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MATERIALS INVESTIGATION

for

ESKOM TUTUKA POWER STATION- SCRAPYARD AREA

Client: RESONANT ENVIRONMENTAL

Date: May 2025

Job No: 25059a

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1 INTRODUCTION

1.1 Preamble

On the 24th of March 2025, a revised proposal, reference Z:\Proposals 2025\Resonant Environmental\Tutuka PS - Infrastructure\Tutuka PS - Acrap and Maintainance Areas - REV 1.wpd was submitted to Mr Hendrick Brits of Resonant Environmental Tech (Pty) Ltd, to conduct a near materials investigation for the proposed scrapyard and maintainance areas located in the south central portion of Eskom Tutuka Power Station north-east of Standerton in Mpumalanga.

Each site is approximately 3000m² and the development will comprise a concrete slab on the ground with ancillary structures.

This report presents the findings of the geotechnical investigation carried out on the scrap yard area ONLY, which are necessary for the design purposes of concrete surface bed.

1.2 Database

Prior to the investigation, the following data was consulted:-

Google Earth image showing the extent of the site.

1.3 Objectives

The objective of the investigation was to complete a geotechnical investigation of the site which would:-

- 1.3.1 Identify the soil profile across the site to a depth of approximately 1.5m, or to refusal of TLB.
- 1.3.2 Determine the engineering parameters of the near surface soils.
- 1.3.3 Recommend specific foundations for the structures.
- 1.3.4 Assess the suitability of the near surface soils for use in earthworks and road pavement layers
- 1.3.5 Comment on any geotechnical problems that may impact upon the construction.

2 FACTUAL REPORT

2.1 Programme of Work

2.1.1 *Literary Review*

Prior to the commencement of any field work, a geotechnical literary review was conducted on the relevant data obtained from previous investigations in the vicinity of the site, by both Geopractica, and other consultants.

The 1:250 000 geological map, “No 2628 EAST RAND” was consulted in order to determine the regional geology in the area whilst the 1:50 000 topographical map, “No 2629CD MEYERVILLE” was referenced with regard to supplying the topography of the site.

2.1.2 *Field Work*

On the 10th of April 2025, five (5 no) trial pits were excavated across the site.

The test pits were excavated to refusal or maximum reach using a Bell 315 SJ Turbo 4x4 TLB, fitted with a 600mm wide “soils bucket” supplied by the client.

To ensure comprehensive site coverage, trial hole positions were strategically determined by Geopractica’s engineering geologist. These positions were then coordinated in the field using a handheld GPS device.

Each trial pit deemed safe to enter, was internally profiled by the engineering geologist according to the “Guidelines for soil and rock logging in South Africa, 2nd Impression 2002”, sampled as necessary, and then loosely backfilled.

The test pit locations are indicated on the site layout plan attached as appendix 1, whilst the detailed soil profiles and site photographs are attached as appendix 4 and 6 respectively.

2.1.3 *Office and Laboratory Work*

From the soil samples recovered during the field work the following were selected for testing:-

Foundation Indicator Tests	5
CBR Tests	3
pH and Conductivity Tests	2
Double oedometer	2

The individual test results are attached as appendix 6, whilst the results have been summarised in section 2.7 below.

The final report was prepared using the data obtained from all the sources mentioned above.

2.2 Site Description

The site is situated in the central portion of the Eskom Tutuka Power Station, approximately 22 km north-east of Standerton, within the Lekwa Local Municipality of the Mpumalanga province

The site is centrally located immediately south of the power station infrastructure and is accessible via the Tutuka Power Station access roads from the R38, which is approximately 1.5 km east of the site (see Appendix 1).

The site is located at elevations between 1624m and 1622m above mean sea level and

slopes down towards the east at a gentle gradient of approximately 2%.

At the time of investigation, the site was clear of vegetation although very short veld grass occurring as patches on the ground were observed. General photographs of the site can be found in Appendix 6.

2.3 Site Geology

From available literature as well as the observations during the investigation, it is evident that the site is underlain by shales and sandstones of the Vryheid Formation of the Ecca Group within the Karoo Sequence. While diabase dykes and sills have intruded these rocks in the area, none were encountered in the test pits.

In this region, these formations are overlain by relatively thick Quaternary and Tertiary soil deposits, which comprise fine grained alluvial deposits.

An extract from the regional geological map "2628 EAST RAND" has been attached as Appendix 2 of this report.

2.4 Hydrology

The average annual rainfall in this area is around 580 mm, with the majority falling during the summer months of October to April.

Surface runoff will likely be collected by the existing Tutuka Power Station stormwater drainage system, while some will occur as sheet wash flowing towards the east.

No groundwater seepage was observed in all of the test holes, details of which appear in table 2 below.

2.5 Climate

The climate in the study area can be described as typical highveld conditions with summers that are moderate and wet, while winters are cold and dry. Severe frost and snow are sometimes experienced. The area also falls within the mist belt with an average midday temperature of 35.7°C in October (summer) and 24.5°C in July (winter).

The N-values are therefore used to characterize the weathering processes of the rocks in the area.

Weinert's research showed that chemical decomposition is the primary form of rock weathering in regions with a climatic "N-value" below 5. In areas where the N-value ranges from 5 to 10, disintegration is the dominant weathering process, although some chemical decomposition of the primary rock minerals still occurs. In regions with an N-value greater than 10, secondary minerals do not form significantly, and weathering primarily occurs through mechanical disintegration of the rock.

The climatic N-value for the area under investigation is less than 5, indicating that chemical decomposition is the main weathering process.

As a result of these climatic conditions, the site is covered by a thicker horizon of residual soil.

2.6 Observations

The nature of the soils encountered in the test pits is relatively uniform in terms of the type of material and thicknesses of the various horizons. Table 1 gives the maximum, minimum and average depths to the top of the major horizons and their thicknesses.

Table 1: Soil Horizon Data						
Material Type	Depths to the top of the soil horizons			Soil horizons thicknesses		
	Min(m)	Max(m)	Avg(m)	Min(m)	Max(m)	Avg(m)
Fill	0,00	0,00	0,00	0.3	0.5	0.43
Alluvium	0.3	0.5	0.43	0.51	0.8	0.66
Upper Residual Shale	0.9	1.3	1.1	0.5	0.7	0.65
Residual Shale	1.02	1.9	1.6	0.6	1.78	>1.24

Table 2 below indicate the maximum depth of each test pit, the material encountered at the base and whether or not water seepage was encountered.

Table 2: Test Pit Depth			
TP No.	Depth (m)	Material at base of Pit	Water seepage depth (m)
TP1	No refusal of TLB @ 2.8m	Residual Shale	No water seepage observed
TP2	No refusal of TLB @ 3.0m	Residual Shale	
TP3	Refusal of TLB @ 2.5m	Very Dense, Residual Shale	
TP4	No refusal of TLB @ 2.9m	Residual Shale	
TP5	No refusal of TLB 3.0m	Residual Shale	

2.7 Laboratory Test Results

All laboratory testing results are attached as appendix 5 to this report.

For more accurate determination and classification purposes, particle size distribution and Atterberg Limits tests were carried out on representative samples of the various soil horizons present below the site. The results are summarized in Table 3 below:-

Table 3: Summary of Indicator test results									
TP No.	Depth (m)	Material	PI (%)	PI (ws)	GM	MC (%)	Soil Classification		Activity
							USCS	AASHTO	
Alluvium									
2	0.3 - 0.9	Clayey Sandy SILT	29	28	0.32	25	CH-OH	A.7.6	High
Upper Residual Shale									
2	0.9 - 1.6	Clayey Sandy SILT	27	27	0.32	27	CL-OL/CH-OH	A.7.6	High
4	1.1 - 1.7	Clayey Sandy SILT	25	24	0.36	26	CL-OL	A.7.6	Medium-High
Residual Shale									
1	1.02 - 2.8	Clayey Sandy SILT	27	27	0.28	25	CH-OH	A.7.6	High
4	1.7 - 2.9	Clayey Sandy SILT	24	24	0.24	20	CL-OL	A.7.6	Medium-High

Note: **np** - Non Plastic,
MC - Moisture Content
GM - Grading Modulus,
PI - Plasticity Index,
WS - Whole Sample

To determine the suitability of any of the excavated materials on site for use as general fill or selected layers in earthworks, a number of CBR tests were carried out on bulk samples collected during the field work. These results are presented in Table 4 below :-

Table 4: Summary of Laboratory Test Results - (Roads and Earthworks)										
TP No.	Depth (m)	Material	PI (%)	GM	Modulus of Subgrade Reaction (k) at 95% Mod AASHTO	CBR Value @ % Mod AASHTO				TRH 14 Class
						90	93	95	98	
Alluvium										
2	0.3 - 0.9	Clayey Sandy SILT	29	0.32	22	1	1	2	3	<G10
Upper Residual Shale										
2	0.9 - 1.6	Clayey Sandy SILT	27	0.32	22	1	1	2	3	<G10
Residual Shale										
1	1.0 - 2.8	Clayey Sandy SILT	27	0.28	22	1	1	2	3	<G10

Note: **<G10** = worse than G10 (cannot be classified)

Table 5 below, contain a summary of the Double oedometer tests conducted on the undisturbed samples recovered from site.

Table 5: Double Oedometer Tests							
TP No	Depth (m)	Material	Dry Density (kg/m ³)	MC (%)	Initial VR	Coefficient of Volume Compressibility (kPa ⁻¹)	
						NMC	Soaked
$\Delta\sigma' = 127 \text{ kPa}$							
TP4	0.5 - 1.1	Clayey Sandy SILT: Alluvium	1186	26.21	1.04	3.34x10 ⁻⁴	8.36x10 ⁻⁴
	1.1 - 1.7	Clayey Sandy SILT: Upper Residual Shale	1130	25.17	1.16	2.04x10 ⁻⁴	1.09x10 ⁻³

Table 6 below, summarises the soil pH and conductivity. The degree of soil corrosiveness is determined based on the pH and resistivity according to BS EN 12501-2:2003.

Table 6: Soil pH and Conductivity						
TP No.	Depth (m)	pH	Degree of acidity	Conductivity	Resistivity (Ohm/cm)	Degree of Corrosivity
TP1	1.02 - 2.8	8.4	Moderately Alkaline	341	2933	Medium - High
TP4	1.1 - 1.7	8.6	Strongly Alkaline	440	2273	Medium - High

3 INTERPRETIVE REPORT

3.1 Discussion of Results

A summary of the general soil profiles encountered across the site has been prepared below.

3.1.1 *Fill*

A fill horizon was intersected in all of the test pits from current ground level having an average thickness of 0.4m. The material generally comprises a moist, light brown, very loose sandy gravel, with abundant cobbles and fine grass roots.

No laboratory tests were conducted on the fill horizon.

3.1.2 *Alluvium*

The transported alluvial soils were intersected in all the test pits at depths of between 0.3m and 0.4 m below current ground level with an average thickness of 0.43m.

This layer occurs as a moist, dark grey slickensided firm, clayey sandy silt.

Laboratory tests suggest that this material has a high heave potential with the plasticity index of up to 29%.

Based on the TRH14 classification system, the alluvial horizon classify as <G10 (worse than G10) quality material, and has been allocated an estimated modulus of subgrade of 22kPa/mm.

The double oedometer test suggests that this material is highly compressible under load up to approximately 130kPa.

3.1.3 *Residual Shale*

Two types of shale residuals were intercepted on site:-

Upper Residual Shale
Lower Residual Shale

3.1.3.1 Upper Residual Shale

The upper residual shale was intercepted at depths of between 0.9m and 1.3m below current ground level with an average thickness of 0.65m.

The horizon was observed as the transition between the transported alluvium and the residual shale. The horizon is reworked and has been described as moist light grey speckled yellow, firm clayey sandy silt.

The material exhibits a PRA classification of A-7-6, denoting a clayey material with a higher plasticity index of up to 27% and will exhibit a generally high heave potential.

Based on the TRH14 classification system, the laboratory test results indicate that these classify as <G10 quality material with a grading modulus of between 0.32 and 0.36.

The double oedometer test suggests that this material is highly compressible under load up to approximately 130kPa.

A modulus of subgrade reaction of approximately 22kPa/mm has been allocated to this horizon.

Soil pH and conductivity tests suggest that this horizon is strongly alkaline, posing a medium-high risk of aggressiveness towards buried concrete structures and services.

3.1.3.2 *Lower residual shale*

The Lower residual shale was intercepted at depths of between 1.02m and 1.9m below current ground level with an average thickness of greater than 1.25m.

The horizon was observed in all test pits and has been described as a moist, dark yellow brown mottled grey, generally firm, clayey sandy silt, with visual, relic, soft and friable cobbles which completely break down to their constituent parts when manipulated.

The material holds a PRA classification of A-7-6, denoting a clayey material with a higher plasticity index values of between 24 and 27%. The horizon exhibits a generally high potential.

Based on the TRH14 classification system, the laboratory test results indicate that these classify as <G10 quality material with a grading modulus of between 0.24 and 0.28. A modulus of subgrade reaction of approximately 22kPa/mm has been allocated to this horizon.

Soil pH and conductivity tests suggest that this horizon is moderately alkaline, posing a medium-high risk of aggressiveness towards buried concrete structures and services.

3.2 Geotechnical Mapping of the Site

In order to map the geotechnical characteristics of the underlying soils, the classification method proposed by The Joint Structural Division of SAICE and IstructE The Code of Practice entitled "Foundations and Superstructures for Single Storey Residential Buildings of Masonry Construction" as described in table 7 below:-

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

Based on the visual assessment of the soil profile exposed below the site and the results of the laboratory testing, it is our opinion that the site is classified as a :-

P(fill)/H3

3.3 Design Parameters

Design parameters for the major soil horizons are given in Table 8 below:-

Table 8: Design Parameters		
Material Type	Allowable Bearing Capacity (kPa)	TRH 14 Classification
Fill	n/a	nd
Alluvium	n/a	<G10
Upper Residual Shale	n/a	<G10
Lower Residual Shale	n/a	<G10

Note:- * = interpolated

3.4 Design Solutions (Conventional Buildings)

The geotechnical investigation has revealed that the near surface soils exhibit a generally high expansiveness potential with an associated compressibility under load potential.

