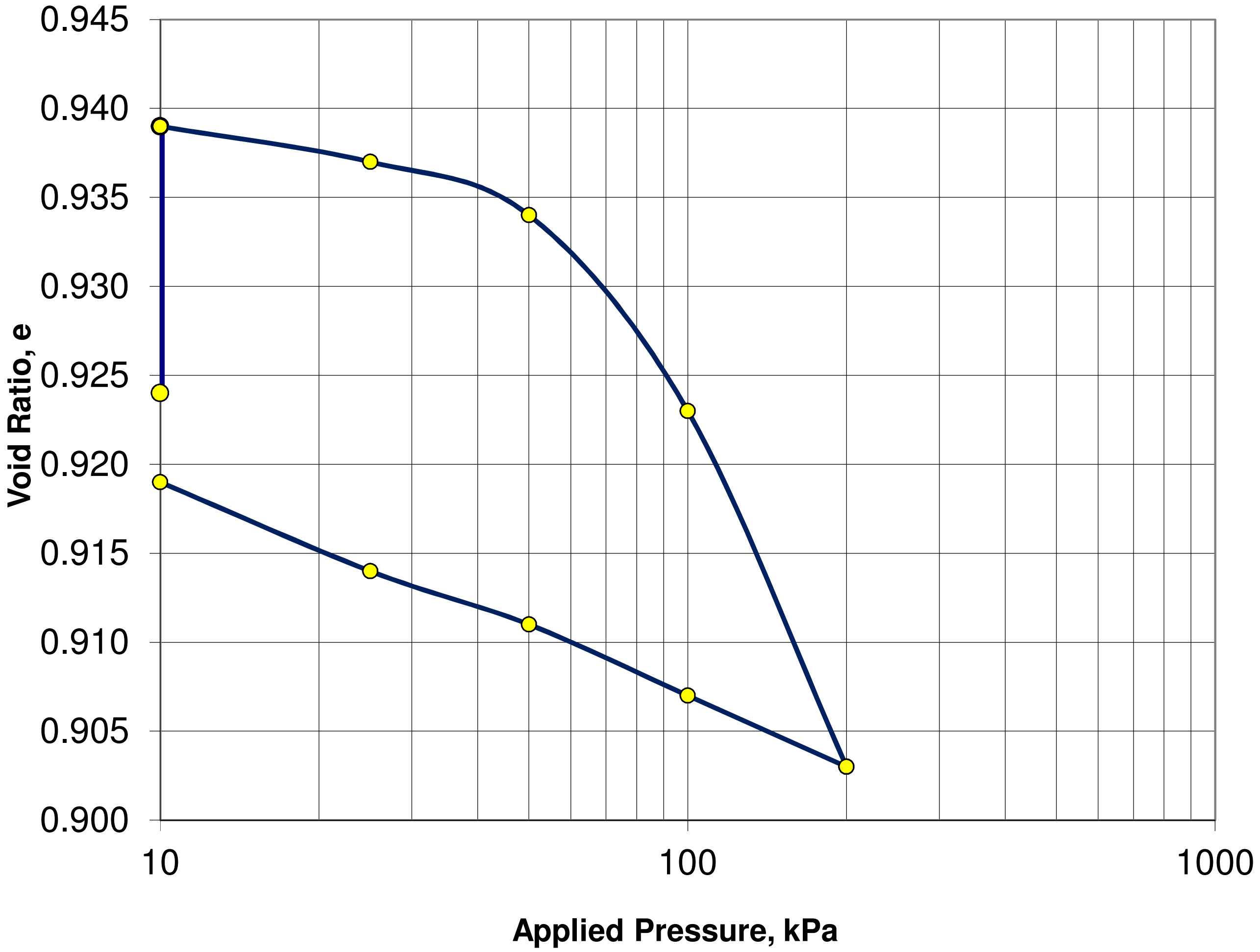
OEDOMETER TEST

Hole. No.
TH.7

Depth 4.10-4.40 m



APPLIED PRESSURE, kPa	VOID RATIO	APPLIED PRESSURE, kPa	VOID RATIO
10	0.924	100	0.907
10	0.939	50	0.911
25	0.937	25	0.914
50	0.934	10	0.919
100	0.923		
200	0.903		

Undisturbed Sample Soaked @ 10kPa

Swell at 10kPa = -0.78%

Dry Density kg/m³	1376
Moisture Content %	36.6
Degree of Saturation %	105%
Specific Gravity	2.65
Liquid Limit	52
Plasticity Index	18

Po, kPa	78
Pc, kPa	
eo	0.926
ec	
ce	0.013
cc	0.066

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Springs Fresh Produce Market

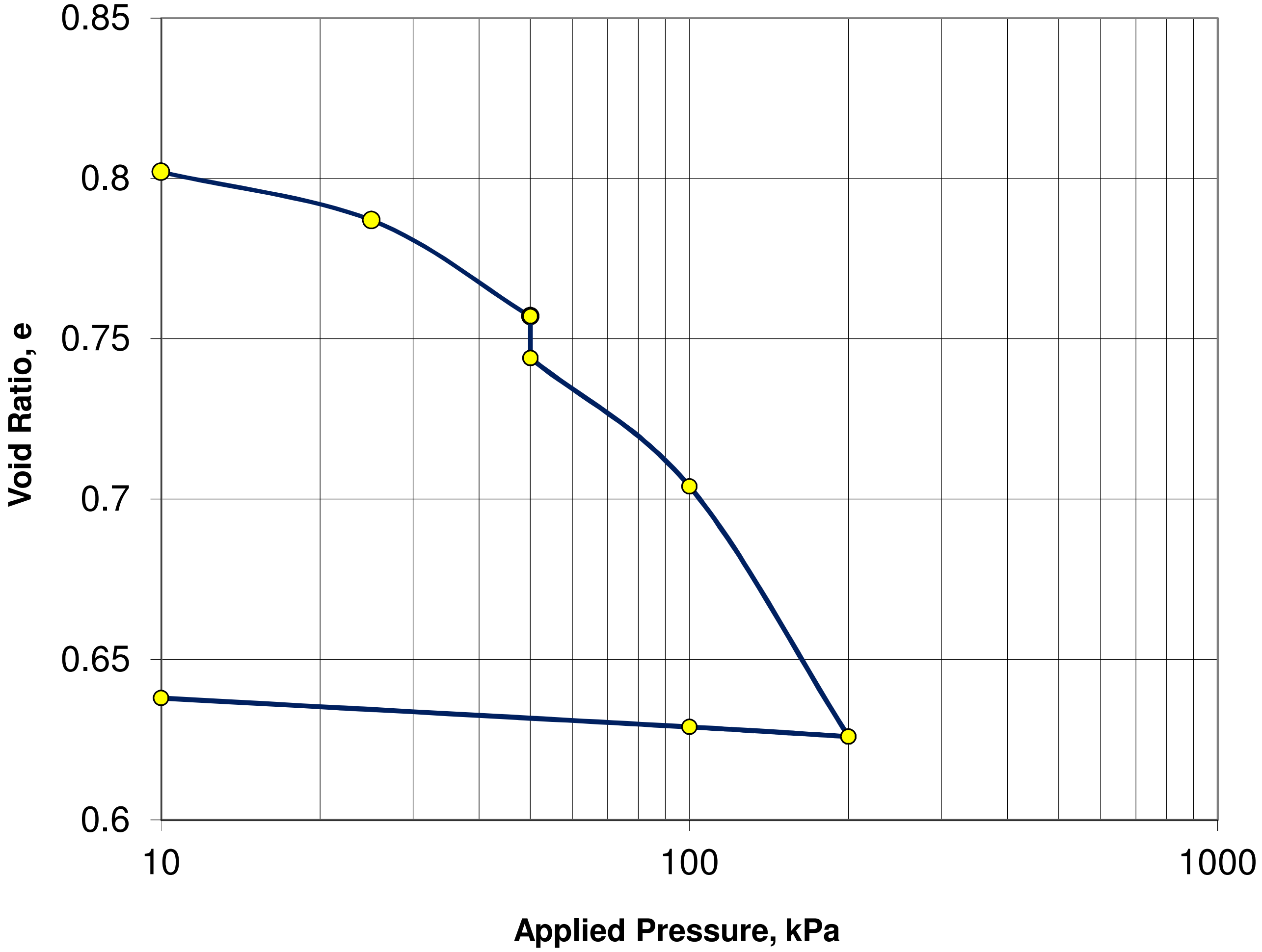
Dwg. No.
3546/53

FIG. NO.
53

OEDOMETER TEST

Hole. No.
TH. 8

Depth 0.80-1.10 m



APPLIED PRESSURE, kPa	VOID RATIO	APPLIED PRESSURE, kPa	VOID RATIO
10	0.802	100	0.629
25	0.787	10	0.638
50	0.757		
50	0.744		
100	0.704		
200	0.626		

Undisturbed Sample Soaked @ 50kPa

Collapse at 50kPa = 0.72%

Dry Density kg/m³	1487
Moisture Content %	21%
Degree of Saturation %	70%
Specific Gravity	2.693
Liquid Limit	31
Plasticity Index	9

Po, kPa	14
Pc, kPa	
eo	0.811
ec	
ce	0.064
cc	0.259

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Geotechnical Investigation For
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Springs Fresh Produce Market

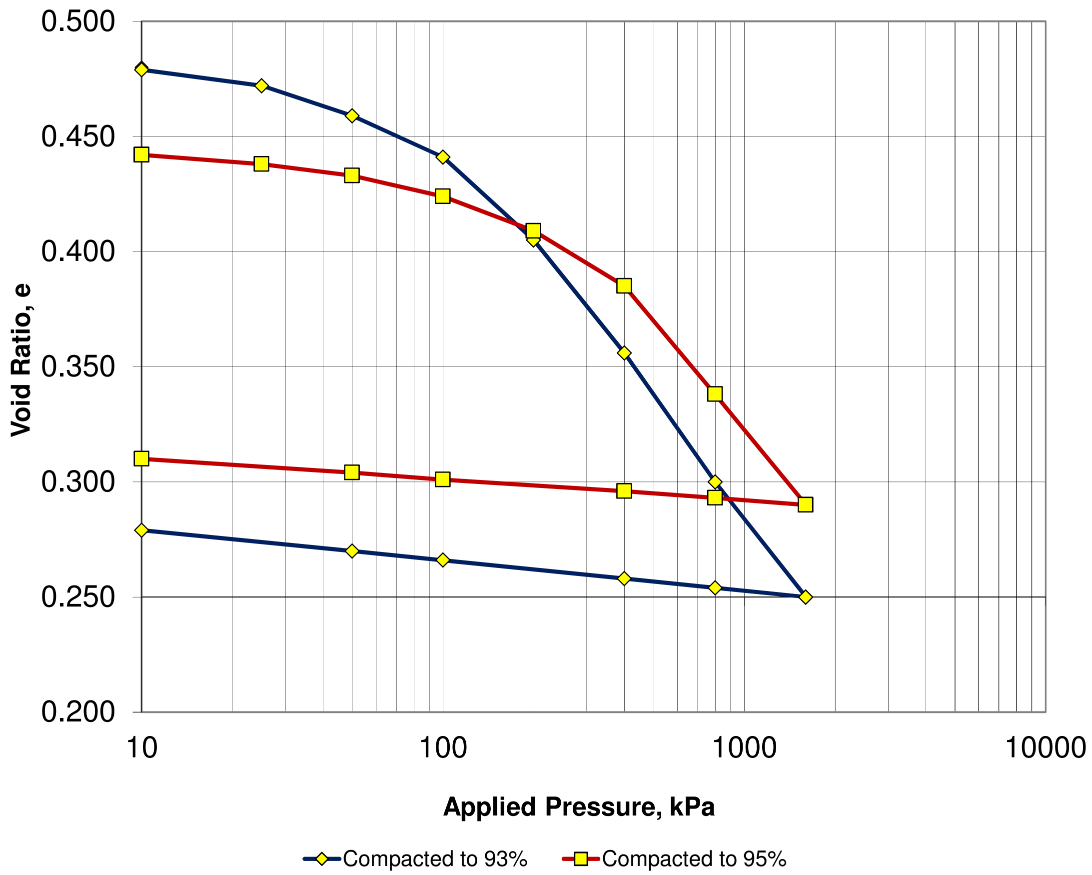
Dwg. No.
3546/54

FIG. NO.
54

OEDOMETER TEST

Hole. No.
TH.12

Depth 0.2-0.8 m



APPLIED PRESSURE, kPa	VOID RATIO	APPLIED PRESSURE, kPa	VOID RATIO
10	0.480	800	0.300
10	0.479	1600	0.250
25	0.472	800	0.254
50	0.459	400	0.258
100	0.441	100	0.266
200	0.405	50	0.270
400	0.356	10	0.279

