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A REPORT

ON

A GEOTECHNICAL INVESTIGATION FOR THE PROPOSED ERAND GARDENS EXTENSION 73 TOWNSHIP ON HOLDINGS 222 AND 223, ERAND AGRICULTURAL HOLDINGS EXTENSION 1, MIDRAND, GAUTENG.

BY

RELLY, MILNER AND SHEDDEN
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APPENDICES

1. INTRODUCTION

This report (07139era222) presents the results of a geotechnical investigation carried out for the proposed township of Erand Gardens Extension 73 on Holdings 222 and 223 of Erand Agricultural Holdings Extension 1 in Midrand.

The purpose of the investigation was to provide information on the nature and geotechnical properties of the shallow soils encountered on the site. This information has been obtained so that areas may be delineated where similar geotechnical problems occur. A prospective developer may then assess the suitability of a particular design within a specific area.

This report has been prepared in accordance with guidelines set out by the South African Institute of Engineering and Environmental Geologists (SAIEG) (Reference 8) regarding the establishment of townships in non-dolomitic areas. The contents of this report are intended for use by town planners and Local Authorities and not for use by individual stand owners. It is not the purpose of this report to provide information necessary for detailed foundation design.

The project was commissioned at the written request of Hocrand Trading, the owners and potential developers of the site.

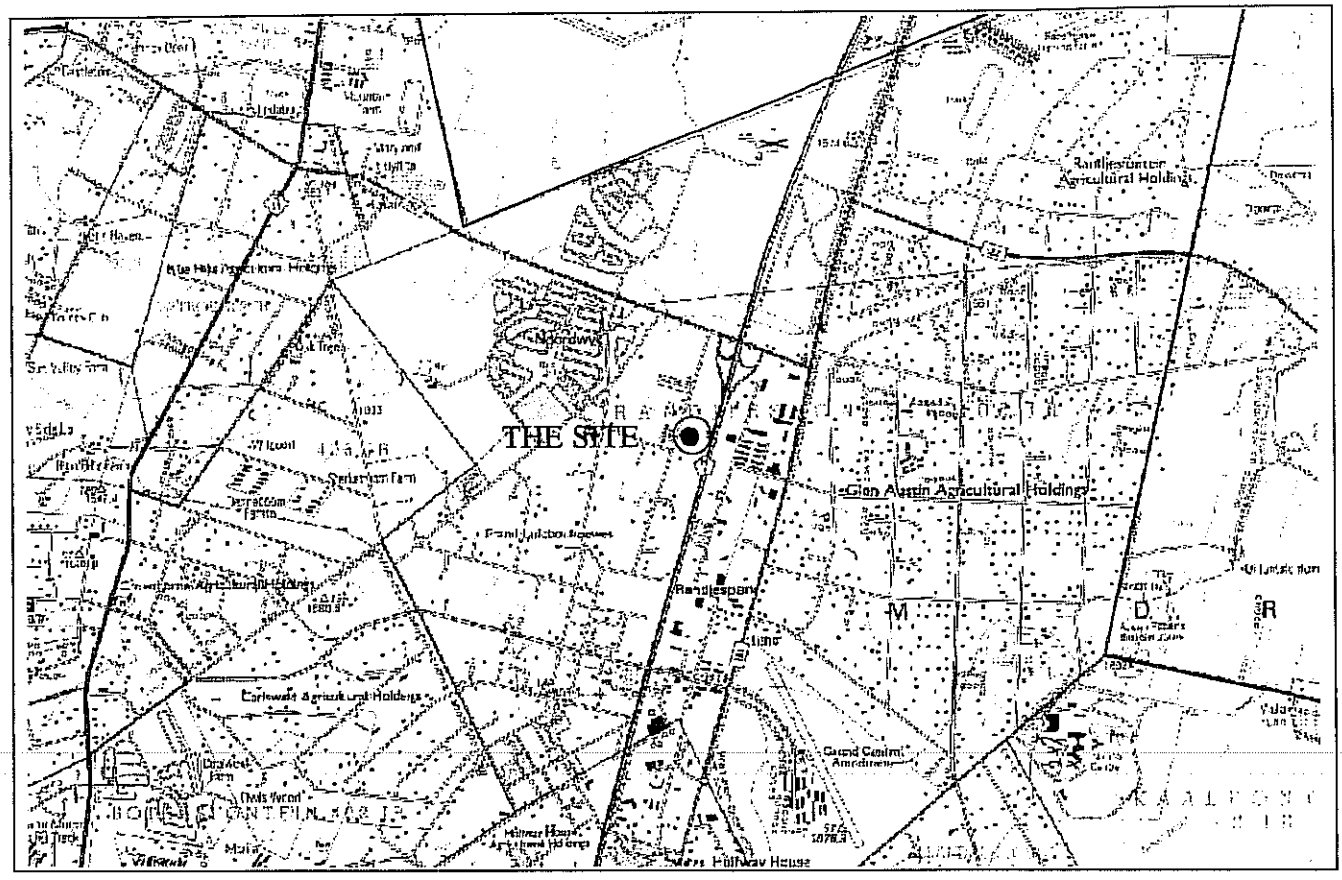
The field work was completed at the end of May 2007.

2. SITE DESCRIPTION

The site is a rectangular area of about 5ha and represents two entire holdings in Erand Agricultural Holdings Extension 1. The properties are bounded in the north and south by Portions 783 and 840 of the farm Randjiesfontein 405-JR, respectively. Portion 783 in the north has been developed as an office park but Portion 840 in the south is undeveloped. The western boundary is formed by 14th Road and the eastern boundary appears to be the road reserve of the N1 highway to Pretoria.

Access to the site is via the 14th Road, an unsurfaced road.

No structural development had taken place on the site at the time of



LOCALITY PLAN

the investigation (May 2007) save for an old concrete reservoir in the south east corner of Stand 223.

Vegetation on the properties consisted of tall veld grasses and a row of exotic pine trees along the eastern boundary of Stand 223. A prominent growth of "bulrushes" is present at the eastern end of Stand 223.

The relief of the site is low with an overall crossfall of about 15m towards the northwest corner. The gradient of the slope is about 5%.

3. SITE INVESTIGATION

The subsoil conditions were investigated by means of eight shallow test pits excavated to depths ranging from 1,7m to 2,2m below existing ground level. The test pits were excavated using a Bell 315SG TLB, supplied by SNALab of Pretoria. The holes were terminated in residual granite at a depth of about 2,0m below the surface. Difficult excavation conditions were encountered in TP 7 because of the volume of ground water present.

