



GEOTECHNICAL INVESTIGATION REPORT FOR THE ACCESS CULVERT TO ALEXANDRIA MOTSELENG PRIMARY SCHOOL AT ALEXANDRIA, BUSHBUCKRIDGE WITHIN THE EHLANZENI DISTRICT MUNICIPALITY OF THE MPUMALANGA PROVINCE

FINAL REPORT

Prepared by

Phezulu Geotechnical Civils

Prepared for

Lihuzu Projects (Pty) Ltd

Date

May 2021

Project Ref

21-406





DISCLAIMER

This geotechnical report was prepared by **Phezulu Geotechnical Civils** solely for **Lihuzu Projects (Pty) Ltd.** As the results, **Phezulu Geotechnical Civils** is bound by the confidentiality agreement that the information of this report will not be reproduced or circulated without **Lihuzu Projects (Pty) Ltd** consent. Its existence may not be communicated with any third party, nor its contents published in any way without the prior written approval of **Lihuzu Projects (Pty) Ltd.**

Prepared by	Phezulu Geotechnical Civils		
Prepared by	F. Mahlatji <i>On Behalf of: Phezulu Geotechnical Civils</i>	Geologist	
Revised and approved by	G. Ndlela <i>On Behalf of: Phezulu Geotechnical Civils</i>	Pr. Sci. Nat., MSAIEG - Reg. No. 400162/11	
Under the directive of	Mr. X.R Nhlabathi <i>On Behalf of: Phezulu Geotechnical Civils</i>	Technical Director	



Contents

Contents	iii
1. INTRODUCTION	1
2. SCOPE OF THE WORK	1
3. NATURE OF THE INVESTIGATION	1
4. AVAILABLE INFORMATION	2
5. GENERAL DESCRIPTION OF SITE	2
5.1. Site location and size	2
5.2 Topography and drainage	3
5.2 General site description and existing facilities	4
5.3 Site geology	4
6 INVESTIGATION RESULTS	5
6.1 Excavation of test pits	5
6.1.1 Generalized soil profiles	6
6.1.2 Groundwater occurrence	7
6.2 DPL test	7
7 LABORATORY TEST RESULTS	8
7.0 GEOTECHNICAL EVALUATIONS	10
7.1 Groundwater seepage and runoff	10
7.2 Excavatability and workability of the material	10
5.4 Estimated compressibility and settlements	10
5.5 Sinkholes or subsidence	10
6 FINAL CONCLUSIONS AND RECOMMENDATIONS	11
10.0 REFERENCES	12

Table of Figures

Figure 1: Ga Phooko Internal Street Locality Map	3
Figure 2 : Ga Phooko geological map	5
Figure 3: Test Pits positions	6

Table of Tables

<i>Table 1: Test pits summary</i>	6
<i>Table 2: Shear strength values per DPL test</i>	7
Table 3: Lab Results Summary	8
<i>Table 4 : Soil classification related to plasticity index, (Van Der Merwe, 1964)</i>	9

Table 5 : Activity based classification of clays (Van Der Merwe, 1964) 9

Table 4: II. Moisture/Density and CBR..... 9

Appendices:

Appendix A: Maps

Appendix B: Soil profiles and profile photos

Appendix C: DPL (Dynamic Probe Light)

Appendix D: Laboratory Results



1. INTRODUCTION

In accordance with your authorization, **Phezulu Geotechnical Civils** has completed the centerline investigation for the proposed access culvert to Alexandria Motseleng Primary School within the Bushbuckridge Local Municipality of the Mpumalanga Province. Recommendations with respect to site preparation, excavation, backfilling, and road structure, are addressed. The recommendations herein have been prepared in accordance with the current guidelines and specifications regulated by the geotechnical division of the South African Institution of Civil Engineers (SAICE).

2. SCOPE OF THE WORK

Investigation was carried out in accordance with guidelines and specification regulated by the geotechnical decision of South African Institute of Civil Engineers (Code of Practice,2010), South African Pavement Engineering Manual (SANRAL).

The objectives of the geotechnical investigation included but not limited to:

- 🌐 Evaluate the geological and geotechnical conditions of the soils underlying the site,
- 🌐 Establish the soil profiles across the site and expected founding conditions,
- 🌐 Evaluate their engineering properties and suitability for the proposed development,
- 🌐 Highlighting any problem soils, slope stability or drainage issues,
- 🌐 Assess the groundwater conditions, including surface run off possibilities, seepage, ponding, and note the occurrence of any perched or permanent water tables.
- 🌐 Determining the suitability of the site for the proposed development and make recommendations for the design earthwork, beddings, and backfilling.
- 🌐 Evaluate the workability of the site materials with regard to their excavatability and compactability and propose possible remedial processes for the existing stab.

3. NATURE OF THE INVESTIGATION

The geotechnical site investigation involved excavating a total of **4 trial pits** with a TLB to a maximum of 2m or refusal, soil profiling, soil sampling for laboratory tests and conducting DPL test.



Soil samples were collected for the following laboratory tests:

- 🌐 Road indicator test
- 🌐 MOD/CBR/ Indicator tests (Determine the suitability for possible road pavements material use),

4. AVAILABLE INFORMATION

The following maps and/or plans were available for reference purposes and are reproduced in this report:

- 🌐 Google Earth® imagery maps,
- 🌐 1:250 000 Geological maps of the area: **2430 Pilgrim's Rest**,
- 🌐 Topographical sheet, raster image 2530,
- 🌐 South African National Standards: Geotechnical investigations for township development (SANS 634:2012),
- 🌐 South African Pavement Engineering Manual (SANRAL).

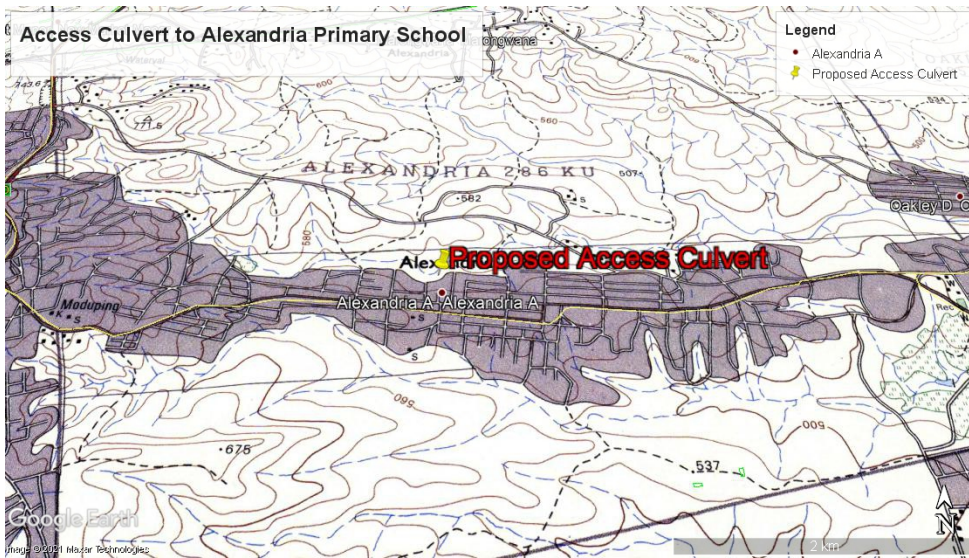
5. GENERAL DESCRIPTION OF SITE

5.1. Site location and size

The study area for this investigation is located at **Alexandria**, Bushbuckridge Local Municipality, Ehlanzeni District Municipality, Mpumalanga, South Africa. The area is approximately **26km** North east of Bushbuckridge town. **The culvert will be** located at the following absolute coordinates: Latitude **-24.956053°** and Longitude **31.162117°**. See figure 1 on the next page.



Locality Map



Access Culvert to Alexandria Motseleng

Primary School

Prepared For:

Lihuzu Projects (Pty) Ltd

Prepared By:

Phezulu Geotechnical Civils

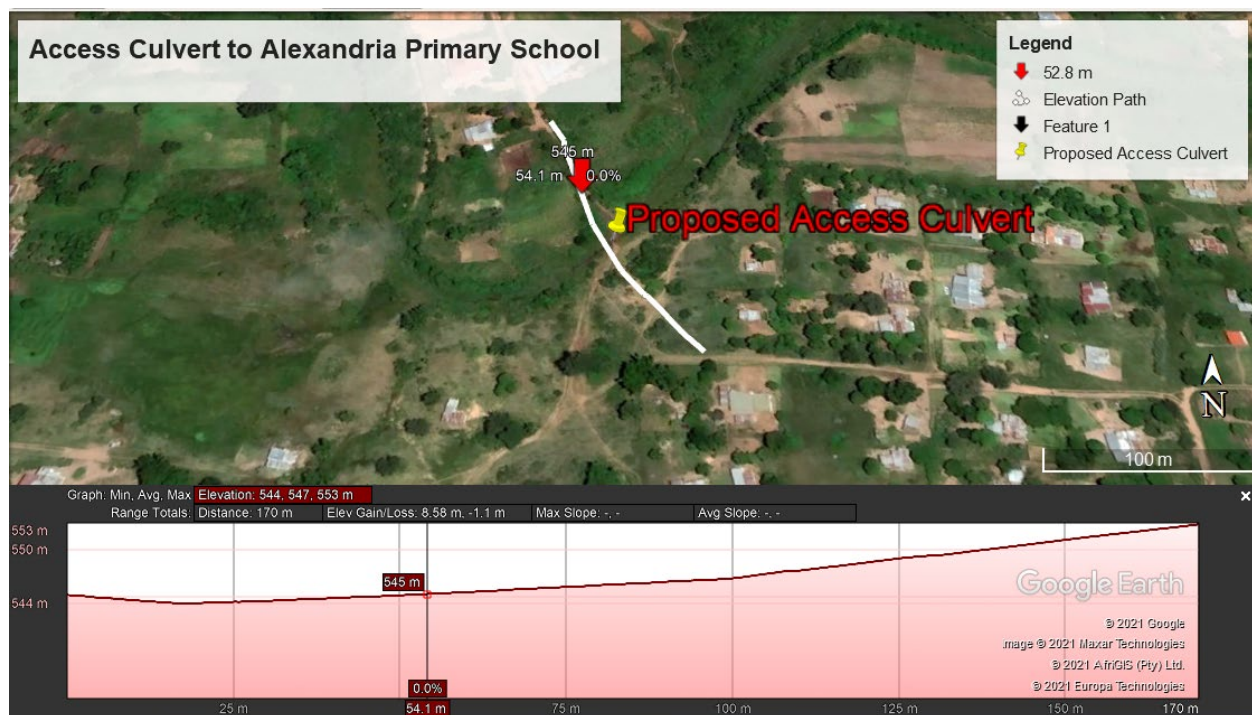


12 Suikeriet Street, Mbombela, 1200, South Africa



Figure 1: Access Culvert Locality Map

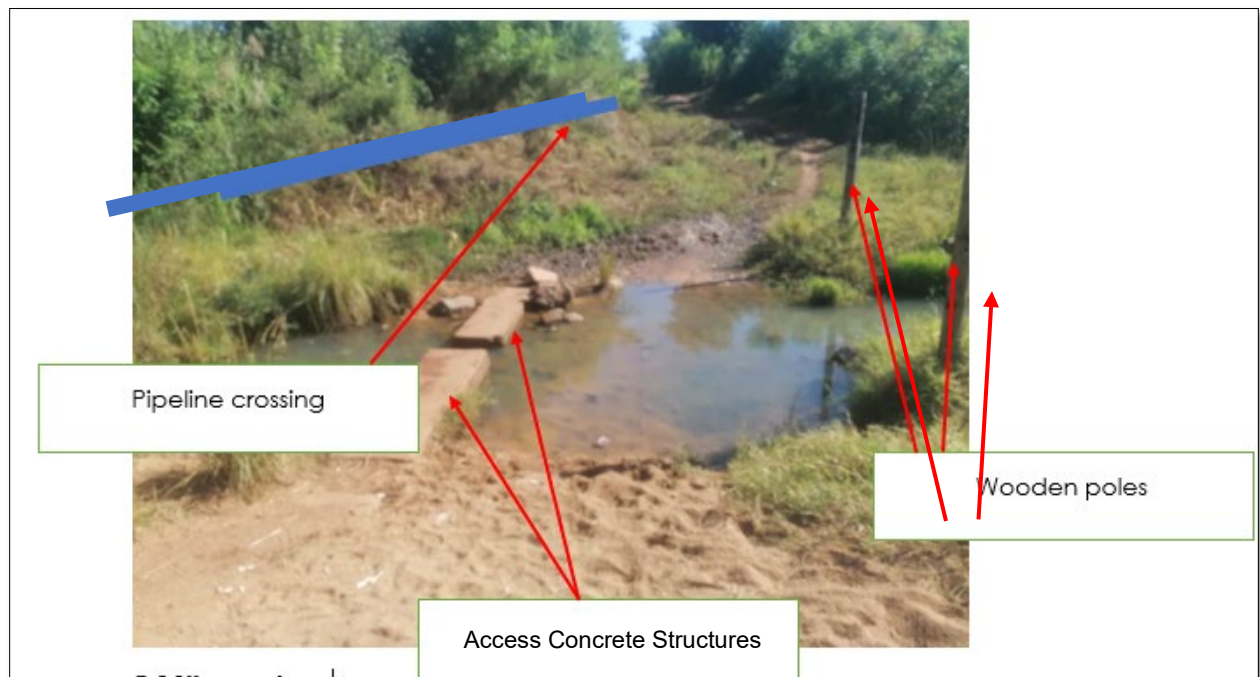
5.2 Topography and drainage



The site elevation is ranging from approximately **544 to 553m** above the mean sea level. The area drains towards the north east into the **Bejani river** that feeds into the Sabie river.

5.2 General site description and existing facilities

Minor masonry used as access to cross a river was found on site as well as 2 setting wooden poles pipeline passing through the stream was observed on site, no existing culvert or remainders found.



5.3 Site geology

According to the published 1:250 000 **2430 pilgrims rest** geological map and the 1:250 000 of **South African Geological Map**. The area is sitting on the Potassic Gneiss of the Nelspruit Suite.

