GEOTECHNICAL REPORT

FOR THE PROPOSED RESIDENTIAL APARTMENTS ON ERF 3420 ST FRANCIS BAY (THE ADMIRAL)

5 September 2022 (Rev 0)

Prepared by:
OUTENIQUA GEOTECHNICAL SERVICES
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Prepared for:
CHRYSTAL CHIMES PROPERTIES (PTY) LTD
PORT HOME BUILDING
PORT ST FRANCIS
ST FRANCIS BAY

Ref No: 2022\Ntaba Holdings\Erf 3420 St Francis Bay (The Admiral)\Report\Geotechnical Report 5.9.2022 Rev0

Report review history:

Revision No	Date	Prepared by:	Reviewed by:	Approved by:
0	5.9.2022	I Paton Pr Sci Nat Pr Tech Eng	S Gallant BSc Geol	I Paton Pr Sci Nat Pr Tech Eng
				

Authors qualifications and affiliations:

Iain Paton has post graduate degrees in Geology and Geotechnical Engineering and over 25 years' experience in the mining, energy and construction industries. Iain Paton is a registered geotechnical professional with the Engineering Council of South Africa (ECSA) and the South African Council for Natural and Scientific Professions (SACNSP). Iain Paton is a member of the Geotechnical Division of the South African Institute of Civil Engineering (SAICE), South African Institute of Engineering and Environmental Geologists (SAIEG), the and the Institute of Municipal Engineering of South Africa (IMESA).

Declaration of independence:

The authors of this report are independent professional consultant with no vested interest in the project, other than remuneration for work associated with the compilation of this report.

General limitations:

1. The investigation has been conducted in accordance with generally accepted engineering practice, and the opinions and conclusions expressed in the report are made in good faith based on the information at hand at the time of the investigation.
2. The contents of this report are valid as of the date of preparation. However, changes in the condition of the site can occur over time as a result or either natural processes or human activity. In addition, advancements in the practice of geotechnical engineering and changes in applicable practice codes may affect the validity of this report. Consequently, this report should not be relied upon after an eclipsed period of one year without a review by this firm for verification of validity. This warranty is in lieu of all other warranties, either expressed or implied.
3. Unless otherwise stated, the investigation did not include any specialist studies, including but not limited to the evaluation or assessment of any potential environmental hazards or groundwater contamination that may be present.
4. The investigation is conducted within the constraints of the budget and time and therefore limited information was available. Although the confidence in the information is reasonably high, some variation in the geotechnical conditions should be expected during and after construction. The nature and extent of variations across the site may not become evident until construction. If variations then become apparent this could affect the proposed project, and it may be necessary to re-evaluate recommendations in this report. Therefore, it is recommended that Outeniqua Geotechnical Services is retained to provide specialist geotechnical engineering services during construction in order to observe compliance with the design concepts, specifications and recommendations and to allow design changes in the event that subsurface conditions differ from those anticipated prior to the start of construction. Any significant deviation from the expected geotechnical conditions should be brought to the author's attention for further investigation.
5. The assessment and interpretation of the geotechnical information and the design of structures and services and the management of risk is the responsibility of the appointed engineer.

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List of Appendices

1. Introduction

1.1 Background information

A new group residential development, The Admiral, consisting of multi-storey apartment blocks with up to 4 levels, has been proposed on Erf 3420 St Francis Bay in the Eastern Cape Province (see locality map in **Figure 1**).

The site was investigated in order to determine the geology and geotechnical properties of the site for the design of new structures and civil engineering services.

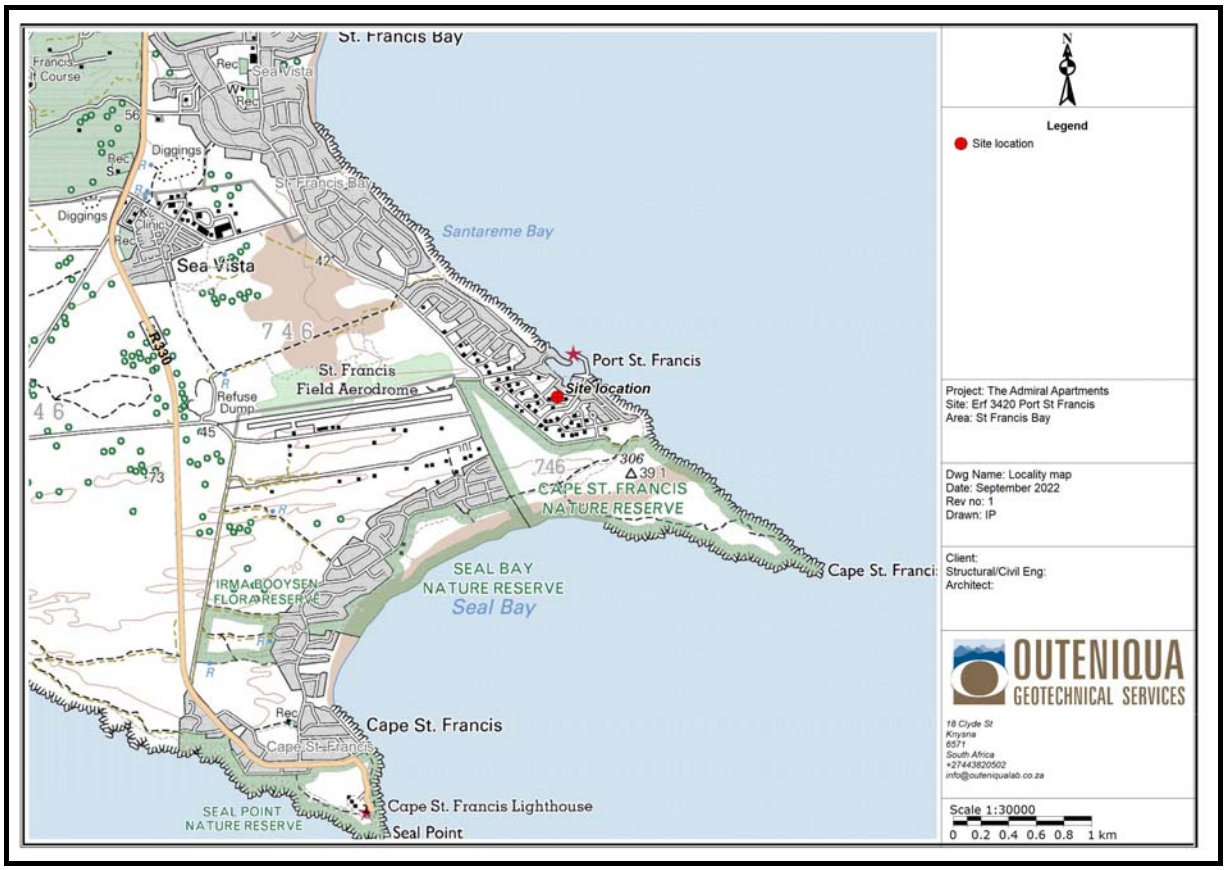

Figure 1: Site locality map

1.2 Scope of work

The scope of work was to conduct a broad-scope geotechnical survey and the following methods were proposed and accepted by the client:

- Review all available geotechnical information on the area.
- Conduct a walk-over survey of the site to assess the terrain, surface processes and apparent geotechnical risks.
- Conduct subsurface investigations to determine soil/rock profile and groundwater conditions, consisting of:
    - 8x test pits, excavated with TLB/backhoe to max depth of 3m or refusal on rock/boulders.
- Log all test pits in accordance with South African standard methods (SAICE Guidelines for Soil and Rock logging in South Africa, 2002).
- Collect soil samples for testing at SANAS-accredited civil engineering laboratory in accordance with South African and/or American/British Standard methods (SANS or ASTM/BS).

- Conduct insitu tests as per South African Standard methods (SANS or TMH).
- Prepare a concise factual and interpretive report, written by a registered Engineering Geologist/Geotechnical Engineer (SACNASP/ECSA), containing all information from the investigation and including soil classifications and recommendations for the design of foundations for structures and civil services, as required in the scope of works.
- Discuss geotechnical data and recommendations with civil and structural designers as and when required.

1.3 Available information

The following information was available for consultation:

- 1:250 000 geological maps of the area, obtained from the Council for Geoscience;
- Topo-cadastral data for the area, obtained from the National Geospatial Institute (NGI).
- Aerial photos of the area, obtained from the NGI and Google Earth.
- Site development plans provided by the developer.
- In-house geotechnical database.

2. Site description

The proposed site was located close to Port St Francis harbour area, to the north of the site (see **Figure 2**). The proposed site was vacant at the time of the investigation and sloped very gently toward the north, although the northern edge of the site had clearly been artificially raised with a block retaining wall up to 5m high (see **Figures 3-4**). The vegetation on the site consisted of long grass, small shrubs and medium to large bushes along the southern and western boundary (See **Figures 3-6**). The ground conditions were generally dry but the surface was irregular in places, with some fairly large depressions (see **Figure 6**), indicating historical filling/dumping of soil and rubble. The site was easily accessible with vehicles from the entrance road on the eastern side of the site.

The site was located in an area with a temperate climate (Weinert N-value ~2-5) which experiences all-year rain. On average, the warmest month is January at 25° C, and the coolest month is July at 19°C. The average annual maximum temperature is 22°C and the average annual minimum temperature is 13°C.

Figure 2: Aerial photo map of the site

Figure 3: View of the site, looking to the west

Figure 4: View of the retaining wall along the northern boundary, looking to the west

Figure 5: View of the site, looking to the east

Figure 6: View of the western side of the site looking northwest (note hollow in foreground)

3. Methods of investigation

A walk-over survey of the site was conducted prior to a subsurface investigation. The subsurface investigation consisted of nine (9) randomly-spaced test pits across the site (See **Appendix 1** for a plan of the test positions). The test pits were excavated with a TLB to a maximum depth of approximately 3m or refusal. This exercise was conducted in order to investigate the near-surface geology and geotechnical nature of the site, including the soil profile and groundwater conditions. The soil profiles and photographs of the test pits were included in **Appendix 2** of this report.

Samples of insitu soils were collected from test pits for laboratory tests including Foundation Indicator (grading, Atterberg limits and moisture content), Modified AASHTO maximum dry density, optimum moisture content, CBR and Direct Shear. The tests were conducted at a SANAS-accredited civil engineering laboratories in accordance with standard test methods. See **Appendix 3** for details.

In situ dynamic cone penetrometer (DCP) tests were conducted at each of the test pit positions. The probes penetrated from ground level (GL) to a depth of ~2m or refusal. Details of the tests were included in **Appendix 4** of this report.

An analysis of the information was then conducted to determine geotechnical parameters and recommendations were then formulated based on the available data.

4. Results of the site investigation

4.1 Regional geology

The regional geological maps indicated that the site was underlain by aeolian sand deposits of Quaternary age, which were unconformably underlain by quartzitic sandstone rock of the Skurweberg Formation of the Table Mountain Group which outcrop along the coastline (**Figure 7**).

Local observations on the site indicated some possible outcrops of calc-arenite (calcareous sandstone) on the southern boundary of the site (see **Figure 8**).

The geology of the area has been widely considered macro stable for urban development purposes with due consideration given to potential geotechnical constraints on a site-level.

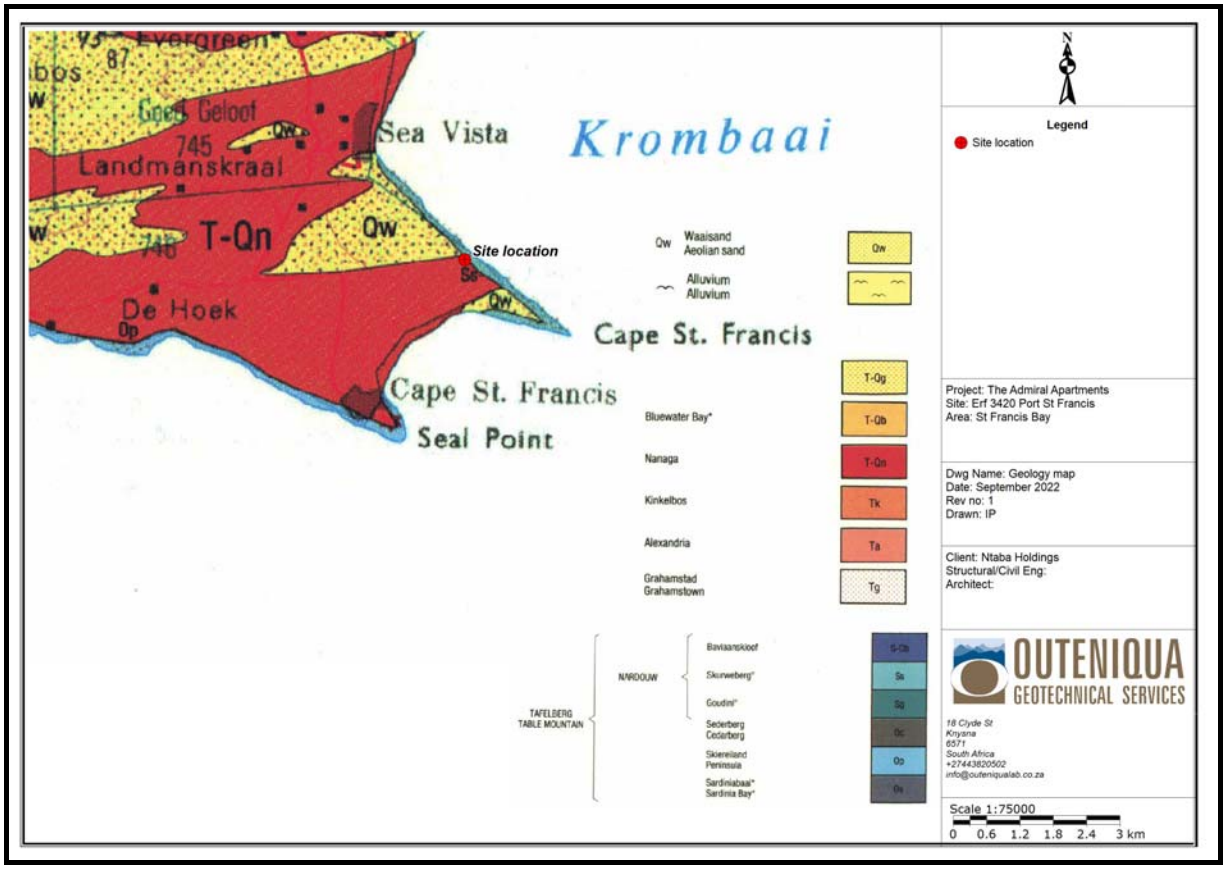

Figure 7: Geological map of site

Figure 8: Possible outcrop of calcarenite rock on the site

4.2 Local soil and rock types

The test pits undertaken as part of this investigation indicated that the soil profile on the site generally consisted of a layer of uncontrolled fill soil & rubble, which was underlain by the insitu aeolian sands. The thickness of the fill material over the majority of the site was approximately 0.5-1.5m but increasing significantly along the western and northern boundary.

In test pits TP1, TP2 and TP4 (central and eastern side of site), soft calcrete rock and boulders was encountered below the insitu aeolian sand at depths ranging from 2.5m to

3m below surface. The TLB machine refused on this hard calcrete. In test pits TP3 and TP5, a gravel & cobble layer was encountered below the aeolian sand (alluvial or marine terrace gravel).

Visual and tactile observations in test pits indicated that the soil moisture contents were generally moist (normal) and no groundwater tables were encountered.

The soil profile was then broadly summarised as follows (note depth intervals were approximated and varied across the site):

- 0-1.5m: Moist, light-dark red brown, loose-medium dense, voided, SILTY GRAVELLY SAND, imported (fill with rubbish and rubble - See **Figure 9**).
- 1.5-3.0m: Moist, light brown/yellow, medium dense to dense, intact, SILTY FINE SAND, aeolian. See **Figure 10**.
- >3.0m: Light brown, dense, GRAVELLY SAND, COBBLES & BOULDERS OR very soft rock CALCRETE rock. See **Figure 11**.

A summary of each of the test pit profiles has been provided in **Table 1**.