Detailed soil profiles were drawn up from a visual examination of the in situ material observed in the test pits by an engineering geologist according to recommended standard procedures (Reference 4).

Individual soil profile descriptions are given in the Soil Profiles in Appendix B and the positions of the test pits are shown on the map in Appendix H.

4. LABORATORY TESTING:

Sieve analyses and Atterberg Limits were determined for nine disturbed soil samples obtained during the investigation. The soils were classified according to Unified Soil and T R B classification systems and the results are tabulated in Appendix C.

Two bulk samples were submitted for California Bearing Ratio (CBR) tests to obtain an indication of the suitability of the soil for construction purposes. The results are presented in Appendix F.

5. GEOLOGY

According to the 1:50 000 Geological Series (1973), Sheet No. 2528CC Lyttelton, the entire site is underlain by granite, gneiss and migmatite of the Halfway House Granite which forms part of the Basement Complex in the Gauteng area (see Appendix A).

The hard rock geology is mantled by an irregular layer of colluvial and residual soil.

6. SOILS

The site is characterised by a fairly similar soil profile throughout most of the site.

A generalised profile may be described as

0,0-0,3 slightly moist, light reddish brown, dense, silty sand (colluvium) overlying

0,3-0,7 medium and fine with scattered coarse, sub-angular to subrounded gravel of quartz and ferricrete glaebules (concretions) and nodules in a trace matrix slightly moist to dry, light brown mottled orange, slightly ferruginised, silty sand; overall consistency is dense with medium dense pockets (slightly ferruginised pebble marker) overlying

0,7-1,8 slightly moist, orange mottled and blotched grey and khaki speckled black, medium dense to dense, fractured, silty sand with occasional ferruginous concretions (residual granite) grading into

1,8-2,0 slightly moist, light orange mottled khaki speckled white, medium dense to dense, silty sand with pockets of completely weathered very soft rock granite (residual granite).

An exception to this profile occurs in TP 7 at the eastern end of the Holding 223. Pedogenesis is more advanced in this hole with a layer of honeycomb ferricrete between 0,4m and 0,8m. The process of pedogenesis has been facilitated by the presence of a prominent perched water table. A grove of bulrushes and the presence of marsh-type grass in the vicinity of TP 7 indicate an area of surface ponding.

The soil profile across the remainder of the site is fairly similar with slight variations in the depth to the pebble marker, the thickness

of the pebble marker and the degree of ferruginisation in the soil. The surface layer of sandy colluvium ranges from 0,1m to about 0,6m. The sandy colluvium appears to be potentially collapsible. Residual granite, in the form of silty sand with pockets of sandy silt, is intersected below the pebble marker/honeycomb ferricrete layer at a depth of about 1,0m. Ferruginised glaebules (concretions and nodules) occur at the top of the residual layer and decrease in frequency with depth. The residual soil grades into completely weathered to highly weathered very soft granite at the bottom of some test pits.

7. BEDROCK

No hard rock granite was intersected within the top 2,2m of the ground profile. It would appear that extensive pockets of shallow (<2,0m), hard rock granite are unlikely to be encountered on this site even though the depth of weathering can vary significantly within a granitic terrain. This statement is based on the observations made in the eight test pits excavated for this investigation.

8. HYDROLOGY

Moderate ground water seepage was observed in TP 7 from a depth of about 0,5mm below the surface. The test pit is located towards the north eastern corner of the site next to a growth of bulrushes. The vegetation in the vicinity of TP 7 suggests a regular accumulation of surface water in the immediate area. Perched water tables are formed by the ponding surface water percolating through sandy colluvium until an impermeable layer is reached. Flow then takes place under gravity. A fluctuating perched water table facilitates pedogenesis and the ultimate result is the formation hardpan ferricrete.

The source of the surface water appears to be from a ditch associated with drainage from the N1 highway just to the east of the site. A perusal of Google Earth™ coverage of the site clearly shows the discharge end of the ditch within the existing site (see Appendix G).

No natural surface drainage features occur on this site and run off, in the form of sheetwash, should occur in a north westerly direction.

9. GEOTECHNICAL DISCUSSION

The following observations are based upon our interpretation of the conditions on the site, of the soil material sampled and of the tests performed in the laboratory.

The National Home Builders Registration Council (NHBRC)(Reference 6) has proposed a classification into which a site is subdivided according to the type and severity of geotechnical problems and the founding solutions required to solve the problems. The NHBRC classification, rather than the one proposed by Local Authorities, has been adopted for this report because of its relevance to township development.

9.1 Potentially Expansive Soil: Field observations indicated that no soil horizons intersected in the test pits would exhibit expansive properties.

Laboratory test results confirm the observations and indicate the soils on the site to non-expansive.

Using the standard Van der Merwe method of estimating heave (Reference 10), potential heave values for each sample may be calculated. From these results extrapolations may be made to calculate the total potential heave of the whole soil profile. The total potential heave value calculated for this site using the aforementioned methods is 0mm.

Soil profiles may be classified according to the total potential heave (Reference 6) as detailed in Table 1.

TABLE 1.

NHBRC CLASSIFICATION OF EXPANSIVE SOILS

CLASS	ESTIMATED TOTAL HEAVE (mm)
H	<7,5
H 1	7,5 - 15
H 2	15 - 30
H 3	>30

Differential movement = 50% total heave.

The site has been classified as **Class H** according to Table 1.

9.2 Collapsible Soil: No soils were tested for potentially collapsible soils since the sandy colluvium is rarely thicker than 0,5m. Nevertheless, the colluvial sandy horizon overlying the pebble marker should be considered potentially collapsible. The western half of the site has a slightly thicker cover of colluvial sand than the eastern side.

The residual silty sand underlying the pebble marker does not appear potentially collapsible although some normal settlement should be expected if heavy loads are founded within the upper layers of residual soil.

A site may be delineated into three different classes depending on the severity of the collapse problem (Reference 6). The classification is set out in Table 2.

TABLE 2.

NHBRC CLASSIFICATION OF COLLAPSIBLE SOILS

CLASS	ESTIMATED TOTAL SETTLEMENT (mm)
C	<5
C1	>5 - <10
C2	>10

Differential movement = 75% total heave.

The western half of the site has been classified as **Class C 1** where the colluvial sand approaches half a metre thick. The remainder of the site is classified as **Class C**.

