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A REPORT

ON

A FEASIBILITY INVESTIGATION FOR THE PROPOSED DEVELOPMENT OF THE ROBERT STRACHAN HOSTELS AND PORTIONS 103 AND 193 ON THE FARM DRIEFONTEIN 171-IR, EKURHULENI METRO, GAUTENG.

BY

RELLY, MILNER AND SHEDDEN
PRETORIA

DATE: June 2013

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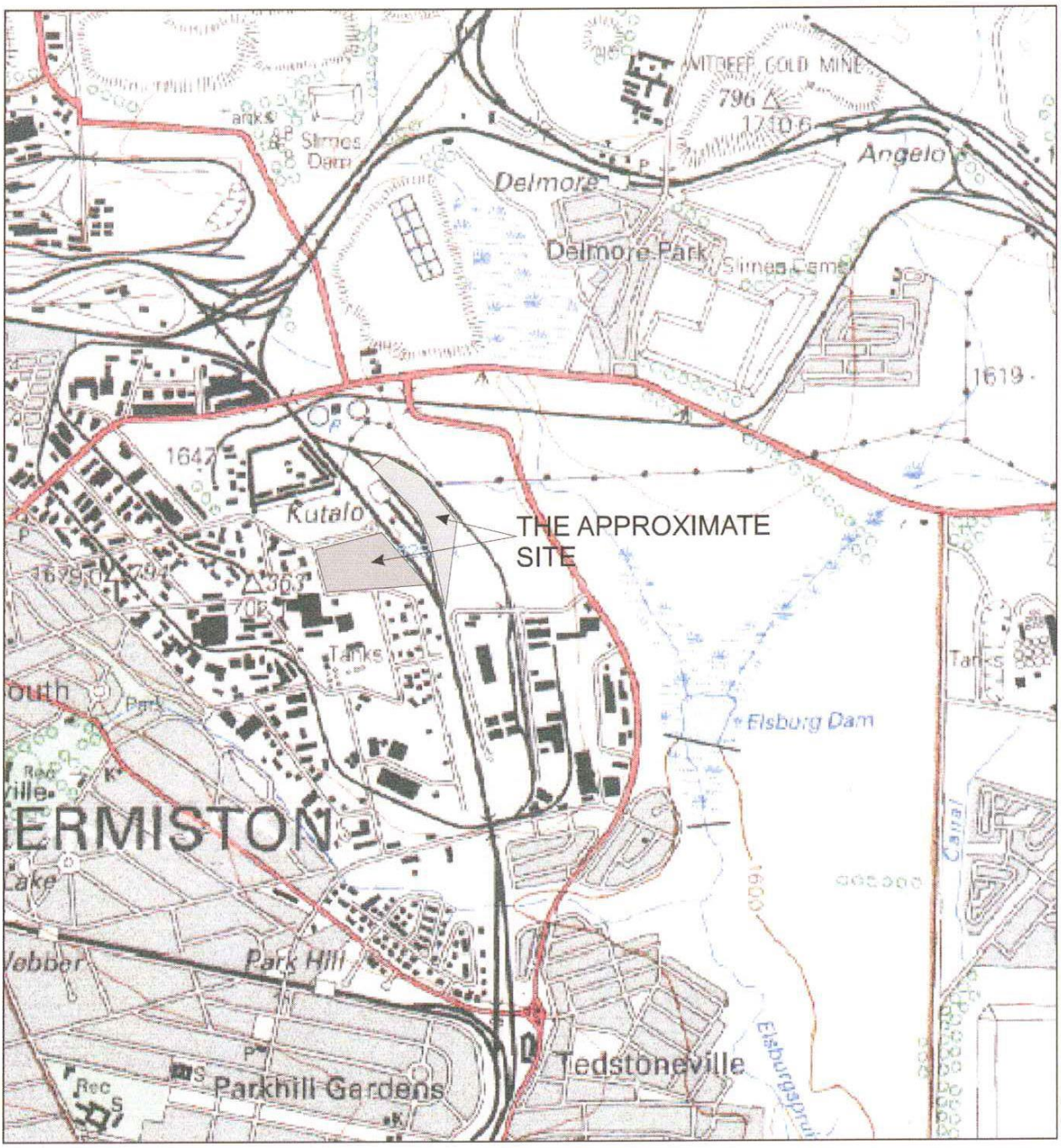

LOCALITY PLAN

Robert Strachan Hostel and
Portion 103 Driefontein 87-IR,
Ekurhuleni Metro, Gauteng.

