

# PROPOSED SOLAR POWER FACILITY PORTION 6 OF OLYVEN KOLK 187 KENHARDT SOUTH AFRICA

**GEOTECHNICAL REPORT** 

September 2018

Compiled by:

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Document No: W1484/3.5-6.1

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#### 1 EXECUTIVE SUMMARY

SKCMasakhizwe Engineers (Pty) Ltd (SKCM) was appointed by Greencontinent to perform a geotechnical investigation on Portion 6 of the Farm Olyven Kolk 187, approximately 30km south west of Kenhardt in the Northern Cape of South Africa.

The main objective of the investigation was:

- 1. To determine the consistency of the soil profile
- 2. To assess the pH of the soils
- 3. To evaluate the suitability of in-situ material for use in construction of the works
- 4. To assess the agricultural potential of the proposed sites
- 5. To assess the seismic risk of the sites

The site is situated to the west of the Kenhardt /Pofadder gravel road and approximately 7km north-east of the existing Eskom Aries substation.

The proposed sites have a low risk of flooding and seismic activity in the area is limited. Ground movement is less than approximately 50cm/s with a 10% probability of exceeding this limit in 50 Years.

The agricultural potential of the sites is low and is suitable for limited grazing only, mainly due to the harsh climate, shallow soils and low annual rainfall.

The soil profile over the study area can be described as a loose to medium dense sand in the upper layer and generally underlain by dense to very dense calcareous pedogenic layers that disintegrate into coarse gravel during excavation. Only four of the twelve trial pits could be excavated down to 1 600mm by the digger loader. For the rest of the trial pits, the depth to refusal varied from 250mm to 1 600mm. An excavator should however be able to excavate through this layer.

Although the founding method (foundation screws or steel piles) for the solar panels is still to be determined, the dense nature of the soil poses a question mark whether the anchors will be able to penetrate the very dense material. The average depth to weathered rock for this portion is approximately 1 000mm. We propose that additional tests be conducted by the specialist contractor responsible for the design and installation of the anchors. Alternative foundation designs should be investigated for areas where the weathered rock is shallow.

The soil pH ranges between 6.4 and 6.9. The soils are therefore slightly corrosive. Conventional galvanising should be sufficient to protect critical elements in contact with the ground from corrosion.

The study area is considered to be suitable from a geotechnical perspective for the proposed development of a solar power facility.



### 2 INTRODUCTION AND TERMS OF REFERENCE

The company, Wine Estate Management, is investigating the feasibility of establishing a solar power facility near Kenhardt in the Northern Cape. The facility is situated in the close proximity of the existing Eskom Aries Substation. The site location is indicated in Figure 2, while the layout is indicated on Figure 3.

The objectives of the geotechnical study were as follows:

- 1. To determine the consistency of the soil by profiling the vertical succession of soil layers on the proposed sites.
- 2. To determine the pH and conductivity of the soils in order to evaluate the corrosive potential, with specific reference to the use of galvanised ground anchors as a founding system for the photovoltaic panels.
- 3. To evaluate the suitability of in-situ material for use in construction of the works.
- 4. To assess the agricultural potential of the proposed sites.
- 5. To assess the seismic risk of the area.

This report describes the results of the various investigations.

#### **3 INFORMATION USED IN THE STUDY**

#### 3.1 List of Information

The following maps and supplementary information was consulted:

- 1:50 000 Topographic series map 2920 BD, Grootriet, Third Edition, 2003.
- 1:50 000 Topographic series map 2920 DB, Sonderhuis, Third Edition, 2003.
- Google Earth Images.
- 1:250 000 Geological Series Map, 2920 Kenhardt, and the associated explanation sheet entitled "The Geology of the Kenhardt Area". Geological Survey of South Africa, 1999.
- Site layout prepared by Messers Cape Lowlands Environmental Services.
- Agricultural Research Council Database (www.agis.agric.za) regarding soil classification, soil type and land capability.
- Soil Classification, a Taxonomic system for South Africa, Soil Classification Working Group, 1991 as published by the Department of Agricultural Development.
- Unsealed roads: Design, construction and maintenance. TRH 20, Pretoria.

SKCM Engineers were involved in previous geotechnical studies on the farm, dating back to 2011. Information gathered during the previous studies was incorporated in this report. A local farmer, Mr Michael van Niekerk, who farms with sheep on the farm, also provided insight into the local conditions.

#### 3.2 Evaluation Procedures

Initial evaluations were made using the topographic map (2920BD Grootriet and 2920DB Sonderhuis), Google Earth Imagery and by studying the geological map (2920 Kenhardt) and associated explanation sheets.



Proposed site layout, as included in the Environmental Assessment report by Eco Impact was also considered. The layout is included in this report as Figure 3.

No open excavations were found on or near the site. The geotechnical assessments are based on the results of trial pitting and laboratory testing.

#### 4 SITE DESCRIPTION

The proposed sites are situated on Portion 6 of the farm Olyven Kolk 187, approximately 30km south west of Kenhardt.

The site is situated approximately 4km to the north east of the existing homestead and to the east of the Kenhardt/Pofadder gravel road. The Aries Substation is approximately 10km to the south-west (Figure 2). The site is bordered by the Saldanha-Sishen railway line on the east and uncultivated farm land on the other sides. The farm is used mainly for sheep farming.

The site is situated in an arid region with rainfall of approximately 127mm per annum, mostly from December to May. Annual evaporation is expected to be between 2 600mm and 2 800mm. Average temperatures varies between approximately 20°C in July and 36°C in January.

The site slopes to the North West. There is one main and various minor water courses crossing the site. The water courses are defined by the change in vegetation in the water course due to the deeper soils encountered here. The positions of these drainage features are indicated on Figures 7. The site has a gentle slope of less the 1.3% to the north west. Very little to no erosion was observed.

Vegetation cover consists mainly of sparse grass and thorn shrubs.

#### 5 NATURE OF THE INVESTIGATION

#### 5.1 Desk Study

Prior to the site investigations, an initial geotechnical evaluation was done using the information contained in the 1:250 000 geological series map 2920 Kenhardt and the associated explanation sheet.

Site investigations were planned using Google Earth imagery and available Topographic maps. The positions of trial pits were determined on site, taking into consideration the prevailing site conditions and the site layouts prepared by Eco Impact.

#### 5.2 Site Investigations and Laboratory Testing

Site Investigations were conducted by Mr. MPJ Loubser(PrEng) of SKCM Engineers on 23 to 25 August 2018.

Trial pitting was conducted on 24 August 2018 using a Terex digger/loader hired from TR Plant Hire in Kakamas.

Laboratory testing was conducted by Matrocast Laboratories (Pty) Ltd at their laboratory in Brackenfell, Cape Town.



#### 5.2.1 Trial Pitting

A total of 12 Trial Pits were analysed. The positions of the trial pits are indicated on Figure 5.

The aim was to excavate the trial pits to a depth of approximately 2.0m since these are the layers in which the structures are expected to be founded. Machine refusal however varied from a depth of 500m to 1600mm. Four trail pits could be excavated down to 1 600mm.

Trial pits were profiled according to standard South African practice and described in terms of the moisture content, colour, consistency, structure, soil type and origin (MCCSSO). The profile descriptions are included in Annexure A.

#### 5.2.2 DCP Testing

A number of DCP tests have been done on the farm. The combined results of the tests, together with the energy required to excavate the trial pits, indicates that the soils have ample bearing capacity for the loadings envisaged. The results of the CBR test indicate that the selected road building material has a TRH classification of G7.

#### 5.2.3 Laboratory Testing

Road indicator tests, including grading and CBR tests, Conductivity and pH tests were done on various samples.

The result of the laboratory testing is included in Appendix B.

#### 6 SITE GEOLOGY AND GROUNDWATER CONDITIONS

#### 6.1 General Geology

A portion of the 1:250 000 Geological Series Map 2920 Kenhardt, showing the location of the site, is presented as Figure 6.

Based on the Geological Series Map, the area in the vicinity of the site is masked by red brown Aeolian soils of Quaternary age (Q) of the Kalahari Group, Gordonia Formation. These soils are underlain by soils and weathered rock of the Karoo Supergroup, Dwyka Group (C-Pd), comprising Carboniferous Tillite, Diamictite, subordinate Sandstone, Mudstone and Dolomitic Limestone.

#### 6.2 Site Geology and soil profile

The site is overlain with brown to reddish brown Aeolian soils that form the topsoil layer (Orhic A diagnostic horison). Below this layer a hard calcareous pedogenic layer is encountered that disintegrates into coarse gravel when excavated. The diagnostic layers can be identified as a Neocarbonate B horizon underlain by Dorbank or a hardpan carbonate horizon.

Using these diagnostic horizons and information contained on the Agricultural Research Council database (ARC) (www.agis.agric.za), the soils of the site is classified as Augrabies and Trawal soil forms.

Dolorite gravel and cobbles are evident on the surface layer of the site.



#### 6.3 Water Table

No seepage water or water table was observed during trial pitting.

#### 7 GEOTECHNICAL EVALUATION

#### 7.1 Engineering and material characteristics and constraints

#### 7.1.1 Site Topography

The gentle slopes (approximately 1,3%) of the site will aid storm water drainage and prevent ponding of surface water. Due to the gentle slope of the terrain, the risk of erosion will remain low.

#### 7.1.2 Soil Profile

The general soil profile comprises a layer of medium to coarse sand underlain by a calcareous pedogenic layer that is dense to very dense in the undisturbed form. This material disintegrates into coarse gravel during excavation.

The materials have a low swell potential. Closer to the drainage channels, the sands tend to be deeper and finer with lower clay content.

The various soil types found on the farm were analysed previously and are included in this report. The general soil parameters of the samples are as follows:

- 1) Material Classification: Sand
- 2) Plasticity Index: NP to SP
- 3) Linear Shrinkage: 0 0.5%
- 4) Heave Classification: Low
- 5) Grading Modulus: 2.20 2.56
- 6) PH: 6.4 6.9

#### 7.1.3 Seismic Activity

According to the seismic hazard map contained in SABS 0160-1993, (reproduced as Figure 7 below), the proposed sites are located in an area where the peak ground acceleration will not exceed 0.05g (gravity acceleration) or approximately 50cm/s<sup>2</sup>, with a 10% probability of exceeding this limit in 50 years.



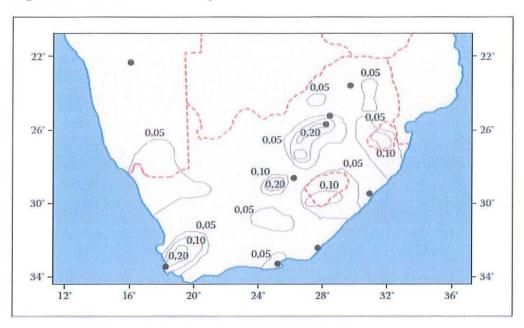


Figure 6: Seismic hazard map from SABS 0160-1993

According to a map produced by the United Nations Office for the Coordination of Humanitarian affairs depicting earthquake intensity zones in Africa (reproduced in Appendix C), the proposed sites are located in a area where earthquake magnitude may vary from instrumental to fairly strong. (Earthquake intensity degree I –V according to the Modified Mercalli scale of 1956.)

No incidences of widely perceived seismic activity have been recorded in the area. No special foundation measures are therefore required due to possible seismic activity.

#### 7.1.4 Conductivity and pH

The conductivity and pH gives an indication of the corrosion potential of the soils. The pH of the soil varies between 6.4 and 6.9. The soils are therefore expected to be very slightly corrosive. Conventional galvanising of critical elements in contact with the soil will provide adequate long term corrosion protection to all metal elements.

#### 7.1.5 CBR test results

The material identified as road building material has a CBR of 36 at 95% of MOD AASHTO. The material has a TRH classification of G7 and a COLTO classification G6. This material will be suitable as a sub base layer in the roads. The material is however not suitable for use as a wearing course on the gravel access roads. It is therefore recommended that an investigation be commissioned to identify borrow pits in the vicinity of the site where suitable material for use as a wearing coarse may be found if required.