9.3 Excavation Properties: No serious excavation difficulties were experienced by a Bell 315SG TLB excavating to a depth of about 2,0m. Occasional pockets of honeycomb ferricrete caused some resistance. The excavation of trenches for the installation of services should not pose a problem for a TLB provided excavation depths are less than 2m.

The use of pneumatic equipment and/or blasting is unlikely to be required within the top 2m of the soil profile on this site.

9.4 Sidewall Stability: No problems were encountered with the stability of the sidewalls except in TP 7 where seepage water caused erosion of some of the colluvial layer.

The stability of a sidewall is a function of the moisture content of the soil. If the moisture content increases through poor surface drainage, unstable conditions may occur.

Although no stability problems were encountered, any excavation deeper than 1,5m should be considered potentially unstable. The presence of seepage water within an excavation must be regarded as a warning sign with respect to sidewall stability. Workers safety must be taken into account in these deeper (>1,5m) excavations.

9.5 Construction Material: The pebble marker gravel and residual granite were tested for use as construction materials as they appeared to have the most potential. The CBR results indicate the materials meet G5 to G6 specifications (Reference 4) and can be used in upper pavement layers (stabilised base or subbase) and selected subgrade. Unfortunately, the volume of gravel is limited and would probably not be sufficient for any large civil project. There is an unlimited supply of residual granite but the quality is inconsistent and may vary across the site as suggested by the variation in test results in TP 1 [A-7-6(9) below 1,4m] and in TP 6 [A-2-6(0) below 0,7m].

The CBR results are tabled in Appendix F.

9.6 Drainage: Drainage problems are likely to manifest themselves on this site in the vicinity of the bulrushes as evinced by the volume of seepage water encountered in TP 7. The source of the water is from storm water run-off from the adjacent N1 highway. The discharge end of the ditch may have to be altered to ensure adequate drainage of the site. The ditch is visible in an image taken from Google Earth™.

Perched water tables are likely to pose problems on this site in the vicinity of TP 7. Attention must be paid to the appropriate placement of damp-proofing and cut-off drains, particularly where hardpan ferricrete is evident. Perched water table problems will be greatly reduced if engineered platforms are created and appropriate upslope drainage is properly implemented.

9.7 Shallow Founding Conditions: Normal strip footings for lightly loaded, single storey structures may be considered on this site provided they are located on the slightly ferruginised pebble marker horizon and loads do not exceed 75kPa. Floor slabs should not be placed on unimproved colluvium. Compaction of the base of shallow foundations should be considered to ensure a uniform medium upon which to found. The variable consistency of residual granite, both laterally and vertically, precludes the blanket use of shallow foundations for heavier structures.

Some form of ground improvement should be considered where heavy structures are envisaged to overcome any normal settlement due to low bearing capacities in the residual soil.

9.8 Road Subgrade: The soil on this site should provide an adequate road subgrade provided the surface layer of potentially collapsible sand is improved or removed before construction takes place.

9.9 Chemical tests: Laboratory results indicate the colluvium and residual granite from surface to a depth of 2,0m in TP's 1 and 8 to be acidic with pH values of ranging from 6,25 to 6,42. A pH of 7 is neutral.

The Electrical Conductivity values (EC) of the samples lie between 17mS/m (resistivity 5 882ohms/cm) and 23mS/m (resistivity 4 348ohms/cm). A table in Appendix E indicates that soils with EC values of between 17mS/m and 23mS/m represent a slightly corrosive to medium corrosive environment for galvanised pipes.

The corrosion of buried galvanised pipes is a complex problem influenced by a number of factors such as EC, acidic soils (pH < 7,0), corrosive bacteria and stray electrical currents. No attempt has been made to analyse all of these factors but the conductivity values in TP's 1 and 8 do offer a warning.

10. CONCLUSIONS AND RECOMMENDATIONS

No conditions are encountered on this site that prevent township establishment provided appropriate design and construction modifications are implemented to overcome the geotechnical problems

identified. All of the founding solutions are made with respect to the erection of lightly loaded, single storey structures *but this should not be construed as indicating larger structures are unacceptable.*

10.1 Expansive Soils: Normal construction methods may be adopted throughout the site as the soils do not exhibit any expansiveness. However, *cognisance must be taken of all of the other geotechnical recommendations* before normal construction methods are implemented.

10.2 Collapsible Soils: The recommended solutions for the various classes of collapse settlement are given in Table 3.

TABLE 3

RECOMMENDED CONSTRUCTION METHODS

NHBRC Profile Classification	**Estimated Total Settlement (mm)**	**Recommended Construction Method**
C	<5	Normal Construction below sandy topsoil, loads <75kPa.
C 1	>5 - <10	Modified Normal; Compaction of in situ Soil; Deep Strip Foundations or Soil Raft
C 2	>10	Absent

Differential heave = 75% of total heave.

Normal construction methods may be used over that portion of the site classified as **Class C** provided foundations are located on the gravely layer below the sandy colluvium and loads do not exceed 75kPa. Sandy soil should be compacted below floor slabs.

The following founding solutions may be considered for use in **Class C1** areas:

i) **Modified Normal:** Reinforced strip footings with articulation joints at some internal and all external doors. The masonry should be lightly reinforced. Foundation pressures should not exceed 50kPa.

ii) **Soil Compaction below Footings:** Remove in situ soil to a depth and width of 1,5 times the foundation width or to a competent horizon. Replace with suitable material compacted

to 93% MOD. AASHTO density at -1% and +2% of optimum moisture content (OMC). The removed material is often suitable for replacement. Normal construction with lightly reinforced strip foundations and masonry may then be utilised.

iii) **Deep Strip Footings:** Found structures on a uniform, competent horizon below the layer of collapsible soil. Foundations should be suitably reinforced where single structures straddle different material types such as ferricrete and soil. Material below floor slabs should be compacted.

iv) **Soil Raft:** Remove in situ soil to a metre beyond the perimeter of a building to a depth of 1,5 times the widest foundation or to a competent horizon and replace with suitable material compacted at 93% MOD. AASHTO at -1% to +2% of OMC. The use of normal construction methods with lightly reinforced strip foundations and masonry may then be considered.

10.3 Excavation Properties: A TLB should be capable of excavating trenches to a depth of at least 2m below surface except possibly for isolated areas where hardpan ferricrete has developed. A larger, more powerful machine (CAT 320 or Komatsu PC200) should be able to easily excavate to greater depths.

It is unlikely that the use of pneumatic tools or blasting will be required if excavations are limited to 2m in depth on this site.

