REPORT ON GEOTECHNICAL INVESTIGATION FOR THE PROPOSED NEW ERICA ROAD BRIDGE OVER NATIONAL ROUTE R300, KUILS RIVER

JULY 2018

K&T PROJECT REFERENCE: 15642GG

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Engineering African Development

REPORT ON GEOTECHNICAL INVESTIGATION FOR THE PROPOSED NEW ERICA ROAD BRIDGE OVER NATIONAL ROUTE R300, KUILS RIVER

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REPORT ON GEOTECHNICAL INVESTIGATION FOR THE PROPOSED NEW ERICA ROAD BRIDGE OVER NATIONAL ROUTE R300, KUILS RIVER

1. TERMS OF REFERENCE

In terms of written instructions, Kantey & Templer was requested by ITS Global on behalf of the Client (City of Cape Town), to investigate and advise on subsoil conditions at the site of new Erica road bridge structure (crossing the R300 highway) located in Kuilsriver.

In particular we were requested to assess the following specific aspects:

- Nature of the underlying soils
- Site Geohydrology
- Excavation Conditions
- Materials Utilisation Potential
- Founding Conditions

2. INFORMATION RECEIVED

The following information was available and referred to in the compilation of this report:

- South African Geological Survey 1:250 000 Geological Series Map 3318 Cape Town with legends.
- South African Geological Survey 1:50 000 Geological maps 3318CD with legend.
- Published explanation booklet "The Geology of the Cape Town and Environs by F.N. Theron accompanying the 1:50 000 scale map.
- Google earth imagery and available aerial photographs.
- Layout diagram showing the location of bridge to be constructed.

It is understood that the loading of the subsoils by the new bridge will exert bearing pressures in the order of 450kPa.

Reference was also made to the results of previous geotechnical investigations carried out by Kantey & Templer in the Kuilsriver area.

3. SCOPE OF INVESTIGATION

3.1 Field Investigation

For the field investigation, four (4) small diameter rotary boreholes were put down to depths varying from 18.30 to 20.38m below existing ground level.

The boreholes were drilled using NX and NWD4 techniques to allow for the recovery of continuous core. The in-situ rock mass characteristics were determined by detailed logging of the drill samples extracted, this undertaken in accordance with the recommendations of the Core Logging Committee of the S.A. Section of the Association of Engineering Geologist (1976).

In-situ penetration tests (SPT) were carried out at 1m intervals in the borehole. The SPT tests are performed in accordance with B.S.1377: Part 9 of 1990, “Determination of Penetration Resistance Using Split-Barrel Sampler (SPT)”.

The borehole and SPT’s were primarily aimed at determining:

- the depth to residual material/bedrock,
- the nature and consistency (strength) of the overlying sandy soils and,
- the level of the water table.

The position of the boreholes, borehole logs and borehole photographs are presented in the Appendices.

4. ANALYSIS OF RESULTS

4.1 Site Geology and Soils Profile

Based on published geological data and previous geotechnical investigations carried out by Kantey & Templer in Kuilsriver, the site is known to be situated in terrain composed of and underlain by deeply weathered meta-sedimentary strata (shales) of the Tygerberg Formation, Malmesbury Group. The shale is mantled by a variable but generally substantial cover of Quaternary Age transported, largely alluvial, soils.

Transported Material

The natural transported soils at this bridge site tends to be fairly uniform, comprising of variably silty, generally fine to medium sand. The transported material starts at existing ground level and varies from 14.01 to 14.45 metres thick on the western side and 14.10 to 15.45 metres thick on the eastern side. The upper 4 metres of the transported soils is of a variable medium dense to loose consistency. The consistency of these soils then becomes denser from approximately 4 metres below existing groundlevel. It is highlighted that the near surface soils (upper 2.0 metres) appear to be of a slightly higher consistency, which may be attributed to 'vibration' of these soils leading to consolidation settllement over the long term.

Malmesbury Group Strata

Residual Malmesbury soils underlie the transported soils and occur from approximately 14.10 to 15.45m below existing ground level. The contact zone between the transported and residual soils tends to be slightly reworked (naturally by groundwater) with the consistency being stiff becoming very stiff with depth. Remnant bedding structure was observed in the recovered core.

The Malmesbury strata is deeply weathered at this bridge crossing the R300. Generally, the very stiff residual Malmesbury tended to very soft Malmesbury bedrock in all the boreholes. This transition in strength was encountered on the eastern side from 17.00 to 17.45m below existing ground level and between 14.10 to 16.20m below existing ground level on the western side.

4.2 Site Geohydrology

Groundwater levels were recorded in August 2018 at the following depths (metres below existing ground level.

- Area of BH1/BH2 - 1.15 to 1.69 m begl
- Area of BH3/BH4 - 2.45 to 1.32 m begl

The groundwater regime essentially comprises of an unconfined aquifer located in the sandy transported soils. The base of this aquifer is located at the contact of the naturally deposited transported deposits with the underlying residual shales of the Malmesbury Group. The aquifer essentially comprises a fine to medium sand with a variable silt content.

Although the groundwater levels were recorded during winter conditions, it is noted that the 2018 winter period has been particularly 'dry' in terms of the average rainfall anticipated in the Cape. It is envisaged that the groundwater levels are subject to seasonal fluctuations due to the permeable nature of the alluvial soil horizons and the natural undulations of the Malmesbury strata underneath. It is possible that the water table could rise close to the existing ground surface during periods of high rainfall. This should be borne in mind when foundation excavations and access for earthmoving or piling rigs are planned.

4.3 Excavation Conditions

In view of the granular non-cohesive nature of the reworked and sandy transported soils, excavation conditions are considered to be favourable. Machine excavation of the foundation or pile bases should therefore not pose any untoward problems with excavation conditions classifying as ‘soft excavation’ in terms of SANS 1200D.

Excavation operations undertaken below approximately 1.00m depth during winter conditions will encounter groundwater seepage, which will cause the upper cohesionless sandy soils to slump/collapse. Where excavations are suitably battered for pile caps or foundations, additional support in the form of sand bags (placed at toe of excavations) or suitable temporary support measures may be required.