Table 1: Summary of test pit data (depths in mm)

Test pos. No.	*Imported (fill)*	*Insitu (natural)*			*Total depth of test pit*	*Refusal?*
		Transported	*Residual*	*Rock*		
TP1	0-900	900-2500	-	2500-2800	2800	Yes
TP2	0-1000	1000-3000	-	3000-3500	3500	Yes
TP3	0-1400	1400-3500	-	-	3500	No
TP4	0-1100	1100-2800	-	2800-3500	3500	Yes
TP5	0-1500	1500-3700	-	-	3700	No
TP6	0-600	600-3000	-	-	3000	No
TP7	0-1000	1000-3300	-	-	3300	No
TP8	0-2200	2200-3800	-	-	3800	No
TP9	0-3150	3150-3600	-	-	3600	No

Figure 9: Gravelly sandy fill material encountered below surface in all pits

Figure 10: Typical insitu aeolian silty sand encountered in the test pits

Figure 11: Boulders and calcrete/calcarenite rock encountered at the base of some pits

4.3 Insitu tests

DCP tests indicated potentially loose consistency of the uncontrolled fill (>40mm/blow), although several tests refused on coarse particles in the fill. The tests indicated that the underlying insitu aeolian sand was typically medium dense to dense (10-20mm/blow – refer to tests TP1, TP3 and TP6 which managed to penetrate the fill).

4.4 Lab tests

Representative samples of the natural/insitu soil types were collected for Foundation Indicator tests to determine the particle size distribution (grading) and Atterberg limits. The results of the Foundation Indicator tests were summarised in **Table 2**.

The particle size analysis indicated the dominance of fine sand particles with minor non-plastic fines. The soils were classified into the following groups under the Unified Soil Classification (USC) system:

- SP – Poorly graded sands.
- SM – Silty sands.

Table 2: **Summary of Foundation Indicator test results**

Test Pit No	Sample Depth (mm)	Atterberg Limits			Particle Analysis (%)				MC *	PE **	USC ***
		PI	LL	LS	Clay	Silt	Sand	Gravel			
TP1	900-2500	NP	NP	0	1	5	94	0	10.8	Low	SP-SM
TP2	1500-3000	NP	NP	0	0	1	98	1	6.0	Low	SP
TP3	2100-3500	NP	NP	0	1	4	70	25	5.5	Low	SP
TP4	1700-2800	NP	NP	0	0	0	100	0	5.1	Low	SP
TP6	1500-3000	NP	NP	0	1	1	98	0	4.8	Low	SP

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

Representative samples were collected for Modified AASHTO density, CBR & Road Indicator tests to determine the potential of the material for structural fill purposes and/or for subgrade fill in road pavement design. The results of the tests were summarised in **Table 3**.

Table 3: Summary of Mod/CBR/Indicator test results

Test Pit No	Sample Depth (mm)	CBR at					Swell (%)	PI (%)	GM	MDD/OMC	TRH14
		100%	98%	95%	93%	90%					
TP1	0-900	43	32	20	15	10	0.0	NP	1.71	1986/8.1	G7
TP2	0-1000	64	46	28	20	12	0.0	NP	1.76	1930/8.8	G7
TP4	1700-2800	28	24	18	15	12	0.0	NP	1.12	1788/10.3	G7
TP6	1500-3000	55	44	31	25	18	0.0	NP	1.00	1748/14.1	G7
TP7	1700-3300	33	25	16	12	8	0.0	NP	1.02	1750/13.0	G9

The tests indicated that the fill material and insitu aeolian sands have low to marginal CBR values (i.e. typically G7-9 class according to TRH14 guidelines), but may be useful for general fill purposes in low structural-loading applications such as behind retaining walls, on platforms, below and around foundations and below surface bed floors. Further recommendations were provided in **Chapter 6**.

5. Geotechnical assessment

5.1 Terrain mapping

Geotechnical mapping is used to classify “terrains” or areas according to the dominant soil types and geotechnical constraints in each area. Each terrain is then classified according to the standard residential site class designations provided under SANS10400-H, which are discussed in the following chapters. The mapping was presented in **Figure 12**.

Due to the broadly consistent profile and conditions, the entire site was mapped as “Terrain 1” which included potentially highly compressible soils (S2) and uncontrolled fill material (P).

5.2 Bearing capacity and settlement

Observations made in test pits and analysis of test results indicated potentially highly compressible uncontrolled fill material (S2/P class) with variable thickness ranging from

0.5m to >3.0m which was underlain by generally medium dense sandy soil with a maximum safe bearing capacity in the order of 100-150kPa with an estimated 5-10mm potential settlement (S1 class). The proposed 3 or 4-storey buildings would therefore have to be founded at greater depth (on deep foundations) or on engineered soil mattress (soil improvement and/or replacement).

5.3 Heave

The investigations indicated no clay on the site.

5.4 Groundwater

Groundwater was not encountered in any of the test pits.

5.5 Surface drainage and soil permeability

The site had a positive gradient fall towards the north and the insitu soils had a medium to high permeability (estimated at $8x10^{-3}$ m/s).

5.6 Natural slope stability

No slope stability issues were identified or expected from the site. The existing retaining wall along the northern boundary appeared to be in good condition.

Figure 12: Geotechnical Map

5.7 Excavation classification and stability

Excavations to a depth of approximately 3m were classified as “Soft” in terms of

SABS1200D. Excavations below 3m on the eastern side of the site were classified as “hard” requiring power-assisted tools, such as hydraulic rock breakers. “Hard excavations on the western side were expected at depths below 4m, but this would have to be confirmed by drilling.

Sidewalls of excavations in sandy overburden were expected to be highly unstable at angles greater than 45° in the short term and 26° in the medium to long term.

6. Recommendations

The design of structures and civil services is the responsibility of the appointed civil and structural engineers. The recommendations contained herein are provided as a guideline only and do not supersede any applicable standards, codes, or project specifications.

The following recommendations are based on limited information gained from the site investigation, and although the confidence in the information is high, variation in ground conditions may occur between information points. All geotechnical information should be confirmed during construction and if necessary, additional investigations may have to be commissioned before construction commences to finalise structural designs. Any significant variations should be brought to the attention of the authors for comment or further recommendations. It is recommended that the structural engineer discuss his/her conceptual design with the geotechnical specialist to ensure that any calculations and recommendations are in line with current information.

6.1 Earthworks and civils

Civil works should be designed and constructed in accordance with SABS 1200 and/or any site-specific specifications provided by the civil engineer.

Some minor bush clearing, including removal of some scattered small trees, and earthworks will be required to clear site in preparation for construction. It is recommended that 150mm of organic-rich topsoil is stripped from below surface on the development areas (roads, platforms, etc) and stockpiled separately on site for landscaping purposes or carted away. Tree roots should also be grubbed from these areas. Any localised depressions (that may also contain wet soils) encountered during site clearance should be excavated and backfilled if necessary with suitable compacted fill to reinstate ground to the required levels. Fill material containing deleterious materials such as rubbish or large boulders, blocks of rubble should be cut to spoil.

Insitu soil material obtained from excavations for road box cuts, foundations and services trenches should be stockpiled for low-loading structural applications such as platforming, roadbed filling, general filling over pipe cradles and against foundations. Soil containing high organic content (typically dark brown topsoil) should be cut to spoil or as directed by the engineer.

Caution should be taken when working near the existing retaining wall on the northern side of the site, as excavations may disturb any reinforcement behind the wall or cause a surcharge loading on the wall.

Recommendations for roadway design include the cutting of the roadbed to the required line and level, followed by compaction of the road bed to 100% MDD to identify soft spots, which should be removed and replaced with suitable imported compactable fill,

such as G7 or G9. The recommended road layerworks for light traffic include 150mm of G6/7 SSG (compacted to 93%MDD), followed by 150-180mm G4/5 subbase (compacted to 95%MDD), followed by 150-180mm G1/2 base course and HMA, or alternatively 60mm concrete or clay brick pavers.

Good site landscaping and a piped underground stormwater management system is recommended to collect, divert and control the discharge of stormwater from structures, hard surfaces and roads to prevent excessive ingress into subsoils or erosion on site, which could affect the stability of structures and roads, causing settlement or other stability problems.

6.2 Foundations

Foundations for structures should be designed and constructed in accordance with SANS 10400-H or any site-specific specification issued by the structural engineers.

Site testing indicates the presence of potentially problematic soils, mainly including deposits of uncontrolled fill (possibly up to 4m thick in places), which could result in settlement of structures if improperly founded on this material. The impact of this is the requirement for mitigation measures, possibly involving significant excavation and replacement of unsuitable soil with engineered fill (e.g. imported material or stabilised soil ex-insitu), or deep foundations (e.g. piles). The recommended method for multi-storey structures (i.e. 3-4 storey) is bored cast insitu pile foundations (e.g. temporary cased rota piles), socketed through boulder horizons and into the underlying bedrock at depths to be determined by further investigations (e.g. drilling).

Detached Type 1 masonry buildings (single/double storey with foundation pressure less than 150kPa) can be founded on a raft foundation a recompacted soil mattress, the thickness of which can be determined on site depending on applied loads. The soil mattress can consist of recompacted insitu soils or suitable existing fill, possibly with basal geogrid reinforcement. Allowance should also be made for imported of some high-quality fill materials for final layerworks, such as G5 crushed rock, or any other materials to facilitate preparation of the final founding medium. At-grade concrete slabs/surface beds should be supported on suitable fill, compacted to 95%MDD and reinforced with steel mesh.

7. Conclusions

The site is generally considered suitable for the proposed development but there are some geotechnical constraints expected which may incur significant additional costs to mitigate. Some preliminary recommendations have been provided for consideration by the design engineers, but further investigations may be required.

Appendix 1

Maps

N

Legend

Site location

Project: The Admiral Apartments
Site: Erf 3420 Port St Francis
Area: St Francis Bay

Dwg Name: Locality map
Date: September 2022
Rev no: 1
Drawn: IP

Client:
Structural/Civil Eng:
Architect:

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6571
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Scale 1:30000

0 0.2 0.4 0.6 0.8 1 km

N

Legend

Site boundary

Project: The Admiral Apartments
Site: Erf 3420 Port St Francis
Area: St Francis Bay

Dwg Name: Aerial photo map
Date: September 2022
Rev no: 1
Drawn: IP

Client: Ntaba Holdings
Structural/Civil Eng:
Architect:

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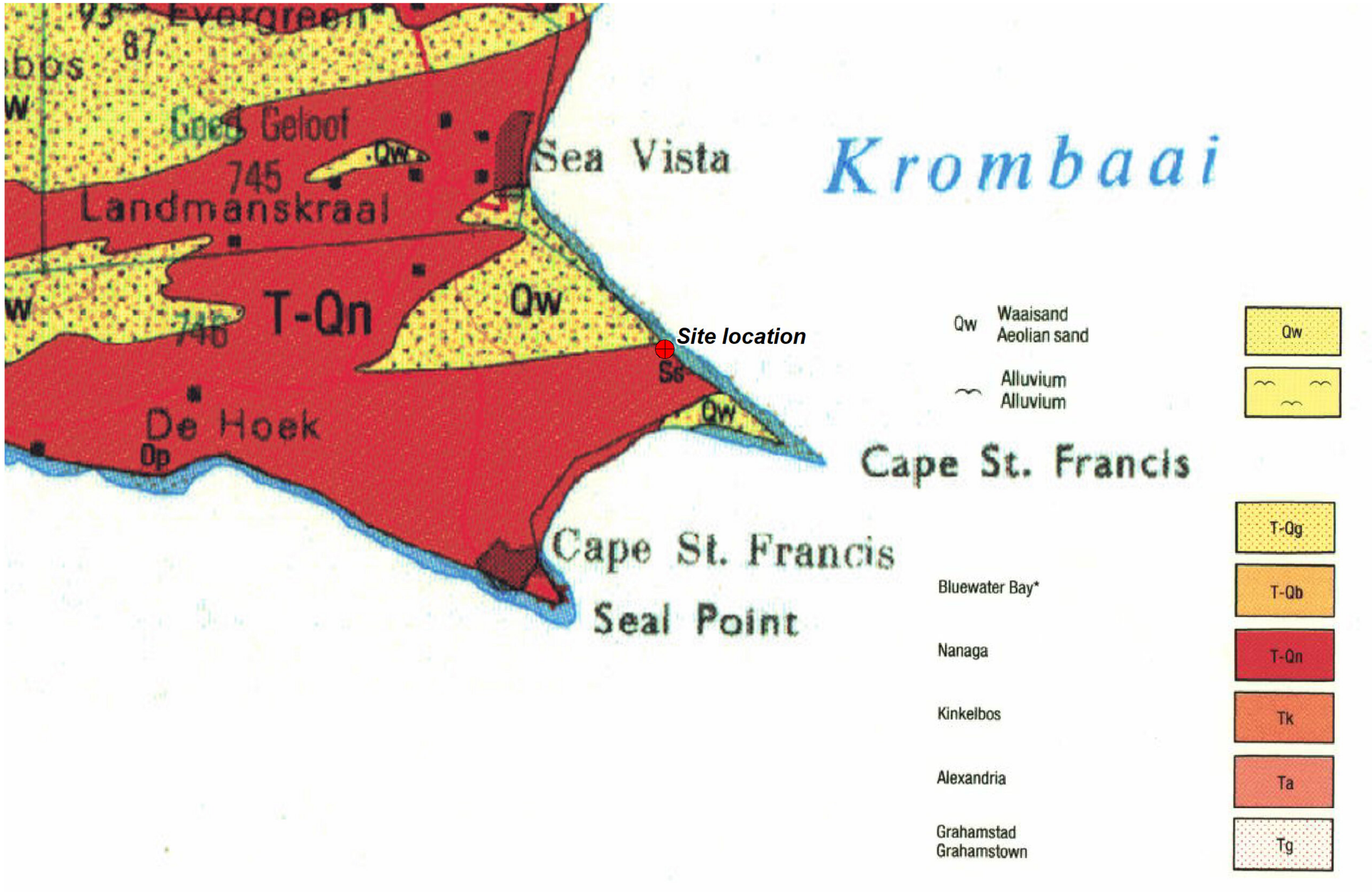
Scale 1:5000

0 30 60 90 150 m



N

Legend

Site location

Project: The Admiral Apartments
Site: Erf 3420 Port St Francis
Area: St Francis Bay

Dwg Name: Geology map
Date: September 2022
Rev no: 1
Drawn: IP

Client: Ntaba Holdings
Structural/Civil Eng:
Architect:

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Scale 1:75000

0 0.6 1.2 1.8 2.4 3 km

N

Legend

- Site boundary

Geotechnical terrains

- Terrain 1 (S2/P)
- Test positions
- Fill thickness

Project: The Admiral Apartments
Site: Erf 3420 Port St Francis
Area: St Francis Bay

Dwg Name: Geotechnical map
Date: September 2022
Rev no: 1
Drawn: IP

Client: Ntaba Holdings
Structural/Civil Eng:
Architect:

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Scale 1:1250

0 6 12 24 36 48 60 m

Appendix 2

Test pit profiles

Geotechnical Soil Profile

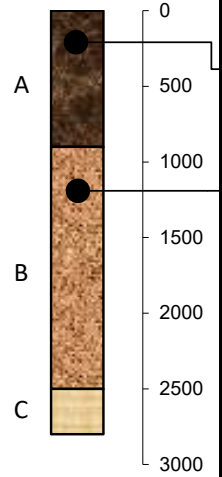
OUTENIQUA GEOTECHNICAL SERVICES

Client:	Ntaba Holdings
Project:	Erf 3420 (The Admiral)
Area:	St Francis Bay
Date:	02.08.2022
Excavator:	TLB

TP 1

Datum: NGL | Co-ords: 25 Y0013654 X3784261

Key to symbols: ● Sample taken | Groundwater



(0 to 900) Moist, light brown, medium dense, intact, **GRAVELLY SILTY SAND**, imported (fill)

MOD/CBR/Indicator

(900 to 2500) Moist, dark brown, medium dense, intact, **SILTY SAND**, transported.

Foundation Indicator

(2500 to 2800) Light brown, highly weathered, slightly fractured, very soft rock, **CALCARENITE/CALCRETE**.

