

BARKLY WEST
DIKGATLONG LOCAL MUNICIPALITY

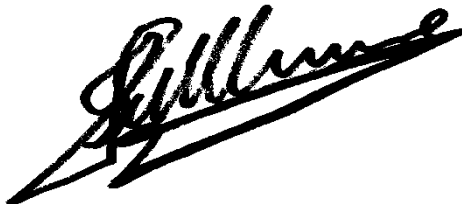
PHASE 1 ENGINEERING GEOLOGICAL INVESTIGATION
to DETERMINE the POTENTIAL for TOWNSHIP DEVELOPMENT
at BARKLY WEST,
DIKGATLONG LOCAL MUNICIPALITY, NORTHERN CAPE PROVINCE.

Georeference: 2824CB Barkly West

GEOSET cc

CK 1999/65610/23

Engineering geologist:

A handwritten signature in black ink, appearing to read 'D. Van der Merwe', written over a horizontal line.

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REPORT ON THE ENGINEERING GEOLOGICAL INVESTIGATION CONDUCTED AT BARKLY WEST, DIKGATLONG LOCAL MUNICIPALITY, NORTHERN CAPE PROVINCE.

Executive Summary

A phase 1 engineering geological investigation with reference to GSFH-2 specification was conducted on the proposed development site at Barkly West, Dikgatlong Local Municipality, Northern Cape Province, with the aim to assess aspects such as geology, relief and subsoil conditions which may influence the planned urban development in the area. The area is underlain by amygdaloidal lava, agglomerate and tuff of the Platberg Group, Ventersdorp Supergroup, but is locally covered by recent aeolian sand and calcrete gravel. No dolomite occurs on site and no stability investigation or evaluation is required. The mechanical properties of the soil layers were determined by means of laboratory tests performed on disturbed samples taken during the profiling of trial pits. The obtained site information is evaluated with regard to the development of masonry structures by the application of standard evaluation techniques. Development zonation for township development according to the NHBRC and SAIEG guidelines were done, indicating the geotechnical conditions of the site. **Normal construction** techniques will be required to enable proper development. This includes the use of **compaction techniques** and **site drainage** as described. Some problems regarding **excavatability** are expected across the site inducing an elevated development cost, and a competent TLB, excavator, pneumatic tools and blasting will be required to reach installation depths for services in many places. These proposed mitigation measures will be sufficient to successfully address the anticipated geotechnical problems and to ensure the sustainable development as planned.

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APPENDIX C: LABORATORY RESULTS

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STL Summary of Laboratory Results
STL Laboratory Results

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Extract from: THE SOUTH AFRICAN INSTITUTE OF ENGINEERING GEOLOGISTS (SAIEG), 1997.
Guidelines for Urban Engineering Geological Investigations.

Table 1. Categories of Urban Engineering Geological Investigation

Table 2. Geotechnical Classification for Urban Development:
Partridge, Wood & Brink (1993)

Table 3. Residential Site Class Designations:
SAICE, SAIEG & NHBRC (1995)

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REPORT ON THE ENGINEERING GEOLOGICAL INVESTIGATION CONDUCTED AT BARKLY WEST, DIKGATLONG LOCAL MUNICIPALITY, NORTHERN CAPE PROVINCE.

1. INTRODUCTION AND TERMS OF REFERENCE

On request of Maxim Planning Solutions, and on behalf of Barzani, an engineering geological investigation was conducted for the proposed development on the property for the Barkly West, Dikgatlong Local Municipality, Northern Cape Province, and communication between us and the abovementioned parties lead to the field work, commencing on 5 March 2020.

The aim of this investigation was to identify and evaluate any possible engineering geological problems before commencement of proper township proclamation.

This report is based on the in-situ evaluation of all the representative soil horizons within the ground profile, visual results of the site visit and other relative exposed geotechnical properties on site and derived from interpretation of laboratory results.

The proposed site is located at Barkly West, Dikgatlong Local Municipality, approximately 188 hectares in size. It is situated adjacent west of the existing Barkly West town. Figures 1-4 in Appendix A delineates the site.

2. INFORMATION USED IN THE STUDY

The following was consulted during the investigation:

- 1.3.1 The geological map 2824 Kimberly. Scale 1:250 000. The Geological Survey of South Africa.
- 1.3.2 The topography map 2824CB Barkly West. Scale 1:50 000. The Chief Directorate: Surveys and Land Information, Mowbray.

3. SITE DESCRIPTION

3.1 PHYSIOGRAPHY

3.1.1 Topography

The site is located on a slope from 1125 to 1134 masl towards the western portion of the site, and then westwards into the Vaal River.

3.1.2 Climate

The region is characterized by summer rainfall with thunderstorms, with annual very low rainfall figures of 427 mm for Barkly West recorded at the closest weather stations to the site. Winters are dry with frost common.

The warmest months are normally December and January with February the warmest month, and the coldest months are June and July.

An analysis of the data confirms a Weinert's N-Value in the order of 2 for Barkly West.

The mechanical disintegration of rocks will therefore be dominant over chemical decomposition, and shallow soil horizons will be expected in areas of poor drainage, underlain by igneous rocks.

Storm water drainage and road pavement design must incorporate the climatic extremes above.

3.1.3 Vegetation

The area is typically characterized by Kalahari Thornveld *veld type* (Acocks, 1988).

The site itself is covered by sparse grasslands of which some was used as agriculture land, and a few indigenous thorn trees are present on site.

4. NATURE OF INVESTIGATION

4.1 SITE INVESTIGATION

All available information (paragraph 1.3) was studied before and during the site visit.

The investigation commenced with a desk study, where all relevant information is collected and compiled on a base map. The site was divided into land forms, after which the accuracy of the information was checked by means of a field visit.

Test pits were dug and representative disturbed samples were collected and tested. The position of the test pits are represented in FIGURE 4 (Appendix A). The soil profiles were described by a registered engineering geologist according to the methods described by Jennings *et al* (Jennings 1973). This method describes each horizon in terms of moisture content, colour, consistency, structure, type of soil and origin of the soil.

Disturbed samples of the soil materials were taken for laboratory analysis. The grading of the soils were determined by sieve and hydrometer analysis, resulting in cumulative grading curves.

The mechanical properties of the soil material are described in terms of the liquid limit and plasticity index (determined by means of the Atterberg Limit tests) and the linear shrinkage. These values can be used to calculate the potential expansiveness of the soils, and to evaluate the materials for use as construction material. The consistency of a soil is described by means of its Atterberg limits, where the effect of a change in the moisture content on the consistency of a cohesive soil is measured. According to Cernica (1982) these tests are useful "mostly for soil identification and classification".

It can also be used to determine the mechanical properties of cohesive soil material¹.

The linear shrinkage test to determine the percentage shrinkage that can be expected, is performed by wetting a soil to approximately its liquid limit and drying the resultant paste in a linear shrinkage mould.

The potential expansiveness of a soil depends upon its clay content, the type of clay mineral, its chemical composition and mechanical character. A material is potentially expansive if it exhibits the following properties (Kantey and Brink, 1952):

- a clay content greater than 12 percent,
- a plasticity index of more than 12,
- a liquid limit of more than 30 percent, and
- a linear shrinkage of more than 8 percent.

The potential expansiveness (low, medium, high, very high) is calculated by means of Van der Merwe's method (Van der Merwe, 1964), where the equivalent plasticity index versus the clay content of the material is plotted on a graph divided into heave categories. If any sample in the study area classifies as potentially expansive, the amount of heave or mobilization in mm measured on the surface will be calculated.

4.2 LABORATORY TESTS

The minimum requirements for areas 188ha large is 18 samples for foundation indicator tests (GFSH-2 guideline). This may vary and is sometimes limited according to the variability of the geotechnical character such as limited depths of test pits before refusal of the TLB, as well as the uniformity or simplicity of a site. Only 13 samples were tested as the material consisted mainly of gravel and lava rock without the possibility of sampling matrix material or soil.

No free swell tests were done as all these areas falls within the drainage features and outside the developable areas.

No consolidometer or collapse potential tests were done as it was impossible to secure any undisturbed soil sample required for these tests.

No soil chemistry samples were tested as all new developments use synthetic pipes

¹ Note that cohesionless soils (i.e. sandy material) cannot be tested for plasticity or collapse potential as this material does not contain enough fines to exhibit consistency. The taking of undisturbed samples is not possible due to disintegration.

not reactive to soil aggressiveness.

The disturbed samples taken during the investigation were tested by the accredited laboratory of Specialised Testing Laboratory in Pretoria to determine their physical properties. Indicator tests include a grading analyses, the determination of Atterberg limits and linear shrinkage. The original laboratory results and a summary of results are represented in Table A, Appendix C.

5. SITE GEOLOGY AND GROUNDWATER CONDITIONS

5.1 Geology

The site is underlain by amygdaloidal lava, agglomerate and tuff of the Platberg Group, Ventersdorp Supergroup, but is locally covered by recent aeolian sand, alluvial and calcrete gravel.

No dolomite occurs on site and a stability investigation and evaluation is not required.

5.2 Groundwater Conditions

Plate flow is the dominant drainage pattern on site, with a drainage channel in the centre portion of the site. Drainage occurs in a westerly direction towards a drainage feature and then in a southern direction towards the Vaal River.

The permanent or perched water table on site is deeper than 1,5m below ground surface.

6. GEOTECHNICAL EVALUATION

6.1 ENGINEERING AND MATERIAL CHARACTERISTICS

6.1.1 SOIL PROFILES

According to the generic specification GFSH-2 guidelines, the minimum number of test pits for an area of 188ha is calculated to 56 test pits, but according to the specification

of SAIEG in our document on Guidelines for Urban Engineering Geological Investigation, 1997, Table 1 (Appendix D), at least 19 test pits should be adequate for areas with a low variable geotechnical character and sites where extensive development with services exist with limited access and almost fully built-up and fenced, or where more than half of the site is developed and serviced and for the formalization of the planning process such as this site. We recorded positions, photographed, described and characterized 44 test positions covering this site.

All terrain land forms or mapping units were extensively sampled and more than adequate representative characterization of each unit took place.

The soil profiles with accompanied plates of profiles and rock outcrop are represented in Appendix B.

Typical soil profile

Dry to slightly moist, red brown, loose to dense, open textured sand with gravel of calcrete. Hillwash.

Slightly moist, dark brown, well to sub rounded, small & medium, intact lava pebbles, clast supported in a subordinate matrix of the above. Pebble marker. Consistency is dense.

Slightly moist, grey green mottled white, dense, intact, sandy gravel. Moderately to slightly weathered lava sometimes with large core stones.

Some severe problems regarding excavatability can be expected on the site, and a competent TLB, excavator, pneumatic tools and even blasting will be required to reach installation depths for services in many places, and the average refusal depth was calculated at 1,15m.

To ensure the stability of excavations, it will need standard sidewall protection in excavations exceeding 1,5m.

6.1.2 LABORATORY RESULTS

The laboratory tests indicated a slight collapse potential and compressibility of the matrix material with a low expansive potential of the material (according to the method of Van der Merwe, 1964). It had an expected range of total soil movement measured at surface as collapse calculated to less than 5mm consolidation or less than 7,5 mm swell, with a site classification of CR.

The laboratory result indicated that the samples had a clay content of less than 15%, a linear shrinkage of less than 3,5%, the plasticity index was not determined as the material consisted of a slightly plastic matrix resulting that no liquid limit could be determined, and with a low expansive potential.

The Unified classification was SC-SM (7 samples) as clayey silty sand to SM (5 samples) as silty sand, poorly graded sand silt mixtures, and A-2-4 (12 samples) as sand and gravel with low plasticity silt fines, according to the PRA classification.

The limited amount of samples tested are justified as the high gravel content with limited sandy matrix material have the same character across the site, as well as the limited depth of refusal of the competent TLB.

No mining activities on site or history of mining or contaminated land in the area were found. Previous local diamond alluvial gravel mining were noted on portions of the site.

The site is located far from any mining activities and in an inactive area regarding seismic activity.

Due to the level of development surrounding the area, the likelihood for the development of borrow pits on site are low.

All road building and construction materials for the building industry will be sourced from established commercial activities in and around Barkly West.

6.2 SLOPE STABILITY AND EROSION

The potential for lateral soil movement or erosion is medium to high, and the loose sand is easily washed away during thunderstorms. Except for local slope instability within opened trenches and the collapse of pit side walls, no other slope instability is expected within these relative flat areas.

6.3 EXCAVATION CLASSIFICATION WITH RESPECT TO SERVICES

The excavation characteristics of the different soil horizons encountered have been evaluated according to the South African Bureau of Standards standardized excavation classification for earthworks (SABS – 1200D) and earthworks (small works – SABS 1200DA). In terms of this classification and the in-situ soil/rock consistencies as profiled, the relationships given below are generally applicable:

1. "soft excavation" - very loose/very soft through to dense or stiff.
2. "intermediate excavation" - very dense/very stiff through to very soft rock.
3. "hard excavation" - soft rock or better

Severe problems regarding excavatability can be expected on the site, and sub outcrop, shallow rock or outcrop areas were found that were classified as hard rock excavation, and the average refusal depth was calculated at 1,15m.

Problems regarding excavations of the upper material is expected and it is difficultly excavated by the competent TLB, and it was classified as intermediate in restricted and non-restricted excavation (SANS 1200 D).

Severe problems regarding excavatability can be expected for excavations deeper than 1,5m on the site, and a competent TLB or excavator, pneumatic tools and blasting will be required to reach installation depths for services. It was classified as intermediate to hard excavation in restricted and non-restricted excavation (SANS 1200 D).

To ensure the stability of excavations, it will need standard sidewall protection in excavations exceeding 1,5m.

6.4 IMPACT OF THE GEOTECHNICAL CHARACTER OF THE SITE ON SUBSIDY HOUSING DEVELOPMENTS

During the engineering geological investigation it is essential to determine and quantify the extent of potential problems associated with the area (addressed in **bold** below), before proper township proclamation. The ideal conditions for urban development may be listed as follows:

- * A smooth surface gradient with slopes less than 12°. Accessibility should not be restricted by topography (plateau areas).
- * No potential for slope instability features - landslides, mud flows.
- * Easy **excavation** for foundations and installation of services (normal depth of 1,5 m required).
- * Foundations above the ground water level or perched water table, with not too low permeability.
- * Development above the **1:50 year flood line**.
- * Adequate surface and subsurface drainage conditions, with minimal erosion potential.

- * No presence of problematic soils, for example heaving clays, **compressible clays, sand with some collapse potential**, or dispersive soils, that will require expensive remedial measures.
- * No potential for surface subsidence due to the presence of dolomite (sinkholes) or undermining.
- * No damaging differential subsidence or movement (less than 5mm total movement at the surface allowed).
- * The site should be placed away from potential pollutants such as waste disposal sites.

6.4.1 EVALUATION FOR URBAN DEVELOPMENT

Seepage and the presence of perennial fluctuations of ground water were not encountered on site, but a seasonal perched water table may exist.

Special care must be taken to ensure adequate surface drainage to prevent the accumulation of water next to structures.

The site contains slightly collapsible and compressible soil with a low expansive potential, and foundations will require normal treatment to withstand movement associated with the variable moisture content of the soil.

Severe problems regarding excavatability to 1,5m can be expected on the site, and shallow lava rock and outcrop were noted on many portions of the site.

Large lava rock core stones and boulders on surface, possibly from previous diamond gravel mining activities will restrict accessibility and movement of small vehicles on portions of the site.

Retaining walls as well as slope stabilization measures are recommended on all constructed embankments exceeding 1,5m.

Storm water diversion measures such as ponding pools are recommended to control peak flows during thunderstorms.

All embankments must be adequately compacted and planted with grass to stop any excessive erosion and scouring of the landscape.

7. **SITE CLASSIFICATION**

By grouping together all the land facets with the same geotechnical characteristics, the site can be divided into development zones, this being the main objective or result of a phase 1 engineering geological investigation. Each zone can therefore be defined as a grouping of areas with specific geotechnical properties placing similar constraints upon development.

With the above-mentioned criteria in mind, the study area can be divided into typical development zones for residential development (SAICE, SAIEG & NHBRC, 1995):

Land suitable for development: Standard foundation techniques and normal construction with normal site drainage and standard building practice will be adequate for development.

Land suitable for development with precaution or risk: A few precautionary measures for problematic soils in this zone are necessary before urban development can be initiated, with a higher than normal cost implication to overcome geotechnical constraints. The risk of restricted excavatability for the placing of services induces a higher cost for development.

Land not suitable for development typically comprises of the drainage features that are susceptible to annual flooding below the 1:50 year flood line, and is also associated with perched water tables. Land in close proximity of unstable ground such as a potential slope failure or mud flow induced by rainfall is also not suitable for development.

