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REPORT ON SUBSOIL INVESTIGATION AT SITE OF PROPOSED ARCH ROCK RESORT REDEVELOPMENT, KEURBOOMSTRAND

November 2021

K&T PROJECT REFERENCE: 16580GG

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REPORT ON SUBSOIL INVESTIGATION AT SITE OF PROPOSED ARCH ROCK RESORT REDEVELOPMENT, KEURBOOMSTRAND

1. TERMS OF REFERENCE

In terms of written instructions, Kantey & Templer was requested by Mr Ryno Odendaal of De Villiers & Hulme Consulting Engineers to investigate and report on subsoil conditions at the sites identified for the construction of new structures within the existing Arch Rock Resort, Keurboomstrand.

In particular, Kantey & Templer was required to investigate and advise on the following specific aspects:

- Site Geology
- Site Geohydrology
- Excavation Conditions
- Foundation Conditions
- Materials Utilisation Potential
- Subgrade Conditions
- Slope stability along sea facing end of the site.

2. INFORMATION RECEIVED

The following information was available at the time of our investigation:

- 1:250 000 Department of Mines geological map number 3322 for Oudtshoorn (which includes the geology of the Keurboomstrand area).

- Site locality diagrams indicating the layout of the existing roads and extent of the proposed development. Contours and site levels form part of these diagrams.

- Google Earth Imagery of the site.

It was stated that for the resort redevelopment, the existing cottages will be removed and replaced with single storey masonry structures seated conventionally on spread footing foundations. The layout and location of the new buildings will approximate that of the existing structures but with the orientation and size of most of the units altered.

3. SCOPE OF INVESTIGATION

3.1 Field Investigation

As the resort redevelopment also allows for the construction of new buildings along the edge of the dune embankment facing the sea, the geotechnical investigation was aimed at assessment not only of the soils profile at shallow depth within the greater resort area but also of the stability characteristics of the deeper seated soils likely to be encountered at depth along the sea facing embankment. The investigations accordingly comprised the following:

- Rotary drilling of four (4) small diameter exploratory boreholes taken to depths of up to 10,0m below existing ground level. The boreholes were drilled during November 2021. Each hole was drilled employing standard washboring and rotary drilling techniques for the extraction of N sized core.

- In situ penetration (SPT) testing at regular intervals in the boreholes. The SPT tests undertaken in South Africa are performed in accordance with B.S. 1377: Part 9: 1990, “Determination of Penetration Resistance Using a Split Barrel Sampler (SPT)”.

- Recovery of disturbed and undisturbed soil samples during the drilling and penetration testing. These were carefully examined during logging.

- Installation of piezometers in the boreholes for monitoring of the groundwater table.

- Excavation by pick-and-shovel of seven ±1,5m deep trial holes excavated at the positions identified for DPSH probing, initially to check for buried services and subsequently for logging of the subsoil profile.

- Dynamic Probe Super Heavy (DPSH) tests at 7 preselected positions for assessment of the in-situ consistency of the subsoils. In this test a 50mm diameter (600) disposable cone is fitted to the bottom of a steel rod and driven into the ground by means of a 63,5kg trip hammer dropped through 762mm. The number of blows required to drive the cone through each successive 300mm of penetration is recorded, this providing an empirical indication of in-situ consistency which closely matches the results obtained from SPT testing in boreholes.

- Assessment of subsoil conditions by detailed inspection of the materials exposed in the trial holes, examination of the drill core extracted and assessment of the DPSH and SPT results.

- The subsoil profiles and drill core were recorded using standard visual and tactile procedures employing the recommended methods set out in the Guideline for Soil and Rock Logging in SA (2002) and Jennings et al (1973).

The approximate locations of the boreholes, trial holes and DPSH tests are given on Diagram No16580GG-01 whilst the detailed borehole logs, trial hole profiles and DPSH results are attached as follows:

- Appendix A – Borehole Logs
- Appendix B – Trial Hole Profiles
- Appendix C – DPSH Results

3.2 Laboratory Investigation

Disturbed soil samples were taken from two specific soil horizons in the trial holes for laboratory testing and further geotechnical analysis aimed at determining the shear strength parameters and soil constants.

The following laboratory tests were undertaken (all in accordance with the South African Standard, Technical Methods for Highways (TMH), British Standards (BS) and/or other recognised International Standards).

- Soil Specimen Preparation, according to:
  TMH1:1986 and B.S. 1377: Part 1:1990

- Particle Size Distribution, according to:
  TMH1:1986 Test Method A1 and A6

- Atterberg Limits, according to:
  TMH1:1986 Test Method A2 to A4 and B.S. 1377: Part 2:1990

- Direct Shear Tests (Consolidated Drained) according to:
  ASTM D 3080

The laboratory results are not available yet and will be submitted as an addendum to this report upon receipt.

4. ANALYSIS OF RESULTS

4.1 Site Geology and Soils Profile

Based on published geological data and previous geotechnical investigations undertaken in Keurboomstrand, Arch Rock is known to be situated in terrain composed of and underlain by sedimentary strata (largely fractured, medium weathered, medium hard to hard rock quarzitic sandstone and shales) of the Table Mountain Group, Cape Supergroup. These are mantled by 6 to 8m of naturally transported aeolian (windblown) and colluvial sands.

The sandstone and shales form outcrop at beach level to the south of the resort with the transported sands underlying the entire development area to depths of 6 to 8m. The sand generally classifies of fine to locally medium grained. The sand is clean, cohesionless and free of significant quantities of silt and clay. Within the upper 1,0-1,5m of the sandy transported profile however, two significant features were identified which would impact on the design of the building foundations, these being:

- the organic rich nature of the uppermost 0,6m to 0,8m of the subsoil profile. This material presents as dark brown to black, silty sand tending to silt/sand which contains a high percentage of organic matter, decomposed roots and roots. This material was deposited over many years with in-situ decomposition resulting in a profile of highly compressible material.

- the presence within the sandy soils down to ± 1,5 to 2,0m of either sparse, hard rock quartzitic sandstone gravel, cobbles and boulder fragments or a well-developed tightly packed ±200m thick layer of angular quartzitic sandstone cobbles and boulders which resemble slab-like concretions of hard rock silcrete. This material could not be penetrated by pick and shovel over the area of several of the trial holes.

  In terms of in-situ consistency, the subsoil profile is in general:

  - considered to be of unacceptably low strength within the organic layer of 'topsoil',

  - considered to be of perfectly acceptable medium dense and competent nature at depths of from 0,5-1,2m below the existing ground level.

4.2 Site Geohydrology

Groundwater was encountered at the following depths:

POSITION	DEPTH OF GROUNDWATER
BH1	4,5m below existing ground level
BH2	4,7m below existing ground level
BH3	4,7m below existing ground level
BH4	2,6m below existing ground level

The groundwater represents a seasonally fluctuating water table which is perched on the bedrock which underlies the site at depth. The current water levels represent conditions likely to be encountered during the dry summer months.

During the rainy season and periods of high rainfall, water levels will rise. Typical seasonal fluctuation of the order of 1,5 – 2,0m can be anticipated.

Given the above, groundwater seepages can be expected in deep services trenches or pits. The water can be expected to emanate from the sidewalls of excavations formed for below grade installation of sewers etc., where construction is programmed for the rainy season.

4.3 Excavation Conditions

In view of the largely 'non-cohesive' granular nature of the transported sands, excavation conditions are largely considered to be favourable. Machine excavation and trenching should therefore not pose any untoward problems with excavation conditions generally classifying as 'soft excavation' in terms of SANS 1200D.

The quartzitic sandstone within the upper sandy soils, in particular where developed into slab-like deposits of hard rock will however require the use of heavier machines for cost effective removal. These machines may need to be fitted with rock buckets or pneumatic hammers to facilitate loosening of the profile.

The shear strength of the sandy site soils is considered low and significant instability of steeply cut unsupported sidewalls of deep services trenches can be expected. Where cut to 45°, cuttings remote from existing services and roads should provide the necessary stability.

In contrast to the 'cohesionless' sands, the organic rich silty materials encountered in the upper 0,6-0,8m of the profile are significantly less susceptible to collapse and of sufficient strength to be cut almost vertically in foundation trenches.

4.4 Founding Conditions

Specific advice on founding conditions for individual structures will not be possible unless each is analysed taking founding levels, foundation type/dimensions, anticipated structural loading, pre-construction earthworks preparations and the subsoil profile into account.

However, based on our observations on site, the results of the geotechnical testing undertaken and the fact that the new buildings will be of single level construction and seated on conventional spread footings, conditions for the use of standard foundations founded at shallow depth *are generally considered to be favourable over the area of the buildings located well away from the dune scarp along the southern end of the site.* The underlying medium dense naturally transported sandy soils will readily provide stable support to spread footings which are dimensioned not to exceed a maximum permissible bearing pressure of 125kPa, *provided these are taken through the organic rich soils and seated at the following levels (or deeper.)*

LOCATION	FOUNDING LEVEL (M BELOW GROUND LEVEL)
Area of BH 1	Not Applicable
Area of BH 2	Not Applicable
Area of BH 3	0,80m
Area of BH 4	0,80m
Area of DPSH 1	1,00m
Area of DPSH 2	0,50m
Area of DPSH 3	0,70m
Area of DPSH 4	0,70m
Area of DPSH 5	1,20m
Area of DPSH 6	Not Applicable
Area of DPSH 6	Not Applicable

Insofar as founding of the units along the sea facing embankment is concerned, the boreholes and DPSH testing indicated that the subsoil conditions along that end of the site are poor. With SPT 'N' values as low as 3 to 5 recorded to depths of ± 4,5m below ground level, the bearing capacity of the subsoils is considered at best, marginal.

Given the proximity of the embankment, these low strength soils are also considered to potentially be at risk of downslope yielding, in particular where subjected to the surcharge loading effected by the structures proposed for this end of the site. For this reason and in order to determine the need for the introduction of non-standard foundations for these buildings, we have undertaken a slope stability analysis to establish the risk of such instability along the embankment scarp area.