#### 7.1.6 Load Bearing capacity of the soils

Although the founding method (foundation screws or steel piles) for the solar panels is still to be determined, the dense nature of the soil poses a question mark whether the anchors will be able to penetrate the very dense material. The vertical and horizontal load bearing capacity of the soil will be sufficient to transmit vertical compression and horizontal loads applied to the screws. Pull out resistance of the screws should be sufficient if the screws are placed deep enough into the calcareous pedogenic material below the sand layers, since minimal wind loads is expected on the screws due to the elevation of the Photovoltaic panels.

Although we are of the opinion that this founding method will be feasible, we propose that additional tests be conducted by the specialist contractor responsible for the design and installation of the anchors.

#### 8 FLOOD RISK

A flood risk assessment was conducted under a separate study. The flood lines are indicated in Figure 7.

As can be seen from this drawing, the proposed photovoltaic panels are located above the 1:100 year flood line. The risk of flooding and associated damage to the structures is in our opinion, low.

#### 9AGRICULTURAL POTENTIAL

The following information was obtained from the ARC (www.agis.agric.za) database regarding the agricultural potential of the sites.

#### **Table 1: Agricultural Potential**

Land Type No	Ag2
Land Capability Class	VII
Land use option	Light Grazing

A land Capability Class VII is defined as follows:

(source: http://www.agis.agric.za/agisweb/?Mlval=land\_capability&rb=Land\_capability\_soil\_capability)

Land in Class VII has very severe limitations that makes it unsuited to cultivation and that restrict its use largely to grazing, woodland or wildlife.

Restrictions are caused by one or more continuing limitations that cannot be corrected, such as:

- 1. Very steep slopes
- 2. Erosion
- 3. Shallow soil
- 4. Stones
- 5. Wet soil
- 6. Salts or sodality
- 7. Unfavourable climate



The physical conditions of this land class are such that it is impractical to apply pasture or range improvements as seeding, liming and fertilizing. Depending on the soil characteristics and climate, land in Class VII may be well or poorly suited to woodland. In unusual instances some occurrences may be used for special crops under unusual management practices.

Based on the above information(the very low annual rainfall and the high average temperatures) it is clear that the agricultural potential of the soils in the study area is low. The soils are only suited to sustain limited grazing, such as sheep farming.

#### 10 CONCLUSIONS AND RECOMMENDATIONS

- 10.1 The general soil profile on the sites can be described as a layer of loose sand underlain by layers of hard, calcareous pedogenic material. The pedogenic material disintegrates into coarse gravel during excavation.
- 10.2 The soil pH is expected to range between 6.4 and 6.9. The soils are therefore very slightly corrosive. Conventional galvanising will be sufficient for long term corrosion protection of critical elements in contact with the soil.
- 10.3 The use of ground screws as foundation system for the photovoltaic cells are feasible based on the initial assessments performed during the study. The specialist contractor responsible for the design and installation of the screws will however need to confirm the soil suitability with appropriate on site tests prior to installation of the screws.
- 10.4 The risk of flooding of the sites is very low.
- 10.5 The risk of seismic movement that could cause damage to structures is low.
- 10.6 The agricultural potential of the sites are low, mainly due to the harsh climate, shallow soils and low annual rainfall.
- 10.7 No significant geotechnical constraints were identified in the study that could negatively affect the proposed development. The site is therefore suited for the development of a solar power facility.

MFJ Coubser PrEng For SKCM Engineers



# Annexure A – Trial Pit Profile Descriptions



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GRAIN SIZE (mm) <0.5 0.5 - 2.0 2.0 - 6.0	CLASIFICATION MEDIUM SAND COARSE SAND FINE GRAVEL				
GRAIN SIZE (mm) <0.5 0.5 - 2.0 2.0 - 6.0 6.0 - 20.0	CLASIFICATION MEDIUM SAND COARSE SAND FINE GRAVEL MEDIUM GRAVEL				
GRAIN SIZE (mm) <0.5 0.5 - 2.0 2.0 - 6.0 6.0 - 20.0 20.0 - 60.0	CLASIFICATION MEDIUM SAND COARSE SAND FINE GRAVEL MEDIUM GRAVEL COARSE GRAVEL				
GRAIN SIZE (mm) <0.5 0.5 - 2.0 2.0 - 6.0 6.0 - 20.0	CLASIFICATION MEDIUM SAND COARSE SAND FINE GRAVEL MEDIUM GRAVEL				

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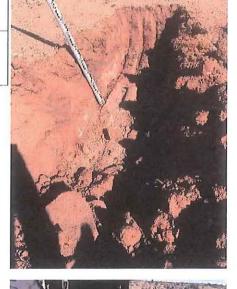
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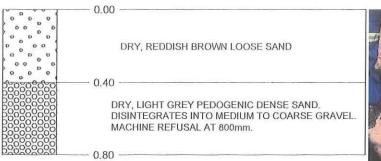


SOIL TE	XTURE
GRAIN SIZE (mm)	CLASIFICATION
<0.5	MEDIUM SAND
0.5 - 2.0	COARSE SAND
2.0 - 6.0	FINE GRAVEL
6.0 - 20.0	MEDIUM GRAVEL
20.0 - 60.0	COARSE GRAVEL
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PROFILE NO :	TP 4	DATE	2018/09/04	PROFILED BY:	ML		



SCALE 1:20



SOIL TE	EXTURE
GRAIN SIZE (mm)	CLASIFICATION
<0.5	MEDIUM SAND
0.5 - 2.0	COARSE SAND
2.0 - 6.0	FINE GRAVEL
6.0 - 20.0	MEDIUM GRAVEL
20.0 - 60.0	COARSE GRAVEL
60.0 - 200	COBBLES
>200	BOULDERS





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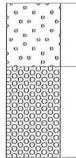
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#### NOTES:

SOIL TE	XTURE
GRAIN SIZE (mm)	CLASIFICATION
<0.5	MEDIUM SAND
0.5 - 2.0	COARSE SAND
2.0 - 6.0	FINE GRAVEL
6.0 - 20.0	MEDIUM GRAVEL
20.0 - 60.0	COARSE GRAVEL
60.0 - 200	COBBLES
>200	BOULDERS

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0.8	5	UNKN	OWN	0.85	
DEPTH OF PR	OFILE PIT (m)	DEPTH OF W	ATER TABLE	DEPTH TO WEATH	HERED ROCK
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DRY LIGHT BROWN COARSE SAND

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SCALE 1:20

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FINE GRAVEL
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COBBLES
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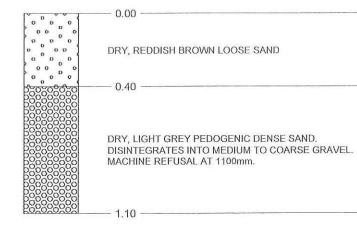
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CLASIFICATION MEDIUM SAND COARSE SAND FINE GRAVEL MEDIUM GRAVEL				
JLD	ERS PRESIST ON	ERS PRESIST ON THE SURFACE WATER TABLE ENCOUNTERED	ERS PRESIST ON THE SURFACE	

	29°27'18"S ROFILE PIT (m) .60	LONGITUDE : DEPTH OF W UNKN	20°53'14"E JATER TABLE IOWN		919
	.60				
		UNKN	IOWN		ATHERED ROCK
	- 0.00			1.6	3 m
	0.00				
			1.7		
	DRY LIGHT REDDISH SAND WITH COBBLES				1
DaDaDaDaDaD	- 0.50			and the second	
		BROWN PEDOGENIC DE TES INTO MEDIUM GRAV			
SCALE 1:20	- 1.60		1 - Contractor		
NOTES:	OR WATER TABLE ENC				
	OR WATER TABLE ENC	OUNTERED			
1. NO SEEPAGE (		OUNTERED			
1. NO SEEPAGE (	TEXTURE	OUNTERED			
1. NO SEEPAGE ( SOIL T	TEXTURE	OUNTERED			
1. NO SEEPAGE ( SOIL T GRAIN SIZE (mm)	TEXTURE ) CLASIFICATION	OUNTERED			
1. NO SEEPAGE ( SOIL T GRAIN SIZE (mm) <0.5	TEXTURE ) CLASIFICATION MEDIUM SAND	OUNTERED			
1. NO SEEPAGE ( SOIL T GRAIN SIZE (mm) <0.5 0.5 - 2.0	TEXTURE ) CLASIFICATION MEDIUM SAND COARSE SAND				
1. NO SEEPAGE ( SOIL T GRAIN SIZE (mm) <0.5 0.5 - 2.0 2.0 - 6.0	TEXTURE ) CLASIFICATION MEDIUM SAND COARSE SAND FINE GRAVEL MEDIUM GRAVEL				
1. NO SEEPAGE ( SOIL T GRAIN SIZE (mm) <0.5 0.5 - 2.0 2.0 - 6.0 6.0 - 20.0	TEXTURE ) CLASIFICATION MEDIUM SAND COARSE SAND FINE GRAVEL MEDIUM GRAVEL				

	TP 9	DATE	2018/09/04	PROFILED BY:	ML
LATITUDE :	29°27'08"S	LONGITUDE :	20°53'31"E	ELEVATION (m)	924
DEPTH OF PR	OFILE PIT (m)	DEPTH OF V	VATER TABLE	DEPTH TO WEA	ATHERED ROCK
1.0	00	UNKI	NMON	1.0	m
•         •	ACHINE REFUSAL AT 1	GENIC DENSE SAND. EDIUM TO COARSE GR/	AVEL.		
1. NO SEEPAGE C	DR WATER TABLE ENC	OUNTERED			
	DR WATER TABLE ENCO				
SOIL TI	EXTURE				
SOIL TI GRAIN SIZE (mm)	EXTURE CLASIFICATION				
SOIL TI GRAIN SIZE (mm) <0.5	EXTURE CLASIFICATION MEDIUM SAND				
SOIL TI GRAIN SIZE (mm) <0.5 0.5 - 2.0	EXTURE CLASIFICATION MEDIUM SAND COARSE SAND				
SOIL TI GRAIN SIZE (mm) <0.5 0.5 - 2.0 2.0 - 6.0	EXTURE CLASIFICATION MEDIUM SAND COARSE SAND FINE GRAVEL				
SOIL TI GRAIN SIZE (mm) <0.5 0.5 - 2.0 2.0 - 6.0 6.0 - 20.0	EXTURE CLASIFICATION MEDIUM SAND COARSE SAND FINE GRAVEL MEDIUM GRAVEL COARSE GRAVEL COBBLES				
SOIL TI GRAIN SIZE (mm) <0.5 0.5 - 2.0 2.0 - 6.0 6.0 - 20.0 20.0 - 60.0	EXTURE CLASIFICATION MEDIUM SAND COARSE SAND FINE GRAVEL MEDIUM GRAVEL COARSE GRAVEL				
SOIL TI GRAIN SIZE (mm) <0.5 0.5 - 2.0 2.0 - 6.0 6.0 - 20.0 20.0 - 60.0 60.0 - 200	EXTURE CLASIFICATION MEDIUM SAND COARSE SAND FINE GRAVEL MEDIUM GRAVEL COBBLES BOULDERS	OSED SOLAR		DEGIONED N	
SOIL TI GRAIN SIZE (mm) <0.5 0.5 - 2.0 2.0 - 6.0 6.0 - 20.0 20.0 - 60.0 60.0 - 200 >200	EXTURE CLASIFICATION MEDIUM SAND COARSE SAND FINE GRAVEL MEDIUM GRAVEL COBBLES BOULDERS TT TT E PROP POW PU	OSED SOLAR ER FACILITY		DESIGNED MI	L 2018/09/04
SOIL TI GRAIN SIZE (mm) <0.5 0.5 - 2.0 2.0 - 6.0 6.0 - 20.0 20.0 - 60.0 60.0 - 200 >200 >200	EXTURE CLASIFICATION MEDIUM SAND COARSE SAND FINE GRAVEL MEDIUM GRAVEL COARSE GRAVEL COBBLES BOULDERS TIME PROP POW POW	OSED SOLAR	AND	DESIGNED MI	
SOIL TI GRAIN SIZE (mm) <0.5 0.5 - 2.0 2.0 - 6.0 6.0 - 20.0 20.0 - 60.0 60.0 - 200 >200	EXTURE CLASIFICATION MEDIUM SAND COARSE SAND FINE GRAVEL MEDIUM GRAVEL COARSE GRAVEL COBBLES BOULDERS BOULDERS	OSED SOLAR ER FACILITY	CUMENT AND NO US	E OR SCALE :	L 2018/09/04