On account of the field observations, laboratory results, previous experience and engineering properties of the soil, it is zoned as follows (SAIEG,1997 - See tabular explanation of classification in Appendix D):

7.1 **Engineering Geological Zonation**

Normal Development with risk:

Site Class CR/1A3F:

This zone represents the majority of the area and comprises of a relative thin top layer sandy material less than 0,75m in thickness of slightly collapsible and compressible or

low expansive soil underlain by a competent pebble marker and lava, with estimated total movement of less than 7,5mm measured at surface with the risk of shallow rock, core stones or lava rock outcrop adding a R site class designation to the zone with problems relating to restricted excavation to less than 1,5m. Development on shallow rock or lava rock core stones will have an inflated cost where special pneumatic tools and blasting will be required for the installation of services. Normal foundation techniques will be adequate to enable proper development, with proper compaction within standard strip foundations and drainage provision will be required. It is classified as CR in terms of the SAIEG & NHBRC guidelines (1995) or the SAICE Code of practice (1995), and 1A3F according to the classification for urban development (Partridge, Wood & Brink)(1993).

Suitable for development with precaution

Site Class PQ:

Areas where small quarries or filling or dumping of spoil (Pq1) were identified must be rehabilitated before any construction, and backfilling with an engineer's material may improve the developability of these zones, but these operations will increase the development cost in this zone.

Undevelopable:

Site Class PD:

Perennial drainage features with local steeper slopes within the upper channels and towards the river. The development is usually restricted to 32m from the centre of the river, and outside the 1:100 year floodline.

The geotechnical problems encountered will require normal foundation techniques and construction, with proper standard compaction techniques.

8. FOUNDATION RECOMMENDATIONS AND SOLUTIONS

8.1 Consolidation or collapse settlement

Site Class C (Estimated total Settlement of less than 5mm):

Normal Construction:

Minor collapse settlement requires normal construction (strip footing and slab on the ground) with compaction in foundation trenches and good site drainage.

Site Class C1 (Estimated total Settlement of between 5 and 10mm):

Modified normal construction:

Reinforced strip footing and slab on the ground.
Articulation joints at some internal and all external doors and openings.
Light reinforcement in masonry.

Site drainage and service/plumbing precautions recommended.
Foundation pressure not to exceed 50 kPa (single storey buildings).

Compaction of in situ soils below individual footings:

Remove in situ material below foundations to a depth and width of 1,5 times the foundation width or to a competent horizon and replace with material compacted to 93% MOD AASHTO density at -1% to +2% of optimum moisture content.

Normal construction with light reinforcement in strip foundation and masonry.

Deep strip foundations

Normal construction with drainage precaution.

Founding on a competent horizon below problem horizon.

Soil Raft

Remove in situ material to 1,0m beyond perimeter of building to a depth and width of 1,5 times the widest foundation or to a competent horizon and replace with material compacted to 93% MOD AASHTO density at -1% to +2% of optimum moisture content.

Normal construction with lightly reinforced strip footings and masonry.

9. DRAINAGE

The site is located on a shallow slope towards the centre portion of the site, and then southwards into the Vaal River.

Plate flow is the dominant drainage pattern on site, and a prominent drainage channel intersects the site.

Although no seepage or the presence of perennial fluctuations of ground water were not encountered on site, we expect that a seasonal perched water table may exist. A calcified profile indicates that some perennial water level fluctuations occur.

Ground water in the form of seepage was not intersected in any test pits during the investigation, but some problems are foreseen and normal water tightening techniques such as damp course on foundation levels are required.

The expected high permeability of the silty sand may lead to leachate from sanitation systems to reach the ground water, and a closed water borne sewage system is recommended.

Special care must be taken to ensure adequate surface drainage to prevent the accumulation of water next to structures.

Storm water diversion measures such as ponding pools are recommended to control peak flows during thunderstorms. All embankments must be adequately compacted and planted with grass to stop any excessive erosion and scouring of the landscape.

10. **CONCLUSIONS**

1. A site of approximately 188 hectares, Barkly West, Dikgatlong Local Municipality, was investigated to determine the engineering geological properties that will influence township proclamation.
2. The site is underlain by amygdaloidal lava, agglomerate and tuff of the Platberg Group, Ventersdorp Supergroup, but is locally covered by recent aeolian sand and calcrete gravel.
3. Some severe problems are foreseen regarding the excavatability to 1,5m depth on site, and shallow rock, core stones and rock outcrop of lava were identified almost across the site. Large lava rock core stones and boulders on surface, possibly from previous diamond gravel mining activities will restrict accessibility and movement of small vehicles on many portions of the site.
4. Zoning of the site revealed zones with minor constraints regarding the **compressibility, collapse potential** and the **expansive potential** of the soil.
5. The following zones were identified on the site:

Normal Development with risk:

Site Class CR/1A3F: This zone represents the majority of the area and comprises of a relative thin top layer sandy material less than 0,75m in thickness of slightly collapsible and compressible or low expansive soil underlain by a competent pebble marker and lava, with estimated total movement of less than 7,5mm measured at surface with the risk of shallow rock, core stones or lava rock outcrop adding a R site class designation to the zone with problems relating to restricted excavation to less than 1,5m. Development on shallow rock or lava rock core stones will have an inflated cost where special pneumatic tools and blasting will be required for the installation of services. Normal foundation techniques will be adequate to enable proper development, with proper compaction within standard strip foundations and drainage provision will be required. It is classified as CR in terms of the SAIEG & NHBCR guidelines (1995) or the SAICE Code of practice (1995), and 1A3F according to the classification for urban development (Partridge, Wood & Brink)(1993).

Suitable for development with precaution

Site Class PQ: Areas where small quarries or filling or dumping of spoil (Pq1) were


identified must be rehabilitated before any construction, and backfilling with an engineer's material may improve the developability of these zones, but these operations will increase the development cost in this zone.

Undevelopable:

Site Class PD: Perennial drainage features with local steeper slopes within the upper channels and towards the river. The development is usually restricted to 32m from the centre of the river, and outside the 1:100 year floodline.

6. **Normal and special construction** techniques will be required to enable proper development. This includes the use of **compaction techniques** and **site drainage** as described.
7. **This investigation was done to reveal the geotechnical properties on site with the techniques as described to form our opinion. Although every possible factor during the investigation was dealt with, it is possible to encounter variable local conditions. This will require the inspection of foundations by a competent person to verify expected problems.**

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APPENDICES

APPENDIX A: FIGURES

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Figure 2: Barkly West, Dikgatlong Local Municipality: Topography Map.
Figure 3: Barkly West, Dikgatlong Local Municipality: Geology Map.
Figure 4: Barkly West, Dikgatlong Local Municipality: Engineering Geological Zone Map with Test Pit Positions on Google Image.

APPENDIX B: SOIL PROFILES

- Soil Profiles Tabled Summary
Soil Profile Descriptions
Soil Profile Photographs

APPENDIX C: LABORATORY RESULTS

- Table A: Summary of Laboratory Results
STL Summary of Laboratory Results
STL Laboratory Result

APPENDIX D: TABULAR EXPLANATION OF ZONING

Extract from: THE SOUTH AFRICAN INSTITUTE OF ENGINEERING GEOLOGISTS (SAIEG), 1997.
Guidelines for Urban Engineering Geological Investigations.

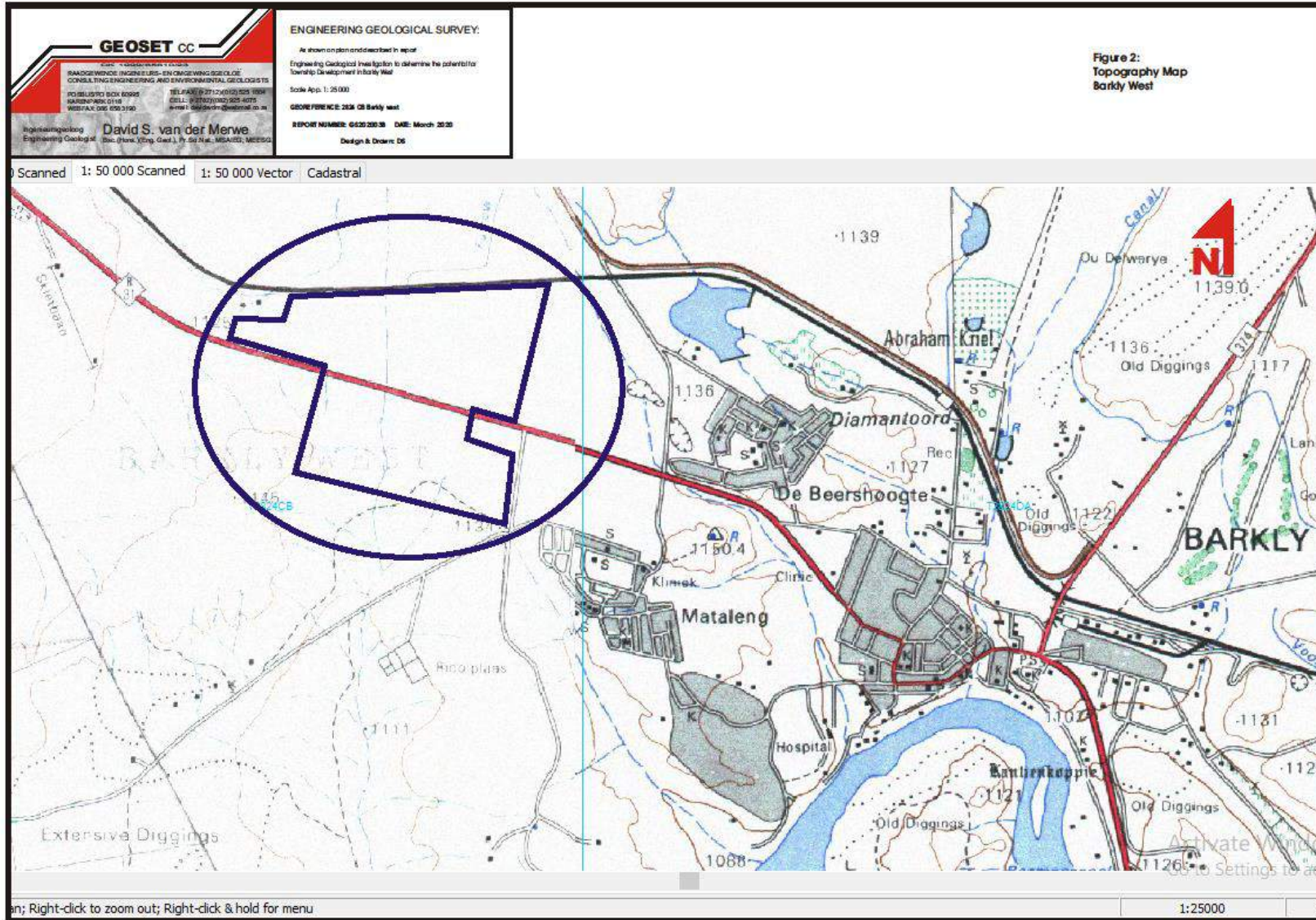
Table 1. Categories of Urban Engineering Geological Investigation

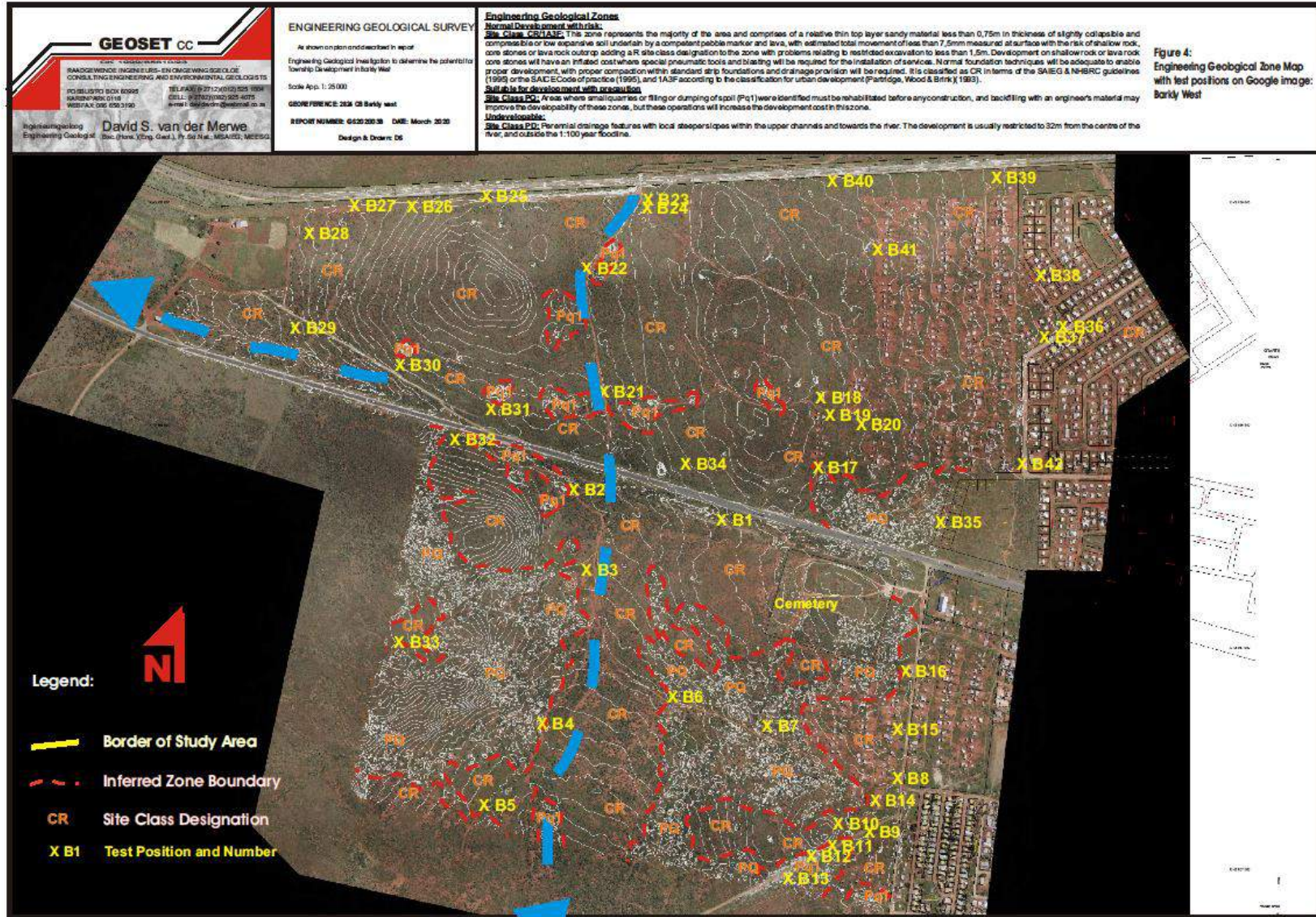
Table 2. Geotechnical Classification for Urban Development:
Partridge, Wood & Brink (1993)

Table 3. Residential Site Class Designations:
SAICE, SAIEG & NHBRC (1995)

APPENDIX A: FIGURES

- Figure 1: Barkly West, Dikgatlong Local Municipality: Regional Locality Map.
- Figure 2: Barkly West, Dikgatlong Local Municipality: Topography Map.
- Figure 3: Barkly West, Dikgatlong Local Municipality: Geology Map.
- Figure 4: Barkly West, Dikgatlong Local Municipality: Engineering Geological Zone Map with Test Pit Positions on Google Image.