Refusal on Calcarenite/Calcrete hardpan @ 2800mm

No Water

Dynamic Cone Penetrometer (DCP)

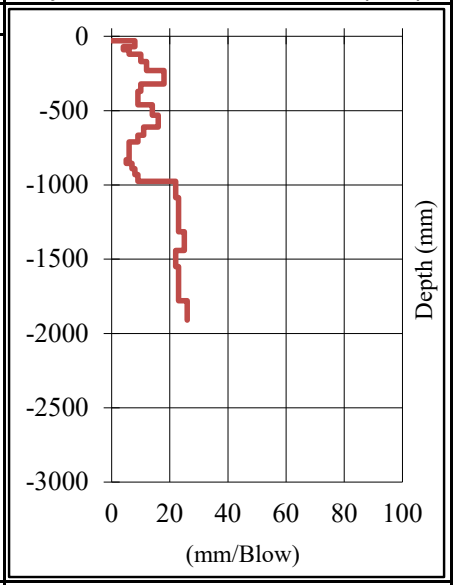
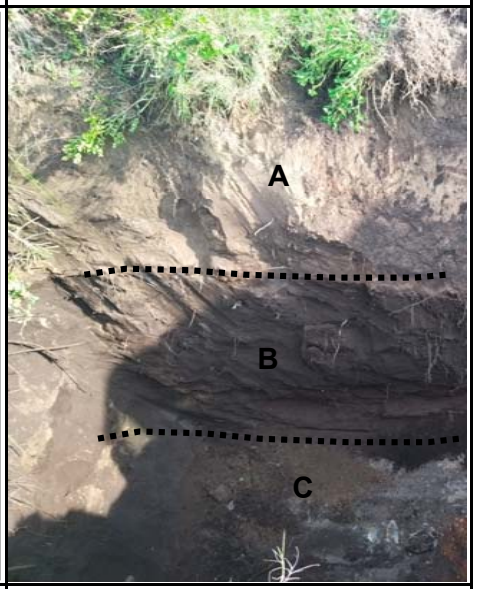


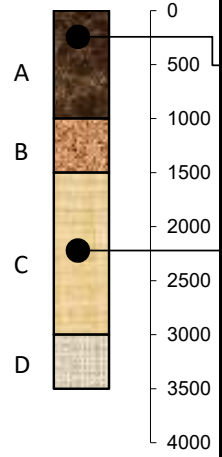
Photo of Test Pit



TP 2

Datum: NGL | Co-ords: 25 Y0013680 X3784248

Key to symbols: ● Sample taken | Groundwater



(0 to 1000) Moist, light brown, medium dense to dense, intact, **SILTY GRAVELLY SAND & BOULDERS, imported** (fill)

MOD/CBR/Indicator

(1000 to 1500) Moist, dark brown, medium dense, intact, **SILTY SAND**, transported.

(1500 to 3000) Moist, light yellow, dense, intact, **SILTY SAND**, transported.

Foundation Indicator

(3000 to 3500) Light yellow to light yellow orange, highly weathered, slightly fractured, very soft rock, **CALCARENITE/CALCRETE**.

Sidewalls Unstable

Refusal @ 3500mm on calcrete hardpan/rock

No Water

Dynamic Cone Penetrometer (DCP)

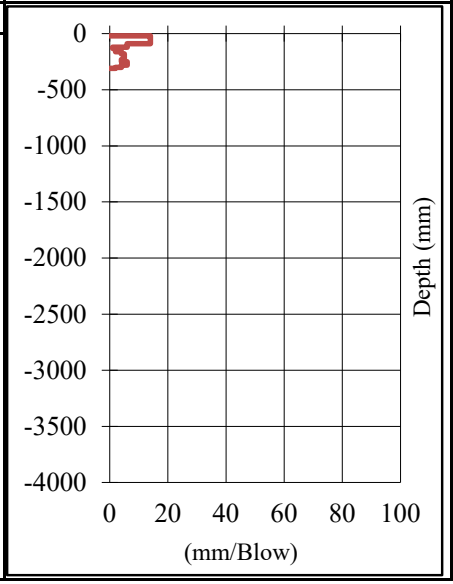
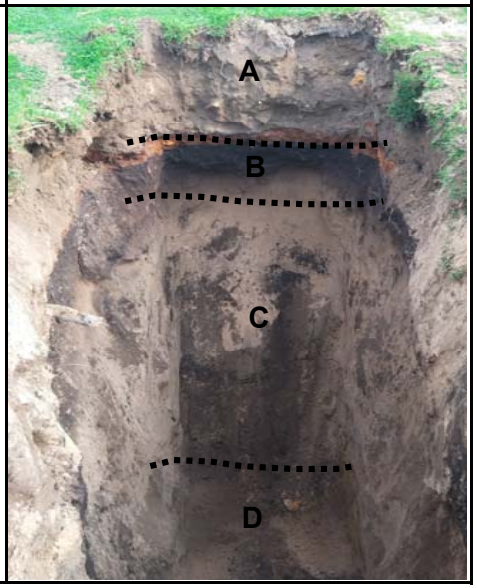


Photo of Test Pit



OUTENIQUA GEOTECHNICAL SERVICES

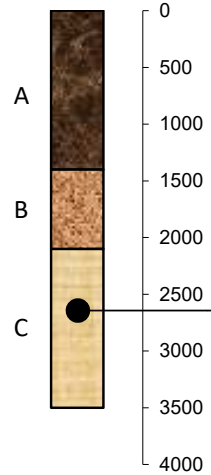
Geotechnical Soil Profile

Client:	Ntaba Holdings
Project:	Erf 3420 (The Admiral)
Area:	St Francis Bay
Date:	02.08.2022
Excavator:	TLB

TP 3

Datum: NGL | Co-ords: 25 Y0013689 X3784264

Key to symbols: ● Sample taken | Groundwater



(0 to 1400) Moist, light brown, loose to medium dense, intact, **SILTY GRAVELLY SAND & BOULDERS**, imported (fill)

(1400 to 2100) Moist, dark brown, medium dense, intact, **SILTY SAND**, aeolian

(2100 to 3500) Moist, light brown to light yellow, dense to very dense, clast supported, **SILTY SAND & COBBLES & BOULDERS**, marine terrace deposit

Foundation Indicator

Sidewalls Unstable

No Water

Dynamic Cone Penetrometer (DCP)

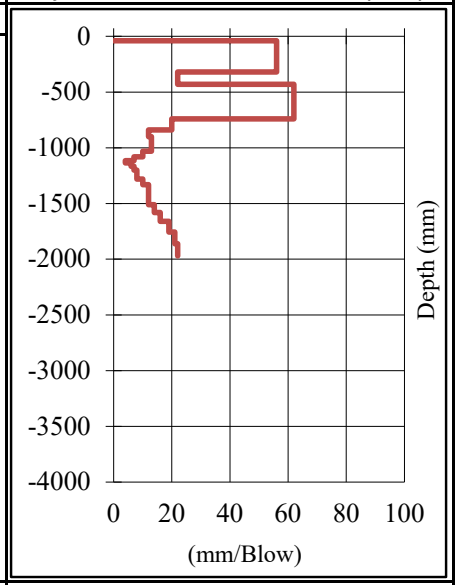
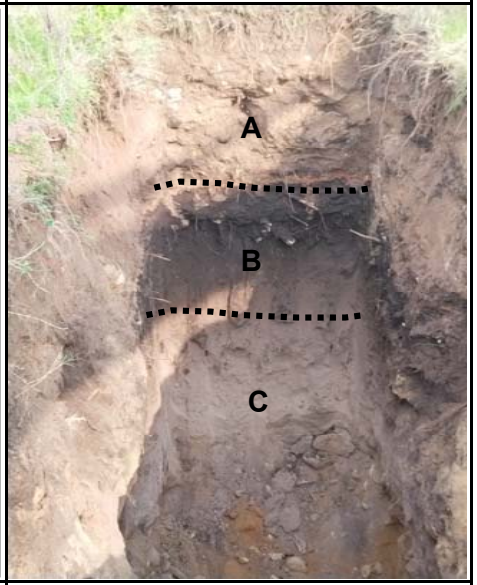


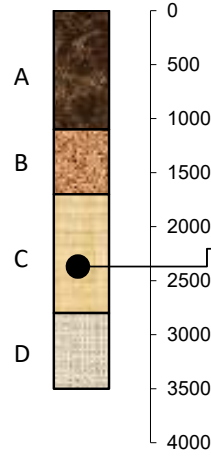
Photo of Test Pit



TP 4

Datum: NGL | Co-ords: 25 Y0013713 X3784248

Key to symbols: ● Sample taken | Groundwater



(0 to 1100) Moist, light red brown, medium dense to dense, intact, **SILTY GRAVELLY SAND & BOULDERS**, imported (fill)

(1100 to 1700) Moist, dark brown, medium dense, intact, **SILTY SAND**, colluvium (topsoil

(1700 to 2800) Moist, light brown to light yellow orange, dense, intact, **GRAVELLY SILTY SAND**, transported (isolated cemented sand)

Foundation Indicator & SHEAR BOX & MOD/CBR/Indicator

(2800 to 3500) Light brown, highly weathered, slightly fractured, very soft rock, **CALCARENITE/CALCRETE hardpan**.

TP Stopped - slow refusal

No Water

Dynamic Cone Penetrometer (DCP)

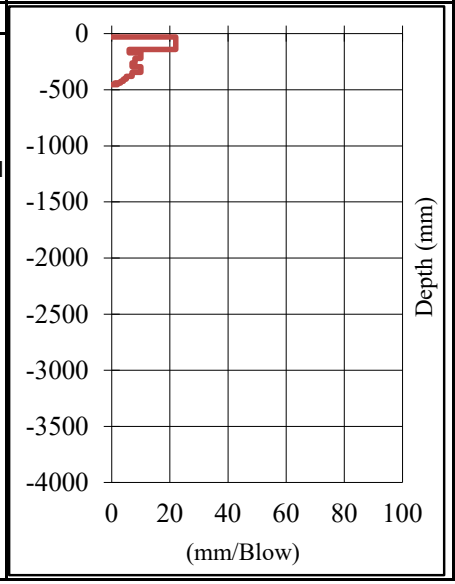
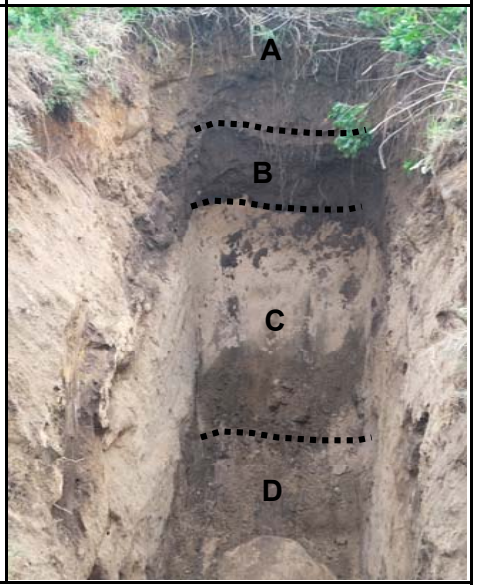


Photo of Test Pit



Geotechnical Soil Profile

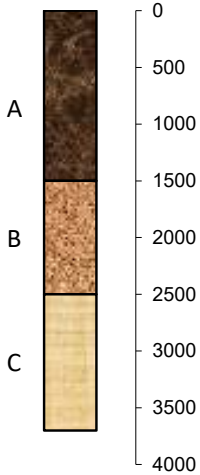
OUTENIQUA GEOTECHNICAL SERVICES

Client:	Ntaba Holdings
Project:	Erf 3420 (The Admiral)
Area:	St Francis Bay
Date:	02.08.2022
Excavator:	TLB

TP 5

Datum: NGL | Co-ords: 25 Y0013722 X3784260

Key to symbols: ● Sample taken | Groundwater



(0 to 1500) Moist, light brown to light red brown, medium dense to dense, voided, **SILTY GRAVELLY SAND & BOULDERS**, imported (fill)

(1500 to 2500) Moist, dark brown, medium dense, intact, **SILTY SAND**, aeolian.

(2500 to 3700) Moist, light brown to light yellow, dense, intact, **GRAVELLY SILTY SAND**, transported (marine terrace deposit).

TP stopped, no refusal
No Water

Dynamic Cone Penetrometer (DCP)

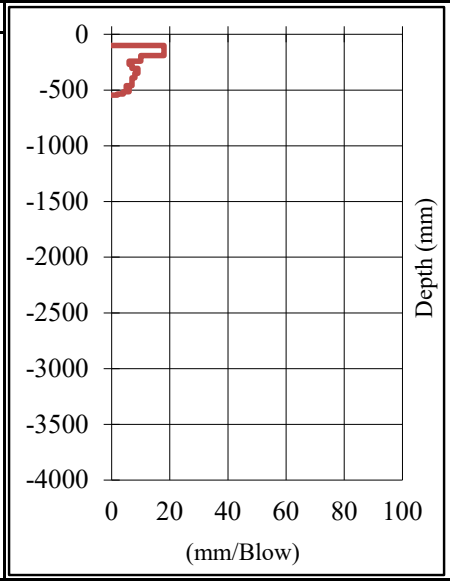
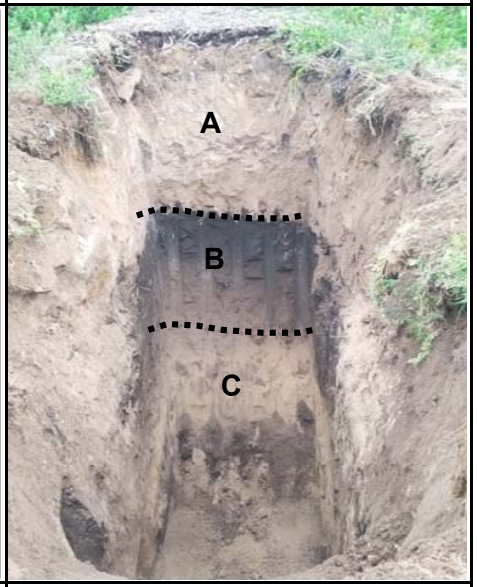


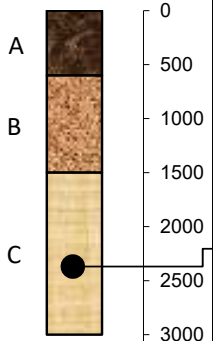
Photo of Test Pit



TP 6

Datum: NGL | Co-ords: 25 Y0013746 X3784248

Key to symbols: ● Sample taken | Groundwater



(0 to 600) Moist, dark red brown, medium dense, voided, **GRAVELLY SILTY SAND & BOULDERS**, imported (fill)

(600 to 1500) Moist, dark brown, medium dense to dense, intact, **SILTY SAND**, aeolian

(1500 to 3000) Moist, light yellow to light brown, dense, intact, **SILTY SAND**, aeolian

Foundation Indicator & MOD/CBR/Indicator

TP stopped, no refusal
Sidewalls Collapsed
No Water

Dynamic Cone Penetrometer (DCP)

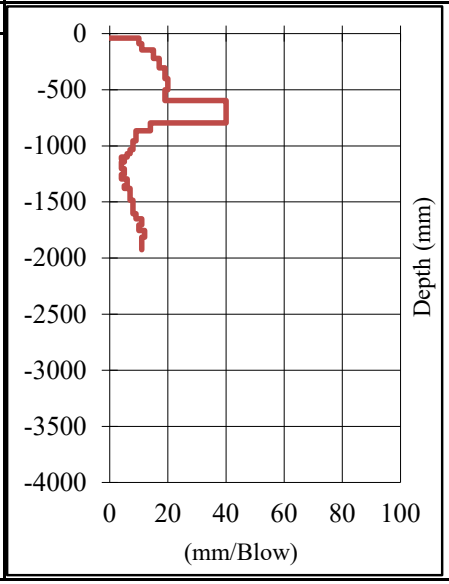
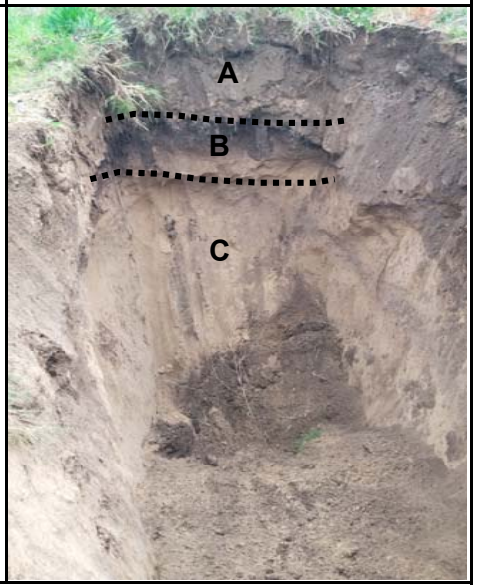