NOT TO SCALE

1. INTRODUCTION

This report (13123germK) presents the results of a feasibility study undertaken for the development of the Robert Strachan Hostel site and Portions 103 and 193 of the farm Driefontein 87-IR in the Ekurhuleni Metro of Gauteng. The sites lie on both sides of the Kutalo station (see locality plan overleaf).

The purpose of the study was to provide generalised information regarding the feasibility of developing housing on the site. The geology, nature of the shallow soils and their geotechnical properties are considered. The cost of obtaining additional information that is deemed necessary to allow the preparation of a comprehensive Phase 1 geotechnical report has been provided (see Section 7). A geotechnical report needs to meet the requirements of the National Home Builders Registration Council's (NHBRC) 1999 guideline (Reference 5) and the requirements of the National Department of Housing guideline [Generic Specification GFSH-2 (September 2002)] (Reference 4).

The feasibility study was commissioned at the request of Izwelisha Town Planners acting on behalf of their client.

A visit was paid to the site in late May 2013.

2. SITE DESCRIPTION

Kutalo Station site: The portion of the site east of the Germiston-Elsburg line is an irregular area of about 7ha and is bounded by railway lines along the western boundary and along the northern and part of the eastern boundaries. The suburb of South Germiston Extension 9 forms the remainder of the eastern boundary. The railway line on the eastern side of the site is a spur line serving the industrial area to the south of South Germiston Extension 9. No structural development has taken place on Portions 103And 193 which is referred to as the Kutalo site in this report.

Access to the Kutalo site is via a rough track that traverses the property from north to south along the western edge. Future access is likely to be along existing roads in the southern portion of South Germiston Extension 9. The eastern spur railway line will limit access to and from Extension 9 in the northern half unless a level crossing or a bridge over the line is considered.

Vegetation is mixture of natural veld grass, weeds and pockets of reeds. Widely scattered, exotic trees are present on the undeveloped site. The weeds are associated with the abundant heaps of waste dumped throughout the property. There is a tendency for the waste heaps to be concentrated along old vehicle tracks. One or two areas have been cleared by the local community for use a make-shift soccer grounds. Vehicular access on the Kutalo site is fairly limited because of the numerous heaps of waste scattered throughout the area.

The relief of the Kutalo site is low with a gentle crossfall of about 9m (Google Earth ™) from north-

west to south-east. The overall gradient of the slope is about 3% towards the south-east. Comments regarding elevations are based on information taken from Google Earth™ in 2013.

Robert Strachan Hostel Site: The site occupies an almost rectangular area of about 6ha and is located between Power, Strachan, Jack Pienaar and Jan Hofmeyer Streets immediately north of South Germiston Extension 8. . The property has two cross-shaped, multi-storey hostels situated in the south western quadrant. The hostels are fully occupied. Ancillary administrative buildings and a boiler room are located in the central area and along the northern boundary. A sports field occupies most of the eastern third of the property.

The hostel entrance is on Strachan Street, a surfaced municipal road along the southern boundary.

Lawns and mature exotic trees cover the grounds around the hostels.

The relief of the site is low with a gentle crossfall of about 5m from north-west to south-east. The gradient of the slope is about 1% towards the south-east.

3. GEOLOGY

According to the 1:250 000 Geological Map, Sheet No 2628 East Rand, the sites are underlain by sediments of the Central Rand Group of the Witwatersrand Supergroup. The sediments comprise quartzite, conglomerate and sandy shale of the Turfontein Subgroup.

The hard rock geology is blanketed by a variable thickness of both colluvial and residual soils. Limited exposures of completely weathered quartzite were observed at one locality (see photograph 4 in Appendix C) but it is unsure whether or not the exposures represent imported road building material.

4. EXISTING INFORMATION

No existing geological information on or in the vicinity of the site could be sourced from the Council for Geosciences' databank.

5. GEOTECHNICAL DISCUSSION

Both sites are underlain by soils derived from the weathering of quartzite. An overburden soil profile is likely to be one of sandy colluvium overlying residual silty sand/sandy silt. The cover of soil blanketing shale is usually fairly thin with bedrock often intersected in the top 0,75m of the ground profile.

