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Our Reference: LL3597

20 July 2020

BAKKOS PROJECTS (Pty)Ltd
P.O. Box 546
Makopane
0600

**Attention: Mr. K. Hassim**

**RE: RECONNAISSANCE INVESTIGATION ON THE VAALBANK INDUSTRIAL SITE, MIDDELBURG, MPUMALANGA PROVINCE**

**Sir,**

A reconnaissance investigation pertaining to the geotechnical and groundwater aspects was carried out on the above site referred to as 'Vaalbank Industrial'.

The investigation comprised an aerial photographic interpretation and a desk top review of available information. Based on this superficial information, a summary of tentative geotechnical and groundwater parameters inclusive of applicable recommendations have been included for the preliminary development of the Vaalbank Industrial site.

Yours faithfully

**PG Hansmeyer *Pr.Sci.Nat***
**AN**

# FACTUAL REPORT

# ON A RECONNAISSANCE INVESTIGATION,

# ON VAALBANK INDUSTRIAL


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**PROJECT NO:** LL3597

**DATE:** 25 July 2020

**BY:** P.G. Hansmeyer *Pr. Sci. Nat.*

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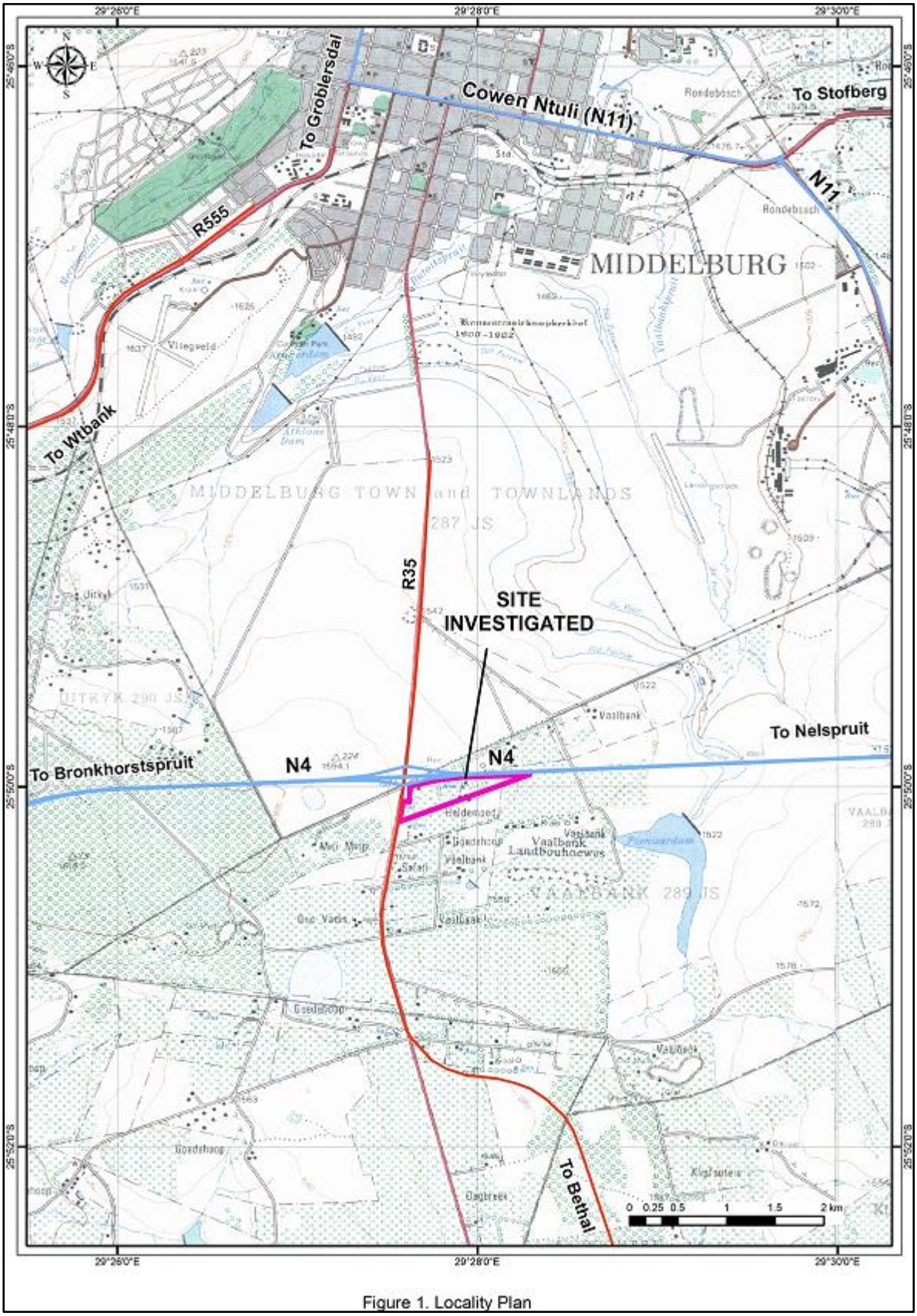



