ESKOM

PAULPUTS SUBSTATION
NEAR ONSEEPKANS IN THE
NORTHERN CAPE

GEOTECHNICAL REPORT

GEOTECHNICAL INVESTIGATION FOR THE PROPOSED NEW PAUL PUTS SUBSTATION

JANUARY 2000

GEOTECHNICAL SERVICES

SUBSTATION TECHNOLOGY

APPENDICES

TITLE : *GEOTECHNICAL REPORT*
GEOTECHNICAL INVESTIGATION FOR THE PROPOSED NEW PAUL PUTS SUBSTATION

PREPARED BY : *Geotechnical Services*
SUBSTATION TECHNOLOGY

CLIENT :

PROJECT TEAM : F A Grové

REPORT NO : *GR-20/99*

DATE : *January 1999*

Approved :

Group Consultant - Geotechnical Services

1.0 INTRODUCTION

A new **275/132/33 kV Electrical Substation is planned approximately 45km to the north of Pofadder in the northern Cape.**

This report deals with the general soil and founding conditions, investigated down to maximum depths of the order of 2,6m below natural ground level, for the proposed new substation structures. Geotechnical Services of Substation Technology was requested to carry out the Geotechnical Investigation for the proposed development.

2.0 OBJECTIVES OF INVESTIGATION

The objectives of this investigation could be summarised as follows:

- nature and engineering properties of the soil and rock horizons underlying the site
- suitability of the insitu materials for use in civil construction
- founding conditions on site for the proposed substation structures

3.0 GEOGRAPHY

3.1 Site Locality and Access

The site for the proposed development is located on the **farm Scuit-Klip**, approximately 35 km to the north of **Pofadder, adjacent west of the road to Warmbad-Noord in the Northern Cape.** The site is accessed from the gravel district road between Warmbad-Noord and Pofadder and is located 100m adjacent west of this road. This gravel road was found in a poor condition at the time of this investigation and it is advised to access the site via the gravel road from Kakemas to Onseepkans. Note should be taken that farm gates often cross these roads, which **might hamper access** to the site, by abnormal loads.

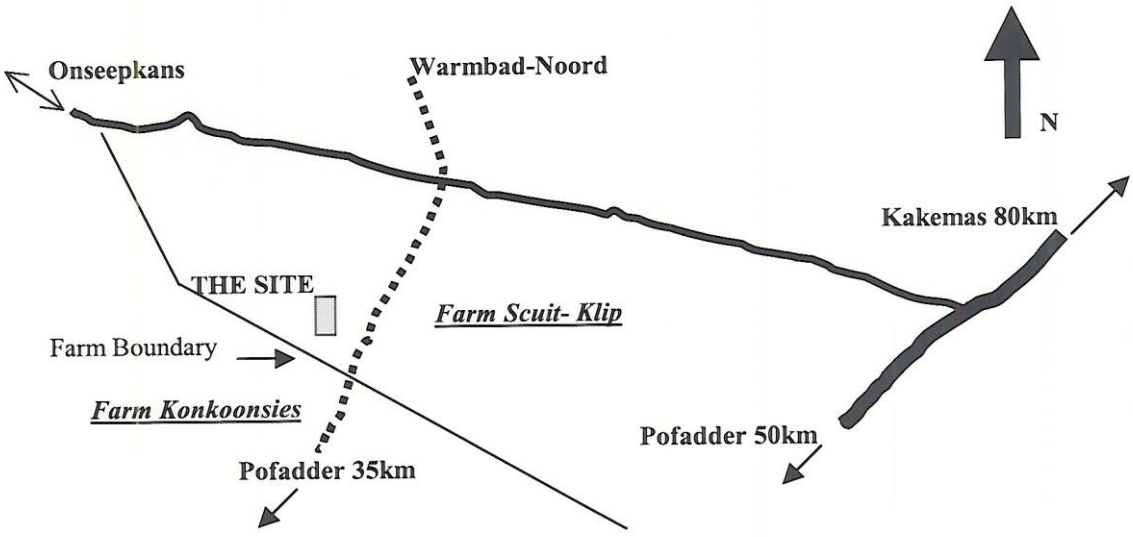


FIGURE I **SITE LOCALITY**

At present the site is being utilised for farming.

3.2 Topography, Drainage and Vegetation

The region is known for its picturesque scenery, formed by the presence of a combination of flats, hillocks, hills, mountains and native flora. The site is located uphill to the north/east of a hillock and partially crosses a waterway with slopes varying from as flat as 1.03% longitudinal to as steep as 2,3% cros-sectional. The proposed area for this development is partly covered by native grass and scattered bush.

The site has a relief of about 3 m (in the worst case) in a northern eastern direction as indicated in **Figure-II** (0,5 m contour intervals) **in Appendix-C.** The topography of the site is undulating with slopes from as flat as ± 1,0% (south-north) to as steep as 2,3 % (east-west).

The area will be **partly reduced and raised** in elevation as part of the construction of the platform.

3.3 Climate

3.3.1 N-Value

The climatic environment is described by the "Weinert N-Value" which is approximately 35. Where N is less than 5, decomposition affects those rocks whose minerals are liable to change chemically under atmospheric conditions and where N is more than 5, disintegration is the predominant form of weathering.

3.3.2 Temperatures

The average maximum daily summer temperature is 30,6° C (recorded during months from October to March), with average minimum yearly winter temperatures of -0,98°C, recorded during months from May to October (measured at Pofadder).

3.3.3 Rainfall

This is a summer rainfall area and the long term (1953 to 1996) average yearly rainfall recorded, is 80,5mm (measured at (Onseepkans). This rain is spread over an average of 9,5 days per year (1951-1999) with a maximum of 64mm measured on 1976/02/03.

4.0 REGIONAL GEOLOGY

The solid geology of the region is masked by transported soils, comprising alluvuim, sand, calcareous soils with dykes of acid igneous rocks in places. The proposed site is underlain by sand, alluvium, calcrete and calcified granite, with the presence of granite corestones confirmed at shallow depths to the east and west.

5.0 METHOD OF INVESTIGATION

5.1 Exploratory Work and Logging Technique

The **site plan (Figure - II)** indicates the contours and **not co-ordinated** positioning of test pits excavated and land marks such as tracks, farm boundaries, fences, the district road and telephone lines.

The general ground conditions were examined by excavating a total number of fifteen trench pits down to depths of 0,5m to 2,5m/refusal, covering the site roughly on a 50m grid. Test pits were numbered from **TP-1 to TP-15.**
A properly qualified operator excavated test holes by means of a SUMITOMO LS-4300(F2) excavator, whom was mechanically in a sound condition and operated. The soil profiles

(Appendix-A), were recorded by insitu inspection applying the visual and tactile procedure advocated by Jennings, Brink and Williams **(Ref. 9.1).** Note should be taken that a number of trench pits were **profiled from the top due to the collapse of sides**, mainly caused by the looseness of the transported soils.

5.2 Laboratory Testing

Laboratory tests on samples were primarily conducted to determine the geotechnical properties and soil chemistry of the materials on site. Though not indicated on laboratory test results (depths) and some soil profiles, samples taken for testing did not include the top organic materials and roots.

The following tests were carried out:

- Grading (Mechanical and Hydrometer)
- Atterberg Limits
- Bulk Density
- Mod AASHTO maximum dry density and CBR
- pH and Conductivity
- Total Soluble Solids
- Basson Index

The Geotechnical Properties are listed in ***Table-I.***

6.0 GROUND WATER TABLE

This investigation was carried out during the normal rainy season and the profile was in general found very dry, with no indication of a moisture increase with depth. A water sample from a borehole was taken at the nearby farm house, for analysis.

7.0 GEOTECHNICAL EVALUATION

7.1 The Soil Profile

The soil profile occurs uniformly over the site, with discrepancies regarding the material occurrences and physical properties with depth. Frequently test pits were profiled from the top due to the danger of collapsing sides as a result of the cohesionless nature of the top transported sands and alluvium.

Information obtained from test pits profiled down to average depths of 1,50m, suggests the site being shallowly underlain by **soft to medium hard ROCK,** experiencing slow **penetration/refusal** at depths with the **Sumitomo LS 4300-F2 excavator**, on either **"HARDPAN CALCRETE" or well calcified GRANITE/GNEISS ROCK.**

The sporadic presence of probably **Granite Corestones** was confirmed adjacent **east and west of the site (TP-7; TP-14; TP-15).**

The Granite dykes and Hardpan Calcrete is blanketed by **Transported** and **Calcified** materials, referred to as very loose, silty fine to clayey medium SAND. In places the **PEBBLE MARKER is present, consisting of** abundant coarse to fine rounded and subrounded quartz gravel.

Note should be taken that the **presence and positioning of corestones within the granite profile can not be accurately predicted.**

The nutrient value of the top 100 to 150mm of the Transported material is considered valuable for re-instating plant growth and landscaping.

It is believed that construction vehicles could experience difficulties in accessing the site initially. This will mainly be caused by the very loose and cohesionless nature of the Transported and Alluvium materials. To overcome these **problem access roads could be surfaced with gravel before construction.** Note should be taken that **the district road was found in a poor state** of maintenance and it should be considered to have this road properly maintained during construction by the local authorities.

7.2 The Platform

7.2.1 Platform Position and Geometry

The substation terrace layout and position was not finalised at the time of this investigation. Rotation to optimise the earthworks geometry of the planned platform should be considered, taking into account the site topography, typical ground conditions, power line and district road servitudes etc. An attempt should be made with the final levels, to achieve a compromise between the ground profile and construction material properties from cut.

7.2.2 Maximum Cut Depth and Fill Height

Topographical contours drawn at half a metre intervals to illustrate the variation in levels across the site, are shown on the site plan **(Fig.-II).**

Assuming the terrace to be ± 80m wide (east to west) and ± 150 m long (north to south), and considering the topography of the site, it could be expected that the maximum depth of cut would not exceed 1m, resulting in a maximum height of fill of about 0,5m. This exercise should however be simulated in order to obtain a compromise between the topography, average ground profile, and material properties of the site.

7.2.3 Physical Properties of Materials

Based on information obtained from the grid of test holes covering the site, the materials that could be expected from cut and excavations in the virgin soil profile are in stratigraphic sequence from the surface down as follows:

Soil Type	**Average Depth (m) from NGL**
Transported Material	
Dry, light reddish brown, medium dense to very loose, intact, slightly clayey silty fine SAND, with occasionally rounded fine Gravel and mainly organic material and grass roots, in the top ± 150mm - Collapse Potential	0,50
Pebble Marker	
Moist to very moist, light red, loose to medium dense, intact, slightly clayey silty SAND in a nodular quartz GRAVEL – Collapse Potential	0,70
Calctrete and Calcified Granite Gravel	
Dry, whitish stained light red, yellow and, dense to very dense, shattered, poor to well developed, calcrete and calcified Granite Gravel	1,6

Soil Type	Average Depth (m) from NGL
Granite Rock/Hardpan Calcrete	
Soft to medium Hard Rock – Dark reddish speckled, stained yellow and white, micaceous, occasionally vertically fissured, well calcified, Soft to Medium Hard ROCK.	1,6m/+

Note should be taken that the calcified profile varies considerably with depth in consistency and quality from test pit to test pit.

From dozing to easy rip will be required to excavate the above materials. It is anticipated that the majority of materials (down to ± 0,5m) could be removed by dozing. Below this level, when excavating into the very dense to soft rock quality Calcrete and Calcified Granite Gravel, ripping will be increasingly required with depth to excavate these materials and corestones. The need for **blasting to excavate rock** is expected to be minimised down to depths investigated, and would only be required for the removal of core stones. For confined excavations, power tools will be required.

7.2.4 Compaction Characteristics

Alluvium soils are known for their collapse potential. For this reason, the transported alluvium materials below the fill should be pre-wetted and insitu compacted to 100% Mod AASHTO maximum dry density at OMC. This could probably be best achieved by pre-wetting and applying a 9 ton vibratory roller. The majority of materials on site are suitable for fill and selected subgrade. The top Transported soils (excluding the top ± 150mm-organic) was found dry of optimum moisture content and is considered suitable for selected subgrade and to a lesser extend subbase. As a result of varying material properties lower down the profile (calcareous gravel) it is advised to have this **material (Transported) mixed with materials from below**. The alluvium has excellent properties, which will contribute to quality and workability once brought to optimum moisture content and mixed with other materials from site, to increase the cohesion.

The properties of the residual calcified Granite varies with depth, from coarse gravel to intact hardpan calcrete. The Atterberg Limits are expected to vary considerably, which is normal to Calcrete. The **top sand and calcrete gravel** from TP-12 (see photograph) was mixed (50/50) in the laboratory and tested. Results indicated this material, when mixed to the required ratio, [considering Atterberg Limits from TP-10 (0,9-1,5m)] to be suitable for subbase and gravel wearing coarse requirements.

The **need to import suitable materials** for the access road might also arise during construction. For this purpose, an area was identified immediately to the south west of the proposed site **(see Fig.-II).**

Considering the structural requirements of the fill and soil properties of the site it is recommended to have, the fill **compacted to 100% of Mod. AASHTO maximum dry density at OMC (±2%), CBR > 20,** in layer work not exceeding 150 mm after compaction. As a result of the relatively low insitu dry density of the alluvial and calcareous materials, and the compacted density of 2145 kg/m³ achieved at 100% Mod AASHTO maximum dry density, it is expected that the volume from cut will balance the fill volume required close to a 1: 0,8 ratio. This will mean that one m³ from cut will reduce in volume to ± 0,8m³ when compacted to 100% Mod.AASHTO maximum dry density at OMC.

Allowance to **import material to improve the quality and to replace volumes of unsuitable materials** spoiled from excavations should be made. Due to the low cohesion of the transported materials, it is recommended to provide for a blanket layer to protect the

completed terrace against deterioration. It should be noticed that this measure would only contribute to slow down erosion of the completed surface.

7.2.5 Cut and Fill Slopes

The cut slopes in the Transported and Residual materials is expected to be stable at minimum slopes of 1:2, and the **fill slope** is expected to stand safely up at slopes of 1:2. The materials on site is however considered **sensitive to water erosion, due to it's low cohesion and it is expected that cut slopes** in the materials on site will result in erosion which is **expected to stabilise at approximately 1 on 2**. Considering protection measures facilitating erosion on slopes, it is recommended not to exceed slopes of **one vertical on three horizontal** in both the cut and fill.

7.3 Foundations

7.3.1 Foundations in Cut (Insitu Materials)

Foundation excavations in cut, assuming platform levels not exceeding NGL - 1,0m in depth, will require from **soft to intermediate excavation** for removal. Though excavations in confined areas might require wedging, classified as **HARD excavation**. Below these depths it is expected that material will change rapidly to soft rock. Provision to excavate **core-stones** normally found in granite profiles, should be made. For this purpose, blasting might be required to a limited extent.

The consistency of the insitu Transported materials are loose to medium dense with collapse potential, and will **require overexcavation and re-compaction for founding light structures** on strip footings with foundation loads not exceeding 150kPa. Provision should be made **for importation of suitable gravel material as supplement for** the expected reduction in volume after compaction. In places, **increased depths of founding** might be more viable.

Overexcavation and backfill below foundations should be carried out to one metre in excess of the plan dimensions, in **level layer work not exceeding 150mm** after compaction. Approved material should be compacted to **100% Mod. AASHTO maximum dry density** at Optimum Moisture Content, and not be allowed to dry.

The floor of excavations should be properly levelled and insitu compacted to 100% (alluvium) of Mod. AASHTO maximum dry density at ± 2% OMC prior to backfilling taking place.

All foundation loads **should be founded on either improved (recompacted) alluvium or on the dense to very dense calcareous materials.**

7.3.2 Foundations in Fill

Foundations for structures will be placed at varying depths within the fill. The **structural requirements of the fill)** will provide sound founding material when compaction extends down to levels of foundation load influences. A minimum compacted thickness of one metre is required below all foundation loads when foundations are placed in **the loose alluvium materials (max. 150kPa).** For this reason, allowance should be made to overexcavate and recompact all alluvium materials (insitu) to a maximum thickness of 1,0m below founding levels. The allowable maximum bearing pressure in solid fill is 150 kPa, considering the depth of influence for foundation loads.

7.3.3 Stability of Excavations

Sides of excavations often collapsed in the transported materials. It is anticipated that sides will erode easily due to the low cohesion in the Transported materials, **causing unstable**

conditions during construction. Therefore, special measures will be required to ensure workmen safety during construction.

8.0 BORROW PIT

An area adjacent south east of the proposed site was identified as a potential borrow pit. Results from materials on site indicate the transported and calcareous materials to have excellent properties once compacted, except for the low cohesion, which is evident. However, it is believed that **the cohesion could be improved if these materials are mixed to the required ratio**. Results from a **50/50 mix prepared by the laboratory** shows promising results, with a **Plasticity Index of 4 and a CBR of 62** at 98% Mod AASHTO max. dry density (see Appendix – B). Provision should also be made to **import materials from a commercial borrow pit.**

9.0 SOIL CHEMISTRY

9.3 Soil Corrosiveness

From communication with local Consultants, it is concluded that the soil is in general believed to be corrosive and provision is normally made to take preventative measures.

Due to the limited availability of laboratory services in the area, a sample was brought to Gauteng for analysis. Results received indicate the soil to be mildly to moderately aggressive, with leaching being the dominant mode of attack. For this reason a **competent concrete design and well-controlled construction** will be required to counteract for these conditions. The quantity sulphates and chlorides present is considered very low, indicating the soil to be slightly aggressive towards unprotected metals.

9.4 Chemical Analysis

9.4.1 Water

The only source of water within the immediate area of the substation area is the supply to the substation from a borehole, from the nearby farm house, Skuitklip, approximately 3km to the north of the site. Since it is expected that borehole water from a local source will be used during construction, a sample of this water was taken for analysis. Results obtained indicated the **"Total Dissolved Solids" to exceed the upper limit of 2000 PPM**, as is proposed by Fulton. This result is a strong indication that a concrete design based on testing of beams (BS 3148), will be required for all concrete to be used, before construction, should this water be used in the mix.

10.0 THE ACCESS ROAD

The proposed lining and design detail of the access road was not available at the time of this investigation. The district road to the site is passing the site longitudinally in a north/south direction, adjacent to the east. The lining and design of the access road is thus not expected to be problematic.

11.0 CONCLUSIONS AND RECOMMENDATIONS

11.1 The grass and roots should be grubbed, cleared, and spoiled. The top 150mm of the topsoil (organic) should be removed and stockpiled for later use. To minimise soil being removed during this process use should be made of harrow and raking.

11.2 Prior to placing the fill layers insitu ripping to at least 150mm, material watered to OMC and compacted to100% Mod. AASHTO maximum dry density at OMC will be required. Structural fill layers should be compacted in layers not exceeding 150mm after compaction, to **100% of**

Mod. AASHTO maximum dry density at OMC (minimum CBR- 20). The maximum allowable safe bearing pressure for the solid fill **(considering depth of foundation stress influence)** is **150 kPa**

11.3 As a result of the bulking factor of the materials within the transported profile, **provision to import suitable fill material** should be made for compaction below founding levels within the transported materials.

11.4 For the buildings, **bulk over excavation and recompaction of the loose transported materials will be required. Backfill material** should be compacted to **100 % of Mod AASHTO** (CBR > 20) maximum dry density **at ± 2 % of optimum moisture content.**

The construction of **concrete aprons** (minimum of 1,0m wide) on perimeters of buildings, sloping away from brickwork to avoid artificial saturation of founding material, should be considered. No ponding of water should be allowed near buildings.

11.6 Concrete design should include for provision of corrosive attack. Services not prone to corrosive attack should be used. The silica and potenrtial reactivity of all concrete aggregate should be confirmed prior to mix designs.

