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FALCON PROPERTY SERVICES (Pty) Ltd

REPORT ON THE GEOTECHNICAL INVESTIGATION FOR TOWNSHIP ESTABLISHMENT PURPOSES AT VALLEY VIEW ESTATE IN CENTURION

REPORT 100548-G1 OCTOBER 2003

AFRICON

ROADS AND STORMWATER GEOLOGY REPORT

TOWNSHIP: KOSMOSDAL X 13 (VALLEY VIEW ESTATE)

CROSS REF:

CONSULTANT: AFRICON ENGINEERING DATE: 10/2003

EFILE: BKS NO:

ABSTRACT

A geotechnical site investigation was conducted in July 2003 for township establishment at the Valley View Estate in Centurion.

The investigation comprised profiling ten test pits excavated with a backhoe and sampling of selected soil horizons for laboratory testing. The findings and test results of a previous geotechnical investigation at the site were also incorporated into this report.

The soil profile comprised combinations hillwash, ferruginised hillwash, a pebble marker, reworked ferruginised residual granite, reworked residual granite and residual granite.

The presence of ferruginised horizons and hardpan ferricrete in some of the test pits suggest that shallow perched water tables can be expected in the rainy season. Shallow refusal occurred in some of the test pits excavated at the site. Machine excavatability of in situ materials for services may therefore be problematic in places.

No adverse conditions prohibiting the development of the site were observed and the site is zoned into one zone, which can be described as follows:

Zone C1: Zone characterised by collapsible/compressible soil profile with total expected movements between 5 mm and 10 mm. Development can take place provided appropriate precautions against differential settlement are implemented.

Recommendations regarding proposed development include the following:

- Founding alternatives;
- The use of construction materials encountered at the site; and
- Drainage precautions that represent good practice.

1 INTRODUCTION

Africon was appointed by Falcon Property Services (Pty) Ltd. to conduct a geotechnical investigation for a township establishment at the Valley View Estate in Centurion. The main purpose of this investigation is to classify the area in terms of the requirements of the NHBRC and the Council for Geosciences.

The objectives of this report are to:

- Describe the investigation procedure;
- Provide an overview of the geology of the site;
- Discuss the soil profile encountered;
- Identify problematic geotechnical considerations;
- Provide a geotechnical zoning of the site.

2 AVAILABLE INFORMATION

At the time of the investigation the following information was available:

- The 1 : 50 000 scale geological map of the area (2528CC Lyttelton).
- A 1 : 2000 scale site layout plan, showing the boundaries of the site.
- Geotechnical investigation reports compiled by Geo Specialist Incorporated entitled "Report on the Phase 1 Geotechnical Investigation of 205 ha at the proposed Olievenhoutbosch Industrial Development, Verwoerdburg", report 53052/G1/1994, compiled in August 1994.

3 SITE LOCATION AND DESCRIPTION

The site is located east of Rooihuiskraal Road and South of Rietspruit Road, as indicated on the locality plan, Drawing 100548-G1-LP01. The site has a moderate slope to the northeast and was undeveloped at the time of the investigation. Vegetation comprised veld grass.

4 SITE INVESTIGATION

The investigation was conducted on 1 October 2003 and consisted of the excavation of ten (10) test pits with a backhoe. The positions of the test pits (EH1 to EH10) are indicated on the site layout plan, Drawing 100548-G1-SLP01.

The test holes were profiled according to the standard methodology proposed by Jennings, Brink and Williams (Ref 1). All test holes were backfilled after completion of the soil

profiling and sampling.

The following table provides a summary of test hole information gained during the current investigation:

Table 1 : Test hole summary

Hole no	Depth to residium (m)	Total depth (m)	Remarks
EH1	0,5	2,4	No refusal – test pit stopped at maximum depth
EH2	0,6	2,6	No refusal – test pit stopped at maximum depth
EH3	+1	1	No refusal – test pit stopped due to very slow progress
EH4	0,4	2,3	No refusal – test pit stopped due to very slow progress
EH5	0,5	1,8	Refusal on VERY SOFT ROCK granite
EH6	+1,1	1,1	Refusal on hardpan ferricrete
EH7	0,5	2,3	No refusal – test pit stopped at maximum depth
EH8	0,5	1,3	Refusal on hardpan ferricrete
EH9	0,5	2,4	No refusal – test pit stopped at maximum depth
EH10	0,5	1,1	Refusal on hardpan ferricrete

To confirm the visual assessments of the engineering properties of the soil, a number of representative soil samples were taken and submitted for laboratory testing.