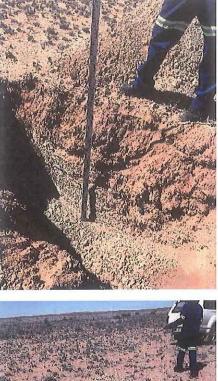
1.1	0	UNKN	OWN	1.1 m	
DEPTH OF PR	COFILE PIT (m)	DEPTH OF W	ATER TABLE	DEPTH TO WEATH	HERED ROCK
LATITUDE :	29°27'14"S	LONGITUDE :	20°53'40"E	ELEVATION (m)	926
PROFILE NO :	TP 10	DATE	2018/09/04	PROFILED BY:	ML



SCALE 1:20

NOTES:

SOIL TE	XTURE
GRAIN SIZE (mm)	CLASIFICATION
<0.5	MEDIUM SAND
0.5 - 2.0	COARSE SAND
2.0 - 6.0	FINE GRAVEL
6.0 ~ 20.0	MEDIUM GRAVEL
20.0 - 60.0	COARSE GRAVEL
60.0 - 200	COBBLES
>200	BOULDERS





		THE PROPOSED SOLAR	CLIENT		BY	DATE	СН
SK		POWER FACILITY	OWINE ESTATE	DESIGNED	ML	2018/09/04	
SKCMaaakhizu	e Engineers (Pty) Ltd	PORTION 6	South Armica	DRAWN	M.dB	2018/09/04	
	EERS TO BUILD THE NATION	NOTE:		TRACED			
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PAARL 7620 TEL: (021) 871 1422/3 FAX: (021) 872 7740	MALMESBURY 7300 TEL: (022) 487 3017 eMail: skcmsouth@skcm.co.za	REPRODUCTION OR DUPLICAT WITHOUT THE WRITTEN CONS		DRAWING NO W14	o.: 84 - TI	241 0211000	REVISION: 0

PROFILE NO :	TP 11	DATE	2018/09/11	PROFILED BY:	ML.
LATITUDE :	29°27'18"	LONGITUDE :	20°52'01"	ELEVATION (m)	904
DEPTH OF PROFILE PIT (m)		DEPTH OF W	ATER TABLE	DEPTH TO WEAT	HERED ROCK
1.0	50	UNKN	OWN	1.6 m	1
	0.60 DRY, LIGHT GRI MATERIAL DISII GRAVEL DURIN REFUSAL AT 16	BROWN MEDIUM DENSE S EY PEDOGENIC DENSE S NTEGRATES ONTO A MED G EXCAVATION. MACHINI 00mm	AND.		
SCALE 1:20					

SOIL TE	XTURE
GRAIN SIZE (mm)	CLASIFICATION
<0.5	MEDIUM SAND
0.5 - 2.0	COARSE SAND
2.0 - 6.0	FINE GRAVEL
6.0 - 20.0	MEDIUM GRAVEL
20.0 - 60.0	COARSE GRAVEL
60.0 - 200	COBBLES
>200	BOULDERS

		THE PROPOSED SOLAR	CLIENT		BY	DATE	СН
SKCD		POWER FACILITY	WINE ESTATE	DESIGNED	ML	2018/09/11	
SKCMasakhizu	(Phy) Ltd	PORTION 6	BOUTH AFRECA	DRAWN	M.dB	2018/09/11	
SKCMasakhizwe Engineers (Pty) Ltd consulting engineers to build the nation		NOTE:		TRACED			
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PAARL 7620 TEL: (021) 871 1422/3 FAX: (021) 872 7740	MALMESBURY 7300 TEL: (022) 487 3017 eMaiE skomsouth@skom.co.za			DRAWING NO W14	d.: 84 - TF		REVISION: 0

TP 12	DATE	2018/09/11	PROFILED BY:	ML
29°27'31"	LONGITUDE :	20°52'08''	ELEVATION (m)	904
DEPTH OF PROFILE PIT (m)		ATER TABLE	DEPTH TO WEAT	HERED ROCK
D	UNKN	OWN	UNKNO	WN
SMALL ANGULA 0.30	R BUILDERS. EY TO LIGHT OLIVE PEDC MATERIAL DISINTEGRATE			
	29°27'31" <u>DFILE PIT (m)</u> D D D D D D D D D D N D D N M LIGHT BRC SMALL ANGULA D SMALL ANGULA D SMALL ANGULA D SMALL ANGULA A D SMALL ANGULA A T 1600mm.	29°27'31"       LONGITUDE :         DFILE PIT (m)       DEPTH OF W         D       UNKN         D       UNKN         DO       DRY, LIGHT BROWN SAND WITH SMALL ANGULAR BUILDERS.         D.30       DRY, LIGHT GREY TO LIGHT OLIVE PEDC DENSE SAND. MATERIAL DISINTEGRATE A COARSE GRAVEL. MACHINE REFUSAL AT 1600mm.	29°27'31"       LONGITUDE :       20°52'08"         DFILE PIT (m)       DEPTH OF WATER TABLE       0         0       UNKNOWN         0.00       DRY, LIGHT BROWN SAND WITH SMALL ANGULAR BUILDERS.       0         0.30       DRY, LIGHT GREY TO LIGHT OLIVE PEDOGENIC DENSE SAND. MATERIAL DISINTEGRATES INTO A COARSE GRAVEL. MACHINE REFUSAL AT 1600mm.       0	29°27'31"       LONGITUDE :       20°52'08"       ELEVATION (m)         DFILE PIT (m)       DEPTH OF WATER TABLE       DEPTH TO WEAT         0       UNKNOWN       UNKNOWN         0.00       DRY, LIGHT BROWN SAND WITH SMALL ANGULAR BUILDERS.       DITO UIGHT OLIVE PEDOGENIC DENSE SAND. MATERIAL DISINTEGRATES INTO A COARSE GRAVEL. MACHINE REFUSAL AT 1600mm.       DRY, LIGHT GREY TO LIGHT OLIVE PEDOGENIC DENSE SAND. MATERIAL DISINTEGRATES INTO A COARSE GRAVEL. MACHINE REFUSAL AT 1600mm.       DRY

1. DISTURBED SAMPLE TAKEN @ 0.30m & 1.6m DEPTH 2. NO SEEPAGE OR WATER TABLE ENCOUNTERED

SOIL TE	XTURE
GRAIN SIZE (mm)	CLASIFICATION
<0.5	MEDIUM SAND
0.5 - 2.0	COARSE SAND
2.0 - 6.0	FINE GRAVEL
6.0 - 20.0	MEDIUM GRAVEL
20.0 - 60.0	COARSE GRAVEL
60.0 - 200	COBBLES
>200	BOULDERS

SKCD		PROPOSED SOLAR			BY	DATE	CH
				DESIGNED	ML	2018/09/11	
SKCMasakhizu	A Engineers (Ptv) Ltd	PORTION 6	South Armen	DRAWN	M.dB	2018/09/11	
SKCMasakhizwe Engineers (Pty) Ltd consulting engineers to build the nation		NOTE:		TRACED			
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AARL 520 EL: (021) 871 1422/3 AX: (021) 872 7740	MALMESBURY 7300 TEL: (022) 487 3017 eMail: skcmsouth@skcm.co.za	REPRODUCTION OR DUPLICATION THEREOF MAY OCCUR WITHOUT THE WRITTEN CONSENT OF THE AUTHOR		DRAWING NO W14	o.: 84 - TI		REVISION:

# Annexure B – Laboratory Test Results

Document No.: W1484/3.5-6.1





FORM: C1





Page 4 of 4

4 HARBOT CLOSE , BRACKENDUST , 7560 P.O BOX 1106 , BRACKENFELL

Tel. : 021 9815558 Fax : 021 9816724 Email: info@matrocast.co.za

### TEST RESULTS

SKC ENGINEERS P.O. BOX 229 PAARL 7620 Attention: MR W.VOSLOO

Project : KENHARDT SOLAR ENERGY FARM

Your Ref Our Ref Date Reported

39630 : 13,09.2011

# **pH TEST RESULTS : METHOD A20**

Mark TP 1 (Top)	Description D/Y/Or	рН		
_ <u></u>	D/Y/Or			
(Top)		6.8		
	Material			
TP 1	Ol Clayey	6.4		
(Middle)	Material			
TP 2	D/OI Clayey	6.7		010 <sup>-1</sup>
(Bottom)	Material			
TP 1 / 1.6	D/R/Br Material	6.9		
TP 2 / 2.0	D/R/Br Material	6.4		
TP 4 / 1.3	D/OI Material	6.7		
		N A Van	M	
	TP 2 (Bottom) TP 1 / 1.6 TP 2 / 2.0	TP 2       D/OI Clayey         (Bottom)       Material         TP 1 / 1.6       D/R/Br Material         TP 2 / 2.0       D/R/Br Material	TP 2       D/OI Clayey       6.7         (Bottom)       Material       6.9         TP 1 / 1.6       D/R/Br Material       6.9         TP 2 / 2.0       D/R/Br Material       6.4         TP 4 / 1.3       D/OI Material       6.7	TP 2       D/OI Clayey       6.7         (Bottom)       Material       -         TP 1 / 1.6       D/R/Br Material       6.9         TP 2 / 2.0       D/R/Br Material       6.4

3.3R (06.10.2010) Technical Signatory : Gregory Bell





(Sanas Testing Laboratory

4 HARBOT CLOSE , BRACKENDUST , 7560 P.O BOX 1106 , BRACKENFELL Tel. : 021 9815558 Fax : 021 9816724 Email: info@matrocast.co.za

# TEST RESULTS

SKC ENGINEERS P.O. BOX 229		Project : KENHA	Project : KENHARDT SOLAR ENERGY FARM				
PAARL		Your Ref					
7620		OurRef	: 39630				
Attention: MR W.VOSLO		Date Reported	: 12.09.2011				
SIE	E ANALYSIS, ATTERBE	RG LIMITS, CBR, U	JCS(TMH1:A1-A5)				
SAMPLE NO.	E 0372	E 0373 TP 1	E 0374				

Di uni CE ITO.	L OUIZ			<i>i</i> 1
HOLE NO.	TP 1	TP 1	TP 2	Į į
ROAD NO.	-	-	-	1
DEPTH	~	-	-	
CHAINAGE	Тор	Middle	Bottom	
LAYER TYPE	~	-	-	
STABILISED WITH	Neat	Neat	Neat	
SUPPLIER	-	-	į	
CURING METHOD	N/a	N/a	N/a	
DESCRIPTION	Dark Yellow Orange	Olive Clavey	Dark Olive	1
	Material	Material	Clayey Material	
SIEVE ANALYSIS (% PASSING)	- <b></b>		J	
75 mm	100			
63 mm	90			
53 mm	90		100	
37.5 mm	88	100	98	-
26.5 mm	86	99	97	
19.0 mm	83	98	95	
13.2 mm	78	96	95	
4.75 mm	62	83	82	1
2.0 mm	53	70	68	
0.425 mm	41	52	49	
0.075 mm	21	42	44	
SOIL MORTAR			Į	l <sub>m-</sub>
COARSE SAND<2.000mm >0.425mm	23	26	28	
FINE SAND <0.425mm >0.075mm	38	14	7	
MATERIAL <0.075mm	39	60	65	
CONSTANTS			1	
GRADING MODULUS	1.85	1,36	1.39	
PRA CLASSIFICATION	A-2-4(0)	A-7-6(4)	A-7-6(4)	
UNIFIED SOIL CLAS,	SC	SC	SM	
LIQUID LIMIT (%)	23	43	42	
PLASTICITY INDEX (0.425mm)	9	20	16	]
LINEAR SHRINKAGE (%)	4.5	9.5	7.5	

