

## *Geohydrological assessment – three memorial parks, Stellenbosch Municipality*

### **REPORT:**

GEOSS Report No: 2017/11-03

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## **EXECUTIVE SUMMARY**

The Stellenbosch Municipality urgently requires additional burial sites (also known as Memorial Parks) to service the larger Stellenbosch Municipal area. In order to meet expected requirements, three sites of approximately 30 ha each, have been selected after a rigorous selection process. Initially nine sites were under consideration. The memorial parks will be expanded cemeteries, which will allow significant leeway for walkways and landscaping (which could take the form of natural corridors).

GEOSS was tasked to complete a preliminary geohydrological study of three potential sites. The three sites are:

- Calcutta (as an alternative for De Novo): Remainder of Farm Calcutta No. 29, approximately 39 ha in size.
- Louw se Bos (Central District): Remainder of Farm 502, approximately 217 ha in size.
- Meer Lust (Eastern District): Portion 1 of the Farm Meer Lust No. 1006, approximately 67 ha in area.

The Calcutta site is located north of Stellenbosch on shales of the Malmesbury Group thus the groundwater occurrence is very limited and groundwater quality will be slightly saline. There is no known groundwater use in the area and the area has a “medium” groundwater vulnerability rating. There are no known geological faults in the area.

The Louw se Bos site is located south of Stellenbosch in the vicinity of the Stellenbosch airfield. The site is located on granite, where groundwater does occur and there are high-yielding boreholes, with good groundwater quality, to the south of the site. The site has a “medium-high” groundwater vulnerability rating.

The Meer Lust site, is located in the Boschendal area, to the north-west of Stellenbosch, and is located on granite. There are high yielding boreholes on and close to the site due to the presence of geological faults. A recently drilled borehole is planned for municipal use. The groundwater vulnerability rating is “very high”.

Based on the above information, from a geohydrological perspective, the Calcutta site is the most favourable and the Meer Lust site the least favourable.

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## ABBREVIATIONS

CFB	Cape Fold Belt
ch	collar height
DWA	Department of Water Affairs (2010 - 2014)
DWAF	Department of Water Affairs and Forestry (pre- 2010)
DWS	Department of Water and Sanitation (2014 - current)
ERMD	Environmental Resource Management Department
ha	hectare
L/s	litres per second
m	metres
MAE	Mean Annual
mamsl	metres above mean sea level
MAP	Mean Annual Precipitation
MAR	Mean Annual Runoff
mbch	metres below collar height
mbgl	metres below ground level
mg/ℓ	milligrams per litre
Mm/a	millimetres per annum
mS/m	milliSiemens per meter
NGA	National Groundwater Archive
TMG	Table Mountain Group
WGS84	Since the 1st January 1999, the official co-ordinate system for South Africa is based on the World Geodetic System 1984 ellipsoid, commonly known as WGS84.

## GLOSSARY OF TERMS

- Aquifer:** a geological formation, which has structures or textures that hold water or permit appreciable water movement through them [from National Water Act (Act No. 36 of 1998)].
- Borehole:** includes a well, excavation, or any other artificially constructed or improved groundwater cavity which can be used for the purpose of intercepting, collecting or storing water from an aquifer; observing or collecting data and information on water in an aquifer; or recharging an aquifer [from National Water Act (Act No. 36 of 1998)].
- Fractured aquifer:** Fissured and fractured bedrock resulting from decompression and/or tectonic action. Groundwater occurs predominantly within fissures and fractures.
- Groundwater:** water found in the subsurface in the saturated zone below the water table or piezometric surface i.e. the water table marks the upper surface of groundwater systems.

- Hydraulic conductivity: measure of the ease with which water will pass through earth material; defined as the rate of flow through a cross-section of one square metre under a unit hydraulic gradient at right angles to the direction of flow (in m/d)
- Intergranular Aquifer: Generally unconsolidated but occasionally semi-consolidated aquifers. Groundwater occurs within intergranular interstices in porous medium. Typically occur as alluvial deposits along river terraces.
- Intergranular and fractured aquifers: Largely medium to coarse grained granite, weathered to varying thicknesses, with groundwater contained in intergranular interstices in the saturated zone, and in jointed and occasionally fractured bedrock.
- Transmissivity: the rate at which a volume of water is transmitted through a unit width of aquifer under a unit hydraulic head ( $\text{m}^2/\text{d}$ ); product of the thickness and average hydraulic conductivity of an aquifer.
- Vadose zone: the unsaturated zone above the water table and below the ground surface.

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**Suggested reference for this report:**

GEOSS (2017). Geohydrological assessment – three memorial parks, Stellenbosch Municipality. Report Number 2017/11-03. GEOSS - Geohydrological & Spatial Solutions International (Pty) Ltd. Stellenbosch, South Africa.

**Cover photo:**

Google Earth map showing the three study sites.

**GEOSS project number:**

2015\_07-1490

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## 1. INTRODUCTION

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Stellenbosch Municipality urgently requires additional burial sites (also known as Memorial Parks) to service the larger Stellenbosch Municipal area. In order to meet expected requirements, three sites of approximately 30 ha each, have been selected after a rigorous selection process. Initially nine sites were under consideration. The memorial parks will be expanded cemeteries, which will allow significant leeway for walkways and landscaping (which could take the form of natural corridors).

GEOSS was tasked to complete a preliminary geohydrological study of three potential sites. The three sites are:

- Calcutta (as an alternative for De Novo): Remainder of Farm Calcutta No. 29, approximately 39 ha in size.
- Louw's Bos (Central District): Remainder of Farm 502, approximately 217 ha in size.
- Meer Lust (Eastern District): Portion 1 of the Farm Meer Lust No. 1006, approximately 67 ha in area.

## 2. TERMS OF REFERENCE

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The prime objective of the project is to determine the geohydrological setting of the proposed Memorial Parks by means of a desktop GIS feasibility study as well as on-site assessments. A visit to the sites was completed on 28 June 2017.

## 3. THE “CALCUTTA” SITE

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The site is approximately 6 km north of Stellenbosch just to the east of the R304 (**Map 1, Appendix A**). The site is not developed at all and is heavily infested with alien vegetation. It is of low relief and quite a flat area (**Map 2, Appendix A**).

### 3.1 *Geology*

The proposed memorial park is located on surficial Quaternary (Qg) geology. The Quaternary is characterised by loam and sandy loam material. The bedrock mainly comprises of shale and phyllites of the Tygerberg Formation of the Malmesbury Group (**Map 3, Appendix A**).

### 3.2 *Hydrogeology*

The proposed Memorial Park site is located on an aquifer which is classified as a “fractured” aquifer i.e. fissured and fractured bedrock resulting from decompression and/or tectonic action. Groundwater occurs predominantly within fissures and fractures. If a borehole was drilled within this site, the borehole yield may be in the region of 0.5 to 2 L/s (**Map 4, Appendix A**).

The estimated groundwater quality of the site is good, with expected electrical conductivity values of 0 – 70 mS/m. Without drilling a borehole on or close to the site it is difficult to know the groundwater quality with a high degree of certainty. The authors believe the groundwater quality at the proposed site will be of good quality, from a domestic use point of view, although borehole yields are likely to be low (**Map 5, Appendix A**).

### 3.3 Hydrology

A small northeast / southwest water course, a tributary to the Plankenburg river, flows to the east of the proposed memorial site. Flow within this watercourse will only occur during heavy rainfall events. Adjacent to the watercourse, to the north-east of the proposed Memorial Park, an agricultural dam is located.

### 3.4 Groundwater use and vulnerability

The proposed memorial park is located within a mostly an agricultural region. Based on the agricultural dams in the region the agricultural sector utilizes mostly surface water to supply their needs. A search of the National Groundwater Archive (NGA) indicated that there are no registered boreholes within 1 km of the proposed site.

A national groundwater vulnerability map was developed using the DRASTIC methodology. The DRASTIC system is the most widely method used to evaluate intrinsic vulnerability for a wide range of potential contaminants. It is an overlay and index model designed to produce vulnerability scores by combining several thematic maps. It was originally developed in USA under cooperative agreement between the National Water Well Association (NWWA) and the US Environmental Protection Agency (EPA) for detail hydrogeological evaluation of pollution potential (Aller et al. 1987). The word DRASTIC is acronym for most important factors within the hydrogeological settings which control groundwater pollution. Hydrogeological setting is a composite description of all major geologic and hydrogeological factors which affect the groundwater movement into, through, and out of the area. These factors are:

- depth to water,
- net recharge,
- aquifer media,
- soil media,
- topography (slope),
- impact of vadose zone, and
- hydraulic conductivity.

The DRASTIC numerical ranking system contains three major parts: weights, ranges, and ratings.

The proposed study site is on an area classified as having a “medium” groundwater vulnerability rating.

## 4. THE “LOUW SE BOS” SITE

In 1974, Alan Stuart and Arthur Albertyn succeeded in obtaining a lease for land from Stellenbosch Municipality. This property, known to the locals as “Louw se Bos”, was a pine tree plantation situated next to the R 44 between Stellenbosch and Somerset West. This land was slowly developed into the premises for the Stellenbosch Flying Club. There is also municipal land in this area and it is also being considered as a “Memorial Park” option.

