Appendix G.3

DESKTOP GEOTECHNICAL ASSESSMENT

R-Bay Properties (Pty) Ltd

PIETERMARITZBURG CHEMICAL STORAGE WAREHOUSE

Geotechnical Desktop Study

APRIL 2023

CONFIDENTIAL

R-Bay Properties (Pty) Ltd

PIETERMARITZBURG CHEMICAL STORAGE WAREHOUSE

Geotechnical Desktop Study

FINAL REPORT REV 0: CONFIDENTIAL

PROJECT NO. 41103633

DATE: APRIL 2023

WSP

Building 1, Maxwell Office Park
Magwa Crescent West, Waterfall City
Midrand, 1685
South Africa

Phone: +27 11 254 4800

WSP.com

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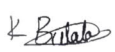
Signature	
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1 INTRODUCTION

WSP Group Africa (Pty) Ltd (WSP) was appointed by R-Bay Properties (Pty) Ltd (R-Bay) to undertake a geotechnical desktop assessment for the development of a chemical storage warehouse in Pietermaritzburg, KwaZulu-Natal Province.

1.1 PROJECT DESCRIPTION

R-Bay is intending to construct a purpose-built chemical warehousing structure covering an area of an approximately 2000m^2.

In addition to the warehouse, there will be ancillary structures including the following:-

- An administration building
- A structure housing a canteen and changing rooms.
- Loading and offloading bays
- A security-controlled entrance and exit
- Parking bays.

1.2 SCOPE OF WORK

The scope of work is limited to a desktop study and interpretation of the findings. The desktop assessment included the following:

- Literature reviews of available published and unpublished information including, but not limited to geological data, geological maps, topographical maps, aerial images and any existing geotechnical investigation reports of the study area
- Assessment of relevant geotechnical and geological fatal flaws within the study area
- Assessment of the excavation conditions across the site
- Assessment of shallow foundation conditions on site
- Assessment of the potential stability problems across the site

As no site walkover of the site has been completed, there is a degree of uncertainty associated with the data reviewed as conditions may have changed since data sources were created. The uncertainty, however, is considered acceptable for the purpose of the desktop assessment stage.

2 STUDY AREA INFORMATION

2.1 SITE DESCRIPTION

The site occupies Erf 2306 and 2307 of Shortts Retreat in Pietermaritzburg, KwaZulu Natal Province. The site lies on the western side of Yarborough Road and covers an area of approximately 5 730m^2.

The location of the site is as indicated in Figure 2-1 and the proposed development is indicated in Figure 2-2.

2.2 DRAINAGE AND TOPOGRAPHY

The site lies at an elevation that ranges between approximately 753m and 758m. The topography is relatively flat and stable and is characterised by a slope gently dipping in a north westerly direction.

No drainage features were observed throughout the site. However, a drainage feature is evident to the west of the site with no development in the vicinity of this features.

The site lies within the Quaternary catchment U20J. The total average rainfall is 966mm per annum with the highest rainfall occurring between October and January.

Figure 2-3 indicates the drainage features around the site.

2.3 VEGETATION AND LAND USE

The site lies within the Sub-escarpment Savanna Bioregion and is covered in short veld grass and scattered trees.

In addition, the 2023 Google Earth image of the site indicates that there has been some placement of fill material on the site which appears as “mounds” on the site. These mounds are not visible in the mid 2021 imagery and, therefore, have been placed since mid-2021. It cannot, at this time, be confirmed if the fill is still present on the site.

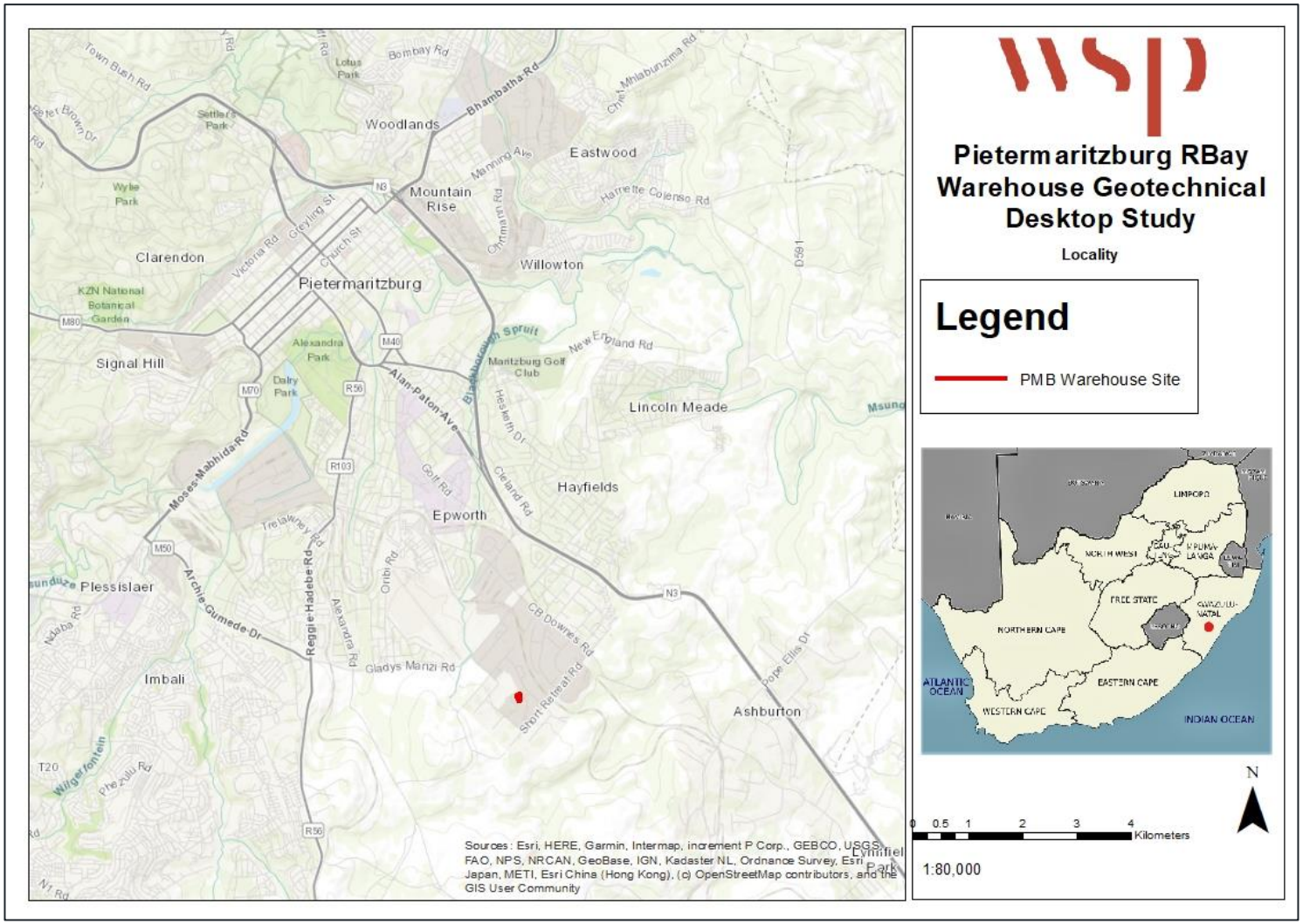

Figure 2-1 - Location of the site

Figure 2-2 - Proposed development

Figure 2-3 - Watercourses in the area

3 GEOLOGY

According to the published 1:250 000 geological map (Sheet 2930 Durban), the study area is underlain by rocks of the Pietermaritzburg Formation (Pp), Ecca Group of the Karoo Supergroup. This Pietermaritzburg Formation comprises dark grey shale, siltstone and subordinate sandstone.

The Ecca Group have been extensively intruded by dolerite both in the form of large sills, or sheets, and as dykes.

An excerpt of the published geological map showing the project area is presented as Figure 3-1.

