PROPOSED DEVELOPMENT OF THE 147MW RIETKLOOF WIND ENERGY FACILITY AND ASSOCIATED INFRASTRUCTURE NEAR MAITJIESFONTEIN, WESTERN CAPE PROVINCE

DESKTOP GEOTECHNICAL REPORT

NOVEMBER 2021

REVISION 01

Prepared by:

JG AFRIKA (PTY) LTD

Pietermaritzburg
6 Pin Oak Avenue, Hilton
3201
Phone: 033 343 6700
Email: norrisj@jgafrika.com
Project Director: Jan Norris

VERIFICATION PAGE	Qual-frm-026
	Rev 14

TITLE:
PROPOSED DEVELOPMENT OF THE 147MW RIETKLOOF WIND ENERGY FACILITY AND ASSOCIATED INFRASTRUCTURE NEAR MAITJIESFONTEIN, WESTERN CAPE PROVINCE

JGA REF. NO.	DATE:	REPORT STATUS
5613	23/11/2021	Final

CARRIED OUT BY:	COMMISSIONED BY:
JG AFRIKA (PTY) LTD **Pietermaritzburg** 6 Pin Oak Avenue Hilton 3201 Tel.: +27 33 3434 6700 Email: pmb@jgafrika.com	**WSP ENVIRONMENTAL AND ENERGY** **Johannesburg** 33 Sloane Street Johannesburg 2191 Tel.: +27 21 300 0610 Email: Ashlea.strong@wsp.com
AUTHOR K Bulala	**CLIENT CONTACT PERSON** A Strong

SYNOPSIS

Desktop geotechnical investigation for the proposed Rietkloof wind energy Facility.

KEY WORDS:

Sandstone, shale, Mudstone, Foundations, Shallow, Bedrock, Resistivity.

QUALITY VERIFICATION

This report has been prepared under the controls established by a quality management system that meets the requirements of ISO 9001: 2015 which has been independently certified by DEKRA Certification.

Verification	Capacity	Name	Signature	Date
By Author	Engineering Geologist	K Bulala Cand.Sci.Nat.	p.p.	23/11/2021
Checked by:	Senior Associate	T Speirs Pr.Sci.Nat	p.p.	23/11/2021
Authorised by:	Director Geotechnical	J Norris Pr.Eng		23/11/2021

Filename:	W:\Geotech\5613 - WSP Desktops (KB)\2. Technical Data\Reporting\Rietkloof\WEF\5613 Rietkloof WEF - Desktop Geotechnical Report DRAFT.docx

National Environmental Management Act, 1998 (Act No. 107 of 1998) and Environmental Impact Regulations 2014 (as amended) Requirements for Specialist Reports (Appendix 6)

Section in EIA Regulations 2014 (as amended)	Clause		Section in Report
Appendix 6	(1)	A specialist report prepared in terms of these Regulations must contain —	
	(a)	details of –	
		(i) the specialist who prepared the report; and	Verification Page
		(ii) the expertise of that specialist to compile a specialist report including a curriculum vitae.	Appendix C
	(b)	A declaration that the person is independent in a form as may be specified by the competent authority;	Appendix C
	(c)	An indication of the scope of, and the purpose for which, the report was prepared;	1
	(cA)	An indication of the quality and age of base data used for the specialist report;	4, 5, 6, 11
	(cB)	A description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	Table 8-1, 9-1, 9-2
	(d)	The duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment;	N/A
	(e)	A description of the methodology adopted in preparing the report or carrying out the specialised process; inclusive of equipment and modelling used;	1
	(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;	Appendix A Map 1,2,3,4, 5
	(g)	An indication of any areas to be avoided, including buffers;	Appendix A Map 1,2,3,4
	(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;	Appendix A Map 1,2,3,4,5
	(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;	3, 4, 5, 6, 7
	(k)	Any mitigation measures for inclusion in the EMPr;	Table 8-1
	(l)	Any conditions for inclusion in the environmental authorization;	Table 8-1
	(m)	Any monitoring requirements for inclusion in the EMPr or environmental authorization;	Table 8-1,
	(n)	A reasoned opinion –	
		(i) as to whether the proposed activity, activities or portions thereof should be authorized;	10
		(iA) regarding the acceptability of the proposed activity or activities; and	10
		(ii) if the opinion is that the proposed activity, activities or portions thereof should be authorized, any avoidance, management and mitigation measures	Table 8-1

		that should be included in the EMPr, and where applicable, the closure plan;	
	(o)	A description of any consultation process that was undertaken during the course of preparing the specialist report;	N/A
	(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 authority.	N/A
	(2)	Where a government notice gazetted 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.	N/A

PROPOSED DEVELOPMENT OF THE 147MW RIETKLOOF WIND ENERGY FACILITY AND ASSOCIATED INFRASTRUCTURE NEAR MAITJIESFONTEIN, WESTERN CAPE PROVINCE

DESKTOP GEOTECHNICAL REPORT

TABLE OF CONTENTS

1 INTRODUCTION 1

1.1 Scope of works 2
1.2 Terms of Reference 2
1.3 Specialist Credentials 2
1.4 Assessment Methodology 3

2 ASSUMPTIONS, LIMITATIONS, UNCERTAINTIES - DISCLAIMER 3

3 SITE DESCRIPTION 3

3.1 Locality 3
3.2 Land Use and Vegetation 3
3.3 Climate 4
3.4 Drainage and Topography 5

4 GEOLOGY 5

5 HYDROGEOLOGY 6

6 ENGINEERING GEOLOGY 6

7 GEOTECHNICAL APPRAISAL 7

8 GEOTECHNICAL IMPACT ASSESSMENT 8

8.1 Impact of the Project on the Geological Environment 8

9 GEOTECHNICAL COMPARATIVE ASSESSMENT 14

10 CONCLUSIONS AND RECOMMENDATIONS 14

11 REFERENCES 15

TABLES

Table 3-1: Summary of Climatic Conditions, Matjiesfontein (information extracted from “Climate-Data.org”) 4
Table 8-1: Impact and Mitigation Summary 10
Table 8-2: Geotechnical Impact Assessment Matrix 12
Table 9-1: Geotechnical Comparitive Assessment of Substation Alternatives 14

APPENDICES

Appendix A: Figures

Appendix B: WSP Impact Assessment Methodology

Appendix C: Specialist's CV and Declaration of Interest

EXECUTIVE SUMMARY

This report presents the findings concluded from a desktop study level for the proposed Rietkloof Energy Facility situated in the Western Cape Province. The study area receives a relatively low mean annual precipitation of 264mm, with the warmest months being January and February. Various tributaries of the Roggeveld River, Groot River and Wilgehout River drain the study area. The northern portion of the study area is underlain by rock units of the Abrahamskraal (Pa) Formation. The southern portion is underlain by the Waterford (Pwa) Formation which is underlain by the Fort Brown Formation (Pf), the Tierberg Formation (Pt) and the Collingham (Pc) Formation respectively. The Abrahamskraal Formation form part of the Adelaide Subgroup, forming part of the Beaufort Group. The remaining formations form part of the greater Ecca Group. The Beaufort and Ecca Groups form part of the greater Karoo Supergroup.

Competent, founding conditions can be anticipated in shallow, slightly weathered bedrock, which will have to be assessed during the detailed investigation prior to construction. Colluvial deposits can be anticipated along hillslopes with alluvial deposits anticipated near drainage features. Six-fold features were identified in the study area. Regional borehole data indicates relatively low aquifer yields in the range of 0.1-0.5l/s. Based upon preliminary geological and geotechnical assessments; the desktop study indicates no fatal flaws. The impact of the development from a geotechnical perspective will be restricted to the removal and displacement of soil, boulders and bedrock. Based on the impact assessment matrix undertaken for this project, from a geotechnical perspective the impact of the Rietkloof WEF was found to be "**Negative medium impact - The anticipated impact will have negative effects and will require mitigation**." Based upon this desktop study the site, is considered suitable for the proposed construction of the Wind Energy Facility.

PROPOSED DEVELOPMENT OF THE 147MW RIETKLOOF WIND ENERGY FACILITY AND ASSOCIATED INFRASTRUCTURE NEAR MAITJIESFONTEIN, WESTERN CAPE PROVINCE

DESKTOP GEOTECHNICAL REPORT

1 INTRODUCTION

This report presents the findings of a geotechnical desktop study undertaken by JG Afrika (Pty) Ltd, for the proposed 147MW Rietkloof wind energy facility (WEF) situated near Maitjiesfontein in the Western Cape Province. It is understood that a desktop level geotechnical report is required to supplement an environmental submission for a Basic Assessment (BA) report being undertaken by WSP. The proposed WEF is situated between the towns of Matjiesfontein and Sutherland in the Western Cape Province.

The Energy facility will consist of the following:

- Forty-seven (47No.) turbines, each turbine with a foundation of up to 25m in diameter and up to 4m in depth (area of 490m^2), compacted hard standing areas of 4500m^2 each (total of 211 500m^2).
- The hub height of each turbine will be up to 125m with a rotor diameter of up to 180m and blade length of 90m. The maximum upper tip height will be 215m
- The total foundation area of all 47 turbines is approximately 23 030 m^2.
- The area of electrical turbine transformers will be 10m x 10m per turbine.
- 147MW generation capacity, up to 147MW at the 132kV point of utility connection.
- Operations and maintenance (O&M) buildings will be in proximity of the substation. The O&M building includes operations, on site spares storage and workshop.
- One (1No.) substation
- Internal access roads
- The construction camp typical area will be approximately 10ha and onsite concrete batching plant of up to 1ha.
- The internal roads are no more than 9m wide and will cover an area of approximately 50ha.
- Approximately 4m high palisades or mesh fencing where required.
- Conservancy tanks with portable toilets during the construction phase.
- Area of internal onsite substation of 200m x 200m covering an area of 4ha. The onsite substation capacity will be 33kV and 132kV yards. The medium voltage collector system will comprise of cables (1kV up to and including 33kV) that will be run underground, except where a technical assessment suggests that overhead lines are applicable, in the facility connecting the turbines to the onsite substation.

1.1 Scope of works

The investigation seeks to give a desktop evaluation of the proposed study site. The objective of the study was to assess the geological and geotechnical conditions across the study area.

The desktop study involved a literature review and a review of topographic and geological maps. Consideration was given to, but not limited to the following from a desktop level:

- The influence of topography on site suitability.
- The envisaged geological and geotechnical influences on the competency of foundations for the construction of structures.
- Tectonic influences on overall stability, namely the presence of faulting, lineaments and preferred discontinuity orientations.
- Comments regarding likely founding conditions, geotechnical constraints, problem areas and overall site stability from a desktop level.
- Recommendations regarding requirements for subsequent detailed geotechnical investigations.

1.2 Terms of Reference

The appointment to proceed with the investigation is based upon JG Afrika's cost estimate entitled, "*Quotation for Geotechnical Desktop Studies for Proposed Wind Energy Facilities and Associated Electrical Infrastructure in the Western Cape*." dated the 26th May 2021. JG Afrika received the appointment via a sub-consultancy agreement letter referenced, *41103473-D05*, via email on the 20th of July 2021.

1.3 Specialist Credentials

Ms. Bulala is a qualified engineering geologist, having attained a Bachelor of Science Degree in Geology, from the University of Limpopo. She is registered as a Candidate Natural Scientist (Registration No. 116482). Ms. Bulala holds the position of Engineering Geologist at JG Afrika's Pietermaritzburg branch. She has experience in various fields of earth science and ground engineering, namely: engineering geology, geotechnical engineering, environmental geology and soil surveys. At present Ms. Bulala specializes in conducting foundation investigations and material investigations for dams, roads and renewable energy.

The report was reviewed by Mr. Tom Speirs. Mr Speirs is a qualified senior engineering geologist with over 30 years' experience. He is a registered Professional Natural Scientist (Registration No. 400104/94) in the field of geological science. He has undertaken geotechnical, geological and materials work throughout Southern Africa, East, West and Central Africa, Madagascar and eastern Australia. He has accumulated extensive experience, including in renewable energy projects in South Africa.

1.4 Assessment Methodology

The methodology entailed a literature review and a review of topographic and geological maps. Consideration was given to the terrain, geological, hydrogeology as well as expected geotechnical constraints.

2 ASSUMPTIONS, LIMITATIONS, UNCERTAINTIES - DISCLAIMER

The interpretation of the overall geotechnical conditions across the site is based upon a review of available information on the project area. Subsurface and geotechnical conditions have been inferred at a desktop level from available information, past experience in the project area and professional judgement. The information and interpretations are given as a guideline only and there is no guarantee that the information given is totally representative of the entire area in every respect. No responsibility will be accepted for consequences arising out of the fact that actual conditions vary from those inferred. The information must be verified by the undertaking of a detailed geotechnical site investigation.

3 SITE DESCRIPTION

3.1 Locality

The proposed Rietkloof WEF is situated approximately 15 km north of the town of Matjiesfontein. The site lies within the Komsberg Renewable Energy Development Zone (REDZ) located within the Cape Winelands District Municipality.

A Locality Plan indicating the site location is presented as **Map 1,** which is included in **Appendix A**.

JG Afrika has previous experience in the study area having conducted detailed geotechnical investigations for the Oya energy facility in 2020 and the Roggeveld Windfarm development in 2015. The Roggeveld Windfarm development site overlaps the proposed Rietkloof WEF site. This project comprised fifty-six proposed wind turbines located near District Road 2243. The Oya project comprised a solar photovoltaic farm and twelve wind turbines located approximately 50km north-west from Matjiesfontein.