Remarks :	SAMPLED AND DELIVERED	BY CUSTOMER	4) Vom	Kun	
FORM: A1	3.3R (06.10.2010)	Technical Signatory	y : Gregory Bell		Page 2 of 4
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# TEST RESULTS

SKC ENGINEERS         Project : KENHARDT SOLAR ENERGY FARM           PAARL         Your Ref         : 39630.1           Attention: MR W.VOSLOO         Date Reported         : 209.2011           SIEVE ANALYSIS, ATTERBERG LIMITS, CBR, UCS(TMH1:A1-A5)           SAMPLE NO.         E 0396         E 0396         E 0397           TP 1         TP 2         TP 4         -           ROAD NO.         -         -         -           DEPTIH         1.6m         2.0m         1.0m           CHAINAGE         100 MW         100 MW         100 MW           LAYER TYPE         -         -         -           STABLUSED WITH         Neat         Neat         Na           SUPPLIER         N/a         Na         Na           DESCRIPTION         Dark Red Brown         Dark Red Brown         Material           SIEVE ANALYSIS (% PASSING)         100         98         95           75 mm         94         100         98         96           26.5 mm         91         98         85         94           13.2 mm         74         78         69         36           13.2 mm         34         10         94         <				
PAARL 7620       Your Ref       :         Our Ref       ::       :         Our Ref       ::       :         Our Ref       ::       :         Our Ref       ::       :         Stattention: MR W.VOSLOO       Date Reported       ::         Stattention: MR W.VOSLOO       E::       0396       E::         Stattention: MR W.VOSLOO       F::       0396       E::         Stattention: MR W.VOSLOO       F::       0396       E::         Stattention: MR W.VOSLOO       F::       0:       1:         Deprint       1:6m       2:0m       1:3m         Deprint       Neat       Neat       Neat         Our Ref       ::       .:       .:         Stattention: MR W.VOSLOO       Na       Dark Red Brown       Dark Olive         Material       Material       Material       Material         Statrial       10:       98<	SKC ENGINEERS		Project : KENHARDT	SOLAR ENERGY FARM
7620 Attention: MR W.VOSLOO         Our Ref         : 39630.1 Date Reported           SIEVE ANALYSIS, ATTERBERG LIMITS, CBR, UCS(TMH1:A1-A5)           SAMPLE NO.           HOLE NO.         F 0395           HOLE NO.         TP 1           TP 2         TP 4           OUMW         100 MW           DEPTH         1.6m           CHAINAGE         100 MW           LAYER TYPE         -           STABILISED WITH         Neat           SUPULER         -           CURING METHOD         N/a           Dark Red Brown         Dark Red Brown           Material         Material           SIEVE ANALYSIS (% PASSING)         100           SIEVE ANALYSIS (% PASSING)         100           75 mm         94           100         98           37.5 mm         94           100         98           20.77         18           13.2 mm         74           75 mm         94           100         98           20.75 mm         21           13.2 mm         74           76         77           13.2 mm         74	P.O. BOX 229	ŧ.		
Attention: MR W.VOSLOO         Date Reported         : 12.09.2011           SIEVE ANALYSIS, ATTERBERG LIMITS, CBR, UCS(TMH1:A1-A5)           SAMPLE NO.         E 0395         E 0396         E 0397           HOLE NO.         TP 1         .         .         .           ROAD NO.         -         .         .         .         .           DEPTH         1.6m         2.0m         1.3m         .         .           CHAINAGE         100 MW         100 MW         100 MW         .         .           LAYER TYPE         -         -         .         .         .           SUPPLIER         -         .         .         .         .         .           OLIKING METHOD         N/a         .         .         .         .         .           DESCRIPTION         Dark Red Brown         Material         .         .         .         .           SIEVE ANALYSIS (% PASSING)         .         .         .         .         .         .         .           63 <mm< td="">         100         .         .         .         .         .         .         .         .           13.2<mm< td="">         74         <t< td=""><td>PAARL</td><td></td><td>Your Ref :</td><td></td></t<></mm<></mm<>	PAARL		Your Ref :	
Attention: MR W.VOSLOO         Date Reported         : 12.09.2011           SIEVE ANALYSIS, ATTERBERG LIMITS, CBR, UCS(TMH1:A1-A5)           SAMPLE NO.         E 0395         E 0396         E 0397           HOLE NO.         TP 1         TP 2         TP 4           ROAD NO.         -         -         -           DEPTH         1.6m         2.0m         1.3m           CHAINAGE         100 MW         100 MW         100 MW           LAYER TYPE         -         -         -           SUPPLIER         -         -         -           CURING METHOD         N/a         N/a         Dark Red Brown           Dark Red Brown         Material         Material           SIEVE ANALYSIS (% PASSING)         100         96           75 <mm< td="">         96         98         85           815         85         77         88           910         98         85         69           2.0 mm         44         38         37           9.4 76 mm         56         52         49           2.0 mm         44         38         37           9.4 75 mm         32         18         11     &lt;</mm<>	7620		Our Ref	39630.1
SIEVE ANALYSIS, ATTERBERG LIMITS, CBR, UCS(TMH1:A1-A5)           SAMPLE NO.         E 0396         E 0396         E 0397           HOLE NO.         TP 1         TP 2         TP 4         TP 2         TP 4           ODEPTH         1.6m         2.0m         1.3m         100 MW         100 MW         100 MW           CHAINAGE         100 MW         100 MW         100 MW         100 MW         100 MW         100 MW           LAYER TYPE         -         -         -         -         -           STABILISED WITH         Neat         Neat         N/a         Dark Red Brown         N/a           DESCRIPTION         Dark Red Brown         Material         Material         N/a         Dark Olive           SIEVE ANALYSIS (% PASSING)         7         7         7         9         98         85           7.5 mm         91         96         98         85         100         98         85           9.0 mm         91         98         85         77         13.2 mm         74         76         100         96         32         24         9         2.0 mm         33         266         25         24 <t< td=""><td></td><td>(</td><td></td><td></td></t<>		(		
SAMPLE NO. HOLE NO.         E 0395 TP 1         E 0396 TP 2         E 0397 TP 4           ROAD NO.         -         -         -         -           ROAD NO.         -         1.6m         2.0m         1.3m           DEPTH         1.6m         2.0m         1.3m         -           CHAINAGE         100 MW         100 MW         100 MW         -           CHAINAGE         100 MW         100 MW         100 MW         -           CHAINS METHOD         N/a         Neat         Neat         -           SUEVE ANALYSIS (% PASSING)         -         -         -         -           75 <mm< td="">         Material         Material         Material         Material           SIEVE ANALYSIS (% PASSING)         100         98         -         -           75<mm< td="">         94         100         98         -         -           73.2 mm         94         100         96         -         -           74.75 mm         94         100         96         -         -           70 mm         44         38         37         -         -           70 mm         20 mm         33         26         25</mm<></mm<>		<u></u>	Date Reported .	12:00:2011
HOLE NO.         TP 1         TP 2         TP 4           ROAD NO.         -         -         -         -           DEPTH         1.6m         2.0m         1.3m           CHAINAGE         100 MW         100 MW         100 MW           LAYER TYPE         -         -         -           STABILISED WITH         Neat         Neat         Neat           SUPPLIER         -         -         -           CURING METHOD         N/a         Dark Red Brown         Material           SIEVE ANALYSIS (% PASSING)         -         -         -           75 <mm< td="">         04         100         96         98           37.5<mm< td="">         94         100         96         98           25.5<mm< td="">         91         98         85         100           26.5<mm< td="">         91         98         85         11           SOL MORTAR         20         77         78         69           2.0<mm< td="">         44         38         37         25         25           0.075 mm         21         18         11         11           SOLMORTAR         21         18         11         30     <!--</td--><td>SIEVE ANALYS</td><td>IS, ATTERBERG I</td><td>IMITS, CBR, UCS</td><td>(TMH1:A1-A5)</td></mm<></mm<></mm<></mm<></mm<>	SIEVE ANALYS	IS, ATTERBERG I	IMITS, CBR, UCS	(TMH1:A1-A5)
HOLE NO.         TP 1         TP 2         TP 4           ROAD NO.         -         -         -         -           DEPTH         1.6m         2.0m         1.3m           CHAINAGE         100 MW         100 MW         100 MW           LAYER TYPE         -         -         -           STABILISED WITH         Neat         Neat         Neat           SUPPLIER         -         -         -           CURING METHOD         N/a         Dark Red Brown         Material           SIEVE ANALYSIS (% PASSING)         -         -         -           75 <mm< td="">         04         100         96         98           37.5<mm< td="">         94         100         96         98           25.5<mm< td="">         91         98         85         100           26.5<mm< td="">         91         98         85         11           SOL MORTAR         20         77         78         69           2.0<mm< td="">         44         38         37         25         25           0.075 mm         21         18         11         11           SOLMORTAR         21         18         11         30     <!--</td--><td>SAMPLE NO.</td><td>E 0395</td><td>E 0396</td><td>F 0397</td></mm<></mm<></mm<></mm<></mm<>	SAMPLE NO.	E 0395	E 0396	F 0397
ROAD NO.       -       -       -       -         DEFTH       1.6m       2.0m       1.3m         CHAINAGE       100 MW       100 MW       100 MW         LAYER TYPE       -       -       -         STABILISED WITH       Neat       Neat       -         SUPPLIER       -       -       -         CURING METHOD       Dark Red Brown       Dark Red Brown       Material         SIEVE ANALYSIS (% PASSING)       -       -       -         75 <mm< td="">       96       98       96         37.5<mm< td="">       94       100       96         26.5<mm< td="">       91       98       85         19.0 mm       85       85       77         13.2 mm       74       76       69         2.0 mm       33       26       25         0.075 mm       21       18       11         SOIL MORTAR       21       18       11         COARSE SAND&lt;2.000mm &gt;0.425mm       25       32       32         GRADING MODULUS       2.02       2.18       2.27         PRA CLASSIFICATION       A-1-b(0)       A-2-4(0)       A-1-a(0)         UNIFIED SOIL CLAS.       &lt;</mm<></mm<></mm<>				
DEPTH         1.6m         2.0m         1.3m           CHAINAGE         100 MW         100 MW         100 MW         100 MW           LAYER TYPE         -         -         -         -           STABILISED WITH         Neat         Neat         Neat         -           SUPPLIER         -         -         -         -         -           CURING METHOD         N/a         Dark Red Brown         Dark Red Brown         Material         Material           DESCRIPTION         Dark Red Brown         Material         00         Material         Material           SIEVE ANALYSIS (% PASSING)         -         -         -         -         -           75 <mm< td="">         96         98         95         -         98         -           37.5<mm< td="">         94         100         96         -         98         -           9.0<mm< td="">         85         85         77         -         -         -           19.0 mm         85         85         77         -         -         -           12.0 mm         44         38         37         -         -         -           0.425 mm         21</mm<></mm<></mm<>		-	-	
CHAINAGE         100 MW         100 MW         100 MW           LAYER TYPE         -         -         -           STABILISED WITH         Neat         Neat         Neat           SUPPLIER         -         -         -           CURING METHOD         N/a         Dark Red Brown         Dark Red Brown         Material           DESCRIPTION         Dark Red Brown         Material         Material         Material           SIEVE ANALYSIS (% PASSING)         -         -         -         -           75 <mm< td="">         0         100         98         -           37.5<mm< td="">         94         100         96         -           26.5<mm< td="">         91         98         85         -           13.2<mm< td="">         74         76         69         -           4.75 mm         56         52         49         -           2.0 mm         44         38         37         -         -           0.425 mm         21         18         11         -         -           SOIL MORTAR         25         32         32         32         -           COARSE SAND &lt;0.025mm &gt;0.075mm         27         21</mm<></mm<></mm<></mm<>		1.6m	2.0m	1.3m
LAYER TYPE       -       -       -       -       Neat       Neat       Neat         STABILISED WITH       Neat       Neat       Neat       Neat       Neat         CURING METHOD       N/a       Dark Red Brown       Material       Dark Olive         DESCRIFTION       Dark Red Brown       Material       Dark Olive         75       mm       100       100         53       mm       96       98         37.5       mm       94       100       96         26.5       mm       91       98       85         19.0       mm       85       85       77         13.2       mm       56       52       49         2.0       mm       44       38       37         0.425 mm       33       26       25       25         0.075 mm       21       18       11       11         Soit MORTAR         CONSTANTS         GRADING MODULUS       2.02       2.18       2.27         PRA CLASSIFICATION       A-1-b(0)       A-2-41(0)       A-1-a(0)         UNIFIED SOIL CLAS.       SC       SM-SC       GW-GC				
STABILISED WITH SUPPLIER       Neat       Neat       Neat         CURING METHOD DESCRIPTION       N/a       N/a       N/a         Dark Red Brown Material       N/a       Dark Olive Material         SIEVE ANALYSIS (% PASSING)		-	-	
SUPPLIER         -         -         -         -         -         N/a         N/a         N/a         Dark Olive         N/a         Dark Olive         Material         Material<		Neat	Neat	Neat
CURING METHOD DESCRIPTION         N/a Dark Red Brown Material         N/a Dark Red Brown Material         N/a Dark Red Brown Material         N/a Dark Olive Material           SIEVE ANALYSIS (% PASSING)		-	-	
DESCRIPTION         Dark Red Brown Material         Dark Red Brown Material         Dark Red Brown Material         Dark Olive Material           SIEVE ANALYSIS (% PASSING)		N/a	N/a	N/a
Material         Material         Material         Material           SIEVE ANALYSIS (% PASSING)         75         mm         100				
SIEVE ANALYSIS (% PASSING)           75 mm         100           63 mm         100           53 mm         96           37.5 mm         94           100         96           26.5 mm         91           19.0 mm         85           19.0 mm         20           4.76 mm         56           2.0 mm         44           38         37           0.425 mm         33           21         18           11         11           SOIL MORTAR         25           COARSE SAND<2.000mm >0.425mm         25           32         32           FINE SAND <0.425mm >0.075mm         27           21         38           MATERIAL <0.075mm				
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	SIEVE ANALYSIS (% PASSING)			
63       mm       100       100         53       mm       96       98         37.5       mm       94       100       96         26.5       mm       91       98       85         19.0       mm       85       85       77         13.2       mm       74       78       69         4.75       mm       56       52       49         2.0       mm       44       38       37         0.425       mm       33       26       25         0.075       31       18       11         SOIL MORTAR         COARSE SAND       2.020mm >0.425mm       25       32         SOIL MORTAR       27       21       38       37         COARSE SAND <0.425mm >0.075mm       27       21       38         MATERIAL       <0.075mm		······································	· · · · · · · · · · · · · · · · · · ·	
53     mm     96     98       37.5     mm     94     100     96       26.5     mm     91     98     85       19.0     mm     85     85     77       13.2     mm     74     78     69       4.75     mm     56     52     49       2.0     mm     44     38     37       0.425 mm     33     26     25       0.075 mm     21     18     11       SOIL MORTAR       COARSE SAND       COARSE SAND       2.000mm >0.425mm     25     32       33     26     25     00       COARSE SAND       SAND       SAND       COARSE SAND       2.000mm >0.425mm     25     32       Sate       GRADING MOD       A47       BRA CLASSIFICATION       A-1-b(0)     A-2-4(0)       A-1-b(0)     A-2-4(0)       M-1-a(0)     UNIFIED SOIL CLAS.       LIQUID LIMIT (%)     -     20		100		100
37.5 mm       94       100       96         26.5 mm       91       98       85         19.0 mm       85       85       77         13.2 mm       74       78       69         4.76 mm       56       52       49         2.0 mm       44       38       37         0.425 mm       33       26       25         0.075 mm       21       18       11         SOIL MORTAR         COARSE SAND<2.000mm >0.425mm         25       32       32         0.075 mm       21       18       11         SOIL MORTAR         COARSE SAND<2.000mm >0.425mm         25       32       32         100       48       47       30         CONSTANTS         GRADING MODULUS       2.02       2.18       2.27         PRA CLASSIFICATION       A-1-b(0)       A-2-4(0)       A-1-a(0)         UNIFIED SOIL CLAS.       SC       GW-GC       GW-GC         LIQUID LIMIT (%)       -       20       -       -				
26.5 mm       91       98       85         19.0 mm       85       85       77         13.2 mm       74       78       69         4.75 mm       56       52       49         2.0 mm       44       38       37         0.425 mm       33       26       25         0.075 mm       21       18       11         Soil MORTAR         COARSE SAND<2.000mm >0.425mm         20       21       18       11         Soil MORTAR         COARSE SAND<2.000mm >0.425mm         27       21       38         MATERIAL       <0.075mm			100	
19,0       mm       85       85       77         13.2       mm       74       78       69         4.75       mm       56       52       49         2.0       mm       44       38       37         0.425 mm       33       26       25       0.075 mm         2.0       mm       33       26       25         0.075 mm       21       18       11         SOIL MORTAR         COARSE SAND<2.000mm >0.425mm       25       32       32         FINE SAND <0.425mm >0.075mm       27       21       38       38         MATERIAL       <0.075mm				
13.2 mm       74       76       69         4,75 mm       56       52       49         2.0 mm       44       38       37         0.425 mm       33       26       25         0.075 mm       21       18       11         SOIL MORTAR         COARSE SAND<2.000mm >0.425mm       25         33       26       25       0.075 mm         SOIL MORTAR         COARSE SAND<2.000mm >0.425mm       25         33       26       32       32         SOIL MORTAR         COARSE SAND <2.000mm >0.425mm       25         33       26       32       32         COARSE SAND <0.425mm >0.075mm         27       21       38         MATERIAL <0.075mm				
4.75 mm       56       52       49         2.0 mm       44       38       37         0.425 mm       33       26       25         0.075 mm       21       18       11         SOIL MORTAR         COARSE SAND<2.000mm >0.425mm       25       32         SOIL MORTAR         FINE SAND <0.425mm >0.075mm         27       21       38         MATERIAL       <0.075mm				
2.0 mm       44       38       37         0.425 mm       33       26       25         0.075 mm       21       18       11         SOIL MORTAR         COARSE SAND       2.00mm > 0.425mm         COARSE SAND       2.00mm > 0.425mm         Jac         FINE SAND       2.00mm > 0.425mm         A         FINE SAND       2.00mm > 0.425mm         A       32         SI         GRADING MODULUS         CONSTANTS         GRADING MODULUS         SI         A         GRADING MODULUS         SI         SI         GRADING MODULUS         SI         SI         CONSTANTS         GRADING MODULUS         SI         D         GRADING MODULUS         SI         D         SI         CONSTANTS         SI				
0.425 mm         33         26         25           0.075 mm         21         18         11           SOIL MORTAR         11         11           COARSE SAND         2.000mm > 0.425mm         25         32         32           FINE SAND <0.425mm > 0.075mm         27         21         38           MATERIAL         <0.075mm				
0.075 mm         21         18         11           SOIL MORTAR         COARSE SAND         2.000mm > 0.425mm         25         32         32           FINE SAND <0.425mm > 0.075mm         27         21         38         38           MATERIAL         <0.075mm				
SOIL MORTAR           COARSE SAND<2.000mm >0.425mm         25         32         32           FINE SAND <0.425mm >0.075mm         27         21         38           MATERIAL<0.075mm				
COARSE SAND         2.000mm > 0.425mm         25         32         32           FINE SAND         <0.425mm > 0.075mm         27         21         38           MATERIAL         <0.075mm				
FINE SAND           27         21         38           MATERIAL         <0.075mm		<u>Э</u> Б	32	30
MATERIAL         <0.075mm         48         47         30           CONSTANTS				
CONSTANTS         2.02         2.18         2.27           GRADING MODULUS         2.02         2.18         2.27           PRA CLASSIFICATION         A-1-b(0)         A-2-4(0)         A-1-a(0)           UNIFIED SOIL CLAS.         SC         SM-SC         GW-GC           LIQUID LIMIT (%)         -         20         -				
GRADING MODULUS         2.02         2.18         2.27           PRA CLASSIFICATION         A-1-b(0)         A-2-4(0)         A-1-a(0)           UNIFIED SOIL CLAS.         SC         SM-SC         GW-GC           LIQUID LIMIT (%)         -         20         -		<u> </u>	<u> </u>	
PRA CLASSIFICATION         A-1-b(0)         A-2-4(0)         A-1-a(0)           UNIFIED SOIL CLAS.         SC         SM-SC         GW-GC           LIQUID LIMIT (%)         -         20         -				
UNIFIED SOIL CLAS. SC SM-SC GW-GC LIQUID LIMIT (%) - 20 -				
LIQUID LIMIT (%) - 20 -				
		SC		GW-GC
I PLASTICITY INDEX (0.425mm) SP I / I NP I		-		-
LINEAR SHRINKAGE (%) 0.5 4.0 0.0	LINEAR SHRINKAGE (%)	0.5	4.0	0.0

