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DNV Energy Systems
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Cape Town, South Africa

Date:	**Our reference**:	**Your reference**:
02 November 2021	PP224951-PE-L-01	Choje Solar

Dear Mr Newcombe,

CHOJE SOLAR PV PROJECTS – BASIC ASSESSMENT SUBMISSION: GEOTECHNICAL

The geotechnical investigations, field testing and reporting conducted thus far for the Choje wind and solar PV projects, bears reference.

An initial Desktop Geotechnical Report (*ref PP225941-ZACT-R-01*, February 2019) and a Preliminary Phase Geotechnical Study (*ref PP224951-PE-R-02-A*, September 2019) have been completed by DNV South Africa. These reports cover the Choje West site area, which encompasses the onshore wind and solar PV site footprints being contemplated by Wind Relic (Pty) Ltd. These investigations comprised of base geological, geohydrological, topographical and seismic mapping, followed by site intrusive studies (trial pitting, dynamic density testing and rotary core borehole drilling), selected sampling for laboratory analysis and geotechnical reporting. A 12-month groundwater monitoring survey has also been conducted on monitoring boreholes installed during these studies.

I can confirm that the geotechnical works completed thus for are sufficient for the purposes of initial site geotechnical evaluation as part of a Basic Assessment Reporting process for the contemplated 2x 300MW solar PV facilities.

Upon authorisation, prior to commencement of the design phase, a detailed geotechnical study comprising further drilling, trial pitting, geophysics, laboratory testing and pile deflection (pull-out) testing will need to be conducted in order to categorise and optimise an appropriate foundation design.

Sincerely
for DNV South Africa (Pty) Ltd

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Choje Windfarm Preliminary Geotechnical Investigation

WIND RELIC

Document No.: PP224951-PE-R-02-A
Date: 02 October 2019

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Project name:	Choje Wind Farm	DNV GL - Energy
Report title:	Preliminary Geotechnical Investigation	Renewable Advisory
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Date of issue:	2 October 2019	Africa
Project No.:	PP224951	
Document No.:	PP224951-PE-R-02-A	
Issue:	A	
Status:	DRAFT	

Task and objective:

Preliminary Geotechnical Investigation for the proposed Choje Windfarm, Eastern Cape, South Africa

Prepared by:	Verified by:	Approved by:
R Fyvie Principal Engineer	D Rimmer Senior Engineer	G van der Toorn Country Manager

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Keywords:

Issue	Date	Reason for Issue	Prepared by	Verified by	Approved by
A	2 October 2019	DRAFT	R. Fyvie	D. Rimmer	G van der Toorn

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APPENDICES

List of abbreviations

Abbreviation	Meaning
ACI	American Concrete Institute
AISC	American Institute of Steel Construction
ASTM	American Society for Testing and Materials
BS	British Standard
CBR	California Bearing Pressure
CPT	Cone Penetration Test
CSW	Continuous Surface Wave
DCP	Dynamic Cone Penetrometer
DPSH	Dynamic Penetrometer Super Heavy
DNV	Det Norske Veritas
DNV GL	DNVGL Entity
IBC	International Building Council
IEC	International Electrotechnical Commission
LS	Linear Shrinkage
MASW	Multi-Channel Analysis of Surface Waves
MC	Moisture Content
MDD	Maximum Dry Density
OMC	Optimum Moisture Content
PI	Plasticity Index
RQD	Rock Quality Designation
SANS	South African National Standard
SPT	Standard Penetration Test
TLB	Tractor-Loader-Backhoe
WTG	Wind Turbine Generator

EXECUTIVE SUMMARY

DNV GL has conducted a preliminary geotechnical investigation for the proposed Choje Wind Farm. This report follows from the Choje Wind Farm Desktop Report, which provides the background geological information and site description for the project. The preliminary geotechnical investigation (first phase) consisted of nine rotary core boreholes, drilled from surface to a depth of 30m. Boreholes were supplemented by additional trial pit excavation at borehole positions, as well as at the proposed Eastern Block substation and Western Block 400MTS. Trial pits and boreholes were sampled where appropriate and samples submitted for a suite of laboratory-based geotechnical testing. All logs and test results are contained within this report. The study was conducted as an initial early-stage investigation into the variability of sub-surface conditions that may be expected to be encountered across the site. It is intended to be followed by further Preliminary Geotechnical Investigations, as well as then the detailed geotechnical investigation prior to final foundation design.

The results of the preliminary geotechnical investigation indicate that generally hard rock conditions prevail close to surface across the majority (approximately 70%) of the site. The underlying strata consists of sandstone, siltstone, mudstone and tillite. Excavation for founding will necessitate the use of localized blasting or hard excavation to reach anticipated founding depth. In the remaining 30% of ground conditions, very soft rock, deep sands and weathered pedogenic calcrete were encountered. These would require soil improvement methods through an adapted foundation design, the potential shifting of turbine locations to areas of better founding, or the cancellation of turbines located at complex founding sites.

DNV GL has provided recommendations for further geotechnical testing and investigations required at the Choje Windfarm site during supplementary phases of ground investigation.

1 INTRODUCTION

DNV GL South Africa was appointed to conduct early-stage geotechnical investigations at a site in the Eastern Cape, South Africa, in support of the proposed Choje Wind farm development. The project proceeded with a site visit undertaken by DNV GL and Wind Relic (the "Customer"), culminating in the production of PP225941-ZACT-R-01-A Choje Wind Farm Desktop Geotechnical Report in February 2019. The Choje Wind Farm Desktop Geotechnical Report should be read in conjunction with this report for the project background and supporting geological information.

The Choje Wind Farm project will consist of an estimated 3000MW of onshore wind turbines, divided into an Eastern and Western block, located between Grahamstown and Somerset East, Eastern Cape, South Africa. The project is intended to be developed in multiple phases, with initially approximately 550MW in the Eastern Block, and 1250MW in the West. These may be divided into 6 sub-windfarms, of approximately 200-250MW size. Current layout iterations are being conducted by DNV GL, modeled on a series of differing turbine sizes in the 4 – 6MW range. Provisional layouts have been utilised in selecting the drilling and testing positions for this preliminary geotechnical survey. It is conceivable that the positions may shift with further refinement, however this is not a significant concern as the preliminary geotechnical study is not intended to supply point-specific geotechnical data, but rather an initial insight into potential geologies that may be encountered on the site.

The study involved the drilling of 9 HQ-sized rotary core boreholes at proposed turbine positions, 26 trial pits and 26 in-situ Dynamic Cone Penetrator (DCP) tests at turbine locations, crane platforms and substation positions. Selected disturbed samples were retrieved from testing positions for laboratory analysis.

The ground conditions described in this report refer specifically to those encountered in the excavated trial pits and drilled boreholes. It is therefore quite possible that differing conditions may be encountered elsewhere on the sites during construction. There is no warranty that the information is totally representative of the whole investigation area.

1.1 Terms of Reference

DNV GL has been appointed by Wind Relic (the "Customer") to conduct a number of development-phase activities in support of the establishment of the proposed Choje Wind Farm. This includes the preliminary geotechnical investigation report, conducted by DNV GL South Africa in terms of accepted proposal and signed SFA #L2C177021_SA_P_01-A_V1. Subcontractors utilised in support of the production of this report include *Outeniqua Geotechnical Laboratories* of George (geotechnical testing and field support), *ControLab Materials Testing Laboratory* of East London (rock sample testing) and *JG Afrika Engineers* of Durban (geohydrology).

1.2 Technical Investigation Standards

- The geotechnical investigation was performed according to best practice as directed by the following Standards:
- SANRAL, (2010). Standard Specification for Subsurface Investigation;

- Committee of State Road Authorities, (1993). Standard Specification for Subsurface Investigations;
- SABS 1200D (1988). Standardized Specification for Civil Engineering Construction;
- Jennings, J.E., Brink, A.B.A. and Williams, A.A.B. (1973). *Revised Guide to Soil Profiling for Civil Engineering Purposes in Southern Africa*. Transactions of the South African Institution of Civil Engineers, Vol. 15;
- Proceedings of the Symposium on Exploration for Rock Engineering (1976). *A Guide to Core Logging for Rock Engineering*. Core Logging Committee of the South Africa Section of The Association of Engineering Geologists.

2 LOCAL AND REGIONAL GEOLOGY, SEISMICITY AND TOPOGRAPHY

Readers are referred to the previous issued DNV GL report for this project, PP225941-ZACT-R-01-A *Choje Wind Farm Desktop Geotechnical Report* dated 21 February 2019, for comment on previous geotechnical work in the area, local and regional geological environment, seismicity, a description of the topographical conditions, comment on construction materials, and Geotechnical Founding Classes of the Choje Windfarm site.

3 INVESTIGATION METHODOLOGY

The field investigation entailed:

(i) The drilling of nine (9) HQ3-sized boreholes at predetermined WTG foundation positions utilising rotary core drilling methods. Boreholes were drilled vertically, to depths of 30m each;

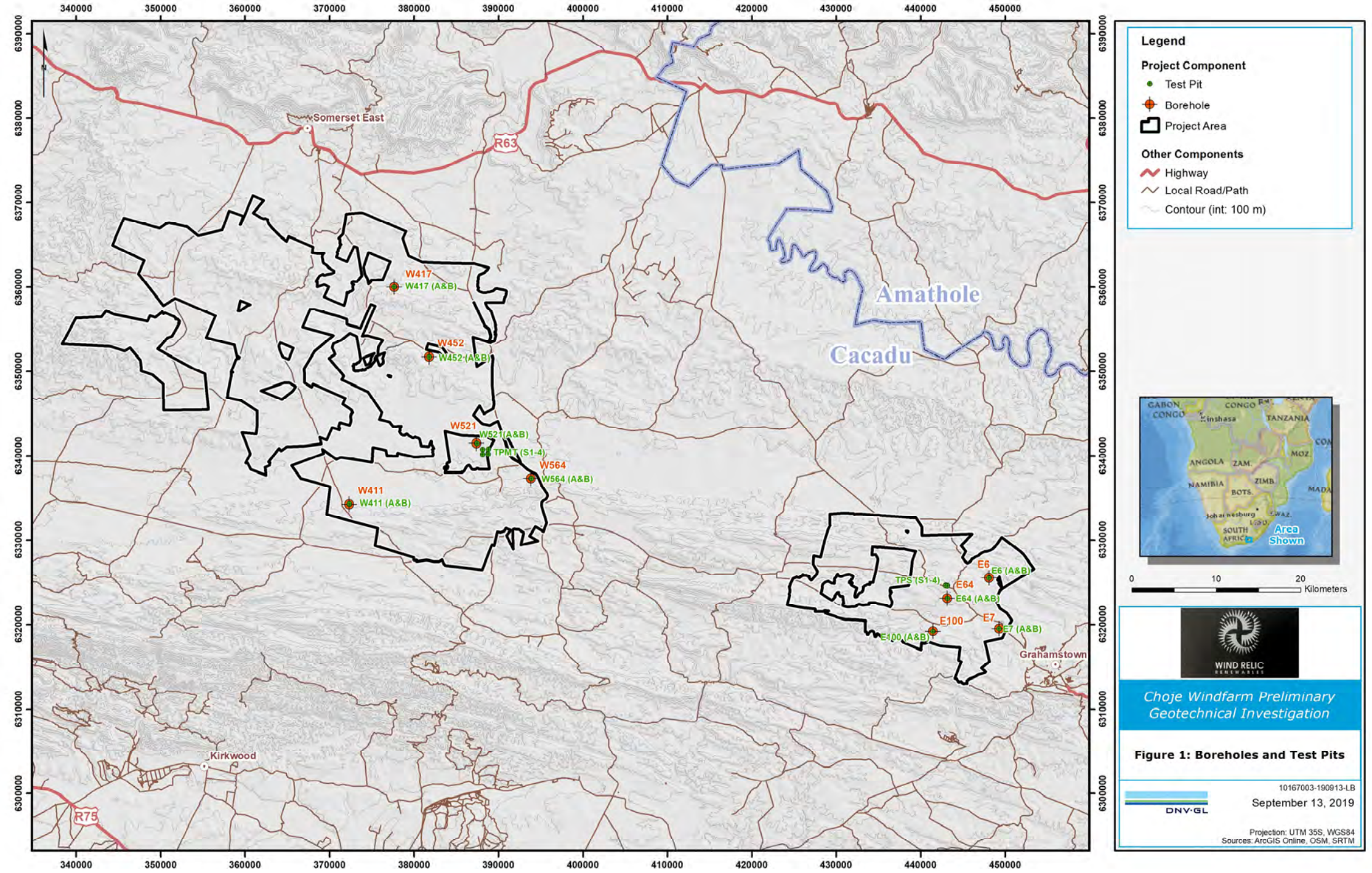
(ii) The machine excavation of trial pits at predetermined positions at each of the 9 selected turbine positions. One trial pit was excavated within the foundation footprint, and a second trial pit excavated approximately 50 – 70m away at the potential crane platform position;

(iii) The retrieval of selected disturbed subsoil samples and groundwater samples for laboratory analyses;

(iv) The establishment of *in situ* density conditions, where possible, adjacent to excavated trial pits through Dynamic Cone Penetrometer (DCP) testing.

(v) Disturbed samples were retrieved from boreholes and trial pits and submitted to a South African SANAS-Accredited Civil Engineering laboratory (*Outeniqua Geotechnical Laboratories*) in accordance with South African National Standards (SANS) test methods (TMH1 and SANS3001), British Standards (BS) or the American Society for Testing and Materials (ASTM) standards as applicable.

Figure 1 overleaf provides illustrates the positions of all borehole and trial pit investigation points on the site.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6320000
6310000
6300000
Somerset East
R63
Amathole
Cacadu
W417
W417 (A&B)
W452
W452 (A&B)
W521
W521 (A&B)
TPMT (S1-4)
W564
W564 (A&B)
W411
W411 (A&B)
E6
E6 (A&B)
TPS (S1-4)
E64
E64 (A&B)
E100
E7
E7 (A&B)
E100 (A&B)
Grahamstown
Kirkwood
R75
Legend
Project Component
Test Pit
Borehole
Project Area
Other Components
Highway
Local Road/Path
Contour (int: 100 m)
GABON
CONGO
Kinshasa
TANZANIA
ANGOLA
ZAM.
MOZ.
NAMIBIA
ZIMB.
BOTS.
SOUTH AFRIC
Area Shown
0
10
20
Kilometers
WIND RELIC
RENEWABLES
Choje Windfarm Preliminary Geotechnical Investigation
Figure 1: Boreholes and Test Pits
10167003-190913-LB
DNV·GL
September 13, 2019
Projection: UTM 35S, WGS84
Sources: ArcGIS Online, OSM, SRTM

Table 3.1 indicates the various investigation methods employed on site. Additional in-situ forms of testing not yet deployed during the preliminary study are still reflected in the table headings for indicative planning for the detailed geotechnical investigation.

Table 3.1: Investigation Methods

Turbine Position	Borehole	Standard Penetration Test	Electrical Resistivity	Thermal Resistivity	Standpipe Installed	CSW	DCP	MASW	Trial Pit
E6	X	X					X2		X2
E7	X	X					X2		X2
E64	X	X					X2		X2
E100	X	X					X2		X2
*SS-E Block							X4		X4
*400 MTS-W Block							X4		X4
W411	X	X			X		X2		X2
W417	X	X			X		X2		X2
W452	X	X			X		X2		X2
W521	X	X			X		X2		X2
W564	X	X			X		X2		X2

* Substation position

3.1 Boreholes

Nine (9) boreholes were drilled at predetermined WTG positions utilising rotary core drilling methods, on a HQ3 drill-string size by the drilling Contractor *EarthTech Geotechnical Services*. Sampling during the exploration was performed using Standard Penetration Test (SPT) where possible, although SPTs widely refused across the site owing to dense residual soils and weathered rock. Split spoon tube sampling was also attempted, however geological conditions did not cater for any successfully being retrieved. The positions of all WTG boreholes are illustrated in Figure 1. The soil conditions and rock strata described using standard methods and terminology outlined by *Jennings et al.* (1973) and the *Core Logging Committee of South Africa* (1976). Borehole logs and photographic plates are included in Annexure B.

Representative soil samples were subjected to laboratory testing, including Particle Size, Atterberg Limits, hydrometer, Moisture Content, whereas representative rock core samples were subjected to Point Load Strength Index and Unconfined Compressive Strength (UCS) tests. Fifty-millimeter standpipes were installed in all boreholes after completion of the drilling and core extraction. Boreholes were flushed after a minimum of three-day period (in order for the drilling fluid *Easimix* to degrade) and then sampled on the recharged groundwater. Groundwater samples were collected from several boreholes for pH and electrical conductivity

(EC) tests to determine the corrosivity (acidity and salinity) of groundwater against buried structures and services.

Plate 1: Rotary core drilling at borehole position E64

3.2 Trial Pits

Twenty-six (26) trial pits were machine excavated at predetermined positions by means of a Tractor-Loader-Backhoe (TLB). The co-ordinate positions of all trial pits are illustrated in the logs attached in Annexure C.

One (1) trial pit, at each of the WTG founding positions was excavated to a depth of 3.00m or refusal, whichever came first. In addition, one (1) trial pit, was excavated approximately 50-70m away at each of the potential crane platform positions. Four (4) trial pits were also excavated as the proposed Eastern Block substation position, to a depth of 3.00m each or refusal, whichever came first. Another four (4) trial pits were additionally excavated at the proposed 400 MTS position on the Western Block.

All trial pits were profiled by and the soil conditions described using standard methods and terminology outlined by Jennings et al. (1973) Representative soil samples retrieved from trial pits were subjected to Modified AASHTO moisture/density, California Bearing Ratio (CBR), Foundation Indicator, Moisture Content, Relative Density and Thermal Resistivity. Representative samples of various soil types were collected for pH and electrical conductivity (EC) to determine the potential aggressiveness (corrosivity) of the soil towards buried structures and underground electrical services.

Plate 2: Trial pit excavation at W417 position *(photo credit: Outeniqua Geotechnical Laboratory)*

3.3 Dynamic Cone Penetrometer (DCP) Tests

DCP tests were conducted adjacent to trial pit at the turbine locations and substation positions. Tests were conducted from the current surface level to depths of 2m or refusal, which ever come first.

An aspect of DCP testing that must always be noted is the climatic condition on the day the tests are undertaken, as precipitation events may adjust the shaft frictional indices and affect results. DCP testing was conducted under *dry conditions* during the Choje Preliminary Study, with no recent rainfall having been recorded in the area. Soil moisture content values were therefore low.

The results of DCP tests are provided in accompaniment to the trial pit logs in Appendix C of this report.

4 TESTING POSITIONS AND ROUTE EXCAVATABILITY

Figure 2 below provides an indication of the borehole and trial pit orientation relationship at WTG E100 position. The remaining 8 borehole/trial pit orientation plots (**Figures 3-10**) are presented in Appendix A.

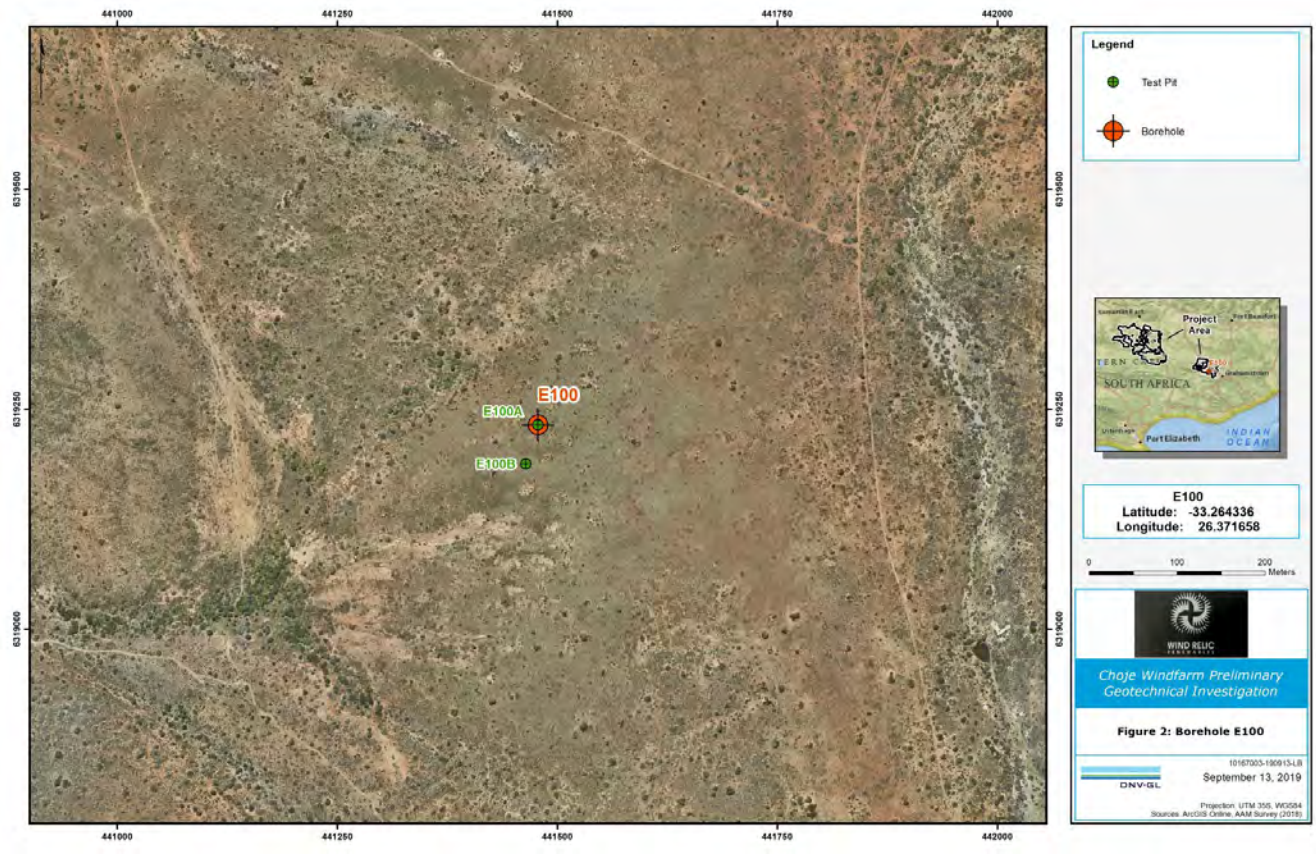


Figure 2: Borehole E100 position plan

Excavatability considerations for the turbine positions and access road routes are described in terms of SABS 1200 D (1988). Excavatability indicates the ease at which *in-situ* material is removed and what excavation methods should be utilised. Excavation classes are provided based upon the ease at which material can be removed by mechanised plant of varying power classes.

4.1 Soft excavation

Soft excavation, other than in restricted excavation, shall be excavation in material that can be efficiently removed or loaded, without prior ripping, by any of the following plant:

i) a bulldozer of mass (including mass of ripper if fitter) approximately 22t and flywheel power approximately 145 kW, or

ii) a tractor-scraper unit of total mass approximately 28t and flywheel power approximately 245 kW, pushed during loading by a bulldozer equivalent to that specified in (b) (1) below, or

iii) (iii) a track type front-end loader of mass approximately 22t and flywheel power approximately 145 kW

In the case of restricted excavation, soft excavation shall be excavation in material that can be efficiently removed by a back-acting excavator of flywheel power approximately 0.1- kW per millimeter of tined-bucket width, without the use of pneumatic tools such as paving breakers.

4.2 Intermediate excavation

Intermediate excavation, other than in restricted excavation, shall be excavation (excluding soft excavation) in material that can be efficiently ripped by a bulldozer of mass approximately 35t, fitted with a single-tine ripper suitable for heavy ripping, and of flywheel power approximately 220 kW.

In the case of restricted excavation, intermediate excavation shall be excavation (excluding soft excavation) in material that requires a back-acting excavator of flywheel power exceeding 0,10 kW per millimeter of tined-bucket width or the use of pneumatic tools before removal by equipment equivalent to that specified in above.

4.3 Hard rock excavation

Hard rock excavation, other than in restricted excavation, shall be excavation (excluding boulder excavation) in material that cannot, before removal, be efficiently ripped by a bulldozer equivalent to that specified in above. It must be noted that such excavation generally includes material such as formations of unweathered rock that can be removed only after blasting.

In the case of restricted excavation, hard rock excavation shall be excavation in material (excluding boulder excavation) that cannot be efficiently removed without blasting or without wedging and splitting.

For the purposes of isolated hard rock excavation, this may also include the use of an excavator-mounted rock hammer (rock pecker).

4.4 Boulder excavation Class A.

Boulder excavation Class A shall be excavation in material containing more than 40% by volume of boulders of size in the range 0,03-20 m^3, in a matrix of soft material or smaller boulders. Excavation of solid boulders or lumps of size exceeding 20 m^3 will be classed as hard rock excavation.

Excavation of fissured or fractured rock will not be classed as boulder excavation but as hard rock or intermediate excavation, according to the nature of the material.

4.5 Boulder excavation Class B.

Boulder excavation Class B shall be excavation of boulders only, which are in a material containing 40% or less by volume of boulders of size in the range of 0,03-20 m^3, in a matrix of soft material or smaller boulders, and which require individual drilling and blasting in order to be loaded by a track type front-end loader or back-acting excavator, as the case may be, as specified in (a) above. The excavation of the rest of the material will be classed as soft or intermediate excavation, according to the nature of the material.
Estimation percentages of excavation classes for the existing access roads on the site are based upon a 1.0m deep roadbed excavation, and reflected below:

	Excavation Class (SABS 1200D)	Estimated Percentage (%)
a	Soft excavation	65
b	Intermediate excavation	15
c	Hard excavation	10
d	Boulder excavation Class A	5
e	Boulder excavation Class B	5

It must be noted that the excavation percentages stated above are estimates generated from point-source information in the form of trial pits placed at potential turbine positions and sub-station sites. No guarantee can be provided for variations in excavatability conditions in between trial pit locations.

5 GEOTECHNICAL RESULTS

5.1 Ground Profile

The results of the field studies at the Choje windfarm site allow a general picture of the regional soil and rock conditions to be compiled. The significant size of the project means that the geological terrain varies markedly across the site area, with individual turbine positions sited in deep soils and hard rock alike. General themes for the broad area, however, are consistent and may be informed upon to guide the initial preliminary design of WTG foundations, access roads and structures. Table 5.1 provides a summary of the most significant information gathered from the nine boreholes drilled on the Eastern and Western Blocks.

The local rock types observed in the boreholes consisted of sedimentary rock types sandstone, siltstone, mudstone and shale, as well as a large amount of glacial tillite. The near-surface part of the rock profile demonstrated high to moderate weathering and a tendency for high to moderate fracturing. Rock hardness varies according to rock type, with sandstone and tillite typically being medium to very hard and the argillaceous rocks being very soft to medium hard.

Significant variation in the hardness of the tillite was observed between boreholes (compare logs from E7 and E64), associated with the degree of weathering the tillite has been subjected to under the influence of groundwater. Significant core loss was recorded in a number of the boreholes at shallow founding depth of

2-4m (e.g. E6, W411, W417 – See Appendix B). Core loss in calcareous soils is unsurprising (W417), as fines wash out during the drilling process, however core loss in rock is largely due to the highly fractured, highly weathered and soft nature of shallow rock at these positions.

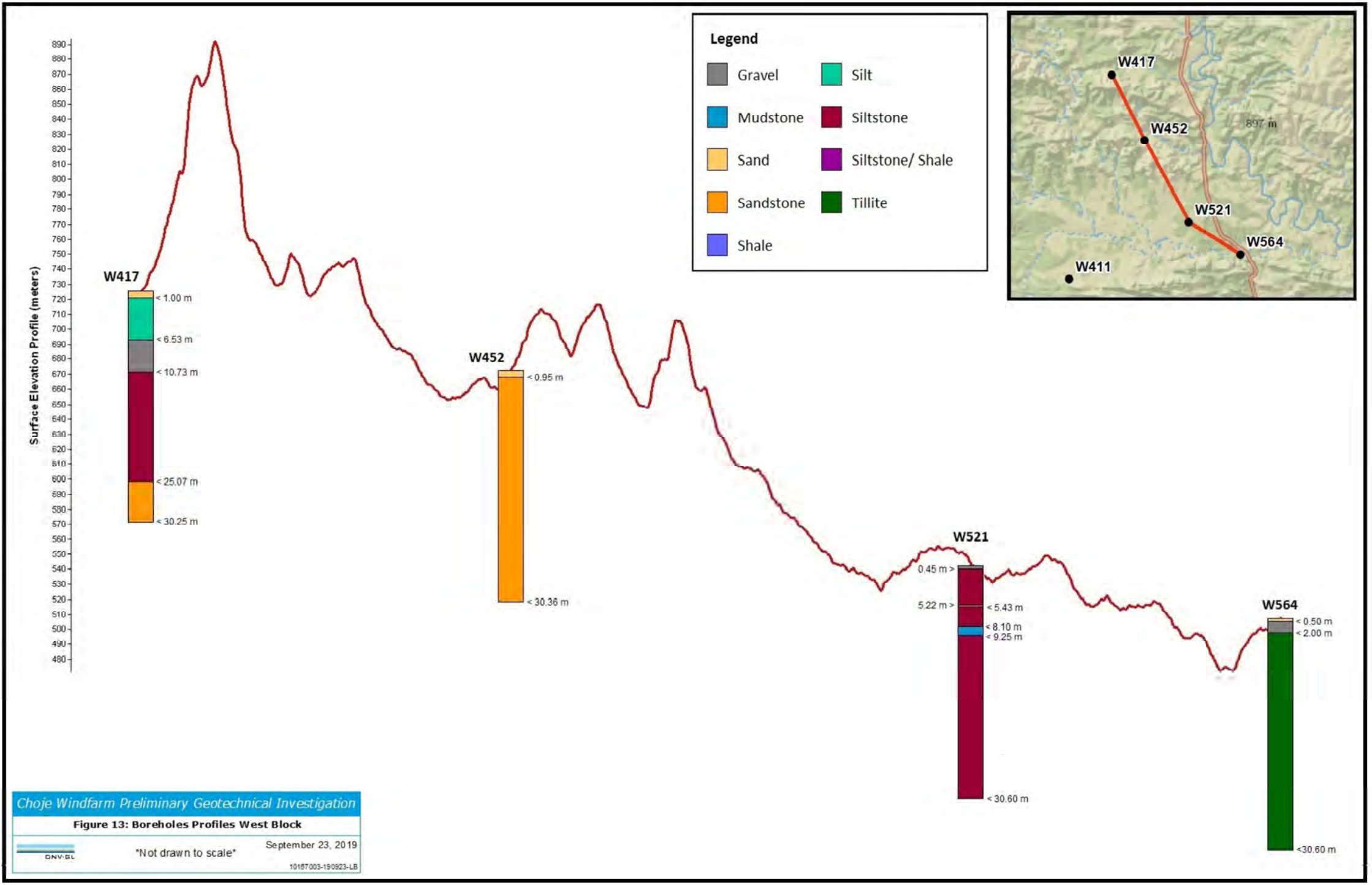
Table 5-1: Borehole Simplified Results

Borehole No.	Description	Soil Cover Depth	SPTs	Rock Condition	Medium Hard Rock Depth	Groundwater Depth
E6	Dense gravelly silty SAND, overlying light brown SILTSTONE rock	2.89m	1.45m (R) 2.80m (R) 5.55m (R)	Highly weathered, highly fractured, very soft rock. **Significant core loss above 6m**.	Below 6m	8.81m
E7	Medium dense gravelly SILT, overlying light brown to grey TILLITE rock	0.75m	1.50m (R)	Highly weathered, very highly to moderately fractured very soft to soft rock,	Below 15.7m	None
E64	Medium dense GRAVEL with COBBLES, overlying dark olive TILLITE rock	0.62m	-	Moderately weathered, very highly to moderately fractured, hard rock	Below 0.62m	22.11m
E100	Medium dense silty GRAVEL, overlying red-orange to black SHALE	1.67m	-	Highly weathered, highly to very highly fractured, very soft rock	Soft rock below 16.6m	16.85m
W411	Dense silty gravelly SAND, overlying dark grey TILLITE	1.58m	1.55m (R)	Highly weathered, highly to very highly fractured, soft to medium hard rock. **Core loss above 8m.**	Below 4.5m	26.27m
W417	Dense gravelly CALCAREOUS SILT with COBBLES, overlying dark olive SILTSTONE	**10.73m**	2.20m (R) 3.80m (R)	Highly weathered, very highly to moderately fractured, soft rock. **Significant core loss above 11m**.	Below 18.7m	23.83m
W452	Dense gravelly silty SAND, overlying dark olive to grey SANDSTONE	0.95m	-	Moderately to slightly weathered, highly to slightly fractured, medium hard to hard rock	Below 0.95m	16.54m
W521	Medium dense clayey GRAVEL, overlying dark grey SILTSTONE	0.45m	-	Highly weathered, very highly fractured, soft to medium hard rock	Below 1.5m	26.05m
W564	Medium dense silty sandy GRAVEL with sporadic BOULDERS, overlying dark olive TILLITE	2.00m	-	Highly to moderately weathered, very highly fractured, soft to medium hard rock	Below 6.8m	19.20m

R = Refusal of SPT in excessively dense substrate / cobbles

The measured orientation of bedding planes varies between horizontal to ~45° (compare E100 to W521). Dominant joint orientation varies from subvertical to ~45°. Joints tend to be narrow to wide, rough to slightly rough, and stained with minimal clay infill, indicating a partial opening of the joint structures. Drawing a correlation for continuity between strata is problematic across such marked distances as between boreholes at Choje WF, as demonstrated by the illustrative cross-section depicted in Figures 13 and 14 overleaf, showing the Western and Eastern block borehole sections respectively. The variation in rock type

and condition is a function to the inclined nature of regional strata in the area, which dips away from the horizontal. It is also a function of the depositional history of the sedimentary strata, showing repeating cycles of sandstone and mudstone with then regional metamorphism altering to shale and quartzitic sandstones. The glacial actions and deposition of tillite equally have affected this strata distribution. Lastly, the variation is a function of localized topography and ensuing chemical alteration at each borehole position.



Choje Windfarm Preliminary Geotechnical Investigation

Figure 13: Boreholes Profiles West Block

Not drawn to scale

September 23, 2019

10167003-190923-LB

Choje Windfarm Preliminary Geotechnical Investigation

Figure 14: Boreholes Profiles East Block

DNV·GL

Not drawn to scale

September 23, 2019

10167003-190923-LB

Surface Elevation Profile (meters)

635 630 625 620 615 610 605 600 595 590 585 580 575 570 565 560 555 550 545 540 535 530 525 520 515 510 505 500

E6

< 2.89 m

< 6.00 m

< 30.00 m

E64

0.62 m >

< 30.40 m

E100

0.41 m >

1.67 m >

16.60 m >

30.10 m >

Legend

- Gravel
- Silt
- Mudstone
- Siltstone
- Sand
- Siltstone/ Shale
- Sandstone
- Tillite
- Shale

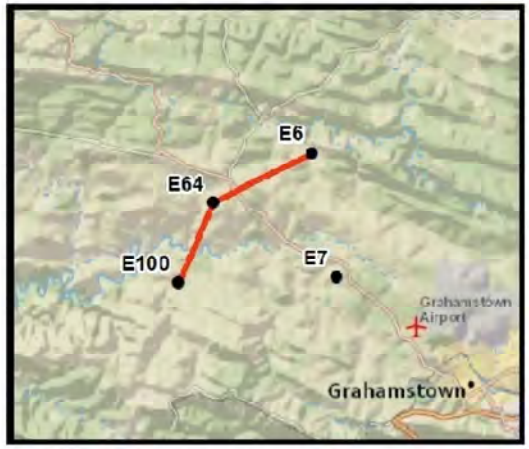


Table 5.2 provides a summary of the soil cover depths and pedogenic variations recorded across the twenty-six excavated trial pits.

Table 5-2: Trial Pit Horizon Summary Table

Trial Pit No.	Imported (fill) soil (mm)	Transported soil (mm)	Residual soil (mm)	Rock/Hardpan (mm)	Total depth of test pit (mm)	Refusal?
E6A	-	2100	-	100	2200	Yes
E6B	-	1750	-	-	1750	Yes
E7A	-	200	300	100	600	Yes
E7B	-	300	500	200	1000	Yes
E64A	-	200	200	150	550	Yes
E64B	-	150	250	200	600	Yes
E100A	-	300	800	400	1500	Yes
E100B	-	400	1100	400	1900	Yes
SS1	-	-	100	200	300	Yes
SS2	-	-	300	100	400	Yes
SS3	-	80	170	150	400	Yes
SS4	-	200	250	150	600	Yes
MTS1	-	200	300	200	700	Yes
MTS2	-	2900	-	-	2900	No
MTS3	-	-	400	350	750	Yes
MTS4	-	600	-	250	850	Yes
W411A	-	1700	-	500	2200	Yes
W411B	-	2300	-	-	2300	Yes
W417A	-	2800	-	-	2800	No
W417B	-	2900	-	-	2900	No
W452A	-	1300	-	50	1350	Yes
W452B	-	350	150	50	550	Yes
W521A	-	150	200	100	450	Yes
W521B	-	100	250	150	500	Yes
W564A	-	350	-	600	950	Yes
W564B	-	350	-	350	700	Yes

As may be noted, the majority of trial pits excavated across the site presented early refusal of the TLB at depths shallower than the anticipated 3.0m below existing ground level. This is symptomatic of the density of the colluvial, alluvial and residual soils across the site, enhanced by the dry conditions and frequency of cobbles and calcification (magnesium and ferric ion deposition as calcrete) in the profile.

The soil profile observed in shallow test pits on the site is quite variable in terms of particle sizes, but is typically dominated by coarse, granular soils with a significant amount of silt-sized fines (i.e. silty gravelly sand and silty sandy gravel). The soil cover recorded in test pits is generally thin (<2m), with localised thick accumulations of transported alluvium occurring along or adjacent to natural drainage lines, most notably at WTG W417 where soil cover extends to a depth of 10.7m. Localised, but significantly thick deposits of high-

level terrace gravel were encountered at the 400MTS substation (refer to soil profile MTS2, Appendix C).

Results of the DCP testing illustrated a picture of generally competent soil conditions for lightly loaded structures at shallow depths across the site. DCPs mostly refused within 1.0m of surface, with many refusing within the upper 0.5m. Refusal was broadly due to dense soil conditions, as well as the presence of cobbles in the profile, which are widespread throughout the transported and residual soils on the Choje site. Pedogenic accumulation of ions and the ensuing calcification of the profile is also widespread in arid conditions such as these, and further "weakly cements" the soil profile, leading to increased density and resistance to the DCP probe.

The results of all DCPs are plotted in Chart 5.1 and demonstrate the general trend of "dense" soil types across the site.

5.2 Laboratory Test Results

Laboratory test results herewith presented are as retrieved from borehole soil and cores, trial pits and groundwater standpipes. All samples may be classified as *disturbed* samples, as Shelby tube sampling within boreholes was unsuccessful due to high soil density.

5.2.1 Grading and Atterberg Limits

Representative soil samples were collected from test pits and borehole core for grading, Atterberg limits and moisture content tests (foundation indicator) to determine the index properties of the insitu soils and classify the soil types according to the Universal Soil Classification (USC) system. The results of the tests are shown in Table 5.3.

The lab results indicate that the soils are dominated by silty sands and silty gravels, with low clay content (generally <10% clay) and low to medium plasticity of fines (PI max 28, but PI of whole sample <15). Potential expansivity according to the Van der Merwe method (Van der Merwe, 1964) is low in all test samples.

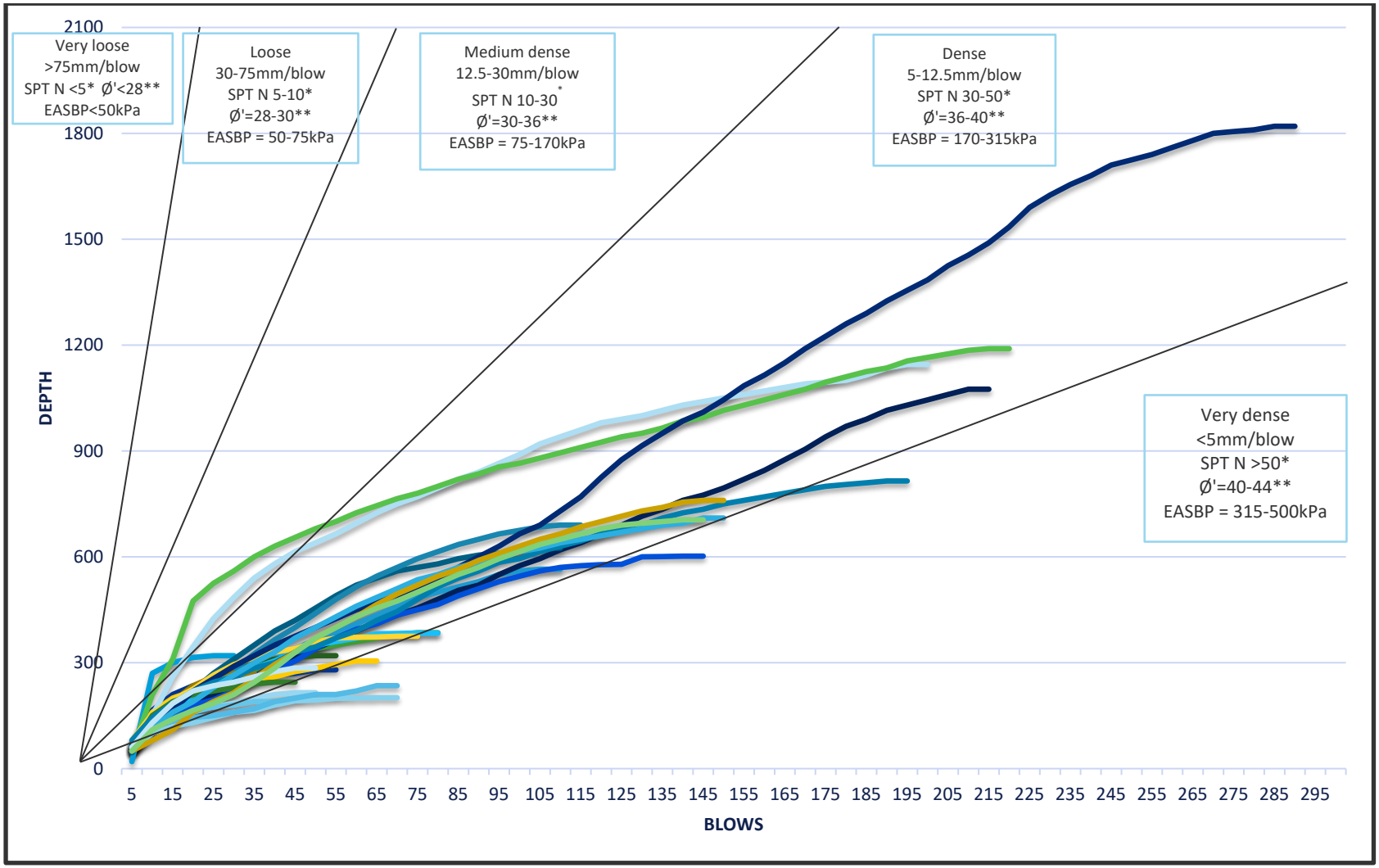
5.2.2 Soil Density and Strength Tests

Representative soil samples were collected for modified AASHTO density, CBR and indicator tests to determine the compaction/strength relationship and potential as natural construction material for use in earthworks and road pavements. The results of the tests are summarised in Table 5.4.

The test results indicate sporadic sources of potentially useful natural materials (G5-G7 quality in terms of the TRH14 classification system) for earthworks and road-building purposes, but the several of the tests indicate moderate plasticity and low CBR values, the combined effect of which reduces the quality of the materials to G9 or G10. The tests also indicate that the *in-situ* soils tend to be slippery in wet conditions and dusty in dry conditions, with corrugations becoming a maintenance problem. Plasticity and grading are important in the selection of suitable materials for gravel wearing course on access roads.

Recommendations for material usage are given in the following section of this report.

Chart 6-1: DCP Penetration Results



*after Brink *et al* (1982)

** after Peck *et al* (1974)

Table 5-3: Atterberg Limits and Particle Size Test Results

TP No	Sample Depth (mm)	Atterberg Limits			Particle Analysis (%)				MC*	PE**	USC ***
		PI	LL	LS	Clay	Silt	Sand	Gravel			
TEST PITS											
E6A	400-2100	5	19	2.5	8	42	49	1	7	Low	CL-ML
E6B	800-1750	7	21	3.5	9	28	46	17	5.2	Low	SM-SC
E7A	200-500	15	36	7.5	3	24	21	52	9.4	Low	GC
E7B	300-800	20	46	10	3	14	13	70	7	Low	GC
E64A	200-400	17	35	8.5	5	32	16	47	8.4	Low	GC
E64B	150-400	16	34	8	4	30	13	53	7.7	Low	GC
E100A	300-1100	20	45	10	7	13	13	67	8.9	Low	GC
E100B	400-1500	19	39	9.5	4	11	15	70	6.8	Low	GC
SS1	0-100	5	20	2.5	2	12	17	69	4	Low	GM-GC
SS2	0-300	11	26	5.5	3	18	20	59	6	Low	GC
SS3	80-250	8	25	4	2	14	12	72	4.2	Low	GC
SS4	200-450	20	39	10	3	26	19	52	10.4	Low	GC
MTS1	200-500	13	35	6.5	1	20	15	64	12.9	Low	GC
MTS2	900-2900	SP	SP	0.5	0	4	46	50	3.9	Low	GP
MTS3	0-400	12	31	6	1	7	15	77	7.8	Low	GC
MTS4	250-600	NP	NP	0	1	10	29	60	9.1	Low	GM
W411A	750-1700	28	56	14	1	12	27	60	13.4	Low	GC
W411B	450-1500	19	44	9.5	1	13	31	55	11.7	Low	GC
W417A	1300-2800	17	40	8.5	1	22	52	25	11.6	Low	SC
W417B	800-2900	15	31	7.5	6	49	31	14	10.7	Low	CL
W452A	500-1800	17	39	9	2	21	42	35	12.5	Low	GC
W452B	350-500	21	38	10.5	3	23	33	41	9.7	Low	GC
W521A	150-350	17	37	8.5	1	7	9	83	6.8	Low	GP-GC
W521B	100-350	8	28	4	1	8	16	75	9.1	Low	GP-GC
W564A	350-950	9	31	4.5	1	6	21	72	10.9	Low	GP-GC
W564B	350-700	4	27	2	1	12	35	52	8.6	Low	GM
BOREHOLES											
E6	500-1500	11	25	5.5	6	49	42	3	12.2	Low	CL
E6	2100-3000	7	22	3.5	2	15	18	65	4.2	Low	GM-GC
E7	500-840	11	25	5.5	9	20	41	30	2	Low	SC
E100	1100-1680	19	44	9.5	6	14	11	69	3.3	Low	GC
W411	550-1500	24	52	12	6	16	31	47	11.9	Low	GC
W417	2180-2980	13	41	6.5	2	19	33	46	10.8	Low	GM
W417	3580-5080	18	42	9	2	26	37	35	26.4	Low	GC

W452	500-950	19	32	9.5	8	46	25	21	6	Low	CL
W564	500-1000	12	51	6	1	7	11	81	5.4	Low	GP-GM

* Insitu Moisture Content ** Potential Expansiveness *** Unified Soil Classification

Table 5-4: Soil Density and Strength Test Results Summary

TP No	Sample Depth (mm)	CBR at					Swell (%)	PI (%)	GM	MDD / OMC	TRH14 Class
		100 %	98%	95%	93%	90%					
E6A	400-2100	20	17	12	9	4	1.33	5	0.59	2006/9.5	G10
E6B	800-1750	17	15	11	8	4	0.94	11	0.77	2026/9.1	G10
E7A	200-500	60	52	40	32	20	0.33	16	2.38	1974/8.9	G9
E7B	300-800	20	18	15	13	10	0.65	19	2.41	2014/12.0	G10
E64A	200-400	20	18	15	13	10	0.28	13	2.61	2056/9.4	G8
E64B	150-400	15	15	14	13	12	0.06	13	2.23	2040/10.0	G8
E100A	300-1100	12	10	8	6	4	0.33	20	2.31	2012/12.1	G10
E100B	400-1500	17	16	14	13	11	1.14	19	2.70	2102/11	G10
SS1	0-100	82	69	49	36	16	0.08	5	2.55	2106/7.8	G5
SS2	0-300	33	29	24	20	14	0.01	7	2.66	2108/8.4	G7
SS3	80-250	33	29	23	19	13	0.17	11	2.44	2130/7.9	G7
SS4	200-450	40	35	26	20	12	0.32	13	2.29	1860/12.5	G8
MTS1	200-500	37	34	30	27	23	0.07	16	2.38	1850/14.3	G8
MTS2	400-900	62	51	34	23	6	0.00	8	2.39	1626/17.3	G7
MTS3	0-400	37	32	24	19	11	0.08	15	2.50	1976/10.7	G9
MTS4	250-600	109	89	57	37	5	0.02	SP	2.43	1612/18.1	G5
W411A	750-1700	51	42	30	21	9	0.81	29	2.00	1598/18.8	G10
W411B	450-1500	23	21	17	15	11	0.33	23	2.14	1762/15.9	G10
W417A	700-1300	16	13	9	7	3	0.06	12	1.82	1766/16.6	G10
W417B	800-2900	33	27	18	12	4	0.20	12	0.98	1766/14.4	G10
W452A	500-1800	55	45	31	21	6	0.08	13	1.94	1832/14.5	G10
W452B	350-500	5	4	3	2	1	1.06	19	2.02	1872/11.7	G10
W521A	150-350	64	54	39	29	14	0.08	18	2.64	1900/12.5	G9
W521B	100-350	62	53	40	31	18	0.18	14	2.61	1896/12.4	G8
W564A	350-950	74	65	52	43	29	0.00	SP	2.59	1730/19.6	G5
W564B	350-700	70	57	39	27	9	0.02	5	1.90	1786/14.8	G6

5.2.3 Rock Strength Tests

Selected samples of intact rock core were collected from foundation influence zones (2 – 4m below existing ground level) in boreholes for Uniaxial Compressive Strength (UCS) tests to determine rock strength and estimate bearing capacity for turbine foundations. The results of the tests are summarised in Table 4.

The tests indicate low UCS values for the weakly cemented calcrete soil at W417 (2.9MPa). The highly

weathered tillite at E7 also displayed relatively low UCS values (9.2MPa) as expected, when compared to the harder, moderately weathered tillite from E64 (50-63MPa). The sandstone from W452 displayed very high UCS values (70-106MPa).

In general, the tests indicate the highly variable strength of the different rock types, with some potentially low UCS values which will have to be factored in to the final foundation design. All tested rock showed, however, UCS values in excess of 2MPa.

Table 5-5: UCS Strength Test Results

BH No	Depth (m)	Strength (MPa)	Failure Type
E7	2.78-3.12	9.2	Shattered
E7	3.17-3.45	29.2	Sheared
E64	1.60-1.87	63.8	Sheared
E64	2.31-2.58	50.0	Shattered
W411	4.93-5.05	14.1	Sheared
W411	7.80-7.93	43.0	Sheared
W417	6.64-6.76	2.9	Shattered
W417	7.43-7.57	2.9	Shattered
W417	10.73-10.93	41.4	Sheared
W452	2.46-2.65	70.8	Shattered
W452	2.65-2.85	106.7	Shattered
W521	2.27-2.46	13.2	Shattered
W521	2.71-2.95	9.6	Shattered
W564	4.96-5.10	27.7	Shattered
W564	6.60-6.72	78.6	Shattered

Selected samples of fragmented rock core were also collected from similar foundation influence zones in borehole cores and subjected to point load strength index (PLT) tests to estimate rock strength and estimate bearing capacity for turbine foundations. The results of the tests are summarised in Table 5.6.

Several of the samples were recorded by the laboratory as fracturing as the test commenced and returned no meaningful results, but several other samples produced results ranging from I_s = 0.2 to 9.1, which roughly correlates to UCS of 4-180MPa. Again, the tests indicate the soft nature of some of the rocks, specifically the shale from E6 and E100 and weathered tillite from E7, and the relatively hard tillite from E64 and W411 and sandstone from W452.

Table 5-6: Point Load Test Results

BH Number	Depth (m)	Point Load (kN)	Point Load strength index I_s
E6	6.57-6.66	0	0.00
E6	6.57-6.66	0	0.00
E6	7.13-7.22	0	0.00
E6	8.00-8.18	0	0.00
E6	8.34-8.46	0	0.00
E7	1.50-1.61	0	0.00
E7	1.61-1.69	0	0.00
E7	2.62-2.70	1	0.29
E64	0.87-1.06	16	4.30
E64	2.62-2.68	2	0.50
E64	3.59-3.70	13	3.28
E100	1.71-1.79	0	0.00
E100	2.00-2.07	0	0.00
E100	10.32-10.42	0	0.00
W411	1.79-1.89	0	0.00
W411	4.65-4.83	12	3.02
W411	4.83-4.88	10	2.52
W417	5.16-5.30	0	0.00
W417	5.30-5.45	0	0.00
W417	5.69-5.79	1	0.27
W417	9.67-9.76	0	0.00
W417	11.30-11.40	6	1.51
W452	2.00-2.08	1	0.27
W452	2.08-2.23	34	9.14
W452	3.92-4.02	17	4.57
W521	2.00-2.15	1	0.25
W521	2.54-2.64	5	1.26
W521	2.95-3.11	0	0.00
W564	2.12-2.24	3	0.76
W564	2.97-3.07	0	0.00
W564	3.07-3.17	12	3.02

5.2.4 Soil and Groundwater Chemistry Results

Representative samples of various soil types were collected for pH and electrical conductivity (EC) to determine the potential aggressiveness (corrosivity) of the soil towards buried structures and underground electrical services. The results of the tests are summarised in Table 5.7.

Table 5-7: Soil corrosivity tests results

TP No	Sample Depth(mm)	pH	EC µS/m
E6A	400-2100	8.09	846
E6B	300-800	7.37	475
E7A	200-500	7.23	287
E7B	300-800	7.39	219
E64A	200-400	6.07	201
E64B	150-400	6.11	213
E100A	300-1100	8.60	361
E100B	400-1500	7.25	463
SS1	0-100	6.20	187
SS2	0-300	6.08	185
SS3	80-250	6.37	212
SS4	200-450	6.61	223
MTS1	200-500	7.48	209
MTS2	400-900	7.58	224
MTS3	0-400	7.67	129
MTS4	250-600	7.97	202
W411A	750-1700	7.70	302
W411B	450-1500	7.55	1685
W417A	1300-2800	7.01	206
W417B	800-2900	7.62	864
W452A	500-1300	8.10	229
W452B	350-500	8.10	272
W521A	150-350	8.26	360
W521B	100-350	7.60	225
W564A	350-900	7.98	250
W564B	350-700	8.00	241

The tests indicate slightly elevated pH levels (alkaline conditions) with sporadic moderate conductivity in some tests, indicating potentially corrosive conditions towards buried metals. The exception being at position WTG E64 and in the vicinity of the Eastern Block proposed substation site, where slightly acidic soils were encountered.

In addition to the soil tests, groundwater samples were also collected from installed standpipes in several boreholes for pH and Electrical Conductivity (EC) tests to determine the corrosivity (acidity and salinity) of groundwater against buried structures and services. This was conducted even though the depth to the groundwater table currently exceeds 8m below natural ground level and would have little effect of foundations, as testing occurred during winter. Seasonal fluctuations of the groundwater table may still result in an upwards movement of the resting groundwater level and proximity to foundations after rainfall events. The results of the tests are summarised in Table 5.8 overleaf.

Table 5-8: Groundwater chemistry tests results

BH No	Depth of water table (m)	pH	EC mS/m
E6	8.81	7.2	101
E7	-	-	-
E64	22.11	6.9	106
E100	16.85	7.3	101
W411	26.27	*	*
W417	23.83	*	*
W452	16.54	8.7	48
W521	26.05	*	*
W564	19.20	8.1	223

The test results indicate slightly elevated pH levels (alkaline) in some samples combined with brackish/slightly saline groundwater quality. The results indicate fairly high dissolved salts (mainly Cl^-), with TDS estimated at 6.7xEC (mS/m). Brackish water can be highly corrosive towards exposed metallic structures and steel reinforcement, requiring adequate concrete cover or polymeric coating.

BS EN1008 does not recommend such water for use in the making of steel-reinforced concrete, nor direct exposure of groundwater towards concrete structures as it registers as being slightly corrosive (chemical environment classified as XA1 in terms of BS EN 206-1). COTO (2018) specifies the maximum EC of water for use in general earthworks and layerworks compaction is 150mS/m. This needs to be accounted for in the final foundation and site structural design.

6 GEOTECHNICAL SITE ASSESSMENT AND RECOMMENDATIONS

The assessment of ground conditions for the establishment of a utility-scale wind farm is a complex and detailed undertaking. The dynamic nature of a turbine necessitates review of a wide variety of geotechnical aspects, including bearing capacity, seismic influences, gapping, overturning, settlement, subgrade reactions, excavatability and buoyancy. Whilst these aspects are taken in to consideration during the Preliminary Geotechnical Study, the early stage of the sequencing of the study does not allow for detailed geotechnical design parameters to yet be isolated for each turbine position. The positions will also in all likelihood, shift somewhat as final layout alterations ensue. The focus of this study is therefore not to provide design calculations for effective foundations, but rather to present the results of the geotechnical information retrieved to date and the general foundation considerations that will apply to the site development.

The Choje site is generally located in a stable geological environment, without the presence of dolomitic risk of sinkholes, active fault lines or notable seismicity. The near-surface rock conditions over much of the site will allow for shifts of turbine positions to made where they lie in localised poor founding. This will

necessitate a detailed geotechnical study to be conducted in order to clearly isolate the most economical founding positions as early as possible.

6.1 Turbine Foundations

As has been discussed in earlier sections of this report, the rockhead contact lies at a relatively shallow depth across most of the site. Wind turbine positions are naturally selected in elevated terrain, and thus these are usually in areas of rock outcrop near to surface. With the wide area selected for the Choje project, however, it is inevitable that some positions will be positioned in floodplains and side slopes, with deeper soil cover. Readers are referred to PP225941-ZACT-R-01-A Choje Wind Farm Desktop Report for a description of the prevailing founding classes on the Choje site.

Review of the 9 borehole profiles indicate the majority as providing bearing on suitable rock types close to surface. Whilst no final selection of turbine model has been made for the Choje site at the time of drafting of this report, and therefore no foundation loadings are available, it may be assumed that a bearing capacity of at least 300kPa will be required, but probably higher than this for the high hub height turbines under contention. “Very soft rock” varies in bearing capacity from 200-400kPa, with a Factor of Safety, whilst “soft rock” may range from 400-950kPa. These values are, however, highly variable and dependent upon structural elements prevailing at the site – very soft rock may still provide sufficient bearing for the turbine, provided the base is designed with a footing broad enough to suit.

The RQD readings for some of the positions with shallow rock still show low values of rock quality in the 3m-below-ground-level range (see W411 and W564). This may be ascribed to the high degree of fracturing of notably the tillite and shales. This is a factor to account for, however may also be factored into a suitable design as there will be confining pressure on the in-situ material below the foundation from the surrounding country rock. Therefore, even though the rock is highly fractured, it could potentially still provide adequate founding. The exception may be in areas of high groundwater table, where a fractured substrate could allow for hydraulic “pumping” under the dynamic load fluctuations of the turbine. This could serve to degrade the foundation base. The deep groundwater table in the area, however, suggests this would be unlikely.

For founding at positions of shallow rock head contact, a standard shallow gravity foundation is predicted as being suitable. Embedment depth would be at least 3m it is anticipated, which will require hard excavation at a number of the positions, either through the use of an excavator-fitted rock pecker, or through directional blasting. Footing design in rock should account for the impermeable nature of the substrate and make allowance for buoyancy.

Boreholes E6 and W417 demonstrated ground conditions that are less favourable and would therefore call for an adapted design. E6 displayed sandy cover to just under 3m and then highly to completely weathered, very soft rock with almost total core loss to 6.0m, associated with its position in a non-perennial drainage line and the resultant alluvial deposition. W417 showed highly weather calcareous silt (poorly formed calcrete) in excess of 10m depth, which is problematic from a weak cementation of grains and potential collapsibility point of view. It is also indicative of “pseudo-karst” features prevailing in the area, where calcrete formation may allow for the presence of small voids in the profile. It such positions the turn=bines should potentially be relocated to nearby sites of more favourable founding. Where relocation is not possible, the foundation design will need to be adapted to suit, as well as the in-situ bed preparation prior to the casting of the base. Ground improvement techniques may here be considered, such as dynamic compaction.

The foundation should be over-excavated, and an improved engineered soil raft be constructed. The soil raft should make use of a minimum of G5 – G3 aggregate quality imported material, deposited in maximum of 200mm layers and compacted from 95% to 98% MDD, above which the gravity footing may be commenced. The depth of the improved soil raft will be a function of the final WTG footing size, and its ensuing pressure bulb's zone of influence.

The position E100 demonstrated very soft rock and RQD readings of "0" for much of its upper extent. Where potentially compressible substrate is located 3-5m below surface, engineered soil rafts are usually considered. It is therefore deemed to be a borderline position, which may or may not require an adapted design with improved soil raft. Dynamic compaction would be deemed unsuitable at this position. Further investigatory techniques, such as the dynamic probing super-heavy and geophysics utilised during the detailed geotechnical investigation, would assist in developing the design for this position further.

An alternative solution for turbines located in deep soil cover may also involve piling. The merits of piling at each position are dependent upon the shear friction that may be expected from the surrounding substrate, and the depth to a competent terminating horizon.

For gravity foundations on slopes, the distance between the edge of the foundation and the slope face (measured horizontally at the foundation level) should ideally be not less than 1x the diameter of the foundation. Furthermore, turbine foundations should ideally not be located on slopes which exceed 18°.

Turbine positions located within the 1:100-year floodline should be relocated wherever possible to higher ground. The Somerset-East area is well-known for the potential occurrences of flash-flooding, which may cause significant erosional forces and foundation undermining, should it reach turbine positions.

6.2 Crane Platforms and Access Roads

Trial pits excavated at turbine positions were used to estimate the material properties and depth of cover, whilst DCP testing was conducted in order to inform on soil densities in the area. The results show a dense soil cover generally across the area, widely inculcated with calcrete deposition to varying degrees. Cobbles and boulders are frequent in the upper profile. Clay percentages are mostly low, with heave not anticipated to be a developmental concern. Most DCPs refused close to surface, on dense soils or cobbles. Crane pads are therefore judged to be constructed in the standard manner. Development of the crane platform should proceed with the topsoil being retrieved to a depth of 300mm or hard rock, and stockpiled for later landscaping use. A mixture of soil and rock material excavated from road box cuts and lay down areas may then be used for bulk filling on platforms (cut to fill platforms), provided it meets the minimum specifications (recommended minimum G9 for bulk fill on platforms, compacted to 93% MDD, rockfill, compacted to 8 roller passes). Layers of imported G5 material should then comprise the upper layers, placed in 200mm increments and compacted to 95% MDD at OMC.

The site topography will exert a significant control over the access road layout. Consideration should be given to existing access roads and stream crossings to minimise impacts of earthworks on the site.

Allowance should be made for hard excavations in road box cuts and lay down areas on sloping terrain. Bulk fill materials should be adequately benched into the *in-situ* sloping ground to prevent sliding of the wedge of fill material. The maximum safe slope of permanent road fill embankments is 1v:2h. Pipe or box culverts will

be required to cross dry riverbeds and streams, and this will require environmental consideration. Adequate camber and side drains should be accommodated in the design of internal access roads to ensure accessibility during peak rainfall events. Access road design widths for blade transport is usually 4.5-6m, as designed by the project pavement engineer. Subsoil drains along roads are not envisaged but may be considered along major access routes.

6.3 Slope Stability

The site topography is characterised by hilly terrain with some steep slopes. The steep hills and ridges are typically underlain by shallow, relatively stable rock formation and global stability problems are unusual. Local stability problems may be encountered adjacent to natural drainage lines where soil cover is typically thicker and stream embankments may be eroded and undermined during peak flood events.

No cuttings were investigated as part of this initial geotechnical study. Any proposed access road cuts in excess of 5m should be drilled as part of the detailed study in order to review the stability and inform on the most appropriate angle of inclination. The Cape and Karoo sediments in the area are relatively horizontal in dip in the low-lying areas, however this changes to near-verticle dipping angles close to ridegelines. Tillite is highly variable in not only composition and weathering, but dip angle as well and should be treated with caution when designing cuttings.

Small portions of the site are also crossed by Jurassic-age dolerite dykes. These form longitudinal ridges that are very resistant to weathering and erosion, as a result of dolerite's high strength and durability. Aggressive blasting may be required to remove unweathered dolerite where access roads are aligned through a ridge.

6.4 Site Structures

The proposed position of the substation in the Eastern Block showed shallow rock conditions, with no trial pit progressing deeper that 0.6m below current ground level. All samples showed silt, sand and gravel, with low activity values bar a single sample from trial pit SS4 between 0.2-0.45m depth which showed a linear shrinkage value of 10. LS values in excess of 8 may be prone to moisture-related shrinkage and lead to cracking of overhead structures. Owing to the shallow depth to rock however, this is not viewed as a significant concern. Structures should proceed on standard strip footings, placed upon medium hard rock at 0.4-0.6m.

The proposed position of the 400MTS in the Western Block showed variability of soil cover. Most trial pits refused at a shallow depth of 0.7m, however one pit proceeded to 2.9m depth without refusing. This may indicate that the three other pits refused on boulders in the profile, and actual rockhead depth is in excess of 3m, or alternatively that the 2.9m pit was positioned over a cavity or rock contact depression. It is recommended that additional pits are excavated at this position prior to foundation design.

All vegetation must be cleared from the areas over which any structures are to be constructed. Furthermore, the upper 200 mm of topsoil must be removed and stockpiled for later use in landscaping / rehabilitation. Cavities remaining in the soil profile must be refilled with a suitable cement-like fill material and re-compacted to a similar density as the surrounding soils.

6.5 Excavatability

Section 4 of this report detailed excavatability conditions that may be expected along the access road routes and provided guidelines for excavation classes. Earthworks and excavations at the turbine positions themselves are likely to encounter bedrock and/or boulders which require special consideration in terms of excavatability. Hard excavations, requiring blasting or wedging and splitting are likely to be encountered at depths beyond 1m in many parts of this site.

Table 6.1 overleaf reflects the estimated excavation conditions that may be expected at the nine drilled turbine positions and is based upon the SABS 1200D (1988) excavation classes. Maximum expected founding depth of 5m has been assumed, with conditions divided into reaches of 0-1m, 1-3m and 3-5m depths.

Table 6-1: Borehole excavatability estimations

PREDICTED EXCAVABILITY CONDITIONS			
Position	Depth (m)		
	0.0 - 1.0m	1.0 - 3.0m	3.0 - 5.0m
WTG E6	**S**	**S**	**I**
WTG E7	**S**	**H**	**H**
WTG E64	**S**	**H**	**H**
WTG E100	**S**	**I-H**	**H**
WTG W411	**S**	**S-H**	**H**
WTG W417	**S**	**S**	**S**
WTG W452	**S**	**H**	**H**
WTG W521	**S-I**	**H**	**H**
WTG W564	**S**	**A-H**	**H**

S - Soft Excavation

I - Intermediate Excavation

H - Hard Rock Excavation

A - Boulder Class A

B - Boulder Class B

Challenging rocky outcrops presenting obstacles to access roads and level platforms may be expected where positions are located on slopes. Neat excavations are generally not expected possible for many of the Choje positions, with a significant amount of overbreak anticipated along trenches.

Maximum slope angles for temporary excavations for turbine foundations and cable trenches are 1v:0.5h in rock and 1v:1h in soil. Temporary lateral support measures may be required where deep excavations are anticipated.

6.6 Use of on-site materials

Preliminary laboratory testing has shown that multiple sources of good construction material persist across the site, particularly where hard rock is located close to surface. As such positions a single or multi-stage crusher may be deployed to service a few nearby turbine positions and be calibrated to produce selected and subbase grade materials.

Several borrow pits are located across the Choje site, most of which are developed by the Department of Roads & Transport. These BPs are currently the source of a separate licencing study being undertaken, however indicate a good availability of G5-G7 grade natural gravels.

Potential may also exist for good quality concrete and bedding sand in alluvial courses on the site, such as near to position E6. These should be explored in greater detailed by way of trial pits and channel sampling during further studies.

Caution should be extended to the use of Karoo mudrock on the site. Such strata, identifiable by their purple and olive-green varietals, appear moderately weathered and medium hard upon excavation, however rapidly degrade in the presence of exposure to air and the absorption of water vapour into the clay particle interlays of the rock. This results in particle expansion and degradation of the material to a completely weathered state in a few weeks. Should mudstone be utilised on access roads at Choje, it is suggested to be added as a binder material to a coarser particle mix. Alternatively, the material may be excavated and emplaced into the road prism and then quickly covered by successive pavement layers, before degradation takes place.

Naturally occurring hardpan calcrete is also widely occurring across the site, although wasn't specifically targeted or sampled during the course of this study. Calcrete in its well-formed state often occurs as an upper crustal surface phenomenon, and therefore is unlikely to be deposited in thicknesses deeper than 1-2m, however is widespread and may yield quality in the G5-G7 range. Where it has been further weathered, it may develop a higher PI and then could also be used as a binder material to hard-crushed aggregate.

The use of hard rock as concrete aggregate is yet to be explored at the Choje site. A commercial quarry located in the Western Block (*Irhafu Middleton Quarry*) currently provides multiple grades of good quality dolerite, which will serve as an acceptable concrete aggregate. For development of the projects in the Eastern Block the economic viability of transport from this commercial quarry to the site will need to be assessed. Should it prove too costly, then a new aggregate source in the Eastern Block should be developed. Initial reconnaissance indicates that potential hard sandstone is available, as well as possibly unweathered tillite. Both sources would require drilling and sampling. The testing of tillite would need to include thin-section analysis for deleterious minerals, as clast inclusions sometimes have the propensity for alteration to clay-minerals with time.

6.7 Site Drainage

The Choje site is cross by a great number of non-perennial drainage lines, as well as permanent river bodies. As mentioned previously, the site is arid with a low rainfall - 683mm per annuum recorded for Grahamstown (Climate-Data.org, 2019). The site is also traversed by the Department of Water Affairs administered irrigation canal.

Drainage lines are subject to rapid flash-flooding and erosion after heavy precipitation events. Caution must therefore be assumed in the stream protection of stream routes around working areas on the site, as well as turbines bases and crane platforms. The use of gabions and reno mattresses is advised for anti-erosional measures.

The groundwater table was measured in all boreholes and found to lie beyond the current depth of influence of turbine foundations. Quarterly inspections of the groundwater table in boreholes will be conducted over the next 12 months as an ongoing monitoring programme. This report may also be read in conjunction with

the DNV GL subcontracting geohydrologist's report "*Desktop Groundwater Feasibility Assessment for Choje Windfarm Projects, Eastern Cape",* and referenced 005020R01.

6.8 Further Studies Required

This report represents the findings of a preliminary geotechnical study, performed to obtain initial ground data on the site as a whole. Prior to finalisation of design, a detailed geotechnical study will need to be performed. As a minimum, this should include the following:

- Rotary core drilling of each proposed foundation position to a depth not less than 1.5B, where B = diameter of the proposed WTG foundation footing. Sampling and logging of all trial pits according to South African standards by a professional engineering geologist;
- Excavation of trial pits for bulk material sampling at each turbine position, as well as nearby crane platform positions. Sampling and logging of all trial pits according to South African standards by a Professional Engineering Geologist;
- Excavation of trial pits for bulk material sampling along access road routes. Trial pit frequency of a minimum of 1km intervals, staggered on alternating sides of the centreline, is advised. Sampling and logging of all trial pits according to South African standards by a Professional Engineering Geologist;
- Retrieval of samples of rock core, disturbed and undisturbed soil and water samples for laboratory analysis. Advanced geotechnical testing;
- Evaluation of subsurface density conditions through the use of DCP and DPSH testing at turbine, road access and structural positions as directed;
- Retrieval of p- and s-wave ground propagation data through the use of CSW and MASW geophysics tests. It is advised to utilise both forms of testing on the site, as CSW may provide better information in the near-surface environment, however MASW will be more effective in the harder rock and deeper penetration of the Karoo and Cape formations;
- *In-situ* electrical resistivity testing at substation positions and selected turbines;
- *In-situ* thermal resistivity testing at selected positions along primary cable routes;
- Further material sources reconnaissance studies as required for hard rock aggregate in the Eastern Block;
- Production of a detailed geotechnical investigation report for each sub-windfarm site detailing all required geotechnical parameters for effective WTG foundation design, as well as cable routes, access roads
- Confirmation of geotechnical conditions expected at each turbine location by a professional engineering geologist or geotechnical engineer during construction. Inspections to be performed after excavation of turbine bases, prior to foundation casting to identify any soft spots, unexpected structural variations or groundwater fissures.

7 CONCLUSION

DNV GL has conducted a preliminary geotechnical investigation for the proposed development of a cluster of utility-scale wind farms between Grahamstown and Somerset East, Eastern Cape. The site was investigated by rotary core drilling, trial pitting, in-situ density testing as well as laboratory soil and groundwater testing.

The site has been found to be favourable for the development of wind turbine generators and associated civil roads and structures. Colluvium, alluvium, residual soils, mudstone, siltstone, tillite and sandstone characterised the trial pit profiles and borehole logs across the investigation site. Comment on the excavatability of the material has been provided for the proposed access roads and turbine positions. It is envisaged that hard excavation techniques will predominantly be required across the site due to the shallow depth to rock encountered, but that in an estimated 30% of positions softer ground conditions may prevail.

A required bearing capacity and founding depth was not provided for the site, as turbine selection is still ongoing. It is estimated, however, that a bearing capacity of approximately 300 kPa is available at a depth of 2-3 m across most of the site, except at a lesser number of weathered positions where an adapted foundation design will be required in the form of ground improvement and engineered soil rafts.

Buoyancy conditions may occur at positions in hard rock after heavy rainfall events, where surface drainage has not been adequately designed to prevent water ingress to the foundation excavation. In other positions, however, the deep water table would negate the threat of buoyancy.

Assessment of the rotational stiffness is dependent on the stiffness limits placed on the design by the turbine manufacturer. These have not yet been assessed for the site or a specific turbine model.

The extent of the investigations undertaken is deemed adequate, within the time and budget constraints, to present an overview of the geotechnical conditions across the investigation site.

It must be borne in mind that the overall interpretation of geotechnical conditions is based upon point information derived from the respective test positions and that conditions intermediate to these have been inferred by interpolation, extrapolation and professional judgement. The interpretation of the geotechnical conditions is based on information available at the time of drafting this report by DNV GL South Africa and it's partners.