It is our opinion that the heave potential is the major risk associated with the near surface soils encountered on site, therefore we recommend that conventional structures should be founded using either a reinforced concrete raft, or an engineered soil mattress that is able to accommodate the heave potential.

3.4.1 Reinforced Concrete Raft

It is recommended that conventional structures should be founded on a suitable designed reinforced concrete raft.

The raft should be placed on at least 450mm of G5 material compacted to 95% Mod AASHTO.

A maximum allowable bearing capacity below the reinforced concrete raft will be restricted to 75kPa.

The concrete raft should be designed by a competent structural engineer.

3.4.2 Engineered Soil Mattress

As an alternative, it is our opinion that conventional structures could be founded on an engineered soil mattress, as described below:-

3.4.2.1 Remove in situ materials to 1.0m beyond perimeter of building (ie. the foot print of the structure) to a depth of 2.0m below current ground level and spoil.

3.4.2.2 Rip the base of the excavation to a depth of 150mm and compact to 90% Mod AASHTO.

3.4.2.3 Import G7 quality material, and place in layers, not exceeding 150mm thick, compacted to 93% Mod AASHTO density at -1% to +2% of OMC.

3.4.2.4 The final two layers below the foundations should be compacted to 95%

Mod AASHTO.

- 3.4.2.5 Foundations should be re-excavated into the soil raft to the minimum depth commensurate with the adequate provision of services, (typically 600mm) where an allowable bearing pressure of 150kPa should be assumed.
- 3.4.2.6 Conventional reinforced strip footings a maximum of 750mm wide may then be employed, although it is recommended that the plinth brickwork be reinforced with brickforce between every course.
- 3.4.2.7 A lightly loaded concrete surface bed, inside the structure, can be cast directly onto the engineered fill.

3.5 Design Solutions (Concrete Surface Bed on the Ground)

The near surface ground conditions are exceptionally poor:-

TRH 4 Material Classification	Worse than a G10
Estimated Modulus Of Subgrade Reaction	~22kPa/mm
Compressibility	High

and in our opinion heave below a large (thin) concrete slab will occur as the seasonal moisture content below the slab varies.

Thus, it is recommended that the design of a concrete surface bed on the ground be undertaken by a specialist.

In our opinion the thickness of active material below the site is estimated to be in the order of 3m and its removal and replacement with an inert engineered material is considered uneconomical.

In our opinion the use of geotextiles such as a RockGrid (supplied by Maccaferri) should be investigated as these are known to limit surface deflection.

3.6 Bulk Earthworks and Roads

The results of the CBR and foundation indicator tests have been used to classify the near surface soils in order to determine their suitability for use in road and pavement layers.

The soils tested on site classify as <G10 quality in terms of the TRH 14 classification system. It is our opinion that only materials classifying as G7 or better should be used in terracing operations.

All the materials tested on site does not qualify as any pavement layers, for subbase layers, the material will need to be outsourced.

Interpolated Modulus of Subgrade Reaction (PCI publication - Concrete Industrial Floors on the Ground) suggests a value of 22kPa/mm for all tested materials suggesting very low (unfavourable) values.

The design of the pavement layers for any roads and terraces must take into account the traffic intensity, anticipated axle loading and availability of suitable material from local commercial suppliers.

Table 9 below suggests minimum material qualities for various road pavement layers.

Table 9 : Pavement Material Classes	
Pavement Layer	TRH 14 Material Class (natural gravels)
Base	G1, G2, G3, G4
Subbase	G5, G6
Selected Layers	G6, G7
Subgrade	G8, G9, G10

3.6.1 *Excavation Classification*

In terms of SABS 1200D:1988 Earthworks, excavations are likely to classify as “soft” to depths of about 3.0m.

Below these depths shale bedrock is likely to be intersected and if encountered during the earthworks, the use of large pneumatic tools or possibly blasting may be required.

All excavations need to be suitably battered back/stepped to a stable angle, or shored where necessary, to ensure the safety of construction personnel working in these excavations. In our opinion a safe batter angle for the soils encountered will be 1 vertical to 1.5 horizontal.

3.6.2 *Groundwater Management*

No groundwater seepage was intersected during the investigation. However most of the ground was moist during the field work.

Precautions will need to be taken with damp proofing around structures in cut. In addition suitable drainage will need to be installed at the toe of earthwork terraces and roadways to avoid potential saturation of the layer works..

3.7 Construction Problems

No major construction problems are envisaged.

3.8 Additional Investigations

No additional investigations are considered necessary for the near surface soils.

4 CONSTRUCTION MONITORING

4.1 Excavation Inspection

It is recommended that all foundations be inspected by a competent person, prior to placing any concrete.

4.2 Control Testing

Regular checks on the quality and compaction of the backfill to the terraces should be made.

5 COMMUNICATIONS

Should there be any queries please do not hesitate to contact one of the under signed.

Authored by:-



Luyanda Ngcongco (BSc Hons)

Reviewed by:-



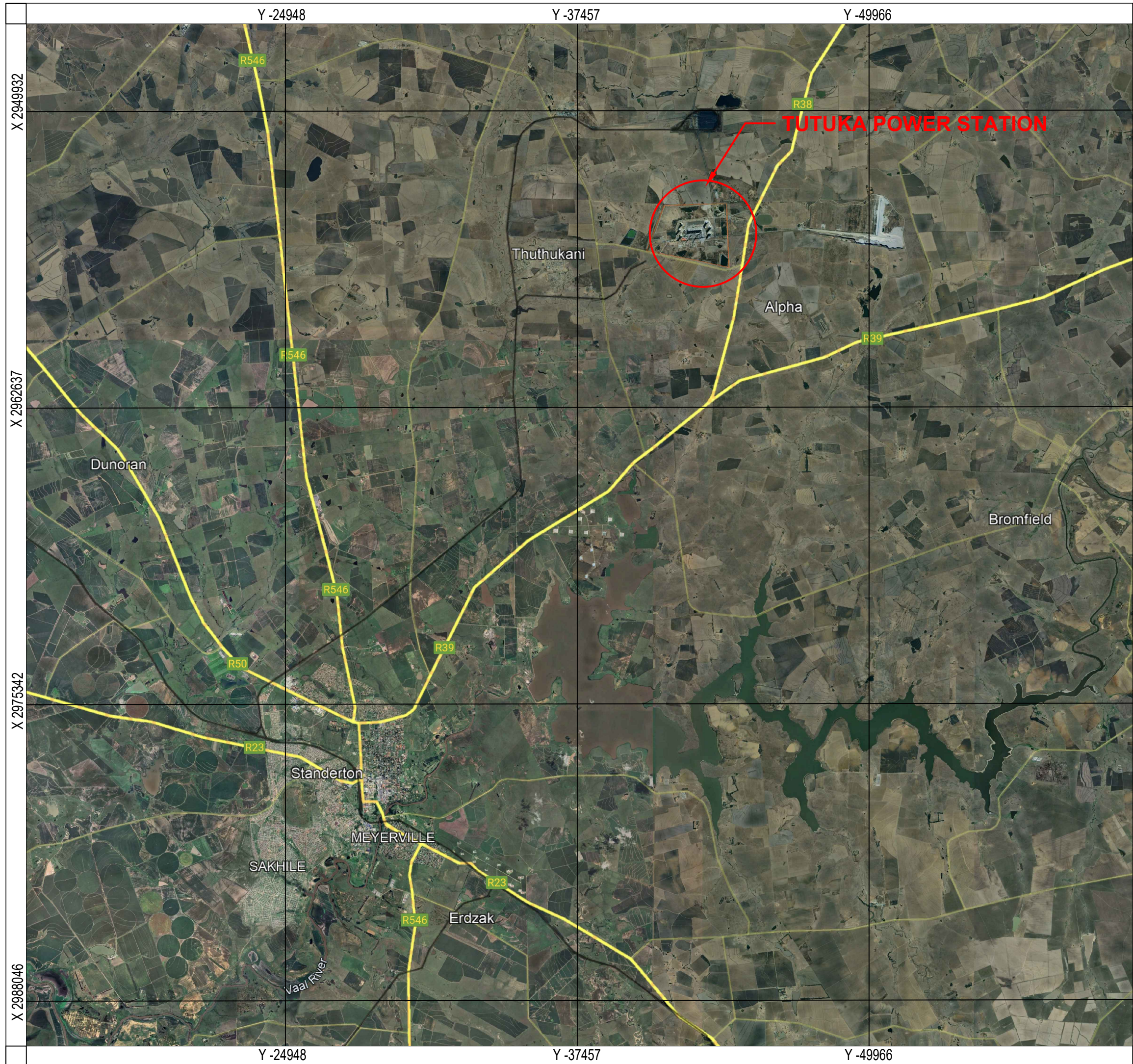
Colin Dalton (Principal)

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1. Jennings JE et al . "Revised Guide to Soil profiling for Civil Engineering Purposes in Southern Africa" - Civil Engineer in South Africa , January 1973
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APPENDIX 1

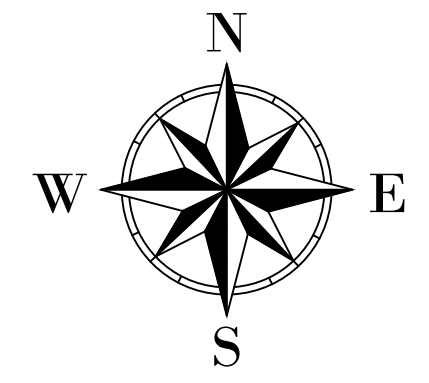
SITE PLANS



Site Locality
 Extract of 1:100 Google Earth
 Aerial Photograph

LEGEND:

 TUTUKA POWER STATION



REV	DATE	DESCRIPTION

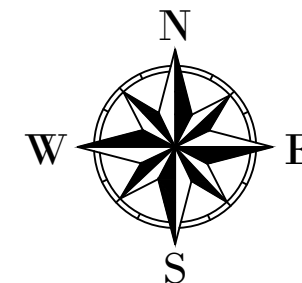
CLIENT:



RESONANT ENVIRONMENTAL TECH.
 Geotechnical investigation - Material Classification, Tutuka Power Station,
 Standerton, Mpumalanga Province

SCALE	DRAWN	CHECKED	DATE
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SITE LAYOUT: TEST PIT POSITIONS

LEGEND:


REV	DATE	DESCRIPTION

CLIENT:

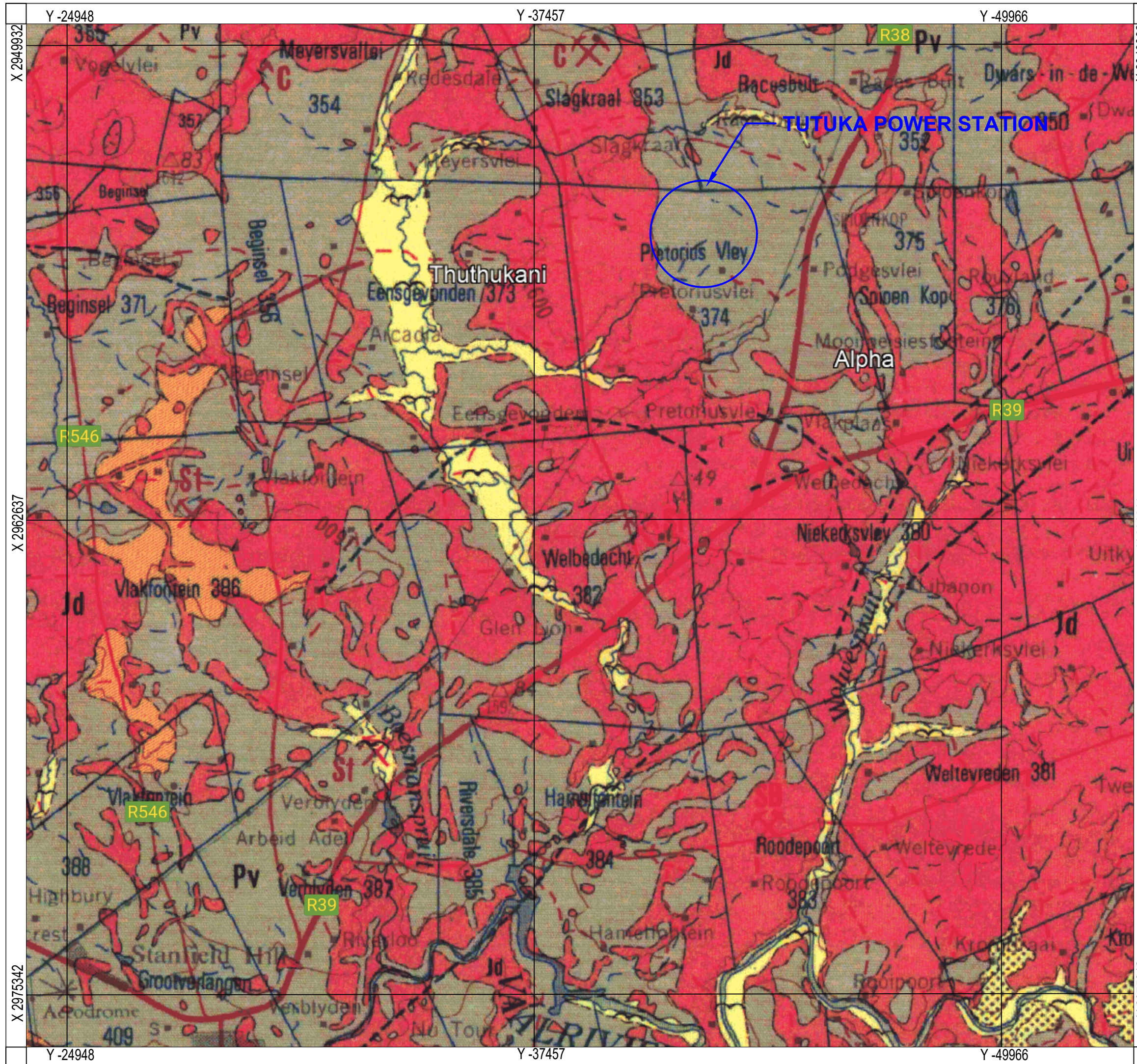

RESONANT ENVIRONMENTAL TECH.
 Geotechnical investigation - Material Classification, Tutuka Power Station,
 Standerton, Mpumalanga Province

