DRENNAN MAUD (PTY) LTD

GEOTECHNICAL ENGINEERS AND ENGINEERING GEOLOGISTS
Incorporating Drennan Maud & Partners (Est.1975) and GAP Consulting

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OUR REF.: 31843-2

YOUR REF

8th November 2017

IDM Consultants
P.O. Box 918
UMHLANGA ROCKS
4320

Attention : Mr K. Wiggishoff E-mail : karlw@idmconsultants.co.za

Dear Sir,

GEOTECHNICAL ASSESSMENT PROPOSED 'MKUZE LODGE 2' DEVELOPMENT, ZULULAND RHINO RESERVE

At the request of K. Wiggishoff of IDM Consultants, Drennan Maud (Pty) Ltd (DML) provided a proposal and quotation to carry out a geotechnical investigation for the proposed new Mkuze Lodge Development in the Zululand Rhino Reserve. An investigation proposal and cost estimate, Ref. 91 dated 22nd February 2017, was submitted to IDM Consultants and DML was subsequently appointed on the 28th February 2017 to undertake the investigation.

We confirm that we carried out an initial site inspection/preliminary geotechnical investigation together with yourselves, the Structural Engineer and the Architects on 3rd March 2017. A preliminary report was subsequently prepared and submitted to IDM Consultants via an email dated 13th March 2017.

The proposed lodge position has subsequently been changed and a second geotechnical assessment/investigation on the proposed second lodge site, 'Mkuze Lodge 2' was carried out on the 10th October 2017.

Set out below are the findings of the investigation, an assessment of the results and recommendations for the proposed development.

1. INFORMATION SUPPLIED AND PROPOSED DEVELOPMENT

1.1 Information supplied to DML included the relevant site and location plans and Surveyor's drawing for the proposed development. The drawings supplied include:

- A Google place mark showing the position of the site on a satellite image.
- A survey plan of the site, titled New Proposed Lodge Mkuze, Overall Site Plan (Alternative Site) Drawing № MKH-01-03 prepared by Joe De Villiers Architect.
- A drop box link giving various plans and reports relevant to the project.

The site plan showed the approximate locations of the proposed structures and was used to create the Site Plan in Drawing № 31843-01 attached.

1.2 Based of the abovementioned information it is apparent the proposed development is to comprise;

- the construction of a Main Lodge with associated outdoor facilities including a Boma and swimming pool, and five sleeper units, located on the South Western portion of the site adjacent to the existing dam.
- the construction of a Safari Lodge on the North Eastern portion of the site, with five sleeper units.

2. SITE DESCRIPTION

The site is located on the mid to lower central slopes of an approximately north south trending ridge, to the east of a southerly flowing small tributary of the Msunduzi River, which flows into the Msunduzi River at a distance of approximately 3.8 km to the south east of the site.

The stream tributary forms the lower south western boundary of the site, at which a small dam is located. The south eastern boundary of the site comprises a gravel road which forms part of the access to the Safari Lodge site located on the northern portion of the site.

The natural ground slopes in a south westerly direction at an angle of approximately 5° towards the small dam and the stream tributary, forming the lower western boundary of the site. However, adjacent to the stream, the slopes become steep, almost vertical, as stream banks, possibly as a result of scour from the stream. In addition, on the lower central western portion a small disused quarry is located.

Slope conformation is generally planar to slightly convex on the upper portions, but becomes planar to slightly concave, indicating the possible presence of deep clayey soils and subsoil seepage.

3. FIELDWORK

The fieldwork was carried out on the 10th October 2017 and consisted of the following:

- Limited Dynamic Cone Penetrometer (DCP) testing,
- Excavation of inspection pits,
- Materials sampling.

The approximate field test positions are indicated on Drawing № 31843-2-01 accompanying this report.

3.1 Excavation of Inspection Pits

A total of four inspection pits (IP1 to IP4) were excavated using a JCB 3CX Eco TLB in the approximate positions indicated on the attached site plan Drawing № 31843-2-01.

The inspection pits were positioned by Drennan Maud (Pty) Ltd, to be located in the general locations of the proposed development as indicated on the overall site plan supplied by the Architect.

The inspection pits were excavated to examine the subsoils at a shallow depth below the existing surface.

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

- For soil : Moisture condition, consistency, structure (where applicable), soil texture and origin.
- For rock : Colour, weathering, discontinuities, hardness and rock name.

The detailed inspection pit logs are presented in Appendix A of this report.

3.2 Dynamic Cone Penetrometer

A total of two Dynamic Cone Penetrometer (DCP) tests, designated DCP1 and DCP2, were carried out to obtain an indication of the consistency of the shallow soils underlying the site. The DCP tests were advanced to a maximum depth of 1.8 m below existing ground level (EGL) into medium dense to dense material.

The results of the DCP tests are graphically presented in Appendix B of this report.

Table 1 below is provided to aid in the interpretation of the DCP test results in terms of the inferred subsoil consistency. It must be noted that the table is based on the DML apparatus and should be used as a guide only as the advancement of the probe is dependent on a number of other factors including materials grain size and moisture content.

Table 1 : Guideline to Interpreting Drennan Maud's DCP Test Results

Non Cohesive Soils		Cohesive Soils	
Blows/300mm Penetration	**Subsoil Consistency**	**Blows/300mm Penetration**	**Subsoil Consistency**
<8	Very Loose	<4	Very Soft
8 - 18	Loose	4 - 8	Soft
19 - 54	Medium Dense	9 - 15	Firm
55 - 90	Dense	16 - 24	Stiff
>90	Very Dense	25 - 54	Very Stiff
		>54	Hard

3.3 Materials Sampling

A total of 4 representative samples of the various strata underlying the site were selected and taken to Thekwini Soils Laboratory in Durban for testing.

A schedule of the materials sampled on site and the testing carried out thereon is included in Table 2 below.

Table 2 : Schedule of Laboratory Testing

IP №	Material Description	Depth (m)	Laboratory Test
			Ind
IP1	Very slightly moist, dark grey brown, very slightly sandy, silty CLAY - (Colluvium)	0.2 -1.5	✔
IP2	Slightly moist, orange brown speckled very light grey, gravelly sandy CLAY - (Residual Basalt)	1.5 -1.8	✔
IP3	Highly weathered, soft rock, dark orange mottled yellow, very closely jointed BASALT - (Lebombo Fm)	0.3 - 1.2	✔
IP4	Very slightly moist, dark brown grey to very dark grey, silty CLAY - (Colluvium))	0.0 - 1.2	✔

The results of the laboratory tests are included in the Laboratory Test Summary and the Materials Analyses Test reports included in Appendix C, and are discussed further in Section 5.8 below.

4. SITE GEOLOGY

4.1 General Geology

The general location of the development, showing the regional geology from the 1:250,000 St Lucia geological plan, Plan № 27½ 32, is included herewith as Drawing № 31843-2-02.

The regional geology of the immediate area is dominated by Jurassic basaltic bedrock of the Letaba Formation of the Lebombo Group and the colluvial and residual soils derived therefrom.

