PROPOSED CONSTRUCTION OF THE KOUP 1 ENERGY FACILITY AND ASSOCIATED GRID INFRASTRUCTURE NEAR BEAUFORT WEST, WESTERN CAPE PROVINCE

DESKTOP GEOTECHNICAL REPORT

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REVISION 02

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SYNOPSIS

Desktop geotechnical investigation for the proposed Koup 1 Energy Facility.

KEY WORDS:

Mudstone, Turbines, Foundations, Shallow Bedrock.

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.	12/04/2022
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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- i. the specialist who prepared the report; and ii. the expertise of that specialist to compile a specialist report including a curriculum vitae;	Verification page, 1.3 Appendix C
b) a declaration that the specialist 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;	1.1
(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;	8, 9
d) the date and season of the site investigation and the relevance of the season to the outcome of the assessment;	-
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
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 1, 2, 3, 4, 5
g) an identification of any areas to be avoided, including buffers;	Appendix A 1, 2, 3, 4, 5
h) a map superimposing the activity including the associated structures and infrastructure on the environmental	Appendix A 1, 2, 3, 4, 5

sensitivities of the site including areas to be avoided, including buffers;	
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 authorisation;	Table 8-1
m) any monitoring requirements for inclusion in the EMPr or environmental authorisation;	Table 8-1
n) a reasoned opinion- 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;	 10 10 Table 8-1
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	N/A
q) any other information requested by the competent 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 CONSTRUCTION OF THE KOUP 1 ENERGY FACILITY AND ASSOCIATED GRID INFRASTRUCTURE NEAR BEAUFORT WEST, WESTERN CAPE PROVINCE

DESKTOP GEOTECHNICAL REPORT

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EXECUTIVE SUMMARY

This report presents the finding of a desktop level study for the proposed Koup 1 Wind Energy Facility, situated near Beaufort West in the Western Cape Province. The study area receives a relatively low mean annual precipitation of 392mm. The proposed project area is drained by non-perennial tributaries of the Soutfonteinse River which forms a dendritic drainage pattern, flowing in a north-easterly direction. The area is underlain by rock units of the Abrahamskraal Formation (Pa) and Teekloof Formation (Pt) of the Adelaide Subgroup, forming part of the Beaufort Group of the Karoo Supergroup. Competent, founding conditions are anticipated at relatively shallow depths in slightly weathered bedrock conditions, although this will have to be confirmed during the detailed investigation stage.

The bedrock geology is overlain by relatively thin transported soil deposits. The geological map 3222 Beaufort West indicates seven-fault features in the study area. Regional borehole data indicates relatively low aquifer yields in the range of 0.1-0.5l/s for the south eastern portion and 0.5-2l/s over the major proportion of the site.

The desktop level study indicates no fatal flaws from a preliminary geotechnical perspective. The impact of the development from a geotechnical perspective will be restricted to the removal and displacement of soil, boulders and bedrock. The impact assessment matrix of the Koup 1 Wind Energy Facility was found to be “Negative low impact - The anticipated impact will have negligible negative effects and will require little to no mitigation.” Hence based upon the desktop level geotechnical study the site is considered suitable for the proposed development as a Wind Energy Facility.

PROPOSED CONSTRUCTION OF THE KOUP 1 ENERGY FACILITY AND ASSOCIATED GRID INFRASTRUCTURE NEAR BEAUFORT WEST, WESTERN CAPE PROVINCE

DESKTOP GEOTECHNICAL REPORT

1 INTRODUCTION

This geotechnical desktop report presents the findings of a desktop study undertaken by JG Afrika (Pty) Ltd, for the proposed Koup 1 Wind Energy Facility (WEF) and associated grid infrastructure, situated in the Western Cape Province. It is understood that a desktop level geotechnical report is required as part of an environmental submission for an Environmental Impact Assessment (EIA) report being undertaken by SiVEST (Pty) Ltd. The proposed wind energy facility is located between the towns of Beaufort West and Prince Albert in the Western Cape Province.

