Shoprite Distribution Centre
Erf 409, Wells Estate
Port Elizabeth

GEOTECHNICAL REPORT

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Prepared for:
Shoprite Checkers Properties

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Executive Summary

This report presents the results of the site investigations for the new, 62500m^2 distribution centre which Shoprite Checkers Properties plan to construct on vacant ground in the southeastern part of Erf 409 in Wells Estate on the eastern outskirts of Port Elizabeth.

The development will comprise a very large, warehouse type building with associated marshalling yard and ancillary structures. The warehouse will be constructed some 1.4m higher than the surrounding yard to facilitate docking.

The building itself will be constructed on a filled platform, but shaping the surrounding areas will require both cutting and filling operations during a bulk earthworks programme. The bulk fill levels will be located at 44.20m and 44.47 and the building will have columns constructed on a 32.5m grid and the clear height within the building will be 13m.

The surface bed will be superflat construction which will require a subgrade with a subgrade reaction of 65MPa/m.

The investigations comprised the excavation of thirty-two trial pits with DCP tests next to and in some pits. Fourteen plate load tests were undertake to determine the elastic properties of the calcrete and calcretised sands. Laboratory testing included foundation and roads indicator, and mod/CBR tests, and determination of natural moisture content of the soils.

The natural soil profile at the site generally comprises combinations of silty sand overlying calcrete (hardpan or gravel), overlying calcareous sand, overlying shelly silty sand or clayey sand, which in turn overlies shale bedrock. Fill material (made ground) occurs in the northwestern, northeastern and southwestern corners of the site.

Groundwater was intersected at 3.1m depth in TP 22 and at 4.5m in TP 28 on 23 March and this water might occur because of the pit's proximity to the channel along the southeastern boundary. Seasonal perched water will probably be present, in places, at the contact between the surficial silty sand and the underlying calcrete, particularly in low areas such as the circular depression.

Site clearance and preparation will mainly include removal of the vegetation (indigenous vegetation and exotic scrub) and the dumped rubbish in the southwestern part of the site and probable removal or reworking of the calcareous fill in the northwestern part of the site. The organic rich surficial layer (±50mm but locally deeper) should also be removed.

Trafficability around the site may be difficult in winter and, if possible, civil construction should be programmed for summer. Failing which, pioneering material would have to be placed to facilitate the movement of construction vehicles around the site.

The soil materials to be excavated during the bulk earthworks programme will generally comprise the silty sand, calcrete and very minor quantities of calcretised sand. The SABS excavation classification of these materials is variable and difficult excavation conditions will occur due to the hardness of the calcrete and the shallow cut.

Excavation of foundation trenches for the small and even the larger bases will be difficult, in places, because of combinations of hard calcrete and the restricted working space and also the depth of excavation below the platform.

To facilitate measurement and to avoid disputes, project-specific excavation classes should be adopted for both bulk and restricted excavation.

None of the materials on the site are suitable for the high quality fill required below the surface beds, and sand should be imported for this purpose.

Consideration could be given to using the existing calcrete fill and/or the piles of fill in the northeastern areas and possibly the mixture of silty sand and calcrete excavated during bulk earthworks for fill in marshalling yards and other areas. However, these materials will all be moisture-sensitive and their usage is weather dependent. Their use cannot be confirmed unless trial embankments are constructed to determine their workability and compactability, and use of cement stabilisation could be considered during these field trials.

Foundations comprising spread footings (pad or strip footings) are appropriate for all structures. Lightly loaded structures, which are located on the platform,

can be founded at a minimum depth of 0.7m with bearing pressures for square and strip footings limited to 125kPa and 150kPa respectively. Heavily loaded footings for the main building should be founded in the calcrete or calcretised sand and a maximum bearing pressure of 300kPa is applicable.

Analyses indicate that, for the KLS proposed layerworks comprising 75mm make-up sand and 150mm G4 material, the total settlement below racks rows will vary from approximately 2mm to 7mm depending on the thickness of the underlying engineered fill and that the settlement between the rack line and the aisles will be approximately 3mm.

Based on the results of recent plate load testing on sands elsewhere for DC warehouses, a subgrade reaction of 65MPa/m is considered achievable provided the bulk earthworks are well conducted and controlled.

Plate load tests using large diameter plates (500mm or 750mm) must be conducted during construction to ensure that the threshold k-value is achieved.

Systematic provision of subsurface drainage is not envisaged, but a surface drain should be provided along the northwestern side of the site to trap and control possible stormwater sheet wash from other higher parts of the site.

1. INTRODUCTION

Shoprite Checkers (Pty) Ltd is planning to construct a new Distribution Warehouse on Erf 409 in Wells Estate on the eastern outskirts of Port Elizabeth.

Mr H Kotzé of KLS Consulting Engineers, therefore requested R.A. Bradshaw & Associates cc to undertake a geotechnical investigation on a part of the erf which is earmarked for the warehouse. The objectives of the investigation were to determine:

- The soil profile and its engineering properties,
- Founding conditions and an appropriate foundation layout,
- Excavation conditions,
- Suitability of excavated material for engineered fill, and
- Groundwater conditions.

A preliminary geotechnical investigation for the majority of the Erf had been undertaken in 2009 by SRK Consulting Engineers and Scientists and their report entitled 'Preliminary Geotechnical Assessment: Shoprite Distribution Warehouse, Ref. 411627, was provided by KLS Consulting Engineers as background information.

A proposal for the investigation was e-mailed to Mr Kotzé on 31 January 2011, and authorisation to proceed with the investigations was given by Shoprite Checkers Property Division, order number 33255, on 7 February. Field investigations were undertaken during the period 22 to 25 February.

In early March, the position of the Distribution Centre was moved to the southeast of the area that had been investigated in February and investigation of the new area was considered appropriate. A proposal for the second investigation was emailed to Mr Mr Kotzé on 14 March 2011 and authorisation to proceed with these investigations was given under Shoprite Checkers Property Division's order number 33262 on 15 March. Field investigations were undertaken on 23 and 24 March.

This report presents the results of the site investigations and the associated laboratory testing which were undertaken in both the areas investigated. However, descriptions in the text generally refer to the current site.

2. DESCRIPTION OF THE SITE AND THE DEVELOPMENT

2.1 The Site

The near rectangular site is a vacant parcel of land which is approximately 17.5Ha in area including the entrance road reserve. The site forms part of a large (83 Ha) erf and it is bounded to the southwest and northeast by open ground. The remainder of Erf 409 extends to the northwest and the servitude for a deep stormwater canal abuts the southeastern boundary.

The site can be accessed via the R102, which cuts across the northwestern parts of the larger site.

The southwestern parts of the site are relatively densely vegetated with indigenous grasses, and particularly exotic scrub and small trees. Scattered vegetation and concentrations of scrub also occur in the other parts.

Three areas of dumped material occur on the site:

- Dumped rubbish and rubble is present near the southwestern corner and extends along the future entrance road.

- Fill material, which comprises predominantly calcrete and calcareous soils, has been dumped and spread over a small area in the northeastern part, but the deposit also extends several hundred metres to the northwest of the site. The thickness of this fill ranges up to approximately 1m.

- Dumped material also occurs in a large area which encroaches into the northeastern corner. This material has been dumped by trucks and consequently occurs as abutting ±6m^3 piles.

The distribution of the three occurrences is shown on Figure 1. Their boundaries were mapped with a hand-held GPS device.

The ground profile generally gently undulates with ground elevations commonly in the range of 42m to just above 43m. However, local high areas occur and there is a circular, 1.3m deep by 30m diameter depression near the southeastern corner of the site. In addition, there is an ill-defined, irregular T-shaped lower area with the base of the T-shape running southeastwards through the centre of the site. The ground profile is also currently very irregular in the area of dumped piles in the southeastern corner.

2.2 The Development

The proposed distribution warehouse will ultimately comprise an approximately 62500m^2 building with docking facilities and marshalling yards on both the western and eastern sides of the building.

The structure will be constructed in more than one phase with Phase 1 comprising the dry goods, perishables and returns areas all located in the central part of the building which is 29231m^2 in area. Future developments will be constructed in the 20788m^2 and 12507m^2 areas at the two ends of the building.

The building will be constructed on a filled platform which will be located at a preliminary elevation of 44.47m. Columns will be constructed on an approximate 32m grid and exterior walls will comprise brickwork up to approximately 3m height with sheeting extending from the top of the brickwork to roof level. The clear height within the building will be 13m.

The surface bed must withstand high stacking loads and will be superflat construction with ±32m by ±32m panels cast without joints. The Structural Engineers require a subgrade for the surface bed with a subgrade reaction of 65MPa/m.

The marshalling yard will be located some 1.4m lower than the main platform to facilitate docking of delivery trucks. Local cut and fill will be required to achieve the required levels. However, the ground, particularly in the northwestern parts of the site, will be shaped to minimise the amount of excavation in ground that will be difficult to excavate.

Horse and trailer parking will be provided in the northwestern parts with transport and truck facilities immediately to the west. A small building, which houses staff facilities and a canteen, and staff parking will be provided in the central parts of the western boundary.

Truck fuelling lines and presumably underground fuel tanks will be constructed immediately to the west of the staff parking.

A large parking area and road access will be provided for suppliers in the southwestern corner.

Access to the facility will be via a road which will run down the western part of the southeastern boundary of the erf. Shoprite's regional offices might be constructed along the southern half of the northern side of the access road. Shoprite's weighbridges would be located towards the eastern end of the access road.

An approximately 2.2Ha detention pond might be constructed in the extreme northeastern corner of the site to deal with stormwater running off the site.

Future development opportunities will be available in areas to the north of the site and to the east of the canal in the area between the canal and the railway line.

3. OUTLINE OF THE INVESTIGATIONS

3.1 Trial Pitting

Twenty trial pits (TP 1 to TP 20) were excavated with an excavator on 22 to 25 February at the locations shown on Figure 1. An additional twelve pits (TP 21 to TP 32) were subsequently excavated in the area of the current site on 23 and 24 March. The pits were excavated to between 0.8m and 4.5m depth. The occurrence of hardpan calcrete or silcrete-like material limited the depth of excavation of some of the pits.

The objective of the trial pitting was to determine the soil types and the engineering properties of the shallow soil profile, to determine excavatability and to provide access for plate load testing and soil sampling.

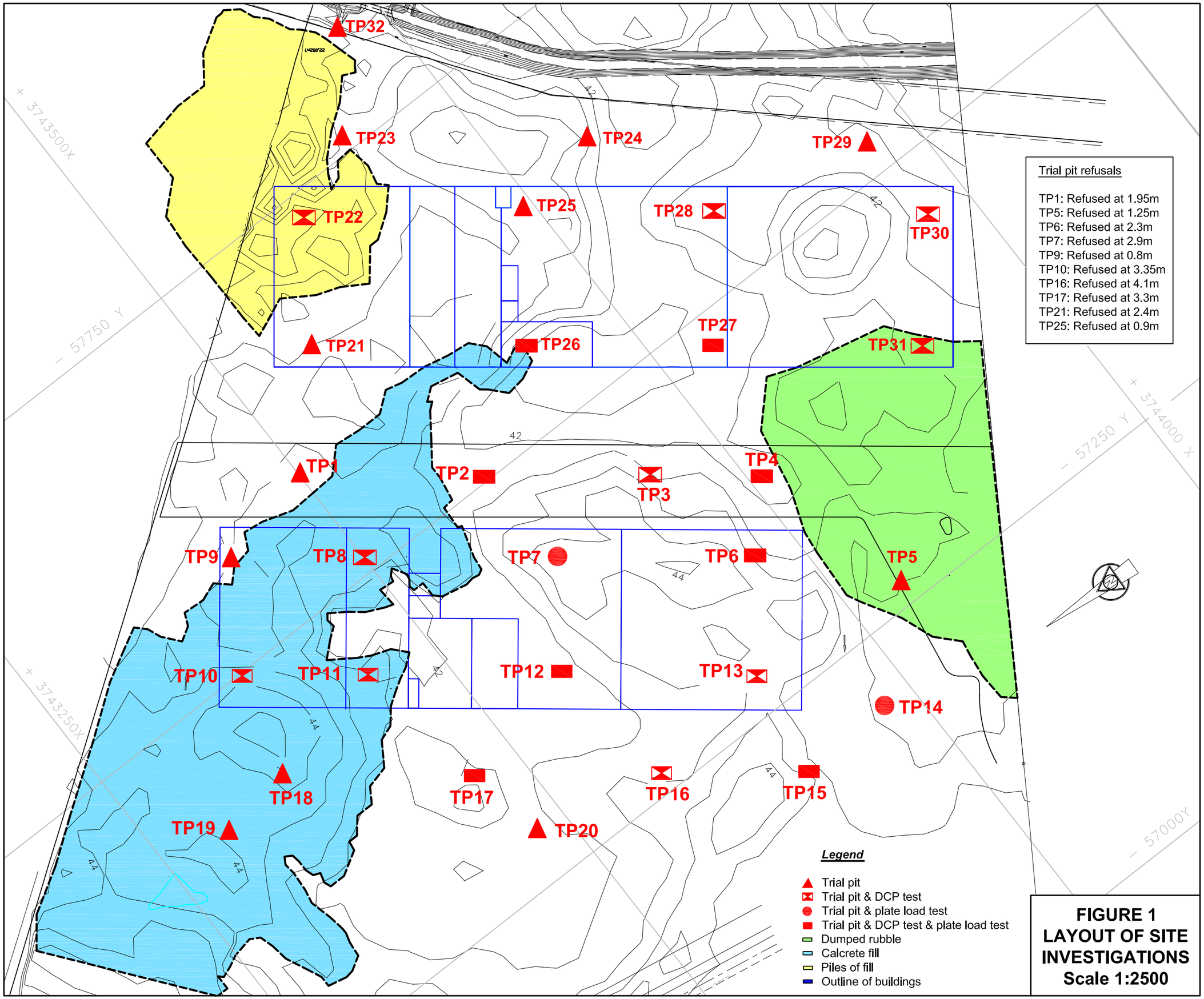
The soils exposed in the sidewalls of the trial pits were profiled according to standard South African practice, and the descriptions of the soil profiles are presented in Appendix A.

3.2 DCP Testing

Two-metre deep DCP tests were undertaken next to and in TP4, TP13, TP 28 and TP 31 and in TP2, TP3, TP6, TP8, TP10, TP11, TP12, TP15, TP16, TP17, TP 22 TP 26, TP 27 and TP 30. Very dense soils limited the depth of penetration. DCP tests could not be undertaken in the other pits because very dense calcareous soils or calcrete rock was present.

The objective of the DCP testing was to determine the relative density or consistency of the shallow soil profile.

The plots of DCP penetration rates versus depth of the tests at the trial pit positions are presented in Appendix A.


TP32
TP23
TP24
TP29
TP22
TP25
TP28
TP30
TP21
TP26
TP27
TP31
TP1
TP2
TP3
TP4
TP9
TP8
TP7
TP6
TP5
TP10
TP11
TP12
TP13
TP14
TP18
TP17
TP16
TP15
TP19
TP20
+ 3743500X
- 57750 Y
+ 3744000 X
- 57250 Y
+ 3743250X
- 57000Y
42
44
Trial pit refusals
TP1: Refused at 1.95m
TP5: Refused at 1.25m
TP6: Refused at 2.3m
TP7: Refused at 2.9m
TP9: Refused at 0.8m
TP10: Refused at 3.35m
TP16: Refused at 4.1m
TP17: Refused at 3.3m
TP21: Refused at 2.4m
TP25: Refused at 0.9m
Legend
Trial pit
Trial pit & DCP test
Trial pit & plate load test
Trial pit & DCP test & plate load test
Dumped rubble
Calcrete fill
Piles of fill
Outline of buildings
FIGURE 1
LAYOUT OF SITE INVESTIGATIONS
Scale 1:2500

3.3 Plate Load Tests

Fourteen plate load tests were undertaken at the positions shown on Figure 1. Where possible, a 600mm diameter plate was used, but a 300mm diameter plate was used at the majority of the positions because a 600mm diameter plate was not practical due to the irregular profile of test surfaces.

The testing comprised vertically jacking the circular steel plate using an excavator as kentledge and measuring the plate's deflection with dial gauges.

The tests were carried out on hardpan calcrete, calcrete gravel and calcretised sand to determine the elastic modulus and modulus of subgrade reaction of these materials.

The results of the tests are presented in Appendix B.

3.4 Laboratory Testing

Laboratory tests were carried out on samples of silty sand, gravelly silty sand, shelly silty sand, calcretised sand, calcrete and shale.

The laboratory testing included thirteen mod/CBR tests, twelve foundation indicator tests, twelve roads indicator tests, and nine moisture content tests.

The laboratory test sheets are presented in Appendix C.

4. RESULTS OF THE INVESTIGATIONS

4.1 The Soil and Rock Types and their Engineering Properties

The natural soil profile at the site currently generally comprises combinations of silty sand overlying calcrete (hardpan or gravel), overlying calcareous sand, overlying shelly silty sand or clayey sand, which in turn overlies shale bedrock. Fill material (made ground) occurs in the northwestern, northeastern and southwestern corners of the site.

The detailed descriptions of the soil and rock types encountered in the trial pits are presented in Appendix A and their distribution is summarised in Figure 2. The properties are summarised below.

- **Made ground (fill):** Generally greyish brown, loose, layered fill comprising a mixture of slightly clayey or calcareous silty sand and fine to coarse, soft to hard rock calcrete gravel was intersected in TP9, TP10, TP11, TP18 and TP19. Scattered boulder-size (600mm) calcrete fragments were intersected in TP18 and they also occur elsewhere. This calcareous and calcrete-rich fill extends into the northwestern part of the site and just into the adjacent parts of the building's footprint. No testing of this material was undertaken, but its engineering properties probably most closely approximate those of the parent calcrete and calcareous soil.

  Fill comprising a mixture of local topsoil and generally minor calcrete covers the northeastern parts of the building footprint. It is understood, but not confirmed, that this material was derived from overburden stripping in the car park areas in the adjacent

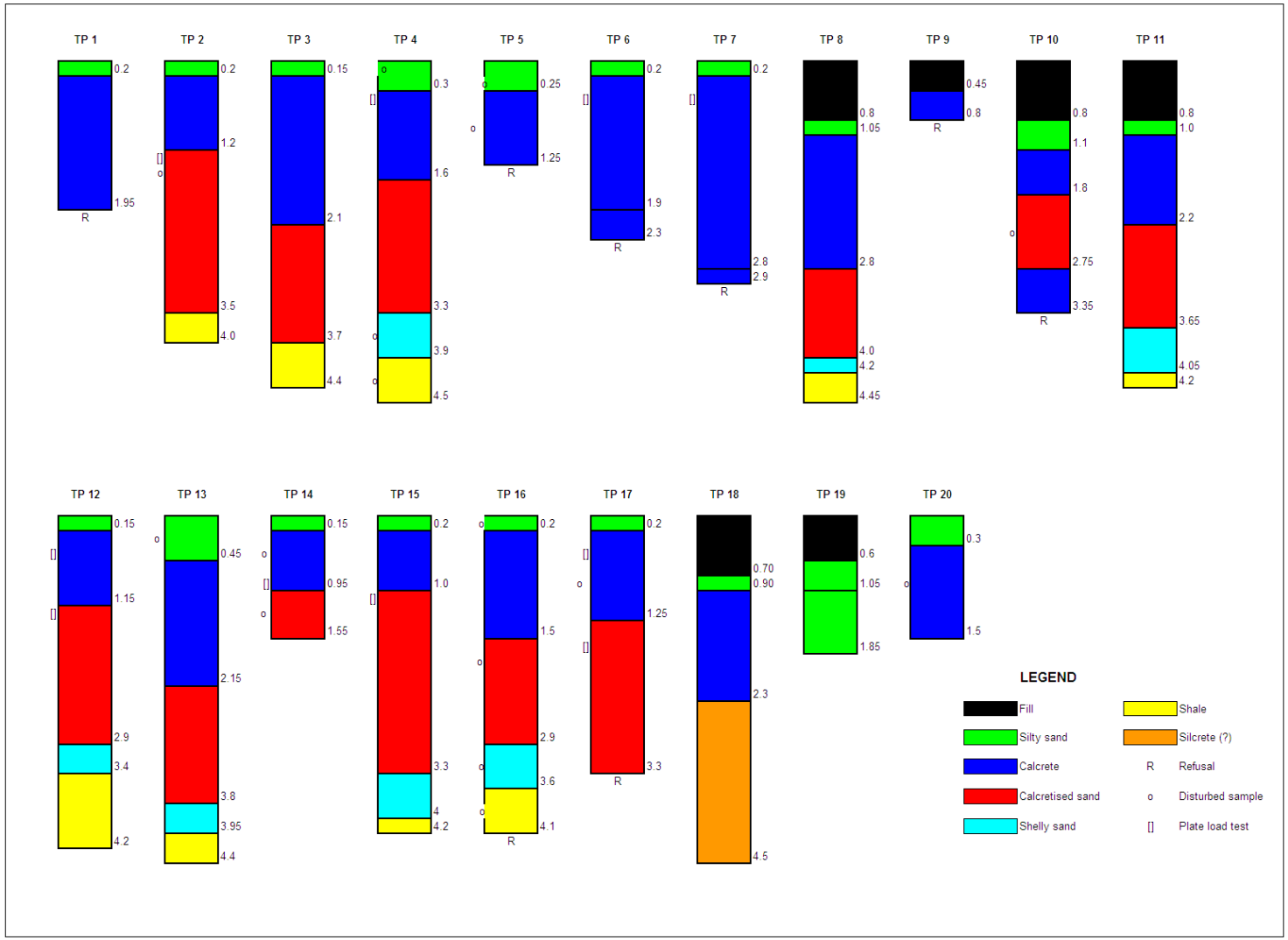


FIGURE 2: SOIL PROFILES IN TRIAL PITS

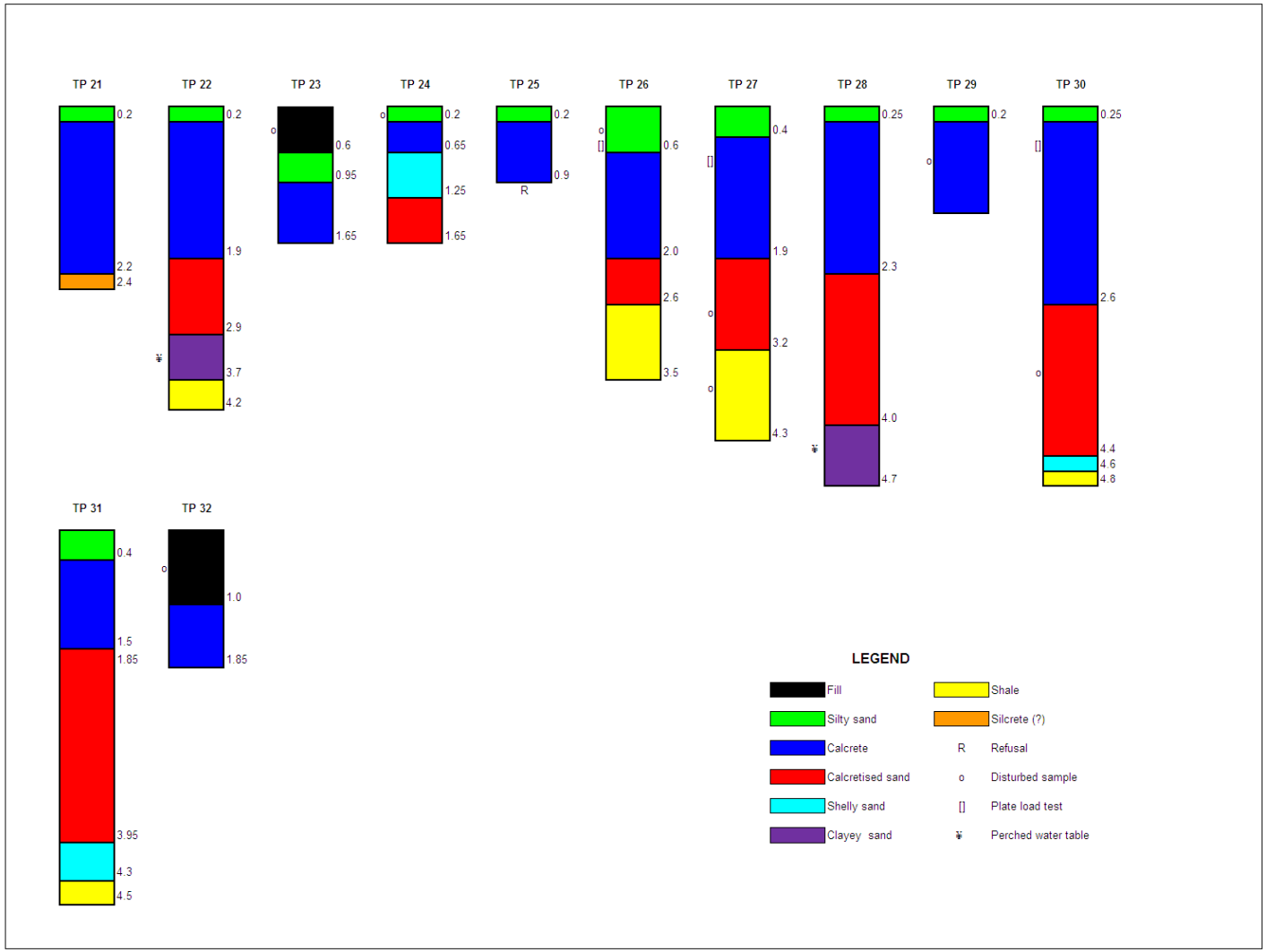


FIGURE 2 (CONT): SOIL PROFILES IN TRIAL PITS

General Motors property. The fill was dumped and now stands in abutting piles and vegetation grows in places on the piles. A sample taken at random in the central part of this occurrence of fill contained 38% fines and it has a plasticity index of 9. Similar soil from TP 23 and TP 32 had 22% and 29% fines and plasticity indices of 5 and 5 respectively. Whereas the fill comprises mainly topsoil, it also contains variable but generally small quantities of calcrete and calcareous soils. The engineering properties are therefore likely to be similar to those of the parent silty sandy topsoil.

Made ground is also present in the extreme southwestern part of the footprint. The material includes household refuse and industrial waste and builder's rubble and active dumping was occurring during both phases of the investigation. The material occurs locally in heaps but it is also partly self spread.

- **Silty sand:** Silty sand was encountered at surface in most of the trial pits. It is absent in TP9 and underlies made ground in TP8, TP10, TP11, TP18 and TP19. It comprises generally medium greyish brown, loose, shattered, silty fine sand with scattered, medium, medium hard calcrete gravel. The silty sand is of aeolian origin and generally between 0.15m and 0.45m thick. A gravelly variety, possibly of marine origin, occurs in TP4, TP5 and TP19.

  The fines content of the silty sands from samples taken from overall site ranged from 22% to 42% and the soils were commonly non plastic although plasticity indices of 5 and 11 were recorded on two of the samples. Grading and hydrometer analyses on the sample from TP 5 indicated 25% gravel, 30% sand, 42% silt and zero clay. It is thus apparent that the silt content of these soils is high and in places they should be more correctly called gravelly sandy silts or sandy silts.

- **Calcrete:** Calcrete occurs below the silty sand throughout the site.

  The calcrete comprises creamy white and pale khaki, very soft to medium hard, hardpan calcrete grading with depth to medium to coarse calcrete gravel in a minor calcretised sand. Where encountered in the pits, the thickness of the calcrete layer ranges between 0.7m and 2.4m. The thickness of the surficial hardpan varies from approximately 0.3m to 1m with an average thickness of approximately 0.6m. In TP5, TP6 and TP13 the calcrete comprises layers and/or lenses of very soft to medium hard hardpan calcrete and medium to coarse calcrete gravel in a minor calcretised sandy matrix.

  Medium hard to very hard, hardpan calcrete, where refusal of the excavator occurred, was encountered in ten of the thirty-two pits at depths between 0.45m and 2.8m. The thickness of this calcrete is unknown. The pits and the depths to refusal are tabulated in Figure 1.

  Tests on five samples of calcrete indicated fines contents of 9% to 17% and plasticity indices of 6 to 12. The grading of this material is very variable and it is partly dependent on the method of excavation, and the excavated material commonly comprises large proportions of boulder and gravel-size material.

- **Calcretised sand:** Pale khaki and khaki, very dense, weakly layered calcretised, fine sand with scattered medium to coarse, medium hard calcrete gravel generally underlies the calcrete. In TP14 it is pale khaki becoming slightly darker with depth and very dense. It was absent in TP18 and TP 21, where silcrete-like material underlies the calcrete. The thickness of the layer is generally between 0.6m and 2.3m, but the contact with the

overlying calcrete is commonly gradational and the true thickness is therefore locally difficult to define precisely.

Tests on six samples indicated fines contents of 11% to 43% and plasticity ranging through non plastic to slightly plastic to plasticity indices of 4 to 6. The fines content apparently mainly comprises silt with negligible quantities of clay. The coarse grading of this material is also very variable and is partly dependent on the method of excavation.

- **Silcrete (?):** Khaki brown and grey, layered, very dense, silcrete-like material comprising cemented sandstone or silcrete with numerous, very small voids was encountered in TP18 and TP 21 below the calcrete. The maximum thickness of this layer is at least 2.2m and its origin is uncertain.

- **Shelly silty sand:** A thin layer (0.15m - 0.9m) of shelly, silty sand underlies the calcretised sand in TP4, TP8, TP11, TP12, TP13, TP15, TP16, TP 30 and TP 31, i.e. the southwestern parts of the site. This marine sand is light orange brown, dense, layered and contains scattered, fine, sub rounded gravel.

  The fines content of the samples from three trial pits ranged from 17%to 48% of which clay generally formed a very minor proportion. The plasticity indices were 2, 3 and 7.

  The shelly silty sand is replaced by thin, marine clayey sand in TP 22 and TP 28.

- **Shale:** Khaki grey and orange brown, highly to moderately weathered, thinly, sub horizontally bedded, generally very soft to soft, rock shale underlies the calcretised sand in TP2, TP3, TP 26 and TP 27 and the shelly silty sand in TP4, TP8, TP11, TP12, TP13, TP15, TP16, TP 30 and TP 31.

  Three samples of shale had plasticity indices of 11, 14 and 15. The shales have a high primary silt content but the excavated grading is partly dependent on the degree of weathering and fracturing of this rock.

4.2 Elastic Moduli of the Soils and Rock

Nine plate load tests were conducted on calcrete and calcretised sand.

The calculated values of E-modulus and the modulus of the subgrade reaction for a plate bearing pressure of 100kPa are presented in Table 1.

The E-moduli for calcrete range from 21MPa to 84MPa, with an average of 42MPa. The lower values were generally recorded in gravelly calcrete (TP 7, TP 17, TP 26, TP 27, TP 30 and TP 31), whereas the higher values (TP 4, TP 6, TP 12) were recorded in the hardpan.

E-moduli in the calcretised sand are generally greater than those recorded in the calcretes. This is counterintuitive and an explanation might be that either consolidation of the bedding material below the plate contributed to deflection of the plate or closure of layers under load contributed to the deflection. The calcretised sand was generally more homogeneous and very dense to marginal weakly cemented which probably contributed to its higher modulus.

The modulus of subgrade reaction mirrors the E-moduli with values for the calcrete varying from 50MPa/m to 372MPa/m and an average of 175MPa/m. For calcretised sand, the range is

71MPa/m to 345MPa/m and an average of 206MPa/m. It should be noted that the modulus of subgrade reaction is dependent on the size of the plate/footing.

Westergaard's moduli of subgrade reaction have been extrapolated for a plate size of 750mm and are included in Table 1.

TABLE 1: RESULTS OF PLATE LOAD TESTS

Trial Pit	*Test Depth (m)*	*Soil Type*	*E-Modulus (MPa)*	*Modulus of Subgrade Reaction (MPa/m)**	*Westergaard's Modulus (MPa/m)**
TP 4**	0.6	Calcrete	56	132	170
TP 6	0.45		79	370	154
TP 7	0.55		25	115	48
TP 12	0.55		84	392	163
TP 17**	0.5		21	50	42
TP 30	0.5		23	102	43
TP 26	0.6	Gravelly calcrete	37	172	72
TP 27	0.75		29	137	57
TP 31	1.2		22	109	45
TP 2	1.35	Calcretised sand	34	156	65
TP 12	1.35		55	256	107
TP 14	1.0		74	345	144
TP 15	1.2		15	71	30
TP 17**	1.6		88	204	170

* Moduli calculated at 100kPa plate pressure

** Tests conducted with a 600m diameter plate. All other tests conducted with a 300mm plate

4.3 Natural Moisture Content of the Soils

The natural moisture contents of ten samples of soil, which were taken during the site investigations at the end of February, are presented in Table 2.

TABLE 2: NATURAL MOISTURE CONTENTS OF SOILS

Trial Pit	*Depth (m)*	*Soil Type*	*Moisture Content (%)*	*Optimum Moisture Content (%)*
TP2	2.0	Calcretised sand	10.5	-
TP5	0-0.25	Silty sand	7.5	13.9
TP5	0.25-1.25	Calcrete	10.6	16.3
TP10	2.0	Calcretised sand	10.0	12.3
TP14	0.15-0.95	Calcrete	5.8	18.8
TP14	0.95-1.55	Calcretised sand	7.3	13.9
TP16	0.1	Silty sand	3.7	-
TP16	1.9	Calcretised sand	6.1	-
TP16	2.9-3.6	Shelly sand	6.5	-
TP20	1.0	Calcrete	6.5	11.2

The site investigations were undertaken towards the end of summer and this explains the generally low natural moisture contents. The natural moisture contents will increase after rainfall and particularly prolonged winter rainfall.

Comparison with the optimum moisture contents indicates that the 'summer' natural moisture contents are significantly lower than optimum.

4.4 Groundwater

No groundwater was encountered in any of the trial pits excavated during the first phase of pitting (TP 1 to TP 20) which was conducted on 28 and 29 February. However, groundwater was intersected at 3.1m depth in TP 22 and at 4.5m in TP 28 on 23 March.

It is uncertain whether groundwater occurs only at depth in the southeastern parts of the site or whether the occurrence of the water at depth is influenced by the continuous presence of water in the channel along the southeastern boundary.

Seasonal perched water will probably be present, in places, at the contact between the surficial silty sand and the underlying calcrete, particularly in low areas such as the circular depression.

5. GEOTECHNICAL ASSESSMENT

5.1 Site Clearance and Preparation

Site clearance will include, but not necessarily limited to the following:

- Removal of the vegetation (indigenous vegetation and exotic scrub),
- Removal of the dumped rubbish in the southwestern part of the site and any sporadically dumped rubbish across the remainder of the site.
- Probable removal or reworking of the calcareous fill in the northwestern part of the site.
- Removal of the organic rich surficial layer (±50mm but locally deeper).
- Trafficability around the site may be difficult in winter and, if possible, civil construction should be programmed for summer. Failing which, pioneering material would have to be placed to facilitate the movement of construction vehicles around the site.

5.2 Earthworks

Substantial earthworks will be required to construct a building platform at the 44.2m and 44.47m elevations, and general shaping of the site will also be required. Both cutting and filling will be undertaken and the current unadjusted volumes for cut and fill are 22245m^3 and 147702m^3 respectively.

5.2.1 Excavation Conditions

Information provided by KLS indicates that 96% of the cut is less than 1m deep and 80% is less than 0.6m.

The soil materials to be excavated will therefore generally comprise the silty sand, calcrete and very minor quantities of calcretised sand. In addition, the piles of dumped fill in the northeastern part of the site will be excavated and removed or possibly reused.

The thickness of the silty sand layer varied from 0.2m to 0.6m with a common thickness of approximately 0.2 m. The surficial, hardpan component of the calcrete layer is, on average, 0.6m thick in all the trial pits.

Excavation in the silty sand (and the fill covering various parts of the site) would be classified as Soft Excavation Class according to SABS 1200 D.

Excavation in the hardpan calcrete would be classified as Intermediate Excavation Class although Hard Excavation Class will be encountered in places. Marginal Intermediate Excavation Class would be experienced in the calcretised sand.

Excavation in the thinly developed shelly sands and clayey sands would be classed as Soft Excavation Class whereas excavation of the shallow bedrock would be Soft to Intermediate Excavation Class. These latter classifications would only be relevant to trench excavation.

Excavation problems will be encountered, particularly where a thin layer of calcrete must be removed. The earthworks contractor must determine the most efficient and practical manner to excavate thin layers of calcrete. Ripping with a bulldozer might be feasible, but the depth of ripping would be difficult to control. Excavation with an excavator equipped with a rock bucket would possibly be more efficient and practical. Over-excavation would probably occur with either method.

Areas of hardpan calcrete, which are massive and have relatively high strength, cannot be mechanically excavated. Very difficult blasting conditions would then occur because of the very shallow depth of cut.

The descriptions above have illustrated that variable excavation conditions will exist and application of the SABS 1200D classification would be problematic. It is therefore recommended that two, project-specific excavation classes are formulated for measurement and payment. The two classes could include:

- **Class A:** Material which can be excavated with a 30-tonne excavator equipped with a rock bucket.

- **Class B:** Material which requires excavation with a monteberre type attachment or splitting or blasting

The quantities of the two excavation classes are difficult to predict, but a possible division is 80% Class A and 20% Class B could be used initially.

5.2.2 Use of Excavated Materials or On-Site Fill for Engineered Fill

From Section 5.2.2, it follows that the only natural, on-site materials potentially usable for engineered fill are the excavated silty sand, calcrete and possibly minor calcretised sand. Because it will probably not be practical to excavate the silty sand and calcrete separately during bulk or other excavations, both will be excavated together and the materials will be mixed.

Calcrete fill and material from the piled fill in the northeastern corner of the site are also potentially available for use as engineered fill.

The silty sand has high silt contents and calcrete will probably be excavated as blocky material, and mixtures of the two material types are not considered suitable for good quality engineered fill.

Individually, the silty sand has an AASHO classification of A-3(0), A-2-4(0), A-4(0) and A-6(0) and the TRH 14 classifications range from G7 to a generally G9 or G10 or worse than G10. These soils will be moisture-sensitive and difficult to compact and subject to pumping and possibly blowing in the subgrade.

The calcrete grading would be very variable. Its strength also varies and whereas use of a grid roller would probably break down some oversize material, higher strength calcrete will not disintegrate. In addition, although calcrete does not contain high proportions of fines, it will also be moisture-sensitive and be impossible or very difficult to work when wet. Testing indicates that the calcrete material classification ranges from G6 to G9, but the relatively small quantities to be excavated suggest that it is not a viable source of engineered fill.

The thin calcrete fill in the northern parts of the site is generally only a mixture of calcrete and calcareous material and would therefore probably also comprise G6 to G9 material. It would also be moisture-sensitive and is thinly developed, but there is possibly some 30 000m^3 of this material available over the greater site. It could possibly be used as fill in the peripheral areas around the distribution centre site, i.e. not in the footprint of the building. Weather conditions would have to be favourable and scalping of oversize material which cannot be broken down would also be required.

