GCS-RP/09/2021: GEOTECHNICAL AND DOLOMITE STUDY REPORT FOR THE PROPOSED CLAYVILLE FILLING STATION, GAUTENG PROVINCE.

Report Prepared for
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Carel de Beer

Executive Summary

Dollis Hill Eiendomme BK, contracted Geotechnical Consult Services (GCS) to conduct a Phase 2 geotechnical investigation for a proposed filling station complex on a plot 1597, Clayville Ext 22, Olifiantsfontein, Ekurhuleni Metropolitan Municipality, Gauteng Province.

This investigation form part of the Environmental Impact Assessment (EIA) Process for the proposed commercial development on the property. The development will consist of 300 000l capacity to store gasoline, diesel, and LP gas.The site is underlain by reworked residual transported soil as well as chert and dolomite of the Malmani Subgroup. . A north south trending syenite dyke traverse the site.

Two soil profile has been identified through the trial pit investigation:

- Profile1: fill and Reworked and weathered chert and dolomite and
- Profile 2: Thicker reworked weathered chert and dolomite

The percussion borehole drilled at the local gravimetric low did not intersect a sinkhole or any significant indication that a collapse structure or is present on the property. No groundwater was intersected to a depth of 34m. Excavatability across the site is soft to intermediate, the western portion of the site soft excavatability terminates at 1.5m. The eastern portion of the site is soft to at least 2.8m. The potential for collapse of side walls of deep excavations is moderate. Dry conditions were experienced in the trial pits. Construction materials should be sourced off site. No Present or past mining activities influence the site.

The geotechnical risk classification for the whole site is A2H2 and the NHBRC Classification is P(H1C1).

The inherent risk class for the site is Class 4 due to the medium risk for small and medium sinkholes and low risk for large sinkholes. The Dolomite Area Designation for the site is D3 and footprint investigations are required. The site investigation conducted is adequate in this regard. The land use classification of the site is **DEVELOPABLE with tolerable risk with respect to sinkhole or doline formation for a C3 commercial land use.**

It is recommended that the following be adopted:

- That the underground fuel storage tanks be installed in the area identified.
- The requirement with respect SANS 1936-3 be followed for the wet services and that the surface water run off on site be managed as required.

From a geotechnical perspective the site is suited for development of a filling station.

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LIST OF ABBREVIATIONS/ACRONYMS

Abbreviations/ Acronyms	Descriptions
%	Percent
°C	Degrees Celsius (Assumed dry bulb unless indicated otherwise)
FOS	Factor of Safety
earthquake	Seismic event induced by tectonics
km	kilometre
kPa	kilopascals
ℓ	Litres
ℓ/m^3	Litres per cubic metre
ℓ/s	Litres per second
m	metres
mamsl	metres above mean sea level
m/s	metres per second (velocity)
m^2	Square metres
m^3	Cubic metres
m^3/s	Cubic metres per second
MCE	Maximum Credible Earthquake
SPT	Standard Penetration Test
tremor	Mining induced seismicity
UCS	Uniaxial Compressive Strength

1. INTRODUCTION

1.1. TERMS OF REFERENCE

Dollis Hill Eiendomme BK, contracted Geotechnical Consult Services (GCS) to conduct a Phase 2 geotechnical investigation for a proposed filling station complex on a plot 1597, Clayville Ext 22, Olifiantsfontein, Ekurhuleni Metropolitan Municipality, Gauteng Province.

This investigation form part of the Environmental Impact Assessment (EIA) Process for the proposed commercial development on the property. The development will consist of 300 000l capacity to store gasoline, diesel, and LP gas.

1.2. SCOPE OF WORK

The scope of work for this project as per Proposal no: GCS/PR/09/2021 for a comprehensive assessment:

- Desktop assessment of soil and rock stratigraphy on the site
- Confirmation of soil and rock stratigraphy on site
- Identification of problem soils
- Assessment of the foundation conditions on site
- Evaluate the geotechnical land use and recommend the land use potential of the property at a scoping level Environmental Impact Assessment (EIA).
- Identification of dolomite stability risk
- Assessment of the land use potential

1.3. LIMITATIONS

The information provided in this specialist report is based on information provided by the client and or the client's representatives, published scientific literature, maps, and information published in the public domain and that collected by Geotechnical Consult Services during the site visit.

1.4. AUTHOR'S CREDENTIALS AND & DECLARATION OF INDEPENDENCE

The Author of this report, Carel J de Beer is a professional engineering geologist, registered with the South African Council of Natural and Scientific Professions (Pri. Sci. Nat # 400211/05). Carel has 25 years' experience in the mining and civil industries. He has work extensively on open pit mines where dolomite stability and dewatering of the aquifer below the mine and associated infrastructure was a significant part of his responsibility from 1997 to 2007. He has conducted dolomite stability investigations for urban development and solar parks in the

Thabazimbi, Lichtenburg, Zeerust and Erasmia Areas between 2007 and 2021. He is also a member if the South African institute of Rock Engineers.

The compilation of the report, and any other work done by Geotechnical Consult Services (GCS) for the Client Company, is strictly in return for professional fees. Payment for the work is not in any way dependent neither on the outcome of the work, nor on the success or otherwise of the Company's own business dealings. As such there is no conflict of interest in GCS undertaking the study as contained in this document.

1.5. STANDARDS AND REFERENCES

The following documents referenced are used as standards and guidelines for this investigation:

- SANS 633, Soil profiling and rotary percussion borehole logging on dolomite land in Southern Africa for engineering purposes.
- SANS 1936-1:2012, Development of dolomite land – Part 1: General principles and requirements.
- SANS 1936-2, Development of dolomite land – Part 2: Geotechnical investigations and determinations.
- SANS 1936-3, Development of dolomite land – Part 3: Design and construction of buildings, structures, and infrastructure.
- SANS 1936-4, Development of dolomite land – Part 4: Risk management.
- SANS 10400-H, The application of the National Building Regulations – Part H: Foundations
- SANS 10160-4: Basis of Structural Design and Actions for Buildings and Industrial Structures — Part 4: Seismic Actions and General Requirements for Building.

2. SITE INFORMATION

2.1. LOCATION AND LAND USE

The site is located north of the R562, on Axle drive opposite Consol Glass (Figure 1). The proposed filling station development is planned on a portion of land that is approximately 5100 m^2 in size.

Refer to figure 1 for the general location of the study area. The site is currently not is use but there are storage areas and an old LP gas tank on site.

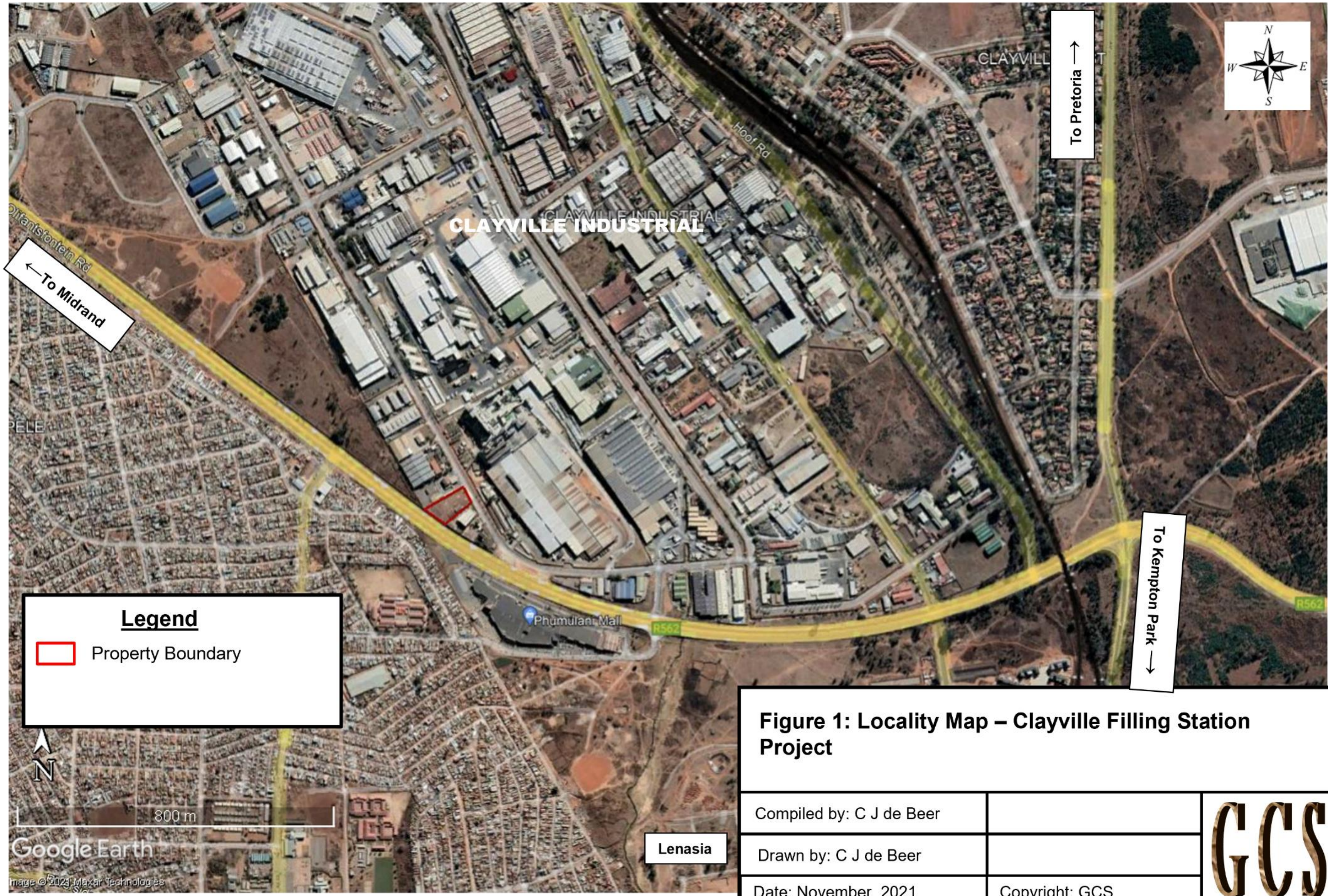

Figure 1: Locality Map – Clayville Filling Station Project		
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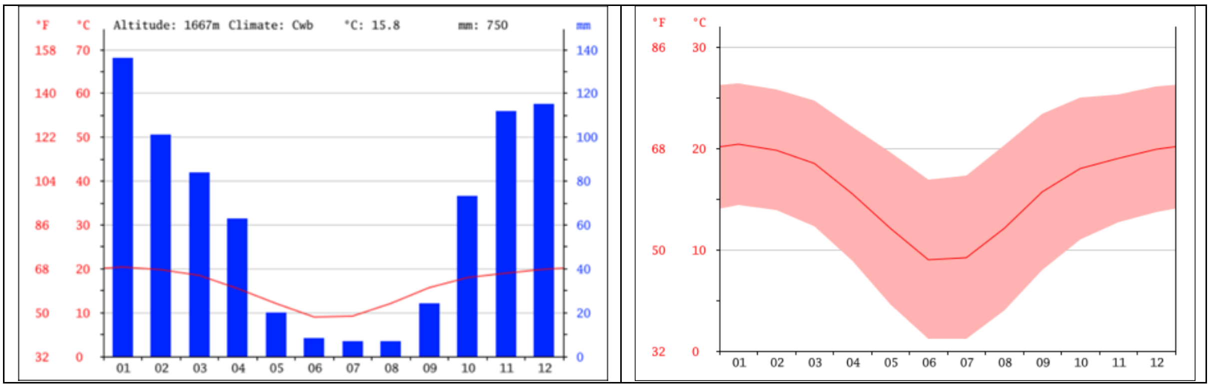
The new structures planned include a provision for 300 000 liters of fuel storage which will include above ground and underground storage facilities.

2.2. CLIMATE

Olifantsfontein, receives an average annual rainfall of 750 mm, occurring mostly in summer. It receives the lowest rainfall (7mm) in July and the highest (136mm) in January. The average midday temperatures for Soweto range from 9.0°C in June (winter) to 20.4°C in January (summer). The region is the coldest during July when the mercury drops to 1.2°C on average during the night.[1]

The climatic N-value for the area is 2.4.



GRAPH 1: CLIMATIC DATA SOWETO GAUTENG

2.3. TOPOGRAPHY AND DRAINAGE

The proposed development area is located on a valley floor, with an average elevation of 1535mamsl. The site is flat with a slight slope towards the east.

Surface drainage occurs as sheet wash towards the east. There is a stormwater drainage system along Axle Road. Natural drainage is northwards and eastwards towards the Hennops River. The site is located within the A21B quaternary catchment. Based on local water levels the groundwater level is generally deeper than 30m as seen from the dry borehole and the water levels in old quarries in the area.

[1] Climatic information obtained from www.saexplorer.co.za

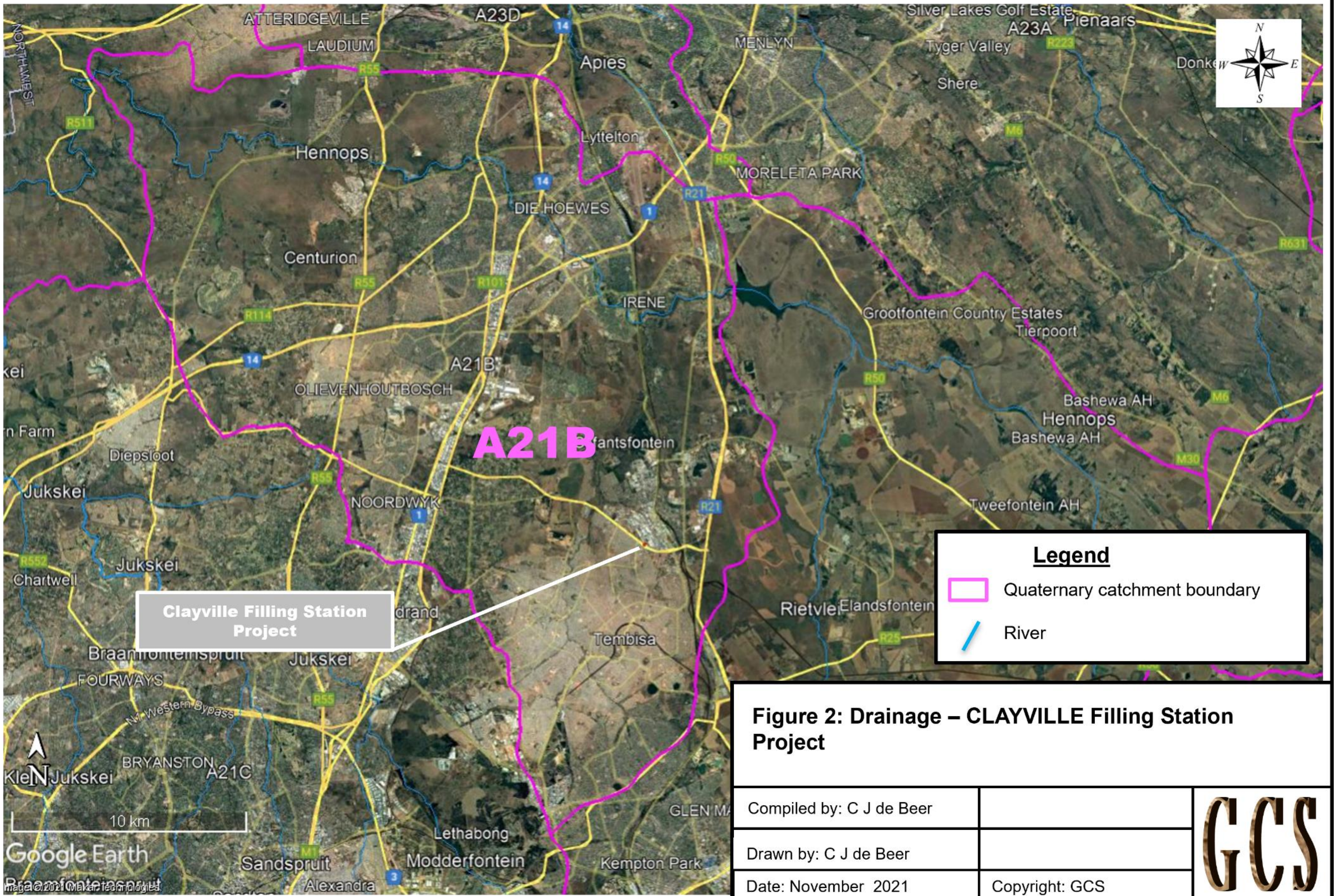


Figure 2: Drainage – CLAYVILLE Filling Station Project

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2.4. REGIONAL GEOLOGY

The site is underlain by dolomite and chert of the Malmani Subgroup (Vmd) (Figure 3). The carbonate rocks and chert of the Malmani Subgroup are considered to have formed as tidal flat deposits and exhibit a wide variety of algal structures and stromatolites. North south trending syenite dykes (S) are also present in the area. The well-known Pretoria Dyke which runs N-S from Pretoria to Tembisa is located west of the site. There are a number odf smaller ancillary dykes also present in the area. There smaller dykes have no surface expression and is difficult to identify on surface. and is generally not visible on surface as they tend to weather negative. No underground mining has been conducted in the area. There are a number of dolomite quarries in the general area but most of them is not actively mined at the moment.