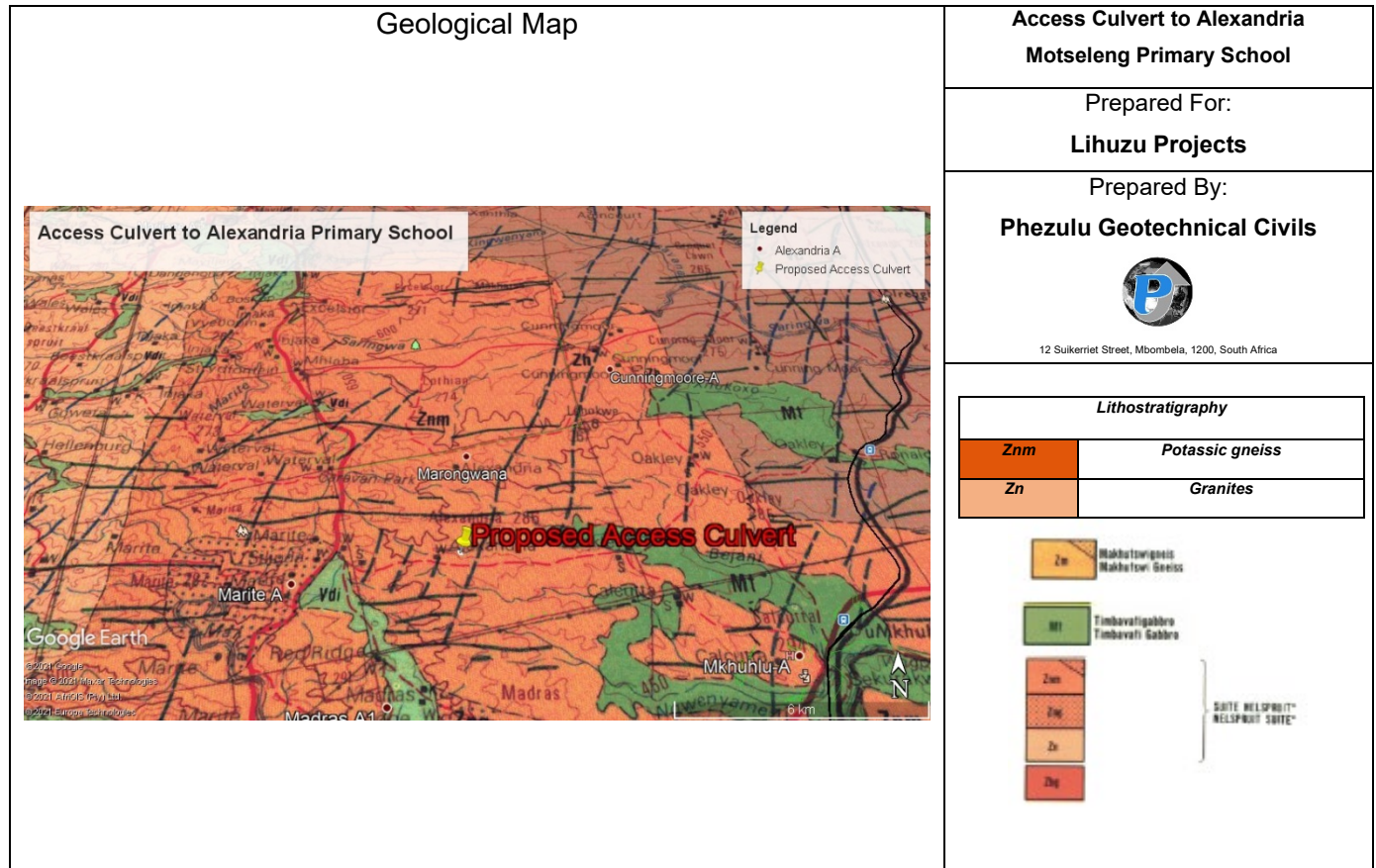


Figure 2 : Alexandria Motseleng Primary School geological map

6 INVESTIGATION RESULTS

6.1 Excavation of test pits

The subsurface investigation comprised of the excavation of **4 test pits**. All trial pits coordinates were recorded using a handheld GPS, the position of test pits was placed with respect to site layout and in such a manner that covers the whole site. The trial pits were excavated to the depth of refusal of the TLB (**CAT 428E Backhoe**) or refusal on a bedrock.

Each trial pit was profiled and photographed by field engineering Geologist in accordance with the current MCCSSO standard procedures proposed by Brink and Bruin (2002). All the test pits are then backfilled and lightly compacted after completion of fieldwork.



Figure 3: Test Pits positions

6.1.1 Generalized soil profiles

Excavation of a total of four test pits, designated TP1 through to TP4 along the proposed area of the culvert, was carried out by means of a backhoe (CAT 428E). The test pits were carried out at the approximate positions shown on the map above and they were excavated to a maximum excavation depth of 2 meters below the existing ground level.

Descriptions of the various soil strata as encountered in the test pits are summarized on table 1 below and detailed soil profiles are given in appendix B.

	Alluvium	Upper Residual	Lower Residual
TP01	0.50	1.10	1.90
TP02	0.50	1.70	1.70+
TP03	0.40	1.60	1.60+
TP04	0.40	1.80	2.00

Table 1: Test pits summary

6.1.2 Groundwater occurrence

Ground water was encountered in all the pits.



Figure 4: Ground water

6.2 DPL (Dynamic Probe Light) test

A total of 4 DPL tests were carried out, 2 on the upstream side and 2 on the downstream side. The DPL tests were carried out to assess the bearing capacity of the insitu material, this was only possible up to a minimum depth of 0.9m and maximum of 1.8m (refusal depth) on the tests carried out closer to the stream. Detailed results are shown on the DPL results attached as appendix C. Table 2 below summarizes the in-situ shear strength values per 300mm depth.

Table 2: Shear strength values per DPL test

Depth (m)	DPL No.			
	1	2	3	4
In-Situ Shear Strength (kPa)				
0.3	150	285	70	55
0.6	80	65	45	<40
0.9	75	>300	220	45
1.2	55	REFUSAL	>300	150
1.5	85		REFUSAL	>300
1.8	>300			REFUSAL
2.1	REFUSAL			



7 LABORATORY TEST RESULTS

Laboratory tests were scheduled on soil samples recovered from the site. The following tests were carried out:

- Road Indicator tests (particle size distribution and Atterberg Limits), and
- Materials strength tests incorporating Modified AASHTO and California Bearing Ratio tests.

The summary of laboratory test results outlining Classification in Terms of the USPR system, Unified Soil Classification System and COLTO: 1998 is presented in Table 3 below and detailed results are included on Appendix D of this report. These tests permit a basic classification of the soils and group them according to typical engineering properties and evaluation of their suitability for use as backfilling materials.

Table 3: Lab Results Summary

PHEZULU GEOTECHNICAL CIVILS														GRAVEL, SOIL AND SAND ANALYSIS SUMMARY													
Client : Lihuzu Projects														Date :						05-May-2021							
Contract : Acces Culvert to Alexandria Motseleng Primary School																											
Position	Depth (m)	Sample No	Description	Sieve Analysis										Atterberg Limits				UCS / CBR					Classification				
				Cumulative percentage passing										GM	LL	PI	%LLS	100	97	95	93	90	Unified Soil	COLTO	US Highway	Group Index	
				50.0	37.5	25.0	19.0	13.2	4.75	2.00	0.425	0.075															
TP 1																											
TP 1	0.5-1.1	21406/1	dk Yel. Orange Well graded silty/clayey sand	100	96	93	89	82	69	55	23	8	2.14	24	6	2.5	71	48	37	28	18	sw/sm/sc	G6	A-1-b	0		
TP 2																											
TP 2	0.50-1.70	21406/2	dk Grey Inorganic clay					100	100	98	85	62	0.55	30	15	7.2	8	5	4	3	2	CL	+G9	A-6	7		
TP 3																											
TP 3	0.4-1.6	21406/3	lt Brown Poorly graded silty sand					100	96	87	22	11	1.80		NP	0	18	14	12	8	5	sp/sm	G9	A-1-b	0		
TP 4																											
TP 4	0.4-1.8	21406/4	lt Brown Clayey sand					100	98	95	84	28	13	1.75	36	18	8.4	15	10	8	4	2	SC	+G9	A-2-6	0	
TP 4	1.8-2.0	21406/5	lt Olive Clayey sand	100	96	91	86	80	68	59	33	18	1.89	29	15	6.9	19	14	11	8	5	SC	G9	A-2-6	0		

Where:

GM = Grading modulus

LL = Liquid Limit

PI = Plasticity Index

LS = Linear Shrinkage

USC=Unified soil classification

The laboratory test shows that the material according to unified soil classification comprises of:

- **SC**: clayey sand.
- **CL**: low to medium plasticity clays
- **SW/SM/SC**: well graded silty/clayey sands



SP/SM: poorly graded silty sands

The materials have a grading modulus ranging from **0.55** to **2.14** and linear shrinkage of **0** to **8.4**. The soil is dominantly characterized by non-plastic to plastic behavior with Liquid limit ranging from **24** to **36**.

Table 4 : Soil classification related to plasticity index, (Van Der Merwe, 1964)

Ip (%)	Soil description
0	Non plastic
1-5	Slightly plastic
5-10	Low plastic
10-20	Medium plastic
20-40	Highly plastic
>40	Very highly plastic

Table 5 : Activity based classification of clays (Van Der Merwe, 1964)

Activity	Classification
<0.75	Inactive
0.75-1.25	Normal
>1.25	Active

I. Moisture/Density and CBR

Table 6: II. Moisture/Density and CBR

Hole no.		TP1	TP2	TP3	TP4	TP4
Sample depth (m)		0.5-1.1	0.5-1.7	0.4-1.6	0.4-1.8	1.8-2.0
OMC (%)		6.5	17.9	4.7	7.2	10.3
MDD (kg/m ³)		2031	1696	1795	1837	2034
CBR at various densities	90%	18	2	5	2	6
	93%	28	3	8	4	8
	95%	37	4	12	8	11
	97%	48	5	14	10	14
	98%	54	6	15	12	16
	100%	71	8	18	15	18
TRH14 Class/COLTO Classification		G6	<G9	G9	<G9	<G9



Where:

CBR- Californian bearing ratio

OMC- optimum moisture content

MDD- maximum dry density

The material has maximum dry density values of ranging from **1696kg/m³** to **2034kg/m³** optimum moisture content values of 4.7 to 17.9%. The material from **tested pits** is classified, according to the COLTO guidelines, as **G6 and G9 Material**.

7.0 GEOTECHNICAL EVALUATIONS

7.1 Groundwater seepage and runoff

Groundwater was encountered in all the test pits, temporary off channelling of groundwater will be required during erection of culvert.

7.2 Excavatability and workability of the material

Excavation procedures for the installation of services and the excavation of cut terraces have been evaluated according to the South African National Standards standardised excavation classification for earthworks (SABS 1200D, DA, DB). According to this classification the area of investigation classifies as soft excavation to intermediate excavation to depth of up to 0.4m, no bedrock was encountered on site during test pitting, slow progress was experienced on Test pit 1 & 4 on dense residual, an excavator may be required for excavations deeper than 1m.

5.4 Estimated compressibility and settlements

Based on the visual assessment of the material onsite, profiles and analysis of laboratory results, the material onsite is incompressible due to its high sand content, however alluvium from test pit 2 & 3 was loose and possessed collapsible behaviour.

5.5 Sinkholes or subsidence

The area falls under the Nelspruit Suite which is non dolomitic, therefore the area is not prone to the possibility of sinkholes.



6 FINAL CONCLUSIONS AND RECOMMENDATIONS

Based on the evaluation of profiles of 4 test pits excavated within the area proposed for the proposed construction of a culvert, together with the analysis of all laboratory tests, the following can be concluded:

The site is generally of wet in-situ sandy material with no outcrop residual bedrock. Provided the foundations are driven into residual soils of at least dense consistency, we recommend usage of borrow materials with better strength and compactability characteristics for layerworks but taking into confidence the G6 (COLTO Classification) materials encountered at TP 1. Noting that in-situ water permeability occurs at a minimum depth of 200mm, thus excavations may need to be dewatered should perched water table develop during construction.

Founding depths will vary significantly across the site congruent to the original ground surface, as dense material occurs at minimum depths of 900mm to 1800mm on the upstream and 1200mm to 1500mm on the downstream side.

The information given in this report is extracted from the tested positions, it is possible that variations in the in-situ conditions may be encountered elsewhere on-site during construction. Such variations, when encountered, generally require additional services to attain a properly constructed project. We, therefore, recommend that a contingency fund be provided to accommodate any additional charges resulting from technical services that may be required. Our recommendations in this report are based on the information sourced from the findings of the investigation and such information relates specifically to the positions of the test pits and DPL tests. Any major deviation should be reported to our office for consideration.



10.0 REFERENCES

- i. Jennings, J.E.B., Brink, A.B.A., Williams, A.A.B., 1973. *Revised guide to Soil Profiling*.
- ii. SANS 634 – *Geotechnical Investigations for township Development*.
- iii. *Profiling for Civil Engineering Purposes in Southern Africa. The Civil Engineer in SA. pp 3-12. January 1973.*
- iv. SAICE. 2010. *Code of Practice: Site Investigation*.
- v. SAIEG, 1996. *Guidelines for Soil and Rock Logging. SAICE/SAIEG*.
- vi. Weinert, H.H., 1980. *The Natural Road Construction Materials of Southern Africa*.
- vii. COLTO (1998) - *Standard Specification for Roads and Bridge Works for State Authorities*.
- viii. SANS 3001:2010 *Civil Engineering Test Methods*.
- ix. *TMH 5 Sampling Methods for Road Construction Materials*.
- x. *Geological Map; 1:250 000 Pilgrim's Rest*.

List of Appendices

Appendix A: Maps

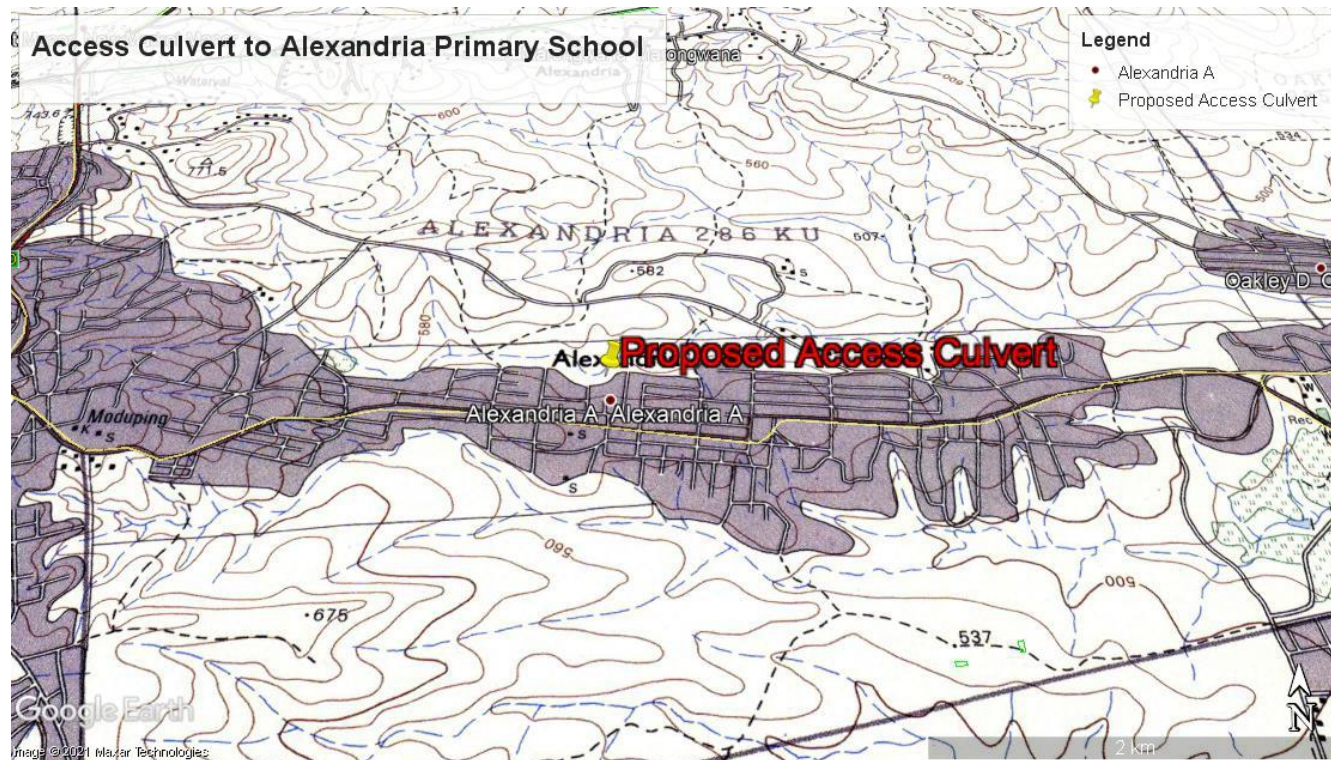
Appendix B: Profiles and photos

Appendix C: DPL

Appendix D: Laboratory results

Appendix A: Maps

Locality Map



Access Culvert to Alexandria Motseleng Primary School

Prepared For:

