REPORT TO

ILISO CONSULTING ENVIRONMENTAL MANAGEMENT (PTY) LTD

ON A

SPECIALIST PRELIMINARY GEOTECHNICAL INVESTIGATION

FOR THE PROPOSED

ESKOM MKUZE SUBSTATION

Ref № 31833

JULY 2017

DRENNAN MAUD (PTY) LTD
GEOTECHNICAL ENGINEERS &
ENGINEERING GEOLOGISTS

Durban Head Office
68 Peter Mokaba Ridge, Tollgate, 4001
P.O. Box 30464, Mayville, 4058
Tel : +27 31 201 8992 Fax : +27 31 201 7920
www.drennanmaud.com

EXECUTIVE SUMMARY

Drennan Maud (Pty) Ltd carried out a preliminary geotechnical investigation in May 2017 at three candidate sites, namely Iphiva 4, 5 and 6 for the proposed Eskom Mkuze Substation which forms part of Eskom's Northern KZN Strengthening Programme. The geotechnical investigation was undertaken as a specialist study for the Environmental Impact Assessment.

Based on the field investigation, Iphiva 4 and 5 are characterised by active colluvium and residual basalt of variable thickness overlying Letaba Formation amygdaloidal basalt. Iphiva 6 is characterised by a thin mantle of hillwash material directly overlying intruded Karoo dolerite. The sites are relatively level with no indication of site instability. No drainage lines / depressions / valleys / streams were observed within the footprints of the three candidate sites during the field investigation.

Regarding material suitability, the active clayey colluvium / hillwash and residual basalt horizons encountered across the sites are not considered suitable for use as engineered fill in platforms or for use in road and pavement layerworks. The weathered basalt and dolerite bedrocks are considered suitable for use as engineered fill and layerworks; however, these materials are likely to be a thin horizon with limited volume.

In general, the colluvium, hillwash, residual and completely to highly weathered bedrock classifies as "Soft Excavation" (after SANS 1200D-1988) below which 'Boulder Excavation Class B" rapidly becoming "Hard Excavation" is to be expected for the weathered basalt and dolerite bedrock. "Soft Excavation" at Iphiva 4 is expected to depths of ±1.50m in the northern portions increasing to ±3.50m toward the south. Iphiva 5 is expected to be excavatable by "Soft Excavation" to ±2.00m in the southwestern / western areas of the site increasing to ±3.50m toward the northeastern portion. At Iphiva 6, "Soft Excavation" can be inferred across the site to depths ranging between 1.00 and 1.50 m below current ground level.

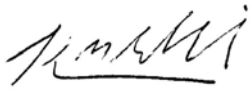
Earthwork plans have not been provided in this preliminary stage; however, minor cutting / filling is envisioned (< 2-3 m). Eskom sites commonly require a 1.0 - 1.5 m capping of Engineered fill comprising G5 / G6 / G7 / G8 type material. Permanent batters of 1:2 (26°) are recommended for all cuts and fill slopes. Temporary cut slopes of limited height (< 3 m) may be steepened to 1:1 (45º).

Founding of structures will be variable depending on structure type, loading and positioning due to the variable geology of the sites. The founding recommendations assume an upper 1.5 m good quality granular fill capping (G5 / G6 / G7 / G8 type) as commonly found at Eskom sites. Small and lightly loaded structures can be founded using strip footings / pads / raft type foundations supported in the upper 1.5 m engineered fill capping. Shallow strip footing / column base pad foundations taken into bedrock are recommended where depth to bedrock is less than 1.5 m. Where thicker clayey soils overlie weathered bedrock, heavier and sensitive structures may require stiffened rafts or rafts / ground beams supported on piles to bedrock.

A seismic assessment of the Mkuze area indicates the proposed sites have an MMI value of VI with a peak horizontal ground acceleration of 50-100 cm/s^2 (0.05-0.1 g) for a 50 year period.

Based on the prevailing geotechnical conditions on the sites, all three candidate sites are developable. Iphiva 6 has shallow bedrock throughout (0.10-0.60 m) which is suitable for founding; however, this results in costly excavation issues for earthworks / service trenches. Conversely, bedrock depths are deeper at Iphiva 4 and 5 (0.40-4.00 m) resulting in deep founding solutions for heavier / sensitive structures; however, less costly excavation issues for earthworks / service trenches.

DOCUMENT CONTROL

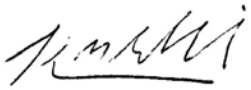
Report Title		Specialist Preliminary Geotechnical Investigation for the Proposed Eskom Mkuze Substation		
Report Reference		31833	**Responsible Person**	K. Ribbink
Client Name		ILISO Consulting Environmental Management (Pty) Ltd	**Client Contact Details**	1761 Tezula Estate, Uranium Street, Witkoppen ext 107 2191
Revision	**Date**		**Current Revision**	
00	19/07/17			
01	09/10/17	Revisions based on Eskom Feedback	01	
Approval				
Author's Signature			**Reviewer's Signature**	
Name		J. Lodge	**Name**	K. Ribbink
Title		Eng. Geol.	**Title**	Pr. Sci. Nat
Professional Body		N/A	**Professional Body**	SACNASP
Registration Number		N/A	**Registration Number**	400051/99

The ground conditions described in this report refer specifically to those encountered in the inspection pits and penetrometer tests carried out across the various sites. It is therefore quite possible that ground conditions may vary from those in the above mentioned testing positions.

This information in this report is given in good faith, as an indication of the materials and conditions likely to be encountered during construction. However, there is no warranty that the information is totally representative of the entire area and no responsibility will be accepted for any consequences arising from actual conditions being different from those indicated in this document.

DECLARATION OF INDEPENDENCE

K. Ribbink and J. Lodge, who are Engineering Geologists from Drennan Maud (Pty) Ltd, are independent consultants to ILISO Consulting Environmental Management (Pty) Ltd (Consultants for ESKOM Holdings SOC Ltd), i.e. they have no business, financial, personal or other interest in the activity, application or appeal in respect of which they were appointed other than fair remuneration for work performed in connection with the activity, application or appeal. There are no circumstances that compromise the objectivity of these specialists performing such work.



19 July 2017

Signature of Engineering Geologist (Pr. Sci. Nat.): K. Ribbink Date

19 July 2017

Signature of Engineering Geologist: J. Lodge Date

CONTENTS

CONTENTS

REPORT TO ILISO CONSULTING ENVIRONMENTAL MANAGEMENT ON A SPECIALIST PRELIMINARY GEOTECHNICAL INVESTIGATION FOR THE PROPOSED ESKOM MKUZE SUBSTATION

1. INTRODUCTION AND TERMS OF REFERENCE

At the request of Ms Terry Calmeyer of ILISO Consulting Environmental Management (Pty) Ltd (ICEM), Drennan Maud (Pty) Ltd (DML) provided a quotation to carry out a preliminary geotechnical investigation at three candidate sites for the proposed Eskom Mkuze Substation, which forms part of Eskom's Northern KZN Strengthening Programme. The quotation, ref 91 dated 15th August 2016, was submitted to ICEM and DML was subsequently appointed by Ms Calmeyer on behalf of Eskom Holdings SOC Ltd (Eskom) on 14th February 2017. The geotechnical investigation was undertaken as a specialist study for the Environmental Impact Assessment (EIA).

The aim of the preliminary geotechnical investigation is to determine the geotechnical subsoil conditions relative to the proposed earthworks, to identify potential problems and to determine the most suitable site for the proposed development according to its geotechnical properties, namely:

- Site geology and stratigraphy
- Soil and rock classification
- Potential geotechnical problems
- Identification of areas of steep and potentially unstable zones
- Earthworks and platform construction recommendations
- Excavatability of material on site as per SANS 1200D specifications
- Establish the on site sources available to obtain suitable material for fill
- Site drainage
- Soil corrosion protection
- Recommended potential foundation solutions
- Seismic assessment and classification of the site

The three candidate sites were visited on the 3rd to 5th May 2017 at which time the geotechnical investigation was carried out.

The findings of the geotechnical investigation, assessment of the results and subsequent recommendations for the proposed development are discussed herewith below.

2. INFORMATION SUPPLIED AND PREVIOUS WORK

Information supplied to DML for the purpose of this investigation included:

- Terms of Reference for Specialist Studies for Eskom's Northern KwaZulu-Natal Strengthening Project
- National Environmental Management Act's Environmental Impact Assessment Regulations, 2014 (GN 982)
- Kmz files of the site locations
- A locality map for Iphiva 4, 5 and 6

In addition to the above, the following geotechnical report from a previous geotechnical investigation conducted in the area by DML was consulted:

- Report reference 24473, titled "Geotechnical Report to Building Energy S.p.A. for the Proposed Biomass Plant of Mkuze, KwaZulu Natal, South Africa", dated March 2014.

3. PROPOSED DEVELOPMENT

It is understood that the proposed development consists of the construction of the new Iphiva 400/132 kV Substation near the town of Mkuze in Northern KwaZulu-Natal (KZN). The new Iphiva Substation will be integrated into the 400 kV network by two 400 kV lines and approximately 65 km of 132 kV distribution powerlines in order to alleviate current and future network constraints in Northern KZN.

The proposed Iphiva 400/132 kV Substation earthworks will be 400 m x 400 m in size within a 600 m x 600 m footprint within a 1 km x 1 km study area. The substation will comprise of the standard electrical equipment such as transformers, reactors, busbars and isolators. The substation will have a microwave radio communication mast that could be up to 70 m high. Oil and fuel storage facilities will be bunded. Construction and/or upgrade of access roads to the substation will be required to accommodate the large heavy loads.

Three candidate sites were identified by the client as possible locations for the proposed substation, namely Iphiva 4, Iphiva 5 and Iphiva 6.

4. SITE DESCRIPTION

The three candidate sites for the proposed Iphiva Substation are located to the southwest of Mkuze in Northern KZN, across the N2 National Road.

Iphiva 4 is accessed via the P234 from the intersection with the N2 highway, followed southwest for approximately 1.2 km and turning right onto the D240. The dirt road is followed for approximately 0.5 km where the site is located 250 m on the right. The site is part of privately owned farm land; however, it was vacant at the time of the investigation. The area is relatively level and is covered by long grasses with numerous thorn trees and bushes.

Iphiva 5 is located across the D240 Road from Iphiva 4. As with Iphiva 4, the site is part of privately owned open farm land which was unoccupied at the time of the investigation. An Eskom distribution line cuts through the southeast corner of the site. The general area is relatively flat and vegetated by long grasses, thorn trees and bushes; however, it is less vegetated than Iphiva 4.

Iphiva 6 is accessed via the P234, approximately 8.8 km from the intersection with the N2, turning right onto an unnamed road toward Obani Primary School which is followed for 0.8 km and the site is located some 300 m to the west. The northern portion of the project area is relatively level while the southern portion is gently sloping toward the south. The site currently comprises numerous dwellings and small shops and other community buildings. It is vegetated by short grasses, aloes and trees and the ground is covered with abundant subrounded dolerite cobbles to large boulders.

The locality of Iphiva 4, 5 and 6 are shown in the Locality Plan, Drawing № 31833-01. Plates 1 to 3 overleaf have been included to show a perspective of the different Iphiva sites.

Plate 1: Iphiva 4

Plate 2: Iphiva 5

Plate 3: Iphiva 6

5. FIELD WORK

The field work was carried out on the 3rd to 5th May 2017 and consisted of the following:

- Mechanically excavated inspection pits,
- Dynamic Cone Penetrometer (DCP) testing; and
- Subsoil sampling.

The approximate field test positions for each of the candidate sites, Iphiva 4, 5 and 6, are indicated on the site plans, Drawing №'s 31833-02A, 31833-02B and 31833-02C, respectively.

5.1 Inspection Pits

A total of twenty-nine (29 №) inspection pits where mechanically dug across the three candidate sites by a JCB 3CX TLB to investigate the nature of the underlying subsoils, depths to bedrock and its excavatability and to obtain samples for laboratory testing. Ten (10 №) were dug across the footprint of Iphiva 4, designated I4-IP1 to I4-IP10, nine (9 №) were excavated for Iphiva 5, designated I5-IP1 to I5-IP9, and ten (10 №) inspection pits were dug across Iphiva 6, designated I6-IP1 to I6-IP10. The inspection pits were advanced to maximum reach of the TLB arm or refusal, these depths ranged between 0.70 m (I6-IP2) and 3.10 m (I4-IP10) below existing ground level (EGL).

The disturbed subsoils recovered from the inspection pit excavations were examined and logged by an Engineering Geologist familiar with the procedures of soil and rock logging in terms of the Guidelines for Soil and Rock Logging in South Africa, edited by A.B.A. Brink & R.M.H. Bruin, 2nd Impression 2002, recording the following parameters:

- For soil: moisture condition, colour, consistency, structure (where applicable), soil texture and origin.
- For rock: colour, weathering, fabric, discontinuities, hardness and rock type.

The detailed profiles as well as their respective photographs are presented in Appendix A of this report.

5.2 Dynamic Cone Penetrometer

A total of twenty-nine (29 №) Dynamic Cone Penetrometer (DCP) tests were conducted adjacent to the inspection pits and some were advanced further from the bottom of the inspection pit. The DCP test number corresponds to the inspection pit number. Ten (10 №) DCP tests were carried out at Iphiva 4, designated DCP1 to DCP10, with an addition three conducted from the bottom of IP3, 4 and 5. Nine (9 №) DCP tests were carried out adjacent the inspection pits at Iphiva 5, designated DCP1 to DCP9, with DCP1, 4 and 9 repeated from at the bottom of the inspection pit. Ten (10 №) DCP tests were conducted at Iphiva 6 adjacent the inspection pits. The aim of the DCP testing was to obtain an indication of the consistency of the subsoils underlying the site at shallow to moderate depths or possible depth to bedrock. The DCP tests were carried out to refusal on very stiff clays, very dense sand or gravel rich horizons or very soft to soft rock bedrock.

The results of the probes are presented graphically in Appendix B of this report. Tables 1 to 3 overleaf provide a quick reference of DCP blow counts / 300 mm penetration for each of the sites.

Table 1 : Summary of DCP Test Results at Iphiva 4 (Blow Count / 300 mm Penetration)

Depth (m)	Iphiva 4 DCP Tests												
	1	2	3 A	3 B	4 A	4 B	5 A	5 B	6	7	8	9	10
0.3	29	22	16		24		25		47	31	14	39	18
0.6	113	97	36		45		46		86	76	36	102	45
0.9		110	86		63		75		128	121	49	98	61
1.2			148		72		150				62		104
1.5					150						56		
1.8											59		
2.1											77		
2.4											98		
2.7													
3													
3.3				86		67		75					
3.6				150		150		109					

Table 2 : Summary of DCP Test Results at Iphiva 5 (Blow Count / 300 mm Penetration)

Depth (m)	Iphiva 5 DCP Tests											
	1 A	1 B	2	3	4 A	4 B	5	6	7	8	9 A	9 B
0.3	40		27	21	52		15	57	5	25	40	
0.6	118		100	100	110		68	86	35	70	100	
0.9							106	101	71	105		
1.2									93			
1.5												
1.8												
2.1												
2.4												
2.7												
3												
3.3		120				150						12

Table 3 : Summary of DCP Test Results at Iphiva 6 (Blow Count / 300 mm Penetration)

Depth (m)	Iphiva 6 DCP Tests									
	1	2	3	4	5	6	7	8	9	10
0.3	27	85	84	63	48	64	49	72	66	34
0.6	47						93			
0.9	59									

Table 4 below is provided to aid in the interpretation of the DCP test results in terms of the inferred subsoil consistency. It should be noted though that the table is based on the DML probe and should be used as a guide only.

Table 4 : Subsoil Consistency Inferred from the DCP Test Results

Non Cohesive Soils		Cohesive Soils	
№ of blows/300 mm Penetration	Subsoil Consistency	№ Of blows/300 mm Penetration	Subsoil Consistency
<8	Very loose	<4	Very soft
8 - 18	Loose	4 - 8	Soft
19 - 54	Medium dense	9 - 16	Firm
55 - 90	Dense	17 - 24	Stiff
>90	Very dense	25 - 54	Very stiff
		>54	Hard

5.3 Subsoil Sampling

In order to classify materials and to assess their suitability for use in construction and for foundations, a total of twelve (12 №) disturbed samples were retrieved from representative soil and bedrock horizons within the excavated inspection pits and returned to Thekweni Soils Laboratory in Durban and Waterlab in Pretoria for analysis. Analysis of the samples included the following:

- Full Grading Analysis (Atterberg Limits, Particle Size Distribution, Hydrometer Analysis)
- Mod AASHTO Dry Density
- California Bearing Ratio (CBR)
- pH
- Conductivity
- Chemical Analysis from Soil Extract (Basson Index) and Special Digest (BRE)

A schedule of the laboratory samples and the tests conducted on each is included in Table 5 below.

Table 5 : Laboratory Testing Schedule

IP	Description	Depth (m)	Test				
			Full Indicator	Mod AASHTO	CBR	pH & Conductivity	Basson & BRE
I4-IP1	Colluvium	0.00 - 0.70	x	x	x	x	x
I4-IP4	Colluvium	0.00 - 0.70	x	x	x		
I4-IP8	Residual Basalt	0.90 - 2.20	x	x	x	x	x
I4-IP9	Residual Basalt	1.30 - 2.40	x	x	x		
I5-IP3	Basalt	0.40 - 1.70	x	x	x		
I5-IP4	Residual Basalt	0.80 - 3.00	x				
I5-IP7	Residual Basalt	0.60 - 2.30	x			x	x
I5-IP9	Colluvium	0.00 - 1.00	x	x	x	x	x
I6-IP1	Hillwash	0.00 - 0.60	x	x	x		
I6-IP5	Dolerite	0.30 - 1.00	x	x	x	x	x
I6-IP6	Dolerite	0.20 - 0.80	x	x	x		
I6-IP7	Hillwash	0.00 - 0.30	x	x	x	x	x

The detailed laboratory results are included in Appendix C of this report and discussed further under Section 7.

6. GEOLOGY AND SOILS

6.1 Regional Geology

Consultation of the 1:250 000 geological series of the area, 2730 Vryheid and 2732 St Lucia, shows the general geology; within which the candidate sites occur; to be underlain by a mantle of transported and residual soils overlying Triassic Period Nyoka Formation and Clarens Formation sandstone, shale and siltstone (Iphiva 6) or Jurassic Period Letaba Formation basalt (Iphiva 4 and 5). The area has been to a large extent intruded by Jurassic Period Karoo dolerite as well as undergone faulting with major geological faults striking north or northeast. The regional geology of the area is shown on the Geological Plan, Drawing № 31833-03.

6.2 Local Geology

6.2.1 *Iphiva 4*

A mantle of colluvial material was encountered across the site. It was encountered from surface to depths ranging between 0.30 to 1.00 m below EGL with an average depth of **0.70 m**. The colluvium generally comprises dry to slightly moist, brown to dark brown, stiff to hard, slightly sandy silty clay with trace gravels of basalt.

Residual basalt was encountered in all the test positions except IP1. It was encountered below the colluvium and extended to depths ranging from 1.10 m below EGL to beyond the final depths of the inspection pit (namely beyond 3 m). Therefore, average depths of **1.20 m in the north, 2.20 m in the central region and > 3.00 m in the south (estimated 3.50 to 4.00 m on average) with no residual basalt in the northern most region** can be expected. The residual soils generally comprise dry to slightly moist, brown to orangey brown, hard / very dense, slightly sandy silty clay to slightly clayey silty sand with abundant gravels of basalt and amygdales.

The residual soils are generally underlain by basalt bedrock; however, bedrock was observed directly below colluvial material in IP1. The contact between bedrock and the overlying soils dips toward the south as the inspection pits revealed relatively shallow bedrock to the north (0.70, 1.10 and 1.30 m below EGL at IP1, 7 and 2, respectively) and deeper soils to the south (greater than 3 m below EGL at IP6, 10, 5, 4 and 3). The basalt bedrock encountered comprises brown, completely weathered, soft rock basalt of the Letaba Formation with slightly weathered, hard rock corestones. The abundance and size of the hard rock corestones is expected to increase rapidly with depth grading down into hard rock bedrock.

Plate 4 below shows the typical shallow subsoil profile across Iphiva 4.

Plate 4: Typical shallow subsoil profile of Iphiva 4 (as observed in IP8)

6.2.2 *Iphiva 5*

Colluvial soils were encountered in all the test positions across Iphiva 5. They were encountered from surface to depths ranging from 0.40 to 1.00 m below EGL with an average depth of **0.70 m**. The soils generally comprises dry, brown to dark brown, very stiff to hard, slightly sandy silty clay with trace to minor gravels of basalt.

Residual basalt was generally encountered directly below the colluvial soils and extended to depths ranging from 1.40 m below EGL to beyond the final depths of the inspection pit (beyond 3 m). Therefore, average depths of **2.30 m in the central region and > 3.00 m in the east (estimated 3.50 to 4.00 m on average) with no residual basalt in the west** can be expected. It generally comprises dry, brown to orangey brown, hard / very dense, slightly sandy silty clay to clayey silt to slightly clayey silty sand with minor to abundant gravels of basalt and amygdales.

The residual soils are generally underlain by basalt bedrock except in IP2 and IP3 were bedrock was observed directly below the colluvial material. The contact between the basaltic bedrock and the overlying soils appears to dip toward the east / northeast as the thicker soils are observed in the east and shallow bedrock in the west (0.40, 0.90 and 1.40 m below EGL at IP3, 2 and 5, respectively). The bedrock generally comprises brown, completely to highly weathered, soft to medium hard rock basalt of the Letaba Formation with slightly weathered, hard rock corestones and fragments. The abundance and size of the hard rock corestones is expected to increase rapidly with depth grading down into hard rock bedrock.

Plate 5 below shows the typical shallow subsoil profile across Iphiva 5.

Plate 5: Typical shallow subsoil profile across Iphiva 5 (as observed in IP7)

6.2.3 *Iphiva 6*

A thin mantle of hillwash was encountered in all the inspection pits. It was encountered from surface to depths ranging between 0.10 and 0.60 m below EGL with an average depth of **0.30 m**. The hillwash generally comprises dry to slightly moist, brown to dark brown, stiff to very stiff, sandy clay with abundant gravels, cobbles and boulders of dolerite.

The hillwash material is underlain directly by dolerite bedrock which extends beyond refusal depths of the inspection pits. The dolerite bedrock comprises light brown, completely to highly weathered, very soft to soft rock dolerite with slightly weathered hard rock corestones and fragments, rapidly becoming blue grey, medium to slightly weathered, medium hard to hard rock dolerite with depth.

Plate 6 and 7 below show the typical profiles for the very soft to soft rock dolerite and the medium hard to hard rock dolerite encountered across Iphiva 6.

Plate 6: Typical profile of very soft to soft rock dolerite with hard rock corestones at Iphiva 6 (as observed in IP9)

Plate 7: Typical profile of medium hard to hard rock dolerite at Iphiva 6 (as observed in IP8)

6.3 Groundwater Seepage

No groundwater seepage was encountered in any of the test positions on any of the sites. However, groundwater seepage could be expected to occur during periods of high rainfall in the form of perched groundwater tables overlying less permeable clay horizons or above the soil / rock interface.

The lack of seepage at the time of the investigation can possibly be attributed to the investigation taking place during winter / the dry season.

7. LABORATORY TESTING

7.1 Material Classification Test Results

The results of the grading analysis, density and CBR tests for the respective materials sampled on site, are included in Table 6 overleaf for ease of reference. The results are also summarised in the Laboratory Test Summary Tables included in Appendix C of this report along with graphical representation of the materials analysis.

Table 6 : Summary of Material Classification Test Results

(Grading Analysis, Atterberg Limits, Mod AASHTO, Optimum Moisture Content, CBR and Respective Classifications)

IP	Depth (m)	Particle Size (%)				Atterberg Limits (%)			GM	Modified AASHTO		CBR VALUES						Classification (AASHTO) (Unified Classification) (TRH 14-1985)
		Clay	Silt	Sand	Gravel	LL	PI	LS		MDD (kg/m^3)	OMC (%)	Compaction MDD (%)					Swell (%)	
												90	93	95	98	100		
COLLUVIUM / HILLWASH																		
I4-IP1	0.0 - 0.7	52	26	13.1	8.6	41	11	7.3	0.4	1598	20.9	3	4	5	9	13	1.34	A-7-6; ML; G10
I4-IP4	0.0 - 0.7	52	24	14.1	9.8	62	20	15	0.5	1487	25	0.6	1	0.7	0.8	0.8	11.5	A-7-5; MH; G10+
I5-IP9	0.0 - 1.0	50	28	10.3	11.8	46	15	9.3	0.5	1443	24.3	2	3	5	7	8	2.69	A-7-5; ML; G10+
I6-IP1	0.0 - 0.6	46	23	17.3	12.6	43	11	11	0.6	1676	18.7	1.3	2	2.7	3.9	4.9	3.9	A-8; ML; G10+
I6-IP7	0.0 - 0.3	22	15	19.6	42.8	40	12	9.3	1.6	1840	15.8	7	8	9	10	11	1.39	A-6; SM; G9
RESIDUAL BASALT																		
I4-IP8	0.9 - 2.2	33	25	20.2	22.3	60	31	15	0.9	1570	24.8	1.5	2	2	2.1	2.2	6.81	A-7-6; CH; G10+
I4-IP9	1.3 - 2.4	9.9	8.2	30.4	51	43	9.7	7.3	2	1871	16.3	16	22	27	27	27	0	A-2-5; SM; G7
I5-IP4	0.8 - 3.0	25	49	19.2	6.5	41	11	6	0.4									A-8; ML; Inferred G10+
I5-IP7	0.6 - 2.3	19	24	27.2	29.5	45	12	8	1.2									A-7-5; SM; Inferred G10+
BASALT																		
I5-IP3	0.4 - 1.7	5.3	3.8	10.1	80.7	47	11	9.3	2.6	2139	11	10	12	14	17	18	0	A-2-7; GP-GM; G8
DOLERITE																		
I6-IP5	0.3 - 1.0	10	7.7	13	48	35	9.5	8	2.3	2053	11.3	7	8	9	16	25	1.28	A-2-4; GM; G9
I6-IP6	0.2 - 0.8	2.1	1.7	4.6	87.4	38	12	8.7	2.8	2025	7.4	22	35	48	60	69	0	A-2-6; GW; G8

7.2 Chemical Corrosivity Test Results

The results of the pH and conductivity tests (performed by Thekwini Soils Laboratory) are included in Appendix C of this report and are summarised in Table 7 below.

Table 7 : Summary of pH and Conductivity Test Results

IP	Description	Depth (m)	pH	Conductivity (mS/cm)
I4-IP1	Colluvium / Hillwash	0.0 - 0.7	5.9	22
I5-IP9		0.0 - 1.0	6.5	118
I6-IP7		0.0 - 0.3	6.9	60
I4-IP8	Residual Basalt	0.9 - 2.2	7.2	364
I5-IP7		0.6 - 2.3	7	41
I6-IP5	Dolerite	0.3 - 1.0	6.9	36

The results of the Chemical Analysis from Soil Extract (Basson Index) and Special Digest (BRE) performed by a specialist laboratory Waterlab are also included in Appendix C of this report. A summary extract of the results is included in Table 8 below; however, the full set of corrosivity results should be interpreted by Eskom's relevant experts in this regard.

Table 8 : Summary of Basson Index and BRE Test Results

Sample Name	Sample Number	Corrosivity Indices	Basson Index
I4-IP1; 0.00-0.70 Colluvium	4896	Corrosive	Aggressive
I5-IP9; 0.00-1.00 Colluvium	4898	Corrosive	Aggressive
I6-IP7; 0.00-0.30 Colluvium	4900	Corrosive	Neutral
I4-IP8; 0.90-2.20 Residual Basalt	4897	Corrosive	Aggressive
I5-IP7; 0.60-2.30 Residual Basalt	4899	Corrosive	Aggressive
I6-IP5; 0.30-1.00 Dolerite	4901	Corrosive	Aggressive

8. GEOTECHNICAL ASSESSMENT

8.1 Site Stability

Iphiva 4 and 5 are relatively flat areas. The basalt bedrock is generally known to be a fairly stable rock formation. There is no evidence of existing slope failures (i.e no hummocky topography indicative of mass movement downslope).

Iphiva 6 is relatively level to gently sloping toward the south and the dolerite bedrock is known to be fairly stable. Again, no evidence of existing slope failures were observed during the investigation.

Care must be exercised during the earthworks operation to not induce slope instability. In this regard recommendations with respect to cutting and filling and general earthworks have been provided and discussed further in Section 9.1 of this report.

8.2 Problem Soils

8.2.1 Active Soils

The laboratory results reveal the colluvial and hillwash material encountered **Iphiva 4, 5 and 6**, as well as the majority of the residual basalt encountered at **Iphiva 4 and 5** are classified as A-6 to A-8 type material with high clay percentages ranging from 19 to 52% and relatively high linear shrinkage percentages between 6 and 15%. Although the results classify the materials as having low to medium activity in terms of the Van Der Merwe Classification, experience has shown these properties result in the material likely having moderate to high activity. As such, they will likely undergo volume change upon fluctuation of their natural moisture content (i.e. shrink when dry and expand when wet).

8.2.2 *Potentially Collapsible Soils*

There was no evidence obtained during the field investigation to suggest highly compressible or collapsible soils within the three candidate site areas as the subsoil consistencies are stiff to hard for clayey material and dense to very dense for sandy material.

8.2.3 *Erosive Soils*

A review of Google Earth imagery reveals no dongas in the areas, providing a good indication that the subsoils are neither dispersive nor erodible to any significant degree.

The upper colluvial / hillwash may be susceptible to minor erosion via wind and flowing water especially once the vegetation, the roots of which have a binding effect on the soil, are removed during development. As such erosion control should be accounted for both during and after development.

Any exposed slopes, natural or unsupported cut / fill batters, must be adequately vegetated as soon as possible after construction.

8.3 Seepage Areas

No drainage lines / depressions / valleys / streams were observed within the footprints of the three candidate sites. However, the upper stiff to hard clays encountered on the sites, could become partially flooded with large areas of pooling water during periods of heavy or prolonged rainfall, as well as perched groundwater tables overlying less permeable clay horizons or along the soil / rock interface as discussed in Section 6.3.

8.4 Excavatability

At **Iphiva 4**, from inspection pitting “Soft Excavation” (according to SABS 1200D-1988) is inferred to approximately 1.00 m greater than the inferred bedrock depths shown on Drawing № 31833-02A, below which ‘Boulder Excavation Class B” rapidly becoming “Hard Excavation” is to be expected. As such, the northern portion of the site is deemed excavatable by “Soft Excavation” to ± 1.50 to 2.50 m increasing to ± 3.50 to 4.00 m below current ground level in the southern portion.

Similarly, **Iphiva 5** is expected to be excavatable by “Soft Excavation” to approximately 1.00 m greater than the inferred bedrock depths shown on Drawing № 31833-02B, below which ‘Boulder Excavation Class B” rapidly becoming “Hard Excavation” is to be expected. As such this indicates the southwestern to western portions are excavatable by “Soft Excavation” to ± 2.00 m increasing to ± 3.50 to 4.00 m below current ground level in the northeastern portion of the site.

At **Iphiva 6**, inspection pitting indicates “Soft Excavation” can be inferred to approximately 0.50 to 1.00 m greater than the inferred bedrock depths shown on Drawing № 31833-02C, below which ‘Boulder Excavation Class B” rapidly becoming “Hard Excavation” is to be expected. Therefore, “Soft Excavation” can be inferred across the site to depths ranging between 1.00 and 1.50 m below EGL.

8.5 Material Suitability

Soil and rock sampling was undertaken in order to:

- Provide an indication of the near surface materials suitability for excavation and reuse in the proposed development as engineered fill in platforms as well as for use in road and pavement layerworks.

- Identify potential problematic soil horizons

The materials have been classified in terms of their suitability for use in engineered fill in platforms and road construction (according to TRH 14-1985 and TRH 20-1990) on the basis of field observations and laboratory testing.

The findings are summarised in Table 9 below. It must be borne in mind that the testing is not definitive and it is recommended that further verification testing be carried out on materials excavated during construction.

Table 9 : Material Classification and Suitability

Material Type	Description	Classification Details	Material Suitability
IPHIVA 4 AND 5			
Colluvium	Brown to dark brown, sandy silty clay	Silt & Clay = 76 to 78% PI = 11 to 20% LS = 7.3 to 15.0% GM = 0.4 to 0.5 Classifies as A-7-5 to A-7-6. G10 to G10+ quality material.	Poor subgrade material. Not recommended for use in engineered fill platforms. Where these clayey soils intersect in cuts at road formation level, material should be boxed out and replaced with suitable subgrade (G10 or better).
Residual Basalt	Brown to orangey brown, slightly sandy silty clay to clayey silt to slightly clayey silty sand with minor to abundant gravel	Silt & Clay = 43 to 74% PI = 11 to 31% LS = 6 to 15% GM = 0.4 to 1.2 Classifies as A-7-5 to A-8. G10+ quality material.	Poor subgrade material. Not recommended for use in engineered fill platforms. Where these clayey soils intersect in cuts at road formation level, material should be boxed out and replaced with suitable subgrade (G10 or better).

Material Type	Description	Classification Details	Material Suitability
Residual to Highly Weathered Soft Rock Basalt	Brown to orangey brown, sandy gravel to completely weathered, soft rock with hard rock corestones	Silt & Clay = 9 to 18% PI = 9 to 11% LS = 7 to 9% GM = 2.0 to 2.6 Classifies as A-2-5 to A-2-7. G7 to G8 quality material.	Good subgrade quality material for use in engineered fill. Suitable for use in lower selected layer of pavement. Type E gravel wearing course - Good. Thin layer of limited volume overlying hard rock basalt / corestones.
IPHIVA 6			
Hillwash	Brown to dark brown, sandy clay with gravels, cobbles and boulders	Silt & Clay = 37 to 69% PI = 11 to 12% LS = 9.3 to 11.0% GM = 0.6 to 1.6 Classifies as A-6 to A-8. G9 to G10+ quality material.	Poor subgrade material. Not recommended for use in engineered fill platforms. Where these clayey soils intersect in cuts at road formation level, material should be boxed out and replaced with suitable subgrade (G10 or better).
Completely to Highly Weathered Karoo Dolerite	Light brown, completely to highly weathered, very soft to soft rock with hard rock corestones	Silt & Clay = 17.7% PI = 9.5% LS = 8.0% GM = 2.3 Classifies as A-2-4. G9 quality material.	Good subgrade quality material for use in engineered fill. Suitable for use in lower selected layer of pavement. Type A gravel wearing course - Erodible.

In summation for **Iphiva 4 and 5**, the above generally shows that the upper (0.00 to 1.00 / 3.50 m) of the materials will essentially comprise clayey colluvium and residual basalt of G10+ quality which are not recommended for use as engineered fill or layerworks. Below (>1.00 / 3.50 m) the completely to highly weathered basalt bedrock is of G7 to G8 quality which is suitable for use as engineered fill and layerworks and classifies as a good (Type E) gravel wearing course. However, the weathered basalt bedrock is at depth and likely to be a thin horizon of limited volume (± 0.50 - 1.00 m thick) overlying hard rock basalt / boulders which will excavate as unsuitable oversized material.

The hillwash at **Iphiva 6** is not recommended for use as engineered fill or layerworks. The completely to highly weathered Karoo dolerite is suitable for engineered fill and lower selected layers of pavement. This horizon is also only expected to be of limited thickness / volume (± 0.50 - 1.00 m thick) grading into hard rock dolerite / boulders which will excavate as unsuitable oversized material.

Eskom construction sites commonly require a capping of 1.00 to 1.50 m G5/G6/G7/G8 granular material. As such, above and in the laboratory test result summary table (Table 6), there is minimal to no suitable natural gravel meeting these specifications on site and, hence, it is recommended that all layerworks be imported. Alternatively, a crusher could be established on each of the three sites to crush the onsite bedrock to achieve G5/G6/G7/G8 type material (expensive).

9. GEOTECHNICAL RECOMMENDATIONS

In terms of the results of the preliminary geotechnical investigation, the development is considered feasible at all three candidate sites, Iphiva 4, 5 and 6. The recommendations below regarding the development of each site are provided as a guide and a further in-depth geotechnical investigation is required once earthwork plans and development plans have been provided for the chosen site.

9.1 Earthworks

No earthwork plans have been provided for this preliminary investigation; however, it is assumed due to the relatively flat nature of the areas, no major cutting or filling is envisaged but rather the earthworks will be limited to minor cuts / fills (< 2 to 3 m) and the excavation of foundations / service trenches and the backfilling thereof.

As mentioned in Section 8.5, Eskom sites commonly have a 1.00 to 1.50 m capping of Engineered Fill comprising G5/G6/G7/G8 type material.

All cut and fill slopes should be restricted to a maximum batter of 1:2 (26º). Temporary cut slopes of limited height (< 3 m) during construction may be steepened to a batter of 1:1 (45º) at the discretion of a responsible Engineer.

Fill embankments should be constructed in layers of 300 mm maximum loose thickness and each layer compacted to a minimum of 95% of the materials maximum Mod AASHTO dry density prior to placement of the next layer. Particles exceeding ⅔ of the compacted layer thickness must be removed to spoil.

Prior to placement of new fills, the natural ground should be stripped of the upper organic topsoil and grubbed of any deleterious materials.

Once trees have been removed from site, all roots must be removed to prevent rotting and subsequent settlement. The voids must be filled and compacted in 300 mm layers to a minimum of 95% of the materials maximum Mod AASHTO dry density prior to placement of the next layer.

Cut and fill slopes should be adequately vegetated post-construction to reduce possible erosion. All cut and fills should be inspected by a Geotechnical professional to confirm stability.

9.2 Site Drainage

Soak pits should not be used for stormwater or effluent disposal as the *in situ* stiff to hard clayey subsoils are likely to be insufficiently permeable for this purpose.

All stormwater runoff must be strictly controlled during and after construction. It must be collected from paved and roofed areas into surface drains to be discharged into the stormwater system ultimately approved for the proposed development. All ground surfaces should be graded after construction in order to prevent ponding and infiltration of surface water below founding level.

9.3 Founding

Founding will be variable depending on structure type / loading and positioning due to the variable geology of the sites. The following recommended foundations assume an upper 1.5 m good quality granular fill capping (G5/G6/G7/G8 type material). The recommended founding must; however, be revisited post earthworks, once it is known what materials are present at the completed platform (i.e. a site specific geotechnical investigation should be performed relative to structure type / positioning / loading / materials at platform level. All foundations should be inspected by an experience Geotechnical professional.

9.3.1 *Iphiva 4 and 5*

Founding across Iphiva 4 and 5 are considered to be fair to poor in view of the high clay content and likely active nature of the soils. Although the DCP tests show favourable stiff to hard / very dense consistencies with variable depths to refusal in both areas, the investigation was undertaken during the dry season and the subsoils are likely to soften during wetter summer rains. In general:

- In the northern area of Iphiva 4 and the western area of Iphiva 5, where depth to weathered bedrock is less than 1.50 m, shallow strip footing or column base pad foundations are considered feasible provided the foundations are taken through the active clayey soils and completely weathered basalt to bear no less than 0.50 m into hard pickable basalt bedrock. Consideration could also be given to founding small and lightly loaded structures using strip footings / pads / rafts supported in the upper 1.00 - 1.50 m good quality granular fill capping (G5/G6/G7/G8 type material).

- Where thicker residual clayey soils occur overlying weathered bedrock, toward the southern portion of Iphiva 4 and the eastern portion of Iphiva 5, small and lightly loaded structures can be founded using strip footings / pads / raft type foundations supported in the upper 1.50 m good quality granular filling capping (G5/G6/G7/G8 type material). However, heavier and sensitive structures may require stiffened rafts or rafts / ground beams supported on piles to bedrock.

9.3.2 *Iphiva 6*

Founding conditions across Iphiva 6 are considered to be good due to the shallow dolerite bedrock across the site, shallow strip footing or pad foundations may be used.

The foundations must be taken through all *in situ* soils and completely weathered dolerite to rest on hard pickable dolerite bedrock. Consideration could also be given to founding small and lightly loaded structures using strip footings / pads / raft type foundations supported in the upper 1.00 - 1.50 m good quality granular fill capping (G5/G6/G7/G8 type material).

9.4 Seismic Activity

This section discusses the finding of a desktop study reviewing available geological maps / seismic maps / seismic literature on Southern Africa, to determine the expected seismicity of the Mkuze area. The geological structure and historic seismic events are discussed, concluding with an estimation of the seismic hazard of the sites from available seismic hazard maps showing the peak horizontal ground acceleration.

9.4.1 *Geological Structures and Tectonics*

The regional geology of the area has been discussed in Section 6.1 and is illustrated in Drawing № 31833-03. Iphiva 6 is located within 1 km of a major northeast-southwest trending fault which forms part of a series of faults in this area. Two major north-south trending faults are shown on the drawing approximately 6 to 8 km northeast of Iphiva 4 and 5. No evidence of faulting was observed at any of the sites during the field investigation.