4.2 Colluvial & Residual Soils

Observations on site indicate that the immediate upper colluvial soils comprise a dark grey and very dark grey, firm to stiff, fissured and shattered, slightly sandy silty clay. This colluvial material derived from the basalt is likely to be highly active and is sometimes referred to as cotton soils. The thickness of the colluvial soils varies from in the order of 500mm on the upper north eastern and central eastern portion of the site but increases in thickness significantly to in the order of 1.5m on the lower southern and south western portion in the position of IP1.

The colluvial soils overlie residual soils derived from the basalt which comprise orange brown, speckled dark brown, firm and slightly fissured, sandy silty clays that may contain some fine gravel derived from the underlying basalt. The residual soils generally occur on the lower central portion of the site and it may be in excess of 1m thick, as observed in the position of IP2.

4.3 Bedrock

The residual soils overlie the weathered basalt which occurs at a relatively shallow depth, less than 1m, on the upper northern and central portion of the site as intersected in IP3 and observed in the abandoned borrow pit to the west of IP1.

The weathered basalt comprises a dark grey stained orange on joints and a dark orange mottled light yellow, slightly weathered and highly weathered soft rock, closely and very closely jointed, very fine grained basalt. Hard excavation was encountered at a depth of 1.2m below the existing ground level in the position of IP3, and due to very close to closely jointed nature of the bedrock the basalt was recovered as a fine gravel.

Weathered bedrock was exposed in the stream bed downstream of the stream crossing below the existing dam south of the site.

4.4 Ground Water

No groundwater was intersected in any of the inspection pits. However, some seepage and groundwater may occur on the lower southern portion of the site adjacent to the existing stream and dam.

5. GEOTECHNICAL ASSESSMENT

5.1 General

5.1.1 In terms of the development proposals, the assessment was to determine the general geotechnical conditions on the site to be used in the planning for the Architect and the Environmental Consultant, and to provide the Design Engineers sufficient preliminary information for the founding and construction of the proposed structures.

In addition, a preliminary assessment for the feasibility of wastewater disposal was required.

5.1.2 Taking the above into consideration, the following are the aspects relevant to the proposed development;

- The suitability of the *in-situ* soils/bedrock for the founding of structures including the road and parking areas.
- The suitability of the *in-situ* subgrade materials for construction purposes.
- The suitability of the *in-situ* materials for the disposal of wastewater by means of subsoil percolation.

5.2 Soil Activity

Although the results from the grading analyses indicate that the soils have a low activity in terms of the Van Der Merwe's Classification, the results from the laboratory swell testing carried out on other sites in the clumsy area indicate that the residual and colluvial soils have relatively high swell potential of in the order of 2.5 to 5%.

In addition, examination of the subsoils in the inspection pits show both a shattered and slickensided structure of the clayey soils, indicating the active nature. As such, these materials are likely to undergo volume change with fluctuating moisture content (i.e swell when wet and shrink when dry). Furthermore, where located at subgrade level, achieving the required Mod AASHTO density through compaction of the clayey material may prove difficult if the materials optimum moisture content is exceeded (i.e. heaving may be encountered).

5.3 Founding Conditions

5.3.1 As the weathered bedrock occurs at a relatively shallow depth on the upper northern and north eastern portions of the site, easy founding of structures will occur on the site and should comprise either shallow column base foundations or strip foundations taken through all colluvial, residual materials to bear into firm weathered basaltic bedrock, at a depth likely to be less than 1m below the existing ground level.

5.3.2 From the drawings provided it is evident that the main lodge structures are to be located on the more gentle slopes adjacent to the dam and the stream forming the western boundary of the site. This area is likely to be underlain by colluvial and residual soils overlying the basalt bedrock that may attain thickness of in excess of 1m. From examination of the subsoils in the inspection pits, it is evident that the colluvial soils are shattered and slickensided indicating relatively high activity.

5.3.3 Based on the above we recommend that rigid structures are founded on column bases or strip footings taken into weathered bedrock, likely to be less then 3m below the existing ground level, or, for flexible structures, foundations must be taken into moisture stable subsoils at a minimum depth of in the order of 1.5m below the existing ground level. Maximum allowable bearing pressure should be restricted to 100 kPa.

5.4 Excavatability

5.4.1 Excavation through the colluvial and residual materials occurring on the site is expected to be easy.

5.4.2 Excavation through the basalt bedrock may however become soft to medium hard rapidly with depth and intermediate excavation at depths in excess of 3m is expected.

5.5 Groundwater Conditions

5.5.1 No groundwater is likely to occur on where the development is proposed. However, during periods of high rainfall groundwater seepage may occur at the contact between the colluvial soils and the residual soils and underlying weathered bedrock.

5.6 Slope Stability

5.5.1 The existing stream bank and dam bank is considered over steep and appears to be undermined during periods of flooding such that there is evidence of collapse of the existing bank.

5.7 Waste Water Disposal

5.7.1 The disposal of sewage in remote areas is problematic in that there are no major treatment plants in the areas to accept sewage either through a piped reticulation system or by tanker truck from a conservancy tank, and on site disposal is the only option. Two alternatives therefore exist, these being;

- Sub surface system (septic tank and french drain)
- Package treatment plant (package treatment plant)

5.7.2 *Sub Surface System*

Subsoil disposal is environmentally the preferred option. However, it is dependent on the soils being suitable and is preferred for relatively small volumes. Percolation testing is currently being undertaken by IDM Consultants.

5.7.3 *Package Treatment Plant*

Package treatment plants are available from various suppliers/manufacturers. These are however generally more suitable to larger types of developments.

5.8 Materials Suitability

5.8.1 Four samples of the materials occurring on site were selected for laboratory testing. Based on the results it is evident that both the colluvial and residual materials have high clay contents with the colluvial soils having a clay content of between about 57 and 61% and the residual materials having a clay content of in the order of 37%. These materials classify as A-7-6 materials in terms of the Revised US Classification and are not suitable for use as subgrade or bulk fill material given their likely generally high clay content.

5.8.2 The weathered basaltic bedrock classifies as an A-2-7 material in terms of the Revised US Classification and is considered suitable as subgrade and can be used as lower and upper selected layers below road and building platforms. It is likely that this is the material that was previously extracted from the abandoned borrow pit.

5.8.3 No materials occurring in the area are likely to be suitable for use as upper selected layers (G6/G7), subbase (G5) and base material (G2/G3) and these materials will need to be imported to site from a local commercial quarry source.

6. RECOMMENDATIONS

6.1 Location of Structures

6.1.1 From the site inspection and the examination of the Google satellite image and the plans provided it is evident that the preliminary siting of the proposed two lodges and accommodation units of the proposed development, on the upper slopes of the area and the lower sloes overlooking the dam is likely to be satisfactory with the structures being underlain by weathered bedrock and stiff residual colluvial soils.

6.1.2 However, prior to the final siting of the structures we consider it essential that an assessment of the slope geometry and limit of the proposed development to the edge of the stream bank and dam is undertaken. In addition a detailed flood analysis should be carried out to determine the limit of the location of the structures in terms of the 1:100 year flood level or any other requirements of the environmentalists.

6.2 Founding

6.2.1 Based on our assessment on site it is consided that founding of the structures on shallow strip footings or column base foundations is likely to be possible on the upper and central portion of the site. Both strip footings and column base footings should be taken into the weathered basaltic bedrock. On the lower portion of the site, any rigid structure should be founded on strip or column base foundations taken into the weathered bedrock at depth. Flexible structures may be founded on column bases taken into stiff subsoils, that are likely to be colluvial or residual basaltic soils, taken to a minimum depth of 1.5m below the current ground level.