### 4.1 *Geology*

The proposed Memorial Park is located on surficial Quaternary geology. The Quaternary is characterised by clay sandy loam or weathered granite material. The bedrock mainly comprises of granite and deposits of the weathering products of granite of the Kuils River-Helderberg Pluton of the Cape Granite Suite.

### 4.2 *Hydrogeology*

The proposed memorial park is located on an aquifer which is classified as an “intergranular and fractured” aquifer i.e. fissured and fractured bedrock resulting from decompression and/or tectonic action. Groundwater occurs predominantly between gravel and sand grains as well as within fissures and fractures. If a borehole was drilled within this site, the borehole yield may be in the region of 0.1 to 0.5 L/s. However there are high yielding boreholes south of the site with yields in the region of 2 – 5 L/s.

The estimated groundwater quality of the site is good, with expected electrical conductivity values of 0 – 70 mS/m. Groundwater does occur to the south of the site and the abstracted groundwater is of good quality ( $EC < 71$  mS/m).

### 4.3 *Hydrology*

Immediately to the south-south-east of the proposed memorial park several dams occur. The dams contain water throughout the year and are mainly used for agricultural purposes.

### 4.4 *Groundwater use*

The proposed Memorial Park is located within a mostly agricultural region. Based on the number of agricultural dams in the region the agricultural sector utilized mostly surface water to supply their needs. However immediately to the south of the proposed Memorial Park there are exceptionally high yield boreholes of outstanding groundwater quality (as mentioned above).

### 4.5 *Groundwater vulnerability*

The groundwater vulnerability rating for the area is “medium-high”.



## 5. THE “MEER LUST” SITE

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### 5.1 *Geology*

The surficial geology is characterised as alluvial material, talus gravel, alluvial sand and gravel. The bedrock mainly comprises of granite of the Stellenbosch Pluton of the Cape Granite Suite.

### 5.2 *Hydrogeology*

The proposed Memorial Park site is located on an aquifer which is classified as a “fractured aquifer” i.e. fissured and fractured bedrock resulting from decompression and/or tectonic action. Groundwater occurs predominantly within fissures and fractures. If a borehole was drilled within this site, the borehole yield may be in the region of 0.1 to 0.5 L/s.

The estimated groundwater quality of the site is good, with expected electrical conductivity values of 0 – 70 mS/m. Without drilling a borehole on or close to the site it is difficult to know the groundwater quality with a high degree of certainty. The authors believe the groundwater quality at the proposed site will be of good quality, from a domestic use point of view.

### 5.3 *Hydrology*

A small north-east / south-west watercourse flows to the east of the proposed Memorial Park as well as a north-east / south-west watercourse to the north-west of the site. Flow within these watercourses will only occur during heavy rainfall events.

### 5.4 *Groundwater use*

The proposed Memorial Park is located within a mostly agricultural region. Based on the agricultural dams in the region the agricultural sector utilized mostly surface water to supply their needs and the Berg River is in close proximity to the site. A search of the NGA indicates that there are boreholes in close proximity to the site. The Rhodes Food Group has recently drilled two successful boreholes near the site and the Stellenbosch Municipality have recently drilled a high yielding borehole on the proposed site.

### 5.5 *Groundwater vulnerability*

The groundwater vulnerability rating for the site is “very high”. The implication of this rating is that the groundwater can easily be contaminated by any surface based contaminants.

## **6. RECOMMENDATIONS**

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The Calcutta site is located north of Stellenbosch on shales of the Malmesbury Group thus the groundwater occurrence is very limited and groundwater quality will be slightly saline. There is no known groundwater use in the area and the area has a “medium” groundwater vulnerability rating. There are no known geological faults in the area.

The Louw se Bos site is located south of Stellenbosch in the vicinity of the Stellenbosch airfield. The site is located on granite, where groundwater does occur and there are high-yielding boreholes, with good groundwater quality, to the south of the site. The site has a “medium-high” groundwater vulnerability rating.

The Meer Lust site, is located in the Boschendal area, to the north-west of Stellenbosch, and is located on granite. There are high yielding boreholes on and close to the site due to the presence of geological faults. A recently drilled borehole is planned for municipal use. The groundwater vulnerability rating is “very high”.

Based on the above information, from a geohydrological perspective, the Calcutta site is the most favourable and the Meer Lust site the least favourable.

## **7. ACKNOWLEDGEMENTS**

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The following people are gratefully thanked for their input and support into this project:

- Anelia Coetzee and Isak Rumboll for assistance with the project and field visits.

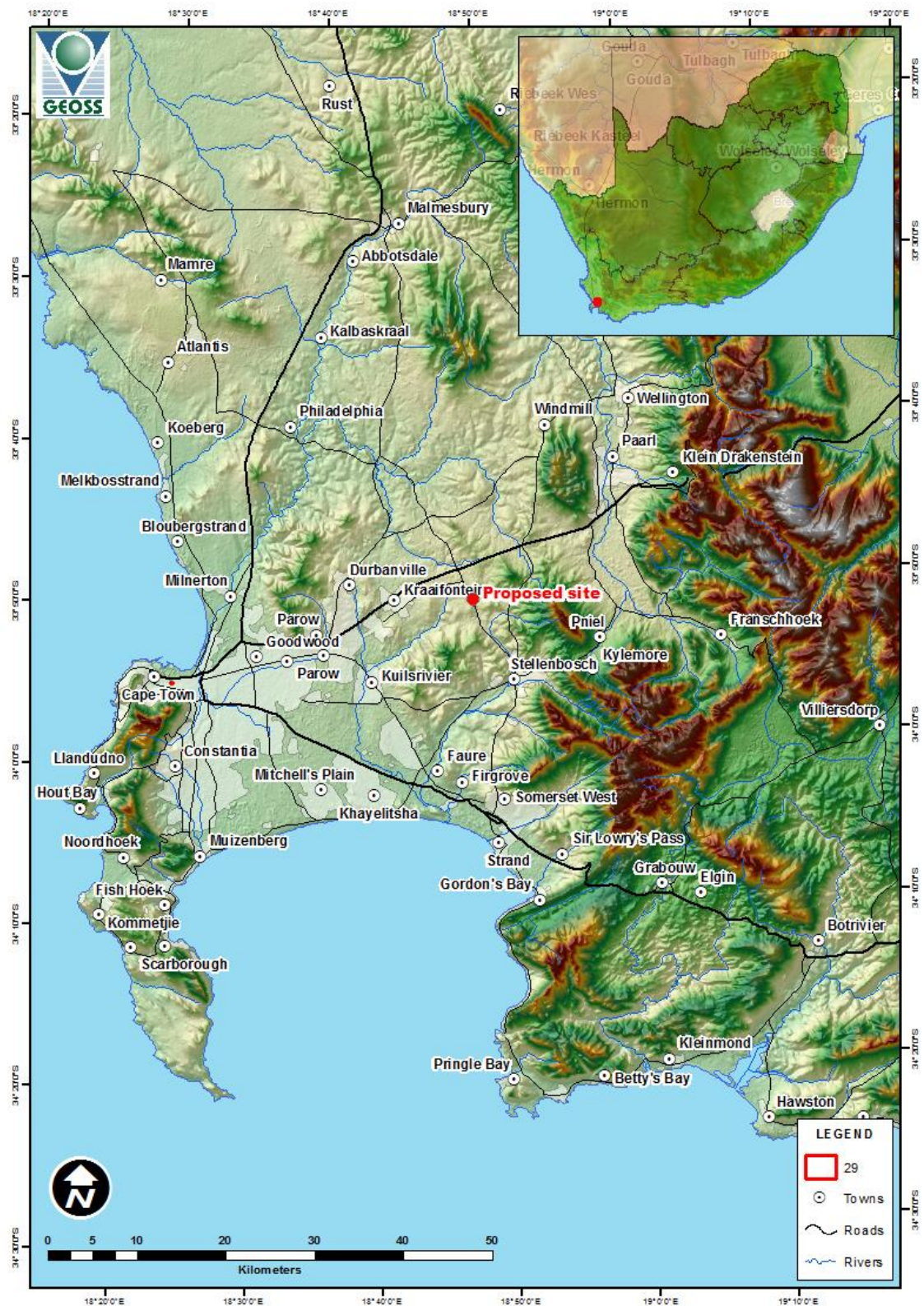
## **8. REFERENCES**

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- Aller L, Bennett T, Lehr J, Petty R, and Hackett G (1987) DRASTIC: A standardized system for evaluation ground water pollution potential using hydrogeological settings. National Water Well Association, Dublin, Ohio and Environmental Protection Agency, Ada, Ok. EPA-600/2-87-035.
- DWS, 2000. National scale mapping of groundwater conditions. Department of Water and Sanitation, Pretoria.
- DWS, 2005. Groundwater Resources Assessment Phase 2. Department of Water and Sanitation, Pretoria.