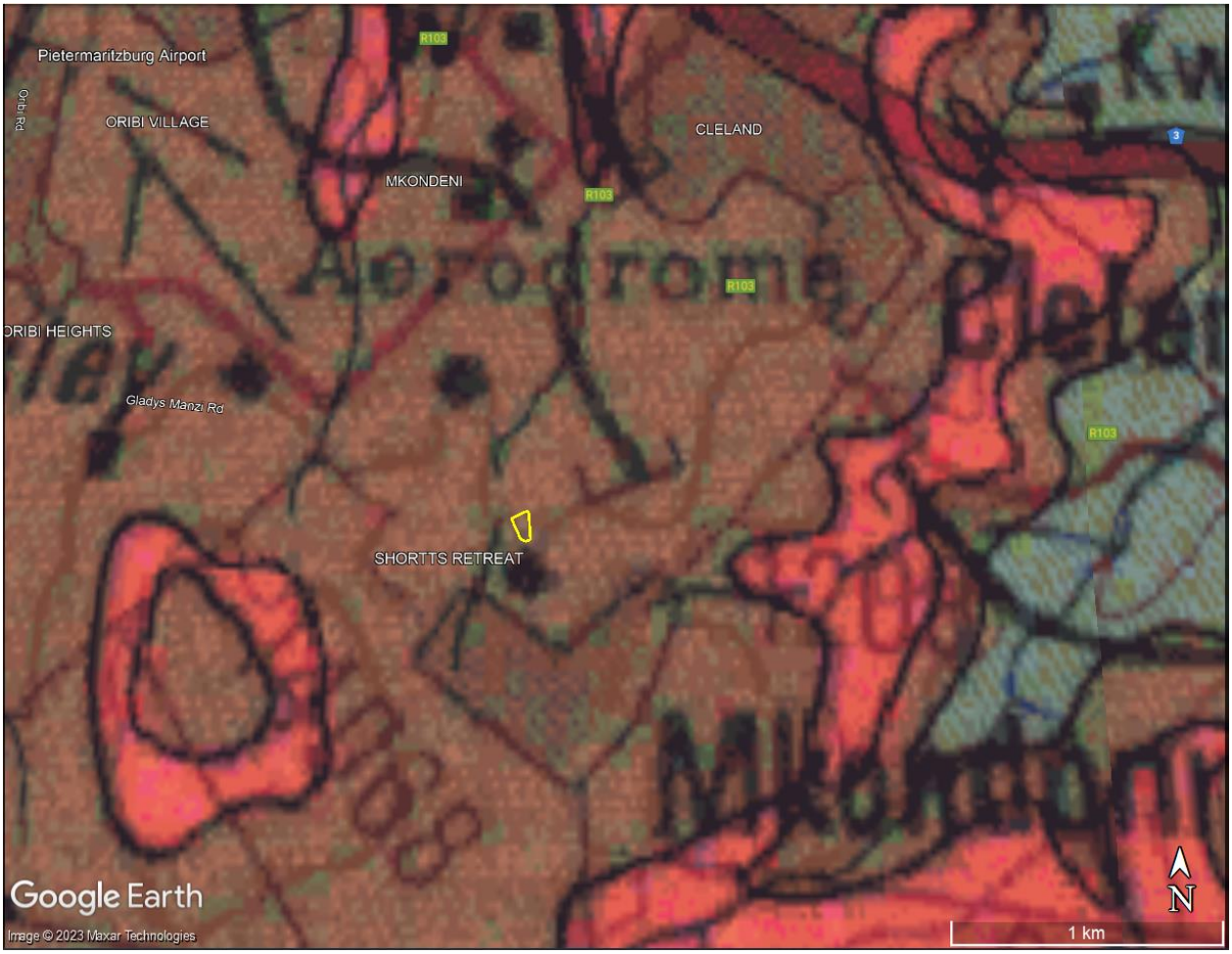

Figure 3-1 - Geology of the area

4 RESULTS OF THE DESKTOP STUDY

4.1 EXISTING REPORT FOR THE ADJACENT SITE

Shardesh Sewlal Engineers (SSE) conducted a geotechnical investigation for the site immediately to the east of the R-Bay site in 2022. A copy of this report was provided to us:-

Title:	Report on the Results of a Geotechnical Investigation Carried out at Portion 2 of Erf 2254 Shortts Retreat in Pietermaritzburg for the Construction of New Commercial Units
Report Number:	GEO/1001/21/22
Client:	Mubarak Family Trust
Date:	22 February 2022

The report is reproduced herein as APPENDIX A. During the investigation, five test pits were excavated and Dynamic Cone Penetration (DCP or DPL) test were conducted adjacent to the test pits. The position of the test pits is indicated in Figure 4-1.

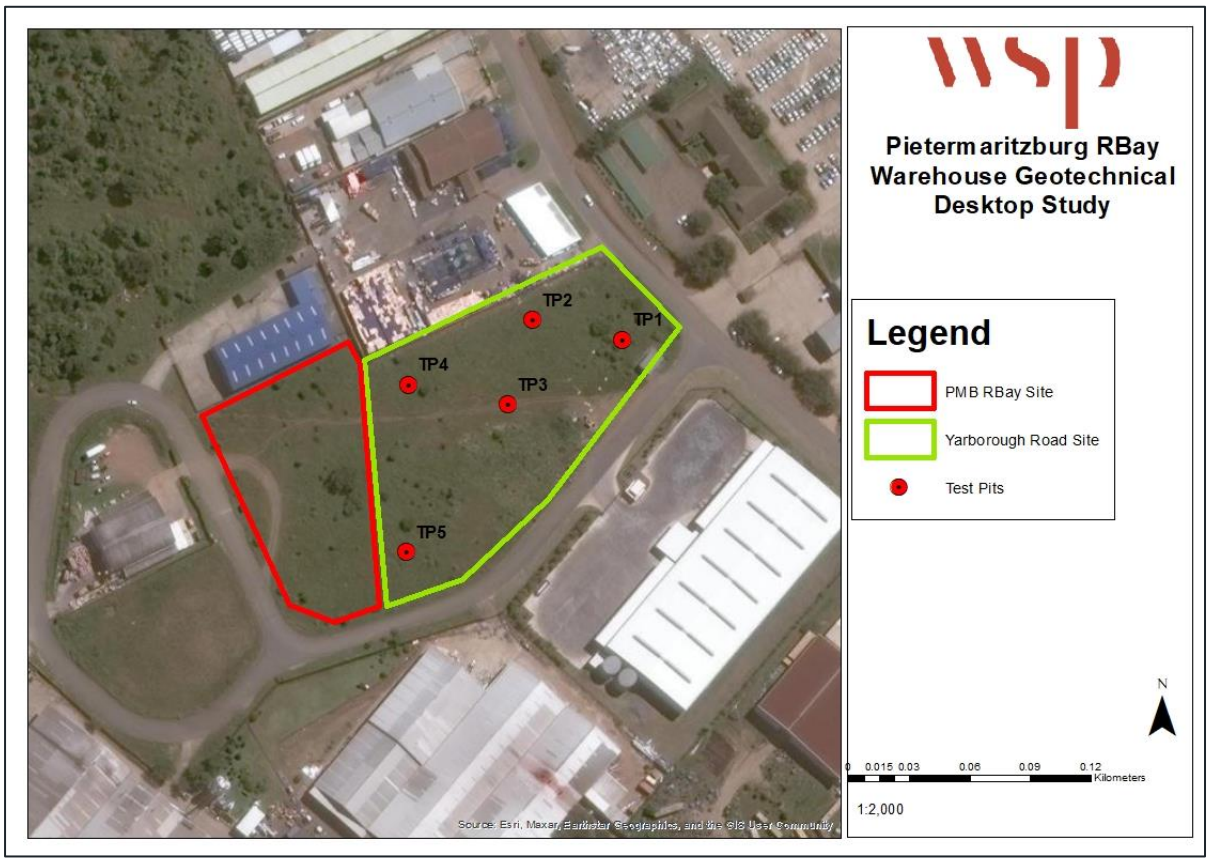

Figure 4-1 - Position of the test pits on the adjacent site

The profile, as encountered in the test pits is summarised in Table 4-1 along with an assessment of the consistency of the material from the results of the DCP tests. The profile is consistent across the site and, generally, comprises residual shale and shale rock. Fill and colluvium were also encountered. TLB refusal was encountered in shale rock.

It must be noted that no laboratory testing was carried out during the investigation.

Table 4-1 – Summary of the test pit profile across the adjacent site

Test pit number	Fill	Colluvium		Residual shale	Very soft to soft rock shale
	Clayey sand	Clayey silt	Clayey sand	Clayey gravel	Highly weathered
TP1	0.00 – 0.37 *Medium dense*	0.37 – 0.59 *Stiff*		0.59 – 0.93 *Very dense*	0.93 - .945
TP2	0.00 – 0.14		0.14 – 0.44 *Medium dense to very dense*		0.44 – 0.68
TP3			0.00 – 0.17		0.17 – 0.46
TP4			0.00 – 0.48 *Medium dense to very dense*		0.48 – 0.54
TP5	0.00 – 0.13 *Medium dense*		0.13 – 0.59 *Medium dense to very dense*	0.59 – 0.90 *Very dense*	0.90 – 0.94

Fill

Fill material was encountered from surface in three test pits located on the north-east and south-west of the site. The thickness of the fill layer ranged between 0.13m and 0.37m. The horizon was profiled as slightly moist, orangey-brown, loose to medium dense, clayey sand with abundant rock fragments and occasional building rubble. The DCP results indicate that the fill is medium dense in situ.