4.4.1 **Analysis of Slope**

Although we have not yet received the laboratory test results, examination of the soils exposed in the trial holes and extracted from the boreholes indicated that the in-situ shear strength of the colluvium would classify as 'low' to 'marginal'. In contrast, the bedrock which occurs at 6-8m depth is significantly more competent and of 'high' shear strength.

Using the *existing slope geometry* which is based on site levels extrapolated from existing survey data and the levels of the different soil horizons observed on site, a slope stability model was created for the analysis. Use was made of the computer programme SLIDE version 6.0 employing 2D Limit Equilibrium Slope Stability Analysis

developed by Rocscience. The non-circular slope analysis method of Spencer and Morgenstern-Price was selected throughout.

We have assigned estimated strength parameters to the sandy subsoils for our analysis. These were based on our observations on site, tests previously undertaken on similar soils and data derived from soil property tables as suggested by Jennings et al (1973).

The material properties used in the analysis were taken as:

Layer	**Cohesion (c) kPa**	**Angle of Internal Friction Ø**	**Unit Weight (kN/m^3)**
Transported Sands	0	28	18.0
Bedrock	500	28	22,0

The analysis indicated that where the buildings are seated conventionally on spread footing foundations constructed at shallow depths, the risk of movement (downslope yielding) of the foundations would be unacceptably high with the Factor of Safety (F.O.S) against slope failure outside acceptable limits, in particular where the subsoils are of high moisture content due to leaking services, high rainfall etc.

A graphical presentation of the slope analysed is given in Appendix D.

4.4.2 Founding of Buildings along Potentially Unstable Embankment

It is interesting to note that the buildings existing along the embankment at present reflect cracking and separation of the sea facing patio areas which are consistent with downslope yielding of the subsoils.

In order to ensure that the new buildings are not at risk of similar yielding or adverse foundation movement, the footings would best be seated at depths where high-capacity soils which are not at risk of semi-circular downslope yielding occur.

Given the non-cohesive nature of the sandy soils however, deep excavation which would allow for the construction of spread footings in stable material is not considered a viable option *with piles offering the most appropriate solution*.

While a wide range of pile types are on offer form local contractors, the following site conditions/constraints will influence the selection of the most appropriate pile type.

- Site access restrictions and positioning of the piles.
- Proximity of existing structures and sensitivity to vibration.
- The presence of a boulder gravel layer (s) at shallow depth.
- The relatively small number of piles required.

Given the above and having regard for the pile types on offer, it is recommended that the foundation loads be taken onto/into competent sandy soils of bedrock at depth by way of either Self Drill Nails (piles) or Percussion (Rota) piles.

Self Drill Pile (Micropile)

Pile Diameter: 100 – 200mm	**Typical Working Load: 225 – 700kN**
Advantages	***Disadvantages***
o Micropiles can be installed in limited access and headroom conditions. o Micropiles can be installed with minimum disturbance to adjacent structures with the appropriate installation methodology. o Micropiles can be installed through existing foundations and are ideally suited to underpinning and as load enhancement of existing foundations. o Due to its high capacity steel reinforcing elements, the self drill piles have high uplift load capacity and can effectively be used for tension structures. o Due to the wide range of installation methods available and the relative ease of penetrating boulders or hard rock formations, micropiles can be economically installed in difficult ground conditions.	o The relatively high cost of micropiles will preclude their use in normal access and soil conditions where conventional pile methodologies are more economical. o Careful assessment of groundwater conditions is essential to ensure corrosive durability of the main load-bearing steel reinforcing elements. o Micropiles are slender members and buckling effects need to be carefully assessed. o Limited horizontal load capacity

Percussion Pile (Rotapile)

Pile Diameter: 255 – 610mm	**Typical Working Load: 300 – 1500kN**
Advantages	***Disadvantages***
o A good range of pile diameters are available for moderately applied loads. o The ability to penetrate hard rock and boulder horizons. o Rock-sockets can be formed relatively easily and economically. o Casing installation associated with the DTH drilling technique provides high levels of pile shaft integrity. o Noise levels are limited to the noise from the equipment. o There is limited vibration associated with the DTH operation. o Depths of up to 30 metres are possible depending on the diameter of the pile.	o The pile is relatively expensive compared to a driven pile with equivalent load capacity. o The introduction of large quantities of air by the DTH system into voided/sensitive subsoil conditions can cause problems with surrounding structures. o Grout must be used on smaller diameters. o Casing will be required in the non-cohesive sandy soils. o Noise and dust pollution generated during installation.

In order establish the most cost effective piling solution for Arch Rock, you will be well advised to select the piling solution in consultation with your preferred Piling Contactor prior to final design and detailing of the ground beams and surface beds. The borehole logs and DPSH results should be made available to the Piling Contractor with their piling design undertaken accordingly.

4.5 Subgrade Conditions for Roads

While we have not been provided with details of any possible landscaping proposals and re-alignment of the roads in Arch Rock, the following may be of relevance in the assessment of road construction (re-construction) options:

- The near surface soils contain high percentages of organic matter throughout the complex.

- The near surface soils and by implication, the materials likely to be exposed in road box cuts, will be highly moisture sensitive and classify as a G9 material only. Exposure of these soils will be best undertaken in ‘dry’ weather conditions to prevent undue softening and deterioration.

- Pavement layerworks design should consider the in-situ soils no better than G9 material with base and/or subbase constructed accordingly.

5. CONCLUSIONS

- The Arch Rock subsoil profile comprises, for the most part, transported fine to medium grained windblown and colluvial sands, generally of medium dense consistency. The sand is underlain at 6-8m depth by bedrock presenting as medium hard to hard rock quartzitic sandstone and shale.

- The upper profile contains up to 800mm of organic rich compressible soils.

- Hard rock quartzitic sandstone boulders, cobbles and gravel occur within the sandy profile down to depths of about 2,0m.

- Founding conditions for the bulk of the site are such that spread footings dimensioned not to exceed a maximum permissible bearing pressure of 175 kPa may be used for the new structures. Founding is possible within the upper 1,0m of the subsoil profile.

- The buildings along the embankment facing the sea will, due to the presence of low strength soils and the risk of slope instability, have to be piled.

- Piling options should be finalised in consultation with a specialist geotechnical contractor and his design engineers.

6. GENERAL

The recommendations and discussions presented in this report are based on the subsurface conditions encountered during the site work at the time of investigation and on the results of the field and laboratory testing. There may be, however, conditions pertaining to the site which have not been taken into account due to the frequency of the boreholes and trial holes.

It is expected that once the new structures have been set out and bulk earthworks have commenced, further inspections of foundation excavations etc. will be undertaken with the assistance of the geotechnical engineers and/or tests be carried out for approval of founding/subgrade conditions throughout.

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LEGEND

- BH4 — Approximate Location of Borehole
- DPSH 1 — Approximate Location of DPSH probe
- DPSH 1 / TH 1 — Approximate Location of DPSH probe with Trial Hole adjacent to DPSH

0 5 10 15 20m

KANTEY & TEMPLER CONSULTING ENGINEERS

CLIENT: deVilliers&Hulme Est. 1983 — Consulting Structural & Civil Engineers, Project Managers, Raadgewende Strukturele & Siviele Ingenieurs, Projek Bestuurders

PROJECT: KEURBOOMS ROCK DEVELOPMENT PLETTENBERG BAY

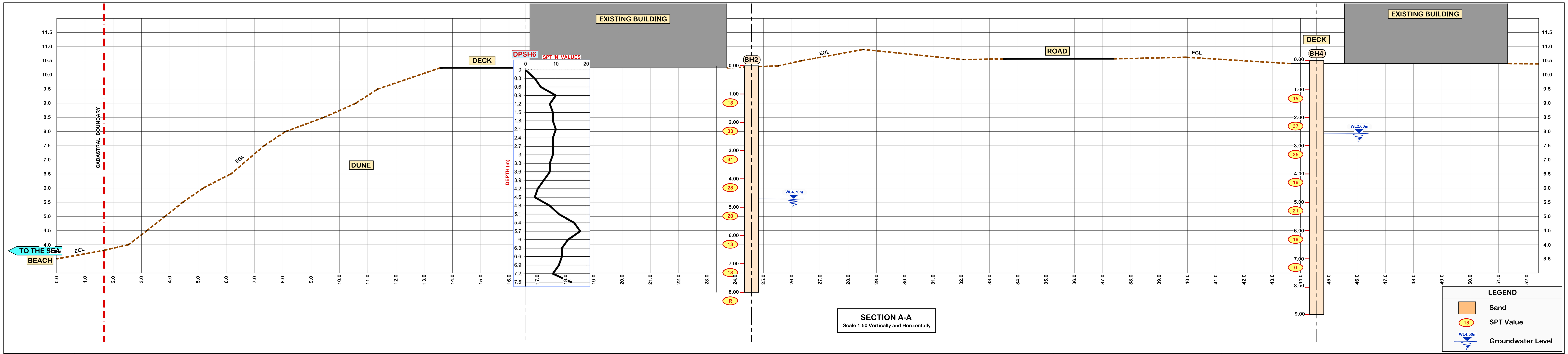
TITLE: EXPLORATORY HOLE LOCATION PLAN

Scale: AS SHOWN

Drawing No.: 16580GG-01

Rev.:

Y:\DWG-G\16580GG Keurbooms Rock Development\20019GG Keurbooms Rock Development Keurbooms River\Working\20019GG Keurbooms Rock Development Exploratory Hole Location Plan.dwg 26/11/2021 01:08 Shirley Mossop