## **9. APPENDIX A: MAPS - CALCUTTA**

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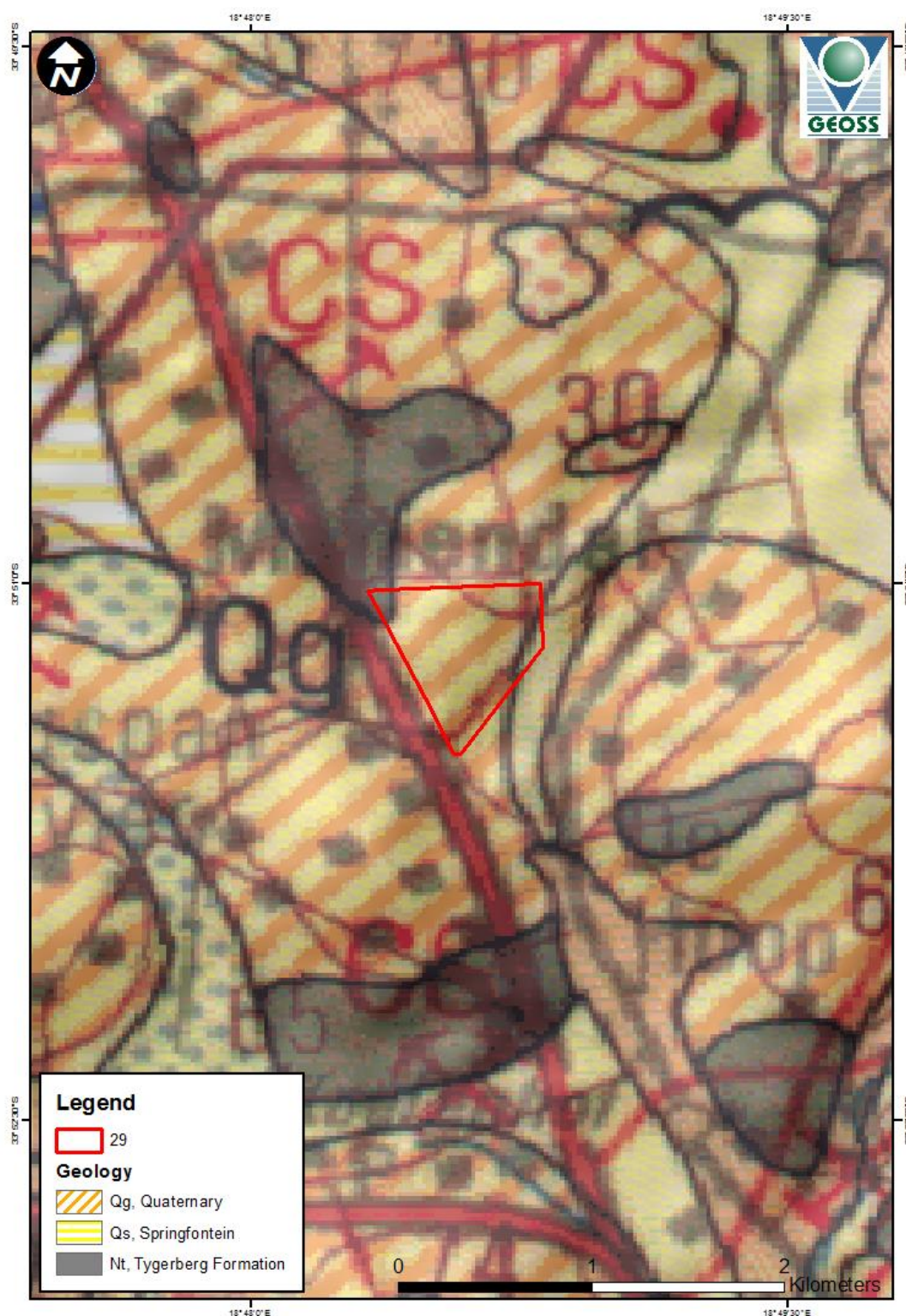