JG Afrika also conducted a previous detailed geotechnical investigation for the stabilisation of the Verlatekloof Pass (2008) approximately 48km from the study area.

3.2 Land Use and Vegetation

The project application site for the proposed WEF is approximately 27 608 ha, while the total area of development assessed is approximately 85ha. The project application site incorporates the following farm portions:

- Portion 1 of Farm Barendskraal 76
- The Remainder of Farm Fortuin 74
- Portion 3 Farm Fortuin 74
- Portion 1 of Farm Hartjieskraal 77
- The Remainder of Farm Hartjieskraal 77

- The Remainder of Farm Nuwerus 284
- Portion 1 of Farm Rietkloof Annexe 88
- The Remainder of Farm Snyders Kloof 80
- Portion 1 of Farm Snyders Kloof 80
- Farm Vogelstruisfontein 81
- Remainder of Farm Wilgehout Fontein 87
- Portion 1 of Farm Ou Mure 74

From the environmental assessment it is understood that the study area was used for low intensity grazing but is no longer actively used for agricultural activities.

The regional biome within which the study site is located is classed as a Succulent Karoo Biome, with the presence of lowland succulent Karoo vegetation species.

A Site Plan indicating the layout of the proposed WEF development is presented as **Map 2,** which is included in **Appendix A**.

3.3 Climate

The study area is characterized by a dry climate with a "BWk" classification according to the Köppen-Geiger climate classification. Matjiesfontein receives a relatively low mean annual precipitation of 264 mm. The average lowest rainfall is received in September (14 mm) and the highest in March (27 mm), which is a seasonal variation of 14 mm.

The maximum midday temperatures for Matjiesfontein ranges from 30°C in January and February to 15.2°C in July. The minimum temperatures for Matjiesfontein ranges from 14.4°C in February to 3.8°C in July. The average temperatures vary during the year by 12.3°C. Table 3-1, summarizes the climatic conditions.

Table 3-1: Summary of Climatic Conditions, Matjiesfontein (information extracted from "Climate-Data.org")

Months	Average Rainfall (mm)	Temperature (°C)		
		Maximum	Minimum	Average
January	16	30.1	14	21.3
February	16	30.0	14.4	21.4
March	27	27.3	12.9	19.5
April	24	23.1	10.1	16.3
May	22	19.2	7.3	12.9
June	25	15.3	4.3	9.4
July	23	15.2	3.8	9.1
August	23	16.5	4.3	10.1
September	14	19.9	6.1	12.7

Months	Average Rainfall (mm)	Temperature (°C)		
		Maximum	Minimum	Average
October	23	23.7	8.7	15.8
November	28	25.9	10.4	17.7
December	23	28.6	12.7	20

3.4 Drainage and Topography

The study area is drained by non-perennial tributaries of Wilgehout River, Groot River and Roggeveld River. The tributaries form dendritic drainage patterns.

Slope aspect and drainage features are presented in **Map 3.1** and **Map 3.2** which is included in **Appendix A**.

The slope gradient map indicates that the turbines are located on gentle slope of 5.1° – 8.7°. The turbines are flanked by steep slopes of 16.4° – 22.5° on the southern portion of the site. The substation and the construction camps are located on flat terrain 1.6˚ slopes. The majority of the internal access roads are characterised by flat to gentle slope along the lower lying valley areas and steep terrain characterises the slope sides.

Spot heights indicate elevation values in the range of 1339m to 1422m above mean sea level were observed. The slope aspect map further highlights the relief difference with elevation values ranging between 844m to 1422 m above sea level.

4 GEOLOGY

According to the 1: 250 000 Geological Maps of Sutherland (3220) and Ladismith (3320) published by the Council for Geoscience, the northern portion of the study area is underlain by rock units of the Abrahamskraal (Pa) Formation. The southern portion is underlain by the Waterford (Pwa) Formation which is underlain by the Fort Brown Formation (Pf), the Laingsburg Formation (Pl), the Vischkuil (Pl), the Tierberg Formation (Pt) and the Collingham (Pc) Formation respectively. The Abrahamskraal Formation form part of the Adelaide Subgroup, forming part of the Beaufort Group. The remaining formations form part of the greater Ecca Group. The Beaufort and Ecca Groups form part of the greater Karoo Supergroup.

The Abrahamskraal Formation (Pa) is represented by grey and green mudstone, siltstone and subordinate sandstone. Thin chert beds are common on the lowermost red mudstones of the Abrahamskraal Formation. The Waterford Formation (Pwa) is represented by grey, mottled feldspathic sandstone, subordinate dark coloured shale and mudstone.

The Fort Brown Formation (Pf) is represented by dark coloured shale with thin siltstone and sandstone beds. The Tierberg Formation (Pt) is represented by dark grey shale and siltstone. The

Laingsburg Formation (Pl) is represented by sandstone, greywacke and siltstone. The Vischkuil Formation (Pv) is represented by arenanceous shale, siltstone and thin sandstone beds. The Collingham (Pc) is represented by siltstone, chert and sandstone with thin interbedded shale and yellow weathering mudstone/tuff.

The sedimentary rocks in the area have been acted upon by numerous tectonic forces resulting in fold structures. Based upon the geology map, six fold features are located within the WEF study area. The fold axes trend in an E-W direction and represent localized synclines and anticlines which forms part of the Cape Fold Belts.

A Geological Map is presented as **Map 4,** which is included in **Appendix A**.

5 HYDROGEOLOGY

The study area lies within the E22A, J11D and J11E catchment areas. The catchments receive mean annual precipitation of 251mm, 240mm and 188mm respectively.

According to the 1: 3 000 000 scaled Groundwater Harvest Potential Map of South Africa, Regional yields of sustainable groundwater abstraction rates, indicate that the study area lies in areas with values of 6000 - 10 000 m^3/km^2/annually.

Regional hydrogeological data indicate the aquifer type is classed as 'b2' which is a, fractured aquifer type. Regional borehole data indicate relatively low yields, estimated to be in the range of 0.1-0.5 l/s. Fractured aquifers (designation b) form as a result of discontinuities, such as faults, fractures and joints, in hard bedrock. These form the primary porosity conduits in which groundwater moves.

An extract of the regional Hydrogeological Map is presented as **Map 5,** which is included in **Appendix A**.

The structural geology in the study area is conducive to the formation of high-yielding aquifer formations. As such a detailed hydrogeological investigation for the proposed borehole water abstraction works, is recommended during the detailed design phase.

6 ENGINEERING GEOLOGY

The engineering geology refers to the engineering characteristics of natural earth material for founding structures and suitability for construction material purposes.

The study area is characterized by a Weinert N value of more than 10, meaning that the type of weathering is primarily by mechanical disintegration. Shallow residual soils are commonly granular and gravelly (Brink, 1983).

The study area is dominated by the Abrahamskraal Formation. Colluvial deposits can be anticipated along hillslopes with alluvial deposits anticipated near drainage features.

Based on previous investigations in the greater Roggeveld area, blocky, greyish-red mudstone with interbedded grey very fine to medium-grained quartzofeldspathic sandstone can be anticipated. Weathered, limestone layers of up to 1.5m in thickness may be present. Greenish-grey cherty layers, of a few centimetres to two metres thickness, may also be present in the Abrahamskraal formation. The chert and limestone layers possess potentially soluble properties.

Where material is required for the construction of roads and laydown areas, natural gravely or crushed sandstone bedrock can potentially be a suitable source. Consideration must be given to the presence of excessive pyrite and muscovite which can cause distress where sandstone is used as basecourse (Brink, 1983). In addition, where chemical stabilization is required the clay matrix of sandstones make them suitable for stabilization with lime (Brink, 1983). The occurrence, nature, material quality and quantity of sandstone and other potential construction material will have to be assessed during the detailed geotechnical investigation.

Mudrocks such as siltstone, mudstone and “mud-shales” are not considered suitable for use as construction material, due to their swelling characteristics, excessive absorption of water, poor engineering performance and lack of durability. Slope stability issues can arise in areas where closely intercalated sandstones and mudrock exist. When mudrocks slake or disintegrate the exposed sandstone layers are undercut, this can result in rockfalls (Brink, 1983). Based on previous investigations in the Roggeveld area, concave cave structures can be anticipated through erosion of the less-competent shale and mudstone bedrock beneath the hard sandstone beds when exposed to the elements.
Based on previous investigations in the Sutherland area (Verlatekloof Pass), the Abrahamskraal Formation is represented by maroon mudstone, greenish grey siltstone and olive grey sandstone. These sedimentary units are intercalated and display variable weathering, as described for the Formation.

7 GEOTECHNICAL APPRAISAL

Competent, founding conditions for the turbines, substation, crane pads and the construction camps are anticipated a relatively shallow depths in slightly weathered bedrock, which will have to be assessed during the detailed investigation stage of the project prior to construction.

Consideration can be given to the following foundation types for the turbines:

- Ballasted Foundations (concrete raft) – these foundations are suitable in areas where shallow bedrock conditions are encountered or in poor, non-cohesive soils, where helical or screw-in piles are not suitable. The limitation is that; ballasted foundations require additional design considerations on steep slopes, they are not suited to areas susceptible to settlement and areas underlain by expansiveness soil conditions.

- Driven Piles - these piles are suited to clay, gravel and dense sand where shallow groundwater conditions can be anticipated. The advantage is that they can be accurately positioned, no curing is required, and the cost of installation is relatively low (e.g Duktus pile).

- Spread Footings – The use of reinforced spread footings designed to resist the uplift and downward pressures. Footings can be dowelled into the bedrock to resist dynamic forces. Deep excavations will be required for the spread footings, excavation side walls will need to be battered back or supported. This should be assessed by the resident engineers on site during construction. All earthworks should be undertaken in accordance with SANS 1200 D. Disadvantages of using spread footing is the speed of construction as piles are quicker to install.

The proposed substation site is underlain by the Abrahamskraal Formation. The site lies on a flat slope with slope of 0-2˚ likely to be shallow transported soils. The site does not traverse and drainage features. Consideration can be given to the following foundation types for the substation, the construction camp sites and the crane pads:

- Normal Strip Footings

- Spread Footing

It is important to select the correct foundation type and optimize the design, as such a detailed and comprehensive geotechnical investigation is required this will be undertaken prior to construction and upon finalisation of the layout plan.

Trial pitting across the WEF site is recommended. For heavily loaded structures such as wind turbines (>300 kPa), rotary core drilling is mandatory in order to more accurately assess the bedrock conditions below the founding level.

The presence of uplift and downward forces in the form of wind loads must be taken into consideration during foundation design.

8 GEOTECHNICAL IMPACT ASSESSMENT

From a preliminary geological and geotechnical assessment, no fatal flaws have been identified.

8.1 Impact of the Project on the Geological Environment

The Karoo Supergroup is known for its fossil bearing sedimentary units which will have to be more accurately assessed by a palaeontologist. The removal of rock which contain these fossils will result in the destruction of these fossils.

The impact of the development from a geotechnical perspective will be restricted to the removal and displacement of soil, boulders and bedrock referred to in this report as “subsoils”. The levelling of areas to create building platforms will also result in the displacement and exposure of subsoils. The potential impact of the development on the terrain and geological environment, will be the increased potential for soil erosion, caused by construction activities and the removal of vegetation.

These impacts will have a negative visual impact on the environment, which in some cases can be remediated. The project requires extensive earthworks to meet the required horizontal and vertical alignments and curvatures for roads, so the aesthetic impact is significant.

The potential impact of the development on the terrain and geological environment, will be the increased potential for soil erosion, caused by construction activities and the removal of vegetation. Areas of concentrated surface flow can be anticipated at energy facilities, resulting in gradual erosion of unconsolidated soil, during the operational life of the facility. This can result in the creation of preferential drainage features, unless remediated through proper engineering design (i.e stormwater drainage).

Based on the impact assessment matrix undertaken for this project, from a geotechnical perspective the impact of the Rietkloof WEF was found to be “**Negative moderate impact - The anticipated impact will have negative effects and will require mitigation**.” The assessment impact assessment matrix is presented as Table 8-2. Table 8-1 summaries the impacts and the mitigation of the proposed development.

Areas with steep slope inclinations are not favoured for the energy developments due to the earthworks requirements and the potential need for advanced foundations. The study area is considered suitable for the proposed development provided that the recommendations presented in this report are adhered too and which need to be verified by more detailed geotechnical investigations during detailed design.

The impact assessment criteria developed by WSP is included in **Appendix B.**

Table 8-1: Impact and Mitigation Summary

PHASE	ASPECT	IMPACT	RECOMMENDED MITIGATION
Construction Phase	The displacement of natural earth material and overlying vegetation.	• Increase stormwater velocity. • Increase in soil and wind erosion due to clearing of vegetation. • Construction and earthmoving vehicles may displace soil. • Creation of drainage paths along access tracks. • Sedimentation of non-perennial features and excessive dust.	• Identify protected areas prior to construction. • Construction of temporary berms and drainage channels to divert surface water. • Minimize earthworks and fills. • Use existing road network and access tracks. • Rehabilitation of affected areas (such as revegetation, mechanical stabilization). • Correct engineering design and construction of gravel roads and water crossings. • Control stormwater flow
	Potential oil spillages from heavy plant.	• Potential groundwater and drainage feature contamination.	• Vehicle repairs to be undertaken in designated areas.
Operational Phase	Displacement of natural earth material during maintenance	• Increase in soil erosion. • Sedimentation of non-perennial features caused by soil erosion.	• Use of existing roads and tracks where possible. • Rehabilitation of affected areas (such as erosion control mats). • Correct engineering design and construction of roads and water crossings during maintenance. • Maintenance of stormwater system.
	Potential oil spillages from heavy plant.	• Potential groundwater and drainage feature contamination.	• Vehicle repairs to be undertaken in designated areas.