Photo of Test Pit



OUTENIQUA GEOTECHNICAL SERVICES

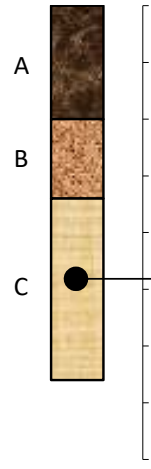
Geotechnical Soil Profile

Client:	Ntaba Holdings
Project:	Erf 3420 (The Admiral)
Area:	St Francis Bay
Date:	02.08.2022
Excavator:	TLB

TP 7

Datum: NGL | Co-ords: 25 Y0013764 X3784252

Key to symbols: ● Sample taken | Groundwater



(0 to 1000) Moist, light brown, medium dense, intact, **SILTY GRAVELLY SAND & BOULDERS**, imported (fill)

(1000 to 1700) Moist, dark brown, medium dense, intact, **SILTY SAND**, colluvium (topsoil)

(1700 to 3300) Moist, light brown to light yellow, dense, intact, **GRAVELLY SILTY SAND**, aeolian/pedogenic (isolated cemented sand nodules)

MOD / CBR / Indicator

Sidewalls Collapsed

No Water

Dynamic Cone Penetrometer (DCP)

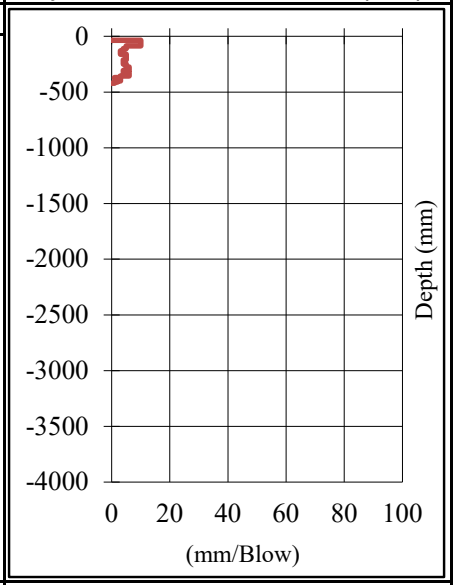


Photo of Test Pit

TP 8

Datum: NGL | Co-ords: 25 Y0013772 X3784233

Key to symbols: ● Sample taken | Groundwater

(0 to 2200) Moist, dark brown to light brown, loose, voided, **SILTY GRAVELLY SAND & BOULDERS**, imported (fill)

(2200 to 3000) Moist, dark brown, medium dense, intact, **SILTY SAND**, colluvium (topsoil)

(3000 to 3800) Moist, light brown to light yellow, dense, intact, **SILTY SAND**, aeolian

Sidewalls Unstable

No Water

Dynamic Cone Penetrometer (DCP)

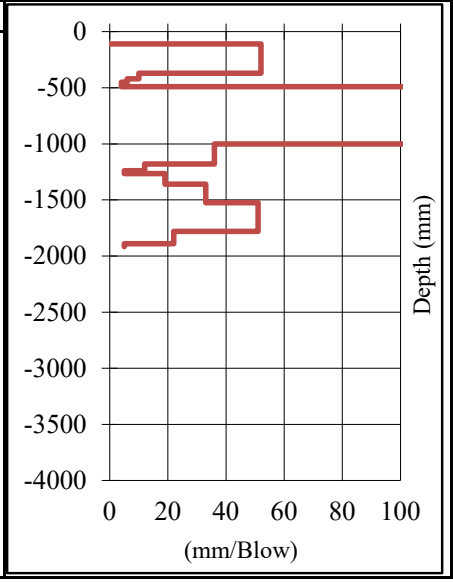
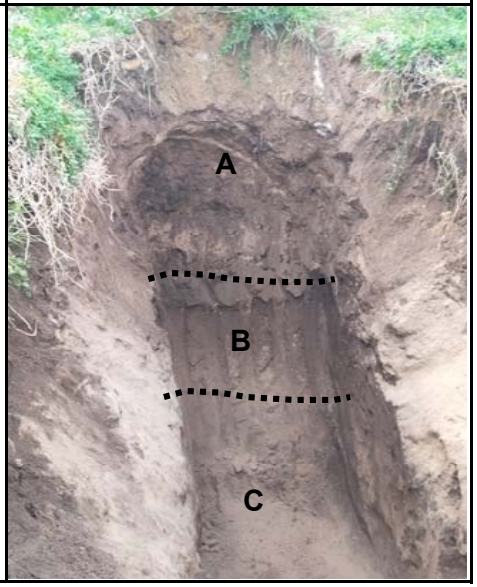


Photo of Test Pit



OUTENIQUA GEOTECHNICAL SERVICES

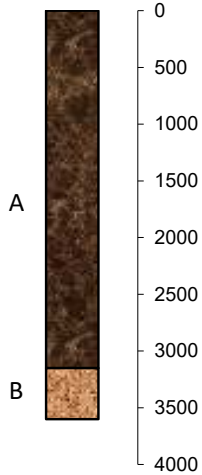
Geotechnical Soil Profile

Client:	Ntaba Holdings
Project:	Erf 3420 (The Admiral)
Area:	St Francis Bay
Date:	02.08.2022
Excavator:	TLB

TP 9

Datum: NGL | Co-ords: 25 Y0013748 X3784210

Key to symbols: ● Sample taken | Groundwater



(0 to 3150) Moist, dark brown to dark red brown, medium dense to dense, intact, **SILTY GRAVELLY SAND & BOULDERS & RUBBLE**, imported (fill)

(3150 to 3600) Moist, dark brown, medium dense, intact, **SILTY SAND**, aeolian

TP Stopped
No Water

Dynamic Cone Penetrometer (DCP)

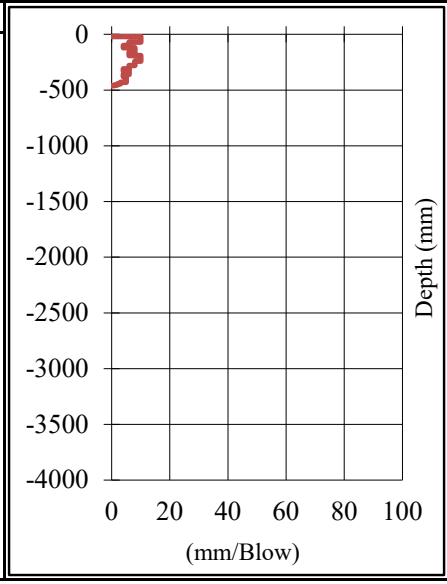
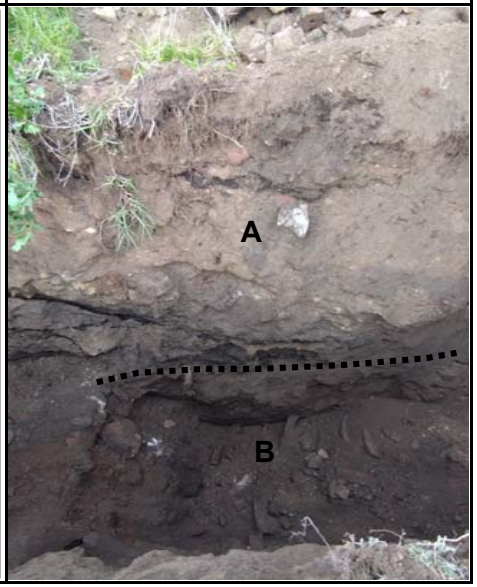


Photo of Test Pit



Appendix 3

Lab test data

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

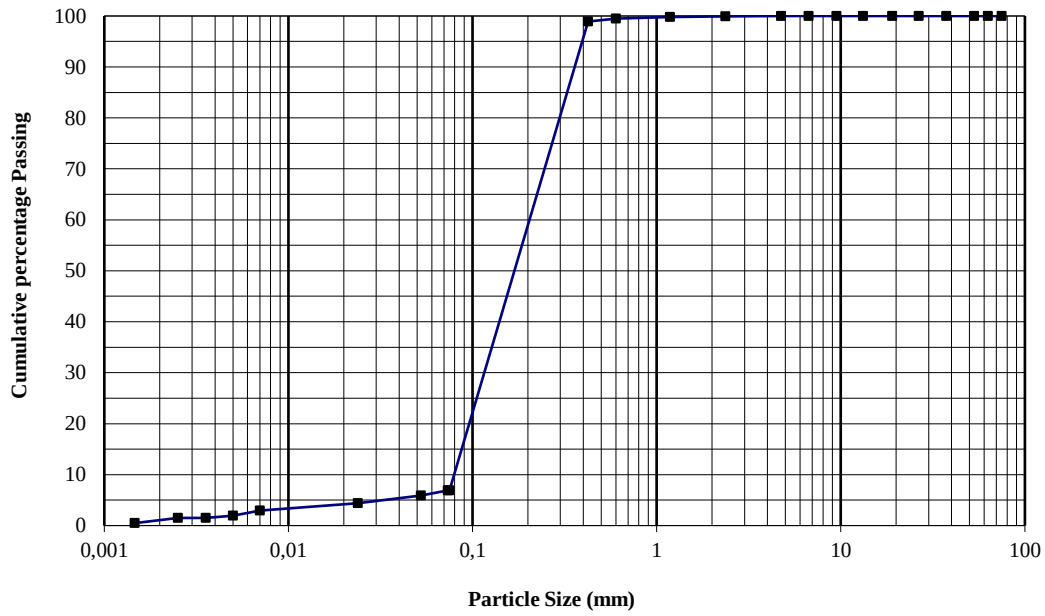
Customer :	Outeniqua Geotechinical Services cc	Project :	Ntaba Holdings - Erf 3420 - ST Francis Bay
	Po Box 964	Date Received :	04/08/22
	Knysna	Date Reported :	31/08/22
	6570	Req. Number :	1438/22
Attention :	I Paton - 0827827793	No. of Pages :	1/5

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

Material Description:	Dark Brown - Silty Sand	Sample Number:	16290		
Position:	TP 1	Liquid Limit	NP	Linear Shrinkage	0
Depth:	900-2500	Plasticity Index	NP	Insitu M/C%	10,8

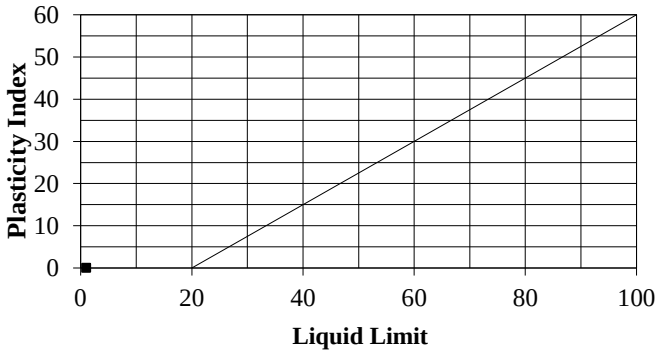
Sieve Size(mm)	% Passing
75,0	100
63,0	100
53,0	100
37,5	100
26,5	100
19,0	100
13,2	100
9,5	100
6,7	100
4,75	100
2,36	100
1,18	100
0,600	100
0,425	99
0,075	7
0,0733	7
0,0524	6
0,0238	4
0,0070	3
0,0050	2
0,0036	1
0,0025	1
0,0015	0

Particle Size Distribution

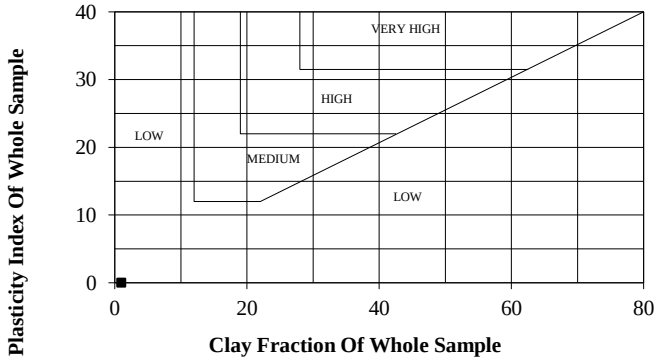


% Clay	1	% Silt	5	% Sand	94	% Gravel	0
Unified Soil Classification		SP-SM		PRA Soil Classification		A-3 / A-2-4	

Plasticity Chart



Potential Expansiveness



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.
2. 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.
3. Results reported in this Test Report relate only to the items tested and are an indication only of the sample provided and/or taken.
4. Measuring Equipment, traceable to National Standards is used where applicable.
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.

Outeniqua Lab EC cc.

Materials Testing Laboratory

Registration No. 2009/230653/23

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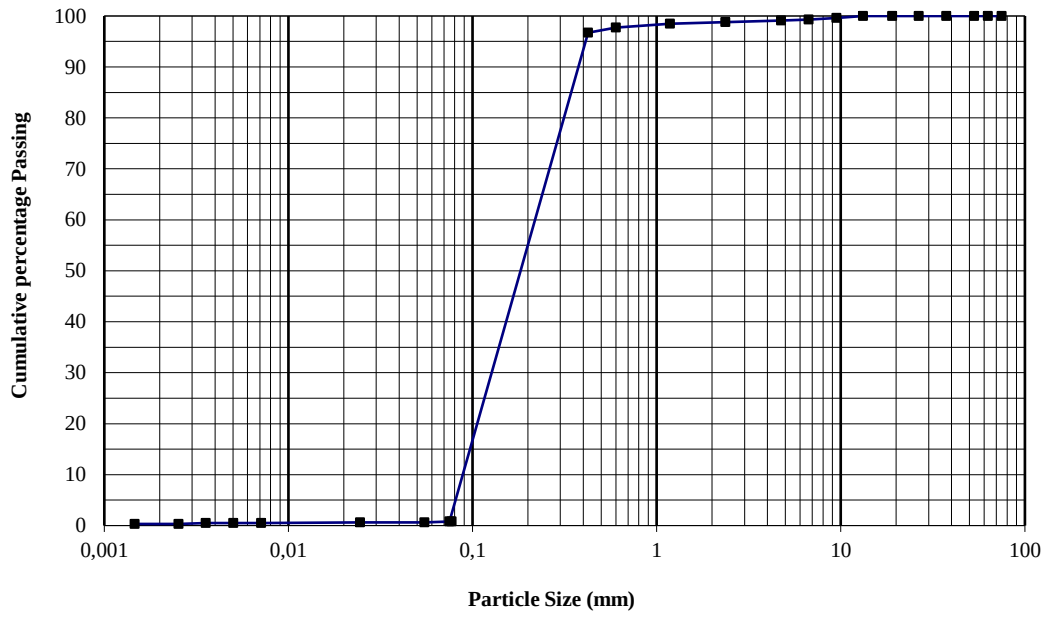
	Po Box 964	Date Received :	04/08/22
	Knysna	Date Reported :	31/08/22
	6570	Req. Number :	1438/22
Attention :	I Paton - 0827827793	No. of Pages :	2/5

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

Material Description:	Light Yellow - Silty Sand	Sample Number:	16292		
Position:	TP 2	Liquid Limit	NP	Linear Shrinkage	0
Depth:	1500-3000	Plasticity Index	NP	Insitu M/C%	6

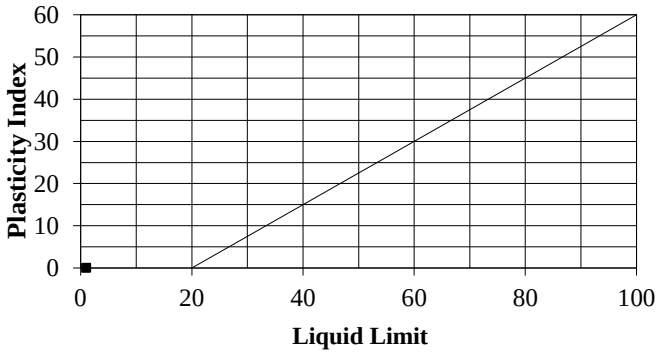
Sieve Size(mm)	% Passing
75,0	100
63,0	100
53,0	100
37,5	100
26,5	100
19,0	100
13,2	100
9,5	100
6,7	99
4,75	99
2,36	99
1,18	99
0,600	98
0,425	97
0,075	1
0,0772	1
0,0547	1
0,0245	1
0,0071	0
0,0050	0
0,0036	0
0,0025	0
0,0015	0

