

CK RUMBOLL AND PARTNERS

**PROPOSED EXTENSION OF CEMETERY ON
ERF 5662, MOORREESBURG**

**REPORT ON
GEOTECHNICAL INVESTIGATION**

FEBRUARY 2023

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1 EXECUTIVE SUMMARY

SKCMasakhizwe Engineers (Pty) Ltd (SKCM) was appointed by CK Rumboll and Partners to perform geotechnical, geohydrological and pedological investigations for the establishment of a new cemetery on erf 5662, Moorreesburg.

The objective of this study was to evaluate the geotechnical, geohydrological and pedological suitability of the site for the proposed development.

Guidelines as prepared by the Council for Geoscience^{1,2} were used to determine the suitability of the site. Based on these guidelines, a summary of which is included under section 3 of this report, the proposed site is suited for a cemetery.

The water table at the proposed site is known to be deep (11.56m below ground level according to Cape Farm Mapper 2.7) and the permeability of the in-situ soils is within the prescribed range for cemeteries.

The pollution risk may be mitigated by preventing lateral groundwater movement through the site. This can be achieved by providing a cut off drain around the site in order to divert surface and near surface water flow around the site and by ensuring that on site drainage is adequate to allow free drainage of surface water off the site. Indigenous vegetation can also be planted to prevent water ponding and erosion.

The proposed site is considered suitable for the development of a cemetery, provided that all the mitigation measures contained in this report are applied.

2 SITE DESCRIPTION

2.1 Locality

The proposed site for the cemetery is situated on the northern outskirts of Moorreesburg, on erf 5662. The proposed cemetery is located on the corner of Agstein Avenue and Omega Street. The site is bordered by farmland. The location of the site is indicated in Figure 1 (drawing W2097-01-LP).

2.2 Rainfall and Climate

Rainfall measuring stations around the proposed site indicates an annual rainfall of 355mm (arid region). The proposed site is in a winter rainfall area, receiving the bulk of its rainfall from May to August.

The average temperature varies between approximately 7.8°C (June) and 30.9°C (February). (Cape Farm Mapper)

2.3 Topography

The slope of the ground is predominantly to the west, with a slope of approximately 4.0°. The site is contoured parallel with the slope.

3 SELECTION CRITERIA

The following documents were referenced in determining the suitability criteria of a site for cemetery development:

1. The selection of cemetery sites in South Africa, report No 2001-0040 for the Council for Geoscience by GJ Fisher¹
2. Guidelines for cemetery site selection, report No 2004-0023 for the Council for Geoscience by NP Richards and L Croukamp²

These documents are available as separate volumes and are not bound into this report.

Ten criteria are identified as decisive when evaluating a site for cemetery development. A summary of these are given below.

3.1 Soil Excavatability

Excavatability is defined as the ease with which soil can be excavated to a depth of at least 1,8m.

An assessment of the excavatability of soil can be made from the soil consistency (Fisher, G.J ¹) as indicated in Table 1 below.

Table 1: Excavatability Assessment

Soil Consistency (after Jennings et al 1973)	Excavation Method	Cemetery Suitability
Very loose and loose Granular Very soft and soft Cohesive	Spade	Suitable, but grave stability may be problematic
Medium dense Granular Firm Cohesive	Pick and Spade	Ideal
Dense Granular Stiff Cohesive Very soft rock	Backactor	Suitable. Weathered rock should be avoided where possible
Very dense Granular Very stiff cohesive Soft and hard rock	Jackhammer	Not suitable. Allowable only if alternative site options do not exist
Very hard and extremely hard rock	Blasting	Not suitable

Transported and cemented pedogenic soils were encountered at surface and to depths in excess of 1.2m below ground level across the entire site. The transported soils can be described as clayey sands with various amounts of gravels. The transported soils are cemented, varying from poorly to moderately well cemented soils to very dense and well cemented pedogenic and ferricrete soils. Excavations will be difficult by excavator due to the hardness of the soils described above. The use of a large excavator is recommended (20 tonne min.). Once excavated, the soil will be suitable for use as backfilling of the graves.

3.2 Grave stability

Grave stability refers to the stability of the sides and lip of the excavated grave. Stable grave sides are required to:

- *Allow the excavations to remain stable (without caving in) for at least a couple of days between the time the grave is excavated and the burial takes place.*
- *To prevent the sides of the grave collapsing during the burial ceremony when numerous people will be moving about close to the lip of the excavation.*
- *To ensure a smooth lowering of the coffin into the grave.*

Using the soil consistency as described in Table 1, a dense granular soil / stiff cohesive soil / very soft rock will ensure adequate grave stability.

Suitable edge protection of the sandy material will be required after excavation to prevent the sides collapsing during the burial ceremony.

3.3 Soil workability

Soil workability refers to the ease with which soil can be manipulated in and out of the grave. Soils should ideally be free of large boulders and clay lumps and must be compactable to prevent excessive settlement of the grave after backfilling.

Soil workability is not ideal. The dense ferricrete is encountered at depths varying from 600mm to in excess of 1.2m below natural ground level. On average, the depth of the stiff material (digger loader refusal) is at 1,0m. An excavator of at least 20 tonne would also have to be utilised to excavate the hard sub-strata.

3.4 Site Topography

In general, a slope of between 2 ° and 6 ° are considered ideal for cemetery establishment. This slope range would ensure adequate drainage, minimum erosion and promote human and mechanical mobility on site.

Where slopes of less than 2 ° are present, the best possible drainage must be ensured by installing the required drainage features. In these areas, a high water table is also commonplace. The planting of various indigenous plant species could assist in lowering the water table to acceptable levels.

On areas with a slope exceeding 6 °, the maximum recommended slope is 9 °. In these areas the graves should be orientated with their long axis perpendicular to the slope and staggered in a brickwork manner. This grave arrangement will minimise surface erosion and prevent rapid fluid movement below ground, which may occur downstream due to the voids formed by the graves and coffins.

The maximum slope of the site is approximately 4°. Water ponding on the site should not be problematic, as the slope is ideal for the use as cemetery.

Cut-off drains and internal roads must be utilised to channel storm water to suitable discharge points.

3.5 Site Drainage

Stormwater runoff must be controlled to prevent ponding on site, ingress of water into open or recently closed graves and to prevent surface erosion of recently closed graves.

Ponding and ingress of water into open or recently closed graves will saturate the soil, increasing the risk of ground water pollution.

The water table at the proposed site is known to be deep (11.56m below ground level according to Cape Farm Mapper 2.7) and the permeability of the in-situ soils is within the prescribed range for cemeteries.

Cut-off drains and internal roads must be utilised to channel storm water to suitable discharge points.

Both these measures will reduce the possibility of groundwater pollution.

3.6 Soil permeability

Soil permeability is the major parameter determining the rate of fluid flow through soil.

A high permeability will allow rapid leachate flow through the soil, posing pollution threats to surface and groundwater sources. Generally, a maximum permeability of 5×10^{-5} cm/s is recommended to safely contain microbiological pollutants and prevent contamination of water sources. In arid regions (regions with less than 500mm rainfall per annum) and in areas where water resources are situated at a greater distance than the minimum recommended from the cemetery, a maximum permeability of 1×10^{-4} cm/s may be acceptable.

A very low permeability inhibit the dispersion of waste products (including pathogenic organisms) originating within the individual graves. The infiltration of water and oxygen into the graves will also be inhibited to such an extent that anaerobic conditions may develop within the grave, resulting in an unacceptably low rate of decomposition. The lowest permeability recommended is 1×10^{-7} cm/s.

Typical permeability ranges for various soil types are indicated in Table 2 below.

Table 2: Soil type and predicted permeability ranges

Soil Type	Permeability (cm/s)	Cemetery suitability
Well graded gravel	1×10^{-1} to 1×10^{-3}	Totally unsuitable
Poorly graded gravel	5×10^0 to 1×10^{-3}	Totally unsuitable
Silty gravel	1×10^{-4} to 1×10^{-7}	Partially suitable
Clayey gravel	1×10^{-5} to 1×10^{-8}	Suitable
Well graded sand	5×10^{-2} to 5×10^{-4}	Unsuitable
Poorly graded sand	5×10^{-1} to 5×10^{-5}	Unsuitable
Silty sand	5×10^{-4} to 1×10^{-7}	Ideal
Clayey sand	5×10^{-5} to 1×10^{-8}	Ideal
Lean clay	1×10^{-6} to 1×10^{-8}	Partially suitable
Silt	5×10^{-5} to 1×10^{-8}	Suitable
Organic silt/clay	1×10^{-5} to 1×10^{-8}	Partially suitable
Fat clay	1×10^{-8} to 1×10^{-10}	Totally unsuitable

Elastic silt	1×10^{-7} to 1×10^{-9}	Unsuitable
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The information contained in Table 2 is given as a guide only. The suitability of a particular site will be dependent on the soil found on site.

Disturbed samples were taken at 1,0m below natural ground level in selected profile pits for permeability testing. The results of these tests are indicated in the table below.