Legend:

- Border of Study Area
- Inferred Zone Boundary
- CR Site Class Designation
- X B1 Test Position and Number

APPENDIX B: SOIL PROFILES

Soil Profiles Tabled Summary

Soil Profile Descriptions

Soil Profile Photographs

<u>Test</u>	<u>Samples</u>	<u>Hillwash</u>	<u>Pebble</u>	<u>Residual</u>	<u>Site</u>	<u>Remarks</u>	<u>GPS Coordinates</u>		<u>Test</u>
<u>Pit</u>	<u>Depth</u>	<u>Depth</u>	<u>Marker</u>	<u>Lava</u>	<u>Class</u>		X Coord	Y Coord	<u>Pit</u>
Nr	m	0m to m	to m	to m					Nr
B 1	0.2	0.3	0.6	1,0+	CR	Refusal on Lava boulders.	28°31,29,53" S	24°29'28,98" E	B 1
B 2	0.4	0.6	0.8	1,0+	CR	Refusal on lava.	28°31,27,48" S	24°29'18,03" E	B 2
B 3		0.3	0.5	1,0+	CR	Refusal on lava.	29°31,33,60" S	24°29'19,00" E	B 3
B 4	0.4	0.5	0.8	1,2+	CR	Refusal on lava.	29°31,44,47" S	24°29'14,64" E	B 4
B 5		0.4	0.6	1,0+	CR	Refusal on lava.	28°31,50,65" S	24°29'09,11" E	B 5
B 6			0.4	1,0+	CR	Refusal on lava.	28°31,42,63" S	24°29'25,06" E	B 6
B 7	0.3	0.8	1.1	1,4+	CR	Refusal on lava.	28°31,45,43" S	24°29'34,78" E	B 7
B 8		0.3	0.8	1,2+	CR	Refusal on Lava boulders.	28°31,50,03" S	24°29'43,88" E	B 8
B 9			0.8	1,4+	CR	Refusal on Lava boulders.	28°31,51,90" S	24°29'42,61" E	B 9
B 10					CR	Photo: hill / outcrop?	28°31,51,05" S	24°29'40,89" E	B 10
B 11					CR	Photo: Lava core stones	28°31,52,41" S	24°29'39,91" E	B 11
B 12					CR	Photo: Sewage spillage	28°31,53,47" S	24°29'37,32" E	B 12
B 13					CR	Photo: Lava core stones	28°31,55,35" S	24°29'24,03" E	B 13
B 14					CR	Photo: Waste with rubble & gravel	28°31,51,24" S	24°29'42,38" E	B 14
B 15					CR	Photo: Lava core stones	28°31,47,20" S	24°29'43,99" E	B 15
B 16	0.7	0.9	1.2	1,4+	CR	Filling up to 0,5m	28°31,40,49" S	24°29'45,07" E	B 16
B 17			1.0	1,4+	CR	Refusal on Lava boulders.	28°31,25,41" S	24°29'37,79" E	B 17
B 18	0.2	0.3	1.0	1,4+	CR	Refusal on lava.	28°31,20,62" S	24°29'37,55" E	B 18
B 19					CR	Photo: Lava pebbles at fence	28°31,21,83" S	24°29'37,61" E	B 19
B 20					CR	Photo: Well rounded pebbles	28°31,24,10" S	24°29'39,17" E	B 20
B 21	0.2	0.3	0.6	1,0+	CR	Refusal on lava.	28°31,21,70" S	24°29'20,91" E	B 21
B 22	0.2	0.2	0.6	1,1+	CR	Refusal on lava.	28°31,11,88" S	24°29'18,61" E	B 22
B 23					CR	Quarry with well rounded lava pebbles	28°31,05,52" S	24°29'22,75" E	B 23
B 24		0.2	0.9		CR	Refusal on Lava boulders.	28°31,06,18" S	24°29'23,04" E	B 24
B 25	0.2	0.4	0.7	1,1+	CR	Refusal on lava.	28°31,06,30" S	24°29'08,62" E	B 25
B 26					CR	Photo: large lava boulders on surface	28°31,06,92" S	24°28'57,13" E	B 26
B 27					CR	Photo: lava pebbles in road	28°31,06,92" S	24°28'57,13" E	B 27
B 28	0.2	0.3	0.8		CR	Refusal on Lava boulders.	28°31,07,98" S	24°28'55,25" E	B 28
B 29		0.4	0.8	1,2+	CR	Refusal on Lava boulders.	28°31,15,14" S	24°28'55,41" E	B 29
B 30		0.3	0.7	1,2+	CR	Refusal on Lava boulders.	28°31,18,60" S	24°29'04,17" E	B 30
B 31	0.4	0.6	1.1	1,3+	CR	Refusal on Lava boulders.	28°31,21,49" S	24°29'11,96" E	B 31
B 32	0.5	1.0	1.2	1,4+	CR	Refusal on Lava boulders.	28°31,24,48" S	24°29'09,32" E	B 32
B 33		0.4	1.0	1,3+	CR	Refusal on Lava.	28°31,38,17" S	24°29'02,28" E	B 33
B 34		0.4	0.6	1,4+	CR	Refusal on Lava.	28°31,25,26" S	24°29'28,89" E	B 34
B 35			0.7	0,9+	CR	Refusal on Lava boulders.	28°31,28,90" S	24°29'47,90" E	B 35
B 36			0.6	0,8+	CR	Refusal on Lava boulders.	28°31,15,26" S	24°29'57,47" E	B 36
B 37					CR	Photo: lava core stones & pebbles	28°31,16,30" S	24°29'55,70" E	B 37
B 38					CR	Photo: lava core stones & pebbles	28°31,12,14" S	24°29'55,69" E	B 38
B 39			0.8	1,0+	CR	Refusal on Pebblemarker.	28°31,04,93" S	24°29'52,95" E	B 39
B 40	0.2	0.3	0.7	1,0+	CR	Refusal on Pebblemarker.	28°31,05,42" S	24°29'38,33" E	B 40
B 41		0.2	0.8	1,2+	CR	Refusal on Pebblemarker.	28°31,09,95" S	24°29'42,46" E	B 41
B 42					CR	Photo: Lava outcrop	28°31,25,27" S	24°29'53,92" E	B 42
B 43		0.2	0.7	1,2+	CR	Refusal on Lava.	28°31,25,27" S	24°29'53,92" E	B 43
B 44					CR	Photo: lava core stones & pebbles	28°31,25,47" S	24°29'52,74" E	B 44

13 Disturbed samples were taken.


No water was encountered in any test pit

A JCB 3DX 4X4 TLB was supplied by Corne Berg, operated by Jonas.

All the test pits were dug to the refusal depth of the TLB usually in lava.

The moisture content of the soil profiles were usually described as dry and sometimes as slightly moist.

The consistency of the soil increased with increasing depth and was described as very loose with refusal on lava as medium hard rock. Refusal on lava was noted in all test pits, with an average refusal depth of 1,15m.

Soil Profile Nr: B1		 GEOSET CC Consulting Engineering & Environmental Geologists Raadgewende Ingenieurs- en Omgewingsgeoloë	
DATE: 5 March 2020			
JOB NR: GS202003B			
Local Municipality of Dikgatlong			
Town: Barkley-West			
CLIENT: Barzani			
TLB Contractor: Corne Berg Contract			
TLB Machine: JCB 3DX 4X4			
TLB Operator: Jonas		P.O. Box / Posbus 60995	Tel: 012 525 1004
		KARENPAK 0118	Webfax: 086 658 3190
		e-mail: davidsvdm@webmail.co.za	Cell: 082 925 4075
		Engineering Geologist:	David S. van der Merwe.
		Ingenieursgeoloog:	Pr. Sci. Nat., MSAIEG.


Depth bngl (m)	Soil Profile Symbol	Sample Nr Symbols	Description of soil and properties
0.1			
0.2		●	Slightly moist, reddish brown, loose to very loose, open textured clayey sand. Hillwast
0.3		B1-0,2	
0.4			
0.5			Slightly moist, dark brown, well to sub rounded, small & medium, intact lava pebbles,
0.6			clast supported in a subordinate matrix of the above. Pebble marker. Consistency is de
0.7			
0.8			Slightly moist, grey green mottled white, dense, intact, sandy gravel.
0.9			Moderately weathered lava
1.0			
1,0+			








Notes:

1. Refusal of TLB on large lava boulders.
2. No groundwater was intersected.
3. ● Disturbed sample B1-0,2.

Lat/long	X Coord:	28°31,29,53" S
WGS84 datum	Y Coord:	24°29'28,98" E

Soil Profile Nr: B1

Soil Profile Nr: B2		 GEOSET CC Consulting Engineering & Environmental Geologists Raadgewende Ingenieurs- en Omgewingsgeoloë	
DATE: 5 March 2020			
JOB NR: GS202003B			
Local Municipality of Dikgatlong			
Town: Barkley-West			
CLIENT: Barzani			
TLB Contractor: Corne Berg Contract			
TLB Machine: JCB 3DX 4X4			
TLB Operator: Jonas		P.O. Box / Posbus 60995	Tel: 012 525 1004
		KARENPAK 0118	Webfax: 086 658 3190
		e-mail: davidsvdm@webmail.co.za	Cell: 082 925 4075
		Engineering Geologist:	David S. van der Merwe.
		Ingenieursgeoloog:	Pr. Sci. Nat., MSAIEG.


Depth bngl (m)	Soil Profile Symbol	Sample Nr Symbols	Description of soil and properties
0.1			
0.2			Slightly moist, reddish brown, loose to very loose, open textured clayey sand. Hillwast
0.3			
0.4		●	
0.5		B2-0,4	Slightly moist, dark brown, well to sub rounded, small & medium, intact lava pebbles,
0.6			clast supported in a subordinate matrix of the above. Pebble marker. Consistency is de
0.7			
0.8			Slightly moist, grey green mottled white, dense, intact, sandy gravel.
0.9			Moderately weathered lava
1.0			
1,0+			




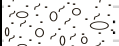



Notes:

1. Refusal of TLB on lava.
2. No groundwater was intersected.
3. ● Disturbed sample B2-0,4.

Lat/long	X Coord:	28°31,27,48" S
WGS84 datum	Y Coord:	24°29'18,03" E

Soil Profile Nr: B2

Soil Profile Nr: B3		 GEOSET CC Consulting Engineering & Environmental Geologists Raadgewende Ingenieurs- en Omgewingsgeoloë	
DATE: 5 March 2020			
JOB NR: GS202003B			
Local Municipality of Dikgatlong			
Town: Barkley-West			
CLIENT: Barzani			
TLB Contractor: Corne Berg Contract			
TLB Machine: JCB 3DX 4X4			
TLB Operator: Jonas		P.O. Box / Posbus 60995	Tel: 012 525 1004
		KARENPAK 0118	Webfax: 086 658 3190
		e-mail: davidsvdm@webmail.co.za	Cell: 082 925 4075
		Engineering Geologist:	David S. van der Merwe.
		Ingenieursgeoloog:	Pr. Sci. Nat., MSAIEG.


Depth bngl (m)	Soil Profile Symbol	Sample Nr Symbols	Description of soil and properties
0.1			
0.2			Slightly moist, reddish brown, loose to very loose, open textured clayey sand. Hillwast
0.3			
0.4			
0.5			Slightly moist, dark brown, well to sub rounded, small & medium, intact lava pebbles,
0.6			clast supported in a subordinate matrix of the above. Pebble marker. Consistency is de
0.7			
0.8			Slightly moist, grey green mottled white, dense, intact, sandy gravel.
0.9			Moderately weathered lava
1.0			
1,0+			


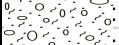


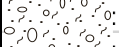
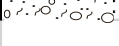

Notes:

1. Refusal of TLB on lava.
2. No groundwater was intersected.
3. No sample.

Lat/long	X Coord:	29°31,33,60" S
WGS84 datum	Y Coord:	24°29'19,00" E

Soil Profile Nr: B3

Soil Profile Nr: B4		 GEOSET CC Consulting Engineering & Environmental Geologists Raadgewende Ingenieurs- en Omgewingsgeoloë	
DATE: 5 March 2020			
JOB NR: GS202003B			
Local Municipality of Dikgatlong			
Town: Barkley-West			
CLIENT: Barzani			
TLB Contractor: Corne Berg Contract			
TLB Machine: JCB 3DX 4X4			
TLB Operator: Jonas		P.O. Box / Posbus 60995	Tel: 012 525 1004
		KAREN PARK 0118	Webfax: 086 658 3190
		e-mail: davidsvdm@webmail.co.za	Cell: 082 925 4075
		Engineering Geologist:	David S. van der Merwe.
		Ingenieursgeoloog:	Pr. Sci. Nat., MSAIEG.


Depth bngl (m)	Soil Profile Symbol	Sample Nr Symbols	Description of soil and properties
0.1			
0.2			
0.3			Slightly moist, reddish brown, loose to very loose, open textured clayey sand. Hillwast
0.4		●	
0.5		B4-0,4	
0.6			
0.7			Slightly moist, dark brown, well to sub rounded, small & medium, intact lava pebbles,
0.8			clast supported in a subordinate matrix of the above. Pebble marker. Consistency is de
0.9			
1.0			Slightly moist, grey green mottled white, dense, intact, sandy gravel.
1.1			Moderately weathered lava
1.2			
1,2+			





Notes:

1. Refusal of TLB on lava.
2. No groundwater was intersected.
3. ● Disturbed sample B4-0,4.

Lat/long	X Coord:	29°31,44,47" S
WGS84 datum	Y Coord:	24°29'14,64" E

Soil Profile Nr: B4

Soil Profile Nr: B5		 GEOSET CC Consulting Engineering & Environmental Geologists Raadgewende Ingenieurs- en Omgewingsgeoloë	
DATE: 5 March 2020			
JOB NR: GS202003B			
Local Municipality of Dikgatlong			
Town: Barkley-West			
CLIENT: Barzani			
TLB Contractor: Corne Berg Contract			
TLB Machine: JCB 3DX 4X4			
TLB Operator: Jonas		P.O. Box / Posbus 60995	Tel: 012 525 1004
		KARENPAK 0118	Webfax: 086 658 3190
		e-mail: davidsvdm@webmail.co.za	Cell: 082 925 4075
		Engineering Geologist:	David S. van der Merwe.
		Ingenieursgeoloog:	Pr. Sci. Nat., MSAIEG.


Depth bng (m)	Soil Profile Symbol	Sample Nr Symbols	Description of soil and properties
0.1			
0.2			Slightly moist, reddish brown, loose to very loose, open textured clayey sand. Hillwast
0.3			
0.4			
0.5			Slightly moist, dark brown, well to sub rounded, small & medium, intact lava pebbles,
0.6			clast supported in a subordinate matrix of the above. Pebble marker. Consistency is de
0.7			Slightly moist, grey green mottled white, dense, intact, sandy gravel.
0.8			Moderately weathered lava
0.9			
1.0			
1,0+			

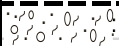

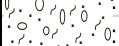
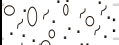

Notes:

1. Refusal of TLB on lava.
2. No groundwater was intersected.
3. No sample.

Lat/long	X Coord:	28°31,50,65" S
WGS84 datum	Y Coord:	24°29'09,11" E

Soil Profile Nr: B5

Soil Profile Nr: B6		 GEOSET CC Consulting Engineering & Environmental Geologists Raadgewende Ingenieurs- en Omgewingsgeoloë	
DATE: 5 March 2020			
JOB NR: GS202003B			
Local Municipality of Dikgatlong			
Town: Barkley-West			
CLIENT: Barzani			
TLB Contractor: Corne Berg Contract			
TLB Machine: JCB 3DX 4X4			
TLB Operator: Jonas		P.O. Box / Posbus 60995	Tel: 012 525 1004
		KARENPAK 0118	Webfax: 086 658 3190
		e-mail: davidsvdm@webmail.co.za	Cell: 082 925 4075
		Engineering Geologist:	David S. van der Merwe.
		Ingenieursgeoloog:	Pr. Sci. Nat., MSAIEG.


Depth bngl (m)	Soil Profile Symbol	Sample Nr Symbols	Description of soil and properties
0.1			
0.2			Slightly moist, dark brown, well to sub rounded, small & medium, intact lava pebbles,
0.3			clast supported in a subordinate matrix of the above. Pebble marker. Consistency is de
0.4			
0.5			
0.6			
0.7			Slightly moist, grey green mottled w hite, dense, intact, sandy gravel.
0.8			Moderately w eathered lava
0.9			
1.0			
1,0+			

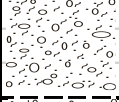





Notes:

1. Refusal of TLB on lava.
2. No groundwater was intersected.
3. No sample.

Lat/long	X Coord:	28°31,42,63" S
WGS84 datum	Y Coord:	24°29'25,06" E

Soil Profile Nr: B6

Soil Profile Nr: B7		 GEOSET CC Consulting Engineering & Environmental Geologists Raadgewende Ingenieurs- en Omgewingsgeoloë	
DATE: 5 March 2020			
JOB NR: GS202003B			
Local Municipality of Dikgatlong			
Town: Barkley-West			
CLIENT: Barzani			
TLB Contractor: Corne Berg Contract			
TLB Machine: JCB 3DX 4X4			
TLB Operator: Jonas		P.O. Box / Posbus 60995	Tel: 012 525 1004
		KARENPAK 0118	Webfax: 086 658 3190
		e-mail: davidsvdm@webmail.co.za	Cell: 082 925 4075
		Engineering Geologist:	David S. van der Merwe.
		Ingenieursgeoloog:	Pr. Sci. Nat., MSAIEG.


Depth bngl (m)	Soil Profile Symbol	Sample Nr Symbols	Description of soil and properties
0.1			
0.2			
0.3		●	
0.4		B7-0,3	Slightly moist, reddish brown, loose to very loose, open textured clayey sand. Hillwast
0.5			
0.6			
0.7			
0.8			
0.9			
1.0			Slightly moist, dark brown, well to sub rounded, small & medium, intact lava pebbles, clast supported in a subordinate matrix of the above. Pebble marker. Consistency is de
1.1			
1.2			Slightly moist, grey green mottled with white, dense, intact, sandy gravel.
1.3			Moderately weathered lava
1.4			
1,4+			

Notes:

1. Refusal of TLB on lava.
2. No groundwater was intersected.
3. ● Disturbed sample B7-0,3.

Lat/long	X Coord:	28°31,45,43" S
WGS84 datum	Y Coord:	24°29'34,78" E

Soil Profile Nr: B7

Soil Profile Nr: B8		 GEOSET CC Consulting Engineering & Environmental Geologists Raadgewende Ingenieurs- en Omgewingsgeoloë	
DATE: 5 March 2020			
JOB NR: GS202003B			
Local Municipality of Dikgatlong			
Town: Barkley-West			
CLIENT: Barzani			
TLB Contractor: Corne Berg Contract			
TLB Machine: JCB 3DX 4X4			
TLB Operator: Jonas		P.O. Box / Posbus 60995	Tel: 012 525 1004
		KARENPAK 0118	Webfax: 086 658 3190
		e-mail: davidsvdm@webmail.co.za	Cell: 082 925 4075
		Engineering Geologist:	David S. van der Merwe.
		Ingenieursgeoloog:	Pr. Sci. Nat., MSAIEG.


