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Contract WQ 65 / 10420

***Report to eThekweni Municipality Water and Sanitation
Unit on the Results of a Shallow Geotechnical
Investigation for the Proposed Sewer Reticulation
Pipelines within Wards 38, 41 and 45 of the Kwa
Mancinza Area, Ntuzuma B, Northern Operational Area
of eThekweni Municipality, KwaZulu-Natal***

Reference: 233-19.R01 Revision 0

Dated: 21 October 2019

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Report Title		Report to eThekweni Municipality Water and Sanitation Unit on the Results of a Shallow Geotechnical Investigation for the Proposed Sewer Reticulation Pipelines within Wards 38, 41 and 45 of the Kwa Mancinza Area, Ntuzuma B, Northern Operational Area of eThekweni Municipality, KwaZulu-Natal	
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Contract WQ 65 / 10420

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Abbreviations and Definitions

Abbreviation	Definition
AASHTO	American Association of State Highway and Transportation
CBR	California Bearing Ratio
DCP	Dynamic Cone Penetrometer
EGL	existing ground level
EXP	exposure
Geosure	Geosure (Pty) Ltd
GM	grading modulus
GPS	Global Positioning System
h	horizontal
IMC	insitu moisture content
IP	inspection pit
km	kilometre(s)
kN/m²	kilonewtons per metre square
LL	liquid limit
LS	linear shrinkage
m	metre (s)
m/s	metres per second
MDD	maximum dry density
mm	millimetre
mPa	MegaPascal
No.	number
NP	non plastic
PI	plasticity index
SANS	South African National Standards
TLB	tractor loader backhoe
TMH	Technical Manual for Highways
TRH	Technical Recommendations for Highways (1985)
UCS	unconfined compressive strength
USCS	Unified Soil Classification System
v	vertical
Unified Soil Classification System	
GC	Clayey GRAVEL / clayey GRAVEL with sand
GM	Silty GRAVELS
ML	Inorganic silts and very fine sand
OL	Organic silt and clay of low plasticity
SC	Clayey sand
SM	Silty sand

Report to eThekweni Municipality Water and Sanitation Unit on the Results of a Shallow Geotechnical Investigation for the Proposed Sewer Reticulation Pipelines within Wards 38, 41 and 45 of the Kwa Mancinza Area, Ntuzuma B, Northern Operational Area of eThekweni Municipality, KwaZulu-Natal

Reference: 233-19.R01 Revision 0

Date: 21 October 2019

1. TERMS OF REFERENCE

Geosure was invited by the Engineering Water and Sanitation Unit of eThekweni Municipality to tender on carrying out a geotechnical investigation for the proposed Sewer Reticulation Pipeline Contract WQ 65 / 10420 within Wards 38, 41 and 45, Kwa Mancinza area, Ntuzuma B, eThekweni Municipality, KwaZulu-Natal.

The scope of works was set out in a document titled “*Provision of Consulting Services for a Geotechnical Investigation for the Construction of Sewer Reticulation at Ntuzuma B within Ward 45, 41 and 38*” and further discussed at a tender briefing held on 18 July 2019.

Accordingly, Geosure submitted the completed tender document, proposal and quotation under the cover of a letter referenced p518-19 (Sewer Reticulation at Ntuzuma B)/mb and dated 22 July 2019.

Subsequently, Geosure was authorised by the Trading Services Cluster, Water and Sanitation Unit, Engineering Department Wastewater Design Branch of eThekweni Municipality, to carry out the geotechnical investigation as proposed, in an appointment letter referenced 845781-1 and dated 05 September 2019.

2. SCOPE OF REPORT

This report details the test results and recommendations arising from a shallow geotechnical investigation for the proposed Sewer Reticulation Pipeline Contract WQ 65 / 10420 within Wards 38, 41 and 45, Kwa Mancinza area, Ntuzuma B, in the northern operational area of eThekweni Municipality, KwaZulu-Natal, hereafter referred to as the site.

The slope and soil conditions are described and comment is made on the general stability of the site. Recommendations for earthworks, drainage, materials excavatability / rippability, materials usage and foundations are provided.

3. GUIDELINES FOR INVESTIGATION

The fieldwork for the investigation was carried out according to guidelines relevant to geotechnical investigations of this nature.

The formation and weathering of geological materials are discontinuous processes and unexpected variations in soil, rock and groundwater regimes may occur even on sites where the conditions seem to be uniform or consistent. Variations in what is reported here

may become evident during construction and it is thus imperative that an appropriately qualified and experienced Competent Person inspects all critical stages of development including, but not limited to, excavations to assess the conditions encountered and to assist in the interpretation of observations at variance with the information supplied in this report.

This report was prepared for use by the Water and Sanitation Unit, Engineering Department Wastewater Design Branch of eThekweni Municipality for the purpose stated and should not be relied upon for any other purpose.

4. INFORMATION UTILISED

The following information was consulted to assist with the field investigation and preparation of this report:

- i. An unreferenced drawing titled “*Sewer Reticulation: Ntuzuma B Kwa Mancinza Area Ward 38, 41 & 45*”, dated 21 June 2010 to scale 1:2500 and prepared by the Engineering Water and Sanitation Unit of eThekweni Municipality;
- ii. Regional geological map sheet titled “*2930 Durban*” (Council for Geoscience, 1988) ; and
- iii. Low-resolution satellite imagery (Google Earth, 2019)

5. SITE DESCRIPTION

The site occurs approximately 21km from the central business district of Durban approximate latitude. Longitude coordinates for approximately the central portion of the site comprise 29°44'18.38"South and 30°56'26.08"East, respectively.

Vehicular and pedestrian access to the site is available via several asphalt roads and footpaths leading off Ingcebo Drive along the western site limit, via Mpangele Road along the southern site boundary, and Mbondwe Road along the northern site extremity.

The regional and local contexts of the site are given in Plate 1 and Plate 2, respectively.

The natural topography of the site has been modified by means of cut to fill earthworks to facilitate the development of road infrastructure and the numerous existing residences located across the extent of the site.

Plate 3 and Plate 4 below show general views across the site.



Plate 3: View of steep and cramped site conditions

Plate 4: Valley bottom with stream flow

Four relatively prominent drainage lines with tributaries occur on site. One major drainage course roughly bisects the site from west to east and is located in Ward 38. Ward 41 includes two major drainage courses with tributaries which traverse the Ward from the west to the east generally. Two major drainage routes and their secondary tributaries occur in Ward 45 and traverse the area from the northwest to the southeast. A poor slope drainage character and marshy terrain are inferred to occur in the general area of the above drainage courses and their tributaries. The general alignment of the major and tributary drainage lines are shown on the site plan, Figure 1 attached.

6. FIELDWORK

The fieldwork for the investigation was initially carried out from 19 September to 20 September 2019, resuming on 25 September and ending on 26 September 2019, and comprised the following scope of works:

- i. Terrain Appraisal;
- ii. Inspection Pits; and
- iii. CBR Dynamic Cone Penetrometer (DCP) tests.

Field tests were positioned generally according to the proposed pipeline reticulation layout shown on the site plan referenced above in Section 4, paragraph i) of this report. Latitude and longitudes given on profiles were obtained with a hand held GPS unit.

A site plan showing the site layout and field test positions is given in Figure 1, attached

6.1 Terrain Appraisal

Prior to commencing with the subsurface investigation, a reconnaissance of the site was carried out to identify the topography and associated landforms, map the surface geology and note and photograph allied features of geotechnical significance.

During the terrain appraisal, nineteen existing exposures, designated EXP1 through EXP3, were profiled at the approximate positions given in Figure 1, attached.

The exposures were profiled in accordance with the South African Geoterminology Guidelines (Brink & Bruin, 2002).

Copies of the detailed exposure profiles are given in Appendix A.

6.2 Inspection Pits

Forty inspection pits, designated IP1 through IP40, were excavated at the approximate positions given in Figure 1, attached. The inspection pits were advanced by means of picks and spades. Where ground conditions permitted (e.g. IP24), inspection pits were advanced further by means of hand auger.

The final/refusal depths of the inspection pits ranged between 0.5m (IP37 and IP39 refer) and 2.45m (IP24 refers) below EGL.

It was a condition of the agreed tender that the option of hand formed inspection pits was required due to the high risk of damage to existing buried services on site.

The inspection pits were profiled using the South African Geoterminology Guidelines (Brink & Bruin, 2002), sampled and backfilled on completion.

Copies of the detailed inspection pit are given in Appendix A.

6.3 CBR Dynamic Cone Penetrometer (DCP) Tests

Forty three Dynamic Cone Penetrometer (DCP) tests, designated DC1 to DC43, were carried out at the approximate positions given in Figure 1, attached.

The DCP tests were advanced to final/refusal depths in the range 0.4m (DC19, DC39 and DC40 refer) to 3.1m (DC6, DC7, DC9 and DC17 refer) below EGL.

The results of the DCP tests comprising plots of blow counts versus depth are given in Appendix B.

7. GEOLOGY AND ANTICIPATED SUBSURFACE CONDITIONS

7.1 Regional Geology

Inferring from the 1:250 000 regional geological map sheet “2930 Durban” (Council for Geoscience, 1988), the site and surrounds are underlain by shale and tillite rocks of the Pietermaritzburg Formation and Dwyka Group, respectively. The greater majority of the site shown to be underlain by the latter mapping unit.

An excerpt of the above regional map sheet is given below in Plate 5.

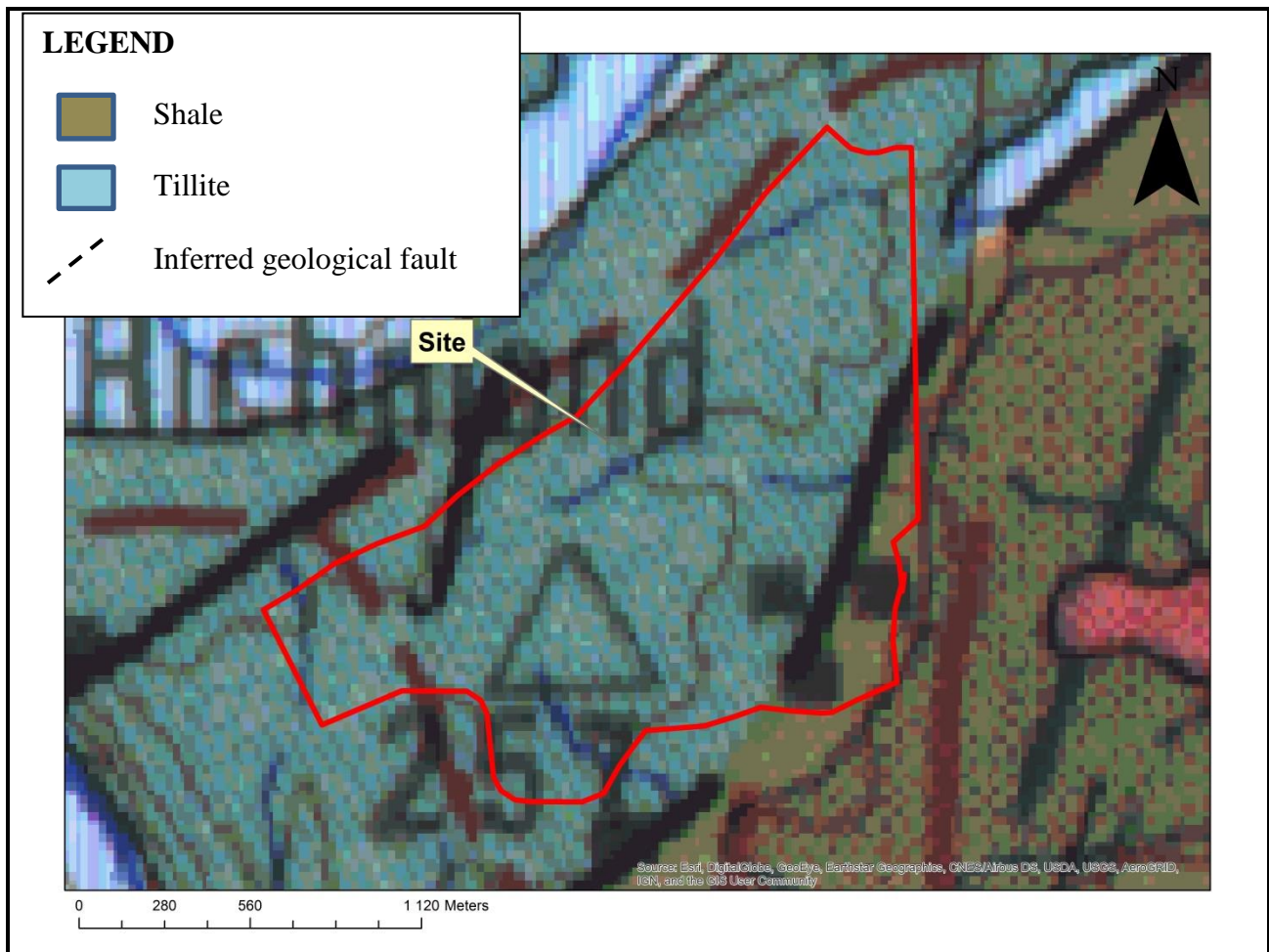


Plate 5: Regional geology of site (Council for Geoscience sheet “2930 Durban”)

7.2 Inferred Geological Subsurface Conditions

At the positions investigated, the site is observed to be underlain by weathered tillite rock.

The weathered rock is observed to be overlain by a generally clay soil mantle comprising residuum (residual tillite), occasional ferricrete (pedogenic deposits), colluvium (fine grained hillwash) and variable uncontrolled fill material. Alluvium (waterborne deposits) were also profiled in the vicinity of water courses.

Descriptions and depth ranges for the geological units encountered are given in Table 2, Section 10.3 of this report. The inferred extent of the above geological formation is shown in Figure 1, attached.

Plate 6 through Plate 9 show soil profiles observed during the field investigation.

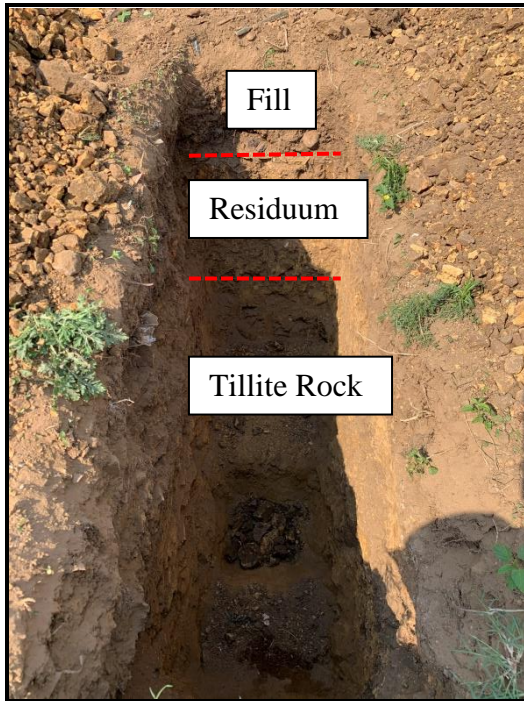


Plate 6: Fill, residuum and tillite rock at IP12



Plate 7: Fill and tillite rock at IP16

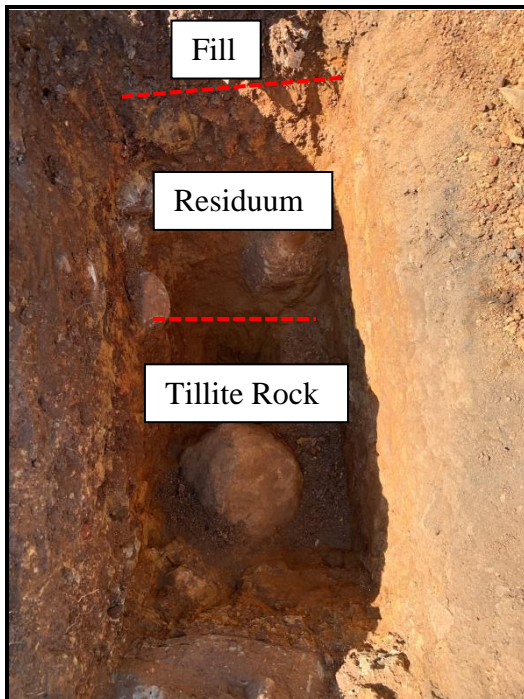


Plate 8: Fill, residuum and tillite rock at IP21

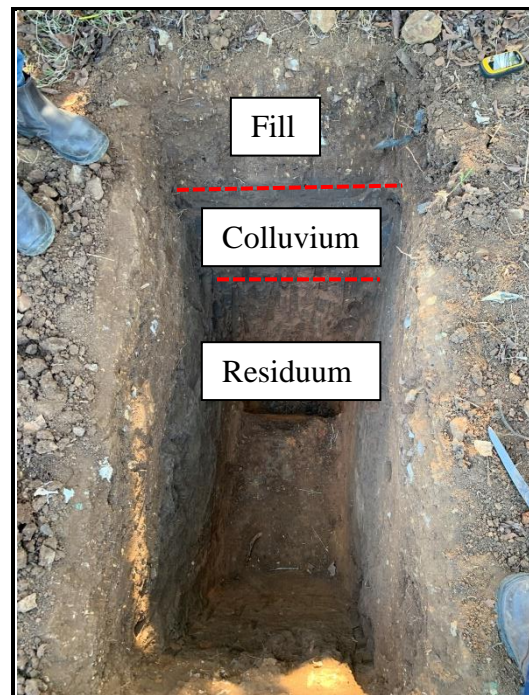


Plate 9: Fill, colluvium and residuum at IP27

8. GROUNDWATER

Slight to moderate groundwater flow was encountered at certain of the inspection pits profiled.

Details of the perched groundwater activity observed are set down overleaf in Table 1.

Table 1: Sewer Reticulation: Wards 38, 41 and 45, Kwa Mancinza Area, Ntuzuma B – Details of Observed Depths and Relative Intensities of Perched Groundwater Flows in Inspection Pits

INSPECTION PIT (IP)	DEPTH OF GROUNDWATER (METRES BELOW EGL)	RELATIVE INTENSITY
1	1.1	Moderate
3	0.7	Moderate
6	0.5	Moderate
35	1.88	Slight
36	0.7	Slight

Generally, the risk of groundwater activity and marshy ground conditions is assessed to increase near the drainage lines observed and associated weakly drained valley bottom landforms observed during the field investigation. In this regard, stream flows were observed in the vicinity of the four major drainage courses and their tributaries, as indicated in Figure 1, attached.

The severity and level of perched groundwater activity is likely to fluctuate in response to local/regional precipitation, becoming raised during the “wet” season / high rainfalls and depressed during the “dry” season.

Due cognisance of the surface and perched groundwater seepage will need to be taken into account during the engineering design and construction.

9. LABORATORY TESTING

The following laboratory tests have been carried out on samples retrieved during the field investigation:

- i. Grading Analysis to 0.075mm sieve with Atterberg Limit Determinations;
- ii. Modified AASHTO tests;
- iii. California Bearing Ratio (CBR) tests;
- iv. Optimum Moisture Content; and
- v. Compactibility Factor.

Laboratory test results are summarised in Table 2, overleaf. Detailed laboratory test results are given in Appendix C.

Table 2: Sewer Reticulation: Wards 38, 41 and 45, Kwa Mancinza Area, Ntuzuma B – Summary of Laboratory Test Results

TESTPIT NO.	SECTION	DEPTH (m)	SAMPLE NO.	DESCRIPTION	PERCENT PASSING SIEVE SIZE																	SOIL MORTAR ANALYSIS			ATTERBERG			GM	Compactability Factor	CBR (%)				TRH14 Class AASHTO Class Unified Class COLTO Class			
					100,00	75,0	63,0	53,0	50,00	37,5	28,00	26,5	20,00	19,0	14,00	13,2	5,00	4,75	2,0	0,425	0,075	CS	FS	MMAT <0,075	LL	PI	LS (%)			MDD	OMC	100% SWELL	90		93	95	
FILL																																					
IP3	Layer 1	0.01-1.1	T22074	Light to medium brown slightly silty SAND to slightly clayey silty SAND	100	100	100	100	100	100	100	100	100	98	98	95	95	89	89	81	59	24	43	27	29	21	6	3	1,3678	0,473	1955	8,7	0,4	9	15	21	G7 A-2-4 (0) SM-SC G7 (#)
IP35	Layer 1	0.01-1.29	T22095	Greyish brown becoming brownish grey stained khaki brown clayey SAND to sandy CLAY	100	100	100	100	97	94	93	93	91	91	90	90	79	79	69	56	36	26	22	52	42	16	7,5	1,3907	0,343	1951	8,6	1,7	1	2	2	Poorer than G10. A-7-6 (1) SM Cannot be Determined	
IP39	Layer 1	0.01-0.5	T22097	Greyish brown to brownish grey clayey SAND to sandy CLAY	100	94	92	92	91	88	85	85	83	83	77	77	67	67	56	45	26	31	23	46	32	10	4,5	1,7318	-	-	-	-	-	-	-	Cannot be Determined A-2-4 (0) SC Cannot be Determined	
COLLUVIUM																																					
IP19	Layer 2	0.5-0.9	T22082	Greyish brown to brown clayey SAND to sandy CLAY	100	100	100	100	100	99	98	98	98	98	96	96	87	87	76	66	37	23	28	49	27	6	3,5	1,2112	0,313	1980	9,5	0,4	7,2	12	16	G9 A-4 (0) SM-SC G8 (#)	
ALLUVIUM																																					
IP6	Layer 1	0.01-0.6	T22076	Dark greyish brown to dark grey silty clayey SAND to sandy CLAY to clayey SILT	100	100	100	100	100	98	96	96	92	92	90	90	81	81	74	65	39	22	25	53	38	13	6,5	1,2292	0,438	1958	8,5	1,2	1	3	5	Poorer than G10 A-6 (1) SM Cannot be Determined	
IP23	Layer 1	0.01-1.05	T22084	Greyish brown to brownish grey clayey SAND to sandy CLAY	100	100	100	100	99	99	96	96	94	94	87	87	63	63	50	36	26	35	13	52	42	16	8	1,8846	0,249	1980	9,6	1,1	5	10	15	G10 A-2-7 (1) SM Cannot be Determined	
FERRICRETE																																					
IP20	Layer 2	0.7-0.9	T22083	Greyish brown mottled reddish brown sandy silty CLAY	100	100	100	100	100	98	98	98	96	96	95	95	82	82	69	53	37	30	17	53	40	14	7	1,4105	0,343	1790	15,1	1,5	3,2	6	10	G10 A-6 (1) SM Cannot be Determined	
RESIDIUM																																					
IP1	Layer 3	0.75-1.6	T22073	Orange brown to reddish brown gravelly clayey SAND to gravelly sandy CLAY	100	100	100	100	100	100	100	100	100	100	100	100	99	99	97	91	60	13	24	62	40	13	7	0,5222	0,423	1946	10,8	0,7	1	3	4	Poorer than G10 A-6 (6) ML/OL± Cannot be Determined	
IP5	Layer 2	0.7-1.6	T22075	Greyish brown becoming khaki brown to yellowish brown silty clayey SAND to sandy CLAY	100	100	100	100	100	100	100	100	100	100	100	100	100	99	92	66	15	19	66	42	15	8	0,4308	0,423	1833	13,6	1,3	1	1	2	Poorer than G10 A-7-6 (9) ML/OL± Cannot be Determined		
IP9	Layer 2	0.3-1.0	T22078	Reddish brown becoming khaki brown clayey silty SAND to silty sandy CLAY	100	100	100	100	100	100	94	94	73	73	52	52	29	29	25	15	11	43	13	43	33	9	5	2,492	0,318	1906	11,4	1,1	2,5	4,2	6	Cannot be Determined A-6 (1) Cannot be Determined	
IP14	Layer 2	0.5-0.86	T22080	Greyish brown becoming khaki brown clayey SAND to slightly silty sandy CLAY	100	100	100	100	100	99	99	99	98	98	98	98	89	89	77	68	50	17	17	66	41	19	9	1,0522	0,323	1821	11,6	1,4	7	11	14	Cannot be Determined A-6 (1) Cannot be Determined	
IP25	Layer 3	0.98-1.2	T22085	Reddish brown to reddish orange brown clayey SAND to slightly silty sandy CLAY	100	100	100	100	100	100	100	100	99	99	94	94	73	73	59	48	36	23	15	62	41	15	7,5	1,5663	0,313	1876	12,3	1,6	3	4	6	G10 A-2-6 (0) SC Cannot be Determined	
IP31	Layer 3	0.58-1.5	T22087	Reddish brown to reddish orange brown clayey SAND to slightly silty sandy CLAY	100	100	100	100	100	100	96	96	93	93	86	86	73	73	55	47	37	18	15	67	39	14	8	1,6098	-	-	-	-	-	-	-	Poorer than G10. A-7-6 (1) SM Cannot be Determined	
WEATHERED TILLITE ROCK																																					
IP8	Layer 2	0.2-0.6	T22077	Khaki brown stained brown and grey completely to highly weathered very soft to soft rock	100	100	100	98	96	95	91	91	87	87	86	86	72	72	59	43	31	32	15	53	43	16	8	1,673	0,294	2012	9,2	0,6	8,4	12	15	Cannot be Determined A-2-4 (0) SC Cannot be Determined	
IP10	Layer 3	0.75-1.3	T22079	Khaki brown stained brown and grey completely to highly weathered very soft to soft rock	100	100	100	100	100	100	99	99	99	99	99	99	97	97	92	83	59	15	20	64	42	17	8	0,659	-	-	-	-	-	-	-	Cannot be Determined A-7-6 (8) CL Cannot be Determined	
IP16	Layer 2	0.5-0.9	T22081	Khaki brown stained brown and grey completely to highly weathered very soft to soft rock	100	100	100	100	100	99	99	99	98	98	90	90	65	65	51	34	20	44	16	40	34	10	5	1,9448	0,293532338	1960	10	0,6	3	6	9	G10 A-2-4 (0) SM Cannot be Determined	
IP29	Layer 3	1.1-1.7	T22086	Orange brown to khaki brown stained orange highly to moderately weathered very soft to soft rock	100	100	100	100	100	100	100	100	97	97	96	96	88	88	78	59	40	31	18	51	32	11	6	1,2386	-	-	-	-	-	-	-	Cannot be Determined A-6 (1) SC Cannot be Determined	
IP33	Layer 3	0.48-0.69	T22094	Khaki brown stained grey and orange brown highly weathered very soft to soft rock	100	100	100	100	98	86	82	82	70	70	67	67	48	48	36	20	14	49	14	38	37	13	6,5	2,3023	0,22885721	2016	8,9	1,2	4	6	8	G10 A-2-4 (0) GC Cannot be Determined	
IP36	Layer 2	0.5-1.2	T22096	Khaki brown stained grey and orange brown highly weathered very soft to soft rock	100	89	86	86	85	80	74	74	67	67	66	66	56	56	47	36	24	32	17	51	40	14	7	1,9255	-	-	-	-	-	-	-	Cannot be Determined A-2-6 (0) GM Cannot be Determined	
IP40	Layer 3	1.12-2.5	T22098	Khaki brown stained grey and orange brown highly weathered very soft to soft rock	100	100	100	100	100	100	100	100	100	100	100	100	99	99	99	93	69	12	19	70	44	18	8,5	0,3935	0,467661692	1730	15,3	1,7	1	2	3	Poorer than G10. A-7-6 (12) CL Cannot be Determined	

LL - Liquid Limit
 LS - Linear Shrinkage
 SC - Unified Classification
 CF - Compaction Factor

A-7-6 (8) - Revised US Classification
 SM - Grading Modulus
 Poorer than G10 - Classification in terms of TRH14 (Committee of State Road Authorities, 1985)

PI - Plasticity Index
 - Not Tested

10. DISCUSSION

10.1 Proposed Development

It is understood from information confirmed with Geosure that the proposed sewer scheme is to comprise approximately 13km of reticulation pipeline. Invert design levels are not confirmed, however, test levels of between 1.2m and 4.8m below EGL were proposed as an indication of probable invert levels.

Further design details of the proposed pipeline scheme were not confirmed with Geosure at the time of preparation of this report. Geosure will need to be given the opportunity to review the recommendations in this report once detailed information regarding the design of the pipeline is available. If necessary, the recommendations presented in this report may need to be updated. This exercise will necessitate an extension of the current appointment.

10.2 Subsurface Conditions and Trenchability Assessment along the Proposed Pipelines

The excavation requirements have been assessed according to the guidelines provided in SANS 1200D.

In areas where soils and “very soft” tillite rock are encountered, pipe invert design levels should be relatively easy, in terms of hardness, to achieve using light earthmoving equipment.

In areas where “soft” tillite rock is encountered it is anticipated that excavation with a 20 tonne or 30 tonne tracked excavator and/or pneumatic tools should be allowed for the necessary depths to be achieved.

Blasting may be required in areas if either “medium hard” or “hard” or “very hard” or “extremely hard” rock is encountered. Such hardness of rock was, however, not encountered at the positions and to the depths profiled.

In the event that blasting is carried out, the difficulties, disruption and safety issues surrounding a blasting programme, as well as damage that may occur to adjacent structures will need to be considered.

Importantly, a shallow perched groundwater activity was encountered at five inspection pits, namely, IP1, IP3, IP6, IP35 and IP36, together with stream flows identified along the major drainage lines indicated in Figure 1, attached. A perched groundwater condition may also characterise areas elsewhere on site, with the risk assessed to increase near to weakly drained valley bottom terrain. Trenches/excavations within these areas are considered prone to rapid sidewall collapse, as well as flooding of excavations. Excavation rates within the areas are likely to be variable, furthermore, shoring and dewatering of excavations to engineers’ detail is likely to be required in order to allow for practical and safe working conditions.

The trenchability assessments of the soil and rock materials given overleaf in Section 10.3, Table 2 have been inferred from the profiles of inspection pits and DCP tests.

10.3 **Inferred Geological and Geotechnical Conditions along Proposed Pipeline Route**

A summary of inferred excavation requirements, general geological and other site conditions influencing construction referenced according to field test positions is given in Table 3.

Table 3: Sewer Reticulation: Wards 38, 41 and 45, Kwa Mancinza Area, Ntuzuma B – Summary of Fieldwork, Geological and Trenchability Conditions Inferred along Proposed Pipeline Routes

Location	Field Tests	Depth Range (m below EGL)	Abbreviated Inferred Profile	Depth to rock (m below EGL)	Refusal / Final Depth of Inspection Pits and (DCP) (m below EGL)	Observed Groundwater Seepage (m below EGL)	Inferred Trenchability (Excavation in terms of SANS 1200D)		Comments
							Depth (m below EGL)		
WARD 38	IP1; IP2 DC1; DC2	Variable: 0 – 0.48 (1.68)	Brown to greyish brown dark grey and olive, loose to medium dense, clayey SAND to sandy silty CLAY and clayey SILT, with abundant domestic waste, pieces of plastic and plant roots- <i>FILL</i>	>1.68	1.6 – 1.68 (0.7 – 1.8)	1.1m (IP1)	0 – 1.7	Soft, with allowance for Boulder Class B	<ul style="list-style-type: none"> ➤ Geological variations may require intermediate to hard excavations at shallower depths ➤ Portions of soil cover encountered is likely to be susceptible to rapid erosion due to uncontrolled runoff ➤ High risk for rapid sidewall collapse of excavation/trench sidewalls (potentially unstable) ➤ Clayey residual soils considered potentially active i.e. heave and shrink in response to soil moisture fluctuations ➤ Allow for an intermittent perched groundwater condition and or surface water flow during and after periods of sustained and/or heavy rainfall
		Variable: 0.0 – 0.75	Dark grey and olive greyish brown, loose to medium dense, silty SAND to slightly sandy silty CLAY and clayey SILT, with trace fine roots - <i>COLLUVIUM</i>				> 1.7	Intermediate to Hard, with allowance for intermediate and Boulder Class B	
		Variable: 0.75 – 1.60	Orange brown and reddish brown and olive greyish brown, loose to medium dense, gravelly clayey SAND to gravelly sandy CLAY, with tillite gravel - <i>RESIDUUM</i>						
WARD 41	IP3 – IP20 DC3 - DC20 EXP1 - EXP3	Variable: 0.0 – 0.8	Brown to greyish brown dark grey and olive and light brown, loose to medium dense, silty SAND, clayey SAND, sandy silty CLAY and clayey SILT, with abundant domestic waste, pieces of plastic and plant roots- <i>FILL</i>	0.5 - >3.1	0.6 – 1.85 (0.4 - >3.1)	0.5 (IP6); 0.7 (IP3)	0 – 0.6	Soft, with allowance for intermediate and Boulder Class B	<ul style="list-style-type: none"> ➤ Geological variations may require intermediate to hard excavations at shallower depths ➤ Portions of soil cover encountered is likely to be susceptible to rapid erosion due to uncontrolled runoff ➤ High risk for rapid sidewall collapse of excavation/trench sidewalls (potentially unstable); very high risk in areas of alluvium ➤ Clayey residual soils considered potentially active i.e. heave and shrink in response to soil moisture fluctuations ➤ Allow for an intermittent perched groundwater condition and or surface water flow, including stream flows, during and after periods of sustained and/or heavy rainfall
		Variable: 0.0 – 0.9	Dark grey and olive greyish brown, loose to medium dense, silty SAND to slightly sandy silty CLAY and clayey SILT, with plant roots - <i>COLLUVIUM</i>						
		Variable: 0.0 – 1.85	Dark greyish brown and dark grey, loose to medium dense, silty clayey SAND to sandy silty CLAY and clayey SILT, with cobbles, gravels and roots - <i>ALLUVIUM</i>				Variable: > 0.6	Intermediate to Hard, with allowance for intermediate and Boulder Class B	
		Variable: 0.0 – 1.6	Orange brown and reddish brown and olive greyish brown, loose to medium dense, gravelly clayey SAND to gravelly sandy CLAY, with tillite gravel - <i>RESIDUUM</i>						
		Variable: 0.5 - >3.1	Khaki brown / yellowish brown stained brown and grey, completely to highly weathered, highly fractured, very soft to soft rock - <i>TILLITE</i>						

Location	Field Tests	Depth Range (m below EGL)	Abbreviated Inferred Profile	Depth to rock (m below EGL)	Refusal / Final Depth of Inspection Pits and (DCP) (m below EGL)	Observed Groundwater Seepage (m below EGL)	Inferred Trenchability (Excavation in terms of SANS 1200D)		Comments
							Depth (m below EGL)		
WARD 45	IP21 – IP40 DC21 – DC43	Variable: 0.0 – 2.2	Brown to greyish brown dark grey and olive and light brown, loose to medium dense, silty SAND, clayey SAND, sandy silty CLAY and clayey SILT, with abundant domestic waste, pieces of plastic and plant roots- <i>FILL</i>	0.2 - >2.45	0.5 – 2.45 (0.2 – 2.8)	1.88 (IP35); 0.7 (IP36)	0 – 0.5	Soft, with allowance for intermediate and Boulder Class B	<ul style="list-style-type: none"> ➤ Geological variations may require intermediate to hard excavations at shallower depths ➤ Portions of soil cover encountered is likely to be susceptible to rapid erosion due to uncontrolled runoff ➤ High risk for rapid sidewall collapse of excavation/trench sidewalls (potentially unstable); very high risk in areas of alluvium ➤ Clayey residual soils considered potentially active i.e. heave and shrink in response to soil moisture fluctuations ➤ Allow for an intermittent perched groundwater condition and or surface water flow, including stream flows, during and after periods of sustained and/or heavy rainfall
		Variable: 0.00 – 1.53	Dark grey and olive greyish brown, loose to medium dense, silty SAND to slightly sandy silty CLAY and clayey SILT, with plant roots - <i>COLLUVIUM</i>						
		Variable: 0.0 – 1.50	Dark greyish brown and dark grey, loose to medium dense, silty clayey SAND to sandy silty CLAY and clayey SILT, with cobbles, gravels and roots - <i>ALLUVIUM</i>						
		Variable: 0.0 – 2.45	Orange brown and reddish brown and olive greyish brown, loose to medium dense, gravelly clayey SAND to gravelly sandy CLAY, with tillite gravel – <i>RESIDIUM</i>						
	Variable: 0.2 - >3.1	Khaki brown / yellowish brown and orange brown stained brown and grey, completely to highly weathered, highly fractured, very soft to soft rock - <i>TILLITE</i>	Variable: > 0.5				Intermediate to Hard, with allowance for intermediate and Boulder Class B		

10.4 Materials Evaluation and Pipe Bedding

The following materials evaluation has been based on a visual assessment of the materials encountered in the field and current laboratory test results.

If the pipelines require bedding cradle of “*Selected Granular Material / Bedding Material*”, a fill blanket of “*Select Fill*” and thereafter a “*Main Fill*” as defined by SANS 1200 LB (1983), the following is relevant.

Select Granular Material is defined as “granular, non-cohesive and singularly graded between 0.6 and 19mm. The material must be free draining and have a compactability factor not exceeding 0.4”.

Select Fill is defined as “a material with a Plasticity Index (PI) not exceeding 6, free from lumps, vegetation and stones of a diameter exceeding 30mm”.

Main Fill is the approved filling material placed in a pipe trench after the pipe has been laid and surrounded by a layer of selected fill blanket. It generally comprises the material removed from the pipe trench during excavation. Soils showing a saprolitic character, e.g. residual dolerite / weathered dolerite rock at e.g. IP3, IP14 and IP17, should not be considered for use as general fill

The following general conclusion can be made regarding the suitability of the in-situ materials for use in the construction of the pipeline:

- i. The materials encountered on site are considered unsuitable for use as “*Selected Granular Material*” In general, it is considered that bedding material meeting the above requirements will need to be imported to the site.
- ii. The greater majority of the materials encountered on site are considered unlikely to meet the “*Select Fill*” requirements due to the generally high PIs (≥ 6) of the materials tested. These materials can be utilised for “*Main Fill*” requirements over the select fill.
- iii. Caution should be exercised when using clayey materials eg. Colluvium, alluvium, ferricrete, and residuum soils as these are moisture sensitive and will heave and will be difficult to compact when wet. These materials may also require a long time to dry out and it may not be economically feasible to wait for such in which case material should be spoiled and replaced with a granular backfill.

From experience, the Selected Granular Material requirements in terms of SANS 1200 LB (1983) are very seldom met by natural soils. The very strict grading requirements generally only coincide with specially designed, blended sands and gravels. Furthermore, the natural variability in composition within in-situ materials will make the establishment of a consistent quality very difficult. This could be problematic where the bedding is relied upon for foundation support and additional hoop strength (where required) in the design of pipelines.

Contact details of a commercial supplier of selected granular material and select fill are as follows:

Ramdhani Sands

076 245 6813

rampzr@gmail.com

10.5 Trench Stability

It is considered that trenches excavated in the soil cover encountered during the fieldwork are likely to be unstable to potentially unstable and will require lateral support or battering of slopes to stable temporary angles, as will trenches excavated in areas with groundwater seepage, where encountered.

As a guide, temporary side slopes of trench excavations free of risk of groundwater should be restricted to the following:

- i. **Fill, transported (alluvial and colluvial) and pedogenic (ferricrete) clay / clayey soils** – 1v:1h up to a depth of 1.5m. For deeper depths up to 3m, batters should be formed to 1v:2h ($\leq 26^\circ$) provided there is no groundwater seepage. If seepage is observed then trenches will need to be shored;
- ii. **Residual clay soils** – 1v:0.5h ($\leq 63^\circ$) up to a depth of 1.5m; for deeper excavations up to 3m batter to 1v:2h ($\leq 26^\circ$);
- iii. **Highly to moderately weathered rock (not encountered)** – 1v:0.5h ($\leq 63^\circ$), provided that no daylighting bedding planes or planes of weakness such as clay gouge is visible;
- iv. **Unweathered to slightly weathered, tightly jointed rock (not encountered)** – Vertical, if no daylighting bedding planes or planes of weakness such as clay gouge is visible).

It is recommended that excavations be carried out in the dry season as far as possible and backfilled with the minimum of delay.

It is recommended that both the geotechnical professional and the contractor carry out regular documented inspections of the trenches in order to detect potentially unstable sidewall conditions during the construction phase.

Lateral support should be used in all situations where groundwater is encountered or instability is observed deeper than approximately 1.5m below grade level. In this regard, workers should not enter or work below any excavations/cuts deeper than 1.5m that are not shored or battered back as described above. It remains the responsibility of the contractor, however, to fully comply with the requirements of the current Occupational Health and Safety (OHS) Act.

10.6 Backfill and Erosion Aspects

Any areas underlain by transported sandy / gravelly soils (e.g. colluvium and alluvium) and any residual gravelly / sandy soils encountered on site are generally susceptible to erosion due to uncontrolled runoff. In this regard, based upon site observations, such subgrade materials are considered to be in the minority generally at the positions investigated.

The pipe trench line can also become a route for on-going erosion, and with time could develop into erosion features (dongas) with resultant failure of the proposed pipeline.

Where the pipeline runs perpendicular to contours, over gradients steeper than about 1v:6h ($> 9^\circ$), it is recommended that at intervals of every 3m to 5m, a section of the backfill be stabilised with cement or lime (about 4% by mass). The section of stabilised soil should be about 1m to 2m in length. It is also recommended that a grass cover be reinstated as soon as possible over the trench in order to prevent erosion.

Consideration can also be given to using geotextiles to help with the prevention of erosion especially along the steep approaches along drainage lines.

Compaction of the general backfill soils in trenches over the bedding layer and select fill should be carried out in layers of maximum loose thickness 0.2m (depending on capability of compaction equipment) and compacted to minimum 90% of Modified AASHTO maximum dry density within 1 – 2 percent (wet/dry) of Optimum Moisture Content (OMC). This is critical to ensure that settlements over pipes and within the limits of the trench are kept to a minimum.

If soft and compressible clays and saturated soils are encountered during construction, these materials may require undercutting when exposed at or near formation level in the trench to improve working conditions.

10.7 Stream Crossings

Limited portions of the proposed pipelines in Ward 41 and Ward 45 appear to traverse drainage lines of various sizes and flows e.g. near EXP1 and IP35, respectively.

Stream/river crossings are notoriously difficult whether carrying out micro-tunnelling (pipe jacking), building a pipe bridge or doing an open excavation. The geology and groundwater regime in rivers act against efficient construction making such crossings invariably expensive.

Slight to moderate groundwater seepage flows were observed to occur at relatively shallow depth within/near the major drainage courses e.g. IP3, IP6, IP35 and IP36. Further details in this regard are given above in Sections 8 and 10.3 of this report. Sufficient precautions will need to be taken to prevent floatation of the pipeline(s).

Surface stream flow(s) will need to be diverted in order to form an open excavation across the drainage bed. A pioneer layer, or cofferdam, may need to be constructed in order to create a working platform and to allow plant access across the river/stream bed.

If alluvial soils are encountered beneath the proposed pipe crossings, it is recommended that a reno-mattress be used as a base. The disturbed alluvial sediments beneath the reno mattress should be well compacted to prevent any settlement occurring, or removed and replaced with a pioneer boulder layer if compaction of the alluvium is not feasible due to excessive ground moisture levels and /o boulder inclusions. The reno-mattress will prevent erosion and undermining of the pipe and provide a working platform to construct the pipe over.

At all crossings of drainage courses, dewatering and lateral support during construction will be necessary and it is therefore recommended that construction is carried out late in

the dry season to lessen the risks associated with construction at these positions. It is also recommended that an item be allowed in the Bill of Quantities of the tender document for temporary dewatering during construction.

It is considered that buried pipelines especially under larger and/or fast flowing streams are prone to erosion (scour) and will require careful consideration in the design and construction.

10.8 Road Crossings and Pipe Jackings

Details with regards to any road crossings were not confirmed with Geosure at the time of preparation of this report.

If road crossings are to comprise pipejacking, it is recommended that construction of all pipe jacks follow the guidelines as set out in SANS 1200 LG (1983).

Any pipe jacking is likely to take place beneath road services that will be in operation at all times. It is therefore necessary to carry out the thrust and reception pits and pipe jack to the very best standards to ensure that roads and underground services are totally unaffected by the pipe jacking and associated operations.

In particular, where pipes are to be jacked under fills, precautions must be taken to ensure that thrust and reception pits and the jacking operation do not in any way cause the slope face of fills to erode, slide, slump or move. Consideration should be given to introducing lateral support into the jacking pits and/or reception and thrust pits.

Settlement above the pipe is to be kept to a minimum. Both stormwater runoff and groundwater seepage is to be controlled during construction. In particular, surface drainage must be controlled to prevent runoff entering the jacking or reception pits and all pipe joints should be sealed to prevent groundwater seepage into the jacked pipes. In this regard, it is considered that there is a high risk of problematic groundwater at several of the proposed road crossings.

Backfilling of the thrust and reception pits and pipe trenches should be done using, where possible, *in situ* material, provided this material is not predominantly boulders or rock fragments or saprolyte and can be uniformly compacted to the required compaction. Final layers of backfilling should be raised above the natural ground level to compensate for long-term settlement and to prevent ponding of stormwater at the pit positions once settlement is complete.

The backfill in thrust and reception pits must be compacted to a minimum of 95% of Modified AASHTO maximum dry density throughout the full profile of the pits. Other fills should be compacted to a minimum of 93% Modified AASHTO maximum dry density.

During the jacking operation, excavation must be such that overbreak is kept to a minimum.

10.9 Drainage

Details of the general geotechnical character of the site drainage are given above in Section 8 and Section 10.3, Table 2, of this report.

A critically important factor in the stable development of the site is the control and removal of both surface and groundwater from the site.

Trenching, earthworks and drainage measures should be designed in such a way as to prevent ponding of, or high concentrations of, stormwater or groundwater anywhere on the sites, both during and after the development.

Terraces should be shaped to a gradient to prevent water ponding on the surface and should be graded to direct water away from excavations, under the guidance of the Engineer.

It is recommended that an item be allowed in the Bill of Quantities of the tender document for temporary dewatering during construction to address the risk of surface and subsurface groundwater, especially across the northern portion of the site.

11. SUMMARY FINDINGS AND RECOMMENDATIONS

This report details the test results and recommendations arising from a shallow geotechnical investigation for the proposed Sewer Reticulation Pipelines within Wards 38, 41 and 45 in the Kwa Mancinza area of Ntuzuma B, northern operational area of eThekweni Municipality, KwaZulu-Natal.

Based on the information available, the following observations, conclusions and recommendations are made:

- i. It is considered that the site at the positions investigated is generally stable for the development as proposed and confirmed with Geosure at the time of preparation of this report, provided the recommendations presented in this report are adhered to.
- ii. At the positions investigated, the site is observed to be underlain by weathered tillite rock, derived natural soils and fill materials from anthropic activities. The weathered rock units are observed to be overlain by a soil mantle comprising generally clay residuum, occasional ferricrete, colluvium and variable uncontrolled fill material. Alluvial deposits were encountered in the vicinity of the major drainage courses
- iii. Shallow perched groundwater activity was encountered at IP1, IP3, IP6, IP35 and IP36, together with stream flows observed along the major drainage lines indicated in Figure 1, attached. A perched groundwater condition may also characterise areas elsewhere on site, with the risk assessed to increase near to weakly drained valley bottom terrain. Excavation rates within the areas are likely to be variable, furthermore, shoring and dewatering of excavations to engineers' detail is likely to be required in order to allow for practical and safe working conditions.
- iv. All construction activities need to be carried out in accordance with SANS 1200.
- v. Allowance should be made for suitable dewatering of excavations to engineer's detail in areas where there is a high risk of frequent soil saturation.
- vi. Special measures are considered necessary at any proposed drainage course crossings and road crossings are given in Sections 10.7 through 10.9.

The ground conditions given in this report refer specifically to the field tests carried out on the sites. It is therefore, quite possible that conditions at variance with those given in this

report could be encountered elsewhere on either of the sites during construction. It is therefore important that Geosure be appointed to carry out periodic inspections during construction. Any change from the anticipated ground conditions could then be taken into account to avoid unnecessary expense.

12. Bibliography

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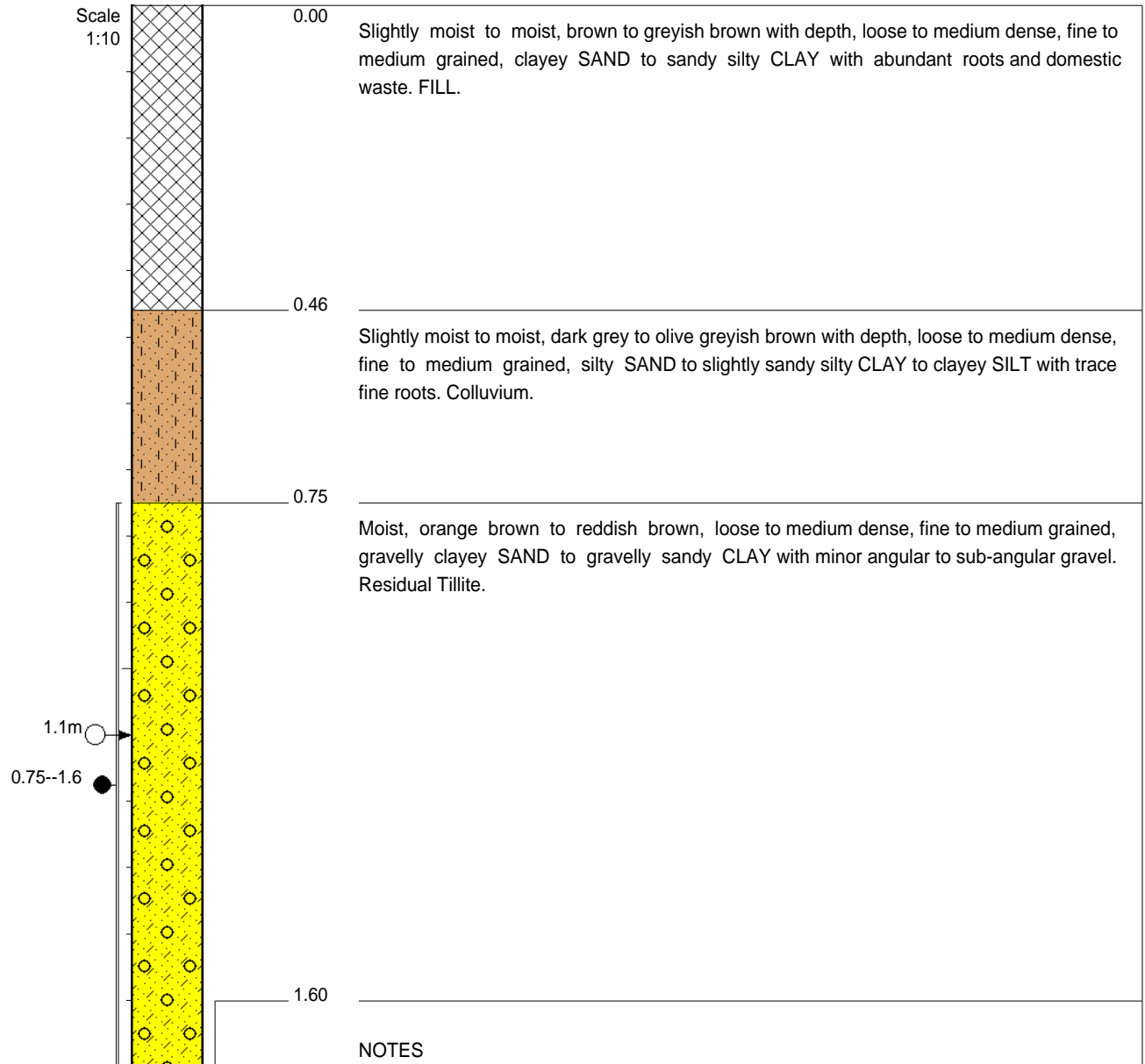


APPENDIX A



**INSPECTION PIT AND
EXPOSURE PROFILES**





NOTES

- 1) Moderate groundwater seepage observed at 1,1m.
- 2) Sample taken at:
S1 0,75--1,6 (2 x Bulk) (1 x Ind)
- 3) Potentially unstable sidewalls.
- 4) Inspection pit extended using hand auger from 1,5m to 1,6m.
- 5) No refusal, inspection pit terminated due to slow advance of auger.
- 6) Final depth at 1,6m.

CONTRACTOR : -

MACHINE : By hand

DRILLED BY :

PROFILED BY : S.R.; F.Smith Pr.Sci.Nat. Reg No. 400049/00

TYPE SET BY : P.Khalili

SETUP FILE : STANDARD.SET

INCLINATION : -

DIAM : -

DATE : 19 September 2019

DATE : 19 September 2019

DATE : 22/10/19 15:49

TEXT : ..C:\LOGS\PITSIP.TXT

ELEVATION : 244m

X-COORD : 30 56'28.4"E

Y-COORD : 29 45'01.2"S

HOLE No: IP1



Geotechnical, Environmental &
Groundwater Engineering
Pile Integrity Testing & Civil
Engineering Laboratory

Ethekewini Municipality - Water and Sanitation Unit
Construction of Sewer Reticulation at
Ntuzuma B within Ward 38

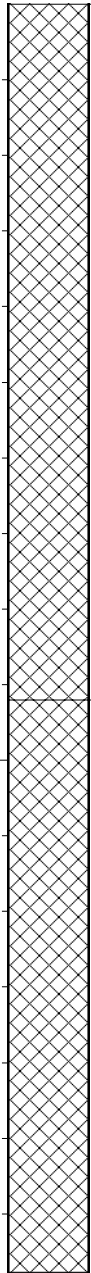
HOLE No: IP2
Sheet 1 of 1

P O Box 1461, Westville, 3630, South Africa
Tel: (031) 266-0458
email: geosure@iafrica.com

Fax: 086 689-5506
www.geosure.co.za

JOB NUMBER: 233-19

Scale
1:10



0.00

Slightly moist to moist, greyish brown to medium brown with depth, loose to medium dense, fine to medium grained, silty SAND to slightly clayey SAND with abundant domestic waste and plastic. FILL.

0.92

Slightly moist to moist, dark grey to olive grey, loose to medium dense, fine to medium grained, clayey SAND to silty CLAY to clayey SILT with abundant plastic. FILL.

1.68

NOTES

- 1) No groundwater seepage observed.
- 2) Potentially unstable sidewalls.
- 3) Inspection pit on reclaimed, slope of field, near a stream.
- 4) Inspection pit extended using hand auger from 1,47m to 1,68m.
- 5) No refusal, inspection pit terminated due to slow advance.
- 6) Final depth at 1,68m.

CONTRACTOR : -

MACHINE : By hand

DRILLED BY :

PROFILED BY : S.R.; F.Smith Pr.Sci.Nat. Reg No. 400049/00

TYPE SET BY : P.Khalili

SETUP FILE : STANDARD.SET

INCLINATION :

DIAM : -

DATE : 19 September 2019

DATE : 19 September 2019

DATE : 22/10/19 15:49

TEXT : ..C:\LOGS\PITSIP.TXT

ELEVATION : 234m

X-COORD : 30 56'32.2"E

Y-COORD : 29 44'58.9"S

HOLE No: IP2



Geotechnical, Environmental &
Groundwater Engineering
Pile Integrity Testing & Civil
Engineering Laboratory

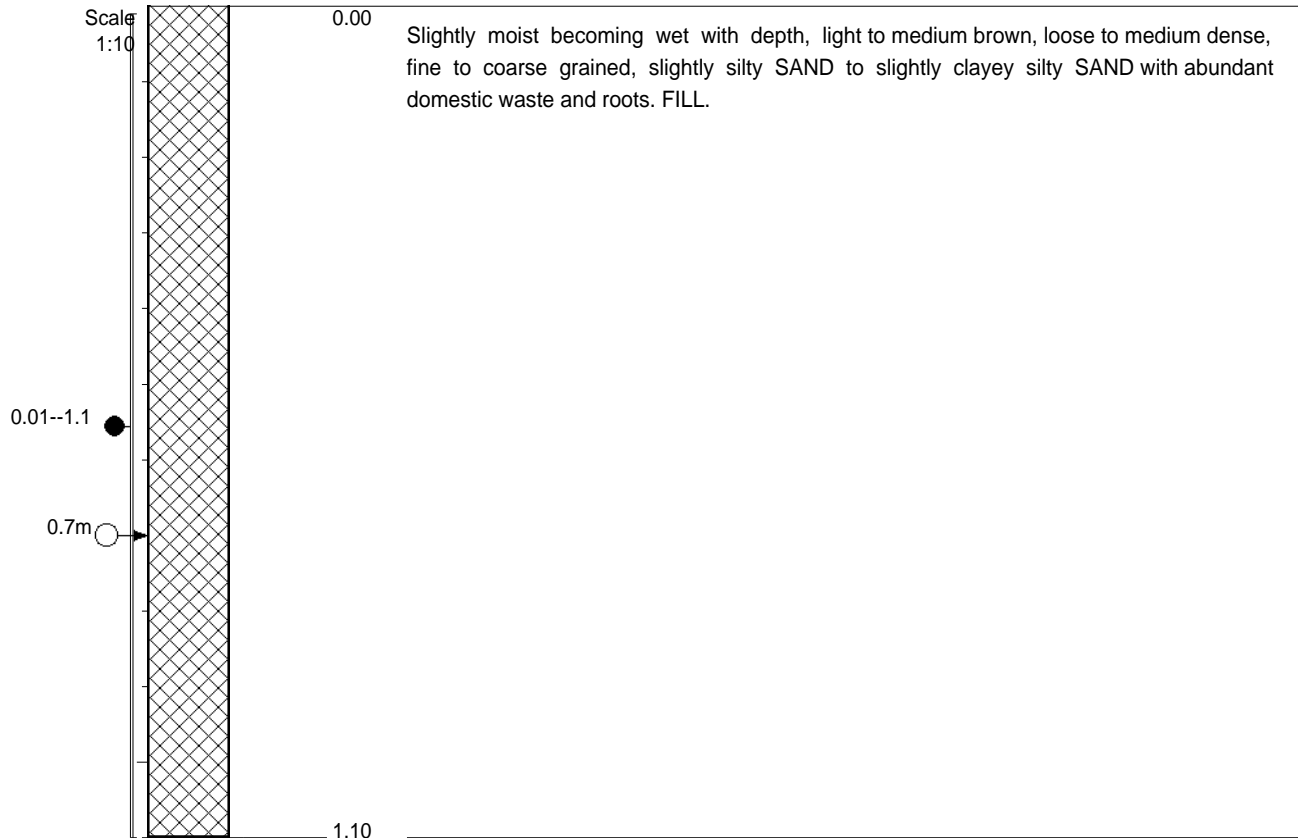
Ethekewini Municipality - Water and Sanitation Unit
Construction of Sewer Reticulation at
Ntuzuma B within Ward 41

HOLE No: IP3
Sheet 1 of 1

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Fax: 086 689-5506
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JOB NUMBER: 233-19



NOTES

- 1) Moderate groundwater seepage observed at 0,7m.
- 2) Sample taken at:
S1 0,01--1,1 (3 x Bulk)
- 3) Collapsing sidewalls observed due to water seepage.
- 4) No refusal, inspection pit terminated due to impractically slow advance.
- 5) Final depth at 1,1m.

CONTRACTOR : -

MACHINE : By hand

DRILLED BY :

PROFILED BY : S.R.; F.Smith Pr.Sci.Nat. Reg No. 400049/00

TYPE SET BY : P.Khalili

SETUP FILE : STANDARD.SET

INCLINATION :

DIAM : -

DATE : 19 September 2019

DATE : 19 September 2019

DATE : 22/10/19 15:49

TEXT : ..C:\LOGS\PITSIP.TXT

ELEVATION : 136m

X-COORD : 30 57'17.9"E

Y-COORD : 29 44'52.7"S

HOLE No: IP3



Geotechnical, Environmental &
Groundwater Engineering
Pile Integrity Testing & Civil
Engineering Laboratory

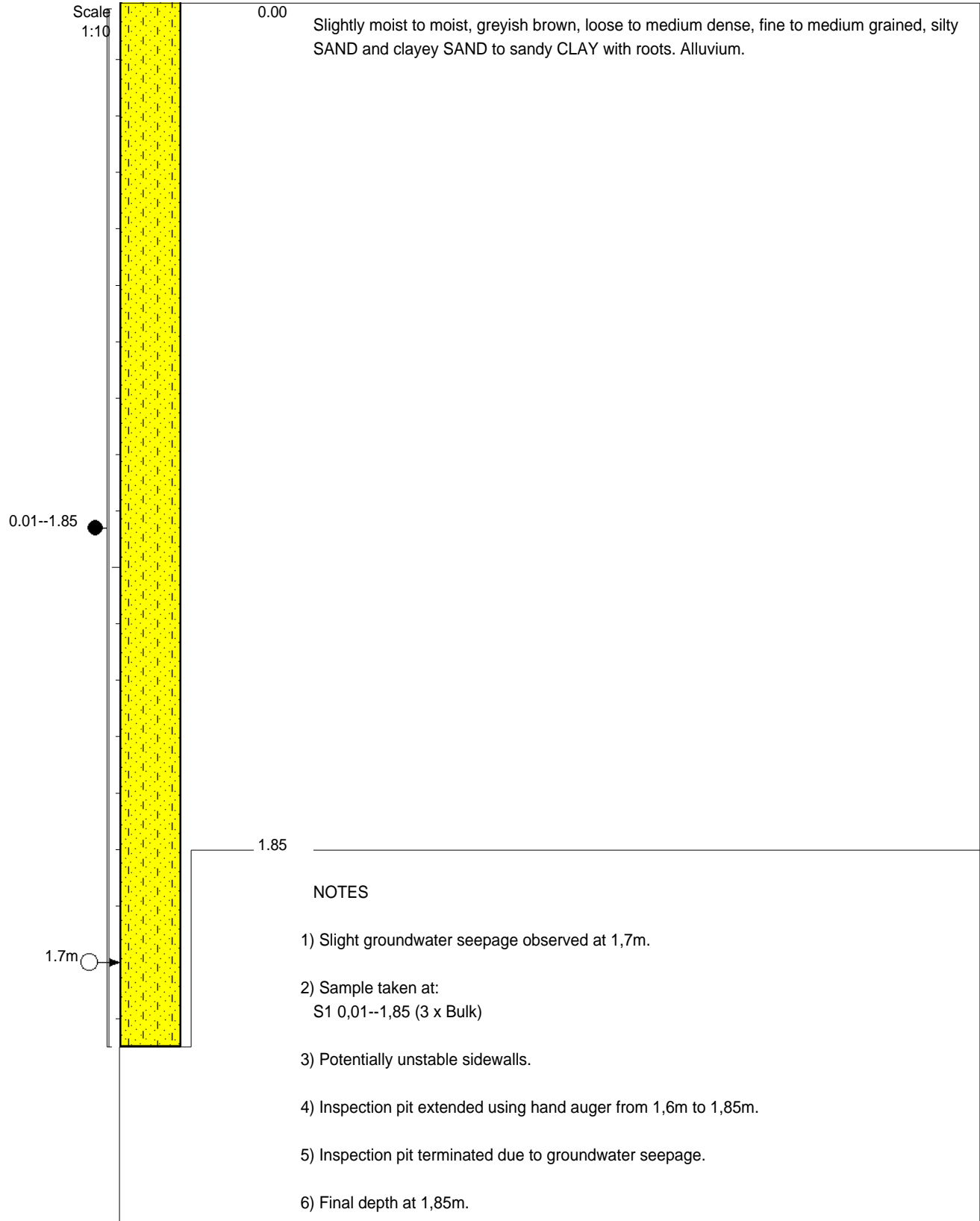
Ethekeeni Municipality - Water and Sanitation Unit
Construction of Sewer Reticulation at
Ntuzuma B within Ward 41

HOLE No: IP4
Sheet 1 of 1

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JOB NUMBER: 233-19



CONTRACTOR : -

MACHINE : By hand

DRILLED BY :

PROFILED BY : S.R.; F.Smith Pr.Sci.Nat. Reg No. 400049/00

TYPE SET BY : P.Khalili

SETUP FILE : STANDARD.SET

INCLINATION :

DIAM : -

DATE : 20 September 2019

DATE : 20 September 2019

DATE : 22/10/19 15:49

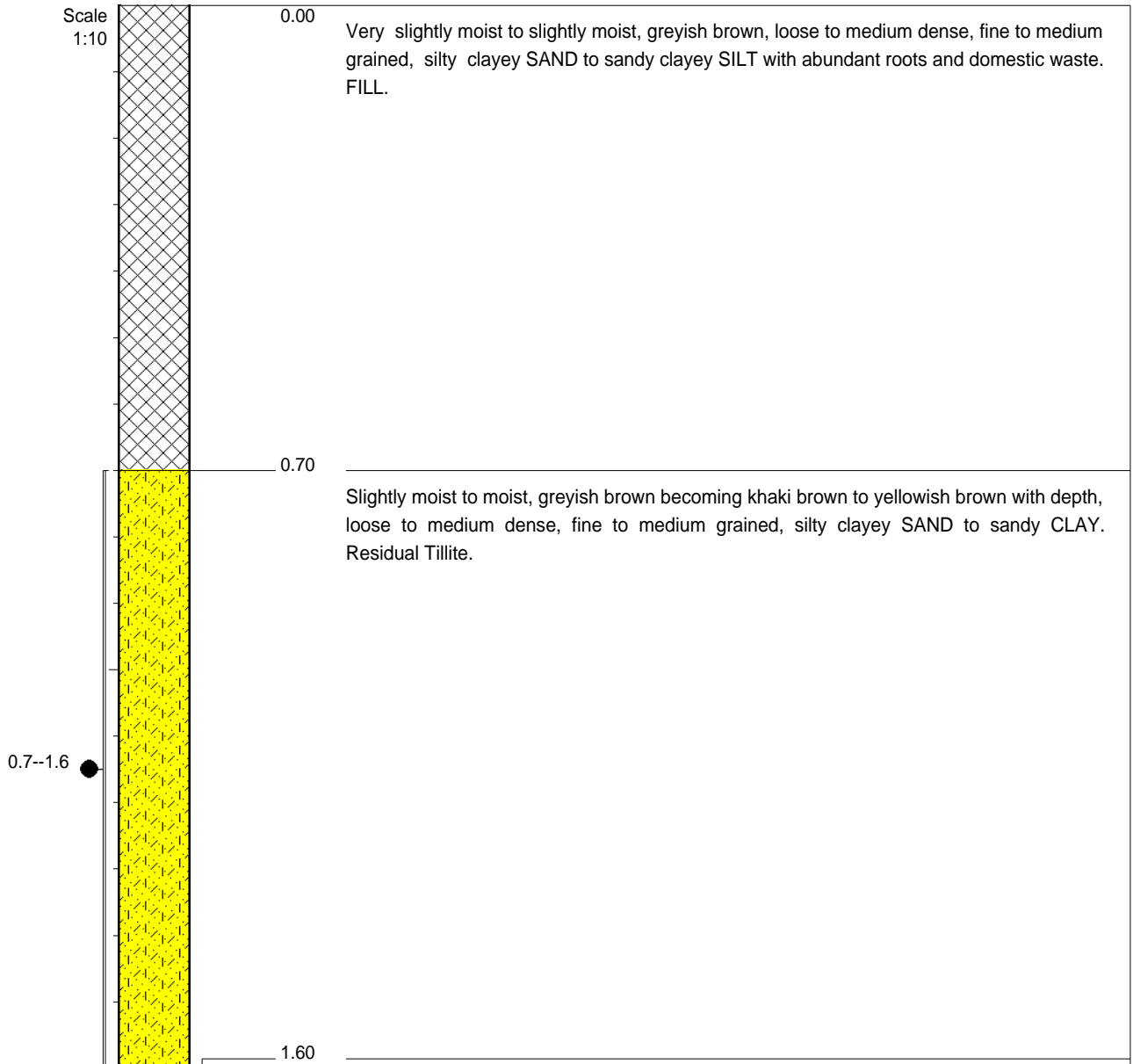
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ELEVATION : 148m

X-COORD : 30 57'14.6"E

Y-COORD : 29 44'53.7"S

HOLE No: IP4



NOTES

- 1) No groundwater seepage observed.
- 2) Sample taken at:
S1 0,7--1,6 (3 x Bulk)
- 3) Potentially unstable sidewalls.
- 4) No refusal, inspection pit terminated due to slow advance.
- 5) Final depth at 1,6m.

CONTRACTOR : -

MACHINE : By hand

DRILLED BY :

PROFILED BY : S.R.; F.Smith Pr.Sci.Nat. Reg No. 400049/00

TYPE SET BY : P.Khalili

SETUP FILE : STANDARD.SET

INCLINATION :

DIAM : -

DATE : 20 September 2019

DATE : 20 September 2019

DATE : 22/10/19 15:49

TEXT : ..C:\LOGS\PITSIP.TXT

ELEVATION : 202m

X-COORD : 30 57'08.4"E

Y-COORD : 29 44'48.3"S

HOLE No: IP5



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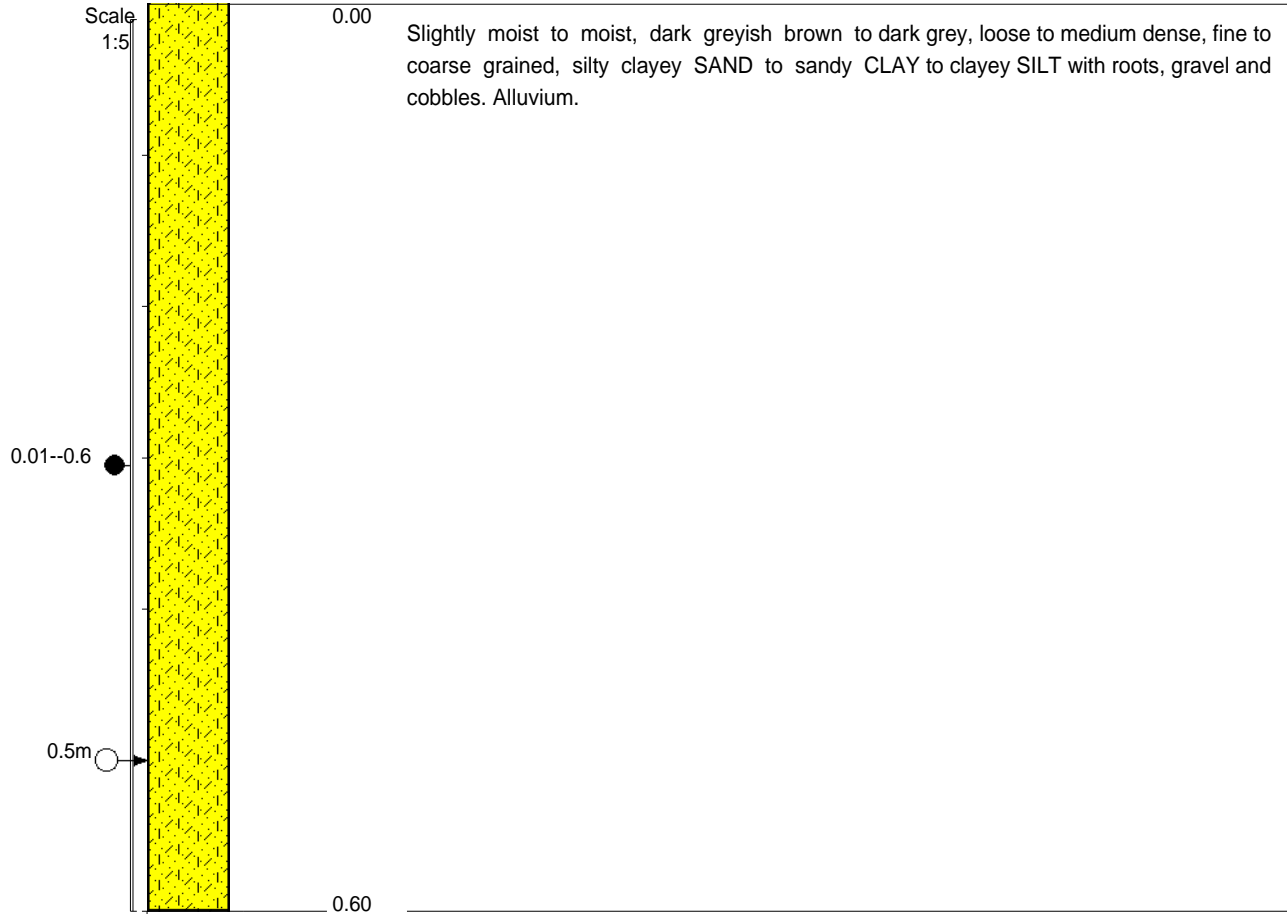
Ethekewini Municipality - Water and Sanitation Unit
Construction of Sewer Reticulation at
Ntuzuma B within Ward 41

HOLE No: IP6
Sheet 1 of 1

P O Box 1461, Westville, 3630, South Africa
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www.geosure.co.za

JOB NUMBER: 233-19



NOTES

- 1) Moderate groundwater seepage observed from 0,5m.
- 2) Sample taken at:
S1 0,01--0,6 (3 x Bulk)
- 3) Potentially unstable sidewalls.
- 4) No refusal, inspection pit terminated due to slow advance of hand implement (pick).
- 5) Final depth at 0,6m.