Figure 1. Locality Plan

# FACTUAL REPORT

# RECONNAISSANCE INVESTIGATION VAALBANK INDUSTRIAL,

# MIDDELBURG, MPUMALANGA PROVINCE

## 1. INTRODUCTION

### *1.1. Terms of Reference*

This factual report presents the results of a reconnaissance investigation into the foundation conditions and the groundwater potential for the proposed development of the Remainder of Portion 58, Vaalbank 289-JS, Middelburg, Mpumalanga Province. The site referred to as 'Vaalbank Industrial' is indicated on the Locality Plan, Figure 1 in the beginning of the report.

A written brief on the scope of work to be carried out (Ref. Q20-17 Rev.) was e-mailed to Mr. K. Hassim of Bakkos Projects (Pty)Ltd, Makopane on 9 July 2020 and permission was granted on the same day to proceed with the work.

The understanding was that a basic reconnaissance investigation will be carried out by means of remote sensing and a desk top study only and that historic investigations carried out by the undersigned in the vicinity will also be consulted.

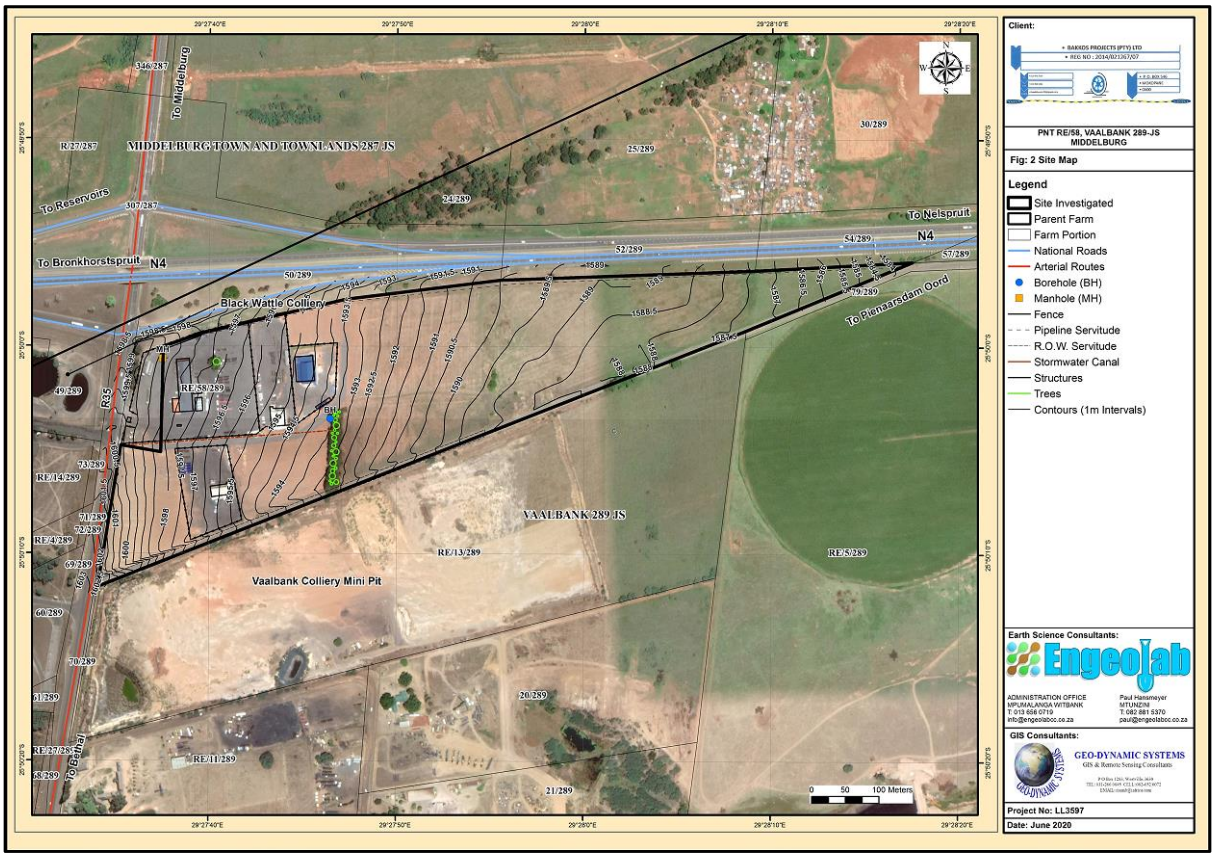
### *1.2. Site Information and Objectives*