According to **Table 2** the soil permeability is ideal for cemeteries.

Table 3: Measured soil permeability

Profile Pit No	Depth sample taken	Permeability (cm/s)
TH4	1.0m	$5,03 \times 10^{-7}$
TP8	1.0m	$6,23 \times 10^{-6}$

Potable water is supplied to Moorreesburg via Municipal pipelines. The nearest registered borehole to the proposed site is unknown, but is assumed to be further away than the min distance of 166m (for a representative maximum permeability of 5×10^{-6} cm/s as per Table 4). No evidence of boreholes or wells on the property adjacent to the proposed cemetery was found during site investigations.

The closest drainage feature to the proposed site is the non-perennial stream running through the area approximately 1300m west of the proposed site boundary. The non-perennial stream is to be further than the minimum recommended safe distance of 66m (for a permeability of 5×10^{-6} cm/s) from the cemetery site boundary.

3.7 Basal buffer zone

A basal buffer zone refers to the vertical succession of soils between the deepest grave and the water table. Through processes of filtration and absorption, this zone ensures that microbiological pollutants do not come into contact with the water table. The depth of this buffer zone is dependent on the prevailing soil permeability, but a minimum depth of 2,5m is recommended.

In areas with a near surface water table, where the 2,5m buffer zone is unattainable, a revised permeability limit of 1×10^{-4} cm/s should be imposed.

Due to the expected deep water table at the site, we foresee that the basal buffer zone will be in excess of 2.5m. Cape Farm Mapper states a water table depth below ground level of 11.56m.

3.8 Position in respect of domestic water sources

Minimum distances between cemeteries and domestic water sources are essential to prevent water sources from being contaminated with potential harmful organisms originating from cemeteries. The recommended safe distances indicated in Table 4 is based on the permeability range of the soil, in conjunction with the maximum survival time of bacteria and viruses and an estimated corpse decomposition time of 10 years. A safety factor of 150m is added to the calculated values.

Table 4: Safe distance to domestic water sources

Soil permeability (cm/s)	Safe distance (including 150m safety factor)
1×10^{-4}	465m
5×10^{-5}	308m
1×10^{-5}	182m
5×10^{-6}	166m
1×10^{-6}	153m
5×10^{-7}	152m
1×10^{-7}	150m

From the permeability range of the clayey sand on site we can conclude that the nearest borehole is to be approximately 166m from the site, as shown in Table 3.

Currently, the closest residence to the site is more than 200m away southwest. No evidence of boreholes or wells on the property adjacent to the proposed cemetery was found during site investigations.

3.9 Position in respect of drainage features

Drainage features, including lakes, dams, rivers, streams, gullies and marshes should not be affected in any way by pollutants emanating from cemeteries. These drainage features must also not pose a flood hazard to the cemetery; therefore the cemetery must be situated above the 1:50 year flood level.

The safe distances indicated in Table 5 are derived from the same criteria used for those in respect of domestic water sources in section 3.8. The only difference being the safety factor which is reduced to 100m and a further reduction for arid regions.

The closest drainage feature to the proposed site is the non-perennial stream running through the area approximately 1300m west of the proposed site boundary. The non-perennial stream is to be further than the minimum

recommended safe distance of 66m (for a permeability of 5×10^{-6} cm/s) from the cemetery site boundary, which it is.

Table 5: Safe distances to drainage features

Soil permeability (cm/s)	Safe distance (including 100m safety factor)	Safe distance (Arid regions)
1×10^{-4}	415m	365m
5×10^{-5}	258m	208m
1×10^{-5}	132m	82m
5×10^{-6}	116m	66m
1×10^{-6}	103m	53m
5×10^{-7}	102m	52m
1×10^{-7}	100m	50m

3.10 Cemetery size

The size of the proposed cemetery must be sufficient to justify the cost associated with the site investigations and environmental authorisations. Adequate ground areas must therefore be investigated to ensure long term utilisation of a proposed cemetery.

The proposed cemetery has an approximate area of 5.0 Ha (50 041.6m²).

4 EXISTING WATER SOURCES AND DRAINAGE FEATURES

4.1 Existing boreholes

From the permeability range of the clayey sand on site we can conclude that the nearest borehole is to be approximately 166m from the site, as shown in Table 4.

No evidence of boreholes or wells on the property adjacent to the proposed cemetery was found during site investigations.

4.2 Existing streams and rivers

The closest drainage feature to the proposed site is the non-perennial stream running through the area approximately 1,3km west of the proposed site boundary. The non-perennial stream is to be further than the minimum recommended safe distance of 66m (for a permeability of 5×10^{-6} cm/s) from the cemetery site boundary.

4.3 Potable water supply

Potable water is supplied to the town of Moorreesburg via the existing Municipal water pipelines. Some of the nearby farms may extract potable water directly from boreholes.

5 SITE GEOLOGY

5.1 General Geology

Based on the exposures in the excavations and the information on the 1:250 000 Geological Series Map 3318, Cape Town, presented in Figure 2 (W2097-02-G01). The location of the site is also shown on this figure.

The general geology of the area consists primarily of Quaternary Aged consolidated and unconsolidated sands at surface. Greywacke phyllite soils and rock as well as quartzitic sandstone and schist of the Moorreesburg and Klipplaat Formations, respectively, (Malmesbury Group) underlie the surface soils. Pedogenic soils of both dorbank and ferricrete are also commonly encountered close to surface.

A soil sample was sent to a laboratory (SGS Matrocast (PTY) LTD) for verification and testing.

5.2 Profile Pits

Eight profile pits were excavated over the area of the proposed cemetery. The holes were excavated on 17 February 2023 to a maximum depth of 1.3m using a 6 tonne tracked Hyundai excavator. The position of the profile pits are indicated on Figure 3 (2097-03-SL) and in Table 6 below.

Table 6: Profile pit positions

Profile Pit No	Latitude (S)	Longitude (E)	Elevation (m)
TP1	33°07' 48.5"	18°40' 8.4"	176
TP2	33°07' 48.5"	18°40' 8.4"	175
TP3	33°07' 48.5"	18°40' 8.4"	175
TP4	33°07' 48.5"	18°40' 8.4"	178
TP5	33°07' 48.5"	18°40' 8.4"	178
TP6	33°07' 48.5"	18°40' 8.4"	183
TP7	33°07' 48.5"	18°40' 8.4"	182
TP8	33°07' 48.5"	18°40' 8.4"	182

5.3 Profile pit descriptions

The typical profile pit log is attached as Figure 4 (W2097-04-TP). The profiles were described in terms of its moisture condition, colour, consistency, structure, soil texture and origin. A short description of each profile is given below.

Profile Pit No TP1

TP1 was profiled to a depth of 0,6m. From ground level, up to a depth of 0,6m a dry, light brown dark orange-brown very dense with random medium dense gravelly silty sand. Pedogenic ferricrete.

The sides of the excavation are stable. No boulders or lumps were encountered. Machine excavation up to burial depth would be difficult due to the stiffness of the ferricrete. After excavation, the material will be easily handled and compacted into the grave.

No groundwater or seepage was observed.

Profile Pit No TP2

TP1 was profiled to a depth of 1,2m. From ground level, up to a depth of 1,2m a dry, light brown dark orange-brown very dense with random medium dense gravelly silty sand. Pedogenic ferricrete.

The sides of the excavation are stable. No boulders or lumps were encountered. Machine excavation up to burial depth would be difficult due to the stiffness of the ferricrete. After excavation, the material will be easily handled and compacted into the grave.

No groundwater or seepage was observed.

Profile Pit No TP3

TP1 was profiled to a depth of 0,9m. From ground level, up to a depth of 0,9m a dry, light brown dark orange-brown very dense with random medium dense gravelly silty sand. Pedogenic ferricrete.

The sides of the excavation are stable. No boulders or lumps were encountered. Machine excavation up to burial depth would be difficult due to the stiffness of the ferricrete. After excavation, the material will be easily handled and compacted into the grave.

No groundwater or seepage was observed.

Profile Pit No TP4

TP1 was profiled to a depth of 0,8m. From ground level, up to a depth of 0,8m a dry, light brown dark orange-brown very dense with random medium dense gravelly silty sand. Pedogenic ferricrete.

The sides of the excavation are stable. No boulders or lumps were encountered. Machine excavation up to burial depth would be difficult due to the stiffness of the ferricrete. After excavation, the material will be easily handled and compacted into the grave.

No groundwater or seepage was observed.

Profile Pit No TP5

TP1 was profiled to a depth of 1,1m. From ground level, up to a depth of 1,1m a dry, light brown dark orange-brown very dense with random medium dense gravelly silty sand. Pedogenic ferricrete.

The sides of the excavation are stable. No boulders or lumps were encountered. Machine excavation up to burial depth would be difficult due to the stiffness of the ferricrete. After excavation, the material will be easily handled and compacted into the grave.

No groundwater or seepage was observed.