CONTRACTOR : -

MACHINE : By hand

DRILLED BY :

PROFILED BY : S.R.; F.Smith Pr.Sci.Nat. Reg No. 400049/00

TYPE SET BY : P.Khalili

SETUP FILE : STANDARD.SET

INCLINATION :

DIAM : -

DATE : 20 September 2019

DATE : 20 September 2019

DATE : 22/10/19 15:49

TEXT : ..C:\LOGS\PITSIP.TXT

ELEVATION : 134m

X-COORD : 30 57'23.5"E

Y-COORD : 29 44'49.9"S

HOLE No: IP6



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Construction of Sewer Reticulation at
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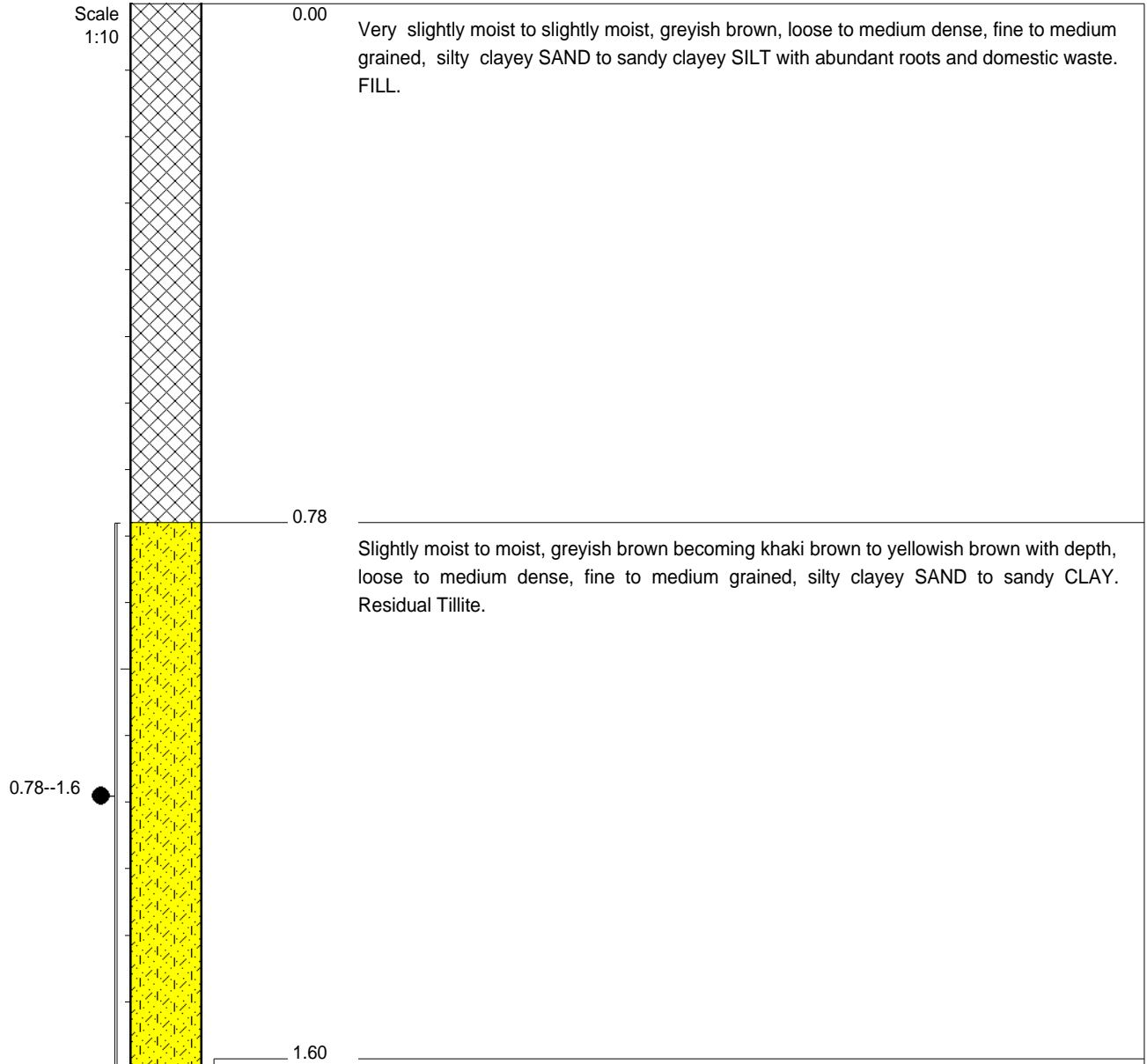
HOLE No: IP7
Sheet 1 of 1

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JOB NUMBER: 233-19

Scale
1:10



NOTES

- 1) No groundwater seepage observed.
- 2) Sample taken at:
S1 0,78--1,6 (3 x Bulk)
- 3) Potentially unstable sidewalls.
- 4) No refusal, inspection pit terminated due to slow advance of pick.
- 5) Final depth at 1,6m.

CONTRACTOR : -

MACHINE : By hand

DRILLED BY :

PROFILED BY : S.R.; F.Smith Pr.Sci.Nat. Reg No. 400049/00

TYPE SET BY : P.Khalili

SETUP FILE : STANDARD.SET

INCLINATION :

DIAM : -

DATE : 20 September 2019

DATE : 20 September 2019

DATE : 22/10/19 15:49

TEXT : ..C:\LOGS\PITSIP.TXT

ELEVATION : 192m

X-COORD : 30 57'10.7"E

Y-COORD : 29 44'48.9"S

HOLE No: IP7



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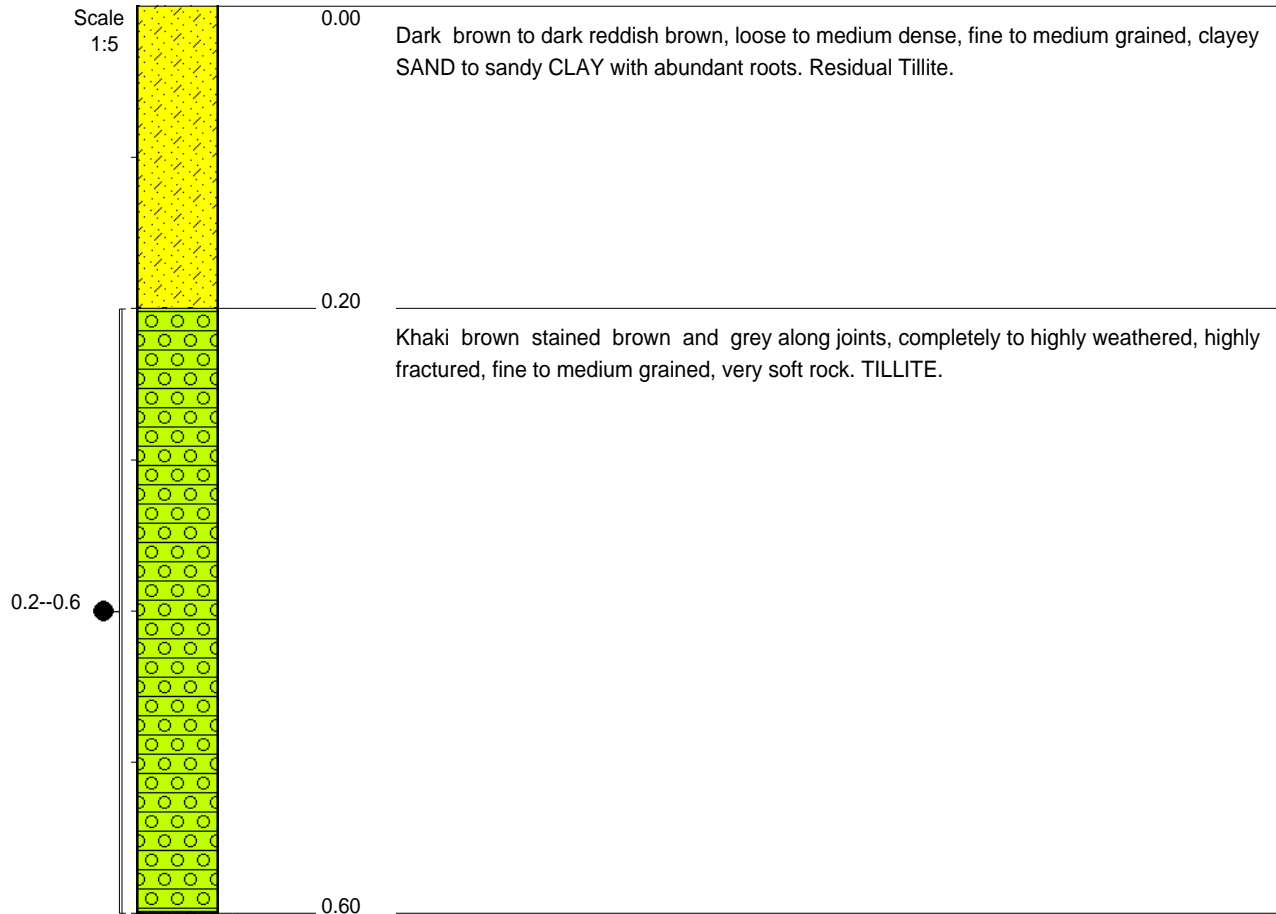
Ethekwini Municipality - Water and Sanitation Unit
Construction of Sewer Reticulation at
Ntuzuma B within Ward 41

HOLE No: IP8
Sheet 1 of 1

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JOB NUMBER: 233-19



NOTES

- 1) No groundwater seepage observed.
- 2) Sample taken at:
S1 0,2--0,6 (3 x Bulk)
- 3) Potentially unstable sidewalls.
- 4) Refusal depth at 0,6m.

CONTRACTOR : -

MACHINE : By hand

DRILLED BY :

PROFILED BY : S.R.; F.Smith Pr.Sci.Nat. Reg No. 400049/00

TYPE SET BY : P.Khalili

SETUP FILE : STANDARD.SET

INCLINATION :

DIAM : -

DATE : 20 September 2019

DATE : 20 September 2019

DATE : 22/10/19 15:49

TEXT : ..C:\LOGS\PITSIP.TXT

ELEVATION : 193m

X-COORD : 30 57'10.9"E

Y-COORD : 29 44'44.1"S

HOLE No: IP8



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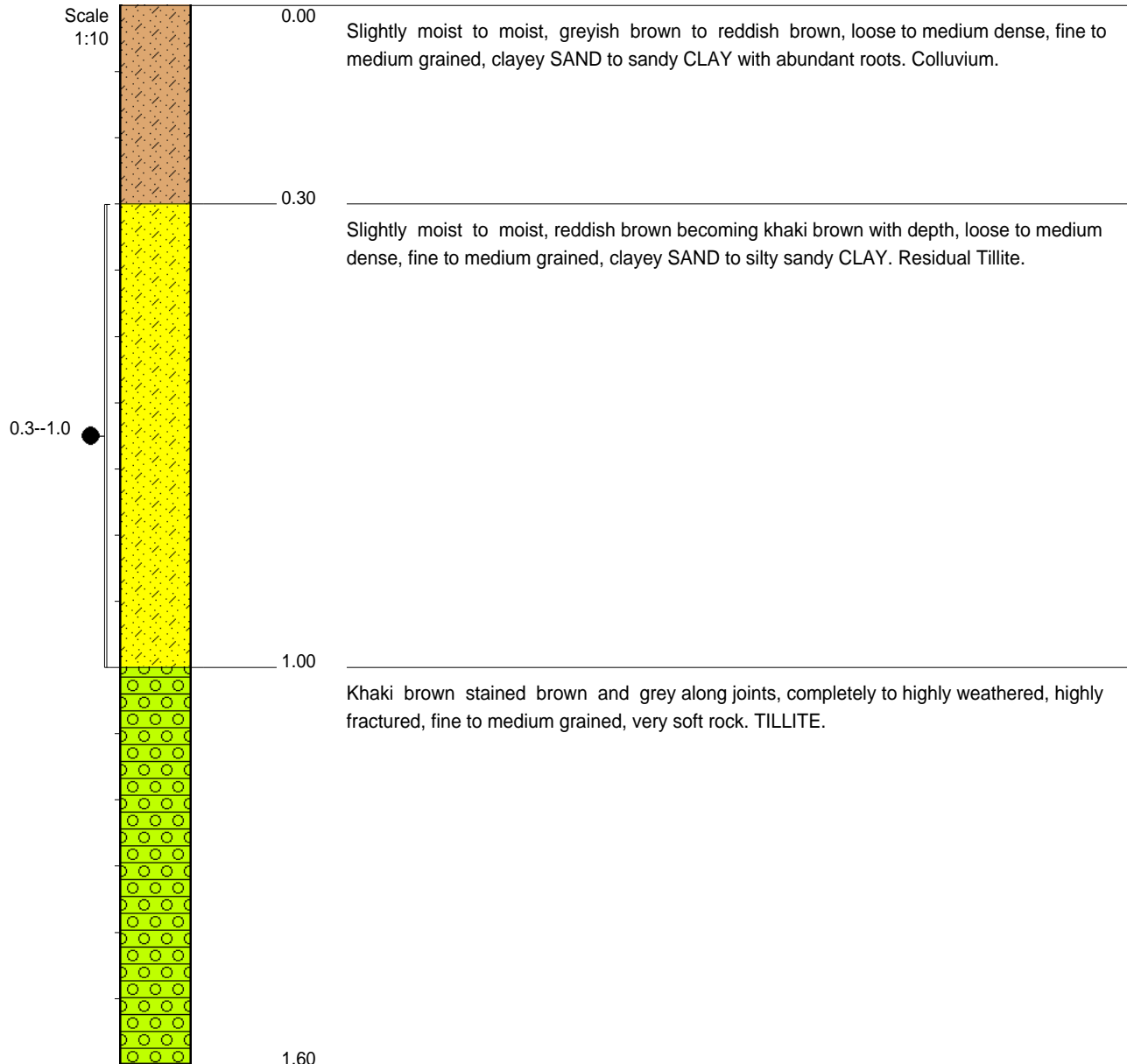
Ethekwini Municipality - Water and Sanitation Unit
Construction of Sewer Reticulation at
Ntuzuma B within Ward 41

HOLE No: IP9
Sheet 1 of 1

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JOB NUMBER: 233-19



NOTES

- 1) No groundwater seepage observed.
- 2) Sample taken at:
S1 0,3--1,0 (3 x Bulk)
- 3) Potentially unstable sidewalls.
- 4) Final depth at 1,6m.

CONTRACTOR : -

MACHINE : By hand

DRILLED BY :

PROFILED BY : S.R.; F.Smith Pr.Sci.Nat. Reg No. 400049/00

TYPE SET BY : P.Khalili

SETUP FILE : STANDARD.SET

INCLINATION :

DIAM : -

DATE : 25 September 2019

DATE : 25 September 2019

DATE : 22/10/19 15:49

TEXT : ..C:\LOGS\PITSIP.TXT

ELEVATION : 216m

X-COORD : 30 57'00.6"E

Y-COORD : 29 44'43.9"S

HOLE No: IP9



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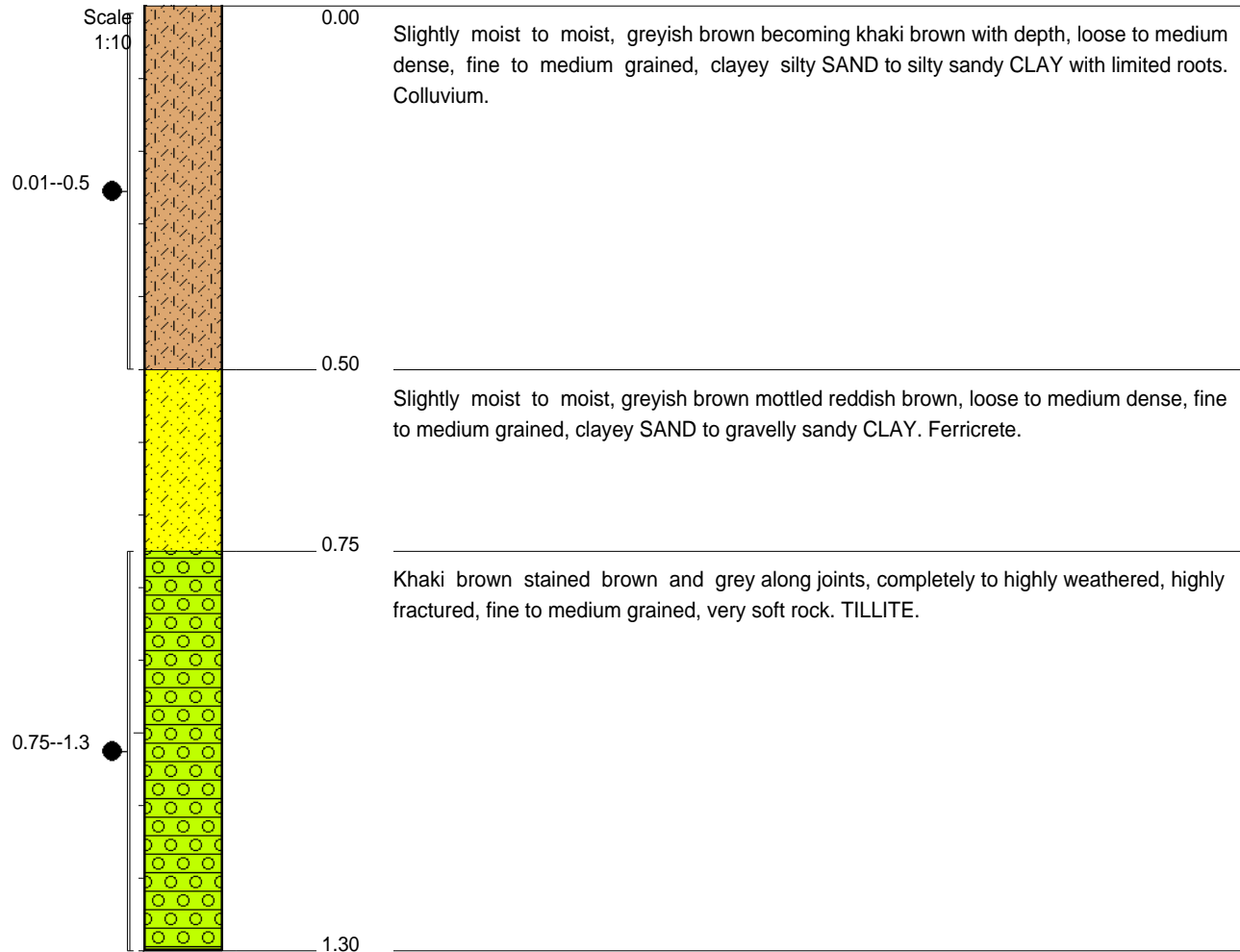
Ethekwini Municipality - Water and Sanitation Unit
Construction of Sewer Reticulation at
Ntuzuma B within Ward 41

HOLE No: IP10
Sheet 1 of 1

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JOB NUMBER: 233-19



NOTES

- 1) No groundwater seepage observed.
- 2) Samples taken at:
S1 0,01--0,5 (2 x Bulk)
S2 0,75--1,3 (1 x Bulk)
- 3) Potentially unstable sidewalls.
- 4) Final depth at 1,3m.

CONTRACTOR : -

MACHINE : By hand

DRILLED BY :

PROFILED BY : S.R.; F.Smith Pr.Sci.Nat. Reg No. 400049/00

TYPE SET BY : P.Khalili

SETUP FILE : STANDARD.SET

INCLINATION :

DIAM : -

DATE : 25 September 2019

DATE : 25 September 2019

DATE : 22/10/19 15:49

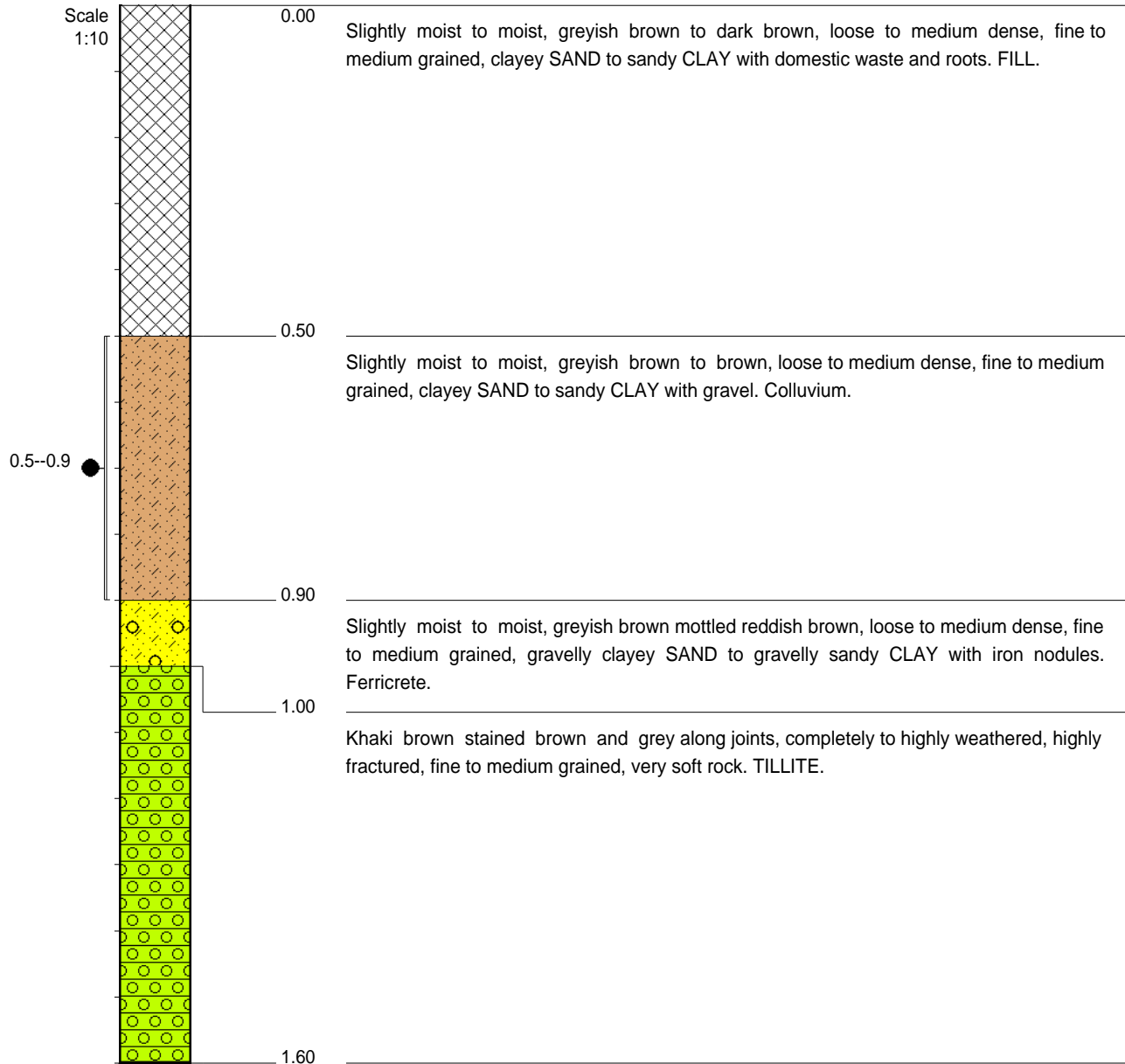
TEXT : ..C:\LOGS\PITSIP.TXT

ELEVATION : 213m

X-COORD : 30 56'59.9"E

Y-COORD : 29 44'47.0"S

HOLE No: IP10



NOTES

- 1) No groundwater seepage observed.
- 2) Sample taken at:
S1 0,5--0,9 (3 x Bulk)
- 3) Potentially unstable sidewalls.
- 4) Refusal depth at 1,6m.

CONTRACTOR : -

MACHINE : By hand

DRILLED BY :

PROFILED BY : S.R.; F.Smith Pr.Sci.Nat. Reg No. 400049/00

TYPE SET BY : P.Khalili

SETUP FILE : STANDARD.SET

INCLINATION :

DIAM : -

DATE : 25 September 2019

DATE : 25 September 2019

DATE : 22/10/19 15:49

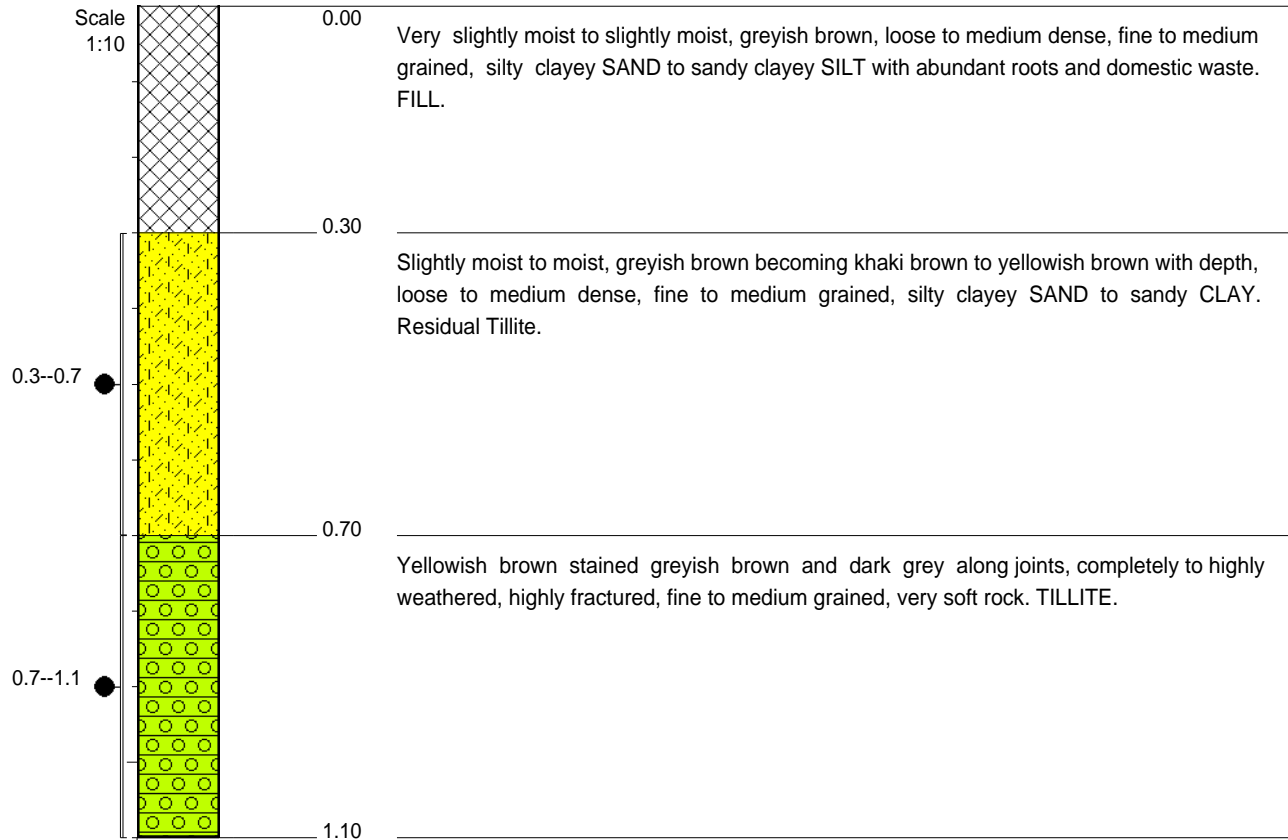
TEXT : ..C:\LOGS\PITSIP.TXT

ELEVATION : 221m

X-COORD : 30 57'03.4"E

Y-COORD : 29 44'42.5"S

HOLE No: IP11



NOTES

- 1) No groundwater seepage observed.
- 2) Samples taken at:
S1 0,3--0,7 (1 x Bulk)
S2 0,7--1,1 (2 x Bulk)
- 3) Potentially unstable sidewalls.
- 4) No refusal, inspection pit terminated due to slow advance.
- 5) Final depth at 1,1m.

CONTRACTOR : -

MACHINE : By hand

DRILLED BY :

PROFILED BY : S.R.; F.Smith Pr.Sci.Nat. Reg No. 400049/00

TYPE SET BY : P.Khalili

SETUP FILE : STANDARD.SET

INCLINATION :

DIAM : -

DATE : 20 September 2019

DATE : 20 September 2019

DATE : 22/10/19 15:49

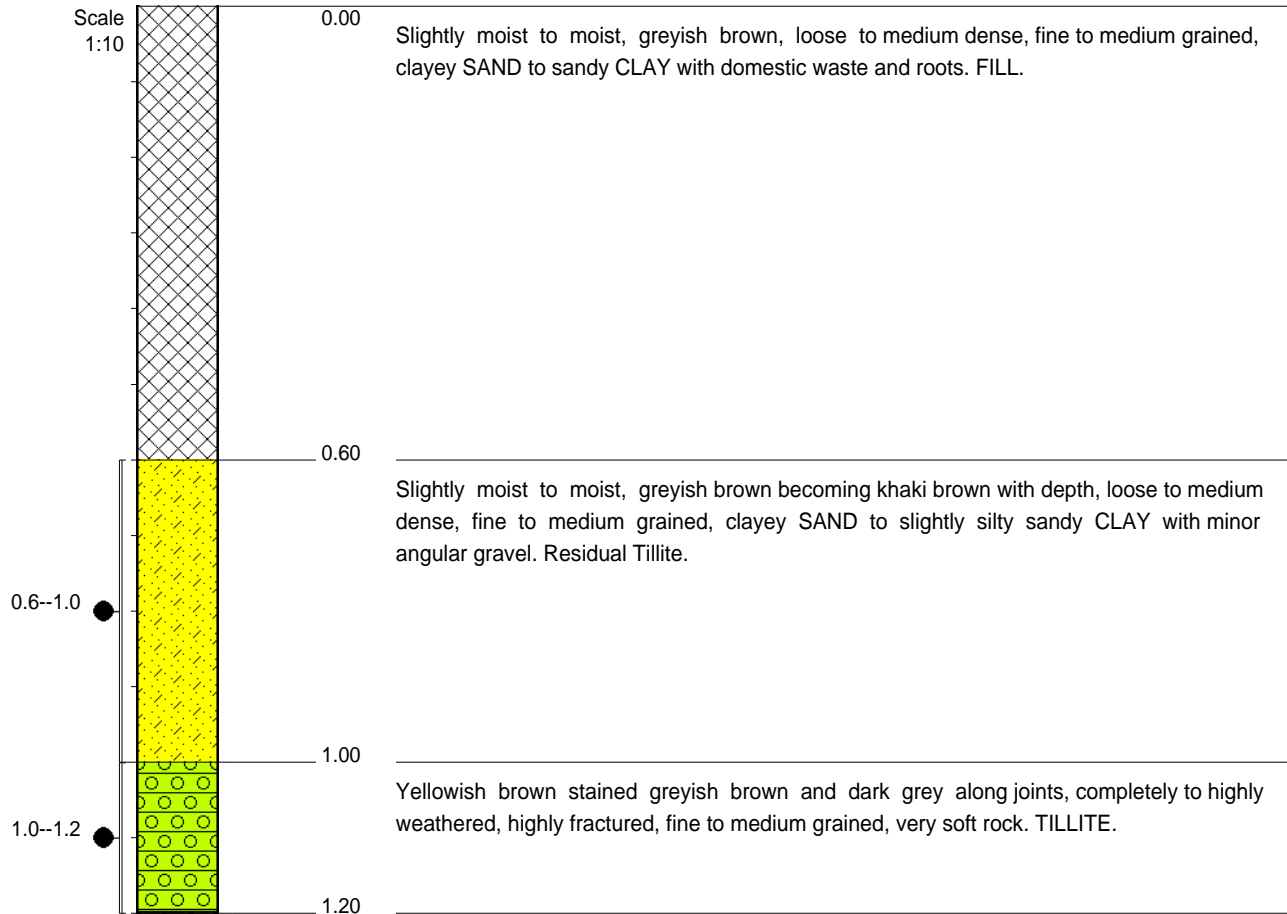
TEXT : ..C:\LOGS\PITSIP.TXT

ELEVATION : 232m

X-COORD : 30 56'59.7"E

Y-COORD : 29 45'04.4"S

HOLE No: IP12



NOTES

- 1) No groundwater seepage observed.
- 2) Samples taken at:
S1 0,6--1,0 (2 x Bulk)
S2 1,0--1,2 (1 x Bulk)
- 3) Potentially unstable sidewalls.
- 4) No refusal, inspection pit terminated due to slow advance.
- 5) Final depth at 1,2m.

CONTRACTOR : -

MACHINE : By hand

DRILLED BY :

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TYPE SET BY : P.Khalili

SETUP FILE : STANDARD.SET

INCLINATION :

DIAM : -

DATE : 20 September 2019

DATE : 20 September 2019

DATE : 22/10/19 15:49

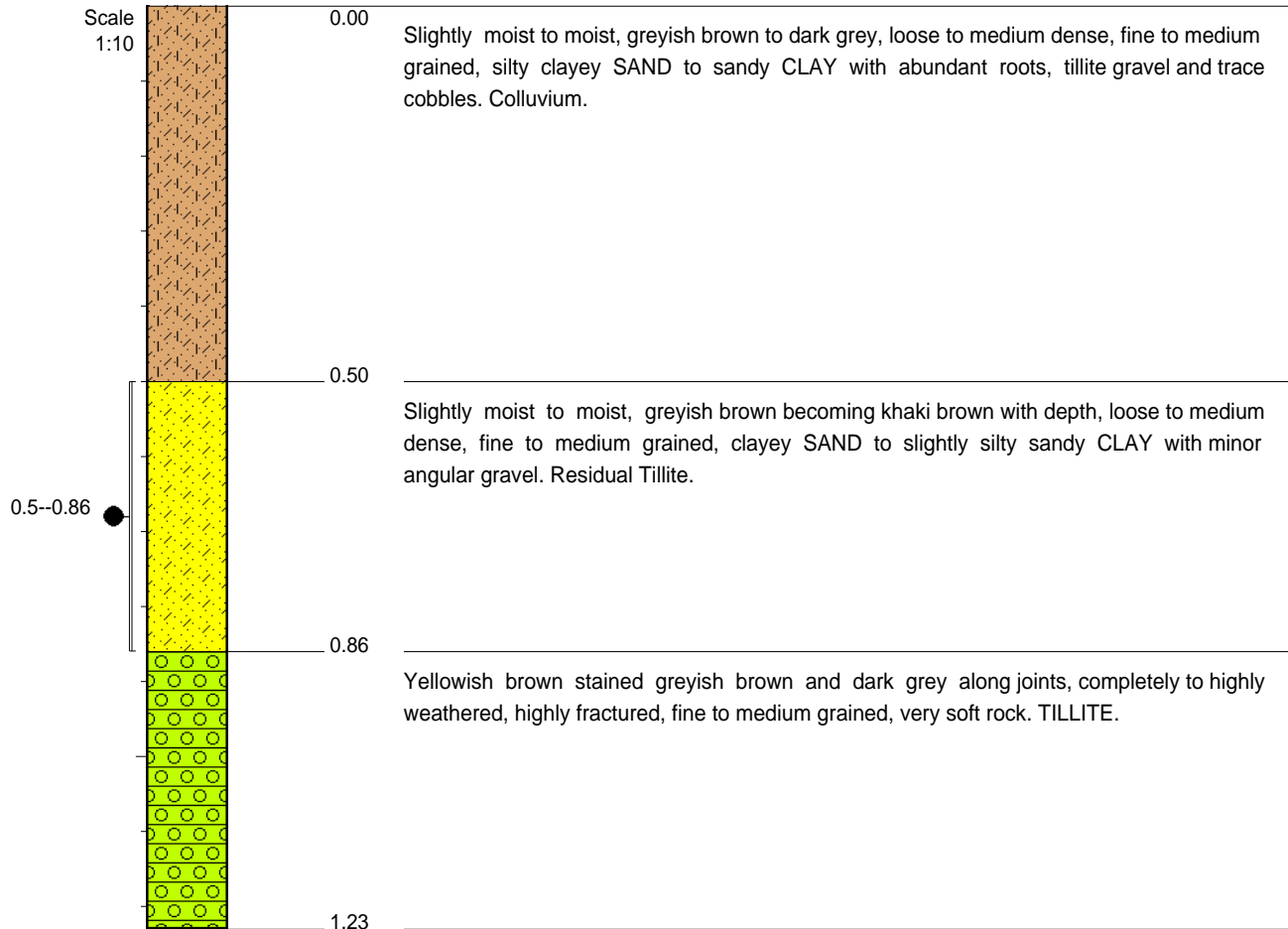
TEXT : ..C:\LOGS\PITSIP.TXT

ELEVATION : 136m

X-COORD : 30 57'27.0"E

Y-COORD : 29 44'52.4"S

HOLE No: IP13



NOTES

- 1) No groundwater seepage observed.
- 2) Sample taken at:
S1 0,5--0,86 (3 x Bulk)
- 3) Potentially unstable sidewalls.
- 4) No refusal, inspection pit terminated due to slow advance (attempted using hand auger - no advance).
- 5) Final depth at 1,23m.

CONTRACTOR : -

MACHINE : By hand

DRILLED BY :

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TYPE SET BY : P.Khalili

SETUP FILE : STANDARD.SET

INCLINATION :

DIAM : -

DATE : 20 September 2019

DATE : 20 September 2019

DATE : 22/10/19 15:49

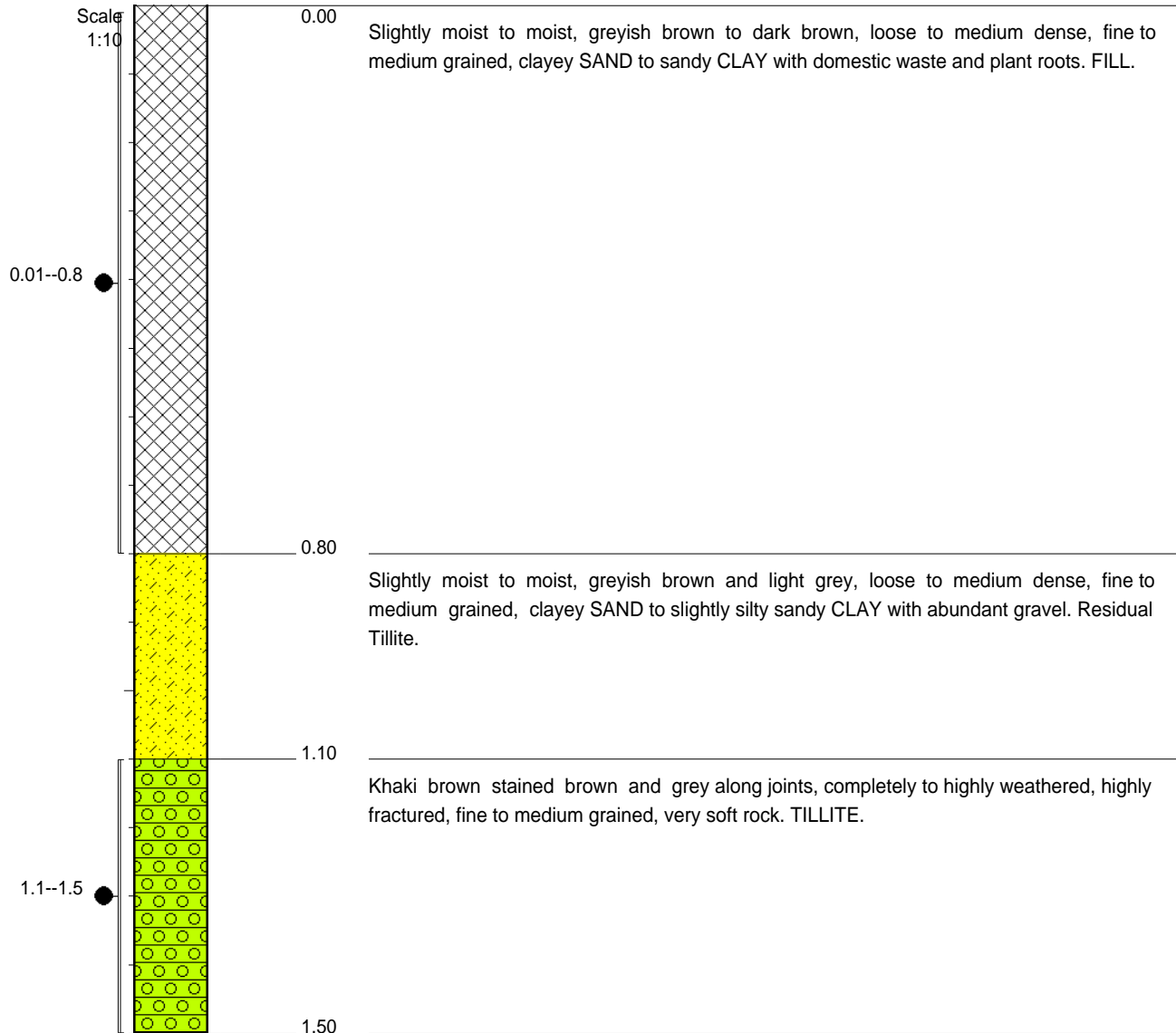
TEXT : ..C:\LOGS\PITSIP.TXT

ELEVATION : 216m

X-COORD : 30 57'03.0"E

Y-COORD : 29 45'03.6"S

HOLE No: IP14



NOTES

- 1) No groundwater seepage observed.
- 2) Samples taken at:
S1 0,01--0,8 (2 x Bulk)
S2 1,1--1,5 (1 x Bulk)
- 3) Potentially unstable sidewalls.
- 4) Refusal depth at 1,5m.

CONTRACTOR : -

MACHINE : By hand

DRILLED BY :

PROFILED BY : S.R.; F.Smith Pr.Sci.Nat. Reg No. 400049/00

TYPE SET BY : P.Khalili

SETUP FILE : STANDARD.SET

INCLINATION :

DIAM : -

DATE : 25 September 2019

DATE : 25 September 2019

DATE : 22/10/19 15:49

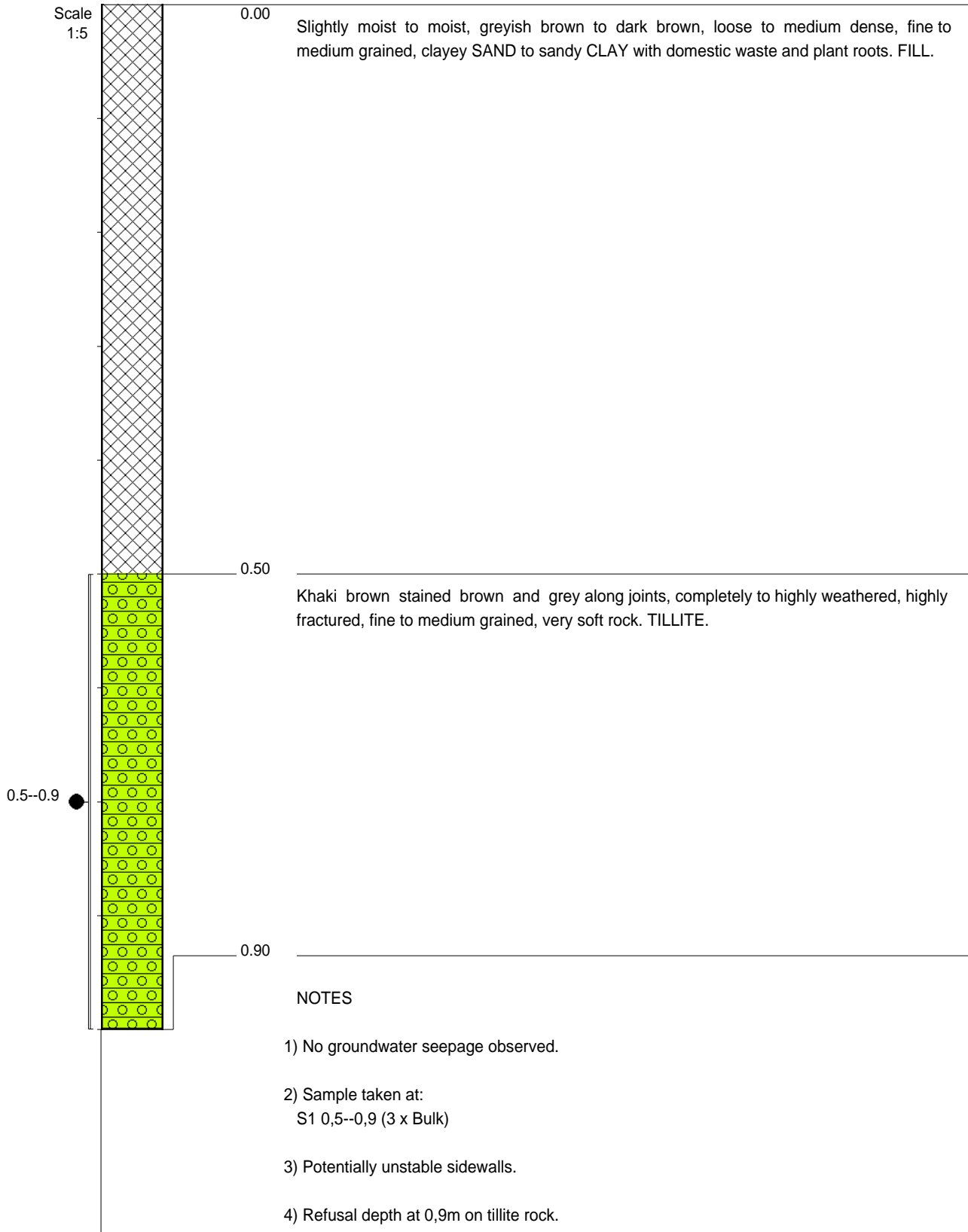
TEXT : ..C:\LOGS\PITSIP.TXT

ELEVATION : 208m

X-COORD : 30 56'56.2"E

Y-COORD : 29 44'46.3"S

HOLE No: IP15



CONTRACTOR : -

MACHINE : By hand

DRILLED BY :

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TYPE SET BY : P.Khalili

SETUP FILE : STANDARD.SET

INCLINATION :

DIAM : -

DATE : 25 September 2019

DATE : 25 September 2019

DATE : 22/10/19 15:49

TEXT : ..C:\LOGS\PITSIP.TXT

ELEVATION : 154m

X-COORD : 30 57'23.5"E

Y-COORD : 29 44'53.1"S

HOLE No: IP16



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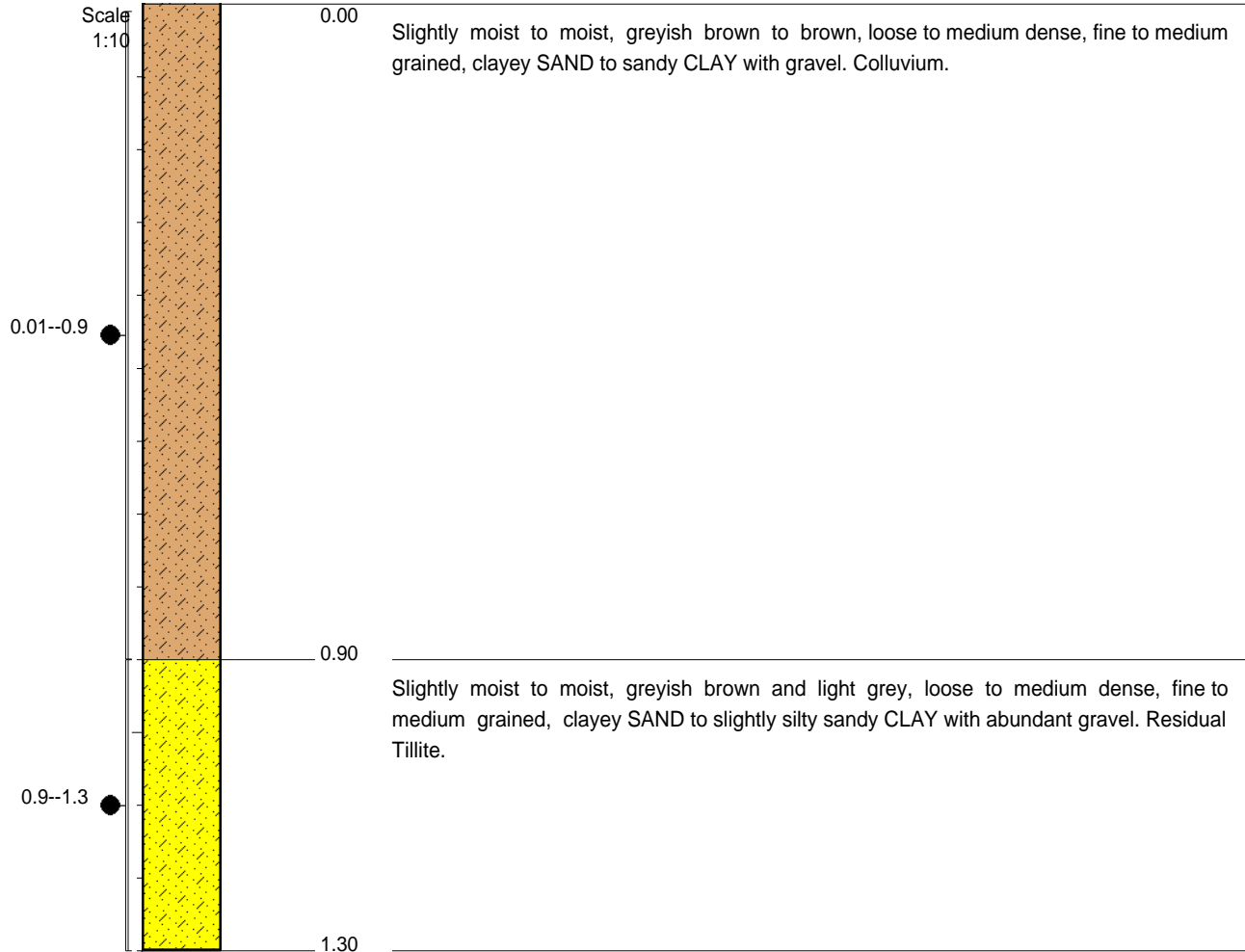
Ethekwini Municipality - Water and Sanitation Unit
Construction of Sewer Reticulation at
Ntuzuma B within Ward 41

HOLE No: IP17
Sheet 1 of 1

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JOB NUMBER: 233-19



NOTES

- 1) No groundwater seepage observed.
- 2) Samples taken at:
S1 0,01--0,9 (2 x Bulk)
S2 0,9--1,3 (1 x Bulk)
- 3) Potentially unstable sidewalls.
- 4) No refusal, inspection pit terminated due to slow advance.
- 5) Final depth at 1,3m.

CONTRACTOR : -

MACHINE : By hand

DRILLED BY :

PROFILED BY : S.R.; F.Smith Pr.Sci.Nat. Reg No. 400049/00

TYPE SET BY : P.Khalili

SETUP FILE : STANDARD.SET

INCLINATION :

DIAM : -

DATE : 25 September 2019

DATE : 25 September 2019

DATE : 22/10/19 15:49

TEXT : ..C:\LOGS\PITSIP.TXT

ELEVATION : 178m

X-COORD : 30 57'16.5"E

Y-COORD : 29 44'44.4"S

HOLE No: IP17



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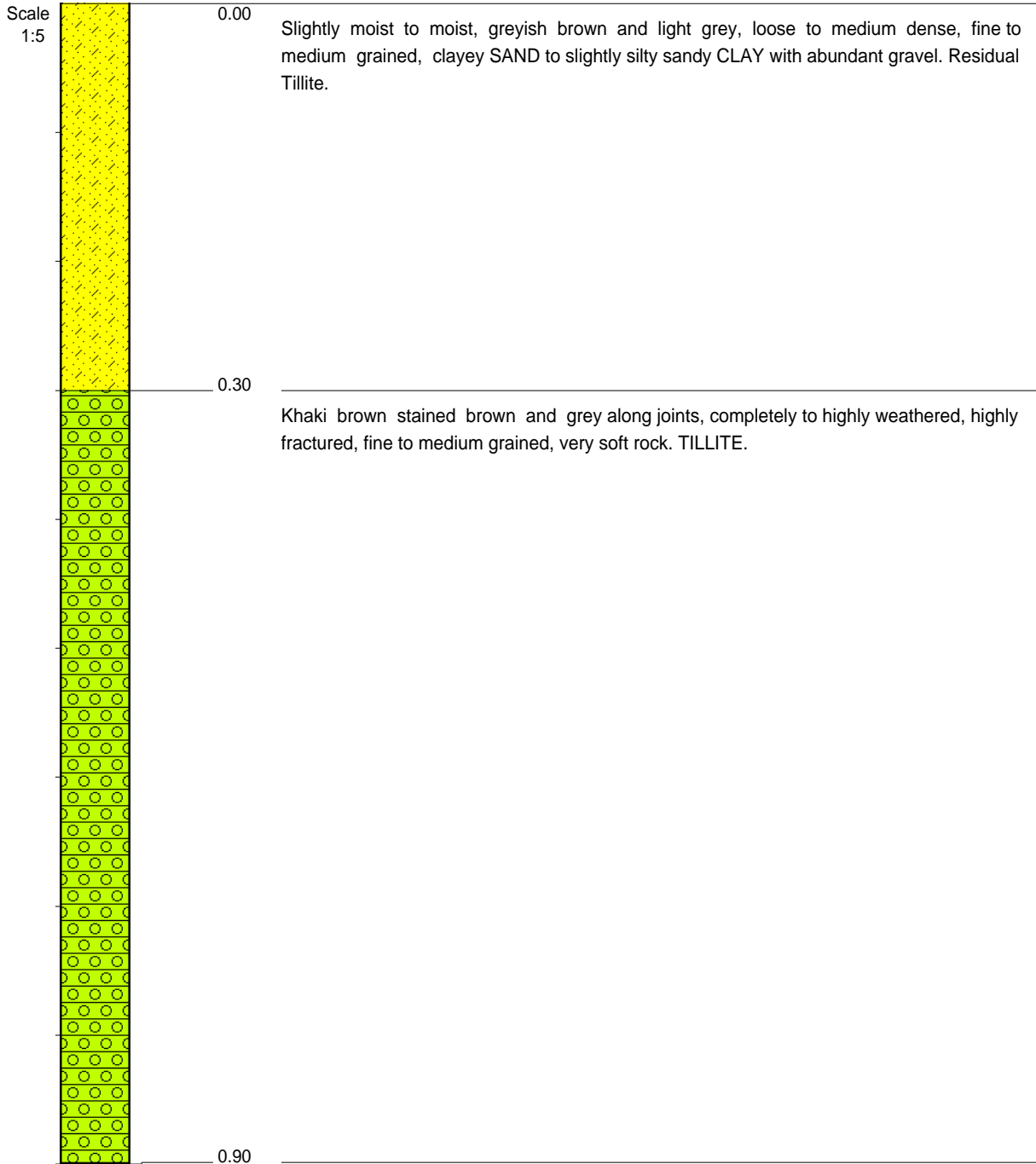
Ethekeeni Municipality - Water and Sanitation Unit
Construction of Sewer Reticulation at
Ntuzuma B within Ward 41

HOLE No: IP18
Sheet 1 of 1

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JOB NUMBER: 233-19



NOTES

- 1) No groundwater seepage observed.
- 2) Potentially unstable sidewalls.
- 3) Refusal depth at 0,9m.

CONTRACTOR : -

MACHINE : By hand

DRILLED BY :

PROFILED BY : S.R.; F.Smith Pr.Sci.Nat. Reg No. 400049/00

TYPE SET BY : P.Khalili

SETUP FILE : STANDARD.SET

INCLINATION :

DIAM : -

DATE : 25 September 2019

DATE : 25 September 2019

DATE : 22/10/19 15:49

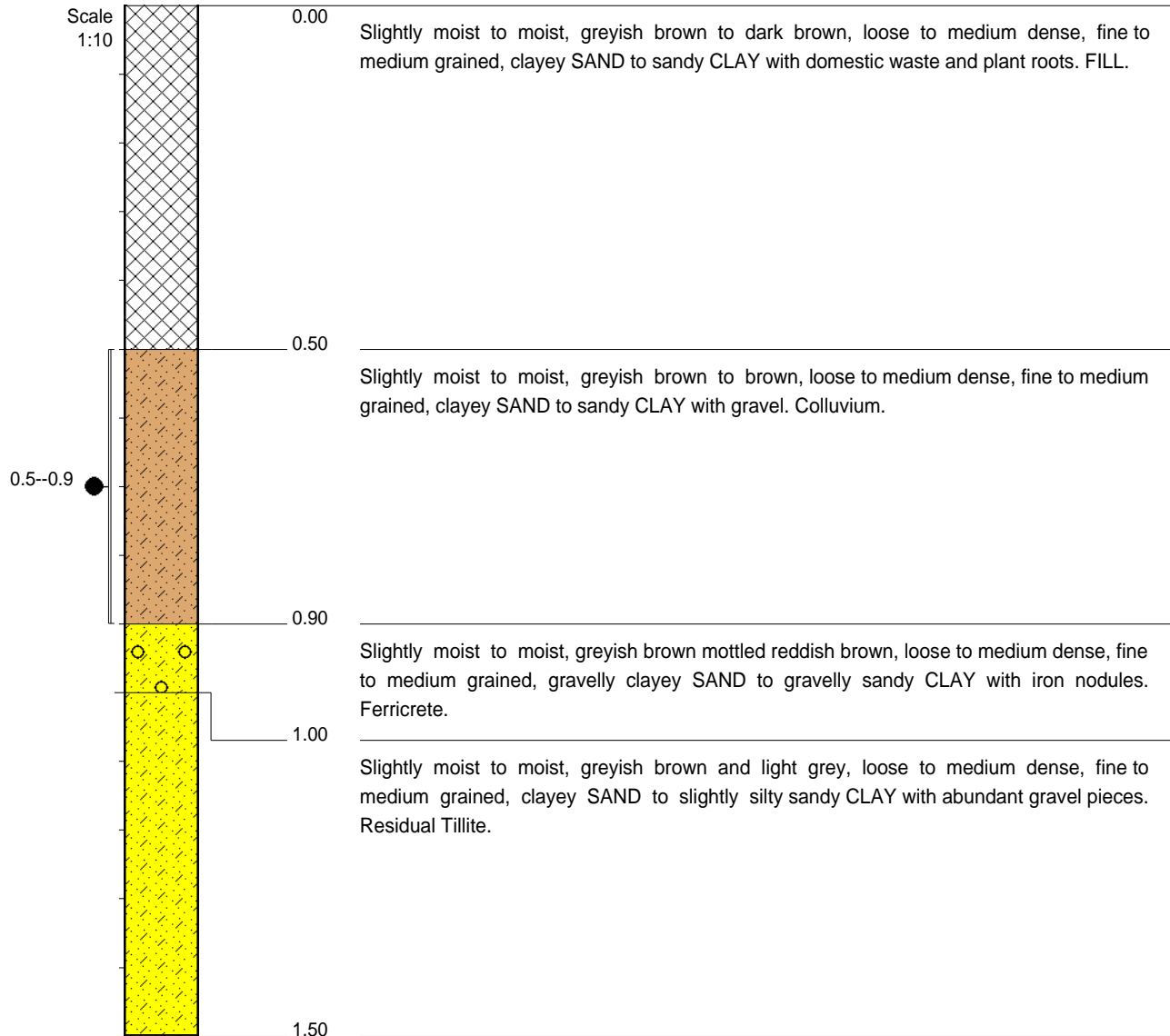
TEXT : ..C:\LOGS\PITSIP.TXT

ELEVATION : 130m

X-COORD : 30 57'27.0"E

Y-COORD : 29 44'47.7"S

HOLE No: IP18



NOTES

- 1) No groundwater seepage observed.
- 2) Sample taken at:
S1 0,5--0,9 (3 x Bulk)
- 3) Potentially unstable sidewalls.
- 4) No refusal, inspection pit terminated due to slow advance.
- 5) Final depth at 1,5m.

CONTRACTOR : -

MACHINE : By hand

DRILLED BY :

PROFILED BY : S.R.; F.Smith Pr.Sci.Nat. Reg No. 400049/00

TYPE SET BY : P.Khalili

SETUP FILE : STANDARD.SET

INCLINATION :

DIAM : -

DATE : 26 September 2019

DATE : 26 September 2019

DATE : 22/10/19 15:49

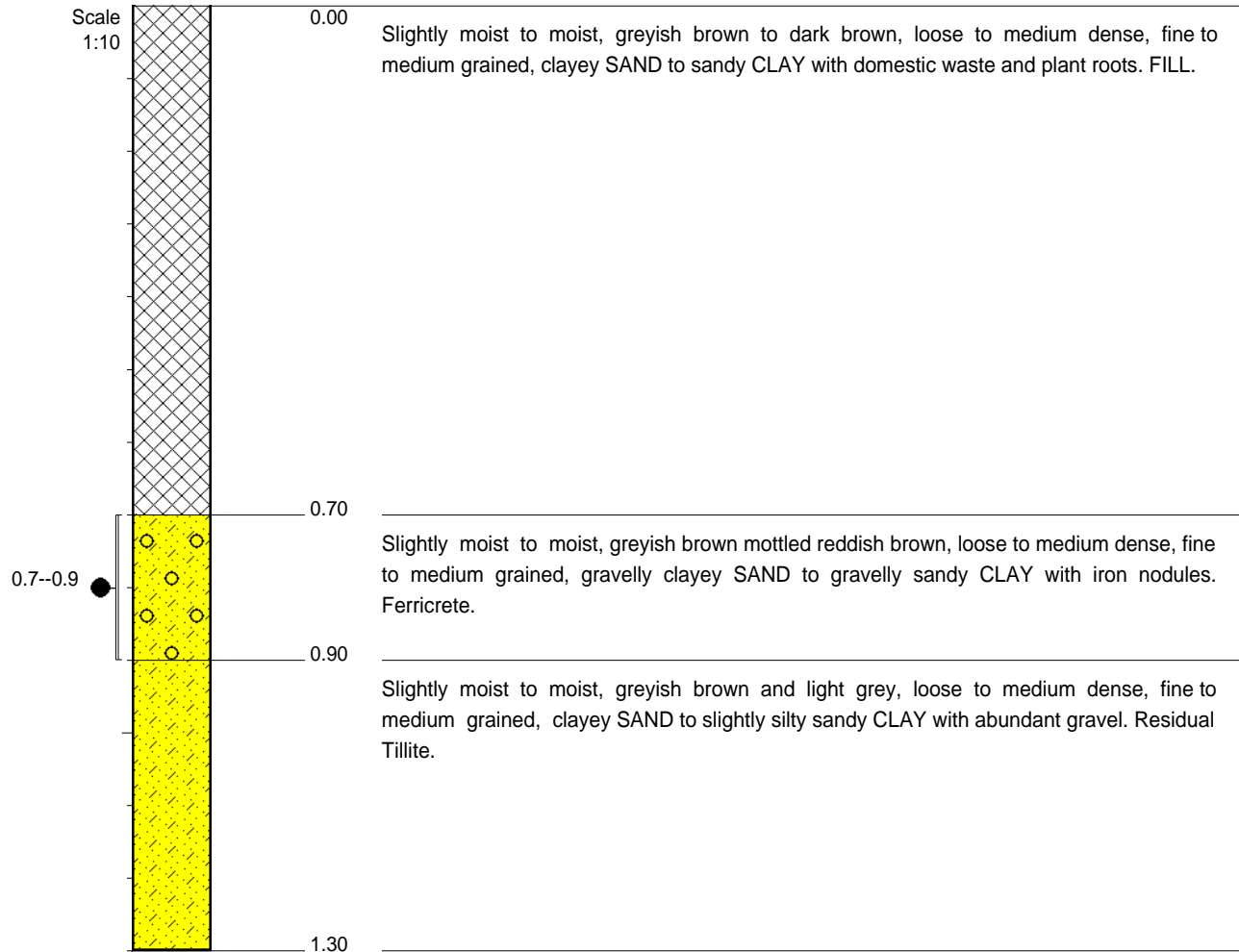
TEXT : ..C:\LOGS\PITSIP.TXT

ELEVATION : 244m

X-COORD : 30 56'57.9"E

Y-COORD : 29 44'40.0"S

HOLE No: IP19



NOTES

- 1) No groundwater seepage observed.
- 2) Sample taken at:
S1 0,7--0,9 (3 x Bulk)
- 3) Potentially unstable sidewalls.
- 4) Refusal depth at 1,3m.

CONTRACTOR : -

MACHINE : By hand

DRILLED BY :

PROFILED BY : S.R.; F.Smith Pr.Sci.Nat. Reg No. 400049/00

TYPE SET BY : P.Khalili

SETUP FILE : STANDARD.SET

INCLINATION :

DIAM : -

DATE : 26 September 2019

DATE : 26 September 2019

DATE : 22/10/19 15:49

TEXT : ..C:\LOGS\PITSIP.TXT

ELEVATION : 239m

X-COORD : 30 57'02.4"E

Y-COORD : 29 44'39.8"S

HOLE No: IP20



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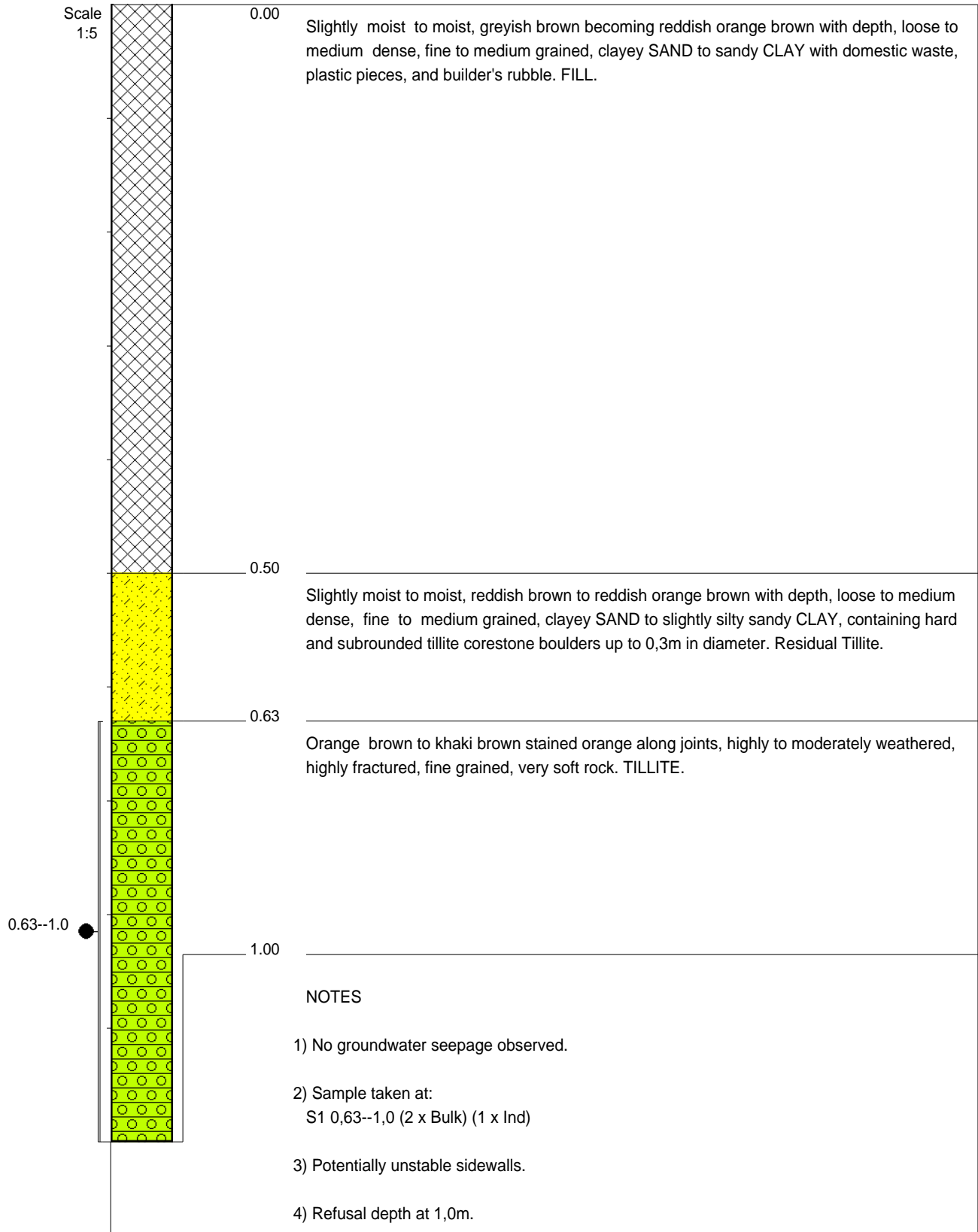
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Ethekwini Municipality - Water and Sanitation Unit
 Construction of Sewer Reticulation at
 Ntuzuma B within Ward 45

HOLE No: IP21
 Sheet 1 of 1

JOB NUMBER: 233-19



CONTRACTOR : -

MACHINE : By hand

DRILLED BY :

PROFILED BY : S.R.; F.Smith Pr.Sci.Nat. Reg No. 400049/00

TYPE SET BY : P.Khalili

SETUP FILE : STANDARD.SET

INCLINATION :

DIAM : -

DATE : 26 September 2019

DATE : 26 September 2019

DATE : 22/10/19 15:49

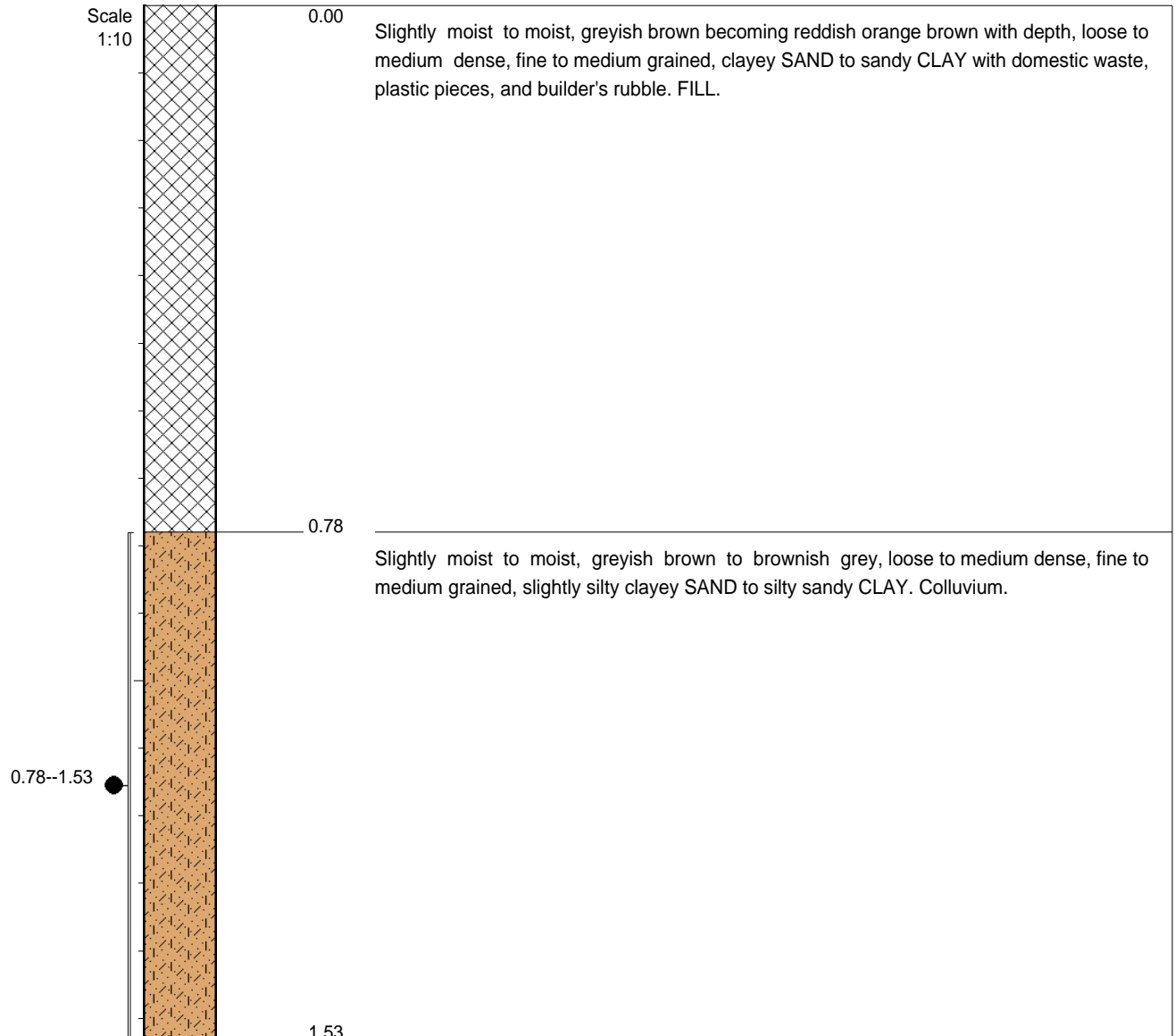
TEXT : ..C:\LOGS\PITSIP.TXT

ELEVATION : 170m

X-COORD : 30 57'25.3"E

Y-COORD : 29 44'39.3"S

HOLE No: IP21



NOTES

- 1) No groundwater seepage observed.
- 2) Sample taken at:
S1 0,78--1,53 (2 x Bulk) (1 x Ind)
- 3) Potentially unstable sidewalls.
- 4) Boulders near inspection pit.
- 5) Refusal of hand auger at 1,53m.