Approximately 30 000m^3 of mixed silty sand and calcrete occur in the piled fill in the northeastern parts of the site. This volume includes the fill outside the site boundaries. Use of this source material would be subject to the same problems described for the mixture of in-situ soils discussed above, namely the presence of a high silt content and oversize calcrete. Also, the piles of fill are partly vegetated and some vegetation is mixed with the fill. Test results from TP 23, TP 32 and the sample named ' fill' indicate that these soils would be classified as A-2-4(0) and A-3(0) or G8 and G9 - similar to the classifications for the in-situ silty sand.

Because of the large volumes and associated cost implications, use of the various mixed sources is potentially attractive. However, a commitment to use these sources should not be made without first conducting field trials comprising test embankments to confirm the workability of the material and the quality of fill constructed from them. Use of cement stabilised fill could also be considered during this process.

5.2.3 Engineered Fill below the Distribution Centre Building

The building will be raised approximately 1.4m above the surrounding ground to provide docking facilities. The thickness of the fill will therefore range from approximately 1.4m, to 3.5m in the area of the circular depression.

The superflat surface beds will be constructed to very high tolerances and minimal settlement can be tolerated.

None of the materials on this site are suitable for the high quality fill required below the surface beds, and sand should be imported for this purpose. The sand should be compacted to 100% of mod AASHTO maximum dry density or a DCP penetration rate of 15mm per blow or less.

The imported sandy fill would be placed on the silty sandy subgrade and small areas of calcrete outcrop. In dry summer conditions, the thin silty sands are medium dense to dense and they would

provide suitable subgrade for engineered fill. They should be rolled with a smooth drum vibratory roller to ensure a compaction of at least 95% of mod density and no scarifying should be undertaken. However, in winter, when soils are very moist or wet, they will be loose and cannot be compacted and will pump. The engineered fill should therefore not be placed on these which materials which would therefore have to be removed with consequent cost and programme implications.

The exposed sandy soils in the second phase areas should be protected with a sub base or other suitable materials or method if the second phase does not follow immediately after the first phase. A gentle gradient should be provided to facilitate run-off and temperas drainage measures adopted to ensure that water erosion does not occur.

5.2.4 Excavation of Service and Foundation Trenches

Service trenches will be excavated in all the soil types and possibly in the shale at depth, and foundation trenches will be excavated through the silty sands and the calcrete.

As discussed in Section 5.2.2, the calcrete would generally be classed as Intermediate Excavation Class, but it grades to Soft Excavation Class at depth where shelly soils will also be encountered. Excavation in the bedrock would probably be classed as margin Intermediate Excavation Class.

Two exceptions occur. Hard Excavation Class will be experienced in some occurrences of calcrete and in areas where the silcrete-like materials occur. Both these material types are locally pervasive, but they grade irregularly to more easily excavated ground.

In common with the excavation classification for the bulk excavations, the SABS classification for excavation in trenches should be superseded by a project-specific classification with two classes of restricted excavation:

- **Class A:** Material which can be excavated with a 30-tonne excavator equipped with a rock bucket

- **Class B:** Material which requires excavation with a monteberre type attachment or splitting or jack hammering or blasting

Without knowledge of the service and foundation trench layouts, it is not possible to quantify the volumes of the different types of restricted excavation.

5.2.5 Stability of Excavations

Although the hardpan calcrete generally will provide a stable upper part of the excavations, the calcretised sand below it is less stable. The following preliminary guidelines are therefore provided for batters for temporary excavations:

Depth of Cut	***Batter***
<1.25m	Vertical
1.25m -2m	1:0.25
2m - 3m	1:0.5
3m - 4m	1:0.75

Local flattening of the upper part of the excavations might also be required in the engineered sandy fill.

The stability of excavated slopes should be re-evaluated as the initial trenches are excavated and they should be routinely inspected and evaluated thereafter by a competent person and the batters modified, as relevant.

Excavation should immediately be stopped and labourers prevented from entering the trenches if groundwater is encountered. The guidelines should be reviewed and lateral support measures including flatter batters or sandbagging or propping may be required before labourers can re-enter the trenches.

All statutory requirements with regard to safety must be adopted in the excavations.

The permanent cut slopes will be excavated in the effectively cohesionless silty sands and in the calcrete. A batter of 1:0.5 for slopes up to 2m deep is considered appropriate. The slopes will be subject to wind and particularly water erosion and measures, such as vegetating the slope or constructing a permanent facing (block walls, vegetated racks etc), must be adopted to prevent this erosion.

Provision of surface channels above the cut slopes should be considered to ensure surface water does not flow onto the slopes.

5.3 Factors Affecting Founding Conditions

The following engineering properties of the soil profile will significantly influence founding conditions and therefore foundation layout:

- **The relative density of the existing fill:** This soil has not been formally placed or compacted and it will not provide acceptable founding for any footings.

- **The relative density of the silty sand:** Whereas the soil was commonly medium dense in the dry conditions at the time of the site investigations, it will loosen when very moist or saturated. It is generally thinly developed and therefore spread footings can and should be founded below it.

- **The relative density of the calcrete and calcretised sand:** The hardpan and gravelly forms of the calcrete are rock-like or very dense whereas the calcretised sand is dense to very dense and locally weakly cemented. They will therefore provide good founding conditions for spread footings.

- **The relative density of the shelly sand:** These soils occur at depth. They are thinly developed and dense and consolidation of these soils due to foundation loads will be minimal.

- **The rock mass properties of the shale bedrock:** The shale immediately below the transported soils is highly to moderately weathered and the rock is very soft to soft to locally medium hard. Consolidation of these rocks due to foundation loads will be minimal.

- **The occurrence of groundwater:** To date, perched groundwater has only been encountered locally at depth in the summer and it is unlikely to affect founding conditions or construction significantly. Local, shallow perched water might be encountered after rainfall and it might interfere with the construction.

5.4 Bearing Capacity

The bearing capacity of footings on the sandy fill and the calcrete/calcretised sand can be determined from the Buisman-Terzaghi equation and assuming conservative angles of friction of 30° and 33° respectively.

For square footings, the safe bearing pressure can be calculated from the following equations:

Qs = 169D + 39B - engineered sandy fill
Qs = 251D + 62B - calcrete/calcretised sand

Where Qs = safe bearing pressure (kPa)
D = founding depth below platform level (m)
B = width of the footing (m)

For strip footings, the safe bearing pressure can be calculated from the following formulae:

Qs = 107D + 65B - engineered sandy fill
Qs = 152D + 103B - calcrete/calcretised sand

The ultimate bearing pressure/bearing capacity is the value of bearing pressure at which the ground fails in shear. The safe bearing pressure is the intensity of applied pressure that the soil will safely support without risk of shear failure, irrespective of the magnitude of settlement of the footing. The safe bearing pressure is related to the ultimate bearing pressure or capacity by a load or safety factor. A Factor of Safety of 3 was used to derive the equations above.

The allowable bearing pressure is the allowed intensity of applied pressure taking into account both bearing capacity and settlement. The allowable bearing pressure can be equal to the safe bearing pressure, but it is generally less in order to minimise the settlement of footings.

It is recommended that the bearing pressure of square footings in the sandy fill should be limited to 150kPa and to 300kPa in the calcrete/calcretised sand. For strip footings, a bearing pressure of 125kPa and 200kPa could be considered in sandy fill and calcrete/calcretised sand respectively.

5.5 Settlement

Large footings will be constructed in the distribution centre building and the sizes could range from 1.5m to approximately 4m square. The larger sizes would be required as a part counter to uplift.

Settlements have been calculated using the following elastic moduli, which are based on the results of plate load tests or from textbook values:

Calcrete	24MPa
Calcretised sand	35MPa
Shelly sand	30MPa
Shale	100MPa

The actual footing sizes and founding depths are currently unknown, but for indicative purposes, if 1.5m and 4m square footings are considered with founding depths of 0.1m and 1.5m and a bearing pressure of 300kPa, the calculated immediate settlements are:

Footing Dimensions	***Founding Depth***	***Settlement***
1.5m x 1.5m	0.1m	8mm
1.5m x 1.5m	1.5m	4 mm
4m x 4m	0.1m	15mm
4m x 4m	1.5m	9mm

For strip footings, assuming founding depths of 0.1m and 1.5m, a width of 1m and 200kPa bearing pressure, the immediate settlements are:

Footing Dimensions	***Founding Depth***	***Settlement***
1m x 10m	0.1 m	6mm
1m x 10m	1.5 m	4mm

Founding at 0.1m depth is unlikely and the settlements are more likely to approximate those for a founding depth of 1.5m.

If lightly loaded footings are founded in sandy engineered fill, and fill thicknesses of 1.5m and 3m, a founding depth of 0.7m and a bearing pressure of 150kPa are considered, the immediate settlements are:

Footing Dimensions	***Fill Thickness***	***Settlement***
2m x 2m	1.5m	3mm
2m x 2m	3m	4mm

It is noted that all the above settlements are immediate settlements and will occur during construction and initial loading.

Settlements due to short-term, eccentric loading due to, for example, wind loading are difficult to estimate. A first approximation could be obtained by taking the increase in pressure due to the eccentric loading and the area subject to the loading and inputting this into an analysis. The additional settlement obtained in this manner is probably minimal because the loads are applied for only short periods.

5.6 Foundation Layout

Based on the assessments in Sections 5.3 to 5.5, a foundation layout comprising the following can be considered:

Foundation type: spread footings (pad or strip footings)

Founding depth: minimum generally 0.7m below platform level for lightly loaded structures founded in engineered fill on the distribution centre platform. For heavily loaded structures, footings should be founded at least 0.5m into calcrete below the engineered platform.

Bearing pressure: The bearing pressure should be limited to 150kPa for lightly loaded structures founded on fill on the platform, and to 300kPa for those foundations located in calcrete or calcretised sand

Reinforcement: reinforcement of strip footings for external walls should be considered, but reinforcement of footings for small, single-storey structures such as security rooms will not be routinely required. All square, column bases would obviously be reinforced.

The following should be noted:

- The founding depth should always be below any zone of influence of any subsurface service next to the footings. The '45° rule' should apply and local founding might have to be in deeper than 0.75m to satisfy this rule.

- The footings for the main distribution centre building will potentially have to be founded at depths varying up to approximately 4m below platform level in the area of the depression and up to 3m in other places. Either the bases and stub columns should be constructed before the bulk fill is placed or, more likely, deep local excavation through the platform will be required. Lateral support or safe batters would be required and the engineered fill around the constructed base and column would have to be reinstated after the bases and columns have been constructed.

- Excavation of small and even the larger bases will be difficult in places because of combinations of hard calcrete and the restricted working space and also the depth of excavation below the platform.

Consideration should be given to placing a soft joint between the columns and the surface bed.

5.7 Surface Beds

The surface beds will be constructed to high standards to carry the high rack loads in the new facility. The superflat surface beds will be constructed in 32.5m square panels and, based on the Engineer's requirements for the surface bed at the Brackenfell Distribution Centre, the subgrade should have a modulus of subgrade reaction of 65MPa/m.

5.7.1 Subgrade Conditions for the Surface Beds

The Consulting Civil Engineer has proposed the following the layerworks below the 200mm thick, concrete surface bed:

75mm sand make-up layer
150mm G4 sub base

The G4 sub base will be constructed on the sandy engineered fill which will probably range in thickness up 4m (in the circular depression) but generally approximately 1.5m to 2.5m.

5.7.2 Settlement of the Surface Bed below the Racks and the Aisle Areas

Settlement analyses were conducted using the layering below the surface bed and the elastic moduli summarised below:

Layer	***Thickness***	***E-value***
Surface bed	200mm	-
Sand make-up layer	75mm	40MPa
G4 layer	150mm	60MPa
Engineered sandy fill	150mm	40MPa
Silty sand	0.75m	30MPa
Calcrete	1m	24MPa

Based on the results of plate load testing at other DC facilities, the E-values are possibly conservative, particularly those for the G4 layer and the engineered fill.

The load per footing of the racks is taken as 10 tonnes and the load due to a single pallet resting on the surface bed is 11.8kN.

The analyses have indicated that the stresses due to the loads from rack footings are small at depths greater than 2.3m below the top of the surface bed.

There are four components to the settlement of the surface bed in filled areas. These comprise:

- settlement of the in-situ silty sand and calcareous materials due to the load of the fill
- settlement of/in the engineered fill itself
- settlement of the fill and the in-situ soil due to rack loads
- settlement of the fill and in-situ sand due to pallet loads

The results of the settlement analyses indicate the following settlements:

Settlement Component	***Thickness of Fill***		
	1m	2m	3m
Settlement of in-situ soil	1mm	1.5mm	2.5mm
Settlement of engineered fill	0.5mm	1.5mm	3.4mm
Settlement due to rack loads	0.8mm	1.2mm	1.4mm
Settlement due to pallets	0.1mm	0.05mm	0.05mm
Totals	2.4mm	4.25mm	7.35mm

It should be noted that the settlement of in-situ sand and the engineered fill will occur as immediate or elastic settlement and the surface beds would then only be subjected to settlement due to the rack and pallet loads.

5.7.3 Subgrade Reaction

Based on the results of plate load tests at other Distribution Centres, the moduli of subgrade reaction (Westergaard's k-value) of compacted sandy fill has always been greater than 65MPa/m and similar high values are expected from the engineered sandy fill at the Wells Estate site.

Plate load tests using large diameter plates (500mm or 750mm) must be conducted during construction to ensure that the threshold k-value is achieved.

5.8 Roads

The subgrade for roads will generally comprise engineered fill or in-situ silty sand or calcrete with a slight possibility that calcretised sand might be exposed in the cut areas in the northwestern parts of the site.

The results of CBR tests on samples of existing fill, silty sand, calcrete and calcretised sand are presented in Table 3.

TABLE 3: RESULTS OF CBR TESTS

Trial Pit	*Depth (m)*	*Soil Type*	*Natural mc*	*Mod A.A.S.H.T.O. Data*		*C.B.R. at*					*Maximum Swell (%)*
				M.D.D. (kg/m³)	O.M.C. (%)	100%	98%	95%	93%	90%	
TP23	0-0.6	Fill		2027	10.6	15	12	7	4	2	0
TP32	0-0.9			1885	12.0	36	33	30	13	1	0.2
Fill	-			1807	14.8	13	12	9	7	4	0.2
TP4	0-0.3	Silty sand		1991	9.9	54	46	36	22	11	0
TP5	0-0.25		7.5	1773	13.9	35	23	12	10	7	2.2
TP24	0-0.2			1864	11.8	28	22	15	8	2	1.1
TP5	0.25-1.25	Calcrete	10.6	1814	16.3	34	21	12	10	8	0
TP14	0.15-0.95		10.0	1741	18.8	34	28	20	17	16	0
TP20	0.3-1.0			1879	11.2	115	85	54	28	9	0
TP29	0.2-1.4			1917	12.3	113	98	80	46	12	0
TP10	1.8-2.75	Calc sand	5.8	1669	12.3	55	41	27	24	22	0
TP14	0.95-1.55		7.3	1848	13.9	48	40	29	28	27	0

The results of the tests indicate that the CBR of the fill at 93% of mod density ranges from 4 to 13 and, according to TRH 14, the fill is classed as G8, G9 and worse than G10 material.

The silty sand also has variable CBR's and is classed as G7, G10 and worse than G10 material.

The calcrete is classed as G6, G7 and G9 material and the calcretised sand as G6 and G7 material.

The natural moisture contents at the end of February were much less than the optimum moisture contents.

5.9 Use of On-site Materials for Backfill and Pipe Bedding

None of the soils on the site are ideally suited for backfill below surface beds in, say, single-storey structures and nor are they suitable for pipe bedding.

Materials for coarse layer works and for drainage measures must be imported.

5.10 Drainage

Shallow groundwater seepage is not expected and the systematic provision of sub surface drainage is not expected, particularly if the silty sands are removed from the road beds.

Drainage measures should be provided behind retaining walls and surface channels will also be required along the base of cut slopes.

It is possible that stormwater could flow as sheet flow onto the northwestern side of the site and provision should be made to create surface drains to prevent this.

6. CONCLUSIONS AND RECOMMENDATIONS

a) The natural soil profile at the site currently generally comprises combinations of silty sand overlying calcrete (hardpan or gravel), overlying calcareous sand, overlying shelly silty sand or clayey sand, which in turn overlies shale bedrock. Fill material (made ground) occurs in the northwestern, northeastern and southwestern corners of the site.

b) Groundwater was intersected at 3.1m depth in TP 22 and at 4.5m in TP 28 on 23 March and this water might occur because of the pit's proximity to the channel along the southeastern boundary. Seasonal perched water will probably be present, in places, at the contact between the surficial silty sand and the underlying calcrete, particularly in low areas such as the circular depression.

c) Site clearance and preparation will mainly include removal of the vegetation (indigenous vegetation and exotic scrub) and the dumped rubbish in the southwestern part of the site and probable removal or reworking of the calcareous fill in the northwestern part of the site. The organic rich surficial layer (±50mm but locally deeper) should also be removed.

d) Trafficability around the site may be difficult in winter and, if possible, civil construction should be programmed for summer. Failing which, pioneering material would have to be placed to facilitate the movement of construction vehicles around the site.

e) The soil materials to be excavated during the bulk earthworks programme will generally comprise the silty sand, calcrete and very minor quantities of calcretised sand. The SABS excavation classification of these materials is variable and difficult excavation conditions will occur due to the hardness of the calcrete and the shallow cut.

f) Excavation of foundation trenches for the small and even the larger bases will be difficult in places because of combinations of hard calcrete and the restricted working space and also the depth of excavation below the platform.

g) To facilitate measurement and to avoid disputes, project-specific excavation classes should be adopted for both bulk and restricted excavation.

h) None of the materials on the site are suitable for the high quality fill required below the surface beds, and sand should be imported for this purpose.

i) Consideration could be given to using the existing calcrete fill and/or the piles of fill in the northeastern areas and possibly the mixture of silty sand and calcrete excavated during bulk

earthworks for fill in marshalling yards and other areas. However, these materials will all be moisture-sensitive and their usage is weather dependent. Their use cannot be confirmed unless trial embankments are constructed to determine their workability and compactability and use of cement stabilisation could be considered during these field trials.

j) Foundations comprising spread footings (pad or strip footings) are appropriate for all structures. Lightly loaded structures, which are located on the platform, can be founded at a minimum depth of 0.7m with bearing pressures for square and strip footings should be limited to 125kPa and 150kPa respectively. Heavily loaded footings for the main building should be founded in the calcrete or calcretised sand and a maximum bearing pressure of 300kPa is applicable.

k) Analyses indicate that, for the KLS proposed layerworks comprising 75mm make-up sand and 150mm G4 material, the total settlement below racks rows will vary from approximately 2mm to 7mm depending on the thickness of the underlying engineered fill and that the settlement between the rack line and the aisles will be approximately 3mm.

l) Based on the results of recent plate load testing on sands elsewhere for DC warehouses, a subgrade reaction of 65MPa/m is considered achievable provided the bulk earthworks are well conducted and controlled.

m) Plate load tests using large diameter plates (500mm or 750mm) must be conducted during construction to ensure that the threshold k-value is achieved.

n) Systematic provision of subsurface drainage is not envisaged, but a surface drain should be provided along the northwestern side of the site to trap and control possible stormwater sheet wash from other higher parts of the site.

R.A. Bradshaw Pr.Sci.Nat.
R.A. BRADSHAW & ASSOCIATES cc

APPENDIX A

DESCRIPTION OF SOIL PROFILES IN TRIAL PITS
AND
RESULTS OF DCP TESTS

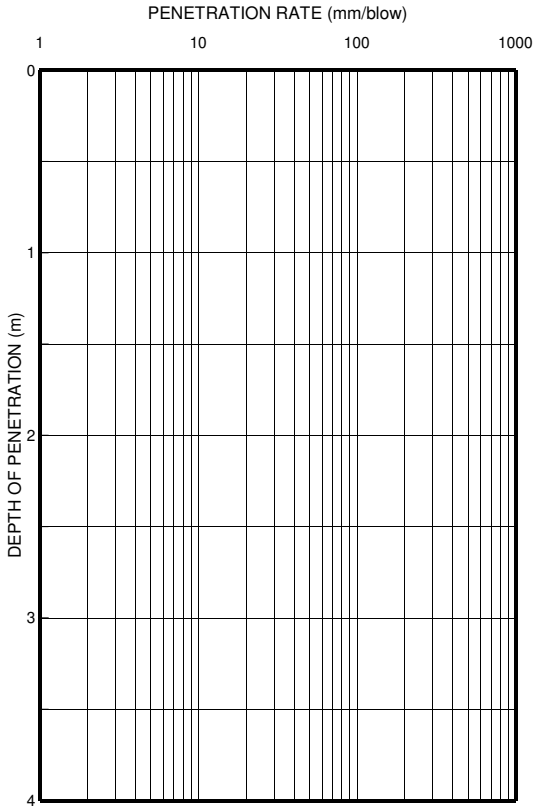
DYNAMIC CONE PENETRATION TEST AND SOIL PROFILE

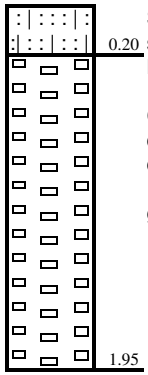
PROJECT: SHOPRITE WAREHOUSE, WELLS ESTATE **PROJECT NO:** 121211 **DATE :** 28/02/2011

TEST NO: **STARTING DEPTH:** **TRIAL PIT NO:** TP1 **METHOD OF INVESTIGATION :** Excavator

GPS COORDINATES: -57585Y, 3743502X

ELEVATION: 42.7m





SILTY SAND Dry, medium greyish brown, medium dense, shattered, silty fine sand with scattered, medium, medium hard calcrete gravel. Numerous roots. Aeolian.

CALCRETE Dry, creamy white and pale khaki, layered calcrete comprising medium hard hardpan calcrete to 0.7m then medium to coarse gravel-size calcrete in a very minor calcretised sand with lenses. Pedogenic. Scattered, very hard, medium, sub angular sandstone gravel throughout.

Note: Machine refused at 1.95m depth on hard calcrete gravel. Dense soils prevented DCP testing.

Sandy Materials:	Very loose	>75	**Clayey Materials:**	Very Soft	>110
(mm/blow)	Loose	30 - 75	(mm/blow)	Soft	55 - 110
	Medium Dense	12.5 - 30		Firm	30 - 55
	Dense	5 - 12.5		Stiff	15 - 30
	Very Dense	2 - 5		Very Stiff	7 - 15

O DISTURBED SAMPLE

[] UNDISTURBED SAMPLE

V WATER TABLE

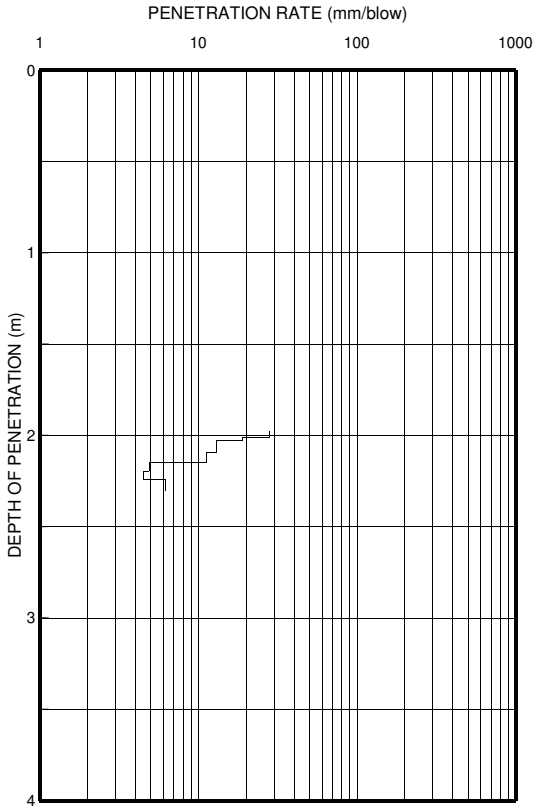
¥ PERCHED WATER TABLE

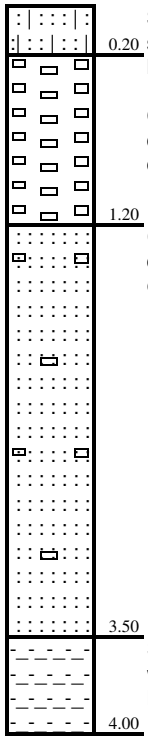
DYNAMIC CONE PENETRATION TEST AND SOIL PROFILE

PROJECT: SHOPRITE WAREHOUSE, WELLS ESTATE **PROJECT NO:** 121211 **DATE :** 28/02/2011

TEST NO: DCP2 **STARTING DEPTH:** In TP2 at 1.65m depth. **TRIAL PIT NO:** TP2 **METHOD OF INVESTIGATION :** Excavator

ELEVATION: 42.2m **GPS COORDINATES:** -57511Y, 3743596X





SILTY SAND Dry, medium greyish brown, medium dense, shattered, silty fine sand with scattered, medium, medium hard calcrete gravel. Numerous roots. Aeolian.

CALCRETE Dry, creamy white and pale khaki, layered calcrete comprising medium hard hardpan calcrete to 0.8m then medium to coarse gravel size calcrete in a very minor calcretised sand with lenses. Pedogenic.

CALCRETISED SAND Slightly moist, khaki, very dense, weakly layered, calcretised fine sand with scattered medium to coarse gravel-size calcrete and irregular lenses of gravelly calcrete. Pedogenic.

SHALE Khaki grey, stained orange brown, highly to locally moderately weathered, thinly, sub horizontally bedded, very soft to locally medium hard rock shale.

Note: Practical depth limit of machine.

Sandy Materials: (mm/blow)	Very loose	>75	**Clayey Materials:** (mm/blow)	Very Soft	>110
	Loose	30 - 75		Soft	55 - 110
	Medium Dense	12.5 - 30		Firm	30 - 55
	Dense	5 - 12.5		Stiff	15 - 30
	Very Dense	2 - 5		Very Stiff	7 - 15

O DISTURBED SAMPLE

[] UNDISTURBED SAMPLE

V WATER TABLE

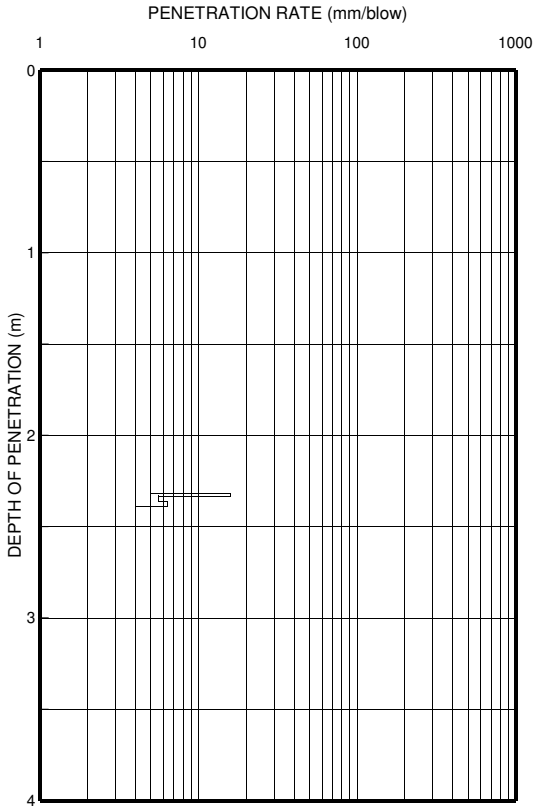
¥ PERCHED WATER TABLE

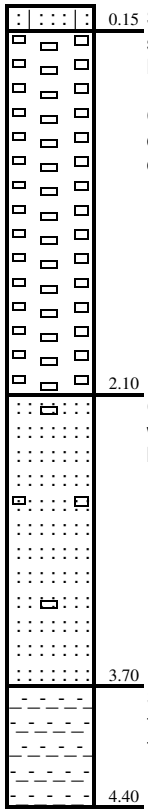
DYNAMIC CONE PENETRATION TEST AND SOIL PROFILE

PROJECT: SHOPRITE WAREHOUSE, WELLS ESTATE **PROJECT NO:** 121211 **DATE :** 28/02/2011

TEST NO: DCP3 **STARTING DEPTH:** In TP3 at 2.15m depth. **TRIAL PIT NO:** TP3 **METHOD OF INVESTIGATION :** Excavator

ELEVATION: 42.8m **GPS COORDINATES:** -57432Y, 3743698X





0.15 **SILTY SAND** Dry, medium greyish brown, medium dense, shattered, silty fine sand with scattered, medium, medium hard calcrete gravel. Numerous roots. Aeolian.

CALCRETE Dry, creamy white and pale khaki, layered calcrete comprising medium hard hardpan calcrete to 0.85m then medium to coarse gravel size calcrete in a very minor calcretised sand with lenses. Pedogenic.

2.10 **CALCRETISED SAND** Slightly moist, pale khaki, very dense, locally weakly layered, calcretised fine sand with scattered, medium, medium hard calcrete gravel and local lenses. Pedogenic.

3.70 **SHALE** Khaki grey and orange brown, highly to moderately weathered, thinly, sub horizontally bedded, closely to medium fractured, very soft to soft rock shale.

4.40

Note: Practical depth limit of machine.

Sandy Materials:	Very loose	>75	**Clayey Materials:**	Very Soft	>110
(mm/blow)	Loose	30 - 75	(mm/blow)	Soft	55 - 110
	Medium Dense	12.5 - 30		Firm	30 - 55
	Dense	5 - 12.5		Stiff	15 - 30
	Very Dense	2 - 5		Very Stiff	7 - 15

O DISTURBED SAMPLE

[] UNDISTURBED SAMPLE

V WATER TABLE

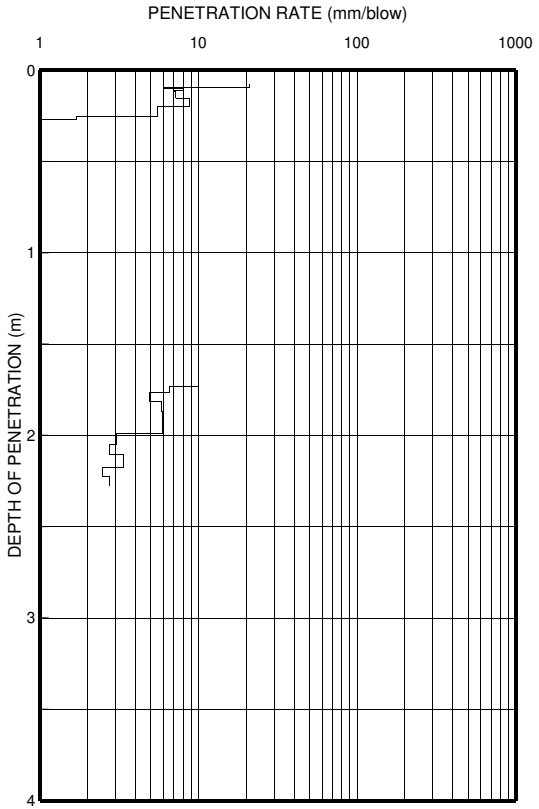
¥ PERCHED WATER TABLE

DYNAMIC CONE PENETRATION TEST AND SOIL PROFILE

PROJECT: SHOPRITE WAREHOUSE, WELLS ESTATE **PROJECT NO:** 121211 **DATE :** 28/02/2011

TEST NO: DCP4 **STARTING DEPTH:** Ground Surface and in TP4 at 1.6m depth. **TRIAL PIT NO:** TP4 **METHOD OF INVESTIGATION :** Excavator

ELEVATION: 41.95m **GPS COORDINATES:** -57369Y, 3743773X



O 0-0.3m — GRAVELLY SILTY SAND Dry, medium greyish brown, loose to medium dense, shattered, silty fine sand with scattered fine to medium, sub rounded, very hard sandstone gravel and scattered medium calcrete gravel. Marine (?) Numerous fine roots. (0.30)

CALCRETE Slightly moist, pale khaki, very dense to dense, weakly layered, calcrete comprising very soft rock hardpan grading downwards into calcretised sand with a variable quantity of very soft rock. (1.60)

O 1.6-3.3m — CALCRETISED SAND Slightly moist, pale khaki, very dense, locally weakly layered, calcretised fine sand with scattered, medium, medium hard calcrete gravel and local lenses. Pedogenic. (3.30)

O 3.3-3.9m — SHELLY SILTY SAND Slightly moist to moist, light orange brown, dense, layered, shelly silty fine sand with scattered, fine, sub rounded gravel. Marine. (3.90)

O 3.9-4.5m — SHALE Khaki grey and orange brown, highly to moderately weathered, thinly sub horizontally bedded, closely to medium fractured, very soft to soft rock shale. (4.50)

Note: Practical depth limit of machine.

Sandy Materials: (mm/blow)	Very loose	>75	**Clayey Materials:** (mm/blow)	Very Soft	>110
	Loose	30 - 75		Soft	55 - 110
	Medium Dense	12.5 - 30		Firm	30 - 55
	Dense	5 - 12.5		Stiff	15 - 30
	Very Dense	2 - 5		Very Stiff	7 - 15

O DISTURBED SAMPLE

[] UNDISTURBED SAMPLE

V WATER TABLE

¥ PERCHED WATER TABLE

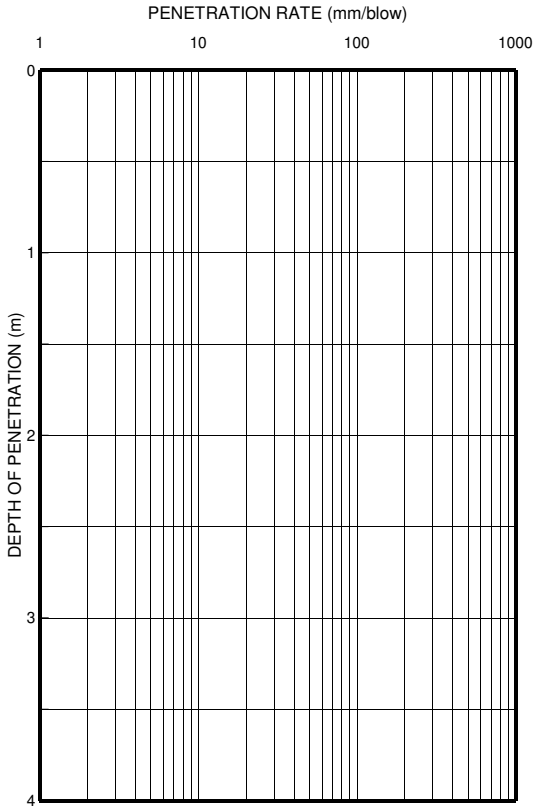
DYNAMIC CONE PENETRATION TEST AND SOIL PROFILE

PROJECT: SHOPRITE WAREHOUSE, WELLS ESTATE **PROJECT NO:** 121211 **DATE :** 28/02/2011

TEST NO: **STARTING DEPTH:** **TRIAL PIT NO:** TP5 **METHOD OF INVESTIGATION :** Excavator

GPS COORDINATES: -57268Y, 3743801X

ELEVATION: 42.80m



O 0-0.25m

GRAVELLY SILTY SAND Dry, medium greyish brown, loose to medium dense, shattered, silty fine sand with scattered fine to medium, sub rounded, very hard sandstone gravel. Marine (?) Numerous fine roots.

0.25

O 0.25-1.25m

CALCRETE Slightly moist, pale khaki, very dense to dense, weakly layered, calcrete comprising medium gravel size, very soft to soft calcrete gravel in a variable but minor matrix of calcretised sand. Pedogenic.

1.25

Note: Machine refused at 1.25m depth.
Dense soils prevented DCP testing.

Sandy Materials: (mm/blow)			**Clayey Materials:** (mm/blow)		
	Very loose	>75		Very Soft	>110
	Loose	30 - 75		Soft	55 - 110
	Medium Dense	12.5 - 30		Firm	30 - 55
	Dense	5 - 12.5		Stiff	15 - 30
	Very Dense	2 - 5		Very Stiff	7 - 15

O DISTURBED SAMPLE

[] UNDISTURBED SAMPLE

V WATER TABLE

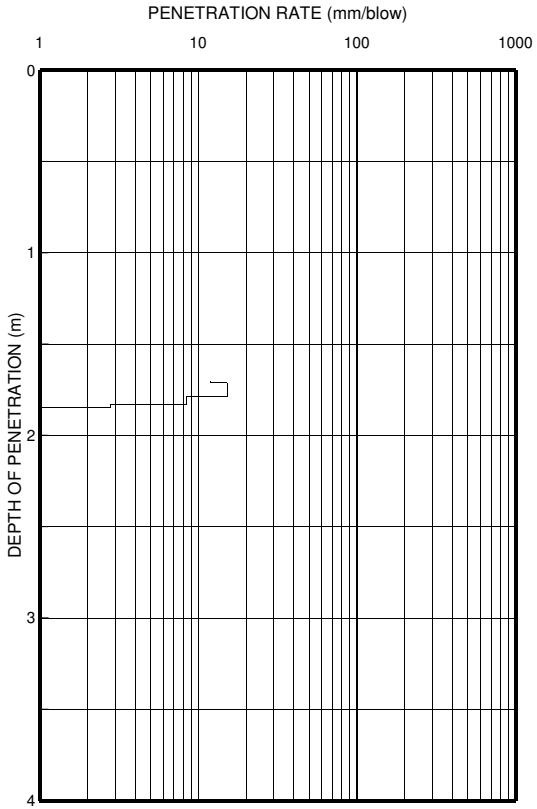
¥ PERCHED WATER TABLE

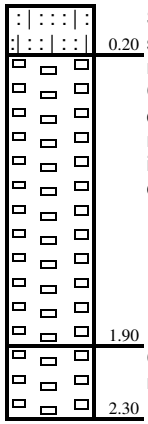
DYNAMIC CONE PENETRATION TEST AND SOIL PROFILE

PROJECT: SHOPRITE WAREHOUSE, WELLS ESTATE **PROJECT NO:** 121211 **DATE :** 28/02/2011

TEST NO: DCP6 **STARTING DEPTH:** In TP6 at 1.55m depth. **TRIAL PIT NO:** TP6 **METHOD OF INVESTIGATION :** Excavator

ELEVATION: 43.49m **GPS COORDINATES:** -57342Y, 3743706X





SILTY SAND Dry, medium greyish brown, medium dense, shattered, silty fine sand with scattered, coarse, calcrete gravel. Aeolian. Numerous roots.

CALCRETE Dry to slightly moist, creamy white and phale khaki, very dense, layered calcrete comprising layers (200mm) and lenses of medium hard hardpan calcrete and medium to coarse calcrete gravel in a minor calcretised sandy matrix. Local patches of predominantly calcretised sand. Pedogenic. Fine roots throughout.

CALCRETE Dry, creamy white, layered, medium hard, hardpan calcrete rock. Pedogenic.

