



GEOHYDROLOGY

GEOTECHNICAL

ENVIRONMENTAL

SOCIAL DEVELOPMENT

Technical Report
2020 / 02 / 08 GTEC

SUNNINGDALE DAIRY EXTENSION - ELIDZ

Soils investigation for the proposed extension of Sunningdale Dairy at the East London IDZ, Buffalo City Metropolitan Municipality

Prepared for: **BVI Border (Pty) Ltd**

Document version 1.0 – Draft 1

Compiled by AGES Omega (Pty) Ltd

February 2020



Proudly Supporting
TOUCHING AFRICA

Prepared by



TECHNICAL REPORT:

SUNNINGDALE DAIRY EXTENSION - ELIDZ

Soils investigation for the proposed extension of Sunningdale Dairy at the East London IDZ, Buffalo City Metropolitan Municipality; Eastern Cape Province

February 2020

Conducted on behalf of:

BVI Border (Pty) Ltd
1st Floor, Esprit House, St Helena Road,
Triple Point, Beacon Bay
5241

PO Box 11015
Southernwood
5213

For Attention:

Mr. Werner de Lange
Tel: +27 (0)43 722 2738
email: WernerDL@bvi.co.za

Compiled by:

Frederick N. De Jager Pr. Sci. Nat 400177/06; MSAIEG
BSc Hons: Engineering Geology – University of Pretoria

Project team:

Mr. Frederick N. De Jager; Pr. Sci. Nat; BSc Hons Engineering Geology
Mr. Malwande Busakwe; BSc Hons Geology
Mr. Wilhelm Blay; BSc Hons Hydrogeology
Mrs. Heidi Schoeman

*AGES Omega (Pty) Ltd: 10 Sansom Road, Vincent, East London, Postnet Suite 203, Private Bag X 9063,
East London, 5200, Tel: +27 86 188 8609, Fax: +27 43 726 9232,
Email: omega@ages-group.com Website: www.ages-omega.co.za*

AGES Group Offices: Eastern Cape North West Limpopo Gauteng KwaZulu-Natal Namibia

AGES Omega Directors & Management: JA Myburgh FN de Jager O Skenjana J Clark Z Pemba

REPORT DISTRIBUTION LIST

Name	Institution
Mr. Werner de Lange	BVI Border (Pty) Ltd

DOCUMENT HISTORY

Report no	Date	Version	Status
Prelim Geotech Report	30 January 2020	-	Prelim Report
Report 2020 02 08 GTEC	14 February 2020	1.0	Draft 1

Although AGES Omega (Pty) Ltd exercises due care and diligence in rendering services and preparing documents, AGES Omega (Pty) Ltd accepts no liability, and the client, by receiving this document, indemnifies AGES Omega (Pty) Ltd and its directors, managers, agents and employees against all actions, claims, demands, losses, liabilities, costs, damages and expenses arising from or in connection with services rendered, directly or indirectly by AGES Omega (Pty) Ltd and by the use of the information contained in this document.



This document contains confidential and proprietary information of AGES Omega (Pty) Ltd and is protected by copyright in favour of AGES Omega (Pty) Ltd and may not be reproduced or used without the written consent of AGES Omega (Pty) Ltd, which has been obtained beforehand. This document is prepared exclusively for **BVI Border (Pty) Ltd** and is subject to all confidentiality, copyright and trade secrets, rules, intellectual property law and practices of South Africa.

Table of contents

1	INTRODUCTION.....	1
1.1	GENERAL	1
1.2	TERMS OF REFERENCE	1
1.3	SPECIFICATIONS FOR THE INVESTIGATION	1
1.4	NATURE OF THE INVESTIGATION	1
1.5	LOCATION OF THE PROJECT AREA.....	2
1.6	AVAILABLE INFORMATION.....	2
1.7	GEOLOGICAL SETTING.....	3
1.8	REGIONAL SEISMIC HAZARD	4
2	SITE INVESTIGATIONS	5
2.1	TEST PIT EXCAVATION	5
2.2	DYNAMIC CONE PENETROMETER TESTING.....	5
2.3	GROUNDWATER SURVEY	5
3	LABORATORY ANALYSIS.....	7
4	RESULTS.....	9
4.1	TEST PIT EXCAVATION AND PROFILING.....	9
4.2	EXCAVATABILITY CONDITIONS	9
4.3	GENERALISED SOIL CONDITIONS.....	10
4.4	GROUNDWATER OCCURRENCES	11
4.5	DYNAMIC CONE PENETROMETER (DCP) TESTING.....	11
4.6	CORROSIVITY TESTING	12
4.7	CONSTRUCTION MATERIALS	12
4.8	SAFE BEARING PRESSURES.....	12
4.9	HEAVE POTENTIAL.....	13
4.10	COLLAPSE / COMPRESSIBILITY SETTLEMENT POTENTIAL.....	13
4.11	SITE CLASSIFICATION	14
5	SUMMARY.....	15
6	BIBLIOGRAPHY	16

Appendixes

APPENDIX A – Test pit profile logs & photos
 APPENDIX B – Dynamic cone penetrometer data
 APPENDIX C – Soil laboratory analysis certificates

List of Figures

Figure 1: Regional site locality as observed in Google Earth	2
Figure 2: Geological setting of project area (Pa – Adelaide Subgroup)	3
Figure 3: Groundwater survey – Position of monitoring boreholes within 1 km radius of project site	6
Figure 4: Detailed layout of test pits	9
Figure 5: Generalised soil conditions	11

List of Tables

Table 1: Detailed summarised and processed laboratory results with classifications	8
Table 2: Excavatability details - Depth to rock, depth to refusal and seepage	10
Table 3: Summarised soil corrosivity data	12

1 INTRODUCTION

1.1 General

AGES Omega (Pty) Ltd was appointed by BVI Border (Pty) Ltd to conduct a soils investigation for the proposed extension of Sunningdale Dairy at the East London Industrial Development Zone, with the aim of determining and evaluating the engineering geological characteristics of the in-situ soil and rock material underlying the project area.

1.2 Terms of reference

The investigation was requested by Mr. Werner de Lange of the firm BVI Border (Pty) Ltd on behalf of their client the ELIDZ. AGES was appointed following the submission of a detailed project quotation. Appointment was received on the 8th of January 2020 via email instruction to proceed.

1.3 Specifications for the investigation

No specifications were given regarding the proposed development and information required from the geotechnical investigation was based on previous geotechnical studies conducted near the site.

- Structural Engineering Requirements
 - Foundation indicators
 - Estimated Safe bearing capacity
 - Activity of material
 - Foundation classifications
- Civil Engineering Requirements
 - Generalised soil profiles
 - Water tables
 - Compaction characteristics

1.4 Nature of the investigation

The investigation was conducted over approximately 2 days of fieldwork as required in order to finalise required specifications. Commencement of the fieldwork was delayed due to rain. The investigation was conducted as follows:

- Site walk over survey and geological mapping.
- Test pit excavation and profiling.
- Dynamic Cone Penetrometer testing.
- Sample selection and submission to laboratory for detailed analysis.
- Data processing and evaluation.
- Preliminary geotechnical report compilation, with no laboratory analysis results.
- Final reporting incorporating laboratory analysis results.

1.5 Location of the project area

The project area comprises sites 60958 and 60959 at the ELIDZ, that is located directly adjacent to the western side of the existing Sundale Dairy. The locality of the project area is indicated in Figure 1 below, as exported from Google Earth Professional Edition. The central point of the project is defined by the following coordinate (Decimal Degrees, WGS84):

- ❑ Latitude: -33.054617° S
- ❑ Longitude: 27.849660° E

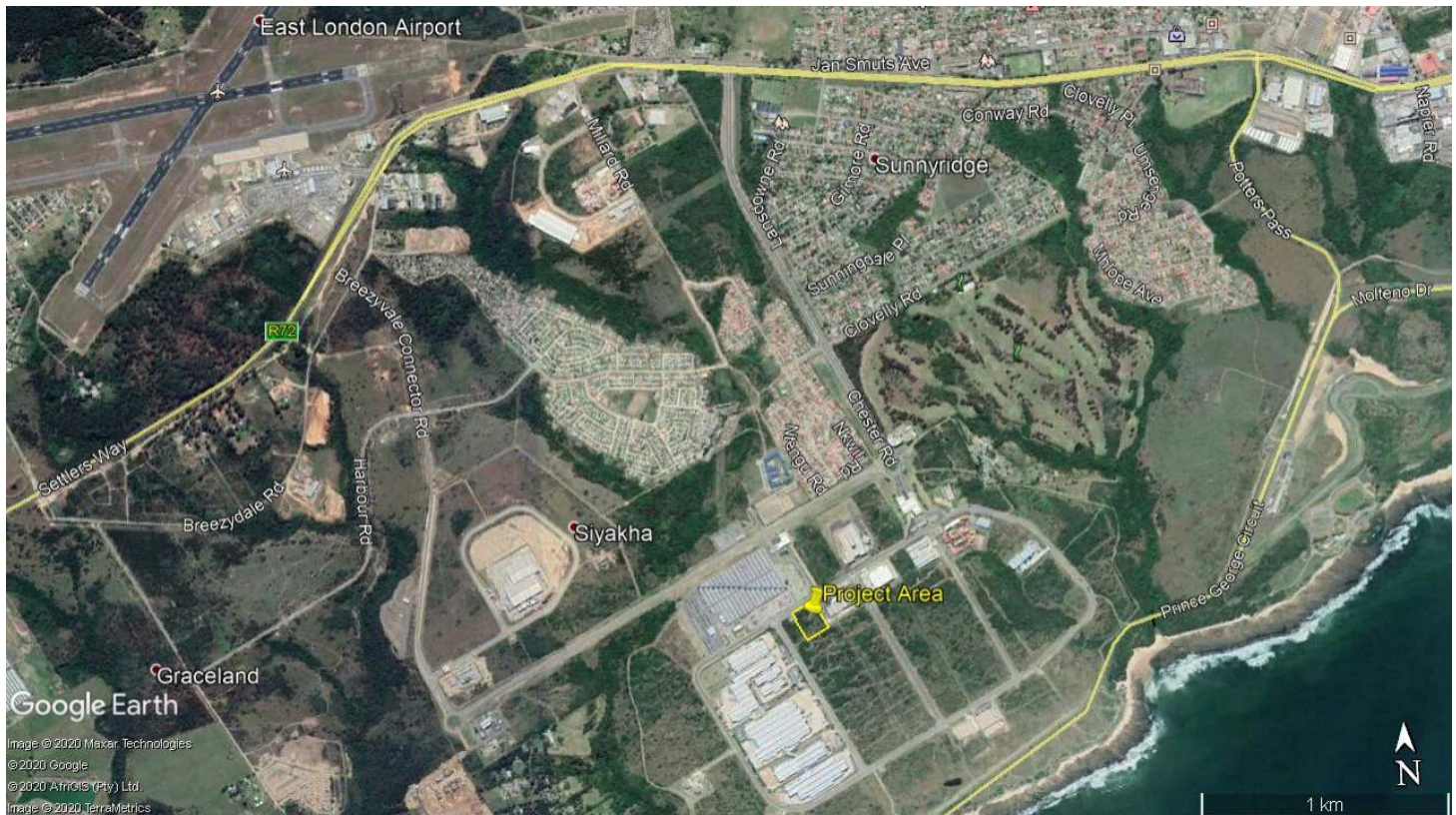


Figure 1: Regional site locality as observed in Google Earth

1.6 Available information

The following sources of information were used during the investigation:

- ❑ Geological maps
 - 3327BB EAST LONDON, scale 1 : 50 000.
- ❑ Hydrogeology map
 - 3126 QUEENSTOWN; scale 1 : 500 000.
- ❑ Electronic maps
 - Site survey supplied by BVI Border (Pty) Ltd.

1.7 Geological Setting

The geological setting of the project area was determined by means of published 1:50 000 scale geological map and the study of aerial imagery.

The project area is underlain by sedimentary rocks of the Middleton and Balfour Formations of the Adelaide Subgroup of the Beaufort Group that is part of the Karoo Supergroup sequence. The lithology comprises of mudstone and sandstone that is locally overlain by soil > 1 m thick.