In addition, the relevant findings and test results of the geotechnical investigation conducted by Geo Specialists Incorporated (GSI) were also incorporated into this report.

The data gained by the aforementioned activities are presented in this report as follows:

- Summary of standard soil and rock profile descriptions - Appendix A
- Soil profile descriptions (Current investigation) - Appendix B
- Laboratory test results (Current investigation) - Appendix C
- Soil profiles and test results (GSI investigation) - Appendix D

5 GEOLOGY AND CLIMATE

According to the 1 : 50 000 scale geological map of Lyttleton the site is situated on the Johannesburg - Pretoria inlier (Halfway House granite). Residual granite was encountered in the majority of test pits excavated at the site.

The area is classified as having a climatic N-value (after Weinert, 1967) of less than 5, which indicates that the main form of weathering of the underlying rocks has been chemical in nature. Residual soils are variably shallow to deep and transported soils are generally thin.

6 SOIL PROFILE

The following generalised horizons were encountered on the site:

6.1 HILLWASH

The site is covered by hillwash material to depths varying between 0,0 m and 1,3 m. The composition of this horizon varied from loose, pinholed, silty sand to medium dense, silty sand.

6.2 FERRUGINISED HILLWASH

The ferruginised hillwash was encountered in four of the test pits excavated at the site to depths varying between 0,2 m and 1,0 m with an average thickness of 0,25 m. This horizon generally comprised dense to very dense, pinholed, ferruginised, gravelly silty sand. In some test pits this horizon contained hard black ferricrete nodules.

6.3 HARDPAN FERRICRETE

The hard pan ferricrete is present below the hillwash in test pits EH6 and EH8 and also below the ferruginised residual granite in test pit EH10. This horizon was encountered at the refusal depths of these test pits, which varied between 1,1 m and 1,3 m.

6.4 PEBBLE MARKER

This horizon is of significance as it indicates the transition between the transported and in-situ weathered horizons. A pebble marker was encountered in four of the test pits excavated at the site, to depths varying between 0,1 m and 0,5 m and with an average thickness of 0,25 m. This horizon generally comprised medium dense, gravelly silty sand.

6.5 REWORKED FERRUGINISED RESIDUAL GRANITE

Ferruginised residual granite is present below the ferruginised hillwash in test pits EH1, EH2 and EH4 and below the pebble maker in test pit EH7. This horizon generally comprised dense, ferruginised, fine gravelly silty sand with abundant hard black ferricrete nodules. It was encountered to depths varying between 0,4 m and 1,0 m with an average thickness of 0,4 m.

6.6 REWORKED RESIDUAL GRANITE

Reworked residual granite, comprising dense, fine gravelly silty sand with patches of medium dense, reworked pinholed, fine gravelly silty sand was present in six test pits excavated during the current investigation. This horizon was encountered to depths varying between 0,5 m and 1,6 m, with an average thickness of 0,6 m.

6.7 RESIDUAL GRANITE

Residual granite, comprising dense, intact, fine gravelly silty sand was also present in six test pits excavated during the current investigation. It was present to depths varying between 1,0m and 2,6 m with an average thickness of 1,03 m.

7 MOISTURE CONDITIONS

Ground water seepage was not encountered in any of the test pits excavated at the site. Varying degrees of ferruginisation, which indicates that a changing water regime can be expected, was however noted in the soil profile. Problems due to ground water seepage are not envisaged but minor seepage may occur in places during and after a very wet rainy season.

8 LABORATORY TEST RESULTS

8.1 INDICATOR TESTS

Representative samples of the various soil horizons were taken and submitted for foundation indicator tests. The results of these tests can be summarised as follows:

Table 2: Indicator test results

Hole No	Depth (m)	Material type	Soil composition				GM	Atterberg limits			Activity
			Clay (%)	Silt (%)	Sand (%)	Gravel (%)		LL (%)	PI (%)	LS (%)	
EH4	0,1 – 0,4	Hillwash	6	22	28	44	1,83	22	3	3,5	Low
EH7	0,2	Hillwash	8	12	77	3	1,15	21	4	2,5	Low
EH7	0,4	Pebble marker	9	11	41	39	1,77	30	5	7,0	Low
EH7	0,8	Reworked residual granite	10	20	61	9	1,01	32	9	6,0	Low
EH7	1,3	Residual granite	10	15	55	20	1,41	45	12	9,5	Low
EH8	1,0	Hillwash	7	16	59	18	1,38	36	8	8,0	Low