2.5. ENGINEERING GEOLOGY

Although carbonate-related instability can take place in any karstic terrain, most of the incidents where sinkholes or dolines developed have been associated with the Chuniespoort Group. In all cases human induced triggering events such as point ingress of water (leaking pipes) and local or regional drawdown of groundwater levels, have been present.

Ancient carbonate rocks are predominantly composed of two minerals: calcite ($CaCO_3$) and dolomite ($CaMg(CO_3)_2$). When a carbonate rock is dominated by calcite (more than 95 %), it is called limestone. When it is dominated by dolomite (the mineral), it is called dolomite (the rock). Limestone is thus a chemical or biochemical sediment consisting essentially of calcium carbonate (CaCO3), primarily in the form of calcite, and minor constituents such as silica, feldspar, pyrite and siderite. Dolomite, as a rock, contains more than 90 % dolomite and less than 10 % calcite as well as detrital minerals and secondary silica (chert). Very few, if any, sedimentary dolomites are truly only $CaMg(CO_3)_2$, and are better represented as: $Ca_{(1+x)}Mg_{(1-x)}(CO_3)_2$, encompassing the spectrum from calcian to magnesian dolomites.

Rainwater (H_2O) takes up carbon dioxide (CO_2) in the atmosphere and soil (where the concentration of this gas can be up to 90 times greater than in the atmosphere) to form a weak carbonic acid (H_2CO_3). The slightly acidic groundwater circulating along tension fractures, faults and joints in the dolomite succession causes leaching of the carbonate minerals. The solubility of dolomite is high in comparison to other rocks, but significant solution cannot be observed over short periods (months and years). The process of dissolution can be represented as follows:

$$CaMg(CO_3)_2 + 2\ H_2CO_3 \rightarrow Ca(HCO_3)_2 + Mg(HCO_3)_2$$

The process of dissolution results in a vertically zoned succession of residual products which, in turn, are generally overlain by geologically younger formations or soils. Strong, unweathered dolomite bedrock is overlain by slightly weathered jointed bedrock and thereafter, through a sudden, dramatic transition, passes upwards to totally weathered and low strength, insoluble residual material consisting of mainly manganese oxides (wad), chert and iron oxides, that reflect the original insoluble matrix structure. Depending upon the local subsurface structure, this very low strength, porous and permeable horizon can, in certain locations, be up to several meters thick but is generally less than 10 m thick. With the passage of geological time, together with the downward progression of the intense weathering of the dolomite bedrock, compaction by the mass of the overlying materials results in a progressive densification of these low strength materials. Consequently, the vertical succession of the residual products of weathering reflects an upward increase in strength and a decrease in porosity and permeability. This process results in a decrease in overburden quality with depth which, in turn, leads to higher rates of penetration (often observed in drilling investigations) when the dolomite bedrock is approached. Infiltrating water from leaking services or surface accumulations acting on this low-density material, result in a loss of support through slumping or subsurface erosion.

Given sufficient time and the correct triggering mechanisms, instability might occur naturally but it is usually expedited by man’s activities. Instability can occur in the form of sinkholes and subsidence.

The primary triggering mechanism in such instances includes:

- the ingress of water from leaking water-bearing services,
- poorly managed surface water drainage, and
- groundwater level drawdown.
- Topography and drainage, the natural thickness and origin of the transported soils and residuum, the nature and topography of the underlying strata, the depth and expected fluctuations of the groundwater level, and the presence of structural features, such as faults, fractures and dykes, are all factors which influence the risk of subsidence taking place.

2.6. GEOHYDROLOGY

The site is located within the A21B Quaternary, and located to the east-central area of the quaternary the area has a number of dykes known as the East Rand dykes, the East-West Dykes and ‘other’ dykes with a ENE trend. As these dykes are generally considered to be mostly impermeable or having a low permeability, act as barriers to groundwater flow within Close to surface these dykes usually weathered and allow groundwater flow across dykes does occur, while at depth the dykes are considered to be essentially impermeable.

Numerous syenite sills and dykes, associated with the Pilansberg alkali volcanic event, are present in the lower formations of the Malmani Subgroup south of Pretoria. The most extensive syenite dyke, referred to as the Pretoria dyke, extends from Pretoria to Tembisa in the south.

FIG

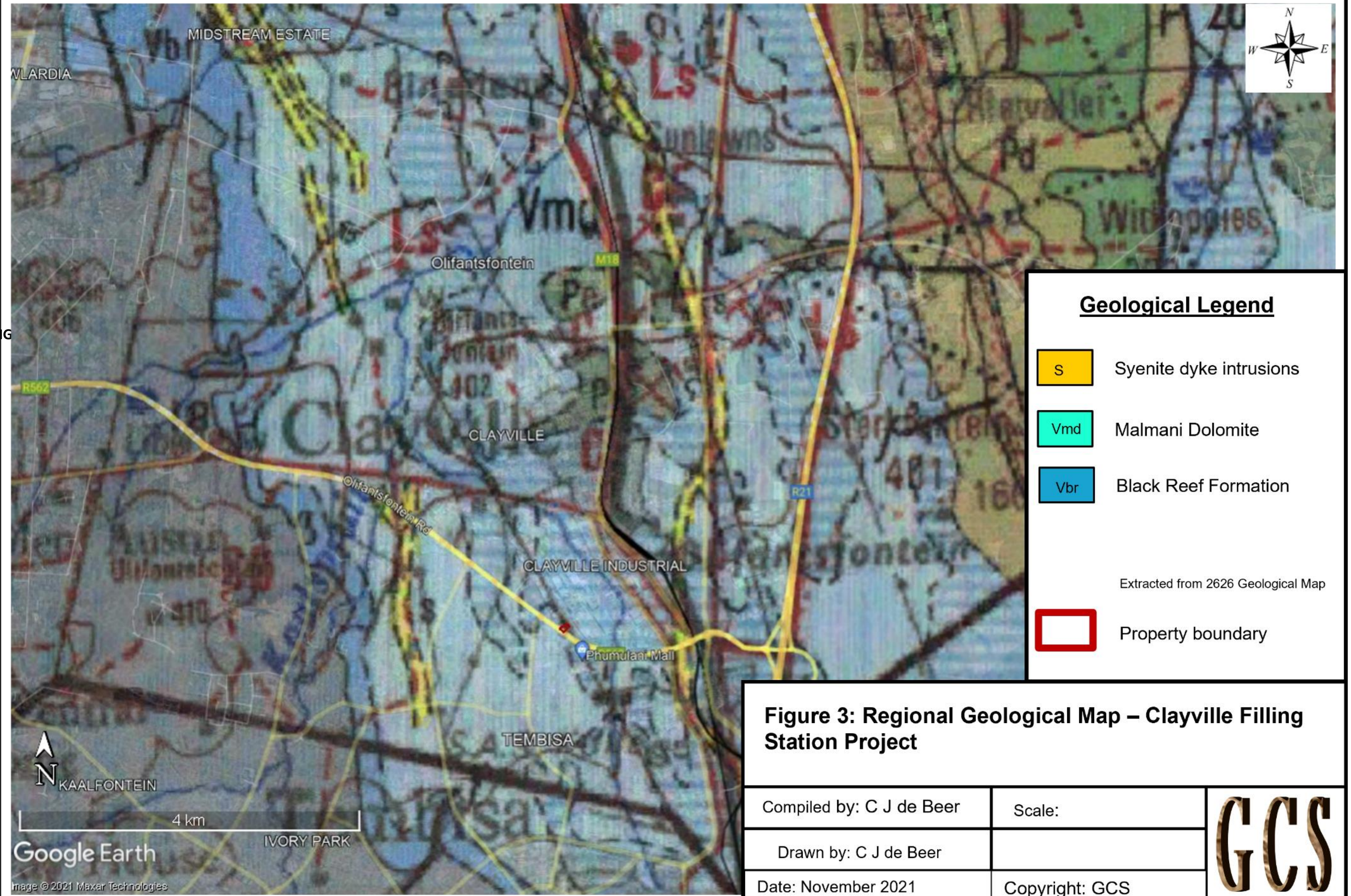

Figure 3: Regional Geological Map – Clayville Filling Station Project

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2.7. SEISMIC HAZARD

The Southern African region is known for its relative seismic stability. Only a small number of medium-intensity earthquakes have occurred since the 17th century.

On the other hand, between 40 and 60 tremors occur monthly, which occur primarily in the gold mining areas of Gauteng, North West and the Free State. Although the effects of these events are much less serious than those caused by larger earthquakes, extensive damage has occurred in one or two cases.

The seismically active areas in South Africa are broadly divided into two groups in SABS 0160 (1989), namely those where seismic activity is due to natural seismic events (Zone 1 areas), and those where it is predominantly due to mining activity (Zone 2 areas). It has been shown that mine tremors are not likely to produce any significant structural response in buildings with natural vibration frequencies of less than 2Hz. Stiff structures such as low-rise, load-bearing masonry structures are therefore influenced the most by mining tremors

With reference to the South African National standards document:

"SANS 10160-4: BASIS OF STRUCTURAL DESIGN AND ACTIONS FOR BUILDINGS AND INDUSTRIAL STRUCTURES — PART 4: SEISMIC ACTIONS AND GENERAL REQUIREMENTS FOR BUILDING"

The SANS 10160-4 document define seismic zones applicable to South Africa. Two zones are identified, namely:

a) Zone I: Natural seismic activity and

b) Zone II: Regions of mining-induced and natural seismic activity.

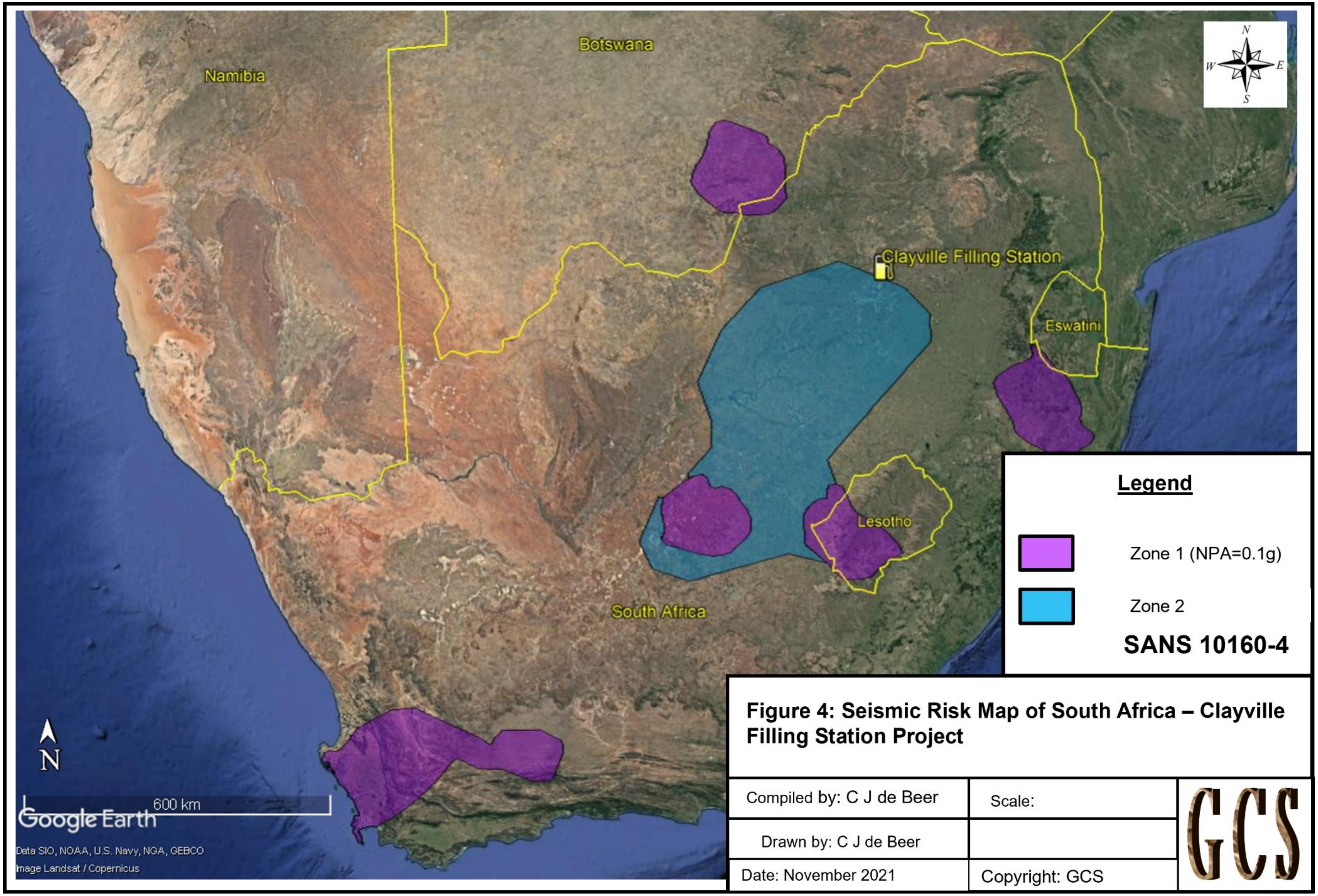

Figure 4: Seismic Risk Map of South Africa – Clayville Filling Station Project

NOTE: The above zones (Figure 4) are determined from the seismic hazard map which presents the peak ground acceleration with a 10% probability of being exceeded in a 50-year period. It includes both natural and mining-induced seismicity).

Reference peak ground acceleration is defined for buildings located in Zone 1. Buildings of Importance Class I, II and III (Table 1) in Zone II need only comply with the minimum requirements for structural and non-structural components and with the requirements for ties, continuity and anchorage, all as detailed in clause 9. Buildings of Importance Class IV in Zone II shall be treated as buildings located in Zone 1.

TABLE 1: SEISMIC RISK CLASSES

Importance Class	Buildings	Importance factor Υ_i
I	Buildings of minor importance for public safety, e.g. agricultural buildings, ect.	0.8
II	Ordinary buildings, not belonging to the other categories	1.0
III	Buildings for which seismic resistance are of importance in view of the consequences associated with the collapse, e.g. schools, assembly halls, cultural institutions, ect.	1.2
IV	Buildings for which integrity during earthquakes is of vital importance for protection, e.g. hospitals, fire stations, power plants, ect	1.4
Note: The numbering of importance classes differs from those in the Eurocode where from these definitions were taken.		

The proposed site is situated inside Zone 2 area where mine induced tremors from the Gold Mining District are experienced (Figure 4). Therefore, no provision has to be made for seismic loading in the design of the structures or foundations.

3. DATA COLLECTION

3.1. DESKTOP STUDY

During the desktop study all the available information was collected and used to compile field maps and design the field investigation. Information obtained from the Council of geoscience shows that there were no dolomite studies done on the property in the past. A field map was compiled for the fieldwork stage from Google Earth images, site plans, and the 1:250 000 (2628 Easr Rand) Geological Map.

Groundwater and quaternary information were collected from the national groundwater database and the Chart program of the Department of Water affairs.

3.2. FIELDWORK

The fieldwork of the Phase 1 investigation consisted of:

- Soil profiling
- A gravimetric survey and
- Percussion drilling at identified gravity low areas.

The gravimetric survey was conducted first on 5 May 2021. The percussion drilling were done on Tuesday 17 May after the gravimetric survey data were analyzed. The soil profiling was conducted on 18 September 2021, refer to figure 5 for the trial pit positions.