4.4 Design Soil Parameters

Although the in-situ soils were not tested, the bulk of the transported soils likely to be intersected during construction will consist of non-plastic fine to medium grained sand (with a variable silt content).

Preliminary soil parameters for the respective ground conditions necessary for the design of foundations are summarised in the table below.

Geological Description	**Average Bulk Density (kg/m^3)**	**Cohesion (kPa)**	**Friction Angle (ϕ')**
Fine silty sand	1800	0	32
Fine to Medium sand	1800	0	32
Stiff to very stiff residual	1900	10	28

4.5 Founding Conditions

4.5.1 Bearing Capacity

As noted previously in this report, the upper zones of the subsoil profile comprises of variable, silty sand horizons typical of a naturally deposited transported soil. Numerous Standard Penetration Tests (SPT) were undertaken in the subsoils, which provided sufficient data to make a meaningful interpretation of the consistency of the underlying subsoils/strata. Normal methods of analysis could then be employed to utilize the SPT 'N' values to interpret the bearing capacities and foundation settlement characteristics of the site soils.

4.5.2 Conventional Founding Conditions

The strength and composition of the subsoil profile in the bridge area has a significant impact on the prediction of the bearing capacity of the subsoils, especially when considering the anticipated heavy structural loading. SPT results recorded from existing ground level during the site investigations are presented in the table below.

Depth (BEGL)	**SPT N - VALUES**			
	BH1	**BH2**	**BH3**	**BH4**
-1	10	16	14	11
-2	8	12	17	9
-3	5	6	6	4
-4	25	39	22	28
-5	27	9	20	16
-6	26	36	28	26
-7	53	35	22	37
-8	47	54	57	R
-9	40	39	67	51
-10	37	42	67	49
-11	38	65	R	R
-12	68	54	R	R
-13	43	36	55	R
-14	40	34	46	58
-15	34	37	32	R
-16	40	⬛	48	R
-17	48	50	46	R
-18	52	52	52	R
-19	R	R	⬛	⬛
-20	R	R	⬛	⬛

🟥 = Refusal of SPT
🟨 = SPT values in 'weaker' subsoils
🟩 = SPT values in 'stronger' subsoils
⬛ = No SPT test undertaken

Based on observations in the boreholes, experience on similar sandy soils and the results of SPT tests undertaken at the bridge site, the maximum permissible bearing capacities are presented in the table below.

Depth (metres below existing ground level)	**Allowable Bearing Capacity (kPa)**
0 - 4.0	150 - 200
4.0 - 8.0	200 to 300
8.0 - 14.0	300 to 400
+14.0	400

4.5.3 Settlement Analysis

The settlement properties of the variably silty, predominantly sandy transported soils was assessed using the following:

- The SPT results based on average corrected SPT results of 18 within 'weaker' upper soil profile; and
- Burland and Burbridge’s method for normally and over-consolidated sand;

Burland and Burbridge’s Method

As discussed in previous sections, the transported subsoils profile can be regarded as fairly uniform across the area that was investigated.

The settlement assessment in terms of the Burland and Burbridge’s Method was undertaken assuming an average corrected SPT ‘N’ value of 18 (i.e. medium dense consistency) assuming that conventional foundations could be founded at shallow depth.

The analyses were undertaken for a typical bridge foundation dimensioned for foundation pressures ranging from 150 kPa to 450 kPa. The calculated/predicted settlements are presented below.

Foundation Dimensions	Gross Foundation Pressure		
	150 kPa	350 kPa	450 kPa
	Predicted Settlement		
8.0m× 3.0m	25mm	62mm	85mm

It should be noted that the above values indicate the total anticipated settlement. Due to the variability in the upper transported soils, the differential settlements are expected to range from 60% to 100% of the total settlement and will likely occur during construction.

The settlement calculations indicate that for the lower foundation pressures, the predicted settlements are low, implying that the subsoils are capable of supporting light structural applications, provided that the structures can tolerate the anticipated differential settlements.

However, in the medium dense transported soils (denoted as the yellow 'weaker' soils with average SPT = 18), the predicted settlement and corresponding differential settlement increase significantly at the higher foundation pressure ranges of 350 kPa or greater. It is therefore not recommended to found the heavily loaded structures on conventional pad footings in the upper soil conditions unless foundations are cast at depth. Founding at depth would require temporary lateral support and dewatering techniques implying both time and cost implications, hence a piled foundation is the recommended founding solution at this site (especially seeing that piled foundations would likely be undertaken for the central pier position).

As a result of the of the thickness and nature of the underlying soils cased augered or CFA piles would be feasible at this site. It is noted that a driven pile system would be feasible at this bridge site, providing higher frictional skin resistance than auger/CFA piles. The disadvantage of the driven system is that there may be vibrational aspects that could affect neighbouring buildings and existing (sensitive) buried services. The ultimate pile type should be discussed in consultation with a geotechnical piling specialist.

Whilst a detailed pile design is beyond the scope of this geotechnical report, it must be noted that the final depth of piling will largely be dependent on the pile type, pile dimensions, pile group capacity and method of installation. Based on observations from the boreholes and the depth to competent founding material (very stiff residual soils or very soft rock), it is likely that cased auger/CFA type piles would not be shorter than the following:

- Area of BH1/BH2 - 16m begl
- Area of central pier - 17m begl
- Area of BH3/BH4 - 17m begl

It is highlighted in terms of the permeable nature of the transported soils and moving groundwater that temporary (or permanent) casing will be required for piling operations. It should be noted that when the casings are extracted, the pile integrity might be affected by the influence of groundwater. Pile integrity tests should be allowed for in the contract documentation as one of the test procedures to check the quality of the new installed piles as well as design assumptions.

Further to above minimum pile lengths, it is likely that driven pile techniques would terminate at shallower depth within the dense to very dense sandy transported horizons (depending on the load requirements).

4.6 Temporary Lateral Support Implications

It is anticipated that the foundations or pile caps for the central pier would extend well into the ground. Taking into account the limited space along the central pier location, suitable temporary shoring will be required and the installtion will need to take into account the piling equipment dimensions.