Colluvium

A thin layer of colluvium was encountered in all the test pits either from surface or underlying the fill to depths ranging between 0.17m – 0.59m. The colluvium was, generally, profiled as dry to slightly moist, grey, medium dense to dense, clayey sand with ferricrete nodules. In TP1 the colluvium was logged as to clayey silt. The DCP tests indicate the clayey sand to be medium dense to dense and the clayey silt as stiff in situ.

Residual Shale

Residual shale was encountered in TP1 and TP5 from a depth of 0.59m and extended to a depth of between 0.90m and 0.93m. The residual shale was profiled as slightly moist, very stiff, intact, clayey gravel with abundant shale rock fragments. The DCP tests show this material to be very dense in situ.

Shale Rock

Very soft to soft rock shale was encountered, in all the test pits, at a depth of 0.17m and 0.93m. Refusal of the TLB occurred at a depth of between 0.46m and 0.945m. The shale rock was profiled as highly weathered, yellow brown to purple, stained red and black, thinly laminated, severely fractured, very soft to soft rock shale.

Water

Water was not encountered in any of the five test pits.

4.2 ENGINEERING GEOLOGY OF THE PIETERMARITZBURG SHALE

Generally, the Pietermaritzburg shale weathers to dark grey and brown cohesive soils with a considerable thickness developing in valleys. The residual soil is clayey with high plasticity and is often compressible and potentially expansive. Expansive soils are those materials that exhibit volume change with a change in moisture content. These materials “shrink” when the moisture content decreases and “heave” or “expand” when the moisture content increases. Where the residual clay profile is thinly developed, it is recommended that the material should be stripped. Where thickly developed, the structural design needs to take cognizance of the potential expansiveness and compressibility of this material.

The residual shale on the adjacent site is described as “clayey gravel. Therefore, a small percentage of clay is expected in relation to gravel. Although this material should be less expansive that material with a greater percentage of clay and less coarse material, testing should be undertaken to determine this.

Shale rock and excavated shale rock, which presents as a gravel, often deteriorate on exposure. Although shale material can be considered for use in construction, the potential for deterioration needs to be pre-determined in the laboratory.

If suitable, the gravel can be used in selected layers in road construction, but seldom as base course. Gravelly shales are occasionally used in the wearing course of gravel roads but not all types are suitable. During construction Karoo shales and siltstones can usually be excavated by ripping, but blasting might occasionally be required.

Pietermaritzburg shales can be unstable in slope faces and tend to exhibit a regional dip of 3^{o}-15^{o} usually in an easterly direction. Slope instability may occur when sliding occurs on bedding planes which are inclined sufficiently. In general, sliding instability occurs if cuttings are made in a direction roughly parallel to the strike of dipping layers. Ingress of water into layers and the resulting high pore-water pressure play a major role in sliding failures.

5 GEOTECHNICAL EVALUATION

5.1 SURFACE DRAINAGE

The groundwater table was not intersected during the shallow investigation conducted in 2022. The gently dipping terrain naturally channels water downslope in a north-eastern direction towards a drainage feature. The design of the proposed development must incorporate a storm-water management system. The presence of rock very close to surface, which may be exposed during construction, indicates that ponding is likely across the site should a positive gradient not be maintained.

5.2 EXCAVATABILITY

The excavation characteristics of the soil horizons has been evaluated according to the South African Bureau of Standards standardized excavation classification for earthworks (SABS – 1200D). The definition of the excavation classes is indicated in Table 5-1 and the assessment of the in-situ profile in Table 5-2. The ease of excavation is a critical financial factor for any development. As evidenced during site investigation in the bordering site, shallow bedrock is anticipated in the site.

Table 5-1 – COLTO Excavation Class

Class of Excavation	General Definition
Soft	Excavation in material which can be efficiently removed or loaded by any of the following plant without prior ripping: A bulldozer with a mass of at least 22 tons (which includes the mass of the ripper, if fitted) and an engine developing approximately 145kW at the flywheel. Or A tractor-scraper unit with a mass of at least 28 tons and an engine developing approximately 245kW at the flywheel, pushed during loading by a bulldozer as specified for intermediate excavation. Or A track type front end loader with a mass of at least 22 tons and an engine developing approximately 140kW at the flywheel
Intermediate	Excavation (excluding soft excavation) in material which can be efficiently ripped by a bulldozer with a mass of at least 35 tons when fitted with a single tine ripper and an engine developing approximately 220kW at the flywheel.
Hard	Excavation (excluding boulder excavation) in material which cannot be efficiently ripped by a bulldozer with properties equivalent to those described for intermediate excavation. This type of excavation generally includes excavation in material such as formations of unweathered rock, which can be removed only after blasting.
Boulder Class A	Excavation in material containing in excess of 40% by volume of boulders between 0.03m3 and 20m3 in size, in a matrix of softer material or smaller boulders. Excavation of fissured or fractured rock shall not be classed as boulder excavation but as hard or intermediate excavation according to the nature of the material.
Boulder Class B	Where material contains 40% or less by volume of boulders in a matrix or soft material or smaller boulders.

Table 5-2 – Excavatability on site

Material	Excavation Class
Colluvium and fill	Soft excavation
Pietermaritzburg shale and residual shale	Soft excavation in residual shale and very soft to soft rock. Intermediate to hard excavation in medium hard and harder rock.

5.3 SLOPE STABILITY

During the 2022 investigation, no sidewall collapse was observed within the excavated test pits. The test pits excavated during the geotechnical investigation give an optimistic indication for the stability of long trench excavations.

Development on site is unlikely to cause any slope instability as no significant cut slopes will be developed. For temporary slopes, in dry conditions, up to a depth of 3m, the soil can be excavated at a 1: 1 batter and rock at 1 : 0.5. up to a depth of 3m. Should any seepage be encountered, the slopes will need to be flattened to at least 1: 2.

Should permanent excavations or deep excavations be proposed for the site, a slope assessment will be required.

No signs of slope instability were identified that may fatally flaw the proposed development.

5.4 FOUNDATIONS

Very soft to soft shale rock shale was encountered at a depth of between 0.17m and 0.93m on the adjacent site with rock being present at a depth of 0.48m and 0.9m in test pits TP4 and TP5, respectively. Rock is, therefore, expected at relatively shallow depth across the warehouse site. The estimated allowable baring pressure of the very soft shale is 500kPa and for 1MPa for the soft rock shale. This would need to be confirmed on site.

Founding on the very soft rock shale, or better, is likely to be the optimum founding solution for the warehouse and ancillary structures. However, the profile on the site itself would need to be determined. In addition, laboratory testing is required especially on the residual shale to determine if the material is potentially expansive as this may dictate the layerworks required for parking areas, roadways and loading areas.

6 SITE SUITABILITY AND CONCLUSIONS

Based on the desk top study, the proposed site is suitable for the development of a warehouse.

A geotechnical site investigation must be undertaken to provide detailed geotechnical information to inform the design of the proposed structures and the utilisation of the in-situ material, prior to construction.

7 ASSUMPTIONS AND LIMITATIONS

Your attention is drawn to APPENDIX B: Document limitations.

The statements presented in this document are intended to advise you of what your realistic expectations of this report should be, and to present you with recommendations on how to minimise and manage the inherent risks associated with the groundworks for this project. The document is not intended to reduce the level of responsibility accepted by WSP Group Africa (Pty) ltd, but rather to ensure that all parties who may rely on this report are aware of the responsibilities each assumes in so doing.

8 REFERENCES

- 1:250 000 Geological Map Series (2930 Durban). Published by the Council of Geoscience.
- Brink. A.B.A (1983). Engineering Geology of Southern Africa: The Karoo Sequence. Volume 3. Building Publications: Cape Town.
- Geotechnical Investigations for Housing Developments (2002). National Department of Housing – Generic Specification GFSH-2.
- South African National Standards 1200D: Earthworks, (1998).