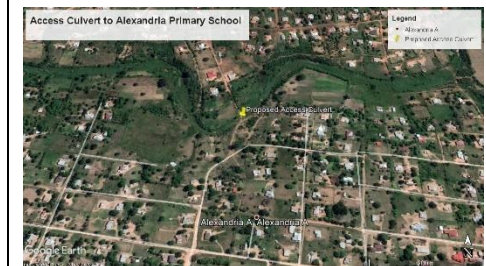
Lihuzu Projects

Prepared By:

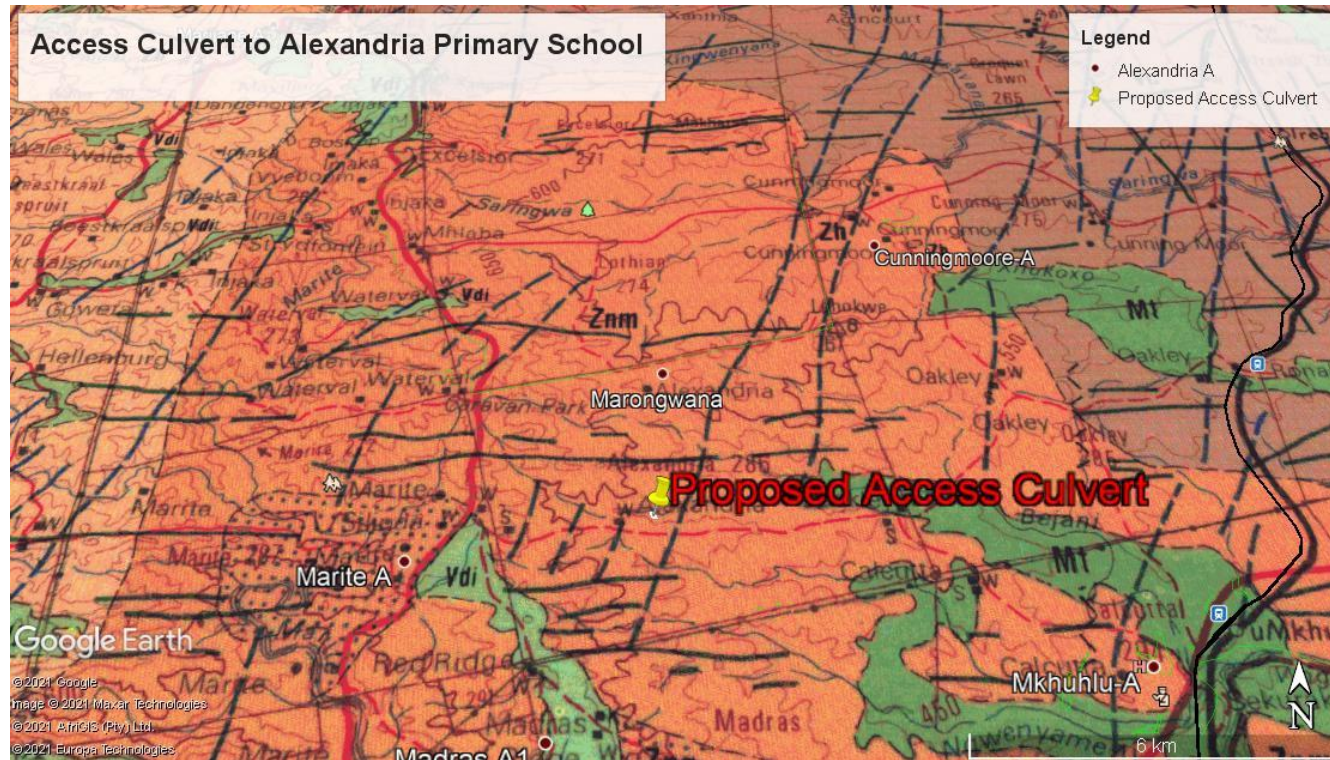
Phezulu Geotechnical Civils



12 Sukeriet Street, Mbombela, 1200, South Africa



Geological map



Prepared By:
Phezulu Geotechnical Civils



Unit 57.1, 12 Suikerriet Street, Central Park, Mbombela, 1200

Job no:
21-406

Access Culvert to Alexandria Motseleng Primary School

Prepared For:
Lihuzu Projects

Access Culvert to Alexandria Primary School

Legend

-  Proposed Access Culvert
-  Stream
-  TP1
-  TP2
-  TP3
-  TP4

TP4
TP3
TP1
Proposed Access Culvert
TP2

Google Earth

Image © 2021 Maxar Technologies

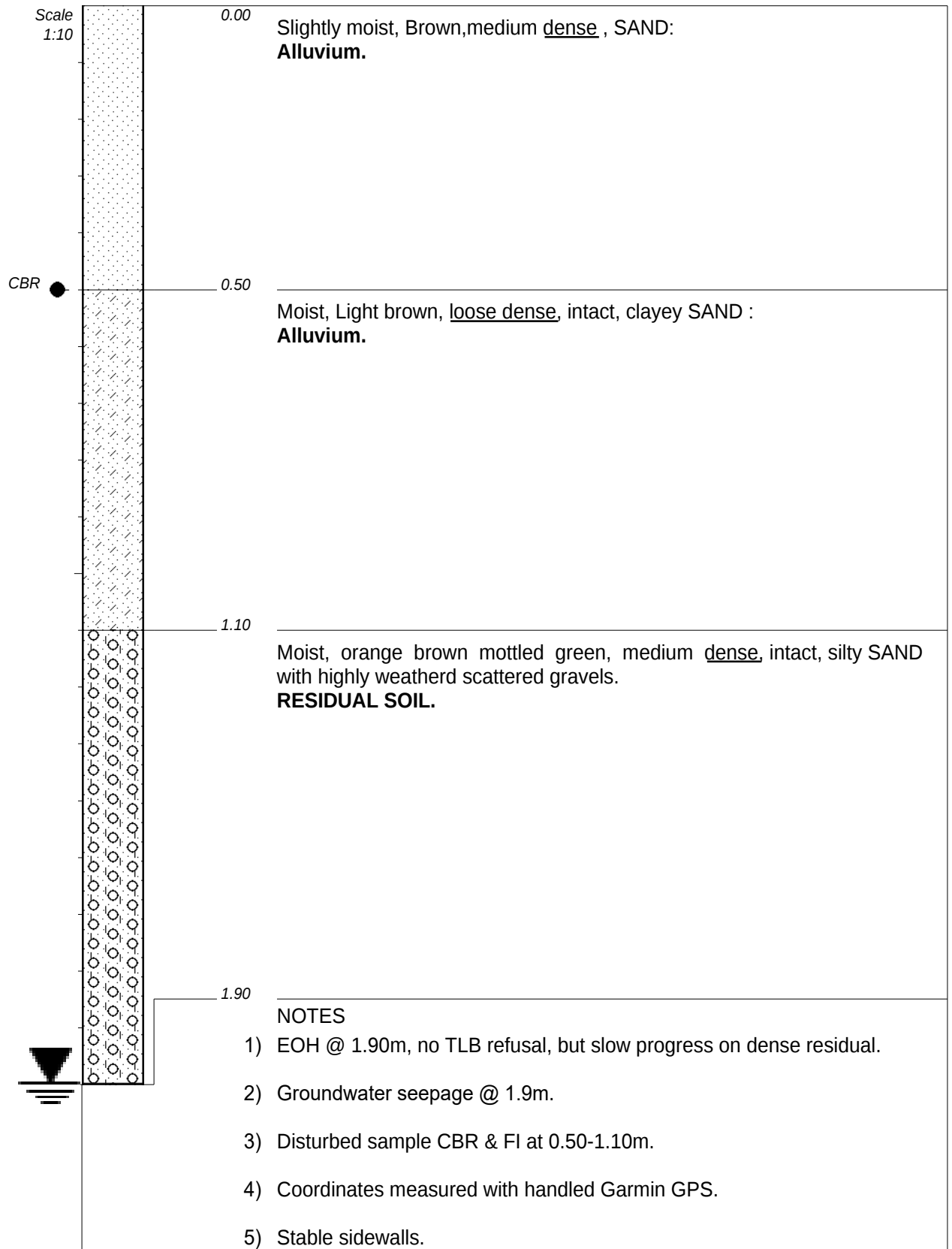
© 2021 AfriGIS (Pty) Ltd.

© 2021 Europa Technologies

40 m



Appendix B: Profiles and photos

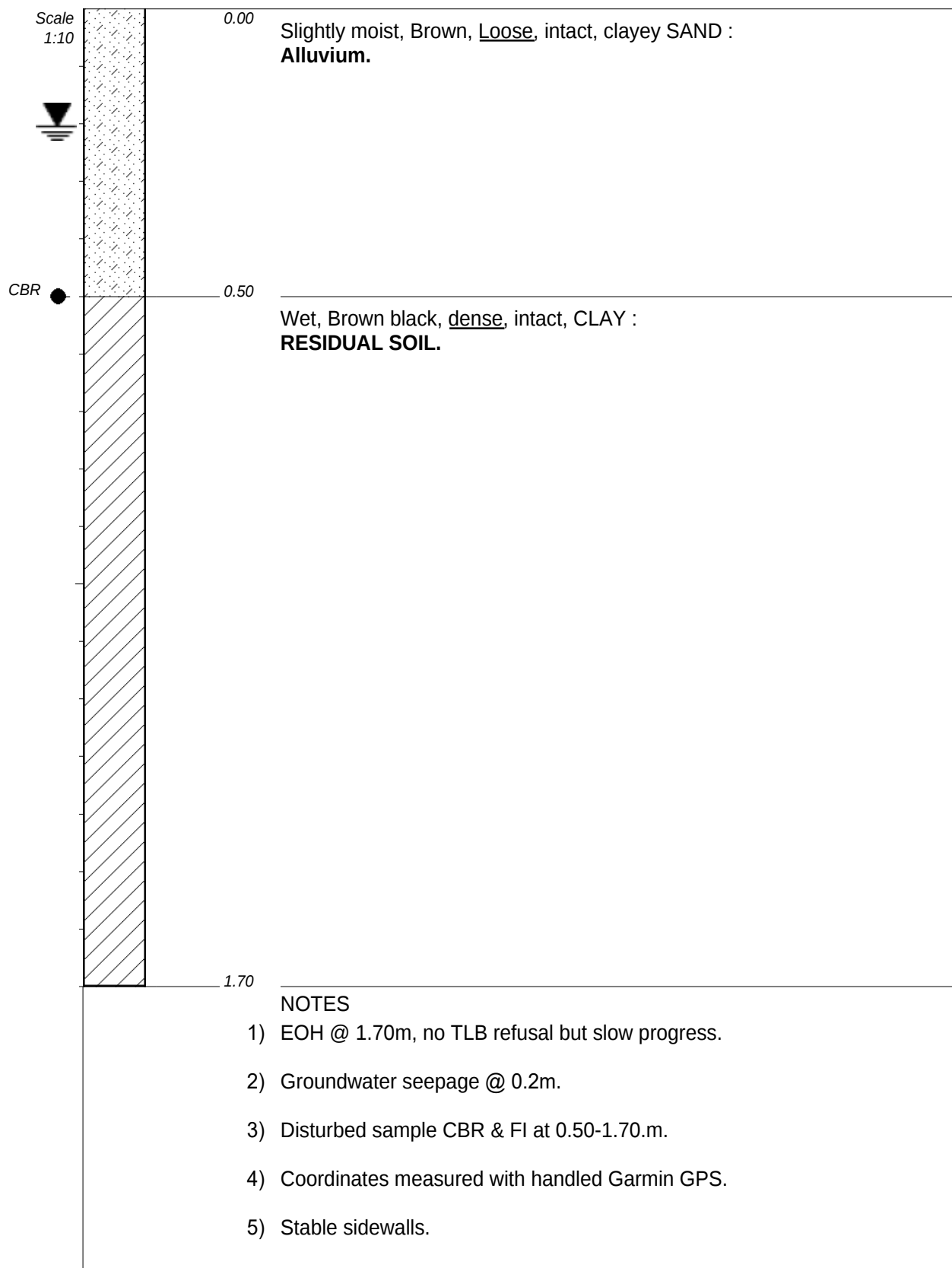


CONTRACTOR : Phezulu Geotechnical Civils
MACHINE : CAT 482E
DRILLED BY :
PROFIED BY : Phezulu Geotechnical Civils
TYPE SET BY :
SETUP FILE : STANDARD.SET

INCLINATION : Vertical
DIAM :
DATE :
DATE : 26/04/2021
DATE : 05/05/2021 16:46
TEXT : ..ofiles\21406Profiles.txt

ELEVATION : 547m
X-COORD : -24.956009'
Y-COORD : 31.162225'