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APPENDIX A – BOREHOLE & TRIAL PIT ORIENTATION PLANS

Legend

- Test Pit
- Borehole

E6
Latitude: -33.207728
Longitude: 26.44335

0 100 200 Meters

WIND RELIC RENEWABLES

Choje Windfarm Preliminary Geotechnical Investigation

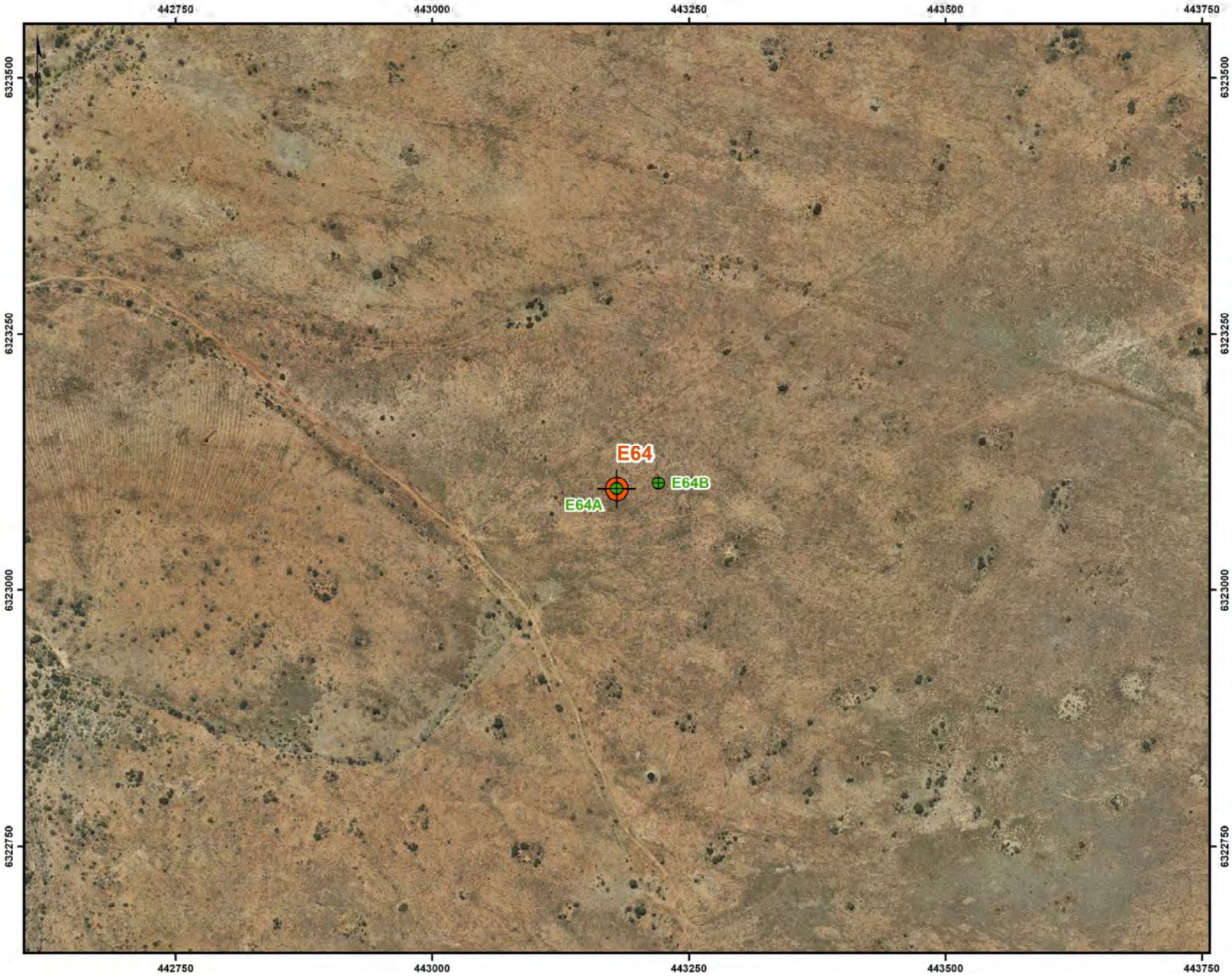
Figure 3: Borehole E6

10167003-190913-LB

DNV·GL

September 13, 2019

Projection: UTM 35S, WGS84
Sources: ArcGIS Online, AAM Survey (2018)



Legend

- Test Pit
- Borehole

E64
Latitude: -33.22955
Longitude: 26.390172

0 100 200 Meters

WIND RELIC RENEWABLES

Choje Windfarm Preliminary Geotechnical Investigation

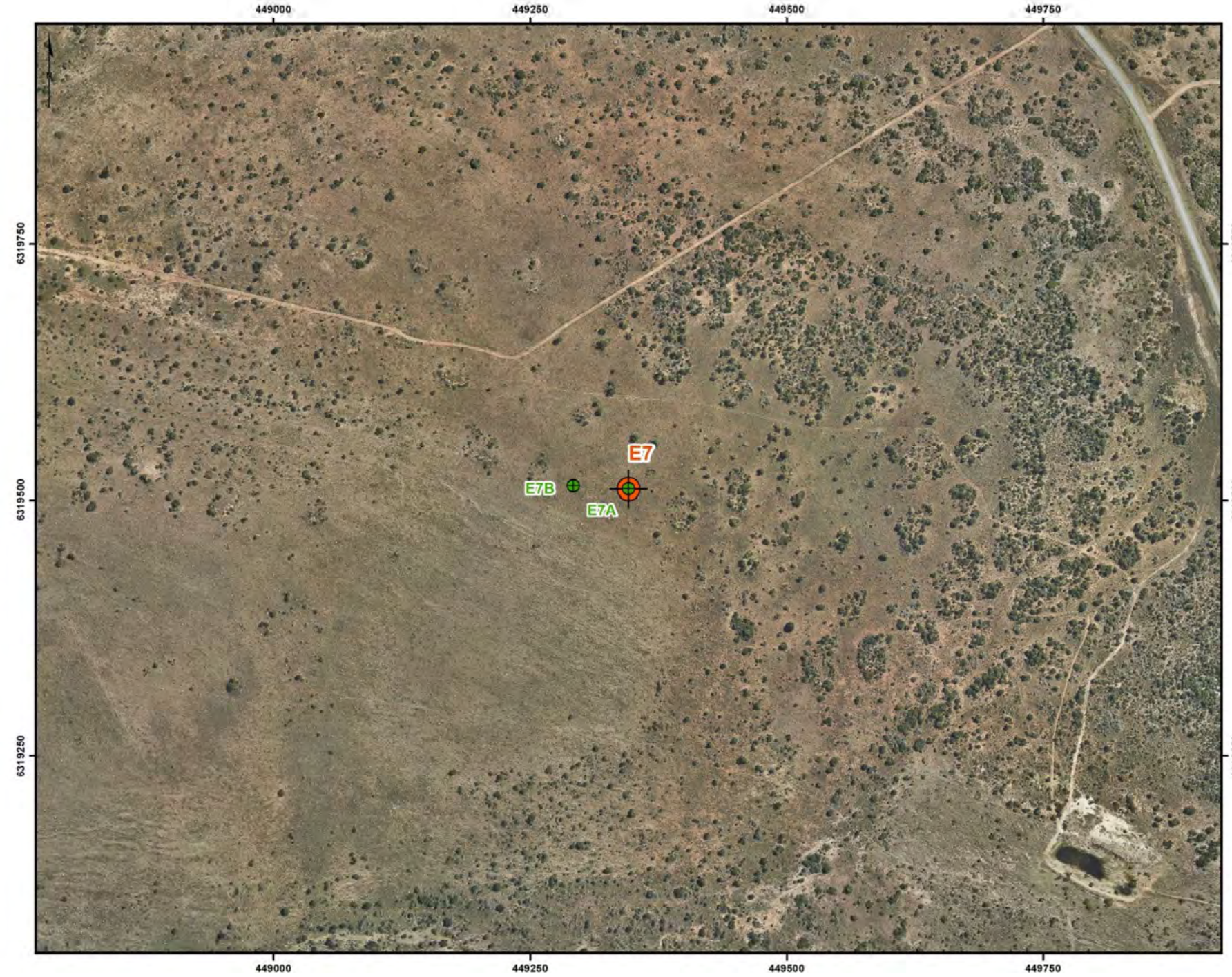
Figure 4: Borehole E64

10167003-190913-LB

DNV·GL

September 13, 2019

Projection: UTM 35S, WGS84
Sources: ArcGIS Online, AAM Survey (2018)



Legend

- Test Pit
- Borehole

E7
Latitude: -33.262219
Longitude: 26.456147

0 100 200 Meters

WIND RELIC RENEWABLES

Choje Windfarm Preliminary Geotechnical Investigation

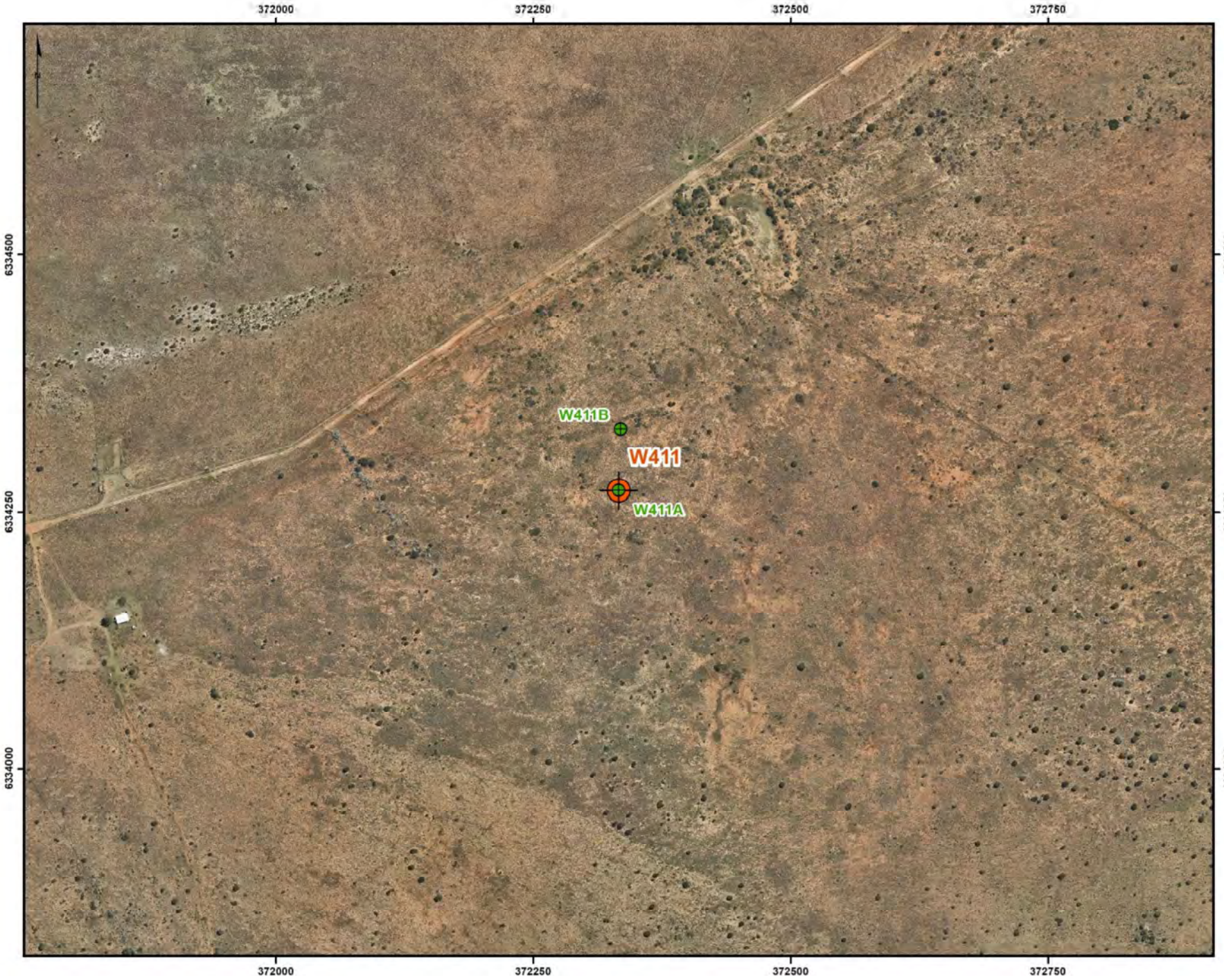
Figure 5: Borehole E7

10167003-190913-LB

DNV·GL

September 13, 2019

Projection: UTM 35S, WGS84
Sources: ArcGIS Online, AAM Survey (2018)



Legend

- Test Pit
- Borehole

W411
Latitude: -33.122756
Longitude: 25.631503

0 100 200 Meters

WIND RELIC RENEWABLES

Choje Windfarm Preliminary Geotechnical Investigation

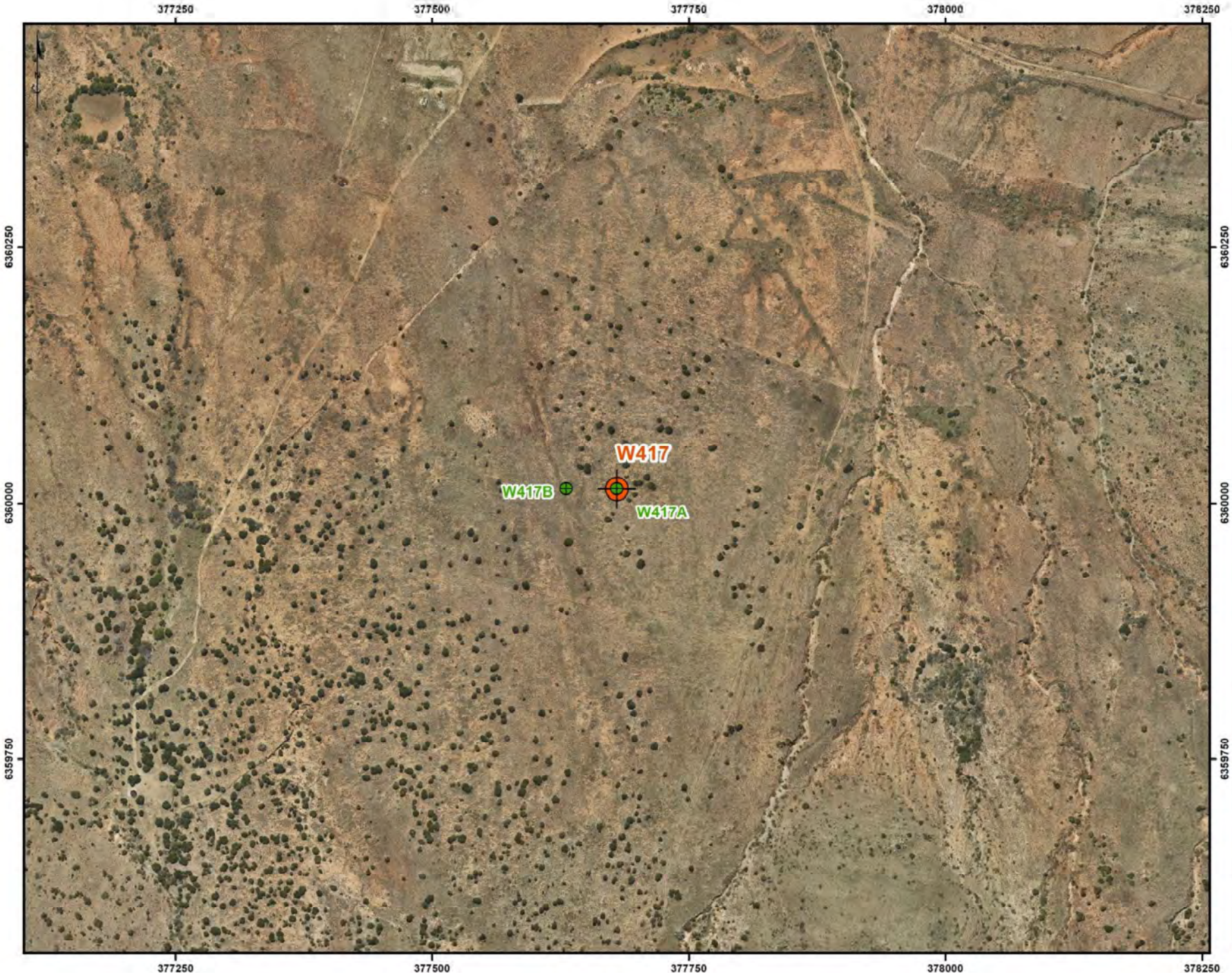
Figure 6: Borehole W411

10167003-190913-LB

DNV·GL

September 13, 2019

Projection: UTM 35S, WGS84
Sources: ArcGIS Online, AAM Survey (2018)



Legend

- Test Pit
- Borehole

W417
Latitude: -32.891221
Longitude: 25.692235

0 100 200 Meters

WIND RELIC RENEWABLES

Choje Windfarm Preliminary Geotechnical Investigation

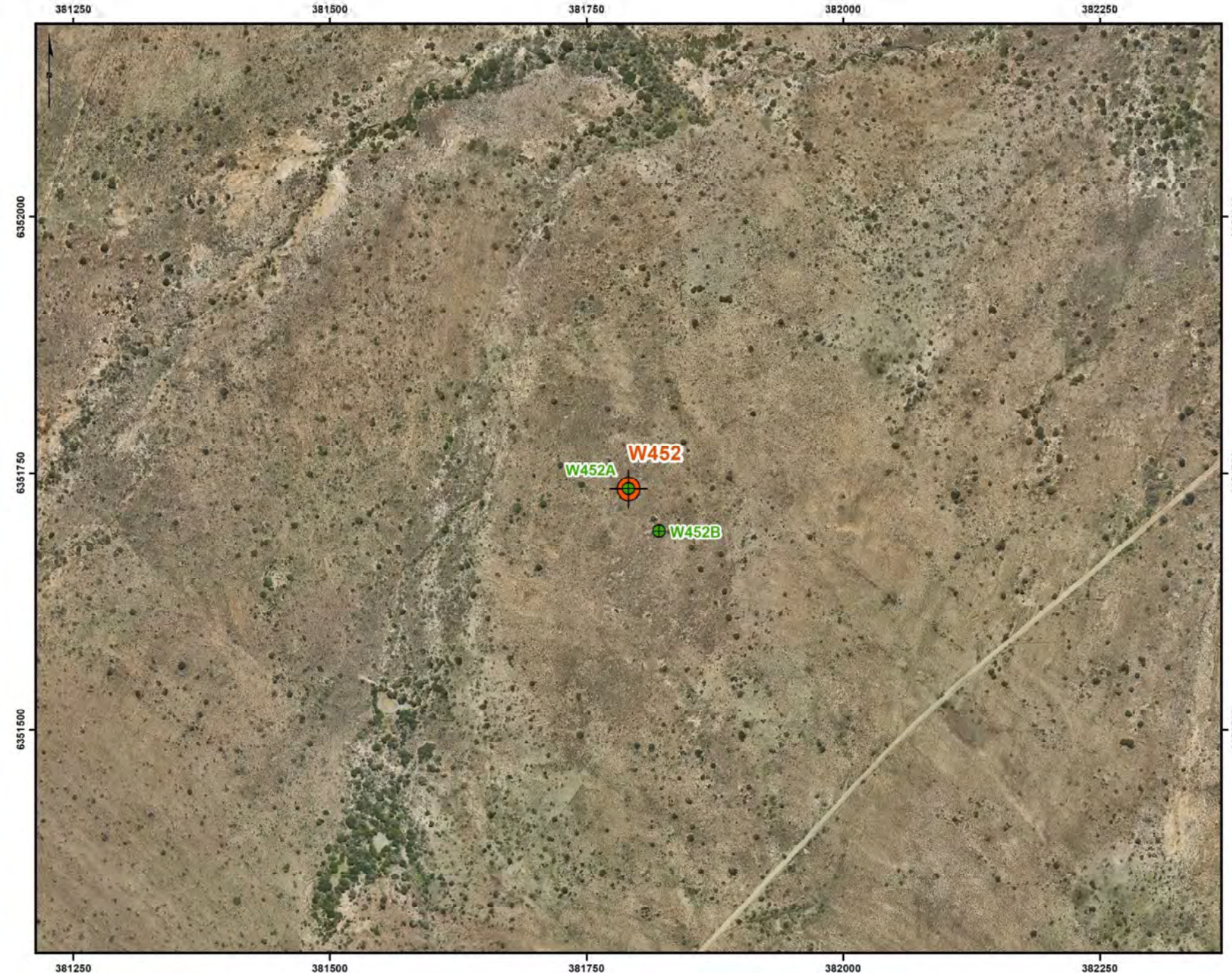
Figure 7: Borehole W417

10167003-190913-LB

DNV·GL

September 13, 2019

Projection: UTM 35S, WGS84
Sources: ArcGIS Online, AAM Survey (2018)



Legend

- Test Pit
- Borehole

W452
Latitude: -32.966336
Longitude: 25.735117

0 100 200 Meters

WIND RELIC RENEWABLES

Choje Windfarm Preliminary Geotechnical Investigation

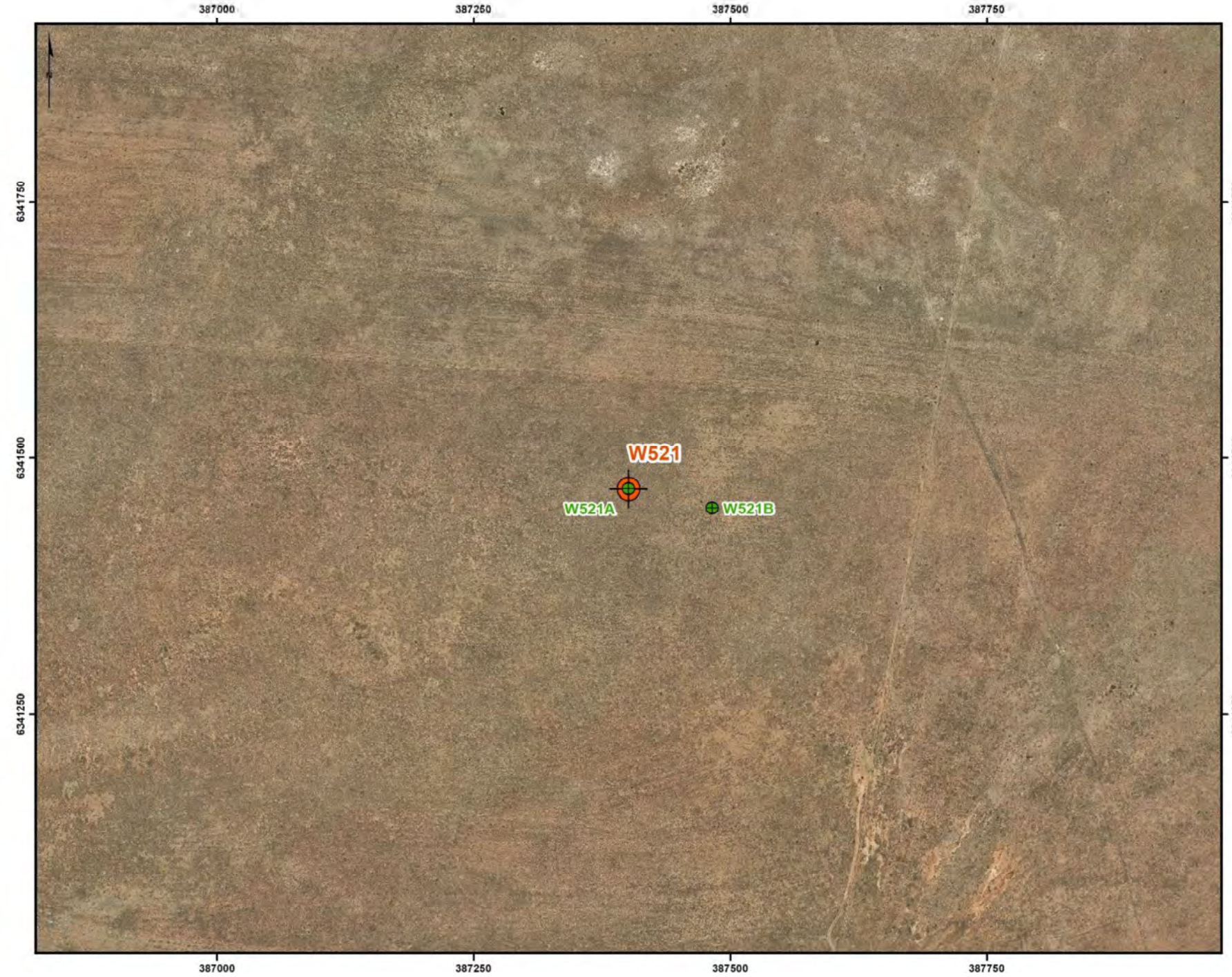
Figure 8: Borehole W452

10167003-190913-LB

DNV·GL

September 13, 2019

Projection: UTM 35S, WGS84
Sources: ArcGIS Online, AAM Survey (2018)



Legend

- Test Pit
- Borehole

W521
Latitude: -33.059503
Longitude: 25.793875

0 100 200 Meters

WIND RELIC RENEWABLES

Choje Windfarm Preliminary Geotechnical Investigation

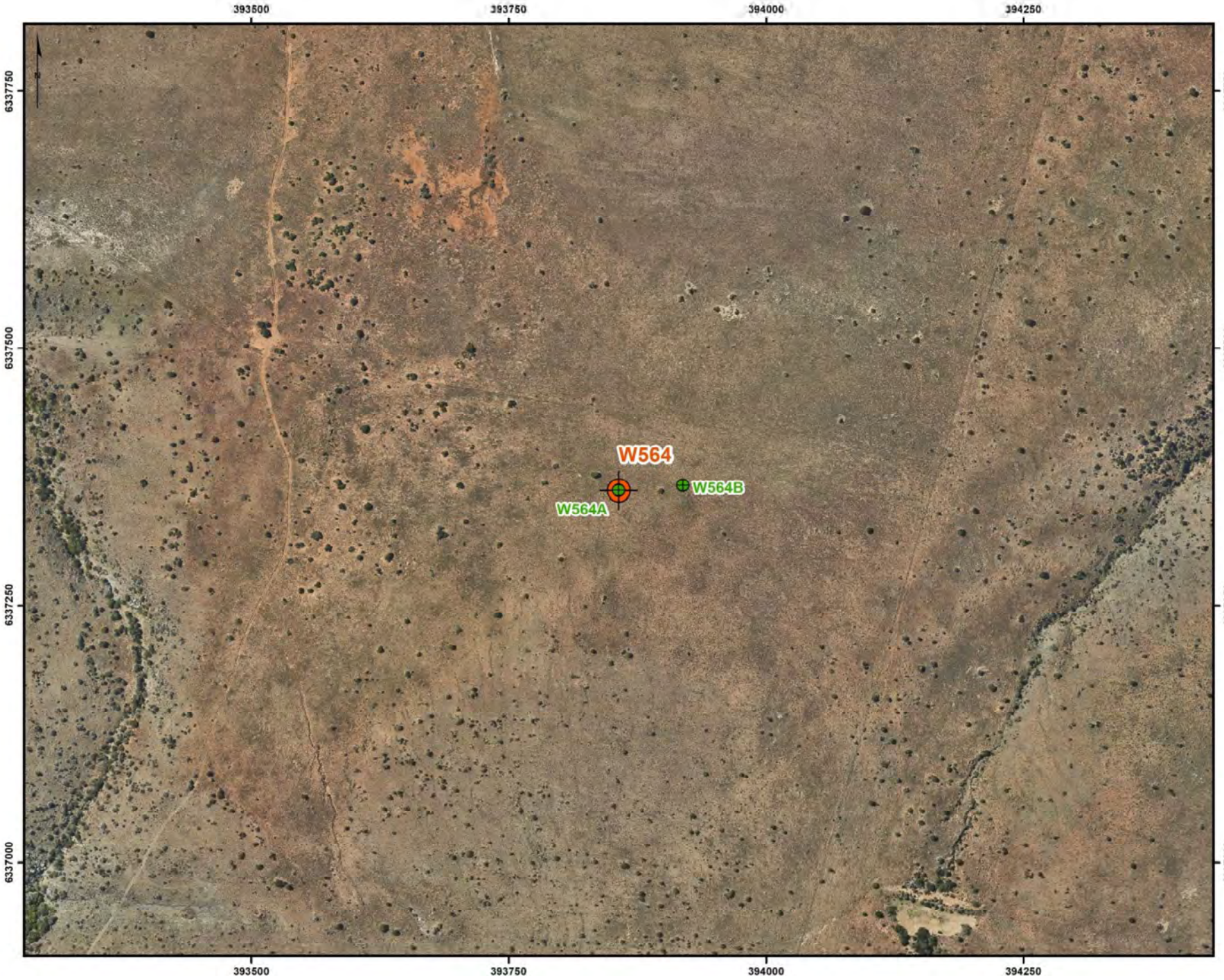
Figure 9: Borehole W521

10167003-190913-LB

DNV·GL

September 13, 2019

Projection: UTM 35S, WGS84
Sources: ArcGIS Online, AAM Survey (2018)



Legend

- Test Pit
- Borehole

W564
Latitude: -33.0972
Longitude: 25.862539

0 100 200 Meters

WIND RELIC RENEWABLES

Choje Windfarm Preliminary Geotechnical Investigation

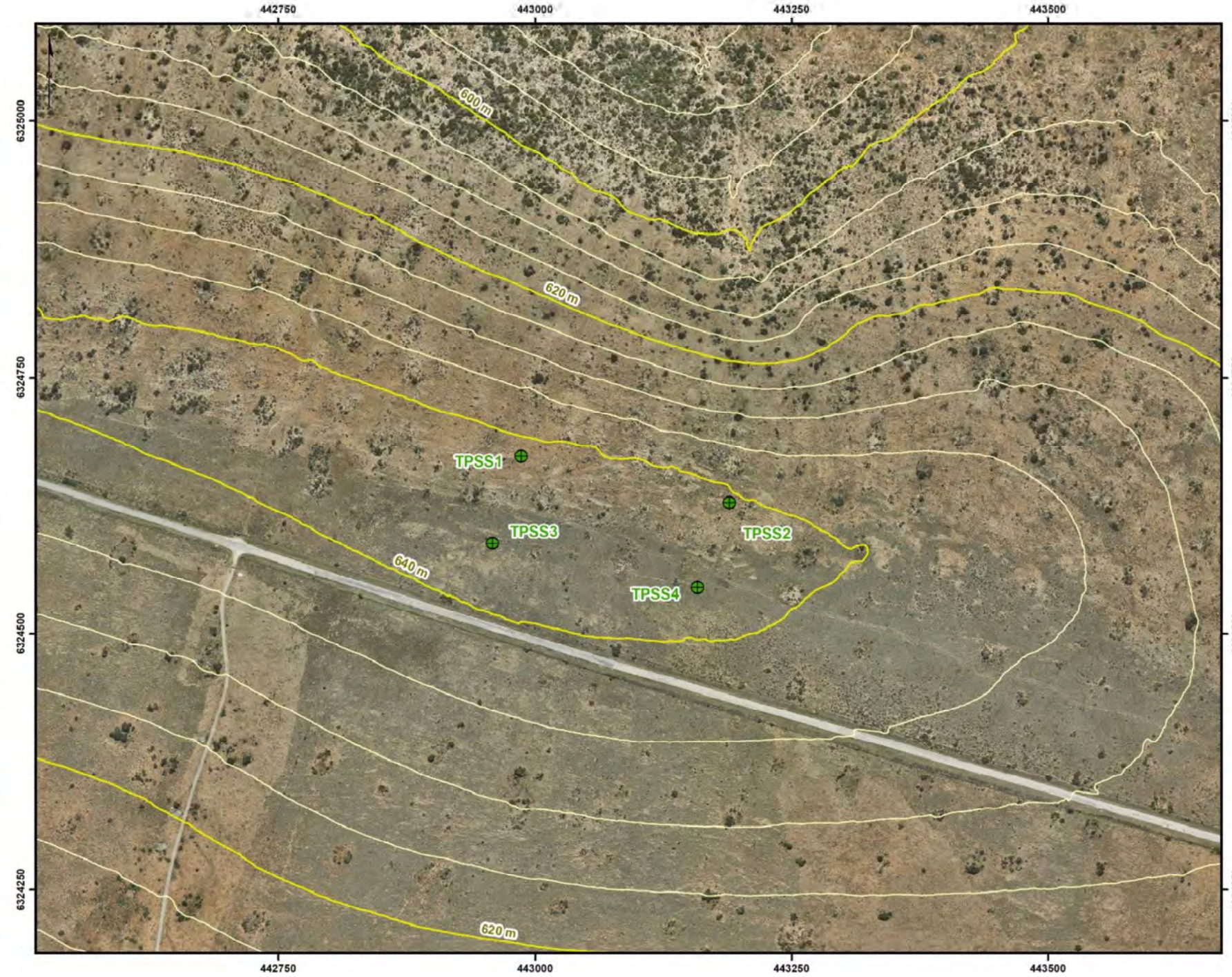
Figure 10: Borehole W564

10167003-190913-LB

DNV·GL

September 13, 2019

Projection: UTM 35S, WGS84
Sources: ArcGIS Online, AAM Survey (2018)



Legend

- Test Pit

Elevation Contours

- 5 m Contour
- 20 m Contour

TPSS1
Latitude: -33.215345
Longitude: 26.388198

0 100 200 Meters

WIND RELIC RENEWABLES

Choje Windfarm Preliminary Geotechnical Investigation

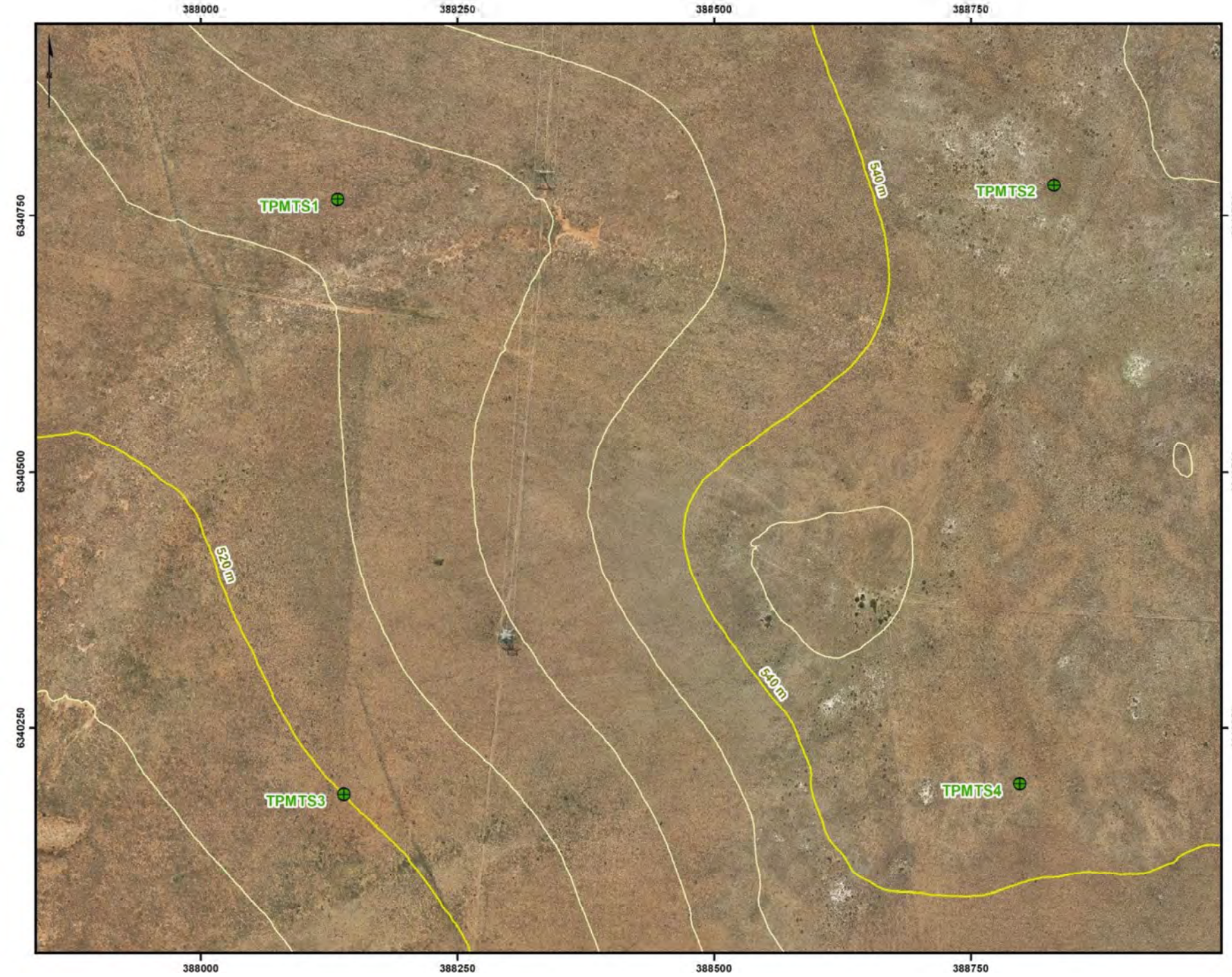
Figure 11: East Block Substation Test Pits

10167003-190925-LB

DNV·GL

September 25, 2019

Projection: UTM 35S, WGS84
Sources: ArcGIS Online, AAM Survey (2018)



Legend

- Test Pit

Elevation Contours

- 5 m Contour
- 20 m Contour

TPMTS1
Latitude: -33.065931
Longitude: 25.801633

0 100 200 Meters

WIND RELIC RENEWABLES

Choje Windfarm Preliminary Geotechnical Investigation

Figure 12: West Block Substation Test Pits

10167003-190925-LB

DNV·GL

September 25, 2019

Projection: UTM 35S, WGS84
Sources: ArcGIS Online, AAM Survey (2018)

APPENDIX B – BOREHOLE LOGS

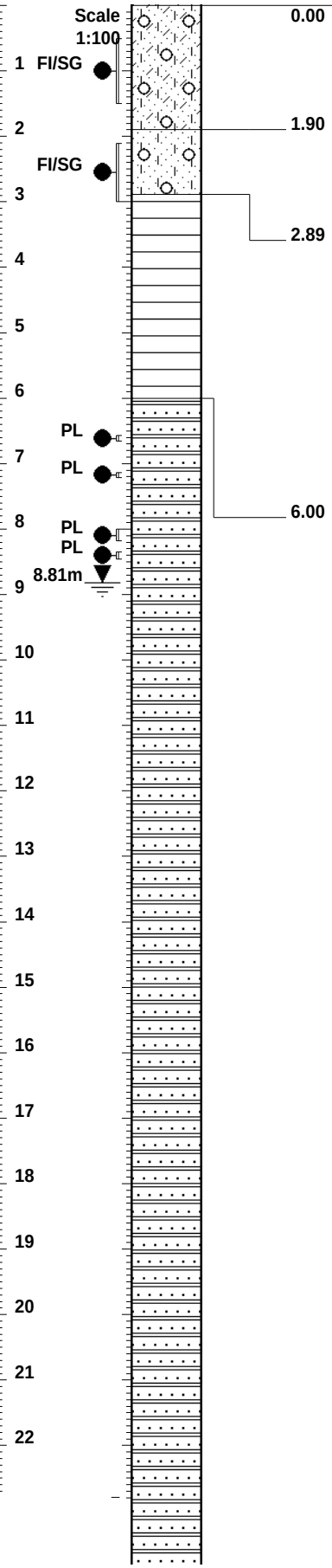
OUTENIQUA GEOTECHNICAL SERVICES

CORE BOREHOLE LOG
CLIENT: WIND RELIC/DNV GL
SITE: EASTERN BLOCK
CONTRACT NO.: CHOJE WIND FARM

HOLE No: E6
Sheet 1 of 2

JOB NUMBER: 000

Core size	% Mat. recov.	% Core recov.	RQD%	Frac. Freq.	SPT
HQ3	98	0	0	0	
HQ3	95	0	0	0	
SPT	87	0	0	0	R
HQ3	90	0	0	0	
HQ3	94	0	0	0	
SPT	0	0	0	0	R
HQ3	27	13	0	8	
HQ3	26	0	0	9	
HQ3	4	4	0	1	
SPT	0	0	0	-	R
HQ3	26	0	0	6	
HQ3	76	65	14	11	
HQ3	67	67	39	3	
HQ3	107	104	55	12	
HQ3	91	81	33	>20	
HQ3	105	94	20	>20	
HQ3	91	87	14	20	
HQ3	93	76	22	>20	
HQ3	87	80	31	17	
HQ3	45	29	0	15	
HQ3	60	0	0	8	
HQ3	45	18	0	10	
HQ3	92	92	43	16	
HQ3	105	93	28	>20	



CLAYEY GRAVELLY SILTY SAND
Dark red orange, CLAYEY GRAVELLY SILTY SAND, alluvium.

GRAVELLY SILTY SAND
Light brown, GRAVELLY SILTY SAND, residual.

SILTSTONE
Light brown, highly weathered, fine grained, massive, very highly fractured, fractures slightly rough, horizontal, narrow to wide, stained, very soft rock, horizontally bedded Lake Mentz Fm SILTSTONE.
Note:
1. Significant core loss.

SILTSTONE/SHALE
Dark grey to black, moderately weathered, fine grained, very intensely to intensely laminated, highly to very highly fractured, fractures slightly rough, horizontal, narrow to closed, stained, soft to medium hard rock, horizontally bedded Lake Mentz Fm SILTSTONE/SHALE with minor sandstone lenses.

OUTENIQUA GEOTECHNICAL SERVICES

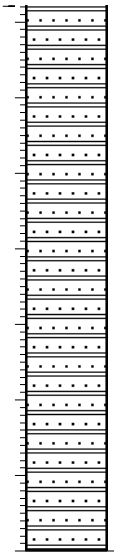
CORE BOREHOLE LOG
CLIENT: WIND RELIC/DNV GL
SITE: EASTERN BLOCK
CONTRACT NO.: CHOJE WIND FARM

HOLE No: E6
Sheet 2 of 2

JOB NUMBER: 000

Core size	% Mat. recov.	% Core recov.	RQD%	Frac. Freq.	SPT
HQ3	101	94	0	>20	
HQ3	93	91	18	>20	
HQ3	93	88	7	>20	
HQ3	94	92	8	>20	
HQ3	125	117	21	>20	

23
24
25
26
27
28
29
30



30.00

Hole stopped. End of Log.

NOTES

1) End of hole at 30.00m

2) Samples: FI/SG at 0.50m--1.50m, FI/SG at 2.10m--3.00m, PL at 6.57m--6.66m, PL at 7.13m--7.22m, PL at 8.00m--8.18m, PL at 8.34m--8.46m

3) Standpipe installed - resting water table at 8.81m - samlpe taken

4) SPT= Standard penetration test

5) R=Refusal

CONTRACTOR : Earthtech
MACHINE :
DRILLED BY : Aubrey
LOGGED BY : I Paton

INCLINATION : -90°

DATE DRILLED : May 2019
DATE LOGGED : July 2019

ELEVATION :
X-COORD : X3675924
Y-COORD : 27 Y0051899

HOLE No: E6

TYPE SET BY : S Gallant
SETUP FILE : SANRAL.SET

DATE : 29/08/2019 16:53
TEXT : C\dot7000\network\E6.txt

CONTRACT: CHOJE WIND FARM, EASTERN CAPE	**BOREHOLE NO: BH E6 SHEET 1/2**
CLIENT: DNV GL/WIND RELIC	

CONTRACT: CHOJE WIND FARM, EASTERN CAPE	**BOREHOLE NO: BH E6 SHEET 2/2**
CLIENT: DNV GL/WIND RELIC	

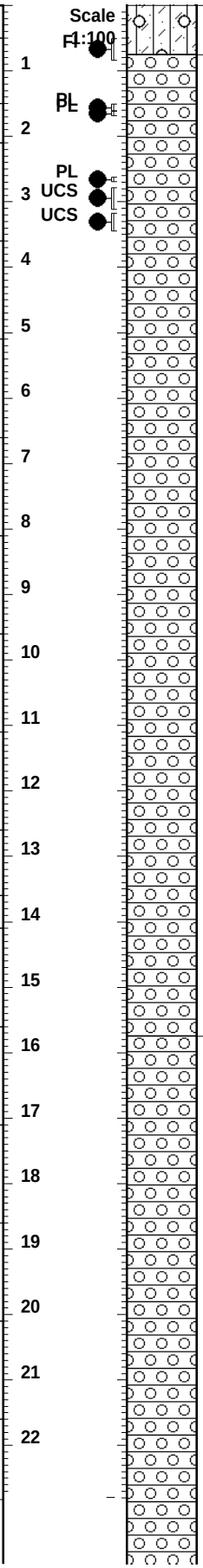
OUTENIQUA GEOTECHNICAL SERVICES

CORE BOREHOLE LOG
CLIENT: WIND RELIC/DNV GL
SITE: EASTERN BLOCK
CONTRACT NO.: CHOJE WIND FARM

HOLE No: E7
Sheet 1 of 2

JOB NUMBER: 000

Core size	% Mat. recov.	% Core recov.	RQD%	Frac. Freq.	SPT
HQ3	60	0	0	0	
HQ3	89	32	23	>20	
SPT	0	0	0	0	R
HQ3	103	83	72	3	
HQ3	79	63	37	15	
HQ3	100	100	96	3	
HQ3	91	87	43	10	
HQ3	95	95	85	7	
HQ3	85	79	60	7	
HQ3	88	85	29	>20	
HQ3	90	72	40	17	
HQ3	83	38	10	18	
HQ3	74	42	20	7	
HQ3	69	31	17	>20	
HQ3	84	83	69	5	
HQ3	85	72	53	15	
HQ3	97	95	83	7	
HQ3	89	87	67	6	
HQ3	89	84	73	5	



0.00

GRAVELLY SANDY CLAYEY SILT
Dark red orange, GRAVELLY SANDY CLAYEY SILT, residual.

0.75

TILLITE
Light reddish orange to light brown, highly weathered, fine grained, massive, very highly to moderately fractured, fractures rough to slightly rough, horizontal to sub-vertical, narrow to wide, stained and filled, very soft ro soft rock, Dwyka TILLITE.
Note:
1. Very highly fractured zones at:
   1.23m-1.50m
   2.30m-2.50m
   3.45m-3.60m
   6.03m-6.46m
   9.50m-15.60m.

15.75

TILLITE
Dark olive, moderately weathered, fine grained, massive, highly to moderately fractured, fractures rough, horizontal to sub-vertical, narrow, stained, medium hard rock, Dwyka TILLITE.

OUTENIQUA GEOTECHNICAL SERVICES

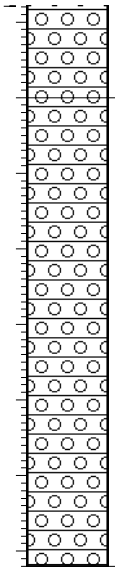
CORE BOREHOLE LOG
CLIENT: WIND RELIC/DNV GL
SITE: EASTERN BLOCK
CONTRACT NO.: CHOJE WIND FARM

HOLE No: E7
Sheet 2 of 2

JOB NUMBER: 000

Core size	% Mat. recov.	% Core recov.	RQD%	Frac. Freq.	SPT
HQ3	69	63	54	4	
HQ3	95	87	72	5	
HQ3	99	97	90	3	
HQ3	96	93	89	3	
HQ3	99	97	77	5	

23
24
25
26
27
28
29
30



24.00

TILLITE
Light grey, slightly weathered, fine grained, massive, highly to moderately fractured, fractures rough, horizontal to sub-vertical, narrow to closed, stained, medium hard rock, Dwyka TILLITE.

30.20

Hole stopped. End of Log.

NOTES

1) **End of hole at 30.20m**
2) **Samples: FI at 0.50m--0.84m, PL at 1.50m--1.61m, PL at 1.61m--1.69m, PL at 2.62m--2.70m, UCS at 2.78m--3.12m, UCS at 3.17m--3.45m**
3) **Standpipe installed. No water table**
4) **SPT= Standard penetration test**
5) **R=Refusal**

CONTRACTOR : **Earthtech**
MACHINE :
DRILLED BY : **Aubrey**
LOGGED BY : **I Paton**
TYPE SET BY : **S Gallant**
SETUP FILE : **SANRAL.SET**

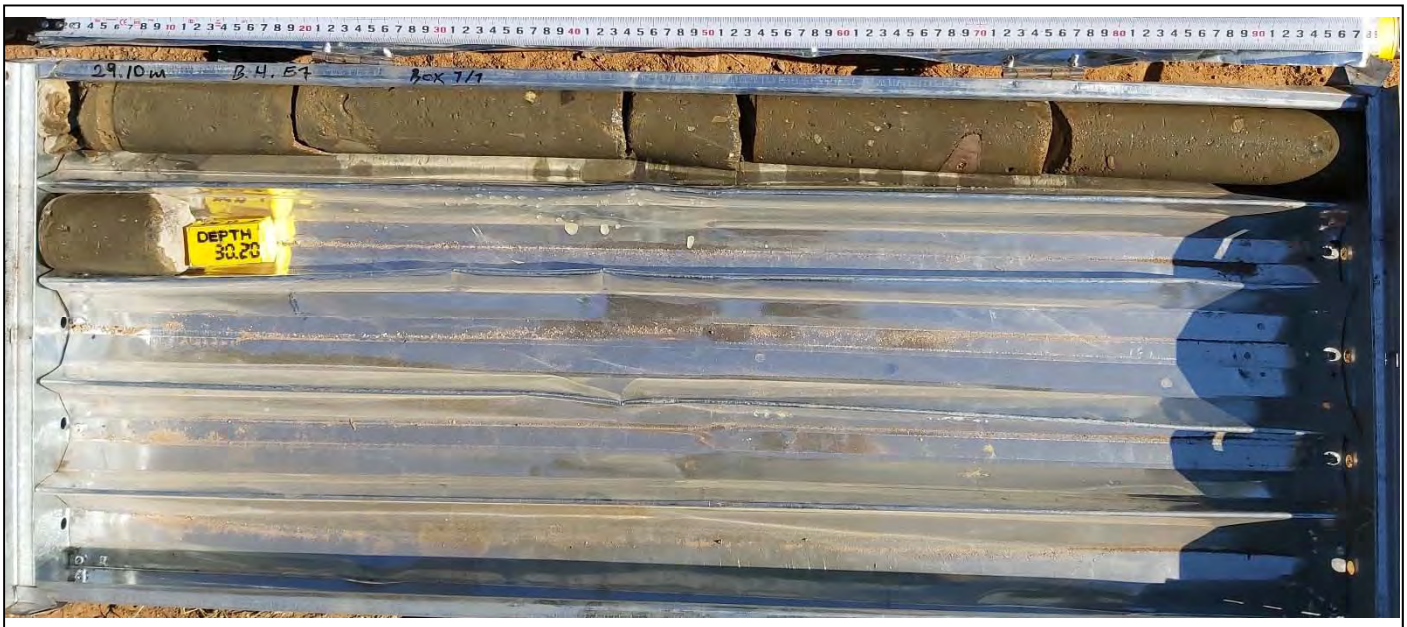
INCLINATION : **-90°**
DATE DRILLED : **June 2019**
DATE LOGGED : **July 2019**
DATE : **29/08/2019 16:54**
TEXT : **C\dot7000\network\E7.txt**

ELEVATION :
X-COORD : **X3681962**
Y-COORD : **27 Y0050674**

HOLE No: E7

CONTRACT: CHOJE WIND FARM, EASTERN CAPE	**BOREHOLE NO: BH E7 SHEET 1/3**
CLIENT: DNV GL/WIND RELIC	

CONTRACT: CHOJE WIND FARM, EASTERN CAPE	**BOREHOLE NO: BH E7 SHEET 2/3**
CLIENT: DNV GL/WIND RELIC	



CONTRACT: CHOJE WIND FARM, EASTERN CAPE	**BOREHOLE NO: BH E7 SHEET 3/3**
CLIENT: DNV GL/WIND RELIC	

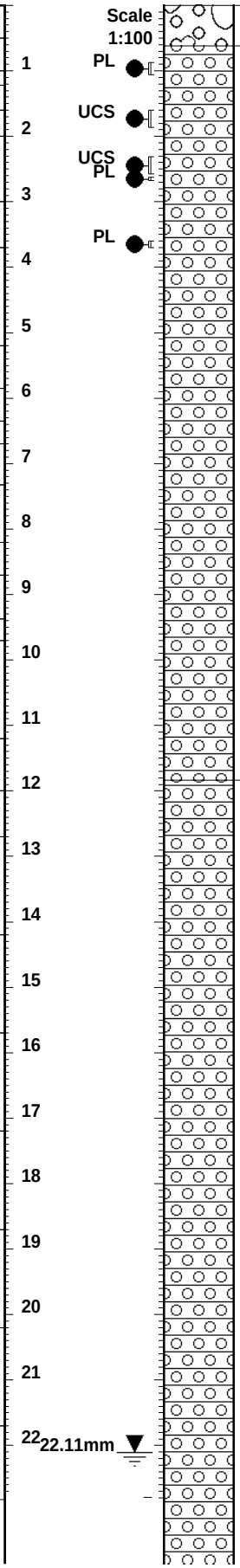
OUTENIQUA GEOTECHNICAL SERVICES

CORE BOREHOLE LOG
CLIENT: WIND RELIC/DNV GL
SITE: EASTERN BLOCK
CONTRACT NO.: CHOJE WIND FARM

HOLE No: E64
Sheet 1 of 2

JOB NUMBER: 000

Core size	% Mat. recov.	% Core recov.	RQD%	Frac. Freq.	SPT
HQ3	92	0	0	0	
HQ3	100	92	36	8	
HQ3	59	0	0		
HQ3	97	97	0	>20	
HQ3	78	78	68	3	
HQ3	94	94	65	1	
HQ3				7	
HQ3	57	57	14	5	
HQ3	99	93	39	15	
HQ3	97	78	37	10	
HQ3	70	0	0	>20	
HQ3	74	54	0	6	
HQ3	116	116	34	15	
HQ3	86	86	42	10	
HQ3	96	96	24	16	
HQ3	97	73	16	24	
HQ3	127	127	36	18	
HQ3	53	53	22	6	
HQ3	118	103	66	13	
HQ3	74	74	43	7	
HQ3	93	69	49	12	
HQ3	97	97	63	8	
HQ3	97	89	41	9	
HQ3	93	89	45	7	
HQ3	94	94	79	5	
HQ3	87	82	61	6	
HQ3	105	105	87	4	



0.00

GRAVEL and COBBLES
Light red brown, GRAVEL and ANGULAR COBBLES, residual.

0.62

TILLITE
Dark olive, moderately weathered, fine grained, massive, moderately to very highly fractured, fractures rough, sub-vertical, narrow to wide, stained, hard rock, Dwyka TILLITE.
Note:
1. Highly fractured zones at:
   0.94m-1.12m
   5.72m-6.40m
   8.70m-9.22m
   11.65m-11.70m.

11.84

TILLITE
Light grey to dark grey, slightly weathered, fine grained, massive, moderately to highly fractured, fractures rough, sub-vertical, narrow, stained, hard rock, Dwyka TILLITE.

OUTENIQUA GEOTECHNICAL SERVICES

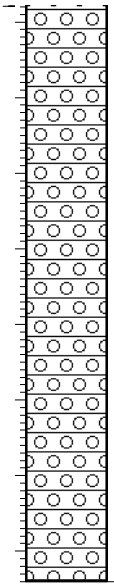
CORE BOREHOLE LOG
CLIENT: WIND RELIC/DNV GL
SITE: EASTERN BLOCK
CONTRACT NO.: CHOJE WIND FARM

HOLE No: E64
Sheet 2 of 2

JOB NUMBER: 000

Core size	% Mat. recov.	% Core recov.	RQD%	Frac. Freq.	SPT
HQ3	101	101	101	2	
HQ3	93	90	84	2	
HQ3	104	93	57	10	
HQ3	95	87	83	4	
HQ3	105	84	59	8	

23
24
25
26
27
28
29
30



30.40

Hole stopped. End of Log.

NOTES

1) End of hole at 30.40m
2) Samples: PL at 0.87m--1.06m, UCS at 1.6m--1.87m, UCS at 2.31m--2.58m, PL at 2.62m--2.68m, PL at 3.59m--3.70m
3) Standpipe installed - Resting water table at 22.11mm. Sample taken
4) SPT= Standard penetration test
5) R=Refusal

CONTRACTOR : Earthtech
MACHINE :
DRILLED BY : Aubrey
LOGGED BY : I Paton

INCLINATION : -90°
DATE DRILLED : May 2019
DATE LOGGED : July 2019

ELEVATION :
X-COORD : X3678372
Y-COORD : 27 Y0056843

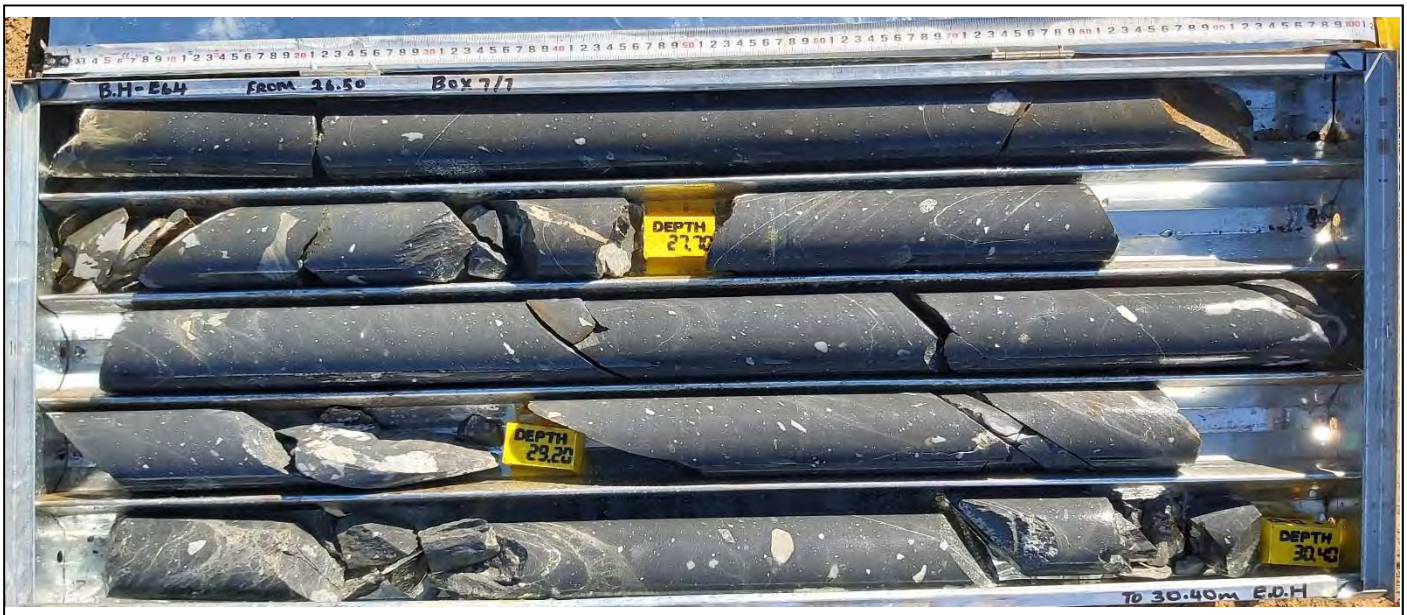
HOLE No: E64

TYPE SET BY : S Gallant
SETUP FILE : SANRAL.SET

DATE : 29/08/2019 16:54
TEXT : C\dot7000\network\E64.txt

CONTRACT: CHOJE WIND FARM, EASTERN CAPE	**BOREHOLE NO: BH E64 SHEET 1/3**
CLIENT: DNV GL/WIND RELIC	

CONTRACT: CHOJE WIND FARM, EASTERN CAPE	**BOREHOLE NO: BH E64 SHEET 2/3**
CLIENT: DNV GL/WIND RELIC	



CONTRACT: CHOJE WIND FARM, EASTERN CAPE	**BOREHOLE NO: BH E64 SHEET 3/3**
CLIENT: DNV GL/WIND RELIC	

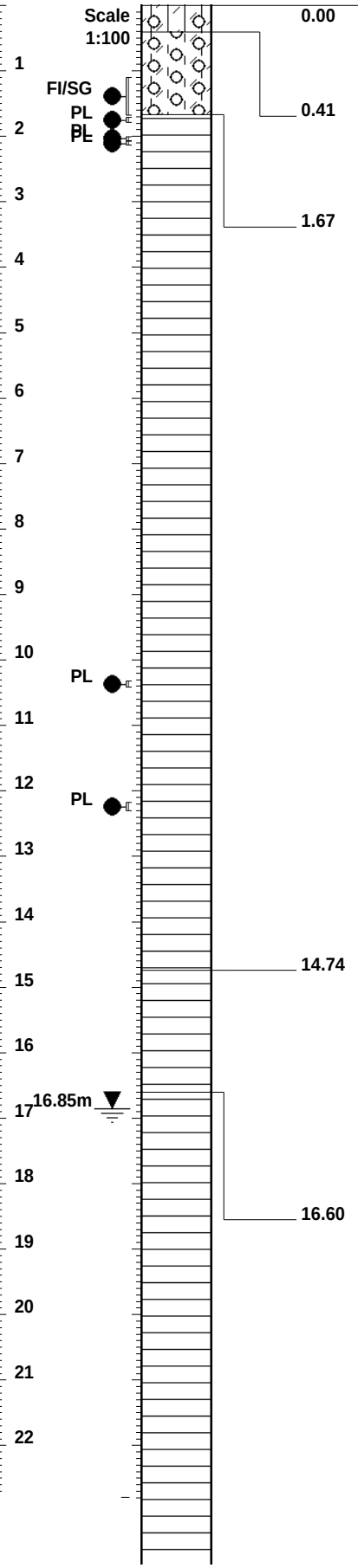
OUTENIQUA GEOTECHNICAL SERVICES

CORE BOREHOLE LOG
CLIENT: WIND RELIC/DNV GL
SITE: EASTERN BLOCK
CONTRACT NO.: CHOJE WIND FARM

HOLE No: E100
Sheet 1 of 2

JOB NUMBER: 000

Core size	% Mat. recov.	% Core recov.	RQD%	Frac. Freq.	SPT
HQ3	87	0	0	0	
HQ3	142	68	0	>20	
HQ3	90	70	0	8	
HQ3	115	115	0	9	
HQ3	72	51	0	>20	
HQ3	91	24	0	>20	
HQ3	69	67	0	>20	
HQ3	103	87	0	>20	
HQ3	79	55	0	>20	
HQ3	71	56	7	>20	
HQ3	73	37	9	>20	
HQ3	81	63	20	>20	
HQ3	23	7	0	>20	
HQ3	68	0	0	>20	
HQ3	64	64	64	1	
HQ3	56	56	53	3	
HQ3	179	153	153	5	
HQ3	89	89	78	3	
HQ3	95	93	73	8	



0.00

GRAVELLY CLAYEY SILT
Dark red orange, GRAVELLY CLAYEY SILT, transported.

0.41

CLAYEY SILTY GRAVEL
Light reddish brown, CLAYEY SILTY GRAVEL, residual.

1.67

SHALE
Dark grey stained light red orange, highly weathered, very fine grained, intensely laminated, highly to very highly fractured, fractures slightly rough, horizontal, narrow to wide, stained and filled, very soft rock, horizontally bedded Lake Mentz Fm SHALE.
Note:
1. Very highly fractured zones at:
   2.80-3.15m
   4.40-4.77m

14.74

SHALE
Dark grey to black, moderately weathered, very fine grained, intensely laminated, very highly fractured, fractures slightly rough, sub-vertical, narrow to wide, stained, very soft rock, Lake Mentz Fm SHALE.

16.60

SILTSTONE
Dark grey to black, slightly weathered, very fine graned to fine grained, intensely laminated, highly to moderately fractured, fractures slightly rough, horizontal, closed to narrow, stained to clean, soft rock, horizontally bedded Lake Mentz Fm SILTSTONE.

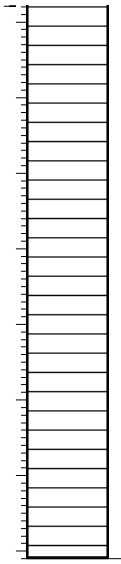
OUTENIQUA GEOTECHNICAL SERVICES

CORE BOREHOLE LOG
CLIENT: WIND RELIC/DNV GL
SITE: EASTERN BLOCK
CONTRACT NO.: CHOJE WIND FARM

HOLE No: E100
Sheet 2 of 2

JOB NUMBER: 000

Core size	% Mat. recov.	% Core recov.	RQD%	Frac. Freq.	SPT	
HQ3	95	95	80	5		23
HQ3	87	87	73	5		24
						25
HQ3	99	87	82	5		26
HQ3	93	89	81	6		27
						28
HQ3	84	77	77	5		29
HQ3	144	128	90	5		30



30.10

Hole stopped. End of Log.

NOTES

1) End of hole at 30.10m
2) Samples: FI/SG at 1.10m--1.68m, PL at 1.71m--1.79m, PL at 2.00m--2.07m, PL at 2.07m--2.14m, PL at 10.32m--10.42m, PL at 12.17m--12.31m
3) Standpipe installed - resting water table at 16.85m. Sample taken
4) SPT= Standard penetration test
5) R=Refusal

CONTRACTOR : Earthtech
MACHINE :
DRILLED BY : Aubrey
LOGGED BY : I Paton

INCLINATION : -90°

DATE DRILLED : June 2019
DATE LOGGED : July 2019

ELEVATION :
X-COORD : X3682241
Y-COORD : 27 Y0058545

HOLE No: E100

TYPE SET BY : S Gallant
SETUP FILE : SANRAL.SET

DATE : 29/08/2019 16:54
TEXT : C\dot7000\network\E100.txt

CONTRACT: CHOJE WIND FARM, EASTERN CAPE	**BOREHOLE NO: BH E100 SHEET 1/2**
CLIENT: DNV GL/WIND RELIC	

CONTRACT: CHOJE WIND FARM, EASTERN CAPE	**BOREHOLE NO: BH E100 SHEET 2/2**
CLIENT: DNV GL/WIND RELIC	

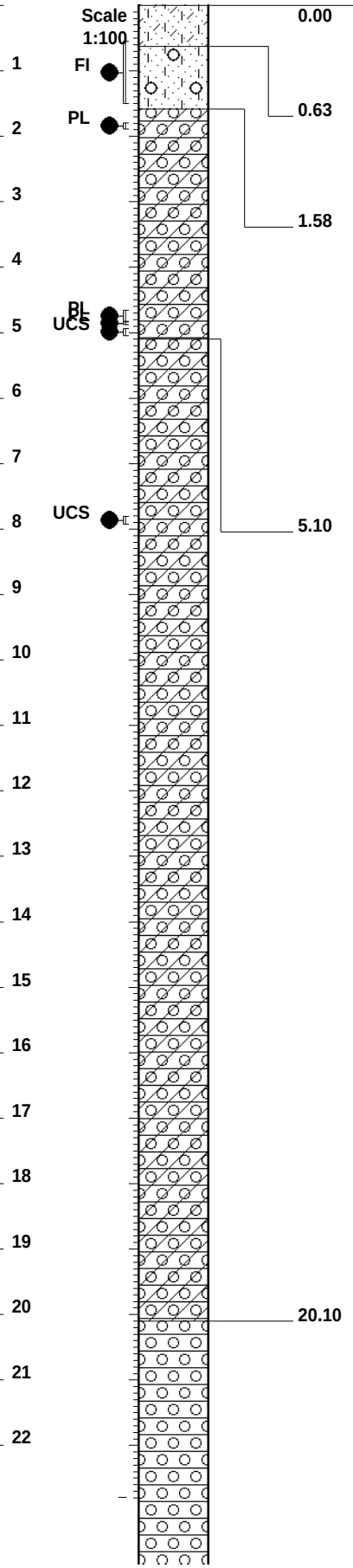
OUTENIQUA GEOTECHNICAL SERVICES

CORE BOREHOLE LOG
CLIENT: WIND RELIC/DNV GL
SITE: WESTERN BLOCK
CONTRACT NO.: CHOJE WIND FARM

HOLE No: W411
Sheet 1 of 2

JOB NUMBER: 000

Core size	% Mat. recov.	% Core recov.	RQD%	Frac. Freq.	SPT
HQ3	100	0	0	0	
HQ3	39	0	0	0	
SPT	87	0	0	0	R
HQ3	61	29	15	15	
HQ3	98	40	19	5	
HQ3	55	22	15	8	
HQ3	136	76	46	14	
HQ3	101	86	27	15	
HQ3	88	88	0	3	
HQ3	72	39	15	15	
HQ3	103	79	35	18	
HQ3	82	45	24	12	
HQ3	96	80	47	7	
HQ3	95	83	41	7	
HQ3	80	61	52	8	
HQ3	43	28	15	12	
HQ3	120	50	30	8	
HQ3	99	75	55	10	
HQ3	102	91	52	16	
HQ3	93	63	43	15	
HQ3	105	92	72	14	
HQ3	102	102	92	6	
HQ3	95	90	66	9	



CLAYEY SILTY SAND
Dark red orange, CLAYEY SILTY SAND, transported.

SILTY GRAVELLY SAND
Dark grey stained light red orange, SILTY GRAVELLY SAND, residual.

TILLITE
Dark grey, highly weathered, fine grained, massive, highly to very highly fractured, fractures rough, horizontal to sub-vertical, narrow to wide, stained and filled, soft to medium hard rock; Dwyka TILLITE.
Note:
1. Clay gauge in fractures from 3.07m-3.80m.

TILLITE
Dark grey, moderately weathered, fine grained, massive, very highly to moderately fractured, fractures rough, horizontal to sub-vertical, narrow to very wide, stained and filled, medium hard rock, Dwyka TILLITE.
Note:
1. Clay gauge in fractures from 9.60m-9.77m and 12.46m-12.52m

OUTENIQUA GEOTECHNICAL SERVICES

CORE BOREHOLE LOG
CLIENT: WIND RELIC/DNV GL
SITE: WESTERN BLOCK
CONTRACT NO.: CHOJE WIND FARM

HOLE No: W411
Sheet 2 of 2

JOB NUMBER: 000

Core size	% Mat. recov.	% Core recov.	RQD%	Frac. Freq.	SPT
HQ3	98	84	33	14	
HQ3	108	103	95	7	
HQ3	87	87	59	8	
HQ3	97	97	85	9	
HQ3	105	105	91	4	

23
24
25
26
26.27m
27
28
29
30
30.30

TILLITE
Dark grey, moderately to slightly weathered, fine grained, massive, highly to moderately fractured, fractures rough, horizontal to sub-vertical, narrow, stained, hard rock, Dwyka TILLITE.

Hole stopped. End of Log.

NOTES

1) **End of hole at 30.30m**
2) **Samples: FI at 0.55m--1.50m, PL at 1.79m--1.89m, PL at 4.65m--4.83m, PL at 4.83m--4.88m, UCS at 4.93m--5.05m, UCS at 7.80m--7.93m**
3) **Standpipe installed - Resting water table @ 26.27m - no sample taken**
4) **SPT= Standard penetration test**
5) **R= Refusal**

CONTRACTOR : Earthtech
MACHINE :
DRILLED BY : Aubrey
LOGGED BY : I Paton

INCLINATION : -90°
DATE DRILLED : July 2019
DATE LOGGED : July 2019

ELEVATION :
X-COORD : X3666540
Y-COORD : 25 Y-058935

HOLE No: W411

TYPE SET BY : S Gallant
SETUP FILE : SANRAL.SET

DATE : 29/08/2019 16:54
TEXT : C\dot7000\network\W411.txt

CONTRACT: CHOJE WIND FARM, EASTERN CAPE	**BOREHOLE NO: BH W411 SHEET 1/3**
CLIENT: DNV GL/WIND RELIC	

CONTRACT: CHOJE WIND FARM, EASTERN CAPE	**BOREHOLE NO: BH W411 SHEET 2/3**
CLIENT: DNV GL/WIND RELIC	

CONTRACT: CHOJE WIND FARM, EASTERN CAPE	**BOREHOLE NO: BH W411 SHEET 3/3**
CLIENT: DNV GL/WIND RELIC	

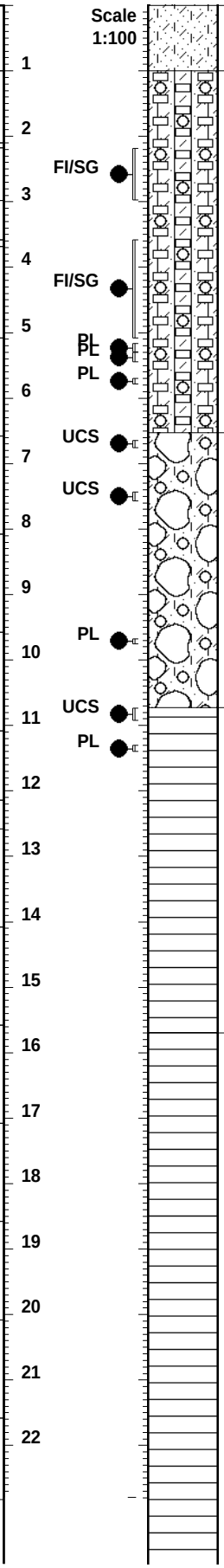
OUTENIQUA GEOTECHNICAL SERVICES

CORE BOREHOLE LOG
CLIENT: WIND RELIC/DNV GL
SITE: WESTERN BLOCK
CONTRACT NO.: CHOJE WIND FARM

HOLE No: W417
Sheet 1 of 2

JOB NUMBER: 000

Core size	% Mat. recov.	% Core recov.	RQD%	Frac. Freq.	SPT
HQ3	96	0	0	0	
HQ3	85	0	0	0	
SPT	100	0	0	0	R
HQ3	66	0	0	0	
HQ3	100	0	0	0	
SPT	0	0	0	0	R
HQ3	96	0	0	0	
HQ3	97	0	0	0	
HQ3	103	0	0	0	
HQ3	103	0	0	0	
HQ3	101	23	14	>20	
HQ3	108	79	54	12	
HQ3	98	68	30	4	
HQ3	107	87	62	>20	
HQ3	100	98	77	9	
HQ3	102	95	43	16	
HQ3	102	81	51	12	
HQ3	97	97	93	5	
HQ3	99	99	89	9	
HQ3	97	97	87	6	



0.00

CLAYEY SILTY SAND
Dark reddish brown, CLAYEY SILTY SAND, alluvium.

1.00

GRAVELLY CLAYEY SANDY SILT
Dark reddish orange to light red, GRAVELLY CLAYEY SANDY SILT, weakly cemented calcrete, alluvium.

6.53

CLAYEY SILTY SANDY GRAVEL with COBBLES and BOULDERS
Light reddish orange, CLAYEY SILTY SANDY GRAVEL with COBBLES and BOULDERS, very dense, cemented calcareous alluvium.

10.73

SILTSTONE
Dark olive stained light brown, highly weathered, fine grained, intensely laminated, very highly to moderately fractured, fractures slightly rough, horizontal, narrow, stained, soft rock, horizontally bedded Middleton FM SILTSTONE.

15.70

SILTSTONE
Dark olive to pale red, moderately weathered, fine grained, intensely laminated, highly to moderately fractured, fractures slightly rough, horizontal to sub-vertical, narrow to closed, stained, soft to medium hard rock, horizontally bedded Middleton FM SILTSTONE.
Note:
1. Highly fractured zones at:
   23.90m-24.12m
   24.69m-25.07m.

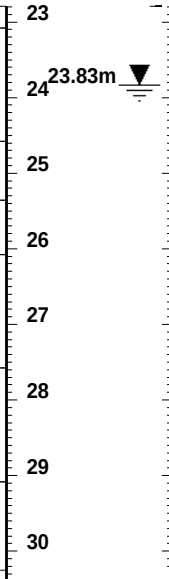
OUTENIQUA GEOTECHNICAL SERVICES

CORE BOREHOLE LOG
CLIENT: WIND RELIC/DNV GL
SITE: WESTERN BLOCK
CONTRACT NO.: CHOJE WIND FARM

HOLE No: W417
Sheet 2 of 2

JOB NUMBER: 000

Core size	% Mat. recov.	% Core recov.	RQD%	Frac. Freq.	SPT
HQ3	97	82	64	>20	
HQ3	91	78	42	13	
HQ3	97	97	97	1	
HQ3	95	95	95	3	
HQ3	95	92	85	5	
HQ3	97	97	97	2	



25.07

SANDSTONE
Dark olive, slightly weathered, fine grained, intensely bedded, highly to moderately fractured, fractures rough, horizontal to sub-vertical, very narrow to closed, stained to clean, medium hard rock, horizontally bedded Middleton FM SANDSTONE.

30.25

Hole stopped. End of Log.

NOTES

1) **End of hole at 30.25m**

2) **Samples: FI/SG at 2.18m--2.98m, FI/SG at 3.58m--5.08m, PL at 5.16m--5.30m, UCS at 6.64m--6.76m, UCS at 7.43m--7.57m, PL at 5.30m--5.45mm, PL at 5.69m--5.79m, PL at 9.67m--9.76m, UCS at 10.73m--10.93m, PL at 11.30m--11.40m**

3) **Standpipe installed - Resting water table @ 23.83m no sample taken**

4) **SPT= Standard penetration test**

5) **R=Refusal**

CONTRACTOR : Earthtech
MACHINE :
DRILLED BY : Andries
LOGGED BY : I Paton

INCLINATION : -90°
DATE DRILLED : July 2019
DATE LOGGED : July 2019

ELEVATION :
X-COORD : X3640897
Y-COORD : 25 Y-064772

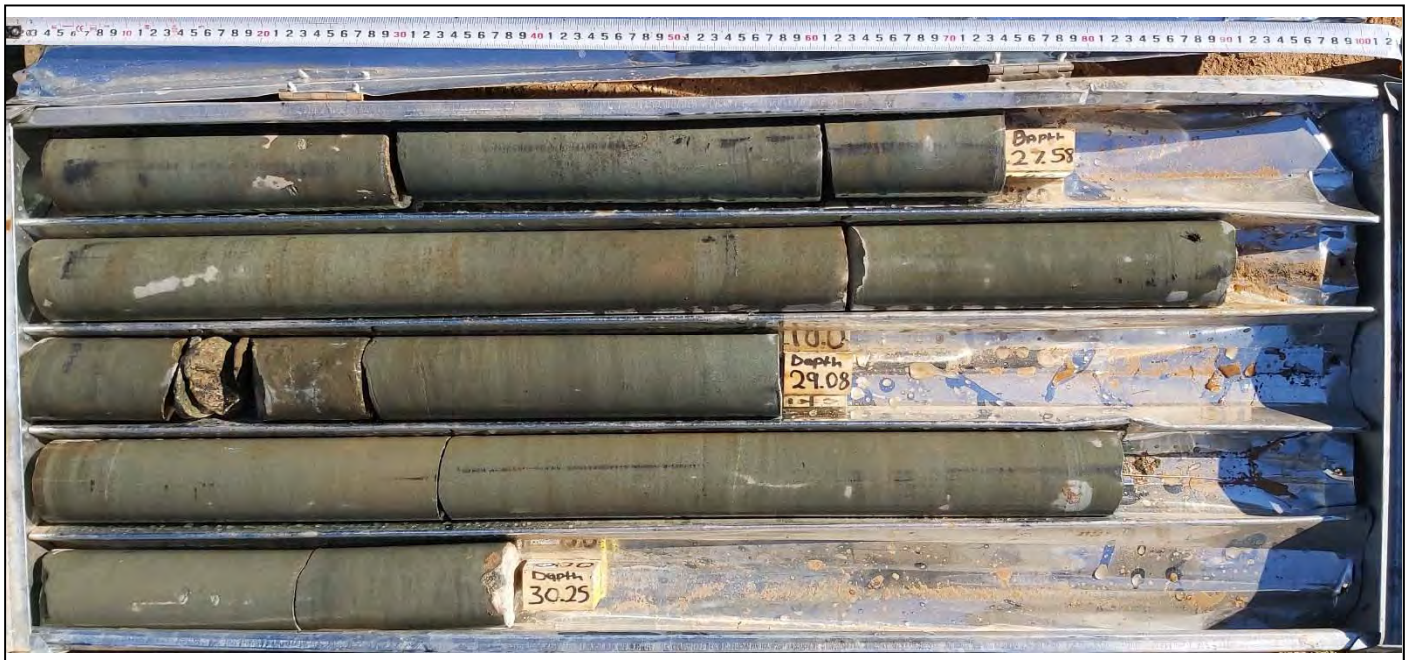
HOLE No: W417

TYPE SET BY : S Gallant
SETUP FILE : SANRAL.SET

DATE : 29/08/2019 16:54
TEXT : C\dot7000\network\W417.txt

CONTRACT: CHOJE WIND FARM, EASTERN CAPE	**BOREHOLE NO: BH W417 SHEET 1/3**
CLIENT: DNV GL/WIND RELIC	

CONTRACT: CHOJE WIND FARM, EASTERN CAPE	**BOREHOLE NO: BH W417 SHEET 2/3**
CLIENT: DNV GL/WIND RELIC	



CONTRACT: CHOJE WIND FARM, EASTERN CAPE	**BOREHOLE NO: BH W417 SHEET 3/3**
CLIENT: DNV GL/WIND RELIC	

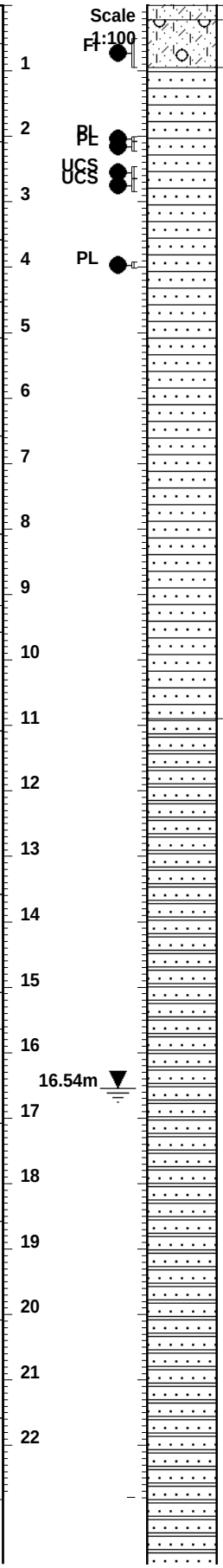
OUTENIQUA GEOTECHNICAL SERVICES

CORE BOREHOLE LOG
CLIENT: WIND RELIC/DNV GL
SITE: WESTERN BLOCK
CONTRACT NO.: CHOJE WIND FARM

HOLE No: W452
Sheet 1 of 2

JOB NUMBER: 000

Core size	% Mat. recov.	% Core recov.	RQD%	Frac. Freq.	SPT
HQ3	98	0	0	0	
HQ3	91	67	61	7	
HQ3	101	101	101	4	
HQ3	102	93	88	5	
HQ3	98	91	91	2	
HQ3	101	91	84	9	
HQ3	97	97	97	0	
HQ3	100	84	66	9	
HQ3	76	76	63	1	
HQ3	105	98	79	8	
HQ3	58	58	44	7	
HQ3	96	96	87	7	
HQ3	100	91	91	3	
HQ3	53	49	35	6	
HQ3	91	91	91	0	
HQ3	107	107	107	2	
HQ3	99	99	99	2	
HQ3	93	93	93	1	



0.00

CLAYEY SILTY SAND
Dark reddish brown, CLAYEY SILTY SAND, transported.

0.22

CLAYEY GRAVELLY SILTY SAND
Dark reddish orange to light brown, CLAYEY GRAVELLY SILTY SAND, residual.

0.95

SANDSTONE
Dark olive to light grey, moderately to slightly weathered, fine grained, medium to thinly bedded, highly to slightly fractured, fractures rough, horizontal to sub-vertical, narrow, stained, medium hard to hard rock, horizontally bedded Middleton FM SANDSTONE.

10.90

SANDSTONE
Dark grey, slightly weathered, fine grained, thinly bedded, highly to moderately fractured, fractures rough, horizontal to sub-vertical, narrow, stained, medium hard to hard rock, horizontally bedded Middleton FM SANDSTONE with minor shale lenses.

OUTENIQUA GEOTECHNICAL SERVICES

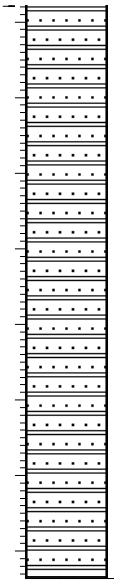
CORE BOREHOLE LOG
CLIENT: WIND RELIC/DNV GL
SITE: WESTERN BLOCK
CONTRACT NO.: CHOJE WIND FARM

HOLE No: W452
Sheet 2 of 2

JOB NUMBER: 000

Core size	% Mat. recov.	% Core recov.	RQD%	Frac. Freq.	SPT
HQ3	89	86	77	6	
HQ3	93	93	77	5	
HQ3	107	105	35	5	
HQ3	100	100	100	4	
HQ3	100	94	85	6	

23 24 25 26 27 28 29 30



30.36

Hole stopped. End of Log.