Profile Pit No TP6

TP1 was profiled to a depth of 1,2m. From ground level, up to a depth of 1,2m a dry, light brown dark orange-brown very dense with random medium dense gravelly silty sand. Pedogenic ferricrete.

The sides of the excavation are stable. No boulders or lumps were encountered. Machine excavation up to burial depth would be difficult due to the stiffness of the ferricrete. After excavation, the material will be easily handled and compacted into the grave.

No groundwater or seepage was observed.

Profile Pit No TP7

TP1 was profiled to a depth of 1,1m. From ground level, up to a depth of 1,1m a dry, light brown dark orange-brown very dense with random medium dense gravelly silty sand. Pedogenic ferricrete.

The sides of the excavation are stable. No boulders or lumps were encountered. Machine excavation up to burial depth would be difficult due to the stiffness of the ferricrete. After excavation, the material will be easily handled and compacted into the grave.

No groundwater or seepage was observed.

Profile Pit No TP8

TP1 was profiled to a depth of 1,1m. From ground level, up to a depth of 1,1m a dry, light brown dark orange-brown very dense with random medium dense gravelly silty sand. Pedogenic ferricrete.

The sides of the excavation are stable. No boulders or lumps were encountered. Machine excavation up to burial depth would be difficult due to the stiffness of the ferricrete. After excavation, the material will be easily handled and compacted into the grave.

No groundwater or seepage was observed.

6 HYDRO-GEOLOGY

6.1 Site drainage

Surface water originating upland of the proposed cemetery will be cut off by the existing drainage channel, and the proposed new drainage channels, as indicated on the site layout.

Little erosion was noticed on site. Due to the relatively flat gradient of the site, erosion is unlikely to occur. The proposed drainage channels will further curb possible erosion around the site.

Surface water that penetrates the top sand/gravel soil layers is expected to flow the same directions as the surface slope, draining into the non-perennial stream west of the proposed cemetery.

6.2 Position in respect of drainage features

A flood line determination did not form part of the scope of the study, but it is clear that the proposed cemetery site is situated above the 1:50 year flood line.

6.3 Ground Water levels and basal buffer zone

No groundwater or seepage was observed in the profile pits during the site visit.

The water table at the proposed site is known to be deep (11.56m below ground level according to Cape Farm Mapper 2.7) and the permeability of the in-situ soils is within the prescribed range for cemeteries.

7 PEDOLOGY (Soil Suitability)

7.1 Land use

The proposed site is currently leased by a local farmer and are utilised for agricultural purposes.

7.2 Soil classification

Based on the exposures in the excavations and the information on the 1:250 000 Geological Series Map 3318, Cape Town, presented in Figure 2 (W2097-02-G01). The location of the site is also shown on this figure.

The general geology of the area consists primarily of Quaternary Aged consolidated and unconsolidated sands at surface. Greywacke phyllite soils and rock as well as quartzitic sandstone and schist of the Moorreesburg and Klipplaat Formations, respectively, (Malmesbury Group) underlie the surface soils. Pedogenic soils of both dorbank and ferricrete are also commonly encountered close to surface.

7.3 Soil permeability

Disturbed samples were taken at 1,0m below natural ground level in selected profile pits for permeability testing. The results of these tests are indicated in the table below.

According to **Table 2** the soil permeability is ideal for cemeteries.

Table 3: Measured soil permeability

Profile Pit No	Depth sample taken	Permeability (cm/s)
TH4	1.0m	$5,03 \times 10^{-7}$
TP8	1.0m	$6,23 \times 10^{-6}$

8 CONCLUSIONS

8.1 Soil excavatability and workability

Soil workability is not ideal. The dense ferricrete is encountered at depths varying from 600mm to in excess of 1.2m below natural ground level. On average, the depth of the stiff material (digger loader refusal) is at 1,0m. An excavator of at least 20 tonne would also have to be utilised to excavate the hard sub-strata.

Once excavated, the soil will be suitable for use as backfilling of the graves, provided that large boulders and cobbles are removed prior to backfilling.

Also see 3.1 and 3.3

8.2 Grave stability

Suitable edge protection of the sandy material will be required after excavation to prevent the sides collapsing during the burial ceremony.

Also see 3.2.

8.3 Site Topography

The maximum natural slope of the site is approximately 4°. Water ponding on the site should not be problematic, as the slope is ideal for the use as cemetery.

Also see 3.4.

8.4 Site Drainage

Surface water drainage must be observed to prevent ponding of water, but we do not foresee this to be required as the slope is in the ideal range. Surface water originating upland of the site must be diverted around the site using maintained drains (see drawing W2097-04-DL) of new cut-off drains to be constructed. These drains must be deep enough to penetrate the weathered rock layers to prevent near surface water from flowing through the site.

Internal roads must be utilised to channel stormwater to suitable discharge points. These discharge points must be protected against scouring and erosion by providing stone masonry or other suitable erosion control measures.

Also see 3.5.

8.5 Soil permeability and basal buffer zone

Occasional water logging of the near surface alluvium layers will be greatly reduced with the implementation of the proposed on site storm water drains as well as the perimeter drains diverting surface water around the site.

Both these measures will reduce the possibility of groundwater pollution.

Also see 3.6 and 3.7.

8.6 Position in respect of domestic water sources and drainage features

Potable water is supplied to Moorreesburg via Municipal pipelines. The nearest registered borehole to the proposed site is unknown but is assumed to be further away than the min distance of 166m (for a representative maximum permeability of 5×10^{-6} cm/s as per Table 4).


The closest drainage feature to the proposed site is the non-perennial stream running through the area approximately 1300m west of the proposed site boundary. The non-perennial stream is to be further than the minimum recommended safe distance of 66m (for a permeability of 5×10^{-6} cm/s) from the cemetery site boundary.

Also see 3.8.

9 RECOMMENDATIONS

The following mitigation measures must be applied to reduce the risk of groundwater pollution:

- 9.1 Adequate surface drainage features must be installed on site to prevent ponding of water and erosion. These must include adequately aligned internal roads to allow free drainage off the burial areas onto the roads, as well as free drainage along the roads to suitable discharge points on the boundary of the proposed site.
- 9.2 Cut-off drains (verges) on the north, east and south boundaries are to be maintained for the drainage of potential runoff on to and from the site. These drains must be of sufficient depth to penetrate the weathered rock layers to intercept near surface water.
- 9.3 Indigenous vegetation must be planted and developed along the site perimeter to lower the water table that may occur seasonally and also to manage potential erosion on the proposed cemetery site.



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For SKCM Engineers

10 REFERENCES

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APPENDIX A:

LABORATORY TESTING ON SOIL

SGS MATROCAST (PTY) LTD
- CIVIL ENGINEERING SERVICES -
Reg.No.: 2000/030983/07 - VAT. Reg.No.: 4130197405
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TEST RESULTS

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 7620
 Attention: MR K.LAUBSCHER

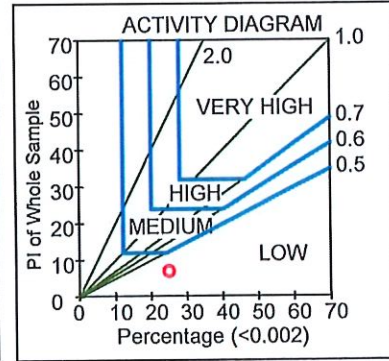
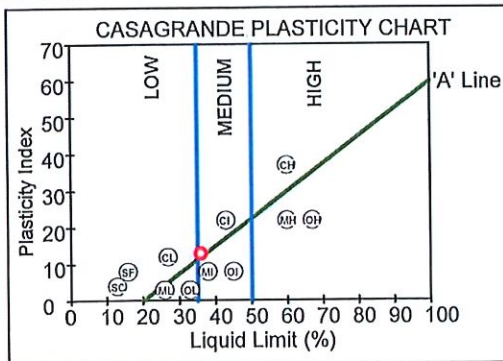
Project : MOORREESBURG BEGRAFPLAAS
 Your Ref :
 Our Ref : 92663
 Date Reported : 03.03.2023

FOUNDATION INDICATOR (ASTM: D422)