HOLE No: **TP-01**

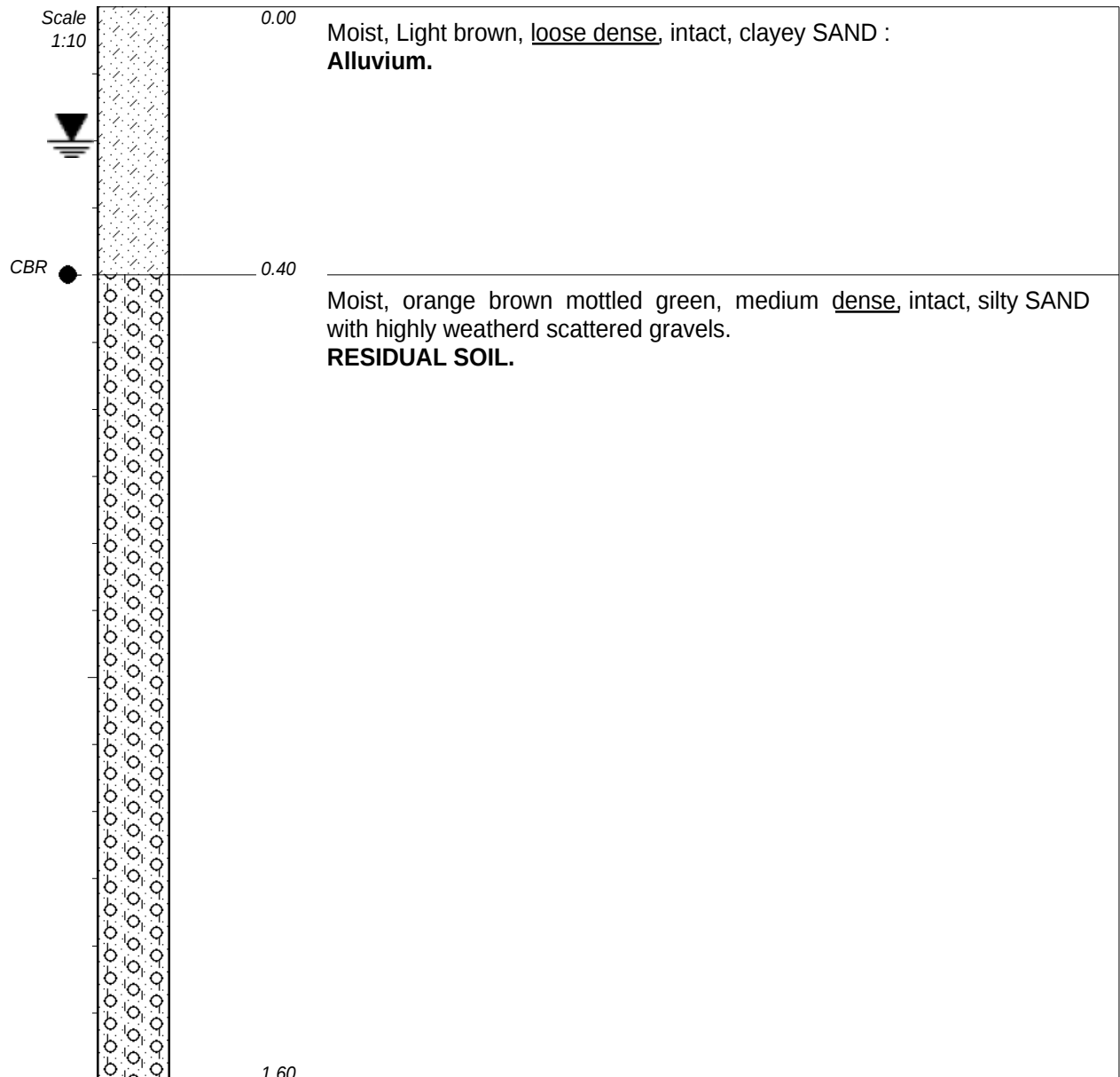


CONTRACTOR : Phezulu Geotechnical Civils
MACHINE : CAT 482E
DRILLED BY :
PROFIED BY : Phezulu Geotechnical Civils
TYPE SET BY :
SETUP FILE : STANDARD.SET

INCLINATION : Vertical
DIAM :
DATE :
DATE : 26/04/2021
DATE : 05/05/2021 16:46
TEXT : ..ofiles\21406Profiles.txt

ELEVATION : 547m
X-COORD : -24.956102'
Y-COORD : 31.162085'

HOLE No: **TP-02**



NOTES

- 1) EOH @ 1.60m, no TLB refusal, but slow progress on dense residual.
- 2) Groundwater seepage @ 0.2m.
- 3) Disturbed sample CBR & FI at 0.40-1.60m.
- 4) Coordinates measured with handled Garmin GPS.
- 5) Stable sidewalls.

CONTRACTOR : Phezulu Geotechnical Civils
MACHINE : CAT 482E
DRILLED BY :
PROFIED BY : Phezulu Geotechnical Civils
TYPE SET BY :
SETUP FILE : STANDARD.SET

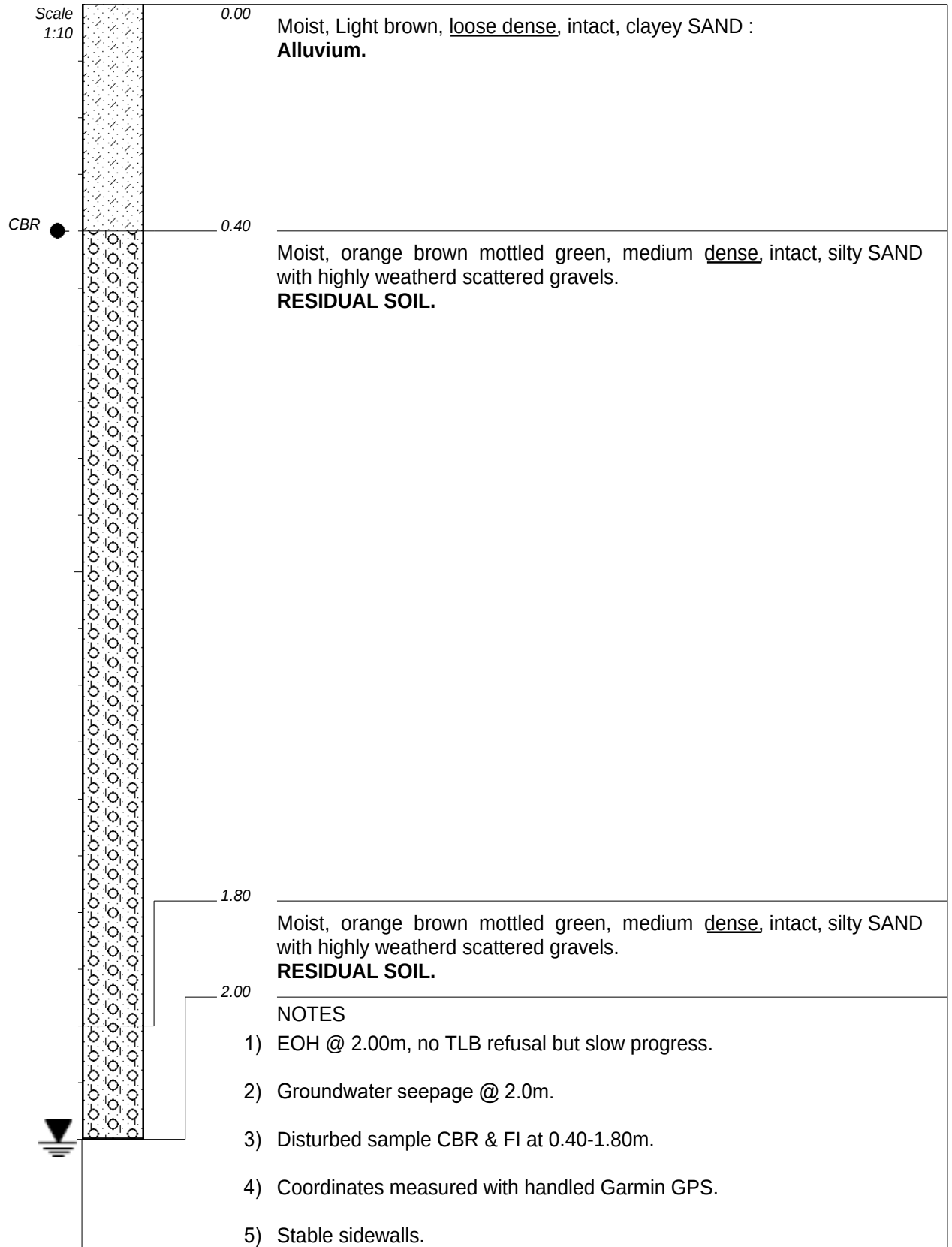
INCLINATION : Vertical

DIAM :
DATE :
DATE : 26/04/2021

DATE : 05/05/2021 16:46
TEXT : ..ofiles\21406Profiles.txt

ELEVATION : 547m
X-COORD : -24.955955'
Y-COORD : 31.162090'

HOLE No: **TP-03**



CONTRACTOR : Phezulu Geotechnical Civils
MACHINE : CAT 482E
DRILLED BY :
PROFILED BY : Phezulu Geotechnical Civils
TYPE SET BY :
SETUP FILE : STANDARD.SET

INCLINATION : Vertical
DIAM :
DATE :
DATE : 26/04/2021
DATE : 05/05/2021 16:46
TEXT : ..ofiles\21406Profiles.txt

ELEVATION : 546m
X-COORD : -24.955914'
Y-COORD : 31.162189'

HOLE No: **TP-04**

Name ●

	GRAVELS	{SA02}
	SAND	{SA04}
	SILTY	{SA07}
	CLAY	{SA08}
	CLAYEY	{SA09}
	DISTURBED SAMPLE	{SA38}

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY :

TYPE SET BY :
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE :

DATE : 05/05/2021 16:46
TEXT : ..ofiles\21406Profiles.txt

ELEVATION :
X-COORD :
Y-COORD :

LEGEND
SUMMARY OF SYMBOLS

P.O Box 1766
12 Suikeriet Street
Central Park
Unit 57.1
Nelspruit
1200
NLA Member No. 241



Phezulu Geotechnical Civils

e-mail : xolani@phezulugc.co.za
Domain www.phezulugc.co.za
Tel : 013 004 0119
Cell : 071 897 3005
Fax : 086 543 8298
Reg. No. 2011/005646/23
Vat no. 4610267686

Geotechnical Site Investigation For Access Culvert to Alexandria
Primary School, South Africa

SOIL PROFILES PHOTOS

TP-01



TP-02



TP-03



TP-04



Appendix C: DPL



Client: **Lihuzu Projects**

Date : 24-Apr-2021

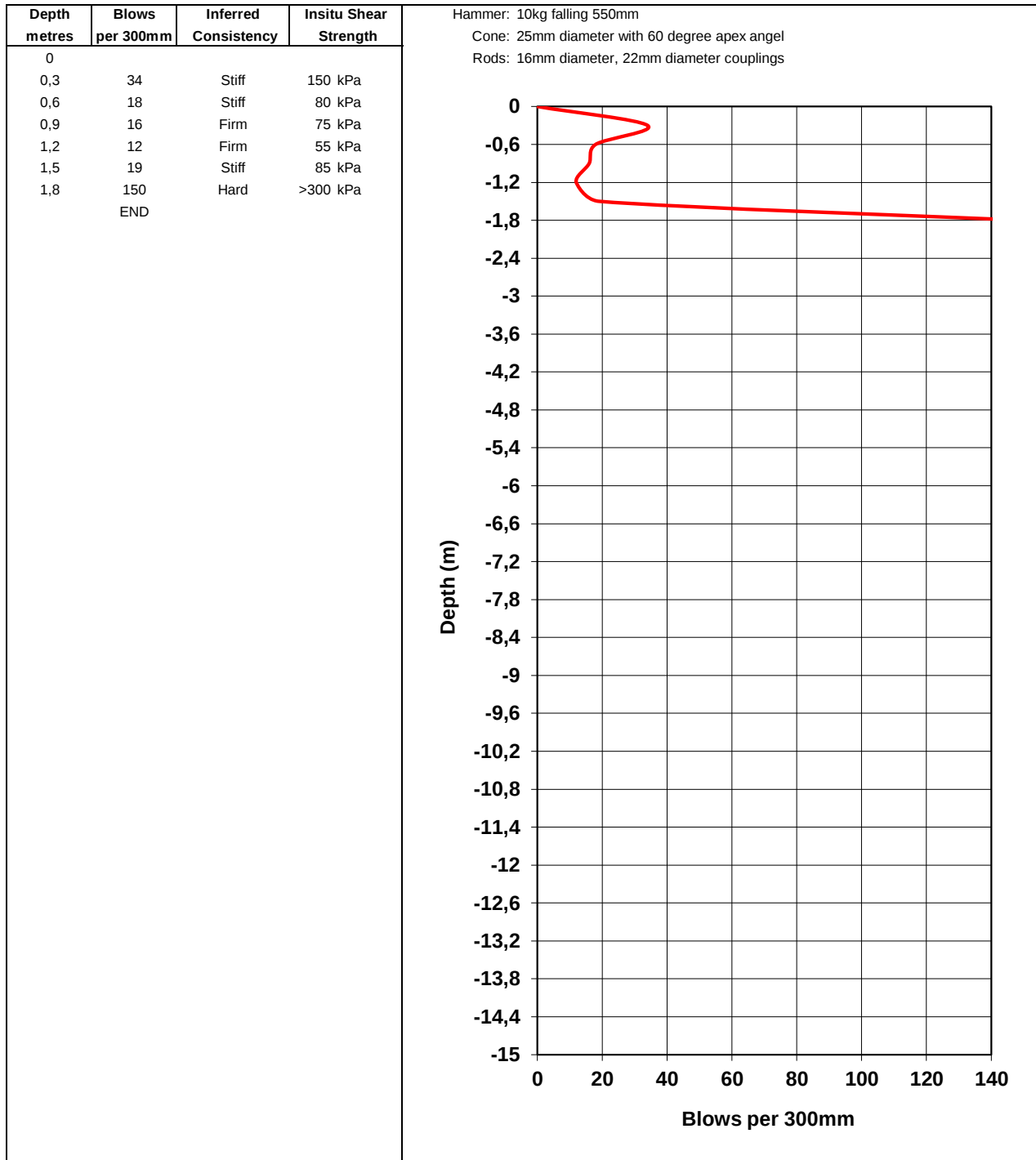
Contract: **Access Culvert to Alexandria Motseng Primary School**

Description: **DPL was done from existing ground level**

DPL No. : **1 @ TP 1**

Light Dynamic Penetrometer Probe

THE INSITU STRENGTH DEPENDS ON SOIL MOISTURE CONTENT AND GRAIN STRUCTURE WHICH HAVE NOT BEEN ASSESSED AND MAY CHANGE. THE VALUES GIVEN ARE THEREFORE INDICATIVE ONLY AND SHOULD BE VERIFIED BY TEST OR OBSERVATION



Notes

Refusal at 1,8 m after 1 attempt

Plotted as Cohesive material



Client: **Lihuzu Projects**

Date : 24-Apr-2021

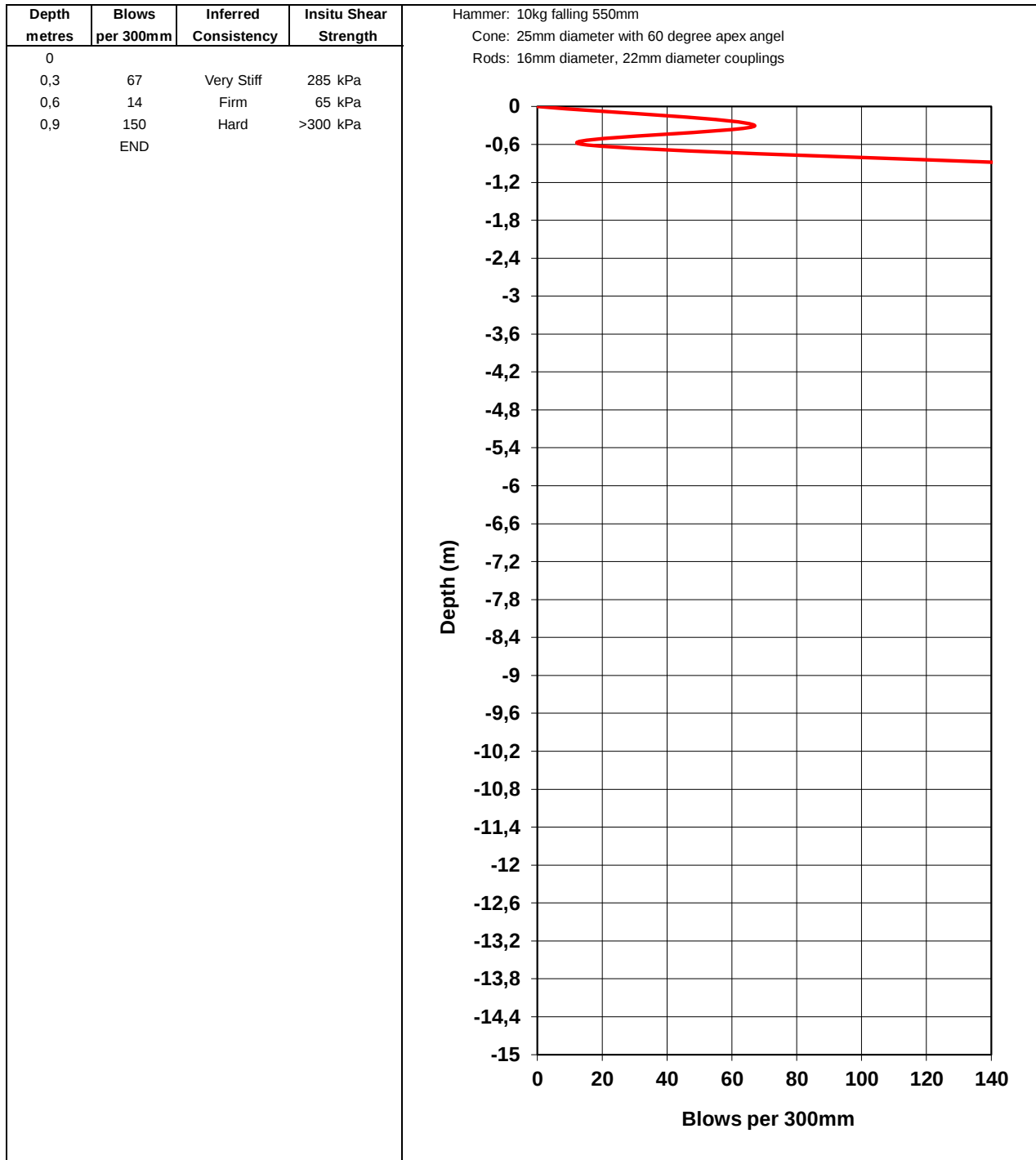
Contract: **Access Culvert to Alexandria Motseng Primary School**