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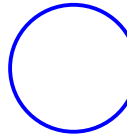
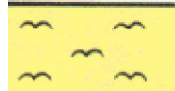

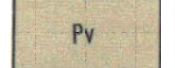
APPENDIX 2

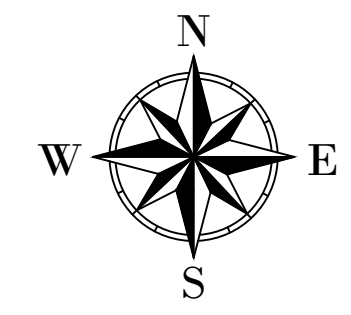
REGIONAL GEOLOGY MAP



Site Geology
 Extract of 1:100 Google Earth
 Aerial Photograph

LEGEND:

-  TUTUKA POWER STATION
-  Alluvium
-  Dolerite
-  Sandstone, shale, coal beds



REV	DATE	DESCRIPTION

CLIENT:

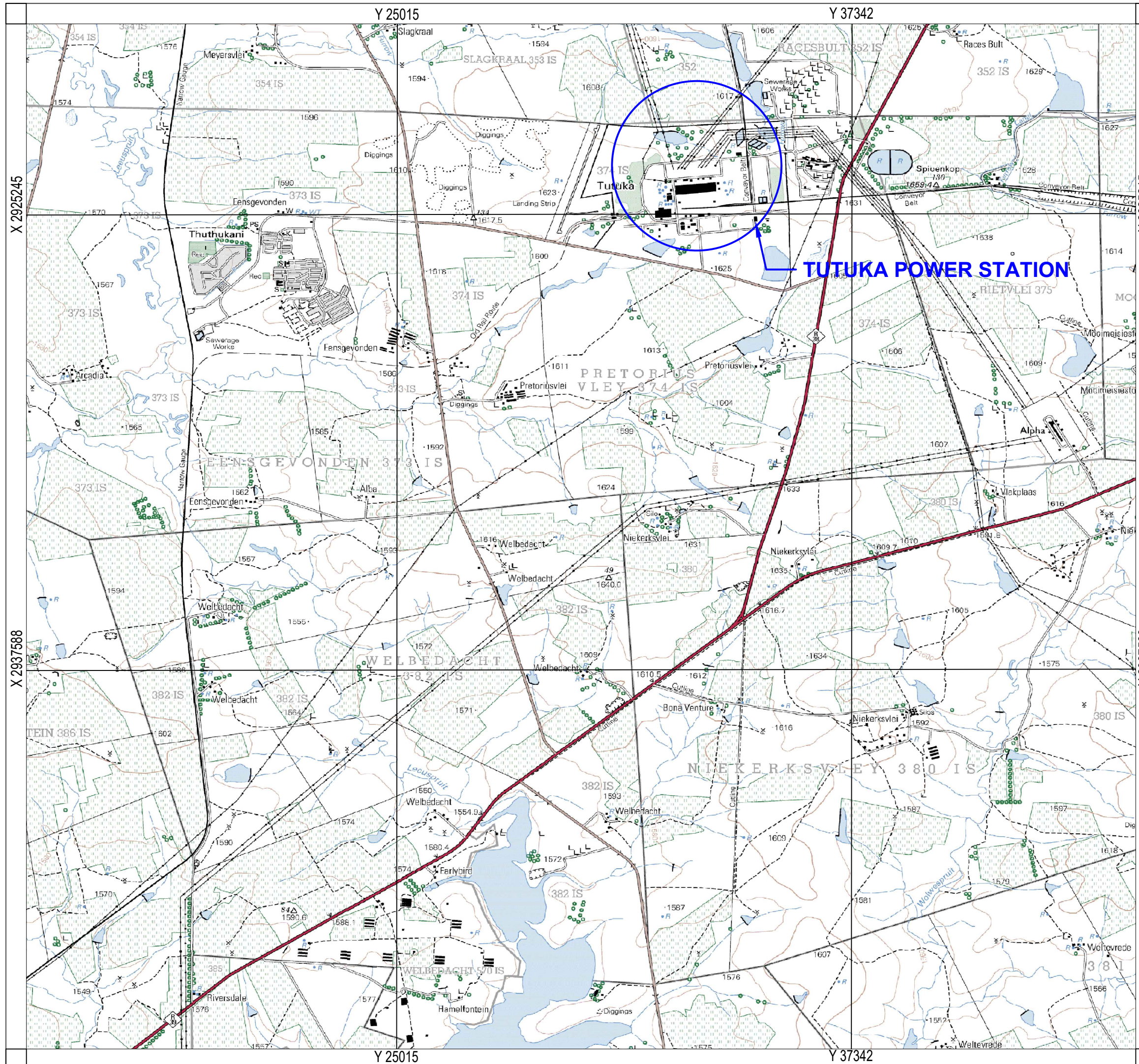
RESONANT

RESONANT ENVIRONMENTAL TECH.
 Geotechnical investigation - Material Classification, Tutuka Power Station,
 Standerton, Mpumalanga Province

SCALE	DRAWN	CHECKED	DATE
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	DRAWING NO. 25059/02	CRS Lo 29	REV

APPENDIX 3

TOPOGRAPHICAL MAP



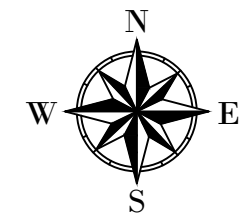
Topographical Map
 Extract of 1:50 000 Topographical
 Map Series: 2628AC Johannesburg
CONTOUR INTERVAL 20M

LEGEND:



**TUTUKA POWER
 STATION**

REFERENCE	VERKLARING
National Freeway; National Route	Nasionale Deurpad; Nasionale Route
Arterial Route	Hoofverkeersroete
Main Road	Hoofpad
Secondary Road; Bench Mark	Sekondêre Pad; Hoogtepunt
Other Road; Bridge	Ander Pad; Brug
Track and Hiking Trail	Downwe Pad en Voetslaanpad
Railway; Station or Siding	Spoorweg; Stasie of Sylyn
Other Railway; Tunnel	Ander Spoorweg; Tonnal
Embankment; Cutting	Opvalling; Deurgangweg
Power Line	Kraglyn
Bull-up Area (High, Low Density)	Babouise Gebied (Hoë, Laë Digtheid)
Building; Ruin	Geboue; Murusie
Post Office; Police Station; Store	Postkantoor; Polisie-stasie; Winkel
Place of Worship; School; Hotel	Plak van Aandigdig; Skool; Hotel
Fence; Wall	Deursluiting; Muur
Windmill; Monument	Windmolen; Monument
Communication Tower	Kommunikasietoring
Mine Dump; Excavation	Mynhoop; Uitgraving
Trigonometrical Station; Marine Beacon	Politeien; Seewarkeem
Lighthouse and Marine Light	Waarwinger en Seewarlig
Cemetery; Grave	Begraafplaas; Graf
International Boundary and Beacon	Internasionale Grans en Baken
Provincial Boundary	Provinsiale Grans
Protected Area	Bewarings Gebied
Paranatal River	Stanshouende River
Paranatal Water	Stanshouende Water
Non-Paranatal River	Nie-stanshouende River
Non-Paranatal Water	Nie-stanshouende Water
Dry Water Course	Droë Loop
Dry Pan	Droë Pan
Marsh and Vlei	Mooie on Vlei
Pipeline (above ground)	Pyplyn (bo die grond)
Water Tower; Reservoir; Water Point	Wateroring; Reservoir; Waterpunt
Coastal Rocks	Kuylroes
Prominent Rock Outcrop	Prominente Klipbakk
Erosion; Sand	Erosie; Sand
Woodland	Babouise Gebied
Cultivated Land	Bewarke Land
Orchard or Vineyard	Boerd of Wingerd
Recreation Ground	Ontspanningsplek
Row of Trees	Rye Bome



REV	DATE	DESCRIPTION	
CLIENT:			
RESONANT ENVIRONMENTAL TECH GEOTECHNICAL INVESTIGATIONS TUTUKA POWER STATION STANDERTON, MPUMALANGA			
SCALE	DRAWN	CHECKED	DATE
A3	TL	LN	MAY'2025
1:100.7859	DRAWING NO.	CRS	REV
	2505/03	Lo 29	

APPENDIX 4

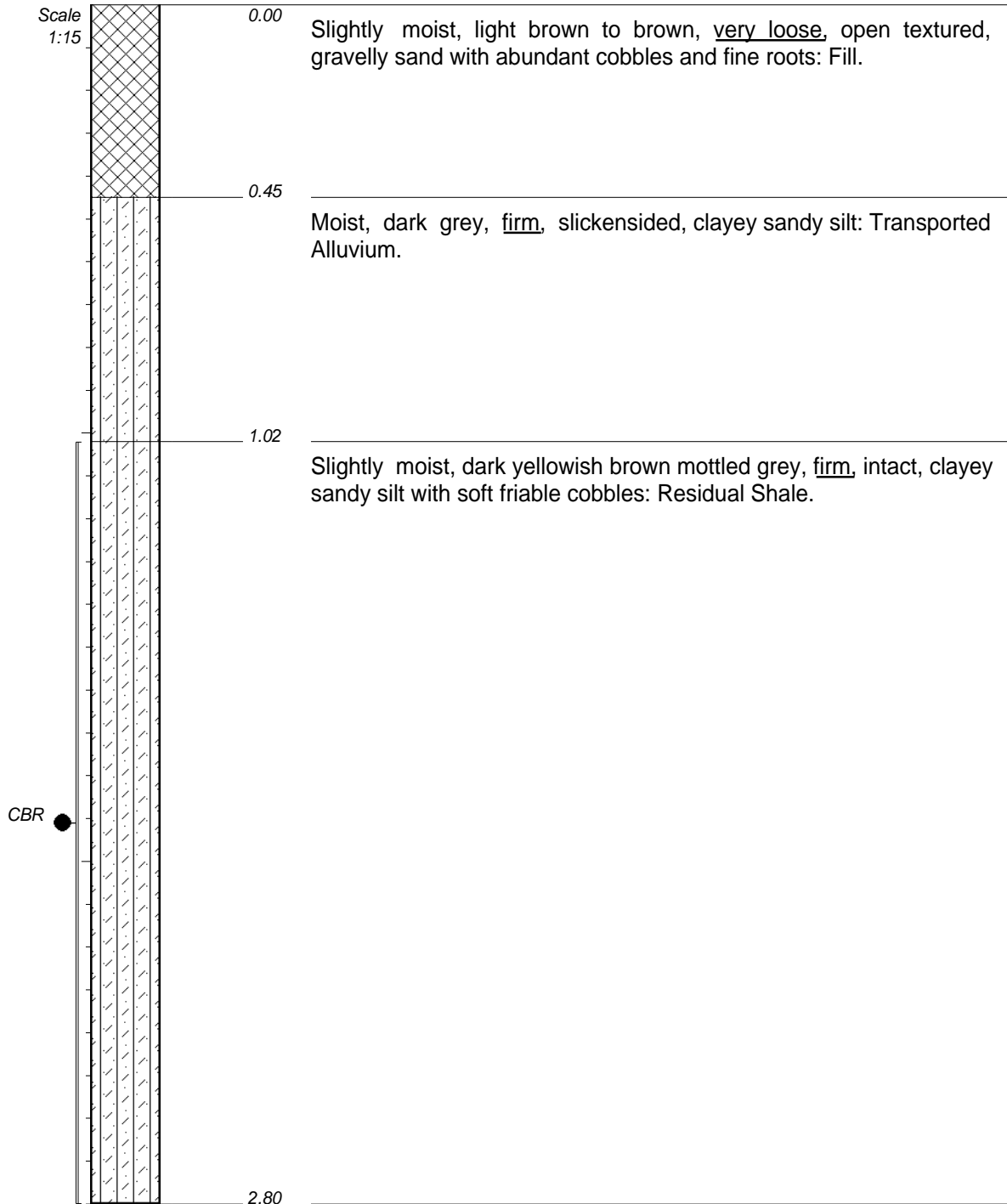
TRIAL HOLE PROFILES



Resonant Environmental
Tutuka Power Station
Scrapyard

HOLE No: TP1
Sheet 1 of 1

JOB NUMBER: 25059a



NOTES

- 1) EOH @ 2.8m
- 2) No water seepage observed
- 3) Disturbed sample CBR @ 1.02--2.8m

CONTRACTOR :
MACHINE : 315 SJ Bell Turbo 4x4
DRILLED BY : Andries
PROFILED BY : TL