It is anticipated that the proposed Koup 1 WEF will comprise twenty-eight (28No.) wind turbines with a maximum total energy generation capacity of up to approximately 140MW. The electricity generated by the proposed WEF development will be fed into the national grid via a 132kV overhead power line. A Battery Energy Storage System (BESS) will be located next to the on-site 33/132kV substation. The storage capacity and type of technology will be determined at a later stage during the development phase but, will most likely will comprise an array of containers, outdoor cabinets and/or storage tanks.

Wind Farm Components

- Up to 28 wind turbines, each between 5.6MW and 6.6MW, with a maximum export capacity of approximately 140MW. This will be subject to allowable limits in terms of the Renewable Energy Independent Power Producer Procurement Programme (REIPPPP). The final number of turbines and layout of the WEF will, however, be dependent upon the outcome of the Specialist Studies conducted during the EIA process;
- Each wind turbine will have a hub height and rotor diameter of up to approximately 200m;
- Permanent compacted hardstanding areas / platforms (also known as crane pads) of approximately 90m x 50m (total footprint of approx. 4 500m²) per turbine during construction and for on-going maintenance purposes for the lifetime of the proposed development;
- Each wind turbine will consist of a foundation of up to approximately 15m x 15m in diameter. In addition, the foundations will be up to approximately 3m in depth;
- Electrical transformers adjacent to each wind turbine (typical footprint of up to approximately 2m x 2m) to step up the voltage to 33kV;
- One (1No.) new 33/132kV on-site substation and/or combined collector substation, occupying an area of approximately 1.5 ha. The proposed substation will be a step-up substation and will include an Eskom portion and an IPP portion, hence the substation has

been included in the WEF EIA and in the grid infrastructure BA (substation and 132kV overhead power line) to allow for handover to Eskom. Following construction, the substation will be owned and managed by Eskom. The current applicant will retain control of the low voltage components (i.e. 33kV components) of the substation, while the high voltage components (i.e. 132kV components) of this substation will likely be ceded to Eskom shortly after the completion of construction;

- The wind turbines will be connected to the proposed substation via medium voltage (33kV) cables. Cables will be buried along access roads wherever technically feasible.
- A Battery Energy Storage System (BESS) will be located next to the onsite 33/132kV substation. The storage capacity and type of technology would be determined at a later stage during the development phase, but will most likely comprise an array of containers, outdoor cabinets and/or storage tanks;
- Internal roads with a width of between 8m and 10m will provide access to each wind turbine. Existing site roads will be used wherever possible, although new site roads will be constructed where necessary. Turns will have a radius of up to 50m for abnormal loads (especially turbine blades) to access the various wind turbine positions. It should be noted that the proposed application site will be accessed via an existing gravel road from the N12 National Route;
- One (1No.) construction laydown / staging area of up to approximately 2.25ha. It should be noted that no construction camps will be required in order to house workers overnight as all workers will be accommodated in the nearby town;
- One (1No.) permanent Operation and Maintenance (O&M) building, including an on-site spares storage building, a workshop and an operations building to be located on the site identified for the construction laydown area.
- A wind measuring lattice (approximately 120m in height) mast has already been strategically placed within the wind farm application site in order to collect data on wind conditions;
- No new fencing is envisaged at this stage. Current fencing is standard farm fence approximately 1-1.5m in height. Fencing might be upgraded (if required) to be up to approximately 2m in height; and
- Water will either be sourced from existing boreholes located within the application site or will be trucked in, should the boreholes located within the application site be found to have limited yield.

Grid Components

The proposed grid connection infrastructure to serve the Koup 1 WEF will include the following components:

- One (1No.) new 33/132kV on-site substation and/or collector substation, occupying an area of up to approximately 1.5 ha. The proposed substation will be a step-up substation and will include an Eskom portion and an IPP portion, hence the substation has been included in both the EIA for the WEF and in the BA for the grid infrastructure to allow for handover to Eskom.