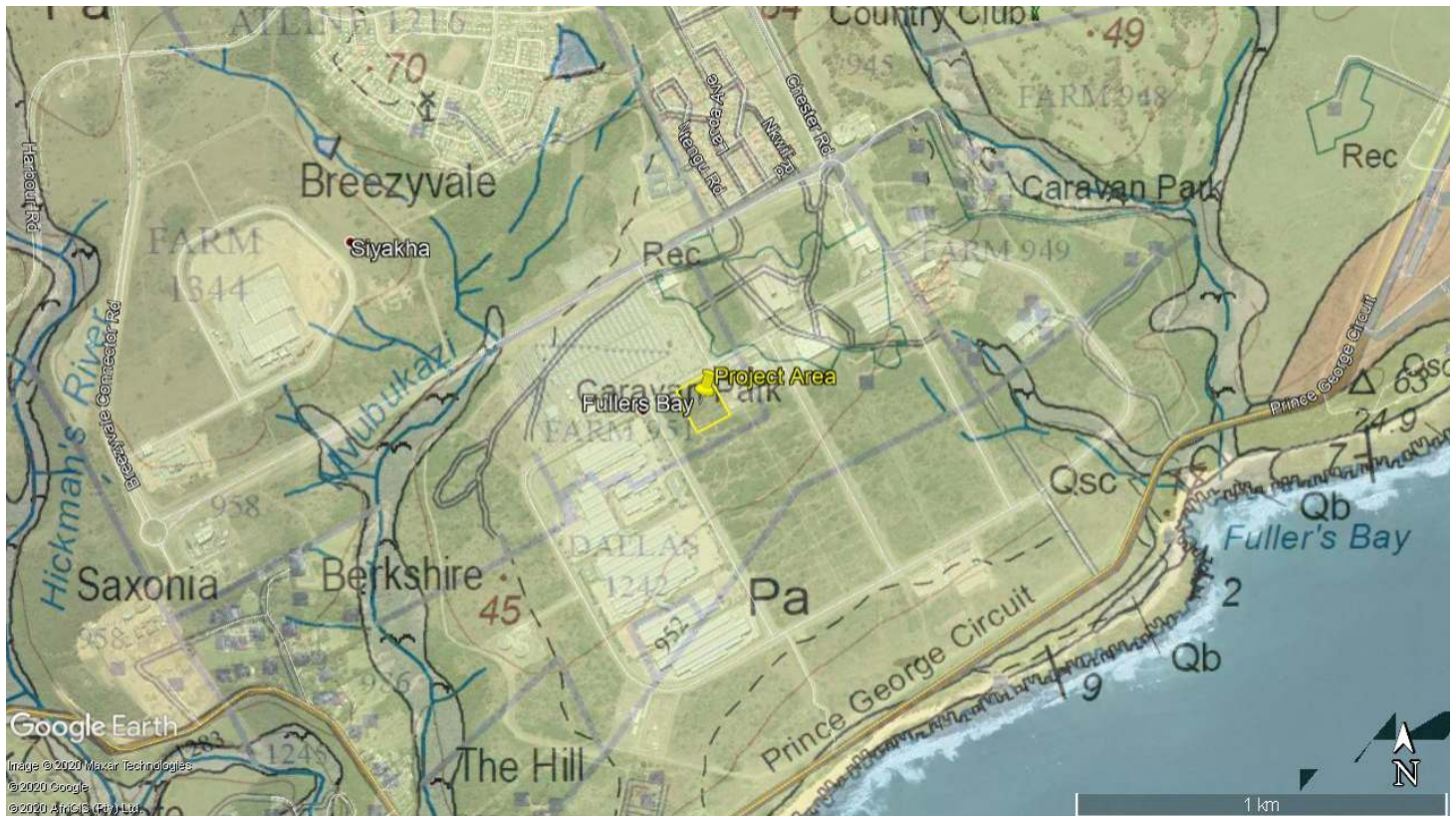


Figure 2: Geological setting of project area (Pa – Adelaide Subgroup)

Dolerite dykes and sills have intruded the sedimentary strata of the Karoo Supergroup during the late Karoo volcanism. The geology map does not indicate the presence of any dolerite dyke or sill intrusions in the project area. A thin dolerite dyke with a basic east-west trend direction was encountered in previous investigations to the south of the project area. The dyke was not encountered in any of the test pits that was excavated as part of this investigation and is not expected to intersect the site.

No other prominent geological structures such as fault zones or LANDSAT derived lineaments occur in the project area.

The area does not reflect any risk for the formation of sinkholes or subsidence caused by the presence of water-soluble rocks (for example: dolomite or limestone).

1.8 Regional Seismic Hazard

According to Fernandez *et al* (1979) the regional seismic hazard in the project area can be defined as follows:

- The area exhibits a 90 % probability of the occurrence of a seismic event not exceeding Class VII-intensity¹ (i.e.: equivalent to a seismic event registering 5.5 to 6.1 on the Richter Scale) within a period of 500 years.

In this light, the natural seismic risk of the project area can be classified as SLIGHT to LOW, and as such requires that Masonry Class B design and construction measures be implemented, incorporating good workmanship and reinforced mortar work, but specific design and construction measures to resist the effect of lateral forces on the proposed development is not deemed necessary.

1 The effects of a Class VII-intensity event (categorized as strong to very strong) can be summarized as follows:

- Difficult to stand
- Noticed by drivers of motorcars
- Hanging objects quiver
- Furniture broken
- Damage to weak materials (such as adobe: poor mortar; low standards of workmanship; weak horizontally) including cracks
- Weak chimneys broken at roof line
- Fall of plaster, loose bricks, stones, tiles, cornices, unbraced parapets and architectural ornaments
- Some cracks in ordinary workmanship and mortar
- Small slides and caving-in along sand or gravel banks and concrete irrigation ditches will be damaged

2 SITE INVESTIGATIONS

2.1 Test Pit Excavation

A total of 8 test pits, numbered SND TP 1 to SND TP8 were excavated on the project area utilising a CAT 428F 4X4 TLB-type excavator on the 14th of January 2020. The position of the test pits was highly influenced by the thick vegetation on site. The test pits were profiled on the same day according to the Guidelines for soil and rock profiling (2002). The positions of the test pits are indicated in the Figure below.

Generalised soil conditions encountered during the investigation are discussed in Chapter 4 of the report with detailed soil profile logs and photographs attached in Appendix A.

2.2 Dynamic Cone Penetrometer Testing

Dynamic Cone Penetrometer (DCP) tests were conducted adjacent to all test pits and in the bottom of selected test pits based on encountered soil conditions.

The DCP testing gives an estimation on the expected excavation conditions and in-situ bearing capacity of the soil materials, with the Unconfined Compressive Strength of the material calculated from the obtained CBR values and mm penetration per blow. The testing is useful to get a basic estimation of existing in-situ soil conditions, but it must be noted that the results are highly influenced by larger soil particles in profile, such as cobbles to boulders, and also by moisture content.

Please note:

- *The moisture content of the soil material is expected to influence the bearing capacity of the material to a large extent, with significant decreases in bearing expected with an increase in material moisture content.*
- *The indicated kPa ranges of the materials are highly influenced by the DCP cone intersecting cobbles and boulders within the alluvium material, that will result in a much higher kPa value than the actual bearing of the material.*

DCP data is discussed in Chapter 4 of the report with detailed data and results attached in Appendix B.

2.3 Groundwater Survey

Two sets of groundwater monitoring boreholes occur within 1 km of the site. The positions of the boreholes are indicated in the figure below. The borehole is utilised for groundwater quality monitoring by the ELIDZ. The static groundwater levels recorded in 2012 was measured at 3.2 - 3.5 m at boreholes 33 and 34 respectively south of the site, and between 1.5 and 9.7 m at boreholes 42 and 43 respectively that occurs to the northwest of the site.



Figure 3: Groundwater survey – Position of monitoring boreholes within 1 km radius of project site

3 LABORATORY ANALYSIS

Selected samples were taken of the prominent soil horizons identified during the site investigation for detailed laboratory analysis. The samples were submitted to Messrs. Controlab South Africa (Pty) Ltd, Civil engineering material and geotechnical laboratory on the on the 15th of January 2020 for detailed analysis of the following:

- Disturbed soil samples (3 samples)
 - Sieve Analysis including Hydrometer to determine % clay
 - Atterberg Limits
 - Moisture Content,
 - pH
 - Electrical Conductivity

- Disturbed bulk soil samples (3 samples)
 - Road Indicators
 - Maximum Dry Density
 - Optimum Moisture Content
 - CBR vs MOD AASHTO density
 - % Swell
 - TRH14 Classification

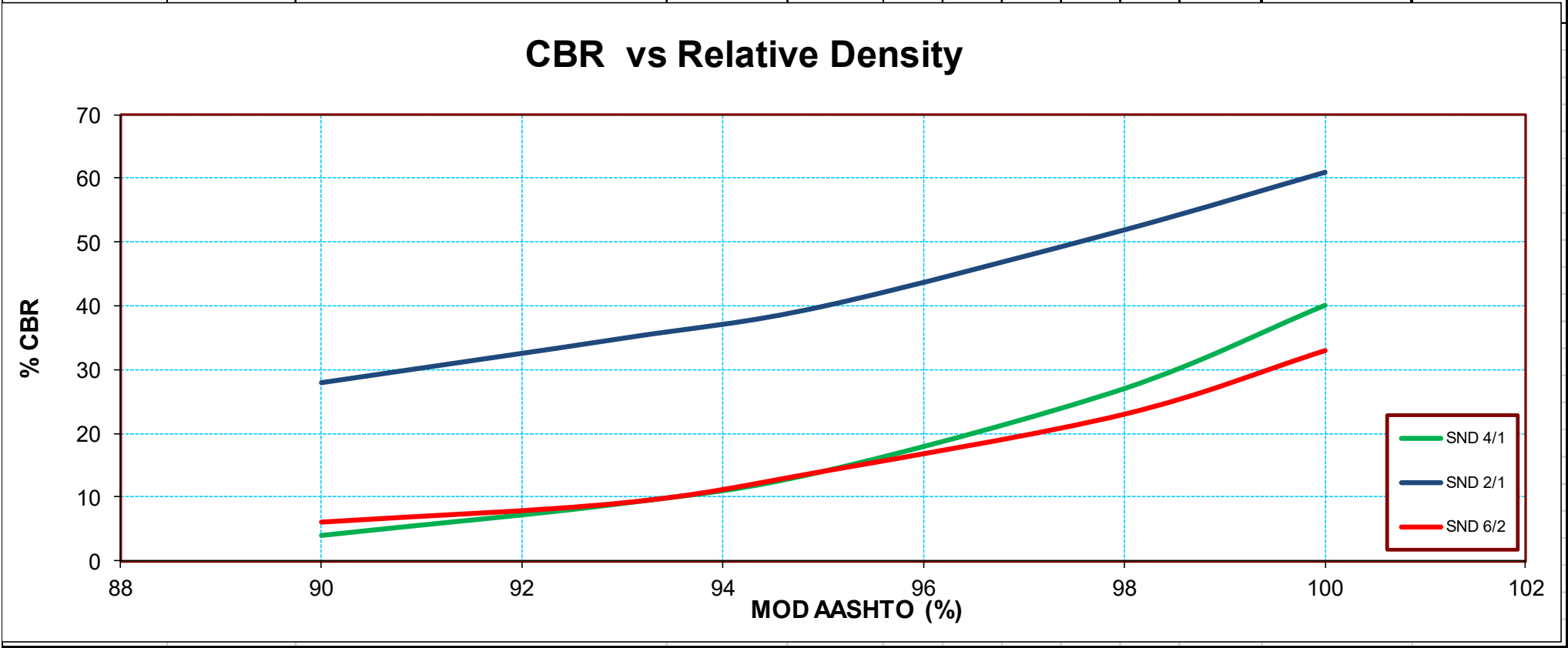
- Undisturbed soil samples (no samples)
 - No testing conducted

Processed laboratory results are summarised in the Tables below and discussed in Chapter 4. Analysis certificates are attached in Appendix C for reference.

Table 1: Detailed summarised and processed laboratory results with classifications

SAMPLE INFORMATION			GRADING ANALYSES				ATTERBERG LIMITS			LS %	SOIL CHEMISTRY				ASTM	POTENTIALLY ADVERSE GEOTECHNICAL CHARACTERISTICS				
Number	Depth (m - m)	Material Origin	Gravel %	Sand %	Silt %	Clay %	LL %	PI	PI'		pH	Conductivity (mS/m)	Soil Resistivity (Ohm/m)	Moisture Content	Soil Classification	Expansiveness	Collapse / Compressibility	Erodibility / Dispersivity	Soil pH Class & Soil Corrosiveness (Conductivity)	Cathodic Protection Classification & Remarks (Resistivity)
SND 1/1	0.10 - 0.50	Hillwash	0	44.2	38.8	17	CBD	SP	SP	1.5	6.06	0.342	2924	6.7	ML: Sandy silt	Low Risk	Very High Risk	High Risk	Slightly Acid / Generally not corrosive	Not generally corrosive / Not generally required
SND 1/2	0.55 - 1.05	Ferruginised Residual Siltstone	35	38.9	16.1	10	22	9	3.7	12.0	6.48	0.389	2571	3.8	SC: Clayey sand with gravel	Low Risk	Low Risk	High Risk	Slightly Acid / Generally not corrosive	Not generally corrosive / Not generally required
SND 6/1	0.80 - 1.30	Ferruginised Residual Siltstone	13	51.7	18.3	17	24	12	7.2	6.0	6.58	0.694	1441	7.1	SC: Clayey sand	Low Risk	Medium Risk	High Risk	Slightly Acid / Generally not corrosive	Not generally corrosive / Not generally required
SND 4/1	0.55 - 0.95	Ferruginised Residual Siltstone	26	43	31		29	14	6.0	7.0	-	-	-	-	-	Low Risk	Low Risk	High Risk	-	-
SND 2/1	1.25 - 1.70	Siltstone Bedrock	64	26.1	9.9		28	14	2.1	7.0	-	-	-	-	-	Low Risk	Low Risk	High Risk	-	-
SND 6/2	1.30 - 1.80	Siltstone Bedrock	49	37.1	13.9		35	20	3.6	9.5	-	-	-	-	-	Low Risk	Low Risk	High Risk	-	-

Sample Number	Depth	Origin	MOD. AASHTO		CBR at % MOD.AASHTO					Swell	TRH14 Class	TRH 20 Class
	m-m		MDD Kg/m ³	OMC %	100	98	95	93	90	%		
SND 4/1	0.55 - 0.95	Ferruginised Residual Siltstone	1940	10.5	40	27	14	9	4	0.4	G9	-
SND 2/1	1.25 - 1.70	Siltstone Bedrock (Highly weathered)	2116	9.0	61	52	40	35	28	0.4	G6	-
SND 6/2	1.30 - 1.80	Siltstone Bedrock	2156	7.9	33	23	14	9	6	0.4	G9	-



4 RESULTS

4.1 Test pit excavation and profiling

A total of 8 test pits, numbered SND TP1 to SND TP8 were excavated in the project area on the 14th of January 2020 utilising a CAT 428F 4x4 TLB-type excavator obtained from Messrs. Plus Plan Hire in East London. The test pits were profiled on the same day according to the Guidelines for soil and rock profiling (2002).

