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PROJECT No: J13/5457 **29th November 2018**

NULEAF PLANNING & ENVIRONMENTAL
Building 8
CSIR Campus
BRUMMERIA 0184

Attention: Ms. Bryony van Niekerk

Dear Madam,

REPORT ON GEOTECHNICAL DESK STUDY INVESTIGATION CARRIED OUT FOR: *THE PROPOSED EXPANSION OF FOUNDERS LODGE IN LAPALALA WILDERNESS RESERVE ON: PORTION 10 OF LAPALALA 1020-LR, WATERBERG DISTRICT,* LIMPOPO PROVINCE

1. INTRODUCTION

This report covers the findings of a geotechnical desk study that was carried out at the request of Ms. Bryony van Niekerk of Nuleaf Planning and Environmental, who is acting on behalf of her client who proposes to apply for the rights to construct a manor house and six tree houses on the property.

The sites in question form part of a large nature conservation area which consists of a number of farms which had been consolidated into the large Lapalala Wilderness Game Reserve which is located due south-east of Lephalale in the Waterberg District of the Limpopo Province. The results of the investigation are based on a literature study during which time all available published information were used in order to compile this report.

2. TERMS OF REFERENCE

The objective of the geotechnical desk study investigation was to: -

- Determine from a desk study investigation, the engineering properties of the site soils and bedrock including potentially expansive material, low bearing capacity soils, areas difficult to excavate, shallow ground water conditions and the quality of the in situ soils in terms of road construction.

- Present appropriate recommendations for residential township development design and precautionary measures in accordance with the requirements of the local authorities as well as the National Home Builders Registration Council's guidelines.

The investigation was carried out in terms of written electronic instructions received from Ms. Bryony van Niekerk during January 2019.

3. INFORMATION CONSULTED

The following information was available and was consulted: -

- The 1: 50 000 scale Topographical Map Sheet Number 2328CD Melkrivier, Third Edition 2008.

- The 1: 250 000 scale Geological Series Maps Sheet Numbers 2328 Pietersburg, 1985.

- KZM files and a basic assessment report prepared by NuLeaf Planning and Environmental landscape architects were supplied, showing existing roads, the boundaries and layout of the proposed development.

- The publication "National Home Builders Registration Council's Home Building Manual, Part 1 & 2, February 1999.

- "The Vegetation of South Africa, Swaziland and Lesotho" by L. Mucina and C. Rutherford. Edition 1, Impression 1, 2006.

- A colour aerial photo of the study area was obtained from Google Earth via the Internet.

- "Engineering Geology of Southern Africa". Volume 1. The first 2 000 million years of geological time. A.B.A. Brink, Building Publications Pretoria, August 1979.

4. SITE DESCRIPTION

The sites for the proposed development areas are located some 65 kilometers due south-east of Lephalale, the study area is of irregular shape and covers a surface areas of less than 6 hectares. The property is accessed by gravel roads and internal link roads originating from Route R518 to the east of Lapalala. A number of internal gravel roads link the various development areas that are located in the southern portion of Lapalala Game Reserve, no permanent structures occur on the site.

The prominent Waterberg mountain range dominates the topography of the study area which ranges in elevation from a maximum of 1 071m (tree house sites) to a minimum of 1 059m (tented camp sites). The site is located in the Waterberg Mountain Bushveld veld type according to Mucina and Rutherford and consists of rugged mountains and plateaus with the ground surface being covered by dense growths of indigenous trees and shrubs. Some of the more abundant tree species that can be expected on the study area are Acacia *karoo*; Acacia *caffra;* Burkea *africana*; Combretum *apiculatum*; Faurae *saligna*; Ficus *natalensis;* Longocarpus *capassa;* Sclerocarya *birrea* and Terminalia *sericia*. Surface drainage takes place via sheetwash towards the north-west at about 6%. The climate consists of summer rainfall of about 500mm with very dry winters and frost being fairly frequent in winter.

5. SITE SOILS AND GEOLOGY

The study area is underlain by transported sandy soils of alluvial and alluvial origin that are presumably underlain by sandstone bedrock belonging to the Mogalakwena Formation, Waterberg Group according to the published geological Map, 2328 Pietersburg. Younger intrusive diabase dykes and sills of Post Transvaal age are known to occur in the area. The regional geology of the study area is shown on the "Geological Map", Drawing Number J13/5457A. The site has been apportioned into two prominent material zones, Soil Zones "A" and "B" as shown on the "Geotechnical Map", Drawing Number J13/5457B in the appendix at the back of the report.

Soil Zone "A" materials will probably consist of a thin to moderate veneer of sandy and gravelly soils overlying purplish brown, *soft rock* to *hard rock* sandstone. The blanketing sandy and gravelly horizons probably has a *loose* to *medium dense* consistency and can be expected to be no more than 0,5m thick in places, scattered sandstone boulders and numerous rock outcrops may also be present.

Soil Zone "B" materials can be expected to consist of a moderate to prominent horizon of dark red, *loose* to *medium dense*, voided, clayey sandy soils of alluvial and colluvial origin probably more than 1m thick and may be possibly be underlain by residual diabase consisting of dark red, *stiff*, shattered, sandy clay possibly grading to orange and yellow silty material which may or may not containing hard rock corestones (small boulders) of diabase.

6. GEOTECHNICAL CONSIDERATIONS

The following observations and recommendations are based purely on a desk study investigation which should preferably be followed up by a Phase 1 geotechnical investigation.

6.1 Collapsible and Compressible Soils

The upper colluvial sandy soils that blanket Soil Zone "B", can be expected to be potentially collapsible and compressible, based on the results of laboratory soil tests carried out on similar material from the study area. The sandy soils can be expected to have a loose to medium dense consistency and a voided texture, indicating that these soils will probably settle appreciably under a load when becoming saturated.

