Technical Report:

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Version 2.0

PROPOSED FILLING STATION ON ERF 4413 AT THE INTERSECTION BETWEEN ROADS R71 AND D978 IN TZANEEN EXTENSION 75, LIMPOPO PROVINCE:

Geo-environmental investigation.

January 2022

Prepared for: Lombard Properties (PTY) Ltd

Compiled by: F. Calitz (*ed.*)

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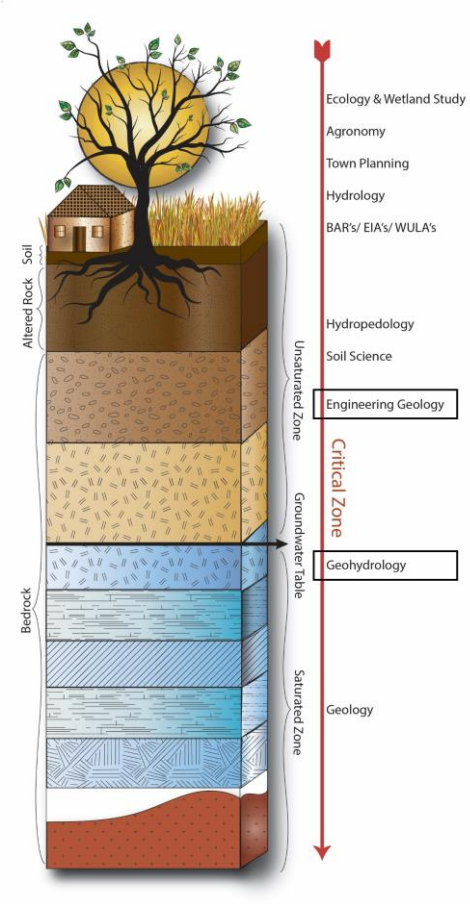

Prepared for:

Messrs. Lombard Properties (PTY) Ltd

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Please note that this report is ideally viewed on a mobile device with zoom capability.

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1 INTRODUCTION

This report described the results of a detailed geo-environmental investigation, comprising both geotechnical and geohydrological actions, conducted in support of the proposed development of a filling station on Erf 4413 in Tzaneen Extension 75.

The investigation comprises a detailed geotechnical site investigation with the following primary aims:

- determine the regional geological setting of the area, including the possible occurrence of dolomitic strata beneath some or all of the site, and the possible occurrence of linear geological structures that could act as preferential groundwater (and by implication, liquid contaminant) flow paths,
- document the various soil and rock layers underlying the site by means of trenching to refusal on bedrock or hardpan pedocrete, or a depth of at least 1.8 m,
- document and assess indications of groundwater seepage within the overburden (where encountered),
- determine the general mechanical properties of the soil materials encountered within the study area,
- assess the excavatability of the soil and rock layers to a depth of approximately 1.8 m,
- assess founding conditions for the filling station forecourt and office / shop buildings with respect to adverse soil mechanical behaviour,
- identify any other geotechnical constraints that could have an adverse effect on the development,
- document and assess surface and groundwater sources within a radius of 1 Km around the proposed filling station
- determine and assess surface and/or groundwater quality to establish baseline values for future quality monitoring and the timeous detection of possible contamination, especially from buried fuel tanks,
- identify possible geological faults, weathered zones and/ or dykes by means of geophysical surveying across the site,
- measure the infiltration rate of surface water into the soil, and
- identify possible drilling sites for the placement of borehole(s) specifically for groundwater quality monitoring purposes.

2 TERMS OF REFERENCE

A geo-environmental investigation for the establishment of a filling station on the property in question was conducted for Messrs. Lombard Properties (PTY) Ltd in 2010/2011, but the project did not come to fruition at that time. This report serves as an update of the technical report rendered at the conclusion of the previous investigation in 2011 to the current national standards, reflecting newly obtained geohydrological information of specific relevance to a site-specific pollution risk assessment, for the same client.

The investigation was primarily conducted for environmental impact assessment purposes within the following regulatory framework:

- SAICE guidelines for site investigations (Code of Practice, 2010).
- standards regarding the conducting of geotechnical investigations (although applicable mainly for residential development, but also relevant to this study) are specified by SANS 634 (2012) – the successor to the GFSH-2 specifications of the National Department of Housing (2002),
- standards regarding the conducting of geotechnical investigations for the construction of foundations as specified by SANS 10400-H (2012), and
- requirements of the Department of Water Affairs for water monitoring at waste management facilities (1989).

It is inferred that the proposed development will comprise the following elements:

- a filling station with buried fuel tanks,
- a convenience store, administrative facilities, and a forecourt, and
- access and internal roads with a number of parking bays.

3 INFORMATION USED DURING THIS STUDY

The following sources of information were utilized:

- Geohydrological map:

  2330 Phalaborwa; scale 1 : 500 000 (scanned copy)

- Geological map:

  2330 Tzaneen; scale 1 : 250 000 (digital copy).

- Topocadastral map:

  ArcGIS™ topographic layer (digital copy).

- Remote sensing information:

  Google Earth™ imagery (digital images).

- Technical report regarding the original geo-environmental investigation:

  Calitz, F, 2011. *Technical report: Proposed filling station at the intersection between roads R71 and D978 on Erf 4413 in Tzaneen Extension 75: geo-environmental assessment*. Unpublished AGES report 2011/03/01/GENV.

4 SITE DESCRIPTION

The study area is defined as Portion 1 of Erf 4413 located directly to the west of the intersection between road R71 to Gravelotte and road D978 to Deerpark in Tzaneen Extension 75 in the Greater Tzaneen Local Municipality that forms part of the Mopani District Municipality, Limpopo Province (Figure 1), at the following coordinate:

Latitude:	Longitude:	Elevation:
23.81506°S	30.17268°E	± 728 mamsl

Figure 1: Locality map.

Figure 2: Site photographs.

The total surface area of the roughly rectangular parcel of land is less than 1 ha. At the time of the updated investigation, the site was mainly lying fallow, with a paved access roads leading to a single-storey structure near the western boundary of the erf. The site is bordered by paved roads to the east and south, and orchards and/or formal gardens to the north and west. A culvert located in the southeastern corner allows drainage of surface water from the stand beneath road R71.

Figure 3: Morphological setting, indicating:

- the regional morphological setting classifies as *low mountains*,
- the site itself is draped along the southeastwardly facing upper side slope of a northeast-southwestwardly trending ridge with a rounded crest that acts as a localized watershed,

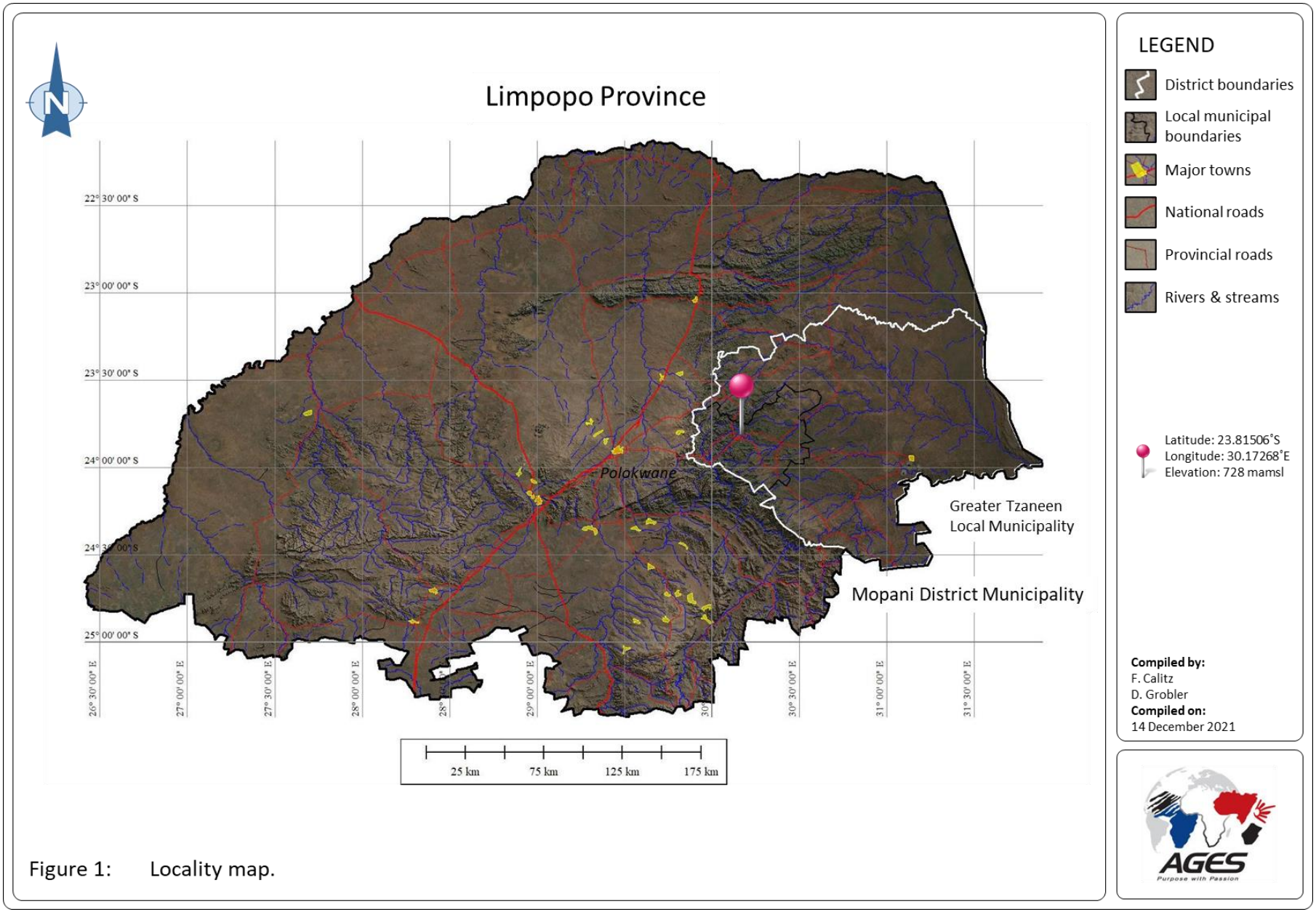

Figure 1: Locality map.

Vertical Google Earth Pro™ image.

Oblique Google Earth Pro™ image from the southeast (vertical scale exaggerated).

Google Earth Pro Streetview™ image from the southeast (taken in 2014).

LEGEND

Study area

Compiled by:
F. Calitz
Compiled on:
14 December 2021

Figure 2: Site photographs.

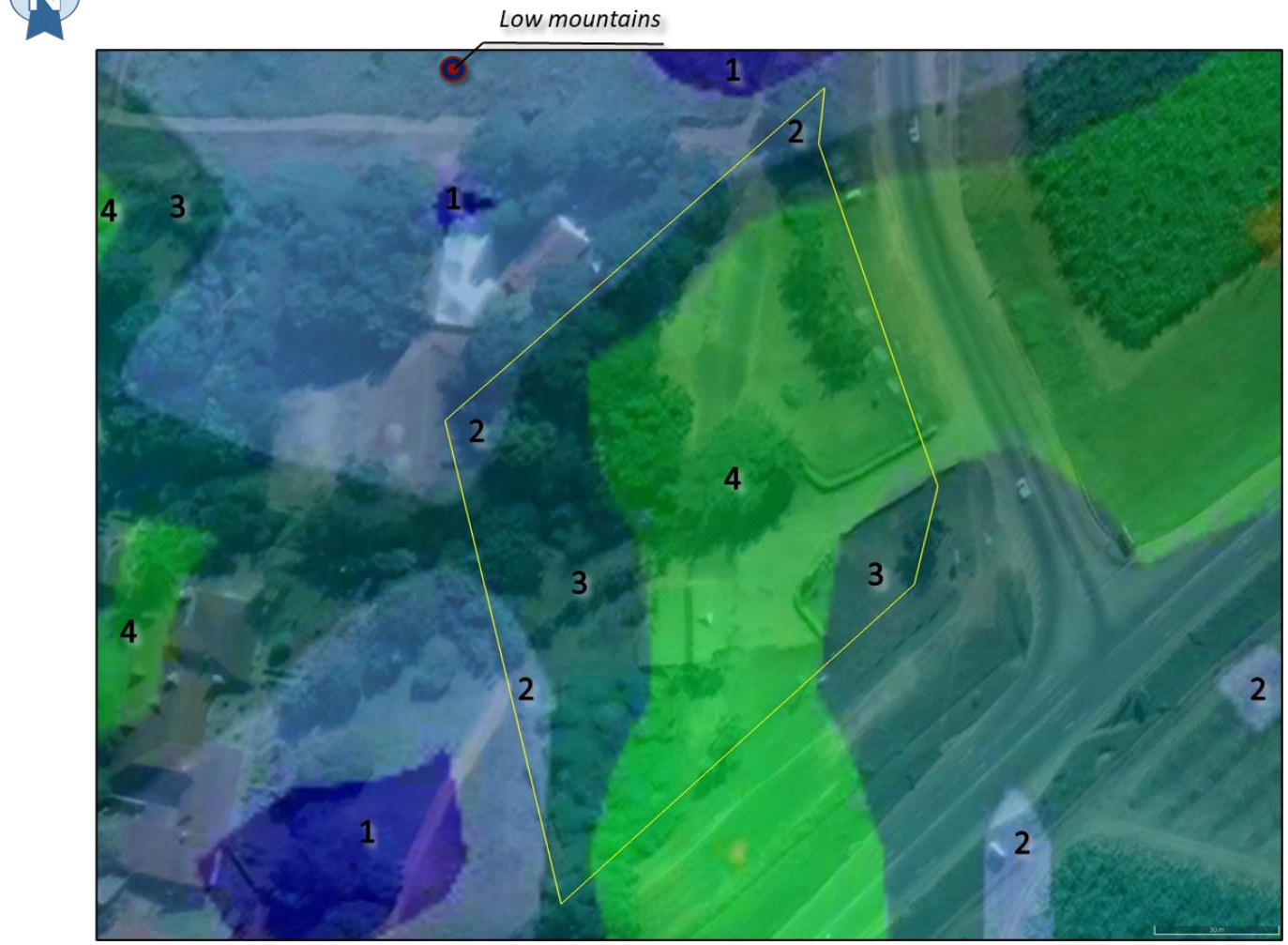

Figure 3: Site-specific morphological setting.

- Based on the results of a regional slope analysis utilizing surface elevation data obtained from Messrs. JAXA (2021), it can be shown that the study area generally exhibits slopes of between 4.5 and 6° (Class 4: moderately steeply sloping) to the southeast, with slopes of between 2 and 4.5° (Class 3: gently sloping) occurring in the southeast, north, and west, with slopes of between 0.5 and 2° (Class 2: very gently sloping) in the extreme north and northwest.

Figure 4: Regional surface flow paths, indicating:

- a dendritic regional surface flow pattern, inferred to correspond to regional geological structures,
- surface drainage across the site mainly concentrates into a southeastwardly flowing non-perennial stream with a pronounced channel only visible to the southeast of the road intersection,
- road R71 has disrupted the surface flow paths in the area to a degree, with limited ponding thus possible in the southeast of the site, although a culvert has been placed in this area to aid surface drainage beneath the R71.

Figure 5: Climatic regime, including:

- mean annual precipitation, and average monthly minimum and maximum temperatures (based on information obtained for Tzaneen from *www.climate-data.org*, 2021),
- a mean annual precipitation of approximately 965 mm,
- the relevant Köppen-Geiger classification, namely: CWa - Warm temperate, Winter dry, warm summer (Conradie, 2012), and
- the climatic N-value (Weinert, 1980) for the study area is approximately 1.3 indicating that weathering predominantly comprises chemical decomposition with secondary breakdown of weathering products also occurring (favouring thick soil formation), rather than mechanical disintegration (resulting in a mixture of rock fragments and soil).

LEGEND

Study area

Inferred surface flow paths

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P. Burgers
Compiled on:
14 December 2021

Figure 4: Regional surface flow paths.

