

Appendix G7 – Geotechnical Assessment



Report to CK Rumboll & Partners on a Geotechnical Investigation carried out for the Culcatta RE/29, Cemetery Site, Stellenbosch, Western Cape

Project No.: 18-811R01



Date Issued: May 2018

Report to CK Rumboll & Partners on a Geotechnical Investigation carried out for the Culcatta RE/29, Cemetery Site, Stellenbosch, Western Cape

TABLE OF CONTENTS

1.	INTRODUCTION	1
2.	INFORMATION SUPPLIED	1
3.	SITE DESCRIPTION	1
4.	FIELDWORK.....	2
4.1	Trial Pits	2
4.2	Dynamic Cone Penetrometer Light (DPL) Tests	3
5.	REGIONAL GEOLOGY	3
5.1	Site Geology	3
6.	GROUNDWATER.....	4
7.	LABORATORY TESTING.....	4
7.1	Materials Usage.....	4
7.2	Permeability Evaluation	7
8.	DEPARTMENT OF WATER AFFAIRS AND FORESTRY (DWA) REQUIREMENTS	7
8.1	Below the 1 in 50 year flood line of a river.....	7
8.2	In close proximity to water bodies such as wetlands, vleis, pans and floodplains	7
8.3	Situated in unstable areas	7
8.4	Sensitive ecological areas	7
8.5	Areas with flat gradients with shallow or emergent groundwater	8
8.6	Areas characterised by steep gradients or shallow bedrock with little soil cover	8
8.7	Areas of groundwater recharge on account of topography and/or highly permeable soils	8
8.8	Areas overlaying or adjacent to important aquifers where these are to be used for water supply purposes	8
9.	BOREHOLES AND DOMESTIC WATER SOURCES.....	8
10.	DEVELOPMENT RECOMMENDATIONS	9
10.1	Proposed Cemetery	9
10.2	Grave Excavations.....	9
10.3	Leachate Migration	9
10.4	Basal Buffer Zone	9
10.5	Soil Workability	9
10.6	Slope.....	10
11.	RATING OF CEMETERY ATTRIBUTES.....	10
12.	CONCLUSION	11

- Appendix A: Trial Pit Profiles
 Appendix B: DPL Test Results
 Appendix C: Laboratory Test Results
 Appendix D: Geotechnical Rating System
 Figures 1 to 4

	PREPARED:	APPROVED:
DATE:	May 2018	May 2018
NAME:	Colin Hartley	Mark Richter
SIGNATURE:		

Report to CK Rumboll & Partners on a Geotechnical Investigation carried out for the Culcatta RE/29, Cemetery Site, Stellenbosch, Western Cape

1. INTRODUCTION

As requested by Ms Anelia Coetzee of CK Rumboll & Partners, Gondwana Geo Solutions (Pty) Ltd (GGS) submitted a proposal to carry out a geotechnical investigation for the proposed Culcatta RE/29, Cemetery Site on the 28th February 2018.

The appointment of GGS to proceed as proposed was confirmed in a signed contract with CK Rumboll and Partners on the 27th March 2018.

The Phase 1, Preliminary Site Assessment comprised a desktop study of the area with a review of available information and meeting with local land owners, mapping of all surface water bodies and conducting a borehole and spring census of the area. This information is included in the Phase 2 report.

The Phase 2 geotechnical investigation comprised the excavation of nine trial pits at locations around the site. The trial pits were put down to obtain logging and sampling of the soils and, where possible, the depth to bedrock. Nine Dynamic Cone Penetrometer Light (DPL) Tests were carried out adjacent to the inspection pits to establish the consistency of the soils with depth.

Recommendations for the suitability of the site for use as a cemetery are provided.

2. INFORMATION SUPPLIED

The following information was supplied for use in the investigation:

- Google Earth Kmz file showing the site position.
- Site Development Plan. Ref: STEL/9494/AC/RB

3. SITE DESCRIPTION

The area on which the geotechnical investigations were carried out consist of a site with an area of 23.7Ha. The R304 surfaced road and road reserve bounds the site on the west side. Commercial farm land consisting of vineyards is located on the northern boundary while the eastern boundary is flanked by grassland with scattered small trees. A minor drainage line runs almost parallel to the road reserve on the west side. A second drainage line is situated on the east side of the site and runs in a north – south direction passing close to the eastern corner of the site, roughly parallel to the R304 road, and some 75m to 100m from the road itself. Both drainage lines were completely dry at the time of the investigation. The site locality is shown on Figure 1.

The site slopes gently towards the south west and south east and is thickly covered in Eucalyptus plantation regrowth and Port Jackson Willow trees, dead grass and weeds. The layout of the site is given in Figure 2.

Plates 1 and 2 below give a detailed perspective of the site.



Plate 1: Site viewed towards the east at TP4



Plate 2: Site viewed towards the west at TP4

4. FIELDWORK

The fieldwork for the investigation was conducted during April 2018 and comprised the following:

- Trial Pits, and
- Dynamic Cone Penetrometer Light (DPL) Tests

4.1 Trial Pits

The trial pits were excavated using a JCB3CX Tractor Loader Backhoe (TLB) supplied by Burcon Plant Hire from Cape Town.

Nine trial pits, designated TP1 through TP9 were put down at the location as shown in Figure 2 at the site. Trial pit TP1 refused on medium hard to hard rock sandstone, Trial Pits TP2, TP3, TP6, TP8 and TP9 terminated in clay at 3.10m, 3.40m, 3.00m, 3.20m and 3.30m respectively. Trial Pits TP4 and TP5 terminated in medium grained sand at a depth of 3.00m and 2.80m respectively, below existing ground level. Trial Pit TP7 refused in very dense ferricrete at 2.20m.

The trial holes were profiled¹ by an engineering geologist and representative soil samples recovered for laboratory testing at Geoscience Laboratories (Pty) Ltd in Cape Town. The detailed logs are provided in Appendix A.

Table 1 below indicates the locations and depths to which the trial holes were excavated.

Table 1
Summary of Trial Pit Details

TP No.	GPS Coordinates (WGS84)		Depth (mbegl)	Comments
	19 Y	X		
TP1	0017838	3747151	2.20	Refusal. No groundwater
TP2	0017820	3747308	3.10	TLB Limit. No groundwater
TP3	0017704	3747564	3.40	TLB Limit. No groundwater
TP4	0017562	3747659	3.00	TLB Limit. No groundwater
TP5	0017329	3747440	2.80	TLB Limit. No groundwater
TP6	0017458	3747085	3.00	TLB Limit. No groundwater
TP7	0017635	3747169	2.20	Refusal. No groundwater
TP8	0017493	3747455	3.20	TLB Limit. No groundwater
TP9	0017283	3747239	3.30	TLB Limit. No groundwater

Note: mbe gl = metres below existing ground level

¹ Geoterminology Workshop (2002) – Guidelines for Soil and Rock Logging - SAIEG-AEG-SAICE (Geotech Div) pp47

4.2 Dynamic Cone Penetrometer Light (DPL) Tests

Nine Dynamic Cone Penetrometer Light, or DPL tests, designated DPL1 to DPL9 were undertaken. All tests were undertaken from surface adjacent to the corresponding trial holes. A maximum depth of 2.4m begl was achieved, in order to assess the consistency of the insitu soils, as well as to provide an indication of the depth to bedrock where possible. DPL1 to DPL9 were advanced to refusal depth.

Table 2 below indicates the depth to which the DPL tests were undertaken. The results of the DPL test, comprising plots of blow count per 300mm advance and inferred consistency against depth are provided in Appendix B.

Table 2
Summary of DPL Test Results

DPL No.	GPS Coordinates (WGS84)		Depth (mbegl)	Comments
	19 Y	X		
DPL1	0017838	3747151	0.90	Loose to 0.3m, medium dense to 0.9m. Refusal
DPL2	0017820	3747308	0.60	Dense to 0.3m, very stiff to 0.6m. Refusal
DPL3	0017704	3747564	0.60	Dense to 0.3m, very stiff to 0.6m. Refusal
DPL4	0017562	3747659	2.10	Dense to 0.3m, stiff to 0.6m, firm to 1.2m, stiff to 2.1m. Refusal
DPL5	0017329	3747440	0.30	Dense to 0.3m. Refusal
DPL6	0017458	3747085	0.60	Very dense to 0.3m. Refusal
DPL7	0017635	3747169	1.20	Medium dense to 1.3m, dense to 0.9m, very dense to 1.2m. Refusal
DPL8	0017493	3747455	2.40	Dense to 0.3m, firm to 1.2m, stiff to 1.5m, dense to 1.8, very stiff to 2.1, stiff to 2.4. Refusal
DPL9	0017283	3747239	1.50	Dense to 0.3m, stiff to 0.6m, firm to 0.9m, stiff to 1.5m. Refusal

5. REGIONAL GEOLOGY

The regional geology of the area is shown in the extract presented in Figure 3 and taken from the 1:250 000 Cape Town 3318 geological map prepared by the Council for Geosciences.

The regional geology consists of;

- Loam and Sandy Loam, Quaternary, overlying
- Greywacke, phyllite and quartzitic sandstone with interbedded lava and tuff of the Tygerberg Formation, Malmesbury Group.
- Granite Plutons comprising mainly coarse grained porphyritic with porphyritic biotite, fine grained leucocratic, hybridic and medium grained tourmaline-bearing variants outcrop towards the east of the site.

5.1 Site Geology

The site is underlain by a mantle of colluvial soils overlying the weathered shales of the Tygerberg Formation of the Malmesbury Group which is the older of the formations mentioned.

The site is overlain, **in the north** by a soil mantle comprising, from ground surface, cream brown loose to dense to very dense fine grained calcareous SAND or SAND with plant roots over the top 0.4m to 0.7m, overlying;

- Cream to grey brown medium dense to dense weakly cemented to cemented CALCRETE overlying;
- Grey brown to olive brown stiff to very stiff slightly shattered sandy CLAY, overlying;
- Light grey highly to medium weathered widely jointed medium hard to hard rock SANDSTONE. The sandstone was not exposed in any of the other trial holes.

In the south, at trial pit TP4 the clay was underlain by olive brown medium dense to dense intact fine to medium grained SAND which was interpreted as being residual sandstone.

In the east, at trial pit TP5 the site is overlain by light grey dense intact SAND with tree roots over the top 0.40m overlying;

- Light grey firm shattered sandy CLAY overlying
- Olive brown to grey brown to light grey to dark grey dense to very dense gravelly SAND.

At Trial Pits TP6, TP8 and TP9 the site is underlain by dense to very dense SAND with tree roots overlying;

- Light cream grey to light olive brown stiff to very stiff intact CLAY. Trial Pit TP8 had a narrow 0.20m layer of medium grained gravelly SAND within the clay profile.

6. GROUNDWATER

Groundwater was not encountered in any of the trial pits, however, water ingress into excavations may be expected if the construction takes place during the normally wet winter months and after heavy rainfall.

7. LABORATORY TESTING

7.1 Materials Usage

In order to classify materials and to assess their suitability for a cemetery development the following laboratory testing was conducted on soils taken from the trial pits.

- Foundation Indicator Tests to determine Atterberg Limits, Particle Size Distribution and clay activity.
- Permeability Tests to determine soil permeability.
- In-Situ Permeability tests to determine in-situ soil permeability.

The results of the laboratory and in-situ tests are provided in Appendix C and summarised in Table 3 and 4 below.