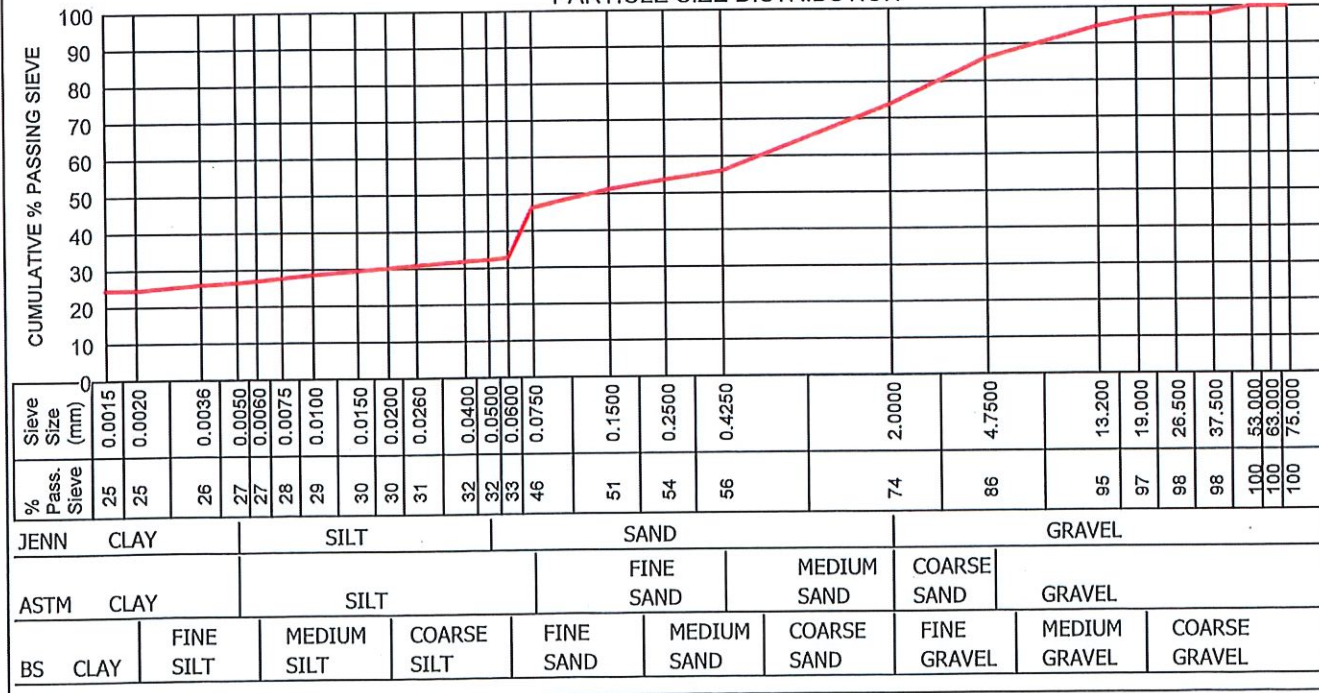
Sample No. : D 0345
 Hole No. : TH4
 Depth : -
 Liquid Limit (%) : 36
 Plasticity Index : 13
 Linear Shrinkage (%) : 7,0
 PI of Whole Sample : 7
 P.R.A. Classification : A-6(3)
 Unified Soil Classificati: SC
 Activity : 0,28
 Heave Classification : LOW
 Grading Modulus : 1,24
 Percentage (<0.002) : 25,0
 Moisture Content (%) : 9,5
 Relative Density : 2,620

Material Description : REDDISH BROWN GRAVEL MATERIAL

	Clay (%)	Silt (%)	Sand (%)	Gravel (%)	Classification
Jennings	26,6	5,7	41,6	26,1	SANDY CLAY
Astm	26,6	19,8	39,9	13,7	SANDY CLAY
British Standard	24,6	8,2	41,1	26,1	SANDY CLAY



PARTICLE SIZE DISTRIBUTION



Remarks :
 FORM: A6
 4.5.0(SGS)(2021.05.05)

Gregory Bell
 Technical Signatory : Mr Gregory Bell (N.DIP Civ.Eng)

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 a SANAS Accredited Testing Laboratory, No. T0245

4 HARBOT CLOSE, BRACKENDUST, 7560
 P.O.BOX 1106, BRACKENFELL
 Tel. : 021 9815558/9
 Fax : 021 9816724
 Email : nico.engelbrecht@sgs.com

TEST RESULTS

SKCM ENGINEERS
 P.O.BOX 229
 PAARL
 7620
 Attention: MR K.LAUBSCHER

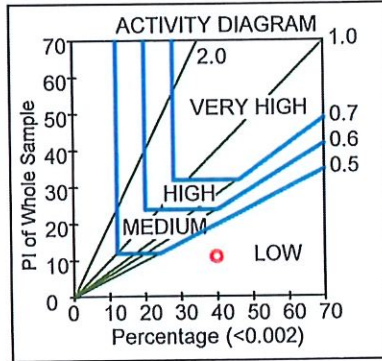
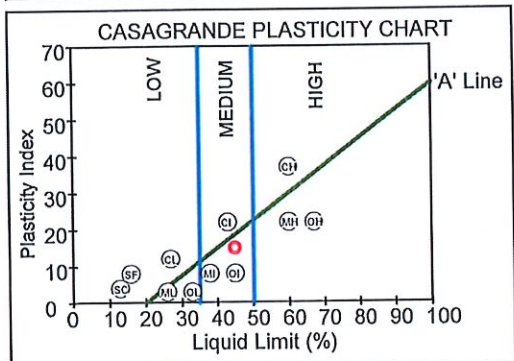
Project : MOORREESBURG BEGRAFPLAAS
 Your Ref :
 Our Ref : 92663
 Date Reported : 03.03.2023

FOUNDATION INDICATOR (ASTM: D422)

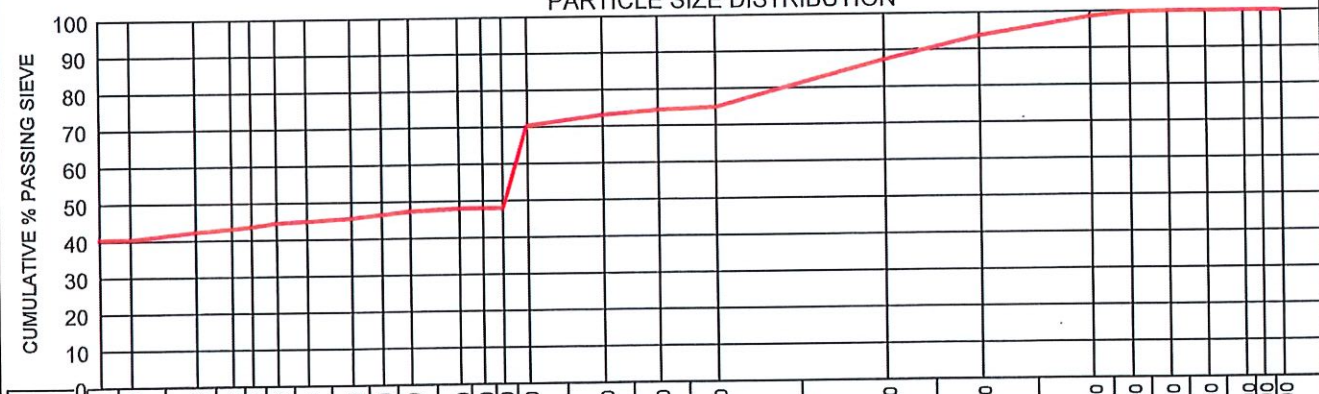
Sample No. : D 0346
 Hole No. : TH8
 Depth : -
 Liquid Limit (%) : 45
 Plasticity Index : 15
 Linear Shrinkage (%) : 7,5
 PI of Whole Sample : 11
 P.R.A. Classification : A-7-5(10)
 Unified Soil Classificati: ML
 Activity : 0,28
 Heave Classification : LOW
 Grading Modulus : 0,68
 Percentage (<0.002) : 40,0
 Moisture Content (%) : 11,2
 Relative Density : 2,685

Material Description : REDDISH BROWN GRAVEL MATERIAL

	Clay (%)	Silt (%)	Sand (%)	Gravel (%)	Classification
Jennings	43,2	4,8	39,4	12,6	SANDY CLAY
Astm	43,2	27,2	23,4	6,3	SILTY CLAY
British Standard	40,5	7,5	39,4	12,6	SANDY CLAY



PARTICLE SIZE DISTRIBUTION



Sieve Size (mm)	% Pass. Sieve	JENN	CLAY	SILT	SAND	GRAVEL
0.0015	41					
0.0020	41					
0.0036	42					
0.0050	43					
0.0060	44					
0.0075	45					
0.0100	45					
0.0150	46					
0.0200	47					
0.0260	47					
0.0400	48					
0.0500	48					
0.0600	48					
0.0750	70					
0.1500	73					
0.2500	74					
0.4250	75					
2.0000	87					
4.7500	94					
13.200	99					
19.000	100					
26.500	100					
37.500	100					
53.000	100					
63.000	100					
75.000	100					

Remarks :
 FORM: A6

Gregory Bell
 Technical Signatory : Mr Gregory Bell (N.DIP Civ.Eng)