Decommissioning Phase	Disturb the geological environment	• Increase in soil and wind erosion due to clearance of structures. • Construction and earthmoving vehicles will displace the soil. • Creation of drainage paths. • Excessive sediments in non-perennial features.	• Use of temporary berms and drainage channels to divert surface water. • Minimize earthworks and demolish footprints. • Use of existing roads and tracks were feasible. • Rehabilitation of affected areas (such as revegetation). • Develop a chemical spill response plan. • Develop dust and demolition fly suppression plan. • Reinstate channelized drainage features.
	Potential oil spillages from heavy plant.	• Potential groundwater and drainage feature contamination.	• Vehicle repairs to be undertaken in designated areas.
Cumulative	None	None	None

Table 8-2: Geotechnical Impact Assessment Matrix

Project Name	Proposed Development of the 147MW Rietkloof Wind Energy Facility and Associated Infrastructure near Maitjiesfontein, Western Cape Province																			
Impact Assessment	Geotechnical																			
CONSTRUCTION																				
Impact number	**Aspect**	**Description**	**Stage**	**Character**	**Ease of Mitigation**	**Pre-Mitigation**							**Post-Mitigation**							
						(M+)	**E+**	**R+**	**D)x**	**P=**	**S**	**Rating**	**(M+)**	**E+**	**R+**	**D)x**	**P=**	**S**	**Rating**	
Impact 1:	Subsoil Removal	Increase Soil Erosion	Construction	Negative	Moderate	4	2	3	3	5	**60**	**N3**	2	1	1	2	2	**12**	**N1**	
					Significance	**N3 - Moderate**							**N1 - Very Low**							
Impact 2:	Potential Oil Spillage	Ground and Surface Water Contamination	Construction	Negative	Moderate	4	3	5	5	4	**68**	**N4**	3	1	3	1	2	**16**	**N2**	
					Significance	**N4 - High**							**N2 - Low**							
OPERATIONAL																				
Impact number	**Receptor**	**Description**	**Stage**	**Character**	**Ease of Mitigation**	**Pre-Mitigation**							**Post-Mitigation**							
						(M+)	**E+**	**R+**	**D)x**	**P=**	**S**		**(M+)**	**E+**	**R+**	**D)x**	**P=**	**S**		
Impact 1:	Displacement of natural material	Increase Soil Erosion	Operational	Negative	Moderate	3	2	3	4	4	**48**	**N3**	2	1	1	4	2	**16**	**N2**	
					Significance	**N3 - Moderate**							**N2 - Low**							
Impact 2:	Potential Oil Spillage	Ground and Surface Water Contamination	Operational	Negative	Moderate	3	2	5	5	3	**45**	**N3**	2	1	3	1	2	**14**	**N1**	
						N3 - Moderate							**N1 - Very Low**							
DECOMISSIONING																				

Impact number	Receptor	Description	Stage	Character	Ease of Mitigation	Pre-Mitigation							Post-Mitigation						
						(M +)	E +	R +	D) x	P =	S		(M +)	E +	R +	D) x	P =	S	
Impact 1:	Subsoil Removal	Increase Soil Erosion	Decommissioning	Negative	Moderate	4	2	3	3	5	**60**	**N3**	2	1	1	2	2	**12**	**N1**
					Significance	**N3 - Moderate**							**N1 - Very Low**						
Impact 2:	Potential Oil Spillage	Ground and Surface Water Contamination	Decommissioning	Negative	Moderate	4	3	5	5	4	**68**	**N4**	3	1	3	1	2	**16**	**N2**
					Significance	**N4 - High**							**N2 - Low**						
CUMULATIVE																			
Impact number	**Receptor**	**Description**	**Stage**	**Character**	**Ease of Mitigation**	**Pre-Mitigation**							**Post-Mitigation**						
						(M +)	E +	R +	D) x	P =	S		(M +)	E +	R +	D) x	P =	S	
Impact 1:	Overall Cumulative Impact	The Construction of the Proposed WEF	Cumulative	Negative	Moderate	4	2	3	3	5	**60**	**N3**	2	1	3	3	2	**18**	**N2**
					Significance	**N3 - Moderate**							**N2 - Low**						

9 GEOTECHNICAL COMPARATIVE ASSESSMENT

Design and layout alternatives were considered and assessed as part of this geotechnical report. These include alternatives for the substation and the laydown area locations. The various alternatives, as shown in Map 2 (Appendix A), are described below. The O&M building, including an on-site spares storage building, a workshop and an operations building will be located on the site identified for the construction laydown area. The BESS locations are not specified; however, they will be located adjacent to the substations.

Construction Camp Sites

Three (2No.) substation area alternatives were considered as follows:

- Construction Camp Site 1: Alternative 1 is located on The Remainder of Farm Nuwerus 284.
- Construction Camp Site 2: Alternative 2 is located on Portion 1 of Farm Rietkloof Annexe 88.
- Construction Camp Site 3: Alternative 3 is located on Remainder of Farm Wilgehout Fontein 87.

A geotechnical comparative assessment is provided in Table 9-1.

Table 9-1: Geotechnical Comparitive Assessment of Substation Alternatives

CONSTRUCTION CAMP SITES	
Alternative	**Geotechnical Comparison**
Construction Camp Site Alternative 1	• Alternatives 1 is underlain by Abrahamskraal Formation. • Alternative 2 is underlain by Collingham Formation. • Alternative 3 is underlain by Fort Brown which is underlain by Laingsburg Formation and Vischkuil. • All the alternatives lie on a flat slope of 0.0-1.6˚, likely to be shallow transported soils. • Alternatives 1 and 2 do not traverse any drainage features. Alternative 3 traverses a drainage feature. • Shallow foundations are anticipated at all alternatives. • Serviceability and access will be easy for all at they are adjacent an internal road and the R354.
Construction Camp Site Alternative 2	
Construction Camp Site Alternative 3	

From the above comparative assessment, alternatives 1 and 2 will have the same impact. Alternative 3 will require diversion of the drainage feature to avoid the environmental impact.

10 CONCLUSIONS AND RECOMMENDATIONS

The foregoing report presents the findings concluded from a desktop study undertaken for the proposed Rietkloof WEF. The site is anticipated to be underlain by shallow bedrock conditions. It is

recommended that the turbines be constructed on relatively flat slopes. It is recommended that the turbines be constructed on relatively flat to gentle terrain, open areas with maximum wind exposure.

No fatal flaws from a geotechnical perspective were identified during this desktop study. The impact of the WEF was found to be "**Negative moderate impact - The anticipated impact will have negative effects and will require mitigation.**"

Conclusions presented in this report will have to be more accurately confirmed during the detailed geotechnical investigation phase. The site from a desktop level geotechnical study is considered suitable for the proposed wind energy facility.

It recommended that a detailed geotechnical investigation be undertaken during the detailed design phase of the project. The detailed geotechnical investigation must entail the following:

- Profiling and sampling of exploratory trial pits to determine founding conditions for the turbine modules and substation.
- An investigation to determine the subgrade conditions for internal roads and a materials investigation (if required).
- Thermal resistivity and electrical resistivity geophysical testing for electrical design and ground earthing requirements.
- Groundwater sampling of existing boreholes to establish a baseline of the groundwater quality for construction purposes.
- Dynamic Probe Super Heavy (DPSH) tests and rotary core drilling will be required depending on the soil profiles and imposed loads of the structures.

11 REFERENCES

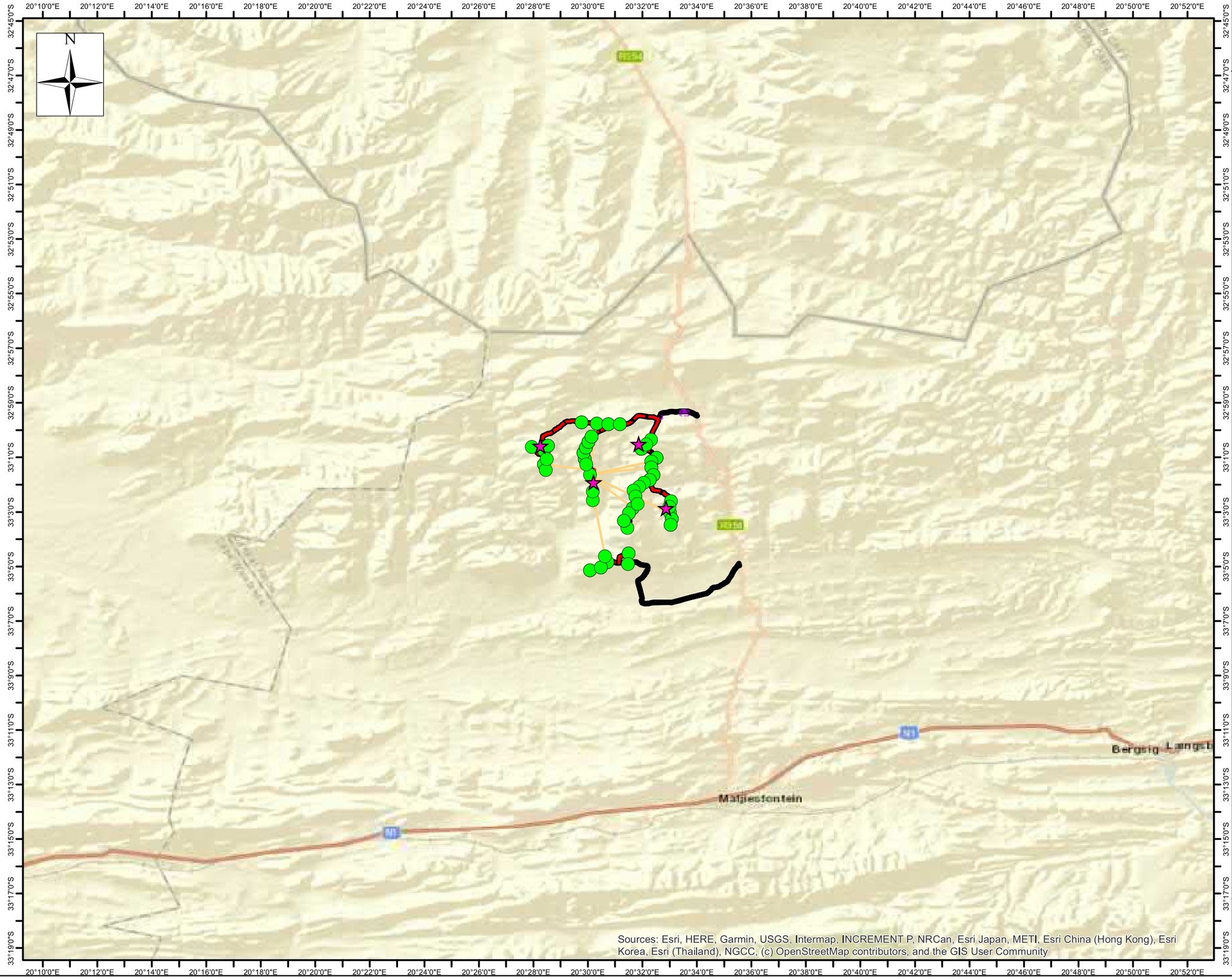
- Brink. A.B.A (1983). Engineering Geology of Southern Africa: The Karoo Sequence. Volume 3. Building Publications: Cape Town.
- Climatic Data, Matjiesfontein. Accessed August 2021 from: https://en.climate-data.org/
- Singh. K. (2020). Solar photovoltaic (PV) and wind turbine infrastructure, Matjiesfontein, western cape province geotechnical investigation. JG Afrika (Pty) Ltd.
- Hayes. T. (2015). Geotechnical Investigation for the proposed Roggeveld Windfarm site. Jeffares & Green, Port Elizabeth. JG Afrika (Pty) Ltd.
- Speirs. T. (2008). Geotechnical Assessment of Instability of Verlatekloof Pass. Jeffares & Green, Pietermaritzburg.
- 1: 250 000 Geological Map Series (3220 Sutherland). Published by the Council of Geoscience.

- 1: 3 000 000 Groundwater Harvest Potential of the Republic of South Africa. Published by the Department of Water Affairs and Forestry.