Table 3
Summary of Results of Particle Size Distribution Analysis and Atterberg Limit Determinations

TP No.	Depth (m)	Description	Particle Size %				Atterberg Limits			GM	Classification
			Clay	Silt	Sand	Gravel	LL	PI	LS %		
TP1	0.30-0.50	Dry light brown to cream brown loose intact fine grained calcareous SAND. Colluvium	5	6	88	1	0	NP	0	1.11	A-3(0); SW; Low heave; Type B Gravel Wearing Course
	1.60-1.90	Slightly moist olive brown stiff to very stiff slightly shattered sandy CLAY	31	3	61	4	23	11	6.0	0.89	A-2-6(0); SL; Medium heave; Type D Gravel Wearing Course
TP4	0.60-2.40	Slightly moist grey brown firm to stiff slightly shattered sandy CLAY	40	30	30	0	28	14	7.0	0.37	A-2-6(7); SL; High heave; Type D Gravel Wearing Course

LL - Liquid Limit
PI - Plasticity Index
LS - Linear Shrinkage

GM - Grading Modulus

Classification in Terms of:

USPRA²
Unified Soil Classification System³
D.H. Van Der Merwe (1964)⁴
TRH14 (1985)⁵
TRH20 (1990), Suitability for gravel wearing course⁶
Type A Erodible materials
Type B Ravels & corrugates
Type C Ravels
Type D Slippery when wet
Type E Good but may be dusty

² US Public Roads Administration Classification (Modified from Allen 1945)

³ ASTM D 2487-06 Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System), June 2006

⁴ D.H. Van Der Merwe (1964), The Prediction of Heave from the Plasticity Index and Percentage Clay Fraction of Soils. The Civil Engineer, pp 103-107

⁵ TRH 14 (1985) - Guidelines for Road Construction Materials; Technical Recommendations for Highways, South African National Institute for Transport and Road Research

⁶ TRH 20 (1990) - The Structural Design, Construction and Maintenance of Unpaved Roads, Committee of State Road Authorities

**Table 4
Summary of Results of Permeability Testing**

TP No.	Depth (m)	Description	Test Type	Permeability k(cm/s)	Result ⁷
TP1	0.00-0.70	Dry light brown to cream brown loose intact fine grained calcareous SAND. Colluvium	In-situ Permeability	2.18E-01	Porous
	0.70-0.90	Dry cream to grey brown medium dense to dense weakly cemented to cemented CALCRETE. Pedogenic	Falling Head Permeability*	1.76E-07	Impervious
	1.60-1.90	Slightly moist olive brown stiff to very stiff slightly shattered sandy CLAY. Colluvium	Falling Head Permeability*	2.37E-06	Impervious
TP4	0.70-0.80	Slightly moist grey brown firm to stiff slightly shattered sandy CLAY. Colluvium	In-situ Permeability	4.42E-03	Semi pervious
TP7	0.20-0.40	Dry light grey to cream grey medium dense to dense intact fine to medium grained SAND. Colluvium	In-situ Permeability	2.15E-01	Porous
TP8	0.57-	Slightly moist dark grey brown firm to stiff slightly shattered CLAY. Colluvium	In-situ Permeability	9.29E-03	Semi pervious

*Note: Test carried out on material compacted to 95% MDD

⁷ Williams 1993 in Stapelberg FDJ 2005, The Engineering Geology of Cape Town and Environs, Western Cape South Africa.

7.2 Permeability Evaluation

The materials underlying the site have been classified in terms of their permeability characteristics. The results are shown in Table 4 above.

The calcrete and sandy clay found in the soil profiles at trial Pits TP1 are found to be impervious while the clay tested in TP4 and TP8 is found to be semi pervious. The calcareous sand found at surface in Trial Pit TP1 is porous as expected. The fine to medium grained sand at 0.20m in TP7 is also porous.

8. DEPARTMENT OF WATER AFFAIRS AND FORESTRY (DWAF) REQUIREMENTS

The DWAF requirements with regards to the siting of cemeteries are that the following areas⁸ should be avoided:

8.1 Below the 1 in 50 year flood line of a river

If the very small drainage line on the west side of the site and the extreme edge of the site on the east side where it is in close proximity to the Plankenburgrivier are avoided this requirement will be met.

8.2 In close proximity to water bodies such as wetlands, vleis, pans and floodplains

While there are small areas which could become vleis in wet years, notably in the north-west where a 140m furrow channels water from the neighbouring farmland in the north onto the site, (Plates 3 and 4), the bulk of the proposed area will comply if the area bounded by the drainage line in the west is avoided.



Plate 4: View towards the north along furrow

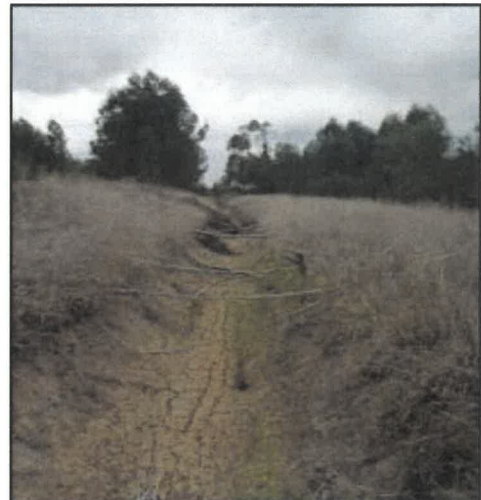


Plate 5: View towards the south along furrow

8.3 Situated in unstable areas

As there are no fault zones, seismic zones, dolomite or cast areas on the site, sinkholes and ground subsidence related to unstable geological conditions are unlikely

8.4 Sensitive ecological areas

The area is a eucalyptus plantation which was harvested in the past and has regrown. The regrowth is now interspersed with Port Jackson Willow. There is this no ecological impact on the site by the proposed cemetery in this regard.

⁸ National Water Act No 36 of 1998. Sections 22(3) and 22(4).

8.5 Areas with flat gradients with shallow or emergent groundwater

The site slopes gently to the south west (approximately at 3.9%) and south east (approximately at 6%) with a spur of higher ground trending in a north - south direction between the two slopes. No groundwater was intersected in any of the trial pits (Figure 4).

8.6 Areas characterised by steep gradients or shallow bedrock with little soil cover

As mentioned, the site slopes gently to the south west and south east at approximately 3.9% and 6% respectively (Figure 4). Bedrock was intersected in Trial Pit TP1 only, at 2.20m begl. This area will be avoided as it falls fairly close to the small drainage line in the west. Trial pit TP7 refused on ferricrete at a depth of 2.20m having intersected the ferricrete from a depth of 1.50m. All the other trial pits were terminated at between 2.8m and 3.40mbgl without exposing any rock.

The Stellenbosch Municipality Bye-Laws pertaining to Burial Parks and Cemeteries⁹ defines a grave as being 1.80m deep. Bye-Law 2.9(a) states that after a coffin is covered it rests at least 1.00m below the ground surface. This implies that the grave depth should not be shallower than 1.80m from surface. This criteria is met over the area proposed for the cemetery (Figure 4).

8.7 Areas of groundwater recharge on account of topography and/or highly permeable soils

Impervious and semi pervious calcrete and clay layers in the upper soil profile will limit the groundwater recharge capability. These conditions may lead to a shallow perched water table in the normally wet winter months or periods of high rainfall.

8.8 Areas overlaying or adjacent to important aquifers where these are to be used for water supply purposes

The area is classified as a Minor Aquifer¹⁰ and as a result complies.

9. BOREHOLES AND DOMESTIC WATER SOURCES

There are no boreholes on the site. The position of the boreholes on the neighbouring farms are shown in Figure 2. Table 5 summarises the details

**Table 5
Summary of Borehole Details**

TP No.	GPS Coordinates (WGS84)		Depth (mbegl)	Distance from cemetery site	Yield (litres/hr)	Comments
	19 Y	X				
BH1	0018102	3747633	40.0m	350	4000	Water quality poor. Brak. Unfit for domestic consumption
BH2	0018053	3747731	40.0m	340	3000	Water quality poor. Brak. Unfit for domestic consumption
BH3	0018149	3747800	40.0m	450	4000	Water quality poor. Brak. Unfit for domestic consumption
BH4	0018088	3747706	40.0m	350	4000	Water quality poor. Brak. Unfit for domestic consumption
BH5*	0018044	3748365	40m-50m	650	3000 to 4000	Water quality poor. Brak. Unfit for domestic consumption
BH6*	00178858	3748519	40m-50m	670	3000 to 4000	Water quality poor. Brak. Unfit for domestic consumption
BH7*	0017990	3748451	40m-50m	660	3000 to 4000	Water quality poor. Brak. Unfit for domestic consumption

* Estimated positions and information

⁹ Stellenbosch Municipality, Burial Parks / Cemeteries By -Laws 2007

¹⁰ Aquifer Classification of South Africa. Department of Water Affairs 2012

The borehole information was obtained by personal communication from Mr Arambo Baschiera, the land owner on which boreholes BH1 to BH4 are located. Borehole depths are approximately 40m below ground level. The water quality is poor and is therefore not suitable for domestic consumption or the irrigation of agricultural crops with the exception of grass pastures. Municipal water is supplied to the properties. All the boreholes are further than 300m from the site (Table 5). The area proposed for the cemetery has impervious and semi -pervious clay in the profile and leachate migration will therefore be limited.

10. DEVELOPMENT RECOMMENDATIONS

10.1 Proposed Cemetery

The proposed cemetery will comprise a memorial park with cemetery areas, remembrance wall and park areas with trees and grass.

10.2 Grave Excavations

As a general observation the insitu materials to a maximum depth of between 2.80m and 3.4m below existing ground level, as determined by trial pit excavations and DPL tests, will classify as Soft Excavation (SABS1200 DM). The area at trial pits TP1 and TP7 will classify as Hard Excavation in the sandstone and ferricrete below a level of 2.00m and 2.20m respectively, below ground level. The area around these trial pits has however been excluded from the proposed site because of the drainage line in the west and hard rock ferricrete in the profile with regards TP7 (Figure 4).

Sidewall collapse was not observed in any of the trial pits put down and it is therefore assumed that grave excavations will stay open for a reasonable length of time. It must be noted that when the soils are wet by precipitation or otherwise, sidewall collapse is possible. Provided the grave excavation is stable when formed and no groundwater is present, the stand-up time for the sidewalls should be taken as maximum 24 hours, however this would need to be monitored over this period by the grave diggers in the event that rainfall could saturate the soils and cause collapse.

10.3 Leachate Migration

The western part of the site, from trial holes TP1 to TP4 and TP7 will not be included in the proposed cemetery site because of the proximity to the small drainage line in the west and the ferricrete in the profile in TP7 (Figure 4).

Trial pit TP4 indicates a clay layer down to 2.40m below ground level and then sand to 3.00m. Therefore, if the grave depth is deeper than 2.40m leachate will migrate in the sand. Trial Pit TP5, indicates gravelly sand down to 2.80m. Leachate migration may therefore be problematic as it could flow downslope in the sand and find its way into the Plankenburghrivier which flows towards the south through Stellenbosch joining the Eersterivier on the southern side of the town. TP6, TP8 and TP9 Indicate clay in the profile which would limit the leachate migration.

The area suitable for the proposed cemetery site would therefore be limited to approximately the east side of a line joining TP4 and TP7 and excluding the area around TP5. This approximate area is shown in the shaded area in Figure 4.

10.4 Basal Buffer Zone

No water was intersected in any of the trial pits put down. The depth to the water table is therefore unknown. The requirement that the basal buffer zone of 2.5m between grave and water table is met but it should be noted that this investigation was carried out during a severe drought and that in times of winter rain or heavy rain fall, the water table may be present at shallower depths.

10.5 Soil Workability

The sands in the profile will compact without difficulty on return to the grave whereas the clays will be more difficult to compact. Compaction will generally consist of the tamping of the soils backfilled in layers by use of the excavator bucket. A maximum compaction of about 90% could be expected by this method. Allowance is always made therefore for the subsidence of the grave backfill and subsequent releveling before any memorial structure of tombstone is constructed over the grave.

10.6 Slope

As mentioned earlier, the surface slopes over the site range from approximately 3.9% to 6.0% and are therefore suitable for cemetery construction. This slope is considered ideal for encouraging surface drainage and will facilitate stormwater runoff management.