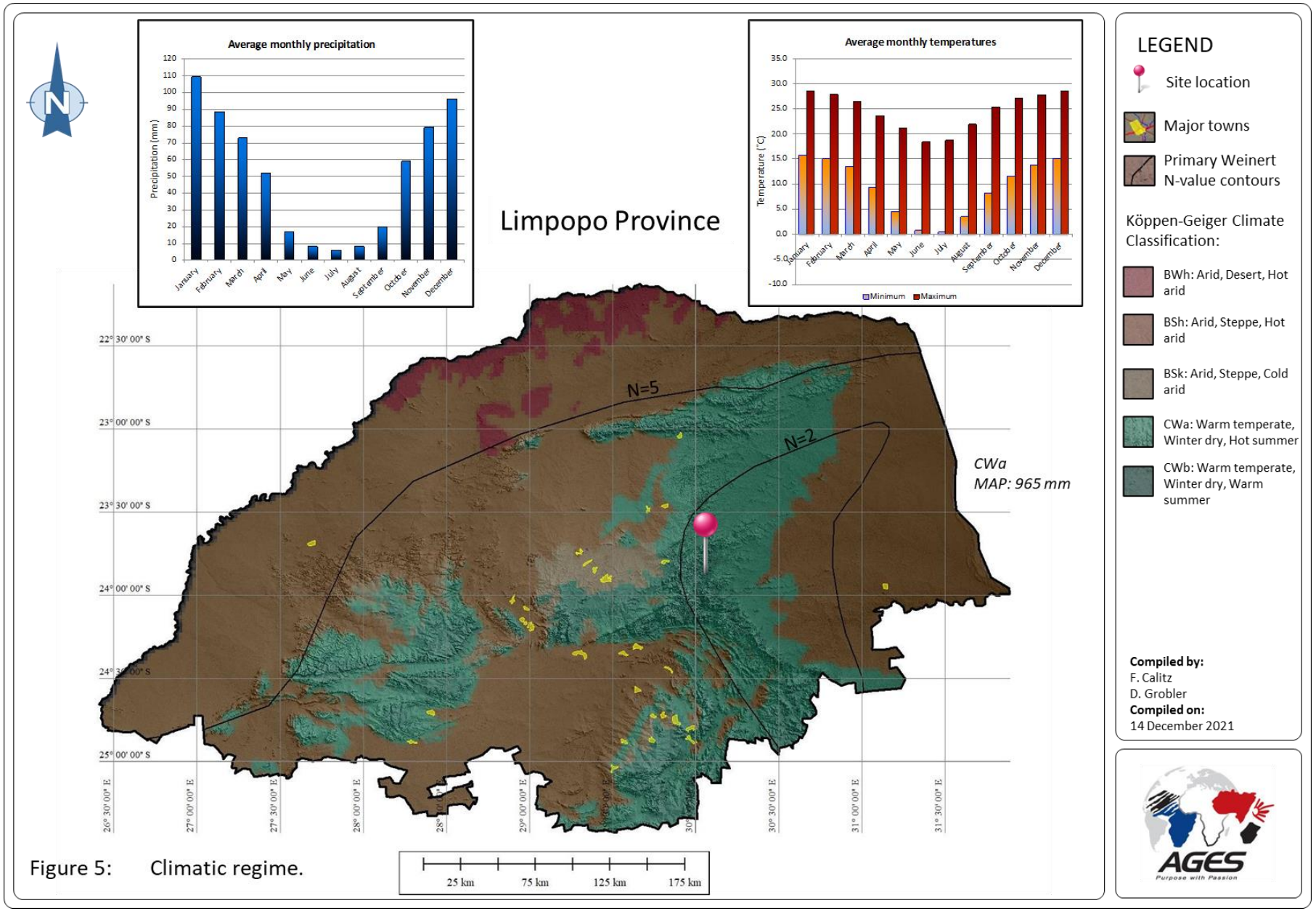


Figure 5: Climatic regime.

5 NATURE OF THE INVESTIGATION

5.1 Geological actions

The regional geological character of the area was assessed by means of the following actions:

- The available remote sensing images were used to delineate regionally prominent geological structures.
- Magnetic and resistivity surveys were undertaken along three traverses cutting across the site in order to identify possible geological structures beneath the proposed filling station.

5.2 Geotechnical actions

The geotechnical component of the study was conducted on the hand of the following actions:

- Three test pits, numbered TP/1 to TP/3, were excavated within the northern portion of the study area by means of a Bell TLB-type light mechanical excavator on 16 February 2011, after which the exposed soil and rock layers were profiled according to the relevant industry standards. No test pits were placed in the areas around the existing structure and in the vicinity of the paved access road in the south to prevent damage to above-ground and buried infrastructure.

  The test pits were backfilled and lightly compacted after completion of the fieldwork actions. Detailed test pit profile logs are included as Appendix A.

- One Double-Ring Infiltrometer (DRIT) test was conducted on 16 February 2011 from surface within the least disturbed portion of the study area, focussing mainly on determination of the in-situ permeability of the soil-like overburden covering the area where the filling station forecourt and buried fuel tanks are inferred to be placed. Detailed results are included as Appendix B.

- Material samples of the following soil layers collected from the test pits were submitted to Messrs. TPT Lab (a part of the SGS Matrolab Group) in Polokwane (a SANAS-accredited laboratory) for analysis, namely:

Material Type	Disturbed	Chemical	Bulk	Undisturbed
Hillwash	2	2		
Reworked residual granite		1	1	

  Detailed results are included as Appendix C.

5.3 Geohydrological actions

The following geohydrological actions were undertaken:

- A hydrocensus was conducted within a radius of approximately 1 Km of the study area on 08 December 2021 in order to determine the current status of surface and groundwater use in the area, as well as to assess groundwater levels and associated flow directions. Detailed results are included as Appendix D.

- Samples were taken of surface and groundwater occurrences, where possible, for determination of the presence of any chemical and/or petroleum-related (SOG[1], TPH[2], and VOC[3]) contaminants, if present. These samples were submitted to Messrs. Capricorn Veterinary Laboratories (Polokwane) for analysis, with the following samples collected:

Water origin	Macro chemical	SOG	TPH	VOC
Groundwater - taken from borehole BH1		1	1	1
Groundwater - taken from borehole BH3		1	1	1
Groundwater - taken from borehole BH8	1	1	1	1

The results of water quality testing were subsequently compared to the standards for drinking water quality specified by SANS 241 (2015). Detailed results are included as Appendix E.

- Classification of the aquifer underlying the study area is according to the system proposed by Parsons (1995), created for strategic purposes by allowing the grouping together of aquifer areas according to their associated supply potential, water quality, and local importance as a resource. The revised classification system (DWS, 1998) is provided in Table 1.

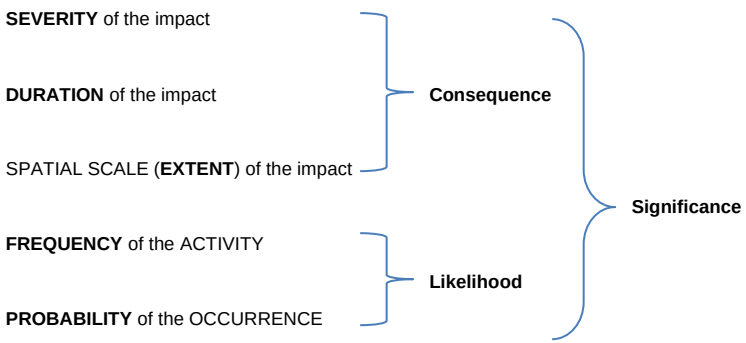
Table 1: Revised aquifer classification system (DWS, 1998).

Aquifer System	Defined by Parsons (1995)	Defined by DWAF Min Requirements (1998)
Sole Source Aquifer	An aquifer which is used to supply 50 % or more of domestic water for a given area, and for which there are no reasonably available alternative sources should the aquifer be impacted upon or depleted. Aquifer yields and natural water quality are immaterial.	An aquifer, which is used to supply 50% or more of urban domestic water for a given area for which there are no reasonably available alternative sources should this aquifer be impacted upon or depleted.
Major Aquifer	High permeable formations usually with a known or probable presence of significant fracturing. They may be highly productive and able to support large abstractions for public supply and other purposes. Water quality is generally very good (<150 mS/m).	High yielding aquifer (5-20 L/s) of acceptable water quality.
Minor Aquifer	These can be fractured or potentially fractured rocks, which do not have a high primary permeability or other formations of variable permeability. Aquifer extent may be limited and water quality variable. Although these aquifers seldom produce large quantities of water, they are important both for local supplies and in supplying baseflow for rivers.	Moderately yielding aquifer (1-5 L/s) of acceptable quality or high yielding aquifer (5-20 L/s) of poor quality water.
Non-Aquifer	These are formations with negligible permeability that are generally regarded as not containing groundwater in exploitable quantities. Water quality may also be such that it renders the aquifer as unusable. However, groundwater flow through such rocks, although imperceptible, does take place, and need to be considered when assessing the risk associated with persistent pollutants.	Insignificantly yielding aquifer (< 1 L/s) of good quality water or moderately yielding aquifer (1-5 L/s) of poor quality or aquifer which will never be utilised for water supply and which will not contaminate other aquifers.
Special Aquifer	An aquifer designated as such by the Minister of Water Affairs, after due process.	An aquifer designated as such by the Minister of Water Affairs, after due process.

1 SOG: Soap, Oil, & Grease.
2 TPH: Total Petro-Hydrocarbons.
3 VOC: Volatile Organic Compounds.

5.4 Impact Assessment methodology

The possible environmental impacts from the proposed development on the local and regional geohydrological environment are considered using the industry-standard semi-quantitative risk assessment methodology. In order to assess the significance as objectively as possible, the following criteria will be used:



This system derives environmental **significance** on the basis of the consequence of the impact on the environment and the likelihood of the impact occurring. **Consequence** is calculated as the average of the sum of the ratings of severity, duration, and extent of the environmental impact, while **likelihood** considers the frequency of the activity together with the probability of an environmental impact occurring.

These factors are assessed as follows:

- **Consequence** is calculated as the average of the sum of the ratings of severity, duration, and extent of the environmental impact, based on the following ratings:

Rating	Description
Rating of Impact Severity	
1	Negligible/ non-harmful / minimal deterioration
2	Minor/ potentially harmful / measurable deterioration
3	Moderate / harmful / moderate deterioration
4	Significant / very harmful / substantial deterioration
5	Irreversible / permanent
Rating of Impact Duration	
1	Less than 1 month / quickly reversible
2	Less than 1 year / quickly reversible
3	More than 1 year / reversible over time
4	More than 10 years / reversible over time / life of project or facility
5	Beyond life of project of facility / permanent
Rating of Impact Extent	
1	Within immediate area of activity
2	Surrounding area within project area
3	Beyond project boundary
4	Regional / provincial
5	National / international
Rating of Impact Consequence	
C	= (Severity + Duration + Extent) / 3

- **Likelihood** considers the frequency of the activity together with the probability of the environmental impact associated with that activity occurring.

Rating	Description
Rating of Impact Frequency	
1	Less than once a year
2	Once a year
3	Quarterly
4	Weekly
5	Daily
Rating of Impact Probability	
1	Almost impossible
2	Unlikely
3	Probable
4	Highly likely
5	Definite
Rating of Impact Likelihood	
L	= (Frequency + Probability) / 2

with:

Rating	Score	Symbol
Low (L)	1 - 4	
Medium (M)	5 - 14	
High (H)	15 - 25	

- Overall **significance** of an event on the risk of groundwater pollution is determined using the matrix below:

Likelihood \ Consequence	1	2	3	4	5
1	1	2	3	4	5
2	2	4	6	8	10
3	3	6	9	12	15
4	4	8	12	16	20
5	5	10	15	20	25

6 SITE GEOLOGY AND GEOHYDROLOGY

6.1 Regional geological setting

The regional geological setting of the study area is discussed on the hand of the following:

Figure 6: Regional stratigraphy and geological structures,

with the following of importance:

- According to the published geological map, the property is underlain by an as yet unnamed *leucocratic biotite-rich granite* (see infocard) of **Vaalian Age**. The area is invariably soil-covered with little or no bedrock outcrops.
- The available geological information does not indicate the presence of prominent geological features in the immediate vicinity of the study area. However, numerous mainly northeastwardly, and occasionally northwardly, striking *diabase* **dyke intrusions** and localized shear zones along which crustal deformation has occurred (with the *Tzaneen Lineament* being the most prominent) cut through the Tzaneen area. These are generally present as highly weathered rock occurring at shallow depth, and/or linear rows of dark-coloured, rounded boulders at the surface. The results of geophysical surveys conducted in the vicinity of the study area indicate that two weakly defined linear structures, deemed to represent diabase dyke intrusions, does indeed cut through the site itself, with an eastwardly trending structure occurring in the extreme north (visible at the surface as a discontinuous line of rounded diabase boulders), while the second cuts through the extreme southeastern corner of the site (not visible at the surface). It must be noted that the original bedrock may be highly fractured and hardened (i.e.: baked) in the direct vicinity of these structures, due to heat and pressure during intrusion. Additionally, localized fracturing and alteration of the underlying strata could have occurred in the direct vicinity of these structures, along which preferential recharge of underlying groundwater aquifers could occur. This was indeed encountered in a test pit placed in the extreme northern portion of the site, where more competent granite bedrock was encountered relatively close to the surface.

INFOCARD

General character of granite:

Granite is an intrusive volcanic rock that weathers into either a slightly plastic sandy residual soil considered to be potentially compressible, or a moderately to highly plastic clayey residual soil deemed potentially moderately expansive and compressible. The residual soil can occasional contain highly to slightly weathered granite corestones, and readily grades into highly weathered rock at depth.

General character of dolerite / diabase:

Dolerite / diabase is an intrusive volcanic rock composed of feldspar and pyroxenite, with minor amounts of quartz, mica, and amphibole. Residual soils in more humid areas tend to comprise plastic (and as such potentially expansive) and potentially compressible clayey material, without any traces of the original rock structure or composition, in places containing gravel, cobbles and/or boulders. Classification of this material varies between solid to fractured, boulder, gravelly, and granular material, capped by soil-like residuum. Weathering invariably occurs inwards from the corners and edges of large boulders and blocks.

Based on the 1 : 250 000 scale geological series map:
2330 Tzaneen (CGS)

SUPERGROUP	GROUP	FORMATION	DESCRIPTION	SYMBOLS
INTRUSIONS			*Dolerite / diabase*	
VAALIAN	unnamed		*Leucocratic biotite granite*	Vlg
SWAZIAN	Goudplaats Gneiss		*Grey biotite gneiss & migmatite, with anatectic mobilisates*	Zg

Inferred structures from geophysical survey results (2011)

LEGEND

Study area

f Prominent regional faults

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F. Calitz
Compiled on:
14 December 2021

Figure 6: Regional stratigraphy and geological structures.

- The area is not underlain by water-soluble strata as defined by SANS 1936 (2012), and as such is **NOT classified as dolomite land**.
- No sources of natural materials of economic importance are indicated to occur in the vicinity of the site, and the available information does not indicate any current or past mining activity in the direct vicinity of the stand, which is as such not deemed affected by undermining.

Figure 7: regional seismicity,

with the following of importance in terms of natural and man-induced seismicity according to SANS 10160:4 (2009), namely:

- the presence of bedrock at a depth of less than 5 m classifies the overburden as Ground Type 1,
- the site falls outside of both Seismic Zones I and II, and as such is not expected to be potentially at significant risk of natural and/or mining-induced seismic events, and
- the proposed filling station classifies as Building Importance Class III (*buildings for which seismic resistance is of importance in view of consequences associated with collapse*).

The results of research conducted by Singh *et al.* (2009) indicate that natural seismic events have occurred along the regionally developed *Pietersburg Greenstone Belt* to the north of Tzaneen, with the most notable being an event classifying as magnitude V on the Modified Mercalli-scale that occurred in 1940 near Tzaneen. Occasionally the effects of earthquakes along the edges of the *Kaapvaal Craton* or along the *Great African Rift System* have also been felt by residents of the area, the most recent being an earthquake measuring 7.0 on the Richter Scale that occurred in Mozambique on 22 February 2006 (USGS, 2010), and

According to Kijko *et al*. (2003) the regional seismic hazard in the project area can be defined as SLIGHT, exhibiting a 10% probability of a seismic event with a peak ground acceleration that will exceed 0.1 G within a period of 50 years. In the light of the regional tectonic character of the area, as well as the occurrence of seismic events along the *Pietersburg Greenstone Belt*, it is assumed that crustal displacement along some of these structures, some of which pass by the study area, may still occur in the future.