Particle Size Distribution

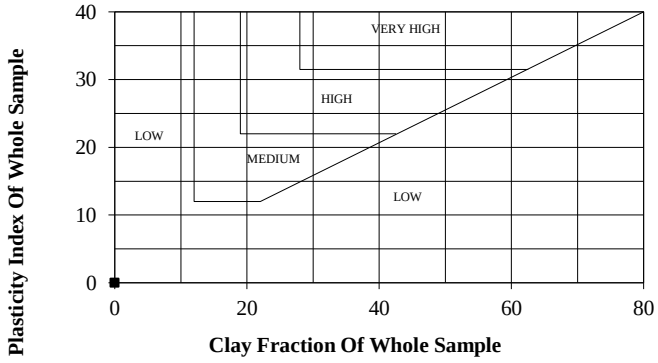


% Clay	0	% Silt	1	% Sand	98	% Gravel	1
Unified Soil Classification		SP		PRA Soil Classification		A-3 / A-2-4	

Plasticity Chart



Potential Expansiveness



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

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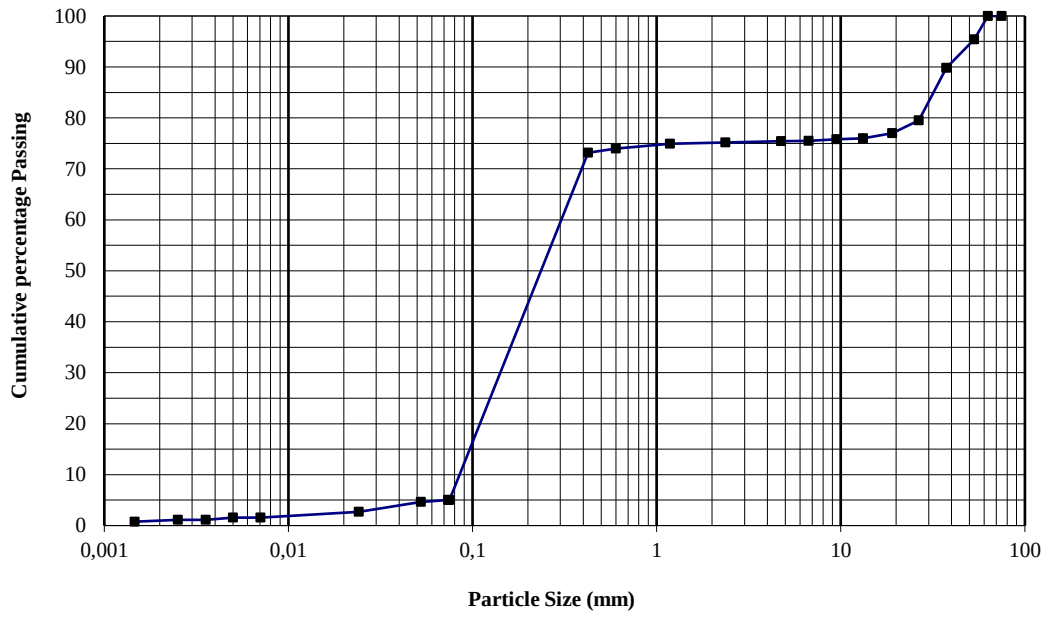
	Po Box 964	Date Received :	04/08/22
	Knysna	Date Reported :	31/08/22
	6570	Req. Number :	1438/22
Attention :	I Paton - 0827827793	No. of Pages :	3/5

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

Material Description:	Light Brown to Light Yellow - Silty Sand with Cobbles & Boulders	Sample Number:	16293		
Position:	TP 3	Liquid Limit	NP	Linear Shrinkage	0
Depth:	2100-3500	Plasticity Index	NP	Insitu M/C%	5,5

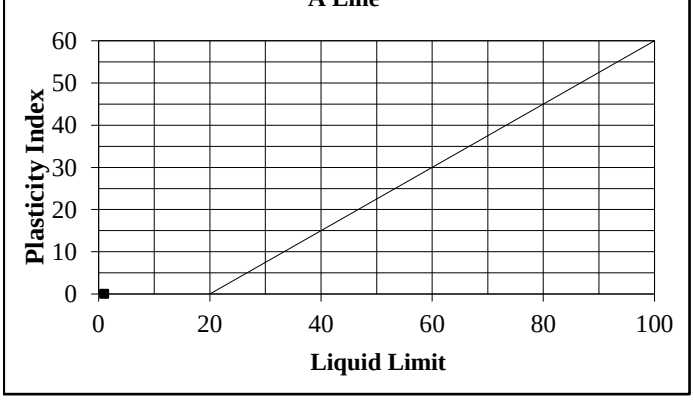
Sieve Size(mm)	% Passing
75,0	100
63,0	100
53,0	95
37,5	90
26,5	80
19,0	77
13,2	76
9,5	76
6,7	76
4,75	75
2,36	75
1,18	75
0,600	74
0,425	73
0,075	5
0,0739	5
0,0524	5
0,0242	3
0,0071	2
0,0050	2
0,0036	1
0,0025	1
0,0015	1

Particle Size Distribution

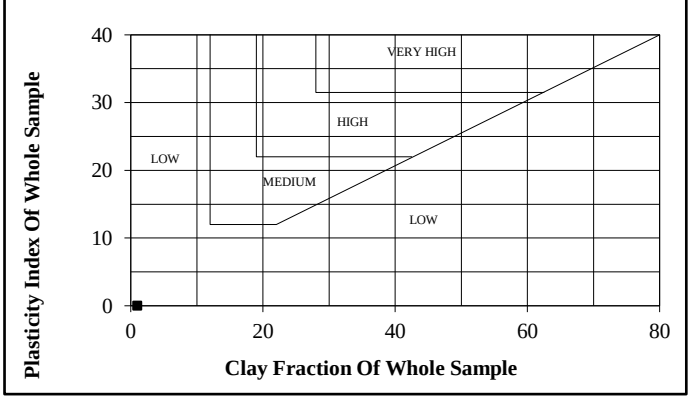


% Clay	1	% Silt	4	% Sand	70	% Gravel	25
Unified Soil Classification		SP		PRA Soil Classification		A-3 / A-2-4	

Plasticity Chart



Potential Expansiveness



Notes:

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

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For Outeniqua Lab EC cc.

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Outeniqua Lab EC cc.

Materials Testing Laboratory

Registration No. 2009/230653/23

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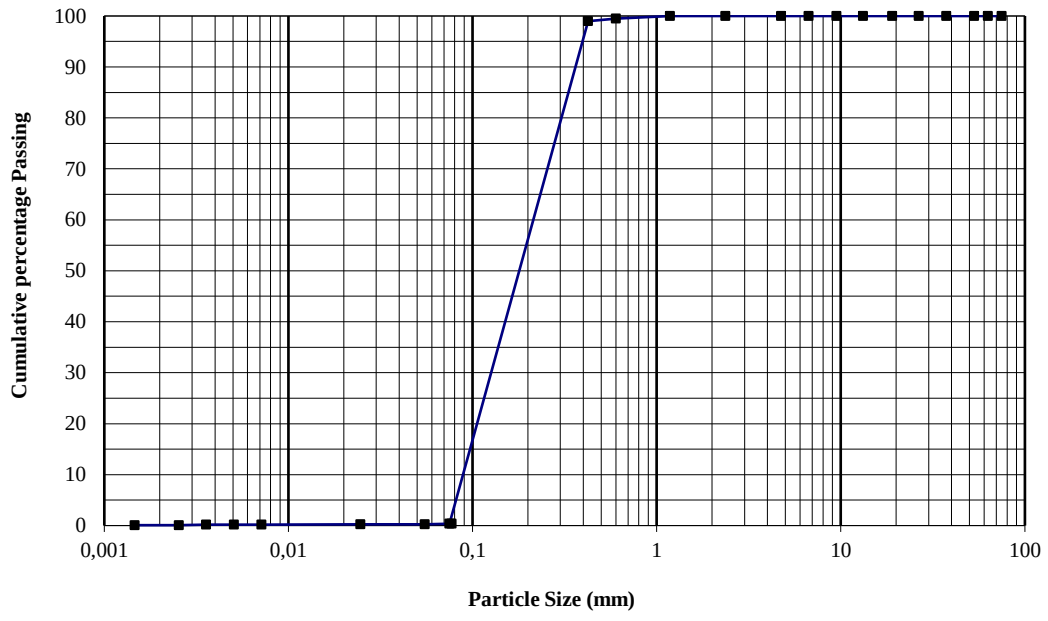
	Po Box 964	Date Received :	04/08/22
	Knysna	Date Reported :	31/08/22
	6570	Req. Number :	1438/22
Attention :	I Paton - 0827827793	No. of Pages :	4/5

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

Material Description:	Light Brown to Light Yellowish Orange - Gravelly Silty Sand	Sample Number:	16294		
Position:	TP 4	Liquid Limit	NP	Linear Shrinkage	0
Depth:	1700-2800	Plasticity Index	NP	Insitu M/C%	5,1

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	100
1,18	100
0,600	100
0,425	99
0,075	0
0,0772	0
0,0551	0
0,0246	0
0,0072	0
0,0051	0
0,0036	0
0,0025	0
0,0015	0

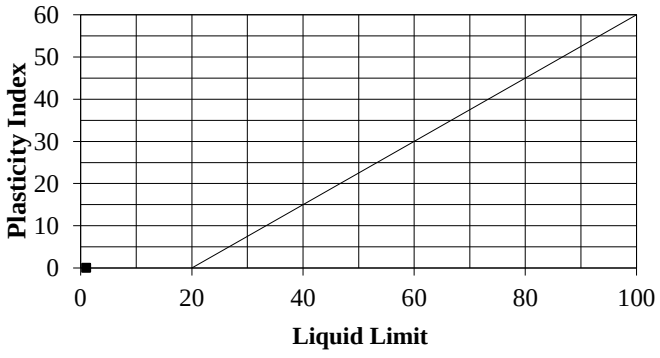
Particle Size Distribution



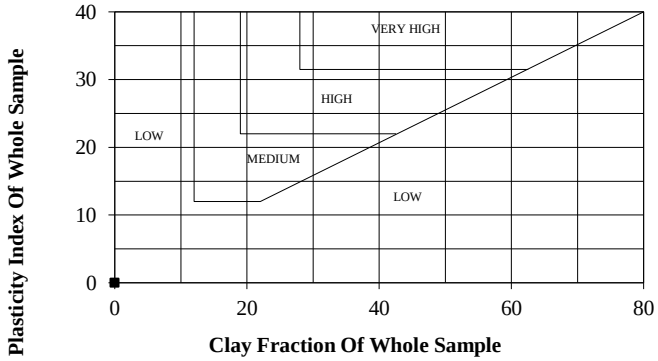
% Clay	0	% Silt	0	% Sand	100	% Gravel	0
Unified Soil Classification		SP		PRA Soil Classification		A-3 / A-2-4	

Plasticity Chart

A Line



Potential Expansiveness



Notes:

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

L Malgraff (Member)
For Outeniqua Lab EC cc.

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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

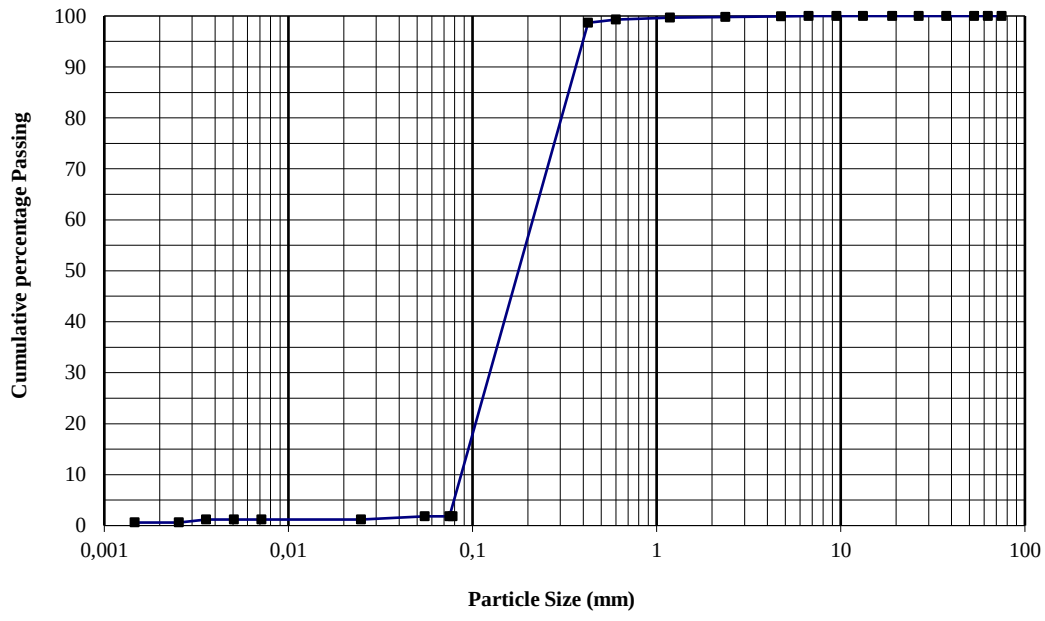
Customer :	Outeniqua Geotechinical Services cc	Project :	Ntaba Holdings - Erf 3420 - ST Francis Bay
	Po Box 964	Date Received :	04/08/22
	Knysna	Date Reported :	31/08/22
	6570	Req. Number :	1438/22
Attention :	I Paton - 0827827793	No. of Pages :	5/5

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

Material Description:	Light Yellow to Light Brown - Silty Sand	Sample Number:	16295		
Position:	TP 6	Liquid Limit	NP	Linear Shrinkage	0
Depth:	1500-3000	Plasticity Index	NP	Insitu M/C%	4,8

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	100
1,18	100
0,600	99
0,425	99
0,075	2
0,0779	2
0,0551	2
0,0248	1
0,0072	1
0,0051	1
0,0036	1
0,0025	1
0,0015	1

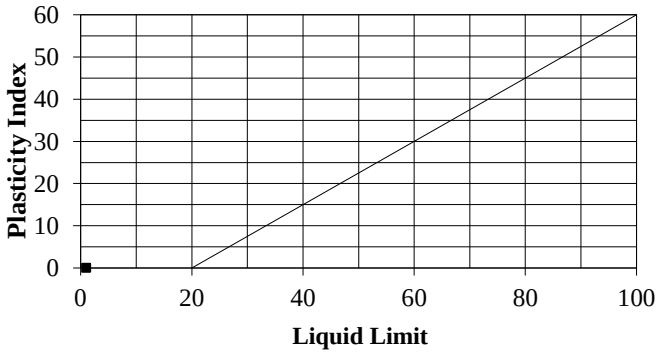
Particle Size Distribution



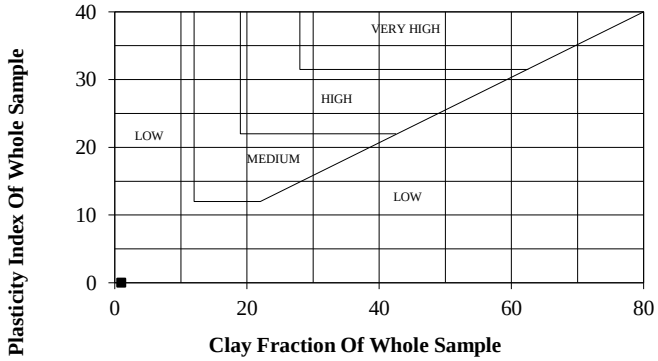
% Clay	1	% Silt	1	% Sand	98	% Gravel	0
Unified Soil Classification		SP		PRA Soil Classification		A-3 / A-2-4	

Plasticity Chart

A Line



Potential Expansiveness



Notes:

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

L Malgraff (Member)
For Outeniqua Lab EC cc.