11. RATING OF CEMETERY ATTRIBUTES

Since a large degree of research was conducted by several geotechnical consultants^{11; 12} over the period 1990 to 2005 on the siting of cemeteries the rating of a cemetery site in terms of selected attributes is normally carried out and provides a useful guideline for planning.

The attributes used for cemetery rating are the following:

- Excavatability
- Grave stability
- Soil workability
- Groundwater
- Soil permeability, and
- Backfill Permeability

The above attributes are each further subdivided into graduations with rating values assigned to each. The site attributes are then scored against the rating values given in Tables 1 through Table 6 in Appendix D. A total rating score for the site is obtained and compared with the Site Suitability Rating in Table 6 below.

**Table 6
Site Suitability Rating**

Rating Total Score	Site Suitability Rating
>90	Very good
75 to 90	Satisfactory
60 to 75	Poor – precautions needed
<60	Unacceptable

In terms of the ratings, the following scores are determined for the cemetery site:

Attribute	Score
Excavatability	12
Grave stability	20
Soil workability	3
Groundwater	10
Subsoil permeability	20
Backfill permeability	10
Total Score	75

Therefore, in terms of the ratings of the site attributes, the site is assessed as being marginally **satisfactory** for use as a Cemetery site. The site is therefore considered generally suitable for its intended use as a cemetery provided the recommendations in this report are adhered to.

¹¹ Hall, B. & Hanbury, R (1990) Some Geotechnical Considerations in the Selection of Cemetery Sites. IMIESA March 1990.

¹² Welland, A.M and Venter, J.P (1997). Guidelines for the Investigation of Cemetery Sites: Adaptation of "Minimum Requirements for Waste Disposal by Landfill" Applicable to Cemetery Site Investigations. Prepared by BKS (Pty); Report No 108/568; project reference P412680.

12. CONCLUSION

This report presents the results of the geotechnical investigation conducted for the proposed new cemetery at the Culcatta site in the Stellenbosch Municipal area.

The site is underlain by a soil mantle comprising, from ground surface, loose to dense sands of colluvial origin overlying sandy clay, gravelly sand, sand and clay horizons. Two of the trial pits intersected pedogenic ferricrete and calcrete layers while sandstone of the Tygerberg Formation Malmesbury Group was indicated at depth in one of the trial pits.

The DWAF and Stellenbosch Municipality By-Laws, requirements for the siting of cemeteries are met, however the anticipated porosity of the sands in the profile could lead to leachate migration into the upper Plankenburgrivier unless the cemetery is sited as proposed and shown in Figure 4. Therefore, the area recommended for the location of the cemetery limited to approximately the east side of a line joining TP4 and TP7 and excluding the area around TP5. This approximate area is shown in the shaded area in Figure 4.

The cemetery site was rated in terms of the attribute rankings and a score of 75 obtained. This indicates that in terms of the **Site Suitability Rating Index**, the site is considered **satisfactory** for development as a cemetery.

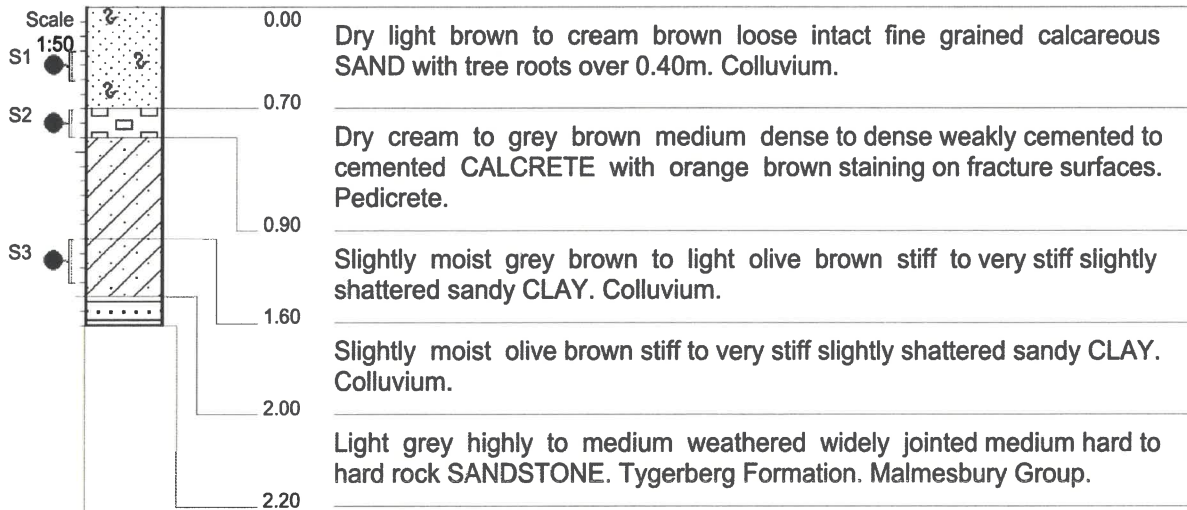
In conclusion, the information and recommendations provided in this report relates to the location of the trial holes and DPL tests put down on site. It is quite possible that variations to the ground conditions will be encountered elsewhere on the site during construction. Therefore, it is recommended that GGS be appointed to carry out periodic inspections on the earthworks and foundation excavations during construction to confirm the recommendations given in this report.

APPENDIX A

Geotechnical Investigation for the Culcatta Cemetery Site, Stellenbosch,
Western Cape.

Path : C:\Users\Merrill\Desktop\Job Folders\1. Cape Town jobs\18-811 Culcatta Cemetery\Report\App A cover page.docx





NOTES

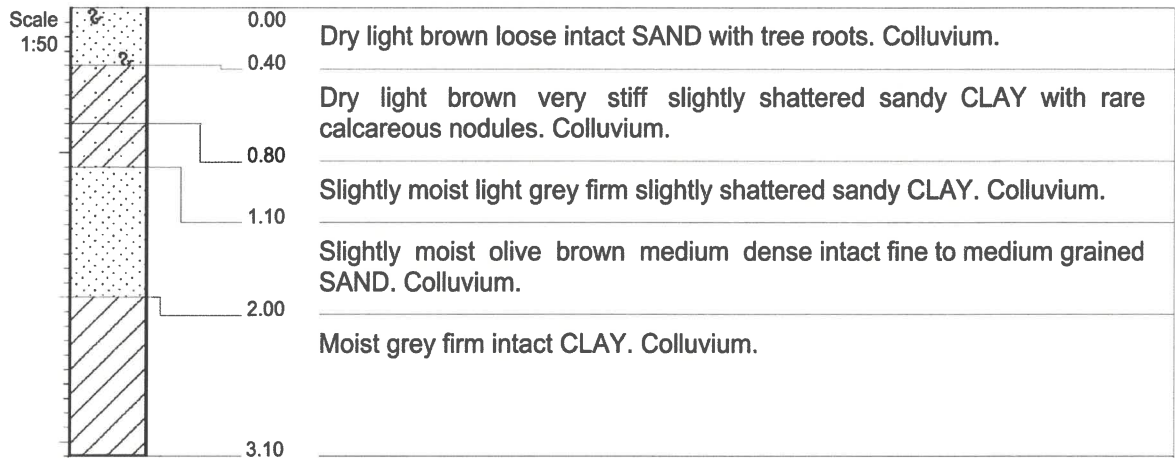
- 1) Refusal depth at 2.20m.
- 2) No groundwater seepage.
- 3) No sidewall collapse.
- 4) Samples taken :
S1 0.30--0.50m
S2 0.70--0.90m
S3 1.60--1.90m



CONTRACTOR :
MACHINE : JCB3CX
DRILLED BY :
PROFILED BY : CLH

INCLINATION :
DIAM :
DATE : 12/04/2018
DATE : 12/04/2018
DATE : 30/04/2018 07:52
TEXT : ..Cemetery\Logs\TP1TP5.doc

ELEVATION :
X-COORD : 3747151
Y-COORD : 19Y 0017838



NOTES

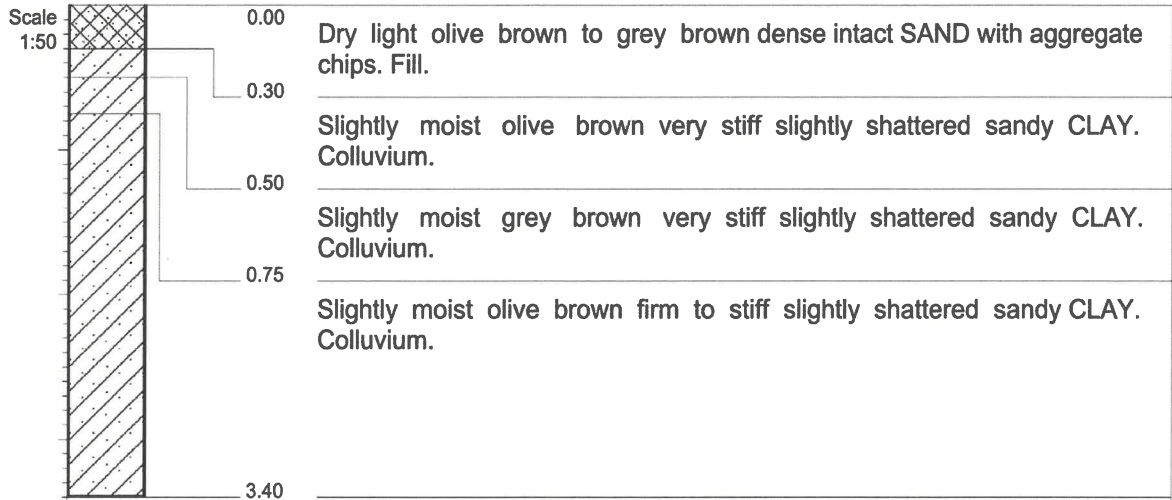
- 1) Final depth at 3.10m. TLB limit.
- 2) No groundwater seepage.
- 3) No sidewall collapse.
- 4) No samples taken.



CONTRACTOR :
MACHINE : JCB3CX
DRILLED BY :
PROFILED BY : CLH
TYPE SET BY : MC
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE : 12/04/2018
DATE : 12/04/2018
DATE : 30/04/2018 07:52
TEXT : ..Cemetery\Logs\TP1TP5.doc

ELEVATION :
X-COORD : 3747308
Y-COORD : 19Y 0017820



NOTES

- 1) Final depth at 3.40m. TLB limit.
- 2) No groundwater seepage.
- 3) No sidewall collapse.
- 4) No samples taken.