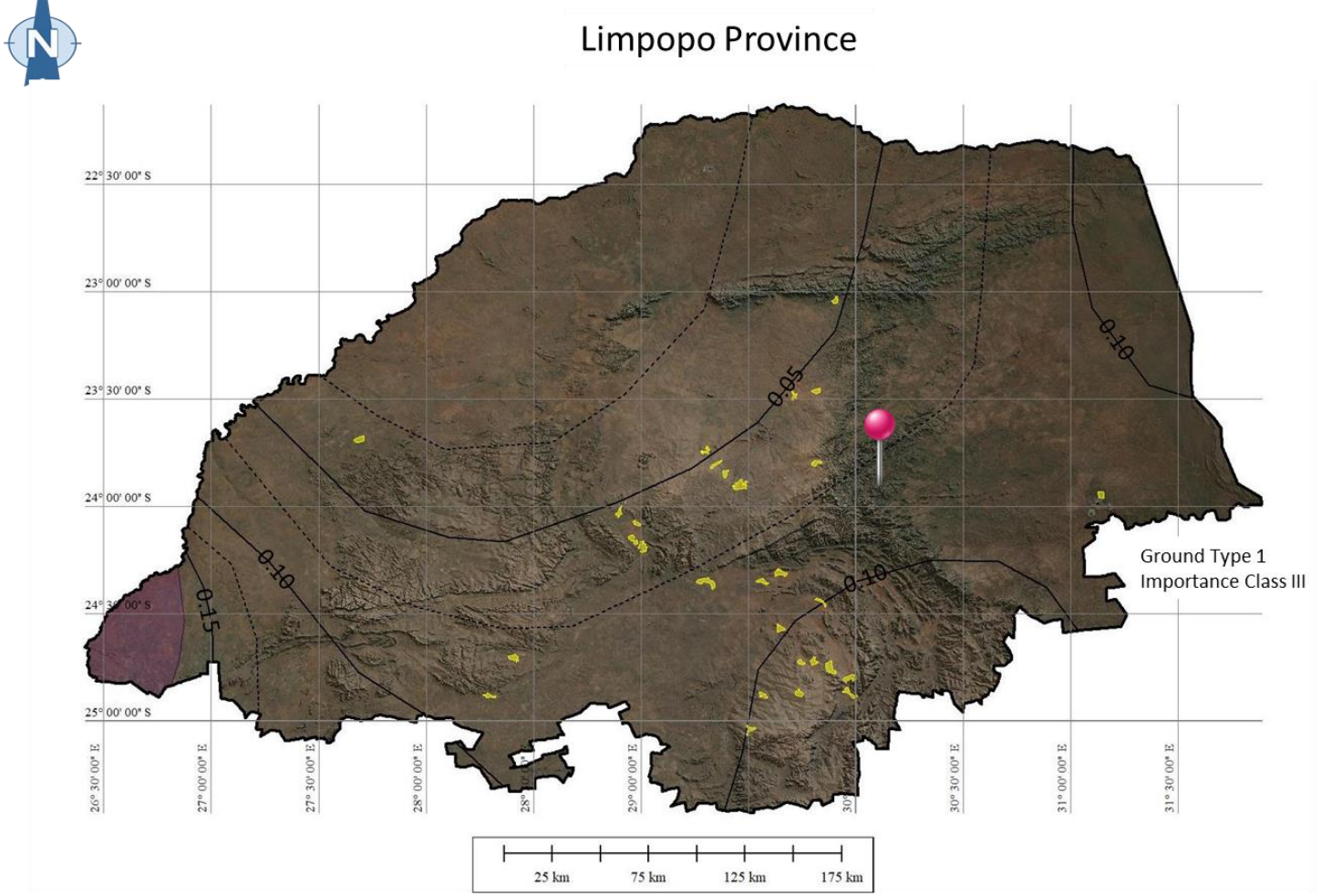


Figure 7: Regional seismicity.

6.2 Soil profile

Figure 8: Geological and geotechnical field tests.

Detailed test pit profile logs are included as Appendix B. Note that the soil profiles were also classified according to the soil forms of the Natural and Anthropogenic Soil Classification System (Soil Classification Working Group, 2018) that together with the underlying stratigraphic setting, allow grouping of the test pits into modal profiles to simplify assessment of the trenching information in a sensible manner. The dominant soil form is defined as follows:

APEDAL[4] SOILS		
SOIL FORM	TOPSOIL HORIZON	SUB-SURFACE HORIZONS
Hutton	Orthic[5]	Red apedal[6]

The test pits revealed a degree of variation from north to south across the northern portion of the site, mainly as a result of localized metamorphism of the underlying granitic strata along a dolerite / diabase dyke intrusion inferred to occur along the northern boundary, as well as the localized pockets of anthrosols[7]. This necessitates grouping of the test pit profiles into two relatively distinct modal profiles, namely:

Figure 9: Modal profiles.

- Modal profile *Hutton1*

Representative test pits:	TP/1
Geological setting:	granite
Primary character:	thin covering of man-made soil overlying a very thick layer of clayey hillwash & residual material that exhibits little or no structure
Succession of layers:	thin layer of firm, weakly structured clayey topsoil with occasional gravel - considered to have replaced a portion of the natural topsoil (hillwash) very thick layer of firm, weakly structured, clayey hillwash & reworked[8] residual granite
Bedrock:	not encountered to at least ± 3.0 m

- Modal profile *Hutton2*

Representative test pits:	TP/2 and TP/3
Geological setting:	granite, with possible metamorphic influences from dyke intrusion
Primary character:	thick layers of clayey hillwash and residual granite that exhibit little or no structure
Succession of layers:	thick layer of firm, weakly structured clayey hillwash, in places with gravel thin Pebble Marker Horizon[9] comprising firm, weakly structured clayey material with gravel & cobbles thin layer of firm, weakly structured, clayey reworked residual granite
Bedrock:	highly weathered, very soft rock from ± 2.2 m in places

4. A non-calcareous, well-drained, sub-surface layer exhibiting uniform yellow and brown colors as a result of an oxidizing environment, with little or no structure (i.e., apedal).
5. A topsoil layer that does not exhibit characteristics typical of the other distinct topsoil horizons.
6. A non-calcareous, well-drained sub-surface layer exhibiting uniform red colours with little or no structure.
7. Soil material that has been physically altered by human activities to such a degree that its character has been significantly to permanently altered.
8. Residual material that has undergone weathering to such a degree that no remnants of the original rock texture or structure remain.
9. A relatively coarse-textured transported soil layer typically representing the boundary between transported and residual soil, formed either through biotic activity, or pediment depositional processes. This layer separates materials with substantially different geotechnical characteristics.

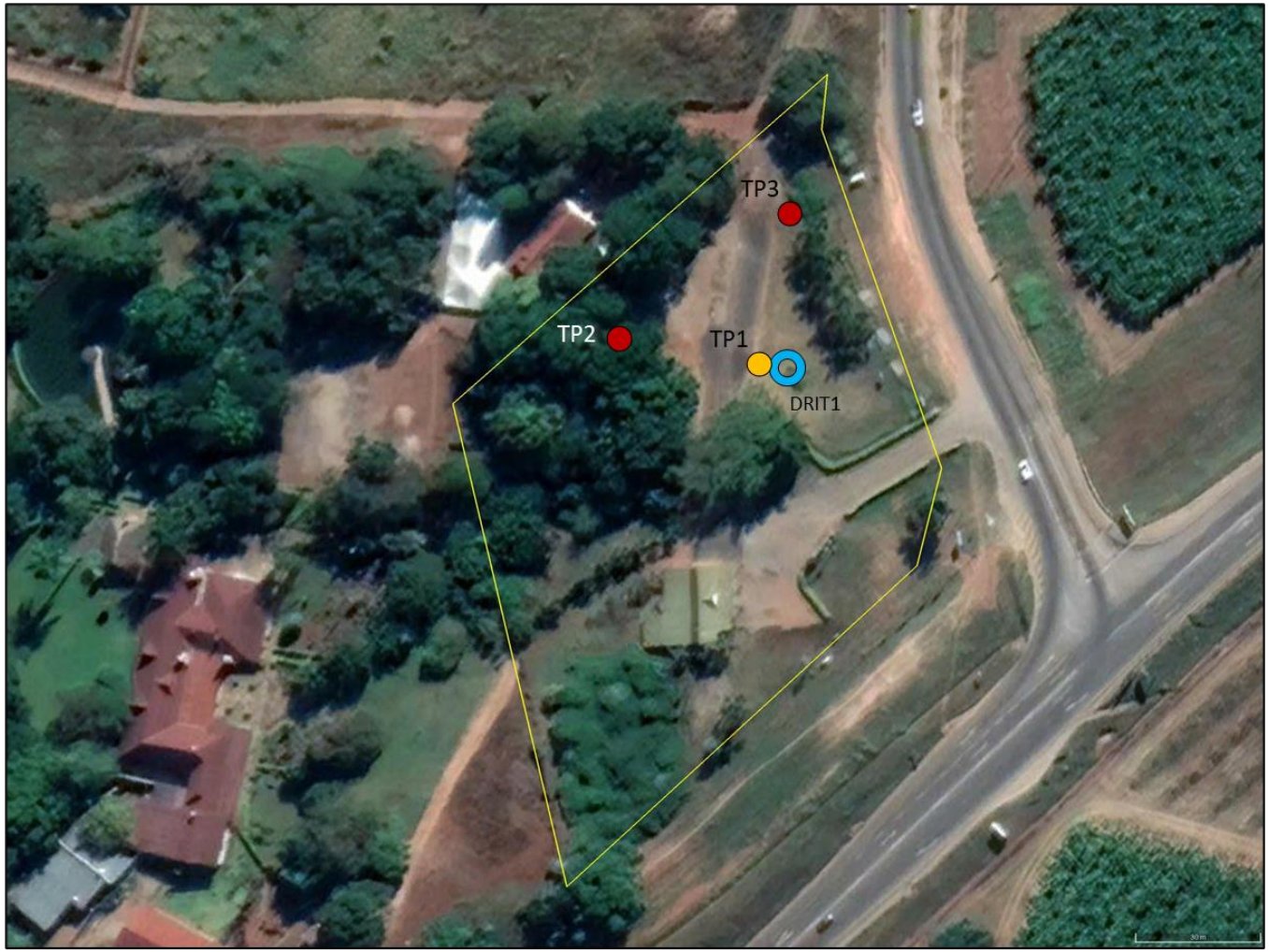
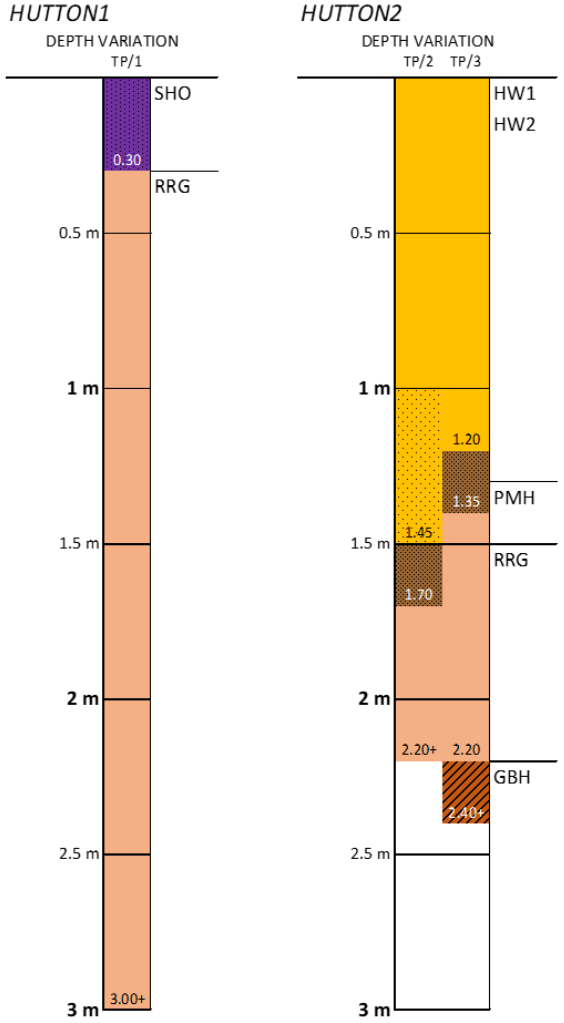


Figure 8: Geological and geotechnical field tests.



LEGEND

MAN-MADE SOILS - COMPACTED FILL:

SHO Firm, weakly micro-shattered, silty/clayey sand; with occasional quartz gravel.

TRANSPORTED SOILS - ALLUVIUM (WEAKLY GLEYED):

HW1 Firm, weakly micro-shattered to weakly slickensided, silty/clayey sand.

HW2 Firm, weakly slickensided, silty/clayey sand; occasionally with dolerite/diabase gravel.

TRANSPORTED SOILS - PEBBLE MARKER HORIZON:

PMH Firm, weakly slickensided, silty/clayey sand; with frequent quartz & dolerite/diabase gravel.

RESIDUAL SOILS - COMPLETELY WEATHERED GRANITE:

RRG Firm, weakly slickensided, silty/clayey sand; with occasional cobble-sized very soft rock corestones.

BEDROCK - GRANITE:

GBH Highly weathered, very soft rock.

LEGEND

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Compiled on:
14 December 2021

Figure 9: Modal profiles.

Note that the hillwash and reworked residual granite was found to be very similar in character, with the absence of a distinct Pebble Marker Horizon in test pit TP/1 probably obscuring a very indistinct contact between the two types of materials in modal profile *Hutton1*.

6.3 Groundwater table

The hydropedological character exhibited by the various natural soil forms comprising the modals classify as follows (Van Tol & Le Roux, 2019):

- Modal profiles *Hutton1* and *Hutton2*:

  Recharge soil - Deep, facilitating ingress of water from the surface and soil layers into the fractured bedrock occurring at depth.

Groundwater seepage was not encountered during the field work phase of the investigation. It must be noted that the investigation was conducted during the relatively wet summer season.

The absence of prominent iron and manganese-rich stains and concretions within the transport and residual layers indicates that the seasonal concentration of soil moisture (i.e., a weak perched water table) within the soil-like overburden above weathered bedrock (and as such beneath roads, foundations, and floor slabs) is NOT expected during and/or after the rainy season.

However, the relatively sandy nature of the soil-like overburden implies that the concentrated soil moisture can be expected to rapidly dissipate (either through evaporation or ingress into the underlying bedrock).

Material infill along joint planes within the weathered bedrock does not exhibit a gleyed[10] character, further corroborating the absence of prolonged concentration of sub-surface moisture at depth (seasonal weak perched water table).

10. Greyish mottles and/or matrix colours are deemed indicative of anaerobic conditions during prolonged saturation, typically associated with the formation of static groundwater tables.

7 GEOTECHNICAL EVALUATION

7.1 Engineering and material characteristics

7.1.1 Double-Ring Infiltrometer test

The thick layers of soil-like overburden is inferred to exhibit a measured saturated permeability of approximately 1.6 x 10^{-3} cm.s^{-1}, considered MODERATELY PERMEABLE (Magni & Du Cann, 1978), translating to a saturated percolation rate in the order of 1.36 m per day.

It must, however, be noted that the initial contaminant travel rate could be higher than the stated value until saturation of the soil-like overburden has been reached.

7.1.2 Laboratory tests

The most pertinent results can be summarized as follows:

- Soil-like overburden (mixture of hillwash and residual granite):

Grading (ASTM)	Atterberg Limits	Soil moisture chemistry	Compaction character - neat (1 sample)	USCS class COLTO
Gravel: ± 0% Sand: 19 - 21% Fines: 78 - 81% (clay: 45 - 60%)	LL: 49 - 54% PI: 12 - 14 PI': 11 - 13 LS: ± 10.0%	pH: 5.93 - 7.57 EC: 0.0003 - 0.0008 S/m	MDD: ± 1 734 Kg/m^3 OMC: ± 18.2% CBR @ 90, 93, 95, & 100% MDD: 9.2, 14, 15, 18	ML / MH G8/G9 C4 (with 3% OPC)

LEGEND:
Gravel: > 4.75 mm
Sand: > 0.075 to < 4.75 mm
Fines: < 0.075 mm
(clay: < 0.002 mm)
LL: Liquid Limit
PI: Plasticity Index
PI': Weighted Plasticity Index
(np: non-plastic)
LS: Linear Shrinkage
MDD: Maximum Dry Density
OMC: Optimum Moisture Content
CBR: California Bearing Ratio

Stabilization of the material by the addition of various amounts of OPC, utilizing rapid curing, yielded a material exhibiting the following strength:

2% cement added: 0.26 MPa at 93% MOD compaction

2.5% cement added: 0.41 MPa at 93% MOD compaction

3% cement added: 0.70 MPa at 93% MOD compaction

The addition of cement significantly the plasticity of the material, with a PI of 8 obtained for the material with 2% cement and 6 for the material with 3% cement.