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

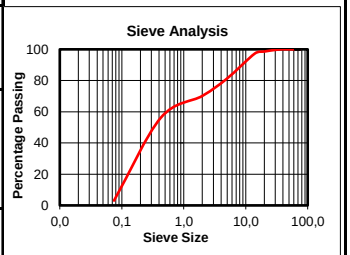
Customer :	Outeniqua Geotechinical Services cc	Project :	Ntaba Holdings - Erf 3420 - St.Francis Bay
	Po Box 964	Date Received :	04/08/22
	Knysna	Date Reported :	09/09/22
	6570	Req. Number :	1438/22
Attention :	I Paton - 0827827793	No. of Pages :	1/3

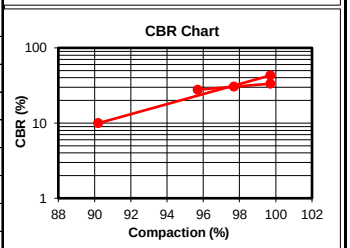
TEST REPORT

CALIFORNIA BEARING RATIO - (SANS 3001 Method GR1,PR5*,GR10,GR20,GR30,GR40)

Material Indicators				
Sample Position (SV)		TP 1		TP 2
Depth (mm)		0-900		0-1000
Sample No		**16289**		**16291**
Materials Description	Source	Test Pit		Test Pit
	Colour	Light Brown		Light Brown
	Soil Type	Gravelly Silty Sand		Silty Gravelly Sand with Boulders
	Classification	Unknown		Unknown
Max. Stone size in hole (mm)				
Percentage Passing	75.0mm	100		79
	63.0mm	100		79
	50.0mm	100		79
	37.5mm	100		77
	28.0mm	100		75
	20.0mm	99		74
	14.0mm	97		70
	5.00mm	81		64
	2.00mm	70		62
	0.425mm	56		55
	0.075mm	3,1		7,1
Soil Mortar & Constants				
Grading Modulus		1,71		1,76
Coarse Sand (%)		20		11
Fine Sand (%)		76		78
Silt & Clay (%)		4		12
Liquid Limit (%)		NP		NP
Plasticity Index (%)		NP		NP
Linear Shrinkage (%)		0,0		0,0
CBR / Density Relationship				
MOD	Max Dry Density (kg/m³)	1986		1930
	Opt Moisture Content (%)	8,1		8,8
	Mould Moisture Con. (%)	8,1		8,7
	@100% Mod AASHTO	99,7		100,0
	Swell (%)	0,00		0,00
Proc NRB	100% NRB	95,7		95,6
	Swell (%)	0,00		0,00
Proc	100% Proctor	90,2		90,6
	Swell (%)	0,00		0,00
CBR	@ 100% Mod AASHTO	43		64
	@ 98% Mod AASHTO	32		46
	@ 95% Mod AASHTO	20		28
	@ 93% Mod AASHTO	15		20
	@ 90% Mod AASHTO	10		12
Insitu Moisture Content (%)				
Soil Classification Achieved By The Material				
TRH 14:		G7 SSG		G7 SSG
AASTHO System		A-3 / A-2-4		A-3 / A-2-4
Unified System		SW		SW-SM

16289





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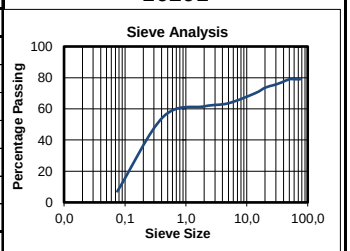

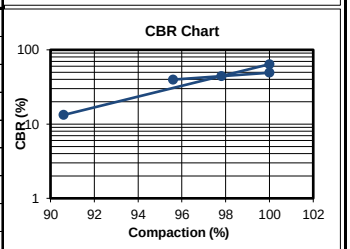

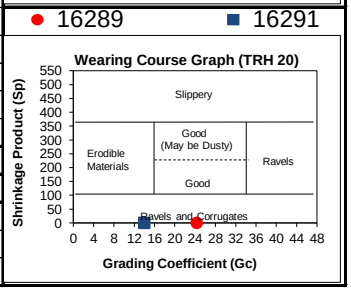

- **Specimens delivered to Outeniqua Lab in good order.**
- ***Non Accredited Test Method.**

Luwayne Malgraff
Technical Signatory
For Outeniqua Lab EC cc.

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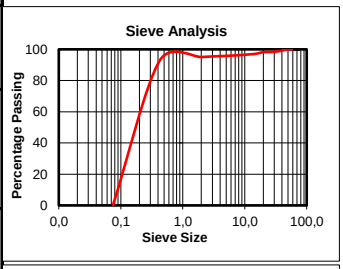
	Po Box 964	Date Received :	04/08/22
	Knysna	Date Reported :	09/09/22
	6570	Req. Number :	1438/22
Attention :	I Paton - 0827827793	No. of Pages :	2/3

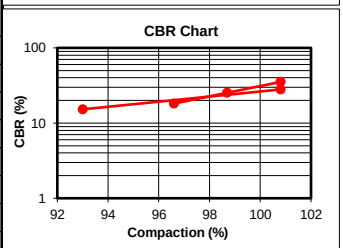
TEST REPORT

CALIFORNIA BEARING RATIO - (SANS 3001 Method GR1,PR5*,GR10,GR20,GR30,GR40)

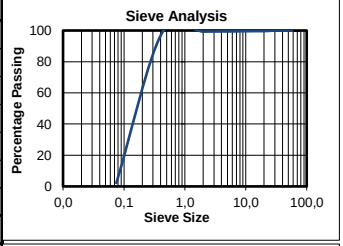
Material Indicators							
Sample Position (SV)		TP 4			TP 6		
Depth (mm)		1700-2800			1500-3000		
Sample No		**16294**			**16295**		
Materials Description	Source	Test Pit			Test Pit		
	Colour	Light Brown - Light Yellow Orange			Light Yellow - Light Brown		
	Soil Type	Gravelly Silty Sand			Silty Sand		
	Classification	Unknown			Unknown		
Max. Stone size in hole (mm)							
Percentage Passing	75.0mm	100			100		
	63.0mm	100			100		
	50.0mm	100			100		
	37.5mm	99			100		
	28.0mm	98			100		
	20.0mm	98			100		
	14.0mm	97			100		
	5.00mm	96			99		
	2.00mm	95			99		
	0.425mm	93			99		
	0.075mm	0,4			2,2		
Soil Mortar & Constants							
Grading Modulus		1,12			1,00		
Coarse Sand (%)		2			1		
Fine Sand (%)		97			97		
Silt & Clay (%)		0			2		
Liquid Limit (%)		NP			NP		
Plasticity Index (%)		NP			NP		
Linear Shrinkage (%)		0,0			0,0		
CBR / Density Relationship							
MOD	Max Dry Density (kg/m³)	1788			1748		
	Opt Moisture Content (%)	10,3			14,1		
	Mould Moisture Con. (%)	10,3			14,0		
	@100% Mod AASHTO	100,8			100,0		
	Swell (%)	0,00			0,00		
Proc NRB	100% NRB	96,6			95,4		
	Swell (%)	0,00			0,00		
	100% Proctor	93,0			91,9		
	Swell (%)	0,00			0,00		
CBR	@ 100% Mod AASHTO	28			55		
	@ 98% Mod AASHTO	24			44		
	@ 95% Mod AASHTO	18			31		
	@ 93% Mod AASHTO	15			25		
	@ 90% Mod AASHTO	12			18		
Insitu Moisture Content (%)							
Soil Classification Achieved By The Material							
TRH 14:		G7 SSG			G7 SSG		
AASTHO System		A-3 / A-2-4			A-3 / A-2-4		
Unified System		SP			SP		

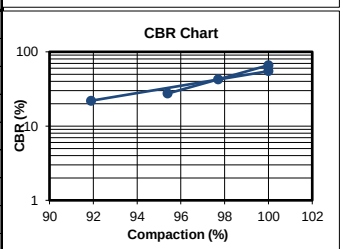
16294

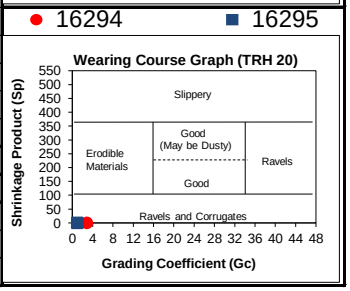




16295







- **Specimens delivered to Outeniqua Lab in good order.**
- ***Non Accredited Test Method.**

Luwayne Malgraff
Technical Signatory
For Outeniqua Lab EC cc.

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Registration No. 2009/230653/23

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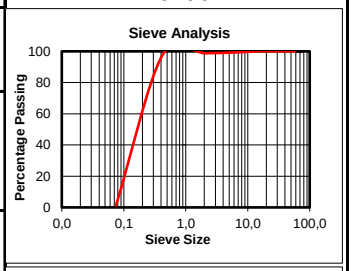
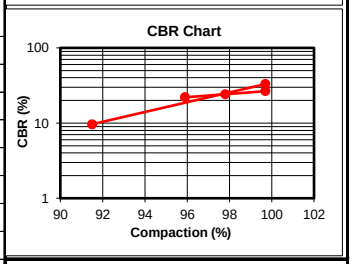
	Po Box 964	Date Received :	04/08/22
	Knysna	Date Reported :	09/09/22
	6570	Req. Number :	1438/22
Attention :	I Paton - 0827827793	No. of Pages :	3/3

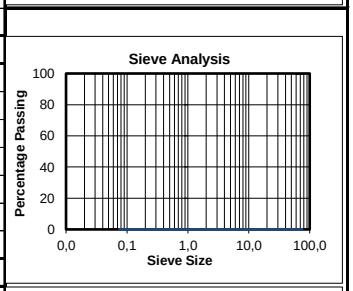
TEST REPORT

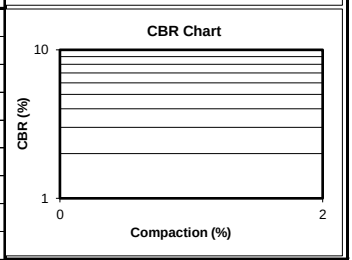
CALIFORNIA BEARING RATIO - (SANS 3001 Method GR1,PR5*,GR10,GR20,GR30,GR40)

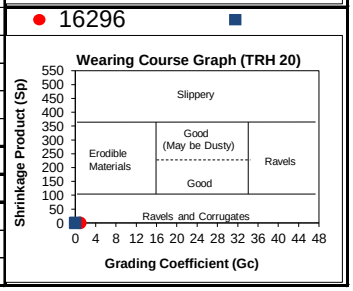
Material Indicators		16296
Sample Position (SV)		TP 7
Depth (mm)		1700-3300
Sample No		**16296**
Materials Description	Source	Test Pit
	Colour	Light Brown - Light Yellow
	Soil Type	Gravelly Silty Sand
	Classification	Unknown
Max. Stone size in hole (mm)		
Percentage Passing	75.0mm	100
	63.0mm	100
	50.0mm	100
	37.5mm	100
	28.0mm	100
	20.0mm	100
	14.0mm	100
	5.00mm	99
	2.00mm	99
	0.425mm	98
	0.075mm	1,4
Soil Mortar & Constants		
Grading Modulus		1,02
Coarse Sand (%)		1
Fine Sand (%)		98
Silt & Clay (%)		1
Liquid Limit (%)		NP
Plasticity Index (%)		NP
Linear Shrinkage (%)		0,0
CBR / Density Relationship		
MOD	Max Dry Density (kg/m³)	1750
	Opt Moisture Content (%)	13,0
	Mould Moisture Con. (%)	13,2
	@100% Mod AASHTO	99,7
	Swell (%)	0,00
Proc NRB	100% NRB	95,9
	Swell (%)	0,00
Proc	100% Proctor	91,5
	Swell (%)	0,00
CBR	@ 100% Mod AASHTO	33
	@ 98% Mod AASHTO	25
	@ 95% Mod AASHTO	16
	@ 93% Mod AASHTO	12
	@ 90% Mod AASHTO	8
Insitu Moisture Content (%)		
Soil Classification Achieved By The Material		
TRH 14:		G9 Subgrade
AASTHO System		A-3 / A-2-4
Unified System		SP











- **Specimens delivered to Outeniqua Lab in good order.**
- ***Non Accredited Test Method.**

Luwayne Malgraff
Technical Signatory
For Outeniqua Lab EC cc.

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Appendix 4

DCP test data

Outeniqua Geotechnical Services cc.

Geotechnical Engineering Consultants

Registration No. 1999/062743/23

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

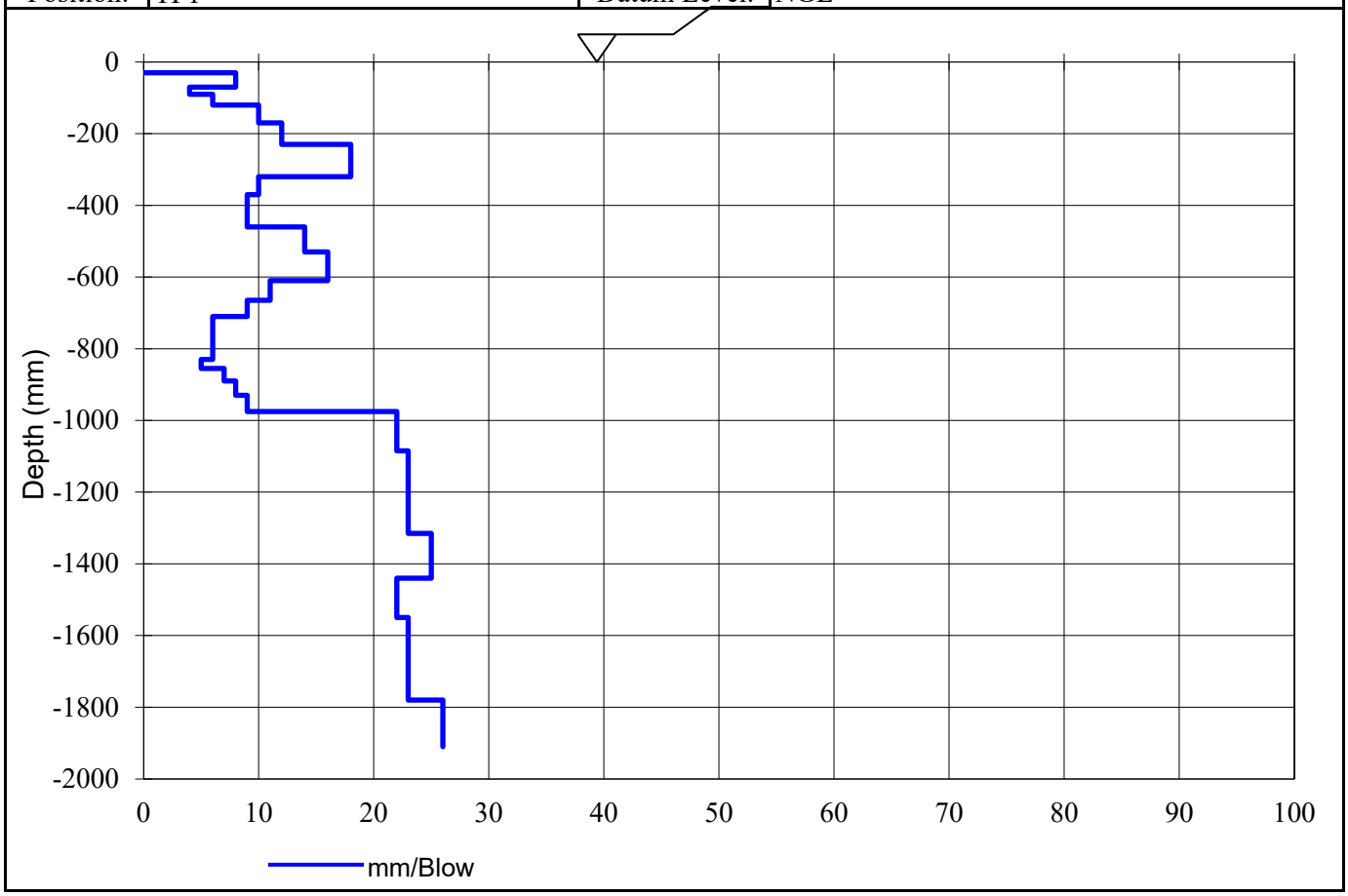
Tel: 044 3820502 : Fax: 044 3820503 : e-mail: iain@outeniqualab.co.za

Customer :	Ntaba Holdings/Eco Route Environmental Cons 69 Lyme Road North St Francis Bay 6312	Project :	Erf 3420 (The Admiral) St Francis Bay
		Date Received :	28.07.2022
		Date Reported :	02.08.2022
		Req. Number :	
Attention :	Tiaan Potgieter	No. of Pages :	1 of 9

