PAARDEVLEI SOLAR PHOTO-VOLTAIC FARM GEOTECHNICAL INVESTIGATION

FEBRUARY 2024

REVISION 00

FINAL REPORT

Prepared by:

JG AFRIKA (PTY) LTD

Cape Town
[redacted]

Project director: J.C. Norris

VERIFICATION PAGE	Form 4.3.1 Rev 13

TITLE:
PAARDEVLEI SOLAR PHOTO-VOLTAIC FARM GEOTECHNICAL INVESTIGATION

JGA REF. NO.	DATE:	REPORT STATUS
6047	08/02/2024	Final

CARRIED OUT BY:	COMMISSIONED BY:
JG AFRIKA (PTY) LTD **CAPE TOWN** [redacted] [redacted]	**INTEGRATION ENVIRONMENT & ENERGY** **GRAEFENBERG** [redacted] [redacted]

AUTHOR	CLIENT CONTACT PERSON
T Hlongwane	M Imran

SYNOPSIS

Geotechnical Investigation to establish the geological and geotechnical conditions for the proposed Paardevlei Solar PV Farm.

KEY WORDS:

Geology, bearing pressure, calcrete, residual shale, shale bedrock, thermal resistivity, DPSH, founding conditions, piled foundation.

QUALITY VERIFICATION

This report has been prepared under the controls established by a quality management system that meets the requirements of ISO9001: 2015 which has been independently certified by DEKRA Certification under certificate number 90906882

Verification	Capacity	Name	Signature	Date
Author	Engineering Geologist	T Hlongwane Pr.Sci.Nat	[redacted]	08/02/2024
Checked by:	Associate Geotechnical	K Singh Pr.Sci.Nat	[redacted]	08/02/2024
Authorised by:	Director Geotechnical	Jan Norris Pr.Eng.	[redacted]	08/02/2024

Filename:	6047 - Paardevlei Solar PV Farm - Final Geotechnical Report.docx

PAARDEVLEI SOLAR PHOTO-VOLTAIC FARM
GEOTECHNICAL INVESTIGATION

FINAL REPORT

TABLE OF CONTENTS

TABLES

FIGURES

APPENDICES

PAARDEVLEI SOLAR PHOTO-VOLTAIC FARM GEOTECHNICAL INVESTIGATION

FINAL REPORT

1 INTRODUCTION

This final geotechnical report presents the findings of a shallow geotechnical investigation undertaken by JG Afrika (Pty) Ltd, for the proposed photo-voltaic (PV) plant for the Paardevlei Solar PV Farm in Somerset West near Cape Town in the Western Cape Province. The project developers, Integration Environment & Energy, have identified 3No. land parcels, which are approximately 34 Ha (south-west), 38 Ha (north-west), and 80 Ha (east) in extent and forms part of this investigation. It is understood that the project developers have not yet finalised the position of the new substation, and hence the substation site was not investigated under this current assessment.

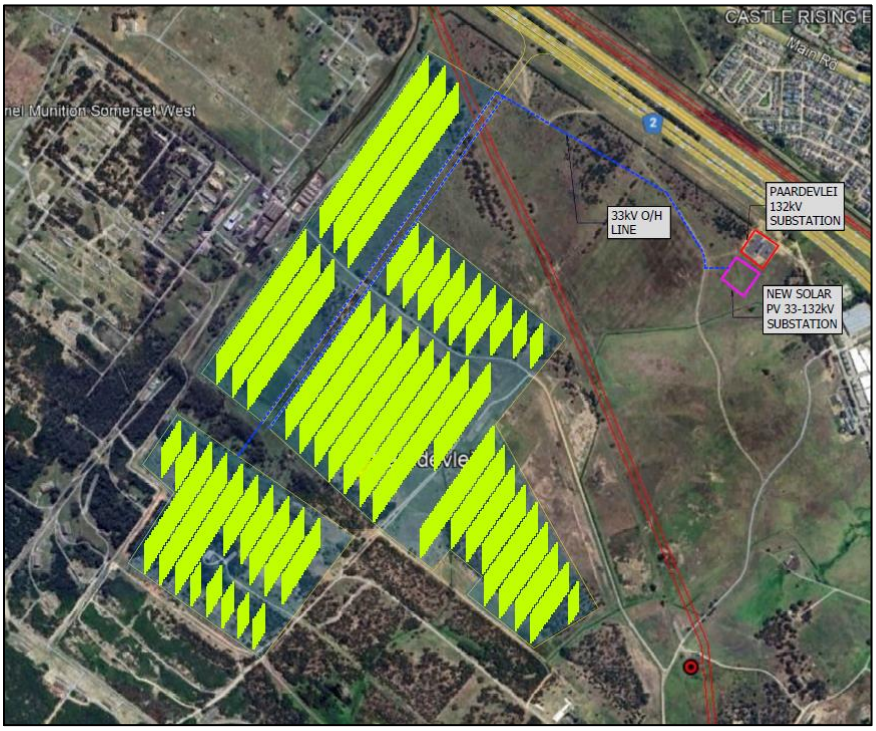


Figure 1-1: Proposed Paardevlei Solar PV Farm

2 TERMS OF REFERENCE

The appointment to proceed with the investigation is based upon JG Afrika's quotation referenced 5938-1053b entitled "Quotation to undertake a geotechnical investigation for the Paardevlei Solar PV project in Somerset West in the Western Cape Province," dated 31st August 2023. Integration Environment & Energy appointed JG Afrika via a signed service agreement letter, entitled "Framework Contract for Short Term Assignment" dated the 12th of April 2023.

2.1 Scope of works

The investigation seeks to give a general geotechnical evaluation of the proposed study site. The objectives of the geotechnical investigation were to assess the founding conditions for the proposed photovoltaic structures, ease of excavation, materials utilisation, electrical resistivity of the subsurface, earthworks requirements and overall site stability.

The methodology proposed in the quotation, made provision for the following scope of work:

- A total of twenty-nine (29No.) trial pits were mechanically excavated with a tractor-loader-backhoe (TLB) and profiled.
- A total of twenty-nine (29No.) Dynamic Probe Light (DPL) tests were conducted adjacent to the trial pit positions.
- One trial pit and DPL test could not be conducted at the location of TP6 and DPL6 due to the presence of possible buried subsurface explosive residuals.
- Fifteen (15No.) Dynamic Probe Super Heavy (DPSH) tests were conducted across the development site.
- Disturbed samples were taken from different subsurface horizons for laboratory analysis. The tests included Atterberg Limit determinations, sieve analysis, hydrometer, compaction/density testing, chemical testing, remoulded shear box testing, thermal resistivity testing, and corrosivity testing;
- Comments are made on the depth to bedrock and excavation conditions of the subsurface material.
- Recommendations on the proposed foundation option are provided.

2.2 Disclaimer

The interpretation of the overall geotechnical conditions across the site was based on observations and point information acquired from the respective investigation positions. Subsurface geotechnical conditions intermediate to these have been inferred by extrapolation, interpolation, and professional judgement. Consequently, whilst considered unlikely, there is a possibility of actual conditions encountered during construction being at variance to those inferred and for this reason it is recommended that the services of an engineering geologist or geotechnical engineer be retained on an *ad-hoc* basis during construction. The information and interpretations are given as a guideline only. There is no guarantee that the information given is totally representative of the entire area in every respect and no responsibility will be accepted for consequences arising out of the fact that actual conditions vary from those inferred.

3 SITE DESCRIPTION

3.1 Locality

The proposed Paardevlei Solar PV Farm is situated approximately 3 km south-east of Somerset Mall in the town of Somerset West in the Western Cape Province. Access to the site is via Ou Paardevlei Road, which is located north-east of the site. A Locality Plan indicating the site location is presented in Figure 1, **Appendix A**.

3.2 Topography and Land Use

The terrain across the site undulates from south-west to the north-east. The highest elevation on site is approximately 20 meters above mean sea level (mamsl) in the north-east. According to the 1:50 000 scaled Topographical Map Series (3418 BB) of Somerset West, there are no water bodies that traverse through the site. The Eerste Rivier is approximately 1.50 km west of the site and the wetland Paardevlei is approximately 1.00 km south-west of the site. A Site Plan is presented in Figure 2, **Appendix A**.

3.3 Climate

The study area is characterized by a warm-summer Mediterranean climate with a "**Csb**" classification according to the Köppen-Geiger climate classification. Somerset West receives a mean annual precipitation of 787 mm. The lowest average rainfall is received in February (20 mm) and the highest in June (141 mm), which is a seasonal variation of 121 mm.

The maximum midday temperatures for Somerset West ranges from 16.0°C in July to 26.4°C in February. The minimum temperatures for Somerset West ranges from 8.0°C in July to 17°C in February. Table 3-1 below, summarizes the climatic conditions.

The month with the highest daily hours of sunshine is December with an average of 10.8 hours of sunshine daily. The month with the lowest daily hours of sunshine is June, with an average of 6.2 hours of sunshine daily.

*Table 3-1**:** Summary of Climatic Conditions, Somerset West (information extracted from "Climate-Data.org")*

Months	Average Rainfall (mm)	Temperature (°C)			Average Daylight (Hours/day)
		Maximum	Minimum	Average	
January	23	26.1	16.7	21.1	3
February	20	26.4	17.0	21.3	3
March	23	24.9	15.9	19.9	3
April	64	22.3	13.6	17.5	5
May	95	19.1	11.3	14.8	7
June	141	16.4	8.8	12.4	8
July	127	16.0	8.0	11.7	8
August	107	16.1	8.3	12.0	8
September	70	17.6	9.4	13.3	7
October	47	20.3	11.6	15.7	5
November	43	22.2	13.2	17.4	4
December	27	24.6	15.5	19.8	4
Average	**-**	**21.0**	**12.4**	**16.4**	**5.4**

3.4 Vegetation

Scattered trees and shrubs are the predominant type of vegetative cover across the site. The regional biome within which the study site is located is classed as a “Fynbos Biome”.

4 GEOLOGY

According to the 1:250 000 scaled Geological Map Series (No.3318) of Cape Town, the study area is underlain by unconsolidated soils of Springfontyn Formation and Witzand Formation. The Springfontyn Formation is represented by brackish calcareous soil (**Qb**). The Witzand Formation is represented by partly calcified dune sand with calcrete lenses (**Qw**) and light grey to pale red coloured sandy soil (**Qg**).

During the investigation, non-engineered fill, colluvium, aeolian, residual shale horizon, calcrete and shale bedrock conditions were intersected. During a review of the relevant maps and field investigation, no structural lineaments in the form of faults were identified. A Geological Map illustrating the geology of the site is presented as Figure 3, **Appendix A**.

The study area is characterised by a climatic N-value that ranges from 2 to 5, implying that chemical decomposition and mechanical disintegration will occur.

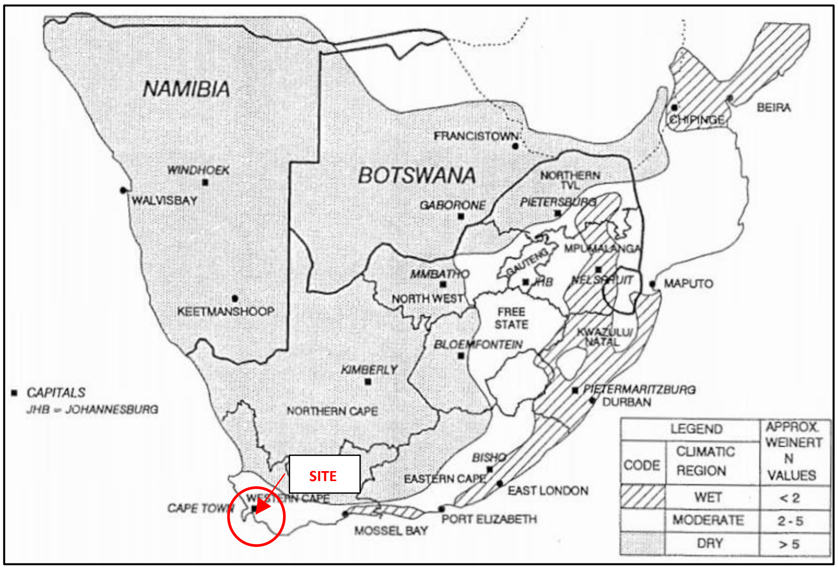


Figure 4-1: Micro-climate region of South Africa (TRH 14, 1996 adapted from Weinert, 1980)

4.1 Seismicity

According to the 1:6 000 000 Seismic Intensity Map of Southern Africa, the site falls within a level 7 (VII) area on the Modified Mercalli Scale (MMS). Peak horizontal ground acceleration values of greater than 200 cm/s^2 have been recorded, with a 10% probability of this being exceeded in a 50 year period. This implies that there is a 10% probability of an earthquake occurring within a 50 year period, with maximum horizontal ground acceleration values greater than 200 cm/s^2. According to the 1:6 000 000 Seismic Hazard Map of Southern Africa, a maximum ground acceleration (A) value of 0.0293g may be anticipated at the epicentre of the earthquake.

A Seismic Map indicating the location of site is presented as Figure 5 which is included in **Appendix A**.

5 HYDROGEOLOGY

According to the 1: 500 000 Hydrogeological Map (3126) of Cape Town, the study area is classed as an intergranular system (**a3**). This implies that the mechanism of groundwater recharge is via percolation through joints and fractures into the underlying bedrock. Median borehole yields range from 0.5 l/s to 2.0 l/s. A Hydrogeological Map indicating the location of the site is presented as Figure 4 which is included in **Appendix A**.

6 FIELDWORK

The fieldwork for this investigation was carried out over the period from the 04th of December to the 06th of December 2023. Trial pits were profiled and their locations recorded using a hand-held Garmin etrex GPS unit. All trial pits were back-filled in such a way as to minimize environmental damage, using the first-out last-in philosophy. Signage board indicating the presence of possible buried subsurface explosive residuals was encountered in the north-western portion of the site in vicinity of trial pit TP6. The location of the trial pits is indicated on Figure 2, **Appendix A**.

6.1 Trial Pits

A total of twenty-nine (29No.) trial pits, referenced TP1 to TP29, were mechanically excavated using a Tractor Loader Backhoe (TLB) to depths ranging from 0.50 to 3.00 m below Natural Ground Level (NGL). The subsoils were profiled by a suitably experienced and qualified Engineering Geologist according to the Guidelines for Soil and Rock Logging in South Africa (2002). The full trial pit profile descriptions are presented in **Appendix B**.

6.2 Dynamic Probe Light (DPL) Testing

A total of twenty-nine (29No.) DPL tests, referenced DPL1 to DPL29, were advanced to refusal depths ranging from 0.30 m to 2.10 m below NGL. The DPL tests were conducted adjacent to the trial pits (TP1 to TP29) in order to determine the subsoil consistency. DPL test results were used to empirically derive the Estimated Allowable Safe Bearing Pressures (EASBP) for the soils, according to the methods of Terzaghi & Peck, modified by Meyerhof (Craig, 1997). The results of the DPL testing are presented in **Appendix C**.

6.3 Dynamic Probe Super Heavy (DPSH) Testing

A total of fifteen (15No.) DPSH tests, referenced DPSH1 to DPSH15, were advanced to refusal depths ranging from 1.20 m to 7.60 m below NGL. DPSH testing is generally used to provide consistency of the subsoil and to empirically correlate DPSH ‘N’ values into SPT ‘N’ values. DPSH probing is a dynamic test whereby a 63.5 kg hammer is repetitively dropped over a distance of 760 mm onto an anvil driving a string of rods, at the end of which is attached a 50.5 mm diameter cone with an apex angle of 60°.

Figure 6-1: DPSH rig setup (left) and DPSH testing at Paardevlei Solar PV Farm site (right)

7 ENGINEERING GEOLOGY AND TERRAIN EVALUATION

A summary of the subsoils encountered across the study area is discussed below in terms of lithologies, consistency, and material properties:

Figure 7-1: General overview of the site showing typical vegetation cover on the south-west portion of the site

Figure 7-2: General overview of the showing typical vegetation cover on the north portion of the site

7.1 Subsoil Profile

- Non-Engineered Fill Horizon

A non-engineered fill horizon was intersected in trial pits TP2 and TP17 over a depth range of 0.00 to 1.90 m below NGL. The non-engineered fill horizon was profiled as abundant (>50%), sub-angular, sandstone pebble sized fragments, loosely compacted in a silt matrix with moist, brown, dense, clayey sandy silt with gravel sized fragments and builder's rubble.

- Colluvium Horizon

A colluvium horizon was intersected in all the excavated trial pits. The colluvium horizon was generally profiled as dry to moist, brown to reddish brown, loose to dense, fine grained sandy silt to gravelly silt. The colluvium horizon was generally intersected over a depth range of 0.00 to 2.00 m below NGL. The colluvium horizon was intersected in twenty-five trial pits, with the exception of TP2, TP9, TP12, and TP17.

- Aeolian Horizon

An aeolian horizon was intersected in trial pit TP9, TP11, TP12, TP19, and TP29. The aeolian horizon was intersected over a depth range of 0.00 to 2.70 m below NGL. The aeolian horizon was profiled as very moist to wet, white to light grey speckled light yellowish orange, loose to medium dense, clayey sand to silty medium grained sand.

- Residual Shale Horizon

A residual shale horizon was intersected in trial pit TP3 to TP8, TP20 to TP22, TP24 to TP26, TP28 to TP30. The residual shale was intersected over a depth range of 0.20 to 3.00 m below NGL. The residual shale was profiled as a moist to very moist, greyish green to light grey speckled light orange, intact, soft to firm, sandy clay.

Figure 7-3: Residual shale excavation spoil material (left) and aeolian excavation spoil material (right)

- Hardpan Calcrete

Hardpan calcrete conditions were only intersected in trial pit TP10, TP13 to TP16, and TP18. The hardpan calcrete was intersected over a depth range of 0.20 to 2.80 m below NGL. The hardpan calcrete was profiled as white, moderately weathered, fine to medium grained, moderately fractured, soft to medium rock strength.

- Shale Bedrock

Shale bedrock conditions were only intersected in trial pit TP1 to TP8, and TP20 to TP22, over a depth range of 0.30 to 2.30 m below NGL. The shale bedrock was profiled as greyish blue to olive brown, slightly to moderately weathered, fine grained, planar laminated, highly fractured, soft to medium rock strength.

Figure 7-4: Hardpan calcrete (left) and weathered shale bedrock spoil material (right)

An Engineering Geological Map indicating trial pit excavation conditions, DPL and DPSH refusal depths and the geological conditions on site is presented in Figure 8, **Appendix A**.

7.2 Subsoil Consistencies

7.2.1 DPL Results

Table 7-1 overleaf summarizes the results of the DPL testing, with the full set of DPL results presented in **Appendix C.**

Table 7-1: Summary of DPL Test Results Indicating EASBP Values

DPL No.	Depth (m)							
	0.3	0.6	0.9	1.2	1.5	1.8	2.1	2.4
	EASBP’s (kPa)							
DPL1	143	227	**Refusal**					
DPL2	67	**Refusal**						
DPL3	147	**Refusal**						
DPL4	213	260	**Refusal**					
DPL5	147	204	**Refusal**					
DPL6	**No DPL test was carried out due to the presence of possible buried subsurface explosive residuals**							
DPL7	175	241	274	**Refusal**				
DPL8	153	213	270	**Refusal**				
DPL9	213	241	296	**Refusal**				
DPL10	213	265	**Refusal**					
DPL11	119	251	289	**Refusal**				
DPL12	110	100	157	138	147	194	213	**Refusal**
DPL13	53	67	86	147	**Refusal**			
DPL14	86	**Refusal**						
DPL15	67	62	62	86	119	**Refusal**		
DPL16	72	110	119	147	204	223	**Refusal**	
DPL17	86	**Refusal**						
DPL18	204	**Refusal**						
DPL19	241	298	270	**Refusal**				
DPL20	204	265	355	**Refusal**				

DPL No.	Depth (m)							
	0.3	0.6	0.9	1.2	1.5	1.8	2.1	2.4
	EASBP's (kPa)							
DPL21	138	194	185	213	237	**Refusal**		
DPL22	175	232	**Refusal**					
DPL23	133	**Refusal**						
DPL24	91	**Refusal**						
DPL25	171	206	**Refusal**					
DPL26	185	218	**Refusal**					
DPL27	296	289	**Refusal**					
DPL28	223	204	**Refusal**					
DPL29	204	213	**Refusal**					
DPL30	190	227	194	204	223	**Refusal**		

7.2.2 DPL Test Results

The subsoils generally displayed uncorrected SPT “N” values ranging from 3 to 27 over a depth range of 0.00 m to 2.10 m below NGL. DPL refusal was encountered in all the DPL positions in the non-engineered fill horizon, aeolian horizon, residual shale horizon, hardpan calcrete and shale bedrock condition over a depth range of 0.30 m to 2.40 m below NGL.

7.2.3 DPSH Test Results

Table 7-2 below summarizes the results of the DPSH testing, with the full set of DPSH results presented in **Appendix D.**

Table 7-2: Summary of DPSH Test Results Indicating EASBP Values and Equivalent Uncorrected SPT “N” Values

DPSH No.	Depth (m)	Equivalent Uncorrected SPT “N” Value	EASBP (kPa)
DPSH1	0.0-0.30	10	144
	0.30-0.60	27	355
	0.60-0.90	31	404
	0.90-1.20	36	465
	1.20-1.50	DPSH Refusal	
DPSH2	0.0-0.30	15	205
	0.30-0.60	27	352
	0.60-0.90	30	397
	0.90-1.20	28	364
	1.20-1.50	30	394
	1.50-1.80	32	415
	1.80-2.10	DPSH Refusal	
DPSH3	0.0-0.30	12	163
	0.30-0.60	13	181
	0.60-0.90	15	205
	0.90-1.20	31	410
	1.20-1.50	32	417
	1.50-1.80	DPSH Refusal	
DPSH4	0.0-0.30	10	144
	0.30-0.60	13	181
	0.60-0.90	7	112
	0.90-1.20	16	220
	1.20-1.50	32	422
	1.50-1.80	DPSH Refusal	
DPSH5	0.0-0.30	8	123
	0.30-0.60	14	197
	0.60-0.90	18	240
	0.90-1.20	20	264
	1.20-1.50	31	408
	1.50-1.80	37	475
	1.80-2.10	DPSH Refusal	
DPSH6	0.0-0.30	9	134
	0.30-0.60	6	89
	0.60-0.90	8	123

DPSH No.	Depth (m)	Equivalent Uncorrected SPT "N" Value	EASBP (kPa)
	0.90-1.20	16	220
	1.20-1.50	11	154
	1.50-1.80	5	76
	1.80-2.10	7	101
	2.10-2.40	7	112
	2.40-2.70	14	197
	2.70-3.00	25	330
	3.00-3.30	DPSH Refusal	
DPSH7	0.0-0.30	14	189
	0.30-0.60	16	212
	0.60-0.90	18	240
	0.90-1.20	16	212
	1.20-1.50	16	212
	1.50-1.80	9	134
	1.80-2.10	12	172
	2.10-2.40	8	123
	2.40-2.70	12	172
	2.70-3.00	13	181
	3.00-3.30	18	246
	3.30-3.60	21	275
	3.60-3.90	20	264
	3.90-4.20	14	197
	4.20-4.50	20	270
	4.50-4.80	19	258
	4.80-5.10	18	246
	5.10-5.40	DPSH Refusal	
DPSH8	0.0-0.30	8	123
	0.30-0.60	3	63
	0.60-0.90	10	144
	0.90-1.20	26	348
	1.20-1.50	21	281
	1.50-1.80	22	291
	1.80-2.10	17	233
	2.10-2.40	17	233
	2.40-2.70	22	296
	2.70-3.00	23	309
	3.00-3.30	22	296
	3.30-3.60	21	286
	3.60-3.90	17	233
	3.90-4.20	19	258
	4.20-4.50	16	212
	4.50-4.80	16	220
	4.80-5.10	11	154
	5.10-5.40	5	76
	5.40-5.70	11	154
	5.70-6.00	12	163
	6.00-6.30	14	189
	6.30-6.60	20	270
	6.60-6.90	20	270
	6.90-7.20	31	410
	7.20-7.50	26	338

DPSH No.	Depth (m)	Equivalent Uncorrected SPT “N” Value	EASBP (kPa)
	7.50-7.80	DPSH Refusal	
DPSH9	0.0-0.30	3	63
	0.30-0.60	3	63
	0.60-0.90	7	101
	0.90-1.20	6	89
	1.20-1.50	3	63
	1.50-1.80	6	89
	1.80-2.10	7	101
	2.10-2.40	14	197
	2.40-2.70	16	212
	2.70-3.00	15	205
	3.00-3.30	19	258
	3.30-3.60	18	246
	3.60-3.90	18	246
	3.90-4.20	13	181
	4.20-4.50	7	101
	4.50-4.80	8	123
	4.80-5.10	16	220
	5.10-5.40	DPSH Refusal	
DPSH10	0.0-0.30	7	112
	0.30-0.60	3	63
	0.60-0.90	3	63
	0.90-1.20	7	112
	1.20-1.50	16	212
	1.50-1.80	27	358
	1.80-2.10	12	163
	2.10-2.40	7	112
	2.40-2.70	7	112
	2.70-3.00	7	101
	3.00-3.30	18	240
	3.30-3.60	25	330
	3.60-3.90	18	246
	3.90-4.20	18	240
	4.20-4.50	23	300
	4.50-4.80	32	422
	4.80-5.10	31	404
	5.10-5.40	DPSH Refusal	
DPSH11	0.0-0.30	19	253
	0.30-0.60	13	181
	0.60-0.90	10	144
	0.90-1.20	12	163
	1.20-1.50	12	172
	1.50-1.80	15	205
	1.80-2.10	16	220
	2.10-2.40	7	112
	2.40-2.70	13	181
	2.70-3.00	26	348
	3.00-3.30	DPSH Refusal	
DPSH12	0.0-0.30	12	172
	0.30-0.60	3	63
	0.60-0.90	5	76
	0.90-1.20	7	112

DPSH No.	Depth (m)	Equivalent Uncorrected SPT "N" Value	EASBP (kPa)
	1.20-1.50	14	189
	1.50-1.80	19	253
	1.80-2.10	16	212
	2.10-2.40	21	281
	2.40-2.70	32	421
	2.70-3.00	DPSH Refusal	
DPSH13	0.0-0.30	15	205
	0.30-0.60	8	123
	0.60-0.90	11	154
	0.90-1.20	24	314
	1.20-1.50	25	330
	1.50-1.80	19	253
	1.80-2.10	17	233
	2.10-2.40	18	246
	2.40-2.70	26	345
	2.70-3.00	25	330
	3.00-3.30	DPSH Refusal	
DPSH14	0.0-0.30	5	76
	0.30-0.60	18	246
	0.60-0.90	13	181
	0.90-1.20	15	205
	1.20-1.50	9	134
	1.50-1.80	6	89
	1.80-2.10	6	89
	2.10-2.40	14	189
	2.40-2.70	13	181
	2.70-3.00	17	233
	3.00-3.30	18	240
	3.30-3.60	19	258
	3.60-3.90	23	309
	3.90-4.20	26	345
	4.20-4.50	28	367
	4.50-4.80	28	361
	4.80-5.10	26	338
	5.10-5.40	DPSH Refusal	
DPSH15	0.0-0.30	9	134
	0.30-0.60	9	134
	0.60-0.90	12	163
	0.90-1.20	14	189
	1.20-1.50	12	163
	1.50-1.80	17	233
	1.80-2.10	17	233
	2.10-2.40	13	181
	2.40-2.70	10	144
	2.70-3.00	12	163
	3.00-3.30	14	189
	3.30-3.60	17	233
	3.60-3.90	17	233
	3.90-4.20	33	432
	4.20-4.50	DPSH Refusal	

The subsoils generally displayed uncorrected SPT "N" values ranging from 7 to 32 over a depth range of 2.10 m to 3.00 m below NGL. An average uncorrected SPT "N" value of 15 can be anticipated over a depth range of 2.10 m to 3.00 m below NGL. DPSH refusal was encountered in all 15No. DPSH positions in the aeolian horizon, residual shale horizon, hardpan calcrete and shale bedrock conditions over a depth range of 1.70 m to 7.80 m below NGL.

8 ELECTRICAL RESISTIVITY SURVEY (ERS) AND HYDROCENSUS

This section presents the results of a resistivity survey carried out for the proposed Paardevlei Solar PV Farm in Somerset West in the Western Cape. The purpose of the assessment was to determine the in situ electrical resistivity of the subsoils through inversion modelling.

8.1 Resistivity Survey Methodology

The resistivity survey was carried out over the period from the 13th of December to the 15th of December 2023. A total of fifteen (15No.) sounding locations designated by the geotechnical trial pit numbering were carried out at the site. The approximate positions of field test locations are presented in Figure 8-1 below.

Figure 8-1: Site Plan Showing Field Test Positions

Soil resistivity testing was carried out in accordance with the Wenner array configuration, according to the practise recommended by the South African Council for Scientific and Industrial Research (CSIR) National Physical Laboratory. Electrical resistivity soundings were performed to establish the inferred soil resistivity to an inferred depth of 20 m.

The Wenner electrical resistivity array consisted of two current electrodes (A and B) and two potential electrodes (M and N) set out about the sounding position (O). The current electrodes were used to pass current and the potential electrodes used to measure the potential difference during a measurement cycle. The four electrodes were driven into the ground at specified distances from the central sounding point (O) and set out in a straight line. For a given measurement, the spacing between any two adjacent electrodes (A and M, M and N, and N and B) was kept equal and designated (a).

Apparent resistivity measurements were taken while increasing the electrode spacing (a), allowing for deeper sounding penetration. Apparent resistivity measurements were taken at electrode spacings of 1, 2, 3, 5, 7, 10, 15, and 20 metres, corresponding to the same depths of inferred penetration below ground level.

8.2 Resistivity Results

The results of the resistivity soundings were modelled using a computer inversion model (IPI2WIN) that interprets the apparent resistivity variations of the ground by fitting internally generated model data to the field data through an inversion process. The field measurements for resistivity testing are presented in **Appendix F**.

The results of inversion modelling of Wenner soundings were reviewed and inferred layers and electrical resistivity presented. The inferred corrosivity potential was assigned to each layer. The American Water Treatment Association (ASTM) suggests a stringent limit for soils with a resistivity up to 10 Ω.m as being potentially aggressive and severely corrosive. The following ASTM[1] **steel pipe corrosion classification** has been used:

Resistivity (Ω.m)	Classification
0 - 10	very severely corrosive
10 - 20	severely corrosive
20 -50	moderately corrosive
50 -100	mildly corrosive
>100	very mildly corrosive

Inversion models presented in this report act as an illustrative mechanism and aid in interpretation of the subsoil conditions at each test location. The typical number of layers input into the models was three (3No.), with a maximum of four (4No.). It is possible that the interpretation of depths and resistivity values of deeper layers through inversion modelling may become inaccurate, as underlying or deeper sounding readings are absent. Modelling of the data will infer these layers to

---

[1] Report STP1013 of American Society for Testing Materials (ASTM), titled "Effects of Soil Characteristics on Corrosion", dated 1989, edited by Chalker and Palmer

continue to an infinite depth. It is also possible that variance of observed resistivity between sounding locations may occur. The inversion models are presented in **Appendix F**. The summary of inversion modelling is summarised in 8-1.

Table 8-1: Summary Results of Inversion Modelling

Sounding	Latitude	Longitude	Layer	Depth of Layer Base (mbgl)	Inferred Layer Resistivity (Ω.m)	Inferred Corrosivity
TP01	34.06601	18.80041	1	0.50	181	very mildly corrosive
			2	0.55	0.26	very severely corrosive
			3	>	1528	very mildly corrosive
TP03	34.06737	18.79651	1	0.50	409	very mildly corrosive
			2	11.10	27.8	moderately corrosive
			3	>	29210	very mildly corrosive
TP05	34.07025	18.79880	1	0.50	7.09	very severely corrosive
			2	0.84	9266	very mildly corrosive
			3	>	2.04	very severely corrosive
TP06	34.06993	18.79376	1	0.57	307.9	very mildly corrosive
			2	5.19	29.04	moderately corrosive
			3	>	219.2	very mildly corrosive
TP10	34.07419	18.79001	1	1.15	29.9	moderately corrosive
			2	2.22	5.11	very severely corrosive
			3	4.17	78	mildly corrosive
			4	>	4.68	very severely corrosive
TP12	34.07664	18.79155	1	1.84	30.7	moderately corrosive
			2	9.39	8.71	very severely corrosive
			3	>	6134	very mildly corrosive
TP15	34.07967	18.78704	1	2.34	829	very mildly corrosive
			2	7.51	15.5	severely corrosive
			3	>	8047	very mildly corrosive
TP17	34.08059	18.79256	1	1.45	190	very mildly corrosive
			2	3.01	5.99	very severely corrosive
			3	>	23059	very mildly corrosive
TP19	34.07857	18.79566	1	0.50	179	very mildly corrosive
			2	2.36	11.6	severely corrosive
			3	3.54	0.98	very severely corrosive
			4	>	1762	very mildly corrosive
TP20	34.07569	18.79736	1	0.70	2.844	very severely corrosive
			2	1.71	0.762	very severely corrosive
			3	>	40.69	moderately corrosive
TP21	34.07302	18.79807	1	0.73	31.63	moderately corrosive
			2	3.90	7.635	very severely corrosive
			3	>	53.09	mildly corrosive
TP23	34.07255	18.80274	1	1.83	10.5	severely corrosive
			2	16.60	21.2	moderately corrosive

Sounding	Latitude	Longitude	Layer	Depth of Layer Base (mbgl)	Inferred Layer Resistivity (Ω.m)	Inferred Corrosivity
			3	>	913	very mildly corrosive
TP24	34.07669	18.80130	1	2.76	1.64	very severely corrosive
			2	11.80	7.07	very severely corrosive
			3	>	1292	very mildly corrosive
TP26	34.07962	18.80266	1	2.90	1.4	very severely corrosive
			2	10.70	201	very mildly corrosive
			3	>	807	very mildly corrosive
TP27	34.08059	18.79988	1	0.50	26.5	moderately corrosive
			2	7.62	5.42	very severely corrosive
			3	29.40	602	very mildly corrosive
			4	>	5149	very mildly corrosive

> indicates inferred depth of final layer modelled as infinite

The results of inversion modelling are variable across the site. Typically, the results do indicate that the surface layer of variable thickness is of low resistivity (average 149 Ω.m), which is underlain by a second layer of variable thickness of high resistivity (average 640 Ω.m). Both these layers are then underlain by a horizon of classified as very high resistivity (average 4800 Ω.m) modelled to infinite depth. A statistical review of the data is difficult given the influence of variable geology, topography, depth to groundwater, and inferred saline groundwater conditions across the site.

It is preferred that the soil resistivity results are considered in isolation, and low resistivity results with corresponding high conductivity should have suitable earthing mechanisms and corrosion protection placed in the designs. The summary of the minimum, maximum and average values of the modelled layers is presented in Table 8-2.

Table 8-2: Summary Layer Statistics

Layer	Description	Minimum	Maximum	Average
1	Depth (m)	0.50	2.90	1.25
	Resistivity (Ω.m)	1.40	829	149
2	Depth (m)	0.55	16.6	6.30
	Resistivity (Ω.m)	0.26	9266	640
3	Resistivity (Ω.m)	0.98	29210	4799

Resistivity, although a major factor, is not the only consideration when determining the corrosivity of a soil on a metal or concrete object. Other considerations include pH, redox potential, sulphide content, moisture content, and chloride content. The resistivity values should be regarded as a first indication of corrosive potential. It is further noted that the expected elevated EC in the groundwater will influence the model outputs.

Conductivity is the inverse of the resistivity and soils with a high resistivity value will have a corresponding low conductivity value. Resistivity therefore indicates the ability of the media to carry corrosive currents. There generally exists a linear relationship between corrosivity of steel and the conductance of the medium around it. It is therefore expected that a medium with a high resistivity value will have a corresponding low corrosive nature. Aggressiveness of the subsoil profiles on concrete structures is partially related to the conductivity of the subsoils, and primarily to the chemical constituents present. Typical literature- based resistivity values for certain geological media are presented in Table 8-3.

Table 8-3: Literature Based Resistivity Values for Certain Geological Media

Material	Resistivity (Ω.m)
Igneous and Metamorphic Rocks	
Granite	$5x10^3$ - 10^6
Basalt	10^3 - 10^6
Slate	$6x10^2$ - $4x10^7$
Marble	10^2 - $2.5x10^8$
Quartzite	10^2 - $2x10^8$
Sedimentary Rocks	
Sandstone	8 - $4x10^3$
Shale	20 - $2x10^3$
Limestone	50 - $4x10^2$
Soils and Waters	
Clay	1 - 100
Alluvium	10 - 800
Groundwater (fresh)	10 - 100
Sea water	0.2

9 LABORATORY TEST RESULTS

In order to assess the engineering properties and the behavioural characteristics of the subsurface material encountered across the site, samples were retrieved and submitted to Steyn-Wilson Civil Engineering Testing Laboratories for testing. The following tests were carried out:

- 9No. Foundation Indicator (Grading, Hydrometer Analyses, and Atterberg Limits).
- 5No. Road Indicator (Grading analyses, and Atterberg Limits)
- 5No. Modified AASHTO density and California Bearing Ratio tests.
- 1No. Remoulded Shear Box.
- 1No. Standard consolidation.
- 1No. Falling Head Permeability.
- 5No. Thermal Resistivity.
- 6No. Basson Index: Corrosivity and Aggressivity.

Table 9-1: Summary of Foundation Indicator Test Results – Paardevlei Solar PV Farm

TP No.	Depth (m)	Description	Lithology	Particle Size Distribution (AASHTO)				Atterberg Limits (%)			MC (%)	Pot Exp (Van Der Merwe, 1964)
				Gravel	Sand	Silt	Clay	LL	PI	LS		
TP7	0.30 – 1.70	Gravelly sand	Residual Shale	25	41	14	20	31.4	14.2	7.4	2.0	Low
TP12	0.00 – 2.60	Silty sand	Colluvium	2	87	6	5	0	0	0	3.5	Low
TP16	0.50	Silty sand	Colluvium	2	88	9	1	0	0	0	0.3	Low
TP18	0.50	Gravelly sand	Hardpan Calcrete	9	79	8	4	0	0	0	0.5	Low
TP20	0.50	Clayey sand	Residual Shale	15	56	12	17	32	16.2	7.9	3.0	Low to Medium
TP26	1.20 – 2.90	Silty sand	Residual Shale	1	50	32	17	34.3	16.9	8.3	2.8	Medium
TP27	0.50	Silty sand	Colluvium	17	61	18	4	0	0	0	4.6	Low
TP29	1.70 – 2.20	Silty sand	Aeolian	2	92	4	2	0	0	0	0.5	Low
TP30	0.60 – 2.20	Clayey sand	Residual Shale	1	64	15	20	39.6	17.6	7.7	1.6	Medium

Key:	
LL = liquid limit	Pot Exp = potential expansiveness
LS = linear shrinkage	MC = moisture content
PI = plasticity index	m = meter

Table 9-2: Summary of Moisture Density Test Results – Paardevlei Solar PV Farm

TP No.	Depth (m)	Description	Lithology	Particle Size Distribution (AASHTO)			Atterberg Limits (%)			GM	MDD (kg/m^3)	OMC (%)	CBR Values					Material Class (COTO, 2020)
													Compaction MDD %					
				Gravel	Sand	Silt & Clay	LL	PI	LS				90	93	95	98	100	
TP1	0.60-0.90	Gravelly sand	Shale Bedrock	40	57	3	0	0	0	2.41	2173	8.2	10	16	23	37	50	**G6**
TP13	1.10-2.40	Clayey silty sand	Hardpan Calcrete	3	90	1	0	0	0	1.14	1672	12.4	8	12	16	23	29	**G8**
TP15	0.00-2.60	Clayey silty sand	Colluvium	1	86	13	0	0	0	1.15	1854	10.4	5	7	9	11	15	**G9**
TP19	0.90-2.00	Clayey silty sand	Aeolian	0	91	9	0	0	0	1.28	1755	12.3	8	10	12	15	17	**G8**
TP24	0.90-3.00	Sandy silty clay	Residual Shale	1	40	59	49	28	12.9	0.53	1846	12.3	1	1	1	1	1	**CBD**

Key:	
GM = grading modulus	Material Class = according to COLTO (2020)
LL = liquid limit	m = meter
LS = linear shrinkage	CBR = California bearing ratio
PI = plasticity index	MDD = Maximum dry density
CBD = could not be determined	OMC = Optimum moisture content

Table 9-3: Plasticity Index Range of Soil (Burmaster, 1949)

Plasticity Index	Description
0	Non-Plastic
1 – 5	Slightly Plastic
5 – 10	Low Plasticity
10 – 20	Medium Plasticity
20 – 40	High Plasticity
>40	Very High Plasticity

9.1 Grading Index and Moisture-Density Relationship

The colluvium horizon generally grades as having a major sand component with a minor silt component. According to the laboratory test results, a Plasticity Index **(PI)** value of 0 and a Linear Shrinkage **(LS)** value of 0.0% were attained. According to Burmaster (1949), the sampled material displays “Non-Plastic” soil properties. According to Van der Merwe (1964), the colluvium material generally has low potential expansivity. A **CBR** strength value of 9 was attained at 95 % of Mod AASHTO compaction. According to COTO (2020) the material classifies as a **G9 quality material**. The material is not suitable for use in construction but can be utilised for general fills and landscaping.

The aeolian horizon generally grades as having a major sand component with a minor silt component. According to the laboratory test results, a **PI** value of 0 and a **LS** value of 0.0% were attained. According to Burmaster (1949), the sampled material displays “Non-Plastic” soil properties. According to Van der Merwe (1964), the aeolian material generally has low potential expansivity. A **CBR** strength value of 12 was attained at 95 % of Mod AASHTO compaction. According to COTO (2020) the material classifies as a **G8 quality material**. The material is not suitable for use in construction but can be utilised for general fills and landscaping.

The residual shale generally grades as having a major sand component with a minor clay component in some samples, and grades as having a major silt and clay component with a minor sand component in some samples. According to the laboratory test results, **PI** values ranging from 16.2 to 17.6 and **LS** values ranging from 7.7 to 8.3% were attained. According to Burmaster (1949), the sampled material displays “Medium Plasticity” soil properties. According to Van der Merwe (1964), the material has “Low potential” to “Medium potential” expansivity. The attained **LS** values indicates that the residual shale will be subjected to minor shrinkage on drying out. A **CBR** strength value of 1 was attained at 95 % of Mod AASHTO compaction. According to COTO (2020) the material, the residual shale material could not be classified, and is therefore not suitable for use in construction.

The hardpan calcrete generally grades as having a major sand component with a minor gravel component. According to the laboratory test results, a **PI** value of 0 and a **LS** value of 0.0% were attained. According to Burmaster (1949), the sampled material displays “Non-Plastic” soil properties. According to Van der Merwe (1964), the hardpan calcrete generally has low potential expansivity. A **CBR** strength value of 16 was attained at 95 % of Mod AASHTO compaction. According to COTO (2020) the material classifies as a **G8 quality material**. The material is not suitable for use in construction but can be utilised for general fills and landscaping.

The shale bedrock generally grades as having a major sand component with a minor gravel component. According to the laboratory test results, a **PI** value of 0 and a **LS** value of 0.0% were attained. According to Burmaster (1949), the sampled material displays “Non-Plastic” soil properties. A **CBR** strength value of 23 was attained at 95 % of Mod AASHTO compaction. According to COTO (2020) the material classifies as a **G6 quality material**. The material is suitable for use in construction layerworks. It must be noted that shale bedrock weathers rapidly when exposed to elements.

9.2 Falling Head Permeability

One (1No.) drained shear box test was carried out from the material sampled from trial pit TP13 over a depth range of 1.10 to 2.40 m below NGL. The falling head permeability test results indicate that the hardpan calcrete sampled from trial pit TP13, obtained an average permeability value of 2.25×10^{-4} cm/s. According to Terzaghi et al. 1996, the permeability value indicates “poor” draining properties.

Table 9-4: Falling Head Permeability Test Results

Trial Pit	Depth (m)	Dry density (kg/m^3)	Moisture Content (%)	Permeability (cm/s)
TP13	1.10 – 2.40	1677	12.4	2.25×10^{-4}

9.3 Chemical Test – Basson Index

A guideline on the interpretation of the N_c value is given in Table 9-5, with a summary of Basson Index values presented in Table 9-6 below.

Table 9-5: Guidelines for Assessing Overall Aggressiveness (N_c)

N_c	Aggressiveness
Not greater than 300	None to mild
400 - 700	Mild to moderate
800 - 1000	High
= or > 1100	Very High

Table 9-6: Summary of Selected Determinants from Chemical Testing

TP No.	Depth (m)	Description	N_c	Corrosivity Indices – Corrosiveness Towards Steel	Basson Index – Aggressiveness Towards Buried Concrete	Recommendation based on N_c Results
TP9	0.50	Aeolian	**260**	**Corrosive**	**Aggressive**	Use concrete class as required for structural design
TP16	0.50	Colluvium	**502**	**Non-Corrosive**	**Aggressive**	Use concrete class as required for structural design

TP No.	Depth (m)	Description	N_c	Corrosivity Indices – Corrosiveness Towards Steel	Basson Index – Aggressiveness Towards Buried Concrete	Recommendation based on N_c Results
TP18	0.50	Calcrete – Bedrock	**163**	**Non-Corrosive**	**Aggressive**	Use concrete class as required for structural design
TP20	0.50	Residual Shale	**200**	**Corrosive**	**Aggressive**	Use concrete class as required for structural design
TP27	0.50	Shale - Bedrock	**345**	**Non-Corrosive**	**Aggressive**	Use concrete class as required for structural design

Based on the laboratory results, the overall aggressiveness (**N_c**) ranges from 163 to 502 for the material sampled across the Paardevlei Solar PV Farm development site. According to guidelines for assessing overall aggressiveness, the material generally indicates “None to Mild” and “Mild to Moderate” aggressiveness. The corrosivity indices indicates “Non-Corrosive” to “Corrosive” subsurface conditions. According to the Electrical Resistivity Survey (**ERS**) results, the subsurface conditions on site are generally “Very Mildly Corrosive” to “Very Severely Corrosive”.

The Basson Index (Corrosivity Indices) laboratory test is the most accurate test compared to the **ERS**. It is inferred that the subsurface conditions on site are variable and both “Non-Corrosive” to “Corrosive” subsoils were encountered. It is recommended that the design of subsurface structures should be designed for “Corrosive” subsurface conditions.

The sampled material is generally aggressive towards buried concrete and fibre cement pipes, and is corrosive towards steel.

A full set of the resistivity survey results is included in the “Resistivity Survey” report which is presented in **Appendix F**.

9.4 Thermal Dissipation Capacity

Thermal conductivity is the measure of material’s ability to conduct heat, and it is proportional to the moisture content and inversely proportional to the thermal resistance. A summary of the thermal resistivity results is presented in Table 9-7 below.

Table 9-7: Summary of Thermal Resistivity Results

TP No.	Depth (m)	Lithology	Moisture Content (%)	Thermal Resistivity (K.m/W)	Thermal Conductivity (W/m.K)
TP9	0.50	Aeolian	0.50	9.3168	**0.1073**
			2.00	7.0922	**0.1410**
TP16	0.50	Colluvium	0.50	8.6705	**0.1153**
			2.00	6.4655	**0.1547**
TP18	0.50	Hardpan Calcrete	0.50	6.2762	**0.1593**

TP No.	Depth (m)	Lithology	Moisture Content (%)	Thermal Resistivity (K.m/W)	Thermal Conductivity (W/m.K)
			2.00	5.4348	**0.1840**
TP20	0.50	Residual Shale	0.50	6.4655	**0.1547**
			2.00	5.9172	**0.1690**
TP27	0.50	Colluvium	0.50	8.0429	**0.1243**
			2.00	6.1475	**0.1627**

A total of five (5No.) thermal resistivity tests were conducted across the Paardevlei Solar PV Farm site. The sampled material was retrieved at a fixed depth of 0.50 m below NGL corresponding to approximate cable burial depths. The test results generally indicate that at lower moisture contents (0.50%), relatively higher thermal resistivity values were obtained. Conversely, at higher moisture contents (2.0%) lower thermal resistivity values were obtained.

According to the thermal resistivity test results for the Paardevlei Solar PV Farm development site, the thermal resistivity of the sampled material ranged from 5.4348 to 7.0922 K.m/W at a test moisture content of 2.0%, which is representative of *in-situ* moisture conditions.

Thermal conductivity is the inverse of thermal resistivity as such high thermal resistivity values will have a corresponding low thermal conductivity value. At a moisture content of 2.0%, the material averaged a thermal resistivity value of 6.21 K.m/W and thermal conductivity value of 0.16228 W/K.m. Thermal bedding material must take these values into account.

According to SANS 10198-5:2004 "The selection, handling, and installation of electric power cables of rating not exceeding 33 kV: Determination of thermal and electrical resistivity of soil", when thermal resistivity of the soil is high, cables will need to be derated so that the cable temperature does not exceed the design value. SANS 10198:5 further suggest that stabilised cable surrounding should ideally have a dried out thermal resistivity ranging from 1.20 to 1.50 K.m/W provided adequate compaction is achieved.

The thermal resistivity of the material on site exceeds the ideal value of 1.20 to 1.50 K.m/W.

9.5 Remoulded Drained Shear Box

One (1No.) drained shear box test was carried out from the material sampled from trial pit TP13. The shear box test results indicate that the hardpan calcrete has an internal effective friction angle (ϕ') value of 39.4° and effective cohesion (c') value of 0.0 kPa. It is recommended that a value of 35° and 0 kPa, be used for the effective friction and cohesion values respectively for the hardpan calcrete.

Based on the DPSH and DPL test results which indicates the aeolian horizon has a medium dense consistency. it is inferred that the aeolian horizon has an effective internal friction angle of 30° and an effective cohesion of 0 kPa.

Table 9-8: Remoulded Drained Shear Box Test Results

Trial Pit	Depth (m)	Description	Effective Internal Friction Angle (°)	Effective Cohesion (kPa)
TP13	1.10 – 2.40	Hardpan Calcrete	39.4	0.0

9.6 Standard Consolidation

One (1No.) standard consolidation test was carried out from the <u>residual shale horizon</u> material sampled from trial pit TP7 over a depth range of 0.30 – 1.70 m below NGL. The standard consolidation test results indicate a consolidation settlement ranging from 57.4 to 68.6 mm for foundation pressures ranging from 50 to 200 kPa in the clayey gravelly sand residual shale horizon over a depth range of 0.30 to 1.70 m below NGL. Based on the estimated consolidation settlement, the residual shale horizon on site is <u>highly compressible</u>.

Deep residual shale was encountered on the south-eastern portion of the site. Based on the laboratory results, the clayey residual shale is compressible and has medium potential expansivity soil properties. It is recommended that no structure be founded directly on the residual shale horizon without undertaking ground improvement measures.

Figure 9-1: Residual shale excavation spoil adjacent to trial pit TP7 (left) and residual shale excavation spoil adjacent to trial pit TP25

Table 9-9: Summary of Standard Consolidation Test Results

Sample No.	Depth (m)	Material Origin	Assumed Foundation Pressure (kPa)	Thickness of clay layer (m)	Standard Consolidation	
					Volume of Compressibility (m^2/kN)	Estimated Consolidation Settlement (mm)
TP7	0.30 – 1.70	Residual Shale	50kPa	1.40	8.2x10^{-4}	57.4
			100kPa		4.9x10^{-4}	68.6
			200kPa		2.4x10^{-4}	67.2
$m_v = (\frac{1}{1+e_0})(\frac{e_0-e_1}{\sigma'_1-\sigma'_0})$						

10 GEOTECHNICAL APPRAISAL

10.1 PV Plant Site - Allowable Bearing Pressures

A total of fifteen (15No.) DPSH tests were carried across the Paardevlei Solar PV Farm. The subsoils generally displayed uncorrected SPT “N” values ranging from 7 to 32 over a depth range of 2.10 m to 3.00 m below NGL. An average uncorrected SPT “N” value of 15 can be anticipated over a depth range of 2.10 m to 3.00 m below NGL. DPSH refusal was encountered in all 15No. DPSH positions in the aeolian horizon, residual shale horizon, hardpan calcrete and shale bedrock conditions over a depth range of 1.70 m to 7.80 m below NGL.

Based on DPL test results, the subsoils generally displayed uncorrected SPT “N” values ranging from 3 to 27 over a depth range of 0.00 m to 2.10 m below NGL. DPL refusal was encountered in all the DPL positions in the non-engineered fill horizon, aeolian horizon, residual shale horizon, hardpan calcrete and shale bedrock condition over a depth range of 0.30 m to 2.40 m below NGL.

10.2 Ground Stability

The study site is underlain at depths by non-engineered fill, colluvium, aeolian, residual shale horizon, hardpan calcrete and weathered shale bedrock. Colluvium horizon was generally intersected across the upper soil profile on site. The DPL test results, indicates that the unconsolidated aeolian horizon is generally medium dense in consistency.

It is recommended that areas in which the vegetation is removed, be suitably revegetated soon after construction so as to prevent excessive wind erosion. No signs of slope instability were observed during the investigation.

10.3 Excavation Conditions

“Soft” excavation conditions can be anticipated in the non-engineered fill, colluvium, aeolian, residual shale horizons, and soft bedrock conditions (calcrete and shale) over a depth range of 0.00 m to 3.00 m below NGL. “Intermediate” excavation conditions can be anticipated in the medium rock strength bedrock (calcrete and shale) over a depth range of 0.70 m to depths greater than 3.00

m below NGL. “Hard” excavation and “Boulder” excavation conditions are not anticipated over a depth range of 0.00 to 3.00 below NGL. Excavation classes according to COTO (2020) are described in Table 10-1.

Table 10-1: Summary of Excavation Conditions (COTO, 2020)

Class of Excavation	Definition
Soft	Material that can be efficiently excavated, without prior ripping by the following equipment: • Bulldozer with a mass of at least 22 tons and an engine developing approximately 145 kW at the flywheel. • A tractor-scraper unit with a mass of at least 28 tons and an engine developing approximately 245kW at the flywheel, pushed by a bulldozer during loading (35 tons, 220 kW). • Track-type front end loader with a mass of at least 22 tons and an engine developing approximately 140 kW at the flywheel.
Intermediate	Material that can be efficiently ripped by a bulldozer with a mass of at least 35 tons when fitted with a single tine ripper and an engine developing approximately 220 kW at the flywheel.
Hard	Material that cannot be efficiently ripped by a bulldozer equivalent to that described for Intermediate Excavation and requires blasting.
Boulder Class A	Material containing in excess of 40% by volume of boulders between 0.03 m³ and 20 m³ in size, in a matrix of softer material or smaller boulders.
Boulder Class B	Materials containing 40% or less by volume of boulders ranging from 0.03 m³ to 20 m³ in size, in a matrix of soft material or smaller boulders

10.4 Cut and Fill Slopes

It is recommended that all earthworks be carried out in accordance with SANS 1200DB: 1989, as amended from time to time. Temporary support for the proposed structures will be required for depths exceeding 1.50 m below NGL. This must be assessed on site by the contractor’s duly appointed “competent person” as required by the Construction Regulations 2003.

Fill embankments should not exceed 1V:2H units (26°). Fill heights of greater than 1.50 m will need more detailed geotechnical analysis in order to determine the slope stability and need for subgrade treatment.

Trenches should not exceed 1V:2H units (26°) in the non-engineered fill, colluvium and aeolian horizon for depths of up to 1.50 m. The sand is unstable when unretained, therefore, we recommend 1V:3H (18°) slope where cut batters are required. Trenches should not exceed 1V:1.75H units (30°) in the residual shale horizon for depths of up to 1.50 m. Trenches should not exceed 1V:1H units (45°) in the calcrete and shale bedrock for depths of up to 1.50 m. Trenches to be shored where groundwater seepage is intersected or unstable sidewalls are observed.

10.5 Groundwater and Drainage

Groundwater seepage was only intersected in trial pit TP29 at a depth of 2.20 m below NGL. The development area undulates, which promotes free drainage towards non-perennial features and as such minimal landscaping and drainage measures will be required. Buoyancy effects are not anticipated at the Paardevlei Solar PV Farm development site.

It is imperative that appropriate drainage measures be implemented throughout the development to ensure that surface water is diverted away from the vicinity of the proposed structures and its foundations. This is to ensure that the integrity of the structure is not compromised due to lowered subsoil strength that could lead to differential settlement. Surface run-off should therefore be diverted away from the foundation via subsurface drains.

10.6 Erosion Control

The colluvium and aeolian horizons are potentially erodible and susceptible to wind erosion once the covering grassland vegetation is disturbed. It is recommended that areas in which the vegetation is removed be suitably revegetated soon after construction so as to prevent excessive wind erosion.

11 FOUNDATION RECOMMENDATIONS

11.1 Solar PV Modules

Due to the presence of non-engineered fill, colluvium, aeolian, residual shale horizon, and bedrock conditions (calcrete and shale) across the Paardevlei Solar PV Farm study area over a depth range of 0.00 to 3.00 m below NGL, consideration can be given to a combination of driven piles and pre-bored holes for piled structural foundations.

