ENGINEERING GEOLOGICAL INVESTIGATION FOR THE PROPOSED DEVELOPMENT OF PORTION 4 OF THE WILLOWS 340-JR

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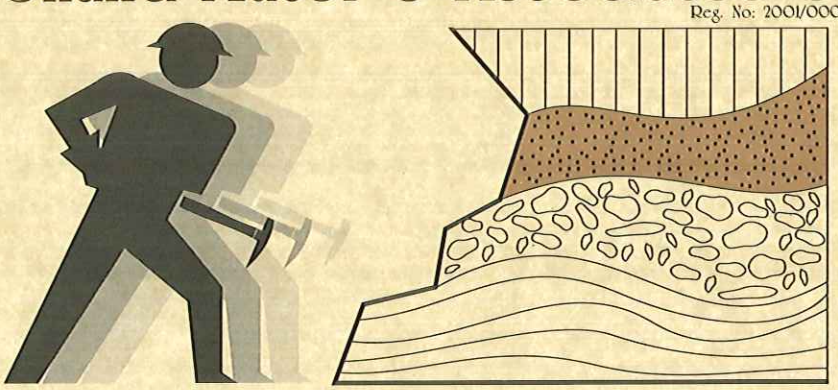

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ABSTRACT

This report details and comments on the results of an engineering geological investigation conducted for the proposed light industrial or commercial township development, The Willows X4, which is situated on Portion 4 of the farm Willows 340 - JR, Pretoria.

The purpose of the study was to investigate and identify areas geotechnically suitable for the proposed commercial/industrial development. This report provides details of the investigation methods adopted and later used to categorise the geotechnical developability of the area.

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APPENDIX INDEX

FIGURES

1. INTRODUCTION

This report details and comments on the results of an engineering geological investigation conducted for the proposed light industrial or commercial township development, The Willows X4, which is to be situated on Portion 4 of the farm Willows 340 - JR, Pretoria. The project was conducted for Messrs Uniqon Construction CC.

The aim of the study was to undertake a geotechnical investigation in terms of the normal requirements for township proclamation in which particular attention was devoted to the possible presence of collapsing sands, perched water tables, heaving clays and shallow bedrock. The information gained during the investigation was intended for township planning as well as to enable design and construction precautions to be taken for light structures, thus reducing the risk for damage in those areas where such conditions occur.