The triangular site of some 22.13ha is located adjacent to the N4 highway off-ramp, with the main entrance on the Bethal/Middelburg R35 tar road, opposite Black Wattle Colliery. The southern boundary is separated from the Vaalbank Colliery Mini Pit open cast mine by a gravel servitude road to Pienaardam Oord.

There are four buildings on the site – two used by transporting firms, another building is used as a diesel depot for transporters and the fourth by an engineering and construction firm – refer to the Site Plan, Figure 2 on the following page. Part of the open space is used by an electrical contractor for the storage of transformers and treated poles. The area to the east of the buildings that was used in the past to plant cash crops is shielded from road side view by a lane of mature black wattle trees. The undeveloped easterly portion of the site will be used to accommodate future light industrial stands. Water for domestic purposes is provided by Black Wattle Colliery; ESKOM provides electrical power (there is a 315KVA transformer on site) whilst the removal of refuse is carried out by the lessees themselves.

The objectives of the reconnaissance investigation were to: -

i. Determine the site soils and the geology;
ii. Tentatively establish the soil and weathered rock profiles over the two sites;
iii. Evaluate the workability of the site materials with regard to their excavatability and compactability and potential use with future site developments;
iv. Identify the geotechnical constraints;
v. Comment on the groundwater aspects.




**SITE PLAN, FIGURE 2**

### *1.3 Available Information*

Information was obtained from the following sources: -

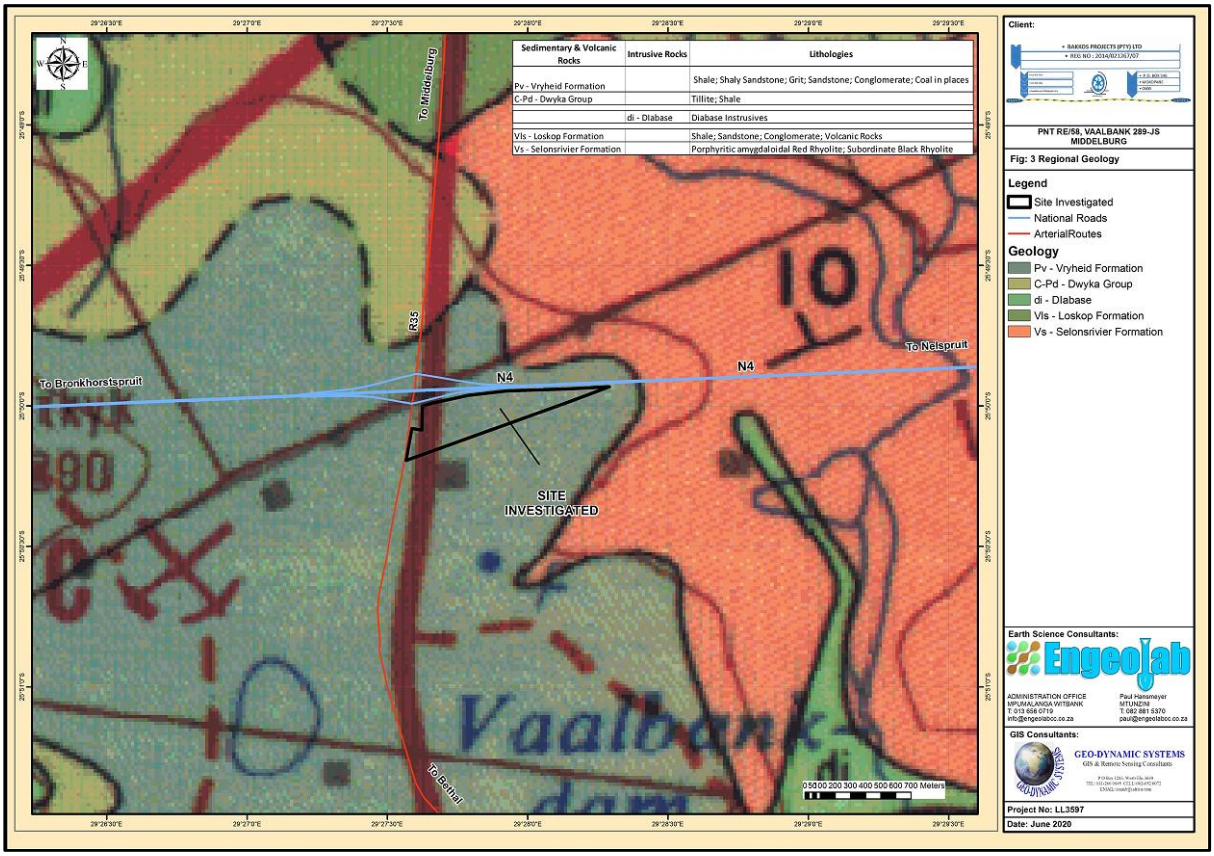
A Google Earth Image of the site,

i. TopoCadastral Map Sheet 2529 CD Middelburg,
ii. The site geology was obtained from the 1:250,000 scale Sheet 2827 Pretoria geological map, published in 1988,
iii. The site geohydrology was obtained from the 1:500,000 scale Sheet 2526 Johannesburg published in 1999,
iv. Cadastral information of the site was provided by Johan Meiring, Professional Surveyor, Middelburg.

## 2. GEOLOGY AND SITE SOILS

The three lithological formations present on site comprise the sediments of the Vryheid Formation underlain by tillite of the Dwyka Group deposited on basement bedrock – that is rhyolite of the Selonsrivier Formation, a volcanic rock type. The Vryheid sediments and underlying Dwyka tillite become progressively thinner eastwards, pinching out against the north-westward dipping basement rhyolite about 150m from the easterly corner against the N4 highway – refer to the Geology Map, Figure 3 below.

As far as can be ascertained, there are no outcrops on site and the underlying Vryheid sandstone is blanketed by silt-sand mixes of various origins. The hardstand area of the site is covered by imported material to form an adequate wearing course for the transport trucks.