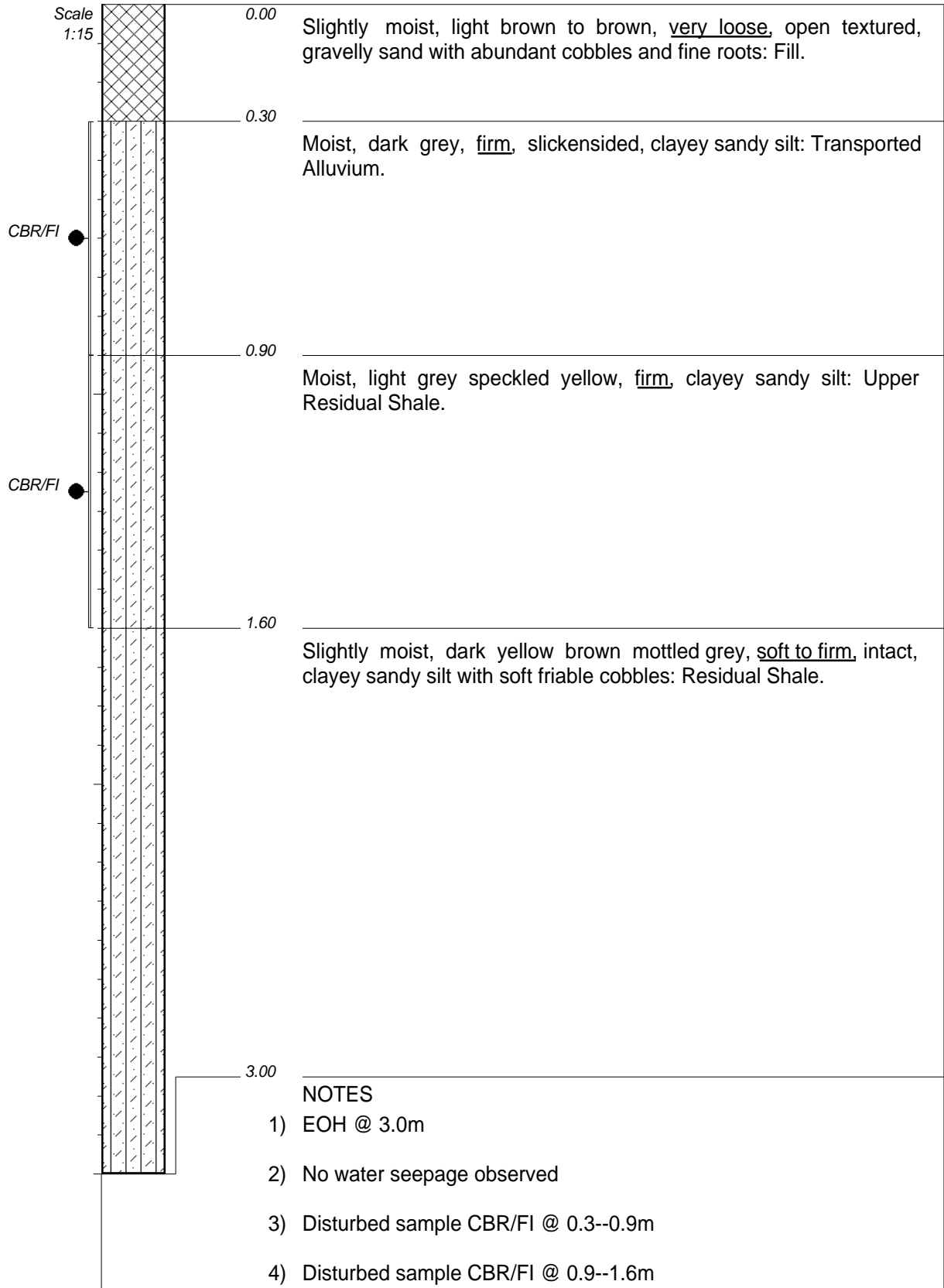
TYPE SET BY : Sofia
SETUP FILE : STANDARD.SET

INCLINATION : Vertical
DIAM :
DATE : 10/04/2025
DATE : 10/04/2025

DATE : 08/05/2025 09:56
TEXT : ..TutukaPowerStationTP.txt

ELEVATION :
X-COORD :
Y-COORD :

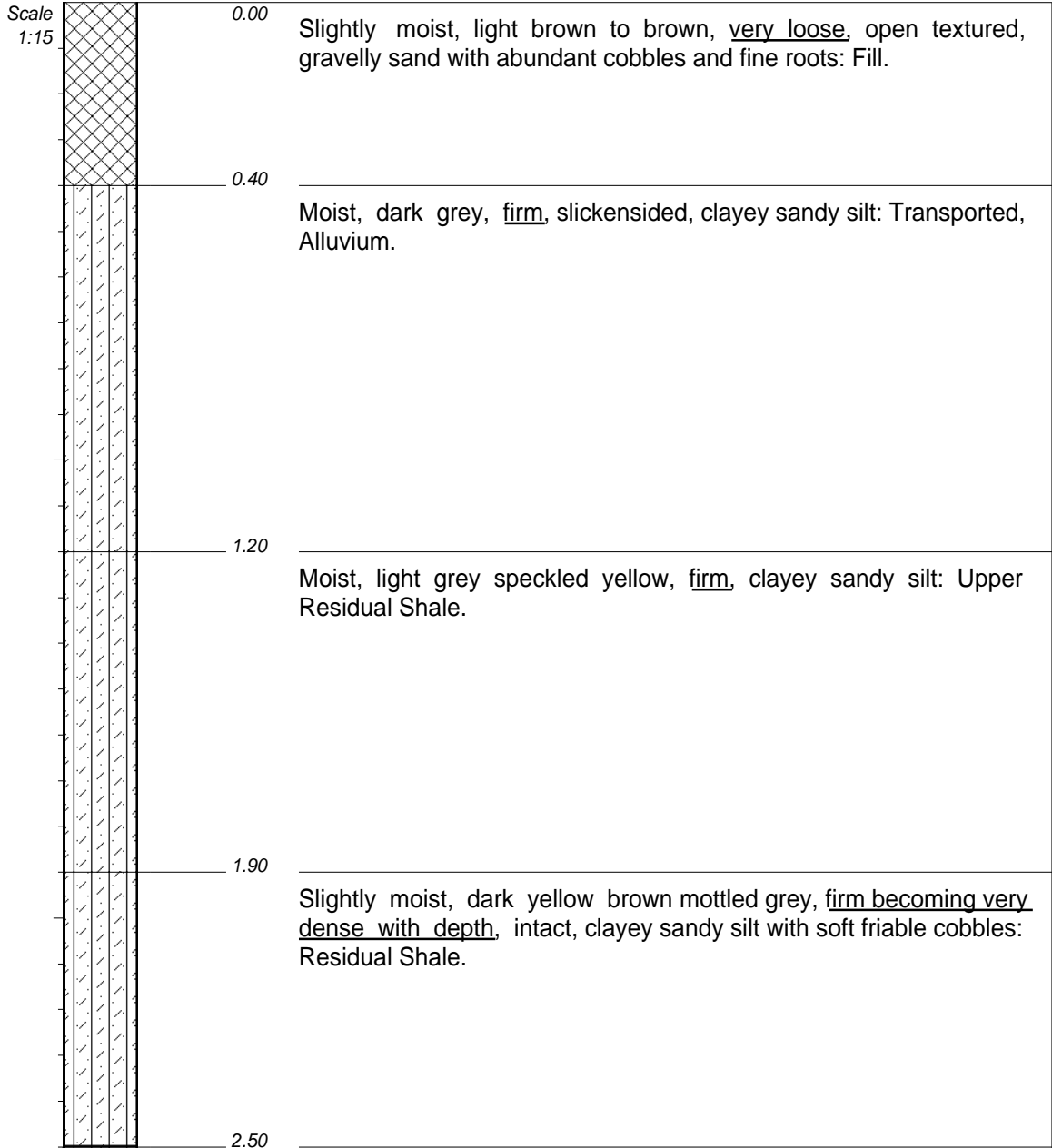
HOLE No: TP1



CONTRACTOR :
 MACHINE : 315 SJ Bell Turbo 4x4
 DRILLED BY : Andries
 PROFILED BY : TL
 TYPE SET BY : Sofia
 SETUP FILE : STANDARD.SET

INCLINATION :
 DIAM :
 DATE : 10/04/2025
 DATE : 10/04/2025
 DATE : 08/05/2025 09:56
 TEXT : ..TutukaPowerStationTP.txt

ELEVATION :
 X-COORD :
 Y-COORD :

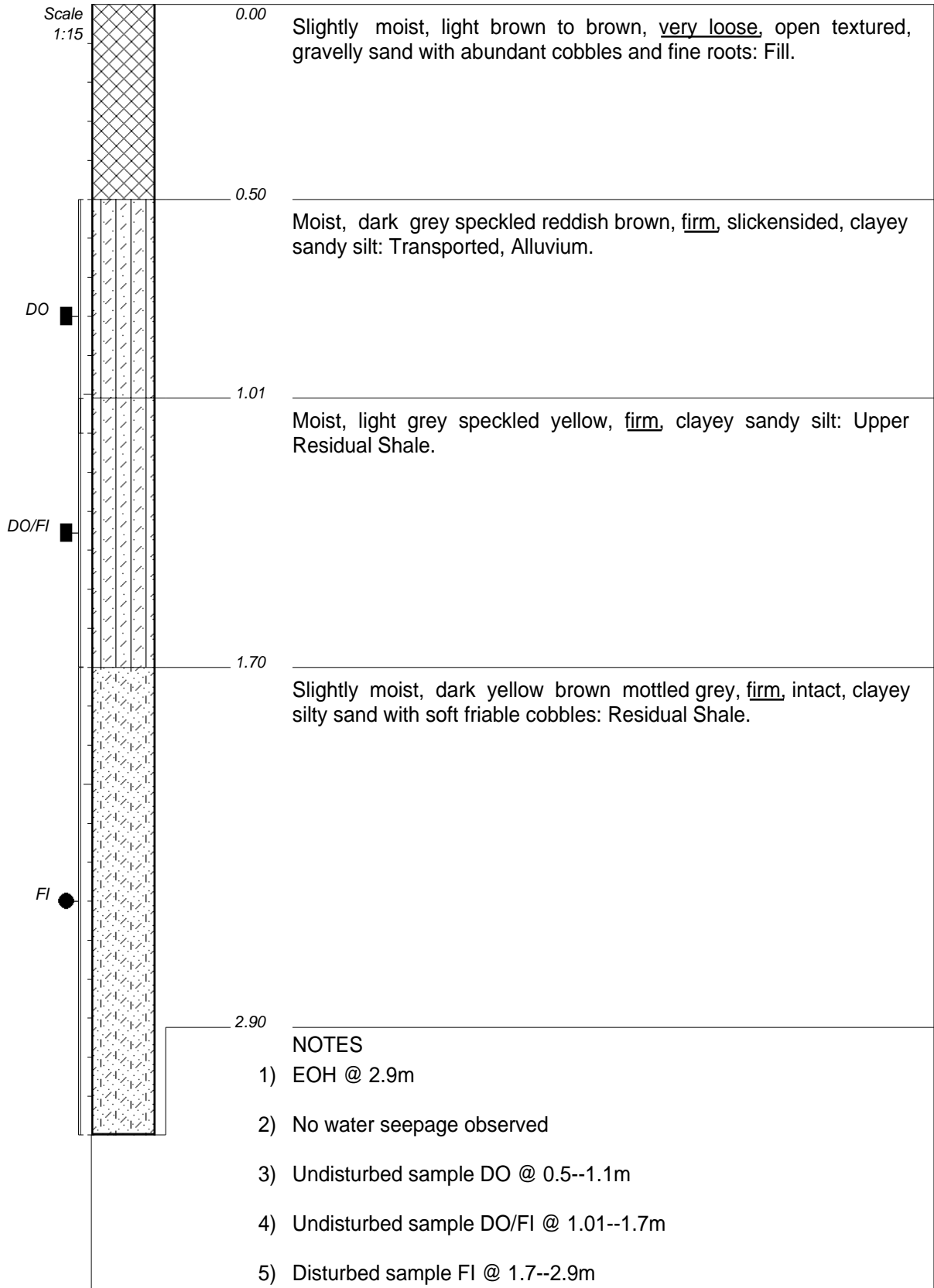


- NOTES**
- 1) Refusal of TLB @ 2.5m on very dense residual shale
 - 2) No water seepage observed

CONTRACTOR :
 MACHINE : 315 SJ Bell Turbo 4x4
 DRILLED BY : Andries
 PROFILED BY : TL

INCLINATION :
 DIAM :
 DATE : 10/04/2025
 DATE : 10/04/2025
 DATE : 08/05/2025 09:56
 TEXT : ..TutukaPowerStationTP.txt

ELEVATION :
 X-COORD :
 Y-COORD :



CONTRACTOR :
 MACHINE : 315 SJ Bell Turbo 4x4
 DRILLED BY : Andries
 PROFILED BY : TL
 TYPE SET BY : Sofia
 SETUP FILE : STANDARD.SET

INCLINATION :
 DIAM :
 DATE : 10/04/2025
 DATE : 10/04/2025
 DATE : 08/05/2025 09:56
 TEXT : ..TutukaPowerStationTP.txt

