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Memorandum

To	**Natanya Whitehorn, Deon Esterhuizen**	**From**	**Danica Mong, Steven Seymour**
Copy	**Gary Davis**	**Reference**	**1002570-0000-REP-GG-0002-Rev0**
Date	**2023-09-27**	**Pages (including this page)**	**11**
Subject	**Olifants Management Model Programme Bulk Raw Water Study Phase (OMMP-BRWSP): Geotechnical Desktop Study for Environmental Authorisation of the Proposed Sekuruwe Water Treatment Works**		

This memorandum provides a geotechnical desktop study for the proposed Sekuruwe Water Treatment works in the Limpopo Province. The intention of this geotechnical desktop study is to provide a site sensitivity verification assessment of the site as it pertains to the environmental authorisation process. The desktop study therefore focusses on the geotechnical aspects of the sites from an environmental perspective. The assessment was limited to a desktop study only and no site walk-over was conducted.

1 Available Information

The information available for the geotechnical desktop study included:

- An environmental screening report of the proposed Sekuruwe water treatment works "Screening report for an environmental authorisation as required by the 2014 EIA Regulations – proposed site environmental sensitivity", by Zinzi Portia Xakayi, dated 10/07/2023.
- Locality KMZ file with the position of the proposed water treatment works and its access road.
- Satellite imagery (QGIS Development Team, 2023).
- Published maps including:
  - 1:250 000 geology map (Sheet 2328 Polokwane, Council for Geoscience, 1985)
  - Weinert climatic N-value map from "The natural road construction materials of southern Africa", Weinert H. H. (1980)
  - Seismicity map from "Basis of structural design and actions for buildings and industrial structures, Part 4: Seismic actions and general requirements for buildings (SANS 10160-4:2011 Edition 1.1)", SABS (2011)
  - Council for Geoscience (2023) online maps.
- Report of a previous geotechnical investigation conducted at the site:
  "WSM Leshika Consulting (2016) Phase 1 Shallow Soil Engineering Geological Investigation foe the Proposed Sekuruwe Water Treatment Works No. 2, Mogalakwena Local Municipality, Limpopo Province, South Africa. Report version V1.0, dated 22 August 2016".
  - The report covered the proposed Sekuruwe Water Treatment Works as of 2016.
  - Scope included a geotechnical desktop study, 11 no. test pits, and laboratory testing.
  - Photographs of the site walkover conducted in June 2016.

2 Site Location

The proposed Sekuruwe water treatment works site is situated north of the Village of Sekuruwe in the Limpopo Province, South Africa, approximately 26km north-northwest of Mokopane CBD. The N11 runs past the village of Sekuruwe and is approximately 400m west of the proposed site as shown in Figure 1. The proposed site is centred on a gentle slope dipping in the north-northwest direction at an approximate angle of 3.7° (WSM Leshika Consulting, 2016). It must be noted that the proposed access road coincides with an existing road, and therefore it is understood that no new access road is required. Therefore, only the site of the water treatment works was addressed in this document.