The positions of the test pits are indicated in the Figure below, with detailed test pit logs attached in Appendix A. Please note that several test pits could not be excavated in the required positions due to very dense vegetation.



Figure 4: Detailed layout of test pits

4.2 Excavatability Conditions

It was possible to excavate the test pits utilising a CAT 428F 4x4 TLB-type excavator to a depth between 1.35 and 1.85 mbgl (mean 1.68 mbgl) after which excavation refused in all test pits on moderately hard rock to hard rock siltstone bedrock material. Soft rock siltstone bedrock material was encountered in all test pits from between 0.85 and 1.30 mbgl (mean 1.02 mbgl).

Excavatability conditions can be summarised as follow:

- From Surface to 1.0 mbgl - Soft Excavation Class

- From 1.0 mbgl to 2.0 mbgl - Intermediate Excavation Class with pockets of Hard Rock

Table 2: Excavatability details - Depth to rock, depth to refusal and seepage

TP	EXCAVATION DEPTH	ROCK HEAD	REFUSAL	SEEPAGE
SND TP 1	1.35	1.05	Refusal	-
SND TP 2	1.70	1.25	Refusal	-
SND TP 3	1.80	0.85	Refusal	-
SND TP 4	1.85	0.95	Refusal	-
SND TP 5	1.60	0.85	Refusal	-
SND TP 6	1.85	1.30	Refusal	1.85
SND TP 7	1.70	1.00	Refusal	-
SND TP 8	1.60	0.90	Refusal	-
MIN	1.35	0.85		1.85
MAX	1.85	1.30		1.85
AVERAGE	1.68	1.02		1.85

4.3 Generalised soil conditions

The following generalised soil conditions can be expected based on limited point source test pit information obtained from test pits.

A localised portion of the site at SND TP6 is covered by fill material generally composed of sandy clay with frequent gravel that extends to a depth of approximately 0.40 mbgl.

The site is covered by transported soil material or hillwash / colluvium origin that is generally composed of clayey sand. The material exhibits an intact to micro-shattered soil structure and a firm to stiff consistency. The material extends to an average depth of approximately 0.6 mbgl with the exception of SND TP6 where the material extends to 0.80 mbgl.

The transported material is underlain by ferruginised residual siltstone that is generally composed of sandy clay with frequent siltstone gravel and scattered to abundant ferricrete nodules. The material exhibits a firm to stiff consistency and micro-shattered soil structure. The material has a thickness of up to approximately 0.50 m.

Siltstone bedrock material was encountered in all test pits. The material is highly weathered to moderately weathered, medium grained, thinly bedded and highly to medium fractured with a soft rock to moderately hard rock hardness. The material was encountered from a depth between 0.85 and 1.30 mbgl (mean 1.02 mbgl) with refusal occurring from a depth between 1.35 and 1.85 mbgl (mean 1.68 mbgl).

The generalised soil profile and sections are indicated in the figures below.

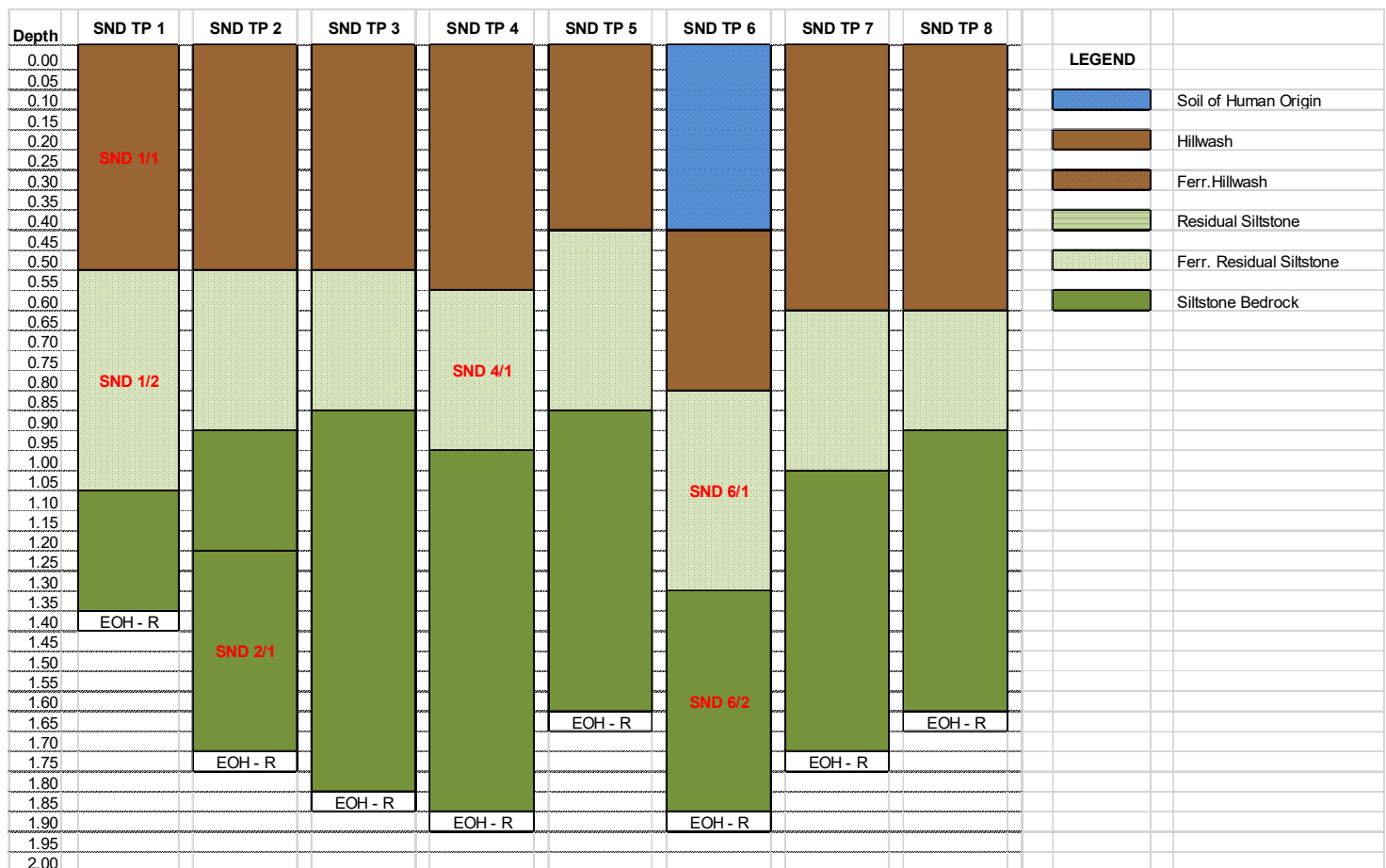


Figure 5: Generalised soil conditions

4.4 Groundwater Occurrences

Slight groundwater seepage was encountered in 1 of the 7 test pits (SND TP6) at a depth of 1.85 mbgl.

Pedogenic soil in the form of ferricrete was encountered all the test pits. The pedogenic soil material is indicative that the soils are not suitably drained, and that the seasonal occurrence of perched groundwater conditions is highly likely to occur over the site. Suitable subsoil drainage and dampness measures will have to be implemented.

4.5 Dynamic Cone Penetrometer (DCP) testing

Dynamic Cone Penetrometer (DCP) tests were conducted adjacent to test pits and in the bottom of selected test pits based on encountered soil conditions as deemed necessary.

The DCP testing gives an estimation on the expected excavation conditions and in-situ bearing capacity of the soil materials that was intersected with the test. The calculated Unconfined Compressive Strength of the materials as obtained from the penetration of the cone in mm per blow is averaged and can be summarised as follow:

- Fill material has a UCS of 100 to 764 kPa (average 383 kPa)
- Hillwash material has a UCS of 60 to 1000 kPa (average 681 kPa)

- Ferruginised residual siltstone material has a UCS of 348 to 1000 kPa (average 950 kPa)
- Weathered siltstone bedrock material has a UCS of 264 to >1000 kPa (average 976 kPa)

4.6 Corrosivity testing

Corrosivity testing was conducted on selected soil samples. The measured pH and Electrical Conductivity values of the soil materials are summarised in the Table below. The soils in the project area classify as slightly acid with a pH between 6.06 and 6.58 and generally not corrosive with a conductivity well below 50 mS/m.

Table 3: Summarised soil corrosivity data

SAMPLE INFORMATION			SOIL CHEMISTRY				SOIL CORROSIVITY	
Number	Depth (m - m)	Material Origin	pH	Conductivity (mS/m)	Soil Resistivity (Ohm/m)	Moisture Content	Soil pH Class & Soil Corrosiveness (Conductivity)	Cathodic Protection Classification & Remarks (Resistivity)
SND 1/1	0.10 - 0.50	Hillwash	6.06	0.342	2924	6.7	Slightly Acid / Generally not corrosive	Not generally corrosive / Not generally required
SND 1/2	0.55 - 1.05	Ferruginised Residual Siltstone	6.48	0.389	2571	3.8	Slightly Acid / Generally not corrosive	Not generally corrosive / Not generally required
SND 6/1	0.80 - 1.30	Ferruginised Residual Siltstone	6.58	0.694	1441	7.1	Slightly Acid / Generally not corrosive	Not generally corrosive / Not generally required
SND 4/1	0.55 - 0.95	Ferruginised Residual Siltstone	-	-	-	-	-	-
SND 2/1	1.25 - 1.70	Siltstone Bedrock	-	-	-	-	-	-
SND 6/2	1.30 - 1.80	Siltstone Bedrock	-	-	-	-	-	-

4.7 Construction materials

The materials encountered and tested exhibit variable qualities. It is essential that proper quality control be conducted on all in-situ materials utilised during construction. Based on laboratory analysis the materials exhibit the following general properties:

- The hillwash material is expected to classify as G8 to G10 according to TRH14 and is marginally suitable to unsuitable for use during construction.
- The ferruginised residual siltstone classifies as G9 according to TRH14 and is not suitable for any use during construction.
- The slightly weathered to fresh siltstone bedrock material classifies as G6 according to TRH14 and is suitable for use during construction. The moderately to highly weathered material classify as G9 according to TRH14. The material is non-durable and prone to slaking and will break down rapidly when exposed to changing moisture conditions, with a resulting decreasing strength and downgraded classification. This material cannot be stockpiled for long as the quality will degrade rapidly and is not suitable for use as erosion control / durable material.

Utilisation of any of the materials can be discussed based on design requirements.

4.8 Safe bearing pressures

The following estimated safe bearing capacities are estimated based on the site investigation and interpretation of DCP results.

- Hillwash materials - 40 kPa

- Ferruginised residual siltstone - 75 kPa
- Siltstone bedrock (very soft rock) - 100 kPa
- Siltstone bedrock (refusal of TLB) => 400 kPa

4.9 Heave potential

The foundation indicator results indicate that the materials encountered in the project area all have low expansive properties, indicating that these materials will have a low potential for heave on wetting up or shrinkage on drying out.

Experience of other nearby sites indicate that the residual siltstone and ferruginised residual siltstone materials can be medium expansive (as encountered at projects directly south of the project area). Although potential heave of the residual materials cannot be completely ruled out, the general problems with heave and shrinkage of these materials are expected to be minor.

4.10 Collapse / compressibility settlement potential

The transported and residual soil materials are potentially moderately to very highly compressible / collapsible, with general settlement of 8% of layer thickness expected.

Consolidation test results utilised from a nearby geotechnical site investigation was utilised and indicate the following:

- The material is normally consolidated with a pre-consolidation pressure of 40 kPa
- 200 kPa load – settlement of 8 – 12 % of layer thickness
- 400 kPa load – settlement of 10 – 14 % of layer thickness

These results can be utilised as an indication of expected differential settlement under load.

4.11 Site Classification

Based on the results of the investigation the platform can be classified as follow:

- C2 – expected collapse / consolidation settlement > 10 mm
- H – potential heave / expansiveness up to 7.5 mm
- P(perched gw) – seasonal perched groundwater conditions expected
- [R] – shallow bedrock conditions < 1.20 mbgl [in localised portions]
- The transported and residual soil materials are potentially moderately to very highly compressible / collapsible.

The NHBRC site classification designation is: **Site Class C2 – H – P – [R]**

5 SUMMARY

- AGES Omega (Pty) Ltd was appointed by BVI Border (Pty) Ltd to conduct a soils investigation for the proposed extension of Sunningdale Dairy at the East London Industrial Development Zone, with the aim of determining and evaluating the engineering geological characteristics of the in-situ soil and rock material underlying the project area.
- No specifications were given regarding the proposed development and information required from the geotechnical investigation was based on previous geotechnical studies conducted near the site.
 - Structural Engineering Requirements
 - Foundation indicators
 - Estimated Safe bearing capacity
 - Activity of material
 - Foundation classifications
 - Civil Engineering Requirements
 - Generalised soil profiles
 - Water tables
 - Compaction characteristics
- A total of 8 test pits, numbered SND TP 1 to SND TP8 were excavated on the project area utilising a CAT 428F 4X4 TLB-type excavator on the 14th of January 2020. The position of the test pits was highly influenced by the thick vegetation on site. The test pits were profiled on the same day according to the Guidelines for soil and rock profiling (2002).
- Disturbed and undisturbed soil samples was taken during the site investigation and submitted for detailed laboratory analysis for foundation indicators, atterberg limits, compaction characteristics, soil corrosivity and consolidation testing. Processed data is discussed in Chapter 3 of this report.
- Two sets of groundwater monitoring boreholes occur within 1 km of the site. The positions of the boreholes are indicated in the figure below. The borehole is utilised for groundwater quality monitoring by the ELIDZ. The static groundwater levels recorded in 2012 was measured at 3.2 - 3.5 m at boreholes 33 and 34 respectively south of the site, and between 1.5 and 9.7 m at boreholes 42 and 43 respectively that occurs to the northwest of the site.
- Results of the investigation are discussed per platform in Chapter 4 of the report.
- It is recommended that on-site inspections of piling solutions, open foundation trenches and excavations be carried out by AGES in order to identify and evaluate soil conditions at variance with those encountered during the investigation.