Description: **DPL was done from existing ground level**

DPL No. : **2 @ TP 2**

Light Dynamic Penetrometer Probe

THE INSITU STRENGTH DEPENDS ON SOIL MOISTURE CONTENT AND GRAIN STRUCTURE WHICH HAVE NOT BEEN ASSESSED AND MAY CHANGE. THE VALUES GIVEN ARE THEREFORE INDICATIVE ONLY AND SHOULD BE VERIFIED BY TEST OR OBSERVATION



Notes

Refusal at 0,9 m after 1 attempt

Plotted as Cohesive material



Client: **Lihuzu Projects**

Date : 24-Apr-2021

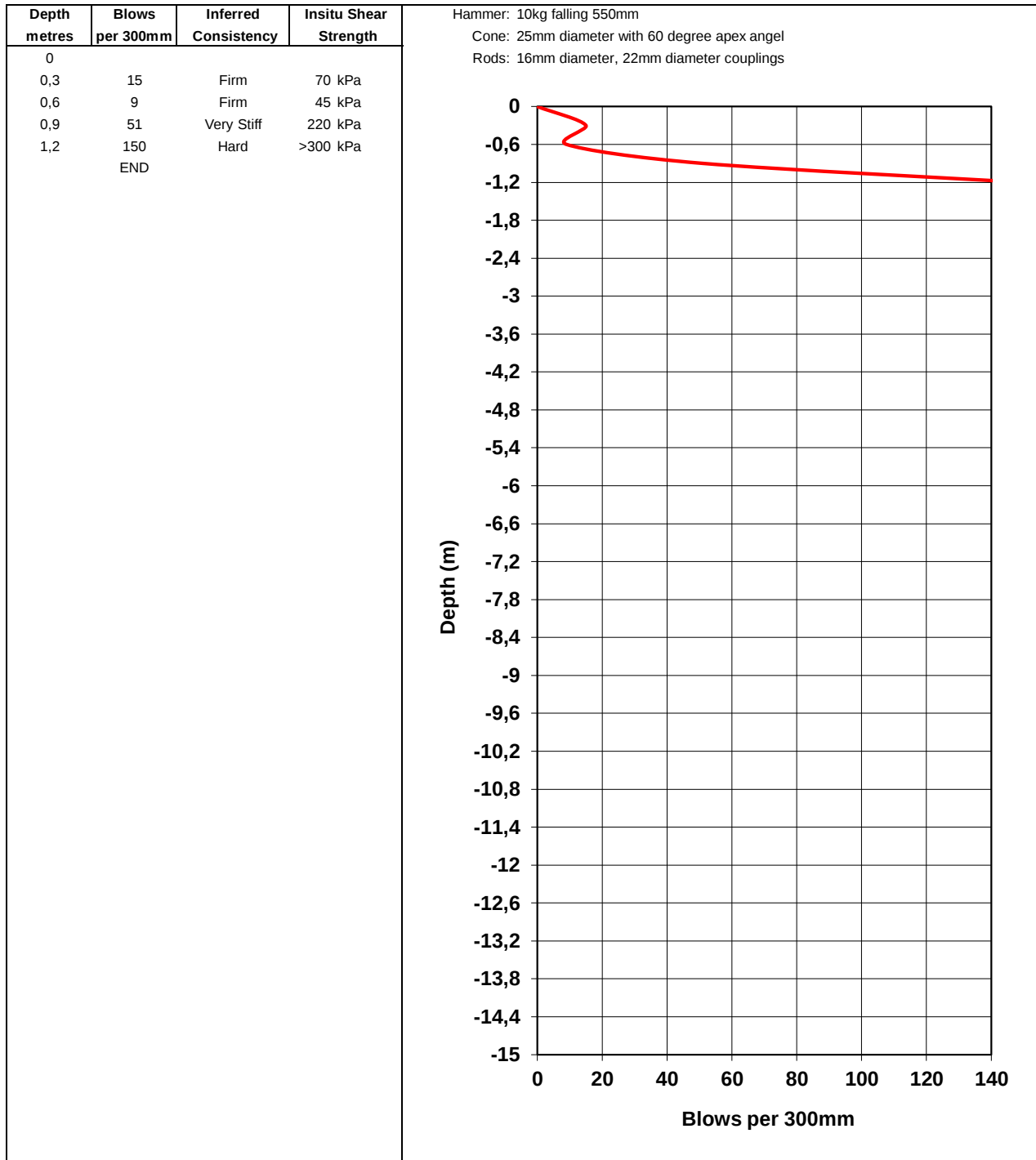
Contract: **Access Culvert to Alexandria Motseng Primary School**

Description: **DPL was done from existing ground level**

DPL No. : **3 @ TP 3**

Light Dynamic Penetrometer Probe

THE INSITU STRENGTH DEPENDS ON SOIL MOISTURE CONTENT AND GRAIN STRUCTURE WHICH HAVE NOT BEEN ASSESSED AND MAY CHANGE. THE VALUES GIVEN ARE THEREFORE INDICATIVE ONLY AND SHOULD BE VERIFIED BY TEST OR OBSERVATION



Notes

Refusal at 1,2 m after 1 attempt

Plotted as Cohesive material



Client: **Lihuzu Projects**

Date : 24-Apr-2021

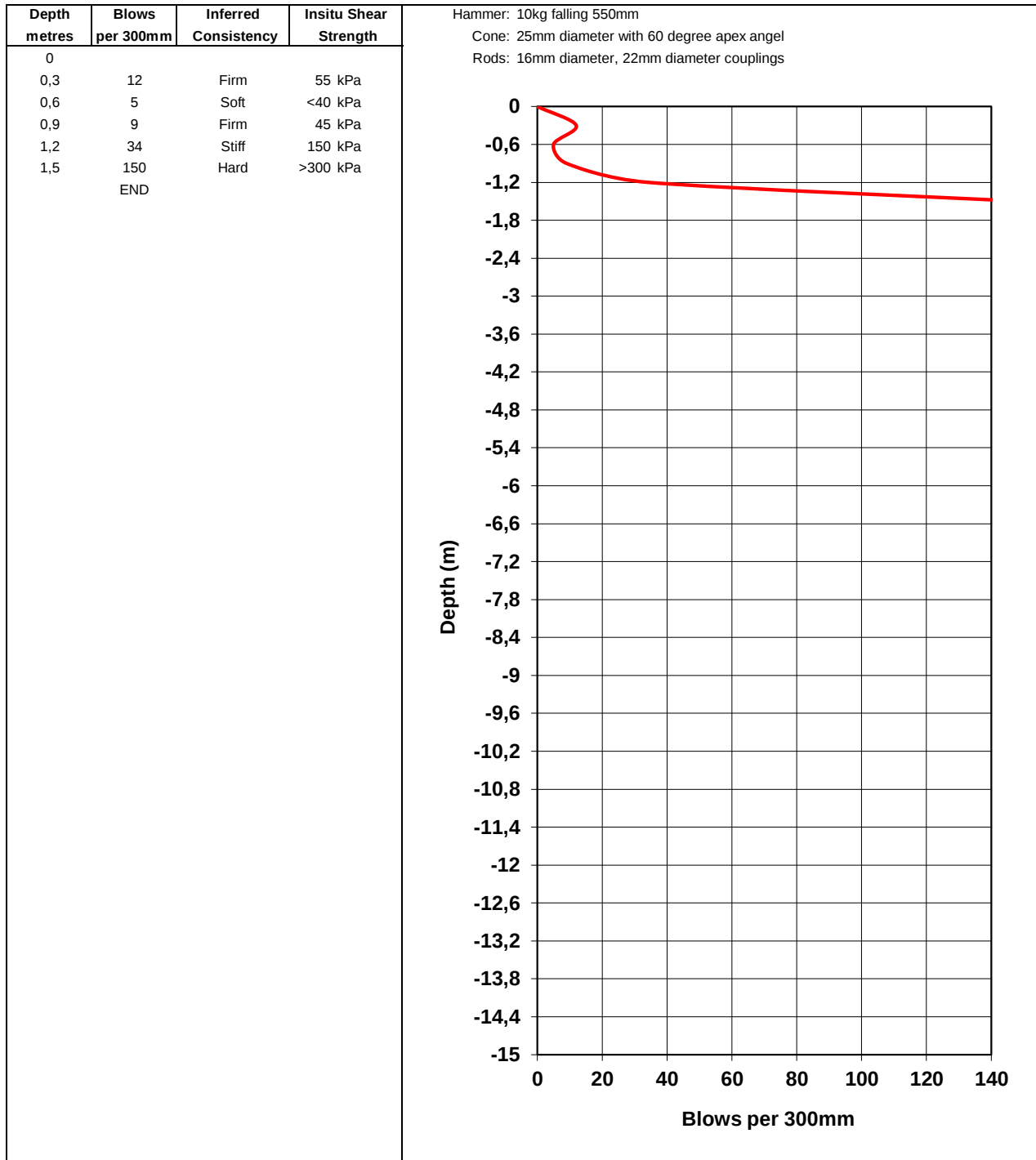
Contract: **Access Culvert to Alexandria Motseng Primary School**

Description: **DPL was done from existing ground level**

DPL No. : **4 @ TP 4**

Light Dynamic Penetrometer Probe

THE INSITU STRENGTH DEPENDS ON SOIL MOISTURE CONTENT AND GRAIN STRUCTURE WHICH HAVE NOT BEEN ASSESSED AND MAY CHANGE. THE VALUES GIVEN ARE THEREFORE INDICATIVE ONLY AND SHOULD BE VERIFIED BY TEST OR OBSERVATION



Notes

Refusal at 1,5 m after 1 attempt

Plotted as Cohesive material

D-LABORATORY RESULTS

PHEZULU GEOTECHNICAL CIVILS														GRAVEL, SOIL AND SAND ANALYSIS SUMMARY													
Client : Lihuzu Projects																		Date :		05-May-2021							
Contract : Acces Culvert to Alexandria Motseleng Primary School																											
Position	Depth (m)	Sample No	Description	Sieve Analysis								GM	Atterberg Limits			UCS / CBR					Classification						
				Cumulative percentage passing									LL	PI	% L.S.	100	97	95	93	90	Unified Soil	COLTO	US Highway	Group Index			
				53.0	37.5	26.5	19.0	13.2	4.75	2.00	0.425	0.075															
TP 1																											
TP 1	0.5-1.1	21406/1	drk Yel. Orange Well graded silty/clayey sand	100	96	93	89	82	69	55	23	8	2.14	24	6	2.5	71	48	37	28	18	sw/sm/sc	G6	A-1-b	0		
TP 2																											
TP 2	0.50-1.70	21406/2	drk Grey Inorganic clay					100	100	98	85	62	0.55	30	15	7.2	8	5	4	3	2	CL	<G9	A-6	7		
TP 3																											
TP 3	0.4-1.6	21406/3	lt Brown Poorly graded silty sand					100	96	87	22	11	1.80		NP	0	18	14	12	8	5	sp/sm	G9	A-1-b	0		
TP 4																											
TP 4	0.4-1.8	21406/4	lt Brown Clayey sand				100	98	95	84	28	13	1.75	36	18	8.4	15	10	8	4	2	SC	<G9	A-2-6	0		
TP 4	1.8-2.0	21406/5	lt Olive Clayey sand	100	96	91	86	80	68	59	33	18	1.89	29	15	6.9	19	14	11	8	5	SC	G9	A-2-6	0		



ROAD INDICATOR

Client : Lihuzu Projects

Date : 23-Apr-2021

Contract : Access Culvert to Alexandria Motseleng Primary School

Description : Material sampled from TP 1 @ 0.5-1.1 m below Existing Ground Level

Sample No : 21406/1

Sampled Depth : 0.5-1.1m below Existing Ground Level

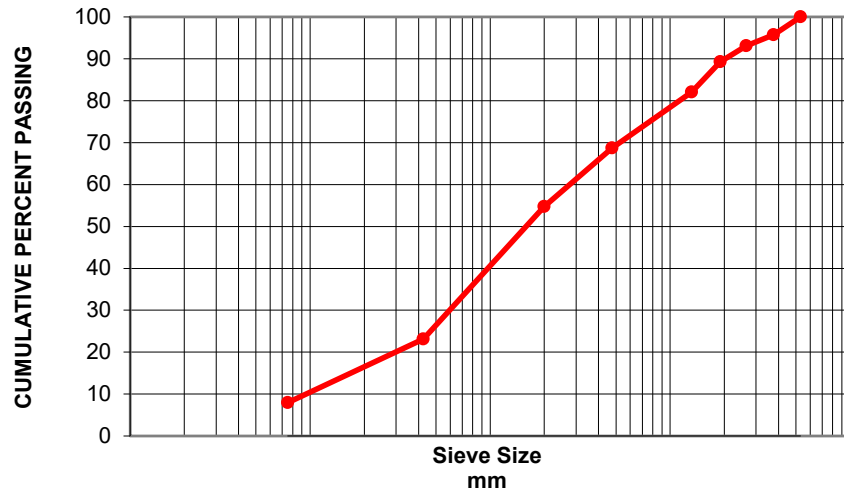
Grading Analysis

Sieve Size (mm)	Cumulative % Passing
53.0	100
37.5	96
36.5	93
19.0	89
13.2	82
4.75	69
2.0	55
0.425	23
0.075	8

Atterberg Limits

Liquid limit :	24
Plasticity Index :	6
Linear shrinkage :	2.5

GRADING ANALYSIS CURVE



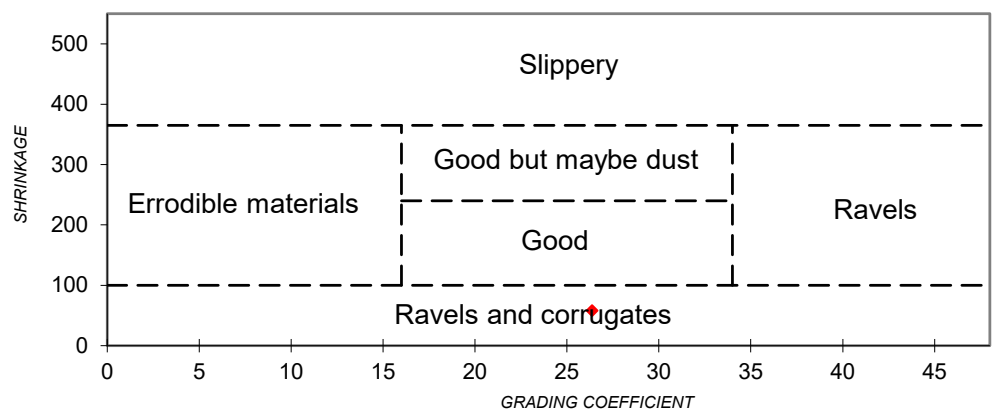
Material Classification

COLTO (1998) : G6
U.S.C.S : drk Yel. Orange Well graded silty/clayey sand
U.S.C.S : sw/sm/sc
AASHTO : A-1-b
Group Index : 0

Other Constraints

Grading Modulus : 2.14
Effective size : 0.095
Uniformity co-eff. : 29
Curvature co-eff. : 1.4
Oversize Index : 4
Shrinkage Product : 58
Grading co-eff. : 26.4

PERFORMANCE AS GRAVEL WEARING COURSE



ABBREVIATIONS

COLTO - Committee Of Land Transport Officials.
U.S.C.S - Unified Soil Classification System.
AASHTO - American Association Of State Highway Officials.