2. AVAILABLE INFORMATION

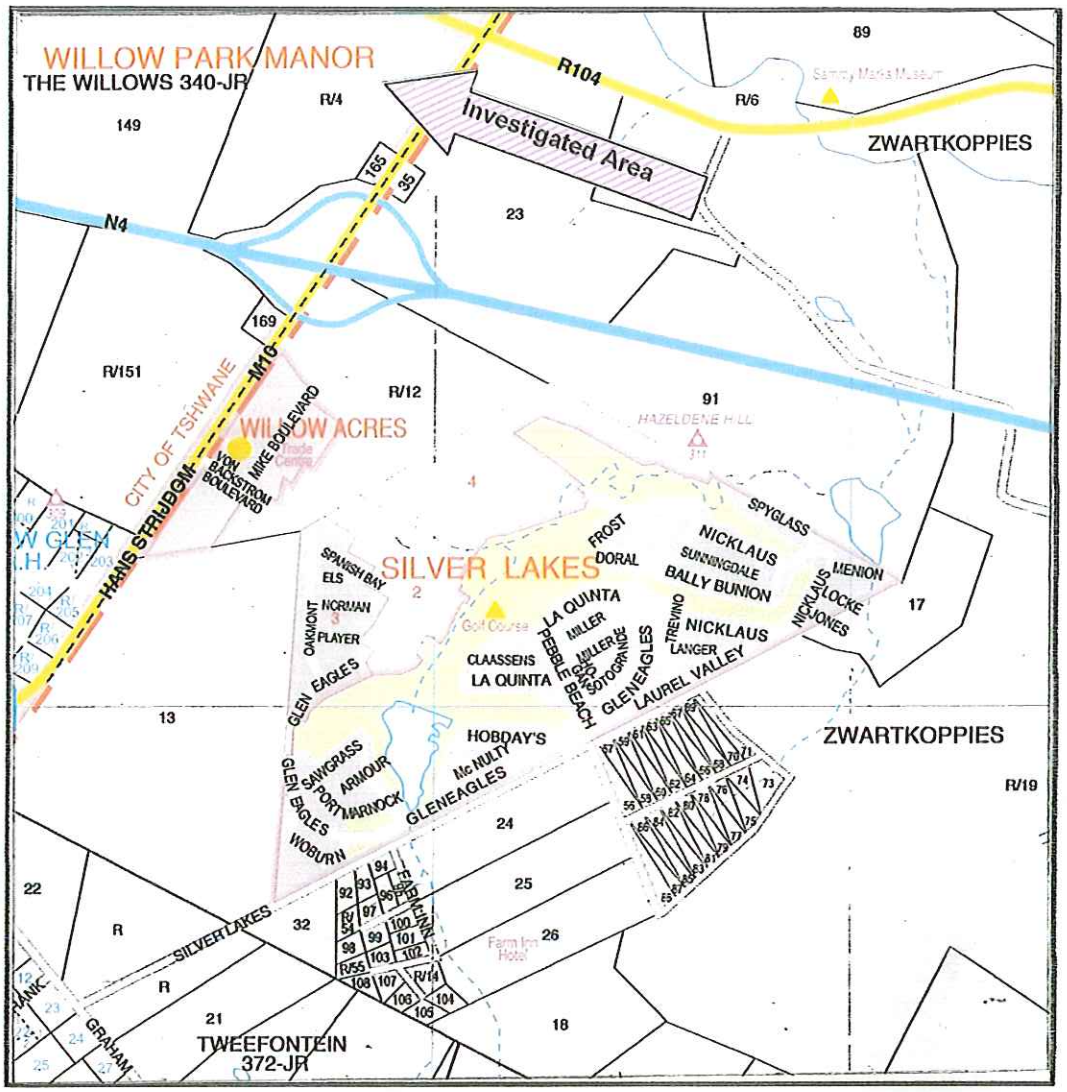
The following information has been used in the investigation and assessment of the designated site namely: -

- Topographical map to scale 1:50 000; Sheet 2528 CD RIETVLEIDAM
- Geological map: Sheet 2528 PRETORIA at a scale of 1:250 000.
- Panchromatic aerial photographs, scale 1:10 000, Job "Pretoria Munisipale Gebied" strip 12.
- Terrain map to scale 1: 6000

3. SITE DESCRIPTION

The proposed township is approximately 66ha in extent and is located on the western side of Hans Strijdom Road and directly north of the N4 highway between Pretoria and Witbank (See Figure 1 : Locality Map).

The investigated terrain forms part of an undulating landscape with a moderate relief sloping towards the north to northeast. The higher elevated area of the site occurs in the southwest and is drained by means of sheetwash towards a prominent well-defined, south to north draining river channel and two tributaries from the west. Impeded, subsurface drainage occurs along the drainage channels which results in marshy conditions in places. The greater part of the site is underlain by pedisediments with alluvium in the lower lying parts and along the drainage channel. The highest part of the terrain is formed by a diabase rocky "koppie"while the rest of the terrain is covered by deeper colluvial and alluvial materials. Rock outcrop of shale occurs on the eastern boundary of the terrain while prominent diabase rock occurs in the northwestern part of the site. Appearances of both rock types occur scattered over the terrain which is predominantly overlain by a thin veneer of colluvial soils. The greater area of the site is deforested. An abandoned shallow road materials borrow pit was also observed on the terrain. The vegetation consists predominantly of short grass and a few shrubs. The elevation of the natural topography on the terrain varies between 1304m and 1319m a.m.s.l.



Investigated Area

Scale : 1 : 30 000
City of Tshwane Street Guide
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FIGURE 1 : LOCALITY MAP : PORTION 4 OF THE WILLOWS 340-JR

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4. INVESTIGATION METHODS AND PROCEDURES

4.1 FIELDWORK

The soil conditions were investigated by means of 44 trial pits, ranging in depth from 0,8 m to 2,0 m below the present ground surface.