Note: Machine refused at 2.3m depth.

Sandy Materials:	Very loose	>75	**Clayey Materials:**	Very Soft	>110
(mm/blow)	Loose	30 - 75	(mm/blow)	Soft	55 - 110
	Medium Dense	12.5 - 30		Firm	30 - 55
	Dense	5 - 12.5		Stiff	15 - 30
	Very Dense	2 - 5		Very Stiff	7 - 15

O DISTURBED SAMPLE

[] UNDISTURBED SAMPLE

V WATER TABLE

¥ PERCHED WATER TABLE

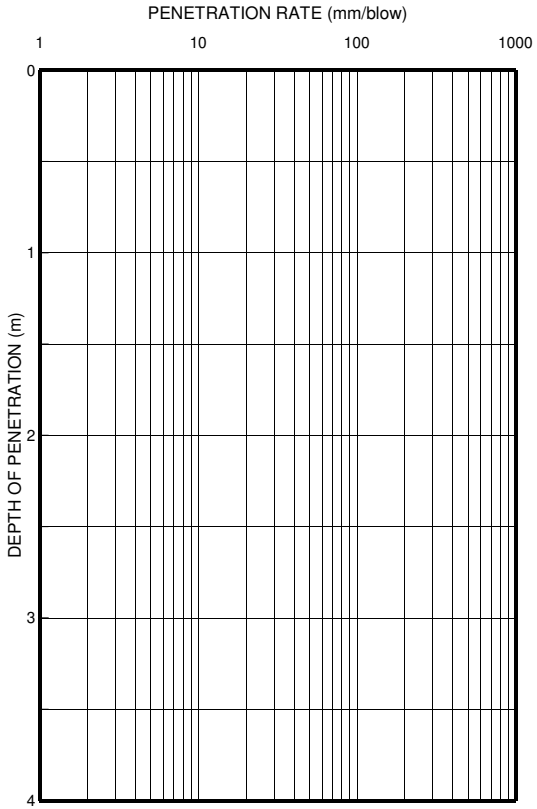
DYNAMIC CONE PENETRATION TEST AND SOIL PROFILE

PROJECT: SHOPRITE WAREHOUSE, WELLS ESTATE **PROJECT NO:** 121211 **DATE :** 28/02/2011

TEST NO: **STARTING DEPTH:** **TRIAL PIT NO:** TP7 **METHOD OF INVESTIGATION :** Excavator

GPS COORDINATES: -57427Y, 3743609X

ELEVATION: 43.75m



0.20 SILTY SAND Dry, medium greyish brown, medium dense, shattered, silty fine sand with scattered, coarse, calcrete gravel. Aeolian. Numerous roots.

CALCRETE Dry, creamy white and pale khaki, layered calcrete comprising medium hard hardpan calcrete to 0.8m then medium to coarse gravel size calcrete in a very minor calcretised sand with lenses. Pedogenic. Scattered, very hard, medium, sub angular sandstone gravel throughout.

2.80

2.90 CALCRETE Dry, creamy white, layered, medium hard, hardpan calcrete rock. Pedogenic.

Note: Machine refused at 2.9m depth.
Dense soils prevented DCP testing.

Sandy Materials:	Very loose	>75	**Clayey Materials:**	Very Soft	>110
(mm/blow)	Loose	30 - 75	(mm/blow)	Soft	55 - 110
	Medium Dense	12.5 - 30		Firm	30 - 55
	Dense	5 - 12.5		Stiff	15 - 30
	Very Dense	2 - 5		Very Stiff	7 - 15

O DISTURBED SAMPLE

[] UNDISTURBED SAMPLE

V WATER TABLE

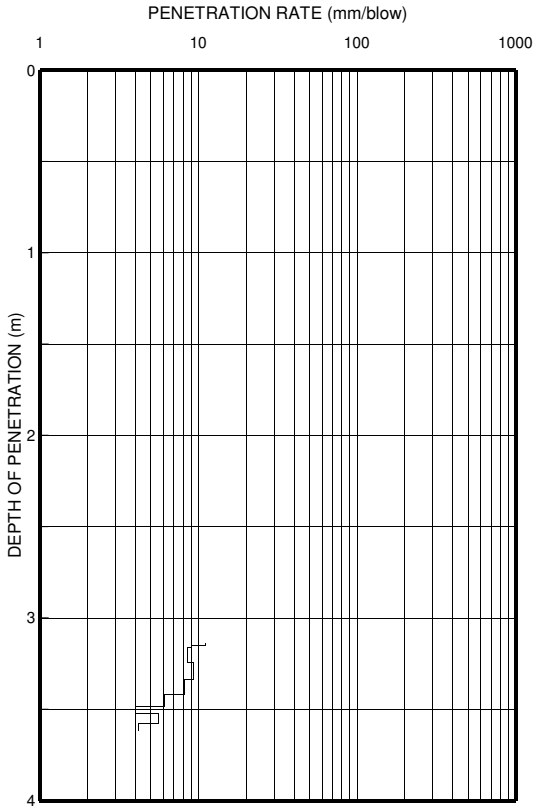
¥ PERCHED WATER TABLE

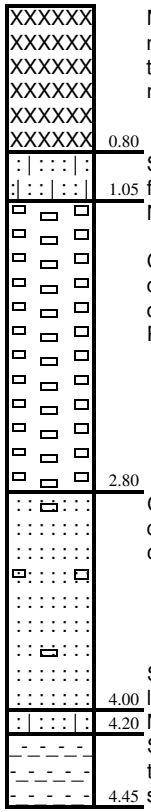
DYNAMIC CONE PENETRATION TEST AND SOIL PROFILE

PROJECT: SHOPRITE WAREHOUSE, WELLS ESTATE **PROJECT NO:** 121211 **DATE :** 28/02/2011

TEST NO: DCP8 **STARTING DEPTH:** In TP8 at 2.8m depth. **TRIAL PIT NO:** TP8 **METHOD OF INVESTIGATION :** Excavator

ELEVATION: 42.5m **GPS COORDINATES:** -57502Y, 3743504X





MADE GROUND Dry, reddish brown, loose, layered fill comprising medium to coarse, medium hard to hard calcrete gravel and scattered tabular boulders up to 1.6m maximum diameter in a calcareous silty sandy matrix.

0.80

SILTY SAND Dry, medium greyish brown, medium dense, shattered, silty fine sand with scattered, medium, medium hard calcrete gravel. Aeolian. Numerous roots.

1.05

CALCRETE Dry, creamy white and pale khaki, layered calcrete comprising medium hard hardpan calcrete to 1.8m then medium to coarse gravel size calcrete in a very minor calcretised sand with lenses. Pedogenic.

2.80

CALCRETISED SAND Slightly moist, khaki, dense, weakly layered, calcretised fine sand with scattered medium to coarse gravel-size calcrete and irregular lenses of gravelly calcrete. Pedogenic.

SHELLY SILTY SAND Slightly moist to moist, light orange brown, dense, layered, shelly silty fine sand with scattered, fine, sub rounded gravel.

4.00

4.20 Marine.

SHALE Khaki grey and orange brown, highly to moderately weathered, thinly sub horizontally bedded, closely to medium fractured, very soft to soft rock shale.

4.45

Note: Practical depth limit of machine.

Sandy Materials: (mm/blow)	Very loose	>75	**Clayey Materials:** (mm/blow)	Very Soft	>110
	Loose	30 - 75		Soft	55 - 110
	Medium Dense	12.5 - 30		Firm	30 - 55
	Dense	5 - 12.5		Stiff	15 - 30
	Very Dense	2 - 5		Very Stiff	7 - 15

O DISTURBED SAMPLE

[] UNDISTURBED SAMPLE

V WATER TABLE

¥ PERCHED WATER TABLE

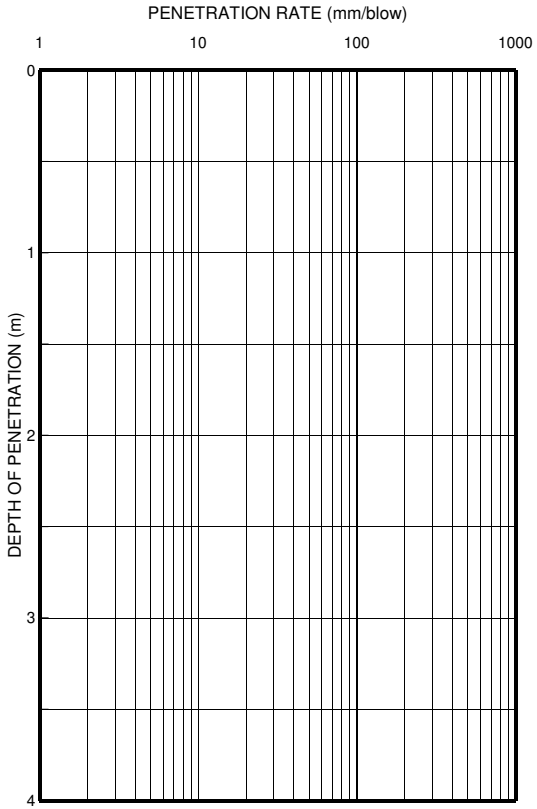
DYNAMIC CONE PENETRATION TEST AND SOIL PROFILE

PROJECT: SHOPRITE WAREHOUSE, WELLS ESTATE **PROJECT NO:** 121211 **DATE :** 28/02/2011

TEST NO: **STARTING DEPTH:** **TRIAL PIT NO:** TP9 **METHOD OF INVESTIGATION :** Excavator

GPS COORDINATES: -57563Y, 3743432X

ELEVATION: 42.8m



XXXXXX
XXXXXX
XXXXXX 0.45 MADE GROUND Dry to slightly moist, medium grey brown, loose, layered fill comprising 40% to 50% medium to coarse, medium hard to hard calcrete gravel in a calcareous silty sandy matrix.

0.80 CALCRETE Light grey, hard to very hard, hardpan calcrete.

Note: Machine refused at 0.8m depth.
Dense soils prevented DCP testing.

Sandy Materials:	Very loose	>75	**Clayey Materials:**	Very Soft	>110
(mm/blow)	Loose	30 - 75	(mm/blow)	Soft	55 - 110
	Medium Dense	12.5 - 30		Firm	30 - 55
	Dense	5 - 12.5		Stiff	15 - 30
	Very Dense	2 - 5		Very Stiff	7 - 15

O DISTURBED SAMPLE

[] UNDISTURBED SAMPLE

V WATER TABLE

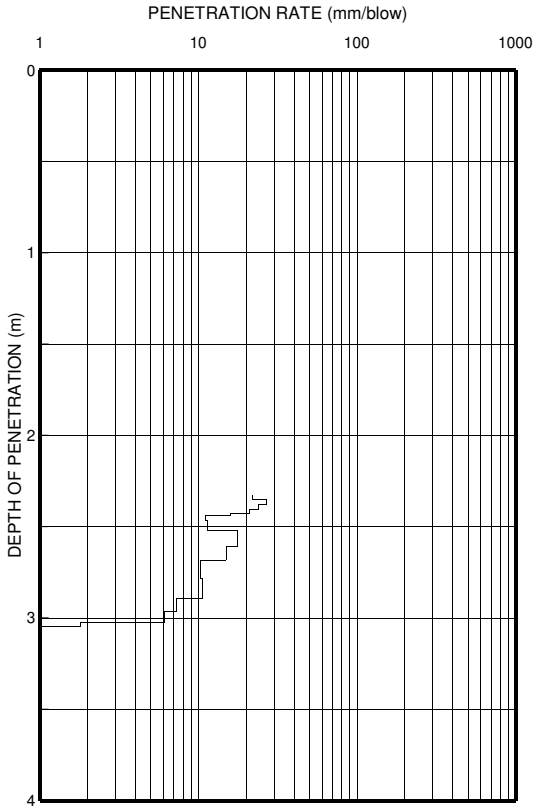
¥ PERCHED WATER TABLE

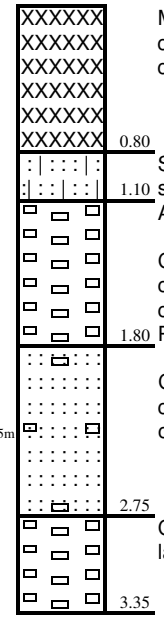
DYNAMIC CONE PENETRATION TEST AND SOIL PROFILE

PROJECT: SHOPRITE WAREHOUSE, WELLS ESTATE **PROJECT NO:** 121211 **DATE :** 28/02/2011

TEST NO: DCP10 **STARTING DEPTH:** In TP10 at 2.1m depth. **TRIAL PIT NO:** TP10 **METHOD OF INVESTIGATION :** Excavator

ELEVATION: 43.8m **GPS COORDINATES:** -57502Y, 3743386X





MADE GROUND Dry, medium greyish brown, loose, layered fill comprising mainly slightly clayey silty sand with minor medium and coarse, medium hard calcrete gravel.

SILTY SAND Dry, medium greyish brown, medium dense, shattered, silty fine sand with scattered, medium, medium hard calcrete gravel. Aeolian. Numerous roots.

CALCRETE Dry, creamy white and pale khaki, layered calcrete comprising medium hard hardpan calcrete to 1.6m then medium to coarse gravel size calcrete in a very minor calcretised sand with lenses. Pedogenic.

CALCRETISED SAND Slightly moist, khaki, very dense, weakly layered, calcretised fine sand with scattered medium to coarse gravel-size calcrete and irregular lenses of gravelly calcrete. Pedogenic.

CALCRETE Slightly moist, khaki, blotched orange brown, very dense, layered, hardpan calcrete. Pedogenic.

Note: Machine refused at 3.35m depth.

Sandy Materials: (mm/blow)	Very loose	>75	**Clayey Materials:** (mm/blow)	Very Soft	>110
	Loose	30 - 75		Soft	55 - 110
	Medium Dense	12.5 - 30		Firm	30 - 55
	Dense	5 - 12.5		Stiff	15 - 30
	Very Dense	2 - 5		Very Stiff	7 - 15

O DISTURBED SAMPLE

[] UNDISTURBED SAMPLE

V WATER TABLE

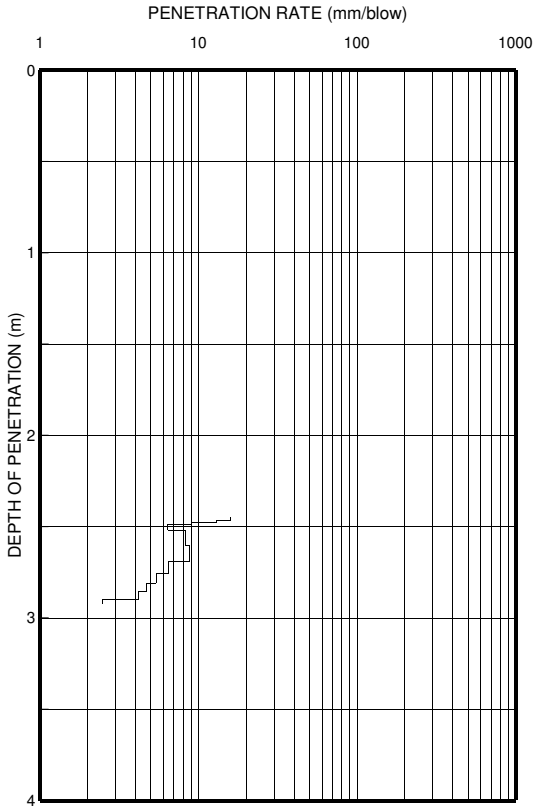
¥ PERCHED WATER TABLE

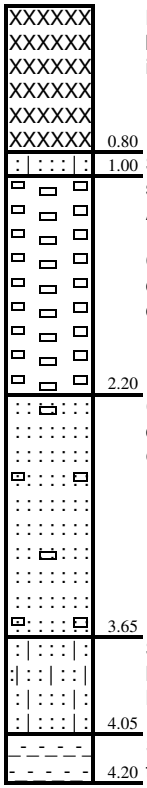
DYNAMIC CONE PENETRATION TEST AND SOIL PROFILE

PROJECT: SHOPRITE WAREHOUSE, WELLS ESTATE **PROJECT NO:** 121211 **DATE :** 28/02/2011

TEST NO: DCP11 **STARTING DEPTH:** In TP11 at 2.25m depth. **TRIAL PIT NO:** TP11 **METHOD OF INVESTIGATION :** Excavator

ELEVATION: 42.6m **GPS COORDINATES:** -57440Y, 3743454X





MADE GROUND Dry, creamy white and light greyish brown, loose, layered fill comprising fine to coarse, soft to medium hard calcrete gravel in a calcareous matrix.

0.80

1.00 SILTY SAND Dry, medium greyish brown, medium dense, shattered, silty fine sand with scattered, medium, medium hard calcrete gravel. Aeolian. Numerous roots.

CALCRETE Dry, creamy white and pale khaki, layered calcrete comprising medium hard hardpan calcrete to 1.8m then medium to coarse gravel size calcrete in a very minor calcretised sand with lenses. Pedogenic.

2.20

CALCRETISED SAND Slightly moist, khaki, dense, weakly layered, calcretised fine sand with scattered medium to coarse gravel-size calcrete and irregular lenses of gravelly calcrete. Pedogenic.

3.65

SHELLY SILTY SAND Slightly moist to moist, light orange brown, dense, layered, shelly silty fine sand with scattered, fine, sub rounded gravel. Marine.

4.05

4.20 SHALE Khaki grey and orange brown, highly to moderately weathered, thinly sub horizontally bedded, closely to medium fractured, very soft to soft rock shale.

Note: Practical depth limit of machine.

Sandy Materials: (mm/blow)	Very loose	>75	**Clayey Materials:** (mm/blow)	Very Soft	>110
	Loose	30 - 75		Soft	55 - 110
	Medium Dense	12.5 - 30		Firm	30 - 55
	Dense	5 - 12.5		Stiff	15 - 30
	Very Dense	2 - 5		Very Stiff	7 - 15

O DISTURBED SAMPLE

[] UNDISTURBED SAMPLE

V WATER TABLE

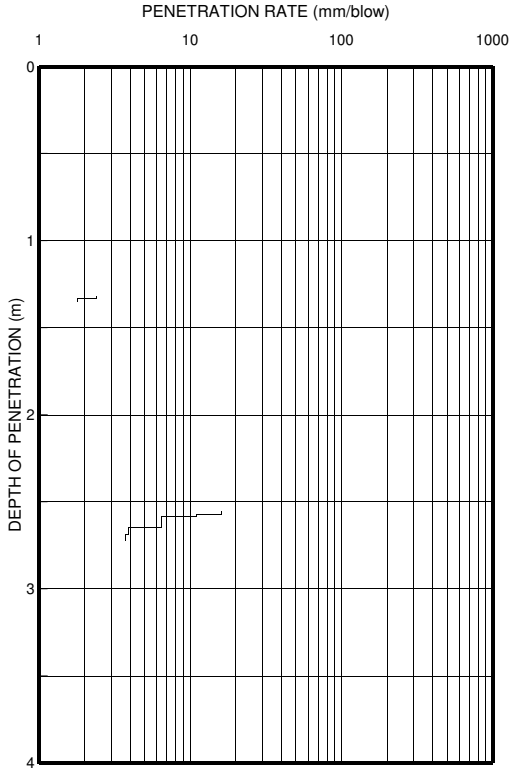
¥ PERCHED WATER TABLE

DYNAMIC CONE PENETRATION TEST AND SOIL PROFILE

PROJECT: SHOPRITE WAREHOUSE, WELLS ESTATE **PROJECT NO:** 121211 **DATE :** 28/02/2011

TEST NO: DCP12 **STARTING DEPTH:** In TP12 at 1.2m and 2.35m depth. **TRIAL PIT NO:** TP12 **METHOD OF INVESTIGATION :** Excavator

ELEVATION: 42.2m **GPS COORDINATES:** -57363Y, 3743562X



0.15	SILTY SAND Dry, medium greyish brown, loose, shattered, silty fine sand with scattered coarse calcrete gravel. Aeolian. Numerous roots.
1.15	CALCRETE Dry, creamy white and pale khaki, layered calcrete comprising medium hard hardpan calcrete to 0.8m then medium to coarse gravel size calcrete in a very minor calcretised sand with lenses. Pedogenic.
2.90	CALCRETISED SAND Slightly moist, pale khaki, very dense, locally weakly layered, calcretised fine sand with scattered, medium, medium hard calcrete gravel and local lenses. Pedogenic.
3.40	SHELLY SILTY SAND Slightly moist to moist, light orange brown, dense, layered, shelly silty fine sand with scattered, fine, sub rounded gravel. Marine.
4.20	SHALE Khaki grey, stained khaki, highly to moderately weathered, thinly bedded, soft to medium hard rock shale.

Note: Practical depth limit of machine.

Sandy Materials: (mm/blow)			**Clayey Materials:** (mm/blow)		
	Very loose	>75		Very Soft	>110
	Loose	30 - 75		Soft	55 - 110
	Medium Dense	12.5 - 30		Firm	30 - 55
	Dense	5 - 12.5		Stiff	15 - 30
	Very Dense	2 - 5		Very Stiff	7 - 15

O DISTURBED SAMPLE

[] UNDISTURBED SAMPLE

V WATER TABLE

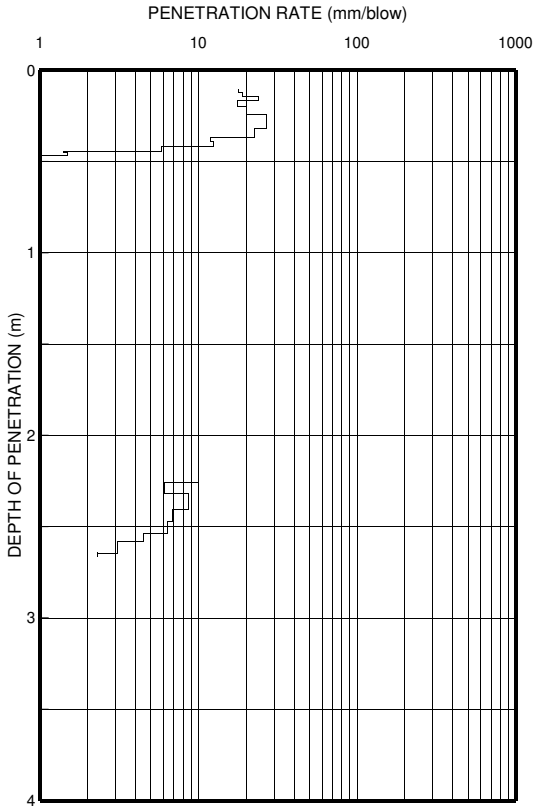
¥ PERCHED WATER TABLE

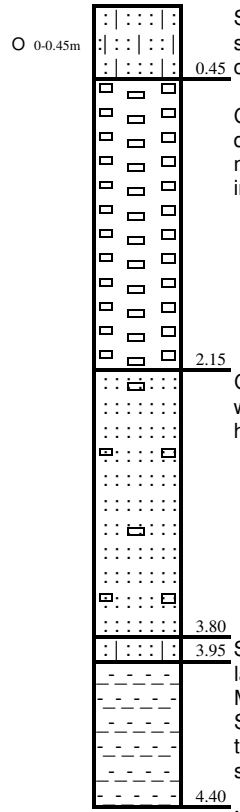
DYNAMIC CONE PENETRATION TEST AND SOIL PROFILE

PROJECT: SHOPRITE WAREHOUSE, WELLS ESTATE **PROJECT NO:** 121211 **DATE :** 28/02/2011

TEST NO: DCP13 **STARTING DEPTH:** Ground surface and in TP13 at 2.15m and 4.1m depth. **TRIAL PIT NO:** TP13 **METHOD OF INVESTIGATION :** Excavator

ELEVATION: 43.0m **GPS COORDINATES:** -57281Y, 3743661X





SILTY SAND Dry, medium orange brown, dense, intact to slightly shattered, silty fine sand. Aeolian. Fine roots throughout. Scattered coarse gravel at base.

CALCRETE Dry to slightly moist, creamy white and phale khaki, very dense, layered calcrete comprising layers (200mm) and lenses of medium hard hardpan calcrete and medium to coarse calcrete gravel in a minor calcretised sandy matrix. Pedogenic. Fine roots throughout.

CALCRETISED SAND Slightly moist, pale khaki, very dense, locally weakly layered, calcretised fine sand with scattered, medium, medium hard calcrete gravel. Pedogenic.

SHELLY SILTY SAND Slightly moist to moist, light orange brown, dense, layered, shelly silty fine sand with scattered, fine, sub rounded gravel. Marine.

SHALE Khaki grey and orange brown, highly to moderately weathered, thinly sub horizontally bedded, closely to medium fractured, very soft to soft rock shale.

Note: Practical depth limit of machine.

Sandy Materials:	Very loose	>75	**Clayey Materials:**	Very Soft	>110
(mm/blow)	Loose	30 - 75	(mm/blow)	Soft	55 - 110
	Medium Dense	12.5 - 30		Firm	30 - 55
	Dense	5 - 12.5		Stiff	15 - 30
	Very Dense	2 - 5		Very Stiff	7 - 15

O DISTURBED SAMPLE

[] UNDISTURBED SAMPLE

V WATER TABLE

¥ PERCHED WATER TABLE

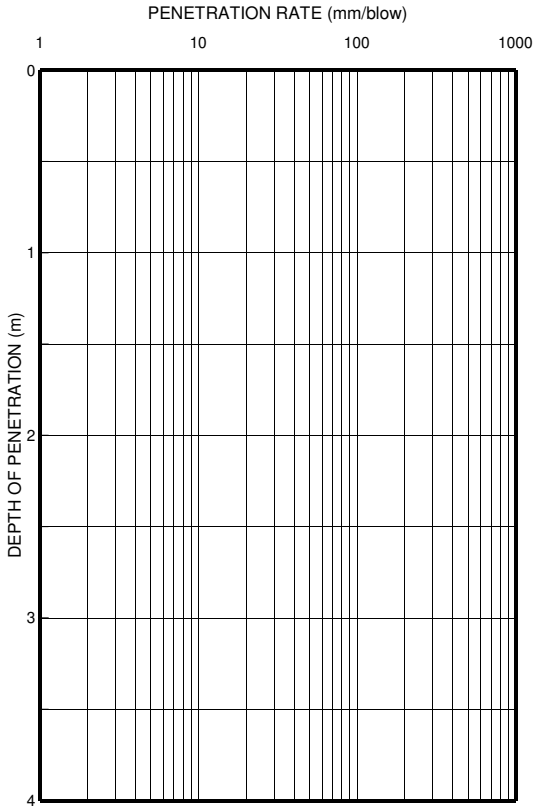
DYNAMIC CONE PENETRATION TEST AND SOIL PROFILE

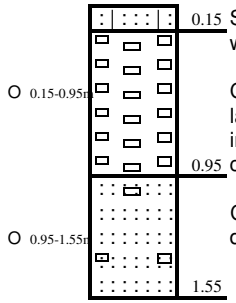
PROJECT: SHOPRITE WAREHOUSE, WELLS ESTATE **PROJECT NO:** 121211 **DATE :** 28/02/2011

TEST NO: **STARTING DEPTH:** **TRIAL PIT NO:** TP14 **METHOD OF INVESTIGATION :** Excavator

GPS COORDINATES: -57174Y, 3743722X

ELEVATION: 42.45m





0.15 SILTY SAND Dry, medium greyish brown, loose, shattered, silty fine sand with scattered coarse calcrete gravel. Aeolian. Numerous roots.

CALCRETE Slightly moist, pale khaki, very dense to dense, weakly layered, calcrete comprising very soft rock hardpan grading downwards into calcretised sand with a high but variable quantity of medium and coarse gravel-size calcrete. Pedogenic. 0.95

CALCRETISED SAND Slightly moist, pale khaki becoming slightly darker with depth, very dense, intact, calcretised fine sand. Pedogenic. 1.55

Note: Dense soils prevented DCP testing.

Sandy Materials:	Very loose	>75	**Clayey Materials:**	Very Soft	>110
(mm/blow)	Loose	30 - 75	(mm/blow)	Soft	55 - 110
	Medium Dense	12.5 - 30		Firm	30 - 55
	Dense	5 - 12.5		Stiff	15 - 30
	Very Dense	2 - 5		Very Stiff	7 - 15

O DISTURBED SAMPLE

[] UNDISTURBED SAMPLE

V WATER TABLE

¥ PERCHED WATER TABLE

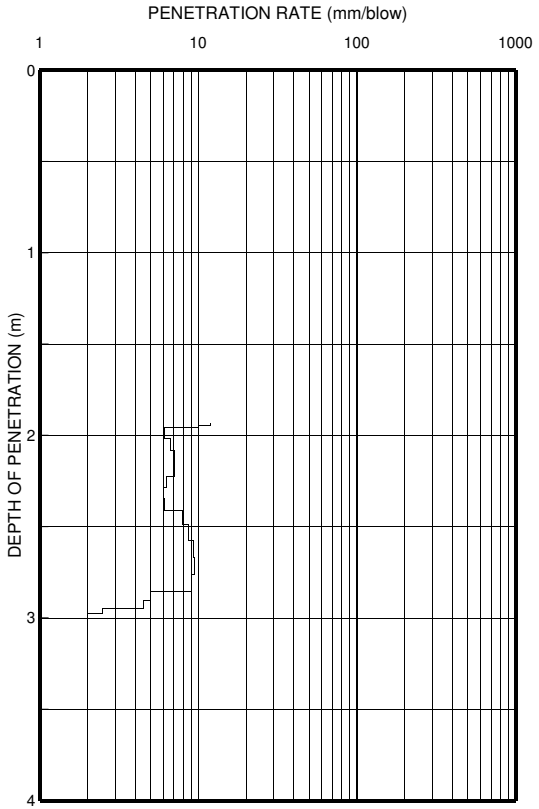
DYNAMIC CONE PENETRATION TEST AND SOIL PROFILE

PROJECT: SHOPRITE WAREHOUSE, WELLS ESTATE **PROJECT NO:** 121211 **DATE :** 28/02/2011

TEST NO: DCP15 **STARTING DEPTH:** In TP15 at 1.8m depth. **TRIAL PIT NO:** TP15 **METHOD OF INVESTIGATION :** Excavator

GPS COORDINATES: -57206Y, 3743650X

ELEVATION: 43.6m



0.20	SILTY SAND Dry, medium greyish brown, loose, shattered, silty fine sand with scattered coarse calcrete gravel. Aeolian. Numerous roots.	
	CALCRETE Dry, creamy white and pale khaki, layered calcrete comprising medium hard hardpan calcrete to 0.7m then medium to coarse gravel-size calcrete in a very minor calcretised sand with lenses.	
1.00	Pedogenic.	
	CALCRETISED SAND Slightly moist, pale khaki, dense, locally weakly layered, calcretised fine sand with scattered, medium, medium hard calcrete gravel. Pedogenic.	
3.30		
	SHELLY SILTY SAND Slightly moist to moist, light orange brown, dense, layered, shelly silty fine sand with scattered, fine, sub rounded gravel. Marine.	
4.00		
	SHALE Khaki grey and orange brown, highly to moderately weathered, thinly sub horizontally bedded, closely to medium fractured, very soft to	
4.20	soft rock shale.	

Note: Hardpan calcrete very difficult to excavate.
Practical depth limit of machine.

Sandy Materials:	Very loose	>75	**Clayey Materials:**	Very Soft	>110
(mm/blow)	Loose	30 - 75	(mm/blow)	Soft	55 - 110
	Medium Dense	12.5 - 30		Firm	30 - 55
	Dense	5 - 12.5		Stiff	15 - 30
	Very Dense	2 - 5		Very Stiff	7 - 15

O DISTURBED SAMPLE

[] UNDISTURBED SAMPLE

V WATER TABLE

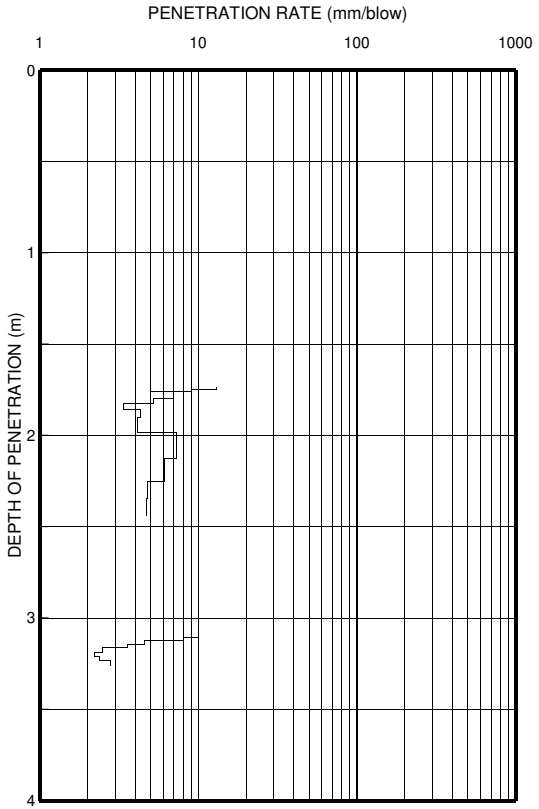
¥ PERCHED WATER TABLE

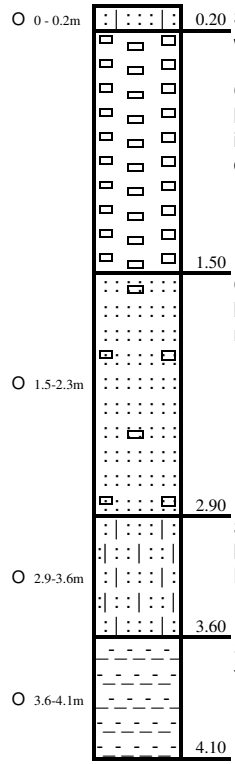
DYNAMIC CONE PENETRATION TEST AND SOIL PROFILE

PROJECT: SHOPRITE WAREHOUSE, WELLS ESTATE **PROJECT NO:** 121211 **DATE :** 28/02/2011

TEST NO: DCP16 **STARTING DEPTH:** In TP16 at 1.6m and 3m depth. **TRIAL PIT NO:** TP16 **METHOD OF INVESTIGATION :** Excavator

ELEVATION: 42.9m **GPS COORDINATES:** -57269Y, 3743567X





SILTY SAND Dry, medium greyish brown, loose, shattered, silty fine sand with scattered coarse calcrete gravel. Aeolian. Numerous roots.

CALCRETE Slightly moist, pale khaki, very dense to dense, weakly layered, calcrete comprising very soft rock hardpan grading downwards into calcretised sand with a high but variable quantity of medium and coarse gravel-size calcrete. Pedogenic.

CALCRETISED SAND Slightly moist, pale khaki, dense to very dense, locally weakly layered, calcretised fine sand with scattered, medium, medium hard calcrete gravel. Pedogenic.

SHELLY SILTY SAND Slightly moist to moist, light orange brown, dense, layered, shelly silty fine sand with scattered, fine, sub rounded gravel. Marine.

SHALE Khaki grey, stained khaki, highly to moderately weathered, thinly bedded, soft to medium hard rock shale.

Note: Machine refused at 4.1m depth.

Sandy Materials:	Very loose	>75	**Clayey Materials:**	Very Soft	>110
(mm/blow)	Loose	30 - 75	(mm/blow)	Soft	55 - 110
	Medium Dense	12.5 - 30		Firm	30 - 55
	Dense	5 - 12.5		Stiff	15 - 30
	Very Dense	2 - 5		Very Stiff	7 - 15

O DISTURBED SAMPLE

[] UNDISTURBED SAMPLE

V WATER TABLE

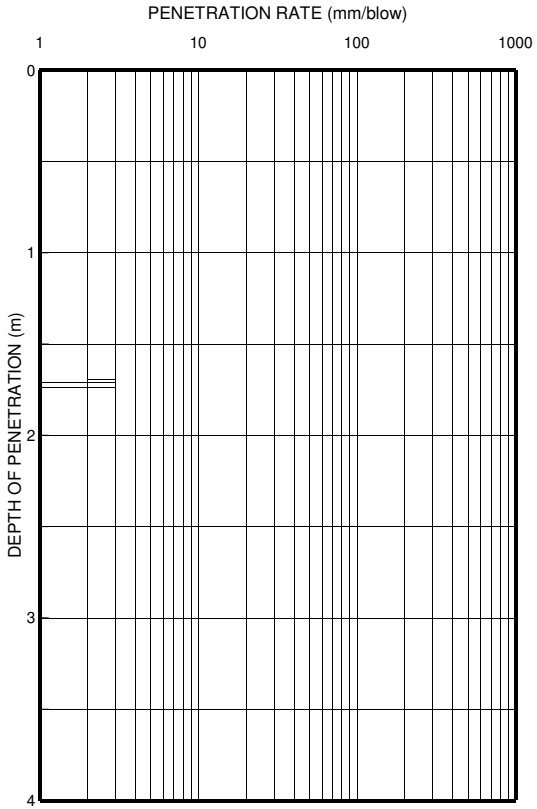
¥ PERCHED WATER TABLE

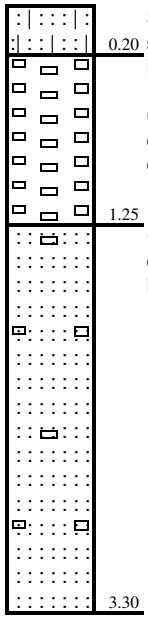
DYNAMIC CONE PENETRATION TEST AND SOIL PROFILE

PROJECT: SHOPRITE WAREHOUSE, WELLS ESTATE **PROJECT NO:** 121211 **DATE :** 28/02/2011

TEST NO: DCP17 **STARTING DEPTH:** In TP17 at 1.6m depth. **TRIAL PIT NO:** TP17 **METHOD OF INVESTIGATION :** Excavator

ELEVATION: 42.6m **GPS COORDINATES:** -57357Y, 3743462X





SILTY SAND Dry, medium greyish brown, medium dense, shattered, silty fine sand with scattered, medium, medium hard calcrete gravel. Aeolia Numerous roots.

CALCRETE Dry, creamy white and pale khaki, layered calcrete comprising medium hard hardpan calcrete to 0.6m then medium to coarse gravel size calcrete in a very minor calcretised sand with lenses. Pedogenic.

CALCRETISED SAND Slightly moist, khaki, very dense, layered, calcretised sand with numerous medium to coarse gravel-size medium hard to hard calcrete and irregular discontinuous lenses of calcrete.

Note: Machine refused at 3.3m depth.