6.3 Earthworks

In terms of the above proposals and the general gently sloping nature of the site, we consider it likely that only minor earthworks will be required to accommodate the new proposals. Notwithstanding this, general recommendations with regard to earthworks are given below.

6.3.1 *Cuts*

Where cutting is proposed the following recommendations apply;

- All permanent cut slopes into the silty and clayey colluvial and residual basalt materials should be restricted to a maximum of 1:2 (26°). The maximum height of any cut slope should not exceed 3.00m without being assessed by the Engineer.

- All permanent cut slope batters into the slightly and highly weathered, closely and very closely jointed, bedrock shale should be sloped to a maximum batter of 1:1.5 (33°). Temporary cut banks during construction may be laid back to a slope batter of ranging between 1:1.5 (33°) and 1:1 (45°) depending on the materials exposed in the cut.
- Should hard to medium hard weathered bedrock be encountered, cut slopes may be steepened to 1:1 (45°) or steeper at the discretion of the Engineer.
- All cut embankments must be protected against surface erosion by the incorporation of suitable drainage and planting of vegetation immediately after construction.

6.3.2 ***Fills***

Where fill platforms have to be created the following recommendations apply;

- Prior to the placement of any fill the in-situ subsoil materials containing vegetation should be removed.
- The fills should be constructed layers a maximum of 300mm loose thickness and be compacted to 93% of the materials Max Mod AASHTO Density, for suitable material, likely to be imported onto site, as the in-situ materials are not considered suitable for bulk for fill, below the proposed structures.
- The maximum particle size within the fill should be restricted to two thirds of the layers loose thickness.
- Permanent fill batters should be no steeper than 1:2 (26°) and should in general not exceed a maximum vertical height of about 3m.
- Where these batter angles cannot be accommodated, lateral support may be required.

6.4 Slope Stability

6.4.1 As indicated above, a detailed geotechnical assessment needs to be undertaken to determine the effects of construction on the edge of the stream bank or dam.

6.5 Services

6.5.1 Due to the likely presence of colluvial/residual soils overlying the weathered bedrock it is likely that it will be possible to bury all the services in the positions of the proposed development.

6.6 Waste Water Disposal

6.6.1 As indicated in Section 5.7 above, the most practical means of waste water disposal on a remote site is a sub surface system such as a septic tank french drain system.

6.6.2 Although not likely to be ideal due to the clayey soil cover in the area of the proposed development, from our site assessment it appears that a suitable area for waste water disposal by subsoil percolation, with a suitable evapotranspiration area, is likely to occur on the slopes to the north east of the proposed main lodge development. It will therefore be necessary to pump effluent to this area.

6.6.3 Once the development proposals are finalised and details of the lodge uses are available detailed design of the wastewater disposal system must be carried out.

7. CONCLUSION

Based on the results of the preliminary geotechnical assessment carried out of the site we consider that the proposed development of two lodges and associated facilities on the site is feasible.

As the terrain in the area of proposed development is topgraphically slight to moderate and the area is underlain at a relatively shallow depth by stiff soils, conventional structural development comprising shallow founding on normal strip or column base foundations is considered feasible.

In addition, we consider it feasible to use a septic tank and french drain system for the effective and efficient disposal of effluent for the development, provided the system is correctly constructed and placed, in terms of the recommendations given once the details of the development have been made available.

It should be noted that this report is a preliminary report outlining the concept and feasibility of the development and a detailed geotechnical assessment may be required prior to final design and during the development of the site.

We trust that this meets with your immediate requirements in this matter and will be pleased to furnish you with any further information you may require.

Yours faithfully
DRENNAN MAUD (PTY) LTD

M.J. HADLOW Pr.Sci.Nat.

Encls.	Appendix A	-	Inspection Pit Logs
	Appendix B	-	DCP Test Results.
	Appendix C	-	Laboratory Test Result
	Drawing № 31843-2-01	-	Site Plan
	Drawing № 31843-2-02	-	Geological Plan

/mh/kc

APPENDIX A

INSPECTION PIT PROFILES
(IP 1 - IP 4)

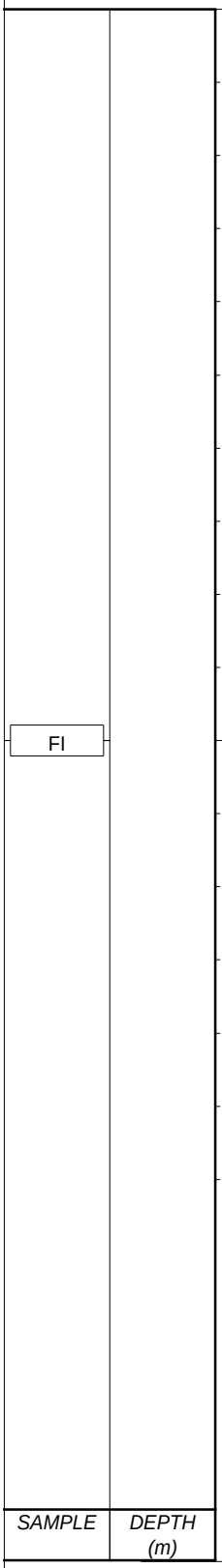
DRENNAN MAUD (PTY) LTD

Geotechnical Engineers & Engineering Geologists

IDM Consultants
Mkuze Lodge 2, Zululand Rhino Reserve

HOLE No: **IP 1**
Sheet 1 of 1

JOB NUMBER: **31843**



SAMPLE	DEPTH (m)	
	0.00	Very slightly moist, very dark brown grey occasionally speckled orange brown, firm to stiff, sandy silty CLAY containing root material - (Colluvium)
	0.20	
	0.20	Very slightly moist to dry, very dark grey brown, stiff, fissured and slickensided, very slightly sandy silty CLAY - (Colluvium)
FI	1	
	1.50	
	1.50	Very slightly moist to slightly moist, dark grey speckled orange brown, firm, slightly fissured, slightly sandy and gravelly silty CLAY - (Residual Basalt)
	1.60	

NOTES

1) End of hole

2) Sample 1 taken between 0.20 – 1.50m

CONTRACTOR : NA
MACHINE : TLB
DRILLED BY : NA
PROFILED BY : MJH

TYPE SET BY : kc
SETUP FILE : DMPSP.SET

INCLINATION : NA
DIAM : NA
DATE : NA
DATE : 11 October 2017

DATE : 08/11/17 11:38
TEXT : ..C:\DOTIN\SPMASTER.DOC

ELEVATION :
X-COORD :
Y-COORD :