10.4 Sidewall Stability: Unstable sidewalls are not expected in excavations of less than 1,5m, provided adequate drainage prevents ingress of surface water. Competent personnel must inspect excavations deeper than 1,5m. Trenches should be closed without delay.

Poor surface drainage around any excavations may increase the probability of unstable conditions.

10.5 Construction Material: The removal and stockpiling of the top 1m to 1,5m of the soil profile may provide a reasonable quantity of

construction material meeting G6 specifications. The residual granite from TP 6 (see Appendix F) classifies as G5 material and is suitable for road building purposes. It should be noted that the quality of the residual soil varies significantly across the site from A-7-6(9) in TP 1 to A-2-6(0) in TP 5.

The in situ soil (both colluvial and residual) should be suitable for use in the construction of engineered fills. Additional testing is recommended if certain material specifications need to be met.

10.6 Drainage: Perched water tables should be expected in the vicinity of the bulrushes. The problem of seepage water will be exacerbated in a wet season if attention is not paid to the storm water run-off from the highway. Water-logged trenches may hamper the installation of services. Adequate cut-off drains should be installed if extensive cut and fill operations are envisaged. Careful attention should be given to the proper placement of damp-proofing in all structures.

10.7 Shallow Founding Conditions: Normal strip footings are suitable for lightly loaded single storey structures on this site provided foundations are located below the sandy colluvium and loads do not exceed 75kPa.

Consideration should be given to the blanket use of compacted engineered fills (soil rafts) where large structures are envisaged. A compacted soil raft provides a uniform medium upon which foundations are placed at nominal depths. In many instances the waste material (possibly G5 or G6) from cut and fill operations maybe suitable for construction of the raft. An engineered fill should not be placed on unimproved colluvium. Rafts should be compacted to about 95% Mod. AASHTO dry density at -1% to +2% OMC. Normal construction methods with light reinforcing may be considered on top of the raft depending of the envisaged loads. Heavy structures may require the importation of better quality fill than available on-site.

10.8 Road Subgrade: A suitable road subgrade is present below the layer of sandy colluvium.

The influence of seepage water from perched water tables should be considered during pavement design as well as the presence of potentially collapsible sands in the top 0,75m of the soil profile. The sandy layers should be compacted to achieve 90% Mod AASHTO for 0,0-0,5m and 85% Mod AASHTO for 0,5-1,0m.

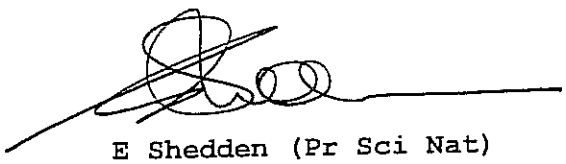
10.9 Soil Chemistry: The chemical test results indicate slightly to medium corrosive conditions towards galvanised pipes in terms of conductivity.

Although numerous factors influence the aggressiveness of a soil environment, it is recommended that plastic pipes rather than galvanised pipes be used for buried, water-bearing services on this site in the light of the chemical results.

11. GENERAL

It must be borne in mind that an investigation of this nature is aimed at delineating broad areas in which problems may occur. Consequently, certain generalisations have to be made to avoid the necessity of a very costly investigation.

It may be found that soil conditions at variance with those discussed in this report do occur locally. The variant conditions should be inspected by competent personnel to ensure that these conditions do not pose a problem for a specific development. An inspection of service trenches by competent personnel should highlight any significant variations from those discussed in the report.



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JUNE 2007

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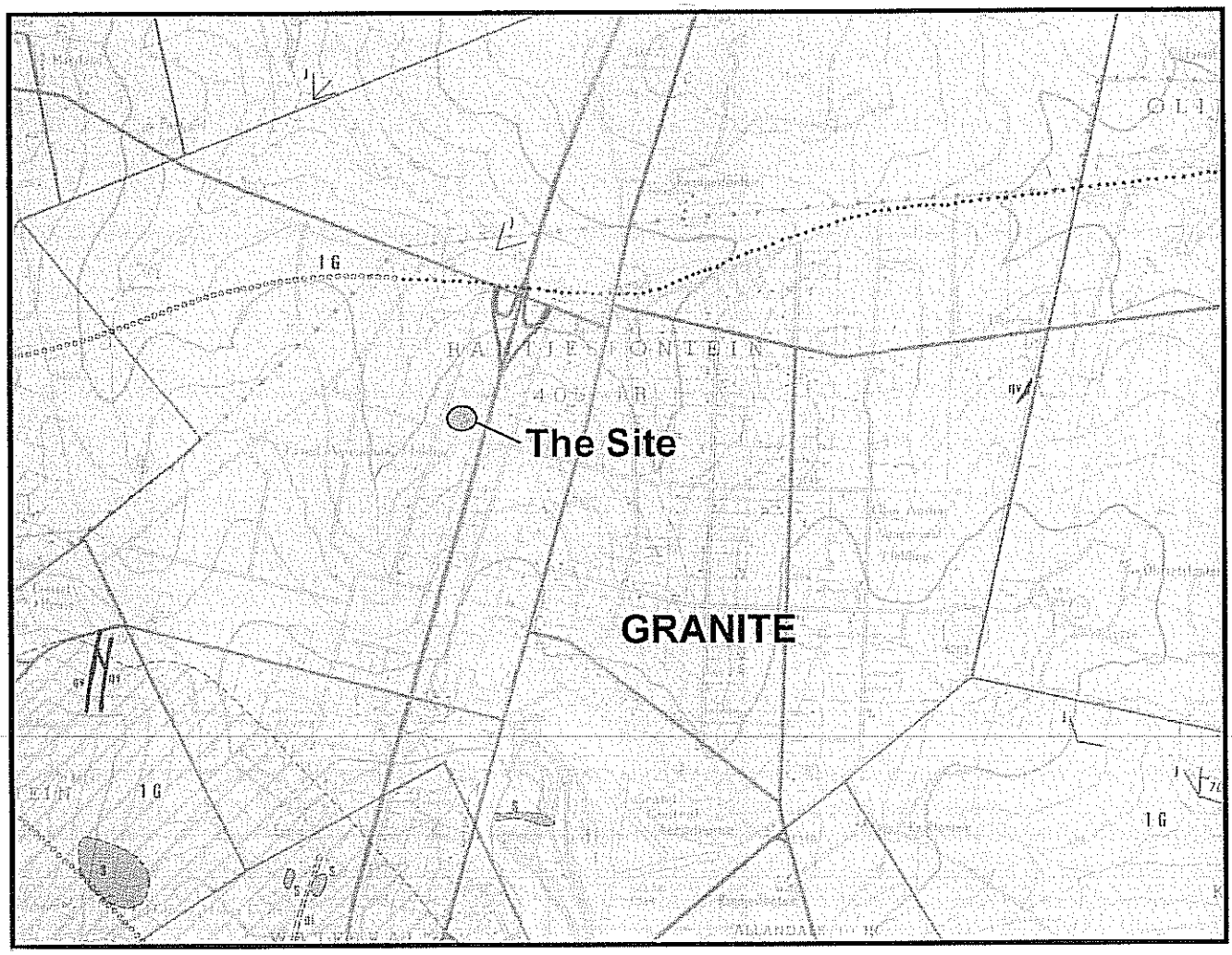
APPENDIX A

REGIONAL GEOLOGY

REGIONAL GEOLOGY
Portions 222 and 223, ERAND A. H. X1.