Depth bngl (m)	Soil Profile Symbol	Sample Nr Symbols	Description of soil and properties
0.1			
0.2			Slightly moist, reddish brown, loose to very loose, open textured clayey sand. Hillwast
0.3			
0.4			
0.5			Slightly moist, dark brown, well to sub rounded, small & medium, intact lava pebbles,
0.6			clast supported in a subordinate matrix of the above. Pebble marker. Consistency is de
0.7			
0.8			
0.9			
1.0			Slightly moist, grey green mottled white, dense, intact, sandy gravel.
1.1			Moderately weathered lava
1.2			
1,2+			

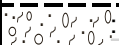
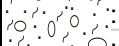
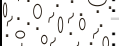

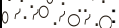

Notes:

1. Refusal of TLB on large lava boulders.
2. No groundwater was intersected.
3. No sample.

Lat/long	X Coord:	28°31,50,03" S
WGS84 datum	Y Coord:	24°29'43,88" E

Soil Profile Nr: B8

Soil Profile Nr: B9		 GEOSET CC Consulting Engineering & Environmental Geologists Raadgewende Ingenieurs- en Omgewingsgeoloë	
DATE: 5 March 2020			
JOB NR: GS202003B			
Local Municipality of Dikgatlong			
Town: Barkley-West			
CLIENT: Barzani			
TLB Contractor: Corne Berg Contracto			
TLB Machine: JCB 3DX 4X4			
TLB Operator: Jonas		P.O. Box / Posbus 60995	Tel: 012 525 1004
		KARENPAK 0118	Webfax: 086 658 3190
		e-mail: davidsvdm@webmail.co.za	Cell: 082 925 4075
		Engineering Geologist:	David S. van der Merwe.
		Ingenieursgeoloog:	Pr. Sci. Nat., MSAIEG.


Depth bngl (m)	Soil Profile Symbol	Sample Nr Symbols	Description of soil and properties
0.1			
0.2			
0.3			
0.4			Slightly moist, dark brown, well to sub rounded, small & medium, intact lava pebbles,
0.5			clast supported in a subordinate matrix of the above. Pebble marker. Consistency is de
0.6			
0.7			
0.8			
0.9			
1.0			
1.1			Slightly moist, grey green mottled white, dense, intact, sandy gravel.
1.2			Moderately weathered lava
1.3			
1.4			

Notes:

1. Refusal of TLB on large lava boulders.
2. No groundwater was intersected.
3. No sample.

Lat/long	X Coord:	28°31,51,90" S
WGS84 datum	Y Coord:	24°29'42,61" E

Soil Profile Nr: B9

Soil Profile Nr: B16		 GEOSET CC Consulting Engineering & Environmental Geologists Raadgewende Ingenieurs- en Omgewingsgeoloë	
DATE: 5 March 2020			
JOB NR: GS202003B			
Local Municipality of Dikgatlong			
Town: Barkley-West			
CLIENT: Barzani			
TLB Contractor: Corne Berg Contract			
TLB Machine: JCB 3DX 4X4			
TLB Operator: Jonas		P.O. Box / Posbus 60995	Tel: 012 525 1004
		KAREN PARK 0118	Webfax: 086 658 3190
		e-mail: davidsvdm@webmail.co.za	Cell: 082 925 4075
		Engineering Geologist:	David S. van der Merwe.
		Ingenieursgeoloog:	Pr. Sci. Nat., MSAIEG.


Depth bngl (m)	Soil Profile Symbol	Sample Nr Symbols	Description of soil and properties
0.1	<#%&* >		
0.2	<#%&* >		
0.3	<#%&* >		Filling consisting of building rubble and lava gravel & pebbles.
0.4	<#%&* >		
0.5	<#%&* >		
0.6			
0.7		●	Slightly moist, reddish brown, loose to very loose, open textured clayey sand. Hillwast
0.8		B16-0,7	
0.9			
1.0	○○○○○		
1.1	○○○○○		Slightly moist, dark brown, well to sub rounded, small & medium, intact lava pebbles,
1.2	○○○○○		clast supported in a subordinate matrix of the above. Pebble marker. Consistency is de
1.3	○○○○○		
1.4	○○○○○		
1.5	○○○○○		Slightly moist, grey green mottled white, dense, intact, sandy gravel.
1.6	○○○○○		Moderately weathered lava
1,2+			

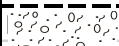
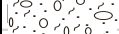
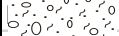
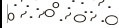
Notes:

1. Refusal of TLB on large lava boulders.
2. No groundwater was intersected.
3. ● Disturbed sample B16-0,7.

Lat/long	X Coord:	28°31,40,49" S
WGS84 datum	Y Coord:	24°29'45,07" E

Soil Profile Nr: B16

Soil Profile Nr: B17		 GEOSET CC Consulting Engineering & Environmental Geologists Raadgewende Ingenieurs- en Omgewingsgeoloë	
DATE: 5 March 2020			
JOB NR: GS202003B			
Local Municipality of Dikgatlong			
Town: Barkley-West			
CLIENT: Barzani			
TLB Contractor: Corne Berg Contract			
TLB Machine: JCB 3DX 4X4			
TLB Operator: Jonas		P.O. Box / Posbus 60995	Tel: 012 525 1004
		KARENPAK 0118	Webfax: 086 658 3190
		e-mail: davidsvdm@webmail.co.za	Cell: 082 925 4075
		Engineering Geologist:	David S. van der Merwe.
		Ingenieursgeoloog:	Pr. Sci. Nat., MSAIEG.


Depth bngl (m)	Soil Profile Symbol	Sample Nr Symbols	Description of soil and properties
0.1			
0.2			
0.3			
0.4			
0.5			Slightly moist, dark brown, well rounded, small & medium, intact lava pebbles,
0.6			clast supported in a subordinate matrix of the above. Pebble marker. Consistency is de
0.7			
0.8			
0.9			
1.0			
1.1			
1.2			Slightly moist, grey green mottled white, dense, intact, sandy gravel.
1.3			Moderately weathered lava
1.4			

Notes:

1. Refusal of TLB on lava pebbles & core stones.
2. No groundwater was intersected.
3. No sample.

Lat/long	X Coord:	28°31,25,41" S
WGS84 datum	Y Coord:	24°29'37,79" E

Soil Profile Nr: B17

Soil Profile Nr: B18		 GEOSET CC Consulting Engineering & Environmental Geologists Raadgewende Ingenieurs- en Omgewingsgeoloë	
DATE: 5 March 2020			
JOB NR: GS202003B			
Local Municipality of Dikgatlong			
Town: Barkley-West			
CLIENT: Barzani			
TLB Contractor: Corne Berg Contract			
TLB Machine: JCB 3DX 4X4			
TLB Operator: Jonas		P.O. Box / Posbus 60995	Tel: 012 525 1004
		KARENPAK 0118	Webfax: 086 658 3190
		e-mail: davidsvdm@webmail.co.za	Cell: 082 925 4075
		Engineering Geologist:	David S. van der Merwe.
		Ingenieursgeoloog:	Pr. Sci. Nat., MSAIEG.


Depth bngl (m)	Soil Profile Symbol	Sample Nr Symbols	Description of soil and properties
0.1			
0.2		B18-0,2	Slightly moist, reddish brown, loose to very loose, open textured clayey sand. Hillwast
0.3		●	
0.4			
0.5			
0.6			
0.7			Slightly moist, dark brown, well to sub rounded, small & medium, intact lava pebbles,
0.8			clast supported in a subordinate matrix of the above. Pebble marker. Consistency is de
0.9			
1.0			
1.1			
1.2			
1.3			Slightly moist, grey green mottled w hite, dense, intact, sandy gravel.
1.4			Moderately w eathered lava
1,4+			

Notes:

1. Refusal of TLB on lava.
2. No groundwater was intersected.
3. ● Disturbed sample B18-0,2.

Lat/long	X Coord:	28°31,20,62" S
WGS84 datum	Y Coord:	24°29'37,55" E

Soil Profile Nr: B18

Soil Profile Nr: B21		 GEOSET CC Consulting Engineering & Environmental Geologists Raadgewende Ingenieurs- en Omgewingsgeoloë	
DATE: 5 March 2020			
JOB NR: GS202003B			
Local Municipality of Dikgatlong			
Town: Barkley-West			
CLIENT: Barzani			
TLB Contractor: Corne Berg Contract			
TLB Machine: JCB 3DX 4X4			
TLB Operator: Jonas		P.O. Box / Posbus 60995	Tel: 012 525 1004
		KARENPAK 0118	Webfax: 086 658 3190
		e-mail: davidsvdm@webmail.co.za	Cell: 082 925 4075
		Engineering Geologist:	David S. van der Merwe.
		Ingenieursgeoloog:	Pr. Sci. Nat., MSAIEG.


Depth bngl (m)	Soil Profile Symbol	Sample Nr Symbols	Description of soil and properties
0.1			
0.2		B21-0,2	Slightly moist, reddish brown, loose to very loose, open textured clayey sand. Hillwast
0.3		●	
0.4			
0.5			Slightly moist, dark brown, well to sub rounded, small & medium, intact lava pebbles,
0.6			clast supported in a subordinate matrix of the above. Pebble marker. Consistency is de
0.7			
0.8			Slightly moist, grey green mottled white, dense, intact, sandy gravel.
0.9			Moderately weathered lava
1.0			


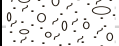
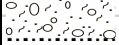
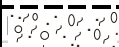


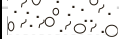


Notes:

1. Refusal of TLB on lava.
2. No groundwater was intersected.
3. ● Disturbed sample B21-0,2.

Lat/long	X Coord:	28°31,21,70" S
WGS84 datum	Y Coord:	24°29'20,91" E

Soil Profile Nr: B21

Soil Profile Nr: B22		 GEOSET CC Consulting Engineering & Environmental Geologists Raadgewende Ingenieurs- en Omgewingsgeoloë	
DATE: 5 March 2020			
JOB NR: GS202003B			
Local Municipality of Dikgatlong			
Town: Barkley-West			
CLIENT: Barzani			
TLB Contractor: Corne Berg Contracto			
TLB Machine: JCB 3DX 4X4			
TLB Operator: Jonas		P.O. Box / Posbus 60995	Tel: 012 525 1004
		KARENPAK 0118	Webfax: 086 658 3190
		e-mail: davidsvdm@webmail.co.za	Cell: 082 925 4075
		Engineering Geologist:	David S. van der Merwe.
		Ingenieursgeoloog:	Pr. Sci. Nat., MSAIEG.


Depth bngl (m)	Soil Profile Symbol	Sample Nr Symbols	Description of soil and properties
0.1		B22-0,2	
0.2		●	Slightly moist, reddish brown, loose to very loose, open textured clayey sand. Hillwast
0.3			
0.4			Slightly moist, dark brown, well to sub rounded, small & medium, intact lava pebbles,
0.5			clast supported in a subordinate matrix of the above. Pebble marker. Consistency is de
0.6			
0.7			
0.8			Slightly moist, grey green mottled white, dense, intact, sandy gravel.
0.9			Moderately weathered lava
1.0			
1.1			

Notes:

1. Refusal of TLB on lava.
2. No groundwater was intersected.
3. ● Disturbed sample B22-0,2.

Lat/long	X Coord:	28°31,11,88" S
WGS84 datum	Y Coord:	24°29'18,61" E

Soil Profile Nr: B22

Soil Profile Nr: B24		 GEOSET CC Consulting Engineering & Environmental Geologists Raadgewende Ingenieurs- en Omgewingsgeoloë	
DATE: 5 March 2020			
JOB NR: GS202003B			
Local Municipality of Dikgatlong			
Town: Barkley-West			
CLIENT: Barzani			
TLB Contractor: Corne Berg Contract			
TLB Machine: JCB 3DX 4X4			
TLB Operator: Jonas		P.O. Box / Posbus 60995	Tel: 012 525 1004
		KARENPAK 0118	Webfax: 086 658 3190
		e-mail: davidsvdm@webmail.co.za	Cell: 082 925 4075
		Engineering Geologist:	David S. van der Merwe.
		Ingenieursgeoloog:	Pr. Sci. Nat., MSAIEG.


Depth bngl (m)	Soil Profile Symbol	Sample Nr Symbols	Description of soil and properties
0.1			Slightly moist, dark brown, well to sub rounded, small & medium, intact lava pebbles,
0.2			clast supported in a subordinate matrix of the above. Pebble marker. Consistency is de
0.3			
0.4			
0.5			
0.6			Slightly moist, grey green mottled w hite, dense, intact, sandy gravel w ith lava boulders
0.7			Moderately w eathered lava
0.8			
0.9			
1.0			
1,0+			


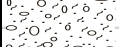
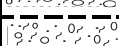


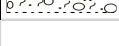

Notes:

1. Refusal of TLB on lava boulders.
2. No groundwater was intersected.
3. No sample.

Lat/long	X Coord:	28°31,06,18" S
WGS84 datum	Y Coord:	24°29'23,04" E

Soil Profile Nr: B24

Soil Profile Nr: B25		 GEOSET CC Consulting Engineering & Environmental Geologists Raadgewende Ingenieurs- en Omgewingsgeoloë	
DATE: 5 March 2020			
JOB NR: GS202003B			
Local Municipality of Dikgatlong			
Town: Barkley-West			
CLIENT: Barzani			
TLB Contractor: Corne Berg Contract			
TLB Machine: JCB 3DX 4X4			
TLB Operator: Jonas		P.O. Box / Posbus 60995	Tel: 012 525 1004
		KARENPAK 0118	Webfax: 086 658 3190
		e-mail: davidsvdm@webmail.co.za	Cell: 082 925 4075
		Engineering Geologist:	David S. van der Merwe.
		Ingenieursgeoloog:	Pr. Sci. Nat., MSAIEG.


Depth bngl (m)	Soil Profile Symbol	Sample Nr Symbols	Description of soil and properties
0.1			
0.2		B25-0,2	Slightly moist, reddish brown, loose to very loose, open textured clayey sand. Hillwast
0.3		●	
0.4			
0.5			
0.6			Slightly moist, dark brown, well to sub rounded, small & medium, intact lava pebbles,
0.7			clast supported in a subordinate matrix of the above. Pebble marker. Consistency is de
0.8			
0.9			Slightly moist, grey green mottled white, dense, intact, sandy gravel.
1.0			Moderately weathered lava
1.1			






Notes:

1. Refusal of TLB on lava.
2. No groundwater was intersected.
3. ● Disturbed sample B25-0,2.

Lat/long	X Coord:	28°31,06,30" S
WGS84 datum	Y Coord:	24°29'08,62" E

Soil Profile Nr: B25

Soil Profile Nr: B24		 GEOSET CC Consulting Engineering & Environmental Geologists Raadgewende Ingenieurs- en Omgewingsgeoloë	
DATE: 5 March 2020			
JOB NR: GS202003B			
Local Municipality of Dikgatlong			
Town: Barkley-West			
CLIENT: Barzani			
TLB Contractor: Corne Berg Contracto			
TLB Machine: JCB 3DX 4X4			
TLB Operator: Jonas		P.O. Box / Posbus 60995	Tel: 012 525 1004
		KARENPAK 0118	Webfax: 086 658 3190
		e-mail: davidsvdm@w e b m a i l . c o . z a	Cell: 082 925 4075
		Engineering Geologist:	David S. van der Merwe.
		Ingenieursgeoloog:	Pr. Sci. Nat., MSAIEG.