Sample Compacted to 93% Mod AASHTO Dry Density @ OMC

Dry Density kg/m³	1797
Moisture Content %	14.3%
Degree of Saturation %	79%
Specific Gravity	2.679
Liquid Limit	28
Plasticity Index	9

Po, kPa	
Pc, kPa	
eo	0.485
ec	
ce	0.013
cc	0.176

APPLIED PRESSURE, kPa	VOID RATIO	APPLIED PRESSURE, kPa	VOID RATIO
10	0.442	800	0.338
10	0.442	1600	0.290
25	0.438	800	0.293
50	0.433	400	0.296
100	0.424	100	0.301
200	0.409	50	0.304
400	0.385	10	0.310

Sample Compacted to 95% Mod AASHTO Dry Density @ OMC

Dry Density kg/m³	1842
Moisture Content %	15%
Degree of Saturation %	77%
Specific Gravity	2.679
Liquid Limit	28
Plasticity Index	9

Po, kPa	
Pc, kPa	
eo	0.449
ec	
ce	0.009
cc	0.160

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Dwg. No.
3546/49

FIG. NO.
49

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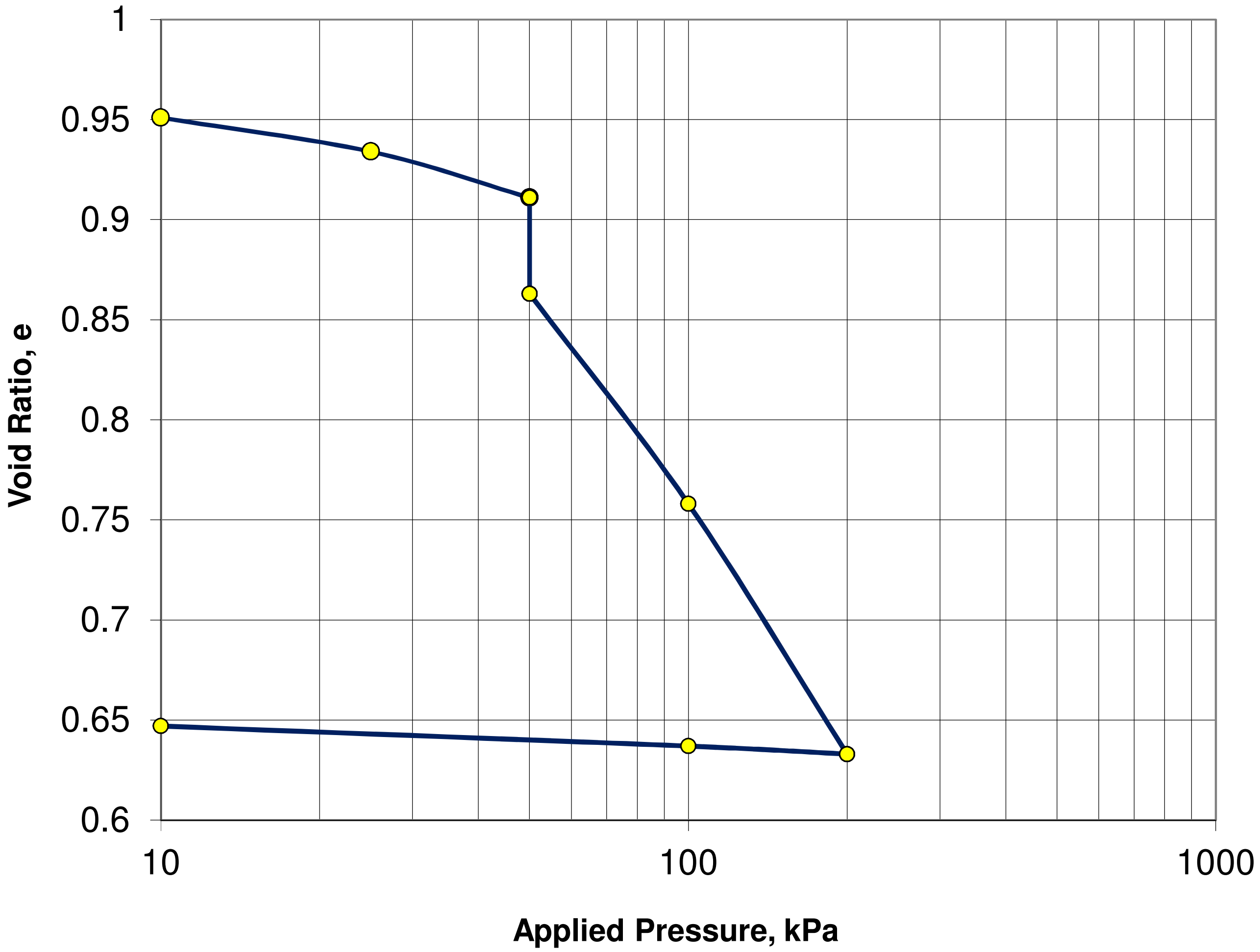
OEDOMETER TEST

Hole. No.
TH. 12

Depth 0.45-0.60 m



APPLIED PRESSURE, kPa	VOID RATIO	APPLIED PRESSURE, kPa	VOID RATIO
10	0.951	100	0.637
25	0.934	10	0.647
50	0.911		
50	0.863		
100	0.758		
200	0.633		

Undisturbed Sample Soaked @ 50kPa

Collapse at 50kPa = 2.45%

Dry Density kg/m³	1357
Moisture Content %	17%
Degree of Saturation %	46%
Specific Gravity	2.665
Liquid Limit	27
Plasticity Index	10

Po, kPa	7
Pc, kPa	
eo	0.963
ec	
ce	0.126
cc	0.415

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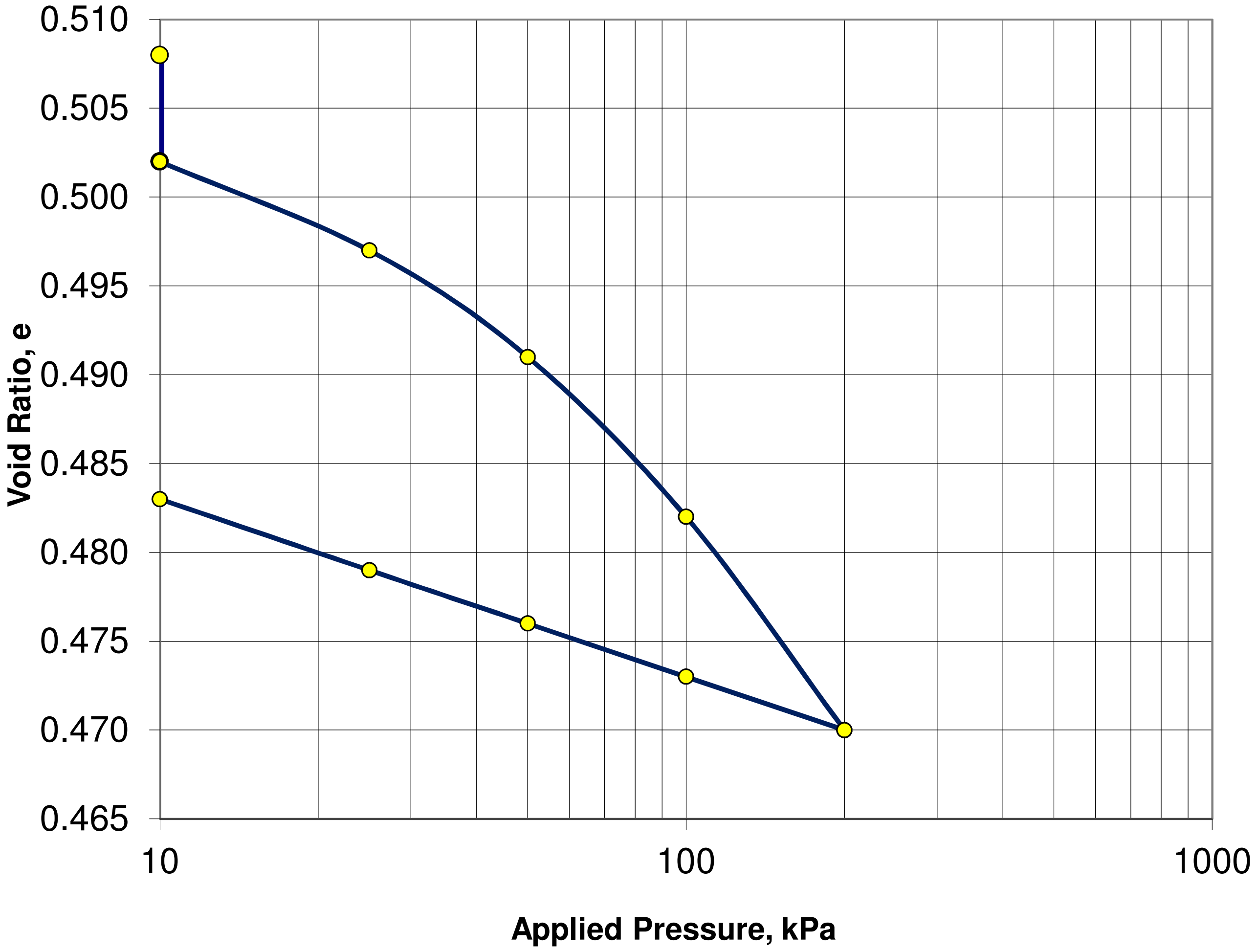
Dwg. No.
3546/56

FIG. NO.
56

OEDOMETER TEST

Hole. No.
TH.13

Depth 2.65-3.10 m



APPLIED PRESSURE, kPa	VOID RATIO	APPLIED PRESSURE, kPa	VOID RATIO
10	0.508	100	0.473
10	0.502	50	0.476
25	0.497	25	0.479
50	0.491	10	0.483
100	0.482		
200	0.470		

Undisturbed Sample Soaked @ 10kPa

Swell at 10kPa = 0.40%

Dry Density kg/m³	1756
Moisture Content %	19.2
Degree of Saturation %	100%
Specific Gravity	2.65
Liquid Limit	37
Plasticity Index	17

Po, kPa	59
Pc, kPa	
eo	0.509
ec	
ce	0.010
cc	0.040

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Springs Fresh Produce Market