HOLE No: **IP 1**

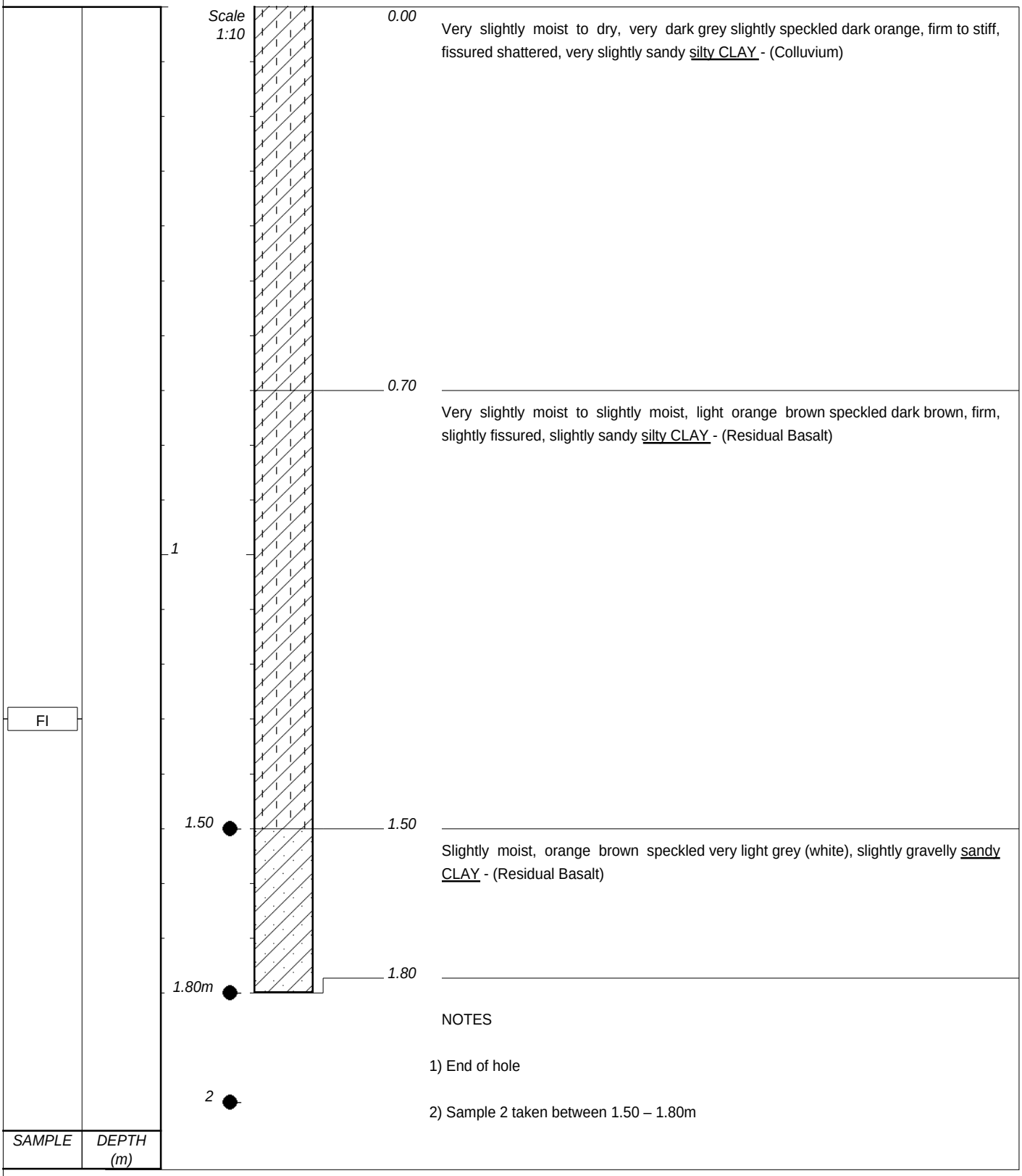
DRENNAN MAUD (PTY) LTD

Geotechnical Engineers & Engineering Geologists

IDM Consultants
Mkuze Lodge 2, Zululand Rhino Reserve

HOLE No: IP 2
Sheet 1 of 1

JOB NUMBER: 31843



CONTRACTOR : NA
MACHINE : TLB
DRILLED BY : NA
PROFILED BY : MJH

INCLINATION :
DIAM : NA
DATE : NA
DATE : 11 October 2017

ELEVATION :
X-COORD :
Y-COORD :