Depth bngl (m)	Soil Profile Symbol	Sample Nr Symbols	Description of soil and properties
0.1		B28-0,2	
0.2		●	Slightly moist, reddish brown, loose to very loose, open textured clayey sand. Hillwast
0.3			
0.4			
0.5			
0.6			Slightly moist, dark brown, well to sub rounded, small & medium, intact lava pebbles,
0.7			clast supported in a subordinate matrix of the above. Pebble marker. Consistency is de
0.8			



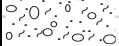
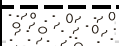




Notes:

1. Refusal of TLB on lava boulders.
2. No groundwater was intersected.
3. ● Disturbed sample B28-0,2.

Lat/long	X Coord:	28°31,07,98" S
WGS84 datum	Y Coord:	24°28'55,25" E

Soil Profile Nr: B24

Soil Profile Nr: B29		 GEOSET CC Consulting Engineering & Environmental Geologists Raadgewende Ingenieurs- en Omgewingsgeoloë	
DATE: 5 March 2020			
JOB NR: GS202003B			
Local Municipality of Dikgatlong			
Town: Barkley-West			
CLIENT: Barzani			
TLB Contractor: Corne Berg Contract			
TLB Machine: JCB 3DX 4X4			
TLB Operator: Jonas		P.O. Box / Posbus 60995	Tel: 012 525 1004
		KARENPAK 0118	Webfax: 086 658 3190
		e-mail: davidsvdm@webmail.co.za	Cell: 082 925 4075
		Engineering Geologist:	David S. van der Merwe.
		Ingenieursgeoloog:	Pr. Sci. Nat., MSAIEG.


Depth bngl (m)	Soil Profile Symbol	Sample Nr Symbols	Description of soil and properties
0.1			
0.2			Slightly moist, reddish brown, loose to very loose, open textured clayey sand. Hillwast
0.3			
0.4			
0.5			
0.6			Slightly moist, dark brown, well to sub rounded, small & medium, intact lava pebbles,
0.7			clast supported in a subordinate matrix of the above. Pebble marker. Consistency is de
0.8			
0.9			
1.0			Slightly moist, grey green mottled w hite, dense, intact, sandy gravel.
1.1			Moderately w eathered lava
1.2			

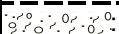
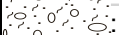
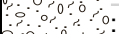

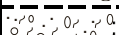

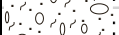
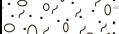
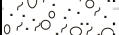
Notes:

1. Refusal of TLB on lava.
2. No groundwater was intersected.
3. No samples.

Lat/long	X Coord:	28°31,15,14" S
WGS84 datum	Y Coord:	24°28'55,41" E

Soil Profile Nr: B29

Soil Profile Nr: B30		 GEOSET CC Consulting Engineering & Environmental Geologists Raadgewende Ingenieurs- en Omgewingsgeoloë	
DATE: 5 March 2020			
JOB NR: GS202003B			
Local Municipality of Dikgatlong			
Town: Barkley-West			
CLIENT: Barzani			
TLB Contractor: Corne Berg Contract			
TLB Machine: JCB 3DX 4X4			
TLB Operator: Jonas		P.O. Box / Posbus 60995	Tel: 012 525 1004
		KARENPAK 0118	Webfax: 086 658 3190
		e-mail: davidsvdm@webmail.co.za	Cell: 082 925 4075
		Engineering Geologist:	David S. van der Merwe.
		Ingenieursgeoloog:	Pr. Sci. Nat., MSAIEG.


Depth bngl (m)	Soil Profile Symbol	Sample Nr Symbols	Description of soil and properties
0.1			
0.2			Slightly moist, reddish brown, loose to very loose, open textured clayey sand. Hillwash
0.3			
0.4			
0.5			Slightly moist, dark brown, well to sub rounded, small & medium, intact lava pebbles,
0.6			clast supported in a subordinate matrix of the above. Pebble marker. Consistency is de
0.7			
0.8			
0.9			
1.0			Slightly moist, grey green mottled white, dense, intact, sandy gravel.
1.1			Moderately weathered lava
1.2			

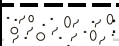

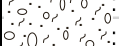
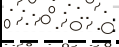

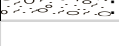

Notes:

1. Refusal of TLB on lava.
2. No groundwater was intersected.
3. No samples.

Lat/long	X Coord:	28°31,18,60" S
WGS84 datum	Y Coord:	24°29'04,17" E

Soil Profile Nr: B30

Soil Profile Nr: B31		 GEOSET CC Consulting Engineering & Environmental Geologists Raadgewende Ingenieurs- en Omgewingsgeoloë	
DATE: 5 March 2020			
JOB NR: GS202003B			
Local Municipality of Dikgatlong			
Town: Barkley-West			
CLIENT: Barzani			
TLB Contractor: Corne Berg Contract			
TLB Machine: JCB 3DX 4X4			
TLB Operator: Jonas		P.O. Box / Posbus 60995	Tel: 012 525 1004
		KARENPAK 0118	Webfax: 086 658 3190
		e-mail: davidsvdm@webmail.co.za	Cell: 082 925 4075
		Engineering Geologist:	David S. van der Merwe.
		Ingenieursgeoloog:	Pr. Sci. Nat., MSAIEG.


Depth bngl (m)	Soil Profile Symbol	Sample Nr Symbols	Description of soil and properties
0.1			
0.2			Slightly moist, reddish brown, loose to very loose, open textured clayey sand. Hillwast
0.3		B31-0,4	
0.4		●	
0.5			
0.6			
0.7			
0.8			Slightly moist, dark brown, well to sub rounded, small & medium, intact lava pebbles,
0.9			clast supported in a subordinate matrix of the above. Pebble marker. Consistency is de
1.0			
1.1			
1.2			Slightly moist, grey green mottled white, dense, intact, sandy gravel.
1.3			Moderately weathered lava



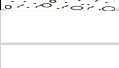

Notes:

1. Refusal of TLB on lava.
2. No groundwater was intersected.
3. ● Disturbed sample B31-0,4.

Lat/long	X Coord:	28°31,21,49" S
WGS84 datum	Y Coord:	24°29'11,96" E

Soil Profile Nr: B31

Soil Profile Nr: B32		 GEOSET CC Consulting Engineering & Environmental Geologists Raadgewende Ingenieurs- en Omgewingsgeoloë	
DATE: 5 March 2020			
JOB NR: GS202003B			
Local Municipality of Dikgatlong			
Town: Barkley-West			
CLIENT: Barzani			
TLB Contractor: Corne Berg Contract			
TLB Machine: JCB 3DX 4X4			
TLB Operator: Jonas		P.O. Box / Posbus 60995	Tel: 012 525 1004
		KAREN PARK 0118	Webfax: 086 658 3190
		e-mail: davidsvdm@webmail.co.za	Cell: 082 925 4075
		Engineering Geologist:	David S. van der Merwe.
		Ingenieursgeoloog:	Pr. Sci. Nat., MSAIEG.


Depth bngl (m)	Soil Profile Symbol	Sample Nr Symbols	Description of soil and properties
0.1			
0.2			
0.3			
0.4		B32-0,5	
0.5		●	Slightly moist, reddish brown, loose to very loose, open textured clayey sand. Hillwash
0.6			
0.7			
0.8			
0.9			
1.0			
1.1			Slightly moist, dark brown, well to sub rounded, small & medium, intact lava pebbles,
1.2			clast supported in a subordinate matrix of the above. Pebble marker. Consistency is de
1.3			Slightly moist, grey green mottled white, dense, intact, sandy gravel.
1.4			Moderately weathered lava

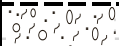

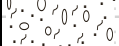
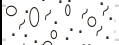
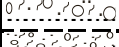
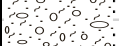
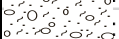


Notes:

1. Refusal of TLB on lava.
2. No groundwater was intersected.
3. ● Disturbed sample B32-0,5.

Lat/long	X Coord:	28°31,24,48" S
WGS84 datum	Y Coord:	24°29'09,32" E

Soil Profile Nr: B32

Soil Profile Nr: B33		 GEOSET CC Consulting Engineering & Environmental Geologists Raadgewende Ingenieurs- en Omgewingsgeoloë	
DATE: 5 March 2020			
JOB NR: GS202003B			
Local Municipality of Dikgatlong			
Town: Barkley-West			
CLIENT: Barzani			
TLB Contractor: Corne Berg Contracto			
TLB Machine: JCB 3DX 4X4			
TLB Operator: Jonas		P.O. Box / Posbus 60995	Tel: 012 525 1004
		KAREN PARK 0118	Webfax: 086 658 3190
		e-mail: davidsvdm@webmail.co.za	Cell: 082 925 4075
		Engineering Geologist:	David S. van der Merwe.
		Ingenieursgeoloog:	Pr. Sci. Nat., MSAIEG.


Depth bngl (m)	Soil Profile Symbol	Sample Nr Symbols	Description of soil and properties
0.1			
0.2			Slightly moist, reddish brown, loose to very loose, open textured clayey sand. Hillwast
0.3			
0.4			
0.5			
0.6			
0.7			Slightly moist, dark brown, well to sub rounded, small & medium, intact lava pebbles,
0.8			clast supported in a subordinate matrix of the above. Pebble marker. Consistency is de
0.9			
1.0			
1.1			
1.2			Slightly moist, grey green mottled w hite, dense, intact, sandy gravel.
1.3			Moderately weathered lava

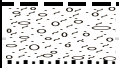






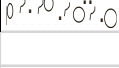


Notes:

1. Refusal of TLB on lava core stones.
2. No groundwater was intersected.
3. No samples.

Lat/long	X Coord:	28°31,38,17" S
WGS84 datum	Y Coord:	24°29'02,28" E

Soil Profile Nr: B33

Soil Profile Nr: B34		 GEOSET CC Consulting Engineering & Environmental Geologists Raadgewende Ingenieurs- en Omgewingsgeoloë	
DATE: 5 March 2020			
JOB NR: GS202003B			
Local Municipality of Dikgatlong			
Town: Barkley-West			
CLIENT: Barzani			
TLB Contractor: Corne Berg Contract			
TLB Machine: JCB 3DX 4X4			
TLB Operator: Jonas		P.O. Box / Posbus 60995	Tel: 012 525 1004
		KARENPAK 0118	Webfax: 086 658 3190
		e-mail: davidsvdm@webmail.co.za	Cell: 082 925 4075
		Engineering Geologist:	David S. van der Merwe.
		Ingenieursgeoloog:	Pr. Sci. Nat., MSAIEG.


Depth bngl (m)	Soil Profile Symbol	Sample Nr Symbols	Description of soil and properties
0.1			
0.2			Slightly moist, reddish brown, loose to very loose, open textured clayey sand. Hillwast
0.3			
0.4			
0.5			Slightly moist, dark brown, well to sub rounded, small & medium, intact lava pebbles,
0.6			clast supported in a subordinate matrix of the above. Pebble marker. Consistency is de
0.7			
0.8			
0.9			
1.0			Slightly moist, grey green mottled w hite, dense, intact, sandy gravel.
1.1			Moderately to slightly w eathered lava
1.2			
1.3			
1.4			

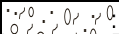

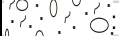
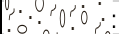

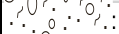
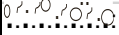


Notes:

1. Refusal of TLB on slightly weathered lava.
2. No groundwater was intersected.
3. No samples.

Lat/long	X Coord:	28°31,25,26" S
WGS84 datum	Y Coord:	24°29'28,89" E

Soil Profile Nr: B34

Soil Profile Nr: B35		 GEOSET CC Consulting Engineering & Environmental Geologists Raadgewende Ingenieurs- en Omgewingsgeoloë	
DATE: 5 March 2020			
JOB NR: GS202003B			
Local Municipality of Dikgatlong			
Town: Barkley-West			
CLIENT: Barzani			
TLB Contractor: Corne Berg Contract			
TLB Machine: JCB 3DX 4X4			
TLB Operator: Jonas		P.O. Box / Posbus 60995	Tel: 012 525 1004
		KARENPAK 0118	Webfax: 086 658 3190
		e-mail: davidsvdm@webmail.co.za	Cell: 082 925 4075
		Engineering Geologist:	David S. van der Merwe.
		Ingenieursgeoloog:	Pr. Sci. Nat., MSAIEG.


Depth bngl (m)	Soil Profile Symbol	Sample Nr Symbols	Description of soil and properties
0.1			
0.2			
0.3			Slightly moist, dark brown, well to sub rounded, small & medium, intact lava pebbles,
0.4			clast supported in a subordinate matrix of the above. Pebble marker. Consistency is de
0.5			
0.6			
0.7			
0.8			Slightly moist, grey green mottled w hite, dense, intact, sandy gravel.
0.9			Moderately w eathered lava

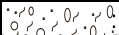
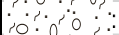

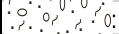
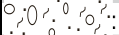
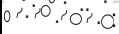


Notes:

1. Refusal of TLB on lava boulders.
2. No groundwater was intersected.
3. No samples.

Lat/long	X Coord:	28°31,28,90" S
WGS84 datum	Y Coord:	24°29'47,90" E

Soil Profile Nr: B35

Soil Profile Nr: B36		 GEOSET CC Consulting Engineering & Environmental Geologists Raadgewende Ingenieurs- en Omgewingsgeoloë	
DATE: 5 March 2020			
JOB NR: GS202003B			
Local Municipality of Dikgatlong			
Town: Barkley-West			
CLIENT: Barzani			
TLB Contractor: Corne Berg Contracto			
TLB Machine: JCB 3DX 4X4			
TLB Operator: Jonas		P.O. Box / Posbus 60995	Tel: 012 525 1004
		KARENPAK 0118	Webfax: 086 658 3190
		e-mail: davidsvdm@webmail.co.za	Cell: 082 925 4075
		Engineering Geologist:	David S. van der Merwe.
		Ingenieursgeoloog:	Pr. Sci. Nat., MSAIEG.


Depth bngl (m)	Soil Profile Symbol	Sample Nr Symbols	Description of soil and properties
0.1			
0.2			
0.3			Slightly moist, dark brown, well to sub rounded, small & medium, intact lava pebbles,
0.4			clast supported in a subordinate matrix of the above. Pebble marker. Consistency is de
0.5			
0.6			
0.7			Slightly moist, grey green mottled w hite, dense, intact, sandy gravel.
0.8			Moderately w eathered lava

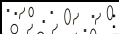

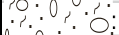
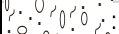

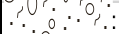
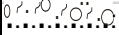
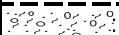
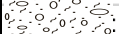
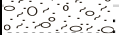
Notes:

1. Refusal of TLB on lava boulders.
2. No groundwater was intersected.
3. No samples.

Lat/long	X Coord:	28°31,15,26" S
WGS84 datum	Y Coord:	24°29'57,47" E

Soil Profile Nr: B36

Soil Profile Nr: B39		 GEOSET CC Consulting Engineering & Environmental Geologists Raadgewende Ingenieurs- en Omgewingsgeoloë	
DATE: 5 March 2020			
JOB NR: GS202003B			
Local Municipality of Dikgatlong			
Town: Barkley-West			
CLIENT: Barzani			
TLB Contractor: Corne Berg Contract			
TLB Machine: JCB 3DX 4X4			
TLB Operator: Jonas		P.O. Box / Posbus 60995	Tel: 012 525 1004
		KARENPAK 0118	Webfax: 086 658 3190
		e-mail: davidsvdm@webmail.co.za	Cell: 082 925 4075
		Engineering Geologist:	David S. van der Merwe.
		Ingenieursgeoloog:	Pr. Sci. Nat., MSAIEG.


Depth bngl (m)	Soil Profile Symbol	Sample Nr Symbols	Description of soil and properties
0.1			
0.2			
0.3			Slightly moist, dark brown, well to sub rounded, small & medium, intact lava pebbles,
0.4			clast supported in a subordinate matrix of the above. Pebble marker. Consistency is de
0.5			
0.6			
0.7			
0.8			Slightly moist, grey green mottled w hite, dense, intact, sandy gravel.
0.9			Moderately w eathered lava
1.0			

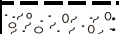
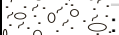
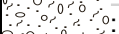

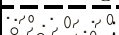

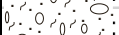
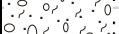
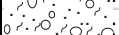
Notes:

1. Refusal of TLB on lava boulders.
2. No groundwater was intersected.
3. No samples.

Lat/long	X Coord:	28°31,04,93" S
WGS84 datum	Y Coord:	24°29'52,95" E

Soil Profile Nr: B39

Soil Profile Nr: B40		 GEOSET CC Consulting Engineering & Environmental Geologists Raadgewende Ingenieurs- en Omgewingsgeoloë	
DATE: 5 March 2020			
JOB NR: GS202003B			
Local Municipality of Dikgatlong			
Town: Barkley-West			
CLIENT: Barzani			
TLB Contractor: Corne Berg Contract			
TLB Machine: JCB 3DX 4X4			
TLB Operator: Jonas		P.O. Box / Posbus 60995	Tel: 012 525 1004
		KARENPAK 0118	Webfax: 086 658 3190
		e-mail: davidsvdm@webmail.co.za	Cell: 082 925 4075
		Engineering Geologist:	David S. van der Merwe.
		Ingenieursgeoloog:	Pr. Sci. Nat., MSAIEG.