The applicant will remain in control of the low voltage components (i.e. 33kV components) of the substation, while the high voltage components (i.e. 132kV components) of this substation will likely be ceded to Eskom shortly after the completion of construction; and

- One (1No.) new 132kV overhead power line connecting the on-site and/or collector substation either to an off-site collector substation, or via a direct tie-in to the existing 400kV overhead power lines and thereby feeding the electricity into the national grid. Power line towers being considered for this development include self-supporting suspension monopole structures for relatively straight sections of the line and angle strain towers where the route alignment bends to a significant degree. Maximum tower height is expected to be approximately 25m.

Wind Energy Facility alternatives

Design and layout alternatives will be considered and assessed as part of the EIA. These include alternatives for the Substation locations and also for the construction / laydown area.

The grid connection infrastructure proposals include two (2No.) switching and collector substation site alternatives and three (3No.) power line route alignment alternatives. These alternatives will be considered and assessed as part of the BA process and will be amended or refined to avoid identified environmental sensitivity issues.

All three (3) power line route alignments will be assessed within a 300m wide assessment corridor (150m on either side of power line). These alternatives are described below:

- Power Line Corridor Option 1 is approximately 1.3km in length, linking either substation / collector Option 1 or Option 2 to the existing 400kV transmission lines.
- Power Line Corridor Option 2 is approximately 9.9km in length, linking either substation / collector Option 1 or Option 2 to a proposed Collector Substation to the south, adjacent to the existing 400kV transmission lines.
- Power Line Corridor Option 3 is approximately 12.9km in length, linking either substation / collector Option 1 or Option 2 to a proposed Collector Substation to the north, adjacent to the existing 400kV transmission lines.

1.1 Scope of works

The objectives of this desk-top level study were to assess the geological and geotechnical conditions prevailing across the study area.

This 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, "Proposal for a Geotechnical Desktop Study for the Proposed Koup 1 and Koup 2 Windfarms, Western Cape.," dated the 1st of February 2021. JG Afrika received the appointment via a sub-consultancy agreement letter entitled, "16017 Koup WEF sub consultancy JG Afrika May 2021" received on the 21st of May 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 the 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 Scientist (400104/94). 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. He has accumulated abundant experience 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, geology, hydrogeology and envisaged geotechnical constraints.

An Environmental Impact Assessment matrix was provided by SiVEST:

- 16343_SiVEST Impact Rating Table_Ver1_20190128 AG
- Updated Environmental Impact Assessment Methodology_Ver1 - 2019

2 ASSUMPTIONS, LIMITATIONS, UNCERTAINTIES - DISCLAIMER

The interpretation of the overall geotechnical conditions across the site is based on a review of available information on the project area. Subsurface and geotechnical conditions have been inferred at a desktop level from the 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 Koup 1 WEF and the associated grid infrastructure is situated approximately 55 km south of the town of Beaufort West, Western Cape Province. The site lies within the Beaufort West and Prince Albert Local Municipalities, in the Central Karoo 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 stabilisation of the Teekloof Pass (2006), the stabilisation of the Verlatekloof Pass (2008) and the Noblesfontein Wind Power Project near Victoria West (2012).

During the previous investigation for the Noblesfontein Wind Farm, mudstone, siltstone and sandstone of the Teekloof were encountered. The sandstone was generally feldspathic, fine to medium grained and grey to greenish grey in colour. Grain size and colour variations in the sandstone were evident. The results of the investigation indicated generally good founding conditions at the turbine positions, with competent rock generally occurring at relatively shallow depths.

3.2 Land Use and Vegetation

The proposed energy facility buildable area is approximately 2445.667 ha, while the total area of WEF project application site is approximately 4279.398 ha. The project application site incorporates the following farm portions:

- The Farm Riet Poort No 231
- Portion 11 Of The Farm Brits Eigendom No 374
- Portion 15 Of The Farm Brits Eigendom No 374
- Portion 5 Of Farm 380
- Portion 10 Of Farm 380
- Portion 11 Of Farm 380

According to Mucina *et al* (2005), the regional biome within which the study site is located is classed as a Gamka Karoo (NKI1) of the lower Karoo bioregional vegetation.