HOLE No: IP 2

TYPE SET BY : kc
SETUP FILE : DMPSP.SET

DATE : 08/11/17 11:38
TEXT : ..C:\DOTIN\SPMASTER.DOC

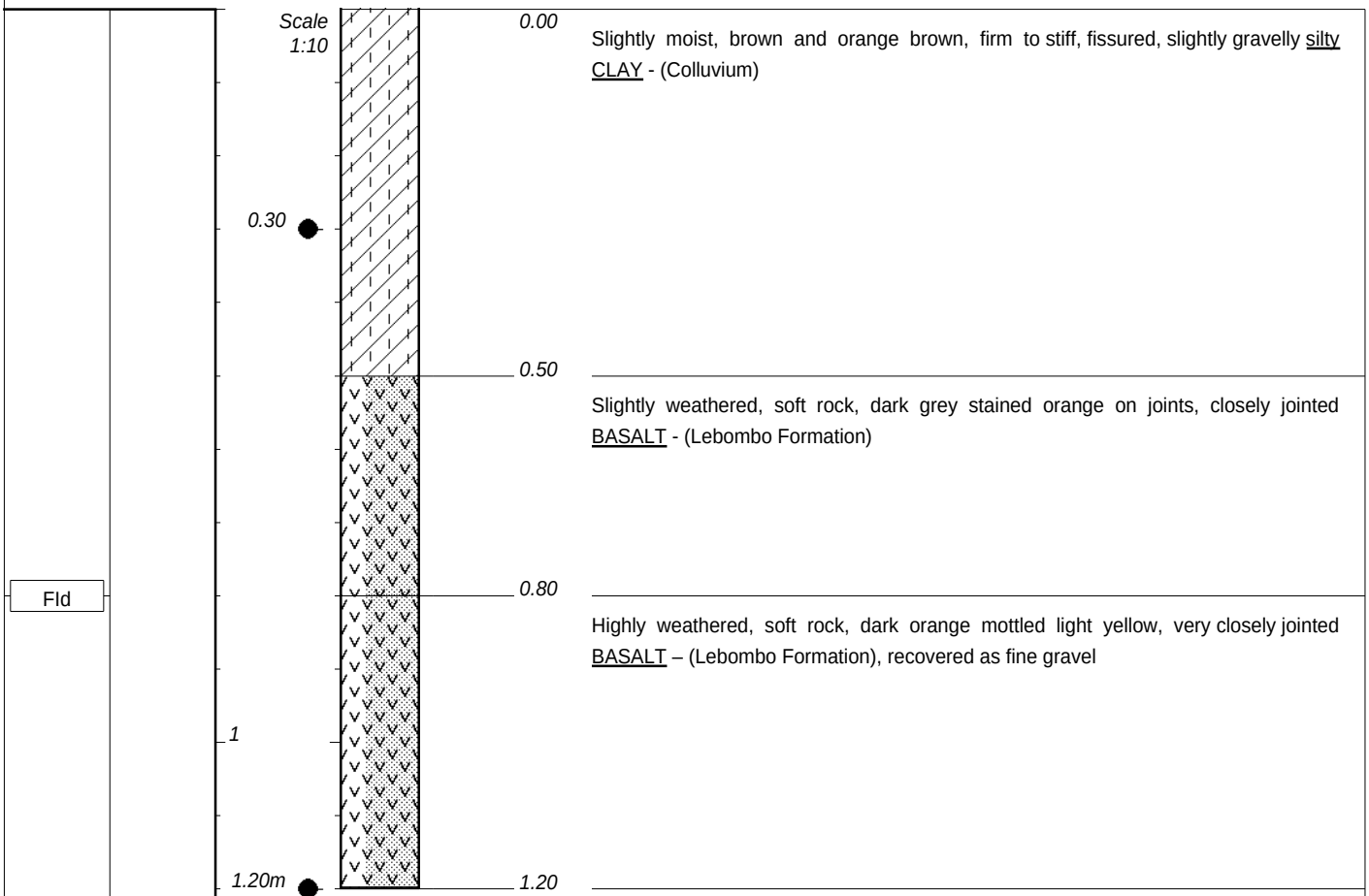
DRENNAN MAUD (PTY) LTD

Geotechnical Engineers & Engineering Geologists

IDM Consultants
Mkuze Lodge 2, Zululand Rhino Reserve

HOLE No: IP 3
Sheet 1 of 1

JOB NUMBER: 31843



Slightly moist, brown and orange brown, firm to stiff, fissured, slightly gravelly silty CLAY - (Colluvium)

Slightly weathered, soft rock, dark grey stained orange on joints, closely jointed BASALT - (Lebombo Formation)

Highly weathered, soft rock, dark orange mottled light yellow, very closely jointed BASALT – (Lebombo Formation), recovered as fine gravel

NOTES

1) End of hole

2) Sample 3 taken between 0.30 – 1.20m

SAMPLE	DEPTH (m)

CONTRACTOR : NA
MACHINE : TLB
DRILLED BY : NA
PROFILED BY : MJH

TYPE SET BY : kc
SETUP FILE : DMPSP.SET

INCLINATION :
DIAM : NA
DATE : NA
DATE : 11 October 2017

DATE : 08/11/17 11:38
TEXT : ..C:\DOTIN\SPMASTER.DOC

ELEVATION :
X-COORD :
Y-COORD :

HOLE No: IP 3

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IDM Consultants
Mkuze Lodge 2, Zululand Rhino Reserve

HOLE No: **IP 4**
Sheet 1 of 1

JOB NUMBER: **31843**

Scale 1:15

0.00

Very slightly moist becoming slightly moist, dark brown grey becoming very dark grey occasionally mottled light yellow grey and brown, firm, fissured shattered silty CLAY - (Colluvium)

1

FI *1.30m*

2

2.40

NOTES

1) End of hole

2) Sample 4 taken at 1.30m

SAMPLE

CONTRACTOR : NA
MACHINE : TLB
DRILLED BY : NA
PROFILED BY : MJH

TYPE SET BY : kc
SETUP FILE : DMPSP.SET

INCLINATION :
DIAM : NA
DATE : NA
DATE : 11 October 2017

DATE : 08/11/17 11:38
TEXT : ..C:\DOTIN\SPMASTER.DOC

ELEVATION :
X-COORD :
Y-COORD :

HOLE No: **IP 4**

APPENDIX B

DYNAMIC CONE PENETROMETER TEST RESULTS (DCP 1 - DCP 2)

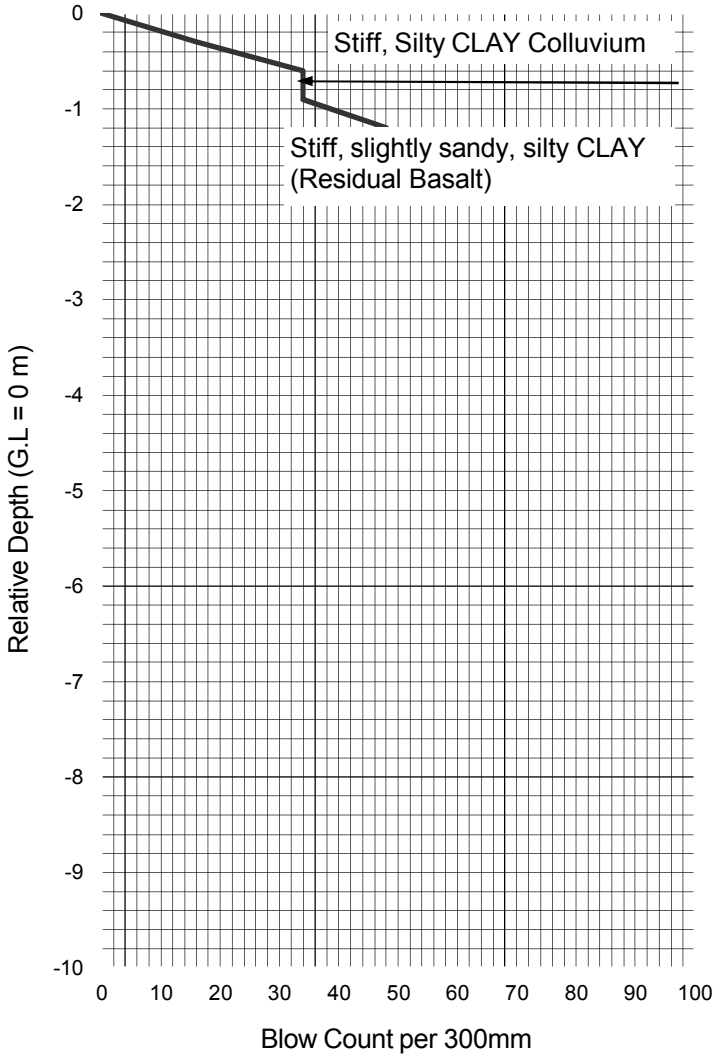
Dynamic Cone Penetrometer

Test No. : 1

Project : **Mkuze Lodge 2**
Client: **IDM Consultants**
Date: 07-11-2017 Remarks: At IP 2
Test Location: Zululand Rhino Reserve -
Date of Test: 11 -10-2017 Depth Interval (m) : 0.3

Depth (m)	Count Blows/0.3m
0	0
-0.3	16
-0.6	34
-0.9	34
-1.2	48

Blow Count vs Depth



Reference No. : 31843-2

Drennan Maud (Pty) Ltd.

