



PeraGage

SPECIALIST GEOTECHNICAL ENGINEERS



Report on the Desktop Geotechnical Specialist Study for
**THE SOLAR PHOTOVOLTAIC FACILITY,
“RHINO” PV ON REMAINDER OF FARM
RHENOSTERKOP 155 AND “SUNNYSIDE” PV
ON FARM 400, BEAUFORT WEST**

Western Cape, South Africa

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51 Wessel Road, Rivonia,
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Project name: BASIC ASSESSMENT PROCESS FOR THE SOLAR PHOTOVOLTAIC FACILITY, "RHINO" PV ON REMAINDER OF FARM RHENOSTERKOP 155 AND "SUNNYSIDE" PV ON FARM 400, BEAUFORT WEST

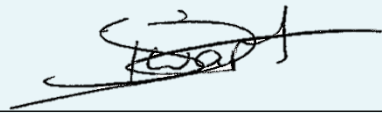

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Project Team
<p>Duan Swart <i>MSc(Eng.Geology)</i></p> <p>Steven Bok <i>PrSciNat BSc(Hons) Geology</i></p>

Report by	Reviewed by
 <hr/> <p>Duan Swart PrSciNat Senior Engineering Geologist <i>MSc Eng Geo</i></p>	 <hr/> <p>Steven Bok PrSciNat Technical Director – Engineering Geology <i>BSc Hons Geology</i></p>

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BASIC ASSESSMENT PROCESS FOR THE SOLAR PHOTOVOLTAIC FACILITY, “RHINO” PV ON REMAINDER OF FARM RHENOSTERKOP 155 AND “SUNNYSIDE” PV ON FARM 400, BEAUFORT WEST DESKTOP GEOTECHNICAL SPECIALIST STUDY

Executive Summary

This desktop geotechnical specialist study was undertaken for the development of the 500 MWac Rhino and Sunnyside Solar PV Facility near Beaufort West in the Western Cape Province. The assessment area is underlain by rock units of Adelaide Subgroup of the Beaufort Group and intrusive dolerite. The bedrock geology is covered by transported silts, sands and gravels, as well as well-developed calcrete. Some geotechnical constraints have been identified, primarily shallow and outcropping bedrock and calcrete which may cause excavation difficulties, and existing drainage channels with concentrated water flow. These conditions and associated constraints may be mitigated via standard engineering design and construction measures.

The assessment Rhino and Sunnyside Solar PV Facility area may be divided into two (2 No.) ZONES (I and II) where similar geotechnical conditions are anticipated. ZONE I is defined by shallow occurring bedrock covered by thin, loose transported material and varying degrees of cemented calcrete. ZONE II can be characterised by relatively thicker alluvial deposits, identifiable by erosion paths, rills, and continuous drainage features.

No fatal flaws or ‘no-go’ areas have been identified that would render any assessment areas unsuitable from a geological and geotechnical perspective. It is recommended any substation and offices be planned to be built within FACET I which is expected to provide good founding conditions and minimal earthworks before construction, therefore reducing the potential environmental impact.

Vital infrastructure at Sunnyside and Rhino PV developments, such as the substation and battery area, footprints are located within the FACET II area. This area is susceptible to flooding during and immediately after heavy rains. It is advised erosion berms and divergence drains are placed upstream of the site to limit the amount of water flow through these areas.

The proposed development assessed to have a “Negative Low impact - the anticipated impact will have negligible negative effects” provided that the recommended mitigation measures are implemented. The remaining mitigation measures provided minimise the impacts related to the appropriate engineering design of earthworks and site drainage, erosion control, and topsoil and spoil material management. These do not exceed civil engineering and construction best practices.

Intrusive investigation may reveal additional facets once variations in the subsoil profile become apparent.

Further intrusive geotechnical investigations should be undertaken to confirm the engineering recommendations provided in this report.

From a geotechnical perspective, it is anticipated that the proposed development, will not result in any significant cumulative environmental impacts.



From a geotechnical and geological perspective, no fatal flaws or sensitivities have been identified within or close to the Rhino and Sunnyside Solar PV Facility assessment area. It is therefore recommended that the proposed activity be authorised.



NATIONAL ENVIRONMENTAL MANAGEMENT ACT, 1998 (ACT NO. 107 OF 1998) AND ENVIRONMENTAL IMPACT REGULATIONS, 2014 (AS AMENDED) - REQUIREMENTS FOR SPECIALIST REPORTS (APPENDIX 6)

Regulation GNR 326 of 4 December 2014, as amended 7 April 2017, Appendix 6	Section of Report
1. (1) A specialist report prepared in terms of these Regulations must contain-	
a) details of-	1.3
i. the specialist who prepared the report; and	Appendix B
ii. the expertise of that specialist to compile a specialist report including a curriculum vitae;	
b) a declaration that the specialist is independent in a form as may be specified by the competent authority;	Appendix A
c) an indication of the scope of, and the purpose for which, the report was prepared;	1.1, 1.2
(cA) an indication of the quality and age of base data used for the specialist report;	1.4, References
(cB) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	5, 6
d) the date and season of the site investigation and the relevance of the season to the outcome of the assessment;	Not applicable
e) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used;	1.4, Appendix C
f) details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternatives;	3, 6, 7
g) an identification of any areas to be avoided, including buffers;	None identified
h) a map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	No sensitivities identified
i) a description of any assumptions made and any uncertainties or gaps in knowledge;	2
j) a description of the findings and potential implications of such findings on the impact of the proposed activity, (including identified alternatives on the environment) or activities;	5,6,7
k) any mitigation measures for inclusion in the EMPr;	6.1 Appendix D
l) any conditions for inclusion in the environmental authorisation;	6.1 Appendix D
m) any monitoring requirements for inclusion in the EMPr or environmental authorisation;	6.1 Appendix D
n) a reasoned opinion-	6.1, 8
i. (as to) whether the proposed activity, activities or portions thereof should be authorised;	
(iA) regarding the acceptability of the proposed activity or activities; and	
ii. if the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan;	6.1 Appendix D
o) a description of any consultation process that was undertaken during the course of preparing the specialist report;	Not applicable
p) a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	None
q) any other information requested by the competent authority.	None
2) Where a government notice <i>gazetted</i> by the Minister provides for any protocol or minimum information requirement to be applied to a specialist report, the requirements as indicated in such notice will apply.	Not applicable



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1. Introduction

PeraGage South Africa (Pty) Ltd (hereafter referred to as PeraGage) was appointed by SiVEST SA (PTY) Ltd (hereafter referred to as SiVEST) to undertake a desktop study for the proposed development of the Rhenosterkop Solar Photovoltaic (PV) Facility, “Rhino” PV on Remainder of Farm Rhenosterkop 155 and “Sunnyside” PV on Farm 400, Beaufort West, in the Western Cape Province, South Africa.

The Applicant, K2022578692 South Africa (PTY) LTD, has appointed SiVEST to undertake the required Basic Assessment (BA) process for the proposed development of the 500 megawatt alternating current (MWac) solar PV facility and associated infrastructure, to be located approximately 20 kilometres (km) to the east and north-east of Beaufort West in the Western Cape Province.

The proposed development will be subject to a BA process in terms of the National Environmental Management Act (Act 107 of 1998) as amended (NEMA) and Environmental Impact Assessment Regulations, 2014 as amended EIA Regulations. Accordingly, the BA process as contemplated in terms of the EIA Regulations being undertaken in respect of the proposed solar energy facility (SEF) project. The competent authority for this BA is the National Department of Forestry, Fisheries and the Environment (DFFE).

The project will consist of one (1) Environmental Authorisation (EA); one (1) BA for the SEF including related infrastructure. Thus, the entire project will require one EA process.

1.1 Scope and Objectives

Assess the impacts associated with the installation of the 500 MWac Rhino and Sunnyside Solar PV Facility and the associated infrastructure.

The following key considerations were taken into account during the desktop study:

- The geological and geotechnical conditions (ground conditions) and the influence thereof on the competency of founding of civil infrastructure and structures,
- Site topography and influence thereof on the site stability and suitability,
- The presence of geological or geomorphological features such as faults, lineaments and unstable ground,
- The presence of problem soils, geotechnical constraints, shallow groundwater conditions, and
- Geologically significant or sensitive features such as ridges, outcrops and exposures.

1.2 Terms of Reference

The terms of reference were provided by SiVEST to allow a consistent approach to the various specialist studies that are required as part of the BA being conducted in respect of the SEF and associated infrastructure. This will enable comparison of environmental impacts, efficient review and collation of the specialist studies into the BA report, in accordance with the latest requirements of the EIA Regulations.

Detailed designs will only be available post preferred bidder announcement prior to construction.

1.3 Specialist Credentials

This study has been undertaken by Duan Swart; a Professional Natural Scientist registered by the South African National Council for Natural Scientific Professions (SACNASP) registration number 137549 (Geological Science). The report was reviewed by Steven Bok, a Professional Natural Scientist registered by the SACNASP registration number 400279/07 (Geological Science). Mr Swarts CV is attached in Appendix B.



1.4 Assessment Methodology

The assessment involved a review of the following information:

- I. 1:250 000 Scale Geological Map 3222 Beaufort West
- II. Aerial photographs (Google Earth imagery, current and historical)
- III. Screening Report (national web based environmental screening tool)
- IV. Literature as referenced within this report

An Environmental Impact Assessment (EIA) matrix was used to quantify the potential impacts of the project on the receiving environment (provided by SiVEST and attached as Appendix C).

2. Assumptions and Limitations

The services performed by PeraGage were conducted in a manner consistent with the level of care and skill ordinarily exercised by members of the geotechnical profession practising under similar conditions in the locality of the project. The interpretation of the site conditions is based on available information, experience in the general project area and professional judgement and is considered to provide sufficient confidence to meet the objectives of this specialist study. The nature of geotechnical engineering is such that conditions at variance with those described may be encountered on site. Engineering recommendations provided in this report are preliminary and must be confirmed through further intrusive investigations.

Third party information has been utilised in good faith.

A site visit was not undertaken.



3. Technical Description

3.1 Project Location and Description

The Rhino and Sunnyside project comprises two sites which are located on two separate development areas. The two parcels of land have a combined development surface area of 498.09 hectares (ha), situated 20 km to the east and northeast of Beaufort West in the Western Cape Province. The PV north area, called “Rhino” PV is on Remainder of Farm Rhenosterkop 155, and the PV south areas, called “Sunnyside” PV, is on Farm 400. The sites’ locations are presented in Figure 1.

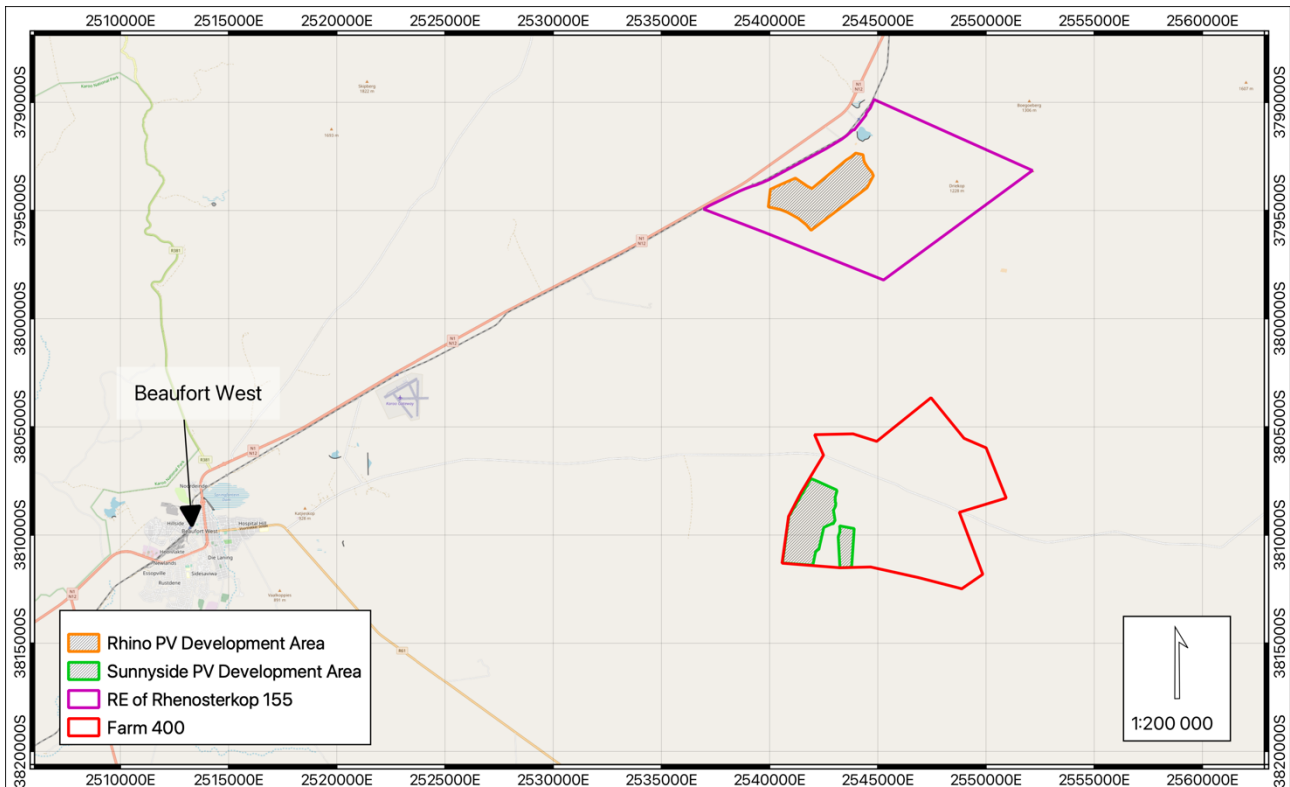


Figure 1: Location of proposed Rhino and Sunnyside PV Facility

3.1.1 SEF Infrastructure

The solar facility will have a generating capacity of up to 500 MWac. The total development footprint of the project will approximately be 498.09 ha, including supporting infrastructure on site. The key components of the proposed project are described below:

PV Panel Arrays: To produce up to 500 MWac the facility will require numerous linked cells placed behind a protective glass sheet to form a panel. Multiple panels will be required to form the solar PV arrays which will comprise the PV facility.