Sandy Materials: (mm/blow)	Very loose	>75	**Clayey Materials:** (mm/blow)	Very Soft	>110
	Loose	30 - 75		Soft	55 - 110
	Medium Dense	12.5 - 30		Firm	30 - 55
	Dense	5 - 12.5		Stiff	15 - 30
	Very Dense	2 - 5		Very Stiff	7 - 15

O DISTURBED SAMPLE

[] UNDISTURBED SAMPLE

V WATER TABLE

¥ PERCHED WATER TABLE

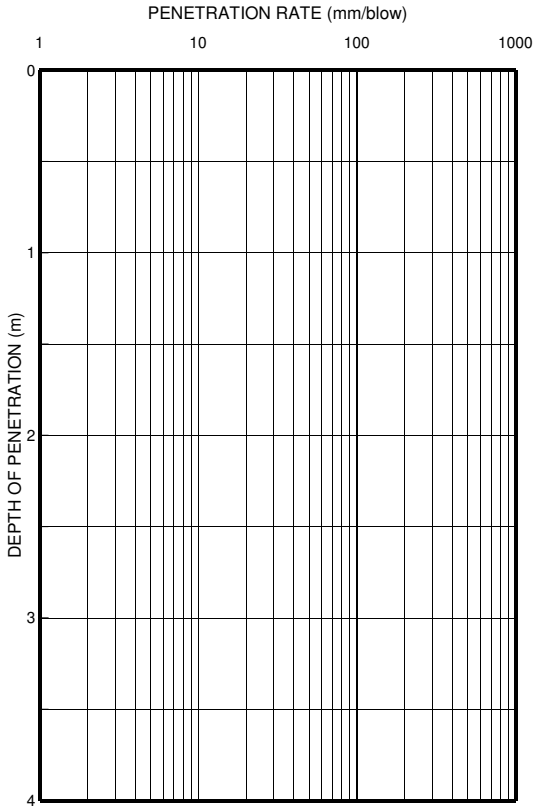
DYNAMIC CONE PENETRATION TEST AND SOIL PROFILE

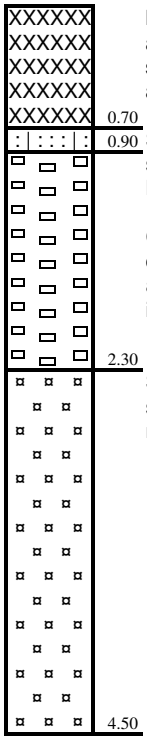
PROJECT: SHOPRITE WAREHOUSE, WELLS ESTATE **PROJECT NO:** 121211 **DATE :** 28/02/2011

TEST NO: **STARTING DEPTH:** **TRIAL PIT NO:** TP18 **METHOD OF INVESTIGATION :** Excavator

GPS COORDINATES: -57438Y, 3743363X

ELEVATION: 44.15m





0.70 MADE GROUND Dry, light greyish brown, loose, layered fill comprising approximately 60% medium to coarse, medium hard calcrete gravel with scattered boulder-size (600mm) calcrete fragments in a slightly clayey and calcareous silty sandy matrix.

0.90 SILTY SAND Dry, medium greyish brown, loose, shattered, silty fine sand with scattered, medium, medium hard calcrete gravel. Aeolian. Numerous roots.

CALCRETE Dry, creamy white and pale khaki, very dense, layered calcrete comprising medium hard hardpan calcrete to 1.7m depth then a high proportion of soft to medium hard, medium calcrete gravel and irregular thin lenses of calcrete in a calcretised sandy matrix. Pedogenic.

2.30 SILCRETE (?) Dry, khaki brown and grey, layered, very dense silcrete-like material comprising cemented sandstone? or silcrete with numerous, very small voids. Origin uncertain.

4.50

Note: Machine excavated calcrete and silcrete (?) very slowly.
Practical depth limit of machine.
Dense soils prevented DCP testing.

Sandy Materials:	Very loose	>75	**Clayey Materials:**	Very Soft	>110
(mm/blow)	Loose	30 - 75	(mm/blow)	Soft	55 - 110
	Medium Dense	12.5 - 30		Firm	30 - 55
	Dense	5 - 12.5		Stiff	15 - 30
	Very Dense	2 - 5		Very Stiff	7 - 15

O DISTURBED SAMPLE

[] UNDISTURBED SAMPLE

V WATER TABLE

¥ PERCHED WATER TABLE

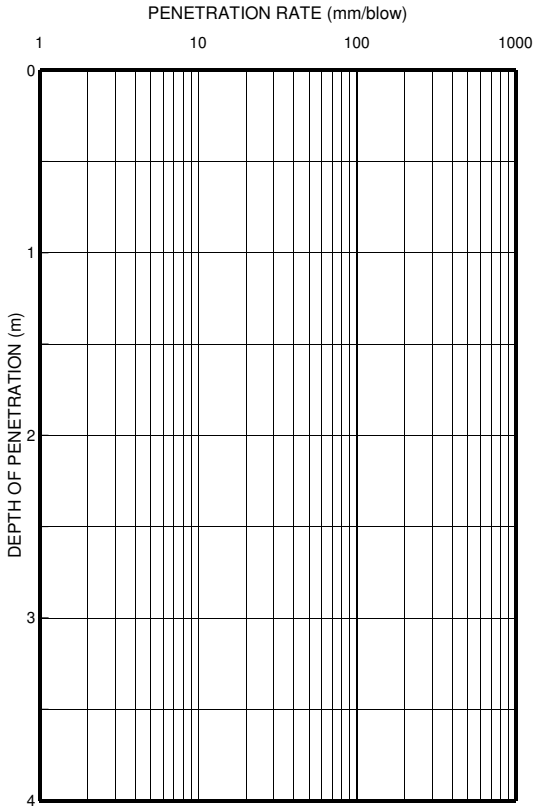
DYNAMIC CONE PENETRATION TEST AND SOIL PROFILE

PROJECT: SHOPRITE WAREHOUSE, WELLS ESTATE **PROJECT NO:** 121211 **DATE :** 28/02/2011

TEST NO: **STARTING DEPTH:** **TRIAL PIT NO:** TP19 **METHOD OF INVESTIGATION :** Excavator

GPS COORDINATES: -57423Y, 3743304X

ELEVATION: 43.80m



XXXXXX XXXXXX XXXXXX XXXXXX XXXXXX 0.60	MADE GROUND Dry, light greyish brown, loose, layered fill comprising approximately 60% medium to coarse, medium hard calcrete gravel in a slightly clayey and calcareous silty sandy matrix.
: o :|: o : :|: : o: |: : : o :|: o : :|: : o: |: : : o :|: o : 1.30	GRAVELLY SILTY SAND Slightly moist, dark greyish brown and orange brown, medium dense to dense, layered, slightly clayey, silty fine sand with scattered medium calcrete gravel. Scattered roots. Topsoil.
: | : : : | : :| : : | : : | : | : : : | : :| : : | : : | 1.85	SILTY SAND Moist, dark orange brown, dense, layered, very slightly clayey, silty fine to medium sand. Marine (?)

Note: Calcrete probably below 1.85m depth.
Slight organic odour from pit.
Dense gravelly soils prevented DCP testing.

Sandy Materials:	Very loose	>75	**Clayey Materials:**	Very Soft	>110
(mm/blow)	Loose	30 - 75	(mm/blow)	Soft	55 - 110
	Medium Dense	12.5 - 30		Firm	30 - 55
	Dense	5 - 12.5		Stiff	15 - 30
	Very Dense	2 - 5		Very Stiff	7 - 15

O DISTURBED SAMPLE

[] UNDISTURBED SAMPLE

V WATER TABLE

¥ PERCHED WATER TABLE

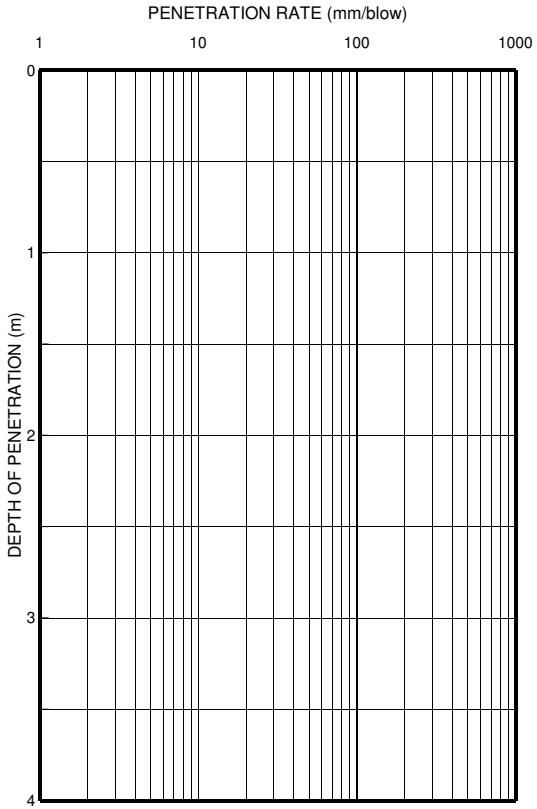
DYNAMIC CONE PENETRATION TEST AND SOIL PROFILE

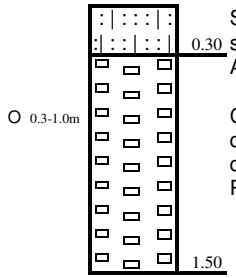
PROJECT: SHOPRITE WAREHOUSE, WELLS ESTATE **PROJECT NO:** 121211 **DATE :** 28/02/2011

TEST NO: **STARTING DEPTH:** **TRIAL PIT NO:** TP20 **METHOD OF INVESTIGATION :** Excavator

GPS COORDINATES: -57300Y, 3743459X

ELEVATION: 42.4m





O 0.3-1.0m

SILTY SAND Dry, medium greyish brown, medium dense, shattered, silty fine sand with scattered, medium, medium hard calcrete gravel. Aeolian. Numerous roots.

CALCRETE Dry, creamy white and pale khaki, layered calcrete comprising medium hard hardpan calcrete to 0.8m then medium to coarse gravel size calcrete in a very minor calcretised sand with lenses. Pedogenic.

Note: Dense soils prevented DCP testing.

Sandy Materials:	Very loose	>75	**Clayey Materials:**	Very Soft	>110
(mm/blow)	Loose	30 - 75	(mm/blow)	Soft	55 - 110
	Medium Dense	12.5 - 30		Firm	30 - 55
	Dense	5 - 12.5		Stiff	15 - 30
	Very Dense	2 - 5		Very Stiff	7 - 15

O DISTURBED SAMPLE

[] UNDISTURBED SAMPLE

V WATER TABLE

¥ PERCHED WATER TABLE

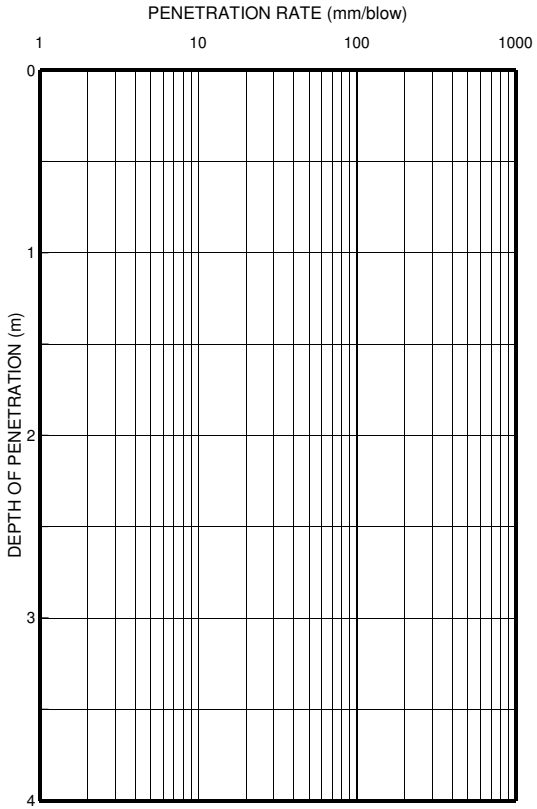
DYNAMIC CONE PENETRATION TEST AND SOIL PROFILE

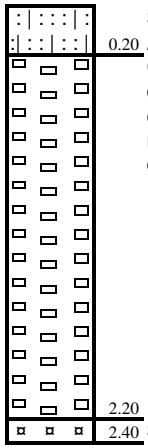
PROJECT: SHOPRITE WAREHOUSE, WELLS ESTATE **PROJECT NO:** 121211 **DATE :** 23/03/2011

TEST NO: **STARTING DEPTH:** **TRIAL PIT NO:** TP21 **METHOD OF INVESTIGATION :** Excavator

GPS CO-ORDINATES: -57655Y; 3743559X

ELEVATION:





0.20 SILTY SAND Dry, medium greyish brown, loose, shattered, fine silty sand Aeolian. Numerous roots.

CALCRETE Dry, creamy white and pale khaki, layered calcrete comprising medium hard hardpan calcrete with layers and lenses of of medium to coarse gravel-size calcrete in a minor calcretised sand matrix to 1.7m then medium to coarse calcrete gravel in a very minor calcretised sand matrix . Pedogenic

2.20

2.40 SILCRETE (?) Dry, khaki brown and grey, very dense, layered silcrete-like material comprising cemented sandstone? or silcrete with numerous, very small voids. Origin uncertain.

Note: Machine refused at 2.4m depth.

Sandy Materials:	Very loose	>75	**Clayey Materials:**	Very Soft	>110
(mm/blow)	Loose	30 - 75	(mm/blow)	Soft	55 - 110
	Medium Dense	12.5 - 30		Firm	30 - 55
	Dense	5 - 12.5		Stiff	15 - 30
	Very Dense	2 - 5		Very Stiff	7 - 15

O DISTURBED SAMPLE

[] UNDISTURBED SAMPLE

V WATER TABLE

¥ PERCHED WATER TABLE

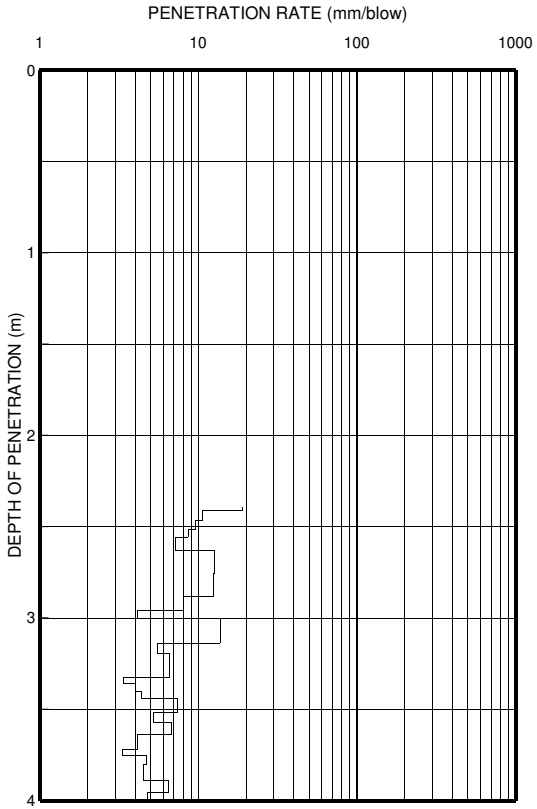
DYNAMIC CONE PENETRATION TEST AND SOIL PROFILE

PROJECT: SHOPRITE WAREHOUSE, WELLS ESTATE **PROJECT NO:** 121211 **DATE :** 23/03/2011

TEST NO: DCP22 **STARTING DEPTH:** In TP22 at 2.1m depth **TRIAL PIT NO:** TP22 **METHOD OF INVESTIGATION :** Excavator

GPS CO-ORDINATES: -57741Y; 3743628X

ELEVATION:



	SILTY SAND Dry, medium greyish brown, loose, shattered, fine silty sand with scattered, medium, medium hard calcrete gravel. Aeolian. Numerous roots.	0.20			
	CALCRETE Dry, creamy white and pale khaki, layered calcrete comprising medium hard hardpan calcrete to 1.2m then medium to coarse gravel size calcrete in a very minor calcretised sand with lenses. Pedogenic.	1.90			
	CALCRETISED SAND Slightly moist, khaki, dense to very dense, weakly layered, calcretised fine sand with scattered, medium, medium hard calcrete gravel and local lenses. Pedogenic.	2.90			
¥ 3.1m	CLAYEY SAND Moist, greyish khaki, very stiff, layered, clayey fine to medium sand with weakly cemented patches. Marine/pedogenic.	3.70			
	SILCRETE (?) Moist, khaki brown and grey, very dense, layered silcrete-like material comprising cemented sandstone? or silcrete with numerous, very small voids. Origin uncertain.	4.20			

Sandy Materials:	Very loose	>75	**Clayey Materials:**	Very Soft	>110
(mm/blow)	Loose	30 - 75	(mm/blow)	Soft	55 - 110
	Medium Dense	12.5 - 30		Firm	30 - 55
	Dense	5 - 12.5		Stiff	15 - 30
	Very Dense	2 - 5		Very Stiff	7 - 15

O	DISTURBED SAMPLE	V	WATER TABLE
[]	UNDISTURBED SAMPLE	¥	PERCHED WATER TABLE

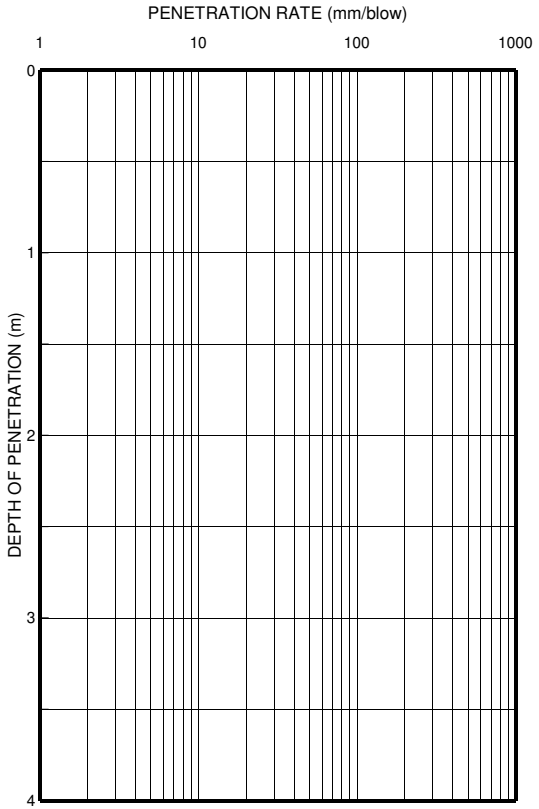
DYNAMIC CONE PENETRATION TEST AND SOIL PROFILE

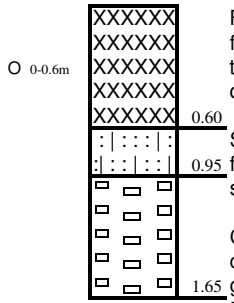
PROJECT: SHOPRITE WAREHOUSE, WELLS ESTATE **PROJECT NO:** 121211 **DATE :** 23/03/2011

TEST NO: **STARTING DEPTH:** **TRIAL PIT NO:** TP23 **METHOD OF INVESTIGATION :** Excavator

GPS CO-ORDINATES: -57756Y; 3743668X

ELEVATION:





FILL Dry to slightly moist, khaki and white, loose to medium dense, layered fill comprising slightly calcareous, silty fine sand with up to 60% medium to coarse gravel size calcrete and tabular blocks up to 500mm maximum dimension. Roots to 0.2m

SILTY SAND Slightly moist, dark brownish grey, medium dense, slightly fissured, slightly organic, silty fine sand with scattered, medium, sub rounded sandstone gravel and fine roots. Aeolian.

CALCRETE Dry, creamy white and pale khaki, layered calcrete comprising medium hard hardpan calcrete to 1.4m then medium to coarse gravel size calcrete in a very minor calcretised sand with lenses. Pedogenic.

Note: Presence of blocky fill and dense gravel prevented DCP testing.

Sandy Materials:	Very loose	>75	**Clayey Materials:**	Very Soft	>110
(mm/blow)	Loose	30 - 75	(mm/blow)	Soft	55 - 110
	Medium Dense	12.5 - 30		Firm	30 - 55
	Dense	5 - 12.5		Stiff	15 - 30
	Very Dense	2 - 5		Very Stiff	7 - 15

O DISTURBED SAMPLE

[] UNDISTURBED SAMPLE

V WATER TABLE

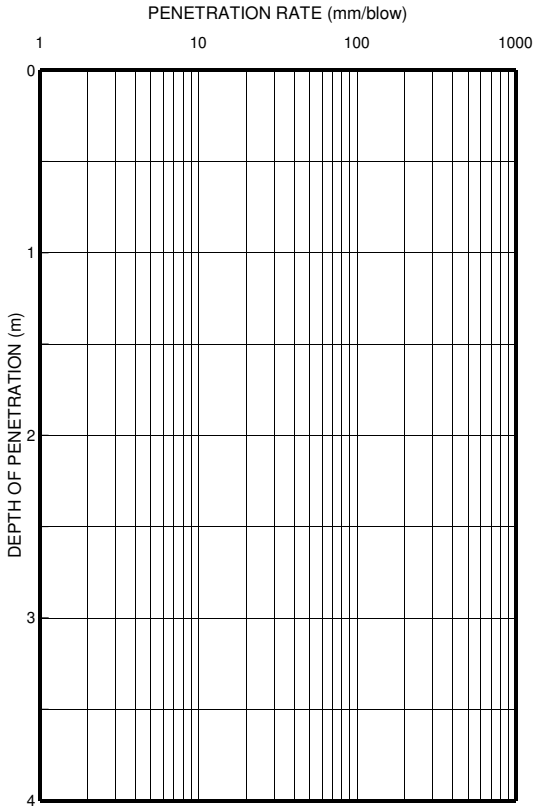
¥ PERCHED WATER TABLE

DYNAMIC CONE PENETRATION TEST AND SOIL PROFILE

PROJECT: SHOPRITE WAREHOUSE, WELLS ESTATE **PROJECT NO:** 121211 **DATE :** 23/03/2011

TEST NO: **STARTING DEPTH:** **TRIAL PIT NO:** TP24 **METHOD OF INVESTIGATION :** Excavator

ELEVATION: **GPS CO-ORDINATES:** -57650Y; 3743803X



O 0-0.2m — 0.20 SILTY SAND Dry, medium greyish brown, medium dense, shattered, fine silty sand with scattered, medium, medium hard calcrete gravel. Aeolian. Roots throughout.

0.65 CALCRETE Dry, white and light grey, medium hard to hard, hardpan calcrete. Pedogenic.

SAND Dry, light brown, dense, layered with an open fabric, medium to coarse, slightly shelly sand. Marine/aeolian.

1.25

1.65 CALCRETISED SAND Slightly moist, fawn, dense, layered, calcretised fine sand. Pedogenic.

Note: Dense soils prevented DCP testing

Sandy Materials:	Very loose	>75	**Clayey Materials:**	Very Soft	>110
(mm/blow)	Loose	30 - 75	(mm/blow)	Soft	55 - 110
	Medium Dense	12.5 - 30		Firm	30 - 55
	Dense	5 - 12.5		Stiff	15 - 30
	Very Dense	2 - 5		Very Stiff	7 - 15

O DISTURBED SAMPLE

[] UNDISTURBED SAMPLE

V WATER TABLE

¥ PERCHED WATER TABLE

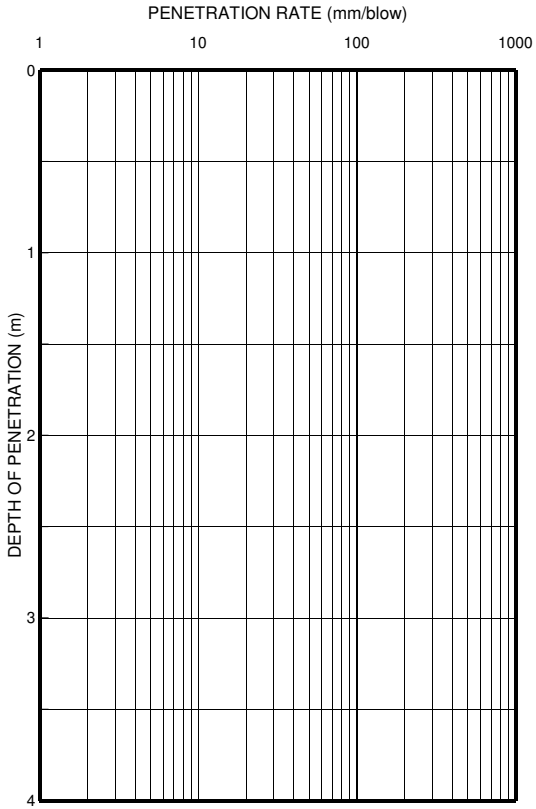
DYNAMIC CONE PENETRATION TEST AND SOIL PROFILE

PROJECT: SHOPRITE WAREHOUSE, WELLS ESTATE **PROJECT NO:** 121211 **DATE :** 23/03/2011

TEST NO: **STARTING DEPTH:** **TRIAL PIT NO:** TP25 **METHOD OF INVESTIGATION :** Excavator

GPS CO-ORDINATES: -57630Y; 3743746X

ELEVATION:



0.20 SILTY SAND Dry, medium greyish brown, medium dense, shattered, fine silty sand with scattered, medium, medium hard calcrete gravel. Aeolian. Roots throughout.

CALCRETE Dry, white and light grey, hard to possibly locally very hard, hardpan calcrete. Pedogenic.

0.90

Note: Machine refused at 0.9m depth.
Dense soils prevented DCP testing.

Sandy Materials:	Very loose	>75	**Clayey Materials:**	Very Soft	>110
(mm/blow)	Loose	30 - 75	(mm/blow)	Soft	55 - 110
	Medium Dense	12.5 - 30		Firm	30 - 55
	Dense	5 - 12.5		Stiff	15 - 30
	Very Dense	2 - 5		Very Stiff	7 - 15

O DISTURBED SAMPLE

[] UNDISTURBED SAMPLE

V WATER TABLE

¥ PERCHED WATER TABLE

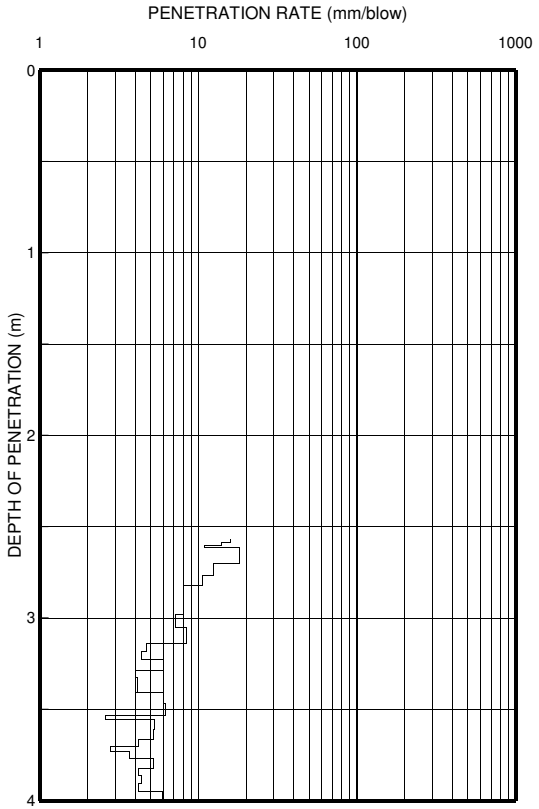
DYNAMIC CONE PENETRATION TEST AND SOIL PROFILE

PROJECT: SHOPRITE WAREHOUSE, WELLS ESTATE **PROJECT NO:** 121211 **DATE :** 23/03/2011

TEST NO: DCP26 **STARTING DEPTH:** In TP26 at 2.4m depth. **TRIAL PIT NO:** TP26 **METHOD OF INVESTIGATION :** Excavator

GPS CO-ORDINATES: -57559Y; 3743685X

ELEVATION:



O 0-0.6m

SILTY SAND Dry, greyish brown, dense, layered and pinholed becoming micro shattered with depth, silty sand with scattered sub rounded sandstone fine to medium gravel becoming clayey with depth. Colluvium. Numerous roots to 0.2m depth.

0.60

CALCRETE Dry, white and khaki, very dense, layered, medium to coarse gravel size calcrete in a very minor matrix of calcretised sand. Pedogenic.

2.00

CALCRETISED SAND Slightly moist, khaki, very dense, weakly layered, calcretised fine sand. Pedogenic.

2.60

SHALE Khaki grey and orange brown, completely to highly weathered, thinly sub horizontally bedded, closely to medium fractured, very soft rock/hard soil grading to very soft rock shale.

3.50

Sandy Materials:	Very loose	>75	**Clayey Materials:**	Very Soft	>110
(mm/blow)	Loose	30 - 75	(mm/blow)	Soft	55 - 110
	Medium Dense	12.5 - 30		Firm	30 - 55
	Dense	5 - 12.5		Stiff	15 - 30
	Very Dense	2 - 5		Very Stiff	7 - 15

O DISTURBED SAMPLE

[] UNDISTURBED SAMPLE

V WATER TABLE

¥ PERCHED WATER TABLE

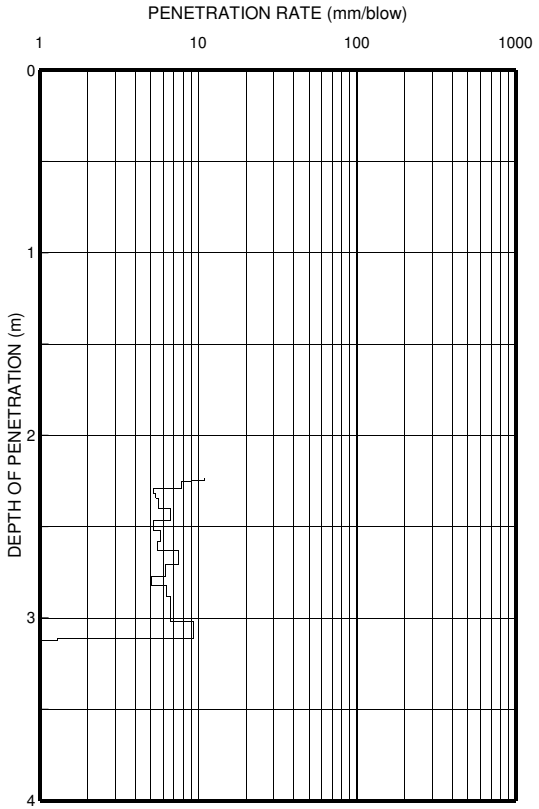
DYNAMIC CONE PENETRATION TEST AND SOIL PROFILE

PROJECT: SHOPRITE WAREHOUSE, WELLS ESTATE **PROJECT NO:** 121211 **DATE :** 23/03/2011

TEST NO: DCP27 **STARTING DEPTH:** In TP27 at 2.1m depth. **TRIAL PIT NO:** TP27 **METHOD OF INVESTIGATION :** Excavator

GPS CO-ORDINATES: -57481Y; 3743782X

ELEVATION:



0.40	SILTY SAND Dry, medium greyish brown, dense, shattered, fine silty sand with scattered, medium, medium hard calcrete gravel and very hard sandstone gravel. Aeolian. Numerous roots.	
1.90	CALCRETE Dry, creamy white and pale khaki, layered calcrete comprising hard to very hard hardpan calcrete to 0.65m then medium to coarse gravel size calcrete in a calcretised sand with lenses. Pedogenic.	
3.20	CALCRETISED SAND Slightly moist, khaki, dense, weakly layered, calcretised fine sand with scattered, medium, medium hard calcrete gravel. Pedogenic.	O 1.9-2.5m
4.30	SHALE Khaki grey and orange brown, highly to moderately weathered, thinly sub horizontally bedded, closely to medium fractured, soft to very soft rock shale. Khaki brown, siltstone layer (300mm thick) overlying shale.	O 3.2-4.3m

Note: Limit of machine at 4.3m depth.

Sandy Materials:	Very loose	>75	**Clayey Materials:**	Very Soft	>110
(mm/blow)	Loose	30 - 75	(mm/blow)	Soft	55 - 110
	Medium Dense	12.5 - 30		Firm	30 - 55
	Dense	5 - 12.5		Stiff	15 - 30
	Very Dense	2 - 5		Very Stiff	7 - 15

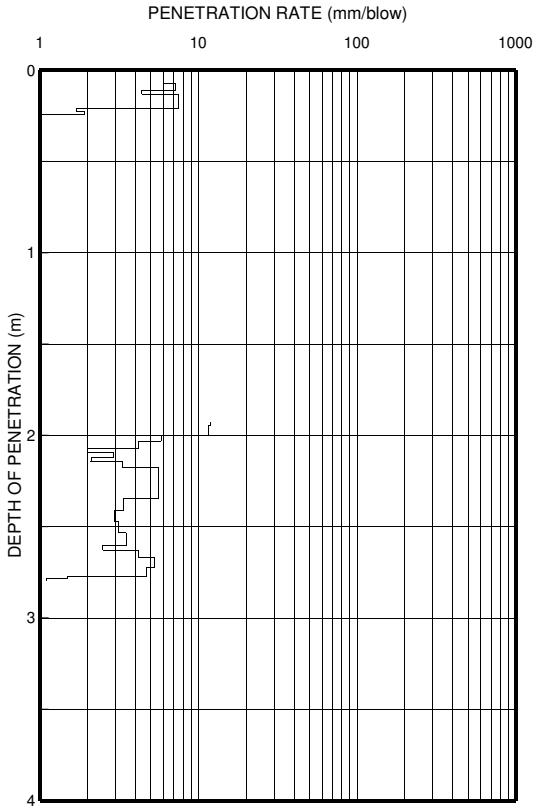
O	DISTURBED SAMPLE	V	WATER TABLE
[]	UNDISTURBED SAMPLE	¥	PERCHED WATER TABLE

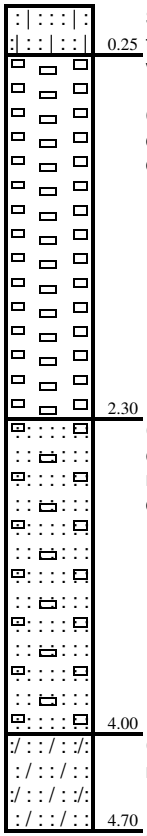
DYNAMIC CONE PENETRATION TEST AND SOIL PROFILE

PROJECT: SHOPRITE WAREHOUSE, WELLS ESTATE **PROJECT NO:** 121211 **DATE :** 23/03/2011

TEST NO: DCP28 **STARTING DEPTH:** Ground surface and in TP28 at 1.8m depth. **TRIAL PIT NO:** TP28 **METHOD OF INVESTIGATION :** Excavator

ELEVATION: **GPS CO-ORDINATES:** -57553Y; 3743847X





SILTY SAND Dry, medium greyish brown, dense to very dense, shattered fine silty sand with scattered, medium, medium hard calcrete gravel and very hard sandstone gravel. Aeolian. Roots throughout.

CALCRETE Dry, creamy white and pale khaki, layered calcrete comprising hard to very hard hardpan calcrete to 1.3m then medium to coarse gravel size calcrete in a calcretised sand with lenses. Pedogenic.

CALCRETISED SAND Slightly moist to very moist at depth, khaki, very dense, weakly layered, calcretised fine sand with scattered, medium, medium hard calcrete gravel. Pedogenic. Becoming more sandy then clayey with depth.

¥ 4.5m

CLAYEY SAND Wet, greyish khaki, very stiff, layered, clayey fine to medium sand with weakly cemented patches. Marine/pedogenic.

Note: Limit of machine at 4.7m depth.

Sandy Materials: (mm/blow)	Very loose	>75	**Clayey Materials:** (mm/blow)	Very Soft	>110
	Loose	30 - 75		Soft	55 - 110
	Medium Dense	12.5 - 30		Firm	30 - 55
	Dense	5 - 12.5		Stiff	15 - 30
	Very Dense	2 - 5		Very Stiff	7 - 15

O DISTURBED SAMPLE

[] UNDISTURBED SAMPLE

V WATER TABLE

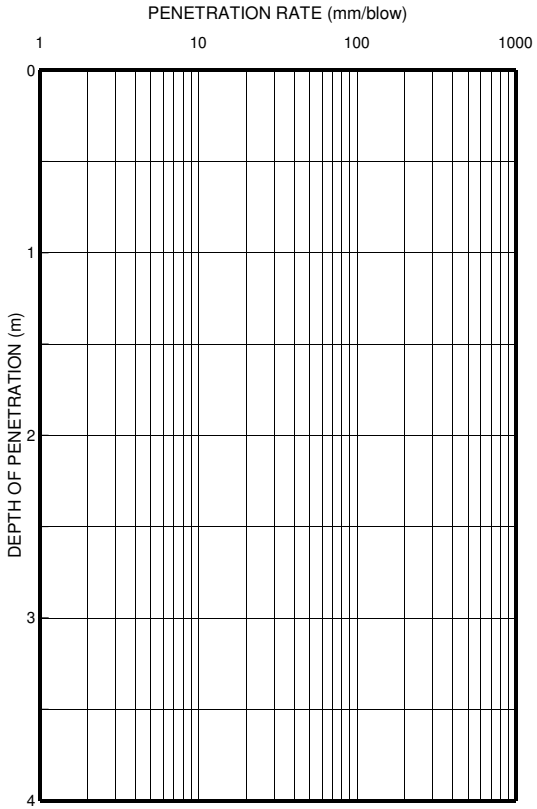
¥ PERCHED WATER TABLE

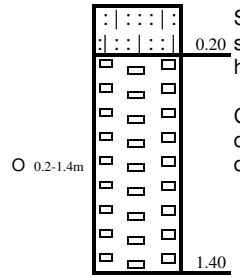
DYNAMIC CONE PENETRATION TEST AND SOIL PROFILE

PROJECT: SHOPRITE WAREHOUSE, WELLS ESTATE **PROJECT NO:** 121211 **DATE :** 23/03/2011

TEST NO: **STARTING DEPTH:** **TRIAL PIT NO:** TP29 **METHOD OF INVESTIGATION :** Excavator

ELEVATION: **GPS CO-ORDINATES:** -57512Y; 3743978X





SILTY SAND Dry, medium greyish brown, dense, shattered, fine silty sand with scattered, medium, medium hard calcrete gravel and very hard sandstone gravel. Aeolian. Roots throughout.

CALCRETE Dry, creamy white and pale khaki, layered calcrete comprising hard to very hard hardpan calcrete to 1.2m then medium to coarse gravel size calcrete in a calcretised sand with lenses. Pedogenic.

Note: No DCP test undertaken.