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

3.3 Climate

The study area is characterized by a hot semi-arid climate with a “BSk” classification according to the Köppen-Geiger climate classification. Beaufort West receives a relatively low mean annual precipitation of 392 mm. The average lowest rainfall is received in June (15 mm) and the highest in March (57 mm), which is a seasonal variation of 42 mm.

The maximum midday temperatures for Beaufort West ranges from 31.7°C in January to 18°C in July. The minimum temperatures for Beaufort West ranges from 16.6°C in February to 4.4°C in July. The average temperatures vary during the year by 12.9°C. Table 4-1, summarizes the climatic conditions.

Table 3-1: Summary of Climatic Conditions, Beaufort West (information extracted from “Climate-Data.org”)

Months	Average Rainfall (mm)	Temperature (°C)		
		Maximum	Minimum	Average
January	50	31.7	16.2	24
February	52	31.3	16.6	23.8
March	57	28.8	14.8	21.8
April	32	24.7	11.4	18
May	20	21.6	8.4	14.8
June	15	18.1	4.9	11.3
July	15	18	4.4	11.1
August	21	19.8	5.4	12.6
September	17	23.2	7.7	15.6
October	31	26.2	10.6	18.6
November	38	28.3	12.5	20.5
December	44	30.6	15	22.7

3.4 Drainage and Topography

The perennial Soutfonteinse River buffers the eastern extremity of the site which falls within the proposed buildable area of the WEF development zone. The study area is drained by non-perennial tributaries of the Soutfonteinse River which form a dendritic drainage pattern, flowing in a north-easterly direction.

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 site is characterised by flat to gentle terrain (0.40˚ – 8.7˚ slopes). Spot heights indicate elevation values in the range of 901m to 1060m above mean sea level.

4 GEOLOGY

According to the 1: 250 000 Geological Map (3222) of Beaufort West published by the Council for Geoscience, the study area is underlain by rock units of the Teekloof Formation (Pt), which is underlain by rock units of the Abrahamskraal (Pa) Formation. These rock units form part of the Adelaide Subgroup of the Beaufort Group, 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. These rock units are overlain by the Teekloof Formation (Pt) which is represented by mudstone, siltstone and fine to very fine grained wackes and arenites.

Quaternary alluvial deposits overlie the geological formations over localised areas in the east and south east of the site.

Regional measurements indicate that the Teekloof sedimentary strata dip at between 10° and 12° in an easterly direction. The Abrahamskraal sedimentary bedding displays axial dips of 9° in a westerly and 20° in an easterly direction.

The sedimentary rocks in the area have been acted upon by numerous tectonic forces associated with fold features. Based upon the geology map, one reverse fault occurs in the centre of the site trending east to west. Six axial fault features are located within the study area. The faults trend in an E-W direction and represent localized synclines and anticlines.

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

5 HYDROGEOLOGY

The study area lies within the L12C catchment area which receives a mean annual precipitation of 152mm.

According to the 1: 3 000 000 scaled Groundwater Harvest Potential Map of South Africa, Regional yields of sustainable groundwater abstraction rates, indicate values of 2500 - 4000 m^3/km^2/annum.

Regional hydrogeological data indicate that the area is characterised by fractured aquifer types. The south eastern aquifer is classed as 'b2' which indicate relatively low yields, estimated to be in the range of 0.1-0.5 l/s. The major proportion of the site is classed as "b3" which indicates low yields of

0.5-2.0l/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 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

Engineering geology refers to the engineering characteristics of natural earth materials for founding structures and suitability for construction materials.

Beaufort west is characterized by a Weinert Climatic N-value of more than 18.4, meaning that the type of weathering is primarily by mechanical disintegration. Shallow residual soils are commonly granular and gravelly (Brink, 1983).