7.1.3 Summarized material characteristics

In the light of the laboratory test results, as well as visual observations made during the field phase of the investigation, the various soil-like layers are expected to exhibit the following adverse geotechnical characteristics:

- The soil-like overburden is considered slightly compressible, mainly due to its only moderately consolidated nature that allows densification thereof under loading to a degree (especially when

saturated). A significant thickness of this material is expected to occur below the founding depth of mainly single-storey structures (e.g., the convenience store, administrative facilities, and forecourt structures) extending up to the maximum inferred level of influence beneath the footings of these structures (i.e., a depth of approximately 1.2 m).

Guidelines by Watermeyer and Tromp (1992) indicate that the total calculated settlement beneath foundations for a slightly to moderately compressible soil will be as follows:

  - Modal profiles *Hutton1* and *Hutton2*: ± 22.5 mm

- Although the fines fraction of the samples exhibits high plasticity, with a significant clay content, and with weakly developed soil structure (e.g., slickensided or shattered structure, but without gilgai and/or cracks at surface, advocated as essential evidence for the presence of expansive soil by Netterberg, 2019), it is inferred that the soil-like overburden is potentially slightly expansive. Using the method proposed by Van der Merwe (1964), it can be shown that the expected maximum movement at the surface as a result of the potentially expansive soil is in the order of:

  - Modal profiles *Hutton1* and *Hutton2*: ± 30 mm

- In the light of the measured very low EC values, but moderately acidic pH-values, the natural soil-like overburden is not considered potentially corrosive to concrete or steel.

7.2 Geotechnical conclusions and recommendations

7.2.1 Zonation

The geotechnical character of the study area is predominantly determined by that of the soil-like overburden, in particular that of the hillwash and residual granite. Although the study area exhibits geotechnical characteristics deemed to have an adverse effect on the proposed development, these characteristics do not disqualify the site from being used for the placement of a filling station, but rather require the strict implementation of site-specific precautionary measures with regard to design and construction of the proposed structures, access roads, and parking areas. Adverse geotechnical effects include:

- the presence of potentially slightly compressible material beneath the foundations that could cause localized differential settlement under loading or when saturated, especially in the period after construction until a state of equilibrium has been achieved,
- the presence of potentially slightly expansive material beneath the foundations that could cause structural damage over time especially when saturated, considered to occur for the entire lifespan of the proposed development, and
- the highly localized occurrence of weathered bedrock at relatively shallow depth, associated with dolerite / diabase dyke intrusions.

The absence of dolomitic strata in and in the immediate vicinity of the stand classifies the whole stand as non-dolomite land, and as such site-specific dolomite risk management and/or mitigation measures in this regard will not be required.

Figure 10: Geotechnical zonation map.

In this light, the geotechnical character of the whole study area can be grouped into the following geotechnical zones:

- Suitable for development, with precautions:

  ZONE A1:

  - represented by modal profiles *Hutton1* and *Hutton2*.
  - most of the whole study area is considered suitable for the placement of relatively lightly loaded, single-storey masonry structures and lightly trafficked roads and parking areas, but requires the implementation of precautionary and/or mitigation measures to counter the effects of various adverse geotechnical characteristics.

  classifies as NHBRC Site Class S2 - H2.

  ZONE A2:

  - represented by modal profiles *Hutton1* and *Hutton2*.
  - the extreme northern portion of the study area is considered suitable for the placement of relatively lightly loaded, single-storey masonry structures and lightly trafficked roads and parking areas, but requires the implementation of precautionary and/or mitigation measures to counter the effects of various adverse geotechnical characteristics, and with the risk of pockets of weathered bedrock at relatively shallow depth.

  classifies as NHBRC Site Class S2 - H2 - (R).

7.2.2 Foundation solutions

In the light of the geotechnical characteristics of the material in and on which the foundations of relatively lightly loaded masonry structures will be placed, it is recommended that use be made of any of the following design and construction methods:

ZONES A1 and A2:

Option 1: *Stiffened or cellular raft*

Option 2: *Split construction*

Option 3: *Soil raft*

7.2.3 Natural drainage

The generally gently sloping topography indicates that most of the study area is well drained, with ponding of surface water possible in the southeast along road R71, especially after heavy precipitation events. However, concentrated surface flow is possible along the inferred natural surface drainage path that cuts into the study area.

In this light, proper site drainage that includes the removal of water runoff from building and forecourt roofs is essential to prevent large-scale changes in soil moisture beneath and near structures.

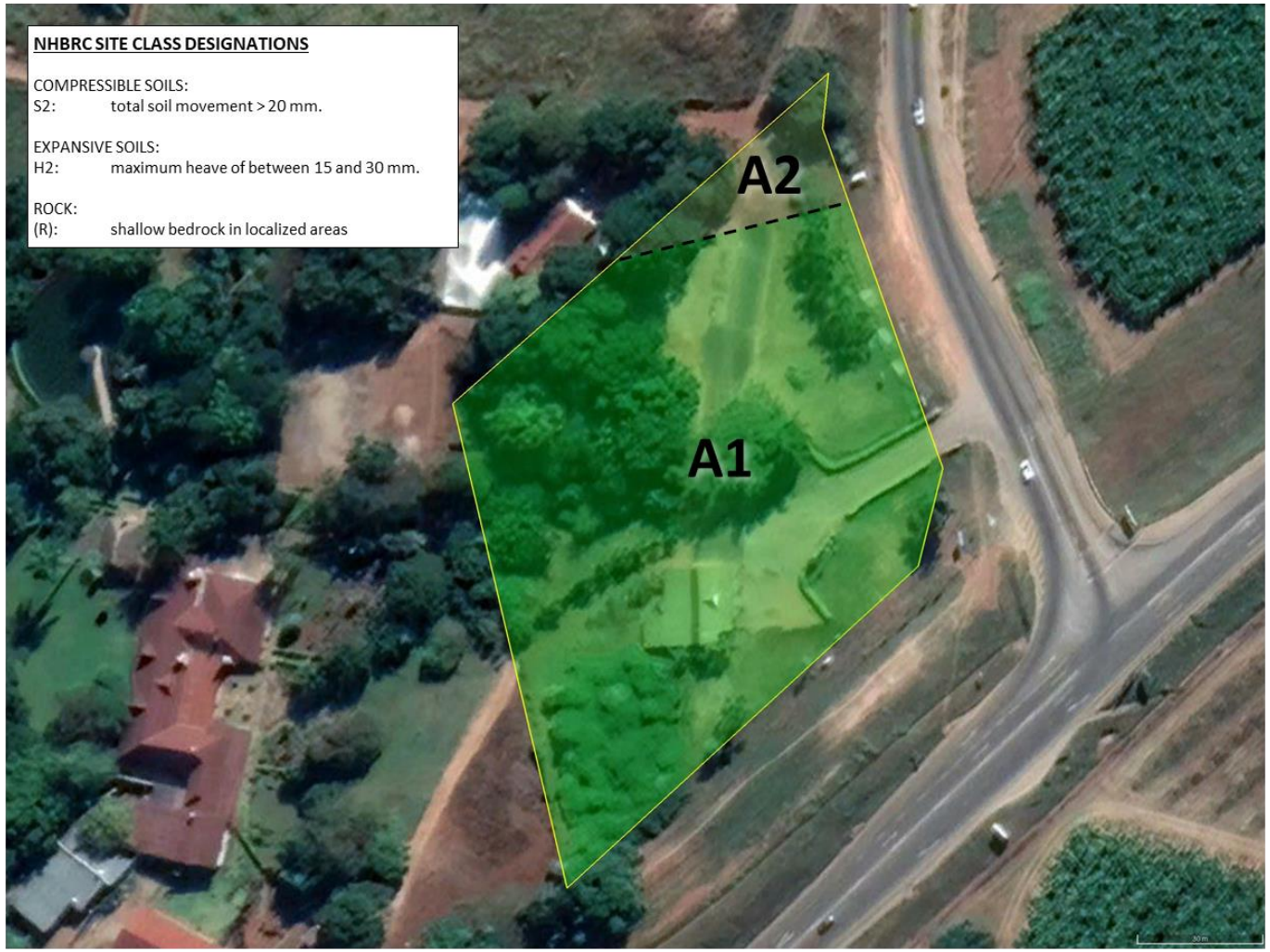


Figure 10: Geotechnical zonation map.

7.2.4 Slope stability and erosion

As the average slope of the site is generally less than 6° (very gently to moderately steeply sloping terrain), instability of the natural slopes is not expected.

Significant surface erosion was not observed in the area. Additionally, the topography of the area indicates a low risk of surface erosion.

No evidence of potentially dispersive material (e.g., a weakly to strongly developed prismatic soil structure) was observed.

7.2.5 Excavation classification

Excavation of roadworks, shallow service trenches, and foundation trenches into the natural soil-like overburden generally classifies as "better than soft" (both restricted and non-restricted) excavation class to a depth of between at least between 2.2 and 3.0 m, allowing excavation by hand or TLB-type light mechanical excavator.

However, the highly to moderately weathered granite and dolerite/diabase bedrock occurring at depth, as well occasional corestones thereof at shallower depth within the soil-like overburden, classify as "intermediate" (restricted) excavation class, requiring at least a tracked excavator or power tools to remove within deep service excavations.

7.2.6 Material re-use potential

The relatively fine-textured soil-like overburden to be removed during construction is at best only marginally suitable for re-use in compacted engineered fills beneath roads and foundations.

Stabilization of this material by the addition of 3% OPC yielded a COLTO C4-type material suitable for use in construction of soil rafts beneath structures.

8 GEOHYDROLOGICAL EVALUATION

8.1 Geohydrological setting

Figure 11: Regional geohydrological character.

The study area is located within Quaternary Catchment Area **B81C** that forms part of the Levubu & Letaba Water Management Area. The available hydrogeological information indicates that the strata underlying the study area define an intergranular and fractured aquifer with borehole yields of between 0.5 to 2.0 l/s. Groundwater occurrences are limited to fault and/or contact zones and dyke structures, with groundwater recharge and lateral movement primarily restricted to these zones. The rate of movement / recharge will likely be very low due to the fine-grained nature of the parent material. According to Vegter (2003), groundwater strikes generally occur at a depth of between 20 and 30 m below surface, with aquifer depth at 24 m below surface. Water bearing fractures are predominantly restricted to a shallow zone beneath the static groundwater level.

8.2 Hydrocensus results

Figure 12: Hydrocensus results.

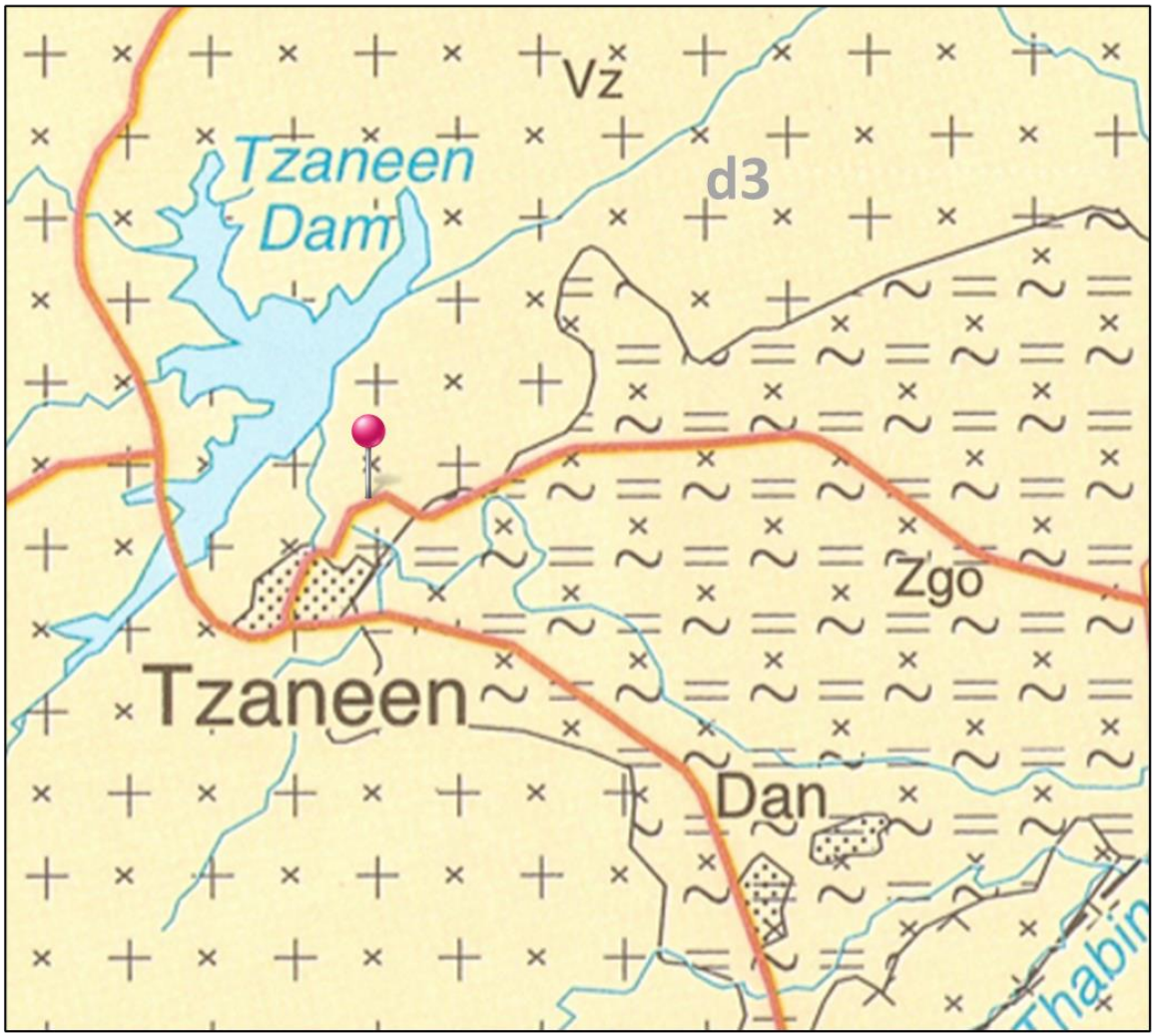
8.2.1 Surface water

The results of the hydrocensus revealed a significant surface water source, a small dam with a compacted earth wall, approximately 650 m to the southeast of the proposed filling station. Three streams flow into the dam, with surface flow along the least prominent two primarily originating at springs occurring directly to the south of road R71, with the most relevant located approximately 260 m to the southeast of the proposed filling station. The third, more prominent stream represents regional flow that drains a relatively large area to the north and northeast of the dam itself that is considered to fall outside the sphere of influence of the proposed filling station. These streams define tributaries of the regionally important perennial Great Letaba River that occurs at least 750 m to the south of the site. The confluence between the more prominent tributary and the river itself is approximately 1 350 m to the southeast.

Surface runoff from the site is expected to occasionally pond along the verge of the intersection between roads R71 and D978 directly to the southeast after heavy precipitation events, before being conveyed across road R71 by means of a culvert, thus possibly reaching the area where the afore-mentioned fountain occurs. However, ponding of surface water was not observed in the area during the hydrocensus, conducted at the start of the typically wet summer rainfall season.

8.2.2 Groundwater

The results of the newly conducted hydrocensus revealed that nine boreholes are located in the vicinity of the proposed filling station (both upstream and downstream of the site). Of these, three are deemed to have been destroyed, while the remainder are currently equipped with submersible pumps and are in use for the abstraction of groundwater for both domestic and agricultural purposes.