6 BIBLIOGRAPHY

BELL, P and WRIGHT, D, 1985.

Rocks and Minerals. Hamlyn Practical Guides, Hamlyn Publishing, England.

BRINK, A B A, 1979.

Engineering Geology of Southern Africa, Vol. 3. Building Publications, Pretoria.

CRAIG RF, 1997.

Soil Mechanics, Sixth Edition. Department of Civil Engineering, University of Dundee UK.

FRANKI

A Guide to Practical Geotechnical Engineering in Southern Africa, Fourth Edition 2008.

Editors ABA BRINK & HMH BRUIN.

Guidelines for soil and rock logging in South Africa, 2nd Impression, 2002. Published and sponsored jointly by: Association of Engineering Geologists South Africa. South African Institution of Civil Engineering – Geotechnical Division. South African Institute for Engineering and Environmental Geologists.

MIDGLEY, D C, PITMAN, W V and MIDDLETON, B J, 1994.

Surface water resources of South Africa 1990, Book of Maps. Water Research Commission report number 298/5.2/94.

SOUTH AFRICAN COMMITTEE FOR STRATIGRAPHY (SACS), 1980.

Stratigraphy of South Africa. Part 1 (Comp L E Kent). Lithostratigraphy of the Republic of South Africa, South West Africa/Namibia, and the Republics of Bophuthatswana, Transkei and Venda. Handbook of the Geological Survey of South Africa, No. 8, Government Printer, Pretoria.

THE NATIONAL HOME BUILDERS REGISTRATION COUNCIL, 1995.

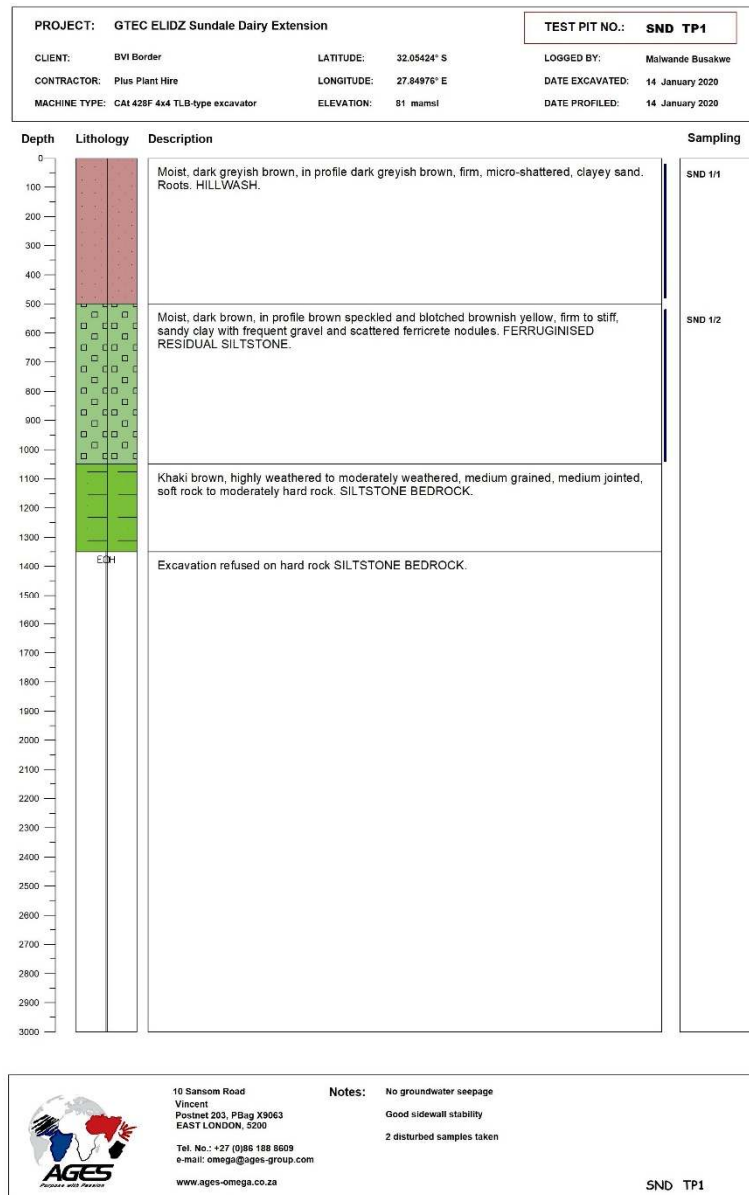
Standards and guidelines. First issue, May 1995.

WEINERT, H H, 1980.

The natural road construction materials of Southern Africa. Academia, Cape Town.


APPENDIX A

Detailed test pit profile logs & photos



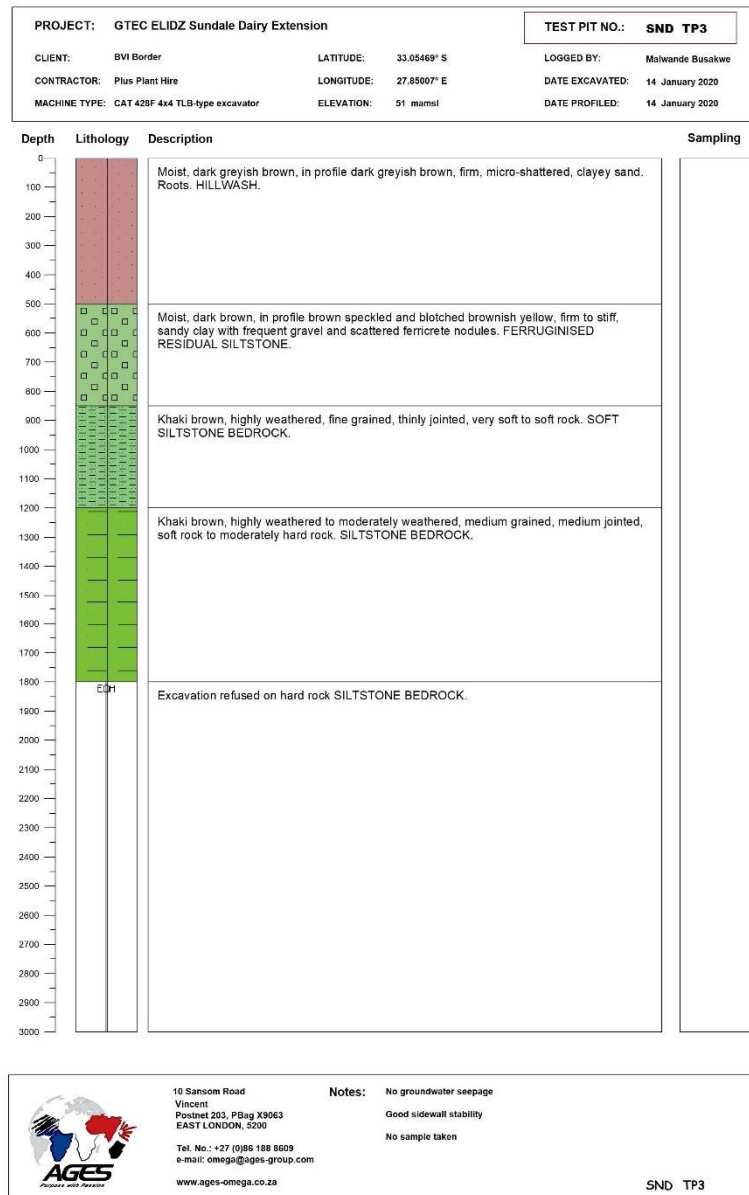
PROJECT: GTEC ELIDZ Sundale Dairy Extension				TEST PIT NO.: SND TP2	
CLIENT:	BVI Border	LATITUDE:	33.05454° S	LOGGED BY:	Malwande Busakwe
CONTRACTOR:	Plus Plant Hire	LONGITUDE:	27.85003° E	DATE EXCAVATED:	14 January 2020
MACHINE TYPE:	CAT 420F 4x4 TLB-type excavator	ELEVATION:	51 mamsl	DATE PROFILED:	14 January 2020

Depth	Lithology	Description	Sampling
0		Moist, dark greyish brown, in profile dark greyish brown, firm, micro-shattered, clayey sand. Roots. HILLWASH.	
100			
200			
300			
400			
500			
600		Moist, dark brown, in profile brown speckled and blotched brownish yellow, firm to stiff, sandy clay with frequent gravel and scattered ferricrete nodules. FERRUGINISED RESIDUAL SILTSTONE.	
700			
800			
900			
1000		Khaki brown, highly weathered, fine grained, thinly jointed, very soft to soft rock. SOFT SILTSTONE BEDROCK.	
1100			
1200			
1300		Khaki brown, highly weathered to moderately weathered, medium grained, medium jointed, soft rock to moderately hard rock. SILTSTONE BEDROCK.	SND 2/1
1400			
1500			
1600			
1700		Excavation refused on hard rock SILTSTONE BEDROCK.	
1800			
1900			
2000			
2100			
2200			
2300			
2400			
2500			
2600			
2700			
2800			
2900			
3000			

	10 Sanson Road Vincent Postnet 203, PBag X9063 EAST LONDON, 5200 Tel. No.: +27 (0)18 188 8609 e-mail: omega@ages-group.com www.ages-omega.co.za	Notes: No groundwater seepage Good sidewall stability 1 bulk samples taken


SND TP2





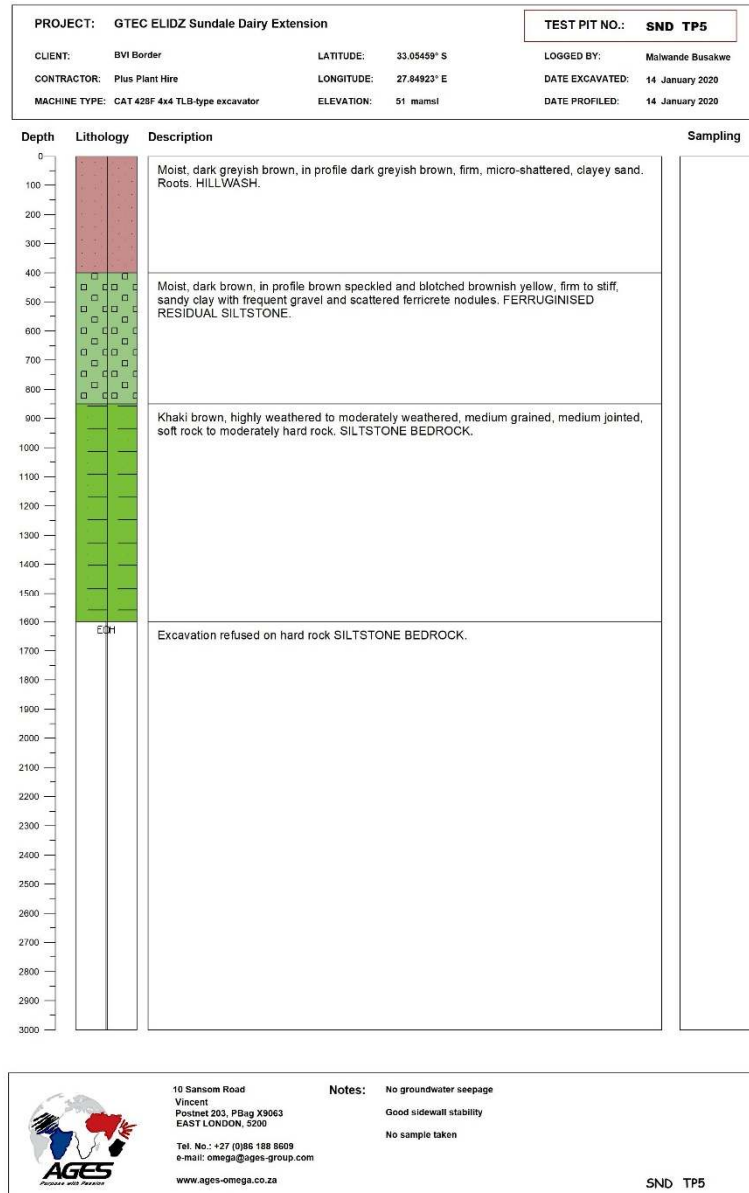
PROJECT: GTEC ELIDZ Sundale Dairy Extension		TEST PIT NO.: SND TP4	
CLIENT: BVI Border	LATITUDE: 33.05445° S	LOGGED BY: Mahwande Busakwe	
CONTRACTOR: Plus Plant Hire	LONGITUDE: 27.84917° E	DATE EXCAVATED: 14 January 2020	
MACHINE TYPE: CAT 420F 4x4 TLB-type excavator	ELEVATION: 51 mamsl	DATE PROFILED: 14 January 2020	