Sandy Materials:	Very loose	>75	**Clayey Materials:**	Very Soft	>110
(mm/blow)	Loose	30 - 75	(mm/blow)	Soft	55 - 110
	Medium Dense	12.5 - 30		Firm	30 - 55
	Dense	5 - 12.5		Stiff	15 - 30
	Very Dense	2 - 5		Very Stiff	7 - 15

O DISTURBED SAMPLE

[] UNDISTURBED SAMPLE

V WATER TABLE

¥ PERCHED WATER TABLE

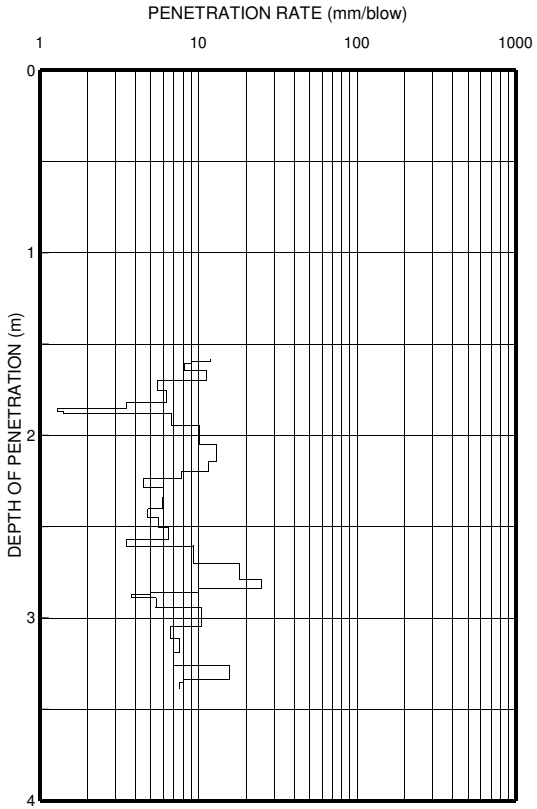
DYNAMIC CONE PENETRATION TEST AND SOIL PROFILE

PROJECT: SHOPRITE WAREHOUSE, WELLS ESTATE **PROJECT NO:** 121211 **DATE :** 23/03/2011

TEST NO: DCP30 **STARTING DEPTH:** In TP30 at 1.45m depth. **TRIAL PIT NO:** TP30 **METHOD OF INVESTIGATION :** Excavator

GPS CO-ORDINATES: -57455Y; 3743962X

ELEVATION:



	SILTY SAND Dry, medium greyish brown, dense, shattered, fine silty sand with scattered, medium, medium hard calcrete gravel and very hard sandstone gravel. Aeolian.	0.25			
	CALCRETE Dry, creamy white and pale khaki, layered calcrete comprising hard to very hard hardpan calcrete to 0.85m then medium to coarse gravel size calcrete in a calcretised sand with lenses. Pedogenic.	2.60			
O 2.6-4.4m	CALCRETISED SAND Slightly moist, khaki, generally dense, weakly layered, calcretised fine sand. Pedogenic.	4.40			
	SHELLY CLAYEY SAND Slightly moist to moist, light orange brown, very dense, layered, shelly clayey fine sand. Marine.	4.60			
	SHALE Khaki grey and orange brown, highly weathered, thinly sub horizontally bedded, closely to medium fractured, soft to very soft shale.	4.80			

Sandy Materials:	Very loose	>75	**Clayey Materials:**	Very Soft	>110
(mm/blow)	Loose	30 - 75	(mm/blow)	Soft	55 - 110
	Medium Dense	12.5 - 30		Firm	30 - 55
	Dense	5 - 12.5		Stiff	15 - 30
	Very Dense	2 - 5		Very Stiff	7 - 15

O DISTURBED SAMPLE

[] UNDISTURBED SAMPLE

V WATER TABLE

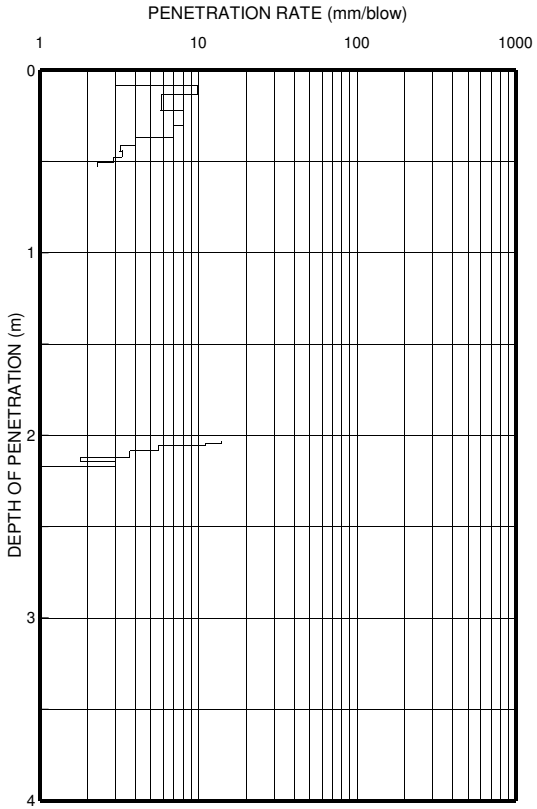
¥ PERCHED WATER TABLE

DYNAMIC CONE PENETRATION TEST AND SOIL PROFILE

PROJECT: SHOPRITE WAREHOUSE, WELLS ESTATE **PROJECT NO:** 121211 **DATE :** 23/03/2011

TEST NO: DCP31 **STARTING DEPTH:** Ground surface and in TP31 at 1.9m depth. **TRIAL PIT NO:** TP31 **METHOD OF INVESTIGATION :** Excavator

ELEVATION: **GPS CO-ORDINATES:** -57383Y; 3743912X



0.40			SILTY SAND Dry, medium greyish brown, dense, shattered, fine silty sand with scattered, medium, medium hard calcrete gravel. Aeolian. Numerous roots.
1.50			CALCRETE Dry, creamy white and pale khaki, layered calcrete comprising hard to very hard hardpan calcrete to 1.2m then medium to coarse gravel size calcrete in a very minor calcretised sand with lenses. Pedogenic.
3.95			CALCRETISED SAND Slightly moist, khaki, dense to very dense, weakly layered, calcretised fine sand. Pedogenic.
4.30	O	3.95-4.3m	SHELLY CLAYEY SAND Slightly moist to moist, light orange brown, very dense, layered, shelly clayey fine sand. Marine.
4.50	O	4.3-4.5m	SHALE Khaki grey and orange brown, highly weathered, thinly sub horizontally bedded, closely to medium fractured, soft to very soft rock shale.

Note: Machine refused at 4.5m depth.

Sandy Materials: (mm/blow)			**Clayey Materials:** (mm/blow)		
	Very loose	>75		Very Soft	>110
	Loose	30 - 75		Soft	55 - 110
	Medium Dense	12.5 - 30		Firm	30 - 55
	Dense	5 - 12.5		Stiff	15 - 30
	Very Dense	2 - 5		Very Stiff	7 - 15

O DISTURBED SAMPLE

[] UNDISTURBED SAMPLE

V WATER TABLE

¥ PERCHED WATER TABLE

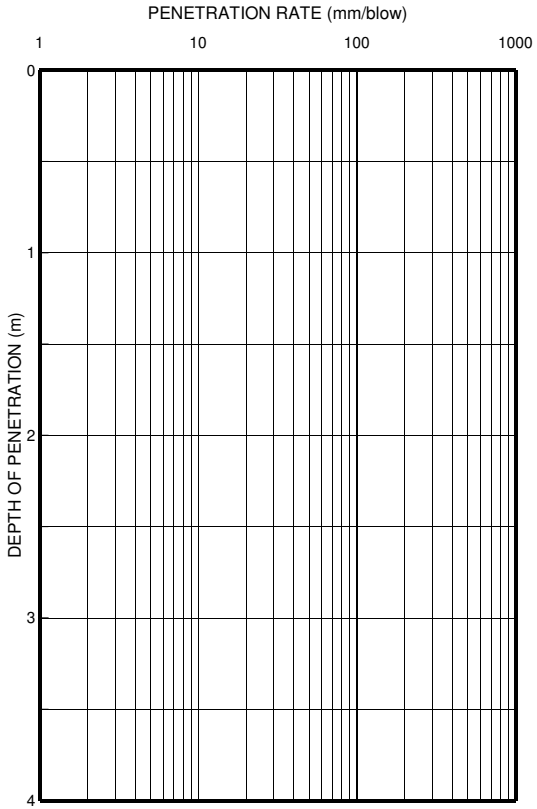
DYNAMIC CONE PENETRATION TEST AND SOIL PROFILE

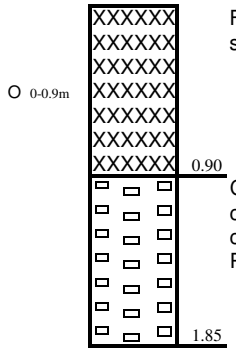
PROJECT: SHOPRITE WAREHOUSE, WELLS ESTATE **PROJECT NO:** 121211 **DATE :** 23/03/2011

TEST NO: **STARTING DEPTH:** **TRIAL PIT NO:** TP32 **METHOD OF INVESTIGATION :** Excavator

GPS CO-ORDINATES: -57819Y; 3743716X

ELEVATION:





FILL Dry, brownish grey, medium dense, layered fill comprising silty fine sand with scattered fine to medium calcrete gravel.

CALCRETE Dry, creamy white and pale khaki, layered calcrete comprising hard to very hard hardpan calcrete to 1.2m then medium to coarse gravel size calcrete in a very minor calcretised sand with lenses. Pedogenic. Scattered, very hard, medium, sub angular sandstone gravel.

Sandy Materials:	Very loose	>75	**Clayey Materials:**	Very Soft	>110
(mm/blow)	Loose	30 - 75	(mm/blow)	Soft	55 - 110
	Medium Dense	12.5 - 30		Firm	30 - 55
	Dense	5 - 12.5		Stiff	15 - 30
	Very Dense	2 - 5		Very Stiff	7 - 15

O DISTURBED SAMPLE

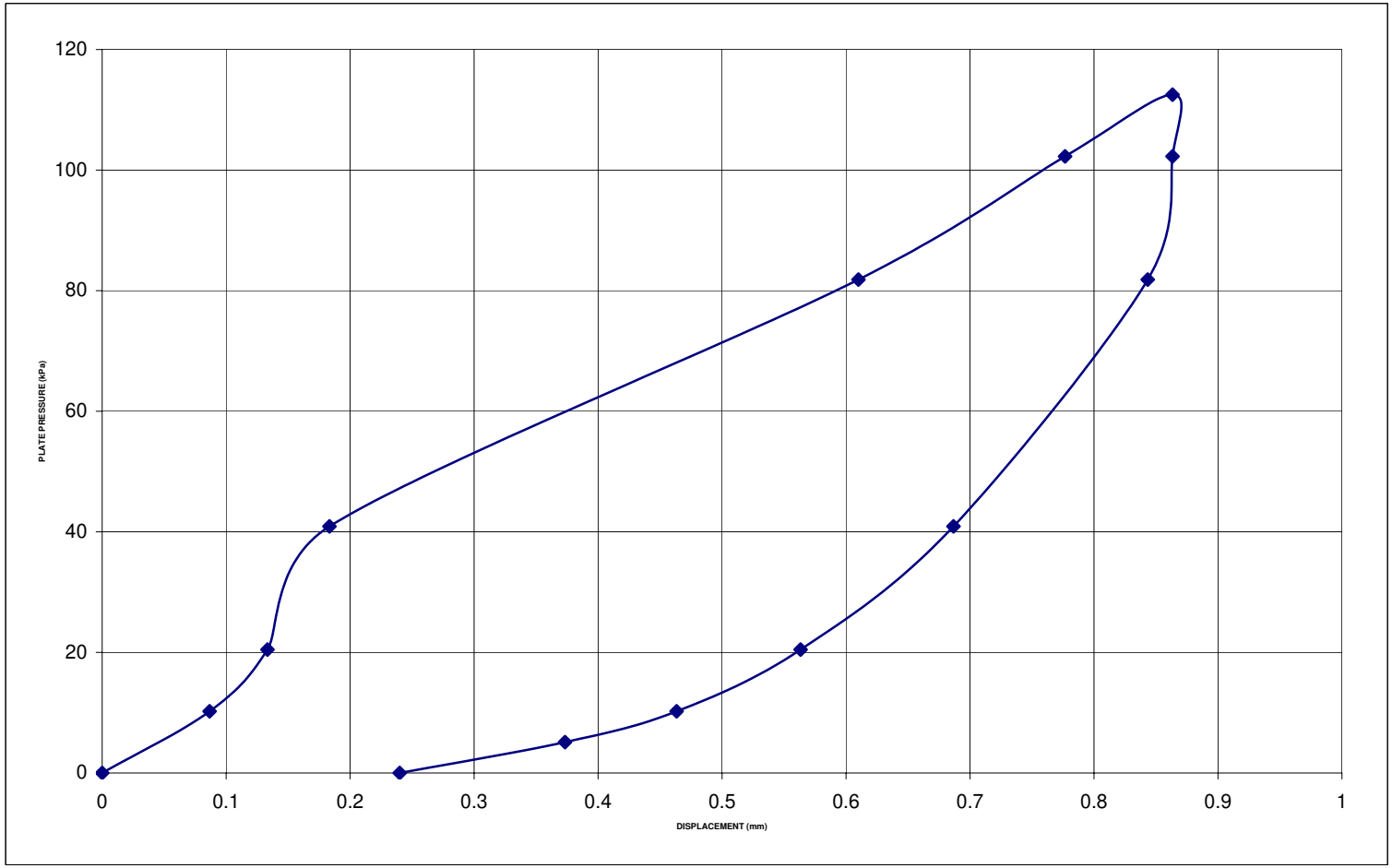
[] UNDISTURBED SAMPLE

V WATER TABLE

¥ PERCHED WATER TABLE

APPENDIX B

RESULTS OF PLATE LOAD TESTS



R.A. Bradshaw & Associates cc
Consulting Engineering Geologists
17 Midwood Ave., Newlands
Cape Town, 7708 South Africa
Tel +27 21 6711995 e-mail rab@intekom.co.za

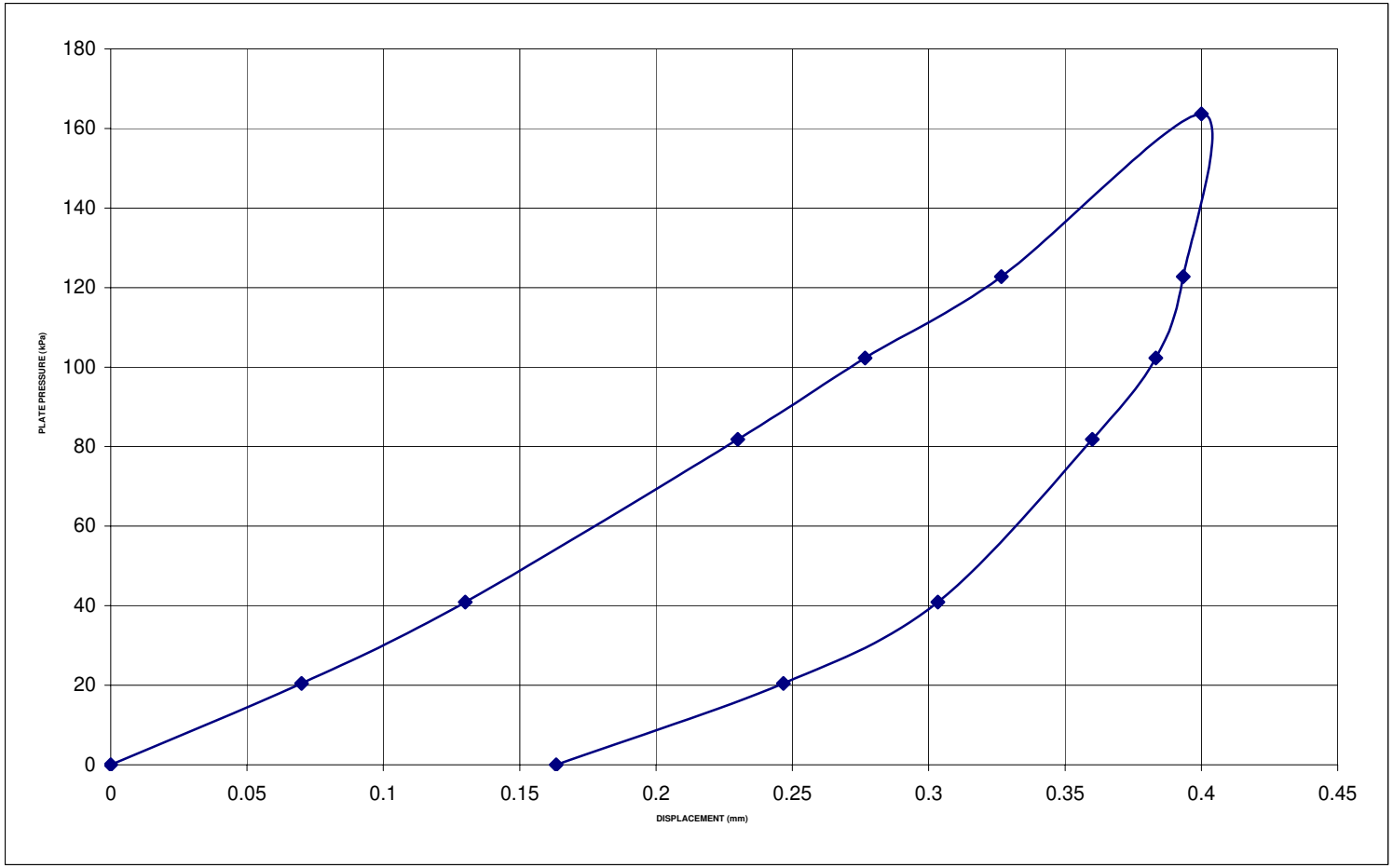
Project No. 121211 Date 1/03/2011

Remarks: Plate diameter = 600mm
X = 3743773, Y = -57369, Z = 41.95m

SHOPRITE, WELLS ESTATE

POSITION: TP4 at 0.6m depth

SOIL TYPE: Calcrete



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17 Midwood Ave., Newlands
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Tel +27 21 6711995 e-mail rab@intekom.co.za

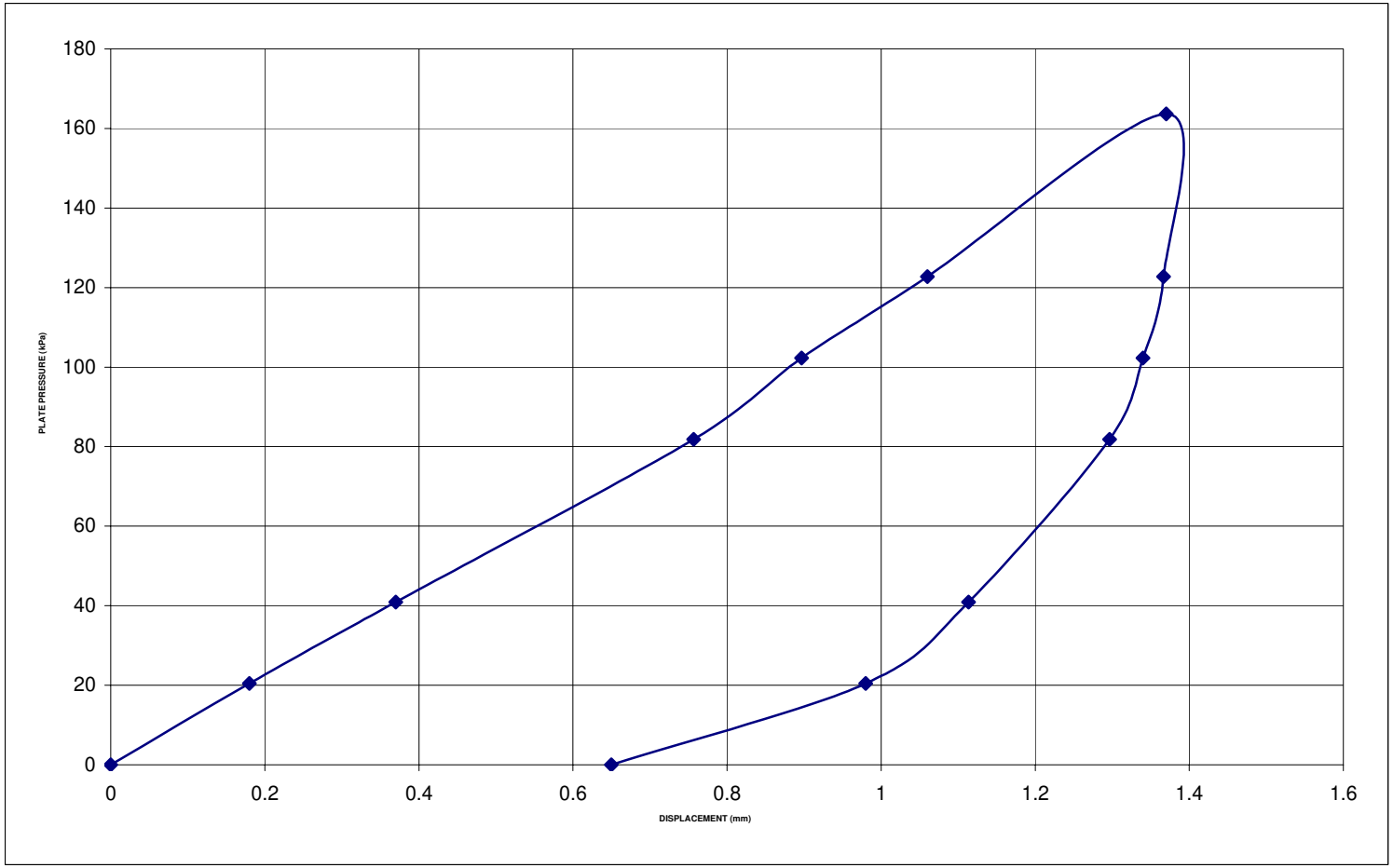
Project No. 121211 Date 1/03/2011

Remarks: Plate diameter = 300mm
X = 3743706, Y = -57342, Z = 43.49m

SHOPRITE, WELLS ESTATE

POSITION: TP6 at 0.45m depth

SOIL TYPE: Calcrete



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Cape Town, 7708 South Africa
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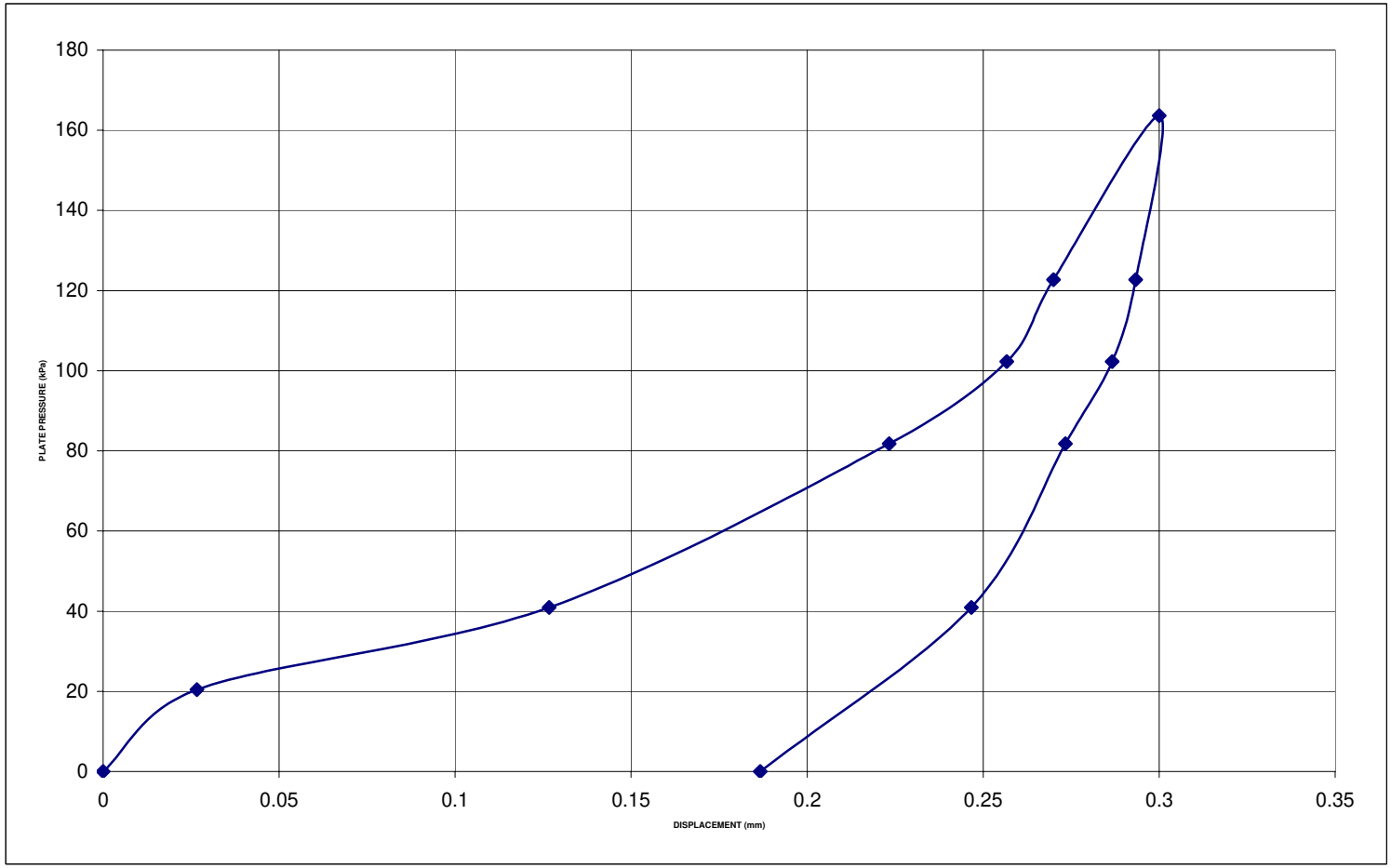
Project No. 121211 Date 1/03/2011

Remarks: Plate diameter = 300mm
X = 3743609, Y = -57427, Z = 43.75m

SHOPRITE, WELLS ESTATE

POSITION: TP7 at 0.55m depth

SOIL TYPE: Calcrete



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Cape Town, 7708 South Africa
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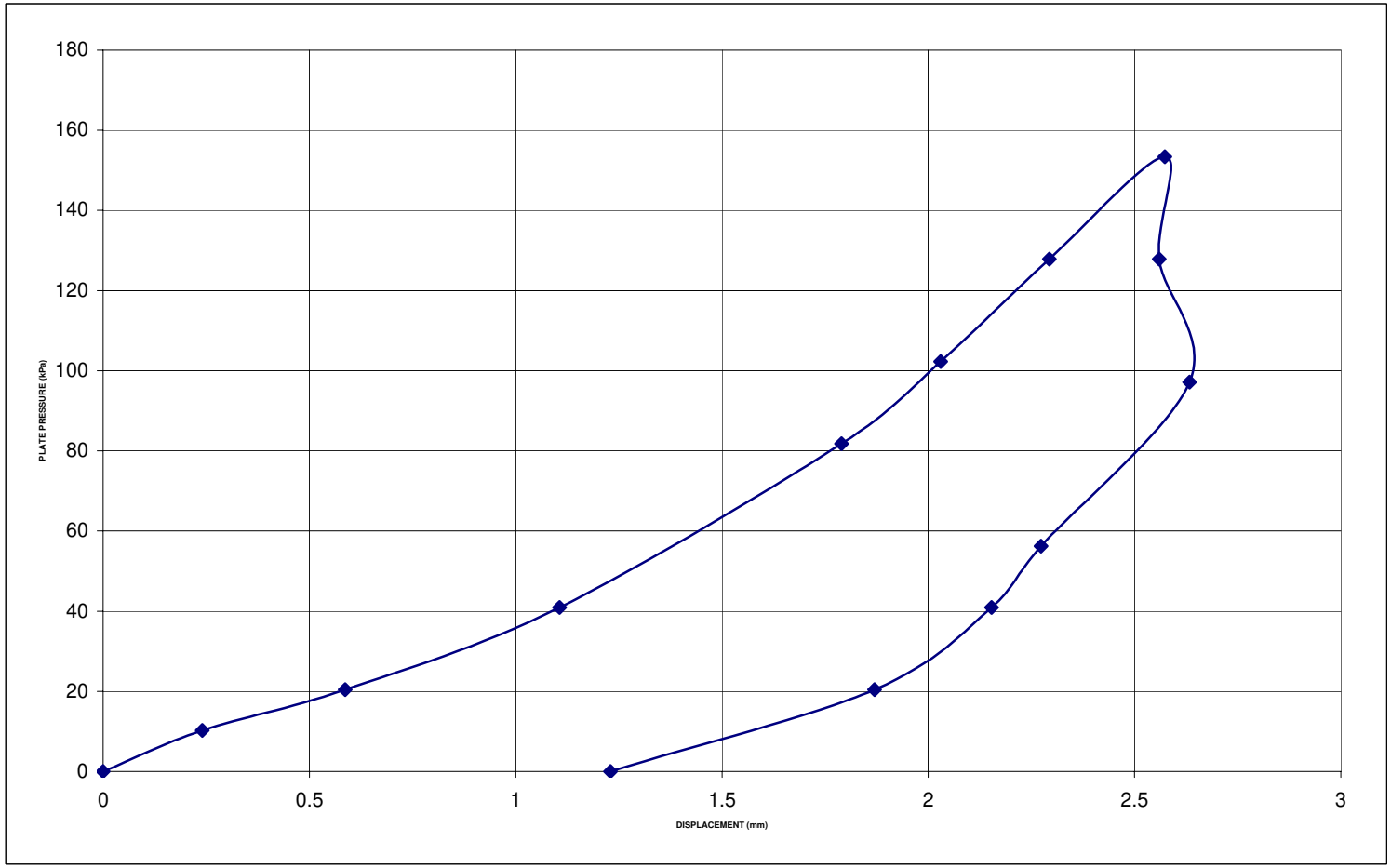
Project No. 121211 Date 1/03/2011

Remarks: Plate diameter = 300mm
X = 3743562, Y = -57363, Z = 42.2m

SHOPRITE, WELLS ESTATE

POSITION: TP12 at 0.55m depth.

SOIL TYPE: Calcrete



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Cape Town, 7708 South Africa
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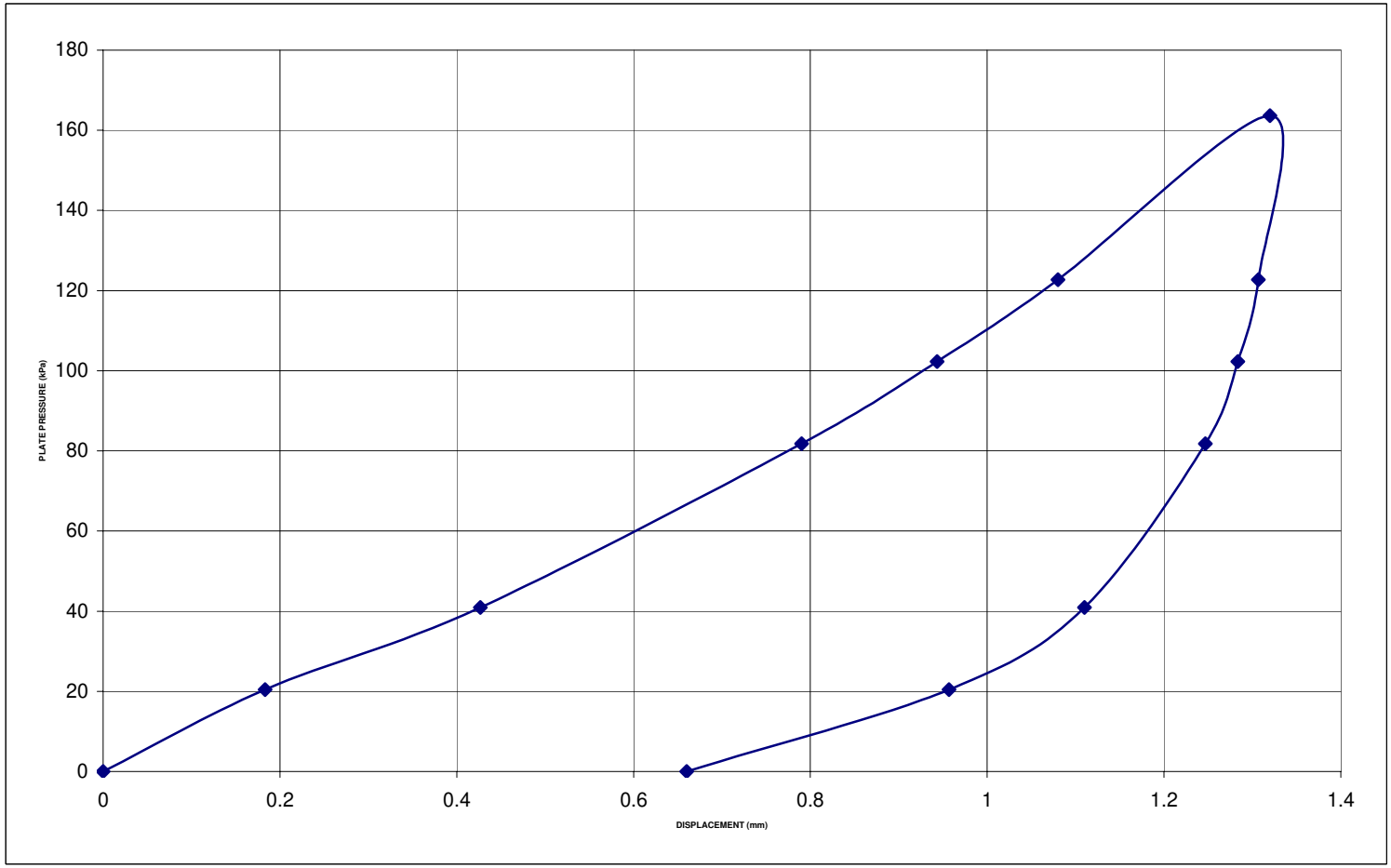
Project No. 121211 Date 1/03/2011

Remarks: Plate diameter = 600mm
X = 3743462, Y = -57357, Z = 42.6m

SHOPRITE, WELLS ESTATE

POSITION: TP17 at 0.5m depth.