11.2 Driven Piles

Rammed piles can be considered in areas underlain by deep aeolian horizon. These areas are illustrated on the Engineering Geological Map, **Figure 8**, showing extrapolated geotechnical conditions.

11.3 Bored Piles

Pre-bored piles can be considered in areas underlain by hardpan calcrete and shale bedrock conditions. Pre-bored pile options include; piles sleeved into bedrock and concrete encased piles. These areas are illustrated on the Engineering Geological Map, **Figure 8**, showing extrapolated geotechnical conditions.

The structural steel piles are anticipated to be either ‘H’, ‘I’ or ‘C’ section piles.

11.3.1 Pre-bored Holes - Piles Sleeved into Bedrock

This involves the use of small diameter percussion bored piles sleeved into bedrock. Embedment depths typically varying between 1.50 m to 5.00 m below NGL. Embedment depths may vary depending on the hardness of the substrata. This pile option offers the advantage of founding the end-bearing pile on a competent stratum.

11.3.2 Pre-bored Holes – Concrete Encased Piles

This method entails pre-drilling small diameter percussion bored piles. Thereafter, concrete is pumped and the steel piles are set within the pre-bored soil column. The piles should extend to at least 5.0 m below NGL or to the optimised embedment depth as directed by the design engineer.
This option offers the advantage of embedding the pile in concrete, offering better pull-out resistance.

Due to the consolidation risks that are associated with the clayey residual shale horizon, rammed piled are not feasible in areas underlain by deep residual shale. It is recommended that bored piles be used in areas that are underlain by deep residual shale horizon. Piles in the clayey deep residual shale should extend to depths in excess of 5.0 m below NGL. Down drag from the consolidation of the surrounding residual shale should be taken into consideration in the pile design.

11.4 Panel Foundations

It is anticipated that the photovoltaic structures will impose relatively light foundation loads, but will exert significant uplift and forces due to persistent wind loads.

The minimum pile embedment depth is calculated from the **base resistance** and **shaft resistance**. The base resistance is a function of the shear strength and unit weight of the *in-situ* soil and the area of the pile.

The shaft resistance is a function of the interface friction angle (δ′), effective stress (σ′) acting normal to the pile and the coefficient of lateral earth pressure (*K*). The shaft resistance may be calculated using the following formulae:

$$Q_{su} = K.\sigma^{'} tan\delta' \qquad [1]$$

Where; $K = \frac{K}{K_0} = 1,$ δ′ = 0.75 ϕ′

The final pile embedment depth of the foundations, should account for total compression loads as a result of the self-weight of the panel structure and the wind loads exerted on the solar panels. Total tension loads should account for wind uplift forces that are greater than normal.

11.5 Loading

The loading imposed on the piles includes the self-weight of the panels and piles, wind load imposed on the panels and the load applied by the daily tracking unit. At the time of writing this report, no loads were available. The loads include the following:

- Vertical Direction:
    - $Fv_{central\_down}$ = downward load on central pile
    - $Fv_{central\_uplift}$ = uplift load on central pile
    - Fv_{end_down} = downward load on end pile
    - Fv_{end_uplift} = uplift load on end pile
    - $Fv_{motor\ support}$ = downward on motor foundation
- Horizontal Direction:
    - $Fh_{central}$ = central pile
    - $Mth_{central}$ = moment of central pile
    - $Fh_{end\ pile}$ = end pile
    - Fh_{motor} = motor foundation

These loads are generally applied to theoretical formulae in order to estimate the vertical settlement, horizontal displacement, rotation and minimum embedment depth of the piles. The calculations are generally carried out according to the Eurocode 7 Design Approach 1b standards.

12 CONCLUSION

The foregoing report presents the findings and recommendations from a geotechnical investigation conducted for the Paardevlei Solar PV Farm in Somerset West, Western Cape Province.

- The development area is overlain by non-engineered fill, aeolian, and residual shale horizon which is generally underlain by calcrete and shale bedrock conditions.
- Hardpan calcrete conditions were generally intersected in the south-west portion of the site over a depth of 0.20 m to 2.80 m below NGL.
- Shale bedrock conditions were generally intersected in the north-east portion of the site over a depth range of 0.30 m to 2.30m below NGL.
- Groundwater seepage was only intersected in trial pit TP29 at a depth of 2.20 m below NGL.
- “Soft” excavation conditions can be anticipated in the non-engineered, colluvium, aeolian and residual shale horizon and soft bedrock conditions (calcrete and shale) over a depth range of 0.00 to 3.00 m below NGL.
- “Intermediate” excavation conditions can be anticipated in the medium rock strength bedrock (calcrete and shale) over a depth range of 0.70 m to depths greater than 3.00m.
- “Hard” excavation and “Boulder” excavation conditions are not anticipated on site for depths up to 3.00 m below NGL.
- The colluvium horizon generally grades as having a major sand component with a minor silt component.
- The residual shale horizon generally grades as having a major sand component with a minor clay and silt component in some samples, and grades as having a major silt and clay component and a minor sand component in some samples.
- The sampled calcrete material classifies as a G8 quality material, and is not suitable for use in construction but can be utilised for general fills and landscaping.
- The residual shale displays “low” to “medium” potential expansivity and is compressible.
- The colluvium, aeolian horizon, and hardpan calcrete displays “low” potential expansivity.
- Test results generally indicates that at lower moisture contents, relatively higher thermal resistivity values were obtained, and at higher moisture contents, lower thermal resistivity values were obtained.

- An average thermal resistivity value of 6.21 K.m/W and an average thermal conductivity value of 0.16228 W/ K.m were attained at a moisture content of 2.0%.
- The Basson Index laboratory test indicates “Non-Corrosive” to “Corrosive” subsurface conditions.
- It is recommended that a combination of driven piles and bored piles be considered for the PV plant structures.

13 REFERENCES

- Brink, A.B.A. (1985). Engineering Geology of Southern Africa. Post-Gondwana Deposits. Building Publications: Pretoria.

- Campbell, G.S. (2008). Measuring and Modelling Thermal Properties of Porous Materials. Virtual Seminar.

- Jennings, J. E, Brink, A. B. A and Williams, A. B. (1973). Revised Guide to Soil Profiling for Civil Engineering Purposes in Southern Africa. Transactions of the South African Institution of Civil Engineers, Volume 15, Number 1.

- SAPEM Chapter 3 (2014). South African Pavement Engineering Manual, Materials Testing, Chapter 3, pp.8.

- SANS 1200 D (1988). Standardised Specification for Civil Engineering Construction, Section D: Earthworks. South African National Standards.

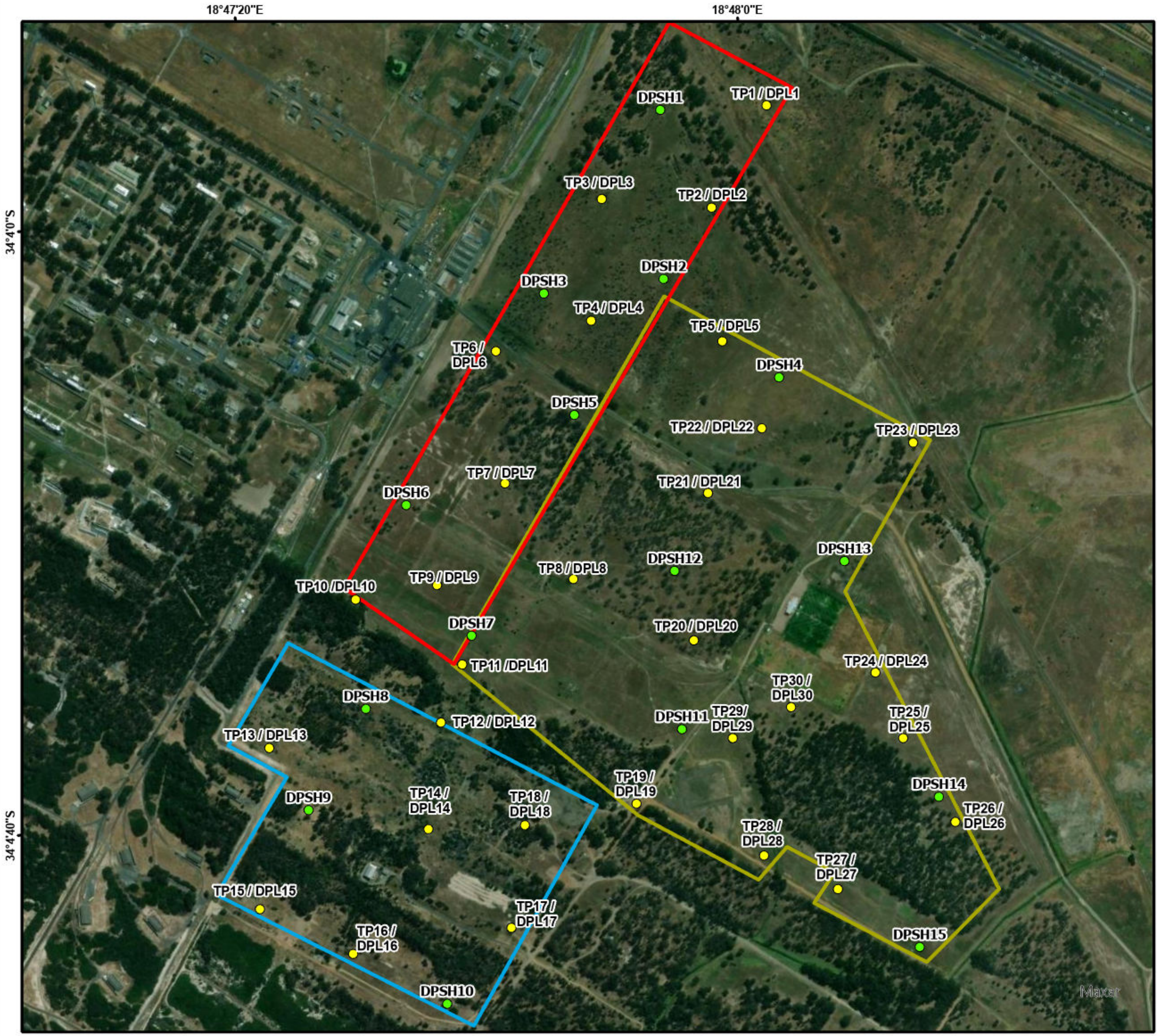
- Terzaghi, K., Peck, R. B., & Mesri, G. (1996). *Soil mechanics in engineering practice*. John Wiley & Sons, pp 73.

- TRH 14 (1985). Guidelines for Road Construction Materials, Committee of State Road Authorities, pp.1-57.

- TRH 14 (1996). Structural Design of Flexible Pavements for Interurban and Rural Roads, Technical Recommendations for Highways, p.40.

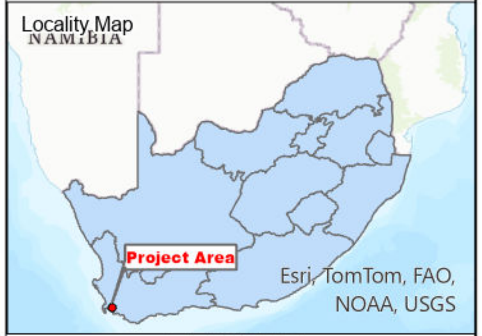
- oOo—

Appendix A: Figures



Paardevlei Solar PV Farm

SITE MAP



LEGEND

- ● DPSH
- ● TP/DPL
- ▭ Area 34 ha
- ▭ Area 38 ha
- ▭ Area 80 ha

Figure 2

Production Date: 24 January 2024
Coordinate System: WGS84

Kilometers
0 0.1 0.2 0.3 0.4

N

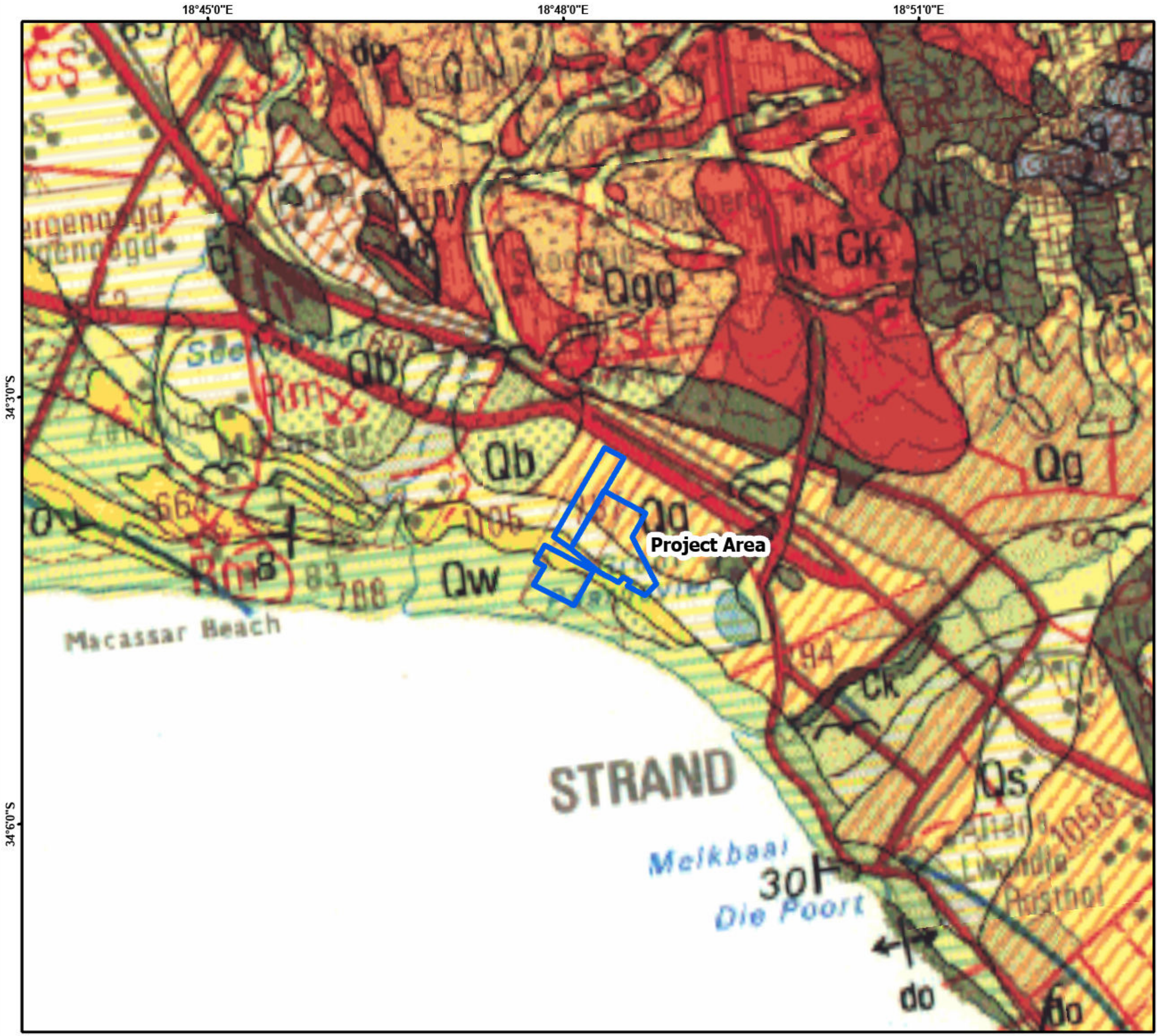
SCALE
1: 11 000

Compiled By:

JG AFRIKA

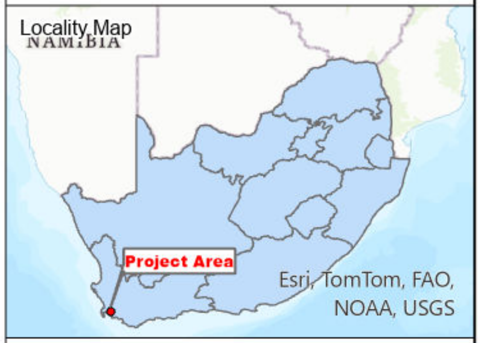
[redacted]

Designed and detailed under the controls established by our quality management system that meet the requirements of ISO 9001:2015 which has been independently certified by DEKRA Certification.



Paardevlei Solar PV Farm

GEOLOGY



Esri, TomTom, FAO, NOAA, USGS

LEGEND

▭	Project Area
Qw	Partly calcified dune sand with calcrete lenses
Qg	Light-grey to pale-red sandy soil
Qb	Brackish, calcareous soil

Figure 3

Production Date: 24 January 2024
Coordinate System: WGS84

Kilometers
0 0.85 1.7 2.55 3.4

N

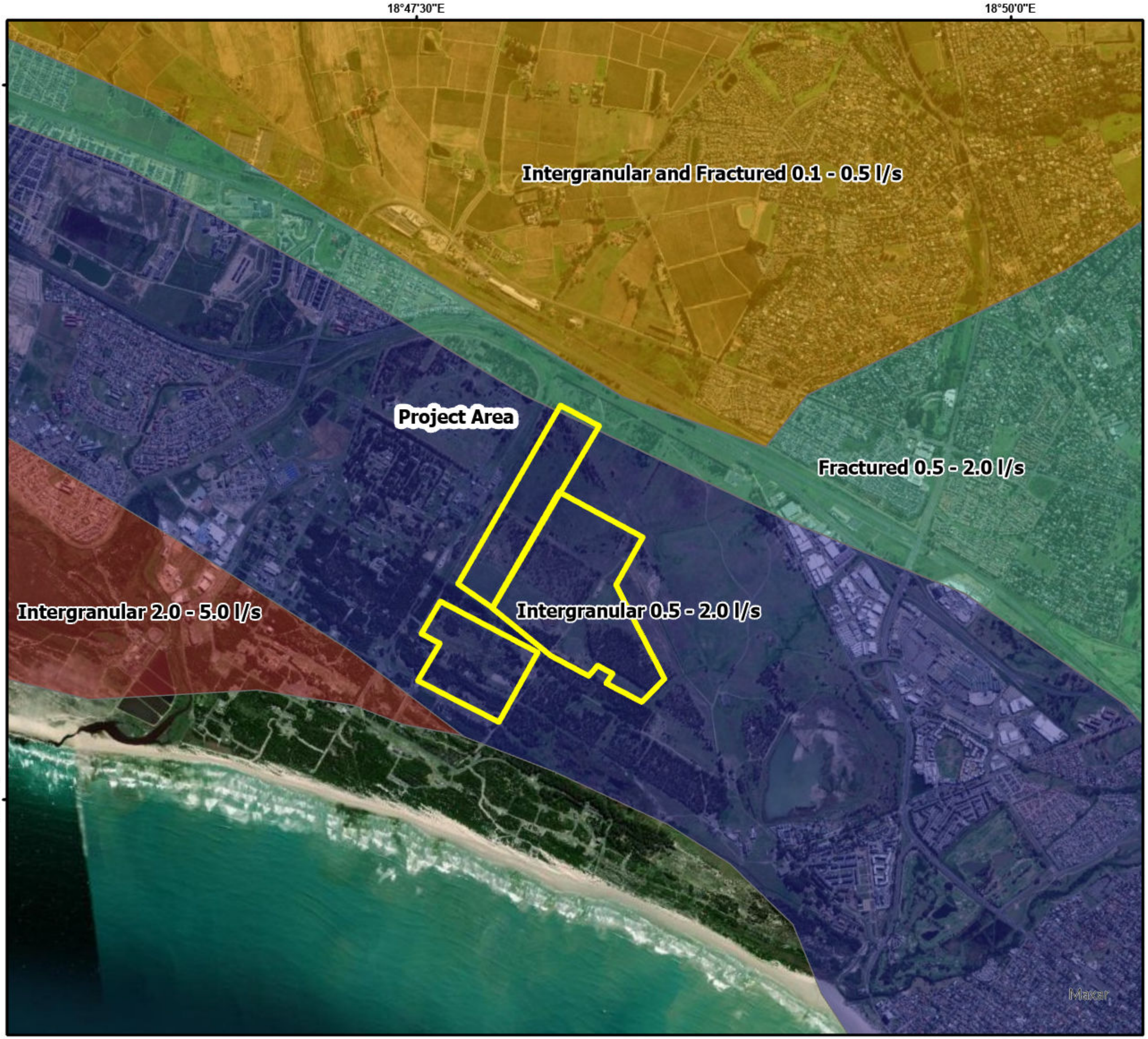
SCALE
1: 70 000

Compiled By:

JG AFRIKA
EXPERIENCE QUALITY INTEGRITY

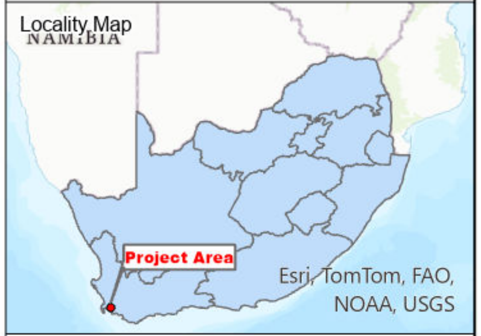
[redacted]

Designed and detailed under the controls established by our quality management system that meet the requirements of ISO 9001:2015 which has been independently certified by DEKRA Certification.



Paardevlei Solar PV Farm

GROUNDWATER OCCURRENCE



LEGEND

□ Project Area

Groundwater occurence

🟩 Fractured 0.5 - 2.0 l/s

🟦 Intergranular 0.5 - 2.0 l/s

🟥 Intergranular 2.0 - 5.0 l/s

🟨 Intergranular and Fractured 0.1 - 0.5 l/s

Figure 4

Production Date: 24 January 2024
Coordinate System: WGS84

Kilometers
0 0.4 0.8 1.2 1.6

N

SCALE
1: 35 000

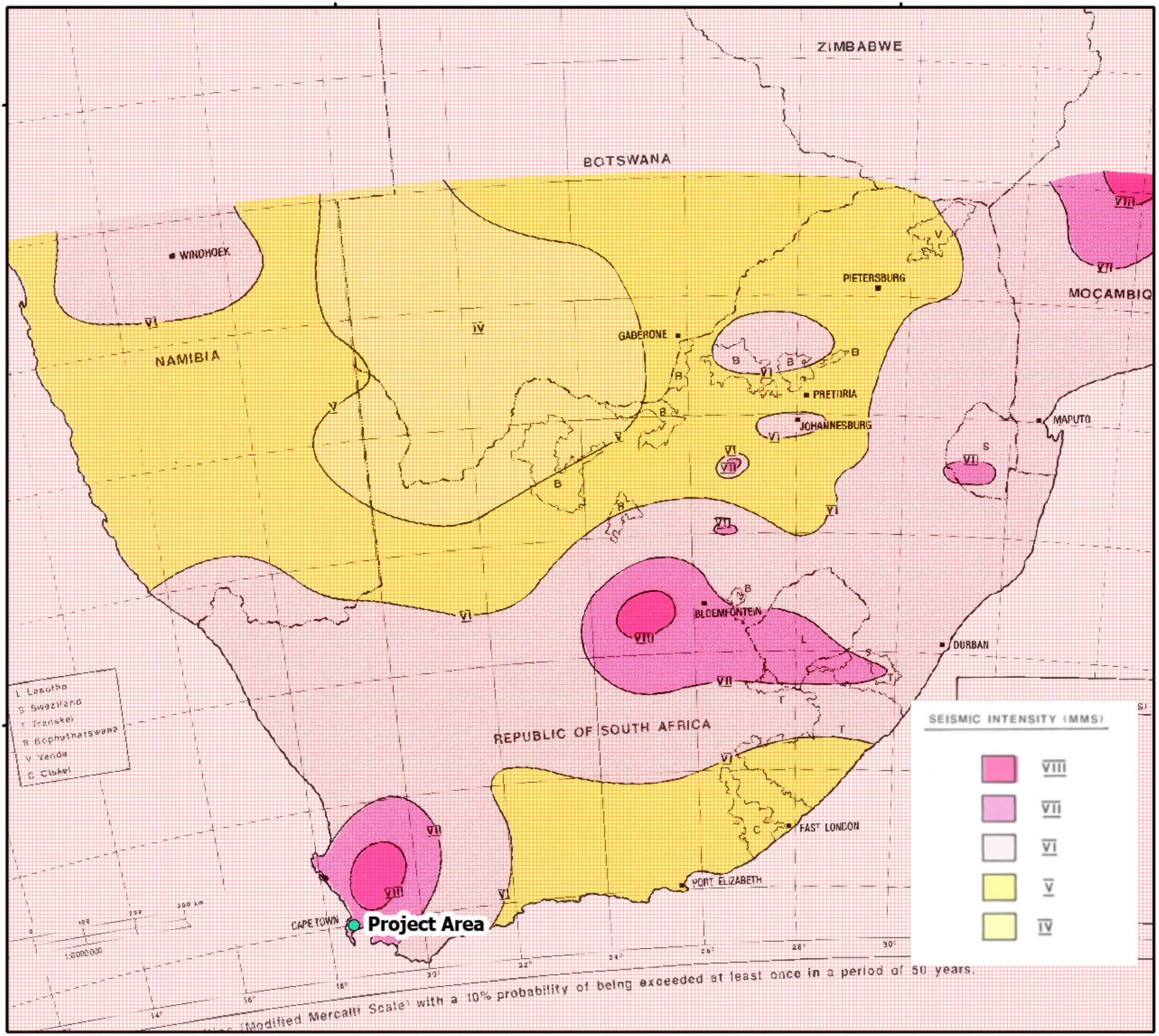
Compiled By:

JG AFRIKA
EXPERIENCE QUALITY INTEGRITY

[redacted]

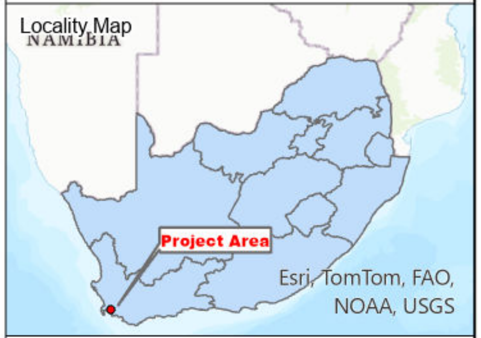
Designed and detailed under the controls established by our quality management system that meet the requirements of ISO 9001:2015 which has been independently certified by DEKRA Certification.

DEKRA



Paardevlei Solar PV Farm

SEISMIC INTENSITY



LEGEND

● Project Area

Figure 5

Production Date: 23 January 2024
Coordinate System: WGS84

Kilometers
0 125 250 375 500

SCALE
1: 10 000 000

Compiled By:

JG AFRIKA

[redacted]

Designed and detailed under the controls established by our quality management system that meet the requirements of ISO 9001:2015 which has been independently certified by DEKRA Certification.

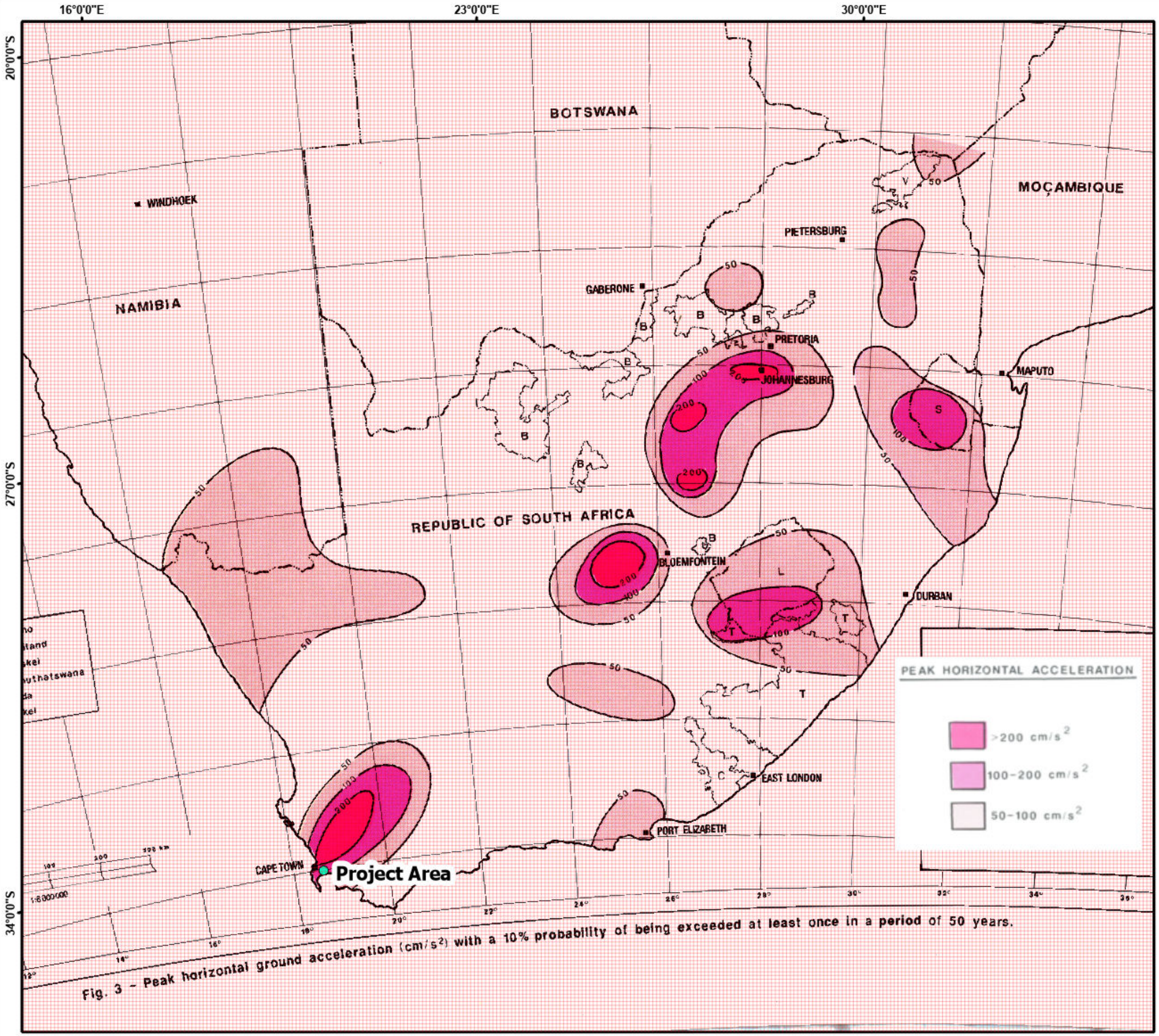
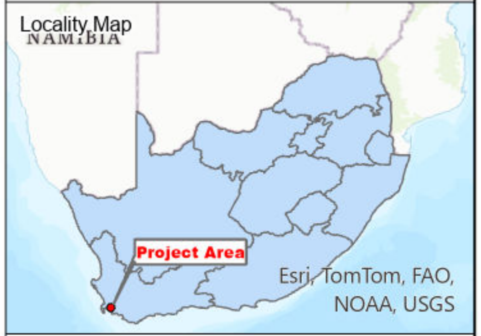


Fig. 3 - Peak horizontal ground acceleration (cm/s²) with a 10% probability of being exceeded at least once in a period of 50 years.

Paardevlei Solar PV Farm

PEAK HORIZONTAL ACCELERATION



LEGEND

● Project Area

Figure 6

Production Date: 24 January 2024
Coordinate System: WGS84

Kilometers
0 125 250 375 500

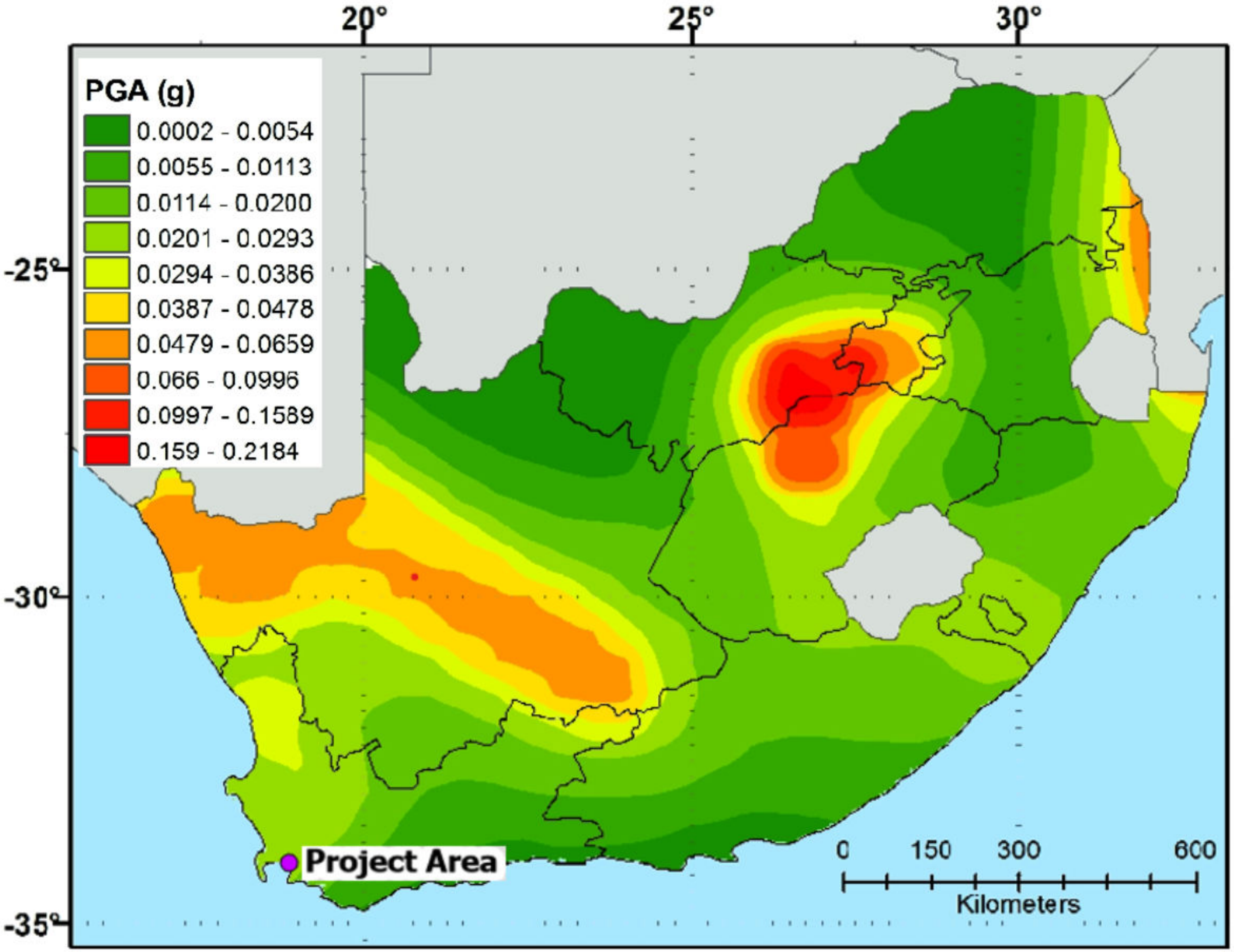
SCALE
1: 10 000 000

Compiled By:

JG AFRIKA

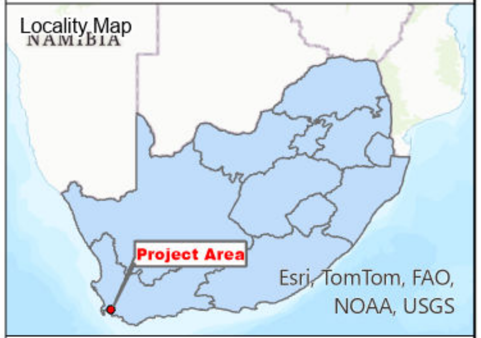
[redacted]

Designed and detailed under the controls established by our quality management system that meet the requirements of ISO 9001:2015 which has been independently certified by DEKRA Certification.



Paardevlei Solar PV Farm

HAZARD MAP



LEGEND

● Project Area

Figure 7

Production Date: 24 January 2024
Coordinate System: WGS84

Compiled By:

JG AFRIKA

[redacted]

Paardevlei Solar PV Farm

ENGINEERING GEOLOGICAL MAP

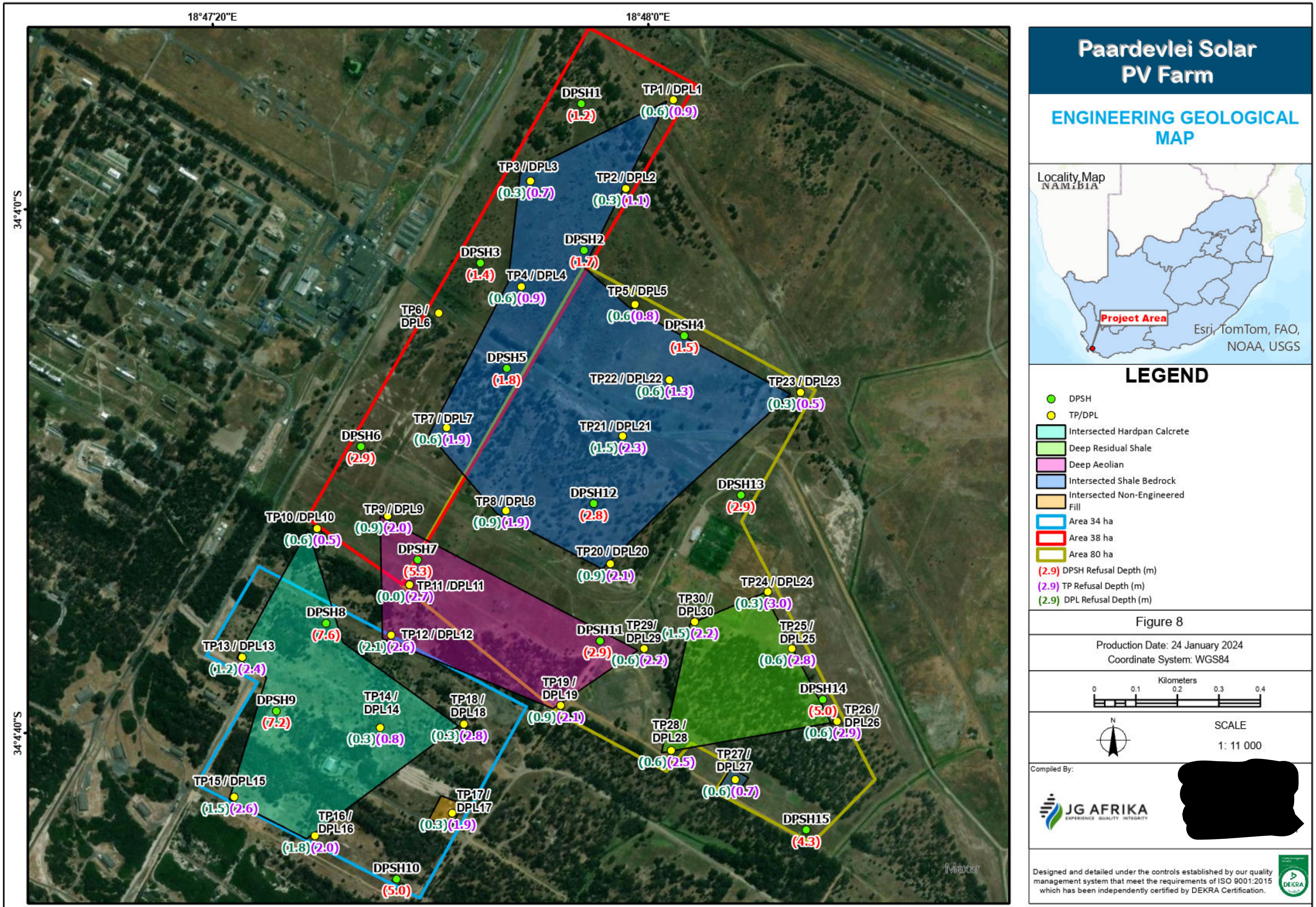


Figure 8

Production Date: 24 January 2024
Coordinate System: WGS84

Compiled By:

JG AFRIKA
EXPERIENCE QUALITY INTEGRITY

[redacted]

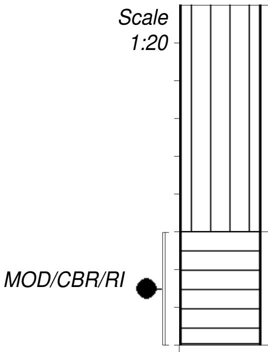
Designed and detailed under the controls established by our quality management system that meet the requirements of ISO 9001:2015 which has been independently certified by DEKRA Certification.

Appendix B: Trial Pits

Integration Environment & Energy
Paardevlei Solar PV Farm

HOLE No: TP1
Sheet 1 of 1

JOB NUMBER: 6047



0.00 Dry, reddish brown, medium dense, gravelly SILT. COLLUVIUM.

0.60 Greyish blue, slightly weathered, fine grained, highly fractured, medium rock strength SHALE. MALMESBURY GROUP.

0.90

NOTES

1) E.O.H - TLB refusal.

2) No groundwater seepage encountered.

3) MOD/CBR/RI sample taken between 0.60--0.90m.

CONTRACTOR :
MACHINE : TLB
DRILLED BY :
PROFILED BY : T. HLONGWANE

TYPE SET BY : T. HLONGWANE
SETUP FILE : TP-JGA-A4.SET

INCLINATION :
DIAM :
DATE :
DATE : 04/12/2023 - 06/12/2023

DATE : 08/02/2024 11:54
TEXT : ..AARDEVLEISOLARPVFARM.TXT

ELEVATION :
Lat.(X) : 34´ 3’57.62"S
Long.(Y) : 18´ 48’1.46"E

HOLE No: TP1

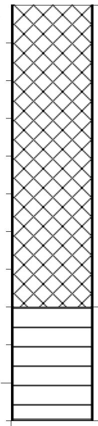
JG AFRIKA

Integration Environment & Energy
Paardevlei Solar PV Farm

HOLE No: TP2
Sheet 1 of 1

JOB NUMBER: 6047

Scale
1:20



0.00	Abundant (>50%), sub-angular sandstone pebbles, loosely compacted, in silty matrix PEBBLES. NON-ENGINEERED FILL.
0.80	Greyish blue, slightly weathered, fine grained, highly fractured, medium rock strength SHALE. MALMESBURY GROUP.
1.10	

NOTES

1) E.O.H - TLB refusal at 1.10m.

2) No groundwater seepage encountered.

3) No sample taken.

CONTRACTOR :
MACHINE : TLB
DRILLED BY :
PROFILED BY : T. HLONGWANE

TYPE SET BY : T. HLONGWANE
SETUP FILE : TP-JGA-A4.SET

INCLINATION :
DIAM :
DATE :
DATE : 04/12/2023 - 06/12/2023

DATE : 08/02/2024 11:54
TEXT : ..AARDEVLEISOLARPVFARM.TXT

ELEVATION :
Lat.(X) : 34´ 4'3.97"S
Long.(Y) : 18´ 47'56.10"E

HOLE No: TP2

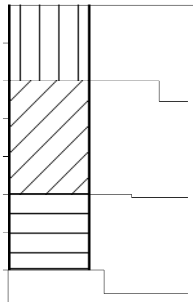
JG AFRIKA

Integration Environment & Energy
Paardevlei Solar PV Farm

HOLE No: TP3
Sheet 1 of 1

JOB NUMBER: 6047

Scale
1:20



0.00	Slightly moist, brown, medium dense, fine grained sandy SILT with rootlets. COLLUVIUM.
0.20	Moist, light grey speckled light orange, firm to stiff, intact, sandy CLAY. RESIDUAL SHALE with rock fragments.
0.50	Greyish blue, slightly weathered, fine grained, highly fractured, medium rock strength SHALE. MALMESBURY GROUP.
0.70	

NOTES

1) E.O.H - TLB refusal at 0.70m.

2) No groundwater seepage encountered.

3) No sample taken.

CONTRACTOR :
MACHINE : TLB
DRILLED BY :
PROFILED BY : T. HLONGWANE

TYPE SET BY : T. HLONGWANE
SETUP FILE : TP-JGA-A4.SET

INCLINATION :
DIAM :
DATE :
DATE : 04/12/2023 - 06/12/2023

DATE : 08/02/2024 11:54
TEXT : ..AARDEVLEISOLARPVFARM.TXT

ELEVATION :
Lat.(X) : 34´ 4’2.51"S
Long.(Y) : 18´ 47’47.44"E

HOLE No: TP3

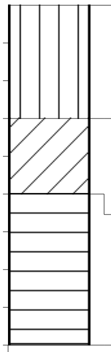
JG AFRIKA

Integration Environment & Energy
Paardevlei Solar PV Farm

HOLE No: TP4
Sheet 1 of 1

JOB NUMBER: 6047

Scale
1:20



0.00	Slightly moist, brown, <u>medium dense</u>, fine grained sandy SILT with rootlets. <u>COLLUVIUM</u>.
0.30	Moist, light grey speckled light orange, <u>firm to stiff</u>, intact, sandy CLAY. <u>RESIDUAL</u> SHALE with rock fragments.
0.50	Greyish blue, slightly weathered, fine grained, highly fractured, <u>medium rock strength</u> SHALE. <u>MALMESBURY GROUP</u>.
0.90	

NOTES

1) E.O.H - TLB refusal at 0.90m.

2) No groundwater seepage encountered.

3) No sample taken.

CONTRACTOR :
MACHINE : TLB
DRILLED BY :
PROFILED BY : T. HLONGWANE

TYPE SET BY : T. HLONGWANE
SETUP FILE : TP-JGA-A4.SET

INCLINATION :
DIAM :
DATE :
DATE : 04/12/2023 - 06/12/2023

DATE : 08/02/2024 11:54
TEXT : ..AARDEVLEISOLARPVFARM.TXT

ELEVATION :
Lat.(X) : 34´ 4’10.49"S
Long.(Y) : 18´ 47’45.42"E

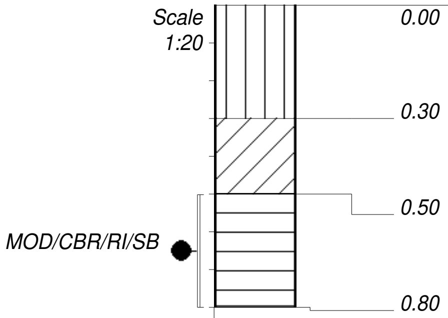
HOLE No: TP4

JG AFRIKA

Integration Environment & Energy
Paardevlei Solar PV Farm

HOLE No: TP5
Sheet 1 of 1

JOB NUMBER: 6047



Depth	Description
0.00 – 0.30	Slightly moist, brown, medium dense, fine grained sandy SILT with rootlets. COLLUVIUM.
0.30 – 0.50	Moist, light grey speckled light orange, firm to stiff, intact, sandy CLAY. RESIDUAL SHALE with rock fragments.
0.50 – 0.80	Greyish blue, slightly weathered, fine grained, highly fractured, medium rock strength SHALE. MALMESBURY GROUP.

NOTES

1) E.O.H - TLB refusal at 0.80m.

2) No groundwater seepage encountered.

3) MOD/CBR/RI/SB sample taken between 0.50--0.80m

CONTRACTOR :
MACHINE : TLB
DRILLED BY :
PROFILED BY : T. HLONGWANE

TYPE SET BY : T. HLONGWANE
SETUP FILE : TP-JGA-A4.SET

INCLINATION :
DIAM :
DATE :
DATE : 04/12/2023 - 06/12/2023

DATE : 08/02/2024 11:54
TEXT : ..AARDEVLEISOLARPVFARM.TXT

ELEVATION :
Lat.(X) : 34´ 4’12.91"S
Long.(Y) : 18´ 47’55.66"E

HOLE No: TP5

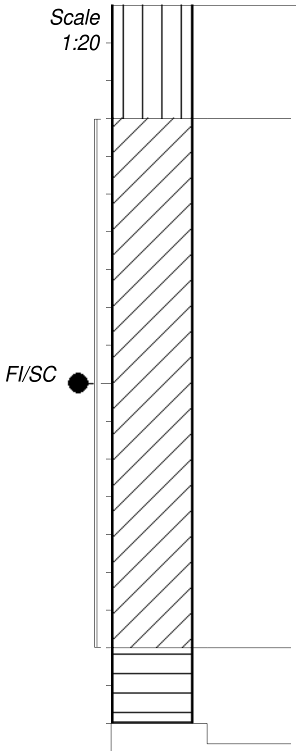
JG AFRIKA

Integration Environment & Energy
Paardevlei Solar PV Farm

HOLE No: TP7
Sheet 1 of 1

JOB NUMBER: 6047

Scale
1:20



0.00	Slightly moist, brown, <u>medium dense</u>, fine grained sandy SILT with rootlets. <u>COLLUVIUM</u>.
0.30	Moist, light grey speckled light orange, <u>firm to stiff</u>, intact, sandy CLAY. <u>RESIDUAL</u> SHALE with rock fragments.
1.70	Greyish blue, slightly weathered, fine grained, highly fractured, <u>medium rock strength</u> SHALE. <u>MALMESBURY GROUP</u>.
1.90	

NOTES

1) E.O.H - TLB refusal at 1.90m.

2) No groundwater seepage encountered.

3) FI/SC sample taken between 0.30--1.70m

CONTRACTOR :
MACHINE : TLB
DRILLED BY :
PROFILED BY : T. HLONGWANE

TYPE SET BY : T. HLONGWANE
SETUP FILE : TP-JGA-A4.SET

INCLINATION :
DIAM :
DATE :
DATE : 04/12/2023 - 06/12/2023

DATE : 08/02/2024 11:54
TEXT : ..AARDEVLEISOLARPVFARM.TXT

ELEVATION :
Lat.(X) : 34´ 4’20.58"S
Long.(Y) : 18´ 47’36.99"E

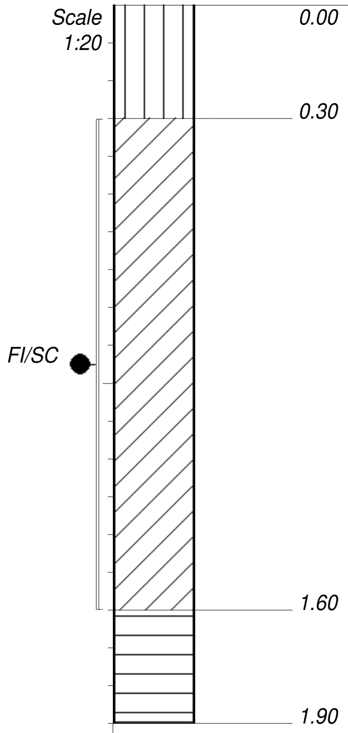
HOLE No: TP7

JG AFRIKA

Integration Environment & Energy
Paardevlei Solar PV Farm

HOLE No: TP8
Sheet 1 of 1

JOB NUMBER: 6047



0.00

Slightly moist, brown, medium dense, fine grained sandy SILT with rootlets. COLLUVIUM.

0.30

Moist, light grey speckled light orange, firm to stiff, intact, sandy CLAY. RESIDUAL SHALE with rock fragments.

1.60

Greyish blue, slightly weathered, fine grained, highly fractured, medium rock strength SHALE. MALMESBURY GROUP.

1.90

NOTES

1) E.O.H - TLB refusal at 1.90m.

2) No groundwater seepage encountered.

3) FI/SC sample taken between 0.30--1.60m

CONTRACTOR :
MACHINE : TLB
DRILLED BY :
PROFILED BY : T. HLONGWANE

TYPE SET BY : T. HLONGWANE
SETUP FILE : TP-JGA-A4.SET

INCLINATION :
DIAM :
DATE :
DATE : 04/12/2023 - 06/12/2023

DATE : 08/02/2024 11:54
TEXT : ..AARDEVLEISOLARPVFARM.TXT

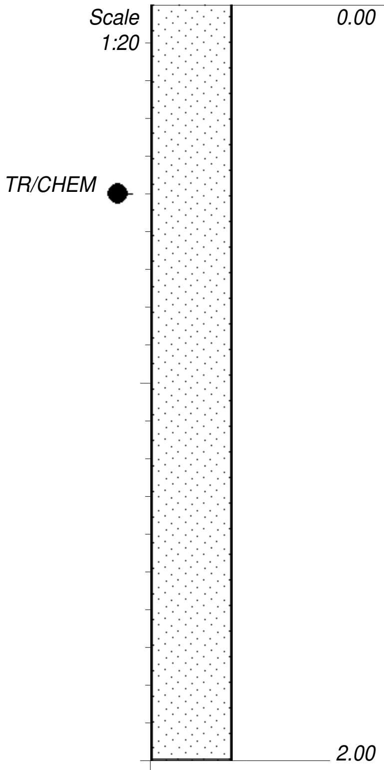
ELEVATION :
Lat.(X) : 34´ 4’27.47"S
Long.(Y) : 18´ 47’41.51"E

HOLE No: TP8

JG AFRIKA

Integration Environment & Energy
Paardevlei Solar PV Farm

HOLE No: TP9	*Sheet 1 of 1*
JOB NUMBER: 6047	



Very moist, light grey speckled light yellowish orange, medium dense, clayey SAND. AEOLIAN.

NOTES

1) E.O.H - TLB refusal at 2.00m.

2) No groundwater seepage encountered.

3) TR/CHEM sample taken @ 0.50m.

CONTRACTOR :
MACHINE : TLB
DRILLED BY :
PROFILED BY : T. HLONGWANE

TYPE SET BY : T. HLONGWANE
SETUP FILE : TP-JGA-A4.SET

INCLINATION :
DIAM :
DATE :
DATE : 04/12/2023 - 06/12/2023

DATE : 08/02/2024 11:54
TEXT : ..AARDEVLEISOLARPVFARM.TXT

ELEVATION :
Lat.(X) : 34´ 4’26.77"S
Long.(Y) : 18´ 47’30.60"E

HOLE No: TP9

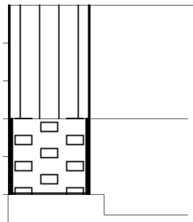
JG AFRIKA

Integration Environment & Energy
Paardevlei Solar PV Farm

HOLE No: TP10
Sheet 1 of 1

JOB NUMBER: 6047

Scale
1:20



0.00	Slightly moist, brown, medium dense, fine grained sandy SILT with rootlets. COLLUVIUM.
0.30	White, moderately weathered, fine to medium grained, moderately fractured, medium rock strength HARDPAN CALCRETE.
0.50	

NOTES

1) E.O.H - TLB refusal at 0.50m.

2) No groundwater seepage encountered.

3) No sample taken.

CONTRACTOR :
MACHINE : TLB
DRILLED BY :
PROFILED BY : T. HLONGWANE

TYPE SET BY : T. HLONGWANE
SETUP FILE : TP-JGA-A4.SET

INCLINATION :
DIAM :
DATE :
DATE : 04/12/2023 - 06/12/2023

DATE : 08/02/2024 11:54
TEXT : ..AARDEVLEISOLARPVFARM.TXT

ELEVATION :
Lat.(X) : 34´ 4’27.08"S
Long.(Y) : 18´ 47’23.98"E

HOLE No: TP10

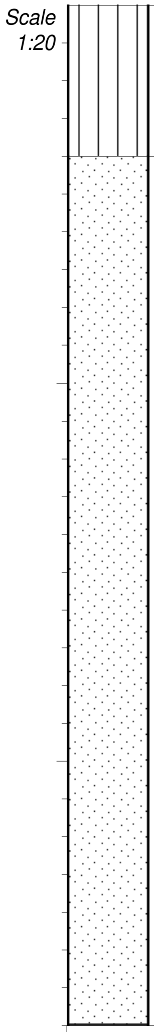
JG AFRIKA

Integration Environment & Energy
Paardevlei Solar PV Farm

HOLE No: TP11
Sheet 1 of 1

JOB NUMBER: 6047

Scale
1:20



0.00 Dry, brown, medium dense, clayey sandy SILT with rootlets. COLLUVIUM.

0.40 Very moist, light grey speckled light yellowish orange, medium dense, clayey SAND. AEOLIAN.

2.70

NOTES

1) E.O.H - No TLB refusal.

2) No groundwater seepage encountered.

3) No sample taken.

CONTRACTOR :
MACHINE : TLB
DRILLED BY :
PROFILED BY : T. HLONGWANE

TYPE SET BY : T. HLONGWANE
SETUP FILE : TP-JGA-A4.SET

INCLINATION :
DIAM :
DATE :
DATE : 04/12/2023 - 06/12/2023

DATE : 08/02/2024 11:54
TEXT : ..AARDEVLEISOLARPVFARM.TXT

ELEVATION :
Lat.(X) : 34´ 4’32.24"S
Long.(Y) : 18´ 47’31.83"E

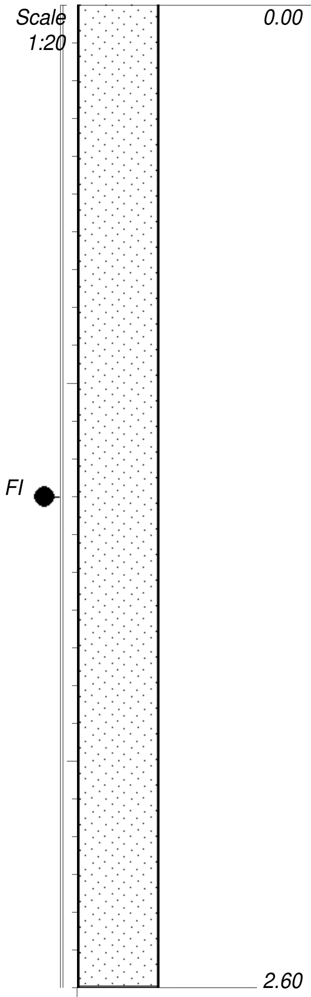
HOLE No: TP11

JG AFRIKA

Integration Environment & Energy
Paardevlei Solar PV Farm

HOLE No: TP12
Sheet 1 of 1

JOB NUMBER: 6047



Very moist, light grey speckled light yellowish orange, <u>medium dense,</u> clayey SAND. <u>AEOLIAN</u>.