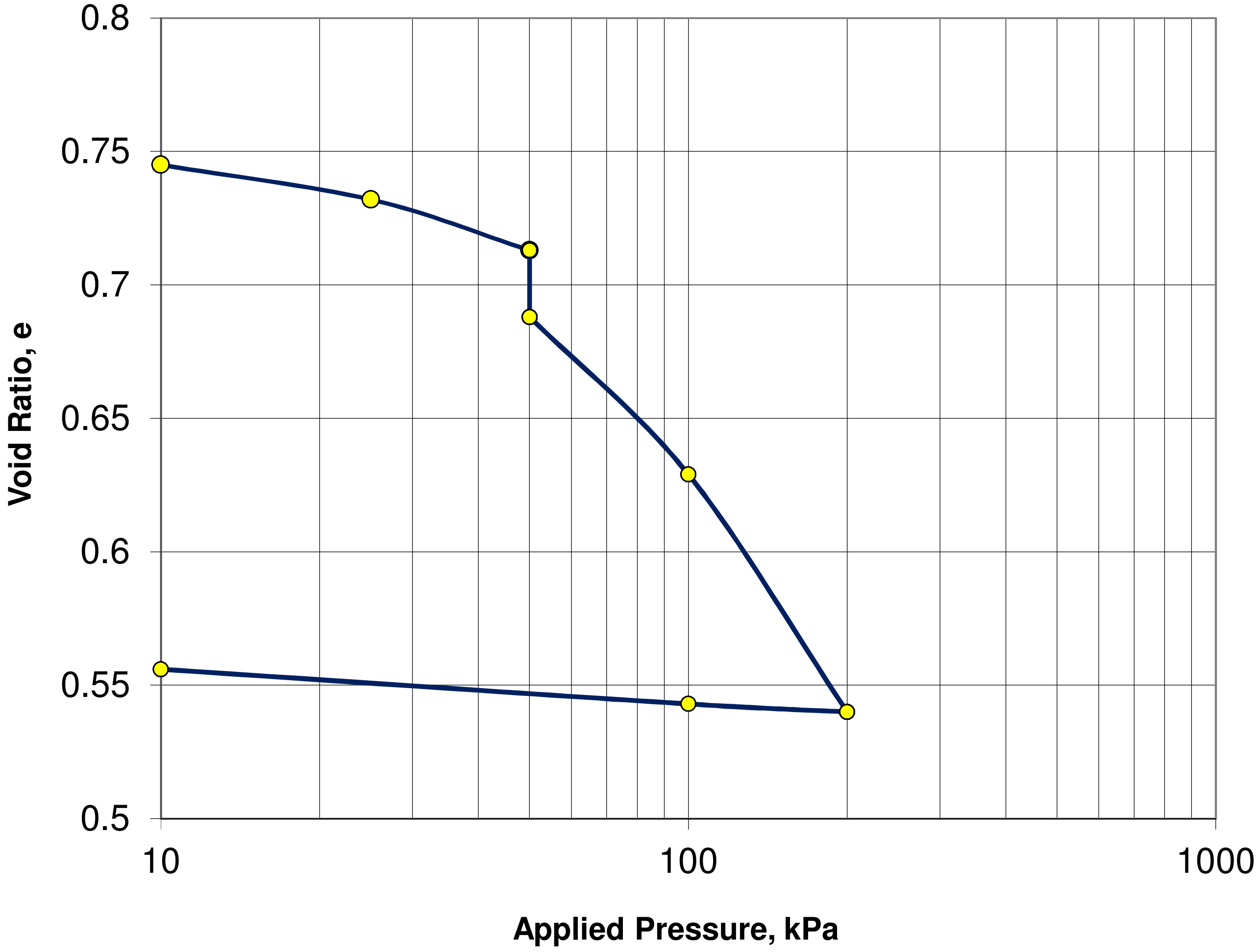
Dwg. No.
3546/57

FIG. NO.
57

OEDOMETER TEST

Hole. No.
TH. 16

Depth 1.00-1.30 m



APPLIED PRESSURE, kPa	VOID RATIO	APPLIED PRESSURE, kPa	VOID RATIO
10	0.745	100	0.543
25	0.732	10	0.556
50	0.713		
50	0.688		
100	0.629		
200	0.540		

Undisturbed Sample Soaked @ 50kPa

Collapse at 50kPa = 1.43%

Dry Density kg/m³	1486
Moisture Content %	19%
Degree of Saturation %	65%
Specific Gravity	2.607
Liquid Limit	31
Plasticity Index	8

Po, kPa	17
Pc, kPa	
eo	0.754
ec	
ce	0.082
cc	0.296

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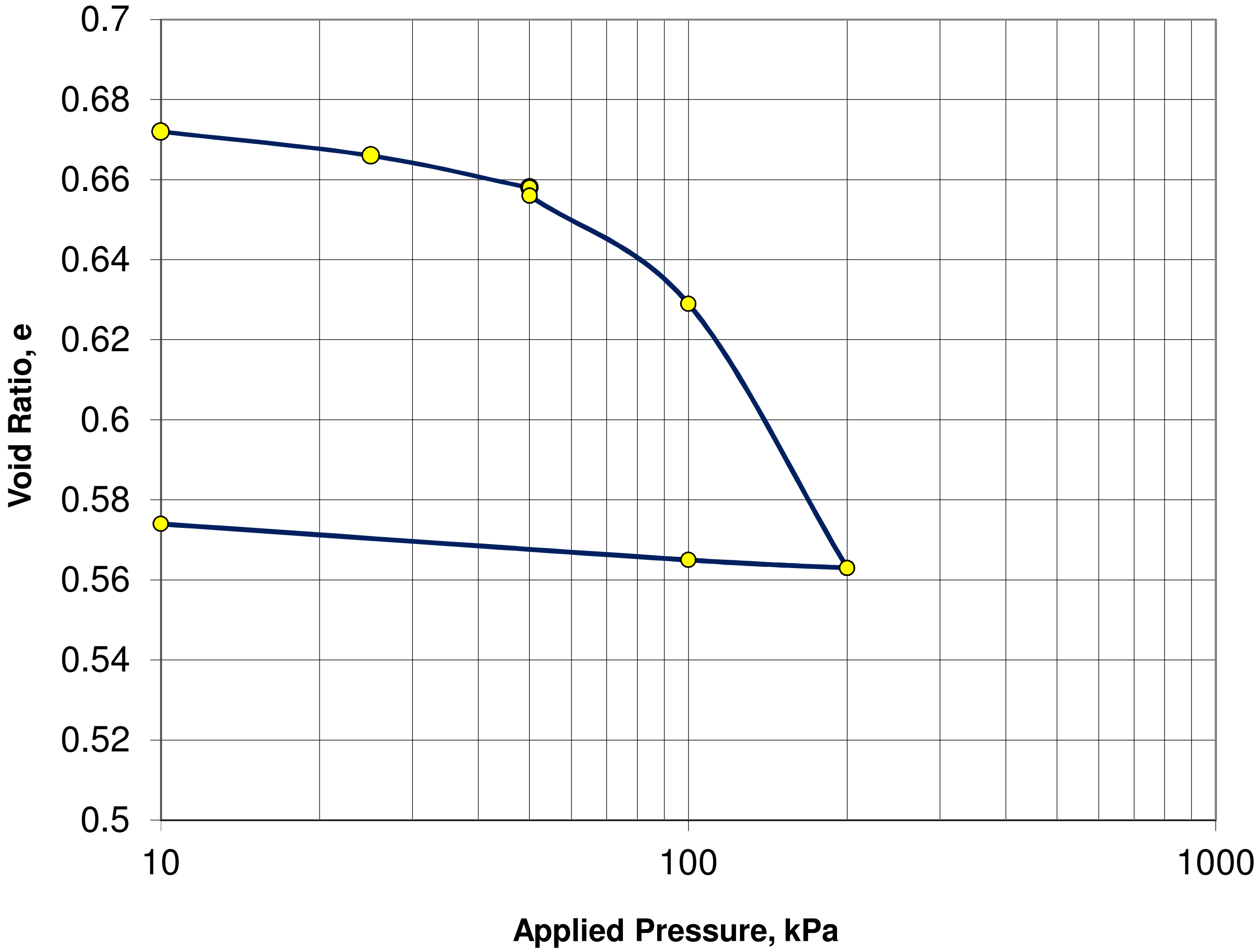
Dwg. No.
3546/58

FIG. NO.
58

OEDOMETER TEST

Hole. No.
TH. 16

Depth 1.70-2.05 m



APPLIED PRESSURE, kPa	VOID RATIO	APPLIED PRESSURE, kPa	VOID RATIO
10	0.672	100	0.565
25	0.666	10	0.574
50	0.658		
50	0.656		
100	0.629		
200	0.563		

Undisturbed Sample Soaked @ 50kPa

Collapse at 50kPa = 0.12%

Dry Density kg/m³	1557
Moisture Content %	21%
Degree of Saturation %	79%
Specific Gravity	2.613
Liquid Limit	34
Plasticity Index	18

Po, kPa	29
Pc, kPa	
eo	0.678
ec	
ce	0.023
cc	0.219

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Dwg. No.
3546/59

FIG. NO.
59

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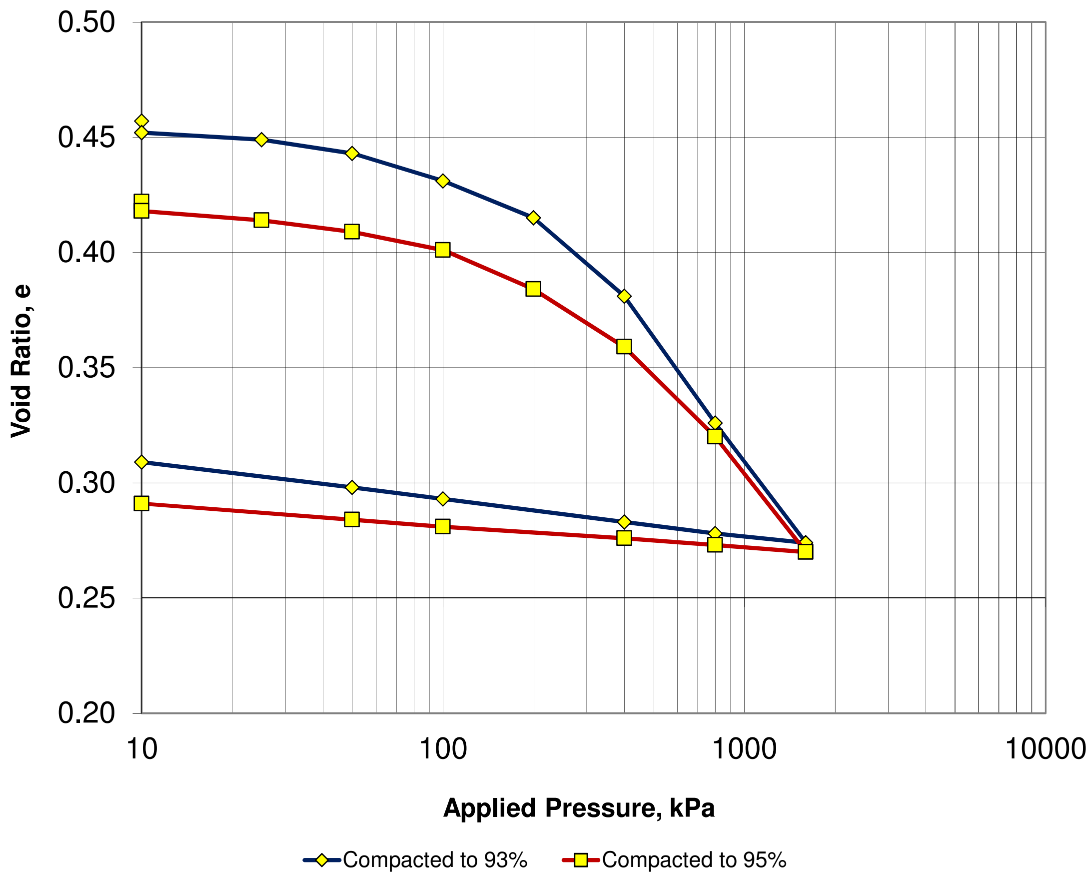
OEDOMETER TEST

Hole. No.
TH.21

Depth 1.20-1.80 m



APPLIED PRESSURE, kPa	VOID RATIO	APPLIED PRESSURE, kPa	VOID RATIO
10	0.462	800	0.326
10	0.457	1600	0.274
25	0.452	800	0.278
50	0.449	400	0.283
100	0.443	100	0.293
200	0.431	50	0.298
400	0.415	10	0.309

Sample Compacted to 93% Mod AASHTO Dry Density @ OMC

Dry Density kg/m³	1933
Moisture Content %	9.0%
Degree of Saturation %	52%
Specific Gravity	2.677
Liquid Limit	31
Plasticity Index	9

Po, kPa	
Pc, kPa	
eo	0.462
ec	
ce	0.016
cc	0.173

APPLIED PRESSURE, kPa	VOID RATIO	APPLIED PRESSURE, kPa	VOID RATIO
10	0.422	800	0.320
10	0.418	1600	0.270
25	0.414	800	0.273
50	0.409	400	0.276
100	0.401	100	0.281
200	0.384	50	0.284
400	0.359	10	0.291

Sample Compacted to 95% Mod AASHTO Dry Density @ OMC

Dry Density kg/m³	1978
Moisture Content %	10%
Degree of Saturation %	60%
Specific Gravity	2.677
Liquid Limit	31
Plasticity Index	9

Po, kPa	
Pc, kPa	
eo	0.428
ec	
ce	0.010
cc	0.166

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Dwg. No.
3546/49

FIG. NO.
49

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MOD AASHTO COMPACTION & CBR TEST

TRIAL HOLE NO.