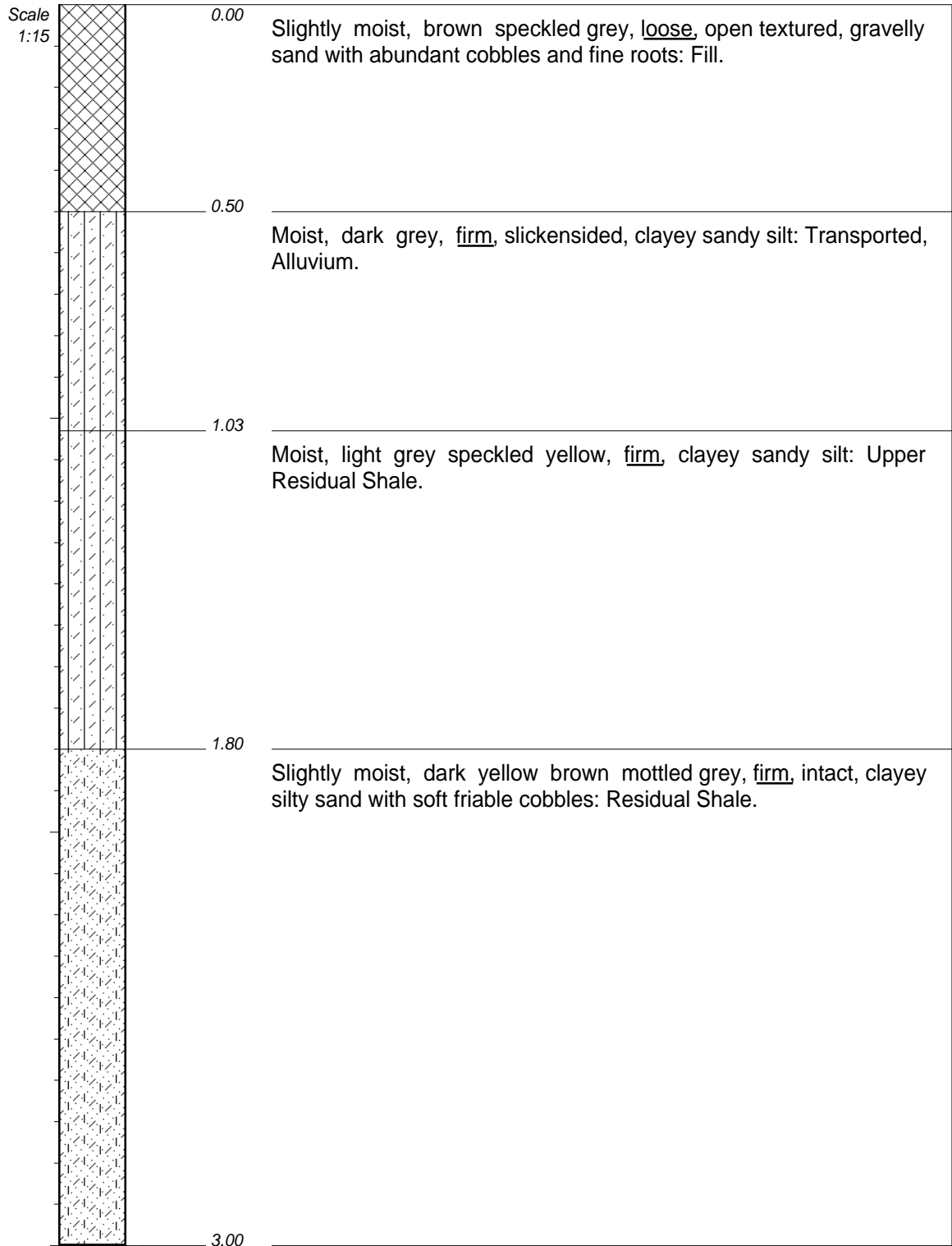
ELEVATION :
 X-COORD :
 Y-COORD :



Resonant Environmental
Tutuka Power Station
Scrapyard

HOLE No: TP5
Sheet 1 of 1

JOB NUMBER: 25059a



NOTES

- 1) EOH @ 3.0m
- 2) No water seepage observed

CONTRACTOR :
MACHINE : 315 SJ Bell Turbo 4x4
DRILLED BY : Andries
PROFILED BY : TL









INCLINATION :
DIAM :
DATE : 10/04/2025
DATE : 10/04/2025
DATE : 08/05/2025 09:56
TEXT : ..TutukaPowerStationTP.txt

ELEVATION :
X-COORD :
Y-COORD :

HOLE No: TP5

TYPE SET BY : Sofia
SETUP FILE : STANDARD.SET



	SAND	{SA04}
	SANDY	{SA05}
	SILT	{SA06}
	SILTY	{SA07}
	CLAYEY	{SA09}
	FILL	{SA32}
	UNDISTURBED SAMPLE	{SA37}
	DISTURBED SAMPLE	{SA38}

Name 

Name 

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY :

TYPE SET BY : Sofia
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE :

DATE : 08/05/2025 09:56
TEXT : ..TutukaPowerStationTP.txt

ELEVATION :
X-COORD :
Y-COORD :

LEGEND
SUMMARY OF SYMBOLS

APPENDIX 5

LABORATORY TEST RESULTS



FOUNDATION INDICATOR

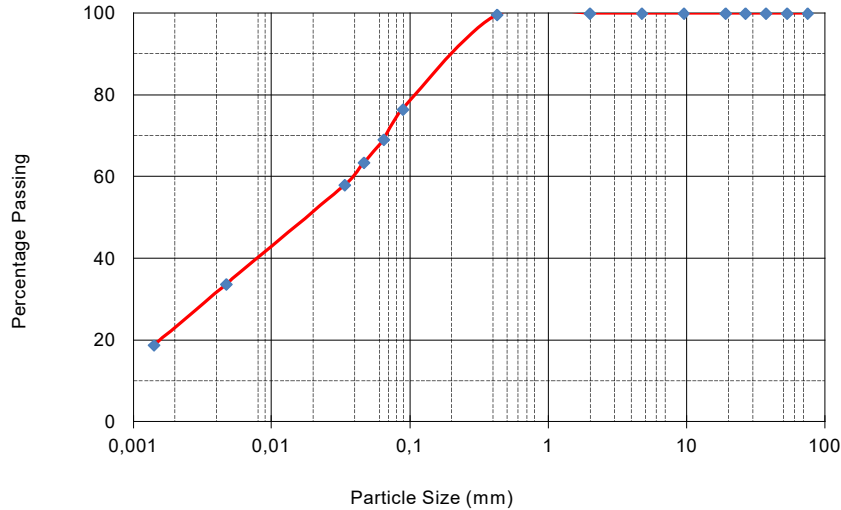
Client	Resonate Enviromenta		
Location	Tutuka Power Station	TP 1 @ 1,02 - 2,8m	
Date	11-Apr-25	Test No	771
Job No	25059	Checked By	SM

SIEVE ANALYSIS

Values are expressed as a percentage of total sample

Sieve Size (mm)	Total Passing (%)
75	100,00
53	100,00
37,5	100,00
26,5	100,00
19	100,00
9,5	100,00
4,75	100,00
2	99,97
0,425	99,59

GRADING ANALYSIS



HYDROMETER ANALYSIS

(TMH 1 Method A6)

Values are expressed as a percentage of total sample

Sieve Size (mm)	Total Passing (%)
0,0888	76,46
0,0646	69,00
0,0467	63,41
0,0337	57,81
0,0247	33,57
0,014	18,65

ATTERBERG LIMITS & OTHER VALUES

(SANS 3001 - GR10)

Liquid Limit	56
Plastic Limit	29
Plastic Index	27
Linear Shrinkage	15
Grading Modulus	0,28
Moisture Content	25
PI on Whole Sample	27
PRA Classification	A.7.6
Unified Classification	See Plasticity Chart
Coefficient of Curvature Cc	#DIV/0!
Coefficient of Uniformity Cu	#DIV/0!

ESTIMATED COMPOSITION (As BS 1377)

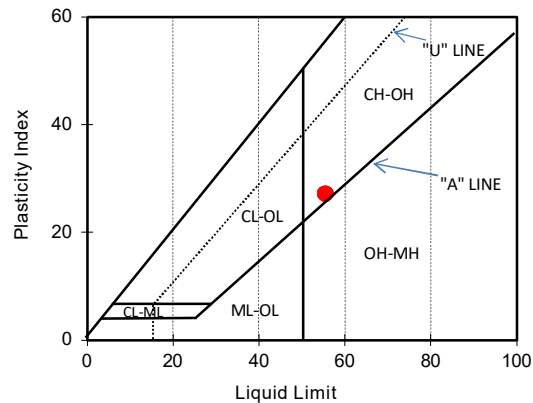
Clay (<0.002)	21,29
0.002 < Silt < 0.06	46,27
0.06 < Sand < 2.0	32,41
Gravel > 2.0	0,03
% less than 0.075	72,20

ACTIVITY CHART



PLASTICITY CHART

Fine Grained Soils: >50% passes 0.075



Revision Number	1	Revised By	sr	Page No.	Page 1 of 1
Date	15-Sept-18		10-Jun-20	Compiled by	Steve Robinson
Document Number	GTR 021			Authorised by	Colin Dalton



FOUNDATION INDICATOR

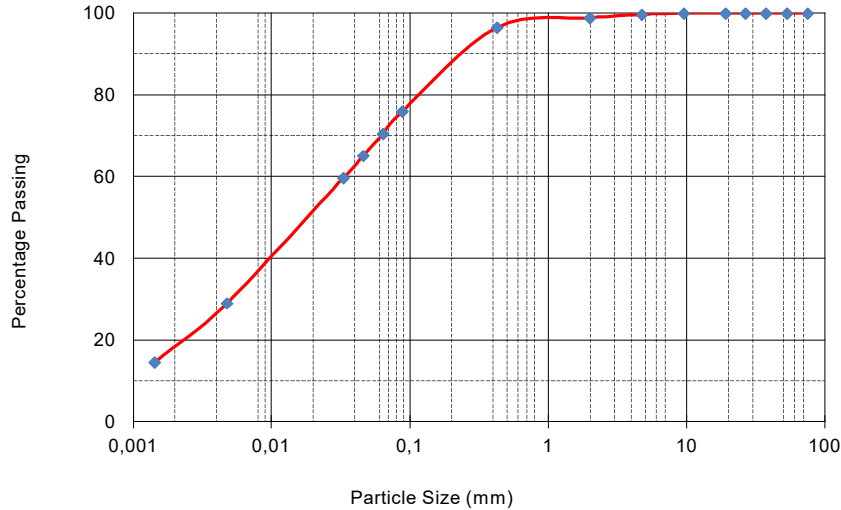
Client	Resonate Enviromenta		
Location	Tutuka Power Station	TP 2 @ 0,3 - 0,9m	
Date	11-Apr-25	Test No	773
Job No	25059	Checked By	SM

GRADING ANALYSIS

SIEVE ANALYSIS

Values are expressed as a percentage of total sample

Sieve Size (mm)	Total Passing (%)
75	100,00
53	100,00
37,5	100,00
26,5	100,00
19	100,00
9,5	100,00
4,75	99,64
2	98,78
0,425	96,51



HYDROMETER ANALYSIS

(TMH 1 Method A6)

Values are expressed as a percentage of total sample

Sieve Size (mm)	Total Passing (%)
0,0881	75,91
0,0637	70,49
0,0460	65,07
0,0332	59,64
0,0248	28,92
0,014	14,46

ATTERBERG LIMITS & OTHER VALUES

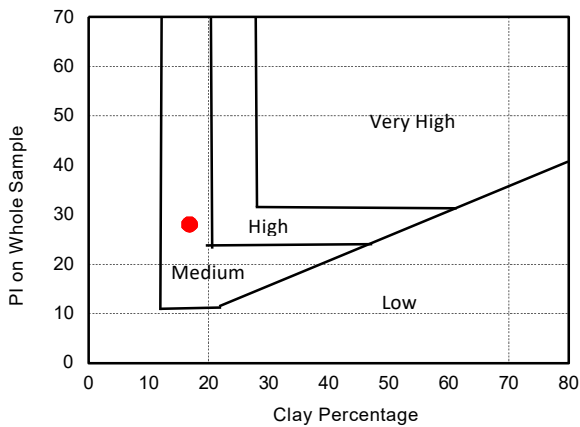
(SANS 3001 - GR10)

Liquid Limit	54
Plastic Limit	25
Plastic Index	29
Linear Shrinkage	15
Grading Modulus	0,32
Moisture Content	25
PI on Whole Sample	28
PRA Classification	A.7.6
Unified Classification	See Plasticity Chart
Coefficient of Curvature Cc	#DIV/0!
Coefficient of Uniformity Cu	#DIV/0!