Access roads: Access roads to be 6.00 to 8.00 m wide with internal roads being 4.00 m wide.

Battery Energy Storage System (BESS): The technology and capacity to be confirmed. The footprint will be up to 5 ha.

On-site Substation: Connecting the arrays to the electrical grid requires the transformation of the voltage from 33 kilovolts (kV) to 132 kV. The normal components and dimensions of a distribution-rated electrical substation will be required.



Borehole and storage tanks: Existing boreholes will be tested. If no potential boreholes (existing), new boreholes will be required.

Supporting Infrastructure: The following auxiliary buildings with basic services including water and electricity will be required on the site:

- Operations and Maintenance (O&M) building/ office (the proposed 1 ha container construction camps will become operation site offices, workshop areas, O&M buildings, permanent parking areas, storage areas, etc.)
- Temporary Laydown Area (~2 ha)

Roads: The main access road providing direct access to the project will be up to 6 - 8 m wide. 4 m internal roads.

Fencing: For health, safety and security reasons, the facility will be required to be fenced off from the surrounding farms. The project will have permanent security on site for 24 hrs per day, 7 days a week. The fence will comprise triple wire fence, electrical fencing with a maximum height of 3.00 m and a total length of 11.5 km.

3.2 EIA Alternatives

3.2.1 Location Alternatives

The proposed solar PV facility forms part of a larger proposed renewable energy (RE) development which includes both solar and wind energy facilities.

Currently, there are two SEF clusters proposed, Rhino and Sunnyside. The wind energy facility (WEF) is referred to as "Rhino WEF" of which a small portion extends into Farm Rhenosterkop 155 and Farm 400. The two solar PV facility sites and the WEF are owned by two different companies whose development is being managed by the applicant.

An Environmental Site Establishment (ESE) process was undertaken from September 2022 to January 2023 to screen the greater project site from an environmental and social perspective. The ESE process included both desktop studies as well as on-site surveys by avifauna, bat, ecology and heritage specialists. The aim of the ESE was to define the scope of the BA phase of the project.

Originally, for the solar PV facility, the farm Rhenosterkop 155 was identified as most suitable from a topographic, local, and environmental perspective. However, due to an avifauna (Martial Eagle) perspective no-development buffer, the development area was reduced significantly. Furthermore, the landowner did not support solar PV facility development on some sections of the property due to (a) agriculture preference, and (b) the development's potential visual impact as the development would be within direct view of the guest house existing in the farm.

To ensure that the project remains feasible, alternative sites were identified to compensate for the 'lost' capacity. The landowners were consulted, and due to the discussions undertaken, agreed to the solar PV facility development under certain conditions.

Development proposed on Farm 400 needed to be located to the southwest of the property so that it is not visible from the farmstead. A layout was then developed and discussed with the landowner which was agreed upon (Figure 2 below). Presented with the proposed development area, the landowner noted their support of the development, and that development would be within an area that is not preferred by sheep for grazing that always migrate back to the preferred areas (green polygon) as shown in Figure 2.



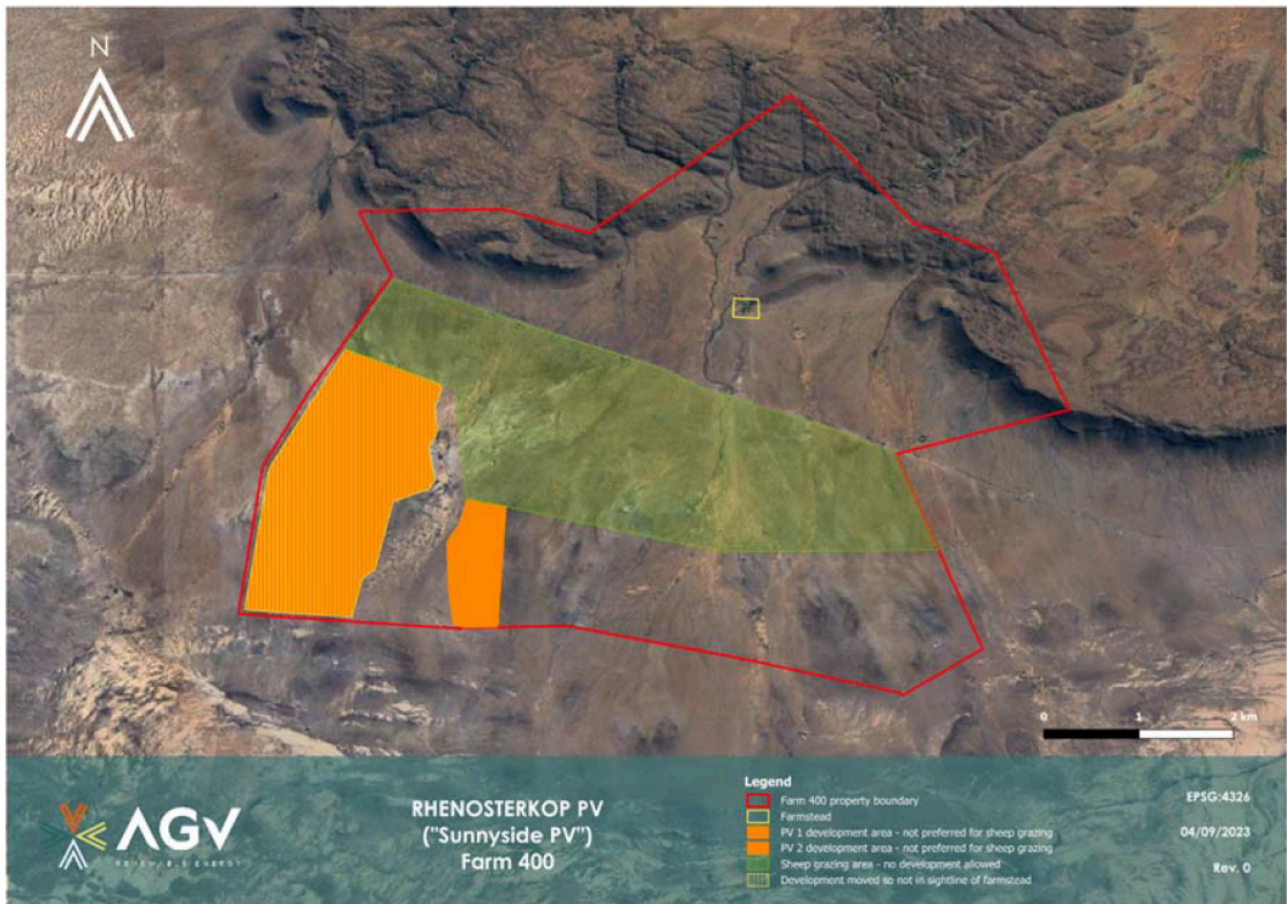


Figure 2: Sunnyside, original development area (green) versus agreed upon development area (orange)

For Farm Rhenosterkop 155, the development footprint was reduced to what is shown in Figure 3 below. The layouts consider the ESE results, and the landowner's comments and recommendations.

Other alternative locations were identified and assessed from a development perspective. The alternative locations, including surrounding farms, are less desirable to develop due to increased distance from the cluster. From a financial and environmental perspective, the development of other properties would also require additional servitudes that may not be feasible from a cost perspective.

The specialist constraints were considered in developing the proposed design and layout. This exercise also fed into the constraints mapping to identify the most suitable areas for the development of a solar PV facility which is envisaged to result in the least environmental and social impact.

In considering the specialist limitations identified in the screening phase, three no-go areas have been identified and excluded from the proposed development as restricted areas are not suitable for the installation of PV modules. The final available land area covers 498.09 ha.

Considering the above, no further alternatives have been considered for the proposed solar PV facility. RE development in South Africa (SA) is highly desirable from a social, environmental and development point of view and a solar energy installation is more suitable for the site due to the high solar resource.



Figure 3: Rhino, original development area (white, blue and green) versus agreed upon development area (orange)

Reason for the location chosen: These sites are preferred due to the suitable climate, conditions and topography including close proximity to the national grid. Based on the above site-specific attributes, the study area is considered highly preferred in terms of the development of solar and WEFs. As such, no further property/ location alternatives have been considered.

3.2.2 Technology Alternatives

No other activity alternatives are being considered. RE development in SA is highly desirable from a social, environmental and development point of view.

3.2.3 No-Go Alternative

The 'no-go' alternative is the option of not undertaking the proposed SEF project. Hence, if the 'no-go' option is implemented, there would be no development. This alternative would result in no environmental impacts from the proposed project on the site or surrounding local area. It provides the baseline against which other alternatives are compared and will be considered throughout the report.

4. Legal Requirement and Guidelines

The desktop study was undertaken according to the guidelines provided by The South African Institution of Civil Engineering Site Investigation (SAICE) Code of Practice published by The Geotechnical Division of SAICE, 2010. This report has been prepared to meet the requirements for a specialist report as provided in the EIA Regulations, Appendix 6.

5. Description of the Receiving Environment

The following description of the receiving environment is relevant to assessing the geological and geotechnical impacts.

5.1 Climate

The area surrounding Beaufort West is considered to have a local steppe climate with little rainfall throughout the year. The area can be classified as cold semi-arid climate (BSk) according to the Köppen-Geiger climate classification. The average annual rainfall is 392 mm with the average maximum and minimum temperatures of 24°C and 11.1°C, respectively.

Climate plays a fundamental role in rock weathering and soil development. The effect of climate on the weathering processes (i.e. soil formation) in a particular area can be determined from the climatic N-value, defined by Weinert (1980). A climatic N-Value of 5 or less implies a water surplus and the dominant mode of weathering is chemical decomposition. These climatic conditions are favourable for the development of a deep residual soil profile. Where the climatic N-value is greater than 5, mechanical disintegration is the predominant mode of rock weathering. In these drier areas residual soils are typically shallow. Climatic N-values of greater than 10 imply an arid climate with a limited or absent residual soil profile.

Weinert's climatic N-value for the site was determined to be approximately 5.5, which indicates a slight deficit of water. Mechanical disintegration will dominate resulting in a shallow weathering profile. A thin soil layer is expected to overlie weathered bedrock.

5.2 Topography and Drainage

The topographic characteristics of Rhino PV and Sunnyside PV areas will be discussed separately below.

The Rhino PV development area is characterised being flat with a very gentle slope to the west at a gradient of less than 2 %. The site drainage is expected to occur as sheetwash and throughflow towards the east into the Renosterspruit before flowing into the Platdoring River heading south. The site exists in a maximum and minimum elevation of 1000 m above mean sea level (AMSL) and 960 m AMSL, respectively. The topographical map is presented in Figure 4 and the expected drainage direction with 20 m contours is shown in Figure 5.

The Sunnyside PV development area is sloping towards the south at gradients approximately equal to 2 %. The site area is flat to slightly undulating. The site drainage is expected to occur as sheetwash and throughflow towards the south into the Platdoring River heading south. The site exists in a maximum and minimum elevation of 940 m and 890 m AMSL, respectively. The topographical map is presented in Figure 6 and the expected drainage direction with 20 m contours is shown in Figure 7.