END OF REPORT

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TEST RESULTS

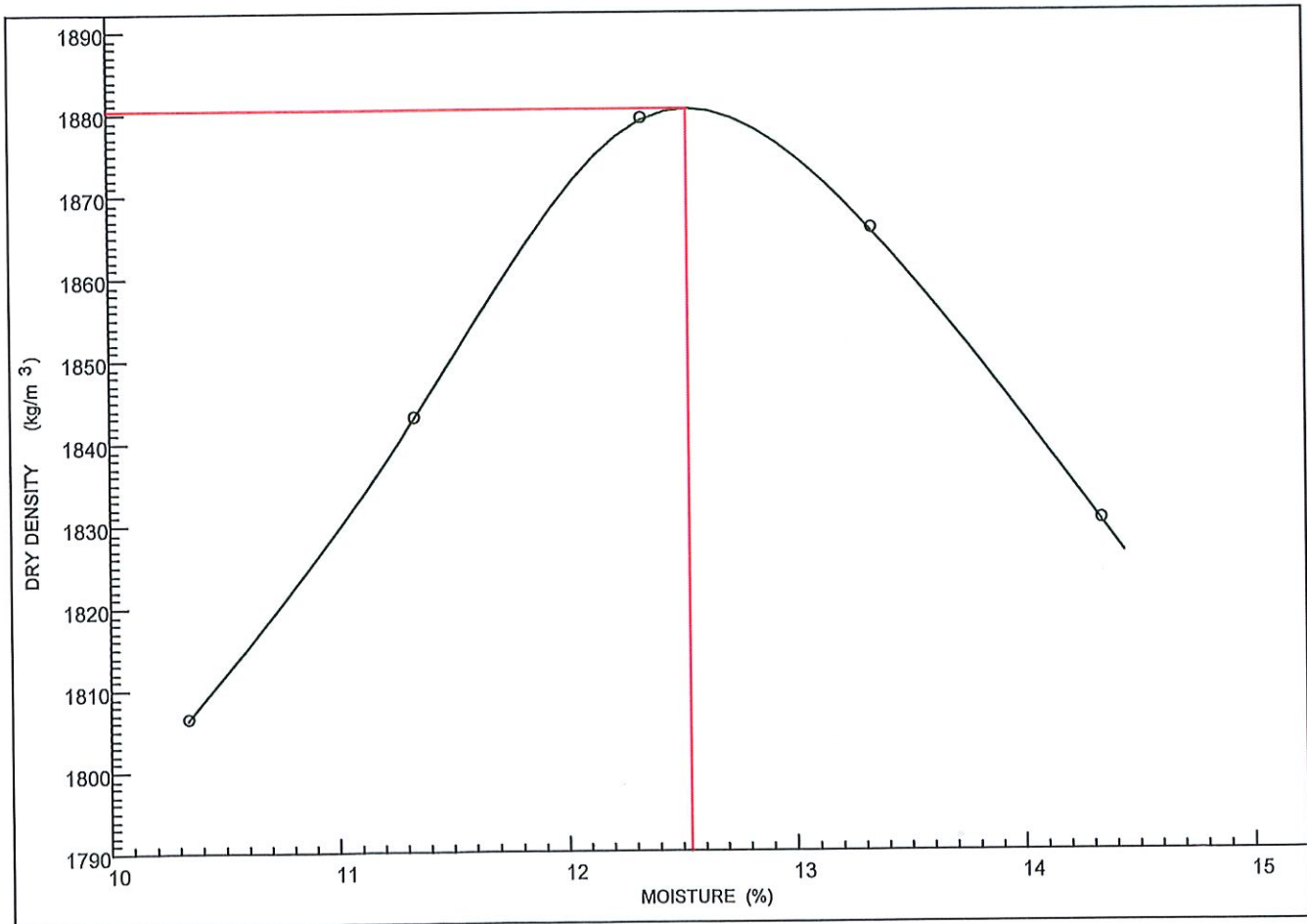
SKCM ENGINEERS
 P.O.BOX 229
 PAARL
 7620
 Attention: MR K.LAUBSCHER

Project : MOORREESBURG BEGRAFPLAAS
 Your Ref :
 Our Ref : 92663
 Date Reported : 03.03.2023

MOISTURE / DENSITY RELATIONSHIP(SANS 3001: GR30(MOD))

Sample No: D 0345	Hole No. : TH4	Depth (mm) : -
Origin : -	Stabilized With : Neat	Compaction Energy : MOD
Material Description : Reddish Brown Gravel		

Maximum Dry Density (kg/m ³) : 1880 Optimum Moisture Content (%) : 12,5	Point No.	1	2	3	4	5			
	Moisture (%)	10,3	11,3	12,3	13,3	14,3			
	Density (kg/m ³)	1806	1843	1879	1866	1830			



Remarks :

FORM: GR30

4.4.1(SGS)(2019.12.04)

Technical Signatory : Mr Gregory F.Bell (N.Dip.Civ.Eng)

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TEST RESULTS

SKCM ENGINEERS
 P.O.BOX 229
 PAARL
 7620
 Attention: MR K.LAUBSCHER

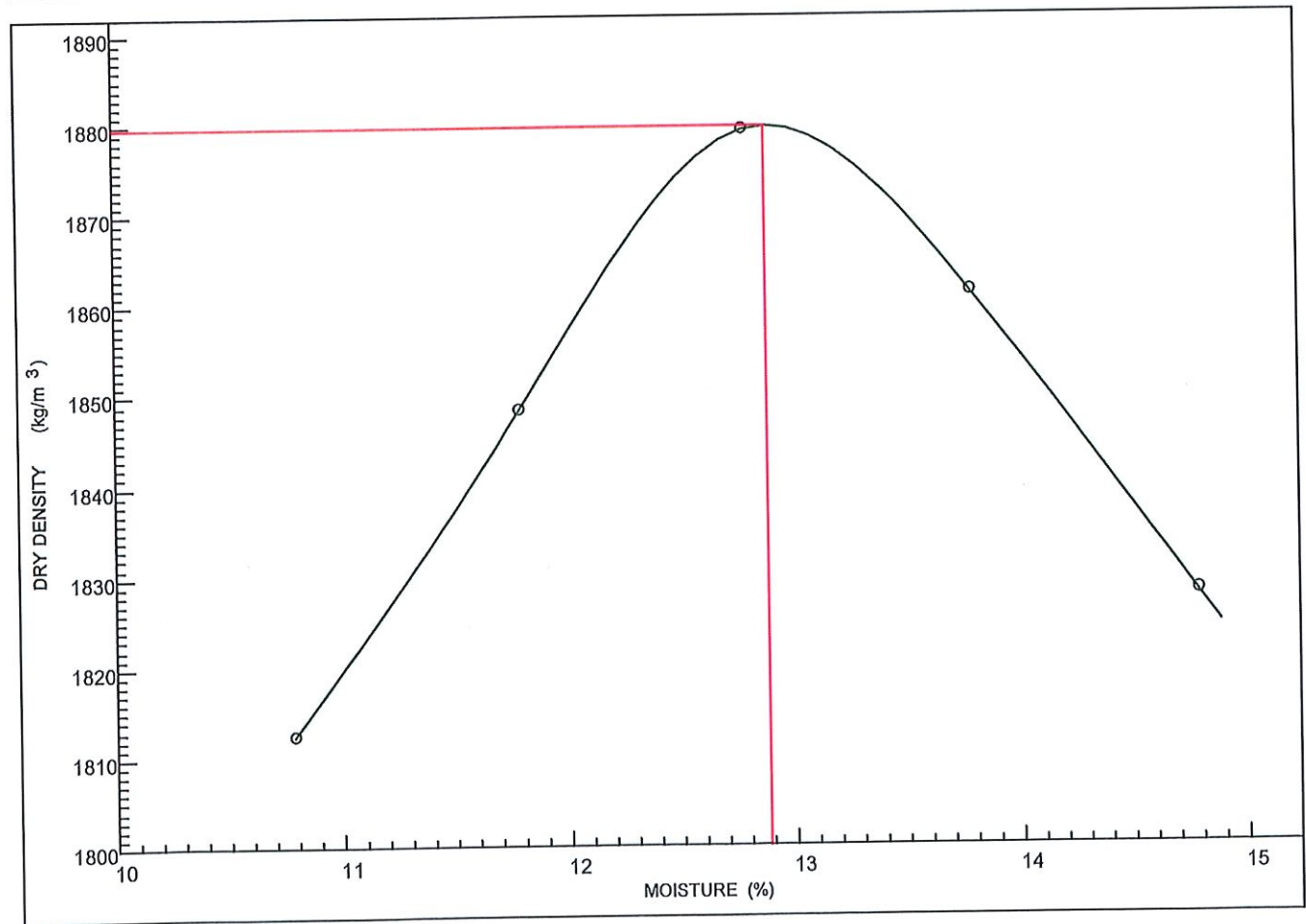
Project : MOORREESBURG BEGRAFFLAAS
 Your Ref :
 Our Ref : 92663
 Date Reported : 03.03.2023

MOISTURE / DENSITY RELATIONSHIP(SANS 3001: GR30(MOD))

Sample No: D 0346	Hole No. : TH8	Depth (mm) : -
Origin :-	Stabilized With : Neat	Compaction Energy : MOD
Material Description : Reddish Brown Gravel		

Maximum Dry Density (kg/m^3) : 1880
 Optimum Moisture Content (%) : 12,9

Point No.	1	2	3	4	5			
Moisture (%)	10,8	11,8	12,8	13,8	14,8			
Density (kg/m^3)	1812	1848	1879	1861	1828			