11.7. The presence of granite corestones and hardpan calcrete might require blasting and/or wedging for excavation in confined areas.

11.8 Provision to break down soft and medium hard rock cobbles and boulders from cut by means of grid rolling or similar for confined areas would be required. Proper mixing of materials from cut *(sandy alluvium and more clayey calcareous materials)* and borrow areas will be required to achieve specifications, and should be practised during construction.

Special provision to obtain water for compaction purposes should be made.

11.9 Due to the typical profile, it is advised to make use of pad type foundations for structures. The geometry of pad foundations will limit excavation depths in the cut areas (near rock) and will in general ease excavation into rock.

11.10 Because of over break and over excavation that could result from foundation excavations in the cut (presence of rock), provision for correction of founding levels in rock should be provided for by means of mass concrete back-fill.

11.11 Where foundation excavation geometry dictates foundations to be constructed on transported materials, special measures might be required for movement sensitive structures. Options like lowering the founding levels to suitable founding materials calcrete/granite or over excavation and re-compaction might be considered.

11.12 Options to import suitable materials for road pavement construction from commercial sources, should be provided for in tender rates, as availability of suitable material and quantities could be limited in the proposed borrow area.

11.12 As a result of drying of the surface after compaction, especially in the transported materials, regular watering to provide proper access will be required, for construction vehicles

11.13 Due to the collapse potential of the transported materials special measures such as the construction of a proper subgrade below roads, and heavy equipment off loading bays, should be provided for.

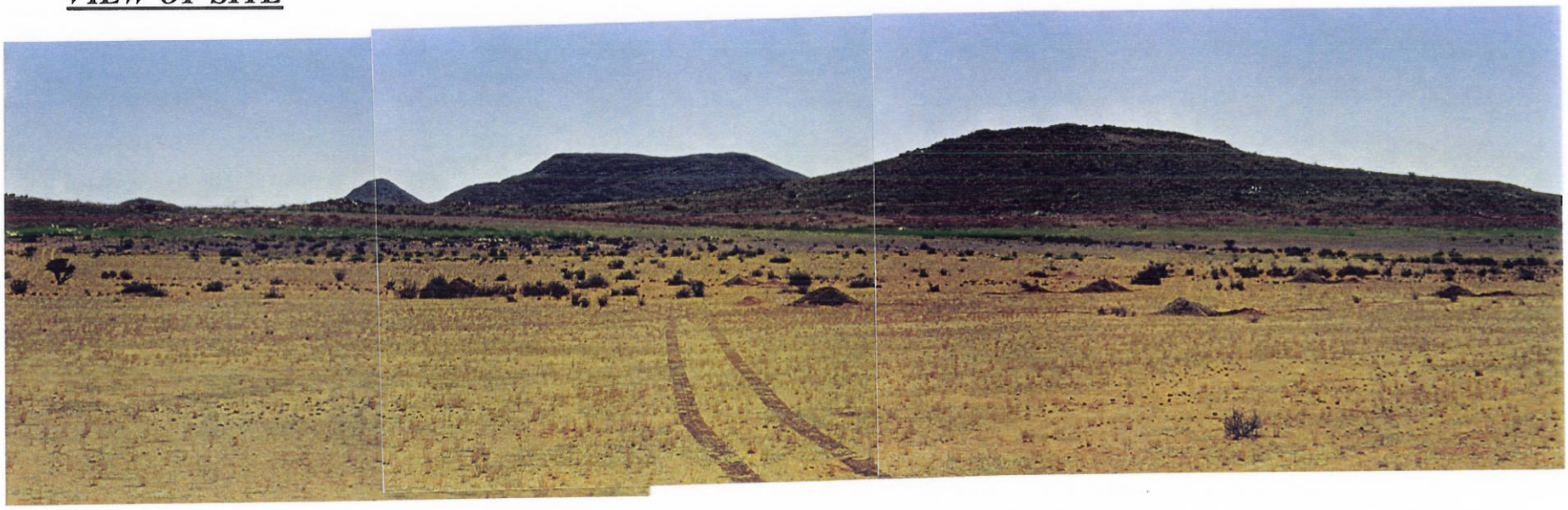
12.0 REFERENCES

12.1 Jennings Brink & Williams (1973). Revised Guide to soil profiling for Civil Engineering purposes in South Africa. The Civil Engineer in S.A. Jan. 1973.

12.2 Engineering Geology of South Africa (1985) Volume-4

12.3 Weather Bureau - Republic of South Africa

VIEW OF SITE



Calcified Gravel Profile
TP-12

View of Material from Excavation

APPENDIX - A
Soil Profiles

PROJECT: PAULPUTS SUBSTATION
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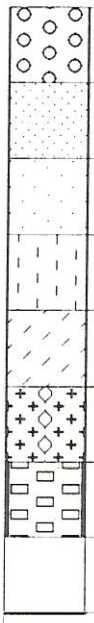
LEGEND
Sheet 1 of 1

JOB NUMBER: GR- 15/99



	GRAVEL	{SA02}
	SAND	{SA04}
	SANDY	{SA05}
	SILTY	{SA07}
	CLAYEY	{SA09}
	GRANITE	{SA17}{SA44}
	HARDPAN CALCRETE	{SA26}{SA29}
Name	DISTURBED SAMPLE	{SA38}

CONTRACTOR :
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PROFILED BY :
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SETUP FILE : STANDARD.SET

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Y-COORD :

LEGEND
SUMMARY OF SYMBOLS

PROJECT: PAULPUTS SUBSTATION
Transmission Group Consultant
GEOTECHNICAL SERVICES

HOLE No: TP-1
Sheet 1 of 1

JOB NUMBER: GR- 15/99

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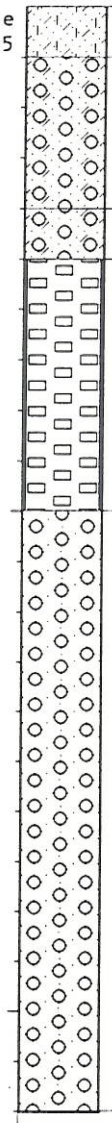

0.00	Dry, light reddish brown, medium dense, intact, slightly clayey silty fine SAND SAND with roots and organic material. Alluvium.
0.10	Dry, light reddish brown, medium dense, intact, clayey, medium, SAND with occasionally rounded fine Gravel. Transported
0.40	As above but medium densely packed, rounded and sub-rounded quartz fine to medium GRAVEL in a slightly clayey fine sand. Pebble Marker.
0.50	Whitish, stained light red occasionally, dense to very dense, medium to well developed, HARDPAN CALCRETE.
1.00	Dark reddish, speckled and stained yellow and white, micaceous, very dense, horizontally bedded, occasionally vertically fissured, micaceous, sandy GRAVEL. Residual Granite
2.20	Refusal on medium hard Rock, probably well calcified GRANITE

CONTRACTOR : CA Bruwer
MACHINE : Sumitomo LS 4300-F2
DRILLED BY :
PROFILED BY : F A Grové
TYPE SET BY :
SETUP FILE : STANDARD.SET

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Y-COORD :

HOLE No: TP-1

PROJECT: PAULPUTS SUBSTATION
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HOLE No: TP-2
Sheet 1 of 1

JOB NUMBER: GR- 15/99

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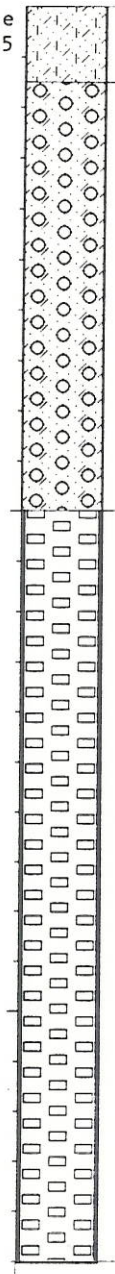

0.00 Dry, light reddish brown, medium dense, intact, slightly clayey silty fine SAND with roots and organic material.
Alluvium.

0.15 Dry, light reddish brown, medium dense, intact, clayey, medium, SAND with occasionally rounded fine Gravel.
Transported

1.00 Whitish, stained light red occasionally, dense to very dense, medium to well developed, HARDPAN CALCRETE.

2.50

NOTES:

1) Slow penetration at bottom

CONTRACTOR : CA Bruwer
MACHINE : Sumitomo LS 4300-F2
DRILLED BY :
PROFILED BY : F A Grové
TYPE SET BY :
SETUP FILE : STANDARD.SET

INCLINATION : VERTICAL
DIAM : Trench Pit
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Y-COORD :

HOLE No: TP-2

PROJECT: PAULPUTS SUBSTATION
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HOLE No: TP-3
Sheet 1 of 1

JOB NUMBER: GR- 15/99

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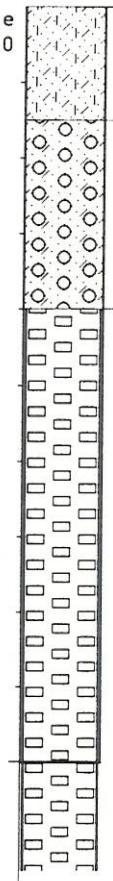

0.00 Dry, light reddish brown, medium dense, intact, slightly clayey silty fine SAND SAND with roots and organic material.
Transported.

0.15 Dry, light reddish brown, medium dense, intact, clayey, medium, SAND with occasionally rounded fine Gravel.
Transported

0.40 Refusal on HARDPAN CALCRETE

CONTRACTOR : CA Bruwer
MACHINE : Sumitomo LS 4300-F2
DRILLED BY :
PROFILED BY : F A Grové
TYPE SET BY :
SETUP FILE : STANDARD.SET

INCLINATION : VERTICAL
DIAM : Trench Pit
DATE : 25/08/99
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Y-COORD :

HOLE No: TP-3

PROJECT: PAULPUTS SUBSTATION
Transmission Group Consultant
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HOLE No: TP-4
Sheet 1 of 1

JOB NUMBER: GR- 15/99

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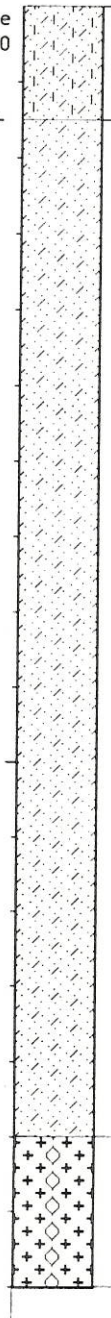

0.00 Dry, light reddish brown, medium dense, intact, slightly clayey silty fine SAND with roots and organic material.
Alluvium.

0.15 Dry, light reddish brown, loose, intact, medium to fine, slightly clayey in places, SAND.
Transported

1.50 Refusal on Well calcified GRANITE ROCK

1.70

NOTES:

1) Sample taken at 0,15-1,5m

CONTRACTOR : CA Bruwer
MACHINE : Sumitomo LS 4300-F2
DRILLED BY :
PROFILED BY : F A Grové
TYPE SET BY :
SETUP FILE : STANDARD.SET

INCLINATION : VERTICAL
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Y-COORD :

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PROJECT: PAULPUTS SUBSTATION
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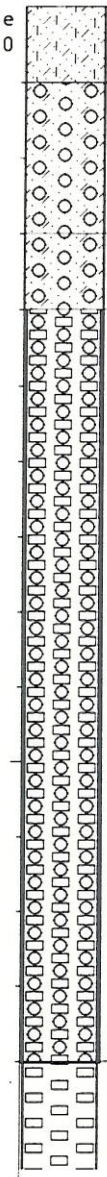
HOLE No: TP-5
Sheet 1 of 1

JOB NUMBER: GR- 15/99

Scale 1:10



0.00 Dry, light reddish brown, medium dense, intact, slightly clayey silty fine SAND with roots and organic material.
Alluvium.

0.10 Dry, light reddish brown, medium dense, intact, clayey, medium, SAND with occasionally rounded fine Gravel.
Transported

0.30 As above but medium densely packed, rounded and sub-rounded quartz fine to medium GRAVEL in a slightly clayey fine sand.
Pebble Marker.

0.40 Whitish, stained light red occasionally, dense to very dense GRAVEL AND COBBLES, well developed HARDPAN CALCRETE.
Residual Granite

1.40 Refusal on probably HARDPAN CALCRETE

CONTRACTOR : CA Bruwer
MACHINE : Sumitomo LS 4300-F2
DRILLED BY :
PROFILED BY : F A Grové
TYPE SET BY :
SETUP FILE : STANDARD.SET

INCLINATION : VERTICAL
DIAM : Trench Pit
DATE : 25/08/99
DATE : 25/08/99
DATE : 16/02/00 13:39
TEXT : B:\PP-2TPPF.TXT

ELEVATION :
X-COORD :
Y-COORD :

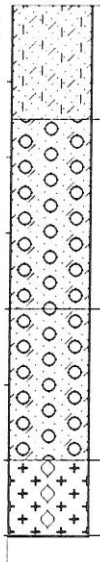
HOLE No: TP-5

PROJECT: PAULPUTS SUBSTATION
Transmission Group Consultant
GEOTECHNICAL SERVICES

HOLE No: TP-6
Sheet 1 of 1

JOB NUMBER: GR- 15/99

Scale 1:10



0.00 Dry, light reddish brown, medium dense, intact, slightly clayey silty fine SAND with roots and organic material.
Transported.

0.15 Dry, light reddish brown, medium dense, intact, clayey, medium, SAND with occasionally rounded fine Gravel.
Alluvium

0.40 As above but medium densely packed, rounded and sub-rounded quartz fine to medium GRAVEL in a slightly clayey fine sand.
Pebble Marker.

0.60 REFUSAL on dark red,speckled white and yellow, micaceous, fissured, medium hard Rock, GRANITE.

0.70

NOTES:

1) Rock excavate in blocks

CONTRACTOR : CA Bruwer
MACHINE : Sumitomo LS 4300-F2
DRILLED BY :
PROFILED BY : F A Grové
TYPE SET BY :
SETUP FILE : STANDARD.SET

INCLINATION : VERTICAL
DIAM : Trench Pit
DATE : 25/08/99
DATE : 25/08/99
DATE : 16/02/00 13:39
TEXT : B:\PP-2TPPF.TXT

ELEVATION :
X-COORD :
Y-COORD :

HOLE No: TP-6

PROJECT: PAULPUTS SUBSTATION
Transmission Group Consultant
GEOTECHNICAL SERVICES

HOLE No: TP-7
Sheet 1 of 1

JOB NUMBER: GR- 15/99

Scale 1:10

0.00 Dry, light reddish brown, medium dense, intact, slightly clayey silty fine SAND with roots and organic material.
Transported.

0.15 REFUSAL on dark red,speckled white and yellow, micaceous, fissured, medium hard Rock, GRANITE.

0.50

NOTES:

1) Rock excavate in blocks

CONTRACTOR : CA Bruwer
MACHINE : Sumitomo LS 4300-F2
DRILLED BY :
PROFILED BY : F A Grové
TYPE SET BY :
SETUP FILE : STANDARD.SET

INCLINATION : VERTICAL
DIAM : Trench Pit
DATE : 25/08/99
DATE : 25/08/99
DATE : 16/02/00 13:39
TEXT : B:\PP-2TPPF.TXT

ELEVATION :
X-COORD :
Y-COORD :

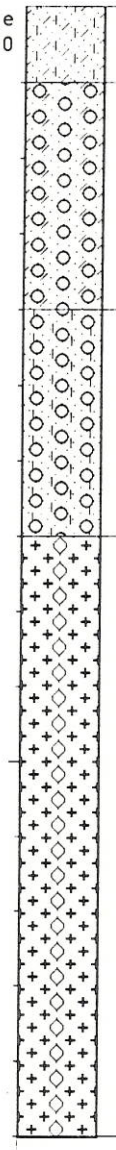
HOLE No: TP-7

PROJECT: PAULPUTS SUBSTATION
Transmission Group Consultant
GEOTECHNICAL SERVICES

HOLE No: TP-8
Sheet 1 of 1

JOB NUMBER: GR- 15/99

Scale 1:10



0.00 Dry, light reddish brown, medium dense, intact, slightly clayey silty fine SAND with roots and organic material.
Transported.

0.10 Dry, light reddish brown, medium dense, intact, clayey, medium, SAND with occasionally rounded fine Gravel.
Alluvium

0.40 Dry, light reddish brown, very dense, densely fissured, calcified GRAVEL in a silty sand.
Residual Granite

0.70 Dark red,speckled white and yellow, micaceous, fissured, medium hard Rock, GRANITE.

1.50

NOTES:

1) Rock excavate in blocks

2) Braking down required

3) Mix profile for fill

CONTRACTOR : CA Bruwer
MACHINE : Sumitomo LS 4300-F2
DRILLED BY :
PROFILED BY : F A Grové
TYPE SET BY :
SETUP FILE : STANDARD.SET

INCLINATION : VERTICAL
DIAM : Trench Pit
DATE : 25/08/99
DATE : 25/08/99
DATE : 16/02/00 13:40
TEXT : B:\PP-2TPPF.TXT

ELEVATION :
X-COORD :
Y-COORD :

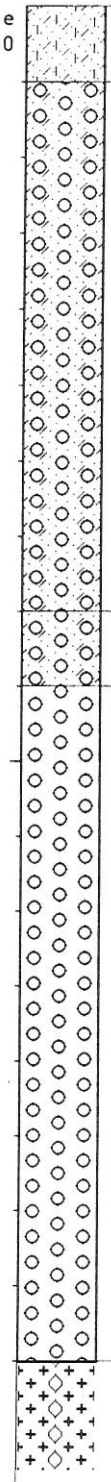
HOLE No: TP-8

PROJECT: PAULPUTS SUBSTATION
Transmission Group Consultant
GEOTECHNICAL SERVICES

HOLE No: TP-9
Sheet 1 of 1

JOB NUMBER: GR- 15/99

Scale 1:10



0.00 Dry, light reddish brown, medium dense, intact, slightly clayey silty fine SAND with roots and organic material.
Transported.

0.10 Dry, light reddish brown, very loose to medium dense with depth, intact, clayey, medium, SAND with occasionally rounded fine Gravel.
Alluvium

0.80 As above but medium densely packed, rounded and sub-rounded quartz fine to medium GRAVEL in a slightly clayey fine sand.
Pebble Marker.

0.90 Dry, white and yellow mottled, dense to very dense, fissured, layered, highly jointed, less jointed with depth, micaceous, calcified GRAVEL.
Residual Granite.

1.80 Refusal on Hard Rock, GRANITE.

NOTES:

1) Rock excavate in blocks

CONTRACTOR : CA Bruwer
MACHINE : Sumitomo LS 4300-F2
DRILLED BY :
PROFILED BY : F A Grové
TYPE SET BY :
SETUP FILE : STANDARD.SET

INCLINATION : VERTICAL
DIAM : Trench Pit
DATE : 25/08/99
DATE : 25/08/99
DATE : 16/02/00 13:40
TEXT : B:\PP-2TPPF.TXT

ELEVATION :
X-COORD :
Y-COORD :

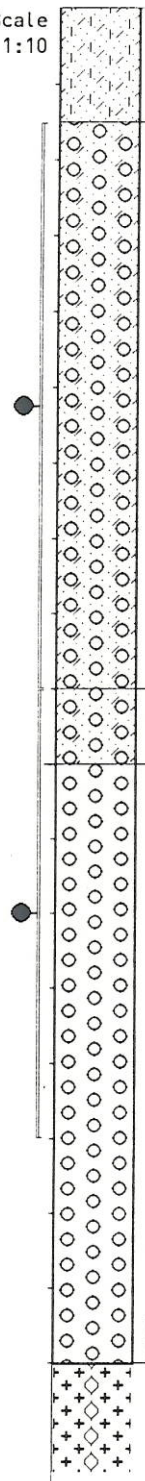
HOLE No: TP-9

PROJECT: PAULPUTS SUBSTATION
Transmission Group Consultant
GEOTECHNICAL SERVICES

HOLE No: TP-10
Sheet 1 of 1

JOB NUMBER: GR- 15/99

Scale 1:10



0.00 — Dry, light reddish brown, medium dense, intact, slightly clayey silty fine SAND with roots and organic material.
Transported.