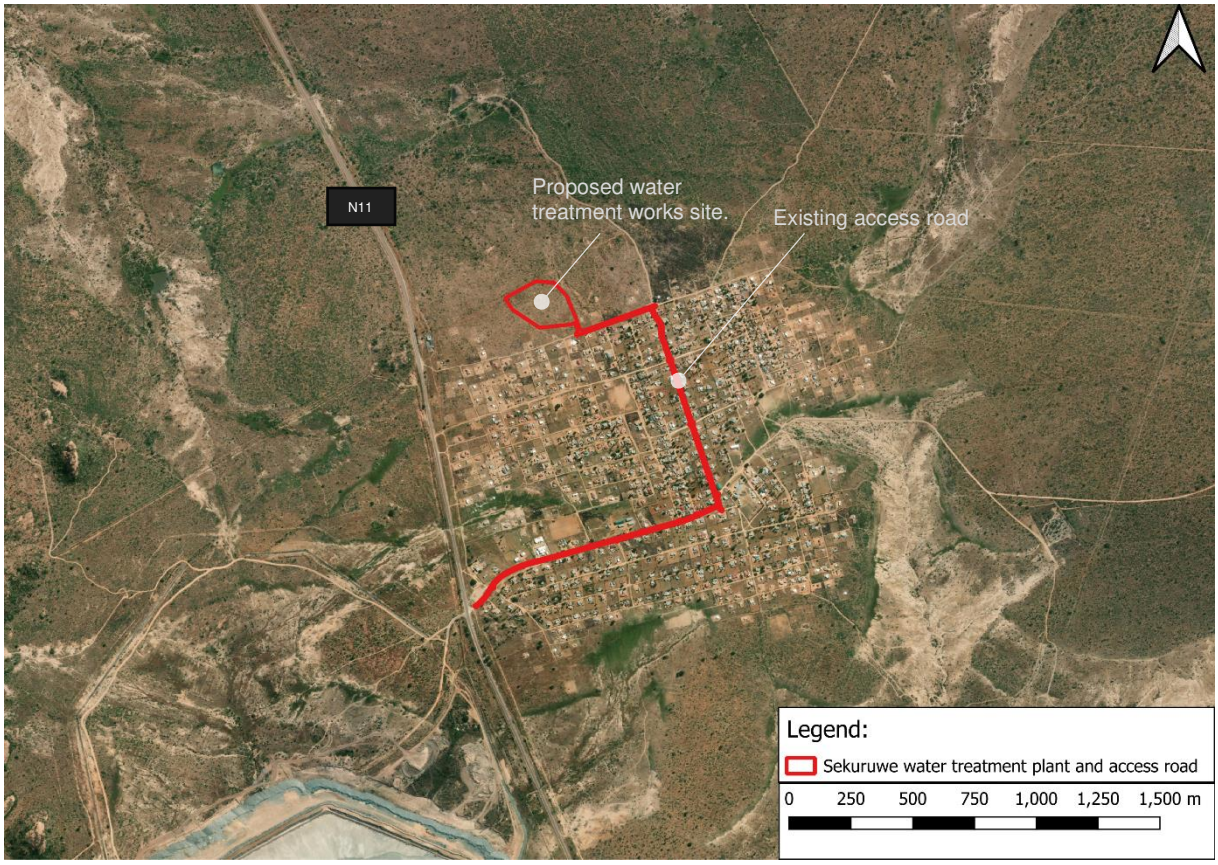

Figure 1 Location of proposed Sekuruwe water treatment works and existing access road (QGIS Development Team, 2023).

3 Site Geology

The geological setting of the proposed Sekuruwe water treatment works is shown in the 1:250 000 geology map in Figure 2. According to the map, the footprint of the water treatment facility is underlain by the Randian-aged Hout River gneisses (Rhr). The lithology is described as grey muscovite-biotite gneiss: leuocogneiss or leucrogranie; banded gneiss, and migmatitic gneiss. Approximately 500m north of the site, a diabase dyke is located, striking in the west-northwest to east-southeast direction. A concealed/inferred fault striking northeast is located 2km south of the site. According to the geological map, no major faults, dykes, or shear zones are present within the site boundary.

To the southwest of the proposed site location, the geological formation changes to Utrecth Granite, an intrusive rock from the Vaalian age. The lithology is described as fine-grained, pink biotite granite. West of the proposed site location, the geological formation changes to Mapela Gabbronorite, forming part of the Rustenburg Suite of the Bushveld Complex, and the lithology is described as gabbro, norite, anorthosite, pyroxenite, harzburgite, troctolite.