SOIL TYPE: Calcrete



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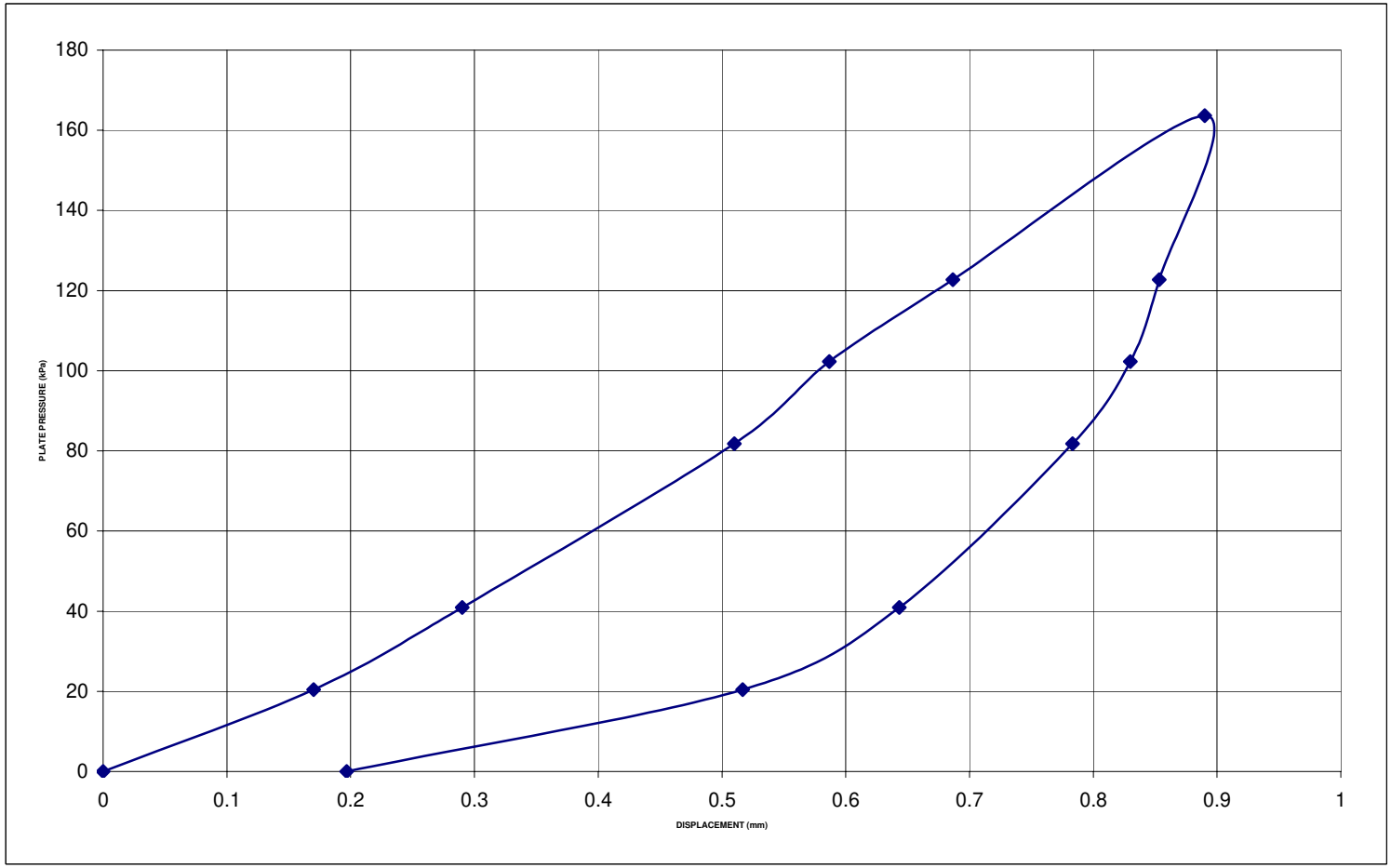
Project No. 121211 Date 24/03/2011

Remarks: Plate diameter = 300mm
X = 3743962, Y = -57455, Z = 440.95m

SHOPRITE, WELLS ESTATE

POSITION: TP30 at 0.5m depth

SOIL TYPE: Calcrete



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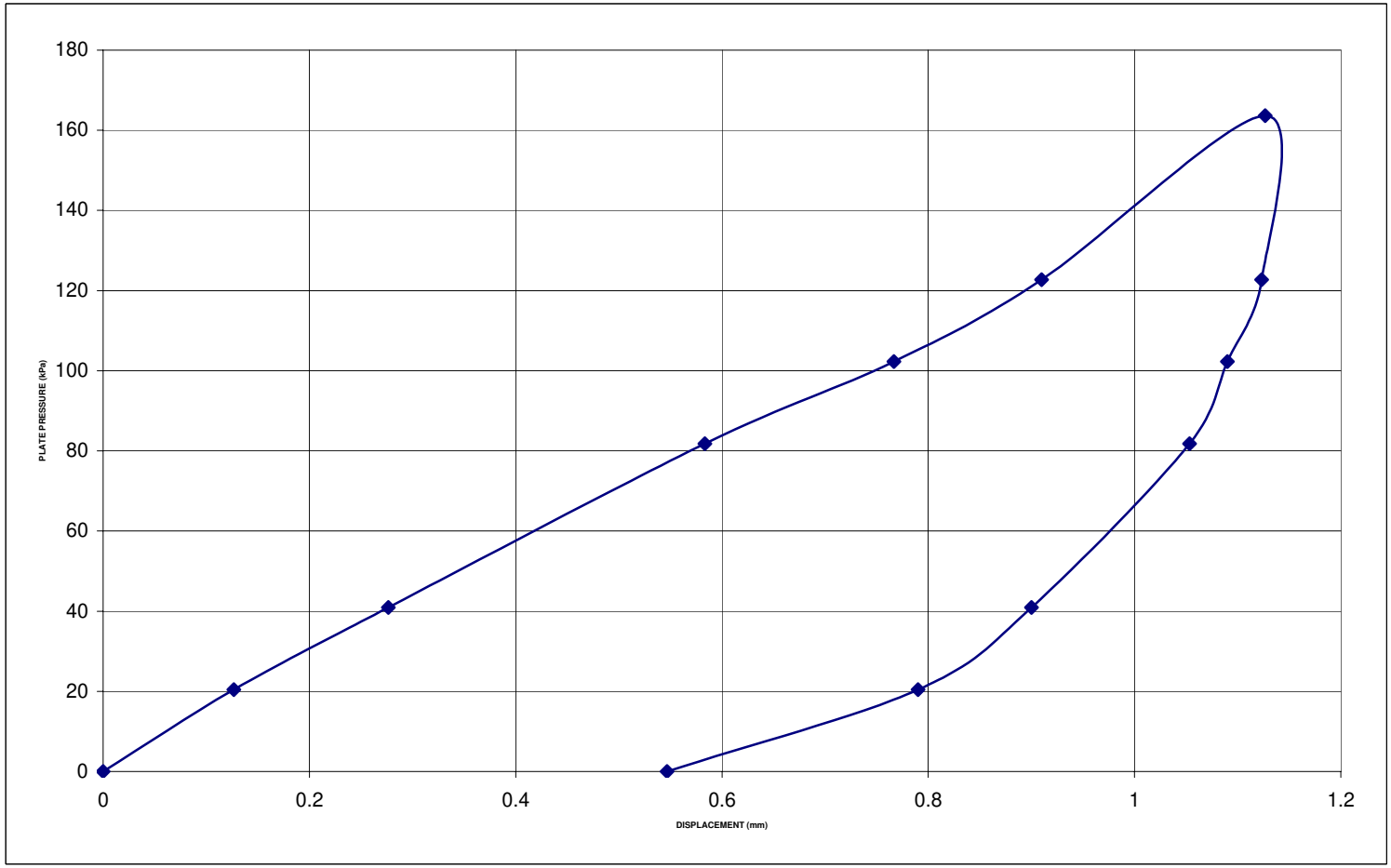
Project No. 121211 Date 24/03/2011

Remarks: Plate diameter = 300mm
X = 3743685, Y = -57559, Z = 40.9m

SHOPRITE, WELLS ESTATE

POSITION: TP26 at 0.6m depth

SOIL TYPE: Calcrete



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Cape Town, 7708 South Africa
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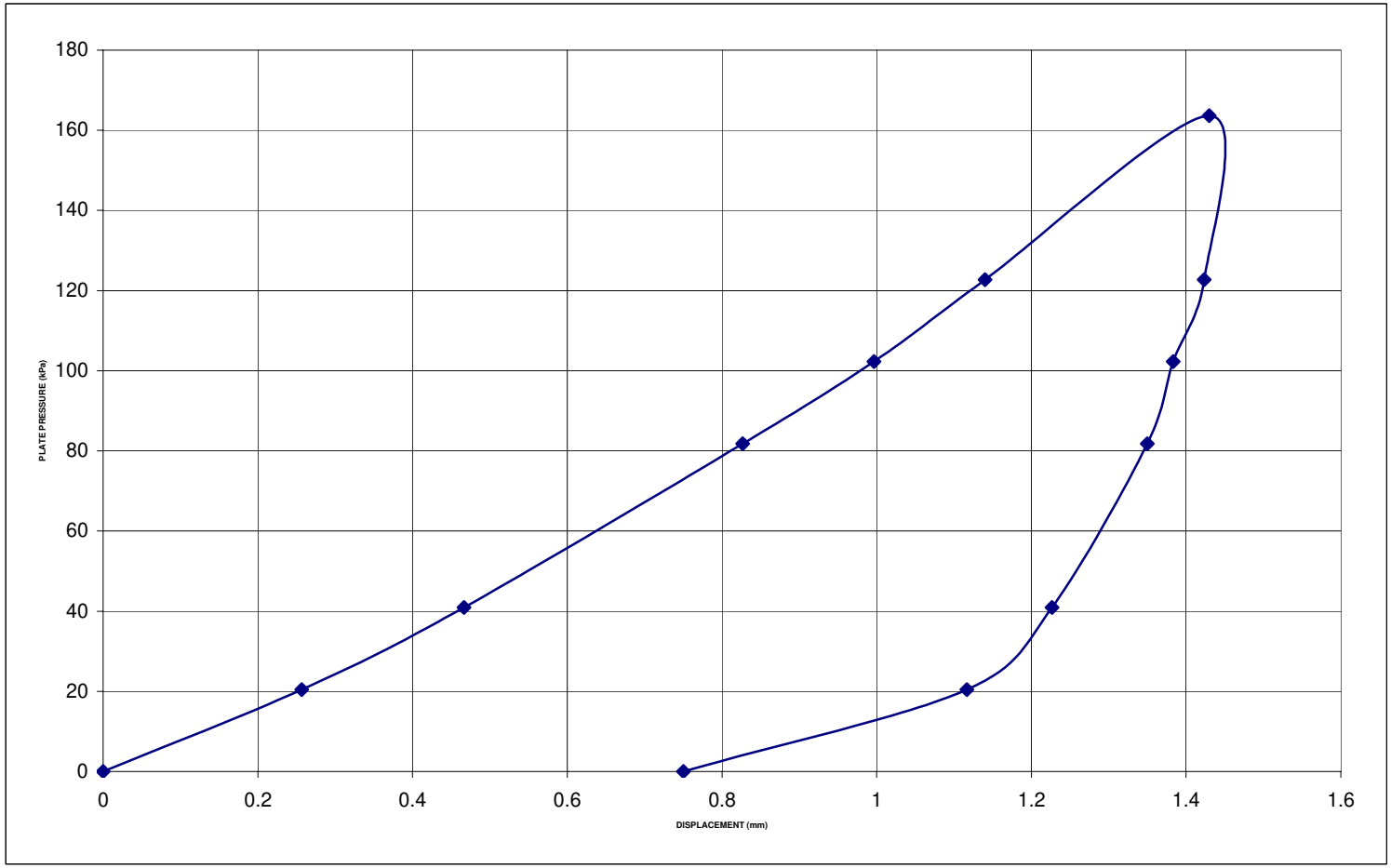
Project No. 121211 Date 24/03/2011

Remarks: Plate diameter = 300mm
X = 3743782, Y = -57481, Z = 40.9m

SHOPRITE, WELLS ESTATE

POSITION: TP27 at 0.75m depth

SOIL TYPE: Calcrete



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Cape Town, 7708 South Africa
Tel +27 21 6711995 e-mail rab@intekom.co.za

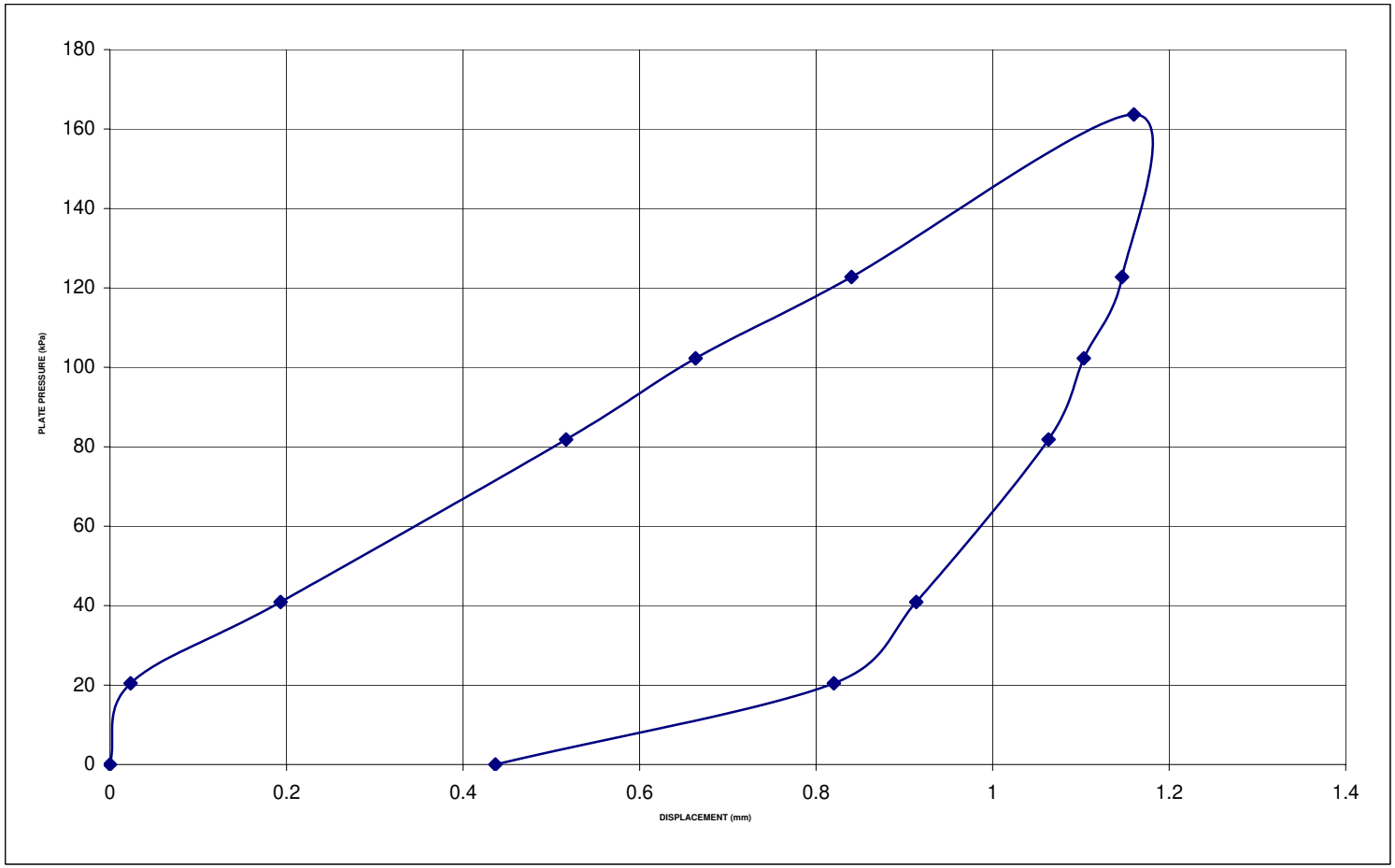
Project No. 121211 Date 24/03/2011

Remarks: Plate diameter = 300mm
X = 3743912, Y = -57383, Z = 440.95m

SHOPRITE, WELLS ESTATE

POSITION: TP31 at 1.2m depth

SOIL TYPE: Calcrete



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Cape Town, 7708 South Africa
Tel +27 21 6711995 e-mail rab@intekom.co.za

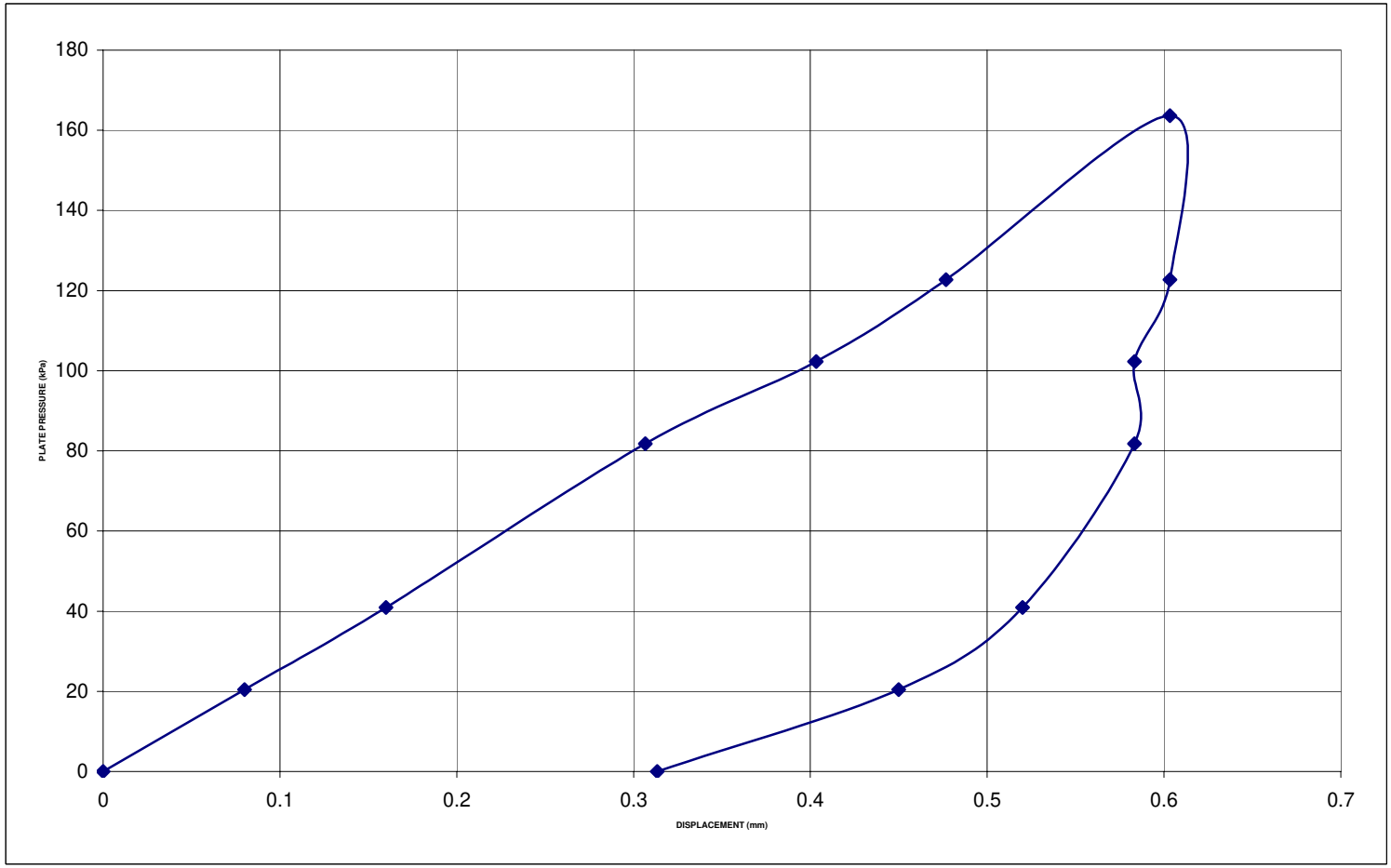
Project No. 121211 Date 1/03/2011

Remarks: Plate diameter = 300mm
X = 3743596, Y = -57511, Z = 42.2m

SHOPRITE, WELLS ESTATE

POSITION: TP2 at 1.35m depth

SOIL TYPE: Calcretised sand



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Cape Town, 7708 South Africa
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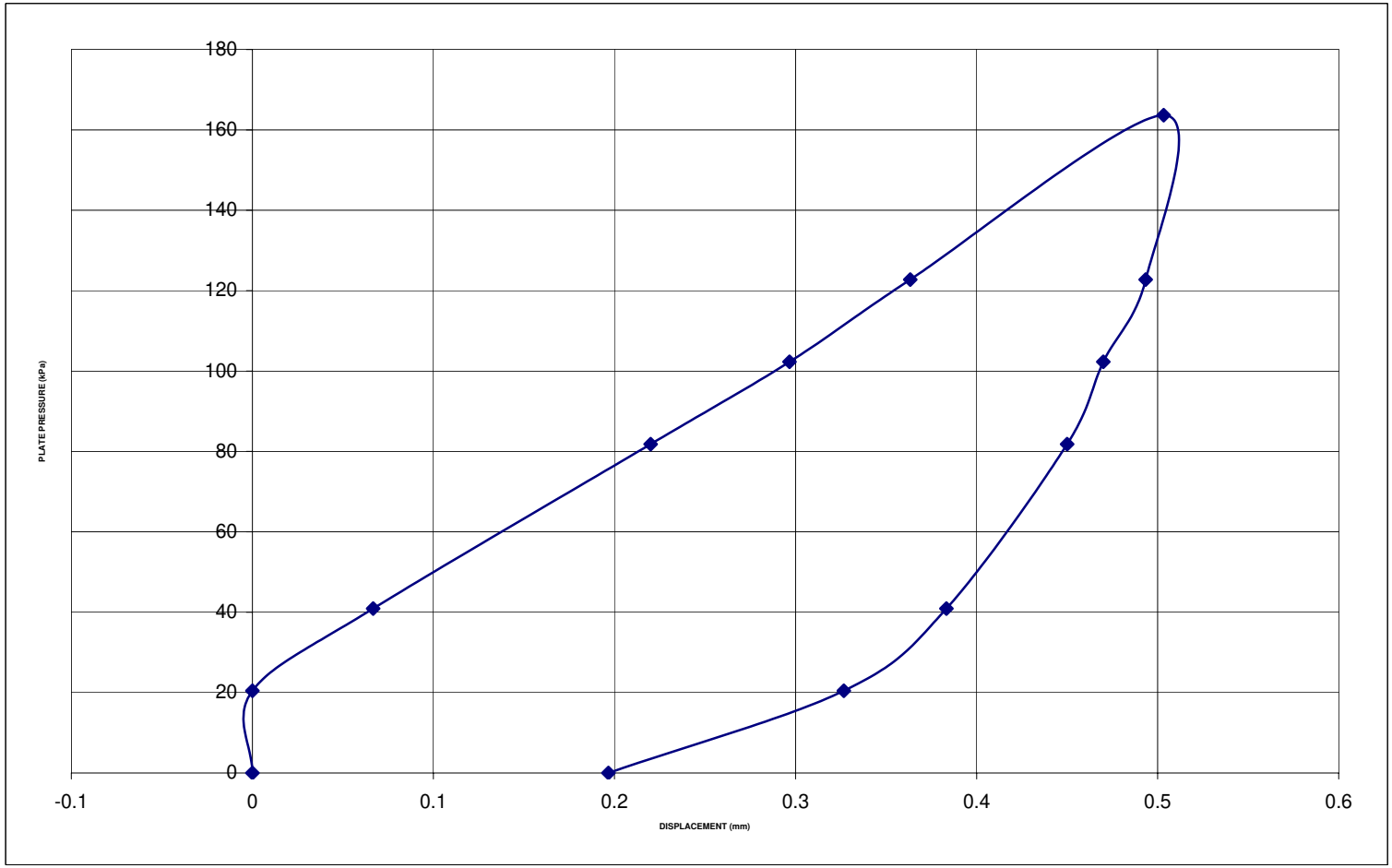
Project No. 121211 Date 1/03/2011

Remarks: Plate diameter = 300mm
X = 3743562, Y = -57363, Z = 42.2m

SHOPRITE, WELLS ESTATE

POSITION:TP12 at 1.35m depth

SOIL TYPE: Calcretised sand



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Cape Town, 7708 South Africa
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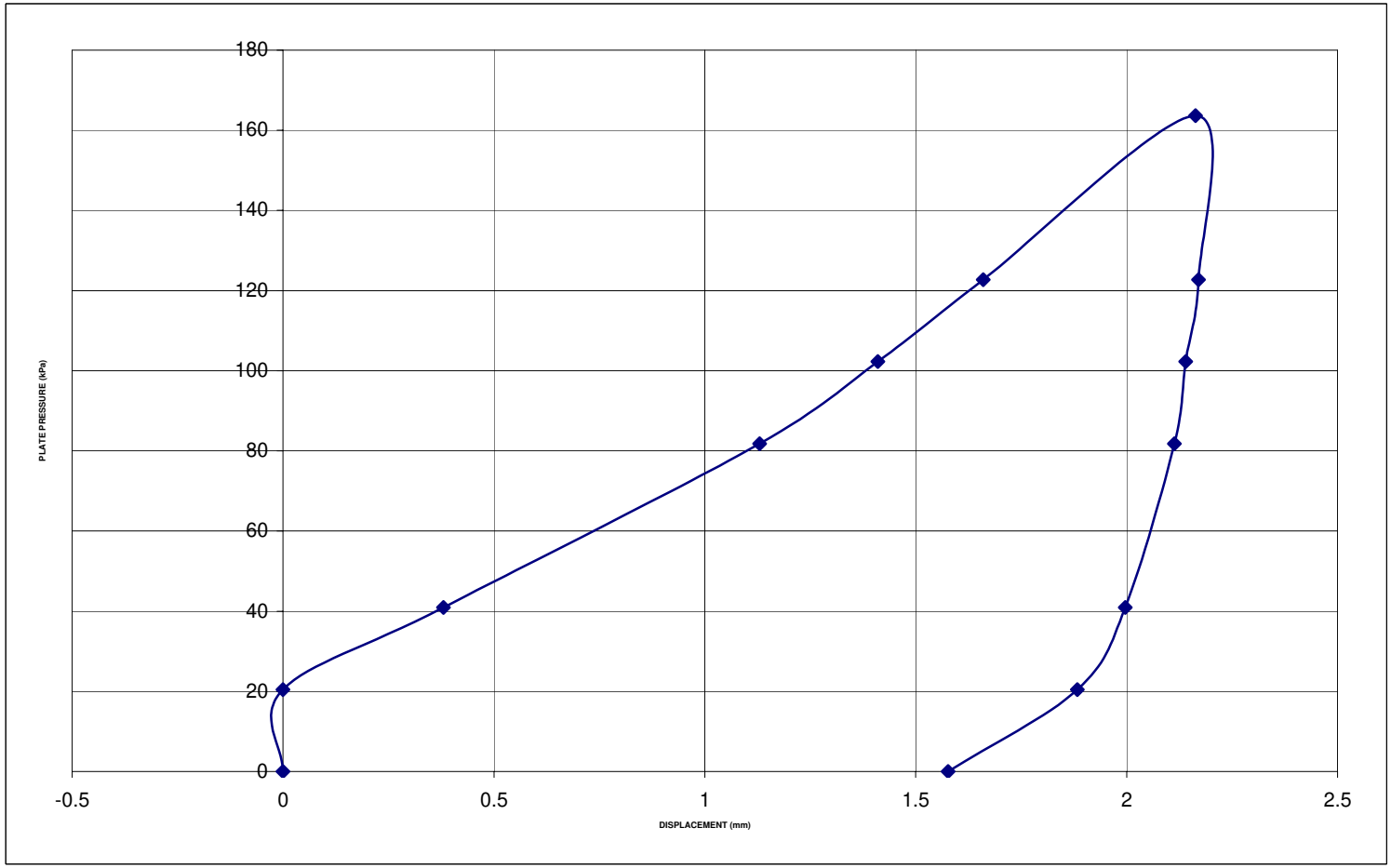
Project No. 121211 Date 1/03/2011

Remarks: Plate diameter = 300mm
X = 3743722, Y = -57174, Z = 42.45m

SHOPRITE, WELLS ESTATE

POSITION: TP14 at 1m depth

SOIL TYPE: Calcretised sand



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Cape Town, 7708 South Africa
Tel +27 21 6711995 e-mail rab@intekom.co.za

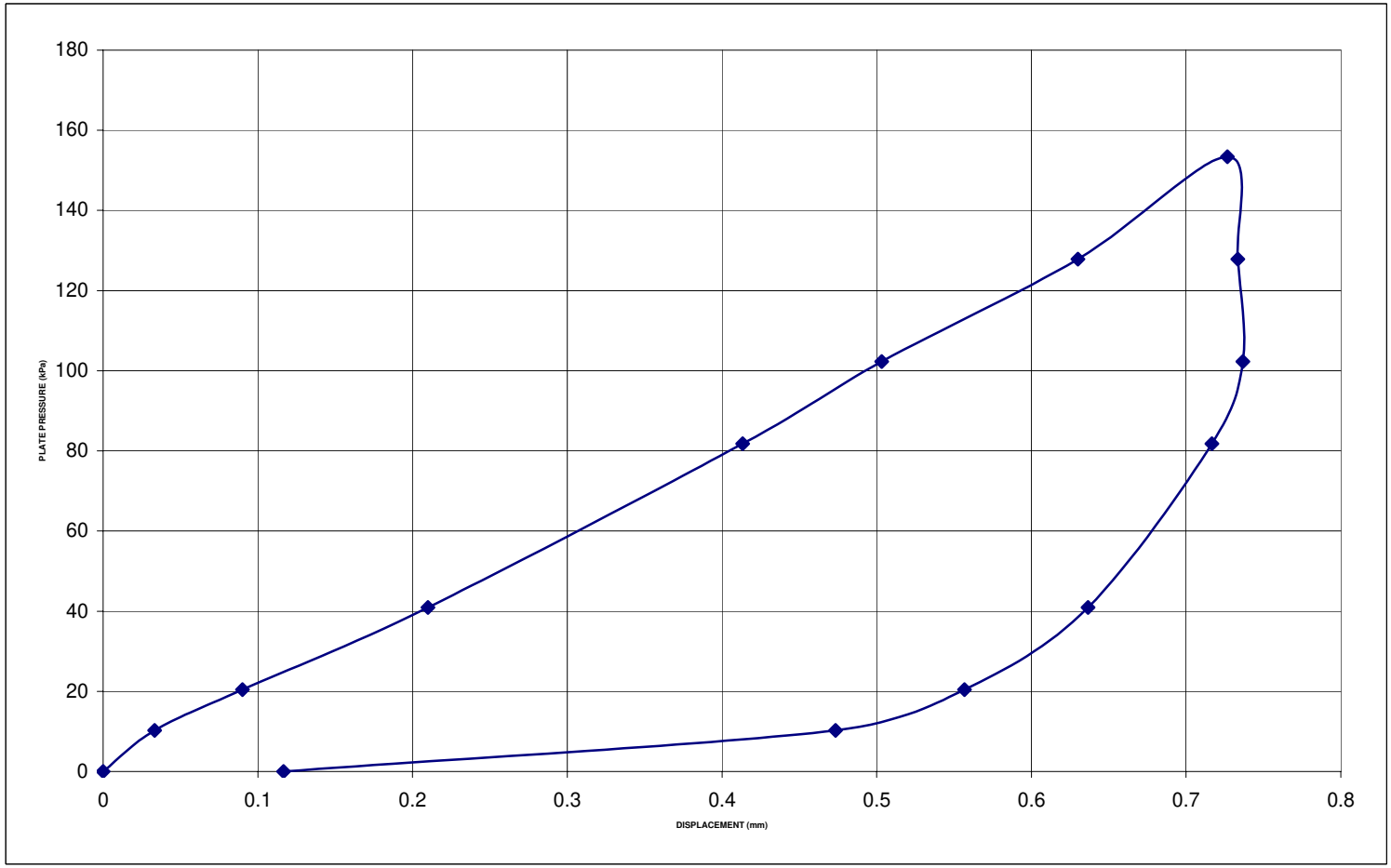
Project No. 121211 Date 1/03/2011

Remarks: Plate diameter = 300mm
X = 3743650, Y = -57206, Z = 43.6m

SHOPRITE, WELLS ESTATE

POSITION: TP15 at 1.2m depth

SOIL TYPE: Calcretised sand



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Cape Town, 7708 South Africa
Tel +27 21 6711995 e-mail rab@intekom.co.za

Project No. 121211 Date 1/03/2011

Remarks: Plate diameter = 600mm
X = 3743462, Y = -57357, Z = 42.6m

SHOPRITE, WELLS ESTATE

POSITION: TP17 at 1.6m depth.

SOIL TYPE: Calcretised sand

APPENDIX C

RESULTS OF LABORATORY TESTS

Labco
63b Pickering Street, Newton Park, Port Elizabeth, 6045
PO Box 10114, Linton Grange, Port Elizabeth, 6015
E-Mail: info@labco.co.za Web: www.labco.co.za
Tel: 041 364-1290 Fax: 041 364-1291

sanas Testing Laboratory

CIVIL ENGINEERING MATERIALS TESTING SERVICES (PTY) Ltd T0227

CUSTOMER : RA Bradshaw & Associates cc
17 Midwood Avenue
Newlands
Cape Town, 7708

ATTENTION : Mr. R. Bradshaw
JOB CARD No. : C12032
SAMPLING PROCEDURE: Delivered to the laboratory

PROJECT : Shoprite Wells Estate
JOB/ROAD : -
SUBMISSION DATE : 24.02.2011
DATE TESTED : 08.03.2011
REPORT DATE : 08.03.2011

SD

INDICATOR / CBR RESULT SUMMARY

SAMPLE NUMBER	X125186	X125152	X125153	X125183	X125154	X125155
LAYER						
CO-ORDINATES						
STAKE VALUE	TP 4	TP 5	TP 5	TP 10	TP 14	TP 14
OFF SET						
DEPTH m	0-0.3	0-0.25	0.25-1.25	1.8-2.75	0.15-0.95	0.95-1.55
DESCRIPTION						
AASHTO CLASSIFICATION	A-2-4(0)	A-6(1)	A-2-6(0)	A-3(0)	A-1-a(0)	A-1-a(0)
Indicator & CBR results comply to TRH14 Specification of	G7	G10	G9	G7	G7	G6

SIEVE ANALYSIS - TMH 1 Test Method A1(a)

% PASSING 105.0 mm					100	100
75.0 mm					85	77
63.0 mm			100		85	77
53.0 mm		100	94		77	70
37.5 mm		93	88		71	61
26.5 mm		83	80		61	56
19.0 mm		78	66	100	54	53
13.2 mm		76	60	99	47	50
4.75 mm	100	75	46	97	35	40
2.00 mm	99	75	37	93	28	35
0.425 mm	95	72	26	84	21	30
0.075 mm	31	42	17	18	10	11

SOIL MORTAR ANALYSIS - TMH 1 Test Method A5

COARSE SAND	(%)	4	4	30	10	25	14
COARSE FINE SAND	(%)	10	5	5	10	8	4
MEDIUM FINE SAND	(%)	18	9	7	16	10	8
FINE FINE SAND	(%)	36	26	13	45	23	43
PASSING 0.075mm	(%)	32	56	45	19	34	31
GRADING MODULUS		0.75	1.11	2.20	1.05	2.42	2.24

ATTERBERG LIMITS : TMH 1 Test Method A2 - A4

LIQUID LIMIT		31	36		37	30
PLASTICITY INDEX	NP	11	12	NP	10	6
LINEAR SHRINKAGE	0.0	5.5	6.0	0.0	5.5	3.0

C.B.R. : TMH 1 Test Method A7 - A8

MOD AASHTO (Kg/m^3)	1991	1773	1814	1669	1741	1848
O.M.C. (%)	9.9	13.9	16.3	12.3	18.8	13.9
C.B.R. @ 100% COMPACTION	54	35	34	55	34	48
C.B.R. @ 98 % COMPACTION	46	23	21	41	28	40
C.B.R. @ 95 % COMPACTION	36	12	12	27	20	29
C.B.R. @ 93 % COMPACTION	22	10	10	24	17	28
C.B.R. @ 90 % COMPACTION	11	7	8	22	16	27
SWELL (MAASHTO) %	0.0	2.2	0.0	0.0	0.0	0.0

Deviation from Test Method : Moisture Contents dried overnight at 105 - 110°C.

Name : Wouter Steyn
Position : Laboratory Manager

Revision 7
17.11.2008
Labco SF 33

Labco
63b Pickering Street, Newton Park, Port Elizabeth, 6045
PO Box 10114, Linton Grange, Port Elizabeth, 6015
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sanas testing laboratory

CIVIL ENGINEERING MATERIALS TESTING SERVICES (PTY) Ltd

T0227

CUSTOMER : RA Bradshaw & Associates cc
17 Midwood Avenue
Newlands
Cape Town, 7708

ATTENTION : Mr. R. Bradshaw

JOB CARD No. : C12032

SAMPLING PROCEDURE: Delivered to the laboratory

PROJECT : Shoprite Wells Estate

JOB/ROAD : -

SUBMISSION DATE : 24.02.2011

DATE TESTED : 08.03.2011

REPORT DATE : 08.03.2011

SD

INDICATOR / CBR RESULT SUMMARY

SAMPLE NUMBER	X125184					
LAYER						
CO-ORDINATES						
STAKE VALUE	TP 20					
OFF SET						
DEPTH m	0.3-1.0					
DESCRIPTION						
AASHTO CLASSIFICATION	A-2-4(0)					
Indicator & CBR results comply to TRH14 Specification of	G6					

SIEVE ANALYSIS - TMH 1 Test Method A1(a)

% PASSING 105.0 mm						
75.0 mm	100					
63.0 mm	87					
53.0 mm	82					
37.5 mm	76					
26.5 mm	65					
19.0 mm	54					
13.2 mm	47					
4.75 mm	32					
2.00 mm	24					
0.425 mm	18					
0.075 mm	12					

SOIL MORTAR ANALYSIS - TMH 1 Test Method A5

COARSE SAND (%)	25					
COARSE FINE SAND (%)	5					
MEDIUM FINE SAND (%)	5					
FINE FINE SAND (%)	18					
PASSING 0.075mm (%)	48					
GRADING MODULUS	2.47					

ATTERBERG LIMITS : TMH 1 Test Method A2 - A4

LIQUID LIMIT	31					
PLASTICITY INDEX	9					
LINEAR SHRINKAGE	4.5					

C.B.R. : TMH 1 Test Method A7 - A8

MOD AASHTO (Kg/m^3)	1879					
O.M.C. (%)	11.2					
C.B.R. @ 100% COMPACTION	115					
C.B.R. @ 98 % COMPACTION	85					
C.B.R. @ 95 % COMPACTION	54					
C.B.R. @ 93 % COMPACTION	28					
C.B.R. @ 90 % COMPACTION	9					
SWELL (MAASHTO) %	0.0					

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Deviation from Test Method : Moisture Contents dried overnight at 105 - 110°C.

Name : Wouter Steyn
Position : Laboratory Manager

Revision 7
17.11.2008
Labco SF 33

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CUSTOMER : RA Bradshaw & Associates cc
17 Midwood Avenue
Newlands
Cape Town, 7708

ATTENTION : Mr. R. Bradshaw
JOB CARD No. : C12218
SAMPLING PROCEDURE: Delivered to the laboratory

PROJECT : Shoprite Wells Estate
JOB/ROAD : -
SUBMISSION DATE : 24.03.2011
DATE TESTED : 04.04.2011
REPORT DATE : 05.04.2011
PKG

INDICATOR / CBR RESULT SUMMARY

SAMPLE NUMBER	X125996	X125997	X125998	X125999	X126000	X126001
LAYER						
CO-ORDINATES						
STAKE VALUE	TP 23	TP 24	TP 26	TP 27	TP 27	TP 29
OFF SET						
DEPTH m	0-0.6	0-0.2	0-0.6	1.9-2.5	3.2-4.3	0.2-1.4
DESCRIPTION	Light brown silty Sand with Calcrete	Dark brown silty Sand with Pebbles	Dark grey Mudstone	Light yellowish brown Sand with Calcrete	Dark grey speckled yellowish clayey Mudstone	Light brown silty Sand with Calcrete
AASHTO CLASSIFICATION	A-3(0)	A-3(0)	A-4(0)	A-2-4(0)	A-7(16)	A-2-4(0)
Indicator & CBR results comply to TRH14 Specification of						G6

SIEVE ANALYSIS - TMH 1 Test Method A1(a)

% PASSING 105.0 mm						
75.0 mm	100					
63.0 mm	88					100
53.0 mm	88			100		96
37.5 mm	84			96		88
26.5 mm	80			95		79
19.0 mm	75		100	91		66
13.2 mm	73	100	97	84	100	57
4.75 mm	65	99	95	77	99	37
2.00 mm	61	98	95	72	97	28
0.425 mm	51	91	91	67	95	20
0.075 mm	22	25	36	31	94	9

SOIL MORTAR ANALYSIS - TMH 1 Test Method A5

COARSE SAND (%)	16	7	4	7	2	29
COARSE FINE SAND (%)	10	12	7	3	0	10
MEDIUM FINE SAND (%)	12	19	15	5	0	11
FINE FINE SAND (%)	26	37	37	42	1	17
PASSING 0.075mm (%)	35	25	37	43	96	33
GRADING MODULUS	1.67	0.86	0.79	1.30	0.15	2.43

ATTERBERG LIMITS : TMH 1 Test Method A2 - A4

LIQUID LIMIT	23			24	42	31
PLASTICITY INDEX	5	NP	NP	4	15	6
LINEAR SHRINKAGE	2.5	0.0	0.0	2.0	7.5	3.0

C.B.R. : TMH 1 Test Method A7 - A8

MOD AASHTO (Kg/m^3)	2027	1864				1917
O.M.C. (%)	10.6	11.8				12.3
C.B.R. @ 100% COMPACTION	15	28				113
C.B.R. @ 98 % COMPACTION	12	22				98
C.B.R. @ 95 % COMPACTION	7	15				80
C.B.R. @ 93 % COMPACTION	4	8				46
C.B.R. @ 90 % COMPACTION	2	2				12
SWELL (MAASHTO) %	0.0	1.1				0.0

Deviation from Test Method : Moisture Contents dried overnight at 105 - 110°C.

Name : Wouter Steyn
Position : Laboratory Manager

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17.11.2008
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ATTENTION : Mr. R. Bradshaw
JOB CARD No. : C12218
SAMPLING PROCEDURE: Delivered to the laboratory

PROJECT : Shoprite Wells Estate
JOB/ROAD : -
SUBMISSION DATE : 24.03.2011
DATE TESTED : 04.04.2011
REPORT DATE : 05.04.2011
PKG

INDICATOR / CBR RESULT SUMMARY

SAMPLE NUMBER	X126002	X126003	X126004	X126005	X126006	
LAYER						
CO-ORDINATES						
STAKE VALUE	TP 30	TP 31	TP 31	TP 32	Fill	
OFF SET						
DEPTH m	2.6-4.4	3.95-4.3	4.3-4.5	0-0.9		
DESCRIPTION	Light yellowish brown Sand	Light grey Clay with Calcrete	Dark grey speckled yellowish clayey Mudstone	Dark brown silty Sand with Calcrete	Dark brown silty Sand with Calcrete	
AASHTO CLASSIFICATION	A-4(0)	A-4(1)	A-7(18)	A-2-4(0)	A-3(0)	
Indicator & CBR results comply to TRH14 Specification of				G8	G9	

SIEVE ANALYSIS - TMH 1 Test Method A1(a)

% PASSING 105.0 mm						
75.0 mm						
63.0 mm						
53.0 mm				100	100	
37.5 mm				97	94	
26.5 mm				94	90	
19.0 mm	100	100		90	86	
13.2 mm	98	98		85	84	
4.75 mm	96	93		80	79	
2.00 mm	93	88	100	77	77	
0.425 mm	88	76	99	72	71	
0.075 mm	39	48	98	29	38	

SOIL MORTAR ANALYSIS - TMH 1 Test Method A5

COARSE SAND	(%)	5	14	1	6	8	
COARSE FINE SAND	(%)	2	2	0	8	7	
MEDIUM FINE SAND	(%)	5	4	0	14	11	
FINE FINE SAND	(%)	46	27	0	34	25	
PASSING 0.075mm	(%)	41	55	98	38	49	
GRADING MODULUS		0.80	0.88	0.03	1.22	1.14	

ATTERBERG LIMITS : TMH 1 Test Method A2 - A4

LIQUID LIMIT		25	46	27	31	
PLASTICITY INDEX	NP	7	14	5	9	
LINEAR SHRINKAGE	0.0	3.5	7.0	3.0	4.5	

C.B.R. : TMH 1 Test Method A7 - A8

MOD AASHTO (Kg/m^3)				1885	1807	
O.M.C. (%)				12.0	14.8	
C.B.R. @ 100% COMPACTION				36	13	
C.B.R. @ 98 % COMPACTION				33	12	
C.B.R. @ 95 % COMPACTION				30	9	
C.B.R. @ 93 % COMPACTION				13	7	
C.B.R. @ 90 % COMPACTION				1	4	
SWELL (MAASHTO) %				0.2	0.2	

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Deviation from Test Method : Moisture Contents dried overnight at 105 - 110°C.