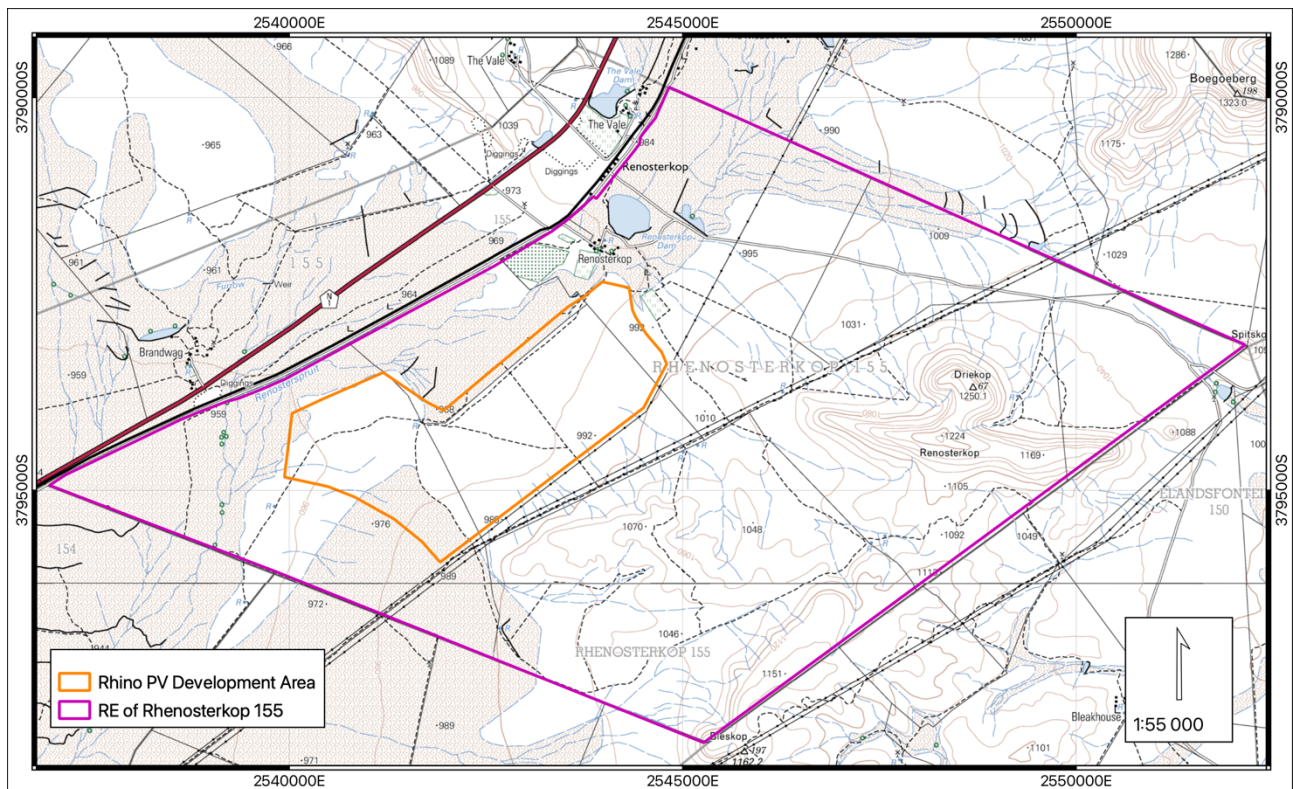


Figure 4: Rhino PV topographical map

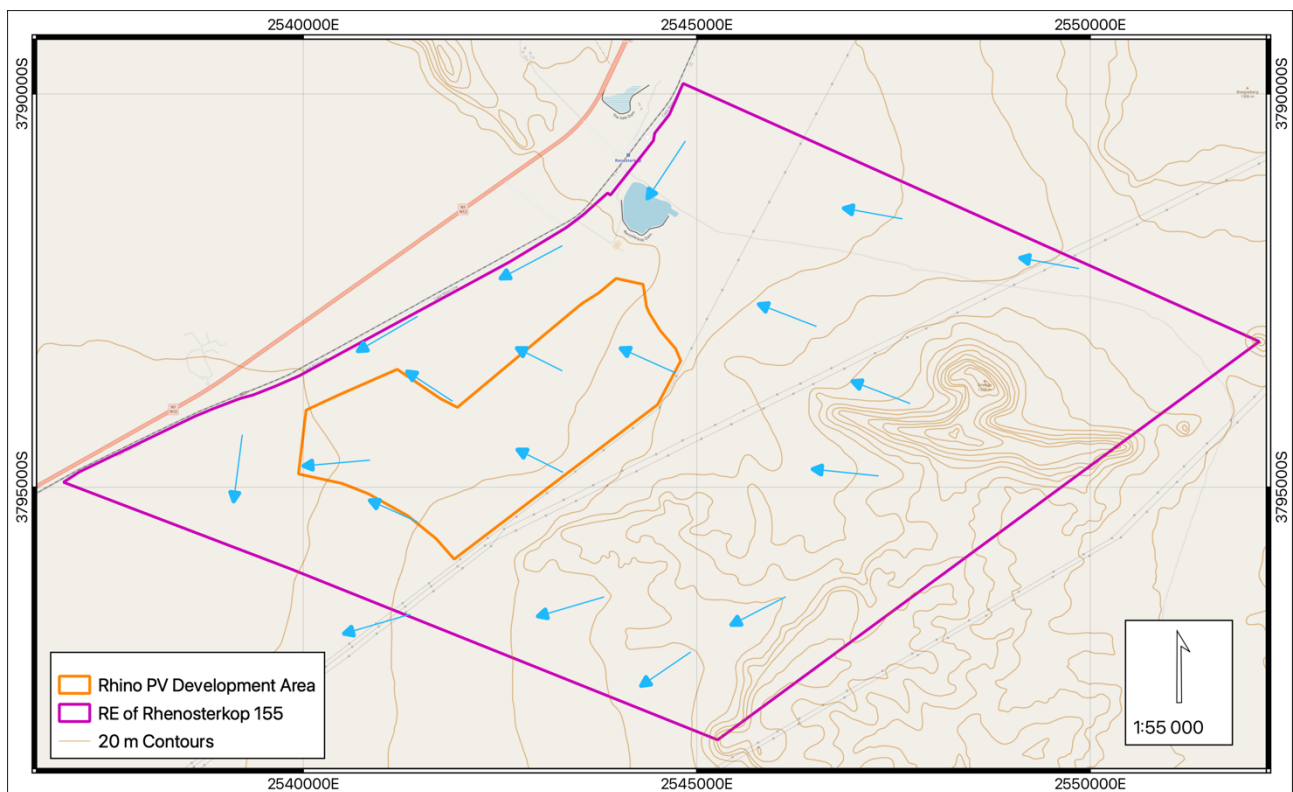


Figure 5: Rhino PV expected drainage direction and 20 m contours



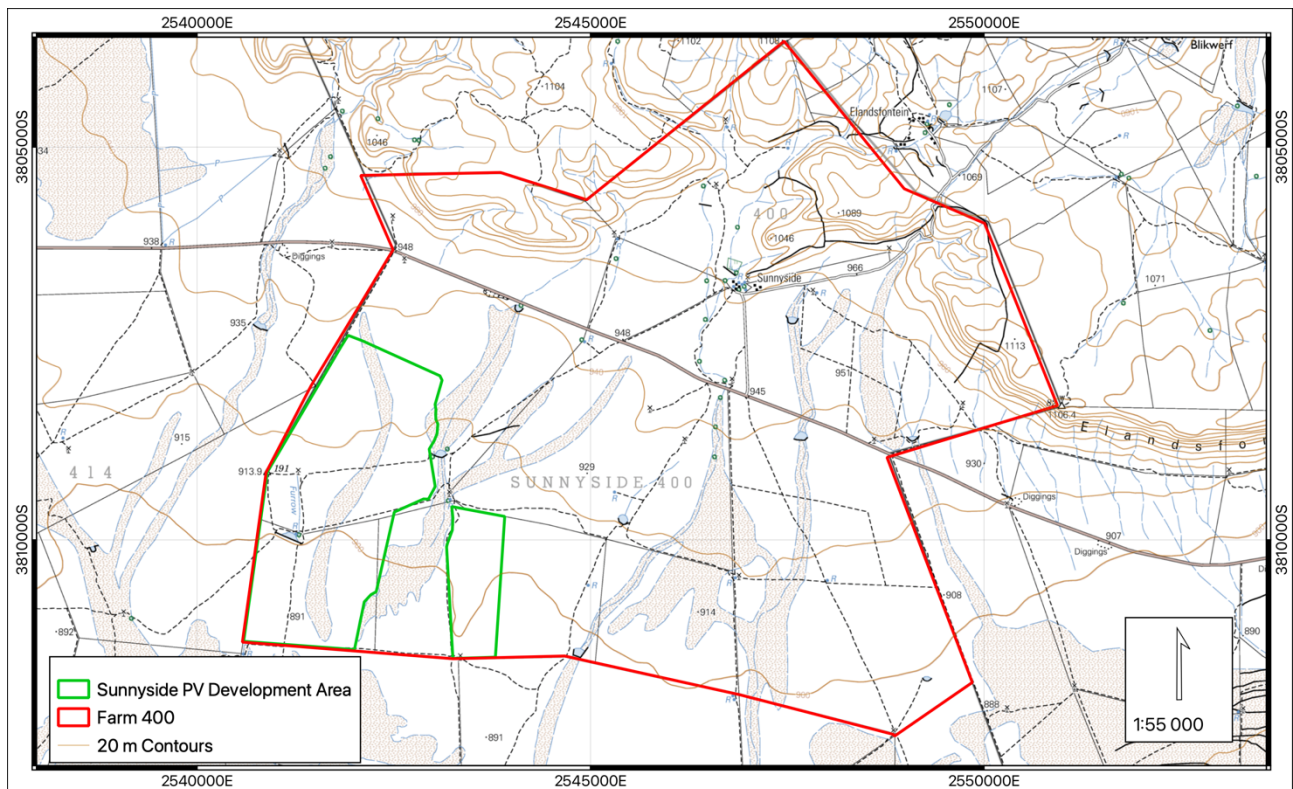


Figure 6: Sunnyside PV topographical map

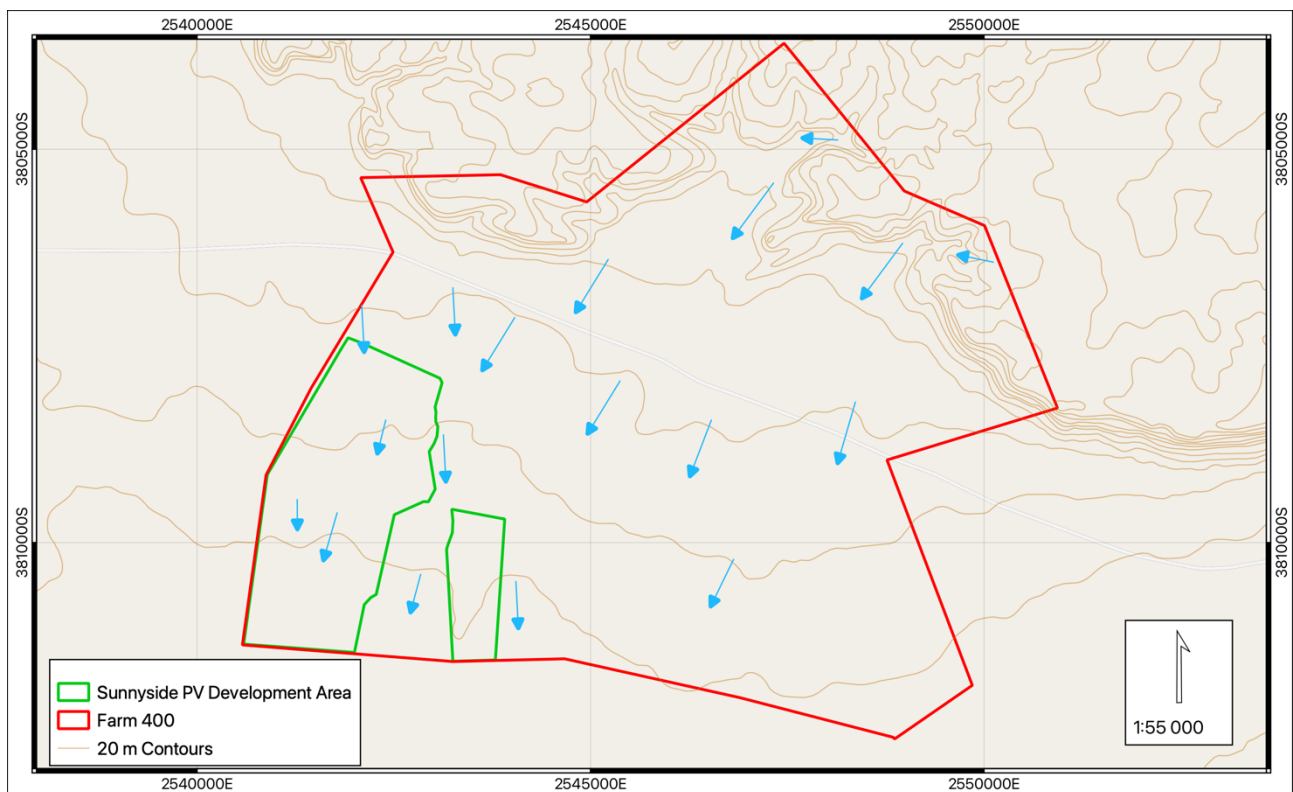


Figure 7: Sunnyside PV expected drainage direction and 20 m contours



5.3 Seismicity

According to the Seismic Hazard Map of South Africa (SANS 10160-4, 2017), the peak ground acceleration is approximately 0.1 g for both Rhino and Sunnyside sites. The peak ground acceleration may be described as the maximum acceleration of the ground shaking during an earthquake, which has a 10% probability of being exceeded in a 50-year period.

5.4 Regional Geology

According to the local 1:250 000 Geological Map (sheet 3222), both sites are underlain by Permian-aged alternating bluish-grey, greenish grey or greyish red mudrocks and grey, very fine to medium-grained lithofeldspathic sandstone of the Teekloof and Abrahamskraal Formations that form the Adelaide Subgroup (denoted by Pt; shaded green) of the Beaufort Group found in the Karoo Supergroup. The Formations boundaries are linked to specific sandstone-rich marker units (Johnson et al 2006). A number of greenish chert bands, existing from a few centimetres to two metres thick, and pink tuff beds have been recorded to exist in the Abrahamskraal Formation. Calcareous nodules and concretions occur in mudstones throughout the Beaufort Group. Adelaide Subgroup is highly faulted with numerous anticline and syncline formations, as well as a few faults, striking generally in an east-west direction. The rock units of the Beaufort Group in the vicinity of the site dip towards the north and south, due to numerous anticline and synclines, varying between dip angles of 10° and 40°.

The site geology is presented in Figure 8.