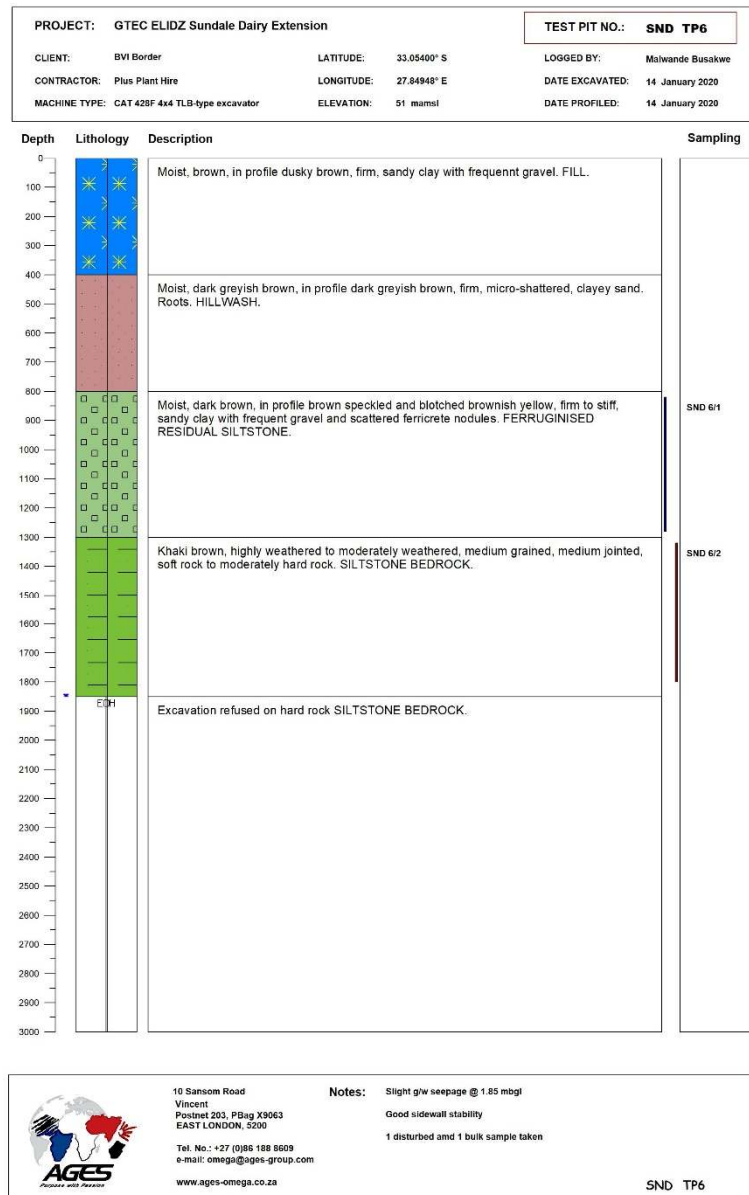
Depth	Lithology	Description	Sampling
0		Moist, dark greyish brown, in profile dark greyish brown, firm, micro-shattered, clayey sand. Roots. HILLWASH.	
100			
200			
300			
400			
500			
600		Moist, dark brown, in profile brown speckled and blotched brownish yellow, firm to stiff, sandy clay with frequent gravel and scattered ferricrete nodules. FERRUGINISED RESIDUAL SILTSTONE.	SND 4/1
700			
800			
900			
1000		Khaki brown, highly weathered, fine grained, thinly jointed, very soft to soft rock. SOFT SILTSTONE BEDROCK.	
1100			
1200			
1300		Khaki brown, highly weathered to moderately weathered, medium grained, medium jointed, soft rock to moderately hard rock. SILTSTONE BEDROCK.	
1400			
1500			
1600			
1700		Excavation refused on hard rock SILTSTONE BEDROCK.	
1800			
1900			
2000			
2100			
2200			
2300			
2400			
2500			
2600			
2700			
2800			
2900			
3000			

	10 Sansom Road Vincent Postnet 203, PBag X9063 EAST LONDON, 5200 Tel. No.: +27 (0)86 188 8609 e-mail: omega@ages-group.com www.ages-omega.co.za	Notes: No groundwater seepage Good sidewall stability 1 bulk sample taken

SND TP4








PROJECT: GTEC ELIDZ Sundale Dairy Extension		TEST PIT NO.: SND TP7	
CLIENT: BVI Border	LATITUDE: 32.05435° S	LOGGED BY: Mahwande Busakwe	
CONTRACTOR: Plus Plant Hire	LONGITUDE: 27.84947° E	DATE EXCAVATED: 14 January 2020	
MACHINE TYPE: CAT 428F 4x4 TLB-type excavator	ELEVATION: 51 mamsl	DATE PROFILED: 14 January 2020	


Depth	Lithology	Description	Sampling
0		Moist, dark greyish brown, in profile dark greyish brown, firm, micro-shattered, clayey sand. Roots. HILLWASH.	
100			
200			
300			
400			
500			
600			
700		Abundant to frequent ferricrete nodules densely to moderately densely packed in a matrix of Moist, brown, sandy clay. Firm overall consistency. FERRUGINISED RESIDUAL SILTSTONE.	
800			
900			
1000			
1100		Khaki brown, highly weathered to moderately weathered, medium grained, medium jointed, soft rock to moderately hard rock. SILTSTONE BEDROCK.	
1200			
1300			
1400			
1500			
1600			
1700		Excavation refused on hard rock SILTSTONE BEDROCK.	
1800			
1900			
2000			
2100			
2200			
2300			
2400			
2500			
2600			
2700			
2800			
2900			
3000			

	10 Sanson Road Vincent Postnet 203, PBag X9063 EAST LONDON, 5200 Tel. No.: +27 (0)86 188 8609 e-mail: omega@ages-group.com www.ages-omega.co.za	Notes: No groundwater seepage Good sidewall stability No sample taken
	SND TP7	



PROJECT: GTEC ELIDZ Sundale Dairy Extension		TEST PIT NO.: SND TP8	
CLIENT: BVI Border	LATITUDE: 32.05479° S	LOGGED BY: Mahwande Busakwe	
CONTRACTOR: Plus Plant Hire	LONGITUDE: 27.84971° E	DATE EXCAVATED: 14 January 2020	
MACHINE TYPE: CAT 420F 4x4 TLB-type excavator	ELEVATION: 51 mamsl	DATE PROFILED: 14 January 2020	

Depth	Lithology	Description	Sampling
0		Moist, dark greyish brown, in profile dark greyish brown, firm, micro-shattered, clayey sand. Roots. HILLWASH.	
100			
200			
300			
400			
500			
600			
700		Abundant to frequent ferricrete nodules densely to moderately densely packed in a matrix of Moist, brown, sandy clay. Firm overall consistency. FERRUGINISED RESIDUAL SILTSTONE.	
800			
900			
1000		Khaki brown, highly weathered to moderately weathered, medium grained, medium jointed, soft rock to moderately hard rock. SILTSTONE BEDROCK.	
1100			
1200			
1300			
1400			
1500			
1600			
1700		Excavation refused on hard rock SILTSTONE BEDROCK.	
1800			
1900			
2000			
2100			
2200			
2300			
2400			
2500			
2600			
2700			
2800			
2900			
3000			

	10 Sanson Road Vincent Postnet 203, PBag X9063 EAST LONDON, 5200 Tel. No.: +27 (0)86 188 8609 e-mail: omega@ages-group.com www.ages-omega.co.za	Notes: No groundwater seepage Good sidewall stability No sample taken

SND TP8



APPENDIX B

Dynamic Cone Penetrometer data

ANALYSES OF DYNAMIC CONE PENETRATION TEST RESULTS

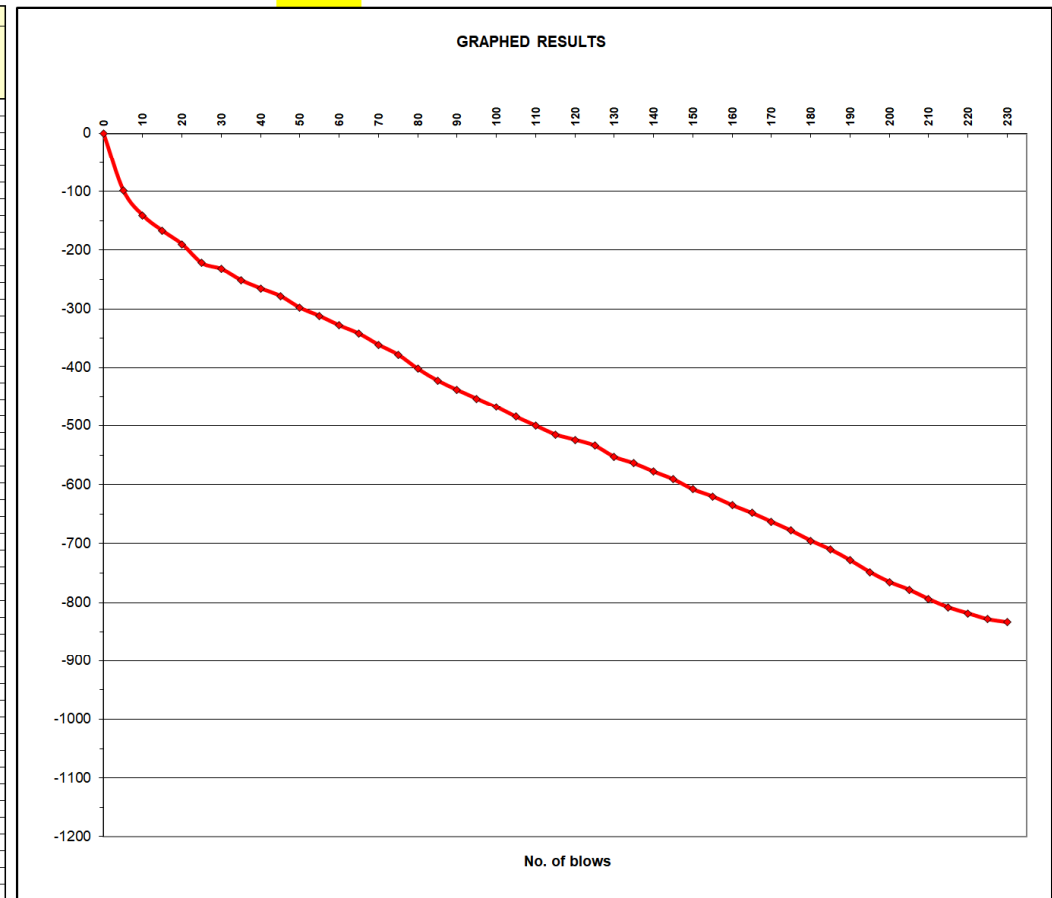
PROJECT: ELIDZ Sundale Dairy Extension

DEPTH: Surface

Traffic Stress σ'_v 250 kPa
 Thickness D 180 mm

CONDUCTED ON: Tuesday, January 14, 2020

NO. OF BLOWS	SND TP 1									
	Values (mm)	Cumulative penetration (mm)	mm/blow	UCS (kPa)	CBR% (Kleyn, 1984)	E (MPa) (Packard, 1973)	E (De Beer, 1991) MPa	E (Jianzhou et al., 1999)	ρ (mm)	k (kN/m3)
0	110	0	0.0							
5	208	-98	19.6	113	9	27	47	106	0.0004	588
10	251	-141	8.6	278	27	51	114	146	0.0003	811
15	277	-167	5.2	481	51	75	194	178	0.0003	987
20	300	-190	4.6	550	59	82	221	186	0.0002	1036
25	332	-222	6.4	383	39	64	155	164	0.0003	910
30	342	-232	2.0	1362	170	156	535	258	0.0002	1433
35	361	-251	3.8	677	75	95	270	201	0.0002	1116
40	375	-265	2.8	944	111	120	374	226	0.0002	1257
45	388	-278	2.6	1023	122	127	405	233	0.0002	1294
50	408	-298	4.0	640	70	91	256	197	0.0002	1094
55	422	-312	2.8	944	111	120	374	226	0.0002	1257
60	438	-328	3.2	816	94	109	325	215	0.0002	1193
65	452	-342	2.8	944	111	120	374	226	0.0002	1257
70	471	-361	3.8	677	75	95	270	201	0.0002	1116
75	488	-378	3.4	764	87	104	304	210	0.0002	1165
80	512	-402	4.8	525	56	79	211	183	0.0002	1018
85	532	-422	4.0	640	70	91	256	197	0.0002	1094
90	548	-438	3.2	816	94	109	325	215	0.0002	1193
95	563	-453	3.0	876	102	114	348	220	0.0002	1223
100	578	-468	3.0	876	102	114	348	220	0.0002	1223
105	595	-485	3.4	764	87	104	304	210	0.0002	1165
110	610	-500	3.0	876	102	114	348	220	0.0002	1223
115	625	-515	3.0	876	102	114	348	220	0.0002	1223
120	634	-524	1.8	1528	185	165	598	269	0.0002	1493
125	644	-534	2.0	1362	170	156	535	258	0.0002	1433
130	663	-553	3.8	677	75	95	270	201	0.0002	1116
135	674	-564	2.2	1228	151	145	483	249	0.0002	1381
140	688	-578	2.8	944	111	120	374	226	0.0002	1257
145	701	-591	2.6	1023	122	127	405	233	0.0002	1294
150	718	-608	3.4	764	87	104	304	210	0.0002	1165
155	730	-620	2.4	1117	135	136	440	240	0.0002	1335
160	745	-635	3.0	876	102	114	348	220	0.0002	1223
165	758	-648	2.6	1023	122	127	405	233	0.0002	1294
170	773	-663	3.0	876	102	114	348	220	0.0002	1223
175	788	-678	3.0	876	102	114	348	220	0.0002	1223
180	805	-695	3.4	764	87	104	304	210	0.0002	1165
185	820	-710	3.0	876	102	114	348	220	0.0002	1223
190	838	-728	3.6	718	81	99	286	205	0.0002	1139
195	858	-748	4.0	640	70	91	256	197	0.0002	1094
200	875	-765	3.4	764	87	104	304	210	0.0002	1165
205	888	-778	2.6	1023	122	127	405	233	0.0002	1294
210	904	-794	3.2	816	94	109	325	215	0.0002	1193
215	918	-808	2.8	944	111	120	374	226	0.0002	1257
220	928	-818	2.0	1362	170	156	535	258	0.0002	1433
225	938	-828	2.0	1362	170	156	535	258	0.0002	1433
230	943	-833	1.0	2900	300	221	1116	338	0.0001	1878
235										