LEGEND

Site location

d3 Intergranular & fractured aquifer (moderate yields)

Compiled by:
F. Calitz
Compiled on:
15 December 2021

Information from 1:1 500 000 scale
2330 Phalaborwa geohydrological map (1998).
Not to scale: scanned and resized image.

Figure 11: Regional geohydrological character.

LEGEND

Study area

Inferred groundwater flow direction

Borehole positions: (with static groundwater levels, where available; mbdl: m below datum level

Equipped & in use

Destroyed

Water samples: (with reporting numbers)

Groundwater

Compiled by:
F. Calitz
D. Van der Walt
Compiled on:
07 January 2022

Figure 12: Hydrocensus results, with inferred groundwater flow direction and sampling points.

It must be noted that boreholes BH1 and BH2 are located very close to the afore-mentioned spring, occurring approximately 260 m to the southeast (i.e., downstream) of the site.

It is inferred that the spring is associated with groundwater flow along the contact between the granite and a diabase dyke intrusion. However, prolonged drought conditions in the area necessitated the drilling of borehole BH1 to augment the supply of water to the dam, with artesian groundwater conditions (i.e., caused by a static groundwater level occurring at an elevation above that of the top of the borehole casing, thus leading to natural groundwater flow from the borehole) encountered.

It was possible to measure the groundwater level at five of these boreholes, with levels of between 2.06, 14.80, and 18.48 mbgl recorded at BH2 close to the spring to the southeast, BH6 at the greenhouses to the north, and BH8 at a guesthouse to the west of the site, respectively, and excluding the artesian conditions encountered at borehole BH1 at the spring. This translates to a groundwater elevation of approximately 690 mamsl at borehole BH2, 663 mamsl at BH3, 707 mamsl at BH6, and 694 mamsl at BH8.

8.3 Groundwater level and flow

In the light of the above-mentioned results, it is evident that the static groundwater level at the proposed filling station can be expected to occur at a depth in excess of 10 mbgl (inferred to be in the order of between 13 and 18 mbgl), with a regional groundwater flow direction towards the south-southeast (i.e., towards the spring and irrigation dam).

8.4 Existing groundwater users

The results of the hydrocensus indicate that groundwater is currently used by several farms and related industries in the vicinity of the proposed filling station.

8.5 Groundwater Recharge

Groundwater recharge for the area is estimated at between 5 and 8% of the mean annual precipitation (MAP) (Vegter, 1995). According to information from the Water Research Council (WRC, 2012), the average expected transmissivity for the aquifer underlying the study area is 175 m^2/day.

8.6 Strategic Aquifer Classification

The aquifer underlying the study area is considered to define a MINOR AQUIFER with regard to the supply of groundwater in support of local agricultural activities and for domestic water supply now and in the future.

8.7 Water quality test results

Detailed results of water quality tests conducted on the various groundwater samples are included in Appendix F and summarized in the following paragraphs.

As the water in the irrigation dam is fed by groundwater originating from among others the spring and artesian borehole BH1, the results of water

quality tests conducted on a sample from the borehole are considered representative of the quality of surface water within the dam.

None of the groundwater samples yielded results indicating possible contamination from petroleum-based components, and the concentrations of the various macro-chemical constituents are considered within acceptable limits for potable water.

Conclusion: The above-mentioned results are inferred to indicate good ground- and surface water quality at present, without the presence of any petroleum-derived contaminants.

9 POLUTION RISK ASSESSMENT

9.1 Sources, pathways, and receptors

The following potential pollution sources are expected to occur at the proposed facility:

- buried fuel storage tanks - leaking tanks,
- pipelines from storage tanks to pumps - leaks,
- pumps - leaks, and
- filling station forecourt and apron - accidental spillages.

Possible pollution pathways include:

- lateral and vertical movement through the unsaturated soil-like overburden overlying less permeable bedrock,
- lateral and vertical movement through the fractured rock aquifer, and
- surface flow resulting from storm water runoff and spillage.

Possible receptors could include the following:

- groundwater aquifer,
- tributaries of the Greater Letaba River (southeast of the site),
- the Greater Letaba River (south of the site), and
- local groundwater users.

9.2 Aquifer vulnerability

In the light of the available geological and geohydrological information it is determined that the aquifer has a medium vulnerability to pollutants penetrating the aquifer and having lateral flow withing the aquifer. Additionally, the aquifer is considered a minor aquifer with low levels of permeability and a limited extent, with groundwater occurrences primarily restricted to geological structures. However, the available information indicates that there are several groundwater users reliant on the aquifer primarily for agricultural purposes.

9.3 Perceived contamination load risk

The proposed facility could yield moderate volumes of petrochemical contaminants either at the surface, or within perched water tables at relatively shallow depth, in the event of equipment failure and/or accidental spills. These contaminants are deemed harmful to humans, crops, and animals, even when present in low concentrations.

As such, the site is inferred to pose a high contaminant load risk to the natural environment, requiring the strict implementation of precautionary measures to prevent pillages or leaks, and remedial measures to alleviate contamination.

9.4 Impact Assessment

9.4.1 Determining consequence

Although the inferred impact that the proposed filling station will have on the natural environment is considered moderate (as implementation of suitable mitigation measures is expected to prevent contamination), possible contaminants from the facility are deemed harmful to humans, crops, and animals, even when present in low concentrations, with subsequent significant / very harmful severity.

Severity rating: 4

The duration of impact is beyond the life of the facility and will continue to be a source of contamination for many years should a leakage occur.

Duration rating: 4

Although the extent of the impact is local, it is expected to extend beyond the project boundary.

Extent rating: 3

Based on the above-mentioned ratings, the *Impact Consequence* of adverse effects on the natural environment that could be caused by the proposed development is calculated to be:

C = 3.7

9.4.2 Determining likelihood

Leakage of contaminants at the proposed facility would be considered as a single event that would be identified with adequate and legislated monitoring.

Frequency rating: 1

Based on the characterisation of the aquifer, it is deemed highly likely that the proposed filling station will have an adverse effect on groundwater or surface water users in the area, if any petrochemicals are introduced in copious volumes released in the sub-surface.

Probability rating: 4

Based on the above-mentioned ratings, the *Impact Likelihood* of adverse effects on the natural environment that could be caused by the proposed development is calculated to be:

L = 2.5

9.4.3 Determining Overall Impact Significance

Using integer values for the obtained C and L values, the overall *Significance* of possible adverse effects on the natural environment that could be caused by the proposed filling station is inferred to be **MEDIUM** with a conservatively calculated score of 12.

9.5 Risk Assessment

Although operation of a filling station comprise a variety of land uses and processes, the primary impacts on the environment from such a facility is considered to be in the form of petrochemical contaminants leaking from buried fuel storage tanks, leaked or spilled on the apron and parking areas, or contained in stormwater runoff.

In this light, as well as the inferred MEDIUM significance level of environmental pollution, the implementation of both **precautionary and remedial actions** is required to further reduce the risk that any pollutants be introduced into the natural environment.

9.5.1 Pollution of surface water sources

Given the geohydrological character of the area, it is evident that there is a **MEDIUM RISK** that contamination moving laterally through the soil horizons could reach surface water sources (to wit, the spring and dam located to the southeast) without being timeously detected, and as such a **MEDIUM ENVIRONMENTAL SIGNIFICANCE** in this regard.

9.5.2 Pollution of groundwater sources

The geohydrological character of the aquifer underlying the area revealed by this study indicates that there is a **MEDIUM RISK** that contaminants moving both laterally and vertically through the soil horizons could reach the static groundwater table. This is considered indicative of a **MEDIUM ENVIRONMENTAL SIGNIFICANCE** due to the high likelihood of

contamination and the subsequent severe impacts thereof.

9.6 Summary: environmental significance

The proposed development of a filling station at this site is deemed to be of **MEDIUM ENVIRONMENTAL SIGNIFICANCE**, mainly due to the following environmental factors:

- The underlying aquifer is regarded as a Minor Aquifer.
- There are currently several users in the vicinity of the site that utilize groundwater from the underlying aquifer that will be impacted by the proposed development.
- The soil-like overburden layer is regarded as being moderately permeable, with a moderately fast rate of infiltration into the underlying soil and weathered rock.
- There is a low to moderate possibility that contaminates will reach the surface water system downstream of the proposed facility, depending on the volume released.
- No preferential groundwater flow paths have been identified.
- The area exhibits only a slight groundwater gradient.

Based on the results of this assessment as detailed in this report, the development of the filling station at this site is deemed viable and supported, but only with strict implementation of mitigation and monitoring measures to prevent environmental degradation in the event of a leak / spill of petrochemicals at the site.

10 PRECAUTIONARY MEASURES

10.1 General

Even though the proposed development poses a risk of contamination, implementation of mitigation and management measures will ensure the sustainability and viability of the filling station. These measures include:

- The requirements of SANS 10089 (2010) must be complied with, including but not limited to:
  - Steel tanks and coatings shall comply with the requirements of SANS 1535 (2018)
  - Fibre-reinforced plastic tanks shall comply with the requirements of SANS 1668 (2013), and all materials used in contact with the tank shall be compatible with the fibre-reinforced resin
  - A full system integrity test in accordance with an approved test method shall be conducted after installation of the tanks

- An efficient storm water management system must be designed and implemented on site. In order to protect the spring and irrigation dam occurring downstream of the proposed filling station, it is strongly recommended that suitable measures be implemented to allow channelling of contaminated (dirty) stormwater runoff to the west-southwest along road R71.
- Runoff water from the clean areas onsite can be released in a south-easterly direction to limit the reduced catchment to the dam downstream.
- Additionally, runoff from the polluted areas (apron area and areas where fuel will be handled) should be channelled into a lined and impermeable oil-water separator located directly downstream of the facility to allow the collection and removal of any liquid contaminants spilled in these areas.
- All surface areas where the handling of fuel will take place must be sealed by means of concrete slabs underlain by bitumen at the intersections thereof to prevent infiltration of liquids into the underlying soil. The soil material itself must be suitably compacted to prevent ingress of liquid contaminants through zones of weakness within the surface seal.
- Buried fuel tanks should be installed according to the specifications of SANS 10089 (2010), preferably placed on a sealed concrete slab suitably equipped to allow drainage of fluids into a lined and impermeable sump.

  This would allow the timeous detection and removal of spilled or leaking fuel before groundwater contamination, especially after heavy precipitation events that could lead to the lateral movement of groundwater at shallow depth within the relatively permeable soil-like overburden.
- Additionally, at least four leak detection observation wells should be installed around the tanks in such a way to allow easy access for monitoring purposes.
- Regular reconciliation of the volumes of petroleum products is recommended to ensure the early detection of leaks.
- Care should be taken to ensure that all fuel lines and dispensers are leak-proof, especially in the light of the corrosive nature of the soil-like overburden.
- A Spillage Contingency Plan must be developed and implemented.

10.2 Long-term monitoring

Figure 13: Proposed water quality and groundwater level monitoring points.

10.2.1 Surface water monitoring

The irrigation dam located downstream of the site (i.e., to the southeast) is considered a suitable surface water body for the monitoring of surface water quality downstream of the proposed facility.

10.2.2 Groundwater monitoring

In the light of the importance of groundwater to agricultural end-users in the area, it is essential that proper geohydrological monitoring points be established to allow long-term documentation of groundwater levels and quality. This will also allow the timeous detection of contamination resulting from spillages and/or leaks at the facility and will establish a purging point for remediation if required.

It is recommended that the identified monitoring boreholes be maintained and finished to prevent localized contamination from surface. The borehole installations need to allow for access to measure groundwater levels and water quality sampling.

LEGEND

Study area

Monitoring boreholes

Surface water quality monitoring

Compiled by:
F. Calitz
D. van der Walt
Compiled on:
11 January 2022

Figure 13: Proposed water quality and groundwater level monitoring points.

Borehole number	Latitude:	Longitude:
BH2	23.81480°S	30.17518°E
BH8	23.81533°S	30.17118°E

The above-mentioned boreholes must be kept secured to prevent unauthorized access and tampering.

Geohydrological monitoring, including both groundwater levels and quality, should preferably be conducted as follows:

- **Monitoring frequency**:

  The following monitoring frequency is proposed:

Monitoring component:	Frequency
Groundwater level:	Monthly
Groundwater quality:	Yearly

- **Water level monitoring:**

  Water level monitoring must be conducted with a calibrated device.

- **Water quality monitoring:**

  Yearly determination and assessment of the following chemical constituents is recommended, based on the expected contaminant loading:

The water quality assessment must include evaluation of a list of macro and micro cations and anions, as well as the presence of VOC (Volatile Organic Compounds) and TPH (Total Petro- Hydro-carbon analysis), in the water.

Chemical constituents:
pH
Electrical Conductivity
Dissolved Oxygen
Ammonia (as N)
Total Nitrogen (NO_2 & NO_3)
COD & BOD
Total Petro Hydrocarbon (TPH)
Sulphate (SO_4)
Chloride (Cl)
Sodium (Na)
Potassium (K)
Calcium (Ca)
Magnesium (Mg)
Iron (Fe)
Ortho-Phosphate (PO_4)
Fluoride (Fl)
VOCs