Excerpt from 1:50 000 Geological Series
SHEET No: 2528 CC Lyttelton
(Not to scale)

APPENDIX B

SOIL PROFILES

SOIL PROFILE

PROJECT: *HOLDINGS 222 and 223, ERAND A. H. Ext. 1, Midrand.* **TEST PIT No.:** *1*

MACHINE: *Bell 315SG TLB.* **JOB No:** *07139era.222* **PROFILED By:** es

CONTRACTOR: *SNALab.* **DATE:** *25/05/07*

UNIFIED/ TRB CLASS.	SAMPLE No.	LEGEND	DEPTH (m)	DESCRIPTION	POTENTIAL EXPANSIVENESS
G6	CBR 8428 2222		0,4	Slightly moist to dry, light brown, dense, intact, silty **SAND** with scattered, fine, quartz gravel; colluvium.	(LOW)
			0,7	Fine with some medium, subangular to subrounded, closely packed **GRAVEL** of hard ferricrete nodules and concretions and subordinate quartz in a minor matrix of slightly moist, light brown mottled orange speckled black, ferruginised, silty sand; overall consistency is medium dense; pebble marker (ferruginised).	
			1,4	Slightly moist, light khaki brown mottled orange speckled black and white, medium dense to dense, fractured, silty **SAND** with occasional, fine gravel of ferricrete concretions; residual granite.	
CL A-7-6(9)	I/1			Moist, khaki blotched orange, stiff, intact, sandy **SILT** with minute voids; residual granite.	LOW
	EOH		2,2		

NOTES:

1) Hole stopped at 2,2m in residual granite. No refusal.
2) Ground water not encountered.
3) Fine roots in top 1,7m.
4) CBR 100%= 61
   98%= 52
   97%= 49
   95%= 40
   93%= 32
   90%= 22

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SOIL PROFILE

PROJECT: *HOLDINGS 222 and 223, ERAND A. H. Ext. 1, Midrand.* **TEST PIT No.:** *2*

MACHINE: *Bell 315SG TLB.* **JOB No:** *07139era.222* **PROFILED By:** es

CONTRACTOR: *SNALab.* **DATE:** *25/05/07*

UNIFIED/ TRB CLASS.	SAMPLE No.	LEGEND	DEPTH (m)	DESCRIPTION	POTENTIAL EXPANSIVENESS
			0,3	Slightly moist to dry, light brown, dense, intact, silty **SAND** with scattered, fine, quartz gravel; colluvium.	
			0,7	Fine and some medium, subrounded, closely packed **GRAVEL** of hard ferricrete concretions and quartz in a trace matrix of slightly moist to dry, light brown, silty sand; overall consistency is dense with medium dense pockets; pebble marker.	
			1,4	Orange mottled black and dark brown, dense to very dense, honeycomb **FERRICRETE** with pockets of dense, ferricrete gravel; pedocrete (residual granite).	(LOW)
			1,7	Slightly moist, light grey blotched and mottled orange, dense, intact, slightly ferruginised, silty **SAND**; residual granite.	
	EOH		2,2	Slightly moist to moist, light khaki stained black on fractures, dense to medium dense, fractured, silty **SAND** with pockets of sandy silt; residual granite.	

NOTES:

1) Hole stopped at 2,2m in residual granite. No refusal.
2) Ground water not encountered.
3) Fine roots in top 600mm.

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SOIL PROFILE

PROJECT: *HOLDINGS 222 and 223, ERAND A. H. Ext. 1, Midrand.* **TEST PIT No.:** *3*

MACHINE: *Bell 315SG TLB.* **JOB No:** *07139era.222* **PROFILED By:** es

CONTRACTOR: *SNALab.* **DATE:** *25/05/07*

UNIFIED/ TRB CLASS.	SAMPLE No.	LEGEND	DEPTH (m)	DESCRIPTION	POTENTIAL EXPANSIVENESS
SC A-2-6(0)	3/1		0,6	Slightly moist to dry, light brown, dense, intact, silty **SAND** with occasional, fine, quartz gravel; colluvium.	LOW
			0,9	Fine and some medium, subrounded, closely packed **GRAVEL** of ferricrete concretions and quartz in a trace matrix of slightly moist to dry, light brown, silty sand; overall consistency is dense with medium dense pockets; pebble marker.	
SC A-4(1)	3/2		1,0	Slightly moist, light khaki mottled light orange, medium dense, intact, silty **SAND** with traces of fine ferricrete gravel; residual granite.	LOW
			1,3	Slightly moist, light khaki grey mottled orange speckled black, medium dense to dense, fractured, silty **SAND** with occasional, hard, ferruginous concretions; residual granite.	
	EOH		1,8	Moist, light khaki blotched orange and black, medium dense to dense, fractured, silty **SAND** with scattered pockets of orange speckled white, completely weathered, very soft rock granite; residual granite.	(LOW)
			2,2		

NOTES:

1) Hole stopped at 2,2m in residual granite. No refusal.
2) Ground water not encountered.
3) Fine roots in top 1,1m.
4) Variable weathering at bottom of hole - sand and very soft rock granite.