NOTES

1) E.O.H - No TLB refusal.

2) No groundwater seepage encountered.

3) FI sample taken between 0.00--2.60m.

CONTRACTOR :
MACHINE : TLB
DRILLED BY :
PROFILED BY : T. HLONGWANE

TYPE SET BY : T. HLONGWANE
SETUP FILE : TP-JGA-A4.SET

INCLINATION :
DIAM :
DATE :
DATE : 04/12/2023 - 06/12/2023

DATE : 08/02/2024 11:54
TEXT : ..AARDEVLEISOLARPVFARM.TXT

ELEVATION :
Lat.(X) : 34´ 4’35.91"S
Long.(Y) : 18´ 47’29.58"E

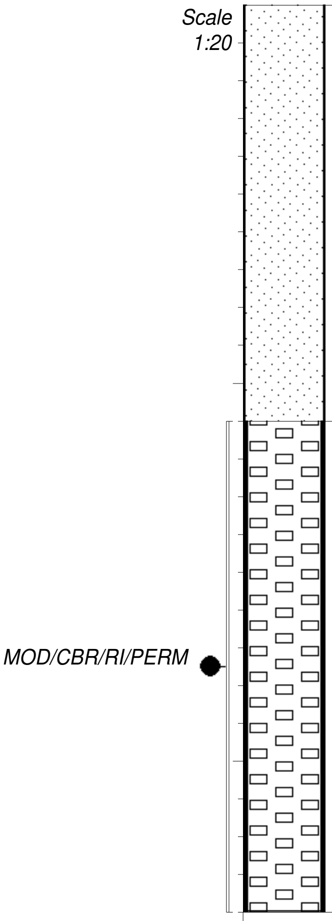
HOLE No: TP12

JG AFRIKA

Integration Environment & Energy
Paardevlei Solar PV Farm

HOLE No: **TP13**
Sheet 1 of 1

JOB NUMBER: 6047



Depth	Description
0.00	Slightly moist, greyish brown, loose, silty fine grained SAND. COLLUVIUM.
1.10	White, moderately weathered, fine to medium grained, moderately fractured, soft to medium rock strength HARDPAN CALCRETE.
2.40	

NOTES

1) E.O.H - TLB refusal at 2.40m.

2) No groundwater seepage encountered.

3) MOD/CBR/RI/PERM sample taken between 1.10--2.40m.

CONTRACTOR :
MACHINE : TLB
DRILLED BY :
PROFILED BY : T. HLONGWANE

TYPE SET BY : T. HLONGWANE
SETUP FILE : TP-JGA-A4.SET

INCLINATION :
DIAM :
DATE :
DATE : 04/12/2023 - 06/12/2023

DATE : 08/02/2024 11:54
TEXT : ..AARDEVLEISOLARPVFARM.TXT

ELEVATION :
Lat.(X) : 34´ 4’36.22"S
Long.(Y) : 18´ 47’15.67"E

HOLE No: **TP13**

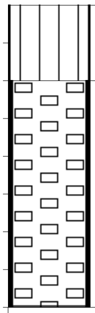
JG AFRIKA

Integration Environment & Energy
Paardevlei Solar PV Farm

HOLE No: TP14
Sheet 1 of 1

JOB NUMBER: 6047

Scale
1:20



0.00	Slightly moist, brown, dense, gravelly sand SILT. COLLUVIUM.
0.20	White, moderately weathered, fine to medium grained, moderately fractured, soft to medium rock strength HARDPAN CALCRETE.
0.80	

NOTES

1) E.O.H - TLB refusal at 0.80m.

2) No groundwater seepage encountered.

3) No sample taken.

CONTRACTOR :
MACHINE : TLB
DRILLED BY :
PROFILED BY : T. HLONGWANE

TYPE SET BY : T. HLONGWANE
SETUP FILE : TP-JGA-A4.SET

INCLINATION :
DIAM :
DATE :
DATE : 04/12/2023 - 06/12/2023

DATE : 08/02/2024 11:54
TEXT : ..AARDEVLEISOLARPVFARM.TXT

ELEVATION :
Lat.(X) : 34´ 4’42.87"S
Long.(Y) : 18´ 47’27.55"E

HOLE No: TP14

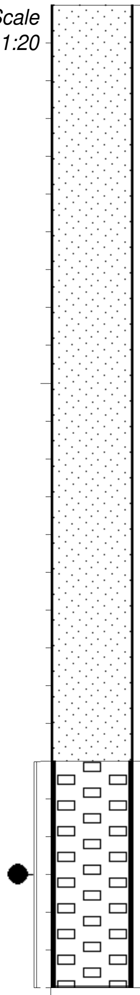
JG AFRIKA

Integration Environment & Energy
Paardevlei Solar PV Farm

HOLE No: TP15
Sheet 1 of 1

JOB NUMBER: 6047

Scale
1:20



Depth	Description
0.00	Slightly moist, greyish brown, loose, silty fine grained SAND. COLLUVIUM.
2.00	White, moderately weathered, fine to medium grained, moderately fractured, soft to medium rock strength HARDPAN CALCRETE.
2.60	

NOTES

1) E.O.H - No TLB refusal.

2) No groundwater seepage encountered.

3) MOD/CBR/RI sample taken between 2.00--2.60m.

CONTRACTOR :
MACHINE : TLB
DRILLED BY :
PROFILED BY : T. HLONGWANE

TYPE SET BY : T. HLONGWANE
SETUP FILE : TP-JGA-A4.SET

INCLINATION :
DIAM :
DATE :
DATE : 04/12/2023 - 06/12/2023

DATE : 08/02/2024 11:54
TEXT : ..AARDEVLEISOLARPVFARM.TXT

ELEVATION :
Lat.(X) : 34´ 4’46.83"S
Long.(Y) : 18´ 47’13.37"E

HOLE No: TP15

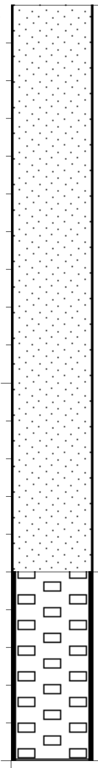
JG AFRIKA

Integration Environment & Energy
Paardevlei Solar PV Farm

HOLE No: TP16
Sheet 1 of 1

JOB NUMBER: 6047

Scale
1:20



0.00

Slightly moist, greyish brown, <u>loose</u>, silty fine grained SAND. <u>COLLUVIUM.</u>

1.50

White, moderately weathered, fine to medium grained, moderately fractured, <u>soft to medium rock strength</u> HARDPAN CALCRETE.

2.00

NOTES

1) E.O.H - TLB refusal at 2.00m.

2) No groundwater seepage encountered.

3) TR/FI/CHEM sample taken @0.50m.

CONTRACTOR :
MACHINE : TLB
DRILLED BY :
PROFILED BY : T. HLONGWANE

TYPE SET BY : T. HLONGWANE
SETUP FILE : TP-JGA-A4.SET

INCLINATION :
DIAM :
DATE :
DATE : 04/12/2023 - 06/12/2023

DATE : 08/02/2024 11:54
TEXT : ..AARDEVLEISOLARPVFARM.TXT

ELEVATION :
Lat.(X) : 34´ 4’50.54"S
Long.(Y) : 18´ 47’20.36"E

HOLE No: TP16

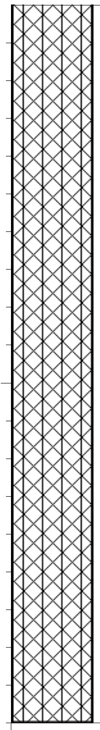
JG AFRIKA

Integration Environment & Energy
Paardevlei Solar PV Farm

HOLE No: TP17
Sheet 1 of 1

JOB NUMBER: 6047

Scale
1:20



0.00

Moist, brown, dense, clayey sandy SILT with gravel sized fragments and builder’s rubble. NON-ENGINEERED FILL.

1.90

NOTES

1) E.O.H - TLB refusal at 1.90m.

2) No groundwater seepage encountered.

3) No sample taken.

CONTRACTOR :
MACHINE : TLB
DRILLED BY :
PROFILED BY : T. HLONGWANE

TYPE SET BY : T. HLONGWANE
SETUP FILE : TP-JGA-A4.SET

INCLINATION :
DIAM :
DATE :
DATE : 04/12/2023 - 06/12/2023

DATE : 08/02/2024 11:54
TEXT : ..AARDEVLEISOLARPVFARM.TXT

ELEVATION :
Lat.(X) : 34´ 4’50.08"S
Long.(Y) : 18´ 47’33.21"E

HOLE No: TP17

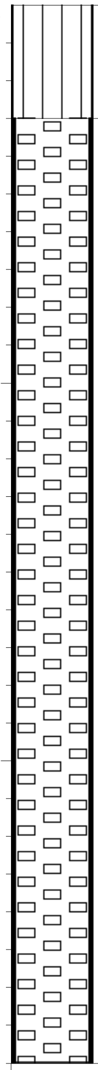
JG AFRIKA

Integration Environment & Energy
Paardevlei Solar PV Farm

HOLE No: TP18
Sheet 1 of 1

JOB NUMBER: 6047

Scale
1:20



0.00

Slightly moist, brown, <u>dense</u>, gravelly sandy SILT. <u>COLLUVIUM.</u>

0.30

White, moderately weathered, fine to medium grained, moderately fractured, <u>soft rock strength</u> HARDPAN CALCRETE.

2.80

NOTES

1) E.O.H - No TLB refusal.

2) No groundwater seepage encountered.

3) TR/FI/CHEM sample taken @0.50m.

CONTRACTOR :
MACHINE : TLB
DRILLED BY :
PROFILED BY : T. HLONGWANE

TYPE SET BY : T. HLONGWANE
SETUP FILE : TP-JGA-A4.SET

INCLINATION :
DIAM :
DATE :
DATE : 04/12/2023 - 06/12/2023

DATE : 08/02/2024 11:54
TEXT : ..AARDEVLEISOLARPVFARM.TXT

ELEVATION :
Lat.(X) : 34´ 4’43.39"S
Long.(Y) : 18´ 47’35.28"E

HOLE No: TP18

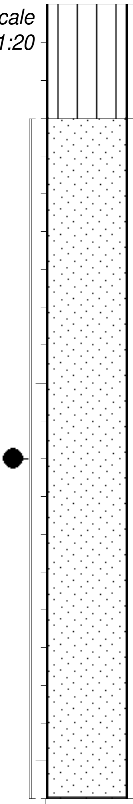
JG AFRIKA

Integration Environment & Energy
Paardevlei Solar PV Farm

HOLE No: **TP19**
Sheet 1 of 1

JOB NUMBER: 6047

Scale
1:20



0.00
Slightly moist, brown, dense, gravelly sandy SILT. COLLUVIUM.

0.30
Wet, white, loose, silty medium grained SAND. AEOLIAN.

2.10

NOTES

1) E.O.H - TLB refusal at 2.10m.

2) No groundwater seepage encountered.

3) MOD/CBR/RI sample taken between 0.30--2.10m.

CONTRACTOR :
MACHINE : TLB
DRILLED BY :
PROFILED BY : T. HLONGWANE

TYPE SET BY : T. HLONGWANE
SETUP FILE : TP-JGA-A4.SET

INCLINATION :
DIAM :
DATE :
DATE : 04/12/2023 - 06/12/2023

DATE : 08/02/2024 11:54
TEXT : ..AARDEVLEISOLARPVFARM.TXT

ELEVATION :
Lat.(X) : 34´ 4’42.86"S
Long.(Y) : 18´ 47’44.37"E

HOLE No: **TP19**

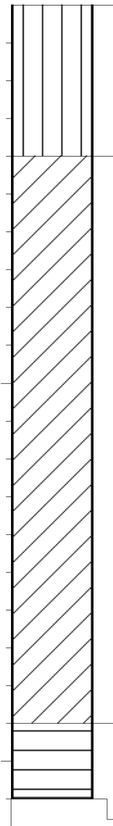
JG AFRIKA

Integration Environment & Energy
Paardevlei Solar PV Farm

HOLE No: **TP20**
Sheet 1 of 1

JOB NUMBER: **6047**

Scale
1:20



0.00

Slightly moist, brown, medium dense, fine grained sandy SILT with rootlets. COLLUVIUM.

0.40

Moist, light grey speckled light orange, firm to stiff, intact, sandy CLAY. RESIDUAL SHALE with rock fragments.

1.90

Greyish blue, slightly weathered, fine grained, highly fractured, medium rock strength SHALE. MALMESBURY GROUP.

2.10

NOTES

1) E.O.H - TLB refusal at 2.10m.

2) No groundwater seepage encountered.

3) FI/TR sample taken @0.50m.

CONTRACTOR :
MACHINE : TLB
DRILLED BY :
PROFILED BY : T. HLONGWANE

TYPE SET BY : T. HLONGWANE
SETUP FILE : TP-JGA-A4.SET

INCLINATION :
DIAM :
DATE :
DATE : 04/12/2023 - 06/12/2023

DATE : 08/02/2024 11:54
TEXT : ..AARDEVLEISOLARPVFARM.TXT

ELEVATION :
Lat.(X) : 34´ 4’32.49"S
Long.(Y) : 18´ 47’50.51"E

HOLE No: **TP20**

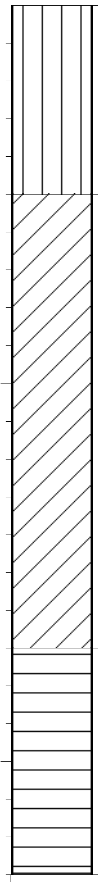
JG AFRIKA

Integration Environment & Energy
Paardevlei Solar PV Farm

HOLE No: **TP21**
Sheet 1 of 1

JOB NUMBER: 6047

Scale
1:20



0.00	Slightly moist, brown, <u>medium dense</u>, fine grained sandy SILT with rootlets. <u>COLLUVIUM</u>.
0.50	Moist, light grey speckled light orange, <u>firm to stiff</u>, intact, sandy CLAY. <u>RESIDUAL</u> SHALE with rock fragments.
1.70	Greyish blue, slightly weathered, fine grained, highly fractured, <u>medium rock strength</u> SHALE. <u>MALMESBURY GROUP</u>.
2.30	

NOTES

1) E.O.H - TLB refusal at 2.30m.

2) No groundwater seepage encountered.

3) No sample taken.

CONTRACTOR :
MACHINE : TLB
DRILLED BY :
PROFILED BY : T. HLONGWANE

TYPE SET BY : T. HLONGWANE
SETUP FILE : TP-JGA-A4.SET

INCLINATION :
DIAM :
DATE :
DATE : 04/12/2023 - 06/12/2023

DATE : 08/02/2024 11:54
TEXT : ..AARDEVLEISOLARPVFARM.TXT

ELEVATION :
Lat.(X) : 34´ 4’22.85"S
Long.(Y) : 18´ 47’53.06"E

HOLE No: **TP21**

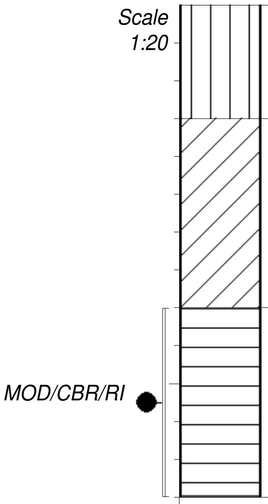
JG AFRIKA

Integration Environment & Energy
Paardevlei Solar PV Farm

HOLE No: TP22
Sheet 1 of 1

JOB NUMBER: 6047

Scale
1:20



0.00	Slightly moist, brown, <u>medium dense</u>, fine grained sandy SILT with rootlets. <u>COLLUVIUM</u>.
0.30	Moist, light grey speckled light orange, <u>firm to stiff</u>, intact, sandy CLAY. <u>RESIDUAL</u> SHALE with rock fragments.
0.80	Greyish blue, slightly weathered, fine grained, highly fractured, <u>medium rock strength</u> SHALE. <u>MALMESBURY GROUP</u>.
1.30	

NOTES

1) E.O.H - TLB refusal at 1.30m.

2) No groundwater seepage encountered.

3) MOD/CBR/RI sample taken between 0.80--1.30m.

CONTRACTOR :
MACHINE : TLB
DRILLED BY :
PROFILED BY : T. HLONGWANE

TYPE SET BY : T. HLONGWANE
SETUP FILE : TP-JGA-A4.SET

INCLINATION :
DIAM :
DATE :
DATE : 04/12/2023 - 06/12/2023

DATE : 08/02/2024 11:54
TEXT : ..AARDEVLEISOLARPVFARM.TXT

ELEVATION :
Lat.(X) : 34´ 4’18.99"S
Long.(Y) : 18´ 47’57.97"E

HOLE No: TP22

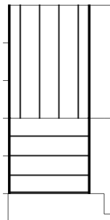
JG AFRIKA

Integration Environment & Energy
Paardevlei Solar PV Farm

HOLE No: TP23
Sheet 1 of 1

JOB NUMBER: 6047

Scale
1:20



0.00	Dry, greyish pale brown, <u>medium dense</u>, gravelly SILT. <u>COLLUVIUM.</u>
0.30	Olive brown, moderately weathered, fine grained, highly fractured, <u>medium rock strength</u> SHALE. <u>MALMESBURY GROUP</u>.
0.50	

NOTES

1) E.O.H - TLB refusal at 0.50m.

2) No groundwater seepage encountered.

3) No sample taken.

CONTRACTOR :
MACHINE : TLB
DRILLED BY :
PROFILED BY : T. HLONGWANE

TYPE SET BY : T. HLONGWANE
SETUP FILE : TP-JGA-A4.SET

INCLINATION :
DIAM :
DATE :
DATE : 04/12/2023 - 06/12/2023

DATE : 08/02/2024 11:54
TEXT : ..AARDEVLEISOLARPVFARM.TXT

ELEVATION :
Lat.(X) : 34´ 4'21.15"S
Long.(Y) : 18´ 48'9.88"E

HOLE No: TP23

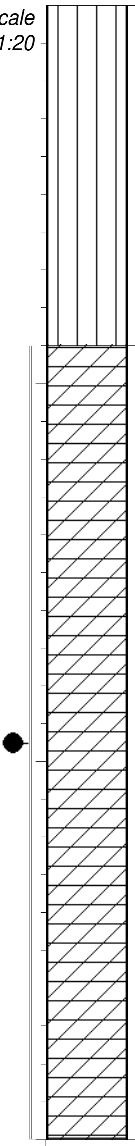
JG AFRIKA

Integration Environment & Energy
Paardevlei Solar PV Farm

HOLE No: **TP24**
Sheet 1 of 1

JOB NUMBER: 6047

Scale
1:20



0.00

Dry, greyish brown, <u>dense</u>, sandy SILT with rootlets. <u>COLLUVIUM.</u>

0.90

Very moist, greyish brown speckled orange, intact, <u>soft to firm</u>, sandy CLAY. <u>RESIDUAL SHALE</u>.

3.00

NOTES

1) E.O.H - No TLB refusal.

2) No groundwater seepage encountered.

3) MOD/CBR/RI sample taken between 0.90--3.00m.

CONTRACTOR :		*INCLINATION :*		*ELEVATION :*	
MACHINE :	TLB	*DIAM :*		*Lat.(X) :*	34´ 4’36.08"S
DRILLED BY :		*DATE :*		*Long.(Y) :*	18´ 48’4.66"E
PROFILED BY :	T. HLONGWANE	*DATE :*	04/12/2023 - 06/12/2023		
TYPE SET BY :	*T. HLONGWANE*	*DATE :*	*08/02/2024 11:54*		
SETUP FILE :	*TP-JGA-A4.SET*	*TEXT :*	*..AARDEVLEISOLARPVFARM.TXT*		

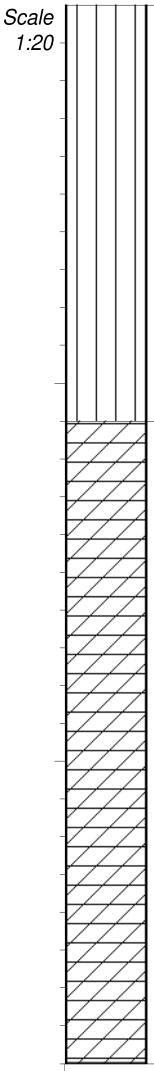
HOLE No: **TP24**

JG AFRIKA

Integration Environment & Energy
Paardevlei Solar PV Farm

HOLE No: TP25
Sheet 1 of 1

JOB NUMBER: 6047



0.00

Dry, greyish brown, dense, sandy SILT with rootlets. COLLUVIUM.

1.10

Very moist, greyish brown speckled orange, intact, soft to firm, sandy CLAY. RESIDUAL SHALE.

2.80

NOTES

1) E.O.H - No TLB refusal.

2) No groundwater seepage encountered.

3) No sample taken.

CONTRACTOR :
MACHINE : TLB
DRILLED BY :
PROFILED BY : T. HLONGWANE

TYPE SET BY : T. HLONGWANE
SETUP FILE : TP-JGA-A4.SET

INCLINATION :
DIAM :
DATE :
DATE : 04/12/2023 - 06/12/2023

DATE : 08/02/2024 11:54
TEXT : ..AARDEVLEISOLARPVFARM.TXT

ELEVATION :
Lat.(X) : 34´ 4’40.65"S
Long.(Y) : 18´ 48’6.24"E

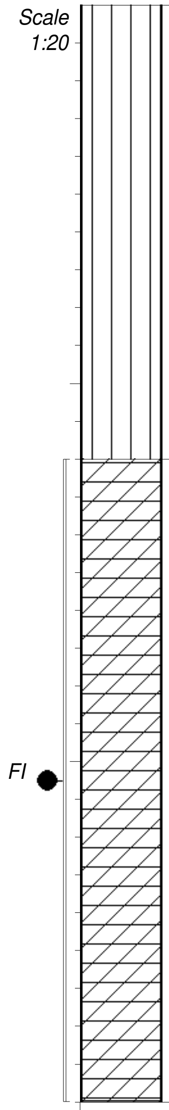
HOLE No: TP25

JG AFRIKA

Integration Environment & Energy
Paardevlei Solar PV Farm

HOLE No: TP26
Sheet 1 of 1

JOB NUMBER: 6047



0.00

Dry, greyish brown, dense, sandy SILT with rootlets. COLLUVIUM.

1.20

Very moist, greyish brown speckled orange, intact, soft to firm, sandy CLAY. RESIDUAL SHALE.

2.90

NOTES

1) E.O.H - No TLB refusal.

2) No groundwater seepage encountered.

3) FI sample taken between 1.20--2.90m.

CONTRACTOR :
MACHINE : TLB
DRILLED BY :
PROFILED BY : T. HLONGWANE

TYPE SET BY : T. HLONGWANE
SETUP FILE : TP-JGA-A4.SET

INCLINATION :
DIAM :
DATE :
DATE : 04/12/2023 - 06/12/2023

DATE : 08/02/2024 11:54
TEXT : ..AARDEVLEISOLARPVFARM.TXT

ELEVATION :
Lat.(X) : 34´ 4'46.62"S
Long.(Y) : 18´ 48'9.58"E

HOLE No: TP26

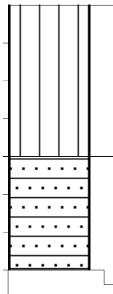
JG AFRIKA

Integration Environment & Energy
Paardevlei Solar PV Farm

HOLE No: TP27
Sheet 1 of 1

JOB NUMBER: 6047

Scale
1:20



0.00	Dry, greyish brown, <u>dense</u>, sandy SILT with rootlets. <u>COLLUVIUM.</u>
0.40	White mottled orange, highly weathered, fine to medium grained, highly fractured, <u>soft to medium rock strength</u> SANDSTONE. <u>MALMESBURY GROUP</u>.
0.70	

NOTES

1) E.O.H - TLB refusal at 0.70m.

2) No groundwater seepage encountered.

3) TR/FI/CHEM sample taken @0.50m.

CONTRACTOR :
MACHINE : TLB
DRILLED BY :
PROFILED BY : T. HLONGWANE

TYPE SET BY : T. HLONGWANE
SETUP FILE : TP-JGA-A4.SET

INCLINATION :
DIAM :
DATE :
DATE : 04/12/2023 - 06/12/2023

DATE : 08/02/2024 11:54
TEXT : ..AARDEVLEISOLARPVFARM.TXT

ELEVATION :
Lat.(X) : 34´ 4’50.14"S
Long.(Y) : 18´ 47’59.59"E

HOLE No: TP27

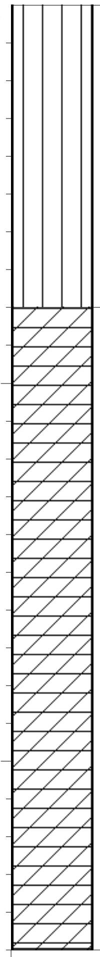
JG AFRIKA

Integration Environment & Energy
Paardevlei Solar PV Farm

HOLE No: TP28
Sheet 1 of 1

JOB NUMBER: 6047

Scale
1:20



0.00

Dry, pale brown, dense, sandy SILT with rootlets. COLLUVIUM.

0.80

Very moist, greyish brown speckled orange, intact, soft to firm, sandy CLAY. RESIDUAL SHALE.

2.50

NOTES

1) E.O.H - No TLB refusal.

2) No groundwater seepage encountered.

3) No sample taken.

CONTRACTOR :
MACHINE : TLB
DRILLED BY :
PROFILED BY : T. HLONGWANE

TYPE SET BY : T. HLONGWANE
SETUP FILE : TP-JGA-A4.SET

INCLINATION :
DIAM :
DATE :
DATE : 04/12/2023 - 06/12/2023

DATE : 08/02/2024 11:54
TEXT : ..AARDEVLEISOLARPVFARM.TXT

ELEVATION :
Lat.(X) : 34´ 4'47.32"S
Long.(Y) : 18´ 47'54.03"E

HOLE No: TP28

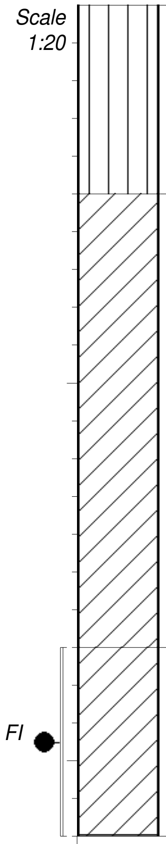
JG AFRIKA

Integration Environment & Energy
Paardevlei Solar PV Farm

HOLE No: TP29
Sheet 1 of 1

JOB NUMBER: 6047

Scale
1:20



0.00

Dry, dark brown, <u>dense</u>, clayey SILT with rootlets. <u>COLLUVIUM.</u>

0.50

Very moist, greyish brown speckled orange, intact, <u>soft to firm,</u> sandy CLAY. <u>AEOLIAN</u>.

1.70

Wet, white, <u>medium dense</u>, silty CLAY. <u>AEOLIAN</u>.

2.20

NOTES

1) E.O.H - No TLB refusal.

2) Watertable @2.20m.

3) FI sample taken between 1.70--2.20m.

CONTRACTOR :
MACHINE : TLB
DRILLED BY :
PROFILED BY : T. HLONGWANE

TYPE SET BY : T. HLONGWANE
SETUP FILE : TP-JGA-A4.SET

INCLINATION :
DIAM :
DATE :
DATE : 04/12/2023 - 06/12/2023

DATE : 08/02/2024 11:54
TEXT : ..AARDEVLEISOLARPVFARM.TXT

ELEVATION :
Lat.(X) : 34´ 4’39.29"S
Long.(Y) : 18´ 47’52.66"E

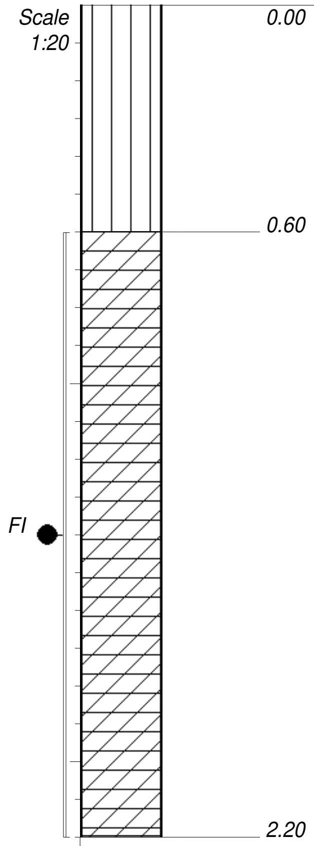
HOLE No: TP29

JG AFRIKA

Integration Environment & Energy
Paardevlei Solar PV Farm

HOLE No: TP30
Sheet 1 of 1

JOB NUMBER: 6047



Dry, greyish brown, dense, sandy SILT with rootlets. COLLUVIUM.

Very moist, greyish green, intact, soft to firm, sandy CLAY. RESIDUAL SHALE.

NOTES

1) E.O.H - TLB refusal at 2.20m.

2) No groundwater seepage encountered.

3) FI sample taken between 0.60--2.20m.

CONTRACTOR :
MACHINE : TLB
DRILLED BY :
PROFILED BY : T. HLONGWANE

TYPE SET BY : T. HLONGWANE
SETUP FILE : TP-JGA-A4.SET

INCLINATION :
DIAM :
DATE :
DATE : 04/12/2023 - 06/12/2023

DATE : 08/02/2024 11:54
TEXT : ..AARDEVLEISOLARPVFARM.TXT

ELEVATION :
Lat.(X) : 34´ 4’37.70"S
Long.(Y) : 18´ 47’57.61"E

HOLE No: TP30

6047 – PAARDEVLEI SOLAR PHOTO-VALTAIC FARM

Plate 1: Trial pit 1

Plate 2: Trial pit 2

Plate 3: Trial pit 3

Plate 4: Trial pit 4

Plate 5: Trial pit 5

Plate 6: Trial pit 7

Plate 7: Trial pit 8

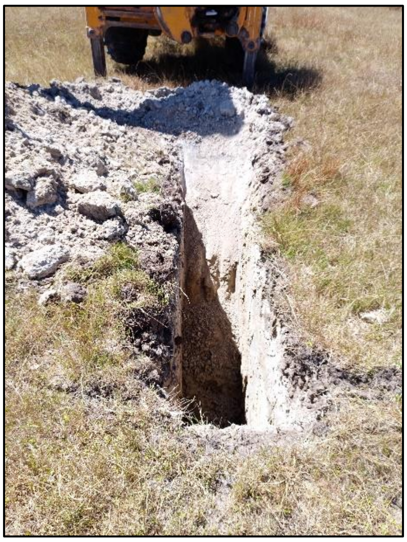


Plate 8: Trial pit 9

Plate 9: Trial pit 10

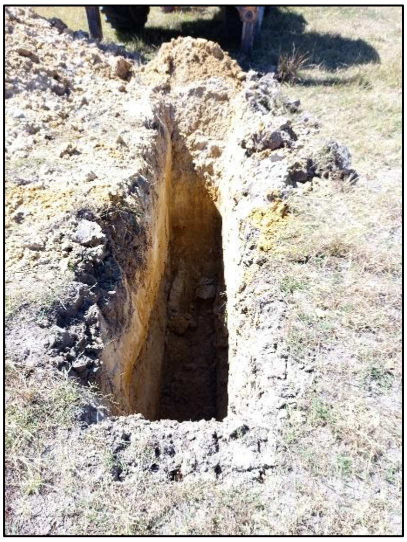


Plate 10: Trial pit 11

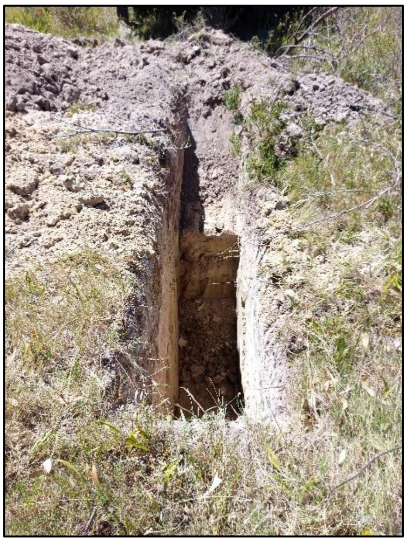


Plate 11: Trial pit 12

Plate 12: Calcrete spoil material from trial pit TP13

Plate 13: Trial pit 14

Plate 14: Hardpan calcrete from trial pit TP15

Plate 15: Trial pit 16

Plate 16: Trial pit 17

Plate 17: Hardpan calcrete from trial pit TP18

Plate 18: Trial pit 19

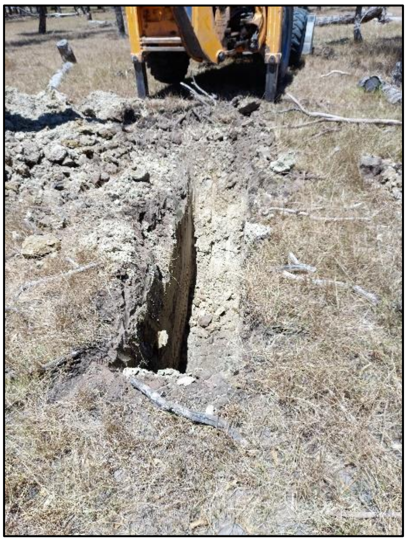


Plate 19: Trial pit 20

Plate 20: Excavation spoil material from trial pit 21

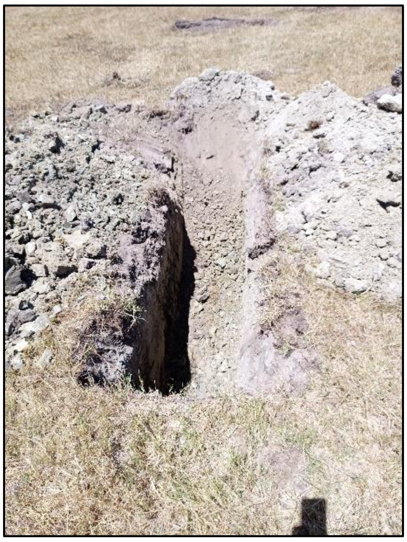


Plate 21: Trial pit 22

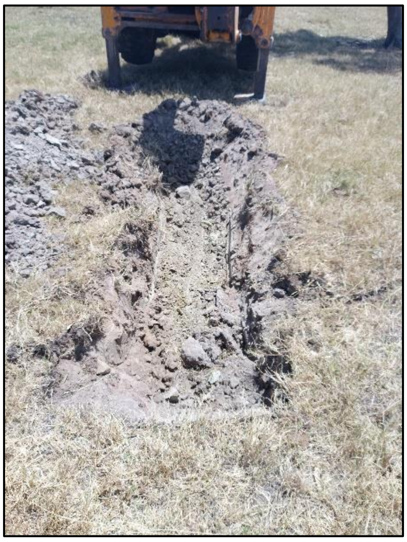


Plate 22: Trial pit 23

Plate 23: Trial pit 24

Plate 24: Trial pit 25

Plate 25: Excavation spoil from trial pit TP26

Plate 26: Trial pit 27

Plate 27: Trial pit 28

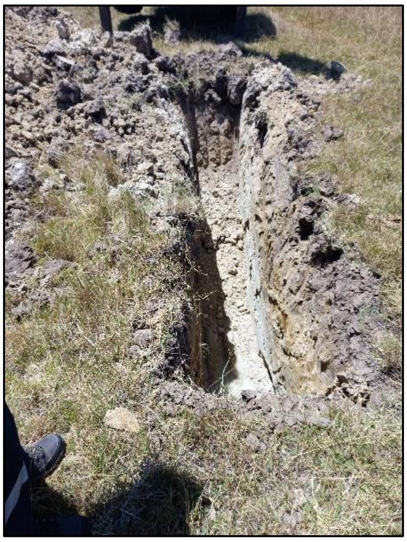


Plate 28: Trial pit 29

Plate 29: Trial pit 30

Appendix C: DPL Tests

ESTIMATED ALLOWABLE SAFE BEARING PRESSURE FROM DCP

Job Name: PAARDEVLEI SOLAR PV FARM

Date of Test: 04/12/2023

Job No: 6047

DPL No: 1

Location: TP1

Hammer: 10 kg hammer
450 mm drop height

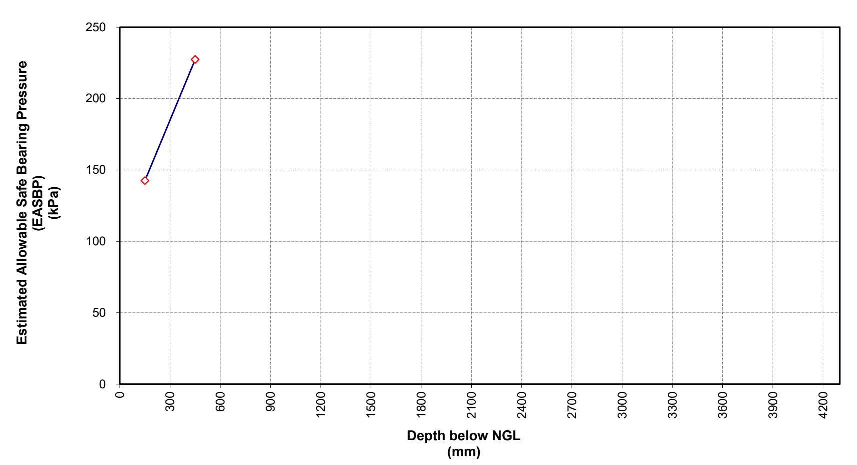
Cone: 25 mm point
60° angle

note:

CBR from Webster, S.L., Grau, R.H., and Williams, T.P., (1992), "*Description and Application of Dual Mass Dynamic Cone Penetrometer*"

EASBP or non-cohesive soils from Terzaghi & Peck p 491 for 25 mm settlement.

EASBP for cohesive soils = Su*Nc/FOS. Shear strength (Su) from N via T3 of Geoterminology.



Penetration Guide: Consistency

SPT N Value	Cohesive soils	Non-cohesive soils
> 50	Very stiff	Very Dense
31 - 50	Stiff	Dense
11 - 30	Firm	Med Dense
5 - 10	Soft	Loose
0 - 4	Very soft	Very Loose

NOTE: EASBP calculated for cohesive and non-cohesive soils

*SPT N value = (DCP blows/300mm) * 0.38*

*CBR = 465 * (DCP Penetration (mm/blow)^-1.31*

NOTE: First select soil type

Depth of hole in which DPL was taken : 0.00 mm below ngl

Remarks : Refusal at 0.60m

Non-cohesive soils

Applied Factor : 1 times Terzaghi's value

OR

Cohesive soils

Nc 5 FOS 3

Reading no.	Layer from (mm)	Layer to (mm)	Average layer depth (mm)	DPL blows/300 mm	Soil type	Depth below NGL (mm)	DPL penetration (mm/blow)	Equivalent SPT N value	Approx *in-situ* CBR (%)	Approx shear strength (kPa)	Approx EASBP (kPa)
1	0	300	150	26	Non-Cohesive	150	12	10	19		143
2	300	600	450	44	Non-Cohesive	450	7	17	38		227

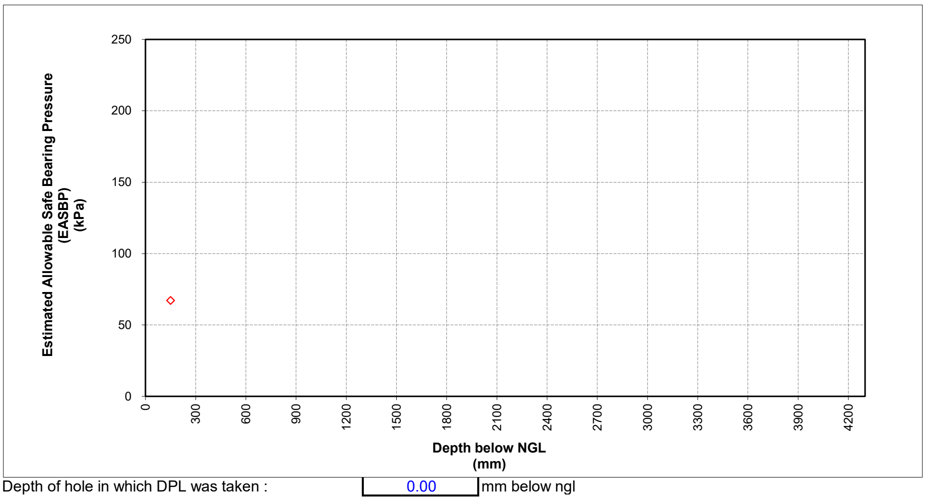
ESTIMATED ALLOWABLE SAFE BEARING PRESSURE FROM DCP

Job Name: PAARDEVLEI SOLAR PV FARM
Date of Test: 04/12/2023
Job No: 6047
DPL No: 2
Location: TP2

Hammer: 10 kg hammer
450 mm drop height
Cone: 25 mm point
60° angle

JG AFRIKA
EXPERIENCE QUALITY INTEGRITY

note:
CBR from Webster, S.L., Grau, R.H., and Williams, T.P., (1992), "*Description and Application of Dual Mass Dynamic Cone Penetrometer*"
EASBP or non-cohesive soils from Terzaghi & Peck p 491 for 25 mm settlement.
EASBP for cohesive soils = Su*Nc/FOS. Shear strength (Su) from N via T3 of Geoterminology.



Penetration Guide: Consistency		
SPT N Value	Cohesive soils	Non-cohesive soils
> 50	Very stiff	Very Dense
31 - 50	Stiff	Dense
11 - 30	Firm	Med Dense
5 - 10	Soft	Loose
0 - 4	Very soft	Very Loose

NOTE: EASBP calculated for cohesive and non-cohesive soils

*SPT N value = (DCP blows/300mm) * 0.38*

*CBR = 465 * (DCP Penetration (mm/blow)^-1.31*

NOTE: First select soil type

Depth of hole in which DPL was taken : 0.00 mm below ngl
Remarks : Refusal at 0.30m

Non-cohesive soils
Applied Factor : 1 times Terzaghi's value

OR

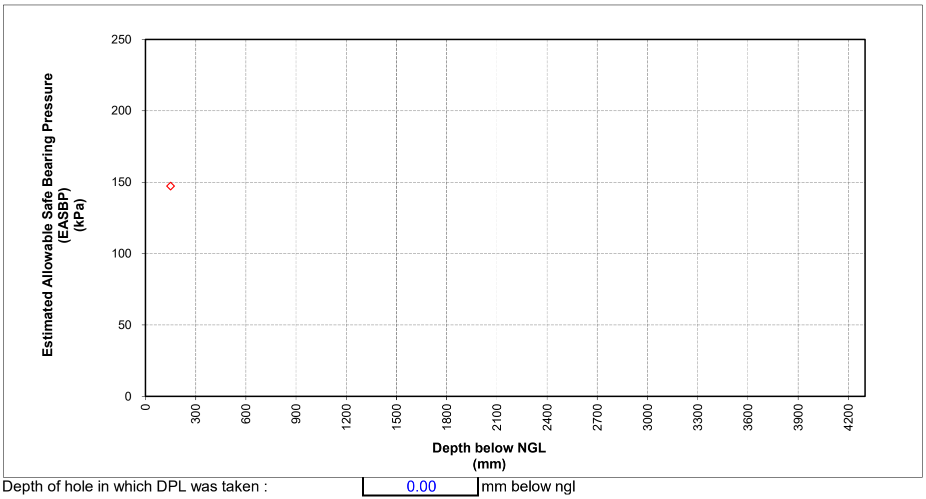
Cohesive soils
Nc 5 FOS 3

Reading no.	Layer from (mm)	Layer to (mm)	Average layer depth (mm)	DPL blows/300 mm	Soil type	Depth below NGL (mm)	DPL penetration (mm/blow)	Equivalent SPT N value	Approx *in-situ* CBR (%)	Approx shear strength (kPa)	Approx EASBP (kPa)
1	0	300	150	10	Non-Cohesive	150	30	4	5		67

ESTIMATED ALLOWABLE SAFE BEARING PRESSURE FROM DCP

Job Name: PAARDEVLEI SOLAR PV FARM
Date of Test: 04/12/2023
Job No: 6047
DPL No: 3
Location: TP3
Hammer: 10 kg hammer
450 mm drop height
Cone: 25 mm point
60° angle

note:
CBR from Webster, S.L., Grau, R.H., and Williams, T.P., (1992), "*Description and Application of Dual Mass Dynamic Cone Penetrometer*"
EASBP or non-cohesive soils from Terzaghi & Peck p 491 for 25 mm settlement.
EASBP for cohesive soils = Su*Nc/FOS. Shear strength (Su) from N via T3 of Geoterminology.



Penetration Guide: Consistency

SPT N Value	Cohesive soils	Non-cohesive soils
> 50	Very stiff	Very Dense
31 - 50	Stiff	Dense
11 - 30	Firm	Med Dense
5 - 10	Soft	Loose
0 - 4	Very soft	Very Loose

NOTE: EASBP calculated for cohesive and non-cohesive soils

*SPT N value = (DCP blows/300mm) * 0.38*

*CBR = 465 * (DCP Penetration (mm/blow)^-1.31*

NOTE: First select soil type

Depth of hole in which DPL was taken : 0.00 mm below ngl
Remarks : Refusal at 0.30m

Non-cohesive soils
Applied Factor : 1 times Terzaghi's value

OR

Cohesive soils
Nc 5 FOS 3

Reading no.	Layer from (mm)	Layer to (mm)	Average layer depth (mm)	DPL blows/300 mm	Soil type	Depth below NGL (mm)	DPL penetration (mm/blow)	Equivalent SPT N value	Approx *in-situ* CBR (%)	Approx shear strength (kPa)	Approx EASBP (kPa)
1	0	300	150	27	Non-Cohesive	150	11	10	20		147

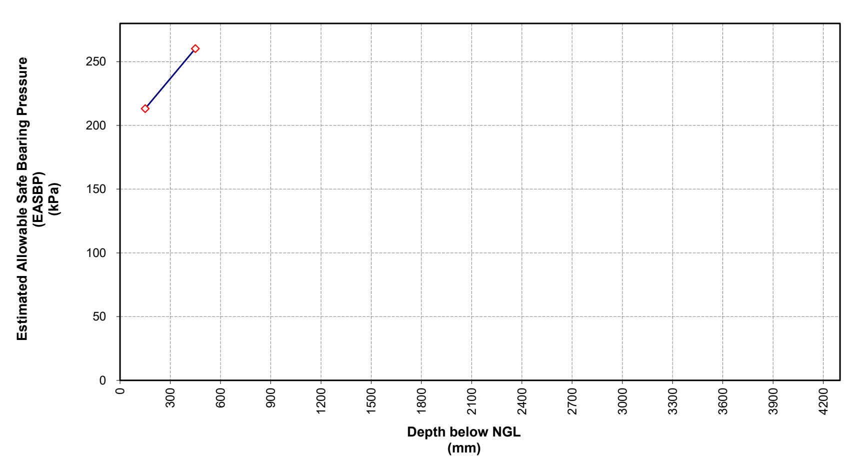
ESTIMATED ALLOWABLE SAFE BEARING PRESSURE FROM DCP

Job Name: PAARDEVLEI SOLAR PV FARM
Date of Test: 04/12/2023
Job No: 6047
DPL No: 4
Location: TP4

Hammer: 10 kg hammer
450 mm drop height
Cone: 25 mm point
60° angle

JG AFRIKA
EXPERIENCE QUALITY INTEGRITY

note:
CBR from Webster, S.L., Grau, R.H., and Williams, T.P., (1992), "*Description and Application of Dual Mass Dynamic Cone Penetrometer*"
EASBP or non-cohesive soils from Terzaghi & Peck p 491 for 25 mm settlement.
EASBP for cohesive soils = Su*Nc/FOS. Shear strength (Su) from N via T3 of Geoterminology.



Penetration Guide: Consistency		
SPT N Value	Cohesive soils	Non-cohesive soils
> 50	Very stiff	Very Dense
31 - 50	Stiff	Dense
11 - 30	Firm	Med Dense
5 - 10	Soft	Loose
0 - 4	Very soft	Very Loose

NOTE: EASBP calculated for cohesive and non-cohesive soils

*SPT N value = (DCP blows/300mm) * 0.38*

*CBR = 465 * (DCP Penetration (mm/blow)^-1.31*

NOTE: First select soil type

Depth of hole in which DPL was taken : 0.00 mm below ngl
Remarks : Refusal at 0.60m

Non-cohesive soils
Applied Factor : 1 times Terzaghi's value

OR

Cohesive soils
Nc 5 FOS 3

Reading no.	Layer from (mm)	Layer to (mm)	Average layer depth (mm)	DPL blows/300 mm	Soil type	Depth below NGL (mm)	DPL penetration (mm/blow)	Equivalent SPT N value	Approx *in-situ* CBR (%)	Approx shear strength (kPa)	Approx EASBP (kPa)
1	0	300	150	41	Non-Cohesive	150	7	16	34		213
2	300	600	450	51	Non-Cohesive	450	6	19	46		260

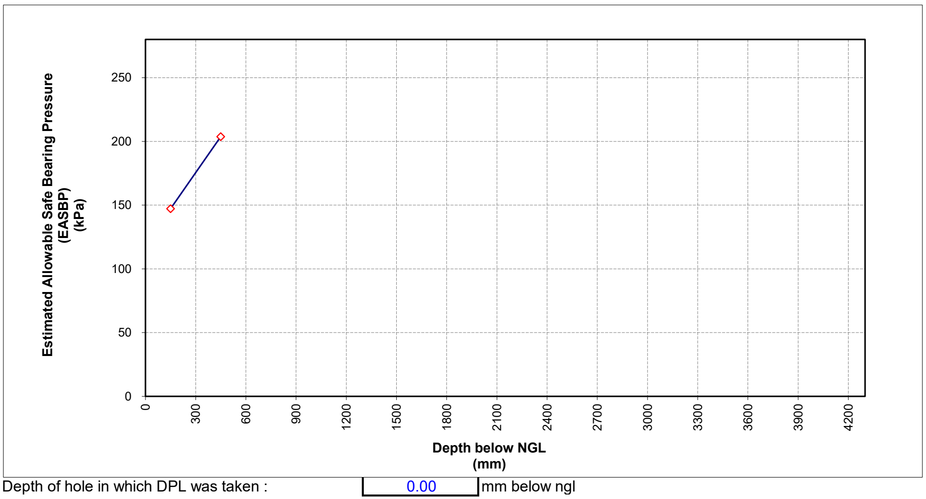
ESTIMATED ALLOWABLE SAFE BEARING PRESSURE FROM DCP

Job Name: PAARDEVLEI SOLAR PV FARM   Date of Test: 04/12/2023
Job No: 6047
DPL No: 5   Location: TP5

Hammer: 10 kg hammer
450 mm drop height
Cone: 25 mm point
60° angle

JG AFRIKA
EXPERIENCE QUALITY INTEGRITY

note:
CBR from Webster, S.L., Grau, R.H., and Williams, T.P., (1992), "*Description and Application of Dual Mass Dynamic Cone Penetrometer*"
EASBP or non-cohesive soils from Terzaghi & Peck p 491 for 25 mm settlement.
EASBP for cohesive soils = Su*Nc/FOS. Shear strength (Su) from N via T3 of Geoterminology.



Penetration Guide: Consistency

SPT N Value	Cohesive soils	Non-cohesive soils
> 50	Very stiff	Very Dense
31 - 50	Stiff	Dense
11 - 30	Firm	Med Dense
5 - 10	Soft	Loose
0 - 4	Very soft	Very Loose

NOTE: EASBP calculated for cohesive and non-cohesive soils

*SPT N value = (DCP blows/300mm) * 0.38*

*CBR = 465 * (DCP Penetration (mm/blow)^-1.31*

NOTE: First select soil type

Depth of hole in which DPL was taken : 0.00 mm below ngl
Remarks : Refusal at 0.60m

Non-cohesive soils
Applied Factor : 1 times Terzaghi's value

OR

Cohesive soils
Nc 5 FOS 3

Reading no.	Layer from (mm)	Layer to (mm)	Average layer depth (mm)	DPL blows/300 mm	Soil type	Depth below NGL (mm)	DPL penetration (mm/blow)	Equivalent SPT N value	Approx *in-situ* CBR (%)	Approx shear strength (kPa)	Approx EASBP (kPa)
1	0	300	150	27	Non-Cohesive	150	11	10	20		147
2	300	600	450	39	Non-Cohesive	450	8	15	32		204

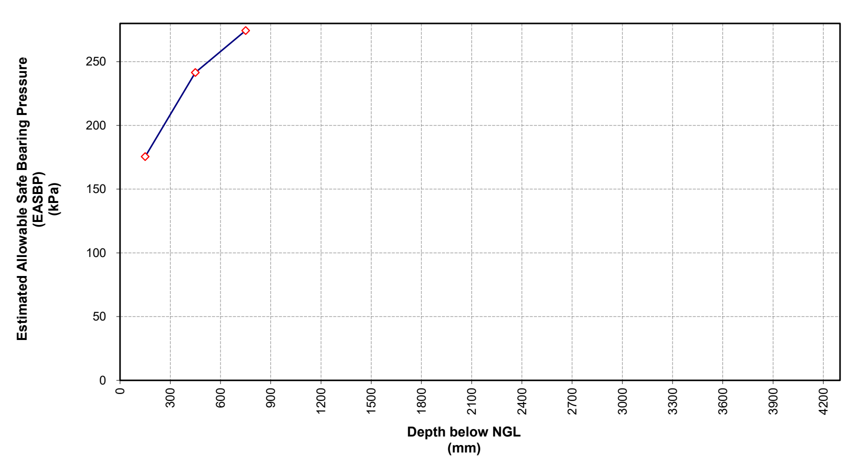
ESTIMATED ALLOWABLE SAFE BEARING PRESSURE FROM DCP

Job Name: PAARDEVLEI SOLAR PV FARM
Date of Test: 04/12/2023
Job No: 6047
DPL No: 7
Location: TP7

Hammer: 10 kg hammer
450 mm drop height
Cone: 25 mm point
60° angle

JG AFRIKA
EXPERIENCE QUALITY INTEGRITY

note:
CBR from Webster, S.L., Grau, R.H., and Williams, T.P., (1992), "*Description and Application of Dual Mass Dynamic Cone Penetrometer*"
EASBP or non-cohesive soils from Terzaghi & Peck p 491 for 25 mm settlement.
EASBP for cohesive soils = Su*Nc/FOS. Shear strength (Su) from N via T3 of Geoterminology.



Penetration Guide: Consistency

SPT N Value	Cohesive soils	Non-cohesive soils
> 50	Very stiff	Very Dense
31 - 50	Stiff	Dense
11 - 30	Firm	Med Dense
5 - 10	Soft	Loose
0 - 4	Very soft	Very Loose

NOTE: EASBP calculated for cohesive and non-cohesive soils

*SPT N value = (DCP blows/300mm) * 0.38*

*CBR = 465 * (DCP Penetration (mm/blow)^-1.31*

NOTE: First select soil type

Depth of hole in which DPL was taken : 0.00 mm below ngl

Remarks : Refusal at 0.90m

Non-cohesive soils
Applied Factor : 1 times Terzaghi's value

OR

Cohesive soils
Nc 5 FOS 3

Reading no.	Layer from (mm)	Layer to (mm)	Average layer depth (mm)	DPL blows/300 mm	Soil type	Depth below NGL (mm)	DPL penetration (mm/blow)	Equivalent SPT N value	Approx *in-situ* CBR (%)	Approx shear strength (kPa)	Approx EASBP (kPa)
1	0	300	150	33	Non-Cohesive	150	9	13	26		175
2	300	600	450	47	Non-Cohesive	450	6	18	41		241
3	600	900	750	54	Non-Cohesive	750	6	21	49		274

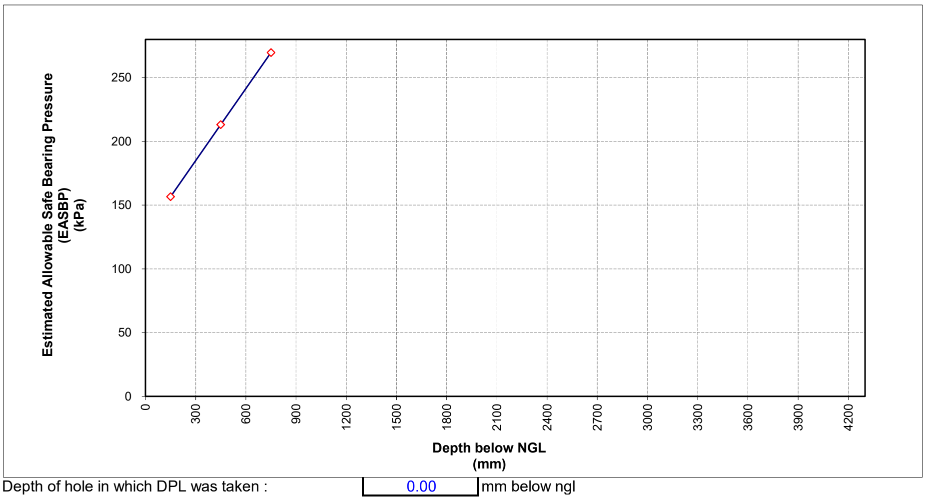
ESTIMATED ALLOWABLE SAFE BEARING PRESSURE FROM DCP

Job Name: PAARDEVLEI SOLAR PV FARM
Date of Test: 04/12/2023
Job No: 6047
DPL No: 8
Location: TP8

Hammer: 10 kg hammer
450 mm drop height
Cone: 25 mm point
60° angle

JG AFRIKA
EXPERIENCE QUALITY INTEGRITY

note:
CBR from Webster, S.L., Grau, R.H., and Williams, T.P., (1992), "*Description and Application of Dual Mass Dynamic Cone Penetrometer*"
EASBP or non-cohesive soils from Terzaghi & Peck p 491 for 25 mm settlement.
EASBP for cohesive soils = Su*Nc/FOS. Shear strength (Su) from N via T3 of Geoterminology.