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APPENDIX A

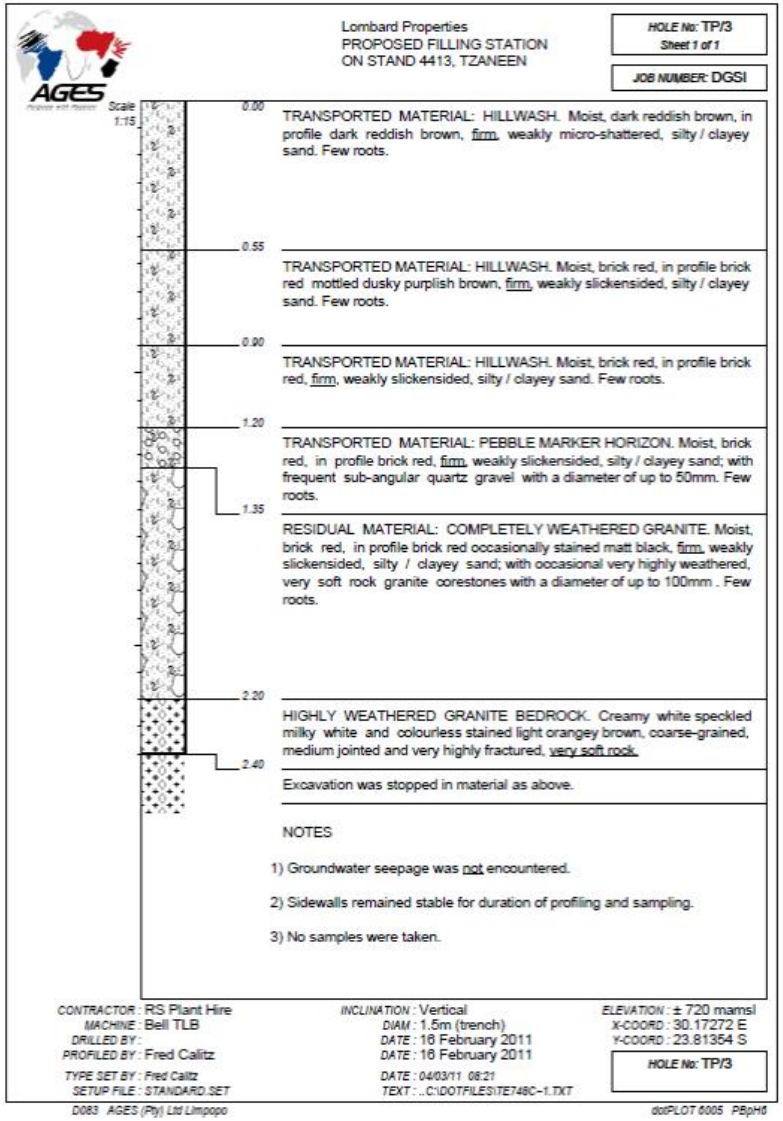
DETAILED HYDROCENSUS RESULTS

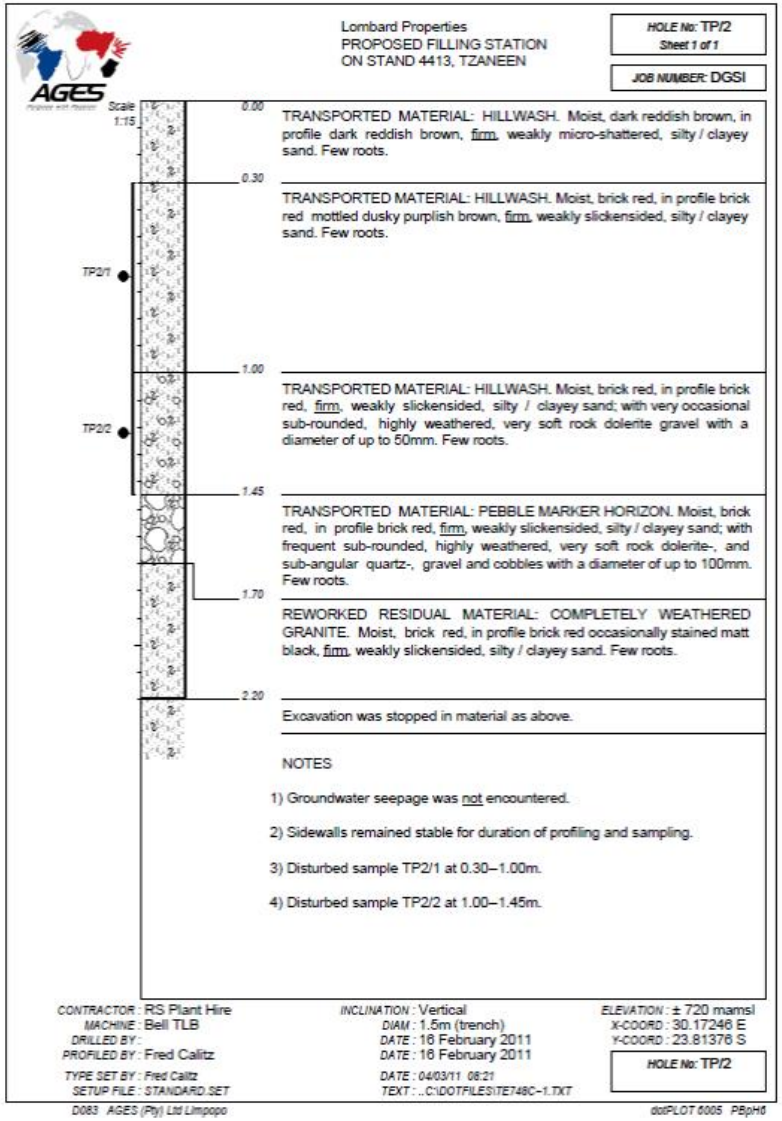
Reference Number	Historical Reference Number	Latitude	Longitude	Status	Equipment	BH depth	2011 Static Water Level (mbdl)	2021 Static Water Level (mbdl)	Datum Level (magl)	Water Quality Analyses	Estimated Daily Use (m^3/day)	Comments
1	2	-23.8148	30.17518	In Use	Submersible	20	-	Artesian	0.65	SOG, TPH & VOC		Borehole drilled recently at spring during drought, approximate potential of 1,1 Ls
2		-23.81454	30.17519	In Use	Submersible	50	-	2.06	0.17	-		Borehole drilled upstream of spring, associated with dolerite dyke, approximate potential 5,5 L/s
3	3	-23.81879	30.17768	In Use	Submersible	-	-	13.59	0.00	TPH & VOC		Used for domestic purposes, ants nest at borehole
4	G1	-23.81429	30.17251	Destroyed	None	0	11	-	-	-		Onsite Borehole
5	G2	-23.81237	30.17284	Destroyed	None	-	-	-	-	-		
6	K1	-23.81072	30.17278	In Use	Submersible	52	8.3	14.8	-0.02	-	15	WD Saailinge
7	K2	-23.81136	30.17374	In Use	Submersible	-	-	-	0	-	5	WD Saailinge, Borehole welded shut
8		-23.81533	30.17118	In Use	Submersible	-	-	18.48	0.5	Chem, SOG, TPH & VOC	5	Closest onsite Borehole, guesthouse. Approximate potential 1,0 L/s
9	SCH 1	-23.81668	30.1712	Destroyed	-	-	-	-	-	-		

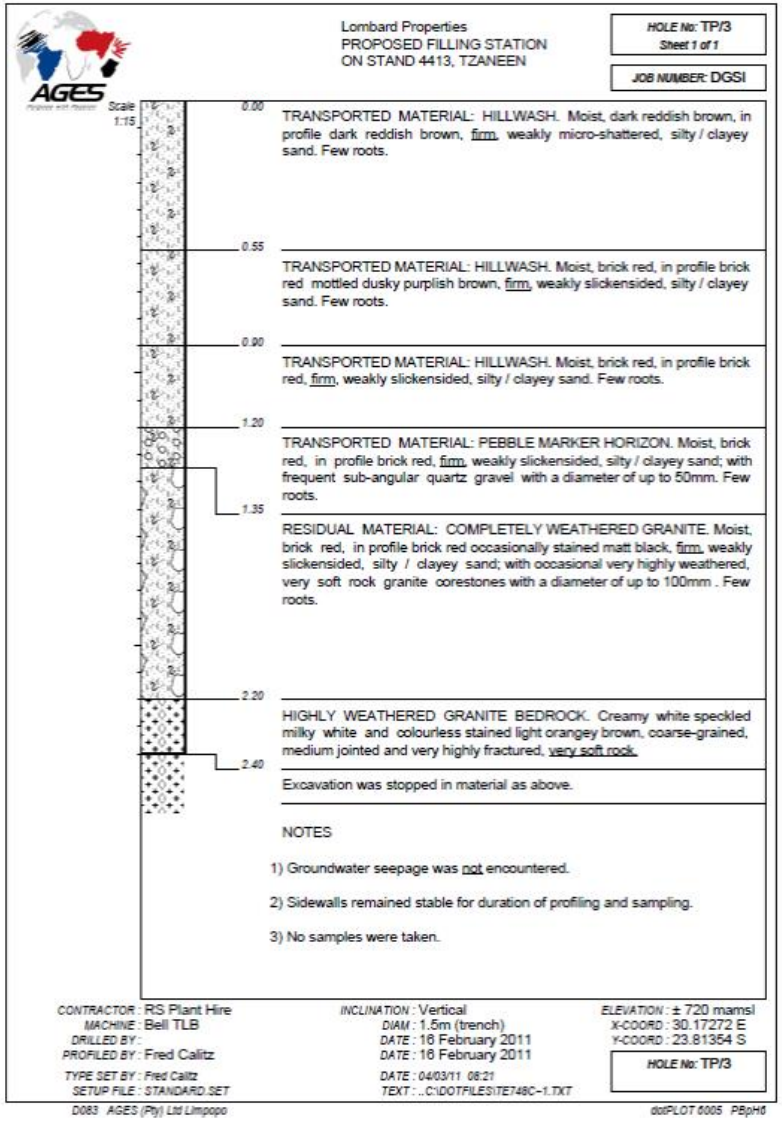
APPENDIX B

DETAILED

TEST PIT PROFILE LOGS


Lombard Properties
PROPOSED FILLING STATION
ON STAND 4413, TZANEEN
HOLE No: TP/3
Sheet 1 of 1
JOB NUMBER: DGSI
Scale 1:15
0.00
TRANSPORTED MATERIAL: HILLWASH. Moist, dark reddish brown, in profile dark reddish brown, firm, weakly micro-shattered, silty / clayey sand. Few roots.
0.55
TRANSPORTED MATERIAL: HILLWASH. Moist, brick red, in profile brick red mottled dusky purplish brown, firm, weakly slickensided, silty / clayey sand. Few roots.
0.90
TRANSPORTED MATERIAL: HILLWASH. Moist, brick red, in profile brick red, firm, weakly slickensided, silty / clayey sand. Few roots.
1.20
TRANSPORTED MATERIAL: PEBBLE MARKER HORIZON. Moist, brick red, in profile brick red, firm, weakly slickensided, silty / clayey sand; with frequent sub-angular quartz gravel with a diameter of up to 50mm. Few roots.
1.35
RESIDUAL MATERIAL: COMPLETELY WEATHERED GRANITE. Moist, brick red, in profile brick red occasionally stained matt black, firm, weakly slickensided, silty / clayey sand; with occasional very highly weathered, very soft rock granite corestones with a diameter of up to 100mm . Few roots.
2.20
HIGHLY WEATHERED GRANITE BEDROCK. Creamy white speckled milky white and colourless stained light orangey brown, coarse-grained, medium jointed and very highly fractured, very soft rock.
2.40
Excavation was stopped in material as above.
NOTES
1) Groundwater seepage was not encountered.
2) Sidewalls remained stable for duration of profiling and sampling.
3) No samples were taken.
CONTRACTOR : RS Plant Hire
MACHINE : Bell TLB
DRILLED BY :
PROFILED BY : Fred Calitz
TYPE SET BY : Fred Calitz
SETUP FILE : STANDARD.SET
INCLINATION : Vertical
DIAM : 1.5m (trench)
DATE : 16 February 2011
DATE : 16 February 2011
DATE : 04/03/11 08:21
TEXT : ..C:\DOTFILES\TE748C~1.TXT
ELEVATION : ± 720 mamsl
X-COORD : 30.17272 E
Y-COORD : 23.81354 S
HOLE No: TP/3
D083 AGES (Pty) Ltd Limpopo
dotPLOT 6005 PBpH6


Lombard Properties
PROPOSED FILLING STATION
ON STAND 4413, TZANEEN
HOLE No: TP/2
Sheet 1 of 1
JOB NUMBER: DGSI
Scale 1:15
0.00
TRANSPORTED MATERIAL: HILLWASH. Moist, dark reddish brown, in profile dark reddish brown, firm, weakly micro-shattered, silty / clayey sand. Few roots.
0.30
TRANSPORTED MATERIAL: HILLWASH. Moist, brick red, in profile brick red mottled dusky purplish brown, firm, weakly slickensided, silty / clayey sand. Few roots.
TP2/1
1.00
TRANSPORTED MATERIAL: HILLWASH. Moist, brick red, in profile brick red, firm, weakly slickensided, silty / clayey sand; with very occasional sub-rounded, highly weathered, very soft rock dolerite gravel with a diameter of up to 50mm. Few roots.
TP2/2
1.45
TRANSPORTED MATERIAL: PEBBLE MARKER HORIZON. Moist, brick red, in profile brick red, firm, weakly slickensided, silty / clayey sand; with frequent sub-rounded, highly weathered, very soft rock dolerite-, and sub-angular quartz-, gravel and cobbles with a diameter of up to 100mm. Few roots.
1.70
REWORKED RESIDUAL MATERIAL: COMPLETELY WEATHERED GRANITE. Moist, brick red, in profile brick red occasionally stained matt black, firm, weakly slickensided, silty / clayey sand. Few roots.
2.20
Excavation was stopped in material as above.
NOTES
1) Groundwater seepage was not encountered.
2) Sidewalls remained stable for duration of profiling and sampling.
3) Disturbed sample TP2/1 at 0.30–1.00m.
4) Disturbed sample TP2/2 at 1.00–1.45m.
CONTRACTOR : RS Plant Hire
MACHINE : Bell TLB
DRILLED BY :
PROFILED BY : Fred Calitz
TYPE SET BY : Fred Calitz
SETUP FILE : STANDARD.SET
INCLINATION : Vertical
DIAM : 1.5m (trench)
DATE : 16 February 2011
DATE : 16 February 2011
DATE : 04/03/11 08:21
TEXT : ..C:\DOTFILES\TE748C~1.TXT
ELEVATION : ± 720 mamsl
X-COORD : 30.17246 E
Y-COORD : 23.81376 S
HOLE No: TP/2
D083 AGES (Pty) Ltd Limpopo
dotPLOT 6005 PBpH6


AGES
Lombard Properties
PROPOSED FILLING STATION
ON STAND 4413, TZANEEN
HOLE No: TP/3
Sheet 1 of 1
JOB NUMBER: DGSI
Scale 1:15
0.00
TRANSPORTED MATERIAL: HILLWASH. Moist, dark reddish brown, in profile dark reddish brown, firm, weakly micro-shattered, silty / clayey sand. Few roots.
0.55
TRANSPORTED MATERIAL: HILLWASH. Moist, brick red, in profile brick red mottled dusky purplish brown, firm, weakly slickensided, silty / clayey sand. Few roots.
0.90
TRANSPORTED MATERIAL: HILLWASH. Moist, brick red, in profile brick red, firm, weakly slickensided, silty / clayey sand. Few roots.
1.20
TRANSPORTED MATERIAL: PEBBLE MARKER HORIZON. Moist, brick red, in profile brick red, firm, weakly slickensided, silty / clayey sand; with frequent sub-angular quartz gravel with a diameter of up to 50mm. Few roots.
1.35
RESIDUAL MATERIAL: COMPLETELY WEATHERED GRANITE. Moist, brick red, in profile brick red occasionally stained matt black, firm, weakly slickensided, silty / clayey sand; with occasional very highly weathered, very soft rock granite corestones with a diameter of up to 100mm . Few roots.
2.20
HIGHLY WEATHERED GRANITE BEDROCK. Creamy white speckled milky white and colourless stained light orangey brown, coarse-grained, medium jointed and very highly fractured, very soft rock.
2.40
Excavation was stopped in material as above.
NOTES
1) Groundwater seepage was not encountered.
2) Sidewalls remained stable for duration of profiling and sampling.
3) No samples were taken.
CONTRACTOR : RS Plant Hire
MACHINE : Bell TLB
DRILLED BY :
PROFILED BY : Fred Calitz
TYPE SET BY : Fred Calitz
SETUP FILE : STANDARD.SET
INCLINATION : Vertical
DIAM : 1.5m (trench)
DATE : 16 February 2011
DATE : 16 February 2011
DATE : 04/03/11 08:21
TEXT : ..C:\DOTFILES\TE748C~1.TXT
ELEVATION : ± 720 mamsl
X-COORD : 30.17272 E
Y-COORD : 23.81354 S
HOLE No: TP/3
D083 AGES (Pty) Ltd Limpopo
dotPLOT 6005 PBpH6

APPENDIX C

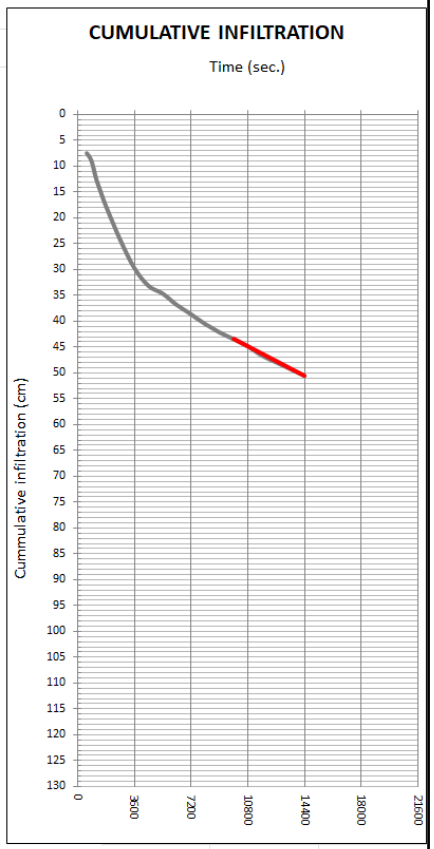
DETAILED

DOUBLE-RING INFILTROMETER

TEST RESULTS

DOUBLE-RING INFILTROMETER TEST RESULTS			DRIT IT/1
Project:	Filling Station on Erf 4413, Tzaneen		
Date Conducted:	Site Location:	Conducted By:	
16 February 2011	Tzaneen	Mr. F. Calitz	
Test Depth:	Layer Tested:		
1.1 mbgl	Silty/Clayey Sand		
Coordinate:	23.813794 °S		
	30.172644 °E		