Name : Wouter Steyn
Position : Laboratory Manager

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17.11.2008
Labco SF 33

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CIVIL ENGINEERING MATERIALS TESTING SERVICES (PTY) Ltd

CUSTOMER : RA Bradshaw & Associates cc
17 Midwood Avenue
Newlands
Cape Town, 7708

ATTENTION : Mr. R. Bradshaw

JOB CARD No. : C12032

SAMPLING PROCEDURE: Delivered to the laboratory

PROJECT : Shoprite Wells Estate

JOB/ROAD : -

SUBMISSION DATE : 24.02.2011

DATE TESTED : 02.03.2011

REPORT DATE : 02.03.2011

SD

MOISTURE CONTENT SUMMARY

SAMPLE NUMBER		X125196	X125152	X125153	X125154	X125155	X125193
TEST PIT NUMBER		TP 2	TP 5	TP 5	TP 14	TP 14	TP 16
STAKE VALUE							
OFF SET							
DEPTH (m)		2.0	0-0.25	0.25-1.25	0.15-0.95	0.95-1.55	1.9
DESCRIPTION							
Moisture Content	%	10.5	7.5	10.6	10.0	7.3	3.7

SAMPLE NUMBER		X125194	X125195	X125197	X125253		
TEST PIT NUMBER		TP 16	TP 16	TP 20	TP 10		
STAKE VALUE							
OFF SET							
DEPTH (m)		0.1	2.9-3.6	2.0	2.0		
DESCRIPTION							
Moisture Content	%	6.1	6.5	6.5	5.8		

SAMPLE NUMBER							
TEST PIT NUMBER							
STAKE VALUE							
OFF SET							
DEPTH (m)							
DESCRIPTION							
Moisture Content	%						

SAMPLE NUMBER							
TEST PIT NUMBER							
STAKE VALUE							
OFF SET							
DEPTH (m)							
DESCRIPTION							
Moisture Content	%						

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Deviation from Test Method : Moisture Contents dried overnight at 105 - 110°C.

Name : Wouter Steyn
Position : Laboratory Manager

Revision 2
17.11.2008
Labco SF 38

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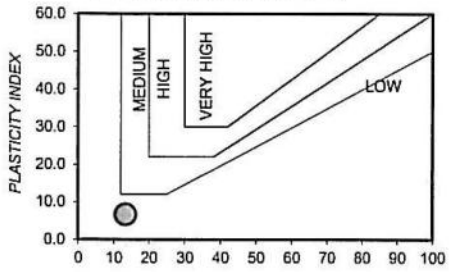
CIVIL ENGINEERING MATERIALS TESTING SERVICES (PTY) Ltd T0227

CLIENT : RA Bradshaw & Associates cc	**PROJECT :** Shoprite Wells Estate
17 Midwood Avenue	**JOB CARD NUMBER:** C12032
Newlands	**SUBMISSION DATE:** 24.02.2011
Cape Town	**DATE TESTED:** 03.03.2011
7708	**REPORT DATE:** 03.03.2011 SD
ATT: Mr. R. Bradshaw	**SECTION:** TP 2 @ 3.5-4.0m

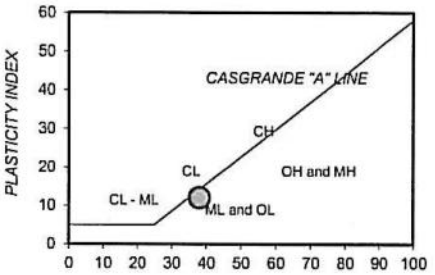
FOUNDATION INDICATOR (TMH 1 :1979 methods A1, A2, A3, A4, A5 & A6*)

S/No. & Description		X125185 -
Sieve analysis Cumulative percentage passing (mm)	75.0	100
	63.0	92
	53.0	92
	37.5	79
	26.5	61
	19.0	57
	13.2	57
	4.75	57
	2.000	56
	0.425	56
	0.075	53
	0.060	53
	0.006	24
	0.0018	13
Soil Mortar Analysis % < 2.00mm	Coarse Sand	0.0
	Coarse Fine Sand	0.0
	Medium Fine Sand	1.0
	Fine Fine Sand	4.0
	Passing 0.075	95.0
Oversize Index		21.0
Shrinkage Product		336.0
Grading Coefficient		2.9
Grading modulus		1.35
Atter-berg Limits	Liquid Limit	38
	Plasticity Index	12
	Linear Shrinkage	6.0

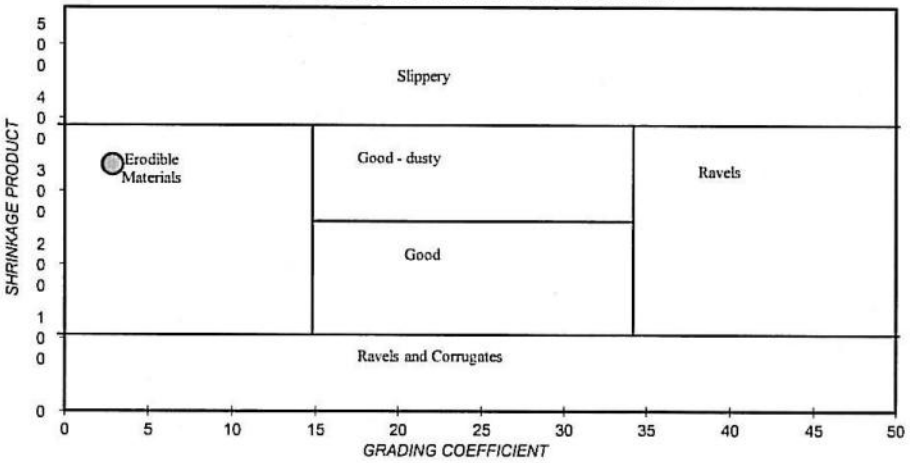
POTENTIAL EXPANSION



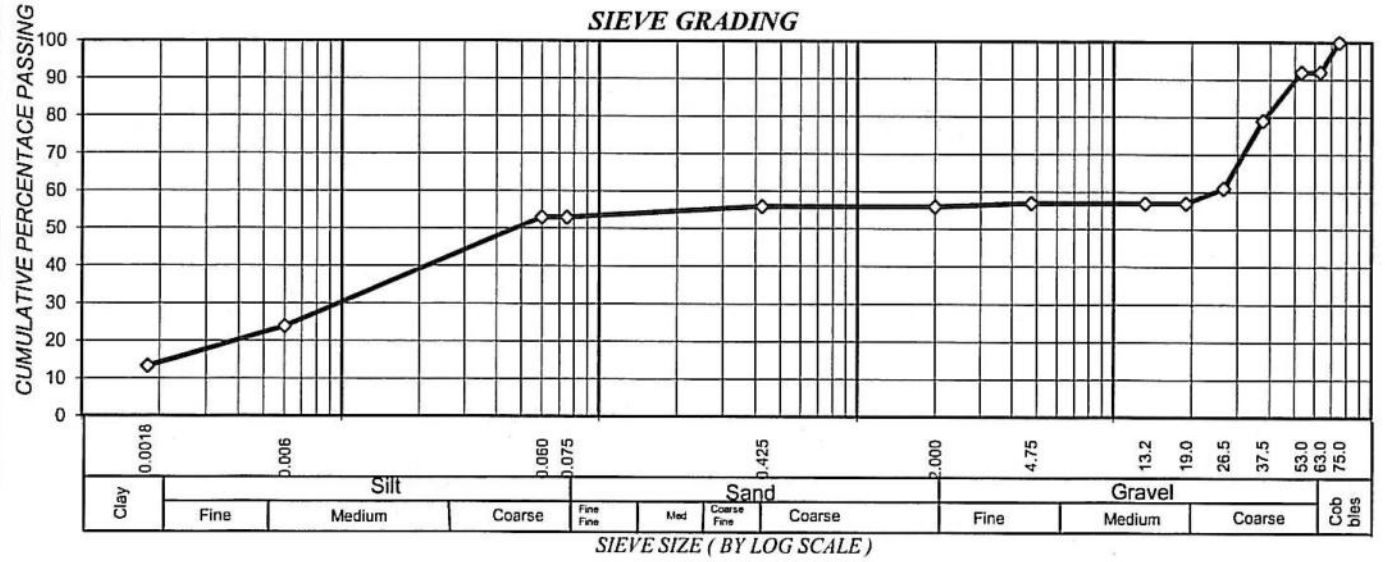
PLASTICITY CHART



PERFORMANCE AS WEARING COURSE



SIEVE GRADING



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Name: Wouter Steyn
Position: Laboratory Manager

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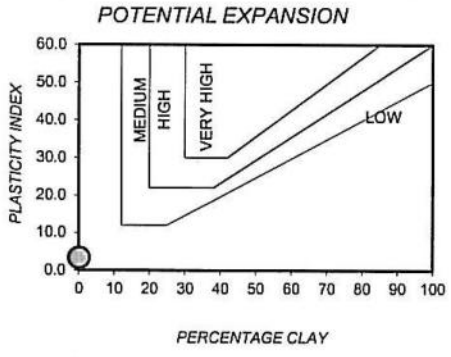
CIVIL ENGINEERING MATERIALS TESTING SERVICES (PTY) Ltd T0227

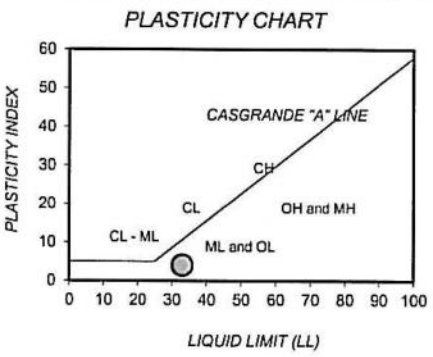
CLIENT : RA Bradshaw & Associates cc
17 Midwood Avenue
Newlands
Cape Town
7708
ATT: Mr. R. Bradshaw

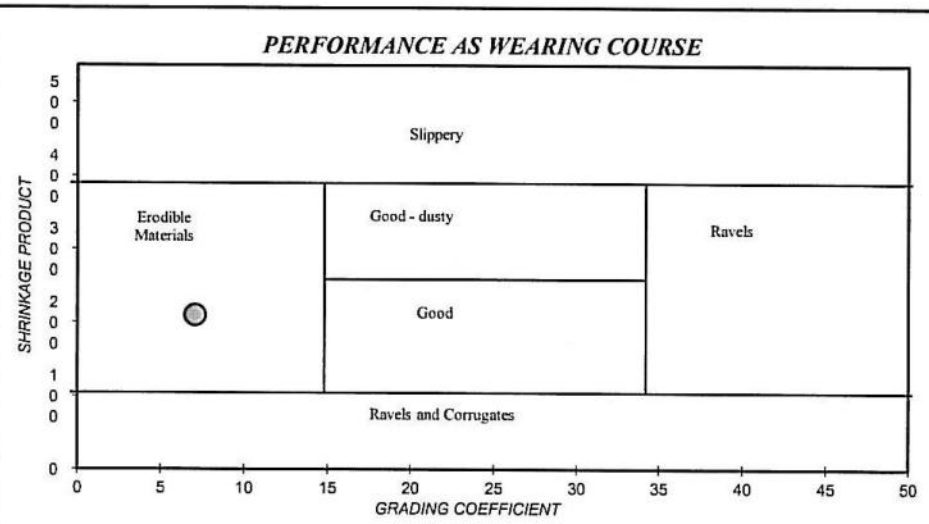
PROJECT : Shoprite Wells Estate
JOB CARD NUMBER: C12032
SUBMISSION DATE: 24.02.2011
DATE TESTED: 03.03.2011
REPORT DATE: 03.03.2011 SD
SECTION: TP 2 @ 1.2-1.9m

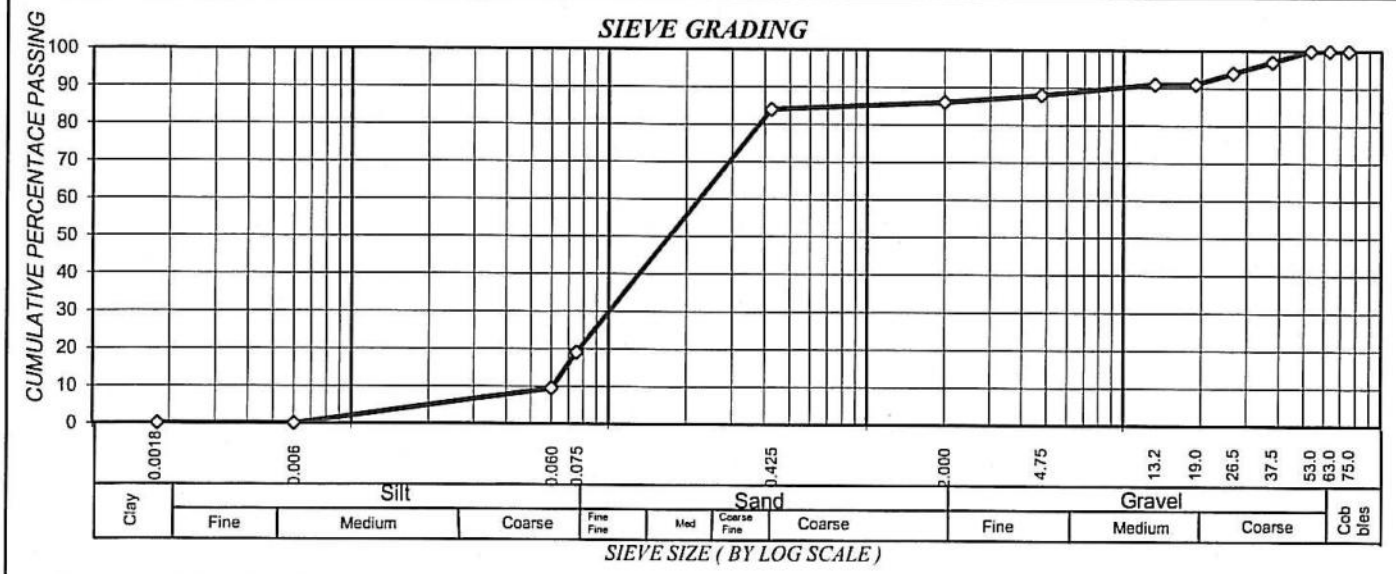
FOUNDATION INDICATOR (TMH 1 :1979 methods A1, A2, A3, A4, A5 & A6*)

S/No. & Description		X125148 -
Sieve analysis Cumulative percentage passing (mm)	75.0	100
	63.0	100
	53.0	100
	37.5	97
	26.5	94
	19.0	91
	13.2	91
	4.75	88
	2.000	86
	0.425	84
	0.075	19
	0.060	10
	0.006	0
	0.0018	0
Soil Mortar Analysis % < 2.00mm	Coarse Sand	2.0
	Coarse Fine Sand	1.0
	Medium Fine Sand	5.0
	Fine Fine Sand	70.0
	Passing 0.075	22.0
Oversize Index		3.0
Shrinkage Product		210.0
Grading Coefficient		7.0
Grading modulus		1.11
Atter-berg Limits	Liquid Limit	33
	Plasticity Index	4
	Linear Shrinkage	2.5









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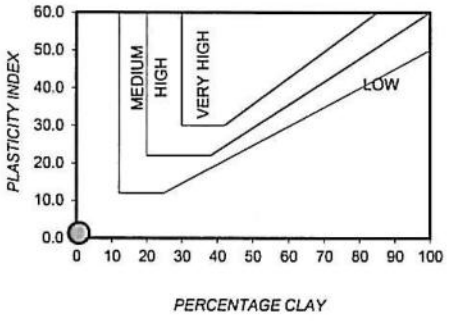
CIVIL ENGINEERING MATERIALS TESTING SERVICES (PTY) Ltd T0227

CLIENT :	RA Bradshaw & Associates cc	**PROJECT :**	Shoprite Wells Estate
	17 Midwood Avenue	**JOB CARD NUMBER:**	C12032
	Newlands	**SUBMISSION DATE:**	24.02.2011
	Cape Town	**DATE TESTED:**	03.03.2011
	7708	**REPORT DATE:**	03.03.2011 SD
ATT:	Mr. R. Bradshaw	**SECTION:**	TP 4 @ 3.3-3.9m

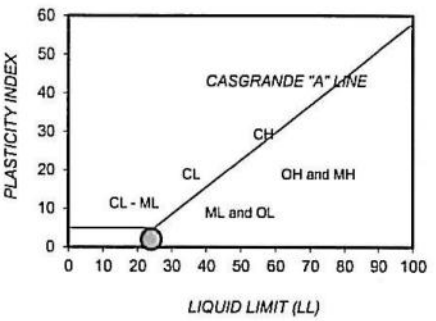
FOUNDATION INDICATOR (TMH 1 :1979 methods A1, A2, A3, A4, A5 & A6*)

S/No. & Description		X125149 -
Sieve analysis Cumulative percentage passing (mm)	75.0	100
	63.0	100
	53.0	100
	37.5	100
	26.5	94
	19.0	92
	13.2	88
	4.75	79
	2.000	73
	0.425	65
	0.075	24
	0.060	19
	0.006	3
	0.0018	1
Soil Mortar Analysis % < 2.00mm	Coarse Sand	11.0
	Coarse Fine Sand	2.0
	Medium Fine Sand	6.0
	Fine Fine Sand	48.0
	Passing 0.075	33.0
Oversize Index		0.0
Shrinkage Product		65.0
Grading Coefficient		16.6
Grading modulus		1.38
Atter-berg Limits	Liquid Limit	24
	Plasticity Index	2
	Linear Shrinkage	1.0

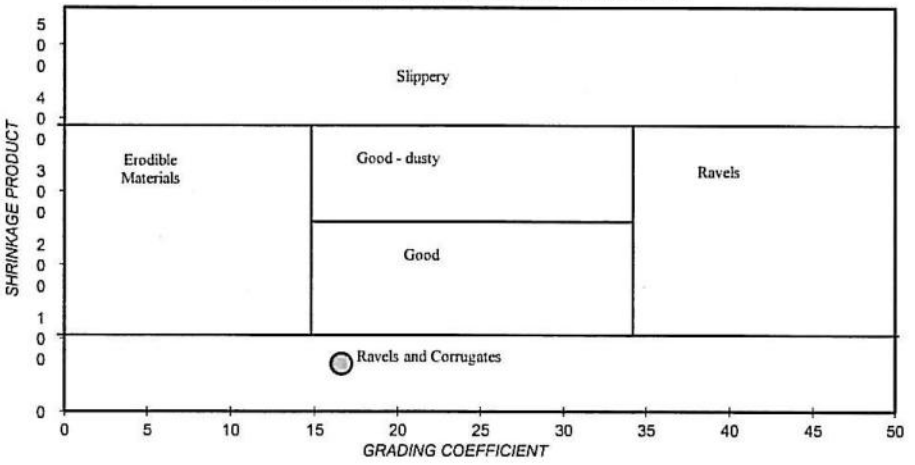
POTENTIAL EXPANSION



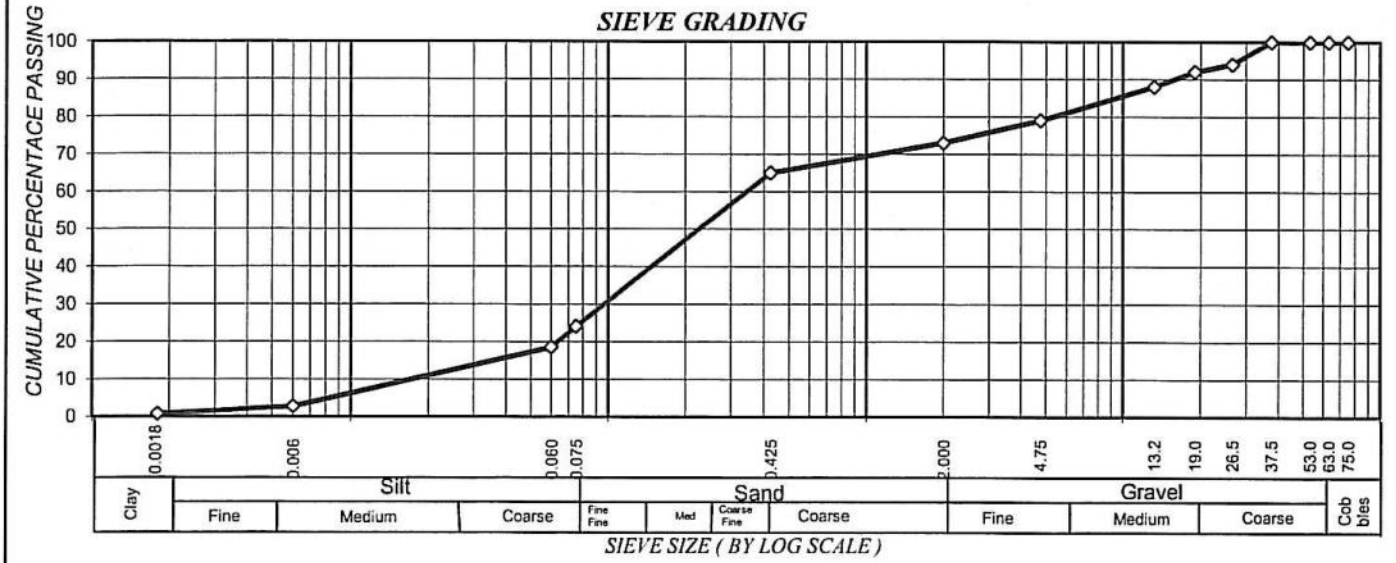
PLASTICITY CHART



PERFORMANCE AS WEARING COURSE



SIEVE GRADING



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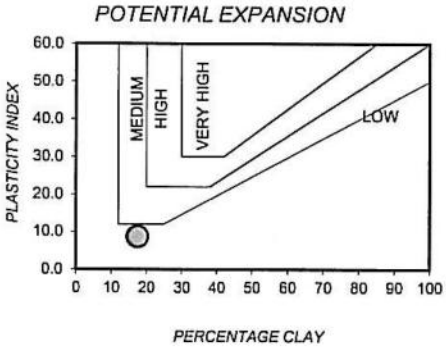
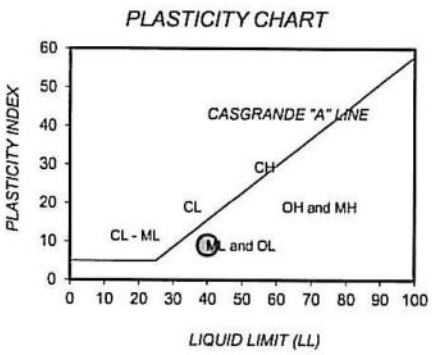
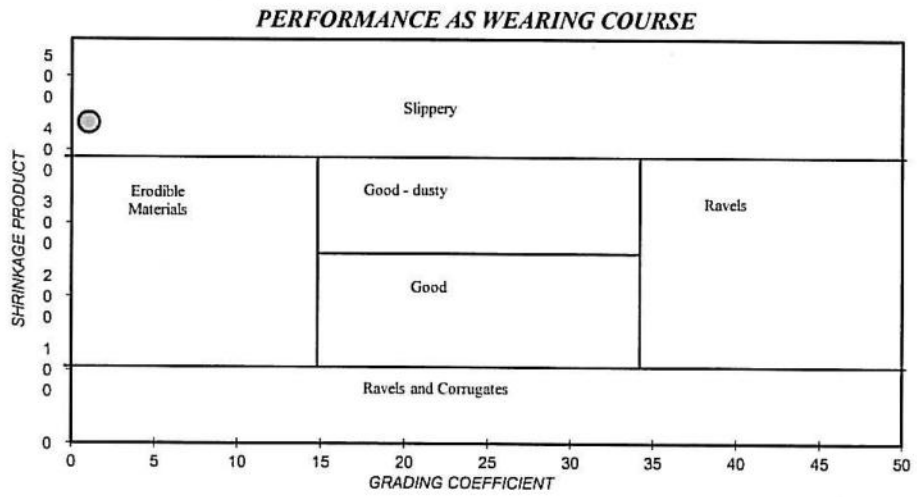
CLIENT : RA Bradshaw & Associates cc	**PROJECT :** Shoprite Wells Estate
17 Midwood Avenue	**JOB CARD NUMBER:** C12032
Newlands	**SUBMISSION DATE:** 24.02.2011
Cape Town	**DATE TESTED:** 03.03.2011
7708	**REPORT DATE:** 03.03.2011 SD
ATT: Mr. R. Bradshaw	**SECTION:** TP 4 @ 3.9-4.5m

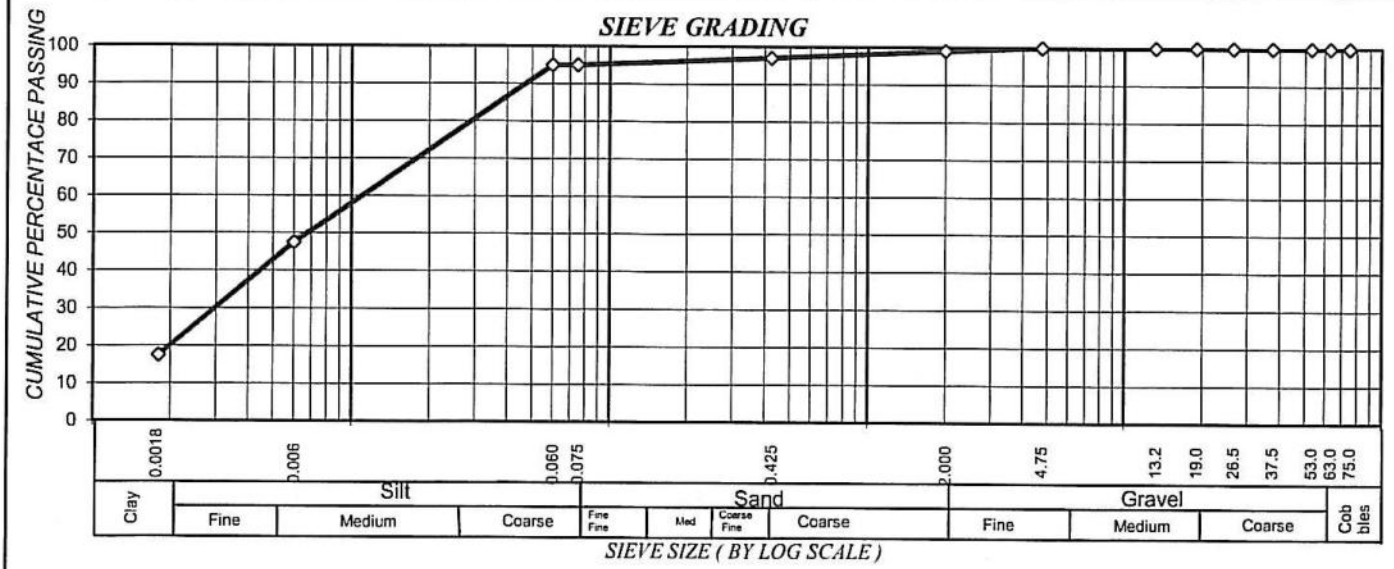
FOUNDATION INDICATOR (TMH 1 :1979 methods A1, A2, A3, A4, A5 & A6*)

S/No. & Description		X125150 -
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	100
	2.000	99
	0.425	97
	0.075	95
	0.060	95
	0.006	48
	0.0018	17
Soil Mortar Analysis % < 2.00mm	Coarse Sand	2.0
	Coarse Fine Sand	0.0
	Medium Fine Sand	0.0
	Fine Fine Sand	2.0
	Passing 0.075	96.0
Oversize Index		0.0
Shrinkage Product		436.5
Grading Coefficient		1.0
Grading modulus		0.09
Atter-berg Limits	Liquid Limit	40
	Plasticity Index	9
	Linear Shrinkage	4.5









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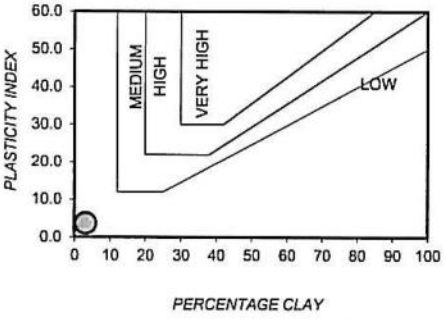
CIVIL ENGINEERING MATERIALS TESTING SERVICES (PTY) Ltd T0227

CLIENT :	RA Bradshaw & Associates cc	**PROJECT :**	Shoprite Wells Estate
	17 Midwood Avenue	**JOB CARD NUMBER:**	C12032
	Newlands	**SUBMISSION DATE:**	24.02.2011
	Cape Town	**DATE TESTED:**	03.03.2011
	7708	**REPORT DATE:**	03.03.2011 SD
ATT:	Mr. R. Bradshaw	**SECTION:**	TP 4 @ 1.6-3.3m

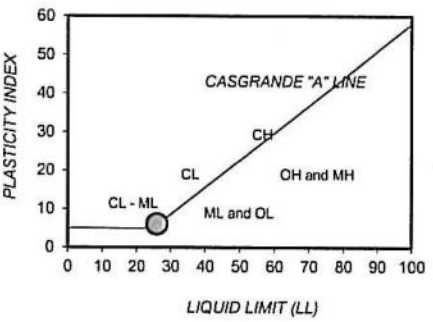
FOUNDATION INDICATOR (TMH 1 :1979 methods A1, A2, A3, A4, A5 & A6*)

S/No. & Description		X125187 -
Sieve analysis Cumulative percentage passing (mm)	75.0	100
	63.0	100
	53.0	91
	37.5	91
	26.5	88
	19.0	84
	13.2	79
	4.75	72
	2.000	67
	0.425	61
	0.075	34
	0.060	30
	0.006	8
	0.0018	3
Soil Mortar Analysis % < 2.00mm	Coarse Sand	9.0
	Coarse Fine Sand	3.0
	Medium Fine Sand	6.0
	Fine Fine Sand	31.0
	Passing 0.075	51.0
Oversize Index		9.0
Shrinkage Product		183.0
Grading Coefficient		15.1
Grading modulus		1.38
Atter-berg Limits	Liquid Limit	26
	Plasticity Index	6
	Linear Shrinkage	3.0

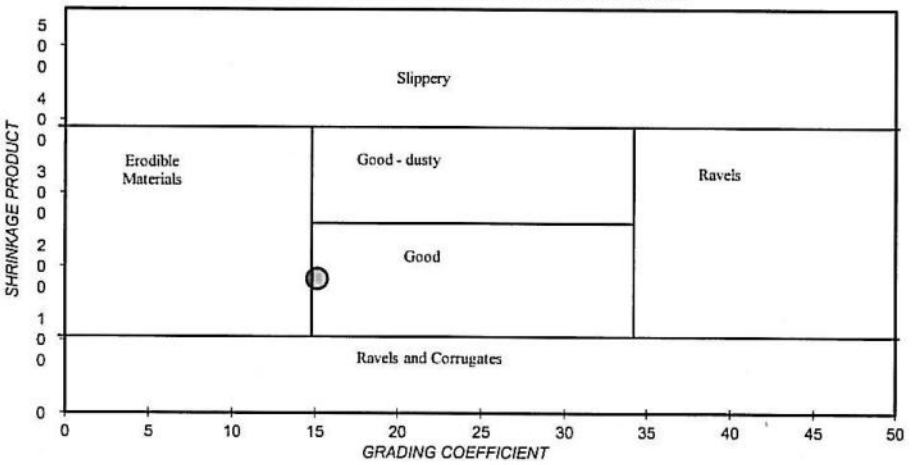
POTENTIAL EXPANSION



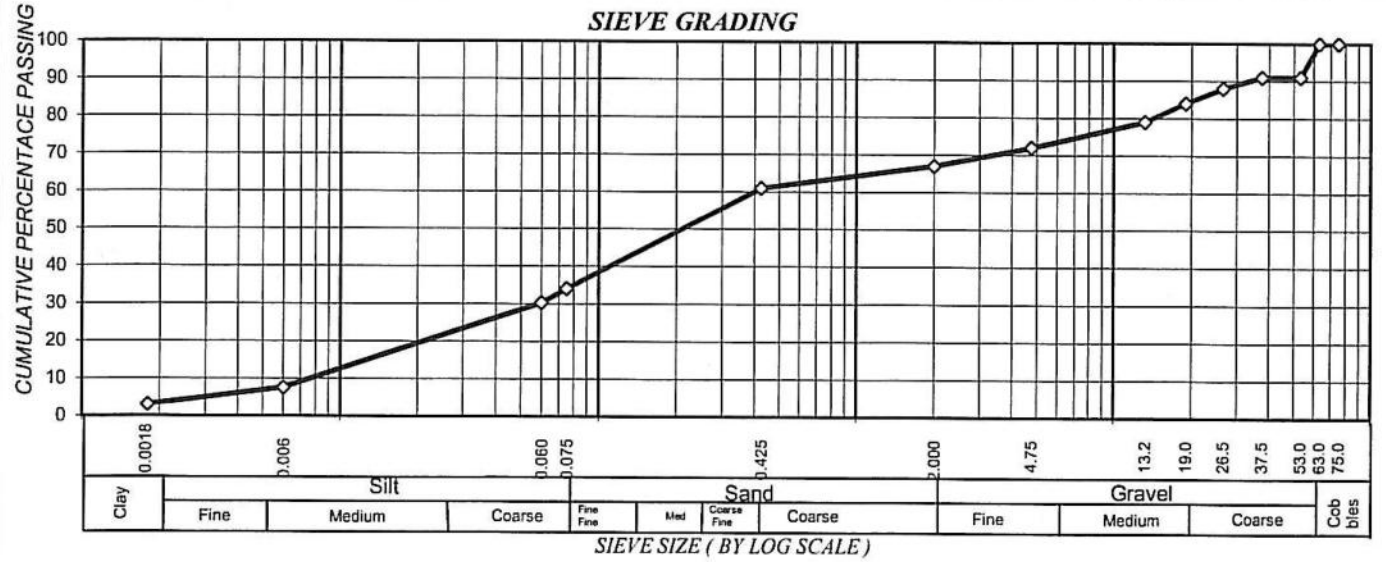
PLASTICITY CHART



PERFORMANCE AS WEARING COURSE



SIEVE GRADING



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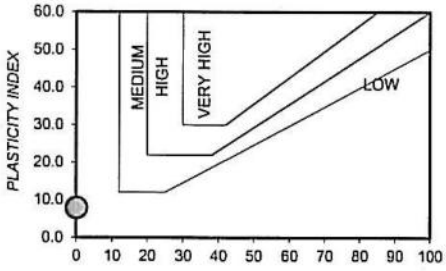
CLIENT : RA Bradshaw & Associates cc	**PROJECT :** Shoprite Wells Estate
17 Midwood Avenue	**JOB CARD NUMBER:** C12032
Newlands	**SUBMISSION DATE:** 24.02.2011
Cape Town	**DATE TESTED:** 03.03.2011
7708	**REPORT DATE:** 03.03.2011 SD
ATT: Mr. R. Bradshaw	**SECTION:** TP 5 @ 0-0.25m

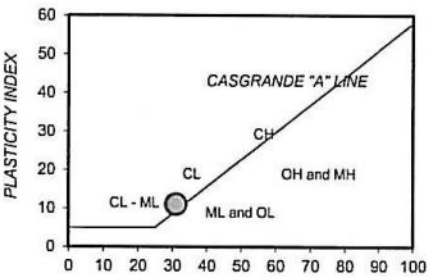
FOUNDATION INDICATOR (TMH 1 :1979 methods A1, A2, A3, A4, A5 & A6*)

S/No. & Description		X125152 -
Sieve analysis Cumulative percentage passing (mm)	75.0	100
	63.0	100
	53.0	100
	37.5	93
	26.5	83
	19.0	78
	13.2	76
	4.75	75
	2.000	75
	0.425	72
	0.075	42
	0.060	32
	0.006	0
	0.0018	0
Soil Mortar Analysis % < 2.00mm	Coarse Sand	4.0
	Coarse Fine Sand	5.0
	Medium Fine Sand	9.0
	Fine Fine Sand	26.0
	Passing 0.075	56.0
Oversize Index		7.0
Shrinkage Product		396.0
Grading Coefficient		6.0
Grading modulus		1.11
Atter-berg Limits	Liquid Limit	31
	Plasticity Index	11
	Linear Shrinkage	5.5