Legend
GM = Grading modulus
LL = Liquid Limit
PI = Weighted Plasticity Index
LS = Linear Shrinkage
Activity = Activity of the soil according to Van der Merwe's method

Table 2 indicates that:

- The composition of **hillwash** sampled in test pits EH4, EH7 and EH8 vary from silty sand to silty sandy gravel. The grading moduli vary correspondingly from 1,15 to 1,83. The weighted plasticity indices of the samples tested varied between 4% and 8%, which indicate a low plastic material. The test results, together with a low clay content of between 6% and 8%, indicate that this material is expected to display a low potential expansiveness.

- The **pebble marker** sampled in test pits at a depth of 0,4 m in test pit EH7 comprises silty gravelly sand with a very high grading modulus 1,77. The weighted plasticity index of 5% is indicative of a low plastic material. This, together with low clay content of 9%, indicates that this material is expected to display a low potential expansiveness.

- The **reworked residual granite** sampled at a depth of 0,8 m in test pit EH7 comprises silty sand with a high grading modulus 1,10. The weighted plasticity index of 9% is indicative of a low plastic material. This, together with low clay content of 10%, indicates that the material is expected to display a low potential expansiveness.

- The **residual granite** sampled at a depth of 1,8 m in test pit EH7 comprises gravelly sand with a very high grading modulus 1,41. The weighted plasticity index of 12% is indicative of a moderate plastic material. This, together with low clay content of 10%, indicates that the material is expected to display a low potential expansiveness.

8.2 CBR TESTS

The hillwash material was identified as a potential source of construction material on the site. Samples were taken to assess the compaction characteristics of this material. The compaction test results are summarised as follows:

Table 3: Compaction test results

Hole no.	Depth (m)	Material type	OMC (%)	MDD (kg/m³)	Swell (%)	CBR at various densities (Mod AASHTO)			
						90%	93%	95%	97%
EH4	0,1 – 0,4	Hillwash	7,0	2156	0	18	40	69	88
EH8	1	Hillwash	11,4	1991	0	28	39	50	59

Legend OMC = Optimum moisture content
MDD = Maximum dry density (Mod AASHTO)
Swell = Soaked at 100% Mod AASHTO compaction

From the results in Table 3 it is evident that:

- The **hillwash** sampled in test pits EH4 has a very high maximum dry density and low optimum moisture content. The CBR swell values are very low and the tests yielded high CBR values at densities typically specified in the field (93 % to 95 %). The material is considered to be suitable for the construction of an engineered fill of high stiffness or selected layer and subbase material in road pavements and can provisionally be classified as G5 material according to the TRH 14 guidelines.

- The **hillwash** sampled in test pits EH8 has a high maximum dry density and moderate optimum moisture content. The CBR swell values are very low and the tests yielded high CBR values at densities typically specified in the field (93 % to 95 %). The material is considered to be suitable for the construction of an engineered fill of low stiffness or subgrade material in road pavements and can provisionally be classified as G10 material according to the TRH 14 guidelines. The low classification of this material is due to the high plasticity index of 16, however if the material is modified with lime the plasticity index could be reduced.

9 GEOTECHNICAL CONSIDERATIONS

The purpose of the investigation was to provide a broad overview and classification of the suitability of the land for the proposed development and outline obvious constraints. Partridge, Wood and Brink (Ref 4), indicates that the following issues have to be considered in the classification of the sites for urban development (see Appendix D for a summary of the constraints and classifications):

- Collapsible / compressible soil profile;
- Shallow seepage or groundwater level;
- Expansive soil profile;
- Erodibility of the soil profile;
- Excavatibility;
- Undermined ground;
- Instability of areas of soluble rock;
- Steep slopes;
- Unstable natural slopes;
- Seismic activity; and
- Areas subject to flooding

Each of the above-mentioned constraints and its applicability to this specific site is discussed in the sections that follow.

9.1 COLLAPSIBLE / COMPRESSIBLE SOIL PROFILE

Indications of collapsible or compressible soil conditions were observed in the hillwash and reworked residual granite horizons at the site.

9.2 SHALLOW SEEPAGE OR GROUND WATER LEVEL

Ground water seepage was not encountered in any of the test pits excavated at the site. The presence of well ferruginised horizons and hardpan ferricrete in some of the test pits suggest that shallow perched water tables can be expected in the rainy season. Seepage into excavations can therefore be expected during and after particularly wet spells.