Map 1: Location of the Calcutta study area within a regional setting



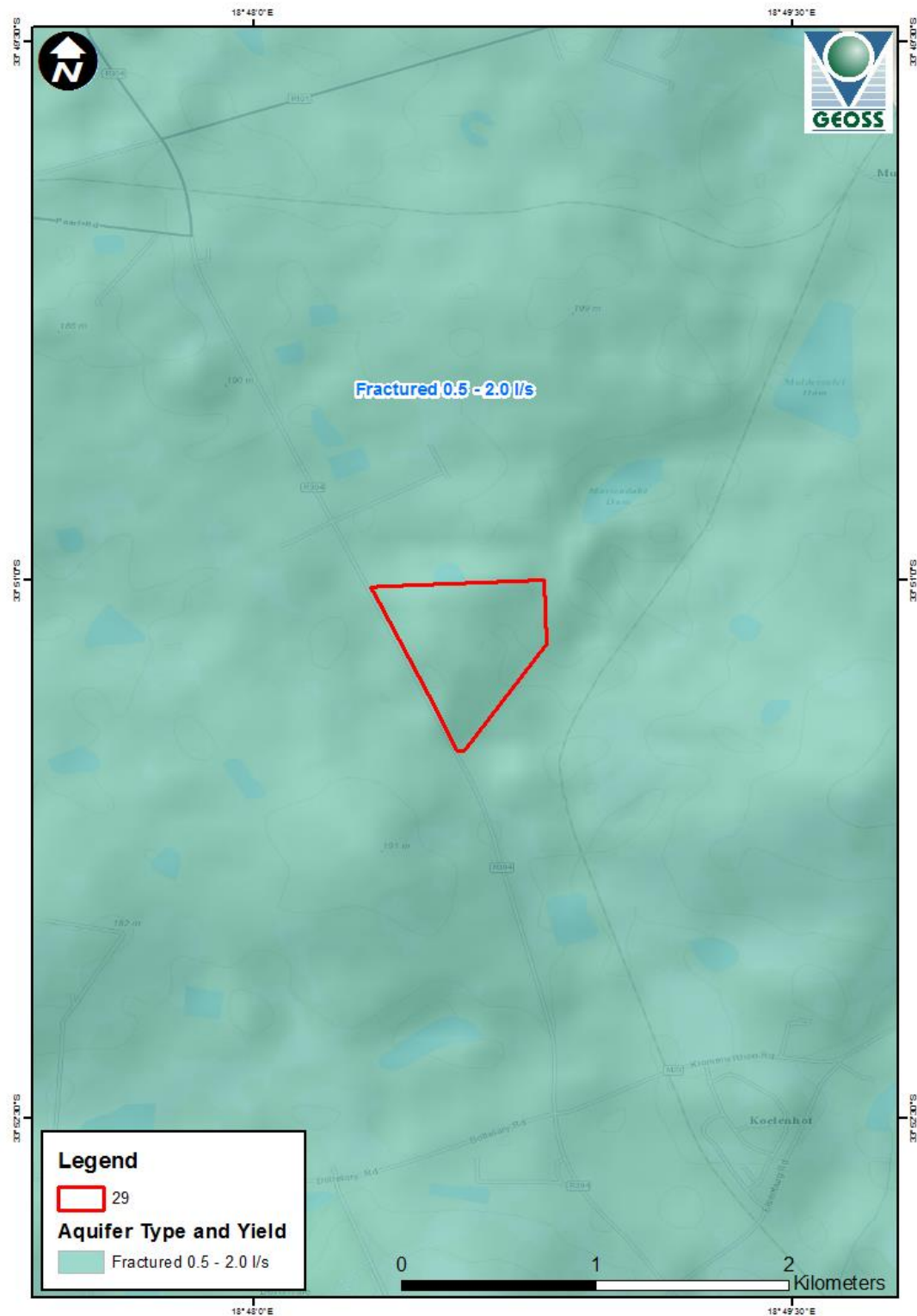


*Map 2: The Calcutta study site superimposed on an aerial photograph*

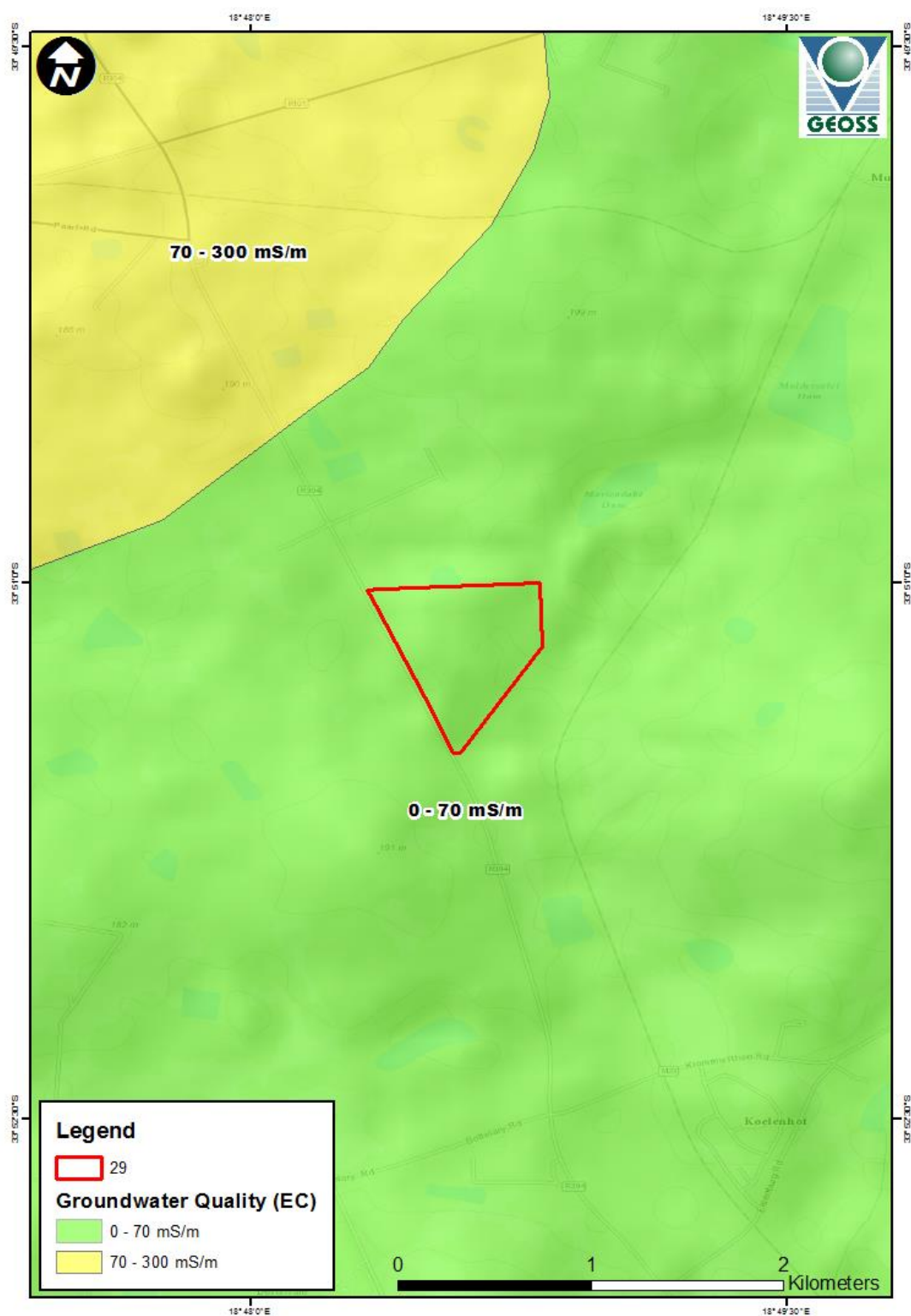


*Map 3: The Calcutta study site and superimposed on a 1:250 000 scale geological map (3318 Cape Town).*



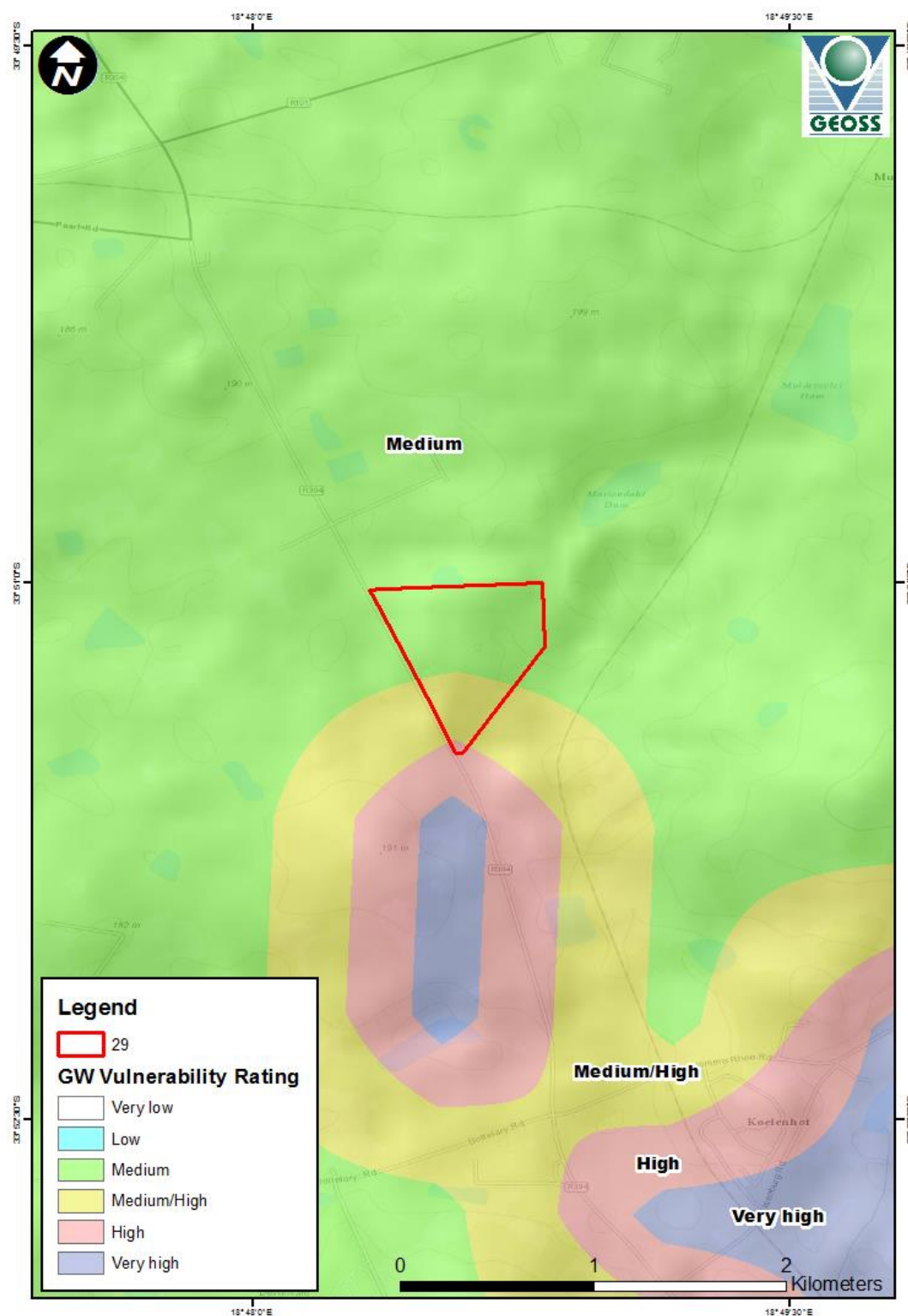


Map 4: Aquifer types of the Calcutta study area (1:500 000 scale DWS, 2000)



Map 5: Groundwater quality within the Calcutta study area (Electrical Conductivity in mS/m), (DWS, 2000).





Map 6: Groundwater vulnerability at the Calcutta site (DWS, 2005).

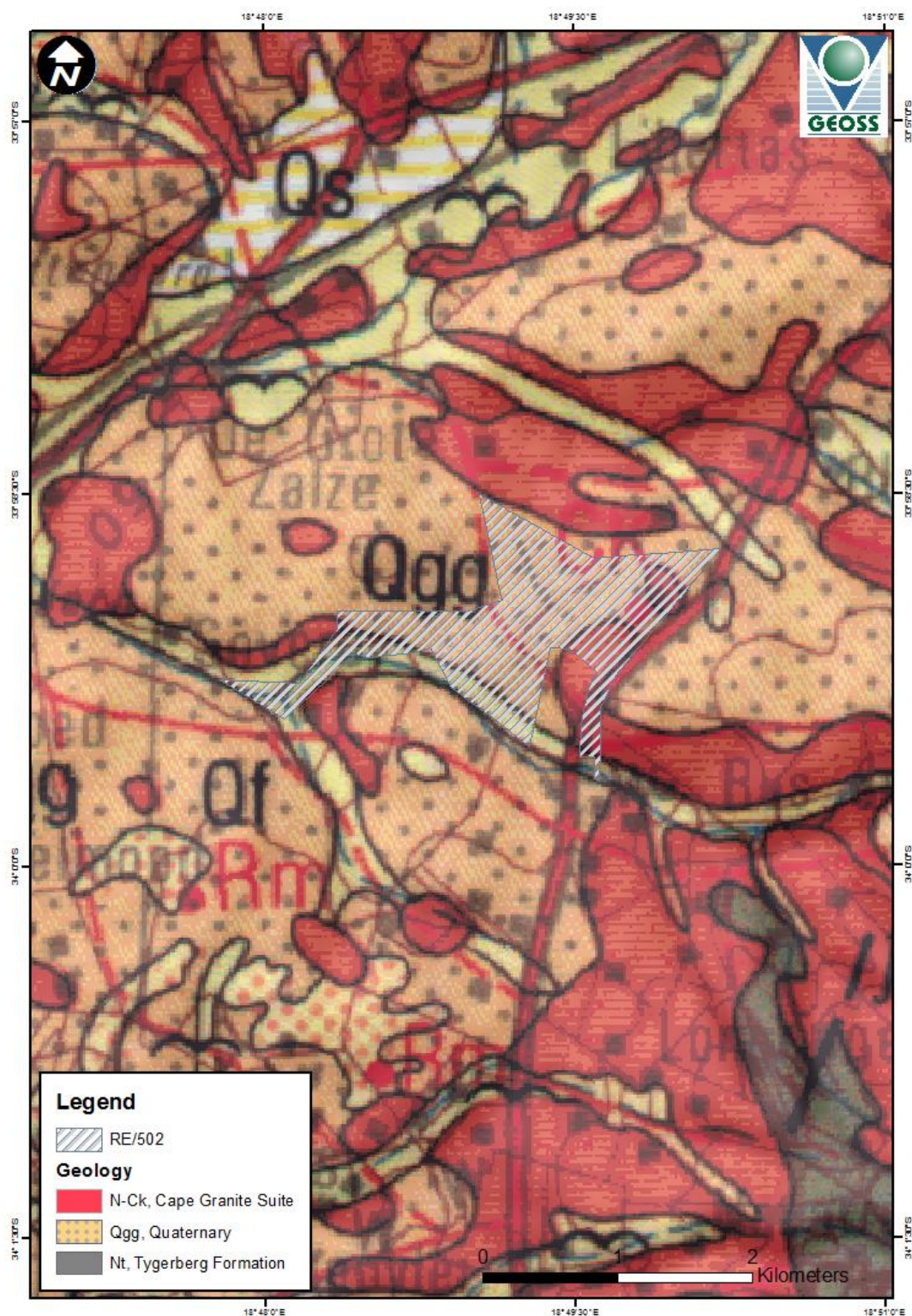
## **10. APPENDIX B: MAPS – LOUWS SE BOS**