The trial pits were excavated with a 46 KW JCB backhoe while each trial pit was entered and inspected by an engineering geologist who described the soil profiles using the visual and tactile procedures advocated by Jennings et al (1973). Detail descriptions of the trial pit profiles are provided in Appendix I. The test pit positions are indicated on the appended Geology and Land-Use Map (See Figure 2 and 3, Appendix III respectively).

4.2 LABORATORY TESTING

The laboratory testing performed consisted of the following: -

- Indicator tests for accurate classification and identification purposes have been carried out on representative disturbed soil samples.
- California Bearing Ratio data were derived from the Indicator test results to obtain the expected compaction properties of the soils

The detailed test results appear in Section 6.2 (See also Appendix II).

5. GEOLOGY AND SOILS

5.1 GEOLOGY

Table I is a summary of the stratigraphic sequence occurring on the terrain namely: -

TABLE I : STRATIGRAPHIC SEQUENCE (See Geological Map)

LITHOLOGY	FORMATION	GROUP	SEQUENCE
Diabase	Post Pretoria Group Intrusions		
Shale	Silverton	Pretoria	Transvaal

The regional geology consists mainly of diabase and shale as presented in Figure 2 : Geology Map.

Since the geological materials in the area under investigation fall within a region with a Weinert N-value of 2.4, a distinct weathering process occurs on these materials. Deeply weathering profiles may occur in those areas underlain by diabase while shallow weathering profiles can be expected on the shales.

5.2 ROCK

5.2.1 Shale

The shale consists of soft to hard, olive-grey to yellow-brown rock. This material is very fine-grained, thinly bedded and fairly homogeneous. The shale is mostly covered by a thin horizon of transported material. In areas where the shale has been subjected to contact metamorphism it occurs as a yellowish brown hard rock, which is more resistant to weathering. The aura around the intrusive varies from a few centimeters up to tens of metres. The shale may occur at shallow depths of less than 1,0 m.

5.2.2 Diabase

The diabase occurs as a very hard, greenish grey, medium grained rock when fresh and weathers to an olive brown to yellow, shattered, silty clay. These materials consist mainly of large, slightly weathered, boulders in a clayey matrix.

5.3 SOILS

Thin, skeletal soils overlie the shale at shallow depth while thick colluvium occurs on the central and western part of the terrain. Although some of the transported soils have a good internal drainage, evidence of volume change due to fluctuating moisture content is manifested in well-developed structures such as wide and deep fissures as well as self-mulching surfaces. Where the transported materials are derived from shale, these soils are well drained with hardpan ferricrete at shallow depth.

6. RESULTS

6.1 RESULTS OF THE FIELDWORK

After the execution of the trial pitting, it was clear that a variety of soil profiles existed. Since many of the soil horizons are similarly based on soil mechanical parameters and composition, the soil profiles were described as diagnostic soil horizons (See Table II):-

TABLE II: DIAGNOSTIC SOIL HORIZONS

DIAGNOSTIC SOIL HORIZON	DESCRIPTION
A1	Slightly moist, light brown, intact, soft, clayey SILT. Hillwash
A2	Slightly moist, dark brown, intact, loose, silty SAND. Hillwash
A3	Slightly moist, dark grey, fissured, soft, silty CLAY. Colluvium
B1/1	Slightly moist, light orange, intact, firm, silty CLAY. Colluvium
B1/2	Slightly moist, light to dark orange, intact to fissured, soft , silty CLAY. Colluvium

Table continued

Table continue

DIAGNOSTIC SOIL HORIZON	DESCRIPTION
B2/1	Slightly moist, dark grey fissured, soft, silty CLAY with abundant calcrete nodules. Colluvium
B3/1	Slightly moist, orange olive grey, slickensided, soft to firm, silty CLAY. Colluvium
C1	Slightly moist, light orange red, intact, soft to stiff, silty CLAY. Residual Shale.
C2	Slightly moist, dark red, intact, soft, silty CLAY. Residual Diabase
R1	Dark orange purple stained black on joints, laminated, highly jointed, soft rock SHALE,
R2	Dark red streaked black to olive green, blocky, slightly to highly weathered, soft to hard rock DIABASE with rounded core stones in places

The site has been grouped into four soil mapping units as follows namely:-

SOIL ZONE I (Land –Use Zone A)