Suitable excavation battering (not greater than 45 degrees) could be undertaken at the abutment locations, but further slope support in the form of sand bags placed at the toe of battered excavations may be required to prevent excavation sidewall slumping where taken into completely saturated soils with depth or where shallow seepage flow is intercepted.

For excavations deeper than 1.5 metres or potential space constraints due to existing buried services, suitable temporary shoring systems will be required to ensure safe working conditions. Although detailed design of the lateral support measures is beyond the scope of this report, the installation of sheet piles has proven successful both in terms of time and in similar saturated soil conditions.

Sheet piling provides suitable temporary support as well as eliminating the need for dewatering techniques.

5. CONCLUSIONS

1. The site is underlain by naturally deposited sandy transported soils of predominantly alluvial origin. These soils are underlain by residual soils and strata of the Malmesbury Group, which tend to be deeply weathered.

2. The site is characterised by a shallow groundwater system, which was measured between 1.32 to 2.45m below existing ground level. The groundwater levels are directly influenced by the seasonal periods. For this bridge site, groundwater seepage water is likely to remain present irrespective of the timing of construction and should be allowed for at all times.

3. Given the predominantly non-cohesive nature of the sandy material, conventional earthmoving equipment will satisfactorily remove the sandy horizons. Excavations deeper than 1.50 metres will require suitable battering or temporary lateral support to ensure safe working conditions. It is preferable that excavations and the installation of piled foundations be planned for the drier summer months when the groundwater levels would be more favourable.

4. In terms of the founding conditions for the bridge site and in view of the anticipated heavy structural loading of the ground, conventional foundations are not suitable at shallow depth. In order to construct conventional foundations, pad foundations would need to be taken through the upper subsoils and founded well into the lower dense to very dense transported soils or very stiff residual Malmesbury material at depths greater than 4.0 metres, which is not practically feasible, therefore piled foundations are recommended.

5. Although every effort has been made to ensure the accuracy of the information contained in this report, the results of the investigation are based upon fieldwork which provides a limited view of the subsoil conditions. Natural soil/rock is never uniform. Its properties change from point to point while our knowledge of its properties are limited to those few spots at which the samples have been collected. As a precautionary measure, it is imperative, due to the potential geotechnical variations in the subsoils and Malmesbury rock strength,

that pile and founding conditions should be inspected and approved by a geotechnical engineer.

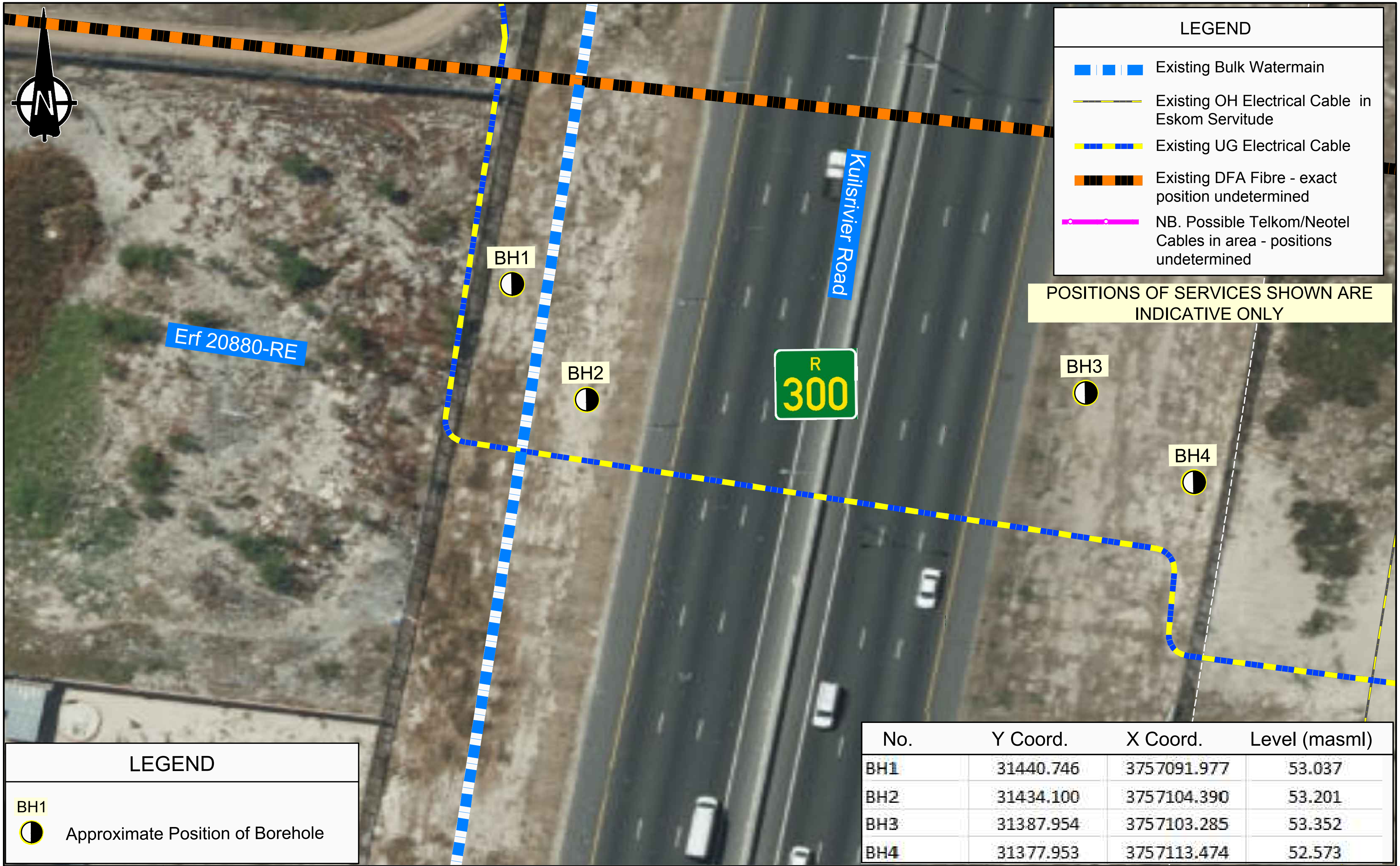
FOR KANTEY & TEMPLER

PD Beales

PATRICK BEALES Pr Eng (20070091)

APPENDIX A

BOREHOLE LOCATION PLAN



No.	Y Coord.	X Coord.	Level (masml)
BH1	31440.746	3757091.977	53.037
BH2	31434.100	3757104.390	53.201
BH3	31387.954	3757103.285	53.352
BH4	31377.953	3757113.474	52.573

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CLIENT
CITY OF CAPE TOWN
ISIXEKO SASEKAPA
STAD KAAPSTAD
Making progress possible. Together.