ANALYSES OF DYNAMIC CONE PENETRATION TEST RESULTS

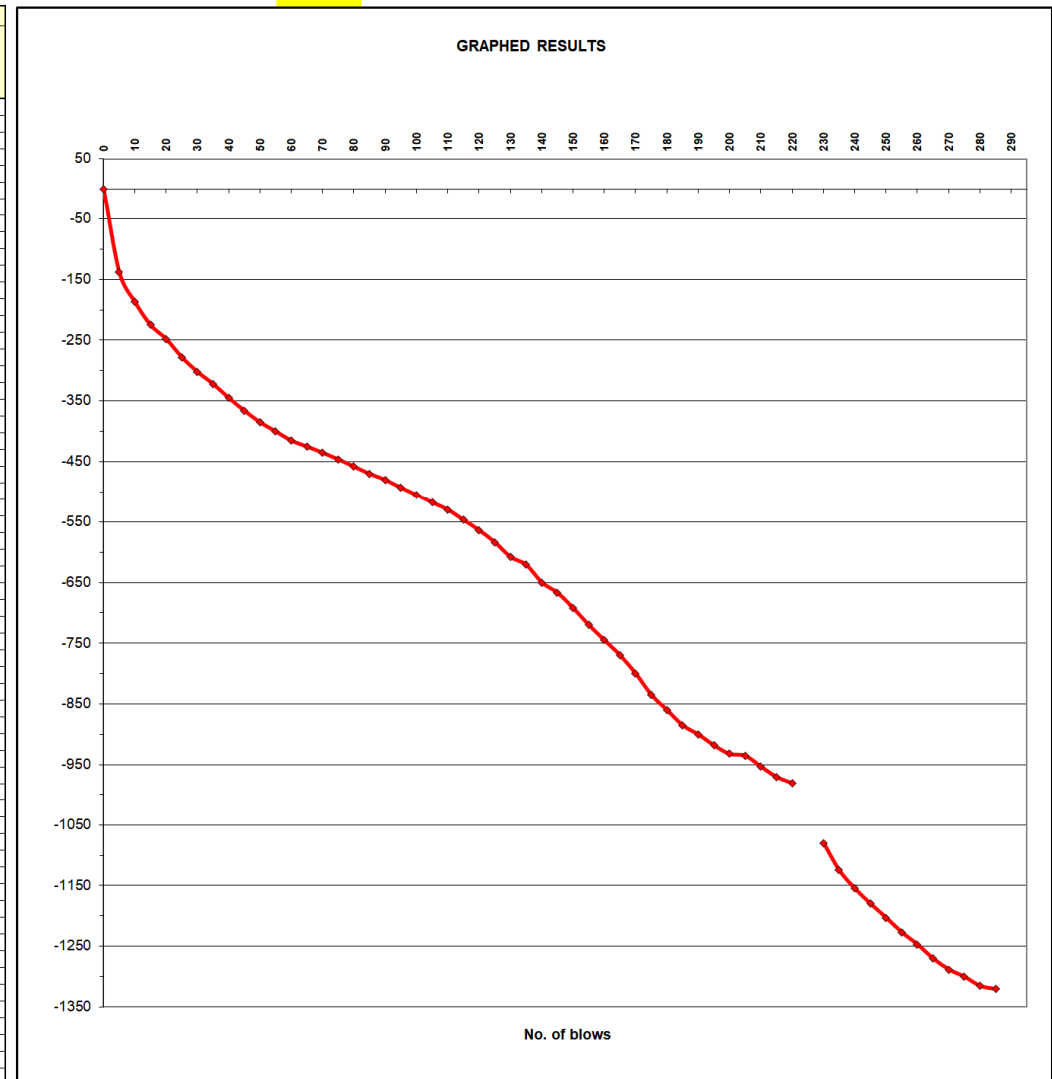
PROJECT: ELIDZ Sundale Dairy Extension

DEPTH: Surface

Traffic Stress σ'_v 250 kPa
 Thickness D 180 mm

CONDUCTED ON: Tuesday, January 14, 2020

NO. OF BLOWS	SND TP 2									
	Values (mm)	Cumulative penetration (mm)	mm/blow	UCS (kPa)	CBR% (Kleyn, 1984)	E (MPa) (Packard, 1973)	E (De Beer, 1991) MPa	E (Jianzhou et al., 1999)	ρ (mm)	k (kN/m3)
0	110	0	0.0							
5	248	-138	27.6	78	6	21	33	93	0.0005	515
10	297	-187	9.8	241	23	46	99	139	0.0003	771
15	335	-225	7.6	318	31	56	130	153	0.0003	851
20	358	-248	4.6	550	59	82	221	186	0.0002	1036
25	388	-278	6.0	411	42	67	167	168	0.0003	934
30	412	-302	4.8	525	56	79	211	183	0.0002	1018
35	432	-322	4.0	640	70	91	256	197	0.0002	1094
40	455	-345	4.6	550	59	82	221	186	0.0002	1036
45	476	-366	4.2	607	66	88	243	193	0.0002	1073
50	495	-385	3.8	677	75	95	270	201	0.0002	1116
55	510	-400	3.0	876	102	114	348	220	0.0002	1223
60	525	-415	3.0	876	102	114	348	220	0.0002	1223
65	535	-425	2.0	1362	170	156	535	258	0.0002	1433
70	545	-435	2.0	1362	170	156	535	258	0.0002	1433
75	556	-446	2.2	1228	151	145	483	249	0.0002	1381
80	568	-458	2.4	1117	135	136	440	240	0.0002	1335
85	580	-470	2.4	1117	135	136	440	240	0.0002	1335
90	590	-480	2.0	1362	170	156	535	258	0.0002	1433
95	603	-493	2.6	1023	122	127	405	233	0.0002	1294
100	615	-505	2.4	1117	135	136	440	240	0.0002	1335
105	628	-518	2.6	1023	122	127	405	233	0.0002	1294
110	640	-530	2.4	1117	135	136	440	240	0.0002	1335
115	657	-547	3.4	764	87	104	304	210	0.0002	1165
120	674	-564	3.4	764	87	104	304	210	0.0002	1165
125	694	-584	4.0	640	70	91	256	197	0.0002	1094
130	718	-608	4.8	525	56	79	211	183	0.0002	1018
135	731	-621	2.6	1023	122	127	405	233	0.0002	1294
140	760	-650	5.8	427	44	69	173	170	0.0003	946
145	777	-667	3.4	764	87	104	304	210	0.0002	1165
150	802	-692	5.0	502	53	77	202	180	0.0002	1002
155	830	-720	5.6	443	46	70	179	173	0.0003	959
160	855	-745	5.0	502	53	77	202	180	0.0002	1002
165	880	-770	5.0	502	53	77	202	180	0.0002	1002
170	910	-800	6.0	411	42	67	167	168	0.0003	934
175	945	-835	7.0	348	35	59	141	158	0.0003	879
180	970	-860	5.0	502	53	77	202	180	0.0002	1002
185	995	-885	5.0	502	53	77	202	180	0.0002	1002
190	1010	-900	3.0	876	102	114	348	220	0.0002	1223
195	1028	-918	3.6	718	81	99	286	205	0.0002	1139
200	1042	-932	2.8	944	111	120	374	226	0.0002	1257
205	1045	-935	0.0	5061	389	259	1919	413	0.0001	2292
210	1063	-953	3.6	718	81	99	286	205	0.0002	1139
215	1080	-970	3.4	764	87	104	304	210	0.0002	1165
220	1090	-980	2.0	1362	170	156	535	258	0.0002	1433
225										
230	1080	-1080	216.0	8	0	4	4	42	0.0011	231
235	1125	-1125	9.0	264	25	49	108	143	0.0003	797
240	1155	-1155	6.0	411	42	67	167	168	0.0003	934
245	1180	-1180	5.0	502	53	77	202	180	0.0002	1002
250	1203	-1203	4.6	550	59	82	221	186	0.0002	1036
255	1227	-1227	4.8	525	56	79	211	183	0.0002	1018
260	1247	-1247	4.0	640	70	91	256	197	0.0002	1094
265	1270	-1270	4.6	550	59	82	221	186	0.0002	1036
270	1288	-1288	3.6	718	81	99	286	205	0.0002	1139
275	1300	-1300	2.4	1117	135	136	440	240	0.0002	1335
280	1315	-1315	3.0	876	102	114	348	220	0.0002	1223
285	1320	-1320	1.0	2900	300	221	1116	338	0.0001	1878
295										



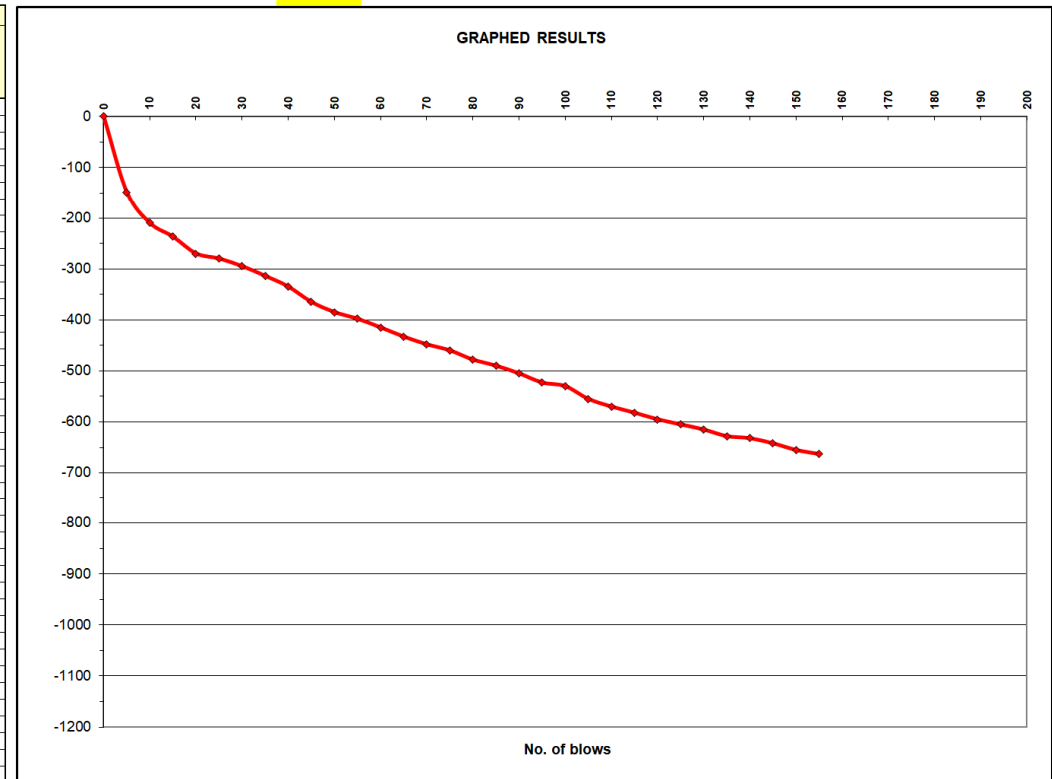
ANALYSES OF DYNAMIC CONE PENETRATION TEST RESULTS

PROJECT: ELIDZ Sundale Dairy Extension

DEPTH: Surface
 Traffic Stress σ'_v 250 kPa
 Thickness D 180 mm

CONDUCTED ON: Tuesday, January 14, 2020

NO. OF BLOWS	SND TP 3									
	Values (mm)	Cumulative penetration (mm)	mm/blow	UCS (kPa)	CBR% (Kieyn, 1984)	E (MPa) (Packard, 1973)	E (De Beer, 1991) MPa	E (Jianzhou et al., 1999)	ρ (mm)	k (kN/m ³)
0	90	0	0.0							
5	238	-148	29.6	72	6	19	31	90	0.0005	501
10	300	-210	12.4	186	17	38	77	127	0.0004	703
15	327	-237	5.4	461	48	72	186	175	0.0003	973
20	360	-270	6.6	371	37	62	150	162	0.0003	900
25	370	-280	2.0	1362	170	156	535	258	0.0002	1433
30	385	-295	3.0	876	102	114	348	220	0.0002	1223
35	404	-314	3.8	677	75	95	270	201	0.0002	1116
40	425	-335	4.2	607	66	88	243	193	0.0002	1073
45	455	-365	6.0	411	42	67	167	168	0.0003	934
50	475	-385	4.0	640	70	91	256	197	0.0002	1094
55	488	-398	2.6	1023	122	127	405	233	0.0002	1294
60	505	-415	3.4	764	87	104	304	210	0.0002	1165
65	523	-433	3.6	718	81	99	286	205	0.0002	1139
70	538	-448	3.0	876	102	114	348	220	0.0002	1223
75	550	-460	2.4	1117	135	136	440	240	0.0002	1335
80	568	-478	3.6	718	81	99	286	205	0.0002	1139
85	580	-490	2.4	1117	135	136	440	240	0.0002	1335
90	595	-505	3.0	876	102	114	348	220	0.0002	1223
95	613	-523	3.6	718	81	99	286	205	0.0002	1139
100	620	-530	1.4	2010	232	189	781	296	0.0002	1647
105	645	-555	5.0	502	53	77	202	180	0.0002	1002
110	660	-570	3.0	876	102	114	348	220	0.0002	1223
115	672	-582	2.4	1117	135	136	440	240	0.0002	1335
120	685	-595	2.6	1023	122	127	405	233	0.0002	1294
125	695	-605	2.0	1362	170	156	535	258	0.0002	1433
130	705	-615	2.0	1362	170	156	535	258	0.0002	1433
135	718	-628	2.6	1023	122	127	405	233	0.0002	1294
140	722	-632	0.8	3699	342	239	1414	369	0.0001	2049
145	732	-642	2.0	1362	170	156	535	258	0.0002	1433
150	745	-655	2.6	1023	122	127	405	233	0.0002	1294
155	753	-663	1.6	1737	206	176	677	281	0.0002	1563
160										
165										
170										
175										
180										
185										
190										
195										
200										