CONTRACTOR : -

MACHINE : By hand

DRILLED BY :

PROFILED BY : S.R.; F.Smith Pr.Sci.Nat. Reg No. 400049/00

TYPE SET BY : P.Khalili

SETUP FILE : STANDARD.SET

INCLINATION :

DIAM : -

DATE : 26 September 2019

DATE : 26 September 2019

DATE : 22/10/19 15:49

TEXT : ..C:\LOGS\PITSIP.TXT

ELEVATION : 167m

X-COORD : 30 57'26.6"E

Y-COORD : 29 44'37.0"S

HOLE No: IP22



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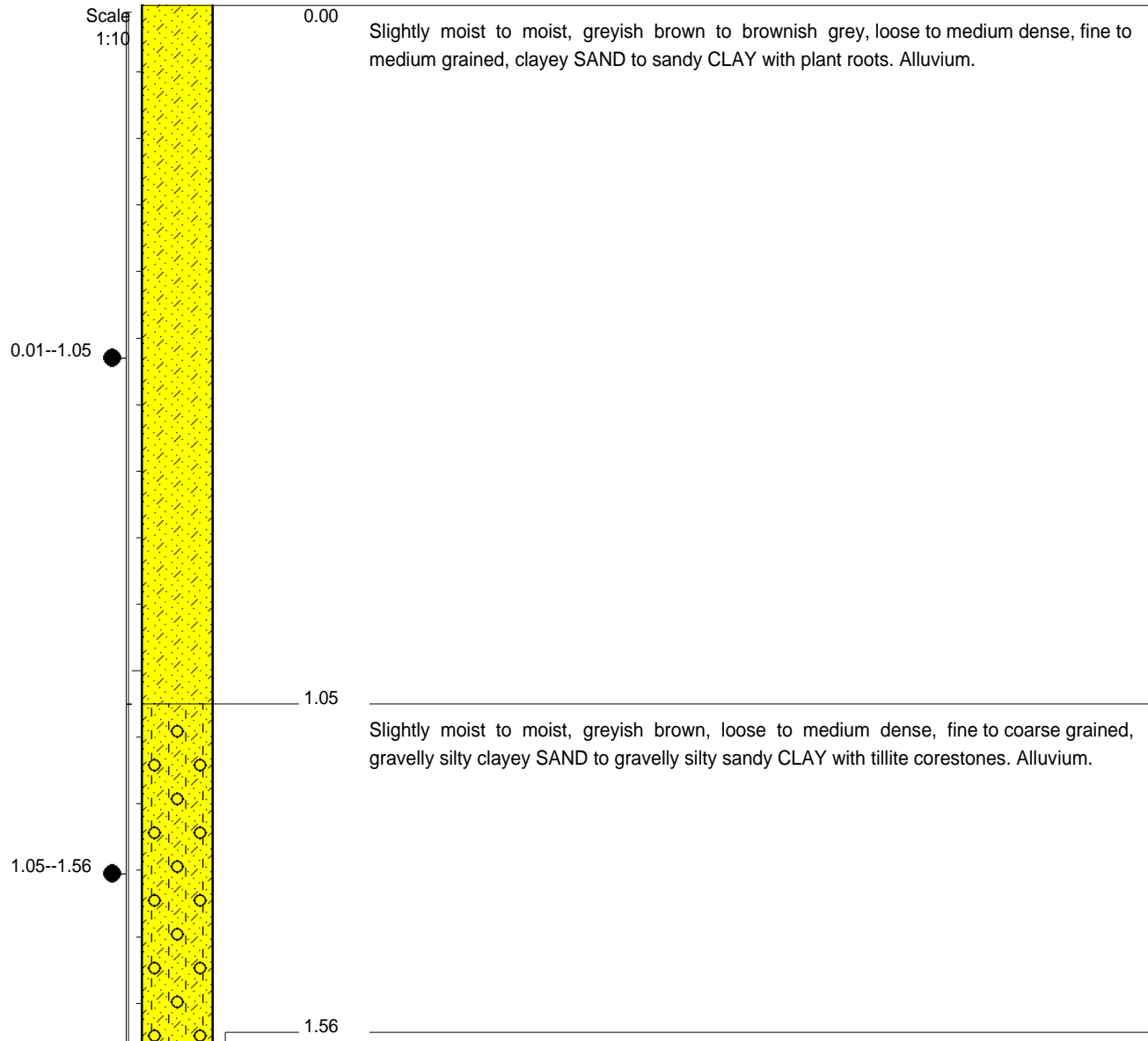
Ethekewini Municipality - Water and Sanitation Unit
Construction of Sewer Reticulation at
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HOLE No: IP23
Sheet 1 of 1

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JOB NUMBER: 233-19



NOTES

- 1) No groundwater seepage observed.
- 2) Samples taken at:
S1 0,01--1,05 (1 x Ind)
S2 1,05--1,56 (2 x Bulk)
- 3) Potentially unstable sidewalls.
- 4) Auger hole refused on ferricrete.
- 5) Refusal depth at 1,56m.

CONTRACTOR : -

MACHINE : By hand

DRILLED BY :

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TYPE SET BY : P.Khalili

SETUP FILE : STANDARD.SET

INCLINATION :

DIAM : -

DATE : 26 September 2019

DATE : 26 September 2019

DATE : 22/10/19 15:49

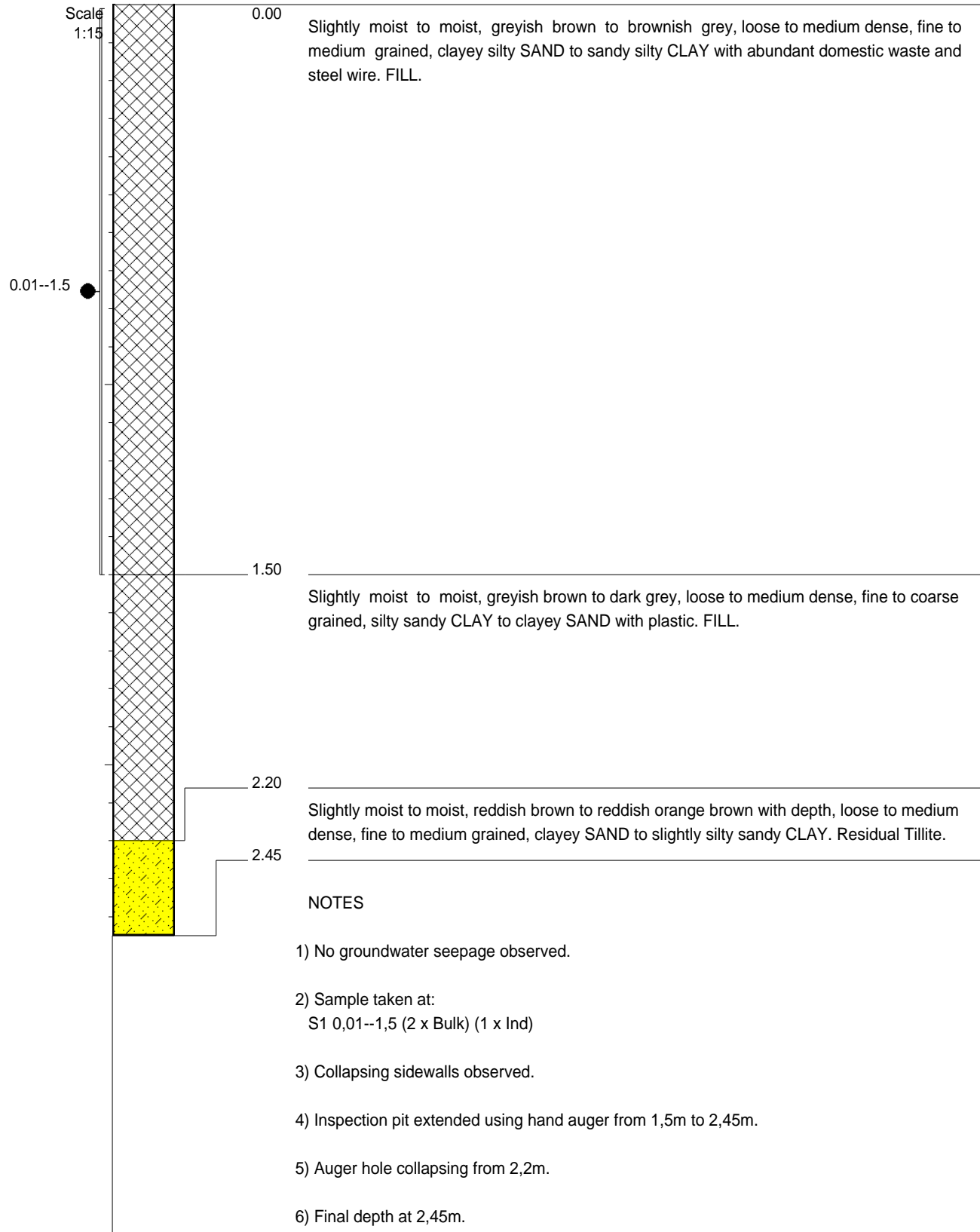
TEXT : ..C:\LOGS\IPITSIP.TXT

ELEVATION : -

X-COORD : 30 57'24.63"E

Y-COORD : 29 44'30.47"S

HOLE No: IP23



CONTRACTOR : -

MACHINE : By hand

DRILLED BY :

PROFILED BY : S.R.; F.Smith Pr.Sci.Nat. Reg No. 400049/00

TYPE SET BY : P.Khalili

SETUP FILE : STANDARD.SET

INCLINATION :

DIAM : -

DATE : 26 September 2019

DATE : 26 September 2019

DATE : 22/10/19 15:49

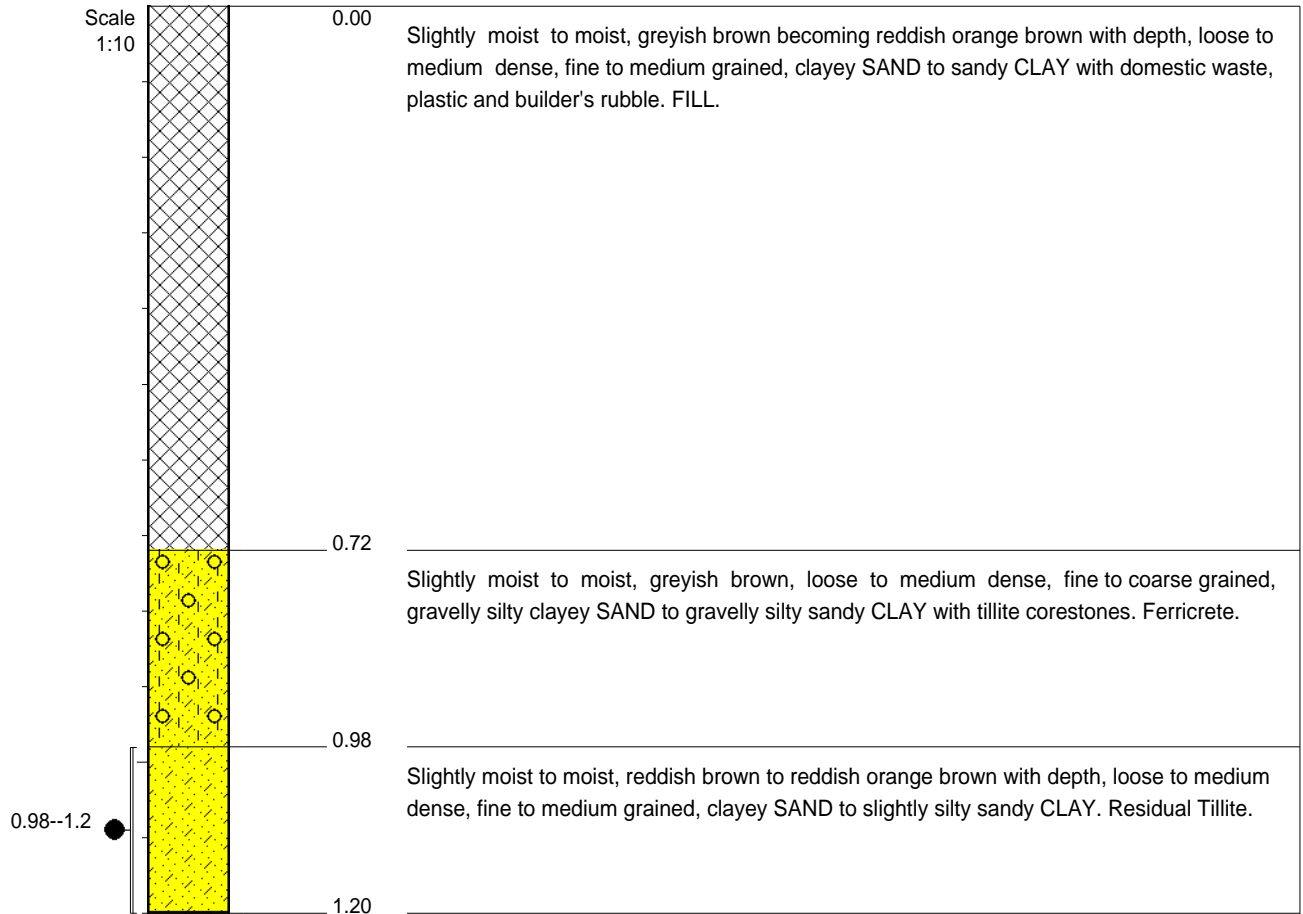
TEXT : ..C:\LOGS\PITSIP.TXT

ELEVATION : -

X-COORD : 30 57'24.9"E

Y-COORD : 29 44'30.5"S

HOLE No: IP24



NOTES

- 1) No groundwater seepage observed.
- 2) Sample taken at:
S1 0,98--1,2 (2 x Bulk) (1 x Ind)
- 3) Potentially unstable sidewalls.
- 4) Refusal depth at 1,2m.

CONTRACTOR : -

MACHINE : By hand

DRILLED BY :

PROFILED BY : S.R.; F.Smith Pr.Sci.Nat. Reg No. 400049/00

TYPE SET BY : P.Khalili

SETUP FILE : STANDARD.SET

INCLINATION :

DIAM : -

DATE : 26 September 2019

DATE : 26 September 2019

DATE : 22/10/19 15:49

TEXT : ..C:\LOGS\PITSIP.TXT

ELEVATION : 192m

X-COORD : 30 57'19.1"E

Y-COORD : 29 44'28.7"S

HOLE No: IP25



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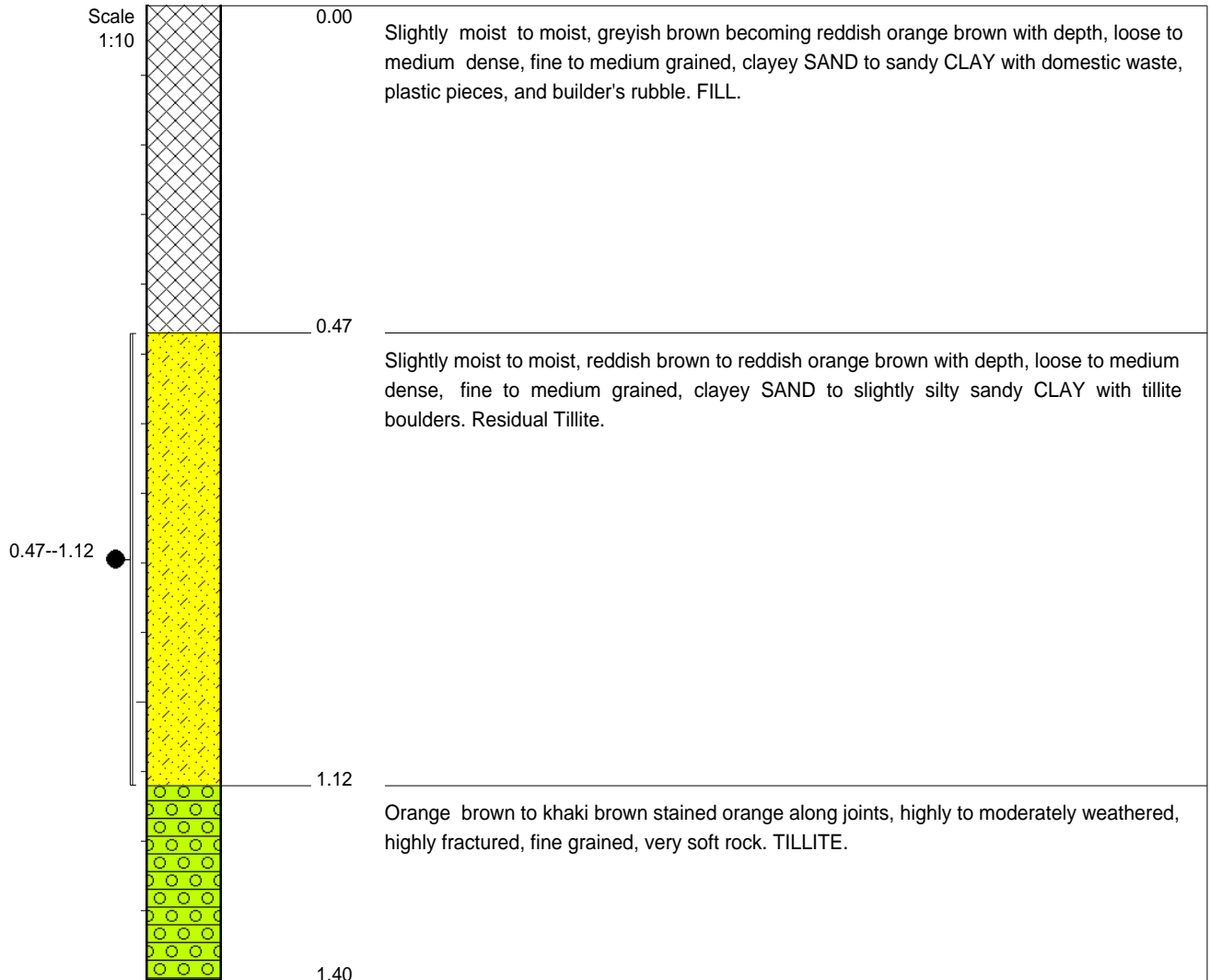
Ethekewini Municipality - Water and Sanitation Unit
Construction of Sewer Reticulation at
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HOLE No: IP26
Sheet 1 of 1

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JOB NUMBER: 233-19



NOTES

- 1) No groundwater seepage observed.
- 2) Sample taken at:
S1 0,47--1,12 (2 x Bulk) (1 x Ind)
- 3) Potentially unstable sidewalls.
- 4) Refusal depth at 1,4m on rock.

CONTRACTOR : -

MACHINE : By hand

DRILLED BY :

PROFILED BY : S.R.; F.Smith Pr.Sci.Nat. Reg No. 400049/00

TYPE SET BY : P.Khalili

SETUP FILE : STANDARD.SET

INCLINATION :

DIAM : -

DATE : 26 September 2019

DATE : 26 September 2019

DATE : 22/10/19 15:49

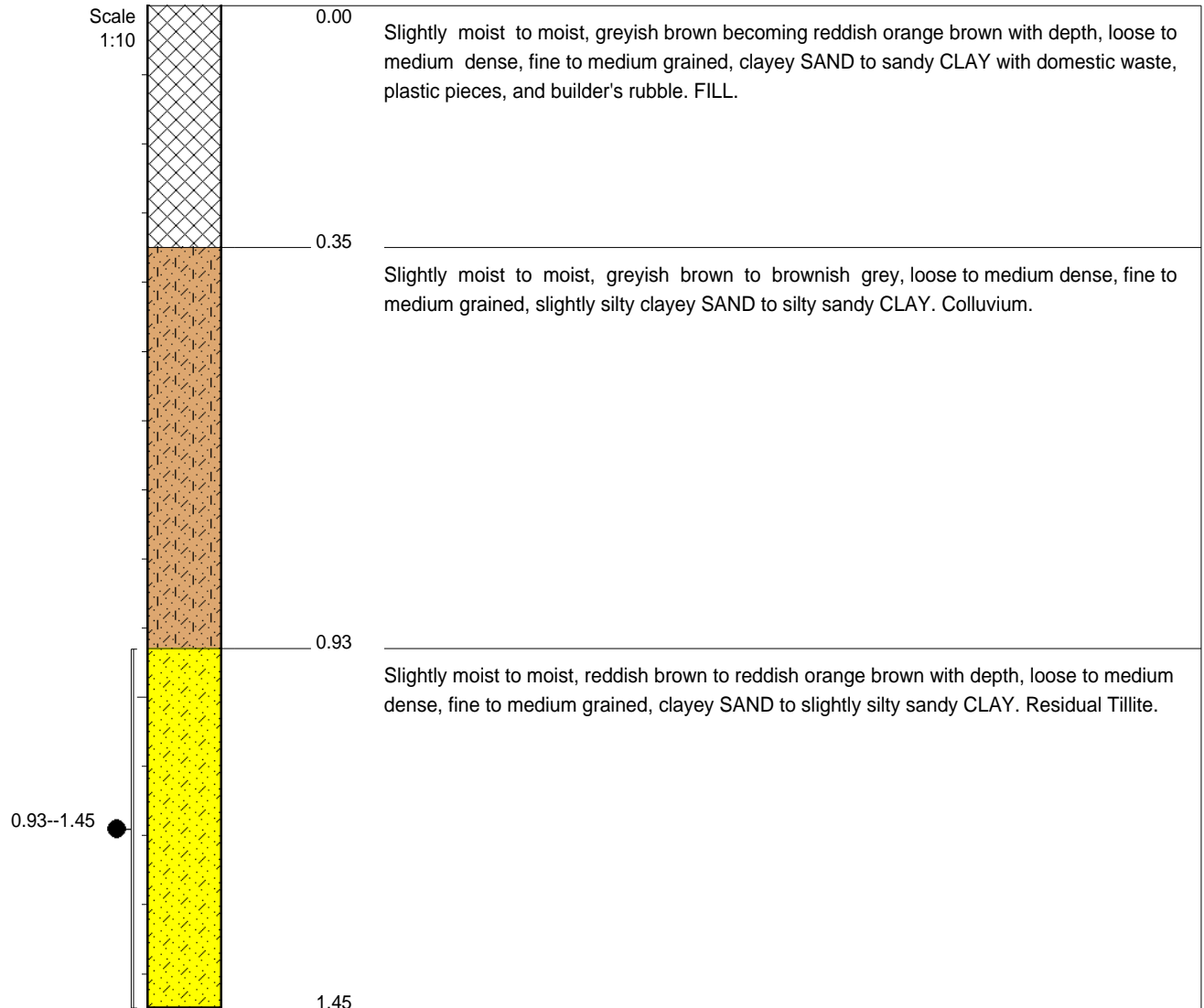
TEXT : ..C:\LOGS\PITSIP.TXT

ELEVATION : 190m

X-COORD : 30 57'22.1"E

Y-COORD : 29 44'26.4"S

HOLE No: IP26



NOTES

- 1) No groundwater seepage observed.
- 2) Sample taken at:
S1 0,93--1,45 (1 x Ind)
- 3) Potentially unstable sidewalls.
- 4) Inspection pit extended using hand auger from 1,45m - hand auger refused.
- 5) Refusal depth at 1,45m.

CONTRACTOR : -

MACHINE : By hand

DRILLED BY :

PROFILED BY : S.R.; F.Smith Pr.Sci.Nat. Reg No. 400049/00

TYPE SET BY : P.Khalili

SETUP FILE : STANDARD.SET

INCLINATION :

DIAM : -

DATE : 26 September 2019

DATE : 26 September 2019

DATE : 22/10/19 15:49

TEXT : ..C:\LOGS\PITSIP.TXT

ELEVATION : 178m

X-COORD : 30 57'28.2"E

Y-COORD : 29 44'26.6"S

HOLE No: IP27



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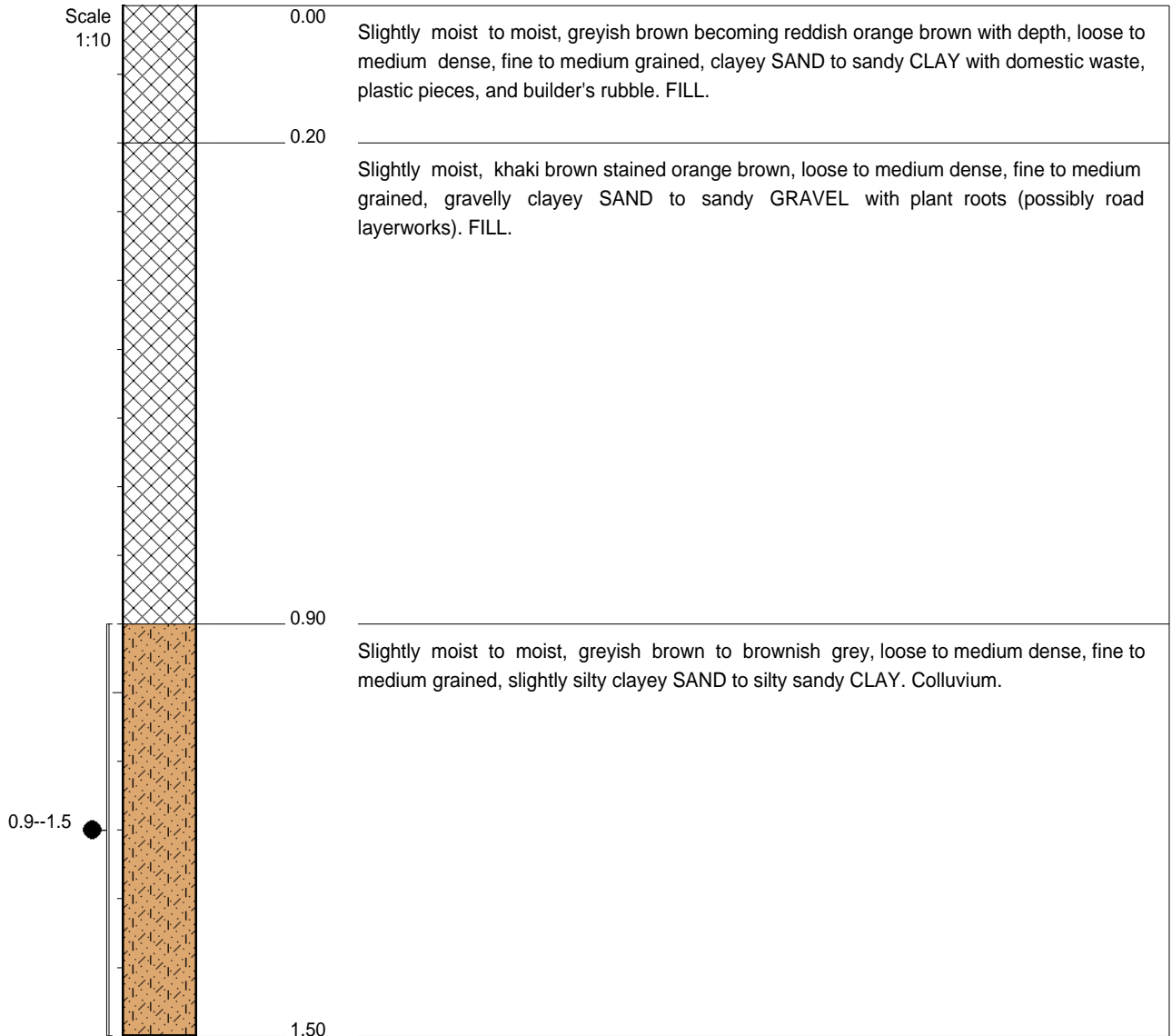
Ethekewini Municipality - Water and Sanitation Unit
Construction of Sewer Reticulation at
Ntuzuma B within Ward 45

HOLE No: IP28
Sheet 1 of 1

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email: geosure@iafrica.com

Fax: 086 689-5506
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JOB NUMBER: 233-19



NOTES

- 1) No groundwater seepage observed.
- 2) Sample taken at:
S1 0,9--1,5 (2 x Bulk) (1 x Ind)
- 3) Potentially unstable sidewalls.
- 4) Refusal of hand auger at 1,5m.

CONTRACTOR : -

MACHINE : By hand

DRILLED BY :

PROFILED BY : S.R.; F.Smith Pr.Sci.Nat. Reg No. 400049/00

TYPE SET BY : P.Khalili

SETUP FILE : STANDARD.SET

INCLINATION :

DIAM : -

DATE : 26 September 2019

DATE : 26 September 2019

DATE : 22/10/19 15:49

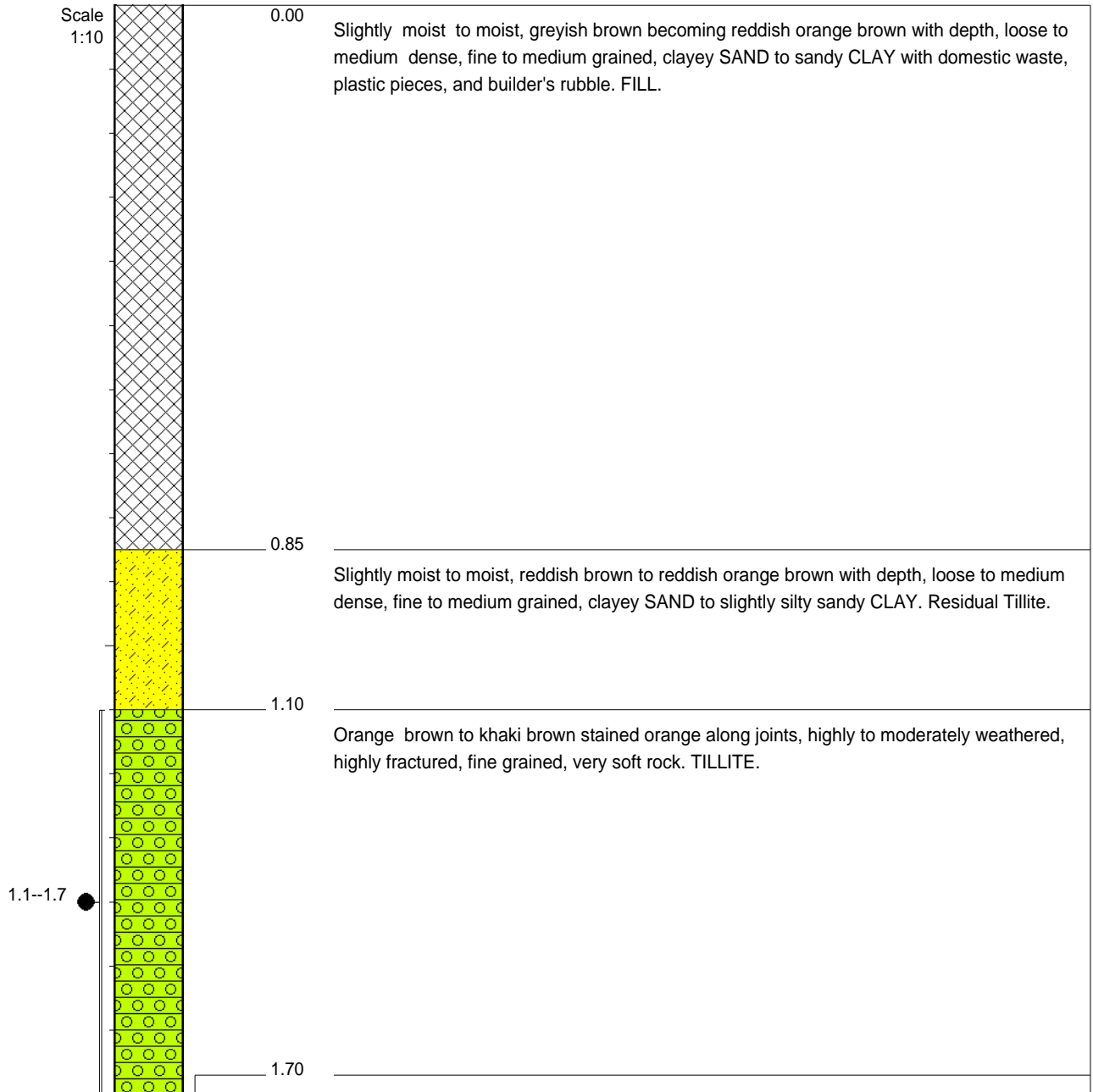
TEXT : ..C:\LOGS\PITSIP.TXT

ELEVATION : 199m

X-COORD : 30 57'30.6"E

Y-COORD : 29 44'20.9"S

HOLE No: IP28



NOTES

- 1) No groundwater seepage observed.
- 2) Sample taken at:
S1 1,1--1,7 (1 x Ind)
- 3) Potentially unstable sidewalls.
- 4) Refusal of hand auger at 1,7m.

CONTRACTOR : -

MACHINE : By hand

DRILLED BY :

PROFILED BY : S.R.; F.Smith Pr.Sci.Nat. Reg No. 400049/00

TYPE SET BY : P.Khalili

SETUP FILE : STANDARD.SET

INCLINATION :

DIAM : -

DATE : 26 September 2019

DATE : 26 September 2019

DATE : 22/10/19 15:49

TEXT : ..C:\LOGS\PITSIP.TXT

ELEVATION : 209m

X-COORD : 30 57'28.3"E

Y-COORD : 29 44'19.2"S

HOLE No: IP29



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Construction of Sewer Reticulation at
Ntuzuma B within Ward 45

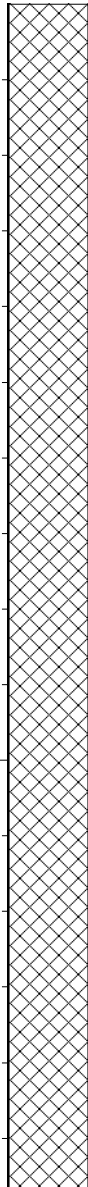
HOLE No: IP30
Sheet 1 of 1

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JOB NUMBER: 233-19

Scale
1:10



0.00

Slightly moist to moist, greyish brown becoming reddish orange brown with depth, loose to medium dense, fine to medium grained, clayey SAND to sandy CLAY with domestic waste, plastic pieces, and builder's rubble. FILL.

1.57

NOTES

- 1) No groundwater seepage observed.
- 2) Potentially unstable sidewalls.
- 3) Pipe encountered at 0,6m.
- 4) Refusal of hand auger at 1,57m.

CONTRACTOR : -

MACHINE : By hand

DRILLED BY :

PROFILED BY : S.R.; F.Smith Pr.Sci.Nat. Reg No. 400049/00

TYPE SET BY : P.Khalili

SETUP FILE : STANDARD.SET

INCLINATION :

DIAM : -

DATE : 26 September 2019

DATE : 26 September 2019

DATE : 22/10/19 15:49

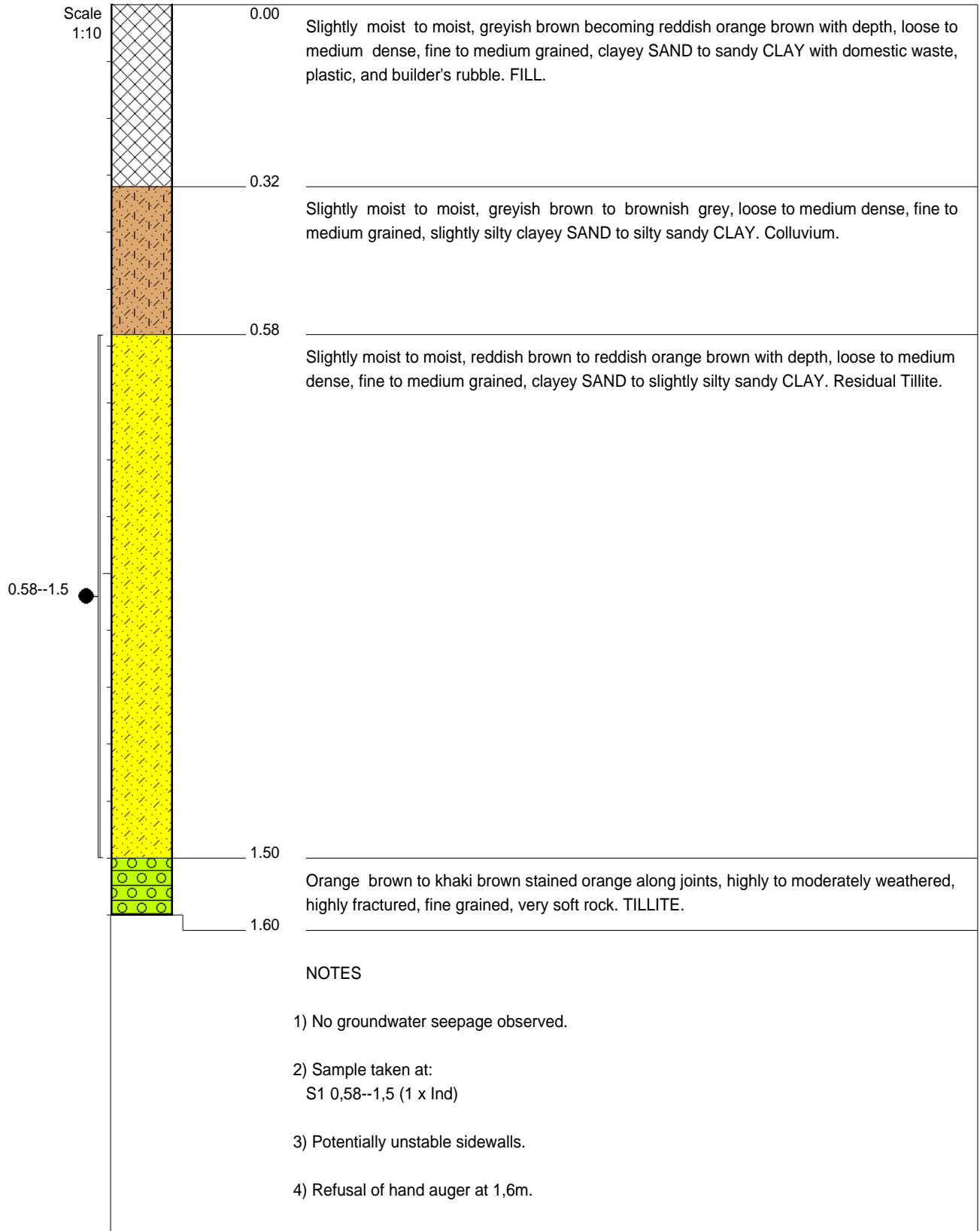
TEXT : ..C:\LOGS\PITSIP.TXT

ELEVATION : 208m

X-COORD : 30 57'31.0"E

Y-COORD : 29 44'14.2"S

HOLE No: IP30



CONTRACTOR : -

MACHINE : By hand

DRILLED BY :

PROFILED BY : S.R.; F.Smith Pr.Sci.Nat. Reg No. 400049/00

TYPE SET BY : P.Khalili

SETUP FILE : STANDARD.SET

INCLINATION :

DIAM : -

DATE : 26 September 2019

DATE : 26 September 2019

DATE : 22/10/19 15:49

TEXT : ..C:\LOGS\PITSIP.TXT

ELEVATION : 232m

X-COORD : 30 57'14.8"E

Y-COORD : 29 44'22.5"S



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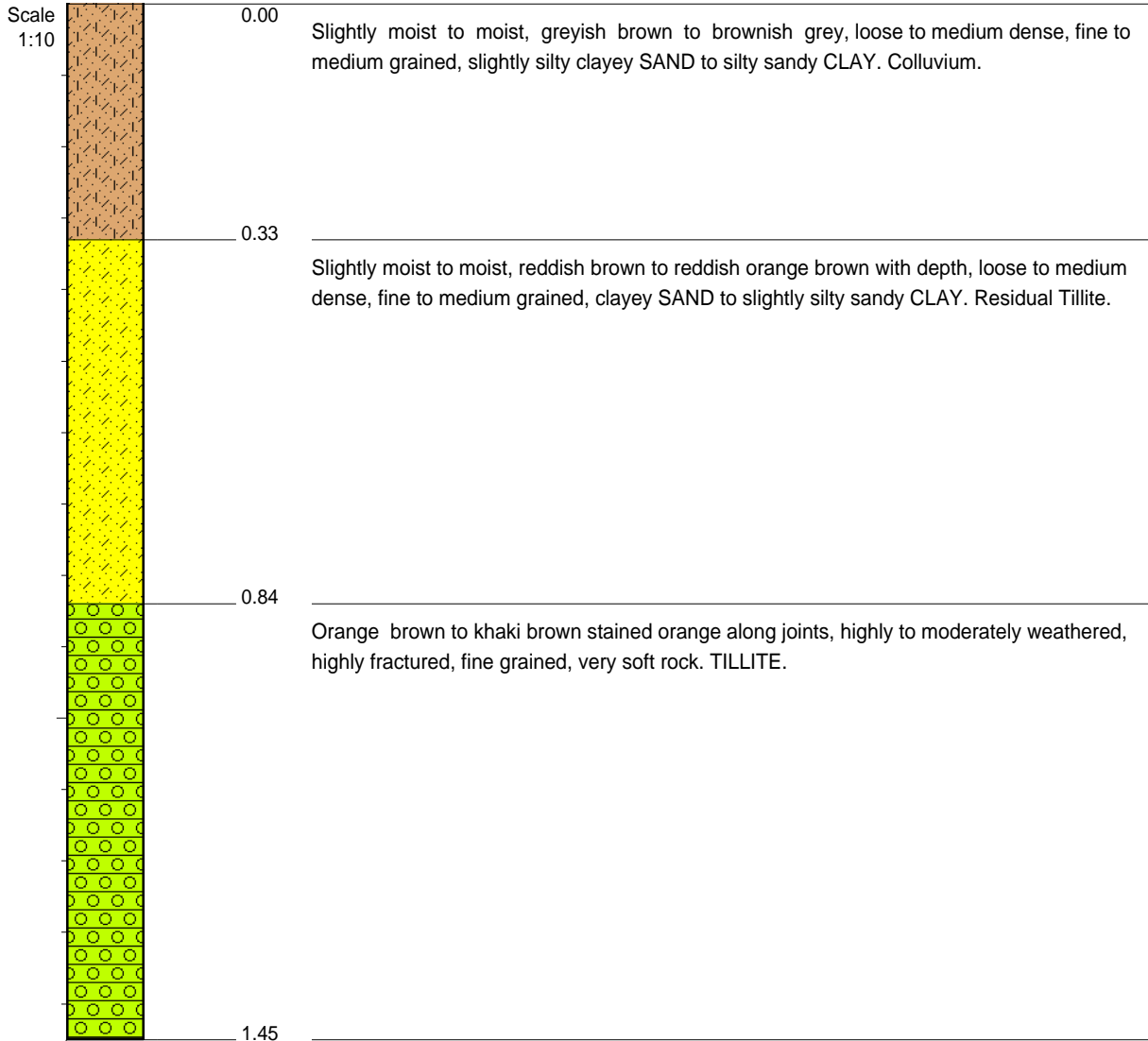
Ethekewini Municipality - Water and Sanitation Unit
Construction of Sewer Reticulation at
Ntuzuma B within Ward 45

HOLE No: IP32
Sheet 1 of 1

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JOB NUMBER: 233-19



NOTES

- 1) No groundwater seepage observed.
- 2) Potentially unstable sidewalls.
- 3) Refusal of hand auger at 1,45m.

CONTRACTOR : -

MACHINE : By hand

DRILLED BY :

PROFILED BY : S.R.; F.Smith Pr.Sci.Nat. Reg No. 400049/00

TYPE SET BY : P.Khalili

SETUP FILE : STANDARD.SET

INCLINATION :

DIAM : -

DATE : 26 September 2019

DATE : 26 September 2019

DATE : 22/10/19 15:49

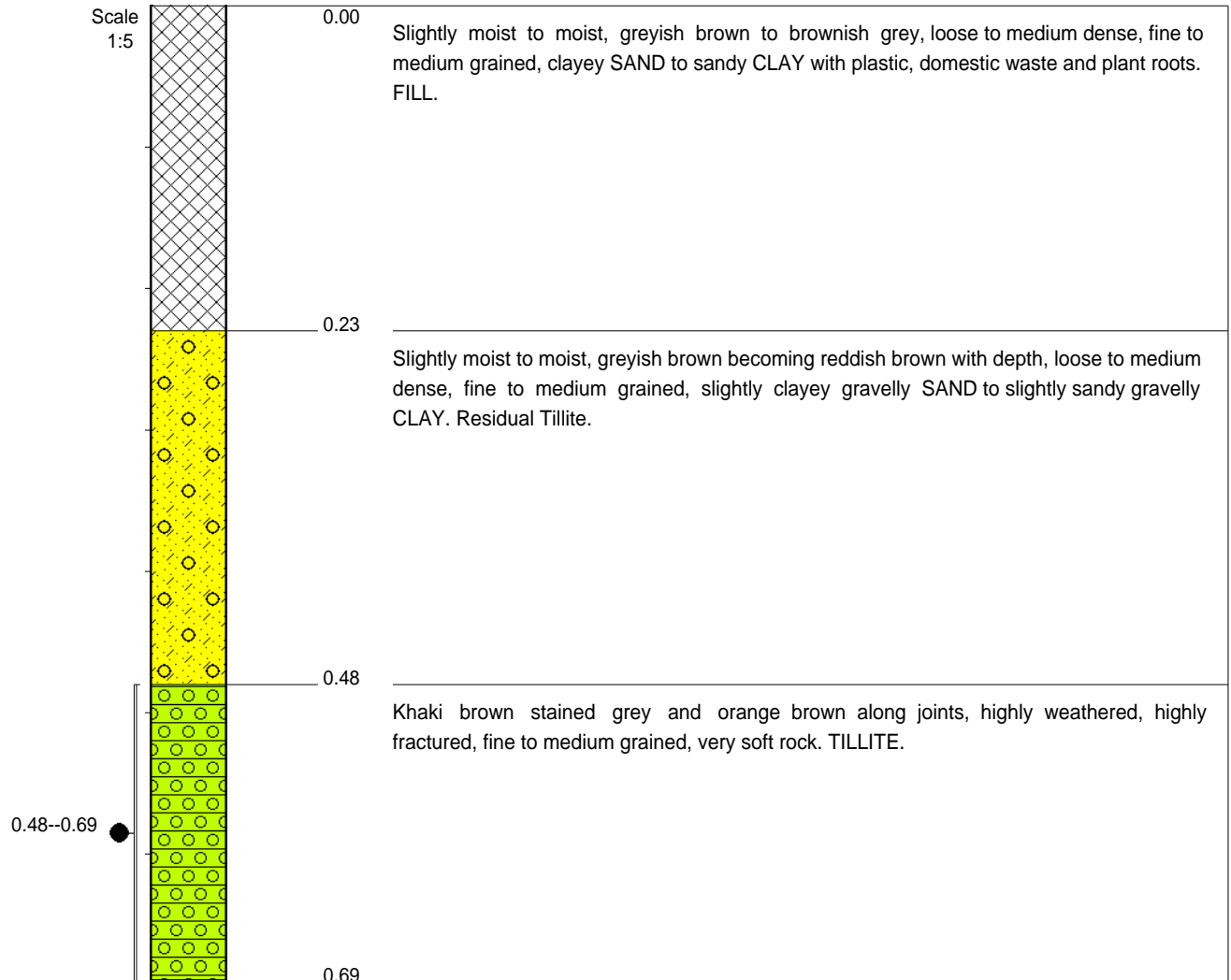
TEXT : ..C:\LOGS\PITSIP.TXT

ELEVATION : 216m

X-COORD : 30 57'15.3"E

Y-COORD : 29 44'24.7"S

HOLE No: IP32



NOTES

- 1) No groundwater seepage observed.
- 2) Sample taken at:
S1 0,48--0,69 (3 x Bulk)
- 3) Potentially unstable sidewalls.
- 4) Refusal of hand auger on tillite rock at 0,69m.

CONTRACTOR : -

MACHINE : By hand

DRILLED BY :

PROFILED BY : S.R.; F.Smith Pr.Sci.Nat. Reg No. 400049/00

TYPE SET BY : P.Khalili

SETUP FILE : STANDARD.SET

INCLINATION :

DIAM : -

DATE : 27 September 2019

DATE : 27 September 2019

DATE : 22/10/19 15:49

TEXT : ..C:\LOGS\PITSIP.TXT

ELEVATION : 227m

X-COORD : 30 57'09.5"E

Y-COORD : 29 44'27.2"S

HOLE No: IP33



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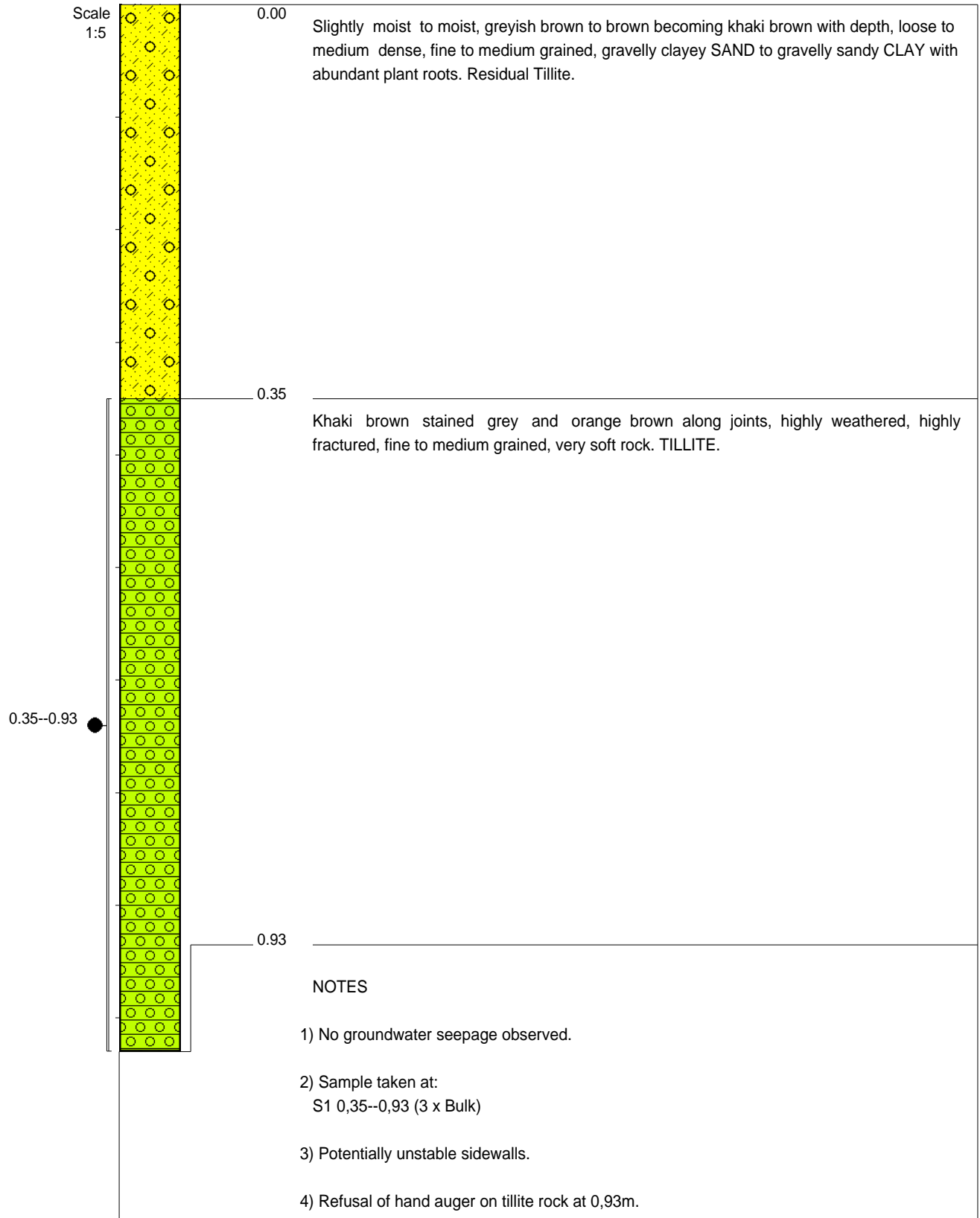
Ethekewini Municipality - Water and Sanitation Unit
Construction of Sewer Reticulation at
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HOLE No: IP34
Sheet 1 of 1

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JOB NUMBER: 233-19



CONTRACTOR : -

MACHINE : By hand

DRILLED BY :

PROFILED BY : S.R.; F.Smith Pr.Sci.Nat. Reg No. 400049/00

TYPE SET BY : P.Khalili

SETUP FILE : STANDARD.SET

INCLINATION :

DIAM : -

DATE : 27 September 2019

DATE : 27 September 2019

DATE : 22/10/19 15:49

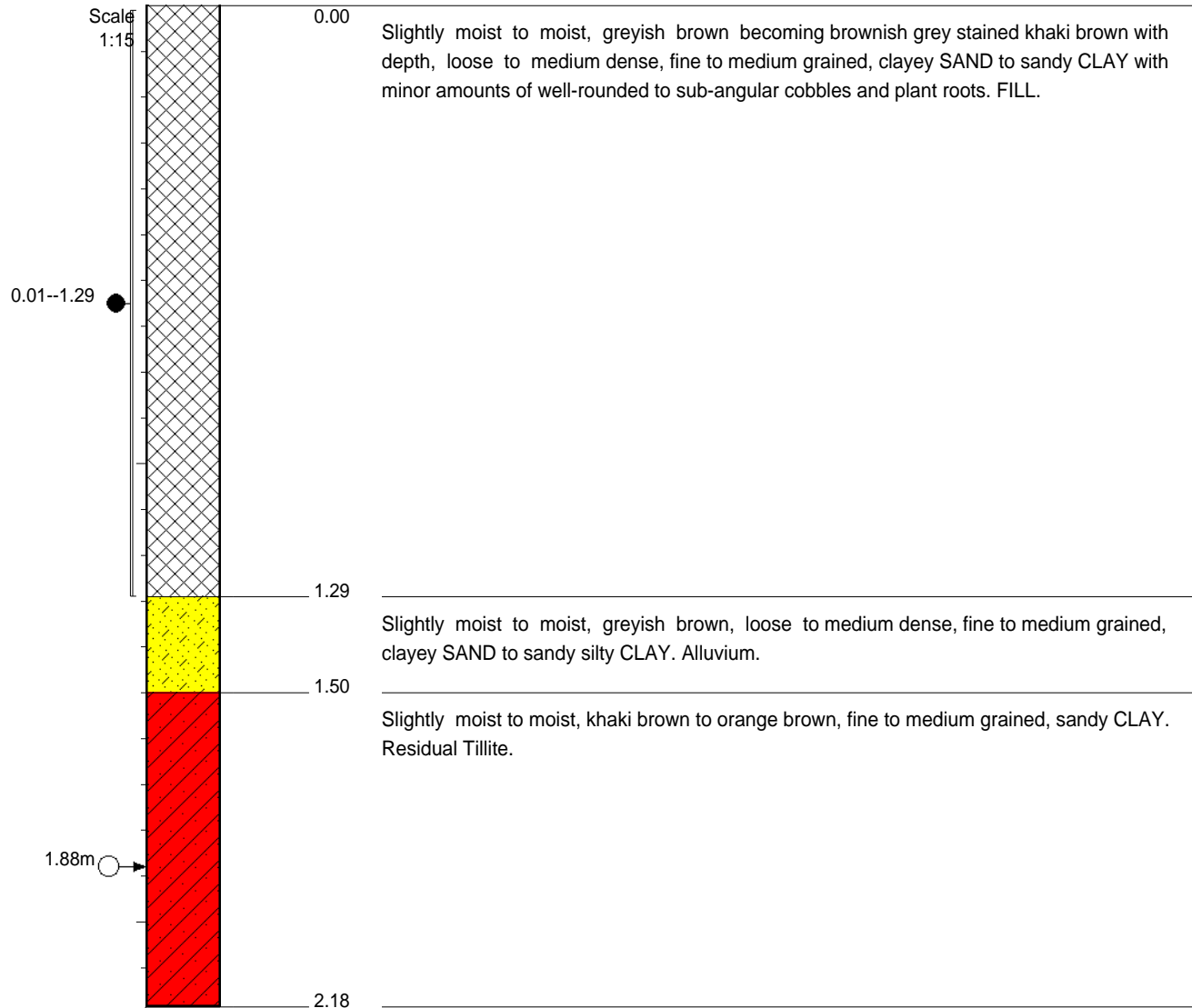
TEXT : ..C:\LOGS\PITSIP.TXT

ELEVATION : 216m

X-COORD : 30 57'13.6"E

Y-COORD : 29 44'30.5"S

HOLE No: IP34



NOTES

- 1) Slight groundwater seepage observed at 1,88m.
- 2) Sample taken at:
S1 0,01--1,29 (3 x Bulk)
- 3) Potentially unstable sidewalls.
- 4) Inspection pit extended using hand auger from 1,5m to 2,186m.
- 5) Refusal depth at 2,186m.

CONTRACTOR : -

MACHINE : By hand

DRILLED BY :

PROFILED BY : S.R.; F.Smith Pr.Sci.Nat. Reg No. 400049/00

TYPE SET BY : P.Khalili

SETUP FILE : STANDARD.SET

INCLINATION :

DIAM : -

DATE : 27 September 2019

DATE : 27 September 2019

DATE : 22/10/19 15:49

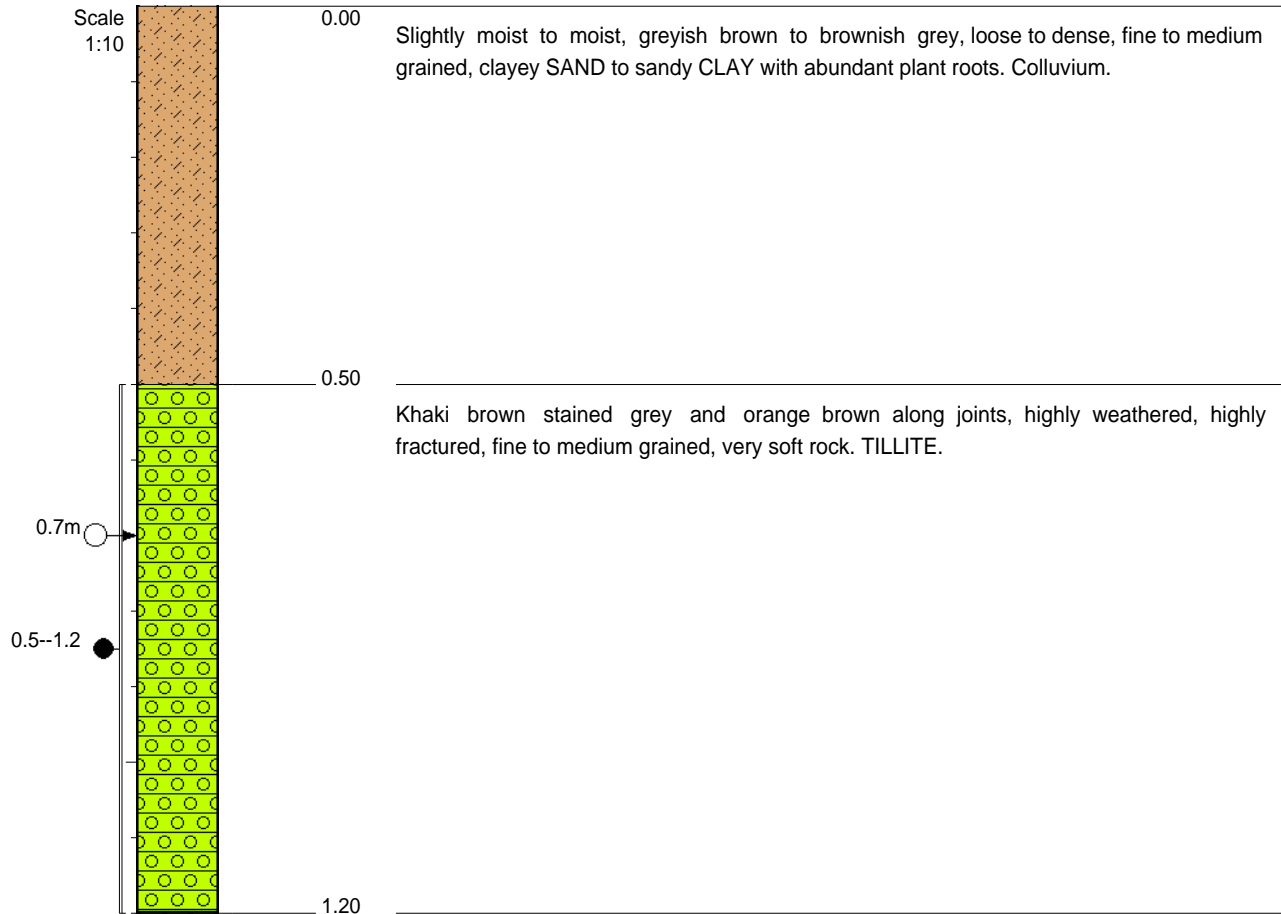
TEXT : ..C:\LOGS\PITSIP.TXT

ELEVATION : 225m

X-COORD : 30 57'06.7"E

Y-COORD : 29 44'31.5"S

HOLE No: IP35



NOTES

- 1) Slight groundwater seepage observed at 0,7m.
- 2) Sample taken at:
S1 0,5--1,2 (3 x Bulk)
- 3) Potentially unstable sidewalls.
- 4) Refusal of hand auger on tillite rock at 1,2m.

CONTRACTOR : -

MACHINE : By hand

DRILLED BY :

PROFILED BY : S.R.; F.Smith Pr.Sci.Nat. Reg No. 400049/00

TYPE SET BY : P.Khalili

SETUP FILE : STANDARD.SET

INCLINATION :

DIAM : -

DATE : 27 September 2019

DATE : 27 September 2019

DATE : 22/10/19 15:49

TEXT : ..C:\LOGS\PITSIP.TXT

ELEVATION : 221m

X-COORD : 30 57'11.7"E

Y-COORD : 29 44'35.5"S

HOLE No: IP36



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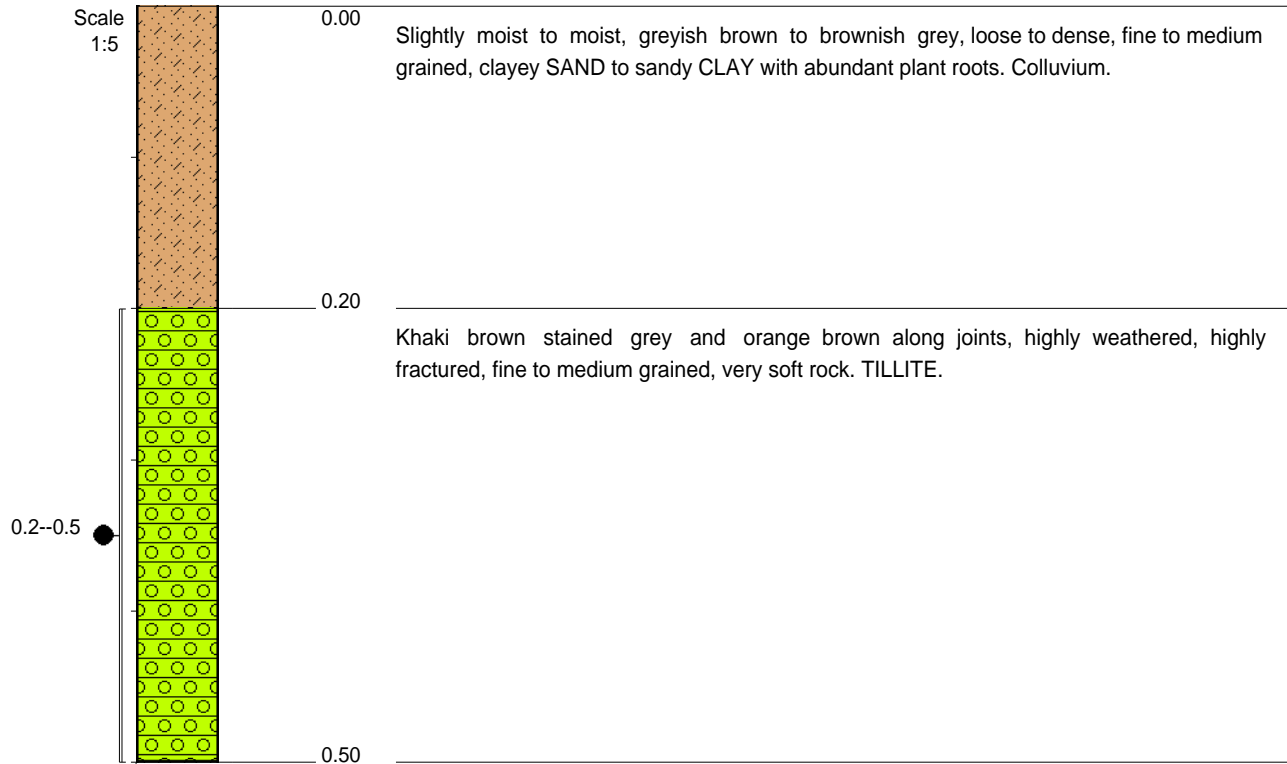
Ethekewini Municipality - Water and Sanitation Unit
Construction of Sewer Reticulation at
Ntuzuma B within Ward 45

HOLE No: IP37
Sheet 1 of 1

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JOB NUMBER: 233-19



NOTES

- 1) No groundwater seepage observed.
- 2) Sample taken at:
S1 0,2--0,5 (3 x Bulk)
- 3) Potentially unstable sidewalls.
- 4) Refusal of hand auger at 0,5m.

CONTRACTOR : -

MACHINE : By hand

DRILLED BY :

PROFILED BY : S.R.; F.Smith Pr.Sci.Nat. Reg No. 400049/00

TYPE SET BY : P.Khalili

SETUP FILE : STANDARD.SET

INCLINATION :

DIAM : -

DATE : 27 September 2019

DATE : 27 September 2019

DATE : 22/10/19 15:49

TEXT : ..C:\LOGS\PITSIP.TXT

ELEVATION : 215m

X-COORD : 30 57'13.9"E

Y-COORD : 29 44'33.1"S

HOLE No: IP37



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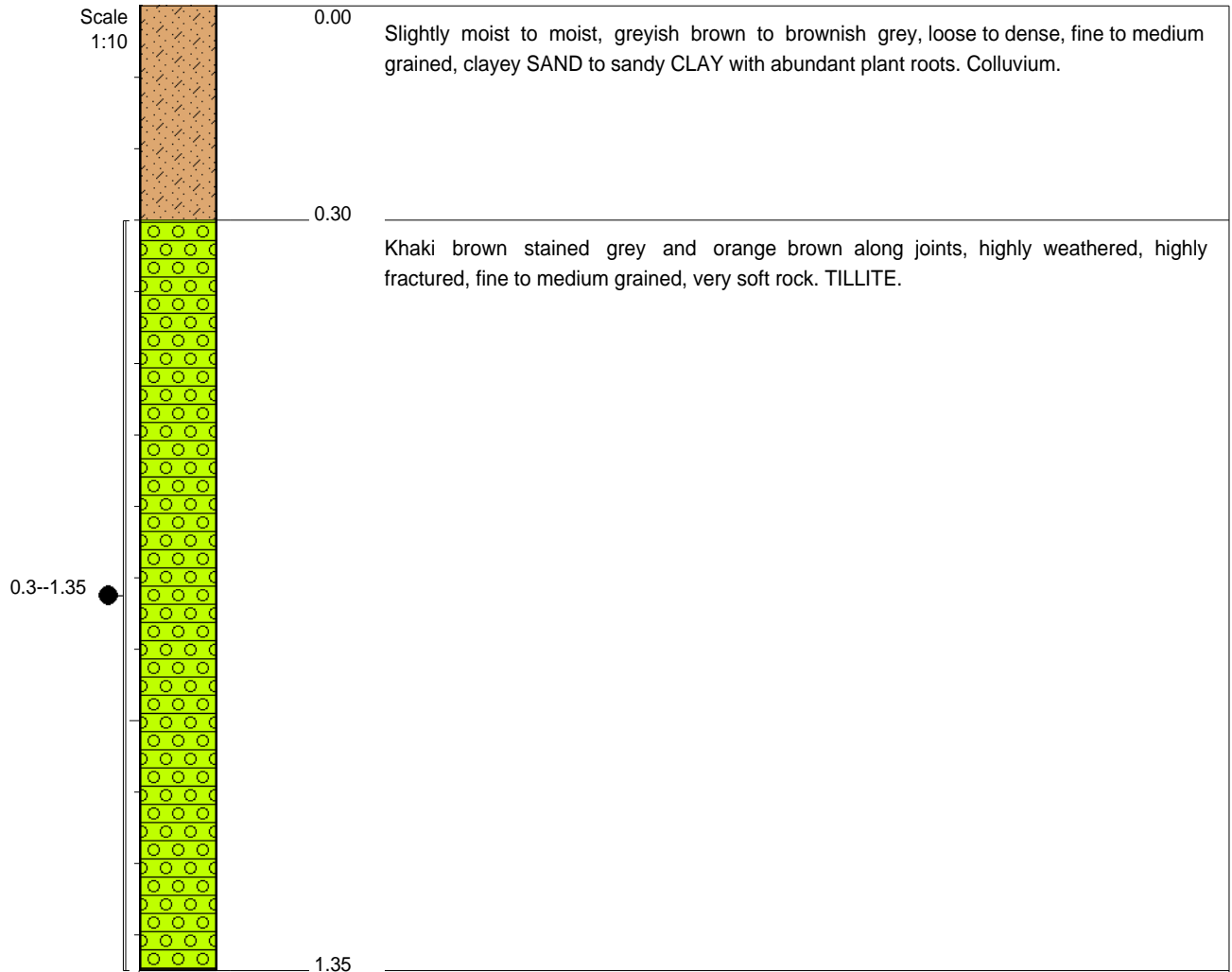
Ethekewini Municipality - Water and Sanitation Unit
Construction of Sewer Reticulation at
Ntuzuma B within Ward 45

HOLE No: IP38
Sheet 1 of 1

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JOB NUMBER: 233-19



NOTES

- 1) No groundwater seepage observed.
- 2) Sample taken at:
S1 0,3--1,35 (3 x Bulk)
- 3) Potentially unstable sidewalls.
- 4) Refusal of hand auger at 1,35m.

CONTRACTOR : -

MACHINE : By hand

DRILLED BY :

PROFILED BY : S.R.; F.Smith Pr.Sci.Nat. Reg No. 400049/00

TYPE SET BY : P.Khalili

SETUP FILE : STANDARD.SET

INCLINATION :

DIAM : -

DATE : 27 September 2019

DATE : 27 September 2019

DATE : 22/10/19 15:49

TEXT : ..C:\LOGS\PIPSIP.TXT

ELEVATION : 194m

X-COORD : 30 57'18.6"E

Y-COORD : 29 44'34.8"S

HOLE No: IP38



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Pile Integrity Testing & Civil
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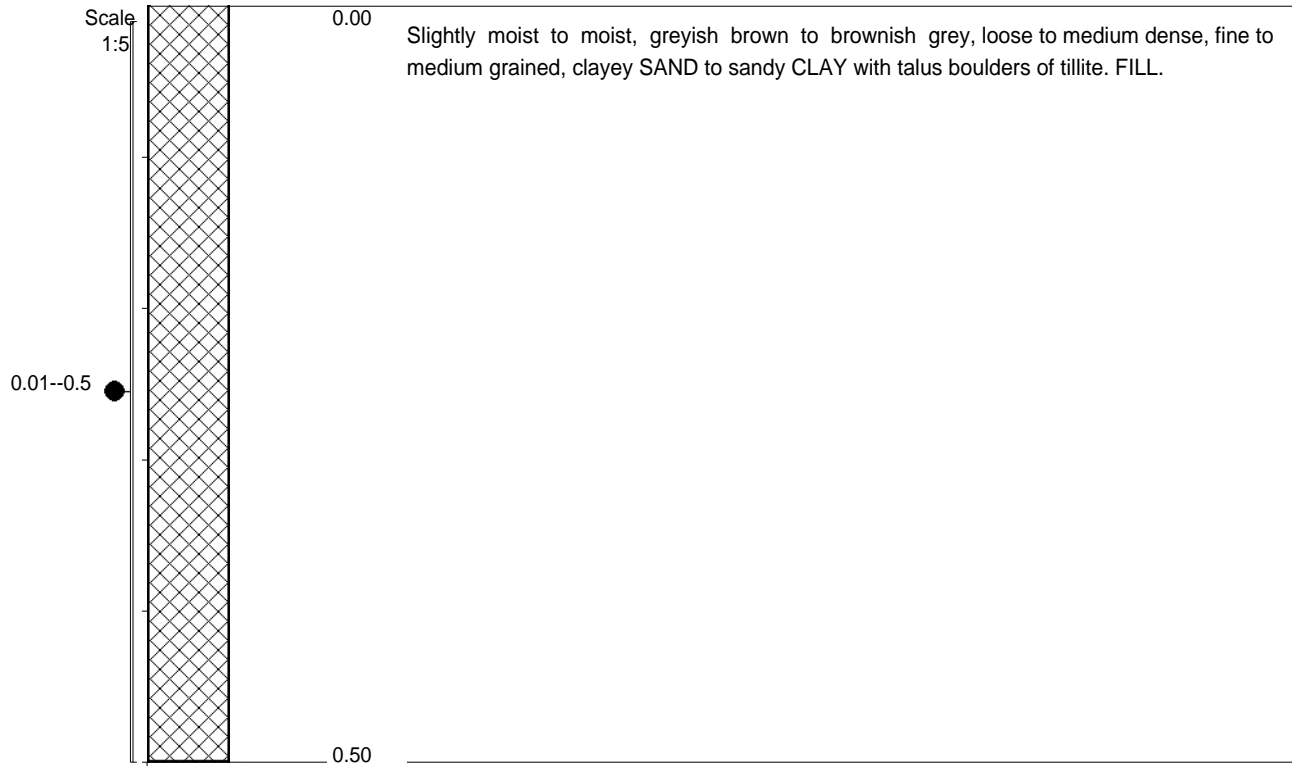
Ethekewini Municipality - Water and Sanitation Unit
Construction of Sewer Reticulation at
Ntuzuma B within Ward 45

HOLE No: IP39
Sheet 1 of 1

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JOB NUMBER: 233-19



NOTES

- 1) No groundwater seepage observed.
- 2) Sample taken at:
S1 0,01--0,5 (3 x Bulk)
- 3) Potentially unstable sidewalls.
- 4) Refusal on boulders at 0,5m.