PROJECT
CITY OF CAPE TOWN
BRIDGES INVESTIGATION

TITLE
BOREHOLE LOCATION PLAN
ERICA ROAD - R300

Scale
1:500

Drawing No.
15642GG-04

Rev.

Y:\DWG-G\20019G Bridge Locations\20019GG Bridge Locations 3785.3 ITS rev a.dwg 22/08/2018 10:31 Shirley Mossop

APPENDIX B

BOREHOLE LOGS

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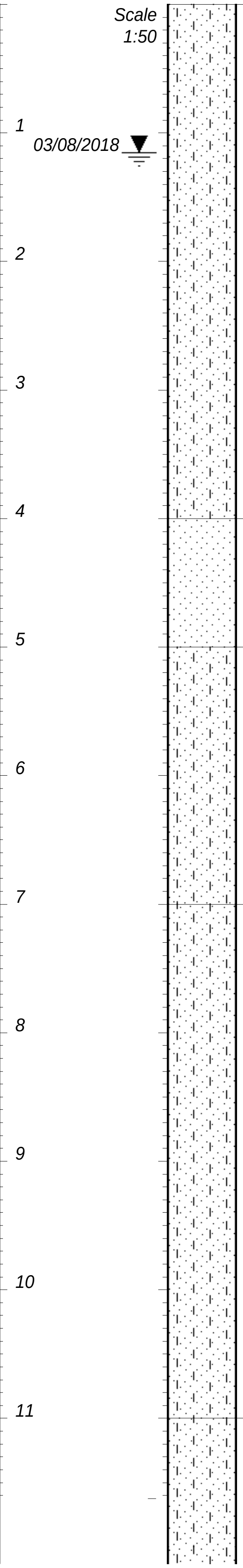
CITY OF CAPE TOWN
R300 BRIDGE

HOLE No: **BH1**
Sheet 1 of 2

JOB NUMBER: 15642GG

DRILLING METHOD	*CORE REC.*	*RQD %*	*FRACT. PER m*	*TEST OR SAMPLE*	*VALUE*
WASH BORE & CORE	WASH SAMPLE				
	53			SPT	10
	WASH SAMPLE				
	60			SPT	8
	WASH SAMPLE				
	100			SPT	5
	WASH SAMPLE				
	96			SPT	25
	WASH SAMPLE				
	89			SPT	27
	WASH SAMPLE				
	69			SPT	26
	WASH SAMPLE				
	89			SPT	55
	WASH SAMPLE				
	78			SPT	47
	WASH SAMPLE				
	93			SPT	40
	WASH SAMPLE				
	96	N/A	N/A	SPT	37
	WASH SAMPLE				
	76			SPT	38

Scale 1:50



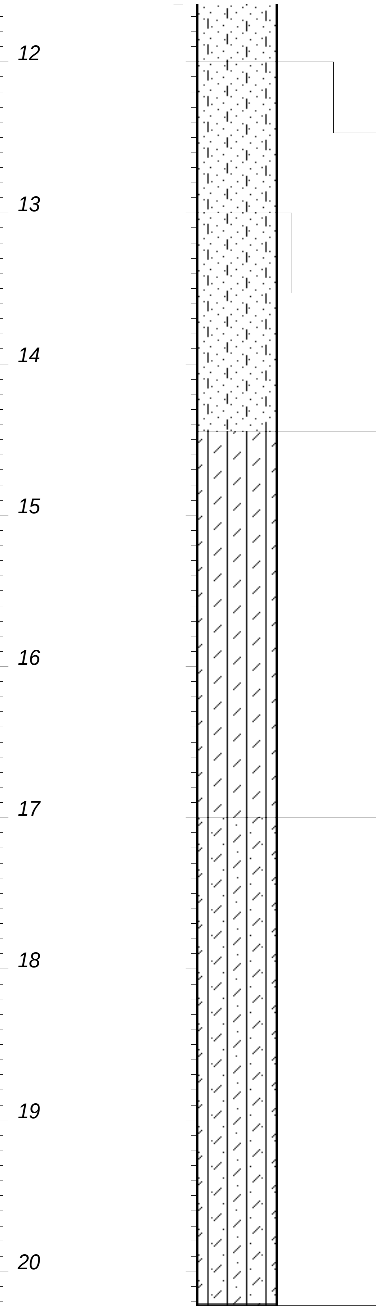
0.00	Light brownish grey occasionally stained dark grey and dark brown loose to medium dense variably slightly silty fine to medium SAND; REWORKED TRANSPORTED.
4.00	Light whitish grey medium dense fine to medium SAND; TRANSPORTED.
5.00	Dark greyish brown to brownish grey medium dense variably slightly silty fine to medium SAND; TRANSPORTED.
7.00	Dark brownish grey to grey stained greyish brown very dense to dense variably silty fine to medium SAND; TRANSPORTED.
11.00	

CITY OF CAPE TOWN
R300 BRIDGE

HOLE No: BH1
Sheet 2 of 2

JOB NUMBER: 15642GG

DRILLING METHOD	CORE REC.	RQD %	FRACT. PER m	TEST OR SAMPLE	VALUE
	WASH SAMPLE				
	56			SPT	68
	WASH SAMPLE				
	38			SPT	43
	WASH SAMPLE				
NDW4	51			SPT	40
	WASH SAMPLE				
	100			SHELBY	
	69			SPT	34
	22				
	64			SPT	40
	73				
	56			SPT	48
	70				
	51			SPT	52
	57				
	61			SPT	R
	70				
	80			SPT	R