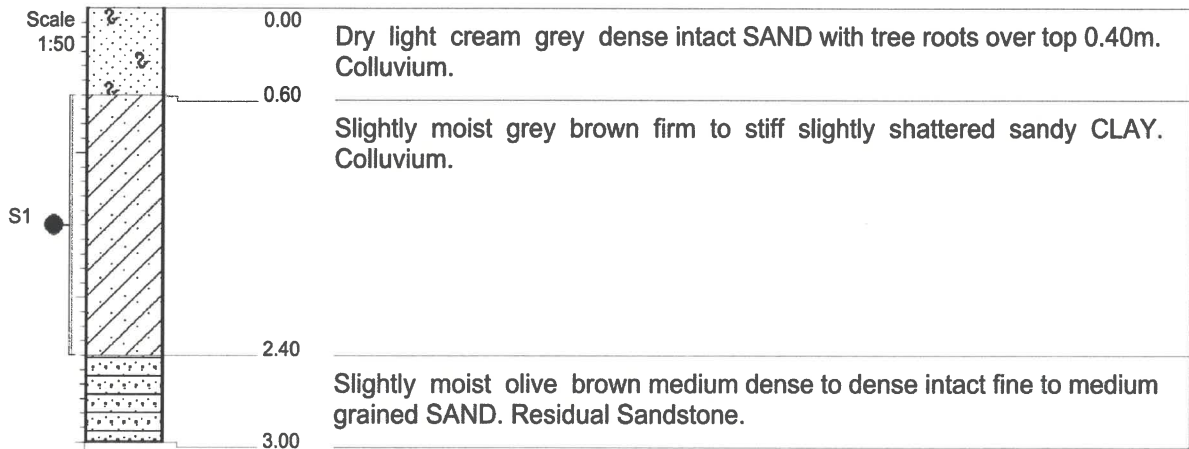


CONTRACTOR :
 MACHINE : JCB3CX
 DRILLED BY :
 PROFILED BY : CLH
 TYPE SET BY : MC
 SETUP FILE : STANDARD.SET

INCLINATION :
 DIAM :
 DATE : 12/04/2018
 DATE : 12/04/2018
 DATE : 30/04/2018 07:52
 TEXT : ..Cemetery\Logs\TP1TP5.doc

ELEVATION :
 X-COORD : 3747564
 Y-COORD : 19Y 0017704

HOLE No: TP3



NOTES

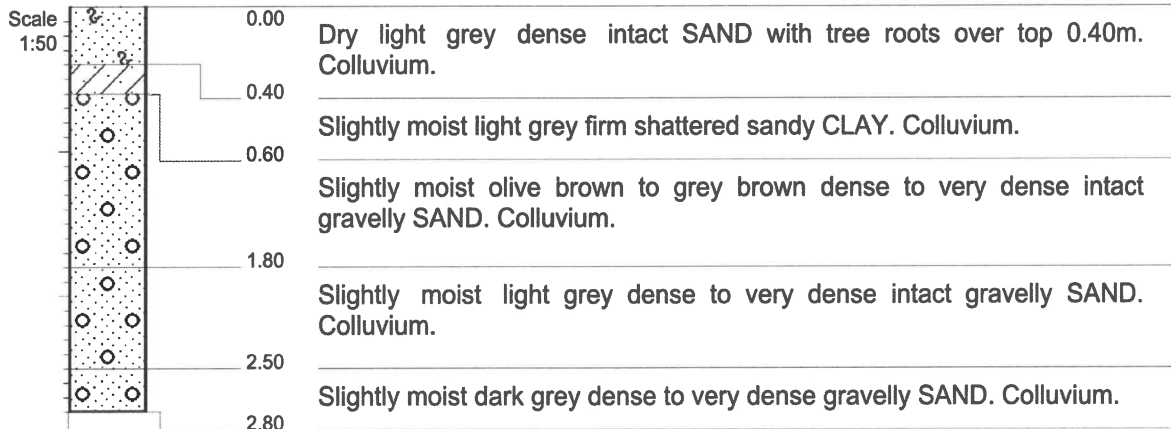
- 1) Final depth at 3.00m. TLB limit.
- 2) No groundwater seepage.
- 3) No sidewall collapse.
- 4) Samples taken :
S1 0.60--2.40m



CONTRACTOR :
MACHINE : JCB3CX
DRILLED BY :
PROFILED BY : CLH
TYPE SET BY : MC
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE : 12/04/2018
DATE : 12/04/2018
DATE : 30/04/2018 07:52
TEXT : ..Cemetery\Logs\TP1TP5.doc

ELEVATION :
X-COORD : 3747659
Y-COORD : 19Y 0017562



NOTES

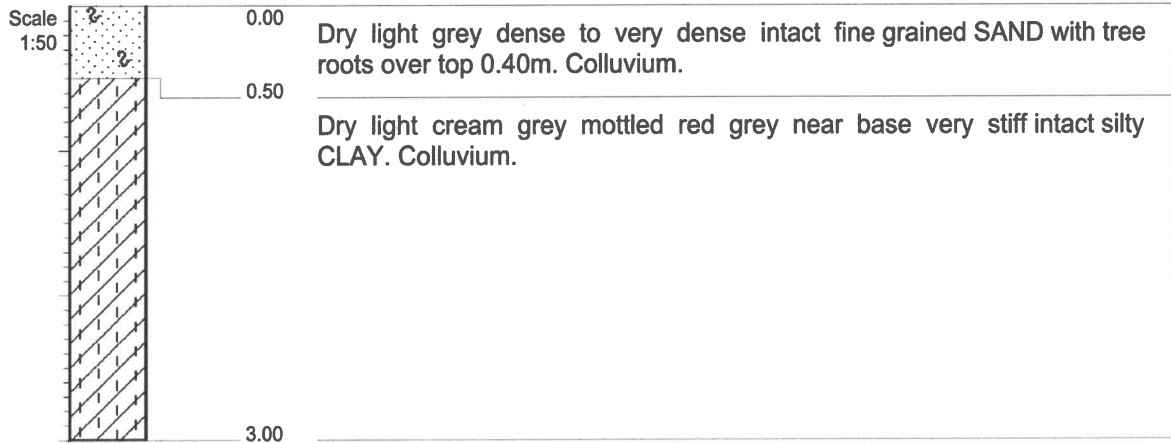
- 1) Final depth at 2.80m. TLB limit.
- 2) No groundwater seepage.
- 3) No sidewall collapse.
- 4) No samples taken.



CONTRACTOR :
MACHINE : JCB3CX
DRILLED BY :
PROFILED BY : CLH
TYPE SET BY : MC
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE : 12/04/2018
DATE : 12/04/2018
DATE : 30/04/2018 07:52
TEXT : ..Cemetery\Logs\TP1TP5.doc

ELEVATION :
X-COORD : 3747440
Y-COORD : 19Y 0017329



NOTES

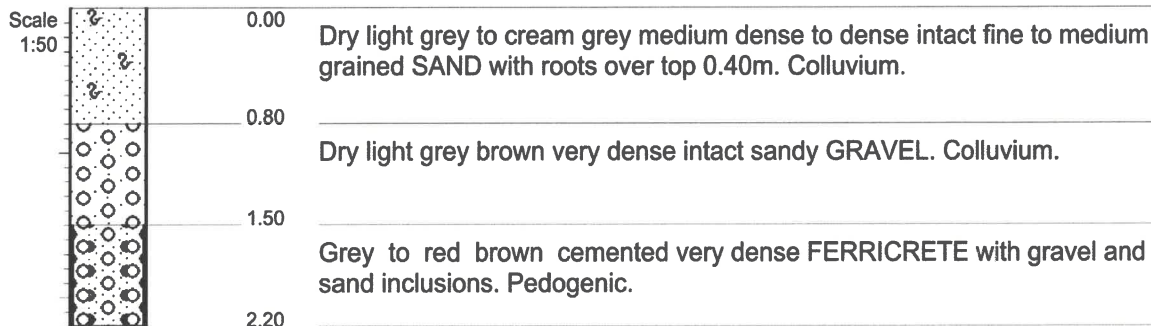
- 1) Final depth at 3.00m. TLB limit.
- 2) No groundwater seepage.
- 3) No sidewall collapse.
- 4) No samples taken.



CONTRACTOR :
MACHINE : JCB3CX
DRILLED BY :
PROFILED BY : CLH
TYPE SET BY : MC
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE : 04/05/2018
DATE : 04/05/2018
DATE : 07/05/2018 08:36
TEXT : ..Cemetery/Logs/TP1TP5.doc

ELEVATION :
X-COORD : 3747085
Y-COORD : 19Y 0017458



NOTES

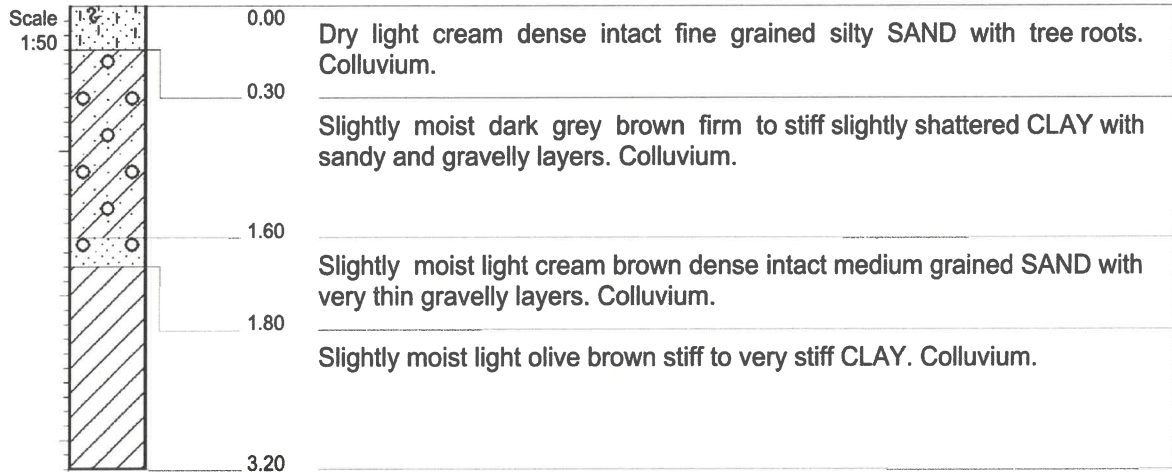
- 1) Refusal depth at 2.20m.
- 2) No groundwater seepage.
- 3) No sidewall collapse.
- 4) No samples taken.



CONTRACTOR :
MACHINE : JCB3CX
DRILLED BY :
PROFILED BY : CLH
TYPE SET BY : MC
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE : 04/05/2018
DATE : 04/05/2018
DATE : 07/05/2018 08:36
TEXT : ..Cemetery/Logs/TP1TP5.doc

ELEVATION :
X-COORD : 3747169
Y-COORD : 19Y 0017635



NOTES

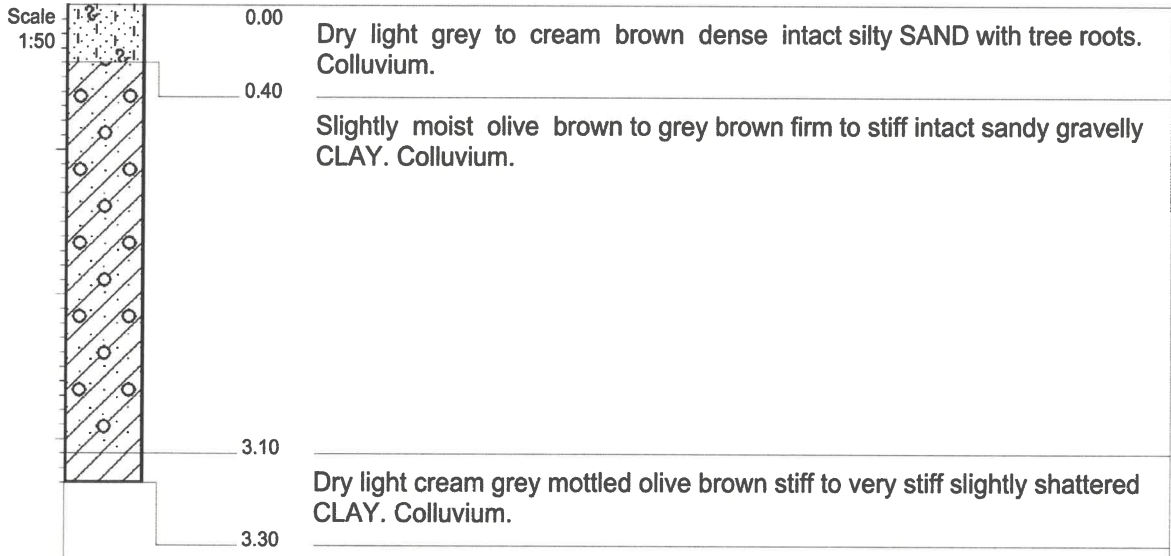
- 1) Final depth at 3.20m. TLB limit.
- 2) No groundwater seepage.
- 3) No sidewall collapse.
- 4) No samples taken.



CONTRACTOR :
MACHINE : JCB3CX
DRILLED BY :
PROFILED BY : CLH
TYPE SET BY : MC
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE : 04/05/2018
DATE : 04/05/2018
DATE : 07/05/2018 08:36
TEXT : ..Cemetery\Logs\TP1TP5.doc

ELEVATION :
X-COORD : 3747455
Y-COORD : 19Y 0017493



NOTES

- 1) Final depth at 3.30m. TLB limit.
- 2) No groundwater seepage.
- 3) No sidewall collapse.
- 4) No samples taken.