Fig. No. 2

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

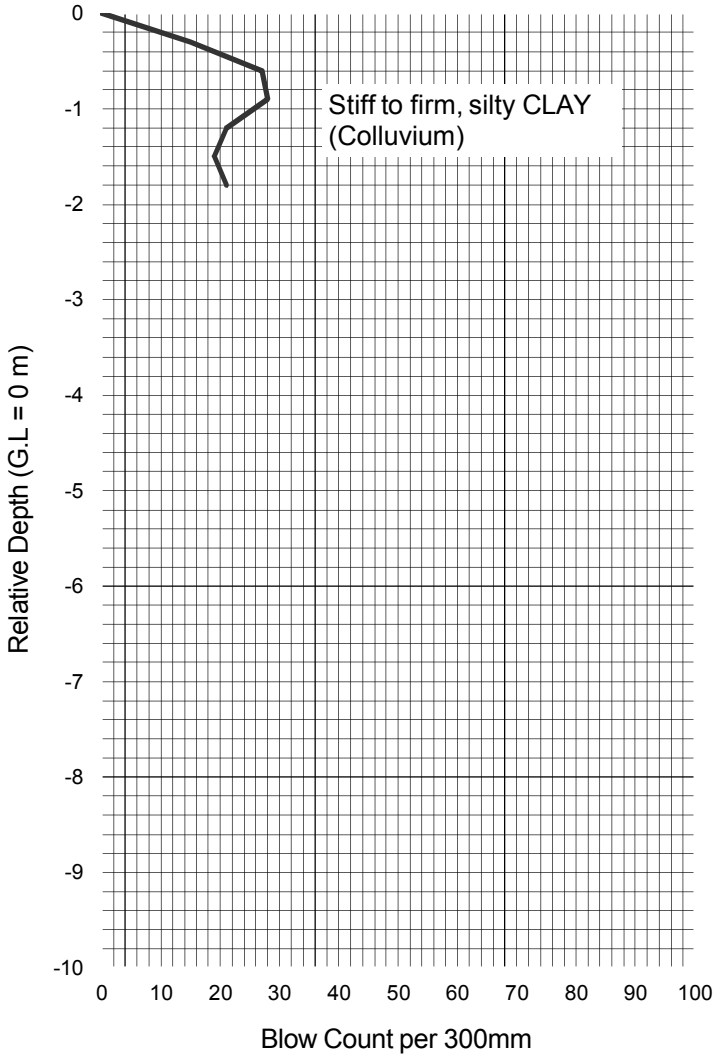
Dynamic Cone Penetrometer

Test No. : 2

Project : **Mkuze Lodge 2**
Client: **IDM Consultants**
Date: 07-11-2017 Remarks: At IP4 -
Test Location: Zululand Rhino Reserve -
Date of Test: 11 -10-2017 Depth Interval (m) : 0.3

Depth (m)	Count Blows/0.3m
0	0
-0.3	15
-0.6	27
-0.9	28
-1.2	21
-1.5	19
-1.8	21

Blow Count vs Depth



Reference No. : 31843-2

Drennan Maud (Pty) Ltd.

Fig. No. 3

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

APPENDIX C

LABORATORY TEST RESULTS

Laboratory Test Summary

THEKWINI SOILS LAB. CC
V.A.T. REGISTRATION NO. 4590210961.
68 Ridge Road, Tollgate, DURBAN
Tel : (031) 201-8992
P.O. Box 30464, MAYVILLE, 4058
Fax : (031) 201-7920

Job Description: Mkhuze Logde - 2
Job no.: 8540
Date: 18-10-2017

Lab no.			10017	10018	10019	10117						
Location			IP.1	IP.2	IP.4	IP.3						
Depth			0.2 - 1.5	1.5 - 1.8	1.3	0.3 - 1.2						
Description			Colluvium	Residuum	Colluvium	Basalt						
			-	-	-	-						
Binder Material			-	-	-	-						
Partide Size (mm)	75	Cumulative % Passing										
	53											
	37.5					100						
	26.5					82						
	19			100		71						
	13.2			88		51						
	9.5		100	82	100	36						
	4.75		100	75	99	15						
	2		99	68	98	7						
	0.425		94	62	97	5						
	0.25		91	60	96	4						
	0.15		88	59	94	4						
	0.075		82	56	90	4						
Hydrometer	0.05	% Passing	80	53	85							
	0.02		74	49	74							
	0.005		61	41	62							
	0.002		54	36	55							
Soil Mortar	Coarse Sand <2.0 >0.425mm	% Passing	4.8	9.5	1.5	35.9						
	Fine Sand <0.425>0.05mm		19.0	42.4	14.6	61.5						
	Silt <0.05 >0.005		18.6	10.8	23.2							
	Clay <0.005		57.6	37.4	60.6							
Atterberg Limits	Liquid Limit % (m/m)		52	63	70.9	43.5						
	Plasticity Index		16.12	24.4	33	13						
	Linear Shrinkage %		12	14.7	16.7	9.3						
	Natural MC %		-	-	-	-						
Mod AASHTO Density	Dry Density kg/m^3											
	OMC %											
CBR	100% MDD											
	98%											
	95%											
	93% (Inferred) *											
	90%											
	CBR Swell (%)											
AASHTO Soil Classification *			A - 7 - 5 (16)	A - 7 - 5 (13)	A - 7 - 5 (37)	A - 2 - 7 (0)						
Grading Modulus			0.25	1.14	0.15	2.84						
TRH 14 (1985) *												

Technical Signitory: .....

TEST REPORT

MATERIALS ANALYSIS

THEKWINI SOILS LAB. CC
V.A.T. REGISTRATION NO. 4590210961.
68 Ridge Road, Tollgate, DURBAN
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P.O. Box 30464, MAYVILLE, 4058
Fax : (031) 201-7920

Project: Mkhuze Logde - 2

Ref no.: 8540 **Lab no.:** 10017 **Borehole/Pit no.:** IP.1
Description: Colluvium

Depth: 0.2 - 1.5 -

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

Grading Analysis	
Grain Size (mm)	%Passing
75	100.0
53	100.0
37.5	100.0
26.5	100.0
19	100.0
13.2	100.0
9.5	100.0
4.75	99.7
2	98.6
0.425	93.9
0.25	91.1
0.15	87.5
0.075	82.2
0.05	80.1
0.02	73.8
0.005	60.5
0.002	54.3

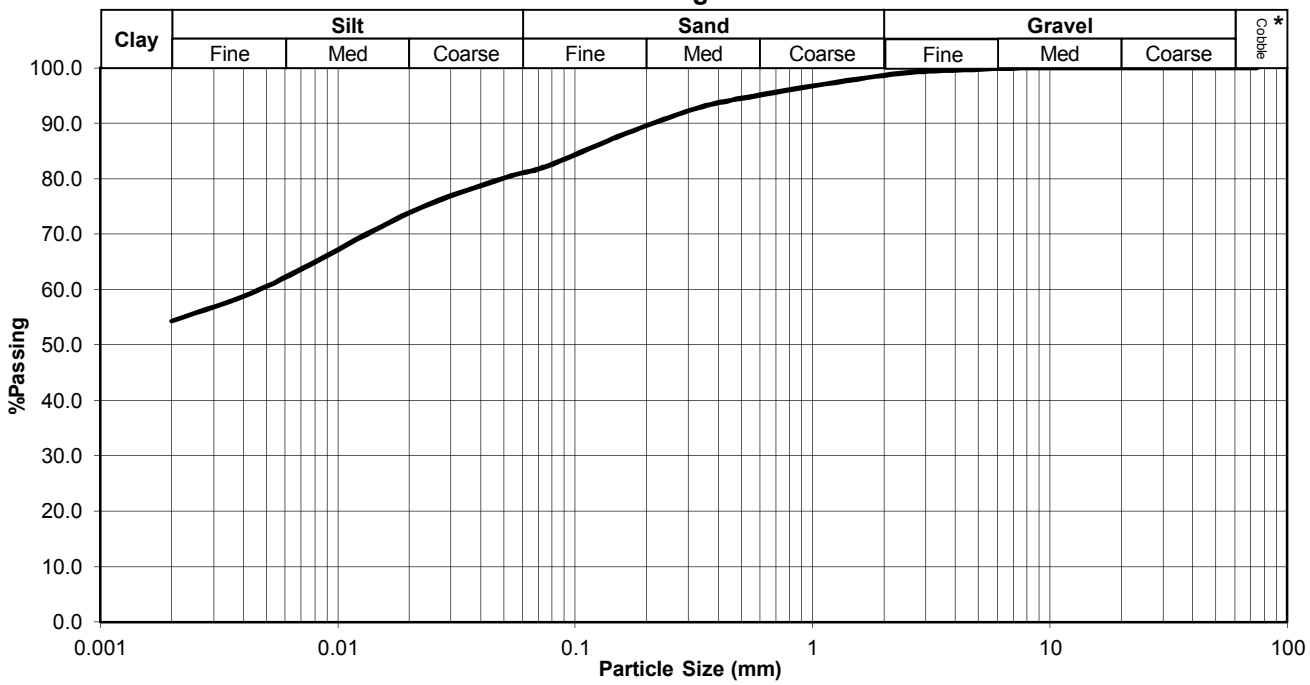
M.I.T SIZE CLASSIFICATION *	
Cobble%	0.0
Gravel%	1.4
Coarse	0.0
Medium	0.2
Fine	1.1
Sand%	17.7
Coarse	4.2
Medium	5.2
Fine	8.4
Silt%	26.6
Coarse	7.1
Medium	12.4
Fine	7.1
Clay%	54.3