ANALYSES OF DYNAMIC CONE PENETRATION TEST RESULTS

PROJECT: ELIDZ Sundale Dairy Extension

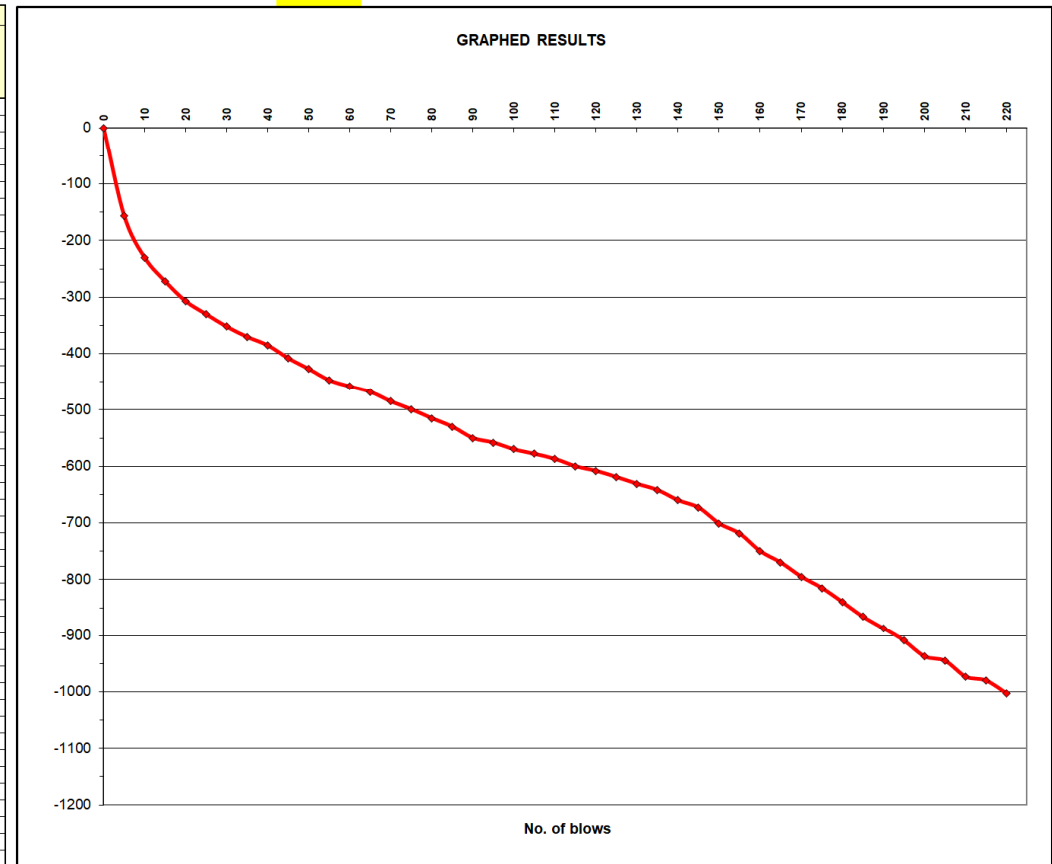
DEPTH: Surface

Traffic Stress σ'_v 250 kPa

CONDUCTED ON: Tuesday, January 14, 2020

Thickness D 180 mm

NO. OF BLOWS	SND TP 4									
	Values (mm)	Cumulative penetration (mm)	mm/blow	UCS (kPa)	CBR% (Kieyn, 1984)	E (MPa) (Packard, 1973)	E (De Beer, 1991) MPa	E (Jianzhou et al., 1999)	ρ (mm)	k (kN/m ³)
0	125	0	0.0							
5	281	-156	31.2	68	5	19	29	88	0.0005	491
10	355	-230	14.8	154	13	33	64	118	0.0004	657
15	397	-272	8.4	285	27	51	116	147	0.0003	819
20	432	-307	7.0	348	35	59	141	158	0.0003	879
25	455	-330	4.6	550	59	82	221	186	0.0002	1036
30	477	-352	4.4	577	62	85	231	190	0.0002	1054
35	495	-370	3.6	718	81	99	286	205	0.0002	1139
40	510	-385	3.0	876	102	114	348	220	0.0002	1223
45	533	-408	4.6	550	59	82	221	186	0.0002	1036
50	552	-427	3.8	677	75	95	270	201	0.0002	1116
55	572	-447	4.0	640	70	91	256	197	0.0002	1094
60	583	-458	2.2	1228	151	145	483	249	0.0002	1381
65	593	-468	2.0	1362	170	156	535	258	0.0002	1433
70	610	-485	3.4	764	87	104	304	210	0.0002	1165
75	624	-499	2.8	944	111	120	374	226	0.0002	1257
80	640	-515	3.2	816	94	109	325	215	0.0002	1193
85	655	-530	3.0	876	102	114	348	220	0.0002	1223
90	675	-550	4.0	640	70	91	256	197	0.0002	1094
95	683	-558	1.6	1737	206	176	677	281	0.0002	1563
100	695	-570	2.4	1117	135	136	440	240	0.0002	1335
105	703	-578	1.6	1737	206	176	677	281	0.0002	1563
110	712	-587	1.8	1528	185	165	598	269	0.0002	1493
115	725	-600	2.6	1023	122	127	405	233	0.0002	1294
120	733	-608	1.6	1737	206	176	677	281	0.0002	1563
125	744	-619	2.2	1228	151	145	483	249	0.0002	1381
130	756	-631	2.4	1117	135	136	440	240	0.0002	1335
135	767	-642	2.2	1228	151	145	483	249	0.0002	1381
140	785	-660	3.6	718	81	99	286	205	0.0002	1139
145	798	-673	2.6	1023	122	127	405	233	0.0002	1294
150	826	-701	5.6	443	46	70	179	173	0.0003	959
155	844	-719	3.6	718	81	99	286	205	0.0002	1139
160	875	-750	6.2	397	40	65	161	166	0.0003	922
165	895	-770	4.0	640	70	91	256	197	0.0002	1094
170	920	-795	5.0	502	53	77	202	180	0.0002	1002
175	940	-815	4.0	640	70	91	256	197	0.0002	1094
180	965	-840	5.0	502	53	77	202	180	0.0002	1002
185	991	-866	5.2	481	51	75	194	178	0.0003	987
190	1012	-887	4.2	607	66	88	243	193	0.0002	1073
195	1034	-909	4.4	577	62	85	231	190	0.0002	1054
200	1062	-937	5.6	443	46	70	179	173	0.0003	959
205	1070	-945	1.6	1737	206	176	677	281	0.0002	1563
210	1098	-973	5.6	443	46	70	179	173	0.0003	959
215	1105	-980	1.4	2010	232	189	781	296	0.0002	1647
220	1128	-1003	4.6	550	59	82	221	186	0.0002	1036
225										



ANALYSES OF DYNAMIC CONE PENETRATION TEST RESULTS

PROJECT: ELIDZ Sundale Dairy Extension

DEPTH: Surface

Traffic Stress σ'_v 250 kPa
 Thickness D 180 mm

CONDUCTED ON: Tuesday, January 14, 2020

NO. OF BLOWS	SND TP 5									
	Values (mm)	Cumulative penetration (mm)	mm/blow	UCS (kPa)	CBR% (Kieyn, 1984)	E (MPa) (Packard, 1973)	E (De Beer, 1991) MPa	E (Jianzhou et al., 1999)	ρ (mm)	k (kN/m ³)
0	120	0	0.0							
5	295	-175	35.0	60	4	17	26	84	0.0005	469
10	370	-250	15.0	152	13	33	63	118	0.0004	653
15	448	-328	15.6	145	13	32	60	116	0.0004	643
20	475	-355	5.4	461	48	72	186	175	0.0003	973
25	556	-436	16.2	139	12	31	58	114	0.0004	634
30	572	-452	3.2	816	94	109	325	215	0.0002	1193
35	591	-471	3.8	677	75	95	270	201	0.0002	1116
40	610	-490	3.8	677	75	95	270	201	0.0002	1116
45	625	-505	3.0	876	102	114	348	220	0.0002	1223
50	638	-518	2.6	1023	122	127	405	233	0.0002	1294
55	650	-530	2.4	1117	135	136	440	240	0.0002	1335
60	660	-540	2.0	1362	170	156	535	258	0.0002	1433
65	674	-554	2.8	944	111	120	374	226	0.0002	1257
70	685	-565	2.2	1228	151	145	483	249	0.0002	1381
75	702	-582	3.4	764	87	104	304	210	0.0002	1165
80	711	-591	1.8	1528	185	165	598	269	0.0002	1493
85	725	-605	2.8	944	111	120	374	226	0.0002	1257
90	738	-618	2.6	1023	122	127	405	233	0.0002	1294
95	753	-633	3.0	876	102	114	348	220	0.0002	1223
100	770	-650	3.4	764	87	104	304	210	0.0002	1165
105	788	-668	3.6	718	81	99	286	205	0.0002	1139
110	803	-683	3.0	876	102	114	348	220	0.0002	1223
115	818	-698	3.0	876	102	114	348	220	0.0002	1223
120	835	-715	3.4	764	87	104	304	210	0.0002	1165
125	854	-734	3.8	677	75	95	270	201	0.0002	1116
130	865	-745	2.2	1228	151	145	483	249	0.0002	1381
135	882	-762	3.4	764	87	104	304	210	0.0002	1165
140	900	-780	3.6	718	81	99	286	205	0.0002	1139
145	918	-798	3.6	718	81	99	286	205	0.0002	1139
150	936	-816	3.6	718	81	99	286	205	0.0002	1139
155	952	-832	3.2	816	94	109	325	215	0.0002	1193
160	975	-855	4.6	550	59	82	221	186	0.0002	1036
165	994	-874	3.8	677	75	95	270	201	0.0002	1116
170	1016	-896	4.4	577	62	85	231	190	0.0002	1054
175	1035	-915	3.8	677	75	95	270	201	0.0002	1116
180	1060	-940	5.0	502	53	77	202	180	0.0002	1002
185	1078	-958	3.6	718	81	99	286	205	0.0002	1139
190	1098	-978	4.0	640	70	91	256	197	0.0002	1094
195	1110	-990	2.4	1117	135	136	440	240	0.0002	1335
200	1125	-1005	3.0	876	102	114	348	220	0.0002	1223
205										



ANALYSES OF DYNAMIC CONE PENETRATION TEST RESULTS

PROJECT: ELIDZ Sundale Dairy Extension

DEPTH: Surface

Traffic Stress σ'_v 250 kPa
 Thickness D 180 mm

CONDUCTED ON: Tuesday, January 14, 2020

NO. OF BLOWS	SND TP 6								
	Values (mm)	Cumulative penetration (mm)	mm/blow	UCS (kPa)	CBR% (Kieyn, 1984)	E (MPa) (Packard, 1973)	E (De Beer, 1991) MPa	E (Jianzhou et al., 1999)	k (kN/m3)
0	110	0	0.0						
5	220	-110	22.0	100	8	24	42	101	0.0004
10	292	-182	14.4	158	14	34	66	119	0.0004
15	372	-262	16.0	141	12	31	59	115	0.0004
20	418	-308	9.2	258	24	48	106	142	0.0003
25	438	-328	4.0	640	70	91	256	197	0.0002
30	463	-353	5.0	502	53	77	202	180	0.0002
35	488	-378	5.0	502	53	77	202	180	0.0002
40	505	-395	3.4	764	87	104	304	210	0.0002
45	522	-412	3.4	764	87	104	304	210	0.0002
50	545	-435	4.6	550	59	82	221	186	0.0002
55	555	-445	2.0	1362	170	156	535	258	0.0002
60	575	-465	4.0	640	70	91	256	197	0.0002
65	592	-482	3.4	764	87	104	304	210	0.0002
70	610	-500	3.6	718	81	99	286	205	0.0002
75	630	-520	4.0	640	70	91	256	197	0.0002
80	660	-550	6.0	411	42	67	167	168	0.0003
85	690	-580	6.0	411	42	67	167	168	0.0003
90	715	-605	5.0	502	53	77	202	180	0.0002
95	742	-632	5.4	461	48	72	186	175	0.0003
100	765	-655	4.6	550	59	82	221	186	0.0002
105	795	-685	6.0	411	42	67	167	168	0.0003
110	825	-715	6.0	411	42	67	167	168	0.0003
115	845	-735	4.0	640	70	91	256	197	0.0002
120	868	-758	4.6	550	59	82	221	186	0.0002
125	888	-778	4.0	640	70	91	256	197	0.0002
130	915	-805	5.4	461	48	72	186	175	0.0003
135	938	-828	4.6	550	59	82	221	186	0.0002
140	961	-851	4.6	550	59	82	221	186	0.0002
145	982	-872	4.2	607	66	88	243	193	0.0002
150	1005	-895	4.6	550	59	82	221	186	0.0002
155	1025	-915	4.0	640	70	91	256	197	0.0002
160	1050	-940	5.0	502	53	77	202	180	0.0002
165	1060	-950	2.0	1362	170	156	535	258	0.0002
170	1086	-976	5.2	481	51	75	194	178	0.0003
175	1110	-1000	4.8	525	56	79	211	183	0.0002
180									
185	1090	-1090	218.0	8	0	4	4	41	0.0011
190	1102	-1102	2.4	1117	135	136	440	240	0.0002
195	1120	-1120	3.6	718	81	99	286	205	0.0002
200	1135	-1135	3.0	876	102	114	348	220	0.0002
205	1140	-1140	1.0	2900	300	221	1116	338	0.0001
210									