0.15 — Dry, light reddish brown, very loose to medium dense with depth, intact, clayey, medium, SAND with occasionally rounded fine Gravel.
Alluvium

0.90 — As above but medium densely packed, rounded and sub-rounded quartz fine to medium GRAVEL in a slightly clayey fine sand.
Pebble Marker.

1.00 — Dry, white and yellow mottled, dense to very dense, fissured, layered, highly jointed, less jointed with depth, micaceous, calcified GRAVEL.
Residual Granite.

1.80 — Refusal on calcified Hard Rock, probably GRANITE.

NOTES:

1) Sample taken at 0,15--0,9m

2) Sample taken at 0,9--1,5m

3) Calcified material excavate in gravel to blocks

CONTRACTOR : CA Bruwer
MACHINE : Sumitomo LS 4300-F2
DRILLED BY :
PROFILED BY : F A Grové
TYPE SET BY :
SETUP FILE : STANDARD.SET

INCLINATION : VERTICAL
DIAM : Trench Pit
DATE : 25/08/99
DATE : 25/08/99
DATE : 16/02/00 13:37
TEXT : B:\PP-2TPPF.TXT

ELEVATION :
X-COORD :
Y-COORD :

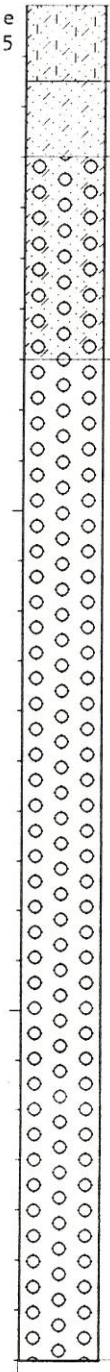
HOLE No: TP-10

PROJECT: PAULPUTS SUBSTATION
Transmission Group Consultant
GEOTECHNICAL SERVICES

HOLE No: TP-11
Sheet 1 of 1

JOB NUMBER: GR- 15/99

Scale 1:15



0.00 Dry, light reddish brown, medium dense, intact, slightly clayey silty fine SAND with roots and organic material.
Transported.

0.15 Dry, light reddish brown, very loose to medium dense with depth, intact, clayey, medium, SAND.
Alluvium

0.30 As above but medium densely packed, rounded and sub-rounded quartz fine to medium GRAVEL in a slightly clayey fine sand.
Pebble Marker.

0.70 Dry, white and yellow mottled, dense to very dense, fissured, layered, highly jointed, less jointed with depth, micaceous, well calcified nodular GRAVEL.
Residual Granite.

2.70

CONTRACTOR : CA Bruwer
MACHINE : Sumitomo LS 4300-F2
DRILLED BY :
PROFILED BY : F A Grové
TYPE SET BY :
SETUP FILE : STANDARD.SET

INCLINATION : VERTICAL
DIAM : Trench Pit
DATE : 25/08/99
DATE : 25/08/99
DATE : 16/02/00 13:37
TEXT : B:\PP-2TPPF.TXT

ELEVATION :
X-COORD :
Y-COORD :

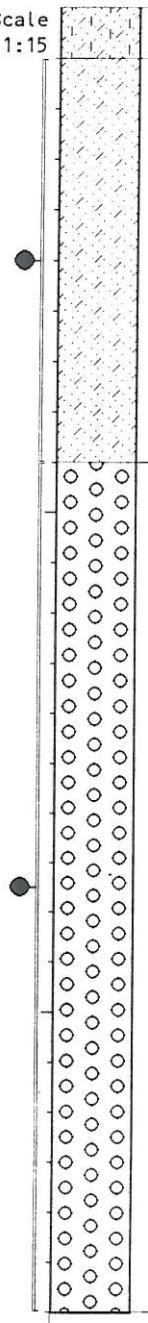
HOLE No: TP-11

PROJECT: PAULPUTS SUBSTATION
Transmission Group Consultant
GEOTECHNICAL SERVICES

HOLE No: TP-12
Sheet 1 of 1

JOB NUMBER: GR- 15/99

Scale 1:15



0.00 Dry, light reddish brown, medium dense, intact, slightly clayey silty fine SAND with roots and organic material.
Transported.

0.10 Dry, light reddish brown, very loose to medium dense with depth, intact, clayey, medium, SAND.
Alluvium

0.90 Dry, white and yellow mottled, dense to very dense, fissured, layered, highly jointed, less jointed with depth, micaceous, wrell calcified GRAVEL.
Residual Granite.

2.60

NOTES:

1) Sample taken at 0,1--0,9m

2) Sample taken at 0,9--2,6m

3) Rock excavate in blocks

CONTRACTOR : CA Bruwer
MACHINE : Sumitomo LS 4300-F2
DRILLED BY :
PROFILED BY : F A Grové
TYPE SET BY :
SETUP FILE : STANDARD.SET

INCLINATION : VERTICAL
DIAM : Trench Pit
DATE : 25/08/99
DATE : 25/08/99
DATE : 16/02/00 13:38
TEXT : B:\PP-2TPPF.TXT

ELEVATION :
X-COORD :
Y-COORD :

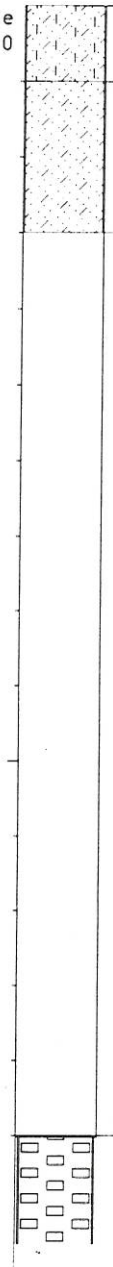
HOLE No: TP-12

PROJECT: PAULPUTS SUBSTATION
Transmission Group Consultant
GEOTECHNICAL SERVICES

HOLE No: TP-13
Sheet 1 of 1

JOB NUMBER: GR- 15/99

Scale 1:10



0.00 Dry, light reddish brown, medium dense, intact, slightly clayey silty fine SAND with roots and organic material.
Transported.

0.10 Dry, light reddish brown, very loose to medium dense with depth, intact, clayey, medium, SAND.
Transported

0.30 Dry, white and yellow mottled, dense to very dense, fissured, layered, highly jointed to less jointed with depth, micaceous, calcified Granite.
Residual Granite.

1.50 Refusal on hard rock, HARDPAN CALCRETE

CONTRACTOR : CA Bruwer
MACHINE : Sumitomo LS 4300-F2
DRILLED BY :
PROFILED BY : F A Grové
TYPE SET BY :
SETUP FILE : STANDARD.SET

INCLINATION : VERTICAL
DIAM : Trench Pit
DATE : 25/08/99
DATE : 25/08/99
DATE : 16/02/00 13:38
TEXT : B:\PP-2TPPF.TXT

ELEVATION :
X-COORD :
Y-COORD :

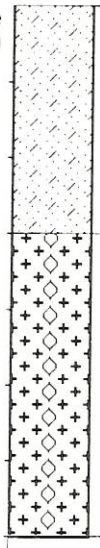
HOLE No: TP-13

PROJECT: PAULPUTS SUBSTATION
Transmission Group Consultant
GEOTECHNICAL SERVICES

HOLE No: TP-14
Sheet 1 of 1

JOB NUMBER: GR- 15/99

Scale 1:10



0.00 Dry, light reddish brown, very loose to medium dense with depth, intact, clayey, medium, SAND.
Transported

0.30 Dry, white, reddish brown and yellow mottled, hard Rock, probably calcified GRANITE.

0.70

CONTRACTOR : CA Bruwer
MACHINE : Sumitomo LS 4300-F2
DRILLED BY :
PROFILED BY : F A Grové
TYPE SET BY :
SETUP FILE : STANDARD.SET

INCLINATION : VERTICAL
DIAM : Trench Pit
DATE : 25/08/99
DATE : 25/08/99
DATE : 16/02/00 13:38
TEXT : B:\PP-2TPPF.TXT

ELEVATION :
X-COORD :
Y-COORD :

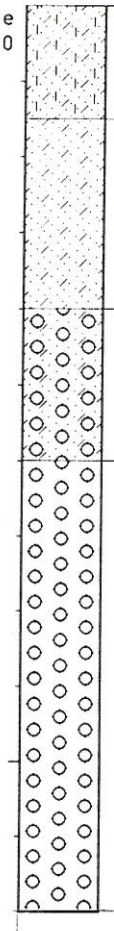
HOLE No: TP-14

PROJECT: PAULPUTS SUBSTATION
Transmission Group Consultant
GEOTECHNICAL SERVICES

HOLE No: TP-15
Sheet 1 of 1

JOB NUMBER: GR- 15/99

Scale 1:10



0.00 — Dry, light reddish brown, medium dense, intact, slightly clayey silty fine SAND with roots and organic material.
Transported.

0.15 — Dry, light reddish brown, very loose to medium dense with depth, intact, clayey, medium, SAND.
Alluvium

0.40 — As above but medium densely packed, rounded and sub-rounded quartz fine to medium GRAVEL in a slightly clayey fine sand.
Pebble Marker.

0.60 — Dry, white and yellow mottled, dense to very dense, fissured, layered, highly jointed, less jointed with depth, micaceous, wrell calcified GRAVEL.
Residual Granite.

1.20

NOTES:

1) Refusal at 1,2m

CONTRACTOR : CA Bruwer
MACHINE : Sumitomo LS 4300-F2
DRILLED BY :
PROFILED BY : F A Grové
TYPE SET BY :
SETUP FILE : STANDARD.SET

INCLINATION : VERTICAL
DIAM : Trench Pit
DATE : 25/08/99
DATE : 25/08/99
DATE : 16/02/00 13:38
TEXT : B:\PP-2TPPF.TXT

ELEVATION :
X-COORD :
Y-COORD :

HOLE No: TP-15

APPENDIX - B
Laboratory Test Results

SAMPLE NO./MONSTER NO.:

M.D.D.: 2154 kg/m³ Mass of dry mat./Massa van droë materiaal: 18000 g.

O.M.C./O. Vog. 7,4 %

% Water required/% Water nodig: (+0,1) -0,9 = 6,6 %.

Volume water required/Volume water nodig: $\frac{18000 \times 6,6}{100 + 0,9}$ = 1188,9 ml.

MOISTURE CONTENT DATA/VOGGEHALTE-DATA: TP12 0,1-0,9

	HYGROSCOPIC M.C. HIGROSKOPIESE VOG		CHECK M.C. AFTER MIX KONTROLE VOG (NA MENG)		MOULDING M.C. VERDIGTINGSVOGGEHALTE	
PAN NO. PAN NO.	21	22	15	16	17	18
MASS: PAN + WET MAT. MASSA: PAN + NAT MAT.	422,3	469,5	306,6	32,47	302,6	314,8
MASS: PAN + DRY MAT. MASS: PAN + DROË MAT.	419,6	466,1	293,6	310,5	287,7	298,8
MASS: PAN MASSA: PAN	94,7	90,2	83,4	85,3	83,4	83,5
MASS: WATER MASSA: WATER	2,7	3,4	13,0	14,2	14,9	16,0
MASS: DRY MAT. MASSA: DROË MAT.	324,9	375,9	210,2	225,2	204,3	215,3
M.C. (%) VOGGEHALTE (%)	0,8	0,9	6,1	6,3	7,3	7,4
				AVERAGE MOULDING M.C. GEMIDDELDE VERDIGTINGSVOGGEHALTE		7,4

COMPACTION DATA/VERDIGTINGSDATA:

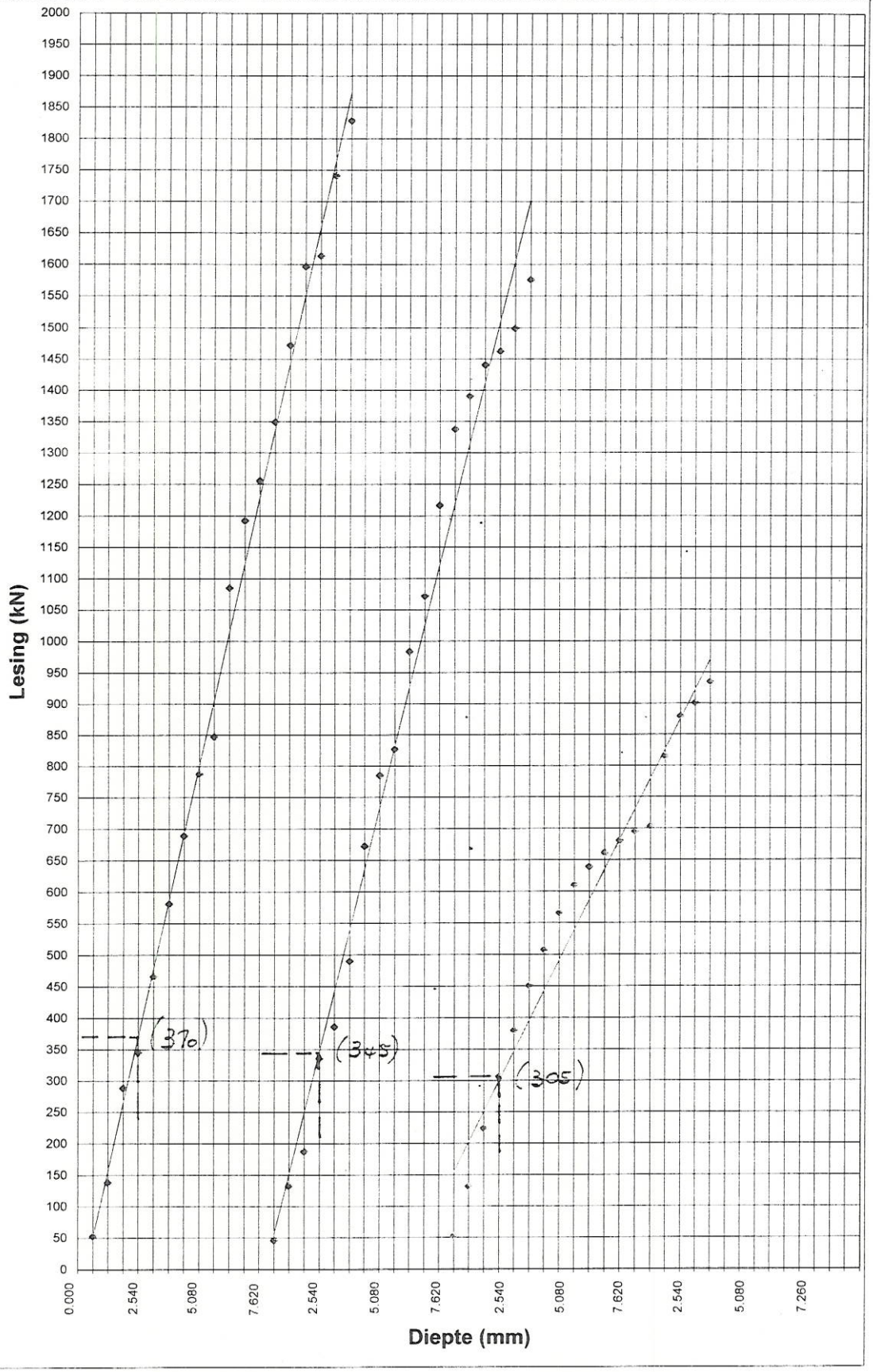
COMPACTIVE EFFORT VERDIGTINGSKRAG		(a)	(b)	(c)
MOULD NO. VORM NO.		7	8	9
VOLUME OF MOULD VOLUME VAN VORM	(1)	4342	4349	4347
MASS: MOULD + MAT. AFTER COMP. MASSA: VORM + MAT. NA VERDIGT.	(2)	10194	10076	9981
MASS: OF MOULD MASSA: VORM	(3)	4860	4864	4868
MASS: OF WET MAT. AFTER COMP. MASSA: NAT MAT. NA VERDIGT.	(2) - (3)	5334	5212	5113
MASS: OF DRY MATERIAL MASSA: DROË MATERIAAL	(4)	2316	2267	2223
DRY DENSITY: kg/m³ DROË DIGHTEID: kg/m³	{(4) x 1000} (1)	2156	2110	2069
% COMPACTION % VERDIGTING		100,1	98,0	96,1

C.B.R. DATA/K.D.V.-DATA				EXPANSION DATA/UITSETTINGS-DATA						
DEPTH DIEPTE	2,54mm	5,08mm	7,62mm	DATE DATUM	7-10-99	8-10-99	9-10-99	10-10-99	11-10-00	SWELL % % SWEL
(a)	73,3			(a)	0	0				
(b)	68,3			(b)	0	0				
(c)	60,4			(c)	0	0				

TP12

DEFLEKSIE LESING — **DIEPTE : 0.1 - 0.9**

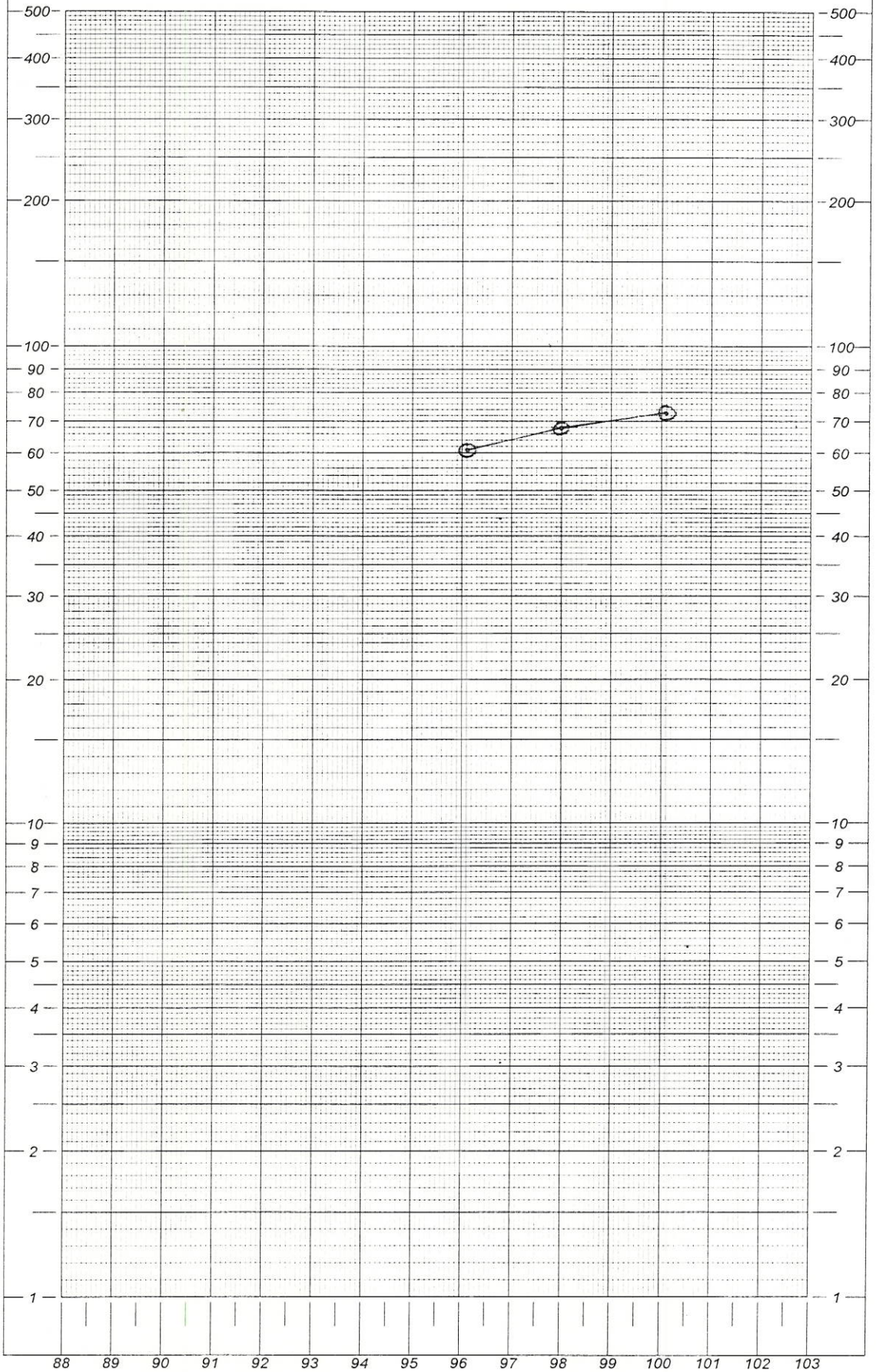
Diepte: (mm)	0.635	1.270	1.905	2.540	3.175	3.810	4.445	5.080	5.715	6.350	6.985	7.620	8.255	8.890	9.525	10.160	10.800	11.430
(a) Krag (7)	52	138	288	345	465	581	689	787	847	1085	1192	1255	1348	1471	1596	1613	1741	1828
(b) Krag (8)	45	132	187	335	385	489	672	785	827	983	1072	1216	1337	1390	1440	1462	1498	1575
(c) Krag (9)	52	131	223	306	379	450	507	566	610	639	661	680	695	703	815	879	901	935