ADDITIONAL INFORMATION :

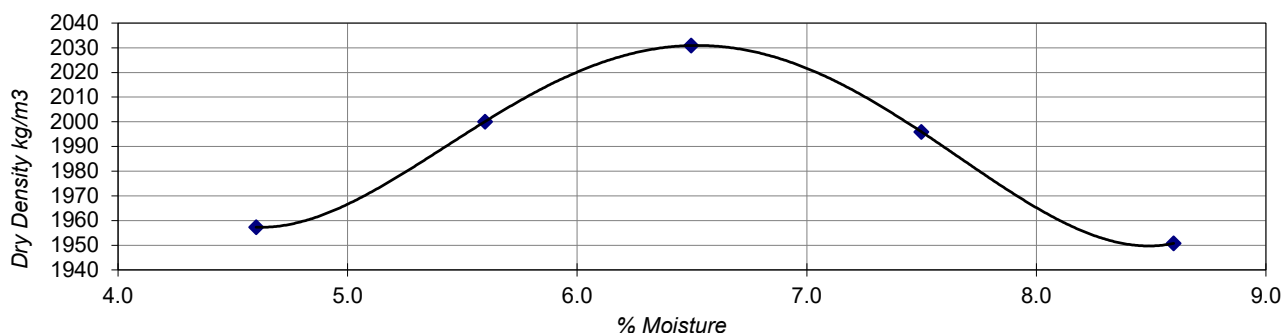


MODIFIED AASHTO & CALIFORNIA BEARING RATIO (CBR)

Client:	Lihuzu Projects	Date:	23-Apr-2021
Contract:	Access Culvert to Alexandria Motseleng Primary School		
Description:	Material sampled from TP 1 @ 0.5-1.1 m below Existing Ground Level		
Sample No.:	21406/1		

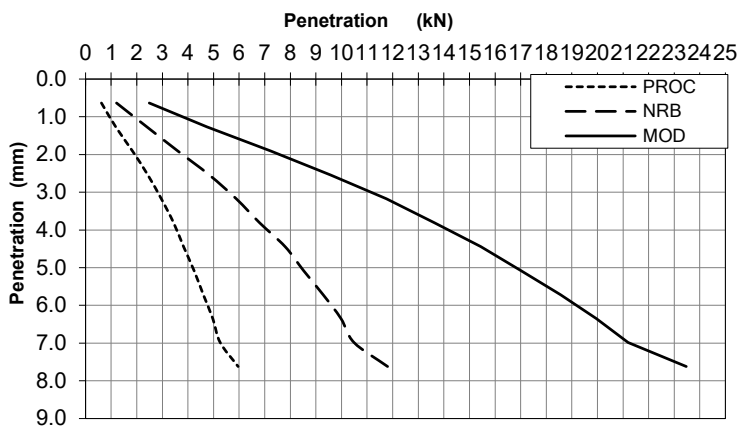
Modified AASHTO Test Results

Maximum dry density :	2031 kg/m³					
Optimum moisture content :	6.5 %					
Dry Density :	1957	2000	2031	1996	1951	0
Moisture Content :	4.6	5.6	6.5	7.5	8.6	0.0



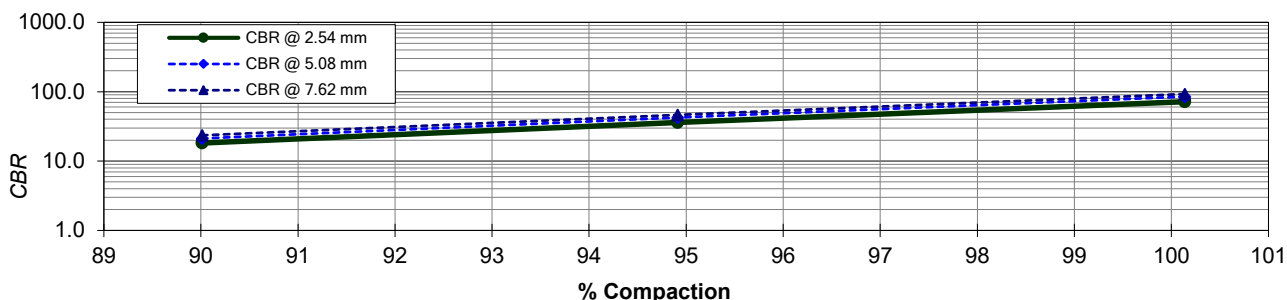
California Bearing Ratio (Penetration Readings & Graph)

Depth	Proc	NRB	Mod
0.635	0.62	1.21	2.49
1.270	1.18	2.40	4.75
1.905	1.83	3.60	7.23
2.540	2.43	4.83	9.58
3.175	2.96	5.89	11.75
3.810	3.44	6.80	13.64
4.445	3.83	7.80	15.44
5.080	4.24	8.52	17.01
5.715	4.60	9.28	18.56
6.350	4.97	9.98	19.95
6.985	5.26	10.49	21.20
7.620	5.96	11.80	23.47



California Bearing Ratio (Values & Graph)

% Compaction	100	98	97	95	93	90
CBR of 13.344 kN	71	54	48	37	28	18
CBR of 20.016 kN	83	64	56	43	32	21
CBR of 25.354 kN	91	70	61	47	36	23



Swell Readings

	Mod	N.R.B.	Proc.
Reading before swelling	1.00	1.00	1.00
Reading after swelling	1.04	1.09	1.11
% Swell	0.03	0.07	0.09



ROAD INDICATOR

Client : Lihuzu Projects

Date : 23-Apr-2021

Contract : Access Culvert to Alexandria Motseleng Primary School

Description : Material sampled from TP 2 @ 0.50-1.70 m below Existing Ground Level

Sample No : 21406/2

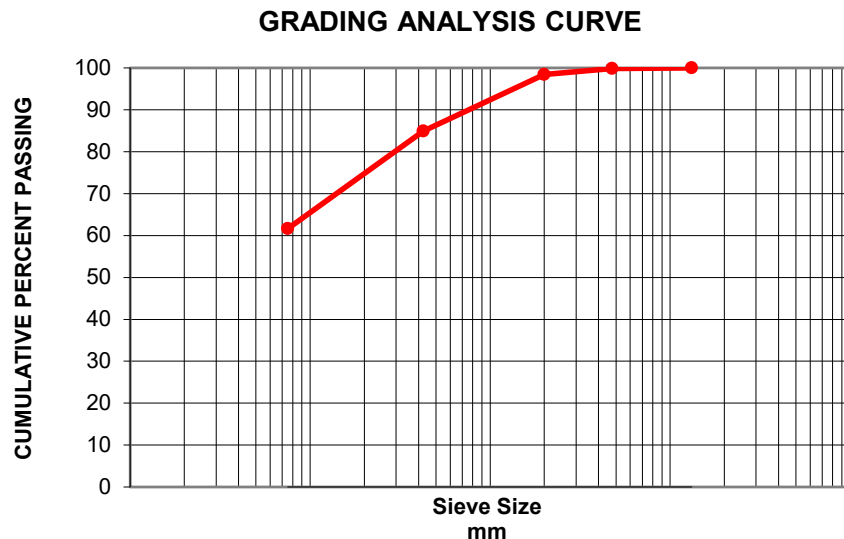
Sampled Depth : 0.50-1.70m below Existing Ground Level

Grading Analysis

Sieve Size (mm)	Cumulative % Passing
53.0	
37.5	
36.5	
19.0	
13.2	100
4.75	100
2.0	98
0.425	85
0.075	62

Atterberg Limits

Liquid limit :	30
Plasticity Index :	15
Linear shrinkage :	7.2

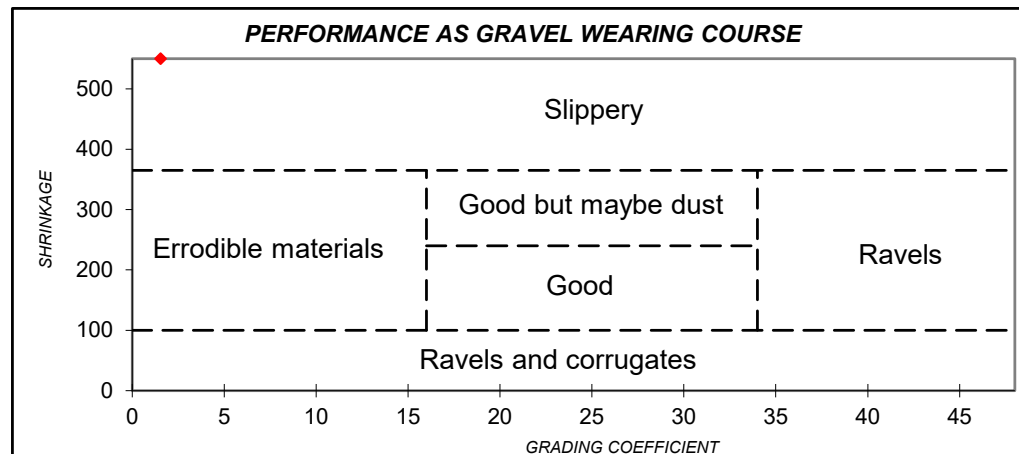


Material Classification

COLTO (1998) : <G9
U.S.C.S : drk Grey Inorganic clay
U.S.C.S : CL
AASHTO : A-6
Group Index : 7

Other Constraints

Grading Modulus : 0.55
Effective size : <0.075
Uniformity co-eff. : 10
Curvature co-eff. : 10.0
Oversize Index : 0
Shrinkage Product : 611
Grading co-eff. : 1.5



ABBREVIATIONS

COLTO - Committee Of Land Transport Officials.
U.S.C.S - Unified Soil Classification System.
AASHTO - American Association Of State Highway Officials.

ADDITIONAL INFORMATION :

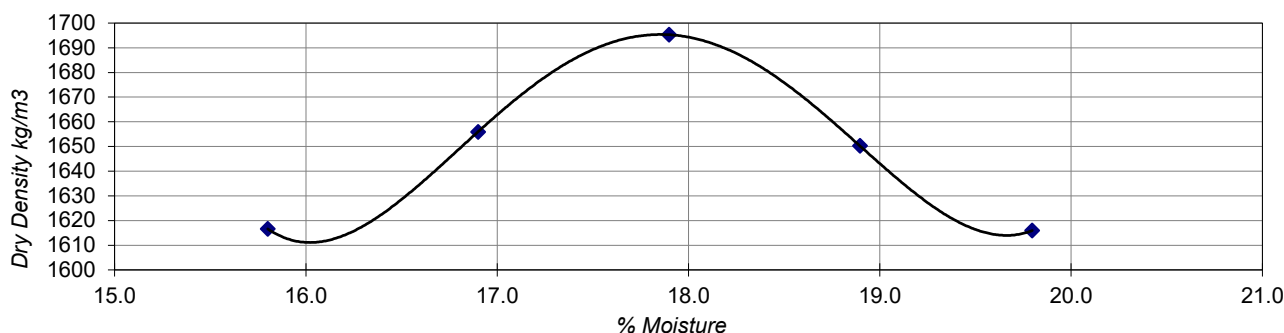


MODIFIED AASHTO & CALIFORNIA BEARING RATIO (CBR)

Client:	Lihuzu Projects	Date:	23-Apr-2021
Contract:	Access Culvert to Alexandria Motseleng Primary School		
Description:	Material sampled from TP 2 @ 0.50-1.70 m below Existing Ground Level		
Sample No.:	21406/2		

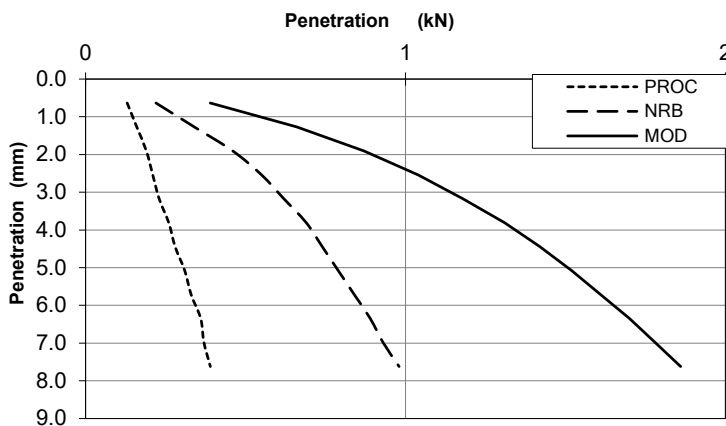
Modified AASHTO Test Results

Maximum dry density :	1696 kg/m³					
Optimum moisture content :	17.9 %					
Dry Density :	1695	1650	1616	1656	1617	0
Moisture Content :	17.9	18.9	19.8	16.9	15.8	0.0