NOTES

1) End of hole at 30.36m
2) Samples: FI at 0.50m--0.95m, PL at 2.00m--2.08m, PL at 2.08m--2.23m, UCS at 2.46m--2.65m, UCS at 2.65m--2.85m, PL at 3.92m--4.02m
3) Standpipe installed - Resting water table @ 16.54m - Sample taken
4) SPT= Standard penetration test
5) R=Refusal

CONTRACTOR : Earthtech
MACHINE :
DRILLED BY : Aubrey
LOGGED BY : I Paton

INCLINATION : -90°

DATE DRILLED : July 2019
DATE LOGGED : July 2019

ELEVATION :
X-COORD : X3649254
Y-COORD : 25 Y-068726

HOLE No: W452

TYPE SET BY : S Gallant
SETUP FILE : SANRAL.SET

DATE : 29/08/2019 16:54
TEXT : C\dot7000\network\W452.txt

CONTRACT: CHOJE WIND FARM, EASTERN CAPE	**BOREHOLE NO: BH W452 SHEET 1/3**
CLIENT: DNV GL/WIND RELIC	

CONTRACT: CHOJE WIND FARM, EASTERN CAPE	**BOREHOLE NO: BH W452 SHEET 2/3**
CLIENT: DNV GL/WIND RELIC	

CONTRACT: CHOJE WIND FARM, EASTERN CAPE	**BOREHOLE NO: BH W452 SHEET 3/3**
CLIENT: DNV GL/WIND RELIC	

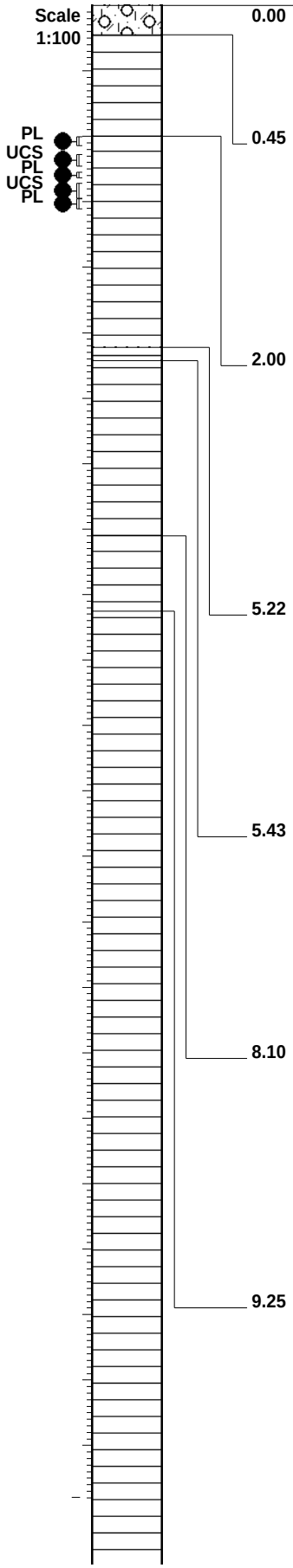
OUTENIQUA GEOTECHNICAL SERVICES

CORE BOREHOLE LOG
CLIENT: WIND RELIC/DNV GL
SITE: WESTERN BLOCK
CONTRACT NO.: CHOJE WIND FARM

HOLE No: W521
Sheet 1 of 2

JOB NUMBER: 000

Core size	% Mat. recov.	% Core recov.	RQD%	Frac. Freq.	SPT
HQ3	86	0	0	0	
HQ3	69	0	0	>20	
HQ3	99	91	71	9	
HQ3	95	83	68	3	
HQ3	94	79	43	7	
HQ3	88	85	47	10	
HQ3	106	99	71	14	
HQ3	99	87	75	9	
HQ3	104	88	68	9	
HQ3	63	63	63	1	
HQ3	90	83	28	13	
HQ3	91	67	28	15	
HQ3	86	71	49	12	
HQ3	104	87	71	9	
HQ3	94	81	53	12	
HQ3	95	86	70	9	
HQ3	73	51	33	11	
HQ3	90	73	62	12	



SILTY CLAYEY SANDY GRAVEL
Light grey to light reddish orange, SILTY CLAYEY SANDY GRAVEL, residual.

SILTSTONE
Dark grey, highly weathered, very fine grained to fine grained, intensely laminated, very highly fractured, fractures slightly rough, sub-vertical, narrow, stained, soft to medium hard rock Middleton FM SILTSTONE.

SILTSTONE
Dark grey, moderately weathered, very fine grained to fine grained, intensely laminated, Fractures: Highly to moderately fractured, fractures slightly rough, sub-vertical, narrow, stained, medium hard rock, Middleton FM SILTSTONE.

SANDSTONE
Dark reddish brown, moderately weathered, fine grained, very thinly bedded, highly fractured, fractures rough, sub-vertical, narrow, stained, medium hard rock, Middleton FM SANDSTONE.

SILTSTONE
Dark grey, slightly weathered, very fine grained, intensely laminated, highly to moderately fractured, fractures slightly rough, sub-vertical, narrow, stained, medium hard rock, Middleton FM SILTSTONE.

MUDSTONE
Dark reddish brown, slightly weathered, very fine grained, very intensely laminated, highly to moderately fractured, fractures slightly rough to smooth, sub-vertical, narrow, stained, soft to medium hard rock, Middleton FM MUDSTONE.

OUTENIQUA GEOTECHNICAL SERVICES

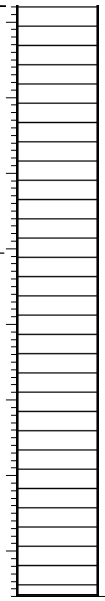
CORE BOREHOLE LOG
CLIENT: WIND RELIC/DNV GL
SITE: WESTERN BLOCK
CONTRACT NO.: CHOJE WIND FARM

HOLE No: W521
Sheet 2 of 2

JOB NUMBER: 000

Core size	% Mat. recov.	% Core recov.	RQD%	Frac. Freq.	SPT
HQ3	101	93	79	6	
HQ3	88	85	74	7	
HQ3	97	89	79	7	
HQ3	89	81	71	5	
HQ3	96	87	53	12	

23
24
25
26 26.05m
27
28
29
30



30.60

SILTSTONE
Dark grey, slightly weathered, very fine grained, intensely laminated, very highly to moderately fractured, fractures slightly rough, sub-vertical, narrow, stained, medium hard rock, Middleton FM SILTSTONE with minor mudstone lenses.

Hole stopped. End of Log.

NOTES

1) End of hole at 30.60m
2) Samples: PL at 2.00m--2.15m, UCS at 2.27m--2.46m, PL at 2.54m--2.64m, UCS at 2.71m--2.95m, PL at 2.95m--3.11m
3) Standpipe installed - resting water table @ 26.05m - no sample taken
4) SPT= Standard penetration test
5) R=Refusal

CONTRACTOR : Earthtech
MACHINE :
DRILLED BY : Aubrey
LOGGED BY : I Paton

INCLINATION : -90°

DATE DRILLED : July 2019
DATE LOGGED : July 2019

ELEVATION :
X-COORD : X3659627
Y-COORD : 25 Y-074141

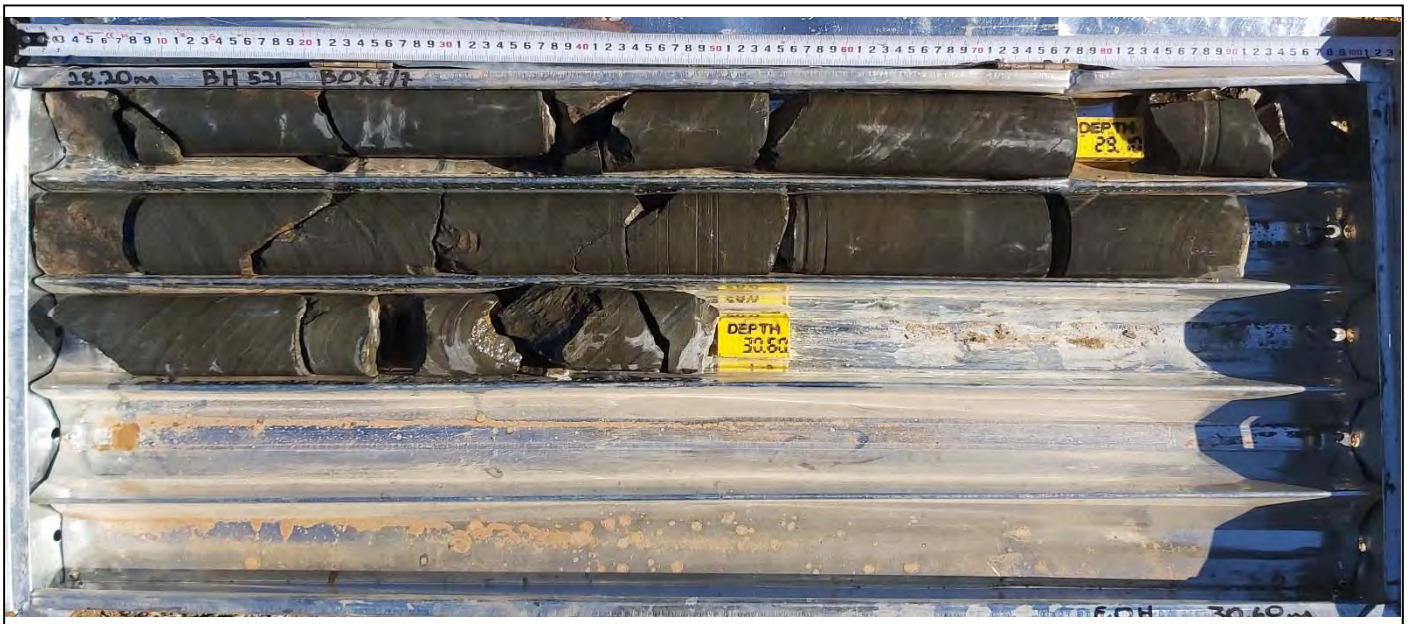
HOLE No: W521

TYPE SET BY : S Gallant
SETUP FILE : SANRAL.SET

DATE : 29/08/2019 16:54
TEXT : C\dot7000\network\W521.txt

CONTRACT: CHOJE WIND FARM, EASTERN CAPE	**BOREHOLE NO: BH W521 SHEET 1/3**
CLIENT: DNV GL/WIND RELIC	

CONTRACT: CHOJE WIND FARM, EASTERN CAPE	**BOREHOLE NO: BH W521 SHEET 2/3**
CLIENT: DNV GL/WIND RELIC	



CONTRACT: CHOJE WIND FARM, EASTERN CAPE	**BOREHOLE NO: BH W521 SHEET 3/3**
CLIENT: DNV GL/WIND RELIC	

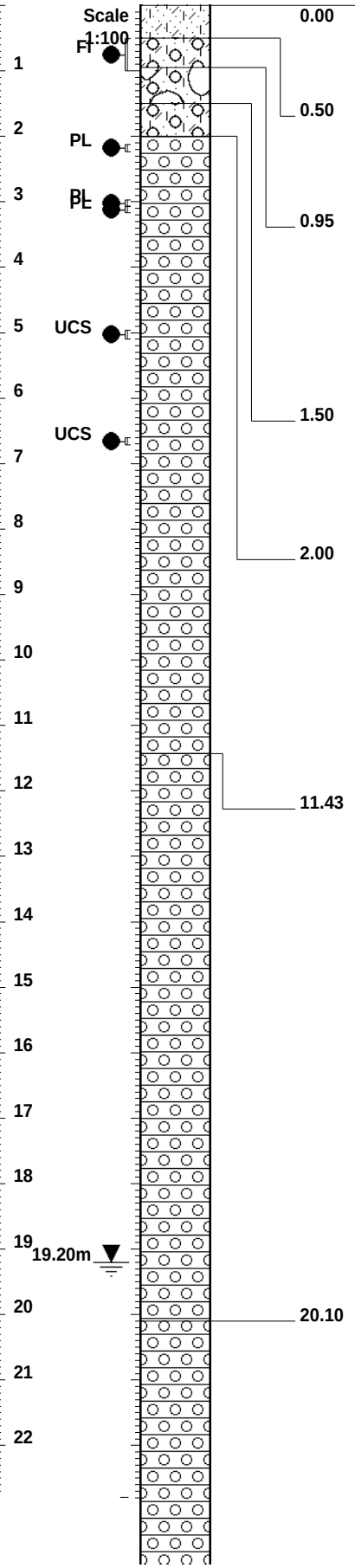
OUTENIQUA GEOTECHNICAL SERVICES

CORE BOREHOLE LOG
CLIENT: WIND RELIC/DNV GL
SITE: WESTERN BLOCK
CONTRACT NO.: CHOJE WIND FARM

HOLE No: W564
Sheet 1 of 2

JOB NUMBER: 000

Core size	% Mat. recov.	% Core recov.	RQD%	Frac. Freq.	SPT
HQ3	100	0	0	0	
HQ3	100	0	0	0	
HQ3	65	0	0	0	
HQ3	98	60	47	10	
HQ3	75	60	20	13	
HQ3	74	51	17	16	
HQ3	34	27	7	>20	
HQ3	98	91	43	6	
HQ3	63	61	24	6	
HQ3	102	85	37	>20	
HQ3	84	115	15	>20	
HQ3	84	70	32	15	
HQ3	95	81	55	>20	
HQ3	76	60	20	6	
HQ3	83	83	57	4	
HQ3	77	73	44	11	
HQ3	97	93	40	19	
HQ3	94	84	47	17	
HQ3	87	87	72	7	
HQ3	103	95	80	7	



0.00

CLAYEY SILTY SAND
Dark reddish orange, CLAYEY SILTY SAND, transported.

0.50

CLAYEY SILTY SANDY GRAVEL
Light reddish orange, CLAYEY SILTY SANDY GRAVEL, transported.

0.95

CLAYEY SILTY SANDY GRAVEL with BOULDERS
Dark olive stained light reddish orange, CLAYEY SILTY SANDY GRAVEL with BOULDERS, transported.

1.50

CLAYEY SILTY SANDY GRAVEL
Dark olive stained light reddish orange, CLAYEY SILTY SANDY GRAVEL, residual.

2.00

TILLITE
Dark olive, highly to moderately weathered, fine grained, massive, very highly fractured, fractures slightly rough, horizontal to sub-vertical, narrow to wide, stained, soft to medium hard rock, Dwyka TILLITE.

11.43

TILLITE
Dark olive to dark grey, moderately weathered, fine grained, massive, very highly to moderately fractured, fractures slightly rough, horizontal to sub-vertical, narrow to wide, stained, medium hard rock, Dwyka TILLITE.

20.10

OUTENIQUA GEOTECHNICAL SERVICES

CORE BOREHOLE LOG
CLIENT: WIND RELIC/DNV GL
SITE: WESTERN BLOCK
CONTRACT NO.: CHOJE WIND FARM

HOLE No: W564
Sheet 2 of 2

JOB NUMBER: 000

Core size	% Mat. recov.	% Core recov.	RQD%	Frac. Freq.	SPT
HQ3	103	89	75	9	
HQ3	103	103	83	6	
HQ3	81	81	57	6	
HQ3	114	114	99	7	
HQ3	106	103	95	4	

23
24
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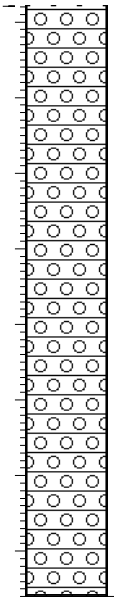
30



30.60

TILLITE
Dark grey, slightly weathered, fine grained, massive, highly to moderately fractured, fractures slightly rough, horizontal to sub-vertical, narrow, stained, medium hard to hard rock, Dwyka TILLITE.

Hole stopped. End of Log.

NOTES

1) End of hole at 30.60m
2) Samples: FI at 0.50m--1.00m, PL at 2.12m--2.24m, PL at 2.97m--3.07m, PL at 3.07m--3.17m, UCS at 4.96m--5.10m, UCS at 6.60m--6.72m
3) Standpipe installed - resting water table @ 19.20m - sample taken
4) SPT= Standard penetration test
5) R=Refusal

CONTRACTOR : Earthtech
MACHINE :
DRILLED BY : Aubrey
LOGGED BY : I Paton

INCLINATION : -90°
DATE DRILLED : July 2019
DATE LOGGED : July 2019

ELEVATION :
X-COORD : X3663859
Y-COORD : 25 Y-080520

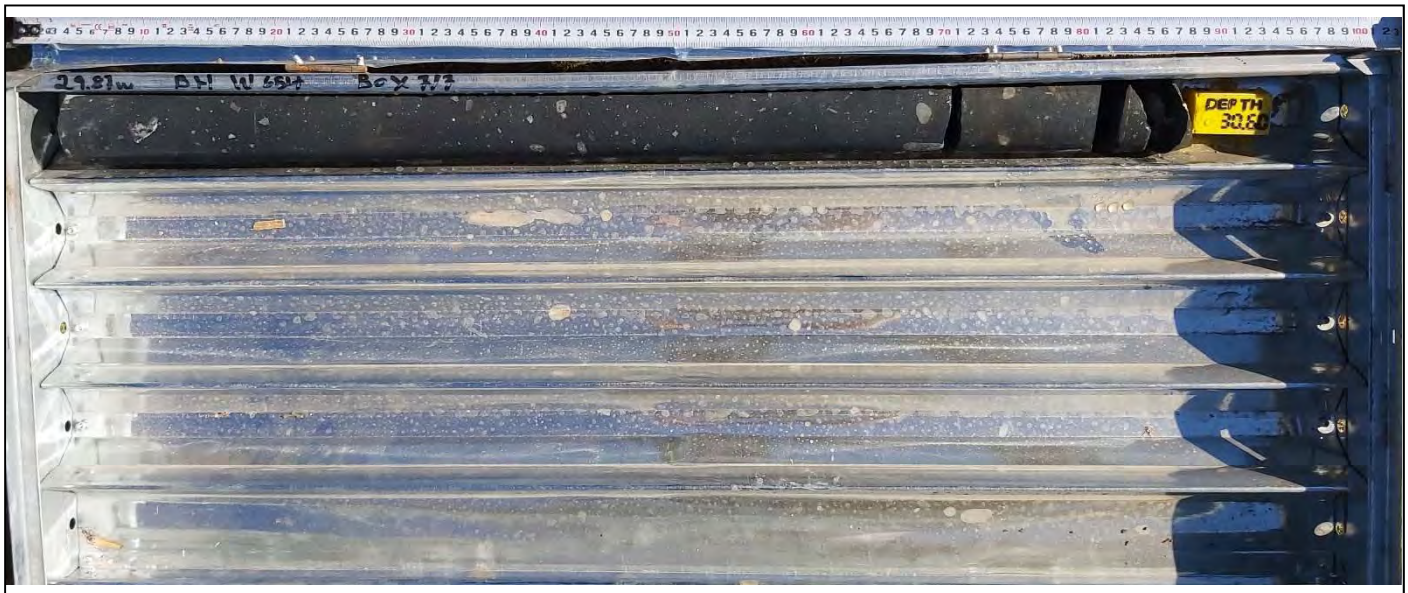
HOLE No: W564

TYPE SET BY : S Gallant
SETUP FILE : SANRAL.SET

DATE : 29/08/2019 16:55
TEXT : C\dot7000\network\W564.txt

CONTRACT: CHOJE WIND FARM, EASTERN CAPE	BOREHOLE NO: BH W564 SHEET 1/3
CLIENT: DNV GL/WIND RELIC	

CONTRACT: CHOJE WIND FARM, EASTERN CAPE	**BOREHOLE NO: BH W564 SHEET 2/3**
CLIENT: DNV GL/WIND RELIC	



CONTRACT: CHOJE WIND FARM, EASTERN CAPE	**BOREHOLE NO: BH W564 SHEET 3/3**
CLIENT: DNV GL/WIND RELIC	

APPENDIX C – TRIAL PIT & DCP LOGS

OUTENIQUA GEOTECHNICAL SERVICES

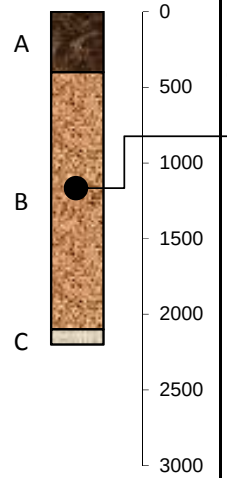
Geotechnical Soil Profile

Client:	DNV-GL South Africa (Pty) Ltd
Project:	Choje Windfarm Preliminary Geotechnical Investigation
Area:	Grahamstown, Eastern Cape
Date:	21.05.19
Excavator:	TLB

E6A

Datum: NGL | Co-ords: 27 Y0051899 X3675924

Key to symbols: ● Sample taken | Groundwater



(0 to 400) Slightly moist, light red orange, medium dense to dense, pinholed, **CLAYEY SANDY SILT & ROOTS**, alluvial.

(400 to 2100) Slightly moist to moist, light red orange, dense to very dense, intact, **CLAYEY SANDY SILT**, alluvial.

MOD/CBR/Indicator
Foundation Indicator
pH & Conductivity
Specific Gravity

(2100 to 2200) Light grey to light olive, medium weathered, slightly fractured, medium hard, **SANDSTONE bedrock or large boulders?**

Refusal @ 2200mm
No Water

Dynamic Cone Penetrometer (DCP)

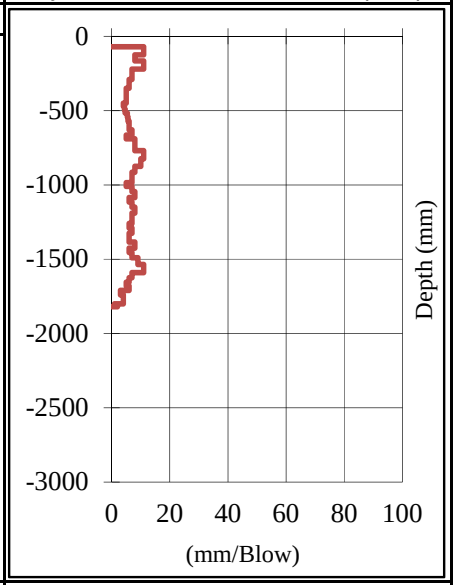
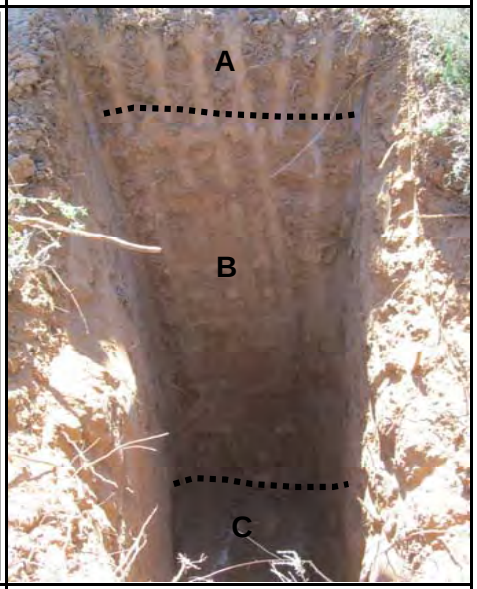


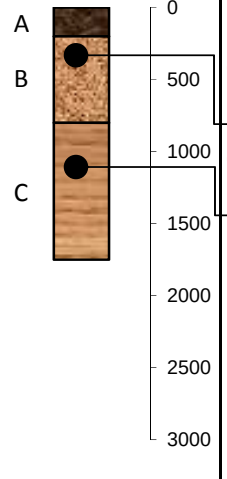
Photo of Test Pit



E6B

Datum: NGL | Co-ords: 27 Y0051915 X3675965

Key to symbols: ● Sample taken | Groundwater



(0 to 200) Slightly moist, light red orange, medium dense to dense, pinholed, **CLAYEY SANDY SILT & ROOTS**, alluvial.

(200 to 800) Slightly moist, light red orange, very dense, intact, **CLAYEY SANDY GRAVEL**, alluvial.

pH & Conductivity

(800 to 1750) Slightly moist, light yellow orange, very dense, intact, calcareous (cemented) **CLAYEY GRAVELLY SILTY SAND**, alluvial/pedogenic.

MOD/CBR/Indicator
Foundation Indicator
Specific Gravity

Refusal @ 1750mm
No Water

Dynamic Cone Penetrometer (DCP)

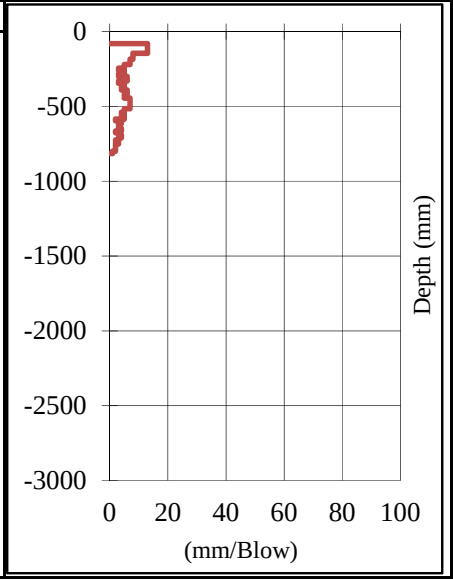
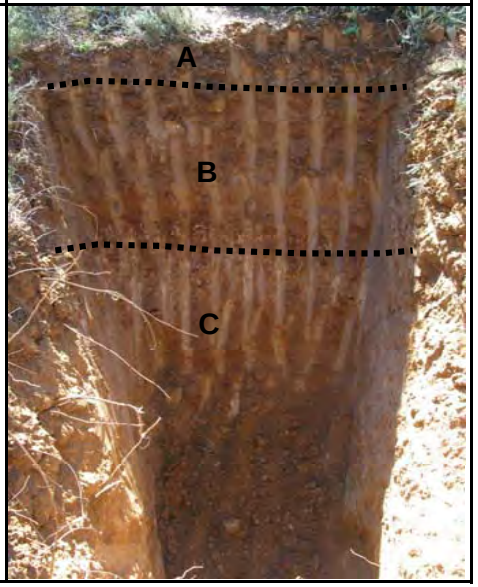


Photo of Test Pit



OUTENIQUA GEOTECHNICAL SERVICES

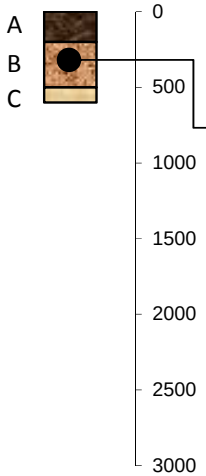
Geotechnical Soil Profile

Client:	DNV-GL South Africa (Pty) Ltd
Project:	Choje Windfarm Preliminary Geotechnical Investigation
Area:	Grahamstown, Eastern Cape
Date:	21.05.19
Excavator:	TLB

E7A

Datum: NGL | Co-ords: 27 Y0050674 X3681962

Key to symbols: ● Sample taken | Groundwater



(0 to 200) Slightly moist, dark red orange, dense, intact, **CLAYEY GRAVELLY SILTY SAND**, transported.

(200 to 500) Slightly moist, light brown, very dense, intact, **CLAYEY SILTY SANDY GRAVEL**, residual.

MOD/CBR/Indicator
Foundation Indicator
Specific Gravity
pH & Conductivity

(500 to 600) Light brown, highly weathered, medium fractured, soft to medium hard rock, **SHALE**

Refusal @ 600mm
No Water

Dynamic Cone Penetrometer (DCP)

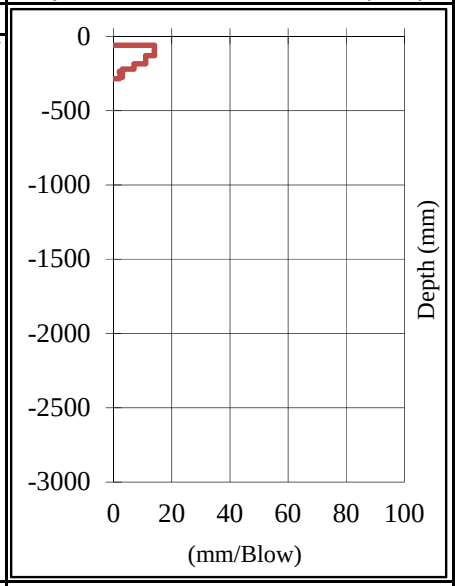
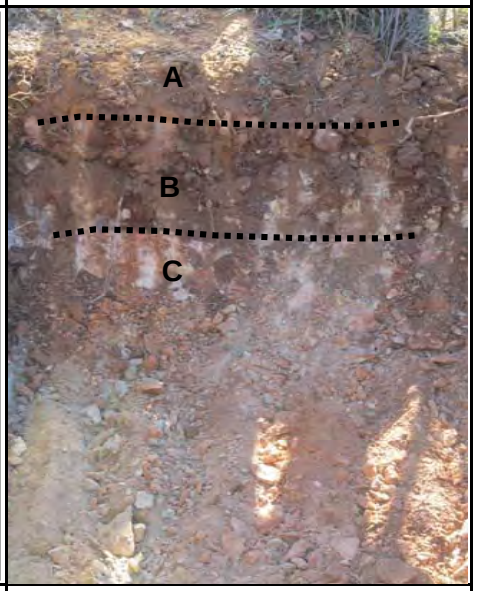


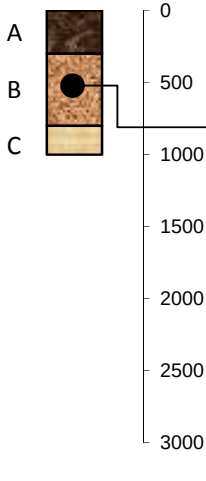
Photo of Test Pit



E7B

Datum: NGL | Co-ords: 27 Y0050728 X3681959

Key to symbols: ● Sample taken | Groundwater



(0 to 300) Slightly moist, dark red orange to dark red brown, dense, intact, **CLAYEY GRAVELLY SILTY SAND**, transported.

(300 to 800) Slightly moist, light red brown to light brown, very dense, intact, **CLAYEY SILTY SANDY GRAVEL**, residual.

MOD/CBR/Indicator
Foundation Indicator
Specific Gravity
pH & Conductivity

(800 to 1000) Light brown, highly weathered, medium fractured, soft rock, **SHALE**

Refusal @ 1000mm
No Water

Dynamic Cone Penetrometer (DCP)

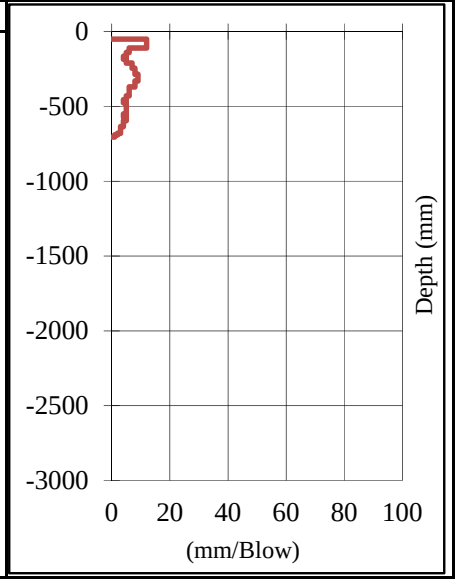
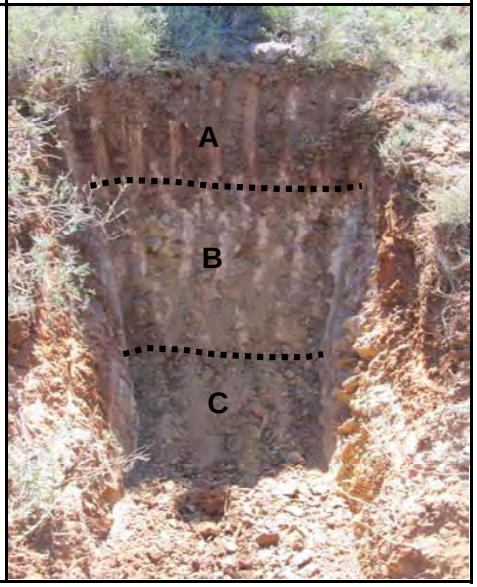


Photo of Test Pit



OUTENIQUA GEOTECHNICAL SERVICES

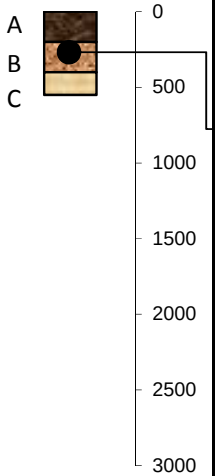
Geotechnical Soil Profile

Client:	DNV-GL South Africa (Pty) Ltd
Project:	Choje Windfarm Preliminary Geotechnical Investigation
Area:	Grahamstown, Eastern Cape
Date:	21.05.19
Excavator:	TLB

E64A

Datum: NGL | Co-ords: 27 Y0056843 X3678372

Key to symbols: ● Sample taken | Groundwater



(0 to 200) Moist, dark red orange, medium dense, intact, **CLAYEY SILTY SAND & ROOTS**, transported.

(200 to 400) Slightly moist, dark red orange, very dense, intact, **CLAYEY SILTY SANDY GRAVEL**, residual.

MOD/CBR/Indicator

Foundation Indicator

Specific Gravity

pH & Conductivity

(400 to 550) Dark olive, slightly weathered, highly fractured, soft to medium hard rock, **TILLITE**.

Refusal @ 550mm

No Water

Dynamic Cone Penetrometer (DCP)

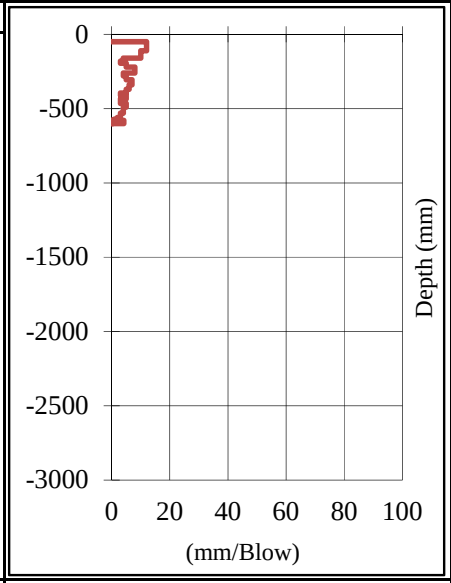
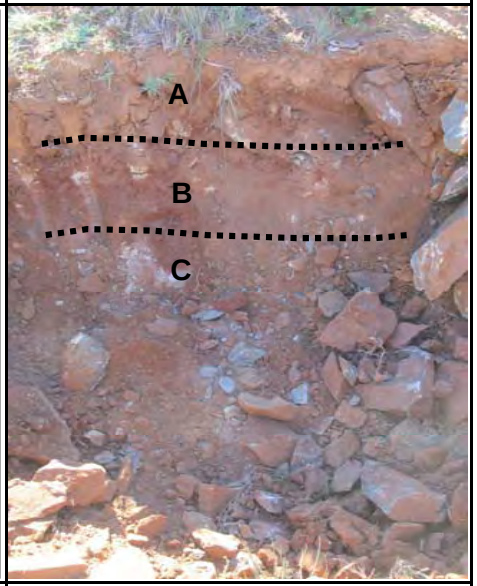


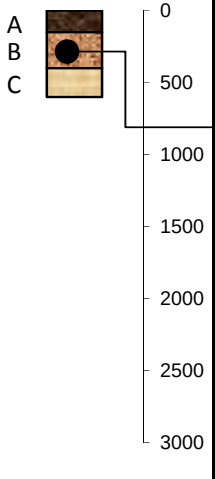
Photo of Test Pit



E64B

Datum: NGL | Co-ords: 27 Y0056802 X3678367

Key to symbols: ● Sample taken | Groundwater



(0 to 150) Moist, dark red orange, medium dense, pinholed, **CLAYEY SILTY SAND & ROOTS**, transported.

(150 to 400) Slightly moist, dark red orange, very dense, intact, **CLAYEY SILTY SANDY GRAVEL**, residual.

MOD/CBR/Indicator

Foundation Indicator

(400 to 600) **Specific Gravity**

pH & Conductivity

Dark olive, slightly weathered, highly fractured, soft to medium hard rock, **TILLITE**.

Refusal @ 600mm

No Water

Dynamic Cone Penetrometer (DCP)

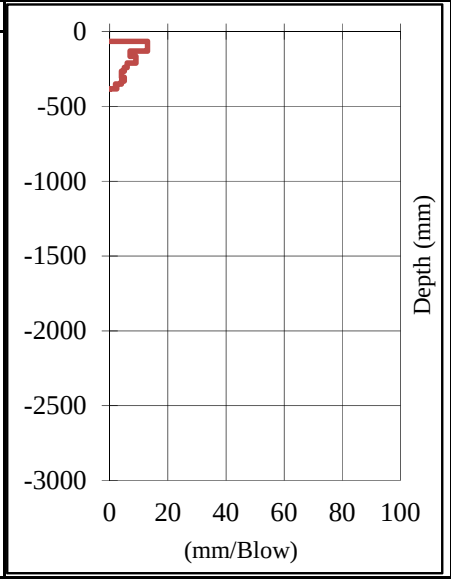
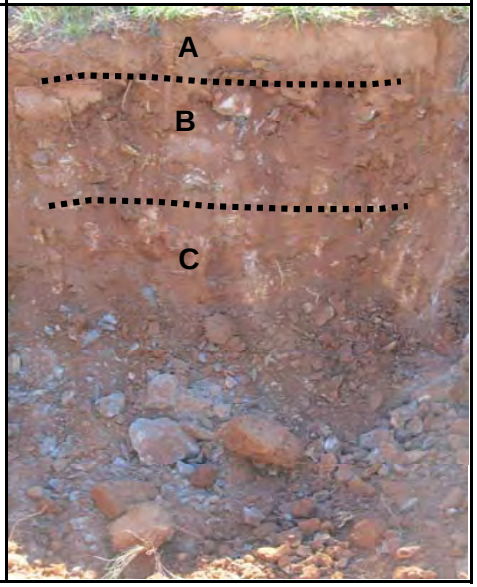


Photo of Test Pit



OUTENIQUA GEOTECHNICAL SERVICES

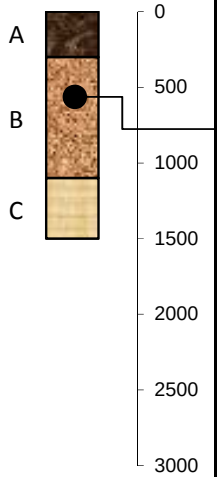
Geotechnical Soil Profile

Client:	DNV-GL South Africa (Pty) Ltd
Project:	Choje Windfarm Preliminary Geotechnical Investigation
Area:	Grahamstown, Eastern Cape
Date:	21.05.19
Excavator:	TLB

E100A

Datum: NGL | Co-ords: 27 Y0058545 X3682241

Key to symbols: ● Sample taken | Groundwater



(0 to 300) Slightly moist, dark red orange, medium dense to dense, pinholed, **CLAYEY SANDY SILT & ROOTS**, transported.

(300 to 1100) Slightly moist, light red brown, very dense, intact, **CLAYEY SILTY SANDY GRAVEL**, residual (completely weathered shale)

MOD/CBR/Indicator

Foundation Indicator

Specific Gravity

pH & Conductivity

(1100 to 1500) Light red brown, highly weathered, highly fractured, very soft to soft rock, **SHALE**.

Refusal @ 1500mm

No Water

Dynamic Cone Penetrometer (DCP)

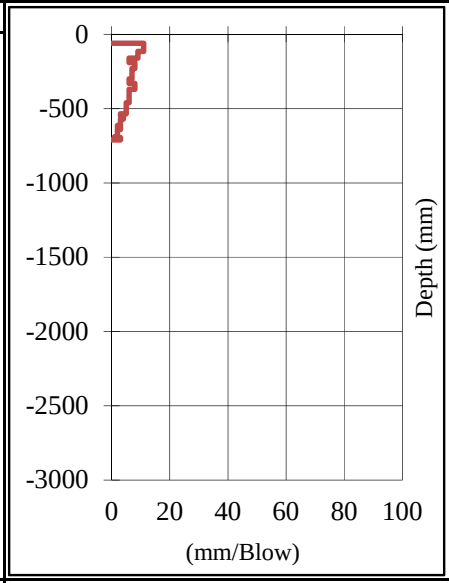
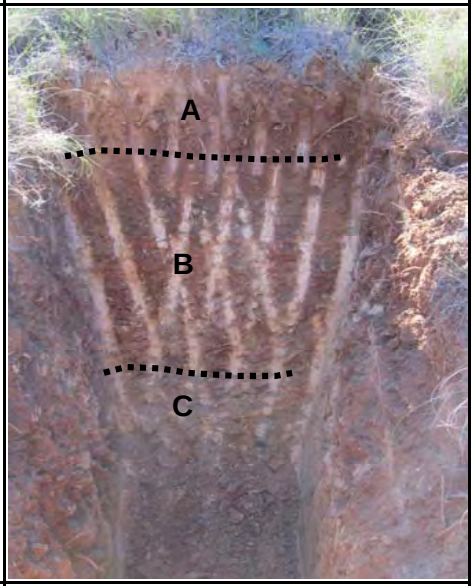


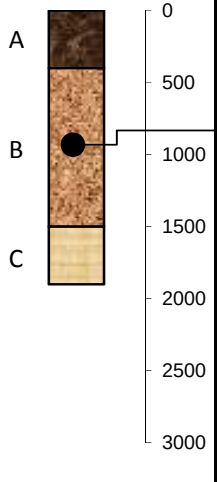
Photo of Test Pit



E100B

Datum: NGL | Co-ords: 27 Y0058559 X3682285

Key to symbols: ● Sample taken | Groundwater



(0 to 400) Slightly moist, dark red orange, medium dense to dense, pinholed, **CLAYEY SANDY SILT & ROOTS**, transported.

(400 to 1500) Slightly moist, light red brown, very dense, intact, **SILTY SANDY GRAVEL**, residual (completely weathered shale)

MOD/CBR/Indicator

Foundation Indicator

Specific Gravity

pH & Conductivity

(1500 to 1900) Light brown, highly weathered, highly fractured, very soft to soft rock, **SHALE**.

Refusal @ 1900mm

No Water

Dynamic Cone Penetrometer (DCP)

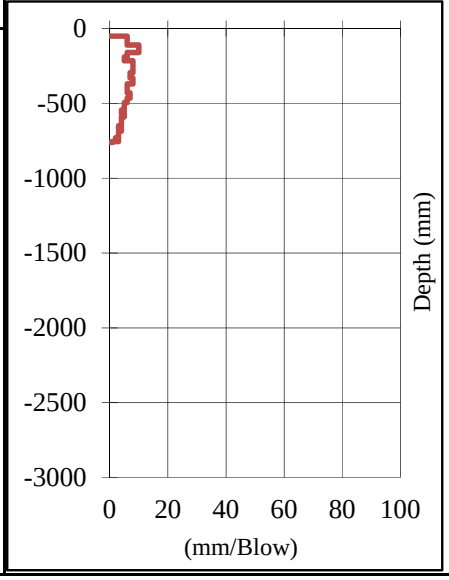
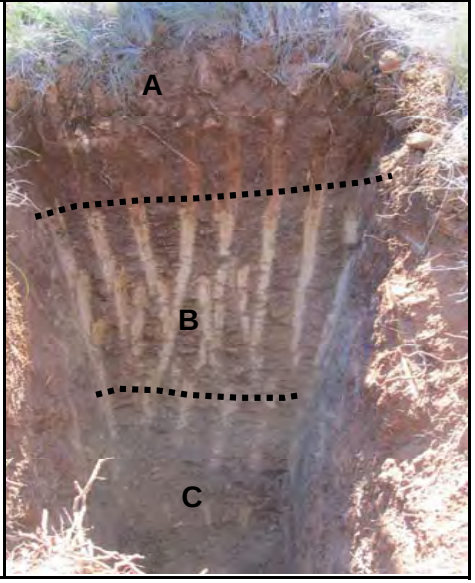


Photo of Test Pit



OUTENIQUA GEOTECHNICAL SERVICES

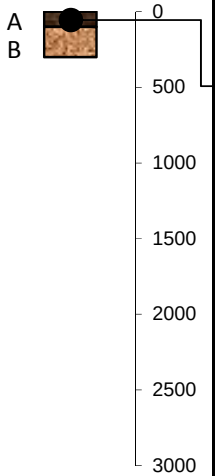
Geotechnical Soil Profile

Client:	DNV-GL South Africa (Pty) Ltd
Project:	Choje Windfarm Preliminary Geotechnical Investigation
Area:	Grahamstown, Eastern Cape
Date:	21.05.19
Excavator:	TLB

TPSS1

Datum: NGL | Co-ords: 27 Y0057036 X3676798

Key to symbols: ● Sample taken | Groundwater



(0 to 100) Moist, light red brown, medium dense, intact, **GRAVELLY SILTY SAND & ROOTS**, residual.

MOD/CBR/Indicator

Foundation Indicator

Specific gravity

pH & Conductivity

(100 to 300) Dark grey stained dark red orange, medium weathered, slightly fractured, medium hard rock, **TILLITE**.

Refusal @ 300mm

No Water

Dynamic Cone Penetrometer (DCP)

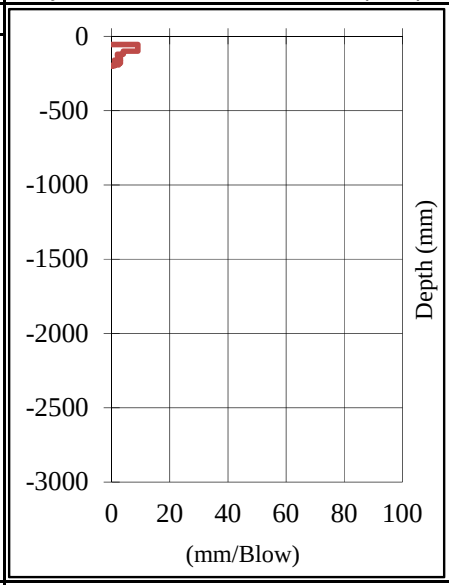
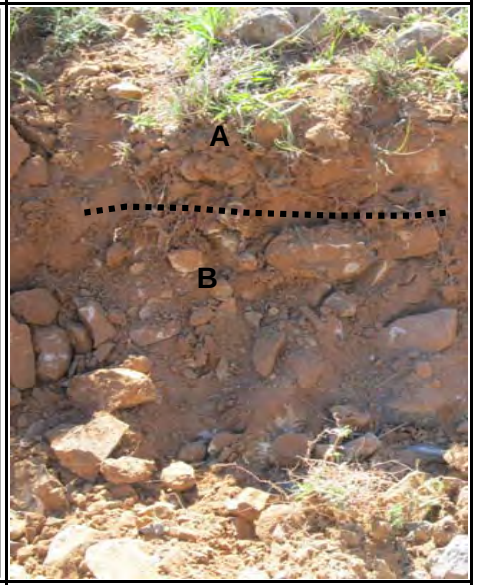


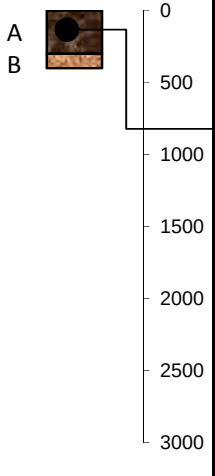
Photo of Test Pit



TPSS2

Datum: NGL | Co-ords: 27 Y0056833 X3676843

Key to symbols: ● Sample taken | Groundwater



(0 to 300) Moist, light brown, medium dense, intact, **SILTY GRAVELLY SAND & BOULDERS & COBBLES**, residual (completely weathered tillite)

Dark grey stained dark red orange, moderately weathered, slightly fractured, medium hard rock, **TILLITE**.

MOD/CBR/Indicator

Foundation Indicator

Specific gravity

pH & Conductivity

(300 to 400) Dark olive, slightly weathered, highly fractured, soft to medium hard rock, **TILLITE**.

Refusal @ 400mm

No Water

Dynamic Cone Penetrometer (DCP)

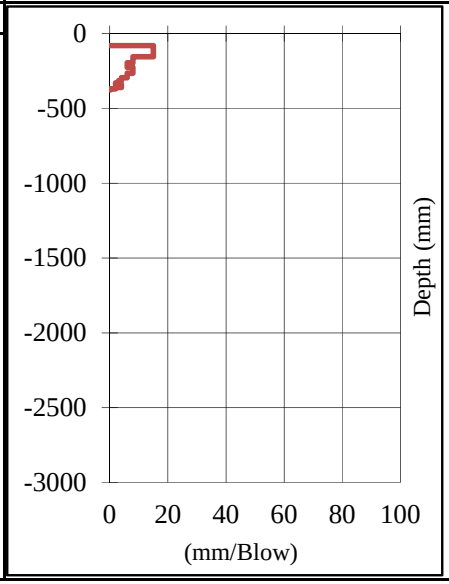
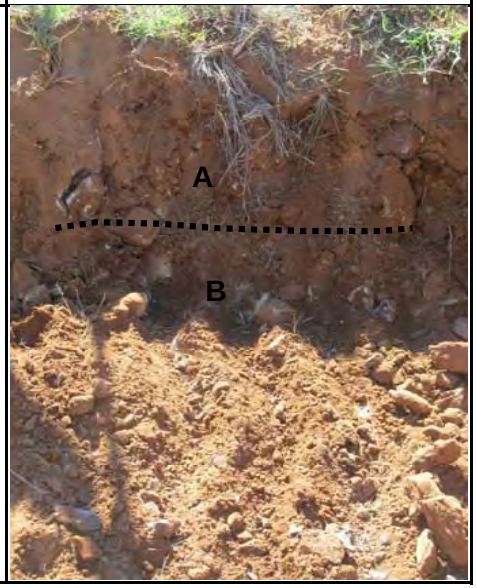


Photo of Test Pit



OUTENIQUA GEOTECHNICAL SERVICES

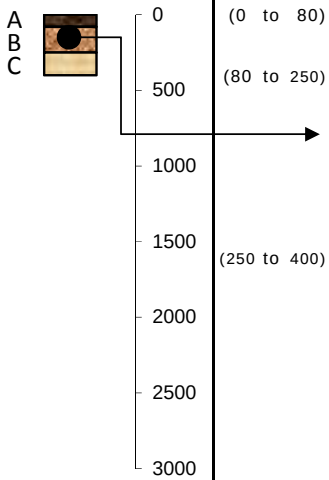
Geotechnical Soil Profile

Client:	DNV-GL South Africa (Pty) Ltd
Project:	Choje Windfarm Preliminary Geotechnical Investigation
Area:	Grahamstown, Eastern Cape
Date:	21.05.19
Excavator:	TLB

TPSS3

Datum: NGL | Co-ords: 27 Y0057064 X3676883

Key to symbols: ● Sample taken | Groundwater



(0 to 80) Moist, light red brown, medium dense, pinholed, **GRAVELLY SILTY SAND & ROOTS**, transported.

(80 to 250) Slightly moist, light red brown, dense, intact, **SILTY SANDY GRAVEL & COBBLES**, residual.

MOD/CBR/Indicator

Foundation Indicator

Specific Gravity

pH & Conductivity

(250 to 400) Dark olive, moderately weathered, slightly fractured, medium hard rock, **TILLITE**.

Refusal @400mm

No Water

Dynamic Cone Penetrometer (DCP)

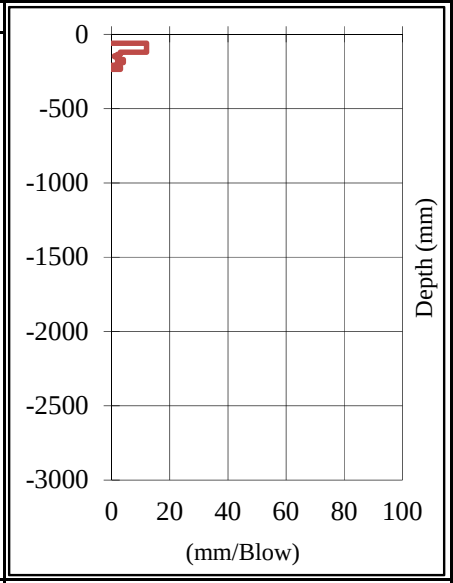
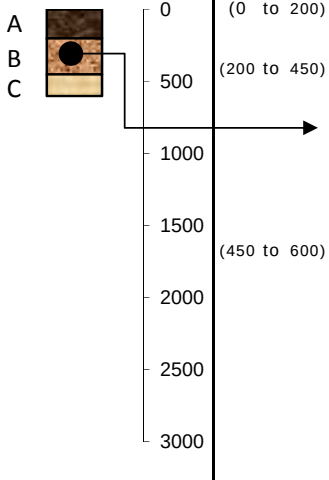


Photo of Test Pit

TPSS4

Datum: NGL | Co-ords: 27 Y0056864 X3676926

Key to symbols: ● Sample taken | Groundwater



(0 to 200) Moist, light red brown, medium dense, pinholed, **CLAYEY SILTY GRAVELLY SAND & ROOTS**, transported.

(200 to 450) Slightly moist, light red brown, dense, intact, **SILTY SANDY GRAVEL**, residual (completely weathered tillite)

MOD/CBR/Indicator

Foundation Indicator

Specific Gravity

pH & Conductivity

(450 to 600) Dark olive, moderately weathered, slightly fractured, soft to medium hard rock, **TILLITE**.

Refusal @ 600mm

No Water

Dynamic Cone Penetrometer (DCP)

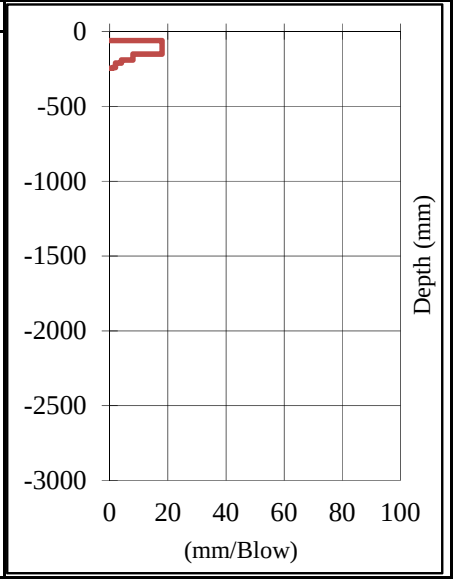
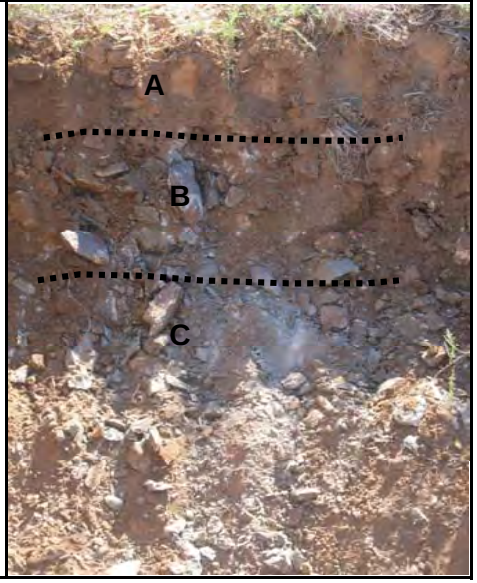


Photo of Test Pit



OUTENIQUA GEOTECHNICAL SERVICES

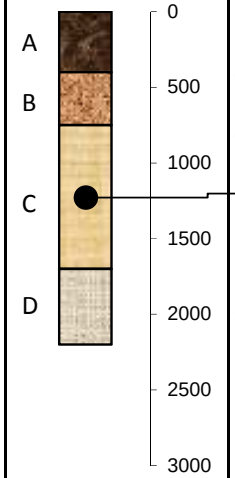
Geotechnical Soil Profile

Client:	DNV-GL South Africa (Pty) Ltd
Project:	Choje Wind Farm
Area:	Somerset East, Eastern Cape
Date:	11.06.19
Excavator:	TLB

W411A

Datum: NGL | Co-ords: 25 Y-058935 X3666540

Key to symbols: ● Sample taken | Groundwater



(0 to 400) Slightly moist, dark red brown, medium dense, pinholed, **SILTY SAND**, transported.

(400 to 750) Slightly moist, dark red orange, medium dense, intact, **CLAYEY SILTY SAND**, transported.

(750 to 1700) Slightly moist, light red orange, dense, intact, **GRAVELLY SANDY SILT**, transported/pedogenic (calcrete nodules present)

MOD/CBR/Indicator
Foundation Indicator
Specific gravity
pH & Conductivity

(1700 to 2200) Light red orange, highly weathered, slightly fractured, very soft rock, **CALCRETE HARDPAN.**

Refusal @ 2200mm on CALCRETE HARDPAN
No Water

Dynamic Cone Penetrometer (DCP)

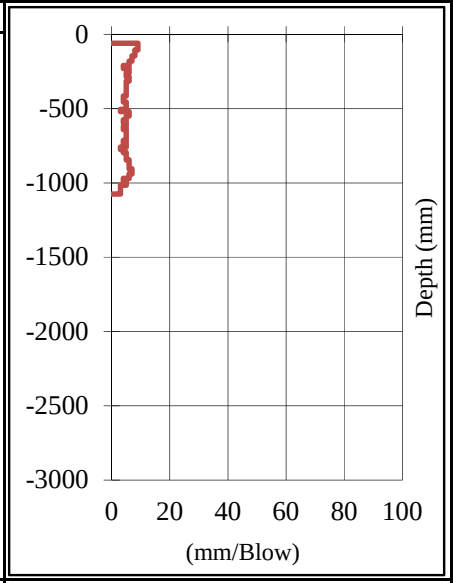
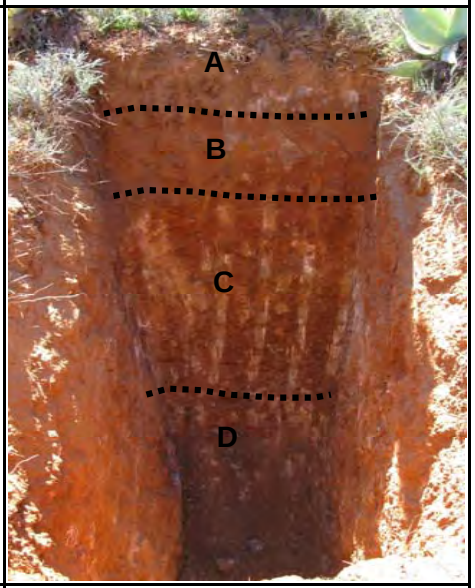


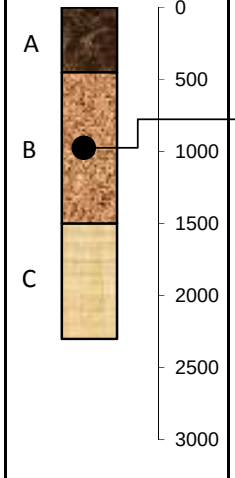
Photo of Test Pit



W411B

Datum: NGL | Co-ords: 25 Y-058938 X3666481

Key to symbols: ● Sample taken | Groundwater



(0 to 450) Slightly moist, dark red brown, medium dense, intact, **CLAYEY SILTY SAND**, transported.

(450 to 1500) Slightly moist, light red orange, very dense, intact, **GRAVELLY SILTY SAND**, transported/pedogenic.

MOD/CBR/Indicator
Foundation Indicator
Specific gravity
pH & Conductivity

(1500 to 2300) Slightly moist, light red orange, very dense, intact, **SILTY SANDY GRAVEL**, transported/pedogenic (calcareous cemented alluvium)

TP stopped
No Water

Dynamic Cone Penetrometer (DCP)

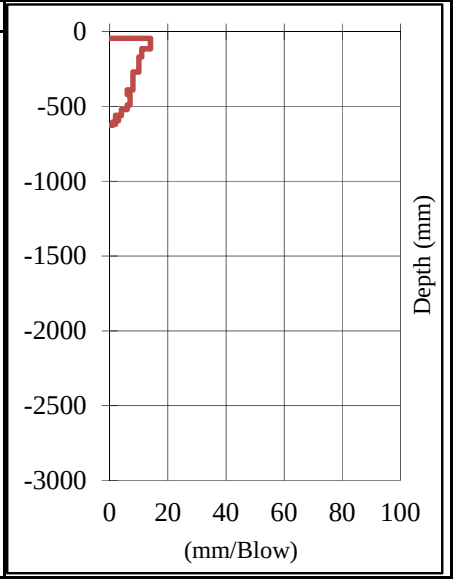
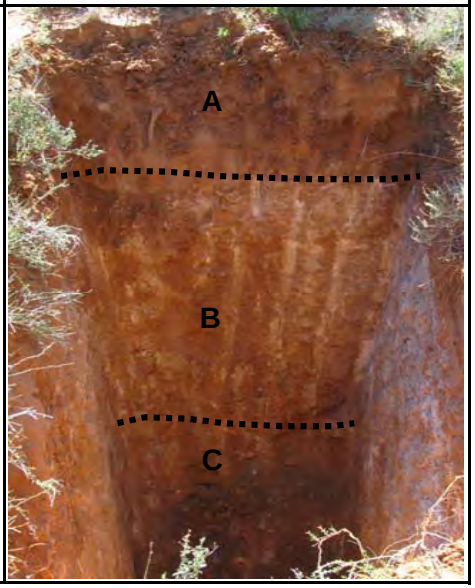


Photo of Test Pit



OUTENIQUA GEOTECHNICAL SERVICES

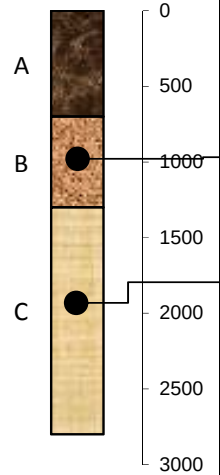
Geotechnical Soil Profile

Client:	DNL-GL South Africa (Pty) Ltd
Project:	Choje Wind Farm
Area:	Somerset East, Eastern Cape
Date:	11.06.19
Excavator:	TLB

W417A

Datum: NGL | Co-ords: 25 Y-064772 X3640897

Key to symbols: ● Sample taken | Groundwater



(0 to 700) Slightly moist, dark red brown, medium dense, intact, **CLAYEY SILTY SAND & ROOTS**, transported.

(700 to 1300) Slightly moist, dark red orange, dense, intact, **CLAYEY GRAVELLY SILTY SAND**, alluvial.

MOD/CBR/Indicator

(1300 to 2800) Slightly moist, light red orange, very dense, intact, **CLAYEY GRAVELLY SANDY SILT**, alluvial/pedogenic (calcrete gravel)

Foundation Indicator

Specific gravity

pH & Conductivity

TP stopped

No Water

Dynamic Cone Penetrometer (DCP)

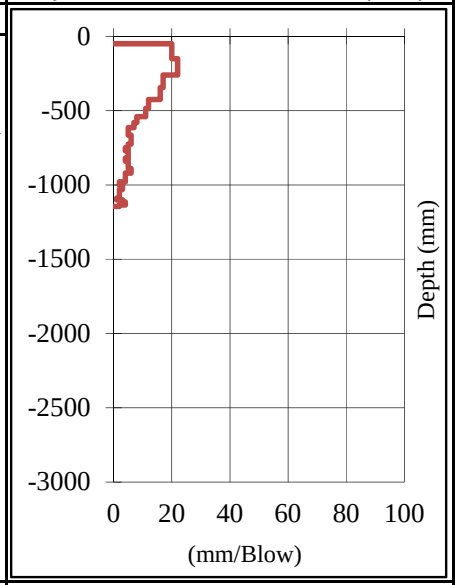
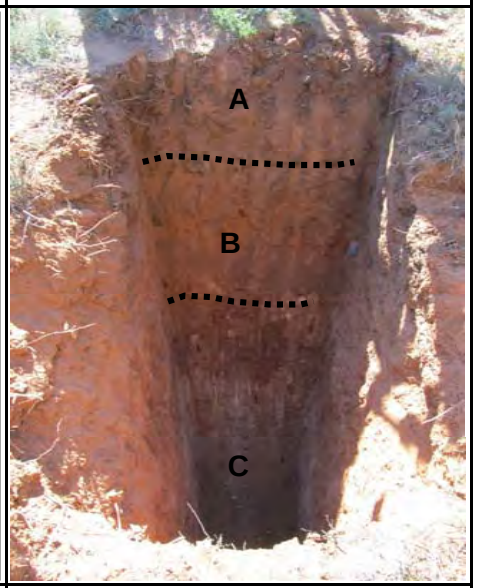


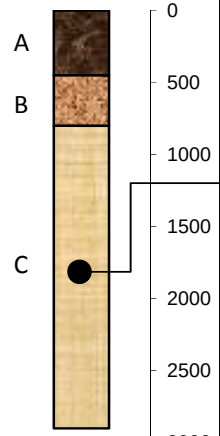
Photo of Test Pit



W417B

Datum: NGL | Co-ords: 25 Y-064722 X3640896

Key to symbols: ● Sample taken | Groundwater



(0 to 450) Slightly moist, dark red brown, medium dense, intact, **CLAYEY SILTY SAND & ROOTS**, transported.

(450 to 800) Slightly moist, dark red orange, stiff, fissured, **CLAYEY SILTY SAND**, alluvial.

(800 to 2900) Slightly moist, light yellow orange, very dense, intact, **CLAYEY GRAVELLY SANDY SILT**, alluvial/pedogenic (calcrete gravel)

MOD/CBR/Indicator

Foundation Indicator

Specific gravity

pH & Conductivity

TP stopped

No Water

Dynamic Cone Penetrometer (DCP)

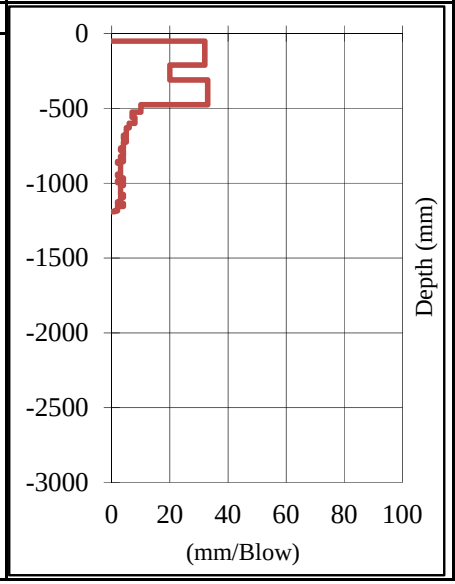
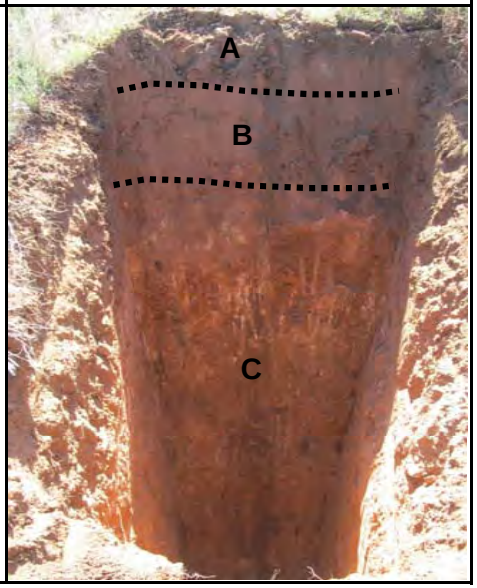


Photo of Test Pit



Geotechnical Soil Profile

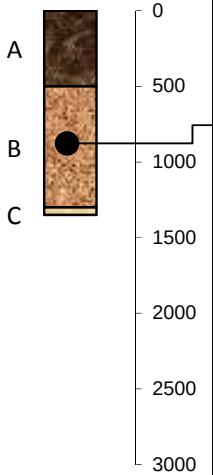
OUTENIQUA GEOTECHNICAL SERVICES

Client:	DNV-GL South Africa (Pty) Ltd
Project:	Choje Wind Farm
Area:	Somerset East, Eastern Cape
Date:	11.06.19
Excavator:	TLB

W452A

Datum: NGL | Co-ords: 25 Y-068726 X3649254

Key to symbols: ● Sample taken | Groundwater



(0 to 500) Slightly moist, dark red brown, dense, intact, **SILTY GRAVELLY SAND**, transported.

(500 to 1300) Slightly moist, light brown, very dense, intact, **SILTY SANDY GRAVEL**, alluvial.

MOD/CBR/Indicator
Foundation Indicator
Specific gravity
pH & Conductivity

(1300 to 1350) Light brown, moderately weathered, slightly fractured, medium hard rock, **SANDSTONE**.

Refusal @ 1350mm on rock
No Water

Dynamic Cone Penetrometer (DCP)

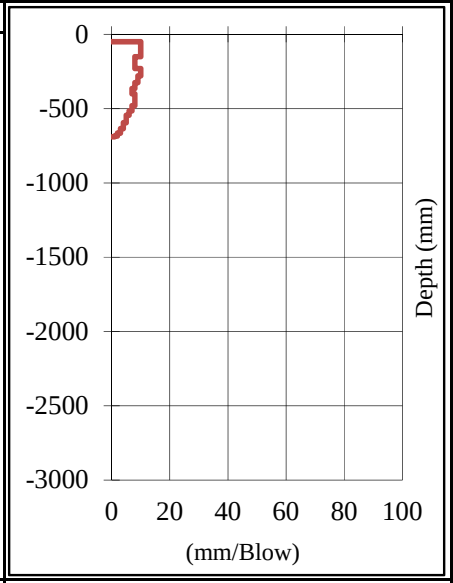
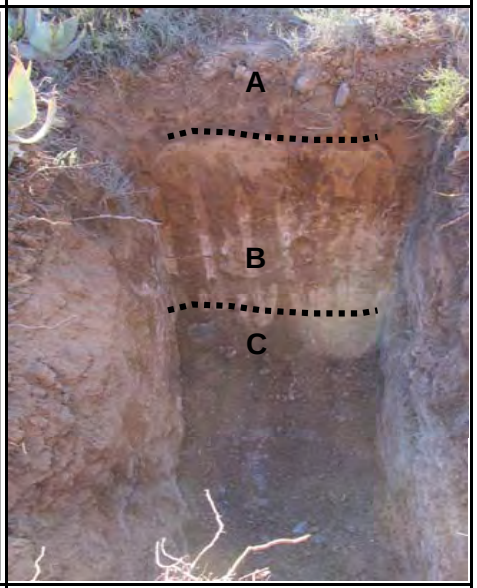


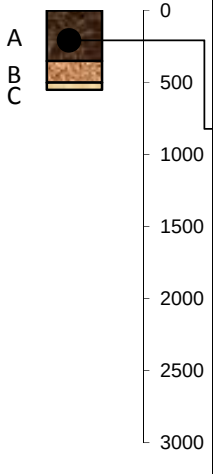
Photo of Test Pit



W452B

Datum: NGL | Co-ords: 25 Y-068755 X3649296

Key to symbols: ● Sample taken | Groundwater



(0 to 350) Slightly moist, dark red brown, medium dense to dense, intact, **SILTY SAND**, transported.

(350 to 500) Slightly moist, dark red brown, very dense, intact, **SILTY GRAVELLY SAND**, residual (completely weathered sandstone)

MOD/CBR/Indicator
Foundation Indicator
Specific gravity
pH & Conductivity

(500 to 550) Light brown, moderately weathered, slightly fractured, medium hard rock, **SANDSTONE**.

Refusal @ 550mm on rock
No Water

Dynamic Cone Penetrometer (DCP)

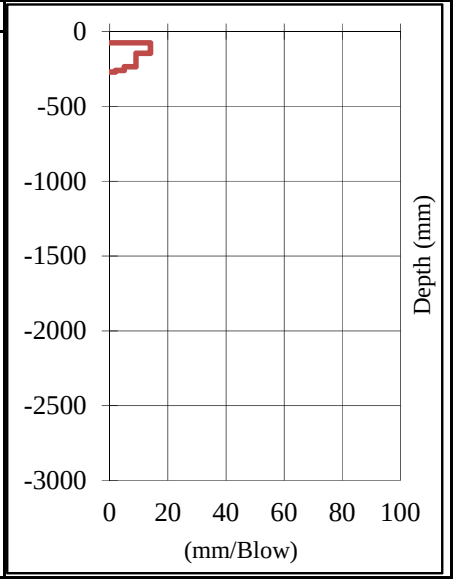
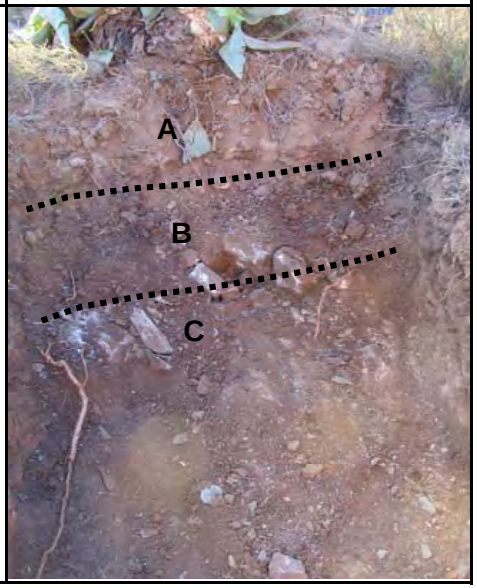


Photo of Test Pit



OUTENIQUA GEOTECHNICAL SERVICES

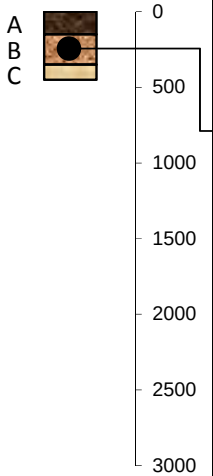
Geotechnical Soil Profile

Client:	DNL-GL South Africa (Pty) Ltd
Project:	Choje Wind Farm
Area:	Somerset East, Eastern Cape
Date:	11.06.19
Excavator:	TLB

W521A

Datum: NGL | Co-ords: 25 Y-074141 X3659627

Key to symbols: ● Sample taken | Groundwater



(0 to 150) Slightly moist, dark red orange, medium dense, intact, **GRAVELLY SILTY SAND**, transported.

(150 to 350) Slightly moist, light red orange, very dense, intact, **SILTY SANDY GRAVEL**, residual (completely weathered shale)

MOD/CBR/Indicator

Foundation Indicator

Specific gravity

pH & Conductivity

(350 to 450) Dark grey, moderately weathered, slightly fractured, medium hard rock, **SHALE**

Refusal @ 450mm on rock

No Water

Dynamic Cone Penetrometer (DCP)

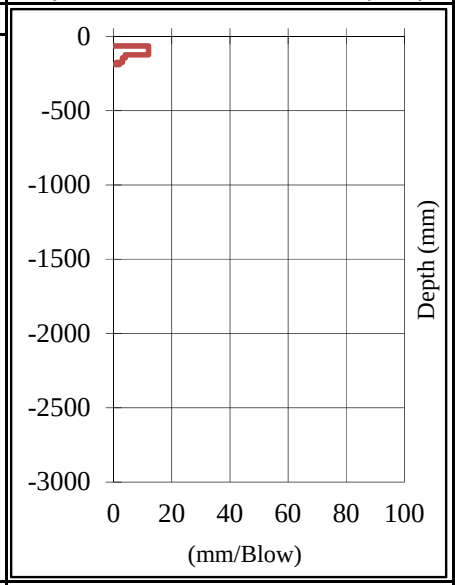
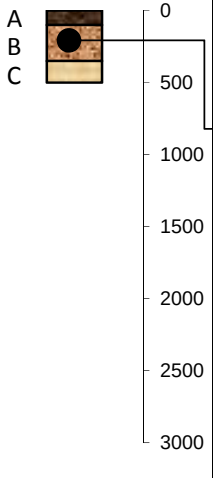


Photo of Test Pit

W521B

Datum: NGL | Co-ords: 25 Y-074222 X3659648

Key to symbols: ● Sample taken | Groundwater



(0 to 100) Slightly moist, dark red orange to dark red brown, medium dense, intact, **GRAVELLY SILTY SAND**, transported.

(100 to 350) Slightly moist, light red orange, very dense, intact, **SILTY SANDY GRAVEL**, residual (completely weathered shale)

MOD/CBR/Indicator

Foundation Indicator

Specific gravity

pH & Conductivity

(350 to 500) Light red orange, moderately weathered, slightly fractured, medium hard, **SHALE**

Refusal @ 500mm on rock

No Water

Dynamic Cone Penetrometer (DCP)

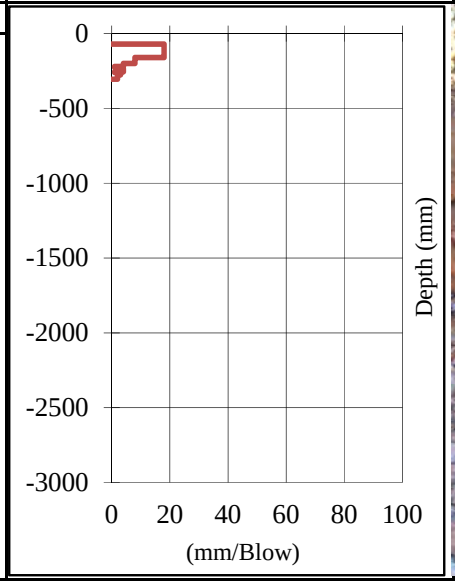


Photo of Test Pit

OUTENIQUA GEOTECHNICAL SERVICES

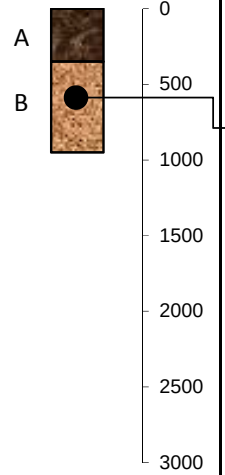
Geotechnical Soil Profile

Client:	DNL-GL South Africa (Pty) Ltd
Project:	Choje Wind Farm
Area:	Somerset East, Eastern Cape
Date:	11.06.19
Excavator:	TLB

W564A

Datum: NGL | Co-ords: 25 Y-080520 X3663859

Key to symbols: Sample taken | Groundwater



(0 to 350) Slightly moist, light red orange, medium dense, pinholed, **SILTY SAND**, transported.

(350 to 950) Light olive to light brown, highly weathered, slightly fractured, very soft rock, **CALCRETE HARDPAN.**

MOD/CBR/Indicator
Foundation Indicator
Specific gravity
pH & Conductivity

Refusal @ 950mm on CALCRETE HARDPAN
No Water

Dynamic Cone Penetrometer (DCP)

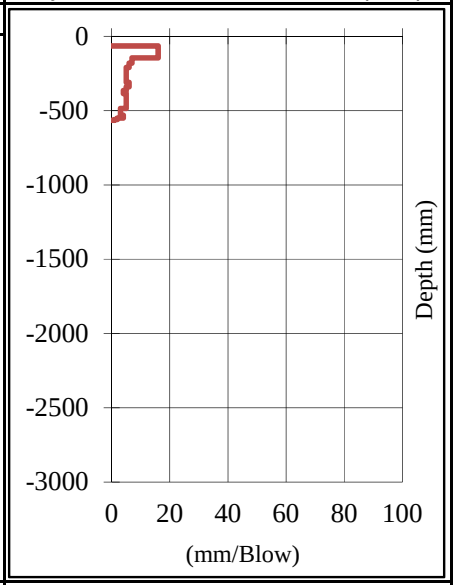
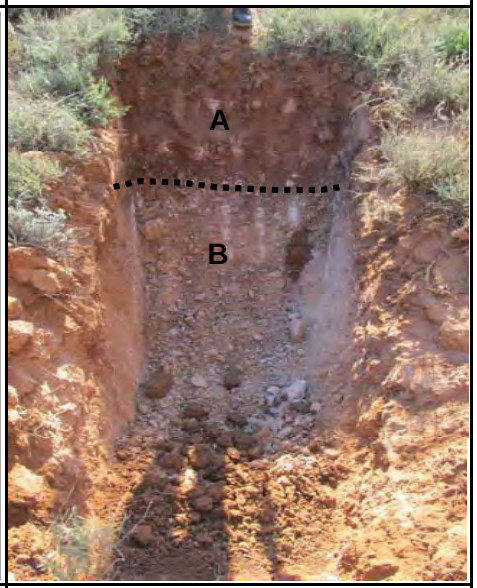


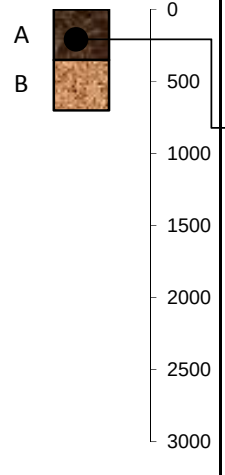
Photo of Test Pit



W564B

Datum: NGL | Co-ords: 25 Y-080582 X3663856

Key to symbols: Sample taken | Groundwater



(0 to 350) Slightly moist, light red orange, medium dense, pinholed, **SILTY SAND**, transported.