KDV / DIGTHEIDVERHOUDING : CBR / DENSITY RELATIONSHIP

TOETSVORM
TEST FORM

MONSTER / SAMPLE No:
Diepte : 0,1 – 0,9 TP 12



BVi RAADGEWENDE INGENIEURS

Verwysings nr.: UL99/881	Datum ontvang: 1999-10-01
	Posbus 1155
	Murraylaan 7
	UPINGTON
	8800
Projek: PAULPUTS SUBSTASIE	Tel./Faksnr. (054) 3376600

Massa geneem: 1583,5 g

Massa <0,425mm :171,7 + 17,7 + 638,5 = 827,9 g

Eskom TR12 0,1-0,9

Sif	Massa op Sif	% op Sif	% deur Sif
75mm			
63mm			
53mm			
37.5mm			
26.5mm			
19.0mm			
13.2mm	**10,1**	**0,6**	**99,4**
4.75mm	**32,8**	**2,1**	**97,3**
2.00mm	**74,5**	**4,7**	**92,6**
0.425mm	**638,0**	**40,3**	**52,3**
<0.425mm	**827,9**	**52,3**	
TOTAAL	1583,3		

Fyngrond (<0.425mm): %

Grondbindstof (<2.00mm) : %

% < 0.05mm = $\frac{x}{100}$ = ...

% <0.075mm = $\frac{x}{100}$ = ...

Growwesand = _____x 100 = ...

Fynsand :.....:.....= .....

Slik en Klei (40 Sek.).....:.....= .....

Slik :.....:.....= .....

Klei (1 Uur) :.....:.....= .....

Temperatuur:.....°C Korreksie: ..... Totaal = ...

		Vloeigrens	Plastiese Grens
	Blik Nr.	**7:8**	**23:24**
(a)	Blik + Nat Grond :	**27,07:27,59**	**21,39:20,60**
(b)	Blik + Droë Grond :	**26,04:26,29**	**20,65:19,83**
(c)	Blik :	**20,70:19,41**	**15,19:14,97**
	Vog (a) - (b) :	**1,03:1,30**	**0,74:0,77**
	Droë Grond (b) - (c) :	**5,34:6,88**	**5,46:4,86**
	% Vog :	**19,3:18,9**	**13,6:15,8**
	Plastisiteitsgetal : (V.G. - PL.G.)	**19,1-14,7=4,4**	
	Krimping : TR3	**4.0**mm x $\frac{100}{150}$ =2,7 %	

BVi RAADGEWENDE INGENIEURS

Laboratoriumnr.: UL99/883

Transmission Group
Eskom
P.O. Box 1091
JOHANNESBURG 2000

Projek: PAULPUTS SUBSTASIE
Massa: 6000g

Datum ontvang: 1999-10-01

Posbus 1155
Murraylaan 7
UPINGTON
8800

Telnr. (054) 3376600
Faksnr.(054) 3376699

VOGDIGTHEID

VORM NR.	E	F	E	F
MASSA: VORM+NAT GROND	10128	10110	10232	
MASSA: VORM	4894	4774	4894	
MASSA: NAT GROND	5234	5336	5338	
VORM FAKTOR	4342	4334	4342	
MAKS. NAT DIGTHEID	2273	2313	2318	
MAKS. DROë DIGTHEID	2138	2154	2134	
WATER BYGEVOEG	6% 360cc	7% 420cc	8% 480cc	
PAN NR.	15	16	17	
MASSA: PAN+NAT GROND	282,5	295,8	311,9	
MASSA: PAN +DROë GROND	270,7	281,3	293,9	
MASSA: PAN	83,0	85,0	83,4	
MASSA: WATER	11,8	14,5	18,0	
MASSA DROë GROND	187,7	196,3	210,5	
%VOG	6,3	7,4	8,6	
HIGRO				

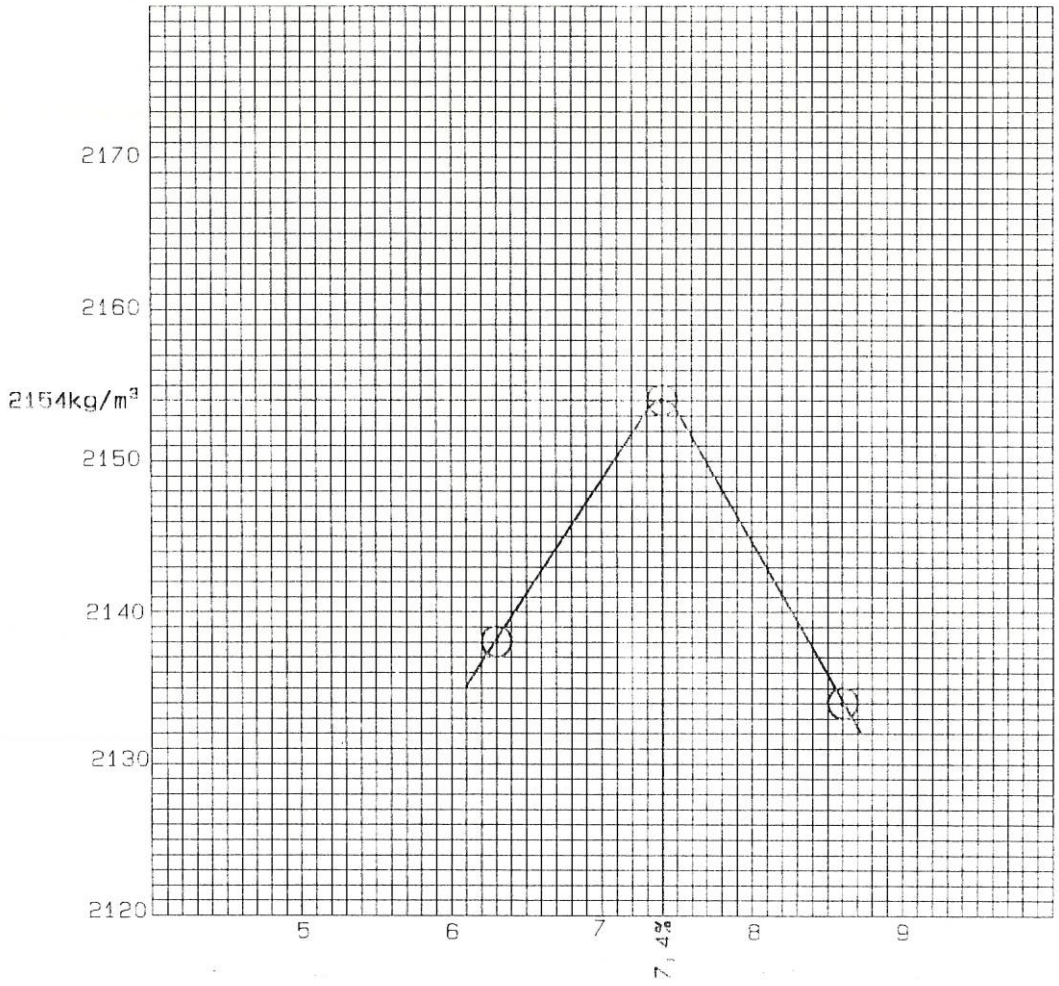
MAKS. DROë DIGTHEID: 2154kg/m³

OPT. VOG: 7,4%

.....
BVi Raadgewende Ing.

Datum: 1999-10-01

UL99/883/1



30 Jaar
1967-1997

BVi RAADGEWENDE INGENIEURS CONSULTING ENGINEERS

Siviel Struktureel
Elektries Projek en
Afvalbestuur
Civil Structural Electrical
Project and Waste Management

Upington: Murray Laan 7 Upington, 8800 (054) 3376600
Springbok: Keeromstraat 17a, Springbok, 8240 (027) 7213614

S:\LABGRAD\UL99-883.1

ul99/885

SAMPLE NO./MONSTER NO.:

M.D.D.: 2115 kg/m³ Mass of dry mat./Massa van droë materiaal: 18000 g.

O.M.C./O. Vog. 6,1 %

% Water required/% Water nodig: (6,1 +0,1) - 0,6 = 5,6 %.

Volume water required/Volume water nodig: $\frac{18000 \times 5,6}{100 + 0,6}$ = 1008,6 ml.

MOISTURE CONTENT DATA/VOGGEHALTE-DATA: TP - 12 0,9-2,6m

	HYGROSCOPIC M.C. HIGROSKOPIESE VOG		CHECK M.C. AFTER MIX KONTROLE VOG (NA MENG)		MOULDING M.C. VERDIGTINGSVOGGEHALTE	
PAN NO. / PAN NO.	5	6	23	24	15	16
MASS: PAN + WET MAT. / MASSA: PAN + NAT MAT.	441,5	455,2	330,6	340,3	325,1	357,6
MASS: PAN + DRY MAT. / MASS: PAN + DROË MAT.	439,7	453,0	317,7	327,5	311,7	342,0
MASS: PAN / MASSA: PAN	83,6	83,2	93,9	92,6	83,0	85,0
MASS: WATER / MASSA: WATER	1,8	2,2	12,9	12,8	13,7	15,6
MASS: DRY MAT. / MASSA: DROË MAT.	356,1	369,8	223,7	235,3	228,7	257,0
M.C. (%) / VOGGEHALTE (%)	0,5	0,6	5,8	5,4	6,0	6,1
				AVERAGE MOULDING M.C. / GEMIDDELDE VERDIGTINGSVOGGEHALTE		6,1

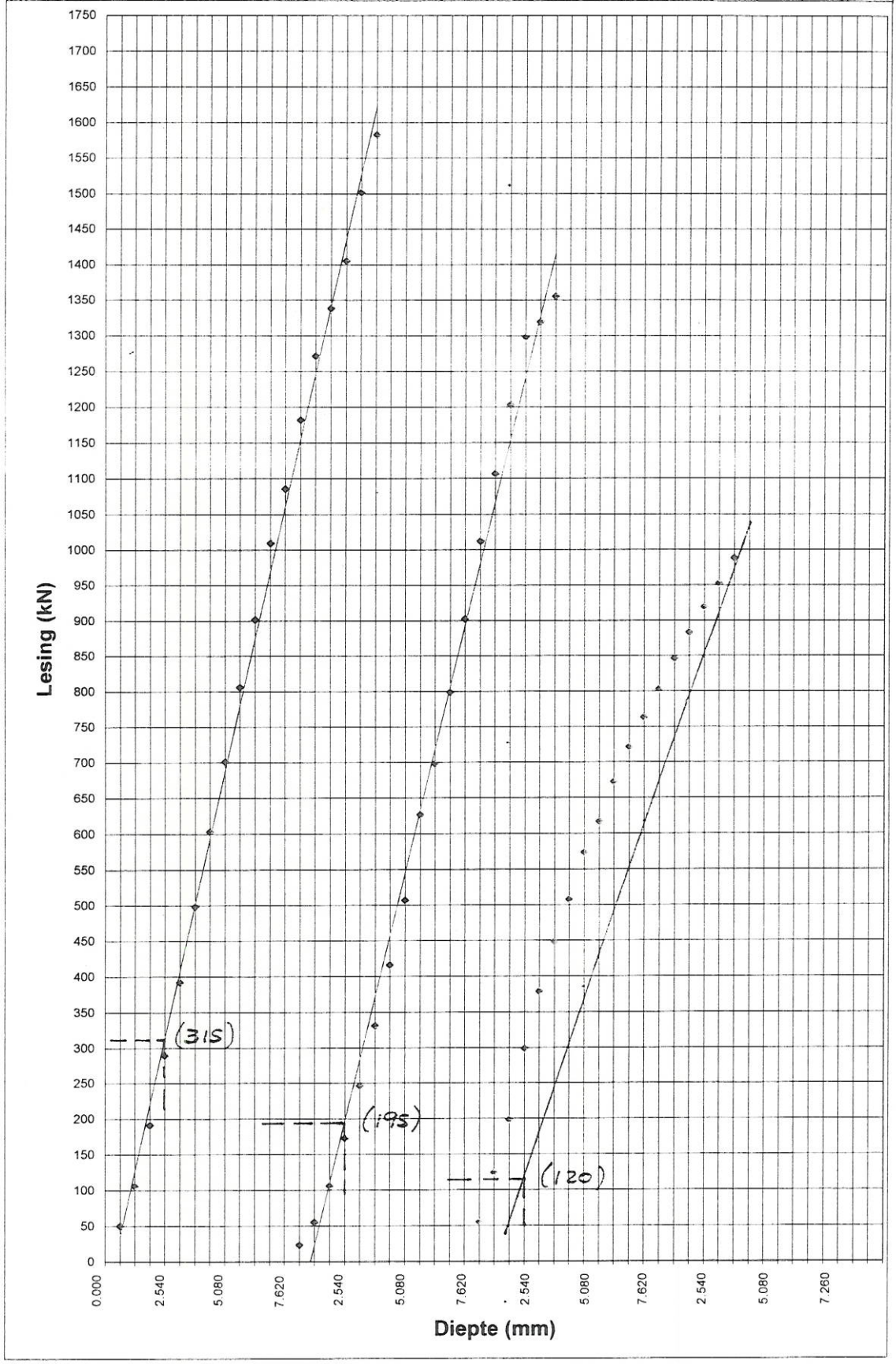
COMPACTION DATA/VERDIGTINGSDATA:

COMPACTIVE EFFORT / VERDIGTINGSKRAG		(a)	(b)	(c)
MOULD NO. / VORM NO.		4	5	6
VOLUME OF MOULD / VOLUME VAN VORM	(1)	4340	4360	4338
MASS: MOULD + MAT. AFTER COMP. / MASSA: VORM + MAT. NA VERDIGT.	(2)	10103	9941	9931
MASS: OF MOULD / MASSA: VORM	(3)	4854	4810	4866
MASS: OF WET MAT. AFTER COMP. / MASSA: NAT MAT. NA VERDIGT.	(2) - (3)	5249	5131	5065
MASS: OF DRY MATERIAL / MASSA: DROË MATERIAAL	(4)	2278	2237	2197
DRY DENSITY: kg/m³ / DROË DIGHTEID: kg/m³	{(4) x 1000} / (1)	2147	2108	2071
% COMPACTION / % VERDIGTING		101,5	99,7	97,9

C.B.R. DATA/K.D.V.-DATA				EXPANSION DATA/UITSETTINGS-DATA						
DEPTH DIEPTE	2,54mm	5,08mm	7,62mm	DATE DATUM	07/10	08/10	09/10	10/10	11/10	SWELL % % SWEL
(a)	62,4			(a) 4	0	0				
(b)	38,6			(b) 5	0	0				
(c)	23,8			(c) 6	0	0				

DEFLEKSIE LESING — **DIEPTE : 0.9 - 2.6**

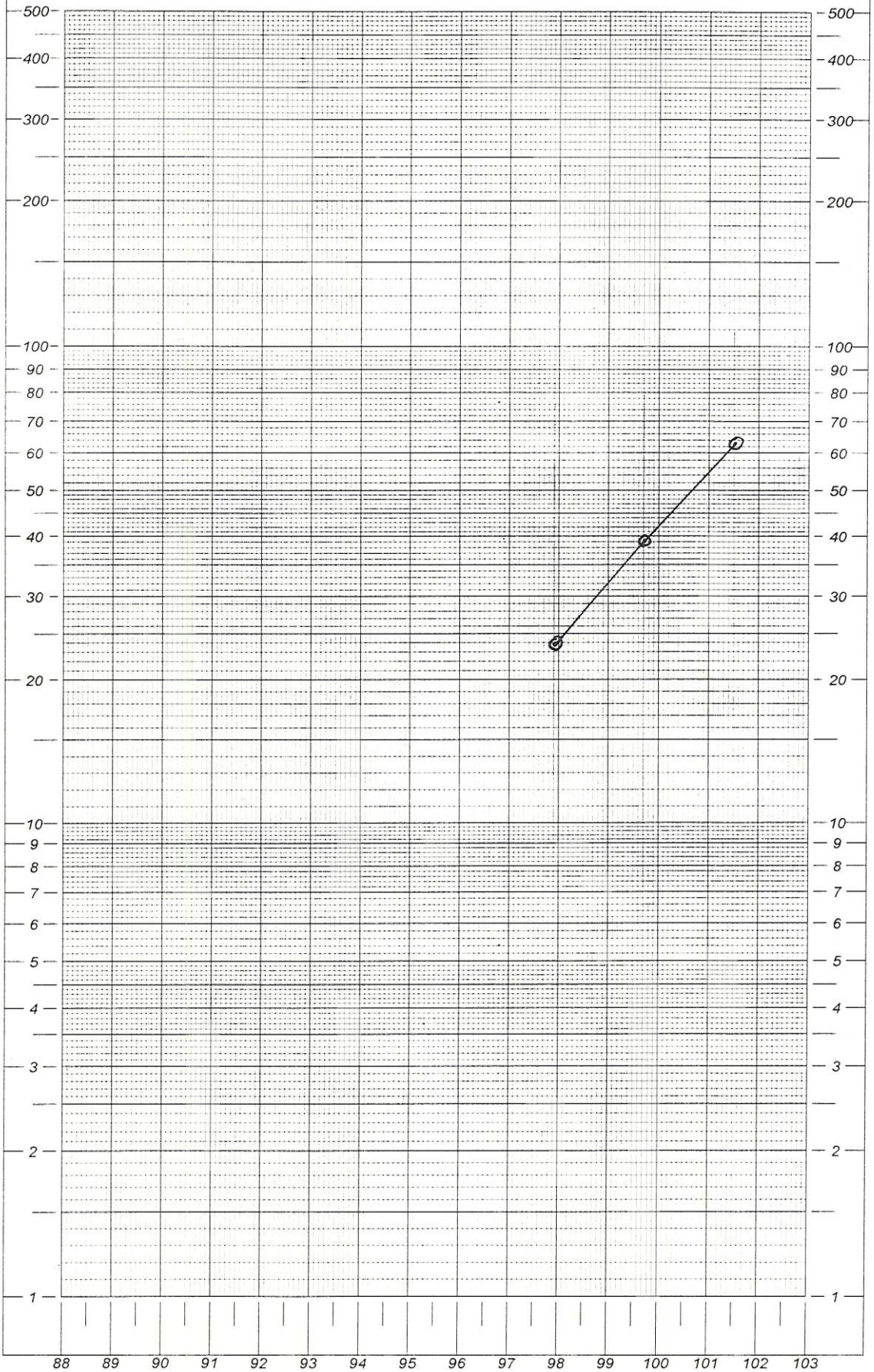
Diepte: (mm)	0.635	1.270	1.905	2.540	3.175	3.810	4.445	5.080	5.715	6.350	6.985	7.620	8.255	8.890	9.525	10.160	10.800	11.430
(a) Krag (4)	50	106	191	289	391	498	603	701	806	901	1009	1085	1182	1271	1338	1405	1501	1582
(b) Krag (5)	23	55	106	172	246	331	415	506	626	698	799	902	1012	1106	1203	1298	1319	1355
(c) Krag (6)	55	124	198	298	378	448	507	573	616	672	721	763	803	846	883	919	952	988



KDV / DIGTHEIDVERHOUDING : CBR / DENSITY RELATIONSHIP

TOETSVORM
TEST FORM

MONSTER / SAMPLE No:
Paulputs : 0,9-2,6



BVi RAADGEWENDE INGENIEURS

Verwysings nr.: UL99/884	Datum ontvang: 1999-10-01
Transmission Group P.O. Box 1091 JOHANNESBURG 2000	Posbus 1155 Murraylaan 7 UPINGTON 8800
Projek: PAULSPUTS SUBSTASIE	Tel./Faksnr. (054) 3376600

Massa geneem: 2045,8 g

Massa <0,425mm :125,9 +23,2 + 311,7 = 460,8 g

Eskom TP - 12 0,9 - 2,6 m

Sif	Massa op Sif	% op Sif	% deur Sif
75mm			
63mm			
53mm			
37.5mm	**113,7**	**5,6**	**94,3**
26.5mm	**101,0**	**4,9**	**89,4**
19.0mm	**251,0**	**12,3**	**77,1**
13.2mm	**73,1**	**3,4**	**73,7**
4.75mm	**325,2**	**16,0**	**57,7**
2.00mm	**248,0**	**12,1**	**45,6**
0.425mm	**472,8**	**23,1**	**22,5**
<0.425mm	**460,8**	**22,5**	
TOTAAL	2045,6		

Fyngrond (<0.425mm): %

Grondbindstof (<2.00mm) : %

% < 0.05mm = $\frac{\text{x}}{100}$ = ...