The faults in the area and all major faulting of the coastal and hinterland portions of KZN are related to the break-up of the southern supercontinent, Gondwana, which acted as conduits for lava and the formation of dolerite dykes and sills (Singh *et al.*, 2013[1]).

[1] Singh, M., Akombelwa, M. And Maud, R. 2013. Geo-database compilation for seismo-tectonic investigations for KZN coastal regions. *SASGI Proceedings 2013 - Stream 2.*

9.4.2 *Historical Seismic Events and Natural Seismicity*

Plate 8 (Appendix D) attached to this report, shows the distribution of earthquake epicentres above intensity II in Southern Africa from 1620 to 1988, courtesy of Brandt, 2011[2]. Intensity is a non-instrumental quantity assigned on the basis of observed structural damage. As shown, the nearest seismicity of any significance is some 40 to 50 km to the northwest along the South Africa / Swaziland border. According to Brandt (2011), Swaziland is one of three regions of greatest seismic hazard in Southern Africa. In October 1919, an earthquake occurred in Swaziland of magnitude 6.5 (Hartnady, 1990[3]). Magnitude is a quantifiable value obtained from the amplitude recorded on a seismograph. Another significant seismic event in the region of the Mkuze occurred in December 1932, a large earthquake of magnitude 6.3 located in the sea offshore the Zululand coast occurred, the nearest point on land to the epicentre was Cape St. Lucia where Modified Mercalli Intensity (MMI) of IX was assigned (Singh *et al.*, 2013).

An area is considered to be naturally seismic if there has been any seismic action caused by natural events within a radius of up to 400 km. The area of the proposed sites is thus situated in a natural seismically active region. However, magnitude and frequency of historical events suggest that the defined source area is one of low to moderate seismicity.

9.4.3 *Seismic Hazard of the Sites*

Damaging effects of earthquakes are generally produced by the horizontal rather than the vertical part of ground motion (or ground acceleration). This is because the horizontal motion is usually larger (except for in the immediate vicinity of the epicentre) and the vertical motion operates against gravity. Structural damage is primarily due to shear waves which have a near vertical direction of propagation creating the horizontal distortion.

The aim of Section 9.4 is to provide the expected peak horizontal ground acceleration (PGA) considered suitable for use in the structural design of the Mkuze Substation. Plate 9 and 10 (Appendix D) attached (taken from Brandt, 2011), are maps showing respectively seismic intensity and peak horizontal ground acceleration levels that have a 10% probability of being exceeded, at least once a year, in a period of 50 years across Southern Africa. The maps represent data from 1620 to 1988. Both maps depict natural as well as mining-related seismicity. The proposed Mkuze Substation has an MMI value of VI with a peak horizontal ground acceleration of 50-100 cm/s^2 (0.05 - 0.1 g) for a 50 year period.

---

2 Brandt, M. 2011. Seismic Hazard in South Africa. *Council for Geoscience Report number: 2011-0061.*

3 Hartnady, C.J.H. 1990. Seismicity and plate boundary evolution on southeastern Africa. *South African Journal of Geology*, 93, 473-484.

10. SITE SUITABILITY RANKING OF CANDIDATE SITES

The aim of the preliminary geotechnical investigation is essentially to determine the geotechnical subsoil conditions relative to the proposed earthworks, to identify potential problems and ultimately to determine the most suitable site for the proposed development according to the sites geotechnical properties.

Table 10 below lists the geotechnical properties of the candidate sites discussed in the report with an indication of which sites are most / least favourable based on those properties.

Table 10 : Summary of Geotechnical Aspects and Preferred Site

Geotechnical Property	Iphiva 4	Iphiva 5	Iphiva 6
Site Stability	✓	✓	✓
Problem Soils	x	x	✓
Site Drainage	✓	✓	✓
Soil Corrosion	x	x	x
Excavatability	✓	✓	x
Material Suitability	x	x	✓
Foundation Solutions	x	x	✓

✓ **denotes more favourable conditions**

x denotes least favourable conditions

All three of the proposed sites are developable. However; the main geotechnical problems with **Iphiva 4 and 5** are:

- The presence of potentially active clays of variable thickness from 1.0 to 3.5 m. The negative effects of the clays are; however, minimised if a 1.0 to 1.5 m engineered fill (G5, G6, G7, G8) capping is placed as is commonly done at Eskom sites.

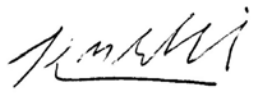
- The lack of onsite suitable materials, i.e. the onsite clays are not suitable for engineered fill of layerworks (no suitable G5 / G6 / G7 / G8 / G9 / G10 type material). These materials will need to be imported or a crusher established on site to crush the basalt bedrock (expensive).

The main geotechnical problems with Iphiva 6 include:

- The presence of hard dolerite bedrock which would require hard excavation (blasting) near surface (± 1.0 m below current ground level) makes excavations for earthworks cuts / service trenches below approximately 1.0 m costly. The negative effects of the shallow bedrock are also; however, minimised should a 1.0 to 1.5 m engineered fill (G5, G6, G7, G8) capping be placed as is common at Eskom sites.

- The lack of onsite suitable materials, i.e. although there is some G9 and G10 quality material there is no suitable G5 - G8 material. These materials will have to be imported or a crusher established to crush the dolerite bedrock.

Based on the foundations of structures alone, Iphiva 6 is marginally more favourable due to its shallower bedrock throughout (± 0.1 - 0.6 m); however as mentioned, this comes with costly excavation issues for earthworks / services. Conversely, bedrock depths are deeper at Iphiva 4 and 5 (± 0.4 - 4.0 m) resulting in deeper founding for heavier / sensitive structures; however, less costly excavation issues for earthworks / service trenches.



K. RIBBINK Pr.Sci.Nat. **J. LODGE (Eng. Geol)**

REFERENCE 31833
JULY 2017
/kr/jl/kc

DRENNAN MAUD (PTY) LTD
68 Peter Mokaba Ridge, Tollgate,
DURBAN, 4001

APPENDIX A

INSPECTION PIT PROFILES

IPHIVA 4 - I4-IP1 - I4-IP10

IPHIVA 5 - I5-IP1 - I5-IP9

IPHIVA 6 - I6-IP1 - I6-IP10

DRENNAN MAUD (PTY) LTD

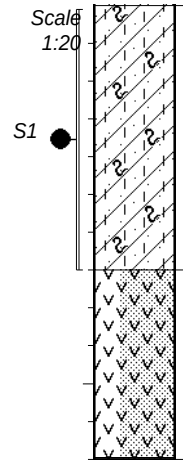
Geotechnical Engineers & Engineering Geologists

ILISO CONSULTING
ENVIRONMENTAL MANAGEMENT
MKUZE SUBSTATION – IPHIVA 4

HOLE No: I4 – IP1
Sheet 1 of 1

JOB NUMBER: 31833

SAMPLE	DEPTH (m)
MOD / CBR / pH / Conductivity / BRE / Basson	
S1	0.00
	0.70
1	1.20



Dry to slightly moist, dark brown, very stiff to hard, slightly shattered, slightly sandy silty CLAY with trace fine to medium subangular gravels of basalt fragments and with roots – (Colluvium)

Brown speckled light brown, completely weathered with highly weathered to slightly weathered corestones, fine grained, soft rock BASALT with hard rock corestones and fragments (50-400mm in size) – (Letaba Formation)
Note: Excavates as sandy fine to coarse gravel with cobbles and boulders.

NOTES

1) Final depth at 1.20m. Hard refusal on hard rock corestones.

2) No groundwater seepage.

3) No sidewall collapse.

4) Same position as DCP1.

5) Samples taken:
S1 0.01--0.70m (IMC /pH /Conductivity /BRE /Basson)

CONTRACTOR : KC BLOCK & PLANT
MACHINE : TLB – JCB 3CX
DRILLED BY : NA
PROFILED BY : JL

TYPE SET BY : JL
SETUP FILE : DMPSP.SET

INCLINATION :
DIAM : NA
DATE : NA
DATE : 03-05-2017

DATE : 29/06/17 11:20
TEXT : ..C:\DOTIN\SPMASTER.DOC

ELEVATION : -
X-COORD : 3058066
Y-COORD : 0096299

HOLE No: I4 – IP1

I4-IP1

REF : 31833

MKUZE SUBSTATION

DRENNAN MAUD (PTY) LTD

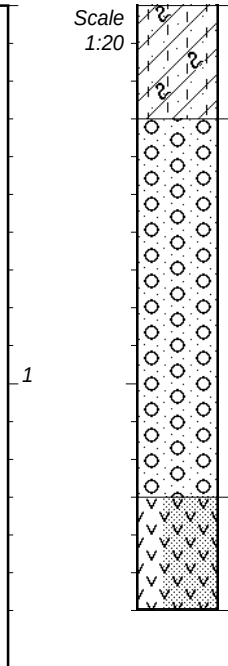
DRENNAN MAUD (PTY) LTD

Geotechnical Engineers & Engineering Geologists

ILISO CONSULTING
ENVIRONMENTAL MANAGEMENT
MKUZE SUBSTATION – IPHIVA 4

HOLE No: I4 – IP2
Sheet 1 of 1

JOB NUMBER: 31833



SAMPLE	DEPTH (m)	
		0.00 – Dry, brown, stiff, intact to slightly shattered, slightly sandy silty CLAY with trace fine subangular to subrounded gravels of basalt and with roots – (Colluvium)
		0.30 – Fine with occasional medium to coarse, angular to subangular closely packed GRAVEL of basalt in a matrix of dry, slightly orangey brown, intact, sand – (Residual to Completely Weathered Basalt) Overall consistency is very dense.
		1.30 – Brown, completely to highly weathered with slightly weathered corestones and fragments, soft rock BASALT with hard rock corestones and fragments (up to 100mm in size) – (Letaba Formation) Note: Excavates as sandy fine to coarse gravel.
		1.60

NOTES

1) Final depth at 1.60m. Hard refusal on hard rock corestones.

2) No groundwater seepage.

3) No sidewall collapse.

4) Same position as DCP2.

5) No samples taken.

CONTRACTOR : KC BLOCK & PLANT
MACHINE : TLB – JCB 3CX
DRILLED BY : NA
PROFILED BY : JL

TYPE SET BY : JL
SETUP FILE : DMPSP.SET

INCLINATION :
DIAM : NA
DATE : NA
DATE : 03-05-2017

DATE : 29/06/17 11:20
TEXT : ..C:\DOTIN\SPMASTER.DOC

ELEVATION : -
X-COORD : 3058288
Y-COORD : 0096622

HOLE No: I4 – IP2

I4-IP2

REF : 31833

MKUZE SUBSTATION

DRENNAN MAUD (PTY) LTD

DRENNAN MAUD (PTY) LTD

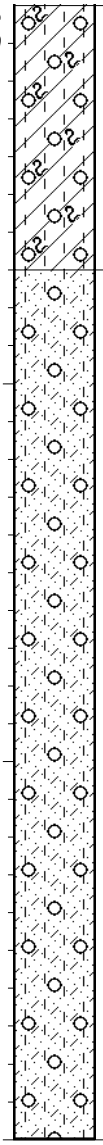
Geotechnical Engineers & Engineering Geologists

ILISO CONSULTING
ENVIRONMENTAL MANAGEMENT
MKUZE SUBSTATION – IPHIVA 4

HOLE No: I4 – IP3
Sheet 1 of 1

JOB NUMBER: 31833

Scale 1:20



0.00

Dry, brown, stiff to very stiff, shattered to intact, slightly sandy gravelly silty CLAY with roots – (Colluvium) Gravel comprises fine (with occasional medium) subangular to subrounded minor basalt fragments.

0.70

Dry, brown to orangey brown, very dense, intact, slightly clayey gravelly silty fine grained SAND – (Residual Basalt) Gravel comprises fine to medium subangular to subrounded minor becoming abundant with depth basalt and amygdale fragments.

1

2

3

3.00

NOTES

1) Final depth at 3.00m. No refusal but TLB struggling.

2) No groundwater seepage.

3) No sidewall collapse.

4) Same position as DCP3.

5) No samples taken.

SAMPLE	DEPTH (m)

CONTRACTOR : KC BLOCK & PLANT
MACHINE : TLB – JCB 3CX
DRILLED BY : NA
PROFILED BY : JL

INCLINATION : NA
DIAM : NA
DATE : NA
DATE : 03-05-2017

ELEVATION : -
X-COORD : 3058610
Y-COORD : 0096404

TYPE SET BY : JL
SETUP FILE : DMPSP.SET

DATE : 29/06/17 11:20
TEXT : ..C:\DOTIN\SPMASTER.DOC

HOLE No: I4 – IP3

I4-IP3

REF : 31833

MKUZE SUBSTATION

DRENNAN MAUD (PTY) LTD

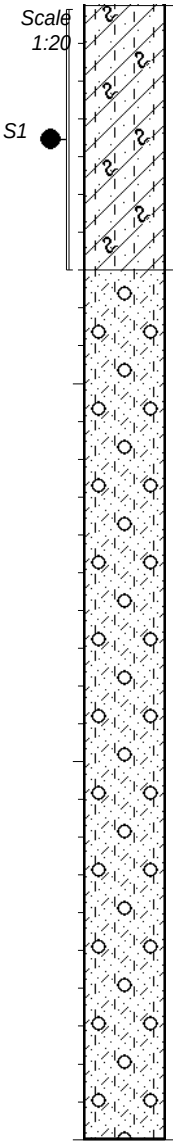
DRENNAN MAUD (PTY) LTD

Geotechnical Engineers & Engineering Geologists

ILISO CONSULTING
ENVIRONMENTAL MANAGEMENT
MKUZE SUBSTATION – IPHIVA 4

HOLE No: **I4 – IP4**
Sheet 1 of 1

JOB NUMBER: **31833**



SAMPLE	DEPTH (m)	
Ind / MOD / CBR		
S1	0.00	Dry, dark brown, stiff to very stiff, shattered, slightly sandy silty CLAY with trace fine subangular gravels of basalt and with roots – (Colluvium)
	0.70	Slightly moist, brown, very dense, intact to slightly shattered, slightly clayey gravelly silty fine to medium grained SAND – (Residual Basalt) Gravel comprises fine to medium subangular trace becoming minor with depth basalt and amygdale fragments and corestones. Note: Amygdale-rich zone from 1.50 to 1.80m which excavates as coarse subrounded closely packed gravel.
	3.00	

NOTES

1) Final depth at 3.00m. No refusal, max TLB reach.

2) No groundwater seepage.

3) No sidewall collapse.

4) Same position as DCP4.

5) Samples taken:
S1 0.01--0.70m (IMC)

CONTRACTOR : KC BLOCK & PLANT
MACHINE : TLB – JCB 3CX
DRILLED BY : NA
PROFILED BY : JL

TYPE SET BY : JL
SETUP FILE : DMPSP.SET

INCLINATION :
DIAM : NA
DATE : NA
DATE : 03-05-2017

DATE : 29/06/17 11:20
TEXT : ..C:\DOTIN\SPMASTER.DOC

ELEVATION : -
X-COORD : 3058391
Y-COORD : 0096077

HOLE No: **I4 – IP4**

I4-IP4

REF : 31833

MKUZE SUBSTATION

DRENNAN MAUD (PTY) LTD

DRENNAN MAUD (PTY) LTD

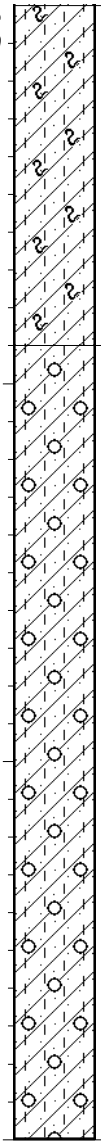
Geotechnical Engineers & Engineering Geologists

ILISO CONSULTING
ENVIRONMENTAL MANAGEMENT
MKUZE SUBSTATION – IPHIVA 4

HOLE No: I4 – IP5
Sheet 1 of 1

JOB NUMBER: 31833

Scale 1:20



0.00

Dry, brown, very stiff to hard, shattered, slightly sandy silty CLAY with trace fine subangular gravels of basalt fragments and with roots – (Colluvium)

0.90

1

Dry to slightly moist, brown to orangey brown, hard, intact, slightly sandy gravelly silty CLAY – (Residual Basalt) Gravel comprises fine becoming coarse subangular fragments of basalt and occasional amygdales.
Note: Large (250x200x150mm) basalt boulder observed at 2.20m.
Note: Amygdale-rich zone from 2.20 to 2.40m which excavates as coarse subrounded closely packed gravel.

2

3

3.00

NOTES

1) Final depth at 3.00m. No refusal, max TLB reach.

2) No groundwater seepage.

3) No sidewall collapse.

4) Same position as DCP5.

5) No samples taken.

SAMPLE	*DEPTH (m)*

CONTRACTOR : KC BLOCK & PLANT
MACHINE : TLB – JCB 3CX
DRILLED BY : NA
PROFILED BY : JL

TYPE SET BY : JL
SETUP FILE : DMPSP.SET

INCLINATION :
DIAM : NA
DATE : NA
DATE : 03-05-2017

DATE : 29/06/17 11:20
TEXT : ..C:\DOTIN\SPMASTER.DOC

ELEVATION : -
X-COORD : 3058445
Y-COORD : 0096281

HOLE No: I4 – IP5

I4-IP5

REF : 31833

MKUZE SUBSTATION

DRENNAN MAUD (PTY) LTD

DRENNAN MAUD (PTY) LTD

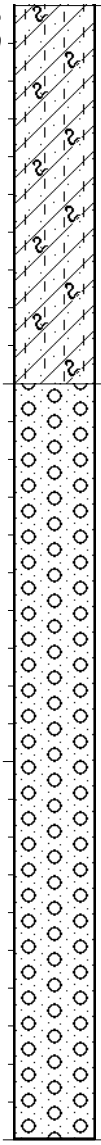
Geotechnical Engineers & Engineering Geologists

ILISO CONSULTING
ENVIRONMENTAL MANAGEMENT
MKUZE SUBSTATION – IPHIVA 4

HOLE No: I4 – IP6
Sheet 1 of 1

JOB NUMBER: 31833

Scale 1:20



0.00 Dry, dark brown, very stiff to hard, shattered, slightly sandy silty CLAY with trace fine to medium subangular gravels of basalt and with roots – (Colluvium)

1.00 Fine to coarse, angular to subangular closely packed GRAVEL of basalt in a matrix of dry, slightly orangey brown, intact, sand – (Residual to Completely Weathered Basalt) Overall consistency is very dense.

3.00

NOTES

1) Final depth at 3.00m. No refusal but TLB struggling.

2) No groundwater seepage.

3) No sidewall collapse.

4) Same position as DCP6.

5) No samples taken.

SAMPLE	DEPTH (m)

CONTRACTOR : KC BLOCK & PLANT
MACHINE : TLB – JCB 3CX
DRILLED BY : NA
PROFILED BY : JL

INCLINATION :
DIAM : NA
DATE : NA
DATE : 03-05-2017

ELEVATION : -
X-COORD : 3058398
Y-COORD : 0096433

HOLE No: I4 – IP6

TYPE SET BY : JL
SETUP FILE : DMPSP.SET

DATE : 29/06/17 11:20
TEXT : ..C:\DOTIN\SPMASTER.DOC

I4-IP6

REF : 31833

MKUZE SUBSTATION

DRENNAN MAUD (PTY) LTD

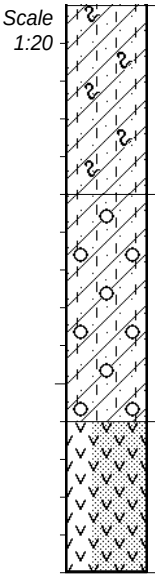
DRENNAN MAUD (PTY) LTD

Geotechnical Engineers & Engineering Geologists

ILISO CONSULTING
ENVIRONMENTAL MANAGEMENT
MKUZE SUBSTATION – IPHIVA 4

HOLE No: **I4 – IP7**
Sheet 1 of 1

JOB NUMBER: **31833**



SAMPLE	DEPTH (m)	
	0.00	Slightly moist, brown to dark brown, very stiff to hard, shattered and pinholed, slightly sandy silty CLAY with trace fine to medium subrounded gravel of basalt and with roots – (Colluvium)
	0.50	Dry, slightly orangey brown, hard, intact, slightly sandy gravelly silty CLAY – (Residual Basalt) Gravel comprises fine to medium subangular to subrounded minor basalt fragments.
	1.10	Brown, completely to highly weathered with slightly weathered corestones and fragments, soft rock BASALT with hard rock corestones and fragments (up to 100mm in size) – (Letaba Formation) Note: Excavates as sandy fine to coarse gravel.
	1.50	

NOTES

1) Final depth at 1.50m. Hard refusal on hard rock corestones.

2) No groundwater seepage.

3) No sidewall collapse.

4) Same position as DCP7.

5) No samples taken.

CONTRACTOR : KC BLOCK & PLANT
MACHINE : TLB – JCB 3CX
DRILLED BY : NA
PROFILED BY : JL

TYPE SET BY : JL
SETUP FILE : DMPSP.SET

INCLINATION :
DIAM : NA
DATE : NA
DATE : 03-05-2017

DATE : 29/06/17 11:20
TEXT : ..C:\DOTIN\SPMASTER.DOC

ELEVATION : -
X-COORD : 3058235
Y-COORD : 0096417

HOLE No: **I4 – IP7**

I4-IP7

REF : 31833

MKUZE SUBSTATION

DRENNAN MAUD (PTY) LTD

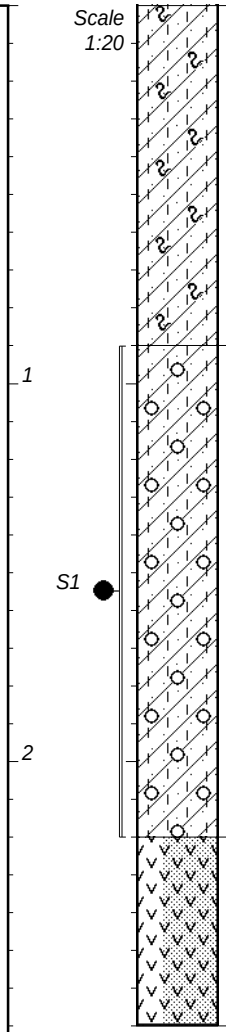
DRENNAN MAUD (PTY) LTD

Geotechnical Engineers & Engineering Geologists

ILISO CONSULTING
ENVIRONMENTAL MANAGEMENT
MKUZE SUBSTATION – IPHIVA 4

HOLE No: I4 – IP8
Sheet 1 of 1

JOB NUMBER: 31833



SAMPLE	DEPTH (m)	
		0.00 Slightly moist, brown to dark brown, stiff to very stiff, pinholed and shattered, slightly sandy silty CLAY with trace fine subrounded gravels of basalt and with roots – (Colluvium)
Ind / MOD / CBR / pH / Conductivity / BRE / Basson		0.90 Dry, brown to orangey brown, hard, shattered to intact, slightly sandy gravelly silty CLAY – (Residual Basalt) Gravel comprises fine to medium angular minor becoming abundant with depth fragments of basalt and occasional amygdales.
		2.20 Brown speckled light brown, completely weathered with medium weathered to slightly weathered corestones, fine grained, soft rock BASALT with hard rock corestones and fragments (50-200mm in size) – (Letaba Formation) Note: Excavates as sandy fine to coarse gravel with cobbles and boulders.
		2.70

NOTES

1) Final depth at 2.70m. Hard refusal on hard rock corestones.

2) No groundwater seepage.

3) No sidewall collapse.

4) Same position as DCP8.

5) Samples taken:
S1 0.90--2.20m (IMC /pH /Conductivity /BRE /Basson)

CONTRACTOR : KC BLOCK & PLANT
MACHINE : TLB – JCB 3CX
DRILLED BY : NA
PROFILED BY : JL

TYPE SET BY : JL
SETUP FILE : DMPSP.SET

INCLINATION :
DIAM : NA
DATE : NA
DATE : 03-05-2017

DATE : 29/06/17 11:20
TEXT : ..C:\DOTIN\SPMASTER.DOC

ELEVATION : -
X-COORD : 3058282
Y-COORD : 0096270

HOLE No: I4 – IP8

I4-IP8

REF : 31833

MKUZE SUBSTATION

DRENNAN MAUD (PTY) LTD

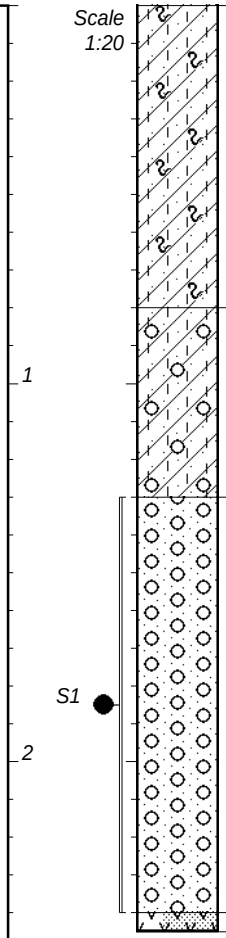
DRENNAN MAUD (PTY) LTD

Geotechnical Engineers & Engineering Geologists

ILISO CONSULTING
ENVIRONMENTAL MANAGEMENT
MKUZE SUBSTATION – IPHIVA 4

HOLE No: I4 – IP9
Sheet 1 of 1

JOB NUMBER: 31833



SAMPLE	DEPTH (m)	
		0.00 Dry, dark brown, very stiff, shattered, slightly sandy silty CLAY with trace fine to medium subangular gravels of basalt and with roots – (Colluvium)
		0.80 Slightly moist, brown, hard, intact, slightly sandy gravelly silty CLAY – (Residual Basalt) Gravel comprises medium to coarse angular to subangular abundant fragments of basalt and amygdales. Note: Multiple amygdale-rich patches.
Ind / MOD / CBR		1.30 Fine to coarse, angular to subangular closely packed GRAVEL of basalt in a matrix of dry, brown, intact, sand – (Residual to Completely Weathered Basalt) Overall consistency is very dense.
		2.40 Brown, completely weathered with slightly weathered corestones and fragments, soft rock BASALT with hard rock corestones and fragments (50-150mm in size) – (Letaba Formation) Note: Excavates as sandy medium to coarse gravel.
		2.45

NOTES

1) Final depth at 2.45m. Hard refusal on hard rock corestones.

2) No groundwater seepage.

3) No sidewall collapse.

4) Same position as DCP9.

5) Samples taken:
S1 1.30--2.40m (IMC)

CONTRACTOR : KC BLOCK & PLANT
MACHINE : TLB – JCB 3CX
DRILLED BY : NA
PROFILED BY : JL

TYPE SET BY : JL
SETUP FILE : DMPSP.SET

INCLINATION :
DIAM : NA
DATE : NA
DATE : 03-05-2017

DATE : 29/06/17 11:20
TEXT : ..C:\DOTIN\SPMASTER.DOC

ELEVATION : -
X-COORD : 3058311
Y-COORD : 0096376

HOLE No: I4 – IP9

I4-IP9

REF : 31833

MKUZE SUBSTATION

DRENNAN MAUD (PTY) LTD

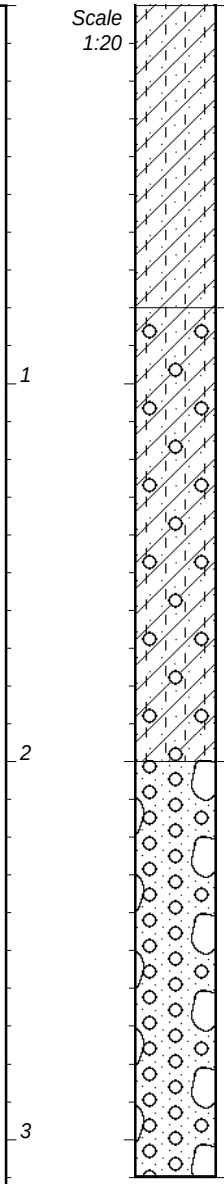
DRENNAN MAUD (PTY) LTD

Geotechnical Engineers & Engineering Geologists

ILISO CONSULTING
ENVIRONMENTAL MANAGEMENT
MKUZE SUBSTATION – IPHIVA 4

HOLE No: **I4 – IP10**
Sheet 1 of 1

JOB NUMBER: **31833**



SAMPLE	DEPTH (m)	
		0.00 Dry, dark brown, very stiff, shattered to intact, slightly sandy silty CLAY with trace fine to medium subangular gravels of basalt and amygdale fragments – (Colluvium)
		0.80 Slightly moist, brown speckled white, hard, intact, slightly sandy gravelly silty CLAY – (Residual Basalt) Gravel comprises fine to medium becoming coarse with depth angular to subangular abundant fragments of basalt and amygdales. Note: Multiple amygdale-rich patches.
		2.00 Medium to coarse, angular to rounded closely packed GRAVEL and COBBLES of basalt in a matrix of dry, brown, intact, sand – (Residual to Completely Weathered Basalt) Overall consistency is very dense.
		3.10

NOTES

1) Final depth at 3.10m. No refusal but TLB struggling.

2) No groundwater seepage.

3) No sidewall collapse.

4) Same position as DCP10.

5) No samples taken.

CONTRACTOR : KC BLOCK & PLANT
MACHINE : TLB – JCB 3CX
DRILLED BY : NA
PROFILED BY : JL

TYPE SET BY : JL
SETUP FILE : DMPSP.SET

INCLINATION :
DIAM : NA
DATE : NA
DATE : 03-05-2017

DATE : 29/06/17 11:20
TEXT : ..C:\DOTIN\SPMASTER.DOC

ELEVATION : -
X-COORD : 3058374
Y-COORD : 0096325

HOLE No: **I4 – IP10**

I4-IP10

REF : 31833

MKUZE SUBSTATION

DRENNAN MAUD (PTY) LTD

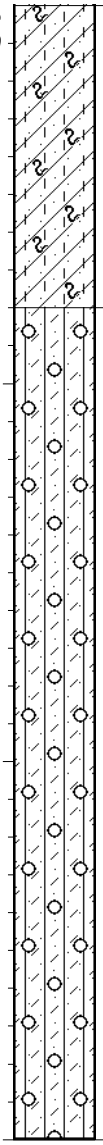
DRENNAN MAUD (PTY) LTD

Geotechnical Engineers & Engineering Geologists

ILISO CONSULTING
ENVIRONMENTAL MANAGEMENT
MKUZE SUBSTATION – IPHIVA 5

HOLE No: **I5 – IP1**
Sheet 1 of 1

JOB NUMBER: **31833**



SAMPLE	DEPTH (m)	
		0.00 Dry, brown to dark brown, very stiff to hard, shattered and pinholed, slightly sandy silty CLAY with trace fine to medium subangular to subrounded gravels of basalt and with roots – (Colluvium)
		0.80 Dry, orangey brown, hard, shattered to intact, slightly sandy gravelly clayey SILT – (Residual Basalt) Gravel comprises fine to coarse subangular to subrounded minor basalt (and occasional amygdale) fragments.
		3.00

NOTES

1) Final depth at 3.00m. No refusal but TLB struggling.

2) No groundwater seepage.

3) No sidewall collapse.

4) Same position as DCP1.

5) No samples taken.

CONTRACTOR : KC BLOCK & PLANT
MACHINE : TLB – JCB 3CX
DRILLED BY : NA
PROFILED BY : JL

TYPE SET BY : JL
SETUP FILE : DMPSP.SET

INCLINATION :
DIAM : NA
DATE : NA
DATE : 04-05-2017

DATE : 29/06/17 10:59
TEXT : ..C:\DOTIN\SPMASTER.DOC

ELEVATION : -
X-COORD : 3058270
Y-COORD : 0097060

HOLE No: **I5 – IP1**

I5-IP1

REF : 31833

MKUZE SUBSTATION

DRENNAN MAUD (PTY) LTD

DRENNAN MAUD (PTY) LTD

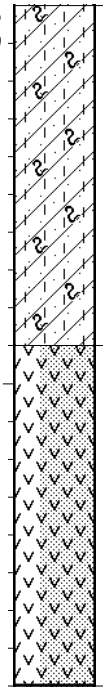
Geotechnical Engineers & Engineering Geologists

ILISO CONSULTING
ENVIRONMENTAL MANAGEMENT
MKUZE SUBSTATION – IPHIVA 5

HOLE No: I5 – IP2
Sheet 1 of 1

JOB NUMBER: 31833

Scale 1:20



0.00

Dry to slightly moist, brown to dark brown, very stiff to hard, shattered and pinholed, slightly sandy silty CLAY with trace fine to medium angular to subangular gravels of basalt and with roots – (Colluvium)
Note: Gravels become abundant from 0.70m with ferricrete nodules.

0.90

1

Brown to light brown stained red, highly weathered, fine grained, very closely jointed to highly fractured, soft to medium hard rock BASALT with occasional HR corestones and amygdales – (Letaba Formation)
Note: Excavates as sandy medium to coarse gravel.

1.80

NOTES

1) Final depth at 1.80m. Soft refusal on medium hard rock basalt.

2) No groundwater seepage.

3) No sidewall collapse.

4) Same position as DCP2.

5) No samples taken.

SAMPLE	*DEPTH (m)*

CONTRACTOR : KC BLOCK & PLANT
MACHINE : TLB – JCB 3CX
DRILLED BY : NA
PROFILED BY : JL

TYPE SET BY : JL
SETUP FILE : DMPSP.SET

INCLINATION :
DIAM : NA
DATE : NA
DATE : 04-05-2017

DATE : 29/06/17 10:59
TEXT : ..C:\DOTIN\SPMASTER.DOC

ELEVATION : -
X-COORD : 3058489
Y-COORD : 0097388

HOLE No: I5 – IP2

I5-IP2

REF : 31833

MKUZE SUBSTATION

DRENNAN MAUD (PTY) LTD

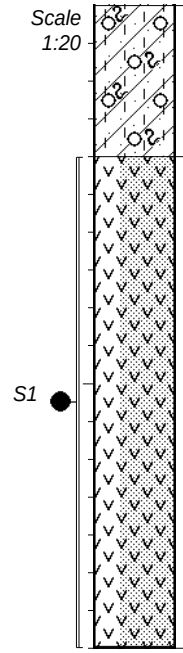
DRENNAN MAUD (PTY) LTD

Geotechnical Engineers & Engineering Geologists

ILISO CONSULTING
ENVIRONMENTAL MANAGEMENT
MKUZE SUBSTATION – IPHIVA 5

HOLE No: I5 – IP3
Sheet 1 of 1

JOB NUMBER: 31833



Dry, dark brown, stiff, slightly shattered, slightly sandy gravelly silty CLAY with roots – (Colluvium) Gravel comprises fine to medium subangular minor basalt fragments.

Brown speckled light brown, highly weathered with occasional slightly weathered corestones, fine grained, very closely jointed to highly fractured, soft to medium hard rock BASALT with occasional hard rock corestones and with amygdales – (Letaba Formation) Note: Excavates as sandy fine to coarse gravel.

Ind / MOD / CBR

1

S1

NOTES

1) Final depth at 1.70m. Hard refusal on medium hard rock basalt.

2) No groundwater seepage.

3) No sidewall collapse.

4) Same position as DCP3.

5) Samples taken:
S1 0.40--1.70m (IMC)

SAMPLE	*DEPTH (m)*

CONTRACTOR : KC BLOCK & PLANT
MACHINE : TLB – JCB 3CX
DRILLED BY : NA
PROFILED BY : JL

TYPE SET BY : JL
SETUP FILE : DMPSP.SET

INCLINATION :
DIAM : NA
DATE : NA
DATE : 04-05-2017

DATE : 29/06/17 10:59
TEXT : ..C:\DOTIN\SPMASTER.DOC

ELEVATION : -
X-COORD : 3058812
Y-COORD : 0097164

HOLE No: I5 – IP3

I5-IP3

REF : 31833

MKUZE SUBSTATION

DRENNAN MAUD (PTY) LTD

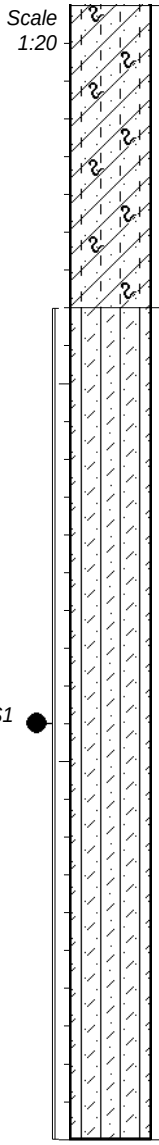
DRENNAN MAUD (PTY) LTD

Geotechnical Engineers & Engineering Geologists

ILISO CONSULTING
ENVIRONMENTAL MANAGEMENT
MKUZE SUBSTATION – IPHIVA 5

HOLE No: I5 – IP4
Sheet 1 of 1

JOB NUMBER: 31833



Dry, brown to dark brown, very stiff to hard, shattered and pinholed, slightly sandy silty CLAY with trace fine to medium subangular to subrounded gravels of basalt and with roots – (Colluvium)

Dry, brown to orangey brown, hard, slightly shattered, slightly sandy clayey SILT with trace medium (occasionally fine and coarse) subangular to subrounded gravels of basalt and amygdale fragments – (Residual Basalt)

Ind / MOD / CBR

S1

NOTES

1) Final depth at 3.00m. No refusal but TLB struggling.

2) No groundwater seepage.

3) No sidewall collapse.

4) Same position as DCP4.

5) Samples taken:
S1 0.80--3.00m (IMC)

SAMPLE	*DEPTH (m)*

CONTRACTOR : KC BLOCK & PLANT
MACHINE : TLB – JCB 3CX
DRILLED BY : NA
PROFILED BY : JL

INCLINATION :
DIAM : NA
DATE : NA
DATE : 04-05-2017

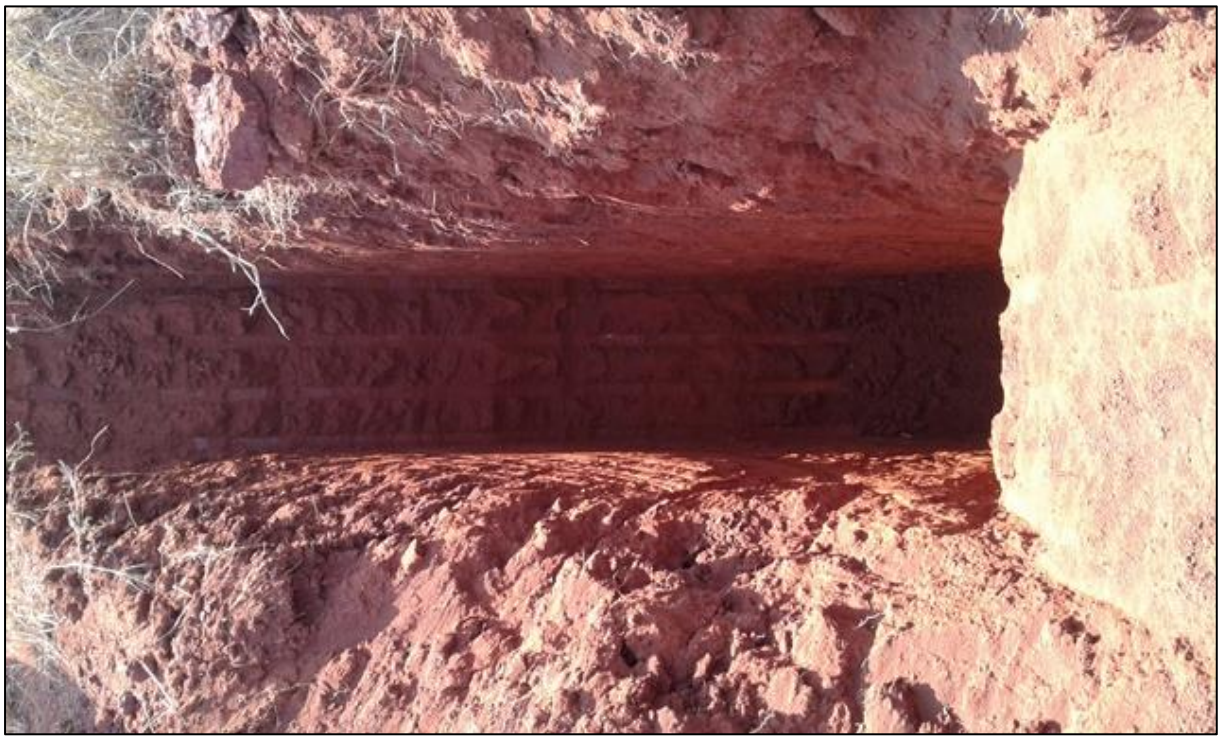
ELEVATION : -
X-COORD : 3058590
Y-COORD : 0096837

HOLE No: I5 – IP4

TYPE SET BY : JL
SETUP FILE : DMPSP.SET

DATE : 29/06/17 10:59
TEXT : ..C:\DOTIN\SPMASTER.DOC

I5-IP4



REF : 31833

MKUZE SUBSTATION

DRENNAN MAUD (PTY) LTD

DRENNAN MAUD (PTY) LTD

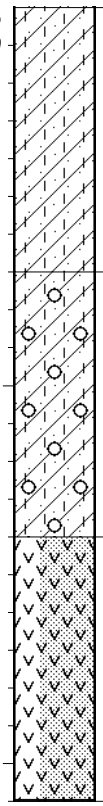
Geotechnical Engineers & Engineering Geologists

ILISO CONSULTING
ENVIRONMENTAL MANAGEMENT
MKUZE SUBSTATION – IPHIVA 5

HOLE No: I5 – IP5
Sheet 1 of 1

JOB NUMBER: 31833

Scale 1:20



0.00 Dry to slightly moist, brown to dark brown, very stiff to hard, shattered and pinholed, slightly sandy silty CLAY with trace fine to medium angular to subangular gravels of basalt and with roots– (Colluvium)

0.70 Dry, brown to orangey brown, hard, shattered to intact, slightly sandy gravelly silty CLAY – (Residual Basalt) Gravel comprises fine to coarse subangular to subrounded minor basalt and amygdales fragments.