Penetration Guide: Consistency		
SPT N Value	Cohesive soils	Non-cohesive soils
> 50	Very stiff	Very Dense
31 - 50	Stiff	Dense
11 - 30	Firm	Med Dense
5 - 10	Soft	Loose
0 - 4	Very soft	Very Loose

NOTE: EASBP calculated for cohesive and non-cohesive soils

*SPT N value = (DCP blows/300mm) * 0.38*

*CBR = 465 * (DCP Penetration (mm/blow)^-1.31*

NOTE: First select soil type

Depth of hole in which DPL was taken : 0.00 mm below ngl
Remarks : Refusal at 0.90m

Non-cohesive soils
Applied Factor : 1 times Terzaghi's value

OR

Cohesive soils
Nc 5 FOS 3

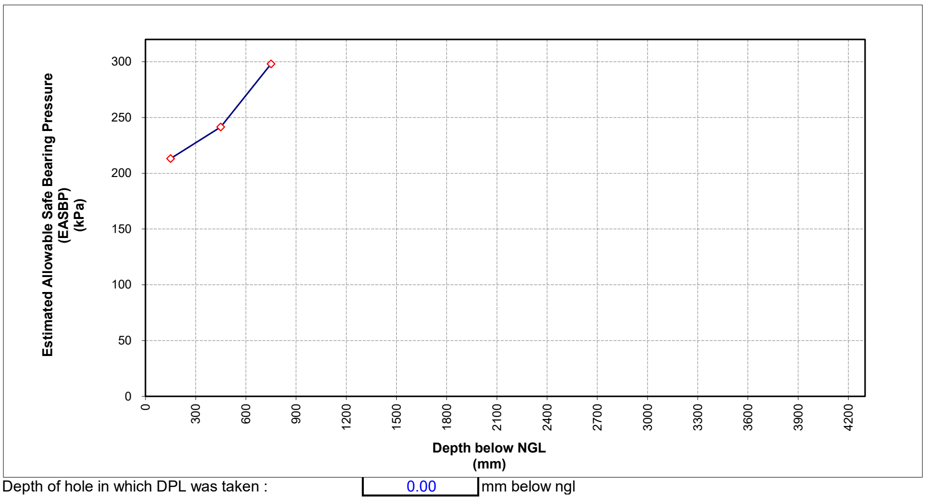
Reading no.	Layer from (mm)	Layer to (mm)	Average layer depth (mm)	DPL blows/300 mm	Soil type	Depth below NGL (mm)	DPL penetration (mm/blow)	Equivalent SPT N value	Approx *in-situ* CBR (%)	Approx shear strength (kPa)	Approx EASBP (kPa)
1	0	300	150	29	Non-Cohesive	150	10	11	22		157
2	300	600	450	41	Non-Cohesive	450	7	16	34		213
3	600	900	750	53	Non-Cohesive	750	6	20	48		270

ESTIMATED ALLOWABLE SAFE BEARING PRESSURE FROM DCP

Job Name: PAARDEVLEI SOLAR PV FARM
Date of Test: 04/12/2023
Job No: 6047
DPL No: 9
Location: TP9

Hammer: 10 kg hammer
450 mm drop height
Cone: 25 mm point
60° angle

note:
CBR from Webster, S.L., Grau, R.H., and Williams, T.P., (1992), "*Description and Application of Dual Mass Dynamic Cone Penetrometer*"
EASBP or non-cohesive soils from Terzaghi & Peck p 491 for 25 mm settlement.
EASBP for cohesive soils = Su*Nc/FOS. Shear strength (Su) from N via T3 of Geoterminology.



Penetration Guide: Consistency

SPT N Value	Cohesive soils	Non-cohesive soils
> 50	Very stiff	Very Dense
31 - 50	Stiff	Dense
11 - 30	Firm	Med Dense
5 - 10	Soft	Loose
0 - 4	Very soft	Very Loose

NOTE: EASBP calculated for cohesive and non-cohesive soils

*SPT N value = (DCP blows/300mm) * 0.38*

*CBR = 465 * (DCP Penetration (mm/blow)^-1.31*

NOTE: First select soil type

Depth of hole in which DPL was taken : 0.00 mm below ngl
Remarks : Refusal at 0.90m

Non-cohesive soils
Applied Factor : 1 times Terzaghi's value

OR

Cohesive soils
Nc 5 FOS 3

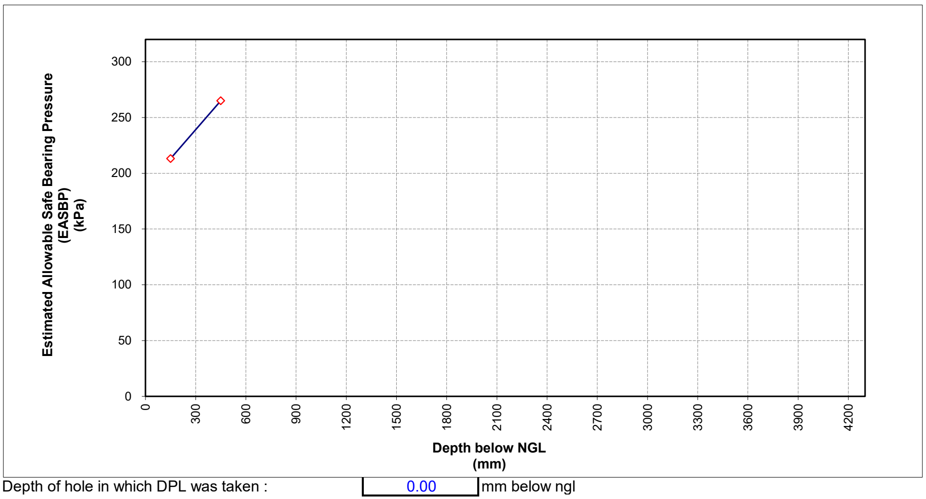
Reading no.	Layer from (mm)	Layer to (mm)	Average layer depth (mm)	DPL blows/300 mm	Soil type	Depth below NGL (mm)	DPL penetration (mm/blow)	Equivalent SPT N value	Approx *in-situ* CBR (%)	Approx shear strength (kPa)	Approx EASBP (kPa)
1	0	300	150	41	Non-Cohesive	150	7	16	34		213
2	300	600	450	47	Non-Cohesive	450	6	18	41		241
3	600	900	750	59	Non-Cohesive	750	5	22	55		298

ESTIMATED ALLOWABLE SAFE BEARING PRESSURE FROM DCP

Job Name: PAARDEVLEI SOLAR PV FARM
Date of Test: 04/12/2023
Job No: 6047
DPL No: 10
Location: TP10

Hammer: 10 kg hammer
450 mm drop height
Cone: 25 mm point
60° angle

note:
CBR from Webster, S.L., Grau, R.H., and Williams, T.P., (1992), "*Description and Application of Dual Mass Dynamic Cone Penetrometer*"
EASBP or non-cohesive soils from Terzaghi & Peck p 491 for 25 mm settlement.
EASBP for cohesive soils = Su*Nc/FOS. Shear strength (Su) from N via T3 of Geoterminology.



Penetration Guide: Consistency

SPT N Value	Cohesive soils	Non-cohesive soils
> 50	Very stiff	Very Dense
31 - 50	Stiff	Dense
11 - 30	Firm	Med Dense
5 - 10	Soft	Loose
0 - 4	Very soft	Very Loose

NOTE: EASBP calculated for cohesive and non-cohesive soils

*SPT N value = (DCP blows/300mm) * 0.38*

*CBR = 465 * (DCP Penetration (mm/blow)^-1.31*

NOTE: First select soil type

Depth of hole in which DPL was taken : 0.00 mm below ngl
Remarks : Refusal at 0.60m

Non-cohesive soils
Applied Factor : 1 times Terzaghi's value

OR

Cohesive soils
Nc 5 FOS 3

Reading no.	Layer from (mm)	Layer to (mm)	Average layer depth (mm)	DPL blows/300 mm	Soil type	Depth below NGL (mm)	DPL penetration (mm/blow)	Equivalent SPT N value	Approx *in-situ* CBR (%)	Approx shear strength (kPa)	Approx EASBP (kPa)
1	0	300	150	41	Non-Cohesive	150	7	16	34		213
2	300	600	450	52	Non-Cohesive	450	6	20	47		265

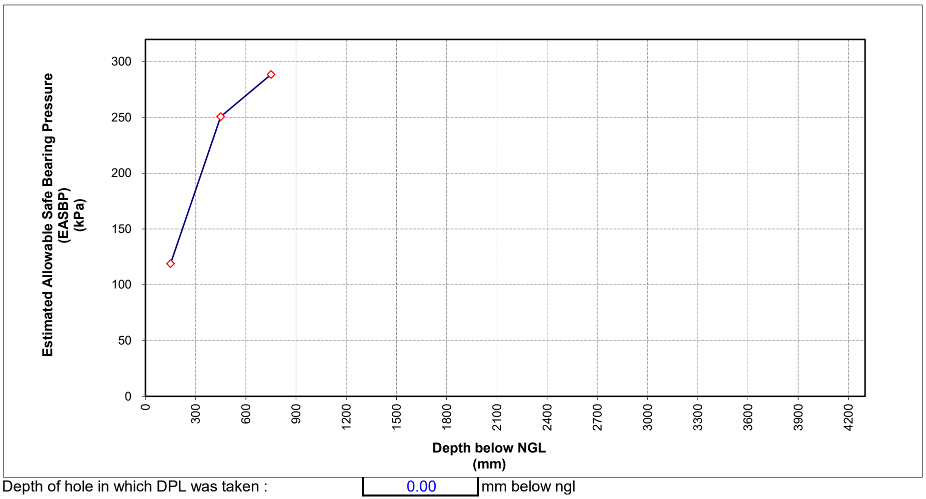
ESTIMATED ALLOWABLE SAFE BEARING PRESSURE FROM DCP

Job Name:	PAARDEVLEI SOLAR PV FARM	Date of Test:	04/12/2023
Job No:	6047		
DPL No:	11	Location:	TP11

Hammer:	10 kg hammer
	450 mm drop height
Cone:	25 mm point
	60° angle

JG AFRIKA
EXPERIENCE QUALITY INTEGRITY

note:
CBR from Webster, S.L., Grau, R.H., and Williams, T.P., (1992), "*Description and Application of Dual Mass Dynamic Cone Penetrometer*"
EASBP or non-cohesive soils from Terzaghi & Peck p 491 for 25 mm settlement.
EASBP for cohesive soils = Su*Nc/FOS. Shear strength (Su) from N via T3 of Geoterminology.



Penetration Guide: Consistency

SPT N Value	Cohesive soils	Non-cohesive soils
> 50	Very stiff	Very Dense
31 - 50	Stiff	Dense
11 - 30	Firm	Med Dense
5 - 10	Soft	Loose
0 - 4	Very soft	Very Loose

NOTE: EASBP calculated for cohesive and non-cohesive soils

*SPT N value = (DCP blows/300mm) * 0.38*

*CBR = 465 * (DCP Penetration (mm/blow)^-1.31*

NOTE: First select soil type

Depth of hole in which DPL was taken : 0.00 mm below ngl

Remarks : Refusal at 0.90m

Non-cohesive soils		OR	Cohesive soils			
Applied Factor :	1 times Terzaghi's value		Nc	5	FOS	3

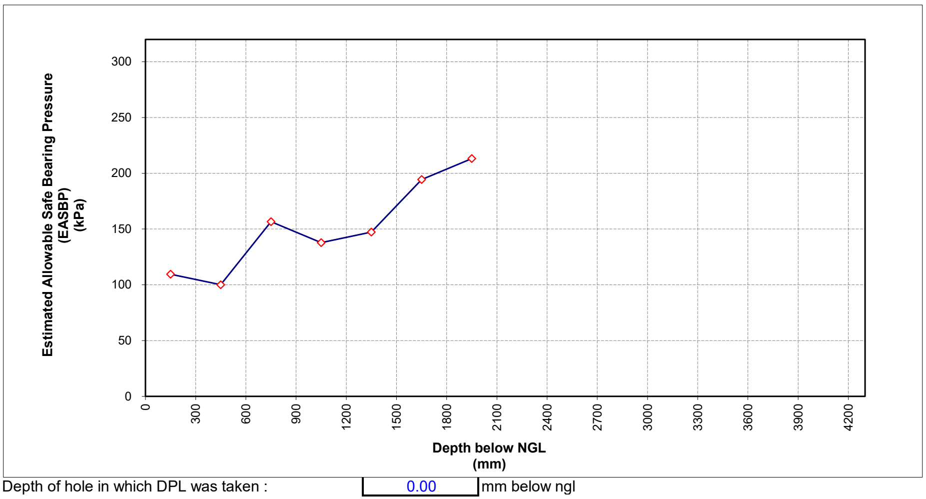
Reading no.	Layer from (mm)	Layer to (mm)	Average layer depth (mm)	DPL blows/300 mm	Soil type	Depth below NGL (mm)	DPL penetration (mm/blow)	Equivalent SPT N value	Approx *in-situ* CBR (%)	Approx shear strength (kPa)	Approx EASBP (kPa)
1	0	300	150	21	Non-Cohesive	150	14	8	14		119
2	300	600	450	49	Non-Cohesive	450	6	19	43		251
3	600	900	750	57	Non-Cohesive	750	5	22	53		289

ESTIMATED ALLOWABLE SAFE BEARING PRESSURE FROM DCP

Job Name: PAARDEVLEI SOLAR PV FARM
Date of Test: 04/12/2023
Job No: 6047
DPL No: 12
Location: TP12
Hammer: 10 kg hammer
450 mm drop height
Cone: 25 mm point
60° angle

JG AFRIKA
EXPERIENCE QUALITY INTEGRITY

note:
CBR from Webster, S.L., Grau, R.H., and Williams, T.P., (1992), "*Description and Application of Dual Mass Dynamic Cone Penetrometer*"
EASBP or non-cohesive soils from Terzaghi & Peck p 491 for 25 mm settlement.
EASBP for cohesive soils = Su*Nc/FOS. Shear strength (Su) from N via T3 of Geoterminology.



Penetration Guide: Consistency

SPT N Value	Cohesive soils	Non-cohesive soils
> 50	Very stiff	Very Dense
31 - 50	Stiff	Dense
11 - 30	Firm	Med Dense
5 - 10	Soft	Loose
0 - 4	Very soft	Very Loose

NOTE: EASBP calculated for cohesive and non-cohesive soils

*SPT N value = (DCP blows/300mm) * 0.38*

*CBR = 465 * (DCP Penetration (mm/blow)^-1.31*

NOTE: First select soil type

Depth of hole in which DPL was taken : 0.00 mm below ngl
Remarks : Refusal at 2.10m

Non-cohesive soils
Applied Factor : 1 times Terzaghi's value

OR

Cohesive soils
Nc 5 FOS 3

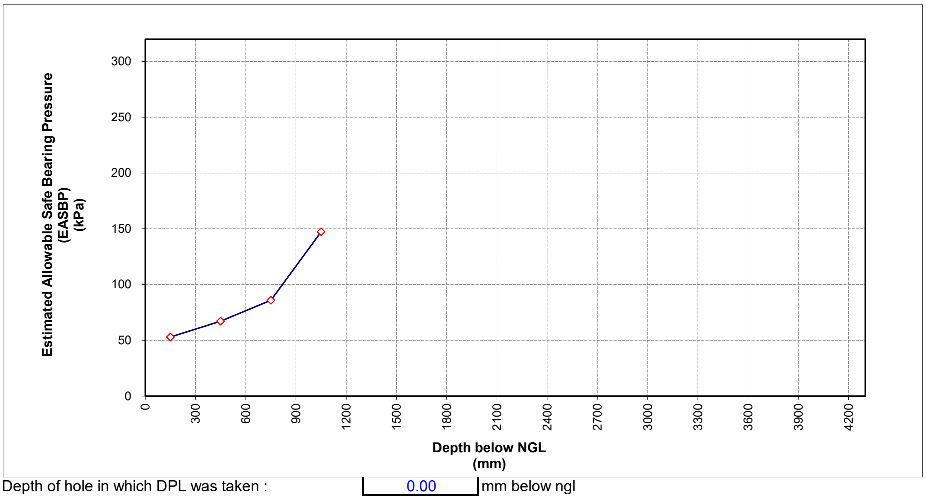
Reading no.	Layer from (mm)	Layer to (mm)	Average layer depth (mm)	DPL blows/300 mm	Soil type	Depth below NGL (mm)	DPL penetration (mm/blow)	Equivalent SPT N value	Approx *in-situ* CBR (%)	Approx shear strength (kPa)	Approx EASBP (kPa)
1	0	300	150	19	Non-Cohesive	150	16	7	13		110
2	300	600	450	17	Non-Cohesive	450	18	6	11		100
3	600	900	750	29	Non-Cohesive	750	10	11	22		157
4	900	1200	1050	25	Non-Cohesive	1050	12	10	18		138
5	1200	1500	1350	27	Non-Cohesive	1350	11	10	20		147
6	1500	1800	1650	37	Non-Cohesive	1650	8	14	30		194
7	1800	2100	1950	41	Non-Cohesive	1950	7	16	34		213

ESTIMATED ALLOWABLE SAFE BEARING PRESSURE FROM DCP

Job Name:	PAARDEVLEI SOLAR PV FARM	Date of Test:	04/12/2023
Job No:	6047		
DPL No:	13	Location:	TP13

Hammer:	10 kg hammer
	450 mm drop height
Cone:	25 mm point
	60° angle

note:
CBR from Webster, S.L., Grau, R.H., and Williams, T.P., (1992), "*Description and Application of Dual Mass Dynamic Cone Penetrometer*"
EASBP or non-cohesive soils from Terzaghi & Peck p 491 for 25 mm settlement.
EASBP for cohesive soils = Su*Nc/FOS. Shear strength (Su) from N via T3 of Geoterminology.



Penetration Guide: Consistency

SPT N Value	Cohesive soils	Non-cohesive soils
> 50	Very stiff	Very Dense
31 - 50	Stiff	Dense
11 - 30	Firm	Med Dense
5 - 10	Soft	Loose
0 - 4	Very soft	Very Loose

NOTE: EASBP calculated for cohesive and non-cohesive soils

*SPT N value = (DCP blows/300mm) * 0.38*

*CBR = 465 * (DCP Penetration (mm/blow)^-1.31*

NOTE: First select soil type

Depth of hole in which DPL was taken : 0.00 mm below ngl

Remarks : Refusal at 1.20m

Non-cohesive soils Applied Factor : 1 times Terzaghi's value

OR

Cohesive soils Nc 5 FOS 3

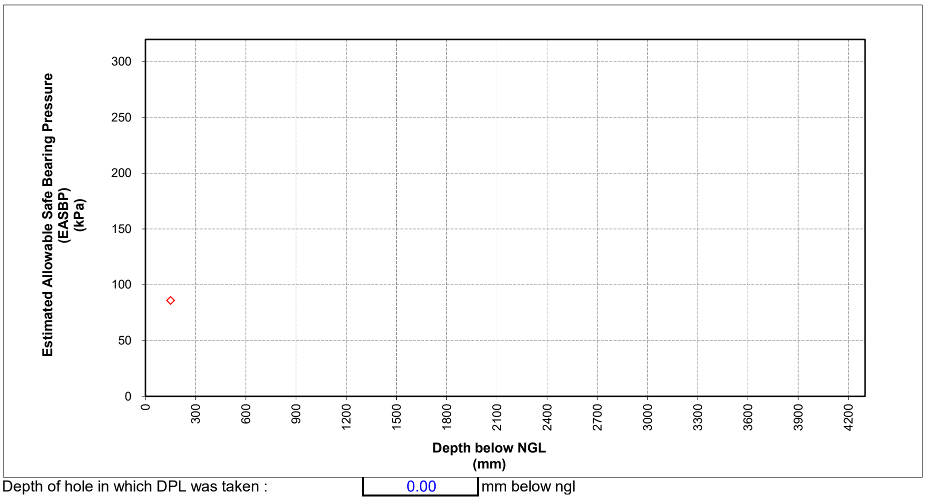
Reading no.	Layer from (mm)	Layer to (mm)	Average layer depth (mm)	DPL blows/300 mm	Soil type	Depth below NGL (mm)	DPL penetration (mm/blow)	Equivalent SPT N value	Approx *in-situ* CBR (%)	Approx shear strength (kPa)	Approx EASBP (kPa)
1	0	300	150	7	Non-Cohesive	150	43	3	3		53
2	300	600	450	10	Non-Cohesive	450	30	4	5		67
3	600	900	750	14	Non-Cohesive	750	21	5	8		86
4	900	1200	1050	27	Non-Cohesive	1050	11	10	20		147

ESTIMATED ALLOWABLE SAFE BEARING PRESSURE FROM DCP

Job Name: PAARDEVLEI SOLAR PV FARM
Date of Test: 04/12/2023
Job No: 6047
DPL No: 14
Location: TP14

Hammer: 10 kg hammer
450 mm drop height
Cone: 25 mm point
60° angle

note:
CBR from Webster, S.L., Grau, R.H., and Williams, T.P., (1992), "*Description and Application of Dual Mass Dynamic Cone Penetrometer*"
EASBP or non-cohesive soils from Terzaghi & Peck p 491 for 25 mm settlement.
EASBP for cohesive soils = Su*Nc/FOS. Shear strength (Su) from N via T3 of Geoterminology.



Penetration Guide: Consistency

SPT N Value	Cohesive soils	Non-cohesive soils
> 50	Very stiff	Very Dense
31 - 50	Stiff	Dense
11 - 30	Firm	Med Dense
5 - 10	Soft	Loose
0 - 4	Very soft	Very Loose

NOTE: EASBP calculated for cohesive and non-cohesive soils

*SPT N value = (DCP blows/300mm) * 0.38*

*CBR = 465 * (DCP Penetration (mm/blow)^-1.31*

NOTE: First select soil type

Depth of hole in which DPL was taken : 0.00 mm below ngl
Remarks : Refusal at 0.30m

Non-cohesive soils
Applied Factor : 1 times Terzaghi's value

OR

Cohesive soils
Nc 5 FOS 3

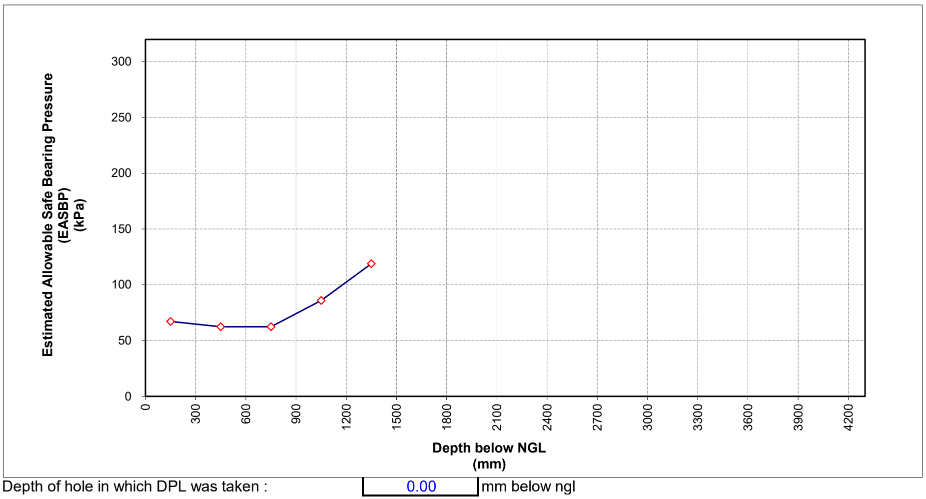
Reading no.	Layer from (mm)	Layer to (mm)	Average layer depth (mm)	DPL blows/300 mm	Soil type	Depth below NGL (mm)	DPL penetration (mm/blow)	Equivalent SPT N value	Approx *in-situ* CBR (%)	Approx shear strength (kPa)	Approx EASBP (kPa)
1	0	300	150	14	Non-Cohesive	150	21	5	8		86

ESTIMATED ALLOWABLE SAFE BEARING PRESSURE FROM DCP

Job Name: PAARDEVLEI SOLAR PV FARM
Date of Test: 04/12/2023
Job No: 6047
DPL No: 15
Location: TP15
Hammer: 10 kg hammer
450 mm drop height
Cone: 25 mm point
60° angle

JG AFRIKA
EXPERIENCE QUALITY INTEGRITY

note:
CBR from Webster, S.L., Grau, R.H., and Williams, T.P., (1992), "*Description and Application of Dual Mass Dynamic Cone Penetrometer*"
EASBP or non-cohesive soils from Terzaghi & Peck p 491 for 25 mm settlement.
EASBP for cohesive soils = Su*Nc/FOS. Shear strength (Su) from N via T3 of Geoterminology.



Penetration Guide: Consistency

SPT N Value	Cohesive soils	Non-cohesive soils
> 50	Very stiff	Very Dense
31 - 50	Stiff	Dense
11 - 30	Firm	Med Dense
5 - 10	Soft	Loose
0 - 4	Very soft	Very Loose

NOTE: EASBP calculated for cohesive and non-cohesive soils

*SPT N value = (DCP blows/300mm) * 0.38*

*CBR = 465 * (DCP Penetration (mm/blow)^-1.31*

NOTE: First select soil type

Depth of hole in which DPL was taken : 0.00 mm below ngl
Remarks : Refusal at 1.50m

Non-cohesive soils
Applied Factor : 1 times Terzaghi's value

OR

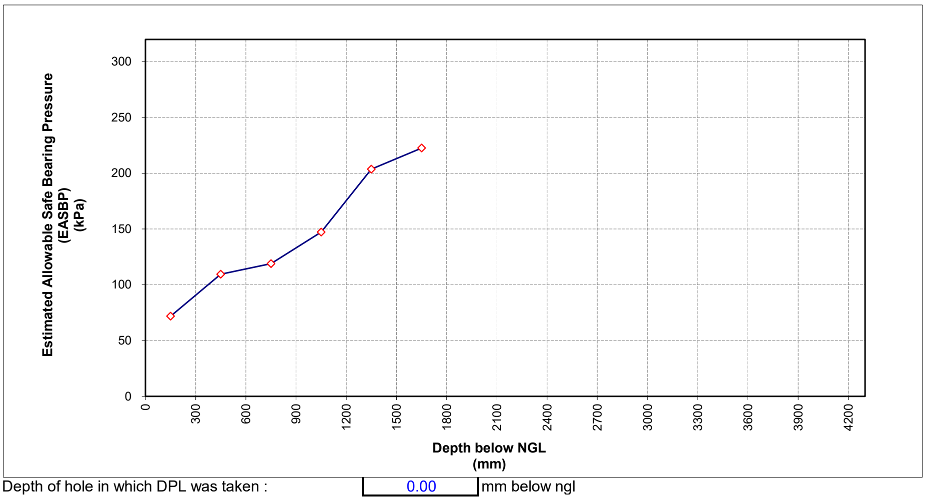
Cohesive soils
Nc 5 FOS 3

Reading no.	Layer from (mm)	Layer to (mm)	Average layer depth (mm)	DPL blows/300 mm	Soil type	Depth below NGL (mm)	DPL penetration (mm/blow)	Equivalent SPT N value	Approx *in-situ* CBR (%)	Approx shear strength (kPa)	Approx EASBP (kPa)
1	0	300	150	10	Non-Cohesive	150	30	4	5		67
2	300	600	450	9	Non-Cohesive	450	33	3	5		62
3	600	900	750	9	Non-Cohesive	750	33	3	5		62
4	900	1200	1050	14	Non-Cohesive	1050	21	5	8		86
5	1200	1500	1350	21	Non-Cohesive	1350	14	8	14		119

ESTIMATED ALLOWABLE SAFE BEARING PRESSURE FROM DCP

Job Name: PAARDEVLEI SOLAR PV FARM
Date of Test: 04/12/2023
Job No: 6047
DPL No: 16
Location: TP16
Hammer: 10 kg hammer
450 mm drop height
Cone: 25 mm point
60° angle

note:
CBR from Webster, S.L., Grau, R.H., and Williams, T.P., (1992), "*Description and Application of Dual Mass Dynamic Cone Penetrometer*"
EASBP or non-cohesive soils from Terzaghi & Peck p 491 for 25 mm settlement.
EASBP for cohesive soils = Su*Nc/FOS. Shear strength (Su) from N via T3 of Geoterminology.



Penetration Guide: Consistency		
SPT N Value	Cohesive soils	Non-cohesive soils
> 50	Very stiff	Very Dense
31 - 50	Stiff	Dense
11 - 30	Firm	Med Dense
5 - 10	Soft	Loose
0 - 4	Very soft	Very Loose

NOTE: EASBP calculated for cohesive and non-cohesive soils

*SPT N value = (DCP blows/300mm) * 0.38*

*CBR = 465 * (DCP Penetration (mm/blow)^-1.31*

NOTE: First select soil type

Depth of hole in which DPL was taken : 0.00 mm below ngl
Remarks : Refusal at 1.80m

Non-cohesive soils
Applied Factor : 1 times Terzaghi's value

OR

Cohesive soils
Nc 5 FOS 3

Reading no.	Layer from (mm)	Layer to (mm)	Average layer depth (mm)	DPL blows/300 mm	Soil type	Depth below NGL (mm)	DPL penetration (mm/blow)	Equivalent SPT N value	Approx *in-situ* CBR (%)	Approx shear strength (kPa)	Approx EASBP (kPa)
1	0	300	150	11	Non-Cohesive	150	27	4	6		72
2	300	600	450	19	Non-Cohesive	450	16	7	13		110
3	600	900	750	21	Non-Cohesive	750	14	8	14		119
4	900	1200	1050	27	Non-Cohesive	1050	11	10	20		147
5	1200	1500	1350	39	Non-Cohesive	1350	8	15	32		204
6	1500	1800	1650	43	Non-Cohesive	1650	7	16	36		223

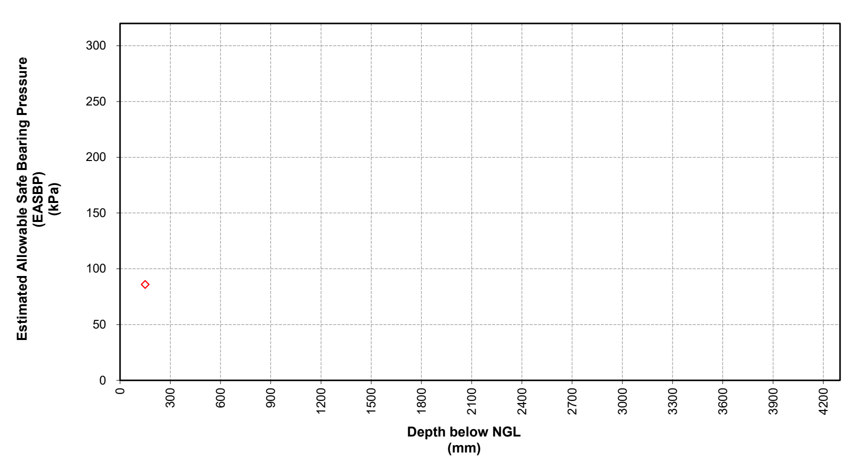
ESTIMATED ALLOWABLE SAFE BEARING PRESSURE FROM DCP

Job Name: PAARDEVLEI SOLAR PV FARM
Date of Test: 04/12/2023
Job No: 6047
DPL No: 17
Location: TP17

Hammer: 10 kg hammer
450 mm drop height
Cone: 25 mm point
60° angle

JG AFRIKA
EXPERIENCE QUALITY INTEGRITY

note:
CBR from Webster, S.L., Grau, R.H., and Williams, T.P., (1992), "*Description and Application of Dual Mass Dynamic Cone Penetrometer*"
EASBP or non-cohesive soils from Terzaghi & Peck p 491 for 25 mm settlement.
EASBP for cohesive soils = Su*Nc/FOS. Shear strength (Su) from N via T3 of Geoterminology.



Penetration Guide: Consistency

SPT N Value	Cohesive soils	Non-cohesive soils
> 50	Very stiff	Very Dense
31 - 50	Stiff	Dense
11 - 30	Firm	Med Dense
5 - 10	Soft	Loose
0 - 4	Very soft	Very Loose

NOTE: EASBP calculated for cohesive and non-cohesive soils

*SPT N value = (DCP blows/300mm) * 0.38*

*CBR = 465 * (DCP Penetration (mm/blow)^-1.31*

NOTE: First select soil type

Depth of hole in which DPL was taken : 0.00 mm below ngl
Remarks : Refusal at 0.30m

Non-cohesive soils
Applied Factor : 1 times Terzaghi's value

OR

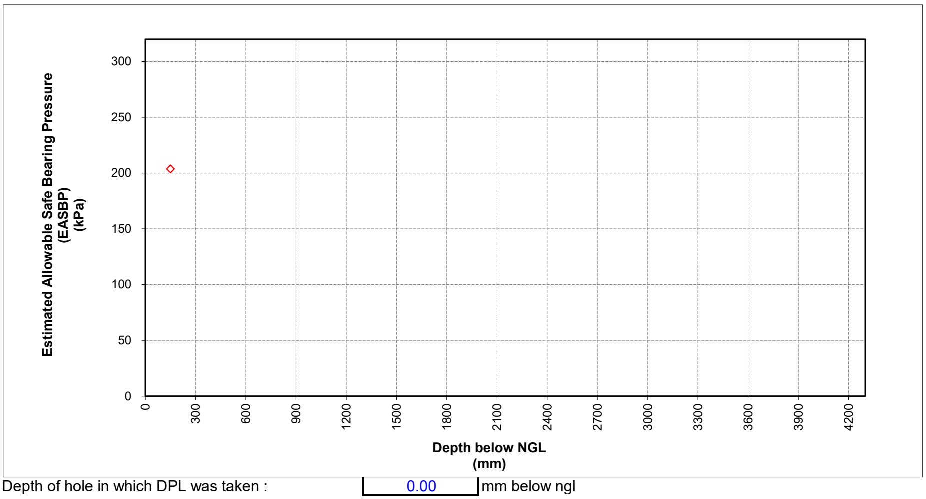
Cohesive soils
Nc 5 FOS 3

Reading no.	Layer from (mm)	Layer to (mm)	Average layer depth (mm)	DPL blows/300 mm	Soil type	Depth below NGL (mm)	DPL penetration (mm/blow)	Equivalent SPT N value	Approx *in-situ* CBR (%)	Approx shear strength (kPa)	Approx EASBP (kPa)
1	0	300	150	14	Non-Cohesive	150	21	5	8		86

ESTIMATED ALLOWABLE SAFE BEARING PRESSURE FROM DCP

Job Name: PAARDEVLEI SOLAR PV FARM
Date of Test: 04/12/2023
Job No: 6047
DPL No: 18
Location: TP18
Hammer: 10 kg hammer
450 mm drop height
Cone: 25 mm point
60° angle

note:
CBR from Webster, S.L., Grau, R.H., and Williams, T.P., (1992), "*Description and Application of Dual Mass Dynamic Cone Penetrometer*"
EASBP or non-cohesive soils from Terzaghi & Peck p 491 for 25 mm settlement.
EASBP for cohesive soils = Su*Nc/FOS. Shear strength (Su) from N via T3 of Geoterminology.



Penetration Guide: Consistency

SPT N Value	Cohesive soils	Non-cohesive soils
> 50	Very stiff	Very Dense
31 - 50	Stiff	Dense
11 - 30	Firm	Med Dense
5 - 10	Soft	Loose
0 - 4	Very soft	Very Loose

NOTE: EASBP calculated for cohesive and non-cohesive soils

*SPT N value = (DCP blows/300mm) * 0.38*

*CBR = 465 * (DCP Penetration (mm/blow)^-1.31*

NOTE: First select soil type

Depth of hole in which DPL was taken : 0.00 mm below ngl
Remarks : Refusal at 0.30m

Non-cohesive soils
Applied Factor : 1 times Terzaghi's value

OR

Cohesive soils
Nc 5 FOS 3

Reading no.	Layer from (mm)	Layer to (mm)	Average layer depth (mm)	DPL blows/300 mm	Soil type	Depth below NGL (mm)	DPL penetration (mm/blow)	Equivalent SPT N value	Approx *in-situ* CBR (%)	Approx shear strength (kPa)	Approx EASBP (kPa)
1	0	300	150	39	Non-Cohesive	150	8	15	32		204

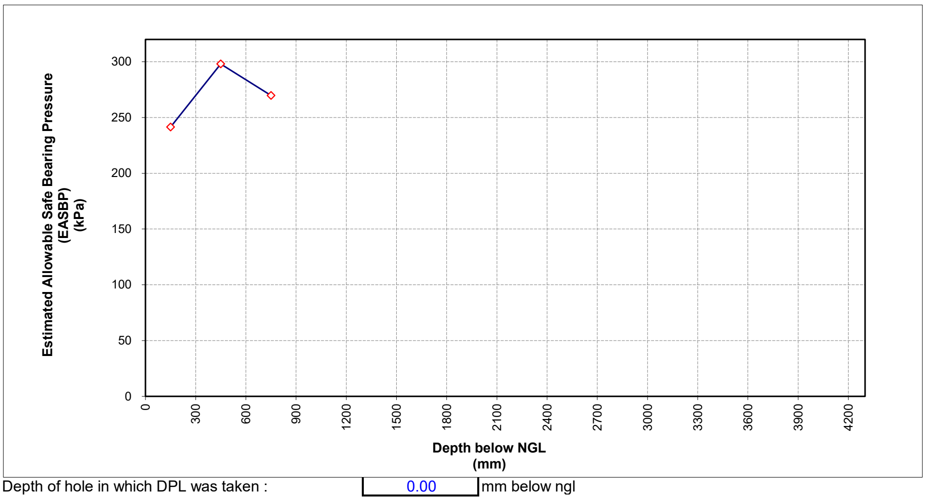
ESTIMATED ALLOWABLE SAFE BEARING PRESSURE FROM DCP

Job Name: PAARDEVLEI SOLAR PV FARM
Date of Test: 04/12/2023
Job No: 6047
DPL No: 19
Location: TP19

Hammer: 10 kg hammer
450 mm drop height
Cone: 25 mm point
60° angle

JG AFRIKA
EXPERIENCE QUALITY INTEGRITY

note:
CBR from Webster, S.L., Grau, R.H., and Williams, T.P., (1992), "*Description and Application of Dual Mass Dynamic Cone Penetrometer*"
EASBP or non-cohesive soils from Terzaghi & Peck p 491 for 25 mm settlement.
EASBP for cohesive soils = Su*Nc/FOS. Shear strength (Su) from N via T3 of Geoterminology.



Penetration Guide: Consistency

SPT N Value	Cohesive soils	Non-cohesive soils
> 50	Very stiff	Very Dense
31 - 50	Stiff	Dense
11 - 30	Firm	Med Dense
5 - 10	Soft	Loose
0 - 4	Very soft	Very Loose

NOTE: EASBP calculated for cohesive and non-cohesive soils

*SPT N value = (DCP blows/300mm) * 0.38*

*CBR = 465 * (DCP Penetration (mm/blow)^-1.31*

NOTE: First select soil type

Depth of hole in which DPL was taken : 0.00 mm below ngl
Remarks : Refusal at 0.90m

Non-cohesive soils
Applied Factor : 1 times Terzaghi's value

OR

Cohesive soils
Nc 5 FOS 3

Reading no.	Layer from (mm)	Layer to (mm)	Average layer depth (mm)	DPL blows/300 mm	Soil type	Depth below NGL (mm)	DPL penetration (mm/blow)	Equivalent SPT N value	Approx *in-situ* CBR (%)	Approx shear strength (kPa)	Approx EASBP (kPa)
1	0	300	150	47	Non-Cohesive	150	6	18	41		241
2	300	600	450	59	Non-Cohesive	450	5	22	55		298
3	600	900	750	53	Non-Cohesive	750	6	20	48		270

ESTIMATED ALLOWABLE SAFE BEARING PRESSURE FROM DCP

Job Name: PAARDEVLEI SOLAR PV FARM
Date of Test: 04/12/2023
Job No: 6047
DPL No: 20
Location: TP20

Hammer: 10 kg hammer
450 mm drop height
Cone: 25 mm point
60° angle

JG AFRIKA
EXPERIENCE QUALITY INTEGRITY

note:
CBR from Webster, S.L., Grau, R.H., and Williams, T.P., (1992), "*Description and Application of Dual Mass Dynamic Cone Penetrometer*"
EASBP or non-cohesive soils from Terzaghi & Peck p 491 for 25 mm settlement.
EASBP for cohesive soils = Su*Nc/FOS. Shear strength (Su) from N via T3 of Geoterminology.

Penetration Guide: Consistency		
SPT N Value	Cohesive soils	Non-cohesive soils
> 50	Very stiff	Very Dense
31 - 50	Stiff	Dense
11 - 30	Firm	Med Dense
5 - 10	Soft	Loose
0 - 4	Very soft	Very Loose

NOTE: EASBP calculated for cohesive and non-cohesive soils

*SPT N value = (DCP blows/300mm) * 0.38*

*CBR = 465 * (DCP Penetration (mm/blow)^-1.31*

NOTE: First select soil type

Depth of hole in which DPL was taken : 0.00 mm below ngl
Remarks : Refusal at 0.90m

Non-cohesive soils
Applied Factor : 1 times Terzaghi's value

OR

Cohesive soils
Nc 5 FOS 3

Reading no.	Layer from (mm)	Layer to (mm)	Average layer depth (mm)	DPL blows/300 mm	Soil type	Depth below NGL (mm)	DPL penetration (mm/blow)	Equivalent SPT N value	Approx *in-situ* CBR (%)	Approx shear strength (kPa)	Approx EASBP (kPa)
1	0	300	150	39	Non-Cohesive	150	8	15	32		204
2	300	600	450	52	Non-Cohesive	450	6	20	47		265
3	600	900	750	71	Non-Cohesive	750	4	27	70		355

ESTIMATED ALLOWABLE SAFE BEARING PRESSURE FROM DCP

Job Name: PAARDEVLEI SOLAR PV FARM   Date of Test: 04/12/2023

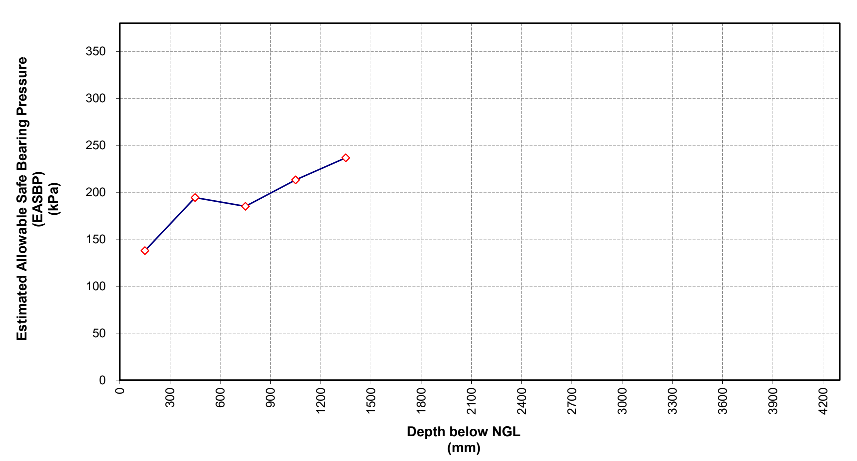
Job No: 6047

DPL No: 21   Location: TP21

Hammer: 10 kg hammer
450 mm drop height

Cone: 25 mm point
60° angle

note:
CBR from Webster, S.L., Grau, R.H., and Williams, T.P., (1992), "*Description and Application of Dual Mass Dynamic Cone Penetrometer*"
EASBP or non-cohesive soils from Terzaghi & Peck p 491 for 25 mm settlement.
EASBP for cohesive soils = Su*Nc/FOS. Shear strength (Su) from N via T3 of Geoterminology.



Penetration Guide: Consistency		
SPT N Value	Cohesive soils	Non-cohesive soils
> 50	Very stiff	Very Dense
31 - 50	Stiff	Dense
11 - 30	Firm	Med Dense
5 - 10	Soft	Loose
0 - 4	Very soft	Very Loose

NOTE: EASBP calculated for cohesive and non-cohesive soils

*SPT N value = (DCP blows/300mm) * 0.38*

*CBR = 465 * (DCP Penetration (mm/blow)^-1.31*

NOTE: First select soil type

Depth of hole in which DPL was taken : 0.00 mm below ngl

Remarks : Refusal at 1.50m

Non-cohesive soils
Applied Factor : 1 times Terzaghi's value

OR

Cohesive soils
Nc 5 FOS 3

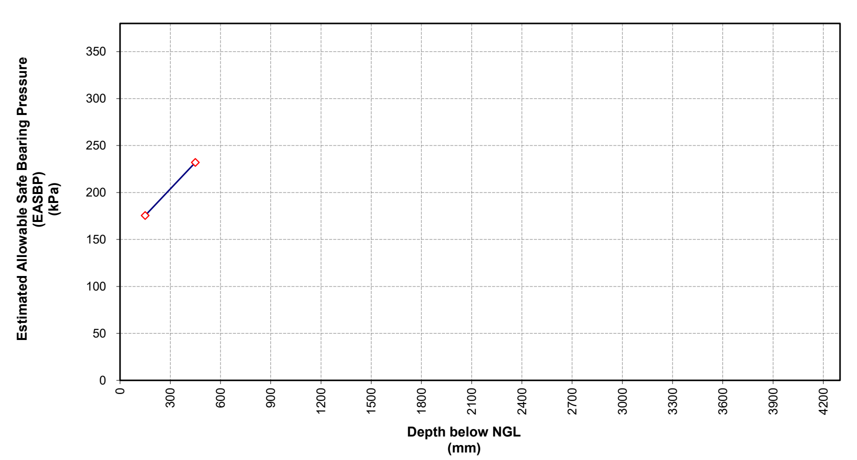
Reading no.	Layer from (mm)	Layer to (mm)	Average layer depth (mm)	DPL blows/300 mm	Soil type	Depth below NGL (mm)	DPL penetration (mm/blow)	Equivalent SPT N value	Approx *in-situ* CBR (%)	Approx shear strength (kPa)	Approx EASBP (kPa)
1	0	300	150	25	Non-Cohesive	150	12	10	18		138
2	300	600	450	37	Non-Cohesive	450	8	14	30		194
3	600	900	750	35	Non-Cohesive	750	9	13	28		185
4	900	1200	1050	41	Non-Cohesive	1050	7	16	34		213
5	1200	1500	1350	46	Non-Cohesive	1350	7	17	40		237

ESTIMATED ALLOWABLE SAFE BEARING PRESSURE FROM DCP

Job Name: PAARDEVLEI SOLAR PV FARM
Date of Test: 04/12/2023
Job No: 6047
DPL No: 22
Location: TP22

Hammer: 10 kg hammer
450 mm drop height
Cone: 25 mm point
60° angle

note:
CBR from Webster, S.L., Grau, R.H., and Williams, T.P., (1992), "*Description and Application of Dual Mass Dynamic Cone Penetrometer*"
EASBP or non-cohesive soils from Terzaghi & Peck p 491 for 25 mm settlement.
EASBP for cohesive soils = Su*Nc/FOS. Shear strength (Su) from N via T3 of Geoterminology.



Penetration Guide: Consistency		
SPT N Value	Cohesive soils	Non-cohesive soils
> 50	Very stiff	Very Dense
31 - 50	Stiff	Dense
11 - 30	Firm	Med Dense
5 - 10	Soft	Loose
0 - 4	Very soft	Very Loose

NOTE: EASBP calculated for cohesive and non-cohesive soils

*SPT N value = (DCP blows/300mm) * 0.38*

*CBR = 465 * (DCP Penetration (mm/blow)^-1.31*

NOTE: First select soil type

Depth of hole in which DPL was taken : 0.00 mm below ngl
Remarks : Refusal at 0.60m

Non-cohesive soils
Applied Factor : 1 times Terzaghi's value

OR

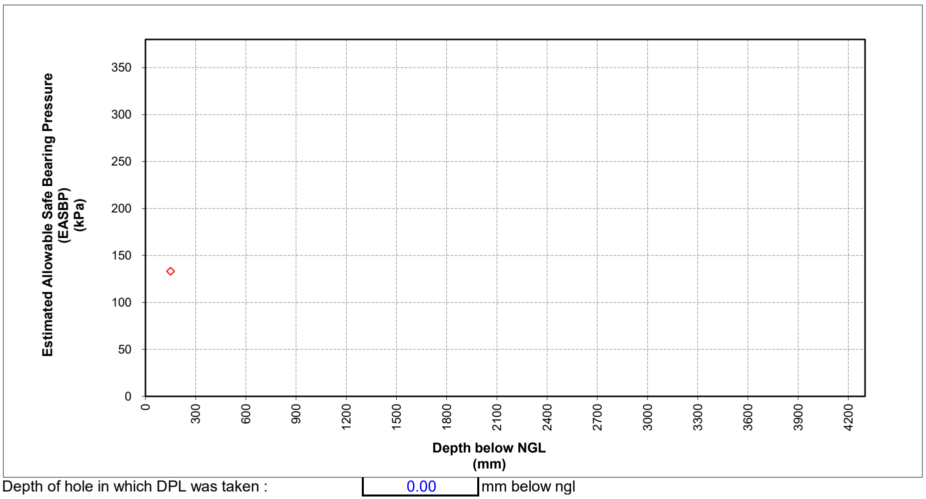
Cohesive soils
Nc 5 FOS 3

Reading no.	Layer from (mm)	Layer to (mm)	Average layer depth (mm)	DPL blows/300 mm	Soil type	Depth below NGL (mm)	DPL penetration (mm/blow)	Equivalent SPT N value	Approx *in-situ* CBR (%)	Approx shear strength (kPa)	Approx EASBP (kPa)
1	0	300	150	33	Non-Cohesive	150	9	13	26		175
2	300	600	450	45	Non-Cohesive	450	7	17	39		232

ESTIMATED ALLOWABLE SAFE BEARING PRESSURE FROM DCP

Job Name: PAARDEVLEI SOLAR PV FARM
Date of Test: 04/12/2023
Job No: 6047
DPL No: 23
Location: TP23
Hammer: 10 kg hammer
450 mm drop height
Cone: 25 mm point
60° angle

note:
CBR from Webster, S.L., Grau, R.H., and Williams, T.P., (1992), "*Description and Application of Dual Mass Dynamic Cone Penetrometer*"
EASBP or non-cohesive soils from Terzaghi & Peck p 491 for 25 mm settlement.
EASBP for cohesive soils = Su*Nc/FOS. Shear strength (Su) from N via T3 of Geoterminology.



Penetration Guide: Consistency		
SPT N Value	Cohesive soils	Non-cohesive soils
> 50	Very stiff	Very Dense
31 - 50	Stiff	Dense
11 - 30	Firm	Med Dense
5 - 10	Soft	Loose
0 - 4	Very soft	Very Loose

NOTE: EASBP calculated for cohesive and non-cohesive soils

*SPT N value = (DCP blows/300mm) * 0.38*

*CBR = 465 * (DCP Penetration (mm/blow)^-1.31*

NOTE: First select soil type

Depth of hole in which DPL was taken : 0.00 mm below ngl
Remarks : Refusal at 0.30m

Non-cohesive soils
Applied Factor : 1 times Terzaghi's value

OR

Cohesive soils
Nc 5 FOS 3

Reading no.	Layer from (mm)	Layer to (mm)	Average layer depth (mm)	DPL blows/300 mm	Soil type	Depth below NGL (mm)	DPL penetration (mm/blow)	Equivalent SPT N value	Approx *in-situ* CBR (%)	Approx shear strength (kPa)	Approx EASBP (kPa)
1	0	300	150	24	Non-Cohesive	150	13	9	17		133

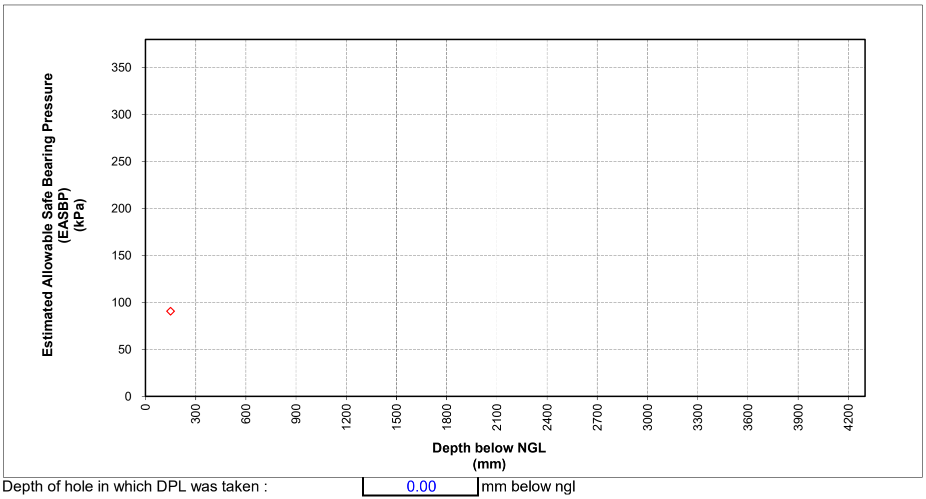
ESTIMATED ALLOWABLE SAFE BEARING PRESSURE FROM DCP

Job Name: PAARDEVLEI SOLAR PV FARM
Date of Test: 04/12/2023
Job No: 6047
DPL No: 24
Location: TP24

Hammer: 10 kg hammer
450 mm drop height
Cone: 25 mm point
60° angle

JG AFRIKA EXPERIENCE QUALITY INTEGRITY

note:
CBR from Webster, S.L., Grau, R.H., and Williams, T.P., (1992), "*Description and Application of Dual Mass Dynamic Cone Penetrometer*"
EASBP or non-cohesive soils from Terzaghi & Peck p 491 for 25 mm settlement.
EASBP for cohesive soils = Su*Nc/FOS. Shear strength (Su) from N via T3 of Geoterminology.



Penetration Guide: Consistency

SPT N Value	Cohesive soils	Non-cohesive soils
> 50	Very stiff	Very Dense
31 - 50	Stiff	Dense
11 - 30	Firm	Med Dense
5 - 10	Soft	Loose
0 - 4	Very soft	Very Loose

NOTE: EASBP calculated for cohesive and non-cohesive soils

*SPT N value = (DCP blows/300mm) * 0.38*

*CBR = 465 * (DCP Penetration (mm/blow)^-1.31*

NOTE: First select soil type

Depth of hole in which DPL was taken : 0.00 mm below ngl
Remarks : Refusal at 0.30m

Non-cohesive soils
Applied Factor : 1 times Terzaghi's value

OR

Cohesive soils
Nc 5 FOS 3

Reading no.	Layer from (mm)	Layer to (mm)	Average layer depth (mm)	DPL blows/300 mm	Soil type	Depth below NGL (mm)	DPL penetration (mm/blow)	Equivalent SPT N value	Approx *in-situ* CBR (%)	Approx shear strength (kPa)	Approx EASBP (kPa)
1	0	300	150	15	Non-Cohesive	150	20	6	9		91

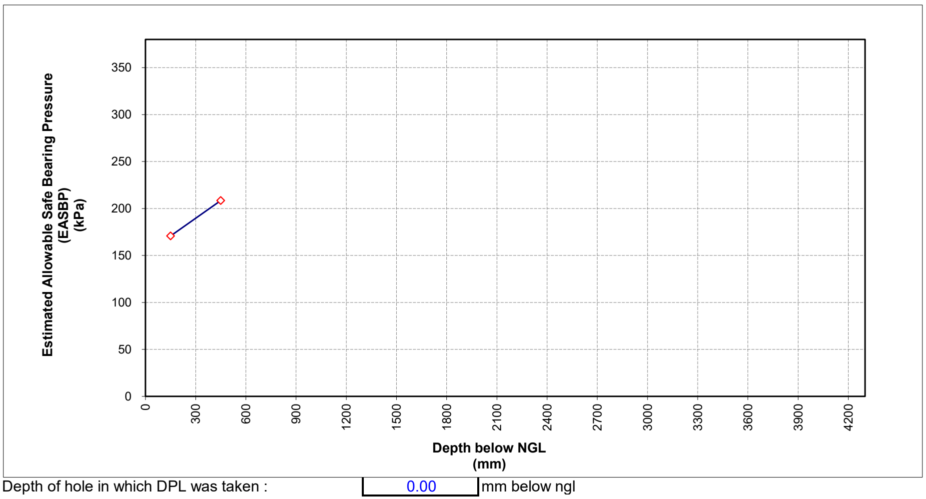
ESTIMATED ALLOWABLE SAFE BEARING PRESSURE FROM DCP

Job Name: PAARDEVLEI SOLAR PV FARM
Date of Test: 04/12/2023
Job No: 6047
DPL No: 25
Location: TP25

Hammer: 10 kg hammer
450 mm drop height
Cone: 25 mm point
60° angle

JG AFRIKA
EXPERIENCE QUALITY INTEGRITY

note:
CBR from Webster, S.L., Grau, R.H., and Williams, T.P., (1992), "*Description and Application of Dual Mass Dynamic Cone Penetrometer*"
EASBP or non-cohesive soils from Terzaghi & Peck p 491 for 25 mm settlement.
EASBP for cohesive soils = Su*Nc/FOS. Shear strength (Su) from N via T3 of Geoterminology.