PLASTICITY	
Liquid Limit, %	52
Plasticity Index	16.12
Linear Shrinkage, % (L/L)	12

GRADING	
D10 Size (mm)	<0.002
Uniformity Coefficient	*
Grading Modulus	0.25

CLASSIFICATION *	
Potential Expansiveness	Low
Group Index	16
AASHTO Soil Classification	A - 7 - 5
Unified Classification	MH or OH

Grading Curve



Ref no.: 8540 Fig no.: -

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Fax : (031) 201-7920

Project: Mkhuze Logde - 2

Ref no.: 8540 **Lab no.:** 10018 **Borehole/Pit no.:** IP.2
Description: Residuum

Depth: 1.5 - 1.8 -

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

Grading Analysis	
Grain Size (mm)	%Passing
75	100.0
53	100.0
37.5	100.0
26.5	100.0
19	100.0
13.2	88.4
9.5	82.4
4.75	75.4
2	68.0
0.425	61.5
0.25	60.1
0.15	58.5
0.075	56.0
0.05	53.2
0.02	48.9
0.005	41.3
0.002	35.6

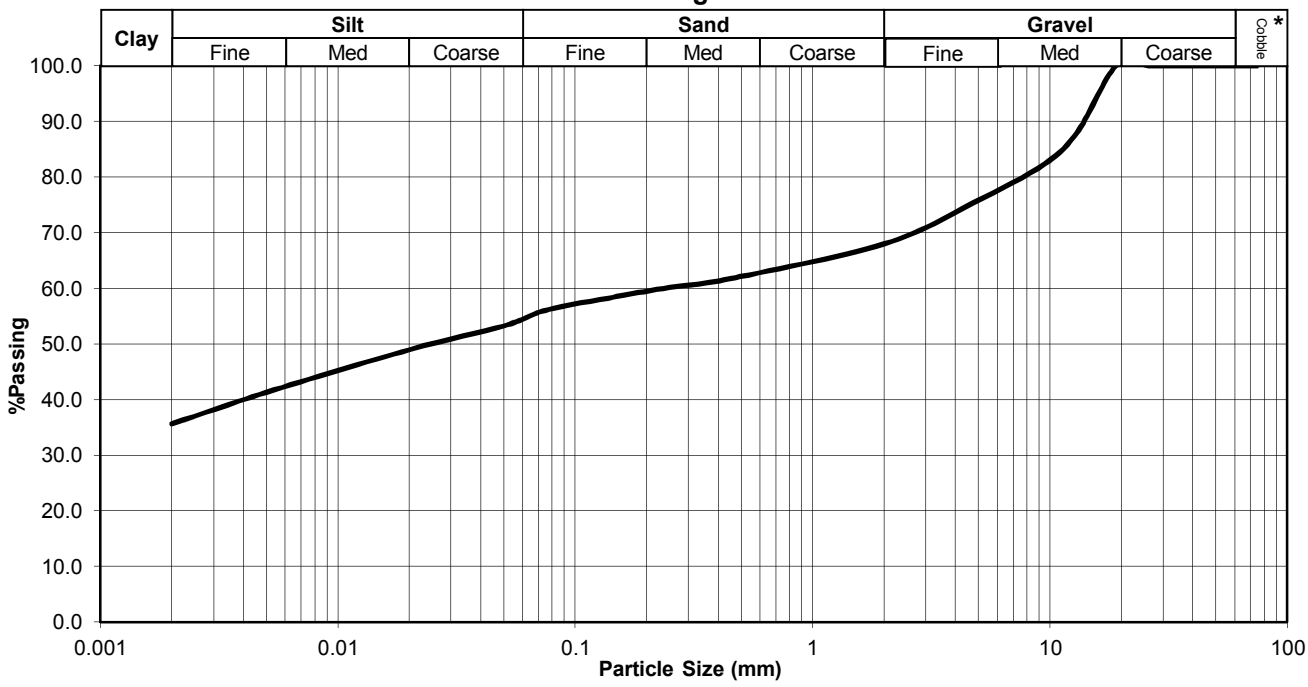
M.I.T SIZE CLASSIFICATION *	
Cobble%	0.0
Gravel%	32.0
Coarse	0.0
Medium	22.8
Fine	9.2
Sand%	13.6
Coarse	5.7
Medium	2.9
Fine	5.0
Silt%	18.7
Coarse	5.4
Medium	7.2
Fine	6.2
Clay%	35.6

PLASTICITY	
Liquid Limit	63
Plasticity Index	24.4
Linear Shrinkage	14.7

GRADING	
D10 Size (mm)	<0.002
Uniformity Coefficient	NA
Grading Modulus	1.14

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

Grading Curve



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Fax : (031) 201-7920

Project: Mkhuze Logde - 2

Ref no.: 8540 **Lab no.:** 10019 **Borehole/Pit no.:** IP.4
Description: Colluvium

Depth: 1.3 -

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

Grading Analysis	
Grain Size (mm)	%Passing
75	100.0
53	100.0
37.5	100.0
26.5	100.0
19	100.0
13.2	100.0
9.5	100.0
4.75	99.1
2	98.3
0.425	96.8
0.25	95.7
0.15	94.0
0.075	89.7
0.05	85.1
0.02	73.8
0.005	61.5
0.002	54.7