CONTRACTOR : -

MACHINE : By hand

DRILLED BY :

PROFILED BY : S.R.; F.Smith Pr.Sci.Nat. Reg No. 400049/00

TYPE SET BY : P.Khalili

SETUP FILE : STANDARD.SET

INCLINATION :

DIAM : -

DATE : 27 September 2019

DATE : 27 September 2019

DATE : 22/10/19 15:49

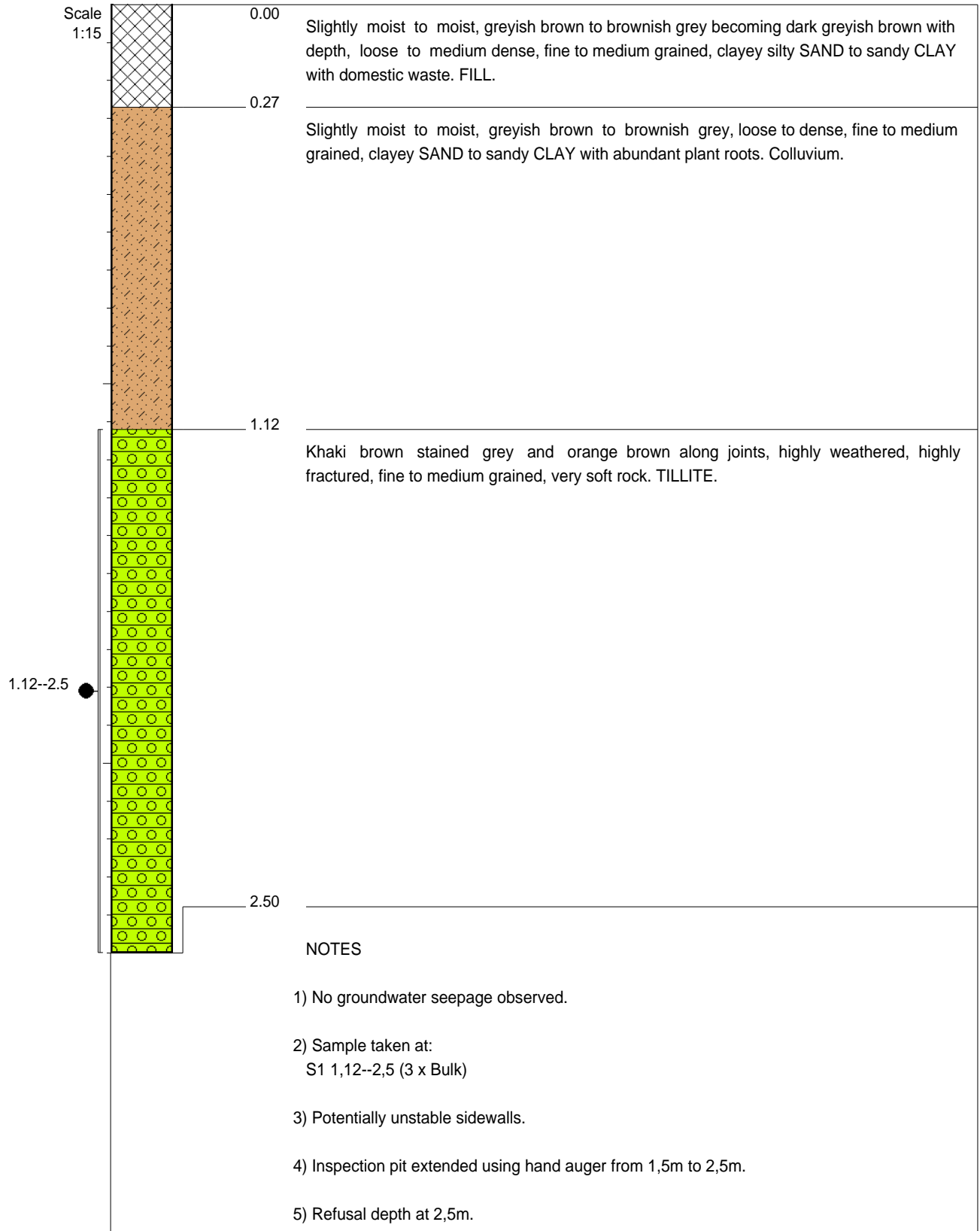
TEXT : ..C:\LOGS\PITSIP.TXT

ELEVATION : 203m

X-COORD : 30 57'19.0"E

Y-COORD : 29 44'27.6"S

HOLE No: IP39



CONTRACTOR : -

MACHINE : By hand

DRILLED BY :

PROFILED BY : S.R.; F.Smith Pr.Sci.Nat. Reg No. 400049/00

TYPE SET BY : P.Khalili

SETUP FILE : STANDARD.SET

INCLINATION :

DIAM : -

DATE : 27 September 2019

DATE : 27 September 2019

DATE : 22/10/19 15:49

TEXT : ..C:\LOGS\PITSIP.TXT

ELEVATION : 179m

X-COORD : 30 57'21.4"E

Y-COORD : 29 44'42.1"S

HOLE No: IP40



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Construction of Sewer Reticulation at
Ntuzuma B within Ward 41

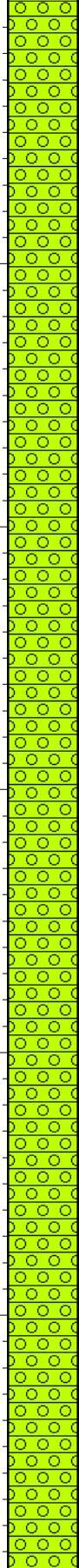
HOLE No: EXP1
Sheet 1 of 2

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JOB NUMBER: 233-19

Scale
1:25



Bluish grey stained orange along joints mottled light grey, highly to moderately weathered, moderately fractured, fine to medium grained, medium hard rock. TILLITE.



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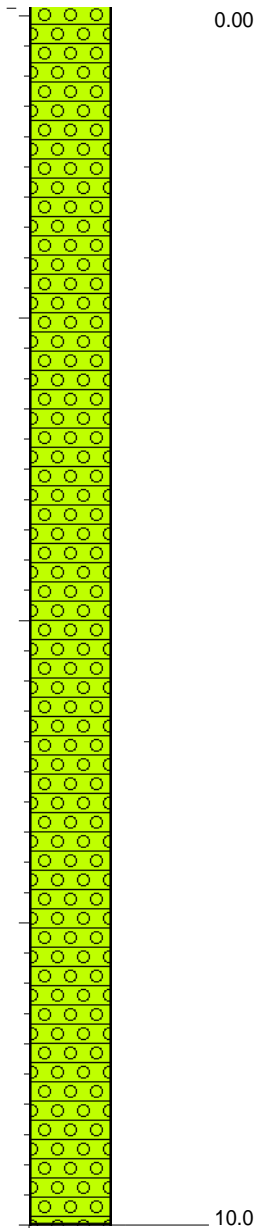
Ethekwini Municipality - Water and Sanitation Unit
Construction of Sewer Reticulation at
Ntuzuma B within Ward 41

HOLE No: EXP1
Sheet 2 of 2

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JOB NUMBER: 233-19



NOTES

- 1) No groundwater seepage observed.
- 2) Exposure located in valley line.
- 3) Near stream, approximately 3m from stream.
- 4) Final depth at 10,0m.

CONTRACTOR : -

MACHINE : By hand

DRILLED BY :

PROFILED BY : S.R.; F.Smith Pr.Sci.Nat. Reg No. 400049/00

TYPE SET BY : P.Khalili

SETUP FILE : STANDARD.SET

INCLINATION : -

DIAM : -

DATE : 25 September 2019

DATE : 25 September 2019

DATE : 22/10/19 15:49

TEXT : ..C:\LOGS\PITSEXP.TXT

ELEVATION : -

X-COORD : 30 57'02.9"E

Y-COORD : 29 44'45.6"S

HOLE No: EXP1



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Ethekewini Municipality - Water and Sanitation Unit
Construction of Sewer Reticulation at
Ntuzuma B within Ward 41

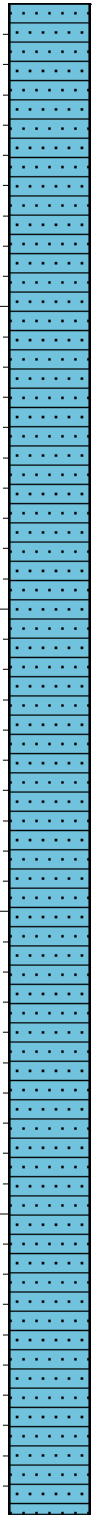
HOLE No: EXP2
Sheet 1 of 1

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Fax: 086 689-5506
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JOB NUMBER: 233-19

Scale
1:25



0.00

Pinkish brown speckled grey, fine grained, highly to moderately weathered, highly to moderately fractured, soft to medium hard rock. SANDSTONE.

5.00

NOTES

- 1) No groundwater seepage observed.
- 2) Final depth at 5,0m.

CONTRACTOR : -

MACHINE : By hand

DRILLED BY :

PROFILED BY : S.R.; F.Smith Pr.Sci.Nat. Reg No. 400049/00

TYPE SET BY : P.Khalili

SETUP FILE : STANDARD.SET

INCLINATION :

DIAM : -

DATE : 20 September 2019

DATE : 20 September 2019

DATE : 22/10/19 15:49

TEXT : ..C:\LOGS\PITSEXP.TXT

ELEVATION : 170m

X-COORD : 30 57'05.3"E

Y-COORD : 29 44'51.6"S

HOLE No: EXP2



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Ntuzuma B within Ward 41

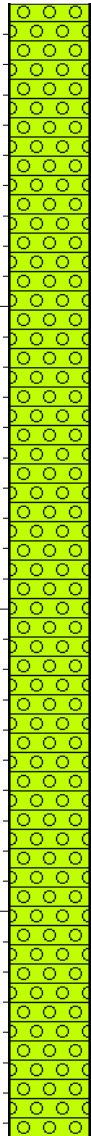
HOLE No: EXP3
Sheet 1 of 1

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JOB NUMBER: 233-19

Scale
1:25



0.00

Khaki brown stained dark grey along joints, highly to moderately weathered, highly to moderately fractured, fine to medium grained, medium hard rock. TILLITE.

3.75

NOTES

- 1) No groundwater seepage observed.
- 2) Final depth at 3,75m.

CONTRACTOR : -

MACHINE : By hand

DRILLED BY :

PROFILED BY : S.R.; F.Smith Pr.Sci.Nat. Reg No. 400049/00

TYPE SET BY : P.Khalili

SETUP FILE : STANDARD.SET

INCLINATION :

DIAM : -

DATE : 20 September 2019

DATE : 20 September 2019

DATE : 22/10/19 15:49

TEXT : ..C:\LOGS\PITSEXP.TXT

ELEVATION : 166m

X-COORD : 30 57'10.6"E

Y-COORD : 29 44'52.7"S

HOLE No: EXP3



APPENDIX B



**RESULTS OF CBR DYNAMIC CONE
PENETROMETER (DCP) TESTS**



GEOSURE (PTY) LTD.

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Email: info@geosure.co.za

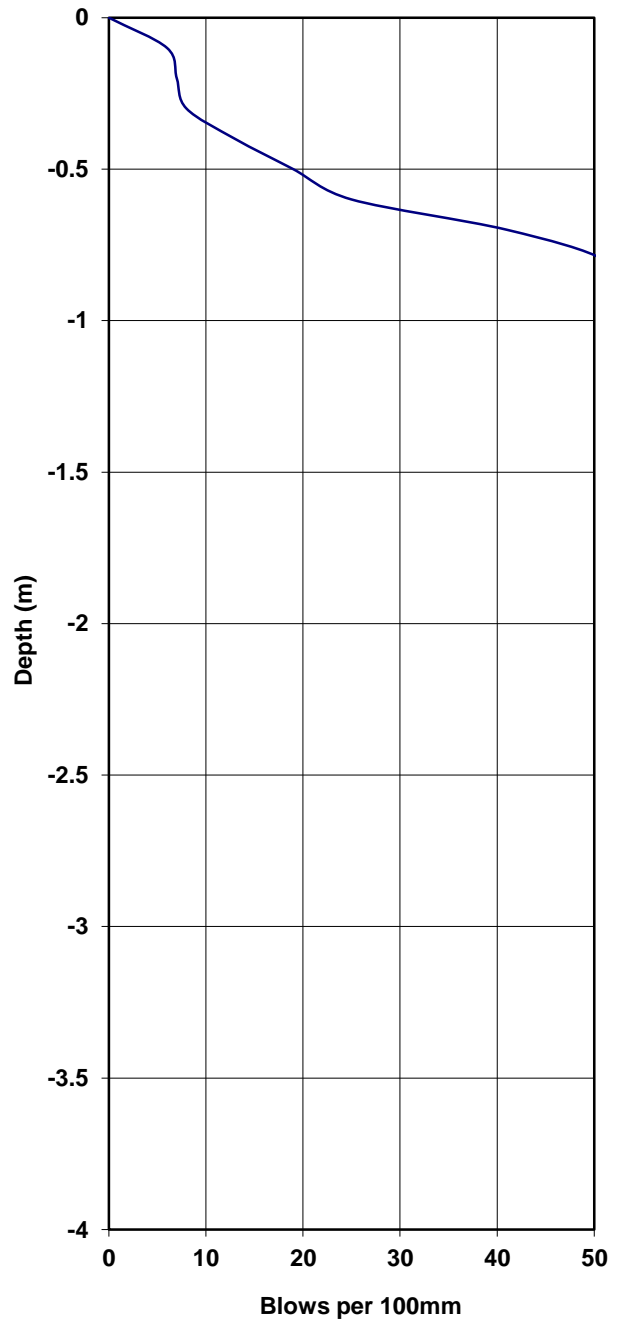


Client: Ethekewini Municipality - Water & Sanitation	Ref.No. 233-19
Project: Construction of Sewer Reticulation	Date: 19-26/09/2019
Section: Ntuzuma B, Wards 38, 41 & 45	Operator: S.Ramesh-warnath

CBR Penetrometer Probe ----- Test No. DC 1

THE STRENGTH AND CBR VALUES ARE EMPIRICAL AND DEPEND ON FACTORS SUCH AS MOISTURE CONTENT WHICH HAVE NOT BEEN DETERMINED. THEY ARE THEREFORE INDICATIVE ONLY AND SHOULD BE VERIFIED BY TEST OR OBSERVATION

Depth (m)	Blows/100mm	Inferred Consistency	Shear Strength	CBR %
0				
0.1	6	Firm	50 kPa	10
0.2	7	Firm	60 kPa	12
0.3	8	Firm	65 kPa	14
0.4	13	Stiff	110 kPa	23
0.5	19	Very Stiff	>150 kPa	35
0.6	25	Very Stiff	>150 kPa	49
0.7	41	Very Stiff	>150 kPa	>55
	Refusal			



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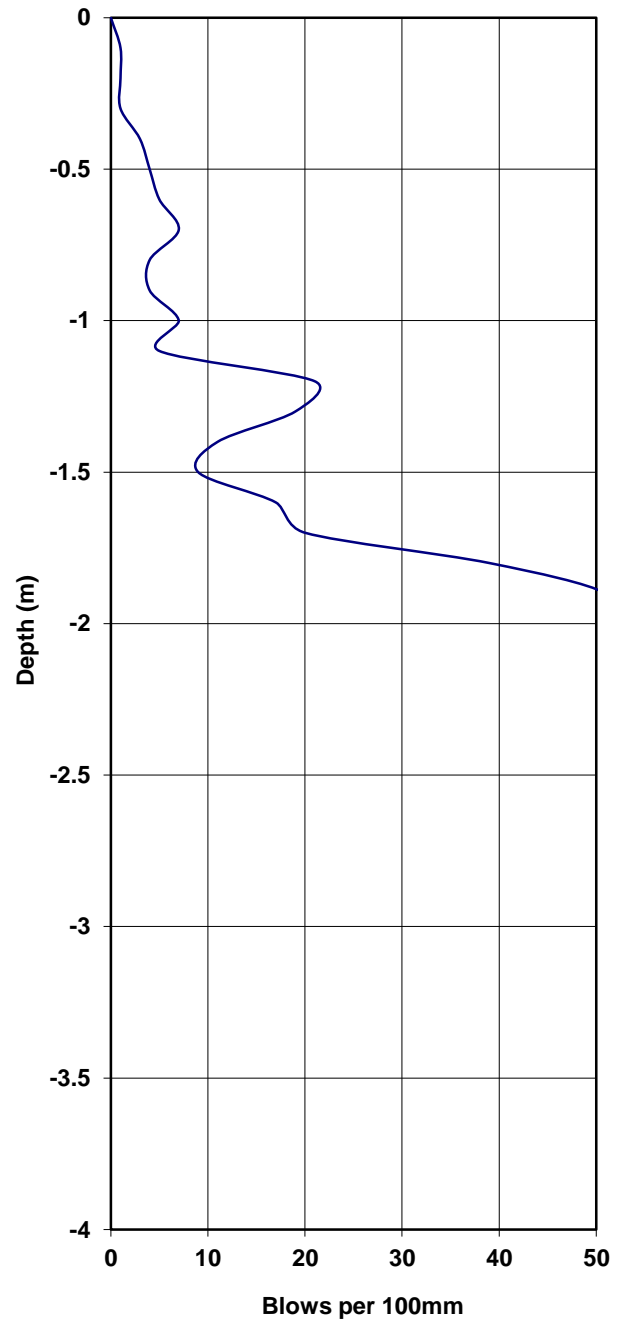


Client: EtheKwini Municipality - Water & Sanitation	Ref.No. 233-19
Project: Construction of Sewer Reticulation	Date: 19-26/09/2019
Section: Ntuzuma B, Wards 38, 41 & 45	Operator: S.Ramesh-warnath

CBR Penetrometer Probe ----- Test No. DC 2

THE STRENGTH AND CBR VALUES ARE EMPIRICAL AND DEPEND ON FACTORS SUCH AS MOISTURE CONTENT WHICH HAVE NOT BEEN DETERMINED. THEY ARE THEREFORE INDICATIVE ONLY AND SHOULD BE VERIFIED BY TEST OR OBSERVATION

Depth (m)	Blows/100mm	Inferred Consistency	Shear Strength	CBR %
0				
0.1	1	Very Soft	<20 kPa	2
0.2	1	Very Soft	<20 kPa	2
0.3	1	Very Soft	<20 kPa	2
0.4	3	Soft	25 kPa	5
0.5	4	Soft	35 kPa	7
0.6	5	Firm	40 kPa	8
0.7	7	Firm	60 kPa	12
0.8	4	Soft	35 kPa	7
0.9	4	Soft	35 kPa	7
1	7	Firm	60 kPa	12
1.1	5	Firm	40 kPa	8
1.2	21	Very Stiff	>150 kPa	40
1.3	19	Very Stiff	>150 kPa	35
1.4	11	Stiff	90 kPa	19
1.5	9	Stiff	75 kPa	15
1.6	17	Stiff	140 kPa	31
1.7	20	Very Stiff	>150 kPa	37
1.8	39	Very Stiff	>150 kPa	>55
	Refusal			



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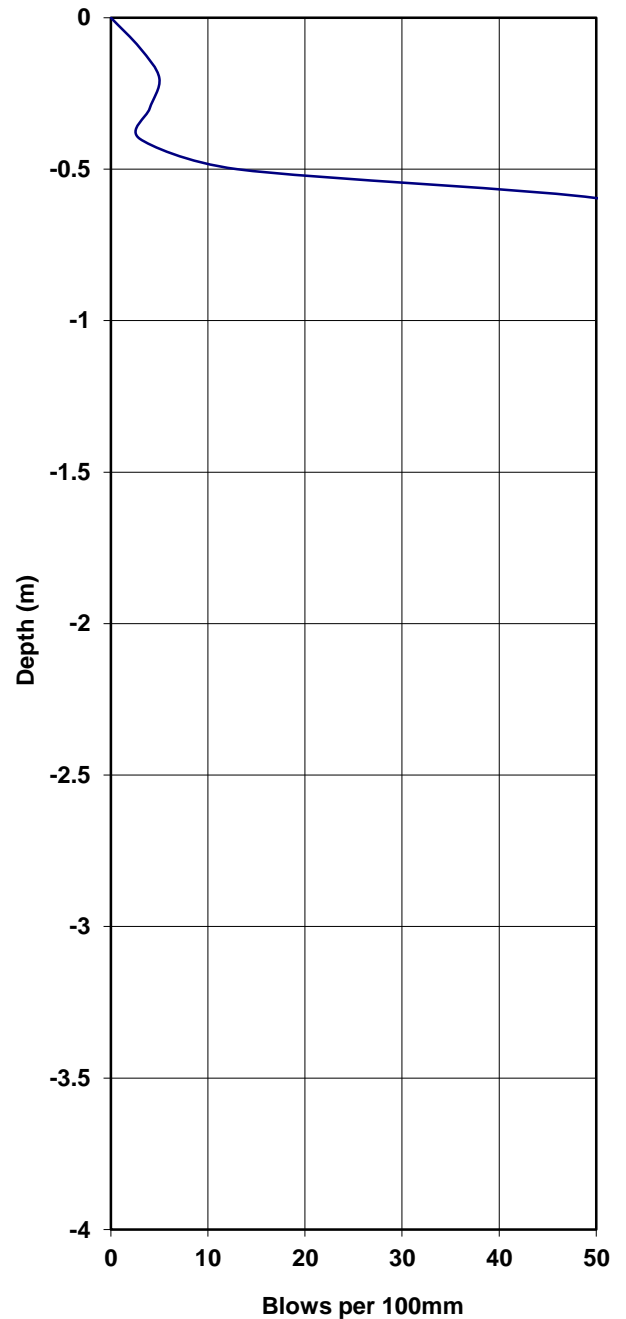


Client: Ethekewini Municipality - Water & Sanitation	Ref.No. 233-19
Project: Construction of Sewer Reticulation	Date: 19-26/09/2019
Section: Ntuzuma B, Wards 38, 41 & 45	Operator: S.Ramesh-warnath

CBR Penetrometer Probe ----- Test No. DC 3

THE STRENGTH AND CBR VALUES ARE EMPIRICAL AND DEPEND ON FACTORS SUCH AS MOISTURE CONTENT WHICH HAVE NOT BEEN DETERMINED. THEY ARE THEREFORE INDICATIVE ONLY AND SHOULD BE VERIFIED BY TEST OR OBSERVATION

Depth (m)	Blows/100mm	Inferred Consistency	Shear Strength	CBR %
0				
0.1	3	Loose	<30 deg	5
0.2	5	Med.Dense	32 deg	8
0.3	4	Med.Dense	30 deg	7
0.4	3	Loose	<30 deg	5
0.5	13	Dense	37 deg	23
	Refusal			



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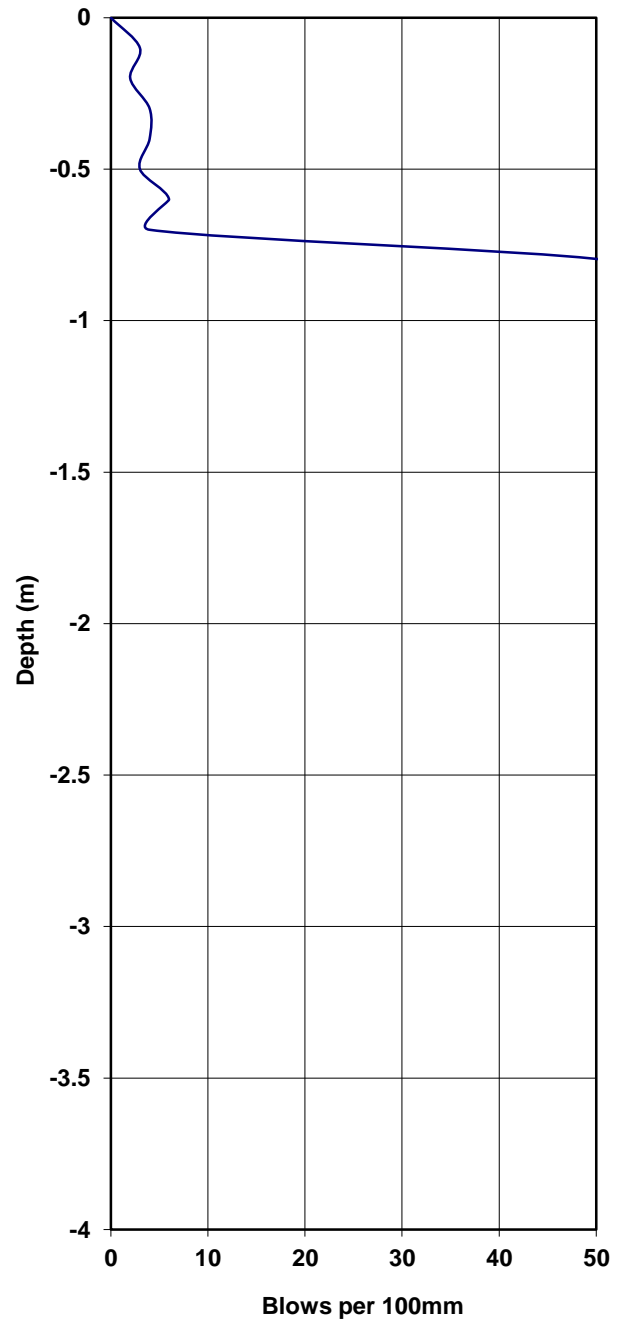


Client: Ethekewini Municipality - Water & Sanitation	Ref.No. 233-19
Project: Construction of Sewer Reticulation	Date: 19-26/09/2019
Section: Ntuzuma B, Wards 38, 41 & 45	Operator: S.Ramesh-warnath

CBR Penetrometer Probe ----- Test No. DC 4

THE STRENGTH AND CBR VALUES ARE EMPIRICAL AND DEPEND ON FACTORS SUCH AS MOISTURE CONTENT WHICH HAVE NOT BEEN DETERMINED. THEY ARE THEREFORE INDICATIVE ONLY AND SHOULD BE VERIFIED BY TEST OR OBSERVATION

Depth (m)	Blows/100mm	Inferred Consistency	Shear Strength	CBR %
0				
0.1	3	Soft	25 kPa	5
0.2	2	Soft	20 kPa	3
0.3	4	Soft	35 kPa	7
0.4	4	Soft	35 kPa	7
0.5	3	Soft	25 kPa	5
0.6	6	Firm	50 kPa	10
0.7	4	Soft	35 kPa	7
	Refusal			



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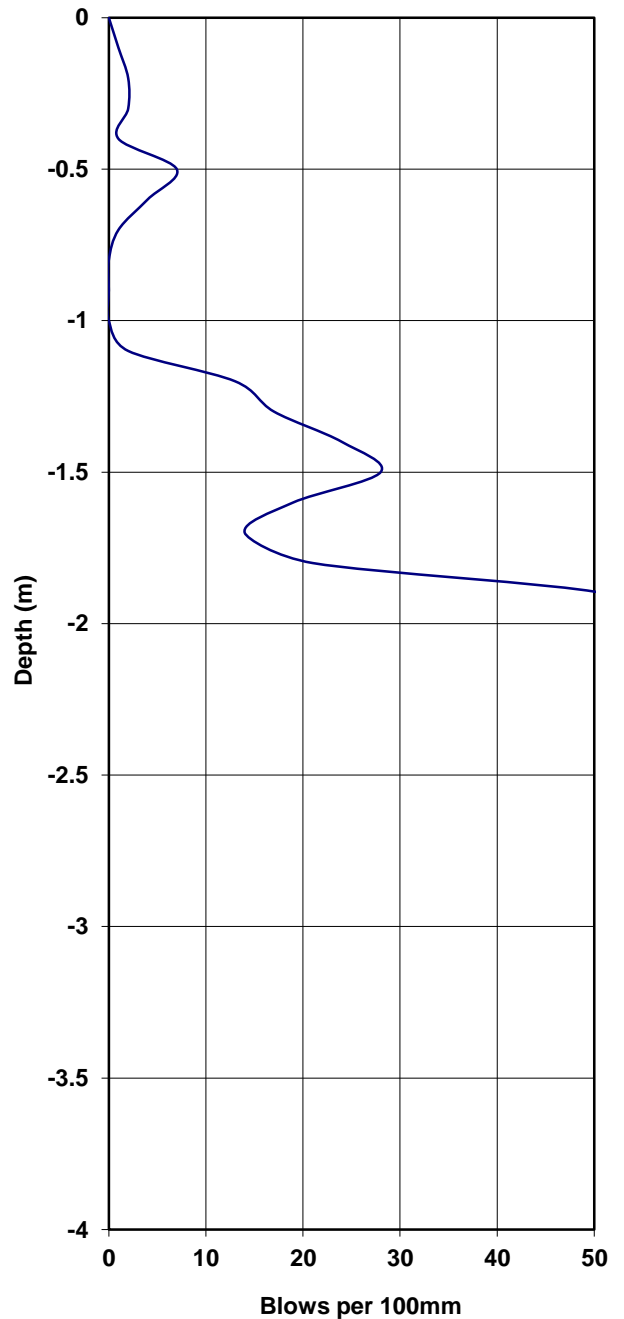


Client: EtheKwini Municipality - Water & Sanitation	Ref.No. 233-19
Project: Construction of Sewer Reticulation	Date: 19-26/09/2019
Section: Ntuzuma B, Wards 38, 41 & 45	Operator: S.Ramesh-warnath

CBR Penetrometer Probe ----- Test No. DC 5

THE STRENGTH AND CBR VALUES ARE EMPIRICAL AND DEPEND ON FACTORS SUCH AS MOISTURE CONTENT WHICH HAVE NOT BEEN DETERMINED. THEY ARE THEREFORE INDICATIVE ONLY AND SHOULD BE VERIFIED BY TEST OR OBSERVATION

Depth (m)	Blows/100mm	Inferred Consistency	Shear Strength	CBR %
0				
0.1	1	Very Loose	<29 deg	2
0.2	2	Loose	<30 deg	3
0.3	2	Loose	<30 deg	3
0.4	1	Very Loose	<29 deg	2
0.5	7	Med.Dense	34 deg	12
0.6	4	Med.Dense	30 deg	7
0.7	1	Very Loose	<29 deg	2
0.8	0	V.V.Loose	<28 deg	<2
0.9	0	V.V.Loose	<28 deg	<2
1	0	V.V.Loose	<28 deg	<2
1.1	2	Loose	<30 deg	3
1.2	13	Dense	37 deg	23
1.3	17	Dense	37 deg	31
1.4	24	Dense	38 deg	47
1.5	28	Very Dense	>38 deg	>55
1.6	19	Dense	37 deg	35
1.7	14	Dense	37 deg	25
1.8	21	Dense	38 deg	40
	Refusal			



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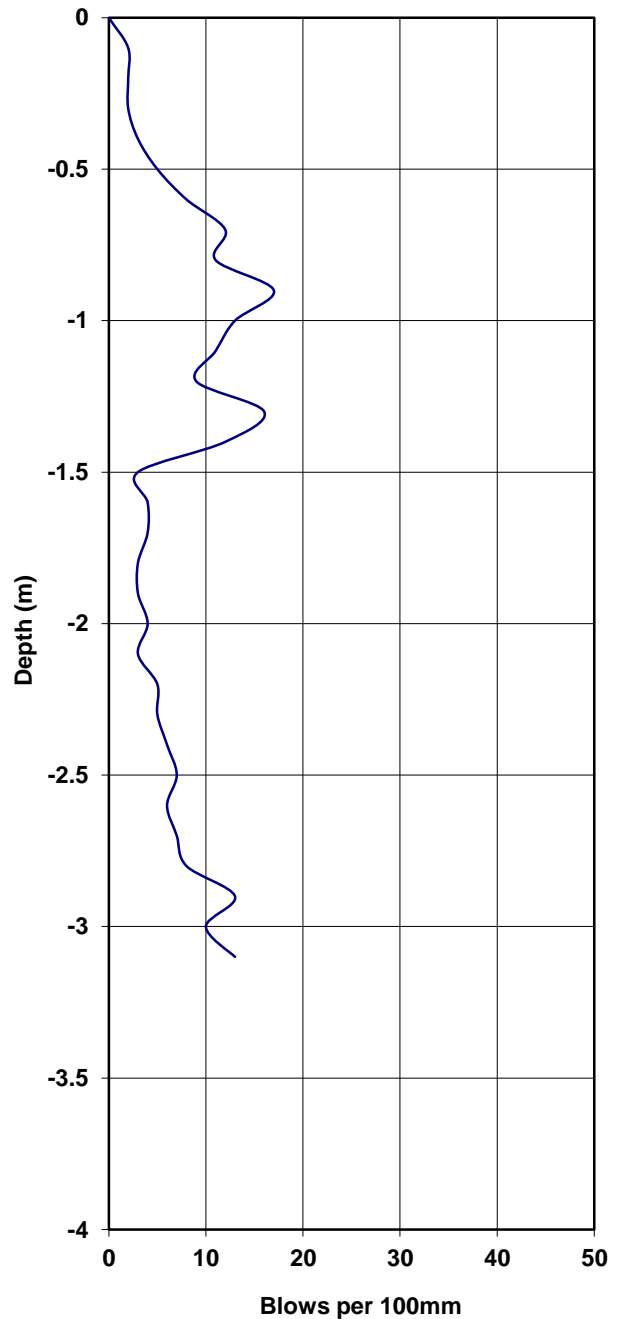


Client: EtheKwini Municipality - Water & Sanitation	Ref.No. 233-19
Project: Construction of Sewer Reticulation	Date: 19-26/09/2019
Section: Ntuzuma B, Wards 38, 41 & 45	Operator: S.Ramesh-warnath

CBR Penetrometer Probe ----- Test No. DC 6

THE STRENGTH AND CBR VALUES ARE EMPIRICAL AND DEPEND ON FACTORS SUCH AS MOISTURE CONTENT WHICH HAVE NOT BEEN DETERMINED. THEY ARE THEREFORE INDICATIVE ONLY AND SHOULD BE VERIFIED BY TEST OR OBSERVATION

Depth (m)	Blows/100mm	Inferred Consistency	Shear Strength	CBR %
0				
0.1	2	Soft	20 kPa	3
0.2	2	Soft	20 kPa	3
0.3	2	Soft	20 kPa	3
0.4	3	Soft	25 kPa	5
0.5	5	Firm	40 kPa	8
0.6	8	Firm	65 kPa	14
0.7	12	Stiff	100 kPa	21
0.8	11	Stiff	90 kPa	19
0.9	17	Stiff	140 kPa	31
1	13	Stiff	110 kPa	23
1.1	11	Stiff	90 kPa	19
1.2	9	Stiff	75 kPa	15
1.3	16	Stiff	130 kPa	29
1.4	12	Stiff	100 kPa	21
1.5	3	Soft	25 kPa	5
1.6	4	Soft	35 kPa	7
1.7	4	Soft	35 kPa	7
1.8	3	Soft	25 kPa	5
1.9	3	Soft	25 kPa	5
2	4	Soft	35 kPa	7
2.1	3	Soft	25 kPa	5
2.2	5	Firm	40 kPa	8
2.3	5	Firm	40 kPa	8
2.4	6	Firm	50 kPa	10
2.5	7	Firm	60 kPa	12
2.6	6	Firm	50 kPa	10
2.7	7	Firm	60 kPa	12
2.8	8	Firm	65 kPa	14
2.9	13	Stiff	110 kPa	23
3	10	Stiff	85 kPa	17
3.1	13	Stiff	110 kPa	23
	End			



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Ref.No. 233-19

Project: Construction of Sewer Reticulation

Date: 19-26/09/2019

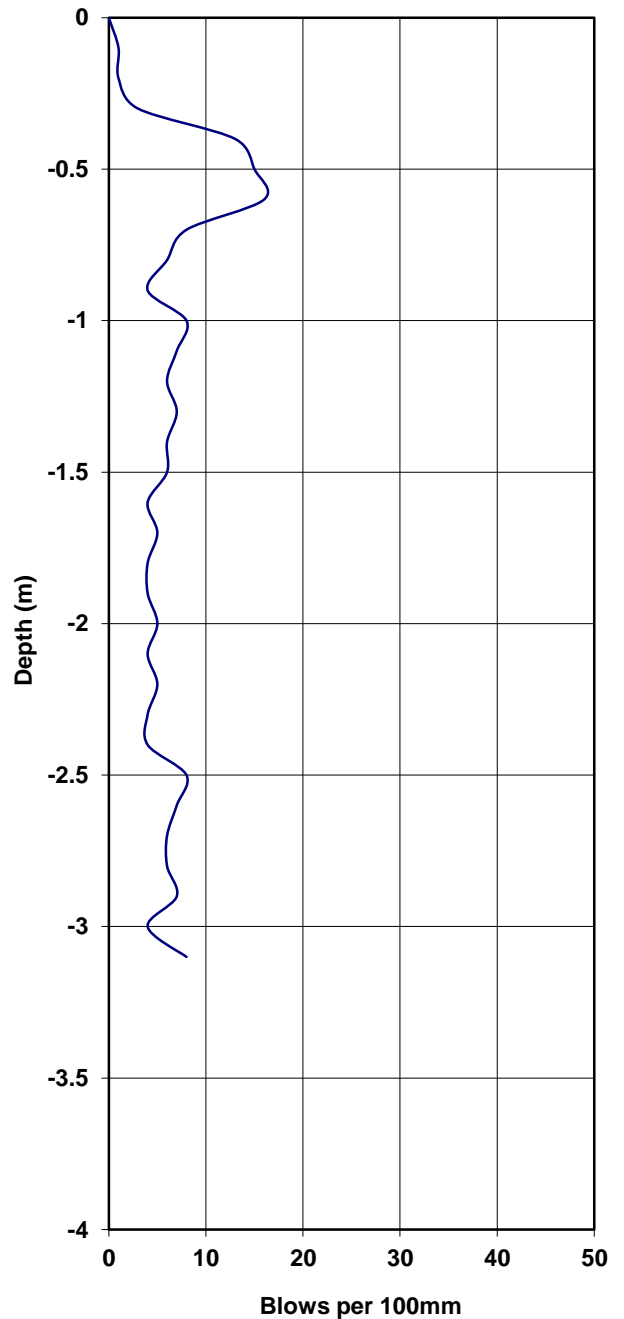
Section: Ntuzuma B, Wards 38, 41 & 45

Operator: S.Ramesh-warnath

CBR Penetrometer Probe ----- Test No. DC 7

THE STRENGTH AND CBR VALUES ARE EMPIRICAL AND DEPEND ON FACTORS SUCH AS MOISTURE CONTENT WHICH HAVE NOT BEEN DETERMINED. THEY ARE THEREFORE INDICATIVE ONLY AND SHOULD BE VERIFIED BY TEST OR OBSERVATION

Depth (m)	Blows/100mm	Inferred Consistency	Shear Strength	CBR %
0				
0.1	1	Very Soft	<20 kPa	2
0.2	1	Very Soft	<20 kPa	2
0.3	3	Soft	25 kPa	5
0.4	13	Stiff	110 kPa	23
0.5	15	Stiff	125 kPa	27
0.6	16	Stiff	130 kPa	29
0.7	8	Firm	65 kPa	14
0.8	6	Firm	50 kPa	10
0.9	4	Soft	35 kPa	7
1	8	Firm	65 kPa	14
1.1	7	Firm	60 kPa	12
1.2	6	Firm	50 kPa	10
1.3	7	Firm	60 kPa	12
1.4	6	Firm	50 kPa	10
1.5	6	Firm	50 kPa	10
1.6	4	Soft	35 kPa	7
1.7	5	Firm	40 kPa	8
1.8	4	Soft	35 kPa	7
1.9	4	Soft	35 kPa	7
2	5	Firm	40 kPa	8
2.1	4	Soft	35 kPa	7
2.2	5	Firm	40 kPa	8
2.3	4	Soft	35 kPa	7
2.4	4	Soft	35 kPa	7
2.5	8	Firm	65 kPa	14
2.6	7	Firm	60 kPa	12
2.7	6	Firm	50 kPa	10
2.8	6	Firm	50 kPa	10
2.9	7	Firm	60 kPa	12
3	4	Soft	35 kPa	7
3.1	8	Firm	65 kPa	14
	End			



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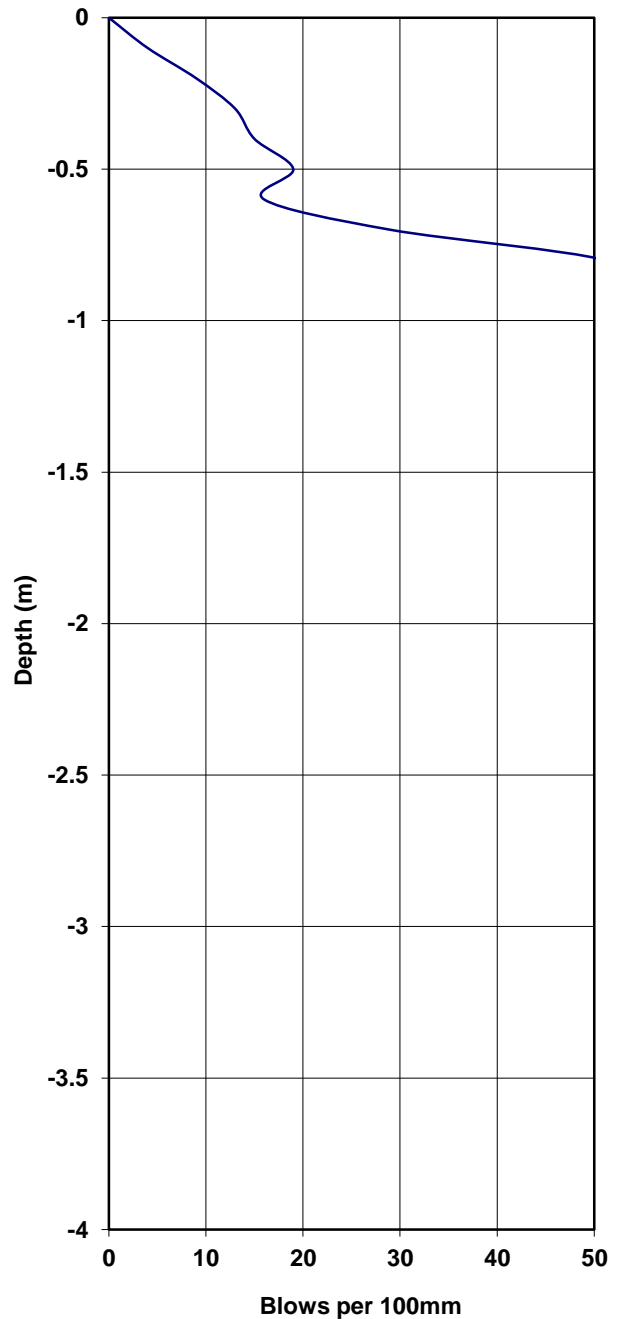


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Project: Construction of Sewer Reticulation	Date: 19-26/09/2019
Section: Ntuzuma B, Wards 38, 41 & 45	Operator: S.Ramesh-warnath

CBR Penetrometer Probe ----- Test No. DC 8

THE STRENGTH AND CBR VALUES ARE EMPIRICAL AND DEPEND ON FACTORS SUCH AS MOISTURE CONTENT WHICH HAVE NOT BEEN DETERMINED. THEY ARE THEREFORE INDICATIVE ONLY AND SHOULD BE VERIFIED BY TEST OR OBSERVATION

Depth (m)	Blows/100mm	Inferred Consistency	Shear Strength	CBR %
0				
0.1	4	Med.Dense	30 deg	7
0.2	9	Med.Dense	35 deg	15
0.3	13	Dense	37 deg	23
0.4	15	Dense	37 deg	27
0.5	19	Dense	37 deg	35
0.6	16	Dense	37 deg	29
0.7	29	Very Dense	>38 deg	>55
	Refusal			



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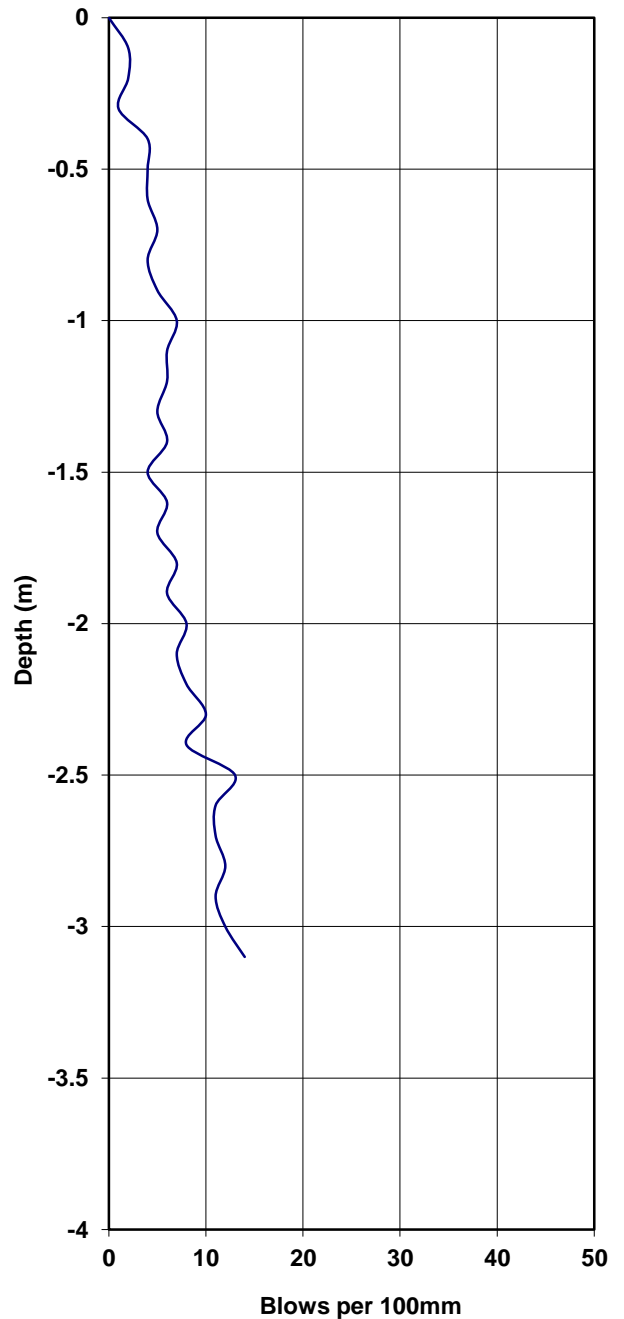


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Project: Construction of Sewer Reticulation	Date: 19-26/09/2019
Section: Ntuzuma B, Wards 38, 41 & 45	Operator: S.Ramesh-warnath

CBR Penetrometer Probe ----- Test No. DC 9

THE STRENGTH AND CBR VALUES ARE EMPIRICAL AND DEPEND ON FACTORS SUCH AS MOISTURE CONTENT WHICH HAVE NOT BEEN DETERMINED. THEY ARE THEREFORE INDICATIVE ONLY AND SHOULD BE VERIFIED BY TEST OR OBSERVATION

Depth (m)	Blows/100mm	Inferred Consistency	Shear Strength	CBR %
0				
0.1	2	Soft	20 kPa	3
0.2	2	Soft	20 kPa	3
0.3	1	Very Soft	<20 kPa	2
0.4	4	Soft	35 kPa	7
0.5	4	Soft	35 kPa	7
0.6	4	Soft	35 kPa	7
0.7	5	Firm	40 kPa	8
0.8	4	Soft	35 kPa	7
0.9	5	Firm	40 kPa	8
1	7	Firm	60 kPa	12
1.1	6	Firm	50 kPa	10
1.2	6	Firm	50 kPa	10
1.3	5	Firm	40 kPa	8
1.4	6	Firm	50 kPa	10
1.5	4	Soft	35 kPa	7
1.6	6	Firm	50 kPa	10
1.7	5	Firm	40 kPa	8
1.8	7	Firm	60 kPa	12
1.9	6	Firm	50 kPa	10
2	8	Firm	65 kPa	14
2.1	7	Firm	60 kPa	12
2.2	8	Firm	65 kPa	14
2.3	10	Stiff	85 kPa	17
2.4	8	Firm	65 kPa	14
2.5	13	Stiff	110 kPa	23
2.6	11	Stiff	90 kPa	19
2.7	11	Stiff	90 kPa	19
2.8	12	Stiff	100 kPa	21
2.9	11	Stiff	90 kPa	19
3	12	Stiff	100 kPa	21
3.1	14	Stiff	115 kPa	25
	End			



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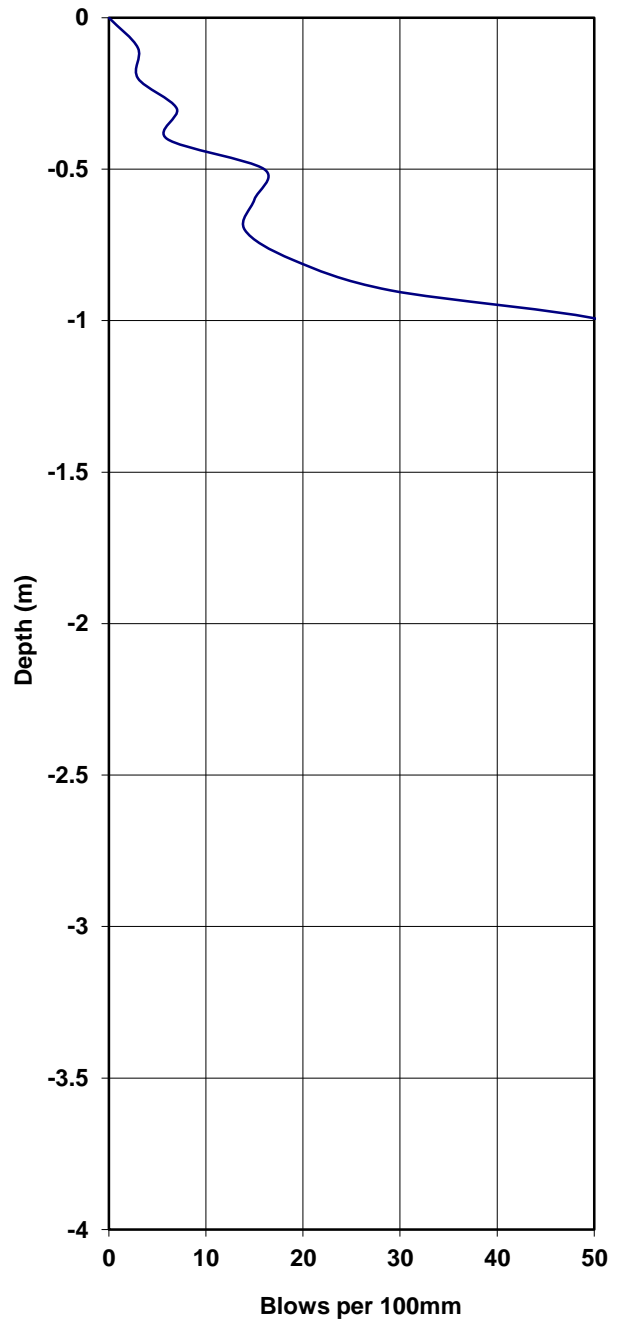


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Project: Construction of Sewer Reticulation	Date: 19-26/09/2019
Section: Ntuzuma B, Wards 38, 41 & 45	Operator: S.Ramesh-warnath

CBR Penetrometer Probe ----- Test No. DC 10

THE STRENGTH AND CBR VALUES ARE EMPIRICAL AND DEPEND ON FACTORS SUCH AS MOISTURE CONTENT WHICH HAVE NOT BEEN DETERMINED. THEY ARE THEREFORE INDICATIVE ONLY AND SHOULD BE VERIFIED BY TEST OR OBSERVATION

Depth (m)	Blows/100mm	Inferred Consistency	Shear Strength	CBR %
0				
0.1	3	Soft	25 kPa	5
0.2	3	Soft	25 kPa	5
0.3	7	Firm	60 kPa	12
0.4	6	Firm	50 kPa	10
0.5	16	Stiff	130 kPa	29
0.6	15	Stiff	125 kPa	27
0.7	14	Stiff	115 kPa	25
0.8	19	Very Stiff	>150 kPa	35
0.9	29	Very Stiff	>150 kPa	>55
	Refusal			



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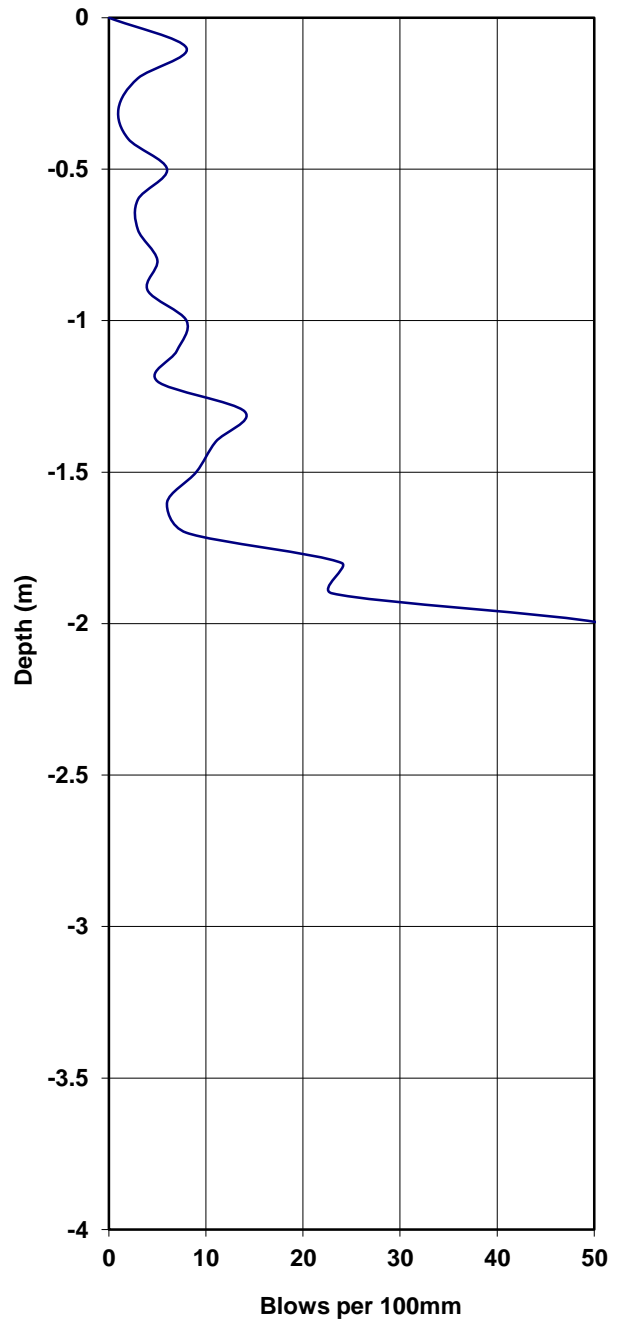


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Project: Construction of Sewer Reticulation	Date: 19-26/09/2019
Section: Ntuzuma B, Wards 38, 41 & 45	Operator: S.Ramesh-warnath

CBR Penetrometer Probe ----- Test No. DC 11

THE STRENGTH AND CBR VALUES ARE EMPIRICAL AND DEPEND ON FACTORS SUCH AS MOISTURE CONTENT WHICH HAVE NOT BEEN DETERMINED. THEY ARE THEREFORE INDICATIVE ONLY AND SHOULD BE VERIFIED BY TEST OR OBSERVATION

Depth (m)	Blows/100mm	Inferred Consistency	Shear Strength	CBR %
0				
0.1	8	Firm	65 kPa	14
0.2	3	Soft	25 kPa	5
0.3	1	Very Soft	<20 kPa	2
0.4	2	Soft	20 kPa	3
0.5	6	Firm	50 kPa	10
0.6	3	Soft	25 kPa	5
0.7	3	Soft	25 kPa	5
0.8	5	Firm	40 kPa	8
0.9	4	Soft	35 kPa	7
1	8	Firm	65 kPa	14
1.1	7	Firm	60 kPa	12
1.2	5	Firm	40 kPa	8
1.3	14	Stiff	115 kPa	25
1.4	11	Stiff	90 kPa	19
1.5	9	Stiff	75 kPa	15
1.6	6	Firm	50 kPa	10
1.7	8	Firm	65 kPa	14
1.8	24	Very Stiff	>150 kPa	47
1.9	23	Very Stiff	>150 kPa	44
	Refusal			



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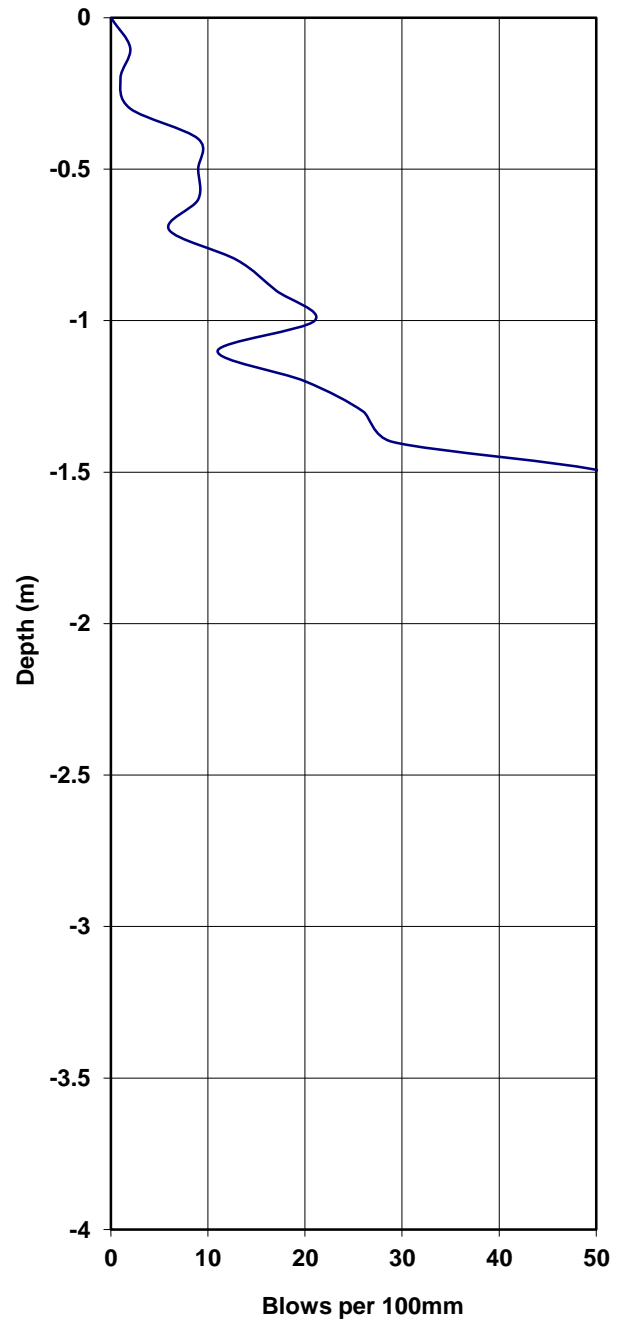


Client: Ethekewini Municipality - Water & Sanitation	Ref.No. 233-19
Project: Construction of Sewer Reticulation	Date: 19-26/09/2019
Section: Ntuzuma B, Wards 38, 41 & 45	Operator: S.Ramesh-warnath

CBR Penetrometer Probe ----- Test No. DC 12

THE STRENGTH AND CBR VALUES ARE EMPIRICAL AND DEPEND ON FACTORS SUCH AS MOISTURE CONTENT WHICH HAVE NOT BEEN DETERMINED. THEY ARE THEREFORE INDICATIVE ONLY AND SHOULD BE VERIFIED BY TEST OR OBSERVATION

Depth (m)	Blows/100mm	Inferred Consistency	Shear Strength	CBR %
0				
0.1	2	Soft	20 kPa	3
0.2	1	Very Soft	<20 kPa	2
0.3	2	Soft	20 kPa	3
0.4	9	Stiff	75 kPa	15
0.5	9	Stiff	75 kPa	15
0.6	9	Stiff	75 kPa	15
0.7	6	Firm	50 kPa	10
0.8	13	Stiff	110 kPa	23
0.9	17	Stiff	140 kPa	31
1	21	Very Stiff	>150 kPa	40
1.1	11	Stiff	90 kPa	19
1.2	20	Very Stiff	>150 kPa	37
1.3	26	Very Stiff	>150 kPa	51
1.4	29	Very Stiff	>150 kPa	>55
	Refusal			



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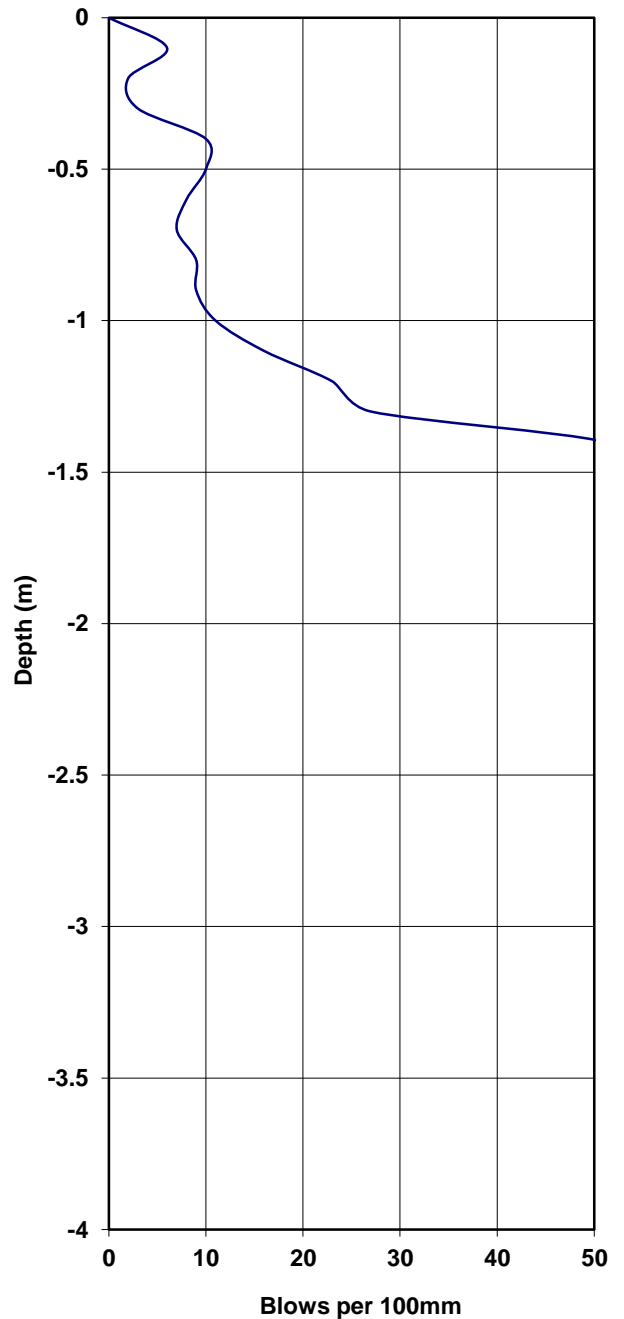


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Project: Construction of Sewer Reticulation	Date: 19-26/09/2019
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CBR Penetrometer Probe ----- Test No. DC 13

THE STRENGTH AND CBR VALUES ARE EMPIRICAL AND DEPEND ON FACTORS SUCH AS MOISTURE CONTENT WHICH HAVE NOT BEEN DETERMINED. THEY ARE THEREFORE INDICATIVE ONLY AND SHOULD BE VERIFIED BY TEST OR OBSERVATION

Depth (m)	Blows/100mm	Inferred Consistency	Shear Strength	CBR %
0				
0.1	6	Firm	50 kPa	10
0.2	2	Soft	20 kPa	3
0.3	3	Soft	25 kPa	5
0.4	10	Stiff	85 kPa	17
0.5	10	Stiff	85 kPa	17
0.6	8	Firm	65 kPa	14
0.7	7	Firm	60 kPa	12
0.8	9	Stiff	75 kPa	15
0.9	9	Stiff	75 kPa	15
1	11	Stiff	90 kPa	19
1.1	16	Stiff	130 kPa	29
1.2	23	Very Stiff	>150 kPa	44
1.3	27	Very Stiff	>150 kPa	54
	Refusal			



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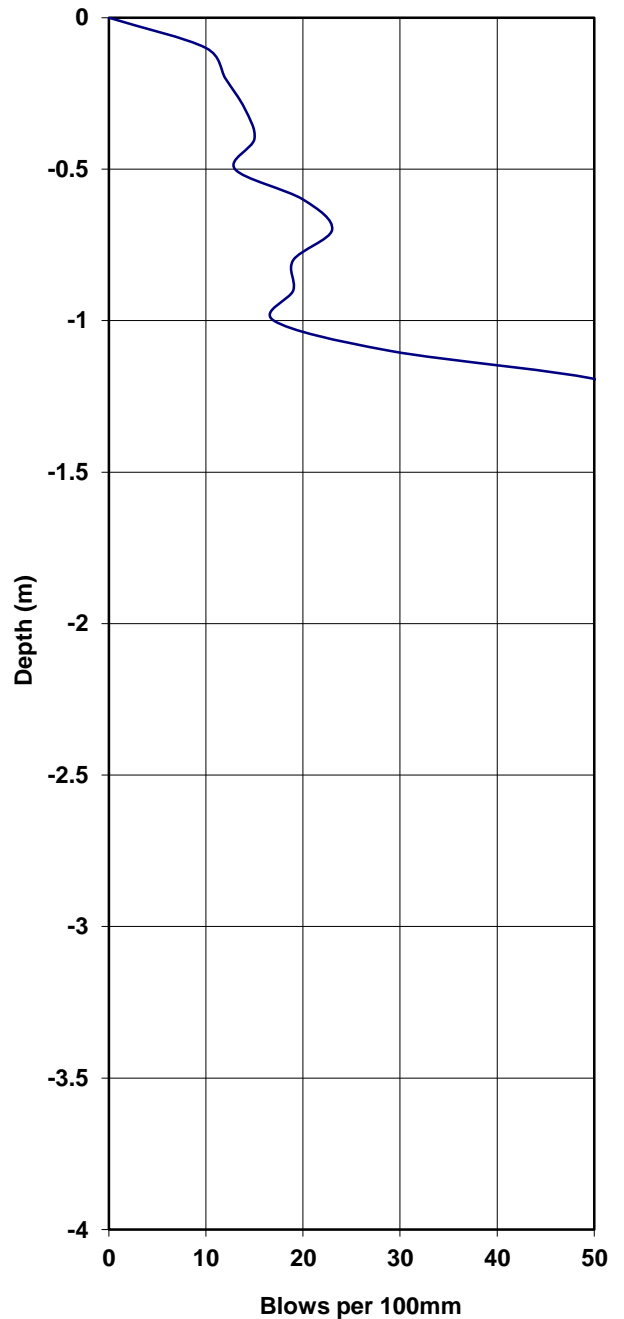


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Project: Construction of Sewer Reticulation	Date: 19-26/09/2019
Section: Ntuzuma B, Wards 38, 41 & 45	Operator: S.Ramesh-warnath

CBR Penetrometer Probe ----- Test No. DC 14

THE STRENGTH AND CBR VALUES ARE EMPIRICAL AND DEPEND ON FACTORS SUCH AS MOISTURE CONTENT WHICH HAVE NOT BEEN DETERMINED. THEY ARE THEREFORE INDICATIVE ONLY AND SHOULD BE VERIFIED BY TEST OR OBSERVATION

Depth (m)	Blows/100mm	Inferred Consistency	Shear Strength	CBR %
0				
0.1	10	Stiff	85 kPa	17
0.2	12	Stiff	100 kPa	21
0.3	14	Stiff	115 kPa	25
0.4	15	Stiff	125 kPa	27
0.5	13	Stiff	110 kPa	23
0.6	20	Very Stiff	>150 kPa	37
0.7	23	Very Stiff	>150 kPa	44
0.8	19	Very Stiff	>150 kPa	35
0.9	19	Very Stiff	>150 kPa	35
1	17	Stiff	140 kPa	31
1.1	29	Very Stiff	>150 kPa	>55
	Refusal			



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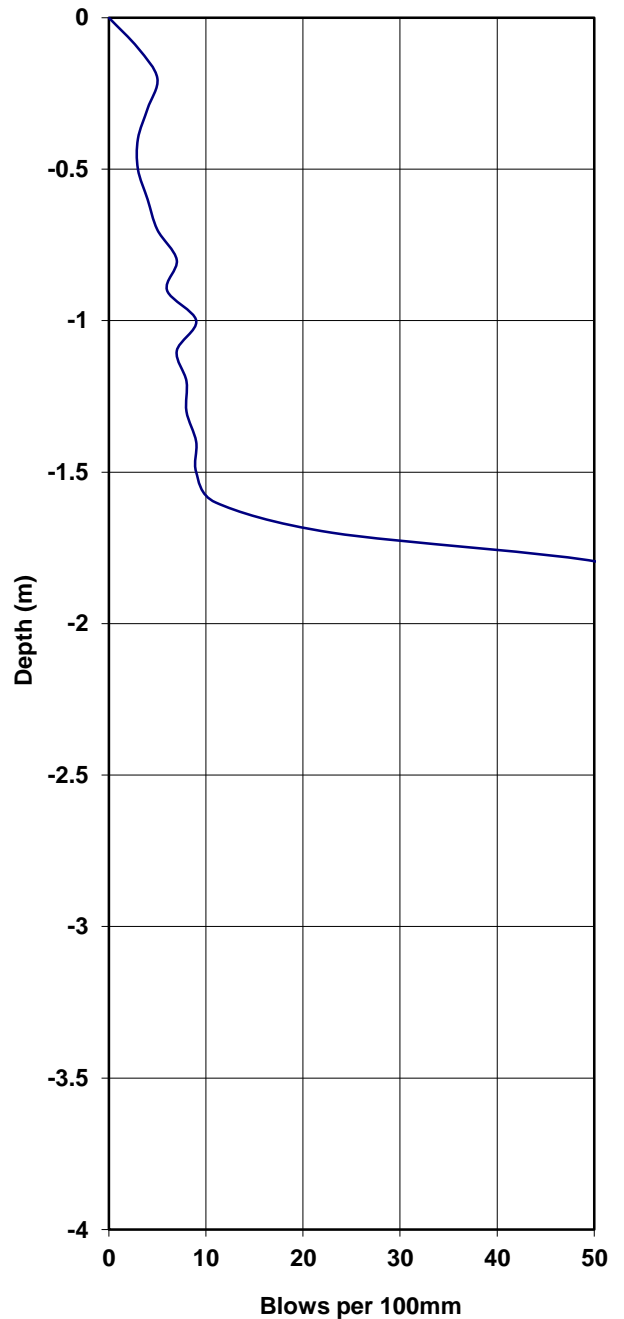


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Project: Construction of Sewer Reticulation	Date: 19-26/09/2019
Section: Ntuzuma B, Wards 38, 41 & 45	Operator: S.Ramesh-warnath

CBR Penetrometer Probe ----- Test No. DC 15

THE STRENGTH AND CBR VALUES ARE EMPIRICAL AND DEPEND ON FACTORS SUCH AS MOISTURE CONTENT WHICH HAVE NOT BEEN DETERMINED. THEY ARE THEREFORE INDICATIVE ONLY AND SHOULD BE VERIFIED BY TEST OR OBSERVATION

Depth (m)	Blows/100mm	Inferred Consistency	Shear Strength	CBR %
0				
0.1	3	Soft	25 kPa	5
0.2	5	Firm	40 kPa	8
0.3	4	Soft	35 kPa	7
0.4	3	Soft	25 kPa	5
0.5	3	Soft	25 kPa	5
0.6	4	Soft	35 kPa	7
0.7	5	Firm	40 kPa	8
0.8	7	Firm	60 kPa	12
0.9	6	Firm	50 kPa	10
1	9	Stiff	75 kPa	15
1.1	7	Firm	60 kPa	12
1.2	8	Firm	65 kPa	14
1.3	8	Firm	65 kPa	14
1.4	9	Stiff	75 kPa	15
1.5	9	Stiff	75 kPa	15
1.6	11	Stiff	90 kPa	19
1.7	23	Very Stiff	>150 kPa	44
	Refusal			