TH.1

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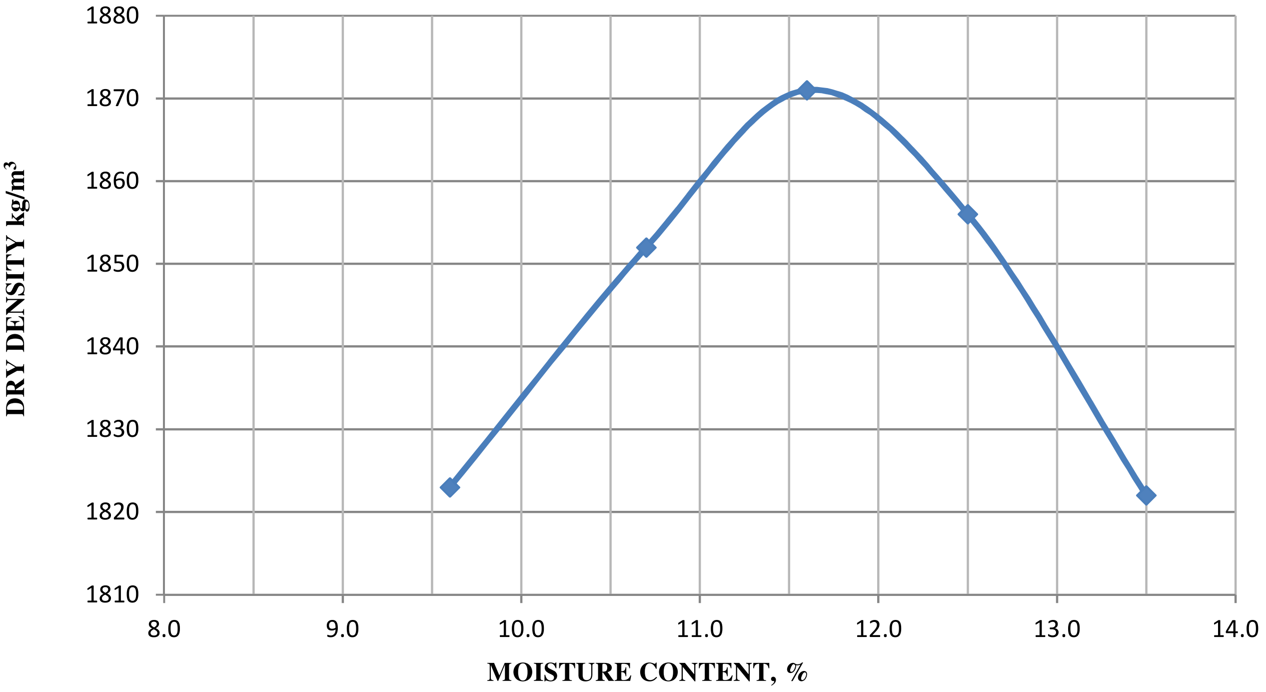
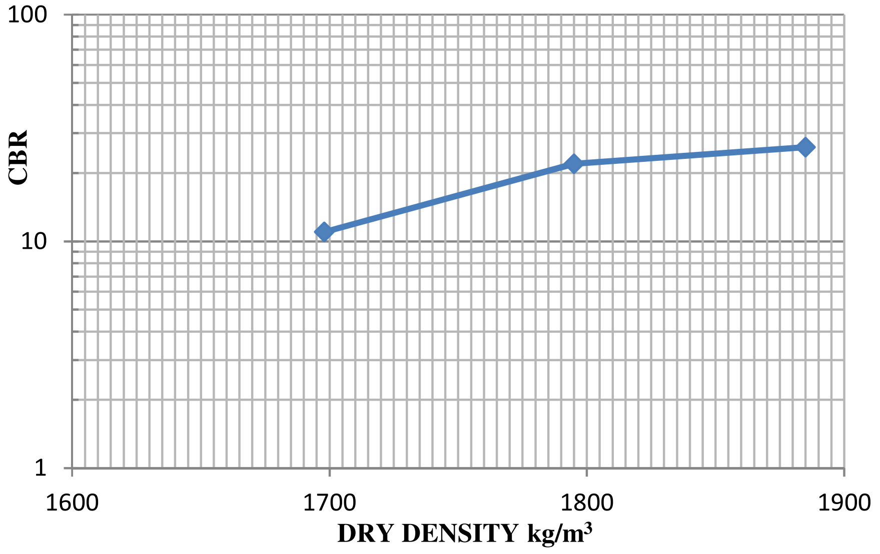
DEPTH : 0.50-1.10





Maximum Dry Density kg/m^3	1871
Optimum Moisture Content %	11.7
90 % CBR	11.0
93 % CBR	14.0
95 % CBR	17.0
98 % CBR	22.0
Max Swell %	0.2

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DWG. NO
3546/61

Fig. No.
61

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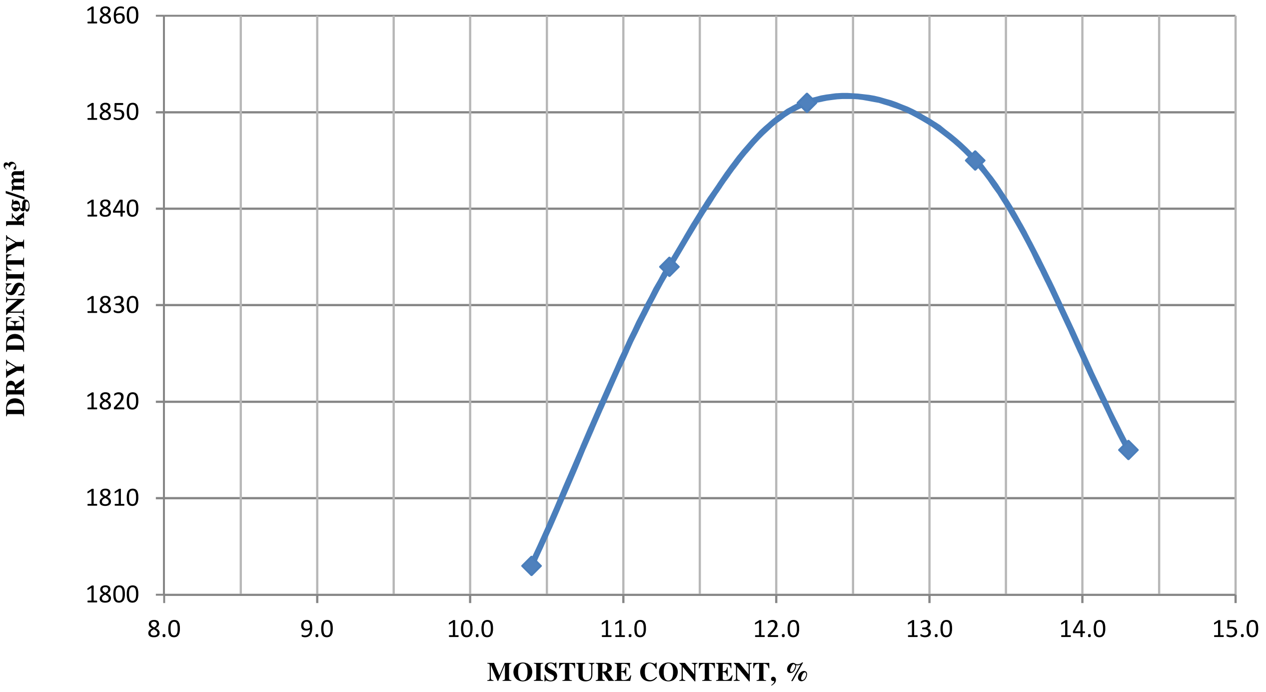
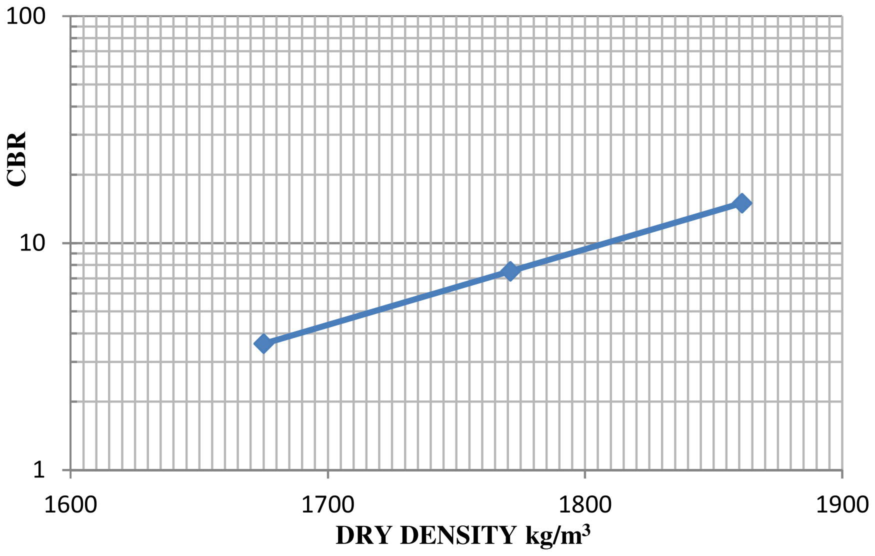
MOD AASHTO COMPACTION & CBR TEST

TRIAL HOLE NO.