Appendix A

REPORT FOR THE ADJACENT SITE

Shardesh Sewlal & Associates cc t/a

SHARDESH SEWLAL ENGINEERS

Geotechnical and Civil Engineering Consultants

Est. 2002

REPORT TITLE:	**REPORT ON THE RESULTS OF A GEOTECHNICAL INVESTIGATION CARRIED OUT AT PORTION 2 OF ERF 2254 SHORTTS RETREAT IN PIETERMARITZBURG FOR THE CONSTRUCTION OF NEW COMMERCIAL UNITS**
REPORT NO:	**GEO/1001/21/22**
REPORT DATE:	**22 FEBRUARY 2022**
REPORT STATUS:	**FINAL REPORT**
PREPARED FOR:	**MUBARAK FAMILY TRUST** **ATT: MR MOHAMMED SHAAZ MOOSA** **TEL: 082 786 2922** **EMAIL: admin@polycorp.co.za / msmoosa16@gmail.com**
PREPARED BY:	**SHARDESH SEWLAL ENGINEERS** **1 HUNTLEY PLACE** **WESTVILLE** **3629** **TEL: 031 266 7299** **MOBILE: 082 3310 780** **EMAIL:** geotech@shardesh.co.za **AUTHOR: SHARDESH SEWLAL (Pr. Sci. Nat.: 400082/00)**
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QUALITY MANAGEMENT
CERTIFICATE NO. 15396

Contents

APPENDICES

REPORT ON THE RESULTS OF A GEOTECHNICAL INVESTIGATION CARRIED OUT AT PORTION 2 OF ERF 2254 SHORTTS RETREAT IN PIETERMARITZBURG FOR THE PROPOSED NEW COMMERCIAL UNITS

1. INTRODUCTION AND TERMS OF REFERENCE

Shardesh Sewlal Engineers was requested by Mr. Mohammed Shaaz Moosa to submit a quotation for the geotechnical investigation at Portion 2 of Erf 2254, Shortts Retreat in Pietermaritzburg for the construction of new commercial units. Shardesh Sewlal Engineers submitted the quotation, referenced Q1284R to Mr. M. S. Moosa on 3rd February 2022 and was subsequently appointed by Mr. Moosa to proceed with the geotechnical investigation and reporting.

The purpose of the geotechnical investigation was to:

i. Characterise the site in terms of the typical underlying soils/rock strata;
ii. Evaluate the general stability of the site;
iii. Assess founding conditions and recommend suitable founding solutions;
iv. Provide estimated safe bearing pressures/load capacities;
v. Record any groundwater occurrence;
vi. Provide recommendations for earthworks and stormwater control.

The interpretation of the overall subsurface conditions across the site is inferred using professional judgement from the interpolation and the extrapolation of information assimilated from the various test points. The purpose of this report includes the recommendations for implementation by the owner to ensure a stable site development.

2. INFORMATION SUPPLIED

The following information was drawn upon for the purposes of this investigation:

- Google Imagery of the site.
- The 1: 250 000 Geological Map of Durban, Map No. 2930 issued by the Council for Geoscience.
- Layout plan showing the proposed positions of the new commercial units.

3. SITE DESCRIPTION

Location:
Portion 2 of ERF 2254 Shortts Retreat (herein referred to as the site) is located on the south western side of Yarborough Road in Shortts Retreat Pietermaritzburg. The site is bordered to the north and south west by existing commercial buildings, to the south by an unnamed road and to the north east by Yarborough Road.

Landuse and Vegetation:
At the time of the geotechnical investigation the site was undeveloped and covered in short growing veld grass and scattered trees.

Topography:
Topographically, the natural landform slopes gently downwards in a north easterly direction. Builder's rubble such as pieces of concrete, bricks and other general household waste was recorded scattered across the site.

Drainage:
No natural drainage features were observed on the site itself.

Figure 1 below shows the north easterly view of the site.

Fig. 1: General north easterly view across the site

4. FIELD WORK AND NATURE OF THE INVESTIGATION

The fieldwork was carried out on 15 February 2022 and comprised the following:

4.1. WALK-OVER SURVEY

A walk-over survey was conducted to establish and identify any surface geological features, drainage features, underground service markers and the general overview of the site and the site boundaries.

4.2. TEST PITS

Five test pits were excavated using a Tractor Loader Backhoe to depths ranging between 0.460m and 0.945m below existing ground level. The test pits were advanced to refusal and profiled according to The South African Guidelines for Soil and Rock Logging. The purpose of the test pitting was to:

- Profile the subsoils across the development area and identify soil/rock strata regarding foundation design.
- Identify problems related to potential slope stability.
- Determine the presence of any perched or shallow ground water tables.

4.3. DYNAMIC CONE PENETROMETER TESTS

A total of 5No. Dynamic Cone Penetrometer (DPL) tests were carried out adjacent the test points. The aim of the DPL testing was to:

- To permit an empirical assessment of the subsoil consistency and strength based on resistance to penetration.
- Establish the depth to bedrock if occurring at shallow to moderate depth.

In order to facilitate an interpretation of the DPL results in respect to the consistency of the subsoils underlying the investigated area, the following table is provided. It must be however noted that it is only a guide to DCP equipment.

Table 1: Subsoil Consistency Inferred from DCP Results

Cohesive Soils		Non-Cohesive Soils	
DCP Blow Count Blow / 300mm	**DCP Blow Count Blow / 300mm**	**DCP Blow Count Blow / 300mm**	**DCP Blow Count Blow / 300mm**
0 – 4	Very Soft	0 – 8	Very Loose
4 – 8	Soft	8 – 18	Loose
8 – 15	Firm	18 – 54	Medium Dense
15 – 24	Stiff	54 – 90	Dense
24 – 54	Very Stiff	>90	Very Dense
>54	Hard		

The positions of the test pits and DCP tests are shown on the site plan attached in Appendix A. The test pit logs are given in Appendix B and the DPL test results are given in Appendix C.

5. SITE GEOLOGY

5.1. GENERAL GEOLOGY

According to the 1:250 000 Geological Map of Durban issued by The Department of Mines and Mineral Affairs, Map No. 2930, the site is underlain by ECCA Group Pietermaritzburg Formation soils/rock consisting of dark grey Shale, Siltstone, subordinate Sandstone.

5.2. STRATIGRAPHY

Based on the geotechnical investigation, the following stratigraphy underlying the site may be described:

- **Fill**: Fill material consisting of dry to slightly moist, brown, loose to medium dense, CLAYEY SAND containing abundant Shale fragments was encountered in test pits 1,2 and 5. The fill extends to depths ranging between 0.130m and 0.370m below the existing ground surface at the test points.

- **Colluvium:** Colluvial deposits comprising dry to slightly moist, medium grey, firm-medium dense, fissured, fine grained, CLAYEY SAND was encountered below the fill material in test pits 1 and 5, and at the ground surface in test pits 2,3 and 4. The colluvium depth varies between 0.170m and 0.540m over the development area. Abundant Shale fragments and Ferricrete nodules were recorded in the colluvium.

- **Pietermaritzburg Formation Shale:** Highly weathered, yellow brown and purple stained red and black along joint surfaces, thinly laminated/bedded, severely fractured, soft rock to very soft rock Shale underlies the colluvium. The upper horizons are weakly bedded with some silt observed within joint and fracture surfaces. The rock strength increases with depth as the degree of weathering is observed to decreases.

  Residual Shale comprising burnt orangey yellow brown, stiff to very stiff, fine to coarse grained clayey gravel was encountered in test pits 1 and 5 above the weathered Shale bedrock.

  Refusal was encountered in the weathered shale at an average depth of 0.710m below the existing ground surface.

Figures 2, 3 4 and 5 below depict the general soil profiles encountered within the test pits.

Fig. 2: General view of test pit 2

Fig. 3: General view of test pit 3

Fig. 4: General view of test pit 4

Fig. 5: General view of test pit 5

6. GENERAL STABILITY OF THE SITE

No signs of gross slope instability were recorded on the site that may fatally flaw the proposed new commercial units.

7. GROUNDWATER

No groundwater seepage was encountered in any of the pits excavated on site. In spite of the apparent lack of groundwater seepage, a perched water table may form at the interface of the colluvium and underlying Shale bedrock during the summer rainfall period or periods of heavy rainfall.

8. DEVELOPMENTAL RECOMMENDATIONS

8.1. PROPOSED DEVELOPMENT

Based on the drawings issued, the landowner intends to multiple commercial units on the site.

8.2. RIPPABILITY AND TRENCHABILITY

Soft excavation in terms of SABS 1200 is generally anticipated to an average depth of 0.7m below existing ground level using light earth moving equipment such as Tractor Loader Backhoe. More difficult excavation may be encountered below 0.7m depth as the Shale strength increases. The use of a tracked excavator may be required for excavations below 0.7m depth.