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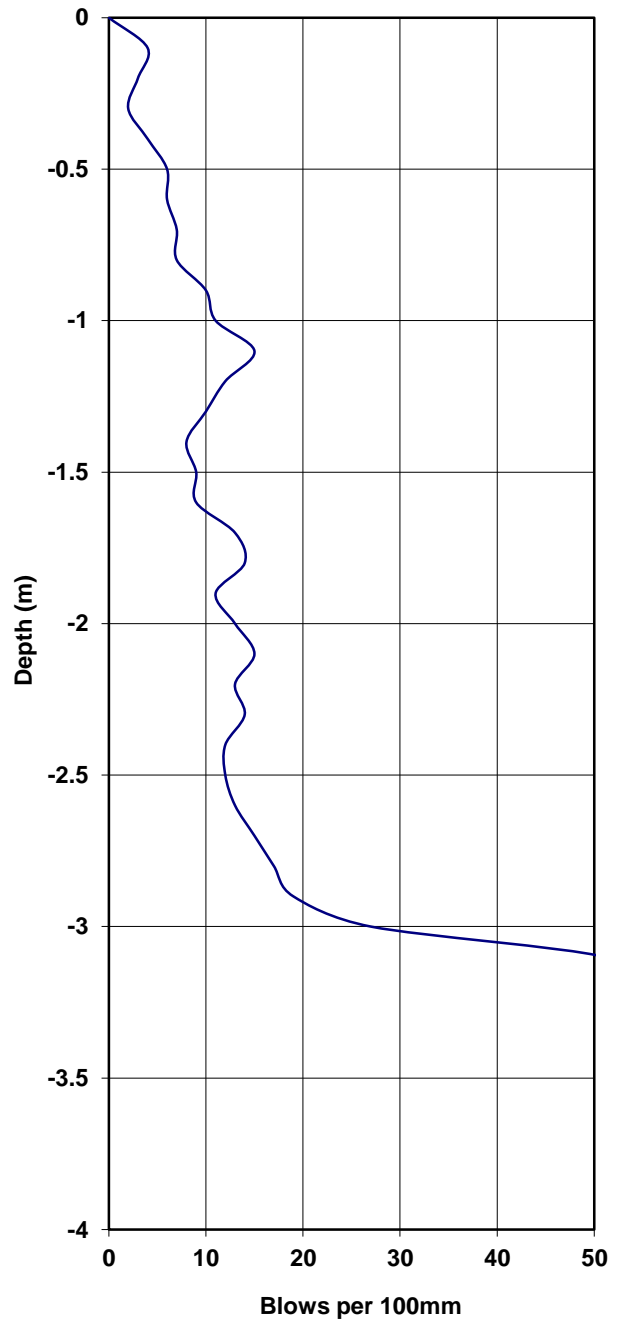


Client: Ethekewini Municipality - Water & Sanitation	Ref.No. 233-19
Project: Construction of Sewer Reticulation	Date: 19-26/09/2019
Section: Ntuzuma B, Wards 38, 41 & 45	Operator: S.Ramesh-warnath

CBR Penetrometer Probe ----- Test No. DC 16

THE STRENGTH AND CBR VALUES ARE EMPIRICAL AND DEPEND ON FACTORS SUCH AS MOISTURE CONTENT WHICH HAVE NOT BEEN DETERMINED. THEY ARE THEREFORE INDICATIVE ONLY AND SHOULD BE VERIFIED BY TEST OR OBSERVATION

Depth (m)	Blows/100mm	Inferred Consistency	Shear Strength	CBR %
0				
0.1	4	Soft	35 kPa	7
0.2	3	Soft	25 kPa	5
0.3	2	Soft	20 kPa	3
0.4	4	Soft	35 kPa	7
0.5	6	Firm	50 kPa	10
0.6	6	Firm	50 kPa	10
0.7	7	Firm	60 kPa	12
0.8	7	Firm	60 kPa	12
0.9	10	Stiff	85 kPa	17
1	11	Stiff	90 kPa	19
1.1	15	Stiff	125 kPa	27
1.2	12	Stiff	100 kPa	21
1.3	10	Stiff	85 kPa	17
1.4	8	Firm	65 kPa	14
1.5	9	Stiff	75 kPa	15
1.6	9	Stiff	75 kPa	15
1.7	13	Stiff	110 kPa	23
1.8	14	Stiff	115 kPa	25
1.9	11	Stiff	90 kPa	19
2	13	Stiff	110 kPa	23
2.1	15	Stiff	125 kPa	27
2.2	13	Stiff	110 kPa	23
2.3	14	Stiff	115 kPa	25
2.4	12	Stiff	100 kPa	21
2.5	12	Stiff	100 kPa	21
2.6	13	Stiff	110 kPa	23
2.7	15	Stiff	125 kPa	27
2.8	17	Stiff	140 kPa	31
2.9	19	Very Stiff	>150 kPa	35
3	27	Very Stiff	>150 kPa	54
	Refusal			



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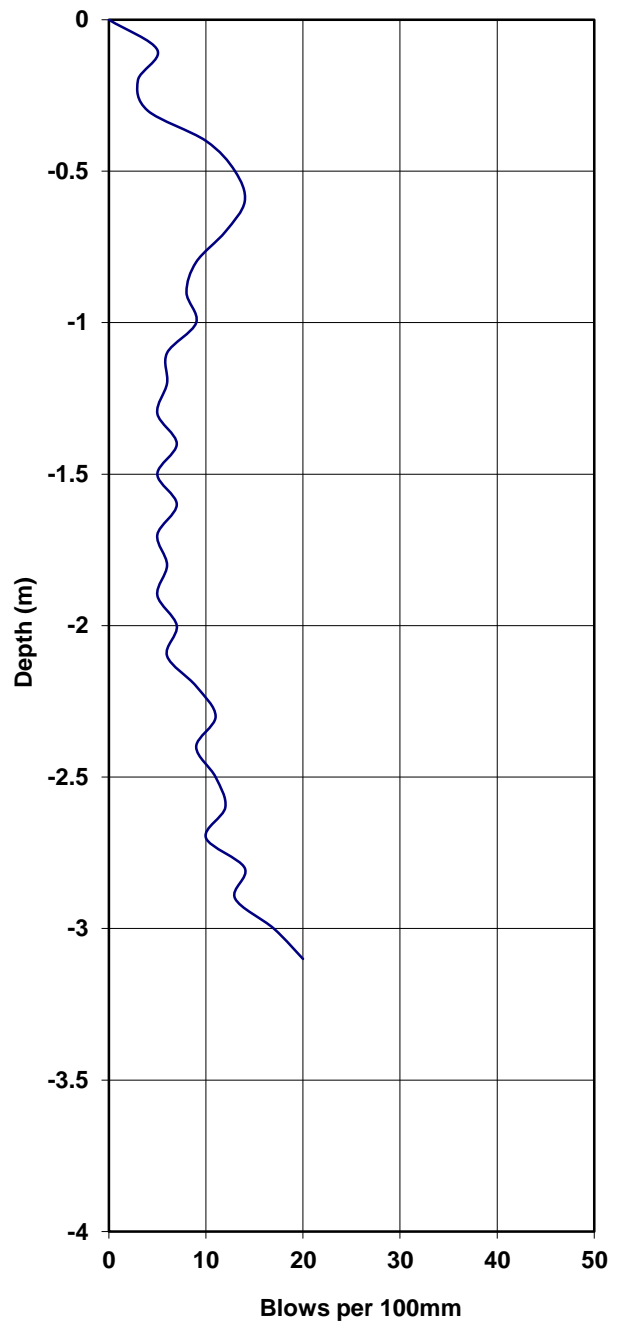


Client: Ethekewini Municipality - Water & Sanitation	Ref.No. 233-19
Project: Construction of Sewer Reticulation	Date: 19-26/09/2019
Section: Ntuzuma B, Wards 38, 41 & 45	Operator: S.Ramesh-warnath

CBR Penetrometer Probe ----- Test No. DC 17

THE STRENGTH AND CBR VALUES ARE EMPIRICAL AND DEPEND ON FACTORS SUCH AS MOISTURE CONTENT WHICH HAVE NOT BEEN DETERMINED. THEY ARE THEREFORE INDICATIVE ONLY AND SHOULD BE VERIFIED BY TEST OR OBSERVATION

Depth (m)	Blows/100mm	Inferred Consistency	Shear Strength	CBR %
0				
0.1	5	Firm	40 kPa	8
0.2	3	Soft	25 kPa	5
0.3	4	Soft	35 kPa	7
0.4	10	Stiff	85 kPa	17
0.5	13	Stiff	110 kPa	23
0.6	14	Stiff	115 kPa	25
0.7	12	Stiff	100 kPa	21
0.8	9	Stiff	75 kPa	15
0.9	8	Firm	65 kPa	14
1	9	Stiff	75 kPa	15
1.1	6	Firm	50 kPa	10
1.2	6	Firm	50 kPa	10
1.3	5	Firm	40 kPa	8
1.4	7	Firm	60 kPa	12
1.5	5	Firm	40 kPa	8
1.6	7	Firm	60 kPa	12
1.7	5	Firm	40 kPa	8
1.8	6	Firm	50 kPa	10
1.9	5	Firm	40 kPa	8
2	7	Firm	60 kPa	12
2.1	6	Firm	50 kPa	10
2.2	9	Stiff	75 kPa	15
2.3	11	Stiff	90 kPa	19
2.4	9	Stiff	75 kPa	15
2.5	11	Stiff	90 kPa	19
2.6	12	Stiff	100 kPa	21
2.7	10	Stiff	85 kPa	17
2.8	14	Stiff	115 kPa	25
2.9	13	Stiff	110 kPa	23
3	17	Stiff	140 kPa	31
3.1	20	Very Stiff	>150 kPa	37
	End			



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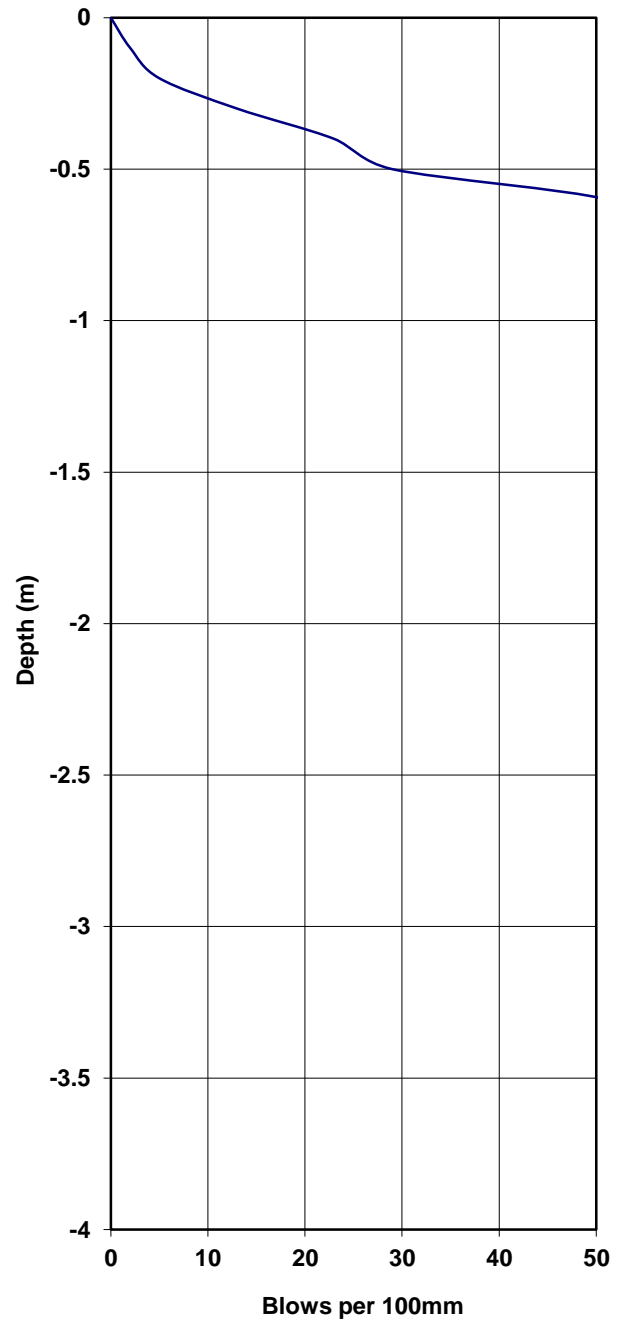


Client: Ethekewini Municipality - Water & Sanitation	Ref.No. 233-19
Project: Construction of Sewer Reticulation	Date: 19-26/09/2019
Section: Ntuzuma B, Wards 38, 41 & 45	Operator: S.Ramesh-warnath

CBR Penetrometer Probe ----- Test No. DC 18

THE STRENGTH AND CBR VALUES ARE EMPIRICAL AND DEPEND ON FACTORS SUCH AS MOISTURE CONTENT WHICH HAVE NOT BEEN DETERMINED. THEY ARE THEREFORE INDICATIVE ONLY AND SHOULD BE VERIFIED BY TEST OR OBSERVATION

Depth (m)	Blows/100mm	Inferred Consistency	Shear Strength	CBR %
0				
0.1	2	Soft	20 kPa	3
0.2	5	Firm	40 kPa	8
0.3	13	Stiff	110 kPa	23
0.4	23	Very Stiff	>150 kPa	44
0.5	29	Very Stiff	>150 kPa	>55
	Refusal			



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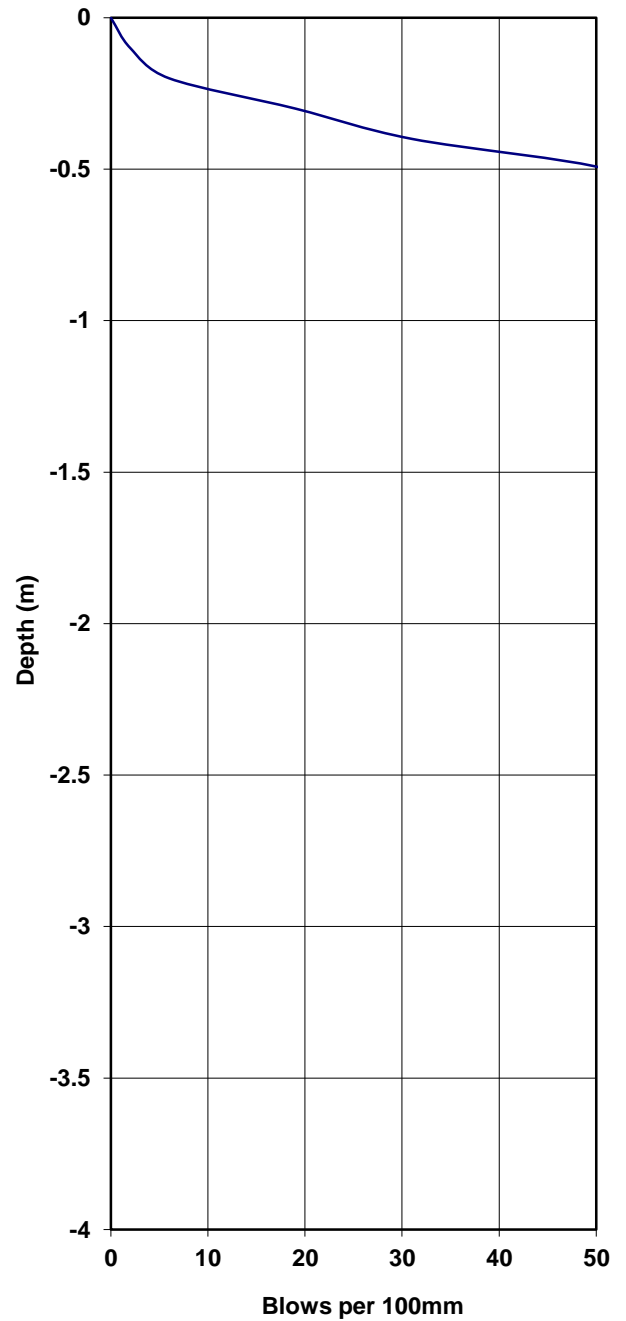


Client: Ethekewini Municipality - Water & Sanitation	Ref.No. 233-19
Project: Construction of Sewer Reticulation	Date: 19-26/09/2019
Section: Ntuzuma B, Wards 38, 41 & 45	Operator: S.Ramesh-warnath

CBR Penetrometer Probe ----- Test No. DC 19

THE STRENGTH AND CBR VALUES ARE EMPIRICAL AND DEPEND ON FACTORS SUCH AS MOISTURE CONTENT WHICH HAVE NOT BEEN DETERMINED. THEY ARE THEREFORE INDICATIVE ONLY AND SHOULD BE VERIFIED BY TEST OR OBSERVATION

Depth (m)	Blows/100mm	Inferred Consistency	Shear Strength	CBR %
0				
0.1	2	Soft	20 kPa	3
0.2	6	Firm	50 kPa	10
0.3	19	Very Stiff	>150 kPa	35
0.4	31	Very Stiff	>150 kPa	>55
	Refusal			



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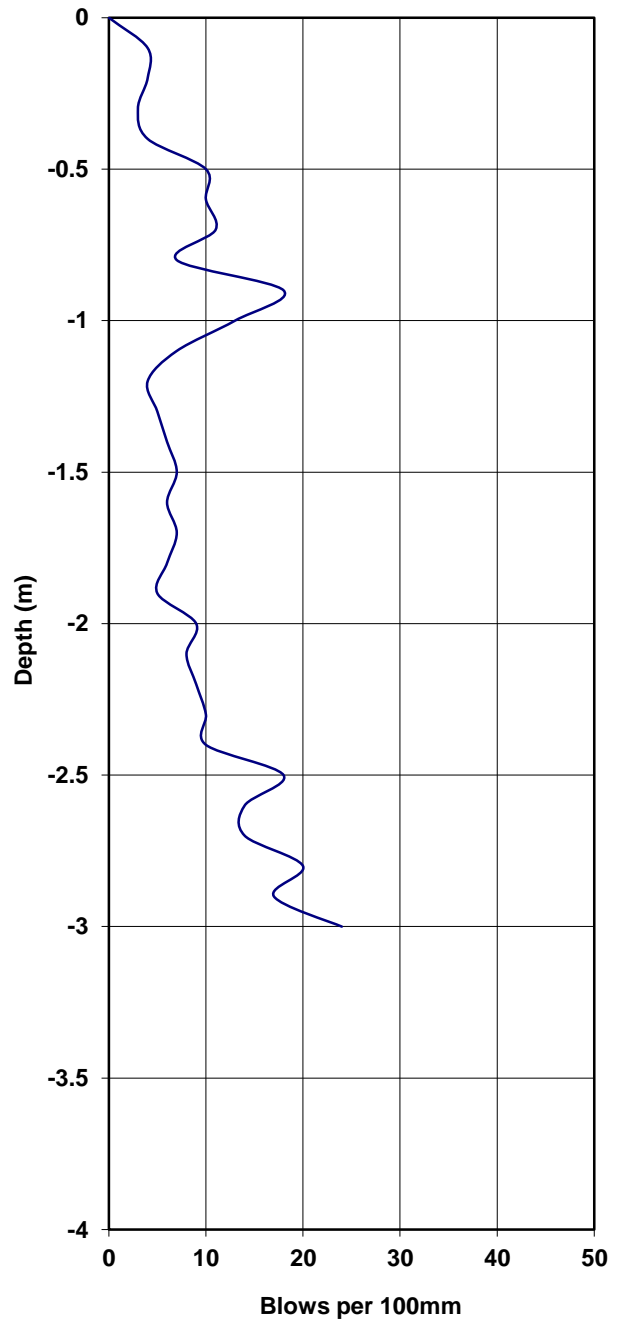


Client: Ethekewini Municipality - Water & Sanitation	Ref.No. 233-19
Project: Construction of Sewer Reticulation	Date: 19-26/09/2019
Section: Ntuzuma B, Wards 38, 41 & 45	Operator: S.Ramesh-warnath

CBR Penetrometer Probe ----- Test No. DC 20

THE STRENGTH AND CBR VALUES ARE EMPIRICAL AND DEPEND ON FACTORS SUCH AS MOISTURE CONTENT WHICH HAVE NOT BEEN DETERMINED. THEY ARE THEREFORE INDICATIVE ONLY AND SHOULD BE VERIFIED BY TEST OR OBSERVATION

Depth (m)	Blows/100mm	Inferred Consistency	Shear Strength	CBR %
0				
0.1	4	Soft	35 kPa	7
0.2	4	Soft	35 kPa	7
0.3	3	Soft	25 kPa	5
0.4	4	Soft	35 kPa	7
0.5	10	Stiff	85 kPa	17
0.6	10	Stiff	85 kPa	17
0.7	11	Stiff	90 kPa	19
0.8	7	Firm	60 kPa	12
0.9	18	Stiff	150 kPa	33
1	13	Stiff	110 kPa	23
1.1	7	Firm	60 kPa	12
1.2	4	Soft	35 kPa	7
1.3	5	Firm	40 kPa	8
1.4	6	Firm	50 kPa	10
1.5	7	Firm	60 kPa	12
1.6	6	Firm	50 kPa	10
1.7	7	Firm	60 kPa	12
1.8	6	Firm	50 kPa	10
1.9	5	Firm	40 kPa	8
2	9	Stiff	75 kPa	15
2.1	8	Firm	65 kPa	14
2.2	9	Stiff	75 kPa	15
2.3	10	Stiff	85 kPa	17
2.4	10	Stiff	85 kPa	17
2.5	18	Stiff	150 kPa	33
2.6	14	Stiff	115 kPa	25
2.7	14	Stiff	115 kPa	25
2.8	20	Very Stiff	>150 kPa	37
2.9	17	Stiff	140 kPa	31
3	24	Very Stiff	>150 kPa	47
	End			



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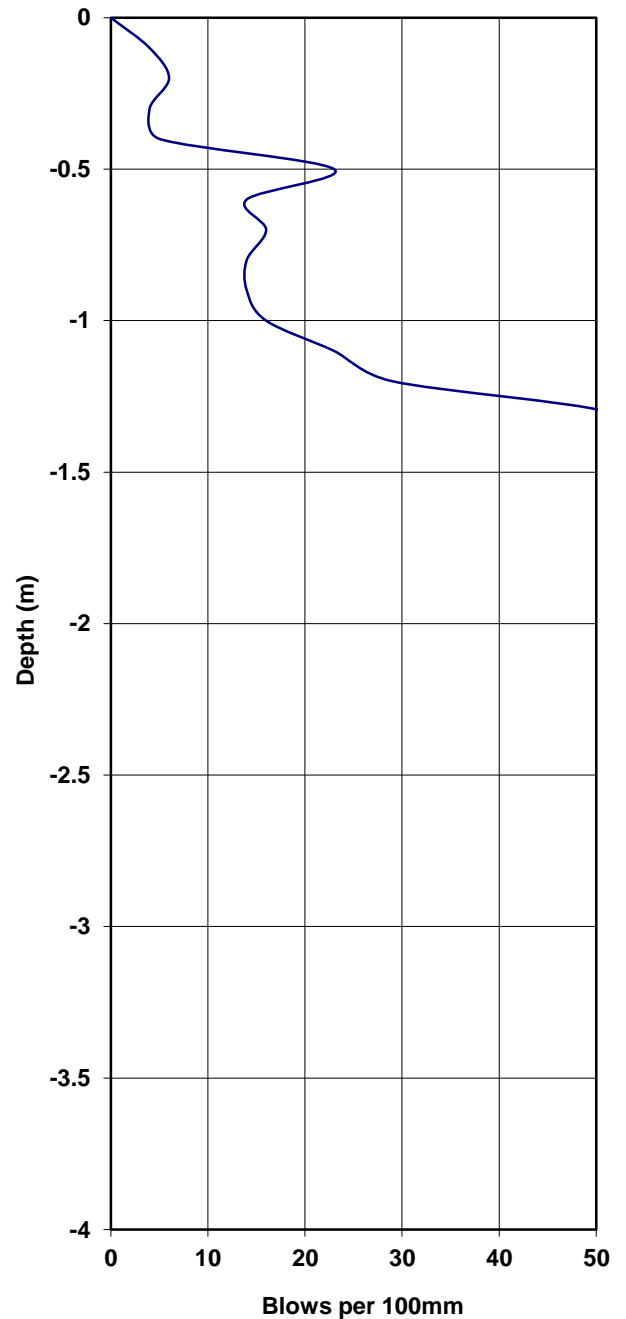


Client: EtheKwini Municipality - Water & Sanitation	Ref.No. 233-19
Project: Construction of Sewer Reticulation	Date: 19-26/09/2019
Section: Ntuzuma B, Wards 38, 41 & 45	Operator: S.Ramesh-warnath

CBR Penetrometer Probe ----- Test No. DC 21

THE STRENGTH AND CBR VALUES ARE EMPIRICAL AND DEPEND ON FACTORS SUCH AS MOISTURE CONTENT WHICH HAVE NOT BEEN DETERMINED. THEY ARE THEREFORE INDICATIVE ONLY AND SHOULD BE VERIFIED BY TEST OR OBSERVATION

Depth (m)	Blows/100mm	Inferred Consistency	Shear Strength	CBR %
0				
0.1	4	Soft	35 kPa	7
0.2	6	Firm	50 kPa	10
0.3	4	Soft	35 kPa	7
0.4	5	Firm	40 kPa	8
0.5	23	Very Stiff	>150 kPa	44
0.6	14	Stiff	115 kPa	25
0.7	16	Stiff	130 kPa	29
0.8	14	Stiff	115 kPa	25
0.9	14	Stiff	115 kPa	25
1	16	Stiff	130 kPa	29
1.1	23	Very Stiff	>150 kPa	44
1.2	29	Very Stiff	>150 kPa	>55
	Refusal			



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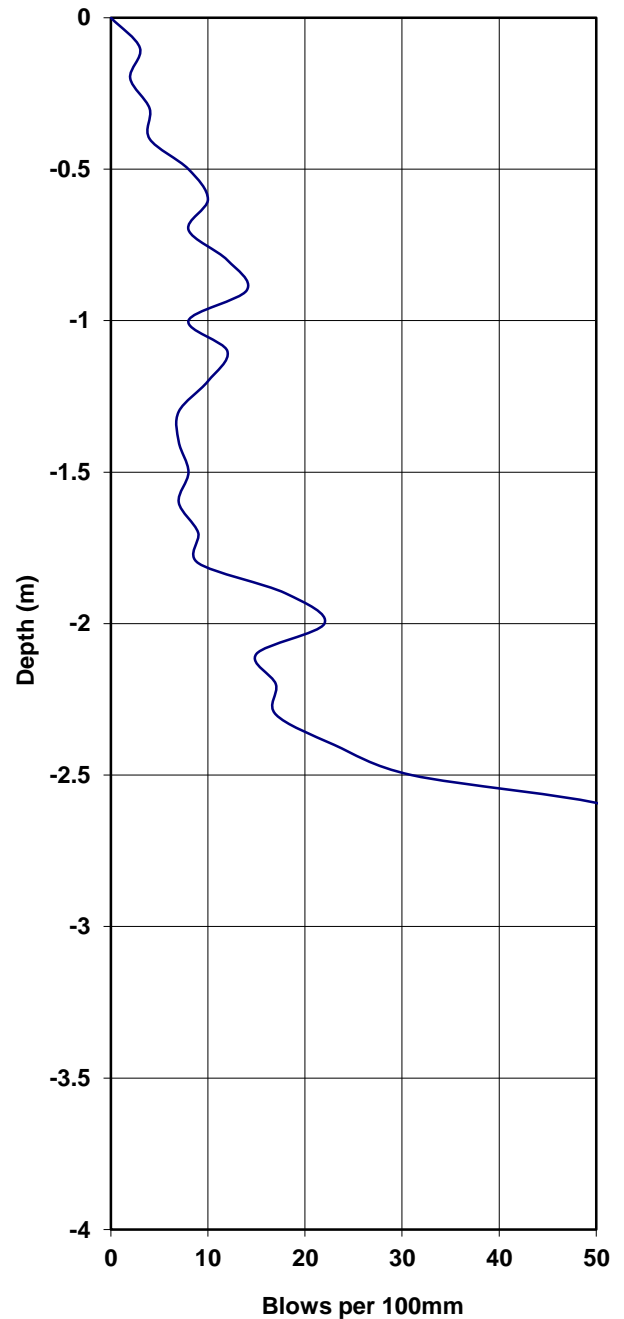


Client: Ethekewini Municipality - Water & Sanitation	Ref.No. 233-19
Project: Construction of Sewer Reticulation	Date: 19-26/09/2019
Section: Ntuzuma B, Wards 38, 41 & 45	Operator: S.Ramesh-warnath

CBR Penetrometer Probe ----- Test No. DC 22

THE STRENGTH AND CBR VALUES ARE EMPIRICAL AND DEPEND ON FACTORS SUCH AS MOISTURE CONTENT WHICH HAVE NOT BEEN DETERMINED. THEY ARE THEREFORE INDICATIVE ONLY AND SHOULD BE VERIFIED BY TEST OR OBSERVATION

Depth (m)	Blows/100mm	Inferred Consistency	Shear Strength	CBR %
0				
0.1	3	Soft	25 kPa	5
0.2	2	Soft	20 kPa	3
0.3	4	Soft	35 kPa	7
0.4	4	Soft	35 kPa	7
0.5	8	Firm	65 kPa	14
0.6	10	Stiff	85 kPa	17
0.7	8	Firm	65 kPa	14
0.8	12	Stiff	100 kPa	21
0.9	14	Stiff	115 kPa	25
1	8	Firm	65 kPa	14
1.1	12	Stiff	100 kPa	21
1.2	10	Stiff	85 kPa	17
1.3	7	Firm	60 kPa	12
1.4	7	Firm	60 kPa	12
1.5	8	Firm	65 kPa	14
1.6	7	Firm	60 kPa	12
1.7	9	Stiff	75 kPa	15
1.8	9	Stiff	75 kPa	15
1.9	18	Stiff	150 kPa	33
2	22	Very Stiff	>150 kPa	42
2.1	15	Stiff	125 kPa	27
2.2	17	Stiff	140 kPa	31
2.3	17	Stiff	140 kPa	31
2.4	23	Very Stiff	>150 kPa	44
2.5	31	Very Stiff	>150 kPa	>55
	Refusal			



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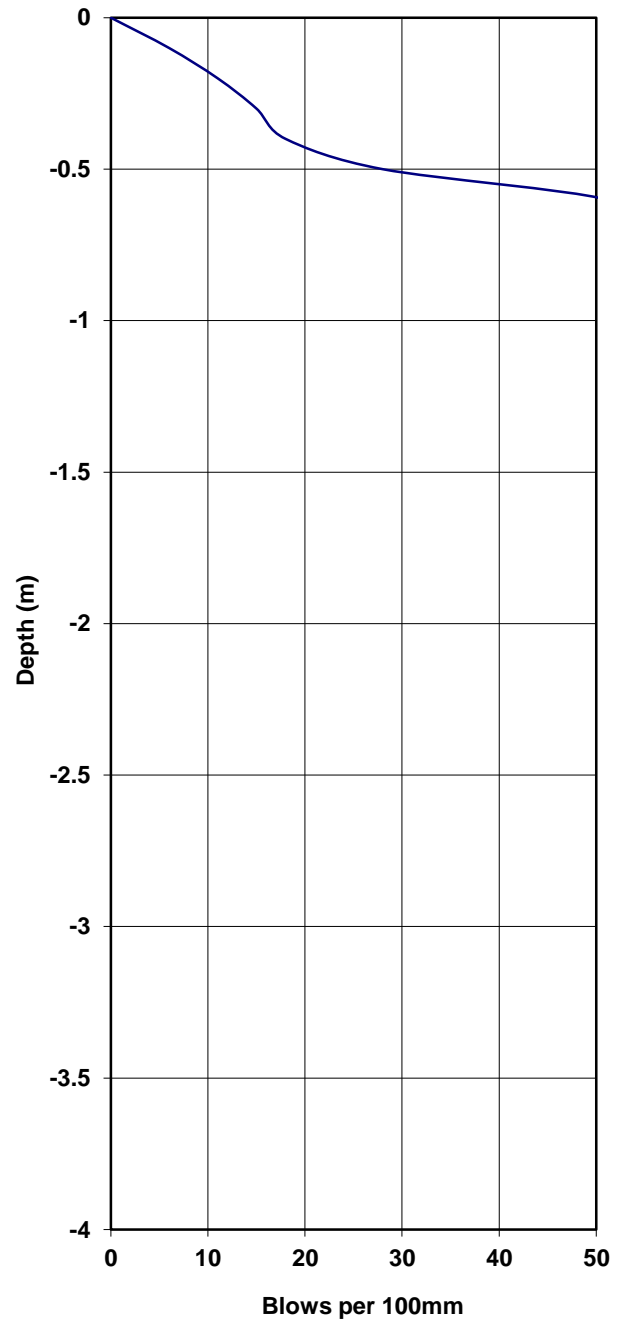


Client: Ethekewini Municipality - Water & Sanitation	Ref.No. 233-19
Project: Construction of Sewer Reticulation	Date: 19-26/09/2019
Section: Ntuzuma B, Wards 38, 41 & 45	Operator: S.Ramesh-warnath

CBR Penetrometer Probe ----- Test No. DC 23

THE STRENGTH AND CBR VALUES ARE EMPIRICAL AND DEPEND ON FACTORS SUCH AS MOISTURE CONTENT WHICH HAVE NOT BEEN DETERMINED. THEY ARE THEREFORE INDICATIVE ONLY AND SHOULD BE VERIFIED BY TEST OR OBSERVATION

Depth (m)	Blows/100mm	Inferred Consistency	Shear Strength	CBR %
0				
0.1	6	Firm	50 kPa	10
0.2	11	Stiff	90 kPa	19
0.3	15	Stiff	125 kPa	27
0.4	18	Stiff	150 kPa	33
0.5	28	Very Stiff	>150 kPa	>55
	Refusal			



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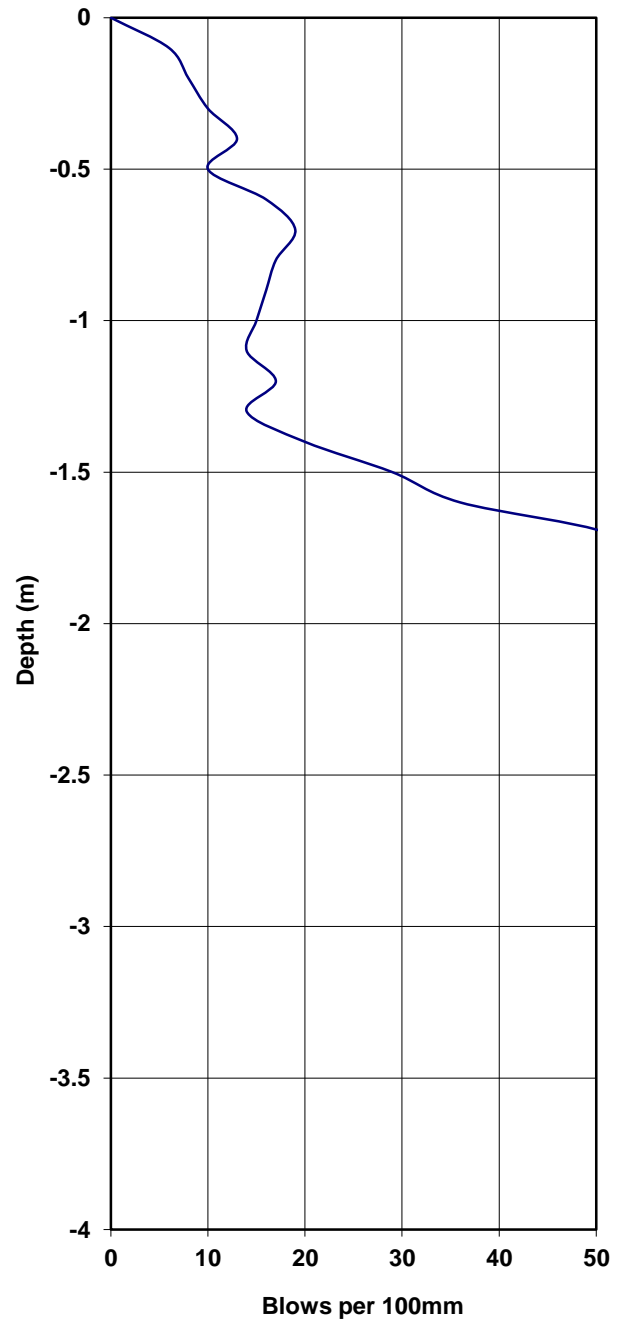


Client: Ethekewini Municipality - Water & Sanitation	Ref.No. 233-19
Project: Construction of Sewer Reticulation	Date: 19-26/09/2019
Section: Ntuzuma B, Wards 38, 41 & 45	Operator: S.Ramesh-warnath

CBR Penetrometer Probe ----- Test No. DC 24

THE STRENGTH AND CBR VALUES ARE EMPIRICAL AND DEPEND ON FACTORS SUCH AS MOISTURE CONTENT WHICH HAVE NOT BEEN DETERMINED. THEY ARE THEREFORE INDICATIVE ONLY AND SHOULD BE VERIFIED BY TEST OR OBSERVATION

Depth (m)	Blows/100mm	Inferred Consistency	Shear Strength	CBR %
0				
0.1	6	Firm	50 kPa	10
0.2	8	Firm	65 kPa	14
0.3	10	Stiff	85 kPa	17
0.4	13	Stiff	110 kPa	23
0.5	10	Stiff	85 kPa	17
0.6	16	Stiff	130 kPa	29
0.7	19	Very Stiff	>150 kPa	35
0.8	17	Stiff	140 kPa	31
0.9	16	Stiff	130 kPa	29
1	15	Stiff	125 kPa	27
1.1	14	Stiff	115 kPa	25
1.2	17	Stiff	140 kPa	31
1.3	14	Stiff	115 kPa	25
1.4	20	Very Stiff	>150 kPa	37
1.5	29	Very Stiff	>150 kPa	>55
1.6	36	Very Stiff	>150 kPa	>55
	Refusal			



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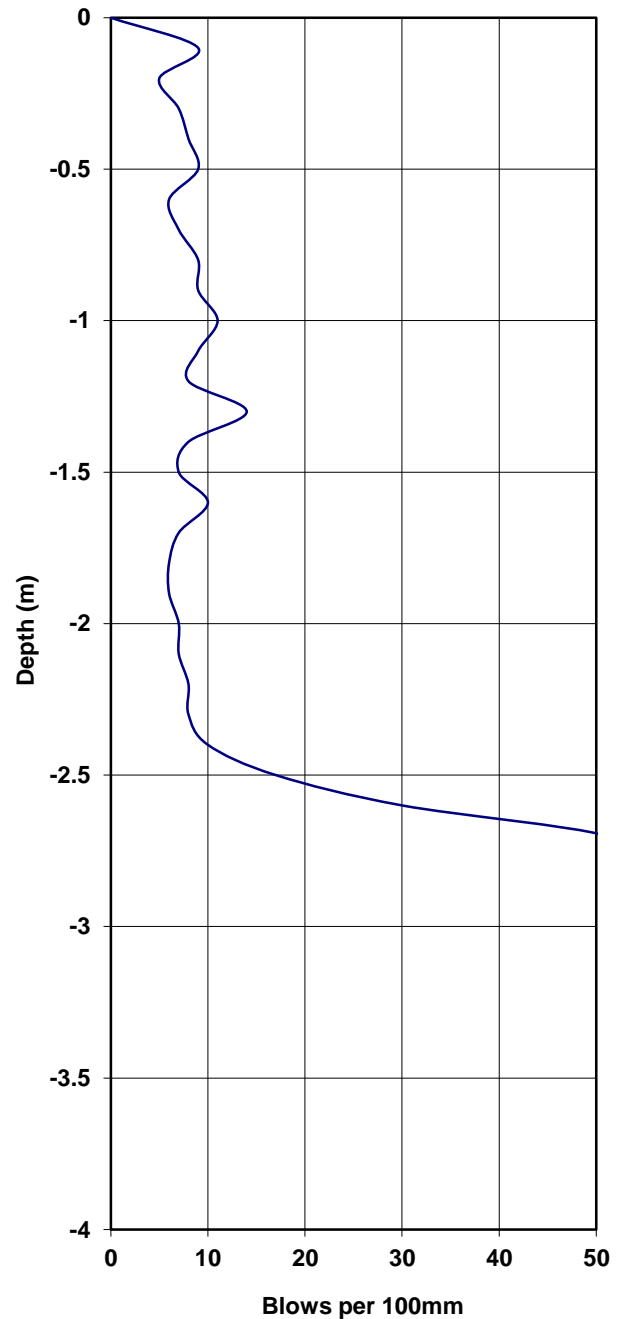


Client: EtheKwini Municipality - Water & Sanitation	Ref.No. 233-19
Project: Construction of Sewer Reticulation	Date: 19-26/09/2019
Section: Ntuzuma B, Wards 38, 41 & 45	Operator: S.Ramesh-warnath

CBR Penetrometer Probe ----- Test No. DC 25

THE STRENGTH AND CBR VALUES ARE EMPIRICAL AND DEPEND ON FACTORS SUCH AS MOISTURE CONTENT WHICH HAVE NOT BEEN DETERMINED. THEY ARE THEREFORE INDICATIVE ONLY AND SHOULD BE VERIFIED BY TEST OR OBSERVATION

Depth (m)	Blows/100mm	Inferred Consistency	Shear Strength	CBR %
0				
0.1	9	Stiff	75 kPa	15
0.2	5	Firm	40 kPa	8
0.3	7	Firm	60 kPa	12
0.4	8	Firm	65 kPa	14
0.5	9	Stiff	75 kPa	15
0.6	6	Firm	50 kPa	10
0.7	7	Firm	60 kPa	12
0.8	9	Stiff	75 kPa	15
0.9	9	Stiff	75 kPa	15
1	11	Stiff	90 kPa	19
1.1	9	Stiff	75 kPa	15
1.2	8	Firm	65 kPa	14
1.3	14	Stiff	115 kPa	25
1.4	8	Firm	65 kPa	14
1.5	7	Firm	60 kPa	12
1.6	10	Stiff	85 kPa	17
1.7	7	Firm	60 kPa	12
1.8	6	Firm	50 kPa	10
1.9	6	Firm	50 kPa	10
2	7	Firm	60 kPa	12
2.1	7	Firm	60 kPa	12
2.2	8	Firm	65 kPa	14
2.3	8	Firm	65 kPa	14
2.4	10	Stiff	85 kPa	17
2.5	17	Stiff	140 kPa	31
2.6	30	Very Stiff	>150 kPa	>55
	Refusal			



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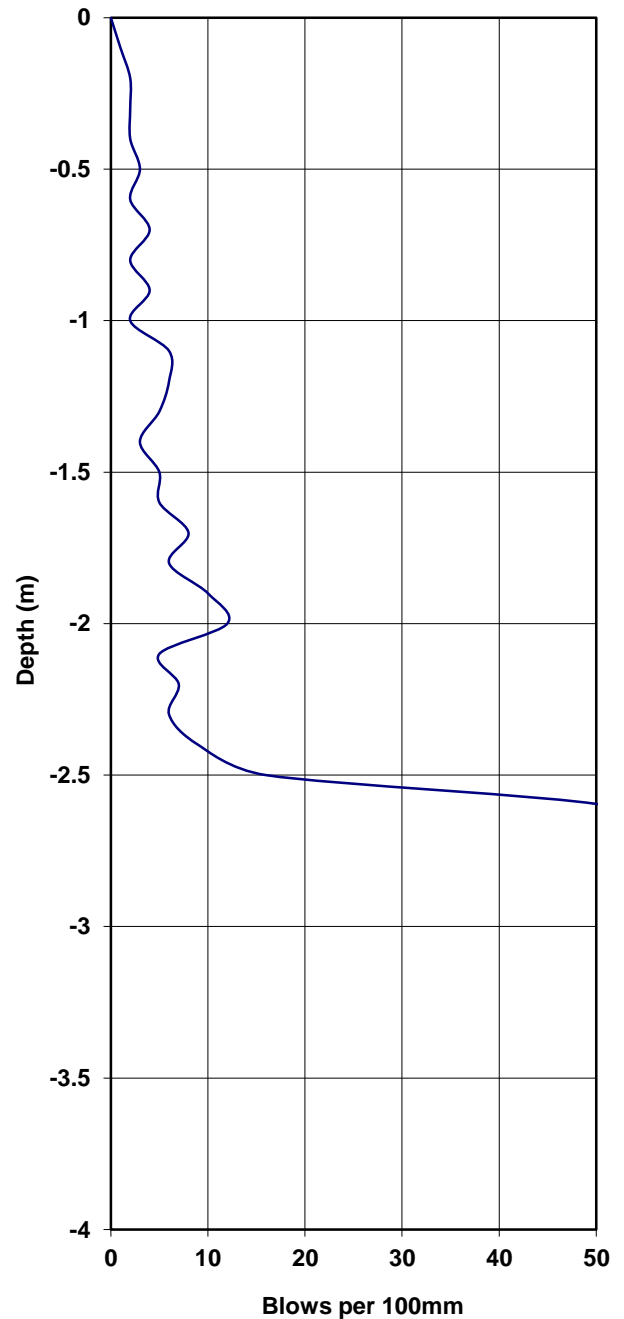


Client: Ethekewini Municipality - Water & Sanitation	Ref.No. 233-19
Project: Construction of Sewer Reticulation	Date: 19-26/09/2019
Section: Ntuzuma B, Wards 38, 41 & 45	Operator: S.Ramesh-warnath

CBR Penetrometer Probe ----- Test No. DC 26

THE STRENGTH AND CBR VALUES ARE EMPIRICAL AND DEPEND ON FACTORS SUCH AS MOISTURE CONTENT WHICH HAVE NOT BEEN DETERMINED. THEY ARE THEREFORE INDICATIVE ONLY AND SHOULD BE VERIFIED BY TEST OR OBSERVATION

Depth (m)	Blows/100mm	Inferred Consistency	Shear Strength	CBR %
0				
0.1	1	Very Soft	<20 kPa	2
0.2	2	Soft	20 kPa	3
0.3	2	Soft	20 kPa	3
0.4	2	Soft	20 kPa	3
0.5	3	Soft	25 kPa	5
0.6	2	Soft	20 kPa	3
0.7	4	Soft	35 kPa	7
0.8	2	Soft	20 kPa	3
0.9	4	Soft	35 kPa	7
1	2	Soft	20 kPa	3
1.1	6	Firm	50 kPa	10
1.2	6	Firm	50 kPa	10
1.3	5	Firm	40 kPa	8
1.4	3	Soft	25 kPa	5
1.5	5	Firm	40 kPa	8
1.6	5	Firm	40 kPa	8
1.7	8	Firm	65 kPa	14
1.8	6	Firm	50 kPa	10
1.9	10	Stiff	85 kPa	17
2	12	Stiff	100 kPa	21
2.1	5	Firm	40 kPa	8
2.2	7	Firm	60 kPa	12
2.3	6	Firm	50 kPa	10
2.4	9	Stiff	75 kPa	15
2.5	16	Stiff	130 kPa	29
	Refusal			



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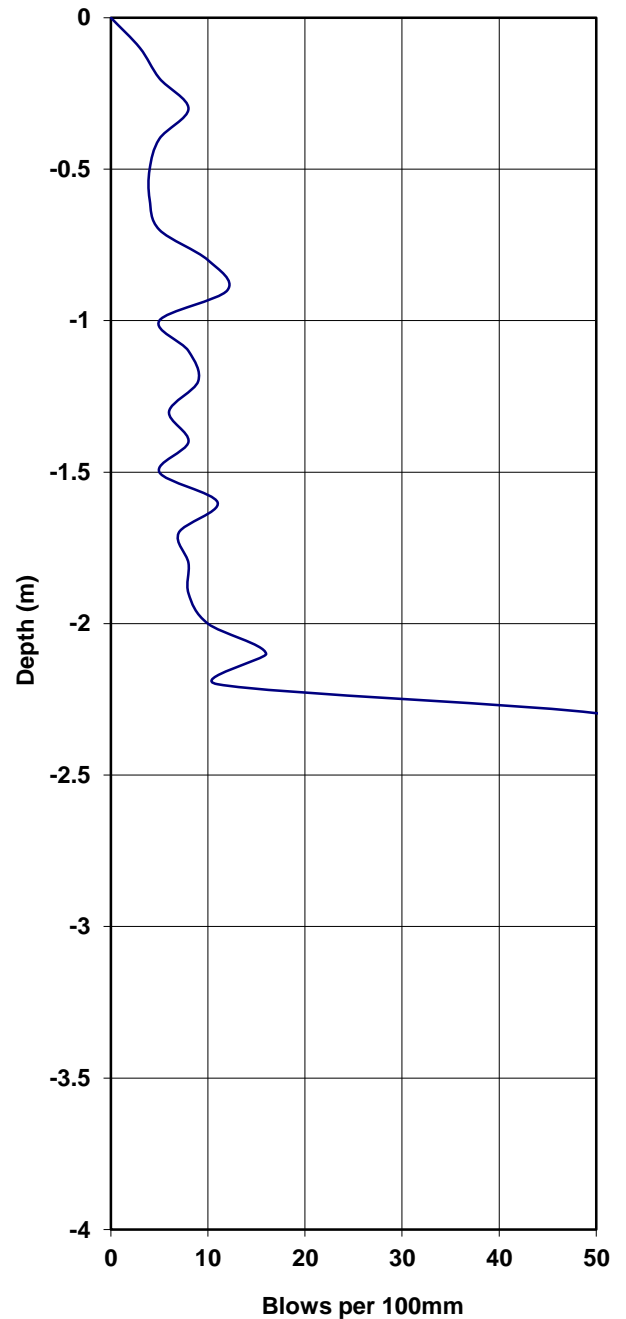


Client: Ethekewini Municipality - Water & Sanitation	Ref.No. 233-19
Project: Construction of Sewer Reticulation	Date: 19-26/09/2019
Section: Ntuzuma B, Wards 38, 41 & 45	Operator: S.Ramesh-warnath

CBR Penetrometer Probe ----- Test No. DC 27

THE STRENGTH AND CBR VALUES ARE EMPIRICAL AND DEPEND ON FACTORS SUCH AS MOISTURE CONTENT WHICH HAVE NOT BEEN DETERMINED. THEY ARE THEREFORE INDICATIVE ONLY AND SHOULD BE VERIFIED BY TEST OR OBSERVATION

Depth (m)	Blows/100mm	Inferred Consistency	Shear Strength	CBR %
0				
0.1	3	Soft	25 kPa	5
0.2	5	Firm	40 kPa	8
0.3	8	Firm	65 kPa	14
0.4	5	Firm	40 kPa	8
0.5	4	Soft	35 kPa	7
0.6	4	Soft	35 kPa	7
0.7	5	Firm	40 kPa	8
0.8	10	Stiff	85 kPa	17
0.9	12	Stiff	100 kPa	21
1	5	Firm	40 kPa	8
1.1	8	Firm	65 kPa	14
1.2	9	Stiff	75 kPa	15
1.3	6	Firm	50 kPa	10
1.4	8	Firm	65 kPa	14
1.5	5	Firm	40 kPa	8
1.6	11	Stiff	90 kPa	19
1.7	7	Firm	60 kPa	12
1.8	8	Firm	65 kPa	14
1.9	8	Firm	65 kPa	14
2	10	Stiff	85 kPa	17
2.1	16	Stiff	130 kPa	29
2.2	11	Stiff	90 kPa	19
	Refusal			



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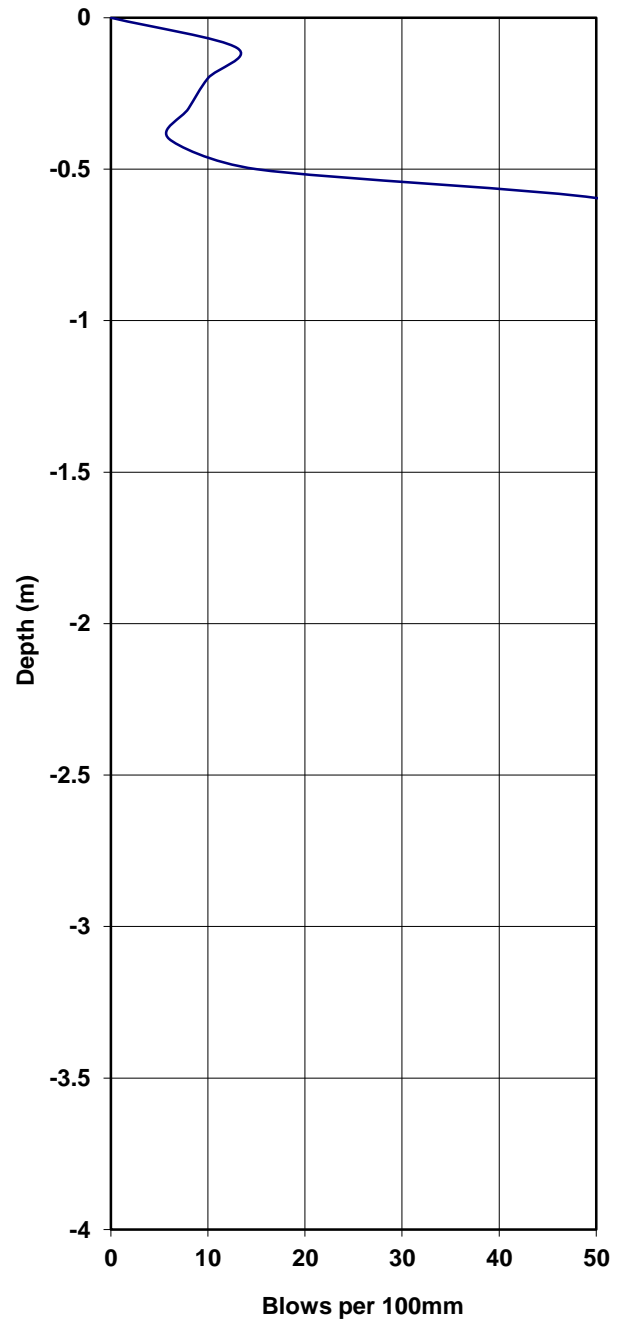


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Project: Construction of Sewer Reticulation	Date: 19-26/09/2019
Section: Ntuzuma B, Wards 38, 41 & 45	Operator: S.Ramesh-warnath

CBR Penetrometer Probe ----- Test No. DC 28

THE STRENGTH AND CBR VALUES ARE EMPIRICAL AND DEPEND ON FACTORS SUCH AS MOISTURE CONTENT WHICH HAVE NOT BEEN DETERMINED. THEY ARE THEREFORE INDICATIVE ONLY AND SHOULD BE VERIFIED BY TEST OR OBSERVATION

Depth (m)	Blows/100mm	Inferred Consistency	Shear Strength	CBR %
0				
0.1	13	Stiff	110 kPa	23
0.2	10	Stiff	85 kPa	17
0.3	8	Firm	65 kPa	14
0.4	6	Firm	50 kPa	10
0.5	15	Stiff	125 kPa	27
	Refusal			



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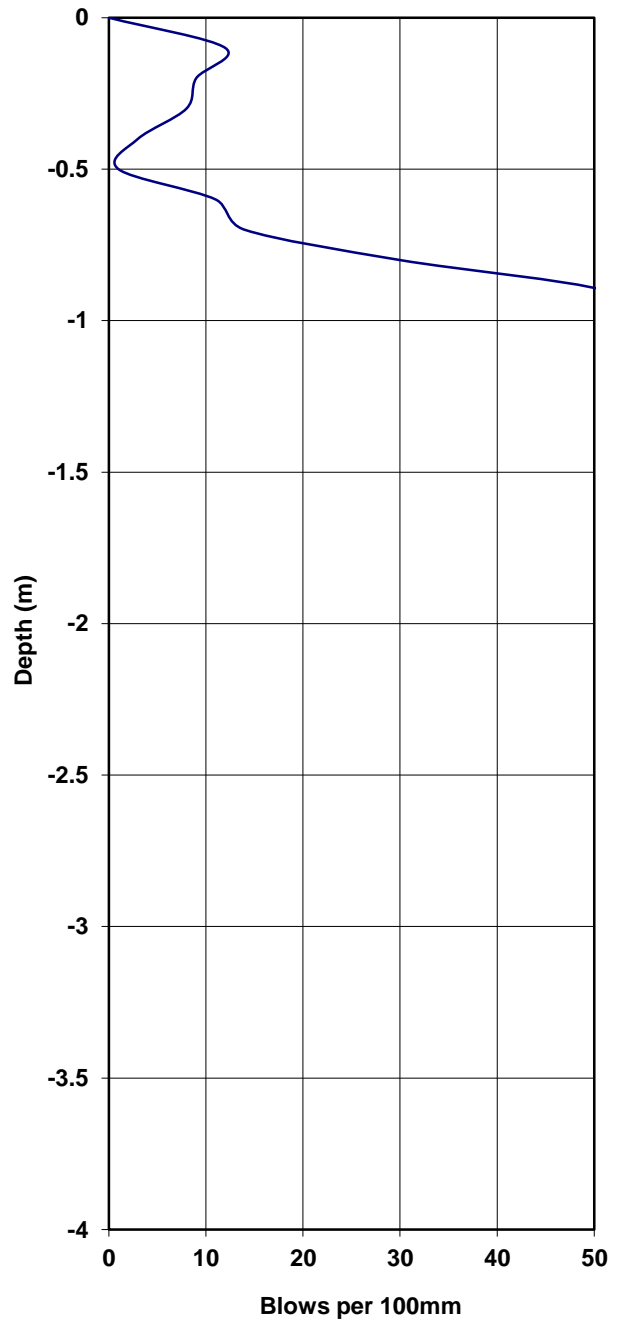


Client: EtheKwini Municipality - Water & Sanitation	Ref.No. 233-19
Project: Construction of Sewer Reticulation	Date: 19-26/09/2019
Section: Ntuzuma B, Wards 38, 41 & 45	Operator: S.Ramesh-warnath

CBR Penetrometer Probe ----- Test No. DC 29

THE STRENGTH AND CBR VALUES ARE EMPIRICAL AND DEPEND ON FACTORS SUCH AS MOISTURE CONTENT WHICH HAVE NOT BEEN DETERMINED. THEY ARE THEREFORE INDICATIVE ONLY AND SHOULD BE VERIFIED BY TEST OR OBSERVATION

Depth (m)	Blows/100mm	Inferred Consistency	Shear Strength	CBR %
0				
0.1	12	Stiff	100 kPa	21
0.2	9	Stiff	75 kPa	15
0.3	8	Firm	65 kPa	14
0.4	3	Soft	25 kPa	5
0.5	1	Very Soft	<20 kPa	2
0.6	11	Stiff	90 kPa	19
0.7	14	Stiff	115 kPa	25
0.8	30	Very Stiff	>150 kPa	>55
	Refusal			



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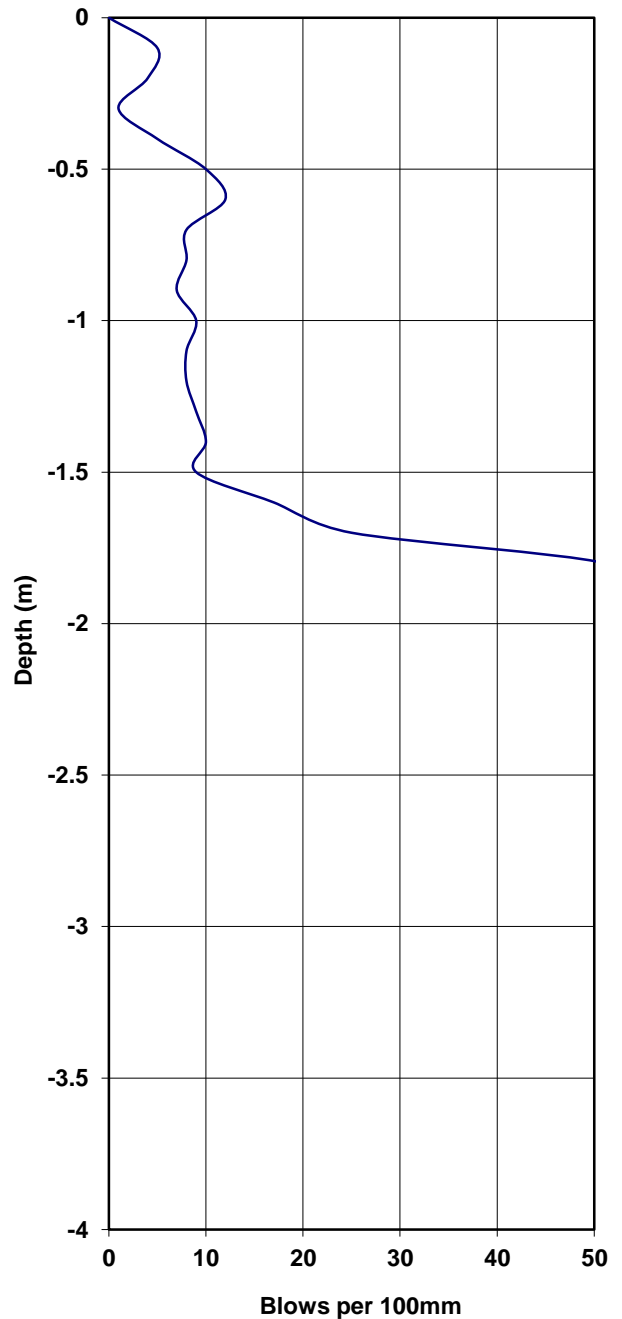


Client: EtheKwini Municipality - Water & Sanitation	Ref.No. 233-19
Project: Construction of Sewer Reticulation	Date: 19-26/09/2019
Section: Ntuzuma B, Wards 38, 41 & 45	Operator: S.Ramesh-warnath

CBR Penetrometer Probe ----- Test No. DC 30

THE STRENGTH AND CBR VALUES ARE EMPIRICAL AND DEPEND ON FACTORS SUCH AS MOISTURE CONTENT WHICH HAVE NOT BEEN DETERMINED. THEY ARE THEREFORE INDICATIVE ONLY AND SHOULD BE VERIFIED BY TEST OR OBSERVATION

Depth (m)	Blows/100mm	Inferred Consistency	Shear Strength	CBR %
0				
0.1	5	Firm	40 kPa	8
0.2	4	Soft	35 kPa	7
0.3	1	Very Soft	<20 kPa	2
0.4	5	Firm	40 kPa	8
0.5	10	Stiff	85 kPa	17
0.6	12	Stiff	100 kPa	21
0.7	8	Firm	65 kPa	14
0.8	8	Firm	65 kPa	14
0.9	7	Firm	60 kPa	12
1	9	Stiff	75 kPa	15
1.1	8	Firm	65 kPa	14
1.2	8	Firm	65 kPa	14
1.3	9	Stiff	75 kPa	15
1.4	10	Stiff	85 kPa	17
1.5	9	Stiff	75 kPa	15
1.6	17	Stiff	140 kPa	31
1.7	25	Very Stiff	>150 kPa	49
	Refusal			



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Client: Ethekewini Municipality - Water & Sanitation

Ref.No. 233-19

Project: Construction of Sewer Reticulation

Date: 19-26/09/2019

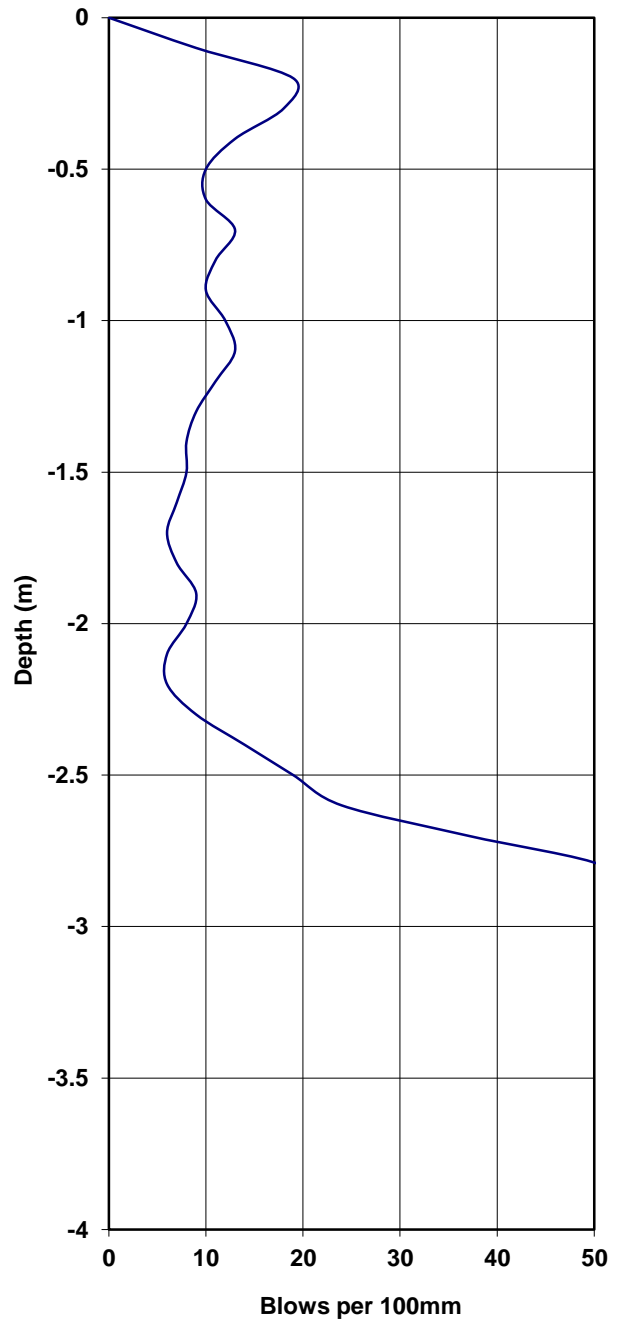
Section: Ntuzuma B, Wards 38, 41 & 45

Operator: S.Ramesh-warnath

CBR Penetrometer Probe ----- Test No. DC 31

THE STRENGTH AND CBR VALUES ARE EMPIRICAL AND DEPEND ON FACTORS SUCH AS MOISTURE CONTENT WHICH HAVE NOT BEEN DETERMINED. THEY ARE THEREFORE INDICATIVE ONLY AND SHOULD BE VERIFIED BY TEST OR OBSERVATION

Depth (m)	Blows/100mm	Inferred Consistency	Shear Strength	CBR %
0				
0.1	9	Stiff	75 kPa	15
0.2	19	Very Stiff	>150 kPa	35
0.3	18	Stiff	150 kPa	33
0.4	13	Stiff	110 kPa	23
0.5	10	Stiff	85 kPa	17
0.6	10	Stiff	85 kPa	17
0.7	13	Stiff	110 kPa	23
0.8	11	Stiff	90 kPa	19
0.9	10	Stiff	85 kPa	17
1	12	Stiff	100 kPa	21
1.1	13	Stiff	110 kPa	23
1.2	11	Stiff	90 kPa	19
1.3	9	Stiff	75 kPa	15
1.4	8	Firm	65 kPa	14
1.5	8	Firm	65 kPa	14
1.6	7	Firm	60 kPa	12
1.7	6	Firm	50 kPa	10
1.8	7	Firm	60 kPa	12
1.9	9	Stiff	75 kPa	15
2	8	Firm	65 kPa	14
2.1	6	Firm	50 kPa	10
2.2	6	Firm	50 kPa	10
2.3	9	Stiff	75 kPa	15
2.4	14	Stiff	115 kPa	25
2.5	19	Very Stiff	>150 kPa	35
2.6	24	Very Stiff	>150 kPa	47
2.7	37	Very Stiff	>150 kPa	>55
	Refusal			



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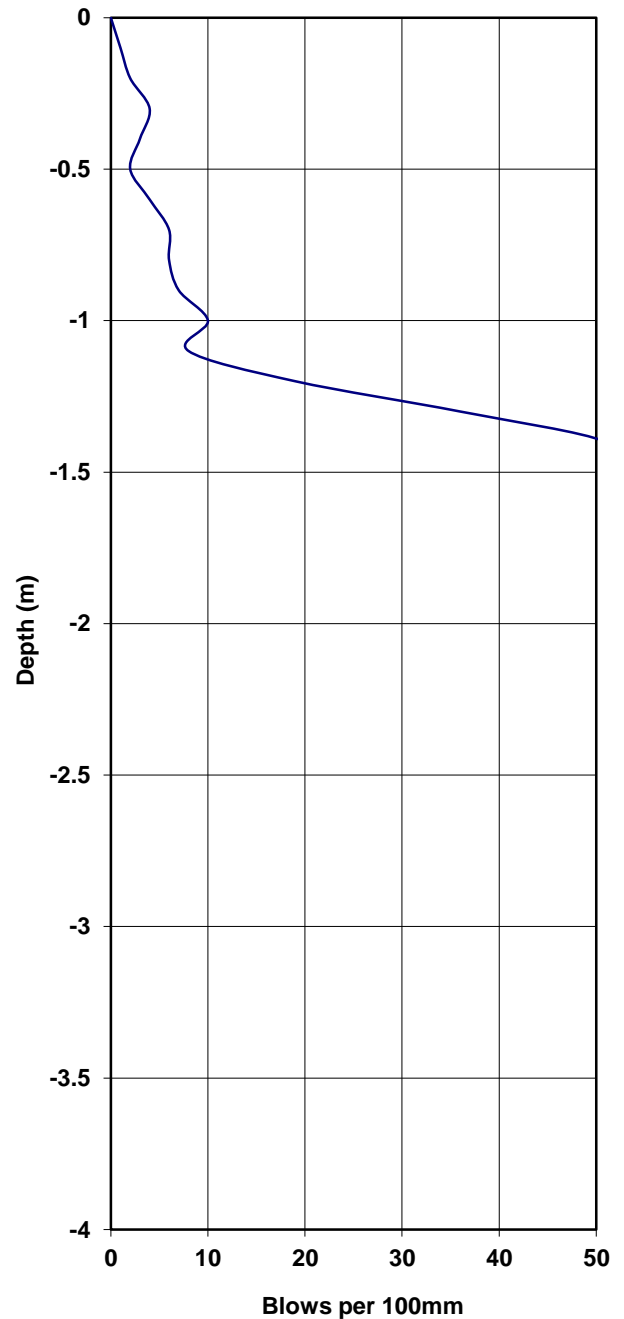


Client: Ethekewini Municipality - Water & Sanitation	Ref.No. 233-19
Project: Construction of Sewer Reticulation	Date: 19-26/09/2019
Section: Ntuzuma B, Wards 38, 41 & 45	Operator: S.Ramesh-warnath

CBR Penetrometer Probe ----- Test No. DC 32

THE STRENGTH AND CBR VALUES ARE EMPIRICAL AND DEPEND ON FACTORS SUCH AS MOISTURE CONTENT WHICH HAVE NOT BEEN DETERMINED. THEY ARE THEREFORE INDICATIVE ONLY AND SHOULD BE VERIFIED BY TEST OR OBSERVATION

Depth (m)	Blows/100mm	Inferred Consistency	Shear Strength	CBR %
0				
0.1	1	Very Soft	<20 kPa	2
0.2	2	Soft	20 kPa	3
0.3	4	Soft	35 kPa	7
0.4	3	Soft	25 kPa	5
0.5	2	Soft	20 kPa	3
0.6	4	Soft	35 kPa	7
0.7	6	Firm	50 kPa	10
0.8	6	Firm	50 kPa	10
0.9	7	Firm	60 kPa	12
1	10	Stiff	85 kPa	17
1.1	8	Firm	65 kPa	14
1.2	19	Very Stiff	>150 kPa	35
1.3	36	Very Stiff	>150 kPa	>55
	Refusal			



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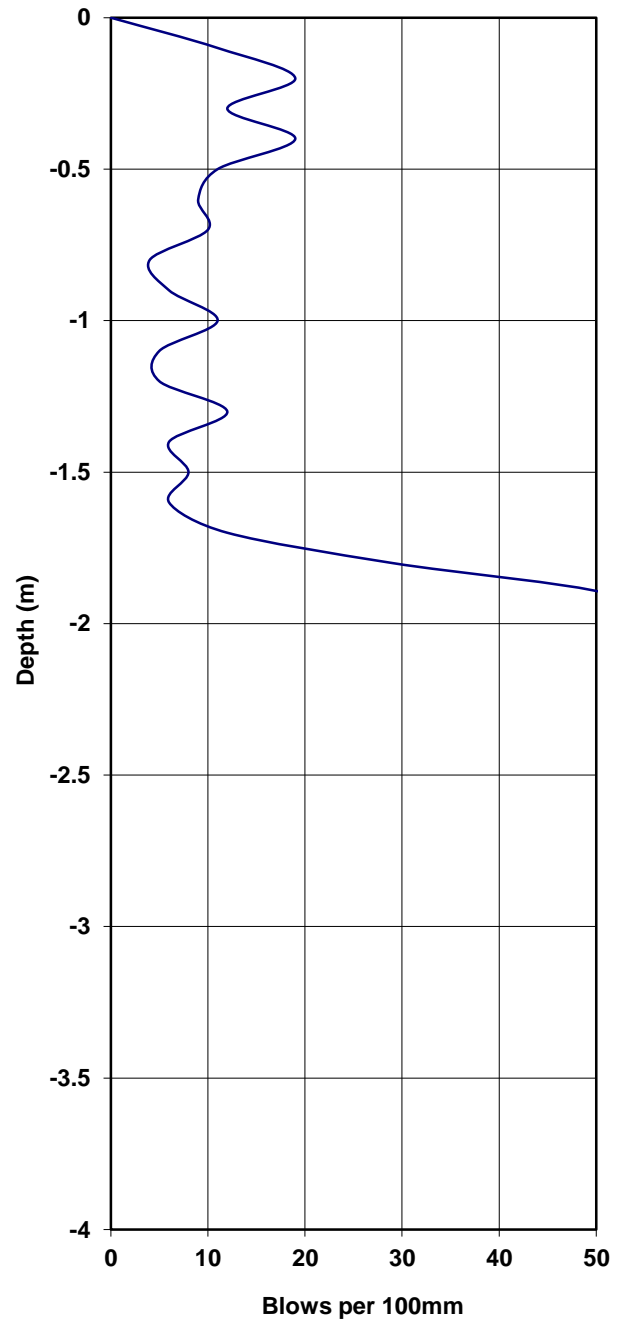


Client: EtheKwini Municipality - Water & Sanitation	Ref.No. 233-19
Project: Construction of Sewer Reticulation	Date: 19-26/09/2019
Section: Ntuzuma B, Wards 38, 41 & 45	Operator: S.Ramesh-warnath