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SOIL PROFILE

PROJECT: *HOLDINGS 222 and 223, ERAND A. H. Ext. 1, Midrand.* **TEST PIT No.:** *4*

MACHINE: *Bell 315SG TLB.* **JOB No:** *07139era.222* **PROFILED By:** es

CONTRACTOR: *SNALab.* **DATE:** *25/05/07*

UNIFIED/ TRB CLASS.	SAMPLE No.	LEGEND	DEPTH (m)	DESCRIPTION	POTENTIAL EXPANSIVENESS
			0,2 0,3 1,0 1,9	Slightly moist to dry, light greyish brown, dense, intact, silty **SAND** with occasional, fine, quartz and ferricrete gravel; colluvium. Thin horizon of fine **GRAVEL** at 0,3m suggests pebble marker. Slightly moist, light orange mottled khaki brown speckled black, medium dense with occasional dense pockets, intact, slightly ferruginised, silty **SAND** with abundant hard and soft, ferruginous concretions; residual granite (slightly ferruginised). Slightly moist, khaki orange mottled black and light grey, dense, fractured, silty **SAND** with pockets of stiff, sandy silt; residual granite. Pockets of completely weathered, very soft rock granite occur below 1,5m.	(LOW)
	EOH			NOTES: 1) Hole stopped at 2,2m in residual granite. No refusal. 2) Ground water not encountered. 3) Fine roots in top 1,1m. 4) Variable weathering at bottom of hole - sand and very soft rock granite.	

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SOIL PROFILE

PROJECT: *HOLDINGS 222 and 223, ERAND A. H. Ext. 1, Midrand.* **TEST PIT No.:** *5*

MACHINE: *Bell 315SG TLB.* **JOB No:** *07139era.222* **PROFILED By:** es

CONTRACTOR: *SNALab.* **DATE:** *25/05/07*

UNIFIED/ TRB CLASS.	SAMPLE No.	LEGEND	DEPTH (m)	DESCRIPTION	POTENTIAL EXPANSIVENESS
SWM A-1-a(0)	5/1		0,1 0,2 0,6	Dry, light brown, loose, intact, silty **SAND** with some fine quartz gravel; colluvium. Medium and fine with occasional coarse, subangular, closely packed **GRAVEL** of quartz in a trace matrix of dry, light brown, silty sand; overall consistency is medium dense to dense; pebble marker.	LOW
SC A-2-6(1)	5/2		0,8 1,5 1,9	Medium and fine, subangular to angular, closely packed **GRAVEL** of hard ferruginous glaebules in a trace matrix of dry, light grey to off-white, ferruginised, silty sand; overall consistency is dense to very dense in places; honeycomb ferricrete (residual granite). Slightly moist, orange mottled and blotched grey, khaki and black, dense, fractured, silty **SAND** with scattered pockets of very soft rock granite; residual granite. Slightly moist, light orange mottled light khaki speckled white, medium dense, fractured, silty **SAND** with numerous pockets of completely weathered, very soft rock granite; residual granite.	LOW
				EOH	

NOTES:

1) Hole stopped at 1,9m in residual granite. No refusal.
2) Ground water not encountered.
3) Fine roots in top 600mm.

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SOIL PROFILE

PROJECT: *HOLDINGS 222 and 223, ERAND A. H. Ext. 1, Midrand.* **TEST PIT No.:** *6*

MACHINE: *Bell 315SG TLB.* **JOB No:** *07139era.222* **PROFILED By:** es

CONTRACTOR: *SNALab.* **DATE:** *25/05/07*

UNIFIED/ TRB CLASS.	SAMPLE No.	LEGEND	DEPTH (m)	DESCRIPTION	POTENTIAL EXPANSIVENESS
			0,2	Dry, light brown, loose, intact, silty **SAND** with some fine quartz and ferricrete gravel; colluvium.	(LOW)
			0,7	Medium and fine, subangular, closely packed **GRAVEL** of quartz and ferruginous concretions in a minor matrix of dry, light brown mottled and speckled black, slightly ferruginised, silty sand; overall consistency is dense; pebble marker.	
	CBR 8024 8399		1,7	Slightly moist, light orange mottled light grey, dense, fractured, silty, fine **SAND** with scattered, coarse feldspar; residual granite.	LOW
	EOH		1,9	Slightly moist to mist, light khaki blotched orange speckled black, medium dense, fractured, silty **SAND** with occasional pockets of completely weathered, very soft rock granite; residual granite.	(LOW)

NOTES:

1) Hole stopped at 1,9m in residual granite. No refusal.
2) Ground water not encountered.
3) Fine roots in top 800mm.
4) Bulk sample of lower layers taken for CBR test.
5) CBR 100%= 61
   98%= 57
   97%= 55
   95%= 50
   93%= 32
   90%= 17

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SOIL PROFILE

PROJECT: *HOLDINGS 222 and 223, ERAND A. H. Ext. 1, Midrand.* **TEST PIT No.:** *7*

MACHINE: *Bell 315SG TLB.* **JOB No:** *07139era.222* **PROFILED By:** es

CONTRACTOR: *SNALab.* **DATE:** *25/05/07*

UNIFIED/ TRB CLASS.	SAMPLE No.	LEGEND	DEPTH (m)	DESCRIPTION	POTENTIAL EXPANSIVENESS
			0,2	Moist to very moist, grey becoming light grey, loose, intact, silty **SAND**; colluvium.	(LOW)
			0,4	Fine with some medium, subangular, closely packed **GRAVEL** of ferruginous glaebules in a minor matrix of wet, grey, silty sand; overall consistency is loose; colluvium (ferruginised).	
SC A-4(1)	7/2		0,7 0,8	Medium and fine, subangular, closely packed, friable **GRAVEL** of hard, ferruginous glaebules in a trace matrix of wet, grey mottled orange brown speckled black, ferruginised, silty sand; overall consistency is loose to very dense in places; honeycomb ferricrete (residual granite).	LOW
	EOH		1,5 1,7	Moist, light orange and khaki blotched grey and black, dense, intact, very slightly ferruginised, silty **SAND** with occasional, ferruginised concretions; residual granite.	

NOTES:

1) Hole stopped at 1,7m in residual granite. No refusal.
2) Ground water seepage from gravel horizon above 0,7m.
3) Fine roots in top 600mm.
4) Standing water at 1,5m after 1,5 hours.
5) Excavated downslope of growth of bulrushes. Surrounding grass is typical marsh grass suggesting water logged conditions at times.