8.3. EARTHWORKS

To promote the long-term stability of the site, all earthworks should be carried out to engineer's design and details; and in accordance with the guidelines provided in SABS 1200. It is important the earthworks are properly planned and supervised. The indiscriminate cutting and filling of the site without reference to predetermined levels could cause irrevocable damage which would be costly to remedy.

All vegetation should be removed before any cutting or filling of the site is undertaken. Topsoil to an average depth of 200mm should be removed and stockpiled for later use in rehabilitating cut and fill slopes. Cut and fill slopes should be topsoiled and vegetated immediately after construction to prevent erosion during heavy rainfall.

No deep cutting or filling is anticipated due to the relatively gentle gradient of the site. It is expected that the majority of the cutting will be in the Shale bedrock. Shallow cut banks may be formed at 1V to 0.5H (less than 63°) batter slopes.

All filling is to be undertaken in maximum 200mm loose thickness and be compacted to minimum 932% Mod AASHTO density at +/- 2% OMC. Aggregate larger than $^{2}/_{3}$ the size of the compacted layer thickness must be removed from the fill material before the material is processed and compacted. Fill embankments may be formed at 1V to 2H (26°) limited to 2.0m height.

The weathered Shale is expected to be of G7 quality and may therefore be utilized for the construction of the subgrade and selected layers of platforms, driveways and parking areas. The colluvium overlying the site is considered to be less than G10 and unsuitable for use as subgrade materials.

8.4. SURFACE DRAINAGE

The site should be well graded to permit water to readily drain away from the building platform, and to prevent ponding of water anywhere on the surface

All surface moisture collected from the roofed and hardened surfaces may be disposed into the stormwater system on Yarborough Road (if this is allowed by the local authority). The use of soakpits is not recommended in the weathered Shale bedrock due to lack of percolation into the bedrock. Attenuation of the stormwater will be required before disposing into the Municipal stormwater system.

8.5. SUB-SURFACE DRAINAGE

Groundwater seepage activity must be monitored during construction. Should any groundwater seepage activity be recorded during construction, subsoil drains may be required to control and affectively dispose the subsurface seepage.

8.6. GEOTECHNICAL CHARACTER OF SUB-SURFACE MATERIALS AND FOUNDATION RECOMMENDATIONS

The geotechnical investigation concludes that the site is underlain by highly weathered, yellow brown and purple stained red and black along joint surfaces, thinly laminated/bedded, severely fractured, soft to very soft rock Shale. The upper horizons of the Shale are weakly jointed become firmly jointed with depth. With increasing depth, the strength of the Shale increases with a decrease in degree of weathering. Joints and fracture surfaces are observed to contain silt. Residual Shale consisting of yellow brown, very stiff, fine to coarse grained clayey gravel was encountered above the weathered Shale in test pits 1 and 5.

Shales are one of the fastest weathering sedimentary rocks and may exhibit some swelling. Highly weathered Shale bedrocks generally exhibits heave less than 7.5mm. In terms of the SANS 10400-H:2016 guidelines, this site is given a **H** site class designation.

TABLE B.1 – RESIDENTIAL SITE CLASS DESIGNATIONs

Typical Founding Material	Nature of Founding Material	Expected Range of Total Soil Movements (mm)	Assumed Differential Movements (% of Total)	Site Class Designation
Fine grained soils with moderate to very high plasticity (clays, silty clays, clayey silts and sandy clays)	Expansive Soils	≤7.5	50%	H

Lightly reinforced strip footing foundations are recommended for supporting the new building structures. A net maximum bearing pressure of 100kN/m^2 is recommended for design purposes. The strip footing foundations are to be taken through the colluvium and socketed into competent, undisturbed Shale bedrock. Suitable foundation depths range between 0.5 and 0.7m below the existing ground level. Under no circumstances should any foundations be placed in fill material.

9. CONCLUSIONS

This reports presents the findings of the geotechnical investigation carried out at Portion 2 of Erf 2254, Shortts Retreat in Pietermaritzburg for the proposed new commercial units.

i. Based on the geotechnical investigation, the construction of the commercial units is considered feasible.

ii. This site is underlain by highly weathered, yellow brown and purple, thinly laminated, severely fractured, soft to very soft rock, Shale of the Pietermaritzburg Formation.

iii. The Shale rock strata underlying the site possesses a low heave potential . This site is given a **H** SANS 10400-H:2016 site class designation.

iv. Reinforced strip footing foundations placed in competent Shale bedrock is recommended for supporting the new commercial unit structures. Foundation loads of 100kN/m^2 is recommended for design purposes.

v. No groundwater seepage activity was observed in the test pits. However, a perched water table may form between the colluvium and the Shale bedrock. Should this occur, subsoil drains may be required to control and dispose of the groundwater seepage.

Finally, the ground conditions described in this report refer specifically to those encountered in the inspection pits. It is possible that conditions at variance to those described in this report can be encountered elsewhere on site. It is recommended that Shardesh Sewlal Engineers undertake periodic inspections during the construction operations to confirm appropriate founding conditions and materials suitability.

SIGNED BY:

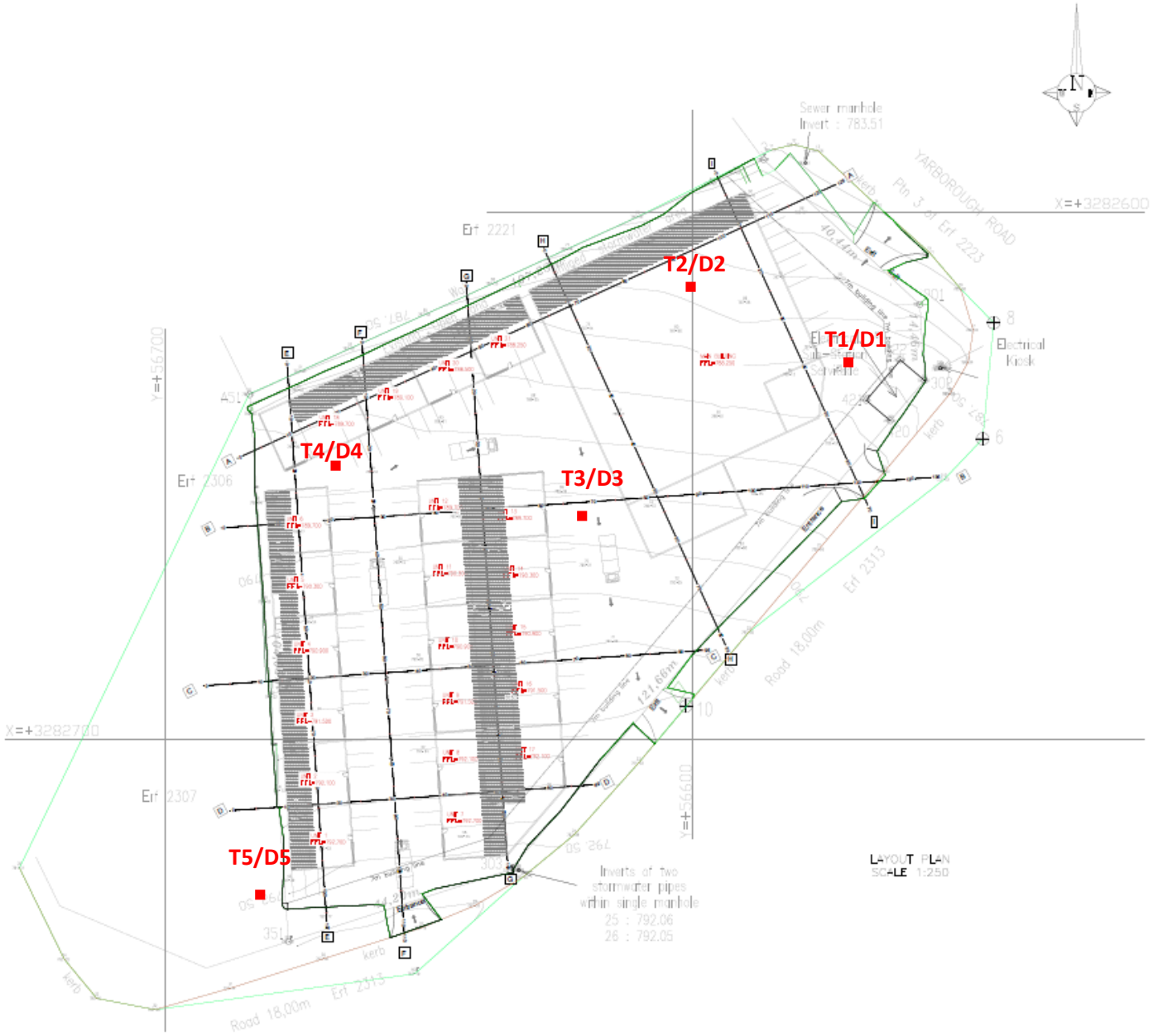
.....
SHARDESH SEWLAL
(PR. SCI. NAT 400082/00)