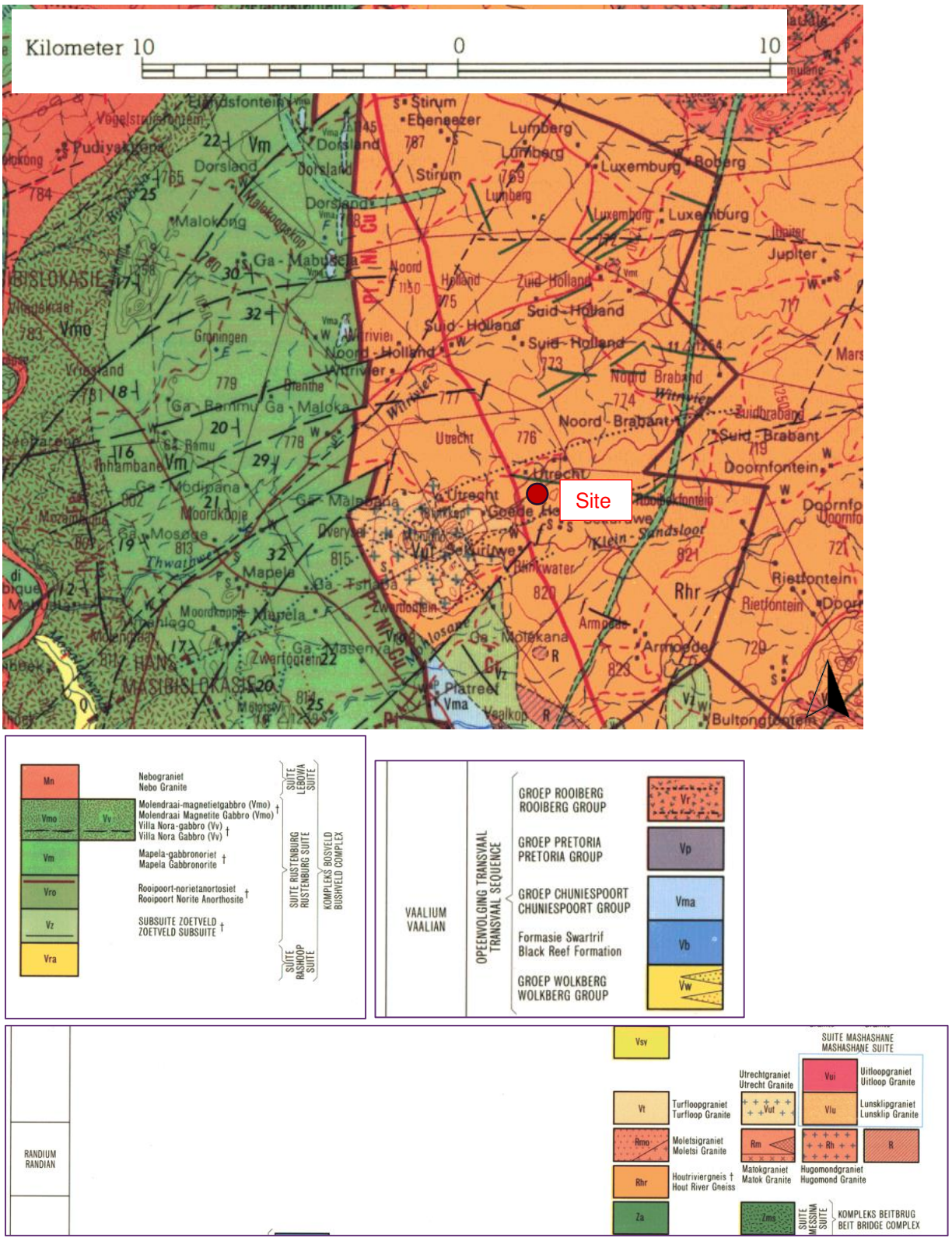

Figure 2 Regional geological setting of the site (from 1:250 000 Geological map; Sheet 2328 Polokwane, Council for Geoscience, 1985)

The site is not underlain by potentially soluble rock such as dolomite. However, for reference, as shown in Figure 3, the Council for Geoscience (2023) indicates that there is a possibility of dolomitic land approximately 6km west of the site. This possible dolomitic area coincides with areas of serpentinized dolomite (Vma) on the geological map. Notwithstanding, the dolomite is a considerable distance away from the site and is not considered a risk for the current site.

The satellite imagery in Figure 3 also indicates that mining occurs in the area. From the satellite imagery, it appears to be open pit mining.

Figure 3 Inferred dolomitic risk map in the Limpopo Province South Africa (Council for Geoscience, 2023)

4 Climate

The Weinert N-value (Weinert, 1980) is an index used to estimate the effect of climate on the rock weathering process. In general, where the N-value is more than 5, disintegration (mechanical weathering) is the dominant form of weathering, and the residual soils are typically only thinly developed. Conversely, where the N-value is less than 5, there is a water surplus and decomposition (chemical weathering) is dominant, typically creating conditions that are favourable for the development of deeper residual soil profiles.

As indicated in Figure 4, the site is situated in an area with a Weinert N-value in the order of N=3.3 (Weinert, 1980). Decomposition (chemical weathering) is therefore the expected mode of weathering at the site, and deeper residual profiles may have resulted over time.