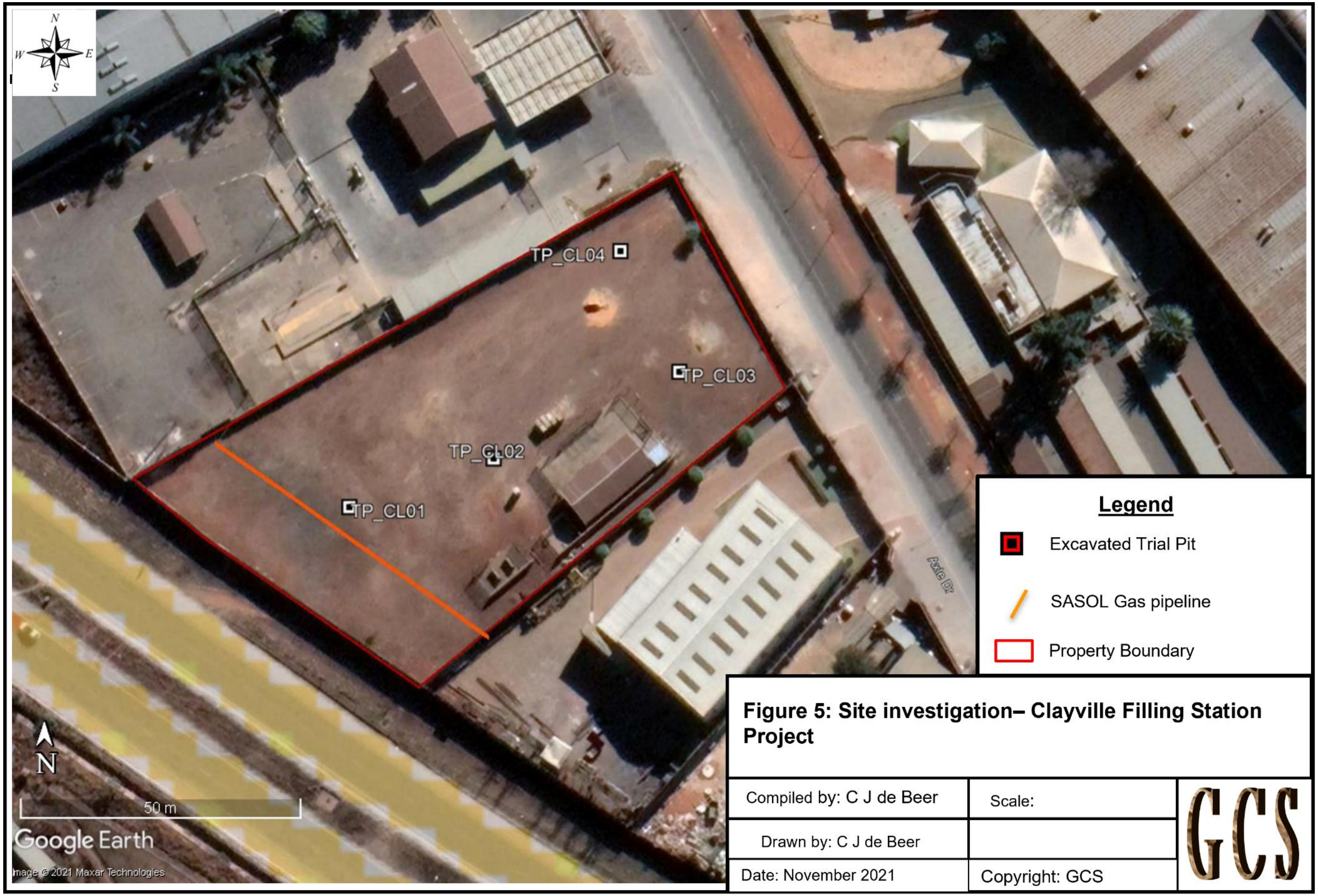

Figure 5: Site investigation– Clayville Filling Station Project

3.2.1. Gravimetric Survey

Geofocus conducted a gravity survey over the footprint area defined. Gravity data were acquired over a 5m grid across the area.

Gravity was observed with a Scintrex CG5 gravimeter whilst a Javad DGPS recorded station locations. Gravity data processing procedures commonly used for dolomite studies were applied, firstly reducing the data to relative Bouguer values by applying elevation, terrain and Bouguer corrections. Secondly, an estimation of the regional gravity field, calculated through linear regression, was removed from the relative Bouguer gravity to produce a provisional residual Bouguer gravity map emphasizing local changes. These steps assume that 1) the bedrock is flat lying and 2) has a homogenous density. The distribution and magnitude of variations between bedrock head intersections and the residual Bouguer gravity data are what highlights problem areas. Subtle variations can either be attributed to 1) a more undulating bedrock topography, 2) variations in bedrock density or both.

Using an elevation correction and a theoretical gravity gradient of 0,189 and 0,00065mGals per meter, respectively. A residual map was created by subtracting a constant from the Bouguer data so that the maximum gravity values are less than zero. Large discrepancies highlight problem areas such as dolomite dissolution and/or karst formation.

Refer to figure 6 for the gravimetric survey results relative to the proposed infrastructure.

3.2.2. Rotary Percussion Drilling

The contours on the residual gravity map results of a gravity survey undertaken by Geofocus were used to position a percussion borehole on the local gravity low anomaly in the north central portion of the site

The borehole was drilled by JK Drilling and the although the borehole was planned to 60m the hole was terminated 6m into solid dolomite at 34m.

The position as indicated in Figure 8 was recorded with a hand-held GPS and appear in **Error! Reference source not found..** The borehole drilling progress and samples were described according to SABS Standards Division (2012. SANS 633). The borehole profiles are included in Appendix 4. The borehole was back filled after completion.

3.2.3. Soil Profiling

A total of seven trial pits were excavated using a CAT 420D tractor-loader-back-actor (TLB). See Figure 5 and Table 2 for the positions of all the trial pits used to define the soil profiles. The different soil horizons encountered in the trial pit was described using the moisture, color, consistency, structure, soil type and origin (MCCSSO classification system), standard descriptors. The soil profiles are presented in.

TABLE 2: LIST OF TRIAL PIT AND BOREHOLE POSITIONS WITH COORDINATES

Position	Lat (S)	Long	Elev
	decimal degr.	decimal degr.	mamsl
TP_CL01	25.973228°	028.227411°	1180
TP_CL02	25.973128°	028.22718°	1180
TP_CL03	25.973019°	028.228052°	1180
TP_CL04	25.972812°	028.227899°	1180
Borehole	25.973077°	28.227489°	1180

One representative disturbed soil sample was collected from the potential problem soil horizon encountered.

3.2.4. LABORATORY TESTING

The following laboratory tests were conducted by RoadLab, a civil engineering materials laboratory in Germiston, on the two selected disturbed soil samples collected from the trial pits:

- Grading analysis, including hydrometer tests (particle size distribution)
- Determination of Atterberg limits (shrinkage limit, plastic limit and liquid limit)

Results of the above-mentioned tests were interpreted and used to substantiate a description of the site’s geotechnical condition.

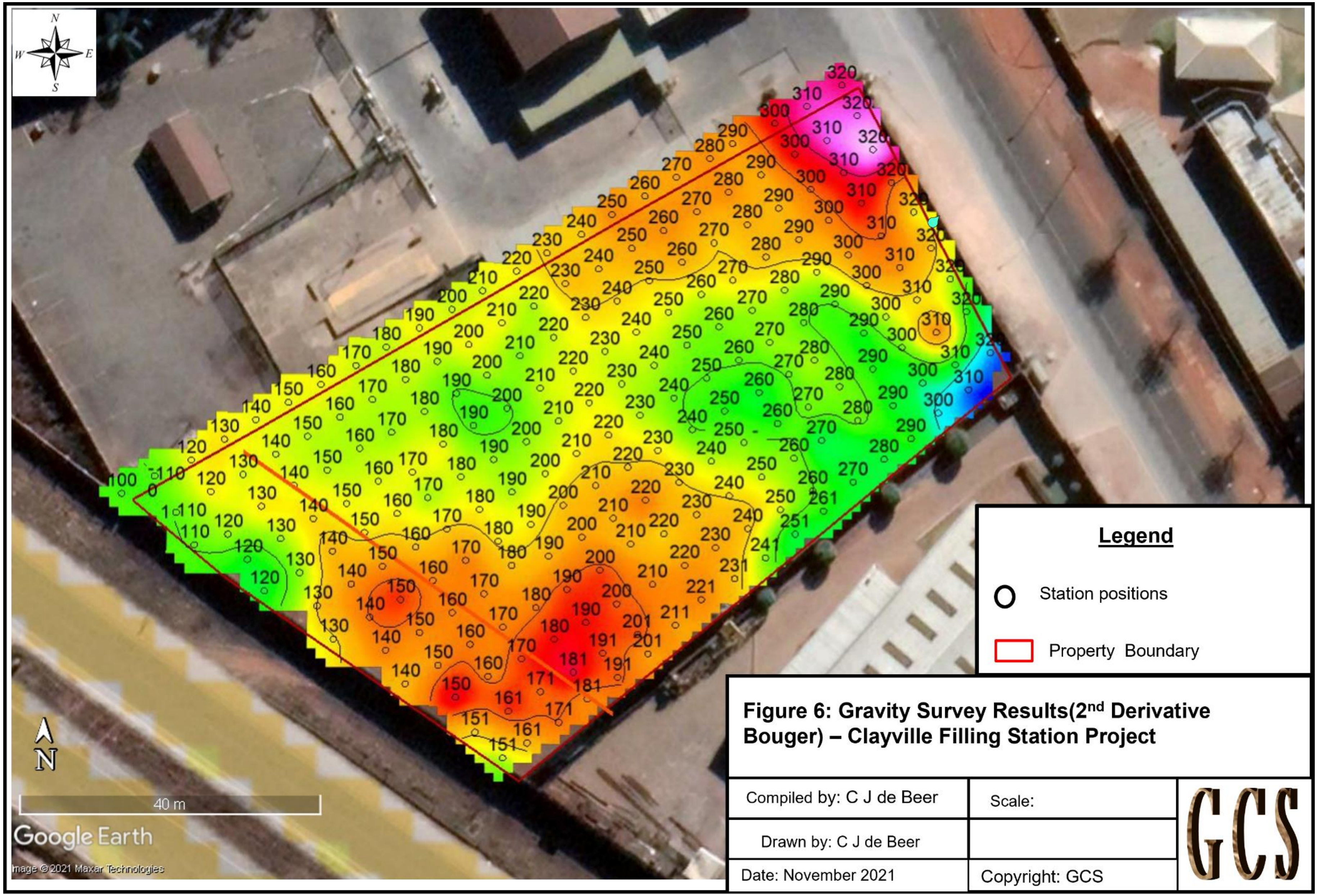

Figure 6: Gravity Survey Results(2nd Derivative Bouger) – Clayville Filling Station Project

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4. SITE INVESTIGATION RESULTS

4.1. SOIL PROFILES

The area where the filling station is proposed is underlain by sub outcrop of weathered shale (profile 1) and deeper weathered shale and transported soil as encountered in trial pit BS-07 as defined in (Figure 7).

Refer to Appendix A for the soil profiles encountered in the four trial pits.