% <0.075mm = $\frac{\text{x}}{100}$ = ...

Growwesand = _____x 100 = ...

Fynsand :.....:.....= .....

Slik en Klei (40 Sek.).....:.....= .....

Slik :.....:.....= .....

Klei (1 Uur) :.....:.....= .....

Temperatuur:.....°C Korreksie: ..... Totaal = ...

		Vloeigrens	Plastiese Grens
	Blik Nr.	**2:3**	**21:22**
(a)	Blik + Nat Grond :	**28,99:28,02**	**21,39:20,60**
(b)	Blik + Droë Grond :	**26,98:26,41**	**20,65:19,83**
(c)	Blik :	**20,48:20,79**	**15,01:14,88**
	Vog (a) - (b) :	**2,01:1,61**	**0,74:0,77**
	Droë Grond (b) - (c) :	**6,50:5,62**	**5,46:4,86**
	% Vog :	**30,9:28,6**	**13,6:15,8**
	Plastisiteitsgetal : (V.G. - PL.G.)	**29,8-14,7 = 4,4**	
	Krimping : TR1	**4.0**mm x $\frac{100}{150}$ = 2,7 %	

BVi RAADGEWENDE INGENIEURS

Laboratoriumnr.: UL99/883	Datum ontvang: 1999-10-01
Transmission Group Eskom P.O. Box 1091 JOHANNESBURG 2000	Posbus 1155 Murraylaan 7 UPINGTON 8800
Projek: PAULPUTS SUBSTASIE Massa: 6000g	Telnr. (054) 3376600 Faksnr.(054) 3376699

VOGDIGTHEID TP 0,9-2,6m

VORM NR.	E	F	E	F
MASSA: VORM+NAT GROND	9998	9962	10061	9796
MASSA: VORM	4894	4774	4894	4774
MASSA: NAT GROND	5104	5188	5167	5022
VORM FAKTOR	4342	4334	4342	4334
MAKS. NAT DIGTHEID	2216	2248	2244	2177
MAKS. DROë DIGTHEID	2102	2113	2085	2081
WATER BYGEVOEG	5% 300cc	6% 360cc	7% 420cc	4% 240cc
PAN NR.	21	22	24	25
MASSA: PAN+NAT GROND	318,2	346,3	345,3	318,5
MASSA: PAN +DROë GROND	306,7	331,0	327,5	308,7
MASSA: PAN	94,8	90,4	93,8	93,9
MASSA: WATER	11,5	15,3	17,8	9,8
MASSA DROë GROND	211,9	240,6	233,7	214,8
%VOG	5,4	6,4	7,6	4,6
HIGRO				

MAKS. DROë DIGTHEID: 2115kg/m³

OPT. VOG: 6,1%

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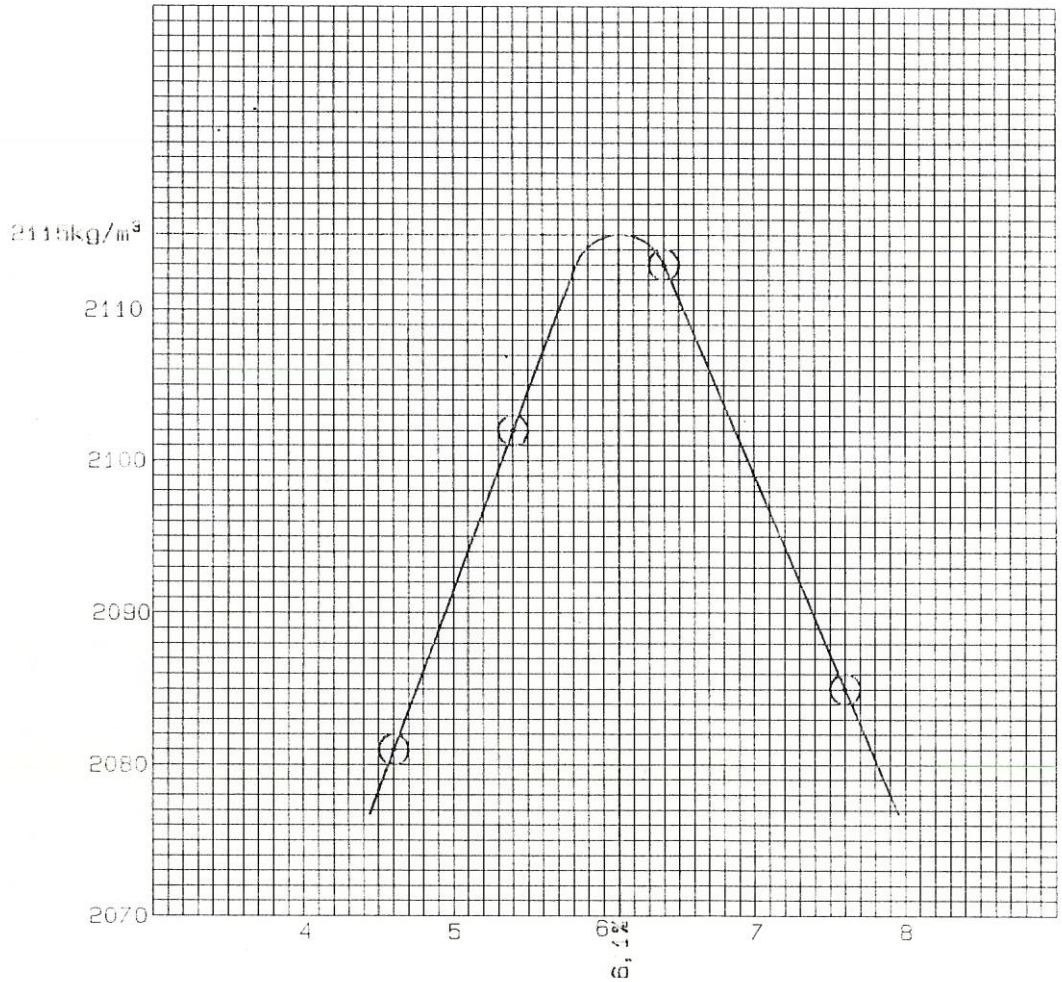
BVi Raadgewende Ing.

Datum: 1999-10-01

2.6

UL99/883/2



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1967-1997

BVi RAADGEWENDE INGENIEURS
CONSULTING ENGINEERS

Siviel Struktureel
Elektries Projek en
Afvalbestuur
Civil Structural Electrical
Project and Waste Management

Upington: Murray Laan 7 Upington, 8800 (054) 3376600
Springbok: Keeromstraat 17a, Springbok, 8240 (027) 7213614

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UL99\935

SAMPLE NO./MONSTER NO.: 50/50%

M.D.D.: 2143 kg/m³ Mass of dry mat./Massa van droë materiaal: 18000 g.

O.M.C./O. Vog. 7,1 %

% Water required/% Water nodig: (7,1 +0,1) - 0,8 = 6,4 %.

Volume water required/Volume water nodig: $\frac{18000 \times 6,4}{100 + 0,8}$ = 1142,8 ml.

MOISTURE CONTENT DATA/VOGGEHALTE-DATA: 50\50%

	HYGROSCOPIC M.C. HIGROSKOPIESE VOG		CHECK M.C. AFTER MIX KONTROLE VOG (NA MENG)		MOULDING M.C. VERDIGTINGSVOGGEHALTE	
PAN NO. / PAN NO.	5	6	24	25	15	16
MASS: PAN + WET MAT. / MASSA: PAN + NAT MAT.	524,9	434,9	353,6	332,5	276,6	290,5
MASS: PAN + DRY MAT. / MASS: PAN + DROË MAT.	521,6	432,4	338,0	317,7	263,9	276,9
MASS: PAN / MASSA: PAN	83,4	83,1	93,8	92,1	83,3	85,3
MASS: WATER / MASSA: WATER	3,3	2,5	15,6	14,8	12,7	13,6
MASS: DRY MAT. / MASSA: DROË MAT.	438,2	349,3	244,2	225,6	180,6	191,6
M.C. (%) / VOGGEHALTE (%)	0,8	0,7	6,4	6,7	7,0	7,1
				AVERAGE MOULDING M.C. / GEMIDDELDE VERDIGTINGSVOGGEHALTE		7,1

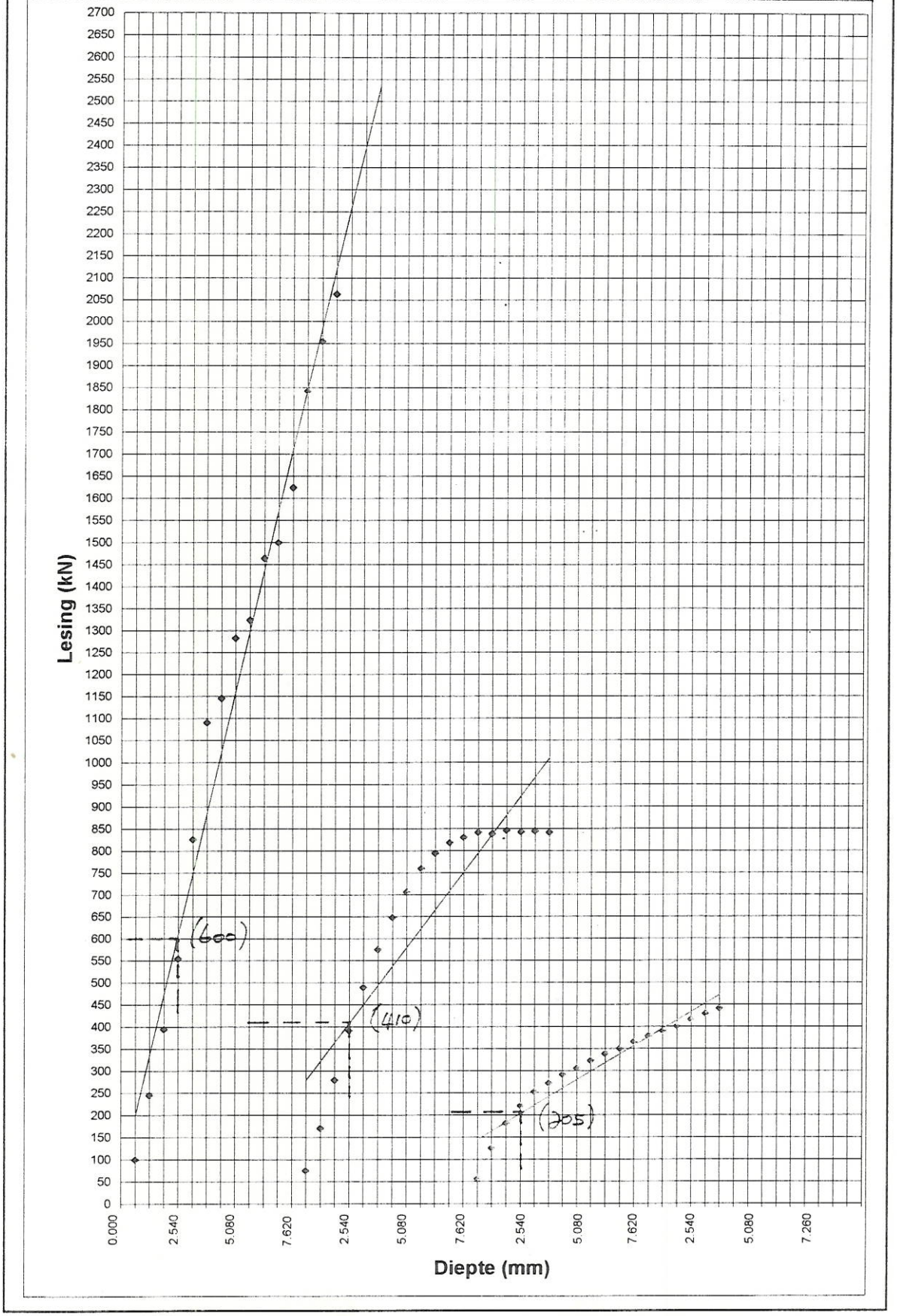
COMPACTION DATA/VERDIGTINGSDATA:

COMPACTIVE EFFORT / VERDIGTINGSKRAG		(a)	(b)	(c)
MOULD NO. / VORM NO.		7	8	9
VOLUME OF MOULD / VOLUME VAN VORM	(1)	4342	4349	4347
MASS: MOULD + MAT. AFTER COMP. / MASSA: VORM + MAT. NA VERDIGT.	(2)	10174	10069	9978
MASS: OF MOULD / MASSA: VORM	(3)	4860	4864	4868
MASS: OF WET MAT. AFTER COMP. / MASSA: NAT MAT. NA VERDIGT.	(2) - (3)	5314	5205	5110
MASS: OF DRY MATERIAL / MASSA: DROË MATERIAAL	(4)	2307	2264	2221
DRY DENSITY: kg/m³ / DROË DIGHTEID: kg/m³	{(4) x 1000} / (1)	2154	2114	2074
% COMPACTION / % VERDIGTING		100,5	98,6	96,8

C.B.R. DATA/K.D.V.-DATA				EXPANSION DATA/UITSETTINGS-DATA						
DEPTH DIEPTE	2,54mm	5,08mm	7,62mm	DATE DATUM	22/10	23/10	24/10	25/10	26/10	SWELL % % SWEL
(a)	118,8			(a) 7	0			0	0	
(b)	81,2			(b) 8	0			0	0	
(c)	40,6			(c) 9	0			0	0	

DEFLEKSIE LESING **50/50%**

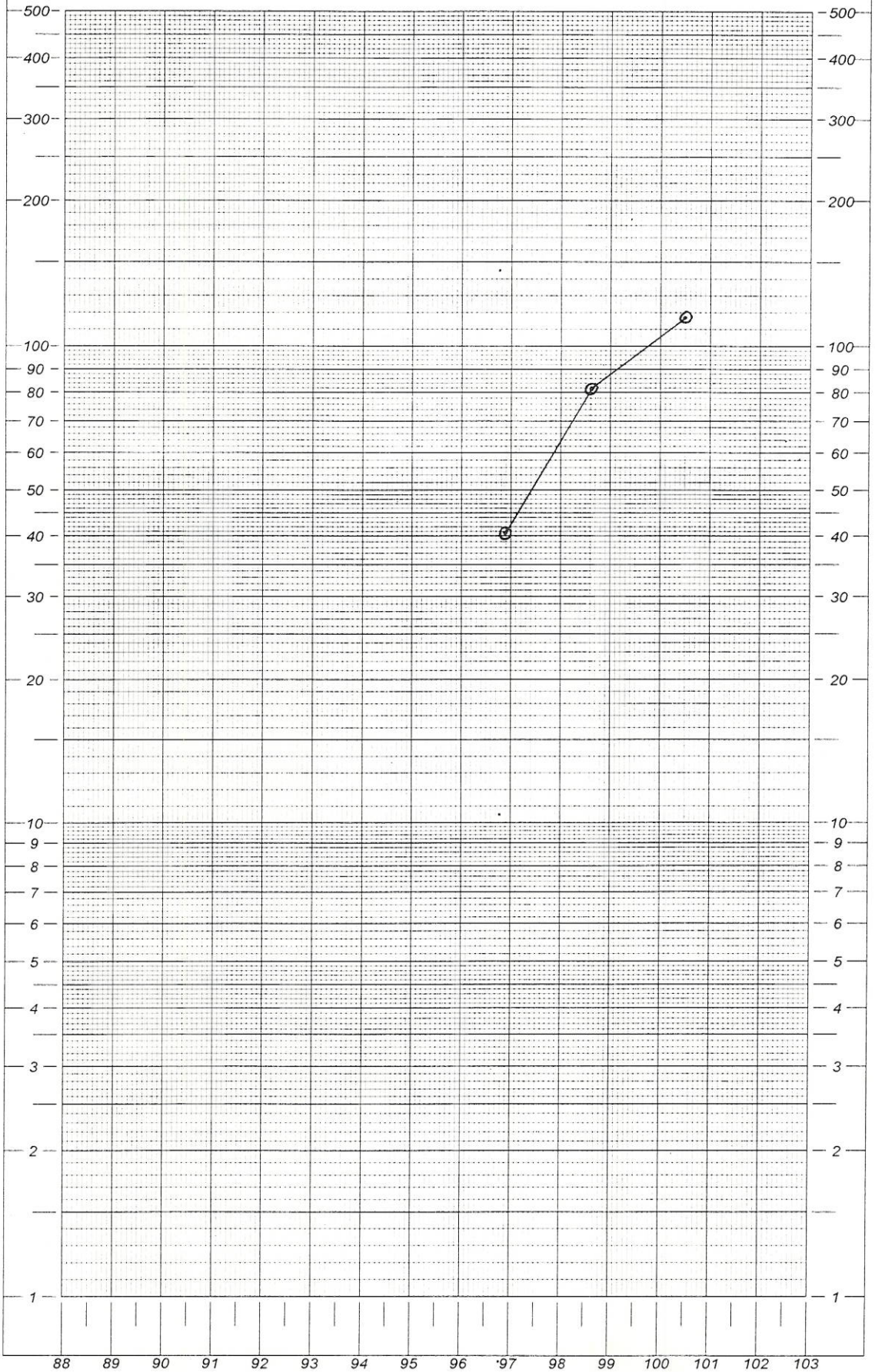
Diepte: (mm)	0.635	1.270	1.905	2.540	3.175	3.810	4.445	5.080	5.715	6.350	6.985	7.620	8.255	8.890	9.525	10.160	10.800	11.430
(a) Krag (7)	100	245	395	555	826	1090	1145	1283	1324	1464	1500	1624	1843	1955	2063			
(b) Krag (8)	75	171	280	392	490	576	648	706	759	794	818	830	841	838	845	842	844	841
(c) Krag (9)	57	126	182	221	252	272	291	306	323	338	350	366	379	391	401	417	430	442



KDV / DIGTHEIDVERHOUDING : CBR / DENSITY RELATIONSHIP

TOETSVORM
TEST FORM

MONSTER / SAMPLE No:
PAALPUTS : 50% / 50%



BVi RAADGEWENDE INGENIEURS

Verwysings nr.: UL99/939	Datum ontvang: 1999-10-01
	Posbus 1155 Murraylaan 7 UPINGTON 8800
Projek: PAULPUTS SUBSTASIE	Tel./Faksnr. (054) 3376600

Massa geneem: 1400,2 g

Massa <0,425mm :16,8 + 77,6 + 436,2 = 530,6 g

50/50% VERMENGING

Sif	Massa op Sif	% op Sif	% deur Sif
75mm			
63mm			
53mm			99,9
37.5mm	88,2	6,3	93,6
26.5mm	57,1	4,1	89,5
19.0mm	36,4	2,6	86,9
13.2mm	63,3	4,5	82,4
4.75mm	101,2	7,2	75,2
2.00mm	111,2	7,9	67,3
0.425mm	412,0	29,4	37,9
<0.425mm	530,6	37,9	
TOTAAL	1400,0		

Fyngrond (<0.425mm): %

Grondbindstof (<2.00mm) : %

% < 0.05mm = $\frac{\quad x \quad}{100}$ = ...