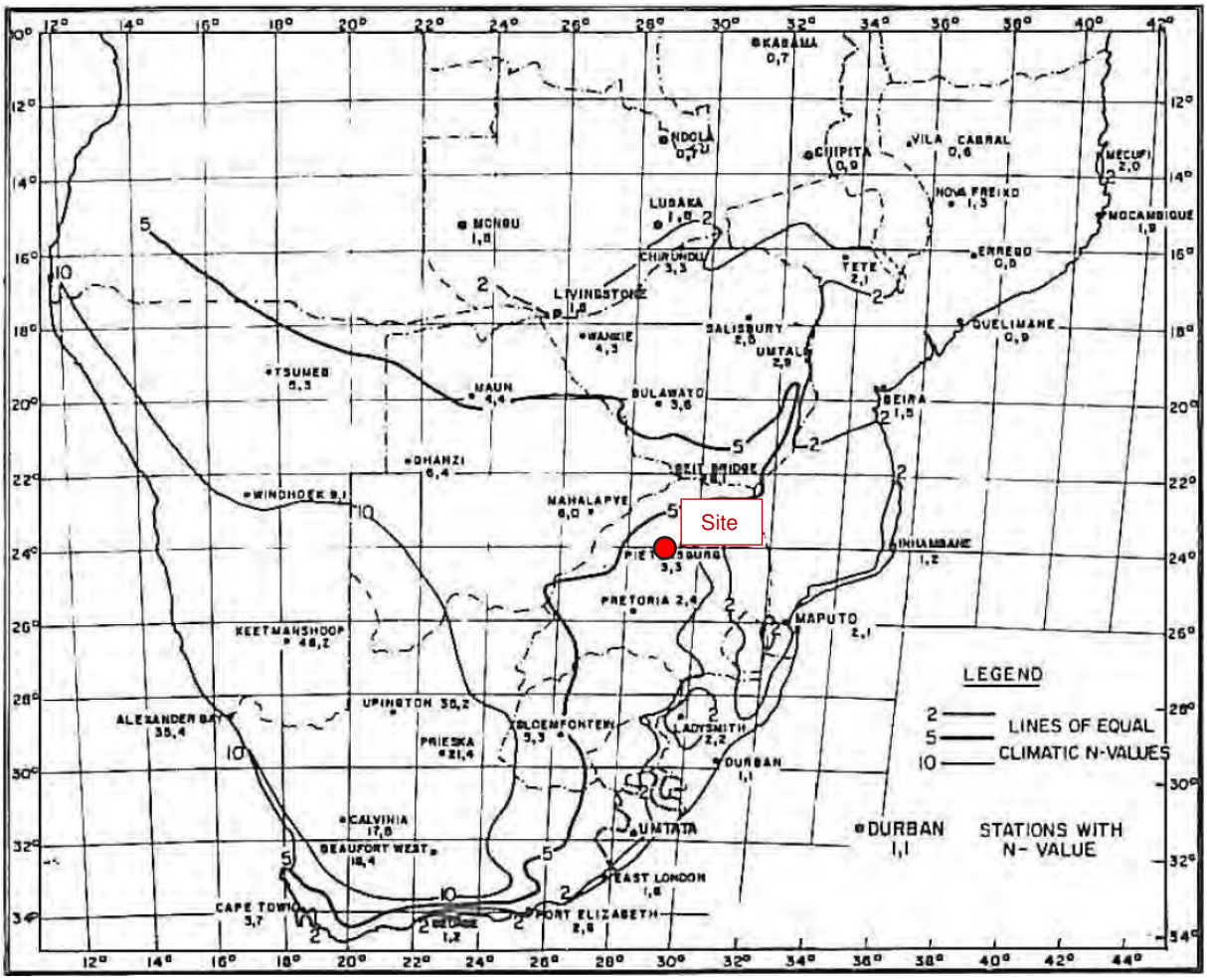

Figure 4 Contour map of climatic N-values for Southern Africa (Weinert, 1980)

5 Seismicity

The South African loading code, SANS 10160-4:2011 (SABS, 2011), suggests that the site is not located in a highly seismic hazard zone (Figure 5). However, as indicated in Figure 5, the site may nonetheless experience a peak ground acceleration in the order of 0.05g to 0.075g. The probability of exceedance of this peak ground acceleration is 10% in a 50-year period.

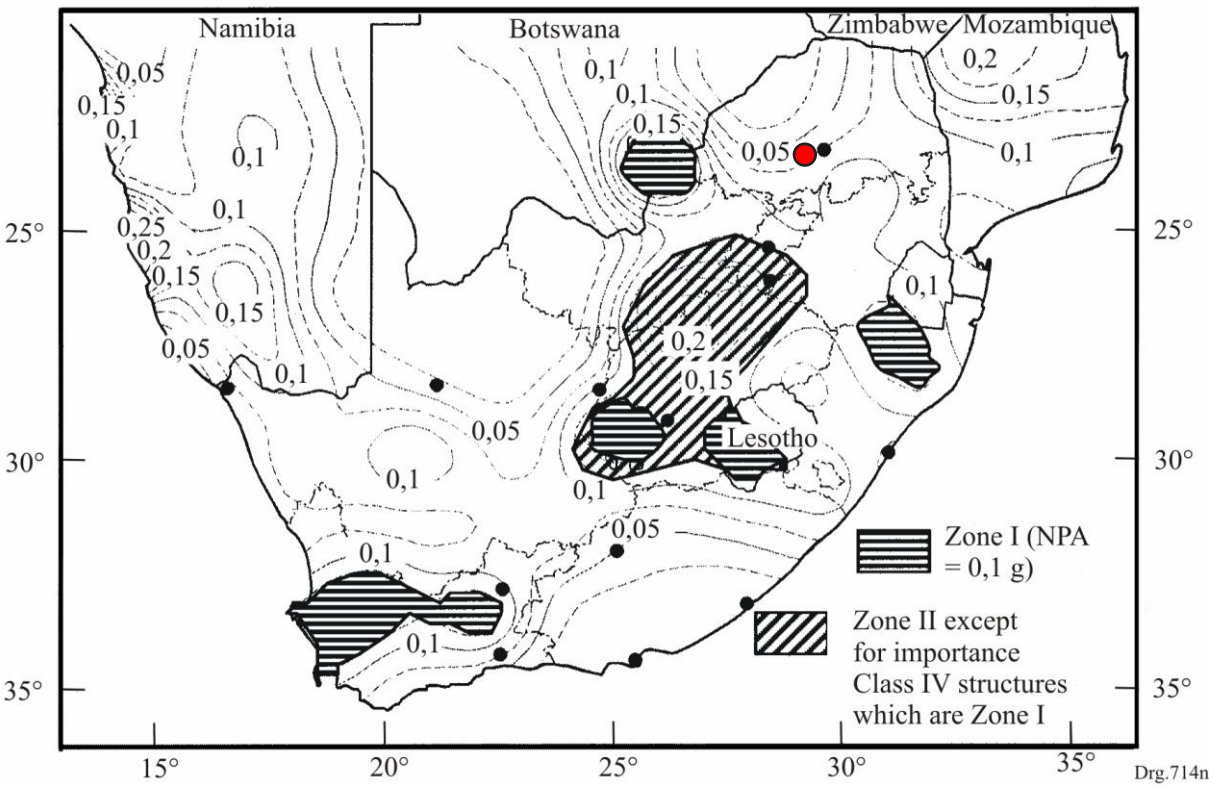

Figure 5 SANS 10160-4:2011 seismic hazard map of South Africa showing peak ground acceleration with 10% probability of being exceeded in a 50-year period (SABS, 2011)