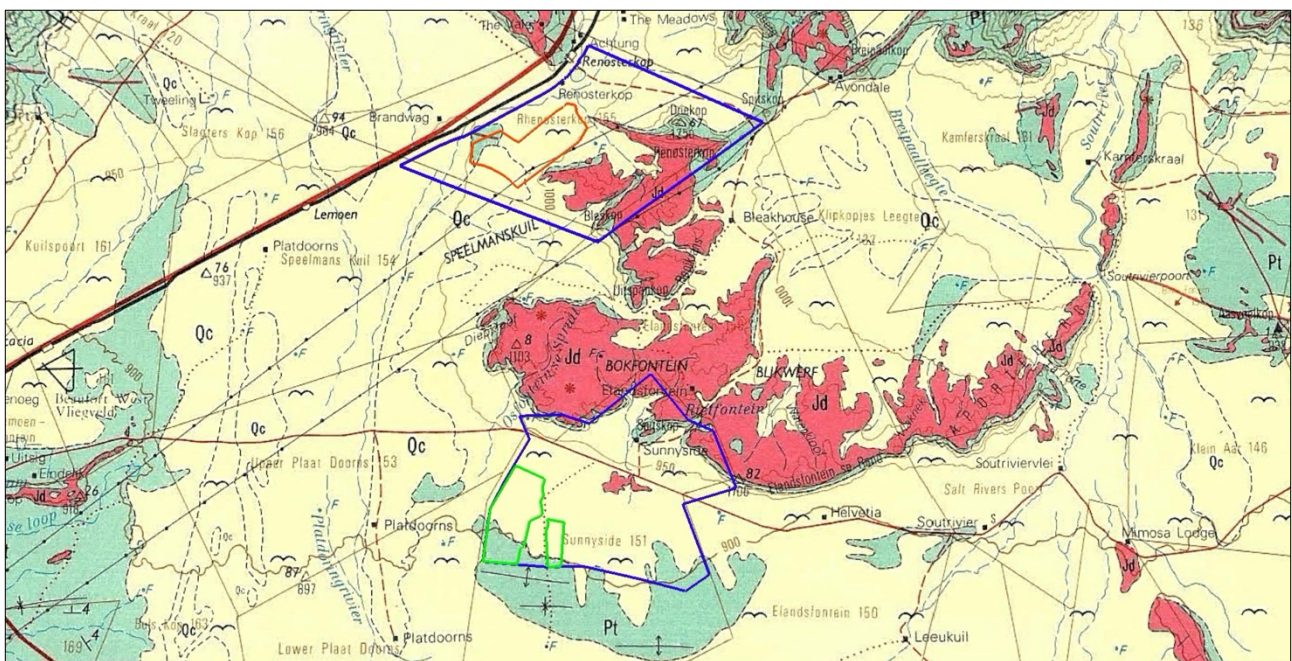


Figure 8: Regional geology of the sites

The Adelaide Subgroup underlies the low-lying areas in this region. Much of this geological unit is covered by transported soils due to the erosion occurring along the Great Escarpment. Due to the sporadic rainfall and high evaporation rates, the area is conducive for formation of calcrete at shallow depths. It is expected the sites will be underlain by varying degrees of cemented, nodular to hardpan calcretes. Where calcrete has not formed, the covering surface soils are expected to comprises unconsolidated, loose, gravels and silts to sands and may be relatively thick (~800 mm).



The Beaufort Group was intensely intruded by dolerite dykes and sills (denoted by Jd; shaded red) during the Jurassic Era. These zones now present in the high-lying koppies and plateaus around Beaufort West. None of the PV developmental areas are seemingly underlain by dolerite.

5.5 Engineering Geology

This section will focus on the developmental areas only.

A large portion of the SEF areas are expected to comprise shallow occurring bedrock covered by transport horizons. The interlayered nature of the bedrock, coupled with the presence of faults, folds and other geological structures, may result in complex and variable geotechnical conditions, even beneath individual foundation footprints. It is possible for less competent shale to be encountered below more competent sandstone layers and for zones of preferential weathering to occur within un-weathered surrounding rock. The transported soils will be variable but generally be silty sand to gravelly sand at varying thicknesses.

The southern to middle portion of Rhino PV has seemingly an east to west striking dolerite intrusion which is expected to have weathered to gravels lying onto of competent dolerite bedrock.

For both Rhino and Sunnyside sites, most of the rills and gullies at the site surface will comprise transported soils of loose, silty gravelly sand, becoming sandier within local drainage features, and occasionally underlain by a very weakly to strongly cemented calcrete horizon. The alluvial material in this area may exhibit collapsible fabric.

Soils with a collapsible structure have an open-voided texture with individual grains being separated or weakly bonded by bridging material such as clay, iron oxides, calcium, or other bridges. While these soils have a high to moderate strength and can withstand fairly large loads under low soil moisture conditions, an increasing moisture content can weaken the bridging materials. Increasing the soil moisture content under load can cause a decrease in the soil volume, resulting in large settlements with no increase in the applied stress. This can lead to sudden settlements beneath foundations and structures.

The formation of duripan (in the form of a variable calcrete horizon ranging from nodules to hardpan calcrete) is expected to occur locally in parts of the site, which is characteristic of the Namaqualand soils. Calcrete is a pedogenic material and its properties are largely determined by the degree of cementation and the nature of the parent material. Lateral and vertical variations often occur over short distances and the soil strength and consistency usually deteriorate with depth (hardpan calcrete may not be laterally continuous and weaker materials may occur beneath the hardpan calcrete layer/s). As such, it is dangerous to found heavy structures on calcrete layers unless these are of adequate thickness and/or the underlying materials have sufficient strength to support the foundation loads.

According to satellite imagery, portions of both sites have seemingly existing infrastructure, namely kraals, wind pumps, dams and trenches. These will need to be mapped during the detailed geotechnical investigation as these areas may need additional earthworks to prepare the site for the development.

5.6 Desktop Geotechnical Appraisal

Based on the desktop study, the entire assessment areas may be divided into three (2 No.) ZONES: I, and II. Intrusive investigation may reveal additional facets once variations in the subsoil profile become apparent. The anticipated geotechnical constraints and mitigation measures are summarised in Table 1. The zonation for the Rhino PV and Sunnyside PV developmental areas are presented in Figure 9 and Figure 10, respectively.



The proposed SEF is mainly underlain by FACET I area which is expected to provide good founding conditions and minimal earthworks before construction, therefore reducing the potential environmental impact. However, zones of the SEFs are seemingly underlain by thicker sandy, possibly alluvial material, which is susceptible to erosion when disturbed or exposed to channelled water flow. It is recommended any substation and offices be planned to be built within FACET I.

The assessment area is considered suitable for the development of the proposed SEF, including the associated infrastructure, from a geotechnical viewpoint, provided that standard engineering design and construction measures are implemented to mitigate the identified geotechnical constraints.

From a geotechnical perspective, it is anticipated that the proposed SEF, will not result in any significant cumulative environmental impacts.

Table 1: Summary of geotechnical conditions

ZONE	Shallow Engineering Geology	Geotechnical Conditions / Constraints	Impacts on Engineering Design and Construction
I	Shallow bedrock covered by thin transported and calcrete material	<ul style="list-style-type: none"> • Shallow bedrock • Thin soil cover • Transported soils comprising sands, silts and gravels • Intermediate to hard excavation conditions with depth • Overlain by transported soils of variable thickness in some areas (in gullies and rills) 	<ul style="list-style-type: none"> • Shallow bedrock • Thin soil cover • Intermediate to hard excavation conditions with depth • Overlain by alluvial soils of variable thickness in some areas (in gullies and rills) • Generally good founding conditions for structures at shallow depths • Minor earth works required at founding level • Conventional shallow foundations suitable • Conventional subgrade preparation for roads • Variable excavation conditions • Intermediate to hard excavation conditions for pole planting / trenching / earthworks
II	Alluvium	<ul style="list-style-type: none"> • Loose sandy soils • Potentially collapsible soils • Moderate soil cover • Moderate bedrock depth • Increased erosion potential • Deep erosion gullies and rills 	<ul style="list-style-type: none"> • Deeper spread footings (found below alluvial sands) • Soft excavation conditions becoming intermediate with depth • Unstable trench sidewalls shoring/battering required • Erodible soils • Surface drainage measures required to minimise risk of flooding and erosion