% <0.075mm = $\frac{\quad x \quad}{100}$ = ...

Growwesand = _____x 100 = ...

Fynsand :.....:.....= .....

Slik en Klei (40 Sek.).....:.....= .....

Slik :.....:.....= .....

Klei (1 Uur) :.....:.....= .....

Temperatuur:.....°C Korreksie: ..... Totaal = ...

			Vloeigrens	Plastiese Grens
	Blik Nr.		7:8	23:24
(a)	Blik + Nat Grond	:	29,21:29,05	19,67:19,48
(b)	Blik + Droë Grond	:	27,65:27,26	18,97:18,79
(c)	Blik	:	20,71:19,46	15,22:15,02
	Vog (a) - (b)	:	1,56:1,79	0,70:0,69
	Droë Grond (b) - (c)	:	6,94:7,80	3,75:3,77
	% Vog	:	22,5:22,9	18,7:18,3
	Plastisiteitsgetal	: (V.G. - PL.G.)	22,7-18,5=4,2	
	Krimping	: TR3	4.0mm x $\frac{100}{150}$ =2,6 %	

BVi RAADGEWENDE INGENIEURS

Laboratoriumnr.: UL99/934	Datum ontvang: 1999-10-27
Transmission Group Eskom P.O. Box 1091 JOHANNESBURG 2000	Posbus 1155 Murraylaan 7 UPINGTON 8800
Projek:PAULPUTS (50\50 Vermenging) Massa: 6000g	Telnr. (054) 3376600 Faksnr.(054) 3376699

VOGDIGTHEID

VORM NR.	E	F	E	F
MASSA: VORM+NAT GROND	10118	10078	10168	9899
MASSA: VORM	4894	4774	4894	4774
MASSA: NAT GROND	5224	5304	5274	5125
VORM FAKTOR	4342	4334	4342	4334
MAKS. NAT DIGTHEID	2268	2299	2290	2221
MAKS. DROë DIGTHEID	2132	2139	2113	2105
WATER BYGEVOEG	6% 360cc	7% 420cc	8% 480cc	5% 300cc
PAN NR.	21	22	23	24
MASSA: PAN+NAT GROND	310,3	284,6	338,3	342,1
MASSA: PAN +DROë GROND	297,4	271,0	319,4	328,9
MASSA: PAN	94,7	90,2	93,8	90,4
MASSA: WATER	12,9	13,6	18,9	13,2
MASSA DROë GROND	202,7	180,8	225,6	238,5
%VOG	6,4	7,5	8,4	5,5
HIGRO				

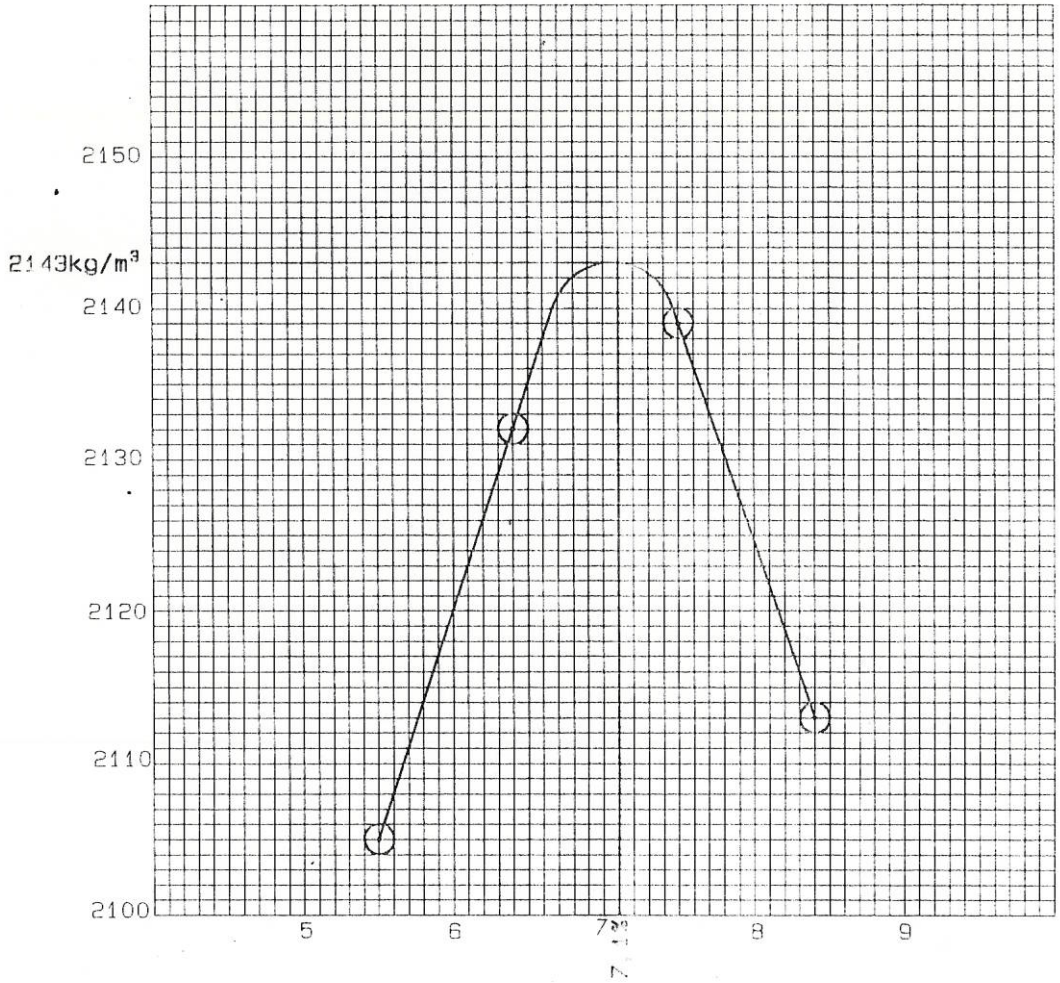
MAKS. DROë DIGTHEID: 2143kg/m³

OPT. VOG: 7,1%

Jaekock
.....
BVi Raadgewende Ing.

Datum: 1999-10-26

UL99/883/3



30 Jaar
1967-1997

Siwel Struktureel
Elektries Projek en
Afvalbestuur

BVi RAADGEWENDE INGENIEURS Civil Structural Electrical
CONSULTING ENGINEERS Project and Waste Management

Upington: Murray Laan 7 Upington, 8800 (054) 3376600
Springbok: Keeromstraat 17a, Springbok, 8240 (027) 7213614

S: \ABGRAD\UL99-883-3

APPENDIX 1

DETERMINATION OF CORROSIVITY OF SOIL SAMPLES

LANGELIER SATURATION AND RYZNAR STABILITY INDICES , AGGRESSIVENESS INDEX AND CHLORIDE + SULPHATE TO ALKALINITY CORROSIVITY RATIO

SAMPLE IDENTIFICATION : ESKOM REF : PM 2002/03

1.1 CHEMICAL ANALYSIS Results are in mg/l unless otherwise stated.		1.2 CORROSIVITY INDICES	
DETERMINANT : 2:1 WATER:SOIL EXTRACT	TP 10 0.15 - 0.9 m	INDEX	TP 10
pH	7.3	Stability pH (pHs) at 20°C	9.0
Conductivity (mS/m)	10.5	Langelier Index at 20°C	-1.7
Total dissolved solids (Calculated)	68	Ryznar Stability Index at 20°C	10.7
Total Hardness as CaCO3	36	Aggressiveness Index	9
Calcium Hardness as CaCO3	24	Cl and SO4 Corrosivity Index (Corrosivity Ratio)	0.3
Calcium as Ca	10		
Magnesium as Mg	3		
Total Alkalinity as CaCO3	34		
Chloride as Cl	4		
Sulphate as SO4	3		

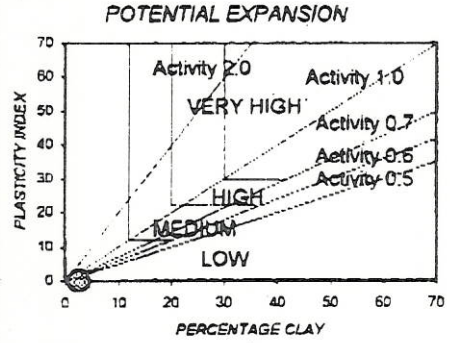
130 Edward Ave, Hennopspark 0157
P O Box 7681, Centurion 0046
Phone: 27 12 653-1818/653-0021. Fax: 27 12 653-0997
E-mail: scowahen@iafrica.com

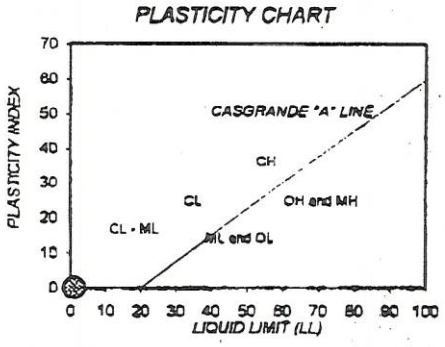
Scowalab
Civil Engineering Testing Laboratories

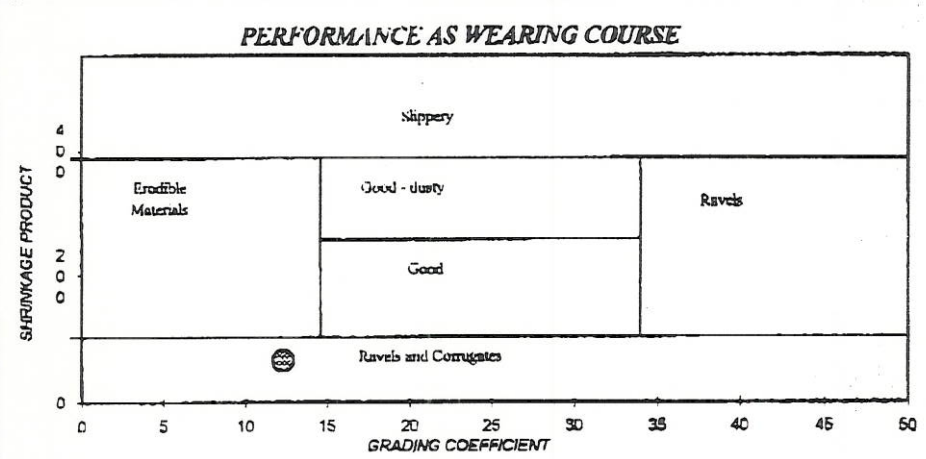
FOUNDATION INDICATOR (TMH 1 : A1, A2, A3, A4, A5 & A6)

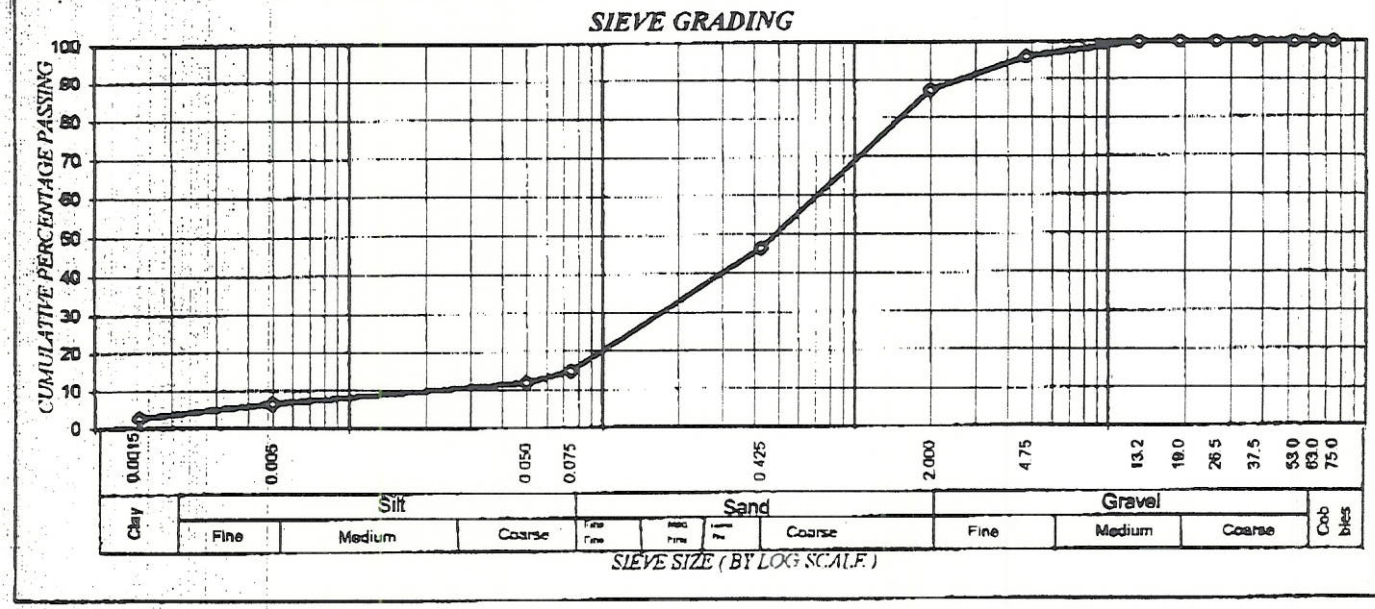
CLIENT	ESKOM	DATE REPORTED :	08-Feb-00
	Geotechnical Services	YOUR REF. :	10038417
	P O Box 1091	OUR REF. :	9986
	Johannesburg, 2000	SAMPLE No. :	14661
Attention	Mr. F A Grove	SAMPLE DESCRIPTION :	TP 10 @ 0.15 - 0.9

Material description		SILTY SAND
Sieve analysis Cumulative percentage passing (mm)	75.0	100
	63.0	100
	53.0	100
	37.5	100
	26.5	100
	19.0	100
	13.2	100
	4.75	98
	2.000	87
	0.425	46
	0.075	15
	0.050	12
	0.005	7
	0.002	3
Soil Mortar Analysis % < 2.00mm	2.000 - 0.425	46.8
	0.425 - 0.250	16.0
	0.250 - 0.150	12.8
	0.150 - 0.075	7.5
	< 0.075	17.0
Effective size		0.020
Uniformity Coefficient		35.0
Curvature Coefficient		2.3
Oversize Index		0.0
Shrinkage Product		65.0
Grading Coefficient		12.3
Grading modulus		1.52
Atterberg Limits	Liquid Limit	-
	Plasticity Index	SP
	Linear Shrinkage	1.4
Unified Soil Classification		SM
U.S. Highway Classification		A-1-b(0)
Moisture Content		-









for ; Scowalab

APPENDIX 2

DETERMINATION OF CORROSIVITY OF SOIL SAMPLES REF : PM 2002/03

AGGRESSIVENESS TOWARDS CONCRETE : AGGRESSIVENESS INDEX
(PORTLAND CEMENT INSTITUTE - J.J. BASSON PUBLICATION)

SAMPLE IDENTIFICATION ESKOM

DETERMINANT	TP 10	VALUE	CONSTANT	INDEX
pH		7.3	200	440
Calcium Carbonate Saturated pH		8.4	-2000	2200
Calcium Hardness as CaCO3		24	2.2	1047
Total Ammonium as NH4		0.7	10	7
Magnesium as Mg		3	0.6	2
Sulphates as SO4		3	0.3	1
Chlorides as Cl		4	0.2	1
Total Dissolved Solids		68		
Leaching - corrosion sub-index , LCSI				1229
Spalling - corrosion sub-index , SCSI				3
Final aggressiveness index at 25 Degr. C, corrected for stagnant conditions. Nc				618

JCG Watertreatment
CK 96/61252/23
33 Toekoms Street PO Box 2974 Upington 8800
Tel (054) ~~27864~~ 3326864 Fax (054) ~~27864~~ 3326864 Cell 082 491 8136