6 Previous Geotechnical Investigation

Reference was made to the report of a previous geotechnical investigation conducted for the proposed Sekuruwe WTW, as reported by WSM Leshika Consulting (2016). The investigation covered the currently proposed location of the site, with the test pit locations shown in Figure 6. Eleven (11 no.) test pits were excavated, nine (9 no.) of which were within the current site boundary with two (2 no.) located just outside of the site boundary. The test pits were excavated with an excavator.

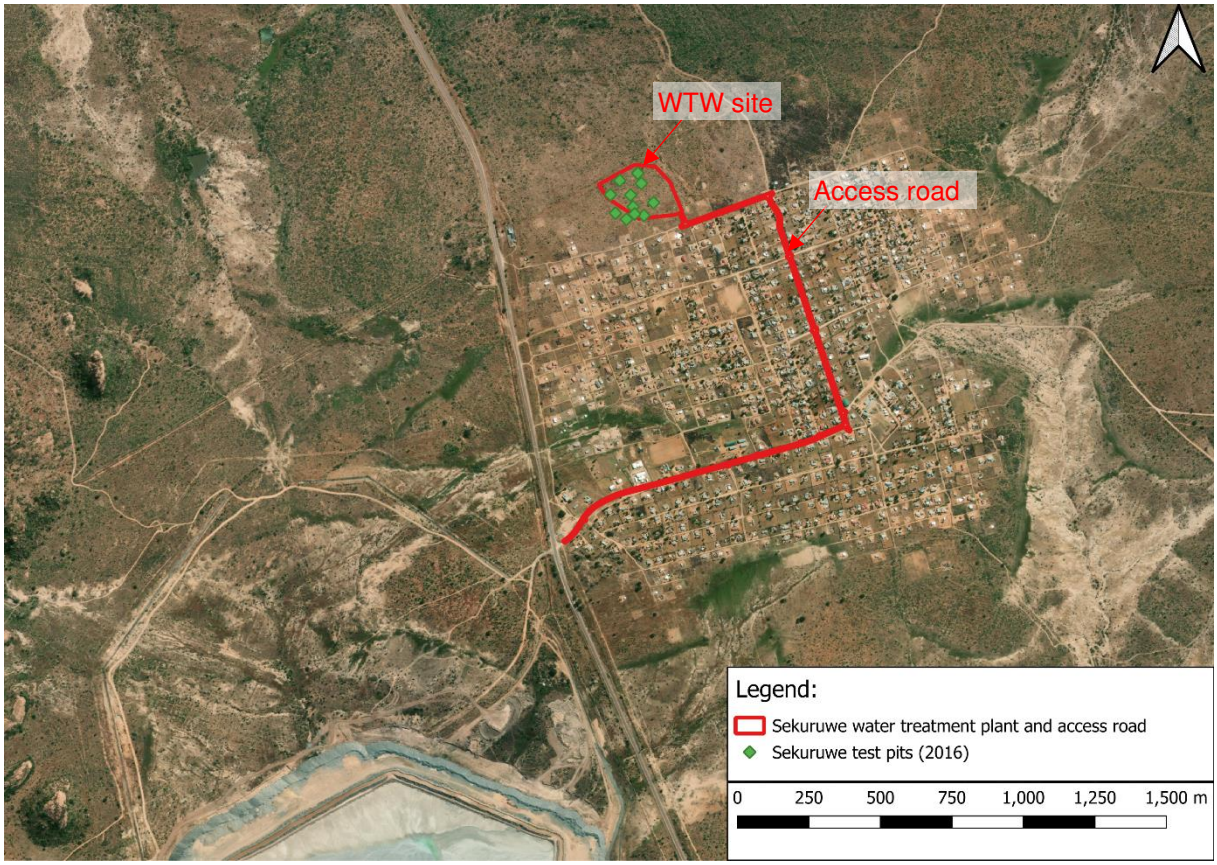

Figure 6 Test pit locations of previous geotechnical investigation study (QGIS Development Team, 2023)

6.1 Soil profile

The ground profile from the eleven (11 no.) test pits is summarised in Figure 7, and a photograph of a typical test pit profile (test pit 8) is shown in Figure 8. An excavator was used to excavate the test pits and a maximum depth of 2.4m was reached due to restricted refusal (refusal on the width of the test pit). From surface, a shallow horizon of topsoil, slightly organic reworked topsoil, and pebble marker horizon was encountered up to a depth of 0.3 m to 0.5 m. The material comprised of either silty sandy gravel or gravelly silty sand and was described with overall consistency of medium dense. WSM Leshika Consulting (2016) reported that the soils found within the region are generally associated with collapse, however, the relatively thin thickness of the layer at the proposed site mitigates the risk of such soils.