APPENDIX A

PLAN SHOWING THE APPROXIMATE POSITIONS OF THE TEST PITS AND DYNAMIC CONE PENETROMETER (DPL) TESTS

T: Test Pits

D: DPL Tests



	SHARDESH SEWLAL ENGINEERS 1 Huntley Place, Westville, 3629 T: 031 - 266 7299 M:082 3310 780 E: geotech@shardesh.co.za	**PROJECT: PROPOSED NEW COMMERCIAL UNITS** **LOCATION: PORTION 2 OF ERF 2254 SHORTTS RETREAT, YARBOROUGH ROAD PIETERMARITZBURG**	**DRAWING: SITE PLAN SHOWING POSITIONS OF TEST PITS & DPL TESTS** **SCALE: N.T.S**	**DRAWN BY: S. KALPEE** **CHECKED: S. SEWLAL**

APPENDIX B

PROFILES OF TEST PITS

SHARDESH SEWLAL ENGINEERS		PROJECT: PROPOSED NEW COMMERCIAL UNITS LOCATION: PTN 2 OF ERF 2254, YARBOROUGH ROAD, SHORTSS RETREAT, PIETERMARITZBURG DATE: 15 FEBUARY 2022 TEST PIT NO. 1
SAMPLE	**DEPTH (m)**	**DESCRIPTION** **(MOISTURE / COLOUR / CONSISTENCY / STRUCTURE / SOIL TYPE / ORIGIN / STRAT. UNIT)**
	0.370	*Dry to slightly moist, brown, loose to medium dense, intact, fine grained, CLAYEY SAND with abundant Shale fragments and occasional building rubble: Fill*
	0.590	*Dry to slightly moist, grey, firm, fissured, fine grained, CLAYEY SILT-SILTY CLAY: Colluvium*
	0.930	*Dry, burnt orangey yellow brown, very stiff, intact, fine to coarse grained, CLAYEY GRAVEL: Residual Shale*
	0.945	*Highly weathered, yellow brown and purple stained red and black, thinly laminated, severely fractured, very soft to soft rock SHALE: Pietermaritzburg Formation* *TLB Refusal at 0.945m*

Notes:

- Refusal: TLB refusal was encountered at 0.945m.
- Groundwater: No water seepage observed.
- Bedrock: Shale bedrock was encountered in the test pit at 0.930m.
- Sidewall Collapse: No sidewall collapse was observed.
- Samples: No samples taken.

Excavation Method: ***TLB***

Profiled By: ***S. Sewlal***

Captured By: ***S. Kalpee***

SHARDESH SEWLAL ENGINEERS		PROJECT: PROPOSED NEW COMMERCIAL UNITS LOCATION: PTN 2 OF ERF 2254, YARBOROUGH ROAD, SHORTSS RETREAT, PIETERMARITZBURG DATE: 15 FEBUARY 2022 TEST PIT NO. 2
SAMPLE	**DEPTH (m)**	**DESCRIPTION** **(MOISTURE / COLOUR / CONSISTENCY / STRUCTURE / SOIL TYPE / ORIGIN / STRAT. UNIT)**
	0.140	*Dry to slightly moist, brown, loose to medium dense, intact, fine grained, very slightly CLAYEY SAND with abundant Shale fragments: Fill*
	0.440	*Dry to slightly moist, medium grey, dense, fine grained, CLAYEY SAND: Colluvium containing abundant Ferricrete nodules*
	0.680	*Highly weathered, yellow brown stained black, thinly laminated, severely fractured, very soft to soft rock SHALE: Pietermaritzburg Formation* *TLB Refusal at 0.680m*

Notes:

- Refusal: TLB refusal was encountered at 0.680.
- Groundwater: No water seepage observed.
- Bedrock: Shale bedrock was encountered in the test pit at 0.440m.
- Sidewall Collapse: No sidewall collapse was observed.
- Samples: No samples taken.

Excavation Method: ***TLB***

Profiled By: ***S. Sewlal***

Captured By: ***S. Kalpee***

SHARDESH SEWLAL ENGINEERS		PROJECT: PROPOSED NEW COMMERCIAL UNITS LOCATION: PTN 2 OF ERF 2254, YARBOROUGH ROAD, SHORTSS RETREAT, PIETERMARITZBURG DATE: 15 FEBUARY 2022 TEST PIT NO. 3
SAMPLE	**DEPTH (m)**	**DESCRIPTION** **(MOISTURE / COLOUR / CONSISTENCY / STRUCTURE / SOIL TYPE / ORIGIN / STRAT. UNIT)**
	0.170	*Dry to slightly moist, medium grey, dense, fine grained, CLAYEY SAND: Colluvium containing abundant Ferricrete nodules and Shale fragments*
	0.460	*Highly weathered, yellow brown stained black, thinly laminated, severely fractured, very soft to soft rock SHALE: Pietermaritzburg Formation* *TLB Refusal at 0.460m*

Notes:

- Refusal: TLB refusal was encountered at 0.460m.
- Groundwater: No water seepage observed.
- Bedrock: Shale bedrock was encountered in the test pit at 0.170m.
- Sidewall Collapse: No sidewall collapse was observed.
- Samples: No samples taken.

Excavation Method: ***TLB***

Profiled By: ***S. Sewlal***

Captured By: ***S. Kalpee***

SHARDESH SEWLAL ENGINEERS		PROJECT: PROPOSED NEW COMMERCIAL UNITS LOCATION: PTN 2 OF ERF 2254, YARBOROUGH ROAD, SHORTSS RETREAT, PIETERMARITZBURG DATE: 15 FEBUARY 2022 TEST PIT NO. 4
SAMPLE	**DEPTH (m)**	**DESCRIPTION** **(MOISTURE / COLOUR / CONSISTENCY / STRUCTURE / SOIL TYPE / ORIGIN / STRAT. UNIT)**
	0.480	*Dry to slightly moist, medium grey, dense, fine grained, CLAYEY SAND: Colluvium containing abundant Ferricrete nodules*
	0.540	*Highly weathered, purplish yellow brown stained black, thinly laminated, severely fractured, very soft to soft rock SHALE: Pietermaritzburg Formation* *TLB Refusal at 0.540m*

Notes:

- Refusal: TLB refusal was encountered at 0.540m.
- Groundwater: No water seepage observed.
- Bedrock: Shale bedrock was encountered in the test pit at 0.480m.
- Sidewall Collapse: No sidewall collapse was observed.
- Samples: No samples taken.

Excavation Method: ***TLB***

Profiled By: ***S. Sewlal***

Captured By: ***S. Kalpee***

SHARDESH SEWLAL ENGINEERS		PROJECT: PROPOSED NEW COMMERCIAL UNITS LOCATION: PTN 2 OF ERF 2254, YARBOROUGH ROAD, SHORTSS RETREAT, PIETERMARITZBURG DATE: 15 FEBUARY 2022 TEST PIT NO. 5
SAMPLE	**DEPTH (m)**	**DESCRIPTION** **(MOISTURE / COLOUR / CONSISTENCY / STRUCTURE / SOIL TYPE / ORIGIN / STRAT. UNIT)**
	0.130	*Slightly moist, orangey brown, loose to medium dense, intact, fine grained, CLAYEY SAND: Fill*
	0.590	*Dry, medium grey, medium dense, fine grained, CLAYEY SAND: Colluvium containing abundant Ferricrete nodules*
	0.900	*Dry, yellow brown, very stiff, intact, fine to coarse grained, CLAYEY GRAVEL: Residual Shale containing abundant Shale fragments*
	0.940	*Highly weathered, yellow brown and purple stained red and black, thinly laminated, severely fractured, very soft to soft rock SHALE: Pietermaritzburg Formation* *TLB Refusal at 0.940m*

Notes:

- Refusal: TLB refusal was encountered at 0.940m.
- Groundwater: No water seepage observed.
- Bedrock: Shale bedrock was encountered in the test pit at 0.900m.
- Sidewall Collapse: No sidewall collapse was observed.
- Samples: No samples taken.