Time (Sec.)		Cumulative Field Measurement (cm)
0		0.0
15		
30		0.0
45		
60	1m	0.5
90		
120	2m	1.5
150		
180	3m	2.5
210		
240	4m	4.4
270		
300	5m	5.0
360	6m	
420	7m	
480	8m	
540	9m	
600	10m	7.5
900	15m	9.0
1200	20m	12.5
1500	25m	15.1
1800	30m	17.6
2700	45m	24.1
3600	1H	29.6
4500	1H 15m	33.1
5400	1H 30m	34.6
6300	1H 45m	36.8
7200	2H	38.6
8100	2H 15m	40.5
9000	2H 30m	42.1
9900	2H 45m	43.4
10800	3H	44.8
11700	3H 15m	46.6
12600	3H 30m	47.9
13500	3H 45m	49.2
14400	4H	50.5
15300	4H 15m	
16200	4H 30m	
17100	4H 45m	
18000	5H	
18900	5H 15m	
	5H 30m	
	5H 45m	
21600	6H	



MEASURED *IN SITU* PERMEABILITY (k):	INFERRED PERCOLATION RATE:
1.6E-03 cm.s^{-1}	1.36 m/day
medium permeability	

APPENDIX D

DETAILED

GEOTECHNICAL LABORATORY

TESTING RESULTS

MATROLAB GROUP TRADING AS

TPT LAB

- CIVIL ENGINEERING SERVICES -

Reg.No.: 2003/029180/07 - VAT. Reg.No.: 4040210587

11 Tin Street,Laboria , POLOKWANE,0699
P.O. BOX 1576 , LADANNA 0704

Tel. : 015 293 1377/1835
Fax : 015 293 0922
Email : tpt@matrolab.co.za

TEST RESULTS

AGES GROUP
P O BOX 2526
POLOKWANE
0700
Attention: D VAN DER WALT

Project : GENV FILLING STATION STAND NO.4113 TZANEEN
Your Ref :
Our Ref : 65410
Date Reported : 07/03/2011

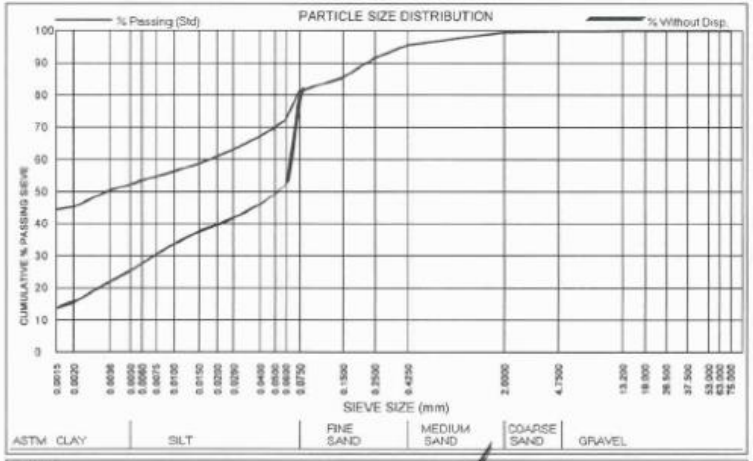
DOUBLE HYDROMETER (ASTM: D422)

Sample No.	G285	Liquid Limit (%)	49	PI of Whole Sample	13	P.R.A. Classification	A-7-5(11)
Hole No.	TP1	Plasticity Index	14	Grading Modulus	0.24	Unified Soil Classification	ML
Depth (mm)	0.3-3.0m	Linear Shrinkage (%)	8.0	Percentage (<0.002)	45.0	Activity	0.29
Description	RD BROWN SANDY SILTY CLAY			Moisture Content (%)		Heave Classification	LOW

Dispersion (%)	Clay (%)	Silt (%)	Sand (%)	Gravel (%)	Classification
33.6	62.3	29.0	18.6	0.1	CLAY

Sieve Size (mm)	75.000	63.000	53.000	37.500	26.500	19.000	13.200	4.7500	2.0000	0.4250	0.2500	0.1500	0.0750
% Passing Sieve	100	100	100	100	100	100	100	100	100	96	92	85	81

Sieve Size (mm)	0.0600	0.0500	0.0400	0.0260	0.0200	0.0150	0.0100	0.0075	0.0060	0.0050	0.0036	0.0020	0.0015
% Passing (Std)	72.51	69.86	67.23	63.13	61.05	58.79	56.33	54.72	53.52	52.26	50.50	49.29	44.40
% Without Disp.	52.40	49.15	45.96	41.44	39.36	37.28	33.40	30.09	27.41	25.06	21.77	15.36	13.71



Remarks :

FORM: A6 3.3(26.01.2010) Technical Signatory : B.H.ROBBELAAR

MATROLAB GROUP TRADING AS

TPT LAB

- CIVIL ENGINEERING SERVICES -

Reg.No.: 2003/029180/07 - VAT. Reg.No.: 4040210587

11 Tin Street,Laboria , POLOKWANE,0699
P.O. BOX 1576 , LADANNA 0704

Tel. : 015 293 1377/1835
Fax : 015 293 0922
Email : tpt@matrolab.co.za

TEST RESULTS

AGES GROUP
P O BOX 2526
POLOKWANE
0700
Attention: ANTON

Project : GENV FILLING STATION STAND NO.4113 TZANEEN
Your Ref :
Our Ref : 65410
Date Reported : 20/02/2011

SIEVE ANALYSIS, ATTERBERG LIMITS, CBR, UCS(TMH1:A1-A5,A7,A8,A14)

SAMPLE NO.	G285	G285	G285	G285
HOLE NO.	TP1	TP1	TP1	TP1
ROAD NO.				
DEPTH (mm)	0.3-3.0m	0.3-3.0m	0.3-3.0m	0.3-3.0m
CHAINAGE				
LAYER TYPE				
STABILISED WITH	NEAT	2% CEMENT	2.5% CEMENT	3% CEMENT
SUPPLIER		OPC 42.5N	OPC 42.5N	OPC 42.5N
CURING METHOD		RAPID	RAPID	RAPID
DESCRIPTION	RD BROWN SA SILTY CLAY	RD BROWN SA SILTY CLAY	RD BROWN SA SILTY CLAY	RD BROWN SA SILTY CLAY
SIEVE ANALYSIS (% PASSING)				
75 mm				
63 mm				
53 mm				
37.5 mm				
26.5 mm				
19.0 mm				
13.2 mm	100			
4.75 mm	100			
2.0 mm	100			
0.425 mm	88			
0.075 mm	78			
SOIL MORTAR				
COARSE SAND<2.000mm >0.425mm	12			
FINE SAND <0.425mm >0.075mm	13			
MATERIAL <0.075mm	75			
CONSTANTS				
GRADING MODULUS	0.37			
PRA CLASSIFICATION	A-7-5(11)			
COLTO CLASSIFICATION	—			
TRH Class.(INSITU (93%)90%))	G8(G9			
LIQUID LIMIT (%)	49	40	40	40
PLASTICITY INDEX (0.425mm)	14	8	7	6
LINEAR SHRINKAGE (%)	8.0	4.5	3.5	3.0
MOD AASHTO				
MAXIMUM DRY DENSITY (kg/m^3)	1734	1712	1712	1712
OPTIMUM MOISTURE CONTENT (%)	18.2	20.2	20.2	20.2
MOULDING MOISTURE (%)	20.7	20.8	20.8	21.5
TYPE OF TEST	CBR	UCS (MPa)	UCS (MPa)	UCS (MPa)
CBR-UCS @ 100% MOD AASHTO	18	0.44 MPa.	0.71 MPa.	1.34 MPa.
CBR-UCS @ 98% MOD AASHTO	17	0.38 MPa.	0.61 MPa.	1.11 MPa.
CBR-UCS @ 97% MOD AASHTO	16	0.35 MPa.	0.56 MPa.	1.01 MPa.
CBR-UCS @ 95% MOD AASHTO	15	0.30 MPa.	0.48 MPa.	0.84 MPa.
CBR-UCS @ 93% MOD AASHTO	14	0.26 MPa.	0.41 MPa.	0.76 MPa.
CBR-UCS @ 90% MOD AASHTO	9.2	0.21 MPa.	0.32 MPa.	0.53 MPa.

CBR-UCS @ % MOD AASHTO derived from calculation.

% SWELL AT [MOD][NRB][PROC]	0.10	0.10	0.04									

DEVIATION FROM TEST METHOD: UCS reported to nearest 0.01 MPa.

Remarks :

FORM: A1 3.3(26.01.2010) Technical Signatory : B.H.ROBBELAAR

MATROLAB GROUP TRADING AS

TPT LAB

- CIVIL ENGINEERING SERVICES -

Reg.No.: 2003/029180/07 - VAT. Reg.No.: 4040210587

11 Tin Street,Laboria , POLOKWANE,0699
P.O. BOX 1576 , LADANNA 0704

Tel : 015 293 1377/1835
Fax : 015 293 0922
Email : tpt@matrolab.co.za

TEST RESULTS

AGES GROUP
P O BOX 2526
POLOKWANE
0700
Attention: D VAN DER WALT

Project : GENV FILLING STATION
STAND NO.4113 TZANEEN
Your Ref :
Our Ref : 68410
Date Reported : 07/03/2011

DOUBLE HYDROMETER (ASTM: D422)

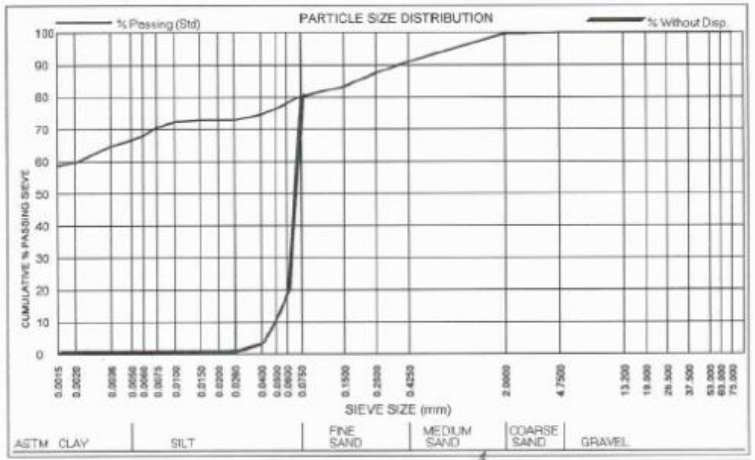
Sample No.	: G286	Liquid Limit (%)	: 53	PI of Whole Sample	: 11
Hole No.	: TP2/1	Plasticity Index	: 12	Grading Modulus	: 0.29
Depth (mm)	: 0.3-1.0m	Linear Shrinkage (%)	: 7.0	Percentage (<0.002)	: 60.0
Description	: RD BROWN SILTY SANDY CLAY			Moisture Content (%)	

P.R.A. Classification	: A-7-5(11)		
Unified Soil Classification	: MH		
Activity	: 0.18		
Heave Classification	: LOW		

Dispersion (%)	Clay (%)	Silt (%)	Sand (%)	Gravel (%)	Classification
0.3	66.6	13.6	19.9	0.0	CLAY

Sieve Size (mm)	75.000	63.000	53.000	37.500	26.500	19.000	13.200	4.7500	2.0000	0.4250	0.2500	0.1500	0.0750
% Passing Sieve	100	100	100	100	100	100	100	100	100	91	87	83	80

Sieve Size (mm)	0.0600	0.0500	0.0400	0.0260	0.0200	0.0150	0.0100	0.0075	0.0060	0.0050	0.0036	0.0020	0.0015
% Passing (Std)	79.01	76.29	74.57	72.86	72.86	72.86	72.29	70.48	68.01	66.58	64.77	60.75	58.84
% Without Disp.	19.34	11.05	2.86	0.34	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18



Remarks :

FORM: A6 3.3(26.01.2010) Technical Signatory : S GROBBELAAR

MATROLAB GROUP TRADING AS

TPT LAB

- CIVIL ENGINEERING SERVICES -

Reg.No.: 2003/029180/07 - VAT. Reg.No.: 4040210587

11 Tin Street,Laboria , POLOKWANE,0699
P.O. BOX 1576 , LADANNA 0704

Tel : 015 293 1377/1835
Fax : 015 293 0922
Email : tpt@matrolab.co.za

TEST RESULTS

AGES GROUP
P O BOX 2526
POLOKWANE
0700
Attention: D VAN DER WALT

Project : GENV FILLING STATION
STAND NO.4113 TZANEEN
Your Ref :
Our Ref : 68410
Date Reported : 07/03/2011

DOUBLE HYDROMETER (ASTM: D422)

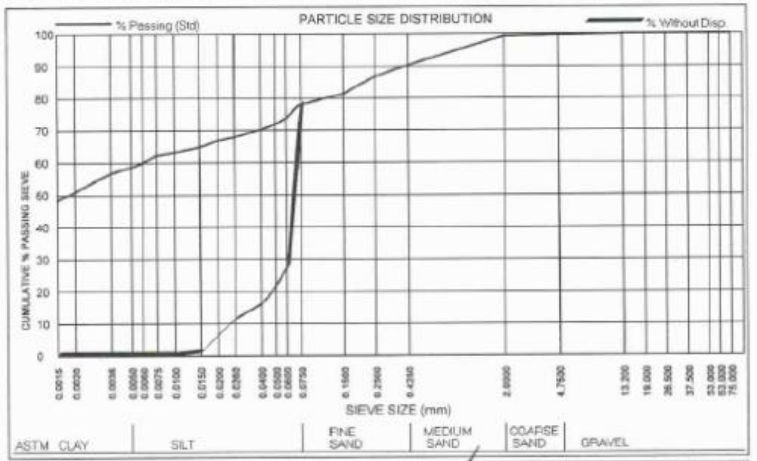
Sample No.	: G287	Liquid Limit (%)	: 54	PI of Whole Sample	: 11
Hole No.	: TP2/2	Plasticity Index	: 12	Grading Modulus	: 0.32
Depth (mm)	: 1.0-1.45m	Linear Shrinkage (%)	: 7.5	Percentage (<0.002)	: 51.0
Description	: RD BROWN SILTY SANDY CLAY			Moisture Content (%)	

P.R.A. Classification	: A-7-5(12)		
Unified Soil Classification	: MH		
Activity	: 0.22		
Heave Classification	: LOW		

Dispersion (%)	Clay (%)	Silt (%)	Sand (%)	Gravel (%)	Classification
0.4	58.6	19.4	21.6	0.3	CLAY

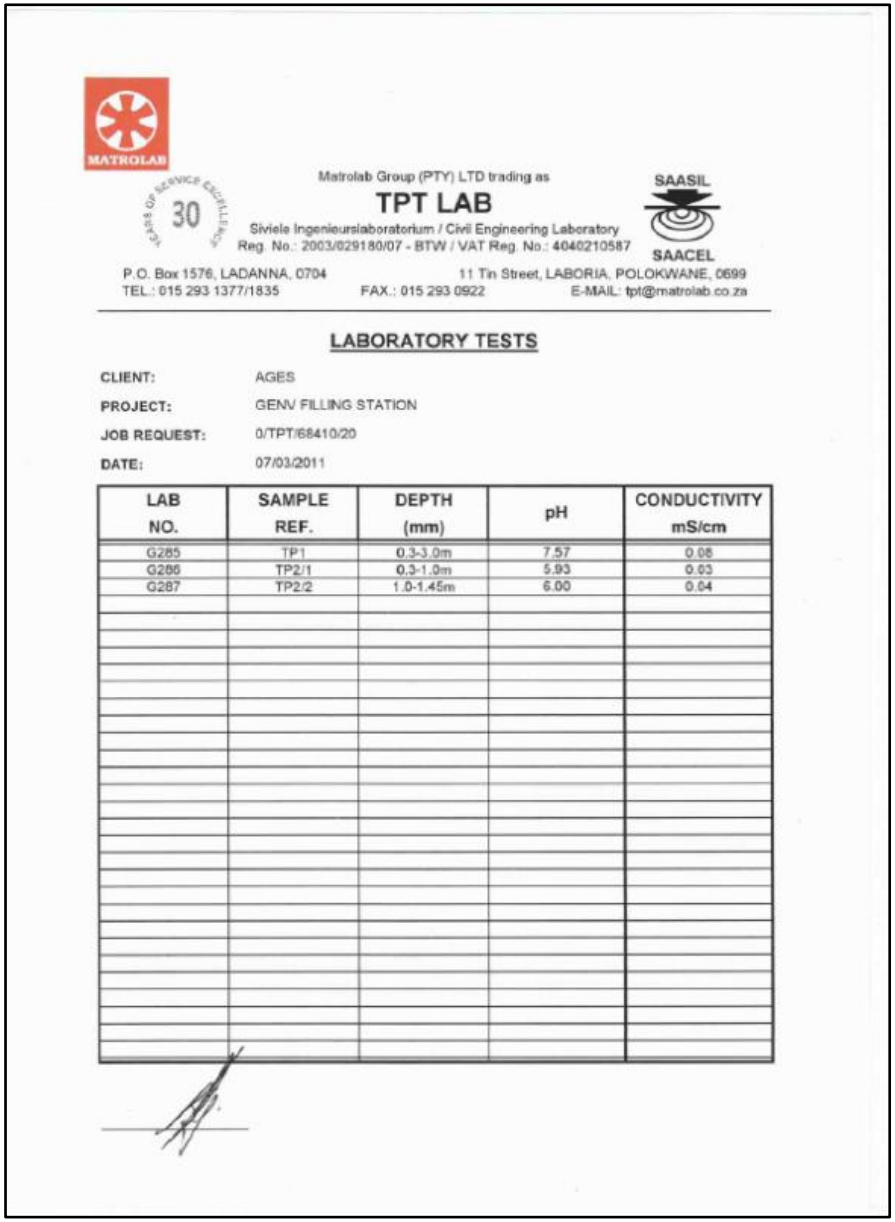
Sieve Size (mm)	75.000	63.000	53.000	37.500	26.500	19.000	13.200	4.7500	2.0000	0.4250	0.2500	0.1500	0.0750
% Passing Sieve	100	100	100	100	100	100	100	100	99	90	87	81	78