Below the upper soil, residual to completely weathered granite was encountered in nine of the eleven test pits. The material was described as dense, sandy gravel to gravelly sand, and the depth ranged from 0.45 m to 0.9 m below ground level. Test pits 10 and 11 did not have a residual granite layer and were directly on bedrock.

Below the residual granite layer, granite was encountered, varying in hardness from very soft rock to medium hard rock with increasing depth. The excavator terminated at depths ranging from 0.6 m to 2.4 m due to restricted refusal (refusal on the width of the test pit). The granite was typically described as very highly to moderately fractured and jointed, medium to coarse grained granite. The rock hardness at refusal depth was assigned an ISRM grade of R2 (weak rock). In general, the excavation conditions at termination depth were described as ‘intermediate’ according to the South African code for earthworks, SABS 1200 D-1988 (SABS, 1988), however this is deemed likely to increase to ‘hard’ within a small depth because of the increase in rock strength, and decrease of rock weathering, with depth.

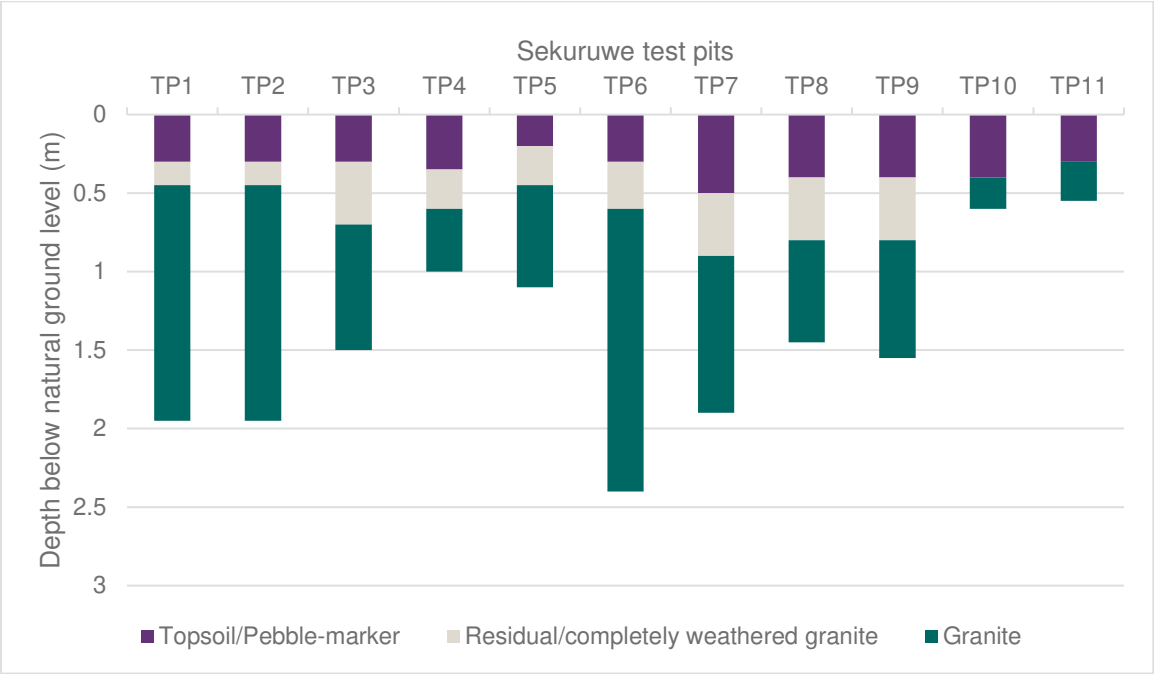

Figure 7 Test pit investigation of water treatment area (as reported by the Geotechnical investigation report (WSM Leshika Consulting, 2016)