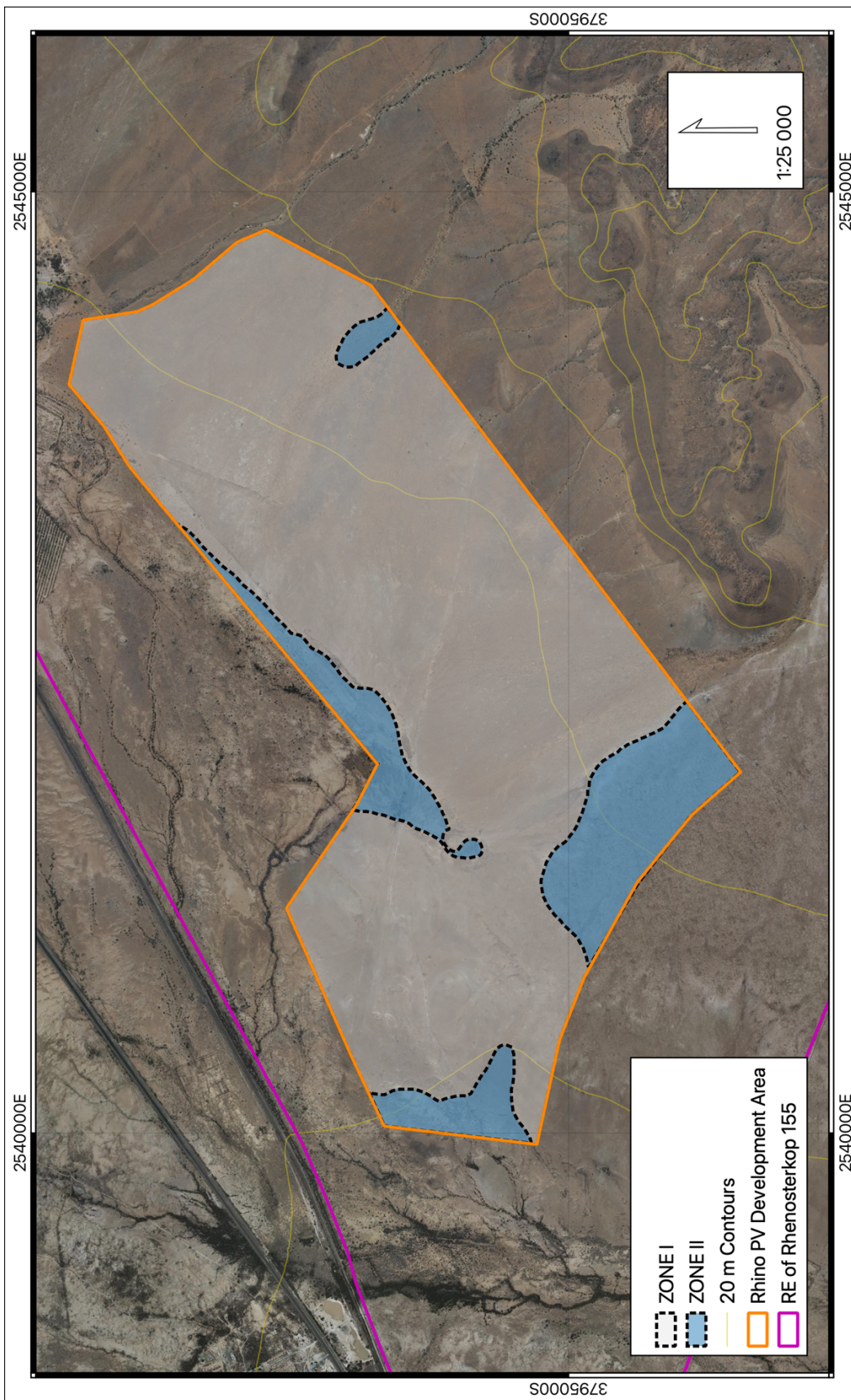


Figure 9: Geotechnical Desktop Zonation for Rhino PV Developmental Area



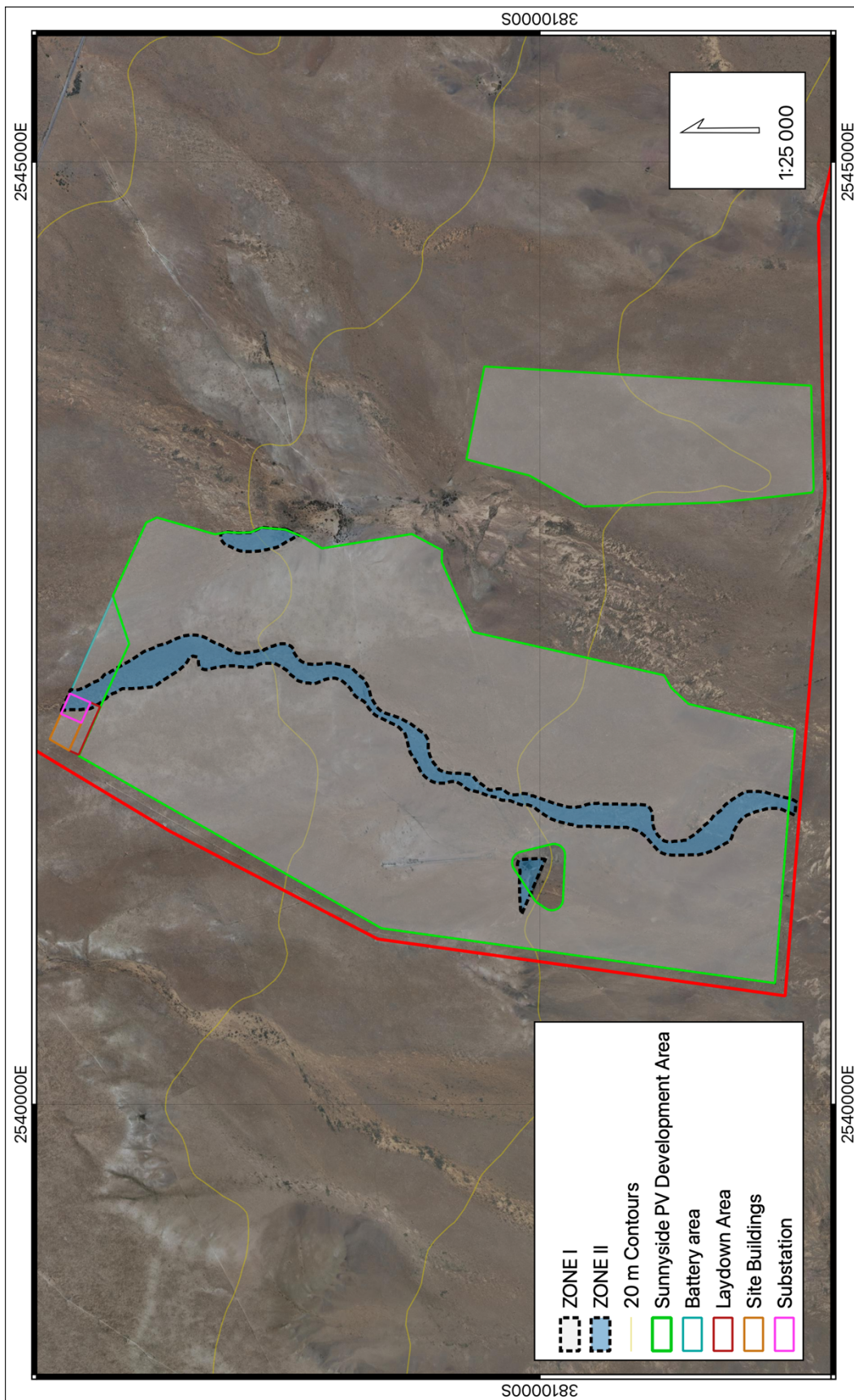


Figure 10: Geotechnical Desktop Zonation for Sunnyside PV Developmental Area



6. Identification and Assessments of Impacts

No fatal flaws or 'no-go' areas have been identified that would render any assessment areas unsuitable from a geological and geotechnical perspective. However, vital infrastructure at Sunnyside and Rhino PV developments, such as the substation and battery area, footprints are located within the FACET II area. This area is susceptible to flooding during and immediately after heavy rains. It is advised erosion berms and divergence drains are placed upstream of the site to limit the amount of water flow through these areas.

The geological impact of the Rhino and Sunnyside Solar PV Facility will be caused by the construction of access roads, earthworks required for the construction of working platforms, and excavations as well as trenching for underground cables. Bulk earthworks, where required, for the construction of access roads and working platforms on or adjacent the steeper sections and within or adjacent streams, may cause a more significant impact. As far as practically possible, steep areas and areas within drainage channels needs to be avoided during construction and operation of plants.

The impact of the substation on the geological environment is limited to topsoil stripping, excavations for plinth foundations, trenching, the construction of access roads and associated light infrastructure. Additional impacts would be caused by the opening of borrow pits that may be undertaken to obtain construction materials.

6.1 Impact of the Rhino and Sunnyside SEF on the Geological Environment

The main impact of the proposed development from a geological perspective is the displacement and removal of soil and rock materials. These activities will predominantly take place during the construction phase. The degree of disturbance is largely dependent on the topography and location of the project site and the nature of the proposed infrastructure. Steep slopes and drainage channels are unfavourable as these require bulk earthworks to create working platforms and access roads. Earthworks on steep slopes increases the risk of soil movements or slope failure. Construction within drainage channels is also unfavourable due to the erosion potential of the loose, sandy soils.

The risk of soil erosion is also increased during construction activities, by the removal of vegetation and by possible disturbance to the natural surface drainage environment. These activities may prevent infiltration of rainwater, increase surface runoff and cause concentration of surface water flow. Erosion will increase the disturbance and displacement of soils and the impact may extend beyond the infrastructure footprint/s over time.

The effects of the proposed development on the geological environment were evaluated using an EIA Methodology, provided by SiVEST, which aids in determining the significance of an environmental impact on an environmental parameter through a systematic analysis. The EIA methodology is attached as Appendix C. The impact rating tables have been attached as Appendix D. The description of the key monitoring recommendations for each applicable mitigation measure identified for each phase of the project is presented in Table 2, below.

Based on the impact ratings for the proposed construction of the Rhino and Sunnyside Solar PV Facility has been assigned a "Negative Low impact" rating provided that the recommended mitigation measures are implemented.

The topography of the site is generally flat with localised areas of steep slopes. The flat areas will require minor earthworks depending on the final layout design. Access routes should be carefully planned to avoid any steep areas and drainage channels. Most of the site is expected to be characterised by outcropping or very shallow bedrock. This will provide good founding for the PV modules.



The majority of soils (when not in large drainage channels) do not render the site particularly susceptible to soil erosion, though mitigation measures need to be implemented, particularly within the steeper sections of the site and lower-lying, drainage channels of the site where concentrated surface flow is anticipated after heavy rainfall events.

Vital infrastructure at Sunnyside and Rhino PV developments, such as the substation and battery area, footprints are located within the FACET II area. This area is susceptible to flooding during and immediately after heavy rains. It is advised erosion berms and divergence drains are placed upstream of the site to limit the amount of water flow through these areas.

Appropriate engineering design of access roads, particularly drainage and erosion control measures, are critical to limit the impact of the development on the geological and geotechnical environment.

Detailed geotechnical materials investigations should be undertaken to assess the suitability of the in-situ materials and the need for processing (e.g., crushing, stabilisation).

7. Comparative Assessment of Alternatives

No geologically or geotechnically sensitive areas were identified that would render the proposed Rhino and Sunnyside Solar PV Facility unsuitable for development, provided that standard engineering design and construction measures are implemented to mitigate the identified geotechnical constraints.

8. Cumulative Impact Assessment

From a geotechnical perspective, it is anticipated that the proposed Rhino and Sunnyside SEF, will not result in any significant cumulative environmental impacts. The cumulative impact is acceptable for the proposed development.

9. Conclusion and Summary

9.1 Summary of Findings

This desktop geotechnical specialist study was undertaken for the development of the 500 MWac Rhino and Sunnyside Solar PV Facility near Beaufort West in the Western Cape Province. The assessment area is underlain by rock units of Adelaide Subgroup of the Beaufort Group and intrusive dolerite. The bedrock geology is covered by transported silts, sands and gravels, as well as well-developed calcrete. Some geotechnical constraints have been identified, primarily shallow and outcropping bedrock and calcrete which may cause excavation difficulties, and existing drainage channels with concentrated water flow. These conditions and associated constraints may be mitigated via standard engineering design and construction measures.

The assessment Rhino and Sunnyside Solar PV Facility area may be divided into two (2 No.) ZONES (I and II) where similar geotechnical conditions are anticipated. ZONE I is defined by shallow occurring bedrock covered by thin, loose transported material and varying degrees of cemented calcrete. ZONE II can be characterised by relatively thicker alluvial deposits, identifiable by erosion paths, rills, and continuous drainage features.

Intrusive investigation may reveal additional facets once variations in the subsoil profile become apparent.

No fatal flaws or 'no-go' areas have been identified that would render any assessment areas unsuitable from a geological and geotechnical perspective. It is recommended that any substation and offices be planned to be built within FACET I which is expected to provide good founding conditions and minimal earthworks before construction, therefore reducing the potential environmental impact.



Vital infrastructure at Sunnyside and Rhino PV developments, such as the substation and battery area, footprints are located within the FACET II area. This area is susceptible to flooding during and immediately after heavy rains. It is advised erosion berms and divergence drains are placed upstream of the site to limit the amount of water flow through these areas.

The proposed developments are assessed to have a “Negative Low impact - the anticipated impact will have negligible negative effects and will require little mitigation” provided that the recommended mitigation measures are implemented.

The remaining mitigation measures provided minimise the impacts related to the appropriate engineering design of earthworks and site drainage, erosion control, and topsoil and spoil material management. These do not exceed civil engineering and construction best practices.

From a geotechnical perspective, it is anticipated that the proposed development, will not result in any significant cumulative environmental impacts.

Further intrusive geotechnical investigations should be undertaken to confirm the engineering recommendations provided in this report.

9.2 Impact Statement and Conclusion

From a geotechnical and geological perspective, no fatal flaws or sensitivities have been identified within or close to the Rhino and Sunnyside Solar PV Facility assessment area. It is therefore recommended that the proposed activity be authorised.



Table 2: Summary of geotechnical conditions for both Rhino and Sunnyside SEF

Impact / Aspect	Mitigation / Methodology	Responsibility	Mitigation objectives	Frequency
Construction				
Disturbance and removal of rock and soil	Design access roads, platforms and post locations to minimise earthworks and levelling. The design must be based on intrusive investigation results and high resolution ground contour information.	Design Team	Reduce the need for large bulk earthworks and reduce the amount of spoiled material quantities.	Once
	Correct topsoil and spoil management.	Construction Contractor	Stockpile organic rich topsoil during construction. Place topsoil on dead soil typically found at bulk earthworks areas.	Once
Soil Erosion	Avoid development in any preferential drainage paths. Temporary berms and drainage channels to divert surface runoff where needed. Landscape and rehabilitate disturbed areas timeously (e.g. regressing). Use designated access and laydown areas only to minimise disturbance to surrounding areas.	Design Team / Construction Contractor	Reduce the impact and intensity of soil erosion in areas where vegetation and natural drainage channels have been removed. Maintain site areas to reduce run-away rills and gullies	Once Monthly
Operational				
Soil Erosion	Maintain access roads including drainage features. Monitor for erosion and remediate and rehabilitate timeously.	Operations Team	Maintain site areas to reduce run-away rills and gullies.	Monthly
Decommission				
Disturbance and removal of rock and soil	Restore natural site topography. Landscape and rehabilitate access roads and disturbed areas timeously (e.g. regressing).	Operations Team	Reduce ponding of water and soil erosion by reinstating natural drainage channels.	Yearly
Soil Erosion	Temporary berms and drainage channels to divert surface runoff where needed. Restore natural site topography. Use designated access and laydown areas only to minimise disturbance to surrounding areas.	Operations Team	Reduce ponding of water and soil erosion by reinstating natural drainage channels. Maintain remaining access roads.	Yearly



References

Brink, A.B.A. Engineering Geology of Southern Africa, Post-Gondwana Deposits, Volume 4. Building Publications, 1985.

Johnson, M.R. Anhaeusser, C.R. Thomas, R.J. The Geology of South Africa. Council for Geoscience, 2006.





Appendix A.

Specialist Declaration of Interest and Undertaking Oath





forestry, fisheries & the environment

Department:
Forestry, Fisheries and the Environment
REPUBLIC OF SOUTH AFRICA

Private Bag X447, Pretoria, 0001, Environment House, 473 Steve Biko Road, Pretoria, 0002 Tel: +27 12 399 9000, Fax: +27 86 625 1042

SPECIALIST DECLARATION FORM – AUGUST 2023

Specialist Declaration form for assessments undertaken for application for authorisation in terms of the National Environmental Management Act, Act No. 107 of 1998, as amended and the Environmental Impact Assessment (EIA) Regulations, 2014, as amended (the Regulations)

REPORT TITLE

BASIC ASSESSMENT PROCESS FOR THE SOLAR PHOTOVOLTAIC FACILITY, “RHINO” ON REMAINDER OF FARM RHENOSTERKOP 155 AND “SUNNYSIDE” ON FARM 400, BEAUFORT WEST

Kindly note the following:

1. This form must always be used for assessment that are in support of applications that must be subjected to Basic Assessment or Scoping & Environmental Impact Reporting, where this Department is the Competent Authority.
2. This form is current as of August 2023. It is the responsibility of the Applicant / Environmental Assessment Practitioner (EAP) to ascertain whether subsequent versions of the form have been published or produced by the Competent Authority. The latest available Departmental templates are available at <https://www.dffe.gov.za/documents/forms>.
3. An electronic copy of the signed declaration form must be appended to all Draft and Final Reports submitted to the department for consideration.
4. The specialist must be aware of and comply with ‘the Procedures for the assessment and minimum criteria for reporting on identified environmental themes in terms of sections 24(5)(a) and (h) and 44 of the act, when applying for environmental authorisation - GN 320/2020’, where applicable.

1. SPECIALIST INFORMATION


Title of Specialist Assessment	Geotechnical Impact Assessment
Specialist Company Name	PeraGage South Africa (Pty) Ltd
Specialist Name	Duan Swart
Specialist Identity Number	93073050200083
Specialist Qualifications:	BSc BSc(Hons) MSc Engineering Geology
Professional affiliation/registration:	SACNASP SAIEG
Physical address:	17 Cowley Road, Bryanston, Johannesburg
Postal address:	PO Box 71572, BRYANSTON
Postal address	Click or tap here to enter text.
Telephone	010 823 1621
Cell phone	0824516394
E-mail	Duan@peragage.com

SPECIALIST DECLARATION FORM – AUGUST 2023

2. DECLARATION BY THE SPECIALIST

I, Duan Swart declare that –

- I act as the independent specialist in this application;
- I am aware of the procedures and requirements for the assessment and minimum criteria for reporting on identified environmental themes in terms of sections 24(5)(a) and (h) and 44 of the National Environmental Management Act (NEMA), 1998, as amended, when applying for environmental authorisation which were promulgated in Government Notice No. 320 of 20 March 2020 (i.e. “the Protocols”) and in Government Notice No. 1150 of 30 October 2020.
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing –
 - any decision to be taken with respect to the application by the competent authority; and
 - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- All the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of Regulation 48 and is punishable in terms of section 24F of the NEMA Act.



Signature of the Specialist

Peragage South Africa (Pty) Ltd

Name of Company:

31 Jan 2024

Date

3. UNDERTAKING UNDER OATH/ AFFIRMATION

I, _ Duan Swart_____, swear under oath / affirm that all the information submitted or to be submitted for the purposes of this application is true and correct.