CBR Penetrometer Probe ----- Test No. DC 33

THE STRENGTH AND CBR VALUES ARE EMPIRICAL AND DEPEND ON FACTORS SUCH AS MOISTURE CONTENT WHICH HAVE NOT BEEN DETERMINED. THEY ARE THEREFORE INDICATIVE ONLY AND SHOULD BE VERIFIED BY TEST OR OBSERVATION

Depth (m)	Blows/100mm	Inferred Consistency	Shear Strength	CBR %
0				
0.1	11	Stiff	90 kPa	19
0.2	19	Very Stiff	>150 kPa	35
0.3	12	Stiff	100 kPa	21
0.4	19	Very Stiff	>150 kPa	35
0.5	11	Stiff	90 kPa	19
0.6	9	Stiff	75 kPa	15
0.7	10	Stiff	85 kPa	17
0.8	4	Soft	35 kPa	7
0.9	6	Firm	50 kPa	10
1	11	Stiff	90 kPa	19
1.1	5	Firm	40 kPa	8
1.2	5	Firm	40 kPa	8
1.3	12	Stiff	100 kPa	21
1.4	6	Firm	50 kPa	10
1.5	8	Firm	65 kPa	14
1.6	6	Firm	50 kPa	10
1.7	12	Stiff	100 kPa	21
1.8	29	Very Stiff	>150 kPa	>55
	Refusal			



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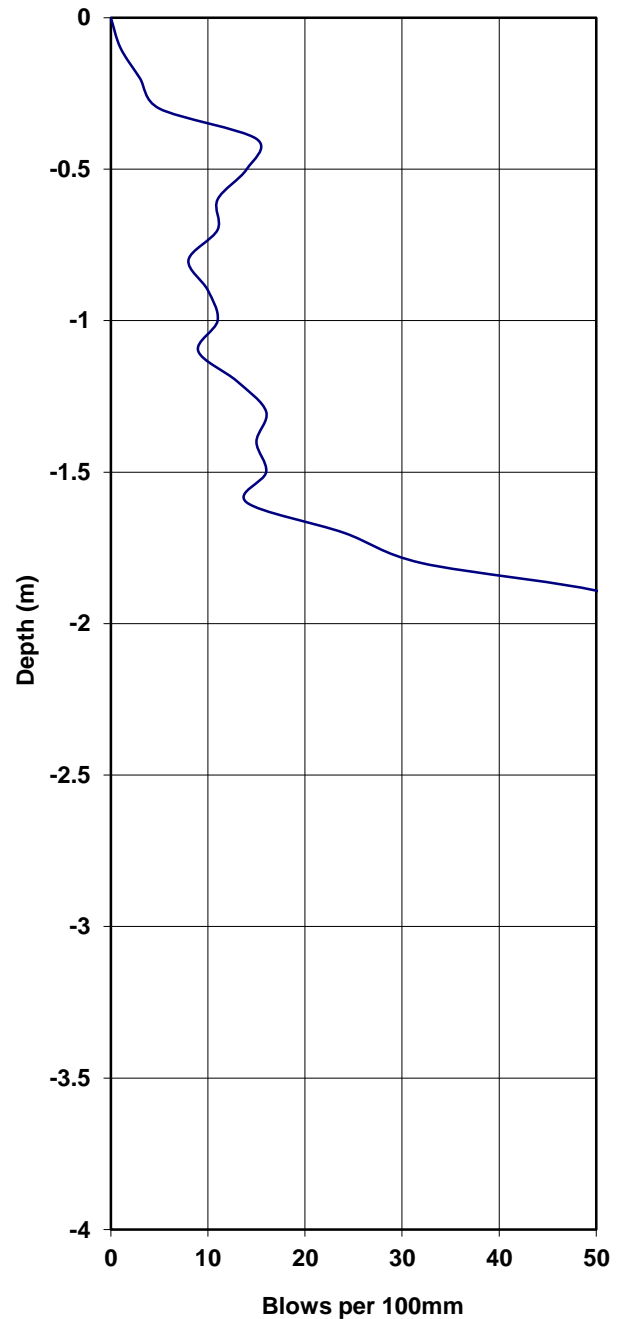


Client: Ethekewini Municipality - Water & Sanitation	Ref.No. 233-19
Project: Construction of Sewer Reticulation	Date: 19-26/09/2019
Section: Ntuzuma B, Wards 38, 41 & 45	Operator: S.Ramesh-warnath

CBR Penetrometer Probe ----- Test No. DC 34

THE STRENGTH AND CBR VALUES ARE EMPIRICAL AND DEPEND ON FACTORS SUCH AS MOISTURE CONTENT WHICH HAVE NOT BEEN DETERMINED. THEY ARE THEREFORE INDICATIVE ONLY AND SHOULD BE VERIFIED BY TEST OR OBSERVATION

Depth (m)	Blows/100mm	Inferred Consistency	Shear Strength	CBR %
0				
0.1	1	Very Soft	<20 kPa	2
0.2	3	Soft	25 kPa	5
0.3	5	Firm	40 kPa	8
0.4	15	Stiff	125 kPa	27
0.5	14	Stiff	115 kPa	25
0.6	11	Stiff	90 kPa	19
0.7	11	Stiff	90 kPa	19
0.8	8	Firm	65 kPa	14
0.9	10	Stiff	85 kPa	17
1	11	Stiff	90 kPa	19
1.1	9	Stiff	75 kPa	15
1.2	13	Stiff	110 kPa	23
1.3	16	Stiff	130 kPa	29
1.4	15	Stiff	125 kPa	27
1.5	16	Stiff	130 kPa	29
1.6	14	Stiff	115 kPa	25
1.7	24	Very Stiff	>150 kPa	47
1.8	32	Very Stiff	>150 kPa	>55
	Refusal			



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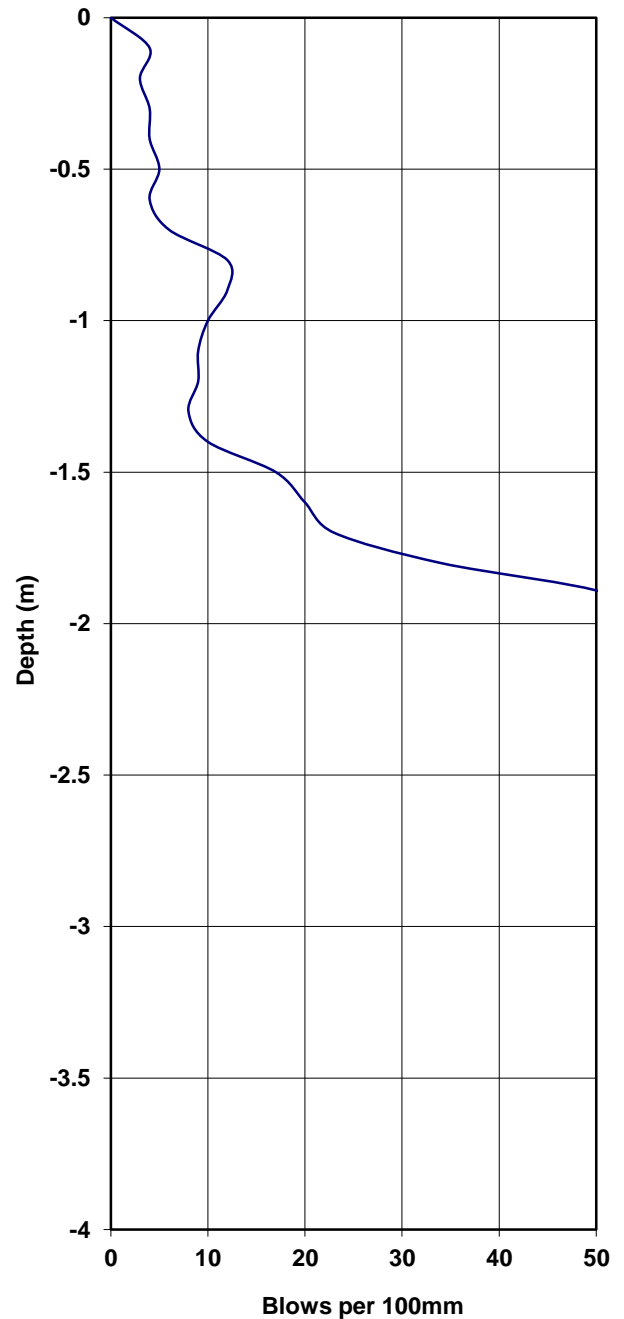


Client: EtheKwini Municipality - Water & Sanitation	Ref.No. 233-19
Project: Construction of Sewer Reticulation	Date: 19-26/09/2019
Section: Ntuzuma B, Wards 38, 41 & 45	Operator: S.Ramesh-warnath

CBR Penetrometer Probe ----- Test No. DC 35

THE STRENGTH AND CBR VALUES ARE EMPIRICAL AND DEPEND ON FACTORS SUCH AS MOISTURE CONTENT WHICH HAVE NOT BEEN DETERMINED. THEY ARE THEREFORE INDICATIVE ONLY AND SHOULD BE VERIFIED BY TEST OR OBSERVATION

Depth (m)	Blows/100mm	Inferred Consistency	Shear Strength	CBR %
0				
0.1	4	Soft	35 kPa	7
0.2	3	Soft	25 kPa	5
0.3	4	Soft	35 kPa	7
0.4	4	Soft	35 kPa	7
0.5	5	Firm	40 kPa	8
0.6	4	Soft	35 kPa	7
0.7	6	Firm	50 kPa	10
0.8	12	Stiff	100 kPa	21
0.9	12	Stiff	100 kPa	21
1	10	Stiff	85 kPa	17
1.1	9	Stiff	75 kPa	15
1.2	9	Stiff	75 kPa	15
1.3	8	Firm	65 kPa	14
1.4	10	Stiff	85 kPa	17
1.5	17	Stiff	140 kPa	31
1.6	20	Very Stiff	>150 kPa	37
1.7	23	Very Stiff	>150 kPa	44
1.8	34	Very Stiff	>150 kPa	>55
	Refusal			



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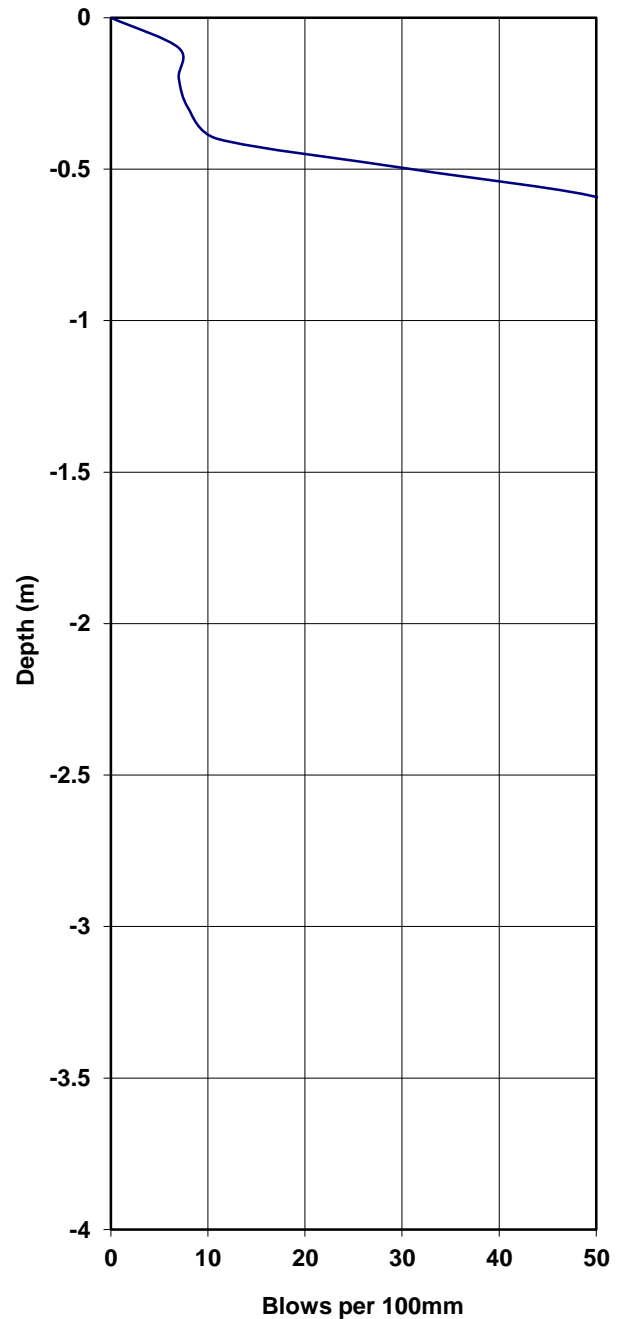


Client: Ethekewini Municipality - Water & Sanitation	Ref.No. 233-19
Project: Construction of Sewer Reticulation	Date: 19-26/09/2019
Section: Ntuzuma B, Wards 38, 41 & 45	Operator: S.Ramesh-warnath

CBR Penetrometer Probe ----- Test No. DC 36

THE STRENGTH AND CBR VALUES ARE EMPIRICAL AND DEPEND ON FACTORS SUCH AS MOISTURE CONTENT WHICH HAVE NOT BEEN DETERMINED. THEY ARE THEREFORE INDICATIVE ONLY AND SHOULD BE VERIFIED BY TEST OR OBSERVATION

Depth (m)	Blows/100mm	Inferred Consistency	Shear Strength	CBR %
0				
0.1	7	Firm	60 kPa	12
0.2	7	Firm	60 kPa	12
0.3	8	Firm	65 kPa	14
0.4	11	Stiff	90 kPa	19
0.5	31	Very Stiff	>150 kPa	>55
	Refusal			



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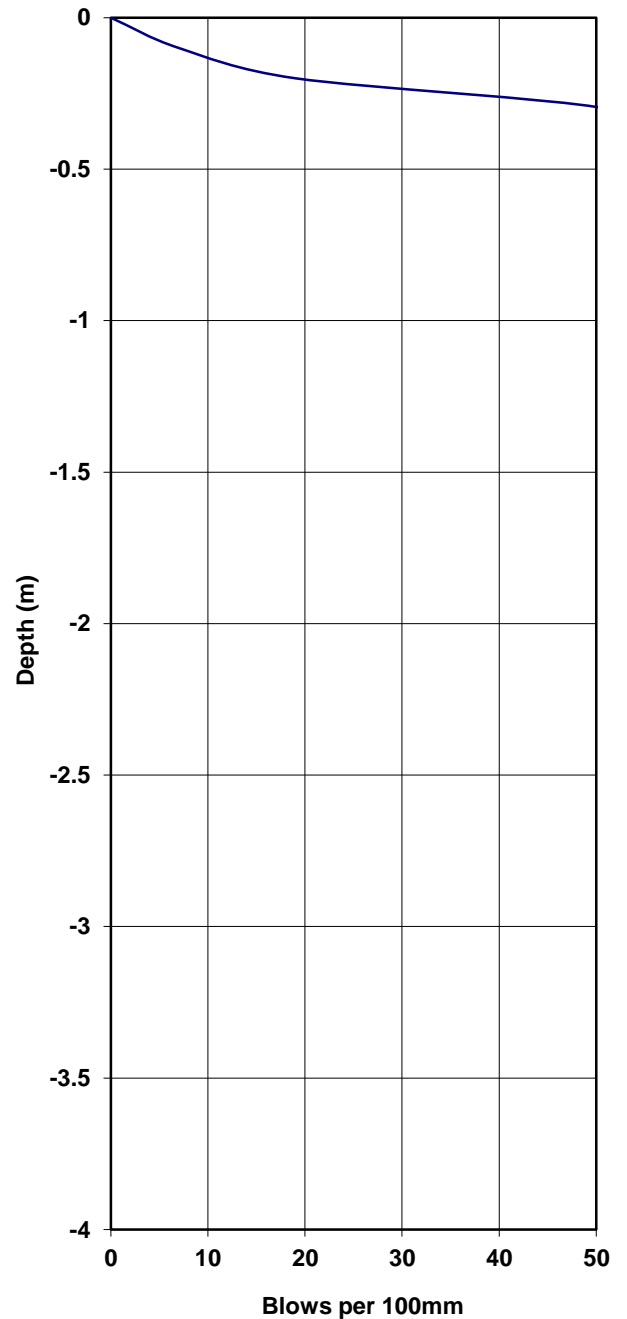


Client: Ethekewini Municipality - Water & Sanitation	Ref.No. 233-19
Project: Construction of Sewer Reticulation	Date: 19-26/09/2019
Section: Ntuzuma B, Wards 38, 41 & 45	Operator: S.Ramesh-warnath

CBR Penetrometer Probe ----- Test No. DC 37

THE STRENGTH AND CBR VALUES ARE EMPIRICAL AND DEPEND ON FACTORS SUCH AS MOISTURE CONTENT WHICH HAVE NOT BEEN DETERMINED. THEY ARE THEREFORE INDICATIVE ONLY AND SHOULD BE VERIFIED BY TEST OR OBSERVATION

Depth (m)	Blows/100mm	Inferred Consistency	Shear Strength	CBR %
0				
0.1	7	Firm	60 kPa	12
0.2	19	Very Stiff	>150 kPa	35
	Refusal			



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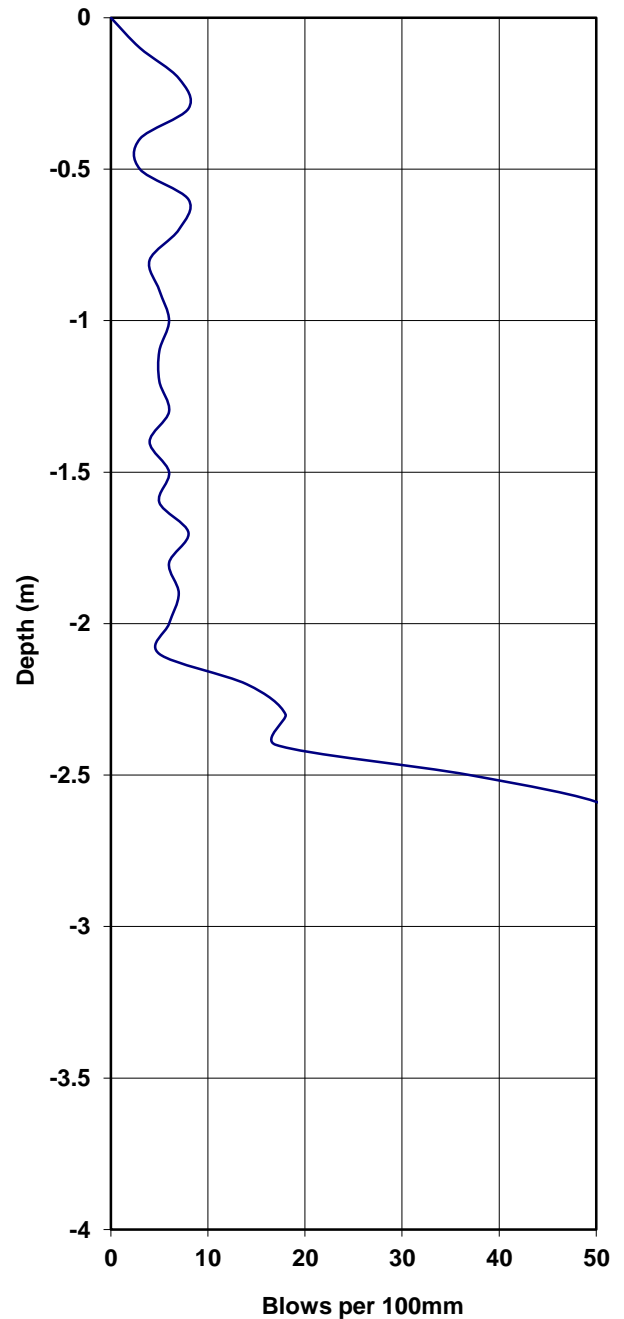


Client: Ethekewini Municipality - Water & Sanitation	Ref.No. 233-19
Project: Construction of Sewer Reticulation	Date: 19-26/09/2019
Section: Ntuzuma B, Wards 38, 41 & 45	Operator: S.Ramesh-warnath

CBR Penetrometer Probe ----- Test No. DC 38

THE STRENGTH AND CBR VALUES ARE EMPIRICAL AND DEPEND ON FACTORS SUCH AS MOISTURE CONTENT WHICH HAVE NOT BEEN DETERMINED. THEY ARE THEREFORE INDICATIVE ONLY AND SHOULD BE VERIFIED BY TEST OR OBSERVATION

Depth (m)	Blows/100mm	Inferred Consistency	Shear Strength	CBR %
0				
0.1	3	Soft	25 kPa	5
0.2	7	Firm	60 kPa	12
0.3	8	Firm	65 kPa	14
0.4	3	Soft	25 kPa	5
0.5	3	Soft	25 kPa	5
0.6	8	Firm	65 kPa	14
0.7	7	Firm	60 kPa	12
0.8	4	Soft	35 kPa	7
0.9	5	Firm	40 kPa	8
1	6	Firm	50 kPa	10
1.1	5	Firm	40 kPa	8
1.2	5	Firm	40 kPa	8
1.3	6	Firm	50 kPa	10
1.4	4	Soft	35 kPa	7
1.5	6	Firm	50 kPa	10
1.6	5	Firm	40 kPa	8
1.7	8	Firm	65 kPa	14
1.8	6	Firm	50 kPa	10
1.9	7	Firm	60 kPa	12
2	6	Firm	50 kPa	10
2.1	5	Firm	40 kPa	8
2.2	14	Stiff	115 kPa	25
2.3	18	Stiff	150 kPa	33
2.4	17	Stiff	140 kPa	31
2.5	37	Very Stiff	>150 kPa	>55
	Refusal			



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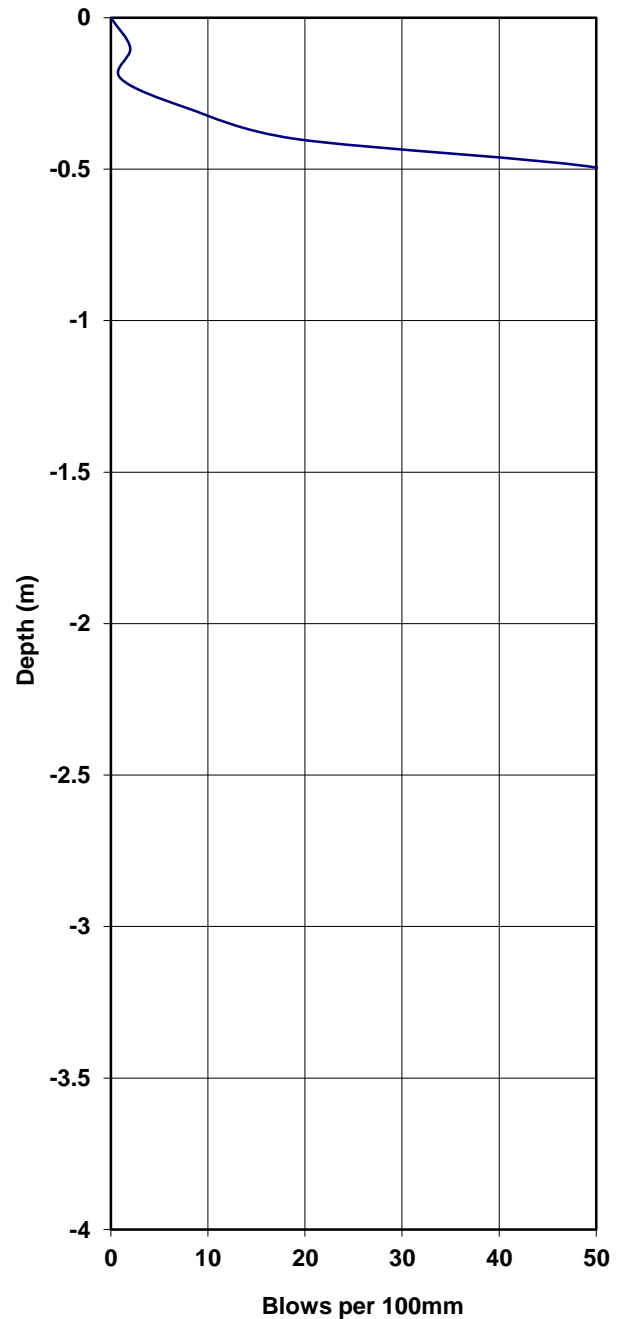


Client: Ethekewini Municipality - Water & Sanitation	Ref.No. 233-19
Project: Construction of Sewer Reticulation	Date: 19-26/09/2019
Section: Ntuzuma B, Wards 38, 41 & 45	Operator: S.Ramesh-warnath

CBR Penetrometer Probe ----- Test No. DC 39

THE STRENGTH AND CBR VALUES ARE EMPIRICAL AND DEPEND ON FACTORS SUCH AS MOISTURE CONTENT WHICH HAVE NOT BEEN DETERMINED. THEY ARE THEREFORE INDICATIVE ONLY AND SHOULD BE VERIFIED BY TEST OR OBSERVATION

Depth (m)	Blows/100mm	Inferred Consistency	Shear Strength	CBR %
0				
0.1	2	Soft	20 kPa	3
0.2	1	Very Soft	<20 kPa	2
0.3	8	Firm	65 kPa	14
0.4	19	Very Stiff	>150 kPa	35
	Refusal			



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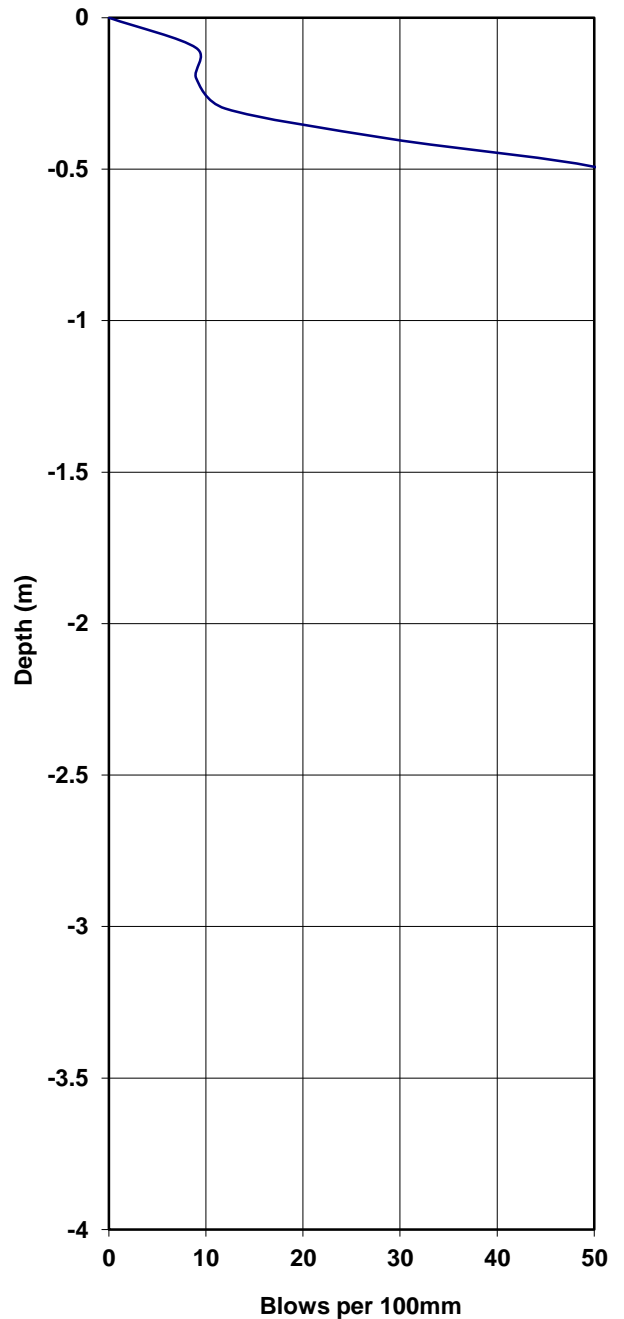


Client: Ethekewini Municipality - Water & Sanitation	Ref.No. 233-19
Project: Construction of Sewer Reticulation	Date: 19-26/09/2019
Section: Ntuzuma B, Wards 38, 41 & 45	Operator: S.Ramesh-warnath

CBR Penetrometer Probe ----- Test No. DC 40

THE STRENGTH AND CBR VALUES ARE EMPIRICAL AND DEPEND ON FACTORS SUCH AS MOISTURE CONTENT WHICH HAVE NOT BEEN DETERMINED. THEY ARE THEREFORE INDICATIVE ONLY AND SHOULD BE VERIFIED BY TEST OR OBSERVATION

Depth (m)	Blows/100mm	Inferred Consistency	Shear Strength	CBR %
0				
0.1	9	Stiff	75 kPa	15
0.2	9	Stiff	75 kPa	15
0.3	12	Stiff	100 kPa	21
0.4	29	Very Stiff	>150 kPa	>55
	Refusal			



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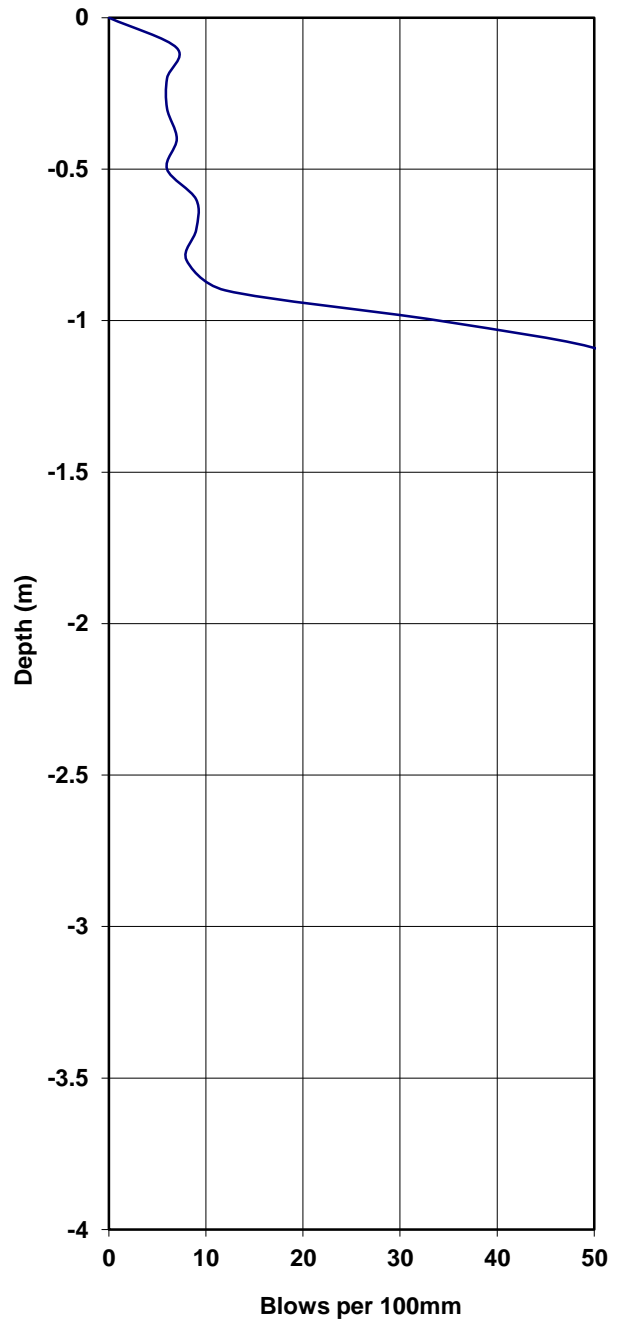


Client: EtheKwini Municipality - Water & Sanitation	Ref.No. 233-19
Project: Construction of Sewer Reticulation	Date: 19-26/09/2019
Section: Ntuzuma B, Wards 38, 41 & 45	Operator: S.Ramesh-warnath

CBR Penetrometer Probe ----- Test No. DC 41

THE STRENGTH AND CBR VALUES ARE EMPIRICAL AND DEPEND ON FACTORS SUCH AS MOISTURE CONTENT WHICH HAVE NOT BEEN DETERMINED. THEY ARE THEREFORE INDICATIVE ONLY AND SHOULD BE VERIFIED BY TEST OR OBSERVATION

Depth (m)	Blows/100mm	Inferred Consistency	Shear Strength	CBR %
0				
0.1	7	Med.Dense	34 deg	12
0.2	6	Med.Dense	33 deg	10
0.3	6	Med.Dense	33 deg	10
0.4	7	Med.Dense	34 deg	12
0.5	6	Med.Dense	33 deg	10
0.6	9	Med.Dense	35 deg	15
0.7	9	Med.Dense	35 deg	15
0.8	8	Med.Dense	35 deg	14
0.9	12	Dense	36 deg	21
1	34	Very Dense	>38 deg	>55
	Refusal			



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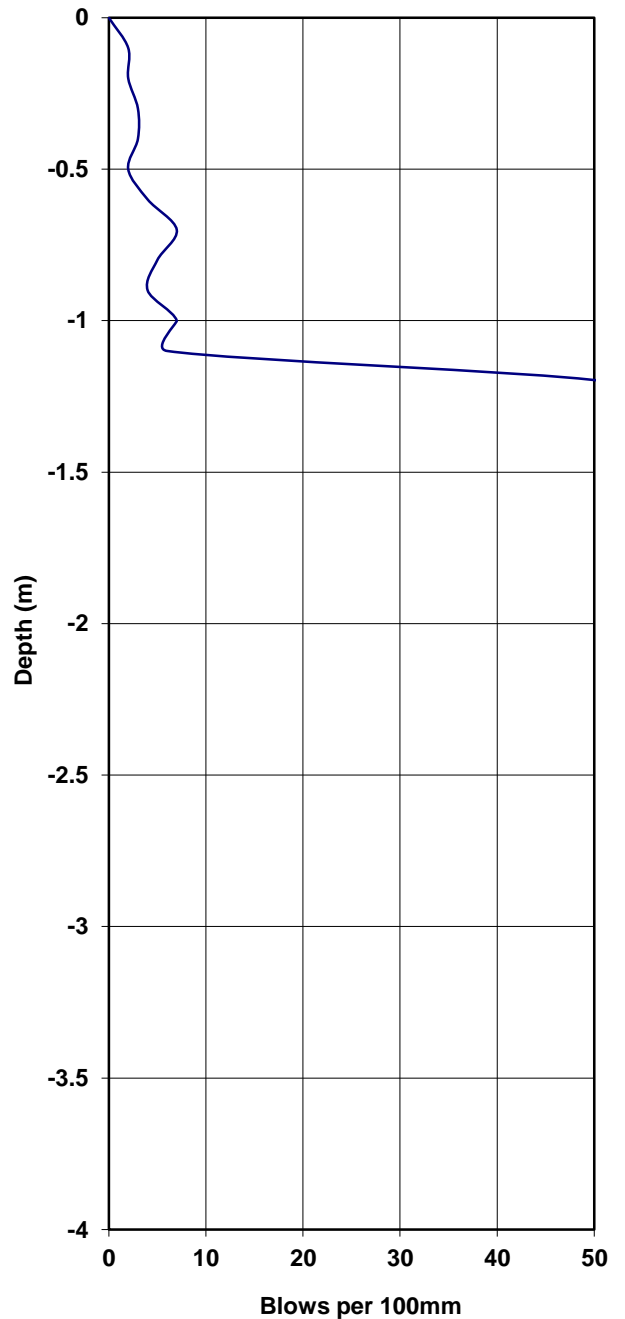


Client: Ethekewini Municipality - Water & Sanitation	Ref.No. 233-19
Project: Construction of Sewer Reticulation	Date: 19-26/09/2019
Section: Ntuzuma B, Wards 38, 41 & 45	Operator: S.Ramesh-warnath

CBR Penetrometer Probe ----- Test No. DC 42

THE STRENGTH AND CBR VALUES ARE EMPIRICAL AND DEPEND ON FACTORS SUCH AS MOISTURE CONTENT WHICH HAVE NOT BEEN DETERMINED. THEY ARE THEREFORE INDICATIVE ONLY AND SHOULD BE VERIFIED BY TEST OR OBSERVATION

Depth (m)	Blows/100mm	Inferred Consistency	Shear Strength	CBR %
0				
0.1	2	Loose	<30 deg	3
0.2	2	Loose	<30 deg	3
0.3	3	Loose	<30 deg	5
0.4	3	Loose	<30 deg	5
0.5	2	Loose	<30 deg	3
0.6	4	Med.Dense	30 deg	7
0.7	7	Med.Dense	34 deg	12
0.8	5	Med.Dense	32 deg	8
0.9	4	Med.Dense	30 deg	7
1	7	Med.Dense	34 deg	12
1.1	6	Med.Dense	33 deg	10
	Refusal			



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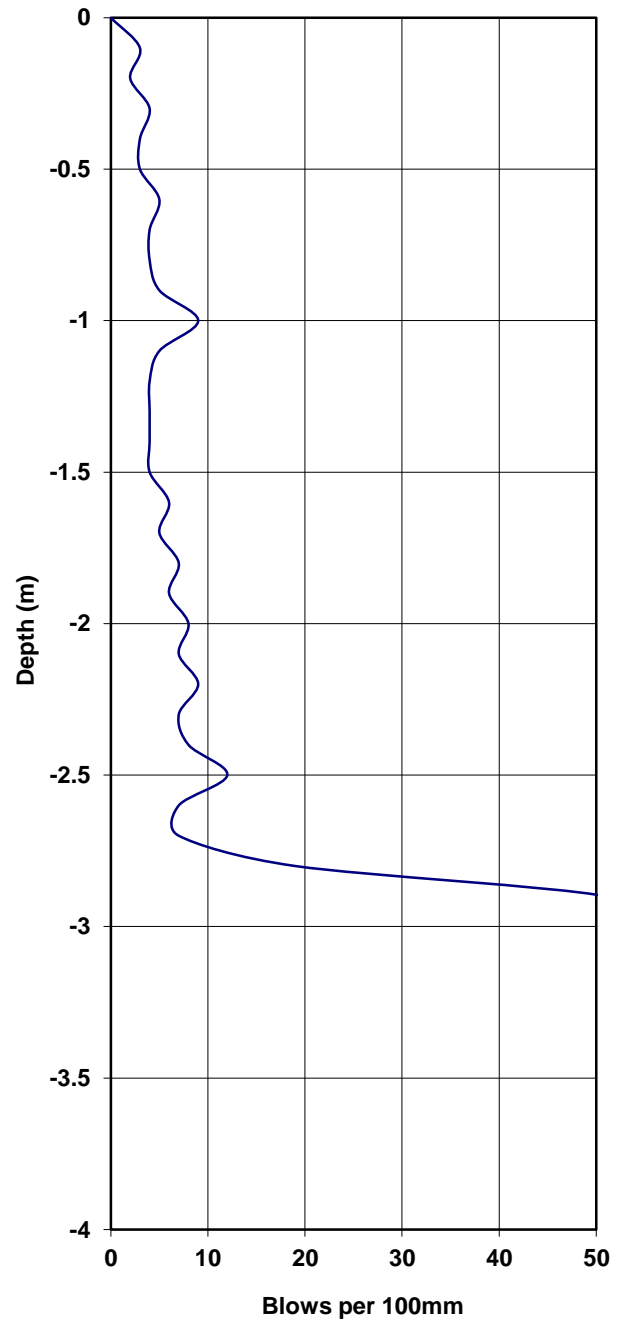


Client: EtheKwini Municipality - Water & Sanitation	Ref.No. 233-19
Project: Construction of Sewer Reticulation	Date: 19-26/09/2019
Section: Ntuzuma B, Wards 38, 41 & 45	Operator: S.Ramesh-warnath

CBR Penetrometer Probe ----- Test No. DC 43

THE STRENGTH AND CBR VALUES ARE EMPIRICAL AND DEPEND ON FACTORS SUCH AS MOISTURE CONTENT WHICH HAVE NOT BEEN DETERMINED. THEY ARE THEREFORE INDICATIVE ONLY AND SHOULD BE VERIFIED BY TEST OR OBSERVATION

Depth (m)	Blows/100mm	Inferred Consistency	Shear Strength	CBR %
0				
0.1	3	Loose	<30 deg	5
0.2	2	Loose	<30 deg	3
0.3	4	Med.Dense	30 deg	7
0.4	3	Loose	<30 deg	5
0.5	3	Loose	<30 deg	5
0.6	5	Med.Dense	32 deg	8
0.7	4	Med.Dense	30 deg	7
0.8	4	Med.Dense	30 deg	7
0.9	5	Med.Dense	32 deg	8
1	9	Med.Dense	35 deg	15
1.1	5	Med.Dense	32 deg	8
1.2	4	Med.Dense	30 deg	7
1.3	4	Med.Dense	30 deg	7
1.4	4	Med.Dense	30 deg	7
1.5	4	Med.Dense	30 deg	7
1.6	6	Med.Dense	33 deg	10
1.7	5	Med.Dense	32 deg	8
1.8	7	Med.Dense	34 deg	12
1.9	6	Med.Dense	33 deg	10
2	8	Med.Dense	35 deg	14
2.1	7	Med.Dense	34 deg	12
2.2	9	Med.Dense	35 deg	15
2.3	7	Med.Dense	34 deg	12
2.4	8	Med.Dense	35 deg	14
2.5	12	Dense	36 deg	21
2.6	7	Med.Dense	34 deg	12
2.7	7	Med.Dense	34 deg	12
2.8	19	Dense	37 deg	35
	Refusal			





APPENDIX C



LABORATORY TEST RESULTS



CLIENT : Geosure (Pty) Ltd
 PHYSICAL ADDRESS : 122 Intersite Avenue, Springfield Park,
 Umgeni
 Durban, 4001
 ATTENTION : Mr D. Naidoo
 PROJECT : Construction of Sewer Reticulation at Ntuzuma B

TEST REPORT REFERENCE NUMBER: 47497

Dear Sir/Madam,

Enclosed herewith, please find the original reports pertaining to the above-mentioned project.

Date Received	30.09.2019		
Date Tested	01.10.2019 to 10.10.2019		
Sample Location	Refer to Report		
Sampling Method	N/A		
Sample Condition	Moist		
Sampling Environmental Condition	N/A		
Sampler(s) Name	Client		
Total Number of Pages	42		
Test Carried Out			
SANS3001 GR1	<input checked="" type="checkbox"/>	TMH1 Method C3	
SANS3001 GR10, GR12	<input checked="" type="checkbox"/>	TMH1 Method C4a	
SANS3001 GR30	<input checked="" type="checkbox"/>	TMH1 Method B6	
SANS3001 GR40	<input checked="" type="checkbox"/>	Hydrometer Analysis - ASTM D422	
TMH1 Method A10(b)		SABS1200 (Compactibility Factor)#	<input checked="" type="checkbox"/>
TMH1 Method A13T + A14app		SANS 5862-1	
TMH1 Method A15d		SANS 5860, 5861-1, 5861-2, 5861-3	
TMH1 Method A13T + A16T		TMH1 Method B9	
<input checked="" type="checkbox"/> - Tick denotes tests that were carried out. #Denotes non accredited tests			

**We would like to take this opportunity of thanking you for your continued support.
 Should you have any queries please do not hesitate to contact me.**

Yours faithfully



**Technical Signatory,
 Pragasen Naidoo for Geosure (Pty) Ltd.**

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LABORATORY: 122 Intersite Avenue, Umgeni Business Park, Durban, 4091 P.O. Box 1461, Westville 3630 Mobile: +27(0)72 870 2621 Tel.: +27 (0)31 701 9732	Reg. No. : 92/03145/07 Durban, 4091 Fax: 086 684 9785 email: lab@geosure.co.za	HEAD OFFICE: 122 Intersite Avenue, Umgeni Business Park, Durban, 4091, KwaZulu Natal, South Africa. Tel: +27 (0)31 266 0458 Fax: 086 689 5506 email: geosure@iafrica.com www.geosure.co.za
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Client : Geosure (Pty) Ltd **Your Ref No. : -**
Project : Construction of Sewer Reticulation at Ntuzuma B **Our Ref No. : 47497**
Attention : Mr D. Naidoo **Date Reported : 11/10/2019**

Test Report - SANS 3001

Sample No.	T22073	T22074	T22075	T22076	T22077
Field No.	IP1	IP3	IP5	IP6	IP8
Position	Layer 3	Layer 1	Layer 2	Layer 1	Layer 2
Depth (m)	0.75-1.6	0.01-1.1	0.7-1.6	0.01-0.6	0.2-0.6
Method of Preparation	N/A	N/A	N/A	Scalped	Scalped
Material Description	Orange brown to reddish brown gravelly clayey SAND to gravelly sandy CLAY. Residual Tillite	Light to medium brown slightly silty SAND to slightly clayey silty SAND. Fill	Greyish brown becoming khaki brown to yellowish brown silty clayey SAND to sandy CLAY. Residual Tillite	Dark greyish brown to dark grey silty CLAYEY SAND to sandy CLAY to clayey SILT. Alluvium	Khaki brown stained brown and grey completely to highly weathered very soft to soft rock. TILLITE

Sieve Analysis - Percent Passing Sieve Size						
Sieve Aperture (mm)	100.00					
	75.00					
	63.00					100
	53.00					98
	50.00				100	96
	37.50				98	95
	28.00				96	91
	26.50		100		96	91
	20.00		98		92	87
	19.00		98		92	87
	14.00		95		90	86
	13.20	100	95		90	86
	5.00	99	89		81	72
	4.750	99	89	100	81	72
	2.000	97	81	99	74	59
0.425	91	59	92	65	43	
0.075	60	24	66	39	31	
Grading Modulus		0.52	1.37	0.43	1.23	1.67
Mechanical analysis - Percent of Soil Mortar (<2 mm) for Grain Size range						
Coarse Sand	2.000 - 0.425	6	27	7	12	27
Coarse-Fine Sand	0.425 - 0.250	7	16	8	10	5
Medium-Fine Sand	0.250 - 0.150	10	15	7	12	7
Fine-Fine Sand	0.150 - 0.075	14	12	12	13	8
Silt and Clay	< 0.075	62	29	66	53	53
Atterberg Limits SANS 3001 on <0.425 mm fraction						
Liquid Limit	% or symbol	40	21	42	38	43
Plasticity Index	% or symbol	13	6	15	13	16
Linear Shrinkage	%	7.0	3.0	8.0	6.5	8.0
Maximum Dry Density and Optimum Moisture Content						
Maximum Dry Density (kg/m³)		1946	1955	1833	1958	2012
Optimum moisture content (%)		10.8	8.7	13.6	8.5	9.2
California Bearing Ratio						
CBR @ 100% Compaction	%	10	50	4.9	21	27
CBR @ 98% Compaction	%	6.9	35	3.3	11	22
CBR @ 97% Compaction	%	5.6	30	2.7	8.5	19
CBR @ 95% Compaction	%	3.8	21	1.8	4.8	15
CBR @ 93% Compaction	%	2.5	15	1.2	2.7	12
CBR @ 90% Compaction	%	1.4	9.2	0.7	1.1	8.4
Swell @ 100% Compaction	%	0.7	0.4	1.3	1.2	0.6
COLTO Classification (1998)**		Cannot be Determined	G7 (#)	Cannot be Determined	Cannot be Determined	Cannot be Determined
TRH 14 Classification (1985)**		Poorer than G10	G7	Poorer than G10	Poorer than G10	G9
AASHTO Classification (Group Index)**		A-6 (6)	A-2-4 (0)	A-7-6 (9)	A-6 (1)	A-2-7 (1)
Unified Classification **		ML/OL‡	SM-SC	ML/OL‡	SM	SM

‡ If LL_(oven dried) / LL_(not dried) < 0.75 then use O-symbol (Organic Material).

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Remarks: *Subject to further testing as required by TRH14.

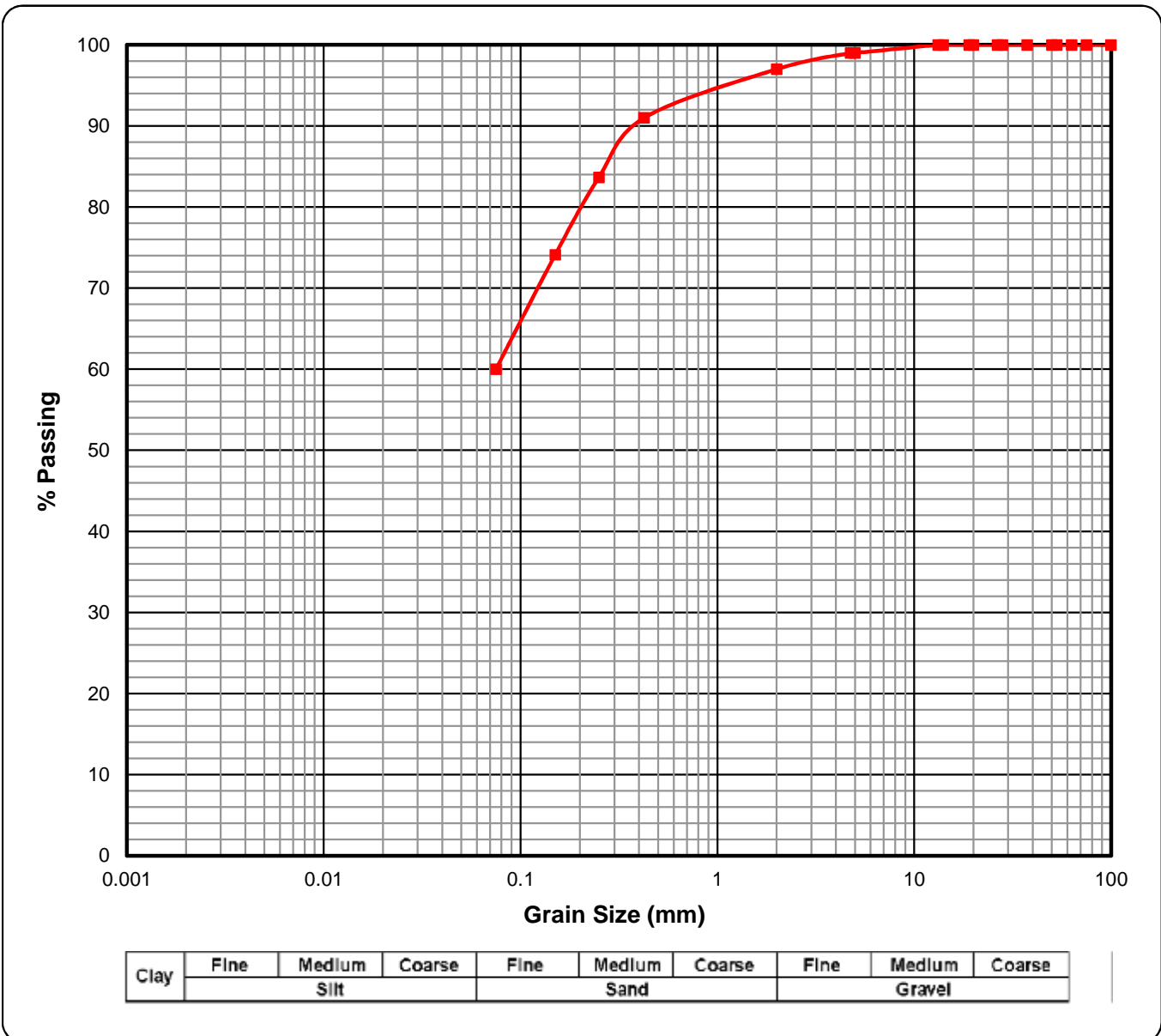
† Subject to further testing as required by COLTO. COLTO above uses only: Atterberg Limits (<0.425 mm fraction; not arithmetic mean), Nominal Max Size, Grading Curve, Coarse Sand Ratio, Grading Modulus, Strength (CBR), and Swell.

Check that Max Size <= 2/3 of compacted layer thickness.

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Client : Geosure (Pty) Ltd Project : Construction of Sewer Reticulation at Ntuzuma B Attention : Mr D. Naidoo	Your Ref No.: - Our Ref No. : 47497 Date Reported : 11/10/2019
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Grading Curve for Sample T22073 – SANS 3001



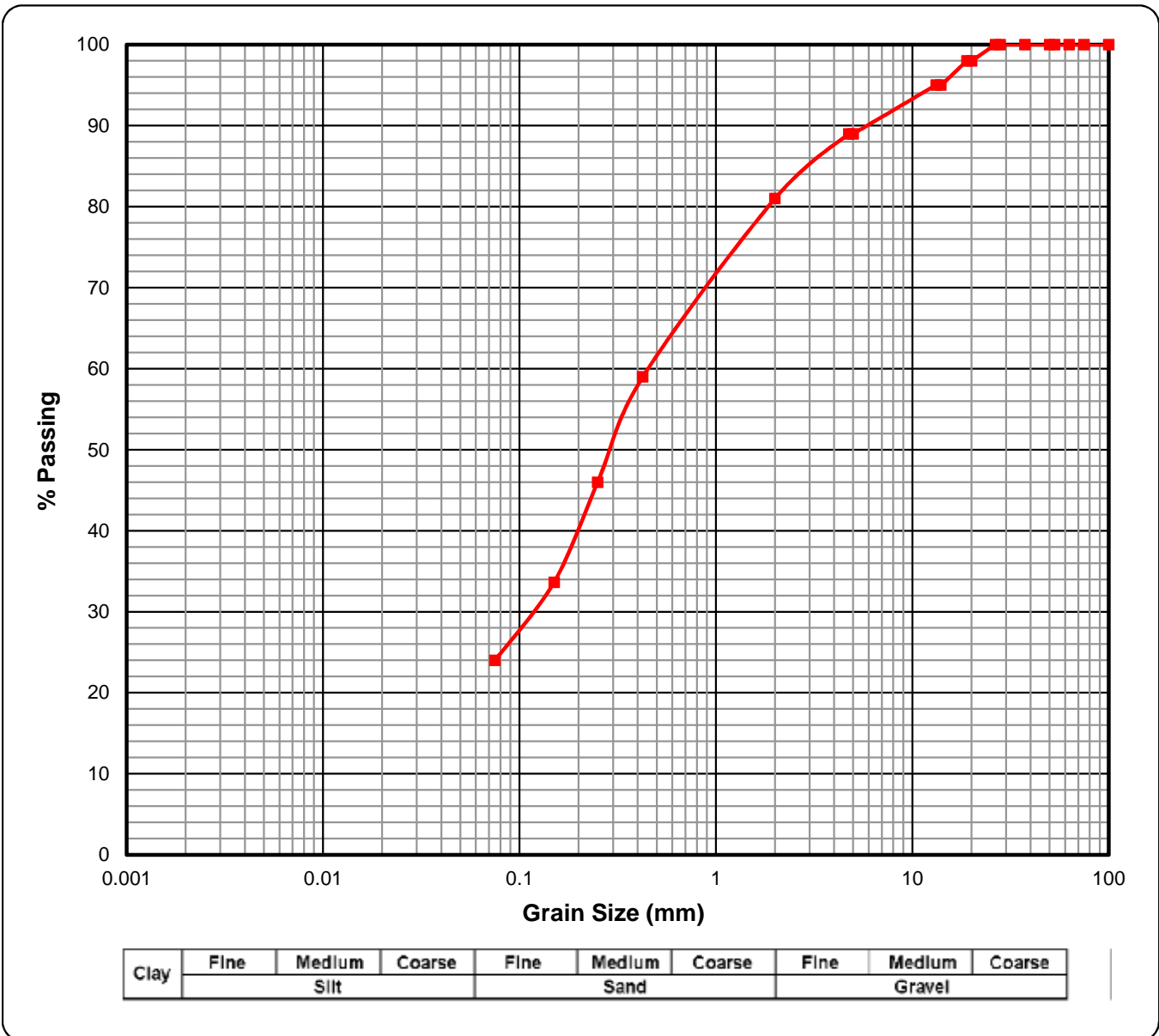
ick Red Line is the Grading Curve (COLTO Classification = Cannot be Determined) (TRH 14 Classification = Poorer than G

Sieve Aperture Size	0.075	0.150	0.250	0.425	2.00	4.75	5.00	13.20	14.00	19.00	20.00	26.50	28.0	37.5	50.0	53.0	63	75	100
Percentage Passing	60%	74%	84%	91%	97%	99%	99%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

LABORATORY: 122 Intersite Avenue, Umgeni Business Park, Durban, 4091 P.O. Box 1461, Westville 3630 Mobile: +27(0)72 870 2621 Fax: 086 684 9785 Tel.: +27 (0)31 701 9732 email: lab@geosure.co.za	Reg. No. : 92/03145/07	HEAD OFFICE: 122 Intersite Avenue, Umgeni Business Park, Durban, 4091, KwaZulu Natal, South Africa. Tel: +27 (0)31 266 0458 Fax: 086 689 5506 email: geosure@iafrica.com www.geosure.co.za
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Client : Geosure (Pty) Ltd Project : Construction of Sewer Reticulation at Ntuzuma B Attention : Mr D. Naidoo	Your Ref No.: - Our Ref No. : 47497 Date Reported : 11/10/2019
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Grading Curve for Sample T22074 – SANS 3001



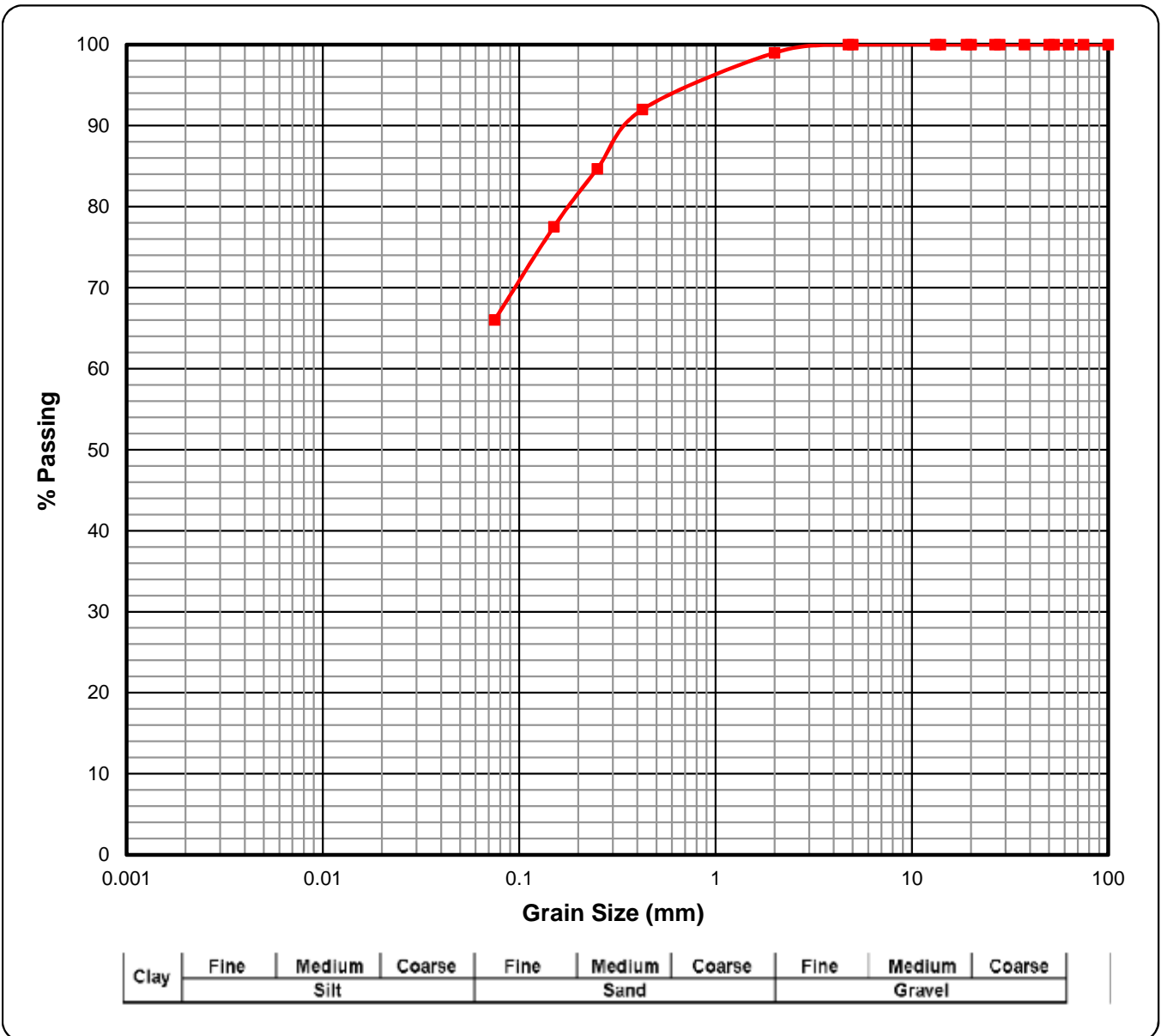
Thick Red Line is the Grading Curve (COLTO Classification = G7 (#)) (TRH 14 Classification = G7)

Sieve Aperture Size	0.075	0.150	0.015	0.026	0.05	0.06	5.00	13.20	14.00	19.00	20.00	26.50	28.0	37.5	50.0	53.0	63	75	100
Percentage Passing	24%	34%	46%	59%	81%	89%	89%	95%	95%	98%	98%	100%	100%	100%	100%	100%	100%	100%	100%

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Client : Geosure (Pty) Ltd Project : Construction of Sewer Reticulation at Ntuzuma B Attention : Mr D. Naidoo	Your Ref No.: - Our Ref No. : 47497 Date Reported : 11/10/2019
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Grading Curve for Sample T22075 – SANS 3001



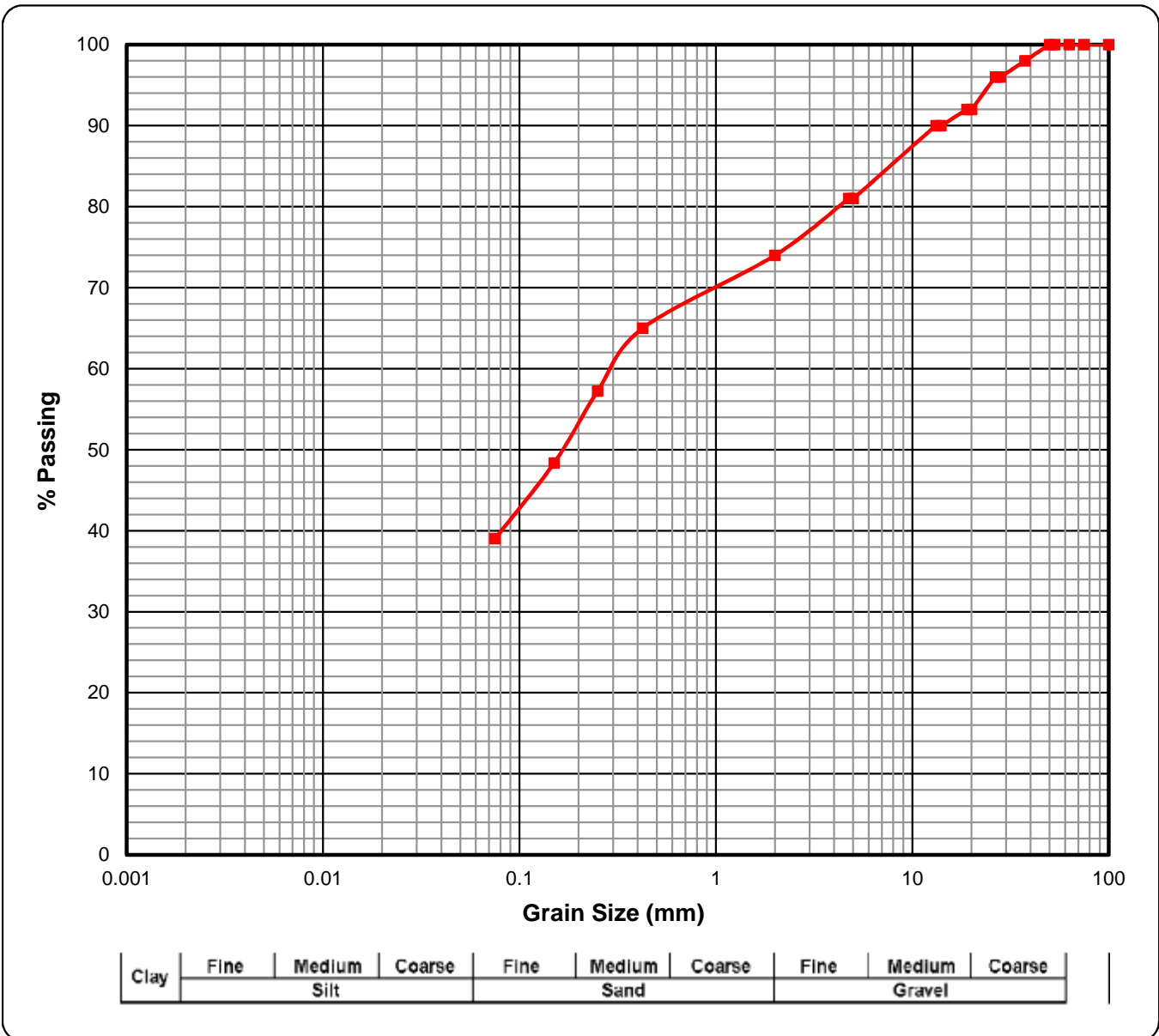
ick Red Line is the Grading Curve (COLTO Classification = Cannot be Determined) (TRH 14 Classification = Poorer than G

Sieve Aperture Size	0.075	0.150	0.250	0.425	2.00	4.75	5.00	13.20	14.00	19.00	20.00	26.50	28.0	37.5	50.0	53.0	63	75	100
Percentage Passing	66%	77%	85%	92%	99%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

LABORATORY: 122 Intersite Avenue, Umgeni Business Park, Durban, 4091 P.O. Box 1461, Westville 3630 Mobile: +27(0)72 870 2621 Fax: 086 684 9785 Tel.: +27 (0)31 701 9732 email: lab@geosure.co.za	Reg. No. : 92/03145/07	HEAD OFFICE: 122 Intersite Avenue, Umgeni Business Park, Durban, 4091, KwaZulu Natal, South Africa. Tel: +27 (0)31 266 0458 Fax: 086 689 5506 email: geosure@iafrica.com www.geosure.co.za
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Client : Geosure (Pty) Ltd Project : Construction of Sewer Reticulation at Ntuzuma B Attention : Mr D. Naidoo	Your Ref No.: - Our Ref No. : 47497 Date Reported : 11/10/2019
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Grading Curve for Sample T22076 – SANS 3001



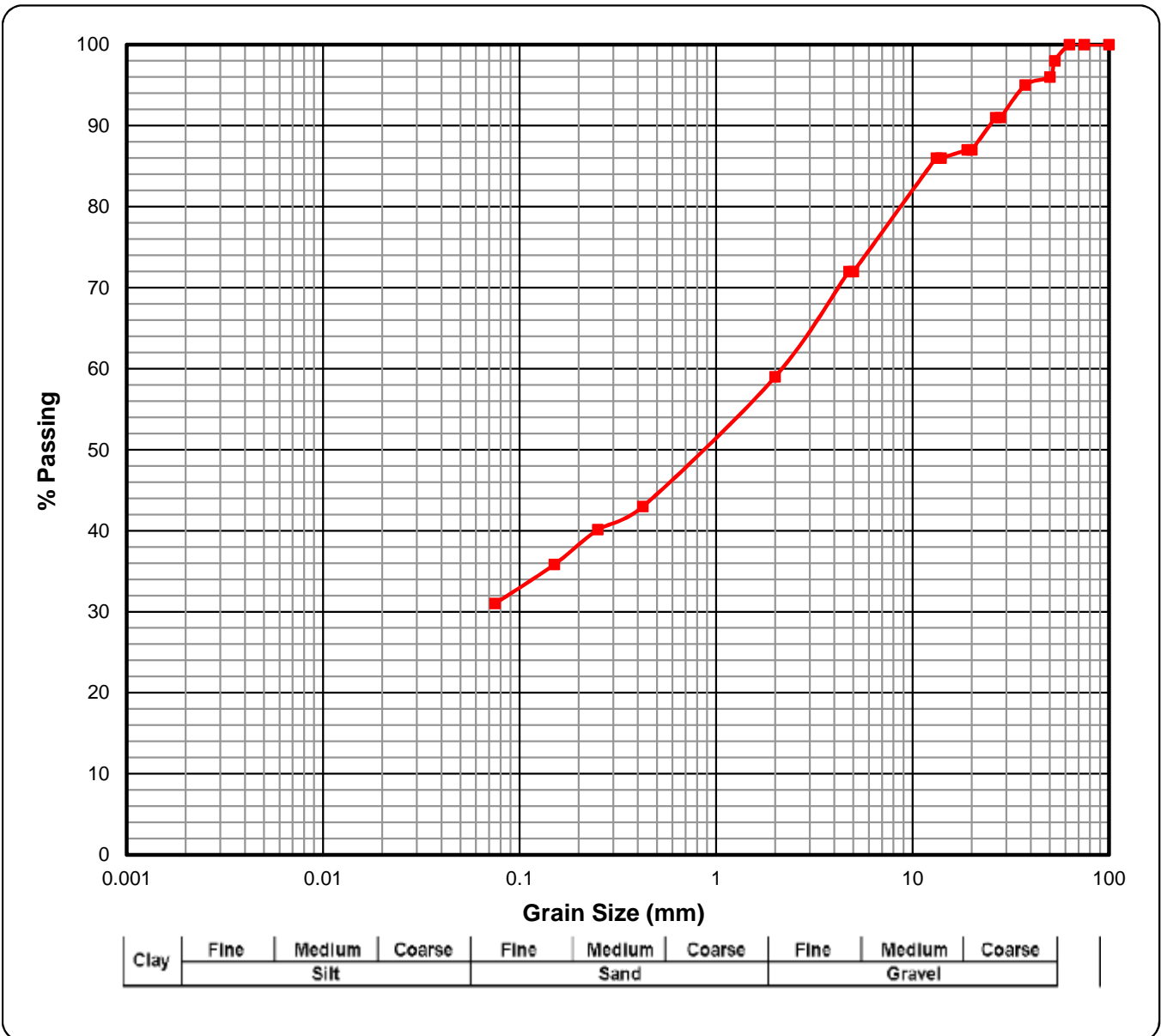
ick Red Line is the Grading Curve (COLTO Classification = Cannot be Determined) (TRH 14 Classification = Poorer than G

Sieve Aperture Size	0.075	0.150	0.250	0.425	2.00	4.75	5.00	13.20	14.00	19.00	20.00	26.50	28.0	37.5	50.0	53.0	63	75	100
Percentage Passing	39%	48%	57%	65%	74%	81%	81%	90%	90%	92%	92%	96%	96%	98%	100%	100%	100%	100%	100%

LABORATORY: 122 Intersite Avenue, Umgeni Business Park, Durban, 4091 P.O. Box 1461, Westville 3630 Mobile: +27(0)72 870 2621 Fax: 086 684 9785 Tel.: +27 (0)31 701 9732 email: lab@geosure.co.za	Reg. No. : 92/03145/07	HEAD OFFICE: 122 Intersite Avenue, Umgeni Business Park, Durban, 4091, KwaZulu Natal, South Africa. Tel: +27 (0)31 266 0458 Fax: 086 689 5506 email: geosure@iafrica.com www.geosure.co.za
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Client : Geosure (Pty) Ltd Project : Construction of Sewer Reticulation at Ntuzuma B Attention : Mr D. Naidoo	Your Ref No.: - Our Ref No. : 47497 Date Reported : 11/10/2019
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Grading Curve for Sample T22077 – SANS 3001



Thick Red Line is the Grading Curve (COLTO Classification = Cannot be Determined) (TRH 14 Classification = G9)

Sieve Aperture Size	0.075	0.150	0.250	0.425	2.00	4.75	5.00	13.20	14.00	19.00	20.00	26.50	28.0	37.5	50.0	53.0	63	75	100
Percentage Passing	31%	36%	40%	43%	59%	72%	72%	86%	86%	87%	87%	91%	91%	95%	96%	98%	100%	100%	100%

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Client : Geosure (Pty) Ltd **Your Ref No. : -**
Project : Construction of Sewer Reticulation at Ntuzuma B **Our Ref No. : 47497**
Attention : Mr D. Naidoo **Date Reported : 11/10/2019**

Test Report - SANS 3001

Sample No.	T22078	T22079	T22080	T22081	T22082
Field No.	IP9	IP10	IP14	IP16	IP19
Position	Layer 2	Layer 3	Layer 2	Layer 2	Layer 2
Depth (m)	0.3-1.0	0.75-1.3	0.5-0.86	0.5-0.9	0.5-0.9
Method of Preparation	N/A	N/A	Scalped	Scalped	Scalped
Material Description	Reddish brown becoming khaki brown clayey silty SAND to silty sandy CLAY. Residual Tillite	Khaki brown stained brown and grey completely to highly weathered very soft to soft rock. TILLITE	Greyish brown becoming khaki brown clayey SAND to slightly silty sandy CLAY. Residual Tillite	Khaki brown stained brown and grey completely to highly weathered very soft to soft rock. TILLITE	Greyish brown to brown clayey SAND to sandy CLAY. Colluvium

Sieve Analysis - Percent Passing Sieve Size

Sieve Aperture (mm)	100.00				
	75.00				
63.00					
53.00					
50.00			100	100	100
37.50	100	100	99	99	99
28.00	94	99	99	99	98
26.50	94	99	99	99	98
20.00	73	99	98	98	98
19.00	73	99	98	98	98
14.00	52	99	98	90	96
13.20	52	99	98	90	96
5.00	29	97	89	65	87
4.750	29	97	89	65	87
2.000	25	92	77	51	76
0.425	15	83	68	34	66
0.075	11	59	50	20	37
Grading Modulus	2.49	0.66	1.05	1.94	1.21

Mechanical analysis - Percent of Soil Mortar (<2 mm) for Grain Size range

Coarse Sand	2.000 - 0.425	39	9	12	35	14
Coarse-Fine Sand	0.425 - 0.250	4	6	5	9	9
Medium-Fine Sand	0.250 - 0.150	5	9	7	8	11
Fine-Fine Sand	0.150 - 0.075	8	11	10	8	17
Silt and Clay	< 0.075	43	64	66	40	49

Atterberg Limits SANS 3001 on <0.425 mm fraction

Liquid Limit	% or symbol	33	42	41	34	27
Plasticity Index	% or symbol	9	17	19	10	6
Linear Shrinkage	%	5.0	8.0	9.0	5.0	3.5

Maximum Dry Density and Optimum Moisture Content

Maximum Dry Density (kg/m³)	1906		1821	1960	1980
Optimum moisture content (%)	11.4		11.6	10.0	9.5

California Bearing Ratio

CBR @100% Compaction	%	14		26	25	34
CBR @ 98% Compaction	%	10		20	17	25
CBR @ 97% Compaction	%	8.4		18	14	21
CBR @ 95% Compaction	%	6.0		14	9.1	16
CBR @ 93% Compaction	%	4.2		11	6.1	12
CBR @ 90% Compaction	%	2.5		7.1	3.3	7.2
Swell @100% Compaction	%	1.1		1.4	0.6	0.4

COLTO Classification (1998)**	Cannot be Determined	Cannot be Determined	Cannot be Determined	Cannot be Determined	G8 (#)
TRH 14 Classification (1985)**	Poorer than G10	Cannot be Determined	G9	G10	G9
AASHTO Classification (Group Index)**	A-2-4 (0)	A-7-6 (8)	A-7-6 (6)	A-2-4 (0)	A-4 (0)
Unified Classification **	GP-GM	CL	CL	SM	SM-SC

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Remarks: *Subject to further testing as required by TRH14.