This zone consists of transported clayey silts or sands. The overall consistency is loose to medium dense. The thickness varies between 0,2m and 1,0m. These materials are underlain by completely weathered residual shale in the form of yellow, stiff, jointed shale and/or jointed, very soft to soft rock on moderate midslopes. Scattered ferricrete glaebules occur in the hillslope-pediment junctions on the contact between the transported and insitu materials. No perched water tables were found in any of the trial pits. The representing soil profile for this zone is as follows:-

0,0 - 0,2m	Slightly moist, light brown, intact, soft, clayey SILT. Hillwash
- 0,6m	Slightly moist, light orange, intact, firm, silty CLAY. Colluvium
- 1,5m	Dark orange purple stained black on joints, laminated, highly jointed, soft rock SHALE,

SOIL ZONE II (Land-Use Zone B)

Zone II is entirely underlain by diabase sills and dykes which have in places metamorphosed some of the shale layers into to hornfels through intrusion. These materials consist of highly jointed hard rock with clay as joint filling, covered by a thin mantle of red silty clay while the diabase outcrop in the northwestern part of the site manifests as small to large boulders . The hornfels can be excavated to a depth of 1,8m whereas the hard rock diabase will require hard excavation or blasting to excavate for services or foundations. A typical profile of this zone is as follows:-

0,0 - 0,2m	Slightly moist, dark grey, fissured, soft, silty CLAY. Colluvium
- 0,5m	Slightly moist, light orange, intact, firm, silty CLAY. Colluvium.
- 0,8m	Slightly moist, dark red, intact, soft, silty CLAY. Residual Diabase
- 1,7m	Dark red streaked black to olive green, blocky, slightly to highly weathered, soft to hard rock DIABASE with rounded core stones in places

SOIL ZONE III (Land –Use Zone C)

Zone III covers the western part of the site and comprises mainly of colluvial clayey silts to silty clays with an indicative collapsible structure in places. Pedogenic materials in various stages of development were encountered in some of the trial pits in the lower

sub-soil horizons. The thickness of the different soil horizons is variable. However, a typical soil profile of this zone is as follows:-

0,0m - 0,1m	Slightly moist, light brown, intact, soft, clayey SILT. Hillwash
- 0,9m	Slightly moist, light orange, intact, firm, silty CLAY. Colluvium
- 1,7m	Slightly moist, light orange, intact, firm, silty CLAY with abundant, loose, glaebular ferricrete nodules.

An open-texture and high void ratio is evident in the feldspathic colluvial soils. A colloidal coating occurs around the individual grains giving a relatively high shear strength in the dry state. However, a collapsible soil fabric can be expected when these soils are saturated under load. The collapsibility is enhanced when the loose to very loose consistency is taken into account. The development of the glaebular ferricrete is indicative of the fluctuating water levels during the wet season of the year. These materials form on the contact between the impeded silty clays and well drained silty sands. The loose consistency of the pedocrete indicates that no problems are expected with excavatability. The clayey materials have a slickensided structure indicating that these materials will swell and shrink during the various seasons of the year. These movements can be damaging to super structures if it is not taken into account during the design and construction.

SOIL ZONE IV (Land-Use Zone D)

This zone comprises transported alluvial materials which occur in the valley bottom and along the river and gully areas. These materials consist of a dark brown, firm, slickensided clay to depths of more than 2,0m and are indicative of a highly active clay.

Nodular ferricrete occurs within the first metre, indicating the presence of a more dense and clayey material deeper down the profile. Perched water tables were observed in some of the trial pits. The typical soil profile for this zone is as follows:-

0,0 - 0,4m	Slightly moist, dark grey, fissured, soft, silty CLAY. Colluvium
- 1,3m	Slightly moist, light to dark orange, intact, soft , silty CLAY. Colluvium.
- 2,0m	Slightly moist, dark grey fissured, soft, silty CLAY with abundant calcrete nodules. Colluvium

6.2 RESULTS OF THE LABORATORY ANALYSIS

6.2.1 Engineering Properties

6.2.1.1 Summary of the Geomechanical Properties

Table III is a summary of the mechanical parameters applicable to a diagnostic soil horizon.