	Light brownish grey occasionally stained dark grey very dense very slightly silty fine to medium SAND; TRANSPORTED.
12.00	Light brownish grey occasionally stained dark grey very dense very slightly silty fine to medium SAND coontaining scattered angular to subangular quartz grit; TRANSPORTED.
13.00	Dark greyish brown very dense variably silty fine to medium SAND; TRANSPORTED.
14.45	Grey to light grey very stiff slickensided clayey SILT; RESIDUAL MALMESBURY.
17.00	Grey to light grey very stiff occasionally slickensided clayey SILT tending to very soft rock. Remnant laminated and occasional steeply dipping bedding structure visible containing occasional sandy infill and angular quartz grit at 10.3m depth; RESIDUAL MALMESBURY.
20.23	

NOTES

1) Groundwater table measured at 1.15m depth on 03/08/2018.

CONTRACTOR : FAIRBROTHER
MACHINE : HD300
DRILLED BY : DAVID DU PLESSIS
PROFILED BY : DLR

TYPE SET BY : CHANTEL
SETUP FILE : K&T-BO~2.SET

INCLINATION : VERTICAL
DIAM :
DATE :
DATE : 03-07-2018

DATE : 03/09/2018 10:19
TEXT : ..LES\DATA\B156421R300.txt

ELEVATION : N/A
X-COORD : 3757091.977
Y-COORD : 31440.746

HOLE No: BH1
Reinstrumentation

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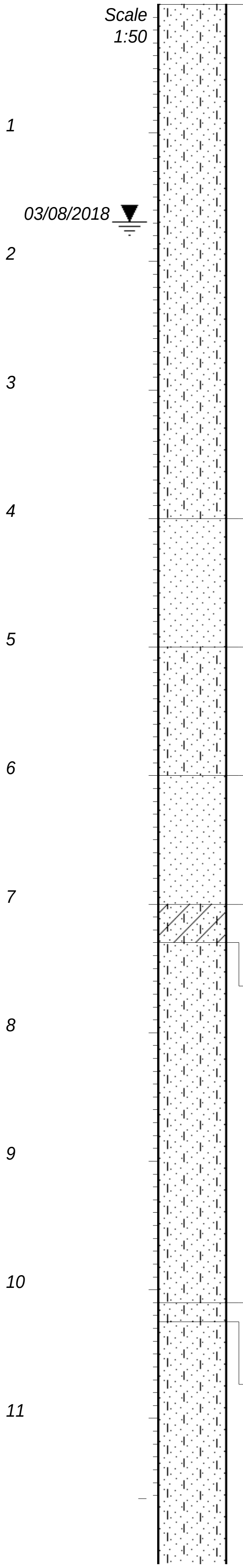
CITY OF CAPE TOWN
R300 BRIDGE

HOLE No: **BH2**
Sheet 1 of 2

JOB NUMBER: 15642GG

DRILLING METHOD	*CORE REC.*	*RQD %*	*FRACT. PER m*	*TEST OR SAMPLE*	*VALUE*
WASH BORE & CORE	WASH SAMPLE	N/A	N/A		
	55			SPT	16
	WASH SAMPLE				
	56			SPT	12
	WASH SAMPLE				
	56			SPT	6
	WASH SAMPLE				
	69			SPT	39
	WASH SAMPLE				
	71			SPT	9
	WASH SAMPLE				
	62			SPT	36
	WASH SAMPLE				
	80			SPT	35
	WASH SAMPLE				
	67			SPT	54
	WASH SAMPLE				
	67			SPT	39
	WASH SAMPLE				
	78			SPT	42
	WASH SAMPLE				
	78			SPT	65

Scale 1:50



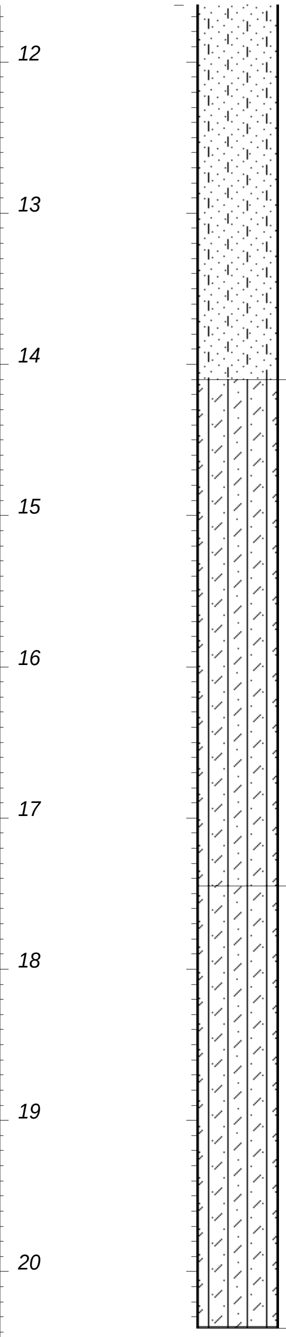
0.00	Light brownish grey to grey loose to medium dense very slightly silty fine to medium SAND; REWORKED TRANSPORTED.
4.00	Light whitish grey dense fine to medium SAND; TRANSPORTED.
5.00	Dark brownish grey loose slightly silty fine to medium SAND; TRANSPORTED.
6.00	Light whitish grey dense fine to medium SAND; TRANSPORTED.
7.00	Dark blackish grey dense slightly silty clayey SAND tending to CLAY/SAND; TRANSPORTED.
7.30	Light brownish grey to brownish grey dense to very dense variably slightly silty fine to medium SAND; TRANSPORTED.
10.10	Dark blackish grey ver dense silty fine to medium SAND; TRANSPORTED.
10.25	Light brownish grey to light greyish brown very dense slightly silty fine to medium SAND; TRANSPORTED.