-oOo-

Appendix A: Figures

RIETKLOOF WEF GEOTECHNICAL DESKTOP STUDY: LOCALITY MAP (MAP 1)



JG AFRIKA

PO Box 794
Hilton 3245

Tel: (033) 343 6789
Fax: (033) 343 6788

Legend

- Met masts
- Turbine positions
- 33kV Medium voltage cables
- 33kV OHL Route
- Hardstands
- Laydown Area
- Roads
- Substation and O&M Building
- Temporary Earth Works

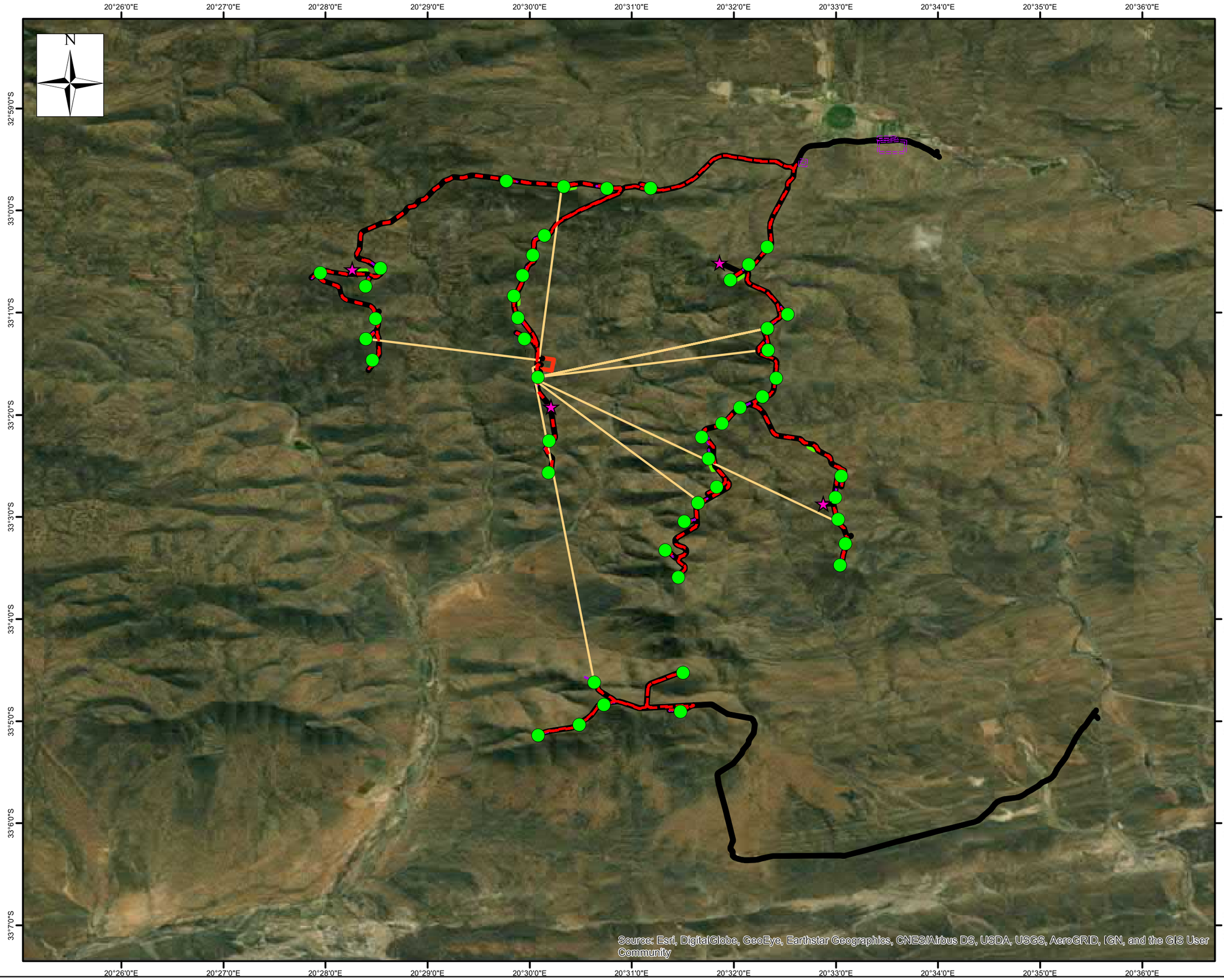
Kilometers

0 3.75 7.5 15

Map No.: 01

Scale (A3): 1:250 000

RIETKLOOF WEF GEOTECHNICAL DESKTOP STUDY: SITE MAP (MAP 2)



JG AFRIKA

PO Box 794
Hilton 3245

Tel: (033) 343 6789
Fax: (033) 343 6788

Legend

- Met masts
- Turbine positions
- 33kV Medium voltage cables
- 33kV OHL Route
- Hardstands
- Laydown Area
- Roads
- Substation and O&M Building
- Temporary Earth Works

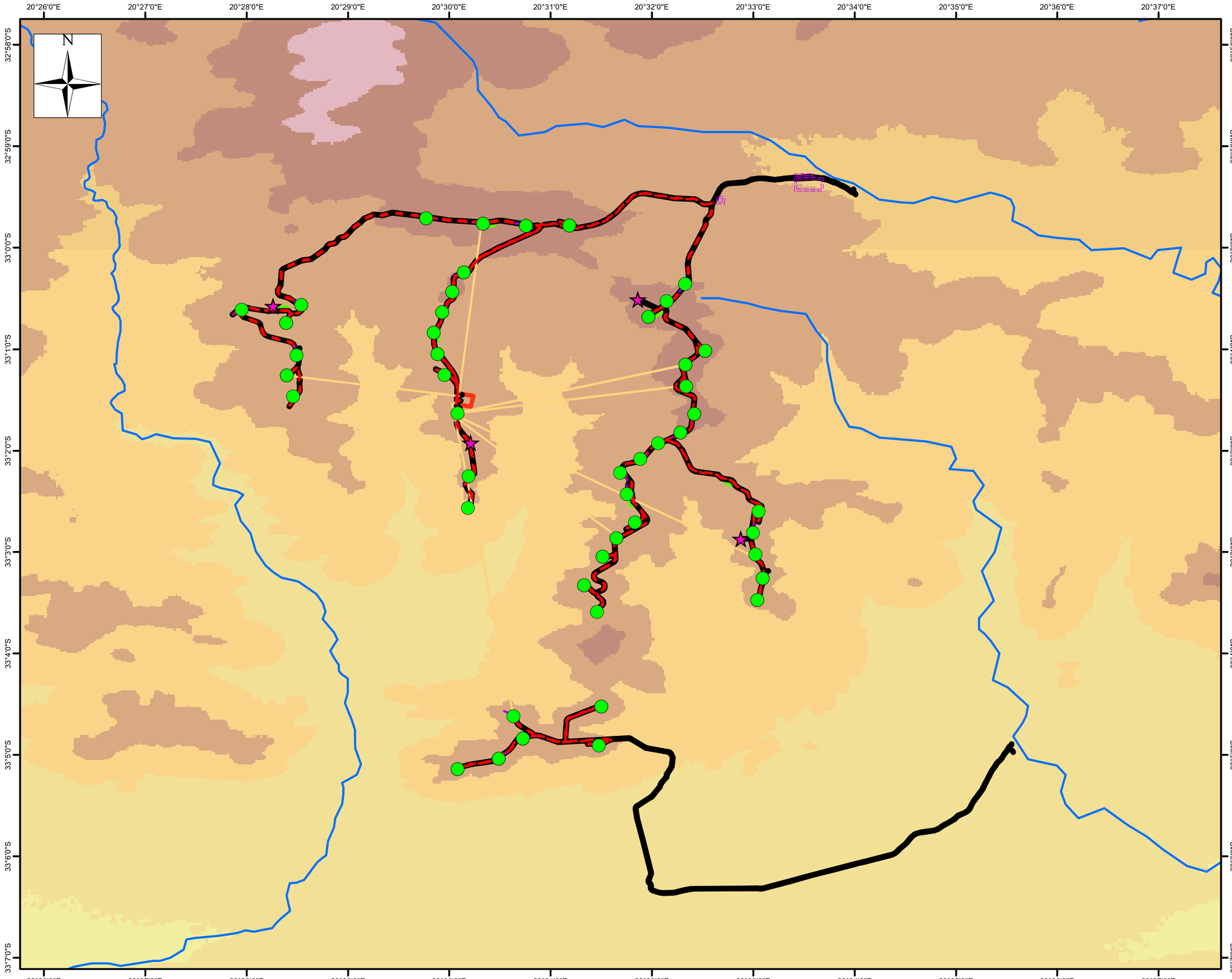
Kilometers

0 1 2 4

Map No.: 02

Scale (A3): 1:66 800

RIETKLOOF WEF GEOTECHNICAL DESKTOP STUDY: ELEVATION MAP (MAP 4)



JG AFRIKA

PO Box 794
Hilton 3245

Tel: (033) 343 6789
Fax: (033) 343 6788

Legend

- Met masts
- Turbine positions
- 33kV Medium voltage cables
- 33kV OHL Route
- Hardstands
- Laydown Area
- Roads
- Substation and O&M Building
- Temporary Earth Works
- Perennial_Watercourses

Elevation

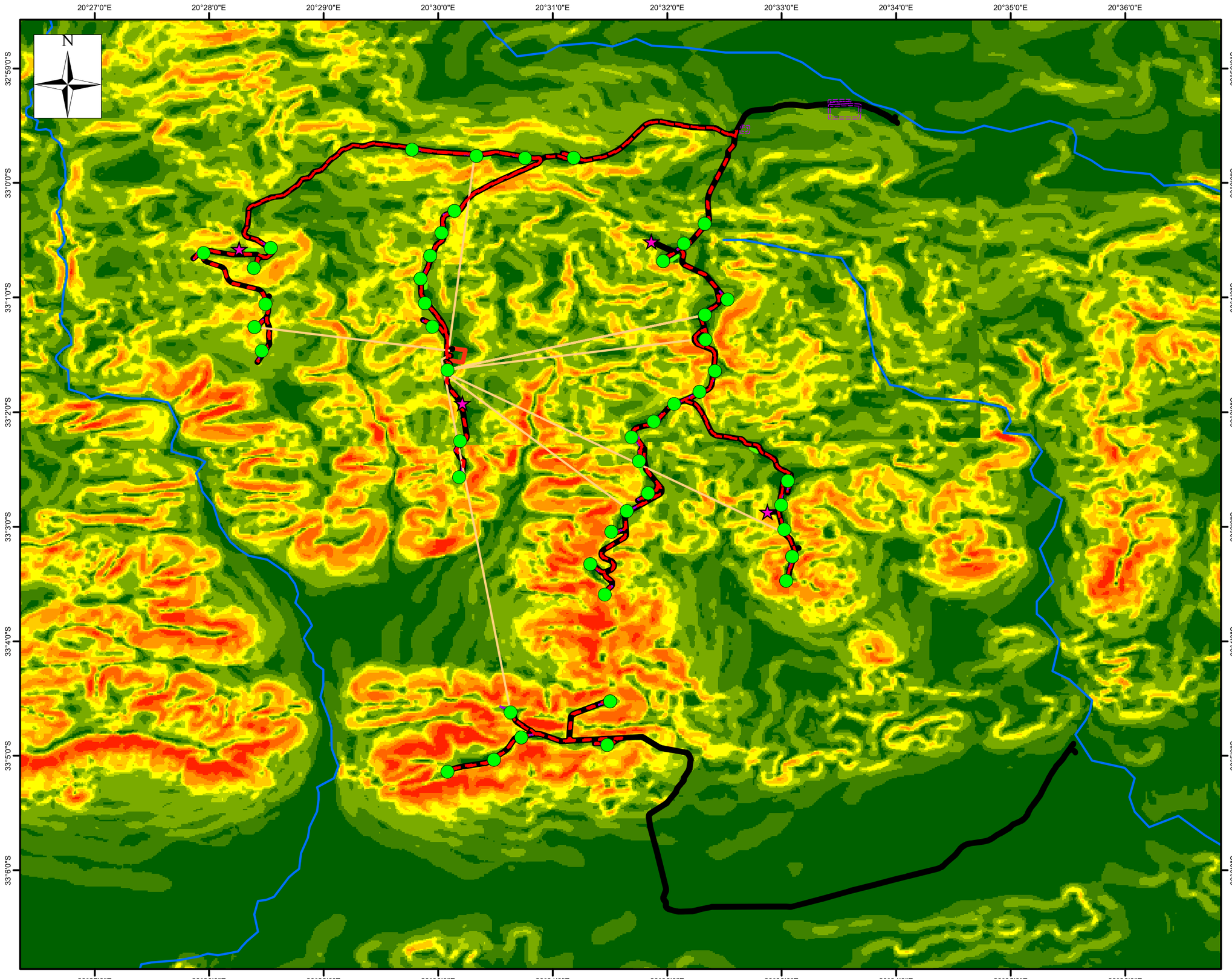
- 368 - 566
- 566 - 722
- 722 - 864
- 864 - 1 004
- 1 004 - 1 148
- 1 148 - 1 284
- 1 284 - 1 405
- 1 405 - 1 523
- 1 523 - 1 846

Kilometers
0 1 2 4

Map No.:	Scale (A3):
04	1:67 800

Designed and detailed under the controls established by our quality management system that meet the requirements of ISO 9001:2000 which has been independently certified by DEKRA Certification under certificate number 90906882.