TABLE III: GEOMECHANICAL PARAMETERS

DIAGNOS-TIC SOIL HORISON	TEST PIT & DEPTH (m)	INDICATOR TEST RESULTS					SOIL CLASS *	ACTIVITY
		LL	PI	LS	GM	CLAY		
B1/1	TP44:0,3 – 1,2	40	15	8	0,86	24	A-6(6)	Low
B2/1	TP42:0,1 – 0,5	56	26	13	0,25	53	A-7-5(23)	Low
B3/1	TP34:0,5 – 1,2	84	27	14	0,25	57	A-7-5(33)	Low

ABBREVIATION
LL = Liquid Limit; PI = Plasticity Index; * = PRA Soil Classification; LS = Linear Shrinkage; GM = Grading Modulus

The transported and residual soil horizons which will have an influence on the development can be described according to the PRA Soil Classification as low-compressibility silts to high compressibility, high-volume-change clays with medium to high plasticity fines. The tested samples indicate a low activity but taking the linear shrinkage into account all the soil horizons should be regarded as medium to highly, active and susceptible to swelling or volume change upon wetting or drying. These active soil materials can consolidate under pressure. From the grading analysis the coefficient of permeability of the different soil horizons indicates semi-pervious to impervious materials. The upper soil horizons of Zones A & C (See paragraph 8.2.4) indicate materials subject to collapse.

6.2.1.2 Compaction Properties

To obtain an indication of the compaction properties of the various soil horizons for construction or earthwork purposes, the indicator values as indicated in Table III were used to determine an approximate CBR value. These compaction properties are summarized in Table IV.

TABLE IV: APPROX. CORRELATION OF SOIL RATINGS BASED ON CBR VALUES

DIAGNOSTIC SOIL HORIZON	P.R.A CLASS	CBR	TO BE USED FOR		
			SUB-GRADE	SUBBASE	BASE
B1/1	A-6(6)	5	Medium	Unacceptable	Unacceptable
B2/1	A-7-5(23)	5	Medium	Unacceptable	Unacceptable
B3/1	A-7-5(33)	5	Medium	Unacceptable	Unacceptable

Note:
- The materials comprise transported materials.
- The PI value vary between 15% and 27%
- According to the tests conducted the transported materials are not recommended for construction purposes.

The values obtained for testing the shales and diabase on Six Fountains situated to the south east of the site are indicated in Table V. The optimum moisture content and maximum dry density relationship was used to specify a standard degree of compaction to be achieved during construction.

TABLE V: APPROX. CORRELATION OF SOIL RATINGS BASED ON CBR VALUES

Soil Zone	Test Pit No, Depth(m) & Zone	P.R.A Class	Opt. Moist. Content %	Max Dry Density Kg/m^3	CBR at % of MOD. AASTHO Density		
					98	95	90
AI	Z13:1,4 - 2,4	A-2-4	10,2	2140	12,0	11,0	6,0
C	Z18:0,0 - 1,2	A-6	16,4	1820	26	22	15

Note: 1.The materials comprise weathered rock
2. The PI values vary between 13% and 15%.
3. According to the tests conducted the materials can be utilised for lower subbase purposes.

7. GEOHYDROLOGY

7.1 DRAINAGE

The area is drained mainly by means of sheetwash and shallow incised gullies towards the north which collects in well-defined drainage channels which subdivide the terrain into three prominent zones.

At the time of the field investigation no surface water conditions were observed which will influence the proposed development. However, some marshy conditions did occur within the drainage system and broad flood plain area which have formed as a result of the variable thicknesses of the relatively impermeable clayey horizons acting as an aquiclude to the overlying colluvial, porous, water bearing, unconsolidated silty sands. During the wetter season and periods of higher rainfall, very shallow water tables develop which may even intersect the ground surface. The clayey alluvium deposits along the drainage course may prevent any groundwater in the colluvium from reaching the gully, with the result that build-up of the water occurs which may further enhance the development of marshy areas or springs.

A detail geohydrological study should be conducted to divide the terrain into its various shallow water regimes.

7.2 WATER TABLE

No boreholes were observed on the site and therefore the depth to the groundwater table is unknown. However, it is unlikely that any pollution problems may arise as a result of any light commercial type of development.

It is imperative that adequate surface and sub-surface drainage conditions be provided prior or during development of the site as a township.