CITY OF CAPE TOWN
R300 BRIDGE

HOLE No: **BH2**
Sheet 2 of 2

JOB NUMBER: **15642GG**

DRILLING METHOD	CORE REC.	RQD %	FRACT. PER m	TEST OR SAMPLE	VALUE
	WASH SAMPLE				
	53			SPT	54
	WASH SAMPLE				
NDW4	62			SPT	36
	WASH SAMPLE				
	71			SPT	34
	54				
	100			SHELBY	
	78			SPT	37
	74				
	98			SPT	50
	90				
	73			SPT	52
	48				
	67			SPT	R
	52				
	80			SPT	R



14.10

Grey very stiff clayey SILT. Remnant laminated and occasional steeply dipping bedding structure visible containing slightly sandy infill; RESIDUAL MALMESBURY.

17.45

Grey occasionally stained light orange-brown very stiff clayey SILT tending to completely to highly weathered very soft rock. Remnant laminated, slickensided and occasional steeply dipping bedding visible, containing sandy infill; RESIDUAL MALMESBURY.

20.38

NOTES

1) Groundwater table measured at 1.69m depth on 03/08/2018.

CONTRACTOR : FAIRBROTHER
MACHINE : LH250
DRILLED BY : NEVILLE
PROFILED BY : DLR

TYPE SET BY : CHANTEL
SETUP FILE : K&T-BO~2.SET

INCLINATION : VERTICAL
DIAM :
DATE :
DATE : 03-07-2018

DATE : 03/09/2018 10:19
TEXT : ..LES\DATA\B156422R300.txt

ELEVATION : N/A
X-COORD : 3757104.390
Y-COORD : 31434.100

HOLE No: **BH2**
Reinstrumentation

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CITY OF CAPE TOWN
R300 BRIDGE

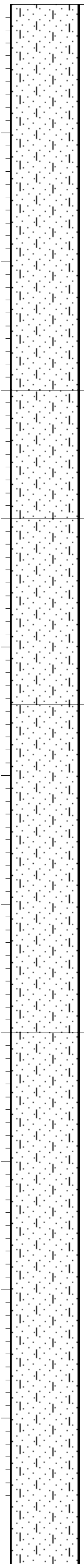
HOLE No: **BH3**
Sheet 1 of 2

JOB NUMBER: 15642GG

DRILLING METHOD	CORE REC.	RQD %	FRACT. PER m	TEST OR SAMPLE	VALUE
WASH BORE & CORE	WASH SAMPLE	N/A	N/A		
	78			SPT	14
	WASH SAMPLE				
	73			SPT	17
	WASH SAMPLE				
	87			SPT	6
	WASH SAMPLE				
	89			SPT	22
	WASH SAMPLE				
	69			SPT	20
	WASH SAMPLE				
	76			SPT	28
	WASH SAMPLE				
	82			SPT	22
	WASH SAMPLE				
	89			SPT	57
	WASH SAMPLE				
	76			SPT	67
	WASH SAMPLE				
	64			SPT	67
	WASH SAMPLE				
	70			SPT	R

Scale 1:50

03/08/2018 ▼



0.00	Light yellowish brown loose to medium dense very slightly silty fine to medium SAND; REWORKED TRANSPORTED.
3.00	Grey occasionally speckled black to light greyish brown loose variably silty fine to medium SAND; REWORKED TRANSPORTED.
4.00	Brown to light yellowish brown medium dense very slightly silty fine to medium SAND; TRANSPORTED.
5.45	Light grey to brownish grey medium dense variably very slightly silty fine to medium SAND; TRANSPORTED.
8.00	Grey to light brownish grey very dense variably very slightly silty fine to medium SAND; TRANSPORTED.

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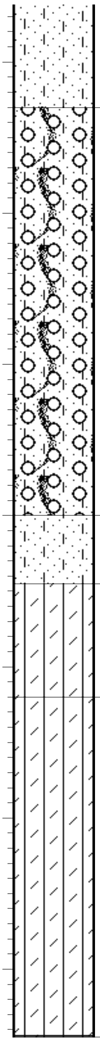
CITY OF CAPE TOWN
R300 BRIDGE

HOLE No: **BH3**
Sheet 2 of 2

JOB NUMBER: 15642GG

DRILLING METHOD	*CORE REC.*	*RQD %*	*FRACT. PER m*	*TEST OR SAMPLE*	*VALUE*
	WASH SAMPLE				
	70			SPT	R
	WASH SAMPLE				
NDW4	76			SPT	55
	WASH SAMPLE				
	27			SPT	46
	WASH SAMPLE				
	73			SPT	32
	67				
	100			SHELBY	
	67			SPT	48
	57				
	82			SPT	46
	37				
	89			SPT	52

12
13
14
15
16
17
18



12.30

Grey to light brownish grey very dense variably very slightly silty medium to coarse SAND containing occasional pockets of subangular fine quartz gravel; TRANSPORTED.

15.00

Dark grey dense slightly silty fine SAND; TRANSPORTED.

15.45

Light grey very stiff slightly clayey to clayey SILT; RESIDUAL MALMESBURY.

16.20

Light grey very stiff slightly clayey to clayey SILT tending to completely to highly weathered very soft rock, occasionally slickensided; RESIDUAL MALMESBURY.

18.45

NOTES

1) Groundwater table measured at 2.45m depth on 03/08/2018.

CONTRACTOR : FAIRBROTHER
MACHINE : LH250
DRILLED BY : NEVILLE
PROFILED BY : DLR

TYPE SET BY : CHANTEL
SETUP FILE : K&T-BO~2.SET

INCLINATION : VERTICAL
DIAM :
DATE :
DATE : 30-07-2018

DATE : 03/09/2018 10:19
TEXT : ..LES\DATA\B156423R300.txt

ELEVATION : N/A
X-COORD : 3757103.285
Y-COORD : 31387.954

HOLE No: **BH3**
Reinstrumentation

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Engineering African Development