The geotechnical conditions that may impact on any residential development are discussed in the following paragraphs. Each geotechnical concern has been classified according to the table

presented in Reference 6. A copy of the aforementioned table is included with this report (see Appendix B).

5.1 **Collapsible soils**: The quartzite weathers to sand which often results in a cover of potentially collapsible material blanketing the bedrock. Shale does not weather deeply and the cover of soil is generally fairly thin. *NHBRC soil classification: C(1-2). Geotechnical assessment: 2A.*

5.2 **Seepage (perched water tables)**: Ferricrete, in the form of hardpan, is often well-developed in the residual soil. Perched water tables are often associated with these hardpan horizons. The sandy nature of the colluvial and residual soil favours the development of short duration perched water tables that reach maximum development at the end of a wet season. Significant perched water tables should not be expected in dry winter months. No evidence of surface seepage was observed during a "ride-over" site visit to the Kutalo site.

Although no evidence of perched water tables was apparent on the hostel site, the two hostels have an elaborate pumping system to control storm water from next to the basements. The writer is of the opinion that the pumping system is a consequence of the building design and not because of extensive, shallow perched water tables. It would appear that ground on either side of parts of the basements were excavated in order to allow windows to be installed. The openings allow the ingress of rain water that then has to be pumped out of the excavations. The water alongside the basements is not believed to be as a result of shallow perched water tables. *Geotechnical assessment: 2B.*

5.3 **Active Soil (expansive clay)**: Active clay is not a weathering product of quartzite or shale. Consequently, expansive residual soils should not be expected on the site. *NHBRC soil classification: H. Geotechnical assessment: 1C.*

5.4 **Highly compressible soil (normal settlement)**: Compressible soils may develop in areas where sandy soils have high moisture contents that favour immediate settlement of lightly loaded structures. These conditions may occur where thick deposits of sandy colluvium or residuum have developed. The piles of waste scattered throughout the Kutalo site would require removal before construction of housing takes place. The flattening of the waste piles should not be considered as foundations are often located on top of these layers with disastrous consequences.

Founding conditions on the hostel site should not pose a serious problem as suggested by the number of structures that already exist on the property. A review of the building plans of the existing structures would provide an indication of the type of foundation used for the multi-storey structures. *NHBRC soil classification: S(1). Geotechnical assessment: 2D.*

5.5 **Erodability of soil**: The erodability of a soil in this context is the ability (or inability) of the clay (colloidal) fraction to deflocculate and go into suspension. Residual quartzite is unlikely to be

susceptible to dispersion. *Geotechnical assessment: 1E.*

5.6 **Excavation properties**: The site would probably be classified as soft to intermediate excavation. A TLB should be able to excavate to depths of at least 2,0m below the surface without too much difficulty except where well-developed layers of hardpan ferricrete have developed or where shallow quartzite bedrock occurs. *Geotechnical assessment: 1F with pockets of 2F.*

5.7 **Undermining**: The site is possibly undermined at depth since numerous gold-bearing reefs are present within the Turfontein Subgroup of the Central Rand Group. The establishment of South Germiston Extensions 8 and 9 immediately south and east of the sites would suggest that shallow undermining is not present. The reefs dip steeply towards the south to a depth of about 150m (Reference 1) before they flatten out. Any shallow undermining would extend in an east-west direction since the strike of the sediments is generally east-west. The development of South Germiston Extension 8 would have been adversely influenced by shallow undermining if present. *Geotechnical assessment: 1G.*

5.8 **Dolomite**: The site is defined as non-dolomitic. There is no risk of dolomite instability. *Geotechnical assessment: 1H.*

5.9 **Steep slopes**: No steep slopes occur on the site. *Geotechnical assessment: 1I.*

5.10 **Unstable natural slopes**: No unstable natural slopes occur on the site. *Geotechnical assessment: 1J.*

5.11 **Seismicity**: According to Reference 2, the natural seismic intensity of the site lies between V and VI on the modified Mercali scale (MMS) with a 90% probability of the intensity not being exceeded in a 100 year period.