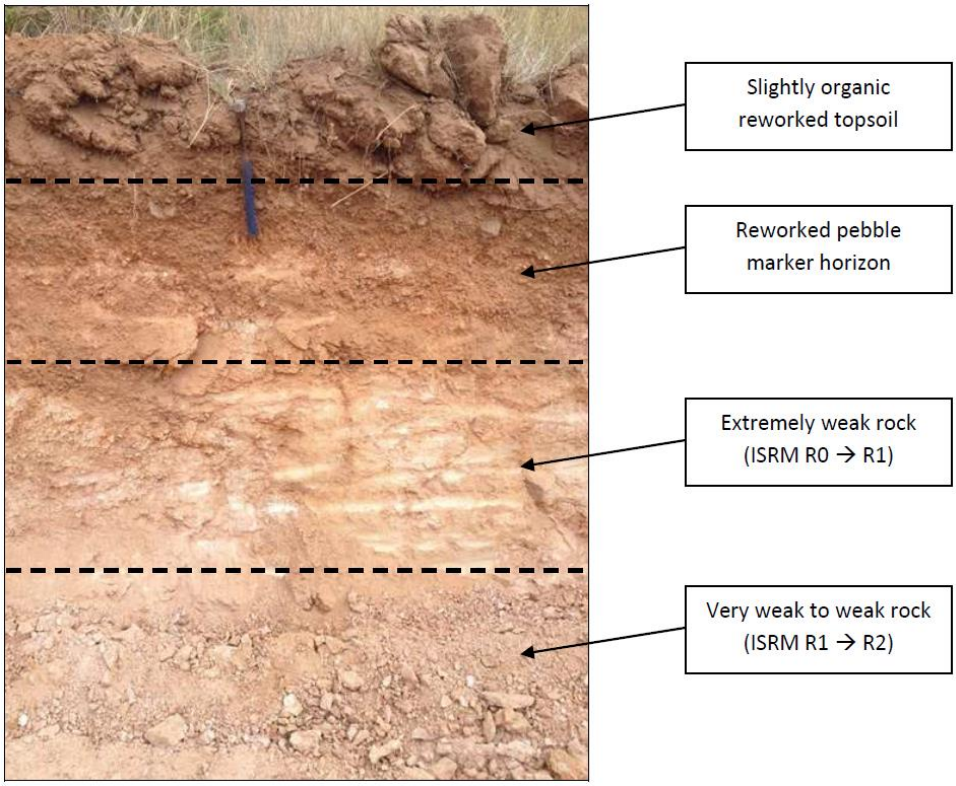

Figure 8 Test pit 8 typical soil profile (WSM Leshika Consulting, 2016)

During the field inspection by WSM Leshika Consulting (2016), numerous localised granite outcrops were identified at the proposed site. The shallower bedrock conditions encountered can be seen in Figure 9. The varying depths of bedrock within the site indicates undulating bedrock in the area.