Remarks :

FORM: GR30

4.4.1(SGS)(2019.12.04)

Technical Signatory : Mr Gregory F. Bell (N.Dip Civ.Eng)

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DRAWINGS:



**PROPOSED CEMETERY
MOORREESBURG**

**FIGURE 1:
LOCALITY PLAN**

**SWARTLAND
MUNICIPALITY**



DESIGNED	BY	DATE	CH
DRAWN	GA	01/03/2023	JV
TRACED			
SCALE:		N.T.S	
DRAWING NO.:		W2097-01-LP	
REVISIONS		DATE	BY
REVISIONS			

PROJECT
PROPOSED CEMETERY
MOORREESBURG

CLIENT
SWARTLAND
Municipality

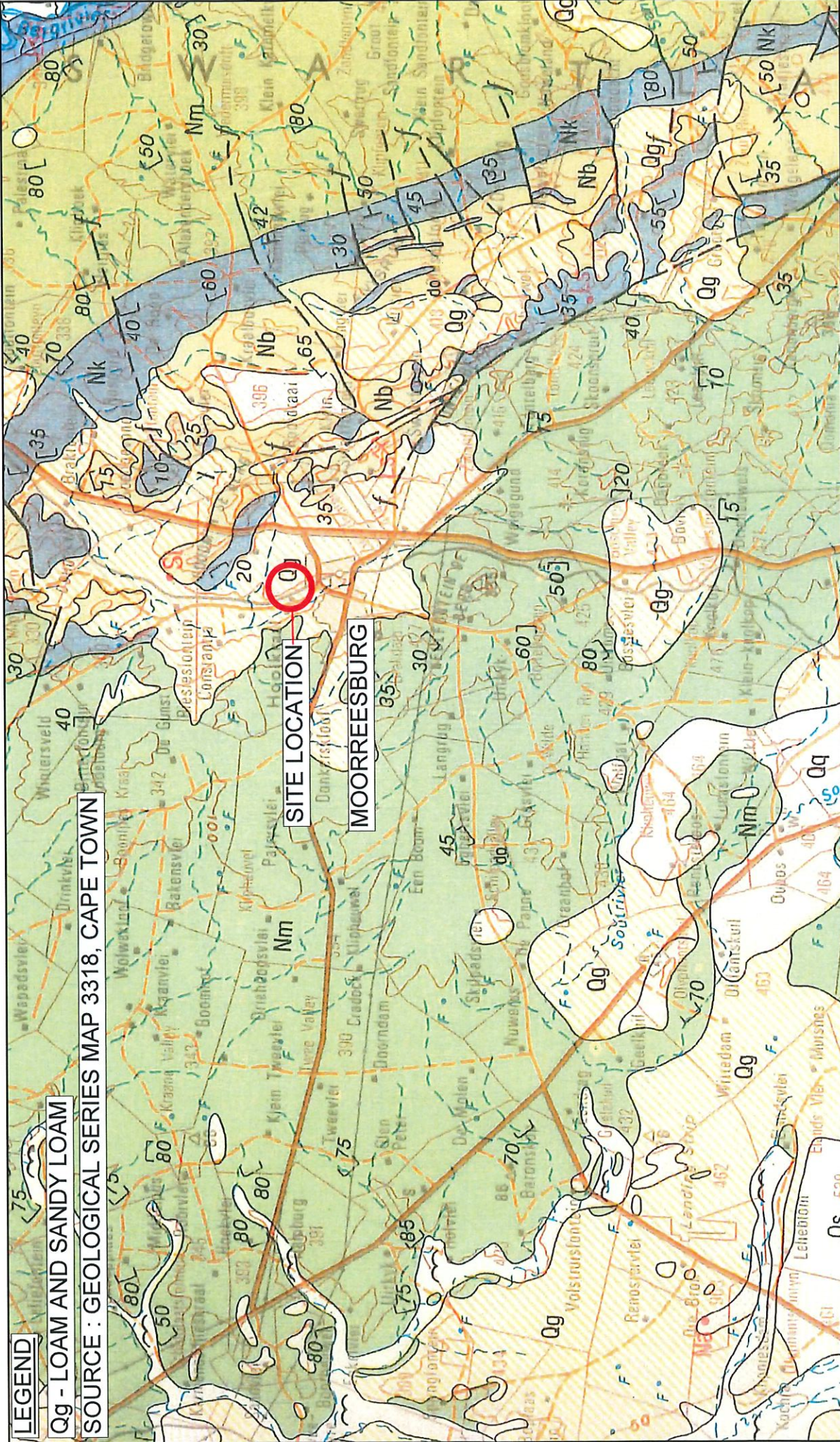
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7800
TEL: (021) 871 1-0223
FAX: (021) 872 7740

P.O. BOX 63
MALLMESBURG
eMail: skcmsouth@skcm.co.za



LEGEND

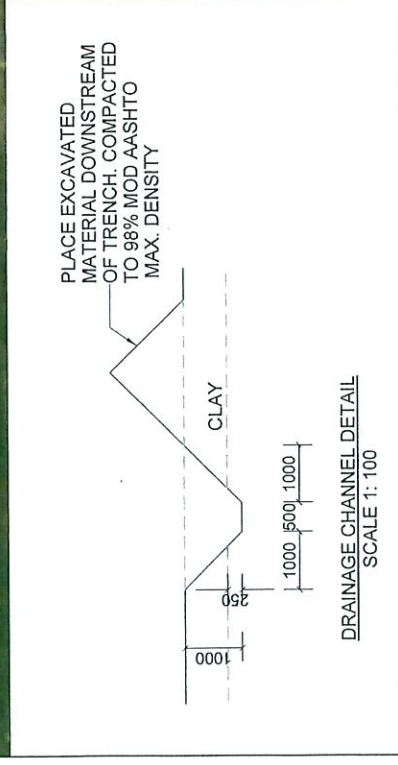
Qg - LOAM AND SANDY LOAM

SOURCE : GEOLOGICAL SERIES MAP 3318, CAPE TOWN

PROJECT		TITLE		BY		DATE		CH	
PROPOSED CEMETERY MOORREESBURG		FIGURE 2: GEOLOGICAL SERIES MAP (3318 CAPE TOWN)		DESIGNED					
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 SKM SKMasakhizwe Engineers (Pty) Ltd CONSULTING ENGINEERS TO BUILD THE NATION P.O. BOX 53 7300 MOORREESBURG eMail: skmsouth@skm.co.za		SCALE: N.T.S		TRACED					
13 PASTORIE AVENUE P.O. BOX 229 7620 TEL: (021) 871 14223 FAX: (021) 872 7740		DRAWING NO.: W2097-02-G01							
		DATE		REFERENCE		BY		REVISION:	



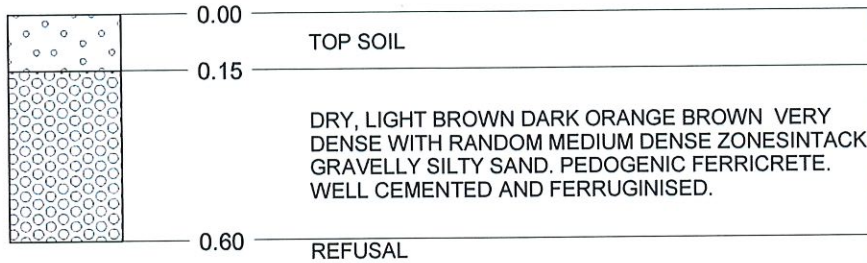
SKCM SKCMasakhizwe Engineers (Pty) Ltd CONSULTING ENGINEERS TO BUILD THE NATION 13 PASTORIE AVENUE P.O. BOX 229 MALMESBURY 7600 TEL: (021) 871 14223 FAX: (021) 872 7740 email: skcmouth@skcm.co.za	PROJECT PROPOSED CEMETERY MOORREESBURG	TITLE FIGURE 3: SITE LAYOUT PROFILE PIT POSITIONS	CLIENT  SWARTLAND MUNICIPALITY	<table border="1"> <tr> <td>DESIGNED</td> <td>BY</td> <td>DATE</td> <td>CH</td> </tr> <tr> <td>DRAWN</td> <td>GA</td> <td>01/03/2023</td> <td>JV</td> </tr> <tr> <td>TRACED</td> <td></td> <td></td> <td></td> </tr> <tr> <td colspan="2">SCALE: N.T.S</td> <td colspan="2">REVISION:</td> </tr> <tr> <td colspan="2">DRAWING NO.: W2097-03-SL</td> <td colspan="2"></td> </tr> </table>	DESIGNED	BY	DATE	CH	DRAWN	GA	01/03/2023	JV	TRACED				SCALE: N.T.S		REVISION:		DRAWING NO.: W2097-03-SL			
	DESIGNED	BY	DATE	CH																				
DRAWN	GA	01/03/2023	JV																					
TRACED																								
SCALE: N.T.S		REVISION:																						
DRAWING NO.: W2097-03-SL																								
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DATE	REFERENCE	BY																						