09/11/99

Aan: Hannes de Kock

Van: Louise

Watertoetse vir Total Dissolved Solids

Hier volg die uitslae van die toetse - TDS - 10400 ppm
Seewater ~ 35000

Groete

Louise

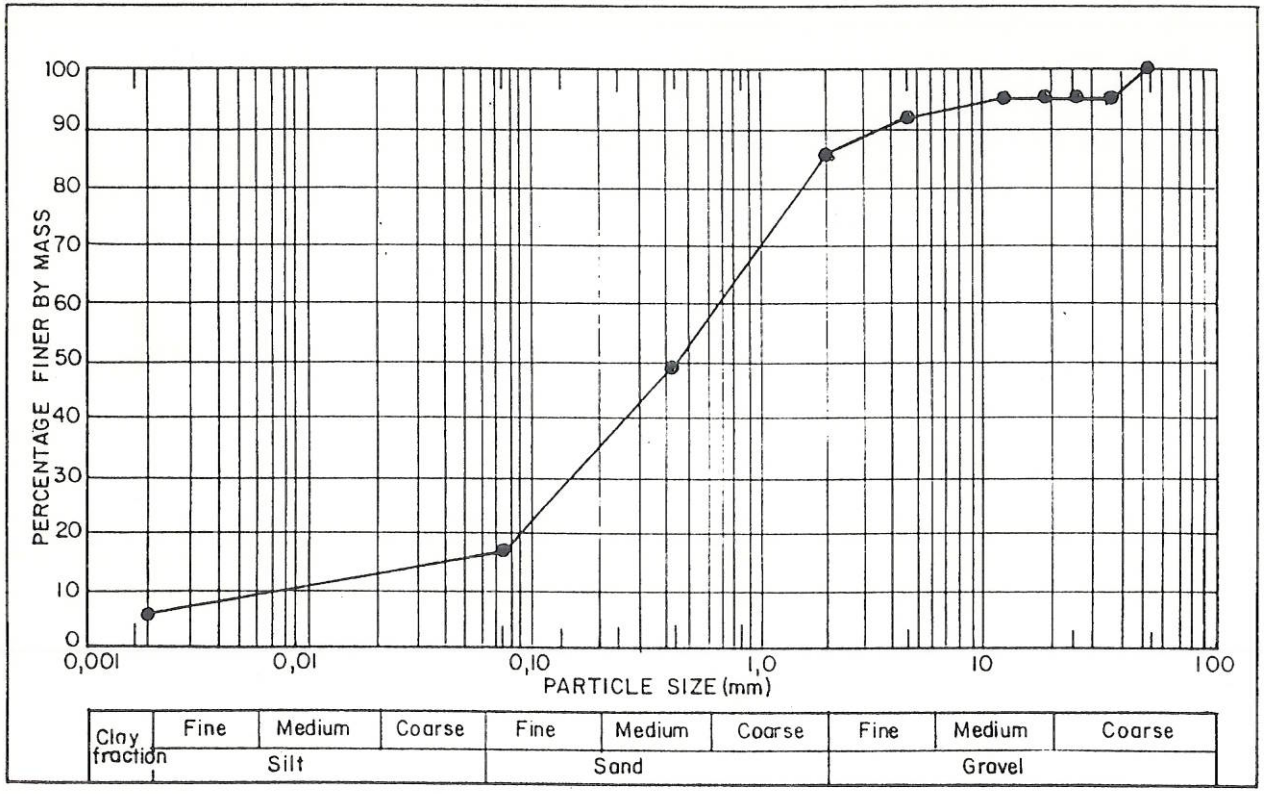
Louise Wiese
JCG Watertreatment

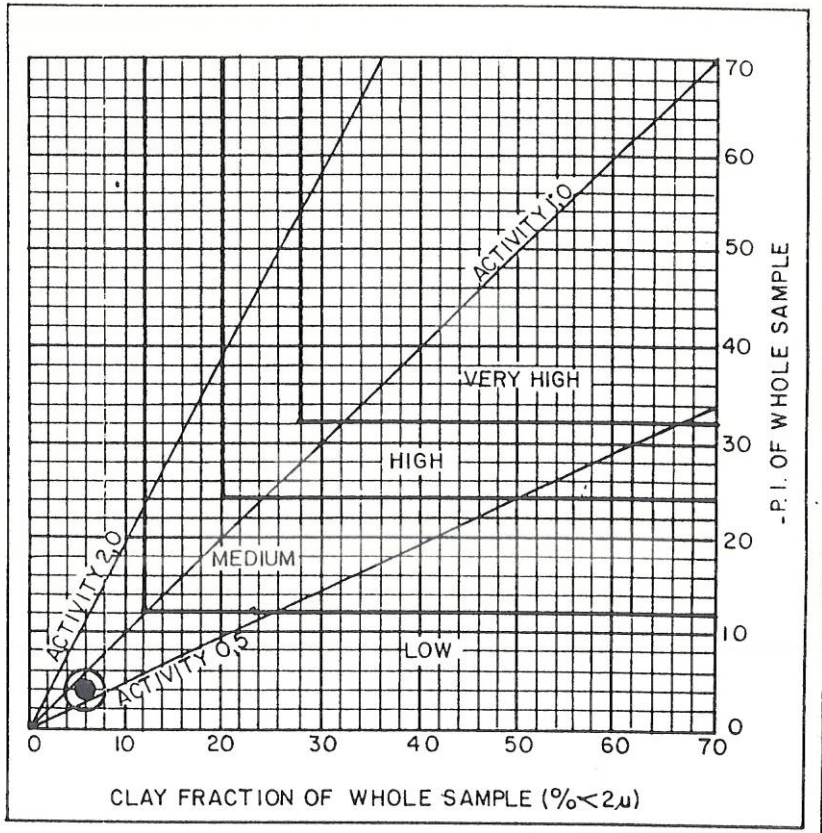
KIMAT LAB

POTENTIAL EXPANSIVENESS TEST

CLIENT BVI RAADGEWENDE INGENIEURS	PROJECT PAUL PUTS SUBSTASIE	YOUR REF MNR DE KOCK	OUR REF SL 1560	DATE 1999.10.27

SAMPLE No. K21-651	TEST HOLE No. TP 10	DEPTH 0,15-0,9m	DESCRIPTION LIGBRUIN, FYN, VERWEERDE, GRANIETIESE GRUIS MET VERSPREIDE HOEKIGE, KWARTSIETKLIPPIES





ATTERBERG LIMITS	SOIL FINES	WHOLE SAMPLE
Liquid Limit	27	13
Plastic Limit	18	
Plasticity Index	9	4
Linear Shrinkage	4	

CLAY FRACTION (%)	
Soil Fines	12
Whole Sample	6

UNDISTURBED / DISTURBED SAMPLE DATA	
Insitu Moisture Content (%)	
Relative Density	
Bulk Density (dry)(kg/m³)	
Bulk Density (wet)(kg/m³)	

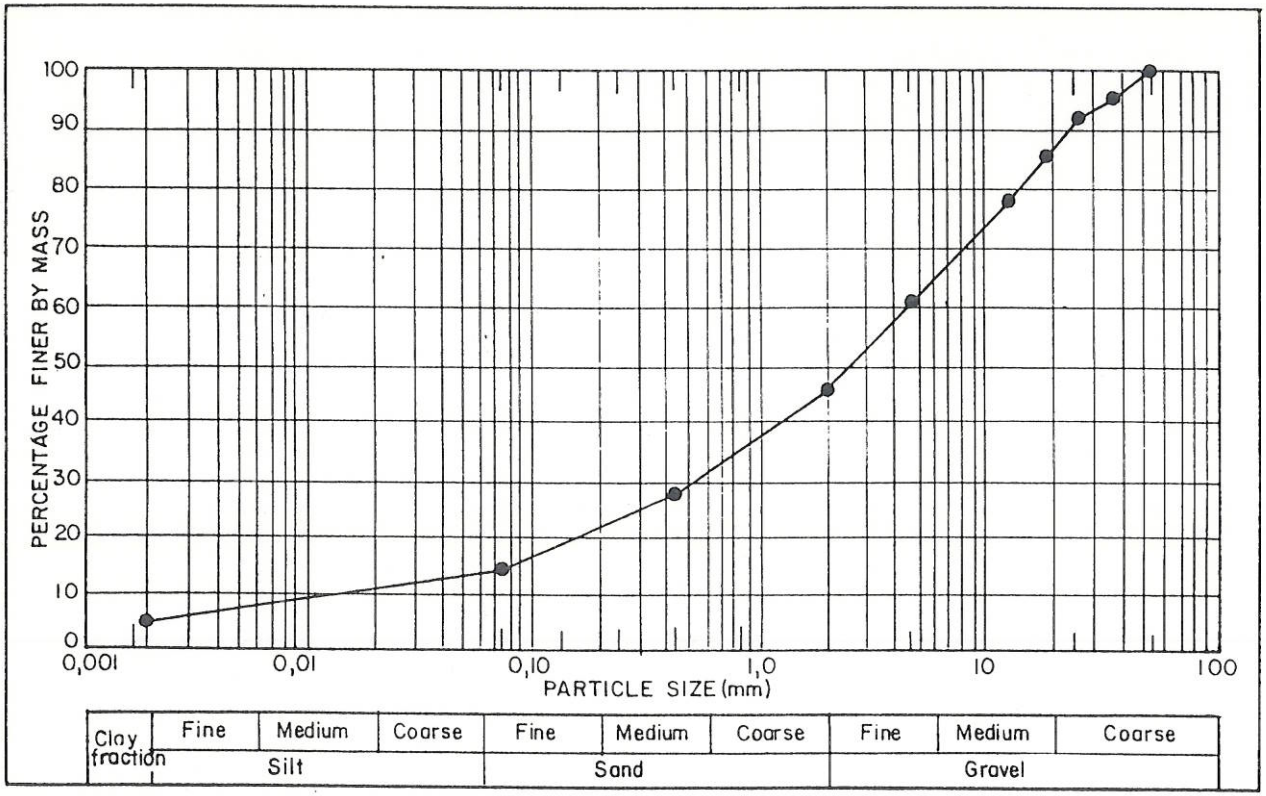
REMARKS VERSTEURDE MONSTER

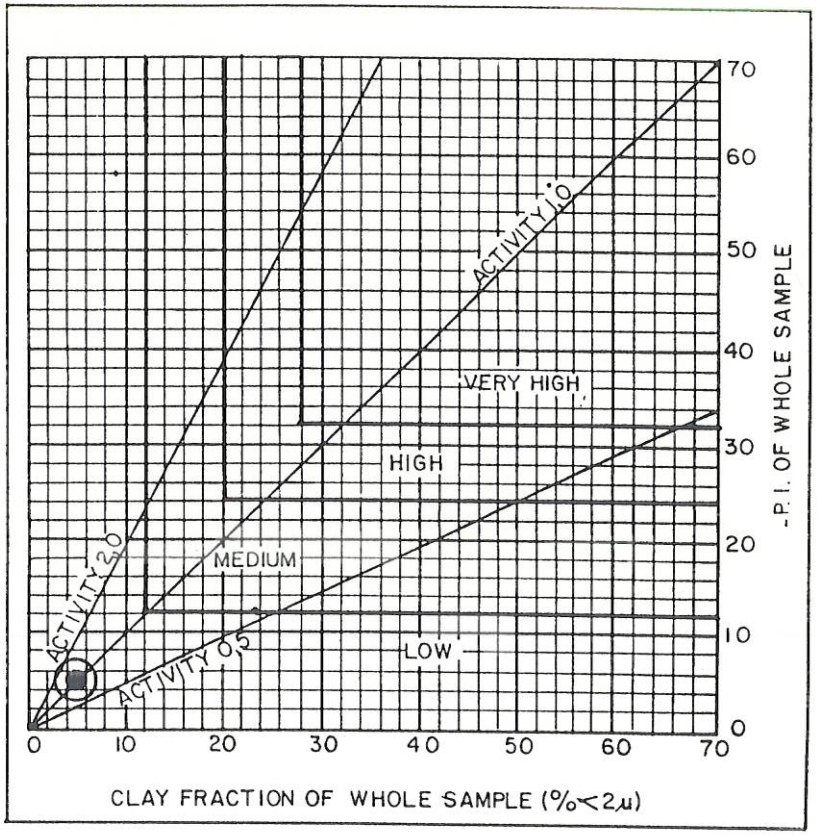
KIMAT.LAB

POTENTIAL EXPANSIVENESS TEST

CLIENT BVI RAADGEWENDE INGENIEURS	PROJECT PAUL PUTS KRAGSTASIE	YOUR REF MNR DE KOCK	OUR REF SL 1560	DATE 1999.10.27

SAMPLE No. K21-652	TEST HOLE No. TP 10	DEPTH 0,9-1,5m	DESCRIPTION LIGBRUIN, EFFE NODULêRE, KALKREETGRUIS





ATTERBERG LIMITS	SOIL FINES	WHOLE SAMPLE
Liquid Limit	45	13
Plastic Limit	28	
Plasticity Index	17	5
Linear Shrinkage	7,5	

CLAY FRACTION (%)	
Soil Fines	18
Whole Sample	5

UNDISTURBED / DISTURBED SAMPLE DATA	
Insitu Moisture Content (%)	
Relative Density	
Bulk Density (dry)(kg/m³)	
Bulk Density (wet)(kg/m³)	

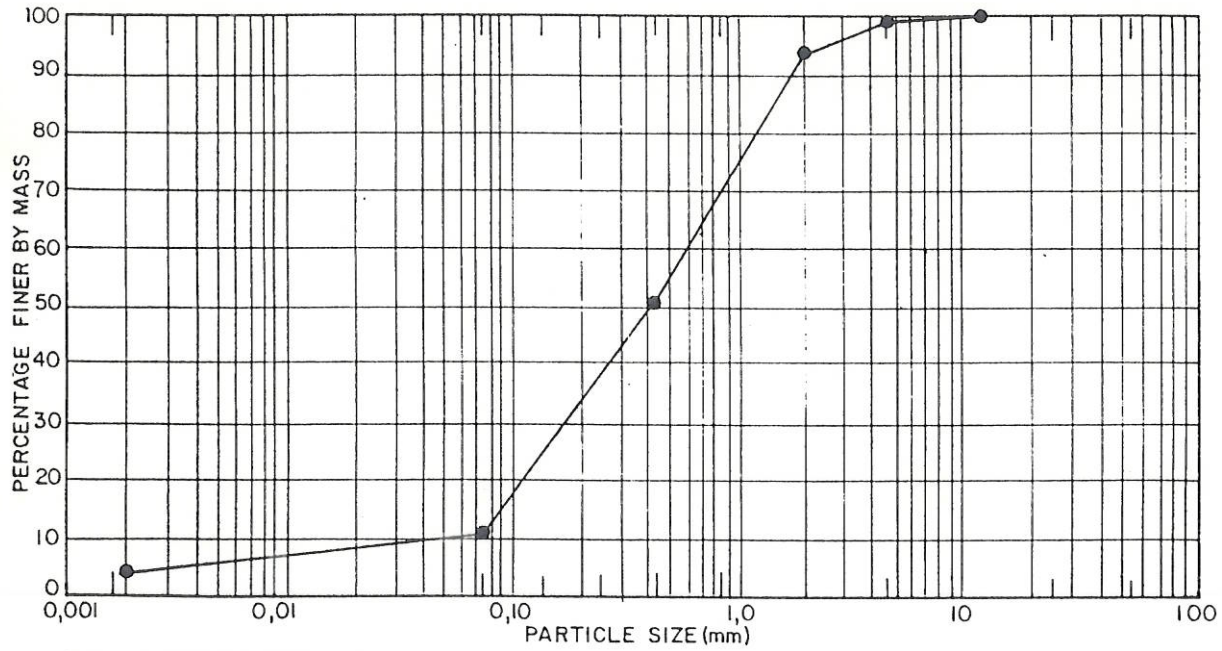
REMARKS VERSTEURDE MONSTER

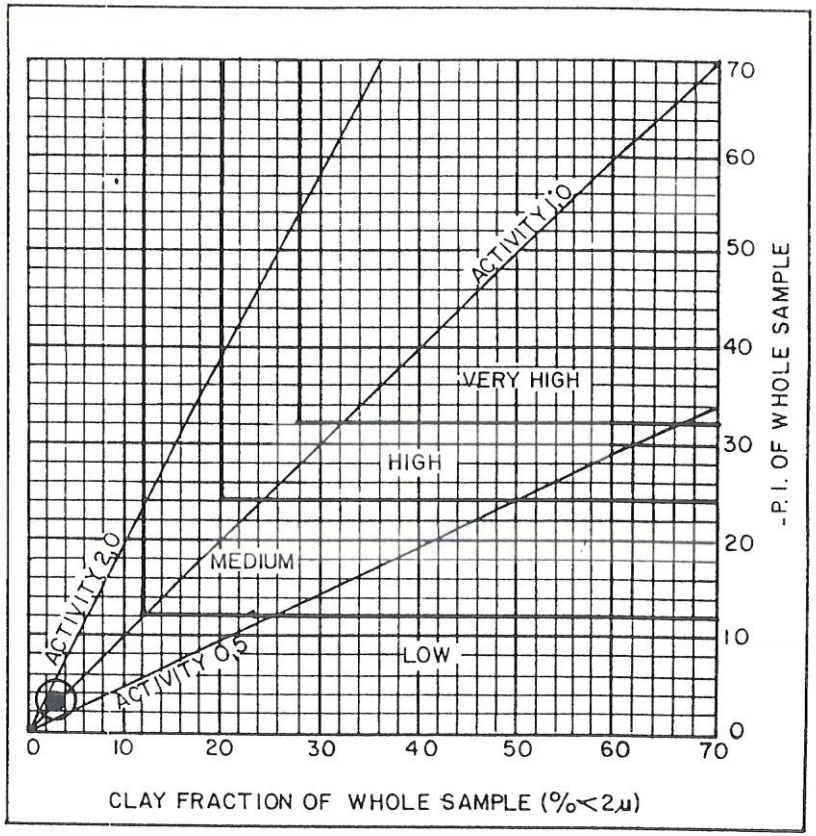
KIMATLAB

POTENTIAL EXPANSIVENESS TEST

CLIENT BVI RAADGEWENDE INGENIEURS	PROJECT PAUL PUTS SUBSTASIE	YOUR REF MNR DE KOCK	OUR REF SL 1560	DATE 1999.10.27

SAMPLE No. K21-650	TEST HOLE No. TP 4	DEPTH 0,15-1,5m	DESCRIPTION LIGBRUIN, FYN, VERWEERDE, GRANIETIESE GRUIS MET VERSPREIDE HOEKIGE, KWARTSIETKLIPPIES





ATTERBERG LIMITS	SOIL FINES	WHOLE SAMPLE
Liquid Limit	23	12
Plastic Limit	18	
Plasticity Index	5	3
Linear Shrinkage	2,5	

CLAY FRACTION (%)	
Soil Fines	8
Whole Sample	4

UNDISTURBED / DISTURBED SAMPLE DATA	
Insitu Moisture Content (%)	
Relative Density	
Bulk Density (dry)(kg/m³)	
Bulk Density (wet)(kg/m³)	