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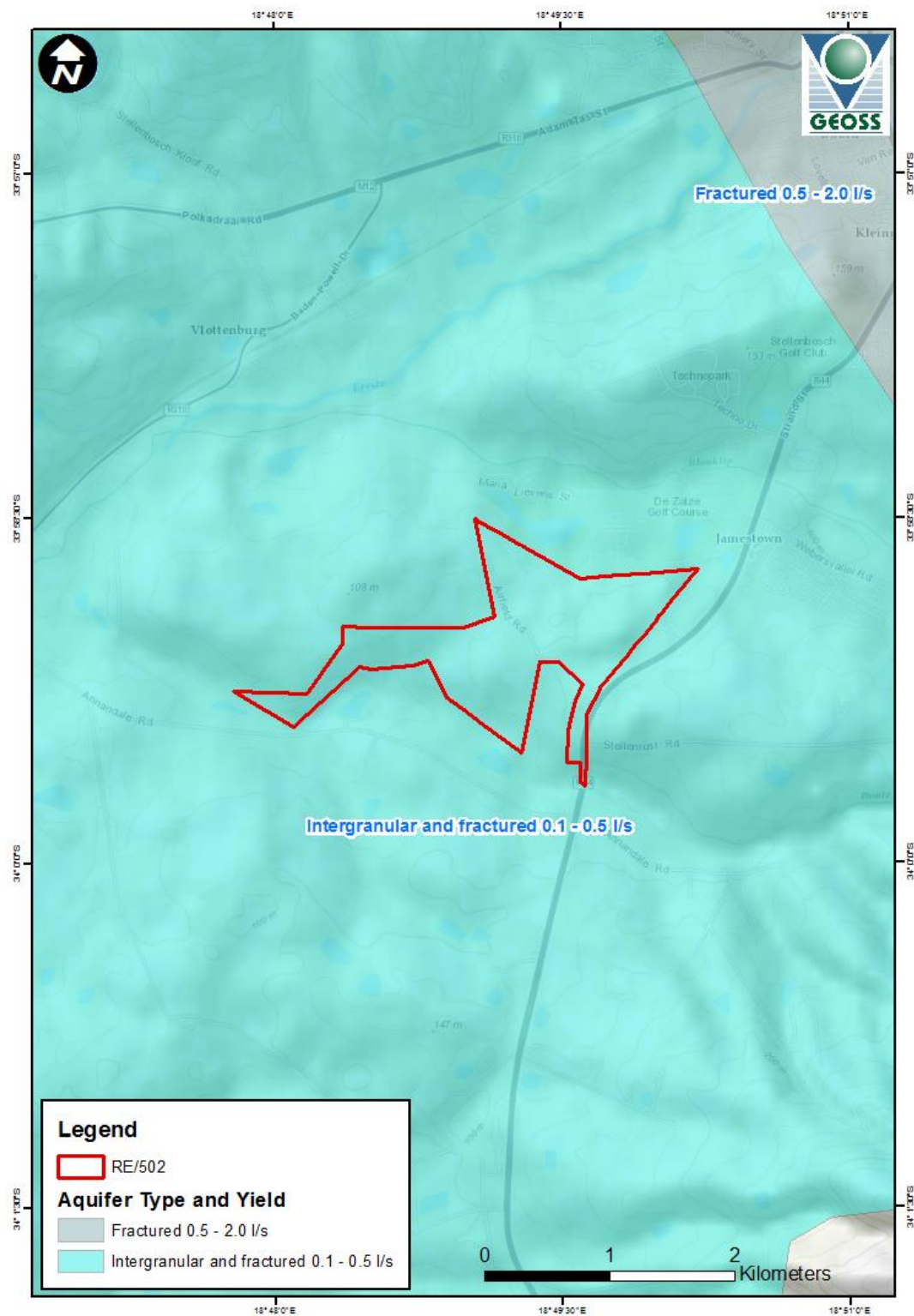


Map 7: Location of the Louw se Bos study area within a regional setting



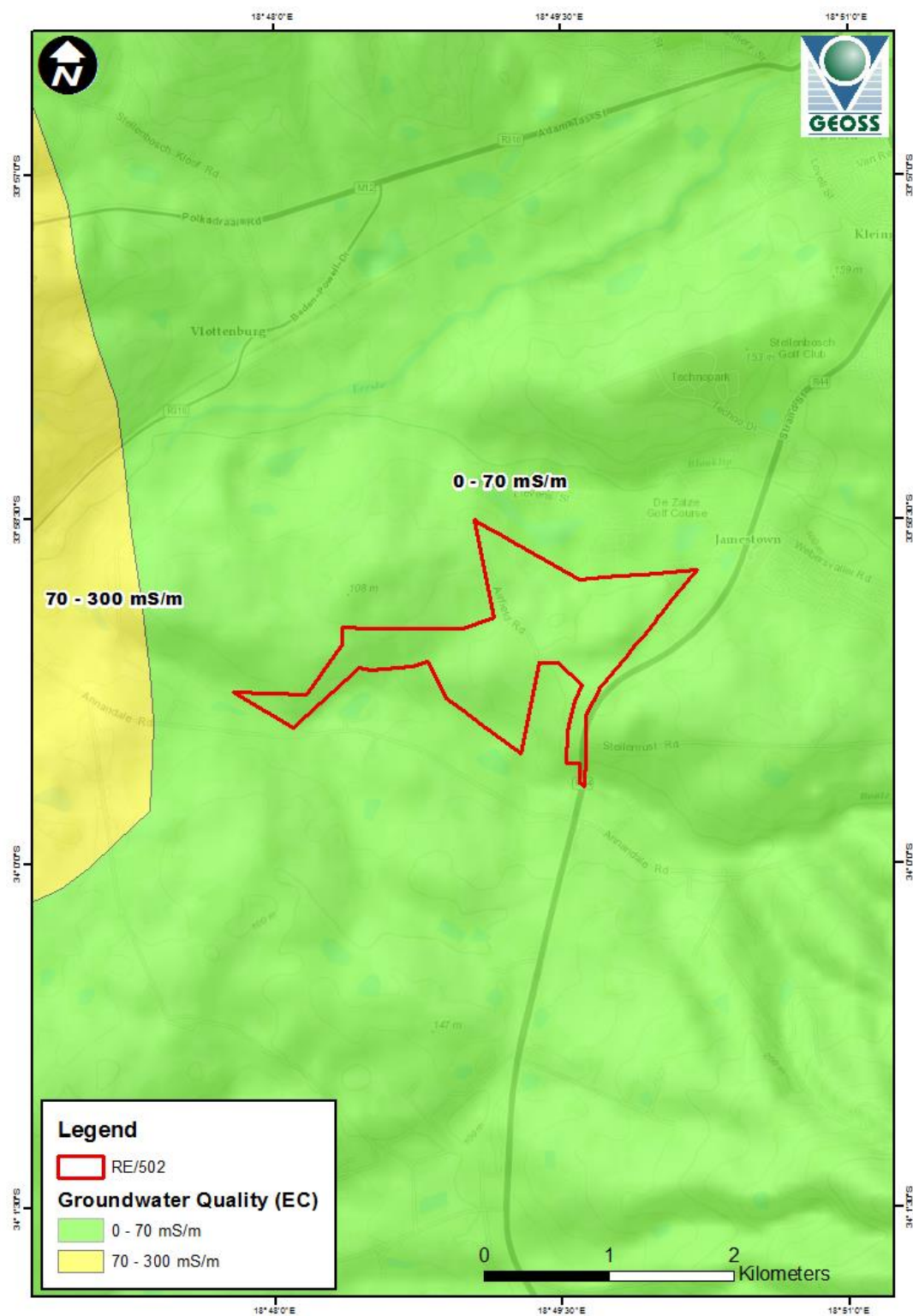


*Map 8: The Louw se Bos study site and superimposed on a 1:250 000 scale geological map (3318 Cape Town).*