1.40 Brown stained red, completely weathered becoming highly weathered with depth, fine grained, very closely to closely jointed, soft to medium hard rock BASALT with occasional HR corestones and amygdales – (Letaba Formation)
Note: Excavates as sandy medium to coarse gravel.

2.10

NOTES

1) Final depth at 2.10m. Hard refusal on medium hard rock basalt.

2) No groundwater seepage.

3) No sidewall collapse.

4) Same position as DCP5.

5) No samples taken.

SAMPLE	DEPTH (m)
	1
	2

CONTRACTOR : KC BLOCK & PLANT
MACHINE : TLB – JCB 3CX
DRILLED BY : NA
PROFILED BY : JL

INCLINATION :
DIAM : NA
DATE : NA
DATE : 04-05-2017

ELEVATION : -
X-COORD : 3058458
Y-COORD : 0097170

HOLE No: I5 – IP5

TYPE SET BY : JL
SETUP FILE : DMPSP.SET

DATE : 29/06/17 10:59
TEXT : ..C:\DOTIN\SPMASTER.DOC

I5-IP5

REF : 31833

MKUZE SUBSTATION

DRENNAN MAUD (PTY) LTD

DRENNAN MAUD (PTY) LTD

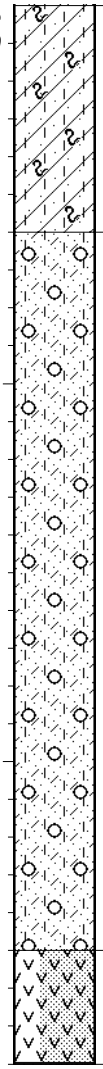
Geotechnical Engineers & Engineering Geologists

ILISO CONSULTING
ENVIRONMENTAL MANAGEMENT
MKUZE SUBSTATION – IPHIVA 5

HOLE No: I5 – IP6
Sheet 1 of 1

JOB NUMBER: 31833

Scale 1:20



SAMPLE	DEPTH (m)	
		0.00 Dry, brown to dark brown, hard, shattered and pinholed, slightly sandy silty CLAY with trace fine subangular to subrounded gravels of basalt and with roots – (Colluvium)
		0.60 Dry, brown to slightly orangey brown, very dense, shattered to intact, slightly clayey silty gravelly fine to medium grained SAND – (Residual Basalt) Gravel comprises fine to medium subangular to subrounded minor becoming abundant with depth basalt and amygdale fragments.
	1	
	2	
		2.50 Brown, completely to highly weathered with slightly weathered corestones, soft rock BASALT with hard rock corestones and fragments (up to 100mm in size) – (Letaba Formation) Note: Excavates as sandy fine to coarse gravel.
		2.80

NOTES

1) Final depth at 2.80m. Soft refusal on soft rock basalt.

2) No groundwater seepage.

3) No sidewall collapse.

4) Same position as DCP6.

5) No samples taken.

CONTRACTOR : KC BLOCK & PLANT
MACHINE : TLB – JCB 3CX
DRILLED BY : NA
PROFILED BY : JL

INCLINATION :
DIAM : NA
DATE : NA
DATE : 04-05-2017

ELEVATION : -
X-COORD : 3058610
Y-COORD : 0097210

HOLE No: I5 – IP6

TYPE SET BY : JL
SETUP FILE : DMPSP.SET

DATE : 29/06/17 10:59
TEXT : ..C:\DOTIN\SPMASTER.DOC

I5-IP6

REF : 31833

MKUZE SUBSTATION

DRENNAN MAUD (PTY) LTD

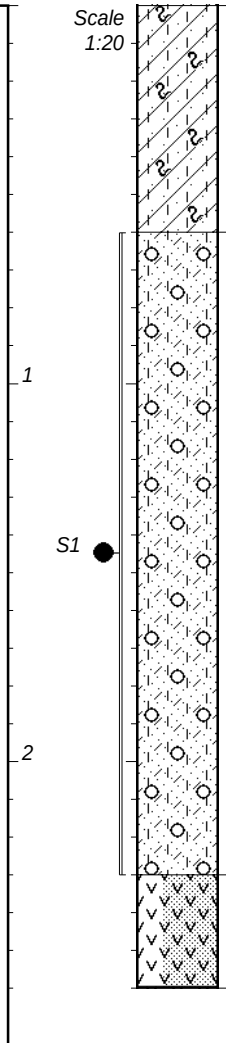
DRENNAN MAUD (PTY) LTD

Geotechnical Engineers & Engineering Geologists

ILISO CONSULTING
ENVIRONMENTAL MANAGEMENT
MKUZE SUBSTATION – IPHIVA 5

HOLE No: **I5 – IP7**
Sheet 1 of 1

JOB NUMBER: **31833**



SAMPLE	DEPTH (m)
Ind / MOD / CBR / pH / Conductivity / BRE / Basson	

Dry, brown to dark brown, very stiff, shattered and pinholed, slightly sandy silty CLAY with trace fine subangular to subrounded gravels of basalt and with roots – (Colluvium)

Dry, brown to slightly orangey brown, very dense, shattered to intact, slightly clayey silty gravelly fine to medium grained SAND – (Residual Basalt) Gravel comprises medium subangular to subrounded minor becoming abundant with depth basalt and amygdale fragments.

Brown to grey stained red, highly to medium weathered, fine grained, very closely to closely jointed, soft to medium hard rock BASALT with occasional hard rock corestones and with amygdales – (Letaba Formation)
Note: Excavates as sandy medium to coarse gravel with cobbles.

NOTES

1) Final depth at 2.60m. Hard refusal on medium hard rock basalt.

2) No groundwater seepage.

3) No sidewall collapse.

4) Same position as DCP7.

5) Samples taken:
S1 0.60--2.30m (IMC /pH /Conductivity /BRE /Basson)

CONTRACTOR : KC BLOCK & PLANT
MACHINE : TLB – JCB 3CX
DRILLED BY : NA
PROFILED BY : JL

TYPE SET BY : JL
SETUP FILE : DMPSP.SET

INCLINATION :
DIAM : NA
DATE : NA
DATE : 04-05-2017

DATE : 29/06/17 10:59
TEXT : ..C:\DOTIN\SPMASTER.DOC

ELEVATION : -
X-COORD : 3058625
Y-COORD : 0097055

HOLE No: **I5 – IP7**

I5-IP7

REF : 31833

MKUZE SUBSTATION

DRENNAN MAUD (PTY) LTD

DRENNAN MAUD (PTY) LTD

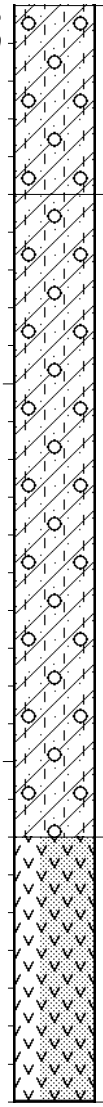
Geotechnical Engineers & Engineering Geologists

ILISO CONSULTING
ENVIRONMENTAL MANAGEMENT
MKUZE SUBSTATION – IPHIVA 5

HOLE No: I5 – IP8
Sheet 1 of 1

JOB NUMBER: 31833

Scale 1:20



SAMPLE	DEPTH (m)	
		0.00 Dry to slightly moist, brown, very stiff to hard, pinholed and slightly shattered, slightly sandy silty gravelly CLAY with roots– (Colluvium) Gravel comprises fine subangular minor fragments of basalt.
		0.50 Dry, slightly orangey brown, hard, shattered to intact, slightly sandy gravelly silty CLAY – (Residual Basalt) Gravel comprises fine to medium angular minor becoming abundant with depth fragments of basalt and amygdale-rich patches.
	1	
	2	
		2.20 Brown speckled light brown, completely weathered with highly weathered to slightly weathered corestones, fine grained, soft rock BASALT with hard rock fragments (30-120mm in size) and subrounded amygdales– (Letaba Formation) Note: Excavates as sandy medium to coarse gravel with cobbles.
		2.90

NOTES

1) Final depth at 2.90m. Soft refusal on gravel.

2) No groundwater seepage.

3) No sidewall collapse.

4) Same position as DCP8.

5) No samples taken.

CONTRACTOR : KC BLOCK & PLANT
MACHINE : TLB – JCB 3CX
DRILLED BY : NA
PROFILED BY : JL

INCLINATION : NA
DIAM : NA
DATE : NA
DATE : 04-05-2017

ELEVATION : -
X-COORD : 3058470
Y-COORD : 0097012

HOLE No: I5 – IP8

TYPE SET BY : JL
SETUP FILE : DMPSP.SET

DATE : 29/06/17 10:59
TEXT : ..C:\DOTIN\SPMASTER.DOC

I5-IP8

REF : 31833

MKUZE SUBSTATION

DRENNAN MAUD (PTY) LTD

DRENNAN MAUD (PTY) LTD

Geotechnical Engineers & Engineering Geologists

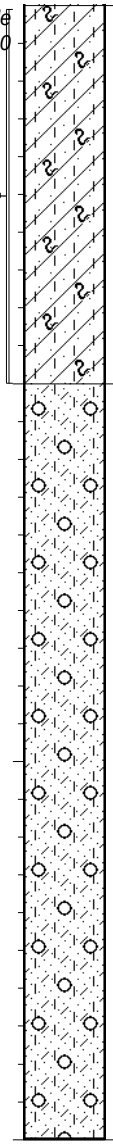
ILISO CONSULTING
ENVIRONMENTAL MANAGEMENT
MKUZE SUBSTATION – IPHIVA 5

HOLE No: I5 – IP9
Sheet 1 of 1

JOB NUMBER: 31833

Ind / MOD / CBR / pH / Conductivity / BRE / Basson

Scale 1:20



0.00

Dry, brown to dark brown, very stiff to hard, shattered and pinholed, slightly sandy silty CLAY with trace fine to medium subangular to subrounded gravels of basalt and with roots – (Colluvium)

1.00

Dry, brown to slightly orangey brown, very dense, shattered to intact, slightly clayey silty gravelly fine to medium grained SAND – (Residual Basalt) Gravel comprises fine to medium (occasionally coarse) subangular to subrounded minor becoming abundant with depth basalt and amygdale fragments.
Note: Amygdale-rich zone at 1.40m.

3.00

NOTES

1) Final depth at 3.00m. No refusal but TLB struggling.

2) No groundwater seepage.

3) No sidewall collapse.

4) Same position as DCP9.

5) Samples taken:
S1 0.01--1.00m (IMC /pH /Conductivity /BRE /Basson)

SAMPLE	*DEPTH (m)*
	1
	2
	3

CONTRACTOR : KC BLOCK & PLANT
MACHINE : TLB – JCB 3CX
DRILLED BY : NA
PROFILED BY : JL

TYPE SET BY : JL
SETUP FILE : DMPSP.SET

INCLINATION :
DIAM : NA
DATE : NA
DATE : 04-05-2017

DATE : 29/06/17 10:59
TEXT : ..C:\DOTIN\SPMASTER.DOC

ELEVATION : -
X-COORD : 3058536
Y-COORD : 0097119

HOLE No: I5 – IP9

I5-IP9

REF : 31833

MKUZE SUBSTATION

DRENNAN MAUD (PTY) LTD

DRENNAN MAUD (PTY) LTD

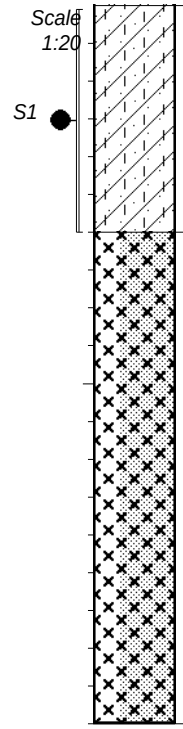
Geotechnical Engineers & Engineering Geologists

ILISO CONSULTING
ENVIRONMENTAL MANAGEMENT
MKUZE SUBSTATION – IPHIVA 6

HOLE No: I6 – IP1
Sheet 1 of 1

JOB NUMBER: 31833

SAMPLE	DEPTH (m)
Ind / MOD / CBR	
S1	0.00
	0.60
	1
	1.90



Dry to slightly moist, dark brown, very stiff, pinholed to intact, slightly sandy silty CLAY with trace coarse gravel to boulder sized angular to subrounded dolerite fragments – (Hillwash)

Blue grey stained red, medium to slightly weathered, fine grained, very closely jointed to highly fractured, medium hard to hard rock DOLERITE – (Karoo Igneous Province)
Note: Excavates as clayey sandy medium to coarse gravel.

NOTES

1) Final depth at 1.90m. Hard refusal on hard rock dolerite.

2) No groundwater seepage.

3) No sidewall collapse.

4) Same position as DCP1.

5) Samples taken:
S1 0.01--0.60m (IMC)

CONTRACTOR : KC BLOCK & PLANT
MACHINE : TLB – JCB 3CX
DRILLED BY : NA
PROFILED BY : JL

INCLINATION : NA
DIAM : NA
DATE : NA
DATE : 05-05-2017

ELEVATION : -
X-COORD : 3059710
Y-COORD : -092609

HOLE No: I6 – IP1

TYPE SET BY : JL
SETUP FILE : DMPSP.SET

DATE : 29/06/17 11:24
TEXT : ..C:\DOTIN\SPMASTER.DOC

I6-IP1

REF : 31833

MKUZE SUBSTATION

DRENNAN MAUD (PTY) LTD

DRENNAN MAUD (PTY) LTD

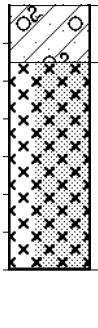
Geotechnical Engineers & Engineering Geologists

ILISO CONSULTING
ENVIRONMENTAL MANAGEMENT
MKUZE SUBSTATION – IPHIVA 6

HOLE No: I6 – IP2
Sheet 1 of 1

JOB NUMBER: 31833

Scale 1:20



0.00

Slightly moist, dark brown, stiff, intact, sandy gravelly CLAY with fine roots – (Hillwash)
Gravel comprises medium subangular minor dolerite fragments.

0.15

Blue grey stained red and yellow, medium to slightly weathered, fine grained, very closely to closely jointed, medium hard to hard rock DOLERITE – (Karoo Igneous Province)
Joint readings: 32°/138°; 32°/116°; 64°/014°; 88°/298°, slightly rough to rough, clayey sand filled.
Note: Excavates as sandy medium to coarse gravel and cobbles.

0.70

NOTES

1) Final depth at 0.70m. Hard refusal on hard rock dolerite.

2) No groundwater seepage.

3) No sidewall collapse.

4) Same position as DCP2.

5) No samples taken.

SAMPLE	*DEPTH (m)*

CONTRACTOR : KC BLOCK & PLANT
MACHINE : TLB – JCB 3CX
DRILLED BY : NA
PROFILED BY : JL

TYPE SET BY : JL
SETUP FILE : DMPSP.SET

INCLINATION :
DIAM : NA
DATE : NA
DATE : 05-05-2017

DATE : 29/06/17 11:24
TEXT : ..C:\DOTIN\SPMASTER.DOC

ELEVATION : -
X-COORD : 3059692
Y-COORD : -092228

HOLE No: I6 – IP2

I6-IP2

REF : 31833

MKUZE SUBSTATION

DRENNAN MAUD (PTY) LTD

DRENNAN MAUD (PTY) LTD

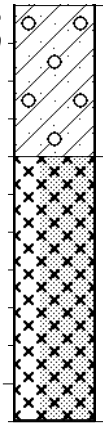
Geotechnical Engineers & Engineering Geologists

ILISO CONSULTING
ENVIRONMENTAL MANAGEMENT
MKUZE SUBSTATION – IPHIVA 6

HOLE No: I6 – IP3
Sheet 1 of 1

JOB NUMBER: 31833

Scale 1:20



SAMPLE	DEPTH (m)	
		0.00 Dry to slightly moist, brown to dark brown, stiff to very stiff, intact, sandy gravelly CLAY – (Hillwash) Gravel comprises fine to coarse (with cobbles and boulders up to 350mm) rounded to subrounded abundant dolerite corestones.
		0.40 Light brown patched blue grey, completely weathered to slightly weathered toward centre of corestones, fine grained, very soft rock (45-55%) DOLERITE with hard rock corestones (45-55% increasing with depth, 50-200mm averaging 100mm in size) – (Karoo Igneous Province) Note: Excavates as sandy medium to coarse gravel and cobbles.
	1	
		1.10

NOTES

1) Final depth at 1.10m. Hard refusal on hard rock corestones.

2) No groundwater seepage.

3) No sidewall collapse.

4) Same position as DCP3.

5) No samples taken.

CONTRACTOR : KC BLOCK & PLANT
MACHINE : TLB – JCB 3CX
DRILLED BY : NA
PROFILED BY : JL

INCLINATION :
DIAM : NA
DATE : NA
DATE : 05-05-2017

ELEVATION : -
X-COORD : 3060087
Y-COORD : -092217

HOLE No: I6 – IP3

TYPE SET BY : JL
SETUP FILE : DMPSP.SET

DATE : 29/06/17 11:24
TEXT : ..C:\DOTIN\SPMASTER.DOC

I6-IP3

REF : 31833

MKUZE SUBSTATION

DRENNAN MAUD (PTY) LTD

DRENNAN MAUD (PTY) LTD

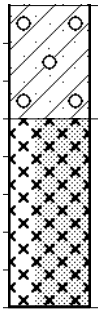
Geotechnical Engineers & Engineering Geologists

ILISO CONSULTING
ENVIRONMENTAL MANAGEMENT
MKUZE SUBSTATION – IPHIVA 6

HOLE No: I6 – IP4
Sheet 1 of 1

JOB NUMBER: 31833

Scale 1:20



0.00

Dry to slightly moist, brown to dark brown, very stiff, intact, sandy gravelly CLAY – (Hillwash) Gravel comprises fine to coarse (with cobbles and boulders up to 350mm) rounded to subrounded abundant dolerite corestones.

0.30

Light brown patched blue grey, completely weathered to slightly weathered toward centre of corestones, fine grained, very soft rock (30-40%) DOLERITE with hard rock corestones and fragments (60-70%, 30-250mm averaging 60mm in size) – (Karoo Igneous Province)
Note: Excavates as clayey sandy coarse gravel, cobbles and boulders.

0.80

NOTES

1) Final depth at 0.80m. Hard refusal on hard rock dolerite.

2) No groundwater seepage.

3) No sidewall collapse.

4) Same position as DCP4.

5) No samples taken.

SAMPLE	DEPTH (m)

CONTRACTOR : KC BLOCK & PLANT
MACHINE : TLB – JCB 3CX
DRILLED BY : NA
PROFILED BY : JL

TYPE SET BY : JL
SETUP FILE : DMPSP.SET

INCLINATION :
DIAM : NA
DATE : NA
DATE : 05-05-2017

DATE : 29/06/17 11:24
TEXT : ..C:\DOTIN\SPMASTER.DOC

ELEVATION : -
X-COORD : 3060085
Y-COORD : -092604

HOLE No: I6 – IP4

I6-IP4

REF : 31833

MKUZE SUBSTATION

DRENNAN MAUD (PTY) LTD

DRENNAN MAUD (PTY) LTD

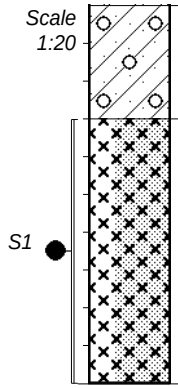
Geotechnical Engineers & Engineering Geologists

ILISO CONSULTING
ENVIRONMENTAL MANAGEMENT
MKUZE SUBSTATION – IPHIVA 6

HOLE No: I6 – IP5
Sheet 1 of 1

JOB NUMBER: 31833

Ind / MOD / CBR / pH / Conductivity / BRE / Basson	SAMPLE	DEPTH (m)
		0.00
	S1	0.30
		1.00
		1



Dry to slightly moist, brown to dark brown, stiff to very stiff, intact, sandy gravelly CLAY – (Hillwash) Gravel comprises fine to coarse (with cobbles and boulders up to 300mm) rounded to subrounded abundant dolerite corestones.

Light brown patched blue grey, completely weathered to slightly weathered toward centre of corestones, fine grained, very soft rock (20-30%) DOLERITE with hard rock corestones (70-80%, 30-350mm averaging 50mm in size) – (Karoo Igneous Province)
Note: Excavates as clayey sandy medium to coarse gravel, cobbles and boulders.

NOTES

1) Final depth at 1.00m. Hard refusal on hard rock corestones.

2) No groundwater seepage.

3) No sidewall collapse.

4) Same position as DCP5.

5) Samples taken:
S1 0.30--1.00m (IMC /pH /Conductivity /BRE /Basson)

CONTRACTOR : KC BLOCK & PLANT
MACHINE : TLB – JCB 3CX
DRILLED BY : NA
PROFILED BY : JL

INCLINATION :
DIAM : NA
DATE : NA
DATE : 05-05-2017

ELEVATION : -
X-COORD : 3059894
Y-COORD : -092544

HOLE No: I6 – IP5

TYPE SET BY : JL
SETUP FILE : DMPSP.SET

DATE : 29/06/17 11:24
TEXT : ..C:\DOTIN\SPMASTER.DOC

I6-IP5

REF : 31833

MKUZE SUBSTATION

DRENNAN MAUD (PTY) LTD

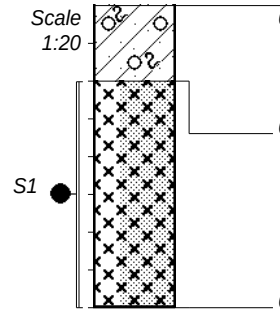
DRENNAN MAUD (PTY) LTD

Geotechnical Engineers & Engineering Geologists

ILISO CONSULTING
ENVIRONMENTAL MANAGEMENT
MKUZE SUBSTATION – IPHIVA 6

HOLE No: I6 – IP6
Sheet 1 of 1

JOB NUMBER: 31833



Slightly moist, dark brown, stiff, intact, sandy gravelly CLAY with fine roots – (Hillwash) Gravel comprises medium to coarse angular to subangular abundant dolerite fragments.

Blue grey stained red and orange, medium to slightly weathered, fine grained, very closely jointed to highly fractured, medium hard to hard rock DOLERITE – (Karoo Igneous Province)
Note: Excavates as slightly sandy medium to coarse gravels with occasional cobbles.

Ind / MOD / CBR

NOTES

1) Final depth at 0.80m. Hard refusal on hard rock dolerite.

2) No groundwater seepage.

3) No sidewall collapse.

4) Same position as DCP6.

5) Samples taken:
S1 0.20--0.80m (IMC)

SAMPLE	*DEPTH (m)*

CONTRACTOR : KC BLOCK & PLANT
MACHINE : TLB – JCB 3CX
DRILLED BY : NA
PROFILED BY : JL

INCLINATION :
DIAM : NA
DATE : NA
DATE : 05-05-2017

ELEVATION : -
X-COORD : 3059895
Y-COORD : -092301

HOLE No: I6 – IP6

TYPE SET BY : JL
SETUP FILE : DMPSP.SET

DATE : 29/06/17 11:24
TEXT : ..C:\DOTIN\SPMASTER.DOC

I6-IP6

REF : 31833

MKUZE SUBSTATION

DRENNAN MAUD (PTY) LTD

DRENNAN MAUD (PTY) LTD

Geotechnical Engineers & Engineering Geologists

ILISO CONSULTING
ENVIRONMENTAL MANAGEMENT
MKUZE SUBSTATION – IPHIVA 6

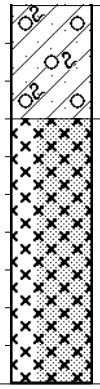
HOLE No: I6 – IP7
Sheet 1 of 1

JOB NUMBER: 31833

CBR / pH / Conductivity / BRE / Basson

Scale 1:20

S1



0.00

Slightly moist, dark brown, very stiff, intact, sandy gravelly CLAY with fine roots – (Hillwash) Gravel comprises medium angular to subangular abundant dolerite fragments.

0.30

Light brown patched blue grey, highly weathered to slightly weathered toward centre of corestones, fine grained, soft rock (20-30%) DOLERITE with hard rock corestones (70-80%, 100-250mm averaging 100mm in size) – (Karoo Igneous Province)
Note: Excavates as sandy medium to coarse gravels and cobbles.

1

1.00

NOTES

1) Final depth at 1.00m. Hard refusal on hard rock corestones.

2) No groundwater seepage.

3) No sidewall collapse.

4) Same position as DCP7.

5) Samples taken:
S1 0.01--0.30m (IMC /pH /Conductivity /BRE /Basson)

SAMPLE	*DEPTH (m)*

CONTRACTOR : KC BLOCK & PLANT
MACHINE : TLB – JCB 3CX
DRILLED BY : NA
PROFILED BY : JL

INCLINATION :
DIAM : NA
DATE : NA
DATE : 05-05-2017

ELEVATION : -
X-COORD : 3059977
Y-COORD : -092424

HOLE No: I6 – IP7

TYPE SET BY : JL
SETUP FILE : DMPSP.SET

DATE : 29/06/17 11:24
TEXT : ..C:\DOTIN\SPMASTER.DOC

I6-IP7

REF : 31833

MKUZE SUBSTATION

DRENNAN MAUD (PTY) LTD

DRENNAN MAUD (PTY) LTD

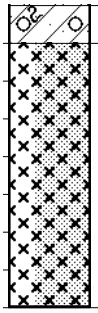
Geotechnical Engineers & Engineering Geologists

ILISO CONSULTING
ENVIRONMENTAL MANAGEMENT
MKUZE SUBSTATION – IPHIVA 6

HOLE No: I6 – IP8
Sheet 1 of 1

JOB NUMBER: 31833

Scale 1:20



0.00 Slightly moist, dark brown, stiff, intact, sandy gravelly CLAY with fine roots – (Hillwash)
Gravel comprises medium to coarse angular to subangular minor dolerite fragments.

0.10 Blue grey stained red, medium weathered, fine grained, very closely to closely jointed, medium hard rock DOLERITE – (Karoo Igneous Province)
Joint readings: 36°/014°; 87°/009°; 76°/088°, slightly rough to rough, sandy clay filled.
Note: Excavates as sandy medium to coarse gravel and cobbles.

0.80

NOTES

1) Final depth at 0.80m. Hard refusal on medium hard rock dolerite.

2) No groundwater seepage.

3) No sidewall collapse.

4) Same position as DCP8.

5) No samples taken.

SAMPLE	*DEPTH (m)*

CONTRACTOR : KC BLOCK & PLANT
MACHINE : TLB – JCB 3CX
DRILLED BY : NA
PROFILED BY : JL

INCLINATION :
DIAM : NA
DATE : NA
DATE : 05-05-2017

ELEVATION : -
X-COORD : 3059787
Y-COORD : -092418

HOLE No: I6 – IP8

TYPE SET BY : JL
SETUP FILE : DMPSP.SET

DATE : 29/06/17 11:24
TEXT : ..C:\DOTIN\SPMASTER.DOC

I6-IP8

REF : 31833

MKUZE SUBSTATION

DRENNAN MAUD (PTY) LTD

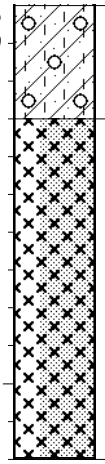
DRENNAN MAUD (PTY) LTD

Geotechnical Engineers & Engineering Geologists

ILISO CONSULTING
ENVIRONMENTAL MANAGEMENT
MKUZE SUBSTATION – IPHIVA 6

HOLE No: I6 – IP9
Sheet 1 of 1

JOB NUMBER: 31833



Dry to slightly moist, brown to dark brown, very stiff, intact, sandy silty gravelly CLAY – (Hillwash) Gravel comprises fine to coarse (with cobbles and boulders up to 300mm) rounded to subrounded abundant dolerite corestones.

Light brown patched blue grey, highly weathered to slightly weathered toward centre of corestones, fine grained, soft rock (25-35%) DOLERITE with hard rock corestones (65-75%, 50-400mm averaging 150mm in size) – (Karoo Igneous Province)
Note: Excavates as sandy medium to coarse gravel, cobbles and boulders.

NOTES

1) Final depth at 1.20m. Hard refusal on hard rock corestones.

2) No groundwater seepage.

3) No sidewall collapse.

4) Same position as DCP9.

5) No samples taken.

SAMPLE	DEPTH (m)

CONTRACTOR : KC BLOCK & PLANT
MACHINE : TLB – JCB 3CX
DRILLED BY : NA
PROFILED BY : JL

TYPE SET BY : JL
SETUP FILE : DMPSP.SET

INCLINATION :
DIAM : NA
DATE : NA
DATE : 05-05-2017

DATE : 29/06/17 11:24
TEXT : ..C:\DOTIN\SPMASTER.DOC

ELEVATION : -
X-COORD : 3059897
Y-COORD : -092469

HOLE No: I6 – IP9

I6-IP9

REF : 31833

MKUZE SUBSTATION

DRENNAN MAUD (PTY) LTD

DRENNAN MAUD (PTY) LTD

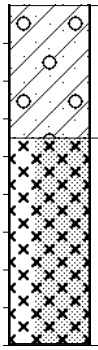
Geotechnical Engineers & Engineering Geologists

ILISO CONSULTING
ENVIRONMENTAL MANAGEMENT
MKUZE SUBSTATION – IPHIVA 6

HOLE No: **I6 – IP10**
Sheet 1 of 1

JOB NUMBER: **31833**

Scale 1:20



0.00

Dry to slightly moist, brown to dark brown, stiff to very stiff, intact, sandy gravelly CLAY – (Hillwash) Gravel comprises fine to coarse (with cobbles and boulders up to 300mm) rounded to subrounded abundant dolerite corestones.

0.35

Light brown patched blue grey, completely weathered to slightly weathered toward centre of corestones, fine grained, very soft rock (20-30%) DOLERITE with hard rock corestones (70-80%, 50-300mm averaging 150mm in size) – (Karoo Igneous Province)
Note: Excavates as sandy medium to coarse gravel and cobbles.

0.90

NOTES

1) Final depth at 0.90m. Hard refusal on hard rock corestones.

2) No groundwater seepage.

3) No sidewall collapse.

4) Same position as DCP10.

5) No samples taken.

SAMPLE	*DEPTH (m)*

CONTRACTOR : KC BLOCK & PLANT
MACHINE : TLB – JCB 3CX
DRILLED BY : NA
PROFILED BY : JL

TYPE SET BY : JL
SETUP FILE : DMPSP.SET

INCLINATION :
DIAM : NA
DATE : NA
DATE : 05-05-2017

DATE : 29/06/17 11:24
TEXT : ..C:\DOTIN\SPMASTER.DOC

ELEVATION : -
X-COORD : 3059900
Y-COORD : -092381

HOLE No: **I6 – IP10**

I6-IP10

REF : 31833

MKUZE SUBSTATION

DRENNAN MAUD (PTY) LTD

APPENDIX B

DYNAMIC CONE PENETROMETER TEST RESULTS

IPHIVA 4 - I4-DCP1 - I4-DCP10

IPHIVA 5 - I5-DCP1 - I5-DCP9

IPHIVA 6 - I6-DCP1 - I6-DCP10

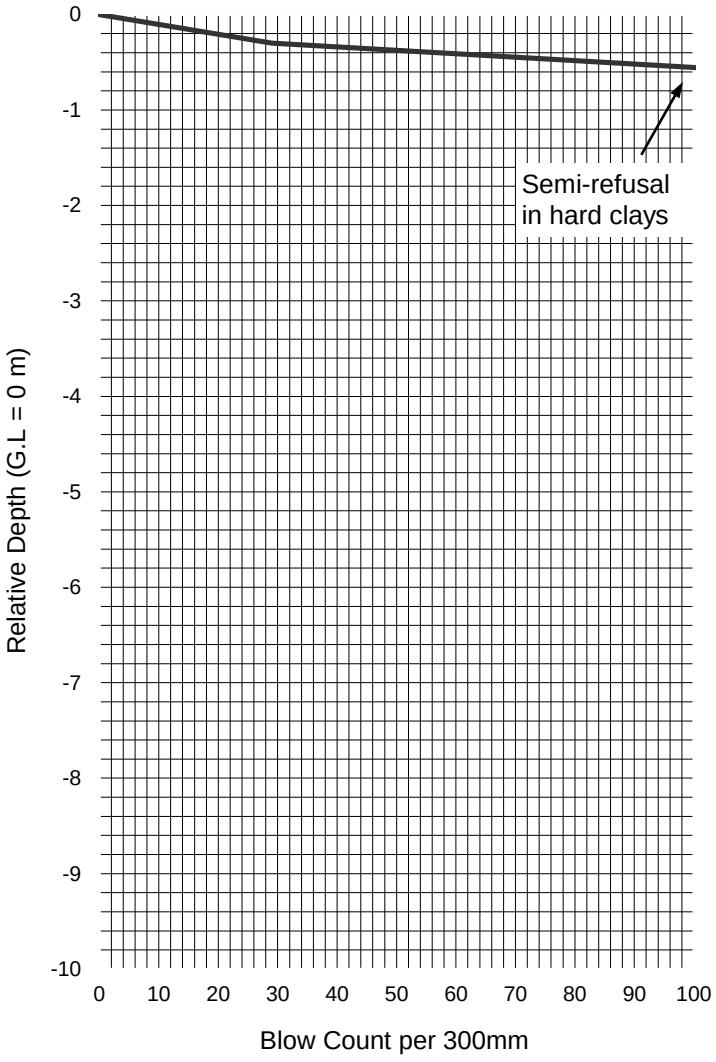
Dynamic Cone Penetrometer

Test No. : 1

Project : **Mkuze Substation**
Client: **ILISO Consulting Environmental Management**
Date: 08-05-2017 Remarks: -
Test Location: **Iphiva 4** -
Date of Test: 03-05-2017 Depth Interval (m) : 0.3

Depth (m)	Count Blows/0.3m
0	0
-0.3	29
-0.6	113

Blow Count vs Depth



Reference No. : 31833

Drennan Maud & Partners.

Fig. No. -

Note: DCP Blow Count equals the number of blows of a 10kg hammer dropping 450mm required to drive a 25mm diameter 60^{o} cone a distance of 300mm.

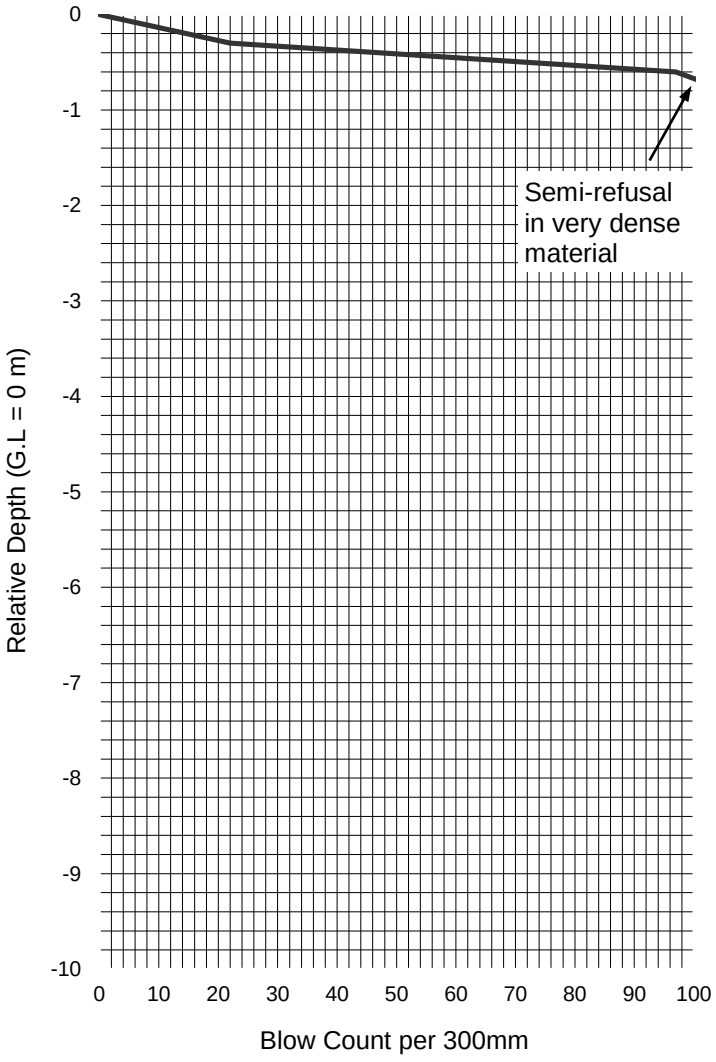
Dynamic Cone Penetrometer

Test No. : 2

Project : **Mkuze Substation**
Client: **ILISO Consulting Environmental Management**
Date: 08-05-2017 Remarks: -
Test Location: **Iphiva 4** -
Date of Test: 03-05-2017 Depth Interval (m) : 0.3

Depth (m)	Count Blows/0.3m
0	0
-0.3	22
-0.6	97
-0.9	110

Blow Count vs Depth



Reference No. : 31833

Drennan Maud & Partners.

Fig. No. -

Note: DCP Blow Count equals the number of blows of a 10kg hammer dropping 450mm required to drive a 25mm diameter 60^{o} cone a distance of 300mm.

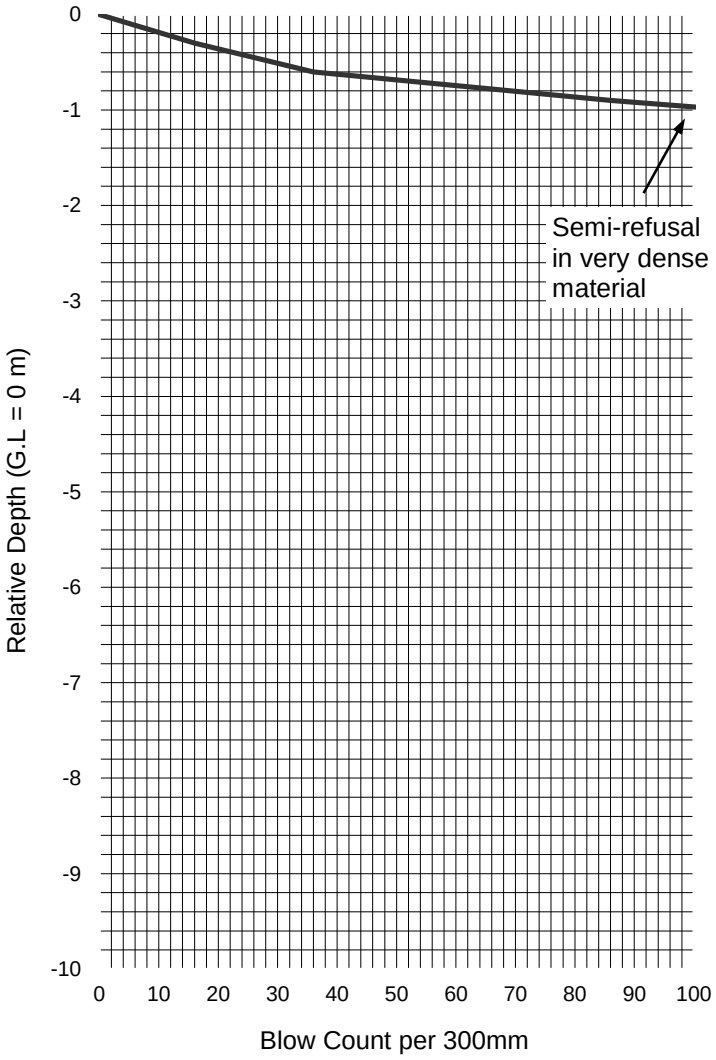
Dynamic Cone Penetrometer

Test No. : 3A

Project : **Mkuze Substation**
Client: **ILISO Consulting Environmental Management**
Date: 08-05-2017 Remarks: -
Test Location: **Iphiva 4** -
Date of Test: 03-05-2017 Depth Interval (m) : 0.3

Depth (m)	Count Blows/0.3m
0	0
-0.3	16
-0.6	36
-0.9	86
-1.2	148

Blow Count vs Depth



Reference No. : 31833

Drennan Maud & Partners.