(350 to 700) Light olive to light brown, highly weathered, slightly fractured, very soft rock, **CALCRETE HARDPAN.**

MOD/CBR/Indicator
Foundation Indicator
Specific gravity
pH & Conductivity

Refusal @ 700mm on CALCRETE HARDPAN
No Water

Dynamic Cone Penetrometer (DCP)

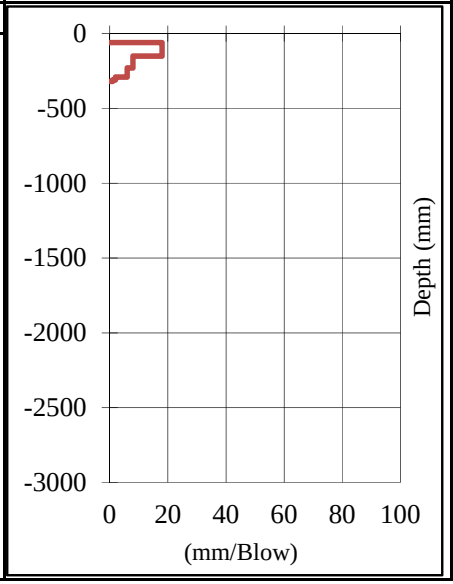
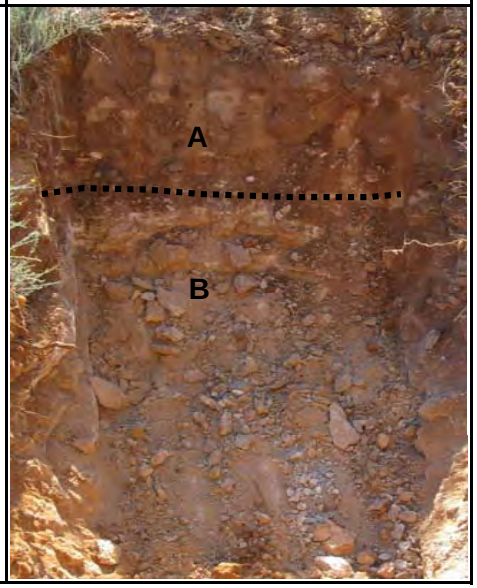


Photo of Test Pit



Geotechnical Soil Profile

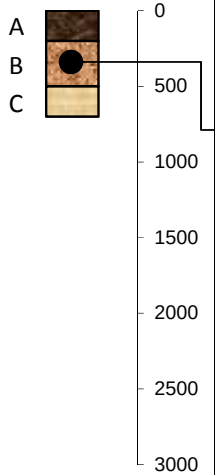
OUTENIQUA GEOTECHNICAL SERVICES

Client:	DNV-GL South Africa (Pty) Ltd
Project:	Choje Wind Farm
Area:	Somerset East, Eastern Cape
Date:	11.06.19
Excavator:	TLB

TPMTS 1

Datum: NGL | Co-ords: 25 Y-074860 X3660346

Key to symbols: ● Sample taken | Groundwater



(0 to 200) Slightly moist, dark red orange, medium dense, intact, **GRAVELLY SILTY SAND**, transported.

(200 to 500) Slightly moist, light red orange, very dense, intact, **SILTY SANDY GRAVEL**, residual (completely weathered shale)

MOD/CBR/Indicator

Foundation Indicator

Specific gravity

pH & Conductivity

(500 to 700) Dark grey stained light red orange, highly weathered, highly fractured, medium hard rock, **SHALE**

Refusal @ 700mm on rock

No Water

Dynamic Cone Penetrometer (DCP)

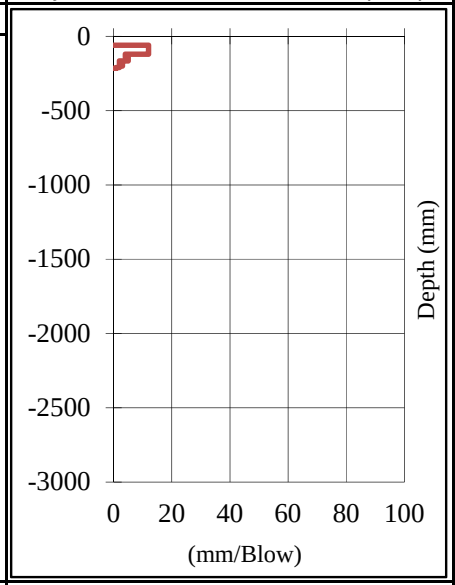
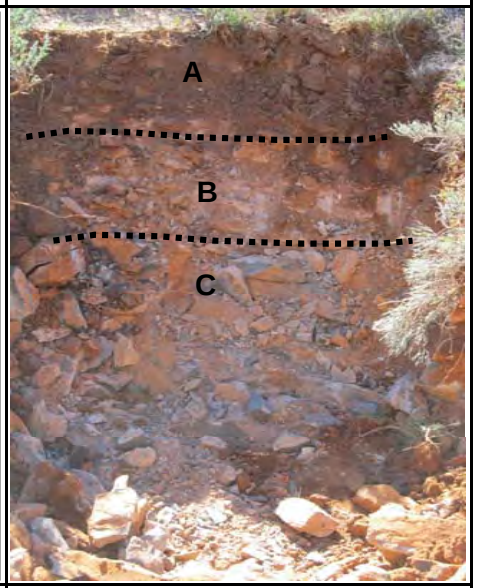


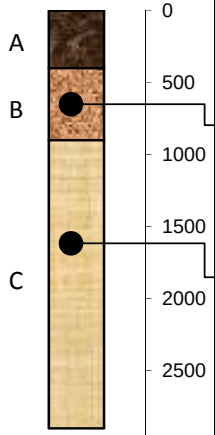
Photo of Test Pit



TPMTS 2

Datum: NGL | Co-ords: 25 Y-075559 X3660345

Key to symbols: ● Sample taken | Groundwater



(0 to 400) Slightly moist, light brown, medium dense to dense, intact, **GRAVELLY SILTY SAND**, transported.

(400 to 900) Slightly moist, light olive, very dense, intact, **SANDY SILTY GRAVEL**, pedogenic (calcrete gravel)

MOD/CBR/Indicator

Specific gravity

pH & Conductivity

(900 to 2900) Slightly moist, dark olive, dense, intact, **SANDY GRAVEL & ROUNDED PEBBLES**, alluvial

Foundation Indicator

TP Stopped

No Water

Dynamic Cone Penetrometer (DCP)

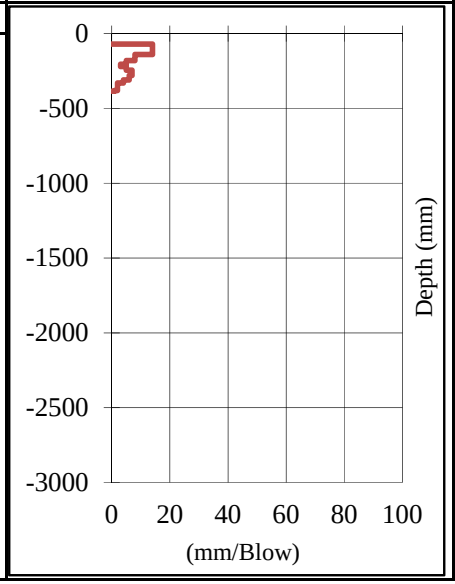
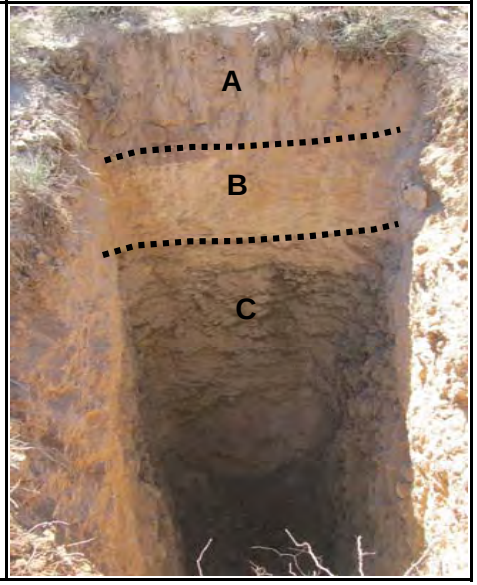


Photo of Test Pit



Geotechnical Soil Profile

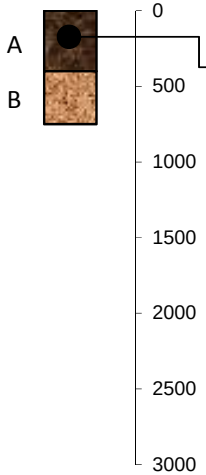
OUTENIQUA GEOTECHNICAL SERVICES

Client:	DNV-GL South Africa (Pty) Ltd
Project:	Choje Wind Farm
Area:	Somerset East, Eastern Cape
Date:	11.06.19
Excavator:	TLB

TPMTS 3

Datum: NGL | Co-ords: 25 Y-074855 X3660926

Key to symbols: ● Sample taken | Groundwater



(0 to 400) Slightly moist, dark red orange, very dense, intact, **SILTY SANDY GRAVEL**, residual (completely weathered shale)

MOD/CBR/Indicator

Foundation Indicator

Specific gravity

pH & Conductivity

(400 to 750) Dark grey stained dark red orange, highly weathered, highly fractured, soft to medium hard rock, **SHALE**

Refusal @ 750mm on SHALE

No Water

Dynamic Cone Penetrometer (DCP)

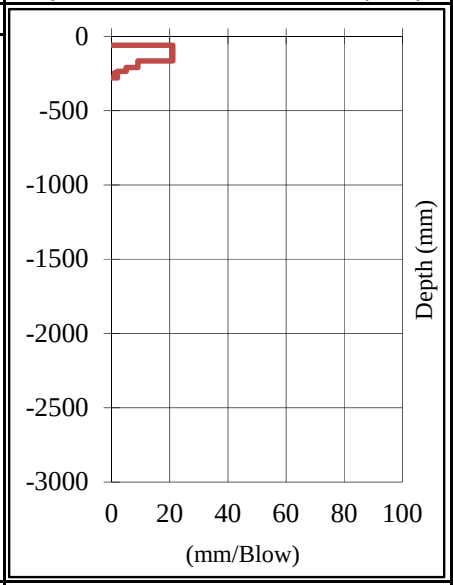
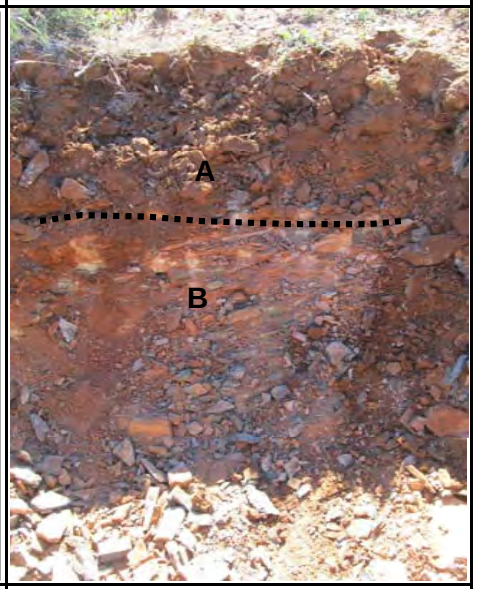


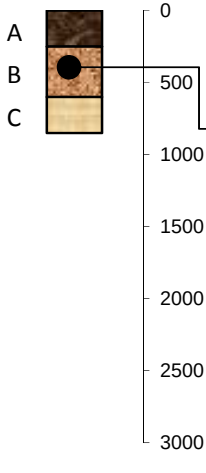
Photo of Test Pit



TPMTS 4

Datum: NGL | Co-ords: 25 Y-075514 X3660929

Key to symbols: ● Sample taken | Groundwater



(0 to 250) Slightly moist, dark red brown, dense, intact, **SILTY GRAVELLY SAND & ROOTS**, transported.

(250 to 600) Slightly moist, light olive to light brown, very dense, intact, **SANDY SILTY GRAVEL & COBBLES**, pedogenic (calcrete gravel)

MOD/CBR/Indicator

Foundation Indicator

Specific gravity

pH & Conductivity

(600 to 850) Light olive, moderately weathered, slightly fractured, soft to very soft rock, **CALCRETE HARDPAN**.

Refusal @ 850mm on CALCRETE HARDPAN

No Water

Dynamic Cone Penetrometer (DCP)

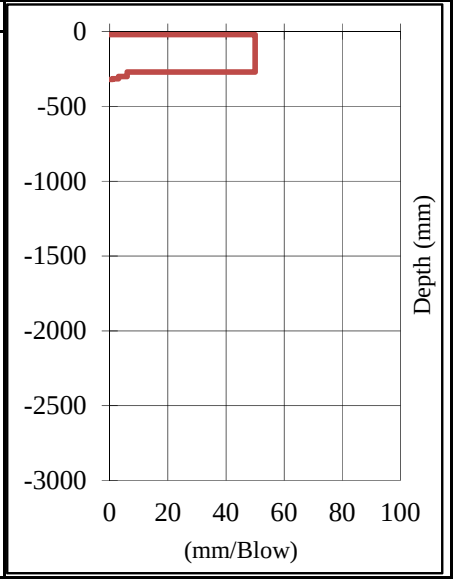
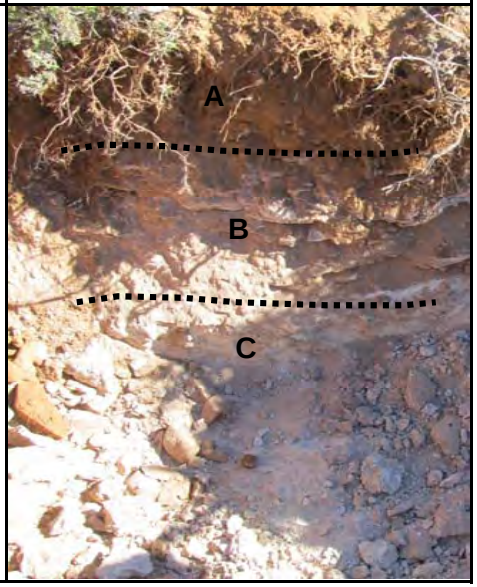


Photo of Test Pit



Outeniqua Geotechnical Services cc.

Geotechnical Engineering Consultants

Registration No. 1999/062743/23

18 Clyde Street, Knysna : PO Box 964, Knysna, 6570

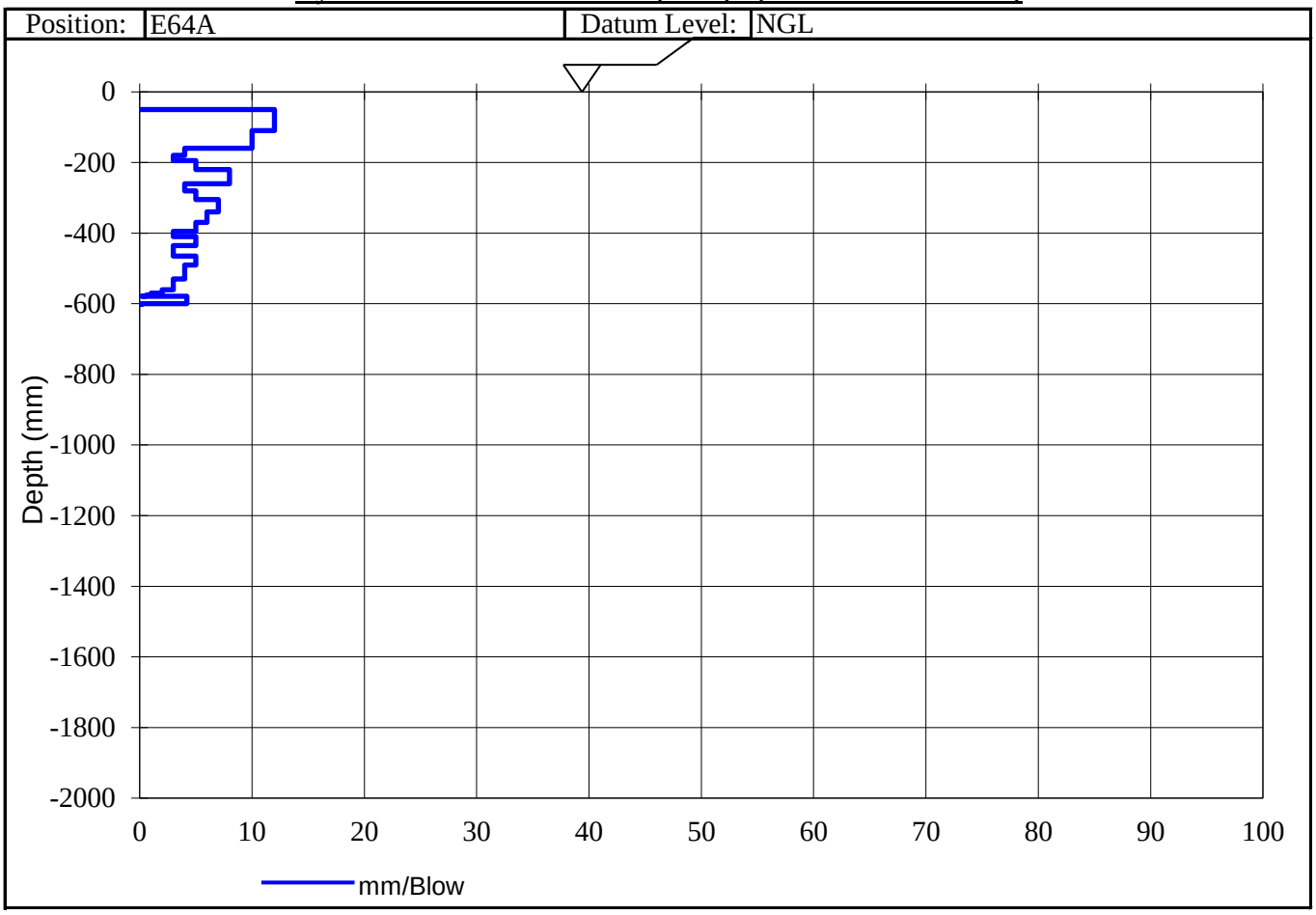
Tel: 044 3820502 : Fax: 044 3820503 : e-mail: iain@outeniqualab.co.za

Customer :	DNV-GL South Africa (Pty) Ltd 15th Floor, Metlife Building 7 Walter Sisulu Ave, Foreshore Cape Town, 8001	Project :	Choje Wind Farm
		Date Received :	28.02.19
		Date Reported :	21.05.19
		Req. Number :	
Attention :	Richard Fyvie	No. of Pages :	1 of 12

TEST REPORT

Dynamic Cone Penetrometer (DCP) - (TMH 6 Method ST6)

Position: E64A Datum Level: NGL



I Paton (Member)
For Outeniqua Geotech. Services cc.
Technical Signatory

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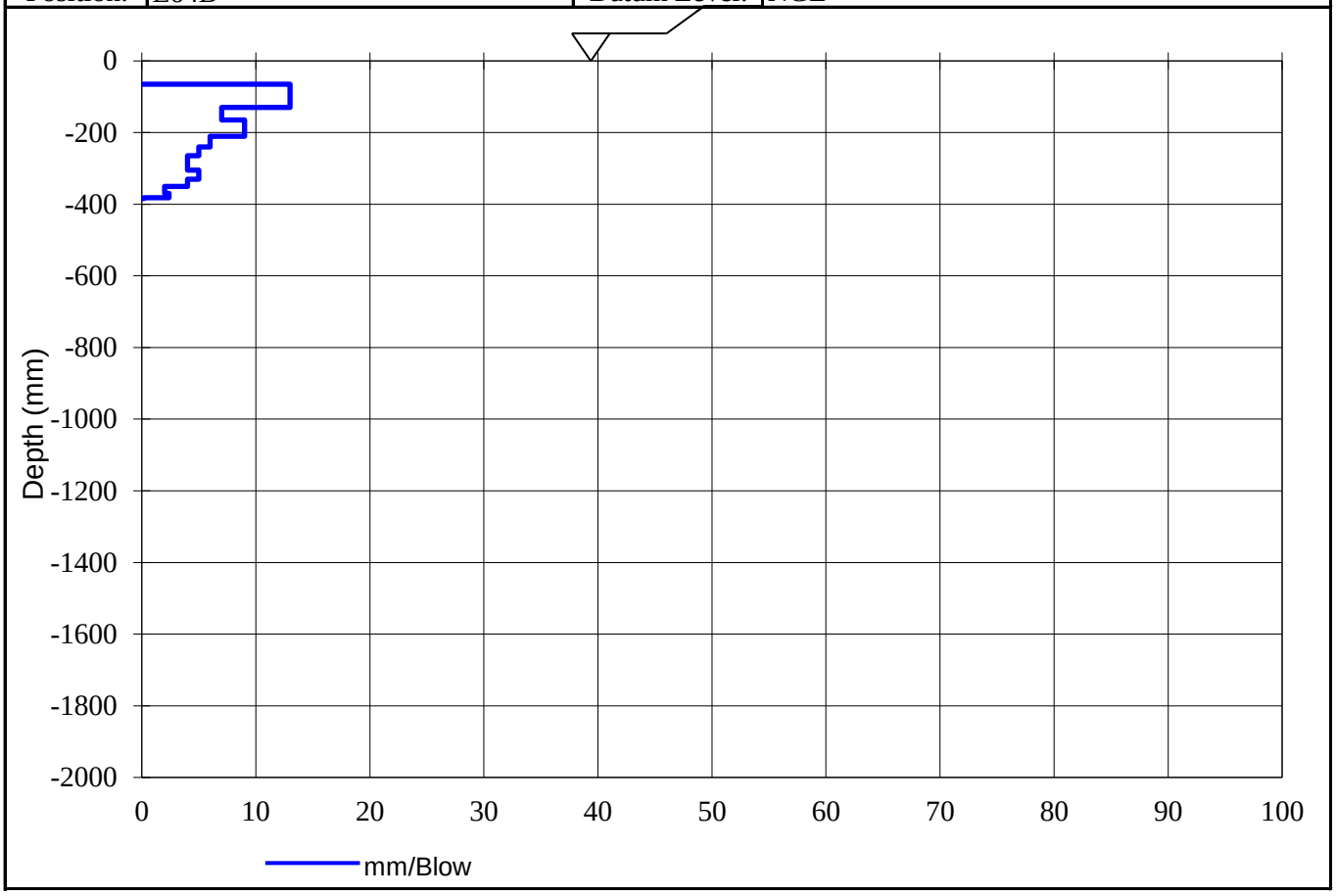
		Date Received :	28.02.19
		Date Reported :	21.05.19
		Req. Number :	
Attention :	Richard Fyvie	No. of Pages :	2 of 12

TEST REPORT

Dynamic Cone Penetrometer (DCP) - (TMH 6 Method ST6)

Position:	E64B	Datum Level:	NGL



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For Outeniqua Geotech. Services cc.
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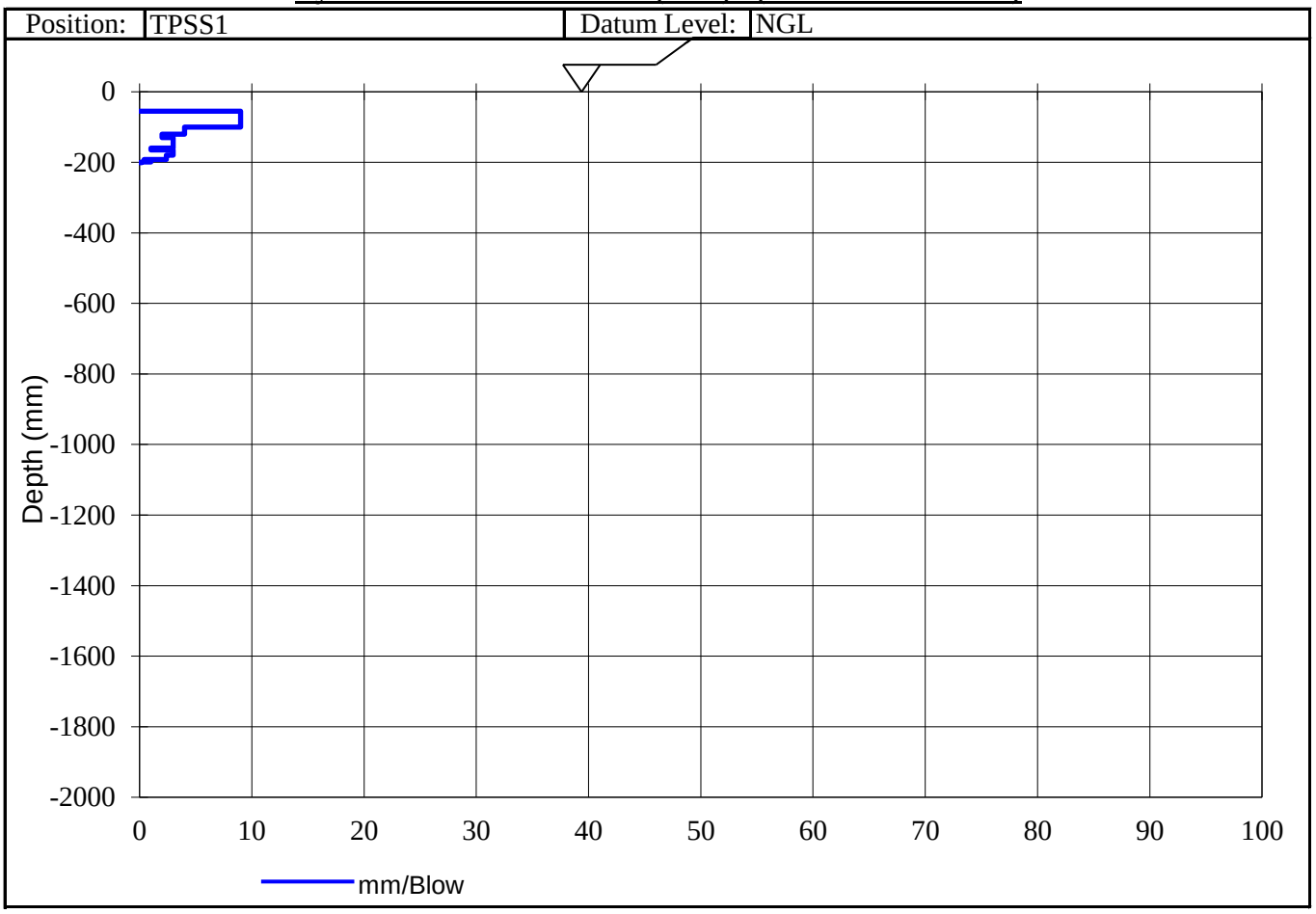
Customer :	DNV-GL South Africa (Pty) Ltd 15th Floor, Metlife Building 7 Walter Sisulu Ave, Foreshore Cape Town, 8001	Project :	Choje Wind Farm
		Date Received :	28.02.19
		Date Reported :	21.05.19
		Req. Number :	
Attention :	Richard Fyvie	No. of Pages :	3 of 12

TEST REPORT

Dynamic Cone Penetrometer (DCP) - (TMH 6 Method ST6)

Position:	TPSS1	Datum Level:	NGL



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For Outeniqua Geotech. Services cc.
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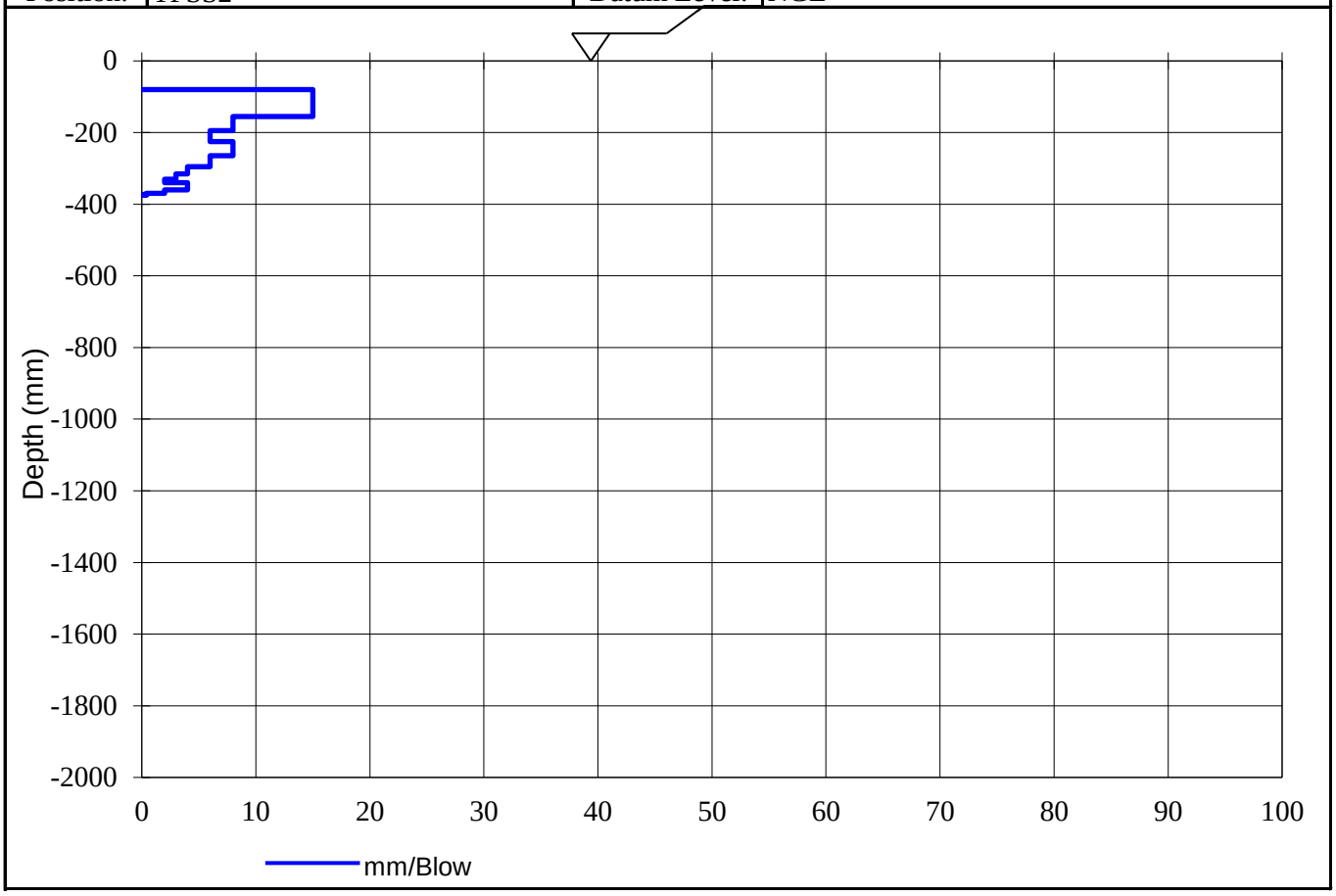
Customer :	DNV-GL South Africa (Pty) Ltd 15th Floor, Metlife Building 7 Walter Sisulu Ave, Foreshore Cape Town, 8001	Project :	Choje Wind Farm
		Date Received :	28.02.19
		Date Reported :	21.05.19
		Req. Number :	
Attention :	Richard Fyvie	No. of Pages :	4 of 12

TEST REPORT

Dynamic Cone Penetrometer (DCP) - (TMH 6 Method ST6)

Position:	TPSS2	Datum Level:	NGL



I Paton (Member)
For Outeniqua Geotech. Services cc.
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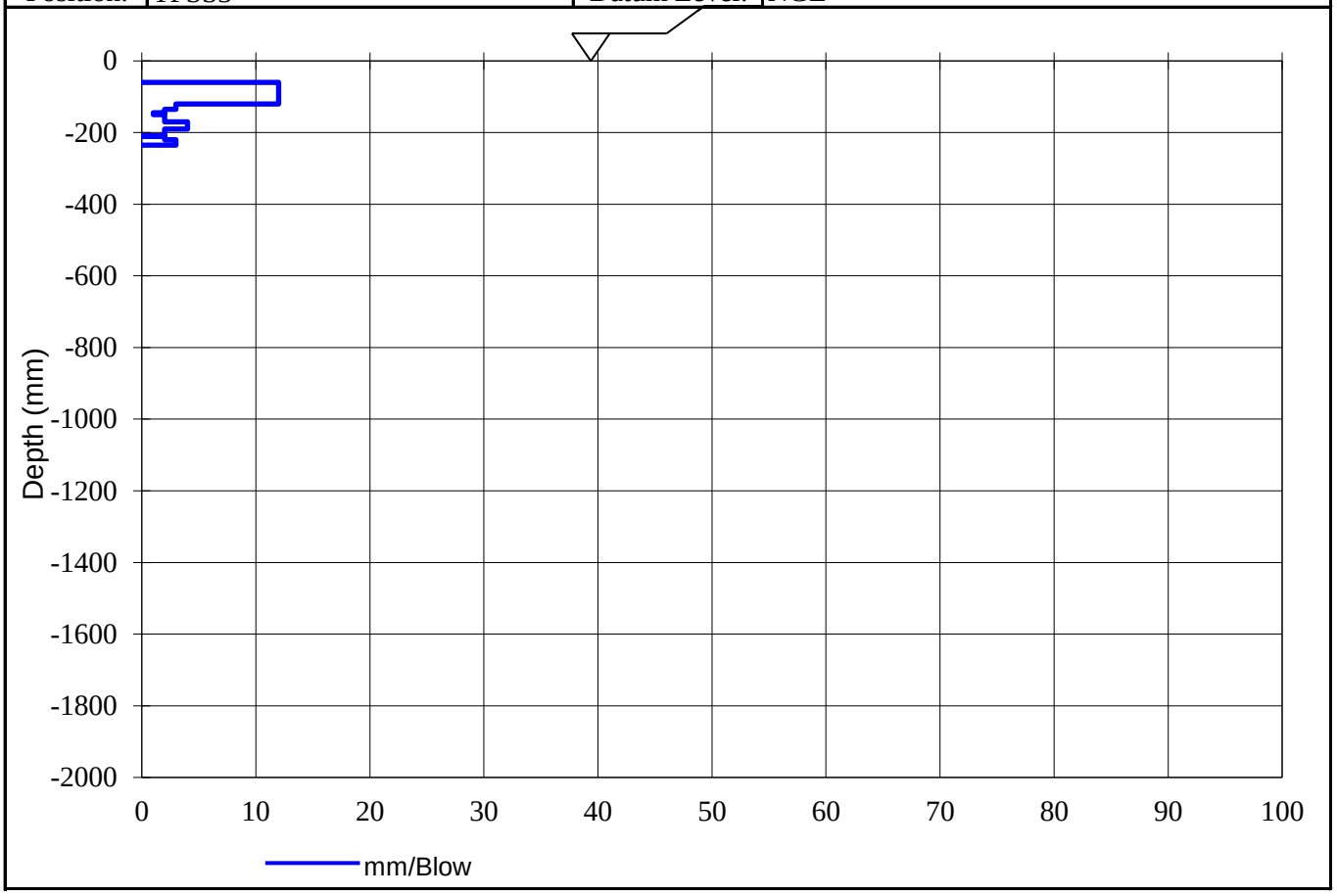
Customer :	DNV-GL South Africa (Pty) Ltd 15th Floor, Metlife Building 7 Walter Sisulu Ave, Foreshore Cape Town, 8001	Project :	Choje Wind Farm
		Date Received :	28.02.19
		Date Reported :	21.05.19
		Req. Number :	
Attention :	Richard Fyvie	No. of Pages :	5 of 12

TEST REPORT

Dynamic Cone Penetrometer (DCP) - (TMH 6 Method ST6)

Position: TPSS3 Datum Level: NGL



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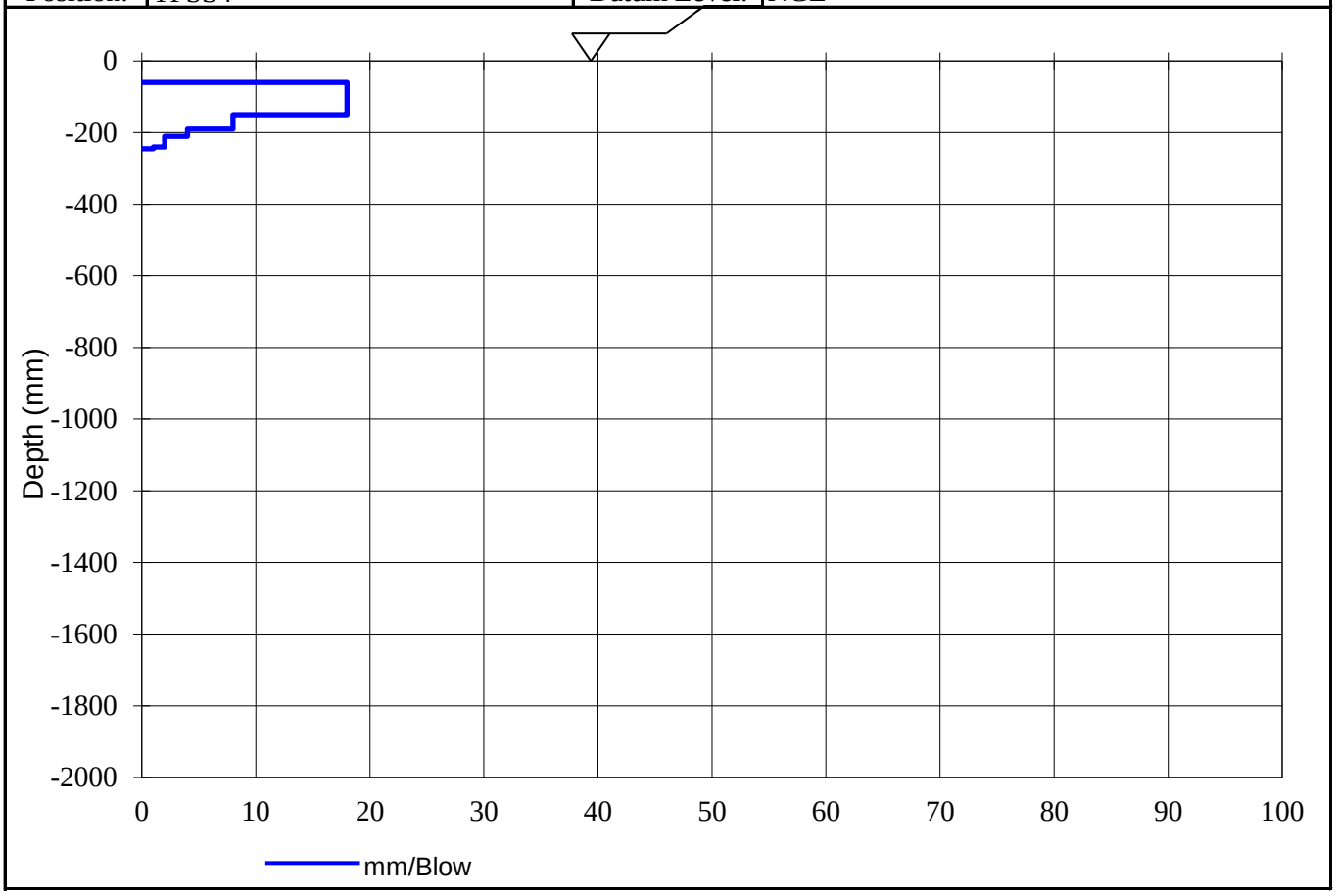
Customer :	DNV-GL South Africa (Pty) Ltd 15th Floor, Metlife Building 7 Walter Sisulu Ave, Foreshore Cape Town, 8001	Project :	Choje Wind Farm
		Date Received :	28.02.19
		Date Reported :	21.05.19
		Req. Number :	
Attention :	Richard Fyvie	No. of Pages :	6 of 12

TEST REPORT

Dynamic Cone Penetrometer (DCP) - (TMH 6 Method ST6)

Position: TPSS4 Datum Level: NGL



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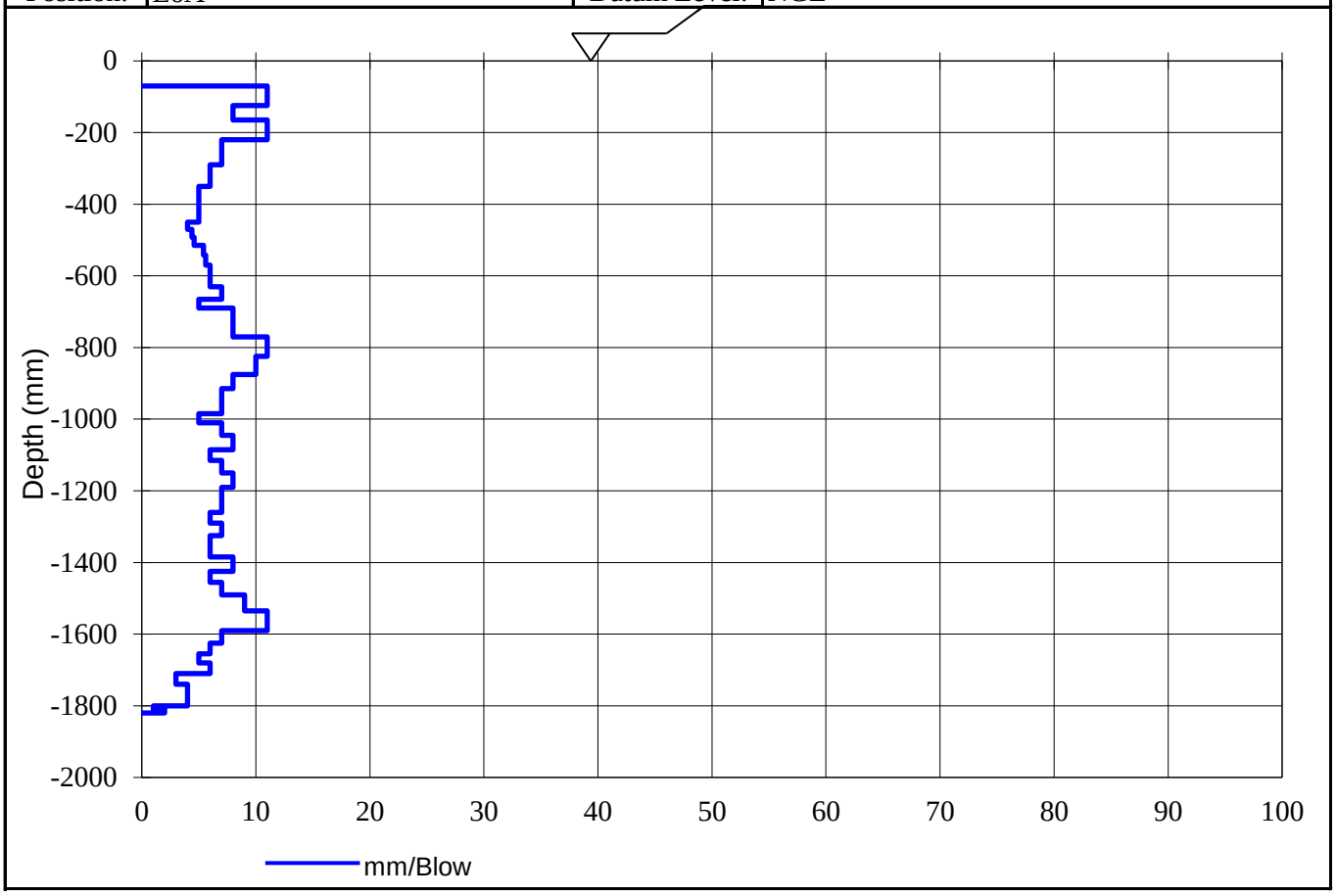
Customer :	DNV-GL South Africa (Pty) Ltd 15th Floor, Metlife Building 7 Walter Sisulu Ave, Foreshore Cape Town, 8001	Project :	Choje Wind Farm
		Date Received :	28.02.19
		Date Reported :	21.05.19
		Req. Number :	
Attention :	Richard Fyvie	No. of Pages :	7 of 12

TEST REPORT

Dynamic Cone Penetrometer (DCP) - (TMH 6 Method ST6)

Position: E6A Datum Level: NGL



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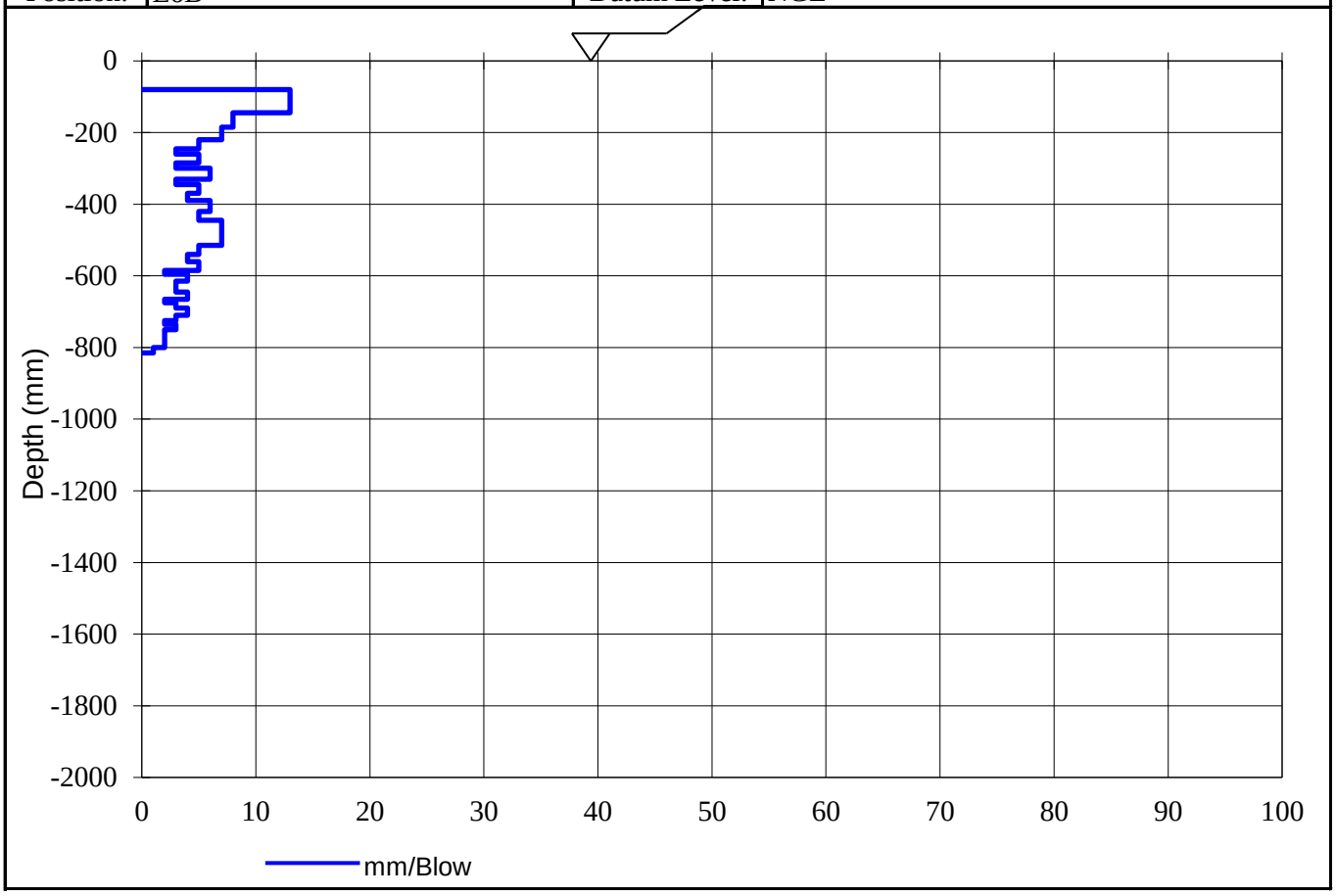
Customer :	DNV-GL South Africa (Pty) Ltd 15th Floor, Metlife Building 7 Walter Sisulu Ave, Foreshore Cape Town, 8001	Project :	Choje Wind Farm
		Date Received :	28.02.19
		Date Reported :	21.05.19
		Req. Number :	
Attention :	Richard Fyvie	No. of Pages :	8 of 12

TEST REPORT

Dynamic Cone Penetrometer (DCP) - (TMH 6 Method ST6)

Position:	E6B	Datum Level:	NGL



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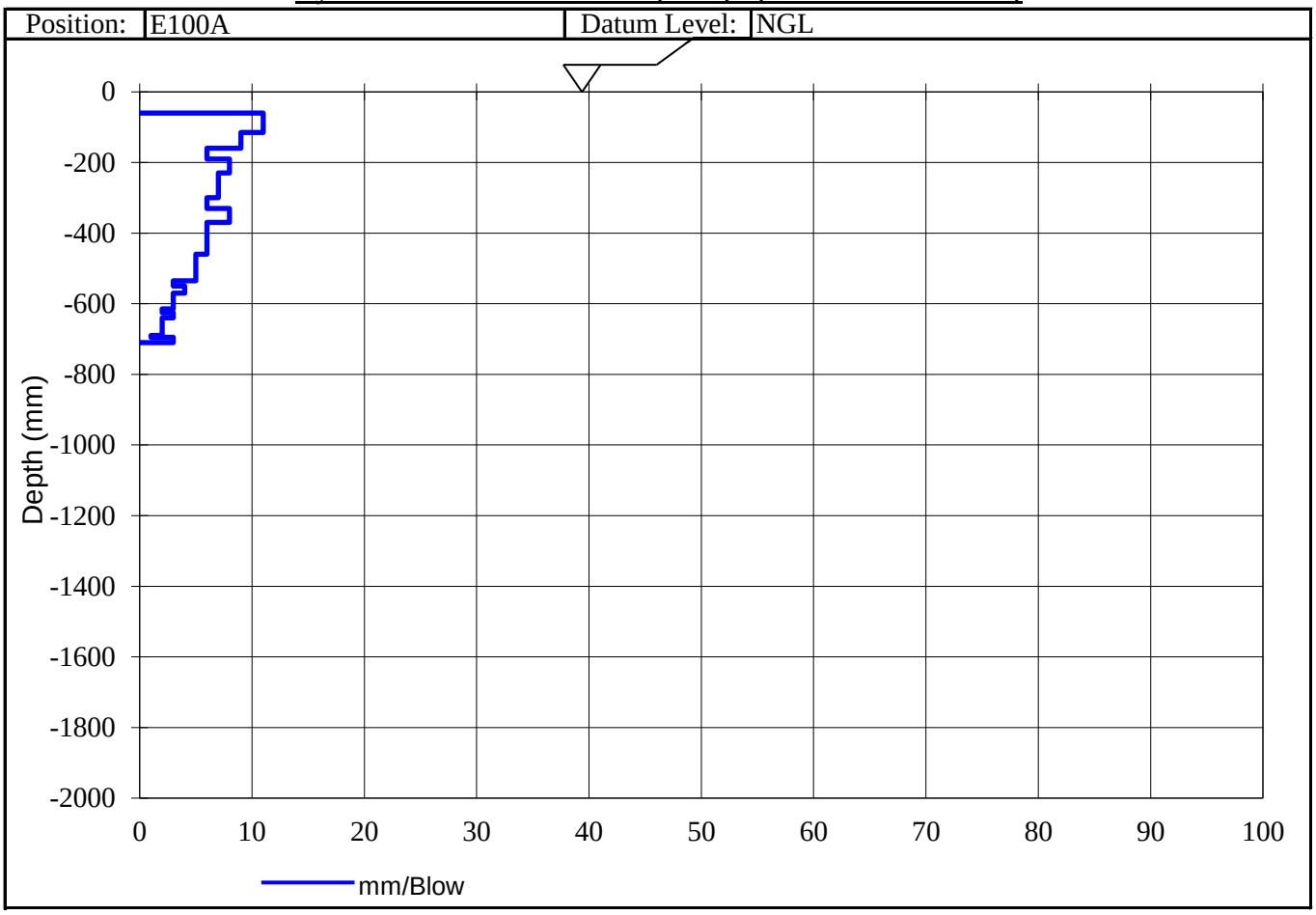
Attention :	Richard Fyvie	No. of Pages :	9 of 12

TEST REPORT

Dynamic Cone Penetrometer (DCP) - (TMH 6 Method ST6)

Position: E100A Datum Level: NGL



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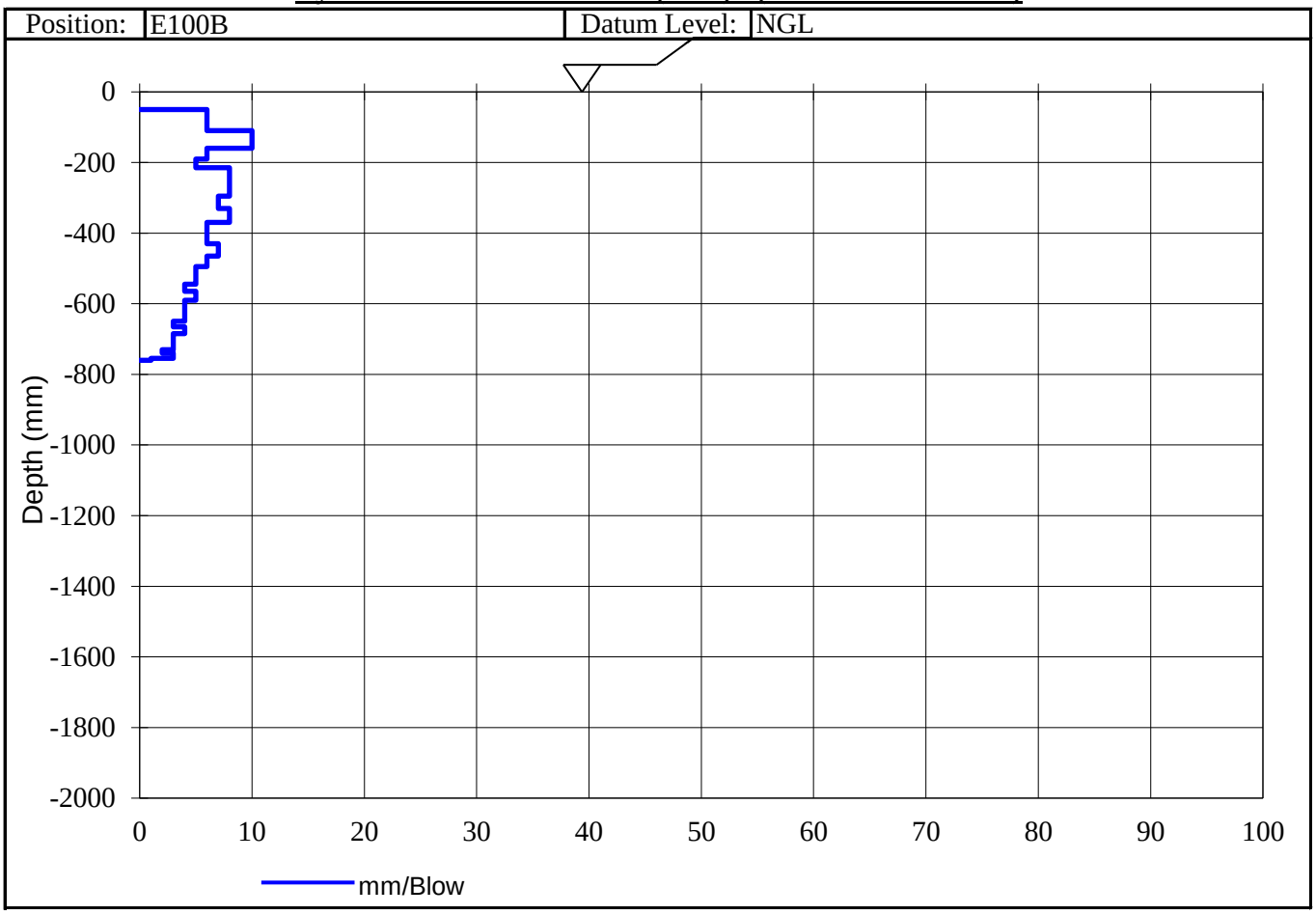
		Req. Number :	
Attention :	Richard Fyvie	No. of Pages :	10 of 12

TEST REPORT

Dynamic Cone Penetrometer (DCP) - (TMH 6 Method ST6)

Position: E100B Datum Level: NGL



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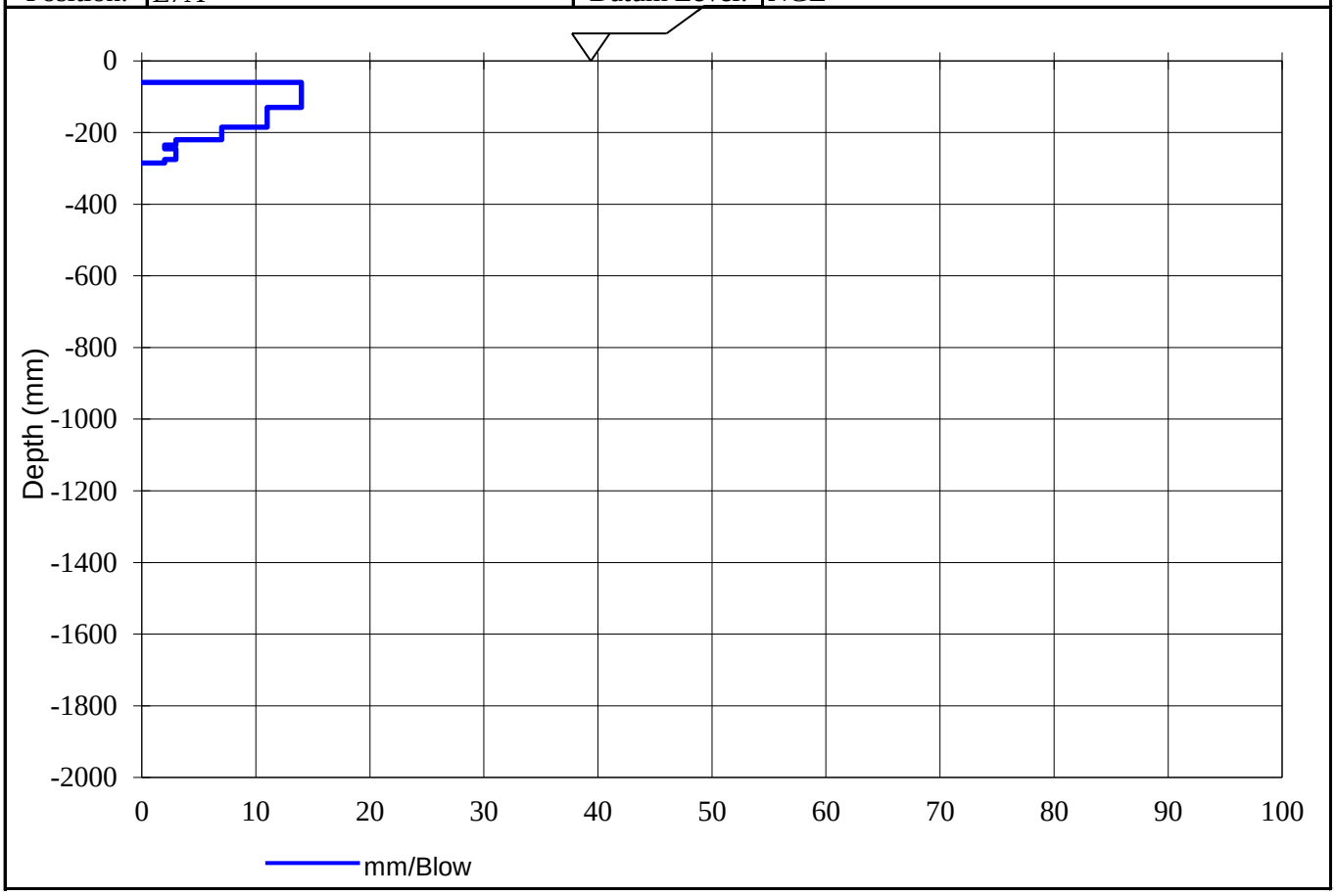
Attention :	Richard Fyvie	No. of Pages :	11 of 12

TEST REPORT

Dynamic Cone Penetrometer (DCP) - (TMH 6 Method ST6)

Position:	E7A	Datum Level:	NGL



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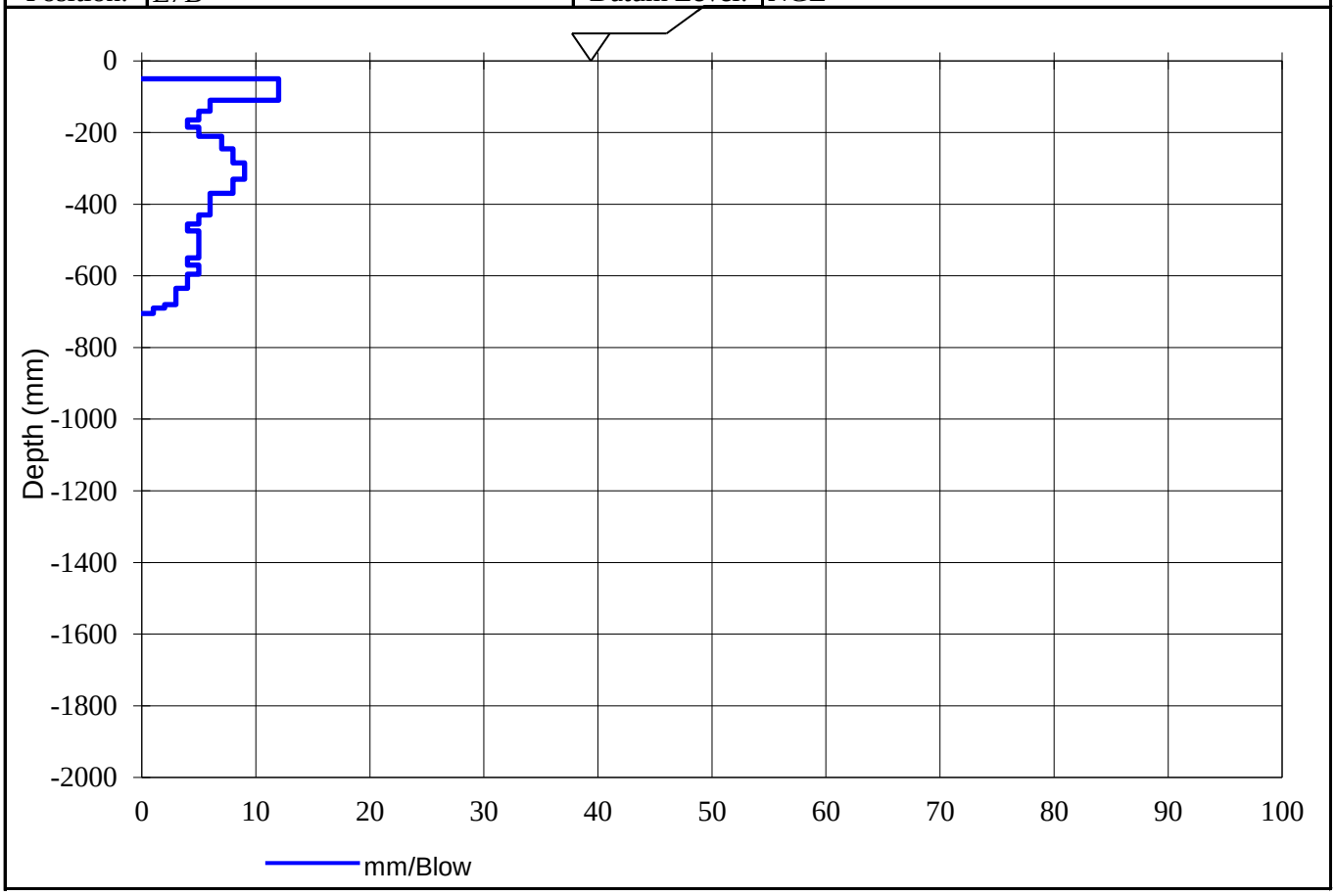
		Date Reported :	21.05.19
		Req. Number :	
Attention :	Richard Fyvie	No. of Pages :	12 of 12

TEST REPORT

Dynamic Cone Penetrometer (DCP) - (TMH 6 Method ST6)

Position:	E7B	Datum Level:	NGL



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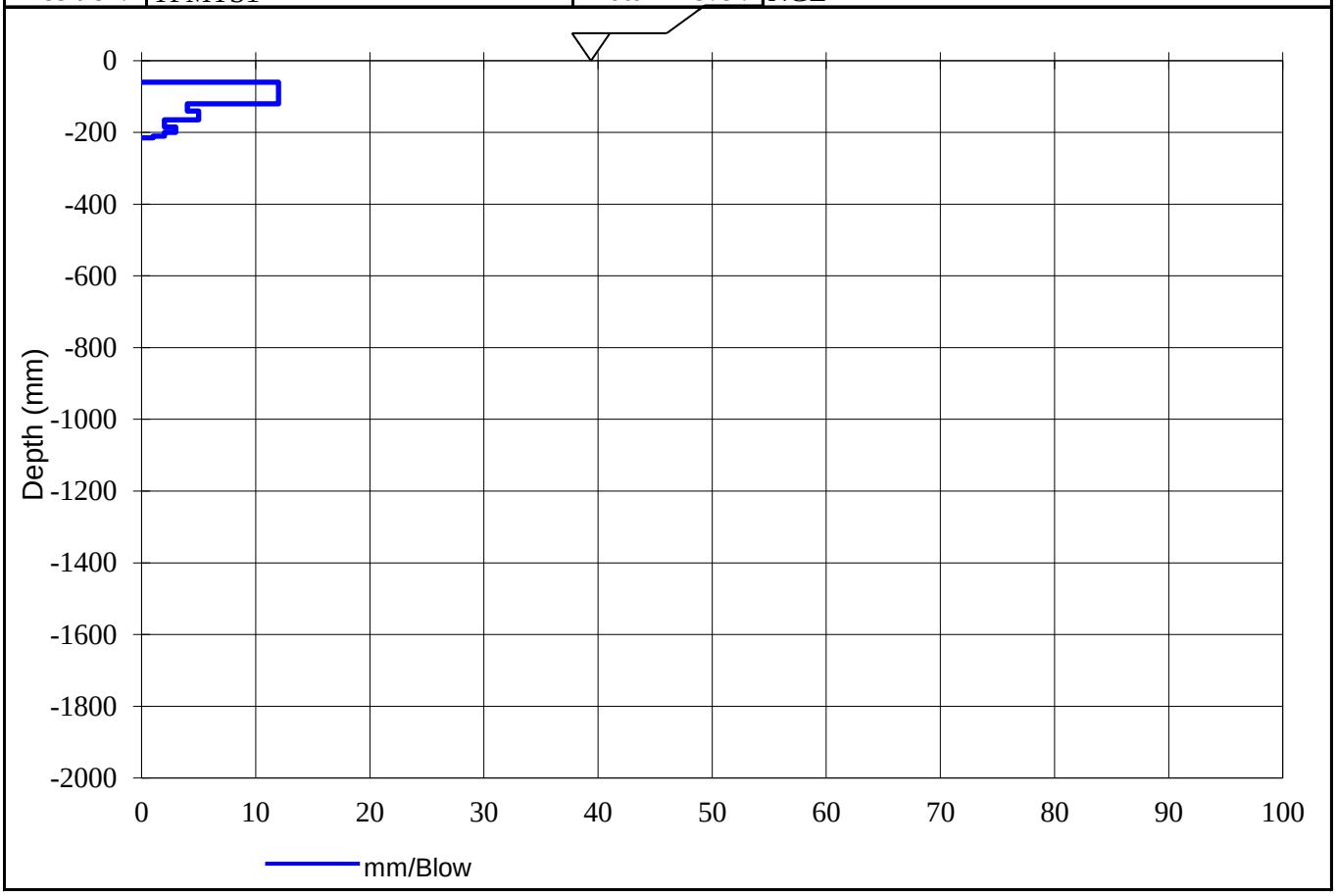
		Date Reported :	11.06.19
		Req. Number :	
Attention :	Richard Fyvie	No. of Pages :	1 of 14

TEST REPORT

Dynamic Cone Penetrometer (DCP) - (TMH 6 Method ST6)

Position:	TPMTS1	Datum Level:	NGL



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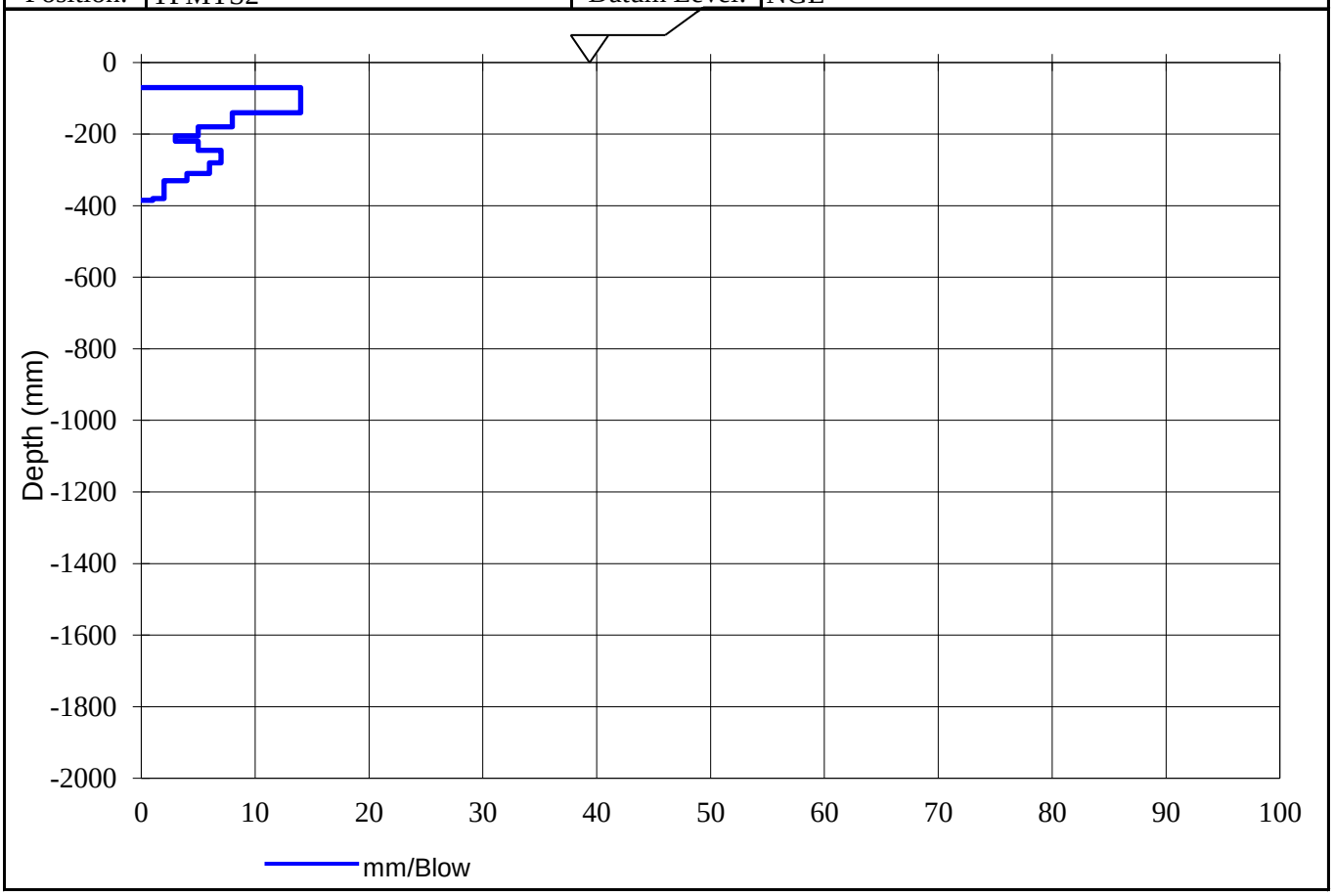
		Date Received :	28.02.19
		Date Reported :	11.06.19
		Req. Number :	
Attention :	Richard Fyvie	No. of Pages :	2 of 14

TEST REPORT

Dynamic Cone Penetrometer (DCP) - (TMH 6 Method ST6)

Position:	TPMTS2	Datum Level:	NGL



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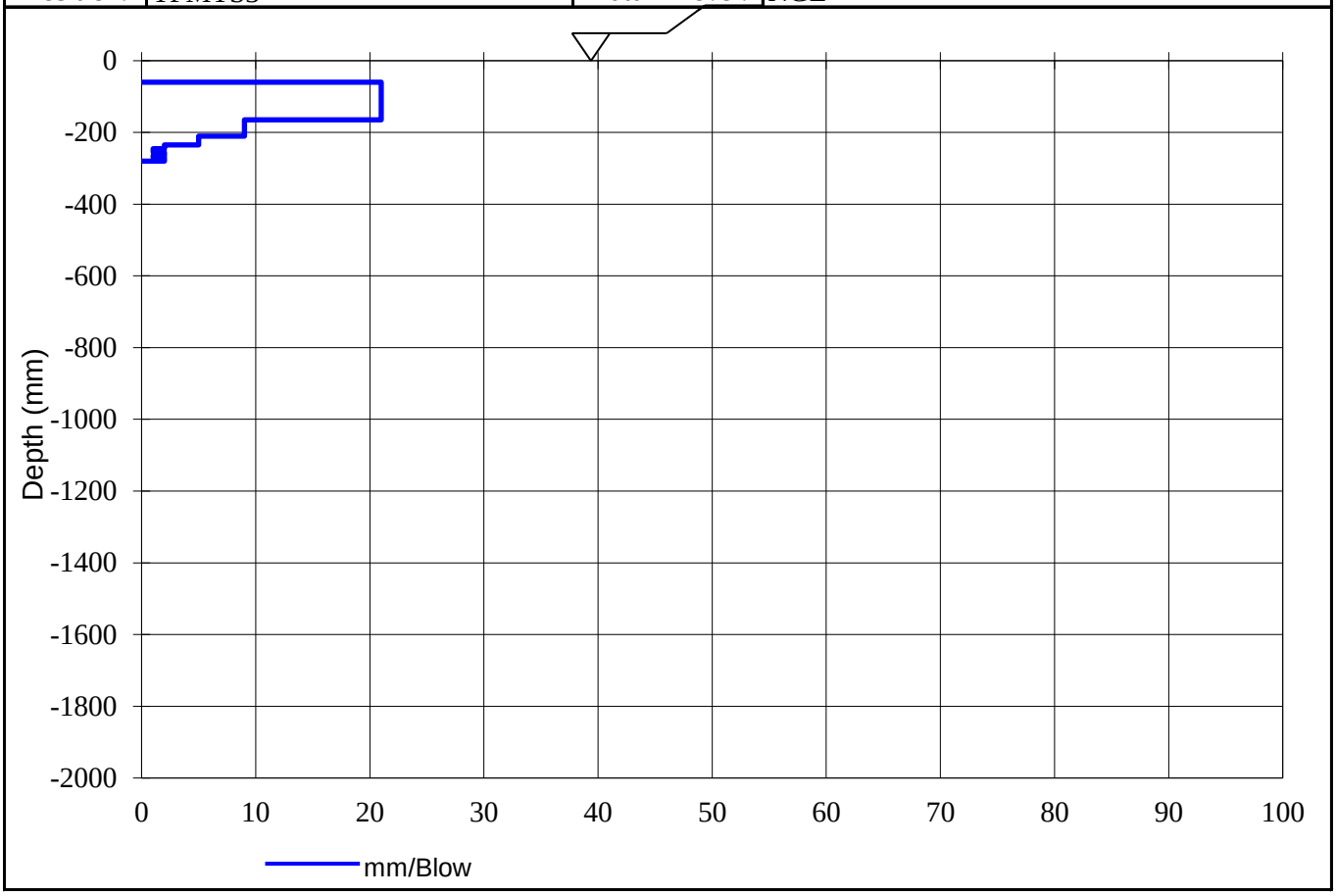
Attention :	Richard Fyvie	No. of Pages :	3 of 14

TEST REPORT

Dynamic Cone Penetrometer (DCP) - (TMH 6 Method ST6)

Position:	TPMTS3	Datum Level:	NGL



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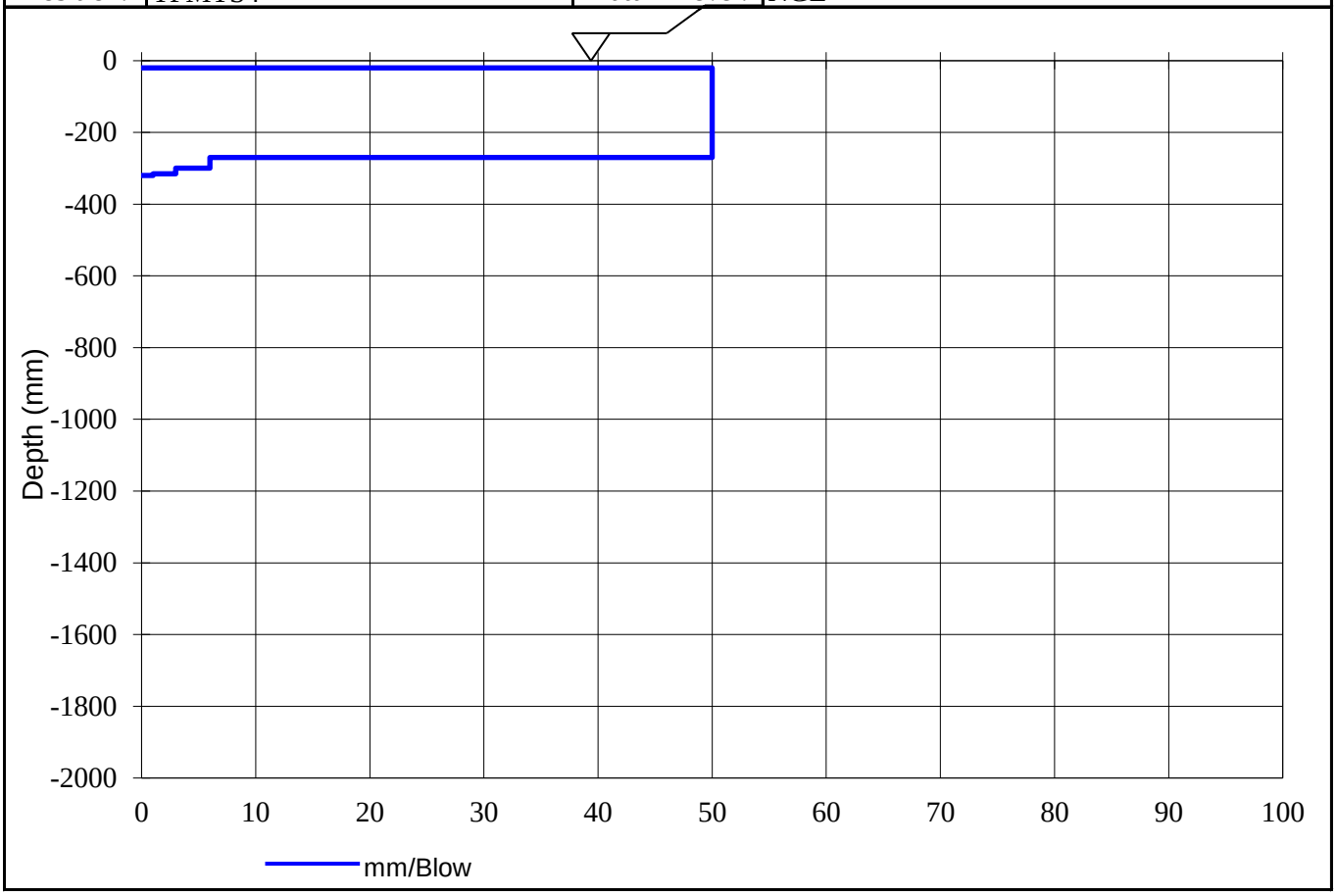
		Date Reported :	11.06.19
		Req. Number :	
Attention :	Richard Fyvie	No. of Pages :	4 of 14

TEST REPORT

Dynamic Cone Penetrometer (DCP) - (TMH 6 Method ST6)