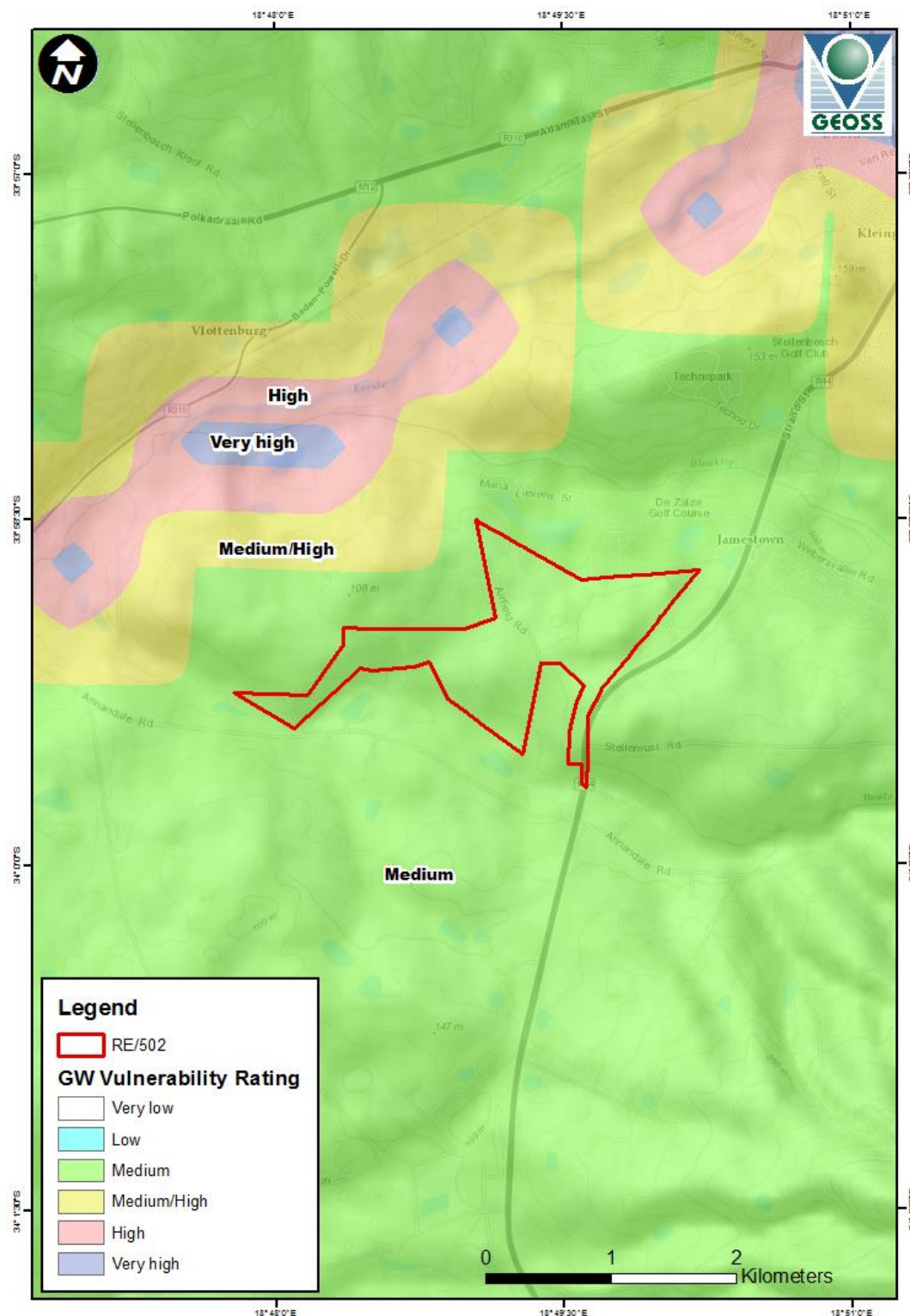


Map 9: Aquifer types of the Louw se Bos study area (1:500 000 scale DWS, 2000)





Map 10: Groundwater quality within the Louw se Bos study area (Electrical Conductivity in mS/m), (DWS, 2000).

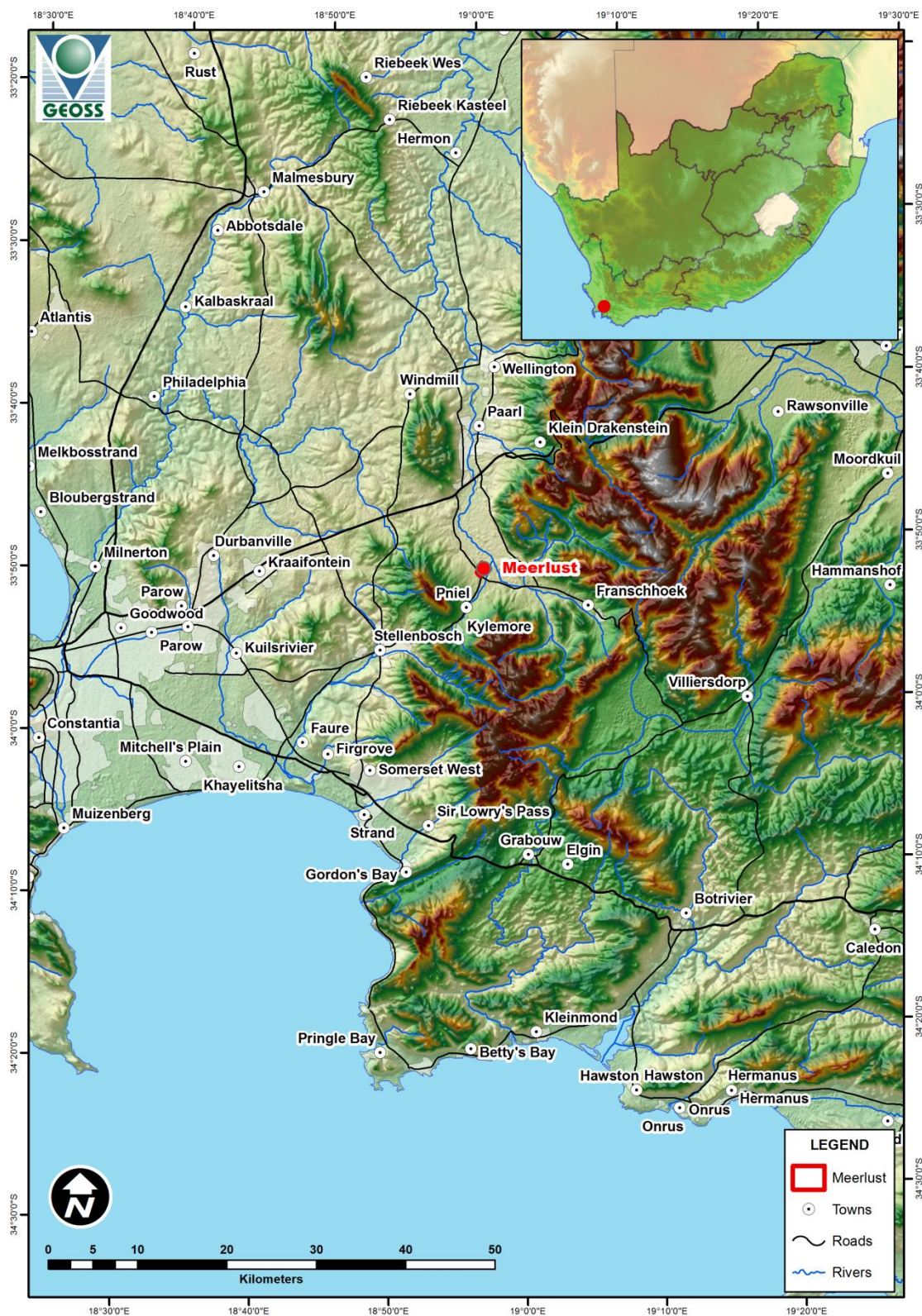


Map 11: Groundwater vulnerability at the Louw se Bos site (DWS, 2005).