Penetration Guide: Consistency		
SPT N Value	Cohesive soils	Non-cohesive soils
> 50	Very stiff	Very Dense
31 - 50	Stiff	Dense
11 - 30	Firm	Med Dense
5 - 10	Soft	Loose
0 - 4	Very soft	Very Loose

NOTE: EASBP calculated for cohesive and non-cohesive soils

*SPT N value = (DCP blows/300mm) * 0.38*

*CBR = 465 * (DCP Penetration (mm/blow)^-1.31*

NOTE: First select soil type

Depth of hole in which DPL was taken : 0.00 mm below ngl
Remarks : Refusal at 0.60m

Non-cohesive soils
Applied Factor : 1 times Terzaghi's value

OR

Cohesive soils
Nc 5 FOS 3

Reading no.	Layer from (mm)	Layer to (mm)	Average layer depth (mm)	DPL blows/300 mm	Soil type	Depth below NGL (mm)	DPL penetration (mm/blow)	Equivalent SPT N value	Approx *in-situ* CBR (%)	Approx shear strength (kPa)	Approx EASBP (kPa)
1	0	300	150	32	Non-Cohesive	150	9	12	25		171
2	300	600	450	40	Non-Cohesive	450	8	15	33		208

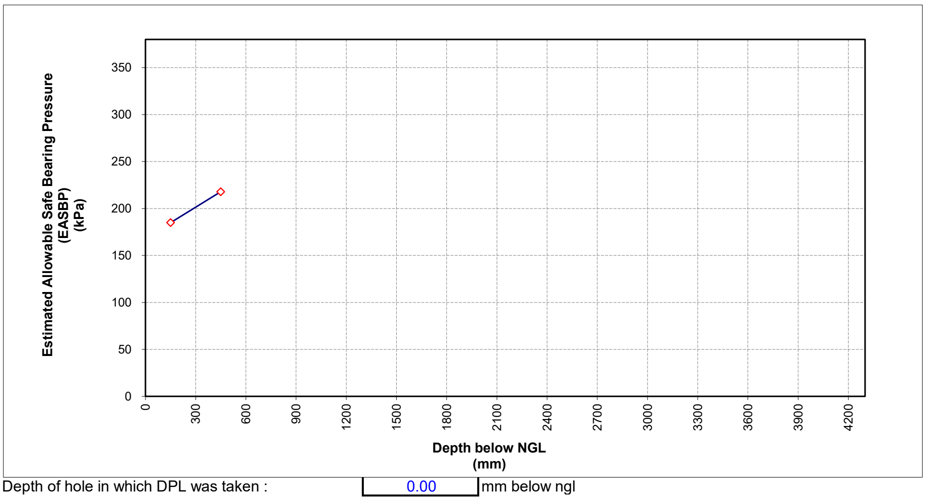
ESTIMATED ALLOWABLE SAFE BEARING PRESSURE FROM DCP

Job Name: PAARDEVLEI SOLAR PV FARM
Date of Test: 04/12/2023
Job No: 6047
DPL No: 26
Location: TP26

Hammer: 10 kg hammer
450 mm drop height
Cone: 25 mm point
60° angle

JG AFRIKA
EXPERIENCE QUALITY INTEGRITY

note:
CBR from Webster, S.L., Grau, R.H., and Williams, T.P., (1992), "*Description and Application of Dual Mass Dynamic Cone Penetrometer*"
EASBP or non-cohesive soils from Terzaghi & Peck p 491 for 25 mm settlement.
EASBP for cohesive soils = Su*Nc/FOS. Shear strength (Su) from N via T3 of Geoterminology.



Penetration Guide: Consistency		
SPT N Value	Cohesive soils	Non-cohesive soils
> 50	Very stiff	Very Dense
31 - 50	Stiff	Dense
11 - 30	Firm	Med Dense
5 - 10	Soft	Loose
0 - 4	Very soft	Very Loose

NOTE: EASBP calculated for cohesive and non-cohesive soils

*SPT N value = (DCP blows/300mm) * 0.38*

*CBR = 465 * (DCP Penetration (mm/blow)^-1.31*

NOTE: First select soil type

Depth of hole in which DPL was taken : 0.00 mm below ngl
Remarks : Refusal at 0.60m

Non-cohesive soils
Applied Factor : 1 times Terzaghi's value

OR

Cohesive soils
Nc 5 FOS 3

Reading no.	Layer from (mm)	Layer to (mm)	Average layer depth (mm)	DPL blows/300 mm	Soil type	Depth below NGL (mm)	DPL penetration (mm/blow)	Equivalent SPT N value	Approx *in-situ* CBR (%)	Approx shear strength (kPa)	Approx EASBP (kPa)
1	0	300	150	35	Non-Cohesive	150	9	13	28		185
2	300	600	450	42	Non-Cohesive	450	7	16	35		218

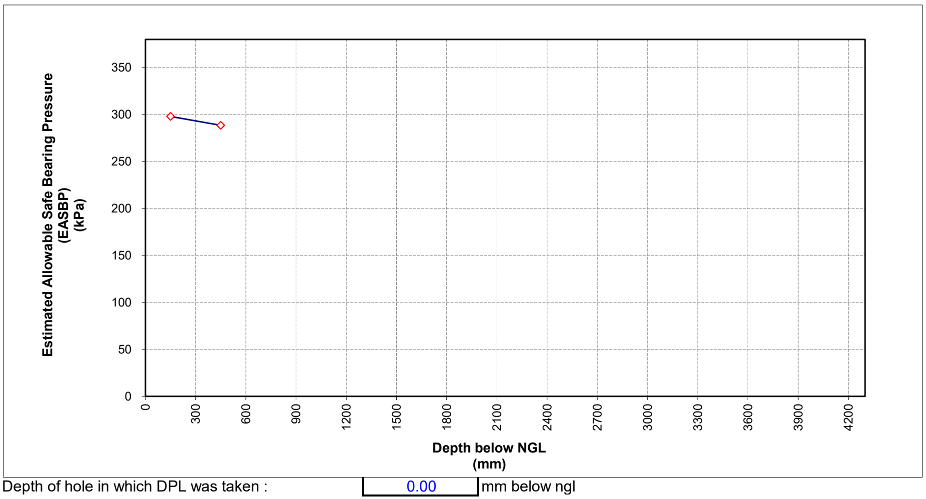
ESTIMATED ALLOWABLE SAFE BEARING PRESSURE FROM DCP

Job Name: PAARDEVLEI SOLAR PV FARM
Date of Test: 04/12/2023
Job No: 6047
DPL No: 27
Location: TP27

Hammer: 10 kg hammer
450 mm drop height
Cone: 25 mm point
60° angle

JG AFRIKA EXPERIENCE QUALITY INTEGRITY

note:
CBR from Webster, S.L., Grau, R.H., and Williams, T.P., (1992), "*Description and Application of Dual Mass Dynamic Cone Penetrometer*"
EASBP or non-cohesive soils from Terzaghi & Peck p 491 for 25 mm settlement.
EASBP for cohesive soils = Su*Nc/FOS. Shear strength (Su) from N via T3 of Geoterminology.



Penetration Guide: Consistency

SPT N Value	Cohesive soils	Non-cohesive soils
> 50	Very stiff	Very Dense
31 - 50	Stiff	Dense
11 - 30	Firm	Med Dense
5 - 10	Soft	Loose
0 - 4	Very soft	Very Loose

NOTE: EASBP calculated for cohesive and non-cohesive soils

*SPT N value = (DCP blows/300mm) * 0.38*

*CBR = 465 * (DCP Penetration (mm/blow)^-1.31*

NOTE: First select soil type

Depth of hole in which DPL was taken : 0.00 mm below ngl
Remarks : Refusal at 0.60m

Non-cohesive soils
Applied Factor : 1 times Terzaghi's value

OR

Cohesive soils
Nc 5 FOS 3

Reading no.	Layer from (mm)	Layer to (mm)	Average layer depth (mm)	DPL blows/300 mm	Soil type	Depth below NGL (mm)	DPL penetration (mm/blow)	Equivalent SPT N value	Approx *in-situ* CBR (%)	Approx shear strength (kPa)	Approx EASBP (kPa)
1	0	300	150	59	Non-Cohesive	150	5	22	55		298
2	300	600	450	57	Non-Cohesive	450	5	22	53		289

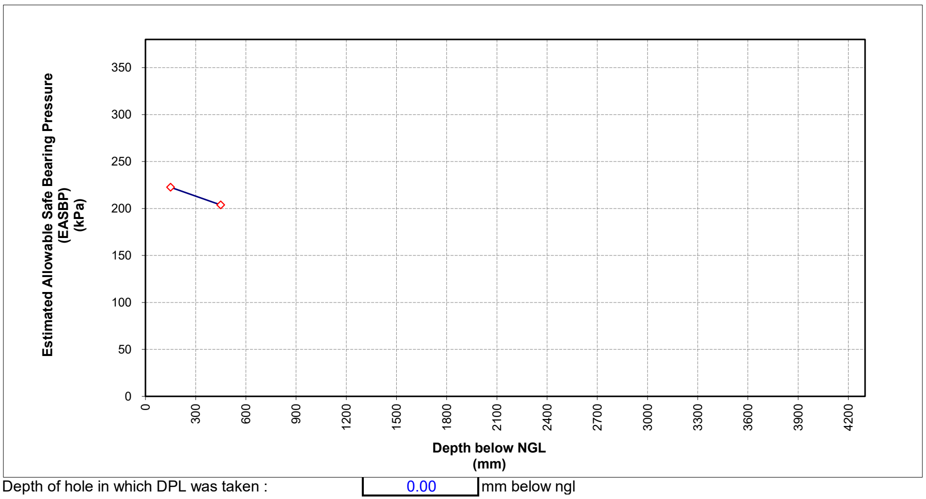
ESTIMATED ALLOWABLE SAFE BEARING PRESSURE FROM DCP

Job Name: PAARDEVLEI SOLAR PV FARM
Date of Test: 04/12/2023
Job No: 6047
DPL No: 28
Location: TP28

Hammer: 10 kg hammer
450 mm drop height
Cone: 25 mm point
60° angle

JG AFRIKA
EXPERIENCE QUALITY INTEGRITY

note:
CBR from Webster, S.L., Grau, R.H., and Williams, T.P., (1992), "*Description and Application of Dual Mass Dynamic Cone Penetrometer*"
EASBP or non-cohesive soils from Terzaghi & Peck p 491 for 25 mm settlement.
EASBP for cohesive soils = Su*Nc/FOS. Shear strength (Su) from N via T3 of Geoterminology.



Penetration Guide: Consistency		
SPT N Value	Cohesive soils	Non-cohesive soils
> 50	Very stiff	Very Dense
31 - 50	Stiff	Dense
11 - 30	Firm	Med Dense
5 - 10	Soft	Loose
0 - 4	Very soft	Very Loose

NOTE: EASBP calculated for cohesive and non-cohesive soils

*SPT N value = (DCP blows/300mm) * 0.38*

*CBR = 465 * (DCP Penetration (mm/blow)^-1.31*

NOTE: First select soil type

Depth of hole in which DPL was taken : 0.00 mm below ngl
Remarks : Refusal at 0.60m

Non-cohesive soils
Applied Factor : 1 times Terzaghi's value

OR

Cohesive soils
Nc 5 FOS 3

Reading no.	Layer from (mm)	Layer to (mm)	Average layer depth (mm)	DPL blows/300 mm	Soil type	Depth below NGL (mm)	DPL penetration (mm/blow)	Equivalent SPT N value	Approx *in-situ* CBR (%)	Approx shear strength (kPa)	Approx EASBP (kPa)
1	0	300	150	43	Non-Cohesive	150	7	16	36		223
2	300	600	450	39	Non-Cohesive	450	8	15	32		204

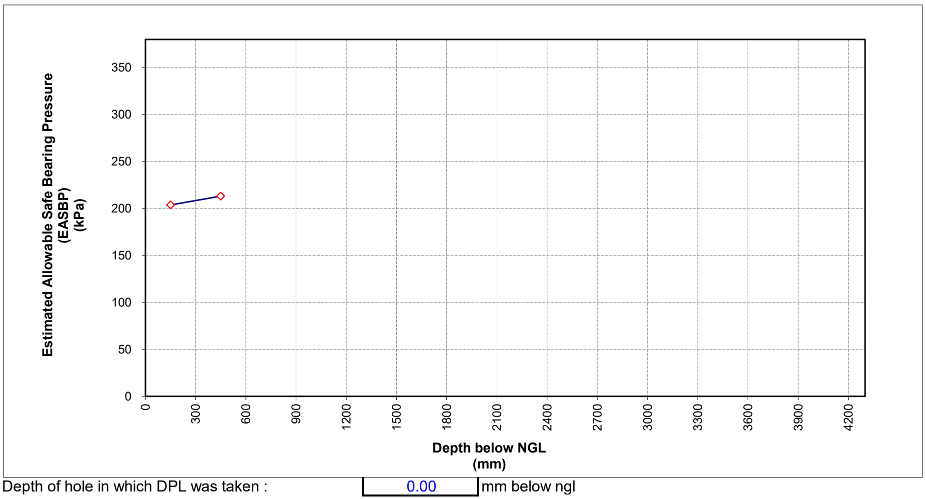
ESTIMATED ALLOWABLE SAFE BEARING PRESSURE FROM DCP

Job Name: PAARDEVLEI SOLAR PV FARM
Date of Test: 04/12/2023
Job No: 6047
DPL No: 29
Location: TP29

Hammer: 10 kg hammer
450 mm drop height
Cone: 25 mm point
60° angle

JG AFRIKA
EXPERIENCE QUALITY INTEGRITY

note:
CBR from Webster, S.L., Grau, R.H., and Williams, T.P., (1992), "*Description and Application of Dual Mass Dynamic Cone Penetrometer*"
EASBP or non-cohesive soils from Terzaghi & Peck p 491 for 25 mm settlement.
EASBP for cohesive soils = Su*Nc/FOS. Shear strength (Su) from N via T3 of Geoterminology.



Penetration Guide: Consistency

SPT N Value	Cohesive soils	Non-cohesive soils
> 50	Very stiff	Very Dense
31 - 50	Stiff	Dense
11 - 30	Firm	Med Dense
5 - 10	Soft	Loose
0 - 4	Very soft	Very Loose

NOTE: EASBP calculated for cohesive and non-cohesive soils

*SPT N value = (DCP blows/300mm) * 0.38*

*CBR = 465 * (DCP Penetration (mm/blow)^-1.31*

NOTE: First select soil type

Depth of hole in which DPL was taken : 0.00 mm below ngl
Remarks : Refusal at 0.60m

Non-cohesive soils
Applied Factor : 1 times Terzaghi's value

OR

Cohesive soils
Nc 5 FOS 3

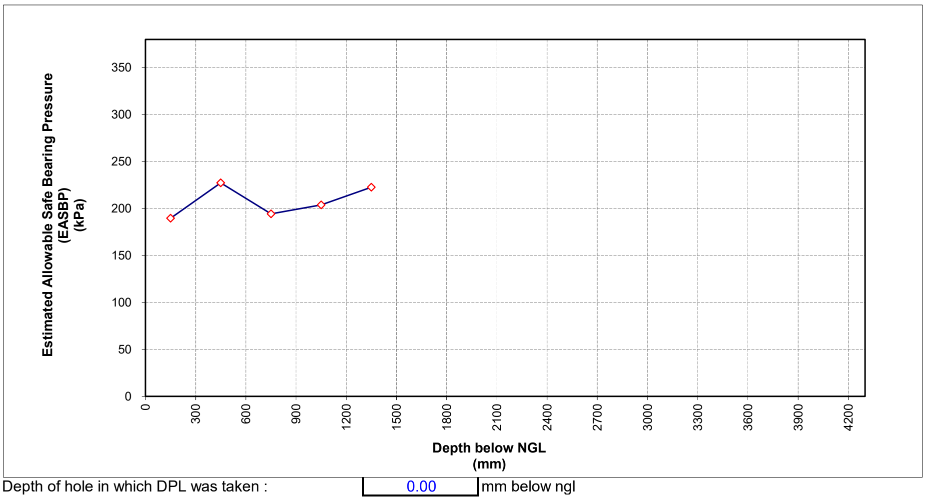
Reading no.	Layer from (mm)	Layer to (mm)	Average layer depth (mm)	DPL blows/300 mm	Soil type	Depth below NGL (mm)	DPL penetration (mm/blow)	Equivalent SPT N value	Approx *in-situ* CBR (%)	Approx shear strength (kPa)	Approx EASBP (kPa)
1	0	300	150	39	Non-Cohesive	150	8	15	32		204
2	300	600	450	41	Non-Cohesive	450	7	16	34		213

ESTIMATED ALLOWABLE SAFE BEARING PRESSURE FROM DCP

Job Name: PAARDEVLEI SOLAR PV FARM
Date of Test: 04/12/2023
Job No: 6047
DPL No: 30
Location: TP30

Hammer: 10 kg hammer
450 mm drop height
Cone: 25 mm point
60° angle

note:
CBR from Webster, S.L., Grau, R.H., and Williams, T.P., (1992), "*Description and Application of Dual Mass Dynamic Cone Penetrometer*"
EASBP or non-cohesive soils from Terzaghi & Peck p 491 for 25 mm settlement.
EASBP for cohesive soils = Su*Nc/FOS. Shear strength (Su) from N via T3 of Geoterminology.



Penetration Guide: Consistency

SPT N Value	Cohesive soils	Non-cohesive soils
> 50	Very stiff	Very Dense
31 - 50	Stiff	Dense
11 - 30	Firm	Med Dense
5 - 10	Soft	Loose
0 - 4	Very soft	Very Loose

NOTE: EASBP calculated for cohesive and non-cohesive soils

*SPT N value = (DCP blows/300mm) * 0.38*

*CBR = 465 * (DCP Penetration (mm/blow)^-1.31*

NOTE: First select soil type

Depth of hole in which DPL was taken : 0.00 mm below ngl
Remarks : Refusal at 1.50m

Non-cohesive soils
Applied Factor : 1 times Terzaghi's value

OR

Cohesive soils
Nc 5 FOS 3

Reading no.	Layer from (mm)	Layer to (mm)	Average layer depth (mm)	DPL blows/300 mm	Soil type	Depth below NGL (mm)	DPL penetration (mm/blow)	Equivalent SPT N value	Approx *in-situ* CBR (%)	Approx shear strength (kPa)	Approx EASBP (kPa)
1	0	300	150	36	Non-Cohesive	150	8	14	29		190
2	300	600	450	44	Non-Cohesive	450	7	17	38		227
3	600	900	750	37	Non-Cohesive	750	8	14	30		194
4	900	1200	1050	39	Non-Cohesive	1050	8	15	32		204
5	1200	1500	1350	43	Non-Cohesive	1350	7	16	36		223

Appendix D: DPSH Tests

FAIRBROTHER
GEOTECHNICAL ENGINEERING

CONTRACT	Paarde Vlei Somerset West		
CONTRACT NUMBER	J1085		
CONSULTING ENGINEER	J.G. Africa		
SUPERVISOR	Neville		
SHEET	1	OF	1

DYNAMIC PROBE SUPER HEAVY

SITE DPSH REPORT

QA240

DPSH- NUMBER	1	DATE	5.12.22.
REMARKS			

PENETRATION (mm)	BLOWS	BLOWS 300	PENETRATION (mm)	BLOWS	BLOWS 300	PENETRATION (mm)	BLOWS	BLOWS 300
100	1		3700			7300		
200	4		3800			7400		
300	5	0	3900		0	7500		0
400	12		4000			7600		
500	17		4100			7700		
600	18	0	4200		0	7800		0
700	18		4300			7900		
800	20		4400			8000		
900	27	0	4500		0	8100		0
1000	30		4600			8200		
1100	32.		4700			8300		
1200	40 .	0	4800		0	8400		0
1300			4900			8500		
1400			5000			8600		
1500		0	5100		0	8700		0
1600			5200			8800		
1700			5300			8900		
1800		0	5400		0	9000		0
1900			5500			9100		
2000			5600			9200		
2100		0	5700		0	9300		0
2200			5800			9400		
2300			5900			9500		
2400		0	6000		0	9600		0
2500			6100			9700		
2600			6200			9800		
2700		0	6300		0	9900		0
2800			6400			10000		
2900			6500			10100		
3000		0	6600		0	10200		0
3100			6700			10300		
3200			6800			10400		
3300		0	6900		0	10500		0
3400			7000			10600		
3500			7100			10700		
3600		0	7200		0	10800		0

FAIRBROTHER
GEOTECHNICAL ENGINEERING

CONTRACT	Paarde Vlei Sewer Set Nest		
CONTRACT NUMBER	J1085		
CONSULTING ENGINEER	J.G. Africa		
SUPERVISOR	Neville		
SHEET	1	OF	1

DYNAMIC PROBE SUPER HEAVY
SITE DPSH REPORT

QA240

DPSH- NUMBER	2.	DATE	5.12.23.
REMARKS			

PENETRATION (mm)	BLOWS	BLOWS 300	PENETRATION (mm)	BLOWS	BLOWS 300	PENETRATION (mm)	BLOWS	BLOWS 300
100	2		3700			7300		
200	5		3800			7400		
300	10	0	3900		0	7500		0
400	17		4000			7600		
500	19		4100			7700		
600	10	0	4200		0	7800		0
700	7		4300			7900		
800	18		4400			8000		
900	37	0	4500		0	8100		0
1000	19		4600			8200		
1100	19		4700			8300		
1200	12	0	4800		0	8400		0
1300	7		4900			8500		
1400	17		5000			8600		
1500	37	0	5100		0	8700		0
1600	34		5200			8800		
1700	36.		5300			8900		
1800		0	5400		0	9000		0
1900			5500			9100		
2000			5600			9200		
2100		0	5700		0	9300		0
2200			5800			9400		
2300			5900			9500		
2400		0	6000		0	9600		0
2500			6100			9700		
2600			6200			9800		
2700		0	6300		0	9900		0
2800			6400			10000		
2900			6500			10100		
3000		0	6600		0	10200		0
3100			6700			10300		
3200			6800			10400		
3300		0	6900		0	10500		0
3400			7000			10600		
3500			7100			10700		
3600		0	7200		0	10800		0

FAIRBROTHER GEOTECHNICAL ENGINEERING	CONTRACT	Psancle Moi Sewer Jet North	
	CONTRACT NUMBER	J1085	
	CONSULTING ENGINEER	J. G Atkin cn	
	SUPERVISOR	Neville.	
	SHEET	1	OF 1

DYNAMIC PROBE SUPER HEAVY

SITE DPSH REPORT

QA240

DPSH- NUMBER	3	**DATE**	5.12.23.
REMARKS	No Penetration at 1,40 to 1,50		

PENETRATION (mm)	BLOWS	BLOWS 300	PENETRATION (mm)	BLOWS	BLOWS 300	PENETRATION (mm)	BLOWS	BLOWS 300
100	1		3700			7300		
200	3		3800			7400		
300	8	0	3900		0	7500		0
400	7		4000			7600		
500	4		4100			7700		
600	3	0	4200		0	7800		0
700	3		4300			7900		
800	4		4400			8000		
900	10	0	4500		0	8100		0
1000	19.		4600			8200		
1100	27		4700			8300		
1200	22	0	4800		0	8400		0
1300	24		4900			8500		
1400	42.	-	5000			8600		
1500	No Penetration		5100		0	8700		0
1600			5200			8800		
1700			5300			8900		
1800		0	5400		0	9000		0
1900			5500			9100		
2000			5600			9200		
2100		0	5700		0	9300		0
2200			5800			9400		
2300			5900			9500		
2400		0	6000		0	9600		0
2500			6100			9700		
2600			6200			9800		
2700		0	6300		0	9900		0
2800			6400			10000		
2900			6500			10100		
3000		0	6600		0	10200		0
3100			6700			10300		
3200			6800			10400		
3300		0	6900		0	10500		0
3400			7000			10600		
3500			7100			10700		
3600		0	7200		0	10800		0

FAIRBROTHER
GEOTECHNICAL ENGINEERING

CONTRACT	Parade [illegible] St West		
CONTRACT NUMBER	J1085.		
CONSULTING ENGINEER	J.G. Africa		
SUPERVISOR	Neville		
SHEET	1	OF	1

DYNAMIC PROBE SUPER HEAVY

SITE DPSH REPORT

QA240

DPSH- NUMBER	4	**DATE**	6.12.23.
REMARKS	No Penetration at 1,40 to 1,50		

PENETRATION (mm)	BLOWS	BLOWS 300	PENETRATION (mm)	BLOWS	BLOWS 300	PENETRATION (mm)	BLOWS	BLOWS 300
100	4		3700			7300		
200	3		3800			7400		
300	3	0	3900		0	7500		0
400	4		4000			7600		
500	5		4100			7700		
600	5	0	4200		0	7800		0
700	4		4300			7900		
800	3		4400			8000		
900	3	0	4500		0	8100		0
1000	4		4600			8200		
1100	4		4700			8300		
1200	11	0	4800		0	8400		0
1300	34		4900			8500		
1400	40		5000			8600		
1500	No Penetration		5100		0	8700		0
1600			5200			8800		
1700			5300			8900		
1800		0	5400		0	9000		0
1900			5500			9100		
2000			5600			9200		
2100		0	5700		0	9300		0
2200			5800			9400		
2300			5900			9500		
2400		0	6000		0	9600		0
2500			6100			9700		
2600			6200			9800		
2700		0	6300		0	9900		0
2800			6400			10000		
2900			6500			10100		
3000		0	6600		0	10200		0
3100			6700			10300		
3200			6800			10400		
3300		0	6900		0	10500		0
3400			7000			10600		
3500			7100			10700		
3600		0	7200		0	10800		0

FAIRBROTHER
GEOTECHNICAL ENGINEERING

CONTRACT	Prands Shoe Scheme Struct
CONTRACT NUMBER	J1085
CONSULTING ENGINEER	J.G. Africa
SUPERVISOR	Neville
SHEET	1 OF 1

DYNAMIC PROBE SUPER HEAVY

SITE DPSH REPORT

QA240

DPSH- NUMBER	5.	**DATE**	6.12.23.
REMARKS			

PENETRATION (mm)	BLOWS	BLOWS 300	PENETRATION (mm)	BLOWS	BLOWS 300	PENETRATION (mm)	BLOWS	BLOWS 300
100	1		3700			7300		
200	3		3800			7400		
300	4	0	3900		0	7500		0
400	3		4000			7600		
500	5		4100			7700		
600	8	0	4200		0	7800		0
700	7		4300			7900		
800	7		4400			8000		
900	8	0	4500		0	8100		0
1000	10		4600			8200		
1100	8		4700			8300		
1200	8	0	4800		0	8400		0
1300	14		4900			8500		
1400	27		5000			8600		
1500	26	0	5100		0	8700		0
1600	34		5200			8800		
1700	37		5300			8900		
1800	39.	0	5400		0	9000		0
1900			5500			9100		
2000			5600			9200		
2100		0	5700		0	9300		0
2200			5800			9400		
2300			5900			9500		
2400		0	6000		0	9600		0
2500			6100			9700		
2600			6200			9800		
2700		0	6300		0	9900		0
2800			6400			10000		
2900			6500			10100		
3000		0	6600		0	10200		0
3100			6700			10300		
3200			6800			10400		
3300		0	6900		0	10500		0
3400			7000			10600		
3500			7100			10700		
3600		0	7200		0	10800		0

FAIRBROTHER
GEOTECHNICAL ENGINEERING

CONTRACT	PAPRC/Vlec Smelter West		
CONTRACT NUMBER	J1085 .		
CONSULTING ENGINEER	J.G Africa		
SUPERVISOR	Neville		
SHEET	1	OF	1

DYNAMIC PROBE SUPER HEAVY

SITE DPSH REPORT

QA240

DPSH- NUMBER	6 .	DATE	4.12.23.
REMARKS	No Penetration at, 2,80 to 2,90 .		

PENETRATION (mm)	BLOWS	BLOWS 300	PENETRATION (mm)	BLOWS	BLOWS 300	PENETRATION (mm)	BLOWS	BLOWS 300
100	2		3700			7300		
200	3		3800			7400		
300	4	0	3900		0	7500		0
400	2		4000			7600		
500	1		4100			7700		
600	2	0	4200		0	7800		0
700	2		4300			7900		
800	2		4400			8000		
900	4	0	4500		0	8100		0
1000	6		4600			8200		
1100	8		4700			8300		
1200	5	0	4800		0	8400		0
1300	4		4900			8500		
1400	4		5000			8600		
1500	3	0	5100		0	8700		0
1600	1		5200			8800		
1700	2		5300			8900		
1800	1	0	5400		0	9000		0
1900	2		5500			9100		
2000	2		5600			9200		
2100	2	0	5700		0	9300		0
2200	2		5800			9400		
2300	3		5900			9500		
2400	2	0	6000		0	9600		0
2500	3		6100			9700		
2600	3		6200			9800		
2700	10	0	6300		0	9900		0
2800	40		6400			10000		
2900	No Penetration		6500			10100		
3000		0	6600		0	10200		0
3100			6700			10300		
3200			6800			10400		
3300		0	6900		0	10500		0
3400			7000			10600		
3500			7100			10700		
3600		0	7200		0	10800		0

FAIRBROTHER
GEOTECHNICAL ENGINEERING

CONTRACT	Papendo Vlec Sewer Set Nbot
CONTRACT NUMBER	J1085
CONSULTING ENGINEER	J.G Africa
SUPERVISOR	Neville
SHEET	1 OF 1

DYNAMIC PROBE SUPER HEAVY
SITE DPSH REPORT

QA240

DPSH- NUMBER	7	DATE	5.12.23
REMARKS	No Penetration at 5,20 to 5,30		

PENETRATION (mm)	BLOWS	BLOWS 300	PENETRATION (mm)	BLOWS	BLOWS 300	PENETRATION (mm)	BLOWS	BLOWS 300
100	3		3700	15		7300		
200	6		3800	7		7400		
300	7	0	3900	4	0	7500		0
400	6		4000	3		7600		
500	5		4100	5		7700		
600	7	0	4200	8	0	7800		0
700	6		4300	9		7900		
800	9		4400	10		8000		
900	7	0	4500	8	0	8100		0
1000	7		4600	9		8200		
1100	5		4700	9		8300		
1200	6	0	4800	7	0	8400		0
1300	6		4900	8		8500		
1400	6		5000	8		8600		
1500	6	0	5100	7	0	8700		0
1600	4		5200	40		8800		
1700	3		5300	No Penetration		8900		
1800	2	0	5400		0	9000		0
1900	4		5500			9100		
2000	5		5600			9200		
2100	4	0	5700		0	9300		0
2200	3		5800			9400		
2300	3		5900			9500		
2400	2	0	6000		0	9600		0
2500	6		6100			9700		
2600	5		6200			9800		
2700	2	0	6300		0	9900		0
2800	3		6400			10000		
2900	6		6500			10100		
3000	5	0	6600		0	10200		0
3100	7		6700			10300		
3200	7		6800			10400		
3300	9	0	6900		0	10500		0
3400	10		7000			10600		
3500	5		7100			10700		
3600	13	0	7200		0	10800		0

FAIRBROTHER
GEOTECHNICAL ENGINEERING

CONTRACT	[illegible] Somerset West
CONTRACT NUMBER	J1085
CONSULTING ENGINEER	J.G. Atkira
SUPERVISOR	Neville
SHEET	1 OF 1

DYNAMIC PROBE SUPER HEAVY

SITE DPSH REPORT

QA240

DPSH- NUMBER	8	**DATE**	5-12.23
REMARKS	No Penetration at 7.40to 7.50		

PENETRATION (mm)	BLOWS	BLOWS 300	PENETRATION (mm)	BLOWS	BLOWS 300	PENETRATION (mm)	BLOWS	BLOWS 300
100	6		3700	9		7300	70	
200	DRop By Weight		3800	7		7400	42	
300		0	3900	5	0	7500	No Penetration	
400			4000	9		7600		
500			4100	8		7700		
600		0	4200	8	0	7800		0
700			4300	6		7900		
800	3		4400	6		8000		
900	6	0	4500	6	0	8100		0
1000	19		4600	7		8200		
1100	14		4700	7		8300		
1200	12	0	4800	5	0	8400		0
1300	10		4900	4		8500		
1400	10		5000	4		8600		
1500	9	0	5100	3	0	8700		0
1600	10		5200	2		8800		
1700	10		5300	1		8900		
1800	11	0	5400	1	0	9000		0
1900	10		5500	2		9100		
2000	6		5600	2		9200		
2100	5	0	5700	4	0	9300		0
2200	5		5800	5		9400		
2300	7		5900	4		9500		
2400	9	0	6000	4	0	9600		0
2500	17		6100	4		9700		
2600	9		6200	4		9800		
2700	6	0	6300	6	0	9900		0
2800	7		6400	5		10000		
2900	10		6500	7		10100		
3000	18	0	6600	8	0	10200		0
3100	12		6700	12		10300		
3200	10		6800	8		10400		
3300	10	0	6900	9	0	10500		0
3400	10		7000	10		10600		
3500	10		7100	14		10700		
3600	10	0	7200	20	0	10800		0

FAIRBROTHER
GEOTECHNICAL ENGINEERING

CONTRACT	Parabolic Moi Scree Setnast		
CONTRACT NUMBER	J1085		
CONSULTING ENGINEER	J.G Afrika		
SUPERVISOR	Neville.		
SHEET	1	OF	1

DYNAMIC PROBE SUPER HEAVY

SITE DPSH REPORT

QA240

DPSH- NUMBER	9	**DATE**	5.12.23
REMARKS			

No Penetration - at 7-10 to 7,20

PENETRATION (mm)	BLOWS	BLOWS 300	PENETRATION (mm)	BLOWS	BLOWS 300	PENETRATION (mm)	BLOWS	BLOWS 300
100	1		3700	7		7300		
200	1		3800	9		7400		
300	1	0	3900	7	0	7500		0
400	1		4000	4		7600		
500	1		4100	5		7700		
600	1	0	4200	5	0	7800		0
700	2		4300	2		7900		
800	2		4400	2		8000		
900	2	0	4500	2	0	8100		0
1000	2		4600	2		8200		
1100	1		4700	2		8300		
1200	2	0	4800	4	0	8400		0
1300	1		4900	4		8500		
1400	1		5000	7		8600		
1500	1	0	5100	8	0	8700		0
1600	1		5200	8		8800		
1700	2		5300	8		8900		
1800	2	0	5400	9	0	9000		0
1900	1		5500	11		9100		
2000	2		5600	12		9200		
2100	3	0	5700	13	0	9300		0
2200	5		5800	10		9400		
2300	5		5900	10		9500		
2400	6	0	6000	11	0	9600		0
2500	5		6100	11		9700		
2600	7		6200	12		9800		
2700	6	0	6300	11	0	9900		0
2800	6		6400	11		10000		
2900	6		6500	11		10100		
3000	5	0	6600	9	0	10200		0
3100	7		6700	9		10300		
3200	9		6800	6		10400		
3300	9	0	6900	12	0	10500		0
3400	8		7000	14		10600		
3500	8		7100	37		10700		
3600	7	0	7200	No Penetration		10800		0

FAIRBROTHER
GEOTECHNICAL ENGINEERING

CONTRACT	Paardevlei Somerset West		
CONTRACT NUMBER	J1085		
CONSULTING ENGINEER	S.G Africa		
SUPERVISOR	Neville.		
SHEET	1	OF	1

DYNAMIC PROBE SUPER HEAVY

SITE DPSH REPORT

QA240

DPSH- NUMBER	10	DATE	5 12 . 23.
REMARKS			

PENETRATION (mm)	BLOWS	BLOWS 300	PENETRATION (mm)	BLOWS	BLOWS 300	PENETRATION (mm)	BLOWS	BLOWS 300
100	5		3700	8		7300		
200	↓		3800	9		7400		
300	↓	0	3900	6	0	7500		0
400	Drop		4000	10		7600		
500			4100	6		7700		
600	By	0	4200	6	0	7800		0
700			4300	10		7900		
800	Neglt.		4400	11		8000		
900		0	4500	12	0	8100		0
1000	↑		4600	19		8200		
1100	3		4700	23		8300		
1200	3	0	4800	32	0	8400		0
1300	4		4900	31		8500		
1400	5		5000	34		8600		
1500	9	0	5100		0	8700		0
1600	18		5200			8800		
1700	19		5300			8900		
1800	11	0	5400		0	9000		0
1900	6		5500			9100		
2000	4		5600			9200		
2100	2	0	5700		0	9300		0
2200	3		5800			9400		
2300	2		5900			9500		
2400	2	0	6000		0	9600		0
2500	3		6100			9700		
2600	2		6200			9800		
2700	2	0	6300		0	9900		0
2800	1		6400			10000		
2900	1		6500			10100		
3000	4	0	6600		0	10200		0
3100	5		6700			10300		
3200	7		6800			10400		
3300	10	0	6900		0	10500		0
3400	14		7000			10600		
3500	14		7100			10700		
3600	12	0	7200		0	10800		0

FAIRBROTHER
GEOTECHNICAL ENGINEERING

CONTRACT	Parndellioc Somerset West		
CONTRACT NUMBER	~~JG Afreeca~~ J1085		
CONSULTING ENGINEER	JG Africa		
SUPERVISOR	Neville		
SHEET	1	OF	1

DYNAMIC PROBE SUPER HEAVY
SITE DPSH REPORT

QA240

DPSH- NUMBER	14	DATE	4.12.23
REMARKS	No Pentration at 2,90 to 3,00		

PENETRATION (mm)	BLOWS	BLOWS 300	PENETRATION (mm)	BLOWS	BLOWS 300	PENETRATION (mm)	BLOWS	BLOWS 300
100	8		3700			7300		
200	8		3800			7400		
300	8	0	3900		0	7500		0
400	5		4000			7600		
500	5		4100			7700		
600	4	0	4200		0	7800		0
700	4		4300			7900		
800	3		4400			8000		
900	3	0	4500		0	8100		0
1000	4		4600			8200		
1100	4		4700			8300		
1200	4	0	4800		0	8400		0
1300	4		4900			8500		
1400	3		5000			8600		
1500	6	0	5100		0	8700		0
1600	6		5200			8800		
1700	5		5300			8900		
1800	6	0	5400		0	9000		0
1900	6		5500			9100		
2000	9		5600			9200		
2100	4	0	5700		0	9300		0
2200	2		5800			9400		
2300	2		5900			9500		
2400	3	0	6000		0	9600		0
2500	5		6100			9700		
2600	6		6200			9800		
2700	3	0	6300		0	9900		0
2800	8		6400			10000		
2900	37		6500			10100		
3000	No Pentration		6600		0	10200		0
3100			6700			10300		
3200			6800			10400		
3300		0	6900		0	10500		0
3400			7000			10600		
3500			7100			10700		
3600		0	7200		0	10800		0

FAIRBROTHER
GEOTECHNICAL ENGINEERING

CONTRACT	Paardevlei Somerset [illegible] A		
CONTRACT NUMBER	J1085		
CONSULTING ENGINEER	J.C. Africa		
SUPERVISOR	Neville		
SHEET	1	OF	1

DYNAMIC PROBE SUPER HEAVY

SITE DPSH REPORT

QA240

DPSH- NUMBER	12.	DATE	4.12.23.
REMARKS	No Penetration AT. 2,70 to 2,80		

PENETRATION (mm)	BLOWS	BLOWS 300	PENETRATION (mm)	BLOWS	BLOWS 300	PENETRATION (mm)	BLOWS	BLOWS 300
100	4		3700			7300		
200	7		3800			7400		
300	2	0	3900		0	7500		0
400	1		4000			7600		
500	1		4100			7700		
600	1	0	4200		0	7800		0
700	1		4300			7900		
800	1		4400			8000		
900	2	0	4500		0	8100		0
1000	3		4600			8200		
1100	2		4700			8300		
1200	2	0	4800		0	8400		0
1300	3		4900			8500		
1400	6		5000			8600		
1500	6	0	5100		0	8700		0
1600	9		5200			8800		
1700	8		5300			8900		
1800	7	0	5400		0	9000		0
1900	5		5500			9100		
2000	5		5600			9200		
2100	8	0	5700		0	9300		0
2200	8		5800			9400		
2300	10		5900			9500		
2400	11	0	6000		0	9600		0
2500	16		6100			9700		
2600	21		6200			9800		
2700	36	0	6300		0	9900		0
2800	No Penetration		6400			10000		
2900			6500			10100		
3000		0	6600		0	10200		0
3100			6700			10300		
3200			6800			10400		
3300		0	6900		0	10500		0
3400			7000			10600		
3500			7100			10700		
3600		0	7200		0	10800		0

FAIRBROTHER
GEOTECHNICAL ENGINEERING

CONTRACT	Parade Mac Sore St West		
CONTRACT NUMBER	J1085 .		
CONSULTING ENGINEER	J. G. Akica		
SUPERVISOR	Nealle		
SHEET	1	OF	1

DYNAMIC PROBE SUPER HEAVY

SITE DPSH REPORT

QA240

DPSH- NUMBER	13 .	**DATE**	6 .12 .23.
REMARKS	No Penetration at 2,80 to 2,90		

PENETRATION (mm)	BLOWS	BLOWS 300	PENETRATION (mm)	BLOWS	BLOWS 300	PENETRATION (mm)	BLOWS	BLOWS 300
100	5		3700			7300		
200	7		3800			7400		
300	5	0	3900		0	7500		0
400	3		4000			7600		
500	3		4100			7700		
600	2	0	4200		0	7800		0
700	1		4300			7900		
800	1		4400			8000		
900	9	0	4500		0	8100		0
1000	12.		4600			8200		
1100	14		4700			8300		
1200	10	0	4800		0	8400		0
1300	12		4900			8500		
1400	15		5000			8600		
1500	13.	0	5100		0	8700		0
1600	7		5200			8800		
1700	9		5300			8900		
1800	8	0	5400		0	9000		0
1900	7		5500			9100		
2000	7		5600			9200		
2100	7	0	5700		0	9300		0
2200	5		5800			9400		
2300	9		5900			9500		
2400	9	0	6000		0	9600		0
2500	9		6100			9700		
2600	11		6200			9800		
2700	24	0	6300		0	9900		0
2800	40		6400			10000		
2900	No	Penetration	6500			10100		
3000		0	6600		0	10200		0
3100			6700			10300		
3200			6800			10400		
3300		0	6900		0	10500		0
3400			7000			10600		
3500			7100			10700		
3600		0	7200		0	10800		0

FAIRBROTHER
GEOTECHNICAL ENGINEERING

CONTRACT	PAARL Moc Sene St West.		
CONTRACT NUMBER	J1085		
CONSULTING ENGINEER	J. G. Afrika		
SUPERVISOR	Neville		
SHEET	1	OF	1

DYNAMIC PROBE SUPER HEAVY

SITE DPSH REPORT

QA240

DPSH- NUMBER	14.	DATE	6-12-23.
REMARKS	No Penetration at 4.90 to 5.00m		

PENETRATION (mm)	BLOWS	BLOWS 300	PENETRATION (mm)	BLOWS	BLOWS 300	PENETRATION (mm)	BLOWS	BLOWS 300
100	2		3700	10		7300		
200	1		3800	12		7400		
300	1	0	3900	13	0	7500		0
400	3		4000	13		7600		
500	13		4100	14		7700		
600	7	0	4200	17	0	7800		0
700	4		4300	23		7900		
800	4		4400	15		8000		
900	6	0	4500	13	0	8100		0
1000	6		4600	10		8200		
1100	4		4700	9		8300		
1200	7	0	4800	30	0	8400		0
1300	5		4900	42.		8500		
1400	2		5000	No Penetration		8600		
1500	2	0	5100		0	8700		0
1600	2		5200			8800		
1700	1		5300			8900		
1800	2	0	5400		0	9000		0
1900	2		5500			9100		
2000	1		5600			9200		
2100	2	0	5700		0	9300		0
2200	3		5800			9400		
2300	5		5900			9500		
2400	7	0	6000		0	9600		0
2500	5		6100			9700		
2600	4		6200			9800		
2700	5	0	6300		0	9900		0
2800	7		6400			10000		
2900	6		6500			10100		
3000	8	0	6600		0	10200		0
3100	9		6700			10300		
3200	7		6800			10400		
3300	6	0	6900		0	10500		0
3400	7		7000			10600		
3500	9		7100			10700		
3600	9	0	7200		0	10800		0

FAIRBROTHER
GEOTECHNICAL ENGINEERING

CONTRACT	Paardevlei Somerset West		
CONTRACT NUMBER	J1055 -		
CONSULTING ENGINEER	JG Africa		
SUPERVISOR	Neville		
SHEET	1	OF	1

DYNAMIC PROBE SUPER HEAVY
SITE DPSH REPORT

QA240

DPSH- NUMBER 15 **DATE** 4.12.23.

REMARKS No Penetration at 4.20 to 4,30

PENETRATION (mm)	BLOWS	BLOWS 300	PENETRATION (mm)	BLOWS	BLOWS 300	PENETRATION (mm)	BLOWS	BLOWS 300
100	3		3700	6		7300		
200	4		3800	7		7400		
300	2	0	3900	8	0	7500		0
400	3		4000	13		7600		
500	3		4100	26		7700		
600	3	0	4200	40	0	7800		0
700	4		4300	No Penetration		7900		
800	4		4400			8000		
900	4	0	4500		0	8100		0
1000	6		4600			8200		
1100	4		4700			8300		
1200	5	0	4800		0	8400		0
1300	4		4900			8500		
1400	4		5000			8600		
1500	4	0	5100		0	8700		0
1600	5		5200			8800		
1700	7		5300			8900		
1800	9	0	5400		0	9000		0
1900	8		5500			9100		
2000	6		5600			9200		
2100	7	0	5700		0	9300		0
2200	5		5800			9400		
2300	5		5900			9500		
2400	4	0	6000		0	9600		0
2500	4		6100			9700		
2600	3		6200			9800		
2700	3	0	6300		0	9900		0
2800	3		6400			10000		
2900	2		6500			10100		
3000	5	0	6600		0	10200		0
3100	5		6700			10300		
3200	4		6800			10400		
3300	6	0	6900		0	10500		0
3400	8		7000			10600		
3500	7		7100			10700		
3600	6	0	7200		0	10800		0

Appendix E: Laboratory Test Results

STEYN-WILSON LABORATORIES
CIVIL ENGINEERING TESTING LABORATORIES

sanas Testing Laboratory T0835

[redacted]

Web: www.steynwilson.co.za

Client: **JG Afrika (Pty) Ltd**

Project: Pardevlei Site

Attention: Mr T Hlongwane

Your Ref. No: -

Date Reported 16/01/2024

TEST REPORT REFERENCE NUMBER / JOB NUMBER : SWL32614

Dear Sir / Madam

Herewith please find the original reports pertaining to the above mentioned project.

Test Requested

1 x FOUNDATION INDICATOR

Site Sampling and Materials Information

Sampling Method	*Specimens delivered to Steyn Wilson Laboratory.*
Environmental Condition	*Sunny*
Deviation from the prescribed test method	*No deviation from standard test method.*
Responsibility of information disclaimer	*The sample information was received from the customer. Results apply to the sample as received from the Customer.*

● **FINAL REPORT**

We would like to take this opportunity to thank you for your valued support.
Should you have any further enquiries please don't hesitate to contact me.

Yours Faithfully
STEYN-WILSON LABORATORIES (PTY) LTD

[redacted]

Technical Signatory

Remarks:

1. Information contained herein is confidential to STEYN-WILSON PTY LTD and the addressee
2. Opinions & Interpretations are not included in our schedule of Accreditation.
3. The samples where subjected and analysed according to ASTM.
4. The results reported relate only to the sample tested, Further use of the attached information is not the responsibility or liability of STEYN-WILSON LABORATORIES (PTY) LTD.
5. This document is the correct record of all measurements made, and may not be reproduced other than with full written approval from a director of STEYN-WILSON LABORATORIES (PTY) LTD.
6. Measuring equipment is traceable to national standards (Where applicable).
7. Should there be any deviation from the prescribed test method comments will be made thereof, pertaining to the test on the relevant materials report.
8. Uncertainty of measurement is calculated and corresponds to a coverage probability of approximately 95%. Available on request.
9. The decision rule states that the measurement of uncertainty can be applied by the customer to the test results, on request. It is not the responsibility or liability of STEYN-WILSON LABORATORIES (PTY) LTD.

DIRECTORS: **Mr. J. Steyn ND-Civil (Managing) | Mr. R. Wilson B-Tech Civil (Operations)**

STEYN-WILSON LABORATORIES
CIVIL ENGINEERING TESTING LABORATORIES

sanas Testing Laboratory T0835

[redacted]
Web: www.steynwilson.co.za

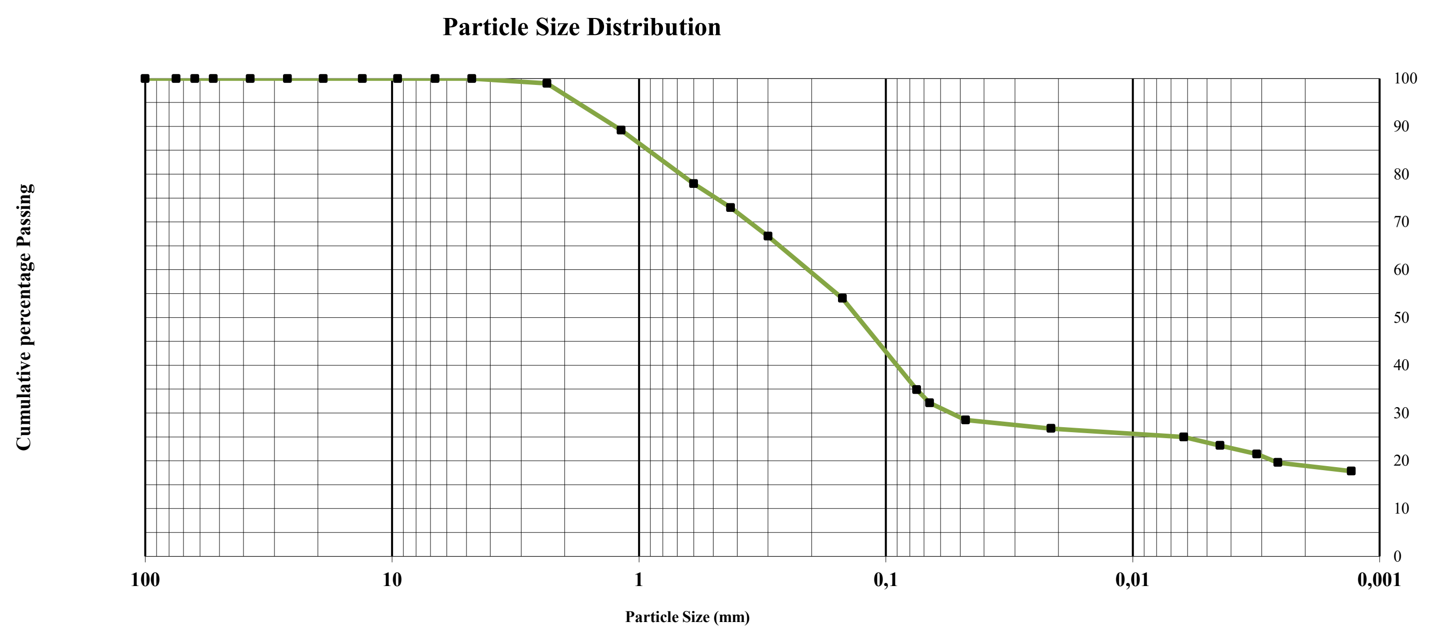
Customer :	**JG Afrika (Pty) Ltd** [redacted]	Project :	Pardevlei Site
		Date Received :	07/12/2023
		Date Reported :	16/01/2024
		Req. Number :	-
Attention :	Mr T Hlongwane	Date Sampled:	07/12/2023

FOUNDATION INDICATOR ASTM D422

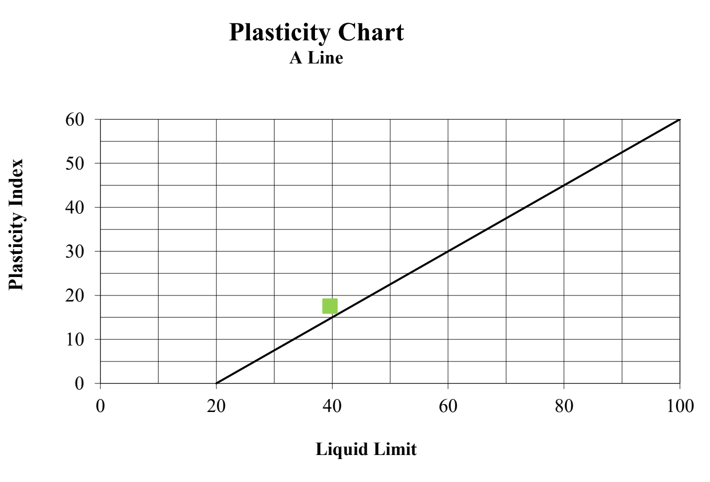
Material Description:	Sandy Clay - Residual Shale	Sample Number:		32614/16		
Position:	TP30	Liquid Limit	Cassgranda SANS 3001 GR12	**39,6**	Linear Shrinkage	**7,7**
Depth:	0,60-2,20m	Plasticity Index		**17,6**	Insitu M/C%	**1,6**

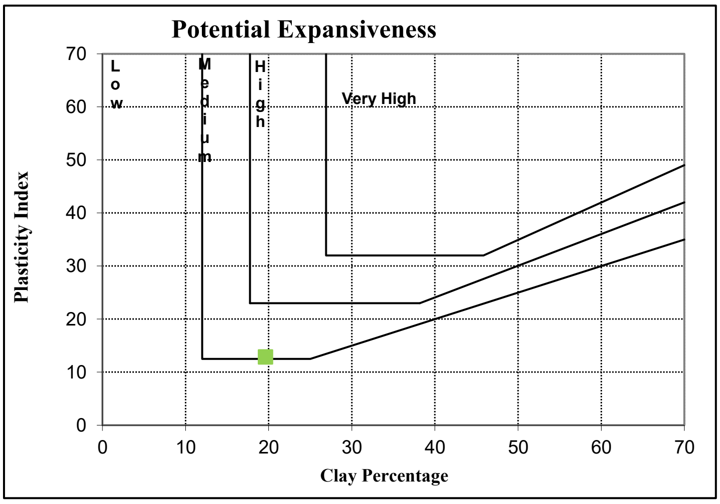
PH (TMH1 A20)		**(TMH1 A21T) Conductivity s.m^{-1}**		**SG (TMH1 A12T)***	**2,615**

SIEVE ANALYSIS (TMH 1 A1a)*																		**HYDROMETER ASTM D422**							
100	75	63	53	37,5	26,5	19,0	13,2	9,5	6,7	4,75	2,36	1,18	0,60	0,425	0,300	0,150	0,075	0,066	0,048	0,021	0,006	0,004	0,003	0,003	0,001
100	100	100	100	100	100	100	100	100	100	100	99	89,2	78	73	67	54	34,9	32,11	28,54	26,76	24,98	23,19	21,41	19,62	17,84
% Passing																									



% Gravel		**% Sand**	**66**	**% Silt**	**14**	**% Clay**	**20**





NOTE: All tests marked with (*) means that those test methods are not accredited.

STEYN-WILSON
LABORATORIES
CIVIL ENGINEERING TESTING LABORATORIES

sanas
Testing Laboratory
T0835

[redacted]

Web: www.steynwilson.co.za

Client:	**JG Afrika (Pty) Ltd**
Project:	Pardevlei Site
Attention:	Mr T Hlongwane
Your Ref. No:	-
Date Reported	16/01/2024

TEST REPORT REFERENCE NUMBER / JOB NUMBER : SWL32614

Dear Sir / Madam

Herewith please find the original reports pertaining to the above mentioned project.

__Test Requested__

4 x FOUNDATION INDICATOR

__Site Sampling and Materials Information__

Sampling Method	*Specimens delivered to Steyn Wilson Laboratory.*
Environmental Condition	*Sunny*
Deviation from the prescribed test method	*No deviation from standard test method.*
Responsibility of information disclaimer	*The sample information was received from the customer. Results apply to the sample as received from the Customer.*

● **FINAL REPORT**

We would like to take this opportunity to thank you for your valued support.
Should you have any further enquiries please don't hesitate to contact me.