† Subject to further testing as required by COLTO. COLTO above uses only: Atterberg Limits (<0.425 mm fraction; not arithmetic mean),

Nominal Max Size, Grading Curve, Coarse Sand Ratio, Grading Modulus, Strength (CBR), and Swell.

Check that Max Size <= 2/3 of compacted layer thickness.

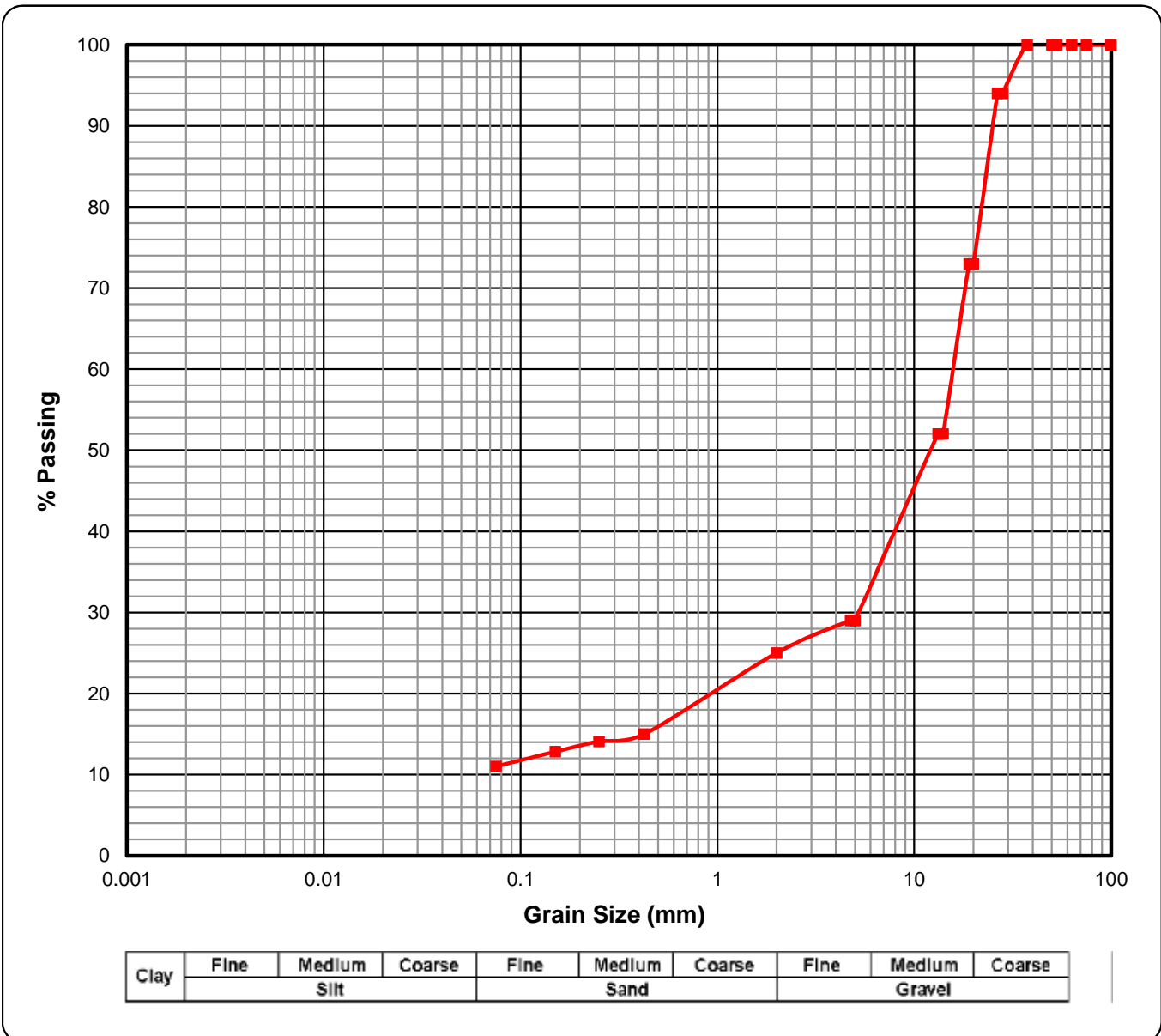
** Opinions and interpretations expressed herein are outside the scope of SANAS accreditation

Version 5.05 - 14 February 2018

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Client : Geosure (Pty) Ltd Project : Construction of Sewer Reticulation at Ntuzuma B Attention : Mr D. Naidoo	Your Ref No.: - Our Ref No. : 47497 Date Reported : 11/10/2019
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Grading Curve for Sample T22078 – SANS 3001



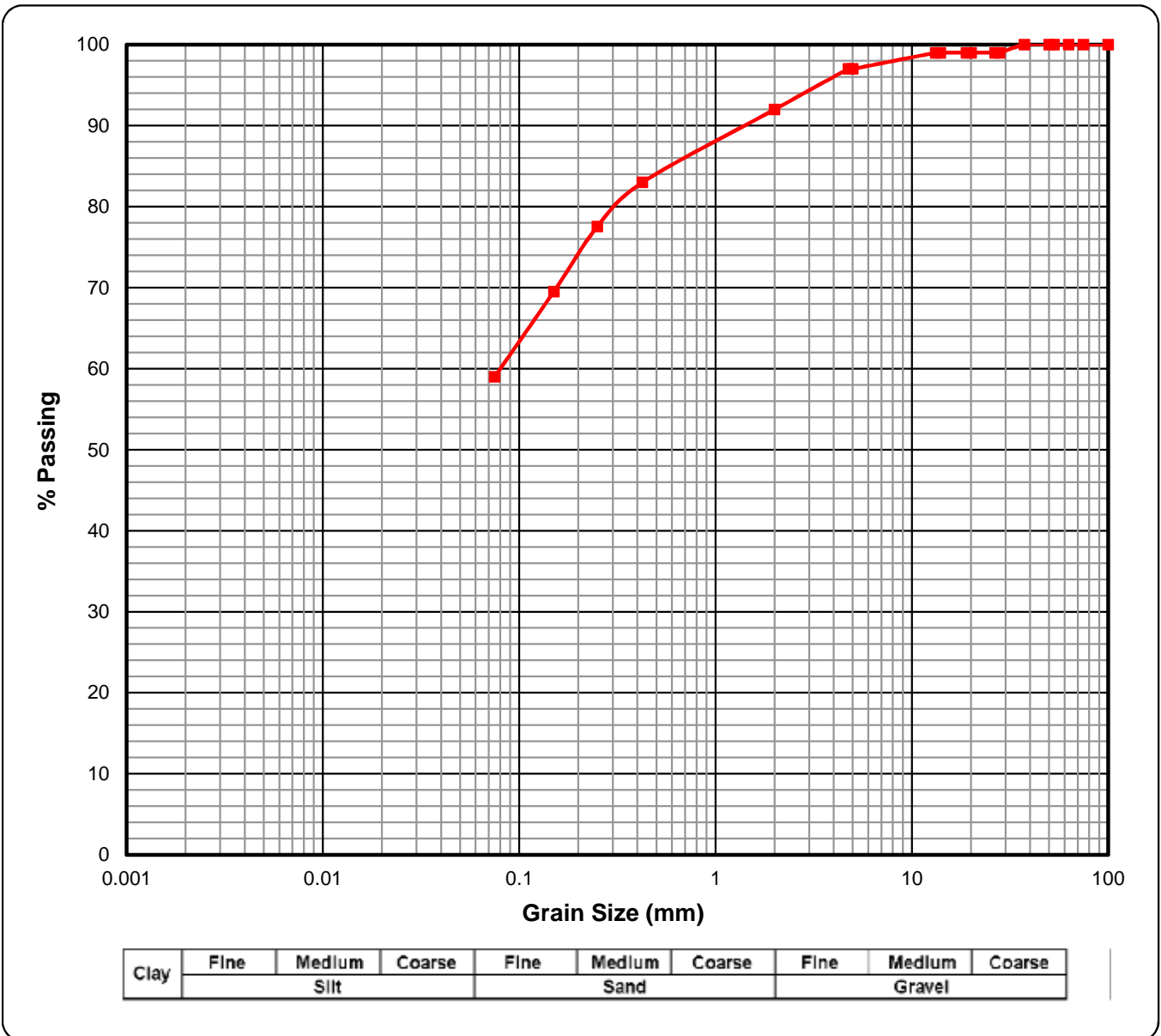
ick Red Line is the Grading Curve (COLTO Classification = Cannot be Determined) (TRH 14 Classification = Poorer than G

Sieve Aperture Size	0.075	0.150	0.250	0.425	2.00	4.75	5.00	13.20	14.00	19.00	20.00	26.50	28.0	37.5	50.0	53.0	63	75	100
Percentage Passing	11%	13%	14%	15%	25%	29%	29%	52%	52%	73%	73%	94%	94%	100%	100%	100%	100%	100%	100%

LABORATORY: 122 Intersite Avenue, Umgeni Business Park, Durban, 4091 P.O. Box 1461, Westville 3630 Mobile: +27(0)72 870 2621 Fax: 086 684 9785 Tel.: +27 (0)31 701 9732 email: lab@geosure.co.za	Reg. No. : 92/03145/07	HEAD OFFICE: 122 Intersite Avenue, Umgeni Business Park, Durban, 4091, KwaZulu Natal, South Africa. Tel: +27 (0)31 266 0458 Fax: 086 689 5506 email: geosure@iafrica.com www.geosure.co.za
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Client : Geosure (Pty) Ltd Project : Construction of Sewer Reticulation at Ntuzuma B Attention : Mr D. Naidoo	Your Ref No.: - Our Ref No. : 47497 Date Reported : 11/10/2019
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Grading Curve for Sample T22079 – SANS 3001



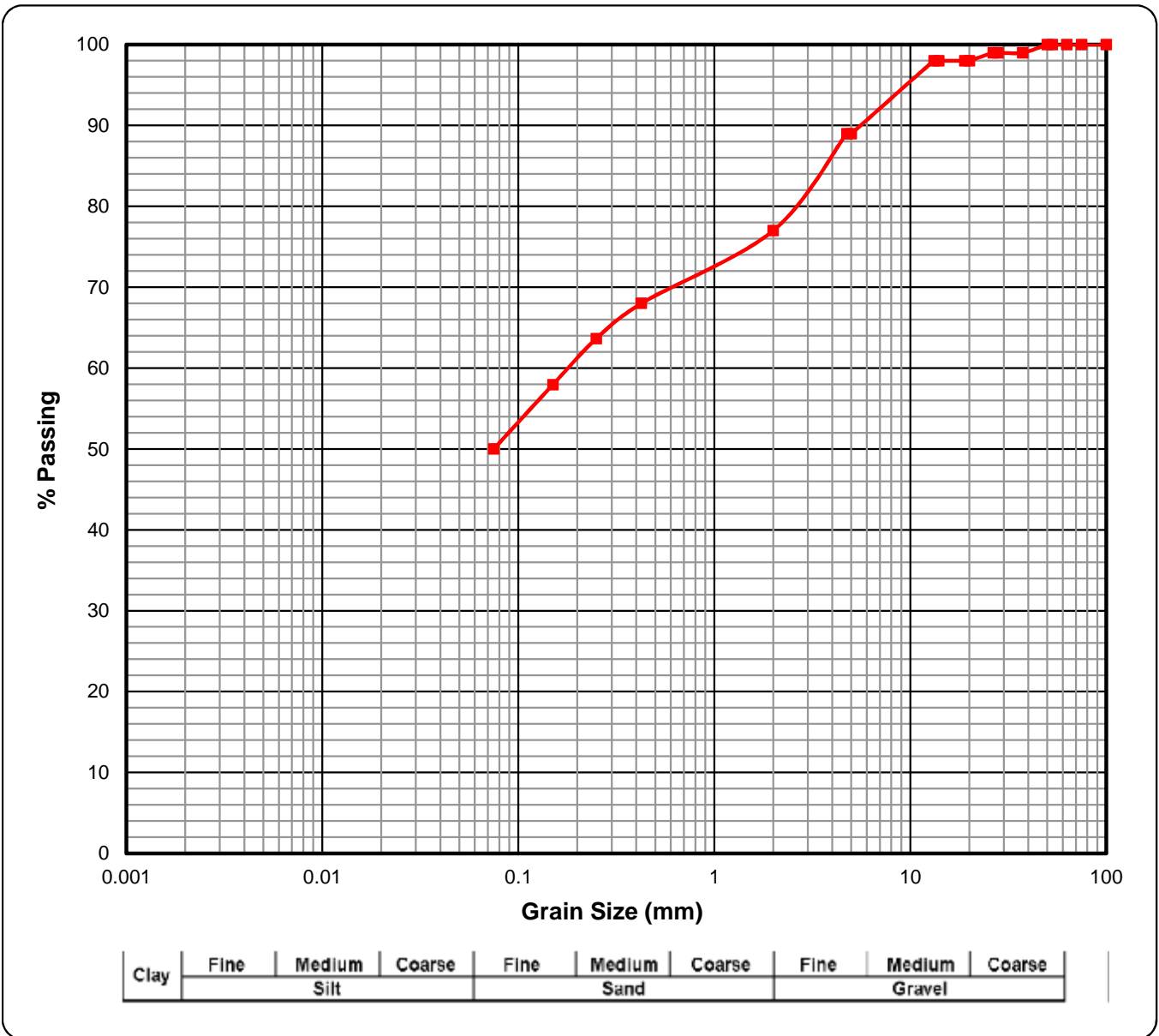
Red Line is the Grading Curve (COLTO Classification = Cannot be Determined) (TRH 14 Classification = Cannot be Determined)

Sieve Aperture Size	0.075	0.150	0.015	0.026	0.05	0.06	5.00	13.20	14.00	19.00	20.00	26.50	28.0	37.5	50.0	53.0	63	75	100
Percentage Passing	59%	70%	78%	83%	92%	97%	97%	99%	99%	99%	99%	99%	99%	100%	100%	100%	100%	100%	100%

LABORATORY: 122 Intersite Avenue, Umgeni Business Park, Durban, 4091 P.O. Box 1461, Westville 3630 Mobile: +27(0)72 870 2621 Fax: 086 684 9785 Tel.: +27 (0)31 701 9732 email: lab@geosure.co.za	Reg. No. : 92/03145/07	HEAD OFFICE: 122 Intersite Avenue, Umgeni Business Park, Durban, 4091, KwaZulu Natal, South Africa. Tel: +27 (0)31 266 0458 Fax: 086 689 5506 email: geosure@iafrica.com www.geosure.co.za
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Client : Geosure (Pty) Ltd Project : Construction of Sewer Reticulation at Ntuzuma B Attention : Mr D. Naidoo	Your Ref No.: - Our Ref No. : 47497 Date Reported : 11/10/2019
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Grading Curve for Sample T22080 – SANS 3001



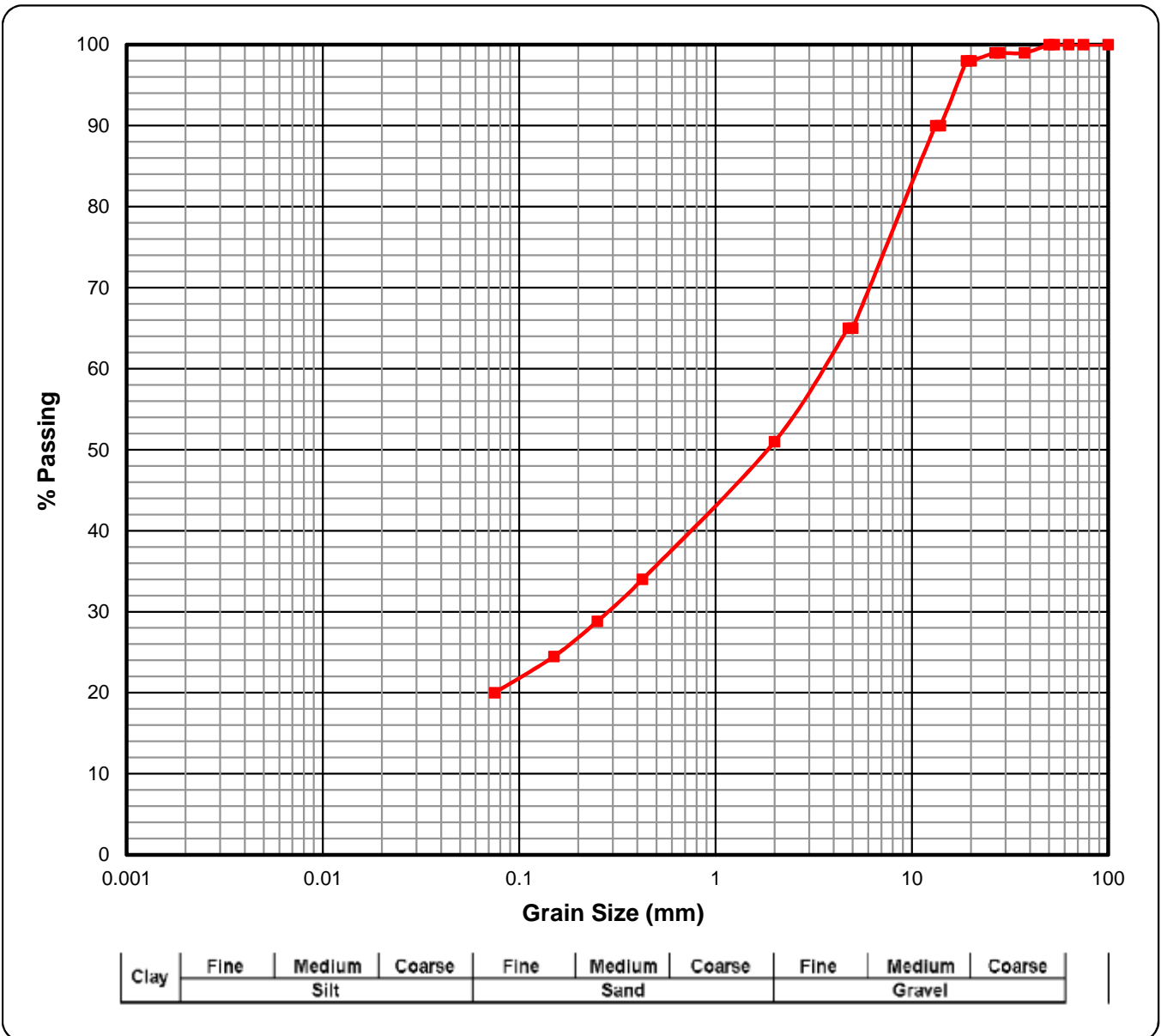
Thick Red Line is the Grading Curve (COLTO Classification = Cannot be Determined) (TRH 14 Classification = G9)

Sieve Aperture Size	0.075	0.150	0.250	0.425	2.00	4.75	5.00	13.20	14.00	19.00	20.00	26.50	28.0	37.5	50.0	53.0	63	75	100
Percentage Passing	50%	58%	64%	68%	77%	89%	89%	98%	98%	98%	98%	99%	99%	99%	100%	100%	100%	100%	100%

LABORATORY: 122 Intersite Avenue, Umgeni Business Park, Durban, 4091 P.O. Box 1461, Westville 3630 Mobile: +27(0)72 870 2621 Fax: 086 684 9785 Tel.: +27 (0)31 701 9732 email: lab@geosure.co.za	Reg. No. : 92/03145/07	HEAD OFFICE: 122 Intersite Avenue, Umgeni Business Park, Durban, 4091, KwaZulu Natal, South Africa. Tel: +27 (0)31 266 0458 Fax: 086 689 5506 email: geosure@iafrica.com www.geosure.co.za
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Client : Geosure (Pty) Ltd Project : Construction of Sewer Reticulation at Ntuzuma B Attention : Mr D. Naidoo	Your Ref No.: - Our Ref No. : 47497 Date Reported : 11/10/2019
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Grading Curve for Sample T22081 – SANS 3001



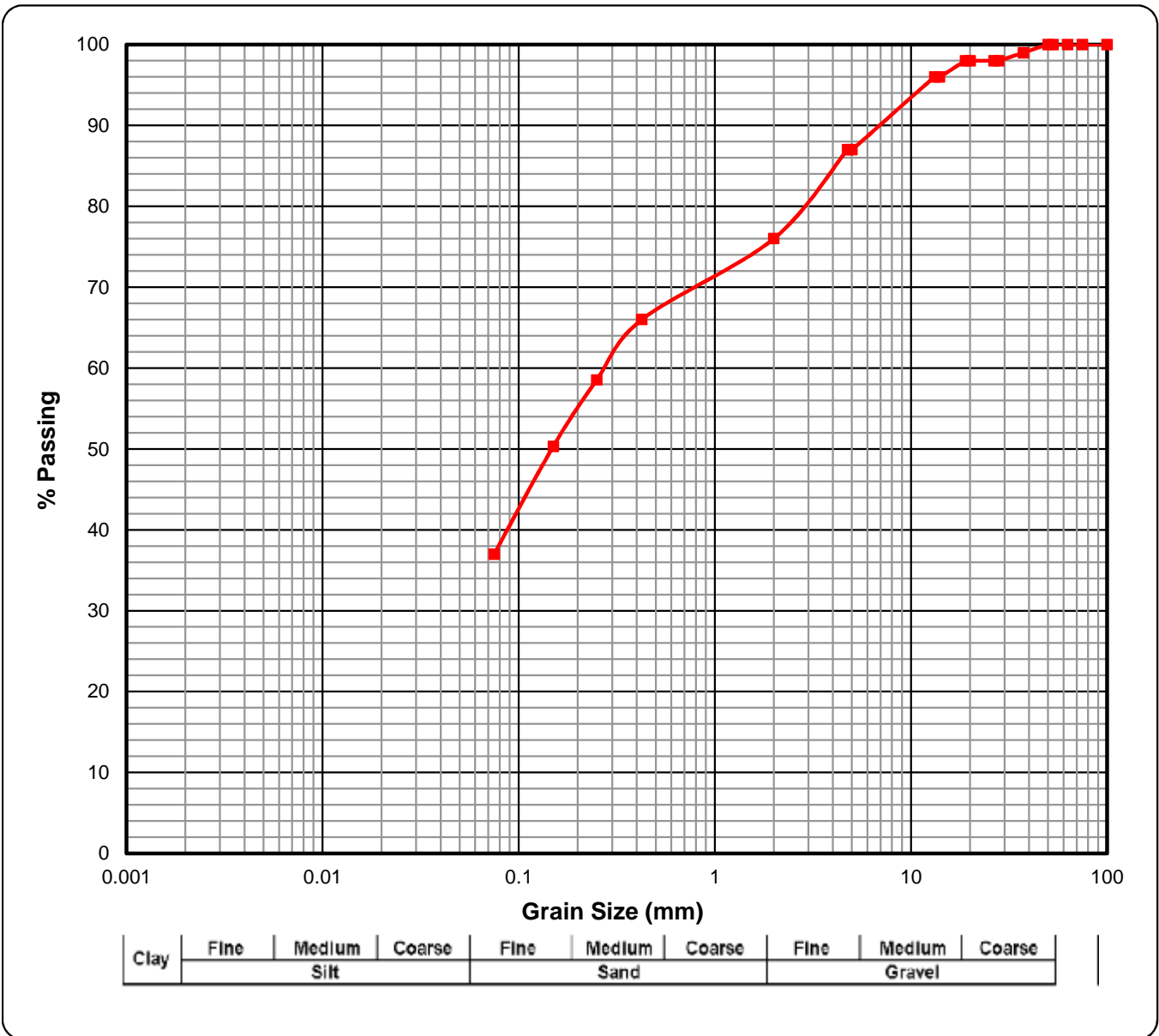
Thick Red Line is the Grading Curve (COLTO Classification = Cannot be Determined) (TRH 14 Classification = G10)

Sieve Aperture Size	0.075	0.150	0.250	0.425	2.00	4.75	5.00	13.20	14.00	19.00	20.00	26.50	28.0	37.5	50.0	53.0	63	75	100
Percentage Passing	20%	24%	29%	34%	51%	65%	65%	90%	90%	98%	98%	99%	99%	99%	100%	100%	100%	100%	100%

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Client : Geosure (Pty) Ltd Project : Construction of Sewer Reticulation at Ntuzuma B Attention : Mr D. Naidoo	Your Ref No.: - Our Ref No. : 47497 Date Reported : 11/10/2019
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Grading Curve for Sample T22082 – SANS 3001



Thick Red Line is the Grading Curve (COLTO Classification = G8 (#)) (TRH 14 Classification = G9)

Sieve Aperture Size	0.075	0.150	0.250	0.425	2.00	4.75	5.00	13.20	14.00	19.00	20.00	26.50	28.0	37.5	50.0	53.0	63	75	100
Percentage Passing	37%	50%	59%	66%	76%	87%	87%	96%	96%	98%	98%	98%	98%	99%	100%	100%	100%	100%	100%

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Client : Geosure (Pty) Ltd **Your Ref No. : -**
Project : Construction of Sewer Reticulation at Ntuzuma B **Our Ref No. : 47497**
Attention : Mr D. Naidoo **Date Reported : 11/10/2019**

Test Report - SANS 3001

Sample No.	T22083	T22084	T22085	T22086	T22087
Field No.	IP20	IP23	IP25	IP29	IP31
Position	Layer 2	Layer 1	Layer 3	Layer 3	Layer 3
Depth (m)	0.7-0.9	0.01-1.05	0.98-1.2	1.1-1.7	0.58-1.5
Method of Preparation	Scalped	Scalped	N/A	N/A	N/A
Material Description	Greyish brown mottled reddish brown sandy silty CLAY. Ferricrete	Greyish brown to brownish grey clayey SAND to sandy CLAY. Alluvium	Reddish brown to reddish orange brown clayey SAND to slightly silty sandy CLAY. Residual Tillite	Orange brown to khaki brown stained orange highly to moderately weathered very soft to soft rock. TILLITE	Reddish brown to reddish orange brown clayey SAND to slightly silty sandy CLAY. Residual Tillite

Sieve Analysis - Percent Passing Sieve Size

Sieve Aperture (mm)	100.00				
	75.00				
	63.00				
	53.00		100		
	50.00	100	99		
	37.50	98	99		100
	28.00	98	96		96
	26.50	98	96	100	100
	20.00	96	94	99	97
	19.00	96	94	99	97
	14.00	95	87	94	96
	13.20	95	87	94	96
	5.00	82	63	73	88
	4.750	82	63	73	88
2.000	69	50	59	78	
0.425	53	36	48	59	
0.075	37	26	36	40	
Grading Modulus	1.41	1.88	1.57	1.24	1.61
Mechanical analysis - Percent of Soil Mortar (<2 mm) for Grain Size range					
Coarse Sand	2.000 - 0.425	24	27	19	24
Coarse-Fine Sand	0.425 - 0.250	6	8	4	7
Medium-Fine Sand	0.250 - 0.150	8	6	6	10
Fine-Fine Sand	0.150 - 0.075	9	7	9	8
Silt and Clay	< 0.075	53	52	62	51
Atterberg Limits SANS 3001 on <0.425 mm fraction					
Liquid Limit	% or symbol	40	42	41	32
Plasticity Index	% or symbol	14	16	15	11
Linear Shrinkage	%	7.0	8.0	7.5	6.0
Maximum Dry Density and Optimum Moisture Content					
Maximum Dry Density (kg/m³)		1790	1980	1876	
Optimum moisture content (%)		15.1	9.6	12.3	
California Bearing Ratio					
CBR @100% Compaction	%	29	47	11	
CBR @ 98% Compaction	%	19	30	8.4	
CBR @ 97% Compaction	%	15	24	7.4	
CBR @ 95% Compaction	%	9.6	15	5.7	
CBR @ 93% Compaction	%	6.2	9.5	4.4	
CBR @ 90% Compaction	%	3.2	4.8	3.0	
Swell @100% Compaction	%	1.5	1.1	1.6	
COLTO Classification (1998)**		Cannot be Determined	Cannot be Determined	Cannot be Determined	Cannot be Determined
TRH 14 Classification (1985)**		G10	G10	Poorer than G10	Cannot be Determined
AASHTO Classification (Group Index)**		A-6 (1)	A-2-7 (1)	A-7-6 (1)	A-6 (1)
Unified Classification **		SM	SM	SM	SC

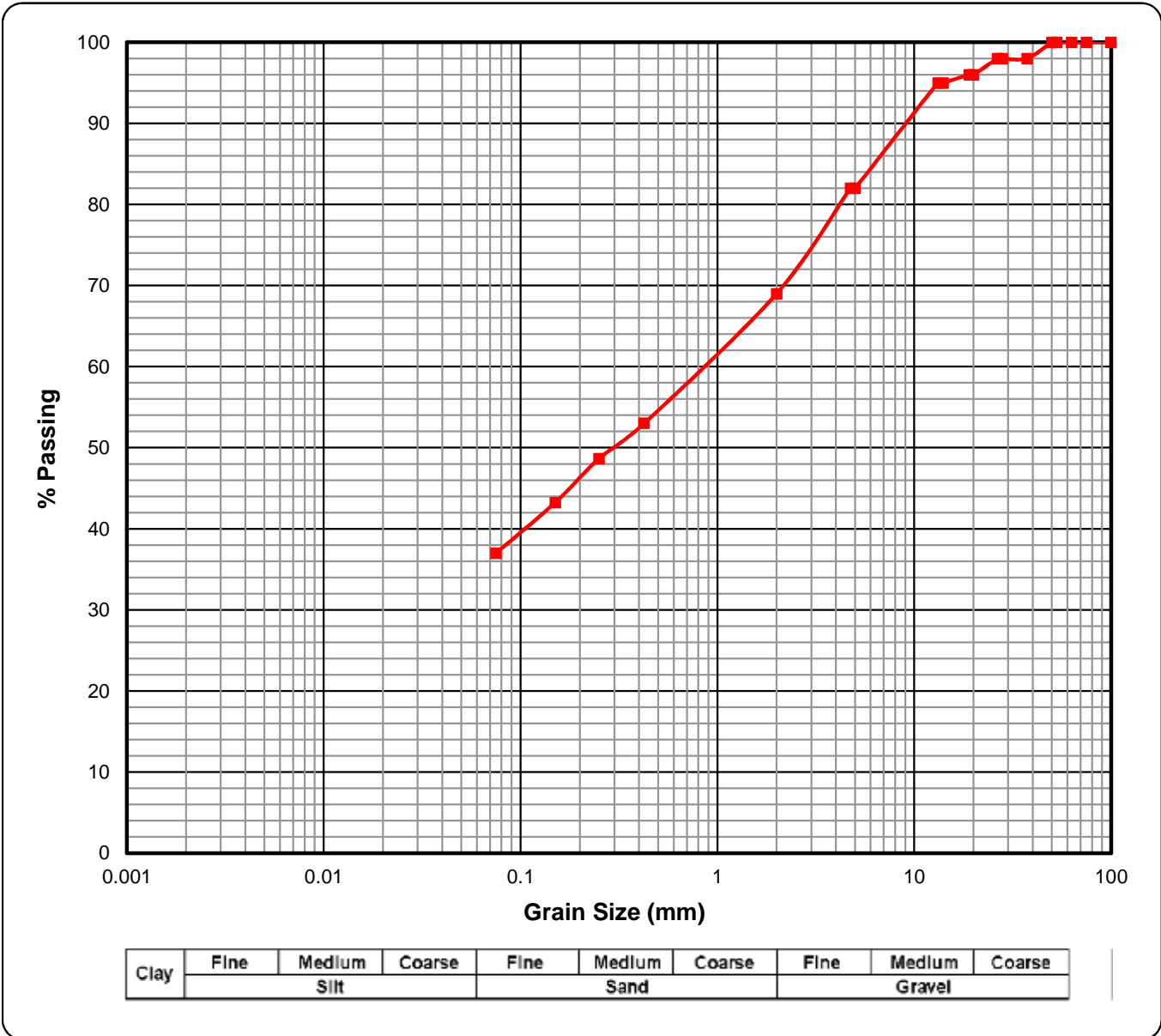
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Remarks: *Subject to further testing as required by TRH14.
† Subject to further testing as required by COLTO. COLTO above uses only: Atterberg Limits (<0.425 mm fraction; not arithmetic mean), Nominal Max Size, Grading Curve, Coarse Sand Ratio, Grading Modulus, Strength (CBR), and Swell.
Check that Max Size <= 2/3 of compacted layer thickness.

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Client : Geosure (Pty) Ltd Project : Construction of Sewer Reticulation at Ntuzuma B Attention : Mr D. Naidoo	Your Ref No.: - Our Ref No. : 47497 Date Reported : 11/10/2019
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Grading Curve for Sample T22083 – SANS 3001



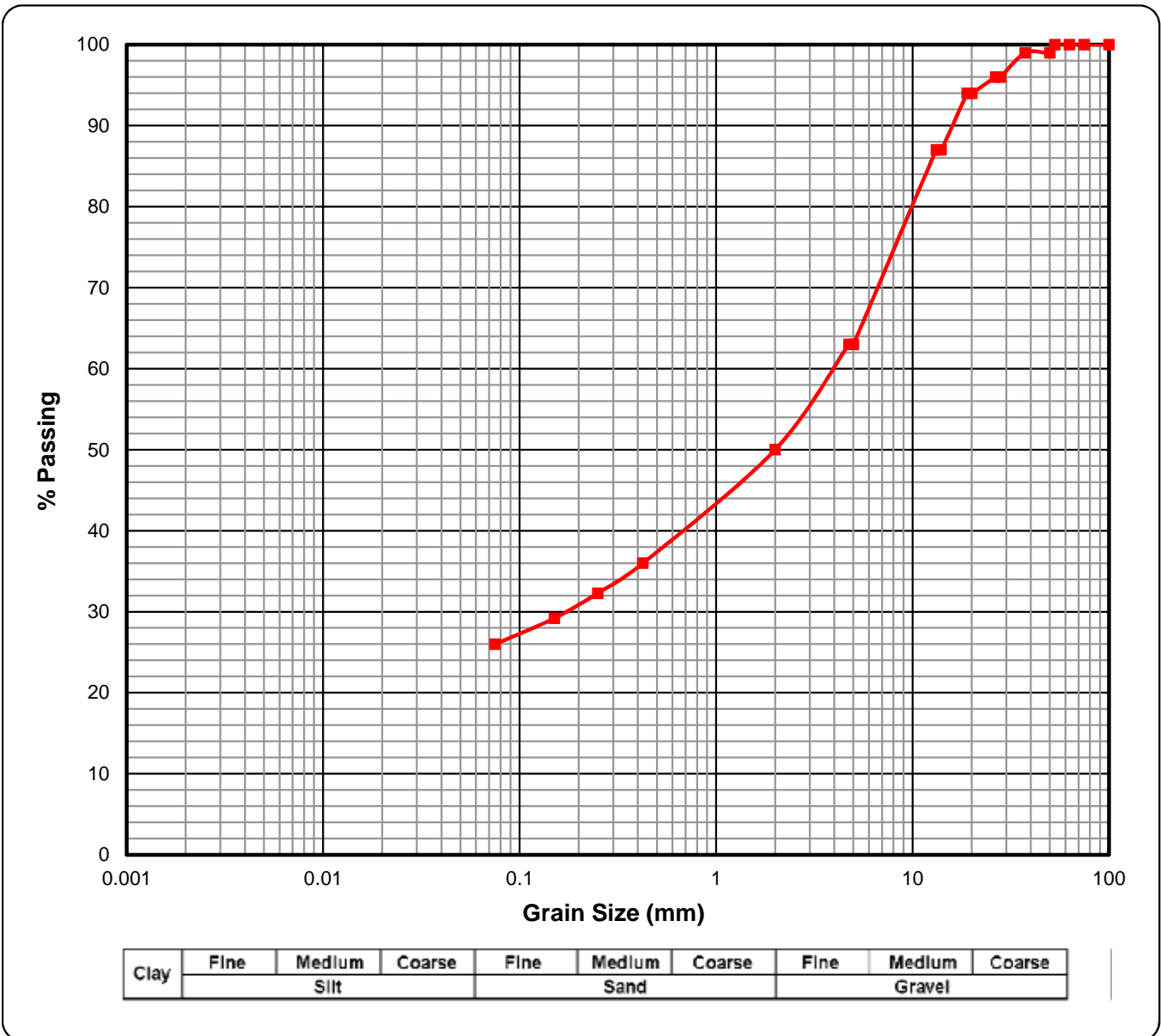
Thick Red Line is the Grading Curve (COLTO Classification = Cannot be Determined) (TRH 14 Classification = G10)

Sieve Aperture Size	0.075	0.150	0.250	0.425	2.00	4.75	5.00	13.20	14.00	19.00	20.00	26.50	28.0	37.5	50.0	53.0	63	75	100
Percentage Passing	37%	43%	49%	53%	69%	82%	82%	95%	95%	96%	96%	98%	98%	98%	100%	100%	100%	100%	100%

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Client : Geosure (Pty) Ltd Project : Construction of Sewer Reticulation at Ntuzuma B Attention : Mr D. Naidoo	Your Ref No.: - Our Ref No. : 47497 Date Reported : 11/10/2019
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Grading Curve for Sample T22084 – SANS 3001



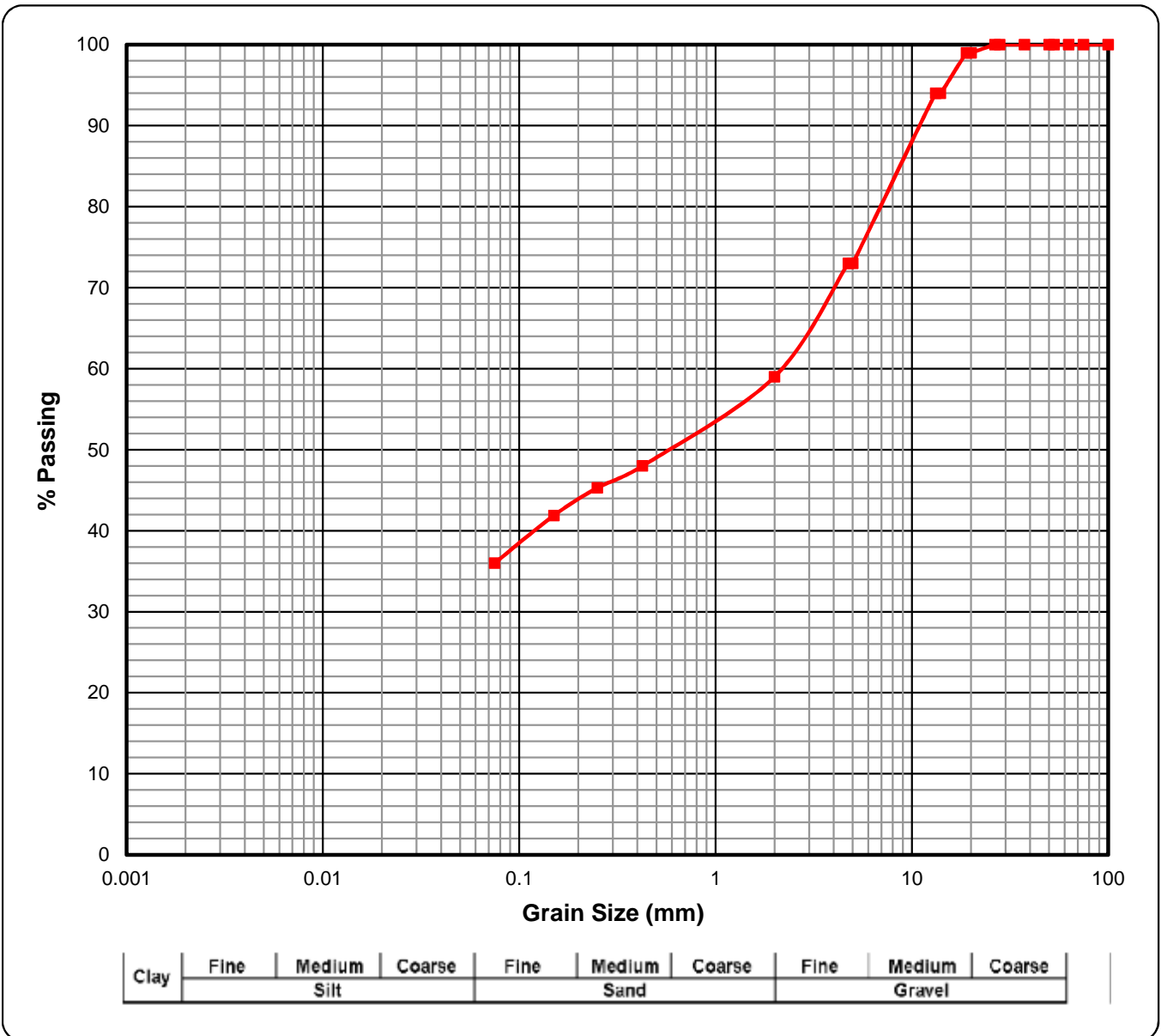
Thick Red Line is the Grading Curve (COLTO Classification = Cannot be Determined) (TRH 14 Classification = G10)

Sieve Aperture Size	0.075	0.150	0.015	0.026	0.05	0.06	5.00	13.20	14.00	19.00	20.00	26.50	28.0	37.5	50.0	53.0	63	75	100
Percentage Passing	26%	29%	32%	36%	50%	63%	63%	87%	87%	94%	94%	96%	96%	99%	99%	100%	100%	100%	100%

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Client : Geosure (Pty) Ltd Project : Construction of Sewer Reticulation at Ntuzuma B Attention : Mr D. Naidoo	Your Ref No.: - Our Ref No. : 47497 Date Reported : 11/10/2019
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Grading Curve for Sample T22085 – SANS 3001



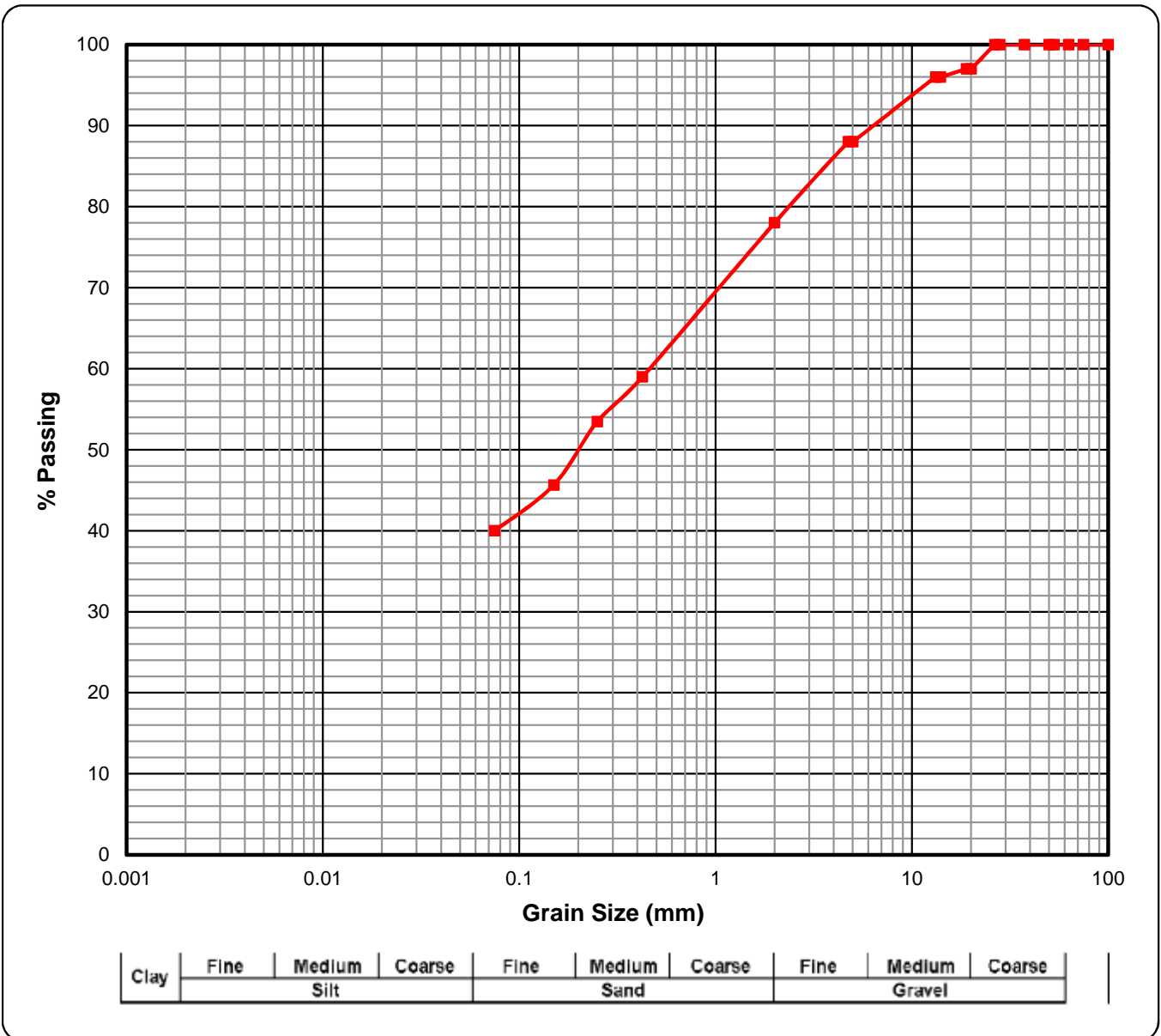
Red Line is the Grading Curve (COLTO Classification = Cannot be Determined) (TRH 14 Classification = Poorer than G1)

Sieve Aperture Size	0.075	0.150	0.250	0.425	2.00	4.75	5.00	13.20	14.00	19.00	20.00	26.50	28.0	37.5	50.0	53.0	63	75	100
Percentage Passing	36%	42%	45%	48%	59%	73%	73%	94%	94%	99%	99%	100%	100%	100%	100%	100%	100%	100%	100%

LABORATORY: 122 Intersite Avenue, Umgeni Business Park, Durban, 4091 P.O. Box 1461, Westville 3630 Mobile: +27(0)72 870 2621 Fax: 086 684 9785 Tel.: +27 (0)31 701 9732 email: lab@geosure.co.za	Reg. No. : 92/03145/07	HEAD OFFICE: 122 Intersite Avenue, Umgeni Business Park, Durban, 4091, KwaZulu Natal, South Africa. Tel: +27 (0)31 266 0458 Fax: 086 689 5506 email: geosure@iafrica.com www.geosure.co.za
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Client : Geosure (Pty) Ltd Project : Construction of Sewer Reticulation at Ntuzuma B Attention : Mr D. Naidoo	Your Ref No.: - Our Ref No. : 47497 Date Reported : 11/10/2019
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Grading Curve for Sample T22086 – SANS 3001



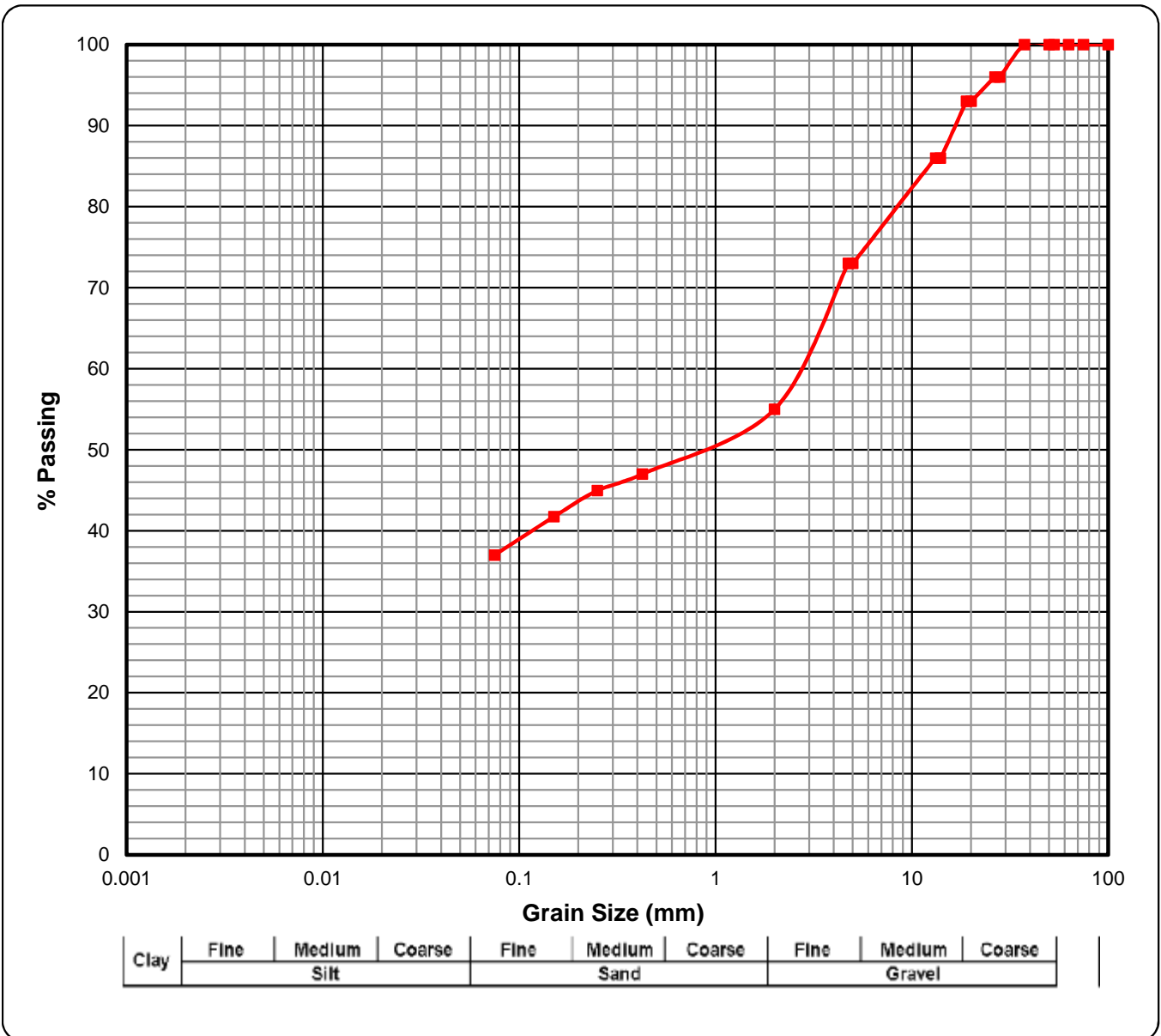
Red Line is the Grading Curve (COLTO Classification = Cannot be Determined) (TRH 14 Classification = Cannot be Determ

Sieve Aperture Size	0.075	0.150	0.250	0.425	2.00	4.75	5.00	13.20	14.00	19.00	20.00	26.50	28.0	37.5	50.0	53.0	63	75	100
Percentage Passing	40%	46%	53%	59%	78%	88%	88%	96%	96%	97%	97%	100%	100%	100%	100%	100%	100%	100%	100%

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Client : Geosure (Pty) Ltd Project : Construction of Sewer Reticulation at Ntuzuma B Attention : Mr D. Naidoo	Your Ref No.: - Our Ref No. : 47497 Date Reported : 11/10/2019
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Grading Curve for Sample T22087 – SANS 3001



Red Line is the Grading Curve (COLTO Classification = Cannot be Determined) (TRH 14 Classification = Cannot be Determined)

Sieve Aperture Size	0.075	0.150	0.250	0.425	2.00	4.75	5.00	13.20	14.00	19.00	20.00	26.50	28.0	37.5	50.0	53.0	63	75	100
Percentage Passing	37%	42%	45%	47%	55%	73%	73%	86%	86%	93%	93%	96%	96%	100%	100%	100%	100%	100%	100%

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Client : Geosure (Pty) Ltd **Your Ref No. : -**
Project : Construction of Sewer Reticulation at Ntuzuma B **Our Ref No. : 47497**
Attention : Mr D. Naidoo **Date Reported : 11/10/2019**

Test Report - SANS 3001

Sample No.	T22094	T22095	T22096	T22097	T22098
Field No.	IP33	IP35	IP36	IP39	IP40
Position	Layer 3	Layer 1	Layer 2	Layer 1	Layer 3
Depth (m)	0.48-0.69	0.01-1.29	0.5-1.2	0.01-0.5	1.12-2.5
Method of Preparation	Scalped	Scalped	N/A	N/A	N/A
Material Description	Khaki brown stained grey and orange brown highly weathered very soft to soft rock. TILLITE	Greyish brown becoming brownish grey stained khaki brown clayey SAND to sandy CLAY. Fill	Khaki brown stained grey and orange brown highly weathered very soft to soft rock. TILLITE	Greyish brown to brownish grey clayey SAND to sandy CLAY. Fill	Khaki brown stained grey and orange brown highly weathered very soft to soft rock. TILLITE

Sieve Analysis - Percent Passing Sieve Size						
Sieve Aperture (mm)	100.00			100	100	
	75.00			89	94	
	63.00			86	92	
	53.00	100	100	86	92	
	50.00	98	97	85	91	
	37.50	86	94	80	88	
	28.00	82	93	74	85	
	26.50	82	93	74	85	
	20.00	70	91	67	83	
	19.00	70	91	67	83	
	14.00	67	90	66	77	
	13.20	67	90	66	77	100
	5.00	48	79	56	67	99
	4.750	48	79	56	67	99
	2.000	36	69	47	56	99
0.425	20	56	36	45	93	
0.075	14	36	24	26	69	
Grading Modulus		2.30	1.39	1.93	1.73	0.39
Mechanical analysis - Percent of Soil Mortar (<2 mm) for Grain Size range						
Coarse Sand	2.000 - 0.425	43	18	25	21	6
Coarse-Fine Sand	0.425 - 0.250	6	8	7	10	6
Medium-Fine Sand	0.250 - 0.150	7	10	8	12	8
Fine-Fine Sand	0.150 - 0.075	7	12	9	11	11
Silt and Clay	< 0.075	38	52	51	46	70
Atterberg Limits SANS 3001 on <0.425 mm fraction						
Liquid Limit	% or symbol	37	42	40	32	44
Plasticity Index	% or symbol	13	16	14	10	18
Linear Shrinkage	%	6.5	7.5	7.0	4.5	8.5
Maximum Dry Density and Optimum Moisture Content						
Maximum Dry Density (kg/m³)		2016	1951			1730
Optimum moisture content (%)		8.9	8.6			15.3
California Bearing Ratio						
CBR @100% Compaction	%	17	3.7			13
CBR @ 98% Compaction	%	13	2.9			7.0
CBR @ 97% Compaction	%	11	2.6			5.2
CBR @ 95% Compaction	%	7.8	2.1			2.9
CBR @ 93% Compaction	%	5.7	1.6			1.6
CBR @ 90% Compaction	%	3.6	1.2			0.7
Swell @100% Compaction	%	1.2	1.7			1.7
COLTO Classification (1998)**		Cannot be Determined	Cannot be Determined	Cannot be Determined	Cannot be Determined	Cannot be Determined
TRH 14 Classification (1985)**		G10	Poorer than G10.	Cannot be Determined	Cannot be Determined	Poorer than G10.
AASHTO Classification (Group Index)**		A-2-6 (0)	A-7-6 (1)	A-2-6 (0)	A-2-4 (0)	A-7-6 (12)
Unified Classification **		GC	SM	GM	SC	CL

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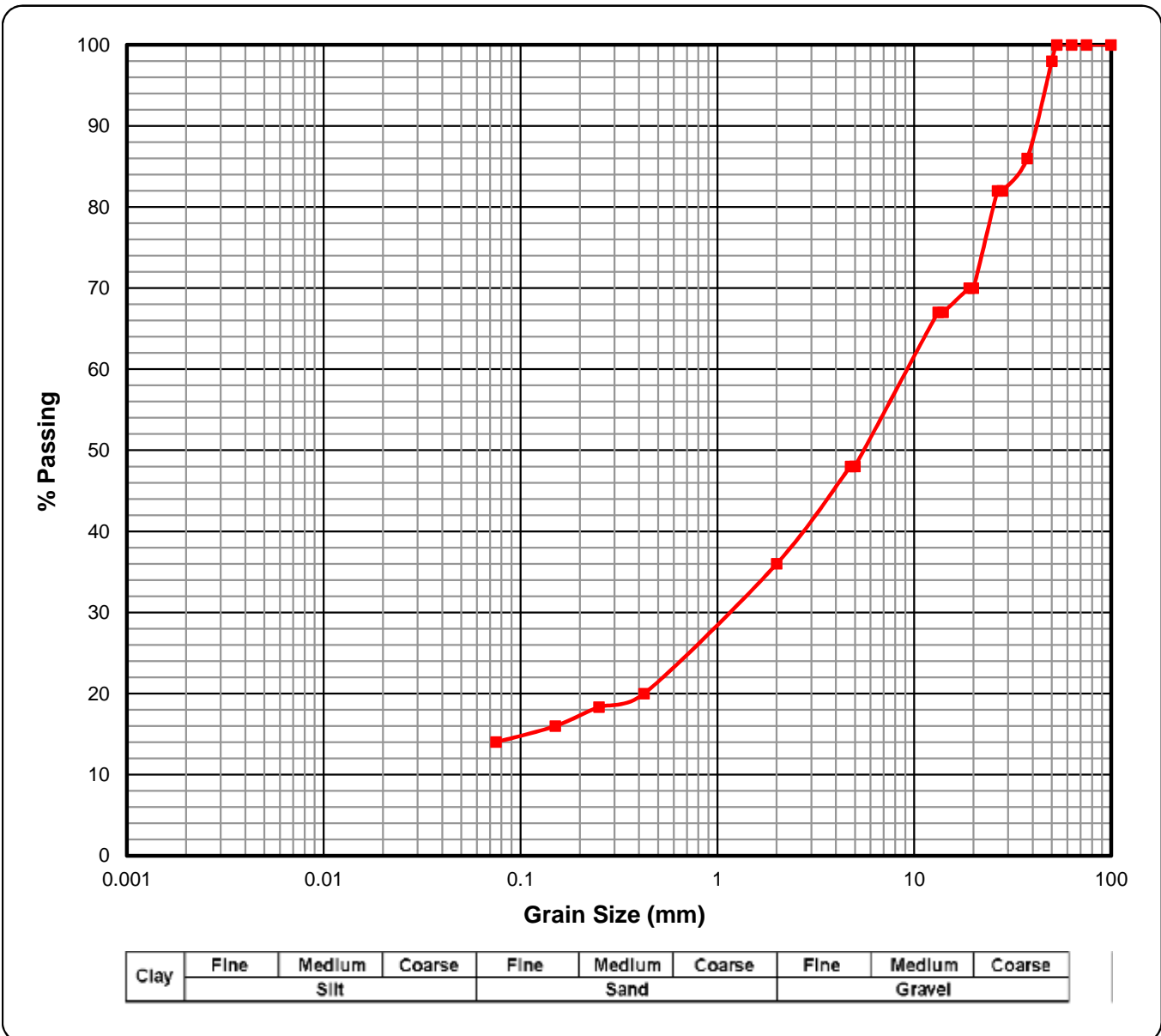
Remarks: ***Subject to further testing as required by TRH14.**
 † Subject to further testing as required by COLTO. COLTO above uses only: Atterberg Limits (<0.425 mm fraction; not arithmetic mean), Nominal Max Size, Grading Curve, Coarse Sand Ratio, Grading Modulus, Strength (CBR), and Swell.
 # Check that Max Size <= 2/3 of compacted layer thickness.

** Opinions and interpretations expressed herein are outside the scope of SANAS accreditation
 Version 5.05 - 14 February 2018

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Client : Geosure (Pty) Ltd Project : Construction of Sewer Reticulation at Ntuzuma B Attention : Mr D. Naidoo	Your Ref No.: - Our Ref No. : 47497 Date Reported : 11/10/2019
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Grading Curve for Sample T22094 – SANS 3001



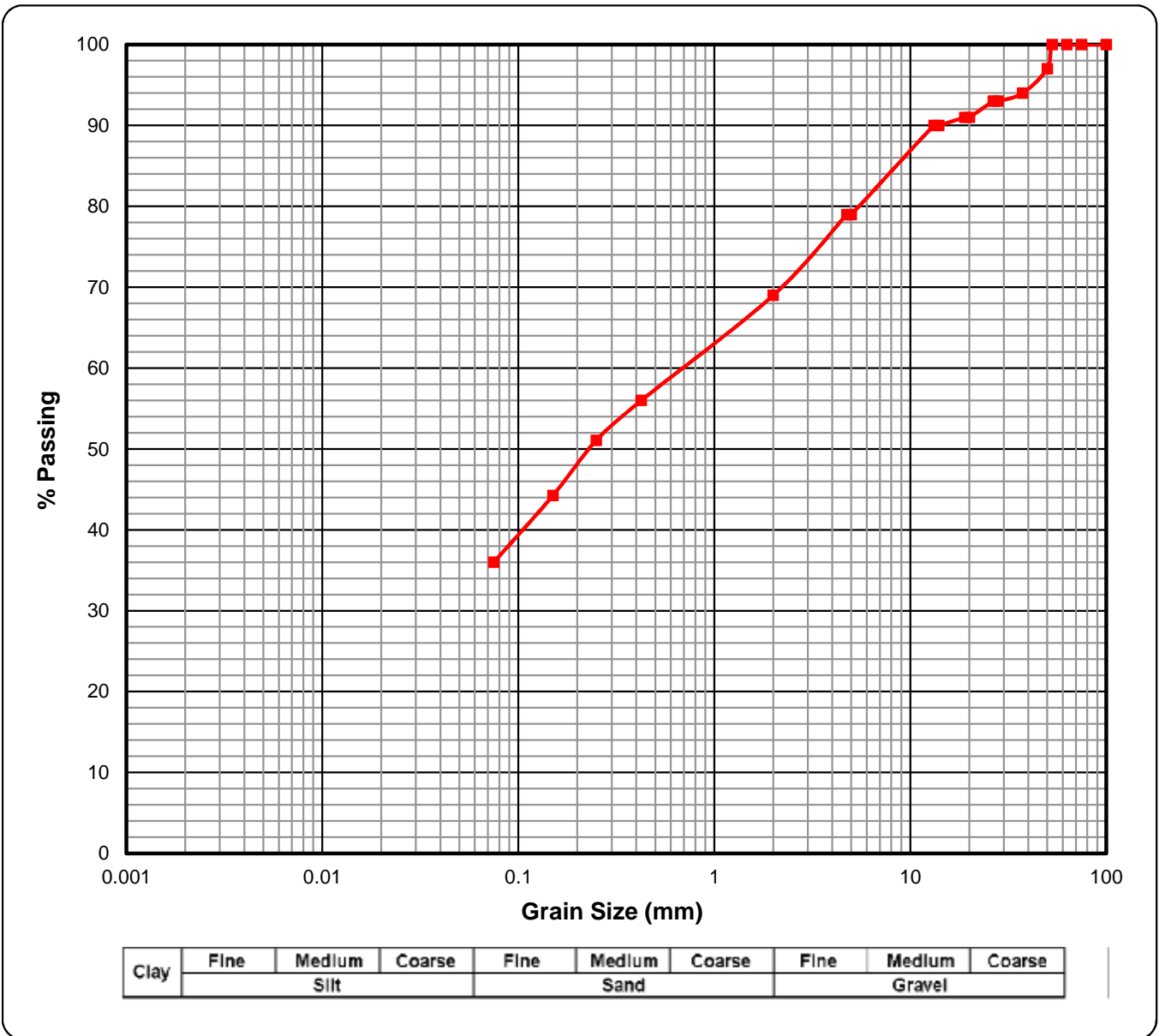
Thick Red Line is the Grading Curve (COLTO Classification = Cannot be Determined) (TRH 14 Classification = G10)

Sieve Aperture Size	0.075	0.150	0.250	0.425	2.00	4.75	5.00	13.20	14.00	19.00	20.00	26.50	28.0	37.5	50.0	53.0	63	75	100
Percentage Passing	14%	16%	18%	20%	36%	48%	48%	67%	67%	70%	70%	82%	82%	86%	98%	100%	100%	100%	100%

LABORATORY: 122 Intersite Avenue, Umgeni Business Park, Durban, 4091 P.O. Box 1461, Westville 3630 Mobile: +27(0)72 870 2621 Fax: 086 684 9785 Tel.: +27 (0)31 701 9732 email: lab@geosure.co.za	Reg. No. : 92/03145/07	HEAD OFFICE: 122 Intersite Avenue, Umgeni Business Park, Durban, 4091, KwaZulu Natal, South Africa. Tel: +27 (0)31 266 0458 Fax: 086 689 5506 email: geosure@iafrica.com www.geosure.co.za
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Client : Geosure (Pty) Ltd Project : Construction of Sewer Reticulation at Ntuzuma B Attention : Mr D. Naidoo	Your Ref No.: - Our Ref No. : 47497 Date Reported : 11/10/2019
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Grading Curve for Sample T22095 – SANS 3001



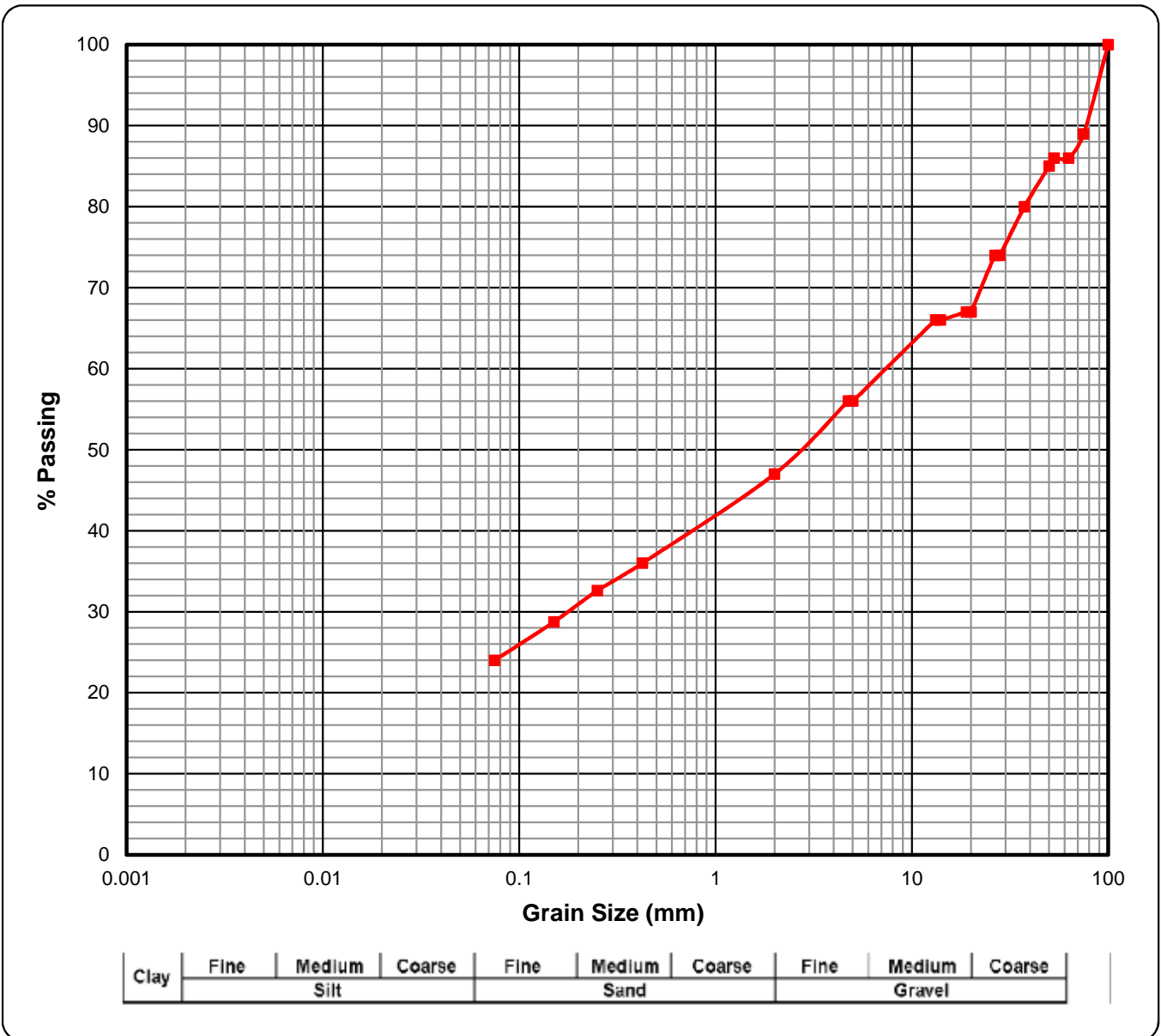
Red Line is the Grading Curve (COLTO Classification = Cannot be Determined) (TRH 14 Classification = Poorer than G1)

Sieve Aperture Size	0.075	0.150	0.015	0.026	0.05	0.06	5.00	13.20	14.00	19.00	20.00	26.50	28.0	37.5	50.0	53.0	63	75	100
Percentage Passing	36%	44%	51%	56%	69%	79%	79%	90%	90%	91%	91%	93%	93%	94%	97%	100%	100%	100%	100%

LABORATORY: 122 Intersite Avenue, Umgeni Business Park, Durban, 4091 P.O. Box 1461, Westville 3630 Mobile: +27(0)72 870 2621 Fax: 086 684 9785 Tel.: +27 (0)31 701 9732 email: lab@geosure.co.za	Reg. No. : 92/03145/07	HEAD OFFICE: 122 Intersite Avenue, Umgeni Business Park, Durban, 4091, KwaZulu Natal, South Africa. Tel: +27 (0)31 266 0458 Fax: 086 689 5506 email: geosure@iafrica.com www.geosure.co.za
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Client : Geosure (Pty) Ltd Project : Construction of Sewer Reticulation at Ntuzuma B Attention : Mr D. Naidoo	Your Ref No.: - Our Ref No. : 47497 Date Reported : 11/10/2019
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Grading Curve for Sample T22096 – SANS 3001