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SOIL PROFILE

PROJECT: *HOLDINGS 222 and 223, ERAND A. H. Ext. 1, Midrand.* **TEST PIT No.:** *8*

MACHINE: *Bell 315SG TLB.* **JOB No:** *07139era.222* **PROFILED By:** es

CONTRACTOR: *SNALab.* **DATE:** *25/05/07*

UNIFIED/ TRB CLASS.	SAMPLE No.	LEGEND	DEPTH (m)	DESCRIPTION	POTENTIAL EXPANSIVENESS
			0,1	Dry, light brown, loose, intact, silty **SAND** with some fine quartz and ferricrete gravel: colluvium.	(LOW)
			0,7	Coarse, medium and fine, angular, closely packed **GRAVEL** of hard, ferruginous glaebules in a trace matrix of dry, light grey to off-white mottled orange, ferruginised, silty sand; overall consistency is very dense to dense with occasional loose pockets; honeycomb ferricrete.	
SC A-6(2)	8/1			Slightly moist, light orange mottled light grey, dense, fractured, silty, fine **SAND**; residual granite.	LOW
				Pockets of sandy silt throughout.	
	EOH		2,0		

NOTES:

1) Hole stopped at 2,0m in residual granite. No refusal.
2) Ground water not encountered.
3) Fine roots in top 800mm.
4) Bulk sample taken of lower layers for CBR test.

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APPENDIX C

SUMMARY OF TECHNICAL INFORMATION ON MATERIALS

SUMMARY OF TECHNICAL INFORMATION ON MATERIALS

PROJECT: *ERAND GARDENS X73.*

SITE: *Holdings 222 and 223, Erand A. H. X1, Midrand.*

HOLE No.	SAMPLE No.	DEPTH (m)	MATERIAL DESCRIPTION	SIEVE ANALYSIS (% PASSING)									SOIL MORTAR ANALYSIS				CONSTANTS				CLASSIFICATION		POTENTIAL EXPANSIVE-NESS
				37,5 mm	26,5 mm	19,0 mm	13,2 mm	4,75 mm	2,00 mm	0,425 mm	0,075 mm	0,002 mm	CS	Fine Sand		<0.075 mm	LL	PI	LS	GM	T.R.B.	UNIF	
TP 1	1/1	1,4-2,2	sandy SILT					100	96	76	62	12	25	4	6	65	42	17	9.2	0.66	A-7-6(9)	CL	LOW
TP 3	3/1	0,0-0,9	gravelly SAND	100	95	91	88	73	51	38	24	14	40	9	7	45	28	14	6.8	1.86	A-2-6(0)	SC	LOW
	3/2	0,9-1,8	silty SAND				100	93	82	57	38	1	38	7	8	46	27	8	3.9	1.23	A-4(1)	SC	LOW
TP 5	5/1	0,0-0,8	sandy GRAVEL		100	94	85	55	45	24	12	12	56	9	9	26	NP	-	-	2.19	A-1-a(0)	SWM	LOW
	5/2	0,8-1,9				100	99	95	82	45	32	11	52	5	4	38	24	14	7.3	1.42	A-2-6(0)	SC	LOW
TP 7	7/2	0,7-1,7	silty SAND				100	95	85	56	38	11	42	7	7	44	22	8	4.0	1.21	A-4(1)	SC	LOW
TP 8	9/1	0,7-2,0	silty SAND				100	97	92	58	41	12	43	6	6	45	25	11	5.9	1.08	A-6(2)	SC	LOW
TP 1	CBR	0,0-0,6	GRAVEL			100	96	63	48	33	25	-	36	6	6	53	32	12	6.5	1.94	A-2-6(0)	G6	LOW
TP 6	CBR	0,7-1,7	gravelly SAND			100	97	79	69	44	31	-	43	6	7	44	24	7	3.8	1.56	A-2-4(0)	G5	LOW

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APPENDIX D

DETAILS OF POTENTIAL EXPANSIVENESS OF MATERIALS

DETAILS OF POTENTIAL EXPANSIVENESS OF MATERIALS

PROJECT: *ERAND GARDENS EXT 73.*

LOCATION: *Holdings 222 and 223,*
Erand A.H.Ext 1,Midrand.

PROFILE No.	SAMPLE No.	DEPTH OF SAMPLE (m)	THICKNESS OF LAYER (m)	POTENTIAL EXPANSIVENESS	PREDICTED HEAVE (mm)	TOTAL PREDICTED HEAVE (mm)
TP 1		0,0-1,4	1,4	(LOW)	(0)	
	1/1	1,4-2,2	0,8	LOW	0	(0)
TP 2		0,0-2,2	2,2	(LOW)	(0)	(0)
TP 3	3/1	0,0-1,0	1,0	LOW	0	
	3/2	1,0-1,8	0,8	LOW	0	
		1,8-2,2	0,4	(LOW)	(0)	(0)
TP 4		0,0-1,9	1,9	(LOW)	(0)	(0)
TP 5	5/1	0,0-0,8	0,8	LOW	0	
	5/2	0,8-1,9	1,1	LOW	0	(0)
TP 6		0,0-0,7	0,7	(LOW)	(0)	
	CBR	0,7-1,7	1,0	LOW	0	
		1,7-1,9	0,2	(LOW)	(0)	(0)
TP 7		0,0-0,8	0,8	(LOW)	(0)	
	7/2	0,8-1,5	0,7	LOW	0	(0)
TP 8		0,0-0,7	0,7	(LOW)	(0)	
	8/1	0,7-2,0	1,3	LOW	0	(0)
NOTES						
1) Values in brackets are extrapolated.						

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APPENDIX E

CHEMICAL TEST RESULTS

CHEMICAL TEST RESULTS

TEST PIT	SAMPLE No.	DEPTH (m)	pH	CONDUCTIVITY mS/m	RESISTIVITY ohm/cm
TP 5	5/1	0,0-0,8	6,42	17	5 882
TP 8	8/16	0,7-2,0	6,25	23	4 348

According to authors Beaton and Stratfull (reference unknown) and based on the above results, a 16 gauge metal culvert would take between 28 years and 32 years to corrode if located in soils encountered in TP's 1 and 8. It should be noted that the above factors are not the only ones which influence the rate of corrosion. A high soil moisture content and corrosive bacteria may also be present which could substantially increase the rate of corrosion.

Table of Corrosiveness

Conductivity	Resistivity	Corrosiveness
>110 mS/m	0 - 900 ohms/cm	Very Highly corrosive
110 - 45 mS/m	900 - 2300 ohms/cm	Highly corrosive
45 - 20 mS/m	2300 - 5000 ohms/cm	Medium corrosive
20 - 10 mS/m	5000 - 10000 ohms/cm	Slightly corrosive
<10 mS/m	>10000 ohms/cm	Non-corrosive

The conductivity and resistivity of the two soil layers indicate a slightly to medium corrosive environment.