Position:	TPMTS4	Datum Level:	NGL



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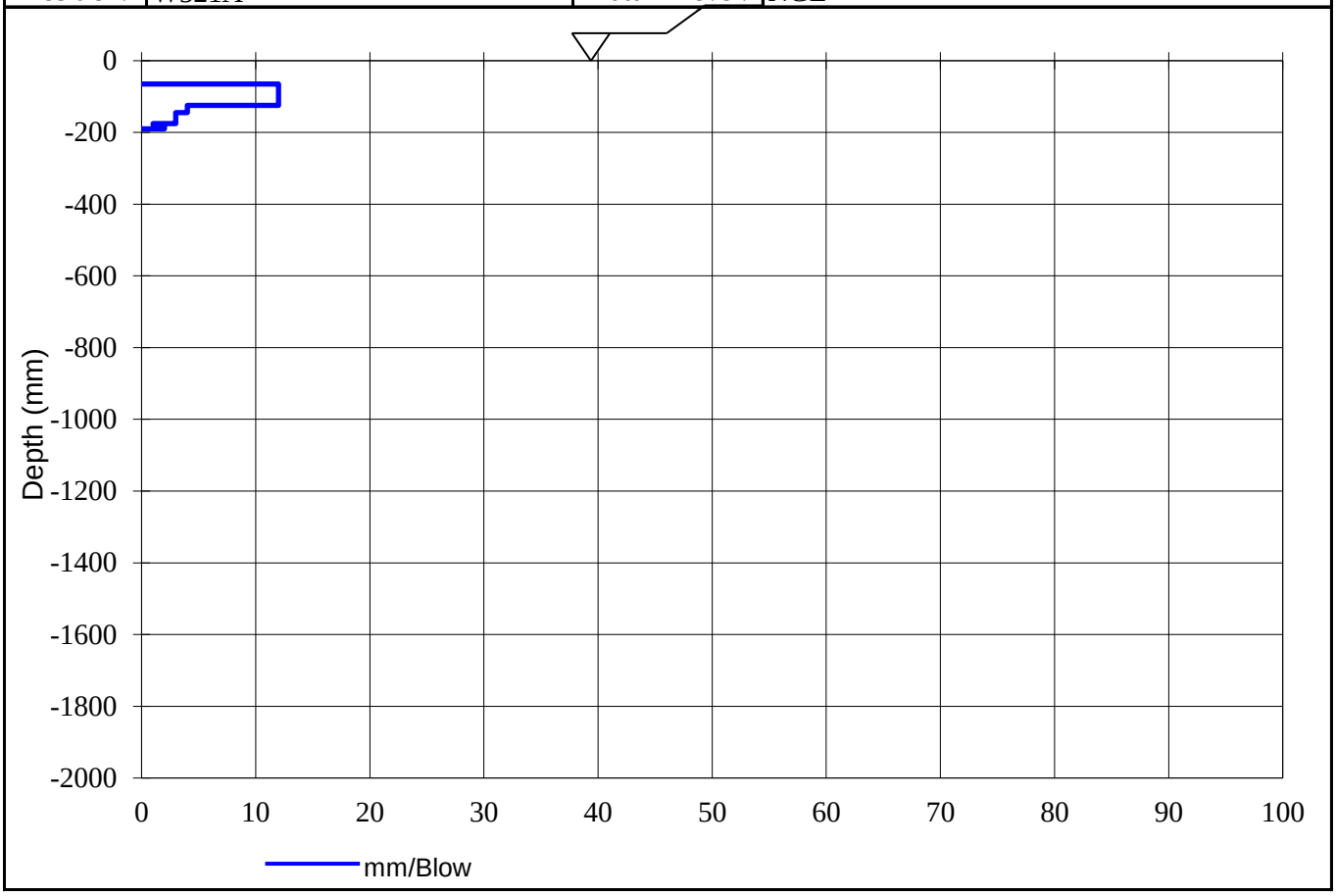
		Date Reported :	11.06.19
		Req. Number :	
Attention :	Richard Fyvie	No. of Pages :	5 of 14

TEST REPORT

Dynamic Cone Penetrometer (DCP) - (TMH 6 Method ST6)

Position:	W521A	Datum Level:	NGL



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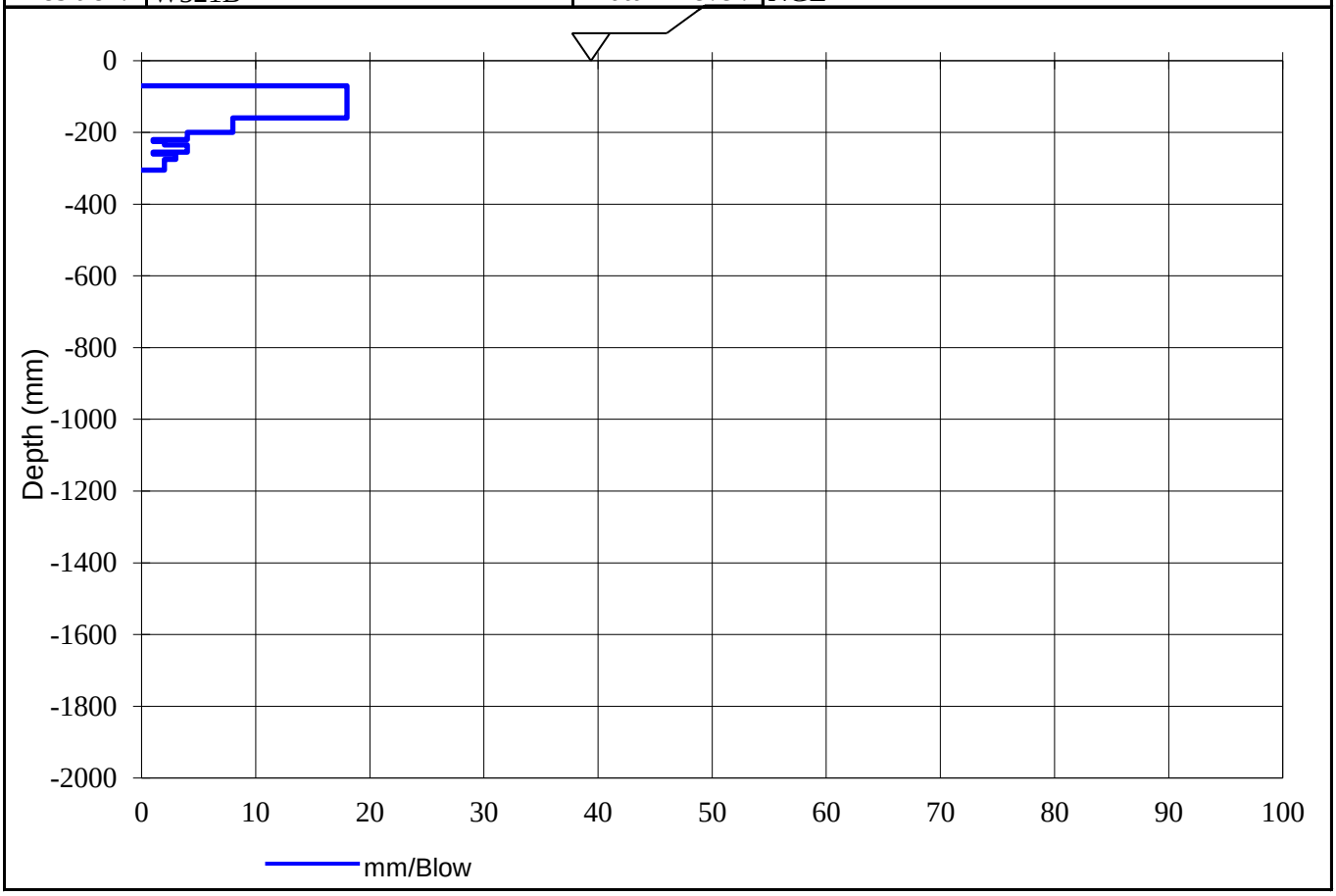
		Date Received :	28.02.19
		Date Reported :	11.06.19
		Req. Number :	
Attention :	Richard Fyvie	No. of Pages :	6 of 14

TEST REPORT

Dynamic Cone Penetrometer (DCP) - (TMH 6 Method ST6)

Position:	W521B	Datum Level:	NGL



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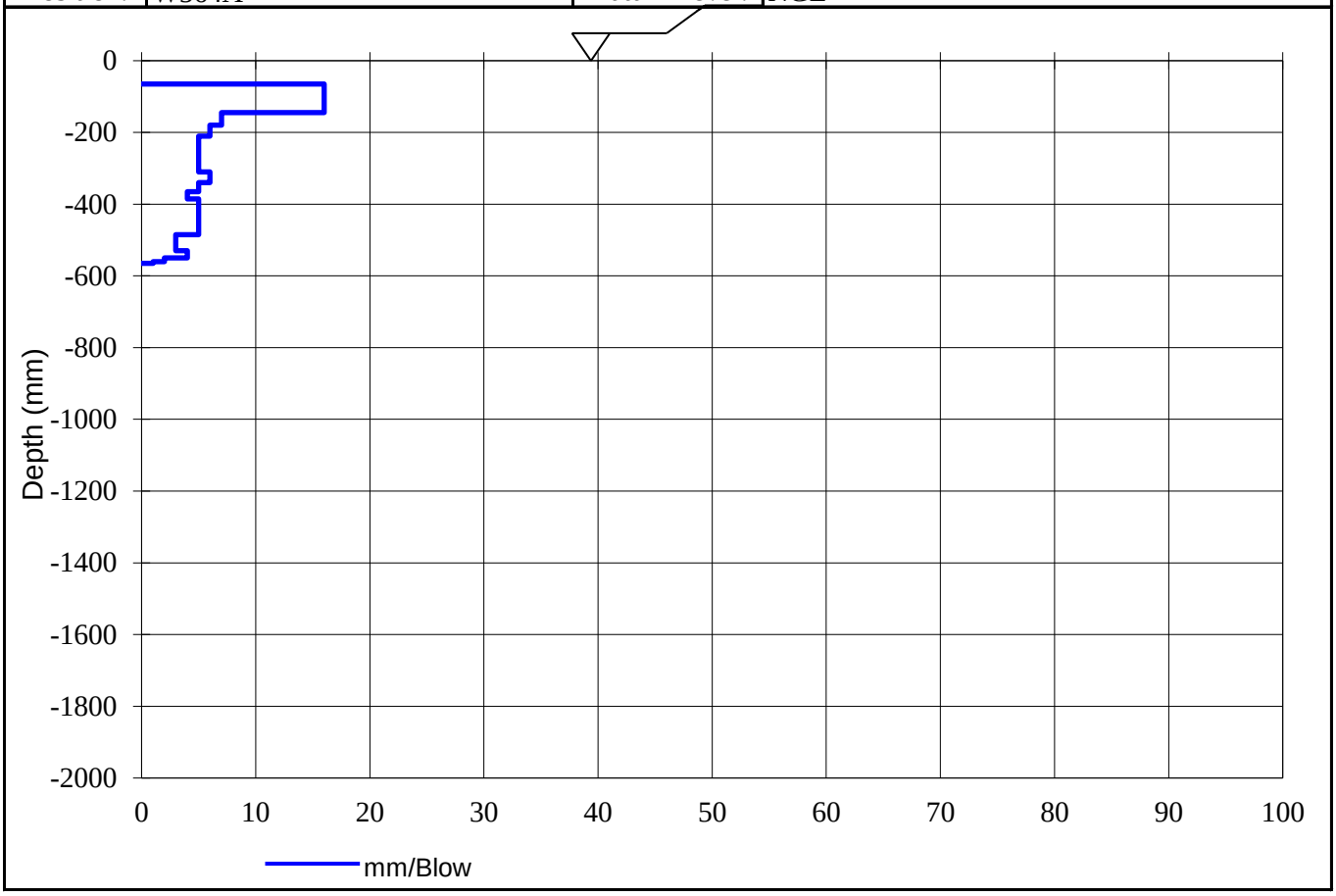
		Date Reported :	11.06.19
		Req. Number :	
Attention :	Richard Fyvie	No. of Pages :	7 of 14

TEST REPORT

Dynamic Cone Penetrometer (DCP) - (TMH 6 Method ST6)

Position:	W564A	Datum Level:	NGL



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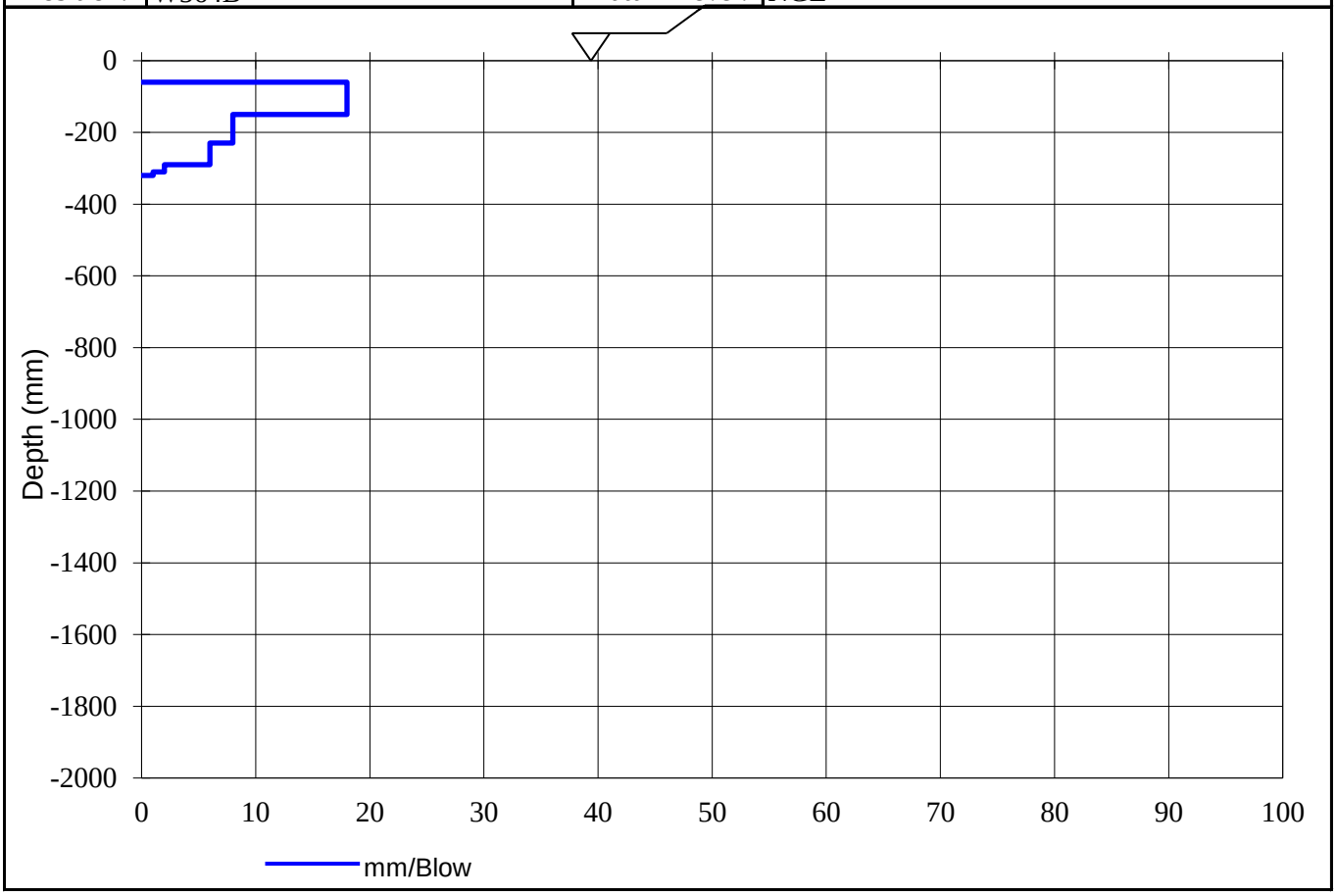
		Date Reported :	11.06.19
		Req. Number :	
Attention :	Richard Fyvie	No. of Pages :	8 of 14

TEST REPORT

Dynamic Cone Penetrometer (DCP) - (TMH 6 Method ST6)

Position:	W564B	Datum Level:	NGL



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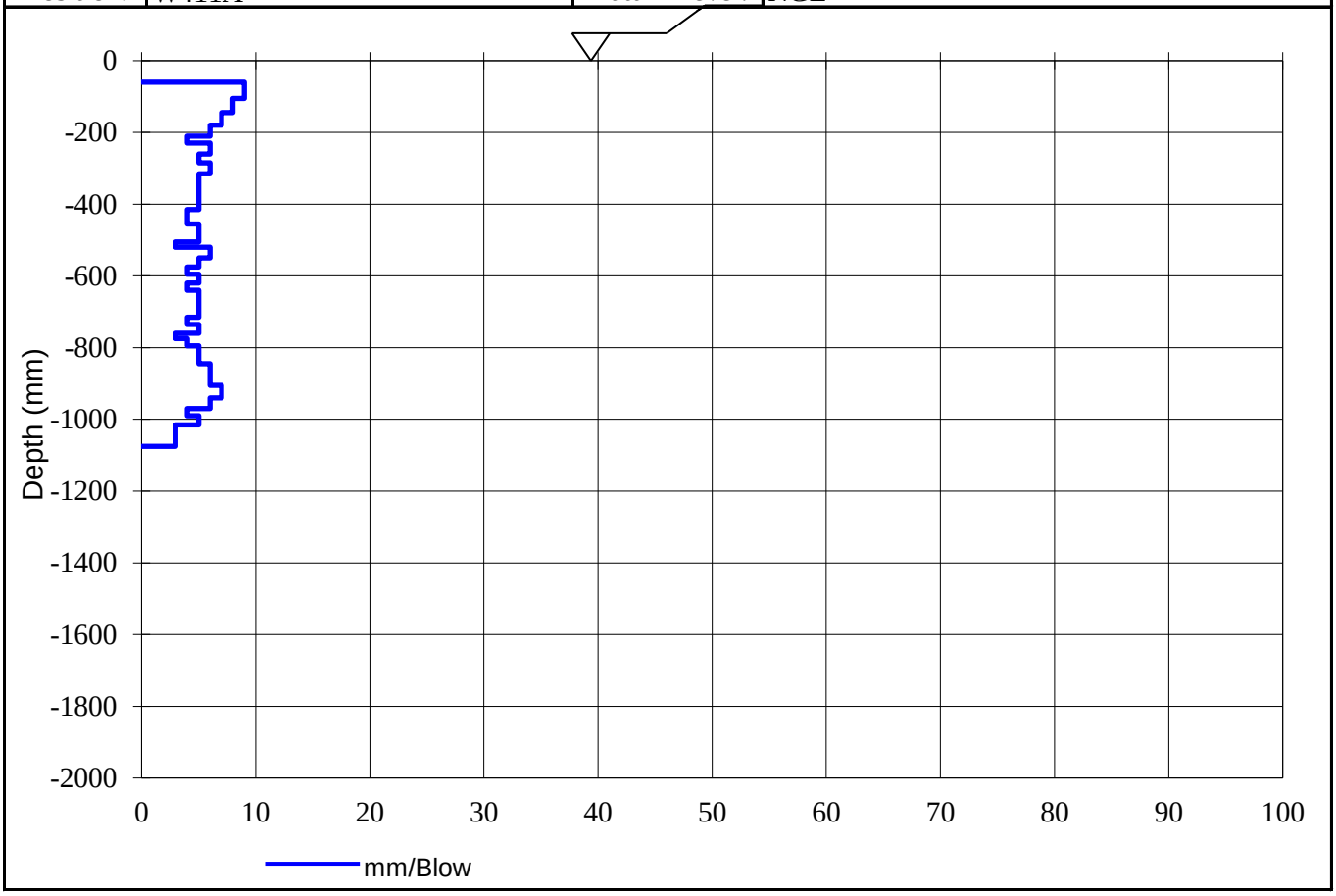
		Date Received :	28.02.19
		Date Reported :	11.06.19
		Req. Number :	
Attention :	Richard Fyvie	No. of Pages :	9 of 14

TEST REPORT

Dynamic Cone Penetrometer (DCP) - (TMH 6 Method ST6)

Position:	W411A	Datum Level:	NGL



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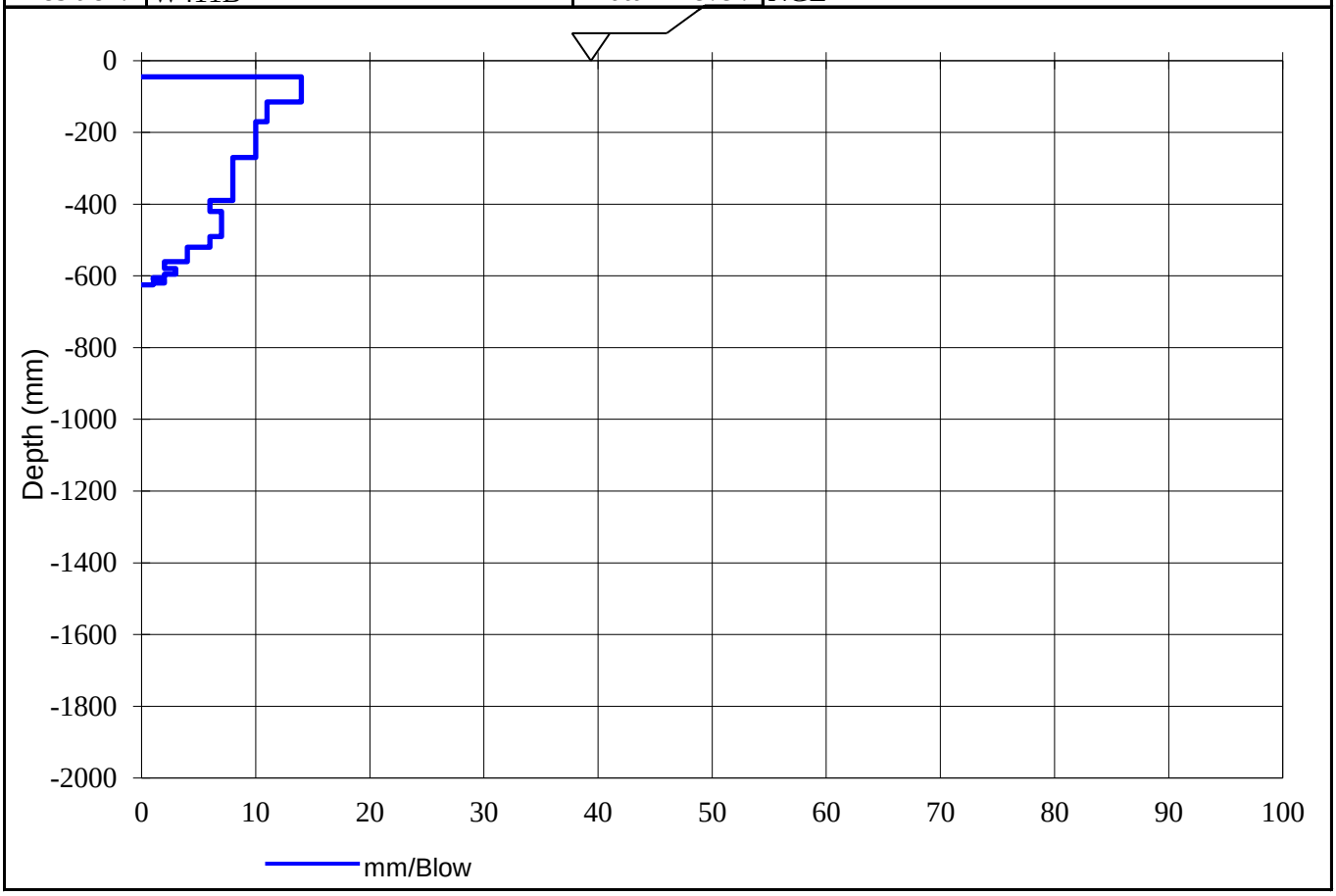
		Date Reported :	11.06.19
		Req. Number :	
Attention :	Richard Fyvie	No. of Pages :	10 of 14

TEST REPORT

Dynamic Cone Penetrometer (DCP) - (TMH 6 Method ST6)

Position:	W411B	Datum Level:	NGL



I Paton (Member)
For Outeniqua Geotech. Services cc.
Technical Signatory

Outeniqua Geotechnical Services cc.

Geotechnical Engineering Consultants

Registration No. 1999/062743/23

18 Clyde Street, Knysna : PO Box 964, Knysna, 6570

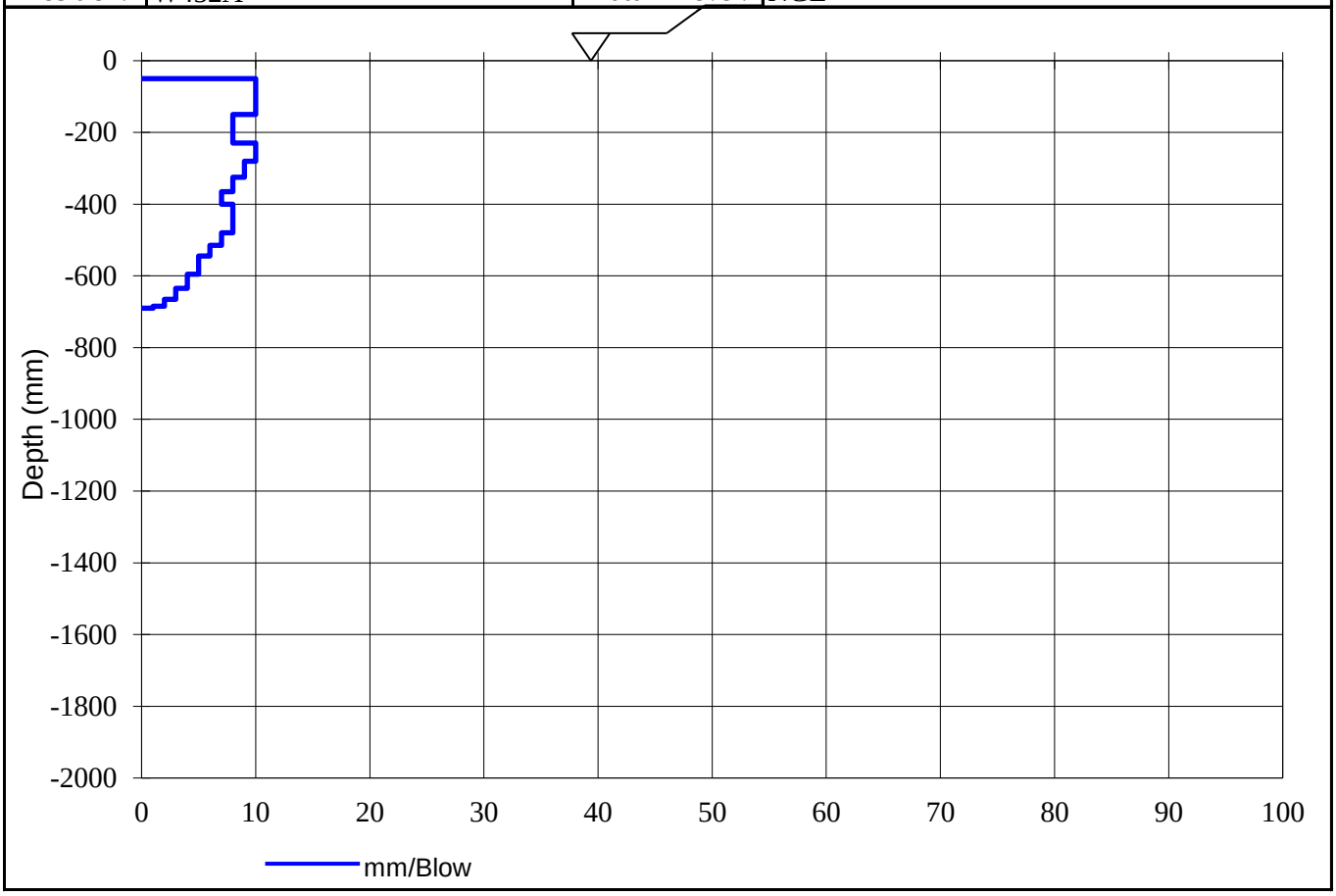
Tel: 044 3820502 : Fax: 044 3820503 : e-mail: iain@outeniqualab.co.za

Customer :	DNV-GL South Africa (Pty) Ltd 15th Floor, Metlife Building 7 Walter Sisulu Ave, Foreshore Cape Town, 8001	Project :	Choje Wind Farm
		Date Received :	28.02.19
		Date Reported :	11.06.19
		Req. Number :	
Attention :	Richard Fyvie	No. of Pages :	11 of 14

TEST REPORT

Dynamic Cone Penetrometer (DCP) - (TMH 6 Method ST6)

Position:	W452A	Datum Level:	NGL



I Paton (Member)
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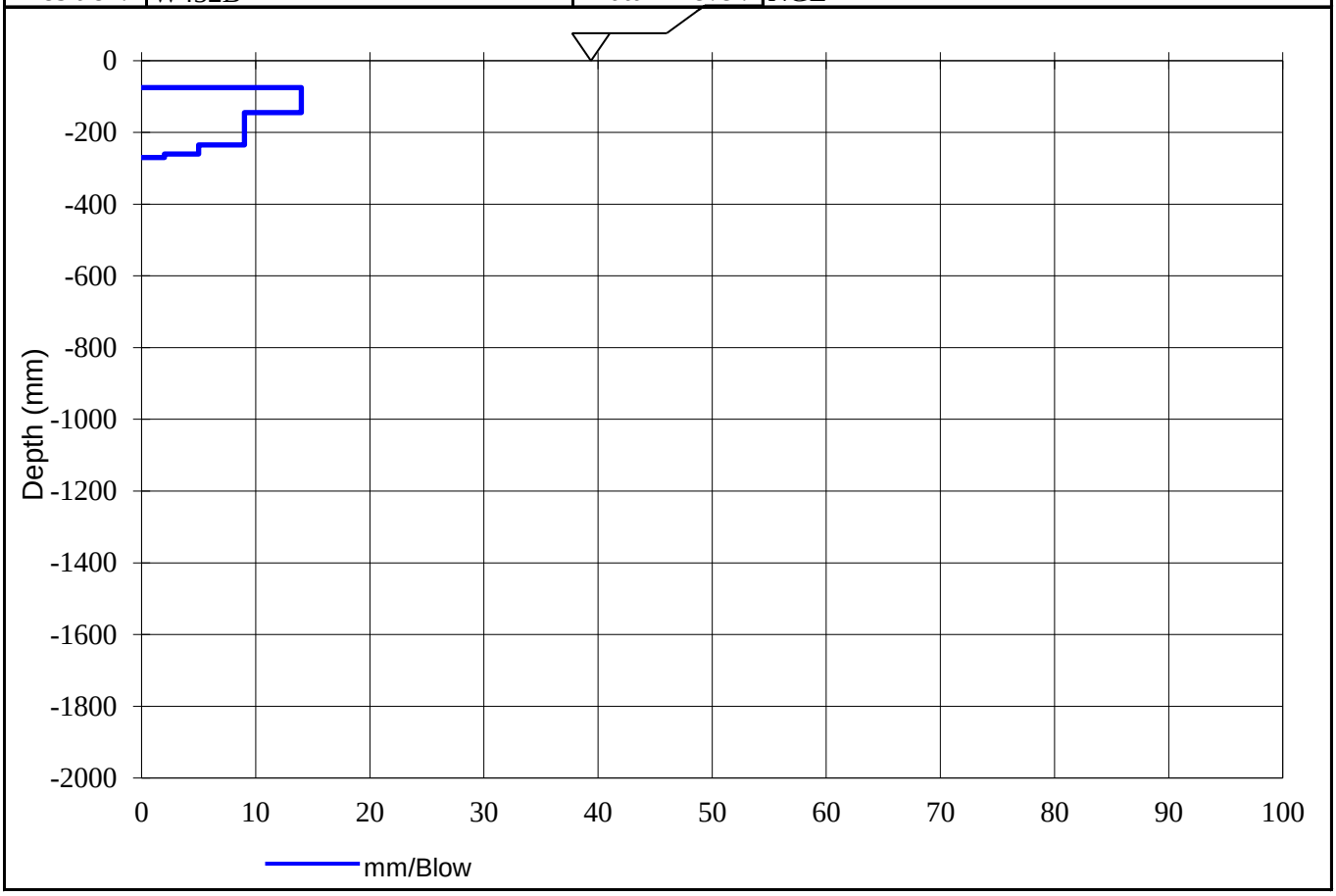
		Date Reported :	11.06.19
		Req. Number :	
Attention :	Richard Fyvie	No. of Pages :	12 of 14

TEST REPORT

Dynamic Cone Penetrometer (DCP) - (TMH 6 Method ST6)

Position:	W452B	Datum Level:	NGL



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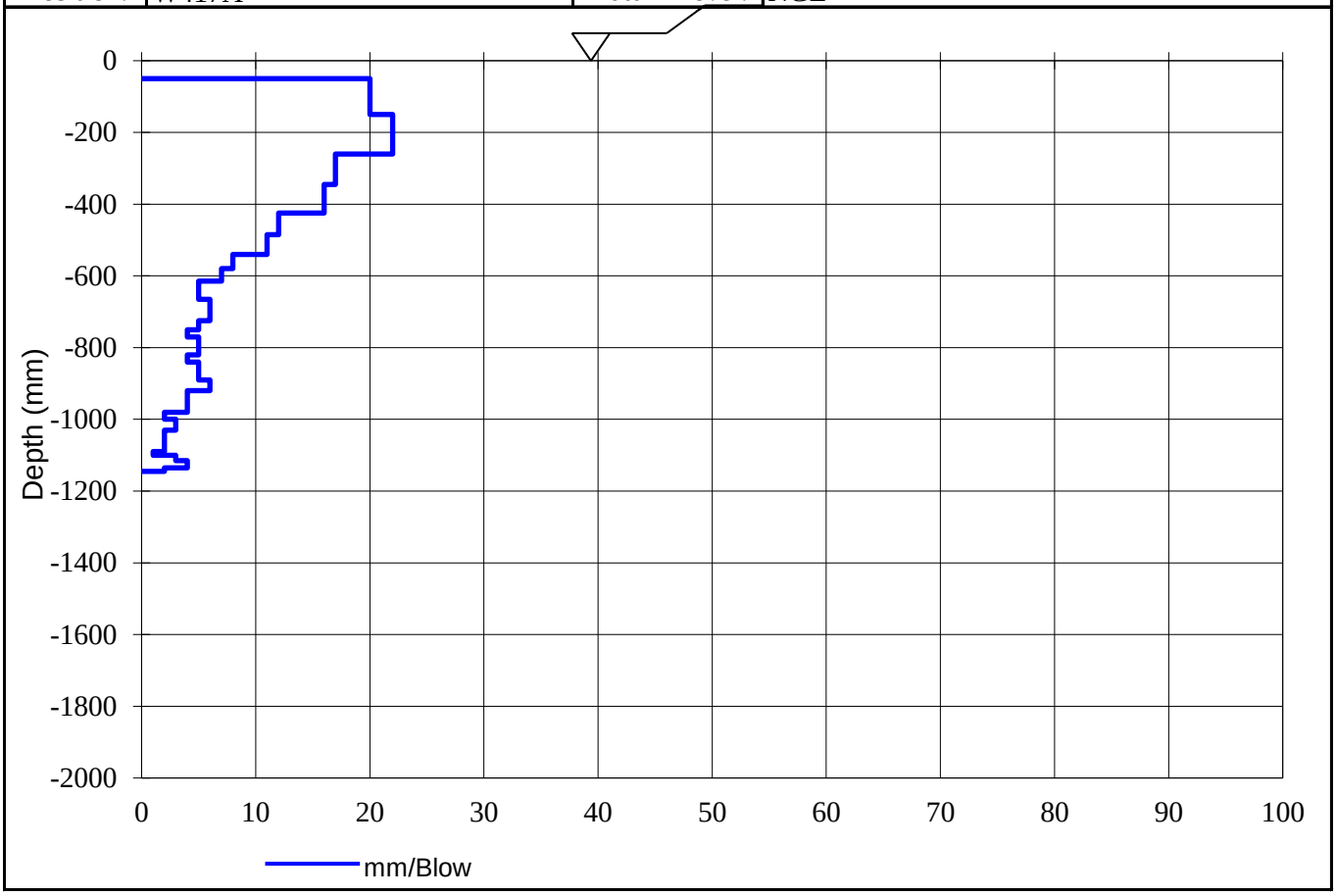
		Date Reported :	11.06.19
		Req. Number :	
Attention :	Richard Fyvie	No. of Pages :	13 of 14

TEST REPORT

Dynamic Cone Penetrometer (DCP) - (TMH 6 Method ST6)

Position:	W417A	Datum Level:	NGL



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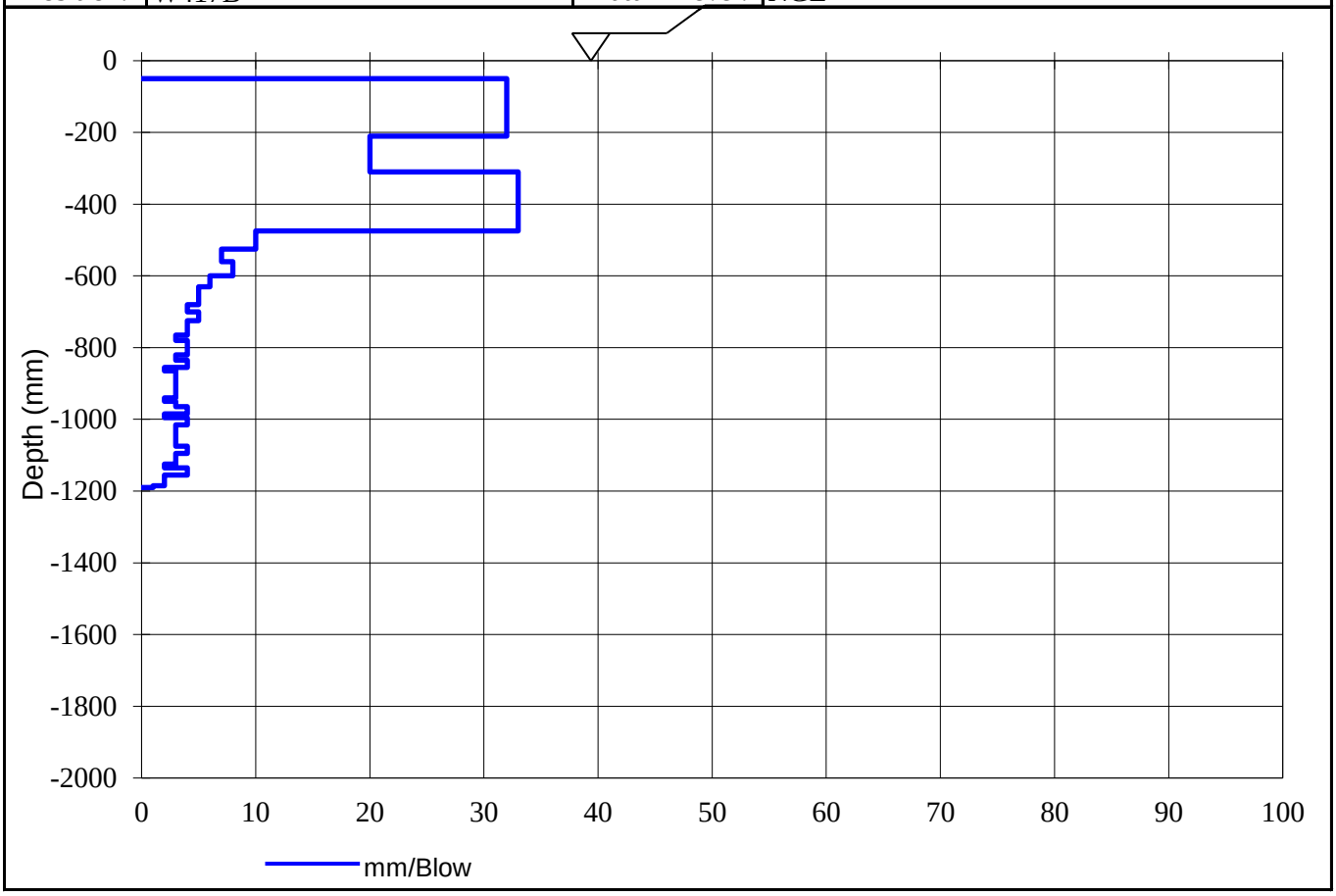
Customer :	DNV-GL South Africa (Pty) Ltd 15th Floor, Metlife Building 7 Walter Sisulu Ave, Foreshore Cape Town, 8001	Project :	Choje Wind Farm
		Date Received :	28.02.19
		Date Reported :	11.06.19
		Req. Number :	
Attention :	Richard Fyvie	No. of Pages :	14 of 14

TEST REPORT

Dynamic Cone Penetrometer (DCP) - (TMH 6 Method ST6)

Position:	W417B	Datum Level:	NGL



I Paton (Member)
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APPENDIX D – LABORATORY TEST RESULTS

Outeniqua Lab EC cc.

Materials Testing Laboratory

Registration No. 2009/230653/23

170 Sidwell Avenue, Sidwell, Port Elizabeth : PO Box 3186, George Industria, 6536

Tel: 041 4512464 : Fax: 041 4534959 : e-mail: luwayne@outeniqualab.co.za / agovender@outeniqualab.co.za

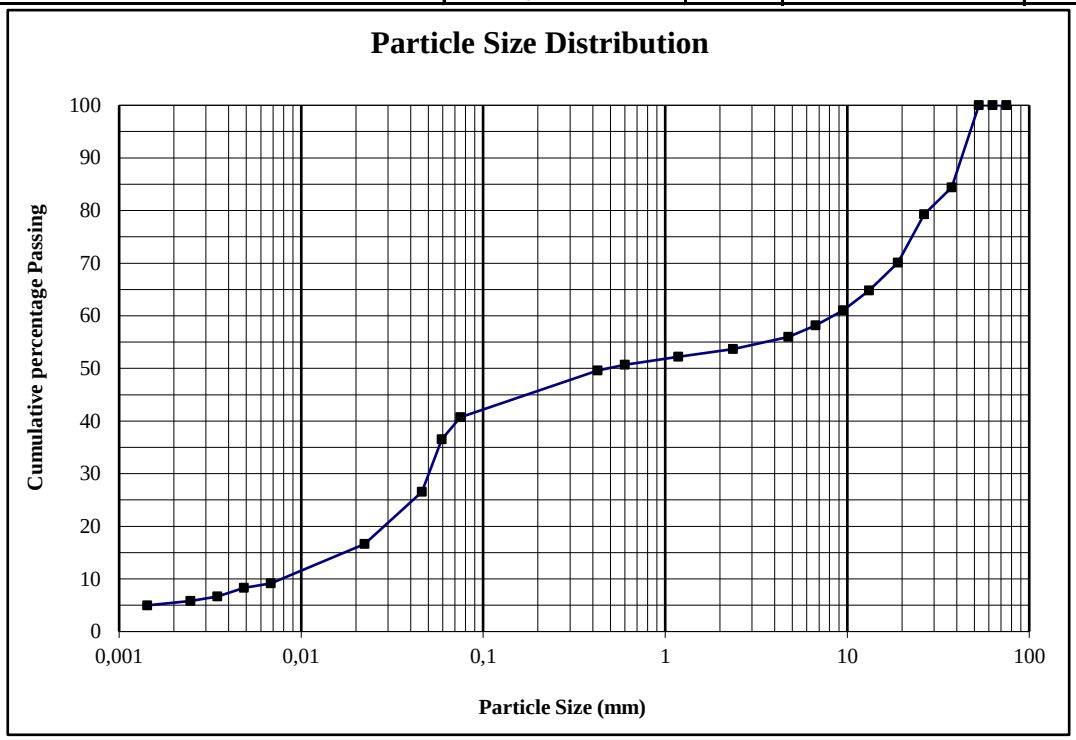
Customer :	Outeniqua Geotechincal Services cc	Project :	Choje Windfarm
	Po Box 964	Date Received :	23/05/19
	Knysna	Date Reported :	26/06/19
	6570	Req. Number :	439/19
Attention :	Iain Paton	No. of Pages :	1/12

TEST REPORT

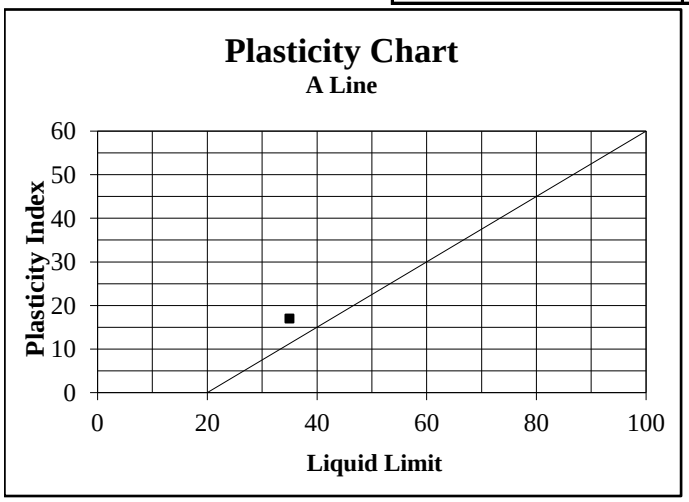
FOUNDATION INDICATOR - (TMH 1 Method A1(a),A2,A3,A4,A5) & (ASTM Method D422)

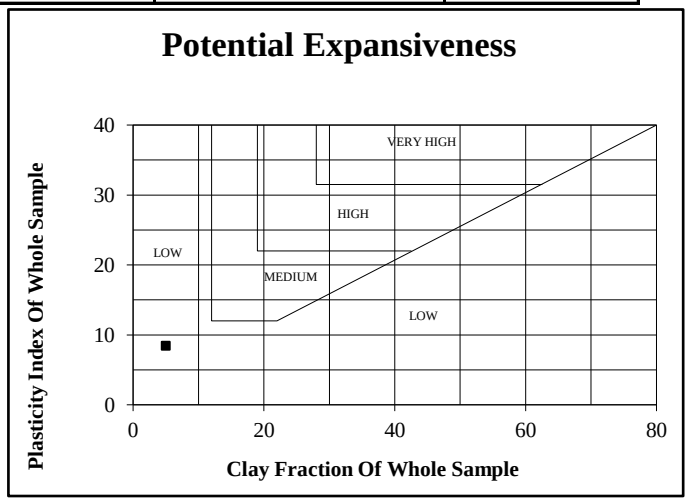
Material Description:	Dark Reddish Orange - Clayey Silty Sandy Gravel	Sample Number:	13130		
Position:	E 64A	Liquid Limit	35	Linear Shrinkage	8,5
Depth:	200-400	Plasticity Index	17	Insitu M/C%	8,4

Sieve Size(mm)	% Passing
75,0	100
63,0	100
53,0	100
37,5	84
26,5	79
19,0	70
13,2	65
9,5	61
6,7	58
4,75	56
2,36	54
1,18	52
0,600	51
0,425	50
0,075	41
0,0591	37
0,0462	27
0,0223	17
0,0068	9
0,0049	8
0,0035	7
0,0025	6
0,0014	5



% Clay	5	% Silt	32	% Sand	16	% Gravel	47
Unified Soil Classification		GC		PRA Soil Classification		A-6	





Notes:

- **Specimens delivered to Outeniqua Lab in good order.**

L Malgraff (Member)
For Outeniqua Lab EC cc.

Outeniqua Lab EC cc.

Materials Testing Laboratory

Registration No. 2009/230653/23

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Tel: 041 4512464 : Fax: 041 4534959 : e-mail: luwayne@outeniqualab.co.za / agovender@outeniqualab.co.za

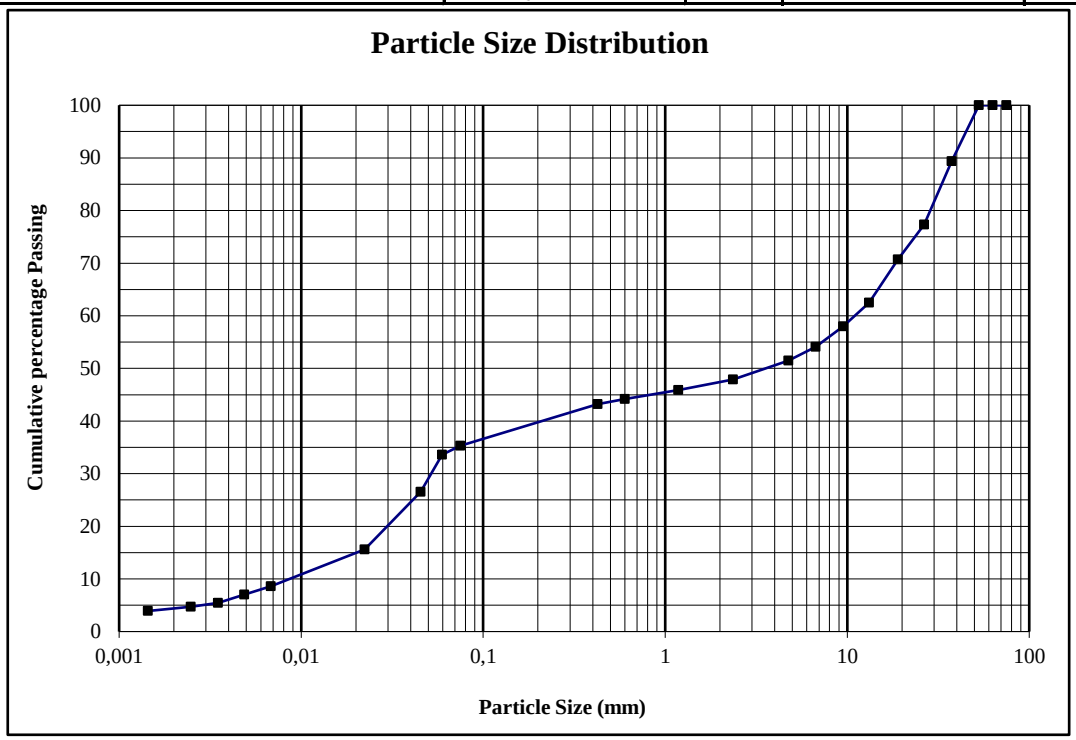
Customer :	Outeniqua Geotechincal Services cc	Project :	Choje Windfarm
	Po Box 964	Date Received :	23/05/19
	Knysna	Date Reported :	26/06/19
	6570	Req. Number :	439/19
Attention :	Iain Paton	No. of Pages :	2/12

TEST REPORT

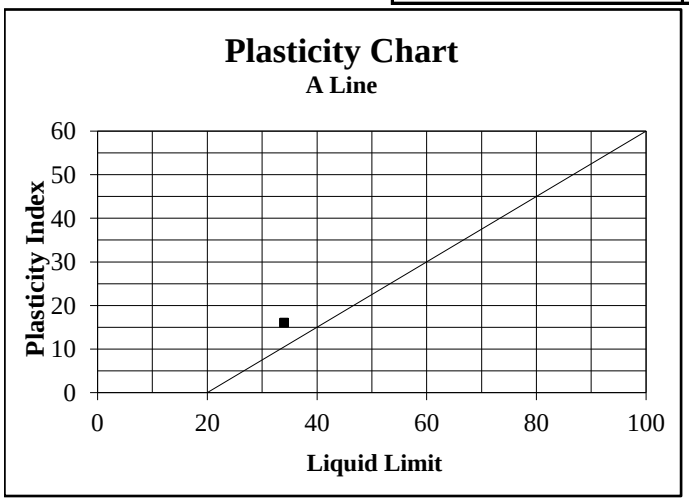
FOUNDATION INDICATOR - (TMH 1 Method A1(a),A2,A3,A4,A5) & (ASTM Method D422)

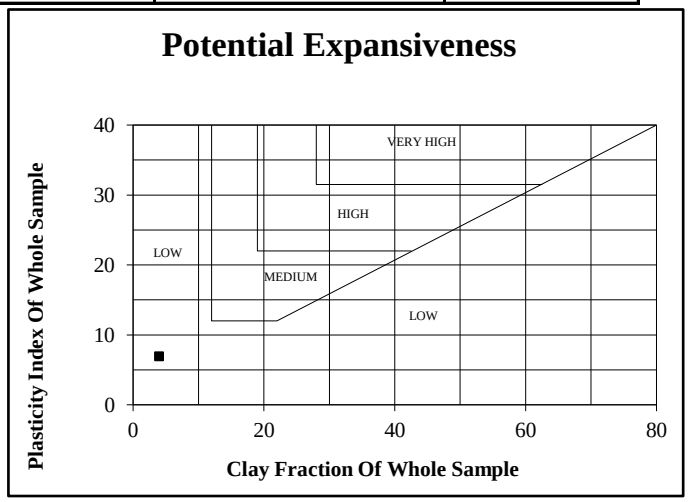
Material Description:	Dark Reddish Orange - Clayey Silty Sandy Gravel	Sample Number:	13132		
Position:	E 64B	Liquid Limit	34	Linear Shrinkage	8
Depth:	150-400	Plasticity Index	16	Insitu M/C%	7,7

Sieve Size(mm)	% Passing
75,0	100
63,0	100
53,0	100
37,5	89
26,5	77
19,0	71
13,2	63
9,5	58
6,7	54
4,75	52
2,36	48
1,18	46
0,600	44
0,425	43
0,075	35
0,0595	34
0,0453	27
0,0223	16
0,0068	9
0,0049	7
0,0035	5
0,0025	5
0,0014	4



% Clay	4	% Silt	30	% Sand	13	% Gravel	53
Unified Soil Classification	GC			PRA Soil Classification		A-6	





Notes:

- **Specimens delivered to Outeniqua Lab in good order.**

L Malgraff (Member)
For Outeniqua Lab EC cc.

1. The test results are reported with an approximate 95% level of confidence.
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Outeniqua Lab EC cc.

Materials Testing Laboratory

Registration No. 2009/230653/23

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Tel: 041 4512464 : Fax: 041 4534959 : e-mail: luwayne@outeniqualab.co.za / agovender@outeniqualab.co.za

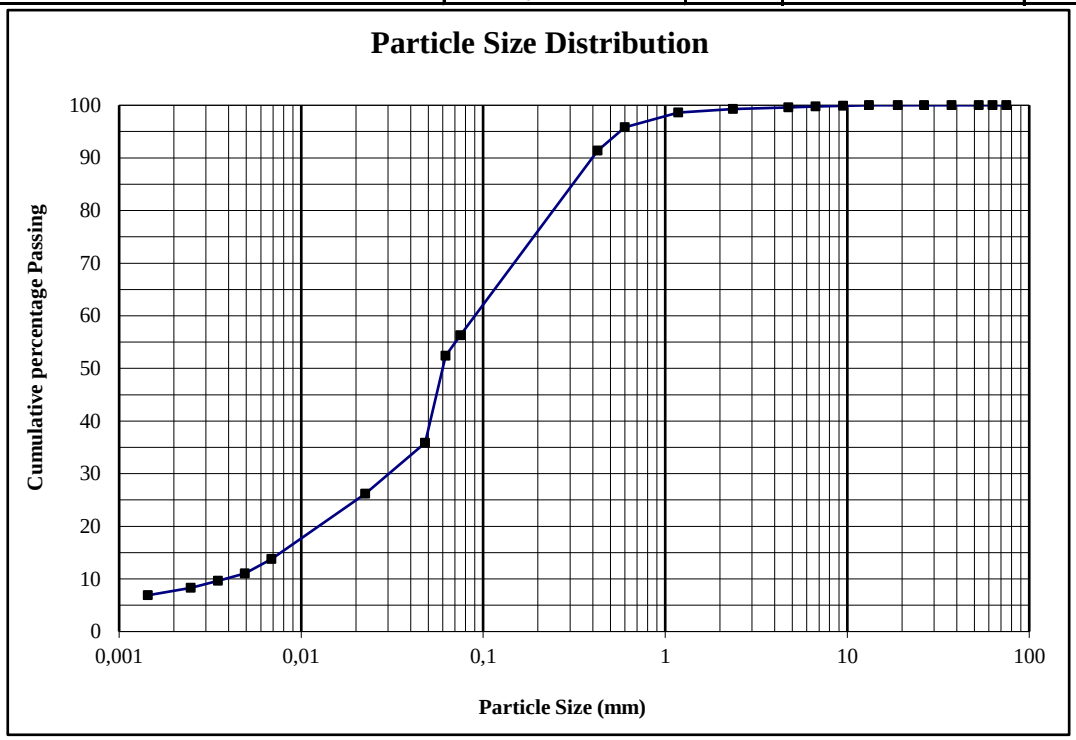
Customer :	Outeniqua Geotechincal Services cc	Project :	Choje Windfarm
	Po Box 964	Date Received :	23/05/19
	Knysna	Date Reported :	26/06/19
	6570	Req. Number :	439/19
Attention :	Iain Paton	No. of Pages :	3/12

TEST REPORT

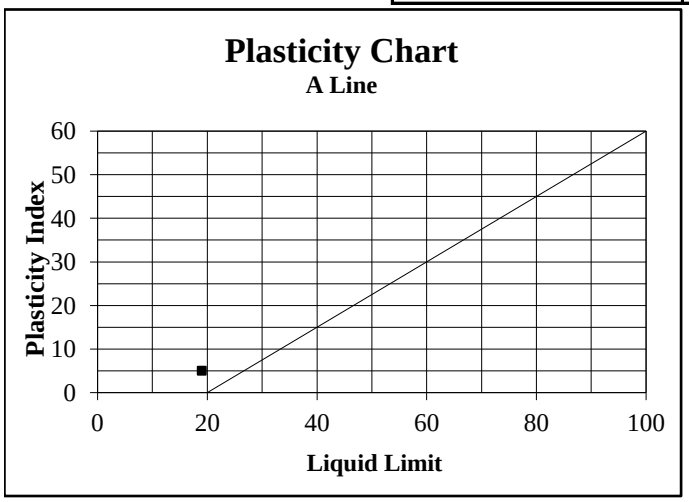
FOUNDATION INDICATOR - (TMH 1 Method A1(a),A2,A3,A4,A5) & (ASTM Method D422)

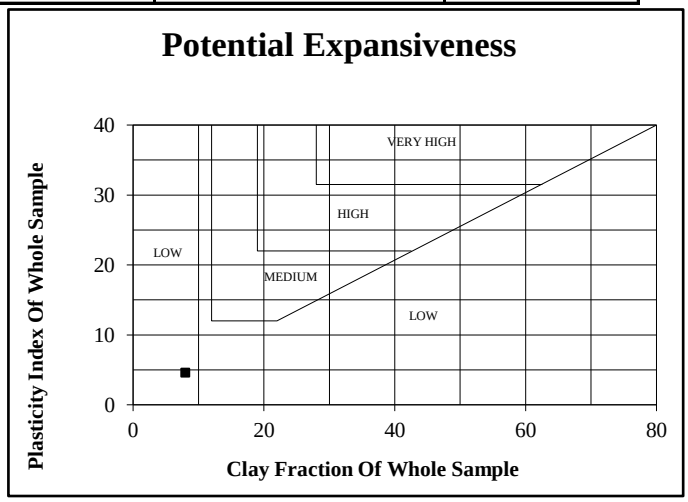
Material Description:	Light Reddish Orange - Clayey Sandy Silt	Sample Number:	13134		
Position:	E 6A	Liquid Limit	19	Linear Shrinkage	2,5
Depth:	400-2100	Plasticity Index	5	Insitu M/C%	7

Sieve Size(mm)	% Passing
75,0	100
63,0	100
53,0	100
37,5	100
26,5	100
19,0	100
13,2	100
9,5	100
6,7	100
4,75	100
2,36	99
1,18	99
0,600	96
0,425	91
0,075	56
0,0623	52
0,0480	36
0,0225	26
0,0069	14
0,0049	11
0,0035	10
0,0025	8
0,0014	7



% Clay	8	% Silt	42	% Sand	49	% Gravel	1
Unified Soil Classification		CL-ML		PRA Soil Classification		A-4	





Notes:

- **Specimens delivered to Outeniqua Lab in good order.**

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For Outeniqua Lab EC cc.

Outeniqua Lab EC cc.

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Customer :	Outeniqua Geotechincal Services cc	Project :	Choje Windfarm
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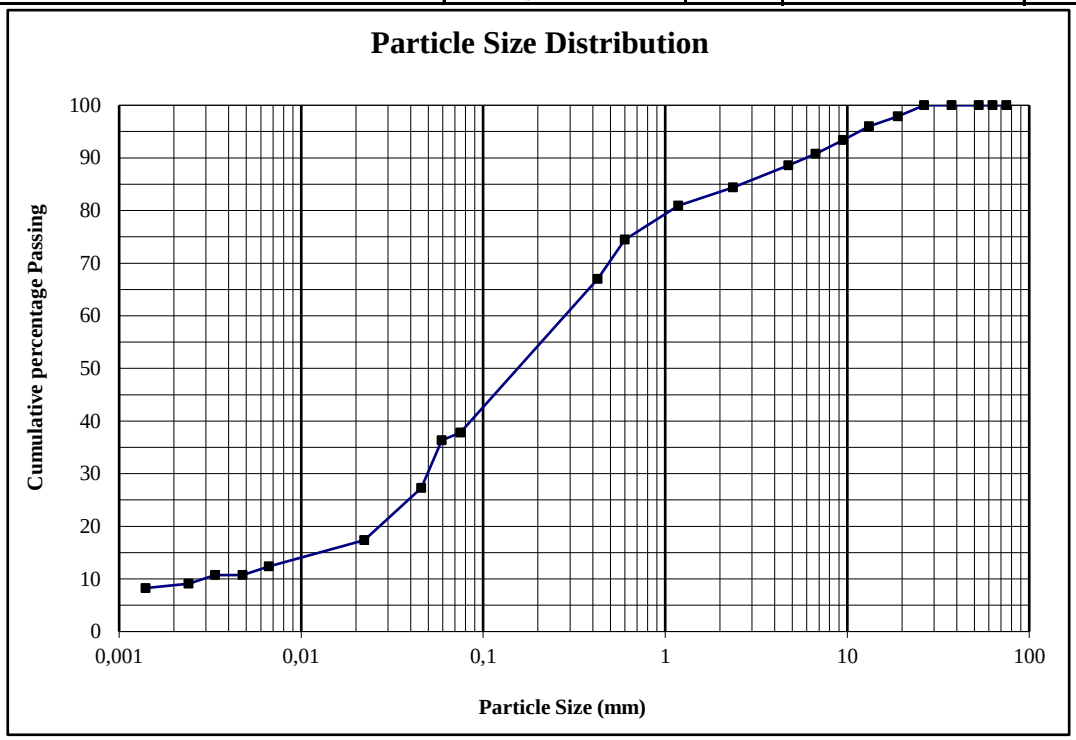
	Knysna	Date Reported :	26/06/19
	6570	Req. Number :	439/19
Attention :	Iain Paton	No. of Pages :	4/12

TEST REPORT

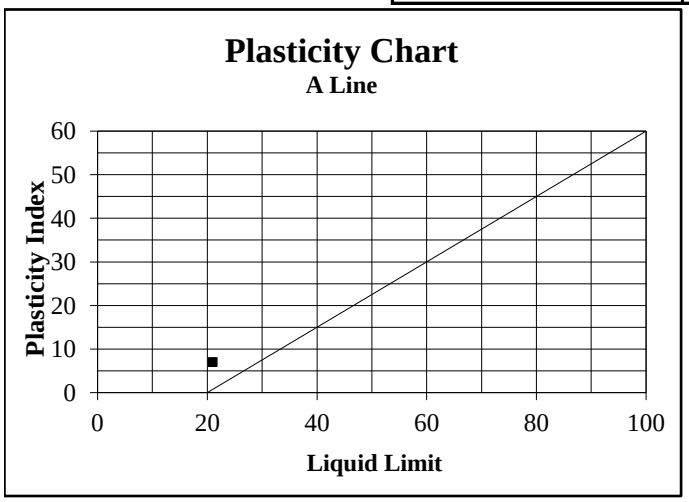
FOUNDATION INDICATOR - (TMH 1 Method A1(a),A2,A3,A4,A5) & (ASTM Method D422)

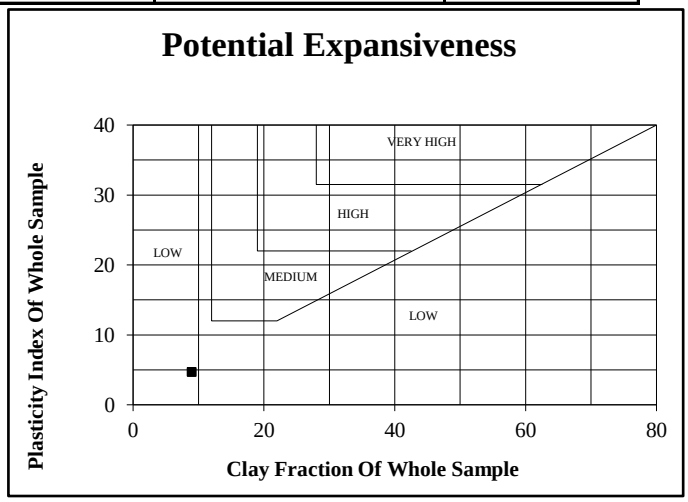
Material Description:	Light Yellowish Orange - Clayey Gravelly Silty Sand	Sample Number:	13136		
Position:	E 6B	Liquid Limit	21	Linear Shrinkage	3,5
Depth:	800-1750	Plasticity Index	7	Insitu M/C%	5,2

Sieve Size(mm)	% Passing
75,0	100
63,0	100
53,0	100
37,5	100
26,5	100
19,0	98
13,2	96
9,5	93
6,7	91
4,75	89
2,36	84
1,18	81
0,600	75
0,425	67
0,075	38
0,0591	36
0,0458	27
0,0223	17
0,0066	12
0,0048	11
0,0034	11
0,0024	9
0,0014	8



% Clay	9	% Silt	28	% Sand	46	% Gravel	17
Unified Soil Classification		SM-SC		PRA Soil Classification		A-4	





Notes:

- **Specimens delivered to Outeniqua Lab in good order.**

L Malgraff (Member)
For Outeniqua Lab EC cc.

Outeniqua Lab EC cc.

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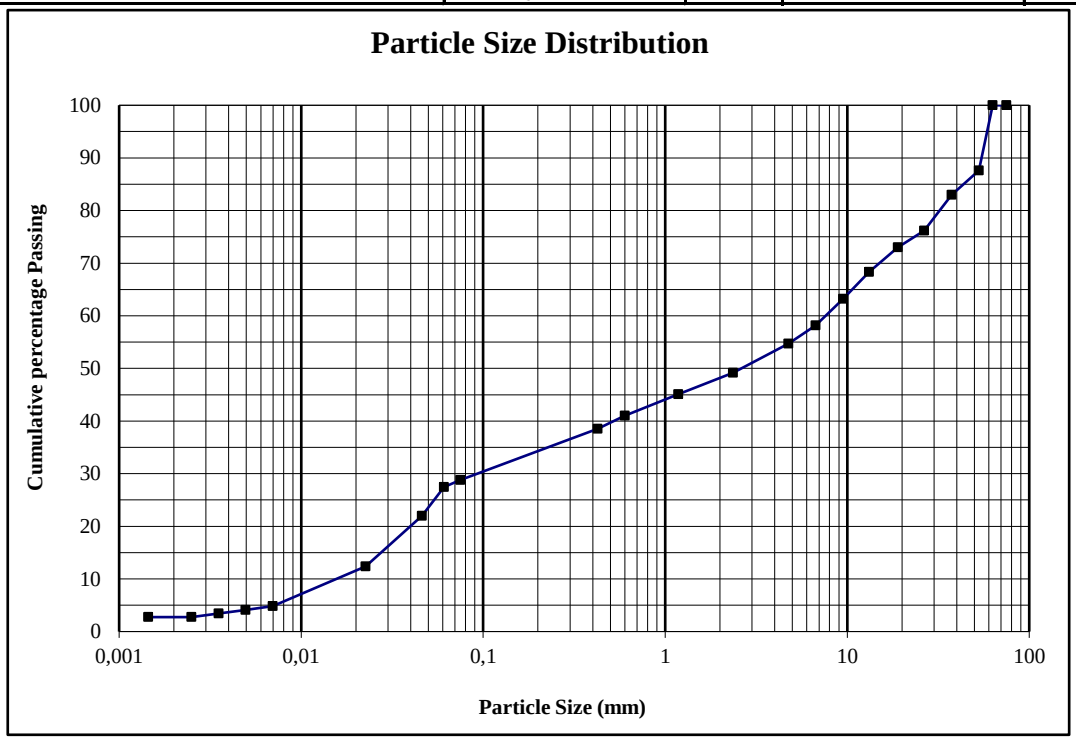
Customer :	Outeniqua Geotechincal Services cc	Project :	Choje Windfarm
	Po Box 964	Date Received :	23/05/19
	Knysna	Date Reported :	26/06/19
	6570	Req. Number :	439/19
Attention :	Iain Paton	No. of Pages :	5/12

TEST REPORT

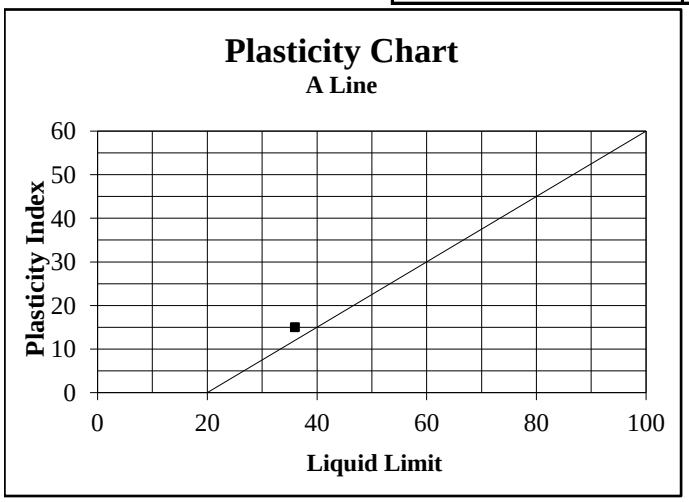
FOUNDATION INDICATOR - (TMH 1 Method A1(a),A2,A3,A4,A5) & (ASTM Method D422)

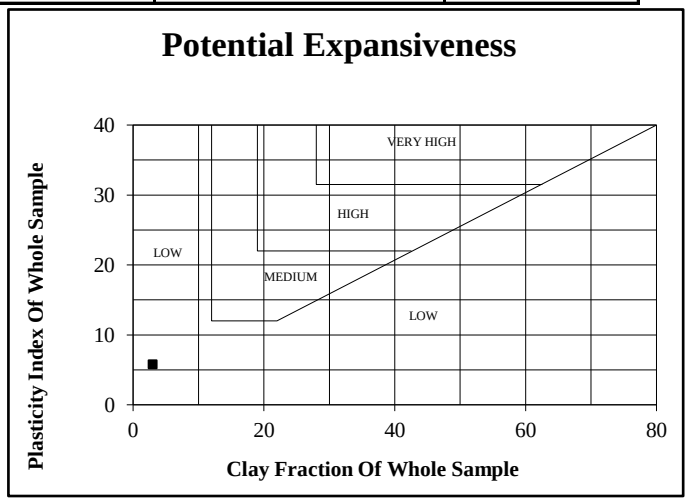
Material Description:	Light Brown - Clayey Silty Sandy Gravel	Sample Number:	13138		
Position:	E 7A	Liquid Limit	36	Linear Shrinkage	7,5
Depth:	200-500	Plasticity Index	15	Insitu M/C%	9,4

Sieve Size(mm)	% Passing
75,0	100
63,0	100
53,0	88
37,5	83
26,5	76
19,0	73
13,2	68
9,5	63
6,7	58
4,75	55
2,36	49
1,18	45
0,600	41
0,425	39
0,075	29
0,0610	27
0,0462	22
0,0226	12
0,0070	5
0,0049	4
0,0035	3
0,0025	3
0,0014	3



% Clay	3	% Silt	24	% Sand	21	% Gravel	52
Unified Soil Classification		GC		PRA Soil Classification		A-2-6	





Notes:

- **Specimens delivered to Outeniqua Lab in good order.**

L Malgraff (Member)
For Outeniqua Lab EC cc.

Outeniqua Lab EC cc.