TH.2

DEPTH : 0.30-0.70





Maximum Dry Density kg/m^3	1852
Optimum Moisture Content %	12.5
90 % CBR	3.4
93 % CBR	5.2
95 % CBR	6.9
98 % CBR	11.0
Max Swell %	0.3

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DWG. NO
3546/62

Fig. No.
62

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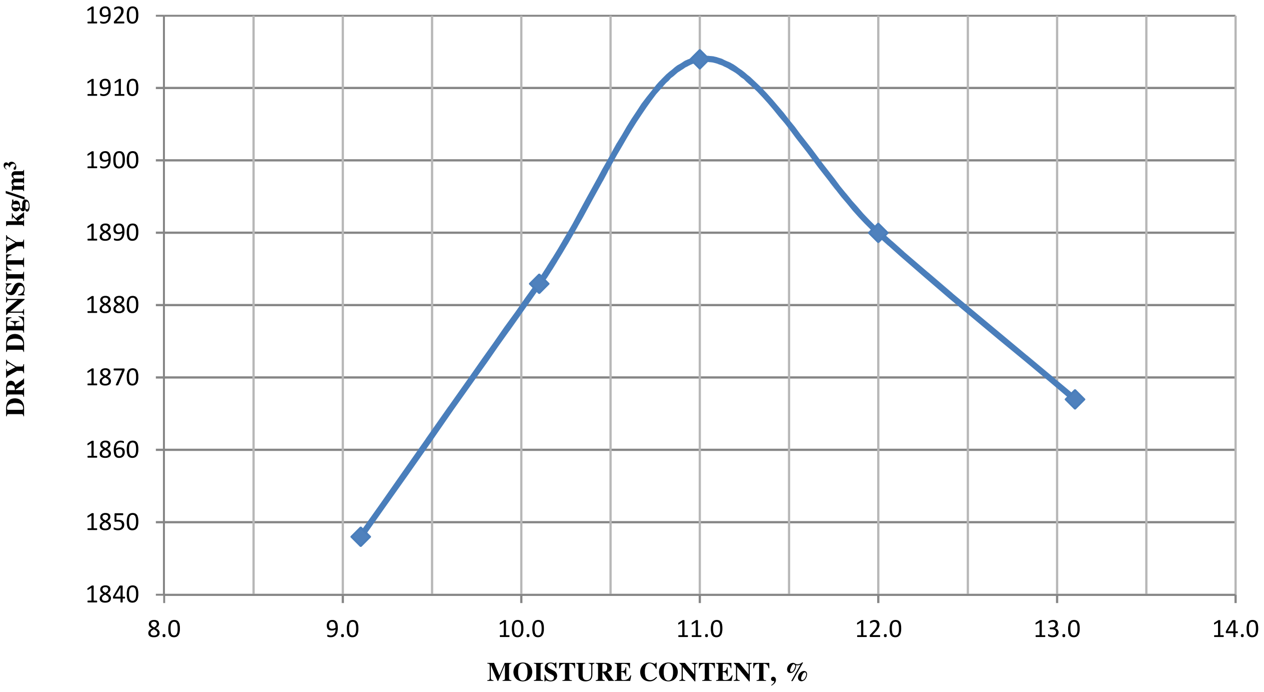
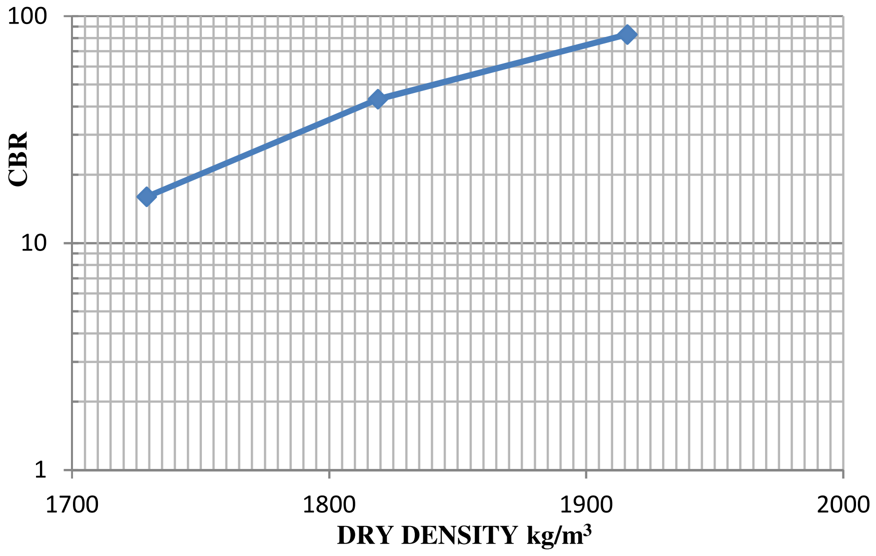
MOD AASHTO COMPACTION & CBR TEST

TRIAL HOLE NO.

TH.2

DEPTH : 0.70-1.40





Maximum Dry Density kg/m^3	1914
Optimum Moisture Content %	11.1
90 % CBR	16.0
93 % CBR	27.0
95 % CBR	38.0
98 % CBR	62.0
Max Swell %	0.2

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Springs Fresh Produce Market

DWG. NO
3546/63

Fig. No.
63

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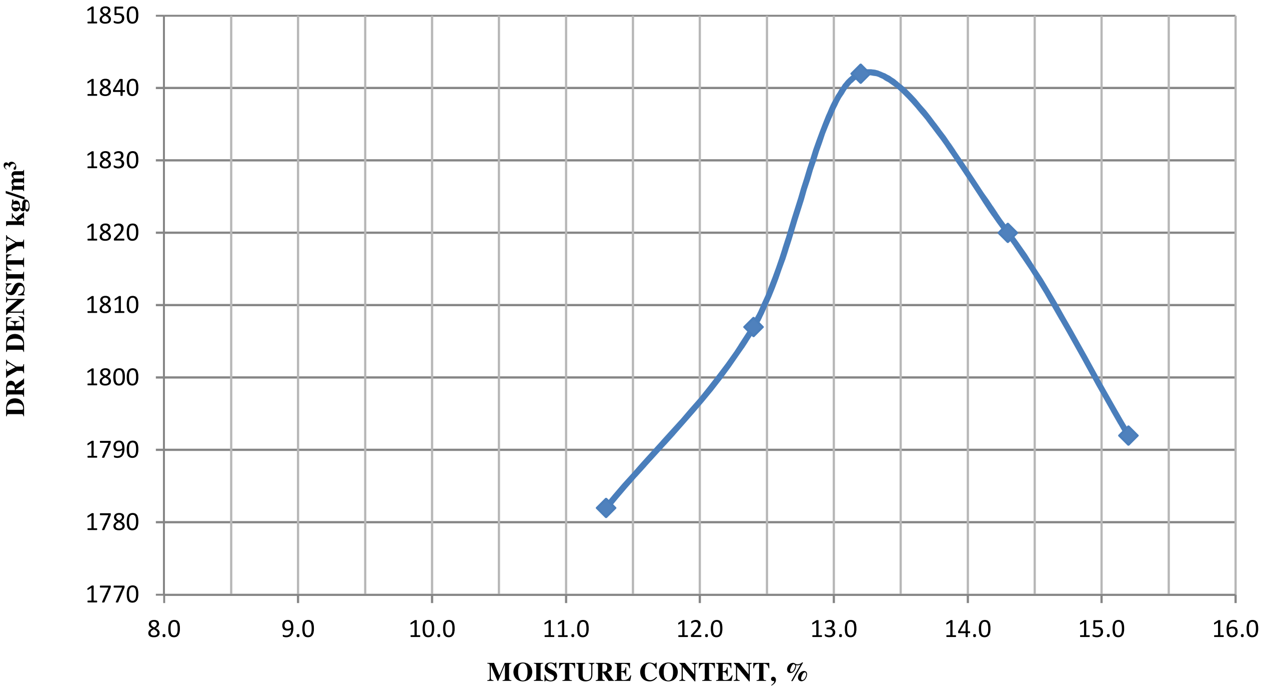
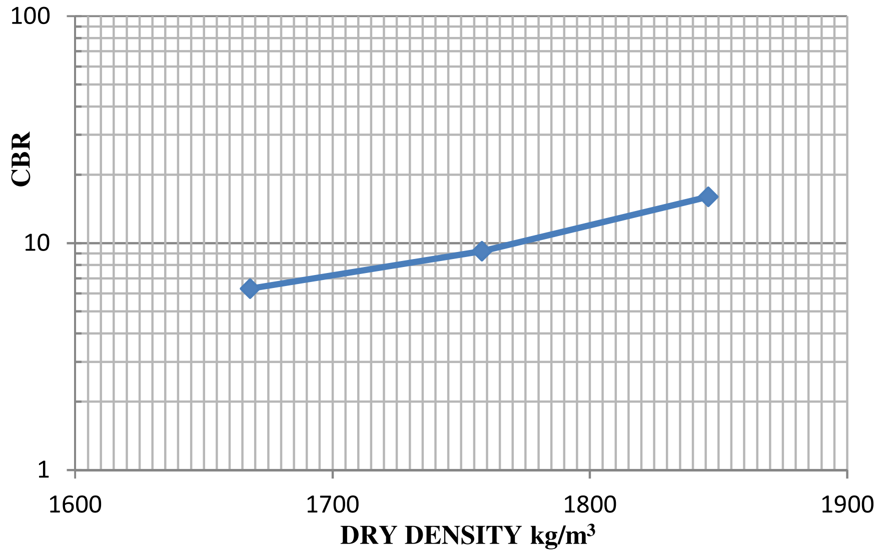
MOD AASHTO COMPACTION & CBR TEST

TRIAL HOLE NO.

TH.3

DEPTH : 0.20-0.80





Maximum Dry Density kg/m^3	1843
Optimum Moisture Content %	13.5
90 % CBR	5.8
93 % CBR	7.8
95 % CBR	9.4
98 % CBR	13.0
Max Swell %	0.3

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DWG. NO
3546/64

Fig. No.
64

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TRIAL HOLE NO.

TH.3

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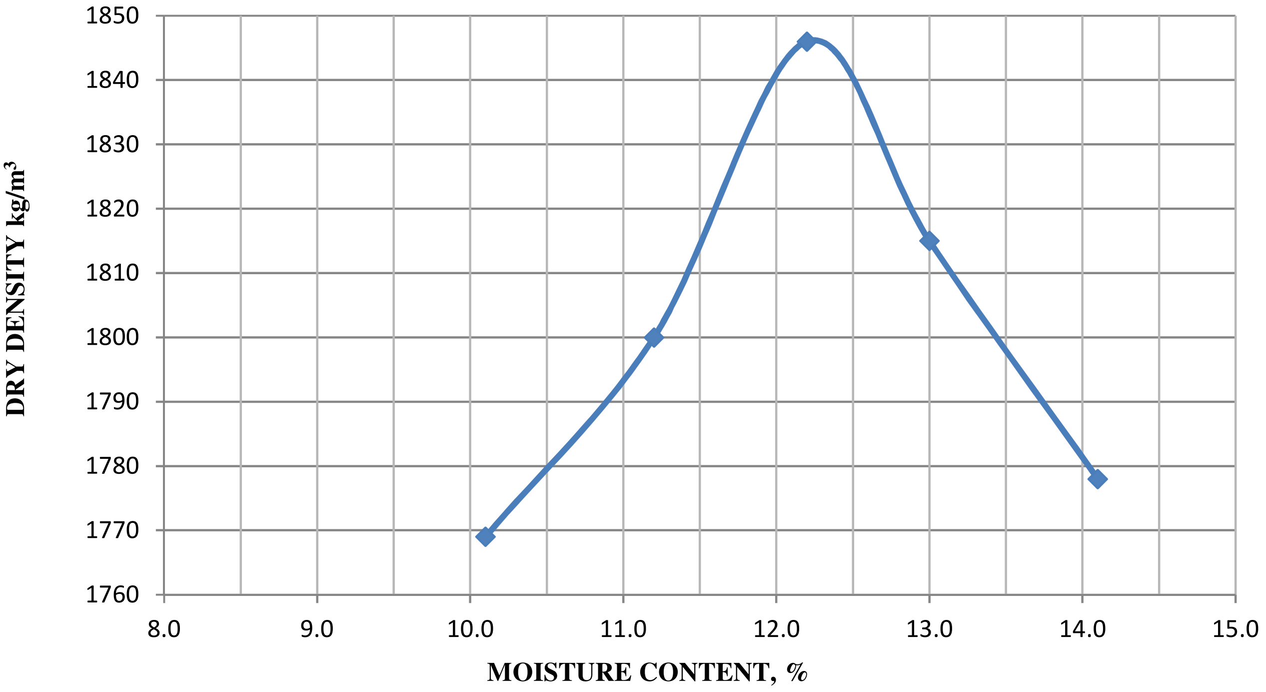
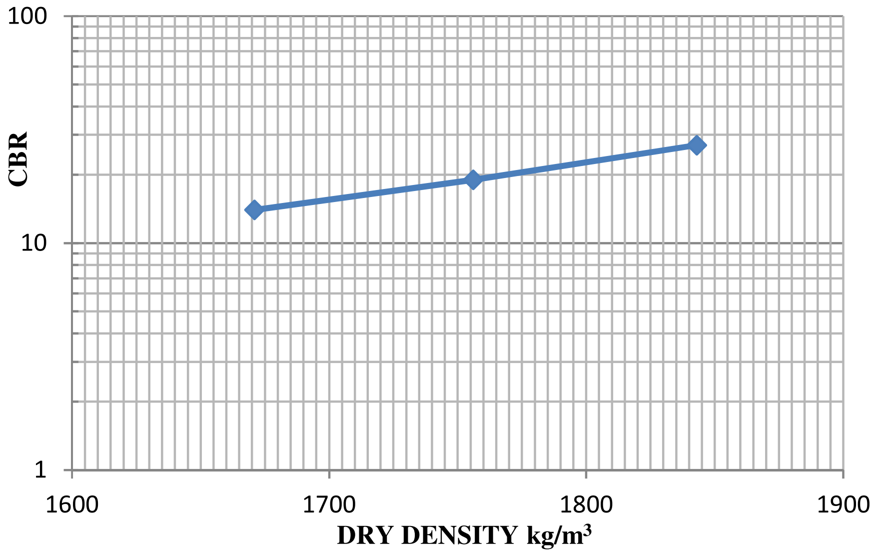
DEPTH : 0.90-1.40





Maximum Dry Density kg/m^3	1846
Optimum Moisture Content %	12.2
90 % CBR	13.0
93 % CBR	17.0
95 % CBR	19.0
98 % CBR	24.0
Max Swell %	0.3

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DWG. NO
3546/65

Fig. No.
65

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TRIAL HOLE NO.