**GEOLOGY MAP, FIGURE 3**

## 3. FOUNDATION and MATERIALS ASSESSMENT

The approach for specifying foundation objectives on the site which has been earmarked for the development of light industrial stands is a function of the type and the sizes thereof, the skill and sophistication of the construction team, construction equipment ('yellow' machinery) and the extent of the site investigation. These objectives are defined as: -

*1. Attain a specific geologic unit for the light industrial stands – say fresh bedrock if shallow; alternatively, if >2m thick compact substrate;*

*2. Excavate to a subgrade that will suffice as a founding medium;*

*3. Attain a specific rock quality/compacted earth for settlement sensitive structures;*

*4. Achieve a surface that meets a construction control test – be it bedrock or competent subgrade material;*

*5. Excavate to a surface based on the ability of excavation equipment;*

*6. Excavate to a depth indicated by design requirements;*

*7. Achieve a foundation material judged to be adequate based on visual and tactile observations, dynamic penetration tests and geotechnical drilling cores (if required);*

The foundation objectives are defined as a combination of objectives 1 – 5. In the light of these objectives, the following specific geotechnical and construction issues are pertinent to the proposed development of light industrial stands, namely: -

- Foundation rock quality – as determined by state of visible weathering and jointing in the sandstone bedrock;
- Expected excavatability and compactability of site materials;
- Susceptibility to flooding, ponding and erosion during high rainfall periods;
- Suitability of the excavated soils to be re-used for construction of roads and/or as foundation materials.

A discussion of these assessments is provided below.

The site is blanketed by soft excavatable cover soils with an estimated thickness of 2.5m – Ref. 1. These soils usually comprise silt-sand mixes and are notoriously compressible, causing settlement of structures. The underlying residuum is usually only 0.5m thick and often partially to well ferruginised followed by intermediate excavatable sandstone bedrock – ideal founding medium with limited settlement (<5mm). The top soils are usually fairly permeable and if ponding occurs, it usually evaporates within a day or two.

A summary of tentative geotechnical aspects is presented by Table 3.1 below followed by additional information pertaining the excavatability.

**TABLE 3.1 SUMMARY OF TENTATIVE GEOTECHNICAL ASPECTS**

| Depth (m) | Soil/ Bedrock Profile | Origin | *Excavation Class | **G Class | Geotechnical Aspects | Recommendations |
|---|---|---|---|---|---|---|
| 0 - 2.5 | Light brown medium grained sand-silt mixes | Transported soils of various origins | Soft | G8, G9 | Loose consistency; highly erodible; highly compressible; prone to wind and water erosion; poor founding medium <50KPa; roots throughout top 0.3m; excavations >1.5m require shoring | Good subgrade material; compact in situ; access roads compact using vibratory smooth drum roller; compact at -1% to +2% of Mod. AASTHO max dry density |
| 2.5 – 3.0 | Dark brown speckled orange usually coarse grained in partially cemented matrix of moist gravel-sand-silt mixes; where well cemented - hardpan ferricrete is encountered which is indicative of perched water table | Ferruginised sandstone residuum | Soft to Intermediate | G5-G7 | Medium dense consistency; erosion-prone; high to medium compressible; bearing capacity <100KPa; low-medium plasticity (PI<12); GM ≅ 1.5-2.0; friction angle Ø~40°; Cohesion C~ 10KPa; excavations cut back to 45°from horizontal; exvavations > 1.5m require shoring | Cut to stockpile ; compact to 95% of Mod.AASHTO @ -1 to +2% of OMC; Mechanical and/or chemical stabilization beneficial; compacted foundation material bearing capacity ~350KPa |
| ➢ 3.0 | Light ivory with orange-brown stained fracture surfaces | Competent sandstone | Intermediate to hard excavation & heavy ripping | G5 | Medium dense to dense consistency; low compressibility; low erosion potential; settlement 5mm; bearing capacity ≅ 1MPa; non-plastic; excavations vertical; | Good founding medium with minimal settlement |