RIETKLOOF WEF GEOTECHNICAL DESKTOP STUDY: SLOPE MAP (MAP 3)



JG AFRIKA

PO Box 794
Hilton 3245

Tel: (033) 343 6789
Fax: (033) 343 6788

Legend

- Met masts
- Turbine positions
- 33kV Medium voltage cables
- 33kV OHL Route
- Hardstands
- Laydown Area
- Roads
- Substation and O&M Building
- Temporary Earth Works
- Perennial_Watercourses

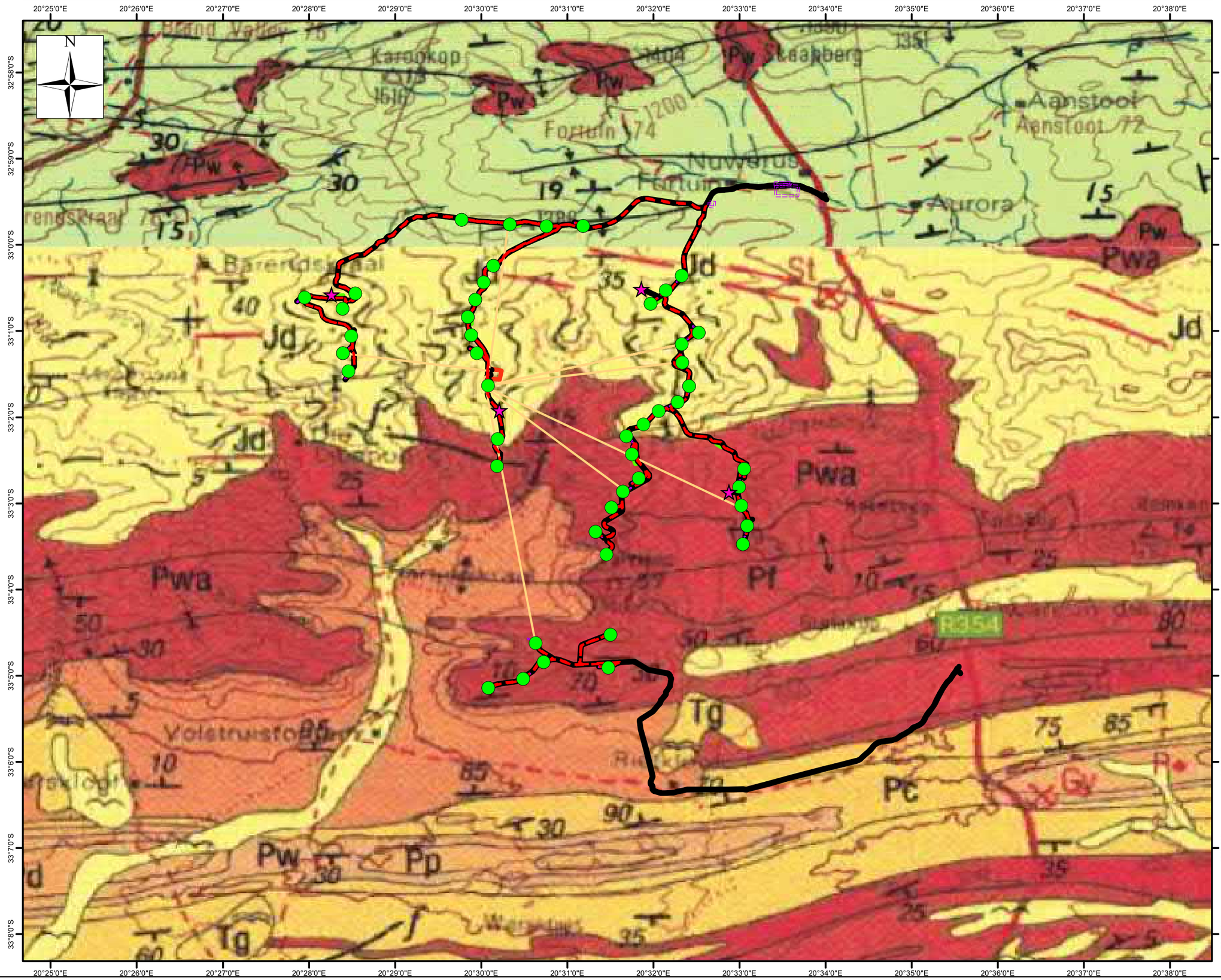
Slope

- 0.0 - 4.8
- 4.8 - 9.9
- 9.9 - 18.8
- 18.8 - 21.9
- 21.9 - 28.8
- 28.8 - 36.3
- 36.3 - 45.2
- 45.2 - 56.9
- 56.9 - 87.4

Kilometers
0 0.75 1.5 3

Map No.:	Scale (A3):
03	1:60 000

RIETKLOOF WEF GEOTECHNICAL DESKTOP STUDY: GEOLOGY MAP (MAP 5)



JG AFRIKA

PO Box 794
Hilton 3245

Tel: (033) 343 6789
Fax: (033) 343 6788

Legend

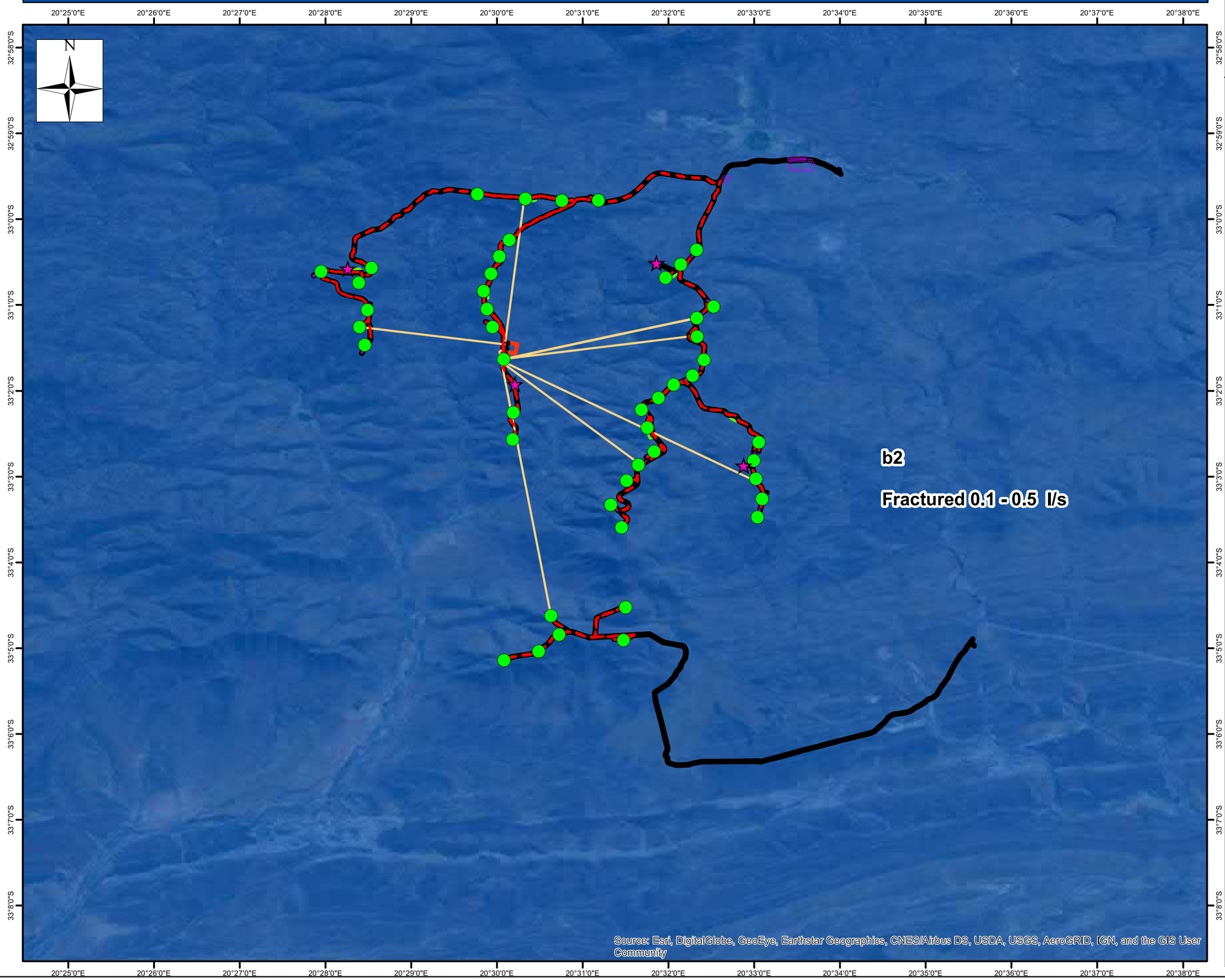
- Met masts
- Turbine positions
- 33kV Medium voltage cables
- 33kV OHL Route
- Hardstands
- Laydown Area
- Roads
- Substation and O&M Building
- Temporary Earth Works

Geology:
Pa - Mudstone, siltstone, sandstone, thin cherty beds (lowermost red mudstone)
Pw - dark grey shale, light grey weathering with cherty siltstone beds
Pwa - grey mottled feldspathic sandstone, subordinate dark coloured shale and sandstone
Pf - dark coloured shale with thin siltstone and sandstone beds
Pt - dark grey shale and siltstone
Pc - Siltstone, chert and sandstone with thin interbedded shale and yellow weathering mudstone/tuff
Jd - Dolerite

Kilometers
0 1.25 2.5 5

Map No.:	Scale (A3):
05	1:79 000

RIETKLOOF WEF GEOTECHNICAL DESKTOP STUDY: GEOHYDROLOGY MAP (MAP 6)



JG AFRIKA

PO Box 794
Hilton 3245

Tel: (033) 343 6789
Fax: (033) 343 6788

Legend

- Met masts
- Turbine positions
- 33kV Medium voltage cables
- 33kV OHL Route
- Hardstands
- Laydown Area
- Roads
- Substation and O&M Building
- Temporary Earth Works

Kilometers

0 1.25 2.5 5

Map No.:	Scale (A3):
06	1:79 000

Appendix B: WSP Impact Assessment Methodology

IMPACT ASSESSMENT METHODOLOGY

ASSESSMENT OF IMPACTS AND MITIGATION

The assessment of impacts and mitigation evaluates the likely extent and significance of the potential impacts on identified receptors and resources against defined assessment criteria, to develop and describe measures that will be taken to avoid, minimise or compensate for any adverse environmental impacts, to enhance positive impacts, and to report the significance of residual impacts that occur following mitigation.

The key objectives of the risk assessment methodology are to identify any additional potential environmental issues and associated impacts likely to arise from the proposed project, and to propose a significance ranking. Issues / aspects will be reviewed and ranked against a series of significance criteria to identify and record interactions between activities and aspects, and resources and receptors to provide a detailed discussion of impacts. The assessment considers direct[1], indirect[2], secondary[3] as well as cumulative[4] impacts.

A standard risk assessment methodology is used for the ranking of the identified environmental impacts pre-and post-mitigation (i.e. residual impact). The significance of environmental aspects is determined and ranked by considering the criteria[5] presented in **Table 0-1**.

Table 0-1: Impact Assessment Criteria and Scoring System

CRITERIA	SCORE 1	SCORE 2	SCORE 3	SCORE 4	SCORE 5
Impact Magnitude (M) The degree of alteration of the affected environmental receptor	Very low: No impact on processes	Low: Slight impact on processes	Medium: Processes continue but in a modified way	High: Processes temporarily cease	Very High: Permanent cessation of processes
Impact Extent (E) The geographical extent of the impact on a given environmental receptor	Site: Site only	Local: Inside activity area	Regional: Outside activity area	National: National scope or level	International: Across borders or boundaries
Impact Reversibility (R) The ability of the environmental receptor to rehabilitate or restore after the activity has caused environmental change	Reversible: Recovery without rehabilitation		Recoverable: Recovery with rehabilitation		Irreversible: Not possible despite action
Impact Duration (D) The length of permanence of the impact on the environmental receptor	Immediate: On impact	Short term: 0-5 years	Medium term: 5-15 years	Long term: Project life	Permanent: Indefinite

[1] Impacts that arise directly from activities that form an integral part of the Project.
[2] Impacts that arise indirectly from activities not explicitly forming part of the Project.
[3] Secondary or induced impacts caused by a change in the Project environment.
[4] Impacts are those impacts arising from the combination of multiple impacts from existing projects, the Project and/or future projects.
[5] The definitions given are for guidance only, and not all the definitions will apply to all the environmental receptors and resources being assessed. Impact significance was assessed with and without mitigation measures in place.

The Pavilion, 1st Floor
Cnr Portswood and Beach Road, Waterfront
Cape Town, 8001
South Africa

T: +27 21 481 8700
F: +086 606 7121
www.wsp.com

CRITERIA	SCORE 1	SCORE 2	SCORE 3	SCORE 4	SCORE 5
Probability of Occurrence (P) The likelihood of an impact occurring in the absence of pertinent environmental management measures or mitigation	Improbable	Low Probability	Probable	Highly Probability	Definite
Significance (S) is determined by combining the above criteria in the following formula:	$[S = (E + D + R + M) \times P]$ $Significance = (Extent + Duration + Reversibility + Magnitude) \times Probability$				
IMPACT SIGNIFICANCE RATING					
Total Score	**4 to 15**	**16 to 30**	**31 to 60**	**61 to 80**	**81 to 100**
Environmental Significance Rating (Negative (-))	**Very low**	**Low**	**Moderate**	**High**	**Very High**
Environmental Significance Rating (Positive (+))	**Very low**	**Low**	**Moderate**	**High**	**Very High**

IMPACT MITIGATION

The impact significance without mitigation measures will be assessed with the design controls in place. Impacts without mitigation measures in place are not representative of the proposed development's actual extent of impact and are included to facilitate understanding of how and why mitigation measures were identified. The residual impact is what remains following the application of mitigation and management measures and is thus the final level of impact associated with the development. Residual impacts also serve as the focus of management and monitoring activities during Project implementation to verify that actual impacts are the same as those predicted in this report.

The mitigation measures chosen are based on the mitigation sequence/hierarchy which allows for consideration of five (5) different levels, which include avoid/prevent, minimise, rehabilitate/restore, offset and no-go in that order. The idea is that when project impacts are considered, the first option should be to avoid or prevent the impacts from occurring in the first place if possible, however, this is not always feasible. If this is not attainable, the impacts can be allowed, however they must be minimised as far as possible by considering reducing the footprint of the development for example so that little damage is encountered. If impacts are unavoidable, the next goal is to rehabilitate or restore the areas impacted back to their original form after project completion. Offsets are then considered if all the other measures described above fail to remedy high/significant residual negative impacts. If no offsets can be achieved on a potential impact, which results in full destruction of any ecosystem for example, the no-go option is considered so that another activity or location is considered in place of the original plan.