TH.4

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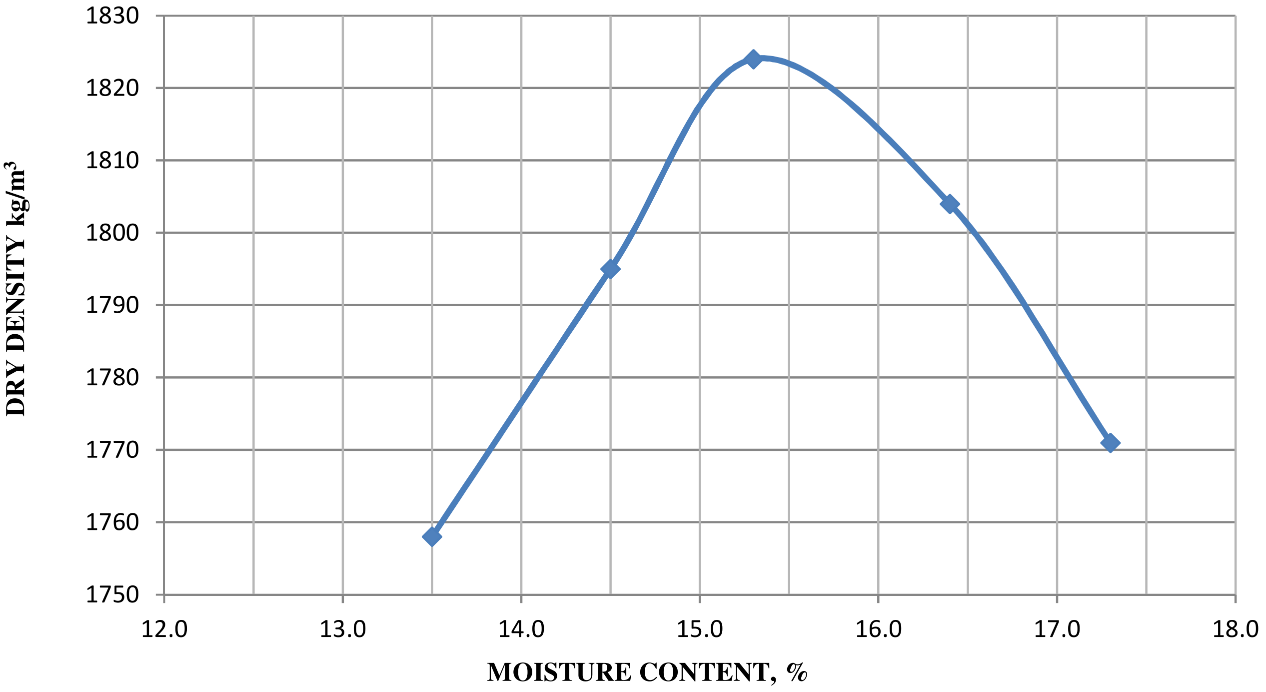
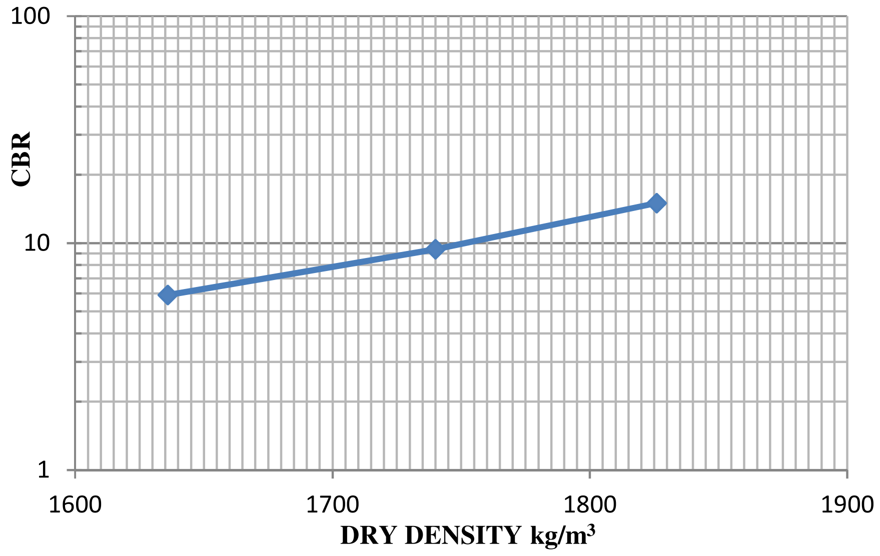
DEPTH : 0.20-1.20





Maximum Dry Density kg/m^3	1825
Optimum Moisture Content %	15.5
90 % CBR	6.0
93 % CBR	7.9
95 % CBR	9.4
98 % CBR	12.0
Max Swell %	0.4

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DWG. NO
3546/66

Fig. No.
66

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TH.10

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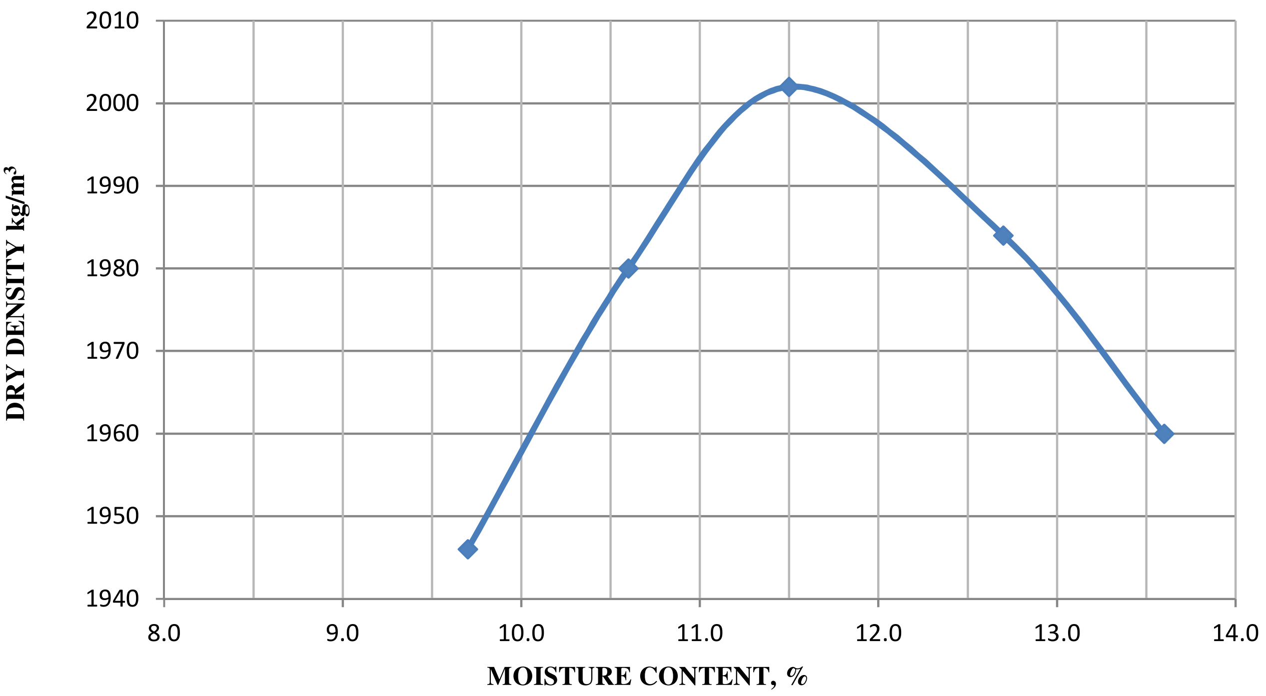
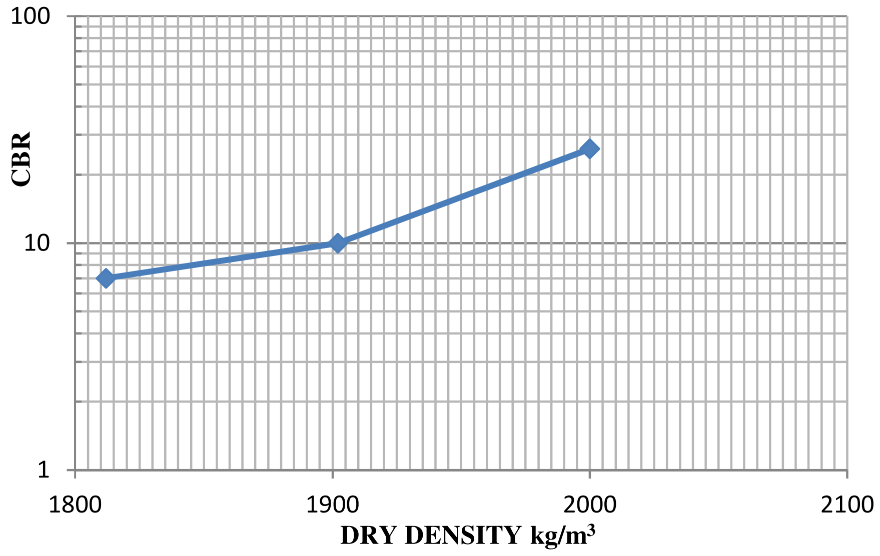
DEPTH : 2.20-2.60





Maximum Dry Density kg/m^3	2002
Optimum Moisture Content %	11.6
90 % CBR	5.9
93 % CBR	9.0
95 % CBR	12.0
98 % CBR	18.0
Max Swell %	0.2