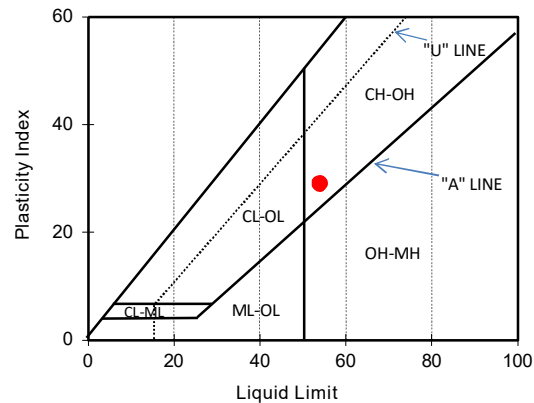
ESTIMATED COMPOSITION (As BS 1377)

Clay (<0.002)	16,93
0.002 < Silt < 0.06	52,41
0.06 < Sand < 2.0	29,43
Gravel > 2.0	1,22
% less than 0.075	73,00

ACTIVITY CHART



PLASTICITY CHART Fine Grained Soils: >50% passes 0.075



Revision Number	1	Revised By	sr	Page No.	Page 1 of 1
Date	15-Sept-18		10-Jun-20	Compiled by	Steve Robinson
Document Number	GTR 021			Authorised by	Colin Dalton



FOUNDATION INDICATOR

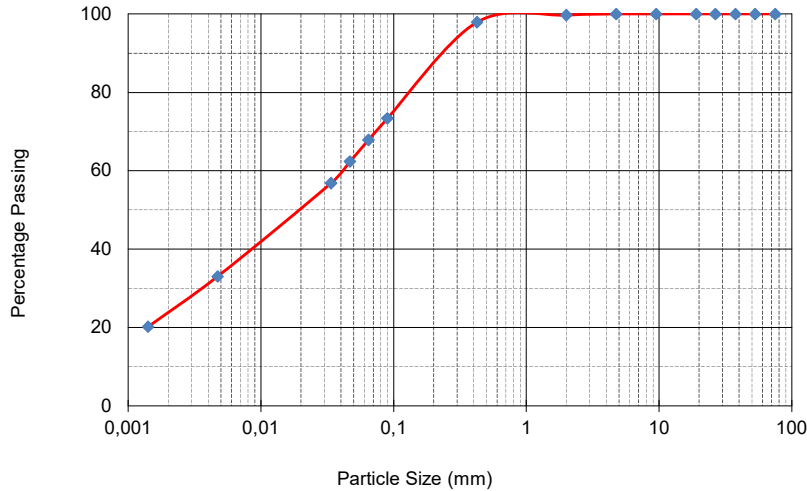
Client	Resonate Enviromenta		
Location	Tutuka Power Station	TP 2 @ 0,9 - 1,6m	
Date	18-Mar-25	Test No	775
Job No	25059	Checked By	SM

SIEVE ANALYSIS

Values are expressed as a percentage of total sample

Sieve Size (mm)	Total Passing (%)
75	100,00
53	100,00
37,5	100,00
26,5	100,00
19	100,00
9,5	100,00
4,75	100,00
2	99,72
0,425	97,91

GRADING ANALYSIS



HYDROMETER ANALYSIS

(TMH 1 Method A6)

Values are expressed as a percentage of total sample

Sieve Size (mm)	Total Passing (%)
0,0895	73,34
0,0646	67,84
0,0467	62,34
0,0337	56,84
0,0047	33,00
0,0014	20,17

ATTERBERG LIMITS & OTHER VALUES

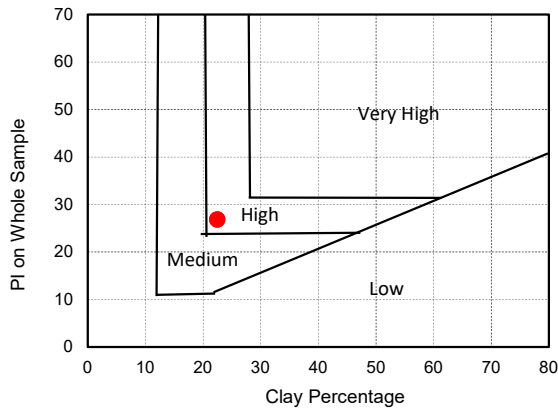
(SANS 3001 - GR10)

Liquid Limit	50
Plastic Limit	23
Plastic Index	27
Linear Shrinkage	14
Grading Modulus	0,32
Moisture Content	27
PI on Whole Sample	27
PRA Classification	A.7.6
Unified Classification	See Plasticity Chart
Coefficient of Curvature Cc	#DIV/0!
Coefficient of Uniformity Cu	#DIV/0!

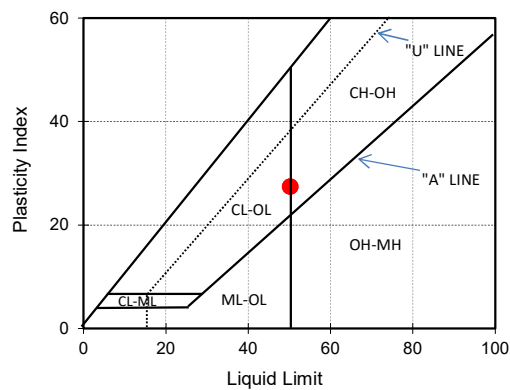
ESTIMATED COMPOSITION (As BS 1377)

Clay (<0.002)	22,47
0.002 < Silt < 0.06	43,95
0.06 < Sand < 2.0	33,30
Gravel > 2.0	0,28
% less than 0.075	70,14

ACTIVITY CHART



PLASTICITY CHART
Fine Grained Soils: >50% passes 0.075



Revision Number	1	Revised By	sr	Page No.	Page 1 of 1
Date	15-Sep-18		10-Jun-20	Compiled by	Steve Robinson
Document Number	GTR 021			Authorised by	Colin Dalton



FOUNDATION INDICATOR

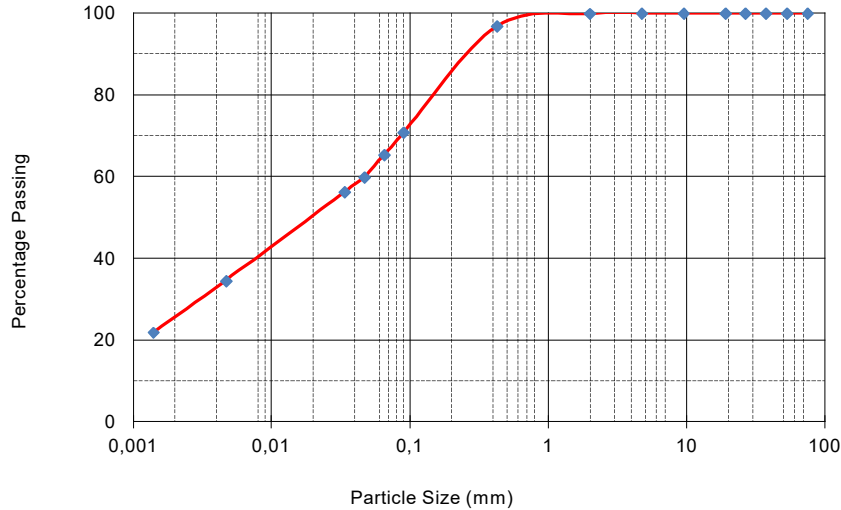
Client	Resonate Enviromenta		
Location	Tutuka Power Station	TP 4 @ 1,1 - 1,7m	
Date	18-Mar-25	Test No	778
Job No	25059	Checked By	SM

GRADING ANALYSIS

SIEVE ANALYSIS

Values are expressed as a percentage of total sample

Sieve Size (mm)	Total Passing (%)
75	100,00
53	100,00
37,5	100,00
26,5	100,00
19	100,00
9,5	100,00
4,75	100,00
2	99,88
0,425	96,81



HYDROMETER ANALYSIS

(TMH 1 Method A6)

Values are expressed as a percentage of total sample

Sieve Size (mm)	Total Passing (%)
0,0901	70,71
0,0651	65,27
0,0470	59,83
0,0337	56,21
0,0047	34,45
0,0014	21,76

ATTERBERG LIMITS & OTHER VALUES

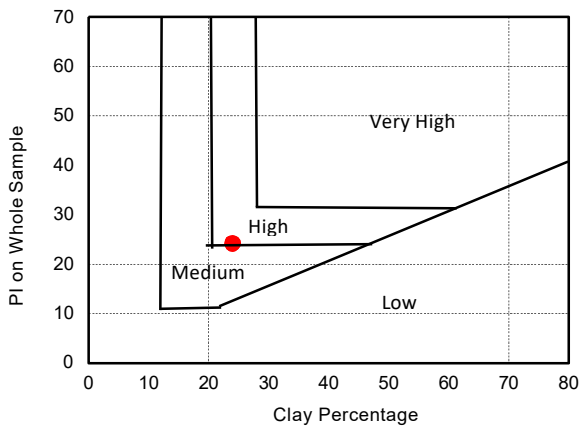
(SANS 3001 - GR10)

Liquid Limit	48
Plastic Limit	23
Plastic Index	25
Linear Shrinkage	13
Grading Modulus	0,36
Moisture Content	26
PI on Whole Sample	24
PRA Classification	A.7.6
Unified Classification	See Plasticity Chart
Coefficient of Curvature Cc	#DIV/0!
Coefficient of Uniformity Cu	#DIV/0!

ESTIMATED COMPOSITION (As BS 1377)

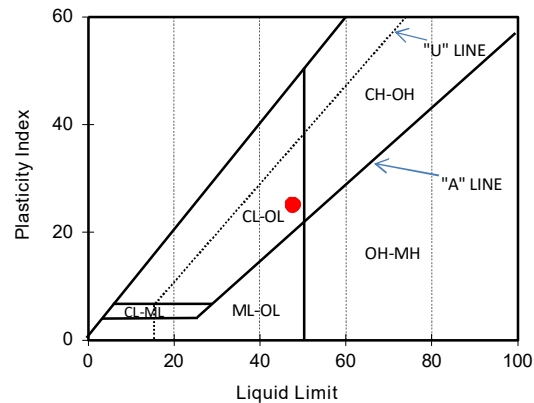
Clay (<0.002)	24,08
0.002 < Silt < 0.06	39,66
0.06 < Sand < 2.0	36,15
Gravel > 2.0	0,12
% less than 0.075	67,42

ACTIVITY CHART



PLASTICITY CHART

Fine Grained Soils: >50% passes 0.075



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Date	15-Sept-18		10-Jun-20	Compiled by	Steve Robinson
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FOUNDATION INDICATOR

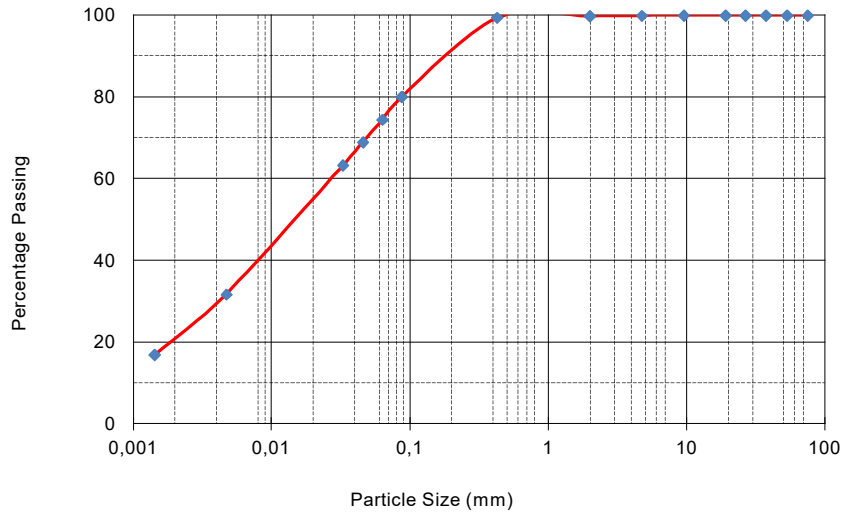
Client	Resonate Enviromenta		
Location	Tutuka Power Station	TP 4 @ 1,7 - 2,9m	
Date	18-Mar-25	Test No	780
Job No	25059	Checked By	SM

GRADING ANALYSIS

SIEVE ANALYSIS

Values are expressed as a percentage of total sample

Sieve Size (mm)	Total Passing (%)
75	100,00
53	100,00
37,5	100,00
26,5	100,00
19	100,00
9,5	100,00
4,75	99,91
2	99,78
0,425	99,33



HYDROMETER ANALYSIS

(TMH 1 Method A6)

Values are expressed as a percentage of total sample

Sieve Size (mm)	Total Passing (%)
0,0874	79,99
0,0633	74,41
0,0457	68,83
0,0330	63,25
0,0247	31,62
0,014	16,74

ATTERBERG LIMITS & OTHER VALUES

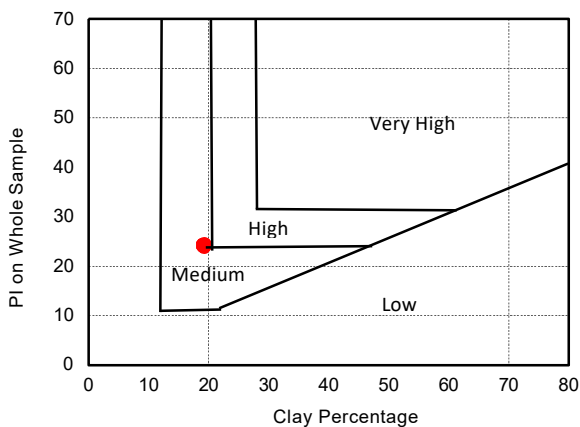
(SANS 3001 - GR10)

Liquid Limit	49
Plastic Limit	25
Plastic Index	24
Linear Shrinkage	12
Grading Modulus	0,24
Moisture Content	20
PI on Whole Sample	24
PRA Classification	A.7.6
Unified Classification	See Plasticity Chart
Coefficient of Curvature Cc	#DIV/0!
Coefficient of Uniformity Cu	#DIV/0!