The mitigation sequence/hierarchy is shown in **Figure 1** below.

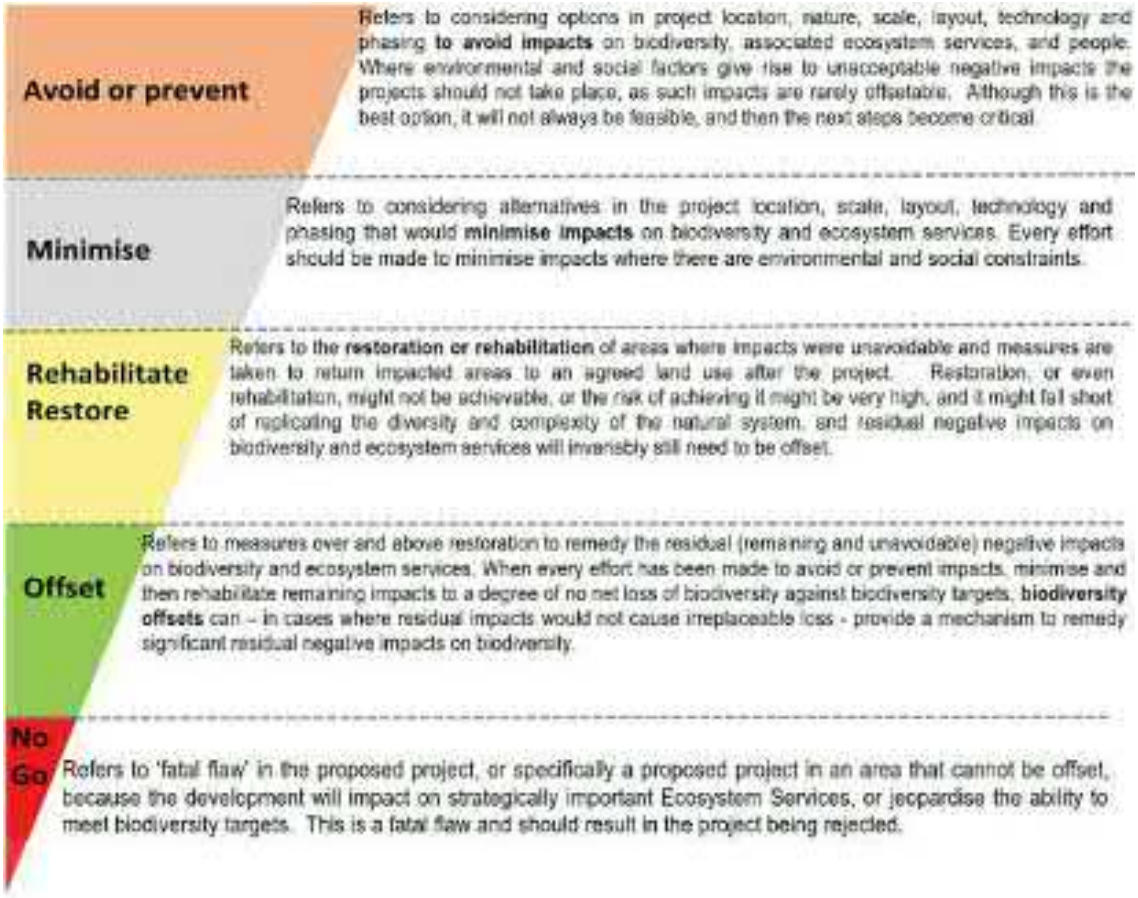


Figure 1: Mitigation Sequence/Hierarchy

Project Name	Proposed Development of the 147mw Rietkloof Wind Energy Facility and Associated Infrastructure near Maitjiesfontein, Western Cape Province
Impact Assessment	Geotechnical

CONSTRUCTION

Impact number	Aspect	Description	Stage	Character	Ease of Mitigation	Pre-Mitigation							Post-Mitigation						
						(M+	E+	R+	D)x	P=	S	Rating	(M+	E+	R+	D)x	P=	S	Rating
Impact 1:	Subsoil Removal	Increase Soil Erosion	Construction	Negative	Moderate	4	2	3	3	5	**60**	**N3**	2	1	1	2	2	**12**	**N1**
					Significance	**N3 - Moderate**							**N1 - Very Low**						
Impact 2:	Potential Oil Spillage	Ground and Surface Water Contamination	Construction	Negative	Moderate	4	3	5	5	4	**68**	**N4**	3	1	3	1	2	**16**	**N2**
					Significance	**N4 - High**							**N2 - Low**						

OPERATIONAL

Impact number	Receptor	Description	Stage	Character	Ease of Mitigation	Pre-Mitigation							Post-Mitigation						
						(M+	E+	R+	D)x	P=	S		(M+	E+	R+	D)x	P=	S	
Impact 1:	Displacement of natural material	Increase Soil Erosion	Operational	Negative	Moderate	3	2	3	4	4	**48**	**N3**	2	1	1	4	2	**16**	**N2**
					Significance	**N3 - Moderate**							**N2 - Low**						
Impact 2:	Potential Oil Spillage	Ground and Surface Water Contamination	Operational	Negative	Moderate	3	2	5	5	3	**45**	**N3**	2	1	3	1	2	**14**	**N1**
					I	**N3 - Moderate**							**N1 - Very Low**						

DECOMISSIONING

Impact number	Receptor	Description	Stage	Character	Ease of Mitigation	Pre-Mitigation							Post-Mitigation						
						(M+	E+	R+	D)x	P=	S		(M+	E+	R+	D)x	P=	S	
Impact 1:	Subsoil Removal	Increase Soil Erosion	Decommissioning	Negative	Moderate	4	2	3	3	5	**60**	**N3**	2	1	1	2	2	**12**	**N1**
					Significance	**N3 - Moderate**							**N1 - Very Low**						
Impact 2:	Potential Oil Spillage	Ground and Surface Water Contamination	Decommissioning	Negative	Moderate	4	3	5	5	4	**68**	**N4**	3	1	3	1	2	**16**	**N2**
					Significance	**N4 - High**							**N2 - Low**						

CUMULATIVE

Impact number	Receptor	Description	Stage	Character	Ease of Mitigation	Pre-Mitigation							Post-Mitigation						
						(M+	E+	R+	D)x	P=	S		(M+	E+	R+	D)x	P=	S	
Impact 1:	Subsoil Removal	Increase Soil Erosion	Cumulative	Negative	Moderate	4	2	3	3	5	**60**	**N3**	2	1	3	3	2	**18**	**N2**
					Significance	**N3 - Moderate**							**N2 - Low**						

Appendix C: Specialist's CV

environmental affairs
Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

DETAILS OF THE SPECIALIST, DECLARATION OF INTEREST AND UNDERTAKING UNDER OATH

	(For official use only)
File Reference Number:	
NEAS Reference Number:	DEA/EIA/
Date Received:	

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)

PROJECT TITLE

Development of a 147MW Rietkloof Wind Energy Facility and Associated Infrastructure near Maitjiesfontein in the Western Cape Province

Kindly note the following:

1. This form must always be used for 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 01 September 2018. 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.environment.gov.za/documents/forms.
3. A copy of this form containing original signatures must be appended to all Draft and Final Reports submitted to the department for consideration.
4. All documentation delivered to the physical address contained in this form must be delivered during the official Departmental Officer Hours which is visible on the Departmental gate.
5. All EIA related documents (includes application forms, reports or any EIA related submissions) that are faxed; emailed; delivered to Security or placed in the Departmental Tender Box will not be accepted, only hardcopy submissions are accepted.

Departmental Details

Postal address:
Department of Environmental Affairs
Attention: Chief Director: Integrated Environmental Authorisations
Private Bag X447
Pretoria
0001

Physical address:
Department of Environmental Affairs
Attention: Chief Director: Integrated Environmental Authorisations
Environment House
473 Steve Biko Road
Arcadia

Queries must be directed to the Directorate: Coordination, Strategic Planning and Support at:
Email: EIAAdmin@environment.gov.za

1. SPECIALIST INFORMATION

Specialist Company Name:	JG Afrika (Pty) Ltd			
B-BBEE	Contribution level (indicate 1 to 8 or non-compliant)	1	Percentage Procurement recognition	
Specialist name:	Khuthadzo Bulala			
Specialist Qualifications:	BSc Hons Geology			
Professional affiliation/registration:	Cand Sci Nat			
Physical address:	06 Pin Oak Avenue, Hilton, Pietermaritzburg			
Postal address:	06 Pin Oak Avenue, Hilton, Pietermaritzburg			
Postal code:	3245	Cell:		
Telephone:	033 343 6700	Fax:	033 343 6701	
E-mail:	bulalak@jgafrika.com			

2. DECLARATION BY THE SPECIALIST

I, Khuthadzo Bulala, declare that –

- I act as the independent specialist in this application;
- 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 Act.

Signature of the Specialist

JG Afrika (Pty) Ltd

Name of Company:

01/03/2021

Date

3. UNDERTAKING UNDER OATH/ AFFIRMATION

I, Khuthadzo Bulala, 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

JG Afrika (Pty) Ltd

Name of Company

01/09/2021

Date

COMMISSIONER OF OATHS
DAWN JANET BURGIN
9/1/6/2 (R/O) KZN (PIETERMARITZBURG)
6 PIN OAK AVENUE, HILTON

Signature of the Commissioner of Oaths

01/09/2021

Date

KHUTHADZO BULALA

Profession	*Engineering Geologist*
Position in Firm	*Engineering Geologist*
Area of Specialisation	*Geotechnical Engineering, Engineering Geology*
Qualifications	*BSc (Hons) (Geology) Cand. Sci. Nat.*
Years of Experience	*5.5 Years*
Years with Firm	*5 years*

SUMMARY OF EXPERIENCE

Khuthadzo is currently an Engineering Geologist based in the Pietermaritzburg office. She was originally employed by the Lesotho Highlands Development Authority (LHDA) as a young professional to work with JG Afrika on site, working on the geotechnical investigation for Phase II of the Lesotho Highlands Water Project. At the completion of the contract with LHDA, she joined JG Afrika as a permanent employee. Through her time on site, she gained valuable experience in site investigations, from assisting with the supervision of the contractor, profiling and logging, analysis of in-situ and laboratory testing, and reporting. She has been involved with a number of small to large scaled geotechnical investigation in KwaZulu-Natal.

PROFESSIONAL REGISTRATIONS & INSTITUTE MEMBERSHIPS

Cand.Sci.Nat. - Registered as a Candidate Natural Scientist with the South African Council for Natural Scientific Professions (SACNASP) - Registration No 116482

EDUCATION

2007 – Matric – Mbilwi Secondary School
2011 – BSc (Geology) – University of Johannesburg, Johannesburg
2013 – BSc (Hons) (Geology) – University of Limpopo, Polokwane

SPECIFIC EXPERIENCE

JG Afrika (Pty) Ltd (Previously Jeffares & Green (Pty) Ltd)

2017 -
Position – Engineering Geologist

Nkobongweni Water Scheme – Project manager responsible for the field investigation and report writing for the proposed water supply project. Client: Makhaotse Narasimulu and Associates (Pty) Ltd

Koup 1 & Koup 2 – Project manager responsible for the geotechnical desktop studies for the Koup 1 and Koup 2 wind energy facilities and their associated grid components. Client: Sivest SA (Pty) Ltd.

Mfulamuni Access Road – Project manager responsible for the field geotechnical investigation and reporting for the re-gravelling of four access roads in Mahlaba, Pomeroy. Client: ZVK Holdings (Pty) Ltd

Zwelisha Moyeni Waste-Water Treatment Works – Project manager responsible for the filed investigation and the report writing for the proposed WWTW extensions. Client: JG Afrika (Pty) Ltd Water Division

Hammersdale Waste-Water Treatment Works – Engineering Geologist responsible for the additional field investigation and the report writing for the proposed WWTW extensions. Client: eThekwini Municipality: Water and Sanitation Division

Emanzini Estate Geohydrology Assessment – Engineering Geologist responsible for the hydrocensus for the soak away pits feasibility at the proposed Mt Verde Estate. Client: Emanzini Private Reserve

Mt Verde Geohydrology Assessment – Engineering Geologist responsible for the hydrocensus and percolation tests for the soak away pits feasibility at the proposed Mt Verde Estate. Client: Venture Partners

Ntabamhlophe Tank – Project manager responsible for the field investigation and the report writing for the proposed tank. Client: JG Afrika Water Division

Kenhardt Solar PV Plant – Project manager responsible for the field investigation and the report writing for the proposed solar PV plant. Client: Scatec Solar South Africa.