The majority of the study area (western through to the eastern region) is dominated by the Abrahamskraal Formation. The northern and southern regions of the study site are dominated by rock units of the Teekloof Formation. Colluvial deposits can be anticipated along hillslopes with alluvial deposits anticipated near drainage features, although these are generally thin.

Based on previous investigations in the area between Leeu Gamka and Fraserburg, intercalated rocks of the Teekloof Formation can be anticipated. From the Teekloof Pass investigation, the sedimentary units were generally purple in colour and were slightly weathered. The intercalated sedimentary rocks illustrated different degrees of resistance to weathering. Mudstones are generally less resistant to weathering compared to siltstone and sandstone. They weather rapidly into low-strength friable gravelly material when exposed sub-aerially.

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 Teekloof Formation.

During the previous investigation for the Noblesfontein Wind Farm, mudstone, siltstone and sandstone of the Teekloof were encountered. The sandstone was generally feldspathic, fine to medium grained and grey to greenish grey in colour. Grain size and colour variations in the sandstone were evident. The results of the investigation indicated generally good founding conditions at the turbine positions, with competent rock generally occurring at relatively shallow depths.

Mudrocks such as siltstone, mudstone and "mud-shales" are not considered suitable for use as construction materials, due to their swelling characteristics, excessive absorption of water and poor engineering performance. Slope stability issues can arise in areas where closely intercalated sandstones and mudrock co-exist. When mudrocks slake or disintegrate the exposed sandstone layers are undercut, which can result in rockfalls (Brink, 1983). Based on previous investigations at Teekloof Pass and at Verlatekloof Pass, concave cave-like features can be formed as a result of erosion of the less-competent shale and mudstone layers occurring beneath harder, more resistant sandstone beds.

In respect of sourcing construction materials for roads and laydown areas consideration could be given to natural gravely or crushed sandstone bedrock. Selective usage must be exercised to avoid using sandstone containing excessive pyrite and muscovite, which can cause distress when 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 materials will have to be assessed during the detailed geotechnical investigation. It is recommended that provision be made to procure aggregates for use in upper pavement layerworks construction and the manufacture of concrete from commercial sources.

7 GEOTECHNICAL APPRAISAL

Competent, founding conditions can be anticipated in shallow, slightly weathered bedrock, which will have to be assessed during the detailed design stage.

Consideration can be given to the following foundation types:

- Spread Footings – The use of reinforced spread footings designed to resist the uplift and downward pressures. Footings will require to be dowelled into bedrock to resist dynamic forces and overturning. Extensive excavations will be required for the spread footings, excavation side walls will need to be battered back or supported. This should be assessed by suitably qualified personnel during construction. All earthworks should be undertaken in accordance with SANS 1200 D. Disadvantages of using spread footing is the speed of construction and extensive excavations.

Alternatively, consideration may be given to an anchored foundation option, which has the potential to be more cost effective due to decreased excavation and concrete volumes.

Deep foundations such as driven or drilled piling should be considered, depending on the geotechnical conditions encountered on site.
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.

The presence of uplift and downward forces in the form of wind loads must be taken into consideration during foundation design. Also, lateral loads due to overturning moments must be considered.

8 GEOTECHNICAL IMPACT ASSESSMENT MATRIX

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

8.1 Impact of the Project on the Geological Environment

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. 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 Karoo Supergroup is known for its fossil bearing 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 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 Koup 1 WEF was found to be "**Negative low impact - The anticipated impact will have negligible negative effects and will require little to no mitigation**." The assessment impact assessment matrix is presented overleaf as Table 8-1.