Remarks :	SAMPLED AND DELIVERED	BY CUSTOMER	D Van	M	
FORM: A1	3.3R (06.10.2010)	Technical Signatory	Gregory Bell		Page 3 of 4

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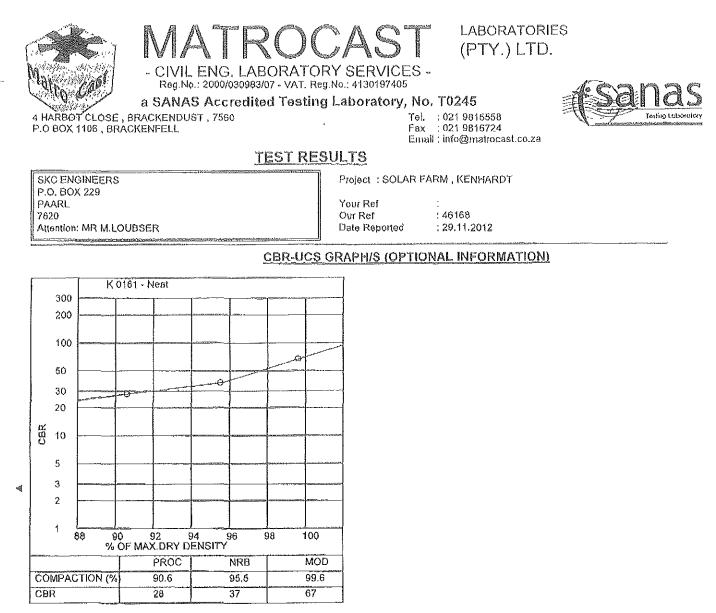
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4 HARBOT CLOSE , B P.O BOX 1106 , BRAC	RACKENDUST, 756 KENFELL	50	Fax	: 021 981 : 021 981 iii : info@m
		<b>TEST RES</b>		<i>—</i>
SKC ENGINEERS P.O. BOX 229			Project : SOLAR F	ARM , KEN
PAARL 7820 Attention: MR M.LOU	BSER		Your Ref Our Ref Date Reported	: : 46168 : 29.11.20
SIEVI	ZANALVSIS AT	TERBERG LIMIT	S CRR UCS/TM	41.04.05
SAMPLE NO. HOLE NO. ROAD NO. DEPTH CHAINAGE LAYER TYPE STABILISED WITH SUPPLIER CURING METHOD DESCRIPTION		K 0161 A + C1 - - Neat - Dusky Mudstone & D/OI Weath,Granite		
SIEVE ANALYSIS (%	PASSING)	100		
75 mm 63 mm 53 mm 37.5 mm 26.5 mm		94 94 90 87		