TEST REPORT

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

Position:	TP1	Datum Level:	NGL



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

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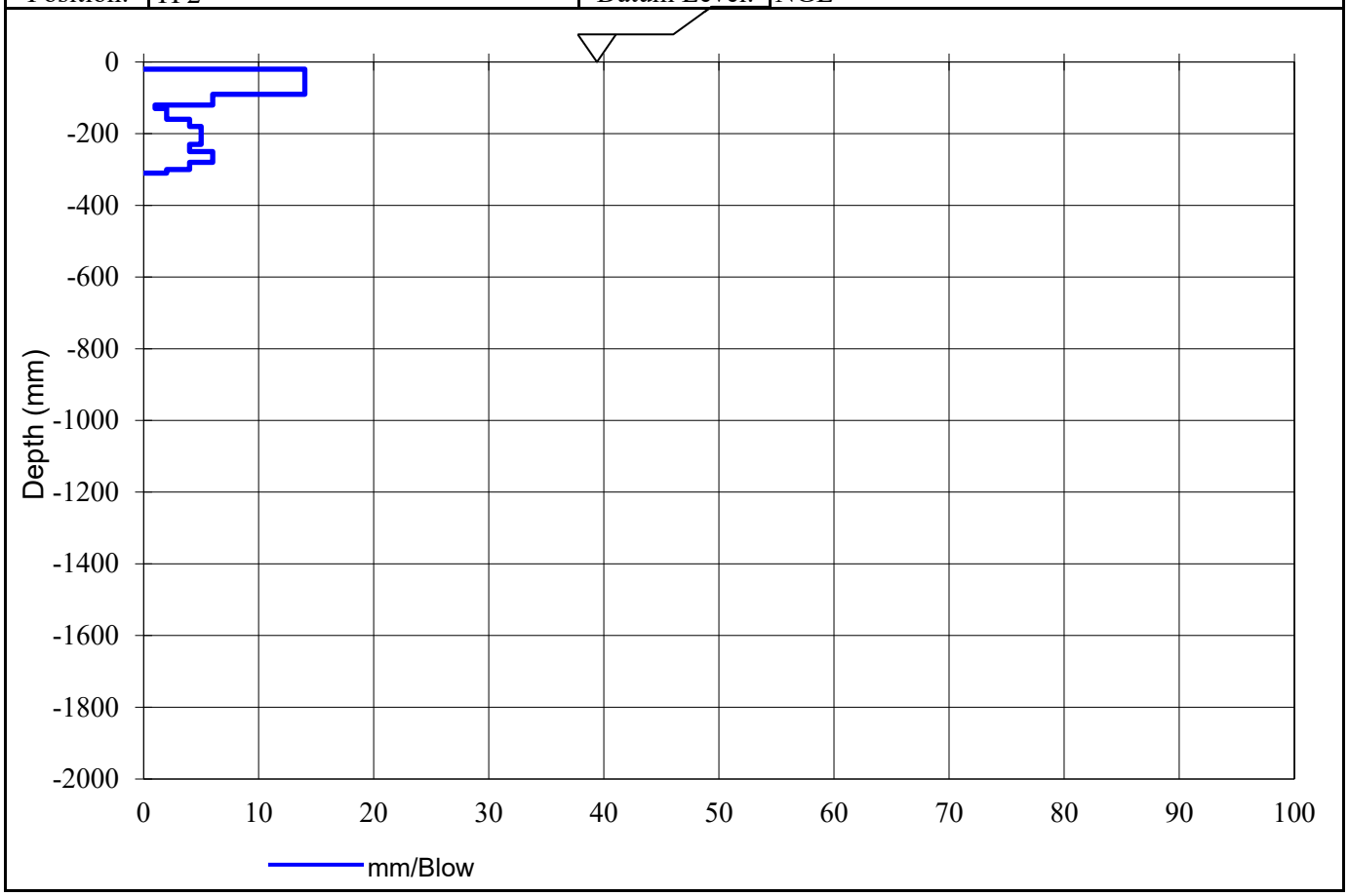
Tel: 044 3820502 : Fax: 044 3820503 : e-mail: iain@outeniqualab.co.za

Customer :	Ntaba Holdings/Eco Route Environmental Cons 69 Lyme Road North St Francis Bay 6312	Project :	Erf 3420 (The Admiral) St Francis Bay
		Date Received :	28.07.2022
		Date Reported :	02.08.2022
		Req. Number :	
Attention :	Tiaan Potgieter	No. of Pages :	2 of 9

TEST REPORT

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

Position:	TP2	Datum Level:	NGL



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

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Geotechnical Engineering Consultants

Registration No. 1999/062743/23

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

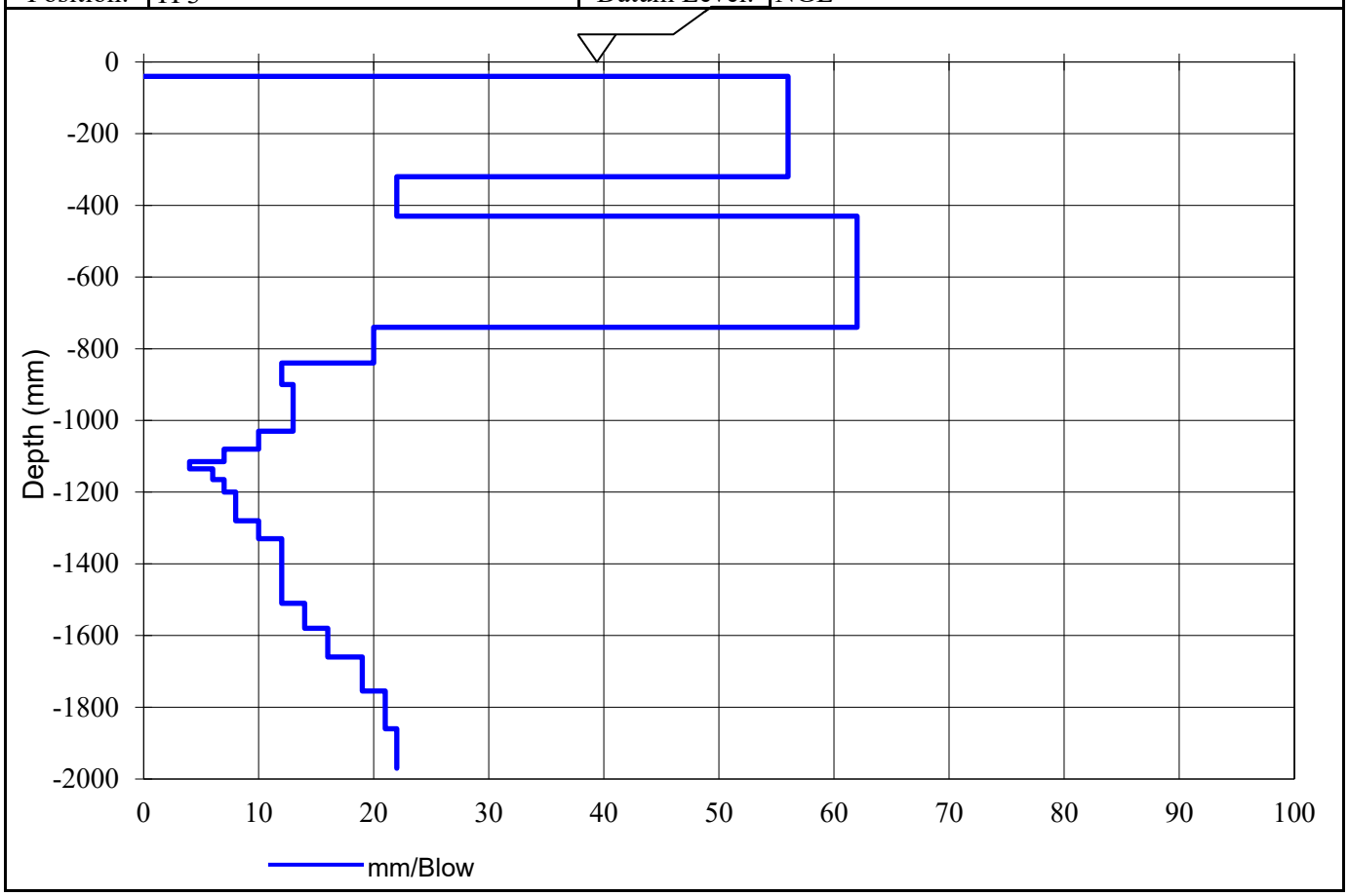
Tel: 044 3820502 : Fax: 044 3820503 : e-mail: iain@outeniqualab.co.za

Customer :	Ntaba Holdings/Eco Route Environmental Cons 69 Lyme Road North St Francis Bay 6312	Project :	Erf 3420 (The Admiral) St Francis Bay
		Date Received :	28.07.2022
		Date Reported :	02.08.2022
		Req. Number :	
Attention :	Tiaan Potgieter	No. of Pages :	3 of 9

TEST REPORT

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

Position:	TP3	Datum Level:	NGL



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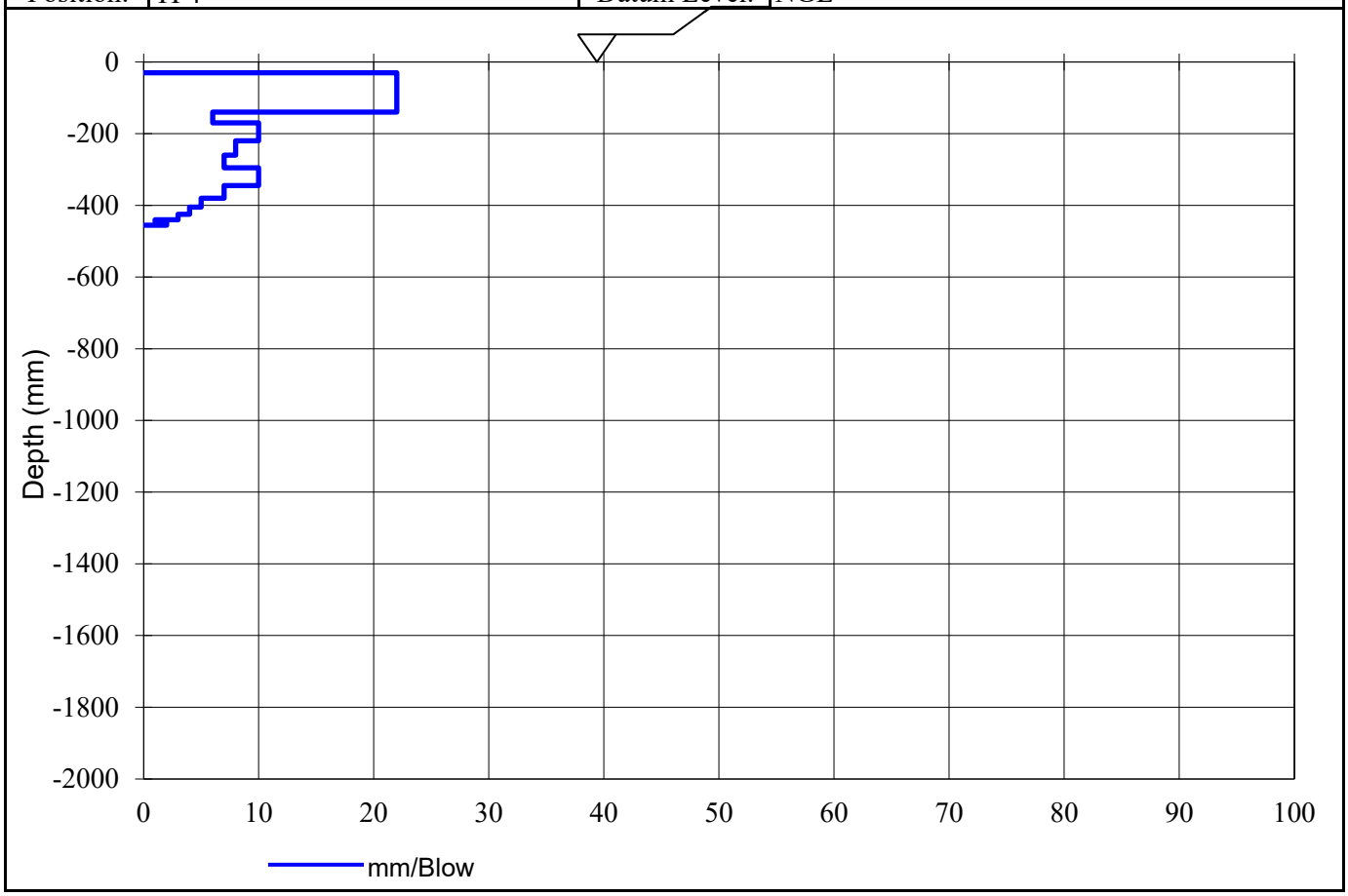
TEST REPORT

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

Position:	TP4	Datum Level:	NGL



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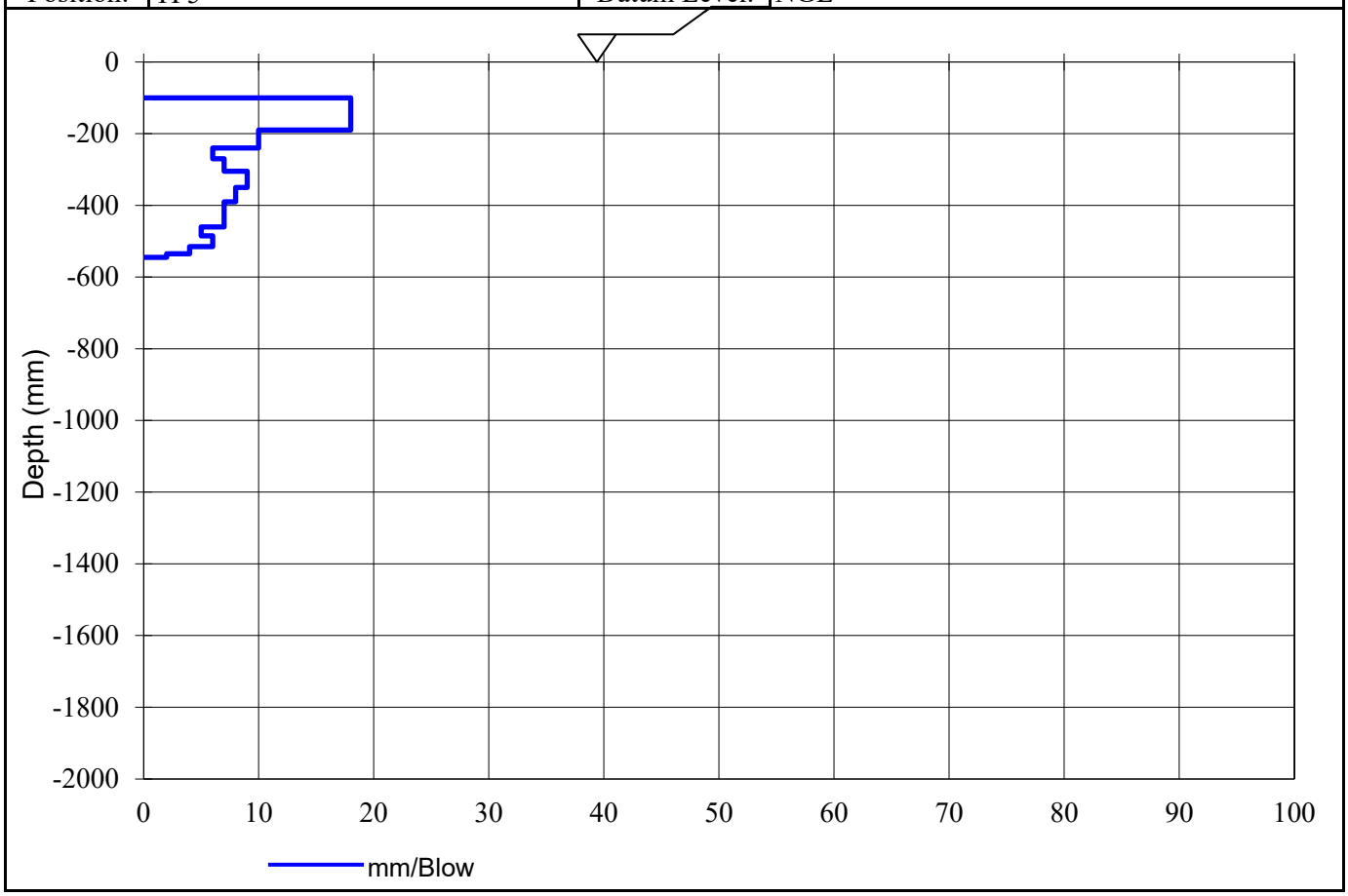
TEST REPORT