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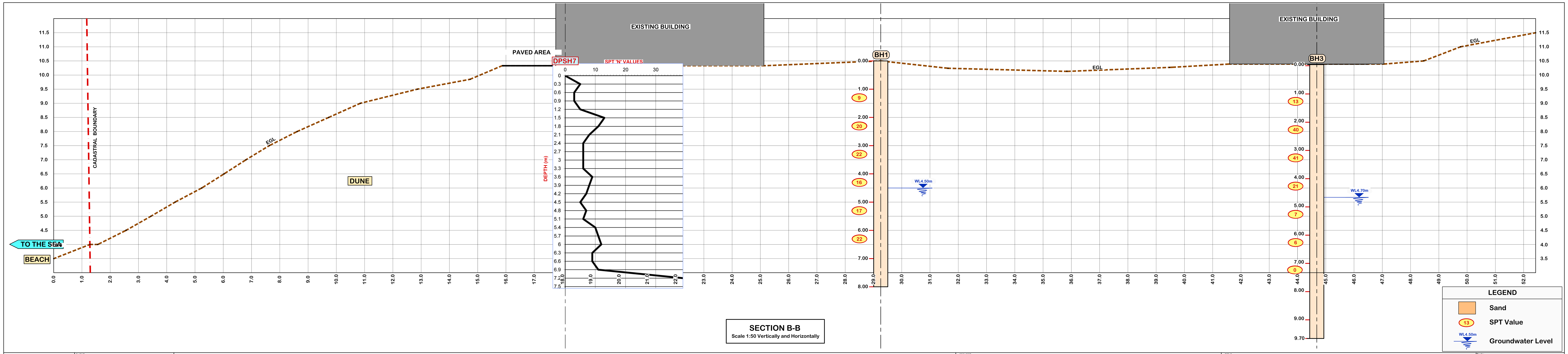
KEURBOOMS ROCK DEVELOPMENT PLETTENBERG BAY

SECTION A-A THROUGH EXPLORATORY HOLES

AS SHOWN

16580GG-10



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KEURBOOMS ROCK DEVELOPMENT PLETTENBERG BAY

SECTION B-B THROUGH EXPLORATORY HOLES

AS SHOWN

16580GG-11

Appendix A

Borehole Logs

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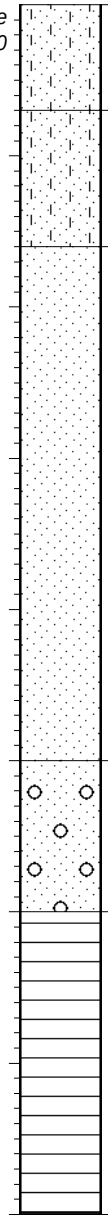
DE VILLIERS & HULME
KEURBOOMSTRAND DEVELOPMENT

HOLE No: BH1
Sheet 1 of 1

JOB NUMBER: 16580GG

DRILLING METHOD	CORE REC.	RQD %	FRACT. PER m	TEST OR SAMPLE	VALUE
	40				
	33			SPT	9
	36				
	62			SPT	20
	24				
	51			SPT	22
	34				
NWD4	49	NA	NA	SPT	16
	30				
	44			SPT	17
	40				
	29			SPT	22
	28				
	75				
	100				

Scale 1:50



0.00	Moist to very moist dark brown to black loose to medium dense organic rich silty SAND tending to silt/sand locally; TRANSPORTED.
0.70	Very moist olive brown medium dense slightly silty fine SAND; TRANSPORTED.
1.60	Light yellowish olive to light grey medium dense fine to medium grained SAND; TRANSPORTED.
5.00	Light brown medium dense fine to medium grained SAND with isolated quartzitic sandstone gravel; TRANSPORTED.
6.00	Dark grey steeply dipping medium weathered to slightly weathered hard to very hard rock SHALE; TABLE MOUNTAIN GROUP, CAPE SUPER GROUP.
8.00	

NOTES

1) Temporary casing installed to 0.00--7.00m depth.
2) Groundwater encountered at 4.50m depth.
3) Upper +/- 1,5m of profile recorded in hand dug trial hole.

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

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

INCLINATION : VERTICAL
DIAM :
DATE :
DATE : 05-11-2021

DATE : 01/12/2021 14:03
TEXT : ..tt\Boreholes\B165801.txt

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

HOLE No: BH1
Reinstrumentation

KANTEY & TEMPLER
CONSULTING ENGINEERS
ESTABLISHED 1953

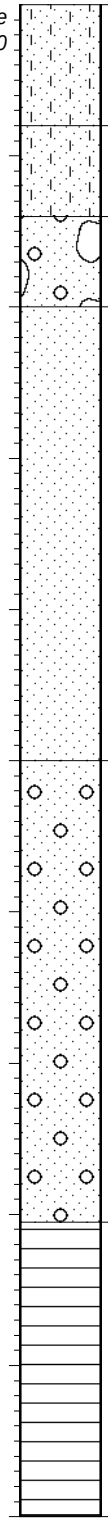
DE VILLIERS & HULME
KEURBOOMSTRAND DEVELOPMENT

HOLE No: BH2
Sheet 1 of 1

JOB NUMBER: 16580GG

DRILLING METHOD	CORE REC.	RQD %	FRACT. PER m	TEST OR SAMPLE	VALUE
	47				
	56			SPT	13
	20				
	40			SPT	33
	30				
	53			SPT	31
	30				
	38			SPT	28
NWD4 & NBLC	30	NA	NA		
	49			SPT	20
	39				
	0			SPT	13
	31				
	31			SPT	18
	25				
	100			SPT	R
	85				
	100				

Scale 1:50



0.00	Moist to very moist dark brown to black loose to medium dense organic rich silty SAND tending to silt/sand locally; TRANSPORTED.
0.80	Very moist olive brown medium dense slightly silty fine SAND; TRANSPORTED.
1.40	Light grey and dark grey angular hard rock quartzitic sandstone BOULDERS and occasional gravel dense packed in a subordinate matrix of dark brown and light olive SAND; TRANSPORTED.
2.00	Light yellowish olive to light grey medium dense fine to medium grained SAND; TRANSPORTED.
5.00	Light brown medium dense fine to medium grained SAND with isolated quartzitic sandstone gravel; TRANSPORTED.
8.05	Dark grey steeply dipping medium weathered to slightly weathered hard to very hard rock SHALE; TABLE MOUNTAIN GROUP, CAPE SUPER GROUP.
10.00	

NOTES

1) Temporary casing installed to 0.00--8.00m depth.
2) Goundwater encountered at 4.70m depth.
3) Upper +/- 1,5m of profile recorded in hand dug trial hole.

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

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

INCLINATION : VERTICAL
DIAM :
DATE :
DATE : 05-11-2021

DATE : 01/12/2021 14:04
TEXT : ..tt\Boreholes\B165802.txt

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

HOLE No: BH2
Reinstrumentation

KANTEY & TEMPLER
CONSULTING ENGINEERS
ESTABLISHED 1953

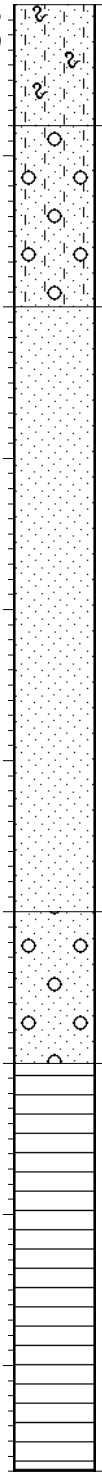
DE VILLIERS & HULME
KEURBOOMSTRAND DEVELOPMENT

HOLE No: BH3
Sheet 1 of 1

JOB NUMBER: 16580GG

DRILLING METHOD	CORE REC.	RQD %	FRACT. PER m	TEST OR SAMPLE	VALUE
	44				
	29			SPT	13
	21				
	56			SPT	40
	25				
	53			SPT	41
	34				
	38			SPT	21
NWD4 & NBLC	30	NA	NA		
	0			SPT	7
	28				
	0			SPT	6
	30				
	0			SPT	R
	70				
	100				
	100				

Scale 1:50



0.00 Moist to very moist dark brown to black loose to medium dense organic rich silty SAND tending to silt/sand locally with thick tree roots; TRANSPORTED.

0.80 Very moist olive brown medium dense slightly silty fine SAND with isolated angular sandstone gravel and cobble sized fragments; TRANSPORTED.

2.00 Light yellowish olive to light grey medium dense fine to medium grained SAND; TRANSPORTED.

6.00 Light brown medium dense fine to medium grained SAND with isolated quartzitic sandstone gravel; TRANSPORTED.

7.00 Dark grey steeply dipping medium weathered to slightly weathered hard to very hard rock SHALE; TABLE MOUNTAIN GROUP, CAPE SUPER GROUP.

9.70

NOTES

1) Temporary casing installed to 0.00--8.00m depth.
2) Goundwater encountered at 4.70m depth.
3) Upper +/- 1,5m of profile recorded in hand dug trial hole.

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

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

INCLINATION : VERTICAL
DIAM :
DATE :
DATE : 05-11-2021

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TEXT : ..tt\Boreholes\B165803.txt

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

HOLE No: BH3
Reinstrumentation

KANTEY & TEMPLER
CONSULTING ENGINEERS
ESTABLISHED 1953

DE VILLIERS & HULME
KEURBOOMSTRAND DEVELOPMENT

HOLE No: BH4
Sheet 1 of 1

JOB NUMBER: 16580GG

DRILLING METHOD	CORE REC.	RQD %	FRACT. PER m	TEST OR SAMPLE	VALUE
	40				
	58			SPT	15
	10				
	69			SPT	37
	27				
	62			SPT	35
	30				
	40			SPT	16
NWD4 & NBLC	30	NA	NA		
	36			SPT	21
	35				
	53			SPT	16
	35				
	0			SPT	R
	23				
	100				

Scale 1:50

0.00	Moist to very moist dark brown to black loose to medium dense organic rich silty SAND tending to silt/sand locally; TRANSPORTED.
0.80	Very moist olive brown medium dense slightly silty fine SAND; TRANSPORTED.
1.20	Light grey and dark grey angular hard rock quartzitic sandstone BOULDERS and occasional gravel densely packed in a subordinate matrix of dark brown and light olive SAND; TRANSPORTED.
1.50	Light yellowish olive to light grey medium dense fine to medium grained SAND; TRANSPORTED.
5.50	Light brown medium dense fine to medium grained SAND with isolated quartzitic sandstone gravel; TRANSPORTED.
7.00	Dark grey steeply dipping medium weathered to slightly weathered hard to very hard rock SHALE; TABLE MOUNTAIN GROUP, CAPE SUPER GROUP.
9.00	

NOTES

1) Temporary casing installed to 0.00--7.00m depth.
2) Goundwater encountered at 2.60m depth.
3) Upper +/- 1,5m of profile recorded in hand dug trial hole.