9.3 EXPANSIVE SOIL PROFILE

The foundation indicator tests conducted during the current investigation reveal that the hillwash have a low potential expansiveness. No evidence expansive soil behaviour was however noted in this horizon.

9.4 EXCAVATABILITY

Shallow refusal (at depths less that 1,5 m) occurred in four test pit excavated during the current investigation. Machine excavatability of in situ materials for services may therefore be problematic locally.

9.5 UNDERMINED GROUND

No indication of the presence of undermined areas was found during the desk study or field investigation.

9.6 INSTABILITY OF AREAS OF SOLUBLE ROCK

No indication of the presence of soluble rock formations was found during the desk study or field investigation.

9.7 STEEP SLOPES

The site has a gentle slope to the northeast and stability of existing slopes is not expected to be problematic.

9.8 UNSTABLE NATURAL SLOPES

No indication of the presence of unstable natural slopes was found during the desk study or the field investigation.

9.9 SEISMIC ACTIVITY

According to Fernandez and Guzman (Ref 5), the area investigated is classified as having a seismic intensity of between V and VI on the modified Mercalli scale (MMS) with a 90% probability of not being exceeded during a 100 year recurrence period.

An earthquake with an intensity of V on the MMS is described as having the following characteristics:

- It can be felt outdoors and its direction estimated;
- Sleepers are awakened;
- Liquids are disturbed and some are spilled;
- Small unstable objects are displaced or upset;
- Doors swing, close or open;
- Shutters and pictures move; and
- Pendulum clocks stop, start or change rate.

An earthquake of VI on the MMS is described as follows:

- All people, in- and outdoors feel it;
- Windows, dishes and glassware are broken;

- Pictures and books fall of walls and shelves;
- Furniture is moved and overturned; and
- Weak plaster and poorly constructed masonry structures crack.

The expected peak ground acceleration values associated with these magnitudes of earthquake are:

- Horizontal acceleration: 32 to 56 cm/s^2
- Vertical acceleration: 9 to 18 cm/s^2

The peak ground acceleration values indicate low intensity of seismic activity. No special seismic design measures are therefore required.

9.10 AREAS SUBJECT TO FLOODING

The 1:50 and 1:100 floodlines of the watercourse east of the site indicate that it is unlikely that the proposed development will be subject to flooding.

10 ENGINEERING GEOLOGICAL ZONING

For urban planning purposes the site is zoned according to the NHBRC classification systems (Ref 3). Due to the presence of collapsible/compressible horizons the entire site is classified as a Zone C1 site. The description of this zoning is as follows:

Zone C1: Zone characterised by collapsible/compressible soil profile with total expected movements between 5 mm and 10 mm. Development can take place provided appropriate precautions against differential settlement are implemented.

11 RECOMMENDATIONS

Recommendations are provided regarding the following:

- Development in general;
- Founding of light structures;
- The use of in situ soils as construction material; and
- Drainage measures.

11.1 DEVELOPMENT

No adverse conditions prohibiting the construction of structures for light industrial and residential development were encountered.

We recommend that township development proceed subject to the following conditions:

- Soil improvement or special founding solutions must be implemented for single and double storey structures.
- Detailed geotechnical investigations must be conducted for all high-rise structures, i.e. structures exceeding conventional double-storey height.

11.2 FOUNDING OF LIGHT STRUCTURES

Founding alternatives for lightly loaded single and double-storey structures include the following:

- Improve the in situ material below individual footings by excavating and recompacting
- Deep strip or pad footings to rest on stable materials below the suspect horizon
- Construction of soil rafts under the entire footprint of the structures
- Deep compaction of the area by means of impact compaction

11.3 CONSTRUCTION MATERIALS

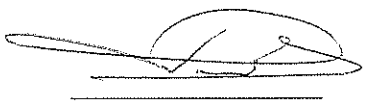
The hillwash material was identified as a potential of construction material at the site. The compaction tests revealed highly variable CBR values and the classification, according to the TRH 14 guideline varied, from G5 to a G10 material.

In view of the above it is recommended that further testing be conducted if this material is to be used for construction of engineered fills.

11.4 DRAINAGE MEASURES

The following drainage measures must be implemented:

- No accumulation of surface water is permitted and the entire development must be properly drained.
- All trenches and excavation works must be properly backfilled and compacted in 150 mm thick layers and compacted to 90% of modified AASHTO density.



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