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

- Felt outdoors.
- Sleepers wakened.
- Liquids disturbed, some spilled.
- Small unstable objects displaced or upset.
- Doors swing, close, open.
- Shutters, pictures move.
- Pendulum clocks stop, start or change rate.

An earthquake with an intensity of VI may be described as follows:

- Felt by all.

- Many frightened and run outdoors.
- People walk unsteadily.
- Windows, dishes, glassware broken.
- Furniture moved or overturned.
- Trees, bushed shaken visibly.

Peak horizontal and vertical acceleration values at these intensities range from 32 to 56cm/s^2 (horizontal) and from 9 to 18 cm/s^2 (vertical). These values indicate a low intensity of natural seismic activity and no special seismic design measures are required.

Mining induced seismicity cannot be excluded in this area as it has been extensively mined over the last century. The risk of mining-induced seismicity is assessed as moderate. *Geotechnical assessment: 2K.*

5.12 **Flooding**: No drainage features cross the site. The risk of extensive flooding is not regarded as a problem on these sites. Minor flooding of the hostel basements may occur if the pump system is allowed to fall into disrepair. *Geotechnical assessment: 1L.*

There are no significant geotechnical conditions that are evident that prevent township establishment on these portions of land. A preliminary NHBRC soils classification for the majority of the two sites would be: **H** (total heave <7,5mm); **C2** (total collapse of >10mm); **S2** (total normal settlement >20mm) **(R)** (pockets of shallow bedrock). Collapsible soils can be fairly easily overcome by a combination of ground improvement and use of concrete reinforced rafts. In general, the sites may be regarded as a favourable in terms geotechnical constraints. The abundance of dumped waste may impact on access and will ultimately require costly removal.

The tables below are an attempt to indicate the additional costs the major geotechnical constraints will have on the price of a typical dwelling taking into account the assumed soil classification.

The site classes given in Table 1 on the next page are those recommended and used by the NHBRC. The values quoted in the table above have been taken from a 2008 feasibility study of an area in the Vaal Triangle.

TABLE 1

Estimated additional house cost per geotechnical classification

Site Class	Estimated additional house cost (%)
H, C, S	0
C1 (S1) (collapse)	1 to 3
C2 (S2) (collapse)	4 to 6
H1 (heave)	2 to 3
H2 (heave)	4 to 8
H3 (heave)	10 to 15
R(outcrop/suboutcrop)	2 to 4

An estimate of the area covered by the various soil classes indicated above is given below in Table 2.

TABLE 2

Estimate of areal extent of soil classes

NHBRC Class	% of site area
H, C, S	15
C1/C2;S1/S2	85
H1/H2/H3	0

6. ADDITIONAL WORK

The National Housing Department guideline (GFSH 2) indicates that a Phase 1 investigation of 13ha of non-dolomitic land should include the following exploratory work:

- Test pitting: A total of about 10 test pits to be excavated over the site.
- Soil samples: Soil samples should be taken from representative soil horizons at a frequency of about 0,75 samples per hectare (i.e. 8 foundation indicator tests, 3 consolidometer/swell tests and 2 chemical tests (pH and conductivity)). Compaction tests (CBR) should be undertaken on samples from potential borrow areas although the areal extent of a site may not favour the establishment of any borrow areas.
- Geotechnical report: The geotechnical information should be collated in a comprehensive report meeting the recommended reporting requirements of GFSH-2. These requirements include the zonation of the site into the various NHBRC soil classifications.

7. COST ESTIMATE

The estimated cost of a Phase 1 geotechnical investigation over 13ha is given below. The rates used in the preparation of the estimate are valid at present. There is an overall trend among soil laboratories to increase rates at least every two years if not every year. The rates for the hire of a

TLB are those generally charged by the larger plant hire firms. It may be possible to reduce these costs if local firms are located close to a site.

Professional Fees:	including travel, field work and reporting	R20 000,00
Laboratory Testing:	As per GFSH-2 recommendations	R 7 500,00
Hire of Equipment (TLB):		
1 day @ R5 000,00/day		R 5 000,00
	Sub total	R32 500,00
	VAT @ 14%	R 4 500,00
	TOTAL	R37 050,00

8. GENERAL

An appointment to undertake a geotechnical investigation as detailed in the preceding paragraphs will be deemed to include:

- Permission to excavate test pits within the lands whether under cultivation or not.
- The contact details and support of the owner(s).
- The position of all buried services in the area. A firm cannot be held responsible for damage to buried services not indicated to site personnel.