Yours Faithfully
STEYN-WILSON LABORATORIES (PTY) LTD

[redacted]

Mr. R.Wilson
Technical Signatory

Remarks:

1. Information contained herein is confidential to STEYN-WILSON PTY LTD and the addressee
2. Opinions & Interpretations are not included in our schedule of Accreditation.
3. The samples where subjected and analysed according to ASTM.
4. The results reported relate only to the sample tested, Further use of the attached information is not the responsibility or liability of STEYN-WILSON LABORATORIES (PTY) LTD.
5. This document is the correct record of all measurements made, and may not be reproduced other than with full written approval from a director of STEYN-WILSON LABORATORIES (PTY) LTD.
6. Measuring equipment is traceable to national standards (Where applicable).
7. Should there be any deviation from the prescribed test method comments will be made thereof, pertaining to the test on the relevant materials report.
8. Uncertainty of measurement is calculated and corresponds to a coverage probability of approximately 95%. Available on request.
9. The decision rule states that the measurement of uncertainty can be applied by the customer to the test results, on request. It is not the responsibility or liability of STEYN-WILSON LABORATORIES (PTY) LTD.

DIRECTORS: **Mr. J. Steyn ND-Civil (Managing) | Mr. R. Wilson B-Tech Civil (Operations)**

STEYN-WILSON LABORATORIES
CIVIL ENGINEERING TESTING LABORATORIES

sanas Testing Laboratory T0835

[redacted]
Web: www.steynwilson.co.za

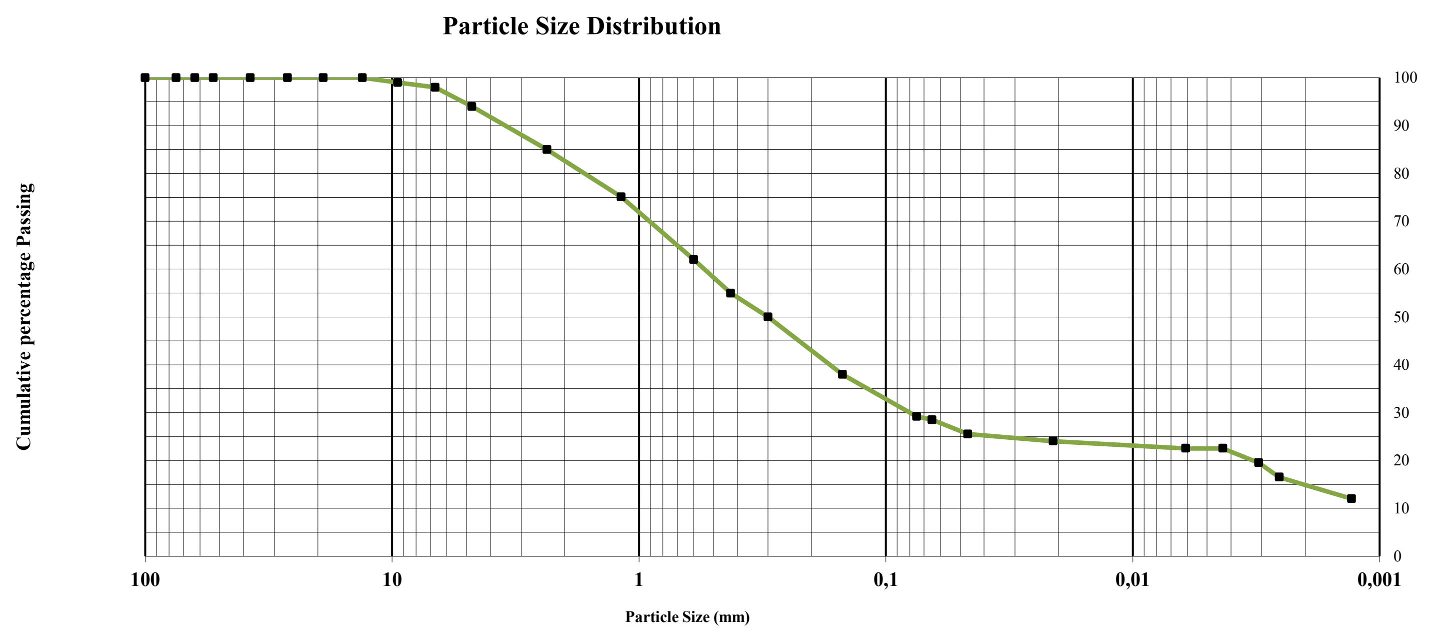
Customer :	**JG Afrika (Pty) Ltd**	Project :	Pardevlei Site
	[redacted]	Date Received :	07/12/2023
		Date Reported :	16/01/2024
		Req. Number :	-
Attention :	Mr T Hlongwane	Date Sampled:	07/12/2023

FOUNDATION INDICATOR ASTM D422

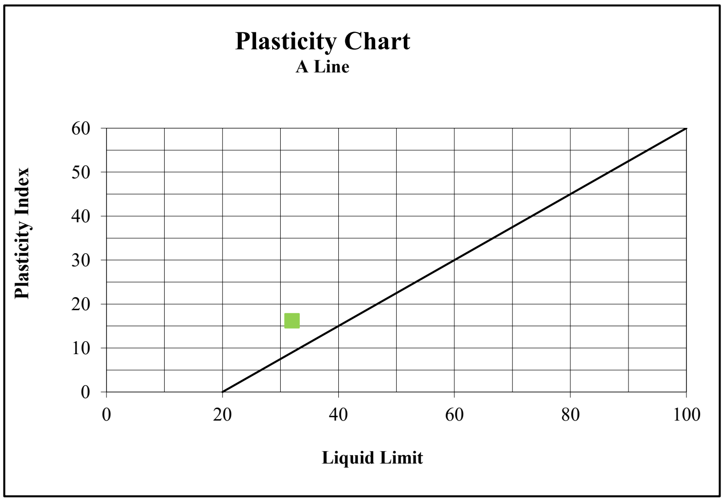
Material Description:	Sandy Clay - Residual Shale	Sample Number:	32614/10		
Position:	TP20	Liquid Limit Cassgranda SANS 3001 GR12	**32**	Linear Shrinkage	**7,9**
Depth:	0,5m	Plasticity Index	**16,2**	Insitu M/C%	**3**

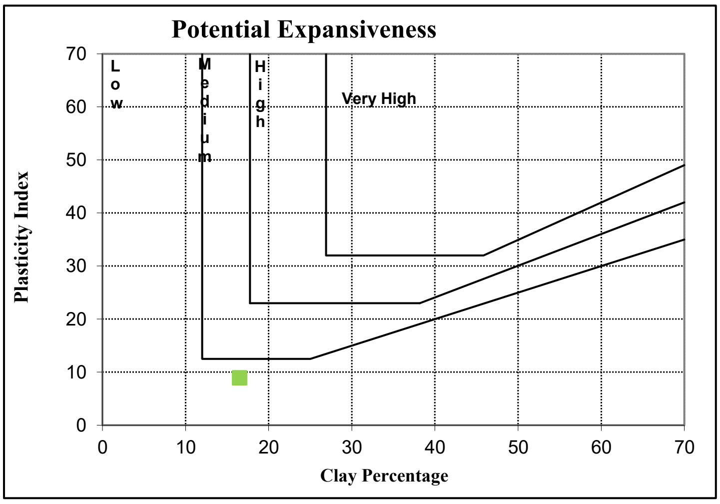
PH (TMH1 A20)		**(TMH1 A21T) Conductivity s.m^{-1}**		**SG (TMH1 A12T)***	**2,548**

SIEVE ANALYSIS (TMH 1 A1a)*																		**HYDROMETER ASTM D422**							
100	75	63	53	37,5	26,5	19,0	13,2	9,5	6,7	4,75	2,36	1,18	0,60	0,425	0,300	0,150	0,075	0,065	0,047	0,021	0,006	0,004	0,003	0,003	0,001
100	100	100	100	100	100	100	100	99	98	94	85	75,1	62	55	50	38	29,2	28,54	25,53	24,03	22,53	22,53	19,53	16,52	12,02
% Passing																									



% Gravel	**6**	**% Sand**	**65**	**% Silt**	**12**	**% Clay**	**17**





NOTE: All tests marked with (*) means that those test methods are not accredited.

STEYN-WILSON LABORATORIES
CIVIL ENGINEERING TESTING LABORATORIES

sanas Testing Laboratory T0835

[redacted]
Web: www.steynwilson.co.za

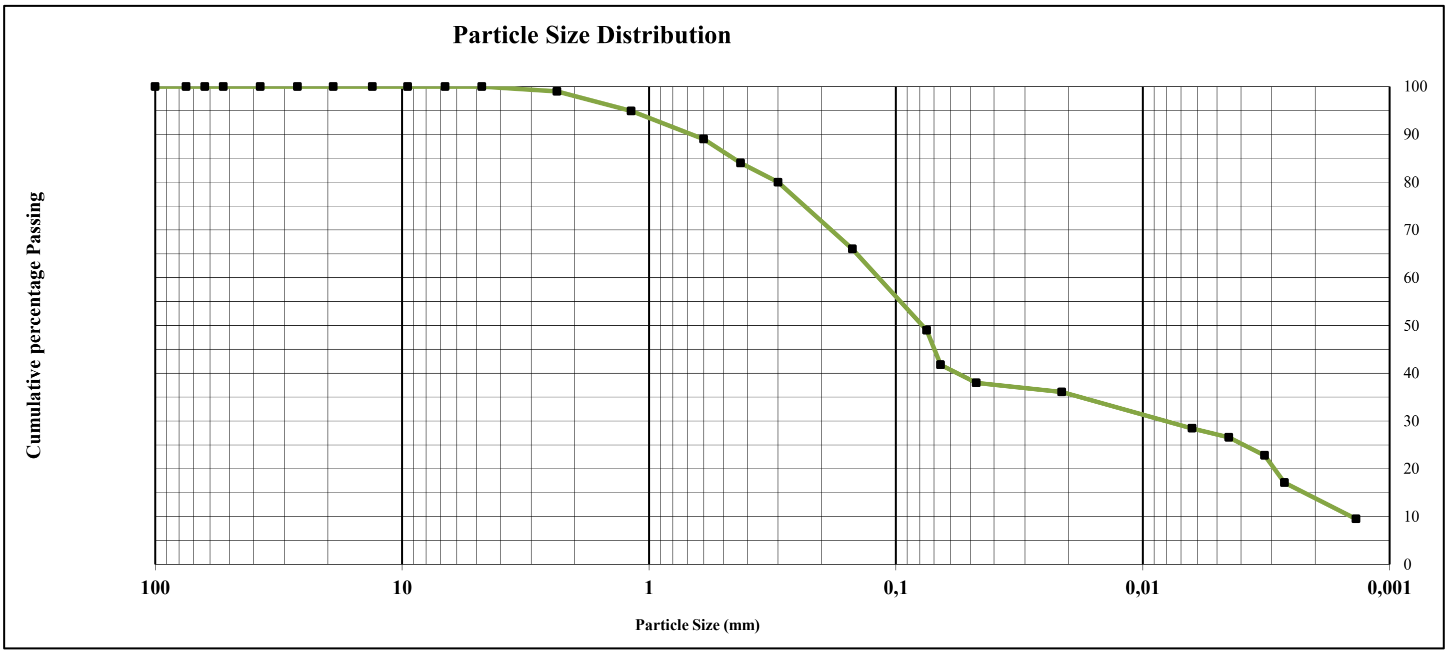
Customer :	**JG Afrika (Pty) Ltd**	Project :	Pardevlei Site
	[redacted]	Date Received :	07/12/2023
		Date Reported :	16/01/2024
		Req. Number :	-
Attention :	Mr T Hlongwane		

FOUNDATION INDICATOR ASTM D422

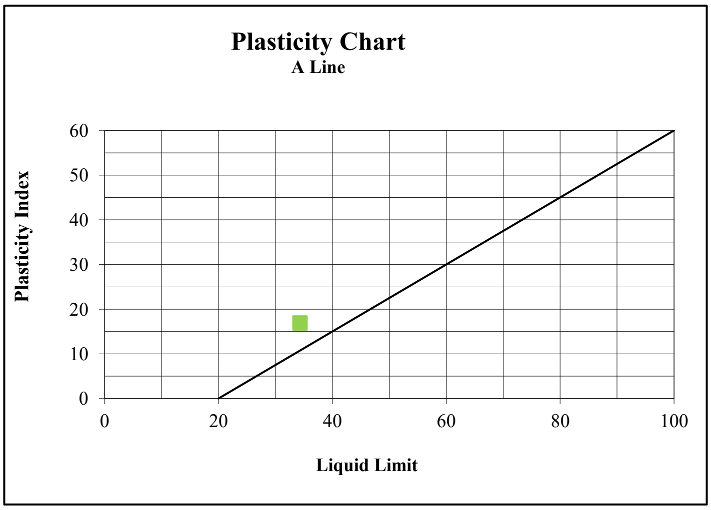
Material Description:	Sandy Clay - Residual Shale	Sample Number:	32614/13		
Position:	TP26	Liquid Limit Cassgranda SANS 3001 GR12	**34,3**	Linear Shrinkage	**8,3**
Depth:	1,20-2,90m	Plasticity Index	**16,9**	Insitu M/C%	**2,8**

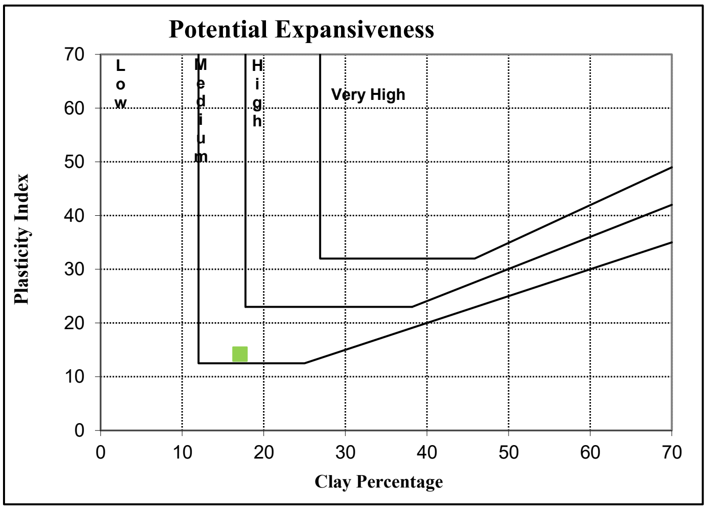
PH (TMH1 A20)*		**(TMH1 A21T)* Conductivity s.m^{-1}**		**SG (TMH1 A12T)***	**2,58**

SIEVE ANALYSIS (TMH 1 A1a)*																		**HYDROMETER ASTM D422**							
100	75	63	53	37,5	26,5	19,0	13,2	9,5	6,7	4,75	2,36	1,18	0,60	0,425	0,300	0,150	0,075	0,066	0,047	0,021	0,006	0,004	0,003	0,003	0,001
100	100	100	100	100	100	100	100	100	100	100	99	94,9	89	84	80	66	49	41,76	37,96	36,06	28,47	26,57	22,78	17,08	9,49
% Passing																									



% Gravel		**% Sand**	**54**	**% Silt**	**29**	**% Clay**	**17**





NOTE: All tests marked with (*) means that those test methods are not accredited.

STEYN-WILSON LABORATORIES

CIVIL ENGINEERING TESTING LABORATORIES

sanas Testing Laboratory T0835

[redacted]

Web: www.steynwilson.co.za

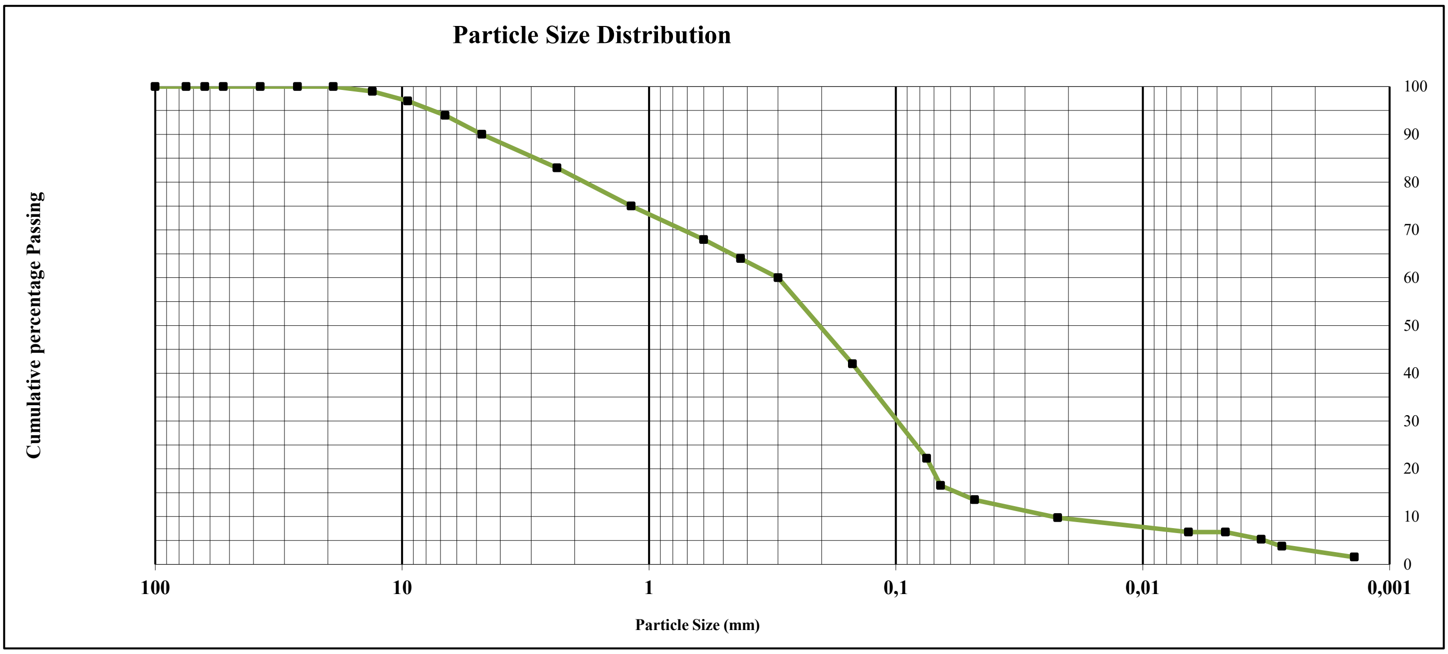
Customer :	**JG Afrika (Pty) Ltd**	Project :	Pardevlei Site
	[redacted]	Date Received :	07/12/2023
		Date Reported :	16/01/2024
		Req. Number :	-
Attention :	Mr T Hlongwane		

FOUNDATION INDICATOR ASTM D422

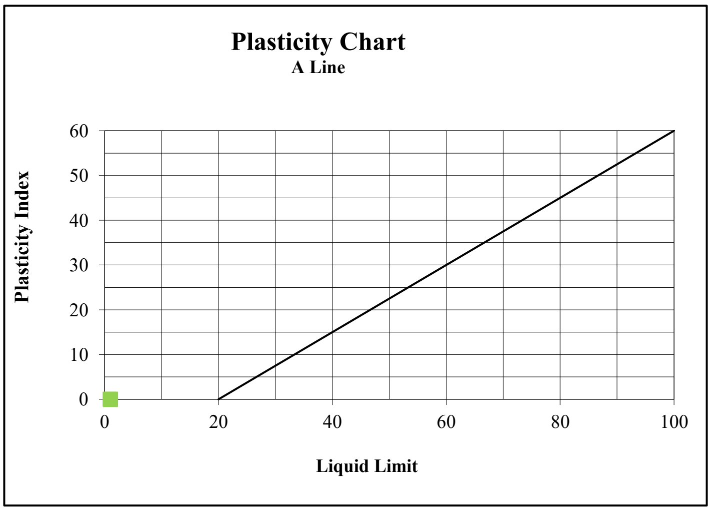
Material Description:	Sandy silt - Colluvium	Sample Number:	32614/14		
Position:	TP27	Liquid Limit Cassgranda SANS 3001 GR12	**N.P**	Linear Shrinkage	**0,0**
Depth:	0,5m	Plasticity Index	**N.P**	Insitu M/C%	**4,6**

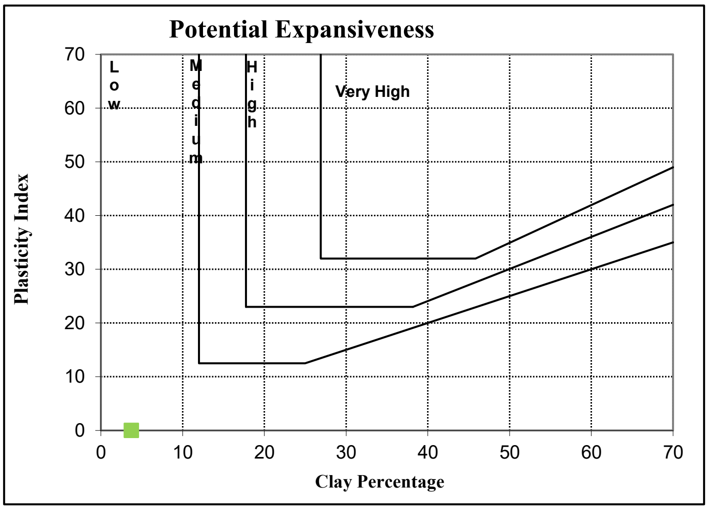
PH (TMH1 A20)*		**(TMH1 A21T)* Conductivity s.m^{-1}**		**SG (TMH1 A12T)***	**2,559**

SIEVE ANALYSIS (TMH 1 A1a)*																		**HYDROMETER ASTM D422**							
100	75	63	53	37,5	26,5	19,0	13,2	9,5	6,7	4,75	2,36	1,18	0,60	0,425	0,300	0,150	0,075	0,066	0,048	0,022	0,007	0,005	0,003	0,003	0,001
100	100	100	100	100	100	100	99	97	94	90	83	75	68	64	60	42	22,2	16,5	13,5	9,75	6,75	6,75	5,25	3,75	1,5
% Passing																									



% Gravel	**10**	**% Sand**	**70**	**% Silt**	**16**	**% Clay**	**4**





NOTE: All tests marked with (*) means that those test methods are not accredited.

STEYN-WILSON LABORATORIES
CIVIL ENGINEERING TESTING LABORATORIES

sanas Testing Laboratory T0835

[redacted]
Web: www.steynwilson.co.za

Customer :	**JG Afrika (Pty) Ltd**	Project :	Pardevlei Site
	[redacted]	Date Received :	07/12/2023
		Date Reported :	16/01/2024
		Req. Number :	-
Attention :	Mr T Hlongwane		

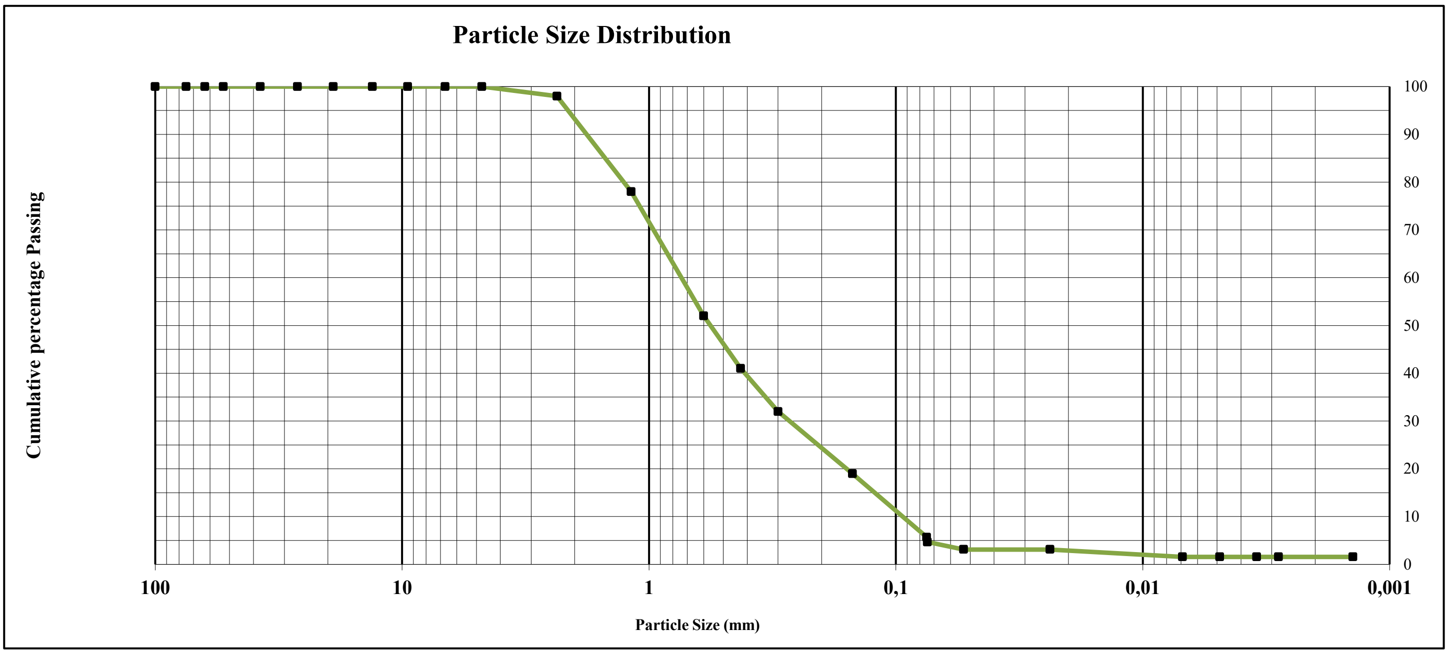
FOUNDATION INDICATOR ASTM D422

Material Description:	TP29	Sample Number:	32614/15		
Position:	Silty Clay - Residual Calcrete	Liquid Limit Cassgranda SANS 3001 GR12	**N.P**	Linear Shrinkage	**0,0**
Depth:	1,70-2,20m	Plasticity Index	**N.P**	Insitu M/C%	**0,5**

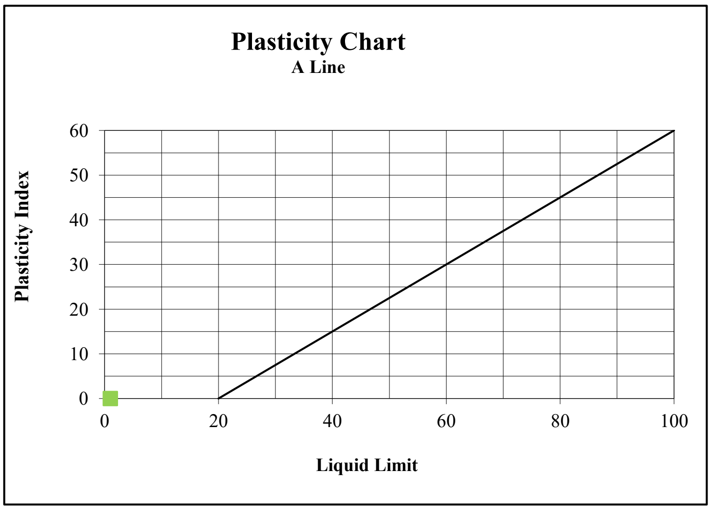
PH (TMH1 A20)*		**(TMH1 A21T)* Conductivity s.m^{-1}**		**SG (TMH1 A12T)***	**2,646**

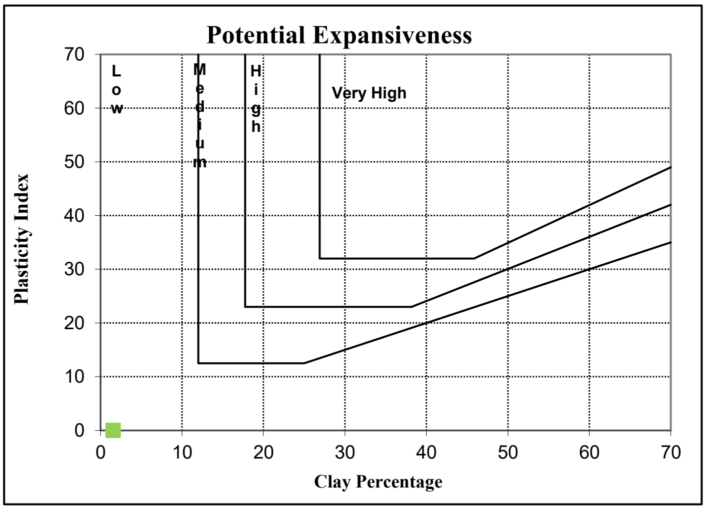
SIEVE ANALYSIS (TMH 1 A1a)*																		**HYDROMETER ASTM D422**							
100	75	63	53	37,5	26,5	19,0	13,2	9,5	6,7	4,75	2,36	1,18	0,60	0,425	0,300	0,150	0,075	0,075	0,053	0,024	0,007	0,005	0,003	0,003	0,001
100	100	100	100	100	100	100	100	100	100	100	98	78	52	41	32	19	5,7	4,68	3,12	3,12	1,56	1,56	1,56	1,56	1,56

% Passing



% Gravel		**% Sand**	95	**% Silt**	4	**% Clay**	2





NOTE: All tests marked with (*) means that those test methods are not accredited.

STEYN-WILSON LABORATORIES
CIVIL ENGINEERING TESTING LABORATORIES

sanas Testing Laboratory T0835

[redacted]

Web: www.steynwilson.co.za

Client: **JG Afrika (Pty) Ltd**

Project: Pardevlei Site

Attention: Mr T Hlongwane

Your Ref. No: -

Date Reported 16/01/2024

TEST REPORT REFERENCE NUMBER / JOB NUMBER : SWL32614

Dear Sir / Madam

Herewith please find the original reports pertaining to the above mentioned project.

Test Requested

4 x FOUNDATION INDICATOR

Site Sampling and Materials Information

Sampling Method	*Specimens delivered to Steyn Wilson Laboratory.*
Environmental Condition	*Sunny*
Deviation from the prescribed test method	*No deviation from standard test method.*
Responsibility of information disclaimer	*The sample information was received from the customer. Results apply to the sample as received from the Customer.*

● **FINAL REPORT**

We would like to take this opportunity to thank you for your valued support.
Should you have any further enquiries please don't hesitate to contact me.

Yours Faithfully
STEYN-WILSON LABORATORIES (PTY) LTD

[redacted]

Mr. R.Wilson
Technical Signatory

Remarks:

1. Information contained herein is confidential to STEYN-WILSON PTY LTD and the addressee
2. Opinions & Interpretations are not included in our schedule of Accreditation.
3. The samples where subjected and analysed according to ASTM.
4. The results reported relate only to the sample tested, Further use of the attached information is not the responsibility or liability of STEYN-WILSON LABORATORIES (PTY) LTD.
5. This document is the correct record of all measurements made, and may not be reproduced other than with full written approval from a director of STEYN-WILSON LABORATORIES (PTY) LTD.
6. Measuring equipment is traceable to national standards (Where applicable).
7. Should there be any deviation from the prescribed test method comments will be made thereof, pertaining to the test on the relevant materials report.
8. Uncertainty of measurement is calculated and corresponds to a coverage probability of approximately 95%. Available on request.
9. The decision rule states that the measurement of uncertainty can be applied by the customer to the test results, on request. It is not the responsibility or liability of STEYN-WILSON LABORATORIES (PTY) LTD.

DIRECTORS: **Mr. J. Steyn ND-Civil (Managing) | Mr. R. Wilson B-Tech Civil (Operations)**

STEYN-WILSON LABORATORIES
CIVIL ENGINEERING TESTING LABORATORIES

sanas Testing Laboratory T0835

[redacted]za
Web: www.steynwilson.co.za

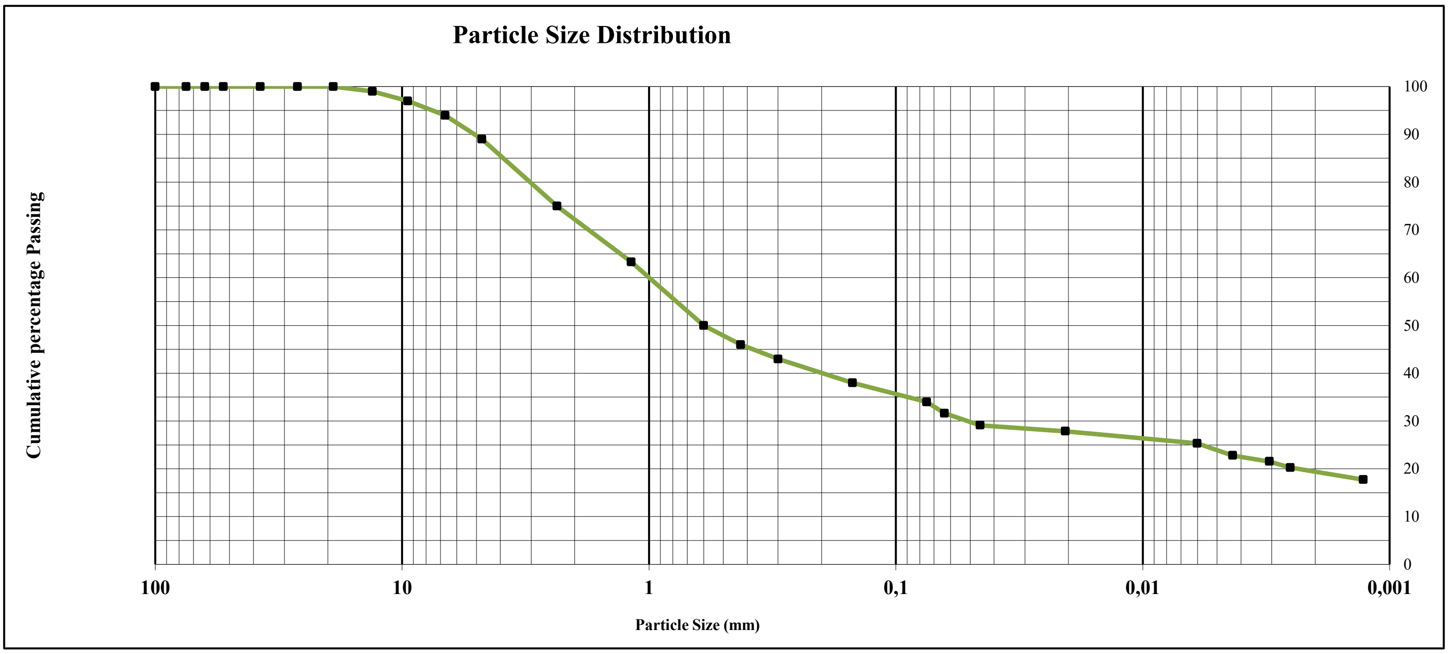
Customer :	**JG Afrika (Pty) Ltd**	Project :	Pardevlei Site
	[redacted]	Date Received :	07/12/2023
		Date Reported :	16/01/2024
		Req. Number :	-
Attention :	Mr T Hlongwane	Date Sampled:	07/12/2023

FOUNDATION INDICATOR ASTM D422

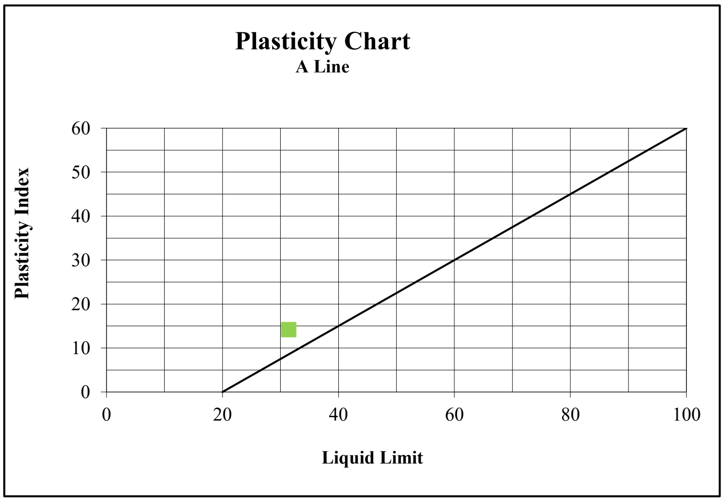
Material Description:	Sandy Clay - Residual Shale	Sample Number:	32614/2		
Position:	TP7	Liquid Limit Cassgranda SANS 3001 GR12	**31,4**	Linear Shrinkage	**7,4**
Depth:	0,30-1,70m	Plasticity Index	**14,2**	Insitu M/C%	**2**

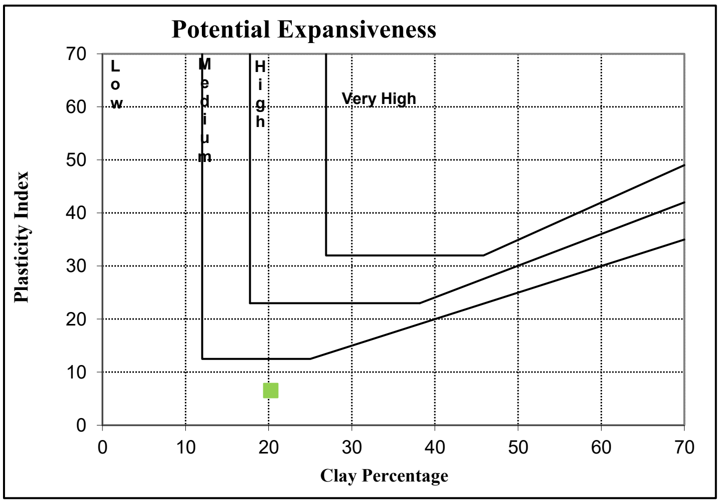
PH (TMH1 A20)		**(TMH1 A21T) Conductivity s.m^{-1}**		**SG (TMH1 A12T)***	**2,621**

SIEVE ANALYSIS (TMH 1 A1a)*																		**HYDROMETER ASTM D422**							
100	75	63	53	37,5	26,5	19,0	13,2	9,5	6,7	4,75	2,36	1,18	0,60	0,425	0,300	0,150	0,075	0,064	0,046	0,021	0,006	0,004	0,003	0,003	0,001
100	100	100	100	100	100	100	99	97	94	89	75	63,3	50	46	43	38	34	31,65	29,12	27,85	25,32	22,79	21,52	20,26	17,72
% Passing																									



% Gravel	**11**	**% Sand**	**56**	**% Silt**	**13**	**% Clay**	**20**





NOTE: All tests marked with (*) means that those test methods are not accredited.

STEYN-WILSON LABORATORIES
CIVIL ENGINEERING TESTING LABORATORIES

sanas Testing Laboratory T0835

[redacted]
Web: www.steynwilson.co.za

Customer : **JG Afrika (Pty) Ltd**
[redacted]
Attention : Mr T Hlongwane

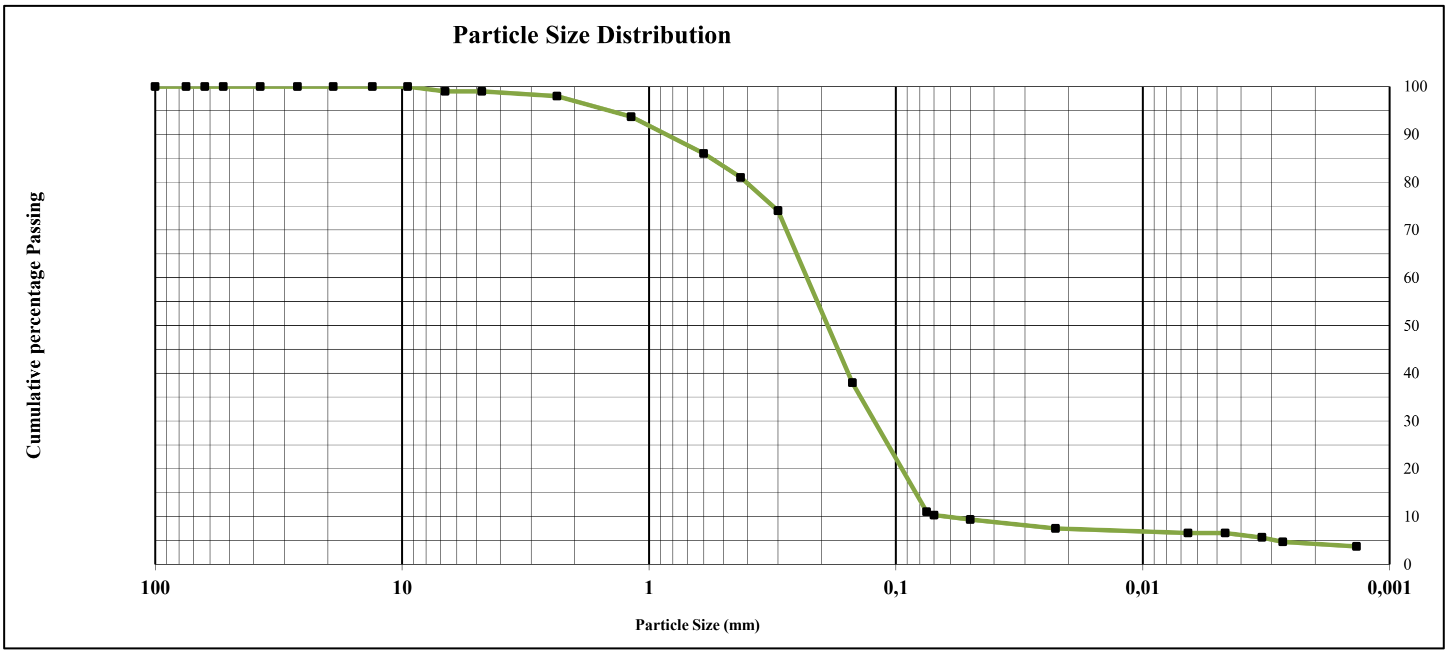
Project : Pardevlei Site
Date Received : 07/12/2023
Date Reported : 16/01/2024
Req. Number : -

FOUNDATION INDICATOR ASTM D422

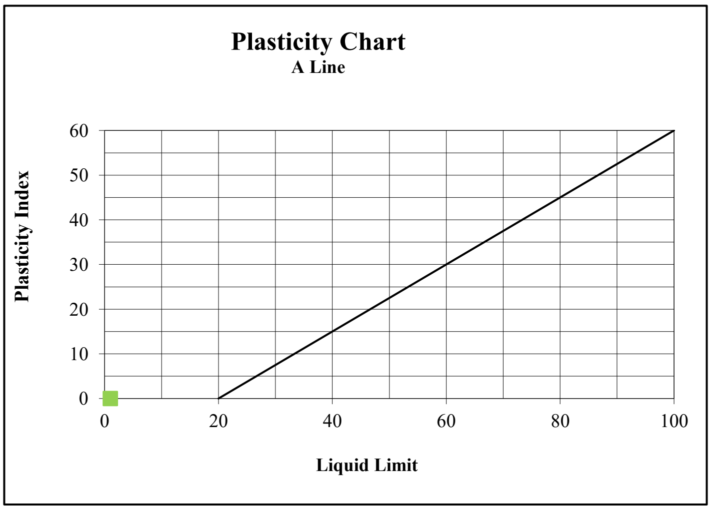
Material Description:	Sandy Silt - Colluvium	Sample Number:	32614/4		
Position:	TP12	Liquid Limit Cassgranda SANS 3001 GR12	**N.P**	Linear Shrinkage	**0,0**
Depth:	0,00-2,60m	Plasticity Index	**N.P**	Insitu M/C%	**3,5**

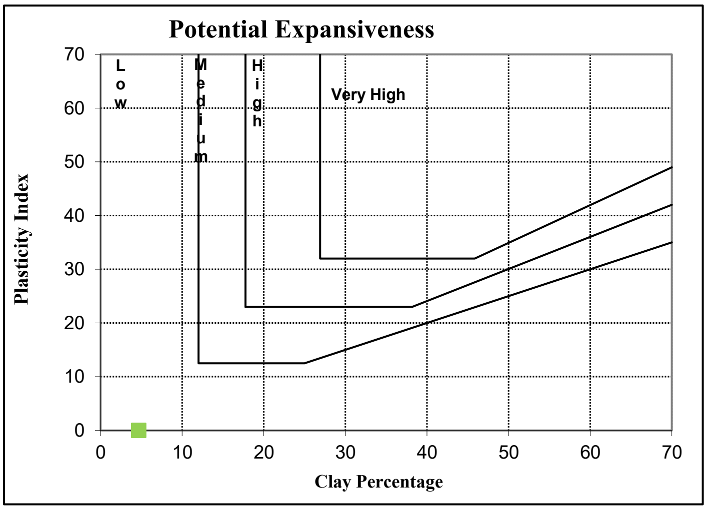
PH (TMH1 A20)*		**(TMH1 A21T)* Conductivity s.m^{-1}**		**SG (TMH1 A12T)***	**2,615**

SIEVE ANALYSIS (TMH 1 A1a)*																		**HYDROMETER ASTM D422**							
100	75	63	53	37,5	26,5	19,0	13,2	9,5	6,7	4,75	2,36	1,18	0,60	0,425	0,300	0,150	0,075	0,070	0,050	0,023	0,007	0,005	0,003	0,003	0,001
100	100	100	100	100	100	100	100	100	99	99	98	93,7	86	81	74	38	11	10,31	9,37	7,496	6,559	6,559	5,622	4,685	3,748
% Passing																									



% Gravel	1	**% Sand**	88	**% Silt**	6	**% Clay**	5





NOTE: All tests marked with (*) means that those test methods are not accredited.

STEYN-WILSON LABORATORIES
CIVIL ENGINEERING TESTING LABORATORIES

sanas Testing Laboratory T0835

[redacted]
Web: www.steynwilson.co.za

Customer : **JG Afrika (Pty) Ltd**
[redacted]
Attention : Mr T Hlongwane

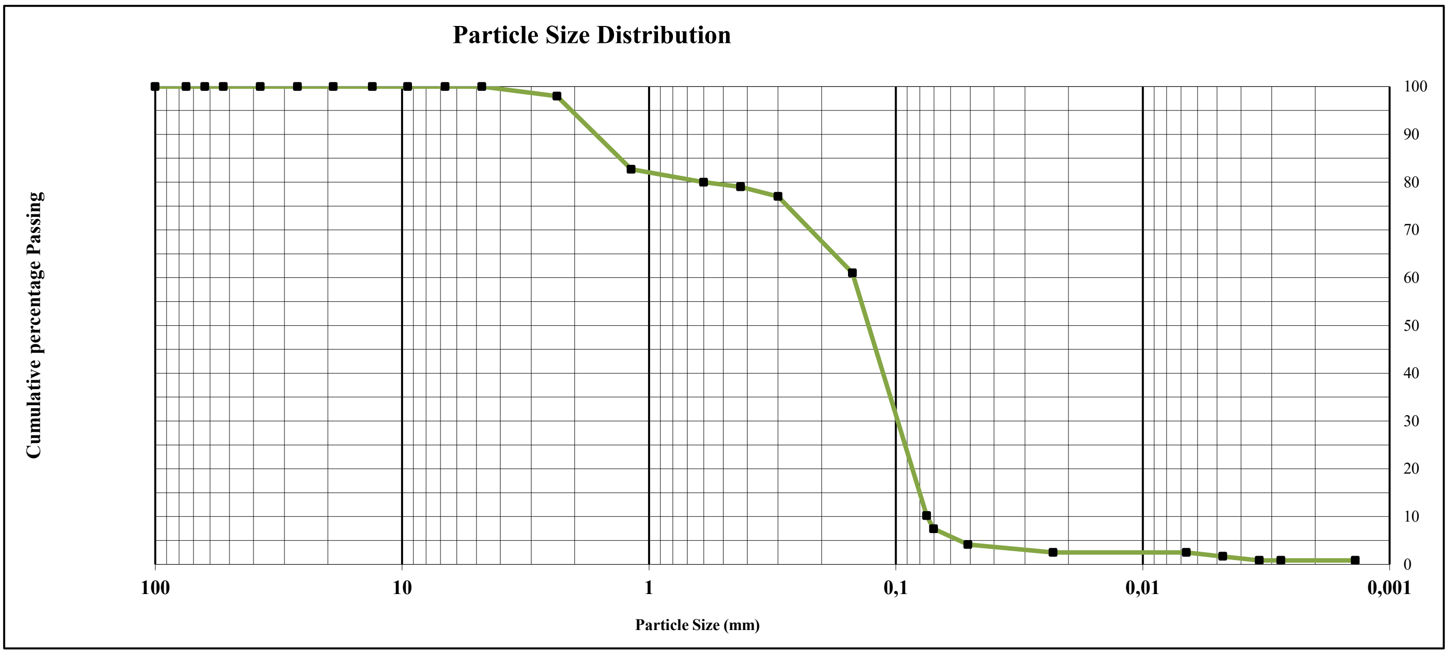
Project : Pardevlei Site
Date Received : 07/12/2023
Date Reported : 16/01/2024
Req. Number : -

FOUNDATION INDICATOR ASTM D422

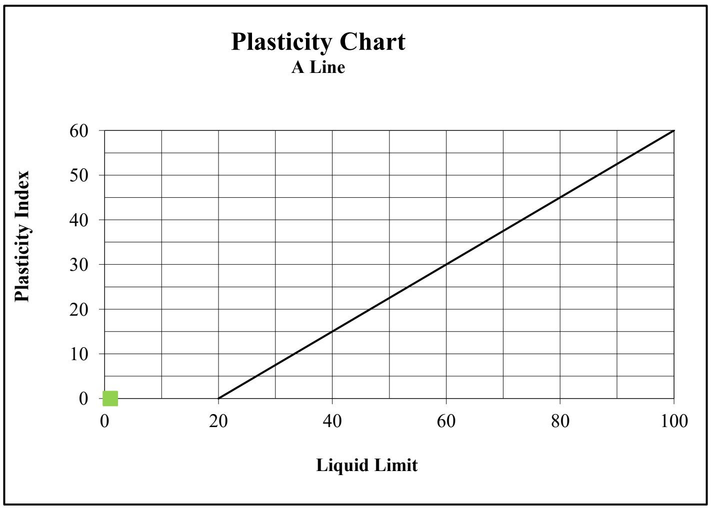
Material Description:	Silty Sand - Colluvium	Sample Number:	32614/7		
Position:	TP16	Liquid Limit Cassgranda SANS 3001 GR12	**N.P**	Linear Shrinkage	**0,0**
Depth:	0,5m	Plasticity Index	**N.P**	Insitu M/C%	**0,3**

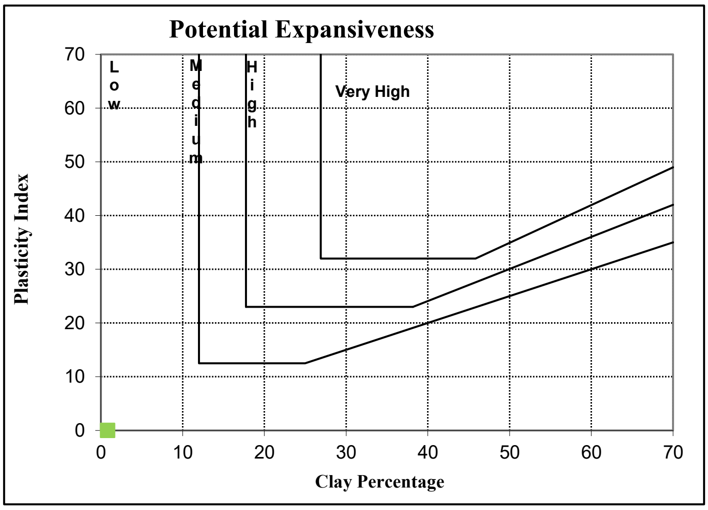
PH (TMH1 A20)*		**(TMH1 A21T)* Conductivity s.m^{-1}**		**SG (TMH1 A12T)***	**2,634**

SIEVE ANALYSIS (TMH 1 A1a)*																		**HYDROMETER ASTM D422**							
100	75	63	53	37,5	26,5	19,0	13,2	9,5	6,7	4,75	2,36	1,18	0,60	0,425	0,300	0,150	0,075	0,070	0,051	0,023	0,007	0,005	0,003	0,003	0,001
100	100	100	100	100	100	100	100	100	100	100	98	82,7	80	79	77	61	10,2	7,443	4,135	2,481	2,481	1,654	0,827	0,827	0,827
% Passing																									



% Gravel		**% Sand**	91	**% Silt**	8	**% Clay**	1





NOTE: All tests marked with (*) means that those test methods are not accredited.

STEYN-WILSON LABORATORIES
CIVIL ENGINEERING TESTING LABORATORIES

sanas Testing Laboratory T0835

[redacted]
Web: www.steynwilson.co.za

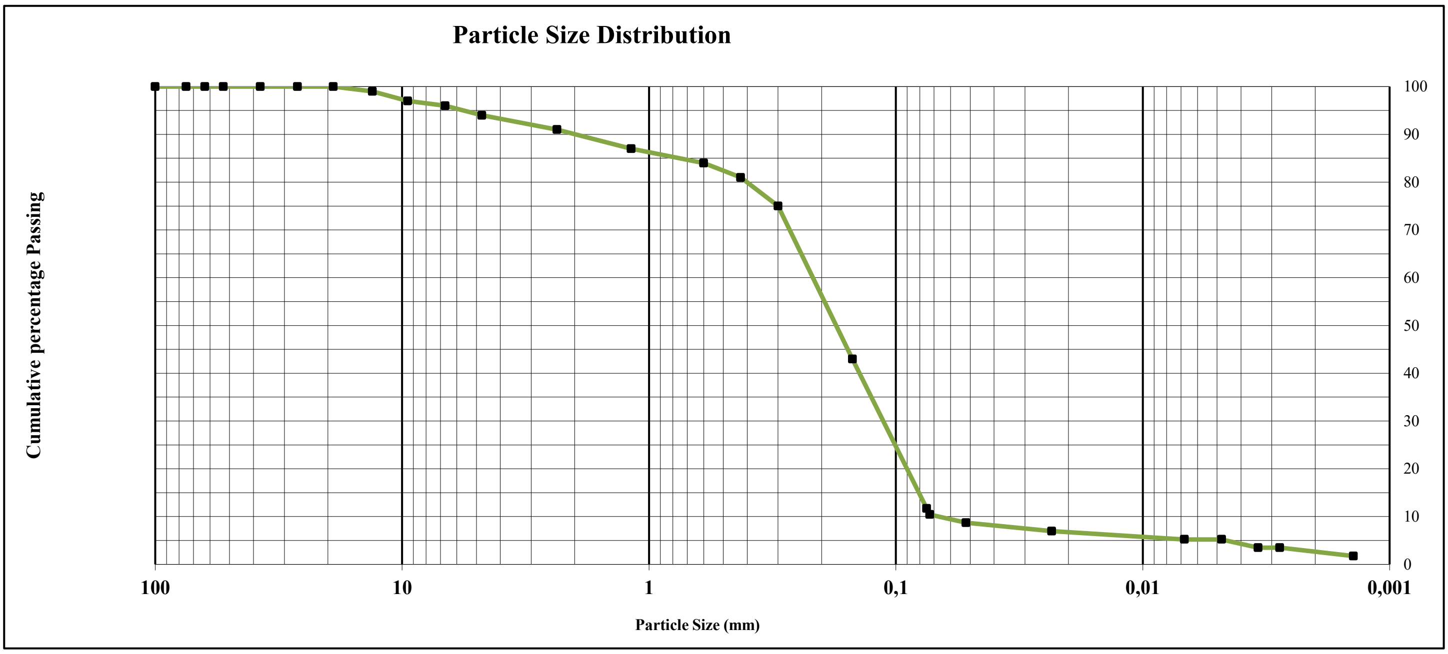
Customer :	**JG Afrika (Pty) Ltd**	Project :	Pardevlei Site
	[redacted]	Date Received :	07/12/2023
		Date Reported :	16/01/2024
		Req. Number :	-
Attention :	Mr T Hlongwane		

FOUNDATION INDICATOR ASTM D422

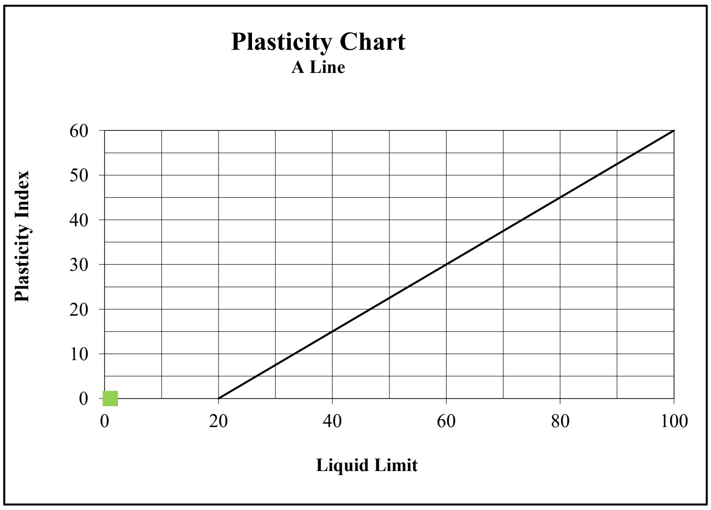
Material Description:	TP18	Sample Number:	32614/8		
Position:	Weathered Calcrete - Hardpan	Liquid Limit Cassgranda SANS 3001 GR12	**N.P**	Linear Shrinkage	**0,0**
Depth:	0,5m	Plasticity Index	**N.P**	Insitu M/C%	**0,5**

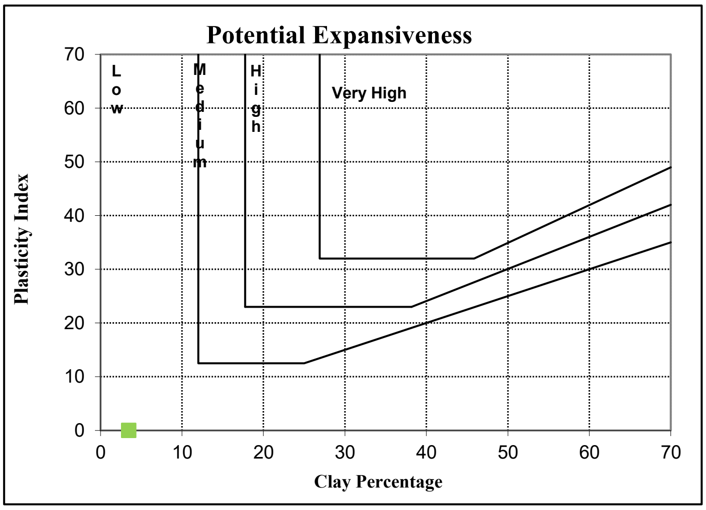
PH (TMH1 A20)*		**(TMH1 A21T)* Conductivity s.m^{-1}**		**SG (TMH1 A12T)***	**2,575**

SIEVE ANALYSIS (TMH 1 A1a)*																		**HYDROMETER ASTM D422**							
100	75	63	53	37,5	26,5	19,0	13,2	9,5	6,7	4,75	2,36	1,18	0,60	0,425	0,300	0,150	0,075	0,073	0,052	0,023	0,007	0,005	0,003	0,003	0,001
100	100	100	100	100	100	100	99	97	96	94	91	87	84	81	75	43	11,7	10,44	8,7	6,96	5,22	5,22	3,48	3,48	1,74
% Passing																									



% Gravel	6	**% Sand**	83	**% Silt**	8	**% Clay**	3





NOTE: All tests marked with (*) means that those test methods are not accredited.