6.2 Expansive Soils

The clayey soils from residual diabase that may be present below the colluvial soils are considered to be potentially "medium" in the degree of expansiveness based on the results of the laboratory soil tests carried out on similar materials and according to the Van der Merwe (1964). A total surface heave value ranging from 10mm to 15m is predicted across this site, depending on locality and assuming the moisture condition will vary from dry to saturated. The upper blanketing colluvial sandy soils are considered to be potentially "low" in the degree of expansiveness with a total surface heave value of less than 7,5mm being predicted.

6.3 Foundations

Soil Zone "A"

This soil zone classifies as a Site Class "C/S/H" according to the guidelines of the NHBRC Standards and Guidelines of 1999 and in view of the shallow quartzite bedrock horizon that is present here, conventional spread or strip footings are envisaged for proposed rigid, single-storey residential structures, founded onto the quartzite bedrock at depths ranging from near surface occurrences down to an isolated maximum depth of 065m below surface and adopting a safe allowable bearing pressure of at least 300 kPa.

Soil Zone "B"

This soil zone will probably classify as a Site Class "C1/S1/H" according to the guidelines of the NHBRC Standards and Guidelines of 1999 and in view of the moderate horizon of potentially collapsible and compressible foundation soils which underlie this portion of the site, one of the following foundation solutions may be considered for the construction of proposed rigid, single-storey, masonry residential structures: -

Deep Strip Foundations

- Normal construction with drainage precautions and with mesh reinforced floor slabs.
- Founding on the sandstone bedrock horizon below the problem soils, provided it is located at a depth of less than 1m below surface.

Compaction of in situ soils below individual footings

- Remove in situ material below foundations to a depth and width of 1,5 times the foundation width or to a competent horizon and replace with material compacted to 93% Mod AASHTO density at -1% to +2% of optimum moisture content.
- Normal construction with lightly reinforced strip footings.
- Light reinforcement in masonry.
- Site drainage and plumbing/service precautions to be taken.

Soil Raft

- Remove in situ material to 1m beyond perimeter of building to a depth of 1,5 times the widest foundation or to a competent horizon and replace with material compacted to 93% Mod AASHTO density at -1% to +2% of optimum moisture content.
- Normal construction with lightly reinforced strip footings.
- Light reinforcement in masonry.
- Site drainage and plumbing/service precautions to be taken.

Modified Normal Construction

- Reinforced strip footings
- Articulation joints at some internal and all external doors
- Light reinforcement in masonry
- Site drainage and plumbing precautions to be taken
- Foundation pressure not to exceed 50 kPa.

The design and construction of raft foundations (whether soil or concrete) should be done in accordance with and under supervision of a civil or structural engineer. The design of heavier structures such as double- and three-storey buildings should take cognizance of the potentially slightly problematic soil conditions that may be present across Soil Zone "B".

Disturbed ground conditions caused by previous activities (removal of trees etc.) should be identified and carefully reinstated prior to the construction of housing units on the site, neglect to do this, may result in structural distress to buildings. Large tree roots should be removed from underneath proposed structures

6.4 Ground Water and Soil Chemistry

Although no shallow ground water seepages are expected to be present, seasonal perched water conditions may possibly occur at the interface between the permeable upper sandy soils and the underlying impermeable sandstone bedrock horizon in Soil Zone "A"). Damp proofing precautions should therefore be taken underneath structures and the design of basement structures and sewerage removal systems should take cognisance of this phenomenon.

The foundation soils can be expected to be potentially chemically aggressive with regards to buried ferrous pipes and the use of non-ferrous metal pipes or plastic pipes are recommended for underground use.

6.5 Excavation Characteristics

Very hard excavation and possibly blasting will be required to remove the sandstone bedrock across Soil Zone "A" from below relatively shallow depth. The transported sandy, gravelly and clayey soils that occupy Soil Zone "B" may be removed by hand tools or conventional earth moving equipment down to a depth of at least 2m below surface. The presence of large, hard rock diabase boulders possibly occurring within the upper soil horizons across Soil Zone "B" may require very difficult excavation and possibly the use of jackhammers and "pop" blasting for removal.

6.6 Earthworks

The sandy soils that blanketing Soil Zone "B" will probably classify as G7/G8 quality in terms of TRH 14. These soils should therefore be suitable for use as backfill underneath surface beds and for use as lower selected layers in road and pavement construction. Material for use in the construction of upper selected, subbase and basecourse layers for road construction will have to be imported. Cognizance should be taken of the potentially compressible nature of the upper soil horizons in the design and construction of roads.

7. GENERAL

The above observations and recommendations are based on a desk study investigation and on a brief site inspection of the property and its surroundings. It should be pointed out that the investigation was carried out using present day and the latest state-of-the-art techniques. Certain assumptions and extrapolations have had to be made and consequently, conditions at variance to those described may occur and should be confirmed by a detailed geotechnical investigation.

It is suggested that the desk study investigation be followed with a Phase 1 and 2 geotechnical investigation, should rigid, masonry structures be planned in future. During the Phase 2 investigation, a competent person should inspect the excavations for foundations during construction in order to verify that the materials thus exposed are not at variance with those described in the report. The placement of the fill must be controlled with suitable field tests to confirm that the required densities are achieved during compaction and that the quality of fill material is within specification.

We trust that the above information will meet with your immediate requirements. Please do not hesitate to call for any further information.

Yours faithfully

JOHANN VAN DER MERWE (Pr.Sci.Nat)
Consulting Engineering Geologist.
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8. APPENDICES

Geological Map

Geotechnical Map