E Shedden (Pr Sci Nat)
RELLY MILNER AND SHEDDEN **JUNE 2013**

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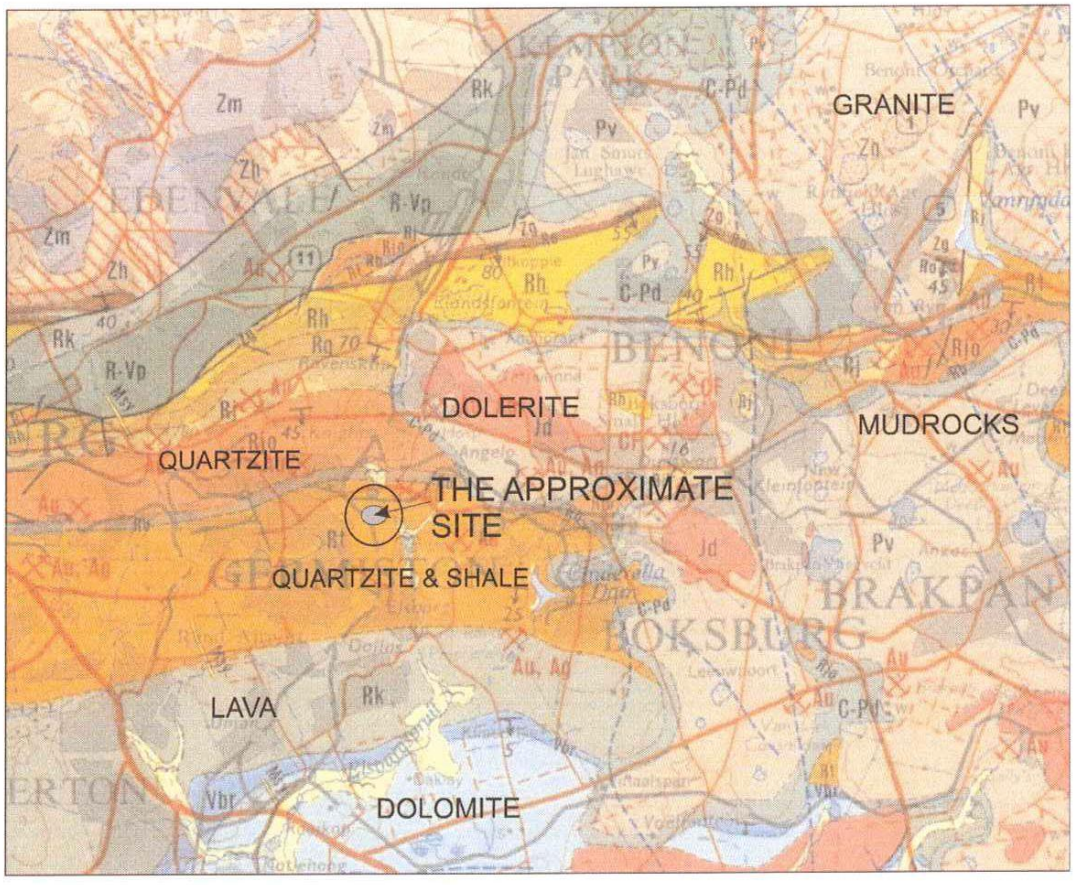
APPENDIX A

REGIONAL GEOLOGY

REGIONAL GEOLOGY

Portions 103 and 193 of the farm Driefontein 87-IR,
Ekurhuleni Metro, Gauteng.