STEYN-WILSON
LABORATORIES
CIVIL ENGINEERING TESTING LABORATORIES

sanas
Testing Laboratory
T0835

[redacted]

Web: www.steynwilson.co.za

Client: **JG Afrika (Pty) Ltd**

Project: Paardevlei Site

Attention: Mr T Hlongwane

Your Ref. No: -

Date Reported 22/01/2024

TEST REPORT REFERENCE NUMBER / JOB NUMBER : SWL32614

Dear Sir / Madam

Herewith please find the original reports pertaining to the above mentioned project.

<u>Test Requested</u>

1 x IND

<u>Site Sampling and Materials Information</u>

Sampling Method	*Sampled by CLIENT*
Enviromental Condition	*Sunny*
Deviation from the prescribed test method	*No deviation from standard test method.*
Responsibility of information disclaimer	*The sample information was received from the customer.* *Results apply to the sample as received from the Customer.*

● **FINAL REPORT**

We would like to take this opportunity to thank you for your valued support.
Should you have any further enquiries please don't hesitate to contact me.

<u>Yours Faithfully</u>
STEYN-WILSON LABORATORIES (PTY) LTD

[redacted]

Mr. R.Wilson
Technical Signatory

Remarks:

1. Information contained herein is confidential to STEYN-WILSON PTY LTD and the addressee
2. Opinions & Interpretations are not included in our schedule of Accreditation.
3. The samples where subjected and analysed according to SANS 3001.
4. The results reported relate only to the sample tested, Further use of the attached information is not the responsibility or liability of STEYN-WILSON LABORATORIES (PTY) LTD.
5. This document is the correct record of all measurements made, and may not be reproduced other than with full written approval from a director of STEYN-WILSON LABORATORIES (PTY) LTD.
6. Measuring equipment is traceable to national standards (Where applicable).
7. Should there be any deviation from the prescribed test method comments will be made thereof, pertaining to the test on the relevant materials report.
8. Uncertainty of measurement is calculated and corresponds to a coverage probability of approximately 95%. Available on request.
9. The decision rule states that the measurement of uncertainty can be applied by the customer to the test results, on request. It is not the responsibility or liability of STEYN-WILSON LABORATORIES (PTY) LTD.

STEYN-WILSON LABORATORIES

CIVIL ENGINEERING TESTING LABORATORIES

sanas Testing Laboratory T0835

[redacted]

Web: www.steynwilson.co.za

JOB NO:	**SWL32614**	**Your Ref**	-	**Date**	**22/01/2024**

CLIENT: JG Afrika (Pty) Ltd
[redacted]

ATTENTION: Mr T Hlongwane

PROJECT: Paardevlei Site

BALANCE: AC1/0004
OVEN: AB1/0002
AUTO COMPACTOR: AD1/0005
CBR PRESS: AA1/0001

CBR REPORT - TMH5 MD1, MD2 / SANS 3001 GR1, PR5, GR10, GR12, GR20, GR30, GR40, AG10, AG4, AG14, TMH1 A20, TMH1 A21T, *COTO, SANS 3001 AG20/21

The unambiguous description of the sample/s as received are as follows :

SAMPLE No.			**32614/11**	SPEC				
HOLE No. / SV. / CHAINAGE			TP22					
ROAD No. OR NAME			Paardevlei Site					
LAYER TESTED / SAMPLED FROM			0,80-1,30m					
DATE RECEIVED			07/12/2023					
CLIENTS MARKING			-					
DESCRIPTION OF SAMPLE (COLOUR & TYPE)			Weathered Shale - Bedrock					
REDUCTION FACTOR / RF CHECK			0,2156					
			0,02	< 1%				
SIEVE ANALYSIS (mm) SANS 3001 GR1	100,0		100					
	75,0		93					
	63,0		85					
	53,0		72					
	37,5		52					
	28,0		39					
	20,0		26					
	14,0		17					
	5,00		10					
	2,00		6					
	0,425		3					
	0,075		1					
ACV	SANS AG10	%						
10 % FACT		kN						
10 % FACT Wet / Dry ratio		%						
FLAKINESS INDEX	SANS AG4	%						
FRACTURED FACES	*COTO	%						
ATTERBERG LIMITS SANS 3001 GR10, GR12	LL% - 0,425mm							
	P.I. - 0,425mm							
	LS% - 0,425mm							
	P.I. - 0,075mm							
	GM		2,90					
SOIL-MORTAR PERCENTAGES SANS 3001 PR5	Coarse sand		52					
	Fine sand		22					
	Coarse fine sand		11					
	Medium fine sand		6					
	Fine fine sand		5					
	Silt and clay		26					
	Coarse sand ratio		0,5					
MOD AASHTO SANS 3001 GR30	OMC	%						
	MDD	(kg/m³)						
APPARENT & BULK DENSITY / WATER ABSORPTION SANS 3001 AG20/21	AD	(kg/m³)						
	BD	(kg/m³)						
	WA	%						
C.B.R. SANS 3001 GR40	COMP MC	%						
	SWELL	%						
	100%							
	98%							
	97%							
	95%							
	93%							
	90%							
pH	TMH1 A20	%						
Conductivity	TMH1 A21T	(S/m)						
Water Soluble Sulfates	*SANS 5850-1	%						
Acid Soluble Sulfates	*SANS 5850-2	%						
Durability Mill Index (max)	SANS AG16	-						
% passing 0,425mm sieve after Test		%						

***NOTE** : All tests marked with (*) means that those test methods are not accredited.*

STEYN-WILSON LABORATORIES
CIVIL ENGINEERING TESTING LABORATORIES

sanas Testing Laboratory T0835

[redacted]

Web: www.steynwilson.co.za

Client:	**JG Afrika (Pty) Ltd**
Project:	Paardevlei Site
Attention:	Mr T Hlongwane
Your Ref. No:	-
Date Reported	22/01/2024

TEST REPORT REFERENCE NUMBER / JOB NUMBER : SWL32614

Dear Sir / Madam

Herewith please find the original reports pertaining to the above mentioned project.

Test Requested

2 x MDD / CBR /IND

Site Sampling and Materials Information

Sampling Method	*Sampled by CLIENT*
Enviromental Condition	*Sunny*
Deviation from the prescribed test method	*No deviation from standard test method.*
Responsibility of information disclaimer	*The sample information was received from the customer. Results apply to the sample as received from the Customer.*

● **FINAL REPORT**

We would like to take this opportunity to thank you for your valued support.
Should you have any further enquiries please don't hesitate to contact me.

Yours Faithfully
STEYN-WILSON LABORATORIES (PTY) LTD

[redacted]

Mr. R.Wilson
Technical Signatory

Remarks:

1. Information contained herein is confidential to STEYN-WILSON PTY LTD and the addressee
2. Opinions & Interpretations are not included in our schedule of Accreditation.
3. The samples where subjected and analysed according to SANS 3001.
4. The results reported relate only to the sample tested, Further use of the attached information is not the responsibility or liability of STEYN-WILSON LABORATORIES (PTY) LTD.
5. This document is the correct record of all measurements made, and may not be reproduced other than with full written approval from a director of STEYN-WILSON LABORATORIES (PTY) LTD.
6. Measuring equipment is traceable to national standards (Where applicable).
7. Should there be any deviation from the prescribed test method comments will be made thereof, pertaining to the test on the relevant materials report.
8. Uncertainty of measurement is calculated and corresponds to a coverage probability of approximately 95%. Available on request.
9. The decision rule states that the measurement of uncertainty can be applied by the customer to the test results, on request. It is not the responsibility or liability of STEYN-WILSON LABORATORIES (PTY) LTD.

STEYN-WILSON LABORATORIES
CIVIL ENGINEERING TESTING LABORATORIES

sanas Testing Laboratory T0835

[redacted]
Web: www.steynwilson.co.za

JOB NO:	**SWL32614**	**Your Ref**	**-**	**Date**	**22/01/2024**

CLIENT: JG Afrika (Pty) Ltd
[redacted]

ATTENTION: Mr T Hlongwane

PROJECT: Paardevlei Site
BALANCE: AC1/0004
OVEN: AB1/0002
AUTO COMPACTOR: AD1/0005
CBR PRESS: AA1/0001

CBR REPORT - TMH5 MD1, MD2 / SANS 3001 GR1, PR5, GR10, GR12, GR20, GR30, GR40, AG10, AG4, AG14, TMH1 A20, TMH1 A21T, *COTO, SANS 3001 AG20/21

The unambiguous description of the sample/s as received are as follows :

SAMPLE No.			**32614/9**	SPEC	**32614/12**	SPEC		SPEC
HOLE No. / SV. / CHAINAGE			TP19	COTO - G8	TP24			
ROAD No. OR NAME			Paardevlei Site		Paardevlei Site			
LAYER TESTED / SAMPLED FROM			0,90-2,0m		0,90-3,0m			
DATE RECEIVED			17/02/2024		17/02/2024			
CLIENTS MARKING			-		-			
DESCRIPTION OF SAMPLE (COLOUR & TYPE)			Silty Sand - Aeolian		Sandy Clay - Residual Shale			
REDUCTION FACTOR / RF CHECK			1,0000		1,0000			
			0,08	< 1%	0,13	< 1%		< 1%
SIEVE ANALYSIS (mm) SANS 3001 GR1	100,0		100	-	100			
	75,0		100	-	100			
	63,0		100	-	100			
	53,0		100	-	100			
	37,5		100	-	100			
	28,0		100	-	100			
	20,0		100	-	100			
	14,0		100	-	100			
	5,00		100	-	100			
	2,00		100	-	99			
	0,425		63	-	89			
	0,075		9	-	59			
ACV	SANS AG10	%						
10 % FACT		kN						
10 % FACT Wet / Dry ratio		%						
FLAKINESS INDEX	SANS AG4	%		-				
FRACTURED FACES	*COTO	%		-				
ATTERBERG LIMITS SANS 3001 GR10, GR12	LL% - 0,425mm		N.P	-	48,5			
	P.I. - 0,425mm		N.P	≤ (3xGM) + 10	27,7			
	LS% - 0,425mm		0,0	-	12,9			
	P.I. - 0,075mm							
	GM		1,28	0,75 ≥ GM ≤ 2,7	0,53			
SOIL-MORTAR PERCENTAGES SANS 3001 PR5	Coarse sand		36		10			
	Fine sand		55		31			
	Coarse fine sand		38		11			
	Medium fine sand		11		11			
	Fine fine sand		6		9			
	Silt and clay		9		60			
	Coarse sand ratio		0,4		0,1			
MOD AASHTO SANS 3001 GR30	OMC	%	12,3		12,3			
	MDD	(kg/m³)	1755		1846			
APPARENT & BULK DENSITY / WATER ABSORPTION SANS 3001 AG20/21	AD	(kg/m³)						
	BD	(kg/m³)						
	WA	%						
C.B.R. SANS 3001 GR40	COMP MC	%	12,2		12,2			
	SWELL	%	0,0	≤ 1,5	4,81			
	100%		17	-	1			
	98%		15	-	1			
	97%		14	-	1			
	95%		12	-	1			
	93%		10	≥ 10	1			
	90%		8	-	1			
pH	TMH1 A20	%						
Conductivity	TMH1 A21T	(S/m)						
Water Soluble Sulfates	*SANS 5850-1	%						
Acid Soluble Sulfates	*SANS 5850-2	%						
Durability Mill Index (max)	SANS AG16	-						
% passing 0,425mm sieve after Test		%						

***NOTE** : All tests marked with (*) means that those test methods are not accredited.*

STEYN-WILSON LABORATORIES
CIVIL ENGINEERING TESTING LABORATORIES

sanas Testing Laboratory T0835

[redacted]

Web: www.steynwilson.co.za

Client: **JG Afrika (Pty) Ltd**

Project: Paardevlei Site

Attention: Mr T Hlongwane

Your Ref. No: -

Date Reported 22/01/2024

TEST REPORT REFERENCE NUMBER / JOB NUMBER : SWL32614

Dear Sir / Madam

Herewith please find the original reports pertaining to the above mentioned project.

Test Requested

3 x MDD / CBR /IND

Site Sampling and Materials Information

Sampling Method	*Sampled by CLIENT*
Enviromental Condition	*Sunny*
Deviation from the prescribed test method	*No deviation from standard test method.*
Responsibility of information disclaimer	*The sample information was received from the customer.* *Results apply to the sample as received from the Customer.*

● **FINAL REPORT**

We would like to take this opportunity to thank you for your valued support.
Should you have any further enquiries please don't hesitate to contact me.

Yours Faithfully
STEYN-WILSON LABORATORIES (PTY) LTD

[redacted]

Mr. R.Wilson
Technical Signatory

Remarks:

1. Information contained herein is confidential to STEYN-WILSON PTY LTD and the addressee
2. Opinions & Interpretations are not included in our schedule of Accreditation.
3. The samples where subjected and analysed according to SANS 3001.
4. The results reported relate only to the sample tested, Further use of the attached information is not the responsibility or liability of STEYN-WILSON LABORATORIES (PTY) LTD.
5. This document is the correct record of all measurements made, and may not be reproduced other than with full written approval from a director of STEYN-WILSON LABORATORIES (PTY) LTD.
6. Measuring equipment is traceable to national standards (Where applicable).
7. Should there be any deviation from the prescribed test method comments will be made thereof, pertaining to the test on the relevant materials report.
8. Uncertainty of measurement is calculated and corresponds to a coverage probability of approximately 95%. Available on request.
9. The decision rule states that the measurement of uncertainty can be applied by the customer to the test results, on request. It is not the responsibility or liability of STEYN-WILSON LABORATORIES (PTY) LTD.

DIRECTORS: **Mr. J. Steyn ND-Civil (Managing) | Mr. R. Wilson B-Tech Civil (Operations)**

STEYN-WILSON LABORATORIES
CIVIL ENGINEERING TESTING LABORATORIES

sanas Testing Laboratory T0835

[redacted]
Web: www.steynwilson.co.za

JOB NO:	**SWL32614**	**Your Ref**	**-**	**Date**	**22/01/2024**

CLIENT: JG Afrika (Pty) Ltd
[redacted]

ATTENTION: Mr T Hlongwane

PROJECT: Paardevlei Site

BALANCE: AC1/0004
OVEN: AB1/0002
AUTO COMPACTOR: AD1/0005
CBR PRESS: AA1/0001

CBR REPORT - TMH5 MD1, MD2 / SANS 3001 GR1, PR5, GR10, GR12, GR20, GR30, GR40, AG10, AG4, AG14, TMH1 A20, TMH1 A21T, *COTO, SANS 3001 AG20/21

The unambiguous description of the sample/s as received are as follows :

SAMPLE No.			**32614/1**	SPEC	**32614/5**	SPEC	**32614/6**	SPEC
HOLE No. / SV. / CHAINAGE			TP1	COTO - G6	TP13	COTO - G8	TP15	COTO - G9
ROAD No. OR NAME			Paardevlei Site		Paardevlei Site		Paardevlei Site	
LAYER TESTED / SAMPLED FROM			0,60-0,90m		1,10-2,40m		0,00-2,60m	
DATE RECEIVED			17/02/2024		17/02/2024		17/02/2024	
CLIENTS MARKING			-		-		-	
DESCRIPTION OF SAMPLE (COLOUR & TYPE)			Weathered Shale		Weathered Calcrete - Hardpan		Silty Sand - Colluvium	
REDUCTION FACTOR / RF CHECK			0,0476		1,0000		1,0000	
			0,07	< 1%	0,09	< 1%	0,08	< 1%
SIEVE ANALYSIS (mm) **SANS 3001 GR1**	100,0		100	-	100	-	100	-
	75,0		100	-	100	-	100	-
	63,0		98	-	100	-	100	-
	53,0		97	-	100	-	100	-
	37,5		95	-	100	-	100	-
	28,0		93	-	100	-	100	-
	20,0		91	-	100	-	100	-
	14,0		87	-	100	-	100	-
	5,00		60	-	97	-	99	-
	2,00		40	-	95	-	94	-
	0,425		15	-	83	-	78	-
	0,075		3	-	7	-	13	-
ACV	**SANS AG10**	%						
10 % FACT		kN						
10 % FACT Wet / Dry ratio		%						
FLAKINESS INDEX	**SANS AG4**	%		None specified		-		-
FRACTURED FACES	***COTO**	%		None specified		-		-
ATTERBERG LIMITS **SANS 3001 GR10, GR12**	LL% - 0,425mm		N.P	-	N.P	-	N.P	-
	P.I. - 0,425mm		N.P	≤ 2GM + 10	N.P	≤ (3xGM) + 10	N.P	≤ (3xGM) + 10
	LS% - 0,425mm		0,0	≤ 7	0,0	-	0,0	-
	P.I. - 0,075mm							
	GM		2,41	1,2 ≥ GM ≤ 2,6	1,14	0,75 ≥ GM ≤ 2,7	1,15	0,75 ≥ GM ≤ 2,7
SOIL-MORTAR PERCENTAGES **SANS 3001 PR5**	Coarse sand		63		13		17	
	Fine sand		28		80		69	
	Coarse fine sand		10		18		7	
	Medium fine sand		8		38		26	
	Fine fine sand		10		23		36	
	Silt and clay		8		8		14	
	Coarse sand ratio		0,6		0,1		0,2	
MOD AASHTO **SANS 3001 GR30**	OMC	%	8,2		12,4		10,4	
	MDD	(kg/m³)	2173		1672		1854	
APPARENT & BULK DENSITY / WATER ABSORPTION **SANS 3001 AG20/21**	AD	(kg/m³)						
	BD	(kg/m³)						
	WA	%						
C.B.R. **SANS 3001 GR40**	COMP MC	%	8,1		12,2		10,5	
	SWELL	%	0,0	≤ 0,5	0,0	≤ 1,5	0,0	≤ 1,5
	100%		50	-	29	-	15	-
	98%		37	-	23	-	11	-
	97%		31	-	20	-	10	-
	95%		23	≥ 25	16	-	9	-
	93%		16	-	12	≥ 10	7	≥ 7
	90%		10	-	8	-	5	-
pH	**TMH1 A20**	%						
Conductivity	**TMH1 A21T**	(S/m)						
Water Soluble Sulfates	***SANS 5850-1**	%						
Acid Soluble Sulfates	***SANS 5850-2**	%						
Durability Mill Index (max)	**SANS AG16**	-						
% passing 0,425mm sieve after Test		%						

***NOTE** : All tests marked with (*) means that those test methods are not accredited.*

STEYN-WILSON LABORATORIES
CIVIL ENGINEERING TESTING LABORATORIES

sanas Testing Laboratory T0835

[redacted]
Web: www.steynwilson.co.za

Client: **JG Afrika (Pty) Ltd**
Project: Paardevlei
Attention: Mr Thabo Hlongwane
Your Ref. No:
Date Reported Wednesday, 10 January 2024

TEST REPORT REFERENCE NUMBER / JOB NUMBER : SWG00729

Dear Sir / Madam

Herewith please find the original reports pertaining to the above mentioned project.

Test Requested

5 x *THERMAL CONDUCTIVITY and RESISTIVITY of SOIL*

Site Sampling and Materials Information

Sampling Method	Sample was Delivered
Enviromental Condition	Sunny
Deviation from the prescribed test method	No deviation from standard test method.
Responsibility of information disclaimer	The sample information was received from the customer. Results apply to the sample as received from the Customer.

● **FINAL REPORT**

We would like to take this opportunity to thank you for your valued support.
Should you have any further enquiries please don't hesitate to contact me.

Yours Faithfully
STEYN-WILSON LABORATORIES (PTY) LTD

[redacted]

F Coetzee
Technical Signatory

Remarks:

1. Information contained herein is confidential to STEYN-WILSON PTY LTD and the addressee
2. Opinions & Interpretations are not included in our schedule of Accreditation.
3. The samples where subjected and analysed according to ASTM.
4. The results reported relate only to the sample tested, Further use of the attached information is not the responsibility or liability of STEYN-WILSON LABORATORIES (PTY) LTD.
5. This document is the correct record of all measurements made, and may not be reproduced other than with full written approval from a director of STEYN-WILSON LABORATORIES (PTY) LTD.
6. Measuring equipment is traceable to national standards (Where applicable).
7. Should there be any deviation from the prescribed test method comments will be made thereof, pertaining to the test on the relevant materials report.
8. Uncertainty of measurement is calculated and corresponds to a coverage probability of approximately 95%. Available on request.
9. The decision rule states that the measurement of uncertainty can be applied by the customer to the test results, on request. It is not the responsibility or liability of STEYN-WILSON LABORATORIES (PTY) LTD.

STEYN-WILSON LABORATORIES
CIVIL ENGINEERING TESTING LABORATORIES

sanas Testing Laboratory T0835

[redacted]

Web: www.steynwilson.co.za

JOB NO: SWG00729	**REFERENCE NO:**	**DATE:**	10 January 2024

CLIENT JG Afrika (Pty) Ltd
[redacted]

PROJECT Paardevlei

ATTENTION Mr Thabo Hlongwane

Determination of Thermal Conductivity of Soil and Soft Rock by Thermal Needle Probe Procedure - ASTM D5334 – 14 / Moisture Content SANS 3001 GR20

Test Pit Number:	TP9				
Material Description:	Sandy silt Colluvium		**Layer Tested:**		-
			Depth Tested:		0,5m
Sample No.	**Moisture Content %**	**Thermal Conductivity**		**Thermal Resistivity**	
		(K) W/cm.°C	**(K) W/m.K**	**(g) °C.cm/W**	**(g) K.m/W**
	0,5%	0,0011	0,1073	931,6770	9,3168
	2%	0,0014	0,1410	709,2199	7,0922

Test Pit Number:	TP16				
Material Description:	Sandy Silt Colluvium		**Layer Tested:**		-
			Depth Tested:		0,5m
Sample No.	**Moisture Content %**	**Thermal Conductivity**		**Thermal Resistivity**	
		(K) W/cm.°C	**(K) W/m.K**	**(g) °C.cm/W**	**(g) K.m/W**
	0,5%	0,0012	0,1153	867,0520	8,6705
	2%	0,0015	0,1547	646,5517	6,4655

Test Pit Number:	TP18				
Material Description:	Weathered Calcrete Hardpan		**Layer Tested:**		-
			Depth Tested:		0,5m
Sample No.	**Moisture Content %**	**Thermal Conductivity**		**Thermal Resistivity**	
		(K) W/cm.°C	**(K) W/m.K**	**(g) °C.cm/W**	**(g) K.m/W**
	0,5%	0,0016	0,1593	627,6151	6,2762
	2%	0,0018	0,1840	543,4783	5,4348

NOTE: All tests marked with (*) means that those test methods are not accredited.

STEYN-WILSON
LABORATORIES
CIVIL ENGINEERING TESTING LABORATORIES

sanas
Testing Laboratory
T0835

[redacted]

Web: www.steynwilson.co.za

JOB NO: SWG00729 **REFERENCE NO:** **DATE:** 10 January 2024

CLIENT JG Afrika (Pty) Ltd
[redacted]

PROJECT Paardevlei

ATTENTION Mr Thabo Hlongwane

Determination of Thermal Conductivity of Soil and Soft Rock by Thermal Needle Probe Procedure - ASTM D5334 – 14 / Moisture Content SANS 3001 GR20

Test Pit Number:	TP20				
Material Description:	Sandy Clay Residual Shale		**Layer Tested:**		-
			Depth Tested:		0,5m
Sample No.	**Moisture Content %**	**Thermal Conductivity**		**Thermal Resistivity**	
		(K) W/cm.°C	**(K) W/m.K**	**(g) °C.cm/W**	**(g) K.m/W**
	0,5%	0,0015	0,1547	646,5517	6,4655
	2%	0,0017	0,1690	591,7160	5,9172

Test Pit Number:	TP27				
Material Description:	Sandy Silt Colluvium		**Layer Tested:**		-
			Depth Tested:		0,5m
Sample No.	**Moisture Content %**	**Thermal Conductivity**		**Thermal Resistivity**	
		(K) W/cm.°C	**(K) W/m.K**	**(g) °C.cm/W**	**(g) K.m/W**
	0,5%	0,0012	0,1243	804,2895	8,0429
	2%	0,0016	0,1627	614,7541	6,1475

NOTE: All tests marked with (*) means that those test methods are not accredited.

Compiled By: M.Steyn Approved By: J.Steyn / R.Wilson

Direct Shear Test

Initial Sample Details

		Specimen 1	Specimen 2	Specimen 3
Height	(mm)	18,8	18,8	18,8
Diameter	(mm)	59,9	59,9	59,9
Mass	(g)	90,3	90,4	90,4
Moisture	(%)	12,4	12,4	12,4
Dry Density	(Mg/m^3)	1,51	1,51	1,51
Bulk Density	(Mg/m^3)	1,70	1,70	1,70
Void Ratio		0,733	0,731	0,731
Particle Density	(Mg/m^3)	2,62		
Sample Method		Bag		
Disturbed/Undisturbed		Disturbed		
Remoulded Desity	(Mg/m^3)	1.677(90%)		

Consolidation Details

		Specimen 1	Specimen 2	Specimen 3
Vertical Displacement	(mm)	0,708	1,090	1,623
Void Ratio After Consolidation		0,668	0,631	0,582

Maximum Shear Stress Results

		Specimen 1	Specimen 2	Specimen 3
Normal Stress	(kPa)	49	99	149
Peak Shear Stress	(kPa)	36,5	86,5	120,5
Horizontal Strain at Failure	(mm)	6,3	6,9	5,3
Verical Strain at Failure	(mm)	0,155	0,291	0,380
Rate of Shear	(mm/min)	0,020	0,020	0,020
Friction Angle (ϕ)	(°)	39,4		
Cohesion (c)	(kPa)	0,00		

Final Sample Details

		Specimen 1	Specimen 2	Specimen 3
Mass	(g)	91,0	91,3	91,2
Moisture	(%)	20,1	19,7	19,1
Void Ratio		0,653	0,604	0,547

STEYN-WILSON GEOTECHNICAL

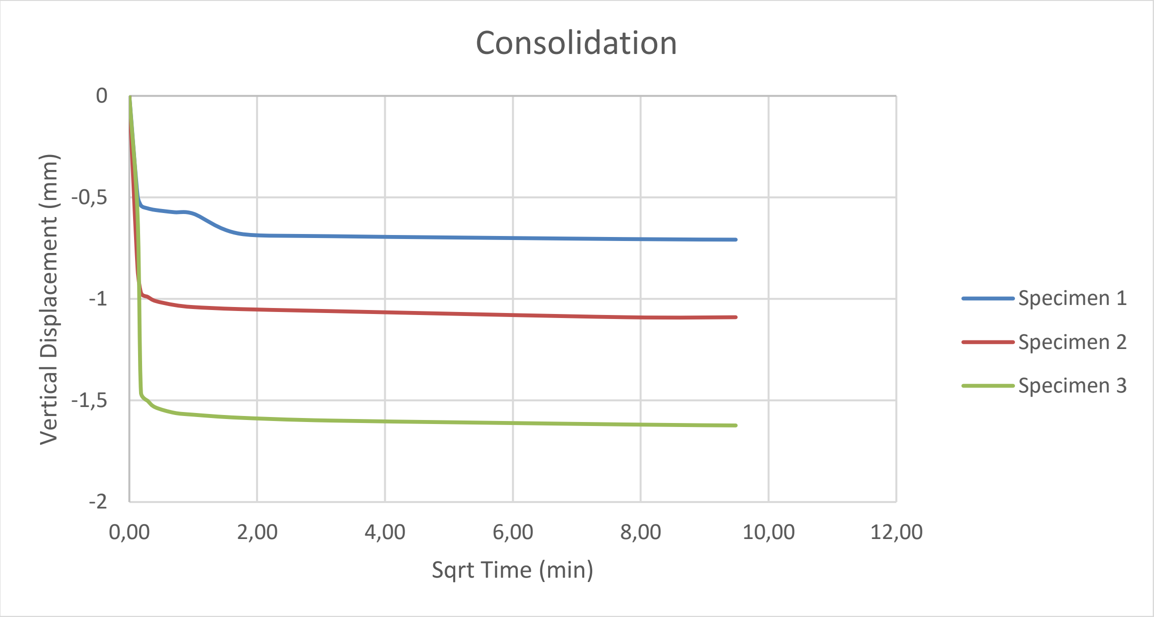
sanas Testing Laboratory T0835

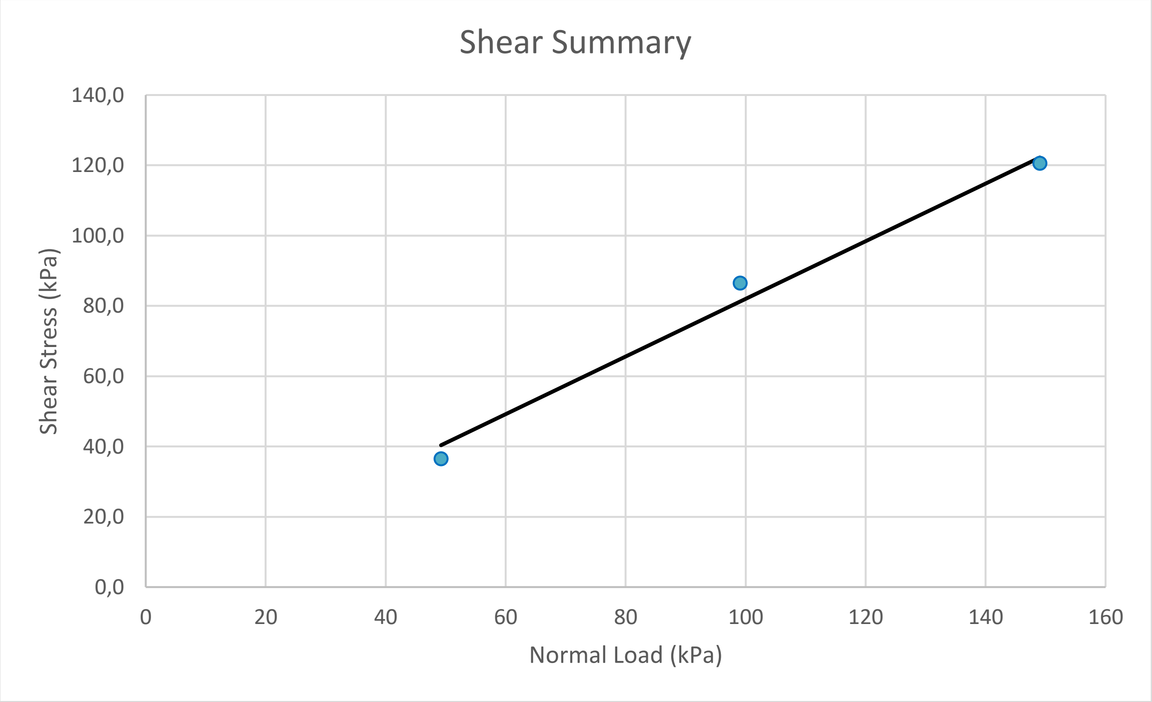
Project	**Paardevlei**		
Sample	**TP13_1.1-2.4_SB**		
Client	JG Africa	Test Method	BS1377 - 7: 1990
Jobfile	SWG00729	Test Date	24/01/2024

Direct Shear Test

Graphs

Friction Angle (ϕ)	(°)	39,4
Cohesion (c)	(kPa)	0,00





STEYN-WILSON GEOTECHNICAL

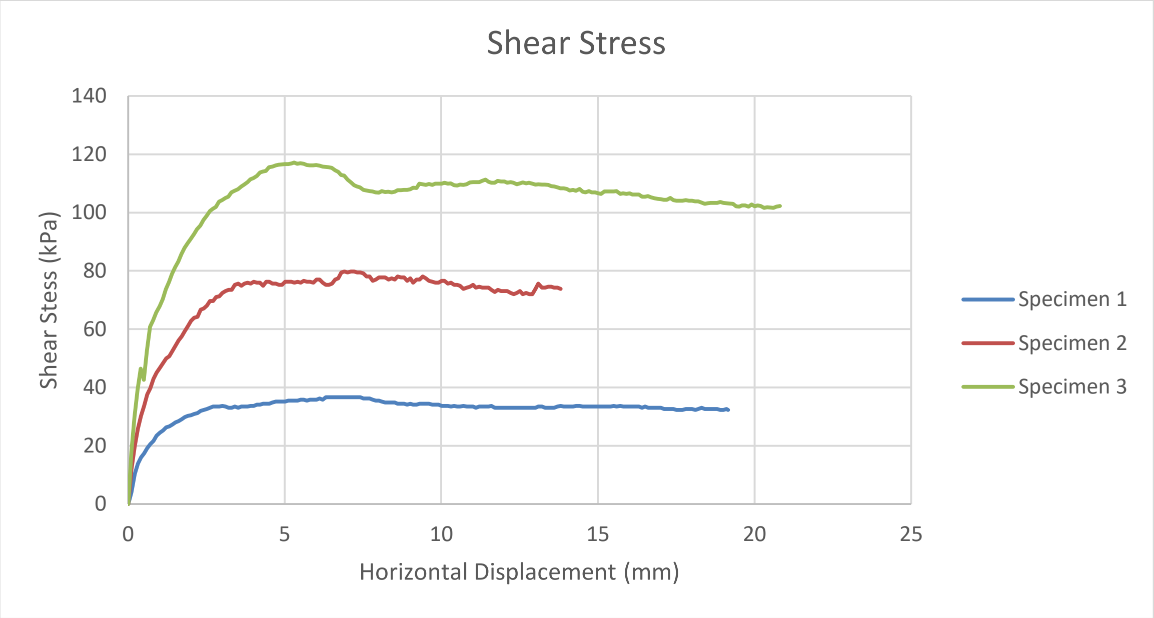
sanas Testing Laboratory T0835

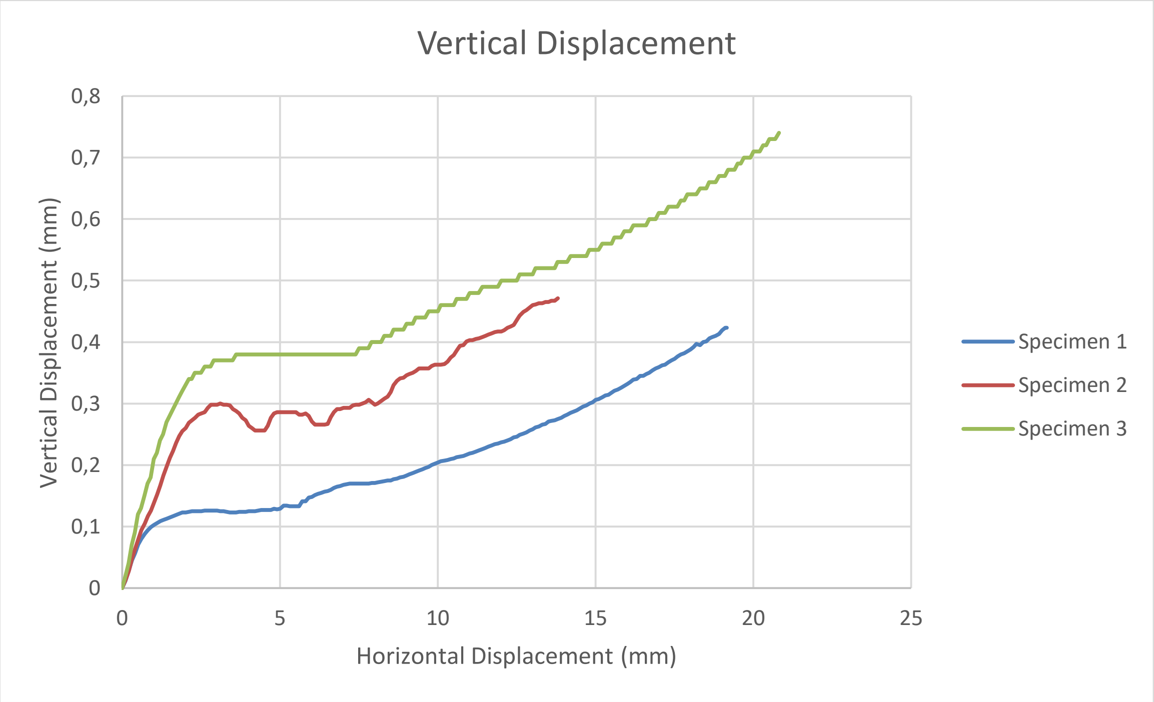
Project	**Paardevlei**		
Sample	**TP13_1.1-2.4_SB**		
Client	JG Africa	Test Method	BS1377 - 7: 1990
Jobfile	SWG00729	Test Date	24/01/2024

Direct Shear Test

Graphs

Friction Angle (ϕ)	(°)	39,4
Cohesion (c)	(kPa)	0,00





STEYN-WILSON GEOTECHNICAL

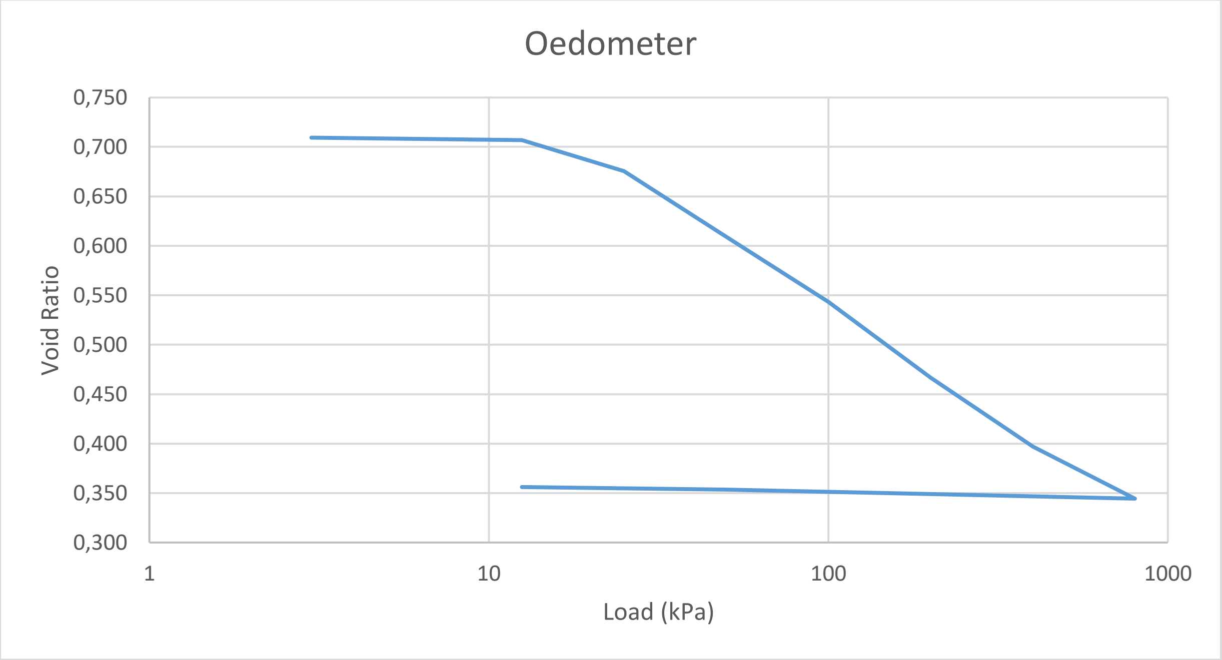
sanas Testing Laboratory T0835

Project	**Paardevlei**		
Sample	**TP13_1.1-2.4_SB**		
Client	JG Africa	Test Method	BS1377 - 7: 1990
Jobfile	SWG00729	Test Date	24/01/2024

Oedometer Test

Sample Detail		Initial	Final
Height	(mm)	20,1	15,9
Diameter	(mm)	59,8	59,8
Weight	(g)	95,4	98,1
Moisture	(%)	12,4	19,6
Dry Density	(Mg/m^3)	1,50	1,83
Bulk Density	(Mg/m^3)	1,69	2,19
Void Ratio		0,709	0,356
Particle Density	(Mg/m^3)	2,57	
Disturbed/Undisturbed		Disturbed	
Remoulded Density	(Mg/m^3)	1.677(90%)	

Load (kPa)	Height (mm)	Void Ratio
3	20,100	0,709
12,5	20,071	0,707
25	19,700	0,675
50	18,922	0,609
100	18,147	0,543
200	17,246	0,467
400	16,428	0,397
800	15,808	0,344
200	15,862	0,349
50	15,916	0,354
12,5	15,945	0,356



Project	**Paardevlei**		
Sample	**TP7_0.30-1.70m_OED**		
Client	JG Africa	Test Method	BS1377 - 5: 1990
Jobfile	SWG00729	Test Date	26/01/24

FALLING HEAD PERMEABILITY TEST REPORT - TEST METHOD: ASTM D2434 & KH HEAD

Sample Details		Remould Details (Proctor)								Tests							
TP13		Specified				Actual				Time							
Sample no.	Depth(m):	Dry Density:		%:	OMC:	Dry density:		%	Moisture Content:	Test:	H1 (mm):	H2 (mm):	h	m	s	Permeability (cm/s)	Permeability (m/s)
2431	1.1-2.4m	1677	kg/m^3	90	12,4	1511	kg/m^3	90,1	12,4	1	**1645**	**685**	0	23	15	3,8239E-04	3,8239E-06
										2	**1645**	**865**	0	34	5	1,9138E-04	1,9138E-06
										3	**1645**	**865**	1	4	21	1,0136E-04	1,0136E-06
													Average:			**2,2504E-04**	**2,2504E-06**

STEYN-WILSON GEOTECHNICAL
CIVIL ENGINEERING TESTING LABORATORIES

sanas
Testing Laboratory
T0835

Project	**Paardevlei**
Client	JG Afrika
Jobfile	SWG00729
Test Date	22/01/24

Coefficient of Permeability m/s (KH HEAD)

	k=1	10^{-1}	10^{-2}	10^{-3}	10^{-4}	10^{-5}	10^{-6}	10^{-7}	10^{-8}	10^{-9}	10^{-10}	10^{-11}	10^{-12}
Drainage characteristics	GOOD						POOR		PRACTICALLY IMPERVIOUS				
Permeability classification	HIGH			MEDIUM		LOW		VERY LOW		PRACTICALLY IMPERMEABLE			
General soil type	GRAVELS		CLEAN SANDS		FISSURED & WEATHERED CLAYS					INTACT CLAYS			
						VERY FINE OR SILTY SANDS							

STEYN-WILSON
GEOTECHNICAL
CIVIL ENGINEERING TESTING LABORATORIES

sanas
Testing Laboratory
T0835

Project	**Paardevlei**
Client	JG Afrika
Jobfile	SWG00729
Test Date	22/01/24

Appendix F: Electrical Resistivity Report

PAARDEVLEI SPV AND BESS PROJECT AT SOMERSET WEST IN THE WESTERN CAPE RESISTIVITY SURVEY REPORT

January 2024

Ref: 006097R01

For:

Prepared by:

JG AFRIKA (PTY) LTD

[redacted]

Project Lead: Robert Schapers

VERIFICATION PAGE

Form 4.3.1
Rev 13

TITLE:

PAARDEVLEI SPV AND BESS PROJECT AT SOMERSET WEST IN THE WESTERN CAPE
RESISTIVITY SURVEY REPORT

JG AFRIKA REF. NO.	DATE:	REPORT STATUS
006097R01	09/01/2024	First Issue

CARRIED OUT BY:	COMMISSIONED BY:
JG AFRIKA (PTY) LTD - DURBAN	**INTEGRATION ENVIRONMENT & ENERGY**
[redacted]	[redacted]
[redacted]	[redacted]
AUTHOR	**CLIENT CONTACT PERSON**
Robert Schapers	Muhammad Imran

SYNOPSIS

Resistivity survey for SPV and BESS facility at Paardevlei, Somerset West, Western Cape

KEY WORDS:

Geology, resistivity, conductivity, inversion models, corrosion potential, earthing.

QUALITY VERIFICATION

This report has been prepared under the controls established by a quality management system that meets the requirements of ISO9001: 2015 which has been independently certified by DEKRA Certification

Verification	Capacity	Name	Signature	Date
Checked by	Geohydrologist	Priantha Subrayen	[redacted]	10 Jan 24
Authorised by	Executive Associate	Robert Schapers	[redacted]	10 Jan 24
Filename:	V:\Active Projects\006097 - Paardevlei Res Survey (RS)\05-Reports\006097R01 Paardevlei SPV Resistivity Survey Report.docx			

PAARDEVLEI SPV AND BESS PROJECT AT SOMERSET WEST IN THE WESTERN CAPE, RESISTIVITY SURVEY REPORT

TABLE OF CONTENTS

TABLES

FIGURES

ANNEXURES

PAARDEVLEI SPV AND BESS PROJECT AT SOMERSET WEST IN THE WESTERN CAPE, RESISTIVITY SURVEY REPORT

1 INTRODUCTION

This report presents the results of a resistivity survey carried out at the site of the proposed Paardevlei Solar Photovoltaic (SPV) facility and Battery Energy Storage System (BESS) at Somerset West in the Western Cape. The purpose of the assessment was to determine the in situ electrical resistivity of the subsoils through inversion modelling.

The site is located between Macassar and Somerset West and is approximately 38.7 km east south east of the centre of Cape Town. The site is bound by the N2 between Cape Town and Somerset West on the northern side, and the False Bay along the southern side. The site can be accessed via De Beers Avenue, which in turn is accessed from Broadway Boulevard (R44) and the N2 from the Somerset West side. The approximate area of the SPV site is 152 ha and comprises three (3 No.) adjacent areas. The site is at approximately 9 to 25 MAMSL and gradually slopes south west towards the coast line. The location of the site is presented in Figure 1.

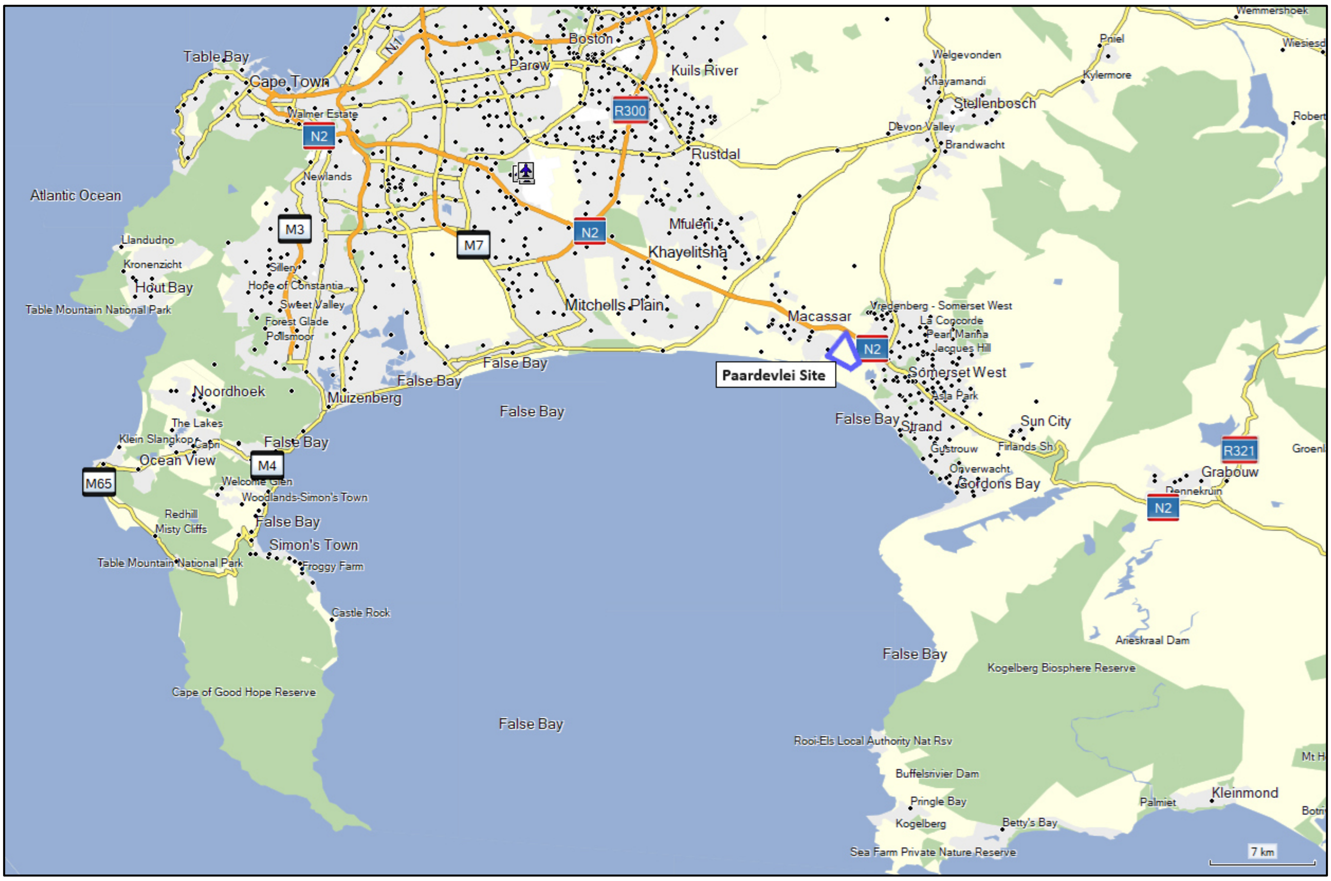


Figure 1: Locality Plan

2 INFORMATION SUPPLIED

The following information has been used in the preparation of this report:

- Specialist Terms of Reference for the Paardevlei Solar PV Project prepared by Integration Environment & Energy, titled "Specialist Terms of Reference", dated August 2023
- J.S.V van Zijl (1987). A Practical Manual on the Resistivity Method. Revised Edition. CSIR Report K79. Council for Scientific and Industrial Research, Pretoria

- Report STP1013 of American Society for Testing Materials (ASTM), titled “Effects of Soil Characteristics on Corrosion”, dated 1989, edited by Chalker and Palmer
- Drawing numbered PAARD-SIT-PLN-01 of Single Destination Engineering, titled “Site Plan Solar Field – Fixed Tilt”, at a scale of 1: 5000, dated 02 October 2023
- Drawing numbered PAARD-SIT-PLN-02 of Single Destination Engineering, titled “Site Plan Solar Field – Single Axis Tracker”, at a scale of 1: 5000, dated 02 October 2023
- Drawing numbered PAARD-SIT-PLN-03 of Single Destination Engineering, titled “Site Plan Solar Field – East West Sheds”, at a scale of 1: 5000, dated 02 October 2023
- Map Sheet titled, “3318 Cape Town”, at a scale of 1:250 000, dated 1988, of the Geological Map Series, supplied by the Department of Mineral and Energy Affairs
- Google Earth Pro version 7.3.6 of December 2022.

3 REGIONAL GEOLOGY AND GEOHYDROLOGY

The site is underlain by quaternary sediments comprising loam and sandy loam, unconsolidated sand, limestone and calcrete, and sandy soil, which extend to approximately 12 m depth beneath the site. The quaternary sediments are underlain by quartzitic sandstone of the Tygerberg Formation of the Malmesbury Group. The primary aquifer conditions within the quaternary sediments indicate groundwater levels between 1 and 8 m depth. The groundwater quality typically indicates saline conditions with elevated electrical conductivity and total dissolved solids.

4 RESISTIVITY SURVEY

4.1 Resistivity Survey Methodology

The resistivity survey was carried from 13 to 15 December 2023. Fifteen (15 No.) sounding locations designated by the geotechnical trial pit numbering were carried out at the site. The approximate positions of field test locations are presented in Figure 2.

Soil resistivity testing was carried out in accordance with the Wenner array configuration, according to the practise recommended by the South African Council for Scientific and Industrial Research (CSIR) National Physical Laboratory. Electrical resistivity soundings were performed to establish the inferred soil resistivity to an inferred depth of 20 m.

The Wenner electrical resistivity array consisted of two current electrodes (A and B) and two potential electrodes (M and N) set out about the sounding position (O). The current electrodes were used to pass current and the potential electrodes used to measure the potential difference during a measurement cycle. The four electrodes were driven into the ground at specified distances from the central sounding point (O) and set out in a straight line. For a given measurement, the spacing between any two adjacent electrodes (A and M, M and N, and N and B) was kept equal and designated (a).

Apparent resistivity measurements were taken while increasing the electrode spacing (a), allowing for deeper sounding penetration. Apparent resistivity measurements were taken at electrode spacings of 1, 2, 3, 5, 7, 10, 15, and 20 metres, corresponding to the same depths of inferred penetration below ground level.

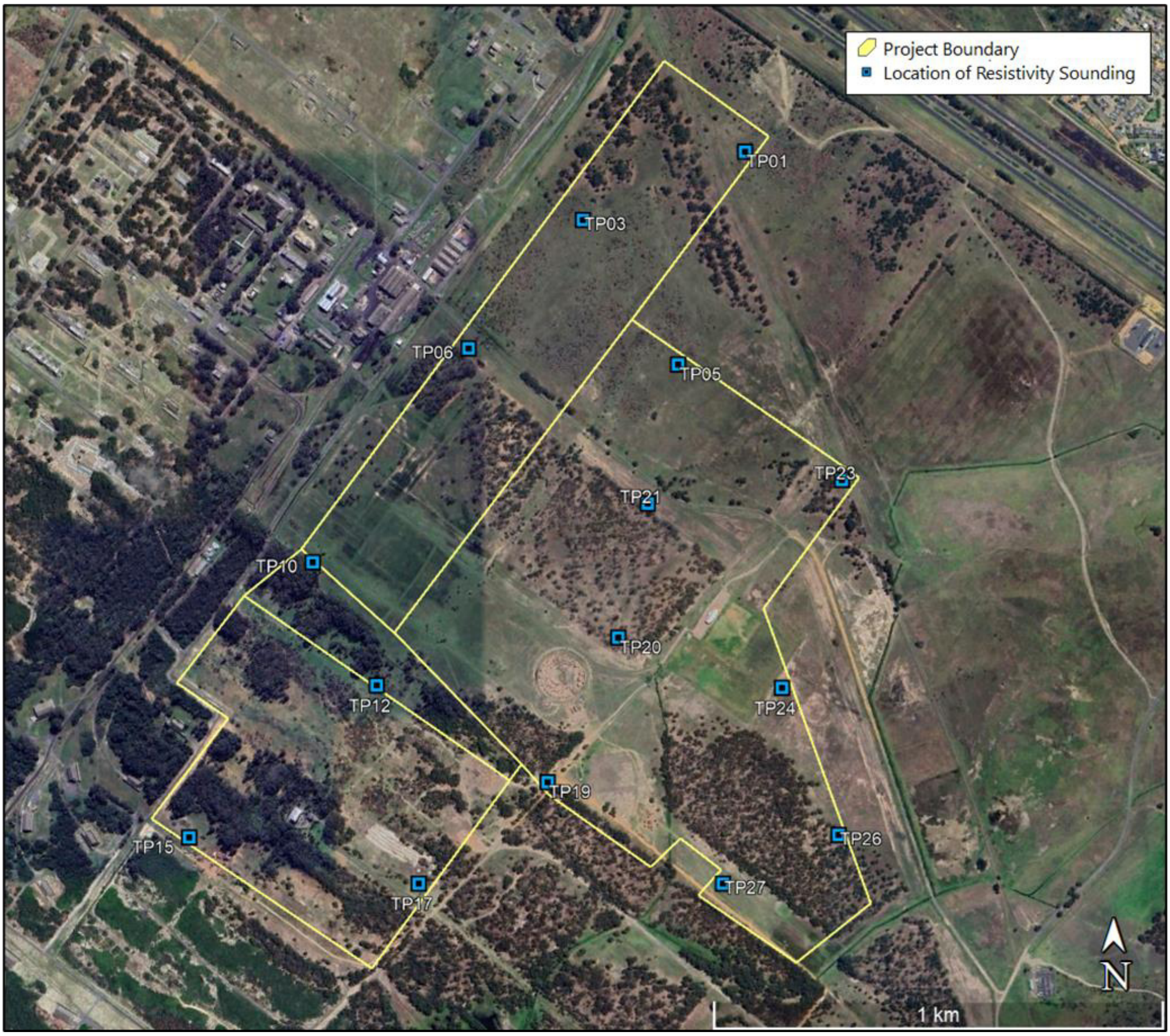


Figure 2: Site Plan Showing Sounding Test Positions

4.2 Resistivity Results

The results of the resistivity soundings were modelled using a computer inversion model (IPI2WIN) that interprets the apparent resistivity variations of the ground by fitting internally generated model data to the field data through an inversion process. The field measurements for resistivity testing are presented in Annexure A.