ESTIMATED COMPOSITION (As BS 1377)

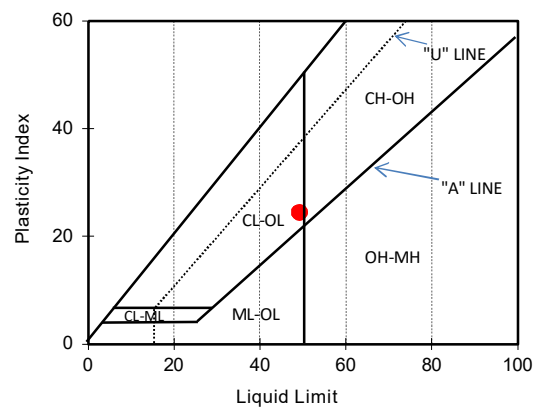
Clay (<0.002)	19,35
0.002 < Silt < 0.06	54,02
0.06 < Sand < 2.0	26,41
Gravel > 2.0	0,22
% less than 0.075	77,12

ACTIVITY CHART



PLASTICITY CHART

Fine Grained Soils: >50% passes 0.075



Revision Number	1	Revised By	sr	Page No.	Page 1 of 1
Date	15-Sept-18		10-Jun-20	Compiled by	Steve Robinson
Document Number	GTR 021			Authorised by	Colin Dalton

C.B.R. REPORT

Client	Resonate Enviromenta		
Location	Tutuka Power Station	TP 1 @ 1,0 - 2,8m	
Date	11 April 2025	Test No	772
Job No	25059	Checked By	SM
Calibration Date	08 July 2024	Calibration Certificate	9480

Direct Results from Test Procedure

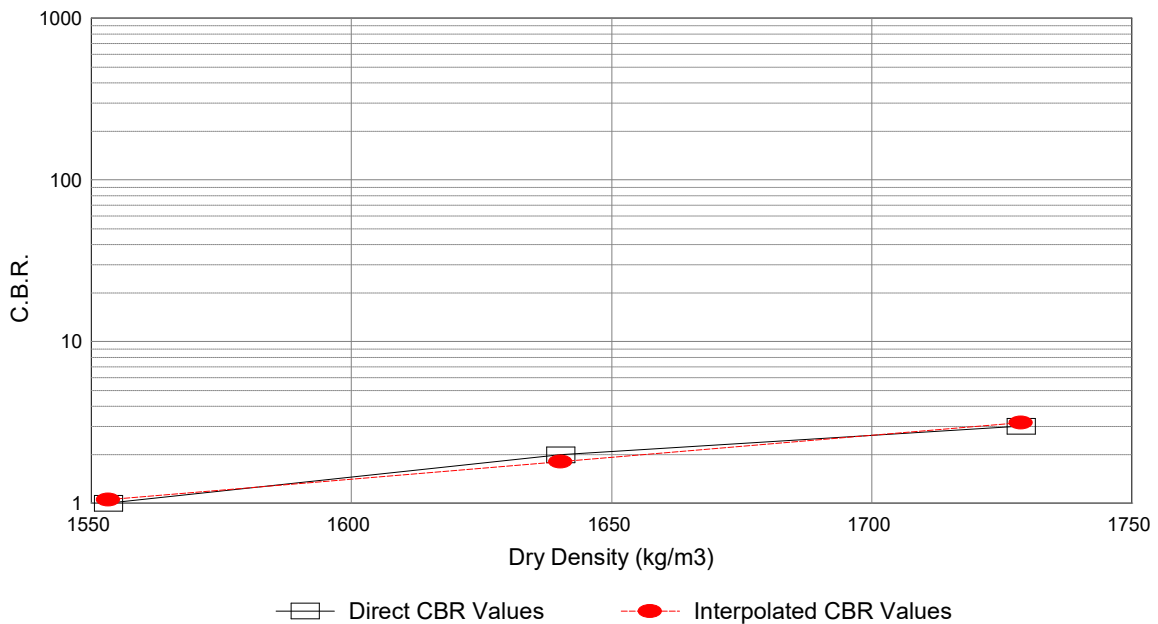
Maximum Dry Density (kg/m ³)	1727
------------------------------------------	------

Optimum Moisture Content (%)	18,5
------------------------------	------

Percentage Mod AASHTO	100,1	95,0	90,0
CBR @ 2.54mm	3	2	1
CBR @ 5.08mm	3	2	1
CBR@ 7.62mm	3	2	1
Average Moisture Content (%)	18,8		
Percentage Swell	1,29	1,34	1,37

Interpolated Results

Percentage Mod AASHTO	90	93	95	98	100
CBR	1	1	2	3	3



C.B.R. REPORT

Client	Resonate Enviromenta		
Location	Tutuka Power Station	TP 2 @ 0,3 - 0,9m	
Date	11 April 2025	Test No	774
Job No	25059	Checked By	SM
Calibration Date	08 July 2024	Calibration Certificate	9480

Direct Results from Test Procedure

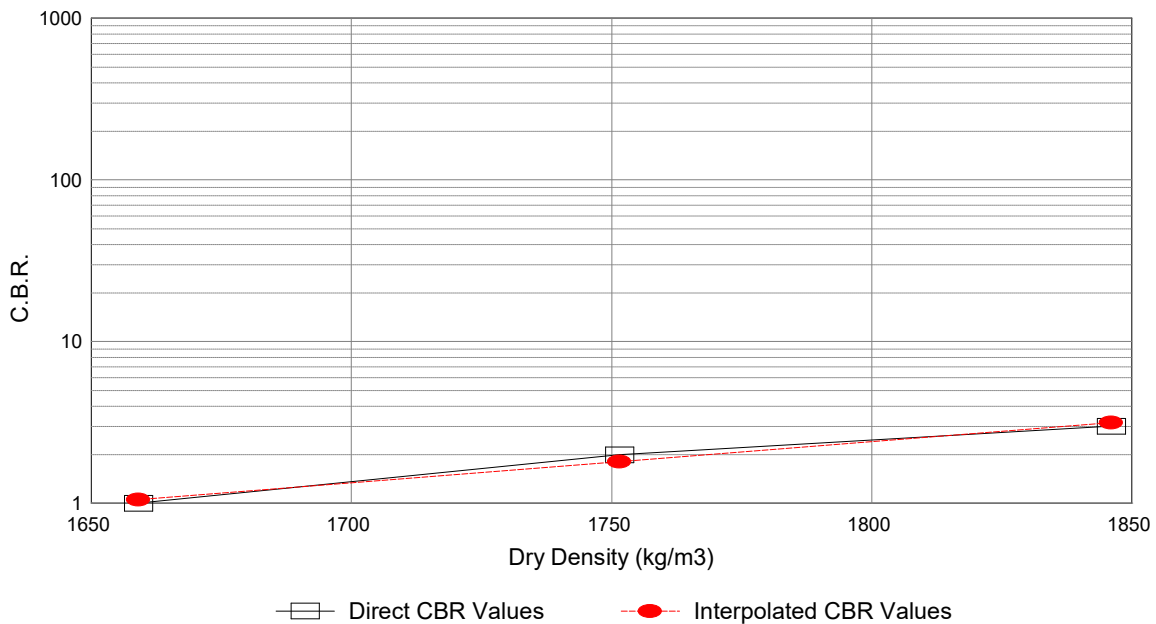
Maximum Dry Density (kg/m ³)	1844
------------------------------------------	------

Optimum Moisture Content (%)	10,8
------------------------------	------

Percentage Mod AASHTO	100,1	95,0	90,0
CBR @ 2.54mm	3	2	1
CBR @ 5.08mm	3	2	1
CBR@ 7.62mm	3	2	1
Average Moisture Content (%)	11,0		
Percentage Swell	1,15	1,26	1,36

Interpolated Results

Percentage Mod AASHTO	90	93	95	98	100
CBR	1	1	2	3	3



C.B.R. REPORT

Client	Resonate Enviromenta		
Location	Tutuka Power Station	TP 2 @ 0,9 - 1,6m	
Date	11 April 2025	Test No	776
Job No	25059	Checked By	SM
Calibration Date	08 July 2024	Calibration Certificate	9480

Direct Results from Test Procedure

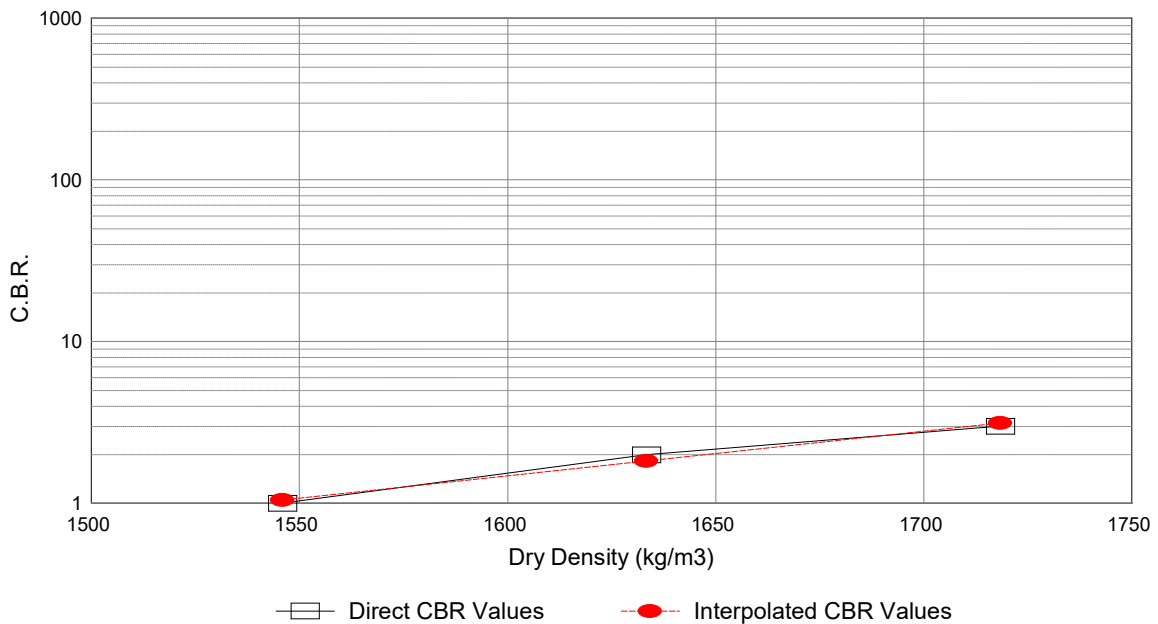
Maximum Dry Density (kg/m3)	1719
-----------------------------	------

Optimum Moisture Content (%)	17,0
------------------------------	------

Percentage Mod AASHTO	100,0	95,0	89,9
CBR @ 2.54mm	3	2	1
CBR @ 5.08mm	3	2	1
CBR@ 7.62mm	3	2	1
Average Moisture Content (%)	17,6		
Percentage Swell	1,10	1,18	1,26

Interpolated Results

Percentage Mod AASHTO	90	93	95	98	100
CBR	1	1	2	3	3



DOUBLE OEDOMETER

Client	Resonate Enviromenta		
Location	Tutuka Power Station	TP 4 @ 0,5 - 1,1m	
Date	11 April 2025	Test No	777
Job No	25059	Checked By	EB

Sample Height (mm)	20	Sample Diameter (mm)	64	Sample Specific Gravity	2,414
--------------------	----	----------------------	----	-------------------------	-------

Sample at NMC

Effective Stress (kPa)	Time (mins)	Consolidation Reading	Voids Ratio	Strain (%)
10	120	560	1,036	0,00
10	1440	565	1,031	0,25
33	1500	572	1,023	0,60
65	1560	582	1,013	1,10
127	1620	603	0,992	2,15
251	1680	645	0,949	4,25
498	1740	704	0,889	7,20
993	1800	782	0,810	11,10
1868	3240	957	0,632	19,85
743	3360	948	0,641	19,40
118	3480	907	0,682	17,35
10	3600	900	0,690	17,00

Sample Soaked

Effective Stress (kPa)	Time (mins)	Consolidation Reading	Voids Ratio	Strain (%)
10	120	937	1,046	0,00
10	1440	922	1,062	-0,75
33	1500	938	1,045	0,05
65	1560	978	1,004	2,05
127	1620	1046	0,935	5,45
251	1680	1115	0,864	8,90
498	1740	1192	0,785	12,75
993	1800	1280	0,695	17,15
1868	3240	1486	0,485	27,45
743	3360	1478	0,493	27,05
118	3480	1438	0,534	25,05
10	3600	1426	0,546	24,45

Moisture Content Calculations

Mass wet sample plus ring before test (gms)	307,00
Mass wet sample plus ring after test (gms)	306,00
Mass dry sample plus ring (gms)	287,00
Mass ring (gms)	210,70
Moisture content before test (%)	26,21
Moisture content after test (%)	24,90

Moisture Content Calculations

Mass wet sample plus ring before test (gms)	303,80
Mass wet sample plus ring after test (gms)	308,00
Mass dry sample plus ring (gms)	283,90
Mass ring (gms)	208,00
Moisture content before test (%)	26,22
Moisture content after test (%)	31,75

Other Data

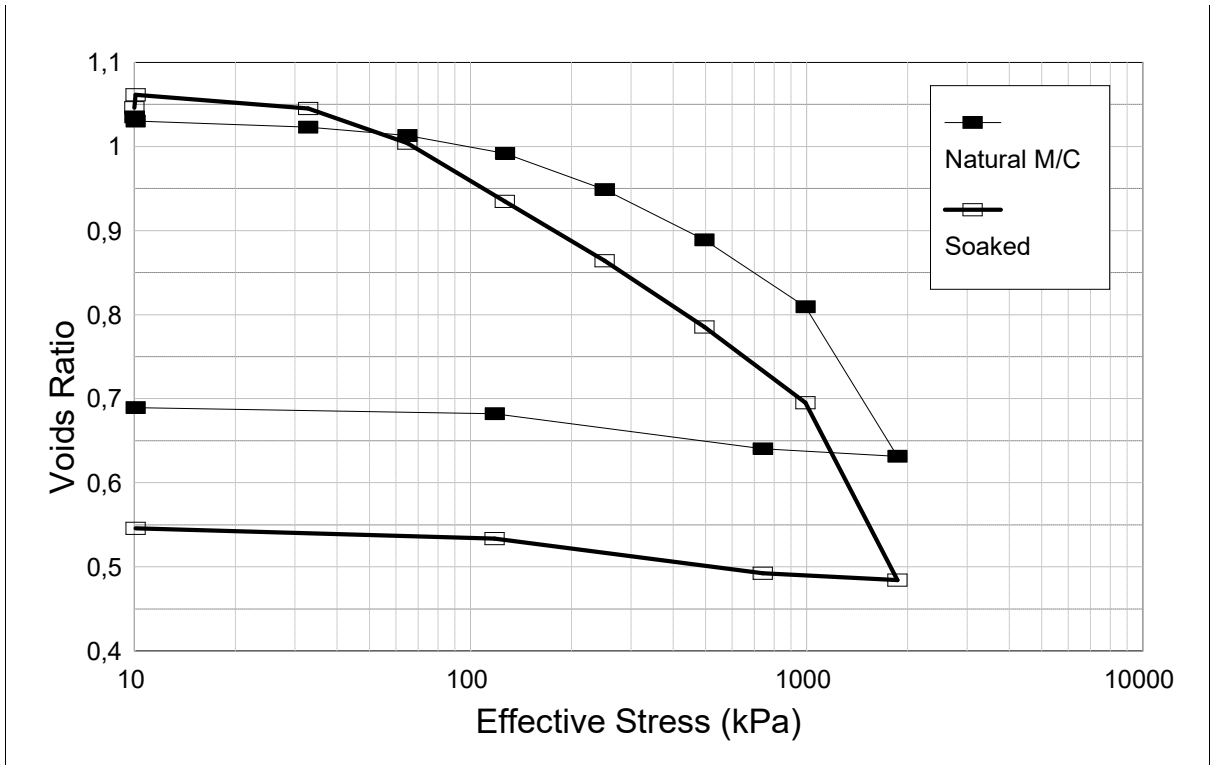
Initial Dry Density (kg/m3)	1186
Initial Void Ratio	1,04