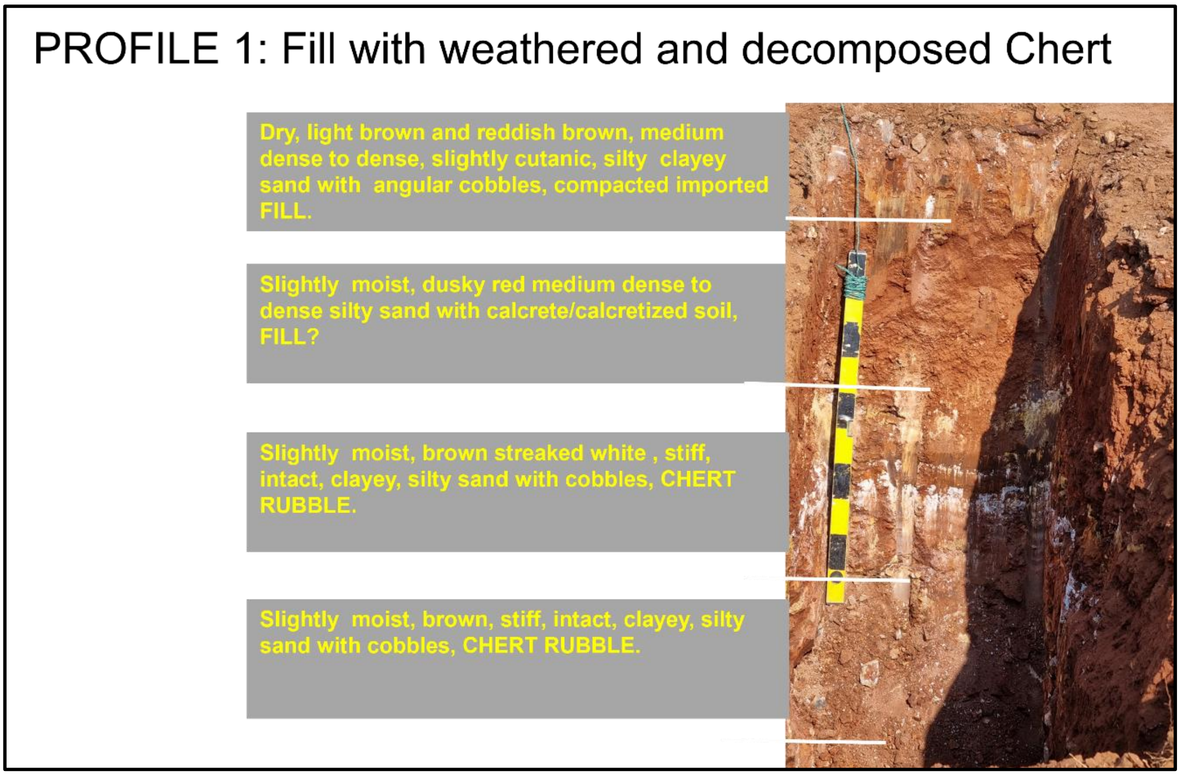

PHOTO 1: SOIL PROFILE; PROFILE 1

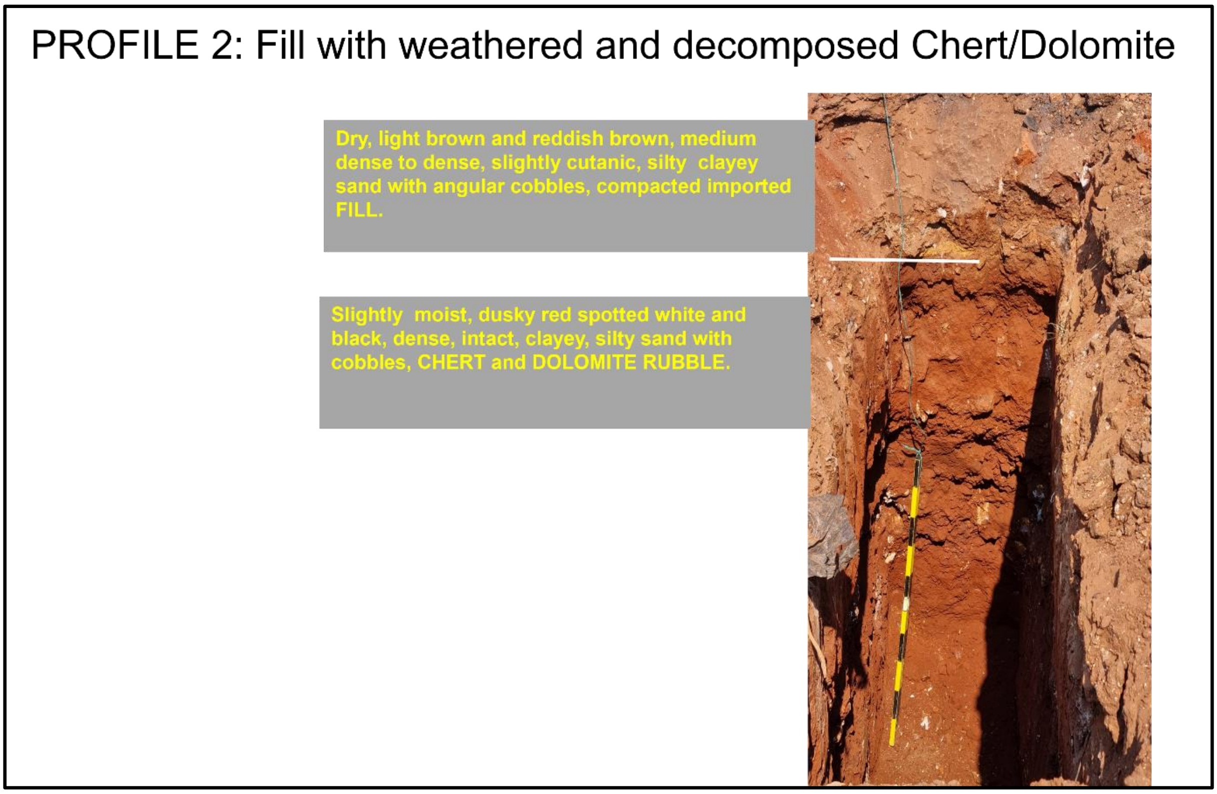

PHOTO 2: SOIL PROFILE PROFILE 2

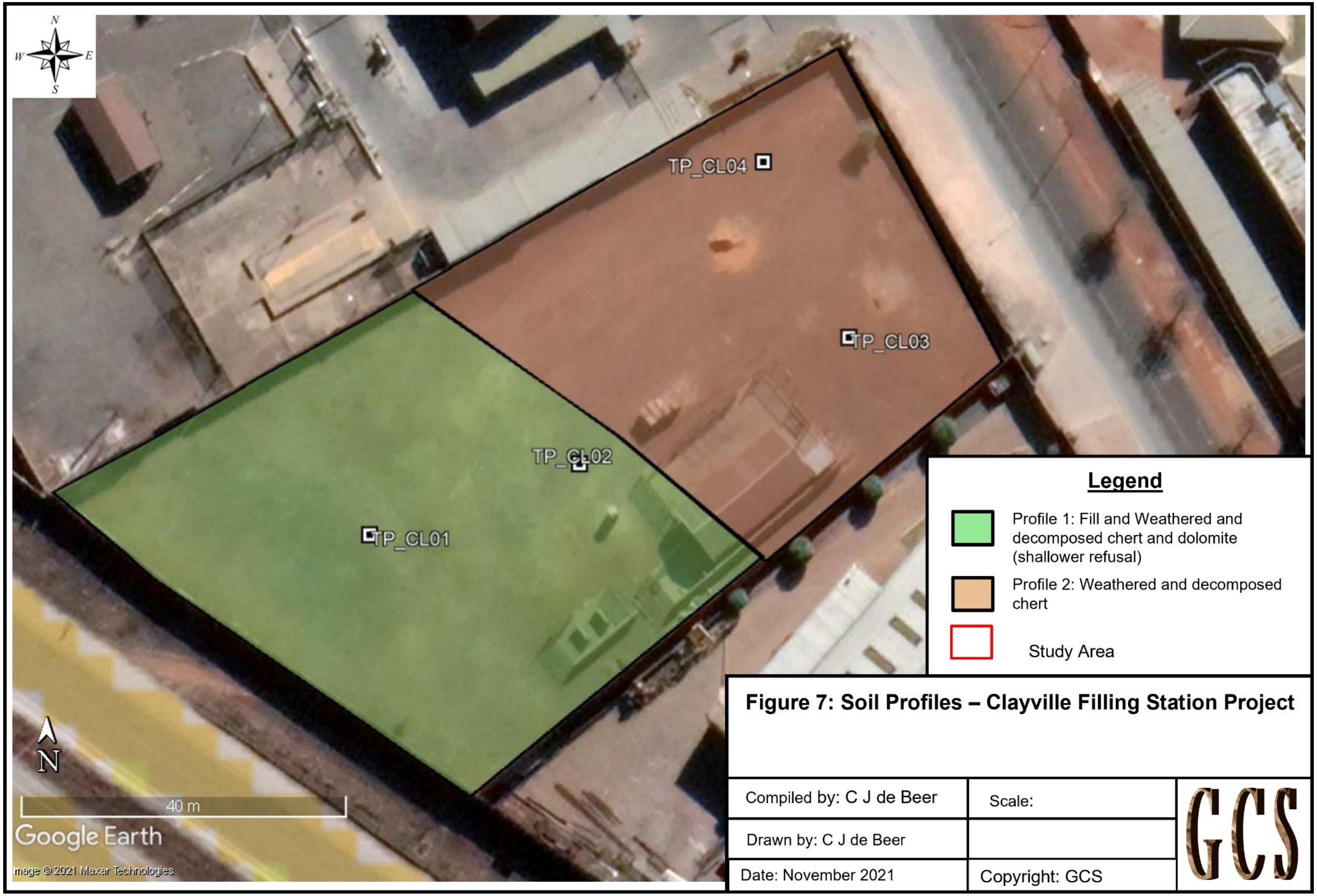

Figure 7: Soil Profiles – Clayville Filling Station Project

4.2. DCP TEST RESULTS

DCP test were planned but due to cobble and boulder sized fragments in the profile premature refusal was encountered

4.3. GEOPHYSICAL SURVEY

The median elevation of the survey area is approximately 1,583masl with a low relief differential. A 1st order approximation of the regional gravity field was removed from the relative Bouguer data, resulting in a residual Bouguer gravity dataset with peak-to-peak distribution of approximately 0.58 mGal (Figure 6).

The Residual Bouguer data were corrected by applying a shift so that the gravity values on average present bedrock deeper than 26m (Figure 8). The variation in residual Bouguer gravity is likely caused by variations in density, topographic and/or geology of the underlying formations. No open voids were intersected up to 34m below surface at the lowest density area on the site as determined by drilling a borehole to 6m into the solid dolomite at the at the local gravimetric low on the property . See figure 7 and 8.

4.4. PERCUSSION DRILLING RESULTS

The borehole was planned to 60m and aimed at investigating the low-density area identified in the gravimetric survey. As the drilling progressed weathered dolomite and chert were observed below the fill up to 6m from where reddish yellow to dark yellow, very weak rock, decomposed weathered syenites was encountered to 20m. From 20m no moisture, were observed in the sample Weathered chert and dolomite were observed from 24m and unweathered dolomite from 28m. The hole was terminated 6m into solid dolomite at 34m.

Refer to photo3 for the drill chips and Appendix 4 for the borehole log of borehope HB01 drilled at the gravity low on the Clayville site.

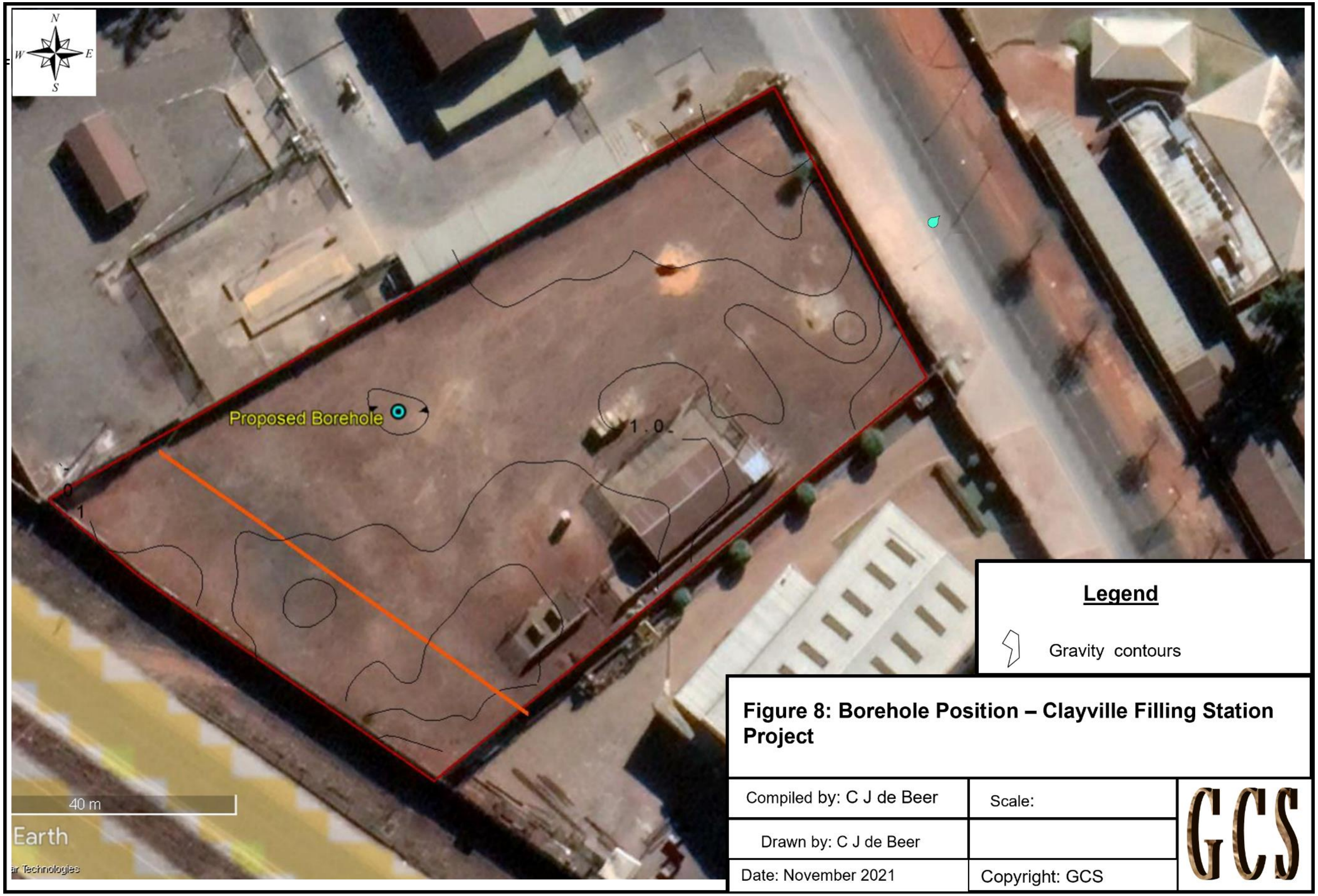

Figure 8: Borehole Position – Clayville Filling Station Project

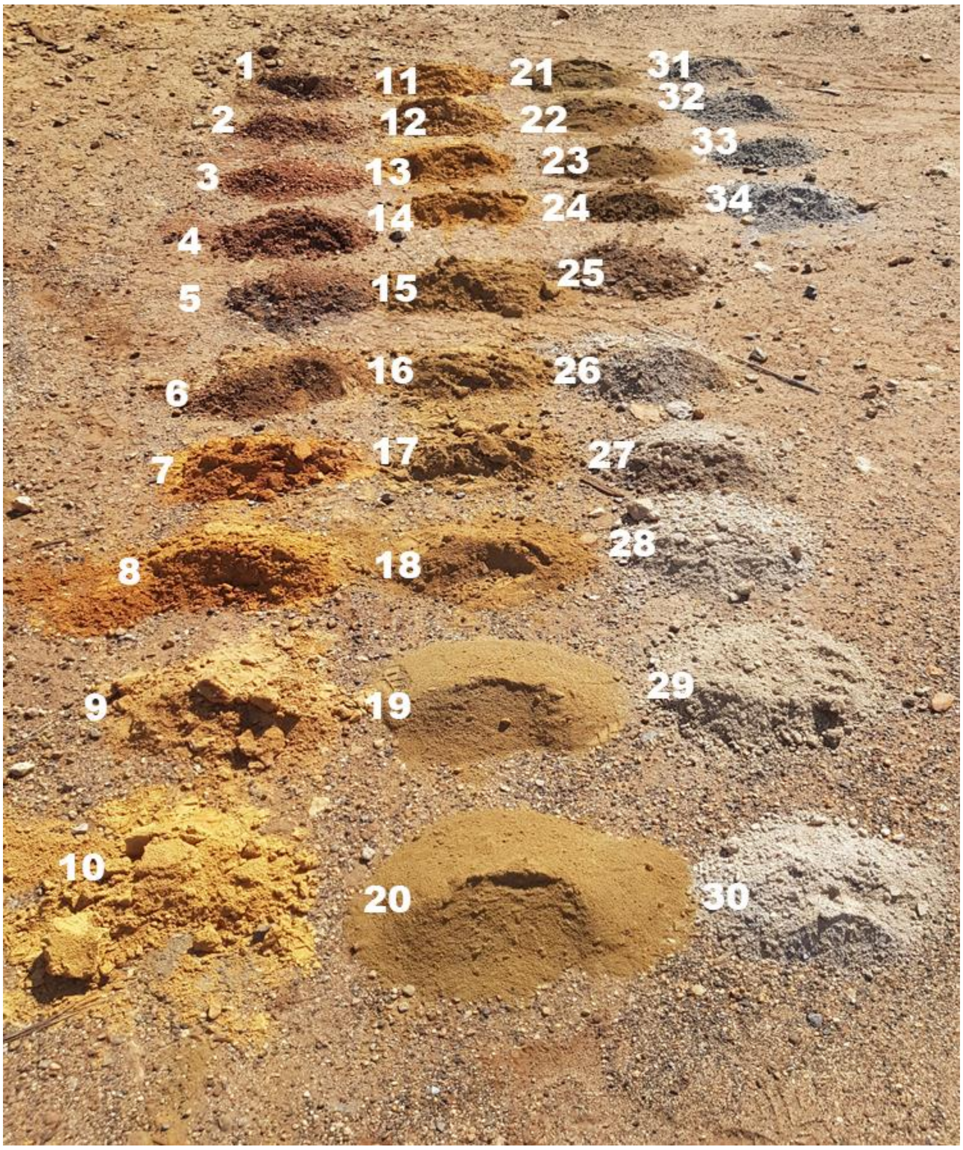

PHOTO 3: BOREHOLEBS_BH_01 PROFILE.

Refer to Appendix 4 for the geotechnical log.

4.5. RESULTS OF THE LABORATORY TESTING

The results of the laboratory testing conducted on the soil sample collected from TP03 are summarized in Table 3 below. The laboratory results are presented in Appendix 3.

TABLE 3: SUMMARY OF LABORATORY RESULTS

Sample nr	Sample Point	Depth (m)	Indicator tests				Material Type1	Unified Soil Classification	Soil Expansiveness	Soil Collapsi-bility	Soil Permeability (cm.s-1)	pH	Electrical Conductivity @ 25°C
			Clay %	Atterberg Limits									
				LL	PI	L S(%)							
CL_TP 3	CL_TP 3A	1.0-1.2	13.9	23	6	3	Dark red silty gravelly silty sand	CL&ML	Low	low	$4x\ 10^{-4}$	5.67	40

1 According to the Revised Standard on the Unified Soil Classification System

2

5. GEOTECHNICAL SITE EVALUATION

The proposed development may have impacts on the geo-environment which may directly or indirectly affect the other environmental processes. This report focused on the soil and bedrock, but excludes features such as caves, addits, middens worship rocks etc., which are important as historical, cultural, archeological or religious heritage sites. Important or prominent geological features (Geo-sites) that contribute to the aesthetic scenery or geological interest such as fossil sites, prominent rock outcrops or features are also considered in this study. The expected geotechnical impacts and conditions are also presented in this section.

5.1. PROBLEM SOILS

All soils will exhibit a degree of consolidation related settlement when and as subjected to loads exceeding their normal consolidation or pre-consolidation pressures. Resulting re-arrangement of soil particles is progressive and the expulsion of air or water results in surface settlement movements, as localized volume reduction occurs.

The clayey sediments associated with profiles 1 have a moderate dry density as seen from the DCP test. These gravelly sandy silty clay soil prone to exhibit a collapsible grain structure but with a linear shrinkage of 3 will only have a low heave potential. The foundation conditions and NHBRC Classification based on problem soil types is discussed later in this section.

5.2. EXCAVATABILITY AND INSTALLATION OF SERVICES

Using the COLTO standard excavatability classification where the soil and or rock is classified as hard (boulders larger than $0.1m^3$, blasting or pneumatic and Mechanical rock breaking tools required) or soft (all other conditions).

The excavatability across the site is soft to intermediate with the soft excavatability terminating at a shallower level ,approximately 1.5m, on the western half of the site while the excavatability of the soft material extend to 3.2m in the eastern portion of the site as defined in figure 9.

The proposed installation of the underground fuel storage tank is between 3.5 and 3.8m. The potential for collapse of side walls of deep excavations is moderate, if left open for extended periods. It is recommended that the sidewalls be battered back to a 1:1.5 grade slope or shored in excavations deeper than 1.5m to comply with minimum safety regulations.

5.3. SHALLOW GROUNDWATER

The soil profile encountered in the trial pits were dry. No groundwater was encountered in the borehole either to a depth of 34m.