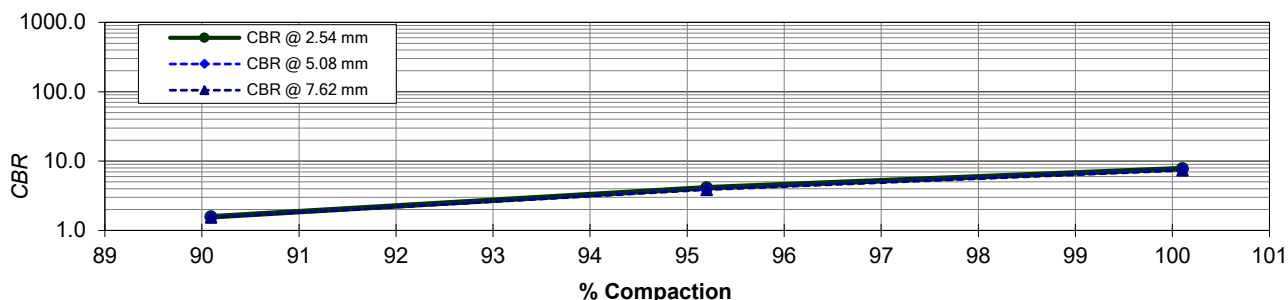
California Bearing Ratio (Penetration Readings & Graph)

Depth	Proc	NRB	Mod
0.635	0.13	0.22	0.39
1.270	0.16	0.34	0.66
1.905	0.19	0.46	0.87
2.540	0.21	0.55	1.04
3.175	0.23	0.62	1.18
3.810	0.26	0.69	1.31
4.445	0.28	0.74	1.42
5.080	0.31	0.79	1.52
5.715	0.33	0.84	1.61
6.350	0.36	0.89	1.70
6.985	0.37	0.93	1.78
7.620	0.39	0.98	1.86



California Bearing Ratio (Values & Graph)

% Compaction	100	98	97	95	93	90
CBR of 13.344 kN	8	6	5	4	3	2
CBR of 20.016 kN	7	6	5	4	3	2
CBR of 25.354 kN	7	6	5	4	3	2



Swell Readings

	Mod	N.R.B.	Proc.
Reading before swelling	1.00	1.00	1.00
Reading after swelling	2.16	3.00	4.31
% Swell	0.91	1.57	2.61



ROAD INDICATOR

Client : Lihuzu Projects

Date : 23-Apr-2021

Contract : Access Culvert to Alexandria Motseleng Primary School

Description : Material sampled from TP 3 @ 0.4-1.6 m below Existing Ground Level

Sample No : 21406/3

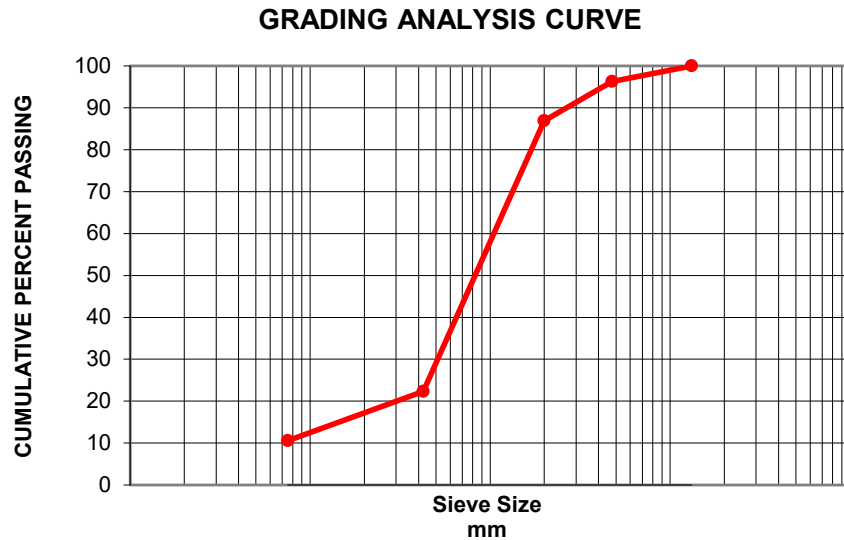
Sampled Depth : 0.4-1.6m below Existing Ground Level

Grading Analysis

Sieve Size (mm)	Cumulative % Passing
53.0	
37.5	
36.5	
19.0	
13.2	100
4.75	96
2.0	87
0.425	22
0.075	11

Atterberg Limits

Liquid limit :
Plasticity Index : NP
Linear shrinkage : 0.0

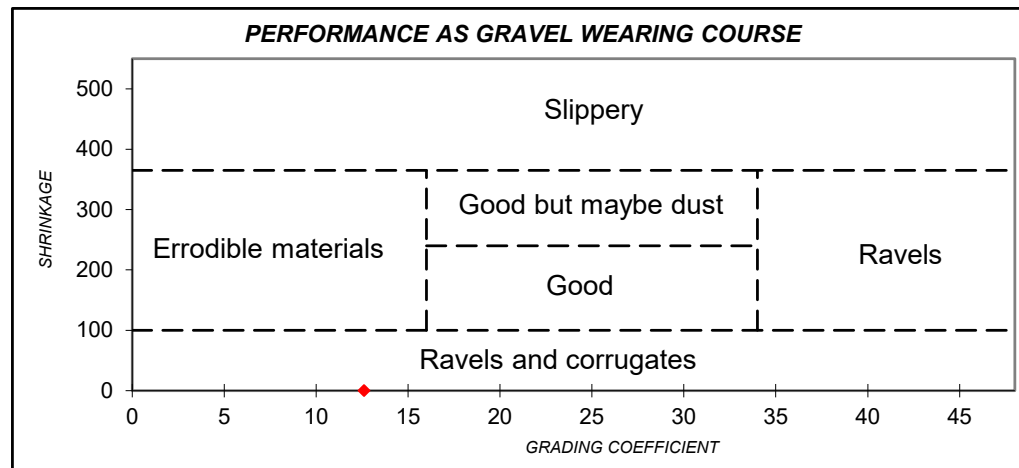


Material Classification

COLTO (1998) : G9
U.S.C.S : It Brown Poorly graded silty sand
U.S.C.S : sp/sm
AASHTO : A-1-b
Group Index : 0

Other Constraints

Grading Modulus : 1.80
Effective size : <0.075
Uniformity co-eff. : 1049
Curvature co-eff. : 248.4
Oversize Index : 0
Shrinkage Product : 0
Grading co-eff. : 12.6



ABBREVIATIONS

COLTO - Committee Of Land Transport Officials.
U.S.C.S - Unified Soil Classification System.
AASHTO - American Association Of State Highway Officials.

ADDITIONAL INFORMATION :

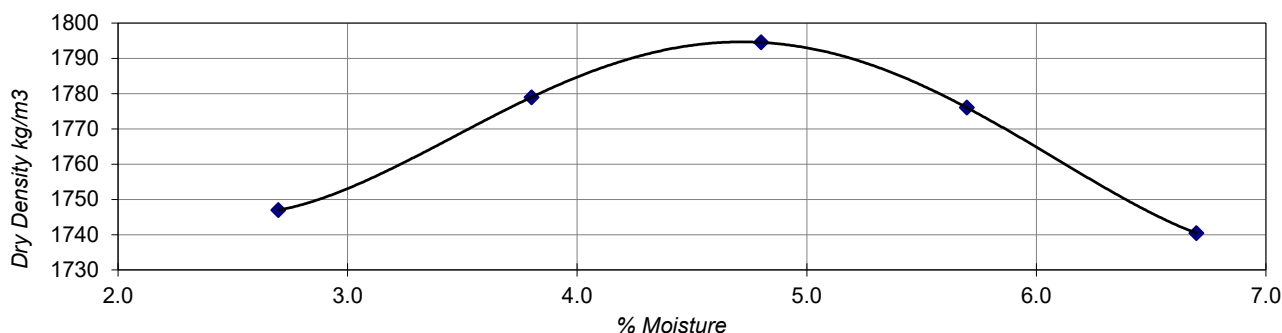


MODIFIED AASHTO & CALIFORNIA BEARING RATIO (CBR)

Client:	Lihuzu Projects	Date:	23-Apr-2021
Contract:	Access Culvert to Alexandria Motseleng Primary School		
Description:	Material sampled from TP 3 @ 0.4-1.6 m below Existing Ground Level		
Sample No.:	21406/3		

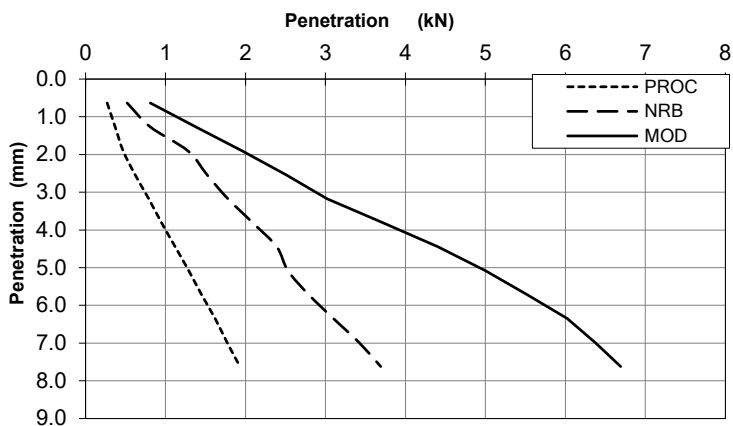
Modified AASHTO Test Results

Maximum dry density :	1795 kg/m³					
Optimum moisture content :	4.7 %					
Dry Density :	1779	1795	1776	1740	1747	0
Moisture Content :	3.8	4.8	5.7	6.7	2.7	0.0



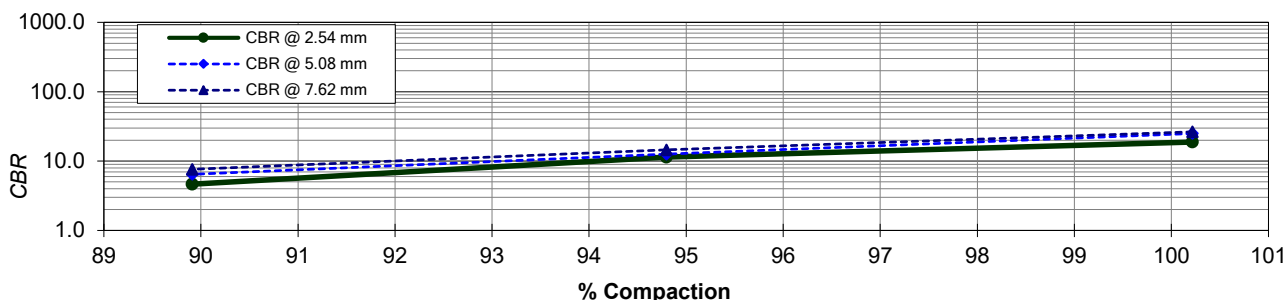
California Bearing Ratio (Penetration Readings & Graph)

Depth	Proc	NRB	Mod
0.635	0.27	0.52	0.81
1.270	0.37	0.81	1.38
1.905	0.47	1.28	1.96
2.540	0.62	1.52	2.51
3.175	0.79	1.78	3.02
3.810	0.95	2.09	3.72
4.445	1.12	2.39	4.40
5.080	1.29	2.53	5.00
5.715	1.45	2.79	5.52
6.350	1.62	3.10	6.02
6.985	1.77	3.42	6.37
7.620	1.93	3.69	6.69



California Bearing Ratio (Values & Graph)

% Compaction	100	98	97	95	93	90
CBR of 13.344 kN	18	15	14	12	8	5
CBR of 20.016 kN	24	19	17	13	10	7
CBR of 25.354 kN	26	21	19	15	11	8



Swell Readings

	Mod	N.R.B.	Proc.
Reading before swelling	1.00	1.00	1.00
Reading after swelling	1.00	1.00	1.01
% Swell	0.00	0.00	0.01



ROAD INDICATOR

Client : Lihuzu Projects

Date : 23-Apr-2021

Contract : Access Culvert to Alexandria Motseleng Primary School

Description : Material sampled from TP 4 @ 0.4-1.8 m below Existing Ground Level

Sample No : 21406/4

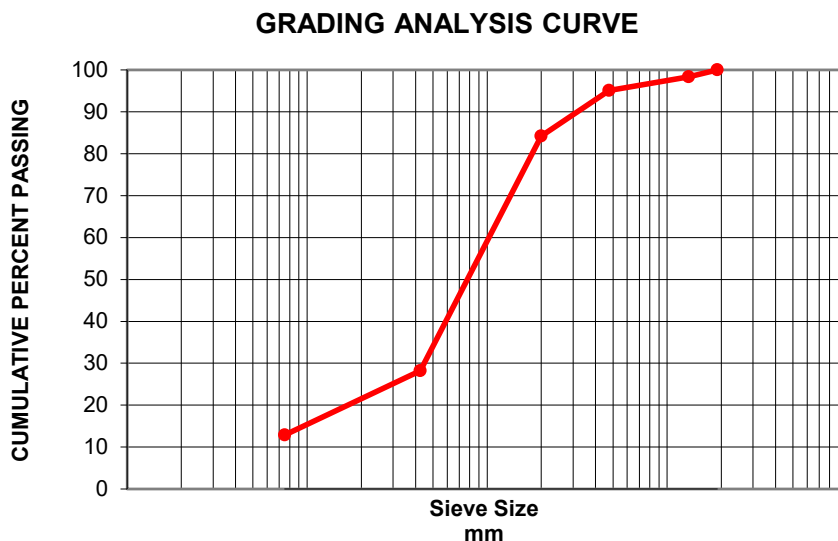
Sampled Depth : 0.4-1.8m below Existing Ground Level

Grading Analysis

Sieve Size (mm)	Cumulative % Passing
53.0	
37.5	
36.5	
19.0	100
13.2	98
4.75	95
2.0	84
0.425	28
0.075	13

Atterberg Limits

Liquid limit :	36
Plasticity Index :	18
Linear shrinkage :	8.4

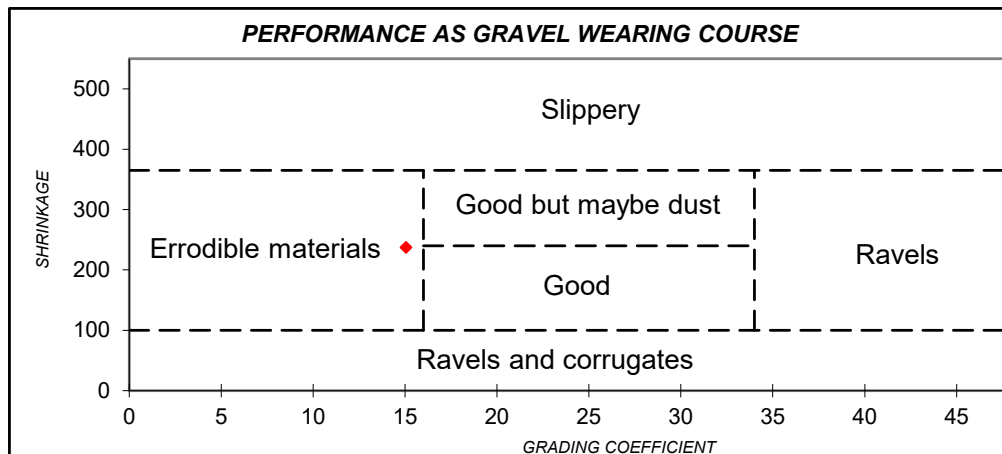


Material Classification

COLTO (1998) : <G9
U.S.C.S : It Brown Clayey sand
U.S.C.S : SC
AASHTO : A-2-6
Group Index : 0

Other Constraints

Grading Modulus : 1.75
Effective size : <0.075
Uniformity co-eff. : 1024
Curvature co-eff. : 194.4
Oversize Index : 0
Shrinkage Product : 237
Grading co-eff. : 15.1



ABBREVIATIONS

COLTO - Committee Of Land Transport Officials.
U.S.C.S - Unified Soil Classification System.
AASHTO - American Association Of State Highway Officials.