Fig. No. -

Note: DCP Blow Count equals the number of blows of a 10kg hammer dropping 450mm required to drive a 25mm diameter 60^{o} cone a distance of 300mm.

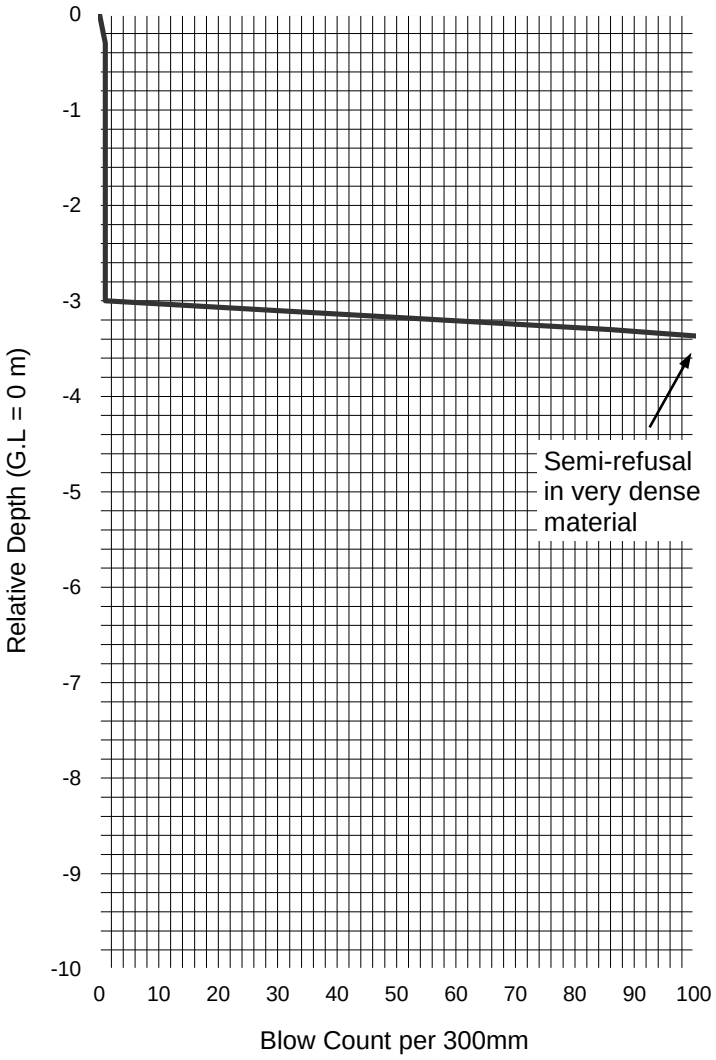
Dynamic Cone Penetrometer

Test No. : 3B

Project : **Mkuze Substation**
Client: **ILISO Consulting Environmental Management**
Date: 08-05-2017 Remarks: -
Test Location: **Iphiva 4** -
Date of Test: 03-05-2017 Depth Interval (m) : 0.3

Depth (m)	Count Blows/0.3m
0	0
-0.3	1
-0.6	1
-0.9	1
-1.2	1
-1.5	1
-1.8	1
-2.1	1
-2.4	1
-2.7	1
-3.0	1
-3.3	86
-3.6	150

Blow Count vs Depth



Reference No. : 31833

Drennan Maud & Partners.

Fig. No. -

Note: DCP Blow Count equals the number of blows of a 10kg hammer dropping 450mm required to drive a 25mm diameter 60° cone a distance of 300mm.

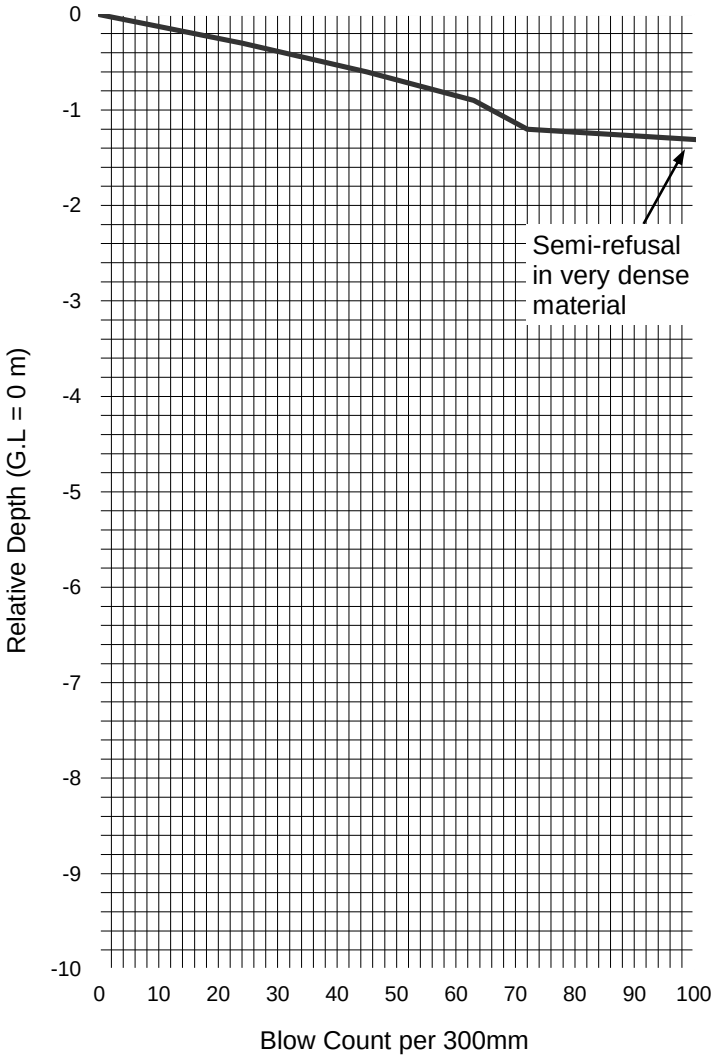
Dynamic Cone Penetrometer

Test No. : 4A

Project : **Mkuze Substation**
Client: **ILISO Consulting Environmental Management**
Date: 08-05-2017 Remarks: -
Test Location: **Iphiva 4** -
Date of Test: 03-05-2017 Depth Interval (m) : 0.3

Depth (m)	Count Blows/0.3m
0	0
-0.3	24
-0.6	45
-0.9	63
-1.2	72
-1.5	150

Blow Count vs Depth



Reference No. : 31833

Drennan Maud & Partners.

Fig. No. -

Note: DCP Blow Count equals the number of blows of a 10kg hammer dropping 450mm required to drive a 25mm diameter 60^{o} cone a distance of 300mm.

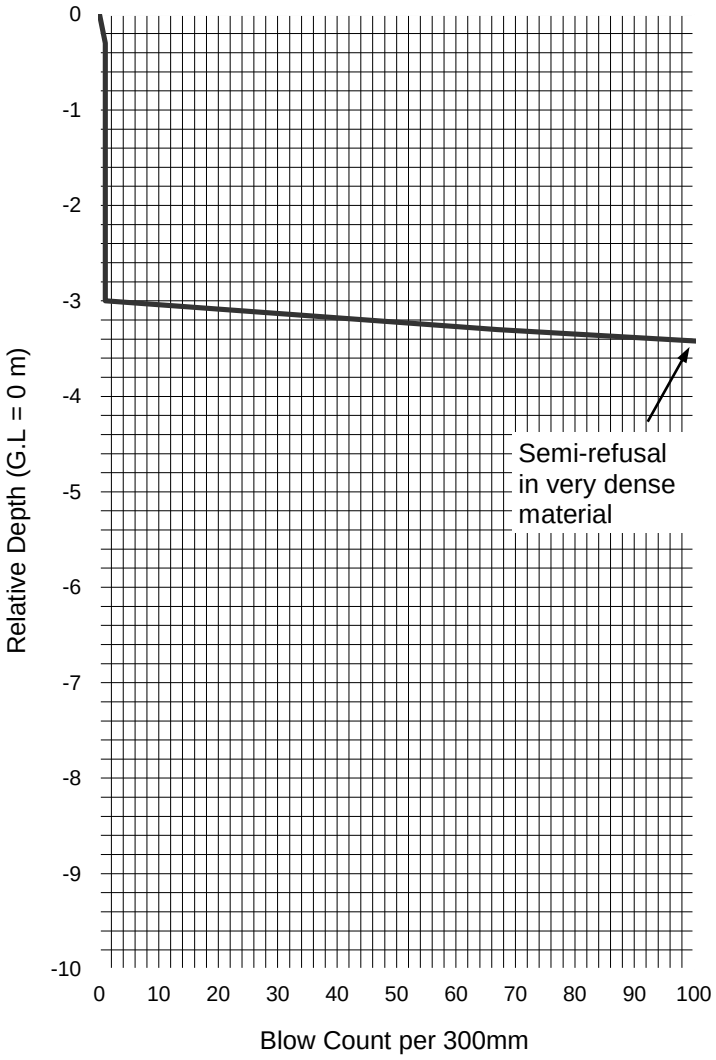
Dynamic Cone Penetrometer

Test No. : 4B

Project : **Mkuze Substation**
Client: **ILISO Consulting Environmental Management**
Date: 08-05-2017 Remarks: -
Test Location: **Iphiva 4** -
Date of Test: 03-05-2017 Depth Interval (m) : 0.3

Depth (m)	Count Blows/0.3m
0	0
-0.3	1
-0.6	1
-0.9	1
-1.2	1
-1.5	1
-1.8	1
-2.1	1
-2.4	1
-2.7	1
-3.0	1
-3.3	67
-3.6	150

Blow Count vs Depth



Reference No. : 31833

Drennan Maud & Partners.

Fig. No. -

Note: DCP Blow Count equals the number of blows of a 10kg hammer dropping 450mm required to drive a 25mm diameter 60^{o} cone a distance of 300mm.

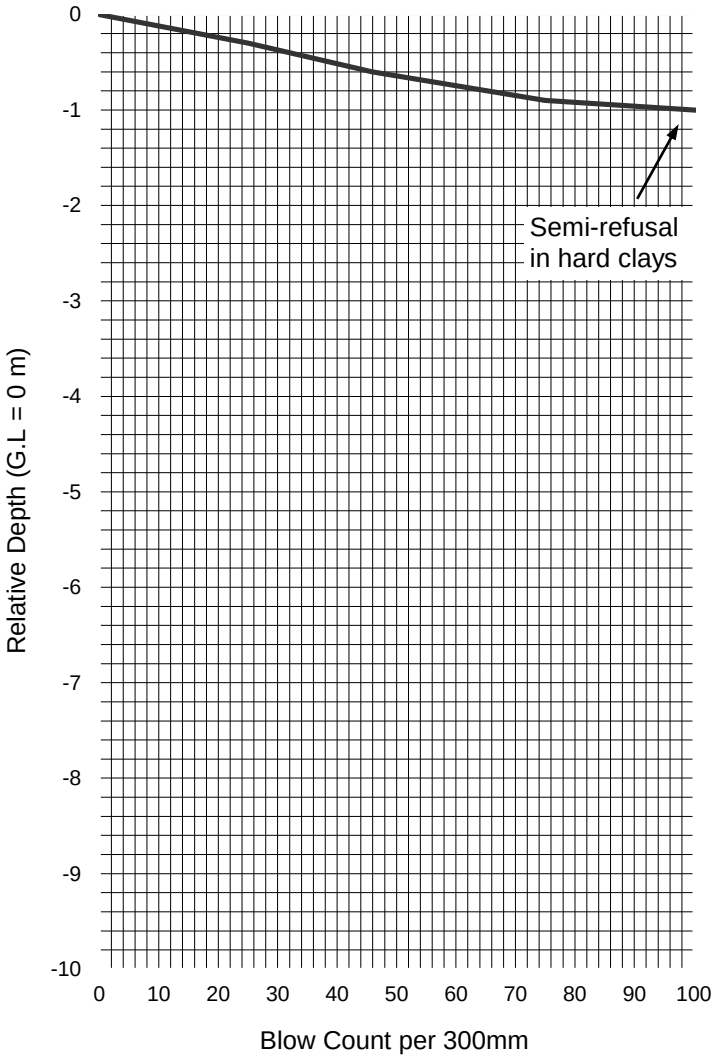
Dynamic Cone Penetrometer

Test No. : 5A

Project : **Mkuze Substation**
Client: **ILISO Consulting Environmental Management**
Date: 08-05-2017 Remarks: -
Test Location: **Iphiva 4** -
Date of Test: 03-05-2017 Depth Interval (m) : 0.3

Depth (m)	Count Blows/0.3m
0	0
-0.3	25
-0.6	46
-0.9	75
-1.2	150

Blow Count vs Depth



Reference No. : 31833

Drennan Maud & Partners.

Fig. No. -

Note: DCP Blow Count equals the number of blows of a 10kg hammer dropping 450mm required to drive a 25mm diameter 60^{o} cone a distance of 300mm.

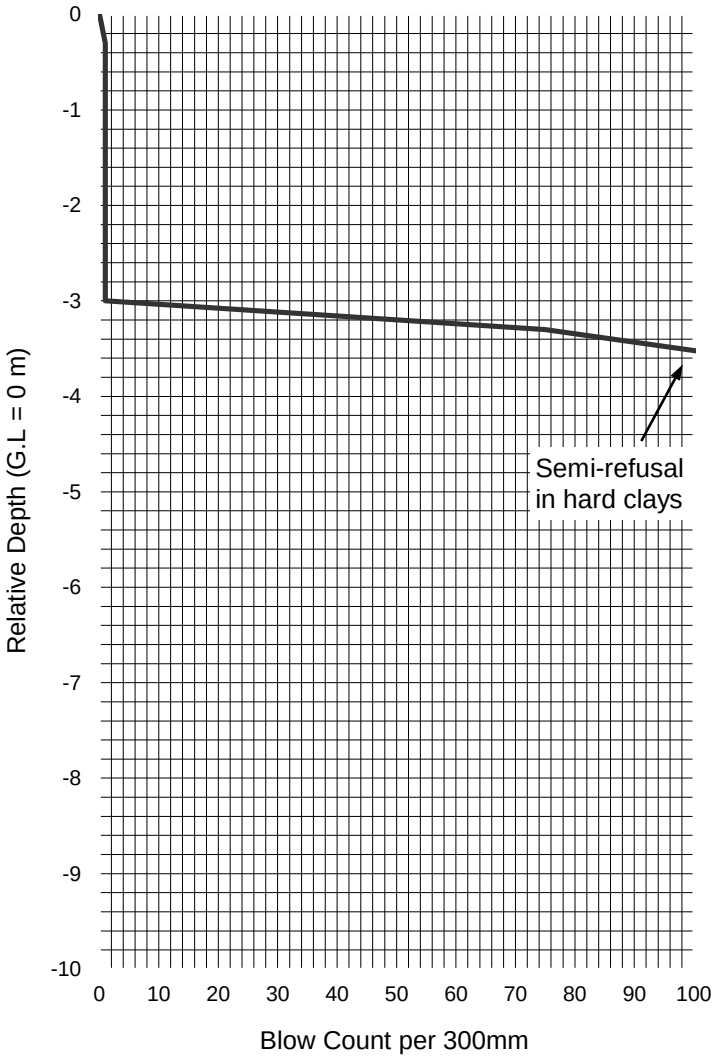
Dynamic Cone Penetrometer

Test No. : 5B

Project : **Mkuze Substation**
Client: **ILISO Consulting Environmental Management**
Date: 08-05-2017 Remarks: -
Test Location: **Iphiva 4** -
Date of Test: 03-05-2017 Depth Interval (m) : 0.3

Depth (m)	Count Blows/0.3m
0	0
-0.3	1
-0.6	1
-0.9	1
-1.2	1
-1.5	1
-1.8	1
-2.1	1
-2.4	1
-2.7	1
-3.0	1
-3.3	75
-3.6	109

Blow Count vs Depth



Reference No. : 31833

Drennan Maud & Partners.

Fig. No. -

Note: DCP Blow Count equals the number of blows of a 10kg hammer dropping 450mm required to drive a 25mm diameter 60^{o} cone a distance of 300mm.

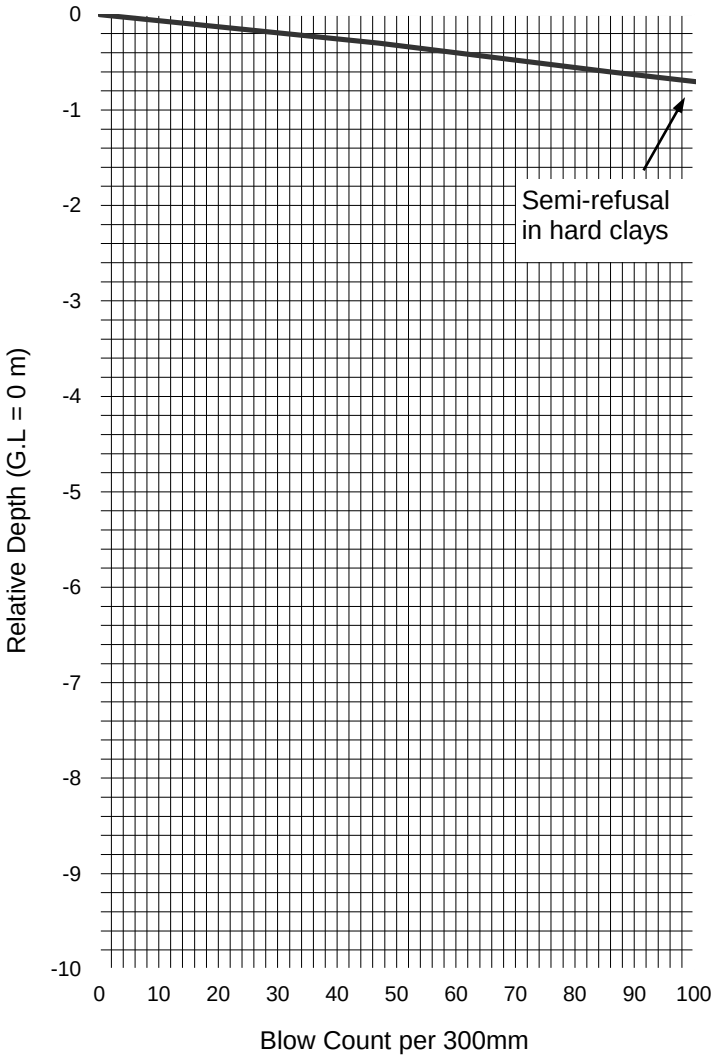
Dynamic Cone Penetrometer

Test No. : 6

Project : **Mkuze Substation**
Client: **ILISO Consulting Environmental Management**
Date: 08-05-2017 Remarks: -
Test Location: **Iphiva 4** -
Date of Test: 03-05-2017 Depth Interval (m) : 0.3

Depth (m)	Count Blows/0.3m
0	0
-0.3	47
-0.6	86
-0.9	128

Blow Count vs Depth



Reference No. : 31833

Drennan Maud & Partners.

Fig. No. -

Note: DCP Blow Count equals the number of blows of a 10kg hammer dropping 450mm required to drive a 25mm diameter 60^{o} cone a distance of 300mm.

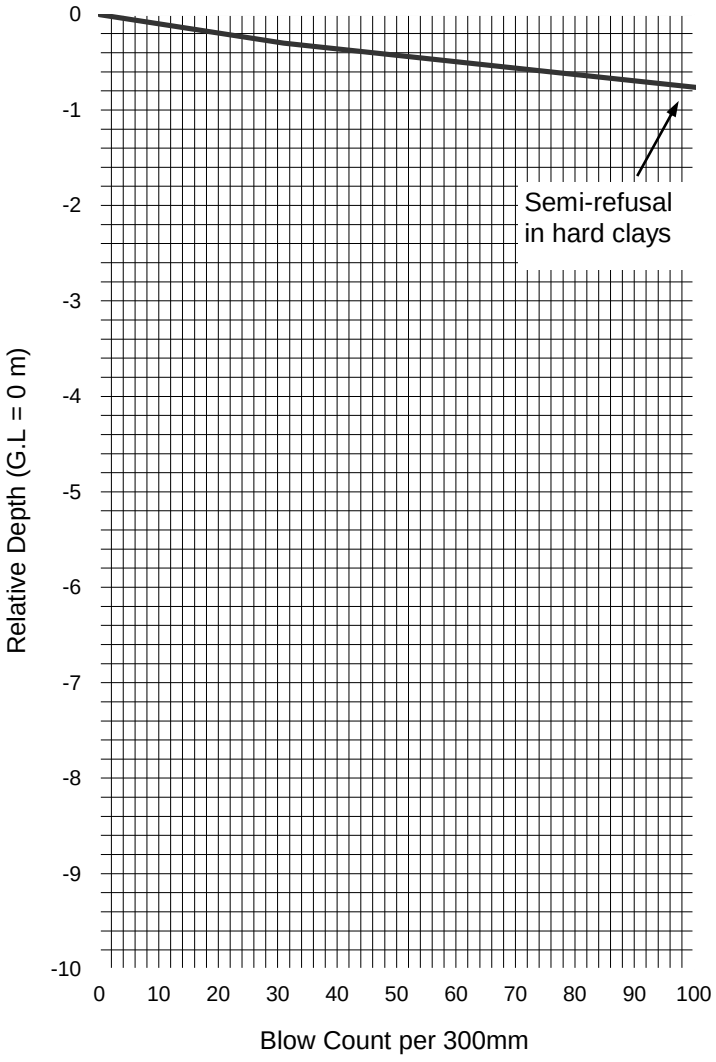
Dynamic Cone Penetrometer

Test No. : 7

Project : **Mkuze Substation**
Client: **ILISO Consulting Environmental Management**
Date: 08-05-2017 Remarks: -
Test Location: **Iphiva 4** -
Date of Test: 03-05-2017 Depth Interval (m) : 0.3

Depth (m)	Count Blows/0.3m
0	0
-0.3	31
-0.6	76
-0.9	121

Blow Count vs Depth



Reference No. : 31833

Drennan Maud & Partners.

Fig. No. -

Note: DCP Blow Count equals the number of blows of a 10kg hammer dropping 450mm required to drive a 25mm diameter 60^{o} cone a distance of 300mm.

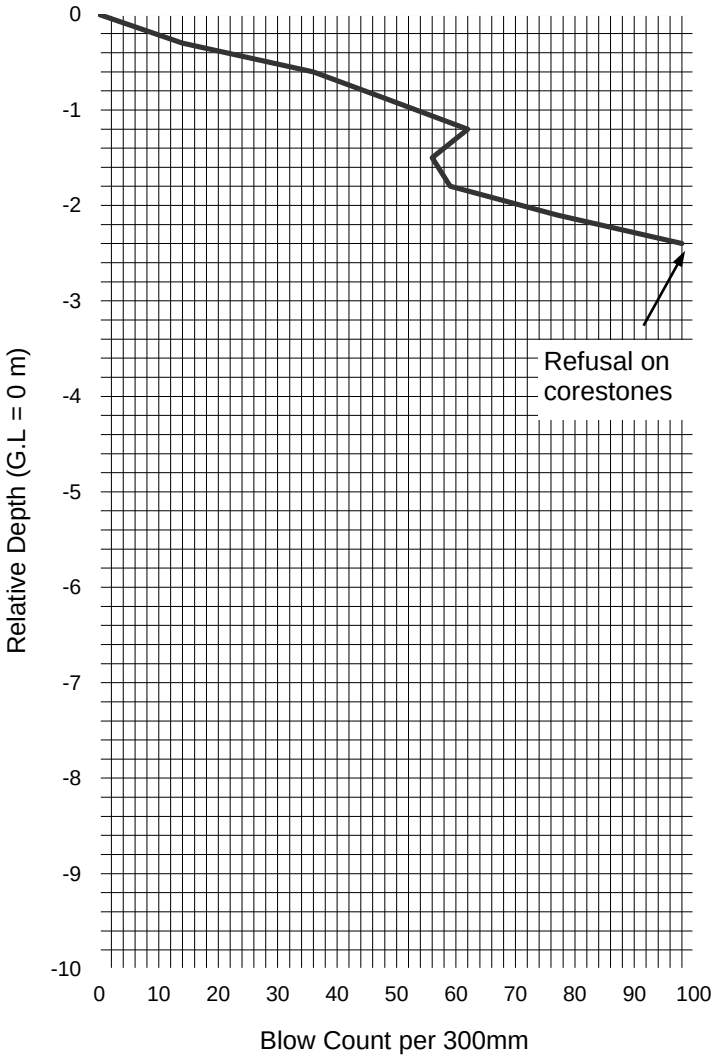
Dynamic Cone Penetrometer

Test No. : 8

Project : **Mkuze Substation**
Client: **ILISO Consulting Environmental Management**
Date: 08-05-2017 Remarks: -
Test Location: **Iphiva 4** -
Date of Test: 03-05-2017 Depth Interval (m) : 0.3

Depth (m)	Count Blows/0.3m
0	0
-0.3	14
-0.6	36
-0.9	49
-1.2	62
-1.5	56
-1.8	59
-2.1	77
-2.4	98

Blow Count vs Depth



Reference No. : 31833

Drennan Maud & Partners.

Fig. No. -

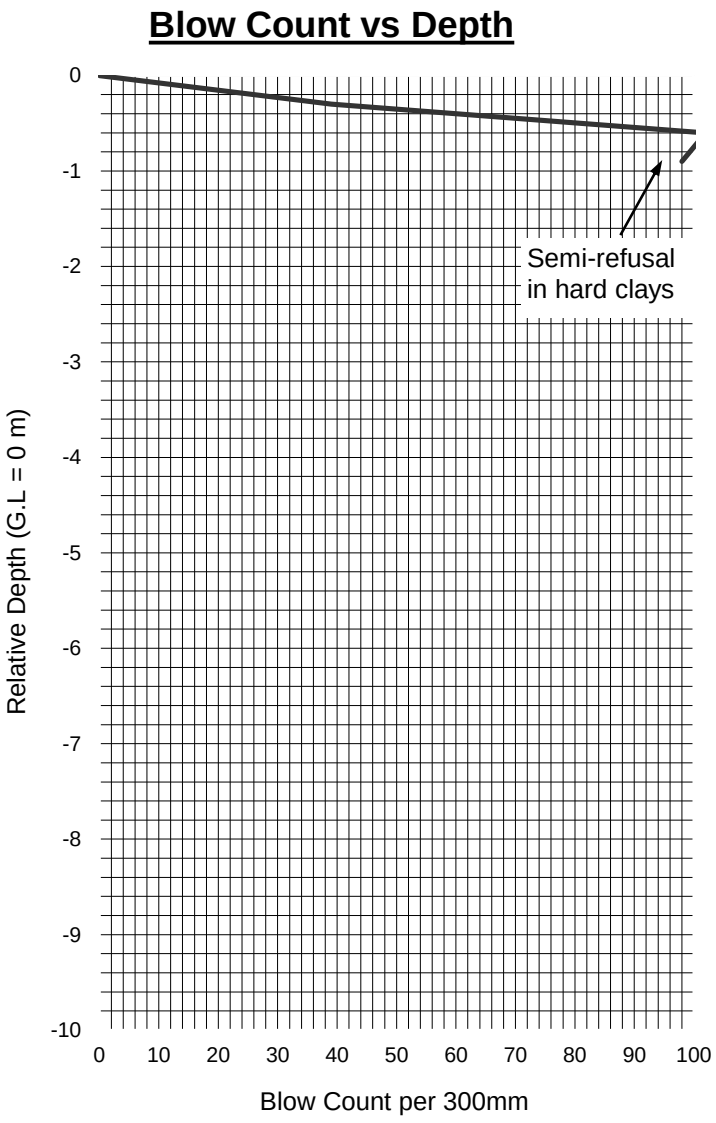
Note: DCP Blow Count equals the number of blows of a 10kg hammer dropping 450mm required to drive a 25mm diameter 60^{o} cone a distance of 300mm.

Dynamic Cone Penetrometer

Test No. : 9

Project : **Mkuze Substation**
Client: **ILISO Consulting Environmental Management**
Date: 08-05-2017 Remarks: -
Test Location: **Iphiva 4** -
Date of Test: 03-05-2017 Depth Interval (m) : 0.3

Depth (m)	Count Blows/0.3m
0	0
-0.3	39
-0.6	102
-0.9	98



Reference No. : 31833

Drennan Maud & Partners.

Fig. No. -

Note: DCP Blow Count equals the number of blows of a 10kg hammer dropping 450mm required to drive a 25mm diameter 60^{o} cone a distance of 300mm.

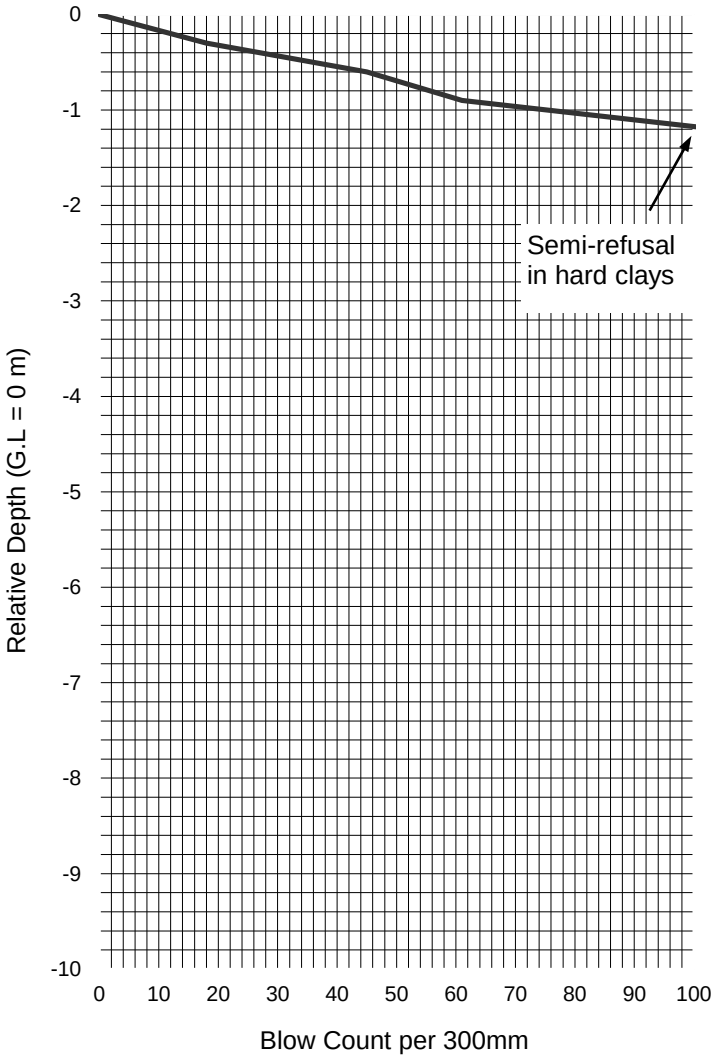
Dynamic Cone Penetrometer

Test No. : 10

Project : **Mkuze Substation**
Client: **ILISO Consulting Environmental Management**
Date: 08-05-2017 Remarks: -
Test Location: **Iphiva 4** -
Date of Test: 03-05-2017 Depth Interval (m) : 0.3

Depth (m)	Count Blows/0.3m
0	0
-0.3	18
-0.6	45
-0.9	61
-1.2	104

Blow Count vs Depth



Reference No. : 31833

Drennan Maud & Partners.

Fig. No. -

Note: DCP Blow Count equals the number of blows of a 10kg hammer dropping 450mm required to drive a 25mm diameter 60^{o} cone a distance of 300mm.

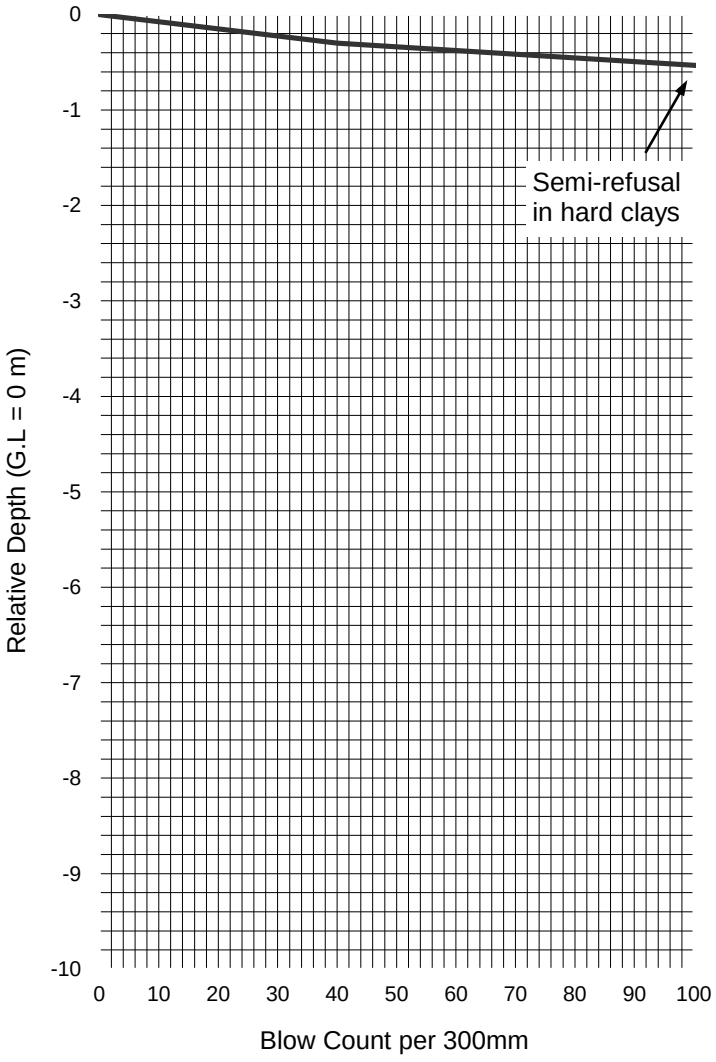
Dynamic Cone Penetrometer

Test No. : 1A

Project : **Mkuze Substation**
Client: **ILISO Consulting Environmental Management**
Date: 08-05-2017 Remarks: -
Test Location: **Iphiva 5** -
Date of Test: 04-05-2017 Depth Interval (m) : 0.3

Depth (m)	Count Blows/0.3m
0	0
-0.3	40
-0.6	118

Blow Count vs Depth



Reference No. : 31833

Drennan Maud & Partners.

Fig. No. -

Note: DCP Blow Count equals the number of blows of a 10kg hammer dropping 450mm required to drive a 25mm diameter 60^{o} cone a distance of 300mm.

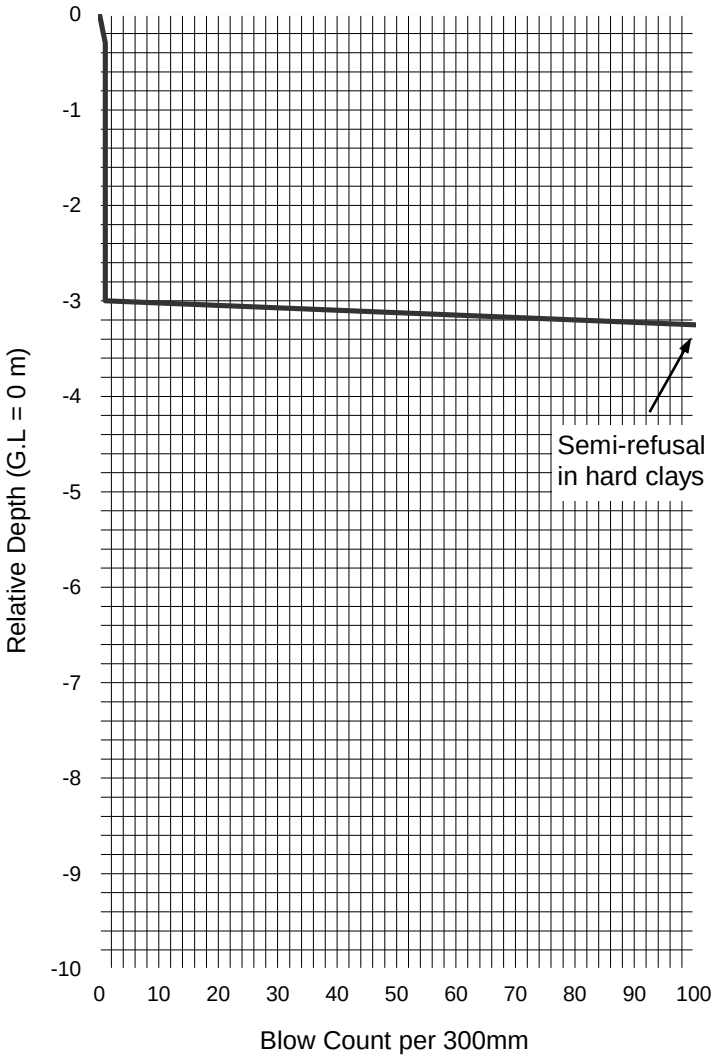
Dynamic Cone Penetrometer

Test No. : 1B

Project : **Mkuze Substation**
Client: **ILISO Consulting Environmental Management**
Date: 08-05-2017 Remarks: -
Test Location: **Iphiva 5** -
Date of Test: 04-05-2017 Depth Interval (m) : 0.3

Depth (m)	Count Blows/0.3m
0	0
-0.3	1
-0.6	1
-0.9	1
-1.2	1
-1.5	1
-1.8	1
-2.1	1
-2.4	1
-2.7	1
-3.0	1
-3.3	120

Blow Count vs Depth



Reference No. : 31833

Drennan Maud & Partners.

Fig. No. -

Note: DCP Blow Count equals the number of blows of a 10kg hammer dropping 450mm required to drive a 25mm diameter 60^{o} cone a distance of 300mm.

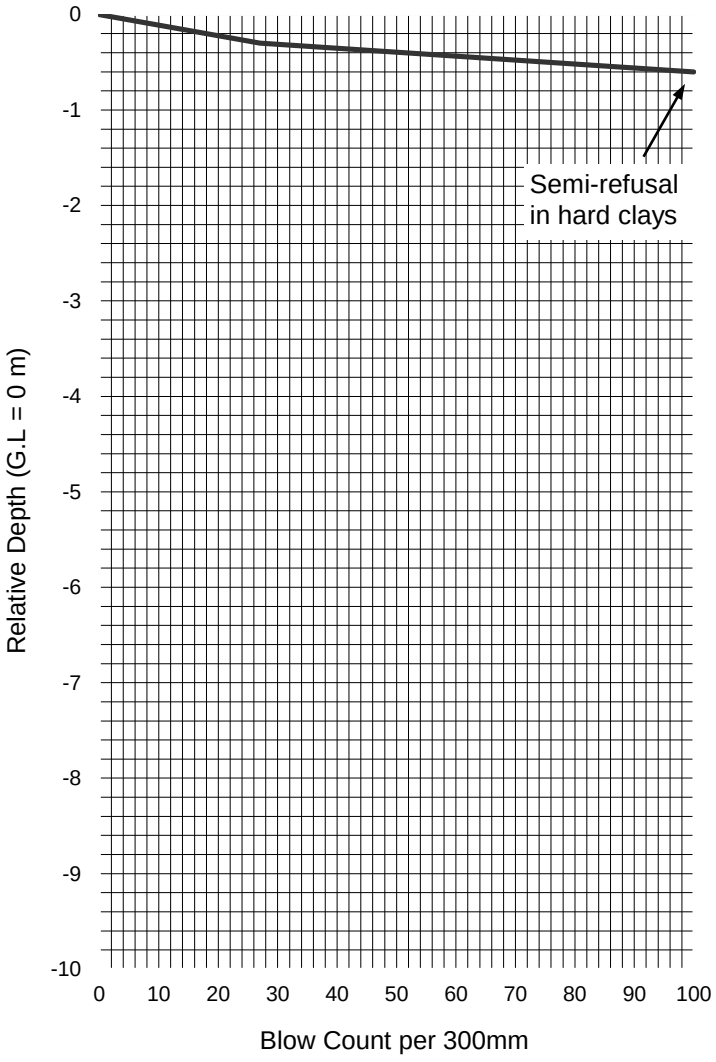
Dynamic Cone Penetrometer

Test No. : 2

Project : **Mkuze Substation**
Client: **ILISO Consulting Environmental Management**
Date: 08-05-2017 Remarks: -
Test Location: **Iphiva 5** -
Date of Test: 04-05-2017 Depth Interval (m) : 0.3

Depth (m)	Count Blows/0.3m
0	0
-0.3	27
-0.6	100

Blow Count vs Depth



Reference No. : 31833

Drennan Maud & Partners.