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DWG. NO
3546/67

Fig. No.
67

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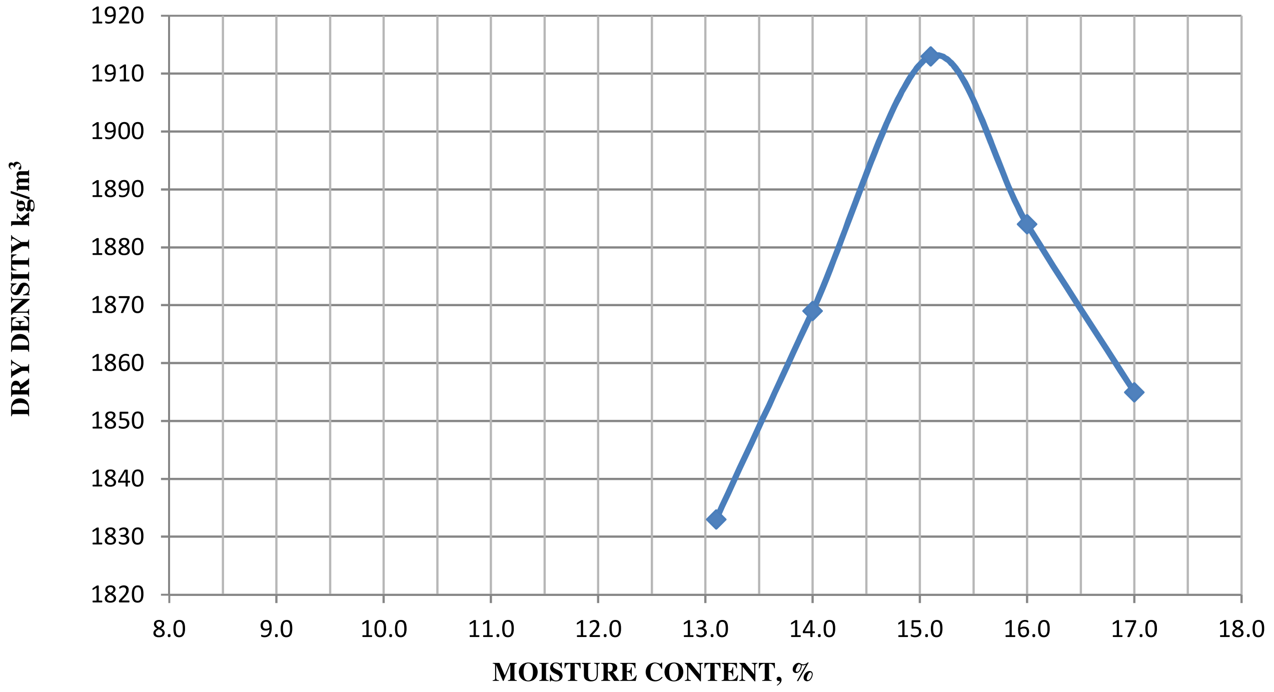
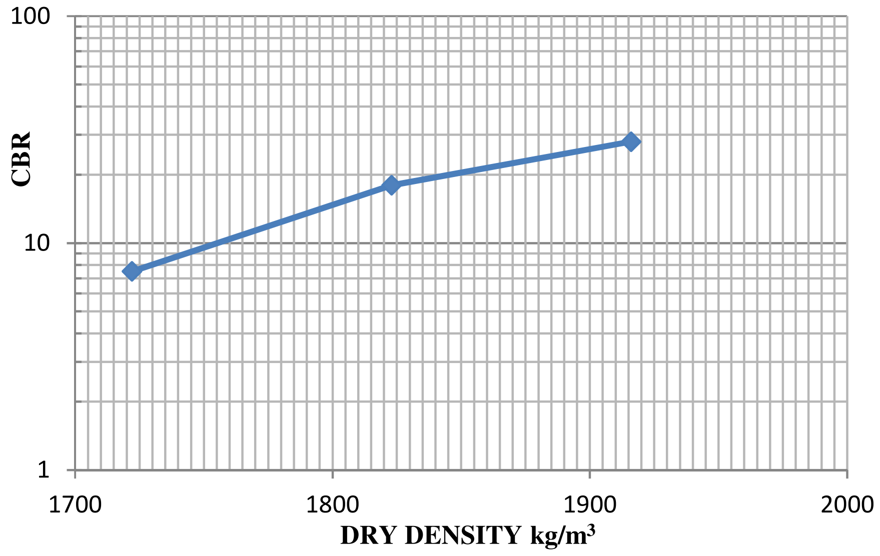
MOD AASHTO COMPACTION & CBR TEST

TRIAL HOLE NO.
TH.12

DEPTH : 0.20-0.80





Maximum Dry Density kg/m^3	1913
Optimum Moisture Content %	15.1
90 % CBR	8.0
93 % CBR	12.0
95 % CBR	15.0
98 % CBR	23.0
Max Swell %	0.2

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Geotechnical Investigation For
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DWG. NO
3546/68

Fig. No.
68

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MOD AASHTO COMPACTION & CBR TEST

TRIAL HOLE NO.

TH.21

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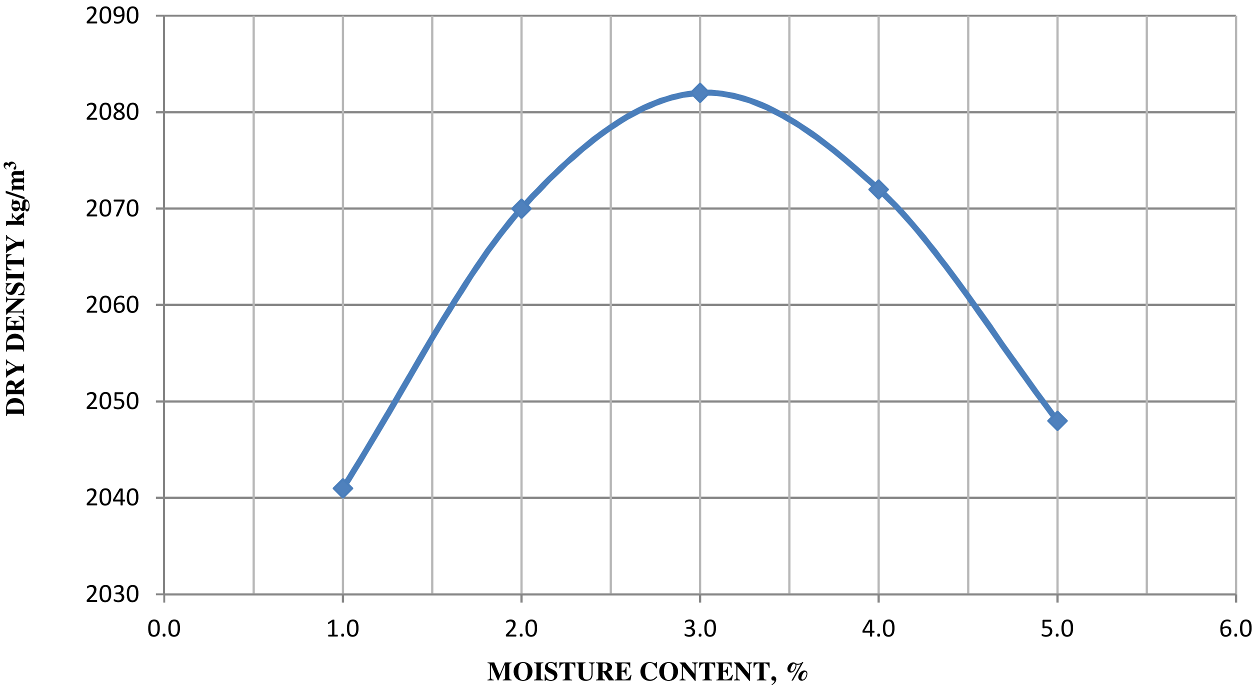
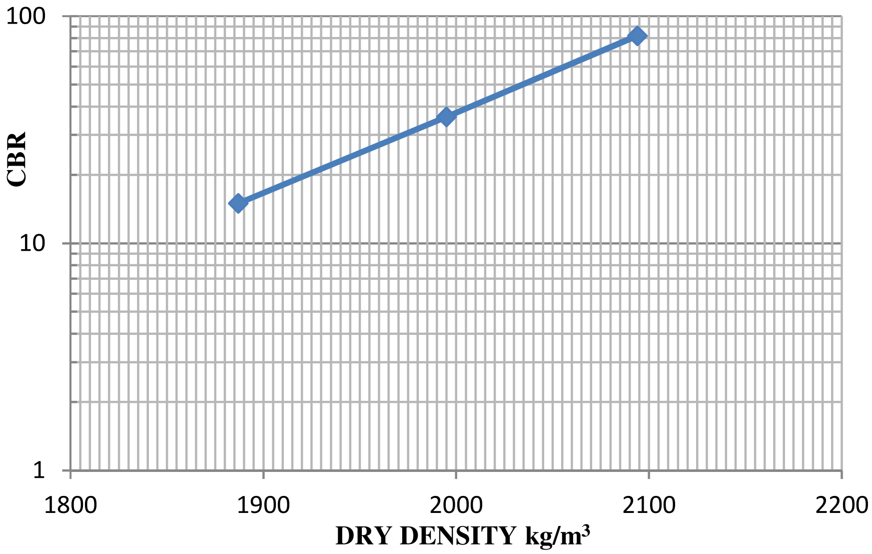
DEPTH : 1.20-1.80





Maximum Dry Density kg/m^3	2082
Optimum Moisture Content %	9.8
90 % CBR	14.0
93 % CBR	22.0
95 % CBR	32.0
98 % CBR	53.0
Max Swell %	0.2

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Geotechnical Investigation For
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Springs Fresh Produce Market

DWG. NO
3546/69

Fig. No.
69

APPENDIX ‘A’

BOREHOLES DRILLED PREVIOUSLY NORTH OF THE EXISTING BUILDINGS

SPRINGS FRESH PRODUCE MARKET

PERCUSSION BOREHOLE LOG

Version 2009.1

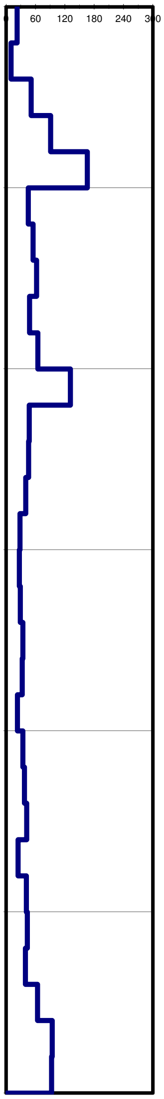
Geo Buro
Geotechnical Surveys

X= X2904878 Y= Y0057689 Z= 1641.00 masl

Project no:	8631-15	Client	**Hlanganani Consulting Engineers**
Project name:	Springs Fresh Produce Market	Drill contractor:	Hennie Erwee
Date drilled:	2015-11-25	Driller:	William
Date profiled:	2015-12-01	**BH NO:**	**BH1**

Penetration rate

seconds/m



Penetr rate min:s/m	Formation					Notes Symbol	Air loss	DEPTH m	Elevation masl	Symbol	Chip size mm	Drill depth (m)	DESCRIPTION
	CAV	V SFT	SFT	FAIR H	SOLID								
0 : 22		1.0					▥	1.0	1640.0	▦	<2		Dark reddish brown sandy clay; Residual shale. 100% sandy clay.
0 : 10		1.0					▥	2.0	1639.0	▦			
0 : 51		1.0					▥	3.0	1638.0	▦			
1 : 31		0.1	0.9			▼	▥	4.0	1637.0	▦		4.0	
2 : 46			1.0				▥	5.0	1636.0	▥	<2		Red brown to yellow brown clay; Residual shale. 100% clay.
0 : 45			1.0				▥	6.0	1635.0	▥			
0 : 55			1.0				▥	7.0	1634.0	▥			
1 : 2			1.0				▥	8.0	1633.0	▥			
0 : 48			1.0				▥	9.0	1632.0	▥			
1 : 5			1.0				▥	10.0	1631.0	▥			
2 : 11			1.0				▥	11.0	1630.0	▥		11.0	
0 : 47		1.0					▥	12.0	1629.0	▥	<5		Red brown clay with yellow white with fine blac speckles, highly weathered, sub-rounded syenite; Residual syenite. 80% clay, 20% syenite.
0 : 46		1.0					▥	13.0	1628.0	▥			
0 : 40		1.0					▥	14.0	1627.0	▥			
0 : 28		1.0					▥	15.0	1626.0	▥			
0 : 27		1.0					▥	16.0	1625.0	▥			
0 : 29		1.0					▥	17.0	1624.0	▥			
0 : 34		1.0					▥	18.0	1623.0	▥		18.0	
0 : 33		1.0					▥	19.0	1622.0	▥	<5		Red brown to yellow clay with red brown with fine black spoeckles, medium to highly weathered, sub-angular syenite; Weathered syenite. 65% clay, 35% syenite.
0 : 23		1.0					▥	20.0	1621.0	+++++++			
0 : 34		1.0					▥	21.0	1620.0	▥			
0 : 37		1.0					▥	22.0	1619.0	+++++++			
0 : 42		1.0					▥	23.0	1618.0	▥			
0 : 24		1.0					▥	24.0	1617.0	+++++++			
0 : 41		1.0					▥	25.0	1616.0	▥			
0 : 43		1.0					▥	26.0	1615.0	+++++++			
0 : 39		1.0					▥	27.0	1614.0	▥			
1 : 4		0.1	0.9				▥	28.0	1613.0	+++++++			
1 : 34			1.0				▥	29.0	1612.0	▥			
1 : 33			1.0				▥	30.0	1611.0	+++++++		30.0	

Notes:

1. Water encountered at 12m. Water rest level at 4,2m.
2. No sample and no air loss.
3. Water used during drilling between 8-29m.
4. Hammer rate generally regular, except between 3-4m and 27-28m where it was irregular.