ADDITIONAL INFORMATION :

P.O Box 1766
12 Suikeriet Street
Central Park
Unit 57.1
Nelspruit
1200
NLA Member No. 241



Phezulu Geotechnical Civils

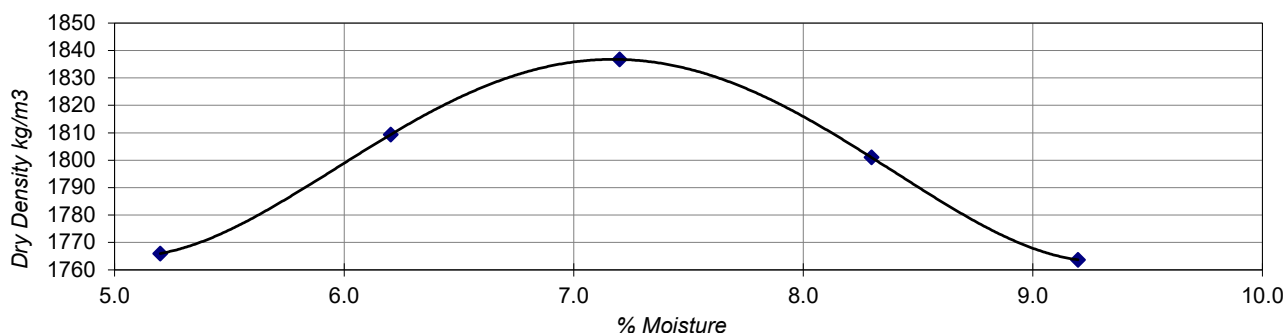
e-mail : xolani@phezulugc.co.za
Domain www.phezulugc.co.za
Tel : 013 004 0119
Cell : 071 897 3005
Fax : 086 543 8298
Reg. No. 2011/005646/23
Vat no. 4610267686

MODIFIED AASHTO & CALIFORNIA BEARING RATIO (CBR)

Client:	Lihuzu Projects	Date:	23-Apr-2021
Contract:	Access Culvert to Alexandria Motseleng Primary School		
Description:	Material sampled from TP 4 @ 0.4-1.8 m below Existing Ground Level		
Sample No.:	21406/4		

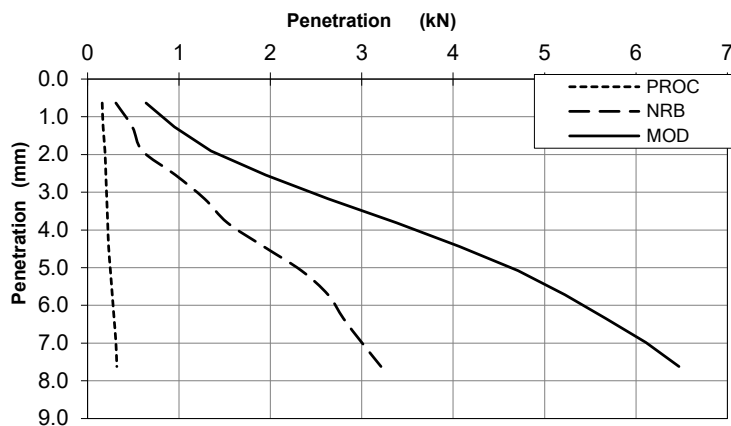
Modified AASHTO Test Results

Maximum dry density :	1837 kg/m³					
Optimum moisture content :	7.2 %					
Dry Density :	1809	1837	1801	1764	1766	0
Moisture Content :	6.2	7.2	8.3	9.2	5.2	0.0



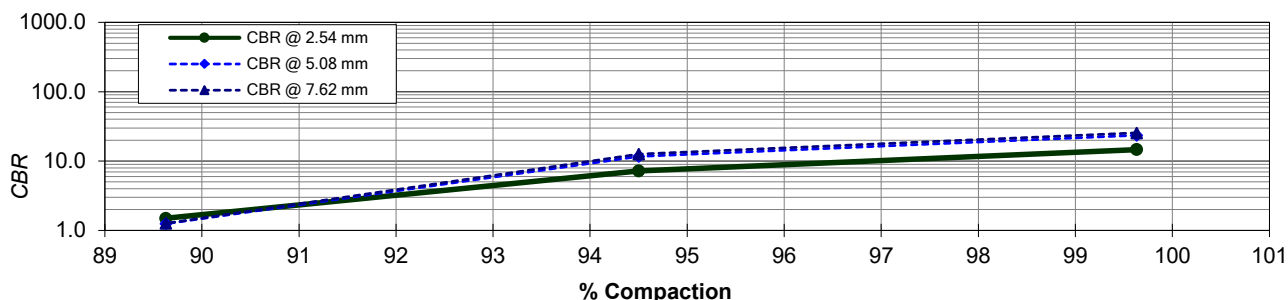
California Bearing Ratio (Penetration Readings & Graph)

Depth	Proc	NRB	Mod
0.635	0.16	0.31	0.64
1.270	0.17	0.49	0.95
1.905	0.19	0.60	1.35
2.540	0.20	0.96	1.95
3.175	0.21	1.28	2.63
3.810	0.22	1.53	3.38
4.445	0.23	1.93	4.07
5.080	0.25	2.34	4.71
5.715	0.27	2.63	5.22
6.350	0.29	2.80	5.67
6.985	0.31	3.00	6.11
7.620	0.32	3.21	6.47



California Bearing Ratio (Values & Graph)

% Compaction	100	98	97	95	93	90
CBR of 13.344 kN	15	12	10	8	4	2
CBR of 20.016 kN	25	19	16	13	6	1
CBR of 25.354 kN	27	20	18	14	6	2



Swell Readings

	Mod	N.R.B.	Proc.
Reading before swelling	1.00	1.00	1.00
Reading after swelling	1.05	1.16	1.24
% Swell	0.04	0.13	0.19



ROAD INDICATOR

Client : Lihuzu Projects

Date : 23-Apr-2021

Contract : Access Culvert to Alexandria Motseleng Primary School

Description : Material sampled from TP 4 @ 1.8-2.0 m below Existing Ground Level

Sample No : 21406/5

Sampled Depth : 1.8-2.0m below Existing Ground Level

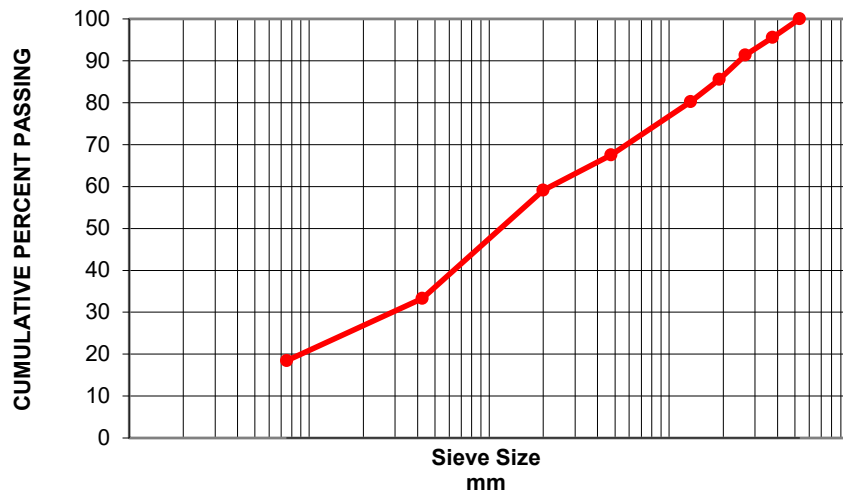
Grading Analysis

Sieve Size (mm)	Cumulative % Passing
53.0	100
37.5	96
36.5	91
19.0	86
13.2	80
4.75	68
2.0	59
0.425	33
0.075	18

Atterberg Limits

Liquid limit :	29
Plasticity Index :	15
Linear shrinkage :	6.9

GRADING ANALYSIS CURVE



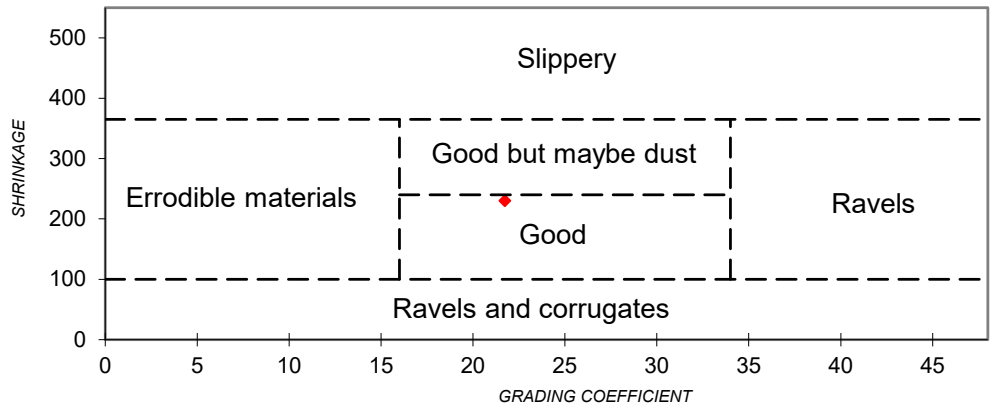
Material Classification

COLTO (1998) : G9
U.S.C.S : It Olive Clayey sand
U.S.C.S : SC
AASHTO : A-2-6
Group Index : 0

Other Constraints

Grading Modulus : 1.89
Effective size : <0.075
Uniformity co-eff. : 2184
Curvature co-eff. : 38.2
Oversize Index : 4
Shrinkage Product : 230
Grading co-eff. : 21.7

PERFORMANCE AS GRAVEL WEARING COURSE



ABBREVIATIONS

COLTO - Committee Of Land Transport Officials.
U.S.C.S - Unified Soil Classification System.
AASHTO - American Association Of State Highway Officials.

ADDITIONAL INFORMATION :

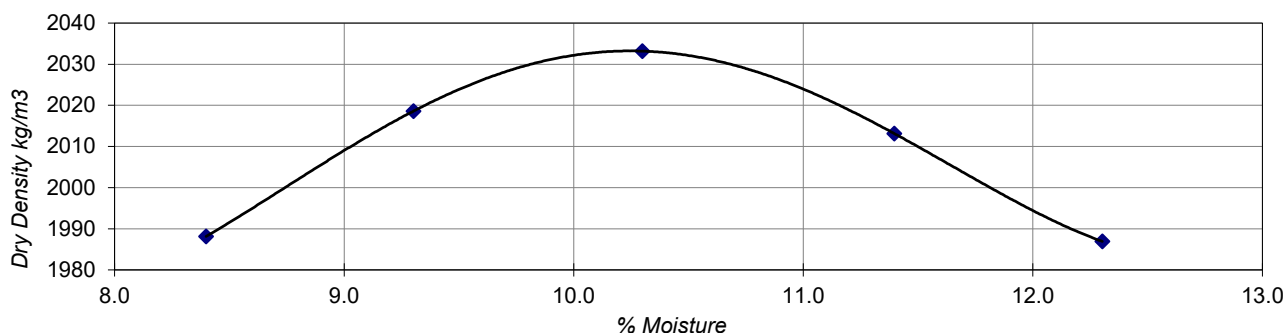


MODIFIED AASHTO & CALIFORNIA BEARING RATIO (CBR)

Client:	Lihuzu Projects	Date:	23-Apr-2021
Contract:	Access Culvert to Alexandria Motseleng Primary School		
Description:	Material sampled from TP 4 @ 1.8-2.0 m below Existing Ground Level		
Sample No.:	21406/5		

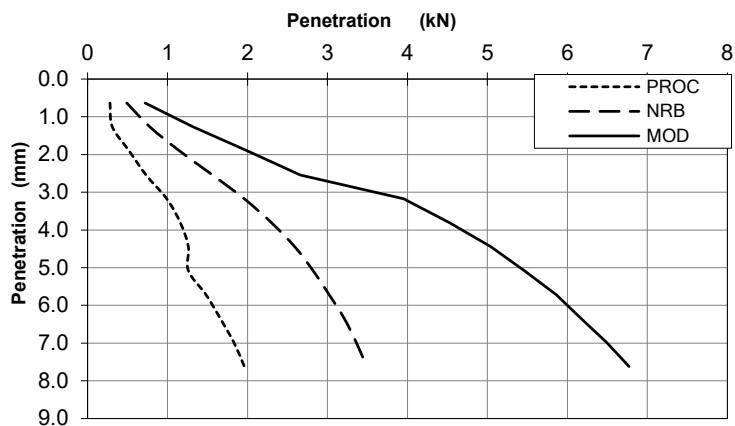
Modified AASHTO Test Results

Maximum dry density :	2034 kg/m³					
Optimum moisture content :	10.3 %					
Dry Density :	1988	2019	2033	2013	1987	0
Moisture Content :	8.4	9.3	10.3	11.4	12.3	0.0



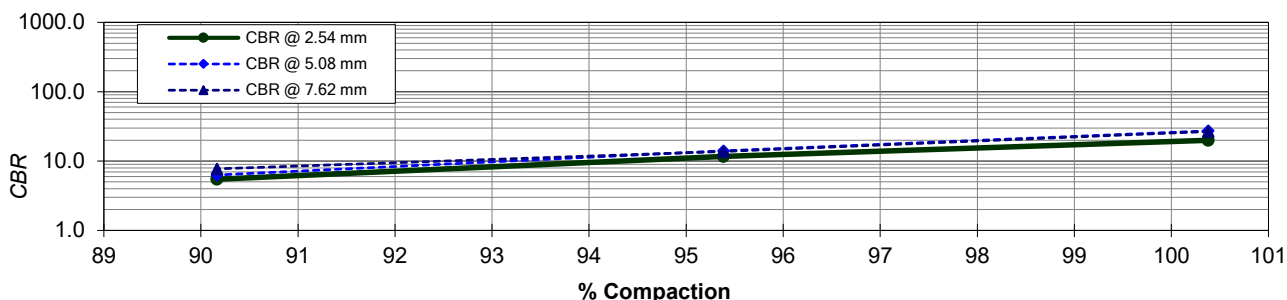
California Bearing Ratio (Penetration Readings & Graph)

Depth	Proc	NRB	Mod
0.635	0.28	0.49	0.72
1.270	0.31	0.78	1.32
1.905	0.52	1.15	2.00
2.540	0.73	1.56	2.66
3.175	0.99	1.96	3.95
3.810	1.16	2.30	4.53
4.445	1.26	2.59	5.04
5.080	1.26	2.82	5.46
5.715	1.48	3.02	5.86
6.350	1.66	3.21	6.17
6.985	1.83	3.36	6.49
7.620	1.96	3.49	6.77



California Bearing Ratio (Values & Graph)

% Compaction	100	98	97	95	93	90
CBR of 13.344 kN	19	15	14	11	8	5
CBR of 20.016 kN	26	20	17	13	10	6
CBR of 25.354 kN	25	19	17	13	11	8



Swell Readings

	Mod	N.R.B.	Proc.
Reading before swelling	1.00	1.00	1.00
Reading after swelling	1.60	2.10	3.09
% Swell	0.47	0.87	1.65