CONTRACTOR :
MACHINE : JCB3CX
DRILLED BY :
PROFILED BY : CLH

TYPE SET BY : MC
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE : 04/05/2018
DATE : 04/05/2018

DATE : 07/05/2018 08:36
TEXT : ..Cemetery\Logs\TP1TP5.doc

ELEVATION :
X-COORD : 3747239
Y-COORD : 19Y 0017283

HOLE No: **TP9**

APPENDIX B

Geotechnical Investigation for the Culcatta Cemetery Site, Stellenbosch,
Western Cape.

Path : C:\Users\Merrill\Desktop\Job Folders\1. Cape Town jobs\18-811 Culcatta Cemetery\Report\Appendix B cover page.docx





Consulting Geotechnical Engineers & Engineering Geologists

Office: 11, Seaside Road, Cape Town
 Cape Town, South Africa
 Tel: +27 (0) 21 461 8144
 Email: info@geotechnical.co.za

Cape Town: 11, Seaside Road, Cape Town
 Cape Town, South Africa
 Tel: +27 (0) 21 461 8144
 Email: info@geotechnical.co.za

Client: CK RUMBOLL & PARTNERS
 Project: Culcatta Cemetery
 Section:

Ref.No. 18-811
 Date: 12/4/2018
 Operator: CH

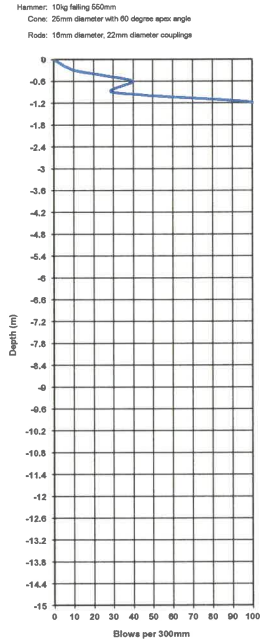
Light Dynamic Penetrometer Probe — Test No. DPL 1

Light Dynamic Penetrometer Probe — Test No. DPL 2

Light Dynamic Penetrometer Probe — Test No. DPL 3

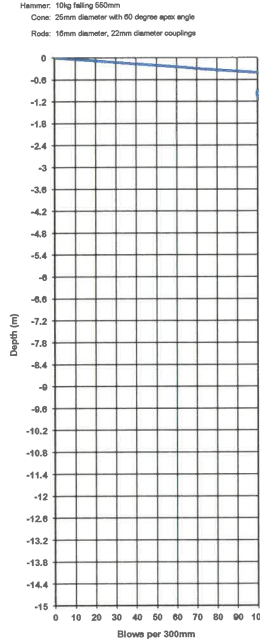
THE INSITU STRENGTH DEPENDS ON SOIL MOISTURE CONTENT AND GRAIN STRUCTURE WHICH HAVE NOT BEEN ASSESSED AND MAY CHANGE. THE VALUES GIVEN ARE THEREFORE INDICATIVE ONLY AND SHOULD BE VERIFIED BY TEST OR OBSERVATION

Depth metres	Blows per 300mm	Inferred Consistency
0	11	Loose
0.3	40	Med Dense
0.6	30	Med Dense
0.9	Ref	



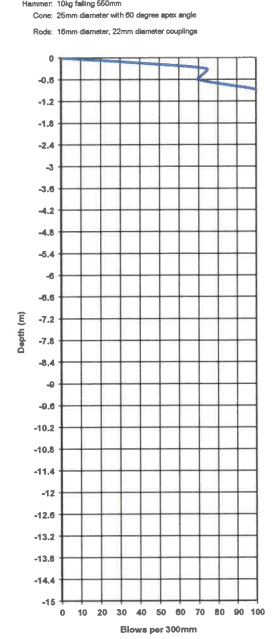
C=1
Phi=0

Depth metres	Blows per 300mm	Inferred Consistency
0	71	Dense
0.3	132	Very Stiff
0.6	Ref	



C=1
Phi=0

Depth metres	Blows per 300mm	Inferred Consistency
0	74	Dense
0.3	70	Very Stiff
0.6	Ref	





Consulting Geotechnical Engineers & Engineering Geologists

20th Floor
14, Riverside
17, Langford Drive
Riverside, 4013
Dunedin
Fax: +7704 771 6114
Email: info@gsol.co.nz

Unit 10
12, Nelson
100, Great South Bay Avenue
Newport, Dunedin
Fax: +7704 771 6117
Email: info@gsol.co.nz

Client: CK RUMBOLL & PARTNERS
Project: Culcatta Cemetery
Section:

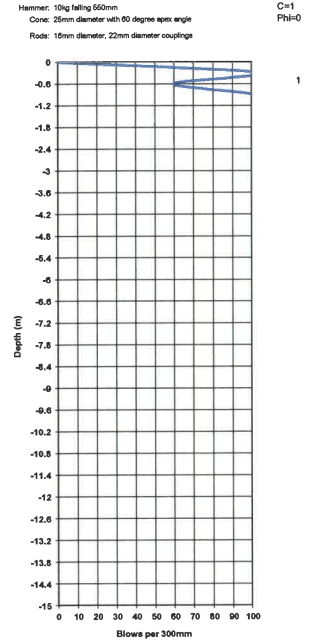
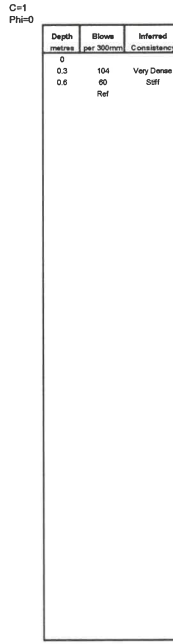
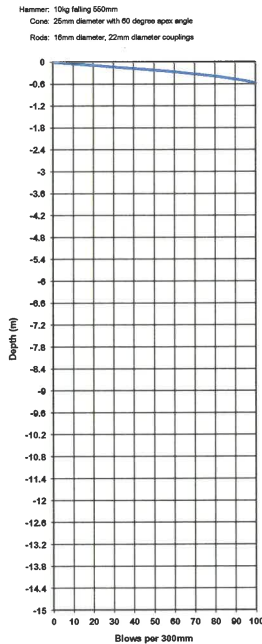
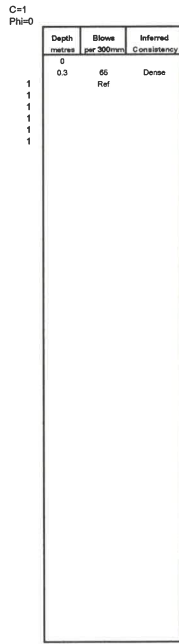
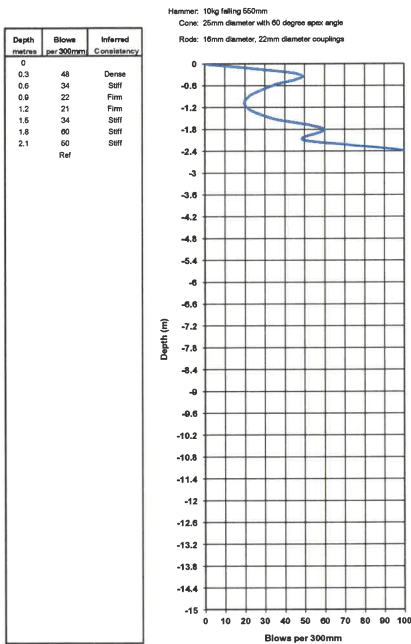
Ref.No.: 18-811
Date: 12/4/2018
Operator: CH

Light Dynamic Penetrometer Probe ——— Test No. DPL 4

Light Dynamic Penetrometer Probe ——— Test No. DPL 5

Light Dynamic Penetrometer Probe ——— Test No. DPL 6

THE INSITU STRENGTH DEPENDS ON SOIL MOISTURE CONTENT AND GRAIN STRUCTURE WHICH HAVE NOT BEEN ASSESSED AND MAY CHANGE. THE VALUES GIVEN ARE THEREFORE INDICATIVE ONLY AND SHOULD BE VERIFIED BY TEST OR OBSERVATION





Consulting Geotechnical Engineers & Engineering Geologists

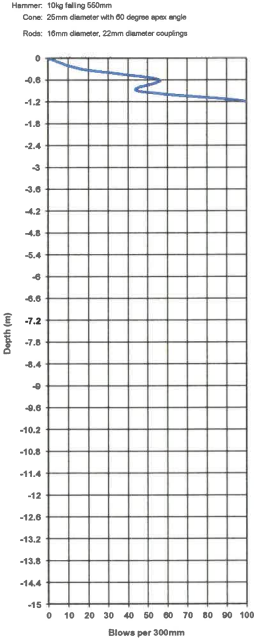
Office: 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100
 Cape Town: +27 (0) 21 551 1111
 Johannesburg: +27 (0) 11 551 1111
 Durban: +27 (0) 31 551 1111
 Email: info@gondwana.co.za

Client: **CK RUMBOLL & PARTNERS** Ref.No. 18-811
 Project: **Culcatta Cemetery** Date: 12/4/2018
 Section: Operator: CH

Light Dynamic Penetrometer Probe ——— Test No. DPL 7 Light Dynamic Penetrometer Probe ——— Test No. DPL 8 Light Dynamic Penetrometer Probe ——— Test No. DPL 9

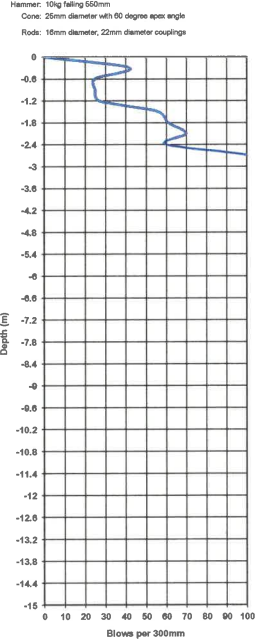
THE INSITU STRENGTH DEPENDS ON SOIL MOISTURE CONTENT AND GRAIN STRUCTURE WHICH HAVE NOT BEEN ASSESSED AND MAY CHANGE. THE VALUES GIVEN ARE THEREFORE INDICATIVE ONLY AND SHOULD BE VERIFIED BY TEST OR OBSERVATION

Depth metres	Blows per 300mm	Inferred Consistency
0		
0.3	17	Mod Dense
0.6	66	Dense
0.9	46	Dense
1.2	100	Very Dense
		Ref



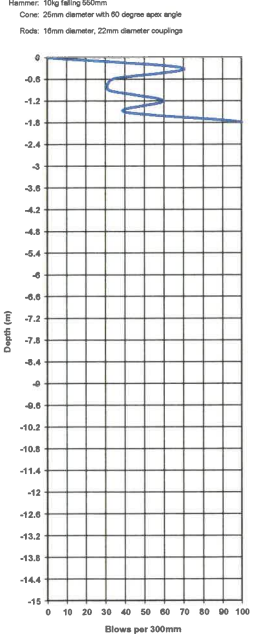
C=1
Phi=0

Depth metres	Blows per 300mm	Inferred Consistency
0		
0.3	42	Dense
0.6	25	Firm
0.9	26	Firm
1.2	37	Firm
1.6	66	Stiff
1.8	61	Dense
2.1	70	Very Stiff
2.4	60	Stiff
		Ref



C=1
Phi=0

Depth metres	Blows per 300mm	Inferred Consistency
0		
0.3	70	Dense
0.6	34	Stiff
0.9	32	Firm
1.2	60	Stiff
1.5	40	Stiff
		Ref



APPENDIX C

Geotechnical Investigation for the Culcatta Cemetery Site, Stellenbosch,
Western Cape.