Depth bngl (m)	Soil Profile Symbol	Sample Nr Symbols	Description of soil and properties
0.1		B40-0,2	
0.2		●	Slightly moist, reddish brown, loose to very loose, open textured clayey sand. Hillwast
0.3			
0.4			
0.5			Slightly moist, dark brown, well to sub rounded, small & medium, intact lava pebbles,
0.6			clast supported in a subordinate matrix of the above. Pebble marker. Consistency is de
0.7			
0.8			
0.9			
1.0			Slightly moist, grey green mottled white, dense, intact, sandy gravel.
1.1			Moderately weathered lava
1.2			

Notes:

1. Refusal of TLB on lava.
2. No groundwater was intersected.
3. ● Disturbed sample B40-0,2.

Lat/long	X Coord:	28°31,05,42" S
WGS84 datum	Y Coord:	24°29'38,33" E

Soil Profile Nr: B40

Soil Profile Nr: B41		 GEOSET CC Consulting Engineering & Environmental Geologists Raadgewende Ingenieurs- en Omgewingsgeoloë	
DATE: 5 March 2020			
JOB NR: GS202003B			
Local Municipality of Dikgatlong			
Town: Barkley-West			
CLIENT: Barzani			
TLB Contractor: Corne Berg Contract			
TLB Machine: JCB 3DX 4X4			
TLB Operator: Jonas		P.O. Box / Posbus 60995	Tel: 012 525 1004
		KARENPAK 0118	Webfax: 086 658 3190
		e-mail: davidsvdm@webmail.co.za	Cell: 082 925 4075
		Engineering Geologist:	David S. van der Merwe.
		Ingenieursgeoloog:	Pr. Sci. Nat., MSAIEG.


Depth bngl (m)	Soil Profile Symbol	Sample Nr Symbols	Description of soil and properties
0.1			
0.2			Slightly moist, reddish brown, loose to very loose, open textured clayey sand. Hillwash
0.3			
0.4			
0.5			Slightly moist, dark brown, well to sub rounded, small & medium, intact lava pebbles,
0.6			clast supported in a subordinate matrix of the above. Pebble marker. Consistency is de
0.7			
0.8			
0.9			
1.0			Slightly moist, kaki grey green mottled w hite, dense, intact, sandy gravel.
1.1			Moderately weathered lava
1.2			

Notes:

1. Refusal of TLB on lava.
2. No groundwater was intersected.
3. No samples.

Lat/long	X Coord:	28°31,09,95" S
WGS84 datum	Y Coord:	24°29'42,46" E

Soil Profile Nr: B41

Soil Profile Nr: B43		 GEOSET CC Consulting Engineering & Environmental Geologists Raadgewende Ingenieurs- en Omgewingsgeoloë	
DATE: 5 March 2020			
JOB NR: GS202003B			
Local Municipality of Dikgatlong			
Town: Barkley-West			
CLIENT: Barzani			
TLB Contractor: Corne Berg Contract			
TLB Machine: JCB 3DX 4X4			
TLB Operator: Jonas		P.O. Box / Posbus 60995	Tel: 012 525 1004
		KARENPAK 0118	Webfax: 086 658 3190
		e-mail: davidsvdm@webmail.co.za	Cell: 082 925 4075
		Engineering Geologist:	David S. van der Merwe.
		Ingenieursgeoloog:	Pr. Sci. Nat., MSAIEG.

Depth bngl (m)	Soil Profile Symbol	Sample Nr Symbols	Description of soil and properties
0.1			
0.2			Slightly moist, reddish brown, loose to very loose, open textured clayey sand. Hillwast
0.3			
0.4			
0.5			Slightly moist, dark brown, well to sub rounded, small & medium, intact lava pebbles,
0.6			clast supported in a subordinate matrix of the above. Pebble marker. Consistency is de
0.7			
0.8			
0.9			
1.0			Slightly moist, kaki grey green mottled w hite, dense, intact, sandy gravel.
1.1			Moderately w eathered lava
1.2			

Notes:

1. Refusal of TLB on lava.
2. No groundwater was intersected.
3. No samples.

Lat/long	X Coord:	28°31,25,27" S
WGS84 datum	Y Coord:	24°29'53,92" E

Soil Profile Nr: B43

























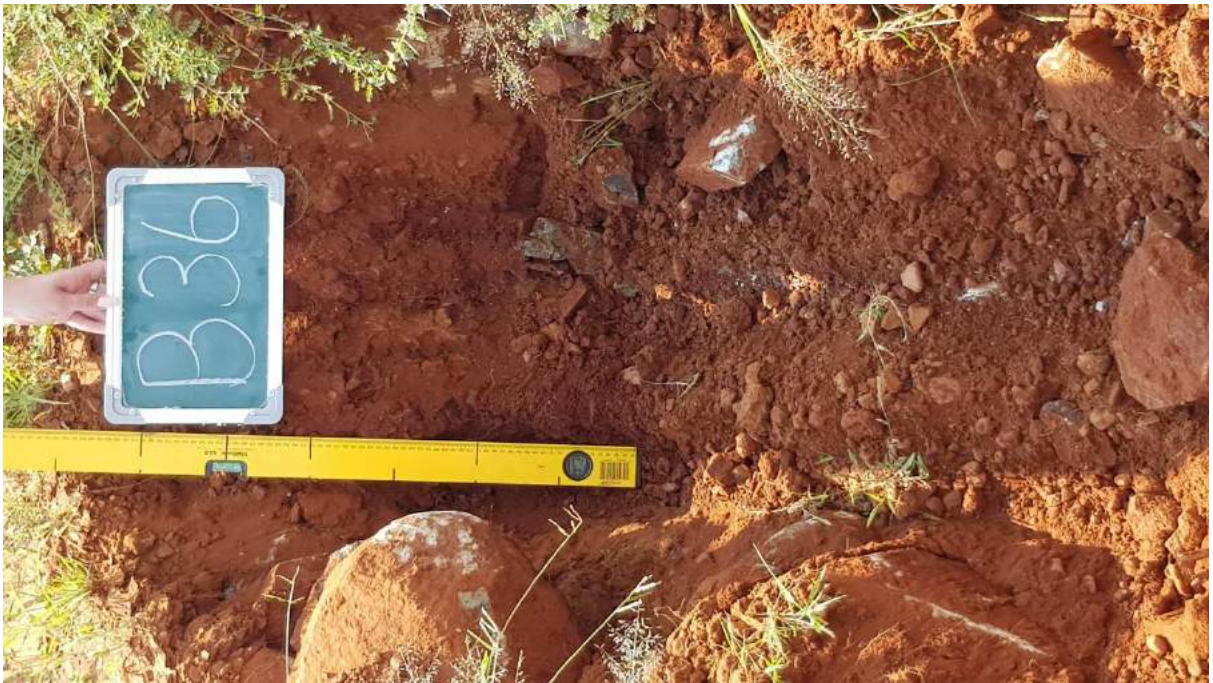




















APPENDIX C: LABORATORY RESULTS

Table A: Summary of Laboratory Results
STL Summary of Laboratory Results
STL Laboratory Results

Table A Summary of Laboratory Results										
Stats	Depth		Material Description	Clay %	Classification		% Linear Shrinkage	Plasticity Index	Liquid Limit	Expansiveness
	Nr	m			Unified	PRA				
1	B1	0,2	Silty sand	5	SM	A-2-4	0,5	SP	ND	L
2	B2	0,4	Silty clayey sand	14	SC	A-2-4	4	9	20	L
3	B4	0,3	Silty clayey sand	15	SC-SM	A-4	3,5	7	17	L
4	B7	0,3	Silty clayey sand	8	SC-SM	A-2-4	2	4	16	L
5	B16	0,7	Silty clayey sand	9	SC-SM	A-2-4	2	5	16	L
6	B18	0,2	Silty clayey sand	5	SM	A-2-4	0,5	SP	ND	L
7	B21	0,2	Silty clayey sand	6	SM	A-2-4	0,5	SP	ND	L
8	B22	0,2	Silty clayey sand	10	SC-SM	A-2-4	2,5	5	15	L
9	B25	0,2	Silty clayey sand	8	SC-SM	A-2-4	2,5	4	17	L
10	B28	0,2	Silty clayey sand	12	SC-SM	A-2-4	2,5	4	15	L
11	B31	0,4	Silty clayey sand	5	SM	A-2-4	0,5	SP	ND	L
12	B32	0,5	Silty clayey sand	12	SM	A-2-4	0,5	SP	ND	L
13	B40	0,2	Sand	4	SC-SM	A-2-4	2,0	5	18	L
Material possibly expansive if value:				>12%			>8%	>12	>30	Exp?
Table A Legend										
Unified										
13	According to the revised ASTM-Standard on the "Unified Soil Classification System" (Weinert).									
5	SM: Silty sand; poorly graded sand silt mixtures									
1	SC: clayey sand, poorly graded sand clay mixtures.									
7	SC-SM: silty clayey sand, poorly graded sand silt clay mixtures.									
PRA										
13	Public Roads Classification (Brink, Partridge & Williams).									
1	A-4: Low compressibility silt.									
12	A-2-4: Sand & gravel with low plasticity silt fines.									
13	Expansiveness according to Van der Merwe's method (Brink, Partridge & Williams).									
13	L: Low									
0	L/M: Low to medium expansiveness									
0	M: Medium									
0	H: High									
A clayey material is potentially expansive with the following properties (Kantey and Brink, 1952):										
2	a clay content greater than 12 percent,									
0	a linear shrinkage of more than 8 percent,									
0	a plasticity index of more than 12, and									
0	a liquid limit of more than 30 percent									
0	NP: Not plastic: sandy material with no cohesion									
5	SP: Slightly plastic with little cohesion									
5	ND: not determined									



Client Name: Geoset
Project Name: Barkley West
Job Number: DVM-109
Date: 09-Apr-20
Method: SANS 3001 GR1, GR3 GR10, GR12 GR20, GR30, GR31, GR40, GR50, GR53, GR54 & BS 1377 (where applicable)

SUMMARY OF TEST DATA

Grading & Hydrometer Analysis (% Passing)								
Sample	B1	B2	B4	B7	B16	B18	B21	B22
Depth (m)	0.2	0.4	0.3	0.3	0.7	0.2	0.2	0.2
Lab No	DVM-109-1034	DVM-109-1035	DVM-109-1036	DVM-109-1037	DVM-109-1038	DVM-109-1039	DVM-109-1040	DVM-109-1041
53.0	100	100	100	100	100	100	100	100
37.5	100	100	100	100	100	95	100	100
26.5	100	100	100	100	100	90	100	100
19.0	100	100	100	100	100	80	100	100
13.2	96	100	98	100	97	76	99	97
9.5	94	99	98	99	95	75	97	95
6.7	92	98	97	98	94	74	96	93
4.75	91	98	97	98	93	73	96	93
2.00	89	96	95	95	91	71	93	90
1.00	87	95	93	92	89	68	92	89
0.425	81	79	89	84	82	64	86	86
0.250	69	64	82	69	70	46	74	72
0.150	56	52	66	52	57	37	57	57
0.075	32	32	38	28	33	24	28	33
0.060	24	26	32	20	25	17	19	24
0.050	20	24	29	18	22	16	16	22
0.035	15	21	24	14	19	13	12	18
0.020	12	18	22	12	16	11	11	16
0.006	8	16	19	10	11	8	8	12
0.002	5	14	15	8	9	5	6	10
GM	0.98	0.93	0.78	0.93	0.94	1.41	0.93	0.91

Atterberg Limits								
LL (%)	-	20	17	16	16	-	-	15
PI (%)	SP	9	7	4	5	SP	SP	5
LS (%)	0.5	4.0	3.5	2.0	2.0	0.5	0.5	2.5

pH & Conductivity								
pH								
EC (S/m)								

MDD / OMC								
MDD (kg/m ³)								
OMC (%)								

CBR								
100%								
98%								
97%								
95%								
93%								
90%								
Swell (%)								

UCS (MPa)								
100%								
97%								
90%								

COLTO Classification								

Remarks:

Although everything possible is done to ensure testing is performed accurately, neither Specialised Testing Laboratory (Pty) Ltd nor any of its directors, managers, employees or contractors can be held liable for any damages whatsoever arising from any error made in performing any tests, nor from any conclusions drawn therefrom. Test results are to be published in full. Samples will be kept for 1 month after the submission of test results due to limited storage space, unless other arrangements are in place.



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Client Name: Geoset
Project Name: Barkley West
Job Number: DVM-109
Date: 09-Apr-20
Method: SANS 3001 GR1, GR3 GR10, GR12 GR20, GR30, GR31, GR40, GR50, GR53, GR54 & BS 1377 (where applicable)

SUMMARY OF TEST DATA

Grading & Hydrometer Analysis (% Passing)

Sample	B25	B28	B31	B32	B40		
Depth (m)	0.2	0.2	0.4	0.5	0.2		
Lab No	DVM-109-1042	DVM-109-1043	DVM-109-1044	DVM-109-1045	DVM-109-1046		
53.0	100	100	100	100	100		
37.5	100	100	100	100	100		
26.5	100	100	100	100	100		
19.0	98	100	100	100	100		
13.2	97	99	100	100	98		
9.5	96	98	100	100	96		
6.7	95	96	100	100	94		
4.75	94	94	100	100	93		
2.00	93	92	100	99	90		
1.00	91	90	99	99	88		
0.425	85	79	82	76	83		
0.250	61	68	69	67	60		
0.150	49	55	54	54	44		
0.075	35	32	19	31	21		
0.060	26	24	16	23	13		
0.050	24	22	15	22	12		
0.035	20	19	12	19	9		
0.020	16	18	10	17	7		
0.006	12	14	8	15	6		
0.002	8	12	5	12	4		
GM	0.87	0.97	0.99	0.94	1.06		

Atterberg Limits

LL (%)	17	15	-	-	18		
PI (%)	4	4	SP	SP	5		
LS (%)	2.5	2.5	0.5	0.5	2.0		

pH & Conductivity

pH							
EC (S/m)							

MDD / OMC

MDD (kg/m ³)							
OMC (%)							

CBR

100%							
98%							
97%							
95%							
93%							
90%							
Swell (%)							

UCS (MPa)

100%							
97%							
90%							

COLTO Classification

Remarks:							
----------	--	--	--	--	--	--	--

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Gerrie | 082 309 4448 | gerrie@stlab.co.za
www.stlab.co.za

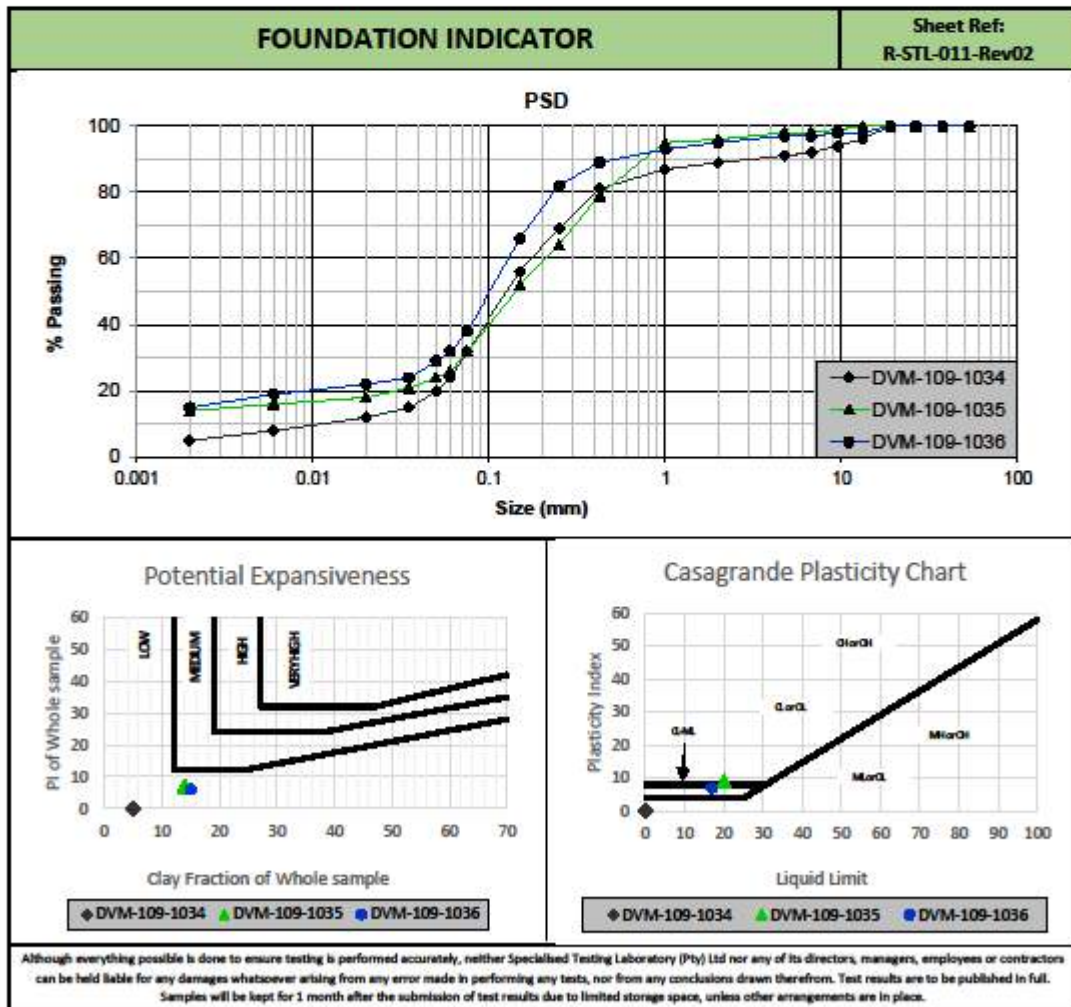
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Client Name: Geoset
Project Name: Barkley West
Job Number: DVM-109
Date: 2020-04-09
Method: SANS 3001 GR1, GR3, GR10 GR12 & BS 1377 (where applicable)