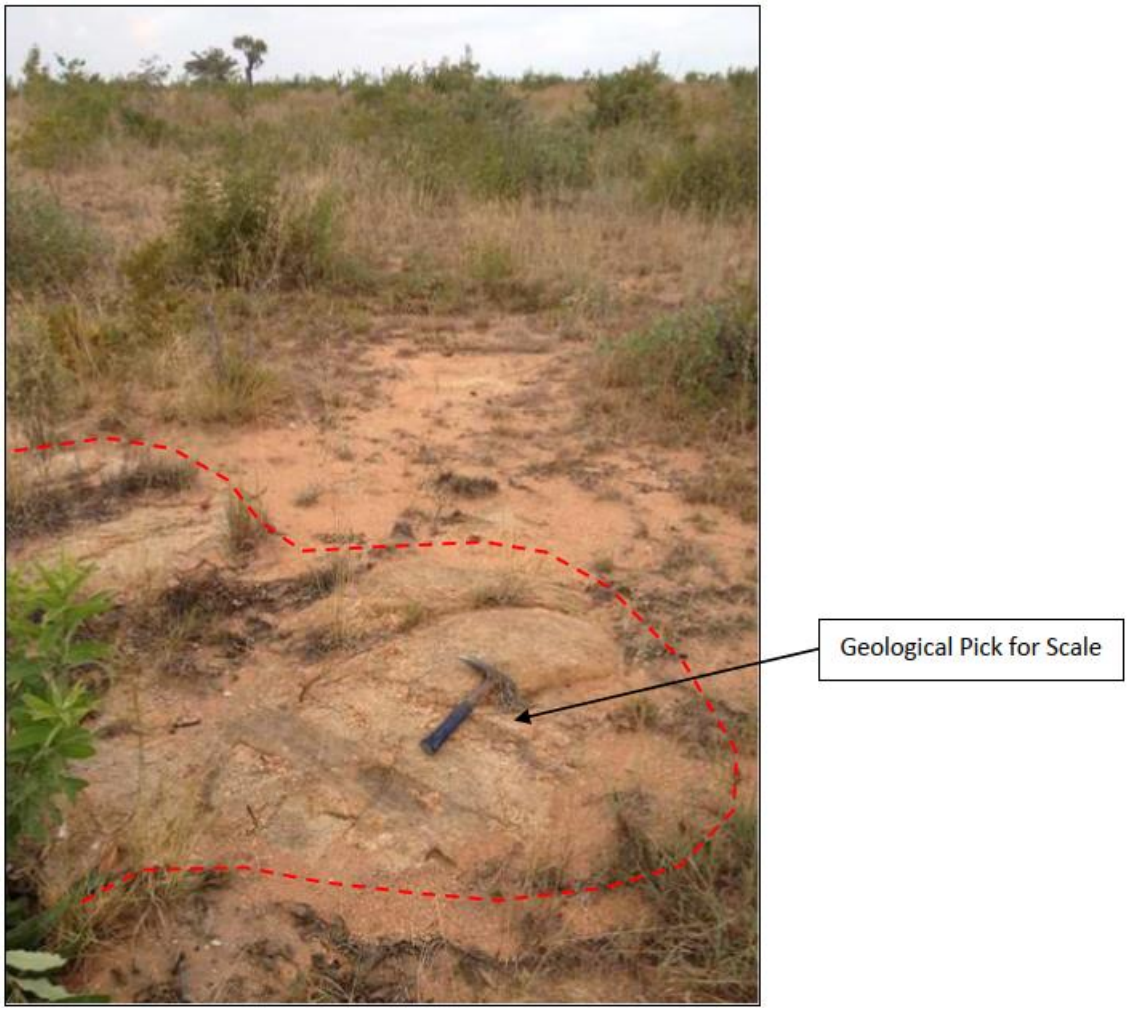

Figure 9 Localised granite outcrop at proposed Sekuruwe water treatment site

6.2 Groundwater

In the WSM Leshika Consulting (2016) geotechnical investigation, no groundwater was encountered during excavation of the test pits and no indications of prolonged waterlogged conditions were identified during inspection of the test pits. However, the test pits were limited to a maximum depth of 2.4 m and the location of the groundwater table below this depth is unknown.

6.3 Laboratory Results

Three (3 no.) soil samples were tested from the test pits, one sample from the upper soil layer (topsoil and pebble marker), and two samples from the weathered granite layer. All the materials classified as GW-GP as per the Unified Soil Classification System (USCS). The California Bearing Ratio (CBR) of the weathered granite ranged from 18% to 20% at 93% Mod AASHTO, and the TRH14 classification was G7. For the upper soil layer, the CBR resulted in 31% at 93% Mod AASHTO, with a TRH14 classification of G6. Based on the limited testing, the materials are considered suitable for reuse as engineered fill.

7 Considerations

Geotechnical considerations relevant to the proposed site for the water treatment plant are discussed below:

- Upper soil erosion: Concentrated water flow during construction, as well as removal of the surrounding vegetation, may cause the upper soils to erode.
- Excavatability to founding level: Test pit excavations were all terminated at relatively shallow depths on rock. Depending on the required founding depths, excavations at the site will therefore likely be difficult and require pneumatic breakers or blasting.
- Undulating bedrock topography: Varying bedrock topography could create variable ground conditions below structures and thus require composite foundation systems. Similarly, in areas where platforms are constructed with fill, the fill is likely to be considerably more compressible than the surrounding competent granite, which could induce differential settlement.
- Perched water table: Although no evidence of a perched water table was found in the shallow geotechnical investigation done by WSM Leshika (2016), it should be noted that seepage might occur at deeper levels through water inflow from joints/discontinuities/fractures in the granite bedrock. Perched water tables could potentially occur during and after heavy rainfalls.
- Stability of cuts/fills: Stability of cuts and fills requires consideration for any excavations and platforms that may be required for the plant infrastructure. Excavation in the shallow rock conditions has potential for kinematic modes of failure, and this would have to be evaluated should there be such deep cuts.
- Material reuse: Based on the limited available laboratory test information, the upper materials at the site are suitable for reuse as selected engineered fill (G6 or G7).
- Collapse potential: The upper soil materials were reported as fairly intact; however, the materials in the area may be associated with collapse potential. Notwithstanding, considering that these upper materials were relatively thin across the site (shallow bedrock less than 1 m deep), the upper soil materials can feasibly be removed and replaced which mitigates the impact of potentially collapsible soils being present.
- Mining: From satellite imagery, there is mining in the area, which appears to be open pit mining. Should there be any underground mining, potential undermining of the site would need to be investigated.

In summary, from a geotechnical perspective, no fatal flaws that would inhibit the proposed development were identified at the site.

8 Conclusions and Recommendations

A geotechnical desktop study was conducted for the proposed site of the Sekuruwe water treatment works.

From the published geology map of the region, the underlying geology of the proposed site is expected to comprise grey muscovite-biotite gneiss, and no potentially soluble rock like dolomite is present. Shallow test pitting from a previous geotechnical investigation at the site encountered the presence of shallow granite rock, within approximately 1 m below ground level. This presents favourable conditions for founding of infrastructure, but difficult excavation conditions that may require blasting. The topography of the site is relatively gentle with an approximate slope of 3.7°, which may mitigate the amount of cut and fill that is required. Notwithstanding, from a geotechnical perspective, no fatal flaws that would inhibit the proposed development were identified at the site.

Given the presence of favourable ground conditions at the site, only limited additional geotechnical investigations may be necessary. The extent of additional investigations is however dependent on the details of the proposed infrastructure at the site, which were not available at the time of preparing this document. For example, if deep excavations are required, the drilling of rotary core boreholes would

be recommended to determine aspects such the frequency and properties of discontinuities, details of which would be required for rock slope stability assessments. The extent of additional investigations, such as site walkovers with mapping of rock outcrops, excavating of test pits, drilling of rotary core boreholes, and laboratory testing, must be determined once the proposed infrastructure at the site is known. The quantity and extent of the geotechnical investigation will take into consideration the chosen site, the details of the infrastructure, and the stage of development, be it feasibility or concept design or detailed design.

9 References

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