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Tel. : 021 9815558 Fax : 021 9816724 Émail : info@matrocest.co.za

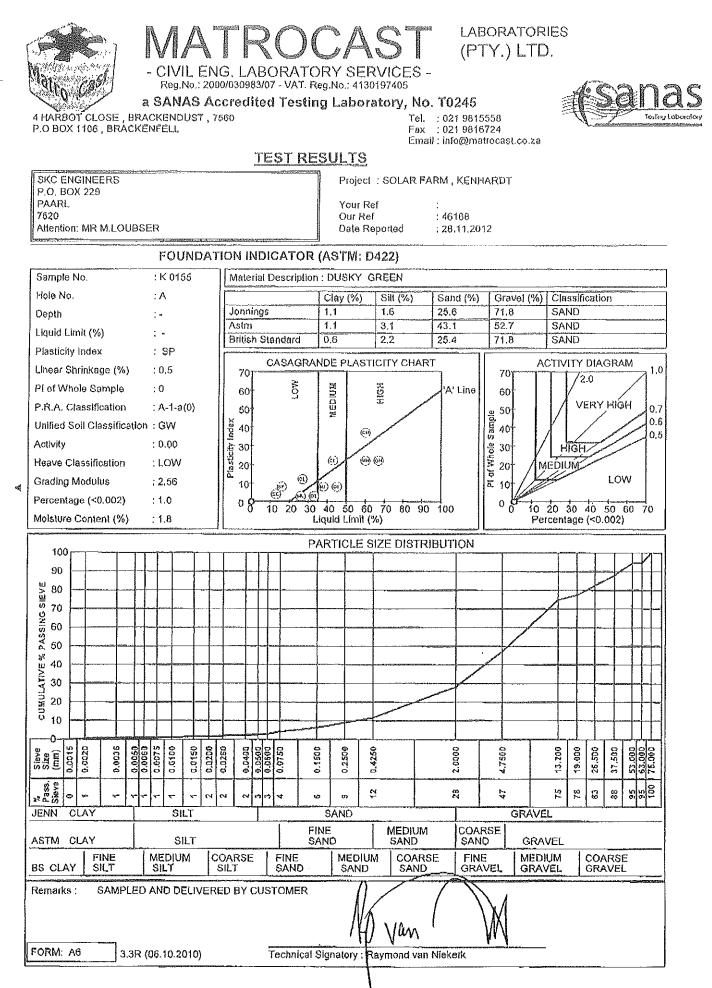
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	IESI RESULIS
SKC ENGINEERS P.O. BOX 229 PAARL 7820 Attention: MR M.LOUBSER	Project : SOLAR FARM , KENHARDT Your Ref : Our Ref : 46168 Date Reported : 29.11.2012
SIEVE ANALYSIS, A	TTERBERG LIMITS, CBR, UCS(TMH1:A1-A5,A7,A8)
SAMPLE NO. HOLE NO. ROAD NO. DEPTH CHAINAGE LAYER TYPE STABILISED WITH SUPPLIER CURING METHOD DESCRIPTION SIEVE ANALYSIS (% PASSING)	K 0161 A + C1 - - - - - - - - - - - - - - - - - - -
75 mm 63 mm 53 mm 37.5 mm 26.5 mm 13.2 mm 4.75 mm 2.0 mm 0.425 mm	100         94           94         94           90         87           83         80           65         32           113         113
0,075 mm SOIL MORTAR COARSE SAND<2.000mm >0.425mm FINE SAND <0.425mm >0.075mm MATERIAL <0.075mm CONSTANTS	4         59           28         13
GRADING MODULUS PRA CLASSIFICATION UNIFIED SOIL CLAS. COLTO CLASSIFICATION TRH CLASSIFICATION LIQUID LIMIT (%) PLASTICITY INDEX (0.425mm) LINEAR SHRINKAGE (%)	2.51 A-1-a(0) SW G6 G7 - NP 0.0
MOD AASHTO MAXIMUM DRY DENSITY (kg/m^3) OPTIMUM MOISTURE CONTENT (%) MOULDING MOISTURE (%)	2066 6.3 6.2
TYPE OF TEST CBR-UCS @ 100% MOD AASHTO CBR-UCS @ 98% MOD AASHTO CBR-UCS @ 97% MOD AASHTO CBR-UCS @ 95% MOD AASHTO CBR-UCS @ 93% MOD AASHTO CBR-UCS @ 90% MOD AASHTO	CBR         Image: CBR
CBR-UCS @ % MOD AASHTO derived fr % SWELL AT [MOD][NRB][PROC]	
Remarks :	A van M
FORM: A1 3.3R (05.10,2010)	Technical Signatory : Raymond van Niekerk





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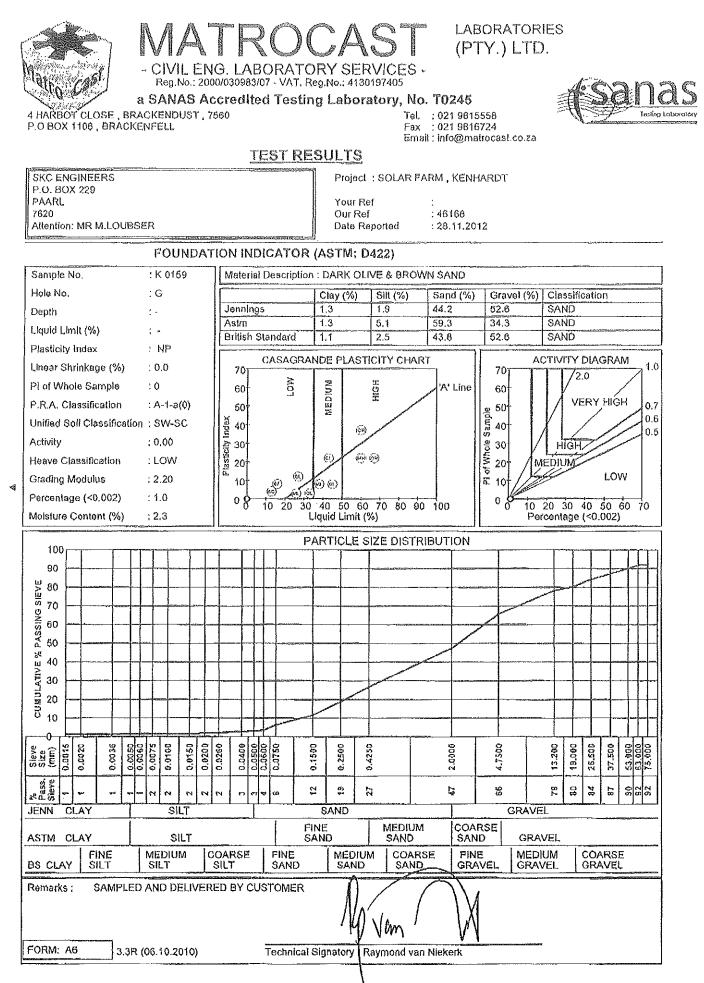
LABORATORIES (PTY.) LTD. CIVIL ENG. LABORATORY SERVICES -Reg.No.; 2000/030983/07 - VAT. Reg.No.: 4130197405 a SANAS Accredited Testing Laboratory, No. T0245 CLOSE, BRACKENDUST, 7560 : 021 9816558 Testing Laboratory Tel. P.O BOX 1106 BRACKENFELL 021 9810724 Fax Email : info@matrocest.co.za TEST RESULTS SKC ENGINEERS Project : SOLAR FARM , KENHARDT P.O. BOX 229 PAARI. Your Ref : 46168 7620 Our Ref Attention; MR M.LOUBSER Date Reported : 28.11.2012 FOUNDATION INDICATOR (ASTM: D422) Sample No. : K 0156 Material Description ; DARK BROWN Hole No. : B Clay (%) Silt (%) Sand (%) Gravel (%) | Classification Jennings 2,5 3.7 30.5 63,3 SAND Depth : -SILTY SAND 42,3 45.4 Astm 2.6 9,9 Liquid Limit (%) t -British Standard 5.2 63.3 SAND 1.4 30.1 Plasticity Index : SP CASAGRANDE PLASTICITY CHART ACTIVITY DIAGRAM 1.0 Linear Shrinkage (%) :0.5 70 70 2.0 50 PL of Whole Sample : 0 HOH 'A' Line 60 60 REDIU VERY HIGH P.R.A. Classification : A-1-a(0) 07 50 50 PI of Whole Sample 0.6 Unified Soll Classification : SW-SC 40 40 웥 (ài) 0.5 Activity :0,00 30 30 HIGH lasticity 6 (00) (01) Heave Classification : LOW MEDIUM 20 20 LOW IČĽ Grading Modulus : 2.23 10 10 (ir) (ac) (iii) (iii) Percentage (<0.002) : 1.0 Û 0 X 10 40 50 60 70 80 90 10 20 30 40 60 60 20 30 100 Żŋ Moisture Content (%) : 3.3 Liquid Limit (%) Percentage (<0.002) PARTICLE SIZE DISTRIBUTION 100 90 PASSING SIEVE 80 70 60 50 CURULATIVE % 40 30 20 10 0-00-50 0.0150 0.0200 0.0400 0.0500 26.500 37.50Đ 53.000 63.000 75.000 0.0075 0.0100 0.0260 2.0000 13.200 19.000 0.0020 0.0036 ន 0.1500 4,7500 Sieve Size (Tim) 0.2500 0.4250 00.0 0.07 Y ass. Sieve 100 ŝ h 6 58 S ទ 22 8 1 ŝ 64 ŧ¢ 1 m ŝ SAND JENN CLAY SILT GRAVEL COARSE SAND FINE SAND MEDIUM ASTM CLAY SILT SAND GRAVEL MEDIUM FINE MEDIUM COARSE FINE COARSE FINE MEDIUM COARSE BS CLAY SILT SILT SILT SAND SAND SAND GRAVEI GRAVEL GRAVEL Remarks : SAMPLED AND DELIVERED BY CUSTOMER Van Technical Signatory : Raymond van Niekerk

FORM: A6 3.3R (06.10.2010)

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	- CIVIL EN	G, LABORATO	RY SERVICES		). Airtheon Ma
4 HARBOT CLOSE , E P.O BOX 1106 , BRAC	RACKENDUST, 7		Ta Fi Ei	<b>Jo. 70245</b> sl. : 021 9815558 ax : 021 9816724 mail : info@matrocast.co.ze	
		<u>TEST RE</u>	<u>SULTS</u>		
SKC ENGINEERS P.O. BOX 229 PAARL 7620 Attention: MR M.LOU			Project : SQLAR Your Ref Our Ref Date Reported	FARM, KENHARDT : : 40188 ; 28.11.2012	
	FOUNDAT	ION INDICATOR	(ASTM: D422)		
Sample No.	: K 0157	Material Description	: DARK OLIVE SAND	}	
Hole No.	: C1		Clay (%) Silt (%)	Sand (%) Gravel (%	
Depth	îн.	Jennings Astm	0.6 1.2	33,9 64.4 60.1 36,7	SAND
Liquid Limit (%)	i z	British Standard	0.6 1.5	33.5 64.4	SAND
Plasticity Index Linear Shrinkage (%)	: NP ; 0.0		VOE PLASTICITY CH		ACTIVITY DIAGRAM
Pl of Whole Sample P.R.A. Classification Unified Soil Classifica Activity Heave Classification Grading Modulus Percentage (<0.002) Moisture Content (%)	: 0 : A-1-a(0)	L	HOI OUH HOI HH HOI HH H H H H H H H H H H H H H H H H H H	90 100	2,0 VERY HIGH HIGH MEDIUM LOW 20 30 40 50 60 70 ercentage (<0.002)
60					
Contraction of the second s	0.0050 0.0050 0.0075 0.0100 0.0150 0.0200	0.0250 0.0400 0.0560 0.0560 0.0750	0.2500	2.0900 4.7500	13.260 19.000 26.500 37.500 53.000 53.000
N TAN STAR	₩ ¥ ¥ + + + +	N(N m) u	o on 💝	8 8	8 0 1 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2
JENN CLAY	SILT		SAND NE MEDIL		
ASTM CLAY		OARSE   FINE		RSE FINE MEI	AVEL DIUM COARSE
BS CLAY SILT		SILT SAND	SAND SAI	ND <u>GRAVEL</u> GRA	AVEL   GRAVEL
FORM: A6 3.3	3R (06.10.2010)	Teohnical S	Signatory : Raymond	van Niekerk	