The results of inversion modelling of Wenner soundings were reviewed and inferred layers and electrical resistivity presented. The inferred corrosivity potential was assigned to each layer. The American Water Treatment Association (ASTM) suggests a stringent limit for soils with a resistivity up to 10 Ω.m as being potentially aggressive and severely corrosive. The following ASTM[1] **steel pipe corrosion classification** has been used:

---

[1] Report STP1013 of American Society for Testing Materials (ASTM), titled "Effects of Soil Characteristics on Corrosion", dated 1989, edited by Chalker and Palmer

Resistivity (Ω.m)	Classification
0 - 10	very severely corrosive
10 - 20	severely corrosive
20 -50	moderately corrosive
50 -100	mildly corrosive
>100	very mildly corrosive

Inversion models presented in this report act as an illustrative mechanism and aid in interpretation of the subsoil conditions at each test location. The typical number of layers input into the models was three (3 No.), with a maximum of four (4 No.). It is possible that the interpretation of depths and resistivity values of deeper layers through inversion modelling may become inaccurate, as underlying or deeper sounding readings are absent. Modelling of the data will infer these layers to continue to an infinite depth. It is also possible that variance of observed resistivity between sounding locations may occur.

The inversion models are presented in Annexure B. The summary of inversion modelling is summarised in Table 1.

Table 1: Summary Results of Inversion Modelling

Sounding	Latitude	Longitude	Layer	Depth of Layer Base (mbgl)	Inferred Layer Resistivity (Ω.m)	Inferred Corrosivity
TP01	34.06601	18.80041	1	0.50	181	very mildly corrosive
			2	0.55	0.26	very severely corrosive
			3	>	1528	very mildly corrosive
TP03	34.06737	18.79651	1	0.50	409	very mildly corrosive
			2	11.10	27.8	moderately corrosive
			3	>	29210	very mildly corrosive
TP05	34.07025	18.79880	1	0.50	7.09	very severely corrosive
			2	0.84	9266	very mildly corrosive
			3	>	2.04	very severely corrosive
TP06	34.06993	18.79376	1	0.57	307.9	very mildly corrosive
			2	5.19	29.04	moderately corrosive
			3	>	219.2	very mildly corrosive
TP10	34.07419	18.79001	1	1.15	29.9	moderately corrosive
			2	2.22	5.11	very severely corrosive
			3	4.17	78	mildly corrosive
			4	>	4.68	very severely corrosive
TP12	34.07664	18.79155	1	1.84	30.7	moderately corrosive
			2	9.39	8.71	very severely corrosive
			3	>	6134	very mildly corrosive
TP15	34.07967	18.78704	1	2.34	829	very mildly corrosive
			2	7.51	15.5	severely corrosive
			3	>	8047	very mildly corrosive
TP17	34.08059	18.79256	1	1.45	190	very mildly corrosive
			2	3.01	5.99	very severely corrosive
			3	>	23059	very mildly corrosive

Sounding	Latitude	Longitude	Layer	Depth of Layer Base (mbgl)	Inferred Layer Resistivity (Ω.m)	Inferred Corrosivity
TP19	34.07857	18.79566	1	0.50	179	very mildly corrosive
			2	2.36	11.6	severely corrosive
			3	3.54	0.98	very severely corrosive
			4	>	1762	very mildly corrosive
TP20	34.07569	18.79736	1	0.70	2.844	very severely corrosive
			2	1.71	0.762	very severely corrosive
			3	>	40.69	moderately corrosive
TP21	34.07302	18.79807	1	0.73	31.63	moderately corrosive
			2	3.90	7.635	very severely corrosive
			3	>	53.09	mildly corrosive
TP23	34.07255	18.80274	1	1.83	10.5	severely corrosive
			2	16.60	21.2	moderately corrosive
			3	>	913	very mildly corrosive
TP24	34.07669	18.80130	1	2.76	1.64	very severely corrosive
			2	11.80	7.07	very severely corrosive
			3	>	1292	very mildly corrosive
TP26	34.07962	18.80266	1	2.90	1.4	very severely corrosive
			2	10.70	201	very mildly corrosive
			3	>	807	very mildly corrosive
TP27	34.08059	18.79988	1	0.50	26.5	moderately corrosive
			2	7.62	5.42	very severely corrosive
			3	29.40	602	very mildly corrosive
			4	>	5149	very mildly corrosive

> indicates inferred depth of final layer modelled as infinite

The results of inversion modelling are variable across the site. Typically, the results do indicate that the surface layer of variable thickness is of low resistivity (average 149 Ω.m), which is underlain by a second layer of variable thickness of high resistivity (average 640 Ω.m). Both these layers are then underlain by a very highly resistive layer (average 4800 Ω.m) modelled to infinite depth. A statistical review of the data is difficult given the influence of variable geology, topography, depth to groundwater, and inferred saline groundwater conditions across the site.

It is preferred that the soil resistivity results are considered in isolation, and low resistivity results with corresponding high conductivity should have suitable earthing mechanisms and corrosion protection placed in the designs. The summary of the minimum, maximum and average values of the modelled layers is presented in Table 2.

Table 2: Summary Layer Statistics

Layer	Description	Minimum	Maximum	Average
1	Depth (m)	0.50	2.90	1.25
	Resistivity (Ω.m)	1.40	829	149
2	Depth (m)	0.55	16.6	6.30
	Resistivity (Ω.m)	0.26	9266	640
3	Resistivity (Ω.m)	0.98	29210	4799

Resistivity, although a major factor, is not the only consideration when determining the corrosivity of a soil on a metal or concrete object. Other considerations include pH, redox potential, sulphide content, moisture content, and chloride content. The resistivity values should be regarded as a first indication of corrosive potential. It is further noted that the expected elevated EC in the groundwater will influence the model outputs.

Conductivity is the inverse of the resistivity and soils with a high resistivity value will have a corresponding low conductivity value. Resistivity therefore indicates the ability of the media to carry corrosive currents. There generally exists a linear relationship between corrosivity of steel and the conductance of the medium around it. It is therefore expected that a medium with a high resistivity value will have a corresponding low corrosive nature. Aggressiveness of the subsoil profiles on concrete structures is partially related to the conductivity of the subsoils, and primarily to the chemical constituents present. Typical literature based resistivity values for certain geological media are presented in Table 3.

Table 3: Literature Based Resistivity Values for Certain Geological Media

Material	Resistivity (Ω.m)
Igneous and Metamorphic Rocks	
Granite	$5x10^3$ - 10^6
Basalt	10^3 - 10^6
Slate	$6x10^2$ - $4x10^7$
Marble	10^2 - $2.5x10^8$
Quartzite	10^2 - $2x10^8$
Sedimentary Rocks	
Sandstone	8 - $4x10^3$
Shale	20 - $2x10^3$
Limestone	50 - $4x10^2$
Soils and Waters	
Clay	1 - 100
Alluvium	10 - 800
Groundwater (fresh)	10 - 100
Sea water	0.2

5 CONCLUSIONS

This report presents the results of a resistivity survey carried out at the proposed Paardevlei SPV and BESS site at Somerset West in the Western Cape.

The results of the resistivity survey were run through an inversion model to interpret the subsoil layer depths and resistivities. The results were compared with the ASTM steel pipe corrosion potential classification to infer corrosion potential at each sounding location. Fifteen (15 No.) soundings to an inferred 20 m depth were carried out. The results of inversion modelling are variable across the site. This may be attributed to the variable quaternary sediments across the site. Further, due to the saline groundwater conditions expected beneath the site, there is little correlation between resistivity and surface topography, layer thickness, and depth to groundwater.

Typically, the results do indicate that the surface layer of variable thickness is of low resistivity which is underlain by a second layer of variable thickness of high resistivity. These in turn are underlain by a very highly resistive layer modelled to infinite depth. Soil resistivity results should be considered in isolation, and low resistivity results with corresponding high conductivity should have suitable earthing mechanisms and corrosion protection placed in the designs.

Corrosive potential of the soil media is also dependant on other parameters including pH, redox potential, temperature, oxygenation, moisture, sulphide, and chloride content. It is noted that elevated EC and other potential historical contaminants which may influence the results of the resistivity survey are expected in the groundwater beneath the site. As tests were carried out at point locations, variations to the reported resistivity and inferred corrosivity may occur across the site.

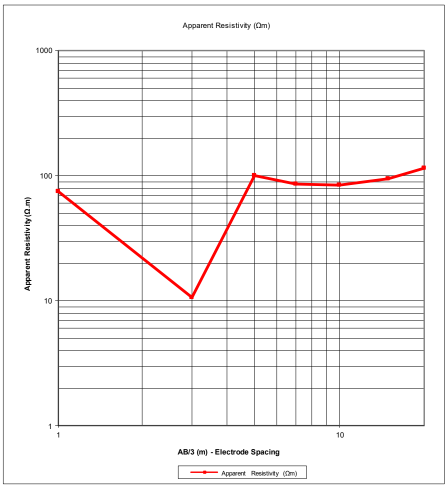
Annexure A: Resistivity Sounding Results

Wenner Electrical Sounding Fieldsheet

Client :	Integration Environment & Energy	**Ref:**	6097
Project :	Paardevlei Resistivity Survey	**Date:**	15-Dec-23

Test No.	TP 01	GPS Co-ordinates			
		South	-34.06601	East	18.80041
Test Date:	15-Dec-23	Time Start:	06:00	Time End:	07:00
Traverse Orientation:	NE - SW	Site Description	Site consists of grass vegetation with shrubs and dry fine grained organic rich sandy soil.		

Electrode Spacing						Field Recorded Results						
AB	MN	OA OB	ON OM	Electrode Spacing	Geometric Factor K	ΔV (mV)	I (mA)	Apparent Resistivity (Ωm)	Standard Deviation	No. Cycles	Base Reading V	Base Reading I
3	1	1.5	0.5	1	6.28	611.4	50.8	75.64	0.1	3		
6	2	3	1	2	12.57	0.0	#N/A	#N/A	0	3		
9	3	4.5	1.5	3	18.85	67.4	118.6	10.69	0.1	3		
15	5	7.5	2.5	5	31.42	593.6	184.7	100.95	0.1	3		
21	7	10.5	3.5	7	43.98	206.8	102.9	85.83	0.1	3		
30	10	15	5	10	62.83	76.0	56.2	84.89	0.1	3		
45	15	22.5	7.5	15	94.25	125.6	126.1	94.12	0.1	3		
60	20	30	10	20	125.66	60.4	66.0	114.67	0.1	3		

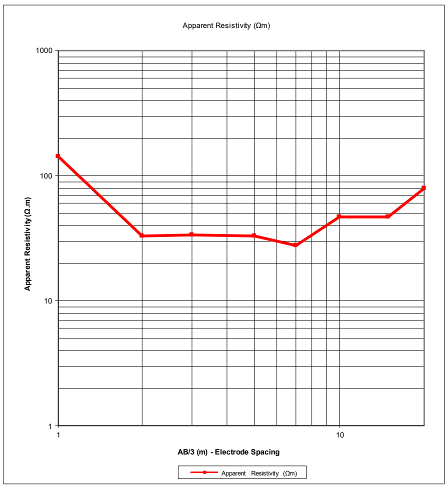


Wenner Electrical Sounding Fieldsheet

Client :	Integration Environment & Energy	**Ref:**	6097
Project :	Paardevlei Resistivity Survey	**Date:**	13-Dec-23

Test No.	TP 03	GPS Co-ordinates			
		South	-34.06737	East	18.79651
Test Date:	13-Dec-23	Time Start:	15:30	Time End:	16:20
Traverse Orientation:	NW - SE	Site Description	Site consists of shrub & grass vegetation with dry calcite sandy soil cover.		

Electrode Spacing						Field Recorded Results						
AB	MN	OA OB	ON OM	Electrode Spacing	Geometric Factor K	ΔV (mV)	I (mA)	Apparent Resistivity (Ωm)	Standard Deviation	No. Cycles	Base Reading V	Base Reading I
3	1	1.5	0.5	1	6.28	428.8	18.9	142.08	0.2	3		
6	2	3	1	2	12.57	94.4	36.8	32.77	0.2	4		
9	3	4.5	1.5	3	18.85	61.8	33.9	33.80	1.2	3		
15	5	7.5	2.5	5	31.42	26.2	25.3	32.72	0.2	3		
21	7	10.5	3.5	7	43.98	15.2	24.5	27.67	1.9	9		
30	10	15	5	10	62.83	28.0	36.8	46.76	0.5	3		
45	15	22.5	7.5	15	94.25	6.8	13.6	46.79	2.2	9		
60	20	30	10	20	125.66	33.6	54.1	79.45	1.5	4		

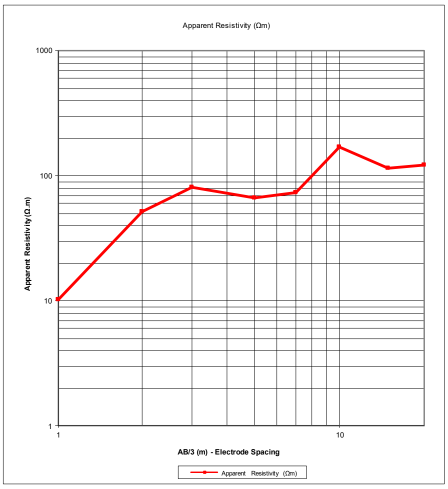


Wenner Electrical Sounding Fieldsheet

Client :	Integration Environment & Energy	**Ref:**	6097
Project :	Paardevlei Resistivity Survey	**Date:**	13-Dec-23

Test No.	TP 05	GPS Co-ordinates			
		South	-34.07025	East	18.7988
Test Date:	13-Dec-23	Time Start:	14:20	Time End:	15:10
Traverse Orientation:	NE - SW	Site Description	Site consists of grass vegetation with dry fine to coarse sandy soil.		

Electrode Spacing						Field Recorded Results						
AB	MN	OA OB	ON OM	Electrode Spacing	Geometric Factor K	ΔV (mV)	I (mA)	Apparent Resistivity (Ωm)	Standard Deviation	No. Cycles	Base Reading V	Base Reading I
3	1	1.5	0.5	1	6.28	28.8	15.4	10.32	2.5	4		
6	2	3	1	2	12.57	57.8	14.2	51.85	0.6	4		
9	3	4.5	1.5	3	18.85	55.6	12.9	81.13	0.6	3		
15	5	7.5	2.5	5	31.42	27.4	13.3	66.18	2	9		
21	7	10.5	3.5	7	43.98	21.2	13.0	73.09	3	6		
30	10	15	5	10	62.83	36.6	13.4	170.59	0.9	3		
45	15	22.5	7.5	15	94.25	16.4	13.4	114.71	0.2	3		
60	20	30	10	20	125.66	16.0	16.6	121.12	1.4	3		

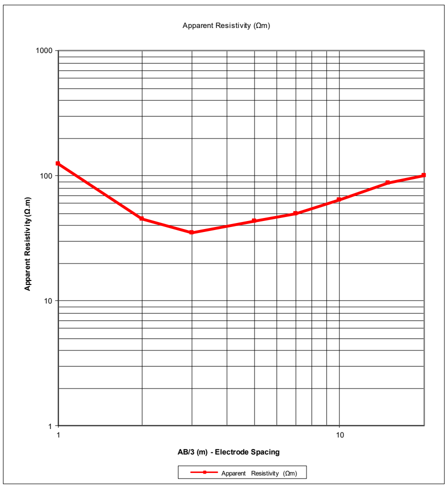


Wenner Electrical Sounding Fieldsheet

Client :	Integration Environment & Energy	**Ref:**	6097
Project :	Paardevlei Resistivity Survey	**Date:**	14-Dec-23

Test No.	TP 06	GPS Co-ordinates			
		South	-34.06993	East	18.79376
Test Date:	14-Dec-23	Time Start:	10:00	Time End:	11:10
Traverse Orientation:	NW - SE	Site Description	Site consists of grass vegetation with dry fine to medium grained sandy soil.		

Electrode Spacing						Field Recorded Results						
AB	MN	OA OB	ON OM	Electrode Spacing	Geometric Factor K	ΔV (mV)	I (mA)	Apparent Resistivity (Ωm)	Standard Deviation	No. Cycles	Base Reading V	Base Reading I
3	1	1.5	0.5	1	6.28	220.2	11.0	125.73	0.2	3		
6	2	3	1	2	12.57	122.2	34.0	45.41	0.1	5		
9	3	4.5	1.5	3	18.85	46.2	25.0	34.73	0	3		
15	5	7.5	2.5	5	31.42	40.4	29.8	43.05	0.3	4		
21	7	10.5	3.5	7	43.98	26.6	23.3	50.10	0	3		
30	10	15	5	10	62.83	52.6	51.9	63.64	0.2	4		
45	15	22.5	7.5	15	94.25	93.4	100.2	87.89	0.1	3		
60	20	30	10	20	125.66	46.6	57.6	101.15	0.2	3		

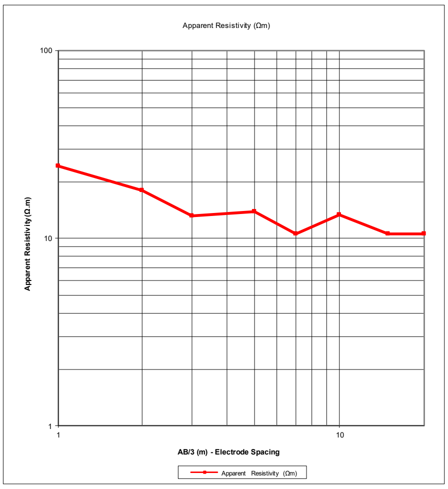


Wenner Electrical Sounding Fieldsheet

Client :	Integration Environment & Energy	**Ref:**	6097
Project :	Paardevlei Resistivity Survey	**Date:**	13-Dec-23

Test No.	TP 10	GPS Co-ordinates			
		South	-34.07419	East	18.79001
Test Date:	13-Dec-23	Time Start:	12:15	Time End:	12:50
Traverse Orientation:	NW - SE	Site Description	Site consists of eucalyptus tree vegetation with organic rich dry calcite fine grained sandy soil.		

Electrode Spacing						Field Recorded Results						
AB	MN	OA OB	ON OM	Electrode Spacing	Geometric Factor K	ΔV (mV)	I (mA)	Apparent Resistivity (Ωm)	Standard Deviation	No. Cycles	Base Reading V	Base Reading I
3	1	1.5	0.5	1	6.28	164.4	41.7	24.35	0.3	6		
6	2	3	1	2	12.57	59.0	40.5	18.04	0.6	3		
9	3	4.5	1.5	3	18.85	38.4	49.0	13.19	0.4	3		
15	5	7.5	2.5	5	31.42	27.8	54.1	13.86	0.2	5		
21	7	10.5	3.5	7	43.98	14.8	35.5	10.51	0.8	4		
30	10	15	5	10	62.83	14.8	52.3	13.31	0.9	6		
45	15	22.5	7.5	15	94.25	6.4	56.8	10.62	0.9	7		
60	20	30	10	20	125.66	3.4	40.3	10.60	0.9	4		

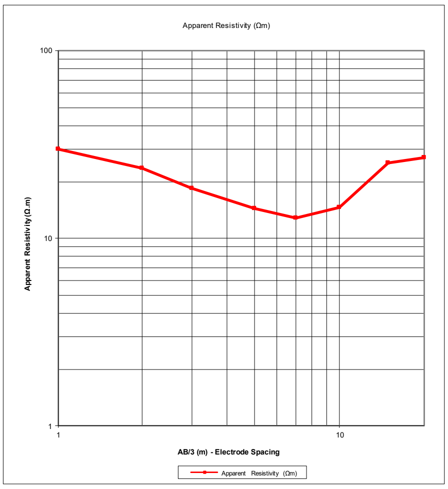


Wenner Electrical Sounding Fieldsheet

Client :	Integration Environment & Energy	**Ref:**	6097
Project :	Paardevlei Resistivity Survey	**Date:**	14-Dec-23

Test No.	TP 12	GPS Co-ordinates			
		South	-34.07664	East	18.79155
Test Date:	14-Dec-23	Time Start:	08:15	Time End:	09:30
Traverse Orientation:	NW - SE	Site Description	Site consists of shrub vegetation with dry calcite sandy soil cover.		

Electrode Spacing						Field Recorded Results						
AB	MN	OA OB	ON OM	Electrode Spacing	Geometric Factor K	ΔV (mV)	I (mA)	Apparent Resistivity (Ωm)	Standard Deviation	No. Cycles	Base Reading V	Base Reading I
3	1	1.5	0.5	1	6.28	170.0	35.7	29.89	0	3		
6	2	3	1	2	12.57	57.4	30.6	23.57	0.2	3		
9	3	4.5	1.5	3	18.85	48.0	49.3	18.53	0.3	3		
15	5	7.5	2.5	5	31.42	18.2	39.3	14.42	0.2	3		
21	7	10.5	3.5	7	43.98	11.0	36.9	12.92	0.4	3		
30	10	15	5	10	62.83	7.6	32.8	14.70	0.3	4		
45	15	22.5	7.5	15	94.25	7.2	26.3	25.29	1.1	4		
60	20	30	10	20	125.66	6.8	31.5	27.01	0.2	3		

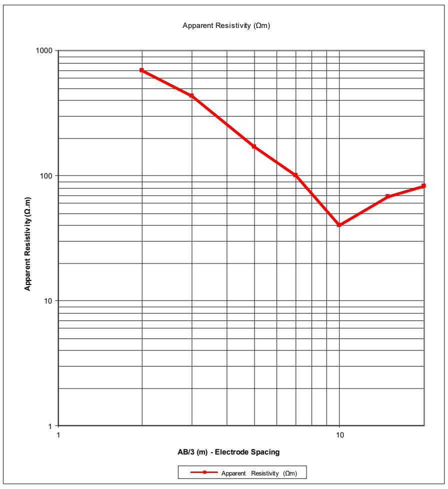


Wenner Electrical Sounding Fieldsheet

Client :	Integration Environment & Energy	**Ref:**	6097
Project :	Paardevlei Resistivity Survey	**Date:**	13-Dec-23

Test No.	TP 15	GPS Co-ordinates			
		South	-34.07967	East	18.787038
Test Date:	13-Dec-23	Time Start:	10:00	Time End:	10:45
Traverse Orientation:	NW - SE	Site Description	Site consists of shrub vegetation with dry calcite sandy soil cover.		

Electrode Spacing					Geometric Factor K	**Field Recorded Results**						
AB	**MN**	**OA OB**	**ON OM**	Electrode Spacing		**ΔV (mV)**	**I (mA)**	**Apparent Resistivity (Ωm)**	**Standard Deviation**	**No. Cycles**	Base Reading	
											V	I
3	1	1.5	0.5	1	6.28	0.0	#N/A	#N/A	0.1	6		
6	2	3	1	2	12.57	852.0	15.5	688.20	0.2	3		
9	3	4.5	1.5	3	18.85	334.6	14.6	431.12	0	3		
15	5	7.5	2.5	5	31.42	69.2	12.8	169.04	0.5	4		
21	7	10.5	3.5	7	43.98	35.8	15.6	101.01	0.2	5		
30	10	15	5	10	62.83	8.6	13.8	40.46	3.8	12		
45	15	22.5	7.5	15	94.25	15.6	22.1	68.10	1.3	11		
60	20	30	10	20	125.66	7.6	10.6	83.19	1.8	6		

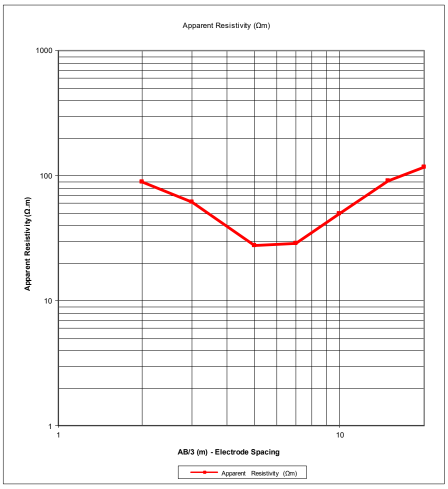


Wenner Electrical Sounding Fieldsheet

Client :	Integration Environment & Energy	**Ref:**	6097
Project :	Paardevlei Resistivity Survey	**Date:**	13-Dec-23

Test No.	TP 17	GPS Co-ordinates			
		South	-34.08059	East	18.79256
Test Date:	13-Dec-23	Time Start:	11:05	Time End:	11:55
Traverse Orientation:	NW - SE	Site Description	Site consists of shrub vegetation with dry slightly hard calcite sandy soil cover.		

Electrode Spacing					Geometric Factor K	**Field Recorded Results**						
AB	**MN**	**OA OB**	**ON OM**	Electrode Spacing		**ΔV (mV)**	**I (mA)**	**Apparent Resistivity (Ωm)**	**Standard Deviation**	**No. Cycles**	Base Reading	
											V	I
3	1	1.5	0.5	1	6.28	0.0	#N/A	#N/A	0	4		
6	2	3	1	2	12.57	449.0	63.0	89.11	0.2	3		
9	3	4.5	1.5	3	18.85	95.6	28.8	61.57	0.4	4		
15	5	7.5	2.5	5	31.42	17.2	20.3	27.78	0.8	6		
21	7	10.5	3.5	7	43.98	14.4	21.3	28.90	1.8	7		
30	10	15	5	10	62.83	14.4	17.3	49.45	1.1	5		
45	15	22.5	7.5	15	94.25	15.4	16.1	91.14	0.5	6		
60	20	30	10	20	125.66	15.6	16.3	116.53	1.7	5		

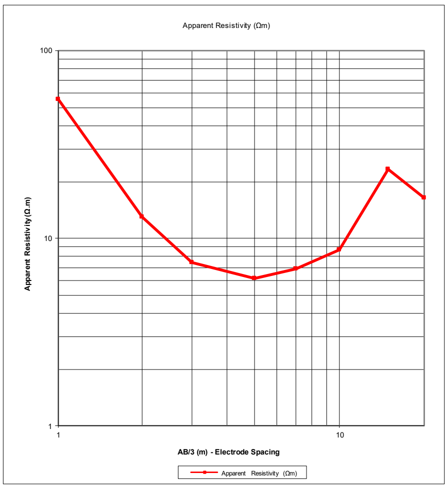


Wenner Electrical Sounding Fieldsheet

Client :	Integration Environment & Energy	**Ref:**	6097
Project :	Paardevlei Resistivity Survey	**Date:**	14-Dec-23

Test No.	TP 19	GPS Co-ordinates			
		South	-34.07857	East	18.79566
Test Date:	14-Dec-23	Time Start:	13:00	Time End:	13:45
Traverse Orientation:	NE - SW	Site Description	Site consists of shrub vegetation with dry compact fine to medium grained sandy soil.		

Electrode Spacing					Geometric Factor K	**Field Recorded Results**						
AB	**MN**	**OA OB**	**ON OM**	Electrode Spacing		**ΔV (mV)**	**I (mA)**	**Apparent Resistivity (Ωm)**	**Standard Deviation**	**No. Cycles**	Base Reading	
											V	I
3	1	1.5	0.5	1	6.28	419.4	47.5	55.44	0.1	4		
6	2	3	1	2	12.57	99.4	95.8	13.04	0.1	3		
9	3	4.5	1.5	3	18.85	27.6	63.6	7.46	2	11		
15	5	7.5	2.5	5	31.42	6.0	32.0	6.12	0.8	4		
21	7	10.5	3.5	7	43.98	5.0	32.8	6.88	0.3	5		
30	10	15	5	10	62.83	5.8	42.5	8.74	0.3	5		
45	15	22.5	7.5	15	94.25	7.0	28.0	23.52	0.1	1		
60	20	30	10	20	125.66	9.2	73.1	16.48	1.1	7		

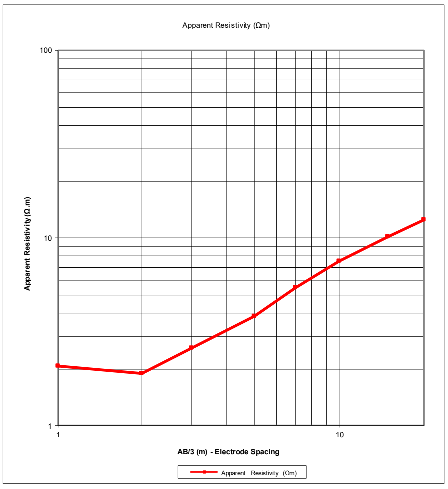


Wenner Electrical Sounding Fieldsheet

Client :	Integration Environment & Energy	**Ref:**	6097
Project :	Paardevlei Resistivity Survey	**Date:**	14-Dec-23

Test No.	TP 20	GPS Co-ordinates			
		South	-34.07569	East	18.79736
Test Date:	14-Dec-23	Time Start:	13:50	Time End:	14:40
Traverse Orientation:	NE - SW	Site Description	Site consists of eucalyptus tree vegetation with dry fine to medium grained organic rich sandy soil.		

Electrode Spacing						Field Recorded Results						
AB	MN	OA OB	ON OM	Electrode Spacing	Geometric Factor K	ΔV (mV)	I (mA)	Apparent Resistivity (Ωm)	Standard Deviation	No. Cycles	Base Reading	
											V	I
3	1	1.5	0.5	1	6.28	146.6	449.1	2.07	0.9	3		
6	2	3	1	2	12.57	21.2	139.8	1.90	0.5	3		
9	3	4.5	1.5	3	18.85	28.8	208.1	2.60	0.1	3		
15	5	7.5	2.5	5	31.42	30.8	252.2	3.85	0.1	5		
21	7	10.5	3.5	7	43.98	21.4	173.4	5.44	0.2	6		
30	10	15	5	10	62.83	19.8	166.0	7.50	0.2	3		
45	15	22.5	7.5	15	94.25	14.2	131.0	10.12	0.4	4		
60	20	30	10	20	125.66	16.0	159.2	12.51	0.5	3		

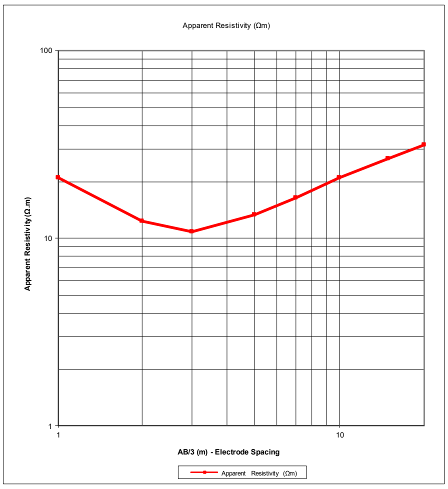


Wenner Electrical Sounding Fieldsheet

Client :	Integration Environment & Energy	**Ref:**	6097
Project :	Paardevlei Resistivity Survey	**Date:**	14-Dec-23

Test No.	TP 21	GPS Co-ordinates			
		South	-34.07302	East	18.79807
Test Date:	14-Dec-23	Time Start:	11:30	Time End:	12:45
Traverse Orientation:	NW - SE	Site Description	Site consists of grass vegetation with dry fine to medium grained sandy soil.		

Electrode Spacing						Field Recorded Results						
AB	MN	OA OB	ON OM	Electrode Spacing	Geometric Factor K	ΔV (mV)	I (mA)	Apparent Resistivity (Ωm)	Standard Deviation	No. Cycles	Base Reading	
											V	I
3	1	1.5	0.5	1	6.28	480.8	143.5	21.04	0.1	4		
6	2	3	1	2	12.57	172.8	176.4	12.28	0.1	3		
9	3	4.5	1.5	3	18.85	73.2	127.6	10.86	0.2	3		
15	5	7.5	2.5	5	31.42	26.2	61.9	13.41	0.4	3		
21	7	10.5	3.5	7	43.98	17.0	45.0	16.49	0.3	3		
30	10	15	5	10	62.83	13.0	38.4	20.93	0.3	3		
45	15	22.5	7.5	15	94.25	15.6	54.6	26.73	0.3	3		
60	20	30	10	20	125.66	10.4	41.8	31.65	0.9	3		

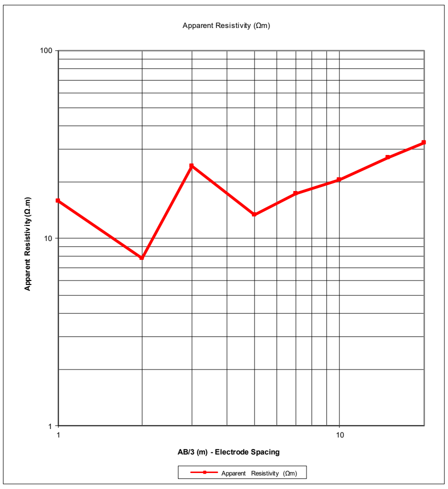


Wenner Electrical Sounding Fieldsheet

Client :	Integration Environment & Energy	**Ref:**	6097
Project :	Paardevlei Resistivity Survey	**Date:**	13-Dec-23

Test No.	TP 23	GPS Co-ordinates			
		South	-34.07255	East	18.80274
Test Date:	13-Dec-23	Time Start:	13:10	Time End:	14:10
Traverse Orientation:	N - S	Site Description	Site consists of shrub vegetation with poorly fine to medium sandy soil.		

Electrode Spacing						Field Recorded Results						
AB	MN	OA OB	ON OM	Electrode Spacing	Geometric Factor K	ΔV (mV)	I (mA)	Apparent Resistivity (Ωm)	Standard Deviation	No. Cycles	Base Reading	
											V	I
3	1	1.5	0.5	1	6.28	39.0	15.4	15.86	1.7	6		
6	2	3	1	2	12.57	10.2	15.9	7.83	2	6		
9	3	4.5	1.5	3	18.85	27.0	20.8	24.36	2	9		
15	5	7.5	2.5	5	31.42	14.8	34.4	13.31	0.3	3		
21	7	10.5	3.5	7	43.98	80.2	203.8	17.33	0.1	4		
30	10	15	5	10	62.83	10.8	33.1	20.61	0.4	3		
45	15	22.5	7.5	15	94.25	25.4	88.1	27.10	0.4	3		
60	20	30	10	20	125.66	3.6	14.0	32.35	0.1	3		

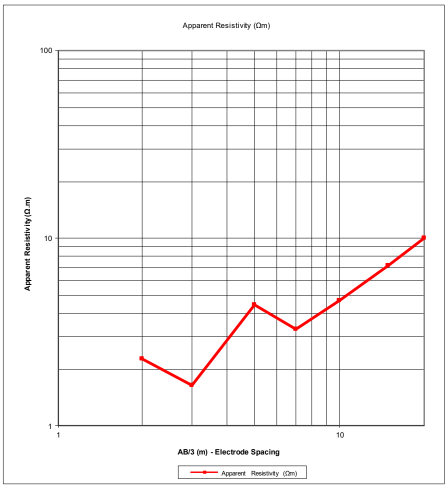


Wenner Electrical Sounding Fieldsheet

Client :	Integration Environment & Energy	**Ref:**	6097
Project :	Paardevlei Resistivity Survey	**Date:**	14-Dec-23

Test No.	TP 24	GPS Co-ordinates			
		South	-34.07669	East	18.8013
Test Date:	14-Dec-23	Time Start:	14:55	Time End:	15:35
Traverse Orientation:	NE - SW	Site Description	Site consists of short succulent vegetation with dry fine grained sandy soil.		

Electrode Spacing						**Field Recorded Results**						
AB	**MN**	**OA OB**	**ON OM**	Electrode Spacing	Geometric Factor K	**ΔV (mV)**	**I (mA)**	**Apparent Resistivity (Ωm)**	**Standard Deviation**	**No. Cycles**	Base Reading V	Base Reading I
3	1	1.5	0.5	1	6.28	0.0	#N/A	**#N/A**	0	3		
6	2	3	1	2	12.57	42.0	236.4	**2.29**	0	3		
9	3	4.5	1.5	3	18.85	37.6	456.3	**1.64**	1.8	7		
15	5	7.5	2.5	5	31.42	39.6	284.4	**4.41**	0.4	3		
21	7	10.5	3.5	7	43.98	35.4	468.4	**3.29**	0.3	3		
30	10	15	5	10	62.83	25.4	339.9	**4.65**	0.5	3		
45	15	22.5	7.5	15	94.25	37.0	488.9	**7.18**	0.2	3		
60	20	30	10	20	125.66	38.6	490.7	**10.08**	0.5	3		

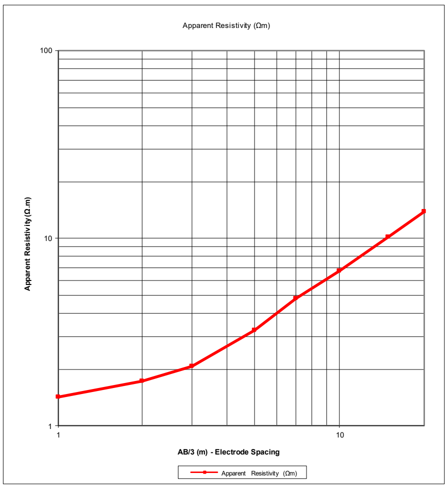


Wenner Electrical Sounding Fieldsheet

Client :	Integration Environment & Energy	**Ref:**	6097
Project :	Paardevlei Resistivity Survey	**Date:**	14-Dec-23

Test No.	TP 26	GPS Co-ordinates			
		South	-34.07962	East	18.80266
Test Date:	14-Dec-23	Time Start:	15:50	Time End:	16:30
Traverse Orientation:	NE - SW	Site Description	Site consists of eucalyptus tree vegetation with dry fine to medium grained organic rich sandy soil.		

Electrode Spacing						**Field Recorded Results**						
AB	**MN**	**OA OB**	**ON OM**	Electrode Spacing	Geometric Factor K	**ΔV (mV)**	**I (mA)**	**Apparent Resistivity (Ωm)**	**Standard Deviation**	**No. Cycles**	Base Reading V	Base Reading I
3	1	1.5	0.5	1	6.28	107.0	474.4	**1.42**	0	3		
6	2	3	1	2	12.57	64.2	463.8	**1.74**	0.1	3		
9	3	4.5	1.5	3	18.85	50.6	455.7	**2.09**	0.2	3		
15	5	7.5	2.5	5	31.42	16.0	157.1	**3.24**	0.3	3		
21	7	10.5	3.5	7	43.98	17.4	163.3	**4.75**	0.6	3		
30	10	15	5	10	62.83	13.8	134.6	**6.72**	0.9	3		
45	15	22.5	7.5	15	94.25	30.6	284.9	**10.14**	0.1	3		
60	20	30	10	20	125.66	49.0	440.6	**13.90**	0.1	3		

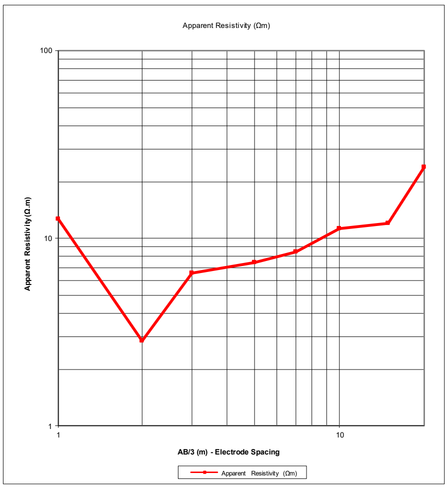


Wenner Electrical Sounding Fieldsheet

Client :	Integration Environment & Energy	**Ref:**	6097
Project :	Paardevlei Resistivity Survey	**Date:**	14-Dec-23

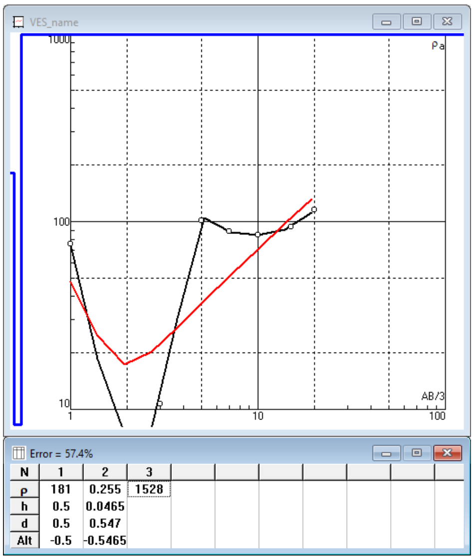
Test No.	TP 27	GPS Co-ordinates			
		South	-34.08059	East	18.79988
Test Date:	14-Dec-23	Time Start:	16:50	Time End:	17:30
Traverse Orientation:	NE - SW	Site Description	Site consists of grass vegetation with dry fine grained organic rich sandy soil.		

Electrode Spacing						**Field Recorded Results**						
AB	**MN**	**OA OB**	**ON OM**	Electrode Spacing	Geometric Factor K	**ΔV (mV)**	**I (mA)**	**Apparent Resistivity (Ωm)**	**Standard Deviation**	**No. Cycles**	Base Reading V	Base Reading I
3	1	1.5	0.5	1	6.28	49.6	24.5	**12.70**	0.1	3		
6	2	3	1	2	12.57	18.4	41.0	**2.83**	0.2	3		
9	3	4.5	1.5	3	18.85	18.0	53.4	**6.57**	1.7	8		
15	5	7.5	2.5	5	31.42	4.8	19.8	**7.48**	1	7		
21	7	10.5	3.5	7	43.98	4.8	25.8	**8.46**	0.7	6		
30	10	15	5	10	62.83	29.6	163.1	**11.33**	0.3	3		
45	15	22.5	7.5	15	94.25	10.4	82.5	**11.98**	2	18		
60	20	30	10	20	125.66	7.0	39.0	**24.10**	1.1	10		



Annexure B: Inversion Models

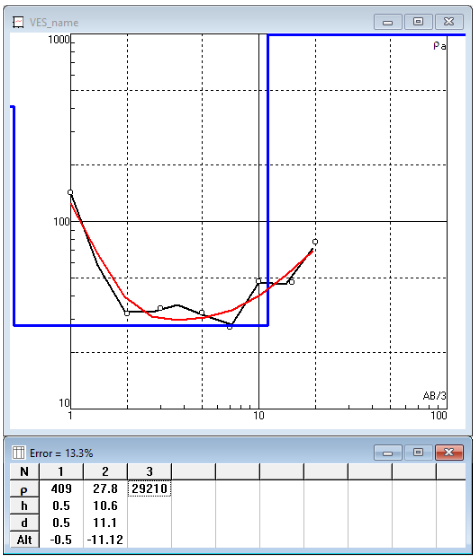
TP01



Error = 57.4%

N	1	2	3
ρ	181	0.255	1528
h	0.5	0.0465	
d	0.5	0.547	
Alt	-0.5	-0.5465	

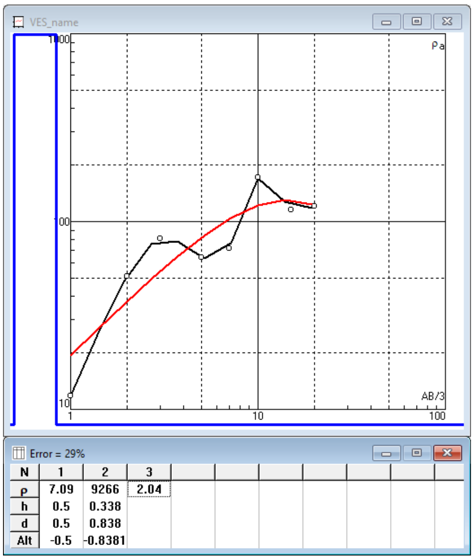
TP03



Error = 13.3%

N	1	2	3
ρ	409	27.8	29210
h	0.5	10.6	
d	0.5	11.1	
Alt	-0.5	-11.12	

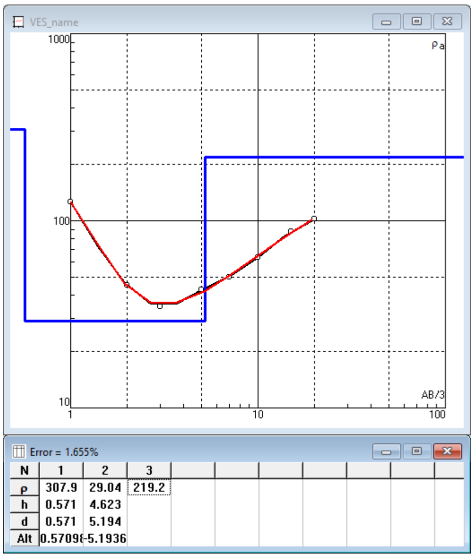
TP05



Error = 29%

N	1	2	3
ρ	7.09	9266	2.04
h	0.5	0.338	
d	0.5	0.838	
Alt	-0.5	-0.8381	

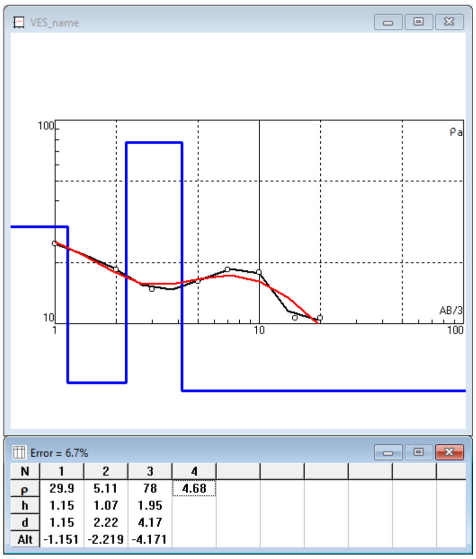
TP06



Error = 1.655%

N	1	2	3
ρ	307.9	29.04	219.2
h	0.571	4.623	
d	0.571	5.194	
Alt	0.5709	-5.1936	

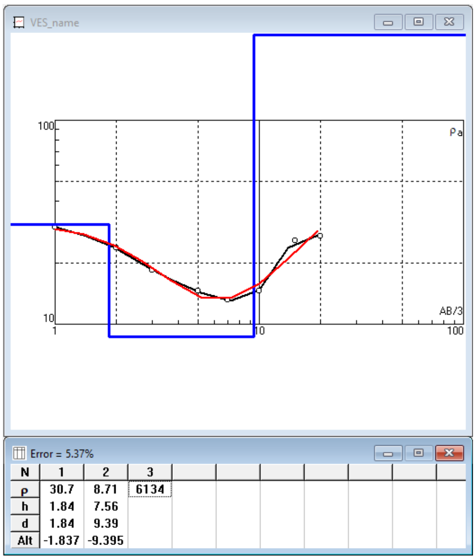
TP10



Error = 6.7%

N	1	2	3	4
ρ	29.9	5.11	78	4.68
h	1.15	1.07	1.95	
d	1.15	2.22	4.17	
Alt	-1.151	-2.219	-4.171	

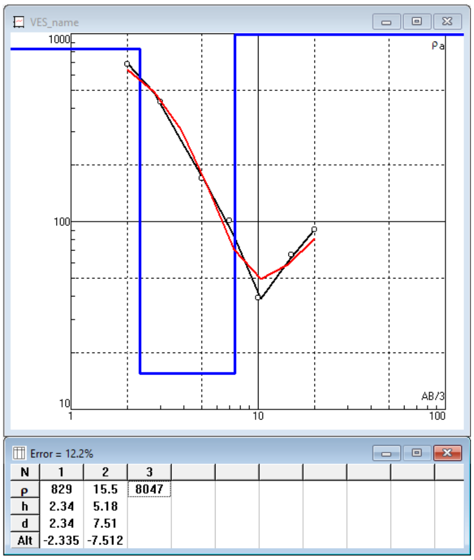
TP12



Error = 5.37%

N	1	2	3
ρ	30.7	8.71	6134
h	1.84	7.56	
d	1.84	9.39	
Alt	-1.837	-9.395	

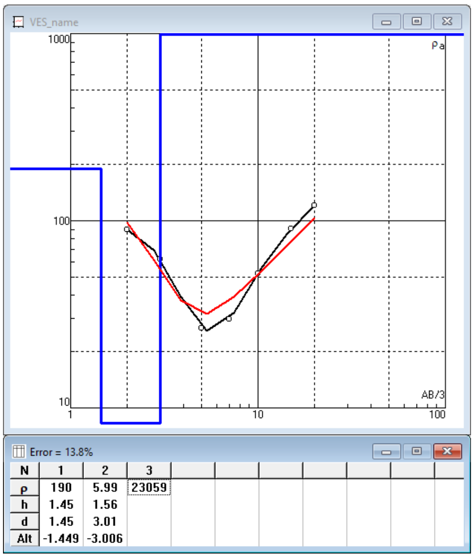
TP15



Error = 12.2%

N	1	2	3
ρ	829	15.5	8047
h	2.34	5.18	
d	2.34	7.51	
Alt	-2.335	-7.512	

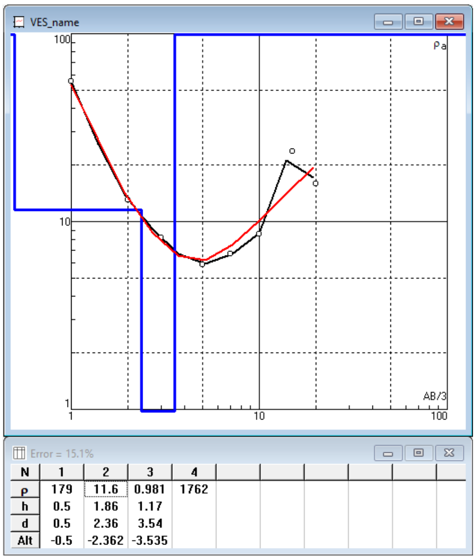
TP17



Error = 13.8%

N	1	2	3
ρ	190	5.99	23059
h	1.45	1.56	
d	1.45	3.01	
Alt	-1.449	-3.006	

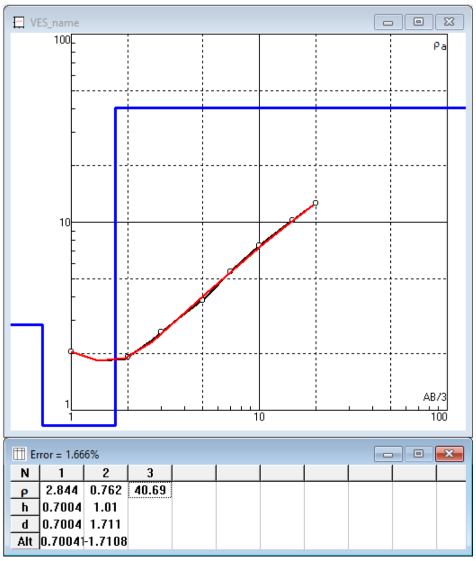
TP19



Error = 15.1%

N	1	2	3	4
ρ	179	11.6	0.981	1762
h	0.5	1.86	1.17	
d	0.5	2.36	3.54	
Alt	-0.5	-2.362	-3.535	

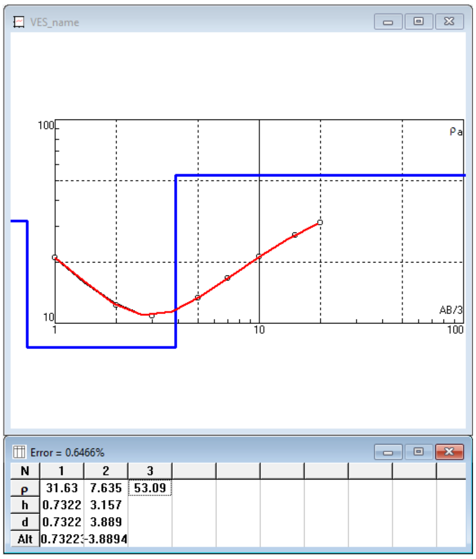
TP20



Error = 1.666%

N	1	2	3
ρ	2.844	0.762	40.69
h	0.7004	1.01	
d	0.7004	1.711	
Alt	0.70041	-1.7108	

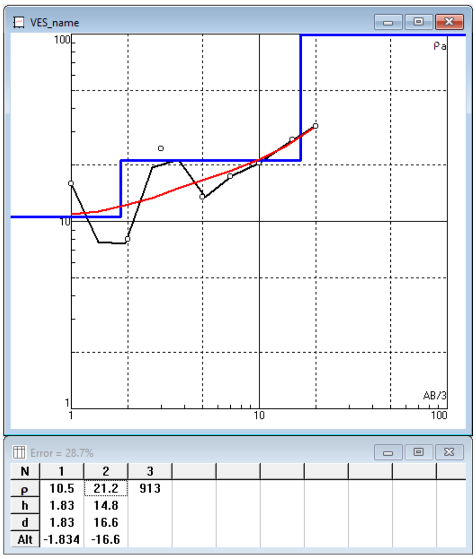
TP21



Error = 0.6466%

N	1	2	3
ρ	31.63	7.635	53.09
h	0.7322	3.157	
d	0.7322	3.889	
Alt	0.73223	-3.8894	

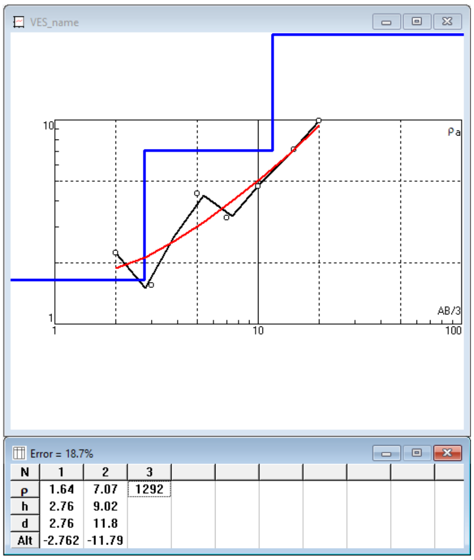
TP23



Error = 28.7%

N	1	2	3
ρ	10.5	21.2	913
h	1.83	14.8	
d	1.83	16.6	
Alt	-1.834	-16.6	

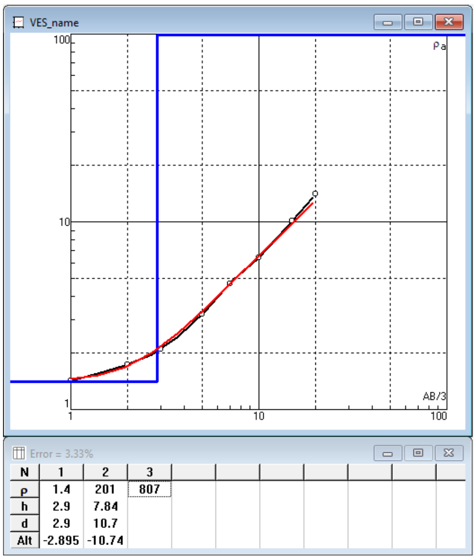
TP24



Error = 18.7%

N	1	2	3
ρ	1.64	7.07	1292
h	2.76	9.02	
d	2.76	11.8	
Alt	-2.762	-11.79	

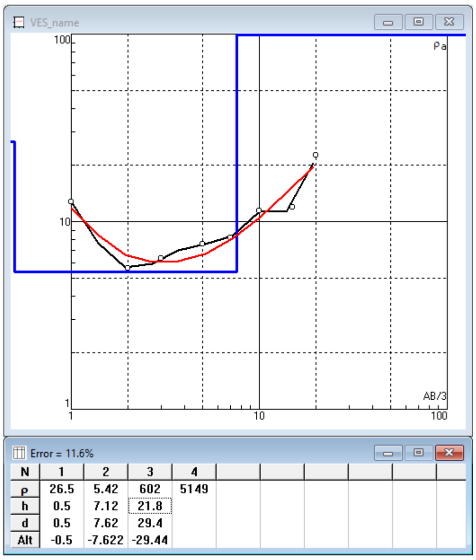
TP26



Error = 3.33%

N	1	2	3
ρ	1.4	201	807
h	2.9	7.84	
d	2.9	10.7	
Alt	-2.895	-10.74	

TP27



Error = 11.6%

N	1	2	3	4
ρ	26.5	5.42	602	5149
h	0.5	7.12	21.8	
d	0.5	7.62	29.4	
Alt	-0.5	-7.622	-29.44	