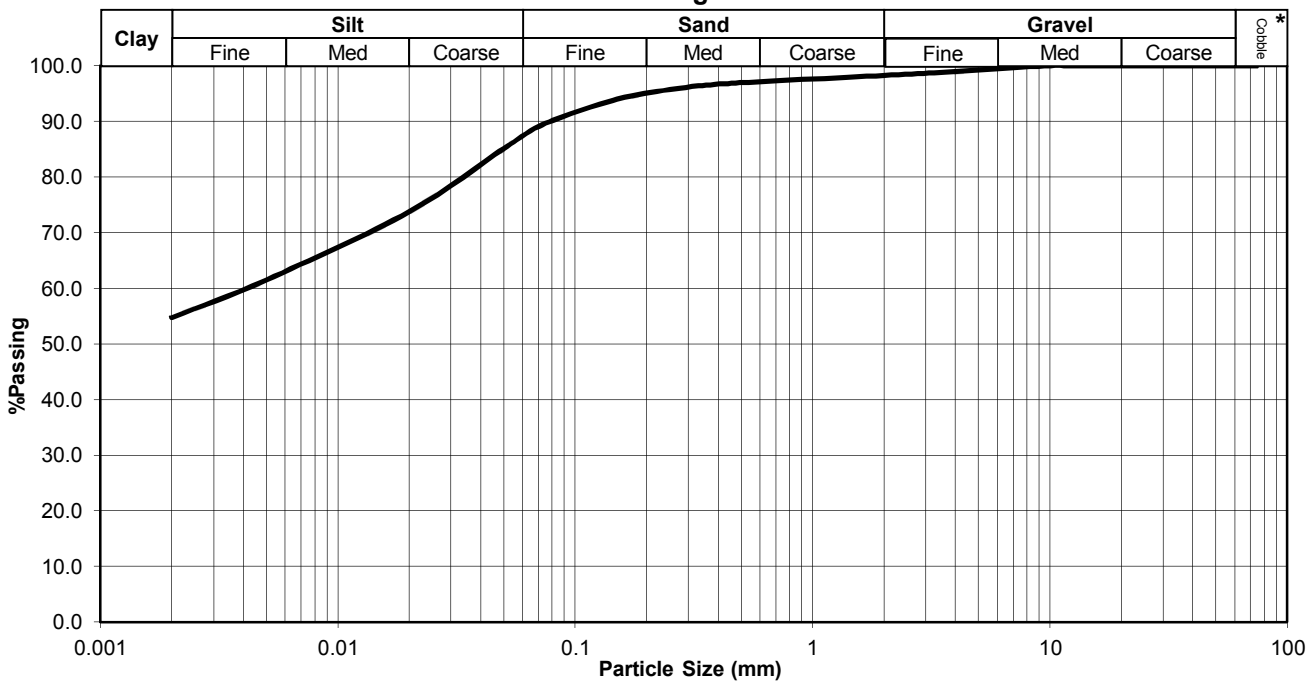
M.I.T SIZE CLASSIFICATION *	
Cobble%	0.0
Gravel%	1.7
Coarse	0.0
Medium	0.6
Fine	1.1
Sand%	11.3
Coarse	1.3
Medium	2.1
Fine	7.9
Silt%	32.2
Coarse	13.2
Medium	11.4
Fine	7.6
Clay%	54.7

PLASTICITY	
Liquid Limit	70.9
Plasticity Index	33
Linear Shrinkage	16.7

GRADING	
D10 Size (mm)	<0.002
Uniformity Coefficient	NA
Grading Modulus	0.15

CLASSIFICATION *	
Potential Expansiveness	High
Group Index	37
AASHTO Soil Classification	A - 7 - 5
Unified Classification	MH or OH

Grading Curve



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Fax : (031) 201-7920

Project: Mkhuze Logde - 2

Ref no.: 8540 **Lab no.:** 10117 **Borehole/Pit no.:** IP.3
Description: Basalt
Depth: 0.3 - 1.2 -

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

Grading Analysis	
Grain Size (mm)	%Passing
75	100.0
53	100.0
37.5	100.0
26.5	82.4
19	70.9
13.2	51.3
9.5	35.8
4.75	15.4
2	7.3
0.425	4.7
0.25	4.5
0.15	4.3
0.075	4.1
0.05	4.1
0.02	
0.005	
0.002	

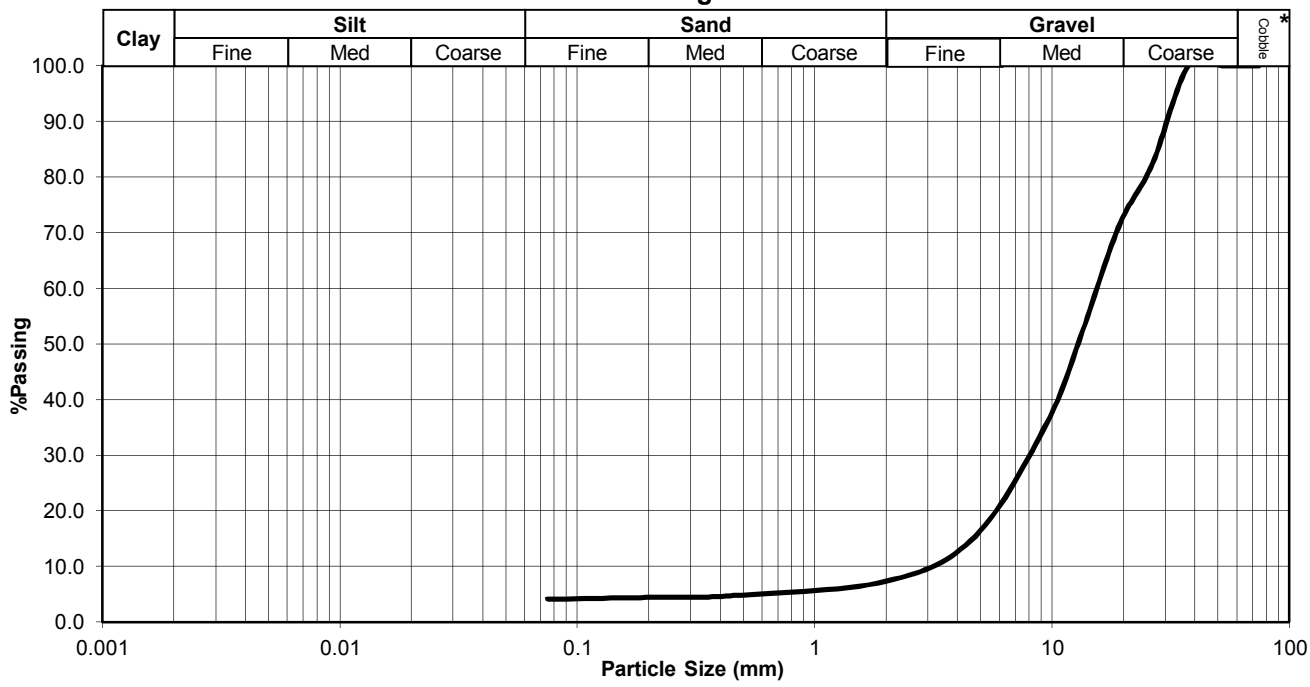
M.I.T SIZE CLASSIFICATION *		
Cobble%		0.0
Gravel%	92.7	
Coarse		27.6
Medium		51.7
Fine		13.5
Sand%	3.2	
Coarse		2.3
Medium		0.6
Fine		0.3
Silt%	0.0	
Coarse		
Medium		
Fine		
Clay%		

PLASTICITY	
Liquid Limit	43.5
Plasticity Index	13
Linear Shrinkage	9.3

GRADING	
D10 Size (mm)	
Uniformity Coefficient	0.00
Grading Modulus	2.84

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

Grading Curve



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DRAWING № 31843-2/01

SITE PLAN

DRAWING № 31843-2/02

GEOLOGICAL PLAN