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

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

INCLINATION : VERTICAL
DIAM :
DATE :
DATE : 05-11-2021

DATE : 01/12/2021 14:05
TEXT : ..tt\Boreholes\B165804.txt

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

HOLE No: BH4
Reinstrumentation

Appendix B

Trial Hole Profiles

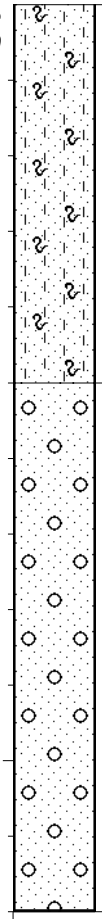
KANTEY & TEMPLER
CONSULTING ENGINEERS
ESTABLISHED 1953

KEURBOOMSTRAND DEVELOPMENT
DE VILLIERS & HULME

HOLE No: DPSH 1 / TH1
Sheet 1 of 1

JOB NUMBER: 16580GG

Scale 1:10



0.00 Moist dark brown medium dense silty SAND with dense concentrations of tree roots; TRANSPORTED (organic rich 'topsoil').

0.50 Very moist light greyish olive dense fine SAND containing isolated quartzitic sandstone gravel and cobbles; TRANSPORTED.

1.20

NOTES

1) Trial hole terminated at 1.2m depth.

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY : FDT

INCLINATION : Vertical
DIAM :
DATE : 05-11-2021
DATE : 24-11-2021

ELEVATION :
X-COORD :
Y-COORD :

HOLE No: DPSH 1 / TH1

TYPE SET BY : LL
SETUP FILE : K&T-TR~1.SET

DATE : 01/12/2021 14:06
TEXT : ..t\TrialHoles\G165801.txt

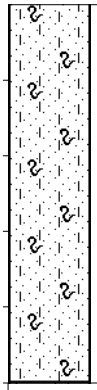
KANTEY & Ttempler
CONSULTING ENGINEERS
ESTABLISHED 1953

KEURBOOMSTRAND DEVELOPMENT
DE VILLIERS & HULME

HOLE No: DPSH 2 / TH2
Sheet 1 of 1

JOB NUMBER: 16580GG

Scale 1:10



0.00 Moist dark brown medium dense silty SAND with dense concentrations of tree roots; TRANSPORTED (organic rich 'topsoil').

0.50

NOTES

1) Trial hole terminated at 0.5m depth due to the presence of abundant large tree roots.

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY : FDT

INCLINATION : Vertical
DIAM :
DATE : 05-11-2021
DATE : 24-11-2021

ELEVATION :
X-COORD :
Y-COORD :

HOLE No: DPSH 2 / TH2

TYPE SET BY : LL
SETUP FILE : K&T-TR~1.SET

DATE : 29/11/2021 11:31
TEXT : ..t\TrialHoles\G165802.txt

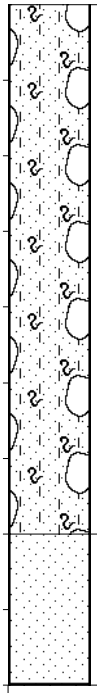
KANTEY & Ttempler
CONSULTING ENGINEERS
ESTABLISHED 1953

KEURBOOMSTRAND DEVELOPMENT
DE VILLIERS & HULME

HOLE No: DPSH 3 / TH3
Sheet 1 of 1

JOB NUMBER: 16580GG

Scale 1:10



0.00 Very moist dark brown to black loose to medium dense organic rich silty SAND containing isolated angular cobbles and boulder fragments of quartzitic sandstone with abundant tree roots; TRANSPORTED (organic rich 'topsoil').

0.70 Very moist greyish olive medium dense to dense fine SAND; TRANSPORTED.

0.90

NOTES

1) Trial hole terminated at 0.9m depth.

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY : FDT

INCLINATION : Vertical
DIAM :
DATE : 05-11-2021
DATE : 24-11-2021

ELEVATION :
X-COORD :
Y-COORD :

HOLE No: DPSH 3 / TH3

TYPE SET BY : LL
SETUP FILE : K&T-TR~1.SET

DATE : 01/12/2021 14:06
TEXT : ..t\TrialHoles\G165803.txt

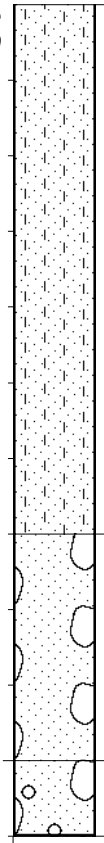
KANTEY & TEMPLER
CONSULTING ENGINEERS
ESTABLISHED 1953

KEURBOOMSTRAND DEVELOPMENT
DE VILLIERS & HULME

HOLE No: DPSH 4 / TH4
Sheet 1 of 1

JOB NUMBER: 16580GG

Scale 1:10



0.00 Moist dark brown to black loose to medium dense organic rich silty SAND; TRANSPORTED (organic rich 'topsoil').

0.70 Dark brown medium dense SAND with isolated angular quartzitic sandstone boulder fragments; TRANSPORTED.

1.00 Light grey and dark grey angular hard rock quartzitic sandstone BOULDERS and occasional gravel densely packed in a subordinate matrix of dark brown and light olive SAND; TRANSPORTED.

1.10

NOTES

1) Trial hole terminated at 1.1m depth.

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY : FDT

TYPE SET BY : LL
SETUP FILE : K&T-TR~1.SET

INCLINATION : Vertical
DIAM :
DATE : 05-11-2021
DATE : 24-11-2021

DATE : 01/12/2021 14:07
TEXT : ..t\TrialHoles\G165804.txt

ELEVATION :
X-COORD :
Y-COORD :

HOLE No: DPSH 4 / TH4

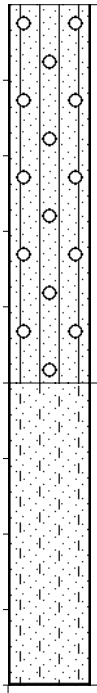
KANTEY & Ttempler
CONSULTING ENGINEERS
ESTABLISHED 1953

KEURBOOMSTRAND DEVELOPMENT
DE VILLIERS & HULME

HOLE No: DPSH 5 / TH5
Sheet 1 of 1

JOB NUMBER: 16580GG

Scale 1:10



0.00 Moist to very moist dark brown to black loose to medium dense organic rich silty SAND tending to silt/sand with scattered gravel locally; TRANSPORTED (organic rich 'topsoil').

0.50 Very moist olive brown medium dense slightly silty fine SAND; TRANSPORTED.

0.90

NOTES

1) Hole excavated by hand.

2) Trial hole terminated at 0.9m depth on sewer pipe.

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY : FDT

INCLINATION : Vertical
DIAM :
DATE : 05-11-2021
DATE : 24-11-2021

ELEVATION :
X-COORD :
Y-COORD :

HOLE No: DPSH 5 / TH5

TYPE SET BY : LL
SETUP FILE : K&T-TR~1.SET

DATE : 29/11/2021 11:38
TEXT : ..t\TrialHoles\G165805.txt

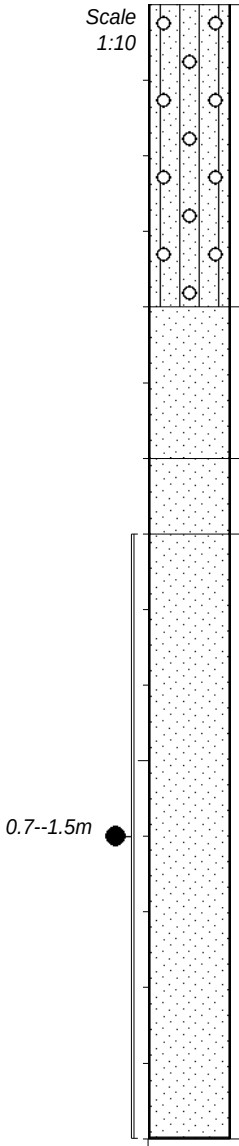
KANTEY & TEMPLER
CONSULTING ENGINEERS
ESTABLISHED 1953

KEURBOOMSTRAND DEVELOPMENT
DE VILLIERS & HULME

HOLE No: DPSH 6 / TH6
Sheet 1 of 1

JOB NUMBER: 16580GG

Scale 1:10



0.00 Moist to very moist dark brown to black loose to medium dense organic rich silty SAND tending to silt/sand with scattered gravel locally; TRANSPORTED (organic rich 'topsoil').

0.40 Moist light yellowish grey medium dense fine SAND; FILL.

0.60 Moist dark brown medium dense slightly organic fine SAND; TRANSPORTED.

0.70 Moist light yellow medium dense SAND; TRANSPORTED.

1.50

NOTES

1) Trial hole excavated by hand and terminated at 1.5m depth.

2) Disturbed soil sample taken at 0.7--1.5m depth.