Areas with steep slope inclinations are not favoured for the energy developments due to the earthworks requirements and the potential need for advanced foundations, which is discussed in Section 4.4. The site 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 SiVEST is included in **Appendix B.**

Table 8-1: Geotechnical Impact Assessment Matrix

KOUP 1 WIND ENERGY FACILITY AND GRID COMPONENTS																				
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																				
Removal of subsoils (soil, rock)	Displacement of natural earth material and overlying vegetation. 1) Increase stormwater velocity. 2) Increase in soil and wind erosion due to clearing of vegetation. 2) Construction and earthmoving vehicles may displace soil during operations. 3) Creation of drainage paths along access tracks. 4) Potential oil spillages from heavy plant. 5) Sedimentation of non-perennial features and excessive dust. 6) Potential groundwater and drainage feature contamination.	1	4	2	2	2	2	22	-	Low Impact	Identify protected areas prior to construction. 1) Construction of temporary berms and drainage channels to divert surface water. 2) Minimize earthworks and fills. 3) Use existing road network and access tracks. 4) Rehabilitation of affected areas (such as regrassing, mechanical stabilization). 5) Correct engineering design and construction of gravel roads and water crossings. 6) Correct construction methods for foundation installations and cut to fill configurations. 7) Vehicle repairs to be undertaken in designated areas. 8) Control stormwater flow	1	2	2	1	4	2	20	-	Low Impact
Operational Phase																				

KOUP 1 WIND ENERGY FACILITY AND GRID COMPONENTS																				
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
Removal of subsoils (soil, rock)	Displacement of natural earth material. 1) Increase in soil erosion. 2) Potential oil spillages from maintenance vehicles. 3) Sedimentation of non-perennial features caused by soil erosion.	1	2	2	2	3	1	10	-	Low Impact	1) Use of existing roads and tracks where feasible. 2) Rehabilitation of affected areas (such as erosion control mats). 3) Correct engineering design and construction of roads and water crossings. 4) Vehicle repairs to be undertaken in designated areas. 5) Maintenance of stormwater system.	1	3	2	2	3	2	22	-	Low Impact
Decommissioning Phase																				
Removal of subsoils (soil, rock)	Decommissioning of the structure will disturb the geological environment. 1) Increase in soil and wind erosion due to clearance of structures. 2) Construction and earthmoving vehicles will displace the soil. 3) Creation of drainage paths. 4) Potential oil spillages from vehicles. 5) Excessive sediments in non-perennial features.	1	4	2	1	1	3	27	-	Low Impact	1) Use of temporary berms and drainage channels to divert surface water were feasible. 2) Minimize earthworks and demolish footprints. 3) Use of existing roads and tracks were feasible. 4) Rehabilitation of affected areas (such as regrassing). 5) Develop a chemical spill response plan. 6) Develop dust and demolition fly suppression plan. 7) Vehicle repairs to be undertaken in designated areas. 8) Reinstate channelized drainage features.	1	3	4	2	2	2	24	-	Low Impact
Cumulative																				

KOUP 1 WIND ENERGY FACILITY AND GRID COMPONENTS																				
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
Removal of subsoils (soil, rock)	None							0			None							0		

9 GEOTECHNICAL COMPARATIVE ASSESSMENT OF ALTERNATIVES

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 laydown area

Two (2) construction laydown area alternatives were considered, namely:

-Construction laydown area alternative 1: is located approximately 30m north of the proposed substation site option 1 on Portion 11 Of The Farm Brits Eigendom No 374; and

-Construction laydown area alternative 2: is located approximately 50m north of the proposed substation site option 2 on Portion 11 Of The Farm Brits Eigendom No 374.

Substation/BESS

Two (2) substation area alternatives were considered by the EAP and specialists as follows:

-Substation site option 1: Alternative 3 is located to the west of the public road on Portion 11 Of The Farm Brits Eigendom No 374; and

-Substation site option 2: Alternative 4 is located to the west of the public road on Portion 11 Of The Farm Brits Eigendom No 374.

Grid Components

All three (3) power line route alignments will be assessed within a 300m wide assessment corridor (150m on either side of power line). These alternatives are described below:

-Power Line Corridor Option 1 is approximately 1.3km in length, linking either substation / collector Option 1 or Option 2 to the existing 400kV transmission lines.