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	Knysna	Date Reported :	26/06/19
	6570	Req. Number :	439/19
Attention :	Iain Paton	No. of Pages :	6/12

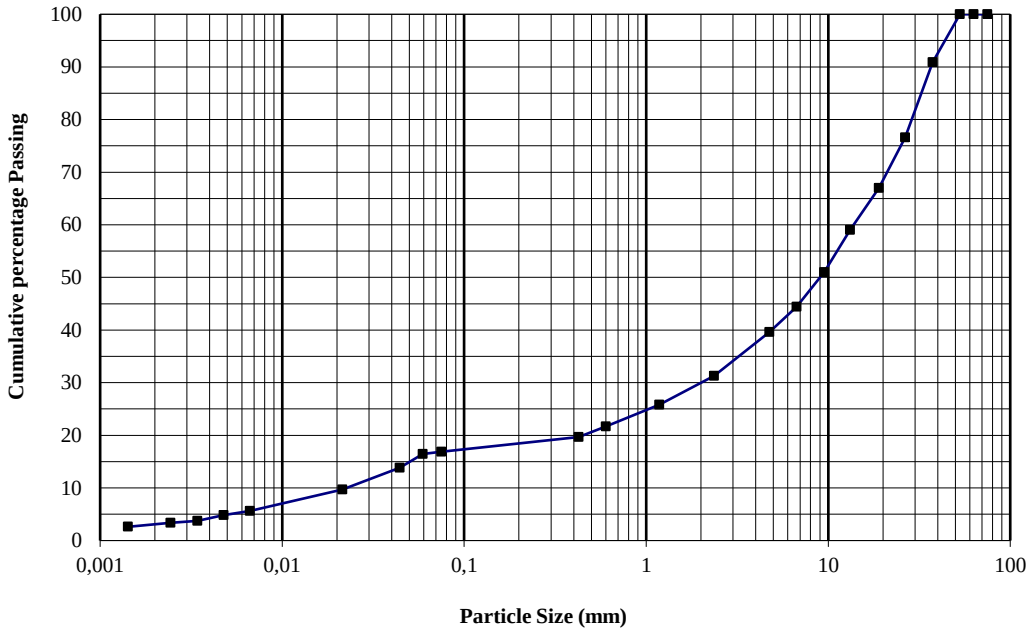
TEST REPORT

FOUNDATION INDICATOR - (TMH 1 Method A1(a),A2,A3,A4,A5) & (ASTM Method D422)

Material Description:	Light Reddish Brown to Light Brown - Clayey Silty Sandy Gravel	Sample Number:	13140		
Position:	E 7B	Liquid Limit	46	Linear Shrinkage	10
Depth:	300-800	Plasticity Index	20	Insitu M/C%	7

Sieve Size(mm)	% Passing
75,0	100
63,0	100
53,0	100
37,5	91
26,5	77
19,0	67
13,2	59
9,5	51
6,7	44
4,75	40
2,36	31
1,18	26
0,600	22
0,425	20
0,075	17
0,0591	16
0,0443	14
0,0215	10
0,0066	6
0,0048	5
0,0034	4
0,0024	3
0,0014	3

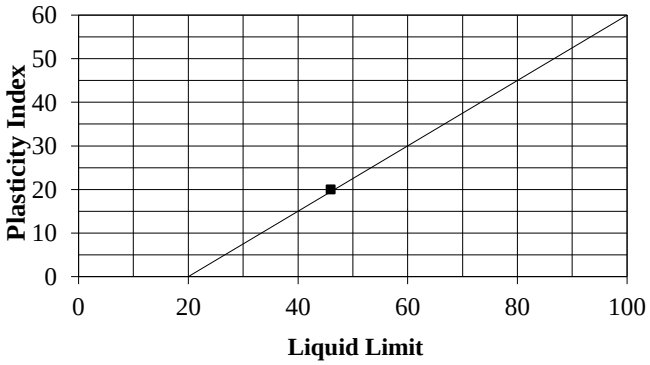
Particle Size Distribution



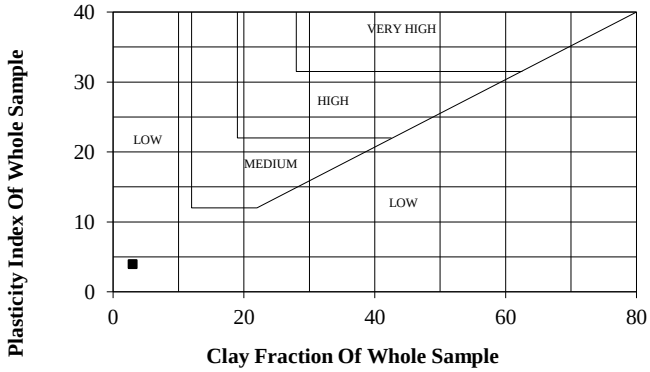
% Clay	3	% Silt	14	% Sand	13	% Gravel	70
Unified Soil Classification		GC		PRA Soil Classification		A-2-7	

Plasticity Chart

A Line



Potential Expansiveness



Notes:

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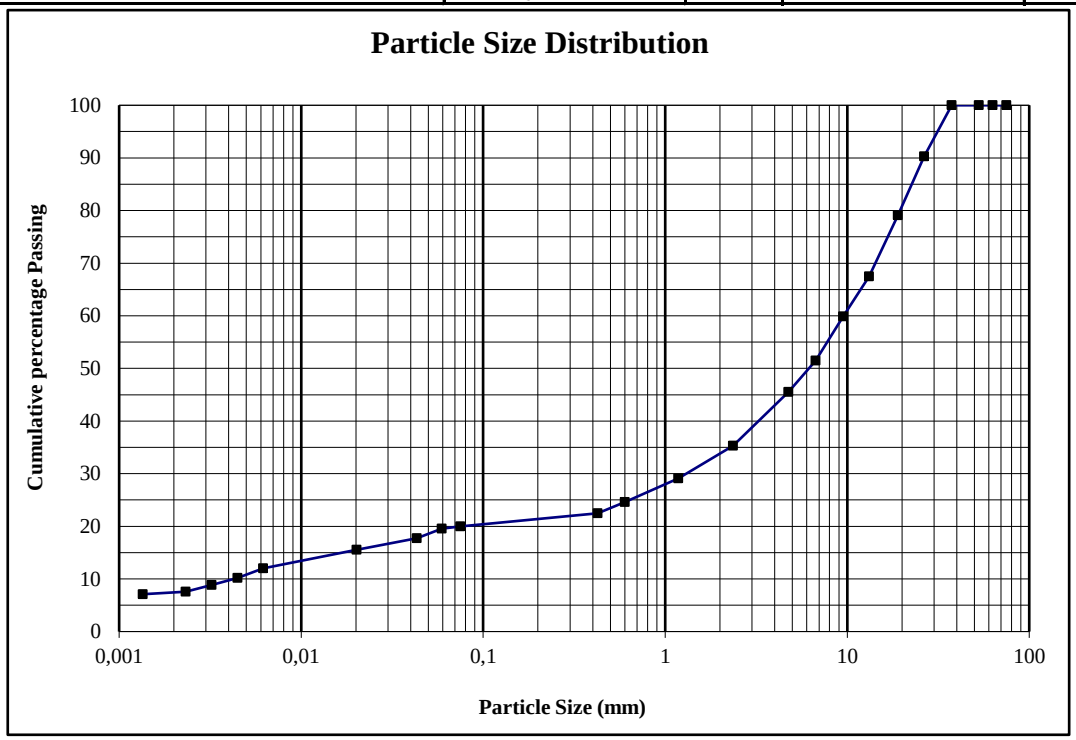
Customer :	Outeniqua Geotechincal Services cc	Project :	Choje Windfarm
	Po Box 964	Date Received :	23/05/19
	Knysna	Date Reported :	26/06/19
	6570	Req. Number :	439/19
Attention :	Iain Paton	No. of Pages :	7/12

TEST REPORT

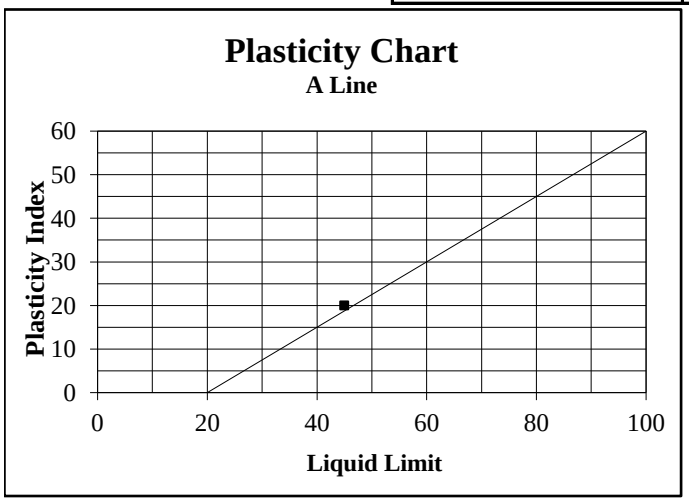
FOUNDATION INDICATOR - (TMH 1 Method A1(a),A2,A3,A4,A5) & (ASTM Method D422)

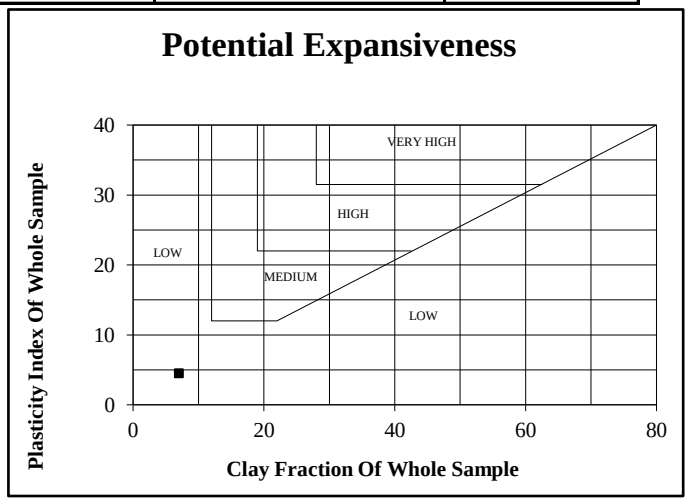
Material Description:	Light Reddish Brown - Clayey Silty Sandy Gravel	Sample Number:	13142		
Position:	E 100A	Liquid Limit	45	Linear Shrinkage	10
Depth:	300-1100	Plasticity Index	20	Insitu M/C%	8,9

Sieve Size(mm)	% Passing
75,0	100
63,0	100
53,0	100
37,5	100
26,5	90
19,0	79
13,2	68
9,5	60
6,7	52
4,75	46
2,36	35
1,18	29
0,600	25
0,425	23
0,075	20
0,0591	20
0,0432	18
0,0202	16
0,0062	12
0,0045	10
0,0032	9
0,0023	8
0,0014	7



% Clay	7	% Silt	13	% Sand	13	% Gravel	67
Unified Soil Classification		GC		PRA Soil Classification		A-2-7	





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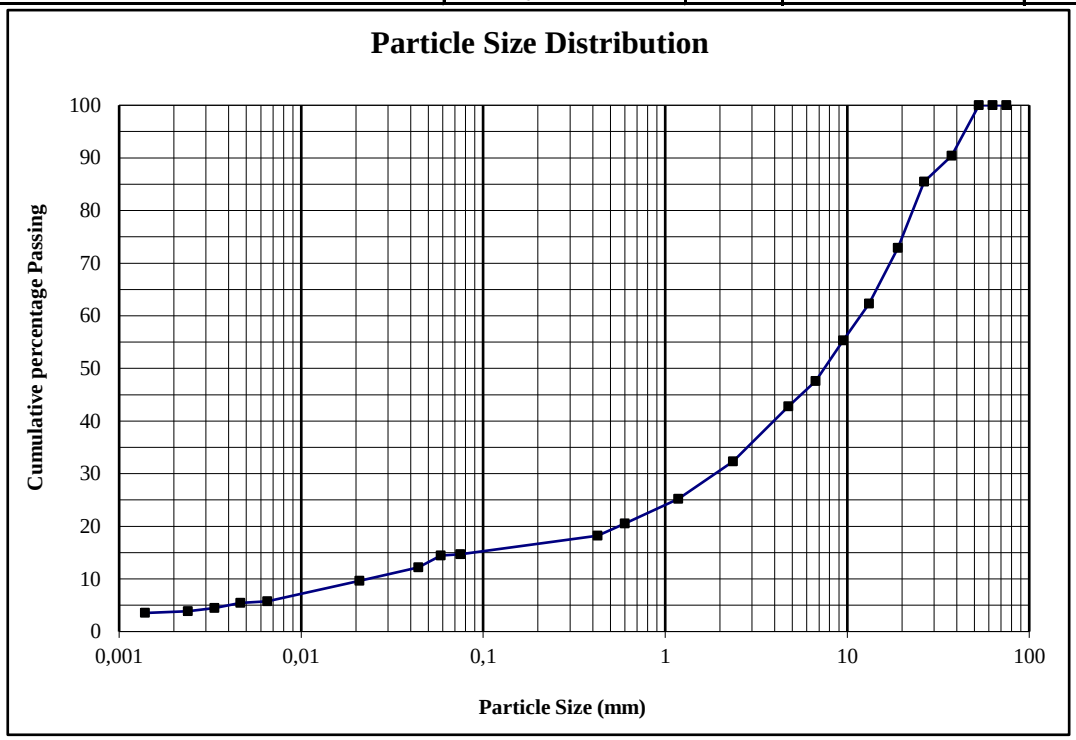
TEST REPORT

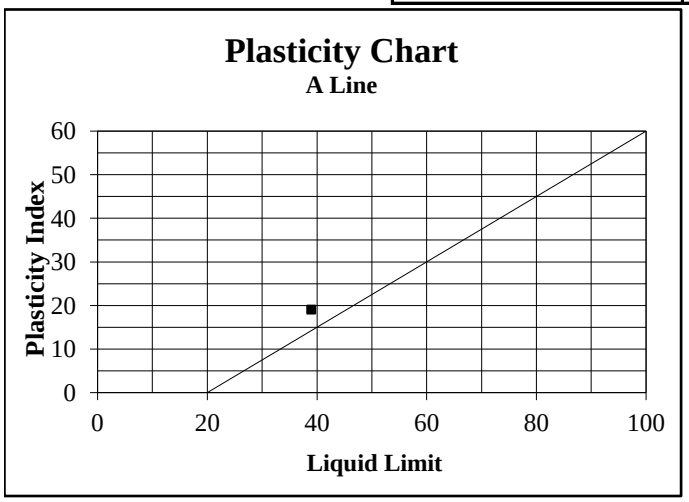
FOUNDATION INDICATOR - (TMH 1 Method A1(a),A2,A3,A4,A5) & (ASTM Method D422)

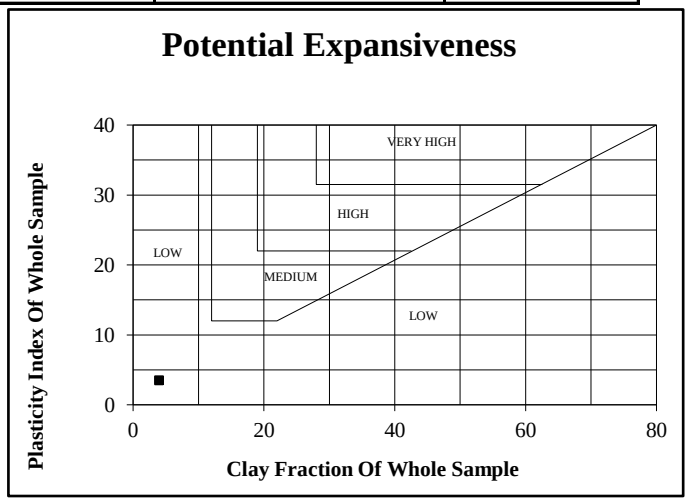
Material Description:	Light Reddish Brown - Silty Sandy Gravel	Sample Number:	13144		
Position:	E 100B	Liquid Limit	39	Linear Shrinkage	9,5
Depth:	400-1500	Plasticity Index	19	Insitu M/C%	6,8

Sieve Size(mm)	% Passing
75,0	100
63,0	100
53,0	100
37,5	90
26,5	86
19,0	73
13,2	62
9,5	55
6,7	48
4,75	43
2,36	32
1,18	25
0,600	21
0,425	18
0,075	15
0,0585	14
0,0440	12
0,0209	10
0,0065	6
0,0046	5
0,0033	4
0,0024	4
0,0014	4



% Clay	4	% Silt	11	% Sand	15	% Gravel	70
Unified Soil Classification		GC		PRA Soil Classification		A-2-6	





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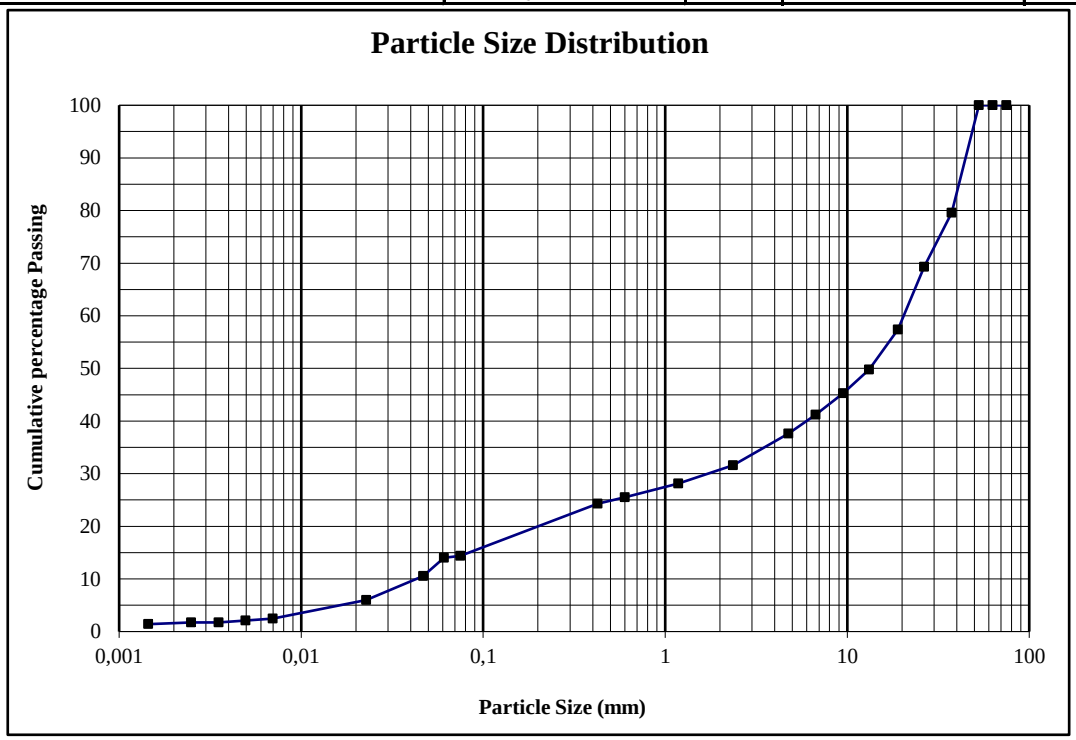
TEST REPORT

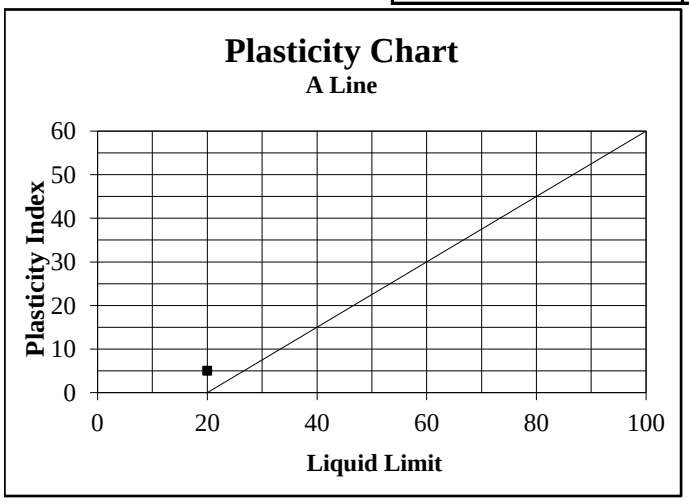
FOUNDATION INDICATOR - (TMH 1 Method A1(a),A2,A3,A4,A5) & (ASTM Method D422)

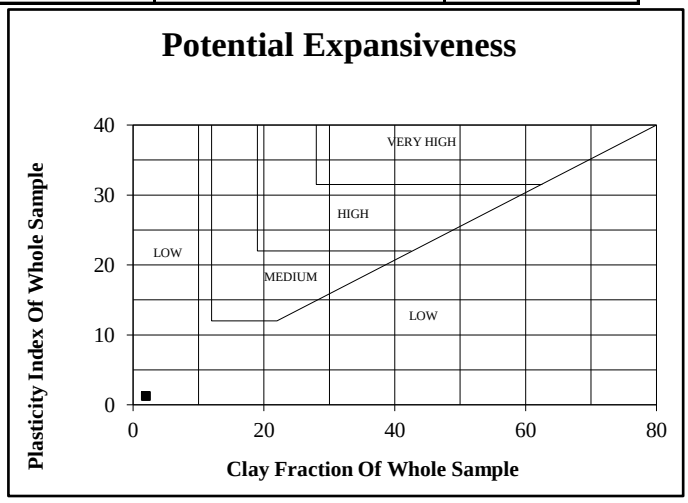
Material Description:	Light Reddish Brown - Gravelly Silty Sand	Sample Number:	13146		
Position:	TP SS1	Liquid Limit	20	Linear Shrinkage	2,5
Depth:	0-100	Plasticity Index	5	Insitu M/C%	4

Sieve Size(mm)	% Passing
75,0	100
63,0	100
53,0	100
37,5	80
26,5	69
19,0	57
13,2	50
9,5	45
6,7	41
4,75	38
2,36	32
1,18	28
0,600	26
0,425	24
0,075	14
0,0610	14
0,0468	11
0,0228	6
0,0070	2
0,0049	2
0,0035	2
0,0025	2
0,0014	1



% Clay	2	% Silt	12	% Sand	17	% Gravel	69
Unified Soil Classification		GM-GC		PRA Soil Classification		A-1-a / A-1-b / A-2-4	





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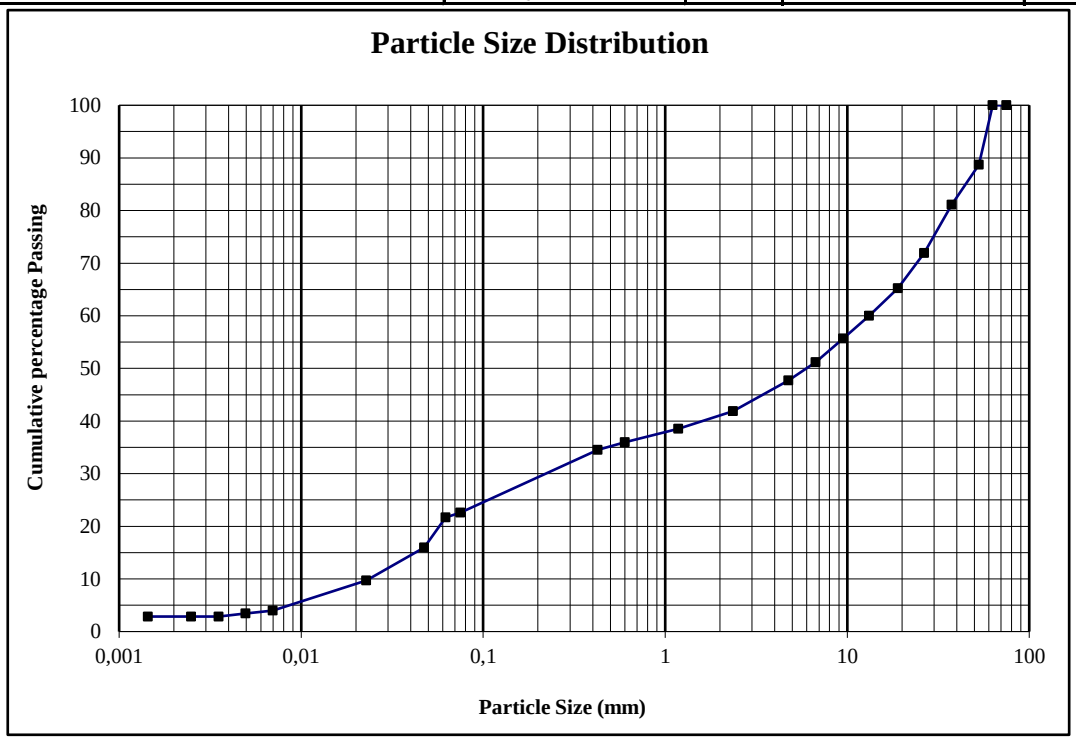
TEST REPORT

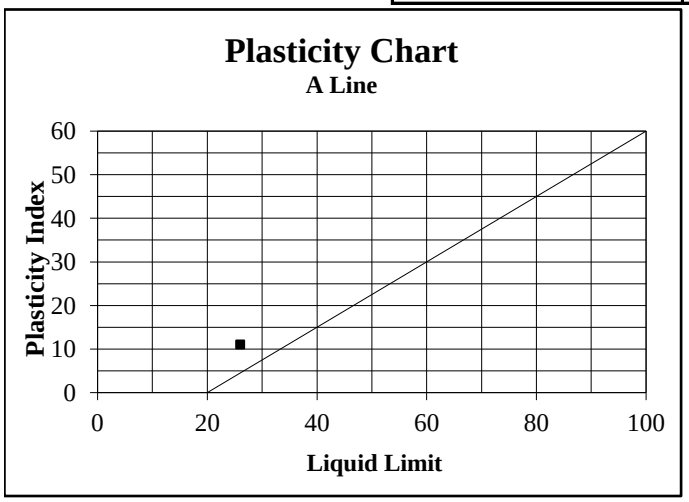
FOUNDATION INDICATOR - (TMH 1 Method A1(a),A2,A3,A4,A5) & (ASTM Method D422)

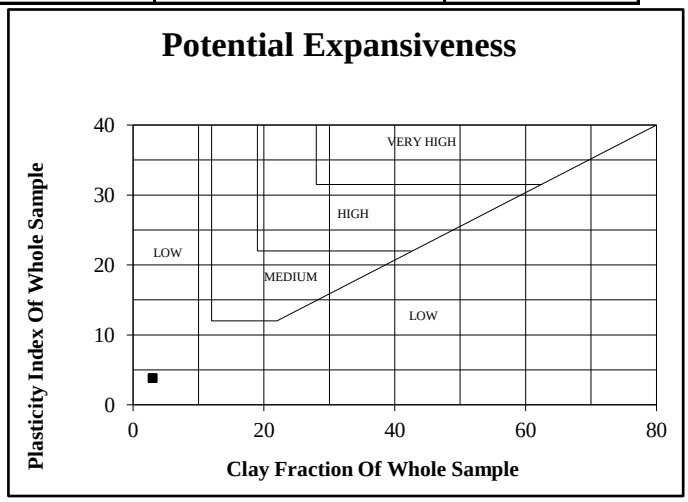
Material Description:	Light Reddish Brown - Silty Gravelly Sand with Boulders & Cobbles	Sample Number:	13148		
Position:	TP SS2	Liquid Limit	26	Linear Shrinkage	5,5
Depth:	0-300	Plasticity Index	11	Insitu M/C%	6

Sieve Size(mm)	% Passing
75,0	100
63,0	100
53,0	89
37,5	81
26,5	72
19,0	65
13,2	60
9,5	56
6,7	51
4,75	48
2,36	42
1,18	39
0,600	36
0,425	35
0,075	23
0,0623	22
0,0474	16
0,0228	10
0,0070	4
0,0049	3
0,0035	3
0,0025	3
0,0014	3



% Clay	3	% Silt	18	% Sand	20	% Gravel	59
Unified Soil Classification		GC		PRA Soil Classification		A-2-6	





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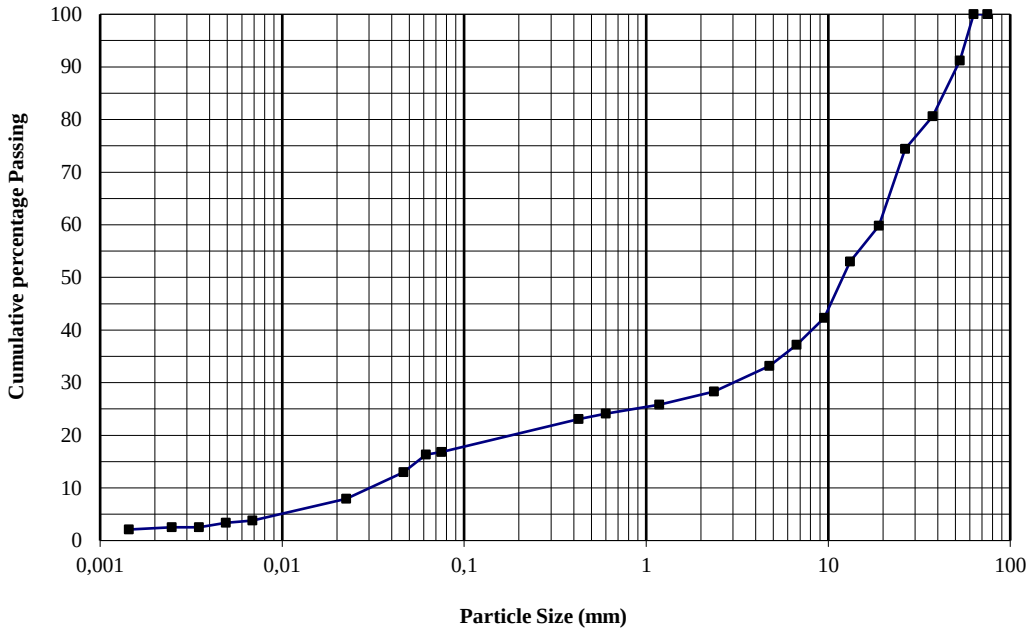
TEST REPORT

FOUNDATION INDICATOR - (TMH 1 Method A1(a),A2,A3,A4,A5) & (ASTM Method D422)

Material Description:	Light Reddish Brown - Silty Sandy Gravel with Cobbles	Sample Number:	13150		
Position:	TP SS3	Liquid Limit	25	Linear Shrinkage	4
Depth:	80-250	Plasticity Index	8	Insitu M/C%	4,2

Sieve Size(mm)	% Passing
75,0	100
63,0	100
53,0	91
37,5	81
26,5	74
19,0	60
13,2	53
9,5	42
6,7	37
4,75	33
2,36	28
1,18	26
0,600	24
0,425	23
0,075	17
0,0617	16
0,0464	13
0,0225	8
0,0069	4
0,0049	3
0,0035	3
0,0025	3
0,0014	2

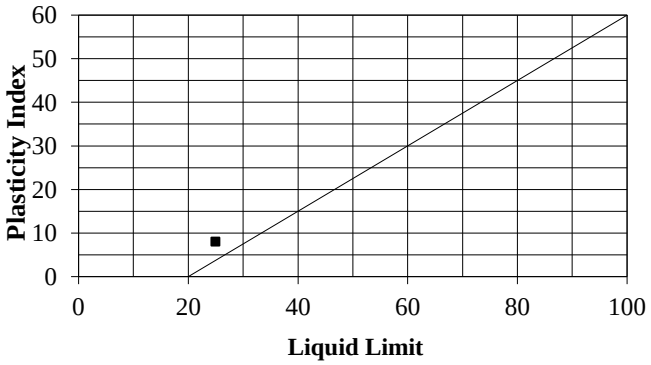
Particle Size Distribution



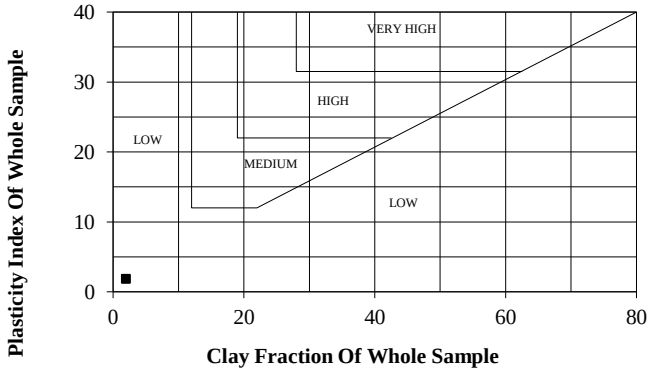
% Clay	2	% Silt	14	% Sand	12	% Gravel	72
Unified Soil Classification		GC		PRA Soil Classification		A-2-4	

Plasticity Chart

A Line



Potential Expansiveness



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Attention :	Iain Paton	No. of Pages :	12/12

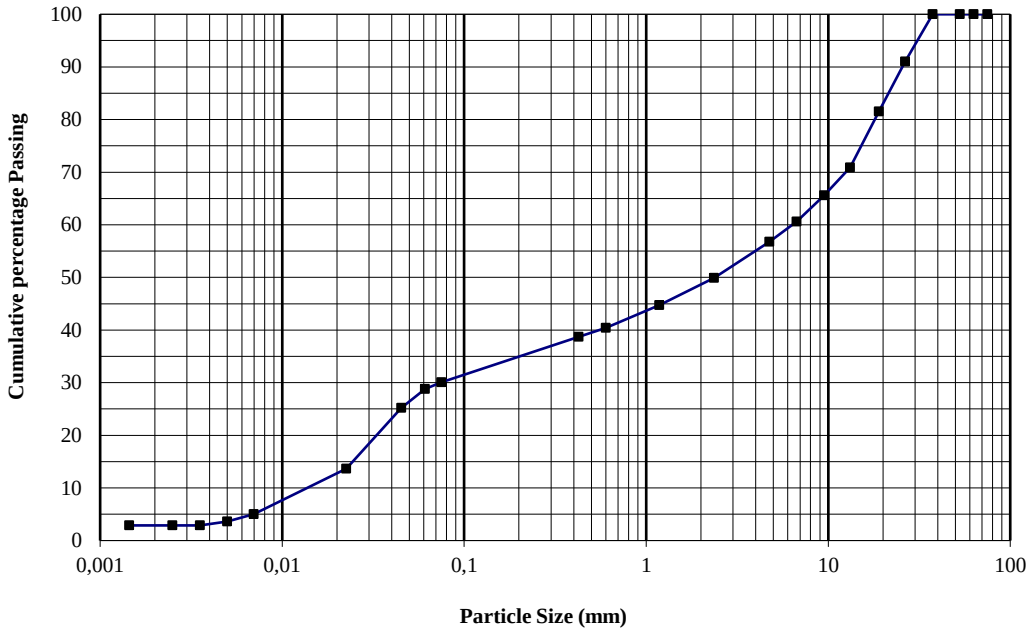
TEST REPORT

FOUNDATION INDICATOR - (TMH 1 Method A1(a),A2,A3,A4,A5) & (ASTM Method D422)

Material Description:	Light Reddish Brown - Silty Sandy Gravel	Sample Number:	13152		
Position:	TP SS4	Liquid Limit	39	Linear Shrinkage	10
Depth:	200-450	Plasticity Index	20	Insitu M/C%	10,4

Sieve Size(mm)	% Passing
75,0	100
63,0	100
53,0	100
37,5	100
26,5	91
19,0	82
13,2	71
9,5	66
6,7	61
4,75	57
2,36	50
1,18	45
0,600	40
0,425	39
0,075	30
0,0610	29
0,0451	25
0,0225	14
0,0070	5
0,0050	4
0,0035	3
0,0025	3
0,0014	3

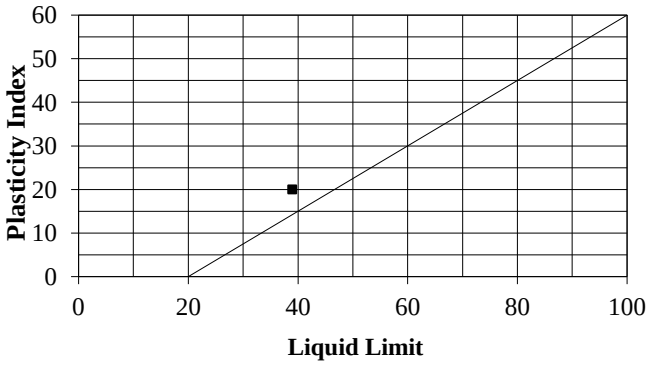
Particle Size Distribution



% Clay	3	% Silt	26	% Sand	19	% Gravel	52
Unified Soil Classification		GC		PRA Soil Classification		A-2-6	

Plasticity Chart

A Line



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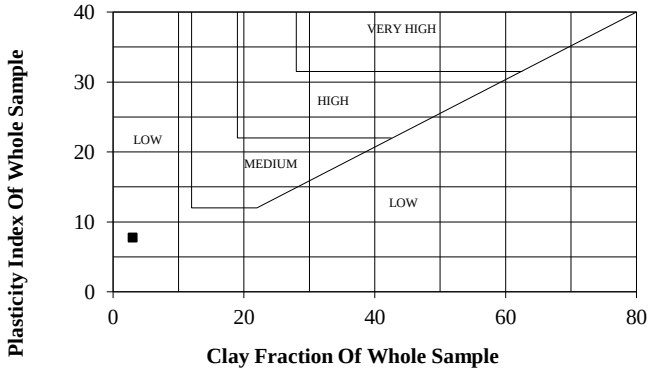

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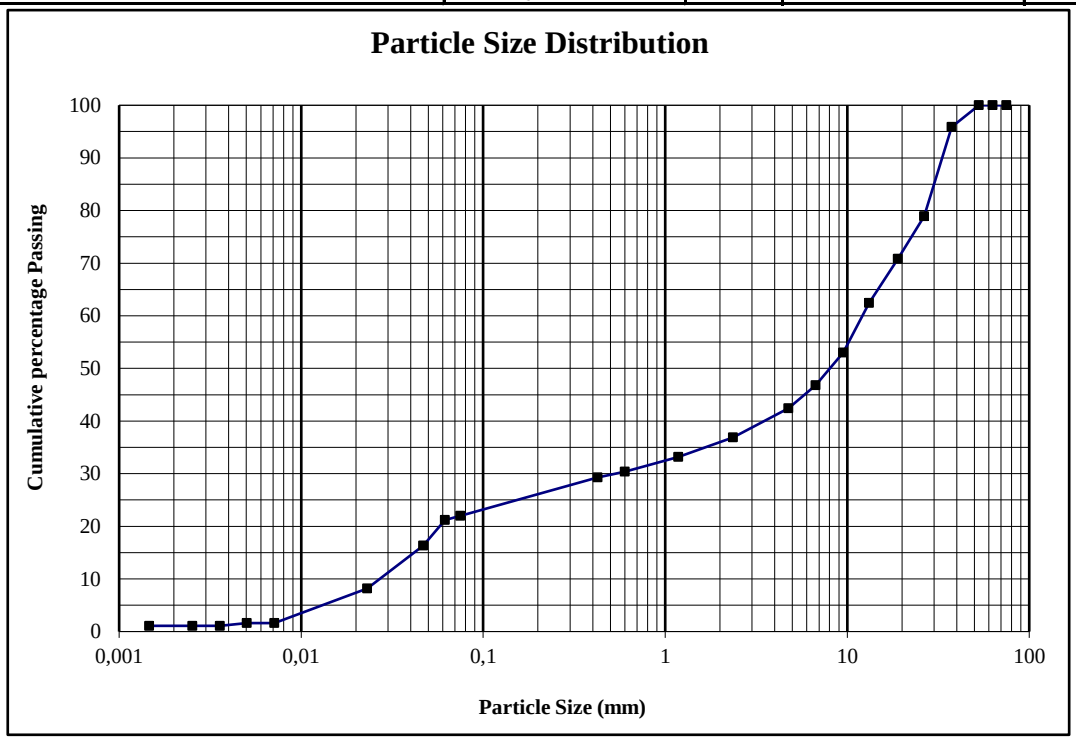
TEST REPORT

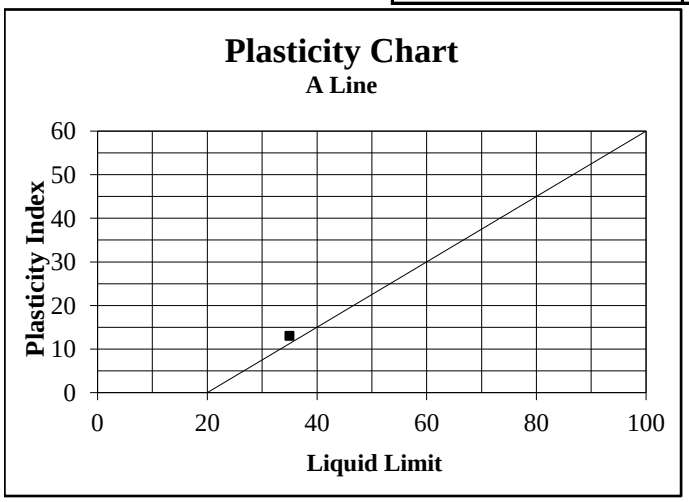
FOUNDATION INDICATOR - (TMH 1 Method A1(a),A2,A3,A4,A5) & (ASTM Method D422)

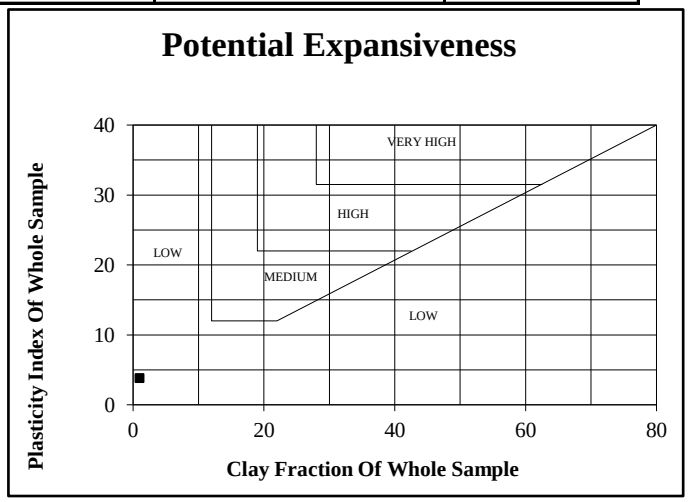
Material Description:	Light Reddish Orange - Silty Sandy Gravel	Sample Number:	13253		
Position:	TP MTS 1	Liquid Limit	35	Linear Shrinkage	6,5
Depth:	200-500	Plasticity Index	13	Insitu M/C%	12,9

Sieve Size(mm)	% Passing
75,0	100
63,0	100
53,0	100
37,5	96
26,5	79
19,0	71
13,2	62
9,5	53
6,7	47
4,75	42
2,36	37
1,18	33
0,600	30
0,425	29
0,075	22
0,0617	21
0,0468	16
0,0230	8
0,0071	2
0,0050	2
0,0036	1
0,0025	1
0,0015	1



% Clay	1	% Silt	20	% Sand	15	% Gravel	64
Unified Soil Classification		GC		PRA Soil Classification		A-2-6	





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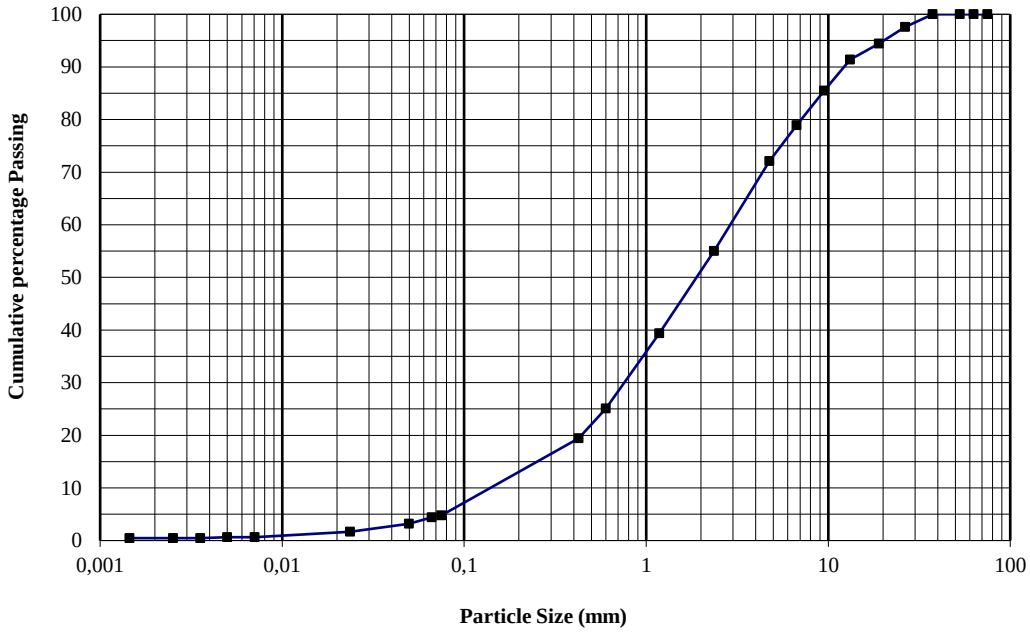
TEST REPORT

FOUNDATION INDICATOR - (TMH 1 Method A1(a),A2,A3,A4,A5) & (ASTM Method D422)

Material Description:	Dark Olive - Sandy Gravel	Sample Number:	13255		
Position:	TP MTS 2	Liquid Limit	SP	Linear Shrinkage	0,5
Depth:	900-2900	Plasticity Index	SP	Insitu M/C%	3,9

Sieve Size(mm)	% Passing
75,0	100
63,0	100
53,0	100
37,5	100
26,5	98
19,0	94
13,2	91
9,5	86
6,7	79
4,75	72
2,36	55
1,18	39
0,600	25
0,425	19
0,075	5
0,0665	4
0,0498	3
0,0236	2
0,0071	1
0,0050	1
0,0036	0
0,0025	0
0,0015	0

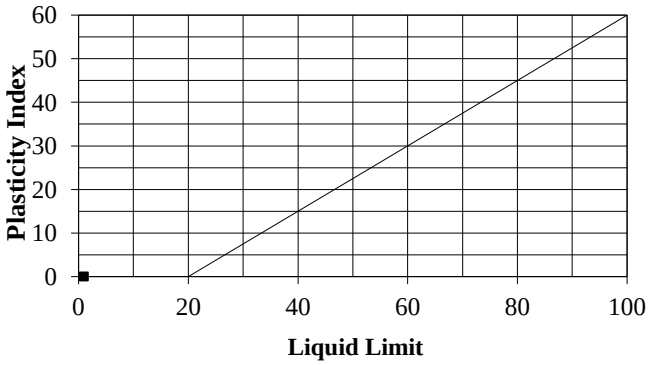
Particle Size Distribution



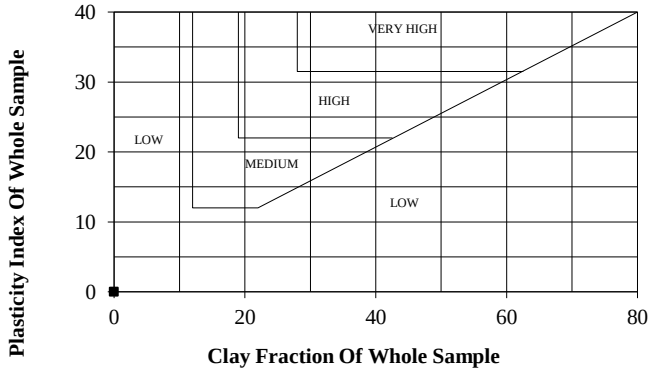
% Clay	0	% Silt	4	% Sand	46	% Gravel	50
Unified Soil Classification		GP		PRA Soil Classification		A-1-a / A-1-b / A-2-4	

Plasticity Chart

A Line



Potential Expansiveness



Notes:

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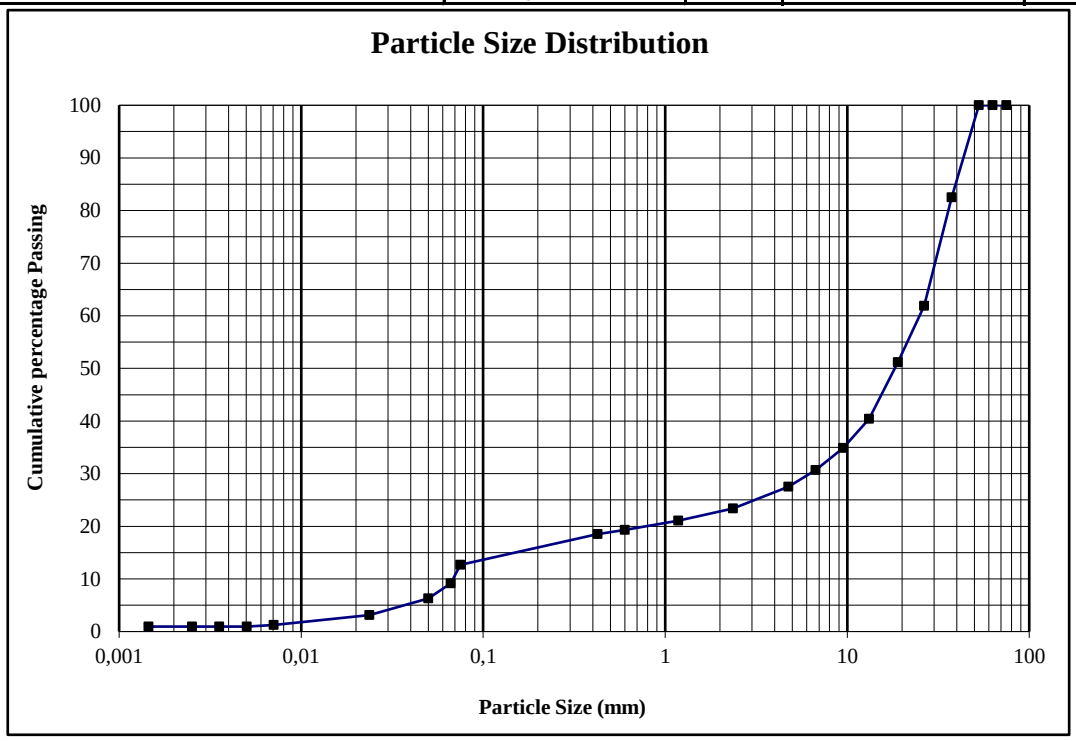
	Po Box 964	Date Received :	14/06/19
	Knysna	Date Reported :	15/08/19
	6570	Req. Number :	511/19
Attention :	Iain Paton	No. of Pages :	3/14

TEST REPORT

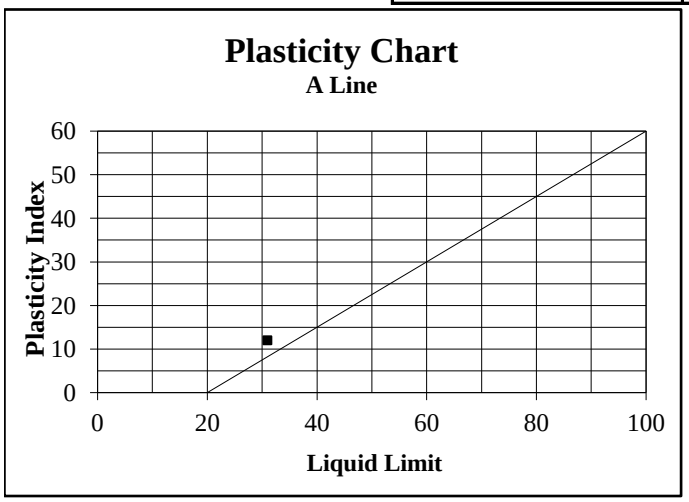
FOUNDATION INDICATOR - (TMH 1 Method A1(a),A2,A3,A4,A5) & (ASTM Method D422)

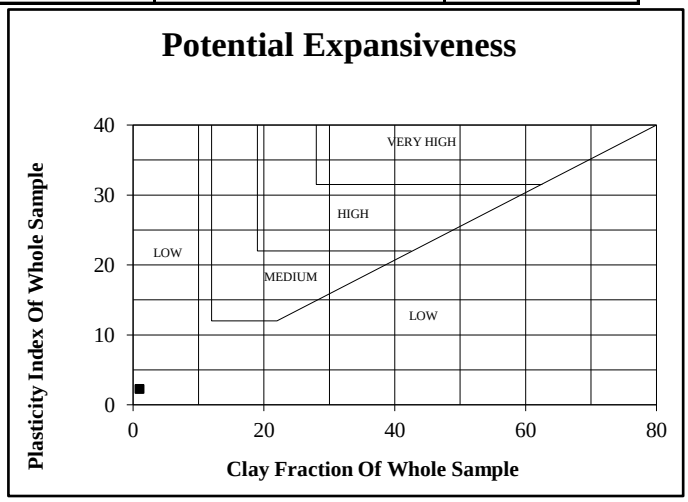
Material Description:	Dark Reddish Orange - Silty Sandy Gravel	Sample Number:	13257		
Position:	TP MTS 3	Liquid Limit	31	Linear Shrinkage	6
Depth:	0-400	Plasticity Index	12	Insitu M/C%	7,8

Sieve Size(mm)	% Passing
75,0	100
63,0	100
53,0	100
37,5	83
26,5	62
19,0	51
13,2	40
9,5	35
6,7	31
4,75	28
2,36	23
1,18	21
0,600	19
0,425	19
0,075	13
0,0665	9
0,0500	6
0,0238	3
0,0071	1
0,0050	1
0,0036	1
0,0025	1
0,0015	1



% Clay	1	% Silt	7	% Sand	15	% Gravel	77
Unified Soil Classification		GC		PRA Soil Classification		A-2-6	





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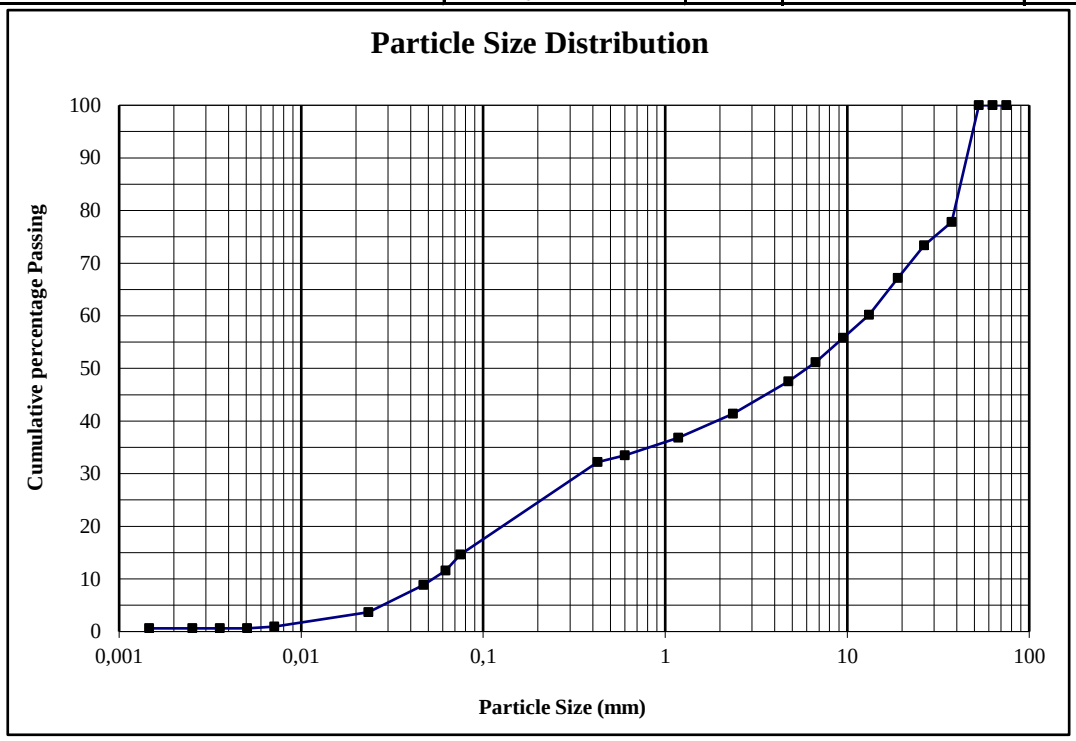
Attention :	Iain Paton	No. of Pages :	4/14

TEST REPORT

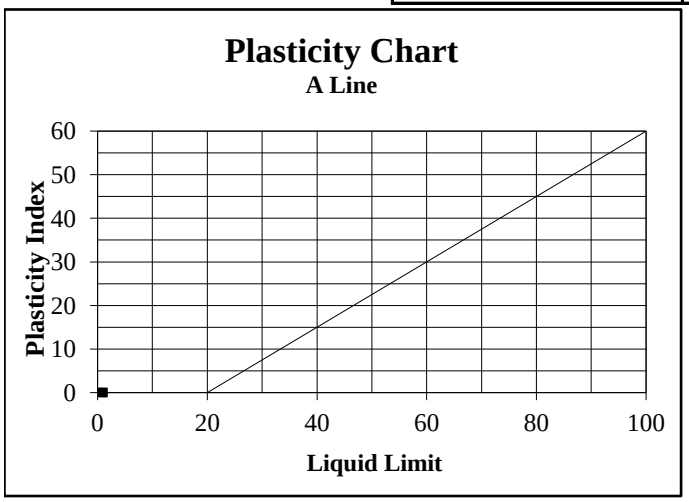
FOUNDATION INDICATOR - (TMH 1 Method A1(a),A2,A3,A4,A5) & (ASTM Method D422)

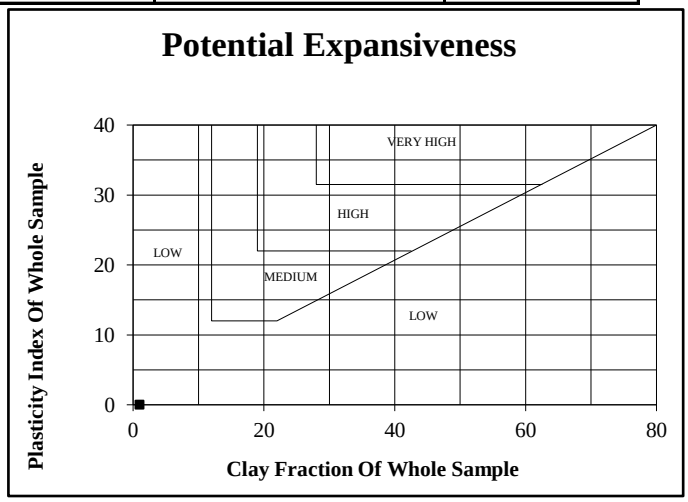
Material Description:	Light Olive to Light Brown - Sandy Silty Gravel with Cobbles	Sample Number:	13259		
Position:	TP MTS 4	Liquid Limit	NP	Linear Shrinkage	0
Depth:	250-600	Plasticity Index	NP	Insitu M/C%	9,1

Sieve Size(mm)	% Passing
75,0	100
63,0	100
53,0	100
37,5	78
26,5	73
19,0	67
13,2	60
9,5	56
6,7	51
4,75	48
2,36	41
1,18	37
0,600	34
0,425	32
0,075	15
0,0623	12
0,0470	9
0,0234	4
0,0071	1
0,0051	1
0,0036	1
0,0025	1
0,0015	1



% Clay	1	% Silt	10	% Sand	29	% Gravel	60
Unified Soil Classification		GM		PRA Soil Classification		A-1-b / A-2-4	





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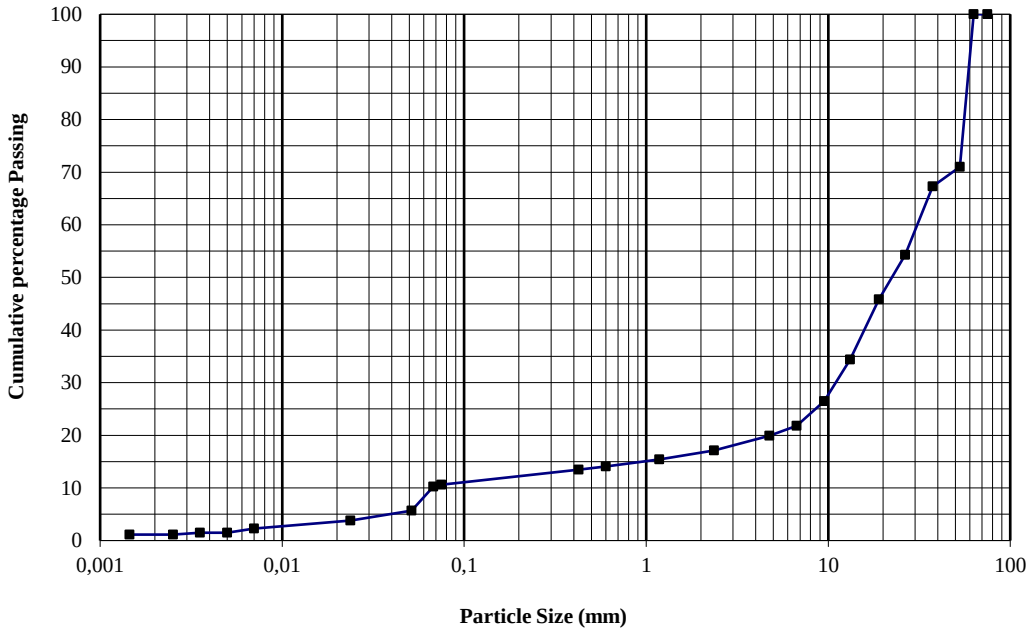
TEST REPORT

FOUNDATION INDICATOR - (TMH 1 Method A1(a),A2,A3,A4,A5) & (ASTM Method D422)

Material Description:	Light Reddish Orange - Silty Sandy Gravel	Sample Number:	13261		
Position:	W 521A	Liquid Limit	37	Linear Shrinkage	8,5
Depth:	150-350	Plasticity Index	17	Insitu M/C%	6,8

Sieve Size(mm)	% Passing
75,0	100
63,0	100
53,0	71
37,5	67
26,5	54
19,0	46
13,2	34
9,5	27
6,7	22
4,75	20
2,36	17
1,18	15
0,600	14
0,425	14
0,075	11
0,0676	10
0,0515	6
0,0238	4
0,0070	2
0,0050	2
0,0035	2
0,0025	1
0,0015	1

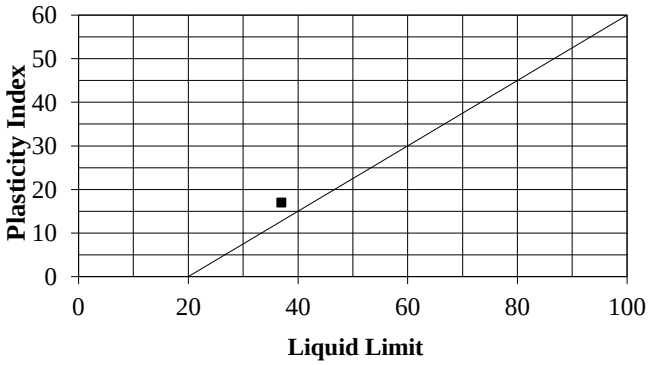
Particle Size Distribution



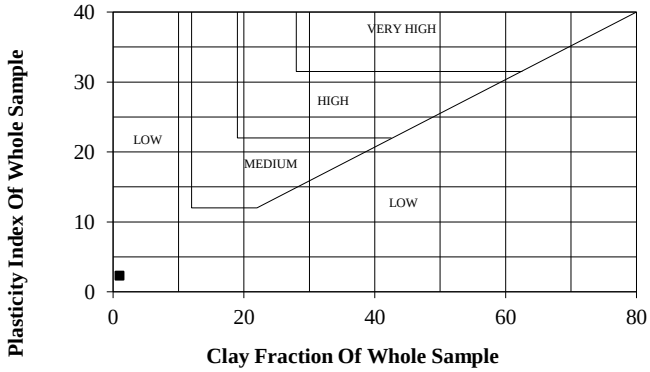
% Clay	1	% Silt	7	% Sand	9	% Gravel	83
Unified Soil Classification		GP-GC		PRA Soil Classification		A-2-6	

Plasticity Chart

A Line



Potential Expansiveness



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	6570	Req. Number :	511/19
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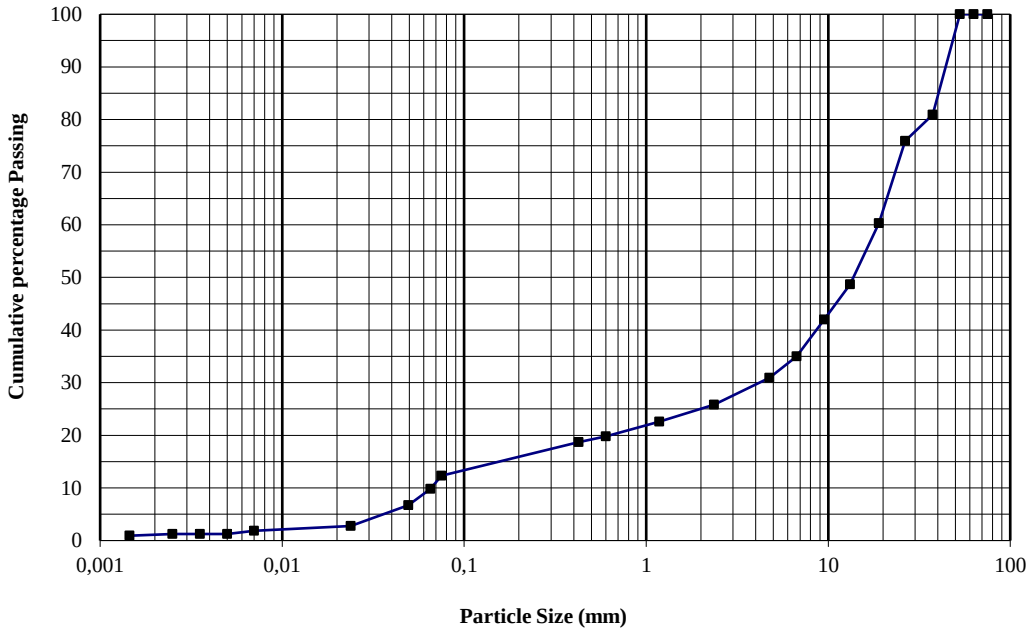
TEST REPORT

FOUNDATION INDICATOR - (TMH 1 Method A1(a),A2,A3,A4,A5) & (ASTM Method D422)

Material Description:	Light Reddish Orange - Silty Sandy Gravel	Sample Number:	13263		
Position:	W 521B	Liquid Limit	28	Linear Shrinkage	4
Depth:	100-350	Plasticity Index	8	Insitu M/C%	9,1

Sieve Size(mm)	% Passing
75,0	100
63,0	100
53,0	100
37,5	81
26,5	76
19,0	60
13,2	49
9,5	42
6,7	35
4,75	31
2,36	26
1,18	23
0,600	20
0,425	19
0,075	12
0,0653	10
0,0494	7
0,0238	3
0,0070	2
0,0050	1
0,0035	1
0,0025	1
0,0015	1

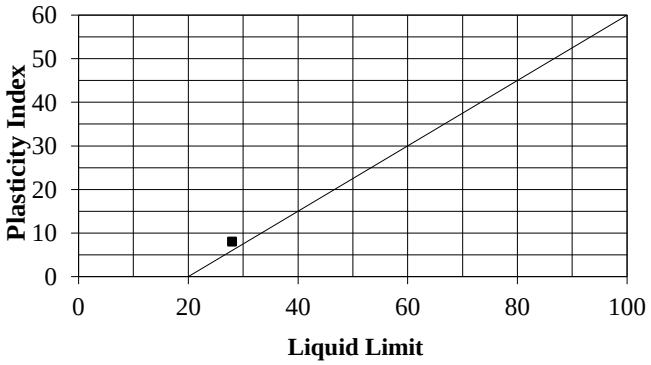
Particle Size Distribution



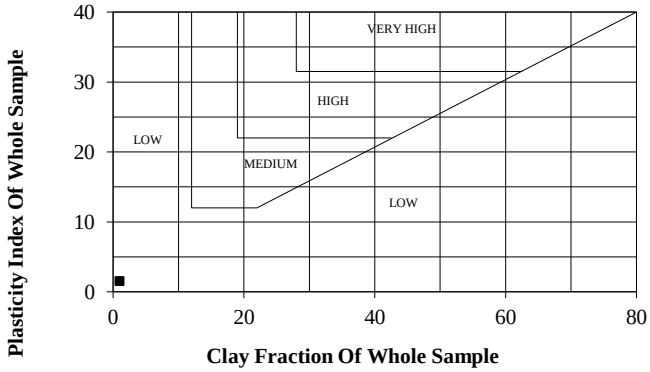
% Clay	1	% Silt	8	% Sand	16	% Gravel	75
Unified Soil Classification		GP-GC		PRA Soil Classification		A-2-4	

Plasticity Chart

A Line



Potential Expansiveness



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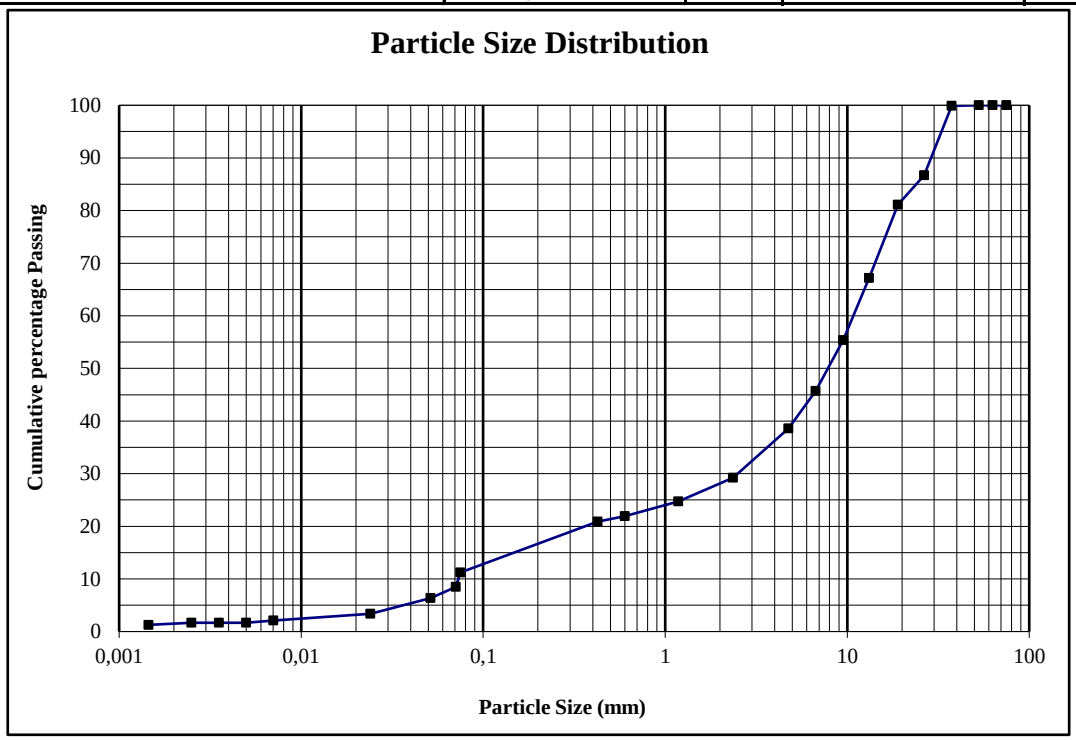
TEST REPORT

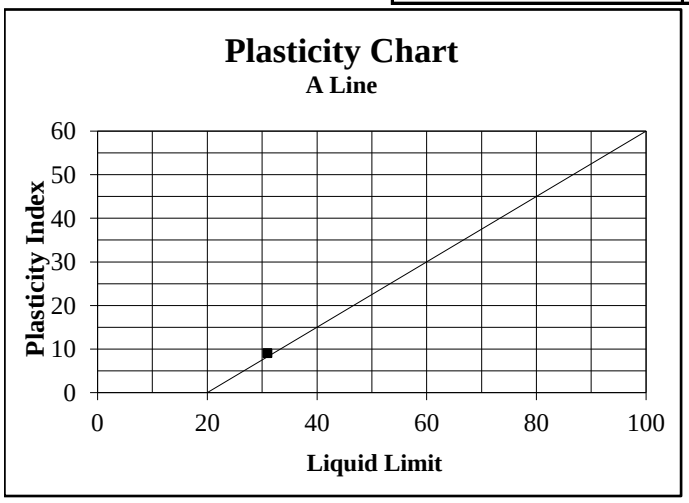
FOUNDATION INDICATOR - (TMH 1 Method A1(a),A2,A3,A4,A5) & (ASTM Method D422)

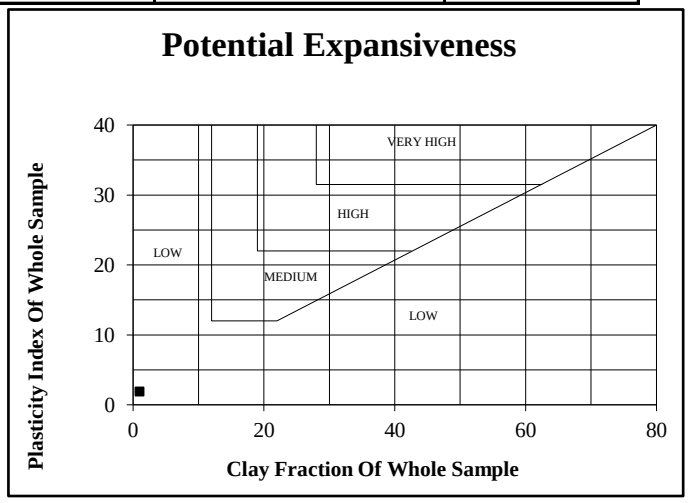
Material Description:	Light Olive to Light Brown - Calcrete	Sample Number:	13265		
Position:	W 564A	Liquid Limit	31	Linear Shrinkage	4,5
Depth:	350-950	Plasticity Index	9	Insitu M/C%	10,9

Sieve Size(mm)	% Passing
75,0	100
63,0	100
53,0	100
37,5	100
26,5	87
19,0	81
13,2	67
9,5	55
6,7	46
4,75	39
2,36	29
1,18	25
0,600	22
0,425	21
0,075	11
0,0707	8
0,0515	6
0,0240	3
0,0070	2
0,0050	2
0,0035	2
0,0025	2
0,0015	1



% Clay	1	% Silt	6	% Sand	21	% Gravel	72
Unified Soil Classification		GP-GC		PRA Soil Classification		A-2-4	





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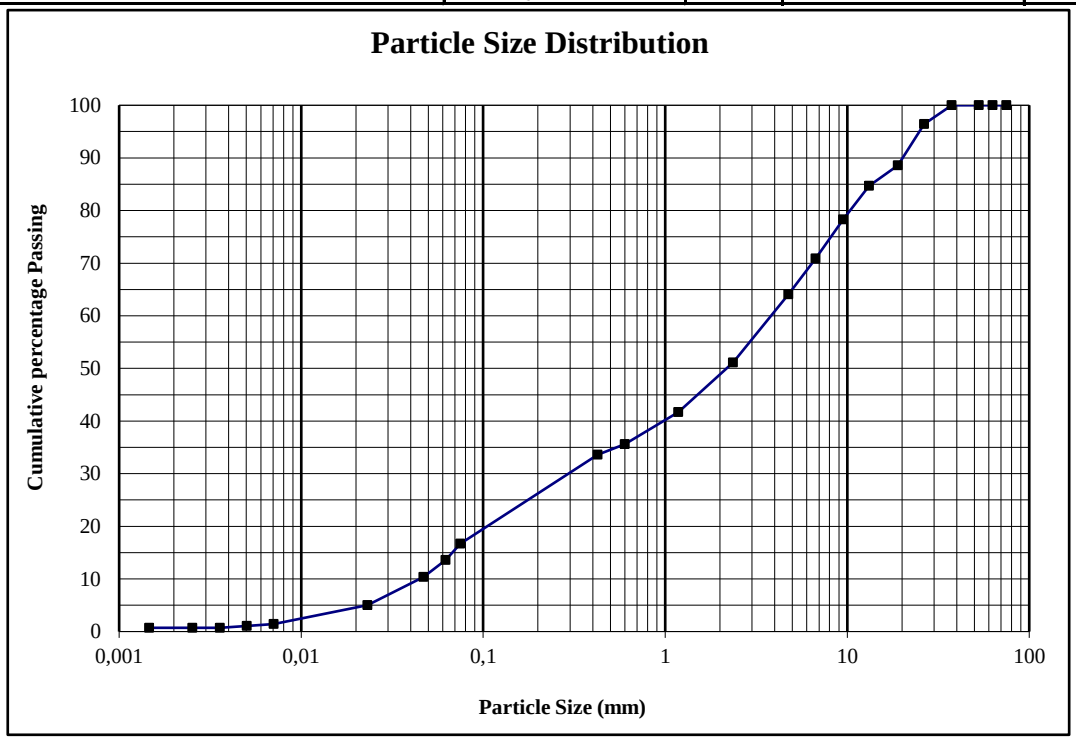
TEST REPORT

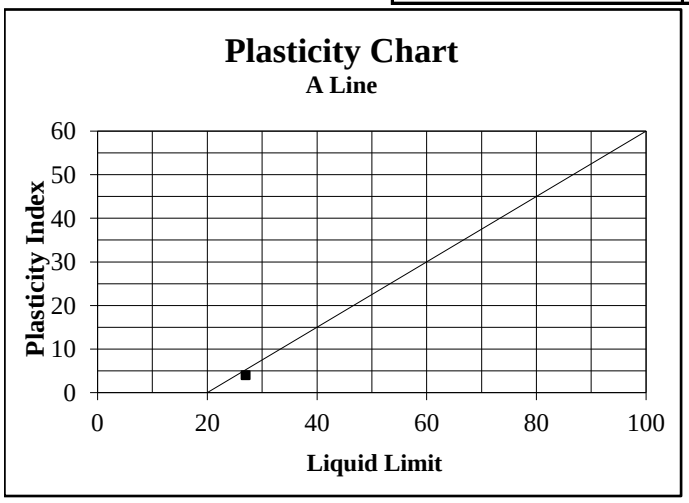
FOUNDATION INDICATOR - (TMH 1 Method A1(a),A2,A3,A4,A5) & (ASTM Method D422)

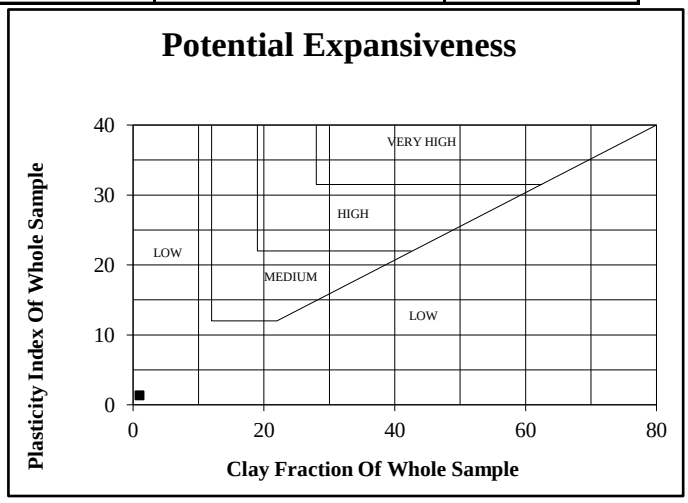
Material Description:	Light Olive to Light Brown - Calcrete	Sample Number:	13267		
Position:	W 564B	Liquid Limit	27	Linear Shrinkage	2
Depth:	350-700	Plasticity Index	4	Insitu M/C%	8,6

Sieve Size(mm)	% Passing
75,0	100
63,0	100
53,0	100
37,5	100
26,5	96
19,0	89
13,2	85
9,5	78
6,7	71
4,75	64
2,36	51
1,18	42
0,600	36
0,425	34
0,075	17
0,0623	14
0,0470	10
0,0232	5
0,0071	1
0,0050	1
0,0036	1
0,0025	1
0,0015	1



% Clay	1	% Silt	12	% Sand	35	% Gravel	52
Unified Soil Classification		GM		PRA Soil Classification		A-1-b / A-2-4	





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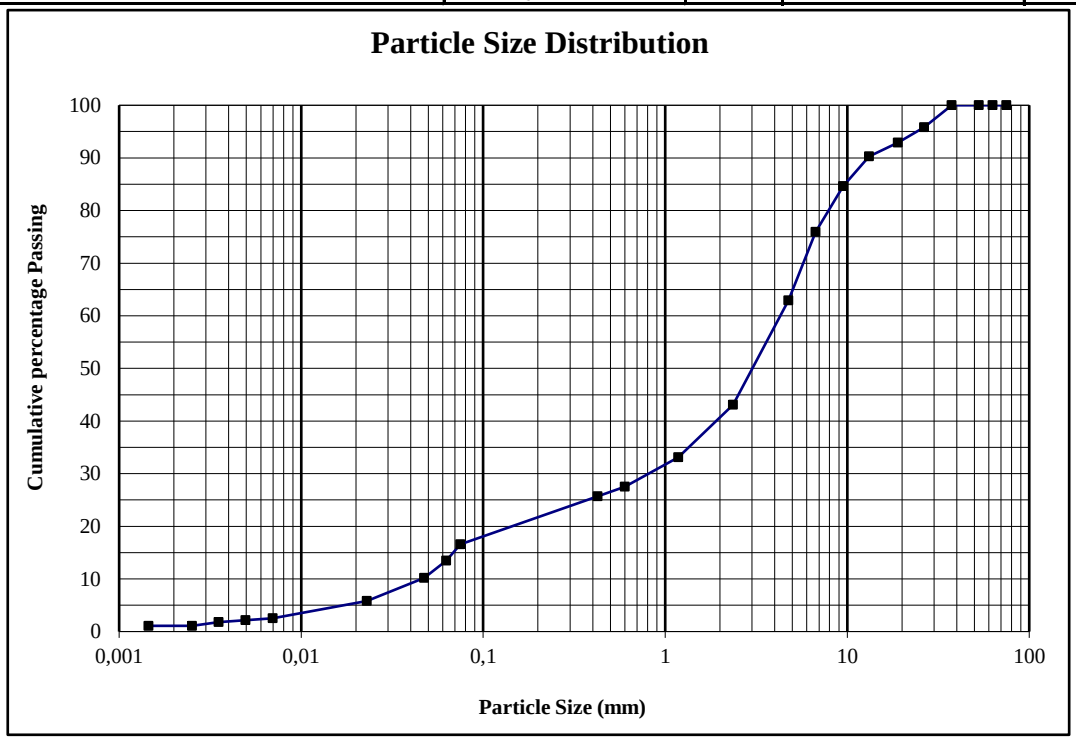
TEST REPORT

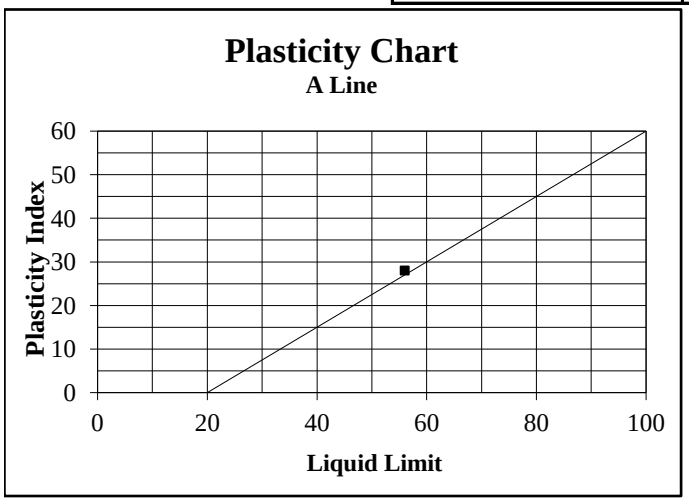
FOUNDATION INDICATOR - (TMH 1 Method A1(a),A2,A3,A4,A5) & (ASTM Method D422)

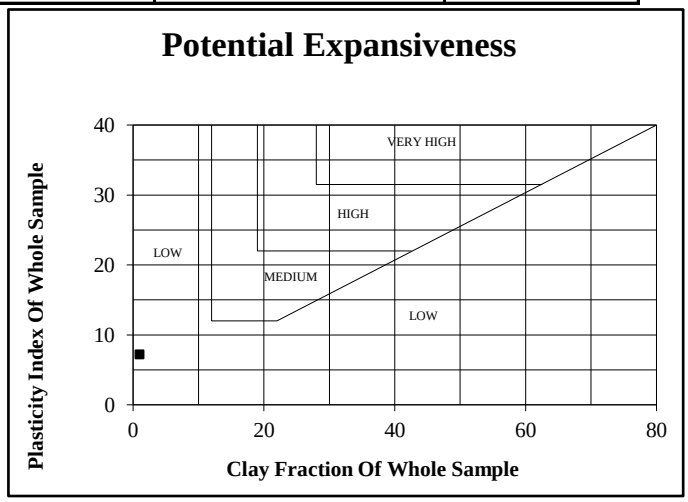
Material Description:	Light Reddish Orange - Gravelly Sandy Silt	Sample Number:	13269		
Position:	W 411A	Liquid Limit	56	Linear Shrinkage	14
Depth:	750-1700	Plasticity Index	28	Insitu M/C%	13,4

Sieve Size(mm)	% Passing
75,0	100
63,0	100
53,0	100
37,5	100
26,5	96
19,0	93
13,2	90
9,5	85
6,7	76
4,75	63
2,36	43
1,18	33
0,600	28
0,425	26
0,075	17
0,0626	13
0,0474	10
0,0229	6
0,0070	3
0,0049	2
0,0035	2
0,0025	1
0,0015	1



% Clay	1	% Silt	12	% Sand	27	% Gravel	60
Unified Soil Classification		GC		PRA Soil Classification		A-2-7	





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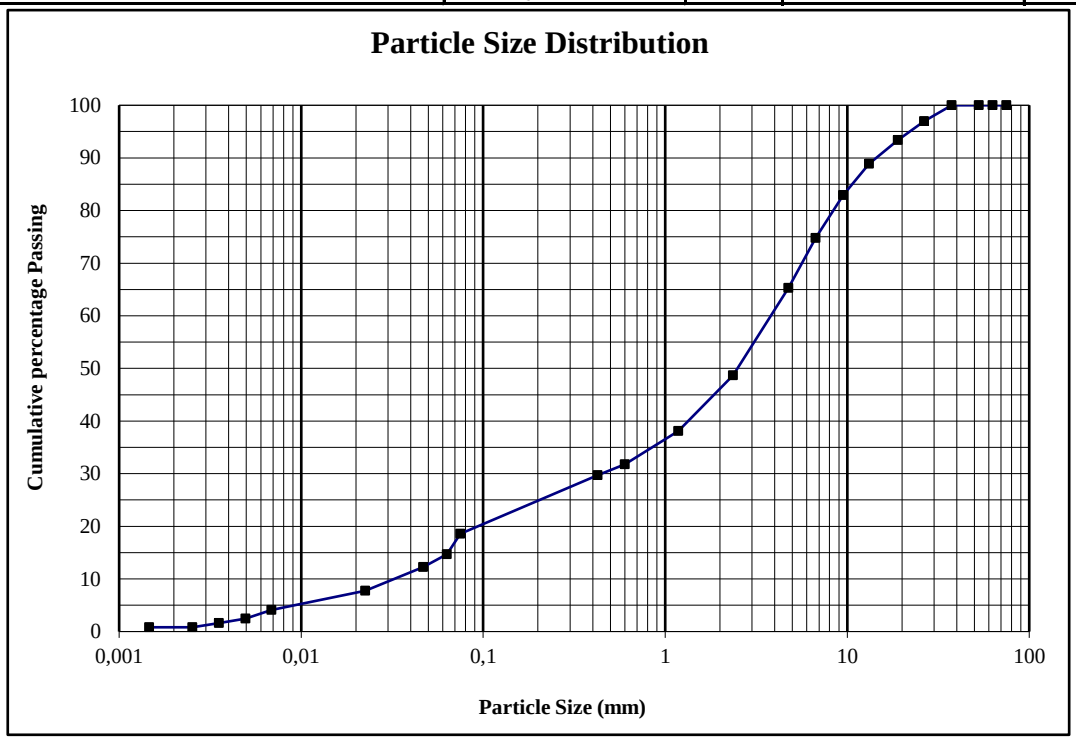
TEST REPORT

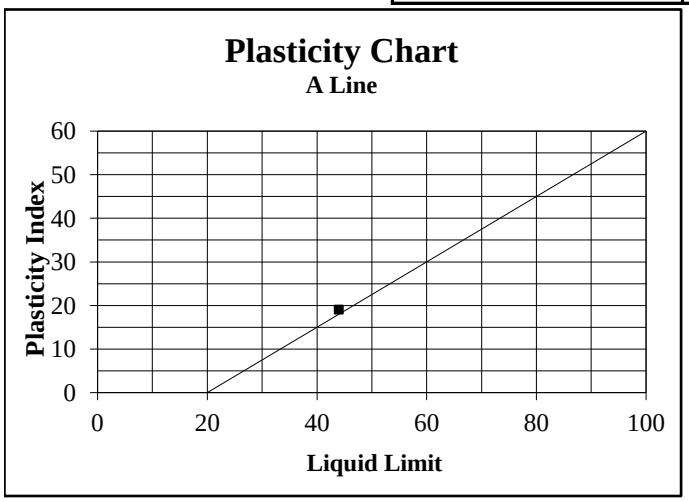
FOUNDATION INDICATOR - (TMH 1 Method A1(a),A2,A3,A4,A5) & (ASTM Method D422)