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	<p>CONNECT TO EXISTING CHANNEL</p> <p>PROPOSED NEW DRAINAGE CHANNEL</p> <p>CONNECT TO EXISTING CHANNEL</p> <p>PROPOSED NEW DRAINAGE CHANNEL</p> <p>FALL 4%</p> <p>PROPOSED NEW DRAINAGE CHANNEL</p> <p>EXISTING CHANNEL</p> <p>DIVERTE CHANNEL INTO DRAINAGE CHANNEL</p> <p>EXISTING CHANNEL</p>	<p>DATE</p> <p>REFERENCE</p> <p>BY</p>	<p>SCALE :</p> <p>N.T.S</p>	<p>REVISIONS</p> <p>DATE</p> <p>REFERENCE</p> <p>BY</p>	<p>DESIGNED</p> <p>BY</p> <p>DATE</p>	<p>CH</p>

FIGURE 4 : SOIL PROFILES

<u>PROFILE NO. :</u>	TP1	<u>DATE</u>	17/02/2023	<u>PROFILED BY:</u>	JV
<u>LATITUDE :</u>	33°07'48.5"S	<u>LONGITUDE :</u>	18°40'08.4"E	<u>ELEVATION (m)</u>	176
<u>DEPTH OF PROFILE PIT (m)</u>		<u>DEPTH OF WATER TABLE (m)</u>		<u>DEPTH TO WEATHERED ROCK</u>	
0.60		NOT ENCOUNTERED		UNKNOWN	





SCALE 1:20

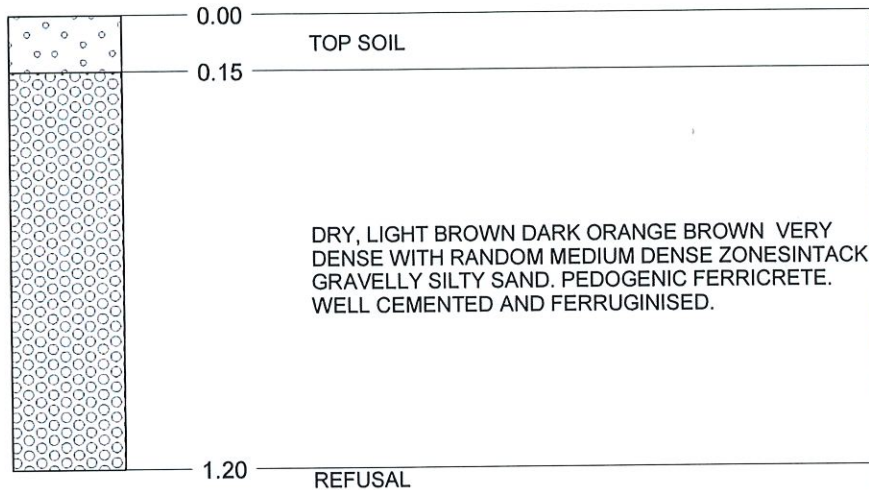


NOTES

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2. NO SIDEWALL COLLAPSE.
3. REFUSAL IN VERY DENSE AND WELL CEMENTED SOILS.

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<u>PROFILE NO.:</u>	TP2	<u>DATE</u>	17/02/2023	<u>PROFILED BY:</u>	JV
<u>LATITUDE:</u>	33°07'45.9"S	<u>LONGITUDE:</u>	18°40'08.1"E	<u>ELEVATION (m)</u>	175
<u>DEPTH OF PROFILE PIT (m)</u>		<u>DEPTH OF WATER TABLE (m)</u>		<u>DEPTH TO WEATHERED ROCK</u>	
1.20		NOT ENCOUNTERED		UNKNOWN	



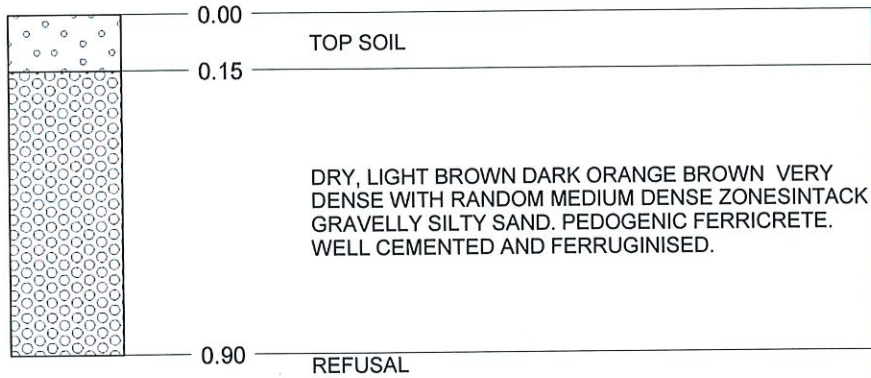
SCALE 1:20

NOTES

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<u>PROFILE NO :</u>	TP3	<u>DATE</u>	17/02/2023	<u>PROFILED BY:</u>	JV
<u>LATITUDE :</u>	33°07'43.8"S	<u>LONGITUDE :</u>	18°40'08"E	<u>ELEVATION (m)</u>	175
<u>DEPTH OF PROFILE PIT (m)</u>		<u>DEPTH OF WATER TABLE (m)</u>		<u>DEPTH TO WEATHERED ROCK</u>	
0.90		NOT ENCOUNTERED		UNKNOWN	





SCALE 1:20

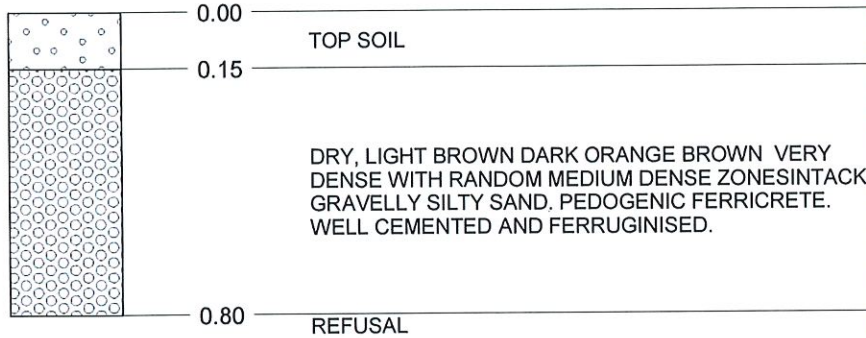
NOTES

1. NO SEEPAGE.
2. NO SIDEWALL COLLAPSE.
3. REFUSAL IN VERY DENSE AND WELL CEMENTED SOILS.



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	DESIGNED	GA	01/03/2023	
	DRAWN			
	TRACED			
	SCALE :	1:20		
DRAWING NO.: W2097-TP3	REVISION: 0			
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<u>PROFILE NO. :</u>	TP4	<u>DATE</u>	17/02/2023	<u>PROFILED BY:</u>	JV
<u>LATITUDE :</u>	33°07'44.2"S	<u>LONGITUDE :</u>	18°40'11.2"E	<u>ELEVATION (m)</u>	178
<u>DEPTH OF PROFILE PIT (m)</u>		<u>DEPTH OF WATER TABLE (m)</u>		<u>DEPTH TO WEATHERED ROCK</u>	
0.80		NOT ENCOUNTERED		UNKNOWN	



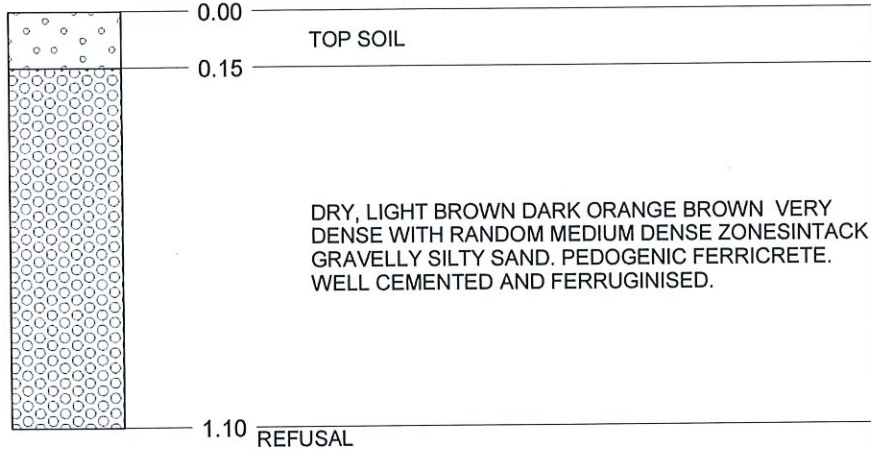
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NOTES

1. NO SEEPAGE.
2. NO SIDEWALL COLLAPSE.
3. REFUSAL IN VERY DENSE AND WELL CEMENTED SOILS.

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				DRAWING NO.: W2097-TP4		REVISION: 0