Signature of the Specialist

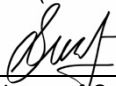
PeraGage South Africa (Pty) Ltd

Name of Company

31/01/2024

Date

GUSTAF SWART PLS 1444 (PROFESSIONAL LAND SURVEYOR)



Signature of the Commissioner of Oaths

31 Jan 2024

Date

Appendix B.

Specialist CV





PeraGage

SPECIALIST GEOTECHNICAL ENGINEERS



DUAN SWART

Senior Engineering Geologist

MSc (Engineering Geology), PrSciNat, MSAIEG

SUMMARY OF CREDENTIALS

Duan is a certified engineering geologist with seven years of valuable consulting experience. He has successfully conducted fieldwork and generated comprehensive reports for a diverse range of geotechnical and geological investigations, encompassing projects such as renewable energy facilities, roads, bridges, excavation sites, natural slopes, and dolomite stability assessments. His responsibilities have encompassed a wide spectrum of tasks, including cost estimation, site investigation planning, both shallow and deep site investigations, subcontractor management, in-situ geophysical testing, and laboratory test scheduling.

In addition to his practical consulting background, Duan has accumulated seven years of academic expertise. His doctoral research is focused on enhancing our understanding of variably saturated saprolitic soil, particularly within the intricate vadose zone, and he actively applies this knowledge to his consulting work. Furthermore, his Master's dissertation unearthed intriguing mineral occurrences within residual dolomite, contributing to our comprehension of the material's distinctive properties.

His experience has developed through numerous intrusive and non-intrusive site investigation methods for both rock and soil orientated projects.

Key professional experience and skills includes:

- ☐ Designing and executing detailed geotechnical investigations for the relevant infrastructure types according to guidelines as set out by: SAICE Geotechnical Division Code of Practice (2010); SANS 634; GFSH-2; as well as SANS 1936 for development on dolomite land.
- ☐ Competency in: soil profiling, chip and core logging as detailed in industry standards as set out by Brink and Bruin (2001); as well as material classification; on-site supervision; on-site testing and sampling.
- ☐ Skills in project management, such as: compiling cost estimates; client communication and liaison; health and safety compliance; delegating work to junior engineering geologists and students; as well as understanding responsibilities as part of a team of scientist and engineers within a project.

In addition to the professional work experience gained in industry, a strong set of skills have been accomplished in academia as a researcher and is a technical team member of the Water Research Commission (WRC) project, K5/2326. Currently, his Ph.D. research contributes to the WRC project Complex Vadose Zone Hydraulics (K5/2826).

DATE OF BIRTH
30 July 1993

NATIONALITY
South African

LANGUAGES
English
Afrikaans

QUALIFICATIONS

Professional registered
SACNASP, PrSciNat (137543),
MSAIEG, Master of Science
(Engineering Geology),
*Doctoral Candidate
(Engineering Geology),
Bachelor of Science (Hons)
(Engineering Geology),
Bachelor of Science
(Environmental and
Engineering Geology)

KEY SKILLS

Geotechnical Investigations,
Dolomite Investigations,
Borrow Pit and Quarry
Investigations,
Slope Stability Assessments,
Materials Assessments,
Vadose Zone Hydrology,
Unsaturated Soil Mechanics,
Limited Equilibrium Analysis.

INTERNATIONAL EXPERIENCE

Democratic Republic of
Congo, Botswana, Guinea,
Swaziland.

Key research experience includes:

- Investigating and executing fundamental scientific research questions on flow through variably saturated residual soil found in South Africa, as well as the influence of unique mineral occurrences on water storage of residual soils.
- Skills in research project management that include: working as a research team; addressing input from experts forming part of a reference group; managing a budget; managing and reviewing work of post-graduate students; and compiling deliverables as well as final research reports.
- Presenting research findings at several conferences; as well as published papers in peer reviewed scientific journals and chapters in books, and as large research reports.
- Lecturing and mentoring to both undergraduate and postgraduate students in the Department of Geology at the University of Pretoria.



PeraGage

SPECIALIST GEOTECHNICAL ENGINEERS

EXPERIENCE: KEY PROJECTS

N6 New Bridge over Orange River, Aliwal North, SOUTH AFRICA (2022-23)

Client: V3 Consulting / South African National Roads Agency (SANRAL) SOC Limited

Agency: (SANRAL) SOC Limited

Position: Engineering Geologist - The project involves the construction of a new bridge over the Orange River for the upgrade of the N6 Highway. Geotechnical works comprises the investigation and design of foundation of bridge abutments and pier foundations, as well as cut and fill design along the route. Duan was responsible for the supervision and management of the consultant tender submission, drilling tender write up and evaluation, setting up Bill of Quantities, site investigation, borehole core logging and write up of the geological, materials and interpretive reports.

Prieska Power Reserve, Prieska (2023)

Client: SMEC / CENEC

Position: Engineering Geologist –The Prieska Power Reserve Project is a catalytic project that will start producing green hydrogen and ammonia in 2025 through a combination of high yielding renewable solar and wind energy resources, along with the other natural resources of water and air. The project comprises the installation of a three Solar Energy Facilities (SEF), one Wind Energy Facility (WEF) and associated grids in the Northern Cape Province of South Africa. The project included the investigation and design of ground mounted solar photovoltaic (PV) systems covering an approximate area of 600 Ha, more than 30 wind turbines and associated substation and access roads. Duan was responsible for the costing proposal, managing on-site works, guiding sub-contractors, and writing up of the report. The total investigation costs were R 3.5 million.

Buffels Solar, Klerksdorp (2022)

Client: Kabi Solar / Solar Pack

Position: Engineering Geologist – The Buffels Solar Project comprises the installation of a 240 MW Solar Energy Facility (SEF) in the North West Province of South Africa. The project included the investigation and design of ground mounted solar photovoltaic (PV) systems covering an approximate area of 100 Ha and associated substation and access roads. Duan was responsible for the costing proposal, managing on-site works, guiding sub-contractors, and writing up of the report. The site was underlain by dolomitic land and Duan liaised with the Council for Geoscience to ensure the correct dolomite stability investigated procedures were followed. The total investigation costs were R 1.4 million.

Sutherland Cluster, Sutherland (2022)

Client: Mainstream Renewables

Position: Engineering Geologist – The Sutherland Cluster comprised the installation of 2040 MW Wind Energy Facility (WEF) in the Northern Cape Province of South Africa. The WEF formed part of the Round 5 of South Africa's Renewable Energy Independent Power Producer Procurement Programme (REIPPPP). The project includes the investigating of 97 wind turbines and associated access roads, laydown areas and grid infrastructure. Duan was responsible for the costing proposal, managing on-site works, guiding sub-contractors, and writing up of the report. The total investigation cost was R 11 million.

Simandou Ore Mine, GUINEA (2022)

Client: Rio Tinto / WSP

Position: Engineering Geologist – The Simandou mountain range contains one of the largest iron ore reserves in the world. The proposed mine will be one of the largest operating iron ore mines in the world. Duan was the engineering geologist for the geotechnical bulk earthworks of the entire mine, associated infrastructure, haul roads, and new airport, including upgrade of the existing 1.80 km dirt runway. The work included slope designs, material utilisation and integration with technical teams such as geometrics, water management and structures. Duan was responsible for the geological model and ground profiles for all the road cuttings and bulk earthworks. Furthermore, Duan was task to design slopes for road cuttings ranging from 30 m high to 125 m high. Duan compiled sections of the 85% and 100% design review report, and presented weekly and work closely with technical staff in WSP Group, Rio Tinto and SRK UK.



Luphohlo – Ezulwini Hydro-Electric Scheme, Mbabane, SWAZILAND (2022)

Client: Swaziland Electricity Company

Position: Engineering Geologist – The scheme comprises a 45m high earth cored rockfill dam, which impounds a reservoir of 24 million cubic metres total capacity on the Lusushwana River. Water is drawn through an intake on the eastern side of the reservoir and transferred through the Luphohlo Mountain in a 4.3km long low-pressure tunnel to a surge chamber on the Ezulwini valley side of the mountain. The project involves the inspection of the 4.2 km long low-pressure tunnel. The tunnel inspection was carried out on foot from the intake down to the rock traps / access audit.

Duan was responsible for inspection of tunnel features such as concrete lining; moisture drains and rock condition along the length of the tunnel. Duan wrote up sections within the geological and interpretive reports.

N4 Montrose Interchange, Mpumalanga, SOUTH AFRICA (2019-21)

Client: Trans African Toll Concession (TRAC) / South African National Roads Agency (SANRAL) SOC Limited Agency (SANRAL) SOC Limited

Position: Engineering Geologist - The project involves the widening and upgrade of the National Route 4 at the intersection of the Ngodwana and Schoemanskloof bypasses. Geotechnical works comprises the investigation and design of cut and fill retaining walls, new, multi-lane arch bridge, structure abutments, soil and rock slopes, foundations for the widening of the bridge over the Crocodile River, and identification of material sources. Duan was responsible for supervision of part of the site investigation, borehole core logging and write up of sections within the geological, materials and interpretive reports.

R574 Groblersdal, Limpopo, SOUTH AFRICA (2020-22)

Client: Nathoo Mbenyane Engineers/ South African National Roads Agency (SANRAL) SOC Limited

Position: Engineering Geologist - The project involves the widening and upgrade on the National Road R574 (District Road D1547) Section 1 from R33 Groblersdal (km 0.0) to R579 Morwaneng (km 38.9). Geotechnical works comprises the investigation and design of soil and rock slopes, structure abutments, foundations for the widening of the bridges, and identification and investigation of material sources. Duan was responsible for building the bill of quantities, supervision of the site investigation, borehole core logging and write up of sections within the geological, materials and interpretive reports.

R36 Tzaneen, Limpopo, SOUTH AFRICA (2020-22)

Client: Nathoo Mbenyane Engineers/ South African National Roads Agency (SANRAL) SOC Limited

Position: Engineering Geologist - The project involves the widening and upgrade of National Road R36 Section 6 from Manchabeni (Km 4.70) to Tzaneen (Km 33.50). Geotechnical works comprises the investigation and design of soil and rock slopes, structure abutments, foundations for the widening of the bridges, and identification and investigation of material sources. Duan was responsible for building the bill of quantities and write up of sections within the factual and interpretive reports.

R578 Giyani Materials, Limpopo, SOUTH AFRICA (2020-22)

Client: SMEC/ South African National Roads Agency (SANRAL) SOC Limited

Position: Engineering Geologist - The project involves the widening and upgrade of National Road R578 Section 1 from Nwamatatani (Km 56.0) to R81 (Km 90.70). Geotechnical works comprises the on-site identification and investigation of material sources. Duan was responsible for building the bill of quantities, on-site investigation, write up of sections within the geological and materials reports.

N3 Mariannhill, Kwa-Zulu Natal, SOUTH AFRICA (2020-22)

Client: SMEC/ South African National Roads Agency (SANRAL) SOC Limited

Position: Engineering Geologist - The project involves the widening and upgrade of the National Route 3 between Key Ridge and Mariannhill Toll Plaza. Geotechnical works comprises the drilling and test pitting of existing cuts and laboratory testing. Duan was responsible for a portion of the on-site investigation, drawing of the geological models, write up of sections within the interpretive report.



KZN Quarries, Kwa-Zulu Natal, SOUTH AFRICA (2019-22)

Client: FDKL/ South African National Roads Agency (SANRAL) SOC Limited

Position: Engineering Geologist - The project involves the identification of potential quarry sources to prospect and secure for future SANRAL contracts in the KZN province. Geotechnical works comprise the on-site identification of material sources. Duan was responsible for developing and implementing of a Quarry-Potential Rating system to categorize and prioritize all sites quantitatively, building the drilling BoQ, writing up of sections in the preliminary assessment report.

N1 R36 Quarries, Free State, SOUTH AFRICA (2021)

Client: HHO/ South African National Roads Agency (SANRAL) SOC Limited

Position: Engineering Geologist - The project involves the identification of potential quarry sources, between Welkom and Koppies, for use on the N1-R34 Route Upgrade project. Geotechnical works comprise the identification and investigation of potential material sources. Duan was responsible for logging and supervising logging of core (1300 m) and percussion chips (950 m) retrieved during the investigation.

EXPERIENCE: OTHER MAJOR PROJECTS

Upgrades to Damani Water Treatment Plant, SOUTH AFRICA (2019)

Client: EVN Africa Consulting Engineers (Pty) Ltd

Position: Engineering Geologist - The project involved the investigation for the addition of 12 new water reservoirs in the Vhembe District Municipality as part of the upgrading of the Damani Water Treatment Plant. Duan was tasked to undertake visual inspections of soil profiles, in excavations and on slopes, and rock outcrops to make recommendations on foundation solutions for elevated steel tanks and large water reservoirs. Duan was responsible for the site investigation, interpretation and writing of reports.

Kisanfu Geotechnical Investigation, DEMOCRATIC REPUBLIC OF THE CONGO (2019)

Client: Piteau Associates

Position: Engineering Geologist - The project encompassed the drilling of rotary core and trial pit excavations by means of a 40-ton excavator to investigate the overburden materials above an enriched ore deposit in the Democratic Republic of Congo (DRC). The nature and depth to the ore deposit necessitated the establishment of an open cast mine. The investigation was undertaken to determine the overburden properties for design input of cut slopes, haul roads and material utilization. Duan was responsible for 2 months on-site supervision while surveying and logging over 150 trial pits and 800 m of core from boreholes and was responsible for sample retrieval and laboratory testing supervision.