Other Data

Initial Dry Density (kg/m3)	1180
Initial Void Ratio	1,05

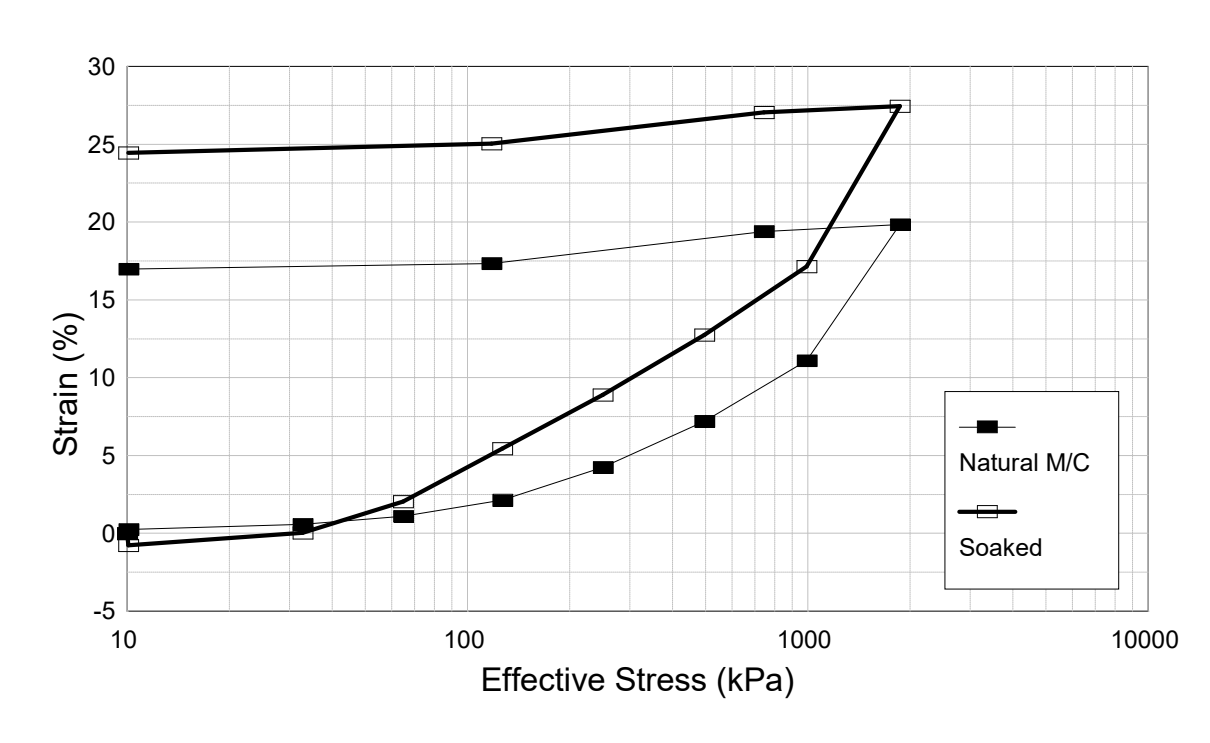
VOIDS RATIO v EFFECTIVE STRESS

Test No: 777



STRAIN v EFFECTIVE STRESS

Test No: 777



DOUBLE OEDOMETER

Client	Resonate Enviromenta		
Location	Tutuka Power Station	TP 4 @ 1,1 - 1,7m	
Date	11 April 2025	Test No	779
Job No	25059	Checked By	EB

Sample Height (mm)	20	Sample Diameter (mm)	64	Sample Specific Gravity	2,439
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Sample at NMC

Effective Stress (kPa)	Time (mins)	Consolidation Reading	Voids Ratio	Strain (%)
10	120	1322	1,159	0,00
10	1440	1328	1,152	0,30
33	1500	1333	1,147	0,55
65	1560	1338	1,141	0,80
127	1620	1349	1,129	1,35
251	1680	1368	1,109	2,30
498	1740	1402	1,072	4,00
993	1800	1474	0,994	7,60
1868	3240	1574	0,887	12,60
743	3360	1565	0,896	12,15
118	3480	1549	0,914	11,35
10	3600	1529	0,935	10,35

Sample Soaked

Effective Stress (kPa)	Time (mins)	Consolidation Reading	Voids Ratio	Strain (%)
10	120	860	1,170	0,00
10	1440	860	1,170	0,00
33	1500	895	1,132	1,75
65	1560	948	1,075	4,40
127	1620	1010	1,008	7,50
251	1680	1076	0,936	10,80
498	1740	1145	0,861	14,25
993	1800	1204	0,797	17,20
1868	3240	1318	0,673	22,90
743	3360	1294	0,699	21,70
118	3480	1264	0,732	20,20
10	3600	1232	0,767	18,60

Moisture Content Calculations

Mass wet sample plus ring before test (gms)	302,30
Mass wet sample plus ring after test (gms)	298,80
Mass dry sample plus ring (gms)	284,00
Mass ring (gms)	211,30
Moisture content before test (%)	25,17
Moisture content after test (%)	20,36

Moisture Content Calculations

Mass wet sample plus ring before test (gms)	296,00
Mass wet sample plus ring after test (gms)	299,80
Mass dry sample plus ring (gms)	277,40
Mass ring (gms)	205,10
Moisture content before test (%)	25,73
Moisture content after test (%)	30,98

Other Data

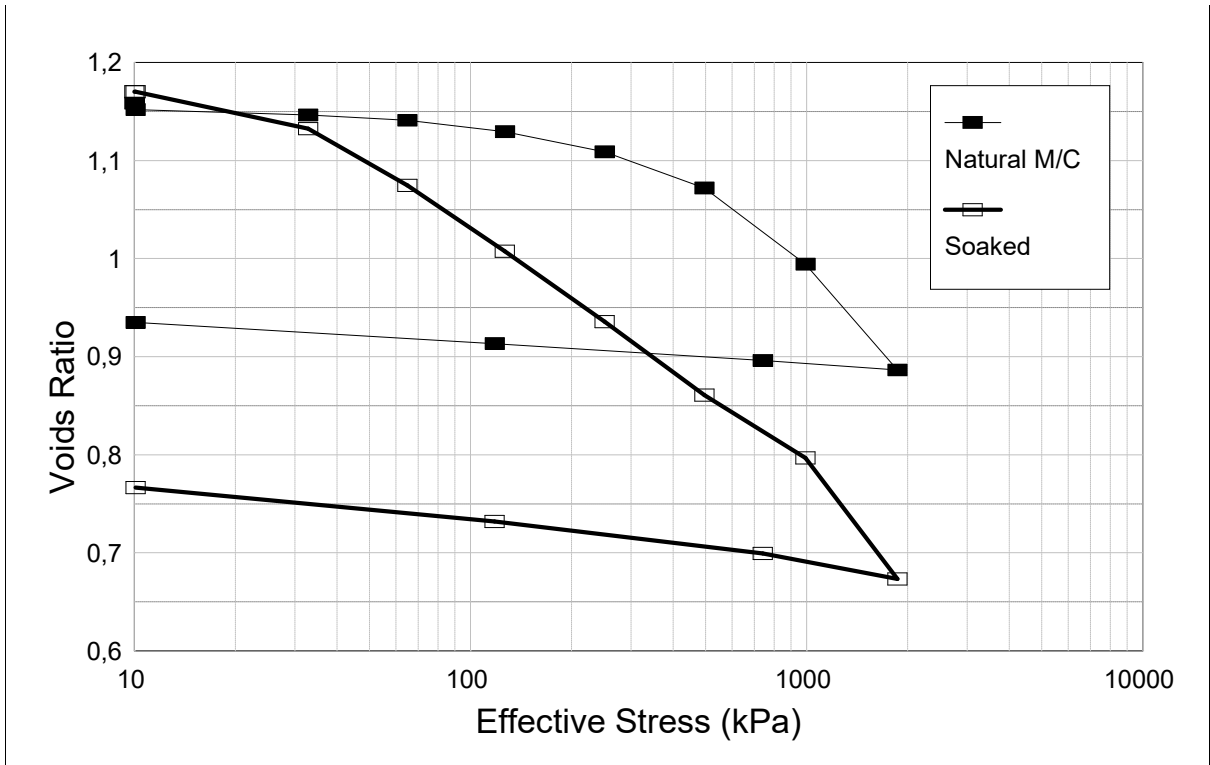
Initial Dry Density (kg/m3)	1130
Initial Void Ratio	1,16

Other Data

Initial Dry Density (kg/m3)	1124
Initial Void Ratio	1,17

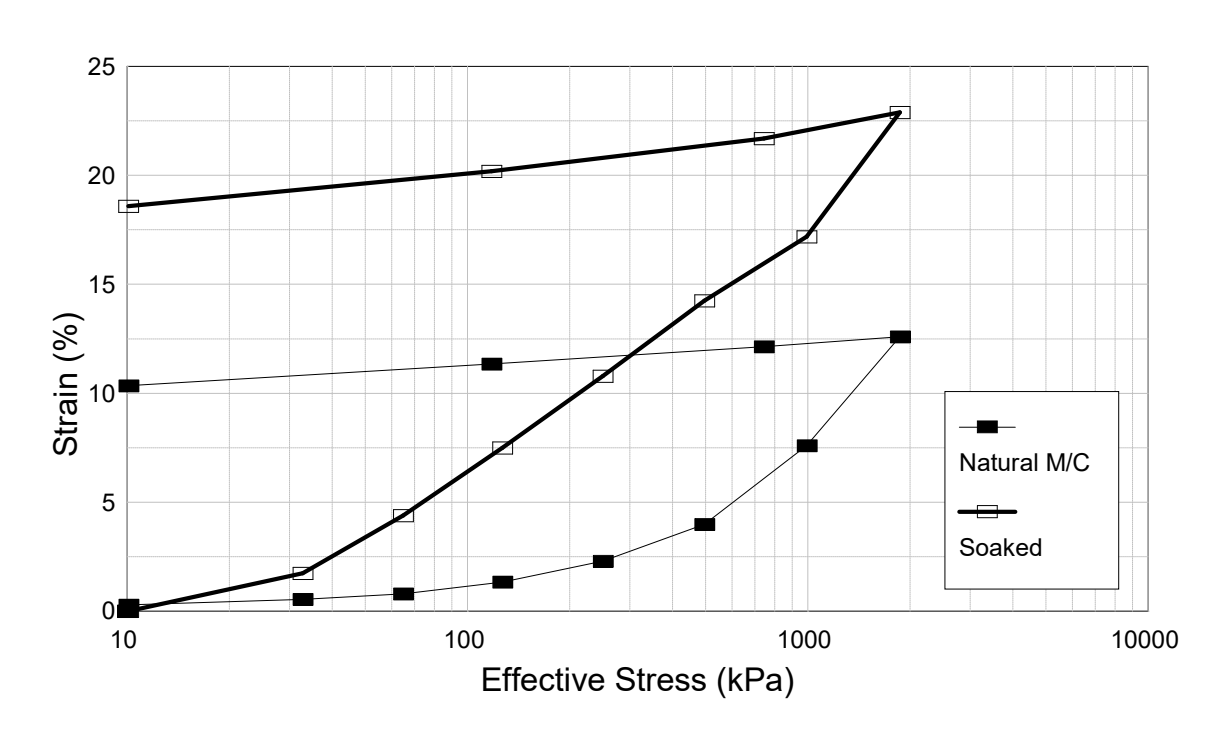
VOIDS RATIO v EFFECTIVE STRESS

Test No: 779



STRAIN v EFFECTIVE STRESS

Test No: 779



APPENDIX 6

PHOTOGRAPHS

Client: **Resonant Environmental**
Location: **Tutuka Power Station, Mpumalanga**
Job No : **25059a**



Overall View of the site - Scrapyard

Client: **Resonant Environmental**
Location: **Tutuka Power Station, Mpumalanga**
Job No : **25059a**



Overall View of the site - Scrapyard

Client: **Resonant Environmental**
Location: **Tutuka Power Station, Mpumalanga**
Job No : **25059a**



Soil Profile as observed in TP-01



Soil Profile as observed in TP-02

Client: Resonant Environmental
Location: Tutuka Power Station, Mpumalanga
Job No : 25059a



Soil Profile as observed in TP-03



Soil Profile as observed in TP-04

Client: **Resonant Environmental**
Location: **Tutuka Power Station, Mpumalanga**
Job No : **25059a**



Soil Profile as observed in TP-05