<u>PROFILE NO :</u>	TP5	<u>DATE</u>	17/02/2023	<u>PROFILED BY:</u>	JV
<u>LATITUDE :</u>	33°07'46.3"S	<u>LONGITUDE :</u>	18°40'11.3"E	<u>ELEVATION (m)</u>	178
<u>DEPTH OF PROFILE PIT (m)</u>		<u>DEPTH OF WATER TABLE (m)</u>		<u>DEPTH TO WEATHERED ROCK</u>	
1.10		NOT ENCOUNTERED		UNKNOWN	



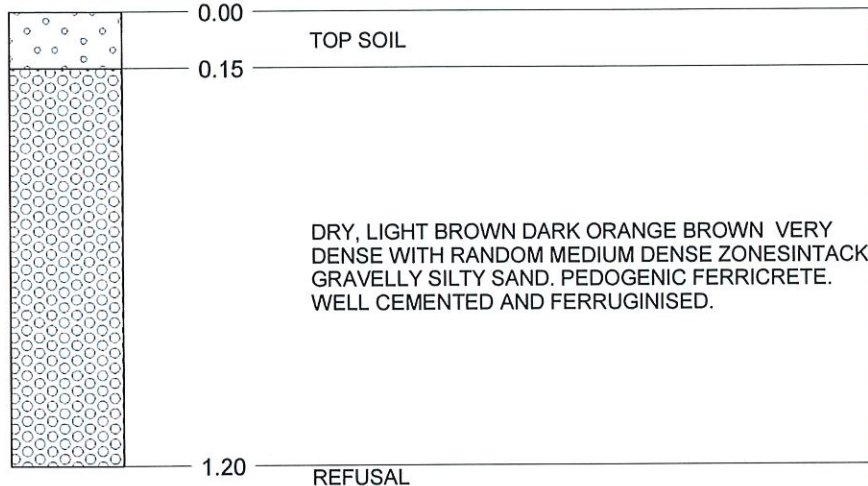
SCALE 1:20

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3. REFUSAL IN VERY DENSE AND WELL CEMENTED SOILS.

 SKCM SKCMasakhizwe Engineers (Pty) Ltd CONSULTING ENGINEERS TO BUILD THE NATION 13 PASTORIE AVENUE PO BOX 229 PAARL 7620 TEL: (021) 871 1422/3 FAX: (021) 872 7740 9B CHURCH STREET P.O BOX 63 MALMESBURY 7300 TEL: (022) 487 3017 eMail: skcmsouth@skcm.co.za	TITLE TEST PIT 5: PROPOSED CEMETERY MOORREESBURG	CLIENT  SWARTLAND MUNICIPALITY	BY GA	DATE 01/03/2023	CH 0	
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	SCALE : 1:20			DRAWING NO.: W2097-TP5	REVISION: 0	



<u>PROFILE NO :</u>	TP6	<u>DATE</u>	17/02/2023	<u>PROFILED BY:</u>	JV
<u>LATITUDE :</u>	33°07'47.5"S	<u>LONGITUDE :</u>	18°40'14.8"E	<u>ELEVATION (m)</u>	183
<u>DEPTH OF PROFILE PIT (m)</u>		<u>DEPTH OF WATER TABLE (m)</u>		<u>DEPTH TO WEATHERED ROCK</u>	
1.20		NOT ENCOUNTERED		UNKNOWN	



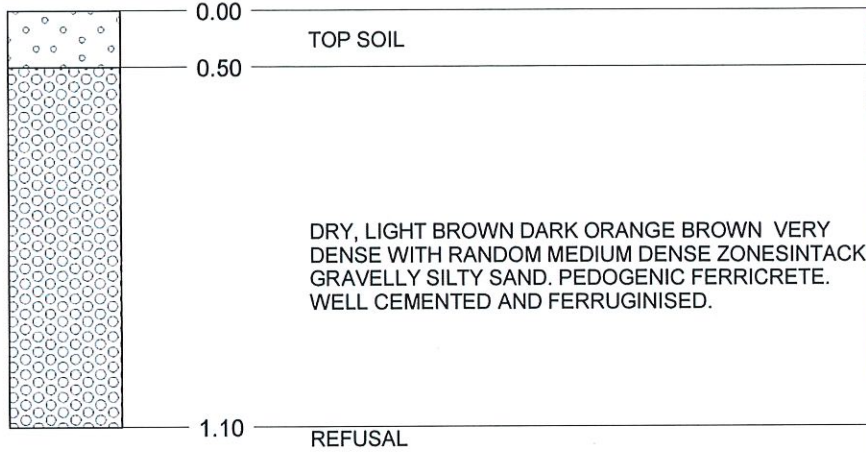
SCALE 1:20

NOTES

1. NO SEEPAGE.
2. NO SIDEWALL COLLAPSE.
3. REFUSAL IN VERY DENSE AND WELL CEMENTED SOILS.

 SKCM Masakhizwe Engineers (Pty) Ltd CONSULTING ENGINEERS TO BUILD THE NATION 13 PASTORIE AVENUE PO BOX 229 PAARL 7620 TEL: (021) 871 1422/3 FAX: (021) 872 7740 9B CHURCH STREET P.O. BOX 63 MALMESBURY 7300 TEL: (022) 487 3017 eMail: skcmsouth@skcm.co.za	TITLE TEST PIT 6: PROPOSED CEMETERY MOORREESBURG	CLIENT  SWARTLAND MUNICIPALITY	BY	DATE	CH
			DESIGNED		
			DRAWN	GA	01/03/2023
			TRACED		
			SCALE : 1:20		
DRAWING NO.: W2097-TP6		REVISION: 0			
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<u>PROFILE NO :</u>	TP7	<u>DATE</u>	17/02/2023	<u>PROFILED BY:</u>	JV
<u>LATITUDE :</u>	33°07'45.1"S	<u>LONGITUDE :</u>	18°40'14.4"E	<u>ELEVATION (m)</u>	182
<u>DEPTH OF PROFILE PIT (m)</u>		<u>DEPTH OF WATER TABLE (m)</u>		<u>DEPTH TO WEATHERED ROCK</u>	
1.10		NOT ENCOUNTERED		UNKNOWN	



SCALE 1:20

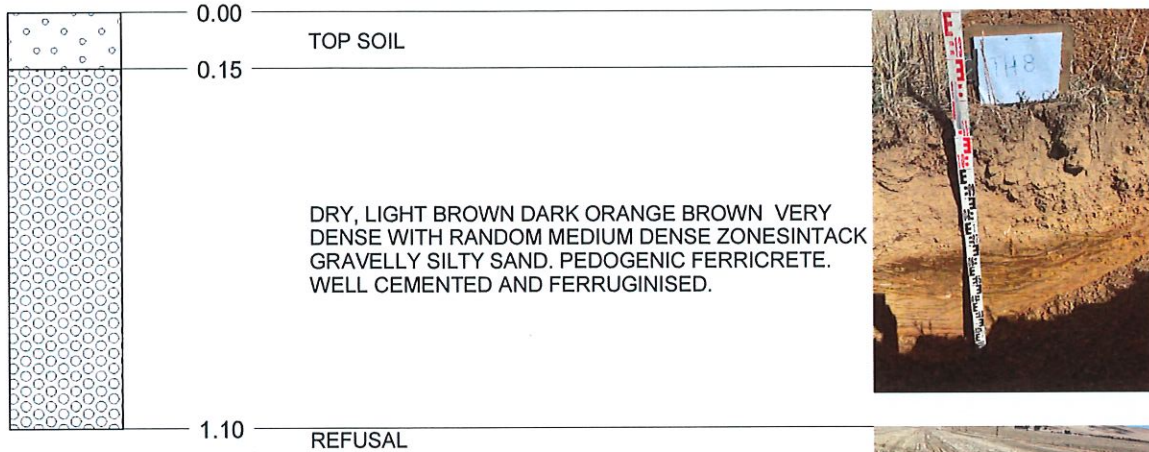
NOTES

1. NO SEEPAGE.
2. NO SIDEWALL COLLAPSE.
3. REFUSAL IN VERY DENSE AND WELL CEMENTED SOILS.

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<u>PROFILE NO :</u>	TP8	<u>DATE</u>	17/02/2023	<u>PROFILED BY:</u>	JV
<u>LATITUDE :</u>	33°07'43.1"S	<u>LONGITUDE :</u>	18°40'14.2"E	<u>ELEVATION (m)</u>	182
<u>DEPTH OF PROFILE PIT (m)</u>		<u>DEPTH OF WATER TABLE (m)</u>		<u>DEPTH TO WEATHERED ROCK</u>	
1.10		NOT ENCOUNTERED		UNKNOWN	



SCALE 1:20

NOTES

1. NO SEEPAGE.
2. NO SIDEWALL COLLAPSE.
3. REFUSAL IN VERY DENSE AND WELL CEMENTED SOILS.