Umlazi and Amatikwe Housing Project, KwaZulu-Natal, SOUTH AFRICA (2019-2020)

Client: Asande Projects Consulting & Engineering

Position: Engineering Geologist - The project involves construction of low-cost housing in the areas of Umlazi and Amatikwe, near Durban in the KwaZulu-Natal Province. Geotechnical works comprises the site investigation, NHBRC classification of the site and the recommendations on foundation design. Duan was responsible for planning of site investigation, supervision of the site investigation, test pit logging and write up of the final geotechnical report. The total project costs are estimated to be R 150 million.

New Ermelo Housing Project, Mpumalanga, SOUTH AFRICA (2020-2021)

Client: Asande Projects Consulting & Engineering

Position: Engineering Geologist - The project involves construction of low-cost housing in the areas of New Ermelo, near Ermelo in the Mpumalanga Province. Geotechnical works comprises the site investigation, NHBRC classification of the site and the recommendations on foundation design. Duan was responsible for planning of site investigation, supervision of the site investigation, test pit logging and write up of the final geotechnical report. The total project costs are estimated to be R 1.3 billion.



PROFESSIONAL HISTORY

2019 (Oct) – to date: PeraGage South Africa (Pty) Ltd, Johannesburg – Engineering Geologist
2019(Jan)-2019(Sep): RockSoil Consult – Engineering Geologist
2018 – 2019: University of Pretoria, Geology Dept. – Lecturer for the following modules:
Groundwater (GLY 265), Engineering Geology (GLY 363), Rock Mechanics (GLY 364)
2018 - 2019: JL Van Rooy - Graduate Engineering Geologist

PROFESSIONAL STANDING, MEMBERSHIPS AND COMMITTEES

Registered Natural Scientist the South African Council for Natural Scientific Professions
(SACNASP): PrSciNat 137543
Member of the South African Institute of Engineering and Environmental Geologists (SAIEG): MSAIEG 21/526
Water Research Commission – Karst Research Group K5/2326 (2018 – 2020)
Water Research Commission – Complex Vadose Zone Research Group K5/2826 (2020 – 2023*)
University of Pretoria – Geology Dept. External Examiner BSc and BSc (Hons) (2020-2023)
University of Pretoria – Geology Dept. External Examiner MSc (2023)

TECHNICAL QUALIFICATIONS

2020*	PhD Engineering Geology (Candidate)	University of Pretoria
2019	Master of Science (Engineering Geology)	University of Pretoria
2017	Bachelor of Science (Hons) (Engineering Geology)	University of Pretoria
2016	Bachelor of Science (Environmental and Engineering Geology)	University of Pretoria

TECHNICAL COURSES AND CONFERENCES PRESENTED

2023 **Presenter**, 10th South Africa Young Geotechnical Engineers Conference (SAYGEC). Winner of Best Presentation of the SAYGEC.
2023 **Presenter**, Vadose Zone: Theory to Practise, Water Research Commission, South Africa.
2022 **Presenter**, Kirkham Conference, Soil Science Society of America, Skukuza, Kruger National Park, South Africa.
2022 **Presenter**, Proceedings of the 20th International Conference on Soil Mechanics and Geotechnical Engineering, Sydney 2022.
2021 **Presenter**, Webinar on Vadose Zone Hydraulics and unsaturated soil mechanics, University of Pretoria
2018 **Presenter**, Dolomite: (dis)solution 2018, SAIEG/ SAICE, Geotechnical Division/ GSSA Groundwater Division.

TECHNICAL PUBLICATIONS

- **Swart, D.**, Dippenaar, M.A. & Van Rooy, J.L. (2023). Field tests for the identification of silts. Bull Eng Geol Environ 82, 425. <https://doi.org/10.1007/s10064-023-03442-7>
- Dippenaar, M.A., Jones B.R., Van Rooy J.L., Maoyi M. & **Swart, D.** (2022) The Karst Vadose Zone: Influence on Recharge, Vulnerability and Surface Stability. Water Research Commission Report No. TT 869/21.
- **Swart, D.**, Gaspar, T.A.V., & Dippenaar, M. (2022). Testing of hydromechanical properties of the variable saturated residual dolomite (wad). Proceedings of the 20th International Conference on Soil Mechanics and Geotechnical Engineering, Sydney.
- Dippenaar, M.A., **Swart, D.**, Van Rooy J.L. & Diamond R.E. (2019) The Karst Vadose Zone: Influence on Recharge, Vulnerability and Surface Stability. Water Research Commission Report No. TT 779/19.
- **Swart, D.**, Dippenaar, M.A., & Van Rooy, J.L. (2019). Mechanical and hydraulic properties of residual dolomite and wad. South African Journal of Geology, 122(3).
- **Swart, D** (2019). Hydromechanical Properties of wad and residual dolomite. Proceedings of the 7th African Young Geotechnical Engineers Conference, 7-12.



herewith certifies that

Duan Swart

Registration Number: 137543

is a registered scientist

in terms of section 20(3) of the Natural Scientific Professions Act, 2003
(Act 27 of 2003)

in the following field(s) of practice (Schedule 1 of the Act)

Geological Science (Professional Natural Scientist)

Effective **7 July 2021**

Expires **31 March 2024**



A handwritten signature in black ink, appearing to read 'S. Neph', is written over a horizontal line.

Chairperson

A handwritten signature in black ink, appearing to read 'N. Swart', is written over a horizontal line.

Chief Executive Officer





STEVEN BOK

Principal Engineering Geologist

PrSciNat BSc (Hons)

DATE OF BIRTH

30 May 1979

NATIONALITY

South African

LANGUAGES

English

Afrikaans

QUALIFICATIONS

Professionally registered
SACNASP 400279/07 (Geological
Science), Bachelor of Science
(Geology, Geography), Bachelor
of Science (Honours) (Geology)

KEY SKILLS

Geotechnical site investigations,
Desktop & feasibility studies,
Materials investigations,
Technical report writing, Project
Management

INTERNATIONAL EXPERIENCE

Botswana, Democratic Republic
of the Congo, Lesotho,
Madagascar, Mozambique, Sierra
Leone, South Africa, Zambia

MEMBERSHIP

GSSA 971552

SUMMARY OF CREDENTIALS

Steven is a registered professional natural scientist with 20 years of experience in the field of engineering geology and geotechnical engineering. He has broad exposure to infrastructure developments and is adept at undertaking and managing geotechnical site investigations, materials investigations and geotechnical report writing. He also has experience in geotechnical verification and monitoring during construction projects.

Steven has worked throughout South Africa and in Africa providing services to private-sector clients in the mining, consulting and construction industries as well as to government and parastatals.

His technical strengths are the planning and undertaking of site investigations for roads, dams, railways, residential and commercial buildings, township development, large infrastructure (e.g. reservoirs, pipelines, bridges, tailings facilities) and lateral support. Materials investigations (borrow pit and quarry identification and assessment) are an area of particular interest.

Many of the projects on which he has worked represent, complex, multi-disciplinary infrastructure developments. He has been responsible for undertaking and managing the geotechnical component of a major coal mine development in Mpumalanga as well as the new Sol Plaatje University project in Kimberly. He was the Project Leader and undertook the detailed geotechnical investigation for the Kazungula Bridge over the Zambezi River and the new ash dam facility at the Eskom Camden Power Station.

He has vast experience in undertaking geotechnical investigations for housing development, for private developers and organs of state in across South Africa.

He has also been involved with several investigations for large dams including the proposed Ludeke Dam (Eastern Cape), a weir and off-channel storage dam on the Black Umfolozi River (Kwa-Zulu Natal), Thuni Dam (Botswana) and three ash dam projects at Eskom power stations.

He has undertaken geophysical investigations for quarries and borrow pits, groundwater identification and bridge and dam site investigation. Geophysical methods used are seismic refraction surveys, 2D resistivity and EM-34 electromagnetic surveys.

Steven has mentored young engineering geologists as a technical manager at a large South African consulting engineering firm.

He ensures that geotechnical investigations are undertaken in accordance with the Occupational Health and Safety Act and the Mine Health and Safety Act. He has experience in Risk Assessment and the preparation of Health & Safety files in terms of current regulations and client requirements.

EXPERIENCE: KEY PROJECTS



Mafube Life Extension Project, Middleburg, Mpumalanga, SOUTH AFRICA (2013-2019)

Client: Mafube Coal (Anglo Coal/Exxaro JV)

Lead Engineering Geologist – the project involved design and construction of mine infrastructure required to utilise the Nooitgedacht coal reserve, located 7km from the existing colliery. This included 7km of overland conveyor, 5km of haul roads, pollution control and water return dams, a new ROM tip, road over rail bridge, major culverts, HMT workshops and associated infrastructure. Steven

was responsible for undertaking or overseeing all site investigation work, from preliminary design commencing in 2013 to detailed design and geotechnical construction supervision during 2018/2019. Services included location and monitoring of rockfill and borrow materials. Effective use of mine overburden and borrow materials during construction resulted in a significant cost saving for the Client.

Project Value: US\$200million.



N4 Upgrades, Rustenburg, SOUTH AFRICA (various phases, 2010 - 2019)

Client: Bakwena

Lead Engineering Geologist – Various upgrade and duelling projects along the N4 between Brits and Swaruggens. Steven was responsible for undertaking and overseeing road prism, materials and bridge investigations required for the detailed design of upgrades between Rustenburg and Swaruggens and duelling along Sections 9, 10 and 13 (approximately 60 km of new carriageway between Brits and Rustenburg). Work included mitigation of highly expansive “black turf” subgrades and

sourcing of construction materials. Drilling investigations were undertaken for approximately 12 bridges, including a new bridge over the Crocodile River. Construction supervision and verification of founding conditions.



New Sol Plaatje University, Kimberly, SOUTH AFRICA (2015-2017)

Client: WITS / Sol Plaatje University

Project Leader for Geotechnical Consultant – the project involved the construction of a new university in Kimberly. Steven was the Project Leader for the geotechnical consultant responsible detailed site investigations and geotechnical construction supervision. The university complex is constructed on variably weathered dolerite bedrock, which posed a challenge for foundation design. The use of geophysics, detailed rock mass characterisation and targeted drilling, coupled with monitoring of the founding conditions during construction, allowed the design

engineers to triple the foundation loads determined during the preliminary design phase.



Camden Power Station new ash dam, water return dam, Ermelo, SOUTH AFRICA (2016)

Client: Eskom 2016

Project Engineering Geologist – the project involved the detailed design and subsequent construction of a new Ash Dam Facility, water return dam and associated slurry pipelines and access roads. Steven was responsible for undertaking the geotechnical site investigations as part of the design

team. The investigation involved a detailed materials investigation, specialised laboratory and in-situ testing and included extensive interaction with the design and Eskom's technical teams. The presence of nearby undermining necessitated the use of various geophysical methods to delineate the extent of tunnels, which could have lead to instability of the ADF.





Various Eskom Substations, SOUTH AFRICA (2013-2015)

Client: Eskom SOC Limited

Project Leader for Geotechnical Consultant – detailed geotechnical investigations for 5 major new substations across South Africa, namely the Northrand Substation (Johannesburg), Nieuwehoop Substation (Northern Cape), Dwaalboom Substation (Limpopo), Upington Substation and Firgrove Substations (Somerset West). Steven undertook the site investigations which included assessment of construction materials and geophysical surveys. Engineering geological models were produced for each site, which assisted Eskom's civil design team to optimise the platform layout and earthworks design. The appointment included conceptual platform and subsoil drainage design. The completed Firgrove Substation is illustrated.



Various Bulk Water Supply pipelines, Gauteng, SOUTH AFRICA (2009-2013)

Client: Rand Water SOC Ltd

Project Engineering Geologist / Project Leader – Steven managed or undertook detailed geotechnical investigations for a major proportion of Rand Water's pipeline construction projects between 2009 and 2013. Work included investigations for sections of the F5, H35, R5, H37, G37, B19, O5, O6 and C25 pipelines. In total, approximately 80 km of route was

investigated, for pipelines ranging from 800 mm to 2500 mm diameter, including detained investigations at numerous pipe jacking positions. The investigation outputs included the compiling detailed geotechnical long sections of the pipeline routes highlighting excavation conditions and geotechnical risks. Most of the projects have been successfully constructed.



Various Rand Water Reservoirs & Pumping Stations, Gauteng, SOUTH AFRICA (2010-2016)

Client: Rand Water SOC Ltd

Project Engineering Geologist / Project Leader – Detailed site investigations (typically drilling investigations) were undertaken for an additional reservoir at the Palmiet Pumping Station (100 MI) the Amanzimtoti Reservoir (20 MI), Bronberg Reservoir (100 MI), extensions to the Palmiet Pumping Station and sections of the Zuikerbosch and Vereeniging WTW extension projects. Steven was involved with geotechnical site supervision during construction on

many of the projects. Palmiet Pumping Station is illustrated.



Kazangula Bridge over the Zambezi River, BOTSWANA (2011),

Client: EGIS BECOM International

Project Engineering Geologist for detailed geotechnical investigations – the 923-metre-long Kazangula Bridge, currently nearing completion, crosses the Zambezi River at Kasane, Botswana. The bridge provides a road and rail crossing between Botswana and Zambia and passes through Namibia, where the country's borders meet. Steven was the project Engineering Geologist for the contractor who undertook the site investigation and was responsible for ensuring that the investigations were undertaken in accordance with European standards and technical reporting. He undertook full-

time supervision of the drilling and in-situ testing works, which were undertaken from a jack-up barge. The reporting included rock mass characterisation beneath the bridge piers, settlement estimates and provision of foundation recommendations.