Fig. No. -

Note: DCP Blow Count equals the number of blows of a 10kg hammer dropping 450mm required to drive a 25mm diameter 60^{o} cone a distance of 300mm.

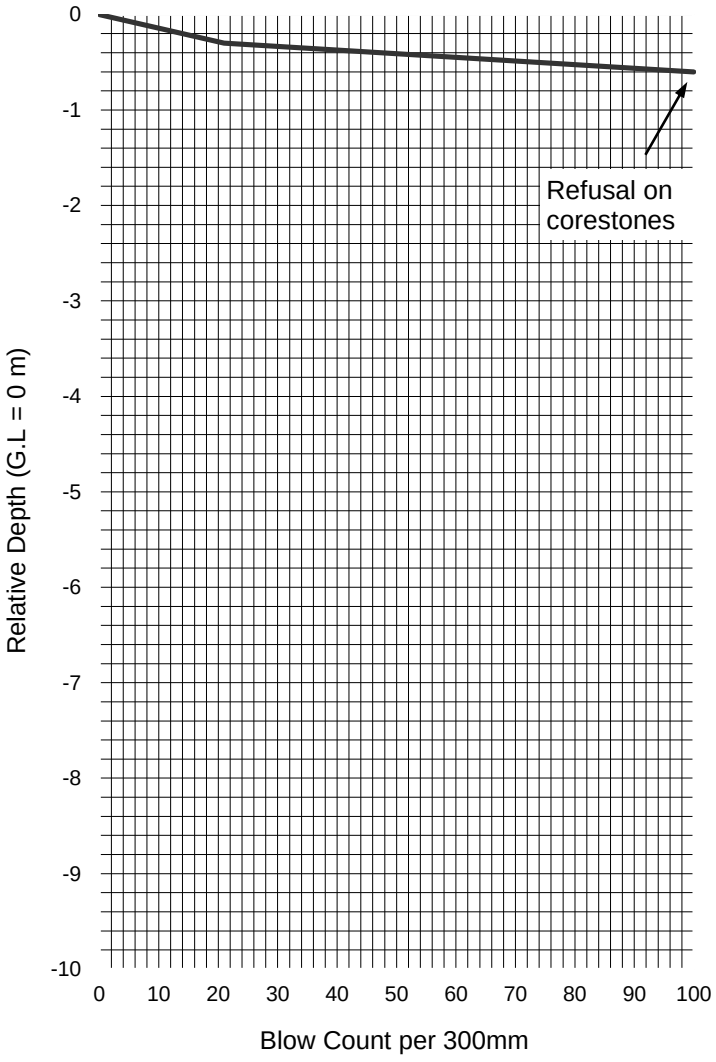
Dynamic Cone Penetrometer

Test No. : 3

Project : **Mkuze Substation**
Client: **ILISO Consulting Environmental Management**
Date: 08-05-2017 Remarks: -
Test Location: **Iphiva 5** -
Date of Test: 04-05-2017 Depth Interval (m) : 0.3

Depth (m)	Count Blows/0.3m
0	0
-0.3	21
-0.6	100

Blow Count vs Depth



Reference No. : 31833

Drennan Maud & Partners.

Fig. No. -

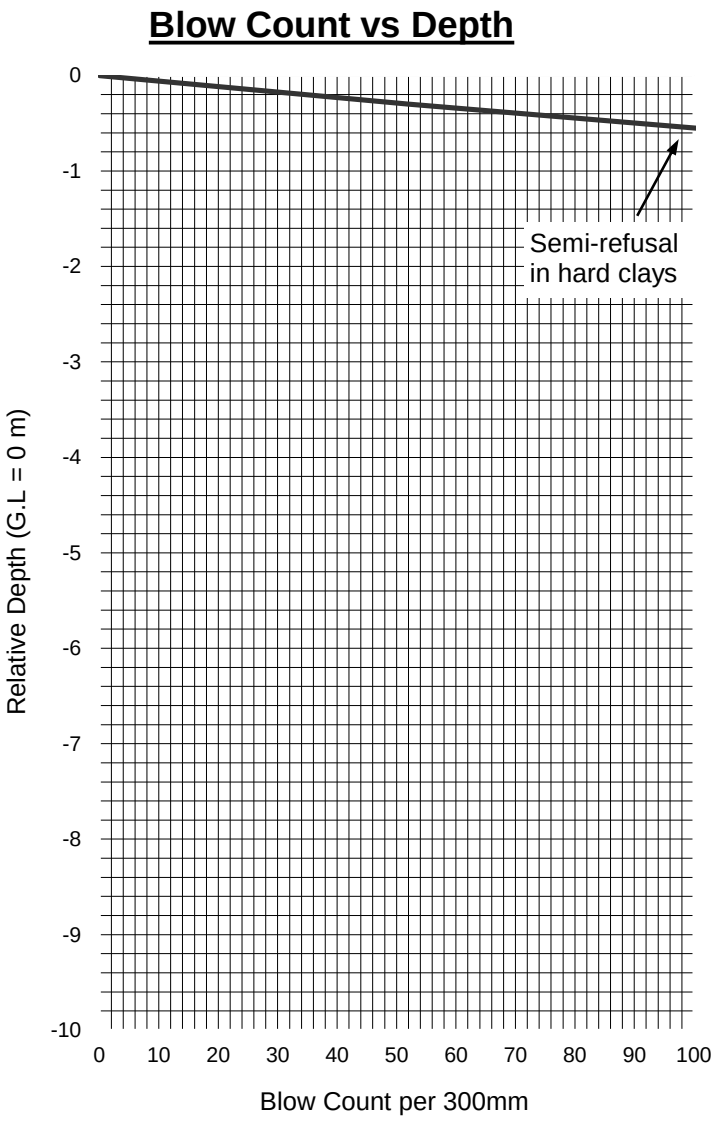
Note: DCP Blow Count equals the number of blows of a 10kg hammer dropping 450mm required to drive a 25mm diameter 60^{o} cone a distance of 300mm.

Dynamic Cone Penetrometer

Test No. : 4A

Project : **Mkuze Substation**
Client: **ILISO Consulting Environmental Management**
Date: 08-05-2017 Remarks: -
Test Location: **Iphiva 5** -
Date of Test: 04-05-2017 Depth Interval (m) : 0.3

Depth (m)	Count Blows/0.3m
0	0
-0.3	52
-0.6	110



Reference No. : 31833

Drennan Maud & Partners.

Fig. No. -

Note: DCP Blow Count equals the number of blows of a 10kg hammer dropping 450mm required to drive a 25mm diameter 60^{o} cone a distance of 300mm.

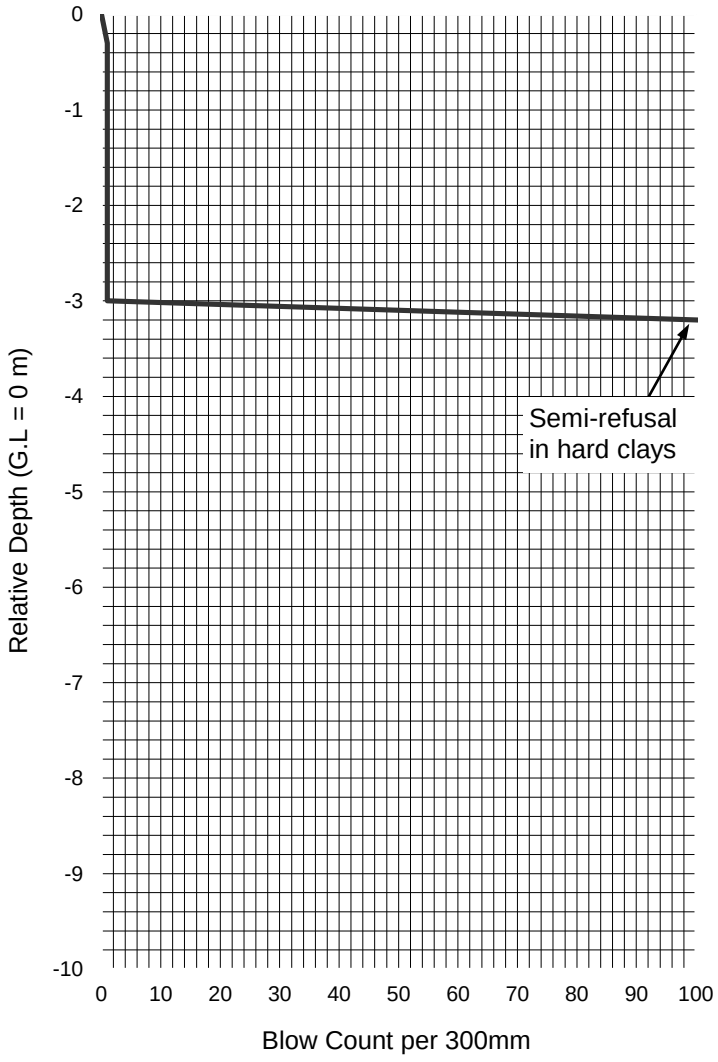
Dynamic Cone Penetrometer

Test No. : 4B

Project : **Mkuze Substation**
Client: **ILISO Consulting Environmental Management**
Date: 08-05-2017 Remarks: -
Test Location: **Iphiva 5** -
Date of Test: 04-05-2017 Depth Interval (m) : 0.3

Depth (m)	Count Blows/0.3m
0	0
-0.3	1
-0.6	1
-0.9	1
-1.2	1
-1.5	1
-1.8	1
-2.1	1
-2.4	1
-2.7	1
-3.0	1
-3.3	150

Blow Count vs Depth



Reference No. : 31833

Drennan Maud & Partners.

Fig. No. -

Note: DCP Blow Count equals the number of blows of a 10kg hammer dropping 450mm required to drive a 25mm diameter 60^{o} cone a distance of 300mm.

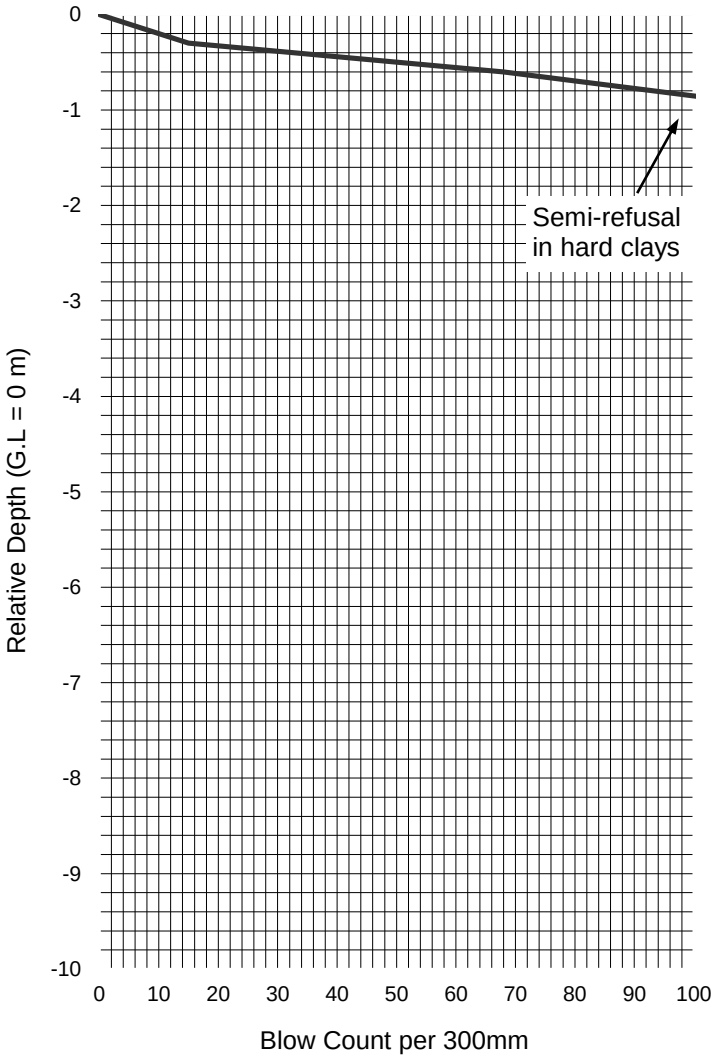
Dynamic Cone Penetrometer

Test No. : 5

Project : **Mkuze Substation**
Client: **ILISO Consulting Environmental Management**
Date: 08-05-2017 Remarks: -
Test Location: **Iphiva 5** -
Date of Test: 04-05-2017 Depth Interval (m) : 0.3

Depth (m)	Count Blows/0.3m
0	0
-0.3	15
-0.6	68
-0.9	106

Blow Count vs Depth



Reference No. : 31833

Drennan Maud & Partners.

Fig. No. -

Note: DCP Blow Count equals the number of blows of a 10kg hammer dropping 450mm required to drive a 25mm diameter 60^{o} cone a distance of 300mm.

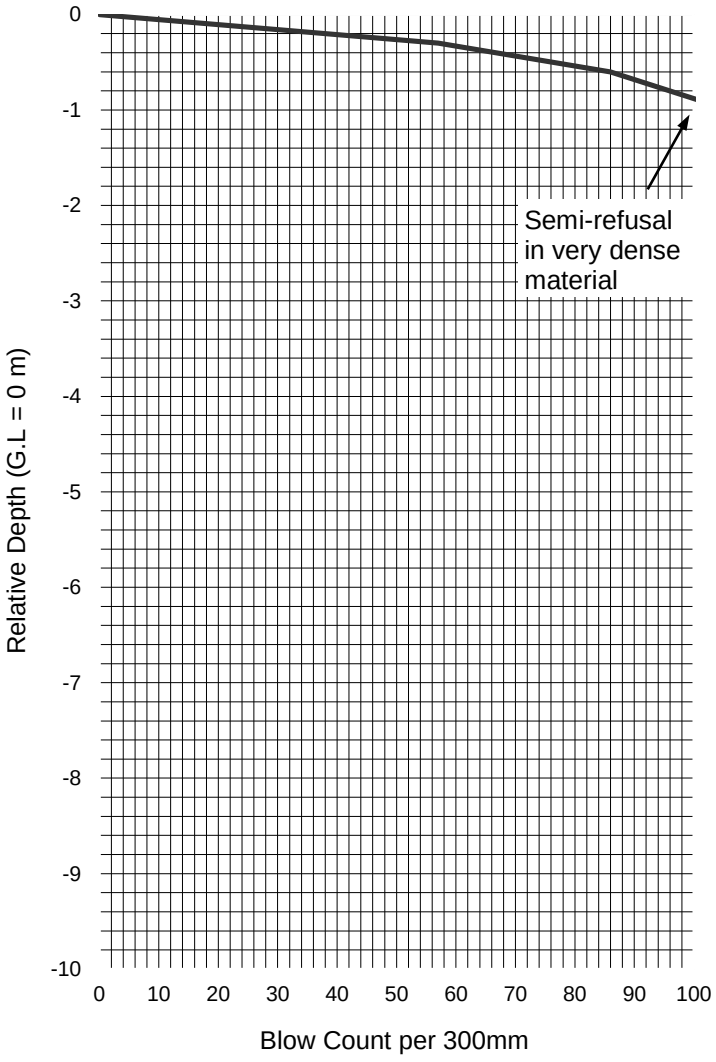
Dynamic Cone Penetrometer

Test No. : 6

Project : **Mkuze Substation**
Client: **ILISO Consulting Environmental Management**
Date: 08-05-2017 Remarks: -
Test Location: **Iphiva 5** -
Date of Test: 04-05-2017 Depth Interval (m) : 0.3

Depth (m)	Count Blows/0.3m
0	0
-0.3	57
-0.6	86
-0.9	101

Blow Count vs Depth



Reference No. : 31833

Drennan Maud & Partners.

Fig. No. -

Note: DCP Blow Count equals the number of blows of a 10kg hammer dropping 450mm required to drive a 25mm diameter 60^{o} cone a distance of 300mm.

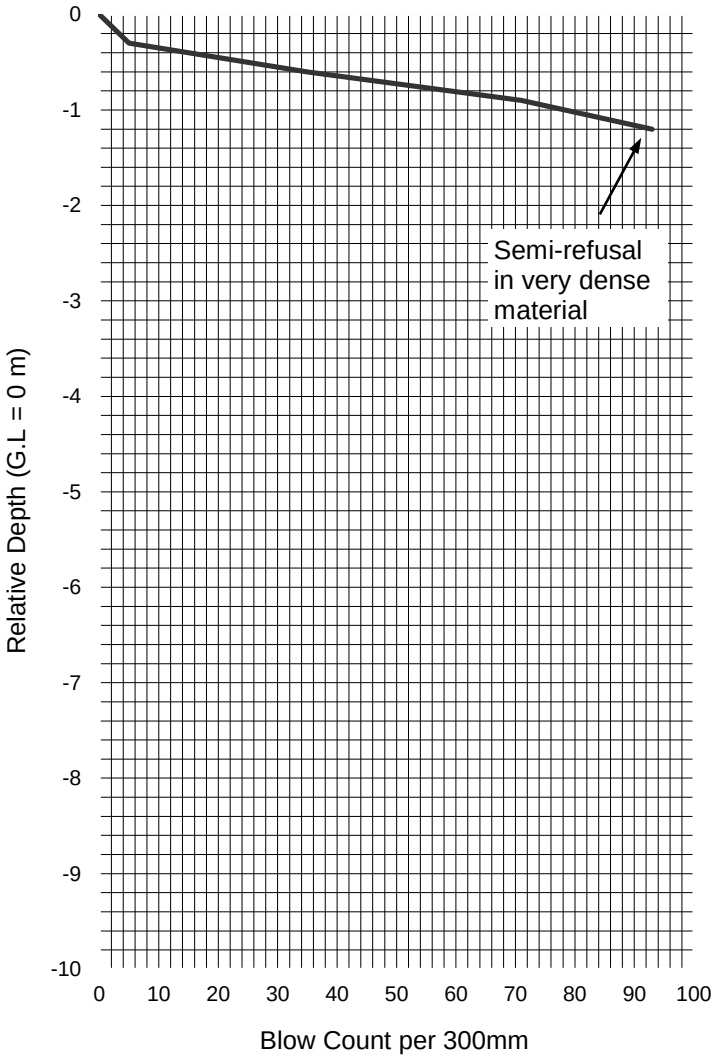
Dynamic Cone Penetrometer

Test No. : 7

Project : **Mkuze Substation**
Client: **ILISO Consulting Environmental Management**
Date: 08-05-2017 Remarks: -
Test Location: **Iphiva 5** -
Date of Test: 04-05-2017 Depth Interval (m) : 0.3

Depth (m)	Count Blows/0.3m
0	0
-0.3	5
-0.6	35
-0.9	71
-1.2	93

Blow Count vs Depth



Reference No. : 31833

Drennan Maud & Partners.

Fig. No. -

Note: DCP Blow Count equals the number of blows of a 10kg hammer dropping 450mm required to drive a 25mm diameter 60^{o} cone a distance of 300mm.

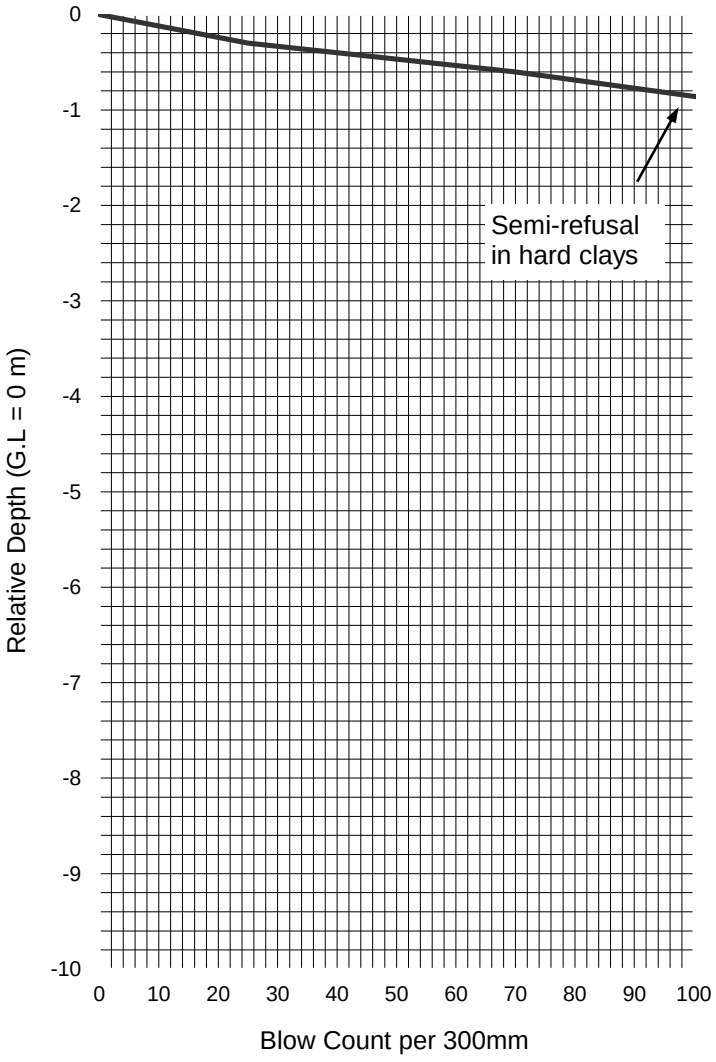
Dynamic Cone Penetrometer

Test No. : 8

Project : **Mkuze Substation**
Client: **ILISO Consulting Environmental Management**
Date: 08-05-2017 Remarks: -
Test Location: **Iphiva 5** -
Date of Test: 04-05-2017 Depth Interval (m) : 0.3

Depth (m)	Count Blows/0.3m
0	0
-0.3	25
-0.6	70
-0.9	105

Blow Count vs Depth



Reference No. : 31833

Drennan Maud & Partners.

Fig. No. -

Note: DCP Blow Count equals the number of blows of a 10kg hammer dropping 450mm required to drive a 25mm diameter 60^{o} cone a distance of 300mm.

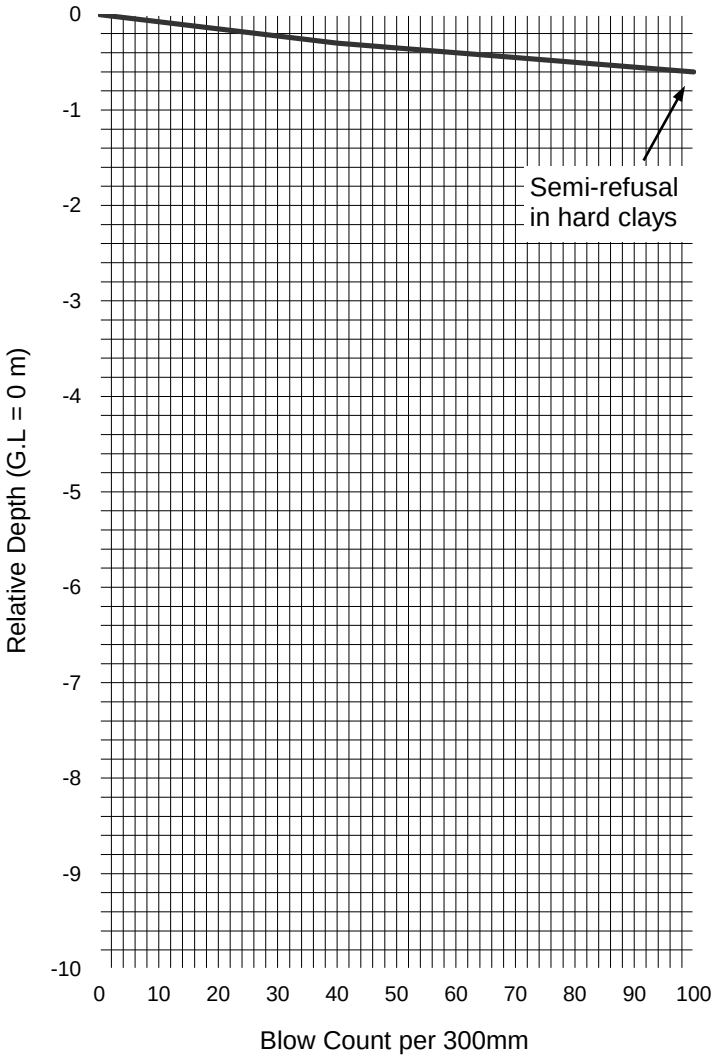
Dynamic Cone Penetrometer

Test No. : 9A

Project : **Mkuze Substation**
Client: **ILISO Consulting Environmental Management**
Date: 08-05-2017 Remarks: -
Test Location: **Iphiva 5** -
Date of Test: 04-05-2017 Depth Interval (m) : 0.3

Depth (m)	Count Blows/0.3m
0	0
-0.3	40
-0.6	100

Blow Count vs Depth



Reference No. : 31833

Drennan Maud & Partners.

Fig. No. -

Note: DCP Blow Count equals the number of blows of a 10kg hammer dropping 450mm required to drive a 25mm diameter 60^{o} cone a distance of 300mm.

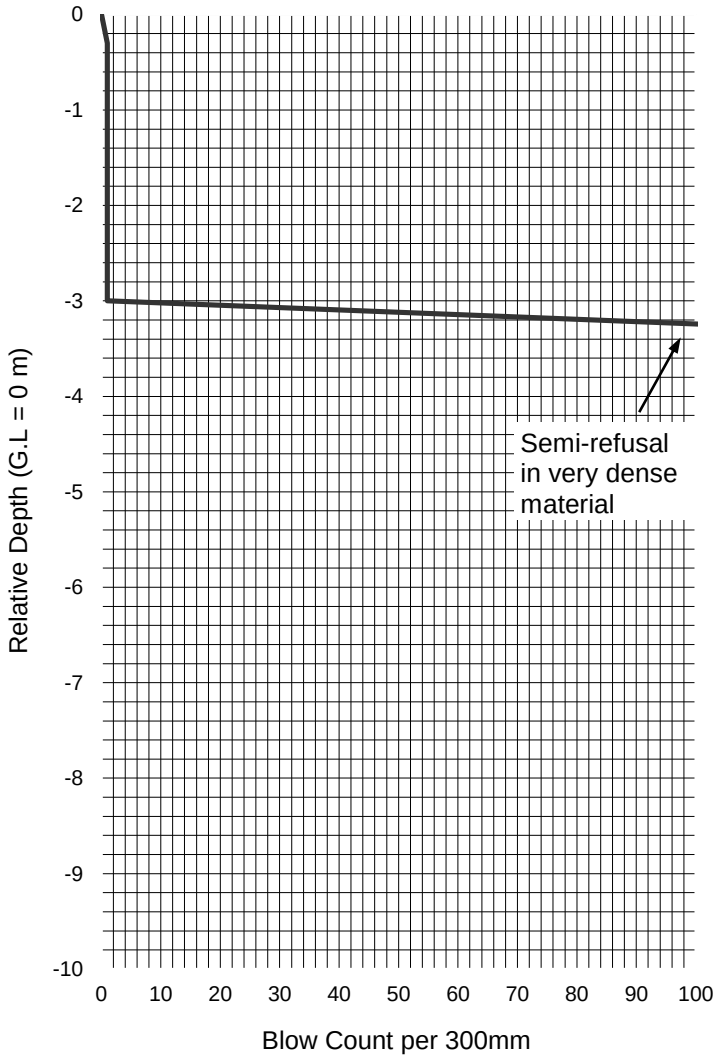
Dynamic Cone Penetrometer

Test No. : 9B

Project : **Mkuze Substation**
Client: **ILISO Consulting Environmental Management**
Date: 08-05-2017 Remarks: -
Test Location: **Iphiva 5** -
Date of Test: 04-05-2017 Depth Interval (m) : 0.3

Depth (m)	Count Blows/0.3m
0	0
-0.3	1
-0.6	1
-0.9	1
-1.2	1
-1.5	1
-1.8	1
-2.1	1
-2.4	1
-2.7	1
-3.0	1
-3.3	124

Blow Count vs Depth



Reference No. : 31833

Drennan Maud & Partners.

Fig. No. -

Note: DCP Blow Count equals the number of blows of a 10kg hammer dropping 450mm required to drive a 25mm diameter 60^{o} cone a distance of 300mm.

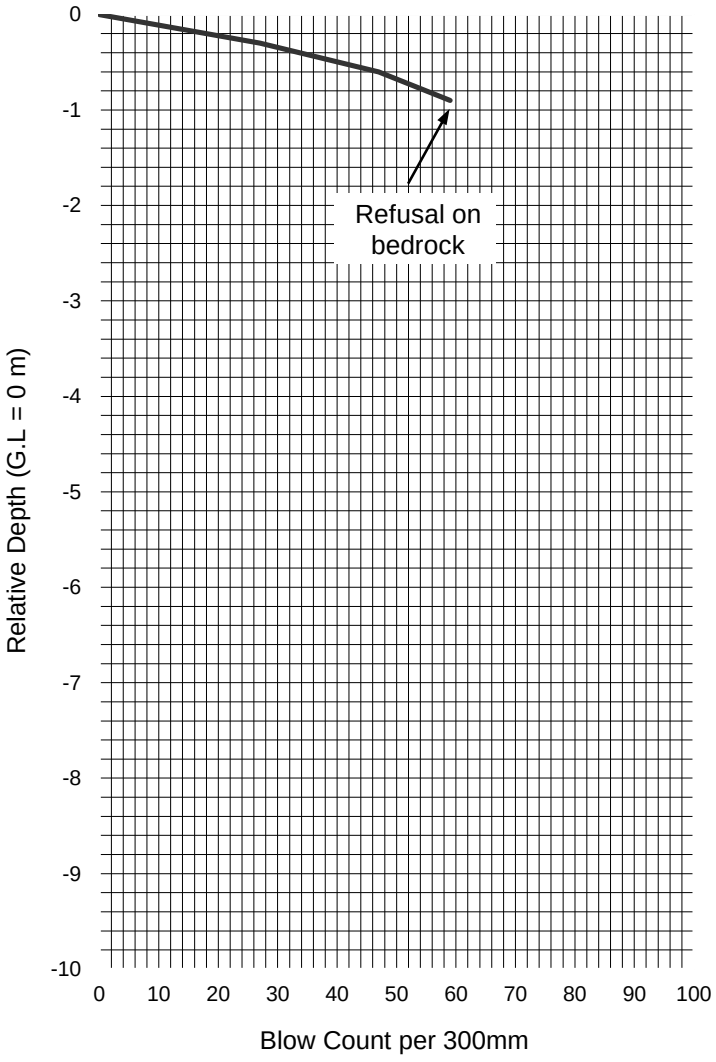
Dynamic Cone Penetrometer

Test No. : 1

Project : **Mkuze Substation**
Client: **ILISO Consulting Environmental Management**
Date: 08-05-2017 Remarks: -
Test Location: **Iphiva 6** -
Date of Test: 05-05-2017 Depth Interval (m) : 0.3

Depth (m)	Count Blows/0.3m
0	0
-0.3	27
-0.6	47
-0.9	59

Blow Count vs Depth



Reference No. : 31833

Drennan Maud & Partners.

Fig. No. -

Note: DCP Blow Count equals the number of blows of a 10kg hammer dropping 450mm required to drive a 25mm diameter 60^{o} cone a distance of 300mm.

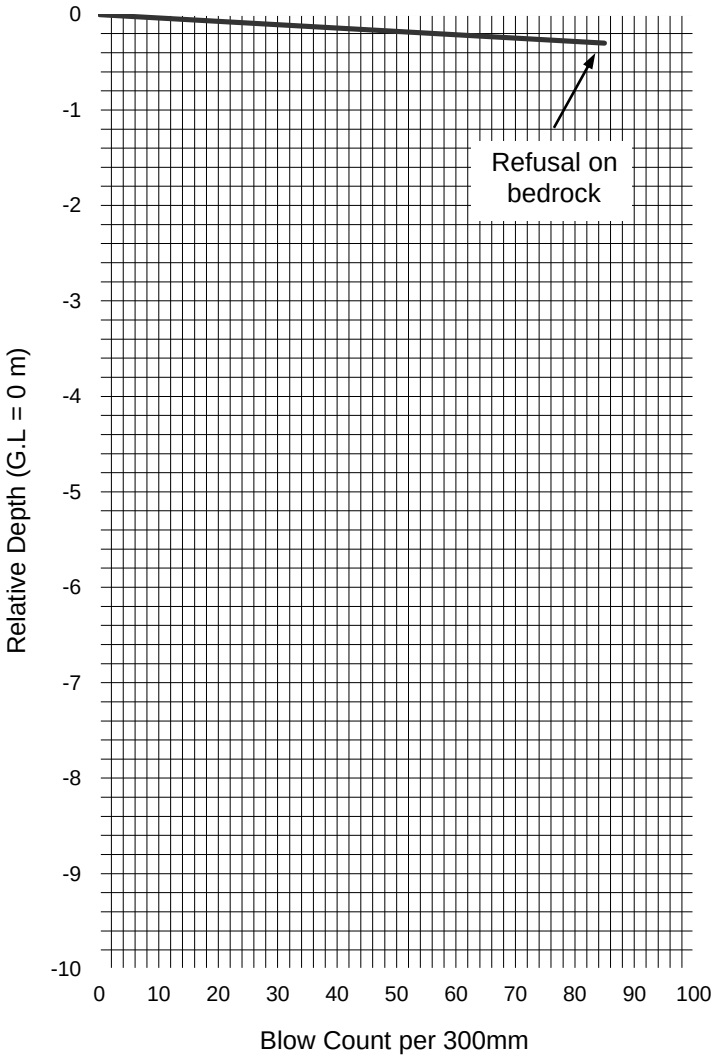
Dynamic Cone Penetrometer

Test No. : 2

Project : **Mkuze Substation**
Client: **ILISO Consulting Environmental Management**
Date: 08-05-2017 Remarks: -
Test Location: **Iphiva 6** -
Date of Test: 05-05-2017 Depth Interval (m) : 0.3

Depth (m)	Count Blows/0.3m
0	0
-0.3	85

Blow Count vs Depth



Reference No. : 31833

Drennan Maud & Partners.

Fig. No. -

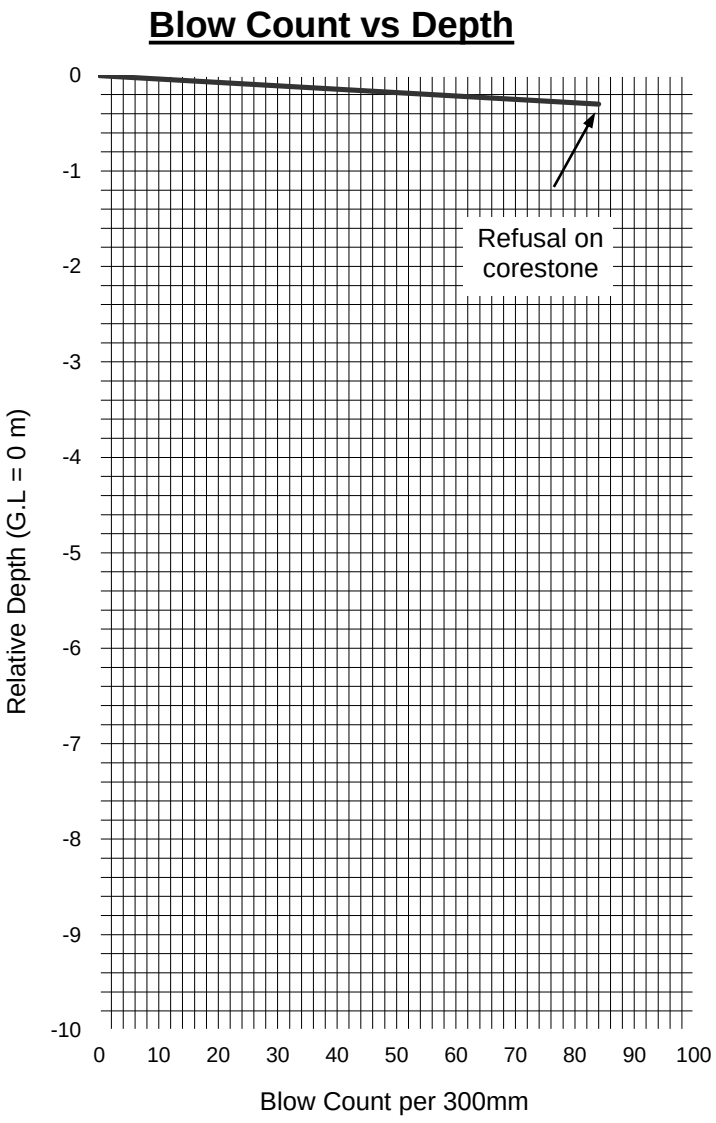
Note: DCP Blow Count equals the number of blows of a 10kg hammer dropping 450mm required to drive a 25mm diameter 60^{o} cone a distance of 300mm.

Dynamic Cone Penetrometer

Test No. : 3

Project : **Mkuze Substation**
Client: **ILISO Consulting Environmental Management**
Date: 08-05-2017 Remarks: -
Test Location: **Iphiva 6** -
Date of Test: 05-05-2017 Depth Interval (m) : 0.3

Depth (m)	Count Blows/0.3m
0	0
-0.3	84



Reference No. : 31833

Drennan Maud & Partners.

Fig. No. -

Note: DCP Blow Count equals the number of blows of a 10kg hammer dropping 450mm required to drive a 25mm diameter 60^{o} cone a distance of 300mm.

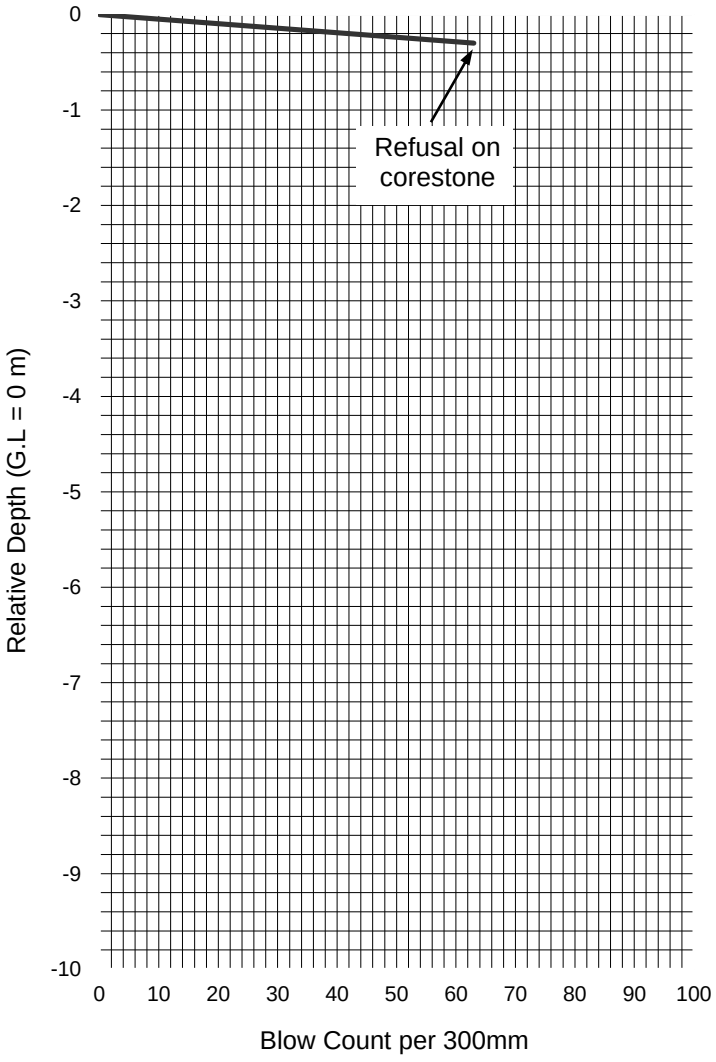
Dynamic Cone Penetrometer

Test No. : 4

Project : **Mkuze Substation**
Client: **ILISO Consulting Environmental Management**
Date: 08-05-2017 Remarks: -
Test Location: **Iphiva 6** -
Date of Test: 05-05-2017 Depth Interval (m) : 0.3

Depth (m)	Count Blows/0.3m
0	0
-0.3	63

Blow Count vs Depth



Reference No. : 31833

Drennan Maud & Partners.