Path : C:\Users\Merrill\Desktop\Job Folders\1. Cape Town jobs\18-811 Culcatta Cemetery\Report\App C cover page.docx



CLIENT: Gondwana Geo Solutions
108 Upper Kenridge Avenue
Durbanville
7550

PROJECT: Culcatta Cemetry

DATE: 20-04-2018
REF: L180428

ATT: Colin Hatrley

ASTM D422 SIEVE ANALYSIS

DESCRIPTION : light brown calcareous sand
POSITION : TP 01 @ 0.30-0.50m

SAMPLE NO. : 30322
CLIENT SAMPLE NO. :

Sieve Analysis	Percent Passing
75,00	
63,00	
53,00	
37,50	
26,50	
19,00	100
13,20	99
9,50	99
6,70	99
4,75	99
2,36	99
2,00	99
1,18	98
0,600	93
0,425	79
0,300	52
0,150	21
0,0750	11

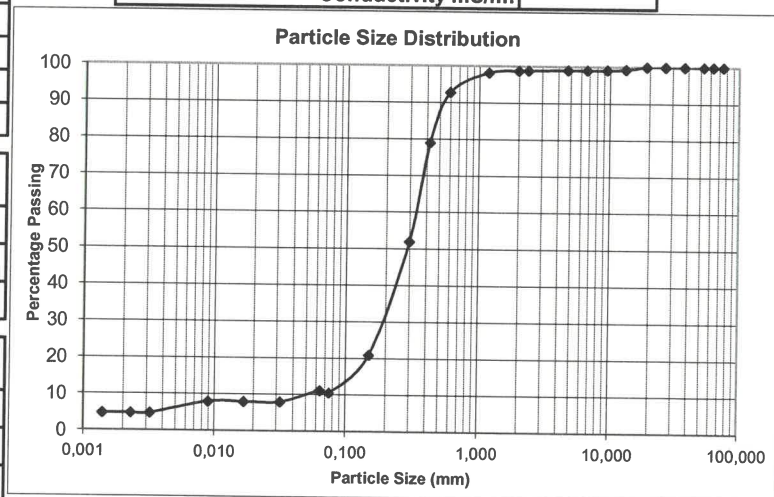
Hydrometer Analysis	
Diameter of particle (mm)	Percentage of soil suspension (%)
0,0760	11
0,0384	8
0,0192	8
0,0099	8
0,0035	5
0,0024	5
0,0014	5

SCS Dispersion Test	
Diameter of particle (mm)	Percentage of soil suspension (%)

% SCS Dispersion:	
Initial Moisture Content (%) :	
pH:	
Conductivity mS/m:	

Atterberg Limits :	
Liquid Limit	
Plastic Index	N-P
Linear Shrinkage	

MOD AASHTO ; C.B.R. :	
MOD AASHTO (Kg/m ³)	
O.M.C. (%)	
C.B.R. @ 100% Comp.	
C.B.R. @ 98 % Comp.	
C.B.R. @ 95 % Comp.	
C.B.R. @ 93 % Comp.	
C.B.R. @ 90 % Comp.	
Swell (max) %	



Tabulated Summary	Percentage
Gravel : Percentage - 4.75 mm	1
Sand : Percentage - 4.75mm and + 0.075mm	88
Silt : Percentage - 0.075mm and + 0.002mm	6
Clay : Percentage - 0.002mm	5

The above test results are pertinent to the samples received and tested only.
While the tests are carried out according to recognized standards Geoscience shall not be liable for erroneous testing or reporting thereof. This report may not be reproduced except in full without prior consent of Geoscience.

For Geoscience:

Remarks:

ConSR22

LABORATORY TEST RESULTS

CLIENT : Gondwana Geo Solutions
PROJECT NAME : Culcatta Cemetery

admin only
JOB NO : **L180428**
SAMPLE NO : **30323**

COMPACTION MOULD PERMEAMETER

POSITION : TP 01 @ 0,720-0,90m
SOIL DESCRIPTION : grey brown cemented calcrete
PERMEANT USED : TAP WATER

SAMPLE DATA		
Standard Proctor	kg/m ³	2028
OMC	%	9,60
Percent of Proctor specified	%	95,00
Dry density of soil required	kg/m ³	1926,60
Moisture content of sample	%	9,60
Length of sample	mm	125,00
Diameter of sample	mm	150,00
Area of sample	mm ²	17671,46
Volume of sample	mm ³	2208932,33
Mass of dry soil required	g	4255,73
Mass of wet soil required	g	4664,28

ACTUAL DATA		
Mould Number		P1
Mass of Mould	g	4399
Mass of Mould and wet soil	g	9063,28
Mass of wet soil	g	4664,28
moisture content	%	9,60
Bulk Density	kg/m ³	2111,55
Dry Density	kg/m ³	1926,60
Percentage Proctor	%	95,00

Standpipe dia	mm	3,75
Standpipe area	mm ²	11,04

TEST READINGS							
Test	Start Test			End Test			Comments
	Height	Time		Height	Time		
	mm	min	sec	mm	min	sec	
1	2200			2150	16	6	
2	2200			2150	17	43	
3	2200			2150	17	9	
4	2200			2150	16	58	

CALCULATIONS FOR FALLING HEAD		
Log H1/H2	Elapsed Time	COEFFICIENT OF PERMEABILITY
0,0100	966,00	1,86E-09
0,0100	1063,00	1,69E-09
0,0100	1029,00	1,74E-09
0,0100	1018,00	1,76E-09

Number of tests = 4

AVERAGE =	1,76E-09	m/s
AVERAGE =	1,76E-07	cm/s

Notes : PROCTOR VALUE SUPPLIED

CLIENT: Gondwana Geo Solutions
108 Upper Kenridge Avenue
Durbanville
7550

PROJECT: Culcatta Cemetry

ATT: Colin Hatrley

DATE: 20-04-2018
REF: L180428

ASTM D422 SIEVE ANALYSIS

DESCRIPTION : olive brown sandy clay
POSITION : TP 01 @ 1.60-1.90m

SAMPLE NO. : 30324
CLIENT SAMPLE NO. :

Sieve Analysis	Percent Passing
75,00	
63,00	
53,00	
37,50	
26,50	
19,00	
13,20	100
9,50	99
6,70	98
4,75	96
2,36	93
2,00	93
1,18	91
0,600	89
0,425	84
0,300	71
0,150	43
0,0750	34

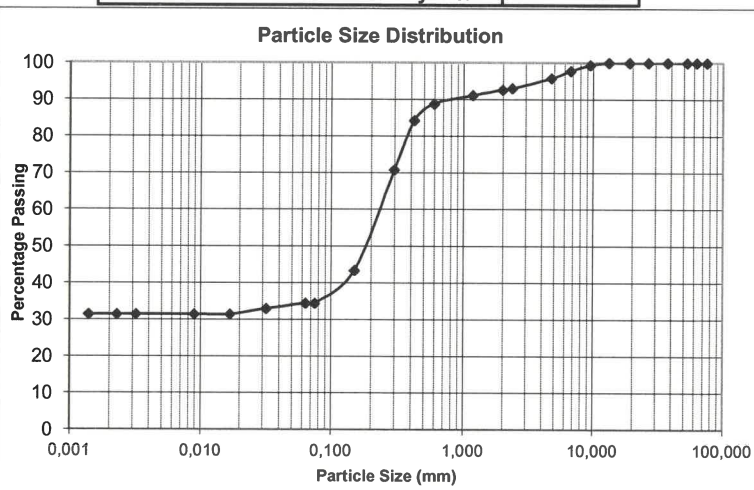
Hydrometer Analysis	
Diameter of particle (mm)	Percentage of soil suspension (%)
0,0707	34
0,0353	33
0,0179	31
0,0092	31
0,0032	31
0,0023	31
0,0013	31

SCS Dispersion Test	
Diameter of particle (mm)	Percentage of soil suspension (%)

% SCS Dispersion:	
Initial Moisture Content (%) :	
pH:	
Conductivity mS/m:	

Atterberg Limits :	
Liquid Limit	23
Plastic Index	11
Linear Shrinkage	6,0

MOD AASHTO ; C.B.R. :	
MOD AASHTO (Kg/m ³)	
O.M.C. (%)	
C.B.R. @ 100% Comp.	
C.B.R. @ 98 % Comp.	
C.B.R. @ 95 % Comp.	
C.B.R. @ 93 % Comp.	
C.B.R. @ 90 % Comp.	
Swell (max) %	



Tabulated Summary	Percentage
Gravel : Percentage - 4.75 mm	4
Sand : Percentage - 4.75mm and + 0.075mm	61
Silt : Percentage - 0.075mm and + 0.002mm	3
Clay : Percentage - 0.002mm	31

The above test results are pertinent to the samples received and tested only. For Geoscience:
While the tests are carried out according to recognized standards Geoscience shall not be liable for erroneous testing or reporting thereof. This report may not be reproduced except in full without prior consent of Geoscience.

Remarks:

ConSR22

LABORATORY TEST RESULTS

CLIENT : Gondwana Geo Solutions
PROJECT NAME : Culcatta Cemetery

admin only
JOB NO : **L180428**
SAMPLE NO : **30324**

COMPACTION MOULD PERMEAMETER

POSITION : TP 01 @ 1,60-1,90m
SOIL DESCRIPTION : olive brown sandy clay
PERMEANT USED : TAP WATER

SAMPLE DATA		
Standard Proctor	kg/m ³	1940
OMC	%	12,60
Percent of Proctor specified	%	95,00
Dry density of soil required	kg/m ³	1843,00
Moisture content of sample	%	12,60
Length of sample	mm	125,00
Diameter of sample	mm	150,00
Area of sample	mm ²	17671,46
Volume of sample	mm ³	2208932,33
Mass of dry soil required	g	4071,06
Mass of wet soil required	g	4584,02

ACTUAL DATA		
Mould Number		P3
Mass of Mould	g	4331
Mass of Mould and wet soil	g	8915,02
Mass of wet soil	g	4584,02
moisture content	%	12,60
Bulk Density	kg/m ³	2075,22
Dry Density	kg/m ³	1843,00
Percentage Proctor	%	95,00

Standpipe dia	mm	3,75
Standpipe area	mm ²	11,04

TEST READINGS							
Test	Start Test			End Test			Comments
	Height	Time		Height	Time		
	mm	min	sec	mm	min	sec	
1	2200			2150	1	6	
2	2200			2150	1	21	
3	2200			2150	1	13	
4	2200			2150	1	26	

CALCULATIONS FOR FALLING HEAD		
Log H1/H2	Elapsed Time	COEFFICIENT OF PERMEABILITY
0,0100	66,00	2,72E-08
0,0100	81,00	2,21E-08
0,0100	73,00	2,46E-08
0,0100	86,00	2,09E-08

Number of tests = 4

AVERAGE =	2,37E-08	m/s
AVERAGE =	2,37E-06	cm/s

Notes : PROCTOR VALUE SUPPLIED

CLIENT: Gondwana Geo Solutions
108 Upper Kenridge Avenue
Durbanville
7550

PROJECT: Culcatta Cemetry

ATT: Colin Hatrley

DATE: 20-04-2018

REF: L180428

ASTM D422 SIEVE ANALYSIS

DESCRIPTION : grey brown sandy clay

SAMPLE NO. : 30325

POSITION : TP 204 @ 0.60-2.40m

CLIENT SAMPLE NO. :

Sieve Analysis	Percent Passing
75,00	
63,00	
53,00	
37,50	
26,50	
19,00	
13,20	
9,50	
6,70	
4,75	
2,36	
2,00	100
1,18	99
0,600	95
0,425	92
0,300	87
0,150	76
0,0750	70