8. ENGINEERING GEOLOGICAL EVALUATION

8.1 GENERAL

Engineering geological evaluations of the terrain conditions within the study area can be done based on the field observations, study of the exposed soil profiles and soil test

results. The engineering geological evaluation will be discussed according to the Land-use Classification Zones indicated in Figure 3, Appendix III.

8.2 FOUNDATION CONDITIONS

8.2.1 General

Where buildings exerting high pressures on the soil are to be erected, a detailed geotechnical investigation should be executed to determine the underlying soil conditions so that an appropriate foundation can be designed.

Where the foundations straddle the soil/rock contact or the uneven weathered rock profile contact such as in Zone B, this may result in point loads which can cause cracks in the super structures if differential settlements of more than 5 mm occur. It is therefore recommended that where such conditions may occur appropriate foundations be utilized such as stiffened or cellular rafts for the envisaged structures. Alternatively the loose materials adjacent to the rock should be excavated to a competent ground layer and backfilled to founding level with the same material compacted at 2% wet of optimum moisture content.

8.2.2 Potential Expansiveness

The different soil horizons which occur on the site range in activity from low to very high. An insignificant amount of heave is anticipated within Zone A where transported silty clays are overlying inactive residual shale or soft, weathered shale. Potentially expansive soils were encountered over the rest of the entire terrain and were evaluated according to the Van der Merwe's (1964) method. Field observations, together with the fissured to slickensided structure of the transported and residual soil layers, confirm that these soil horizons should be regarded as potentially medium active. The total potential heaves calculated for the different soil profiles are summarized in Table VI and have been calculated for a normal founding level of 0,3metres. The differential heave (i.e. the difference experienced by different points in a structure) is approximately 50 to 75 percent that of the total predicted value. The influence of the active materials on the surface has been grouped and specific recommendations made regarding the type of structures which should be erected. The recommended types of construction for single storey structures are given in Table VI.

TABLE VI : TOTAL POTENTIAL HEAVE OR SETTLEMENT

TRIAL PIT	TOTAL POTEN-TIAL HEAVE (mm)	DIFFEREN-TIAL HEAVE (mm) @ 50% Total Heave	ESTIMATED TOTAL SETTLE-MENT (mm)	SITE CLASS	LAND-USE CLASSI-FICATION ZONES	RECOMMENDED TYPE OF CONSTRUCTION FOR SINGLE STOREY BUILDINGS
TP1, TP3, TP16, TP17, TP21, TP37 – 39, TP45 – 46 & TP48				R	A, A1 & B	Normal
TP5, TP12 – 14, TP24 & TP29			5 - 10	C1	A & C (minor in C)	Modified normal Soil Raft
TP4, TP6 – 11, TP15, TP18- 23, TP25, TP30-33, TP36, TP41- 43, TP44 & TP47	12 - 22	6 – 11	>10	C2/H2	C & D	Soil Raft Stiffened or cellular raft Piled construction Split construction Soil raft
TP34 - 35, TP40	17 - 28	8,5 - 14		H2	D	

8.2.3 Settlement

According to the laboratory analysis all the tested soil horizons are potentially low to highly compressible. If these soils are fully saturated, they can consolidate under applied loads. This slow compaction subsidence can cause differential settlements which can be damaging to structures. Laterally, these compressible soils occur over the greater extent of the site at relatively shallow depth while the vertical distribution reaches a thickness of over 2,0m in trial pit TP2. The consistency of the different clayey materials is soft in general with the variance in the soil structure from intact to slickensided with a field observed moisture content of slightly moist.

Since the proposed development structures are expected to exert low pressures on the soils (less than 100 kPa), little to no settlements are expected to occur. However, the precautionary measures required to design appropriate structures to accommodate the movement of the active materials will compensate for any potential settlement which these structures may experience.

8.2.4 Collapsible soils

The clayey nature of the transported materials makes it unlikely that collapsible soils occur on the terrain. Isolated areas may occur where such conditions may occur (Zone A & C). However, the founding solutions as described for the various zones will cater for these problems, should they occur.