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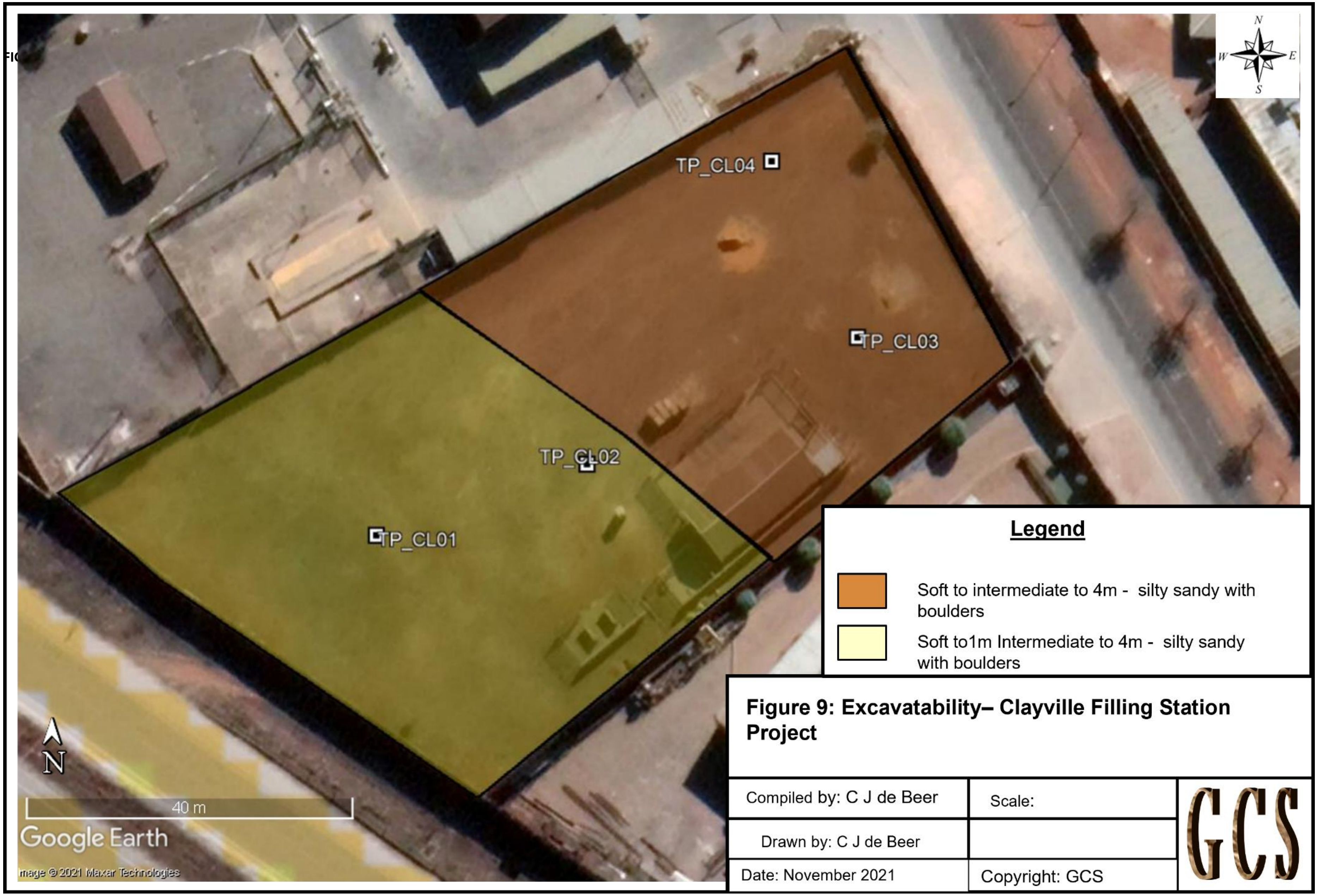

Figure 9: Excavatability– Clayville Filling Station Project

5.4. CONSTRUCTION MATERIALS

The soil and weathered rock present on site are not expected to be suitable for use as construction materials. Construction materials should be sourced off site from commercial suppliers.

5.5. MINING

No current or past mining activities impact the proposed filling station site.

5.6. FLOODING RISK

The study area is located well above the flood levels of the local drainage east of the site.

5.7. GEOTECHNICAL RISK ASSESSMENT AND NHBRC SITE CLASS DESIGNATION

Based on information collected on site and tests conducted, the soil profile encountered on site areas were evaluated and classified according to the geotechnical classification for urban development (proposed by Partridge, Wood and Brink) as summarized in Table 4 below.

The NHBRC Site class designation and proposed foundation solutions for single story buildings are summarized in Table 5.

TABLE 4: GEOTECHNICAL RISK CLASSIFICATION FOR URBAN DEVELOPMENT

CONSTRAINT		MOST FAVORABLE (1)	INTERMEDIATE (2)	LEAST FAVORABLE (3)
A	Collapsible Soil	Any collapsible horizon or consecutive horizons totaling a depth of less than 750 mm in thickness*	Any collapsible horizon or consecutive horizons totaling a depth of more than 750 mm in thickness*	A least favorable situation for this constraint does not occur
B	Seepage	Permanent or perched water table more than 1.5m below ground surface	Permanent or perched water table less than 1.5m below ground surface	Swamps and marches
C	Active Soil	Low soil-heave anticipated*	Moderate soil-heave anticipated	High soil-heave potential anticipated
D	Highly Compressible Soil	Low soil compressibility anticipated*	Moderate soil compressibility anticipated	High soil compressibility anticipated
E	Erodibility of Soil	Low	Intermediate	High
F	Difficult to excavate to 1.5m depth	Scattered or occasional boulders. Less than 10% of volume*	Rock or hardpan pedocretes between 10% and 40% of the total volume	Rock or hardpan pedocretes more than 40% of the total volume
G	Undermined Ground	Undermining at a depth greater than 240m below surface (except where total extraction mining has not occurred	Old undermined areas to a depth of 90 – 240 m below surface where stope closure has ceased	Mining within less than 90-240 m from surface or where total extraction mining has taken place
H	Stability (Dolomite and Limestone	Possibly stable. Areas of dolomite overlain by Karoo rocks or intruded by sills. Areas of Black Reef Rocks. Anticipated Inherent risk class 1	Potentially characterized by instability. Anticipated inherent Risk Classes 2-5	Known sinkholes and dolines in the area. Anticipated Inherent Risk Classes 6-8
I	Steep slopes	Between 2 and 6 degrees	Slopes between 6 and 18 degrees and less than 2 degrees (Natal and Western Cape) Slopes between 6 and 12 degrees and less than 2 degrees (all other regions)	More than 18 degrees (Natal and Western Cape) More than 12 degrees (all other regions)
J	Areas of unstable natural Slopes	Low Risk	Intermediate risk	High Risk (especially in areas subject to Seismic activity)
K	Areas subject to Seismic Activity	10% probability of an event less than 100 cm/s^2 within 50 years	Mining induced seismicity more than 100cm/s^2.	Natural Seismic activity more than 100 cm.s^2.
L	Areas subjected to flooding	A most favorable situation for this constraint does not occur	Areas adjacent to a known drainage channel or floodplain with a slope of less than 1%	Areas within a known drainage channel or floodplain

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

TABLE 5: NHBRC SITE CLASS DESIGNATIONS

Typical Founding Material	Nature of founding material	Expected range of total soil movements (mm)	Assumed differential movement (% of total)	Site Class Designation	Single Storey Masonry House Foundation Recommendation
Rock (excluding mud rocks which might exhibit swelling to some depth)	Stable	negligible	-	R	Normal Strip foot
Fine-grained soils with moderate to very high plasticity (clays, silty clays, clayey silts and sandy clays)	Expansive soils	< 7,5	50	H	Normal Strip foot
		7,5 to 15	50	H1	Modified Normal/ Soil Raft
		15 to 30	50	H2	Stiffened or cellular raft / pile of spit construction / soil raft
		> 30	50	H3	Stiffened or cellular raft / piled construction / soil raft
Silty sands, clayey sands, sands, sandy and gravelly soils	Compressible and potentially collapsible soils	< 5	75	C	Normal
		5 to 10	75	C1	Modified normal/ compaction of in situ soils below individual footings / deep strip foundations / soil raft
		> 10	75	C2	Stiffened strip footings, stiffened or cellular raft / deep strip foundations / compaction of in situ soils below individual footings / piled or pier foundations / soil raft
Fine-grained soils (clayey silts and clayey sands of low plasticity), sands, sandy and gravelly soils	Compressible soils	< 10	50	S	Normal
		10 to 20	50	S1	Modified normal/ compaction of in situ soils below individual footings / deep strip foundations / soil raft
		> 20	50	S2	Stiffened strip footings, stiffened or cellular raft / deep strip foundations / compaction of in situ soils below individual footings / piled or pier foundations / soil raft
Contaminated soils, controlled fill, dolomite land, landslip, landfill, marshy areas, mine waste fill, mining subsidence reclaimed areas, uncontrolled fill, very soft silts/silty clays	Variable	Variable		P	variable

The site is classed according to the Geotechnical Land Use Classification and the results is presented in Table 6 below.

5.7.1. Profile 1, Weathered hillwash and weathered dolomite

For the natural soil profile consisting of transported soil and weathered and decomposed shale overlying dolomite at depth, the geotechnical risk for all constraints is class A2H2 due to the potential collapsible nature of the soil profile and the underlying dolomite (Table 6).

TABLE 6: GEOTECHNICAL RISK ASSESSMENT FOR PROFILE 1

Constraint		Site condition	Class
A	Collapsible soil	Any collapsible horizon or consecutive horizons totaling a depth of more than 750 mm in thickness*	2
B	Seepage	Permanent or perched water table more than 1.5 m below the ground surface	1
C	Active soil	Low soil heave potential anticipated	1
D	Highly Compressible soil	Low soil compressibility anticipated	1
E	Erodibility of soil	Low	1
F	Excavatability to 1.5 m	Scattered or occasional boulders. Less than 10% of volume	1
G	Undermined ground	Undermining at a depth greater than 240 m below surface (except where total extraction mining occurred)	1
H	Stability (dolomite and limestone)	Known sinkholes and dolines in the area. Anticipated Inherent Risk Classes 2-5	2
I	Steep slopes	Slopes are between 2 and 6 degrees	1
J	Unstable Natural Slopes	Low risk	1
K	Seismicity	10% probability of an event less than 100cm/s occurs within 50 years	1
L	Areas subjected to flooding	Potential for flooding is low	1

5.7.2. Profile 2, Weathered hillwash and weathered dolomite

Although Profile area 2 has a thicker weathered. Hilwash profile the geotechnical classification remains the same; For the natural soil profile consisting of transported soil and weathered and decomposed shale overlying dolomite at depth, the geotechnical risk for all constraints is class A2H2 due to the potential collapsible nature of the soil profile and the underlying dolomite.

TABLE 7: GEOTECHNICAL RISK ASSESSMENT FOR PROFILE 2

Constraint		Site condition	Class
A	Collapsible soil	Any collapsible horizon or consecutive horizons totaling a depth of more than 750 mm in thickness*	2
B	Seepage	Permanent or perched water table more than 1.5 m below the ground surface	1
C	Active soil	Low soil heave potential anticipated	1
D	Highly Compressible soil	Low soil compressibility anticipated	1
E	Erodibility of soil	Low	1
F	Excavatability to 1.5 m	Scattered or occasional boulders. Less than 10% of volume	1
G	Undermined ground	Undermining at a depth greater than 240 m below surface (except where total extraction mining occurred)	1
H	Stability (dolomite and limestone)	Known sinkholes and dolines in the area. Anticipated Inherent Risk Classes 2-5	2
I	Steep slopes	Slopes are between 2 and 6 degrees	1
J	Unstable Natural Slopes	Low risk	1
K	Seismicity	10% probability of an event less than 100cm/s occurs within 50 years	1
L	Areas subjected to flooding	Potential for flooding is low	1

5.8. NHBRC Foundation Design Guidelines

The soil profile encountered on site is classified according to the NHBRC Site Classification based on the trial pit profiles and the laboratory test results. The transported soil has a moderate collapse potential and also minor heave potential and the occurrence of dolomite at depth and the recommended foundation solutions are defined as follows (Table 8):

TABLE 8: NHBRC FOUNDATION RECOMMENDATIONS

Soil Profile	NHBRC Site Class	Recommended foundation Solution
Profile 1	{H1C1} P (Dolomite)	Modified normal/ compaction of in situ soils below individual footings / deep strip foundations / soil raft, with light reinforcing is recommended

Figure 10: Geotechnical Risk Classification – Clayville Filling Station Project

5.9. DOLOMITE STABILITY ASSESSMENT

5.9.1. INHERENT DOLOMITE RISK EVALUATION

Postulated mechanisms of sinkhole and doline formation involve different processes, geological settings and agents.

The sinkhole and doline formation mechanism postulated by Buttrick et al (2001) consist of the following elements:

- Blanketing layer
- Receptacles
- Mobilization and mobilization agents
- Maximum potential development space
- Groundwater level
- Bedrock morphology

The hazard to urban development resulting from the formation of sinkholes or dolines is related to the maximum potential development space the structure can or will occupy.

Blanketing layer: Dolomitic overburden comprises all the materials occurring between the ground surface and the dolomitic bedrock surface. It typically includes residual dolomitic soils (wad and chert rubble), fresh and weathered intrusive sills, layers of Karoo sedimentary rocks and Quaternary deposits. The term blanketing layer, however, is defined here as that component of the dolomitic overburden that overlies the potential receptacles. Figure 1 depicts two blanketing layers, one of which (1a)comprises the full thickness of dolomitic overburden, while the other (1b) is relatively thin and overlies interconnected openings within the overburden.

Receptacles: Receptacles may occur either as small disseminated and interconnected openings in the overburden (especially where chert rubble is present), or as substantial openings (cavities) in the bedrock. Both types of openings may be able to receive mobilized (transported) materials from overlying horizons.

Mobilization and mobilizing agents: In the dolomitic context, mobilization is defined as the movement of dolomitic overburden by subsurface erosion. Mobilizing agents include ingress water, ground vibrations, water level drawdown or any activity or process that can induce mobilization of the material within the blanketing layer under the force of gravity. In a non-dewatering scenario the static ground water level is not an agent but a positive, mitigating factor.

Maximum potential development space: The maximum potential development space is a simplified estimation of the maximum size sinkhole that can be expected to develop in the particular profile, provided that the available space is fully exploited by a mobilizing agency . The available space depends on the depth below ground surface to the throat of a receptacle or disseminated receptacle and the 'angle-of-draw' in the various blanketing materials.

Table 9: Sinkhole sizes (after Buttrick & Van Schalkwyk, 1995)

Maximum Potential Development Space	Maximum diameter of surface manifestation (m)	Size Class
Small potential development space	<2	Small sinkhole
Medium potential development space	2-5	Medium size sinkhole
Large Potential Development space	5-15	Large sinkhole
Very large potential development space	>15	Very Large sinkhole

The method utilized to assess the stability and to zone this site is outlined in the paper: "Proposed method for dolomite land hazard and risk assessment in South Africa." By Buttrick, Van Schalkwyk, Kleywegt and Watermeyer 2001, Journal of the South African Institution of Civil Engineering, Volume 43, Number 2.

The predominant mobilizing agencies considered in this investigation are major groundwater level fluctuations (>6m), ingress water, ground vibrations and gravity.

Sites are characterized primarily in terms of eight standard Inherent Risk Classes defined as follows:

The CGS acknowledges that drilling often cannot simply render a zone as a single numbered Inherent Risk Class. Studies of the overburden conditions sometimes present uncertainty regarding the mobilization potential thereof. The CGS therefore accepts that allowance must be made on certain occasions for a range of mobilization potential, e.g. a low to medium- or medium to high mobilization potential.

Table 10: Inherent Risk Class Characterization

Risk Class	Characterization Of Area
Class 1	Areas characterized as reflecting a low Inherent Risk of sinkhole and doline formation (all sizes) with respect to ingress of water.
Class 2	Areas characterized as reflecting a medium Inherent Risk of small sinkholes and low risk for medium and larger sinkholes and doline formation with respect to ingress of water.
Class 3	Areas characterized as reflecting a medium Inherent Risk of small and medium sinkholes and low risk for larger sinkholes and dolines with respect to ingress of water.
Class 4	Areas characterized as reflecting a medium Inherent Risk of small to large size sinkhole and low risk for very large sinkholes and doline formation with respect to ingress of water.
Class 5	Areas characterized as reflecting a high Inherent Risk of small sinkhole and doline formation as well as low risk for medium and larger sinkholes (all sizes) with respect to ingress of water.
Class 6	Areas characterized as reflecting a high Inherent Risk of small and medium size sinkhole and doline formation with respect to ingress of water. Low risk for large and very large sinkholes
Class 7	Areas characterized as reflecting a high Inherent Risk of small to large sinkhole and doline formation with respect to ingress of water. Low risk for very large sinkholes
Class 8	Areas characterized as reflecting a high Inherent Risk of all sizes very large size sinkhole and doline formation with respect to ingress of water.

5.9.2. SITE CHARACTERIZATION

Evaluation of the inherent geotechnical risk for the development of sinkholes is conducted at the hand of the five mechanisms for each of the three soil profiles defined.

5.9.2.1. BLANKETING LAYER

The Blanketing layer across the site is variable and range from 16m to 24m.

5.9.2.2. RECEPTACLES

The receptacles are expected to be small. And the overlying shale layer reduce the risk of small to medium sinkholes to form.

5.9.2.3. MOBILIZATION AND MOBILIZING AGENTS

Mobilization of the blanketing layer is limited. The only mobilization agents present on site is water. But due to large scale dewatering in the area the water table have been drawn down. The risk of sinkhole formation is higher as a result therefore the point ingress of water should be controlled as stipulated in SANS 1936-3

5.9.2.4. BEDROCK MORPHOLOGY

The bedrock morphology is unknown but based on the gravimetric survey it is undulating and pinnicles do occur as observed in other investigations in the Tembisa area.

5.9.2.5. MAXIMUM POTENTIAL DEVELOPMENT SPACE

The maximum potential development space of a potential sinkhole is dependent on the size of the receptacle and the thickness of the blanketing layer. From the investigation the receptacle size is estimated to be less than 1 m in size. The thickness of the blanketing layer varies from 16 to26m, therefore there is a potential for large sinkholes to form. The maximum potential development space is estimated to be between 10 and 15m. There is however no evidence of large sinkholes in the immediate area.