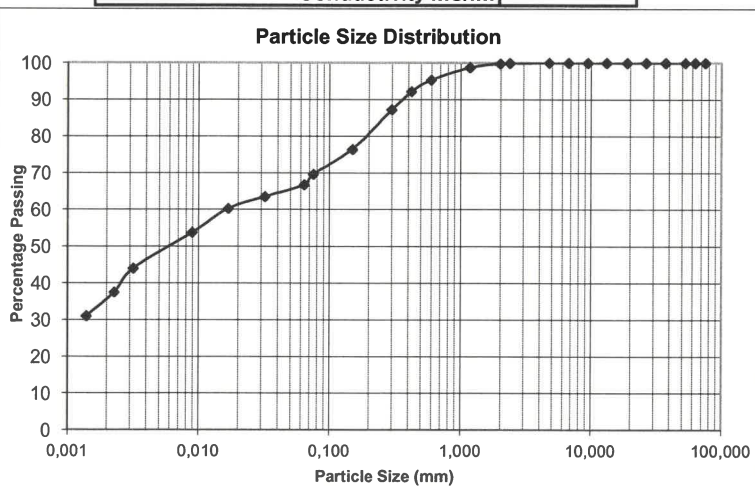
Hydrometer Analysis	
Diameter of particle (mm)	Percentage of soil suspension (%)
0,0640	67
0,0324	63
0,0164	60
0,0087	54
0,0031	44
0,0022	37
0,0013	31

SCS Dispersion Test	
Diameter of particle (mm)	Percentage of soil suspension (%)

% SCS Dispersion:	
Initial Moisture Content (%) :	
pH:	
Conductivity mS/m:	

Atterberg Limits :	
Liquid Limit	28
Plastic Index	14
Linear Shrinkage	7,0

MOD AASHTO ; C.B.R. :	
MOD AASHTO (Kg/m ³)	
O.M.C. (%)	
C.B.R. @ 100% Comp.	
C.B.R. @ 98 % Comp.	
C.B.R. @ 95 % Comp.	
C.B.R. @ 93 % Comp.	
C.B.R. @ 90 % Comp.	
Swell (max) %	



Tabulated Summary	Percentage
Gravel : Percentage - 4.75 mm	0
Sand : Percentage - 4.75mm and + 0.075mm	30
Silt : Percentage - 0.075mm and + 0.002mm	30
Clay : Percentage - 0.002mm	40

The above test results are pertinent to the samples received and tested only. While the tests are carried out according to recognized standards Geoscience shall not be liable for erroneous testing or reporting thereof. This report may not be reproduced except in full without prior consent of Geoscience.

For Geoscience:

Remarks:

ConSR22

APPENDIX D

Geotechnical Investigation for the Culcatta Cemetery Site, Stellenbosch,
Western Cape.

Path : C:\Users\Merrill\Desktop\Job Folders\1. Cape Town jobs\18-811 Culcatta Cemetery\Report\Appendix D cover page.docx



**TABLE 1
EXCAVATABILITY RATINGS**

DESCRIPTION	ASSESSMENT	RATING
Easy Spade	Pick point to 50mm	15
Pick and Spade	Slight indentation	10
Machine	Firm blows (1-3mm)	5
Blasting	Backactor refusal	0

**TABLE 2
STABILITY RATINGS**

DESCRIPTION	ASSESSMENT	RATING
Stable	Excavation can be profiled safely	20
Overbreak	Excavation stable: Overbreak 1.3 - 1.8 *	15
Slightly unstable	Minor falls of material	8
Unstable	Collapse of hole likely	F

Note: Overbreak = Ratio of widths top of trench to base
F = Fatal flaw

**TABLE 3
WORKABILITY RATINGS**

DESCRIPTION	UNIFIED CLASS	MDD (kg/m ³)	RATING
Excellent / Good	GW / SW / GP	+1800	10
Fair	SP / SM	<1800	5
Poor	OL / CL / ML	<1700	2
Very poor	OH / CH / MH	>1800	0

**TABLE 4
WATER TABLE RATINGS**

DESCRIPTION	WATER TABLE DEPTH (m) *	RATING
Deep water table	+8	25
Intermediate	4 - 8	15
Possible perched water	0 - 4	5
Water logged soil	0 - 4	F

**TABLE 5
SUBSOIL PERMEABILITY RATINGS**

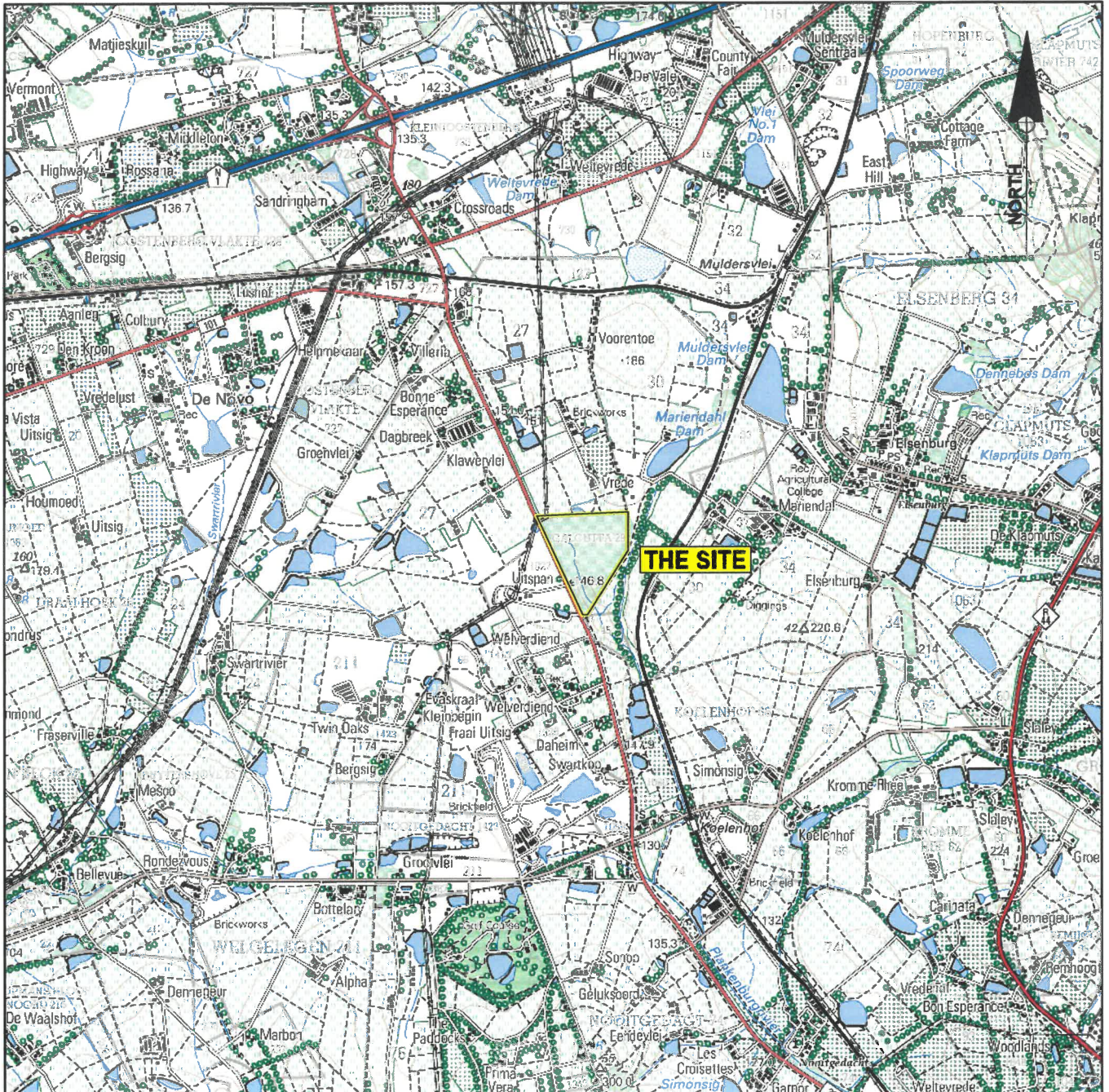
DESCRIPTION	PERCOLATION RATE (mm/hr)	APPROX. PERMEABILITY (cm/sec)	RATING
Impermeable	Not measurable	<10 ⁻⁵	15
Relatively impermeable	10 - 15	10 ⁻⁴ to 10 ⁻⁵	20
Relatively permeable	15 - 50	10 ⁻³ to 10 ⁻⁴	10
Permeable	50 - 1000	>10 ⁻³	0

**TABLE 6
BACKFILL PERMEABILITY RATINGS**

DESCRIPTION	ASSESSMENT	RATING
Impermeable	OH / CI / CH	5
Relatively impermeable	GC / SC / MH	10
Relatively permeable	GP / SP / GW	7
Very permeable	SW / SP	0

Note: * Measured from ground level

FIGURES

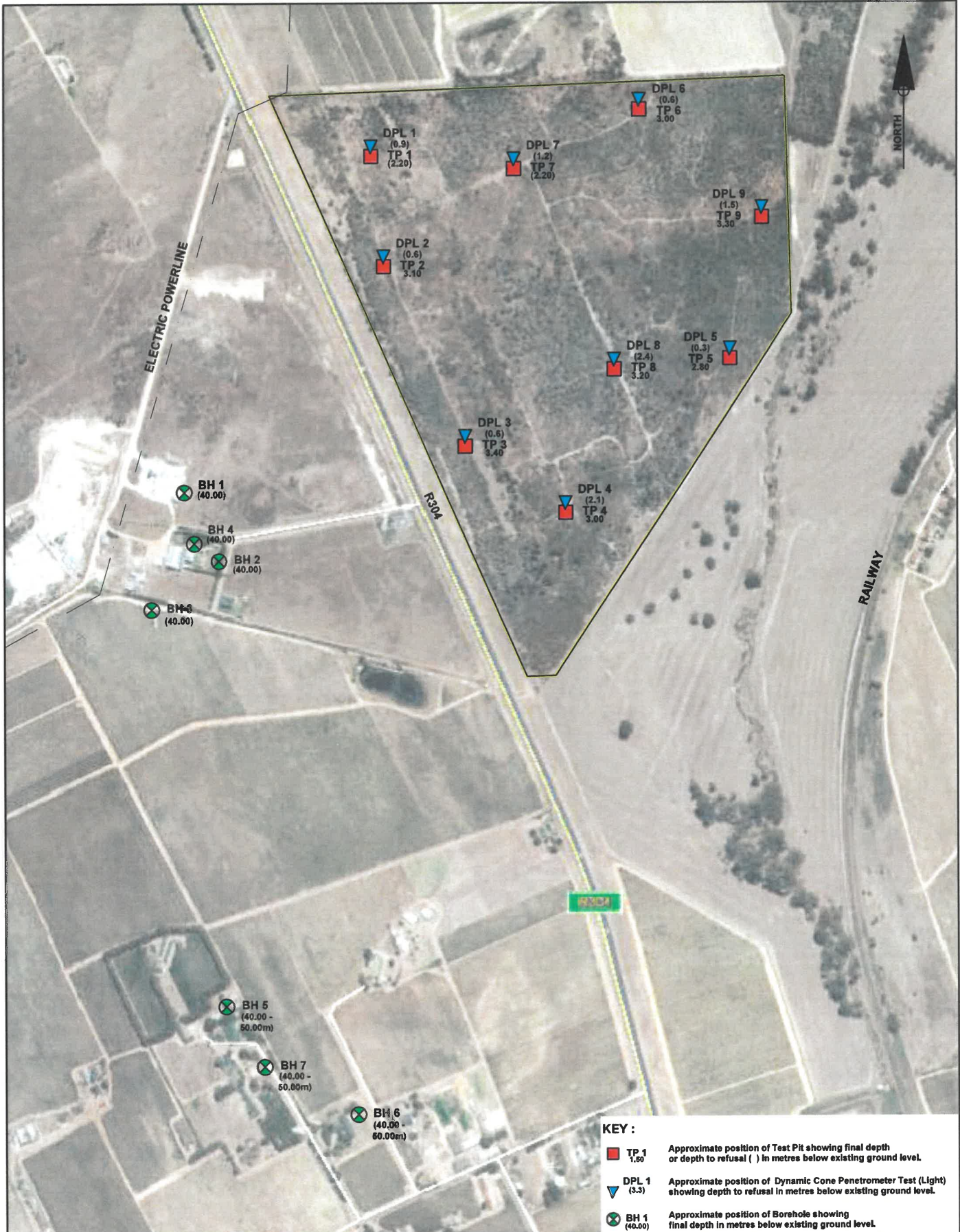


Graphic Scale
1 / 50 000

NB : Please note that the bar scale supercedes the verbal scale due to print sizes etc.