FOUNDATION INDICATOR				Sheet Ref: R-STL-011-Rev02			
Grading & Hydrometer Analysis (Particle Size (mm) & % Passing)				Atterberg Limits & Classification			
Sample	B1	B2	B4	Sample	B1	B2	B4
Depth (m)	0.2	0.4	0.3	Depth (m)	0.2	0.4	0.3
Lab No	DVM-109-1034	DVM-109-1035	DVM-109-1036	Lab No	DVM-109-1034	DVM-109-1035	DVM-109-1036
53.0	100	100	100	Liquid Limit (%)	-	20	17
37.5	100	100	100	Plastic Limit (%)	-	11	10
26.5	100	100	100	Plasticity Index (%)	SP	9	7
19.0	100	100	100	Linear Shrinkage (%)	0.5	4.0	3.5
13.2	96	100	98	PI of whole sample	-	7	6
9.5	94	99	98				
6.7	92	98	97	% Gravel	11	4	5
4.75	91	98	97	% Sand	65	70	63
2.00	89	96	95	% Silt	19	12	17
1.00	87	95	93	% Clay	5	14	15
0.425	81	79	89	Activity	0.0	0.6	0.5
0.250	69	64	82				
0.150	56	52	66	% Soil Mortar	89	96	95
0.075	32	32	38				
0.060	24	26	32	Grading Modulus	0.98	0.93	0.78
0.050	20	24	29	Moisture Content (%)	N / T	N / T	N / T
0.035	15	21	24	Relative Density (SG)*	2.65	2.65	2.65
0.020	12	18	22				
0.006	8	16	19	Unified (ASTM D2487)	SM	SC	SC-SM
0.002	5	14	15	AASHTO (M145-91)	A - 2 - 4	A - 2 - 4	A - 4
Remarks: *: Assumed N / T: Not Tested							
<small>Although everything possible is done to ensure testing is performed accurately, neither Specialised Testing Laboratory (Pty) Ltd nor any of its directors, managers, employees or contractors can be held liable for any damages whatsoever arising from any error made in performing any tests, nor from any conclusions drawn therefrom. Test results are to be published in full. Samples will be kept for 1 month after the submission of test results due to limited storage space, unless other arrangements are in place.</small>							



Client Name: Geoset
Project Name: Barkley West
Job Number: DVM-109
Date: 2020-04-09
Method: SANS 3001 GR1, GR3, GR10 GR12 & BS 1377 (where applicable)



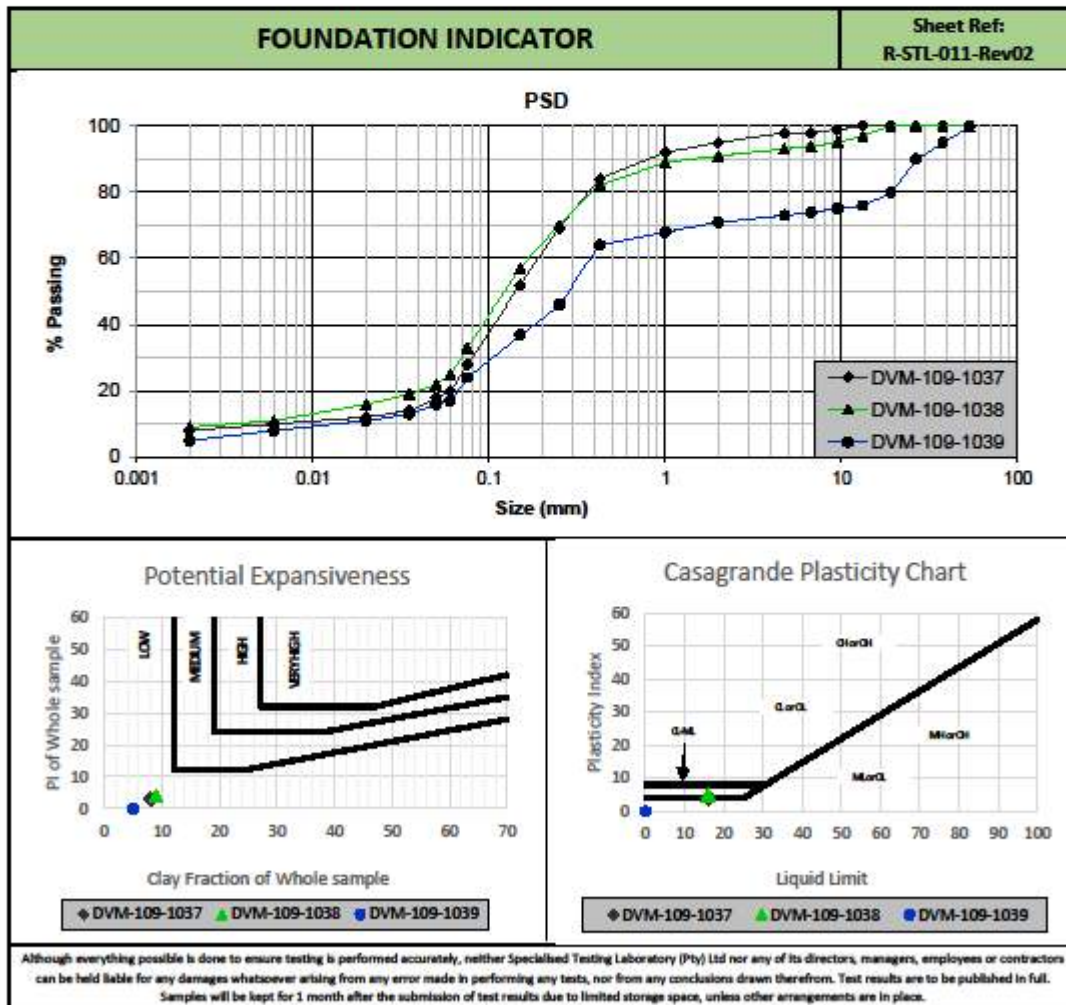


Client Name: Geoset
Project Name: Barkley West
Job Number: DVM-109
Date: 2020-04-09
Method: SANS 3001 GR1, GR3, GR10 GR12 & BS 1377 (where applicable)

FOUNDATION INDICATOR				Sheet Ref: R-STL-011-Rev02			
Grading & Hydrometer Analysis (Particle Size (mm) & % Passing)				Atterberg Limits & Classification			
Sample	B7	B16	B18	Sample	B7	B16	B18
Depth (m)	0.3	0.7	0.2	Depth (m)	0.3	0.7	0.2
Lab No	DVM-109-1037	DVM-109-1038	DVM-109-1039	Lab No	DVM-109-1037	DVM-109-1038	DVM-109-1039
53.0	100	100	100	Liquid Limit (%)	16	16	-
37.5	100	100	95	Plastic Limit (%)	12	11	-
26.5	100	100	90	Plasticity Index (%)	4	5	SP
19.0	100	100	80	Linear Shrinkage (%)	2.0	2.0	0.5
13.2	100	97	76	PI of whole sample	3	4	-
9.5	99	95	75				
6.7	98	94	74	% Gravel	5	9	29
4.75	98	93	73	% Sand	75	66	54
2.00	95	91	71	% Silt	12	16	12
1.00	92	89	68	% Clay	8	9	5
0.425	84	82	64	Activity	0.5	0.6	0.0
0.250	69	70	46				
0.150	52	57	37	% Soil Mortar	95	91	71
0.075	28	33	24				
0.060	20	25	17	Grading Modulus	0.93	0.94	1.41
0.050	18	22	16	Moisture Content (%)	N / T	N / T	N / T
0.035	14	19	13	Relative Density (SG)*	2.65	2.65	2.65
0.020	12	16	11				
0.006	10	11	8	Unified (ASTM D2487)	SC-SM	SC-SM	SM
0.002	8	9	5	AASHTO (M145-91)	A - 2 - 4	A - 2 - 4	A - 2 - 4
Remarks: *: Assumed N / T: Not Tested							
<small>Although everything possible is done to ensure testing is performed accurately, neither Specialised Testing Laboratory (Pty) Ltd nor any of its directors, managers, employees or contractors can be held liable for any damages whatsoever arising from any error made in performing any tests, nor from any conclusions drawn therefrom. Test results are to be published in full. Samples will be kept for 1 month after the submission of test results due to limited storage space, unless other arrangements are in place.</small>							



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Project Name: Barkley West
Job Number: DVM-109
Date: 2020-04-09
Method: SANS 3001 GR1, GR3, GR10 GR12 & BS 1377 (where applicable)



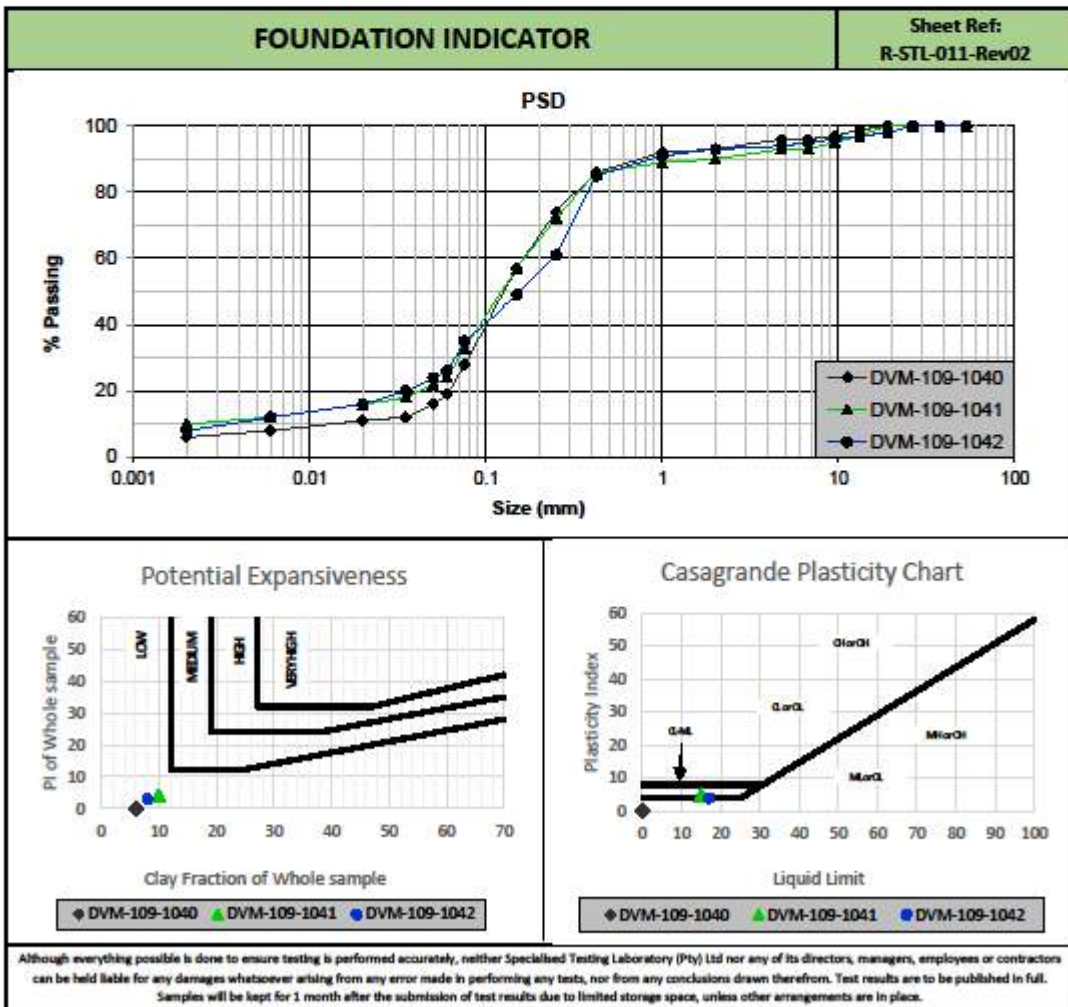


Client Name: Geoset
Project Name: Barkley West
Job Number: DVM-109
Date: 2020-04-09
Method: SANS 3001 GR1, GR3, GR10 GR12 & BS 1377 (where applicable)

FOUNDATION INDICATOR							Sheet Ref: R-STL-011-Rev02	
Grading & Hydrometer Analysis (Particle Size (mm) & % Passing)				Atterberg Limits & Classification				
Sample	B21	B22	B25	Sample	B21	B22	B25	
Depth (m)	0.2	0.2	0.2	Depth (m)	0.2	0.2	0.2	
Lab No	DVM-109-1040	DVM-109-1041	DVM-109-1042	Lab No	DVM-109-1040	DVM-109-1041	DVM-109-1042	
53.0	100	100	100	Liquid Limit (%)	-	15	17	
37.5	100	100	100	Plastic Limit (%)	-	10	13	
26.5	100	100	100	Plasticity Index (%)	SP	5	4	
19.0	100	100	98	Linear Shrinkage (%)	0.5	2.5	2.5	
13.2	99	97	97	PI of whole sample	-	4	3	
9.5	97	95	96					
6.7	96	93	95	% Gravel	7	10	7	
4.75	96	93	94	% Sand	74	66	67	
2.00	93	90	93	% Silt	13	14	18	
1.00	92	89	91	% Clay	6	10	8	
0.425	86	86	85	Activity	0.0	0.5	0.5	
0.250	74	72	61					
0.150	57	57	49	% Soil Mortar	93	90	93	
0.075	28	33	35					
0.060	19	24	26	Grading Modulus	0.93	0.91	0.87	
0.050	16	22	24	Moisture Content (%)	N / T	N / T	N / T	
0.035	12	18	20	Relative Density (SG)*	2.65	2.65	2.65	
0.020	11	16	16					
0.006	8	12	12	Unified (ASTM D2487)	SM	SC-SM	SC-SM	
0.002	6	10	8	AASHTO (M145-91)	A - 2 - 4	A - 2 - 4	A - 2 - 4	
Remarks: *: Assumed N / T: Not Tested								
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Client Name: Geoset
Project Name: Barkley West
Job Number: DVM-109
Date: 2020-04-09
Method: SANS 3001 GR1, GR3, GR10 GR12 & BS 1377 (where applicable)



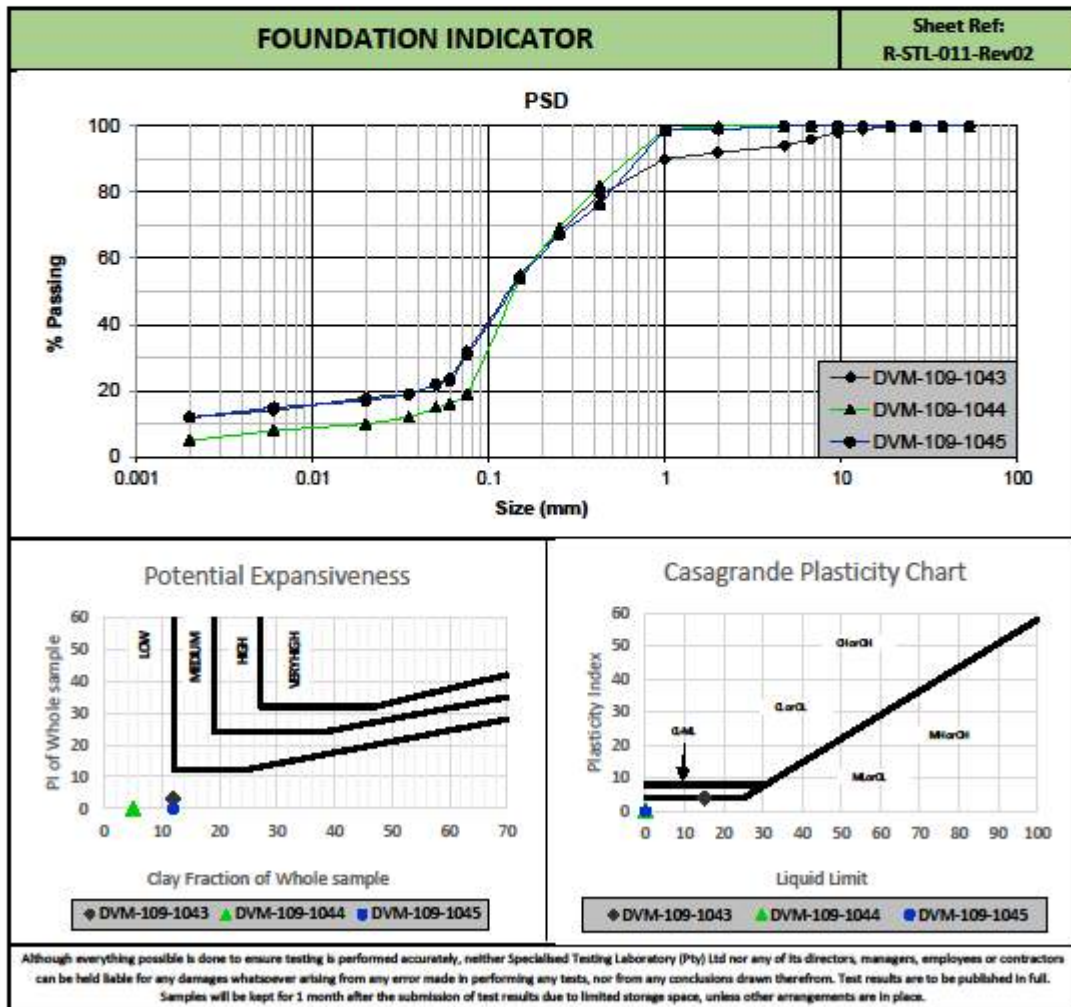


Client Name: Geoset
Project Name: Barkley West
Job Number: DVM-109
Date: 2020-04-09
Method: SANS 3001 GR1, GR3, GR10 GR12 & BS 1377 (where applicable)