5.9.3. INHERENT RISK CLASSIFICATION

The mobilization potential, receptacle size and ground movement are constant across the site. The thickness of the blanketing layer is between 16 and 24m.

The regional and local groundwater level have been drawn down in the past but is at a stable level at the moment.

The gravimetric survey indicated that there is no large gravity low below the site and it was confirmed with the percussion drilling at the local gravity low.

Based on experience, and the testing conducted on site, the risk of small to medium size sinhholes is moderate but the likelihoof of large sinkholes developing is low.

Based on the site conditions and observations made the inherent dolomite risk is defined in Table 11, the inherent risk classification for the proposed development area is CLASS 4 **(**Figure 11**).**

Table 11: Site classification

Profile	Thickness of blanketing layer	Mobilization potential	Receptacle size (m)	Ground movement events /year	Max. Potential development space (m)	Inherent Hazard Class (IHC)
Profile 1	16-24m	Low	1m	low	large	Class 4

Figure 11: Inherent Dolomite Risk Assessment – Clayville Filling Station Project

5.10. LAND USE EVALUATION

The Land use Evaluation is defined in terms of the dolomite hazard and the Geotechnical Risk Classification, with reference to the NHBRC Classification is included.

Based on the outcomes of the investigation, the appropriate dolomite area designation (D1 to D4, see Table 12) and design level investigation requirements shall be determined in accordance with SANS 1936 standards. The aim of dolomite area designations D2 to D4 is to introduce precautionary and mitigating measures that strive to reduce the frequency of events per hectare to what equates to a tolerable hazard. Dolomite area designation D1 applies only to those instances where the development of the land presents a tolerable hazard without precautionary measures. On land categorized as D2 and D3, appropriate precautionary measures in accordance with the principles and requirements of SANS 1936-3 shall be implemented to mitigate the risks associated with the development of such land. On land designated as D4, in terms of Table 12, Additional site specific precautionary measures are required.

TABLE 12: DOLOMITE AREA DESIGNATION AND ADDITIONAL REQUIREMENTS

Dolomite Area Designation	Description
D1	No precautionary measures are required.
D2	General precautionary measures, in accordance with the requirements of SANS 1936-3, that are intended to prevent the concentrated ingress of water into the ground, are required.
D3	Precautionary measures in addition to those pertaining to the prevention of concentrated ingress of water into the ground, in accordance with the relevant requirements of SANS 1936-3, are required, that include a risk management plan
D4	The precautionary measures required in terms of SANS 1936-3 are unlikely to result in a tolerable hazard. Site-specific precautionary measures are required, Designed by an Expert Geotechnical Professional. Expert geotechnical review and oversight is also required during the construction process. Additional risk mitigation measures to be included in the risk management Plan

5.10.1. Permissible land use per Inherent hazard Class

The planned land use for the property is Commercial - non residential C3 (SeeTable 13)

The Inherent Site Class 1 area (see figure 11) attract a D2 (Table 12) level of additional study with footprint investigation.

The whole site have to be managed according to a D2 designation which will require precautionary measures pertaining to the prevention of concentrated ingress of water into the ground as defined in SANS 1936-3.

TABLE 13: PERMISSIBLE LAND USE PER IHC AND ADDITIONAL SITE INVESTIGATIONS REQUIRED

<table>
<tr><th colspan="2">Land usage</th><th colspan="8">Inherent Risk Class Classification (SANS 1936-2)</th></tr>
<tr><th rowspan="2">Designation</th><th rowspan="2">Description</th><th>Class 1</th><th>Class 2</th><th>Class 3</th><th>Class 4</th><th>Class 5</th><th>Class 6</th><th>Class 7</th><th>Class 8</th></tr>
<tr><th colspan="8">Dolomite Area designation and footprint investigation requirement</th></tr>
<tr><td colspan="10">Commercial and miscellaneous non-residential usage</td></tr>
<tr><td>C1</td><td>Places of detention, police stations, and institutional homes for the handicapped or aged</td><td colspan="5">D3 + FPI</td><td colspan="3">D4</td></tr>
<tr><td>C2</td><td>Hospitals, hostels, hotels</td><td colspan="6">D3 + FPI</td><td colspan="2">D4</td></tr>
<tr><td>C3</td><td>Commercial developments < 3 storeys, including railway stations, shops, wholesale stores, offices, places of worship, theatrical, indoor sports or public assembly venues, other institutional land uses such as universities, schools, colleges, libraries, exhibition halls and museums, light (dry) industrial developments, dry manufacturing, commercial uses such as warehousing, packaging, and electrical sub-stations, filling stations</td><td>D2 + FPI</td><td colspan="4">D3 +FPI</td><td colspan="3">D4</td></tr>
<tr><td>C4</td><td>Commercial developments > 3 storeys, including railway stations, shops, wholesale stores, offices, places of worship, theatrical, indoor sports or public assembly venues, other institutional land uses such as universities, schools, colleges, libraries, exhibition halls and museums, light (dry) industrial developments, dry manufacturing, commercial uses such as warehousing, packaging, and electrical sub-stations</td><td>D2 + FPI</td><td>D3 +FPI</td><td colspan="6">D4</td></tr>
<tr><td>C5</td><td>Fuel depots, processing plants or any other areas for storage of liquids, waste sites</td><td>D2 + DLI</td><td colspan="4">D3 + DLI</td><td colspan="3">D4</td></tr>
<tr><td>C6</td><td>Outdoor storage facilities, stock yards, container depots</td><td>D2 + DLI</td><td colspan="6">D3 + DLI</td><td>D4</td></tr>
<tr><td>C7</td><td>Parking Garages</td><td>D2</td><td colspan="5">D3 + FPI</td><td colspan="2">D4</td></tr>
<tr><td>C8</td><td>Parking Areas</td><td>D2</td><td colspan="5">D3</td><td colspan="2">D4</td></tr>
<tr><td colspan="10">DLI = Design level investigation in accordance with requirements of SANS 1936-2, as deemed appropriate by the competent person
FPI = Design Level investigation specifically below the footprint of the structures</td></tr>
</table>

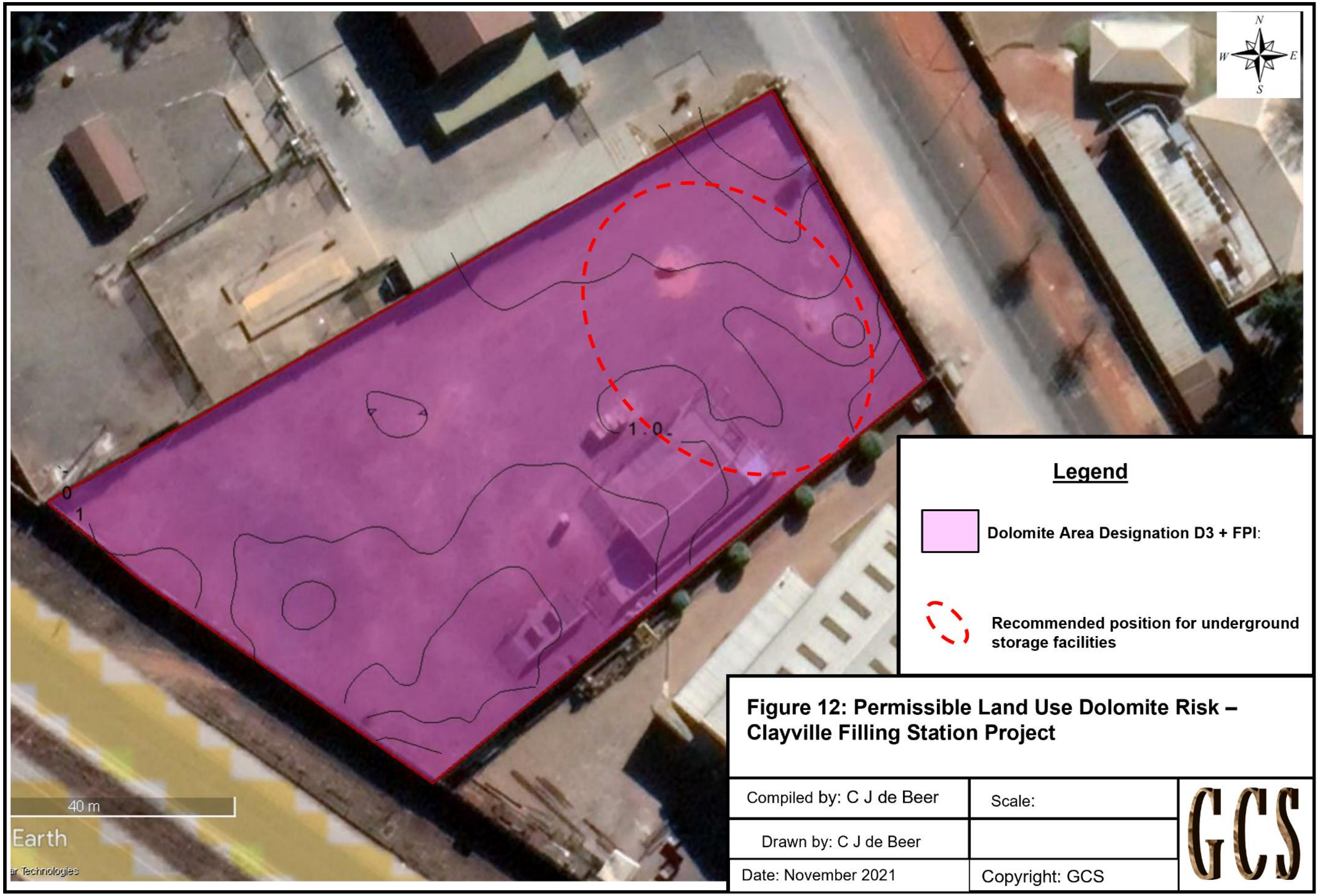

Figure 12: Permissible Land Use Dolomite Risk – Clayville Filling Station Project

5.11.FORWARD WORK PLAN

It is recommended that the underground fuel storage tanks planned for the filling station, be installed in the area defined in Figure 12. The soil properties in this area is better suited for the installation than that of rest of the site.

During the early work construction for the filling station, the excavations should be inspected by a competent responsible person as defined in SANS 634: 2012.

The aim of this investigation shall be to:

- confirm and refine the site class designations
- confirm the stability zoning and dolomite area designations and
- confirm that the mandatory precautions outlined in this report have been observed.

6. RECOMMENDATIONS

To follow on this study, it is recommended that the following be adopted:

- That the underground fuel storage tanks be installed in the area identified.
- The requirement with respect SANS 1936-3 be followed for the wet services and that the surface water run off on site be managed as required.

7. CONCLUSIONS

- The site is underlain by reworked residual transported soil as well as chert and dolomite of the Malmani Subgroup. . A north south trending syenite dyke traverse the site.
- Two soil profile has been identified through the trial pit investigation:
  - Profile1: fill and reworked and weathered chert and dolomite and
  - Profile 2: Thicker reworked weathered chert and dolomite
- The percussion borehole drilled at the local gravimetric low did not intersect a sinkhole or any significant indication that a collapse structure or is present on the property.
- No groundwater were intersected to a depth of 34m
- Excavatability across the site is soft to intermediate, the western portion of the site soft excavatability terminates at 1.5m. The eastern portion of the site is soft to at least 2.8m. The potential for collapse of side walls of deep excavations is moderate.
- Dry conditions were experienced in the trial pits. No seepage was detected.
- Construction materials should be sourced off site.
- No Present or past mining activities influence the site.
- The geotechnical risk classification for the whole site is A2H2 and the NHBRC Classification is P(H1C1)
- The inherent risk class for the site is Class 4 due to the medium risk for small and medium sinkholes and low risk for large sinkholes.
- The Dolomite Area Designation for the site is D3 and footprint investigations are required. The site investigation conducted is adequate in this regard.
- The land use classification of the site is **DEVELOPABLE with tolerable risk with respect to sinkhole or doline formation for a C3 commercial land use.**
- **From a geotechnical perspective the site is suited for development of a filling station.**

8. REFERENCES AND BIBLIOGRAPHY

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9.2. BRINK, A.B.A., PARTRIDGE, T.C., WILLIAMS, A.A.B., 1982. “Soil Survey for Engineering”, Oxford University Press, New York.

9.3. JENNINGS, J.E., BRINK, A.B.A., WILLIAMS, A.A.B., 1973. “Revised Guide to Soil Profiling for Civil Engineering Purposes in Southern Africa”, The Civil Engineer in South Africa, January 1973.

9.4. NATIONAL HOME BUILDERS REGISTRATION COUNCIL (NHBRC) (1995) “Standards and Guidelines” First Issue 1995.

9.5. VAN DER MERWE, D.H., 1964. “The Prediction of Heave from the Plasticity Index and Percentage Clay Fractions of Soils”, The Civil Engineer in South Africa, June 1964.

9.6. WEINERT, H.H., 1980. “The Natural Road Construction Materials of Southern Africa”, Academica, Cape Town.

9.7. WILLIAMS, A.A.B., PIDGEON, J.T. and DAY, P.W., 1985. “Problem Soils in South Africa – State of the Art: Expansive Soils”, The Civil Engineer in South Africa, July 1985

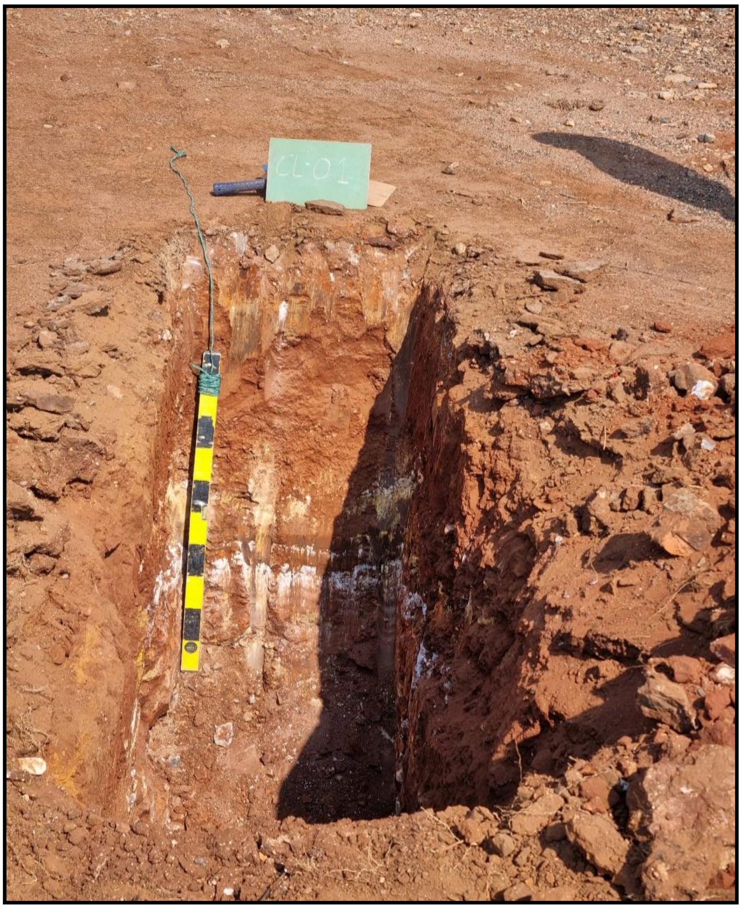
9. APPENDIX 1 – SOIL PROFILES

Soil Profile TP_CL04 (Clayville Filling Station)

Profiled by C de Beer
Diameter
Depth 1.50
Type: Trial Pit

Co-coordinates:
X-coord 25.973228° E
Y-coord 028.227411° S
Z-coord 1180 m
WGS 84 decimal degrees

Contractor James
Machine CAT 420D
Operator Mike



Soil Profile Description

Profile	Depth to (m)	Description
	0.30	Dry, light brown and reddish brown, medium dense to dense, slightly cutanic,silty clayey sand with angular cobbles, compacted imported FILL.
	0.70	Slightly moist,dusky redmedium dense to dense silty sand with calcrete/calcretized soil, FILL?
	1.10	Slightly moist, brown streaked white , stiff, intact, clayey, silty sand with cobbles, CHERT RUBBLE.
	1.50	Slightly moist, brown, stiff, intact, clayey, silty sand with cobbles, CHERT RUBBLE.
		End of Hole @ 1.50 m. TLB near refusal on large chert boulders

Comments

1 DCP test conducted from surface premature refusal on Fill
2 No sample collected
3 No groundwater seepage

GCS

Soil Profile TP_CL04 (Clayville Filling Station)

Profiled by C de Beer
Diameter
Depth 3.10
Type: Trial Pit

Co-coordinates:
X-coord 25.973128° E
Y-coord 028.22718° S
Z-coord 1180 m
WGS 84 decimal degrees