APPENDIX F

CALIFORNIA BEARING RATIO (CBR) TEST RESULTS

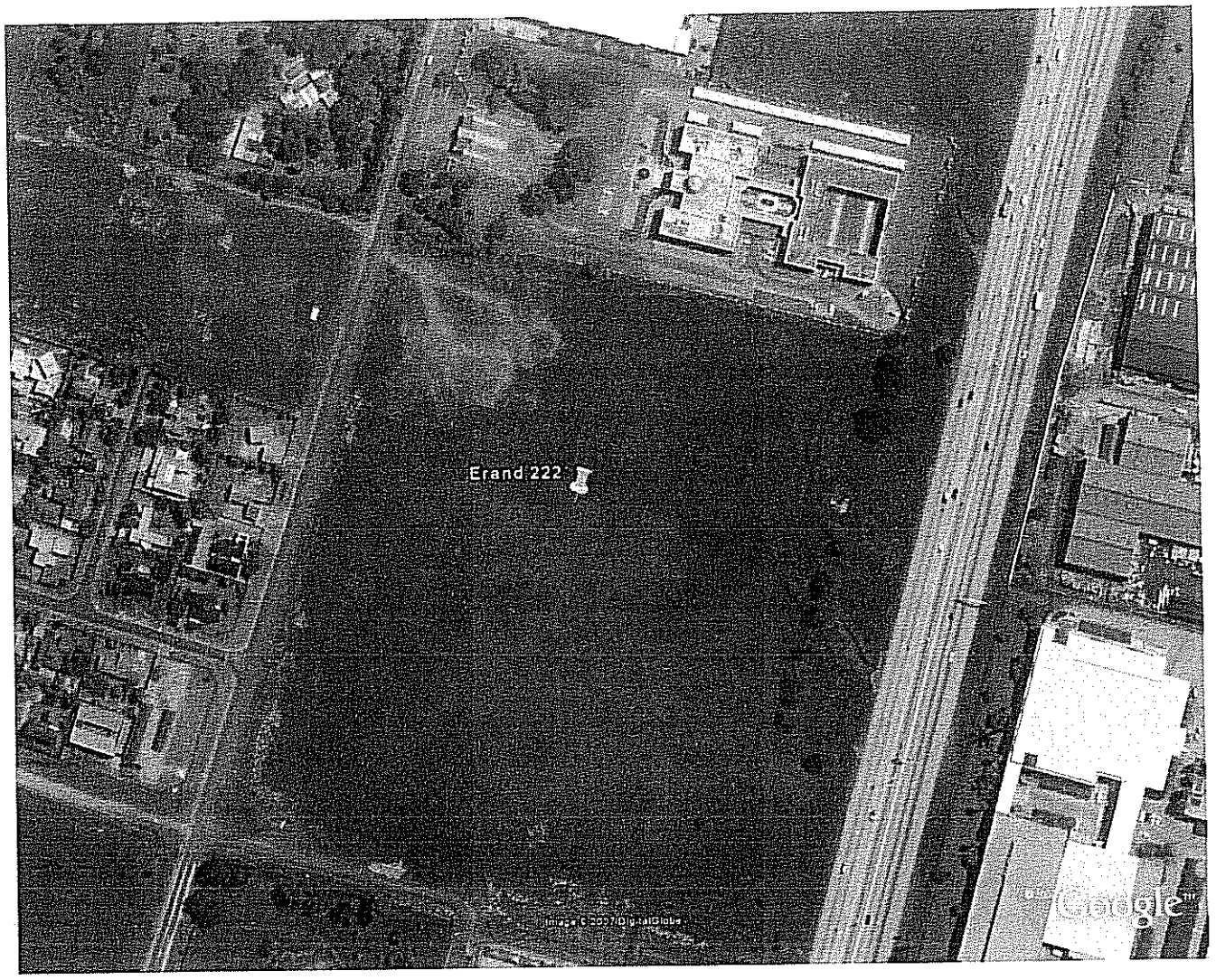
CBR Values for Bulk Samples at Erand Gardens X73 at Holdings 222 & 223, Erand A. H. X1, Midrand.

Locality: TP's 1 & 6.

Soil Type: Test Pit Number: Depth (m):	GRAVEL TP 1 0,0-0,6	GRAVEL TP 6 07-1,7
Screen Analysis (%PASS)		
75.0mm.....	100	100
63.0mm.....	100	100
53.0mm.....	100	100
37.5mm.....	100	100
26.5mm.....	100	100
19.0mm.....	100	100
13.20mm.....	96	97
4.75mm.....	63	79
2.00mm.....	48	69
0.425mm.....	33	44
0.075mm.....	25	31
Soil Mortar		
Coarse Sd 2-0.425	30	24
C Fine Sd 0.425-0.05	18	43
Silt 0.05-0.005	-	-
Clay 0,005-0,002	-	-
Constants		
Grading Modulus.....	1.94	1.56
Liquid Limit.....	32	24
Plasticity Index.....	12	7
Linear Shrinkage (%)...	6.5	3,8
Classification - TRB...	A-2-6(0)	A-2-4(0)
Classification - TRH14..	G6	G5
TYPE OF TEST (CBR/UCS)	CBR	CBR
MOD. AASHTO		
Max Dry Density (kg/m3)	1960	2095
Optimum Moisture Cont(%)	10,7	7,6
Moulding Moisture Cont(%)	10,9	7,9
Dry Density (kg/m3).....	1969	2106
% of Max Dry Density....	100,5	100,5
100% Mod CBR/UCS.....	63	62
% Swell.....	3,94	3,15
NRB		
Dry Density (kg/m3).....	1880	1995
% of Max Dry Density....	95,9	95,2
100% NRB CBR/UCS.....	45	52
% Swell.....	8,66	8,66
PROCTOR		
Dry Density (kg/m3).....	1798	1889
% of Max Dry Density....	91,7	90,2
100% NRB CBR/UCS.....	27	18
% Swell.....	0,12	0,13
CBR/UCS Values		
100% Mod AASHTO.....	61	61
98% Mod AASHTO.....	52	57
97% Mod AASHTO.....	49	55
95% Mod AASHTO.....	40	50
93% Mod AASHTO.....	32	32
90% Mod AASHTO.....	22	17

APPENDIX G

GOOGLE EARTH(™) PHOTOGRAPH



Holdings 222 and 223, Erand A. H. Extension 1, Midrand.
(Note ditch opposite white roofed structure on right of photo)
[GPS position of marker= Latitude S25°57′41.09″ Longitude E28°07′48.9″]

APPENDIX H

GEOTECHNICAL MAP