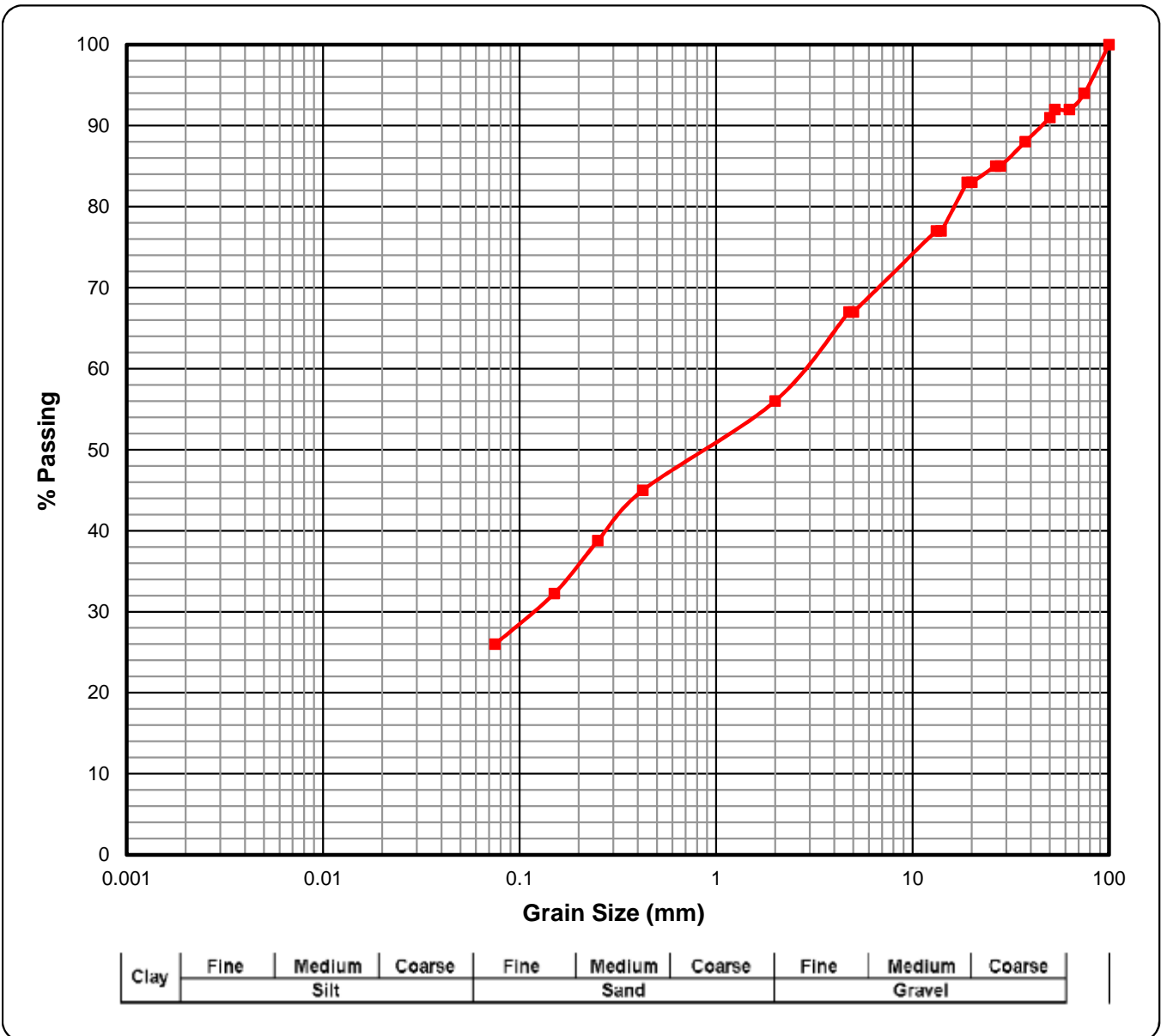
Red Line is the Grading Curve (COLTO Classification = Cannot be Determined) (TRH 14 Classification = Cannot be Determ

Sieve Aperture Size	0.075	0.150	0.250	0.425	2.00	4.75	5.00	13.20	14.00	19.00	20.00	26.50	28.0	37.5	50.0	53.0	63	75	100
Percentage Passing	24%	29%	33%	36%	47%	56%	56%	66%	66%	67%	67%	74%	74%	80%	85%	86%	86%	89%	100%

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Client : Geosure (Pty) Ltd Project : Construction of Sewer Reticulation at Ntuzuma B Attention : Mr D. Naidoo	Your Ref No.: - Our Ref No. : 47497 Date Reported : 11/10/2019
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Grading Curve for Sample T22097 – SANS 3001



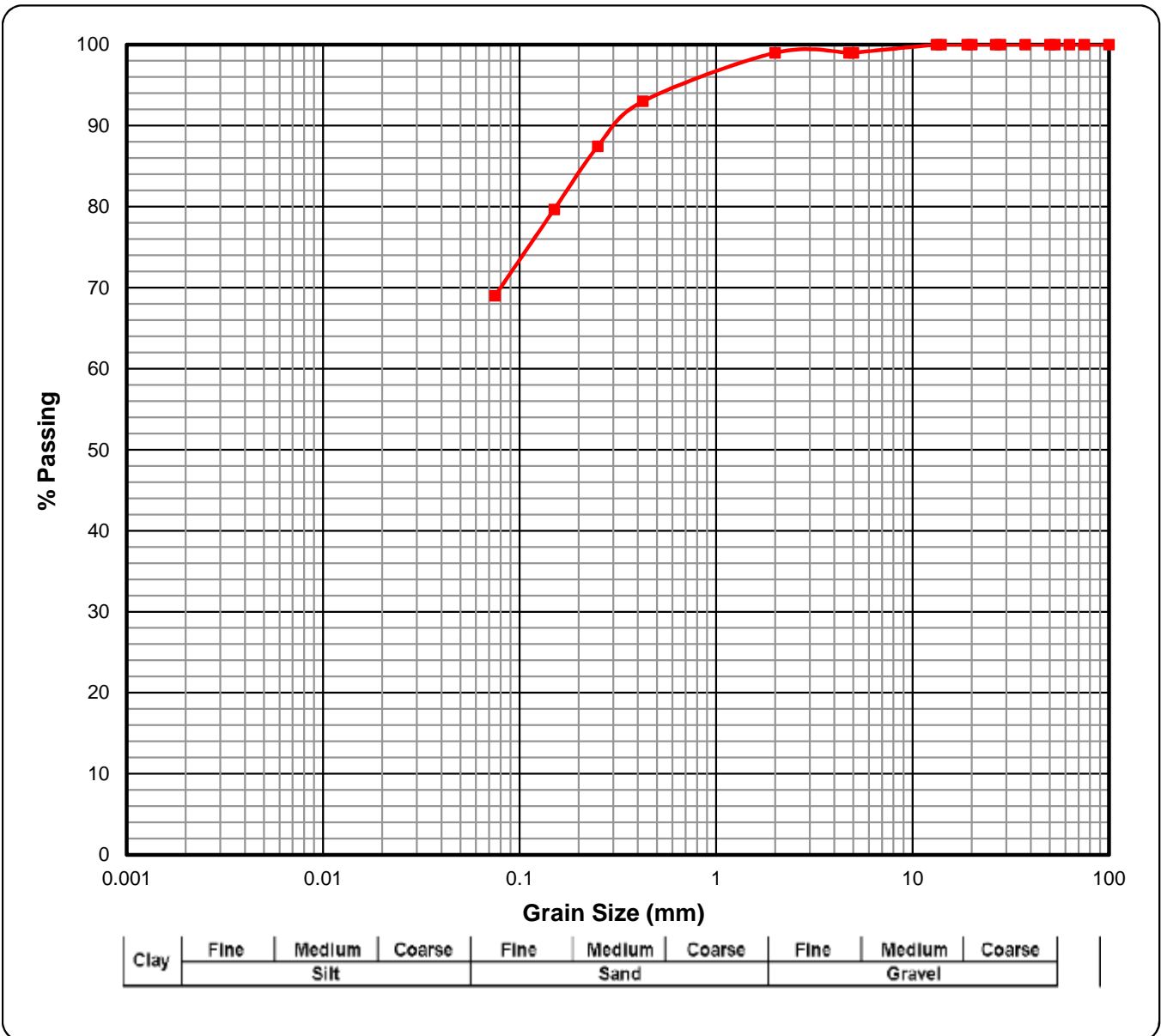
Red Line is the Grading Curve (COLTO Classification = Cannot be Determined) (TRH 14 Classification = Cannot be Determined)

Sieve Aperture Size	0.075	0.150	0.250	0.425	2.00	4.75	5.00	13.20	14.00	19.00	20.00	26.50	28.0	37.5	50.0	53.0	63	75	100
Percentage Passing	26%	32%	39%	45%	56%	67%	67%	77%	77%	83%	83%	85%	85%	88%	91%	92%	92%	94%	100%

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Grading Curve for Sample T22098 – SANS 3001



Red Line is the Grading Curve (COLTO Classification = Cannot be Determined) (TRH 14 Classification = Poorer than G1)

Sieve Aperture Size	0.075	0.150	0.250	0.425	2.00	4.75	5.00	13.20	14.00	19.00	20.00	26.50	28.0	37.5	50.0	53.0	63	75	100
Percentage Passing	69%	80%	87%	93%	99%	99%	99%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%



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Client	: Geosure (Pty) Ltd	Our Ref. : 47497
Project	: Construction of Sewer Reticulation at Ntuzuma B	Your Ref. : 233-19
Attention	: Mr D. Naidoo	Date Reported : 09.10.2019

TEST REPORT : COMPACTIBILITY FACTOR
(METHOD: SABS 1200)

Sample No.	Field No.	Depth (m)	Material Description	Moisture Content	Compactibility Factor
T22073	IP1	0.75-1.6	Orange brown to reddish brown gravelly clayey SAND to gravelly sandy CLAY. Residual Tillite	12.9	0.423
T22074	IP3	0.01-1.1	Light to medium brown slightly silty SAND to slightly clayey silty SAND. Fill	15.0	0.473
T22075	IP5	0.7-1.6	Greyish brown becoming khaki brown to yellowish brown silty clayey SAND to sandy CLAY. Residual Tillite	15.2	0.423
T22076	IP6	0.01-0.6	Dark greyish brown to dark grey silty CLAYEY SAND to sandy CLAY to clayey SILT. Alluvium	13.7	0.438
T22077	IP8	0.2-0.6	Khaki brown stained brown and grey completely to highly weathered very soft to soft rock. TILLITE	9.9	0.294
T22078	IP9	0.3-1.0	Reddish brown becoming khaki brown clayey SAND to silty sandy CLAY. Residual Tillite	11.2	0.318
T22080	IP14	0.50-0.86	Greyish brown becoming khaki brown clayey SAND to slightly silty sandy CLAY. Residual Tillite	18.2	0.323
Remarks:	Date Received: 30.09.2019				
	Date Tested: 04.10.2019				

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WEBSITE:	www.geosure.co.za

Client : Geosure (Pty) Ltd	Our Ref. : 47497
Project : Construction of Sewer Reticulation at Ntuzuma B	Your Ref. : 233-19
Attention : Mr D. Naidoo	Date Reported : 09.10.2019

TEST REPORT : COMPACTIBILITY FACTOR
(METHOD: SABS 1200)

Sample No.	Field No.	Depth (m)	Material Description	Moisture Content	Compactibility Factor
T22081	IP16	0.5-0.6	Khaki brown stained brown and grey completely to highly weathered very soft to soft rock. TILLITE	10.2	0.294
T22082	IP19	0.5-0.9	Greyish brown to brown clayey SAND to sandy CLAY. Colluvium	8.2	0.313
T22083	IP20	0.7-0.9	Greyish brown mottled reddish brown sandy silty CLAY. Ferricrete	15.4	0.343
T22084	IP23	0.01-1.05	Greyish brown to brownish grey clayey SAND to sandy CLAY. Alluvium	7.7	0.249
T22085	IP25	0.98-1.2	Reddish brown to reddish orange brown clayey SAND to slightly silty sandy CLAY. Residual Tillite	12.2	0.313
T22094	IP33	0.48-0.69	Khaki brown stained grey and orange brown highly weathered very soft to soft rock. TILLITE	7.4	0.229
T22095	IP35	0.01-1.29	Greyish brown becoming brownish grey stained khaki brown clayey SAND to sandy CLAY. Fill	13.3	0.343
T22098	IP40	1.12-2.5	Khaki brown stained grey and orange brown highly weathered very soft to soft rock. TILLITE	21.0	0.468

Remarks:	Date Received: 30.09.2019
	Date Tested: 04.10.2019

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Client : Geosure (Pty) Ltd
Project : Construction of Sewer Reticulation at Ntuzuma B
Attention : Mr D. Naidoo

Your Ref No. : 233-19
Our Ref No. : 47497
Date Reported : 03.10.2019

SANS 3001 Moisture/Density Relationship

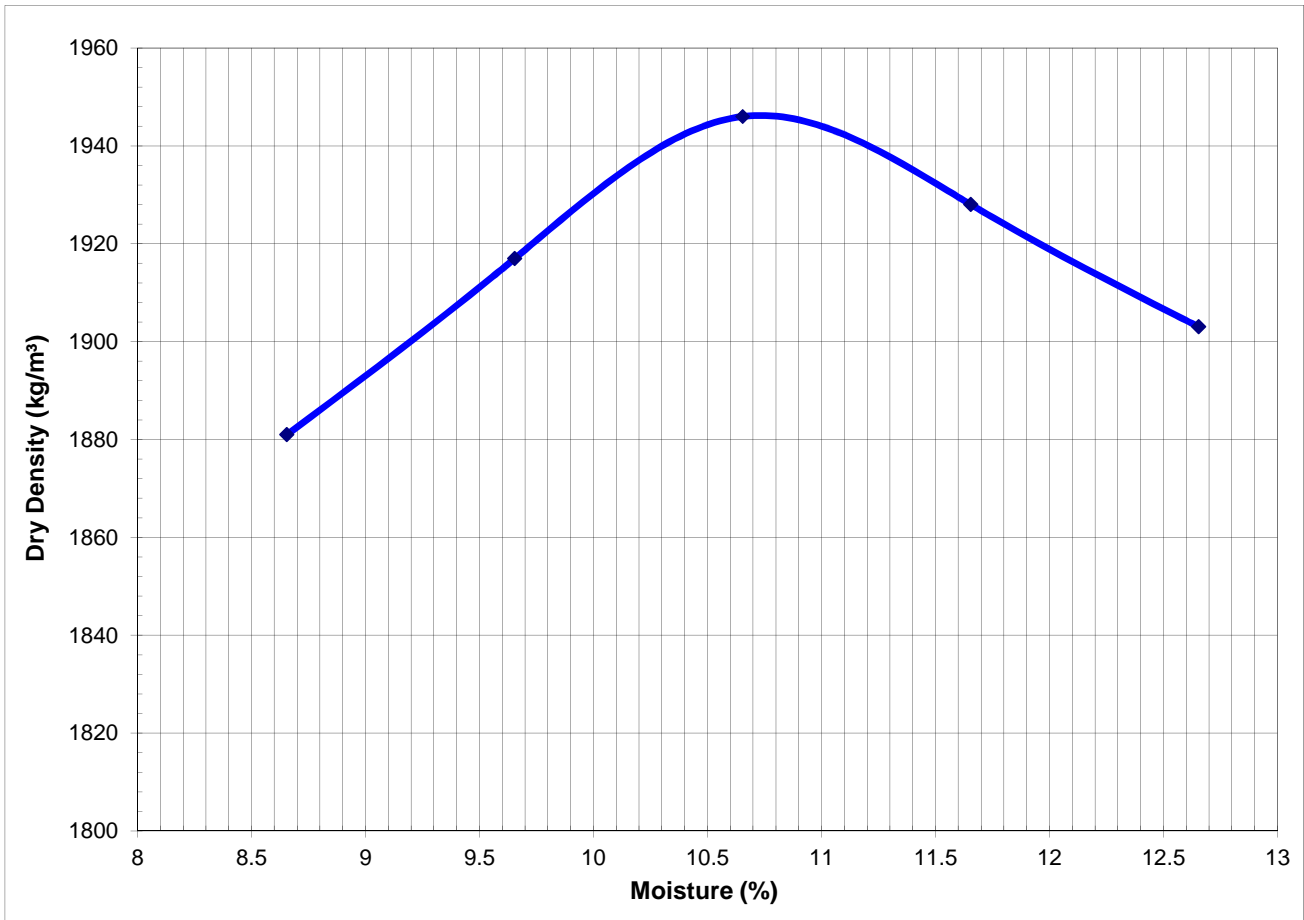
Sample No. : T22073 Field No. : IP1
Method of preparation : N/A Depth (m) : 0.75-1.6
Natural/Stabilised : Natural Origin : Layer 3
Material Description : Or.Br.Rd.Br.gravelly clayey SAND to gravelly sandy Compaction Effort : Mod AASHTO

Maximum Dry Density (kg/m³) 1946

Optimum Moisture Content (%) 10.8

Plotted Values:

Moisture (%)	8.7	9.7	10.7	11.7	12.7
Dry Density (kg/m ³)	1881	1917	1946	1928	1903



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SANS 3001 Moisture/Density Relationship

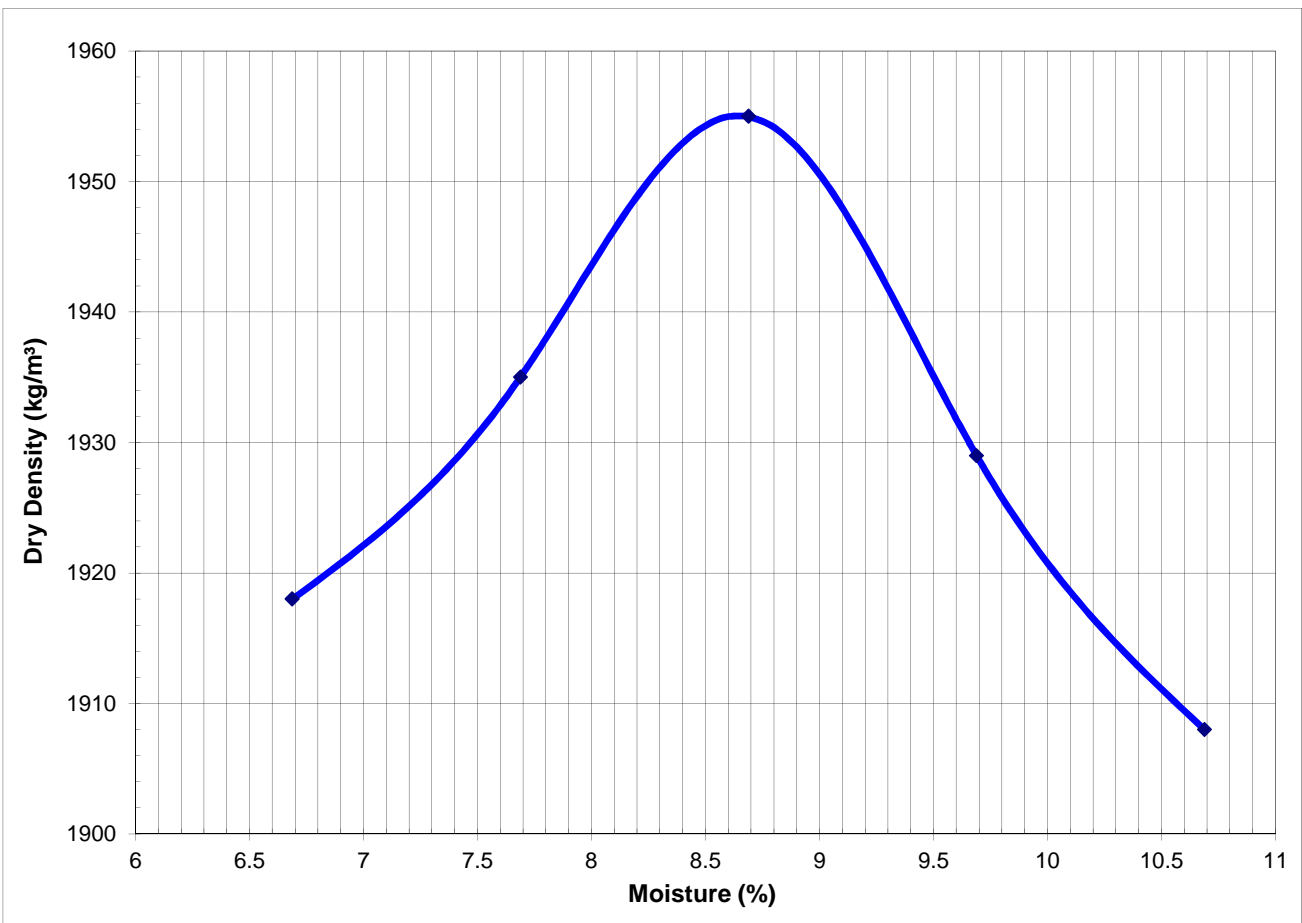
Sample No. : T22074	Field No. : IP3
Method of preparation : N/A	Depth (m) : 0.01-1.1
Natural/Stabilised : Natural	Origin : Layer 1
Material Description : Lt.Med.Br.Sl.silty SAND to Sl.clayey silty SAND. Fill Compaction Effort	: Mod AASHTO

Maximum Dry Density (kg/m³) 1955

Optimum Moisture Content (%) 8.7

Plotted Values:

Moisture (%)	6.7	7.7	8.7	9.7	10.7
Dry Density (kg/m ³)	1918	1935	1955	1929	1908



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Client : Geosure (Pty) Ltd
Project : Construction of Sewer Reticulation at Ntuzuma B
Attention : Mr D. Naidoo

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SANS 3001 Moisture/Density Relationship

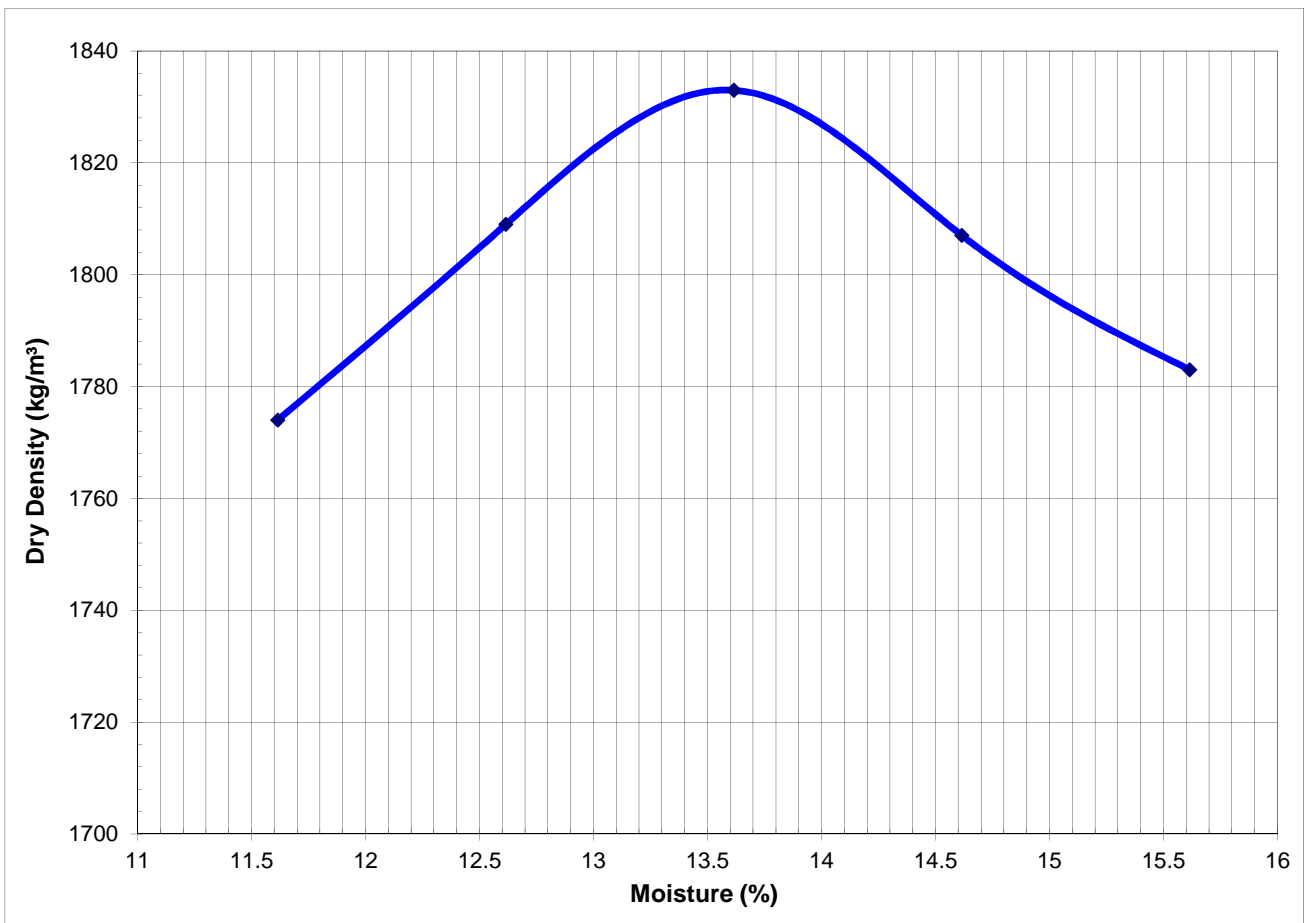
Sample No. : T22075 Field No. : IP5
Method of preparation : N/A Depth (m) : 0.7-1.6
Natural/Stabilised : Natural Origin : Layer 2
Material Description : Gr.Br.khaki Br.Yell.Br.silty clayey SAND to sandy C Compaction Effort : Mod AASHTO

Maximum Dry Density (kg/m³) 1833

Optimum Moisture Content (%) 13.6

Plotted Values:

Moisture (%)	11.6	12.6	13.6	14.6	15.6
Dry Density (kg/m ³)	1774	1809	1833	1807	1783



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SANS 3001 Moisture/Density Relationship

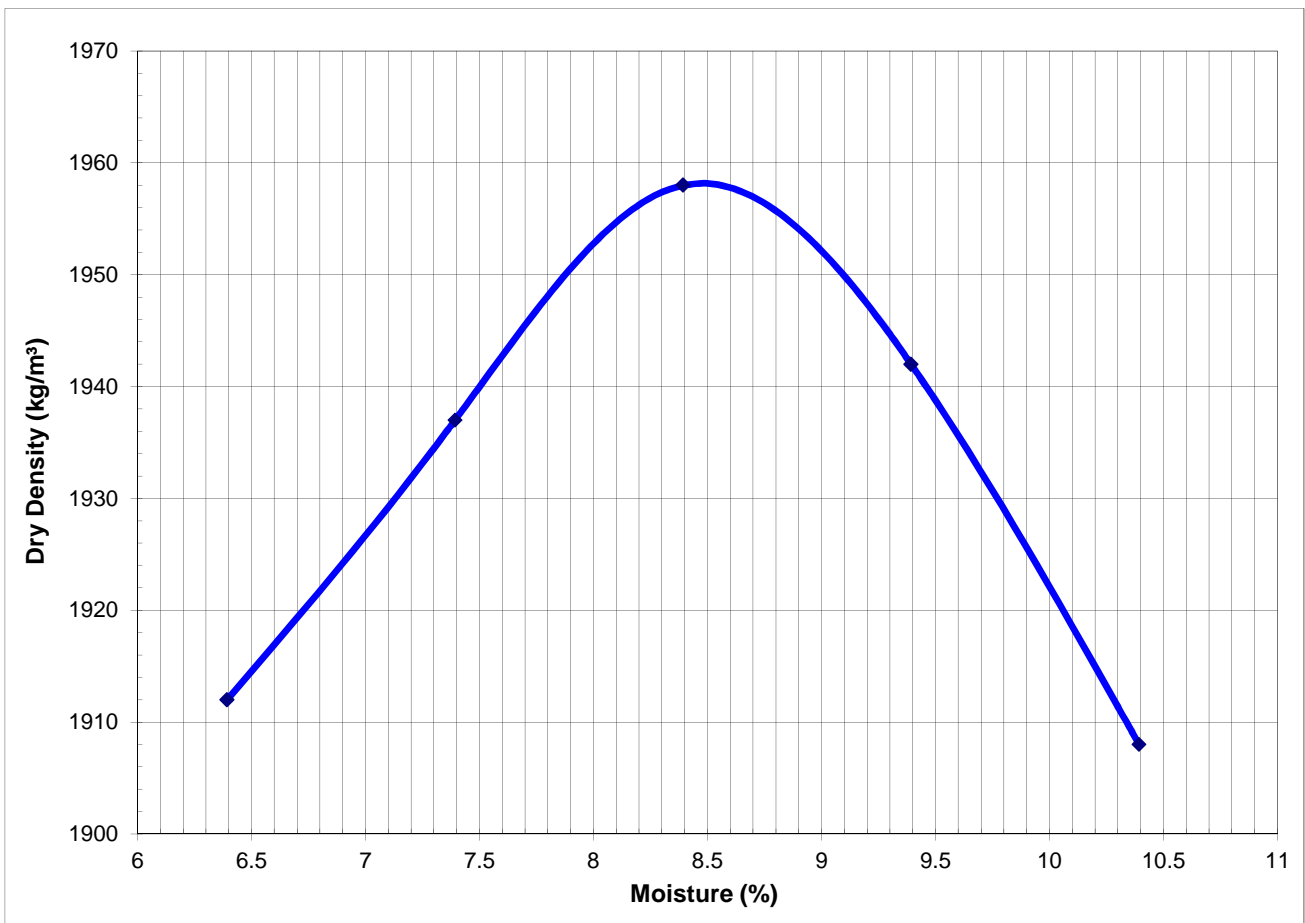
Sample No. : T22076	Field No. : IP6
Method of preparation : Scalped	Depth (m) : 0.01-0.6
Natural/Stabilised : Natural	Origin : Layer 1
Material Description : Dk.Gr.Br.Dk.Gr.silty CLAYEY SAND to sandy CLAY	Compaction Effort : Mod AASHTO

Maximum Dry Density (kg/m³) 1958

Optimum Moisture Content (%) 8.5

Plotted Values:

Moisture (%)	6.4	7.4	8.4	9.4	10.4
Dry Density (kg/m ³)	1912	1937	1958	1942	1908



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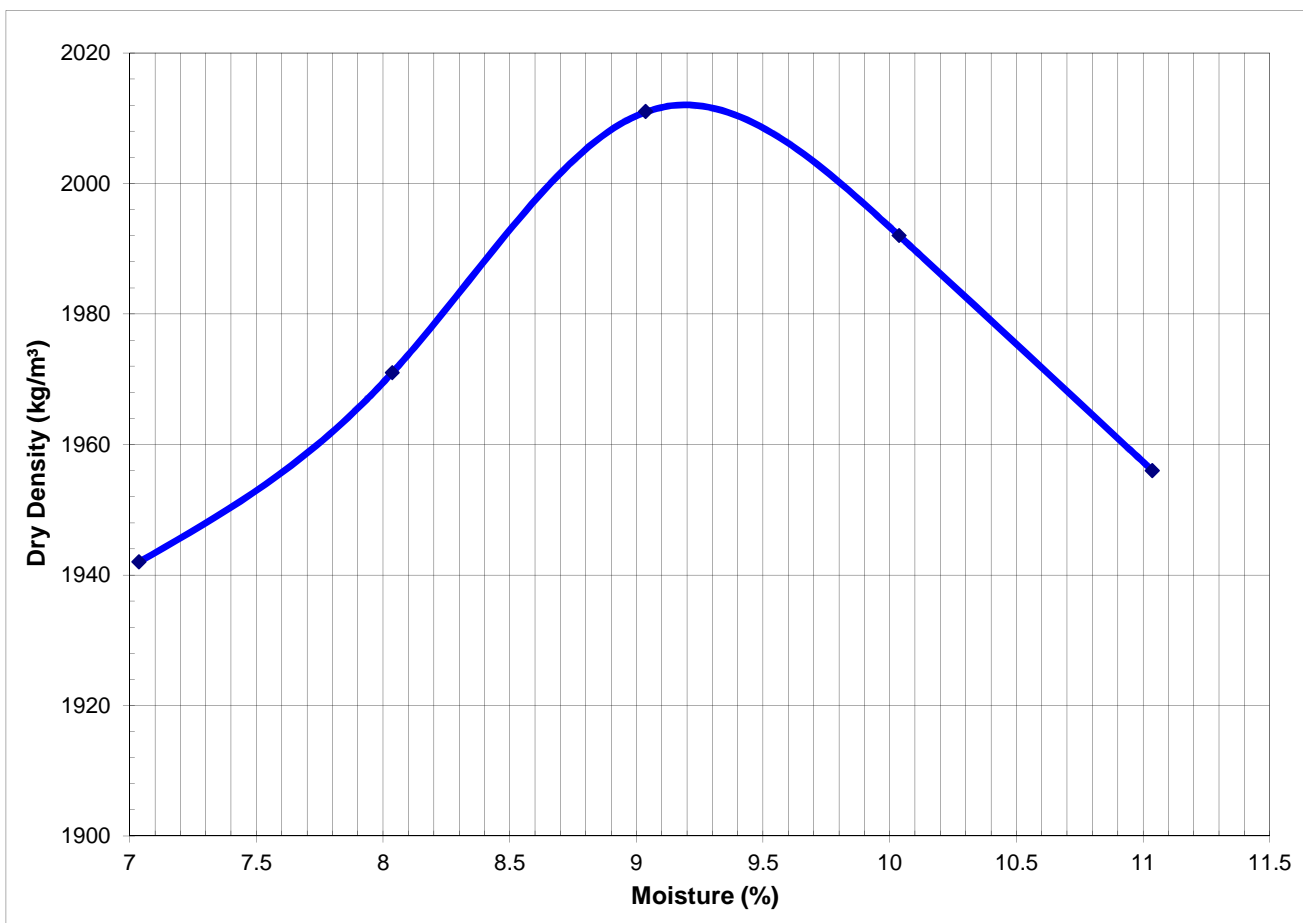
SANS 3001 Moisture/Density Relationship

Sample No. : T22077 Field No. : IP8
Method of preparation : Scalped Depth (m) : 0.2-0.6
Natural/Stabilised : Natural Origin : Layer 2
Material Description : Khak.Br.St.Br.Gr.Comp.Hi.Wth.very soft to soft rocl Compaction Effort : Mod AASHTO

Maximum Dry Density (kg/m³) 2012 Optimum Moisture Content (%) 9.2

Plotted Values:

Moisture (%)	7.0	8.0	9.0	10.0	11.0
Dry Density (kg/m ³)	1942	1971	2011	1992	1956



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SANS 3001 Moisture/Density Relationship

Sample No. : T22078
Method of preparation : N/A
Natural/Stabilised : Natural
Material Description : Rd.Br.khaki Br.clayey SAND to silty sandy CLAY (R Compaction Effort : Mod AASHTO

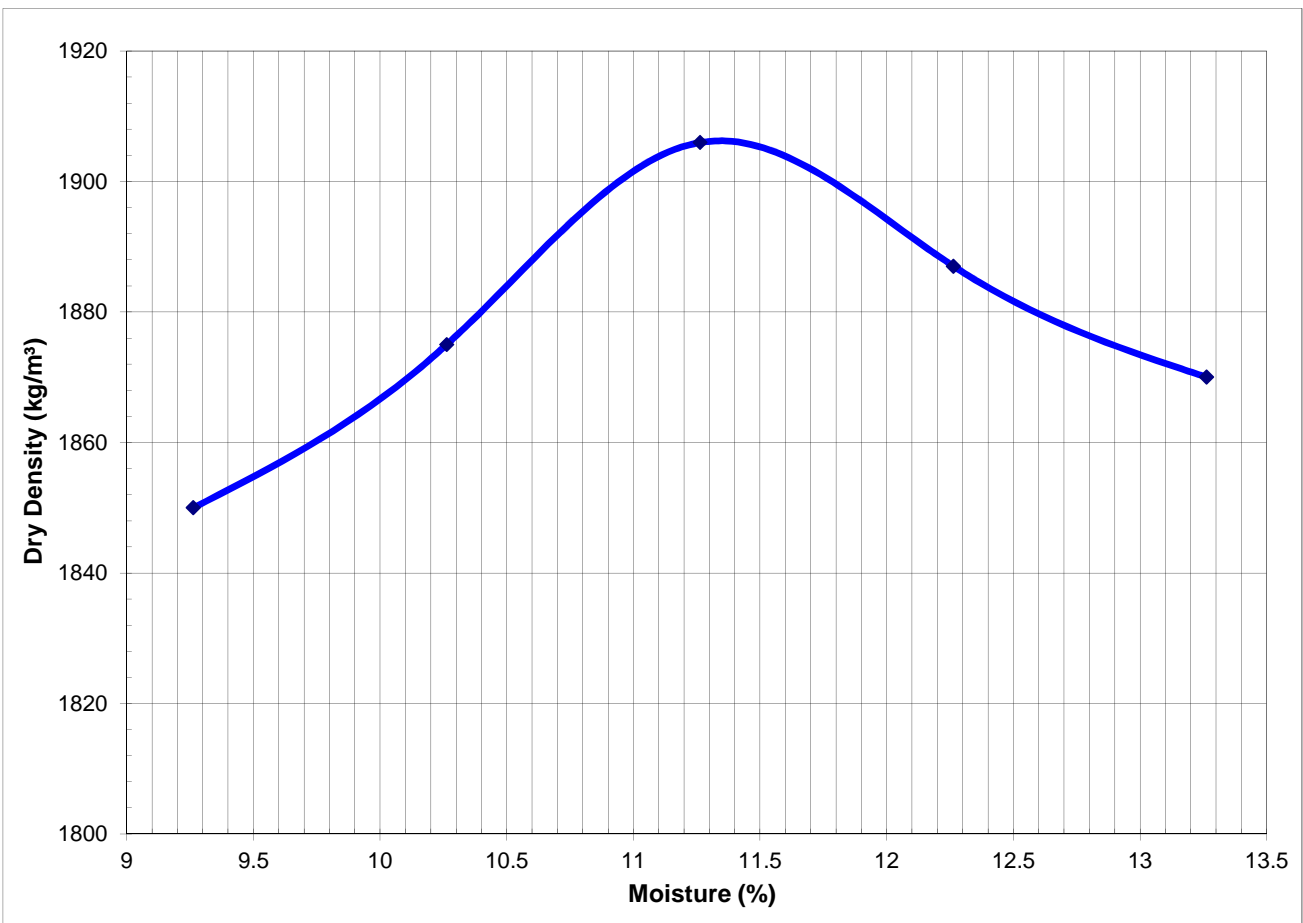
Field No. : IP9
Depth (m) : 0.3-1.0
Origin : Layer 2
R Compaction Effort : Mod AASHTO

Maximum Dry Density (kg/m³) 1906

Optimum Moisture Content (%) 11.4

Plotted Values:

Moisture (%)	9.3	10.3	11.3	12.3	13.3
Dry Density (kg/m ³)	1850	1875	1906	1887	1870



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SANS 3001 Moisture/Density Relationship

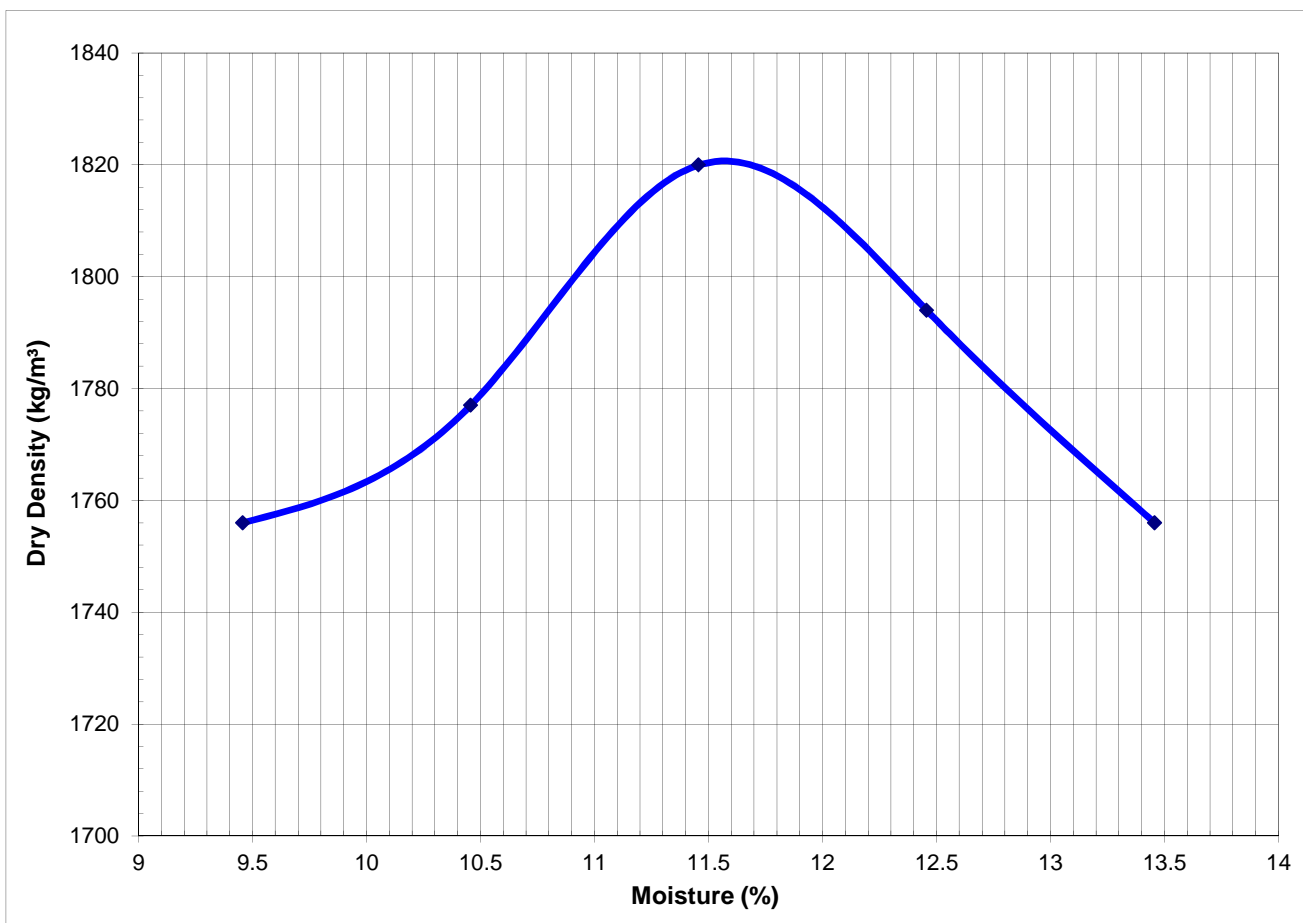
Sample No. : T22080	Field No. : IP14
Method of preparation : Scalped	Depth (m) : 0.5-0.86
Natural/Stabilised : Natural	Origin : Layer 2
Material Description : Gr.Br.Bec.Khaki Br.clayey SAND to Sl.silty sandy C	Compaction Effort : Mod AASHTO

Maximum Dry Density (kg/m³) : 1821

Optimum Moisture Content (%) : 11.6

Plotted Values:

Moisture (%)	9.5	10.5	11.5	12.5	13.5
Dry Density (kg/m ³)	1756	1777	1820	1794	1756



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SANS 3001 Moisture/Density Relationship

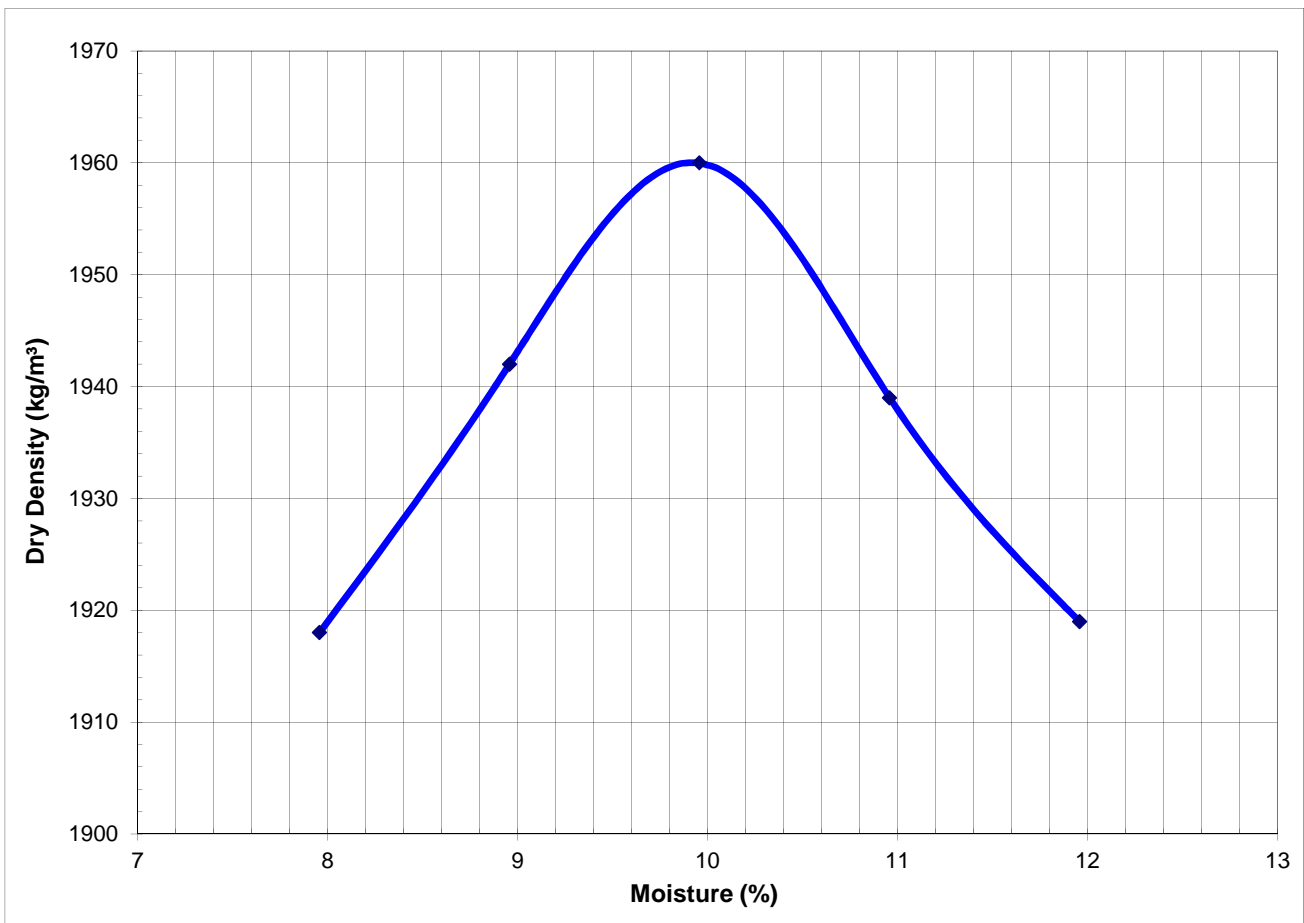
Sample No. : T22081	Field No. : IP16
Method of preparation : Scalped	Depth (m) : 0.5-0.9
Natural/Stabilised : Natural	Origin : Layer 2
Material Description : Khaki Br.Stn Br.Gr.completely to highly wth very so	Compaction Effort : Mod AASHTO

Maximum Dry Density (kg/m³) **1960**

Optimum Moisture Content (%) **10.0**

Plotted Values:

Moisture (%)	8.0	9.0	10.0	11.0	12.0
Dry Density (kg/m ³)	1918	1942	1960	1939	1919



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Client : Geosure (Pty) Ltd Project : Construction of Sewer Reticulation at Ntuzuma B Attention : Mr D. Naidoo	Your Ref No. : 233-19 Our Ref No. : 47497 Date Reported : 02.10.2019
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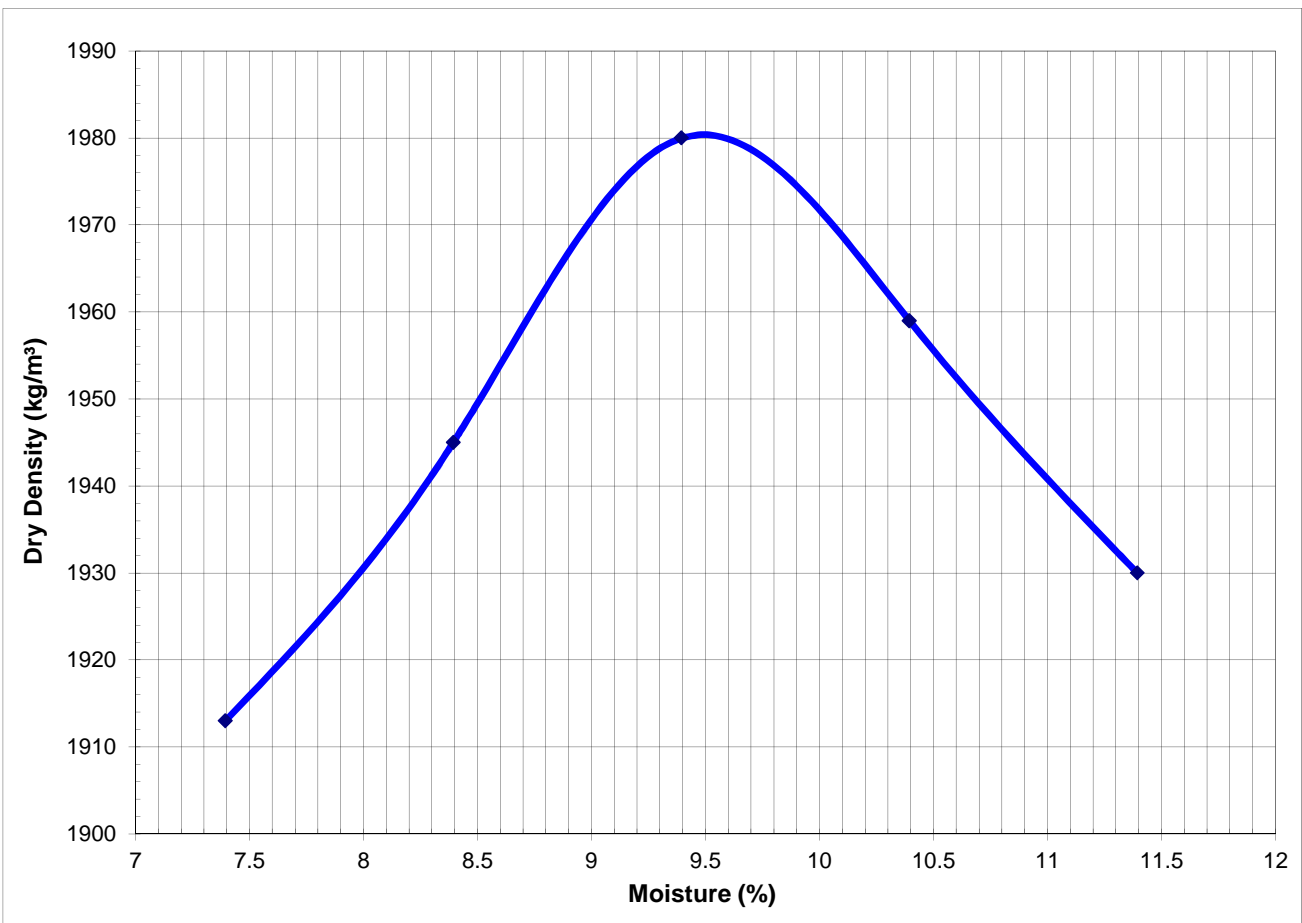
SANS 3001 Moisture/Density Relationship

Sample No. : T22082 Method of preparation : Scalped Natural/Stabilised : Natural Material Description : Gr.Br.to Br.clayey SAND to sandy CLAY. Colluvium Compaction Effort : Mod AASHTO	Field No. : IP19 Depth (m) : 0.5-0.9 Origin : Layer 2
--	---

Maximum Dry Density (kg/m³) : 1980
Optimum Moisture Content (%) : 9.5

Plotted Values:

Moisture (%)	7.4	8.4	9.4	10.4	11.4
Dry Density (kg/m ³)	1913	1945	1980	1959	1930



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SANS 3001 Moisture/Density Relationship

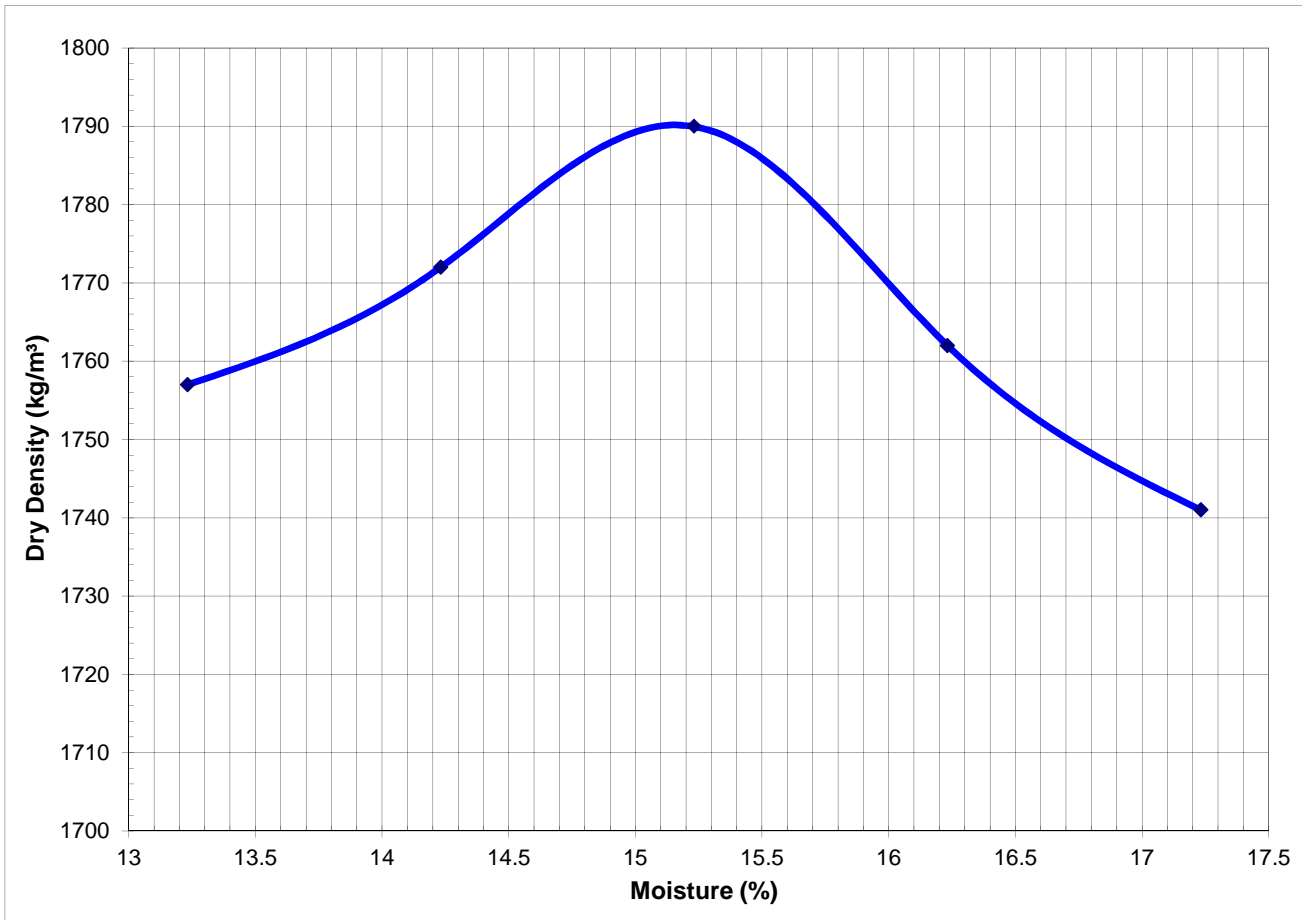
Sample No. : T22083	Field No. : IP20
Method of preparation : Scalped	Depth (m) : 0.7-0.9
Natural/Stabilised : Natural	Origin : Layer 2
Material Description : Gr.Br.Mott.Red.Br.sandy silty CLAY. Ferricrete	Compaction Effort : Mod AASHTO

Maximum Dry Density (kg/m³) : 1790

Optimum Moisture Content (%) : 15.1

Plotted Values:

Moisture (%)	13.2	14.2	15.2	16.2	17.2
Dry Density (kg/m ³)	1757	1772	1790	1762	1741



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Client : Geosure (Pty) Ltd
Project : Construction of Sewer Reticulation at Ntuzuma B
Attention : Mr D. Naidoo

Your Ref No. : 233-19
Our Ref No. : 47497
Date Reported : 03.10.2019

SANS 3001 Moisture/Density Relationship

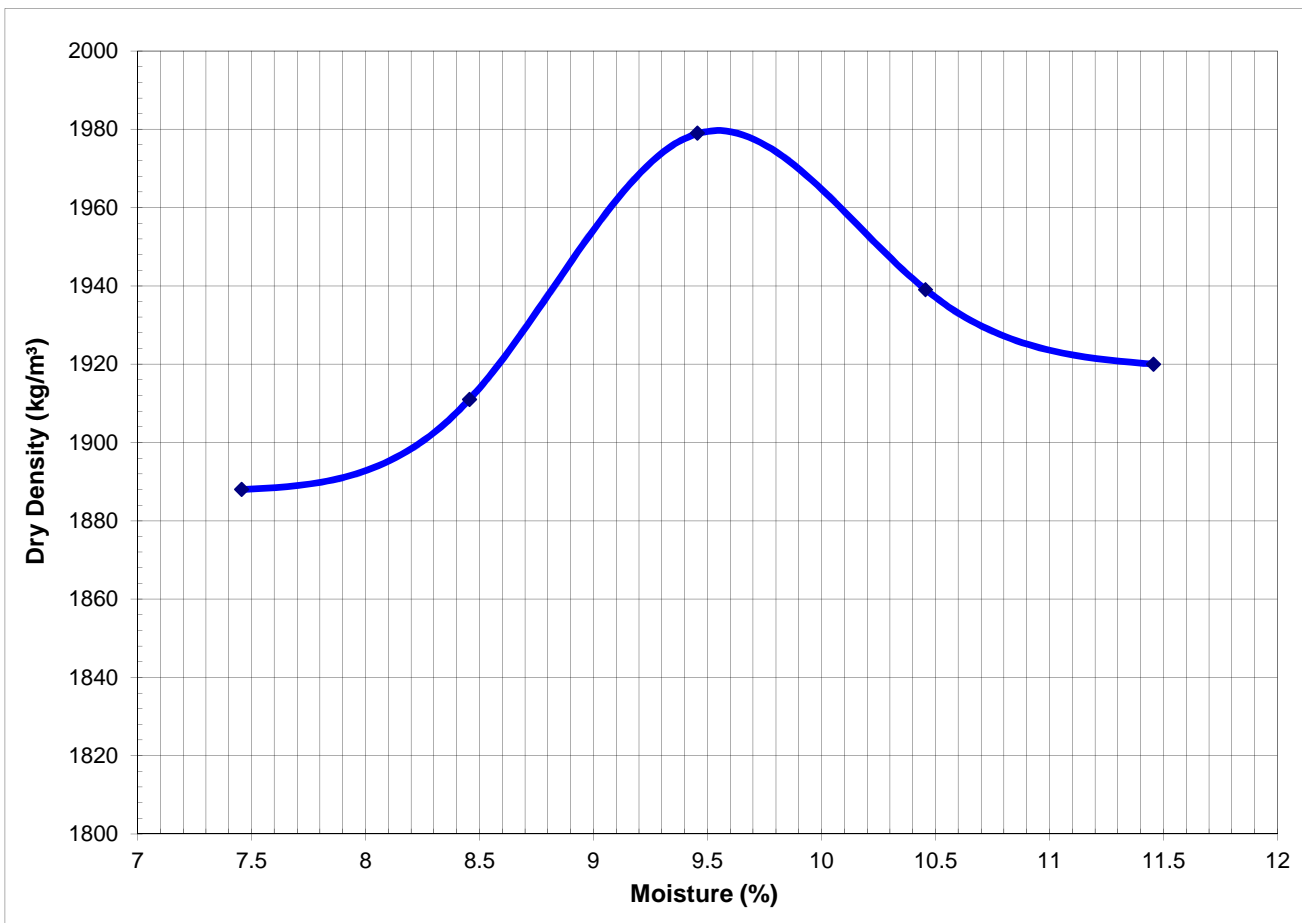
Sample No. : T22084 Field No. : IP23
Method of preparation : Scalped Depth (m) : 0.01-1.05
Natural/Stabilised : Natural Origin : Layer 1
Material Description : Gr.Br.Br.Gr.clayey SAND to sandy CLAY. Alluvium Compaction Effort : Mod AASHTO

Maximum Dry Density (kg/m³) 1980

Optimum Moisture Content (%) 9.6

Plotted Values:

Moisture (%)	7.5	8.5	9.5	10.5	11.5
Dry Density (kg/m ³)	1888	1911	1979	1939	1920



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SANS 3001 Moisture/Density Relationship

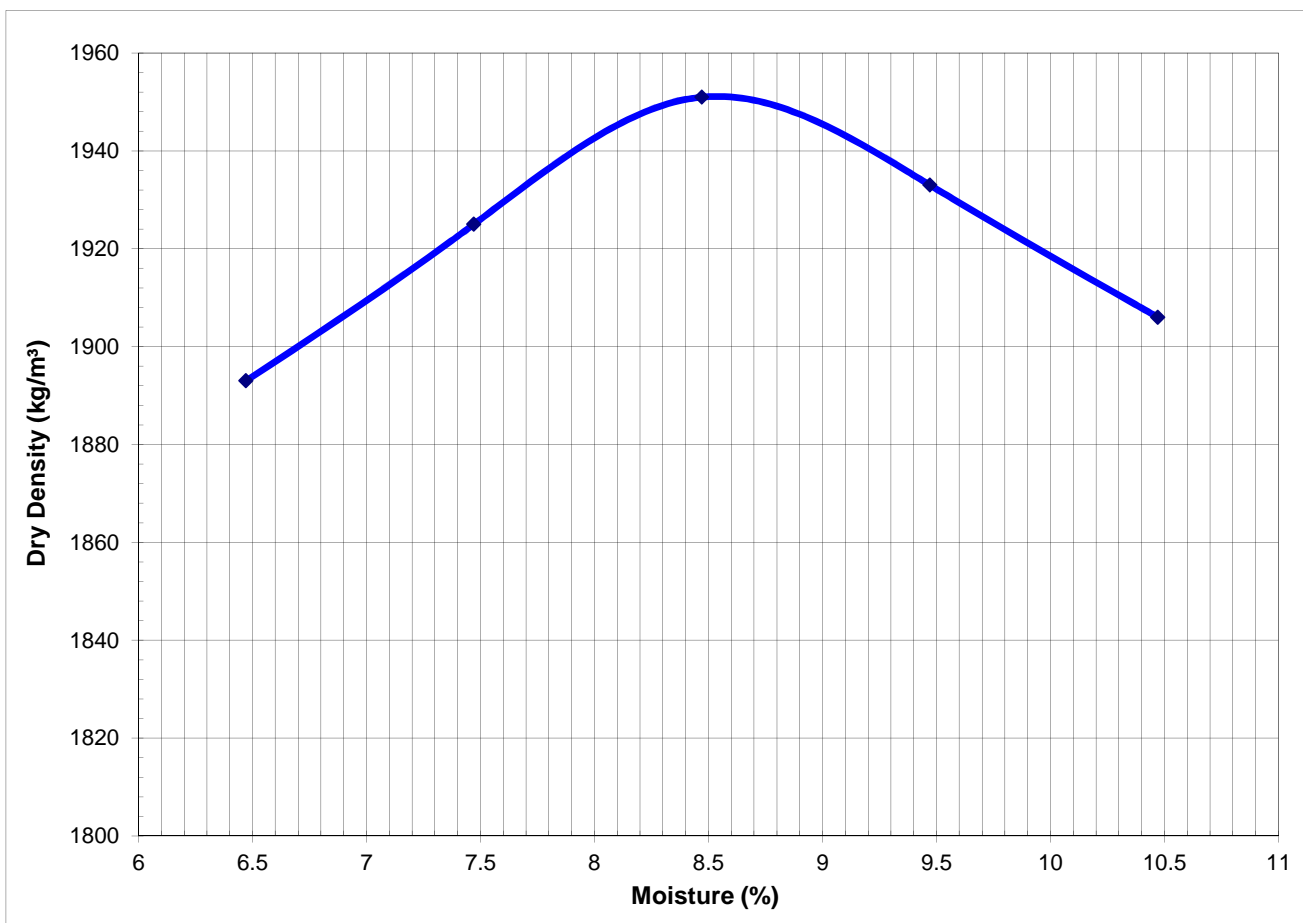
Sample No. : T22095 Field No. : IP35
Method of preparation : Scalped Depth (m) : 0.01-1.29
Natural/Stabilised : Natural Origin : Layer 1
Material Description : Gr.Br.Bec.Br.Gr.St.Khaki Br.clayey SAND to sandy Compaction Effort : Mod AASHTO

Maximum Dry Density (kg/m³) 1951

Optimum Moisture Content (%) 8.6

Plotted Values:

Moisture (%)	6.5	7.5	8.5	9.5	10.5
Dry Density (kg/m ³)	1893	1925	1951	1933	1906



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SANS 3001 Moisture/Density Relationship

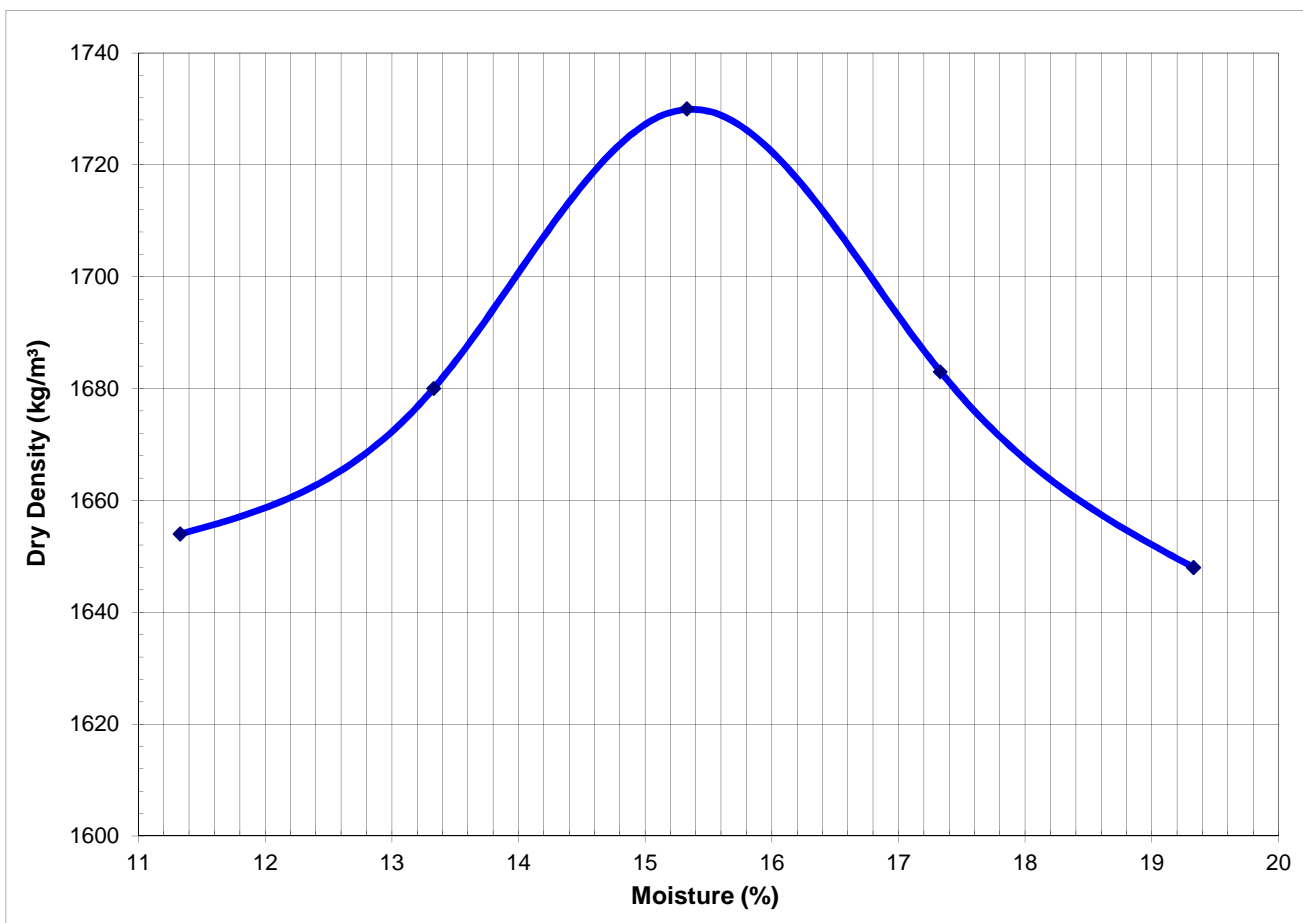
Sample No. : T22098 **Field No.** : IP40
Method of preparation : N/A **Depth (m)** : 1.12-2.5
Natural/Stabilised : Natural **Origin** : Layer 3
Material Description : Khaki Br.St.Gr.Or.Br.Hi.Wth.very soft to soft rock. T Compaction Effort : Mod AASHTO

Maximum Dry Density (kg/m³) 1730

Optimum Moisture Content (%) 15.3

Plotted Values:

Moisture (%)	11.3	13.3	15.3	17.3	19.3
Dry Density (kg/m ³)	1654	1680	1730	1683	1648



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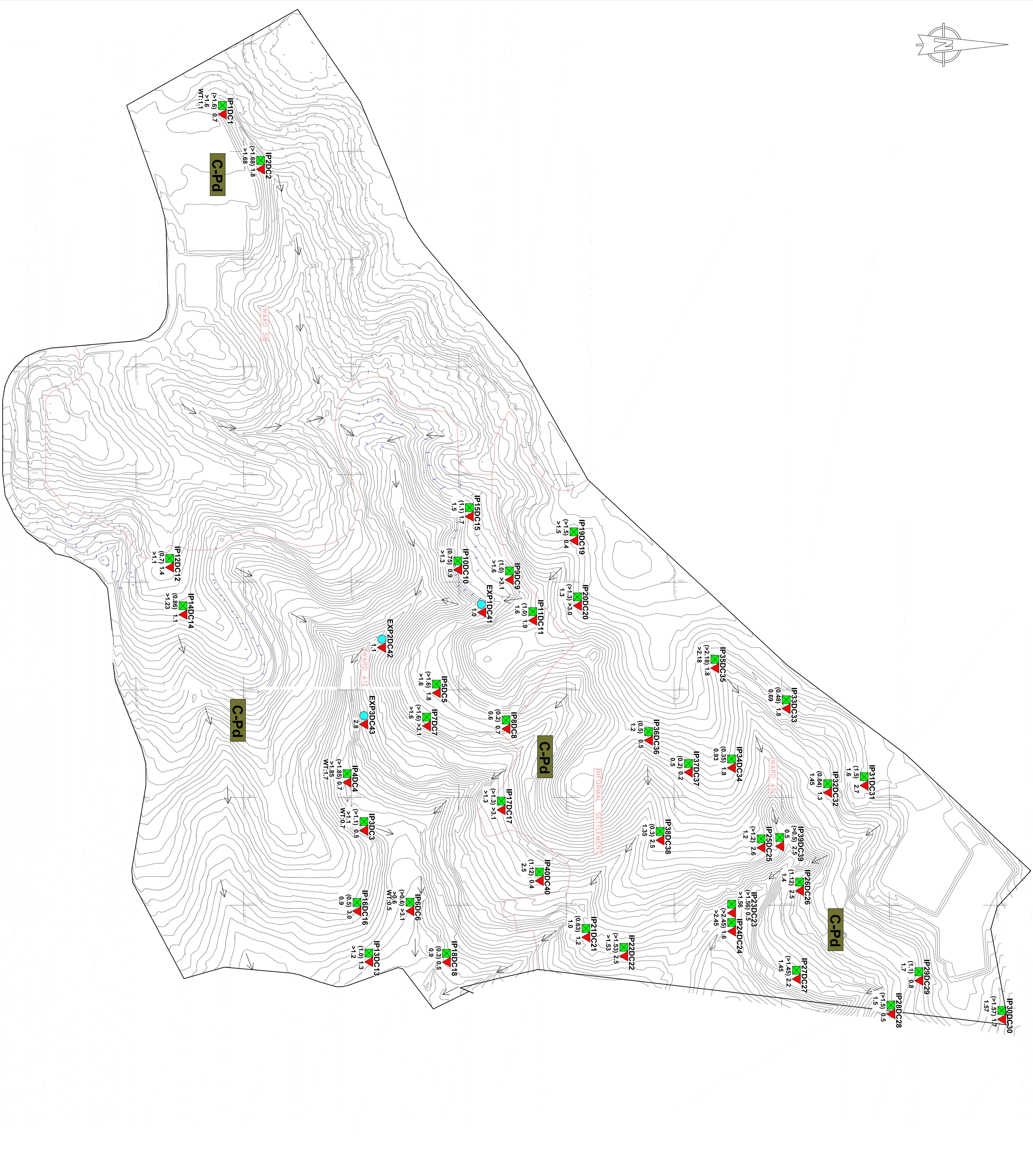
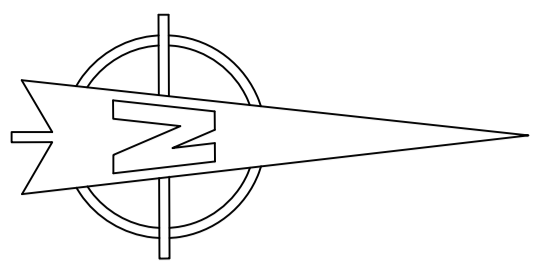


FIGURE 1



SITE PLAN





KEY:

- Outer limit of study area.
- Approximate position of Inspection Pit showing depth to bedrock (I) and depth to refusal in metres below existing ground level.
- Approximate position of CBR Dynamic Cone Penetrometer Test showing depth to refusal in metres below existing ground level.
- Denotes depth to ground water seepage in metres below existing ground level.
- Approximate position of Exposure Profile.
- Approximate alignment and direction of major drainage course.

KEY:

- Approximate area underlain by tillite and derived soils of Dwyka Group.

Site plan showing approximate positions of:

Inspection Pits:
 CBR Dynamic Cone Penetrometer (DCP) Tests:
 Exposure Profiles; and
 Major drainage courses.

SCALE 1:2500

0 25 50
 Metres

eThekweni Municipality
Water & Sanitation Unit
 Construction of Sewer Retention at Ntuzuma B
 Ward 38, 41 & 43 - Geotechnical Investigation

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DATE: 11-10-2019
 DRAWN BY: V.G
 CHECKED BY: S.R.F.S
 REFERENCE NO: 233-19

Figure 1