Contractor James
Machine CAT 420D
Operator Mike

Soil Profile Description

Profile	Depth to (m)	Description
	0.40	Dry, light brown and reddish brown, medium dense to dense, slightly cutanic,silty clayey sand with angular cobbles, compacted imported FILL.
	1.10	Slightly moist, dusky red spotted white and black, dense, intact, clayey, silty sand with cobbles, CHERT RUBBLE.
	2.40	Slightly moist, dark brown, stiff, intact, clayey, silty sand with cobbles and boulders. CHERT and DOLOMITE RUBBLE.
		End of Hole @ 2.40 m. TLB near refusal on large boulders

Comments

1 DCP test conducted from surface premature refusal on Fill
2 No sample collected
3 No groundwater seepage
4 Electrical cable damaged that was not indicated on site

GCS

Soil Profile TP_CL04 (Clayville Filling Station)

Profiled by C de Beer
Diameter
Depth 3.10
Type: Trial Pit

Co-coordinates:
X-coord 25.973019° E
Y-coord 028.228052° S
Z-coord 1180 m
WGS 84 decimal degrees

Contractor James
Machine CAT 420D
Operator Mike

Soil Profile Description

Profile	Depth to (m)	Description
	0.40	Dry, light brown and reddish brown, medium dense to dense, slightly cutanic,silty clayey sand with angular cobbles, compacted imported FILL.
	1.10	Slightly moist, dusky red spotted white and black, dense, intact, clayey, silty sand with cobbles, CHERT RUBBLE.
	3.10	Slightly moist, dark brown, stiff, intact, clayey, silty sand with cobbles and boulders. CHERT and DOLOMITE RUBBLE.
		End of Hole @ 3.10 m. TLB at reach limit

Comments

1 DCP test conducted from surface premature refusal on Fill
2 No sample collected
3 No groundwater seepage

GCS

Soil Profile TP_CL04 (Clayville Filling Station)

Profiled by C de Beer
Diameter
Depth 3.21
Type: Trial Pit

Co-coordinates:
X-coord 25.972812° E
Y-coord 028.227899° S
Z-coord 1180 m
WGS 84 decimal degrees

Contractor James
Machine CAT 420D
Operator Mike

Soil Profile Description

Profile	Depth to (m)	Description
	0.50	Dry, light brown and reddish brown, medium dense to dense, slightly cutanic,silty clayey sand with angular cobbles, compacted imported FILL.
	3.20	Slightly moist, dusky red spotted white and black, dense, intact, clayey, silty sand with cobbles, CHERT and DOLOMITE RUBBLE.

End of Hole @ 3.20 m. TLB at reach limit

Comments

1 DCP test conducted from surface premature refusal on Fill
2 No sample collected
3 No groundwater seepage

10. APPENDIX 2 –– DCP TEST RESULTS

No DCP test conducted

11. APPENDIX 3 – LABORATORY TEST RESULTS

Roadlab Laboratories Pty Ltd
› Materials Testing
› Geotechnical & Road Investigations
› Mobile Lab Services
› Specialised Concrete & Forensic Investigations
+27 11 828 0279
info@roadlab.co.za
www.roadlab.co.za
207 Rietfontein Rd,
Germiston, JHB, 1400

92/GEO007-06/0001/21 Job no- RG 18101 Date- 2021-09-13

Geotechnical Consult Services
11 Jakkalsweg
Van Riebeeck Park
Kempton Park

ATTENTION: **Mr Carel de Beer**

Test Report : **CLAYVILLE FIRE STATION - pH & CONDUCTIVITY TEST RESULTS**

Clients Marking: None
Sample Number: S/11087
Sample delivered to: Roadlab

Date Sampled: 2021/09/06
Date Received: 2021/09/06

Sample Number	Layer / Road :	Temperature (°C) : Conductivity	Conductivity (ms/m)	Temperature (°C) : pH	pH Value
S/11087	CC-03A	24.0	40.0	24.0	5.60

PAGE 1/1

Kind Regards

Mr N Herbst / Mr R Potgieter
Technical Signatory / Manager

Remarks :
The samples were subjected to analysis according to TMH 1
The results reported relate only to the sample tested
Further use of the above information is not the responsibility or liability of Roadlab
Documents may only be reproduced or published in their full context
Compiled By : Rehmat Ally

RLG.s.037.01

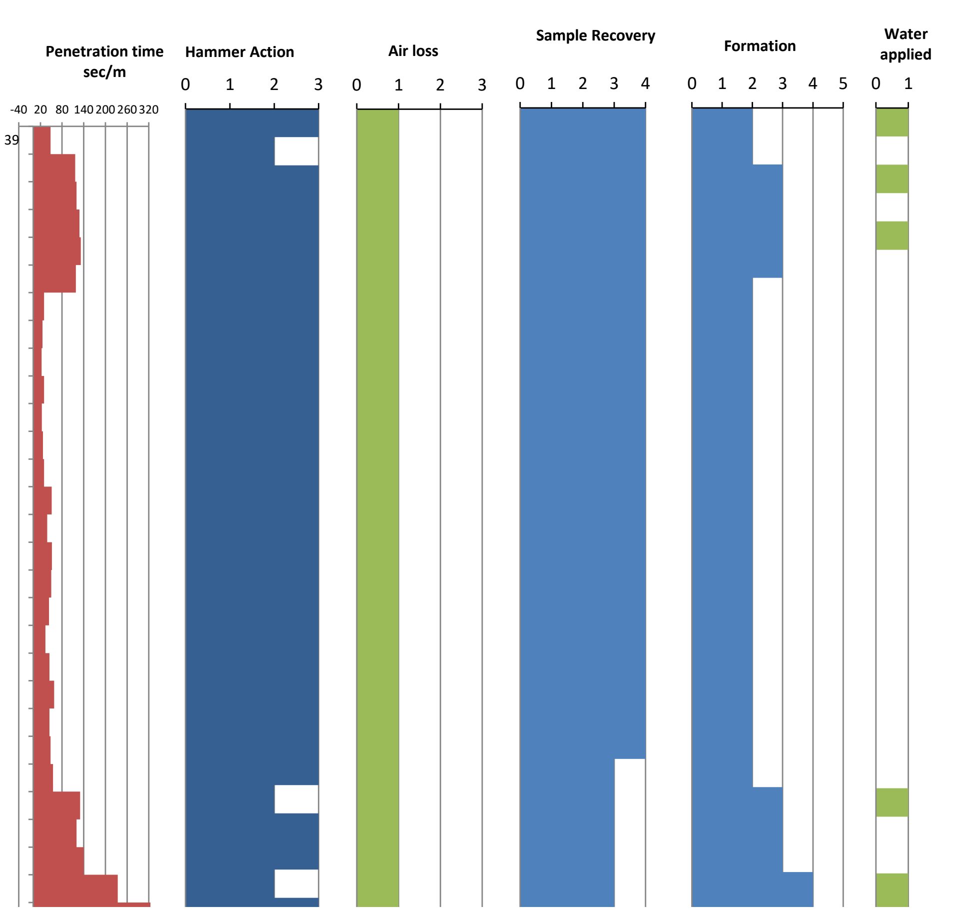
12. APPENDIX 4 – DRILLING LOGS

PERCUSSION BOREHOLE LOG

BOREHOLE : BS_BH_05

Client	**Tekplan**	Total Depth	**34**	Diameter	165mm
Location	**Clayville Filling Station**	Air Pressure	**18 bar**		
Date	**5/5/2021**	Water Strike	**None**		

Lat: -26.291722°
Long: 27.814363°
ELEVATION: 1535m



Depth (m)

From	T0
0	1
1	2
2	3
3	4
4	5
5	6
6	7
7	8
8	9
9	10
10	11
11	12
12	13
13	14
14	15
15	16
16	17
17	18
18	19
19	20
20	21
21	22
22	23
23	24
24	25
25	26
26	27
27	28

Geological Discription

Profile	From	To	
	0	**1**	Slightly moist, pale red brown, clayey silty sand with rock fragments FILL
	1	**3**	Slightly moist, red brown, clayey silty sandwith rock fragments FILL
	3	**6**	Slightly moist, red brown, silty sand with rock fragments FILL
	6	**14**	Slightly moist, reddish yellow to yellow brown, silty clayey extremely weak to weak rock. Decomposed SYENITE
	14	**25**	Slightly moist, yellow brown, silty clayey, very weak rock rock. Highly decomposed SYENITE
	25	**29**	Slightly moist, blue grey and brown, weaK medium strong FRACTURED DOLOMITE

PERCUSSION BOREHOLE LOG

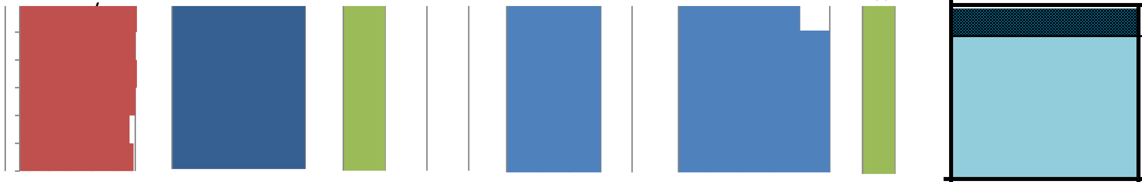
BOREHOLE : BS_BH_05

Client	**Tekplan**	Total Depth	**34**	Diameter	165mm
Location	**Clayville Filling Station**	Air Pressure	**18 bar**		
Date	**5/5/2021**	Water Strike	**None**		

Lat: -26.291722°
Long: 27.814363°
ELEVATION: 1535m

Depth (m) | **Penetration time** | **Hammer Action** | **Air loss** | **Sample Recovery** | **Formation** | **Water applied** | **Geological Discription**

From	To
28	29
29	30
30	31
31	32
32	33
33	34



From	To	Geological Discription
29	34	Slightly moist, blue grey and white moderately weathered to unweathered DOLOMITE WITH MINOR CHERT

Hammer Action	Air loss	Sample Recovery	Water applied
1=Very irregular 2=Irregular 3=regular	1=None 2=Slight 3=Medium 4=total	4=Good 3=Medium 2=Poor 1=None	0=No 1=Yes

Comment: No groundwater intersected. No cavities intersected

31718

JK Drilling (Pty) Ltd

GEOLOGICAL DRILLING

Posbus/PO Box 536
Wiltis Ridge
0040

SLAGBOORSTAAT
PERCUSSION BORE HOLE RECORD

Tel: 012 668 9905/6
Faks/Fax: 012 668 9907
Sel/Cell: 082 554 9443
Email:francois@jayk.co.za

Kliënt / Client: Cosville
Projek / Terrein / Project / Terrain: Filling Station
Gat Nr. / Hole No.: 6H1A.
Gatposisie / Hole Position:

Totale Diepte / Total Depth:
Voering - In & Uit (m) / Casing - In & Out (m):
Voering gelaat (m):
Casing installes (m):
Voering permanent beskadig (m) / Casing permanently damaged (m):

Datum / Date: 05/05/2021
Lugdruk / Air Pressure: Bar
Lugvolume / Air Capacity:
Beiteldeursnee (mm) / Bit Diameter (mm): 165mm
Water aangetref (m) / Water struck (m):
Rusvlak (m) / Rest level (m):

Diepte Depth (m)	Penetrasie tyd Penetration time min: sek/m	Formasie Formation: Holte/Cavity	Baie sag/Very soft	Sag/Soft	Redelik hard/Fairly hard	Solied/Solid	Hamer tempo Hammer rate: Baie ongereeld/Very irregular	Ongereeld/Irregular	Gereeld/Regular	Lugverlies Air Loss: Geen/None	Effend/Slightly	Medium	Totaal/Total	Water aangetref/found	Vog toestand Moisture condition: Nat/Wet	Klam/Moist	Droog/Dry	Gat val toe Hole collapsing	Water aangewend/applied	Voering Casing: Diepte geïnstalleer Depth installed	Monster herwinning Sample recovered: Goed/Good	Medium	Swak/Poor	Geen/None	OPMERKINGS/REMARKS (bv tipe materiaal / eg. type of material)
31	3:29					L			L	L						L			L		L				Sound Dolomite
32	3:20					L			L	L						L			L		L				//
33	3:04					L			L	L						L			L		L				//
34	3:15					L			L	L						L			L		L				//
35	:																								
36	:																								
6-7	:																								
7-8	:																								
8-9	:																								
9-10	:																								
10-11	:																								
11-12	:																								
12-13	:																								
13-14	:																								
14-15	:																								
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23-24	:																								
24-25	:																								
25-26	:																								
26-27	:																								
27-28	:																								
28-29	:																								
29-30	:																								

CO-ORDINATES:
LO:
Y:
X:

Opmerkings / Remarks:

GELOG DEUR / LOGGED BY: Seymour/...

OPERATEUR / OPERATOR: Gabriel

JK Drilling (Pty) Ltd

31717

GEOLOGICAL DRILLING

SLAGBOORSTAAT
PERCUSSION BORE HOLE RECORD

[P]osbus/PO Box 536
[W]eltis Ridge
[0]130

Tel: 012 668 9905/6
Faks/Fax: 012 668 9907
Sel/Cell: 082 554 9443
Email:francois@jayk.co.za

Kliënt: / Client: Claryville
Projek / Terrein: / Project / Terrain: Firing Station
Gat Nr.: / Hole No.: TBH 1 A
Gatposisie: / Hole Position:

Totale Diepte: / Total Depth: 34M
Voering - In & Uit (m): / Casing - In & Out (m):
Voering gelaat (m): / Casing installes (m):
Voering permanent beskadig (m): / Casing permanently damaged (m):

Datum: / Date: 05/05/2021
Lugdruk: / Air Pressure: [illegible] — Lugvolume: / Air Capacity:
Beiteldeursnee (mm): / Bit Diameter (mm): 165mm
Water aangetref (m): / Water struck (m):
Rusvlak (m): / Rest level (m):

Diepte Depth (m)	Penetrasie tyd Penetration time min: sek/m	Formasie Formation: Holte/Cavity	Baie sag/Very soft	Sag/Soft	Redelik hard/Fairly hard	Solied/Solid	Hamer tempo Hammer rate: Baie ongereeld/Very irregular	Ongereeld/Irregular	Gereeld/Regular	Lugverlies Air Loss: Geen/None	Effend/Slightly	Medium	Totaal/Total	Water aangetref/found	Vog toestand Moisture condition: Nat/Wet	Klam/Moist	Droog/Dry	Gat val toe Hole collapsing	Water aangewend/applied	Voering Casing: Diepte geïnstalleer Depth installed	Monster herwinning Sample recovered: Goed/Good	Medium	Swak/Poor	Geen/None	OPMERKINGS/REMARKS (bv tipe materiaal / eg. type of material)
0-1	0 48		✓						✓	✓						✓	✓		✓		✓				Min Chert en Clay
1-2	1 16		[illegible]					✓		✓						✓					✓				Mudstone
2-3	1 20			✓					✓	✓						✓			✓		✓				"
3-4	1 28			✓					✓	✓						✓					✓				Min Chert en Clay
4-5	1 32			✓					✓	✓						✓			✓		✓				"
5-6	1 18			✓					✓	✓						✓					✓				Min Chert en Clay
6-7	0 30		[illegible]				✓			✓						✓	✓				✓				Silty Clay
7-8	0 26		✓						✓	✓						✓	✓				✓				"
8-9	0 23		✓						✓	✓						✓	✓				✓				"
9-10	0 30		✓						✓	✓						✓	✓				✓				"
10-11	0 24		✓						✓	✓						✓					✓				Grey Clay
11-12	0 27		✓						✓	✓						✓					✓				"
12-13	0 20		✓						✓	✓						✓					✓				"
13-14	0 51		✓						✓	✓						✓					✓				"
14-15	0 39		✓						✓	✓						✓	✓				✓				Syenite
15-16	0 52		✓						✓	✓						✓	✓				✓				"
16-17	0 50		✓						✓	✓						✓	✓				✓				"
17-18	0 40		✓						✓	✓						✓	✓				✓				"
18-19	0 34		✓						✓	✓						✓	✓				✓				Syenite
19-20	0 45		✓						✓	✓						✓	✓				✓				"
20-21	0 58		✓						✓	✓						✓	✓				✓				"
21-22	0 45		✓						✓	✓						✓	✓				✓				"
22-23	0 48		✓						✓	✓						✓	✓				✓				Syenite
23-24	0 56		✓						✓	✓						✓	✓				✓				"
24-25	1 30		[illegible]						✓	✓						✓	✓				✓				Syenite en Dolomite
25-26	1 30			✓				✓		✓						✓			✓		✓				Dolomite
26-27	1 40			✓					✓	✓						✓	✓				✓				"
27-28	2 30			✓					✓	✓						✓	✓				✓				"
28-29	3 30				[illegible]			✓		✓						✓			✓		✓				Good Dolomite
29-30	3 30					[illegible]		✓	✓	✓						✓	✓		✓		✓				"