FOUNDATION INDICATOR				Sheet Ref: R-STL-011-Rev02			
Grading & Hydrometer Analysis (Particle Size (mm) & % Passing)				Atterberg Limits & Classification			
Sample	B28	B31	B32	Sample	B28	B31	B32
Depth (m)	0.2	0.4	0.5	Depth (m)	0.2	0.4	0.5
Lab No	DVM-109-1043	DVM-109-1044	DVM-109-1045	Lab No	DVM-109-1043	DVM-109-1044	DVM-109-1045
53.0	100	100	100	Liquid Limit (%)	15	-	-
37.5	100	100	100	Plastic Limit (%)	11	-	-
26.5	100	100	100	Plasticity Index (%)	4	SP	SP
19.0	100	100	100	Linear Shrinkage (%)	2.5	0.5	0.5
13.2	99	100	100	PI of whole sample	3	-	-
9.5	98	100	100				
6.7	96	100	100	% Gravel	8	0	1
4.75	94	100	100	% Sand	68	84	76
2.00	92	100	99	% Silt	12	11	11
1.00	90	99	99	% Clay	12	5	12
0.425	79	82	76	Activity	0.3	0.0	0.0
0.250	68	69	67				
0.150	55	54	54	% Soil Mortar	92	100	99
0.075	32	19	31				
0.060	24	16	23	Grading Modulus	0.97	0.99	0.94
0.050	22	15	22	Moisture Content (%)	N / T	N / T	N / T
0.035	19	12	19	Relative Density (SG)*	2.65	2.65	2.65
0.020	18	10	17				
0.006	14	8	15	Unified (ASTM D2487)	SC-SM	SM	SM
0.002	12	5	12	AASHTO (M145-91)	A - 2 - 4	A - 2 - 4	A - 2 - 4
Remarks: *: Assumed N / T: Not Tested							
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Client Name: Geoset
Project Name: Barkley West
Job Number: DVM-109
Date: 2020-04-09
Method: SANS 3001 GR1, GR3, GR10 GR12 & BS 1377 (where applicable)





Client Name: Geoset
Project Name: Barkley West
Job Number: DVM-109
Date: 2020-04-09
Method: SANS 3001 GR1, GR3, GR10 GR12 & BS 1377 (where applicable)

FOUNDATION INDICATOR					Sheet Ref: R-STL-011-Rev02	
Grading & Hydrometer Analysis (Particle Size (mm) & % Passing)			Atterberg Limits & Classification			
Sample	B40		Sample	B40		
Depth (m)	0.2		Depth (m)	0.2		
Lab No	DVM-109-1046		Lab No	DVM-109-1046		
53.0	100		Liquid Limit (%)	18		
37.5	100		Plastic Limit (%)	13		
26.5	100		Plasticity Index (%)	5		
19.0	100		Linear Shrinkage (%)	2.0		
13.2	98		PI of whole sample	4		
9.5	96					
6.7	94		% Gravel	10		
4.75	93		% Sand	77		
2.00	90		% Silt	9		
1.00	88		% Clay	4		
0.425	83		Activity	1.3		
0.250	60					
0.150	44		% Soil Mortar	90		
0.075	21					
0.060	13		Grading Modulus	1.06		
0.050	12		Moisture Content (%)	N / T		
0.035	9		Relative Density (SG)*	2.65		
0.020	7					
0.006	6		Unified (ASTM D2487)	SC-SM		
0.002	4		AASHTO (M145-91)	A - 2 - 4		
Remarks: *: Assumed N / T: Not Tested						
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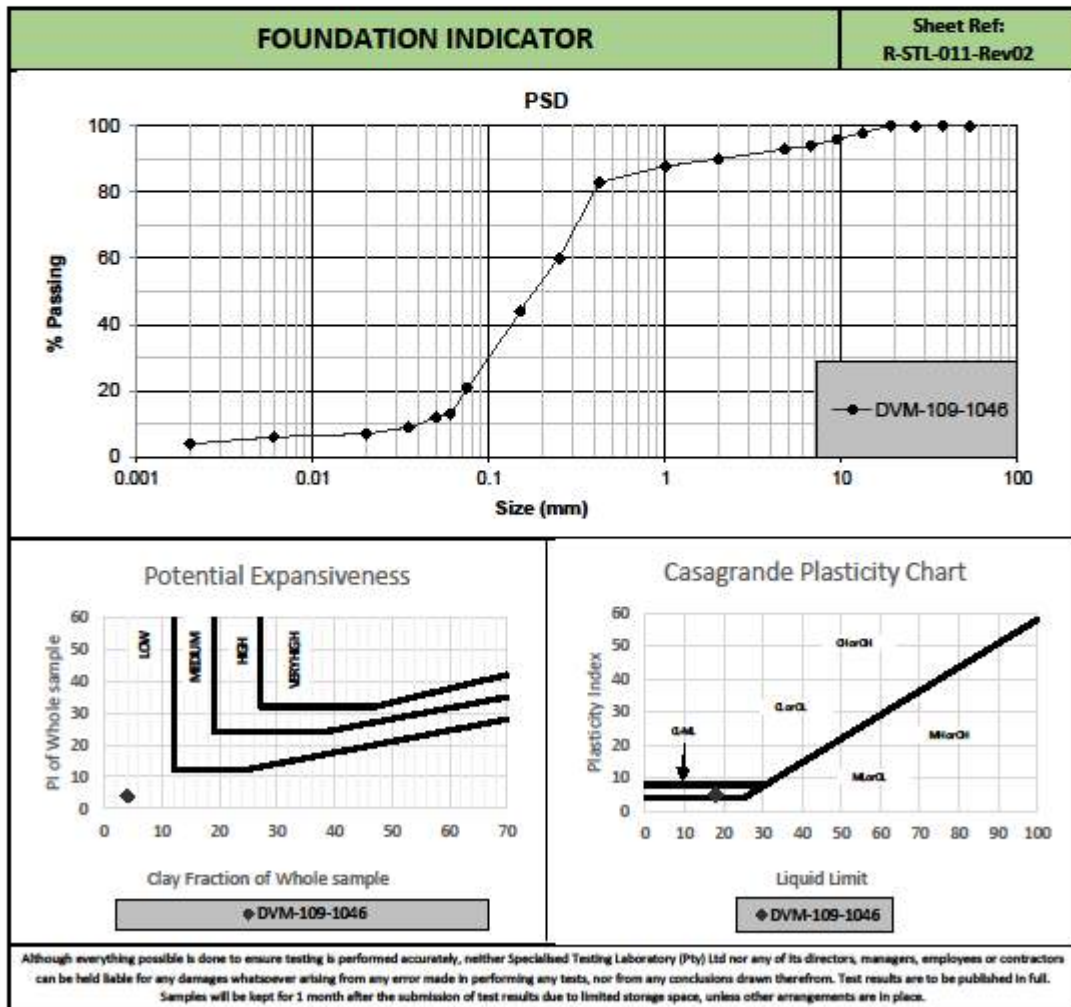


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Client Name: Geoset
Project Name: Barkley West
Job Number: DVM-109
Date: 2020-04-09
Method: SANS 3001 GR1, GR3, GR10 GR12 & BS 1377 (where applicable)



APPENDIX D: TABULAR EXPLANATION OF ZONING

Extract from: THE SOUTH AFRICAN INSTITUTE OF ENGINEERING GEOLOGISTS (SAIEG), 1997.
Guidelines for Urban Engineering Geological Investigations.

Table 1. Categories of Urban Engineering Geological Investigation

Table 2. Geotechnical Classification for Urban Development:
Partridge, Wood & Brink (1993)

Table 3. Residential Site Class Designations:
SAICE, SAIEG & NHBRC (1995)

Table 1. CATEGORIES OF URBAN ENGINEERING GEOLOGICAL INVESTIGATION

Type	Planning Investigations		Urban Development Investigations		Specialised Investigations
	Regional Engineering Geological Mapping (REGM)	Mapping for Urban Planning	Urban Development Investigation	Urban Development Investigation	
Description					Specialised Geotechnical Investigation
Size of study area and field work	More than 1000 ha. Walk-over survey and limited test pits and soil sampling.	Less than 1000 ha. Walk-over survey.	Less than 10 ha. Test pits, trial holes and soil sampling.	More than 10 ha. Walk-over survey with trial pits and test holes and soil sampling.	Not relevant. Specific to type of specialised investigation.
Suggested number of test pits	A minimum of 3 test pits per land facet type.	None suggested. However, a limited number of test pits may be required at the discretion of the consultant.	Between 6 and 10 test pits.*	Between 1 and 6 test pits per 10 ha, depending on the size and variability of the area to as much as 1 test pit per hectare for highly variable sites.*	Dependent on the type of specialised investigation performed.
Mapping unit	Land systems and land facets.	Terrain types: 1 - most favourable 2 - intermediate 3 - least favourable	Soil classes: C, H, S and P and other (e.g. excavation, drainage features)	Soil classes: C, H, S and P and other (e.g. excavation, drainage features)	Not applicable.
Reference	Brink, Partridge and Williams (1982)	Partridge, Wood and Brink (1993)	SAICE Code of Practice (1995)	SAICE Code of Practice (1995)	Not relevant.
Consultants	Engineering geologists.	Engineering geologists and to a lesser extent geotechnical engineers.	Both engineering geologists and geotechnical engineers.	Both engineering geologists and geotechnical engineers.	Geotechnical engineers and to a lesser extent engineering geologists.

* Note that these figures are not intended to be absolute and should serve only as a guideline.

Table 2. GEOTECHNICAL CLASSIFICATION FOR URBAN DEVELOPMENT (after Partridge, Wood and Brink 1993)

CONSTRAINT	Most favourable (1)	Intermediate (2)	Least favourable (3)
A Collapsible Soil	Any collapsible horizon or consecutive horizons totalling a depth of less than 750 mm in thickness.*	Any collapsible horizon or consecutive horizons with a depth of more than 750 mm in thickness.	A least favourable situation for this constraint does not occur.
B Seepage	Permanent or perched water table more than 1,5 m below ground surface.	Permanent or perched water table less than 1,5 m below ground surface.	Swamps and marshes.
C Active soil	Low soil-heave potential predicted.*	Moderate soil heave potential predicted.	High soil-heave potential predicted.
D Highly compressible soil	Low soil compressibility expected.*	Moderate soil compressibility expected.	High soil compressibility expected.
E Erodability of soil	Low.	Intermediate.	High.
F Difficulty of excavation to 1,5 m depth	Scattered or occasional boulders less than 10% of the total volume.	Rock or hardpan pedocretes between 10 and 40 % of the total volume.	Rock or hardpan pedocretes more than 40 % of the total volume.
G Undermined ground	Undermining at a depth greater than 100 m below surface (except where total extraction mining has not occurred.)	Old undermined areas to a depth of 100 m below surface where slope closure has ceased.	Mining within less than 100 m of surface or where total extraction mining has taken place.
H Instability in areas of soluble rock	Possibly unstable.	Probably unstable.	Known sinkholes and dolines.
I Steep slopes	Between 2 and 6 degrees (all regions).	Slopes between 6 and 18 degrees and less than 2 degrees (Natal and Western Cape). Slopes between 6 and 12 degrees and less than 2 degrees (all other regions).	More than 18 degrees (Natal and Western Cape). More than 12 degrees (all other regions).
J Areas of unstable natural slopes	Low risk.	Intermediate risk.	High risk (especially in areas subject to seismic activity).
K Areas subject to seismic activity	10% probability of an event less than 100 cm/s ² within 50 years.	Mining-induced seismic activity more 100 cm/s ² .	Natural seismic activity more than 100 cm/s ² .
L Areas subject to flooding	A "most favourable" situation for this constraint does not occur.	Areas adjacent to a known drainage channel or floodplain with slope less than 1%.	Areas within a known drainage channel or floodplain.

* These areas are designated as 1A, 1C, 1D, or 1F where localised occurrences of the constraint may arise.

Table 3. RESIDENTIAL SITE CLASS DESIGNATIONS (SAICE, 1995)

TYPICAL FOUNDATION MATERIAL	CHARACTER OF FOUNDING MATERIAL	EXPECTED RANGE OF TOTAL SOIL MOVEMENTS (mm)	ASSUMED DIFFERENTIAL MOVEMENT (% OF TOTAL)	SITE CLASS
Rock (excluding mud rocks which exhibit swelling to some depth)	STABLE	NEGLIGIBLE	-	R
Fine-grained soils with moderate to very high plasticity (clays, silty clays, clayey silts and sandy clays)	EXPANSIVE SOILS	< 7,5	50%	H
		7,5 - 15	50%	H1
		15 - 30	50%	H2
		> 30	50%	H3
Silty sands, sands, sandy and gravelly soils	COMPRESSIBLE AND POTENTIALLY COLLAPSIBLE SOILS	< 5,0	75%	C
		5,0 - 10	75%	C1
		> 10	75%	C2
Fine-grained soils (clayey silts and clayey sands of low plasticity), sands, sandy and gravelly soils	COMPRESSIBLE SOIL	< 10	50%	S
		10 - 20	50%	S1
		> 20	50%	S2
Contaminated soils Controlled fill Dolomitic areas Land fill Marshy areas Mine waste fill Mining subsidence Reclaimed areas Very soft silt/silty clays Uncontrolled fill	VARIABLE	VARIABLE		P

NOTES:

1. The classifications C,H,R and S are not intended for dolomitic area sites unless specific investigations are carried out to assess the stability (risk of sinkholes and doline formation) of the dolomites. Where this risk is found to be acceptable, the site shall be designated as Class P (dolomitic areas).
2. Site classes are based on the assumption that differential movements, experienced by single-storey residential buildings, expressed as a percentage of the total soil movements are equal to about 50% for soils that exhibit expansive or compressive characteristics and 75% for soils that exhibit both compressible and collapse characteristics. Where this assumption is incorrect or inappropriate, the total soil movements must be adjusted so that the resultant different movement implied by the table is equal to that which is expected in the field.
3. In some instances, it may be more appropriate to use a composite description to describe a site more fully e.g. C1/H2 or S1 and/or H2. Composite Site Classes may lead to higher differential movements and result in design solutions appropriate to a higher range of differential movement e.g. a Class R/S1 site. Alternatively, a further site investigation may be necessary since the final design solution may depend on the location of the building on a particular site.
4. Where it is not possible to provide a single site designation and a composite description is inappropriate, sites may be given multiple descriptions to indicate the range of possible conditions e.g. H-H1-H2 or C1-C2.
5. Soft silts and clays usually exhibit high consolidation and low bearing characteristics. Structures founded on these horizons may experience high settlements and such sites should be designated as Class S1 or S2 as relevant and appropriate.
6. Sites containing contaminated soils include those associated with reclaimed mine land, land down-slope of mine tailings and old land fills.
7. Where a site is designated as Class P, full particulars relating to the founding conditions on the site must be provided.
8. Where sites are designated as being Class P, the reason for such classification shall be placed in brackets immediately after the suffix - i.e. P(contaminated soils). Under certain circumstances, composite description may be more appropriate - e.g. P(dolomite areas)-C1.
9. Certain fills may contain contaminants which present a health risk. The nature of such fill should be evaluated and should be clearly demarcated as such.