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

Position:	TP5	Datum Level:	NGL



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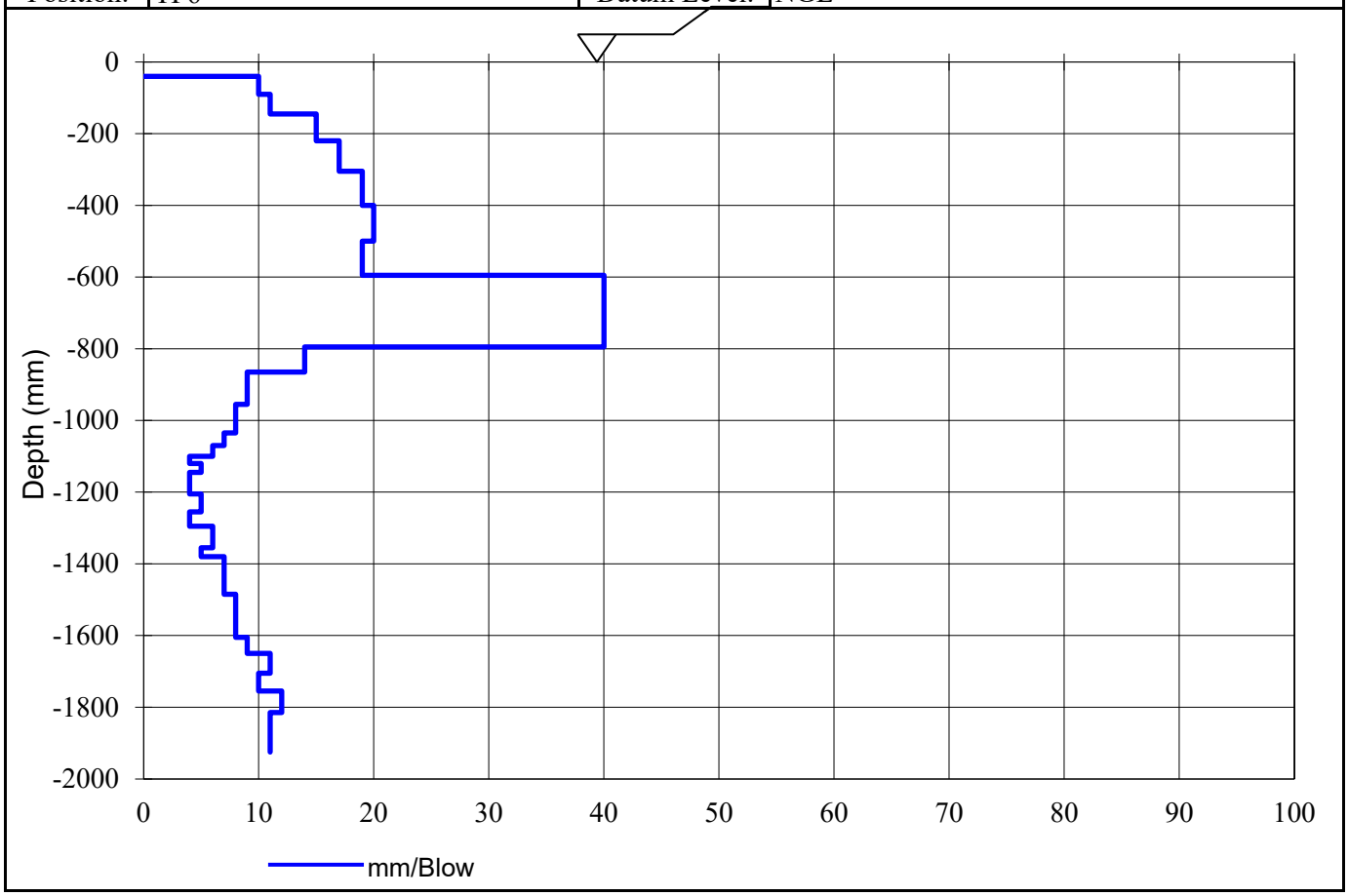
TEST REPORT

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

Position:	TP6	Datum Level:	NGL



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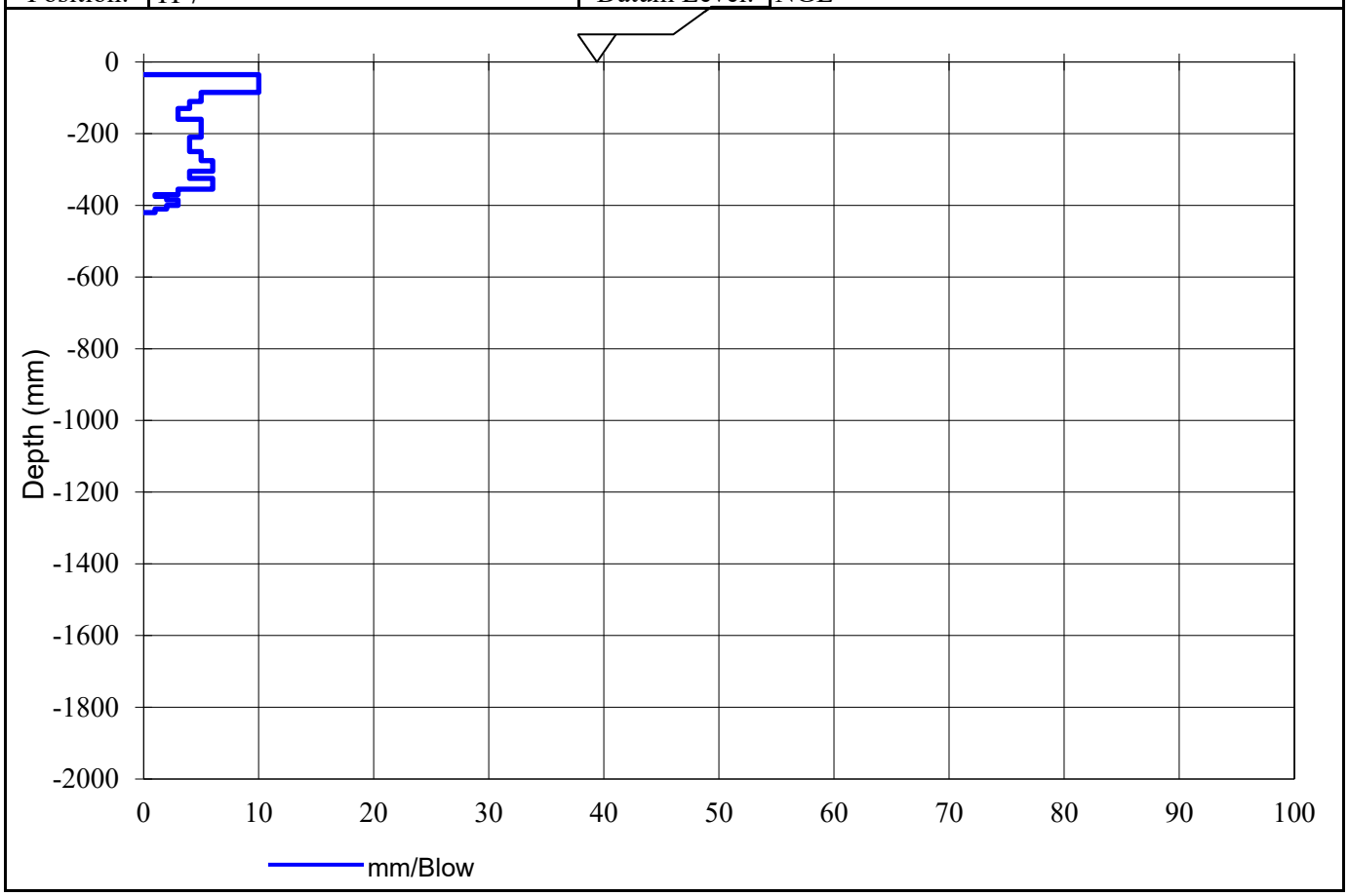
TEST REPORT

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

Position:	TP7	Datum Level:	NGL



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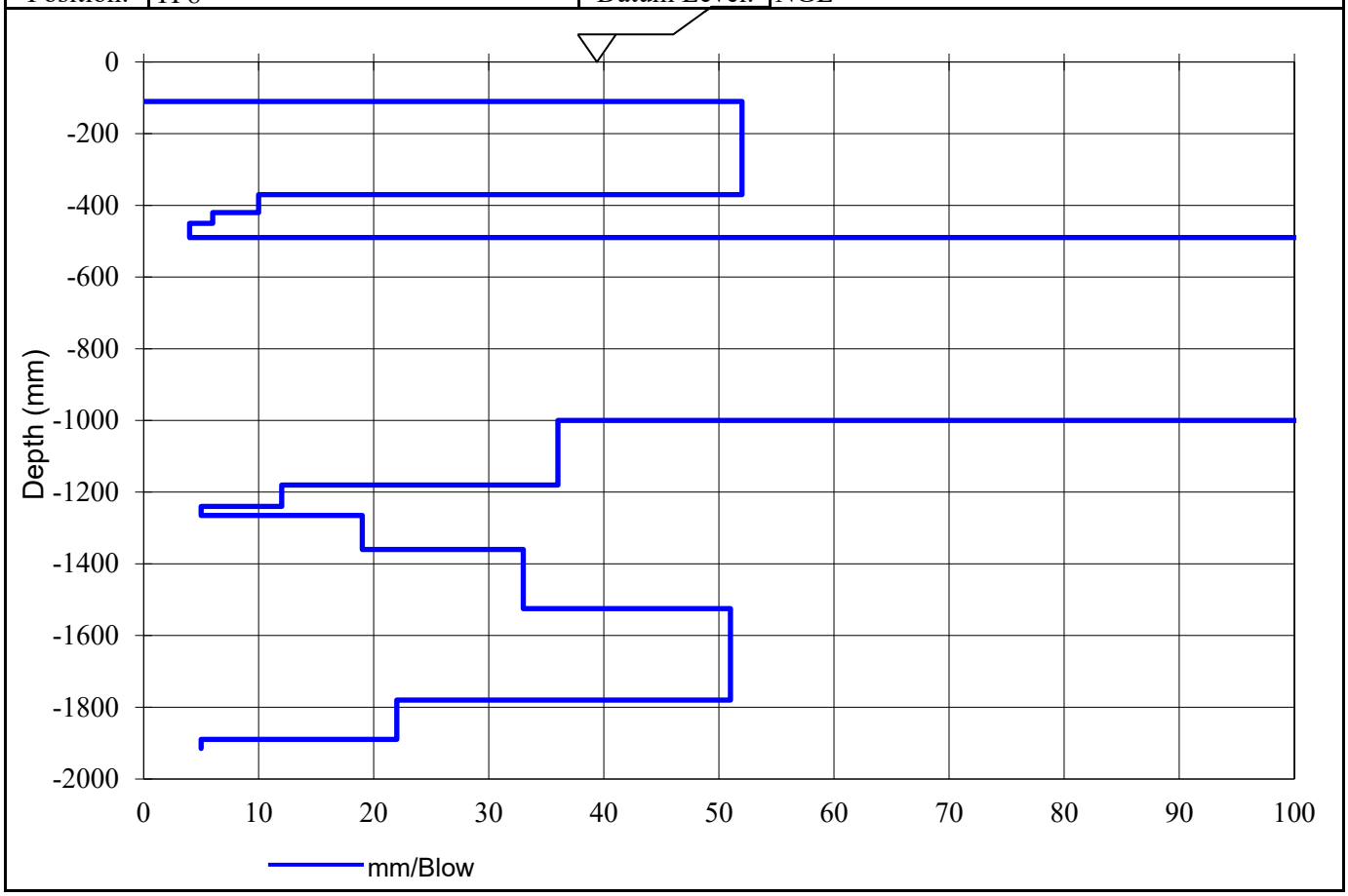
TEST REPORT

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

Position:	TP8	Datum Level:	NGL



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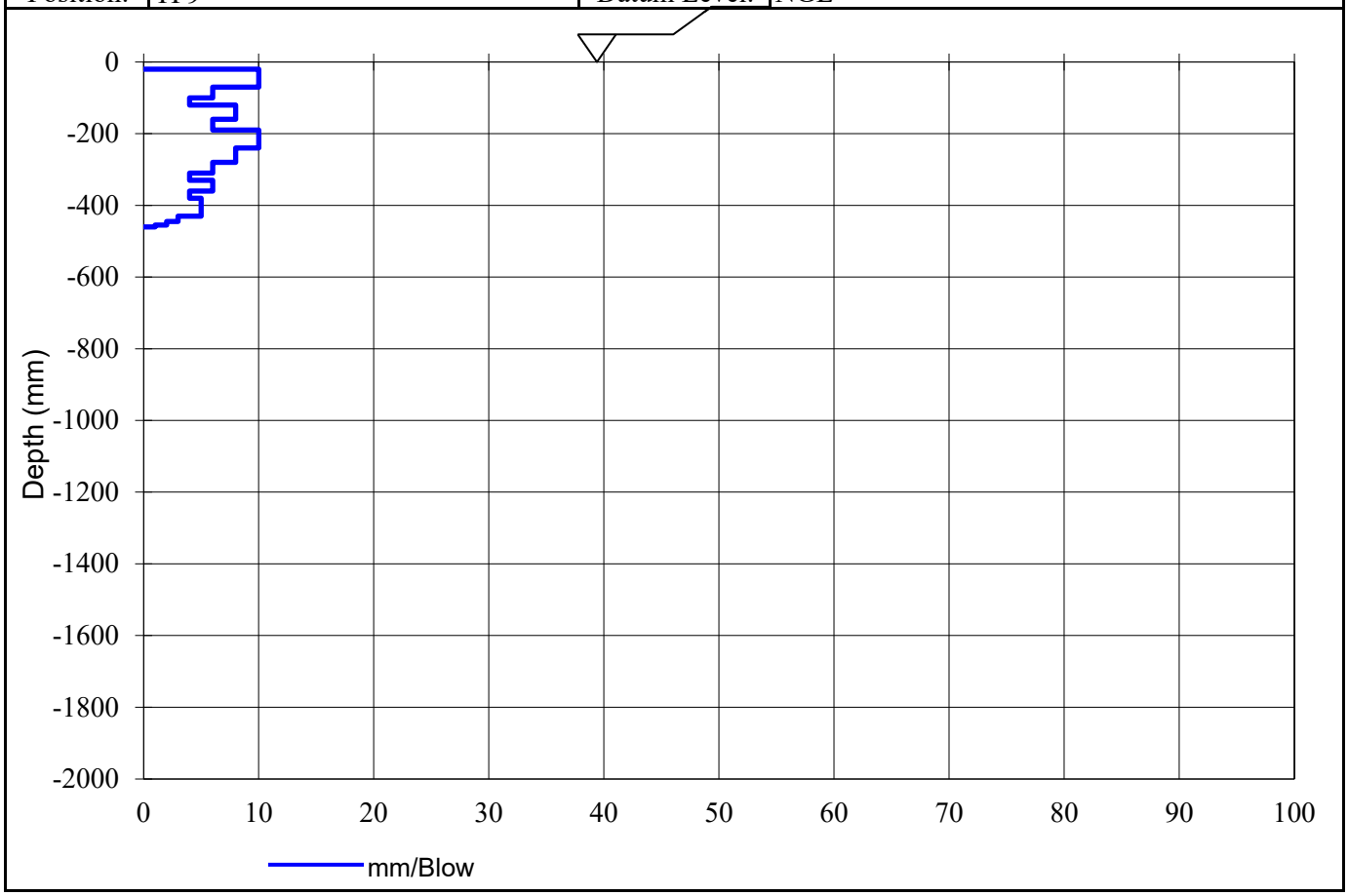
TEST REPORT

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

Position:	TP9	Datum Level:	NGL



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Appendix 5

Calculations