ANALYSES OF DYNAMIC CONE PENETRATION TEST RESULTS

PROJECT: **ELIDZ Sundale Dairy Extension**

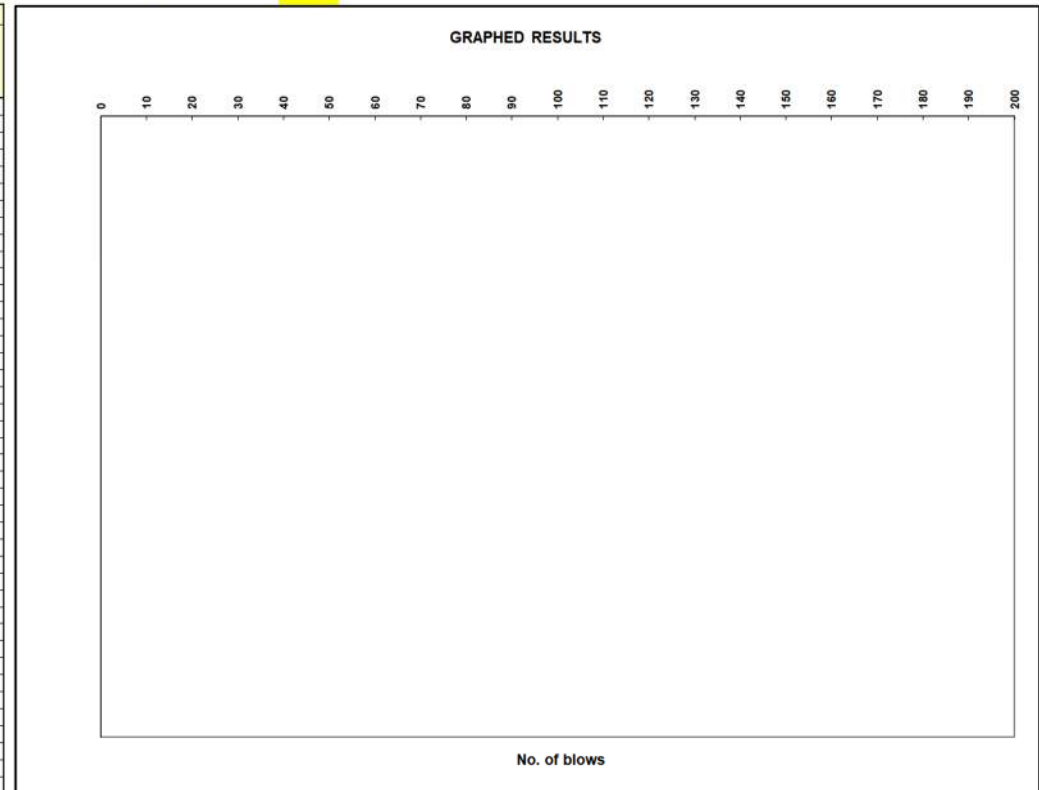
DEPTH: Surface

Traffic Stress σ'_v 250 kPa

CONDUCTED ON: Tuesday, January 14, 2020

Thickness D 180 mm

NO. OF BLOWS	SND TP 7									
	Values (mm)	Cumulative penetration (mm)	mm/blow	UCS (kPa)	CBR% (Kleyn, 1984)	E (MPa) (Packard, 1973)	E (De Beer, 1991) MPa	E (Jianzhou et al., 1999)	ρ (mm)	k (kN/m ³)
0	No DCP Test									
5	Shallow Bedrock									
10										
15										
20										
25										
30										
35										
40										
45										
50										
55										
60										
65										
70										
75										
80										
85										
90										
95										
100										
105										
110										
115										
120										
125										
130										
135										
140										
145										
150										
155										
160										
165										
170										
175										
180										
185										
190										
195										
200										



ANALYSES OF DYNAMIC CONE PENETRATION TEST RESULTS

PROJECT: **ELIDZ Sundale Dairy Extension**

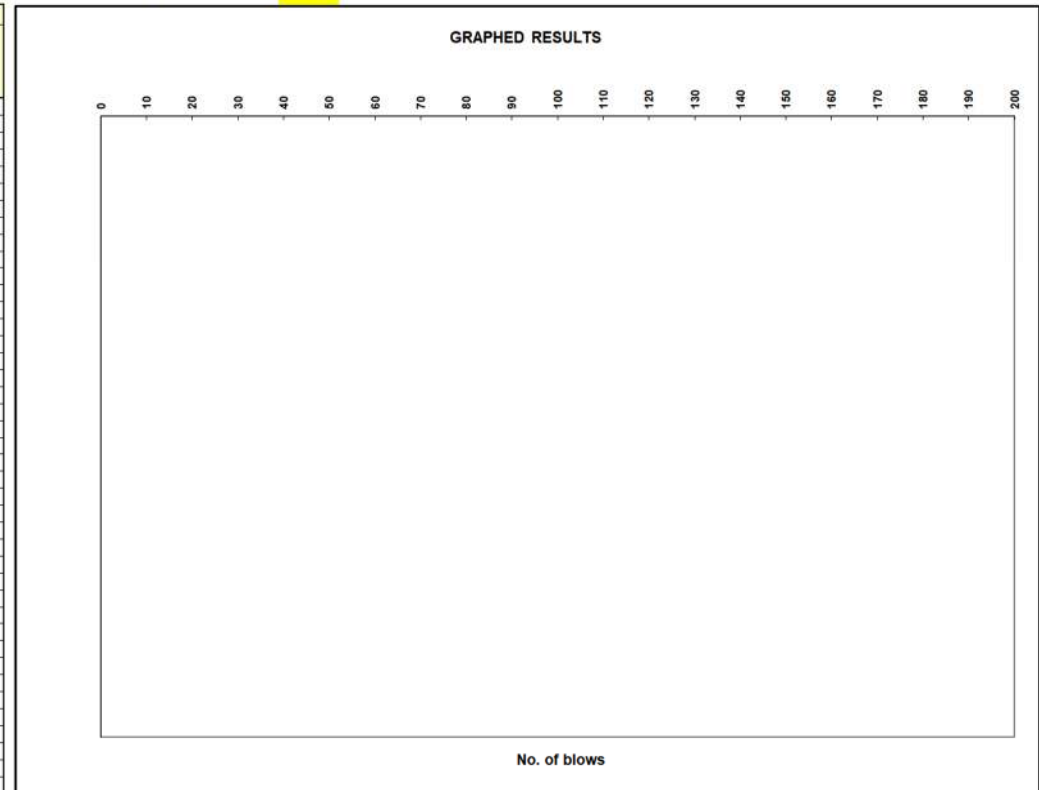
DEPTH: Surface

Traffic Stress σ'_v 250 kPa

CONDUCTED ON: Tuesday, January 14, 2020

Thickness D 180 mm

NO. OF BLOWS	SND TP 8									
	Values (mm)	Cumulative penetration (mm)	mm/blow	UCS (kPa)	CBR% (Kleyn, 1984)	E (MPa) (Packard, 1973)	E (De Beer, 1991) MPa	E (Jianzhou et al., 1999)	ρ (mm)	k (kN/m ³)
0	No DCP Test									
5	Shallow Bedrock									
10										
15										
20										
25										
30										
35										
40										
45										
50										
55										
60										
65										
70										
75										
80										
85										
90										
95										
100										
105										
110										
115										
120										
125										
130										
135										
140										
145										
150										
155										
160										
165										
170										
175										
180										
185										
190										
195										
200										



APPENDIX C

Soil laboratory analysis certificates



ControlLab South Africa (Pty) Ltd

CIVIL ENGINEERING MATERIALS AND GEOTECHNICAL LABORATORY

www.controlab.co.za



ISO/IEC 17025:2005 Accredited Laboratory

HEAD OFFICE: 1 Alfred Road, Vincent 5247, Tel: 043 726 7859, Fax: 043 726 7426

CENTRAL LABORATORY: 10 St Pauls Road, East London, 5201, Tel: 043 722 5420 / 722 8565, Fax 043 743 9942, P O Box 346, East London, 5200

OTHER BRANCH OFFICES: Cape Town, Kokstad, Johannesburg, Mthatha, Queenstown, Lusaka - Zambia

CLIENT: AGES Omega (Pty) Ltd

Postnet Suite 203

Private Bag X9063

EAST LONDON, 5200

ATT: Mr F de Jager

PROJECT: GTEC E20-003 SND EXT

DATE RECEIVED: 2020-01-15

DATE TESTED: 2020-02-20

DATE REPORTED: 2020-02-24

TEST REPORT NO.: 98278

MATERIALS TEST REPORT

SAMPLE NO:	791	792	793		
POSITION / CHAINAGE		SND			
	4/1	2/1	6/2		
DESCRIPTION	dk R Br	fl Br	dk Ol		
	Sh +	Sh	sh		

Sieve Analysis (Wet Preparation) SANS 3001 - Part GR1

% PASSING 75 mm		100			
63 mm		96	100		
50 mm		95	96		
37.5 mm		94	95		
28 mm		90	95		
20 mm	100	81	90		
14 mm	98	66	85		
5 mm	74	36	51		
2.00 mm	54	24	31		
0.425 mm	43	15	18		
0.075 mm	31.0	9.9	13.9		

Soil Mortar Analysis - SANS 3001 - PR5

COURSE SAND (%)	20	40	42		
FINE SAND (%)	22	20	13		
SILT / CLAY (%)	57	40	45		
GRADING MODULUS	1.72	2.51	2.37		

Atterberg Limits - SANS 3001 - GR10 & GR11

LIQUID LIMIT (%)	29	28	35		
PLASTICITY INDEX (%)	14	14	20		
LINEAR SHRINKAGE (%)	7.0	7.0	9.5		

Maximum Dry Density & Optimum Moisture Content - SANS 3001 - GR30 / California Bearing Ratio - SANS 3001 - GR40

Maximum Dry Density (kg/m ³)	1940	2116	2156		
Optimum Moisture Content (%)	10.5	9.0	7.9		
C.B.R. @ 100% COMPACTION	40	61	33		
C.B.R. @ 98% COMPACTION	27	52	23		
C.B.R. @ 95% COMPACTION	14	40	14		
C.B.R. @ 93% COMPACTION	9	35	9		
C.B.R. @ 90% COMPACTION	4	28	6		
SWELL @ 100% COMP. (%)	0.40	0.40	0.40		
T R H 14 CLASSIFICATION	G9	G6	G9		

The above test results are pertinent to the samples tested only. While the tests are carried out according to recognized standards, ControlLab shall not be liable for erroneous testing or reporting thereof. This report may not be reproduced except in full without prior consent of ControlLab.

Technical Signatory

Atterbury

Remarks:

Sample Delivered by Customer

☒

Sampled by ControlLab

Page 1 of 2

STR001


ControlLab South Africa (Pty) Ltd

CIVIL ENGINEERING MATERIALS AND GEOTECHNICAL LABORATORY

www.controlab.co.za



ISO/IEC 17025:2005 Accredited Laboratory

HEAD OFFICE: 1 Alfred Road, Vincent 5247, Tel: 043 726 7859, Fax: 043 726 7426

CENTRAL LABORATORY: 10 St Pauls Road, East London, 5201, Tel: 043 722 5420 / 722 8565, Fax 043 743 9942, P O Box 346, East London, 5200

OTHER BRANCH OFFICES: Cape Town, Kokstad, Johannesburg, Mthatha, Queenstown, Lusaka - Zambia

CLIENT: AGES Omega (Pty) Ltd
Postnet Suite 203
Private Bag X9063
EAST LONDON, 5200

PROJECT: GTEC E20-003 SND EXT

DATE RECEIVED: 2020-01-15

DATE TESTED: 2020-02-21

DATE REPORTED: 2020-02-24

ATT: Mr F de Jager

TEST REPORT NO.: 98278

FOUNDATION INDICATOR REPORT

SAMPLE NO	788	789	790			
POSITION	1/1	1/2	6/1			
DESCRIPTION	dk Br sdy st	dk Br Ferr + sdy st	dk Br Ferr + cly s			

SIEVE ANALYSIS % PASSING SIEVES: Method: SANS 3001-AG1

% PASSING	75 mm					
63 mm						
50 mm						
37.5 mm						
28 mm		100	100			
20 mm		93	98			
14 mm		90	97			
10 mm		84	96			
7.1 mm		74	93			
5.00 mm	100	65	87			
2.00 mm	99	48	68			
1.00 mm	98	43	61			
0.600 mm	97.2	42.0	60.5			
0.425 mm	96.6	41.5	60.1			
0.300 mm	94.1	40.3	58.4			
0.150 mm	74.8	33.3	44.7			
0.075 mm	55.8	26.1	35.3			

GRADING MODULUS	0.5	1.8	1.4			
-----------------	-----	-----	-----	--	--	--

HYDROMETER ANALYSIS: Method: SANS 3001-GR3

0.060 mm	49	23	31			
0.020 mm	27	14	21			
0.006 mm	19	11	18			
0.002 mm	17	10	17			

ATTEBERG LIMITS: Method: SANS 3001-GR10

LIQUID LIMIT	CBD	22	24			
PLASTICITY INDEX	SP	9	12			
LINEAR SHRINKAGE	1.5	5.0	6.0			

PREDICTION OF HEAVE (VAN DER MERWE METHOD)

MOISTURE CONTENT	6.7	3.8	7.1			
PI WHOLE SAMPLE	0.0	4.0	6.0			
POTENTIAL EXPANSIVENESS	LOW	LOW	LOW			

The above test results are pertinent to the samples received and tested only.

While the tests are carried out according to recognized standards ControlLab shall not be liable for erroneous testing or reporting thereof. This report may not be reproduced except in full without prior consent of ControlLab.

Remarks:

Samples Delivered by Customer: YES

Sampled by ControlLab

Technical Signatory:

J. L. Lutterbury

STR0032A



OTHER BRANCH OFFICES: Cape Town, Kokstad, Johannesburg, Mthatha, Queenstown, Lusaka - Zambia

TEST REPORT NO: 98278

Latterbury