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY : FDT

INCLINATION : Vertical
DIAM :
DATE : 05-11-2021
DATE : 24-11-2021

ELEVATION :
X-COORD :
Y-COORD :

HOLE No: DPSH 6 / TH6

TYPE SET BY : LL
SETUP FILE : K&T-TR~1.SET

DATE : 29/11/2021 11:40
TEXT : ..t\TrialHoles\G165806.txt

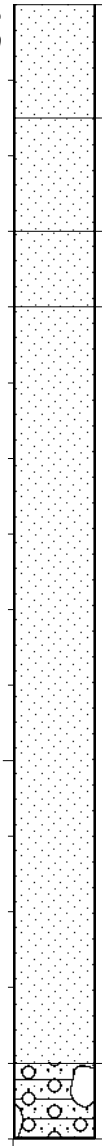
KANTEY & Ttempler
CONSULTING ENGINEERS
ESTABLISHED 1953

KEURBOOMSTRAND DEVELOPMENT
DE VILLIERS & HULME

HOLE No: DPSH 7/ TH7
Sheet 1 of 1

JOB NUMBER: 16580GG

Scale 1:10



0.00	Very moist brown loose to medium dense organic rich SAND; TRANSPORTED (TOPSOIL).
0.15	Very moist black loose organic SAND; FILL.
0.30	Moist light olive brown becoming light olive loose to medium dense SAND; TRANSPORTED.
0.40	Moist olive brown becoming light olive loose to medium dense SAND; TRANSPORTED.
1.40	Light grey and dark grey angular hard rock quartzitic sandstone GRAVEL and cobble sized boulder fragments densely packed in a matrix of light olive sand; TRANSPORTED.
1.50	

NOTES

1) Trial hole excavated by hand and terminated at 1.5m depth.

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY : FDT

INCLINATION : Vertical
DIAM :
DATE : 05-11-2021
DATE : 24-11-2021

ELEVATION :
X-COORD :
Y-COORD :

HOLE No: DPSH 7/ TH7

TYPE SET BY : LL
SETUP FILE : K&T-TR~1.SET

DATE : 01/12/2021 14:08
TEXT : ..t\TrialHoles\G165807.txt

Appendix C

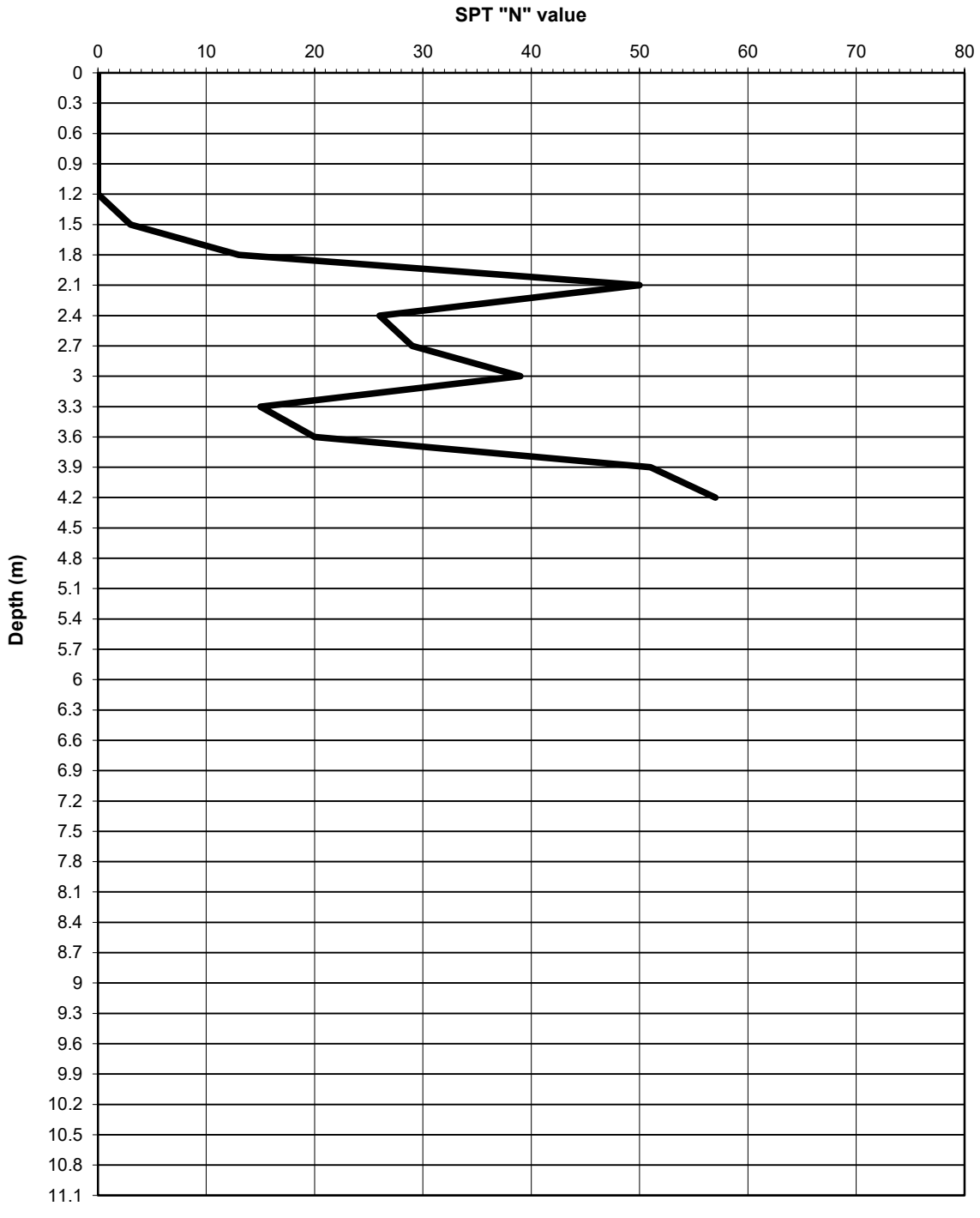
DPSH Test Results

KANTEY & TEMPLER
CONSULTING ENGINEERS
Engineering African Development

CLIENT:	DE VILLIERS & HULME	**PROJECT:**	Keurboom Strand, Plettenberg Bay
FIELD TECHNICIAN:	Neville (Fairbrother)	**JOB No:**	16580GG
		DATE:	11/11/2021

DPSH DATA

DPSH No:	1	**REMARKS:**	Test carried out from 1,2m below ground level

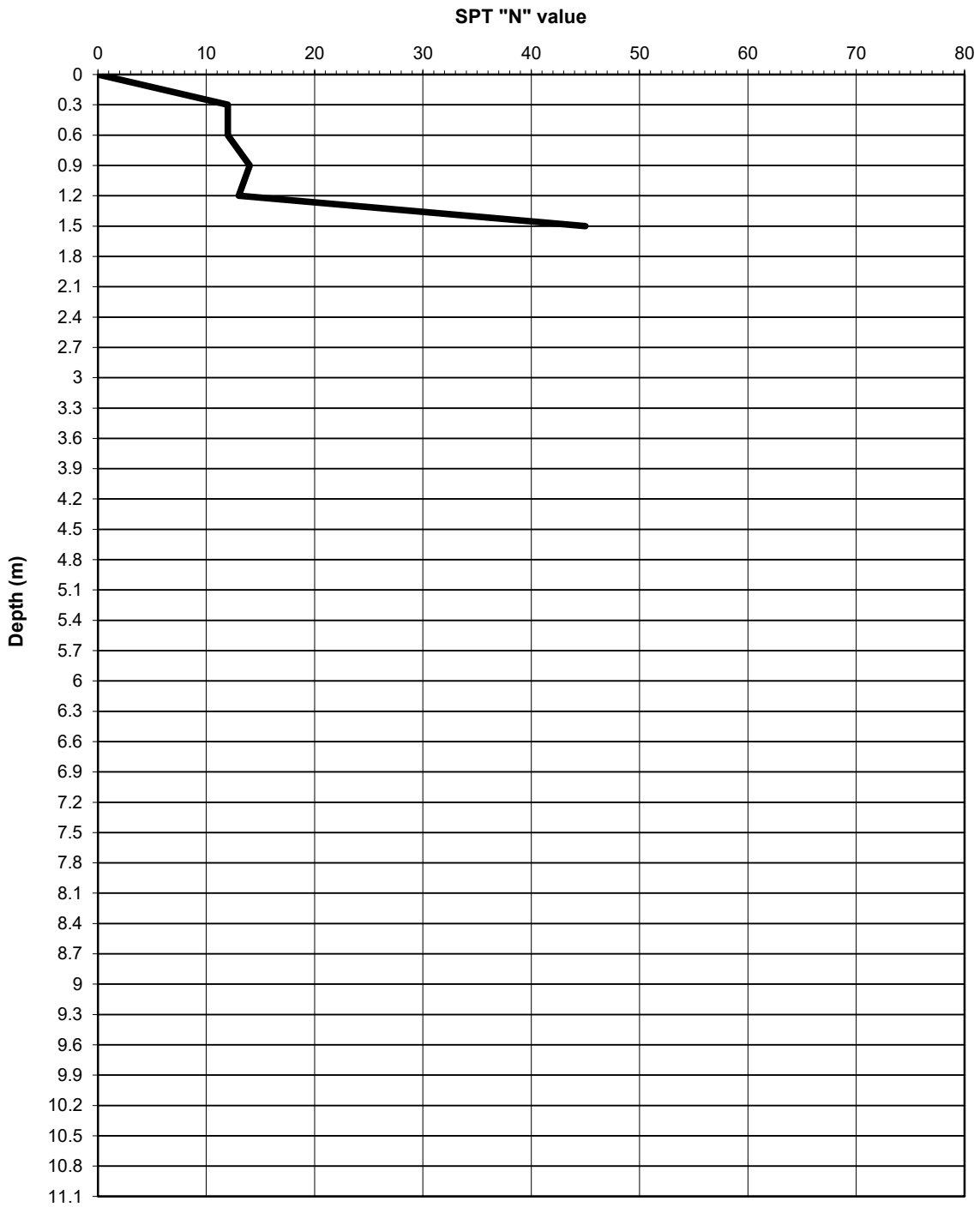


KANTEY & TEMPLER
CONSULTING ENGINEERS
Engineering African Development

CLIENT:	DE VILLIERS & HULME	**PROJECT:**	Keurboom Strand, Plettenberg Bay
FIELD TECHNICIAN:	Neville (Fairbrother)	**JOB No:**	16580GG
		DATE:	11/11/2021