Excerpt from 1:250 000 Geological Series,
Sheet No: 2628 East Rand.
[Not to scale]

APPENDIX B

GEOTECHNICAL CLASSIFICATION FOR URBAN DEVELOPMENT

Geotechnical Classification for Urban Development (after Partridge, Wood and Brink)

CONSTRAINT		Most favourable (1)	Intermediate (2)	Least favourable (3)
A	Collapsible Soil	Any collapsible horizon or consecutive horizons totaling a depth of less than 750mm in thickness*	Any collapsible horizon or consecutive horizons with a depth of more than 750mm in thickness	A least favourable situation for this constraint does not occur
B	Seepage	Permanent or perched water table more than 1,5m below ground surface	Permanent or perched water table less than 1,5m below ground surface	Swamps and marshes
C	Active Soil	Low soil-heave potential anticipated*	Moderate soil heave potential anticipated	High soil-heave potential anticipated
D	Highly compressible soil	Low soil compressibility anticipated*	Moderate soil compressibility anticipated	High soil compressibility anticipated
E	Erodability of soil	Low	Intermediate	High
F	Difficulty of excavation to 1,5m depth	Scattered or occasional boulders less than 10% of the total volume	Rock or hardpan pedocretes between 10 and 40% of the total volume	Rock or hardpan pedocretes more than 40% of the total volume
G	Undermined ground	Undermining at a depth greater than 240m below surface (except where total extraction mining has not occurred)	Old undermined areas to a depth of 90-240 m below surface where stope closure has ceased	Mining within less than 90-240 m of surface or where total extraction mining has taken place
H	Stability: (Dolomite & Limestone)	Possibly stable. Areas of dolomite overlain by Karoo rocks or intruded by sills. Areas of Black Reef rocks. Anticipated Inherent Risk Class I	Potentially characterised by instability. Anticipated Inherent Risk Classes 2 – 5.	Known sinkholes and dolines. Anticipated Inherent Risk Classes 6 –8.
I	Steep slopes	Between 2 and 6 degrees (all regions)	Slopes between 6 and 18 degrees and less than 2 degrees (Natal and Western Cape) Slopes between 6 and 12 degrees and less than 2 degrees (all other regions)	More than 18 degrees (Natal and Western Cape) More than 12 degrees (all other regions)
J	Areas of unstable natural slopes	Low risk	Intermediate risk	High risk (especially in areas subject to seismic activity)
K	Areas subject to seismic activity	10% probability of an event less than 100 cm/s² within 50 years	Mining-induced seismic activity more 100 cm/s²	Natural seismic activity more than 100 cm/s²
L	Areas subject to flooding	A "most favourable" situation for this constraint does not occur	Areas adjacent to a know drainage channel or floodplain with slope less than 1%	Areas within a known drainage channel or floodplain

* These areas are designated as 1A, 1C, 1D, or 1F where localised occurrences of the constraint may arise.

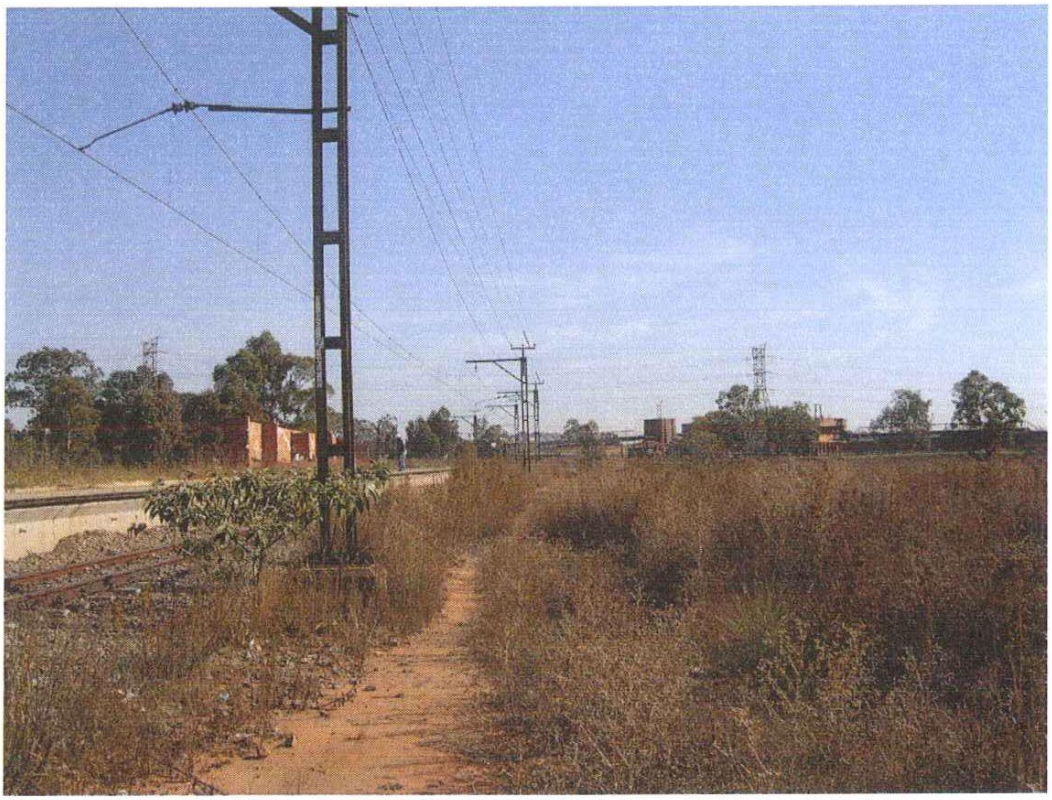
Example: A sub-area designated as Zone 2BF would be an intermediate class with anticipated seepage and excavation problems. A sub-area designated as Zone 3B would be designated as least favourable and not recommended for development due to surface water inundation.