EXPERIENCE: OTHER PROJECTS**R578 Giyani Materials, Limpopo (2020-22)****Client:** SMEC/ South African National Roads Agency (SANRAL) SOC Limited**Engineering Geologist** – Preliminary GI for material sources.**N1 R36 Quarries, Free State (2021)****Client:** HHO/ South African National Roads Agency (SANRAL) SOC Limited**Engineering Geologist** – Logging of core and percussion chips for material sources.**Khwezela Life Extension Project (2019)****Client:** Anglo Coal**Project Leader (PL) & Senior Engineering Geologist** - haul road materials investigation and pavement design project, including construction supervision as part of a coal mine expansion project.**Kriel Ash Dam Stability Analysis (2017-2018)****Client:** Eskom**Senior Engineering Geologist** - responsible for geotechnical investigations to characterise an existing wet ash dam facility.**Hendrina Step-in-and-go-higher project (2015)****Client:** Eskom**Project Engineering Geologist** – geotechnical investigation for the proposed raising of the ash dam facility at Hendrina Power Station.**Leeuwpans OI BFS External Roads Package (2015)****Client:** Exxaro**Project Leader** – a road prism and materials investigation for the realignment of the R50 provincial road around the Leeuwpans Colliery, Ogies, Mpumalanga.**Three story office building at Camden Power Station (2012/13)****Client:** Eskom**Project Leader** - site investigations, piling supervision & pile integrity verification.**Belfast Mine Leachate Dams (2011)****Client:** Exxaro**Senior Engineering Geologist** - GI for preliminary design of two lined earthfill return water dams.**Foundation investigations for approx. 80 Eskom Telecommunication Towers (2010-2014)****Client:** Eskom**Project Leader** - term appointment for undertaking site investigations for foundation design of new Eskom telecommunication towers throughout South Africa**Sierra Leone centre line & materials investigation (2010)****client:** African Minerals**Senior Engineering Geologist** - road prism and materials investigation for 50km of new haul road / railway line in Sierra Leone, including foundation investigations for bridges.**Dumbe Coal Line Stability Analysis (2009-2010)****Client:** Transnet**Project Leader & Senior Engineering Geologist** - GI for slope stability analysis for widening of 6 km of cuttings on the Coal Line near Paulpietersburg.**Lesotho Lowlands Geotech Zone 4&5 (2007)****Client:** Lesotho Ministry of Natural Resources**Engineering Geologist** – Detailed GI for 350 km bulk supply pipeline, 46 Reservoirs & pump stations**Thuni Dam, in Eastern Botswana (2005)****Client:** DWA Botswana**Engineering Geologist** - Detailed geotechnical investigations and materials investigation for a large earthfill dam

PROFESSIONAL HISTORY

2023 – date: PeraGage (Pty) Ltd – Principal Engineering Geologist
2019 – 2023: GaGE Consulting (Pty) Ltd, Cape Town – Principal Engineering Geologist.
2002 – 2019: JG Afrika (Pty) Ltd Engineering & Environmental Consulting. Engineering Geologist (Pietermaritzburg, 2002 to 2007), Senior Engineering Geologist (Pietermaritzburg, 2007 to 2009), Senior Engineering Geologist (Johannesburg, 2009 – 2013), Associate (Johannesburg, 2013 – 2019).

TECHNICAL QUALIFICATIONS

2000	Bachelor of Science (Geology, Geography)	Nelson Mandela University
2001	Bachelor of Science (Honours) (Geology)	Nelson Mandela University

TECHNICAL COURSES AND CONFERENCES ATTENDED (PAST 5 YEARS)

2014 Attendee, SAICE Young Geotechnical Engineers Conference, Stellenbosch.
2008 Attendee, SAICE Young Geotechnical Engineers Conference, Durban.
2005 Attendee, SAICE Young Geotechnical Engineers Conference, Swadini.





herewith certifies that
Steven Nicholas Bok
Registration Number: 400279/07
is a registered scientist

in terms of section 20(3) of the Natural Scientific Professions Act, 2003
(Act 27 of 2003)
in the following field(s) of practice (Schedule 1 of the Act)
Geological Science (Professional Natural Scientist)

Effective **7 November 2007**

Expires **31 March 2024**



A handwritten signature in black ink, appearing to read 'S. N. Bok', is written over a horizontal line.

Chairperson

A handwritten signature in black ink, appearing to read 'N. S. S. S.', is written over a horizontal line.

Chief Executive Officer



Appendix C.

Environmental Impact Assessment (EIA) Methodology



1 ENVIRONMENTAL IMPACT ASSESSMENT (EIA) METHODOLOGY

The Environmental Impact Assessment (EIA) Methodology assists in evaluating the overall effect of a proposed activity on the environment. Determining of the significance of an environmental impact on an environmental parameter is determined through a systematic analysis.

1.1 Determination of Significance of Impacts

Significance is determined through a synthesis of impact characteristics which include context and intensity of an impact. Context refers to the geographical scale (i.e. site, local, national or global), whereas intensity is defined by the severity of the impact e.g. the magnitude of deviation from background conditions, the size of the area affected, the duration of the impact and the overall probability of occurrence. Significance is calculated as shown in **Table 1**.

Significance is an indication of the importance of the impact in terms of both physical extent and time scale, and therefore indicates the level of mitigation required. The total number of points scored for each impact indicates the level of significance of the impact.

1.2 Impact Rating System

The impact assessment must take account of the nature, scale and duration of effects on the environment and whether such effects are positive (beneficial) or negative (detrimental). Each issue / impact is also assessed according to the various project stages, as follows:

- Planning;
- Construction;
- Operation; and
- Decommissioning.

Where necessary, the proposal for mitigation or optimisation of an impact should be detailed. A brief discussion of the impact and the rationale behind the assessment of its significance has also been included.

The significance of Cumulative Impacts should also be rated (As per the Excel Spreadsheet Template).

1.2.1 Rating System Used to Classify Impacts

The rating system is applied to the potential impact on the receiving environment and includes an objective evaluation of the possible mitigation of the impact. Impacts have been consolidated into one (1) rating. In assessing the significance of each issue the following criteria (including an allocated point system) is used:

Table 1: Rating of impacts criteria



ENVIRONMENTAL PARAMETER		
A brief description of the environmental aspect likely to be affected by the proposed activity (e.g. Surface Water).		
ISSUE / IMPACT / ENVIRONMENTAL EFFECT / NATURE		
Include a brief description of the impact of environmental parameter being assessed in the context of the project. This criterion includes a brief written statement of the environmental aspect being impacted upon by a particular action or activity (e.g. oil spill in surface water).		
EXTENT (E)		
This is defined as the area over which the impact will be expressed. Typically, the severity and significance of an impact have different scales and as such bracketing ranges are often required. This is often useful during the detailed assessment of a project in terms of further defining the determined.		
1	Site	The impact will only affect the site
2	Local/district	Will affect the local area or district
3	Province/region	Will affect the entire province or region
4	International and National	Will affect the entire country
PROBABILITY (P)		
This describes the chance of occurrence of an impact		
1	Unlikely	The chance of the impact occurring is extremely low (Less than a 25% chance of occurrence).
2	Possible	The impact may occur (Between a 25% to 50% chance of occurrence).
3	Probable	The impact will likely occur (Between a 50% to 75% chance of occurrence).
4	Definite	Impact will certainly occur (Greater than a 75% chance of occurrence).
REVERSIBILITY (R)		
This describes the degree to which an impact on an environmental parameter can be successfully reversed upon completion of the proposed activity.		
1	Completely reversible	The impact is reversible with implementation of minor mitigation measures
2	Partly reversible	The impact is partly reversible but more intense mitigation measures are required.
3	Barely reversible	The impact is unlikely to be reversed even with intense mitigation measures.
4	Irreversible	The impact is irreversible and no mitigation measures exist.
IRREPLACEABLE LOSS OF RESOURCES (L)		
This describes the degree to which resources will be irreplaceably lost as a result of a proposed activity.		
1	No loss of resource.	The impact will not result in the loss of any resources.
2	Marginal loss of resource	The impact will result in marginal loss of resources.
3	Significant loss of resources	The impact will result in significant loss of resources.
4	Complete loss of resources	The impact is result in a complete loss of all resources.
DURATION (D)		
This describes the duration of the impacts on the environmental parameter. Duration indicates the lifetime of the impact as a result of the proposed activity.		



1	Short term	The impact and its effects will either disappear with mitigation or will be mitigated through natural process in a span shorter than the construction phase (0 – 1 years), or the impact and its effects will last for the period of a relatively short construction period and a limited recovery time after construction, thereafter it will be entirely negated (0 – 2 years).
2	Medium term	The impact and its effects will continue or last for some time after the construction phase but will be mitigated by direct human action or by natural processes thereafter (2 – 10 years).
3	Long term	The impact and its effects will continue or last for the entire operational life of the development, but will be mitigated by direct human action or by natural processes thereafter (10 – 50 years).
4	Permanent	The only class of impact that will be non-transitory. Mitigation either by man or natural process will not occur in such a way or such a time span that the impact can be considered transient (Indefinite).

INTENSITY / MAGNITUDE (I / M)

Describes the severity of an impact (i.e. whether the impact has the ability to alter the functionality or quality of a system permanently or temporarily).

1	Low	Impact affects the quality, use and integrity of the system/component in a way that is barely perceptible.
2	Medium	Impact alters the quality, use and integrity of the system/component but system/ component still continues to function in a moderately modified way and maintains general integrity (some impact on integrity).
3	High	Impact affects the continued viability of the system/component and the quality, use, integrity and functionality of the system or component is severely impaired and may temporarily cease. High costs of rehabilitation and remediation.
4	Very high	Impact affects the continued viability of the system/component and the quality, use, integrity and functionality of the system or component permanently ceases and is irreversibly impaired (system collapse). Rehabilitation and remediation often impossible. If possible rehabilitation and remediation often unfeasible due to extremely high costs of rehabilitation and remediation.

SIGNIFICANCE (S)

Significance is determined through a synthesis of impact characteristics. Significance is an indication of the importance of the impact in terms of both physical extent and time scale, and therefore indicates the level of mitigation required. This describes the significance of the impact on the environmental parameter. The calculation of the significance of an impact uses the following formula:

Significance = (Extent + probability + reversibility + irreplaceability + duration) x magnitude/intensity.



The summation of the different criteria will produce a non-weighted value. By multiplying this value with the magnitude/intensity, the resultant value acquires a weighted characteristic which can be measured and assigned a significance rating.

Points	Impact Significance Rating	Description
5 to 23	Negative Low impact	The anticipated impact will have negligible negative effects and will require little to no mitigation.
5 to 23	Positive Low impact	The anticipated impact will have minor positive effects.
24 to 42	Negative Medium impact	The anticipated impact will have moderate negative effects and will require moderate mitigation measures.
24 to 42	Positive Medium impact	The anticipated impact will have moderate positive effects.
43 to 61	Negative High impact	The anticipated impact will have significant effects and will require significant mitigation measures to achieve an acceptable level of impact.
43 to 61	Positive High impact	The anticipated impact will have significant positive effects.
62 to 80	Negative Very high impact	The anticipated impact will have highly significant effects and are unlikely to be able to be mitigated adequately. These impacts could be considered "fatal flaws".
62 to 80	Positive Very high impact	The anticipated impact will have highly significant positive effects.

The table below is to be represented in the Impact Assessment section of the report. The excel spreadsheet template can be used to complete the Impact Assessment.

Table 2: Rating of impacts template and example[illegible]

[illegible]

[illegible]

Appendix D.

Impact Rating Tables

ENVIRONMENTAL IMPACT ASSESSMENT (EIA) FOR THE SOLAR PHOTOVOLTAIC FACILITY, “RHINO” PV ON REMAINDER OF FARM RHENOSTERKOP 155 AND “SUNNYSIDE” PV ON FARM 400 BEAUFORT WEST, WESTERN CAPE PROVINCE																				
ENVIRONMENTAL PARAMETER	ISSUE / IMPACT / ENVIRONMENTAL EFFECT/ NATURE	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION									RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION								
		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S
Construction Phase (Rhenosterkop PV)																				
Disturbance/ displacement/ removal of soil and rock	Ground disturbance during access road construction, foundation earthworks, platform earthworks	1	4	2	2	3	1	12	-	Low	1) Design access roads and post locations to minimise earthworks and levelling based on high resolution ground contour information 2) Correct topsoil and spoil management	1	4	2	1	2	1	10	-	Low
Soil Erosion	Increased erosion due to vegetation clearing, alteration of natural drainage	1	3	2	2	3	1	11	-	Low	1) Avoid development in preferential drainage paths 2) Appropriate engineering design of road drainage and watercourse crossings 3) Temporary berms and drainage channels to divert surface runoff where needed 4) Landscape and rehabilitate disturbed areas timeously (e.g. regressing) 5) Use designated access and laydown areas only to minimise disturbance to surrounding areas	1	2	1	1	2	1	7	-	Low
Operational Phase (Rhenosterkop PV)																				
Soil Erosion	Increased erosion due to alteration of natural drainage	1	2	1	1	2	1	7	-	Low	1) Maintain access roads including drainage features 2) Monitor for erosion and remediate and rehabilitate timeously	1	1	1	1	2	1	6	-	Low
Decommissioning Phase (Rhenosterkop PV)																				
Disturbance/ displacement/ removal of soil and rock	Ground disturbance during access road construction, foundation earthworks, platform earthworks	1	4	2	2	2	1	11	-	Low	1) Restore natural site topography 2) Landscape and rehabilitate access roads and disturbed areas timeously (e.g. regressing)	1	4	2	1	2	1	10	-	Low
Soil Erosion	Increased erosion due to vegetation clearing, alteration of natural drainage	1	2	2	2	2	1	9	-	Low	1) Temorary berms and drainage channels to divert surface runoff where needed 2) Restore natural site topography 3) Use designated access and laydown areas only to minimise disturbance to surrounding areas	1	1	1	1	2	1	6	-	Low