Excavation Method: ***TLB***

Profiled By: ***S. Sewlal***

Captured By: ***S. Kalpee***

APPENDIX C

DYNAMIC CONE PENETROMETER (DPL) TEST RESULTS

SHARDESH SEWLAL ENGINEERS

PROJECT: PROPOSED NEW COMMERCIAL UNITS

LOCATION: PTN 2 OF ERF 2254 SHORTTS RETREAT, YARBOROUGH ROAD, PMB

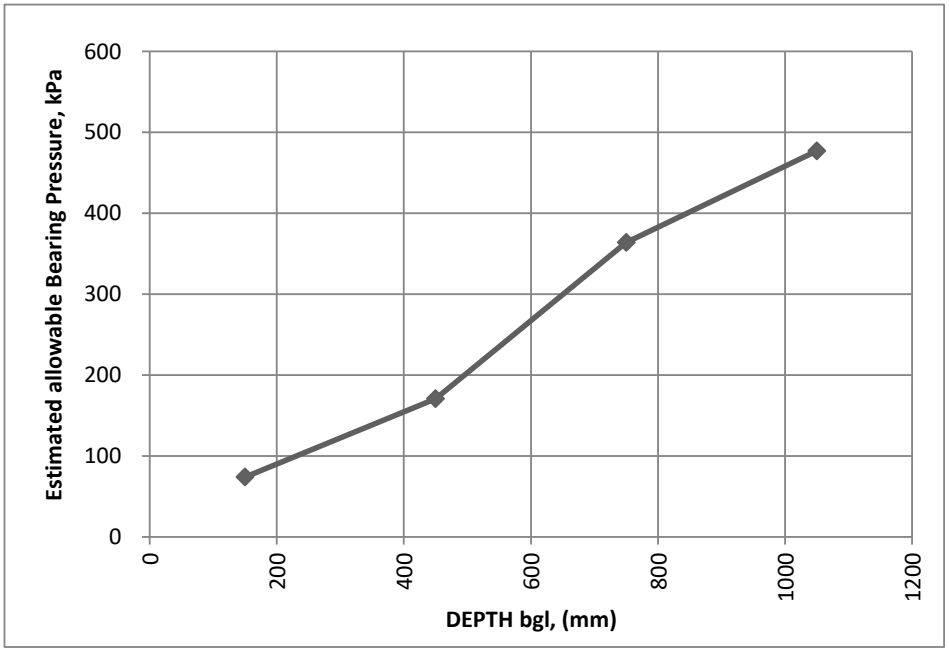
DPL NO. 1

DATE: 15 FEBRUARY 2022

DPL NO. 1

Elevation: **m**
Coord. (S) : **° ' " S**
Coord. (E) : **° ' " E**

DYNAMIC CONE PENETROMETER TEST RESULTS



Non - Cohesive		
Penetration Guide		
SPT mm/blow	DCP DN	Consistency
< 5	132-210	Very Dense
5 - 10	78-132	Dense
10 - 30	25-78	Med Dense
30 - 75	10 25	Loose
75 -100	<10	Very Loose

NOTE: A minimum of 4 readings is required!

Depth of hole in which DCP was taken : 0 mm below NGL
Applied Factor : 1,0 times Terzaghi's value
Remarks :

Reading No.	Layer From	Layer To	Average Layer Depth	DCP DN lows/300m	Level Below NGL mm	DCP penetration mm/blow	Equiv. SPT N Value	Approx In-situ CBR	Approx EASBP kPa	
1	0	300	150	15	150	20	6	9	74	
2	300	600	450	32	450	9	12	25	171	
3	600	900	750	73	750	4	28	73	364	
4	900	1200	1050	97	1050	3	37	106	477	REFUSAL

SHARDESH SEWLAL ENGINEERS

PROJECT: PROPOSED NEW COMMERCIAL UNITS

LOCATION: PTN 2 OF ERF 2254 SHORTTS RETREAT, YARBOROUGH ROAD, PMB

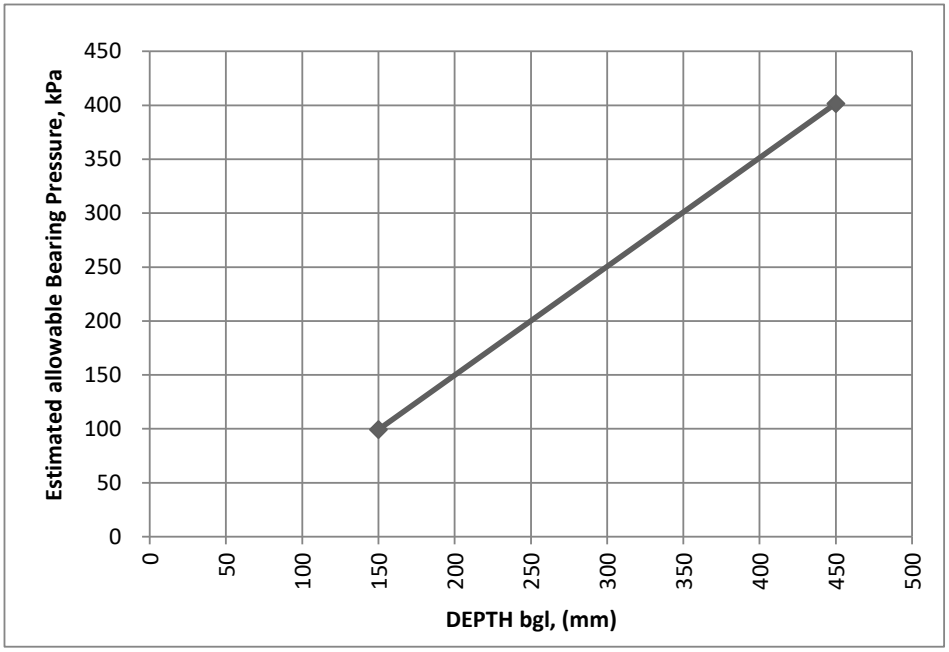
DPL NO. 2

DATE: 15 FEBRUARY 2022

DPL NO. 2

Elevation: **m**
Coord. (S) **: ° ' " S**
Coord. (E) **: ° ' " E**

DYNAMIC CONE PENETROMETER TEST RESULTS



Non - Cohesive		
Penetration Guide		
SPT mm/blow	DCP DN	Consistency
< 5	132-210	Very Dense
5 - 10	78-132	Dense
10 - 30	25-78	Med Dense
30 - 75	10 25	Loose
75 -100	<10	Very Loose

NOTE: A minimum of 4 readings is required!

Depth of hole in which DCP was taken : 0 mm below NGL
Applied Factor : 1,0 times Terzaghi's value
Remarks :

Reading No.	Layer From	Layer To	Average Layer Depth	DCP DN lows/300m	Level Below NGL mm	DCP penetration mm/blow	Equiv. SPT N Value	Approx In-situ CBR	Approx EASBP kPa	
1	0	300	150	22	150	14	8	15	99	
2	300	600	450	81	450	4	31	84	402	REFUSAL

SHARDESH SEWLAL
ENGINEERS

PROJECT: PROPOSED NEW COMMERCIAL UNITS

LOCATION: PTN 2 OF ERF 2254 SHORTTS RETREAT, YARBOROUGH ROAD, PMB

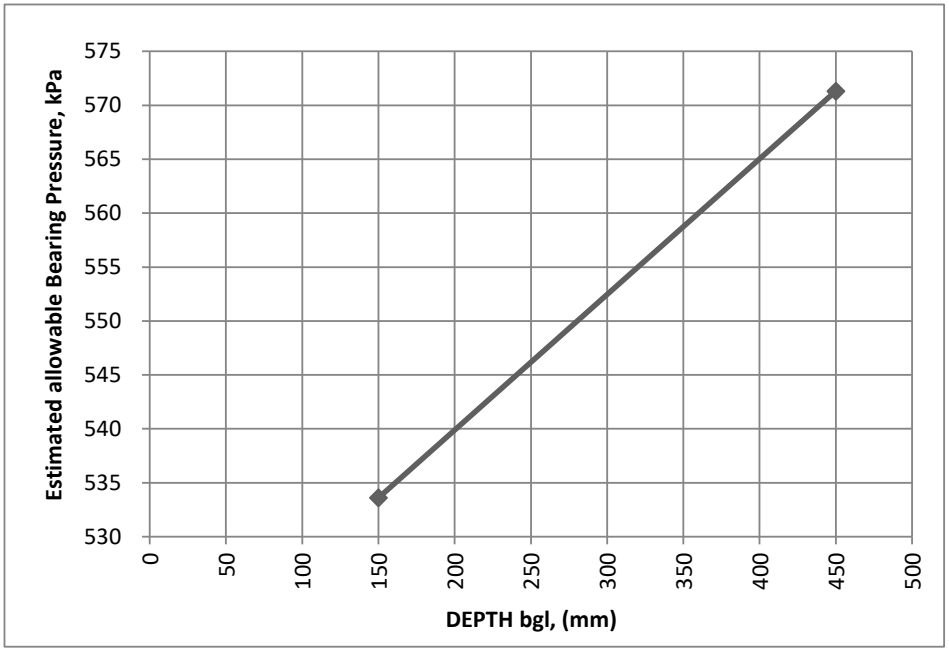
DPL NO. 3

DATE: 15 FEBRUARY 2022

DPL NO. 3

Elevation: **m**
Coord. (S) **: ° ' " S**
Coord. (E) **: ° ' " E**

DYNAMIC CONE PENETROMETER TEST RESULTS



Non - Cohesive		
Penetration Guide		
SPT mm/blow	DCP DN	Consistency
< 5	132-210	Very Dense
5 - 10	78-132	Dense
10 - 30	25-78	Med Dense
30 - 75	10 25	Loose
75 -100	<10	Very Loose

NOTE: A minimum of 4 readings is required!