## **11. APPENDIX C: MAPS – MEER LUST**

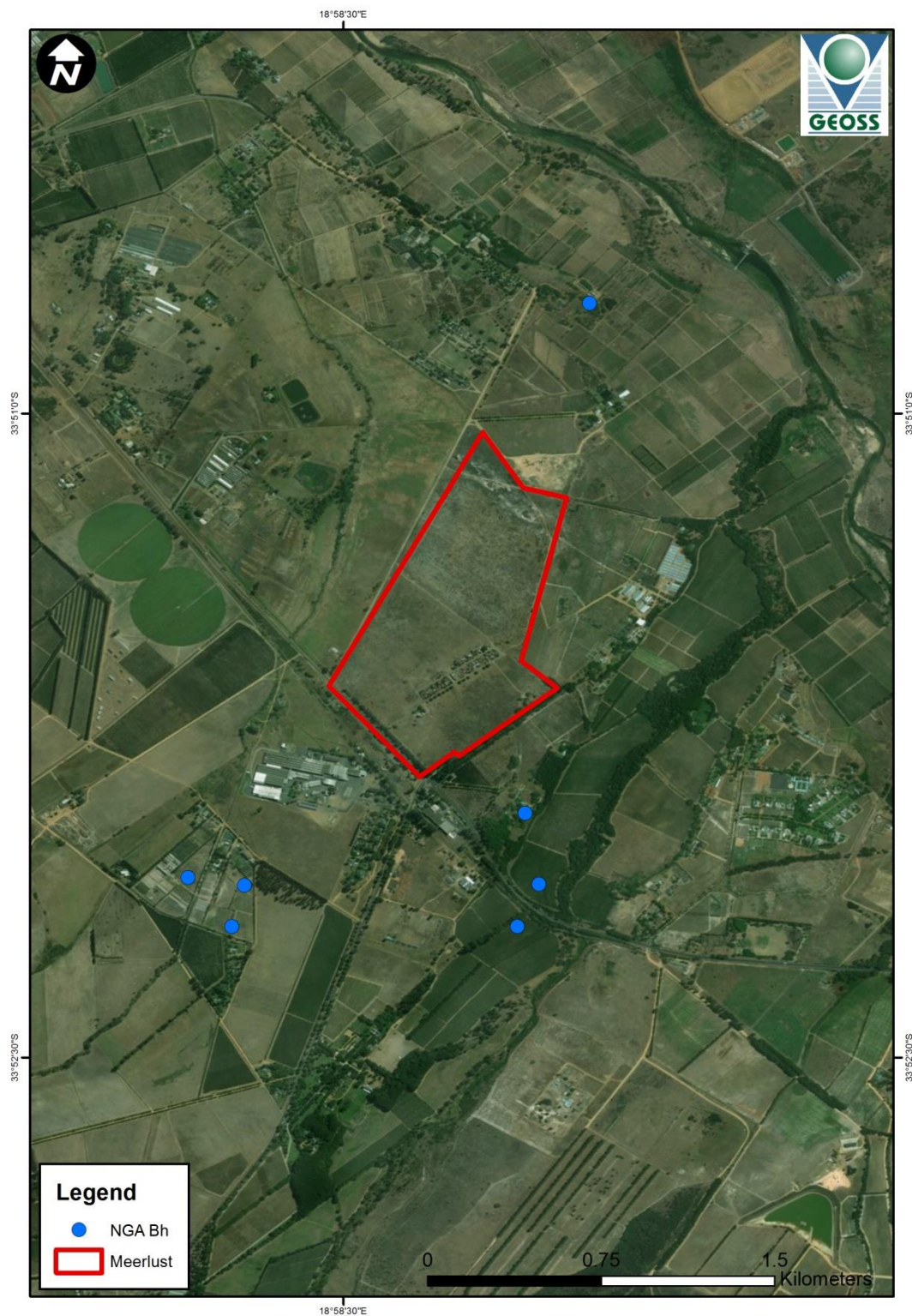
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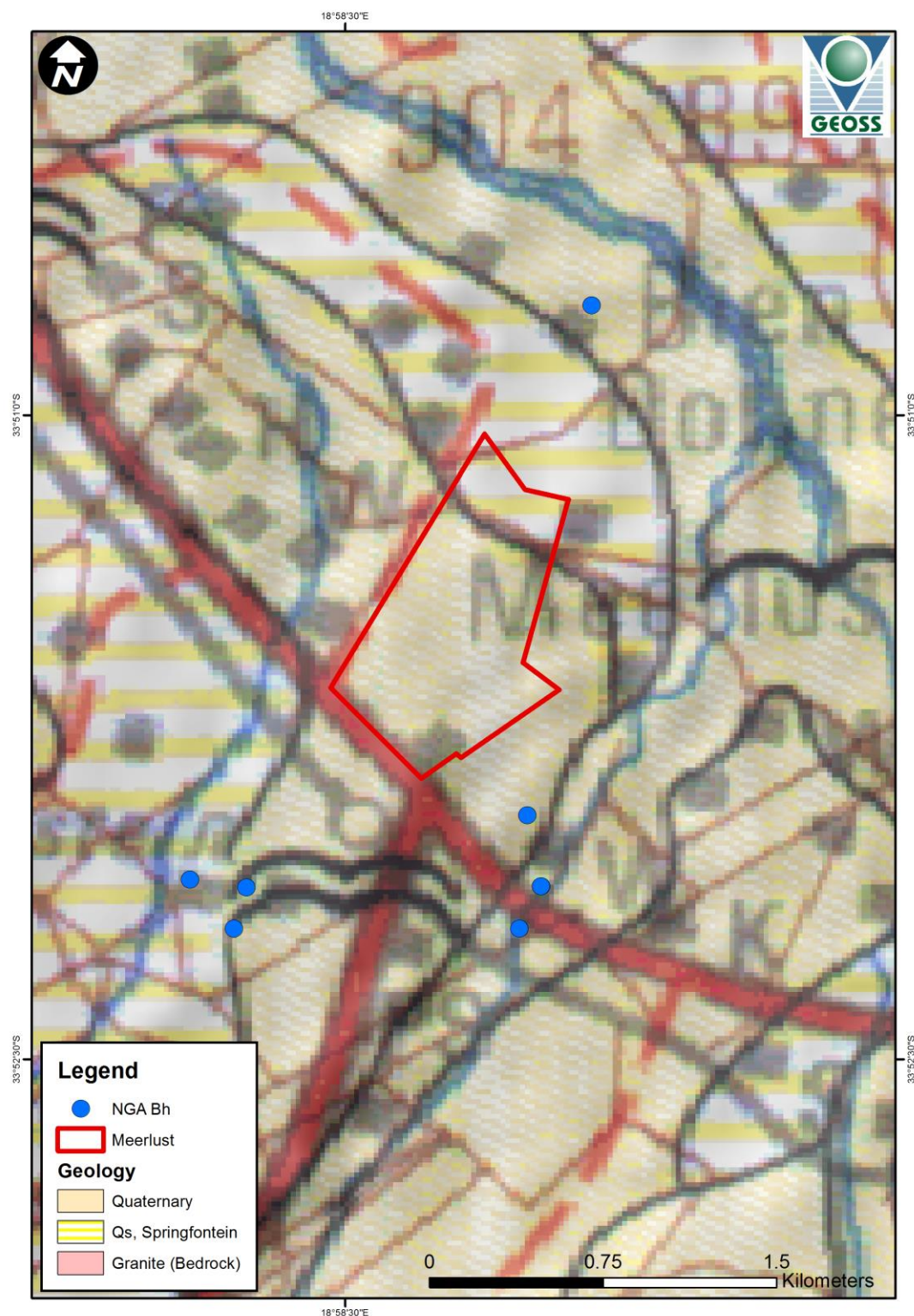