Sieve Size (mm)	0.0600	0.0500	0.0400	0.0260	0.0200	0.0150	0.0100	0.0075	0.0060	0.0050	0.0036	0.0020	0.0015
% Passing (Std)	73.52	71.93	70.24	67.90	66.93	64.83	63.24	62.27	59.91	58.62	56.89	51.01	48.34
% Without Disp.	27.81	21.91	16.00	11.41	6.56	1.04	0.18	0.18	0.18	0.18	0.18	0.18	0.18



Remarks :

FORM: A6 3.3(26.01.2010) Technical Signatory : S GROBBELAAR



Matrolab Group (PTY) LTD trading as
TPT LAB
Siviele Ingenieurslaboratorium / Civil Engineering Laboratory
Reg. No.: 2003/029180/07 - BTW / VAT Reg. No.: 4040210587
SAASIL
SAACEL
P.O. Box 1576, LADANNA, 0704 — 11 Tin Street, LABORIA, POLOKWANE, 0699
TEL.: 015 293 1377/1835 — FAX.: 015 293 0922 — E-MAIL: tpt@matrolab.co.za

LABORATORY TESTS

CLIENT: AGES
PROJECT: GENV FILLING STATION
JOB REQUEST: 0/TPT/68410/20
DATE: 07/03/2011

LAB NO.	SAMPLE REF.	DEPTH (mm)	pH	CONDUCTIVITY mS/cm
G285	TP1	0.3-3.0m	7.57	0.08
G286	TP2/1	0.3-1.0m	5.93	0.03
G287	TP2/2	1.0-1.45m	6.00	0.04

APPENDIX E

DETAILED

WATER QUALITY

TESTING RESULTS

sanas

V3014

CAPRICORN VETERINARY LABORATORIES
ANALYTICAL & DIAGNOSTIC LABORATORY SERVICES
215 Marshall Street, Flora Park, Polokwane, South Africa
P.O. Box 115 Bendor Park 0713
Tel: +27(15) 297-6666
E-mail: info@capvet.co.za

LABORATORY TEST REPORT

WATER CHEMISTRY:

Your reference: Deerpark Intersection Filling Station
Our reference: 21/12/5103B
Enquiries: 015 297-6666
Date report issued: 2021/12/23

Sender/ Client: Ages Group Limpopo
Person sent: Driakus van der Walt
Postal: P.O. Box 2526, Polokwane, 0700
Tel: 015 291-1577
E-mail: dvanderwalt@ages-group.com

Owner: Ref sender
Sample origin: On site – Not specified
Postal: Ref sender, Ref sender, Ref sender
Tel: Ref sender
E-mail: Ref sender

Water

1. **Samples received:**
1 x ground water sample(s) as indicated in Table 1.

1.1 Date sample(s) received: 2021/12/09
1.2 Time sample(s) received: 10h26
1.3 Date test(s) started: 2021/12/11
1.4 Date report completed: 2021/12/23

2. **Required test(s):**
2.1 Water chemistry

3. **Test method**
The sample(s) were tested in accordance with:

3.1 Refer to Table 1.

4. Sample and condition/...

sanas

V3014

4. **Sample and condition :**
4.1 Date of sampling: 2021/12/08
4.2 Date sample submitted: 2021/12/09
4.3 Temp. upon sample reception: 16.1 °C
4.4 Sample defects noted: None

5. **Sub contractor:**
5.1 None

6. **Results:**

Table 1:
Refer to 2.1

Determinand	Test Method Reference	Units	1-21/5103 WL 21 002
Physical and aggregate properties			
pH @ 25°C	CH-METH-001	pH units	6.3
Conductivity @25°C	CH-METH-002	mS/m	22.3
*Total dissolved solids (calculated)	CH-METH-009	mg/l	145
Alkalinity			
*Bicarbonate alkalinity as $CaCO_3$	CH-METH-006	mg/l	56.7
*Carbonate alkalinity as $CaCO_3$		mg/l	0.0
Hardness:			
*Total hardness as $CaCO_3$	CH-METH-009	mg/l	74.12
*Ca hardness as $CaCO_3$		mg/l	42.30
*Mg hardness as $CaCO_3$		mg/l	31.82
Metals			
Calcium as Ca	CH-METH-020	mg/l	16.92
Iron as Fe	CH-METH-020	mg/l	<0.01
Magnesium as Mg	CH-METH-020	mg/l	7.76
Manganese as Mn	CH-METH-020	mg/l	<0.01
Potassium as K	CH-METH-020	mg/l	2.56
Sodium as Na	CH-METH-020	mg/l	13.28
Inorganic non-metallic constituents			
Chloride as Cl	CH-METH-050	mg/l	20.7
Fluoride as F	CH-METH-013	mg/l	<0.10
Nitrogen			
Nitrate as NO_3-N	CH-METH-050	mg/l	5.20
*Nitrite as NO_2-N	CH-METH-011	mg/l	<0.01
Phosphorus			
Orthophosphate as PO_4-P	CH-METH-032	mg/l	<0.05
Sulphur			
Sulphate as SO_4	CH-METH-050	mg/l	3.22
Aggregate organic constituents			
*Soap, Oil and grease	CH-METH-040	mg/l	<1.0

Key:
* - Not a SANAS accredited method

7. Comments/...

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V3014

Page 3 of 3

Disclaimer: Comments and interpretations expressed herein are not within the scope of SANAS accreditation.

7. Comments:
7.1 This report replaces test report 21/12/5103 dated 2021/12/15 in full. The addition of all determinands other than that of SOG has now been included into the report.

8. Interpretations:
8.1 None

Digitally signed by Milan Andrin
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(Technical Signatory)

(END OF REPORT)

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A member & participant of the SABS Water-Check Scheme, the National Laboratory Association's Microbiology Scheme, and Agrilasa's Interlaboratory Control Scheme

Test Report - TPH Analysis

Capricorn Veterinary Laboratories CC
P.O Box 116
Bendor Park
0713

Telephone: 015 297 6666

E-mail: milan@caprivet.co.za

Samples Received: 2021-12-09
Sampled by: Unknown
Report # : F22-03674
Order #: None
Acc # : C108
GC Testing Date: 2021-12-17

Sample condition: Average
Sub-contractor: None

Sample name: 21/12/5101-1

Method of test: TPH GC/MS (Hexane extraction - Aliphatic)*

Compound	Concentration (ppb)
C8	<2.5
C9	<2.5
C10	<2.5
C11	<2.5
C12	<2.5
C13	<2.5
C14	<2.5
C15	<2.5
C16	<2.5
C17	<2.5
C18	<2.5
C19	<2.5
C20	<2.5
C21	<2.5
C22	<2.5
C23	<2.5
C24	<2.5

Compound	Concentration (ppb)
C25	<2.5
C26	<2.5
C27	<2.5
C28	<2.5
C29	<2.5
C30	<2.5
C31	<2.5
C32	<2.5
C33	<2.5
C34	<2.5
C35	<2.5
C36	<2.5
C37	<2.5
C38	<2.5
C39	<2.5
C40	<2.5

TOG (mg/L)**	10

*Cx refers to the linear hydrocarbon of chain length x.
** Gravimetric (Also refered to as HEM)

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Date: 2021-10-21

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Test Report - VOC analysis

Capricorn Veterinary Laboratories CC
P.O Box 115
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0713

Telephone: 015 297 6666

E-mail: milan@caprivet.co.za

Samples Received: 2021-12-09
Sampled by: Unknown
Report # : F22-03674
Order #: None
Acc # : C108
GC Testing Date: 2021-12-13

Sample condition: Average
Sub-contractor: None

Sample name: 21/12/5101-1

Method of test: VOC analysis in water and waste water

Compound	Concentration (ppb)
1,1-Dichloroethene	<10
trans-1,2-Dichloroethene	<10
cis-1,2-Dichloroethene	<10
MTBE	<100
1,1-Dichloroethane	<10
Trichloromethane	<10
Dichloromethane	<10
1,1,1-Trichloroethane	<10
Carbon tetrachloride	<10
1,2-Dichloroethane	<10
Benzene	<10
1,2-Dichloropropane	<10
Trichlororethene	<10
Bromodichloromethane	<10
Dibromochloromethane	<10
Methylcyclohexane	<10
trans-1,3-Dichloropropene	<10
Toluene	<10
cis-1,3-Dichloropropene	<10

Compound	Concentration (ppb)
1,1,2-Trichloroethane	<10
1,2-Dibromoethane	<10
Tetrachloroethene	<10
Chlorobenzene	<10
Ethylbenzene	<10
m+p-Xylene	<10
Bromoform	<10
Styrene	<10
o-Xylene	<10
1,1,2,2-Tetrachloroethane	<10
Isopropylbenzene	<10
1,3-Dichlorobenzene	<10
1,4-Dichlorobenzene	<10
1,2-Dichlorobenzene	<10
1,2-Dibromo-3-chloropropene	<10
1,2,4-trichlorobenzene	<10

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Date: 2021-12-14

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Test Report - TPH Analysis

Capricorn Veterinary Laboratories CC
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Telephone: 015 297 6666

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Samples Received: 2021-12-09
Sampled by: Unknown
Report # : F22-03675
Order #: None
Aco # : C108
GC Testing Date: 2021-12-17

Sample condition: Average
Sub-contractor: None

Sample name: 21/12/5101-2

Method of test: TPH GC/MS (Hexane extraction - Aliphatic)*

Compound	Concentration (ppb)
C8	<2.5
C9	<2.5
C10	<2.5
C11	<2.5
C12	<2.5
C13	<2.5
C14	<2.5
C15	<2.5
C16	<2.5
C17	<2.5
C18	<2.5
C19	<2.5
C20	<2.5
C21	<2.5
C22	<2.5
C23	<2.5
C24	<2.5

Compound	Concentration (ppb)
C25	<2.5
C26	<2.5
C27	<2.5
C28	<2.5
C29	<2.5
C30	<2.5
C31	<2.5
C32	<2.5
C33	<2.5
C34	<2.5
C35	<2.5
C36	<2.5
C37	<2.5
C38	<2.5
C39	<2.5
C40	<2.5

TOG (mg/L)**	26

*Cx refers to the linear hydrocarbon of chain length x.
** Gravimetric (Also refered to as HEM)

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Test Report - VOC analysis

Capricorn Veterinary Laboratories CC
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Telephone: 015 297 6666

E-mail: milan@caprivet.co.za

Samples Received: 2021-12-09
Sampled by: Unknown
Report # : F22-03675
Order #: None
Aco # : C108
GC Testing Date: 2021-12-13

Sample condition: Average
Sub-contractor: None

Sample name: 21/12/5101-2

Method of test: VOC analysis in water and waste water

Compound	Concentration (ppb)
1,1-Dichloroethene	<10
trans-1,2-Dichloroethene	<10
cis-1,2-Dichloroethene	<10
MTBE	<100
1,1-Dichloroethane	<10
Trichloromethane	<10
Dichloromethane	<10
1,1,1-Trichloroethane	<10
Carbon tetrachloride	<10
1,2-Dichloroethane	<10
Benzene	<10
1,2-Dichloropropane	<10
Trichlororethene	<10
Bromodichloromethane	<10
Dibromochloromethane	<10
Methylcyclohexane	<10
trans-1,3-Dichloropropene	<10
Toluene	<10
cis-1,3-Dichloropropene	<10

Compound	Concentration (ppb)
1,1,2-Trichloroethane	<10
1,2-Dibromoethane	<10
Tetrachloroethene	<10
Chlorobenzene	<10
Ethylbenzene	<10
m+p-Xylene	<10
Bromoform	<10
Styrene	<10
o-Xylene	<10
1,1,2,2-Tetrachloroethane	<10
Isopropylbenzene	<10
1,3-Dichlorobenzene	<10
1,4-Dichlorobenzene	<10
1,2-Dichlorobenzene	<10
1,2-Dibromo-3-chloropropene	<10
1,2,4-trichlorobenzene	<10

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Test Report - TPH Analysis

Capricorn Veterinary Laboratories CC
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Telephone: 015 297 6666

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Samples Received: 2021-12-09
Sampled by: Unknown
Report # : F22-03676
Order #: None
Aco # : C108
GC Testing Date: 2021-12-20

Sample condition: Average
Sub-contractor: None

Sample name: 21/12/5101-3

Method of test: TPH GC/MS (Hexane extraction - Aliphatic)*

Compound	Concentration (ppb)
C8	<2.5
C9	<2.5
C10	<2.5
C11	<2.5
C12	<2.5
C13	<2.5
C14	<2.5
C15	<2.5
C16	<2.5
C17	<2.5
C18	<2.5
C19	<2.5
C20	<2.5
C21	<2.5
C22	<2.5
C23	<2.5
C24	<2.5

Compound	Concentration (ppb)
C25	<2.5
C26	<2.5
C27	<2.5
C28	<2.5
C29	<2.5
C30	<2.5
C31	<2.5
C32	<2.5
C33	<2.5
C34	<2.5
C35	<2.5
C36	<2.5
C37	<2.5
C38	<2.5
C39	<2.5
C40	<2.5

TOG (mg/L)**	3

*Cx refers to the linear hydrocarbon of chain length x.
** Gravimetric (Also refered to as HEM)

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Date: 2021-10-21

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Test Report - VOC analysis

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Samples Received: 2021-12-09
Sampled by: Unknown
Report # : F22-03676
Order #: None
Aco # : C108
GC Testing Date: 2021-12-13

Sample condition: Average
Sub-contractor: None

Sample name: 21/12/5101-3

Method of test: VOC analysis in water and waste water

Compound	Concentration (ppb)
1,1-Dichloroethene	<10
trans-1,2-Dichloroethene	<10
cis-1,2-Dichloroethene	<10
MTBE	<100
1,1-Dichloroethane	<10
Trichloromethane	<10
Dichloromethane	<10
1,1,1-Trichloroethane	<10
Carbon tetrachloride	<10
1,2-Dichloroethane	<10
Benzene	<10
1,2-Dichloropropane	<10
Trichlororethene	<10
Bromodichloromethane	<10
Dibromochloromethane	<10
Methylcyclohexane	<10
trans-1,3-Dichloropropene	<10
Toluene	<10
cis-1,3-Dichloropropene	<10

Compound	Concentration (ppb)
1,1,2-Trichloroethane	<10
1,2-Dibromoethane	<10
Tetrachloroethene	<10
Chlorobenzene	<10
Ethylbenzene	<10
m+p-Xylene	<10
Bromoform	<10
Styrene	<10
o-Xylene	<10
1,1,2,2-Tetrachloroethane	<10
Isopropylbenzene	<10
1,3-Dichlorobenzene	<10
1,4-Dichlorobenzene	<10
1,2-Dichlorobenzene	<10
1,2-Dibromo-3-chloropropene	<10
1,2,4-trichlorobenzene	<10

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Date: 2021-12-14

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