8.2.5 Recommendations

ZONE A

This zone describes the area where Shale bedrock occurs within 1,5m from ground surface and is located on the eastern portion of the site. Normal founding can be done for light structures on the soft to very soft rock shale. The unconfined compressive strength for the upper layer ranges between 80 and 180 kPa which is appropriate for double storey structures while the very soft rock has a strength of more than 700 kPa. **The NHBRC Site Classification is R.**

ZONE A1

This zone which is located west and adjacent to Zone A is similar in character to Zone A except that the Shale bedrock head is deeper than 1,5m below ground surface. Founding design should compensate for the compressible transported and residual Shales. The unconfined compressive strength for the upper layer ranges between 80 and 180 kPa while the very soft rock has a strength of more than 700 kPa. **The NHBRC Site Classification is C1.**

ZONE B

Zone B describes the areas underlain by Diabase sills and dykes which occur on the greater north western portion and a small area in the central east and central southern portion of the site. Since the soils cover is very shallow in places, founding can take place on or in the highly to unweathered diabase. The unconfined compressive strength of the hard rock is more than 700 kPa which makes this zone suitable for major structures. **The NHBRC Site Classification is R.**

ZONE C

This zone describes the greater western portion of the site and comprises of colluvial clayey silts to silty clays with an indicative collapsible structure in places. The highly variable nature and thickness of the transported materials which occur in this zone requires that the founding conditions as indicated in Table VI be adhered to. Shallow perched water conditions can be expected to occur in Zone C during the wet season. These conditions must be taken into account during the design of the super structures and special measures will be required to damp-proof ground floors or basements. **The NHBRC Site Classification is C2.**

ZONE D

This zone comprises of the transported alluvial materials which occur in the valley bottom and along the river and gulley areas and should be reserved for parks and recreational activities or the erection of high cost structures. Should this zone be considered for development purposes, construction types for the foundations will be as indicated in Table VI.

8.2.6 Erodibility

The transported materials over the site comprise mainly of silty clays. These materials are also of high plasticity making them not very susceptible to water erosion. It is therefore unlikely that stormwater will cause serious erosion constraints to the development. However, the alluvial materials that occur in Zone D have a dispersive nature causing these materials to be highly prone to internal erosion of the soil profile. It is therefore of the utmost importance that surface water be collected and disposed of in well designed stormwater channels to minimize the surface water of entering the soils and thus restricting internal erosion of the soils as far as possible. The rill erosion and scars along the drainage channel should be rehabilitated to prevent further erosion of the sidewall of the drainage channel and to reduce siltation thereof.

8.2.7 Slope Stability

The areas proposed for development are anticipated to be stable. No adverse features were observed which are indicative of landslide activity. However, failure of the side walls of excavations may occur in all the Zones except Zone A.

8.2.8 Bearing Capacities

A conservative estimate to the strength of an individual soil horizon can be related to the soil consistency and density. For the various soil horizons occurring on the terrain, the following consistencies have been determined: -

TABLE VII : TYPICAL CONSISTENCIES OF NON-&COHESIVE SOILS

SOIL / ROCK HORIZON	FIELD CONSISTENCIES		
	DESCRIPTION	Dry Density (KNm^{-3})	Unconfined compressive strength (kPa)
A1	Soft, clayey SILT.		40 – 80
A2	Loose, silty SAND.	14 – 16	
A3, B1/2, B2/1 & C2	Soft, silty CLAY.		40 - 80
B1/1	Firm, silty CLAY.		80 - 160
B3/1	Soft to firm, silty CLAY.		40 – 160
C1	Soft to stiff, silty CLAY.		40 -320
R1	Soft rock SHALE,		>400
R2	Soft to hard rock DIABASE		>700

The slightly moist conditions of the transported and residual materials occurring on the terrain make it possible that the various soil layers can support a load with a bearing capacity of more than 80 kPa except soil horizons A2. However, taking the high clay content of most of the soil horizons into account, compression under load should be expected if the existing moisture content increases during periods of high precipitation or influence of perched water conditions. Therefore, if the safe bearing pressure, determined by using a factor of 3 against failure, of the structures to be erected is exceeding 40 kPa, a soil raft to found on should be constructed by removing the insitu material to 1,0m beyond the perimeter of the building to a depth of 1,5 times the widest foundation or to a competent horizon and replaced with material compacted to 93% MOD AASTHO density at -1% to + 2% of minimum moisture content.