***Excavation Class SANS 1200D – Ref. 2 **G – Class = TRH 14/1985 – Ref.3**

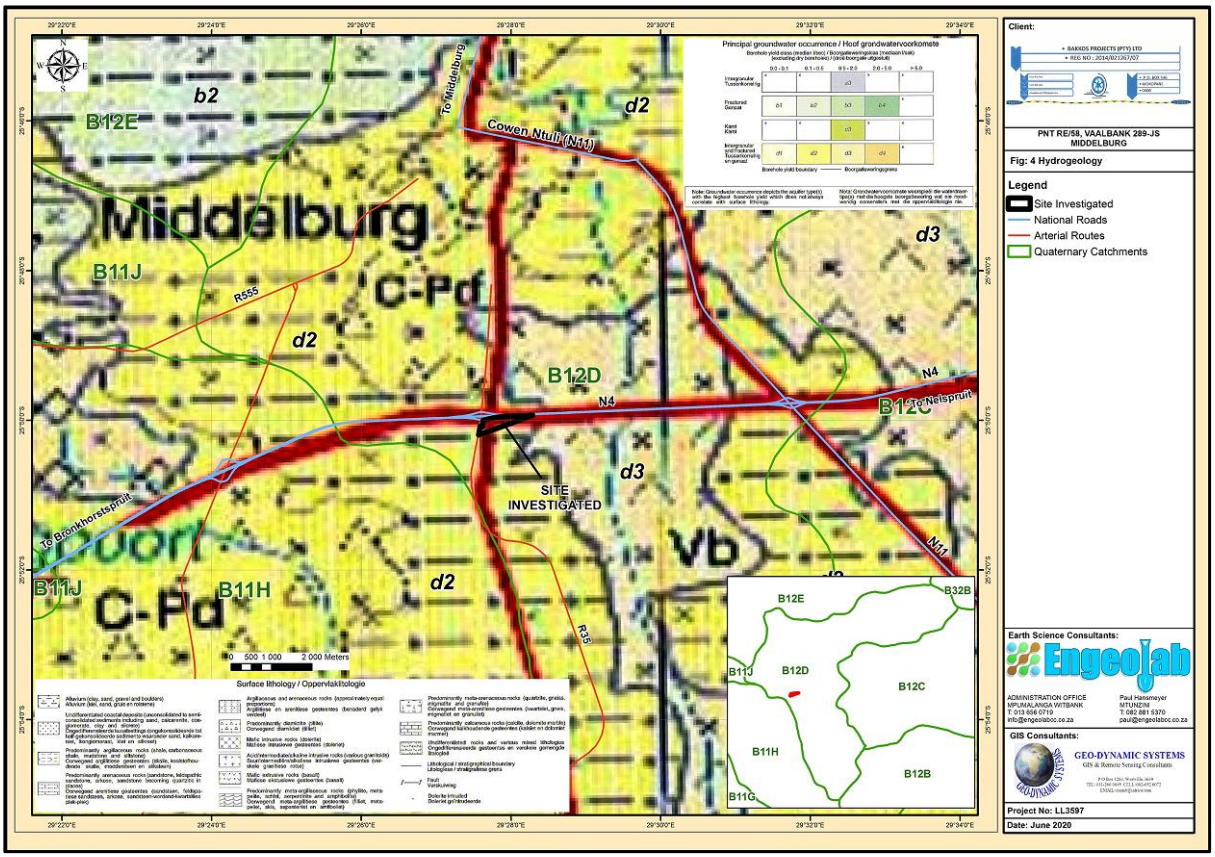
Mechanical excavation with a 65KW powered TLB should be adequate to excavate through the soft overburden materials but a more powerful excavator will be required to excavate

highly weathered sandstone bedrock estimated to be present from a depth of 3m. Difficult excavation and refusal should be experienced in moderately weathered bedrock >3.5m.

## 4. SEEPAGE AND GROUNDWATER

The site is located within the B12D quaternary catchment – refer to Figure 1 – and about 750m east of a local water shed. The terrain dips with an even gradient of about 1.3% eastwards and surface run-off should normally flow in this direction.