Depth of hole in which DCP was taken : 0 mm below NGL
Applied Factor : 1,0 times Terzaghi's value
Remarks :

Reading No.	Layer From	Layer To	Average Layer Depth	DCP DN lows/300m	Level Below NGL mm	DCP penetration mm/blow	Equiv. SPT N Value	Approx In-situ CBR	Approx EASBP kPa	
1	0	300	150	109	150	3	41	110	534	
2	300	600	450	117	450	3	44	110	571	REFUSAL

SHARDESH SEWLAL
ENGINEERS

PROJECT: PROPOSED NEW COMMERCIAL UNITS

LOCATION: PTN 2 OF ERF 2254 SHORTTS RETREAT, YARBOROUGH ROAD, PMB

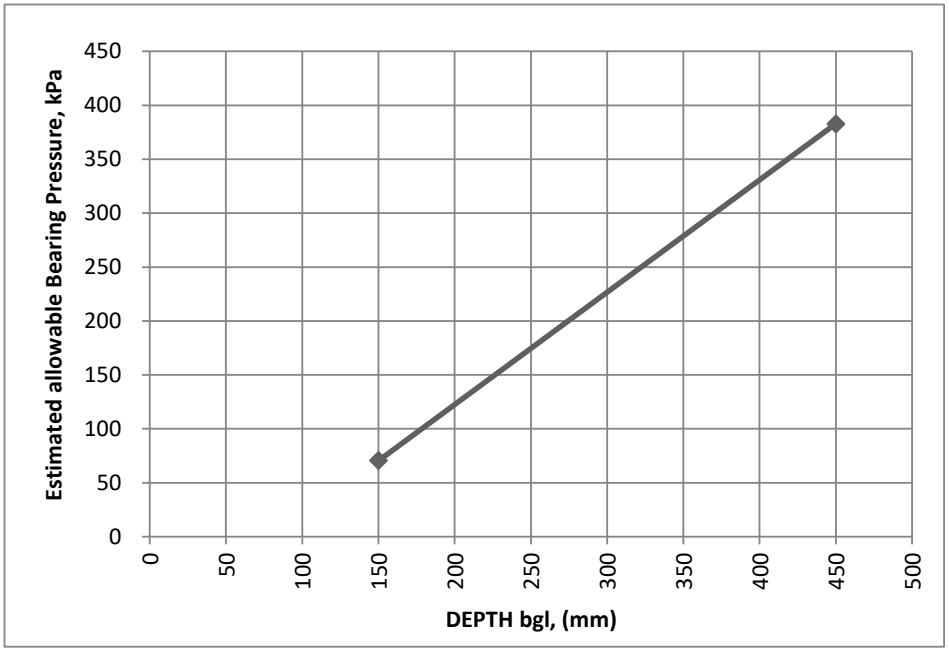
DPL NO. 4

DATE: 15 FEBRUARY 2022

DPL NO. 4

Elevation: **m**
Coord. (S) **: ° ' " S**
Coord. (E) **: ° ' " E**

DYNAMIC CONE PENETROMETER TEST RESULTS



Non - Cohesive		
Penetration Guide		
SPT mm/blow	DCP DN	Consistency
< 5	132-210	Very Dense
5 - 10	78-132	Dense
10 - 30	25-78	Med Dense
30 - 75	10 25	Loose
75 -100	<10	Very Loose

NOTE: A minimum of 4 readings is required!

Depth of hole in which DCP was taken : 0 mm below NGL
Applied Factor : 1,0 times Terzaghi's value
Remarks :

Reading No.	Layer From	Layer To	Average Layer Depth	DCP DN lows/300m	Level Below NGL mm	DCP penetration mm/blow	Equiv. SPT N Value	Approx In-situ CBR	Approx EASBP kPa	
1	0	300	150	14	150	21	5	8	71	
2	300	600	450	77	450	4	29	78	383	REFUSAL

SHARDESH SEWLAL ENGINEERS

PROJECT: PROPOSED NEW COMMERCIAL UNITS

LOCATION: PTN 2 OF ERF 2254 SHORTTS RETREAT, YARBOROUGH ROAD, PMB

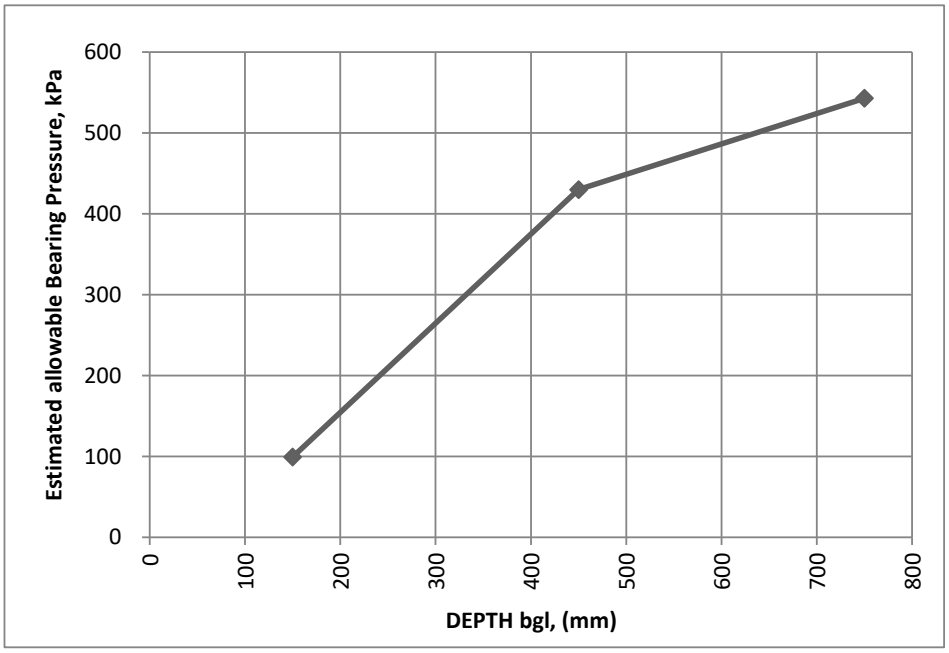
DPL NO. 5

DATE: 15 FEBRUARY 2022

DPL NO. 5

Elevation: **m**
Coord. (S) **: ° ' " S**
Coord. (E) **: ° ' " E**

DYNAMIC CONE PENETROMETER TEST RESULTS



Non - Cohesive		
Penetration Guide		
SPT mm/blow	DCP DN	Consistency
< 5	132-210	Very Dense
5 - 10	78-132	Dense
10 - 30	25-78	Med Dense
30 - 75	10 25	Loose
75 -100	<10	Very Loose

NOTE: A minimum of 4 readings is required!

Depth of hole in which DCP was taken : 0 mm below NGL
Applied Factor : 1,0 times Terzaghi's value
Remarks :

Reading No.	Layer From	Layer To	Average Layer Depth	DCP DN lows/300m	Level Below NGL mm	DCP penetration mm/blow	Equiv. SPT N Value	Approx In-situ CBR	Approx EASBP kPa	
1	0	300	150	22	150	14	8	15	99	
2	300	600	450	87	450	3	33	92	430	
3	600	900	750	111	750	3	42	110	543	REFUSAL

Appendix B

DOCUMENT LIMITATIONS

DOCUMENT LIMITATIONS

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Building 1, Maxwell Office Park
Magwa Crescent West, Waterfall City
Midrand, 1685
South Africa

wsp.com