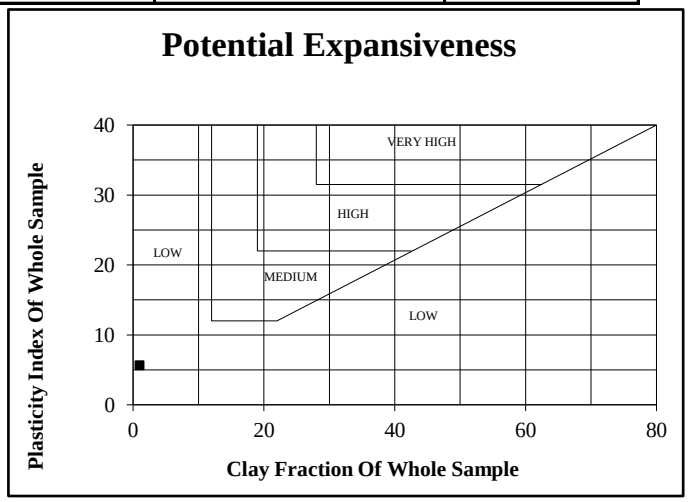
Material Description:	Light Reddish Orange - Gravelly Silty Sand	Sample Number:	13271		
Position:	W 411B	Liquid Limit	44	Linear Shrinkage	9,5
Depth:	450-1500	Plasticity Index	19	Insitu M/C%	11,7

Sieve Size(mm)	% Passing
75,0	100
63,0	100
53,0	100
37,5	100
26,5	97
19,0	93
13,2	89
9,5	83
6,7	75
4,75	65
2,36	49
1,18	38
0,600	32
0,425	30
0,075	19
0,0632	15
0,0468	12
0,0225	8
0,0069	4
0,0049	2
0,0035	2
0,0025	1
0,0015	1



% Clay	1	% Silt	13	% Sand	31	% Gravel	55
Unified Soil Classification		GC		PRA Soil Classification		A-2-7	





Notes:

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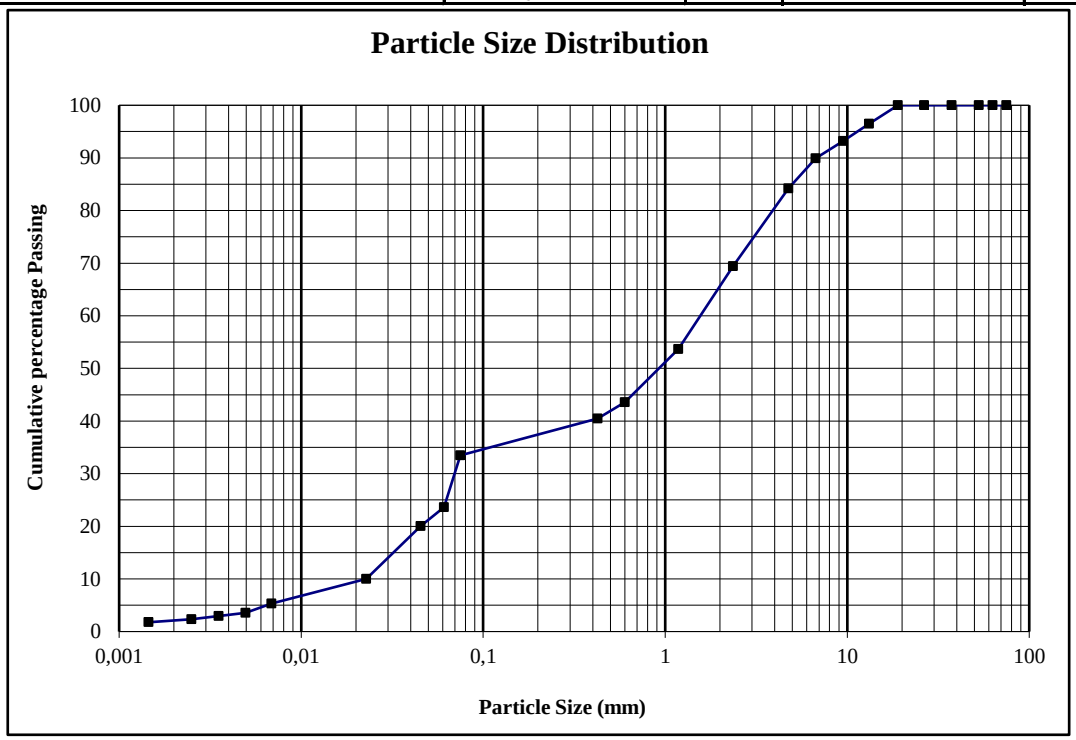
	Knysna	Date Reported :	15/08/19
	6570	Req. Number :	511/19
Attention :	Iain Paton	No. of Pages :	11/14

TEST REPORT

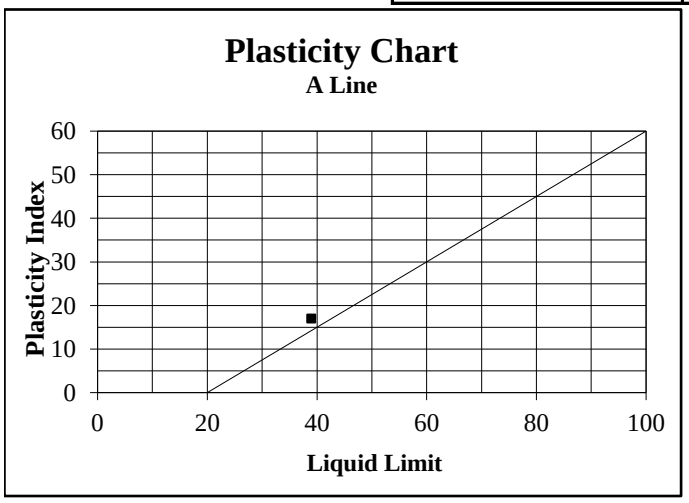
FOUNDATION INDICATOR - (TMH 1 Method A1(a),A2,A3,A4,A5) & (ASTM Method D422)

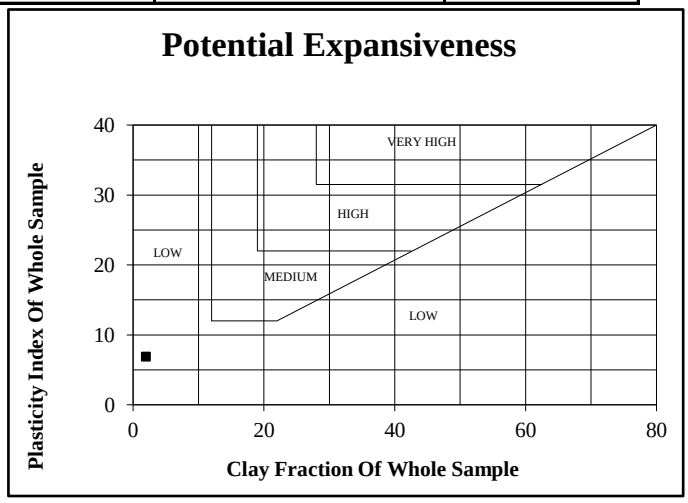
Material Description:	Light Brown - Silty Sandy Gravel	Sample Number:	13273		
Position:	W 452A	Liquid Limit	39	Linear Shrinkage	9
Depth:	500-1800	Plasticity Index	17	Insitu M/C%	12,5

Sieve Size(mm)	% Passing
75,0	100
63,0	100
53,0	100
37,5	100
26,5	100
19,0	100
13,2	97
9,5	93
6,7	90
4,75	84
2,36	69
1,18	54
0,600	44
0,425	41
0,075	34
0,0610	24
0,0453	20
0,0228	10
0,0069	5
0,0049	4
0,0035	3
0,0025	2
0,0015	2



% Clay	2	% Silt	21	% Sand	42	% Gravel	35
Unified Soil Classification		GC		PRA Soil Classification		A-2-6	





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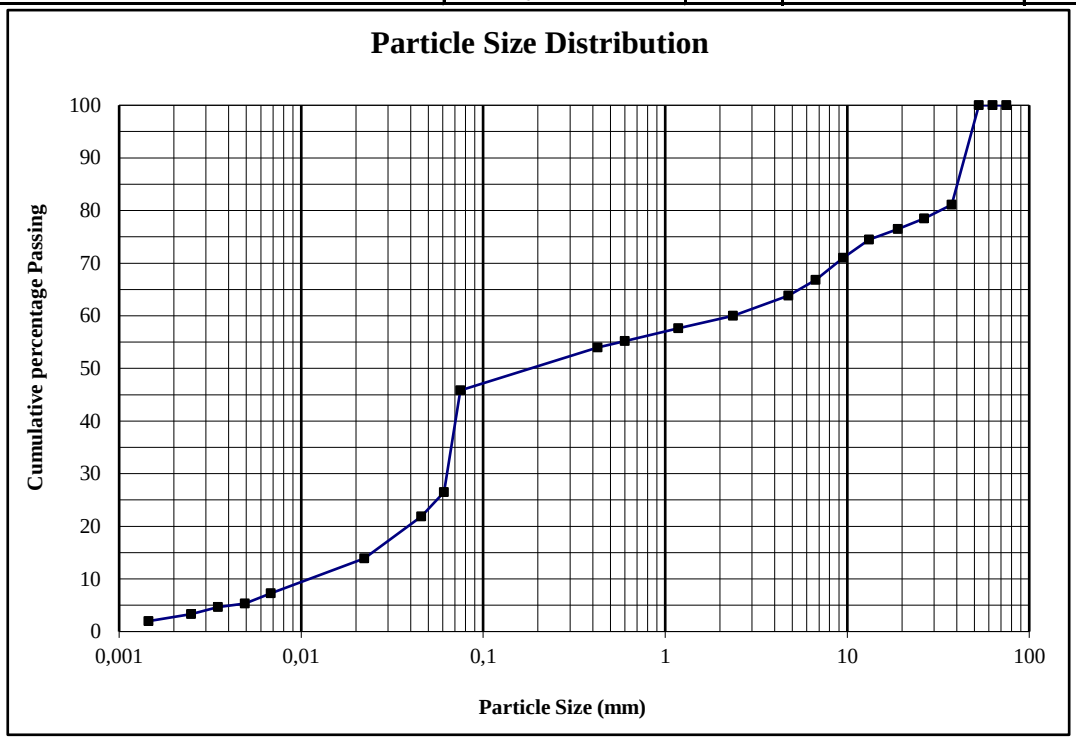
TEST REPORT

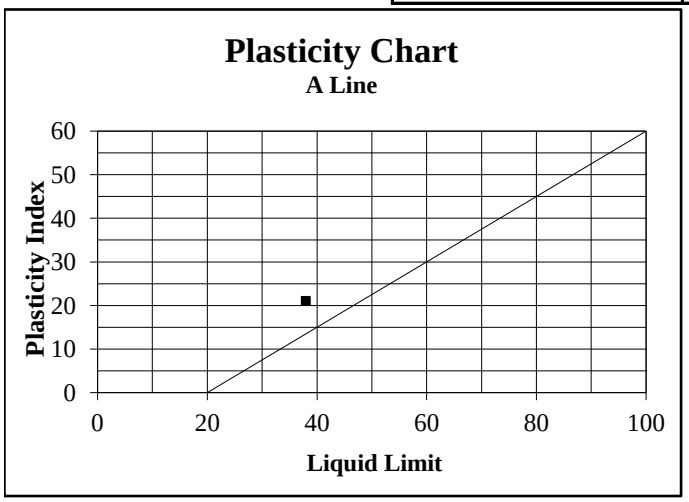
FOUNDATION INDICATOR - (TMH 1 Method A1(a),A2,A3,A4,A5) & (ASTM Method D422)

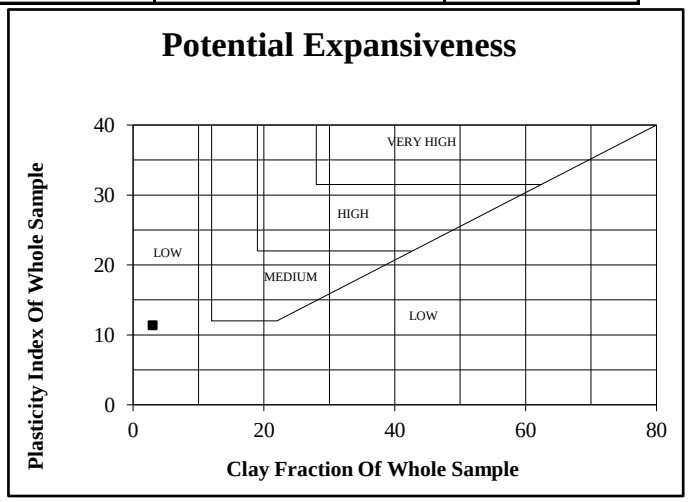
Material Description:	Dark Reddish Brown - Silty Gravelly Sand	Sample Number:	13275		
Position:	W 452B	Liquid Limit	38	Linear Shrinkage	10,5
Depth:	350-500	Plasticity Index	21	Insitu M/C%	9,7

Sieve Size(mm)	% Passing
75,0	100
63,0	100
53,0	100
37,5	81
26,5	79
19,0	77
13,2	75
9,5	71
6,7	67
4,75	64
2,36	60
1,18	58
0,600	55
0,425	54
0,075	46
0,0610	26
0,0458	22
0,0223	14
0,0068	7
0,0049	5
0,0035	5
0,0025	3
0,0015	2



% Clay	3	% Silt	23	% Sand	33	% Gravel	41
Unified Soil Classification		GC		PRA Soil Classification		A-6	





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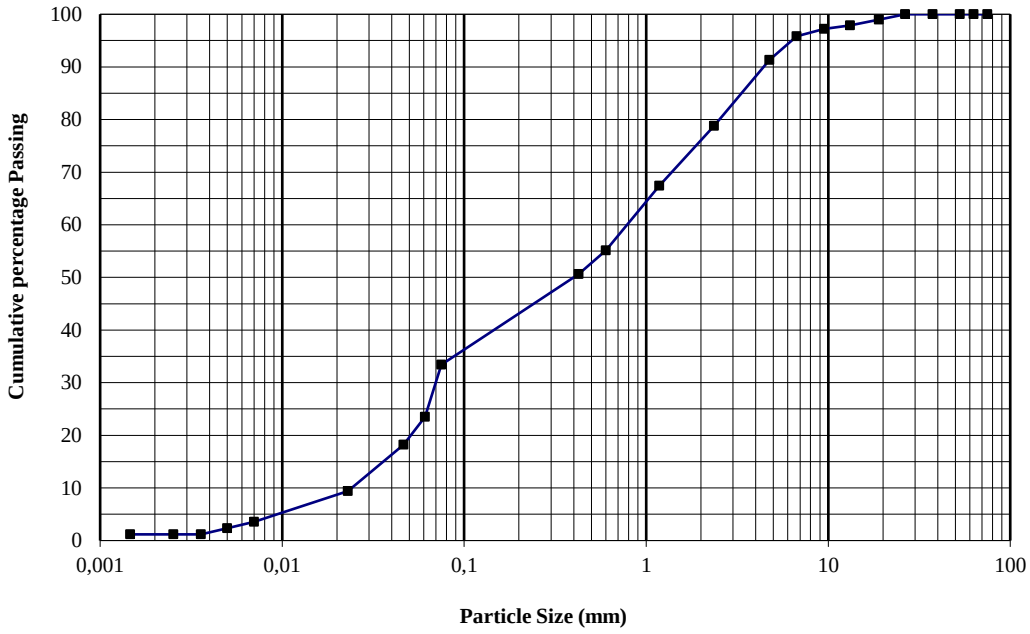
TEST REPORT

FOUNDATION INDICATOR - (TMH 1 Method A1(a),A2,A3,A4,A5) & (ASTM Method D422)

Material Description:	Light Reddish Qrange - Clayey Gravelly Sandy Silt	Sample Number:	13277		
Position:	W 417A	Liquid Limit	40	Linear Shrinkage	8,5
Depth:	1300-2800	Plasticity Index	17	Insitu M/C%	11,6

Sieve Size(mm)	% Passing
75,0	100
63,0	100
53,0	100
37,5	100
26,5	100
19,0	99
13,2	98
9,5	97
6,7	96
4,75	91
2,36	79
1,18	67
0,600	55
0,425	51
0,075	33
0,0610	24
0,0464	18
0,0229	9
0,0070	4
0,0050	2
0,0036	1
0,0025	1
0,0015	1

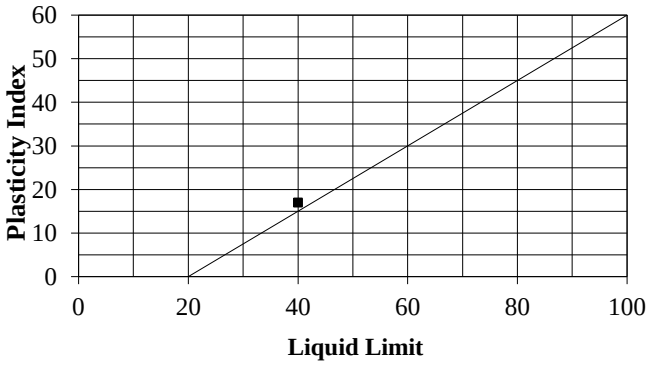
Particle Size Distribution



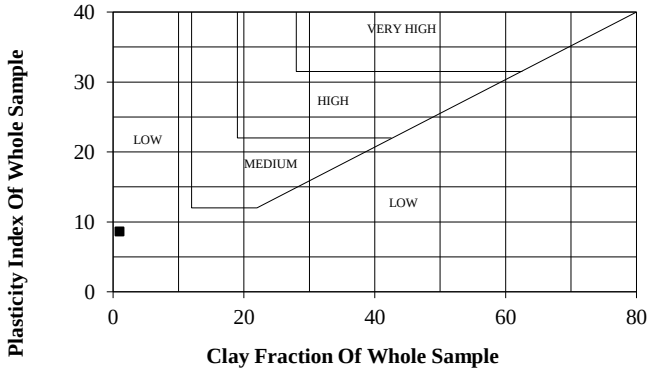
% Clay	1	% Silt	22	% Sand	52	% Gravel	25
Unified Soil Classification		SC		PRA Soil Classification		A-2-6	

Plasticity Chart

A Line



Potential Expansiveness



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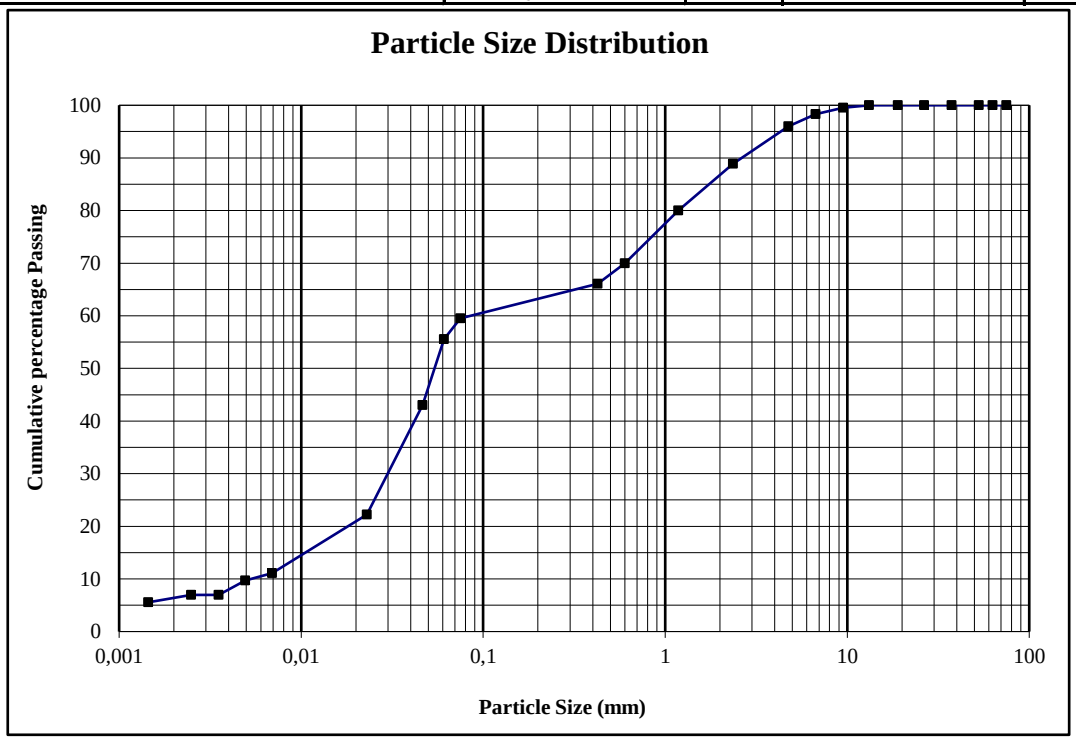
TEST REPORT

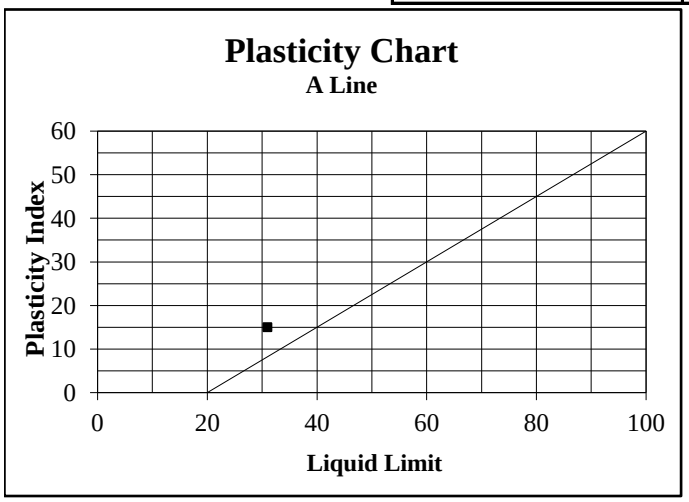
FOUNDATION INDICATOR - (TMH 1 Method A1(a),A2,A3,A4,A5) & (ASTM Method D422)

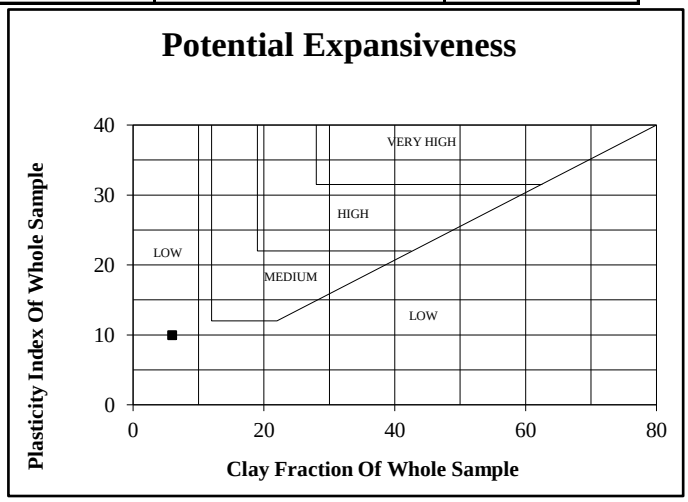
Material Description:	Light Yellowish Orange - Clayey Gravelly Sandy Silt	Sample Number:	13279		
Position:	W 417B	Liquid Limit	31	Linear Shrinkage	7,5
Depth:	800-2900	Plasticity Index	15	Insitu M/C%	10,7

Sieve Size(mm)	% Passing
75,0	100
63,0	100
53,0	100
37,5	100
26,5	100
19,0	100
13,2	100
9,5	100
6,7	98
4,75	96
2,36	89
1,18	80
0,600	70
0,425	66
0,075	60
0,0610	56
0,0464	43
0,0229	22
0,0069	11
0,0049	10
0,0035	7
0,0025	7
0,0014	6



% Clay	6	% Silt	49	% Sand	31	% Gravel	14
Unified Soil Classification		CL		PRA Soil Classification		A-6	





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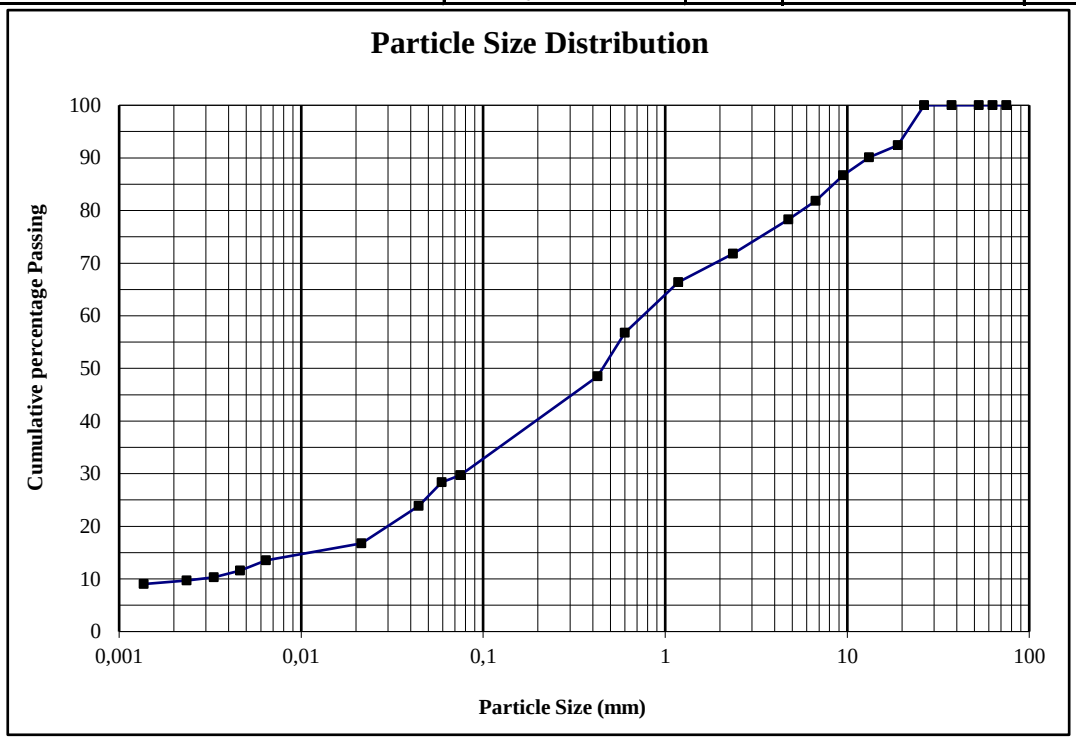
Attention :	Iain Paton	No. of Pages :	1/9

TEST REPORT

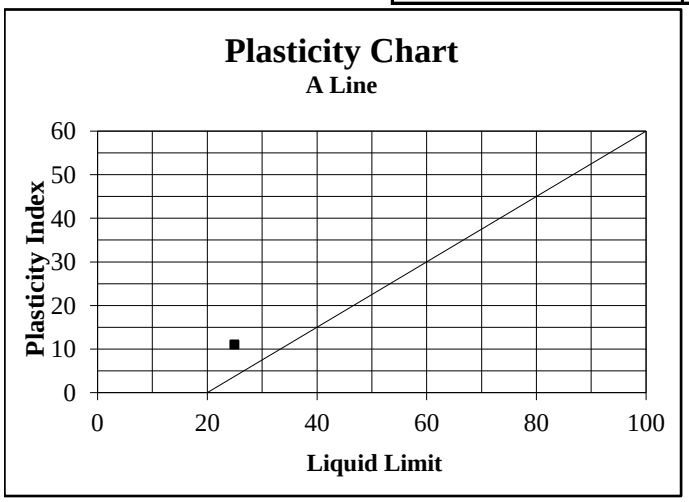
FOUNDATION INDICATOR - (TMH 1 Method A1(a),A2,A3,A4,A5) & (ASTM Method D422)

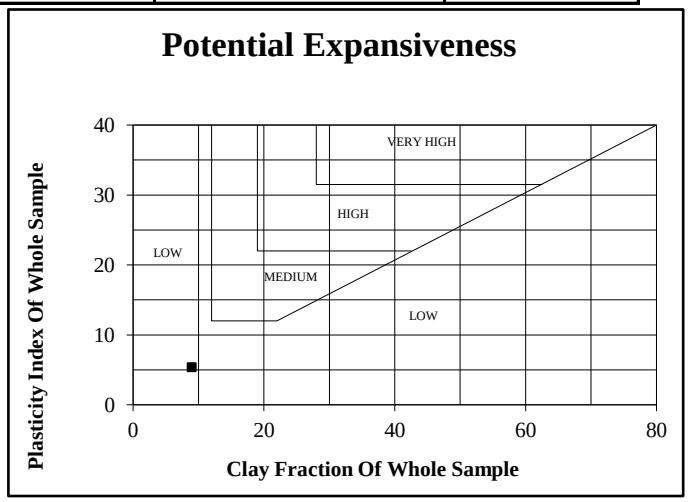
Material Description:	Dark Red Orange - Gravelly Sandy Clayey Silt	Sample Number:	13486		
Position:	BH - E 7A	Liquid Limit	25	Linear Shrinkage	5,5
Depth:	500-840	Plasticity Index	11	Insitu M/C%	2

Sieve Size(mm)	% Passing
75,0	100
63,0	100
53,0	100
37,5	100
26,5	100
19,0	92
13,2	90
9,5	87
6,7	82
4,75	78
2,36	72
1,18	66
0,600	57
0,425	49
0,075	30
0,0591	28
0,0443	24
0,0215	17
0,0064	14
0,0046	12
0,0033	10
0,0024	10
0,0014	9



% Clay	9	% Silt	20	% Sand	41	% Gravel	30
Unified Soil Classification		SC		PRA Soil Classification		A-2-6	





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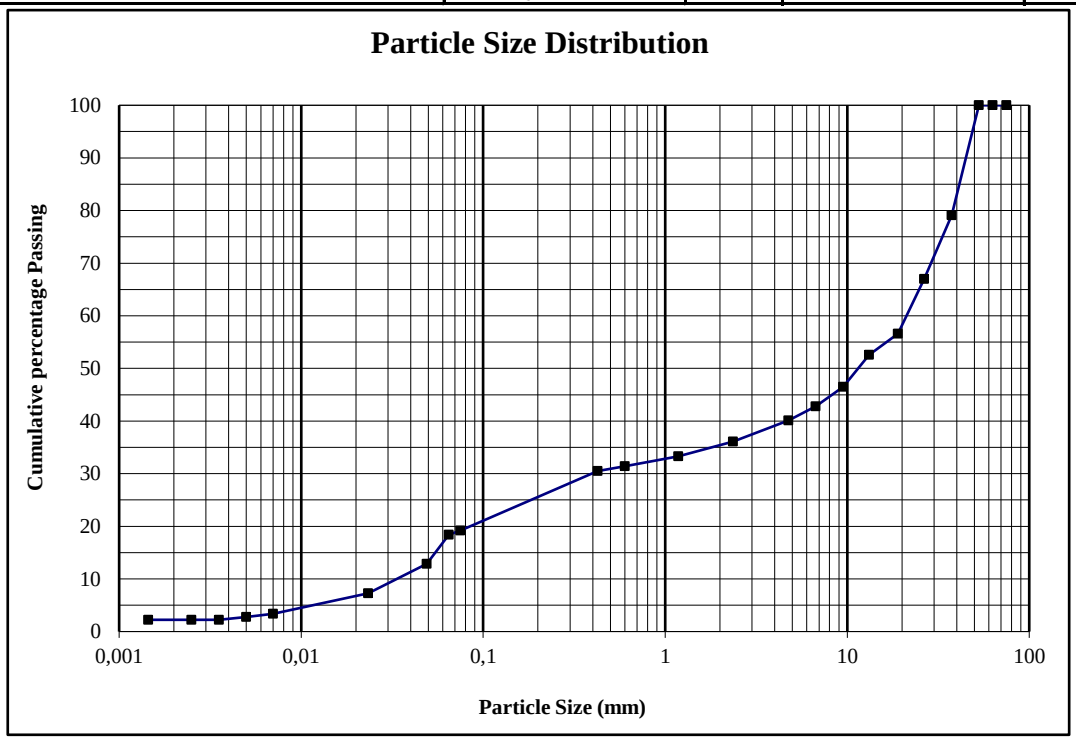
TEST REPORT

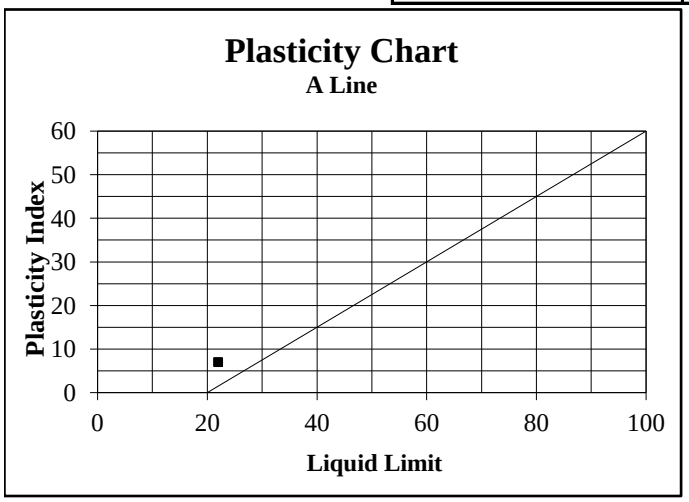
FOUNDATION INDICATOR - (TMH 1 Method A1(a),A2,A3,A4,A5) & (ASTM Method D422)

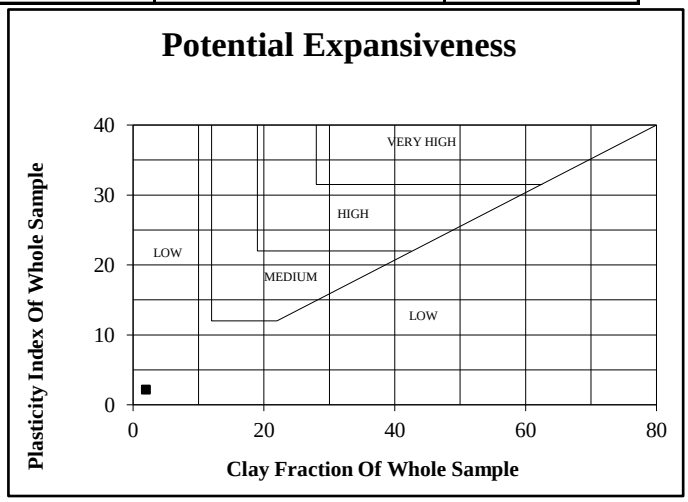
Material Description:	Light Brown - Gravelly Silty Sand	Sample Number:	13487		
Position:	BH - E 6C	Liquid Limit	22	Linear Shrinkage	3,5
Depth:	2100-3000	Plasticity Index	7	Insitu M/C%	4,2

Sieve Size(mm)	% Passing
75,0	100
63,0	100
53,0	100
37,5	79
26,5	67
19,0	57
13,2	53
9,5	47
6,7	43
4,75	40
2,36	36
1,18	33
0,600	31
0,425	31
0,075	19
0,0647	18
0,0490	13
0,0234	7
0,0070	3
0,0050	3
0,0035	2
0,0025	2
0,0014	2



% Clay	2	% Silt	15	% Sand	18	% Gravel	65
Unified Soil Classification		GM-GC		PRA Soil Classification		A-2-4	





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TEST REPORT

FOUNDATION INDICATOR - (TMH 1 Method A1(a),A2,A3,A4,A5) & (ASTM Method D422)

Material Description:	Light Red Brown - Clayey Sandy Gravel	Sample Number:	13488		
Position:	BH - E 100A	Liquid Limit	44	Linear Shrinkage	9,5
Depth:	1100-1680	Plasticity Index	19	Insitu M/C%	3,3

Sieve Size(mm)	% Passing
75,0	100
63,0	100
53,0	100
37,5	100
26,5	100
19,0	97
13,2	79
9,5	65
6,7	51
4,75	43
2,36	33
1,18	27
0,600	24
0,425	23
0,075	21
0,0585	20
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0,0200	16
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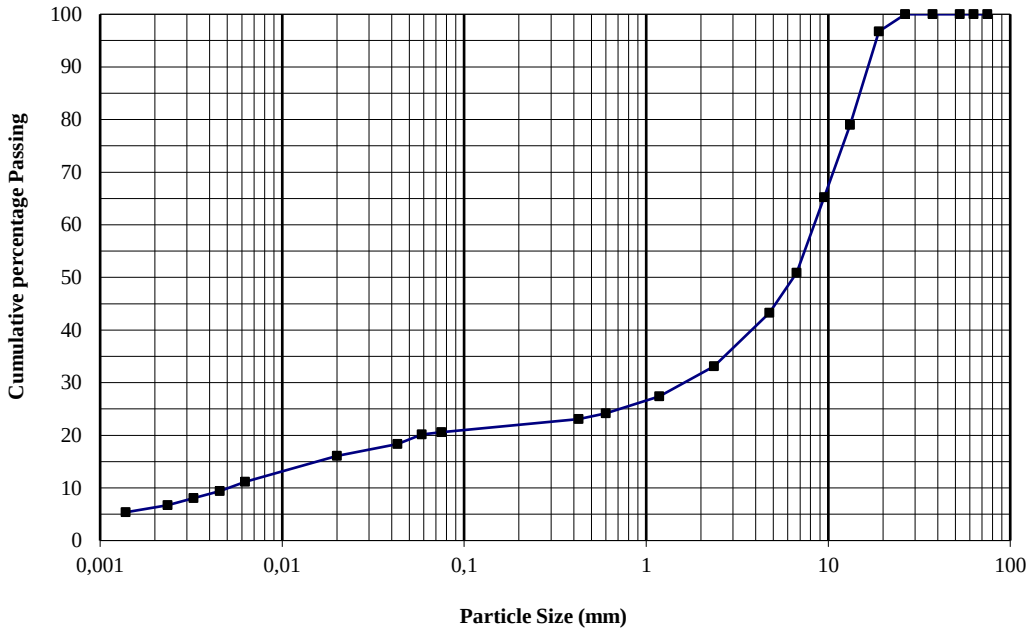
0,0045	9
0,0033	8
0,0024	7
0,0014	5

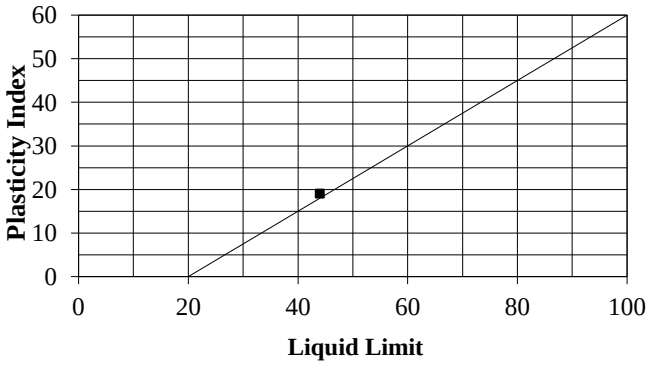
Particle Size Distribution



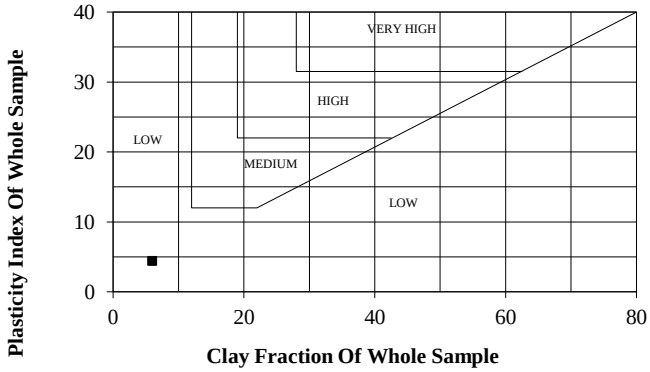
% Clay	6	% Silt	14	% Sand	11	% Gravel	69
Unified Soil Classification	GC			PRA Soil Classification		A-2-7	

Plasticity Chart

A Line



Potential Expansiveness



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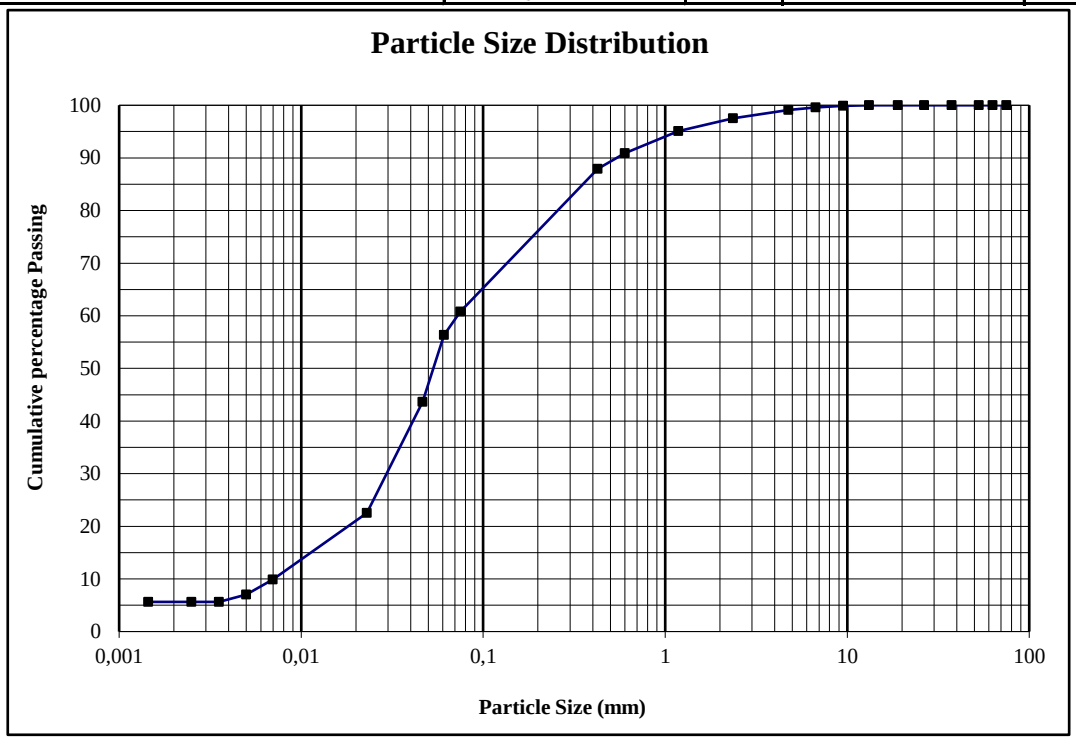
TEST REPORT

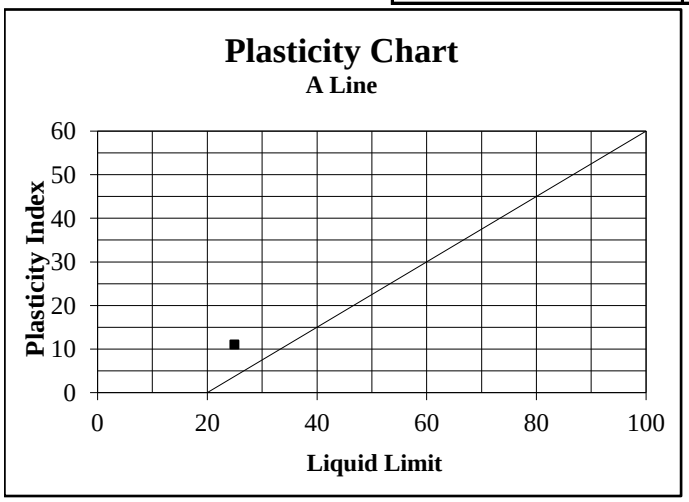
FOUNDATION INDICATOR - (TMH 1 Method A1(a),A2,A3,A4,A5) & (ASTM Method D422)

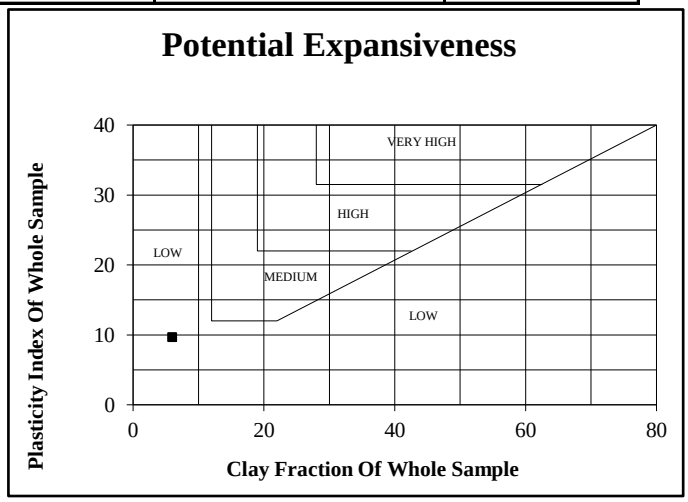
Material Description:	Dark Red Orange - Clayey Gravelly Silty Sand	Sample Number:	13489		
Position:	BH - E 6A	Liquid Limit	25	Linear Shrinkage	5,5
Depth:	500-1500	Plasticity Index	11	Insitu M/C%	12,2

Sieve Size(mm)	% Passing
75,0	100
63,0	100
53,0	100
37,5	100
26,5	100
19,0	100
13,2	100
9,5	100
6,7	100
4,75	99
2,36	98
1,18	95
0,600	91
0,425	88
0,075	61
0,0610	56
0,0464	44
0,0229	23
0,0070	10
0,0050	7
0,0035	6
0,0025	6
0,0014	6



% Clay	6	% Silt	49	% Sand	42	% Gravel	3
Unified Soil Classification		CL		PRA Soil Classification		A-6	





Notes:

- **Specimens delivered to Outeniqua Lab in good order.**

L Malgraff (Member)
For Outeniqua Lab EC cc.

Outeniqua Lab EC cc.

Materials Testing Laboratory

Registration No. 2009/230653/23

170 Sidwell Avenue, Sidwell, Port Elizabeth : PO Box 3186, George Industria, 6536

Tel: 041 4512464 : Fax: 041 4534959 : e-mail: luwayne@outeniqualab.co.za / agovender@outeniqualab.co.za

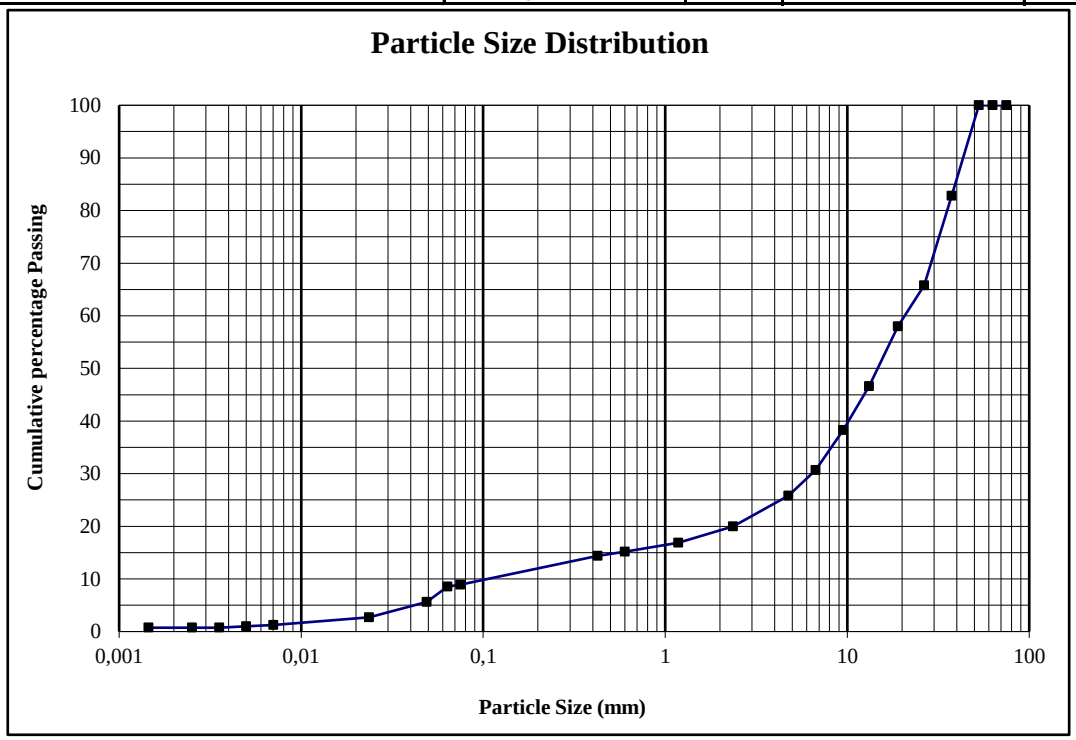
Customer :	Quteniqua Geotechincal Services cc	Project :	Choje Windfarm
	Po Box 964	Date Received :	26/07/19
	Knysna	Date Reported :	26/08/19
	6570	Req. Number :	665/19
Attention :	Iain Paton	No. of Pages :	5/9

TEST REPORT

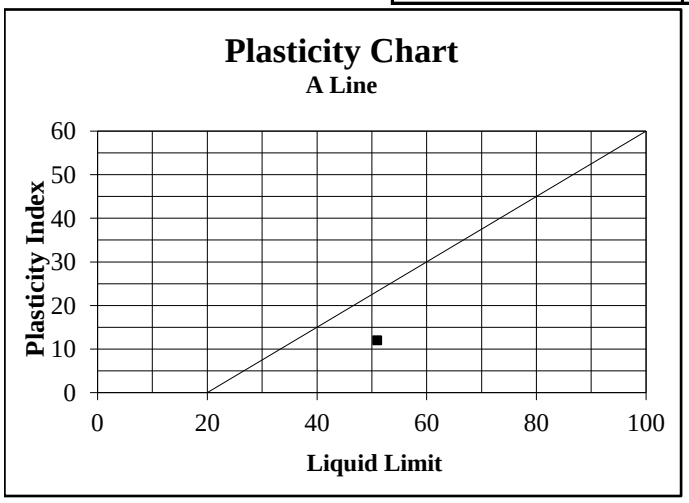
FOUNDATION INDICATOR - (TMH 1 Method A1(a),A2,A3,A4,A5) & (ASTM Method D422)

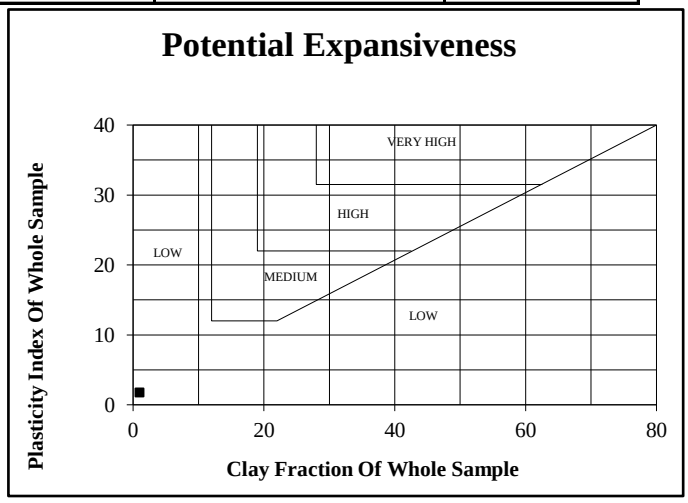
Material Description:	Light Red Orange - Clayey Silty Sandy Gravel	Sample Number:	13490		
Position:	BH - W 564A	Liquid Limit	51	Linear Shrinkage	6
Depth:	500-1000	Plasticity Index	12	Insitu M/C%	5,4

Sieve Size(mm)	% Passing
75,0	100
63,0	100
53,0	100
37,5	83
26,5	66
19,0	58
13,2	47
9,5	38
6,7	31
4,75	26
2,36	20
1,18	17
0,600	15
0,425	14
0,075	9
0,0638	9
0,0490	6
0,0236	3
0,0070	1
0,0050	1
0,0036	1
0,0025	1
0,0015	1



% Clay	1	% Silt	7	% Sand	11	% Gravel	81
Unified Soil Classification		GP-GM		PRA Soil Classification		A-2-7	





Notes:

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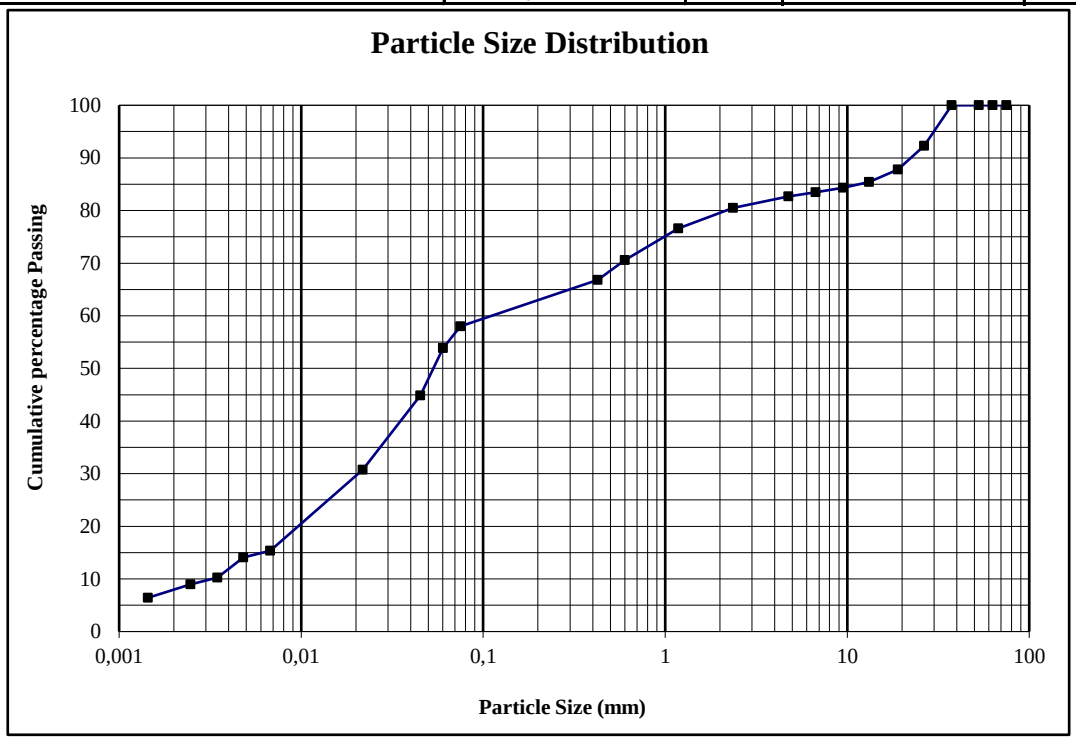
Customer :	Quteniqua Geotechincal Services cc	Project :	Choje Windfarm
	Po Box 964	Date Received :	26/07/19
	Knysna	Date Reported :	26/08/19
	6570	Req. Number :	665/19
Attention :	Iain Paton	No. of Pages :	6/9

TEST REPORT

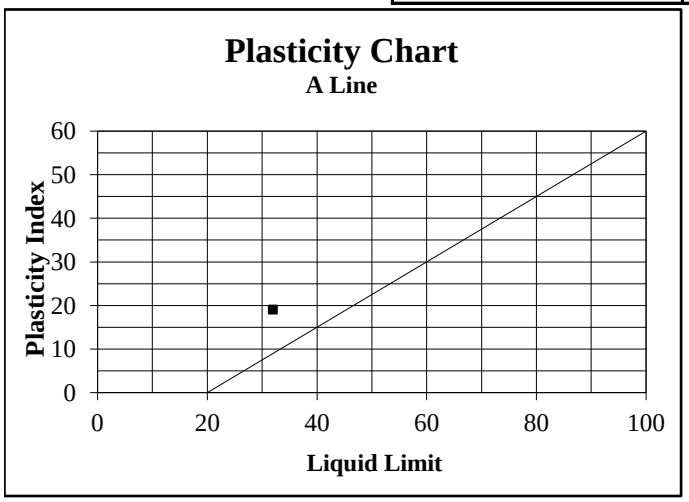
FOUNDATION INDICATOR - (TMH 1 Method A1(a),A2,A3,A4,A5) & (ASTM Method D422)

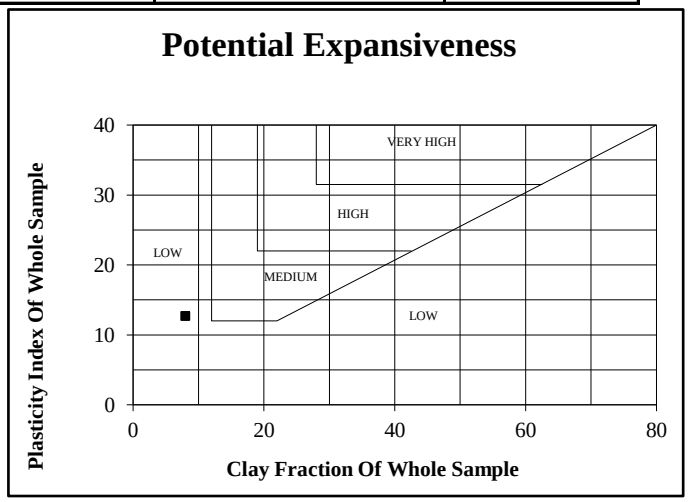
Material Description:	Dark Red Orange-Light Red Brown - Clayey Gravelly Silty Sand	Sample Number:	13491		
Position:	BH - W 452F	Liquid Limit	32	Linear Shrinkage	9,5
Depth:	500-950	Plasticity Index	19	Insitu M/C%	6

Sieve Size(mm)	% Passing
75,0	100
63,0	100
53,0	100
37,5	100
26,5	92
19,0	88
13,2	85
9,5	84
6,7	84
4,75	83
2,36	81
1,18	77
0,600	71
0,425	67
0,075	58
0,0601	54
0,0451	45
0,0218	31
0,0068	15
0,0048	14
0,0035	10
0,0025	9
0,0014	6



% Clay	8	% Silt	46	% Sand	25	% Gravel	21
Unified Soil Classification		CL		PRA Soil Classification		A-6	





Notes:

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L Malgraff (Member)
For Outeniqua Lab EC cc.

Outeniqua Lab EC cc.

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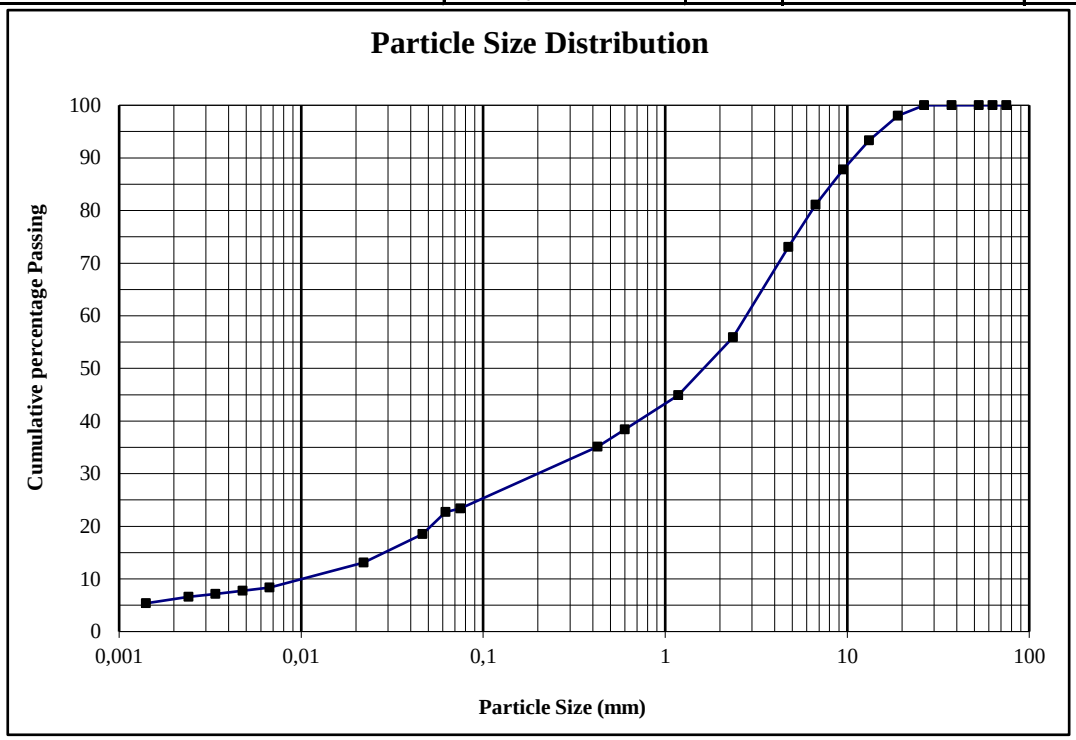
Customer :	Quteniqua Geotechincal Services cc	Project :	Choje Windfarm
	Po Box 964	Date Received :	26/07/19
	Knysna	Date Reported :	26/08/19
	6570	Req. Number :	665/19
Attention :	Iain Paton	No. of Pages :	7/9

TEST REPORT

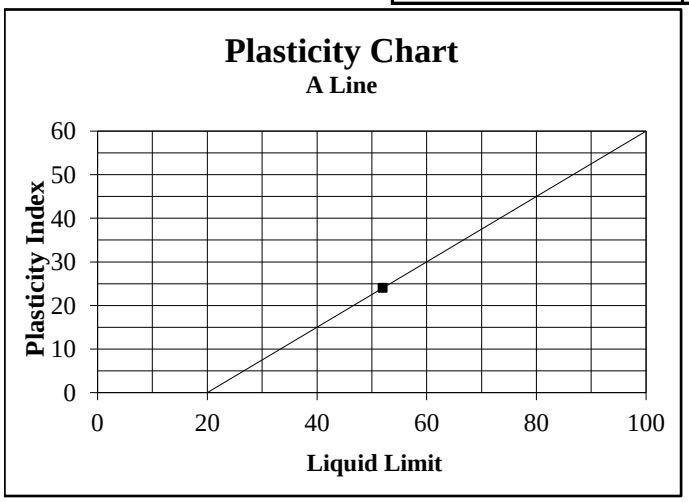
FOUNDATION INDICATOR - (TMH 1 Method A1(a),A2,A3,A4,A5) & (ASTM Method D422)

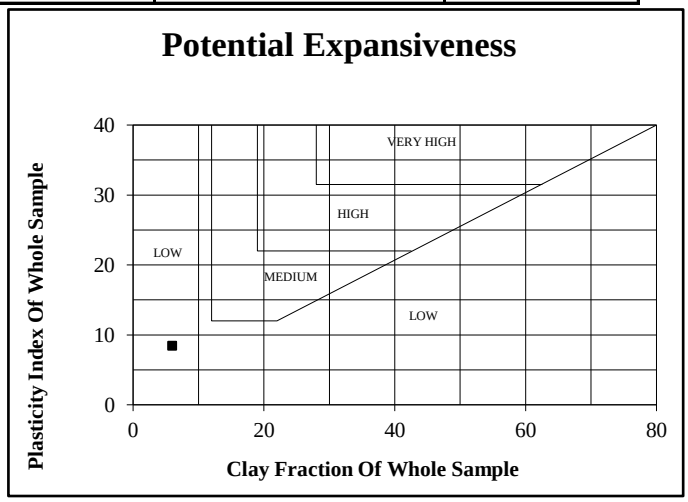
Material Description:	Dark Grey Stained Light Red Orange - Silty Gravelly Sand	Sample Number:	13492		
Position:	BH - W 411A	Liquid Limit	52	Linear Shrinkage	12
Depth:	550-1500	Plasticity Index	24	Insitu M/C%	11,9

Sieve Size(mm)	% Passing
75,0	100
63,0	100
53,0	100
37,5	100
26,5	100
19,0	98
13,2	93
9,5	88
6,7	81
4,75	73
2,36	56
1,18	45
0,600	38
0,425	35
0,075	23
0,0623	23
0,0464	19
0,0221	13
0,0067	8
0,0048	8
0,0034	7
0,0024	7
0,0014	5



% Clay	6	% Silt	16	% Sand	31	% Gravel	47
Unified Soil Classification	GC			PRA Soil Classification		A-2-7	





Notes:

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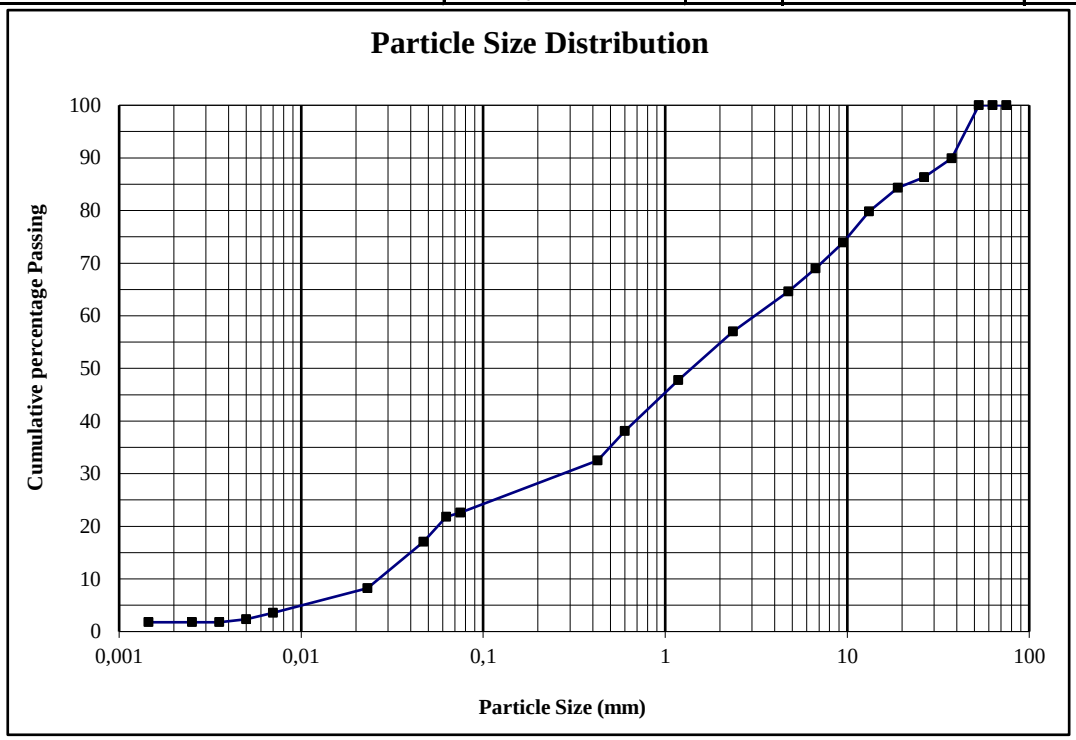
Customer :	Quteniqua Geotechincal Services cc	Project :	Choje Windfarm
	Po Box 964	Date Received :	26/07/19
	Knysna	Date Reported :	26/08/19
	6570	Req. Number :	665/19
Attention :	Iain Paton	No. of Pages :	8/9

TEST REPORT

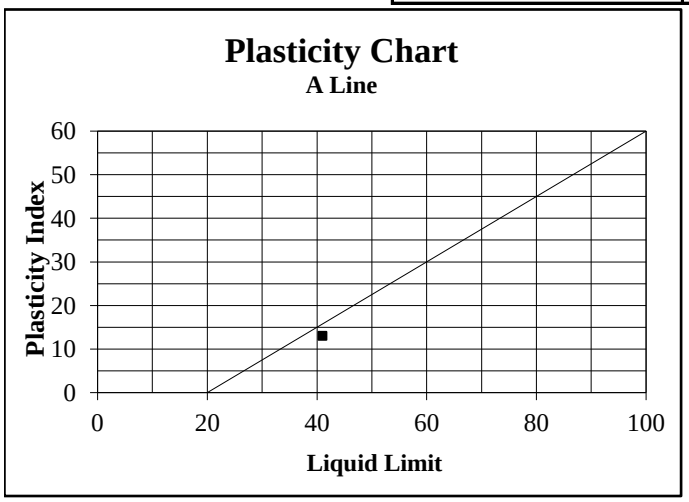
FOUNDATION INDICATOR - (TMH 1 Method A1(a),A2,A3,A4,A5) & (ASTM Method D422)

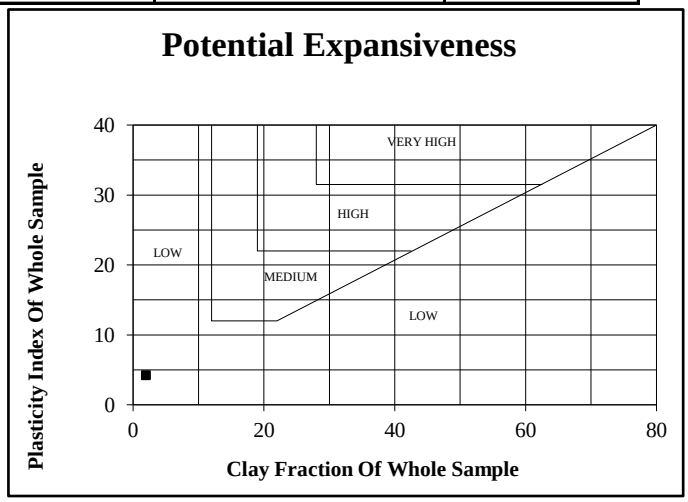
Material Description:	Dark Red Orange to Light Grey - Clayey Sandy Silt	Sample Number:	13493		
Position:	BH - W 417A	Liquid Limit	41	Linear Shrinkage	6,5
Depth:	2180-2980	Plasticity Index	13	Insitu M/C%	10,8

Sieve Size(mm)	% Passing
75,0	100
63,0	100
53,0	100
37,5	90
26,5	86
19,0	84
13,2	80
9,5	74
6,7	69
4,75	65
2,36	57
1,18	48
0,600	38
0,425	33
0,075	23
0,0626	22
0,0470	17
0,0232	8
0,0070	4
0,0050	2
0,0036	2
0,0025	2
0,0015	2



% Clay	2	% Silt	19	% Sand	33	% Gravel	46
Unified Soil Classification		GM		PRA Soil Classification		A-2-7	





Notes:

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Outeniqua Lab EC cc.

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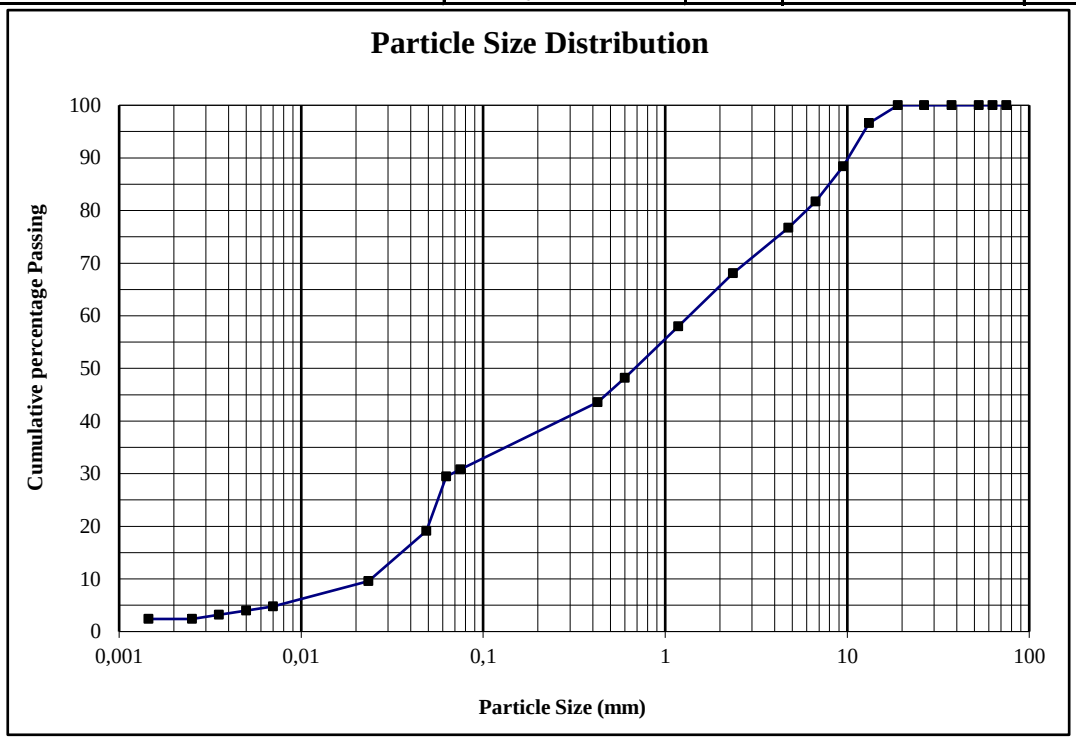
Customer :	Quteniqua Geotechincal Services cc	Project :	Choje Windfarm
	Po Box 964	Date Received :	26/07/19
	Knysna	Date Reported :	26/08/19
	6570	Req. Number :	665/19
Attention :	Iain Paton	No. of Pages :	9/9

TEST REPORT

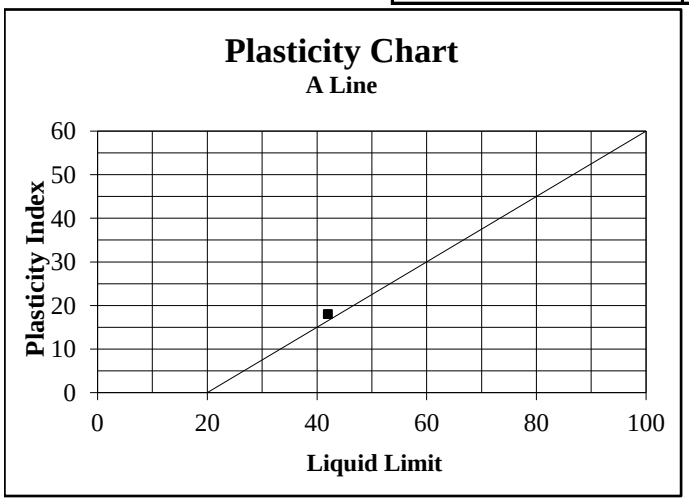
FOUNDATION INDICATOR - (TMH 1 Method A1(a),A2,A3,A4,A5) & (ASTM Method D422)

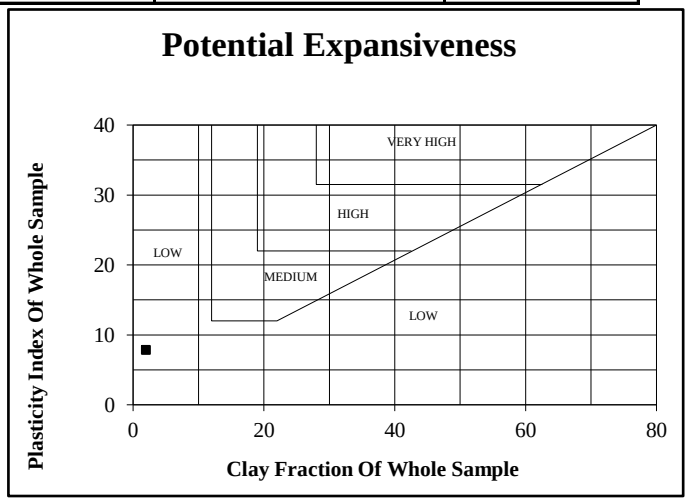
Material Description:	Dark Red Orange to Light Grey - Gravelly Clayey Sandy Silt	Sample Number:	13494		
Position:	BH - W 417C	Liquid Limit	42	Linear Shrinkage	9
Depth:	3580-5080	Plasticity Index	18	Insitu M/C%	26,4

Sieve Size(mm)	% Passing
75,0	100
63,0	100
53,0	100
37,5	100
26,5	100
19,0	100
13,2	97
9,5	88
6,7	82
4,75	77
2,36	68
1,18	58
0,600	48
0,425	44
0,075	31
0,0626	29
0,0488	19
0,0234	10
0,0070	5
0,0050	4
0,0035	3
0,0025	2
0,0015	2



% Clay	2	% Silt	26	% Sand	37	% Gravel	35
Unified Soil Classification		GC		PRA Soil Classification		A-2-7	





Notes:

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For Outeniqua Lab EC cc.

Outeniqua Lab EC cc.

Materials Testing Laboratory

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T0619

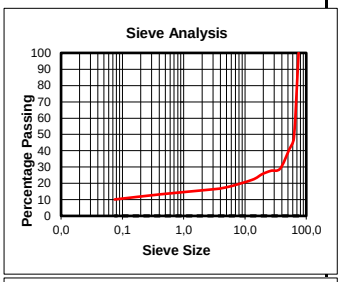
Customer :	Outeniqua Geotechincal Services cc	Project :	Choje Windfarm
	Po Box 964	Date Received :	23/05/19
	Knysna	Date Reported :	19/06/19
	6570	Req. Number :	439/19
Attention :	Iain Paton	No. of Pages :	1/6

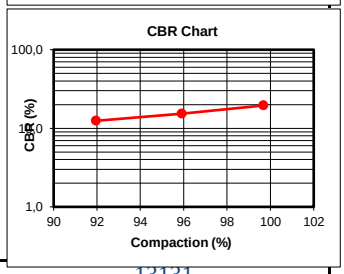
TEST REPORT

CALIFORNIA BEARING RATIO - (TMH 1 Method A1(a),A2,A3,A4,A5,A7,A8)

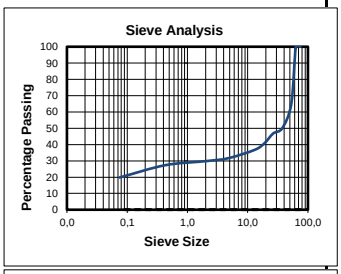
Material Indicators								
Sample Position (SV)		E 64A	Spec. G8 - TRH 14	Opinion	E 64B	Spec. G8 - TRH 14	Opinion
Depth (mm)		200-400			150-400		
Sample No		13129			13131		
Materials Description	Source	Test Pit			Test Pit		
	Colour	Dark Reddish Orange			Dark Reddish Orange		
	Soil Type	Clayey Silty Sandy Gravel			Clayey Silty Sandy Gravel		
	Classification	Unknown			Unknown		
Max. Stone size in hole (mm)							
Percentage Passing	75.0 mm	100			100		
	63.0 mm	48			100		
	53.0 mm	41			65		
	37.5 mm	29			50		
	26.5 mm	28			47		
	19.0 mm	26			41		
	13.2 mm	22			37		
	4.75 mm	17			32		
	2.00 mm	16			30		
	0.425 mm	13			27		
	0.075 mm	10,1			19,8		
Soil Mortar & Constants							
Grading Modulus		2,61			2,23		
Coarse Sand	<2.0 >0.425	15,3			8,4		
Med.	<0.250 >0.150	20,4			25,2		
Silt	<0.075	64,3			66,4		
Liquid Limit (%)		33			30		
Plasticity Index (%)		13			13		
Linear Shrinkage (%)		6,5			6,5		
CBR / Density Relationship							
MOD	Max Dry Density (kg/m^3)	2056			2040		
	Opt Moisture Content (%)	9,4			10,0		
	Mould Moisture Con. (%)	9,4			10,0		
	@100% Mod AASHTO	99,7			100,3		
	Swell (%)	0,28	≤1.5	✓	0,06	≤1.5	✓
NRB	100% NRB	95,9			96,1		
	Swell (%)	0,43			0,08		
Proc	100% Proctor	92,0			91,4		
	Swell (%)	0,55			0,09		
CBR	@ 100% Mod AASHTO	20			15		
	@ 98% Mod AASHTO	18			15		
	@ 95% Mod AASHTO	15			14		
	@ 93% Mod AASHTO	13			13		
	@ 90% Mod AASHTO	10	≥10	∗	12	≥10	∗
Insitu Moisture Content (%)		N/A			N/A		
Soil Classification							
TRH 14		G8			G8		
PRA System		A-2-6			A-2-6		
Unified System		GP-GC			GC		

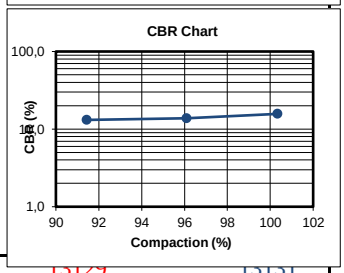
13129



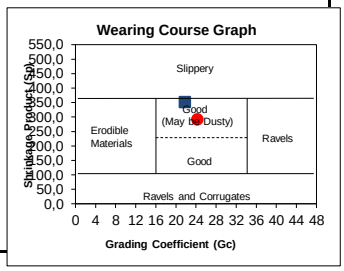


13131





13129 13131



- **Specimens delivered to Outeniqua Lab in good order.**

L Malgraff (Member)
For Outeniqua Lab EC cc.
Technical Signatory

1. The opinion column is an interpretation of the direct comparison between the quoted specification and the single test sample results obtained. The compliant (✓), non compliant (×) and uncertain (∗) opinion indicators are based on an approximate 95% level of confidence with reference to SAMM GUIDANCE 1, Issue 2 : 20 June 2007 Section 2.
2. The uncertain (∗) indicates that the test result is either equal to or is above / below the specified limit by a margin less than the measurement uncertainty; it is therefore not possible to state compliant (✓) or non compliant (×) based on a 95% level of confidence with reference to SAMM GUIDANCE 1, Issue 2 : 20 June 2007 Section 2.
3. This report (with attachments) is the correct record of all measurements made, and may not be reproduced other than with full written approval from the Technical Director of Outeniqua Lab EC cc.
4. Measuring Equipment, traceable to National Standards is used where applicable. Results reported in this Test Report relate only to the items tested and are an indication only of the sample provided and/or taken.
5. While every care is taken to ensure the correctness of all tests and reports, neither Outeniqua Lab nor its employees shall be liable in any way whatever for any error made in the execution or reporting of tests or any erroneous conclusions drawn therefrom or for any consequence thereof.