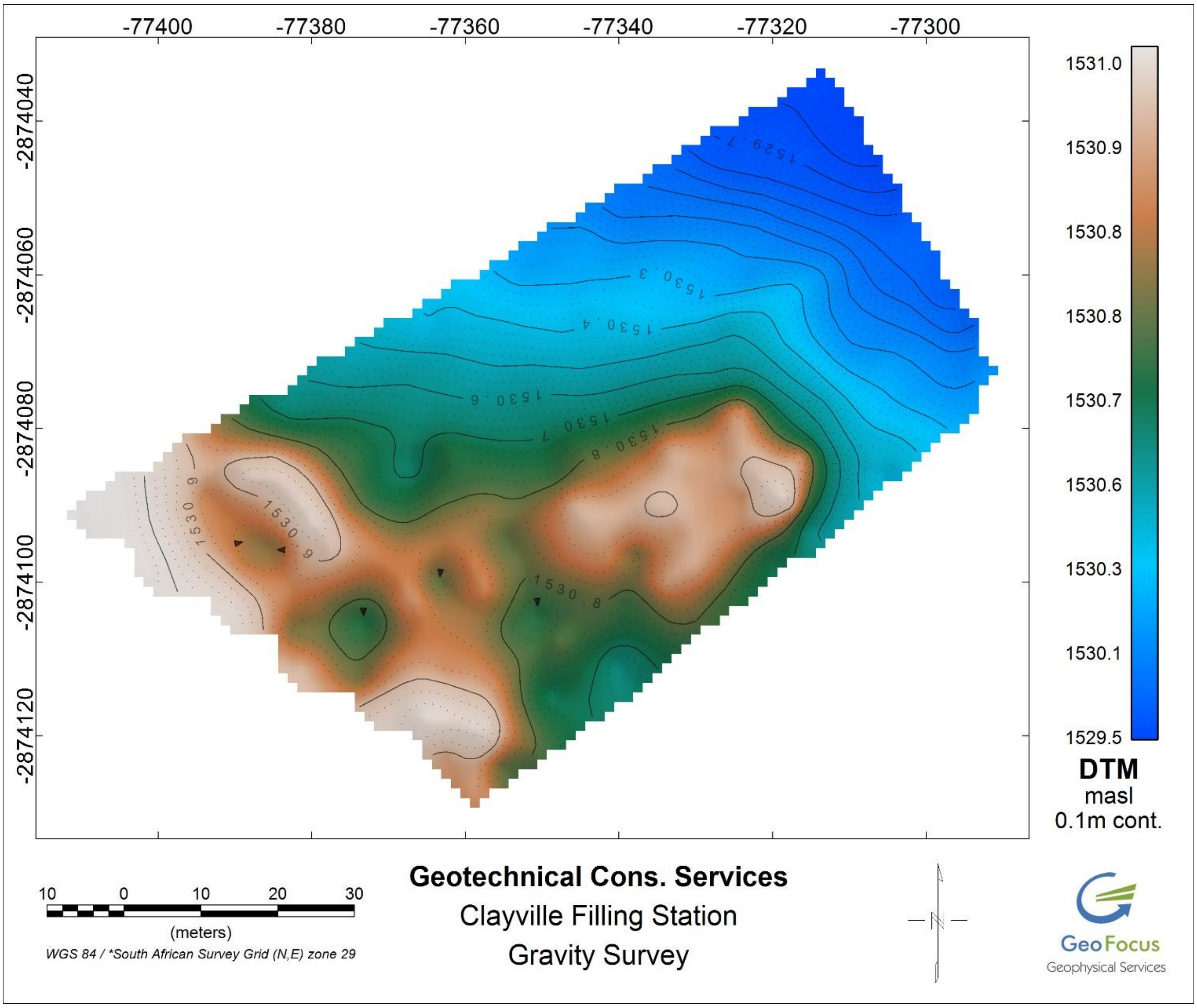
CO-ORDINATES:
LO:
Y: 25°58'22.9"
X: 028°13'39.1"

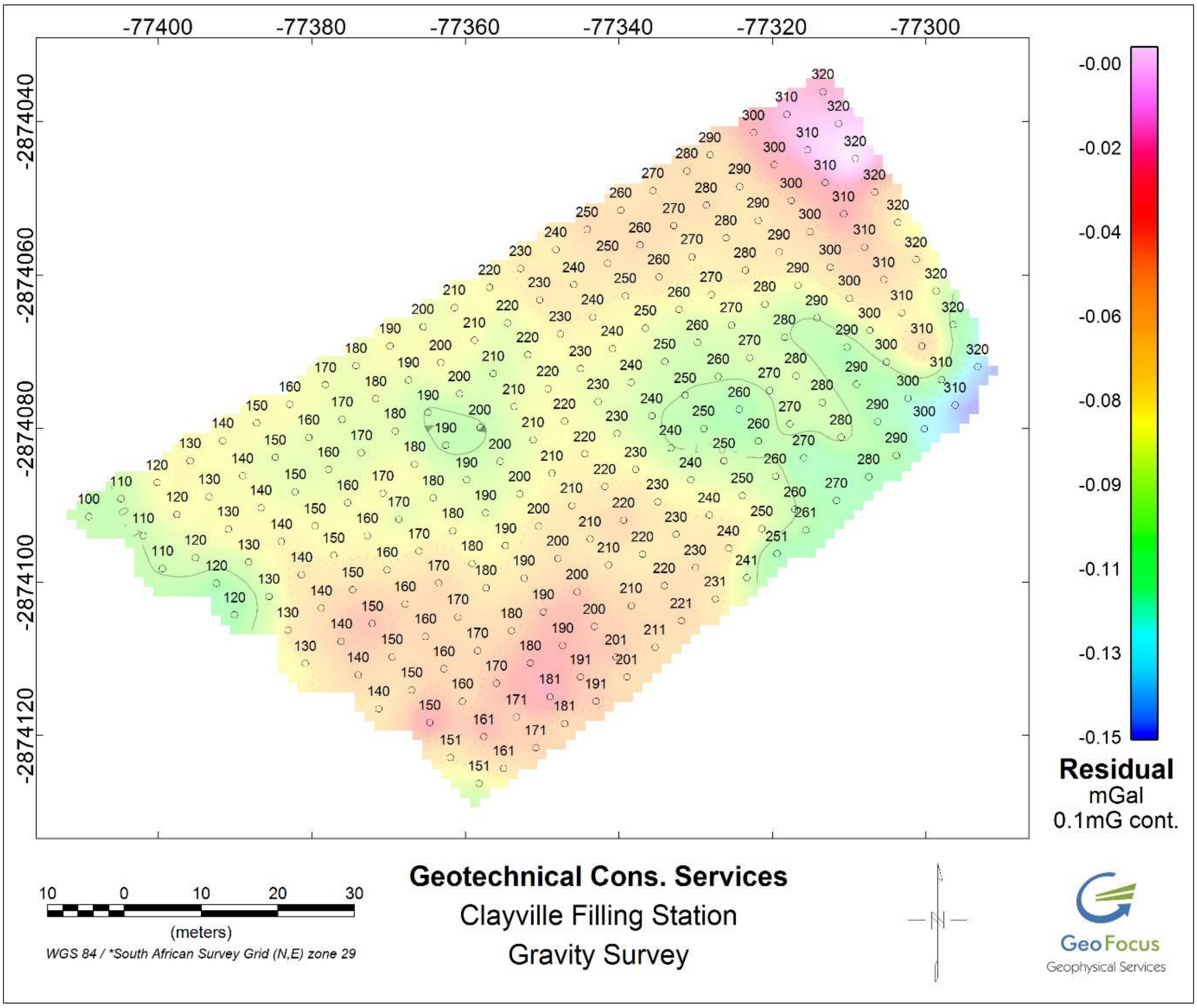
Opmerkings:
Remarks:

DATA BESKRYF DEUR:
DATA DESCRIBED BY: Dalmon Jaa

OPERATEUR:
OPERATOR: [signature]

13. APPENDIX 5 – GRAVITY DATA

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-2874080
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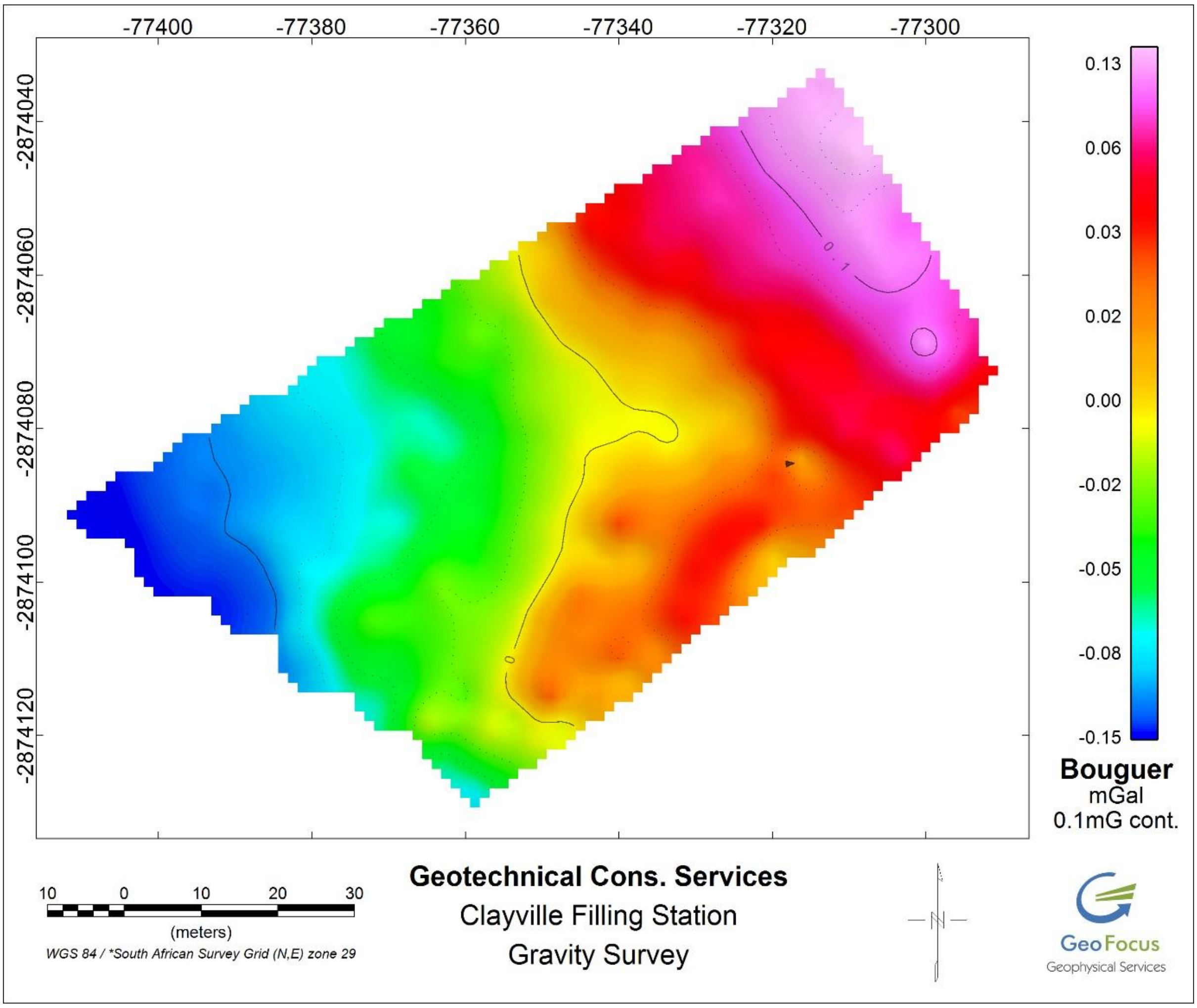
-2874120
-0.00
-0.02
-0.04
-0.06
-0.08
-0.09
-0.11
-0.13
-0.15
Residual
mGal
0.1mG cont.
10 0 10 20 30
(meters)
WGS 84 / *South African Survey Grid (N,E) zone 29
Geotechnical Cons. Services
Clayville Filling Station
Gravity Survey
GeoFocus
Geophysical Services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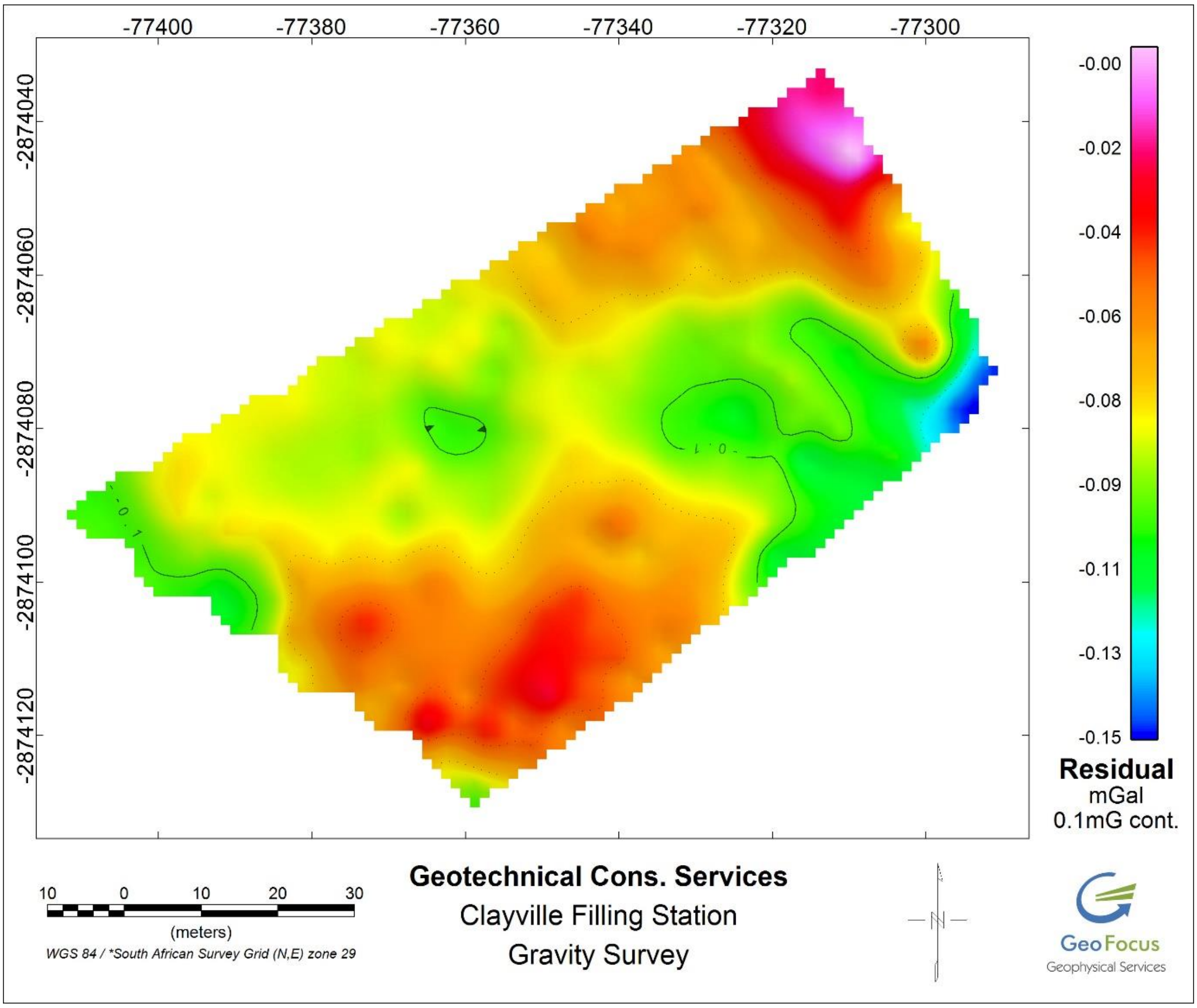
0.1
0.13
0.06
0.03
0.02
0.00
-0.02
-0.05
-0.08
-0.15
Bouguer
mGal
0.1mG cont.
10 0 10 20 30
(meters)
WGS 84 / *South African Survey Grid (N,E) zone 29
Geotechnical Cons. Services
Clayville Filling Station
Gravity Survey
N
GeoFocus
Geophysical Services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-0.00
-0.02
-0.04
-0.06
-0.08
-0.09
-0.11
-0.13
-0.15
Residual
mGal
0.1mG cont.
10
0
10
20
30
(meters)
WGS 84 / *South African Survey Grid (N,E) zone 29
Geotechnical Cons. Services
Clayville Filling Station
Gravity Survey
GeoFocus
Geophysical Services