Heidelberg Cemetery – Project manager and field geologist responsible for the investigation and and the report writing for the proposed existing Heidelberg cemetery extension. Client: Marang Environmental and Associates (Pty) Ltd

Cornubia Fills – Engineering geologist responsible for the field investigation and the report writing for the proposed cut and fill assessments for the Cornubia Boulevard Transit Mall development. Client: Smec

Kokstad CRU Contamination Study – Engineering geologist responsible for the contamination study for the Kokstad community residential units' phase 2 study. Client: Ingcweti Ace Technology

Mandalathi Hall – Project manager responsible for the geotechnical investigation and report writing for the proposed Mandalathi hall. Client: Dartingo Consulting Engineers (Pty) Ltd

Umgungundlovu Landfill Site – Engineering geologist responsible for the percussion drilling site supervision and the hydrocensus for the geohydrological assessment. Client: Séché South Africa

Gluckstaadt Water Supply Scheme – Engineering geologist responsible for the geotechnical investigation and report writing for bulk and reticulation pipeline routes, pump stations, reservoirs and water treatment works for the proposed development. Client: SiVEST

Agribusiness Development Agency Rabbitries – Project manager responsible for the geological investigation and report writing for five ADA Rabbitires development. Client: JG Afrika Agricultural Department. Client: JG Afrika Agricultural Department

Alfred Duma Cemetery – Engineering geologist responsible for writing the site selection desktop study report for eight sites in the Alfred Duma Municipality. Client: Ziphelele Planning and Environmental Consultancy

Eskom Radio Towers – Engineering geologist responsible for the field investigation and report writing for nine Eskom Towers in Eastern Cape. Client: Eskom

220 Murray Road – Project manager, responsible for managing field investigation (conducted by Muhammad Osman) and writing an infill geotechnical investigation report for a multi-story development in Hayfields. Client: Green Door Environmental

Giba Industrial Development – Engineering geologist responsible for the field investigation for Giba Industrial Development and assisted with the Geotech report. Client: Sultex Holdings (Pty) Ltd

Rietfontein Dam Geotechnical Investigation – Project manager, field geologist involved with the geotechnical investigations and reporting for the founding conditions and material investigation of the proposed Rietfontein Dam in Eastern Cape. Client: Calvus Properties Client:

Kirkwood Borrow pit and Retaining Walls – Engineering geologist involved in the geotechnical investigation and reporting for the borrow pit and retaining wall foundations of the proposed R336 Road Upgrade. Client: Royal Haskoning

83 West Street – Project manager, field geologist involved with the geotechnical investigations and report writing. Client: Private Developer

Eastwood Pedestrian Bridge – Project manager, field geologist involved with the geotechnical investigations and report writing. Client: High End Construction

N3 Quarry Logging – Geologist involved in the geotechnical logging of quarries between Durban and Pietermaritzburg, Client: South African National Road Agency Limited

N2 Kangela to Pongola Borrow Pit Geotechnical Investigations – Assisted with the geotechnical report, Client: South African National Road Agency Limited

N2 Kangela to Pongola Road Widening Geotechnical Investigations – Assisted with the geotechnical report, Client: South African National Road Agency Limited

Gowrie Farm Stand No.295 Geotechnical Investigations – Project manager, field geologist involved with the geotechnical investigations and report writing. Client: Delute Construction

45 Richard Carte Road – Geologist involved with the field investigations for the refurbishment of the warehouse. Client: T2 Design Lab

Darvil Sludge Dam – Geologist involved with the field investigations for the founding conditions, slope stability and materials investigations. Client: Umgeni Water

Acaciavale Landfill Closure Geotechnical Investigation- Geologist involved in the field investigation and the report writing. Client: Alfred Duma Municipality

Ntaba Ridge Plots Geotechnical Investigation- Project manager, field geologist involved in the geotechnical investigation at several plots. Involved in trial pitting, profiling and sampling and report writing.

Umhlatuze Cemetery Feasibility Study- Geologist involved in the project management, desktop study report, field investigation and the report writing. Client: uMhlatuze Municipality

Harry Gwala Irrigation Scheme – Client: Department of Rural Development and Land Reform

- Responsible for augering, soil profiling and sampling of the soils
- Assisted with the GIS for the various proposed sites
- Report writing for the project

Intaba Ridge Estate Landswop for Cemetery Geotech Investigation- Field geologist and involved in trial pitting, profiling and sampling.

Horseshoe, Mkhuphula and Nkungumathe Irrigation Scheme – Geologist involved in soil survey and report writing. Client: Department of Rural Development and Land Reform.

Geotechnical Investigations for Maryvale Housing- field geologist and involved in a shallow geotechnical investigation for a housing development. Client: eThekwini Municipality

Manzamnyama River Bridge Geotechnical Investigations – field geologist, involved in a deep geotechnical investigation for a new bridge. Client: Naidu Consulting

Cedara Petrol Filling Station Geotechnical Investigations- field geologist, involved in geotechnical investigations for various structures – Involved in trial pitting, profiling, percolation testing and sampling. Client: Barco Petroleum

Lesotho Highlands Water Project: Phase II (165m high Polihali Dam and Transfer Tunnel)- Assisted with the geotechnical reports for the Polihali Dam Polihali Transfer Tunnel. Client: Lesotho Highlands Development Authority

Mount Edge Combe Underpass Geotechnical Investigations- Involved in geotechnical logging and sampling. Client: Naidu Consulting

Lesotho Highlands Water Project: Phase II: Site geologist for one year based at the Polihali Dam and Transfer Tunnel site in Lesotho. Assisted with the geotechnical rotary core logging of boreholes drilled across the various proposed dam and transfer tunnel design components. Gained valuable experience in logging of the Lesotho Basalts. Client: Lesotho Highlands Development Authority

Lesotho Highlands Development Authority

Mar 2016-Aug 2016
Position – Engineering Geologist Intern

Lesotho Highlands Water Project: Phase II Engineering Geologist Intern at the Polihali Dam Site in Lesotho, seconded to JG Afrika, assisting supervising the LHDA Contract 4016, Polihali Dam and Transfer

Tunnel Geotechnical Investigation. Assisted with borehole logging, and supervision and administration of the rotary core drilling investigation. Client: Lesotho Highlands Development Authority

While seconded to JG Afrika:

Albert Falls: - field geologist involved in geotechnical investigations for a pipeline. Involved in trial pitting, profiling and sampling. Client: BVI Consulting Engineers

Umlazi Housing- field geologist involved in geotechnical investigations for various structures. Involved in trial
pitting, profiling and sampling. Client: BVI Consulting Engineers

South Coast National Route R61- Assistant field geologist involved in geotechnical investigations. Client: South African National Road Agency Limited

PERSONAL DETAILS

Nationality – South African
Date of Birth – 1990-03-30
Domicile – Thohoyandou, South Africa

Languages
English – Good
English - Very Good
Tshivenda - Very Good
Sesotho - Good
Setswana - Good
Sepedi - Good

UNIVERSITY OF LIMPOPO

WE,
THE UNDERSIGNED,
HEREBY CERTIFY THAT

BULALA KHUTHADZO
(201213617)

HAS BEEN AWARDED THE DEGREE

Bachelor of Science Honours

AT A CONGREGATION OF THE UNIVERSITY

Executive Dean

Registrar

Vice-Chancellor and Principal

24 MAY 2017

UNIVERSITY OF LIMPOPO: FORMERLY THE MEDICAL UNIVERSITY OF SOUTHERN AFRICA AND THE UNIVERSITY OF THE NORTH

T 34342

SACNASP

South African Council for Natural Scientific Professions

herewith certifies that

Khuthadzo Bulala

Registration Number: 116482

is a registered scientist

in terms of section 20(3) of the Natural Scientific Professions Act, 2003
(Act 27 of 2003)
in the following fields(s) of practice (Schedule 1 of the Act)

Geological Science (Candidate Natural Scientist)

Effective **9 November 2016** Expires **31 March 2022**

Chairperson

Chief Executive Officer

To verify this certificate scan this code

JAMES THOMAS MAXWELL (TOM) SPEIRS

Profession	*Geologist*
Position in Firm	*Senior Associate*
Area of Specialisation	*Geotechnical/ Engineering Geology*
Qualifications	*Pr.Sci.Nat., BSc*
Years of Experience	*35 Years*
Years with Firm	*32 Years*

SUMMARY OF EXPERIENCE

Tom Speirs has thirty-four years of experience in the fields of engineering geology, geotechnical and materials engineering. He has undertaken geotechnical, geological and materials work throughout Southern Africa, East, West and Central Africa, Madagascar and eastern Australia.

His responsibilities have included all phases of projects from preparing initial proposals and cost estimates through the review and investigation stages to the compilation of completion reports, as well as providing technical input during construction.

He currently manages the technical aspects of the geotechnical division in the Pietermaritzburg branch, including mentorship of subordinates, peer review and quality control.

His fields of expertise include road and dam geotechnical investigations, foundations, identification of construction material sources, slope stabilisation, engineering geological and land utilisation mapping.

PROFESSIONAL REGISTRATIONS & INSTITUTE MEMBERSHIPS

Pr Sci Nat- Registered with the South African Council for Natural Scientific Professions (SACNASP) - Registration No. 400104/94.

NHBRC Registered with the National Home Builders Registration Council (NHBRC) as a competent person (geotechnical). Registration No. 601708.

EDUCATION

1984 – Bachelor of Science – University of Natal

SPECIFIC EXPERIENCE

JG Afrika (Pty) Ltd

2014 to Date
Position - Senior Associate

Anadarko LNG Project - Geotechnical investigations for infrastructure development for the Anadarko liquified natural gas (LNG) project near Palma, Mozambique. Client: WBHO.

Usuthu Dam – Reconnaissance and co-ordination of geotechnical investigations for an off-channel storage dam near Nongoma. Client: RAWS Consulting Engineers

Moses Mabhida Road – Temporary support assessments of a rail embankment for the widening of Moses Mabhida Road in Pietermaritzburg. Client: SiVest.

Varies Geotechnical Investigations for Developments – including a multi-purpose sport s centre in Matatiele, pump-stations for the Mkhupula and Nkungumathe irrigations schemes, multi-storey residential blocks on a site with perched groundwater conditions at Berkshire Downs. Client: Various.

Various SANRAL projects - Co-ordinating and managing geotechnical and materials investigations on national roads projects, including National Route 2 Section 27 between Ballito and the Umvoti Toll Plaza, National Route 2 Sections 30, 31 and 32 between Kangela and Pongola. Slope stability assessments on National Route 2 Section 3 between Caledon and Riviersonderend. Client: SANRAL.

Rietvallei to Mamelodi - Conducting infill geotechnical investigations for the 1.2m diameter pipeline from Rietevallei to Bronberg Reservoir and the 1.4m diameter pipeline from Bronberg to Mamelodi. Client: Rand Water.

Grootgeluk Coal Mine - Geotechnical investigations for strategic coal stockpiles at the Grootgeluk Coal Mine, Lephalale. Client: Exxaro.

Main Road 7 Section 4 - Geotechnical assessment of fill instability on Main Road 7 Section 4, near Underberg. Client: Emzansi Engineers.

Maputo and Tembe River Dam Site Investigations - Reconnaissance of potential dam sites on the Maputo and Tembe Rivers in Maputo Province and the Monapo River in Nampula Province, Mozambique. Client: Conseng.

Maputsoe Urban Roads - Investigations to identify sources of construction materials for the upgrading of the Maputsoe Urban Roads in Lesotho. Client:

Stephen Dlamini Dam - *Ad hoc* investigations to identify potential dam and road construction materials for the construction of the Stephen Dlamini Dam, near Bulwer, KZN. Client: Ubambiswano Projects.

Polihali Dam and Polihali to Katse Transfer Tunnel - *Ad hoc* support on the geotechnical investigations for the Polihali Dam and Polihali to Katse Transfer Tunnel, forming part of the Phase 2 Lesotho Highlands Water Project. Client: LHDA.

Greater Paninkuku Dam, Cabhane Weir and Kilmon Dam - Geotechnical investigations for the proposed Greater Paninkuku Dam, Cabhane Weir and Kilmon Dam in KZN. Client: Ubambiswano Projects.

Mzimvubu Water Project - Detailed feasibility geotechnical investigations for the Laleni Dam, Tunnel and Hydropower Scheme, which forms part of the Mzimvubu Water Project in the Eastern Cape. Client: DWAF.

Matimba Power Station - Geotechnical stability investigations for the proposed raising and extension of an existing ash discard dump at the Matimba Power Station, near Lephalale, Limpopo. Client: RHDHV

Various - Geotechnical investigations for housing and commercial developments comprising single and multi-storey buildings, including a four-storey staff housing complex in the Estcourt Prison and the three-storey Hilton Life Hospital expansion. Client: Various.

Various - Geotechnical investigations for water and sewer reticulation, including the Mandlakazi Bulk Water Supply Scheme, the Mimosadale Water Supply Scheme, Impendle Village waste-water treatment works and outfall sewer, the tertiary pipelines and reservoirs forming part of the Metolong Dam Water Supply Programme in Lesotho. Client: Various

Various - Road construction materials assessments for the EN4 near Maputo in southern Mozambique and the EN1 between Muepane and Quissanga, northern Mozambique. Client: WBHO

2012 to 2014
Position – Associate

Mzimvubu Water Project - Geotechnical suitability assessments of three shortlisted dam sites on the Mzimvubu Water Project in the Eastern Cape. Subsequent feasibility level geotechnical investigations of the selected Ntabelanga dam site. Client: DWAF

Kalia Iron Ore Mine to Yomboyelli - Materials assessments for a 280km haul route from the Kalia Iron Ore Mine to Yomboyelli in Guinea. Client: WBHO.

Mapochs Mine - Geotechnical investigation of embankment distress and stability of Silt Paddocks 16 and 17 at the Mapochs Mine, near Roossenekal. Client: EVRAZ Highveld Steel & Vanadium..

Ubombo Sugar Mill and Big Bend Station - Geotechnical and materials investigations for the 16.5km railway line between the Ubombo Sugar Mill and Big Bend Station in Swaziland- Client: Swaziland Railways.

Noblesfontein Wind Power Plant - Geotechnical investigations for the proposed 75MW Noblesfontein Wind Power Plant near Victoria West in the Northern Cape. Client: Gestamp Wind.