DPSH DATA

DPSH No:	2	**REMARKS:**	Test caried out from ground level

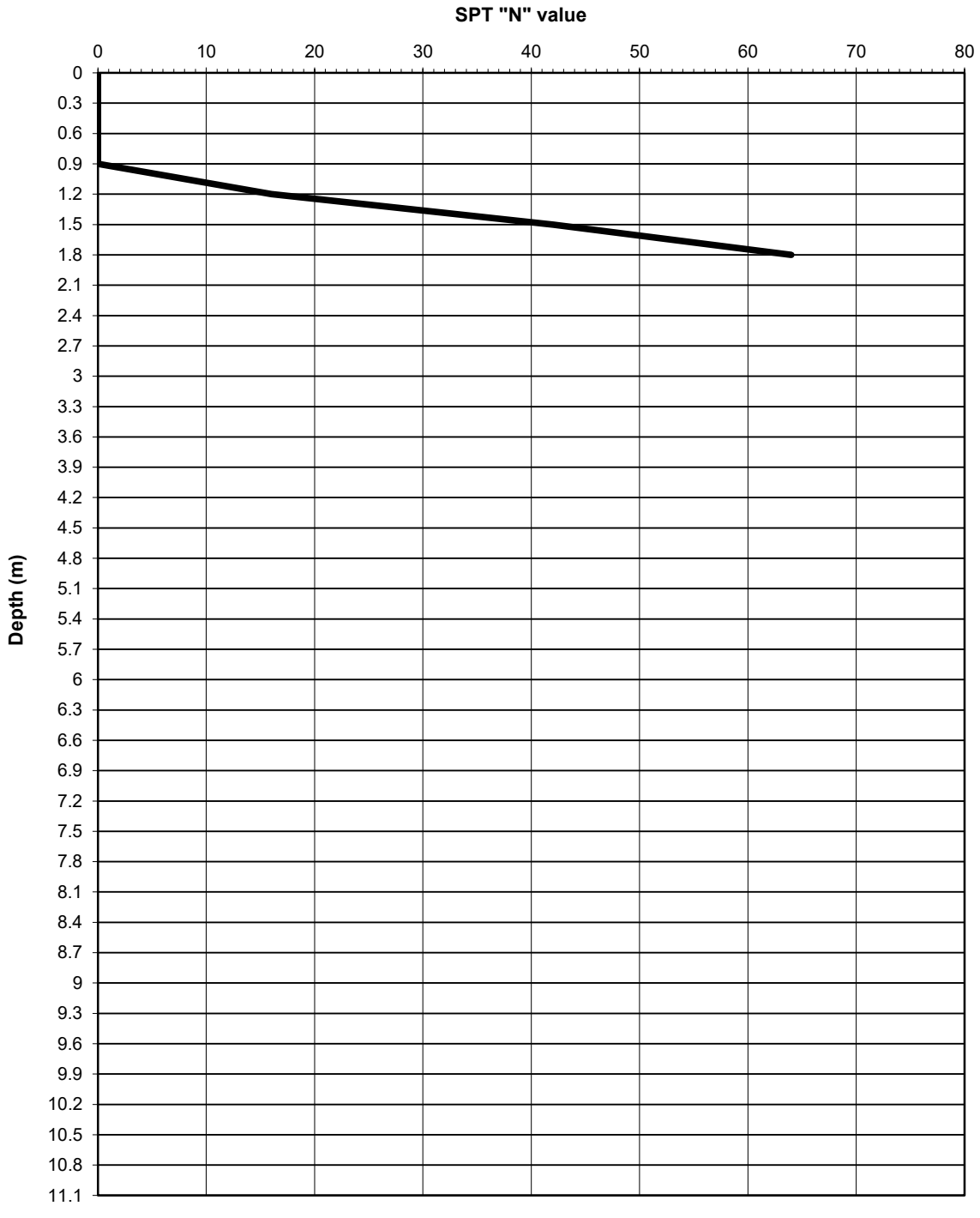


KANTEY & TEMPLER
CONSULTING ENGINEERS
Engineering African Development

CLIENT:	DE VILLIERS & HULME	**PROJECT:**	Keurboom Strand, Plettenberg Bay
FIELD TECHNICIAN:	Neville (Fairbrother)	**JOB No:**	16580GG
		DATE:	11/11/2021

DPSH DATA

DPSH No:	3	**REMARKS:**	Test Carried out from 0.9m depth

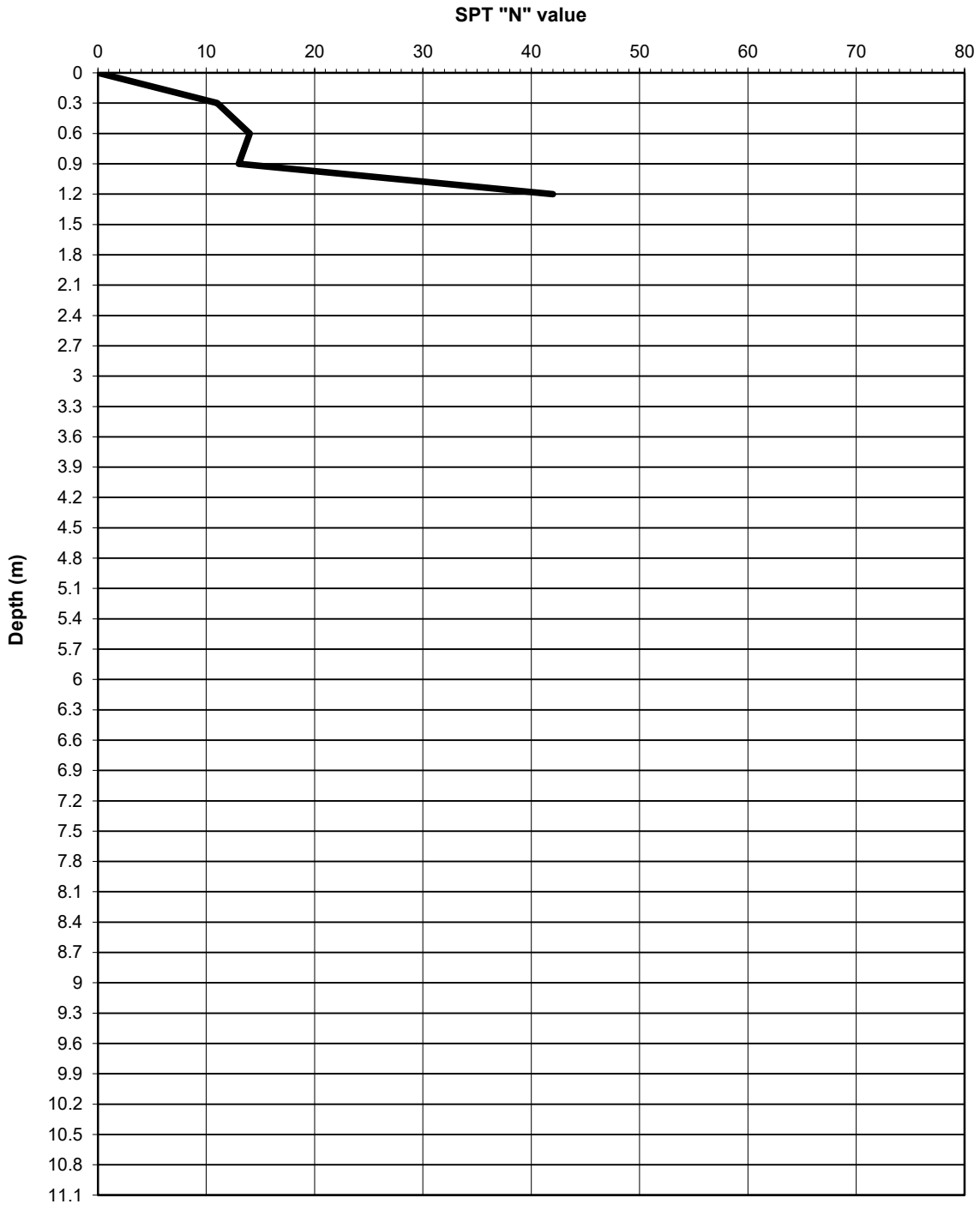


KANTEY & TEMPLER
CONSULTING ENGINEERS
Engineering African Development

CLIENT:	DE VILLIERS & HULME	**PROJECT:**	Keurboom Strand, Plettenberg Bay
FIELD TECHNICIAN:	Neville (Fairbrother)	**JOB No:**	16580GG
		DATE:	11/11/2021