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T0619

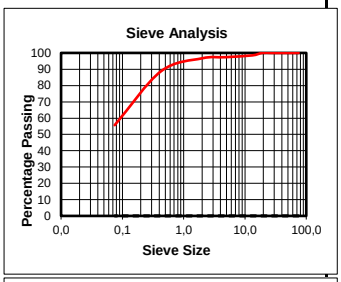
Customer :	Outeniqua Geotechincal Services cc	Project :	Choje Windfarm
	Po Box 964	Date Received :	23/05/19
	Knysna	Date Reported :	19/06/19
	6570	Req. Number :	439/19
Attention :	Iain Paton	No. of Pages :	2/6

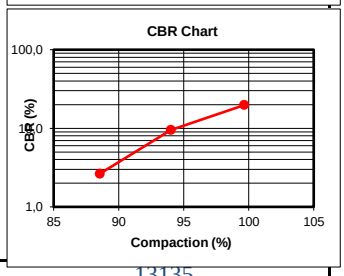
TEST REPORT

CALIFORNIA BEARING RATIO - (TMH 1 Method A1(a),A2,A3,A4,A5,A7,A8)

Material Indicators								
Sample Position (SV)		E 6A	Spec. G10 - TRH 14	Opinion	E 6B	Spec. G10 - TRH 14	Opinion
Depth (mm)		400-2100			800-1750		
Sample No		13133			13135		
Materials Description	Source	Test Pit			Test Pit		
	Colour	Light Reddish Orange			Light Yellowish Orange		
	Soil Type	Clayey Sandy Silt			Clayey Gravelly Silty Sand		
	Classification	Unknown			Unknown		
Max. Stone size in hole (mm)							
Percentage Passing	75.0 mm	100			100		
	63.0 mm	100			100		
	53.0 mm	100			100		
	37.5 mm	100			100		
	26.5 mm	100			100		
	19.0 mm	100			100		
	13.2 mm	99			98		
	4.75 mm	97			95		
	2.00 mm	97			93		
	0.425 mm	89			81		
	0.075 mm	55,7			49,8		
Soil Mortar & Constants							
Grading Modulus		0,59			0,77		
Coarse Sand <2.0 >0.425		8,3			12,5		
Med.	<0.250 >0.150	34,1			33,6		
Silt	<0.075	57,6			53,8		
Liquid Limit (%)		20			26		
Plasticity Index (%)		5			11		
Linear Shrinkage (%)		2,5			5,5		
CBR / Density Relationship							
MOD	Max Dry Density (kg/m^3)	2006			2026		
	Opt Moisture Content (%)	9,5			9,1		
	Mould Moisture Con. (%)	9,2			9,3		
	@100% Mod AASHTO	99,7			99,4		
	Swell (%)	1,33	≤1.5	✓	0,94	≤1.5	✓
NRB	100% NRB	94,0			94,2		
	Swell (%)	1,34			1,26		
Proc	100% Proctor	88,5			90,0		
	Swell (%)	1,43			1,50		
CBR	@ 100% Mod AASHTO	20			17		
	@ 98% Mod AASHTO	17			15		
	@ 95% Mod AASHTO	12			11		
	@ 93% Mod AASHTO	9			8		
	@ 90% Mod AASHTO	4	≥3	✳	4	≥3	✳
Insitu Moisture Content (%)		N/A			N/A		
Soil Classification							
TRH 14		G10			G10		
PRA System		A-4			A-6		
Unified System		CL-ML			SC		

13133





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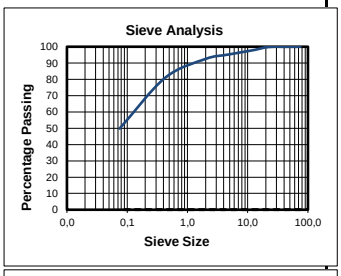
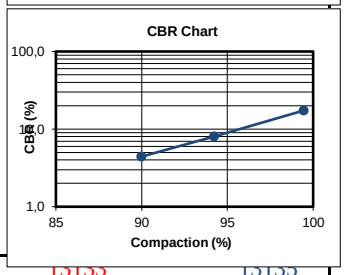
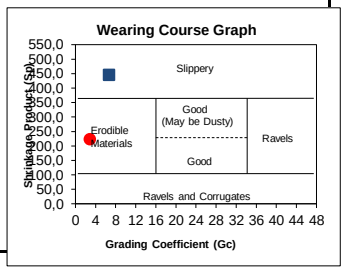




13133 13135



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L Malgraff (Member)
For Outeniqua Lab EC cc.
Technical Signatory

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T0619

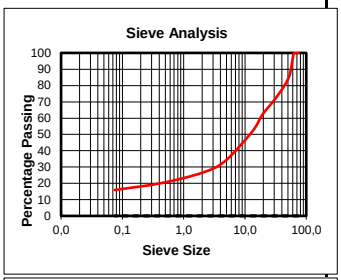
Customer :	Outeniqua Geotechincal Services cc	Project :	Choje Windfarm
	Po Box 964	Date Received :	23/05/19
	Knysna	Date Reported :	19/06/19
	6570	Req. Number :	439/19
Attention :	Iain Paton	No. of Pages :	3/6

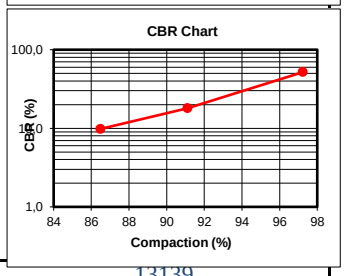
TEST REPORT

CALIFORNIA BEARING RATIO - (TMH 1 Method A1(a),A2,A3,A4,A5,A7,A8)

Material Indicators							
Sample Position (SV)		E 7A	Spec. G9 - TRH 14	Opinion	E 7B	Spec. G10 - TRH 14	Opinion
Depth (mm)		200-500			300-800		
Sample No		13137			13139		
Materials Description	Source	Test Pit			Test Pit		
	Colour	Light Brown			Light Reddish Brown to Light Brown		
	Soil Type	Clayey Silty Sandy Gravel			Clayey Silty Sandy Gravel		
	Classification	Unknown			Unknown		
Max. Stone size in hole (mm)							
Percentage Passing	75.0 mm	100			100		
	63.0 mm	100			100		
	53.0 mm	86			100		
	37.5 mm	76			62		
	26.5 mm	69			58		
	19.0 mm	62			51		
	13.2 mm	52			46		
	4.75 mm	34			32		
	2.00 mm	27			25		
	0.425 mm	20			19		
	0.075 mm	15,9			15,0		
Soil Mortar & Constants							
Grading Modulus		2,38			2,41		
Coarse Sand <2.0 >0.425		24,2			24,9		
Med.	<0.250 >0.150	15,8			14,9		
Silt	<0.075	60,0			60,2		
Liquid Limit (%)		37			42		
Plasticity Index (%)		16			19		
Linear Shrinkage (%)		8,0			9,5		
CBR / Density Relationship							
MOD	Max Dry Density (kg/m^3)	1974			2014		
	Opt Moisture Content (%)	8,9			12,0		
	Mould Moisture Con. (%)	8,8			12,0		
	@100% Mod AASHTO	97,2			98,5		
	Swell (%)	0,33	≤1.5	✓	0,65	≤1.5	✓
NRB	100% NRB	91,1			94,6		
	Swell (%)	0,78			0,95		
Proc	100% Proctor	86,5			87,7		
	Swell (%)	1,09			1,14		
CBR	@ 100% Mod AASHTO	60			20		
	@ 98% Mod AASHTO	52			18		
	@ 95% Mod AASHTO	40			15		
	@ 93% Mod AASHTO	32			13		
	@ 90% Mod AASHTO	20	≥7	✓	10	≥3	✓
Insitu Moisture Content (%)		N/A			N/A		
Soil Classification							
TRH 14		G9			G10		
PRA System		A-2-6			A-2-7		
Unified System		GC			GC		

13137





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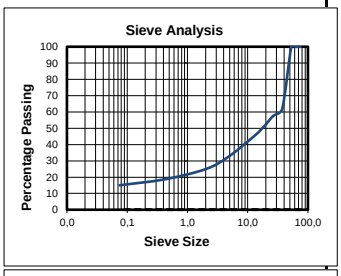
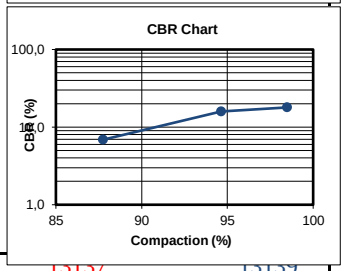
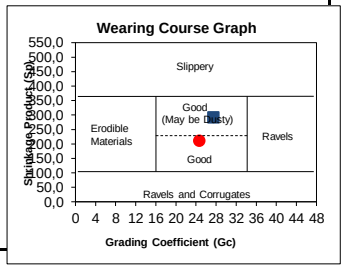




13137 13139



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For Outeniqua Lab EC cc.
Technical Signatory

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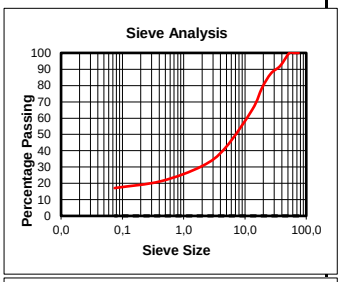
	Knysna	Date Reported :	19/06/19
	6570	Req. Number :	439/19
Attention :	Iain Paton	No. of Pages :	4/6

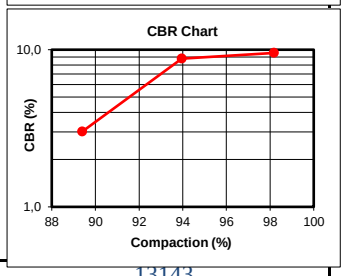
TEST REPORT

CALIFORNIA BEARING RATIO - (TMH 1 Method A1(a),A2,A3,A4,A5,A7,A8)

Material Indicators							
Sample Position (SV)		E 100A	Spec. G10 - TRH 14	Opinion	E 100B	Spec. G10 - TRH 14	Opinion
Depth (mm)		300-1100			400-1500		
Sample No		13141			13143		
Materials Description	Source	Test Pit			Test Pit		
	Colour	Light Reddish Brown			Light Reddish Brown		
	Soil Type	Clayey Silty Sandy Gravel			Silty Sandy Gravel		
	Classification	Unknown			Unknown		
Max. Stone size in hole (mm)							
Percentage Passing	75.0 mm	100			66		
	63.0 mm	100			55		
	53.0 mm	100			49		
	37.5 mm	92			46		
	26.5 mm	87			43		
	19.0 mm	79			38		
	13.2 mm	65			33		
	4.75 mm	42			20		
	2.00 mm	31			14		
	0.425 mm	21			9		
	0.075 mm	17,1			6,7		
Soil Mortar & Constants							
Grading Modulus		2,31			2,70		
Coarse Sand <2.0 >0.425		30,4			37,8		
Med. <0.250 >0.150		13,7			15,4		
Silt <0.075		55,9			46,9		
Liquid Limit (%)		47			37		
Plasticity Index (%)		20			19		
Linear Shrinkage (%)		10,0			9,5		
CBR / Density Relationship							
MOD	Max Dry Density (kg/m^3)	2012			2102		
	Opt Moisture Content (%)	12,1			11,0		
	Mould Moisture Con. (%)	11,8			10,8		
	@100% Mod AASHTO	98,2			97,9		
	Swell (%)	0,33	≤1.5	✓	1,14	≤1.5	✓
NRB	100% NRB	94,0			93,0		
	Swell (%)	0,78			1,34		
Proc	100% Proctor	89,4			88,5		
	Swell (%)	1,09			1,54		
CBR	@ 100% Mod AASHTO	12			17		
	@ 98% Mod AASHTO	10			16		
	@ 95% Mod AASHTO	8			14		
	@ 93% Mod AASHTO	6			13		
	@ 90% Mod AASHTO	4	≥3	∗	11	≥3	✓
Insitu Moisture Content (%)		N/A			N/A		
Soil Classification							
TRH 14		G10			G10		
PRA System		A-2-7			A-2-6		
Unified System		GC			GW-GC		

13141





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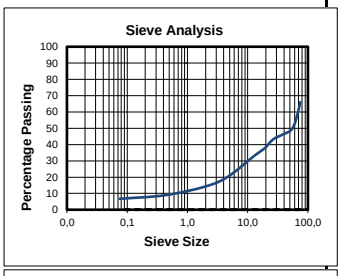
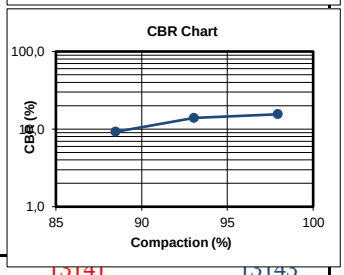
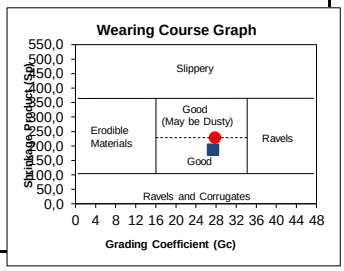




13141 13143



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For Outeniqua Lab EC cc.
Technical Signatory

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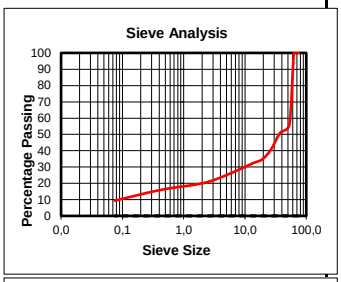
Attention :	Iain Paton	No. of Pages :	5/6

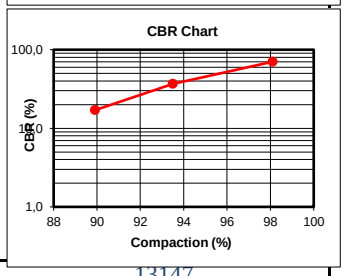
TEST REPORT

CALIFORNIA BEARING RATIO - (TMH 1 Method A1(a),A2,A3,A4,A5,A7,A8)

Material Indicators								
Sample Position (SV)		TP SS1	Spec. G5 - TRH 14	Opinion	TP SS2	Spec. G7 - TRH 14	Opinion
Depth (mm)		0-100			0-300		
Sample No		13145			13147		
Materials Description	Source	Test Pit			Test Pit		
	Colour	Light Reddish Brown			Light Reddish Brown		
	Soil Type	Gravelly Silty Sand			Silty Gravelly Sand with Boulders, Cobbles		
	Classification	Unknown			Unknown		
Max. Stone size in hole (mm)							
Percentage Passing	75.0 mm	100			100		
	63.0 mm	100			54		
	53.0 mm	56			42		
	37.5 mm	51			34		
	26.5 mm	41			31		
	19.0 mm	35			27		
	13.2 mm	32			24		
	4.75 mm	25			18		
	2.00 mm	20			15		
	0.425 mm	16			12		
	0.075 mm	9,4			7,1		
Soil Mortar & Constants							
Grading Modulus		2,55	≥1.5	✓	2,66	≥0.75	✓
Coarse Sand <2.0 >0.425		20,0			19,7		
Med.	<0.250 >0.150	33,0			32,0		
Silt	<0.075	47,0			48,3		
Liquid Limit (%)		19	≤30	✓	24		
Plasticity Index (%)		5	≤10	✓	7	≤12	✓
Linear Shrinkage (%)		2,5	≤5	✓	3,5		
CBR / Density Relationship							
MOD	Max Dry Density (kg/m^3)	2106			2108		
	Opt Moisture Content (%)	7,8			8,4		
	Mould Moisture Con. (%)	7,7			8,3		
	@100% Mod AASHTO	98,1			98,8		
	Swell (%)	0,05	≤0.5	✓	0,01	≤1.5	✓
NRB	100% NRB	93,5			95,3		
	Swell (%)	0,08			0,03		
Proc	100% Proctor	89,9			88,8		
	Swell (%)	0,13			0,06		
CBR	@ 100% Mod AASHTO	82			33		
	@ 98% Mod AASHTO	69			29		
	@ 95% Mod AASHTO	49	≥45	✓	24		
	@ 93% Mod AASHTO	36			20	≥15	✓
	@ 90% Mod AASHTO	16			14		
Insitu Moisture Content (%)		N/A			N/A		
Soil Classification							
TRH 14		G5			G7		
PRA System		A-1-a / A-1-b / A-2-4			A-2-4		
Unified System		GP-GM.GC			GW-GC		

13145





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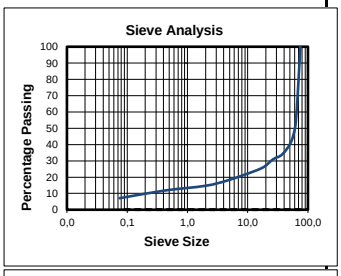
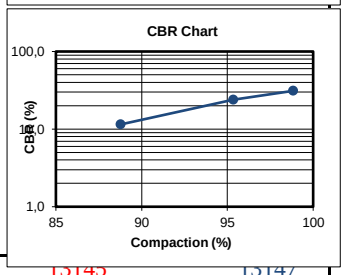
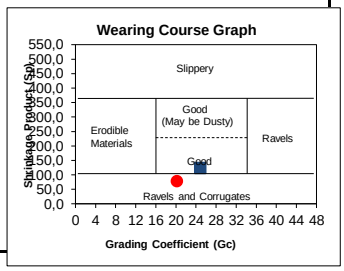




13145 13147



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L Malgraff (Member)
For Outeniqua Lab EC cc.
Technical Signatory

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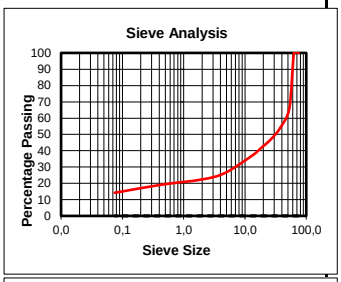
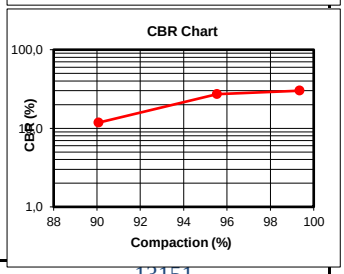
TEST REPORT

CALIFORNIA BEARING RATIO - (TMH 1 Method A1(a),A2,A3,A4,A5,A7,A8)

Material Indicators								
Sample Position (SV)		TP SS3	Spec. G7 - TRH 14	Opinion	TP SS4	Spec. G8 - TRH 14	Opinion
Depth (mm)		80-250			200-450		
Sample No		13149			13151		
Materials Description	Source	Test Pit			Test Pit		
	Colour	Light Reddish Brown			Light Reddish Brown		
	Soil Type	Silty Sandy Gravelly with Cobbles			Silty Sandy Gravel		
	Classification	Unknown			Unknown		
Max. Stone size in hole (mm)							
Percentage Passing	75.0 mm	100			100		
	63.0 mm	100			100		
	53.0 mm	66			86		
	37.5 mm	54			80		
	26.5 mm	47			66		
	19.0 mm	42			61		
	13.2 mm	37			55		
	4.75 mm	26			39		
	2.00 mm	22			30		
	0.425 mm	19			23		
	0.075 mm	14,2			18,4		
Soil Mortar & Constants							
Grading Modulus		2,44	≥0.75	✓	2,29		
Coarse Sand <2.0 >0.425		14,7			25,1		
Med. <0.250 >0.150		21,9			14,2		
Silt <0.075		63,4			60,7		
Liquid Limit (%)		29			34		
Plasticity Index (%)		11	≤12	✓	13		
Linear Shrinkage (%)		4,5			6,5		
CBR / Density Relationship							
MOD	Max Dry Density (kg/m^3)	2130			1860		
	Opt Moisture Content (%)	7,9			12,5		
	Mould Moisture Con. (%)	7,7			12,4		
	@100% Mod AASHTO	99,3			99,6		
	Swell (%)	0,17	≤1.5	✓	0,32	≤1.5	✓
NRB	100% NRB	95,5			94,5		
	Swell (%)	0,43			0,63		
Proc	100% Proctor	90,1			89,6		
	Swell (%)	0,78			0,80		
CBR	@ 100% Mod AASHTO	33			40		
	@ 98% Mod AASHTO	29			35		
	@ 95% Mod AASHTO	23			26		
	@ 93% Mod AASHTO	19	≥15	✓	20		
	@ 90% Mod AASHTO	13			12	≥10	✳
Insitu Moisture Content (%)		N/A			N/A		
Soil Classification							
TRH 14		G7			G8		
PRA System		A-2-6			A-2-6		
Unified System		GC			GC		

13149





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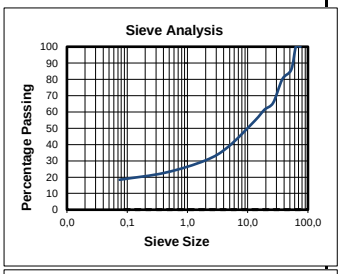
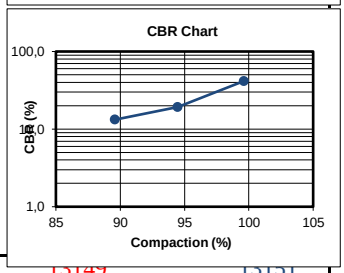
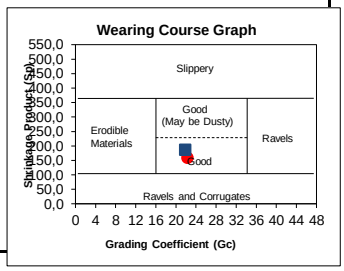




13149 13151



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L Malgraff (Member)
For Outeniqua Lab EC cc.
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T0619

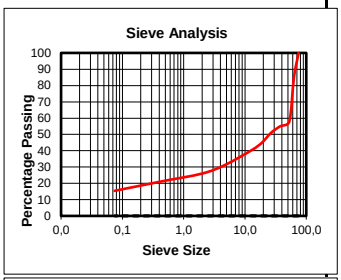
Customer :	Outeniqua Geotechincal Services cc	Project :	Choje Windfarm
	Po Box 964	Date Received :	14/06/19
	Knysna	Date Reported :	15/08/19
	6570	Req. Number :	511/19
Attention :	Iain Paton	No. of Pages :	1/7

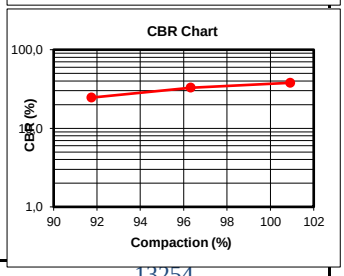
TEST REPORT

CALIFORNIA BEARING RATIO - (TMH 1 Method A1(a),A2,A3,A4,A5,A7,A8)

Material Indicators							
Sample Position (SV)		TP MTS 1	Spec. G8 - TRH 14	Opinion	TP MTS 2	Spec. G7 - TRH 14	Opinion
Depth (mm)		200-500			400-900		
Sample No		13252			13254		
Materials Description	Source	Test Pit			Test Pit		
	Colour	Light Reddish Orange			Light Olive		
	Soil Type	Silty Sandy Gravel			Sandy Silty Gravel		
	Classification	Unknown			Unknown		
Max. Stone size in hole (mm)							
Percentage Passing	75.0 mm	100			100		
	63.0 mm	85			100		
	53.0 mm	58			74		
	37.5 mm	55			64		
	26.5 mm	51			58		
	19.0 mm	45			56		
	13.2 mm	41			51		
	4.75 mm	31			41		
	2.00 mm	26			33		
	0.425 mm	21			20		
	0.075 mm	15,4			8,6		
Soil Mortar & Constants							
Grading Modulus		2,38			2,39	≥0.75	✓
Coarse Sand <2.0 >0.425		18,8			38,7		
Med.	<0.250 >0.150	21,9			35,1		
Silt	<0.075	59,2			26,2		
Liquid Limit (%)		38			32		
Plasticity Index (%)		16			8	≤12	✓
Linear Shrinkage (%)		8,0			4,0		
CBR / Density Relationship							
MOD	Max Dry Density (kg/m^3)	1850			1626		
	Opt Moisture Content (%)	14,3			17,3		
	Mould Moisture Con. (%)	14,3			17,3		
	@100% Mod AASHTO	100,9			100,4		
	Swell (%)	0,07	≤1.5	✓	0,00	≤1.5	✓
NRB	100% NRB	96,3			94,9		
	Swell (%)	0,11			0,03		
Proc	100% Proctor	91,8			90,3		
	Swell (%)	0,14			0,05		
CBR	@ 100% Mod AASHTO	37			62		
	@ 98% Mod AASHTO	34			51		
	@ 95% Mod AASHTO	30			34		
	@ 93% Mod AASHTO	27			23	≥15	✓
	@ 90% Mod AASHTO	23	≥10	✓	6		
Insitu Moisture Content (%)		N/A			N/A		
Soil Classification							
TRH 14		G8			G7		
PRA System		A-2-6			A-2-4		
Unified System		GC			GP-GM		

13252





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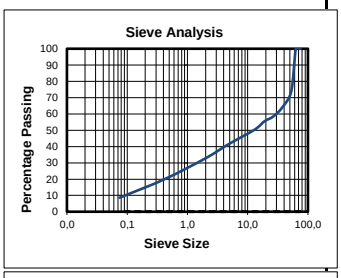
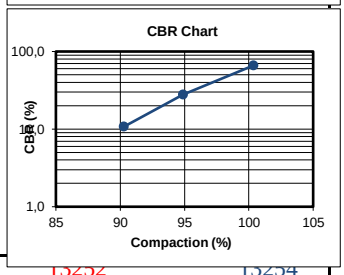
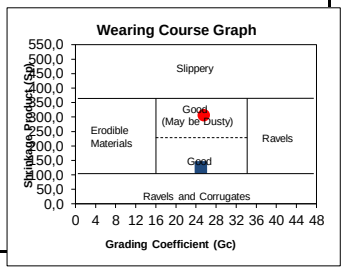




13252 13254



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For Outeniqua Lab EC cc.
Technical Signatory

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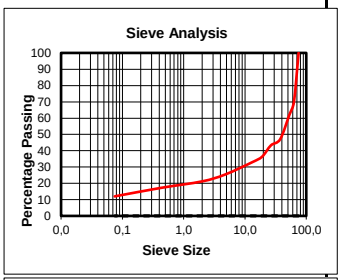
	Po Box 964	Date Received :	14/06/19
	Knysna	Date Reported :	15/08/19
	6570	Req. Number :	511/19
Attention :	Iain Paton	No. of Pages :	2/7

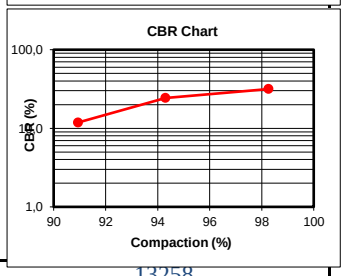
TEST REPORT

CALIFORNIA BEARING RATIO - (TMH 1 Method A1(a),A2,A3,A4,A5,A7,A8)

Material Indicators							
Sample Position (SV)		TP MTS 3	Spec. G9 - TRH 14	Opinion	TP MTS 4	Spec. G5 - TRH 14	Opinion
Depth (mm)		0-400			250-600		
Sample No		13256			13258		
Materials Description	Source	Test Pit			Test Pit		
	Colour	Dark Reddish			Light Olive to Light Brown		
	Soil Type	Silty Sandy Gravel			Sandy Silty Gravel with Cobbles		
	Classification	Unknown			Unknown		
Max. Stone size in hole (mm)							
Percentage Passing	75.0 mm	100			66		
	63.0 mm	70			58		
	53.0 mm	62			58		
	37.5 mm	47			56		
	26.5 mm	43			49		
	19.0 mm	36			45		
	13.2 mm	33			41		
	4.75 mm	25			32		
	2.00 mm	21			27		
	0.425 mm	17			21		
	0.075 mm	12,0			8,6		
Soil Mortar & Constants							
Grading Modulus		2,50			2,43	≥1.5	✓
Coarse Sand <2.0 >0.425		18,9			20,7		
Med. <0.250 >0.150		24,5			47,4		
Silt <0.075		56,6			31,9		
Liquid Limit (%)		31			SP	≤30	✓
Plasticity Index (%)		15			SP	≤10	✓
Linear Shrinkage (%)		7,5			0,5	≤5	✓
CBR / Density Relationship							
MOD	Max Dry Density (kg/m^3)	1976			1612		
	Opt Moisture Content (%)	10,7			18,1		
	Mould Moisture Con. (%)	10,7			18,1		
	@100% Mod AASHTO	98,3			100,3		
	Swell (%)	0,08	≤1.5	✓	0,02	≤0.5	✓
NRB	100% NRB	94,3			93,2		
	Swell (%)	0,13			0,04		
Proc	100% Proctor	90,9			90,1		
	Swell (%)	0,39			0,10		
CBR	@ 100% Mod AASHTO	37			109		
	@ 98% Mod AASHTO	32			89		
	@ 95% Mod AASHTO	24			57	≥45	✓
	@ 93% Mod AASHTO	19			37		
	@ 90% Mod AASHTO	11	≥7	✓	5		
Insitu Moisture Content (%)		N/A			N/A		
Soil Classification							
TRH 14		G9			G5		
PRA System		A-2-6			A-1-a / A-1-b / A-2-4		
Unified System		GP-GC			#DIV/0!		

13256





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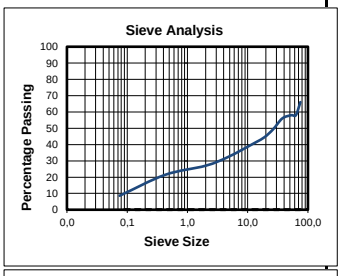
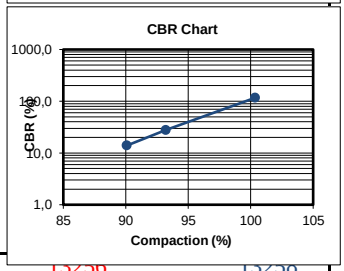
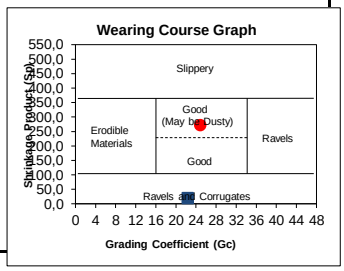




13256 13256



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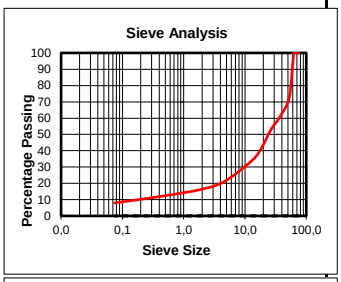
Attention :	Iain Paton	No. of Pages :	3/7

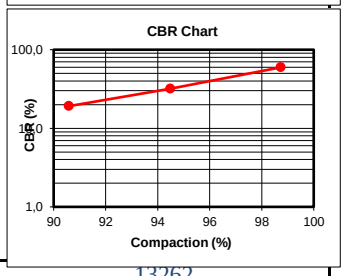
TEST REPORT

CALIFORNIA BEARING RATIO - (TMH 1 Method A1(a),A2,A3,A4,A5,A7,A8)

Material Indicators							
Sample Position (SV)		W5 21A	Spec. G9 - TRH 14	Opinion	W5 21B	Spec. G8 - TRH 14	Opinion
Depth (mm)		150-350			100-350		
Sample No		13260			13262		
Materials Description	Source	Test Pit			Test Pit		
	Colour	Light Reddish Orange			Light Reddish Orange		
	Soil Type	Silty Sandy Gravel			Silty Sandy Gravel		
	Classification	Unknown			Unknown		
Max. Stone size in hole (mm)							
Percentage Passing	75.0 mm	100			100		
	63.0 mm	100			69		
	53.0 mm	73			57		
	37.5 mm	61			52		
	26.5 mm	53			46		
	19.0 mm	42			39		
	13.2 mm	34			33		
	4.75 mm	21			23		
	2.00 mm	16			18		
	0.425 mm	12			13		
	0.075 mm	8,0			8,6		
Soil Mortar & Constants							
Grading Modulus		2,64			2,61		
Coarse Sand <2.0 >0.425		26,8			27,3		
Med.	<0.250 >0.150	24,4			23,9		
Silt	<0.075	48,8			48,9		
Liquid Limit (%)		38			31		
Plasticity Index (%)		18			14		
Linear Shrinkage (%)		9,0			7,0		
CBR / Density Relationship							
MOD	Max Dry Density (kg/m^3)	1900			1896		
	Opt Moisture Content (%)	12,5			12,4		
	Mould Moisture Con. (%)	12,5			12,3		
	@100% Mod AASHTO	98,7			99,9		
	Swell (%)	0,08	≤1.5	✓	0,18	≤1.5	✓
NRB	100% NRB	94,5			94,0		
	Swell (%)	0,13			0,76		
Proc	100% Proctor	90,6			88,5		
	Swell (%)	0,17			0,78		
CBR	@ 100% Mod AASHTO	64			62		
	@ 98% Mod AASHTO	54			53		
	@ 95% Mod AASHTO	39			40		
	@ 93% Mod AASHTO	29			31		
	@ 90% Mod AASHTO	14	≥7	✓	18	≥10	✓
Insitu Moisture Content (%)		N/A			N/A		
Soil Classification							
TRH 14		G9			G8		
PRA System		A-2-6			A-2-6		
Unified System		GP-GC			GW-GC		

13260





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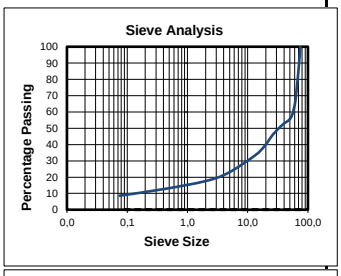
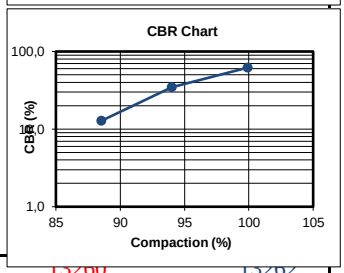
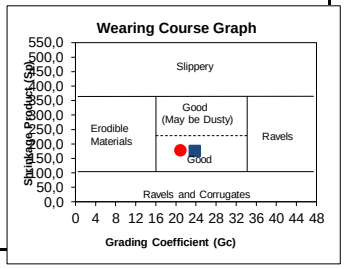




13260 13262



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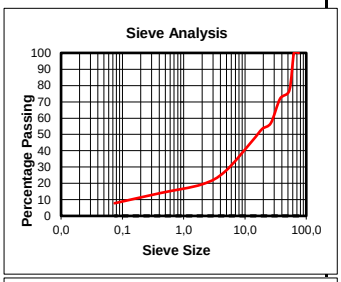
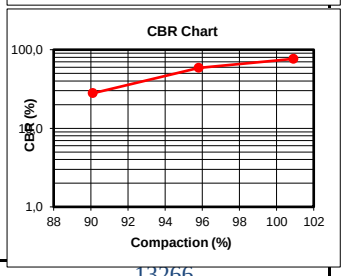
TEST REPORT

CALIFORNIA BEARING RATIO - (TMH 1 Method A1(a),A2,A3,A4,A5,A7,A8)

Material Indicators								
Sample Position (SV)		W5 64A	Spec. G5 - TRH 14	Opinion	W5 64B	Spec. G6 - TRH 14	Opinion
Depth (mm)		350-950			350-700		
Sample No		13264			13266		
Materials Description	Source	Test Pit			Test Pit		
	Colour	Light Olive to Light Brown			Light Olive to Light Brown		
	Soil Type	Calcrete			Calcrete		
	Classification	Unknown			Unknown		
Max. Stone size in hole (mm)							
Percentage Passing	75.0 mm	100			100		
	63.0 mm	100			100		
	53.0 mm	77			93		
	37.5 mm	72			90		
	26.5 mm	57			88		
	19.0 mm	53			82		
	13.2 mm	46			76		
	4.75 mm	27			62		
	2.00 mm	19			51		
	0.425 mm	14			39		
	0.075 mm	7,8			21,1		
Soil Mortar & Constants							
Grading Modulus		2,59	≥1.5	✓	1,90	≥1.2	✓
Coarse Sand <2.0 >0.425		27,3			23,3		
Med.	<0.250 >0.150	32,5			35,0		
Silt	<0.075	40,2			41,7		
Liquid Limit (%)		SP	≤30	✓	27		
Plasticity Index (%)		SP	≤10	✓	5	≤12	✓
Linear Shrinkage (%)		0,5	≤5	✓	2,5		
CBR / Density Relationship							
MOD	Max Dry Density (kg/m^3)	1730			1786		
	Opt Moisture Content (%)	19,6			14,8		
	Mould Moisture Con. (%)	19,6			14,7		
	@100% Mod AASHTO	100,9			99,6		
	Swell (%)	0,00	≤0.5	✓	0,02	≤1.0	✓
NRB	100% NRB	95,8			96,5		
	Swell (%)	0,00			0,05		
Proc	100% Proctor	90,1			91,0		
	Swell (%)	0,00			0,06		
CBR	@ 100% Mod AASHTO	74			70		
	@ 98% Mod AASHTO	65			57		
	@ 95% Mod AASHTO	52	≥45	✓	39		
	@ 93% Mod AASHTO	43			27	≥25	✳
	@ 90% Mod AASHTO	29			9		
Insitu Moisture Content (%)		N/A			N/A		
Soil Classification							
TRH 14		G5			G6		
PRA System		A-1-a / A-1-b / A-2-4			A-1-b / A-2-4		
Unified System		GP-GM			GM		

13264





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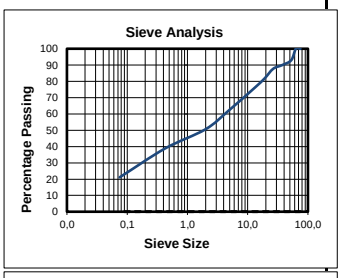
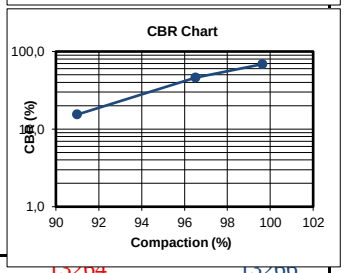
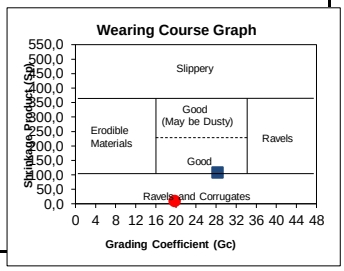




13264 13266



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For Outeniqua Lab EC cc.
Technical Signatory

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T0619

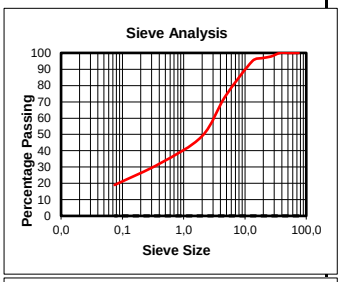
Customer :	Outeniqua Geotechincal Services cc	Project :	Choje Windfarm
	Po Box 964	Date Received :	14/06/19
	Knysna	Date Reported :	15/08/19
	6570	Req. Number :	511/19
Attention :	Iain Paton	No. of Pages :	5/7

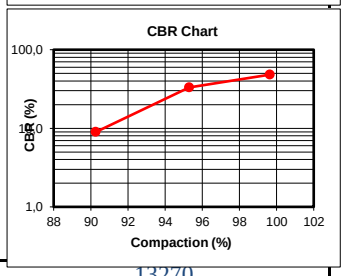
TEST REPORT

CALIFORNIA BEARING RATIO - (TMH 1 Method A1(a),A2,A3,A4,A5,A7,A8)

Material Indicators								
Sample Position (SV)		W 411A	Spec. G10 - TRH 14	Opinion	W 411B	Spec. G10 - TRH 14	Opinion
Depth (mm)		750-1700			450-1500		
Sample No		13268			13270		
Materials Description	Source	Test Pit			Test Pit		
	Colour	Light Reddish Orange			Light Reddish Orange		
	Soil Type	Gravelly Sandy Silt			Gravelly Silty Sand		
	Classification	Unknown			Unknown		
Max. Stone size in hole (mm)							
Percentage Passing	75.0 mm	100			100		
	63.0 mm	100			100		
	53.0 mm	100			100		
	37.5 mm	100			100		
	26.5 mm	98			89		
	19.0 mm	97			84		
	13.2 mm	95			77		
	4.75 mm	73			56		
	2.00 mm	49			41		
	0.425 mm	33			30		
	0.075 mm	19,0			15,5		
Soil Mortar & Constants							
Grading Modulus		2,00			2,14		
Coarse Sand <2.0 >0.425		33,7			25,4		
Med.	<0.250 >0.150	27,6			36,3		
Silt	<0.075	38,8			38,3		
Liquid Limit (%)		61			48		
Plasticity Index (%)		29			23		
Linear Shrinkage (%)		14,5			11,5		
CBR / Density Relationship							
MOD	Max Dry Density (kg/m^3)	1598			1762		
	Opt Moisture Content (%)	18,8			15,9		
	Mould Moisture Con. (%)	18,8			15,9		
	@100% Mod AASHTO	99,6			100,0		
	Swell (%)	0,81	≤1.5	✓	0,33	≤1.5	✓
NRB	100% NRB	95,3			94,9		
	Swell (%)	0,94			0,30		
Proc	100% Proctor	90,3			89,2		
	Swell (%)	0,98			0,63		
CBR	@ 100% Mod AASHTO	51			23		
	@ 98% Mod AASHTO	42			21		
	@ 95% Mod AASHTO	30			17		
	@ 93% Mod AASHTO	21			15		
	@ 90% Mod AASHTO	9	≥3	✓	11	≥3	✓
Insitu Moisture Content (%)		N/A			N/A		
Soil Classification							
TRH 14		G10			G10		
PRA System		A-2-7			A-2-7		
Unified System		GM			GC		

13268





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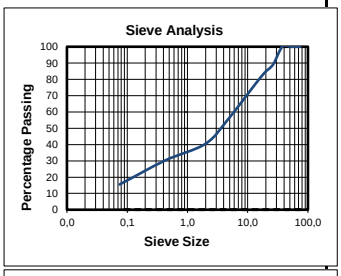
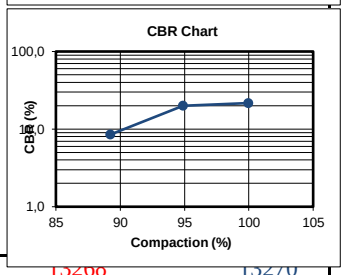
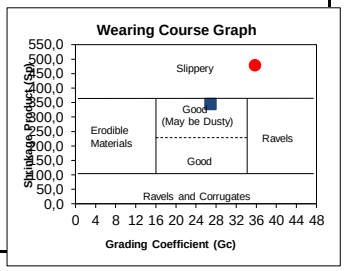




13268 13270



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L Malgraff (Member)
For Outeniqua Lab EC cc.
Technical Signatory

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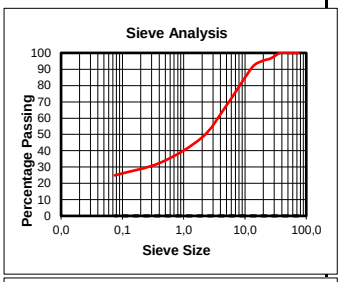
	Knysna	Date Reported :	15/08/19
	6570	Req. Number :	511/19
Attention :	Iain Paton	No. of Pages :	6/7

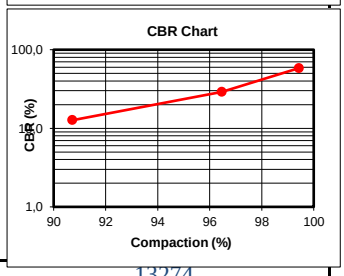
TEST REPORT

CALIFORNIA BEARING RATIO - (TMH 1 Method A1(a),A2,A3,A4,A5,A7,A8)

Material Indicators								
Sample Position (SV)		W 452A	Spec. G10 - TRH 14	Opinion	W 452B	Spec. G10 - TRH 14	Opinion
Depth (mm)		500-1800			350-500		
Sample No		13272			13274		
Materials Description	Source	Test Pit			Test Pit		
	Colour	Light Brown			Dark Reddsish Brown		
	Soil Type	Silty Sandy Gravel			Silty Gravelly Sand		
	Classification	Unknown			Unknown		
Max. Stone size in hole (mm)							
Percentage Passing	75.0 mm	100			100		
	63.0 mm	100			100		
	53.0 mm	100			100		
	37.5 mm	100			49		
	26.5 mm	97			49		
	19.0 mm	95			49		
	13.2 mm	91			48		
	4.75 mm	67			42		
	2.00 mm	48			38		
	0.425 mm	33			32		
	0.075 mm	24,9			27,8		
Soil Mortar & Constants							
Grading Modulus		1,94			2,02		
Coarse Sand	<2.0 >0.425	32,0			14,6		
Med.	<0.250 >0.150	16,4			11,9		
Silt	<0.075	51,7			73,5		
Liquid Limit (%)		29			36		
Plasticity Index (%)		13			19		
Linear Shrinkage (%)		6,5			9,5		
CBR / Density Relationship							
MOD	Max Dry Density (kg/m^3)	1832			1872		
	Opt Moisture Content (%)	14,5			11,7		
	Mould Moisture Con. (%)	14,4			11,8		
	@100% Mod AASHTO	99,4			100,2		
	Swell (%)	0,08	≤1.5	✓	1,06	≤1.5	✓
NRB	100% NRB	96,5			94,1		
	Swell (%)	0,08			1,24		
Proc	100% Proctor	90,7			91,8		
	Swell (%)	0,09			1,55		
CBR	@ 100% Mod AASHTO	55			5		
	@ 98% Mod AASHTO	45			4		
	@ 95% Mod AASHTO	31			3		
	@ 93% Mod AASHTO	21			2		
	@ 90% Mod AASHTO	6	≥3	✳	1	≥3	✳
Insitu Moisture Content (%)		N/A			N/A		
Soil Classification							
TRH 14		G10			G10		
PRA System		A-2-6			A-2-6		
Unified System		GC			GC		

13272





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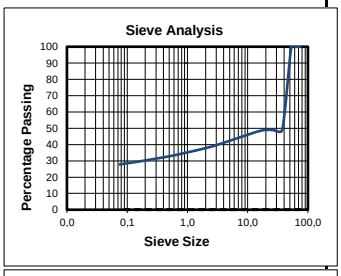

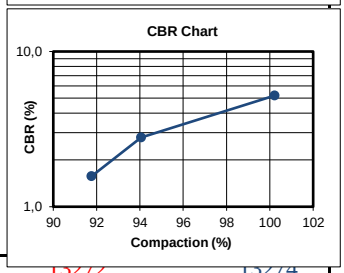

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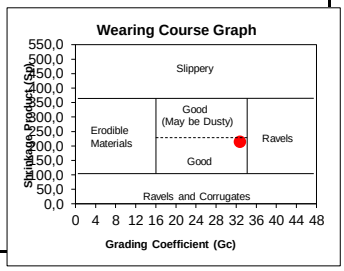

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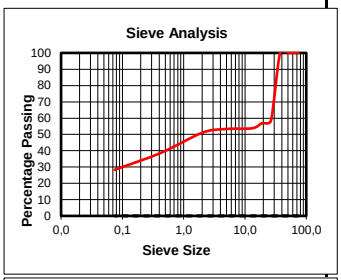
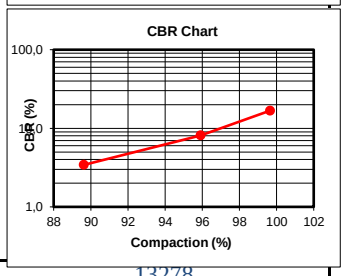
TEST REPORT

CALIFORNIA BEARING RATIO - (TMH 1 Method A1(a),A2,A3,A4,A5,A7,A8)

Material Indicators								
Sample Position (SV)		W 417A	Spec. G10 - TRH 14	Opinion	W 417B	Spec. G10 - TRH 14	Opinion
Depth (mm)		700-1300			800-2900		
Sample No		13276			13278		
Materials Description	Source	Test Pit			Test Pit		
	Colour	Dark Reddish Orange			Light Yellowish Orange		
	Soil Type	Clayey Gravelly Silty Sand			Clayey Gravelly Sandy Silt		
	Classification	Unknown			Unknown		
Max. Stone size in hole (mm)							
Percentage Passing	75.0 mm	100			100		
	63.0 mm	100			100		
	53.0 mm	100			100		
	37.5 mm	100			100		
	26.5 mm	58			100		
	19.0 mm	57			100		
	13.2 mm	54			99		
	4.75 mm	53			96		
	2.00 mm	51			89		
	0.425 mm	39			63		
	0.075 mm	28,3			49,8		
Soil Mortar & Constants							
Grading Modulus		1,82			0,98		
Coarse Sand <2.0 >0.425		24,1			29,5		
Med.	<0.250 >0.150	20,4			14,8		
Silt	<0.075	55,5			55,7		
Liquid Limit (%)		33			32		
Plasticity Index (%)		12			12		
Linear Shrinkage (%)		6,0			6,0		
CBR / Density Relationship							
MOD	Max Dry Density (kg/m^3)	1766			1766		
	Opt Moisture Content (%)	16,6			14,4		
	Mould Moisture Con. (%)	16,6			14,3		
	@100% Mod AASHTO	99,7			100,5		
	Swell (%)	0,06	≤1.5	✓	0,20	≤1.5	✓
NRB	100% NRB	95,9			96,3		
	Swell (%)	0,14			0,24		
Proc	100% Proctor	89,6			91,2		
	Swell (%)	0,28			0,59		
CBR	@ 100% Mod AASHTO	16			33		
	@ 98% Mod AASHTO	13			27		
	@ 95% Mod AASHTO	9			18		
	@ 93% Mod AASHTO	7			12		
	@ 90% Mod AASHTO	3	≥3	∗	4	≥3	∗
Insitu Moisture Content (%)		N/A			N/A		
Soil Classification							
TRH 14		G10			G10		
PRA System		A-2-6			A-6		
Unified System		GC			SC		

13276





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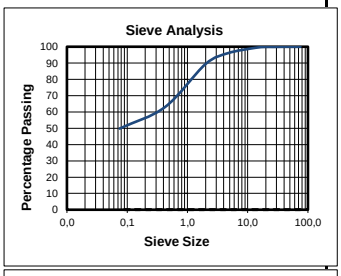

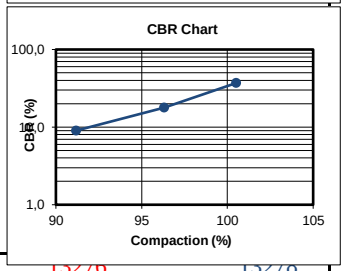

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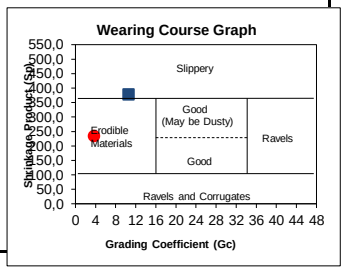

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ControLab South Africa (Pty) Ltd

201000682907

CIVIL ENGINEERING MATERIALS AND GEOTECHNICAL LABORATORY

www.controlab.co.za

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CENTRAL LABORATORY: 10 St Pauls Road, East London, 5201, Tel: 043 722 5420 / 722 8565, Fax 043 743 9942, P O Box 346, East London, 5200
OTHER BRANCH OFFICES: Cape Town, Kokstad, Johannesburg, Mthatha, Queenstown, Lusaka - Zambia

CLIENT: Outeniqua Geotechnical Services
P O Box 964
KNYSNA
6570
ATT : Mr I Paton

PROJECT: CHOJE WIND FARM
DATE RECEIVED: 2019-06-25
DATE TESTED: 2019-07-10
DATE REPORTED: 2019-07-11
TEST REPORT NO: 95584

pH & CONDUCTIVITY

SAMPLE NO.	TEST POSITION & DEPTH (mm)	pH	Conductivity (µS/m) (Micro Siemens / m)
3803	E64A - (200 - 400)	6.07	201
3804	E64B - (150 - 400)	6.11	213
3805	TPSS1 - (0 - 100)	6.20	187
3806	TPSS2 - (0 - 300)	6.08	185
3807	TPSS3 - (80 - 250)	6.37	212
3808	TPSS4 - (200 - 450)	6.61	223
3809	E6A - (400 - 2100)	8.09	846
3810	E6B - (300 - 800)	7.37	475
3811	E100A - (300 - 1100)	8.60	361
3812	E100B - (400 - 1500)	7.25	463
3813	E7A - (200-500)	7.23	287
3814	E7B - (300 - 800)	7.39	219
3815	TPMTS1 - (200 - 500)	7.48	209

Laboratory Manager: J Atterbury

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OTHER BRANCH OFFICES: Cape Town, Kokstad, Johannesburg, Mthatha, Queenstown, Lusaka - Zambia

CLIENT: Outeniqua Geotechnical Services
P O Box 964
KNYSNA
6570
ATT : Mr I Paton

PROJECT: CHOJE WIND FARM
DATE RECEIVED: 2019-06-25
DATE TESTED: 2019-07-10
DATE REPORTED: 2019-07-11
TEST REPORT NO: 95584

pH & CONDUCTIVITY

SAMPLE NO.	TEST POSITION & DEPTH (mm)	pH	Conductivity (µS/m) (Micro Siemens / m)
3816	TPMTS2 - (400 - 900)	7.58	224
3817	TPMTS3 - (0 - 400)	7.67	129
3818	TPMTS4 - (250 - 600)	7.96	202
3819	W521A - (150 - 350)	8.26	360
3820	W521B - (100 - 350)	7.60	225
3821	W564A - (350 - 950)	7.98	250
3822	W564B - (350 - 700)	8.00	241
3823	W411A - (750 - 1700)	7.70	302
3824	W411B - (450 - 1500)	7.55	1685
3825	W452A - (500 - 1300)	8.10	229
3826	W452B - (350 - 500)	8.10	272
3827	W417A - (1300 - 2800)	7.01	206
3828	W417B - (800 - 2900)	7.62	864

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OTHER BRANCH OFFICES: Cape Town, Kokstad, Johannesburg, Mthatha, Queenstown, Lusaka - Zambia

CLIENT:	Outeniqua Geotechnical Services	**PROJECT:**	CHOJE WIND FARM
	P O Box 964	**DATE RECEIVED:**	2019-07-25
	KNYSNA	**DATE TESTED:**	2019-08-08
	6570	**DATE REPORTED:**	2019-08-12
ATT :	Mr I Paton	**TEST REPORT NO.:**	96046 **O/N:**

AGGREGATE ANALYSIS TEST REPORT

SAMPLE NO:	4354	4358	4387	4388	4408	
POSITION	W417	W417	E6	E6	E100	
DEPTH (m)	2.18 - 2.98	3.58 - 5.08	0.50 - 1.50	2.10 - 3.00	1.10 - 1.68	
DESCRIPTION:	Gravelly	Gravelly	cly	Gravelly	cly sty	
	cly sdy	cly sdy	gravelly	sty s	gravel	
	st	st	sty s			

SIEVE ANALYSIS % PASSING SIEVES: Method SANS 3001: AG1

SIEVE APERTURE							
	50.0 mm						
	37.5 mm						
	28.0 mm						
	20.0 mm						
	14.0 mm						
	10.0 mm						
	7.1 mm						
	5.0 mm						
	2.0 mm						
	1.0 mm						
	0.600 mm						
	0.425 mm						
	0.300 mm						
	0.150 mm						
	0.075 mm						

MATERIAL CHARACTERISTICS

Finess Modulus	SANS 3001 PR5						
Apparent Density	SANS 3001 AG20/21	2687	2683	2679	2697	2616	
Loose Bulk Density	TMH1 B9						
Compacted Bulk Density	TMH1 B9						
Ave Least Dimension (ALD)	SANS 3001 AG2						
Flakiness Index	SANS 3001 AG4						
Sand Equivalent	SANS 3001 AG5						

STRENGTH TESTS

A.C.V. (%)	SANS 3001 AG10						
10 % FACT DRY (KN)	SANS 3001 AG10						
10 % FACT WET (KN)	SANS 3001 AG10						
Wet Dry Relationship (%)							

Technical Signatory: J Atterbury

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CLIENT:	Outeniqua Geotechnical Services	**PROJECT:**	CHOJE WIND FARM
	P O Box 964	**DATE RECEIVED:**	2019-06-25
	KNYSNA	**DATE TESTED:**	2019-07-10
	6570	**DATE REPORTED:**	2019-07-30
ATT :	Mr I Paton	**TEST REPORT NO.:**	95584 **O/N:**

AGGREGATE ANALYSIS TEST REPORT

SAMPLE NO:	3803	3804	3805			
POSITION	E64A	E64B	TPSS1			
DEPTH mm	200 - 400	150 - 400	0 - 100			
DESCRIPTION:	cly sty	cly sty	Gravelly			
	sdy gravel	sdy gravel	sty s			

SIEVE ANALYSIS % PASSING SIEVES: Method SANS 3001: AG1

SIEVE APERTURE							
	50.0 mm						
	37.5 mm						
	28.0 mm						
	20.0 mm						
	14.0 mm						
	10.0 mm						
	7.1 mm						
	5.0 mm						
	2.0 mm						
	1.0 mm						
	0.600 mm						
	0.425 mm						
	0.300 mm						
	0.150 mm						
	0.075 mm						

MATERIAL CHARACTERISTICS

Finess Modulus	SANS 3001 PR5						
Apparent Density	SANS 3001 AG20/21	2636	2610	2636			
Loose Bulk Density	TMH1 B9						
Compacted Bulk Density	TMH1 B9						
Ave Least Dimension (ALD)	SANS 3001 AG2						
Flakiness Index	SANS 3001 AG4						
Sand Equivalent	SANS 3001 AG5						

STRENGTH TESTS

A.C.V. (%)	SANS 3001 AG10						
10 % FACT DRY (KN)	SANS 3001 AG10						
10 % FACT WET (KN)	SANS 3001 AG10						
Wet Dry Relationship (%)							

Technical Signatory: J'Atterbury

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CLIENT:	Outeniqua Geotechnical Services	**PROJECT:**	CHOJE WIND FARM
	P O Box 964	**DATE RECEIVED:**	2019-06-25
	KNYSNA	**DATE TESTED:**	2019-07-10
	6570	**DATE REPORTED:**	2019-07-30
ATT :	Mr I Paton	**TEST REPORT NO.:**	95584 **O/N:**

AGGREGATE ANALYSIS TEST REPORT

SAMPLE NO:	3806	3807	3808			
POSITION	TPSS2	TPSS3	TPSS4			
DEPTH mm	0 - 300	80 - 250	200 - 450			
DESCRIPTION:	sty gravelly	sty s	sty sdy			
	sand &	gravel &	gravel			
	Boulders &	Cobbles				
	Cobbles					

SIEVE ANALYSIS % PASSING SIEVES: Method SANS 3001: AG1

SIEVE APERTURE						
50.0 mm						
37.5 mm						
28.0 mm						
20.0 mm						
14.0 mm						
10.0 mm						
7.1 mm						
5.0 mm						
2.0 mm						
1.0 mm						
0.600 mm						
0.425 mm						
0.300 mm						
0.150 mm						
0.075 mm						

MATERIAL CHARACTERISTICS

Finess Modulus SANS 3001 PR5						
Apparent Density SANS 3001 AG20/21	2642	2667	2657			
Loose Bulk Density TMH1 B9						
Compacted Bulk Density TMH1 B9						
Ave Least Dimension (ALD) SANS 3001 AG2						
Flakiness Index SANS 3001 AG4						
Sand Equivalent SANS 3001 AG5						

STRENGTH TESTS

A.C.V. (%) SANS 3001 AG10						
10 % FACT DRY (KN) SANS 3001 AG10						
10 % FACT WET (KN) SANS 3001 AG10						
Wet Dry Relationship (%)						

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CLIENT:	Outeniqua Geotechnical Services	**PROJECT:**	CHOJE WIND FARM
	P O Box 964	**DATE RECEIVED:**	2019-06-25
	KNYSNA	**DATE TESTED:**	2019-07-10
	6570	**DATE REPORTED:**	2019-07-30
ATT :	Mr I Paton	**TEST REPORT NO.:**	95584 **O/N:**

AGGREGATE ANALYSIS TEST REPORT

SAMPLE NO:	3809	3810	3811			
POSITION	E6A	E6B	E100A			
DEPTH mm	400 - 2100	800 - 1750	300 - 1100			
DESCRIPTION:	cly sdy	cly	cly sty			
	st	gravelly	sdy			
		sty s	Gravel			

SIEVE ANALYSIS % PASSING SIEVES: Method SANS 3001: AG1

SIEVE APERTURE							
	50.0 mm						
	37.5 mm						
	28.0 mm						
	20.0 mm						
	14.0 mm						
	10.0 mm						
	7.1 mm						
	5.0 mm						
	2.0 mm						
	1.0 mm						
	0.600 mm						
	0.425 mm						
	0.300 mm						
	0.150 mm						
	0.075 mm						

MATERIAL CHARACTERISTICS

Finess Modulus	SANS 3001 PR5						
Apparent Density	SANS 3001 AG20/21	2665	2666	2667			
Loose Bulk Density	TMH1 B9						
Compacted Bulk Density	TMH1 B9						
Ave Least Dimension (ALD)	SANS 3001 AG2						
Flakiness Index	SANS 3001 AG4						
Sand Equivalent	SANS 3001 AG5						

STRENGTH TESTS

A.C.V. (%)	SANS 3001 AG10						
10 % FACT DRY (KN)	SANS 3001 AG10						
10 % FACT WET (KN)	SANS 3001 AG10						
Wet Dry Relationship (%)							

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CLIENT:	Outeniqua Geotechnical Services	**PROJECT:**	CHOJE WIND FARM
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	KNYSNA	**DATE TESTED:**	2019-07-10
	6570	**DATE REPORTED:**	2019-07-30
ATT :	Mr I Paton	**TEST REPORT NO.:**	95584 **O/N:**

AGGREGATE ANALYSIS TEST REPORT

SAMPLE NO:	3812	3813	3814			
POSITION	E100B	E7A	E7B			
DEPTH mm	400 - 1500	200 - 500	300 - 800			
DESCRIPTION:	sty sdy	cly sty	cly sty			
	Gravel	sdy	sdy			
		Gravel	Gravel			

SIEVE ANALYSIS % PASSING SIEVES: Method SANS 3001: AG1

SIEVE APERTURE							
50.0 mm							
37.5 mm							
28.0 mm							
20.0 mm							
14.0 mm							
10.0 mm							
7.1 mm							
5.0 mm							
2.0 mm							
1.0 mm							
0.600 mm							
0.425 mm							
0.300 mm							
0.150 mm							
0.075 mm							

MATERIAL CHARACTERISTICS

Finess Modulus	SANS 3001 PR5						
Apparent Density	SANS 3001 AG20/21	2742	2783	2633			
Loose Bulk Density	TMH1 B9						
Compacted Bulk Density	TMH1 B9						
Ave Least Dimension (ALD)	SANS 3001 AG2						
Flakiness Index	SANS 3001 AG4						
Sand Equivalent	SANS 3001 AG5						

STRENGTH TESTS

A.C.V. (%)	SANS 3001 AG10						
10 % FACT DRY (KN)	SANS 3001 AG10						
10 % FACT WET (KN)	SANS 3001 AG10						
Wet Dry Relationship (%)							

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CLIENT:	Outeniqua Geotechnical Services	PROJECT:	CHOJE WIND FARM
	P O Box 964	DATE RECEIVED:	2019-06-25
	KNYSNA	DATE TESTED:	2019-07-10
	6570	DATE REPORTED:	2019-07-30
ATT :	Mr I Paton	TEST REPORT NO.:	95584 O/N:

AGGREGATE ANALYSIS TEST REPORT

SAMPLE NO:	3815	3816	3817			
POSITION	TPMTS1	TPMTS2	TPMTS3			
DEPTH mm	200 - 500	400 - 900	0 - 400			
DESCRIPTION:	sty sdy	sty sdy	sty sdy			
	Gravel	Gravel	Gravel			

SIEVE ANALYSIS % PASSING SIEVES: Method SANS 3001: AG1

SIEVE APERTURE							
	50.0 mm						
	37.5 mm						
	28.0 mm						
	20.0 mm						
	14.0 mm						
	10.0 mm						
	7.1 mm						
	5.0 mm						
	2.0 mm						
	1.0 mm						
	0.600 mm						
	0.425 mm						
	0.300 mm						
	0.150 mm						
	0.075 mm						

MATERIAL CHARACTERISTICS

Finess Modulus	SANS 3001 PR5						
Apparent Density	SANS 3001 AG20/21	2754	2608	2611			
Loose Bulk Density	TMH1 B9						
Compacted Bulk Density	TMH1 B9						
Ave Least Dimension (ALD)	SANS 3001 AG2						
Flakiness Index	SANS 3001 AG4						
Sand Equivalent	SANS 3001 AG5						

STRENGTH TESTS

A.C.V. (%)	SANS 3001 AG10						
10 % FACT DRY (KN)	SANS 3001 AG10						
10 % FACT WET (KN)	SANS 3001 AG10						
Wet Dry Relationship (%)							

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CLIENT:	Outeniqua Geotechnical Services	**PROJECT:**	CHOJE WIND FARM
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	KNYSNA	**DATE TESTED:**	2019-07-10
	6570	**DATE REPORTED:**	2019-07-30
ATT :	Mr I Paton	**TEST REPORT NO.:**	95584 **O/N:**

AGGREGATE ANALYSIS TEST REPORT

SAMPLE NO:	3818	3819	3820			
POSITION	TPMTS4	W521A	W521B			
DEPTH mm	250 - 600	150 - 350	100 - 350			
DESCRIPTION:	sty sdy	sty sdy	sty sdy			
	Gravel &	Gravel	Gravel			
	Cobbles					

SIEVE ANALYSIS % PASSING SIEVES: Method SANS 3001: AG1

SIEVE APERTURE							
50.0 mm							
37.5 mm							
28.0 mm							
20.0 mm							
14.0 mm							
10.0 mm							
7.1 mm							
5.0 mm							
2.0 mm							
1.0 mm							
0.600 mm							
0.425 mm							
0.300 mm							
0.150 mm							
0.075 mm							

MATERIAL CHARACTERISTICS

Finess Modulus	SANS 3001 PR5						
Apparent Density	SANS 3001 AG20/21	2593	2555	2663			
Loose Bulk Density	TMH1 B9						
Compacted Bulk Density	TMH1 B9						
Ave Least Dimension (ALD)	SANS 3001 AG2						
Flakiness Index	SANS 3001 AG4						
Sand Equivalent	SANS 3001 AG5						

STRENGTH TESTS

A.C.V. (%)	SANS 3001 AG10						
10 % FACT DRY (KN)	SANS 3001 AG10						
10 % FACT WET (KN)	SANS 3001 AG10						
Wet Dry Relationship (%)							

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CLIENT:	Outeniqua Geotechnical Services	PROJECT:	CHOJE WIND FARM
	P O Box 964	DATE RECEIVED:	2019-06-25
	KNYSNA	DATE TESTED:	2019-07-10
	6570	DATE REPORTED:	2019-07-30
ATT :	Mr I Paton	TEST REPORT NO.:	95584 O/N:

AGGREGATE ANALYSIS TEST REPORT

SAMPLE NO:	3821	3822	3823			
POSITION	W564A	W564B	W411A			
DEPTH mm	350 - 950	350 - 700	750 - 1700			
DESCRIPTION:	Calcrete	Calcrete	Gravelly			
	Hardpan	Hardpan	sdy st			

SIEVE ANALYSIS % PASSING SIEVES: Method SANS 3001: AG1

SIEVE APERTURE							
50.0 mm							
37.5 mm							
28.0 mm							
20.0 mm							
14.0 mm							
10.0 mm							
7.1 mm							
5.0 mm							
2.0 mm							
1.0 mm							
0.600 mm							
0.425 mm							
0.300 mm							
0.150 mm							
0.075 mm							

MATERIAL CHARACTERISTICS

Finess Modulus	SANS 3001 PR5						
Apparent Density	SANS 3001 AG20/21	2637	2558	2654			
Loose Bulk Density	TMH1 B9						
Compacted Bulk Density	TMH1 B9						
Ave Least Dimension (ALD)	SANS 3001 AG2						
Flakiness Index	SANS 3001 AG4						
Sand Equivalent	SANS 3001 AG5						

STRENGTH TESTS

A.C.V. (%)	SANS 3001 AG10						
10 % FACT DRY (KN)	SANS 3001 AG10						
10 % FACT WET (KN)	SANS 3001 AG10						
Wet Dry Relationship (%)							

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	6570	DATE REPORTED:	2019-07-30
ATT :	Mr I Paton	TEST REPORT NO.:	95584 O/N:

AGGREGATE ANALYSIS TEST REPORT

SAMPLE NO:	3824	3825	3826			
POSITION	W411B	W452A	W452B			
DEPTH mm	450 - 1500	500 - 1300	350 - 500			
DESCRIPTION:	Gravelly	sty sdy	sty			
	sty s	Gravel	Gravelly			
			sand			

SIEVE ANALYSIS % PASSING SIEVES: Method SANS 3001: AG1

SIEVE APERTURE							
	50.0 mm						
	37.5 mm						
	28.0 mm						
	20.0 mm						
	14.0 mm						
	10.0 mm						
	7.1 mm						
	5.0 mm						
	2.0 mm						
	1.0 mm						
	0.600 mm						
	0.425 mm						
	0.300 mm						
	0.150 mm						
	0.075 mm						

MATERIAL CHARACTERISTICS

Finess Modulus	SANS 3001 PR5						
Apparent Density	SANS 3001 AG20/21	2492	2613	2752			
Loose Bulk Density	TMH1 B9						
Compacted Bulk Density	TMH1 B9						
Ave Least Dimension (ALD)	SANS 3001 AG2						
Flakiness Index	SANS 3001 AG4						
Sand Equivalent	SANS 3001 AG5						

STRENGTH TESTS

A.C.V. (%)	SANS 3001 AG10						
10 % FACT DRY (KN)	SANS 3001 AG10						
10 % FACT WET (KN)	SANS 3001 AG10						
Wet Dry Relationship (%)							

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CLIENT:	Outeniqua Geotechnical Services	**PROJECT:**	CHOJE WIND FARM
	P O Box 964	**DATE RECEIVED:**	2019-06-25
	KNYSNA	**DATE TESTED:**	2019-07-10
	6570	**DATE REPORTED:**	2019-07-30
ATT :	Mr I Paton	**TEST REPORT NO.:**	95584 **O/N:**

AGGREGATE ANALYSIS TEST REPORT

SAMPLE NO:	3827	3828				
POSITION	W417A	W417B				
DEPTH mm	1300 - 2800	800 - 2900				
DESCRIPTION:	cly	cly				
	Gravelly	Gravelly				
	sdy st	sdy st				

SIEVE ANALYSIS % PASSING SIEVES: Method SANS 3001: AG1

SIEVE APERTURE							
50.0 mm							
37.5 mm							
28.0 mm							
20.0 mm							
14.0 mm							
10.0 mm							
7.1 mm							
5.0 mm							
2.0 mm							
1.0 mm							
0.600 mm							
0.425 mm							
0.300 mm							
0.150 mm							
0.075 mm							

MATERIAL CHARACTERISTICS

Finess Modulus	SANS 3001 PR5						
Apparent Density	SANS 3001 AG20/21	2674	2684				
Loose Bulk Density	TMH1 B9						
Compacted Bulk Density	TMH1 B9						
Ave Least Dimension (ALD)	SANS 3001 AG2						
Flakiness Index	SANS 3001 AG4						
Sand Equivalent	SANS 3001 AG5						

STRENGTH TESTS

A.C.V. (%)	SANS 3001 AG10						
10 % FACT DRY (KN)	SANS 3001 AG10						
10 % FACT WET (KN)	SANS 3001 AG10						
Wet Dry Relationship (%)							

Technical Signatory: J Atterbury

ControLab South Africa (Pty) Ltd

CIVIL ENGINEERING MATERIALS AND GEOTECHNICAL LABORATORY

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CLIENT: Outeniqua Geotechnical Services
P O Box 964
KNYSNA
6570
ATT : Mr I Paton

PROJECT: CHOJE WIND FARM
DATE RECEIVED: 2019-07-25
DATE TESTED: 2019-08-13
DATE REPORTED: 2019-08-15
REF NO.: 96046

ROCK UCS CORE STRENGTH TEST - ASTM D 2938

CORE TEST DATA

SAMPLE NO.:	POSITION	TOTAL LENGTH OF CORE SUBMITTED (mm)	LENGTH OF CORE AFTER TRIMMING (mm)	CORE DIAMETER (mm)	DENSITY (Kg/m^3)	STRENGTH UCS (MPa)	COMMENTS
4362	W417 @ 5.30 - 5.45m	154			SAMPLE BROKEN BEFORE TEST - PLI DONE		
4365	W417 @ 10.73 - 10.93m	210	123	63	2712	41.4	FAILURE TYPE - SHEARED
4370	W411 @ 4.93 - 5.05m	123	110	63	2514	14.1	FAILURE TYPE - SHEARED
4371	W411 @ 7.80 - 7.93m	142	116	63	2666	43.0	FAILURE TYPE - SHEARED
4374	W452 @ 2.46 - 2.65m	192	128	61	2614	70.8	FAILURE TYPE - SHATTERED
4375	W452 @ 2.65 - 2.85m	210	126	61	2675	106.7	FAILURE TYPE - SHATTERED
4378	W521 @ 2.27 - 2.46m	203	122	62	2671	13.2	FAILURE TYPE - SHATTERED
4380	W521 @ 2.71 - 2.95m	220	126	63	2668	9.6	FAILURE TYPE - SHATTERED
4385	W564 @ 4.96 - 5.10m	150	129	61	2618	27.7	FAILURE TYPE - SHATTERED
4386	W564 @ 6.60 - 6.72m	120	110	63	2715	78.6	FAILURE TYPE - SHATTERED
4396	E6 @ 8.00 - 8.18m	138			SAMPLE BROKEN BEFORE TEST - PLI DONE		
4397	E6 @ 8.34 - 8.46m	124			SAMPLE BROKEN BEFORE TEST - PLI DONE		
4401	E7 @ 2.78 - 3.12m	300	120	61	2124	9.2	FAILURE TYPE - SHATTERED
4402	E7 @ 3.17 - 3.45m	298	124	63	2271	29.2	FAILURE TYPE - SHEARED
4404	E64 @ 1.60 - 1.87m	280	122	63	2645	63.8	FAILURE TYPE - SHEARED
4405	E64 @ 2.31 - 2.58m	290	124	63	2677	50.0	FAILURE TYPE - SHATTERED
4412	E100 @ 10.32 - 10.42m	110			SAMPLE BROKEN BEFORE TEST - PLI DONE		
4413	E100 @ 12.17 - 12.31m	120	SAMPLE BROKEN INTO SMALL PIECES BEFORE TEST - NO TEST DONE				
4359	W417 @ 5.16 - 5.30m	140			SAMPLE BROKEN BEFORE TEST - PLI DONE		
4360	W417 @ 6.64 - 6.76m	150	105	63	1995	2.9	FAILURE TYPE - SHATTERED
4361	W417 @ 7.43 - 7.57m	130	104	63	2344	2.9	FAILURE TYPE - SHATTERED
NOTE 1: S/NO.: 4359, 4360, 4361 - CORES TOO HARD FOR TRIAXIAL (CD) - UCS DONE INSTEAD NOTE 2: S/NO.: 4362, 4396, 4397, 4412, 4359 - CORES BROKEN BEFORE TEST - PLI DONE INSTEAD							

Remarks:

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DETERMINATION OF POINT LOAD INDICES - ISRM: RTH 325-89

SAMPLE NO.	TEST POSITION	DEPTH FROM (m)	DEPTH TO (m)	TEST TYPE	HEIGHT D (mm)	WIDTH W (mm)	Min Xsect Area A = W*D	EQUIV CORE DIA De= D²	POINT LOAD P (kN)	P LOAD STRENGTH INDICES
4363	W417	5.69	5.79		61	160	9760	3721	1	0.27
4364	W417	9.67	9.76		63	106	6678	3969	0	0.00
4366	W417	11.30	11.40		63	111	6993	3969	6	1.51
4367	W411	1.79	1.89		63	100	6300	3969	0	0.00
4368	W411	4.65	4.83		63	204	12852	3969	12	3.02
4369	W411	4.83	4.88		63	80	5040	3969	10	2.52
4372	W452	2.00	2.08		61	79	4819	3721	1	0.27
4373	W452	2.08	2.23		61	196	11956	3721	34	9.14
4376	W452	3.92	4.02		61	168	10248	3721	17	4.57
4377	W521	2.00	2.15		63	175	11025	3969	1	0.25
4379	W521	2.54	2.64		63	100	6300	3969	5	1.26
4381	W521	2.95	3.11		63	182	11466	3969	0	0.00
4382	W564	2.12	2.24		63	111	6993	3969	3	0.76
4383	W564	2.97	3.07		63	115	7245	3969	0	0.00
4384	W564	3.07	3.17		63	122	7686	3969	12	3.02
4389A	E6	6.57	6.66	Diam	63	75	4725	3969	0	0.00
4389B	E6	6.57	6.66		63	68	4284	3969	0	0.00
4391	E6	7.13	7.22		63	88	5544	3969	0	0.00
4398	E7	1.50	1.61		59	147	8673	3481	0	0.00
4399	E7	1.61	1.69		61	70	4270	3721	0	0.00
4400	E7	2.62	2.70		59	115	6785	3481	1	0.29
4403	E64	0.87	1.06		61	130	7930	3721	16	4.30
4406	E64	2.62	2.68		63	57	3591	3969	2	0.50
4407	E64	3.59	3.70		63	119	7497	3969	13	3.28
4409	E100	1.71	1.79		61	59	3599	3721	0	0.00
4410	E100	2.00	2.07		61	72	4392	3721	0	0.00
4359	W417	5.16	5.30		63	70	4410	3969	0	0.00
4362	W417	5.30	5.45		63	94	5922	3969	0	0.00
4396	E6	8.00	8.18		63	34	2142	3969	0	0.00
4397	E6	8.34	8.46		63	41	2583	3969	0	0.00
4412	E100	10.32	10.42		61	101	6161	3721	0	0.00

The above test results are pertinent to the samples received and tested only.

While the tests are carried out according to recognized standards ControLab shall not be liable for erroneous testing or reporting thereof.

Technical Signatory:

J Atterbury
TR0050

About DNV GL

Driven by our purpose of safeguarding life, property and the environment, DNV GL enables organizations to advance the safety and sustainability of their business. We provide classification, technical assurance, software and independent expert advisory services to the maritime, oil & gas and energy industries. We also provide certification services to customers across a wide range of industries. Combining leading technical and operational expertise, risk methodology and in-depth industry knowledge, we empower our customers' decisions and actions with trust and confidence. We continuously invest in research and collaborative innovation to provide customers and society with operational and technological foresight. Operating in more than 100 countries, our professionals are dedicated to helping customers make the world safer, smarter and greener.