Notes (continue):

Logged by SPK

PERCUSSION BOREHOLE LOG

Version 2009.1

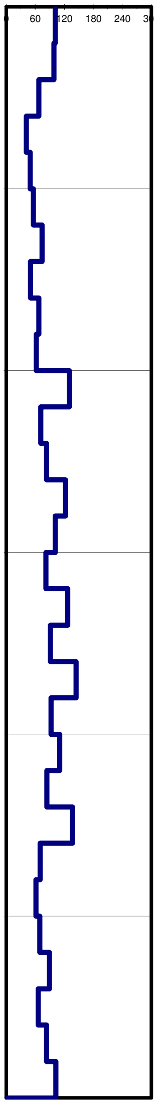
Geo Buro
Geotechnical Surveys

X= X2904878 Y= Y0057689 Z= 1641.00 masl

Project no:	8631-15	Client	**Hlanganani Consulting Engineers**
Project name:	Spring Fresh Produce Market	Drill contractor:	Hennie Erwee
Date drilled:	2015-11-25	Driller:	William
Date profiled:	2015-12-01	**BH NO:**	**BH1 (cont)**

Penetration rate

seconds/m



Penetr rate min:s/m	CAV	V SFT	SFT	FAIR H	SOLID	Notes Symbol	Air loss	DEPTH m	Elevation masl	Symbol	Chip size mm	Drill depth (m)	DESCRIPTION
1 : 41			1.0					31.0	1610.0				
1 : 38			1.0					32.0	1609.0				
1 : 7			1.0					33.0	1608.0				
0 : 41		0.9	0.1					34.0	1607.0				
0 : 49		1.0						35.0	1606.0		<2		Yellow brown clay; Residual shale. 100% clay.
0 : 56		1.0						36.0	1605.0				
1 : 14		0.1	0.9					37.0	1604.0				
0 : 50		1.0						38.0	1603.0				
1 : 7		0.1	0.9					39.0	1602.0			39.0	
1 : 2			1.0					40.0	1601.0				
2 : 10			1.0					41.0	1600.0				
1 : 11			1.0					42.0	1599.0				
1 : 23			1.0					43.0	1598.0				
2 : 2			1.0					44.0	1597.0				
1 : 41			1.0					45.0	1596.0				
1 : 22			1.0					46.0	1595.0				
2 : 7			1.0					47.0	1594.0				
1 : 31			1.0					48.0	1593.0				
2 : 24			1.0					49.0	1592.0				
1 : 32			1.0					50.0	1591.0		<2		Red brown to brown clay; Residual shale. 100% clay.
1 : 50			1.0					51.0	1590.0				
1 : 24			1.0					52.0	1589.0				
2 : 17			1.0					53.0	1588.0				
1 : 10			1.0					54.0	1587.0				
1 : 1			1.0					55.0	1586.0				
1 : 9			1.0					56.0	1585.0				
1 : 29			1.0					57.0	1584.0				
1 : 6			1.0					58.0	1583.0				
1 : 23			1.0					59.0	1582.0				
1 : 42			1.0					60.0	1581.0			60.0	

Notes:

1. No water encountered.
2. No air and no sample loss.
3. No water used during drilling.
4. Hammer rate generally regular except between 33-34m, 36-37m and 38-39m where it was irregular.

Notes (continue):

Logged by SPK

PERCUSSION BOREHOLE LOG

Version 2009.1

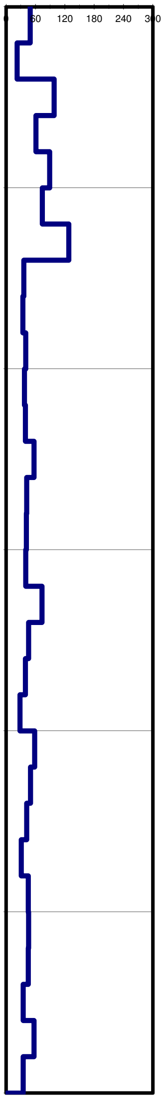
Geo Buro
Geotechnical Surveys

X= X2904937 Y= Y0057782 Z= 1641.00 masl

Project no:	8631-15	Client	**Hlanganani Consulting Engineers**
Project name:	Springs Fresh Produce Market	Drill contractor:	Hennie Erwee
Date drilled:	2015-11-25	Driller:	William
Date profiled:	2015-12-01	**BH NO:**	**BH2**

Penetration rate

seconds/m



Penetr rate min:s/m	Formation					Notes Symbol	Air loss	DEPTH m	Elevation masl	Chip size mm	Drill depth (m)	DESCRIPTION
	CAV	V SFT	SFT	FAIR H	SOLID							
0 : 49		1.0						1.0	1640.0			
0 : 22		1.0						2.0	1639.0	<2		Dark reddish brown clay; Residual shale. 100% clay.
1 : 38		0.1	0.9					3.0	1638.0			
1 : 1			1.0			▼		4.0	1637.0		4.0	
1 : 29			1.0					5.0	1636.0			
1 : 14			1.0					6.0	1635.0			
2 : 8			1.0					7.0	1634.0			
0 : 36			1.0					8.0	1633.0	<2		Red brown clay; Residual shale. 100% clay.
0 : 34			1.0					9.0	1632.0			
0 : 40			1.0					10.0	1631.0			
0 : 37			1.0					11.0	1630.0		11.0	
0 : 39			1.0					12.0	1629.0			
0 : 57			1.0					13.0	1628.0			
0 : 42		1.0						14.0	1627.0			
0 : 41		1.0						15.0	1626.0			
0 : 40		1.0						16.0	1625.0			
1 : 13		0.1	0.9					17.0	1624.0			
0 : 46		1.0						18.0	1623.0			
0 : 39		1.0						19.0	1622.0			
0 : 28		1.0						20.0	1621.0			
0 : 58		1.0						21.0	1620.0	<2		Yellow brown clay; Residual shale/Syenite. 100% clay.
0 : 50		1.0						22.0	1619.0			
0 : 42		1.0						23.0	1618.0			
0 : 31		1.0						24.0	1617.0			
0 : 45		1.0						25.0	1616.0			
0 : 46		1.0						26.0	1615.0			
0 : 45		1.0						27.0	1614.0			
0 : 35		1.0						28.0	1613.0			
0 : 57		1.0						29.0	1612.0			
0 : 35		1.0						30.0	1611.0			

Notes:

Water rest level at 3,4m.

2. No sample and no air loss.

3. Water used during drilling between 13-30m.

4. Hammer rate generally regular, except between 2-3m and 16-17m where it was irregular.

Notes (continue):

Logged by SPK

PERCUSSION BOREHOLE LOG

Version 2009.1

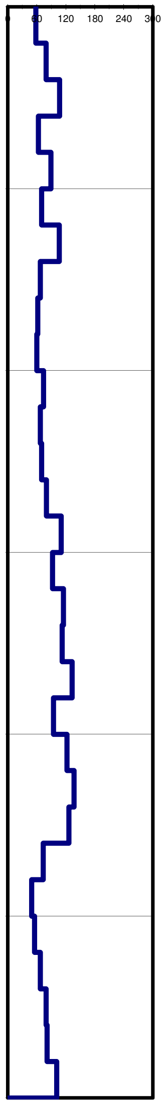
Geo Buro
Geotechnical Surveys

X= X2904937 Y= Y0057782 Z= 1641.00 masl

Project no:	8631-15	Client	**Hlanganani Consulting Engineers**
Project name:	Spring Fresh Produce Market	Drill contractor:	Hennie Erwee
Date drilled:	2015-11-25	Driller:	William
Date profiled:	2015-12-01	**BH NO:**	**BH2 (cont)**

Penetration rate

seconds/m



Penetr rate min:s/m	CAV	V SFT	SFT	FAIR H	SOLID	DEPTH m	Elevation masl	Symbol	Chip size mm	Drill depth (m)	DESCRIPTION
0 : 58		1.0				31.0	1610.0	▥	<2	32.0	Yellow brown clay; Residual shale/Syenite. 100% clay.
1 : 19		0.3	0.7			32.0	1609.0	▥	<5		Yellow brown clay with yellow white with fine black and orange speckles, medium weathered, angular syenite; Weathered syenite. 80% clay, 20% syenite.
1 : 47			1.0			33.0	1608.0	▥			
1 : 3			1.0			34.0	1607.0	▥			
1 : 29			1.0			35.0	1606.0	▥			
1 : 10			1.0			36.0	1605.0	▥			
1 : 46			1.0			37.0	1604.0	▥			
1 : 7			1.0			38.0	1603.0	▥			
1 : 2			1.0			39.0	1602.0	▥			
1 : 0			1.0			40.0	1601.0	▥			
1 : 14			1.0			41.0	1600.0	▥			
1 : 7			1.0			42.0	1599.0	▥		42.0	
1 : 10			1.0			43.0	1598.0	▧	<5		Yellow brown to red brown silty clay with yellow brown with fine black speckles, medium to highly weathered, angular syenite; Weathered syenite. 70% silty clay, 30% syenite.
1 : 20			1.0			44.0	1597.0	+++++++			
1 : 50			1.0			45.0	1596.0	▧			
1 : 32			1.0			46.0	1595.0	+++++++			
1 : 55			1.0			47.0	1594.0	▧			
1 : 52			1.0			48.0	1593.0	+++++++			
2 : 13			0.3	0.7		49.0	1592.0	▧			
1 : 34			1.0			50.0	1591.0	+++++++			
2 : 2			0.1	0.9		51.0	1590.0	▧			
2 : 17				1.0		52.0	1589.0	+++++++			
2 : 6				1.0		53.0	1588.0	▧		53.0	
1 : 13			0.9	0.1		54.0	1587.0	/////////////	<20		Dark grey silt and dark grey and white, slightly to medium weathered, angular quartzite; Weathered quartzite. 50% silt, 50% quartzite.
0 : 49		1.0				55.0	1586.0	▨			
0 : 55		1.0				56.0	1585.0	/////////////			
1 : 7		0.1	0.9			57.0	1584.0	▨			
1 : 19			1.0			58.0	1583.0	/////////////			
1 : 21			1.0			59.0	1582.0	▨			
1 : 41			1.0			60.0	1581.0	/////////////		60.0	

Notes:

1. Water encountered at 30m.
2. No air and no sample loss.
3. water used during drilling between 42-55m .
4. Hammer rate generally regular except between 48-49m, 50-51m, 53-54m and 56-57m where it was irregular.

Notes (continue):

Logged by SPK