CITY OF CAPE TOWN
R300 BRIDGE

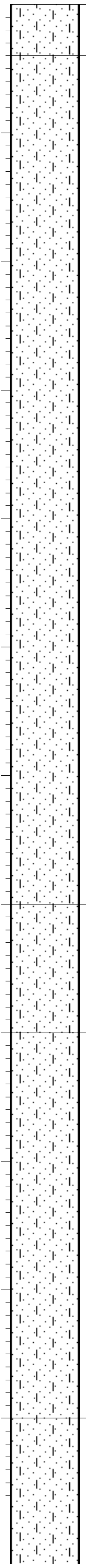
HOLE No: **BH4**
Sheet 1 of 2

JOB NUMBER: 15642GG

Scale 1:50

DRILLING METHOD	*CORE REC.*	*RQD %*	*FRACT. PER m*	*TEST OR SAMPLE*	*VALUE*
WASH BORE & CORE	WASH SAMPLE	N/A	N/A		
	67			SPT	11
	WASH SAMPLE				
	60			SPT	9
	WASH SAMPLE				
	76			SPT	4
	WASH SAMPLE				
	73			SPT	28
	WASH SAMPLE				
	73			SPT	16
	WASH SAMPLE				
	84			SPT	26
	WASH SAMPLE				
	78			SPT	37
	WASH SAMPLE				
	93			SPT	R
	WASH SAMPLE				
	67			SPT	51
	WASH SAMPLE				
	84			SPT	49
	WASH SAMPLE				
	100			SPT	R
	WASH				

03/08/2018 ▼



0.00	Light brownish grey to greyish brown loose very slightly silty fine to medium SAND; REWORKED TRANSPORTED.
0.40	Grey to light grey occasionally stained brown medium dense variably slightly silty fine to medium SAND; TRANSPORTED.
7.00	Brownish grey dense silty fine to medium SAND; TRANSPORTED.
8.00	Dark brownish grey stained black very dense silty fine to medium SAND; TRANSPORTED.
11.00	

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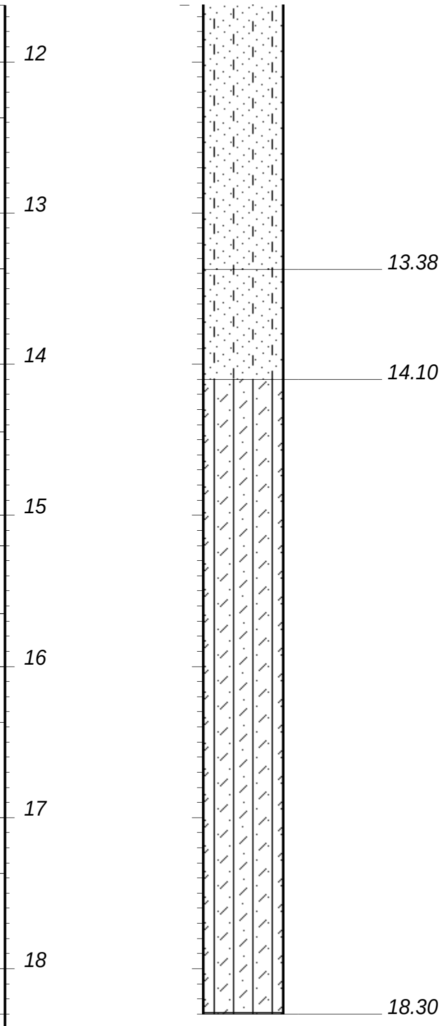
CITY OF CAPE TOWN
R300 BRIDGE

HOLE No: BH4
Sheet 2 of 2

JOB NUMBER: 15642GG

DRILLING METHOD	CORE REC.	RQD %	FRACT. PER m	TEST OR SAMPLE	VALUE
	SAMPLE				
	53			SPT	R
	WASH SAMPLE				
NDW4	59			SPT	R
	WASH SAMPLE				
	71			SPT	58
	50				
	100			SHELBY	
	64			SPT	R
	40				
	80			SPT	R
	73				
	99			SPT	R
	68				
	83			SPT	R



Grey to light grey very dense slightly silty medium to coarse SAND containing scattered subangular quartz grit;TRANSPORTED.

13.38

Dark brownish grey very dense silty fine to medium SAND; TRANSPORTED.

14.10

Grey very stiff clayey SILT tending to completely to highly weathered very soft rock containing very occasional quartz lenses (quartz veins) at 17.0m depth; RESIDUAL MALMESBURY. Remnant laminated and occasional steeply dipping bedding structure visible, containing sandy infill.

18.30

NOTES

1) Groundwater table measured at 1.32m depth on 03/08/2018.