Fig. No. -

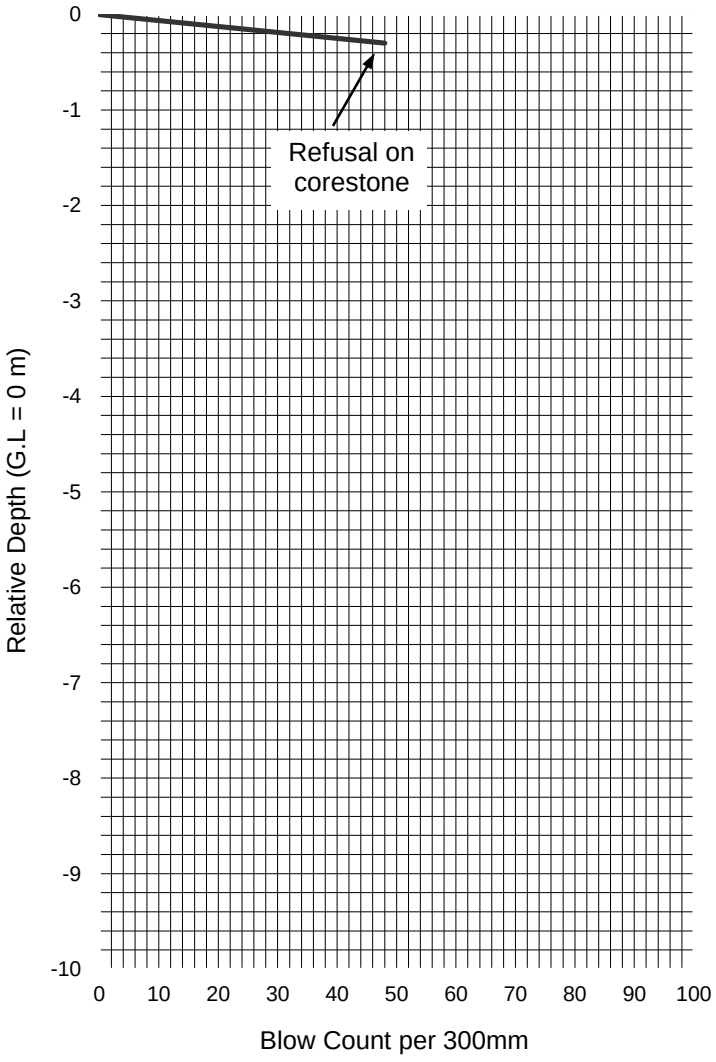
Note: DCP Blow Count equals the number of blows of a 10kg hammer dropping 450mm required to drive a 25mm diameter 60^{o} cone a distance of 300mm.

Dynamic Cone Penetrometer

Test No. : 5

Project : **Mkuze Substation**
Client: **ILISO Consulting Environmental Management**
Date: 08-05-2017 Remarks: -
Test Location: **Iphiva 6** -
Date of Test: 05-05-2017 Depth Interval (m) : 0.3

Depth (m)	Count Blows/0.3m
0	0
-0.3	48



Reference No. : 31833

Drennan Maud & Partners.

Fig. No. -

Note: DCP Blow Count equals the number of blows of a 10kg hammer dropping 450mm required to drive a 25mm diameter 60^{o} cone a distance of 300mm.

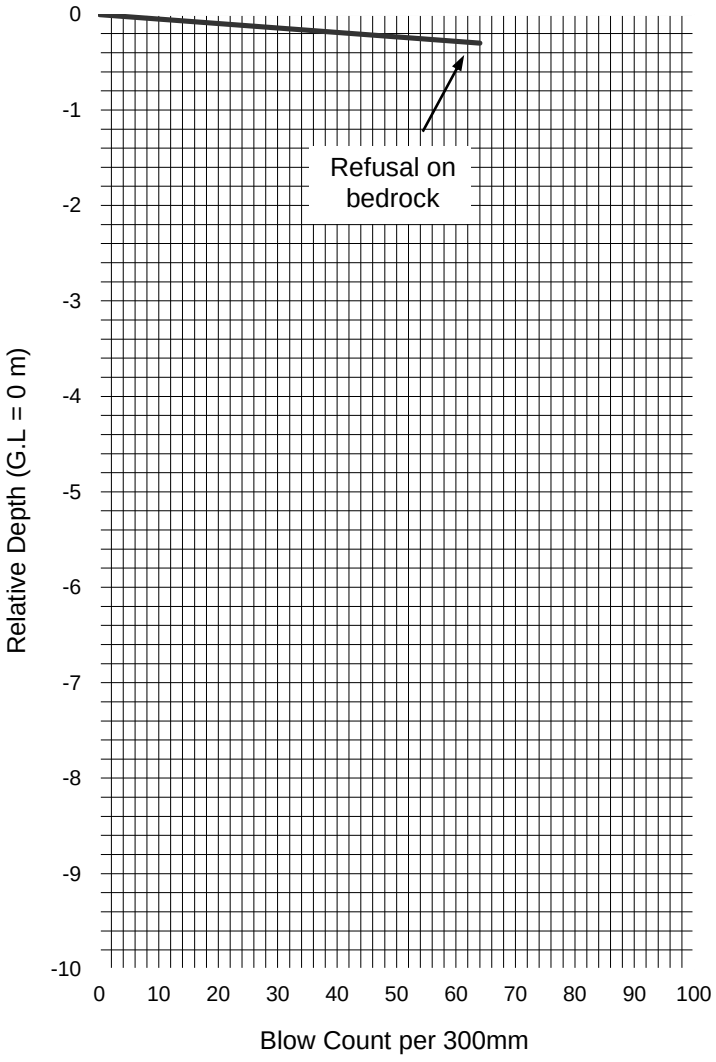
Dynamic Cone Penetrometer

Test No. : 6

Project : **Mkuze Substation**
Client: **ILISO Consulting Environmental Management**
Date: 08-05-2017 Remarks: -
Test Location: **Iphiva 6** -
Date of Test: 05-05-2017 Depth Interval (m) : 0.3

Depth (m)	Count Blows/0.3m
0	0
-0.3	64

Blow Count vs Depth



Reference No. : 31833

Drennan Maud & Partners.

Fig. No. -

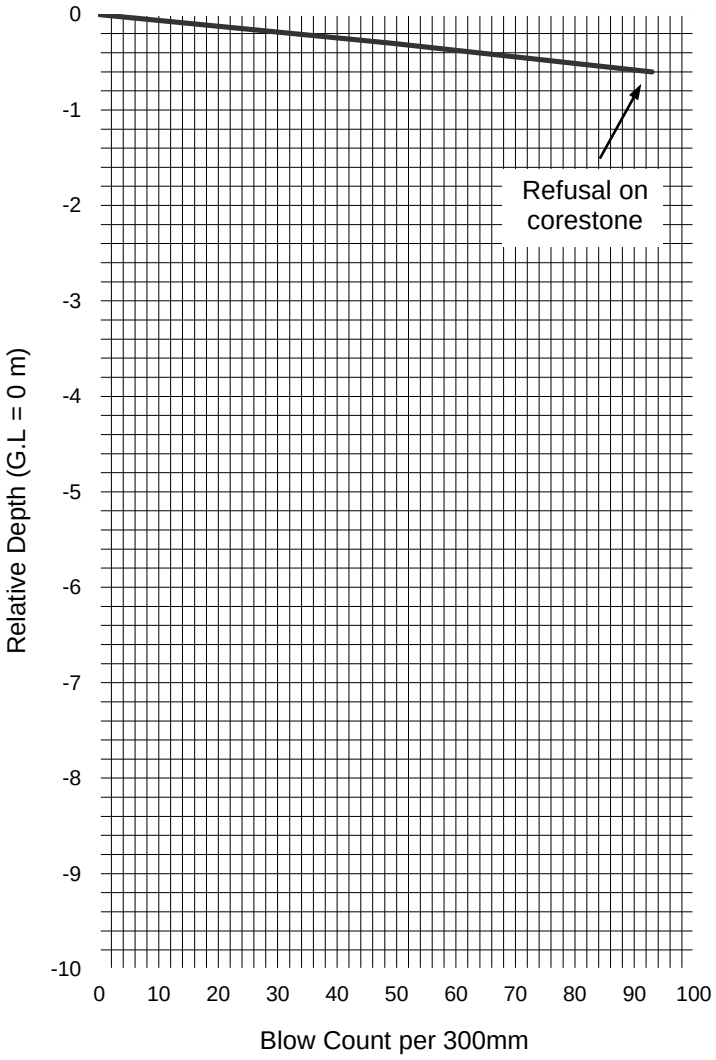
Note: DCP Blow Count equals the number of blows of a 10kg hammer dropping 450mm required to drive a 25mm diameter 60^{o} cone a distance of 300mm.

Dynamic Cone Penetrometer

Test No. : 7

Project : **Mkuze Substation**
Client: **ILISO Consulting Environmental Management**
Date: 08-05-2017 Remarks: -
Test Location: **Iphiva 6** -
Date of Test: 05-05-2017 Depth Interval (m) : 0.3

Depth (m)	Count Blows/0.3m
0	0
-0.3	49
-0.6	93



Reference No. : 31833

Drennan Maud & Partners.

Fig. No. -

Note: DCP Blow Count equals the number of blows of a 10kg hammer dropping 450mm required to drive a 25mm diameter 60^{o} cone a distance of 300mm.

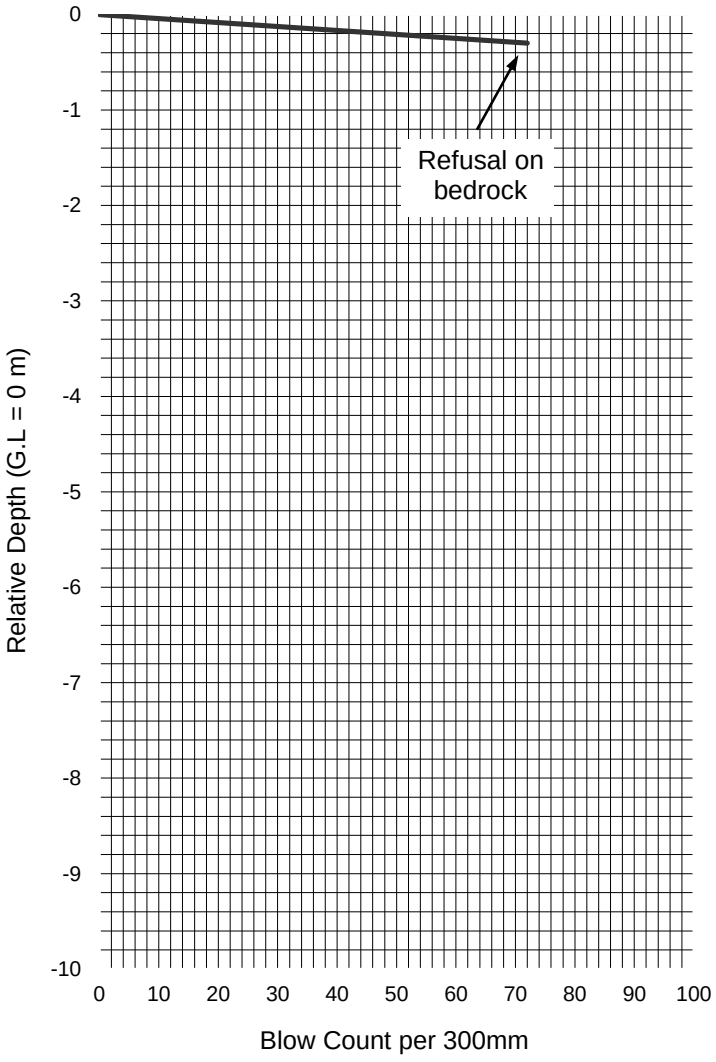
Dynamic Cone Penetrometer

Test No. : 8

Project : **Mkuze Substation**
Client: **ILISO Consulting Environmental Management**
Date: 08-05-2017 Remarks: -
Test Location: **Iphiva 6** -
Date of Test: 05-05-2017 Depth Interval (m) : 0.3

Depth (m)	Count Blows/0.3m
0	0
-0.3	72

Blow Count vs Depth



Reference No. : 31833

Drennan Maud & Partners.

Fig. No. -

Note: DCP Blow Count equals the number of blows of a 10kg hammer dropping 450mm required to drive a 25mm diameter 60^{o} cone a distance of 300mm.

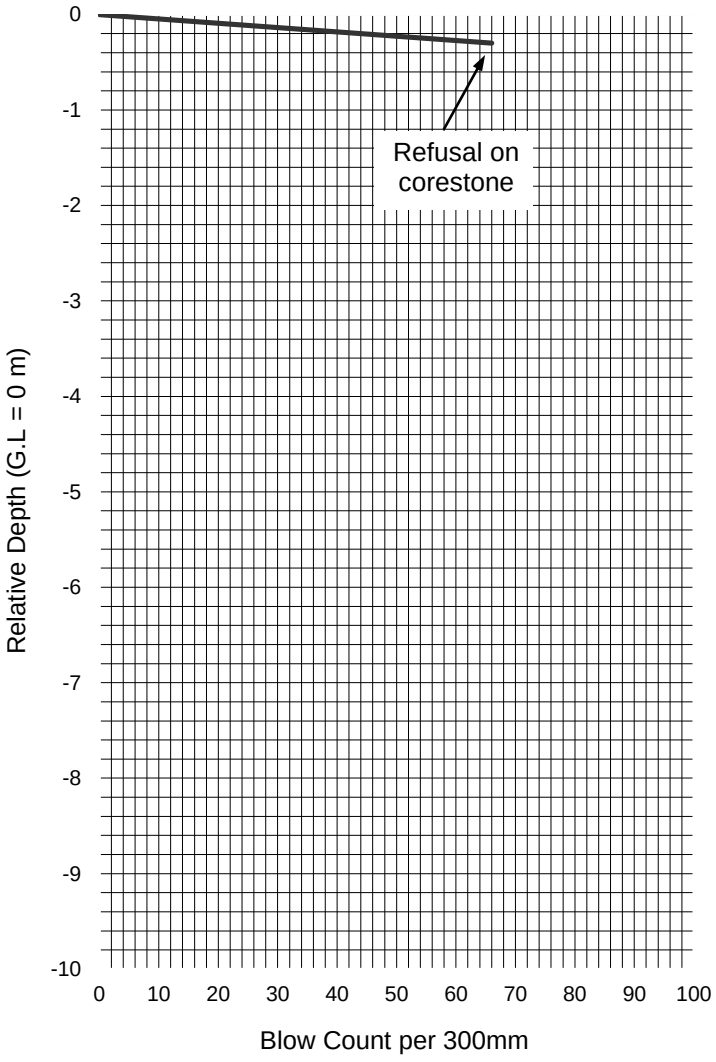
Dynamic Cone Penetrometer

Test No. : 9

Project : **Mkuze Substation**
Client: **ILISO Consulting Environmental Management**
Date: 08-05-2017 Remarks: -
Test Location: **Iphiva 6** -
Date of Test: 05-05-2017 Depth Interval (m) : 0.3

Depth (m)	Count Blows/0.3m
0	0
-0.3	66

Blow Count vs Depth



Reference No. : 31833

Drennan Maud & Partners.

Fig. No. -

Note: DCP Blow Count equals the number of blows of a 10kg hammer dropping 450mm required to drive a 25mm diameter 60^{o} cone a distance of 300mm.

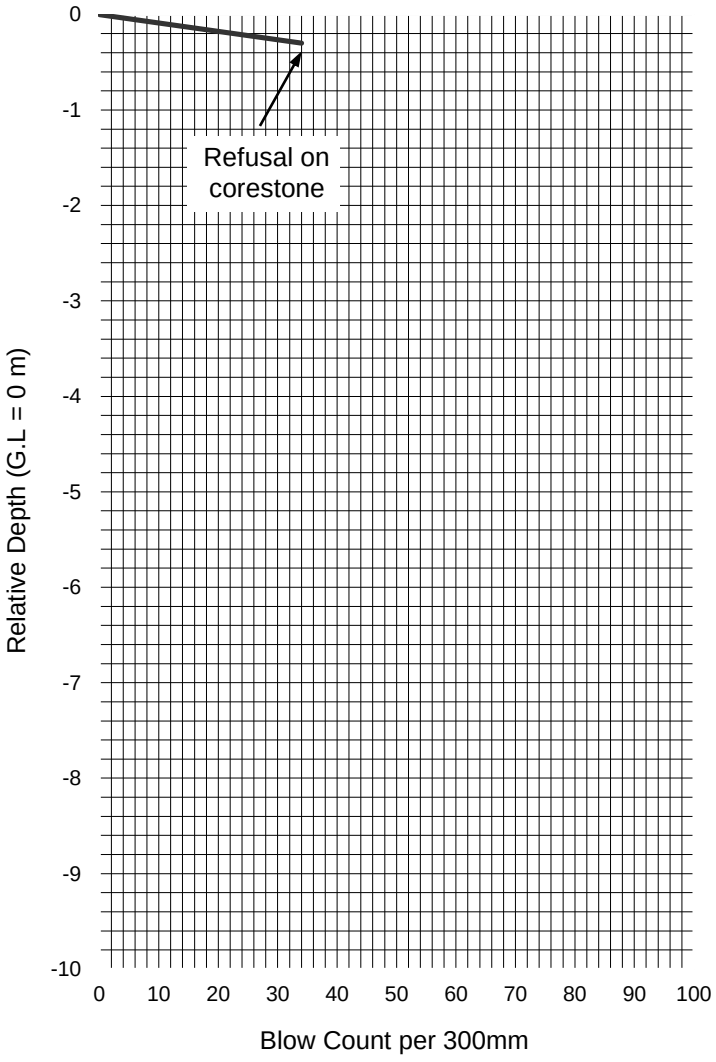
Dynamic Cone Penetrometer

Test No. : 10

Project : **Mkuze Substation**
Client: **ILISO Consulting Environmental Management**
Date: 08-05-2017 Remarks: -
Test Location: **Iphiva 6** -
Date of Test: 05-05-2017 Depth Interval (m) : 0.3

Depth (m)	Count Blows/0.3m
0	0
-0.3	34

Blow Count vs Depth



Reference No. : 31833

Drennan Maud & Partners.

Fig. No. -

Note: DCP Blow Count equals the number of blows of a 10kg hammer dropping 450mm required to drive a 25mm diameter 60^{o} cone a distance of 300mm.

APPENDIX C

LABORATORY TEST RESULTS

Laboratory Test Summary

THEKWINI SOILS LAB. CC
VAT REGISTRATION NO: 4300170061
55 Ridge Road, Tollgate, DURBAN
Tel : (031) 201-8992
P.O. Box 30464, MAYVILLE, 4058
Fax : (031) 201-7920

Job Description: Mkhuze Substation - Ref.31833
Job no.: 8403
Date: 15-06-2017

Lab no.		05071	05072	05073	05074	05075	05076	05077	05078	05079	05080
Location		I4-IP4	I4-IP9	I4-IP1	I4-IP8	I5-IP9	I5-IP7	I5-IP4	I5-IP3	I6-IP1	I6-IP6
Depth		0.0 - 0.7	1.3 - 2.4	0.0 - 0.7	0.9 - 2.2	0.0 - 1.0	0.6 - 2.3	0.8 - 3.0	0.4 - 1.7	0.0 - 0.6	0.2 - 0.8
Description		-	-	-	-	-	-	-	-	-	-
		-	-	-	-	-	-	-	-	-	-
Binder Material		-	-	-	-	-	-	-	-	-	-
Particle Size (mm)	75		100							98	98
	53		99						100	98	95
	37.5		97						98	97	87
	26.5		93						92	95	71
	19	100	89	100	100	100	100	100	79	94	62
	13.2	95	80	97	94	94	86	97	61	91	44
	9.5	92	74	95	89	94	77	95	47	87	33
	4.75	92	63	93	83	92	74	94	29	87	17
	2	90	48	91	78	88	70	93	19	86	8
	0.425	86	28	87	70	83	62	90	12	80	5
	0.25	83	24	86	66	82	56	86	11	78	4
	0.15	81	21	83	63	81	51	82	10	76	4
	0.075	77	19	79	58	79	45	76	9	71	4
Hydrometer	0.05	75	17	77	57	77	42	73	9	67	4
	0.02	69	15	69	50	67	32	53	7	59	3
	0.005	58	13	58	39	58	22	37	6	51	3
	0.002	52	10	52	33	50	19	25	5	45	2
Soil Mortar	Coarse Sand <2.0 >0.425mm	5.0	41.7	4.3	10.3	5.8	12.5	3.7	36.3	6.8	45.9
	Fine Sand <0.425>0.05mm	23.4	48.1	21.6	38.7	21.6	50.6	25.9	58.0	30.9	52.1
	Silt <0.05 >0.005	16.6	2.8	18.7	15.8	17.8	17.7	35.1	2.0	14.3	0.7
	Clay <0.005	55.0	7.4	55.5	35.2	54.8	19.1	35.4	3.8	48.0	1.4
Atterberg Limits	Liquid Limit % (m/m)	61.5	43.2	40.6	60.3	45.9	44.8	41.2	47.1	43.2	38.1
	Plasticity Index	20.1	9.7	11.3	31.4	14.7	11.9	10.9	11.4	10.9	12
	Linear Shrinkage %	14.7	7.3	7.3	14.7	9.3	8	6	9.3	10.7	8.7
	Natural MC %	-	-	-	-	-	-	-	-	-	-
Mod AASHTO Density	Dry Density kg/m^3	1487	1871	1598	1570	1443			2139	1676	2025
	OMC %	25	16.3	20.9	24.8	24.3			11	18.7	7.4
CBR	100% MDD	0.82	27	13	2.2	8			18	4.9	69
	98%	0.75	27	9	2.1	7			17	3.9	60
	95%	0.67	27	5	2	5			14	2.7	48
	93% (Inferred) *	1	22	4	2	3			12	2	35
	90%	0.6	16	3	1.5	2			10	1.3	22
	CBR Swell (%)	11.47	0.00	1.34	6.81	2.69			0.00	3.90	0.00
AASHTO Soil Classification *		A - 7 - 5 (19)	A - 2 - 5 (0)	A - 7 - 6 (10)	A - 7 - 6 (16)	A - 7 - 5 (13)	A - 7 - 5 (3)	A - 8 (9)	A - 2 - 7 (0)	A - 8 (8)	A - 2 - 6 (0)
Grading Modulus		0.47	2.04	0.42	0.94	0.50	1.23	0.40	2.59	0.64	2.83
TRH 14 (1985) *		>G10	G7	G10	>G10	>G10			G8	>G10	G8

Technical Signitory:

Laboratory Test Summary

THEKWINI SOILS LAB. CC
VAT REGISTRATION NO. 4950274061
68 Ridge Road, Tollgate, DURBAN
Tel : (031) 201-8992
P.O. Box 35484, MAYVILLE, 4058
Fax : (031) 201-7920

Job Description: Mkhuze Substation
Job no.: 8403
Date: 15-06-2017

			05081	05082								
Lab no.			05081	05082								
Location			I6-IP7	I6-IP5								
Depth			0.0 - 0.3	0.3 - 1.0								
Description			-	-								
			-	-								
Binder Material			-	-								
Particle Size (mm)	75	Cumulative % Passing	100	88								
	53		99	74								
	37.5		98	62								
	26.5		96	53								
	19		95	48								
	13.2		79	39								
	9.5		72	34								
	4.75		63	32								
	2		57	31								
	0.425		47	23								
	0.25		44	21								
	0.15		42	20								
	0.075		38	18								
Hydrometer	0.05	% Passing	37	17								
	0.02		30	14								
	0.005		25	11								
	0.002		22	10								
Soil Mortar	Coarse Sand <2.0 >0.425mm	% Passing	18.1	25.5								
	Fine Sand <0.425>0.05mm		51.9	61.5								
	Silt <0.05 >0.005		9.9	4.6								
	Clay <0.005		20.2	8.4								
Atterberg Limits	Liquid Limit % (m/m)		40	34.5								
	Plasticity Index		11.7	9.5								
	Linear Shrinkage %		9.3	8								
	Natural MC %		-	-								
Mod AASHTO Density	Dry Density kg/m^3		1840	2053								
	OMC %		15.8	11.3								
CBR	100% MDD		11	25								
	98%		10	16								
	95%		9	9								
	93% (Inferred) *		8	8								
	90%		7	7								
	CBR Swell (%)		1.39	1.28								
AASHTO Soil Classification *			A - 6 (1)	A - 2 - 4 (0)								
Grading Modulus			1.59	2.29								
TRH 14 (1985) *			G9	G9								

Technical Signitory:

TEST REPORT

MATERIALS ANALYSIS

THEKWINI SOILS LAB. CC
V.A.T. REGISTRATION NO. 4690210091
68 Ridge Road, Tollgate, DURBAN
Tel : (031) 201-6992
P.O. Box 30464, MAYVILLE, 4058
Fax : (031) 201-7920

sanas

Project: Mkhuze Substation - Ref.31833

Ref no.: 8403 **Lab no.:** 05071 **Borehole/Pit no.:** I4-IP4

Description: -

Depth: 0.0 - 0.7 -

Test Methods: TMH1 METHOD A1(a), A2, A3 & A4, ASTMD422

Grading Analysis	
Grain Size (mm)	%Passing
75	100.0
53	100.0
37.5	100.0
26.5	100.0
19	100.0
13.2	95.0
9.5	92.2
4.75	91.5
2	90.2
0.425	85.8
0.25	83.5
0.15	80.9
0.075	77.4
0.05	75.4
0.02	69.3
0.005	57.9
0.002	51.9

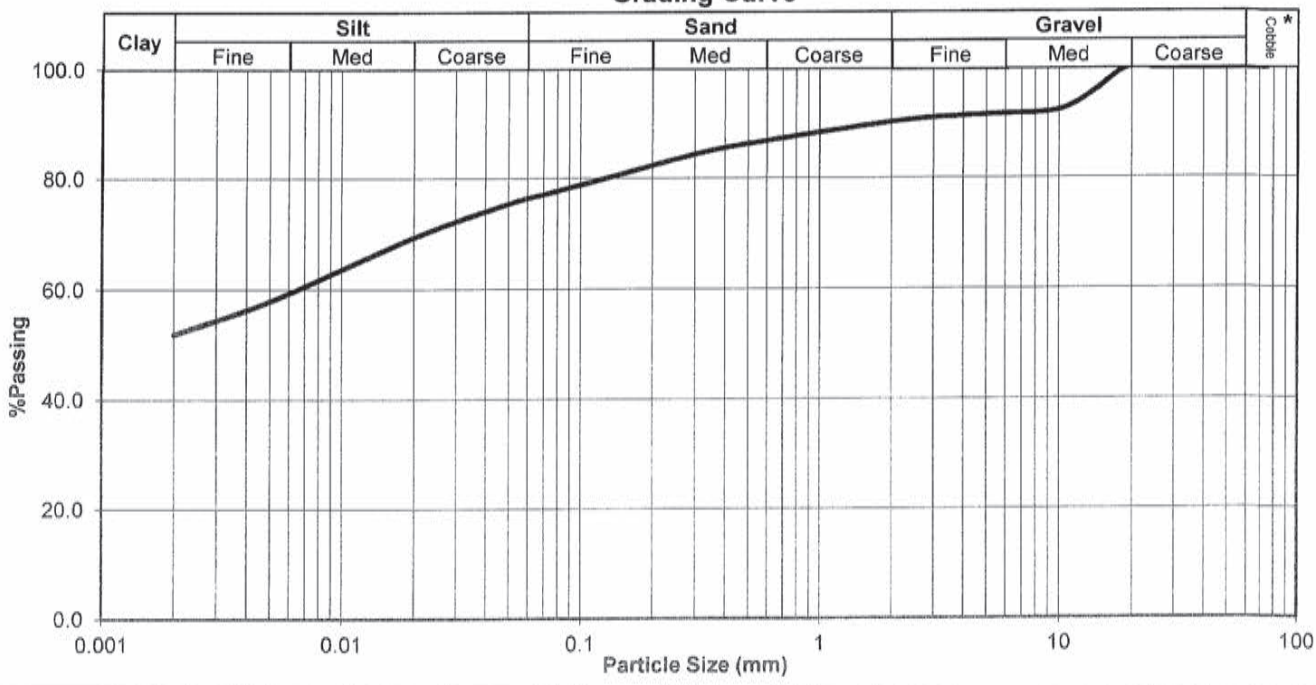
M.I.T SIZE CLASSIFICATION *	
Cobble%	0.0
Gravel%	9.8
Coarse	0.0
Medium	8.3
Fine	1.4
Sand%	14.1
Coarse	4.0
Medium	4.1
Fine	6.0
Silt%	24.3
Coarse	6.8
Medium	10.7
Fine	6.8
Clay%	51.9

PLASTICITY	
Liquid Limit, %	61.5
Plasticity Index	20.1
Linear Shrinkage, % (L/L)	14.7

GRADING	
D10 Size (mm)	<0.002
Uniformity Coefficient	*
Grading Modulus	0.47

CLASSIFICATION *	
Potential Expansiveness	Low
Group Index	19
AASHTO Soil Classification	A - 7 - 5
Unified Classification	MH or OH

Grading Curve



Ref no.: 8403 Fig no.: -

* Information marked with an asterisk is outside the scope of Accreditation.
The results only relate to the samples tested.
The report may not be reproduced except in full.

TEST REPORT

MATERIALS ANALYSIS

THEKWINI SOILS LAB. CC
V.A.T. REGISTRATION NO. 4590210091
68 Ridge Road, Tollgate, DURBAN
Tel : (031) 201-8992
P.O. Box 30464, MAYVILLE, 4058
Fax : (031) 201-7920

sanas Testing Laboratory

Project: Mkhuze Substation - Ref.31833

Ref no.: 8403 **Lab no.:** 05072 **Borehole/Pit no.:** I4-IP9

Description: -

Depth: 1.3 - 2.4 -

Test Methods: TMH1 METHOD A1(a), A2, A3 & A4, ASTMD422

Grading Analysis	
Grain Size (mm)	%Passing
75	100.0
53	99.2
37.5	96.8
26.5	93.3
19	89.4
13.2	80.4
9.5	73.6
4.75	62.5
2	48.4
0.425	28.2
0.25	24.1
0.15	21.5
0.075	18.9
0.05	17.5
0.02	14.6
0.005	12.7
0.002	9.9

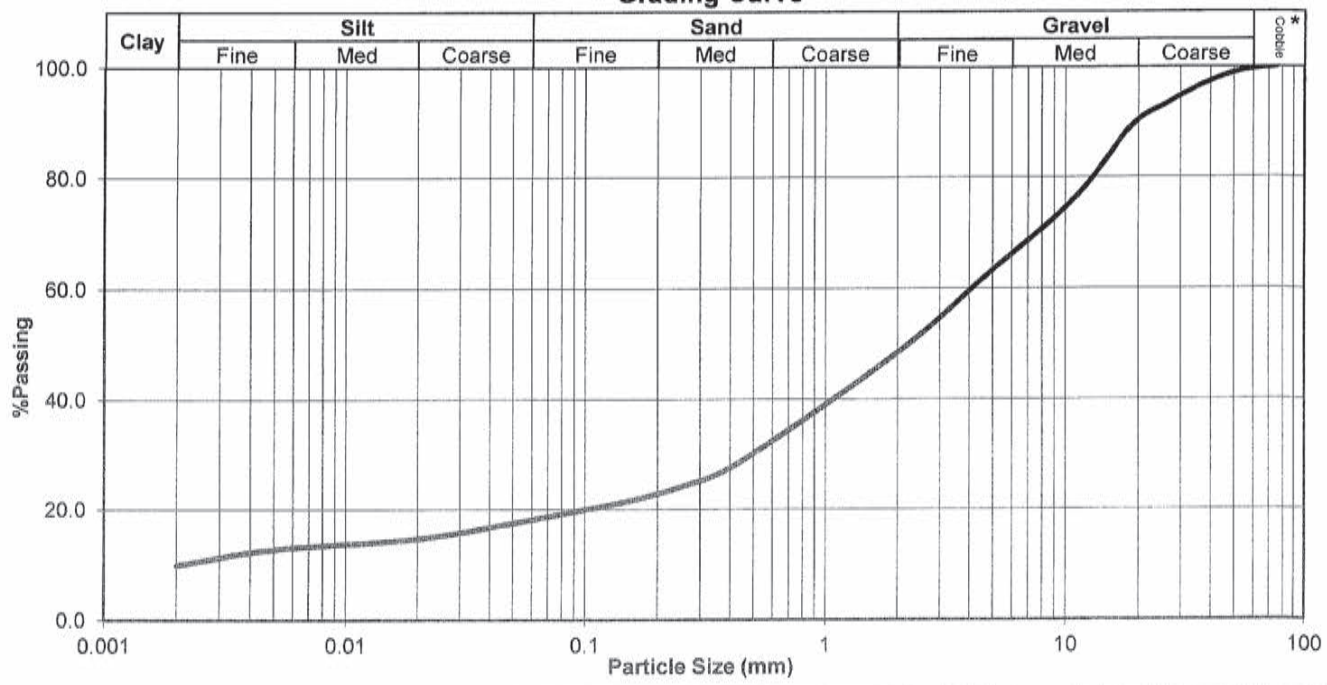
M.I.T SIZE CLASSIFICATION *	
Cobble%	0.6
Gravel%	51.0
Coarse	9.5
Medium	24.5
Fine	17.0
Sand%	30.4
Coarse	18.0
Medium	7.7
Fine	4.7
Silt%	8.2
Coarse	3.4
Medium	1.8
Fine	3.0
Clay%	9.9

PLASTICITY	
Liquid Limit	43.2
Plasticity Index	9.7
Linear Shrinkage	7.3

GRADING	
D10 Size (mm)	0.0021
Uniformity Coefficient	>99
Grading Modulus	2.04

CLASSIFICATION *	
Potential Expansiveness	Low
Group Index	0
AASHTO Soil Classification	A - 2 - 5
Unified Classification	SM

Grading Curve



Ref no.: 8403 Fig no.: -

* Information marked with an asterisk is outside the scope of Accreditation.
The results only relate to the samples tested.
The report may not be reproduced except in full.

TEST REPORT

MATERIALS ANALYSIS

THEKWINI SOILS LAB. CC
VAT REGISTRATION NO: 4090210091
68 Ridge Road, Tollgate, DURBAN
Tel : (031) 201-8892
P.O. Box 30464, MAYVILLE, 4058
Fax : (031) 201-7920

sanas testing laboratory

Project: Mkhuze Substation - Ref.31833

Ref no.: 8403 **Lab no.:** 05073 **Borehole/Pit no.:** I4-IP1

Description: -

Depth: 0.0 - 0.7 -

Test Methods: TMH1 METHOD A1(a), A2, A3 & A4, ASTMD422

Grading Analysis	
Grain Size (mm)	%Passing
75	100.0
53	100.0
37.5	100.0
26.5	100.0
19	100.0
13.2	97.0
9.5	95.3
4.75	93.4
2	91.4
0.425	87.5
0.25	85.8
0.15	83.2
0.075	79.5
0.05	77.5
0.02	69.4
0.005	58.0
0.002	51.9

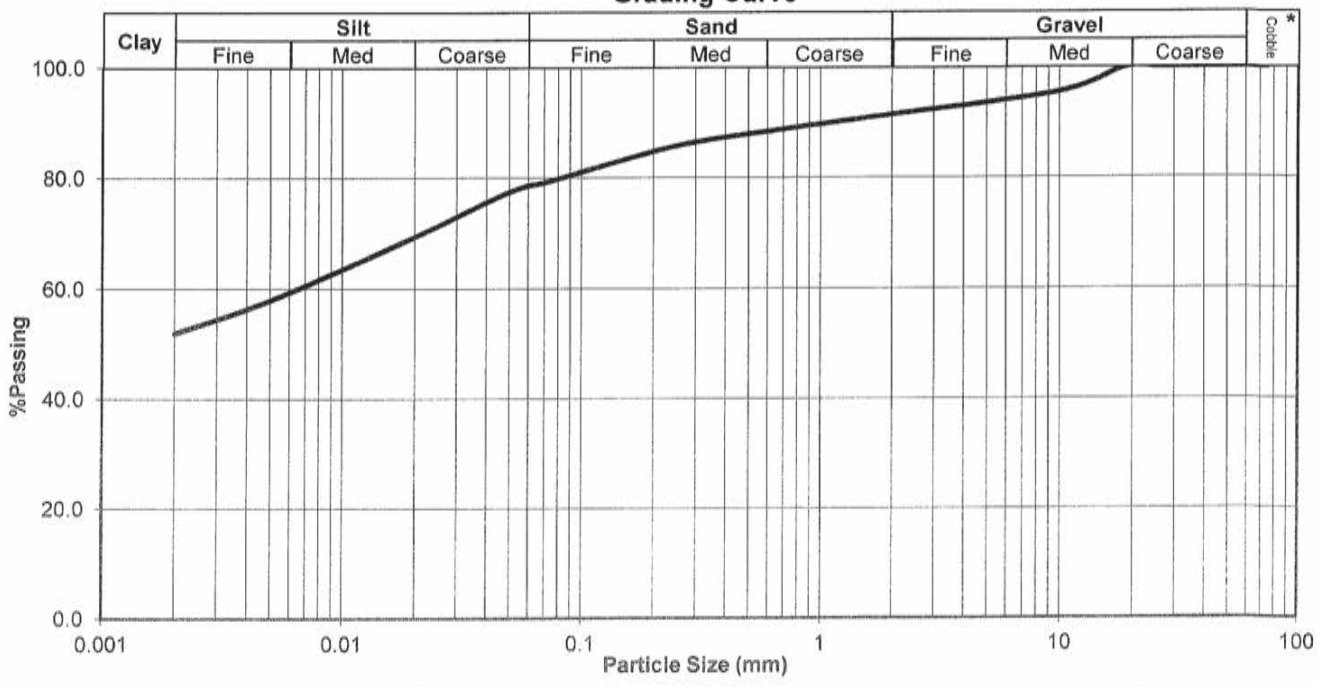
M.I.T SIZE CLASSIFICATION *	
Cobble%	0.0
Gravel%	8.6
Coarse	0.0
Medium	6.1
Fine	2.5
Sand%	13.1
Coarse	3.5
Medium	3.4
Fine	6.2
Silt%	26.4
Coarse	8.9
Medium	10.7
Fine	6.8
Clay%	51.9

PLASTICITY	
Liquid Limit	40.6
Plasticity Index	11.3
Linear Shrinkage	7.3

GRADING	
D10 Size (mm)	<0.002
Uniformity Coefficient	NA
Grading Modulus	0.42

CLASSIFICATION *	
Potential Expansiveness	Low
Group Index	10
AASHTO Soil Classification	A - 7 - 6
Unified Classification	ML or OL

Grading Curve



Ref no.: 8403 Fig no.: -

* Information marked with an asterisk is outside the scope of Accreditation.
The results only relate to the samples tested.
The report may not be reproduced except in full.

TEST REPORT

MATERIALS ANALYSIS

THEKWINI SOILS LAB. CC
V.A.T. REGISTRATION NO: 4090210561
69 Ridge Road, Tollgate, DURBAN
Tel : (031) 201-6992
P.O. Box 30464, MAYVILLE, 4059
Fax : (031) 201-7926

sanas Testing Laboratory

Project: Mkhuze Substation - Ref.31833

Ref no.: 8403 **Lab no.:** 05074 **Borehole/Pit no.:** I4-IP8

Description: -

Depth: 0.9 - 2.2 -

Test Methods: TMH1 METHOD A1(a), A2, A3 & A4, ASTMD422

Grading Analysis	
Grain Size (mm)	%Passing
75	100.0
53	100.0
37.5	100.0
26.5	100.0
19	100.0
13.2	93.7
9.5	88.7
4.75	82.5
2	77.7
0.425	69.6
0.25	66.1
0.15	62.5
0.075	58.5
0.05	56.8
0.02	50.2
0.005	39.2
0.002	32.6

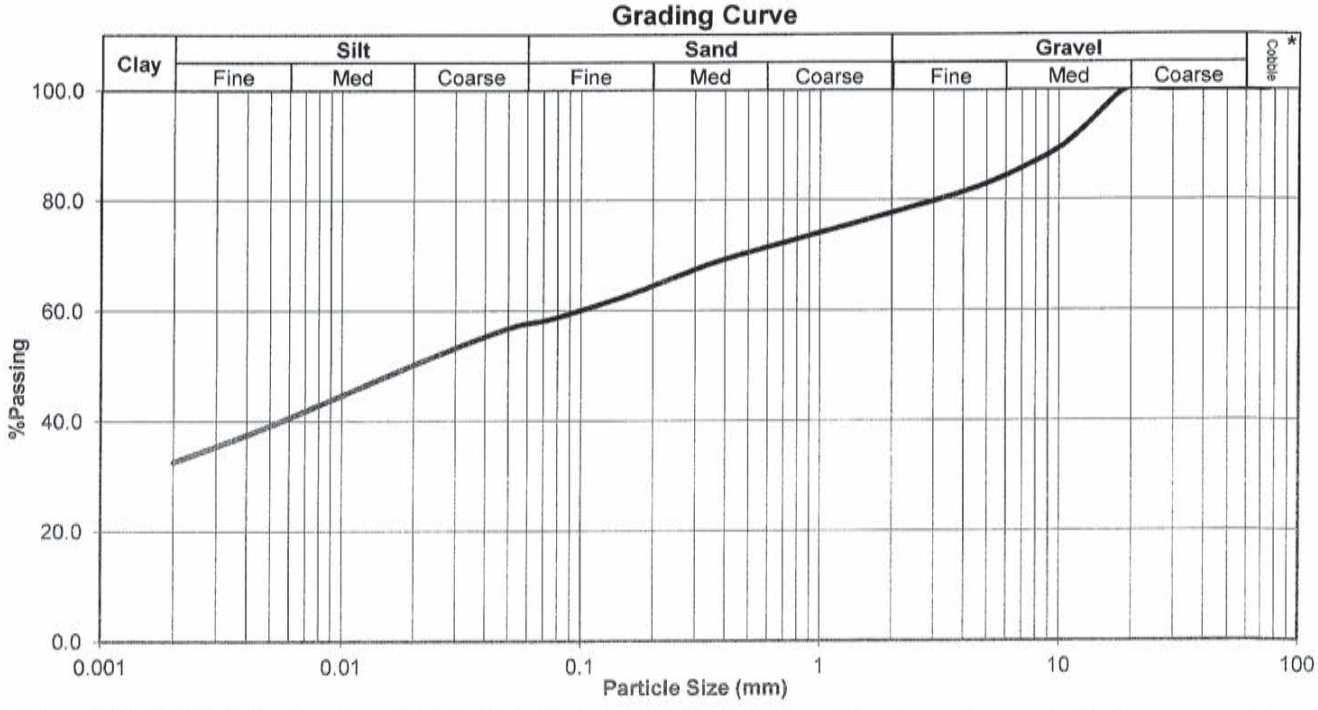
M.I.T SIZE CLASSIFICATION *	
Cobble%	0.0
Gravel%	22.3
Coarse	0.0
Medium	15.9
Fine	6.5
Sand%	20.2
Coarse	7.1
Medium	6.2
Fine	6.8
Silt%	24.9
Coarse	7.2
Medium	10.3
Fine	7.3
Clay%	32.6

PLASTICITY	
Liquid Limit	60.3
Plasticity Index	31.4
Linear Shrinkage	14.7

GRADING	
D10 Size (mm)	<0.002
Uniformity Coefficient	NA
Grading Modulus	0.94

CLASSIFICATION *	
Potential Expansiveness	Medium
Group Index	16
AASHTO Soil Classification	A - 7 - 6
Unified Classification	CH or OH

Grading Curve



Ref no.: 8403 Fig no.: -

* Information marked with an asterisk is outside the scope of Accreditation.
The results only relate to the samples tested.
The report may not be reproduced except in full.