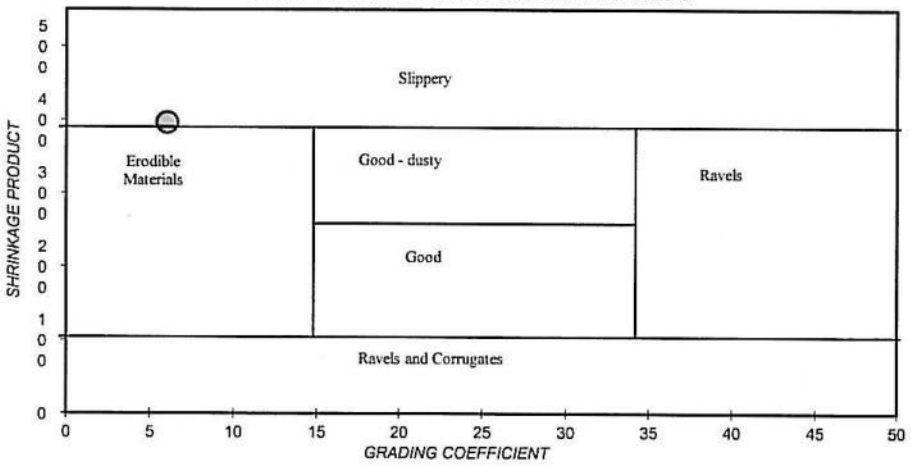
POTENTIAL EXPANSION



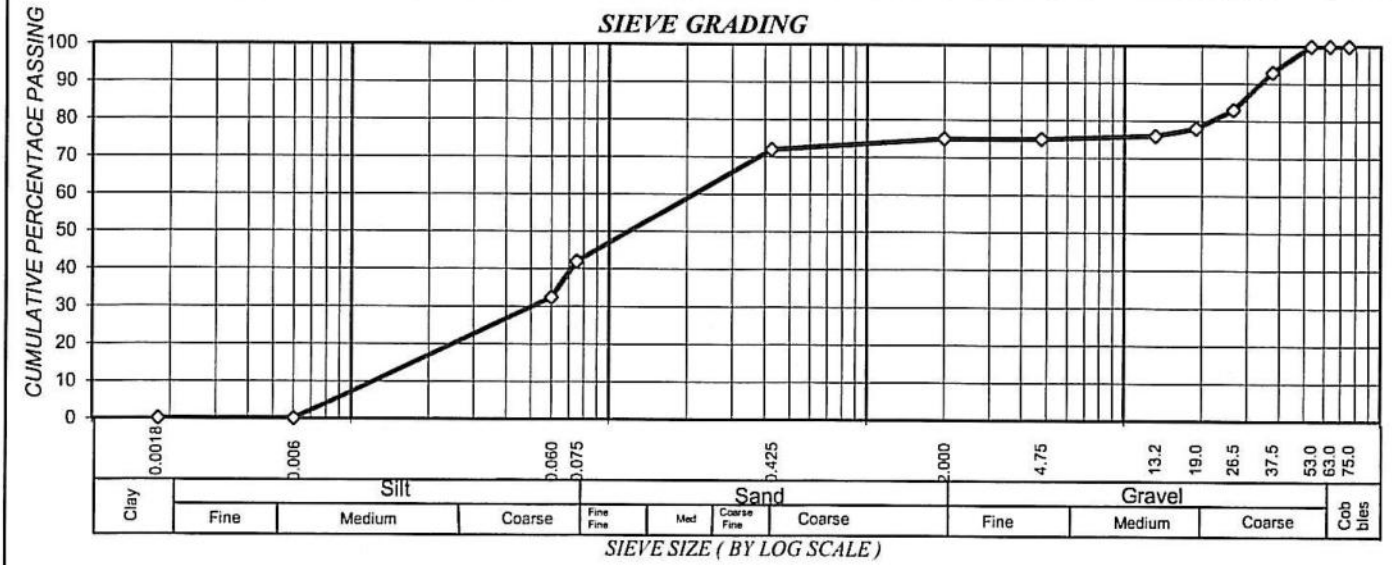
PLASTICITY CHART



PERFORMANCE AS WEARING COURSE



SIEVE GRADING



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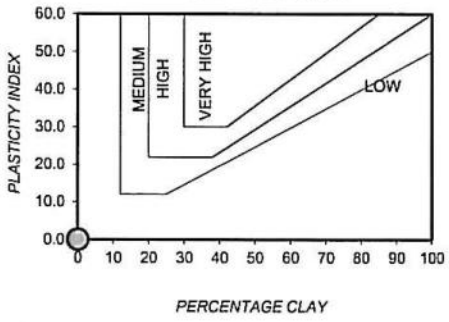
	Newlands	**SUBMISSION DATE:**	24.02.2011
	Cape Town	**DATE TESTED:**	03.03.2011
	7708	**REPORT DATE:**	03.03.2011 SD
ATT:	Mr. R. Bradshaw	**SECTION:**	TP 10 @ 1.8-2.75m

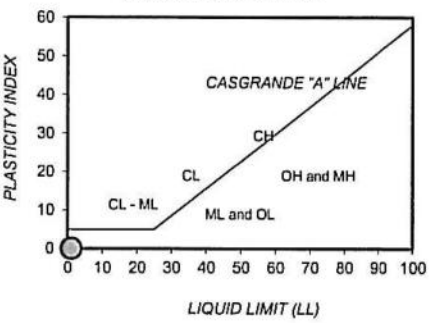
FOUNDATION INDICATOR (TMH 1 :1979 methods A1, A2, A3, A4, A5 & A6*)

S/No. & Description		X125183 -
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	99
	4.75	97
	2.000	93
	0.425	84
	0.075	18
	0.060	11
	0.006	0
	0.0018	0
Soil Mortar Analysis % < 2.00mm	Coarse Sand	10.0
	Coarse Fine Sand	10.0
	Medium Fine Sand	16.0
	Fine Fine Sand	45.0
	Passing 0.075	19.0
Oversize Index		0.0
Shrinkage Product		0.0
Grading Coefficient		6.8
Grading modulus		1.05
Atter-berg Limits	Liquid Limit	-
	Plasticity Index	NP
	Linear Shrinkage	0.0

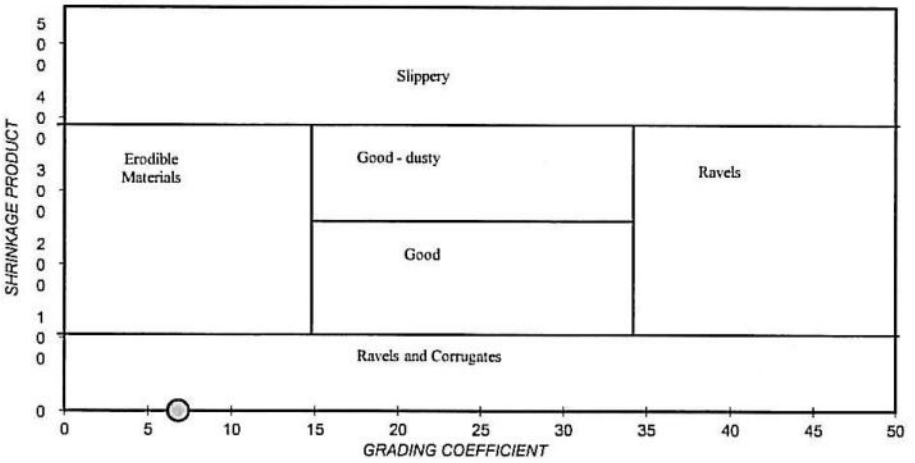
POTENTIAL EXPANSION



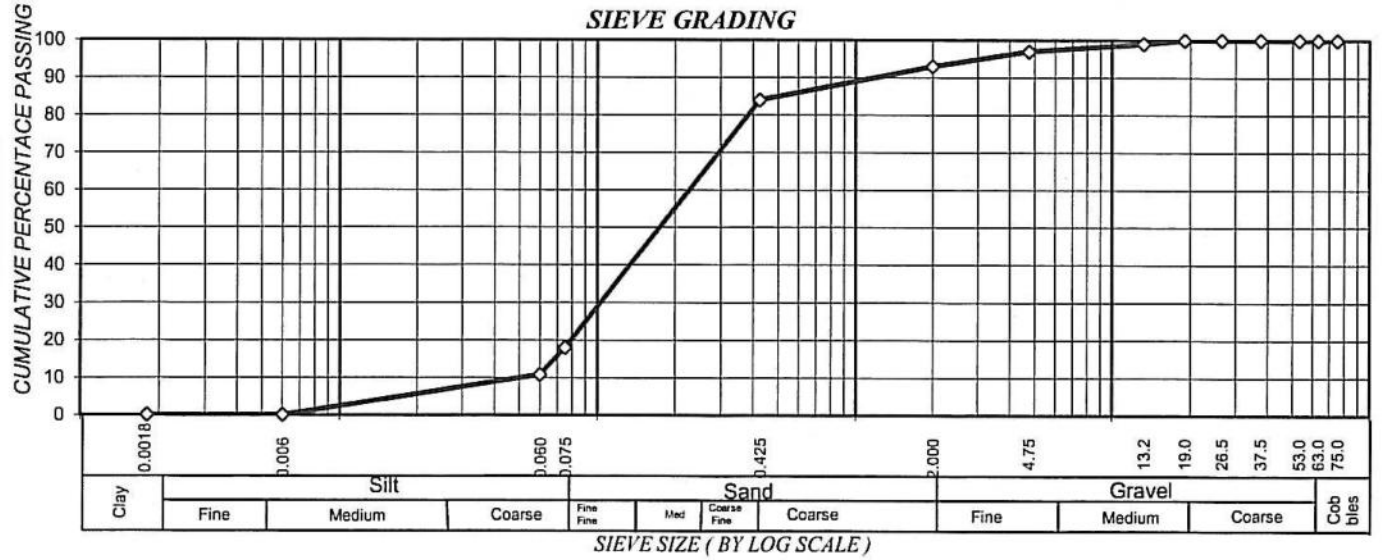
PLASTICITY CHART



PERFORMANCE AS WEARING COURSE



SIEVE GRADING



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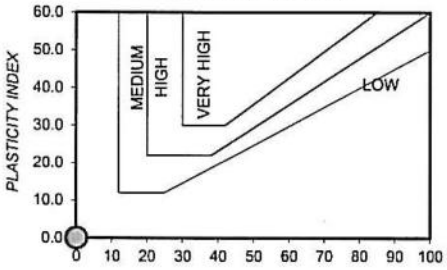
	Newlands	**SUBMISSION DATE:**	24.02.2011
	Cape Town	**DATE TESTED:**	03.03.2011
	7708	**REPORT DATE:**	03.03.2011 SD
ATT:	Mr. R. Bradshaw	**SECTION:**	TP 13 @ 0-0.45m

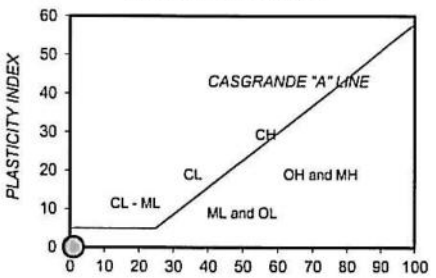
FOUNDATION INDICATOR (TMH 1 :1979 methods A1, A2, A3, A4, A5 & A6*)

S/No. & Description		X125151 -
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	100
	2.000	100
	0.425	96
	0.075	64
	0.060	43
	0.006	0
	0.0018	0
Soil Mortar Analysis % < 2.00mm	Coarse Sand	4.0
	Coarse Fine Sand	7.0
	Medium Fine Sand	9.0
	Fine Fine Sand	17.0
	Passing 0.075	64.0
Oversize Index		0.0
Shrinkage Product		0.0
Grading Coefficient		0.0
Grading modulus		0.40
Atter-berg Limits	Liquid Limit	-
	Plasticity Index	NP
	Linear Shrinkage	0.0

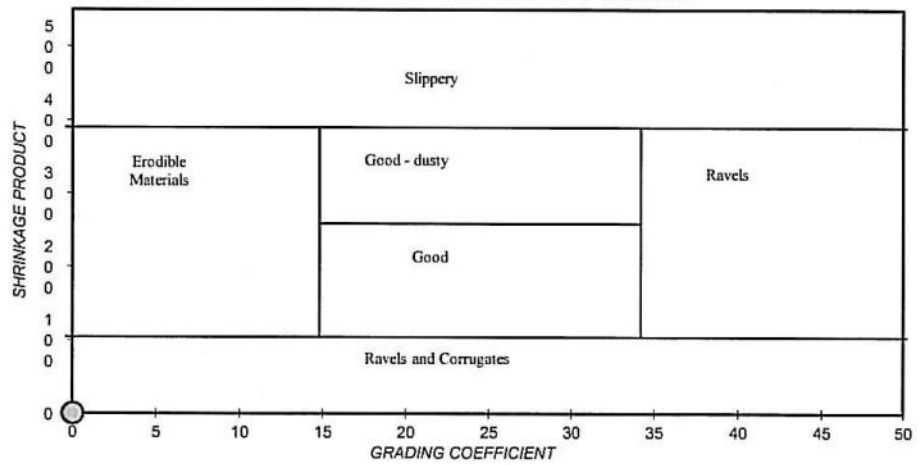
POTENTIAL EXPANSION



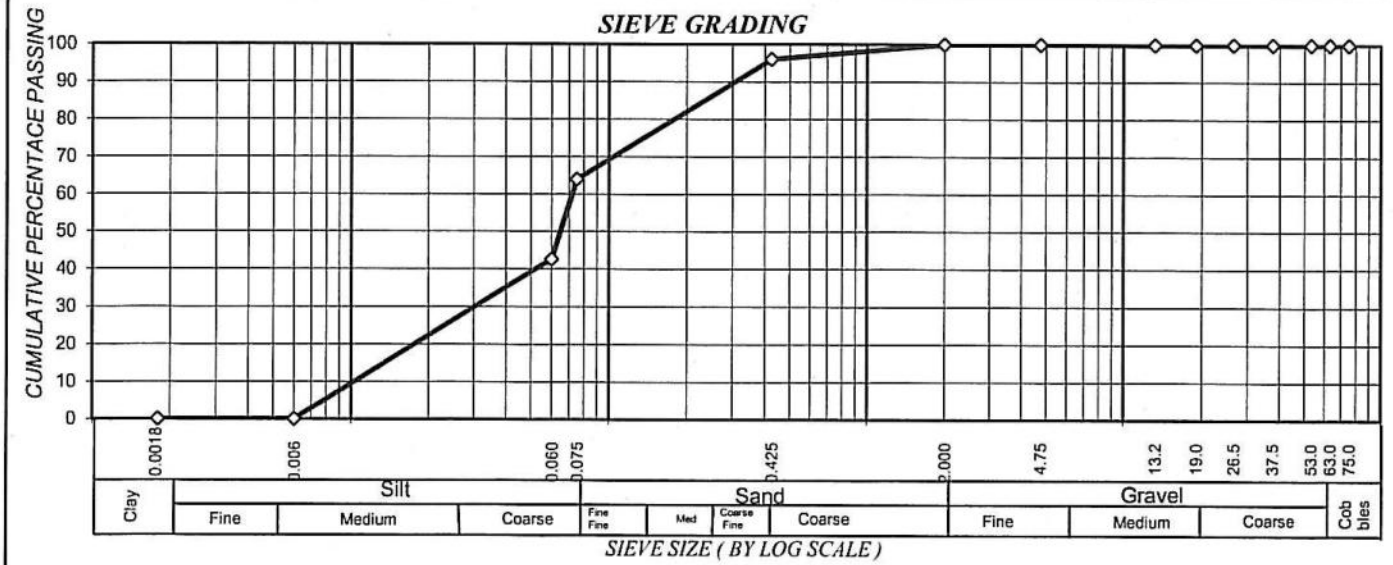
PLASTICITY CHART



PERFORMANCE AS WEARING COURSE



SIEVE GRADING



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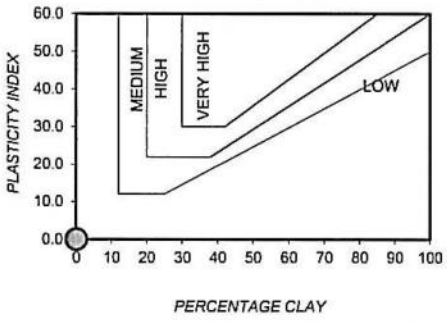
	Newlands	**SUBMISSION DATE:**	24.02.2011
	Cape Town	**DATE TESTED:**	03.03.2011
	7708	**REPORT DATE:**	03.03.2011 SD
ATT:	Mr. R. Bradshaw	**SECTION:**	TP 16 @ 0-0.2m

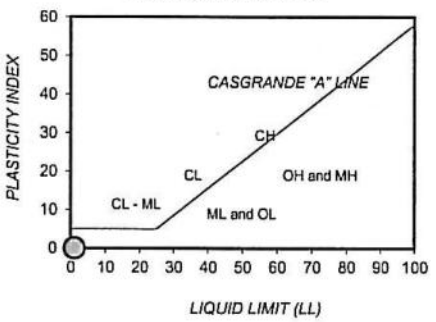
FOUNDATION INDICATOR (TMH 1 :1979 methods A1, A2, A3, A4, A5 & A6*)

S/No. & Description		X125156 -
Sieve analysis Cumulative percentage passing (mm)	75.0	100
	63.0	100
	53.0	94
	37.5	94
	26.5	94
	19.0	93
	13.2	87
	4.75	81
	2.000	79
	0.425	76
	0.075	8
	0.060	6
	0.006	0
	0.0018	0
Soil Mortar Analysis % < 2.00mm	Coarse Sand	4.0
	Coarse Fine Sand	1.0
	Medium Fine Sand	6.0
	Fine Fine Sand	79.0
	Passing 0.075	10.0
Oversize Index		6.0
Shrinkage Product		0.0
Grading Coefficient		12.2
Grading modulus		1.37
Atter-berg Limits	Liquid Limit	-
	Plasticity Index	NP
	Linear Shrinkage	0.0

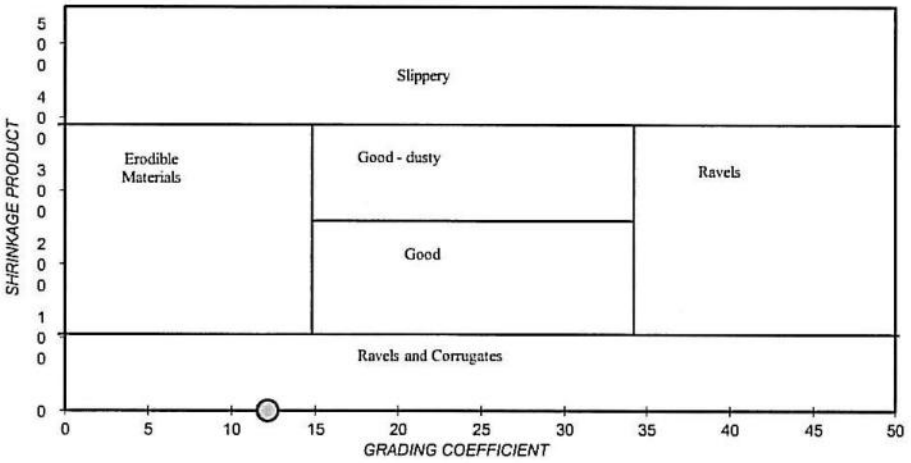
POTENTIAL EXPANSION



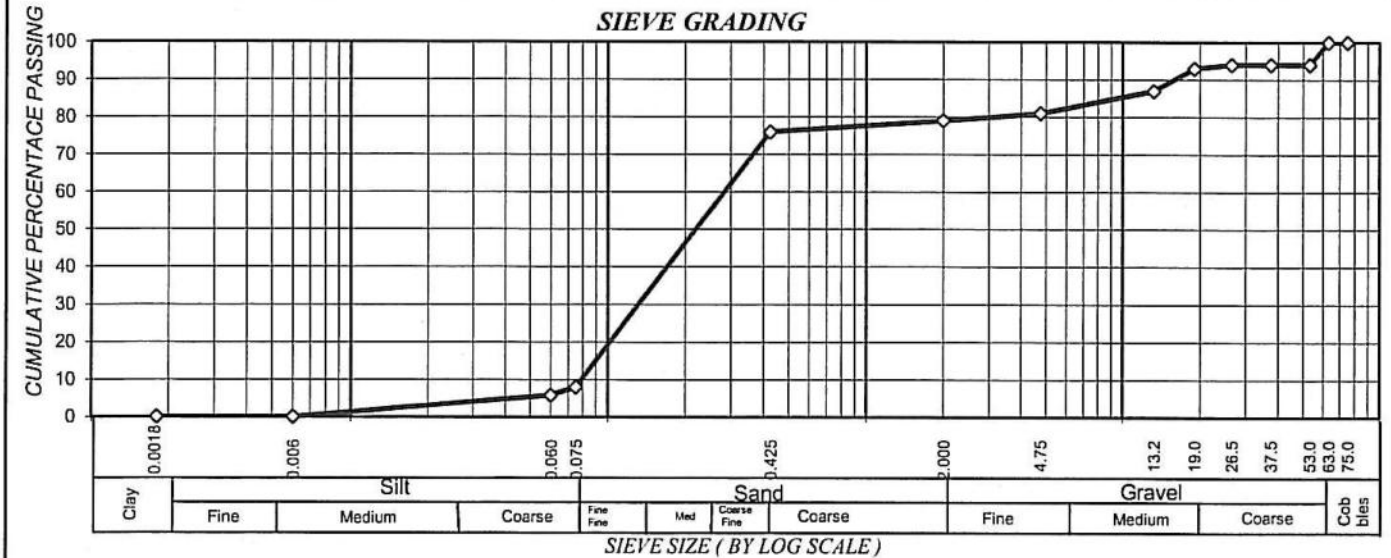
PLASTICITY CHART



PERFORMANCE AS WEARING COURSE



SIEVE GRADING



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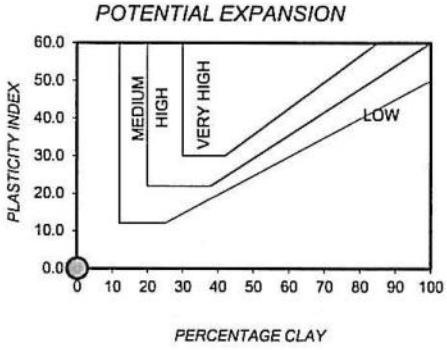
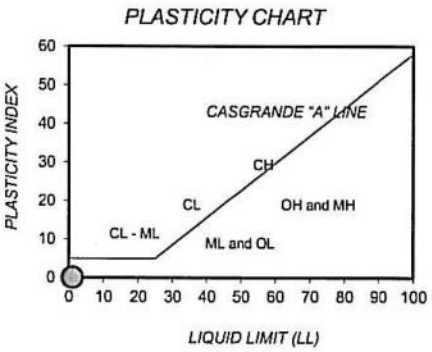
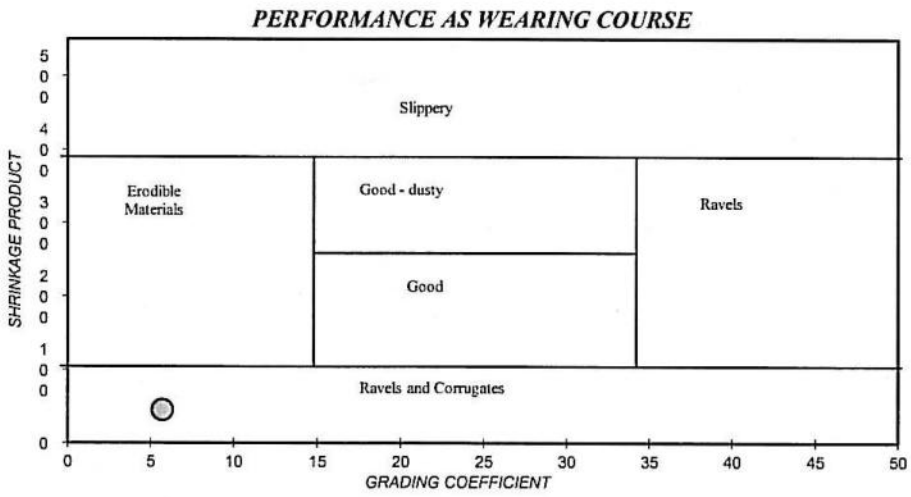
	Cape Town	**DATE TESTED:**	03.03.2011
	7708	**REPORT DATE:**	03.03.2011 SD
ATT:	Mr. R. Bradshaw	**SECTION:**	TP 16 @ 1.5-2.3m

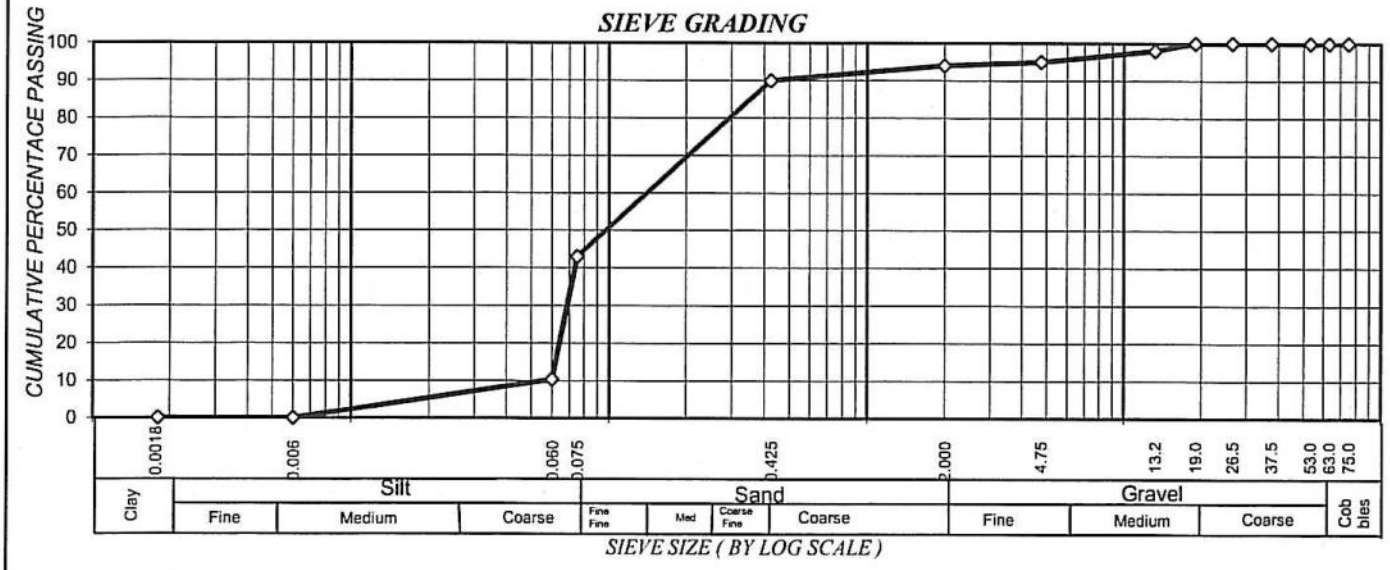
FOUNDATION INDICATOR (TMH 1 :1979 methods A1, A2, A3, A4, A5 & A6*)

S/No. & Description		X125157 -
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	98
	4.75	95
	2.000	94
	0.425	90
	0.075	43
	0.060	10
	0.006	0
	0.0018	0
Soil Mortar Analysis % < 2.00mm	Coarse Sand	4.0
	Coarse Fine Sand	4.0
	Medium Fine Sand	11.0
	Fine Fine Sand	34.0
	Passing 0.075	46.0
Oversize Index		0.0
Shrinkage Product		45.0
Grading Coefficient		5.7
Grading modulus		0.73
Atter-berg Limits	Liquid Limit	-
	Plasticity Index	SP
	Linear Shrinkage	0.5









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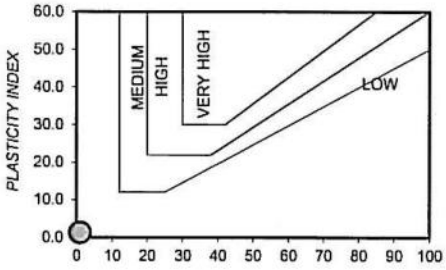
17 Midwood Avenue
Newlands
Cape Town
7708
ATT: Mr. R. Bradshaw

PROJECT : Shoprite Wells Estate
JOB CARD NUMBER: C12032
SUBMISSION DATE: 24.02.2011
DATE TESTED: 03.03.2011
REPORT DATE: 03.03.2011 SD
SECTION: TP 16 @ 2.9-3.6m

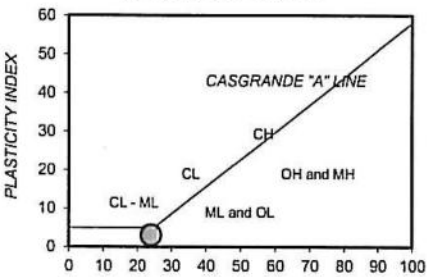
FOUNDATION INDICATOR (TMH 1 :1979 methods A1, A2, A3, A4, A5 & A6*)

S/No. & Description		X125158 -
Sieve analysis Cumulative percentage passing (mm)	75.0	100
	63.0	100
	53.0	100
	37.5	94
	26.5	93
	19.0	91
	13.2	86
	4.75	68
	2.000	55
	0.425	44
	0.075	17
	0.060	14
	0.006	1
	0.0018	1
Soil Mortar Analysis % < 2.00mm	Coarse Sand	20.0
	Coarse Fine Sand	3.0
	Medium Fine Sand	6.0
	Fine Fine Sand	40.0
	Passing 0.075	31.0
Oversize Index		6.0
Shrinkage Product		66.0
Grading Coefficient		25.8
Grading modulus		1.84
Atter-berg Limits	Liquid Limit	24
	Plasticity Index	3
	Linear Shrinkage	1.5

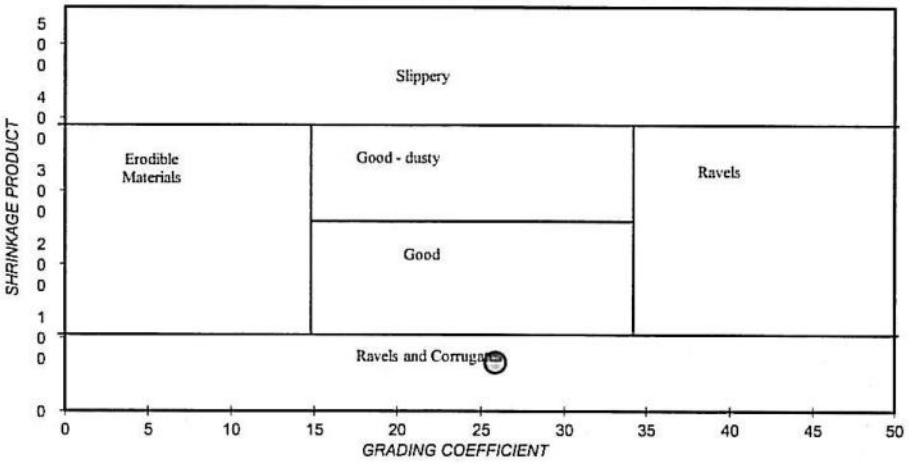
POTENTIAL EXPANSION



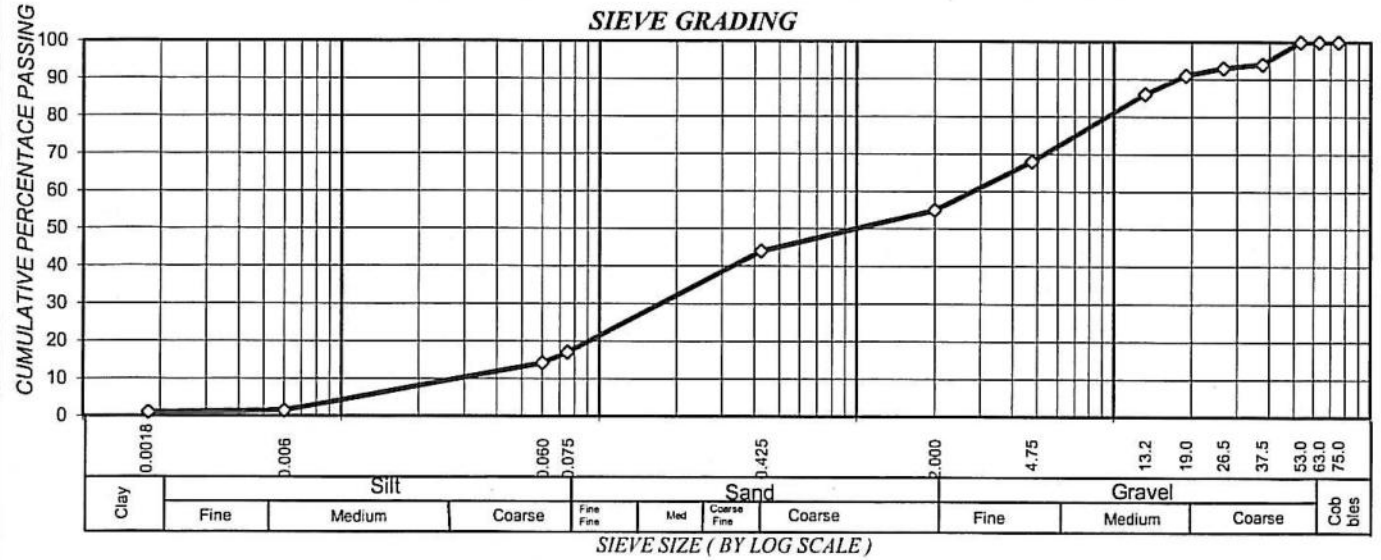
PLASTICITY CHART



PERFORMANCE AS WEARING COURSE



SIEVE GRADING



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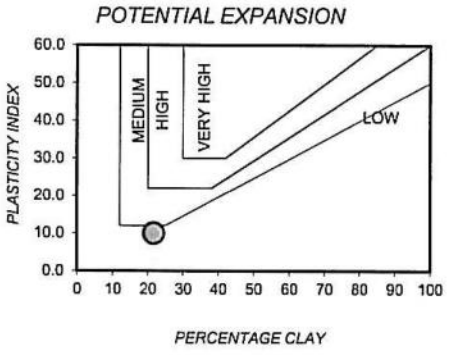
sanas Testing Laboratory

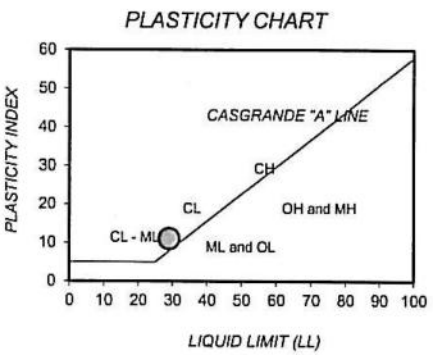
CIVIL ENGINEERING MATERIALS TESTING SERVICES (PTY) Ltd T0227

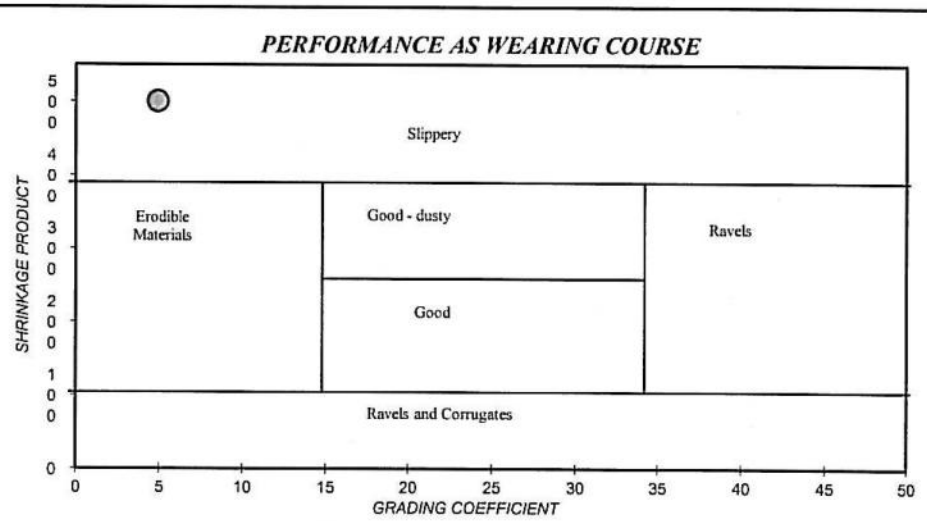
CLIENT : RA Bradshaw & Associates cc	**PROJECT :** Shoprite Wells Estate
17 Midwood Avenue	**JOB CARD NUMBER:** C12032
Newlands	**SUBMISSION DATE:** 24.02.2011
Cape Town	**DATE TESTED:** 03.03.2011
7708	**REPORT DATE:** 03.03.2011 SD
ATT: Mr. R. Bradshaw	**SECTION:** TP 16 @ 3.6-4.1m

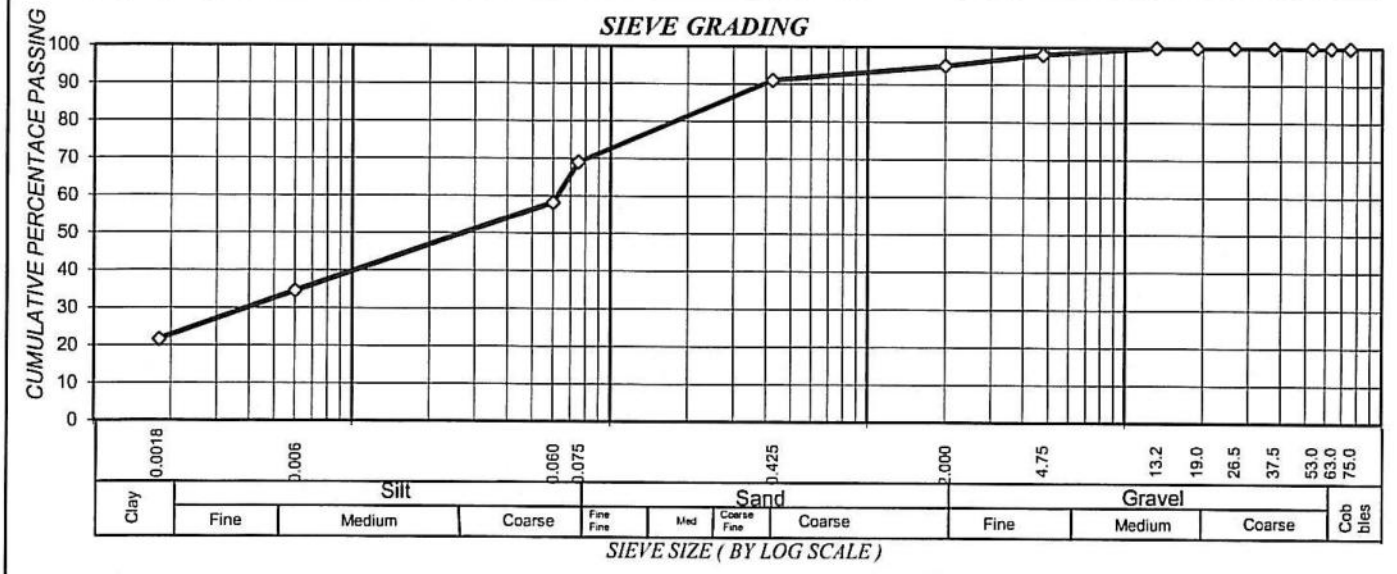
FOUNDATION INDICATOR (TMH 1 :1979 methods A1, A2, A3, A4, A5 & A6*)

S/No. & Description		X125159 -
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	95
	0.425	91
	0.075	69
	0.060	58
	0.006	35
	0.0018	22
Soil Mortar Analysis % < 2.00mm	Coarse Sand	4.0
	Coarse Fine Sand	0.0
	Medium Fine Sand	2.0
	Fine Fine Sand	21.0
	Passing 0.075	73.0
Oversize Index		0.0
Shrinkage Product		500.5
Grading Coefficient		4.9
Grading modulus		0.45
Atter-berg Limits	Liquid Limit	29
	Plasticity Index	11
	Linear Shrinkage	5.5









The above test results are pertinent only to the samples received and tested at the laboratory. This report shall not be reproduced, except in full,without the prior consent of Labco.

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