TEST RESULTS           SXC ENCINEERS Proposition         Protect - SOLAR PARM, KENBAROT You On Fef Our Fef Our Fef Our Fef Our Fef Data Statute: Statute: MI MLOUBSER         Protect - SOLAR PARM, KENBAROT You Our Fef Our Fe	- CIVIL ENC Reg.No.: 200	TRO( G, LABORATC 0/030983/07 - VAT. R credited Testin 560	)RY SERVI( 6g.No,: 41301974	) (P1 CES - 105	724	
P.O. COX 222       PARE, 7620		<u>TEST RE</u>	<u>SULTS</u>			
P.O. COX 222       PARE, 7620	SKC ENGINEERS	»		LAR FARM , KENH	ARDT	
Sample No.       IK 0159       Material Description: DARK BROWN SAND         Dapth       :-       D       Sample No.       :D         Liquid Limit (%)       :-       D       Sample No.       :D         Liquid Limit (%)       :-       D       Sample No.       :D         Liquid Limit (%)       :-       D       D       Sample No.       :D         Limit Rise       :A       :A       :A       Sample No.       :E         Liquid Limit (%)       :-       D       D       Sample No.       :E       D         Plasticky Index       :NP       D       CASAGRANDE PLASTICITY CHART       Gas SAND       CASAGRANDE PLASTICITY CHART       COMPACT PLASTICITY DIAGRAM       1.0         Plasticky Index       :LOW       :O       :S       <	P.O. BOX 229 PAARL 7620 Attention: MR M.LOUBSER	DD-SOftware growing of	Your Ref Our Ref Date Reporte	: : 46168 ed : 28.11.20		0
Heik No.       : D         Daph       : -         Liquid Limit (%)       : -         Liquid Limit (%)       : -         Daph       : -         Liquid Limit (%)       : -         Daph       : -         Liquid Limit (%)       : -         Daph       : -         Daph       : -         Liquid Limit (%)       : -         Daph       : - <td>FOUNDAT</td> <td>ION INDICATOR</td> <td>(ASTM: D422</td> <td>)</td> <td></td> <td></td>	FOUNDAT	ION INDICATOR	(ASTM: D422	)		
Dapth       :-       Jeminings       13       3.4       36.0       58.0       5AND         Liquid Limit (%)       :-       Plosticity Index       :NP       Binish Standard       1.0       4.0       36.2       58.0       SAND         Plosticity Index       :NP       Binish Standard       1.0       4.0       36.2       58.0       SAND         Plosticity Index       :NP       Binish Standard       1.0       4.0       36.2       58.0       SAND         Plosticity Index       :NP       Binish Standard       1.0       4.0       36.2       58.0       SAND         Procentage (Co.022)       :0.0       PR.A. Classification       :LOW       Soft Binish Standard       Soft Binish Standard       0.7       CASAGRANDE PLASTICITY CHART       70       VERY HIGH       0.7         Activity       :0.00       Binish Standard       :Soft Binish Standard       :Soft Binish Standard       :Soft Binish Standard       :Soft Binish Standard       :O       :Soft Binish Standard <td< td=""><td>Sample No. ; K 0158</td><td>Material Description</td><td>: DARK BROWN</td><td>ISAND</td><td></td><td></td></td<>	Sample No. ; K 0158	Material Description	: DARK BROWN	ISAND		
Linuid Linuid (%)          Plasticity Index       : NP         Linuid Linuid (%)       :         Plasticity Index       : NP         Linuid Standard       1.0       4.0       30.2       64.6       SAND         Plasticity Index       : NP         Linuid Standard       1.0       4.0       30.2       64.6       SAND         Plasticity Index       : NP       CASAGRANDE PLASTICITY CHART       70       ACTIVITY DIAGRAM       1.0         P.R. A Classification       : SW-SC <t< td=""><td>Hole No. : D</td><td></td><td></td><td></td><td></td><td>Classification</td></t<>	Hole No. : D					Classification
Liquid Limit (%)       :-       Image: Second Secon	Depth :-	01 10 MAR		and the second		Lasa Ciller attended and the second
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PI of Whole Sample       :0         P.R.A. Classification       :A.1-a(0)         Unified Soil Classification       :SW-SC         Activity       :0.00         Heave Classification       :LOW         Grading Modulus       :2.24         Percentage (c0.002)       :1.0         Matsure Content (%)       :2.3         100	Linear Shrinkage (%) : 0.0		NDE PLASTICITY	Y CHART		1.0
P.R.A. Class#fication       : A-1-a(0)         Unified Soil Classification       : SW-SC         Activity       : 0.00         Heave Class#fication       : LOW         Grading Modulus       : 2.24         Percentage (<0.002)	PL of Whole Sample : 0		<b>F</b> 5	'A' Line		2.0
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Activity       :0.00       :0.00       :0.00       :0.00         Heave Classification       :LOW       :2.3       :0.00       :0.00       :0.00         Percentage (<0.002)	Unified Soil Classification : SW-SC				E 401	
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JENN CLAY     SILT     SAND     GRAVEL       ASTM CLAY     SILT     FINE SAND     MEDIUM SAND     COARSE SAND     GRAVEL       BS CLAY     SILT     COARSE SILT     FINE SILT     MEDIUM SAND     COARSE SAND     FINE SAND     MEDIUM SAND     COARSE SAND     GRAVEL       Remarks :     SAMPLED AND DELIVERED BY CUSTOMER     MEDIUM WWW     VWW     VWW     WWW	XAN N N N T T T N N N N	a 10 m m m	29 <del>2</del> 9 2	E	50 27	81 83 84 79 79 79 79 79
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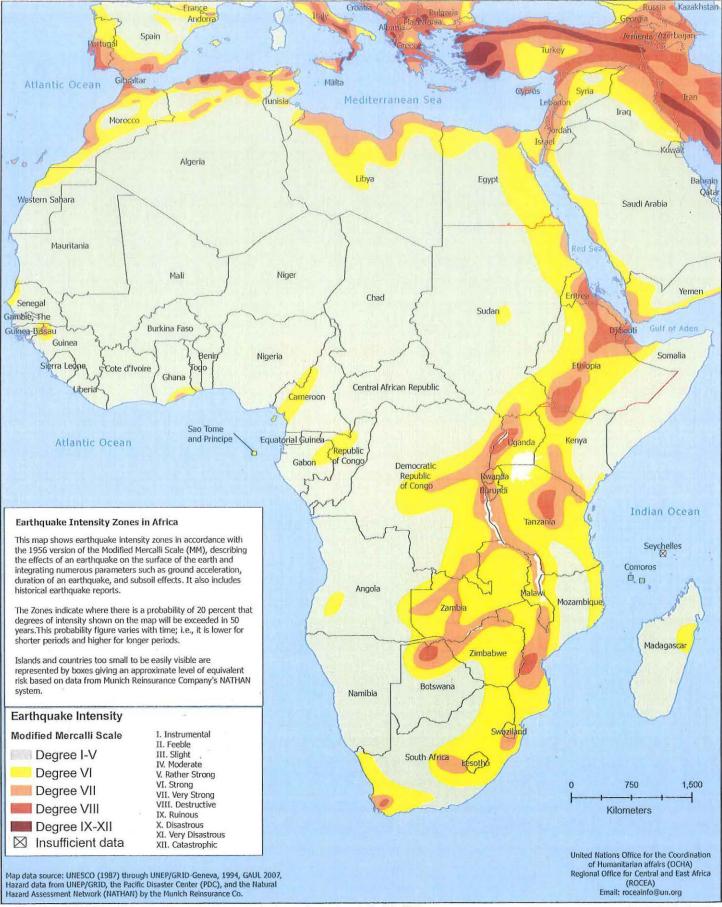


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SKC ENGINEERS P.O. BOX 229 PAARI. 7620 Atlantion: MR M.LOUBSER		Project : S Your Ref Our Ref Date Repo	**		
FOUNDAT	ION INDICATOR	(ASTM: D42	:2)		
Sample No, : K 0160	Material Description	: DARK OLIVE	& BROWN SAI	٧D	
Hole No. : H			Contraction of the opportunity of the local division of the local	1 (%) Gravel (%	and the second sec
Depth :-	Jennings	[	.0 44.4 .9 71.4		SAND
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Figures



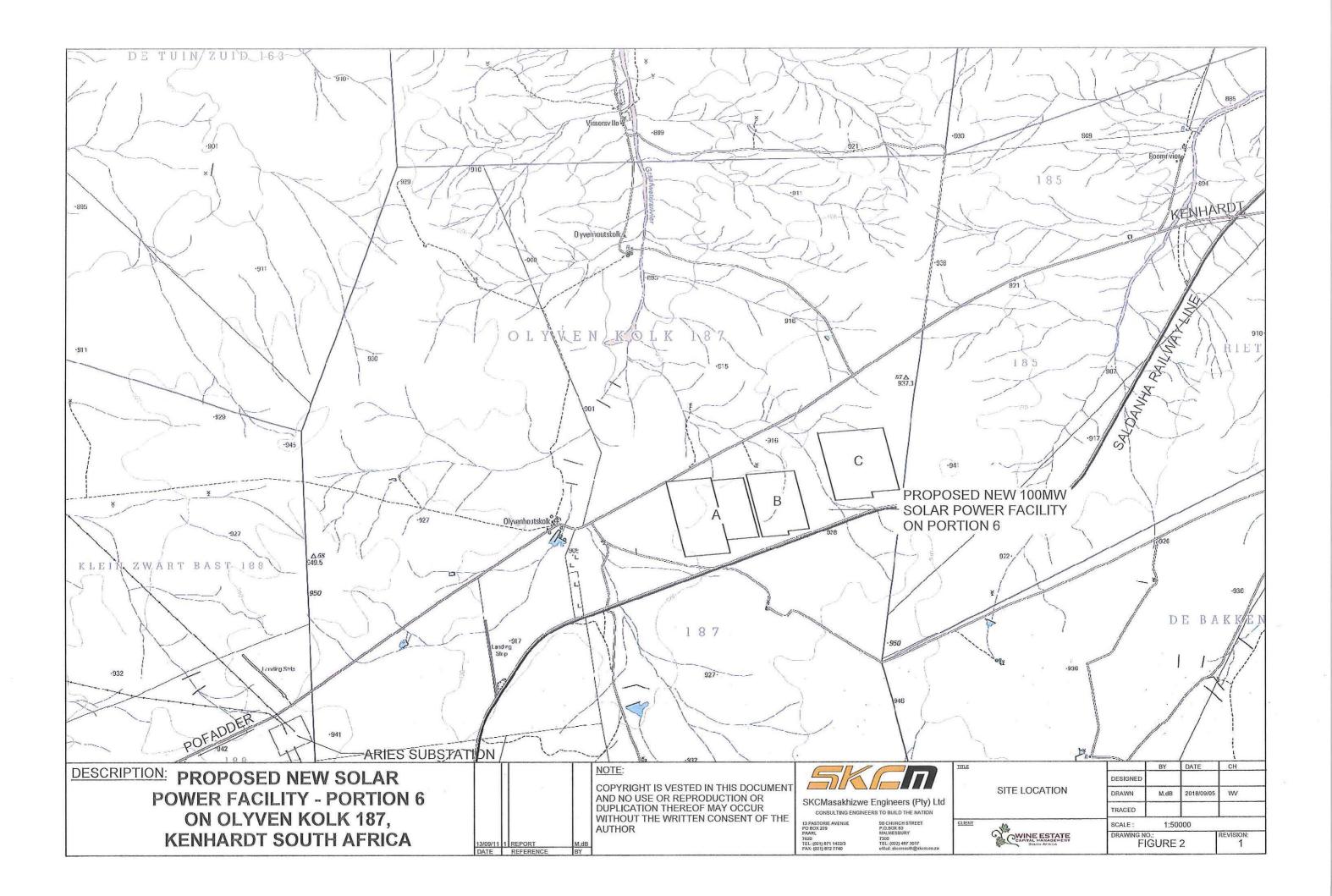
OCHA Regional Office for Central and East Africa Earthquake Risk in Africa: Modified Mercalli Scale Issued: December 2007