TEST REPORT

MATERIALS ANALYSIS

THEKWINI SOILS LAB. CC
V.A.T. REGISTRATION NO. 4690210661
68 Ridge Road, Yellgate, DURBAN
Tel : (031) 201-8992
P.O. Box 30464, MAYVILLE, 4058
Fax : (031) 201-7926

sanas Testing Laboratory

Project: Mkhuze Substation - Ref.31833

Ref no.: 8403 **Lab no.:** 05075 **Borehole/Pit no.:** I5-IP9

Description: -

Depth: 0.0 - 1.0 -

Test Methods: TMH1 METHOD A1(a), A2, A3 & A4, ASTMD422

Grading Analysis	
Grain Size (mm)	%Passing
75	100.0
53	100.0
37.5	100.0
26.5	100.0
19	100.0
13.2	94.5
9.5	93.5
4.75	92.2
2	88.2
0.425	83.1
0.25	81.7
0.15	80.6
0.075	79.0
0.05	77.0
0.02	67.3
0.005	58.1
0.002	50.3

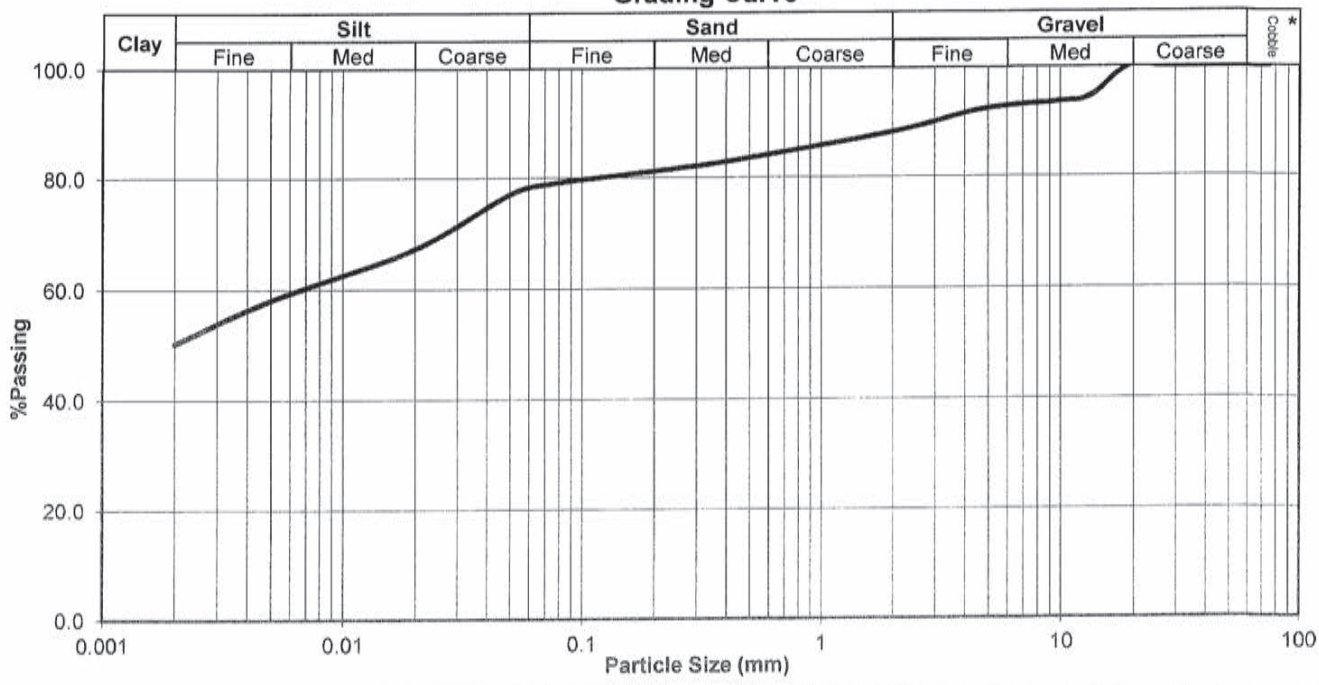
M.I.T SIZE CLASSIFICATION *	
Cobble%	0.0
Gravel%	11.8
Coarse	0.0
Medium	7.4
Fine	4.4
Sand%	10.3
Coarse	4.5
Medium	2.5
Fine	3.3
Silt%	27.5
Coarse	10.5
Medium	8.6
Fine	8.4
Clay%	50.3

PLASTICITY	
Liquid Limit	45.9
Plasticity Index	14.7
Linear Shrinkage	9.3

GRADING	
D10 Size (mm)	<0.002
Uniformity Coefficient	NA
Grading Modulus	0.50

CLASSIFICATION *	
Potential Expansiveness	Low
Group Index	13
AASHTO Soil Classification	A - 7 - 5
Unified Classification	ML or OL

Grading Curve



Ref no.: 8403 Fig no.: -

* Information marked with an asterisk is outside the scope of Accreditation.
The results only relate to the samples tested.
The report may not be reproduced except in full.

TEST REPORT

MATERIALS ANALYSIS

THEKWINI SOILS LAB. CC
VAT REGISTRATION NO. 4690210091
68 Ridge Road, Trilgate, DURBAN
Tel : (031) 201-4992
P.O. Box 30464, MAYVILLE, 4058
Fax : (031) 201-7926

sanas

Project: Mkhuze Substation - Ref.31833

Ref no.: 8403 **Lab no.:** 05076 **Borehole/Pit no.:** I5-IP7

Description: -

Depth: 0.6 - 2.3 -

Test Methods: TMH1 METHOD A1(a), A2, A3 & A4, ASTMD422

Grading Analysis	
Grain Size (mm)	%Passing
75	100.0
53	100.0
37.5	100.0
26.5	100.0
19	100.0
13.2	86.3
9.5	77.0
4.75	74.1
2	70.5
0.425	61.7
0.25	56.1
0.15	50.9
0.075	45.1
0.05	42.1
0.02	31.8
0.005	21.9
0.002	18.9

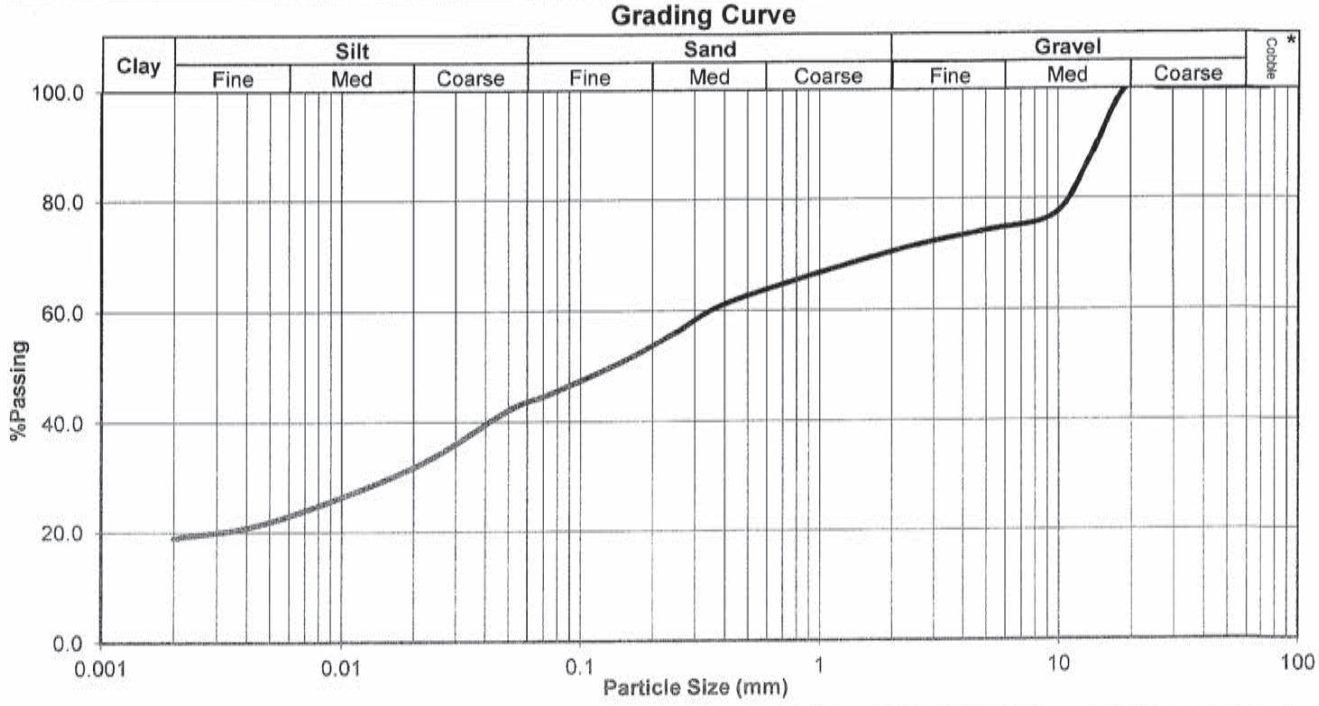
M.I.T SIZE CLASSIFICATION *	
Cobble%	0.0
Gravel%	29.5
Coarse	0.0
Medium	25.2
Fine	4.4
Sand%	27.2
Coarse	7.8
Medium	9.1
Fine	10.2
Silt%	24.4
Coarse	11.5
Medium	9.2
Fine	3.6
Clay%	18.9

PLASTICITY	
Liquid Limit	44.8
Plasticity Index	11.9
Linear Shrinkage	8

GRADING	
D10 Size (mm)	<0.002
Uniformity Coefficient	NA
Grading Modulus	1.23

CLASSIFICATION *	
Potential Expansiveness	Low
Group Index	3
AASHTO Soil Classification	A - 7 - 5
Unified Classification	SM

Grading Curve



Ref no.: 8403 Fig no.: -

* Information marked with an asterisk is outside the scope of Accreditation.
The results only relate to the samples tested.
The report may not be reproduced except in full.

TEST REPORT

MATERIALS ANALYSIS

THEKWINI SOILS LAB. CC
VAT REGISTRATION NO. 4692210191
68 Ridge Road, Overport, DURBAN
Tel : (031) 201-6892
P.O. Box 30464, MAYVILLE, 4058
Fax : (031) 201-7920

sanas Testing Laboratories

Project: Mkhuze Substation - Ref.31833

Ref no.: 8403 **Lab no.:** 05077 **Borehole/Pit no.:** I5-IP4

Description: -

Depth: 0.8 - 3.0 -

Test Methods: TMH1 METHOD A1(a), A2, A3 & A4, ASTMD422

Grading Analysis	
Grain Size (mm)	%Passing
75	100.0
53	100.0
37.5	100.0
26.5	100.0
19	100.0
13.2	97.5
9.5	95.0
4.75	93.9
2	93.5
0.425	90.0
0.25	86.4
0.15	82.4
0.075	76.0
0.05	73.1
0.02	53.1
0.005	36.7
0.002	25.2

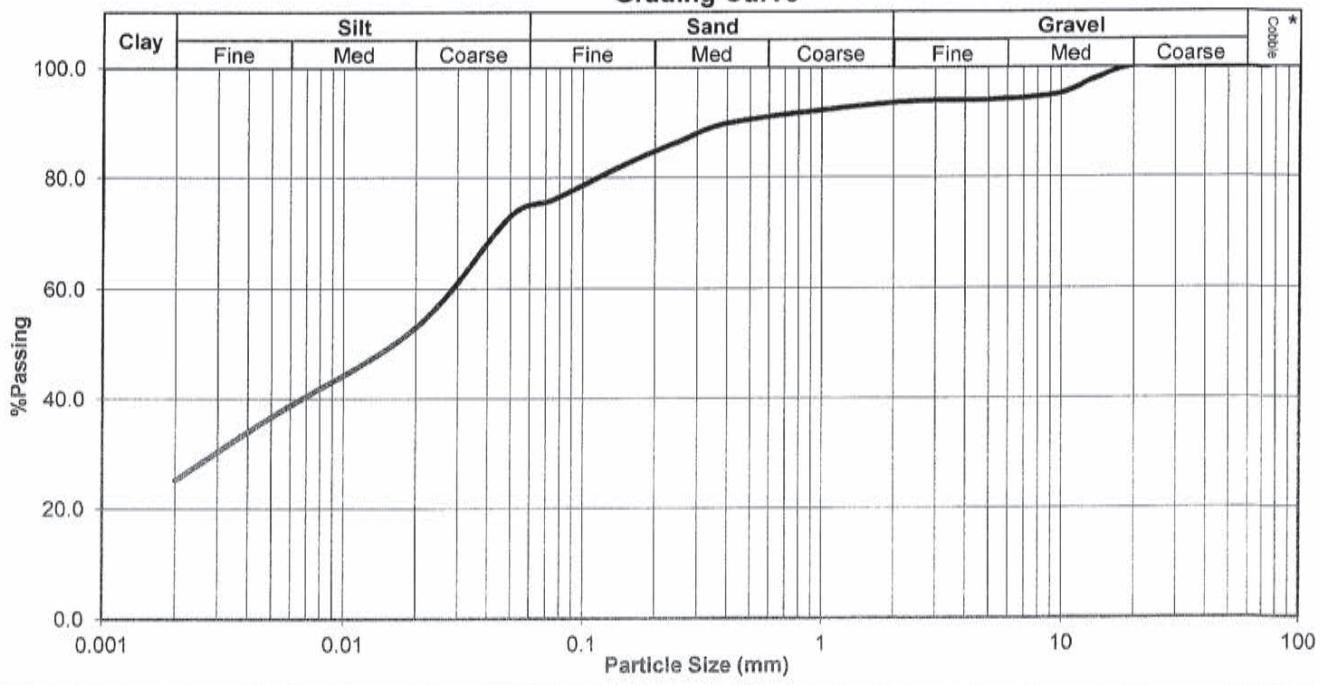
M.I.T SIZE CLASSIFICATION *	
Cobble%	0.0
Gravel%	6.5
Coarse	0.0
Medium	5.8
Fine	0.7
Sand%	19.2
Coarse	3.1
Medium	6.0
Fine	10.1
Silt%	49.0
Coarse	21.2
Medium	15.3
Fine	12.6
Clay%	25.2

PLASTICITY	
Liquid Limit	41.2
Plasticity Index	10.9
Linear Shrinkage	6

GRADING	
D10 Size (mm)	<0.002
Uniformity Coefficient	NA
Grading Modulus	0.40

CLASSIFICATION *	
Potential Expansiveness	Low
Group Index	9
AASHTO Soil Classification	A - 8
Unified Classification	ML or OL

Grading Curve



Ref no.: 8403 Fig no.: -

* Information marked with an asterisk is outside the scope of Accreditation.
The results only relate to the samples tested.
The report may not be reproduced except in full.

TEST REPORT

MATERIALS ANALYSIS

THEKWINI SOILS LAB. CC
V.A.T. REGISTRATION NO: 4690210161
69 Ridge Road, Toilgate, DURBAN
Tel : (031) 201-6902
P.O. Box 30464, MAYVILLE, 4058
Fax : (031) 201-7920

sanas Testing Laboratories

Project: Mkhuze Substation - Ref.31833

Ref no.: 8403 **Lab no.:** 05078 **Borehole/Pit no.:** I5-IP3

Description: -

Depth: 0.4 - 1.7 -

Test Methods: TMH1 METHOD A1(a), A2, A3 & A4, ASTMD422

Grading Analysis	
Grain Size (mm)	%Passing
75	100.0
53	100.0
37.5	98.4
26.5	91.5
19	79.2
13.2	60.8
9.5	46.9
4.75	29.1
2	19.3
0.425	12.3
0.25	10.9
0.15	10.1
0.075	9.3
0.05	9.0
0.02	7.4
0.005	6.0
0.002	5.3

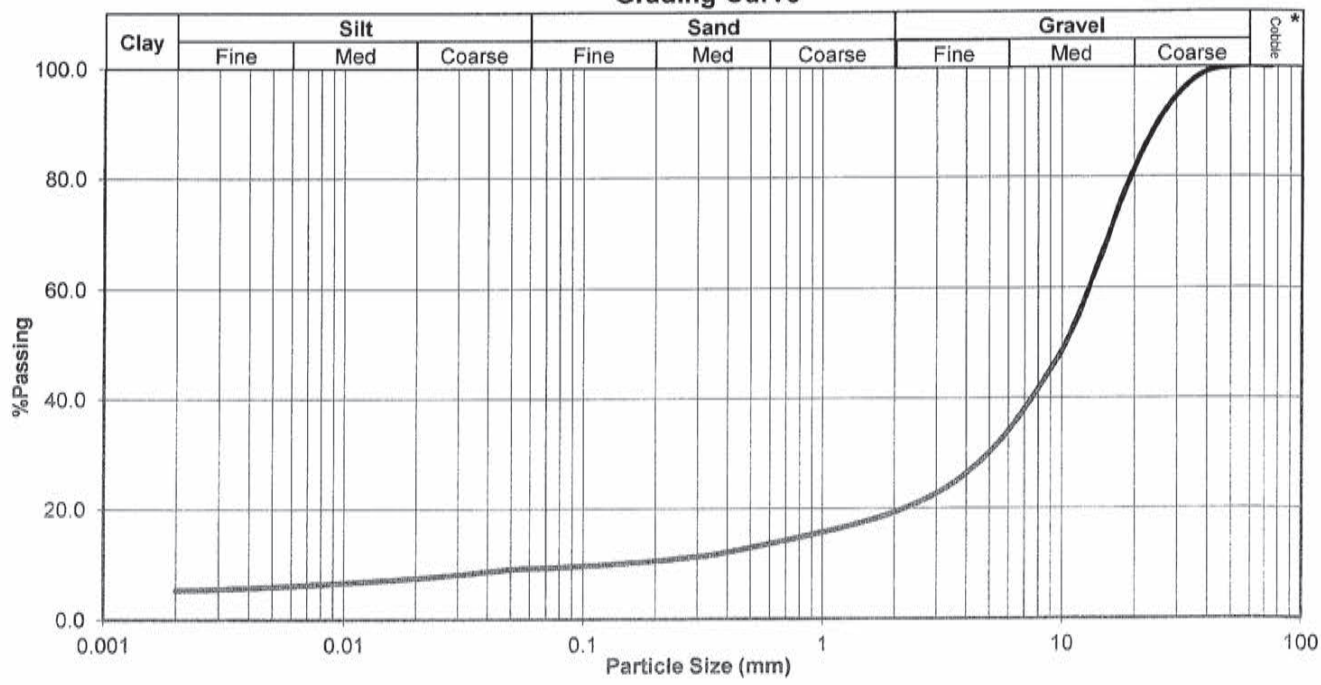
M.I.T SIZE CLASSIFICATION *	
Cobble%	0.0
Gravel%	80.7
Coarse	19.2
Medium	47.0
Fine	14.5
Sand%	10.1
Coarse	6.2
Medium	2.6
Fine	1.4
Silt%	3.8
Coarse	1.7
Medium	1.4
Fine	0.7
Clay%	5.3

PLASTICITY	
Liquid Limit	47.1
Plasticity Index	11.4
Linear Shrinkage	9.3

GRADING	
D10 Size (mm)	0.14
Uniformity Coefficient	92.48
Grading Modulus	2.59

CLASSIFICATION *	
Potential Expansiveness	Low
Group Index	0
AASHTO Soil Classification	A - 2 - 7
Unified Classification	GP - GM

Grading Curve



Ref no.: 8403 Fig no.: -

* Information marked with an asterisk is outside the scope of Accreditation.
The results only relate to the samples tested.
The report may not be reproduced except in full.

TEST REPORT

MATERIALS ANALYSIS

THEKWINI SOILS LAB. CC
VAT REGISTRATION NO 4090210091
68 Ridge Road, Tollgate, DURBAN
Tel : (031) 201-8992
P.O. Box 30464, MAYVILLE, 4058
Fax : (031) 201-7920

sanas Testing Laboratories

Project: Mkhuze Substation - Ref.31833

Ref no.: 8403 **Lab no.:** 05079 **Borehole/Pit no.:** I6-IP1

Description: -

Depth: 0.0 - 0.6 -

Test Methods: TMH1 METHOD A1(a), A2, A3 & A4, ASTMD422

Grading Analysis	
Grain Size (mm)	%Passing
75	98.3
53	98.3
37.5	96.7
26.5	94.8
19	94.3
13.2	90.5
9.5	87.0
4.75	86.9
2	85.7
0.425	79.9
0.25	77.9
0.15	75.9
0.075	70.8
0.05	66.8
0.02	58.8
0.005	51.5
0.002	45.5

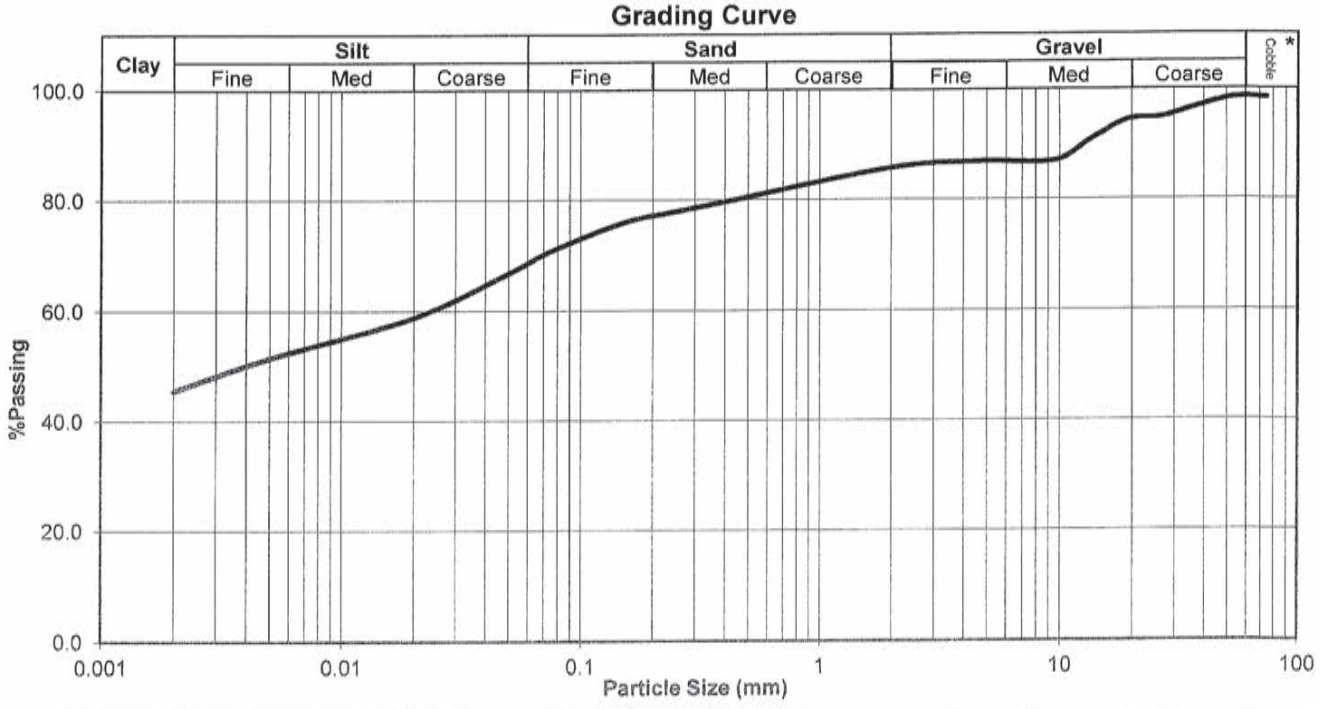
M.I.T SIZE CLASSIFICATION *	
Cobble%	1.7
Gravel%	12.6
Coarse	4.0
Medium	7.4
Fine	1.2
Sand%	17.3
Coarse	5.2
Medium	3.7
Fine	8.5
Silt%	22.9
Coarse	9.6
Medium	6.9
Fine	6.5
Clay%	45.5

PLASTICITY	
Liquid Limit	43.2
Plasticity Index	10.9
Linear Shrinkage	10.7

GRADING	
D10 Size (mm)	<0.002
Uniformity Coefficient	NA
Grading Modulus	0.64

CLASSIFICATION *	
Potential Expansiveness	Low
Group Index	8
AASHTO Soil Classification	A - 8
Unified Classification	ML or OL

Grading Curve



Ref no.: 8403 Fig no.: -

* Information marked with an asterisk is outside the scope of Accreditation.
The results only relate to the samples tested.
The report may not be reproduced except in full.

TEST REPORT

MATERIALS ANALYSIS

THEKWINI SOILS LAB. CC
VAT REGISTRATION NO 4690210091
69 Ridge Road, Tollgate, DURBAN
Tel : (031) 201-6992
P.O. Box 30464, MAYVILLE, 4058
Fax : (031) 201-7920

sanas testing laboratories

Project: Mkhuze Substation - Ref.31833

Ref no.: 8403 **Lab no.:** 05080 **Borehole/Pit no.:** I6-IP6

Description: -

Depth: 0.2 - 0.8 -

Test Methods: TMH1 METHOD A1(a), A2, A3 & A4, ASTMD422

Grading Analysis	
Grain Size (mm)	%Passing
75	98.0
53	94.8
37.5	86.5
26.5	71.0
19	61.9
13.2	43.5
9.5	32.9
4.75	16.9
2	8.4
0.425	4.6
0.25	4.3
0.15	4.2
0.075	4.0
0.05	3.7
0.02	3.0
0.005	2.5
0.002	2.1

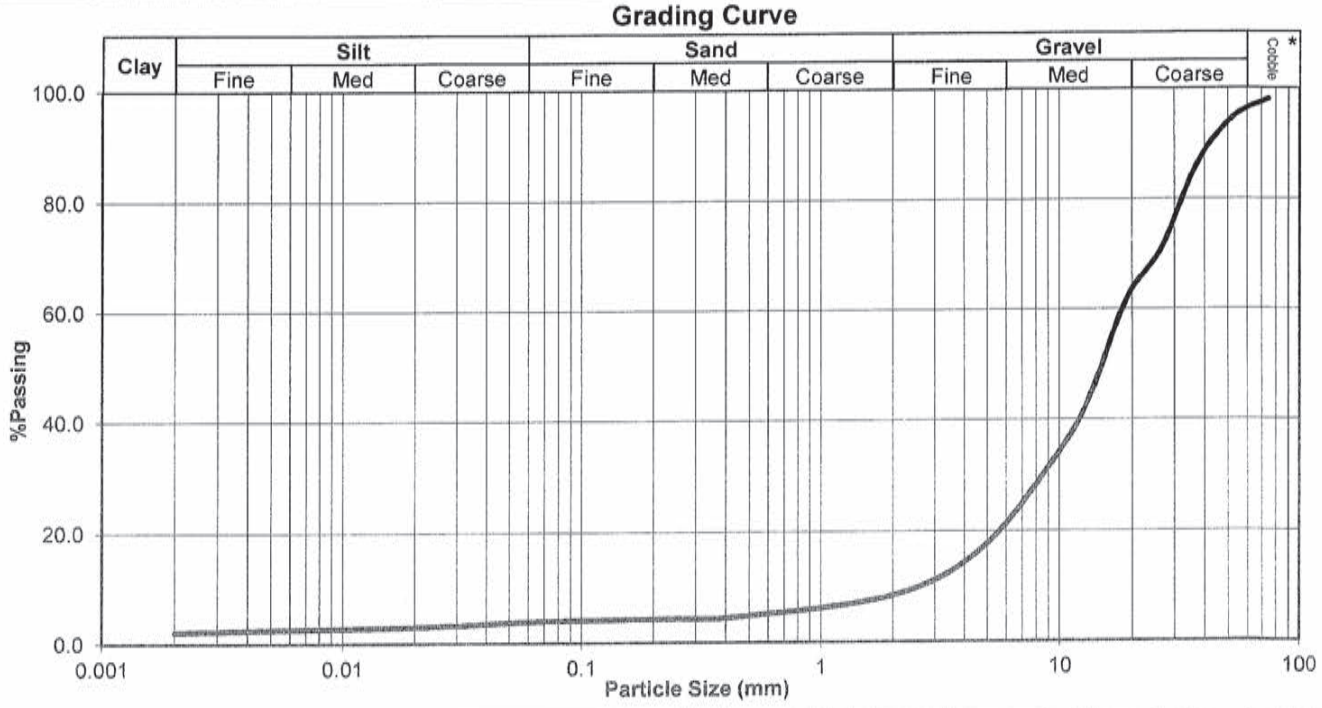
M.I.T SIZE CLASSIFICATION *	
Cobble%	4.2
Gravel%	87.4
Coarse	32.7
Medium	42.0
Fine	12.7
Sand%	4.6
Coarse	3.4
Medium	0.7
Fine	0.4
Silt%	1.7
Coarse	0.9
Medium	0.4
Fine	0.4
Clay%	2.1

PLASTICITY	
Liquid Limit	38.1
Plasticity Index	12
Linear Shrinkage	8.7

GRADING	
D10 Size (mm)	2.3
Uniformity Coefficient	7.79
Grading Modulus	2.83

CLASSIFICATION *	
Potential Expansiveness	Low
Group Index	0
AASHTO Soil Classification	A - 2 - 6
Unified Classification	GW

Grading Curve



Ref no.: 8403 Fig no.: -

* Information marked with an asterisk is outside the scope of Accreditation.
The results only relate to the samples tested.
The report may not be reproduced except in full.

TEST REPORT

MATERIALS ANALYSIS

THEKWINI SOILS LAB. CC
V.A.T. REGISTRATION NO: 4090210061
68 Ridge Road, Tollgate, DURBAN
Tel : (031) 201-8992
P.O. Box 30464, MAYVILLE, 4058
Fax : (031) 201-7920

sanas testing laboratory

Project: Mkhuze Substation

Ref no.: 8403 **Lab no.:** 05081 **Borehole/Pit no.:** I6-IP7

Description: -

Depth: 0.0 - 0.3 -

Test Methods: TMH1 METHOD A1(a), A2, A3 & A4, ASTMD422

Grading Analysis	
Grain Size (mm)	%Passing
75	100.0
53	99.3
37.5	98.0
26.5	96.3
19	95.4
13.2	78.7
9.5	72.1
4.75	63.0
2	56.8
0.425	46.5
0.25	44.0
0.15	41.8
0.075	37.9
0.05	36.7
0.02	30.5
0.005	24.6
0.002	22.1

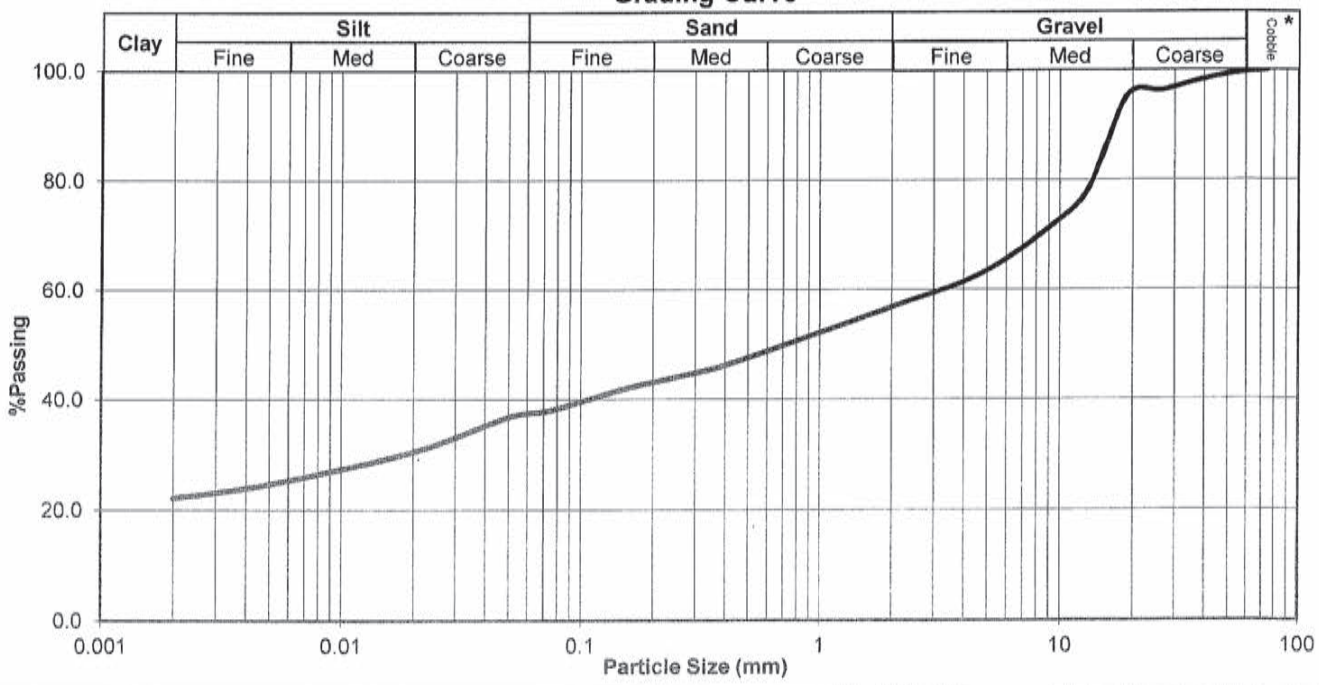
M.I.T SIZE CLASSIFICATION *	
Cobble%	0.4
Gravel%	42.8
Coarse	4.1
Medium	30.1
Fine	8.6
Sand%	19.6
Coarse	9.1
Medium	4.8
Fine	5.7
Silt%	15.1
Coarse	6.7
Medium	5.5
Fine	2.9
Clay%	22.1

PLASTICITY	
Liquid Limit, %	40
Plasticity Index	11.7
Linear Shrinkage, % (L/L)	9.3

GRADING	
D10 Size (mm)	<0.002
Uniformity Coefficient	*
Grading Modulus	1.59

CLASSIFICATION *	
Potential Expansiveness	Low
Group Index	1
AASHTO Soil Classification	A - 6
Unified Classification	SM

Grading Curve



Ref no.: 8403 Fig no.: -

* Information marked with an asterisk is outside the scope of Accreditation.
The results only relate to the samples tested.
The report may not be reproduced except in full.

TEST REPORT

MATERIALS ANALYSIS

THEKWINI SOILS LAB. CC
VAT REGISTRATION NO. 4690210091
69 Ridge Road, Tollgate, DURBAN
Tel : (031) 201-6992
P.O. Box 30464, MAYVILLE, 4058
Fax : (031) 201-7920

sanas Testing Laboratory

Project: Mkhuze Substation

Ref no.: 8403 **Lab no.:** 05082 **Borehole/Pit no.:** I6-IP5

Description: -

Depth: 0.3 - 1.0 -

Test Methods: TMH1 METHOD A1(a), A2, A3 & A4, ASTMD422

Grading Analysis	
Grain Size (mm)	%Passing
75	88.4
53	74.1
37.5	62.3
26.5	52.9
19	48.4
13.2	39.3
9.5	33.9
4.75	32.1
2	30.6
0.425	22.8
0.25	21.2
0.15	19.9
0.075	18.0
0.05	17.4
0.02	13.6
0.005	11.3
0.002	10.0

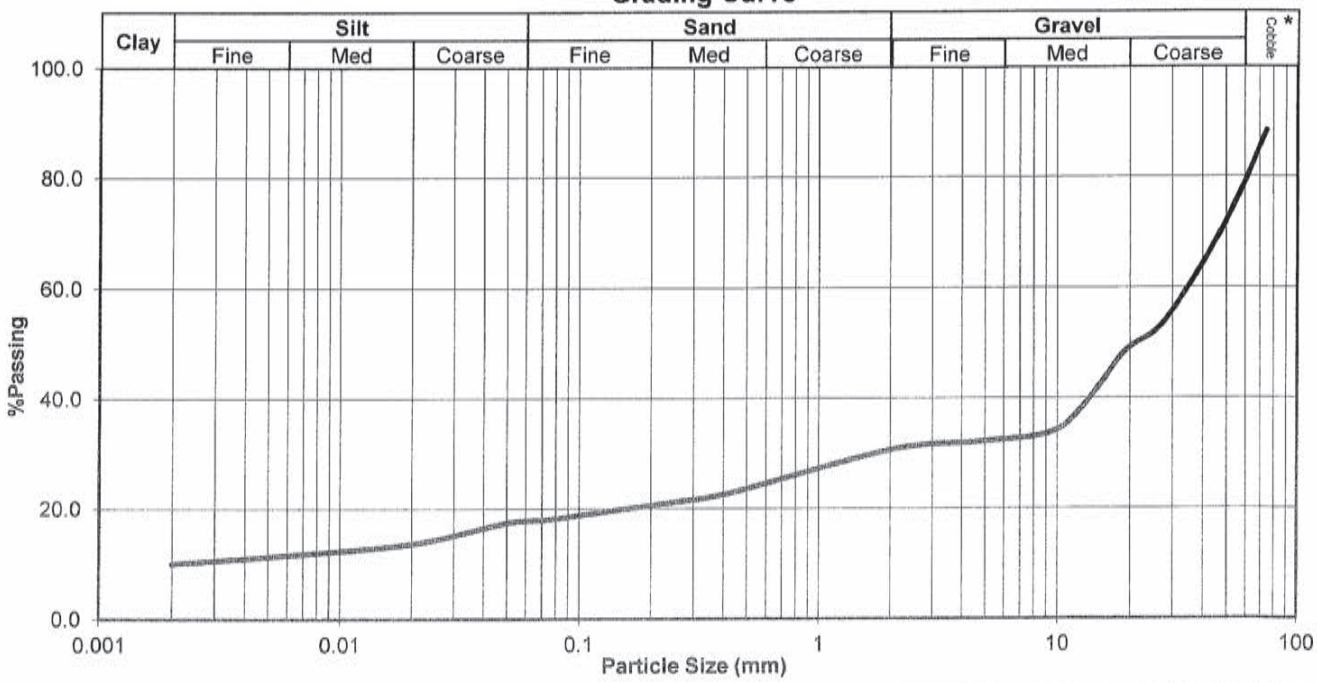
M.I.T SIZE CLASSIFICATION *	
Cobble%	21.4
Gravel%	48.0
Coarse	29.6
Medium	16.4
Fine	1.9
Sand%	13.0
Coarse	6.9
Medium	3.2
Fine	2.8
Silt%	7.7
Coarse	4.1
Medium	2.2
Fine	1.4
Clay%	10.0

PLASTICITY	
Liquid Limit	34.5
Plasticity Index	9.5
Linear Shrinkage	8

GRADING	
D10 Size (mm)	<0.002
Uniformity Coefficient	NA
Grading Modulus	2.29

CLASSIFICATION *	
Potential Expansiveness	Low
Group Index	0
AASHTO Soil Classification	A - 2 - 4
Unified Classification	GM

Grading Curve



Ref no.: 8403 Fig no.: -

* Information marked with an asterisk is outside the scope of Accreditation.
The results only relate to the samples tested.
The report may not be reproduced except in full.