Upington Airport Solar Project - Geotechnical investigation for the proposed 10MW PV power plant for the Upington Airport Solar Project. Client: Pele Green Energy

Jeffares & Green (Pty) Ltd

2008 to 2012
Position- Secondment to Bergstan Gauff Jeffares & Green Dikgatlhong Dam Project Joint Venture

Dikgatlhong Dam - Resident engineering geologist / materials engineer on the construction of the Dikgatlhong Dam in Botswana- a 4.6km long by 41m high zoned earth-fill dam with a full supply storage capacity of 400 million m³. Duties included the evaluation of embankment foundations, foundation grouting, geological mapping, excavation classification, sourcing of construction materials, instrumentation, quality control and construction monitoring. Client: Botswana Department of Water Affairs.

Jeffares & Green (Pty) Ltd

2001 to 2008
Position- Associate

Water Pipeline between Benoni and Mamelodi - Geotechnical investigations for the duplication of the water pipeline between Benoni and Mamelodi, east of Pretoria. A significant proportion of the route is underlain by dolomite. Client: Rand Water.

Various - Geotechnical investigations for numerous residential and commercial developments in KZN, Client: Various.

Teekloof and Verlatekloof Passes - Rock slope stability analyses of the Teekloof and Verlatekloof passes in the Northern Cape, Client: Northern Cape Department of Transport.

Various - Reconnaissance and initial geotechnical investigations of potential dam sites for the Lesotho Lowlands Water Supply Scheme. Co-ordinated the geotechnical investigation of two weir sites and an off-channel storage dam on the Black Mfolozi River, near Nyokeni in northern KZN. Client: Various

Kembe Hydro-Electric Power Plant - Preliminary geotechnical investigations for the Kembe hydro-electric power plant in the Central African Republic.

Various - Geotechnical and materials investigations for the rehabilitation of National Route 2 Section from the Pongola River to Pongola town, the N6/8 near Bloemfontein, Main Road 19 between Bhunya and Sandlane in Swaziland and the construction of a new a mine haul road for QMM in eastern Madagascar, Client: SANRAL, Swaziland Roads Department, QMM.
Hlabisa / Thuni Dams - Geotechnical investigations for the Hlabisa Dam in northern KZN and the Thuni Dam in north eastern Botswana, Client: KZN DOT, Botswana Department of Water affairs.

Roads in the Shinyanga Region - Conducted materials investigations for roads in the Shinyanga region of Tanzania, including roads from Shinyanga to Jomu, Jomu to Isaka and Jomu to Nzega. Client: Grinaker-LTA.

MR235/1 between Nkangala and Hlabisa - Assistant Resident Engineer on the contract for the construction of MR235/1 between Nkangala and Hlabisa in northern KwaZulu-Natal. Duties included contract monitoring and administration, materials assessment and verification, slope stability assessments, co-ordination of laboratory testing and community liaison. Also undertook the geotechnical and materials investigations for MR235/2 between Hlabisa and Bazini Client: KZNDOT

Buhemba Mine - Tailings dam investigation for the Buhemba Mine in Tanzania, Client: Merrameta

Victoria Road in the Cape Peninsula - Slope stability assessments along Victoria Road in the Cape Peninsula, Client: PAWC

Jeffares & Green (Pty) Ltd

1999 to 2001
Position- Senior Engineering Geologist

Various - Geotechnical and materials investigations for the upgrading of the Kei Cuttings in the Eastern Cape, the road between Nhlangano and Sicunusa in Swaziland, the John Ross Highway between Empangeni and Richards Bay, P102 south of Pretoria, the N7 north of Cape Town, Victoria Road between Camps Bay and Llandudno, Khetha Road in Mpendle, R56 near Rietvlei in southern KZN, D81 in Swaziland and the road between Chiweta and Karonga in Northern Malawi. Conducted regional studies to locate potential gravel materials for road construction, either usable naturally or by means of blending, on the

Cape West Coast, the Stormberg region of the Eastern Cape and in northern KZN. Compiled a database of gravel road construction materials for the West Coast District. Client: Various.

Various - Geotechnical foundation assessments for buildings, commercial developments and bridges. Client: Various

Various - Geotechnical assessments of structural distress in buildings for insurance claim loss adjustments. Client: Mutual & Federal

Ramotswa Regional Landfill - Conducted the geotechnical investigations for the Ramotswa Regional Landfill in southern Botswana. Included a preliminary assessment to locate candidate sites, ranking, final selection and detailed investigation of the selected site. Client: Group Consult Botswana.

Gold Mines in the Geita and Musoma areas - Geotechnical investigations for infrastructure developments of gold mines in the Geita and Musoma areas of northern Tanzania. Duties included geotechnical assessments for access roads, processing plants, tailing dams and shaft stability. Client: Merrameta.

Coffey Geosciences (Pty) Ltd (Australia)

1998 to 1999
Position- Senior Engineering Geologist

Northside Storage Tunnel - Co-ordinated the geotechnical investigations and undertook core logging for the Northside Storage Tunnel in North Sydney.

Slope stability assessments in Sydney.

Geotechnical foundation assessments for building developments in Sydney.

Suitability assessment of materials for dam construction near Kempsey, NSW.

Stability assessment of rock face at McCaffery's Hill, Pyrmont and a latite rock cutting at Kiama.

Jeffares & Green (Pty) Ltd

1997 to 1998
Position- Senior Engineering Geologist

Hillendale Mine - Geotechnical investigations for the Hillendale Mine near Richards Bay, including assessments for internal roads, founding conditions for a primary processing plant and a residue disposal dam. Client: Knight Piesold.

Various - Feasibility assessments of potential construction material sources for the Platinum Highway between Rustenburg and the Botswana border. Materials investigation for the reconstruction of the N10, near Middleton in the Eastern Cape. Client: Platinum Toll Concession, SANRAL.

Various - Bridge foundation and quarry investigations for the N11 near Newcastle, northern KZN. Investigations for bridge foundations, approach roads and borrow pits near Francistown, Botswana. Client: SANRAL, Botswana DOT.

Various - Geotechnical foundation investigations for various building structures throughout South Africa and Botswana, including site classifications according to the National Home Builders Registration Council. Client: Various.

Knight Piesold (Pty) Ltd.

1996 to 1997
Position- Senior Engineering Geologist

Nhlangano to Lavumisa - Geotechnical and materials investigation for the upgrading of the 87km road between Nhlangano to Lavumisa in Swaziland. Client: Swaziland Roads Department

Various - Foundation investigations for schools, residential complexes and a water treatment plant in Gauteng and the North-West Province. Client: Various.

Mine Tailings Dams and a Discard Dump - Geotechnical investigations for mine tailings dams and a discard dump in Mphumalanga and KZN. Client: ERGO, Ingwe.

Proposed Dam Site at Masunga - Geotechnical investigation of a proposed dam site at Masunga, in the North-East District of Botswana. Site found to be geotechnically unsuitable. Then undertook the preliminary geotechnical investigation of the Ntimbale dam site, near Francistown, including the dam centre-line investigation, sourcing of construction materials and investigations for appurtenant works. Client: Botswana Department of Water Affairs

Jeffares & Green Inc.

1987 to 1996
Position- Engineering Geologist

Durban Southern Gateway - Undertook the monitoring and supervision of the geotechnical drilling contract on the Durban Southern Gateway project, including core logging and assessment of founding conditions for bridges and road embankments on deep estuarine sediments. Client: SANRAL

Various - Monitoring, stability and settlement analyses of embankments, including a number of road embankments and bridge approaches overlying deep, compressible estuarine and alluvial deposits along the KZN coast and in Gauteng. Client: SANRAL, KZN DOT, PPC Cement

South-Western Outfall Sewer - Contract supervision of piling for a pump station and bridge located on dolomite for the South-Western Outfall sewer, south of Johannesburg. Involved the on-site analysis of percussion drilling results to determine optimum pile founding depths and the monitoring of pile installations. Client: City of Johannesburg

Bulk Water Supply Scheme for Mpendle - Geotechnical feasibility investigations of potential dam sites for a proposed bulk water supply scheme for Mpendle, KZN. Included assessments of founding conditions and stability along dam centre lines and the sourcing of construction materials. Also, undertook geotechnical investigations of founding conditions for appurtenant works and the initial environmental impact assessment. Client: Umgeni Water

South West Outfall Sewer pipeline and the Roodepoort Outfall Sewer pipeline - Geotechnical investigations for the 2.2m diameter South West Outfall Sewer pipeline and the Roodepoort Outfall Sewer pipelines. Included specific investigations for pipe jacking beneath roads, railways and housing. Client: City of Johannesburg

water pipeline from Brakfontein (Halfway House) to Kwaggaspoort (Pretoria) - Geotechnical investigation for the 20km long 1.7m diameter water pipeline from Brakfontein (Halfway House) to Kwaggaspoort (Pretoria). Sections of the route underlain by dolomite. Client: Rand Water.

Various - Geotechnical investigations for structures, transit routes and buildings on problem soils, including expansive clays, collapsible sands compressible clays and silts. Client: Various.

Mzimkulu River Bridge - Undertook the geotechnical investigation for the 300m long Mzimkulu River bridge, which required founding at depths down to 55m. Client: SANRAL / KZN DOT

Various - Numerous foundation investigations throughout Southern Africa for townships, commercial developments, schools, office blocks, hospitals, factories and housing. Clint: Various.

Various - Aerial photographic interpretation for various roads, townships and engineering geological mapping projects. Undertook engineering geological and land utilization mapping of a 43 000 ha area at Rust de Winter in Limpopo Province and the environmentally sensitive Duku-Duku area in KZN. Client: SA Geological Survey

Various - The location and investigation of sources of materials for use in the construction of roads, townships, dams and brick making. Undertook reconnaissance of a 6000km² area in northern KZN to identify potential sources of road construction materials**.** Client: Various

Various - Geotechnical and materials investigations for numerous roads projects including national freeways, urban arterials, township and rural roads, entailing route assessments, identification of problem subgrades, condition evaluations of existing road pavements, slope stability analyses and sourcing of construction materials. Geotechnical testing and instrumentation for embankments, cuttings, tunnels and foundations. Supervision of numerous contracts for rotary core drilling, percussion drilling, in-situ testing, instrumentation and large diameter auger boring. Client: Various.

Various - Ad hoc tunnel mapping and rock mass characterisation for the Inanda-Wiggins Scheme. Portal stability assessments on a number of existing tunnels in the Mngeni valley of KZN. Client: Umgeni Water

1986 to 1987
Position- Assistant Resident Engineer.

Project Floor, near Naboomspruit (now Mookgophong), Limpopo Province. Contract for the dynamic consolidation of collapsing sands for sensitive structures. Duties included contract supervision, monitoring of oedometer testing and settlement analysis. Client: SA Defence Force

1985 to 1986
Position- Resident Geologist

Mpolweni Tunnel, Ulundi, KZN -Resident Geologist for 1½ years on the construction of the 3km long Mpolweni Tunnel. Construction was by drill-and-blast and the tunnel route transected basaltic lava, quartzite, tillite and dolerite dykes. Undertook the engineering geological face and long wall mapping, joint analysis, rock mass descriptions and classifications, convergence monitoring, support and excavation assessment. Client: Spoornet

CONTINUED PROFESSIONAL DEVELOPMENT

Courses

1987 - Road Infrastructure Course (NITRR).
1987 - Kaytech Geosynthetics
1992 - Waste Management Workshop
1994 - In-Situ Testing in Geotechnical Engineering (SAICE)
1996 Dolomite Seminar (SAIEG)
1996 - Workshop on Waste Aquifer Separation Principle (WASP)
1999 - A Short Workshop on Suggested Interpretation Techniques of Soil Movement with Emphasis on Heave and Collapse Conditions (SAIEG)
1999 - Risk of Collapse of Formations in Berea Reds (SAICE)
2001 - Ground Improvement (SAICE)
2002 - Engineering Geology for Developing Countries, 9th IAEG Congress.
2004 - Workshop on Compaction of Road Materials (SARF)
2005 - Workshop on soil Stabilisation (SARF)
2005 - Geosynthetics in Road Construction (GIGSA)
2008 - Introduction to Geosynthetics (SAICE)
2009 - Sustainable Development of Dams in South Africa (SANCOLD)
2010 - Basic Principles of Design, Construction and Evaluation of Small to Medium Dams, especially Embankment Dams (SANCOLD)
2015 - Eurocode 7 Geotechnical Design (SAICE)
2017 - Filtration and Drainage with Geosynthetics (Kaytech)

Published Papers

2009 - Schreiner, HD, Norris, JC, Speirs, T, Melvill, AL "Non-Erosion Filtration Tests for Dam Filter Design" SANCOLD Conference, November 2009.

PERSONAL DETAILS

Nationality – South African
Date of Birth – *1958/11/02*
Domicile – Pietermaritzburg, South Africa

Languages

English – Excellent
isiZulu – Very Good
Afrikaans – Good
Ndebele – Good
Seswati – Fair
Xhosa – Fair

Universitas Nataliensis

hoc scripto nos, Universitatis Nataliensis
Vice-Cancellarius, Registrarius, testamur

JAMES THOMAS RASKELL SPEIRS

Gradum Scientiae Baccalaurei

adeptum

Vice-Cancellarius

Registrarius

[illegible]

400104/94

South African Council for Natural Scientific Professions

This is to certify that

James Thomas Maxwell Speirs

has been registered as a Professional Natural Scientist
in terms of section 11 of the Natural Scientific Professions Act, 1993

SACNASP

1994/09/23
Pretoria

President

Registrar