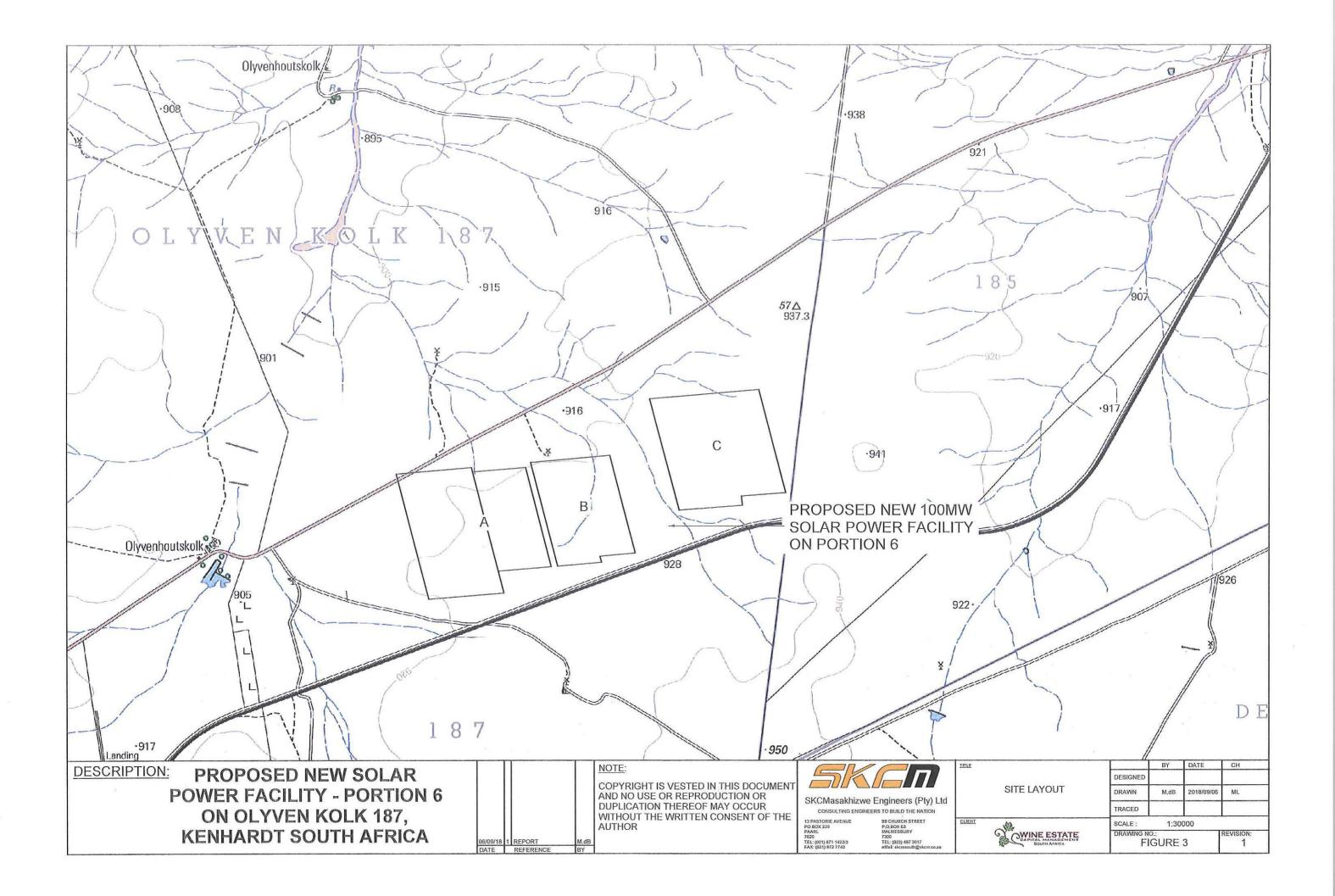


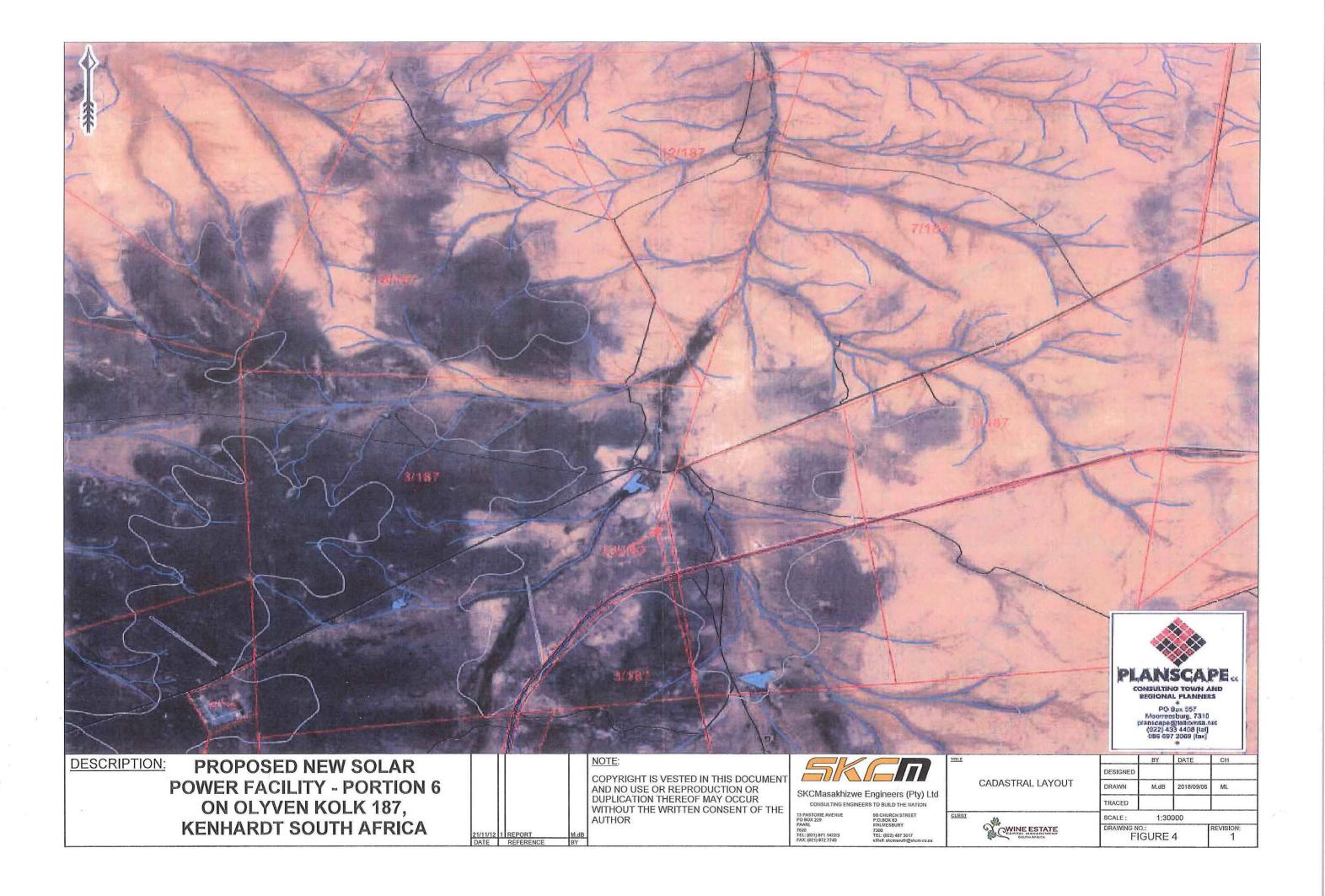
The names shown and the designations used on this map do not imply official endorsement or acceptance by the United Nations

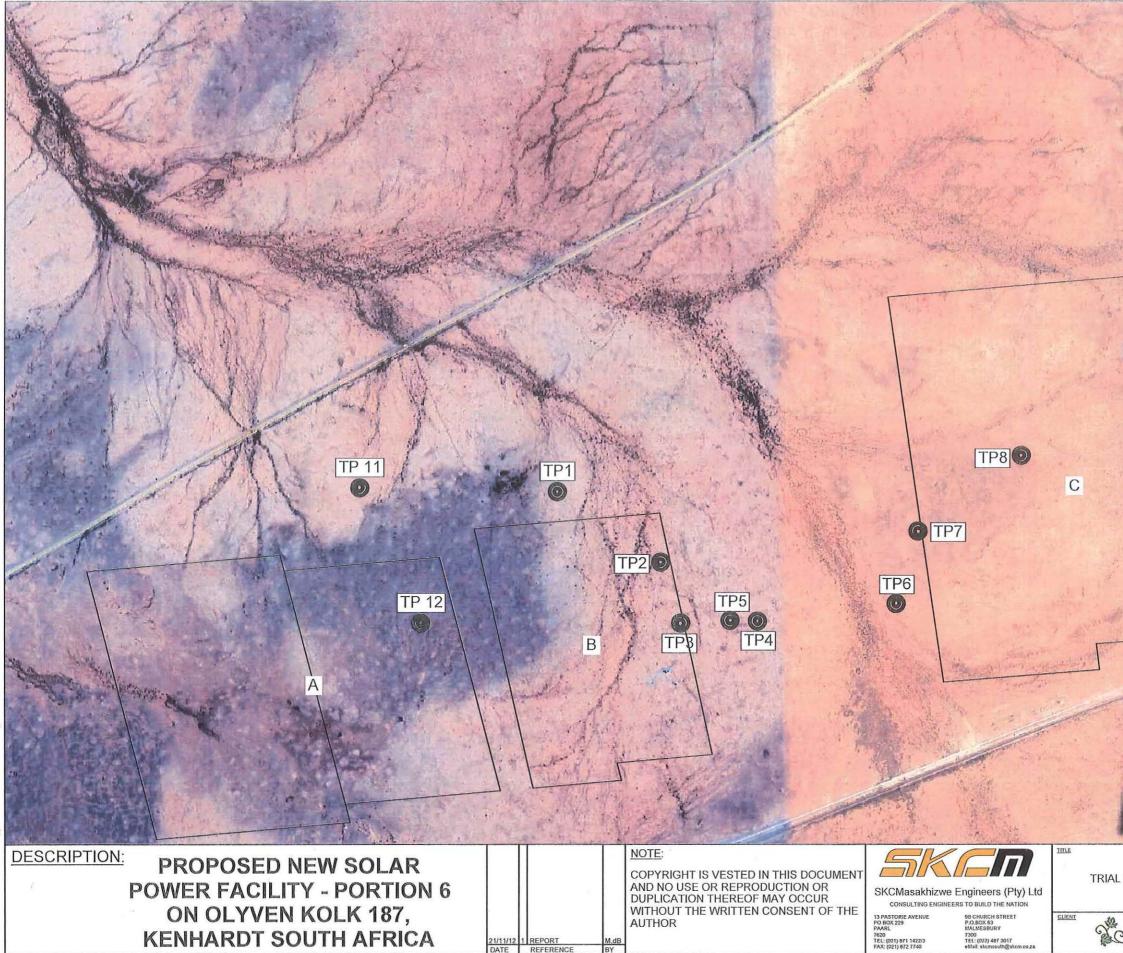
Map: Earthquake\_071219











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