APPENDIX C

PHOTOGRAPHS

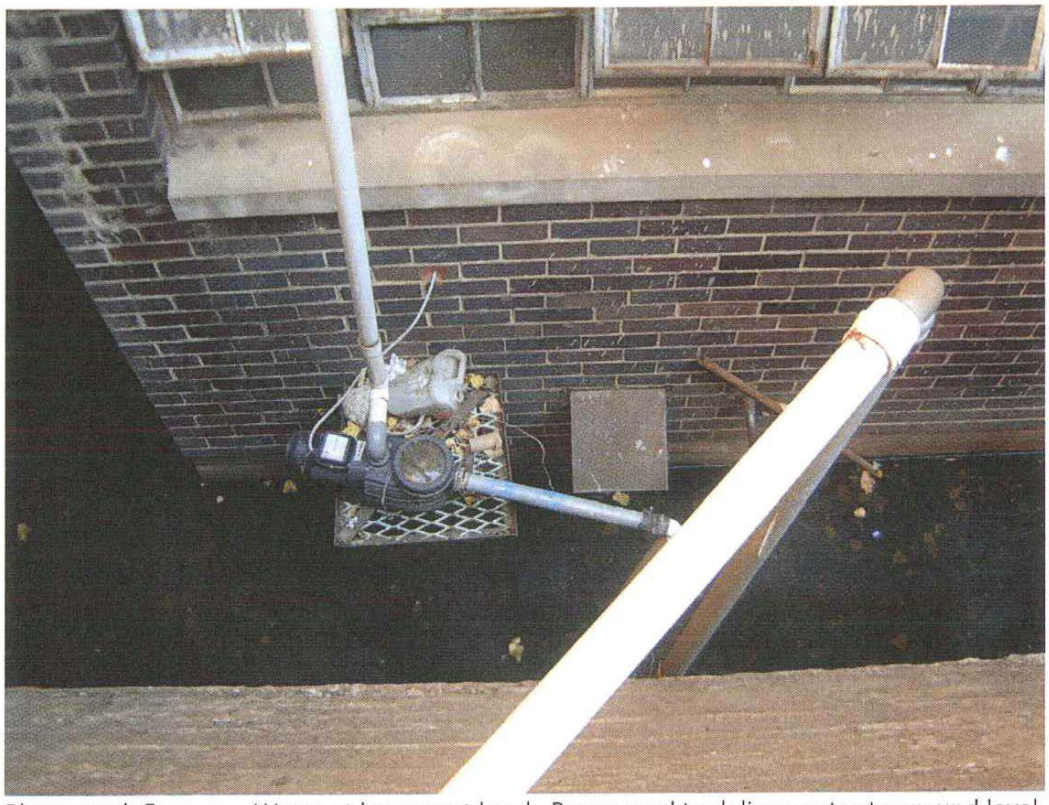
Photograph 1: View of Kutalo site towards south-east.

Photograph 2: View of Kutalo site towards north-east.



Photograph 3: View of Kutalo site towards north along western boundary.

Photograph 4: Shallow quartzite bedrock exposed in track along western boundary.



Photograph 5: Water at basement level. Pump used to deliver water to ground level.

Photograph 6: View of Robert Strachan Hostel from Jan Hofmeyer Street on eastern boundary.