The on-site lithology comprises Vryheid sandstone underlain by Dwyka tillite deposited on rhyolite bedrock. The groundwater occurring in the Vryheid sediments, tillite and basement bedrock are controlled by fracturing, jointing and contact zones with dolerite intrusives. The geological succession can be generally be assigned to the *d2* fractured class with yields of up to 1,800l/h – refer to the Geohydrological Map, Figure 4 on the following page. It must however be noted that the on-site shallow aquifer(s) may yield much less than anticipated due to drainage into the adjacent open pit mine. Deeper boreholes into the basement rhyolite are expected to intersect higher yielding aquifers of the *d3* class with an expected yield range of 1,800l/h to 3,600l/h.




**GEOHYDROLOGICAL MAP, FIGURE 4**

## 5. CONCLUSIONS & RECOMMENDATIONS

This section of the report briefly summarizes the tentative groundwater and geotechnical findings relevant to the site.

The on-site geology comprises Vryheid sandstone overlying Dwyka tillite deposited on rhyolite bedrock. The groundwater occurring in the Vryheid sediments, tillite and basement bedrock are controlled by fracturing, jointing and contact zones with dolerite intrusives. The

geological succession can be generally be assigned to the *d2* and *d3* 'fractured classes' with a maximum potential yield of 3,600l/h.

The tentative geotechnical constraints of the site include loose cover soils susceptible to settlement and if applicable, hard excavation within sandstone bedrock >3.5m. These aspects are discussed briefly below.

1. The cover soils, residuum and decomposed bedrock layers that underlie the site to an approximate depth of 3.5m below natural ground surface are soft to intermediate in terms of their excavatability and a TLB or excavator such as a CAT 225/Hitachi L200 will be able to excavate the overburden. Deeper excavations within fresh bedrock will require hard ripping and blasting.
2. Excavated materials are to be stockpiled for future use and should be thoroughly tested for their intended applications – be it impermeable backfill, or pavement layers for the access and internal roads.
3. The east dipping topography supports good drainage and ponding is unlikely; however, the cover soils are susceptible to erosion and a stormwater management plan will have to be implemented.
4. The pavement layers of the internal and access roads and foundation trenches of buildings are to be wetted up and compacted to prevent undue settlement.

## 6. GENERAL

Every effort was made during the site investigation to ensure that generally accepted practices of our profession were used in the sub-surface evaluation of the site, and that the proposed sampling and testing will be representative of the soil/rock conditions observed on-site. However it is impossible under the constraints of a restricted reconnaissance investigation of this nature to guarantee that zones of either poorer foundation conditions or lower groundwater yields were not identified. The investigation has attempted, through interpolation and extrapolation of recorded site observations, to predict potential problem issues of a geotechnical nature and thus provide guidance to design engineers. Variances in soil, rock and groundwater quality, quantity, aerial distribution and thickness from those predicted may be encountered during development and these should be recorded, however no warranty against these variations is expressed or implied, due to the geological changes that can over time due to natural processes, or human activity.

In view of the variability inherent in natural materials, a competent person must inspect all foundation excavations at the time of construction to ensure that the materials are adequate for the proposed structures and that they are in accordance with the recommendations stated in this report. The placement of engineered fill must be controlled with suitable field tests to ensure that the required densities are achieved during compaction, and that the quality of the fill material – be it soil or rock is within specification.

Although not anticipated at this site, it should be noted that this investigation did not include the assessment of any potential environmental hazards, or groundwater impacts that may be present, or ensue from the development of the site.

## REFERENCES

- **Reference 1:** Extensions To Skietbaan Reservoirs for Afri-Infra Consultants by Engeolab (Pty) Ltd, Project LL2141.
- **Reference 2:** Standardized Conditions of Contract for Construction. SANS 1200 : D-1988
- **Reference 3:** Guidelines For Road Construction Materials - TRH14:1985