DPSH DATA

DPSH No:	4	**REMARKS:**	Test Carried out from 0.9m depth

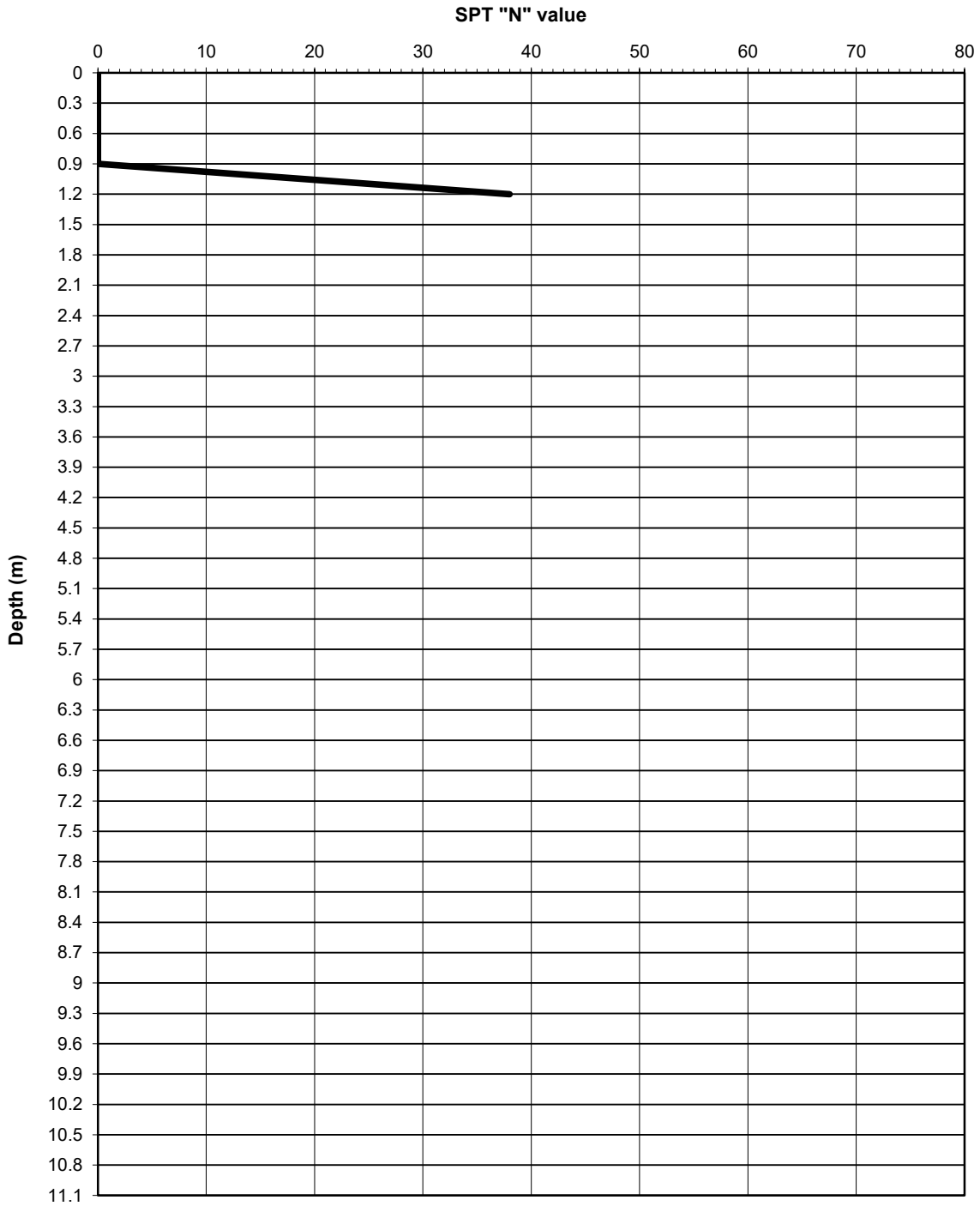


KANTEY & TEMPLER
CONSULTING ENGINEERS
Engineering African Development

CLIENT:	DE VILLIERS & HULME	**PROJECT:**	Keurboom Strand, Plettenberg Bay
FIELD TECHNICIAN:	Neville (Fairbrother)	**JOB No:**	16580GG
		DATE:	11/11/2021

DPSH DATA

DPSH No:	4A	**REMARKS:**	Test Carried out from 0.9m depth

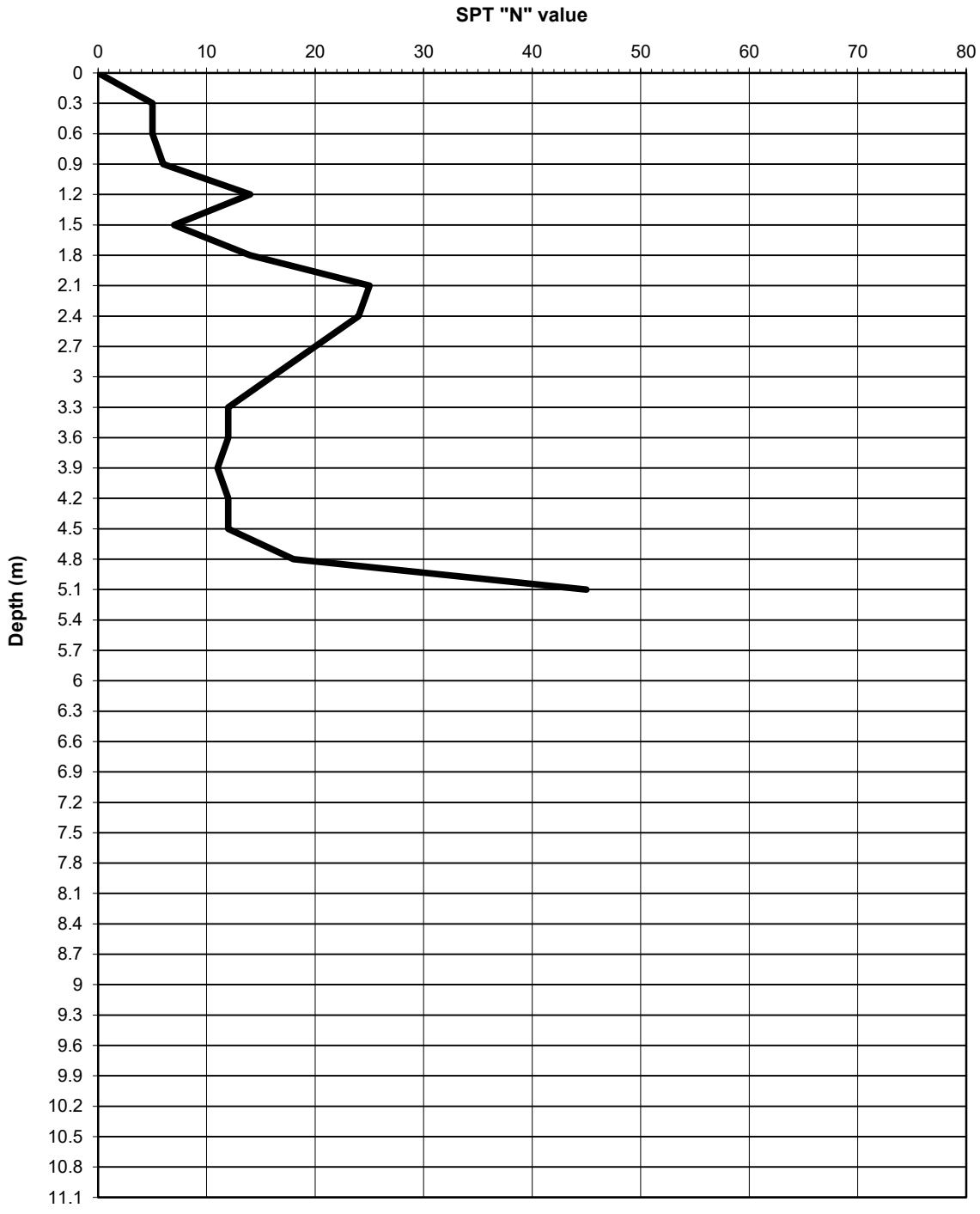


KANTEY & TEMPLER
CONSULTING ENGINEERS
Engineering African Development

CLIENT:	DE VILLIERS & HULME	**PROJECT:**	Keurboom Strand, Plettenberg Bay
FIELD TECHNICIAN:	Neville (Fairbrother)	**JOB No:**	16580GG
		DATE:	11/11/2021

DPSH DATA

DPSH No:	5	**REMARKS:**	Test Carried out from ground level

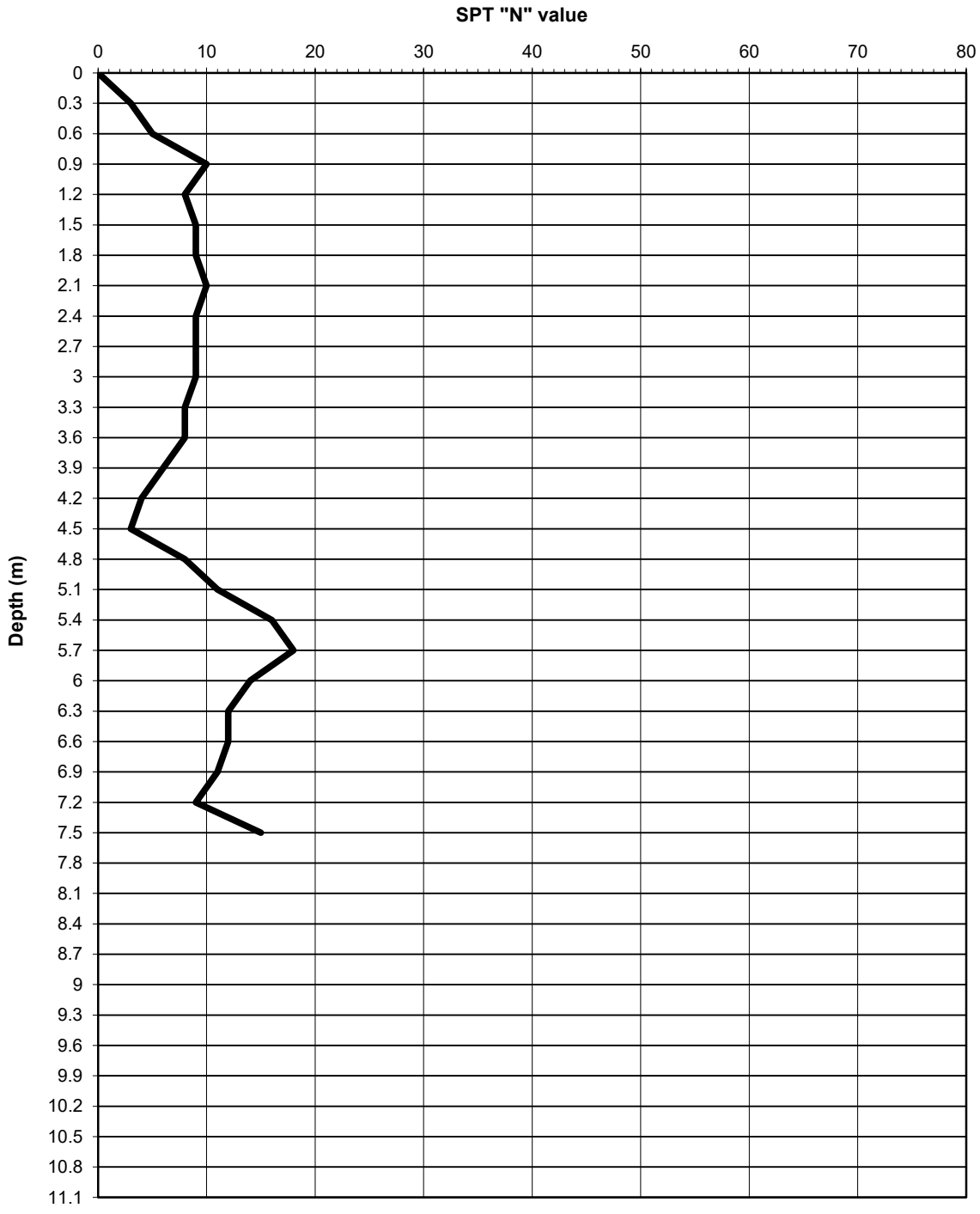


KANTEY & TEMPLER
CONSULTING ENGINEERS
Engineering African Development

CLIENT:	DE VILLIERS & HULME	**PROJECT:**	Keurboom Strand, Plettenberg Bay
FIELD TECHNICIAN:	Neville (Fairbrother)	**JOB No:**	16580GG
		DATE:	11/11/2021