Date: 15-06-2017

Ref. No. : 8403

Project : Mkuze Substation - 31833

THEKWINI SOILS LAB. CC
V.A.T. REGISTRATION NO. 4990210001.
68 Ridge Road, Tollgate, DURBAN
Tel : (031) 201-8992
P.O. Box 30464, MAYVILLE, 4058
Fax : (031) 201-7920

Moisture, pH and Conductivity

Lab. Number	No. BH. CH	Depth m	Moisture Content %	pH	Conductivity m S / cm
05073	I4-IP1	0.0 - 0.7	-	5.9	22
05074	I4-IP8	0.9 - 2.2	-	7.2	364
05075	I5-IP9	0.0 - 1.0	-	6.5	118
05076	I5-IP7	0.6 - 2.3	-	7.0	41
05081	I6-IP7	0.0 - 0.3	-	6.9	60
05082	I6-IP5	0.3 - 1.0	-	6.9	36

WATERLAB (PTY) LTD

23B De Havilland Crescent
Persequor Techno Park,
Meiring Naudé Road, Pretoria
P.O. Box 283, 0020

Telephone: +2712 – 349 – 1066
Facsimile: +2712 – 349 – 2064
Email: accounts@waterlab.co.za

CERTIFICATE OF ANALYSES
BASSON INDEX & BRE

Date received: 2017-05-15 | **Date completed: 2017-06-02**
Project number: 1000 | **Report number: 66964** | **Order number:**

Client name: Drennan Maud (Pty) Ltd
Address: P.O. Box 30464, Mayville, 4058
Telephone: 031 201 8992/3

Contact person: Jamie Lodge
Email: jamie@drennanmaud.com
Fax: 031 201 7920

Analyses in mg/ℓ (Unless specified otherwise)	Sample Identification: 31376 Eskom		
	I4-IP1; 0.00-0.70 Colluvium	**I4-IP8; 0.90-2.20 Residual Basalt (Clay)**	**I5-IP9; 0.00-1.00 Colluvium**
Sample Number	**4896**	**4897**	**4898**
Paste pH	5.4	7.9	6.8
pH Value at 25°C	6.1	8.2	7.4
pHs Value at 20°C (calc)	10.7	8.2	9.4
Electrical Conductivity in mS/m at 25°C	8.9	188	49.7
Total Dissolved Solids* (calc)	60	1260	333
Total Alkalinity as $CaCO_3$	8	128	64
Total Hardness as $CaCO_3$ (calc)	7	130	16
Calcium Hardness as $CaCO_3$ (calc)	2	60	7
Calcium as Ca	1	24	3
Magnesium as Mg	1	17	2
Free & Saline Ammonia	<0.1	<0.1	<0.1
Ammonium as NH_4 (calc)	<0.3	<0.3	<0.3
Acid Soluble Sulphate	656	476	629
Sulphate as SO_4	25	98	45
Chloride as Cl	8	432	95
Nitrate as N	<0.1	1.7	1.1
Total Sulphur (Leco) %	<0.1	<0.1	0.1
Langelier Index at 20°C (calc)	-4.6	0	-2.0
Ryznar Index at 20°C (calc)	15.2	8.2	11.3
Corrosivity Ratio (calc)	4.7	5.6	2.8
Leaching Index [LCSI] (calc)	**3633**	**416**	**1806**
Spalling Index [SCSI] (calc)	**3**	**13**	**5**
Aggressiveness Index [N_c] (calc)	**3636**	**430**	**1811**

***TDS Calculated EC X 6.7**
2:1 Distilled Water : Soil Extract

E. Botha
Geochemistry Project Manager

WATERLAB (PTY) LTD

23B De Havilland Crescent
Persequor Techno Park,
Meiring Naudé Road, Pretoria
P.O. Box 283, 0020

Telephone: +2712 – 349 – 1066
Facsimile: +2712 – 349 – 2064
Email: accounts@waterlab.co.za

CERTIFICATE OF ANALYSES
BASSON INDEX & BRE

Date received: 2017-05-15 | **Date completed: 2017-06-02**
Project number: 1000 | **Report number: 66964** | **Order number:**

Client name: Drennan Maud (Pty) Ltd
Address: P.O. Box 30464, Mayville, 4058
Telephone: 031 201 8992/3

Contact person: Jamie Lodge
Email: jamie@drennanmaud.com
Fax: 031 201 7920

Analyses in mg/ℓ (Unless specified otherwise)	Sample Identification: 31376 Eskom		
	I5-IP7; 0.60-2.30 Residual Basalt (Clay)	**I6-IP7; 0.00-0.30 Colluvium**	**I6-IP5; 0.30-1.00 Dolerite (Gravel)**
Sample Number	**4899**	**4900**	**4901**
Paste pH	7.9	7.6	6.8
pH Value at 25°C	7.9	8.1	7.5
pHs Value at 20°C (calc)	8.3	7.8	9.0
Electrical Conductivity in mS/m at 25°C	35.9	40.9	14.6
Total Dissolved Solids* (calc)	241	274	98
Total Alkalinity as $CaCO_3$	100	132	48
Total Hardness as $CaCO_3$ (calc)	112	168	43
Calcium Hardness as $CaCO_3$ (calc)	55	127	22
Calcium as Ca	22	51	9
Magnesium as Mg	14	10	5
Free & Saline Ammonia	<0.1	<0.1	<0.1
Ammonium as NH_4 (calc)	<0.3	<0.3	<0.3
Acid Soluble Sulphate	327	588	315
Sulphate as SO_4	21	27	11
Chloride as Cl	30	24	5
Nitrate as N	2.0	3.4	0.7
Total Sulphur (Leco) %	<0.1	0.2	<0.1
Langelier Index at 20°C (calc)	-0.4	0.3	-1.5
Ryznar Index at 20°C (calc)	8.7	7.5	10.4
Corrosivity Ratio (calc)	0.6	0.5	0.4
Leaching Index [LCSI] (calc)	**689**	**169**	**1451**
Spalling Index [SCSI] (calc)	**5**	**5**	**2**
Aggressiveness Index [N_c] (calc)	**694**	**174**	**1453**

E. Botha
Geochemistry Project Manager

WATERLAB (PTY) LTD

23B De Havilland Crescent
Persequor Techno Park,
Meiring Naudé Road, Pretoria
P.O. Box 283, 0020

Telephone: +2712 – 349 – 1066
Facsimile: +2712 – 349 – 2064
Email: accounts@waterlab.co.za

CERTIFICATE OF ANALYSES
BASSON INDEX & BRE

Date received: 2017-05-15 | **Date completed: 2017-06-02**
Project number: 1000 | **Report number: 66964** | **Order number:**

Client name: Drennan Maud (Pty) Ltd
Address: P.O. Box 30464, Mayville, 4058
Telephone: 031 201 8992/3

Contact person: Jamie Lodge
Email: jamie@drennanmaud.com
Fax: 031 201 7920

Important notes (see table for corrections on p. 3):

1. The above aggressiveness index is only applicable for conditions of laminar flow at a mean annual temperature of 20°C.
2. For stagnant/turbulent conditions the aggressiveness index must be corrected.
3. For wet/dry cycling conditions (for example in tidal zones) the aggressiveness index must be corrected.
4. For mean annual temperatures lower/higher than 20°C the aggressiveness index must be corrected.

Guidelines for assessing overall aggressiveness (N_c):

N_c	Aggressiveness
Not greater than 300	None to mild
400-700	Mild to moderate
800-1000	High
= or > 1 100	Very high

Aggressiveness Towards *Concrete and Fibre Cement Pipes*			
Index	**Aggressive**	**Neutral**	**Non- Aggressive**
a) Stability pH (pHs)	>pH	= pH	<pH
b) Langelier Index	Neg. Value	Zero	Pos. Value
c) Ryznar Index	>7.5	6-7	<6

Corrosiveness Towards metals	
Corrosivity	>0.2

Sample Name	Sample Number	Corrosivity Indices	Basson Index
I4-IP1; 0.00-0.70 Colluvium	4896	Corrosive	Aggressive
I4-IP8; 0.90-2.20 Residual Basalt (Clay)	4897	Corrosive	Aggressive
I5-IP9; 0.00-1.00 Colluvium	4898	Corrosive	Aggressive
I5-IP7; 0.60-2.30 Residual Basalt (Clay)	4899	Corrosive	Aggressive
I6-IP7; 0.00-0.30 Colluvium	4900	Corrosive	Neutral
I6-IP5; 0.30-1.00 Dolerite (Gravel)	4901	Corrosive	Aggressive

E. Botha
Geochemistry Project Manager

WATERLAB (PTY) LTD

23B De Havilland Crescent
Persequor Techno Park,
Meiring Naudé Road, Pretoria
P.O. Box 283, 0020

Telephone: +2712 – 349 – 1066
Facsimile: +2712 – 349 – 2064
Email: accounts@waterlab.co.za

CERTIFICATE OF ANALYSES
BASSON INDEX & BRE

Date received: 2017-05-15 | **Date completed: 2017-06-02**
Project number: 1000 | **Report number: 66964** | **Order number:**

Client name: Drennan Maud (Pty) Ltd
Address: P.O. Box 30464, Mayville, 4058
Telephone: 031 201 8992/3

Contact person: Jamie Lodge
Email: jamie@drennanmaud.com
Fax: 031 201 7920

To correct for:	Multiply	By: (see Notes 2 to 5 below)
Turbulence	LCSI	1.75
Stagnance	LCSI	0.5
Temperature	LCSI, SCSI, N7 Where N7=0.2 x Cl in mg/l	(1+ [0.05 x (T-20)])
Wet-dry cycles	SCSI	0.23×10^{-6} x TDS x DTF x CPA Where: DTF = Dry Time Fraction CPA = wet-dry cycles per annum

Note 1: Only if the concrete contains embedded steel.
Note 2: To preserve the correct logical relationships when dealing with the negative sub indices (ie LCSI or SCSI having minus values) they should be multiplied by the reciprocal of the relevant factor indicated in this column
Note 3: If more than one correction is required, multiply by the product of the individual correction factors
Note 4: Use subscript c to indicate that the index has been corrected, eg for turbulent conditions $LCSI_c$ = LCSI x 1.75
Note 5: Round off corrected indices to the nearest 100.

E. Botha
Geochemistry Project Manager

APPENDIX D

PLATES 8 - 10

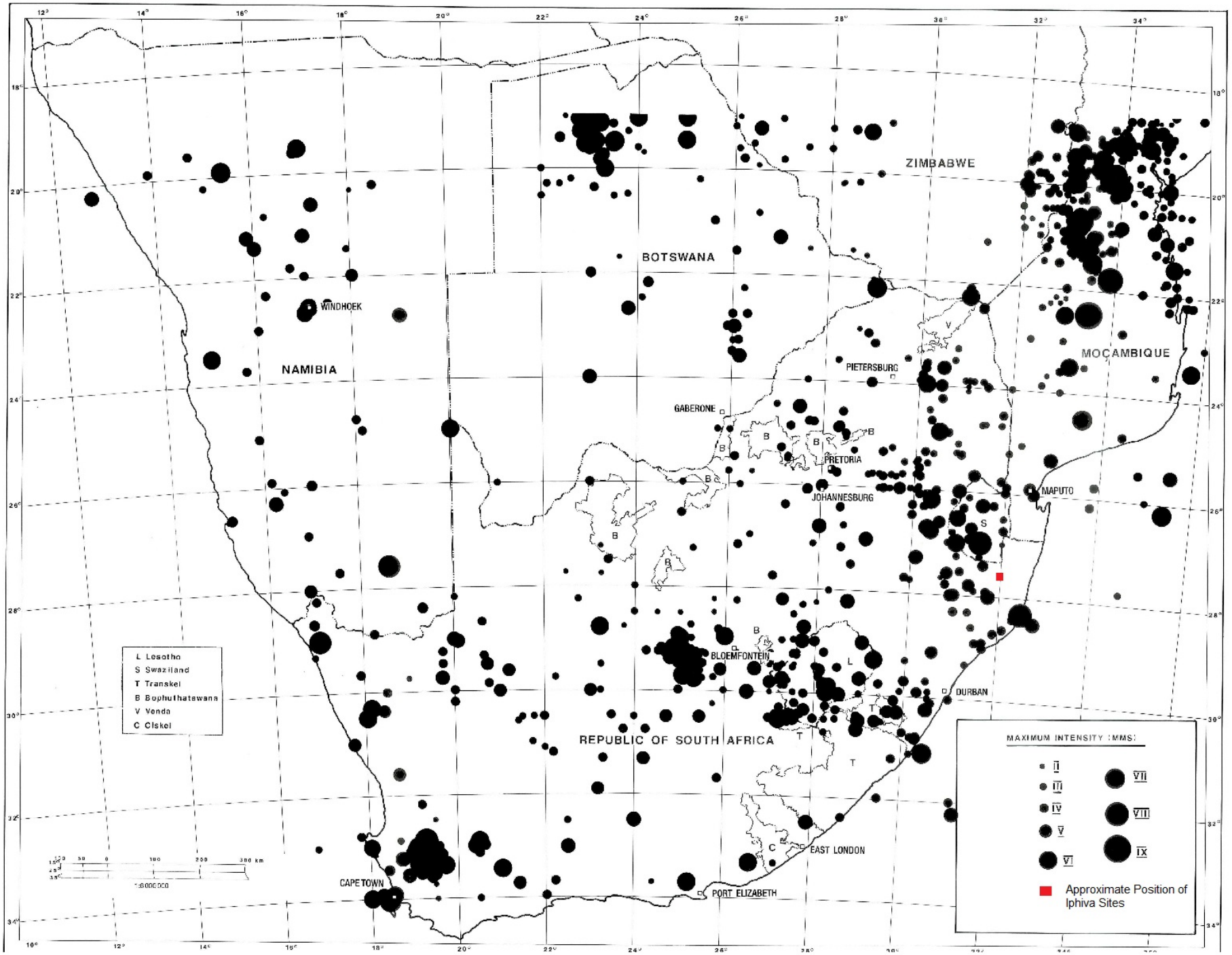


Plate 8: Maximum reported intensities (Modified Mercalli Scale) from 1620 to 1988 (after Brandt, 2011)

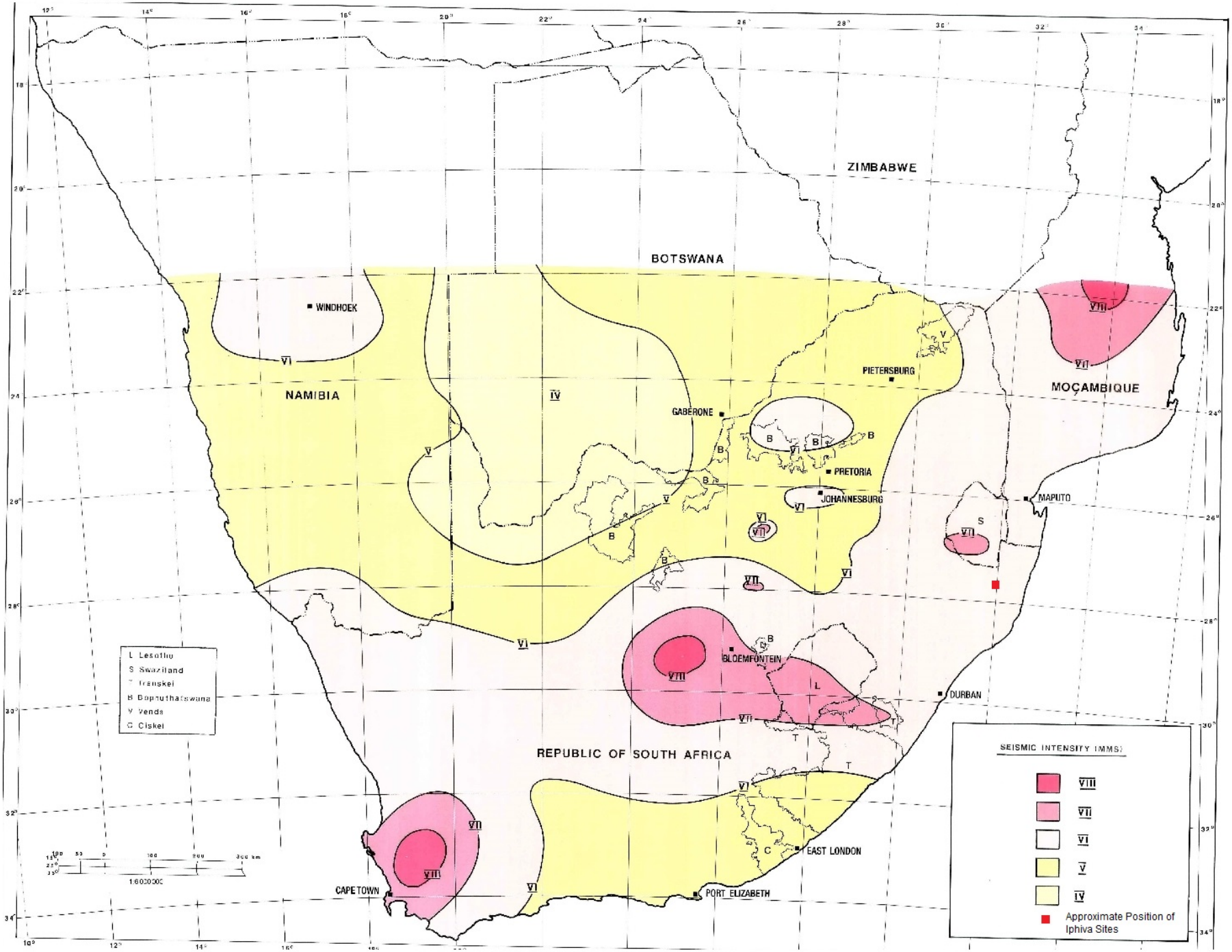


Plate 9: Seismic intensities (Modified Mercalli Scale) with a 10% probability of being exceeded at least once in a period of 50 years

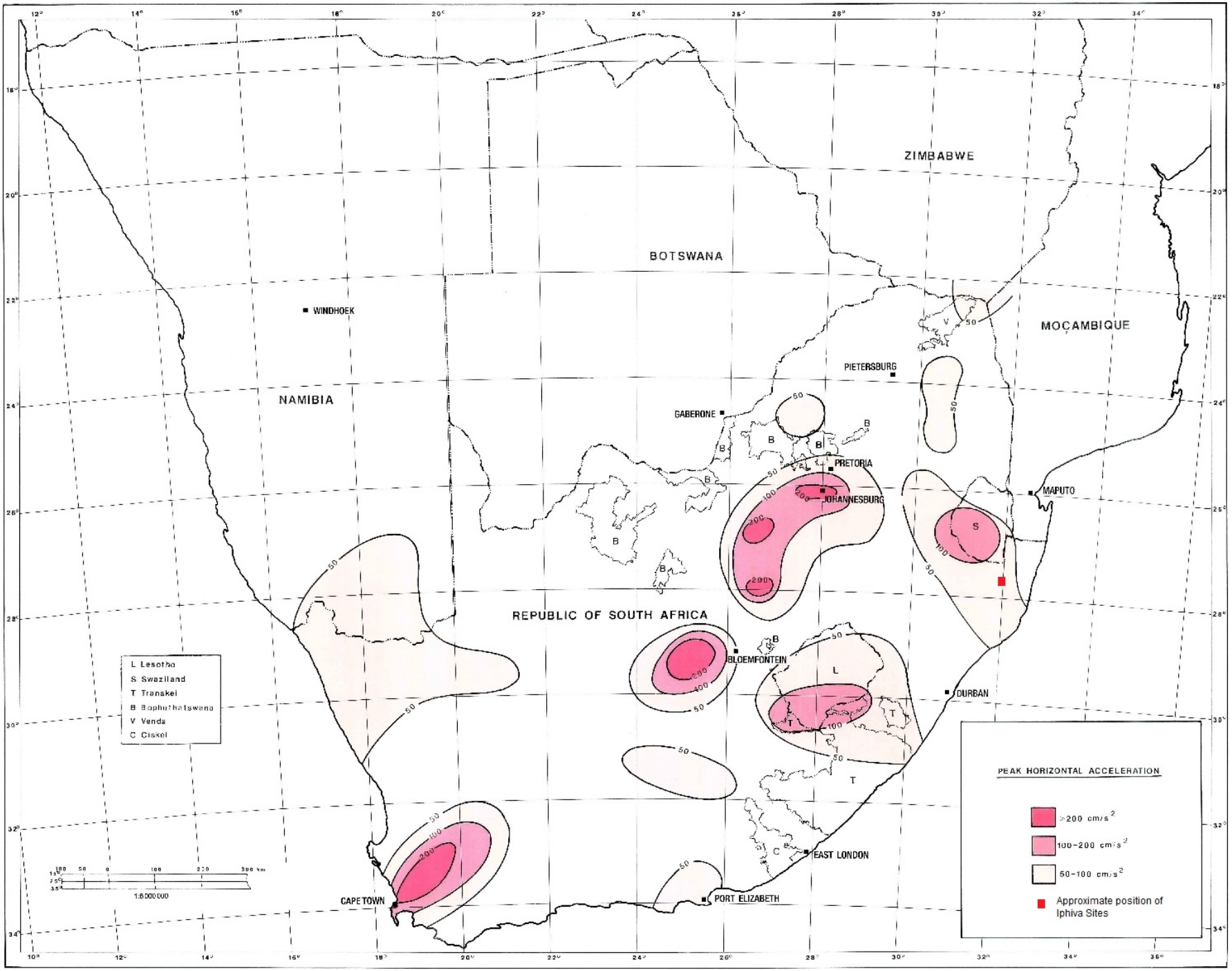


Plate 10: Peak horizontal acceleration (cm/s ^{2}) with a 10% probability of being exceeded at least once in a period of 50 years

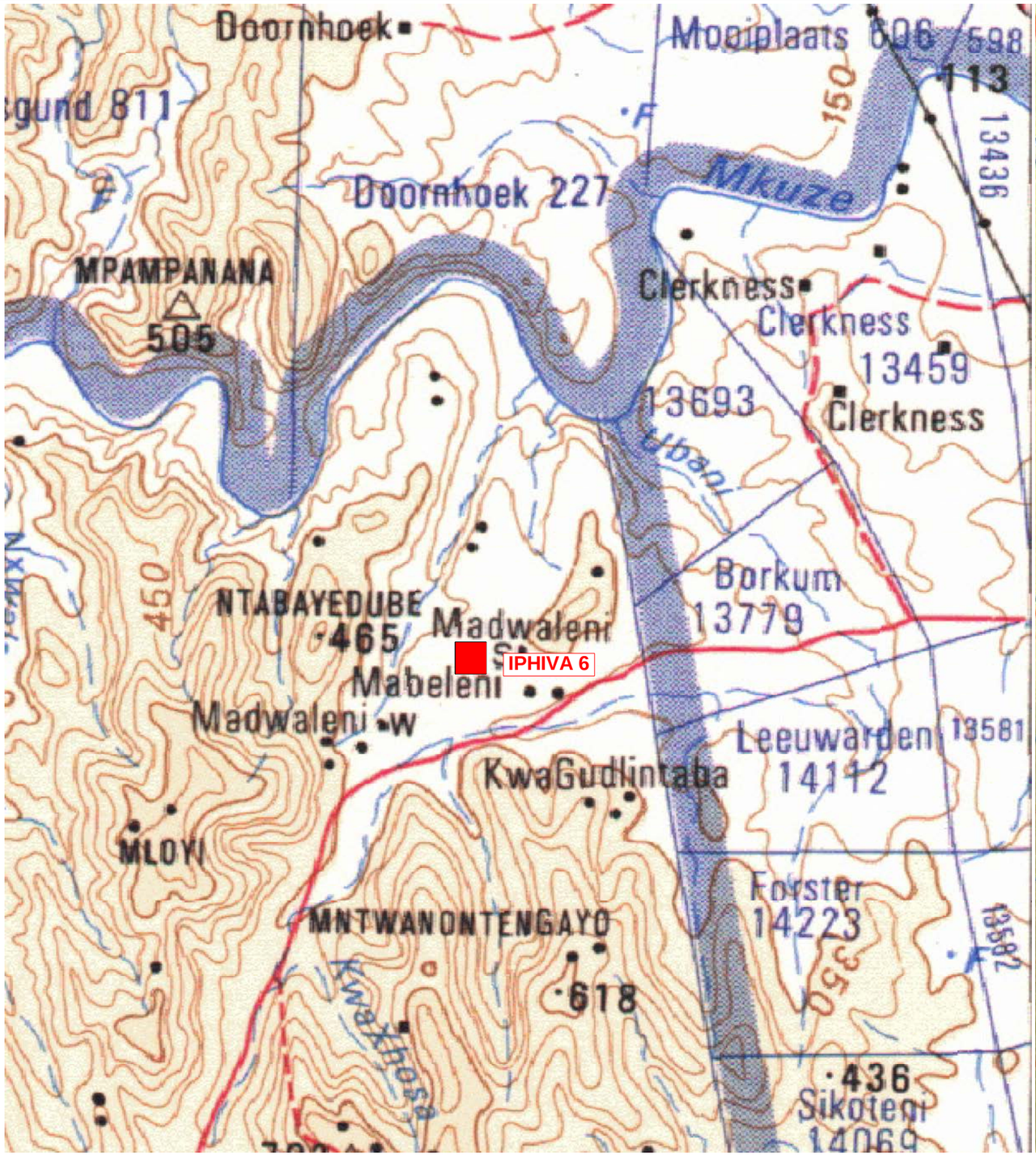
DRAWING [1] 31833/01 - LOCALITY SITE PLAN

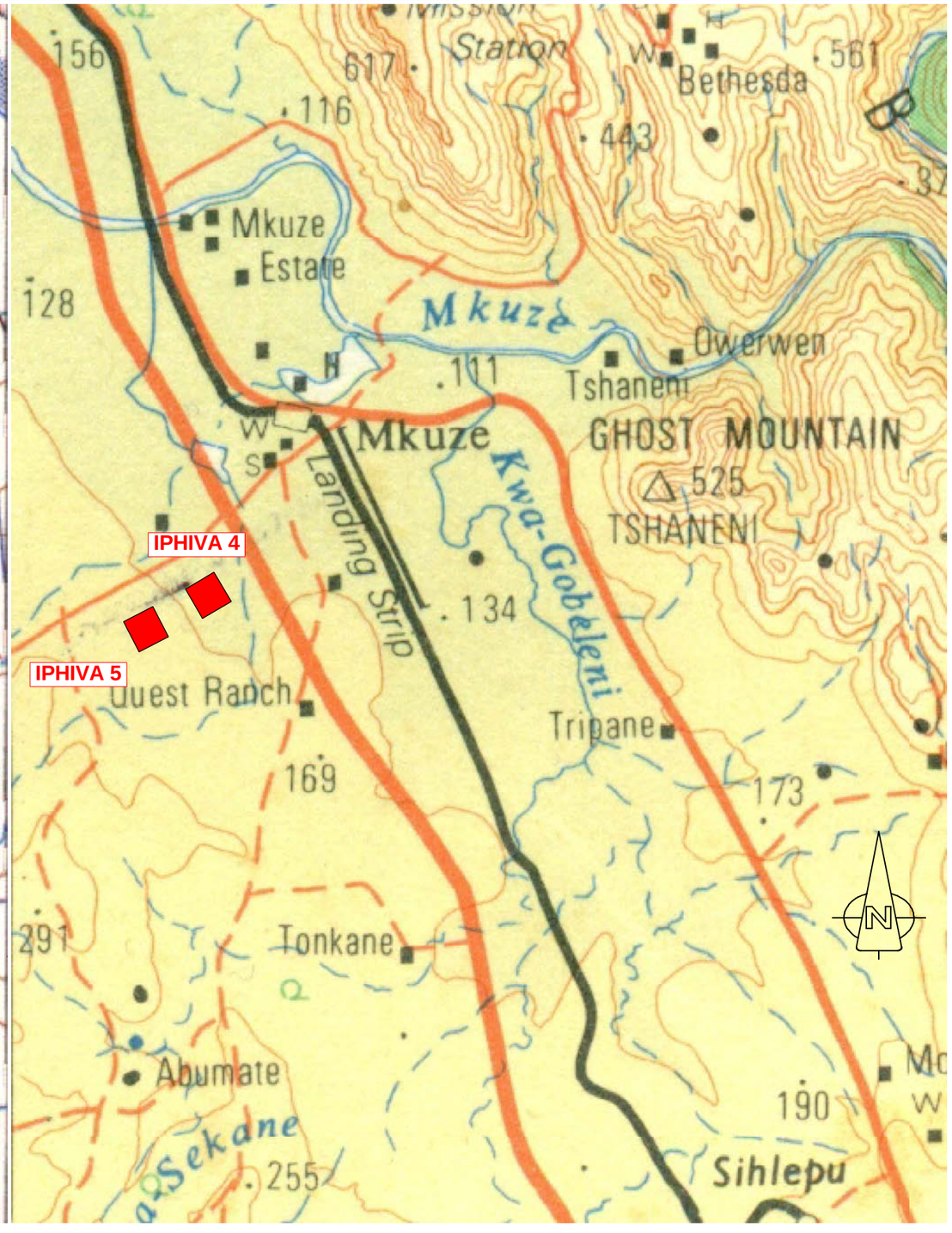
DRAWING [1] 31833/02A - IPHIVA 4 SITE PLAN

DRAWING [1] 31833/02B - IPHIVA 5 SITE PLAN

DRAWING [1] 31833/02C - IPHIVA 6 SITE PLAN

DRAWING [1] 31833/03 - GEOLOGICAL PLAN





DRENNAN MAUD (PTY) LTD
Geotechnical Engineers & Engineering Geologists

68 Peter Mokaba Ridge
Tollgate
DURBAN
4001
Telephone 031-201-8992

P.O. Box 30464
MAYVILLE
4058
Telefax 031-201-7920
e-mail:info@drennanmaud.com

DESIGNED :	J.L.
DRAWN :	S.P.
DATE :	8/05/2017
SCALE :	N.T.S.
CHECKED :	

PRELIMINARY GEOTECHNICAL INVESTIGATION
PROPOSED MKUZE SUBSTATION
LOCALITY PLAN

DRAWING NO.

31833-01

KEY

IP1/DCP1 ■ **APPROX. POSITION OF INSPECTION PITS/ DYNAMIC CONE PENETROMETER TESTS**

(>3,6m/3,6m)

(INFERRED BEDROCK DEPTH / FINAL DEPTH)

DRENNAN MAUD (PTY) LTD

Geotechnical Engineers & Engineering Geologists

68 Peter Mokaba Ridge
Tollgate
DURBAN
4001
Telephone 031-201-8992

P.O. Box 30464
MAYVILLE
4058
Telefax 031-201-7920
e-mail:info@drennanmaud.com

DESIGNED :	J.L.
DRAWN :	S.P.
DATE :	14/7/2017
SCALE :	N.T.S.
CHECKED :	

PRELIMINARY GEOTECHNICAL INVESTIGATION
MKUZE SUBSTATION
IPHIVA 4

DRAWING NO.

31833-02A

KEY

IP1/DCP1 ■ **APPROX. POSITION OF INSPECTION PITS/ DYNAMIC CONE PENETROMETER TESTS**

(>3,3m/3,3m)

(INFERRED BEDROCK DEPTH / FINAL DEPTH)

DRENNAN MAUD (PTY) LTD

Geotechnical Engineers & Engineering Geologists

68 Peter Mokaba Ridge
Tollgate
DURBAN
4001
Telephone 031-201-8992

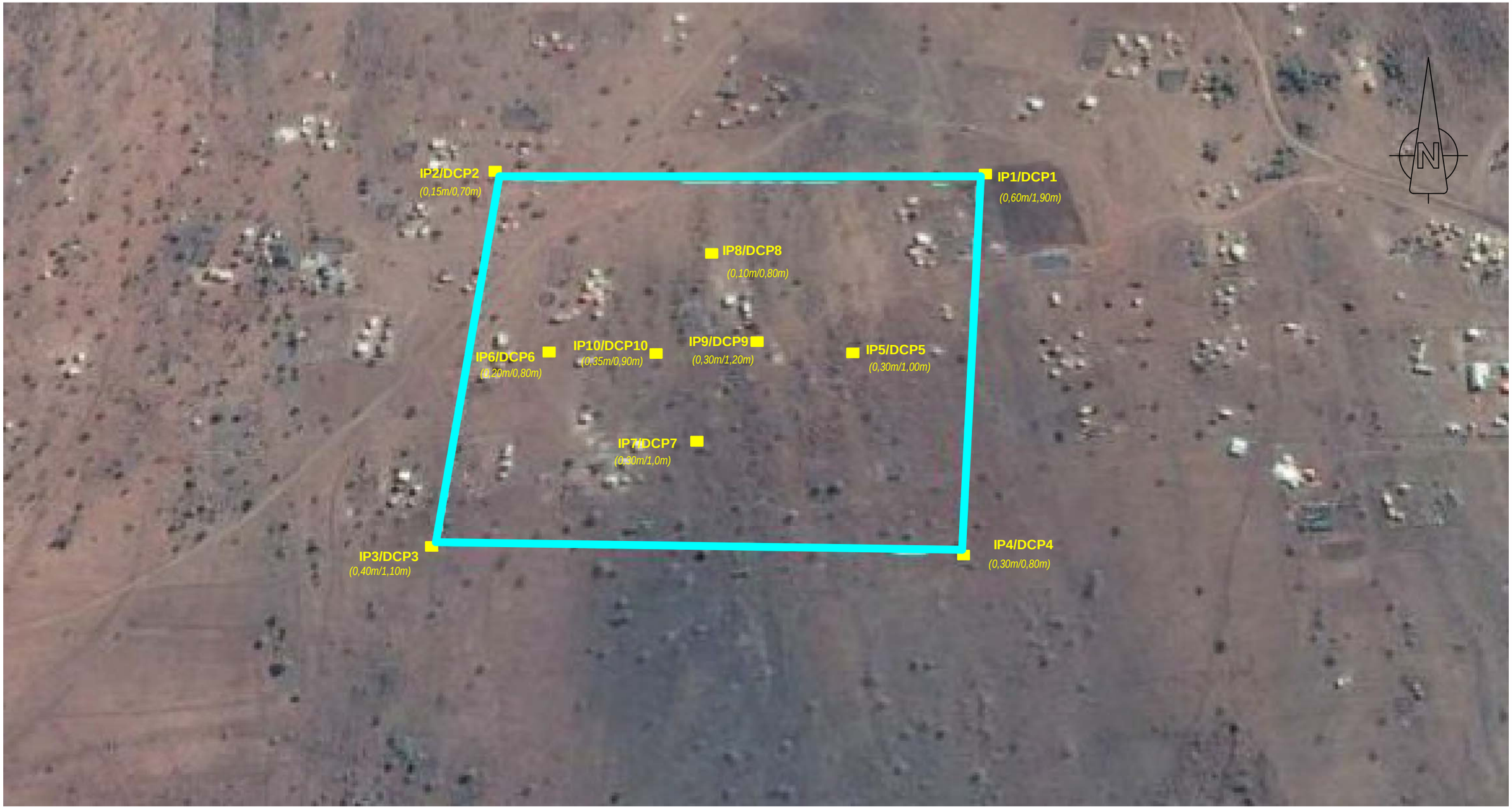
P.O. Box 30464
MAYVILLE
4058
Telefax 031-201-7920
e-mail:info@drennanmaud.com

DESIGNED :	J.L.
DRAWN :	S.P.
DATE :	14/7/2017
SCALE :	N.T.S.
CHECKED :	

PRELIMINARY GEOTECHNICAL INVESTIGATION
MKUZE SUBSTATION
IPHIVA 5

DRAWING NO.

31833-02B



KEY

IP1/DCP1
(>3,6m/3,6m)

APPROX. POSITION OF INSPECTION PITS/ DYNAMIC CONE PENETROMETER TESTS

(INFERRED BEDROCK DEPTH / FINAL DEPTH)

DRENNAN MAUD (PTY) LTD
Geotechnical Engineers & Engineering Geologists

68 Peter Mokaba Ridge
Tollgate
DURBAN
4001
Telephone 031-201-8992

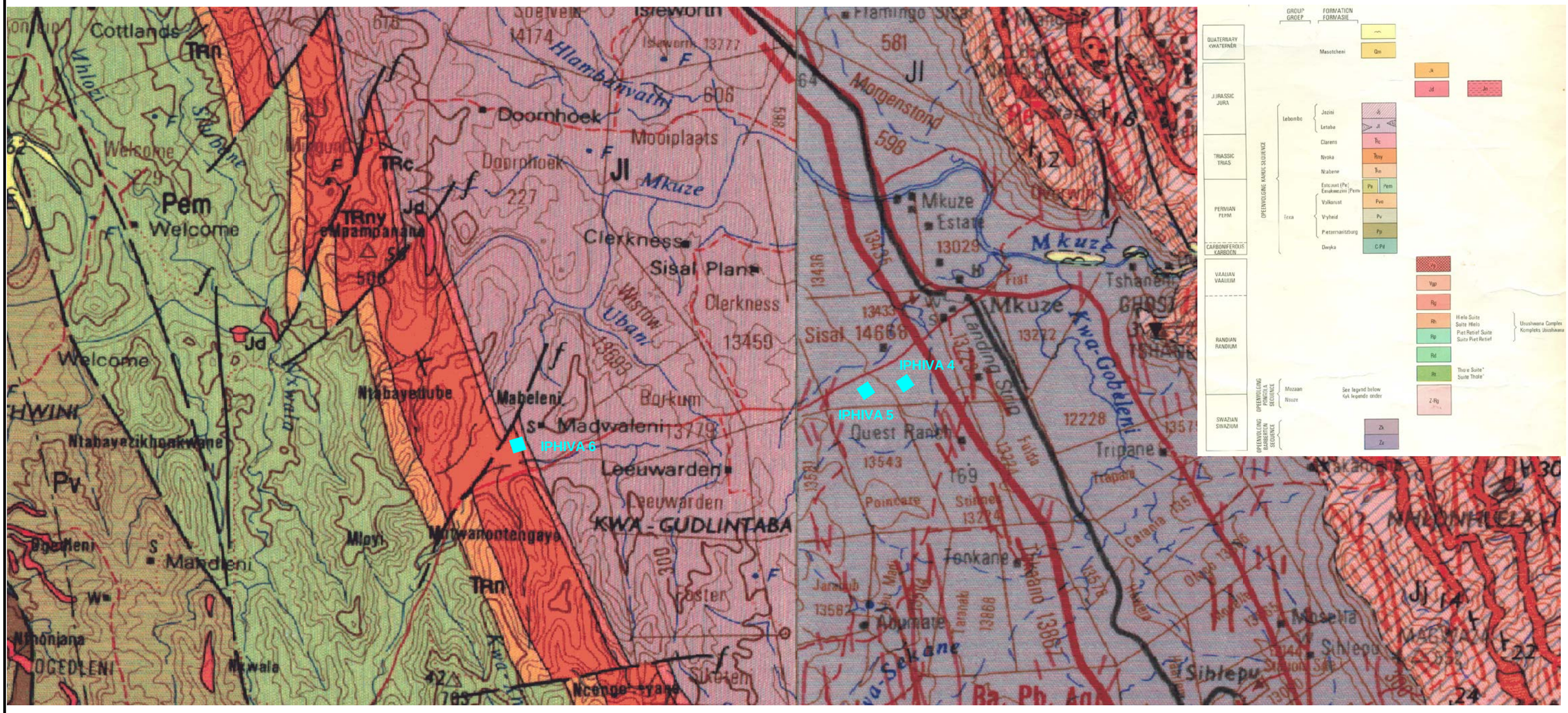
P.O. Box 30464
MAYVILLE
4058
Telefax 031-201-7920
e-mail:info@drennanmaud.com

DESIGNED :	J.L.
DRAWN :	S.P.
DATE :	14/7/2017
SCALE :	N.T.S.
CHECKED :	

PRELIMINARY GEOTECHNICAL INVESTIGATION
MKUZE SUBSTATION
IPHIVA 6

DRAWING NO.

31833-02c



DRENNAN MAUD (PTY) LTD

Geotechnical Engineers & Engineering Geologists

68 Peter Mokaba Ridge
Tollgate
DURBAN
4001
Telephone 031-201-8992

P.O. Box 30464
MAYVILLE
4058
Telefax 031-201-7920
e-mail:info@drennanmaud.com

DESIGNED :	J.L.
DRAWN :	S.P.
DATE :	8-05-2017
SCALE :	N.T.S.
CHECKED :	

PRELIMINARY GEOTECHNICAL INVESTIGATION
PROPOSED MKUZE SUBSTATION
GEOLOGICAL PLAN

DRAWING NO.

31833-03