8.3 EXCAVATION CHARACTERISTICS

The presence of rock outcrops or shallow rockhead requiring mechanised or very slow manual excavation for services and foundations are a severe constraint on development. The ease of excavation depends on certain parameters such as the consistency and type of material, the portion of boulders in the material, presence or absence of solid rock and the height of the water table. If material is not excavatable or rippable then jack-hammering and blasting are required.

No problems are foreseen with the excavatability of the area except where hard rock outcrops or occurs at shallow depth below surface. The surficial and most of the residual soils are easily excavatable with slow penetration of the backhoe near the rock head. The overall excavatability for foundations and services can be done with a pick and shovel in the transported and residual soils which classify as *soft excavation* (Zones A, C & D) (SABS 1200) but the medium hard, boulder diabase will require large back-actors or jack-hammers to excavate to a depth of 1,5 m. Between 10 and 50 percent hard rock is expected. This material classifies as *intermediate to hard excavation* (Zone B).The shallow perched water conditions which can occur during the wet season can cause trouble during the excavations for foundations or services.

8.4 GROUNDWATER & DRAINAGE CONDITIONS

The moderate to steep slope character of the terrain may cause the velocity of the stormwater to scour the building sites during the construction phase, especially when the vegetation has been disturbed. It is therefore imperative that the development should be conducted in such a manner that minimum velocities in stormwater runoff are created. Control of the stormwater can be done by coordinating the road layout with the drainage systems. Where the roads are to be used to retard the stormwater runoff, the gradients should be as flat as possible. The pH values of the soils are 4.1 on average which may be slightly aggressive to concrete or iron pipes. Perched water conditions can be expected to manifest in the shallow rock head areas during periods of high precipitation as well as the foot slope areas and along the flood plain area of the incised drainage channel. These waters can pose a problem with respect to the excavation for services and foundations which will most probably be flooded, creating unstable trench sidewalls. To minimise the effect of perched water conditions the surface water runoff.

should be collected and conveyed to be disposed of in the natural drainage channel The general drainage character of the soils can be described as grounds with good surface runoff but with deficiency in deep drainage.

8.5 WATER-BEARING SERVICES

It is assumed that sanitation will be by means of a water-borne sewerage system. It is recommended that flexible couplings be used for the pipes to allow opportunity for relative movement caused by the active soils. The service trenches should be located at least 1,5m away from any structures. The trenches should be backfilled with the insitu materials compacted to not less than 88% MOD AASHTO density. Clay should be utilised as backfill material in the 300 mm layer nearest the ground surface.

8.6 CONSTRUCTION MATERIALS

Although roadbed materials suitable for fill are available on the site, it is advisable to obtain construction materials from the quarry in the vicinity of the terrain.

9. CONCLUSIONS AND RECOMMENDATIONS

9.1 The greater extent of the site is covered by colluvium comprising mainly of transported hillwash underlain by weathered shale or diabase.

9.2 Soil tests were done on disturbed soil samples from representative soil horizons. The results of these tests were utilised to determine the engineering properties of the various diagnostic soil horizons.

9.3 The in situ materials (diabase) can be used as fill and subbase materials. However, it is recommended that construction materials be imported to the site to optimise the development potential of the terrain.

9.4 Adequate bearing capacity exists for the intended commercial structures. However, precautionary measures should be taken during design and construction for the expected differential settlements associated with heave, collapse and compression potential of the transported and residual soils which may occur between the founding depth and bedrock. The uneven weathered bedrock may result in differential movements in the super structures.

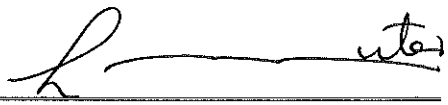
9.5 First class site drainage must be provided to reduce the risk of subsurface materials from becoming saturated, the risk of differential settlement and to prevent scouring and erosion of the surface materials.

9.6 Some difficulty is envisaged for mechanical excavations for the installation of services and foundations in the areas underlain by the diabase.

10. GENERAL

It may be discovered that soil conditions at variance with those discussed in this report do occur in very small localised patches. We are, however, of the opinion that the soils are generally of a somewhat homogeneous nature and little variability is expected, except in the hard rock profile variation.

The proposed commercial development is supported from a geotechnical perspective, provided that all recommendations and precautions, as presented in the report, are adhered to.



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