Map 12: Location of the Meer Lust study area within a regional setting



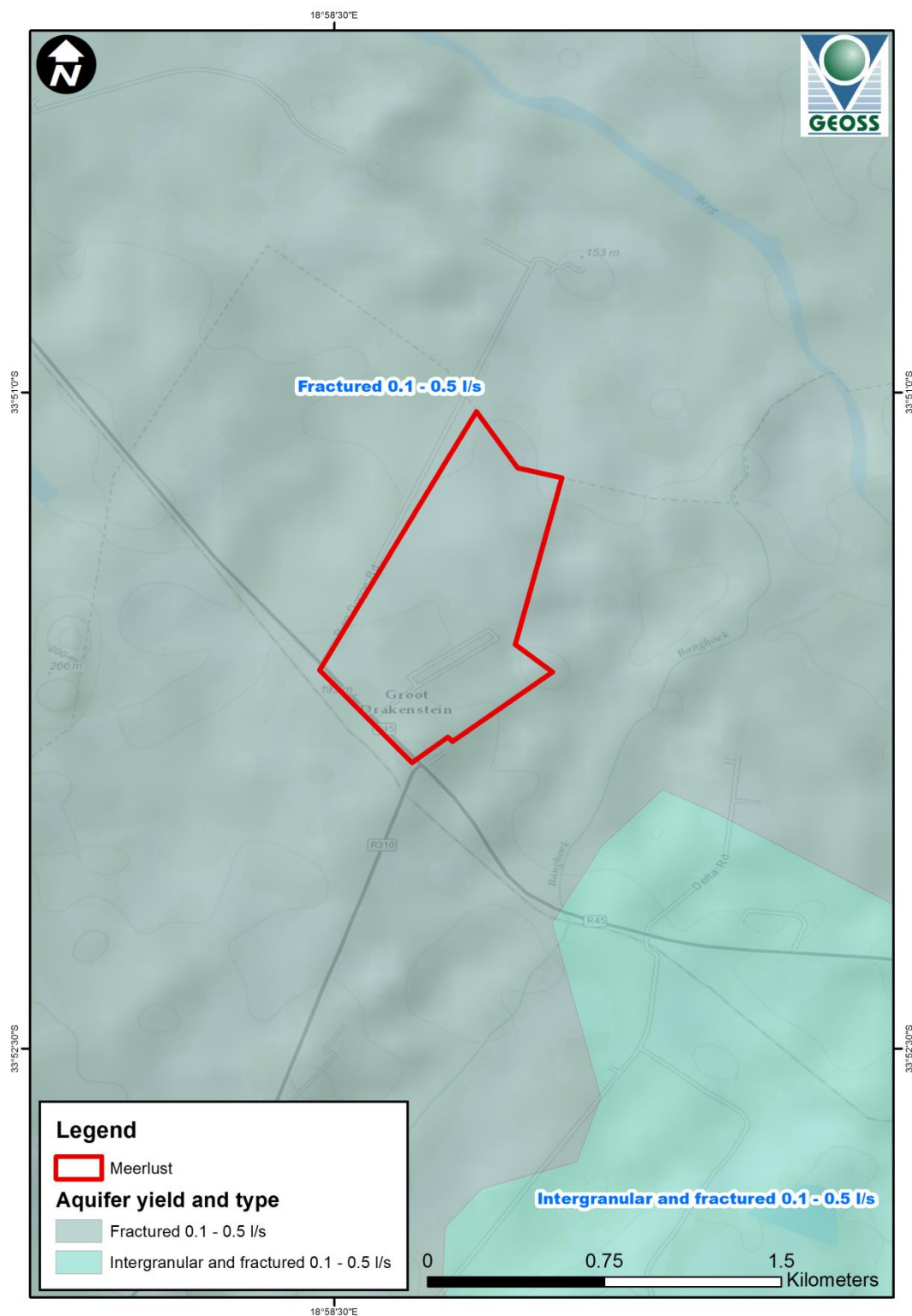


*Map 13: The Meer Lust study site superimposed on an aerial photograph*

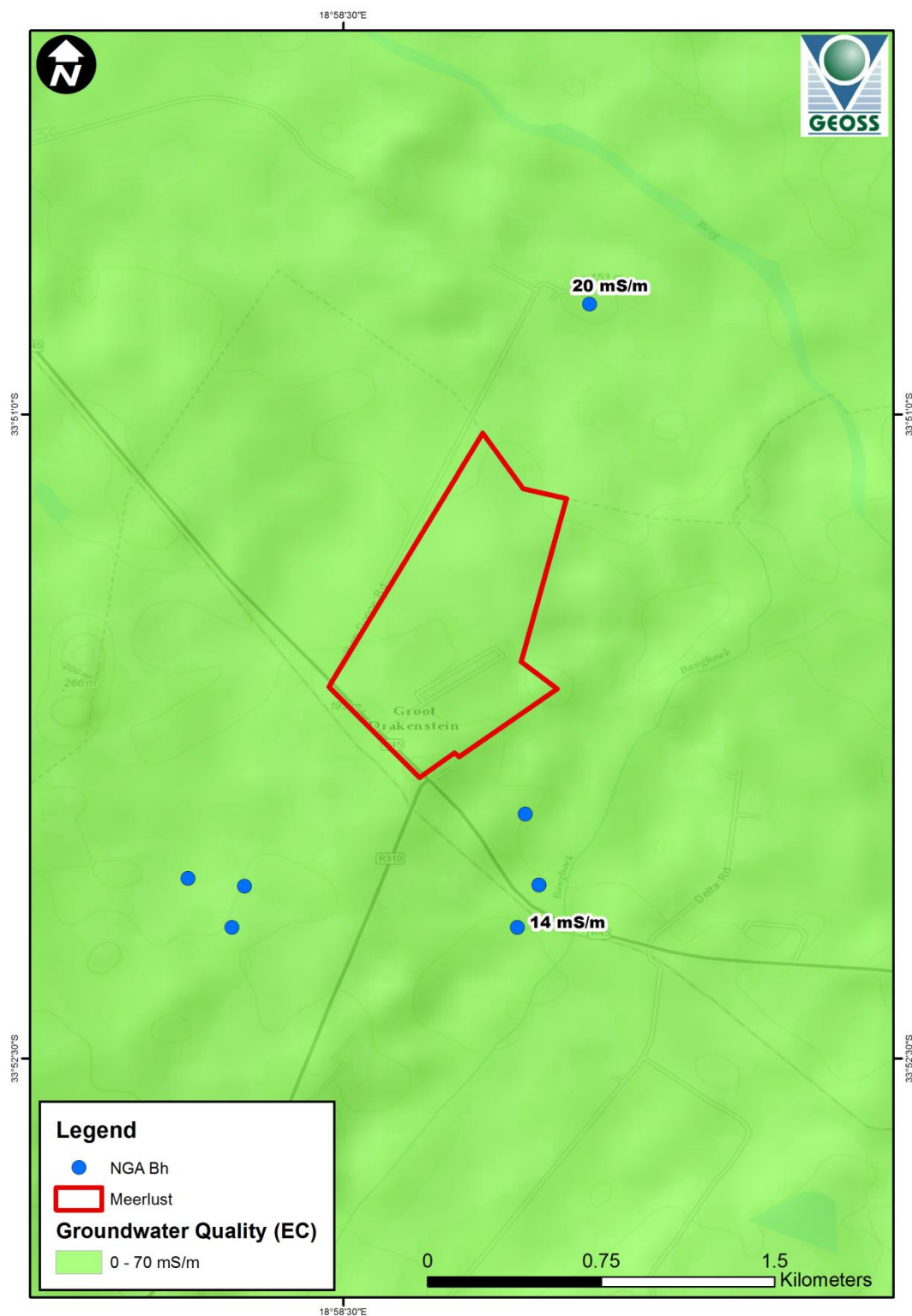


*Map 8: The Meer Lust study site and superimposed on a 1:250 000 scale geological map (3318 Cape Town).*

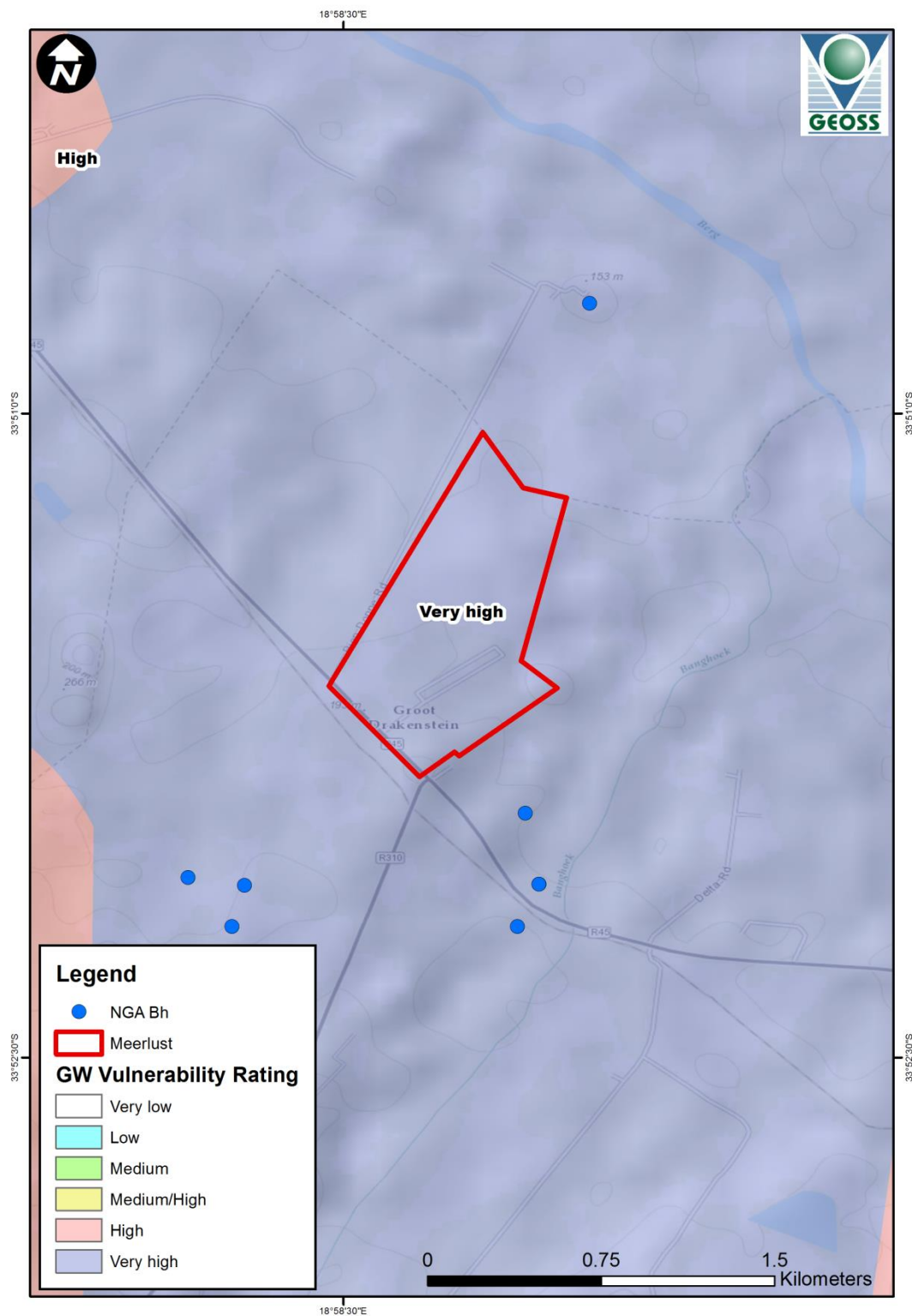




Map 15: Aquifer types of the Louw se Bos study area (1:500 000 scale DWS, 2000)



Map 16: Groundwater quality within the Meer Lust study area (Electrical Conductivity in mS/m), (DWS, 2000).



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