CONTRACTOR : FAIRBROTHER
MACHINE : HD 300
DRILLED BY : DAVID DU PLESSIS
PROFILED BY : DLR

TYPE SET BY : CHANTEL
SETUP FILE : K&T-BO~2.SET

INCLINATION : VERTICAL
DIAM :
DATE :
DATE : 03-07-2018

DATE : 03/09/2018 10:18
TEXT : ..LES\DATA\B156424R300.txt

ELEVATION : N/A
X-COORD : 3757113.474
Y-COORD : 31377.953

HOLE No: BH4
Reinstrumentation

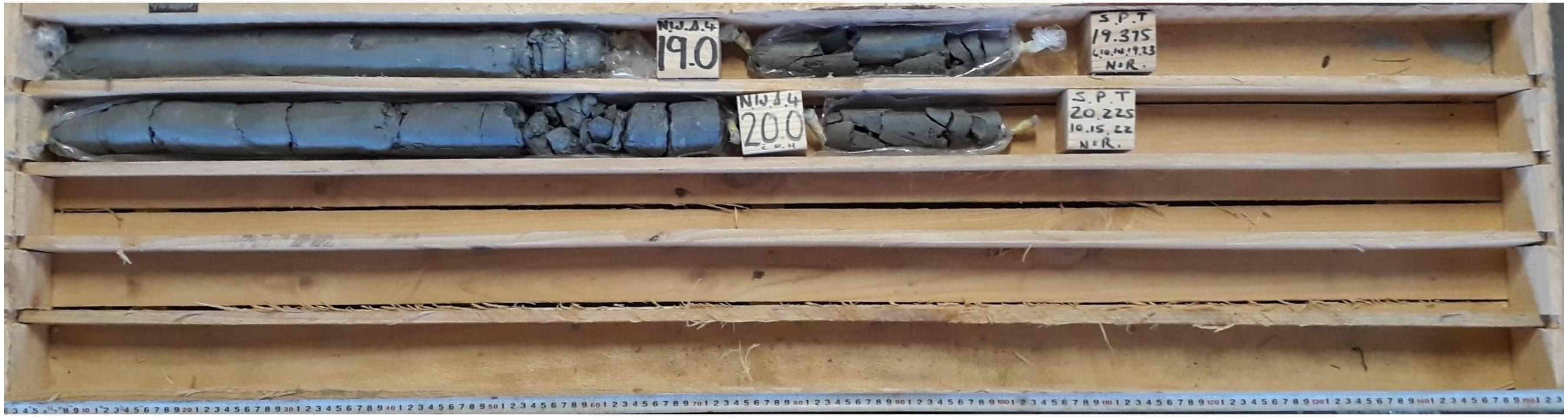
APPENDIX C

BOREHOLE PHOTOGRAPHS

Borehole 1: 0.0 – 11.00m depth

Borehole 1: 11.00 – 18.45m depth

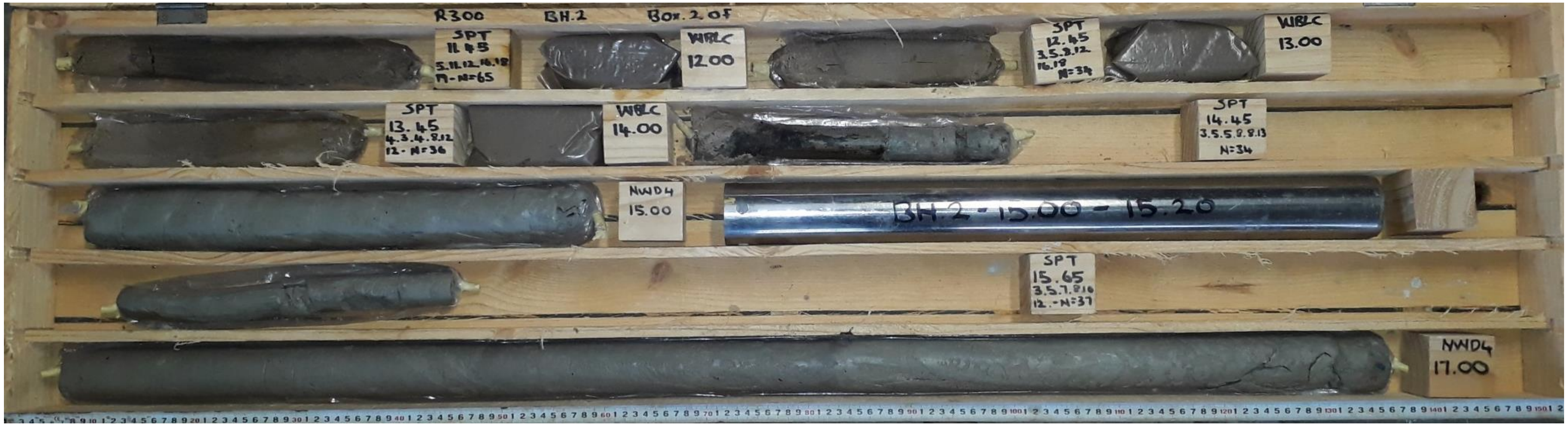
KANTEY & TEMPLER CONSULTING ENGINEERS	CLIENT: CITY OF CAPE TOWN ISIXEKO SASEKAPA STAD KAAPSTAD	PROJECT: ERICA ROAD (R300) BRIDGE GEOTECHNICAL INVESTIGATION	TITLE: BOREHOLE PHOTOS	PROJECT NO: 15642GG



Borehole 1: 18.45 – 20.225m depth

	CLIENT:	**PROJECT:**	**TITLE:**	**PROJECT NO:**
K&T KANTEY & TEMPLER CONSULTING ENGINEERS	CITY OF CAPE TOWN ISIXEKO SASEKAPA STAD KAAPSTAD	BELHAR ROAD (R300) BRIDGE GEOTECHNICAL INVESTIGATION	BOREHOLE PHOTOS	15642GG

Borehole 2: 0.0 – 11.00m depth



Borehole 2: 11.00 – 17.0m depth

KANTEY & TEMPLER
CONSULTING ENGINEERS

	CLIENT:	**PROJECT:**	**TITLE:**	**PROJECT NO:**
K&T KANTEY & TEMPLER CONSULTING ENGINEERS	CITY OF CAPE TOWN ISIXEKO SASEKAPA STAD KAAPSTAD	ERICA ROAD (R300) BRIDGE GEOTECHNICAL INVESTIGATION	BOREHOLE PHOTOS	15642GG

Borehole 2: 17.0 – 20.375m depth

K&T KANTEY & TEMPLER CONSULTING ENGINEERS	**CLIENT:** CITY OF CAPE TOWN ISIXEKO SASEKAPA STAD KAAPSTAD	**PROJECT:** BELHAR ROAD (R300) BRIDGE GEOTECHNICAL INVESTIGATION	**TITLE:** BOREHOLE PHOTOS	**PROJECT NO:** 15642GG

Borehole 3: 0.0 – 11.00m depth

Borehole 3: 11.00 – 18.45m depth

KANTEY & TEMPLER CONSULTING ENGINEERS	**CLIENT:** CITY OF CAPE TOWN ISIXEKO SASEKAPA STAD KAAPSTAD	**PROJECT:** ERICA ROAD (R300) BRIDGE GEOTECHNICAL INVESTIGATION	**TITLE:** BOREHOLE PHOTOS	**PROJECT NO:** 15642GG

Borehole 4: 0.0 – 10.45m depth

Borehole 4: 10.45 – 18.3m depth

	CLIENT:	**PROJECT:**	**TITLE:**	**PROJECT NO:**
KANTEY & TEMPLER CONSULTING ENGINEERS	CITY OF CAPE TOWN ISIXEKO SASEKAPA STAD KAAPSTAD	ERICA ROAD (R300) BRIDGE GEOTECHNICAL INVESTIGATION	BOREHOLE PHOTOS	15642GG