DPSH DATA

DPSH No:	6	**REMARKS:**	Test Carried out from ground level

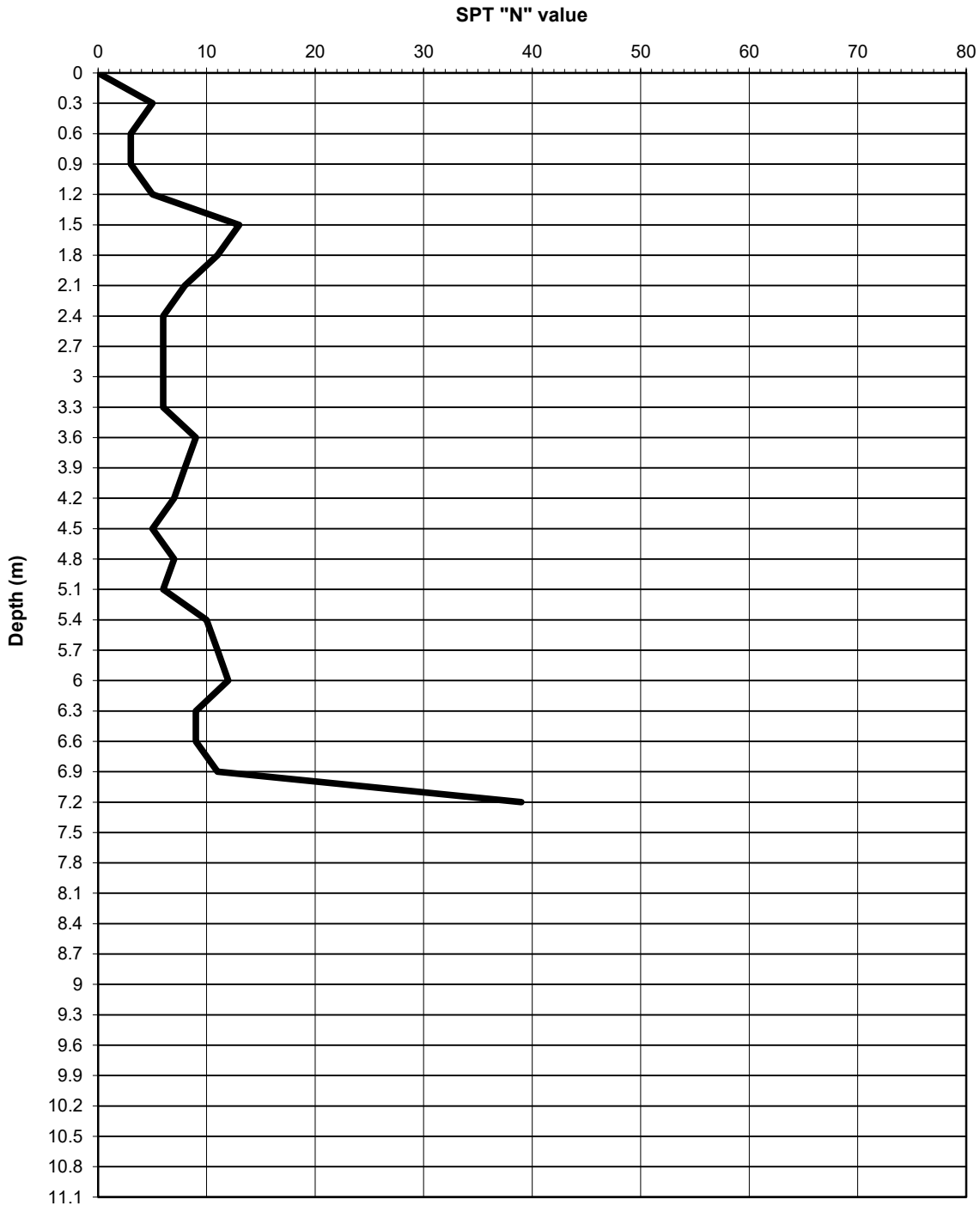


KANTEY & TEMPLER
CONSULTING ENGINEERS
Engineering African Development

CLIENT:	DE VILLIERS & HULME	**PROJECT:**	Keurboom Strand, Plettenberg Bay
FIELD TECHNICIAN:	Neville (Fairbrother)	**JOB No:**	16580GG
		DATE:	11/11/2021

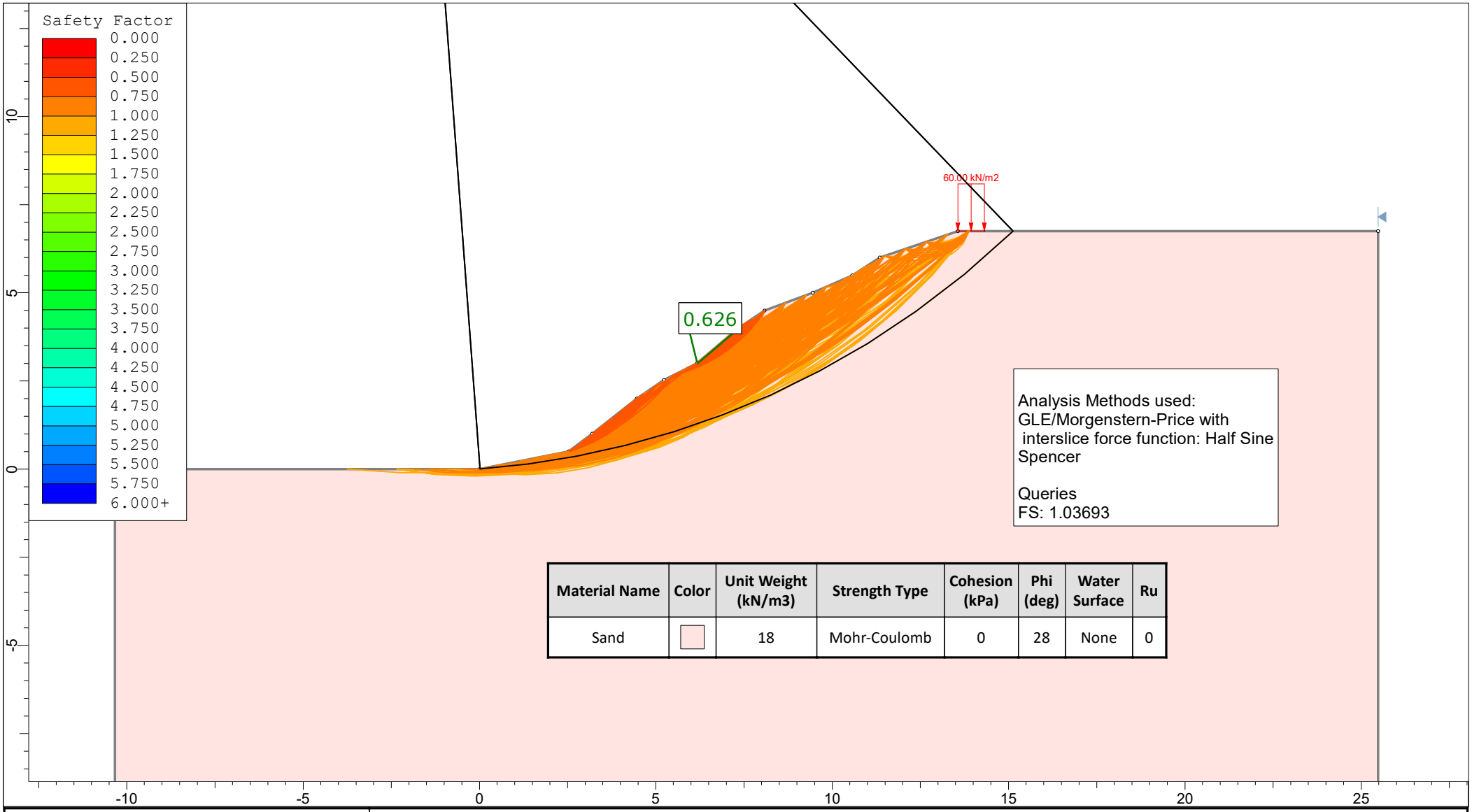
DPSH DATA

DPSH No:	7	**REMARKS:**	Test Carried out from ground level



Appendix D

Slope Stability Analysis



Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Ru
Sand		18	Mohr-Coulomb	0	28	None	0

rocscience

SLIDEINTERPRET 8.022

Project	Keurbooms				
Analysis Description	Section 1				
Drawn By	LC	*Scale*	1:150	*Company*	K&T
Date				*File Name*	Slide1.slmd