REMARKS VERSTEURDE MONSTER

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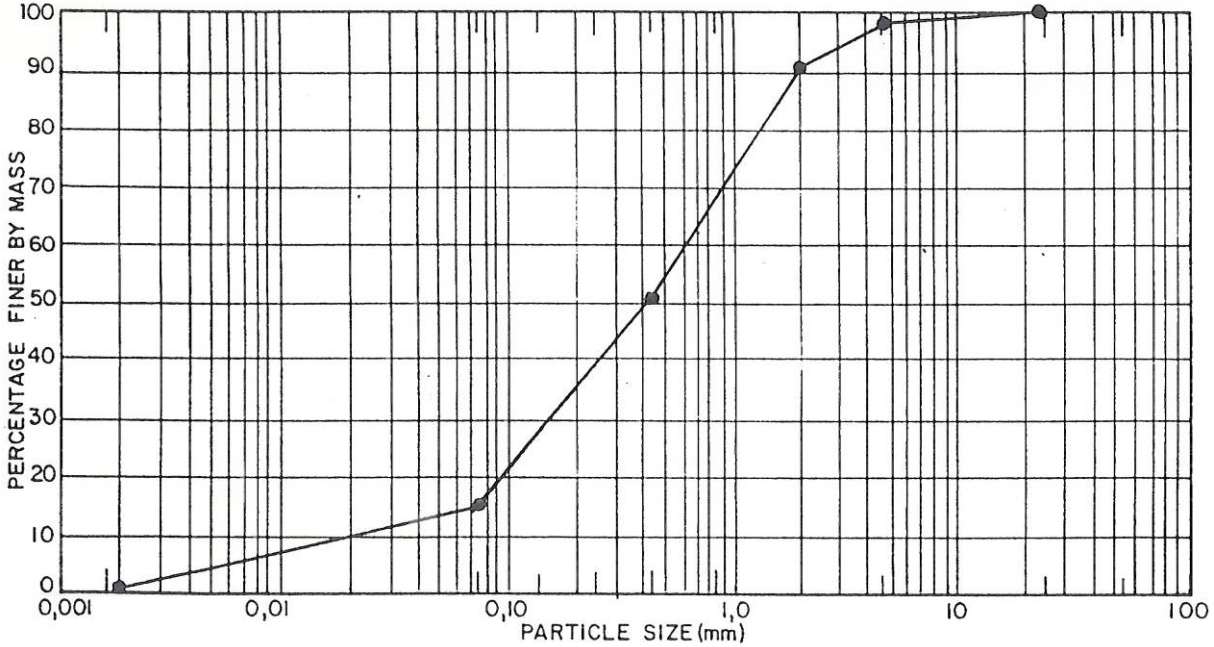
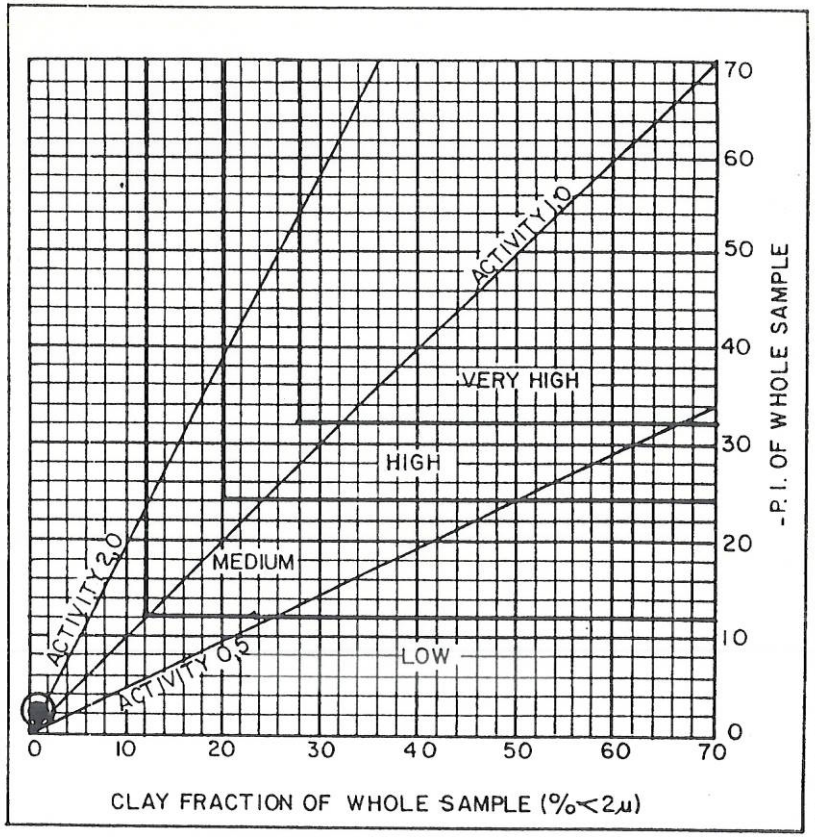
POTENTIAL EXPANSIVENESS TEST

CLIENT BVI RAADGEWENDE INGENIEURS	PROJECT PAUL PUTS SUBSTASIE	YOUR REF MNR DE KOCK	OUR REF SL 1560	DATE 1999.11.12

SAMPLE No. K21-730	TEST HOLE No. TP 12	DEPTH 0,1 - 0,9m	DESCRIPTION LIGBRUIN TOT LIG-ROOIBRUIN, FYN, VERWEERDE GRANIET EN KWARTSIETGRUIS





ATTERBERG LIMITS	SOIL FINES	WHOLE SAMPLE
Liquid Limit	17	9
Plastic Limit	14	
Plasticity Index	3	2
Linear Shrinkage	1,4	

CLAY FRACTION (%)	
Soil Fines	2
Whole Sample	1

UNDISTURBED / DISTURBED SAMPLE DATA	
Insitu Moisture Content (%)	
Relative Density	
Bulk Density (dry)(kg/m³)	
Bulk Density (wet)(kg/m³)	

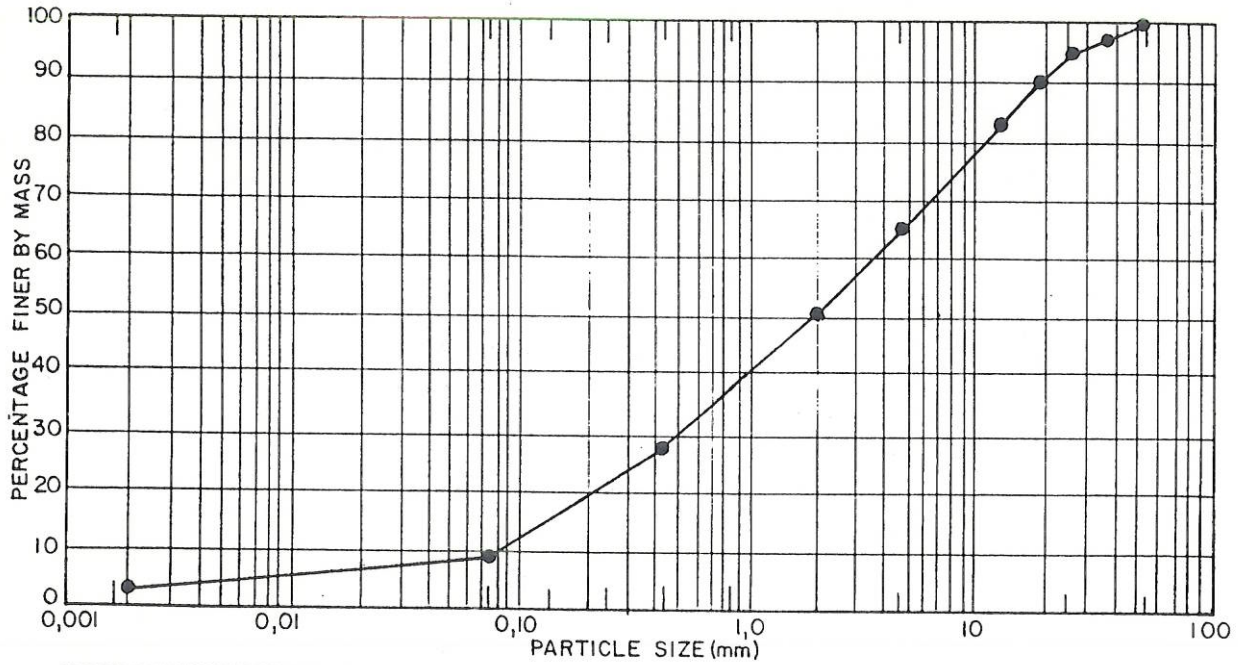
REMARKS VERSTEURDE MONSTER

KIMATLAB

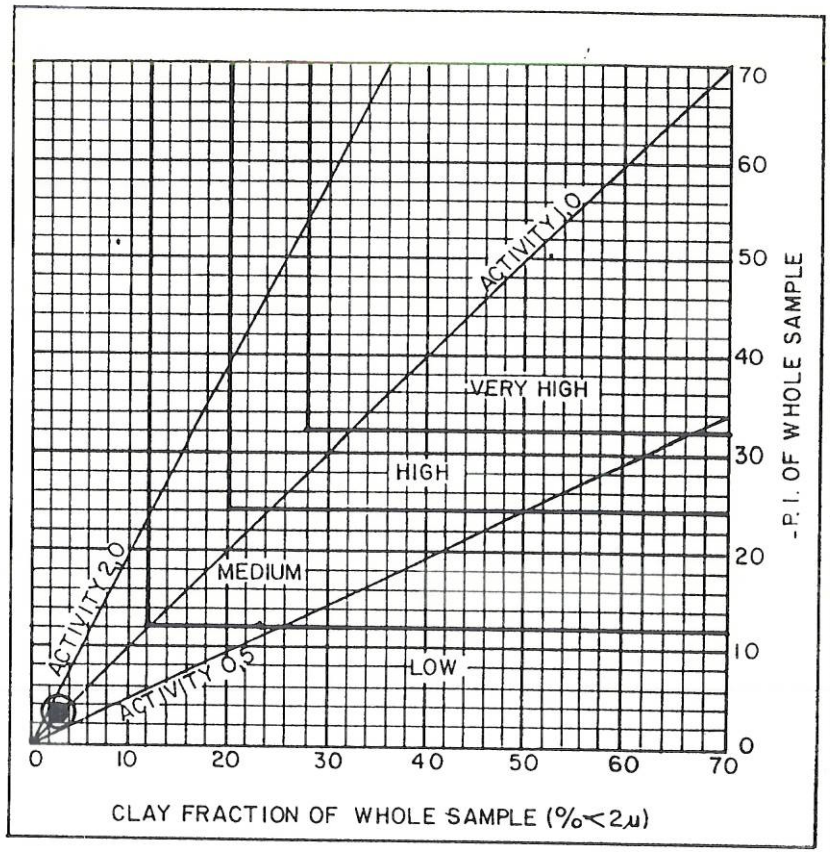
POTENTIAL EXPANSIVENESS TEST

CLIENT BVI RAADGEWENDE INGENIEURS	PROJECT PAUL PUTS SUBSTASIE	YOUR REF MNR DE KOCK	OUR REF SL 1560	DATE 1999.11.12

SAMPLE No. K21-731	TEST HOLE No. TP 12	DEPTH 0,9 - 2,6m	DESCRIPTION LIGBRUIN EN LIGPERS, SKERFAGTIGE, SANDSTEEN EN VERWEERDE GRANIETIESE GRUIS



Clay fraction	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse
	Silt			Sand			Gravel		



ATTERBERG LIMITS	SOIL FINES	WHOLE SAMPLE
Liquid Limit	31	9
Plastic Limit	22	
Plasticity Index	9	3
Linear Shrinkage	4	

CLAY FRACTION (%)	
Soil Fines	11
Whole Sample	3

UNDISTURBED / DISTURBED SAMPLE DATA	
Insitu Moisture Content (%)	
Relative Density	
Bulk Density (dry) (kg/m³)	
Bulk Density (wet) (kg/m³)	

REMARKS VERSTEURDE MONSTER

TABLE - I GEOTECHNICAL PROPERTIES

PROJECT PAULPUTS SUBSTATION

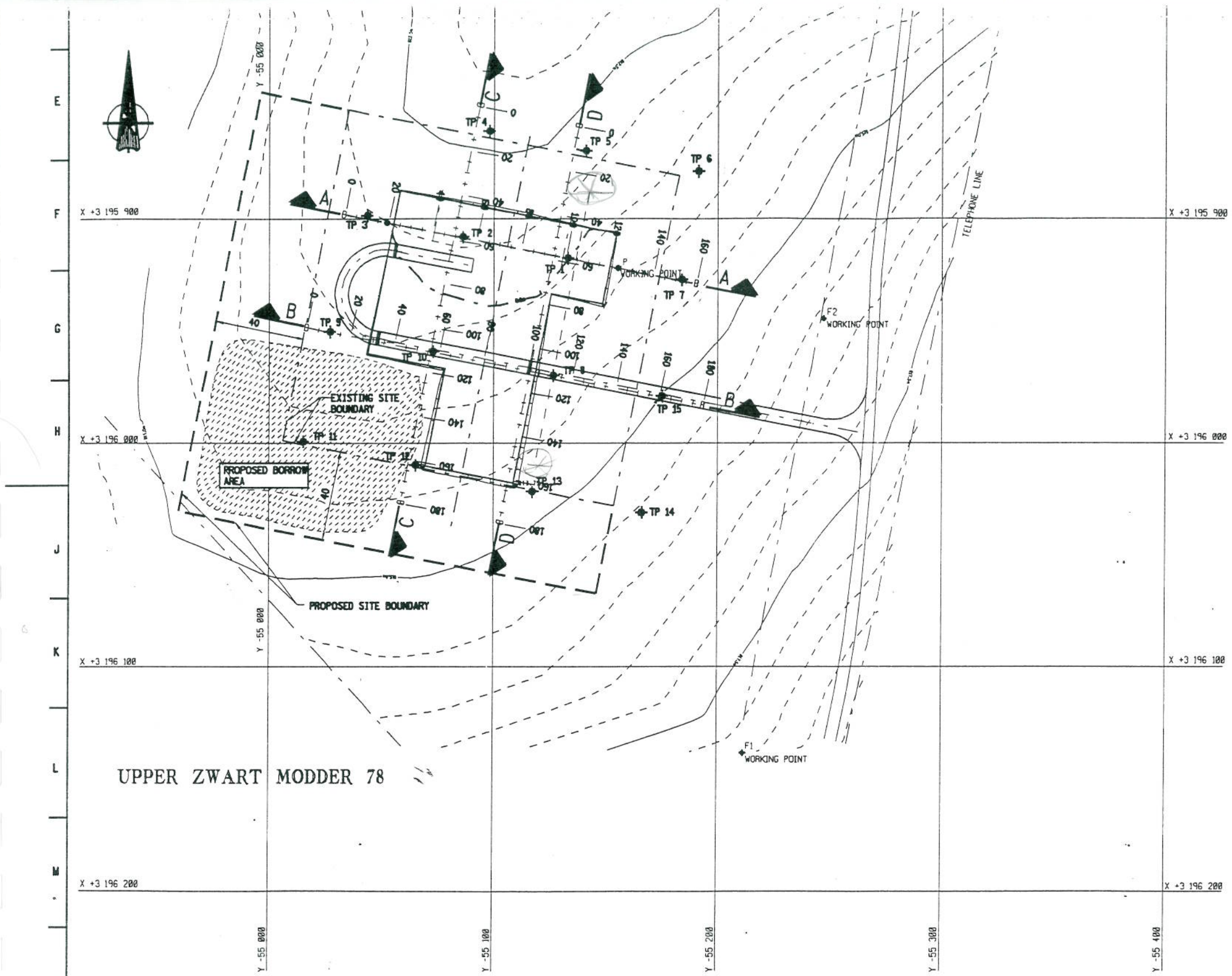
JOB NO: G-11/99 Page No_____of

DATE: November 1999 _____Pages

TP/ BH NO	DEPTH (m)	ATTERBERG LIMITS			GM	PI OF WS	-2 µm %	PE	SOIL CHEMISTRY				COMPACTION								SOIL CLAS-SIFICATION		DESCRIPTION	
										Con-ducti-vity mS/	Lange lier Index	Total Disso-lved Solids	Insitu Properties			OMC	MDD	CBR % Mod AASHTO				PRA	UCS	Insitu Profile	Labora-tory Descrip-tion
		LL	PI	LS					pH	cm		ppm	CP %	MC %	Density kg/m3	%	kg/m3	90	95	98	100				
TP-4	0,15-1,5	23	5	2,5	1,43	SP	5	L																
TP-10	0,15-0,9	27	9	4,0	1,46	SP	6	L																
TP-10	0,9- 1,5	45	17	7,5	2,17	5	5	L																
TP-12	0,1-0,9	19	4	2,7												7,4	2154	-	-	68	72				
TP-12	0,9-2,6	30	4	2,7												6,1	2115	-	-	24	42				
TP-12	0,1-2,6																								
	50/50	23	4	2,6												7,1	2143	-	-	62	100				
Water	Borehole											10400													

LEGEND

TP	- Test Pit	LS	- Linear Shinkrage	BD	- Insitu Dry Density kg/m3		
BH	- Borehole	GM	- Grading Modul	MC	- Moisture Content	PRA	- Modification of U.S. Bureau of
LL	- Liquid Limit	µm	- Clay Fraction	OMC	- Optimum Moisture Content		Public Roads Administration
PI	- Plastic Index	PE -	- Potential Expansiveness	CBR	- California Bearing Ratio		Classification Systems
PI/WS	- PI of Whole Sample	MDD	- Maximum Dry Density kg/m3				



UPPER ZWART MODDER 78

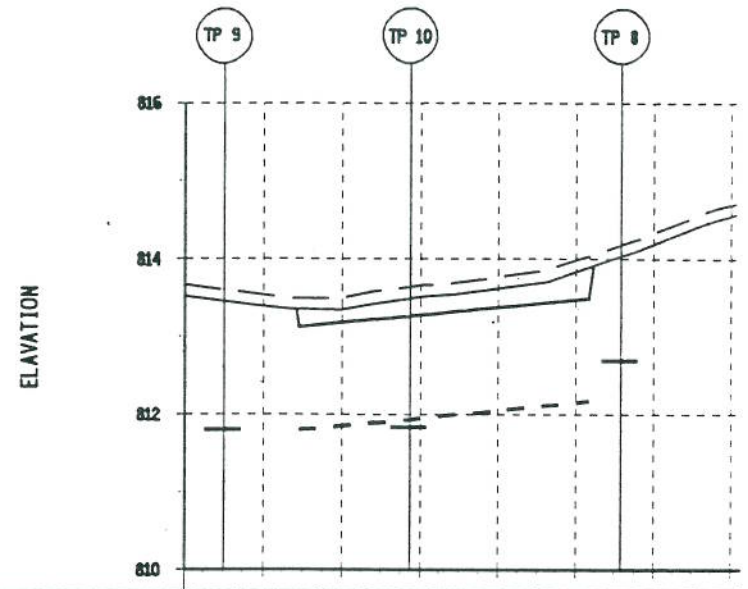
LAYOUT
SCALE 1 : 1000

1 : 2000

1 : 2000

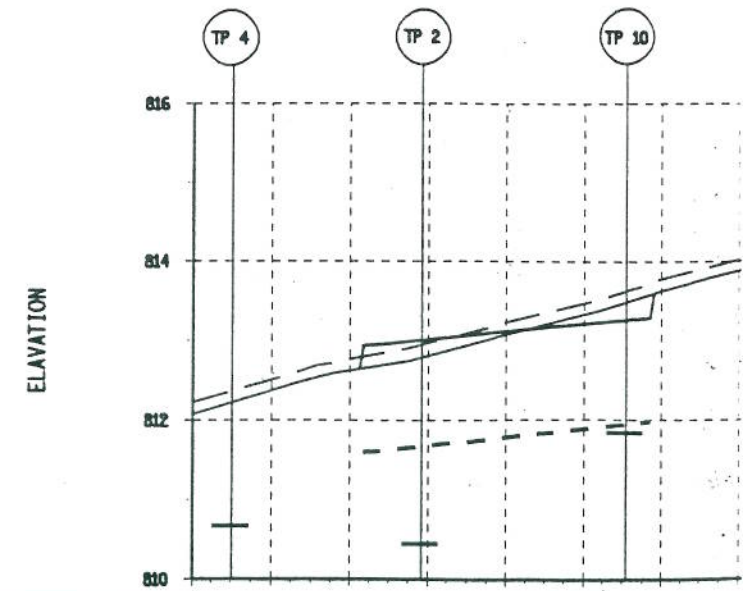
EXISTING GROUND LEVEL	813.18	813.00	812.96	812.96	813.08	813.26	813.85	814.13	
PREPARED GROUND LEVEL	813.03	812.86	812.80	812.81	812.93	813.23	813.70	813.98	
TERRACE LEVEL			812.95	813.05	813.15	813.25	813.44		
CHAINAGE	0	20	40	60	80	100	120	140	

SECTION A – A
SCALE :- HORIZ 1 : 1000
VERT 1 : 50



EXISTING GROUND LEVEL	813.67	813.54	813.50	813.67	813.77	814.00	814.26	814.71	
PREPARED GROUND LEVEL	813.52	813.39	813.35	813.52	813.62	813.85	814.20	814.56	
TERRACE LEVEL			813.18	813.28	813.38	813.48			
CHAINAGE	0	20	40	60	80	100	120	140	

SECTION B – B
SCALE :- HORIZ 1 : 1000
VERT 1 : 50



EXISTING GROUND LEVEL	812.23	812.52	812.77	812.97	813.22	813.48	813.78	814.05	
PREPARED GROUND LEVEL	812.08	812.37	812.62	812.82	813.07	813.33	813.63	813.90	
TERRACE LEVEL			812.65	812.85	813.10	813.35			
CHAINAGE	0	20	40	60	80	100	120	140	