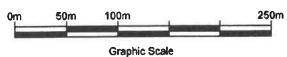
Drawing prepared from 1 / 50 000 TOPOGRAPHICAL SERIES : 3318 DD

DRAWING DESCRIPTION	CLIENT	DATE
	PROJECT	DRAWN
Locality Plan		CHECK
		REFERENCE No.
		FIGURE No. REV.
Scale 1 : 50 000 (On A4 Original)		



KEY :

	TP 1 (1.50)	Approximate position of Test Pit showing final depth or depth to refusal () in metres below existing ground level.
	DPL 1 (3.3)	Approximate position of Dynamic Cone Penetrometer Test (Light) showing depth to refusal in metres below existing ground level.
	BH 1 (40.00)	Approximate position of Borehole showing final depth in metres below existing ground level.



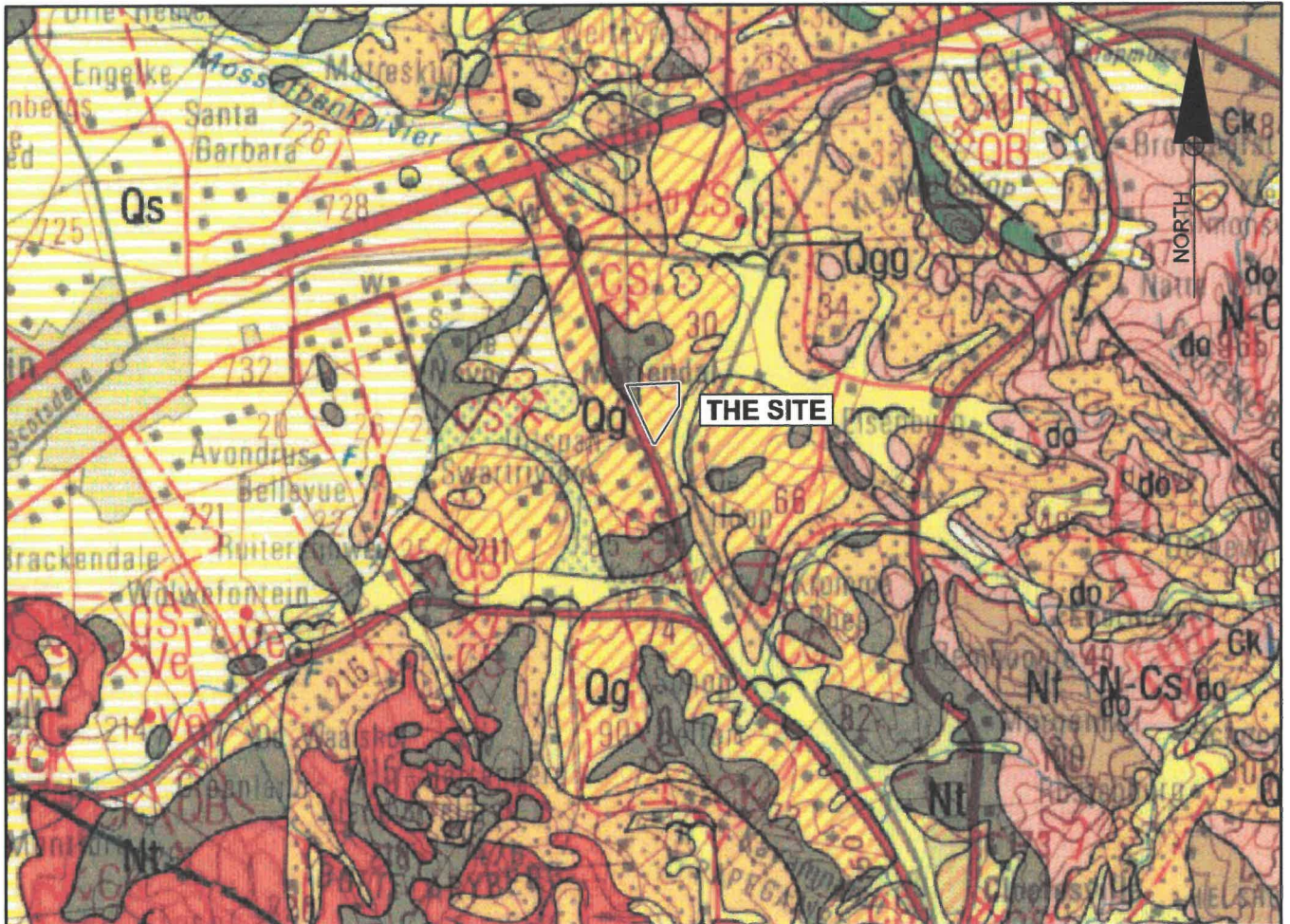
NB : Please note that the bar scale supersedes the verbal scale due to print sizes etc.

DRAWING DESCRIPTION
 Site Plan showing approximate positions of :
 a.) Test Pits.
 b.) Dynamic Cone Penetrometer Tests (Light)
 c.) Boreholes
 Scale 1 : 5000 (On A3 Original)











CLIENT
CK RUMBOLL & PARTNERS

PROJECT
 Geotechnical Investigation for
 Calcutta Cemetery

DATE	02/05/2018
DRAWN	A.S.
CHECK	M.V.R.
REFERENCE No.	18 - 811
FIGURE No.	2
REV.	0



LEGEND

-  **Alluvium**
-  **Terrace gravel**
-  **Qgg** Gravelly clay/loam soil
-  **Qg** Loam and sandy loam
-  **Qs** Sandy soil - Springfontyn Formation
-  **do** Dolerite - Intrusive rock
-  **Nf** Feldspathic conglomerate, grit and sandstone - Franschhoek Formation. CAPE GRANITE SUITE
-  **N-Ck** Granite - porphyritic, biotitic, with tourmaline-bearing variants. CAPE GRANITE SUITE
-  **N-Cs** Granite - porphyritic with leucocratic, hybridic, biotitic variants. CAPE GRANITE SUITE
-  **Nt** Greywacke, phyllite and quartzitic sandstone - interbedded lava and tuff - Tygerberg Formation. MALMESBURY GROUP



Graphic Scale
1 / 100 000

N3: Please note that the bar scale precedes the verbal scale due to print sizes etc.

Drawing prepared from 1 / 250 000 GEOLOGICAL SERIES : CAPE TOWN 3318

DRAWING DESCRIPTION

**Locality Plan showing
Regional Geology**

Scale 1 : 100 000 (On A4 Original)

CLIENT

CK RUMBOLL & PARTNERS

PROJECT

**Geotechnical Investigation for
Calcutta Cemetery**



DATE

02/05/2018

DRAWN

A.S.

CHECK

M.V.R.

REFERENCE No.

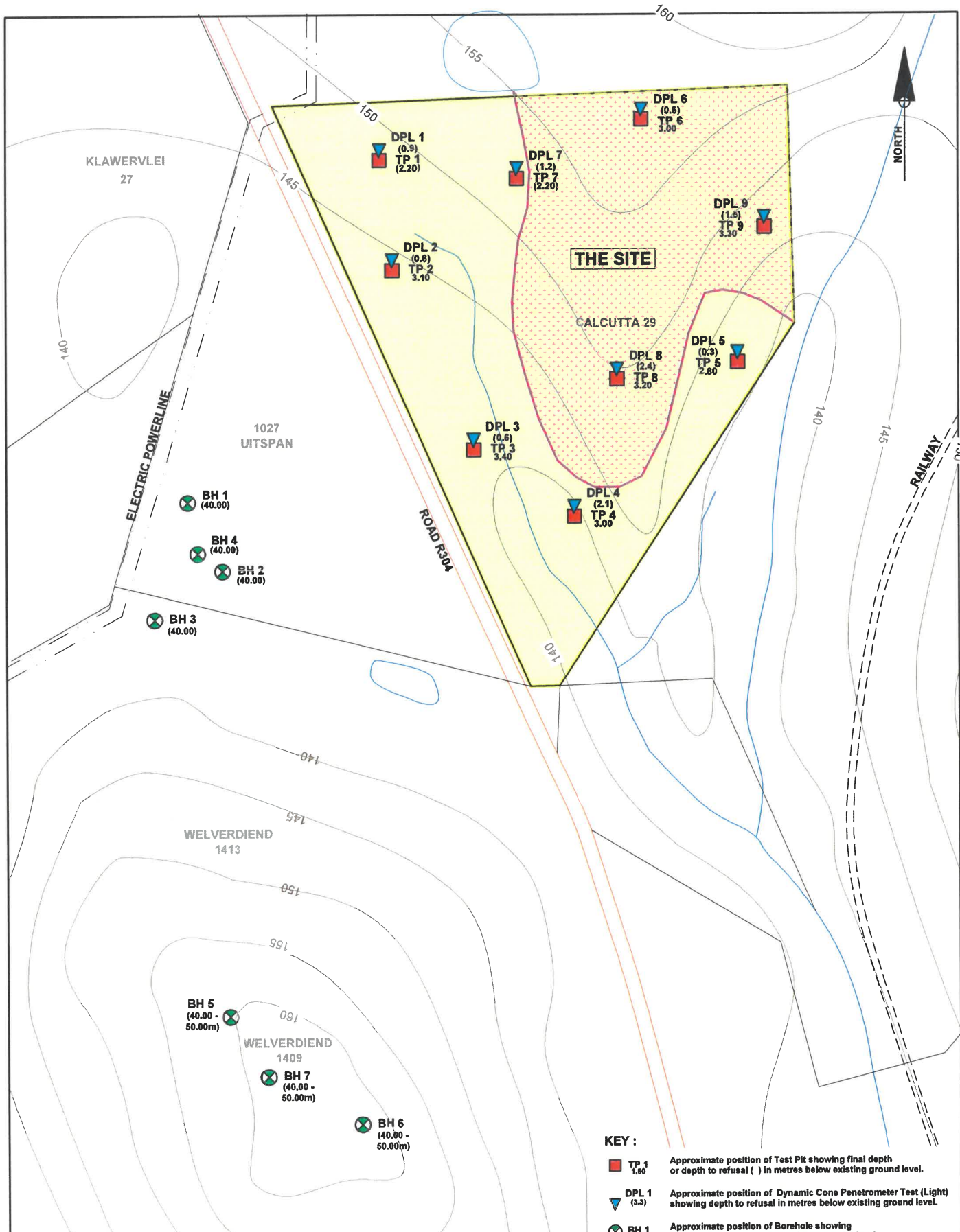
18 - 811

FIGURE No.

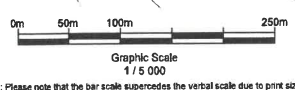
3

REV.

0



- KEY :**
- TP 1 (1.5) Approximate position of Test Pit showing final depth or depth to refusal () in metres below existing ground level.
 - ▼ DPL 1 (3.3) Approximate position of Dynamic Cone Penetrometer Test (Light) showing depth to refusal in metres below existing ground level.
 - ⊗ BH 1 (40.00) Approximate position of Borehole showing final depth in metres below existing ground level.



NS : Please note that the bar scale supercedes the verbal scale due to print sizes etc.

DRAWING DESCRIPTION

Site Plan showing Topography of the Site

 Proposed Cemetery Site

Scale 1 : 5000 (On A3 Original)

CLIENT
CK RUMBOLL & PARTNERS

PROJECT
Geotechnical Investigation for Calcutta Cemetery

GONDWANA
GEO SOLUTIONS

DATE	02/06/2018
DRAWN	A.S.
CHECK	M.V.R.
REFERENCE No.	18 - 811
FIGURE No.	4
REV.	0