-Power Line Corridor Option 2 is approximately 9.9km in length, linking either substation / collector Option 1 or Option 2 to a proposed Collector Substation to the south, adjacent to the existing 400kV transmission lines.

-Power Line Corridor Option 3 is approximately 12.9km in length, linking either substation / collector Option 1 or Option 2 to a proposed Collector Substation to the north, adjacent to the existing 400kV transmission lines.

A 132kV overhead power line will connect the Koup 1 WEF on-site switching substation / collector to the national grid either by way of an off-site collector substation, or via a direct tie-in to existing 400kV transmission lines that traverse the Koup 1 WEF project.

Construction activities on steeply inclined slopes will require additional earthworks, longer access routes in comparison to lower topographic areas.

Slope stability issues can arise in steeply inclined terrain which will require retention structures and advanced foundations. Mountainous terrain will require earthworks to create level platforms for structures.

None of the alternatives are considered fatally flawed provided the recommendations presented in this report are adhered to.

This assessment is based on the comparative assessment criteria developed by SiVEST, which is given in Table 9-1, with the full assessment presented in Table 9-2 and Table 9-3.

Table 9-1: Comparative Assessment Criteria

PREFERRED	The alternative will result in a low impact / reduce the impact / result in a positive impact
FAVOURABLE	The impact will be relatively insignificant
LEAST PREFERRED	The alternative will result in a high impact / increase the impact
NO PREFERENCE	The alternative will result in equal impacts

The geotechnical comparative assessment is provided in Table 9-2 and Table 9-3.

Table 9-2: Geotechnical Comparative Assessment of Alternatives for the Wind Energy Facility

Alternative	Preference	Reasons (incl. potential issues)
CONSTRUCTION LAYDOWN AREA		
Construction Laydown Area Alternative 1	**NO PREFERENCE**	• Construction laydown area 2 and the western boundary of construction laydown area option 1 are underlain by the quaternary deposits which are underlain by the Teekloof Formation. Majority of construction laydown area option 1 is underlain by the Teekloof Formation. • A non-perennial drainage feature traverses' option 2 from north to south, this must be channelized affecting the cost. • Option 1 lies on a flat 0.9-2˚ slope, likely to be shallow, unstable transported soils. • Option 2 lies on a flat 0.4-1.5˚ slope, likely to be shallow, unstable transported soils. • Both options lie close to the road, easy access. • Haulage distance to all locations are a potential constraint.
Construction Laydown Area Alternative 2	**NO PREFERENCE**	
SUBSTATION AND BATTERY ENERGY STORAGE SYSTEM		
Substation Site Option 1	**NO PREFERENCE**	• Substation Option 2 is underlain by the quaternary deposits which are underlain by the Teekloof Formation. • Substation option 1 is underlain by the Teekloof Formation. • Both options lie on a flat slope with slope of 0.9-2˚ for option 1 and 1.5-2˚ for option 2, likely to be shallow transported soils. • Option 2 traverses a drainage feature, this will have to be channelized thus increasing construction costs.
Substation site Option 2	**NO PREFERENCE**	

Alternative	Preference	Reasons (incl. potential issues)
		• Shallow foundations are anticipated at both sites. • Serviceability and access will be easy for both options at they are adjacent an internal road.

Table 9-3: Geotechnical Comparative Assessment of Alternatives for the Grid Components

Alternative	Preference	Reasons (incl. potential issues)
POWER LINE CORRIDOR		
Power Line Corridor Option 1	**NO PREFERENCE**	• Power Line Corridor Option 1 is underlain by the Teekloof Formation. In the western section, the Teekloof Formation is overlain by quaternary alluvial deposits. • Majority (southern and central sections) of Power Line Corridor Option 2 is underlain by the Abrahamskraal Formation. The northern section is underlain by the quaternary deposits which are underlain by the Teekloof Formation. • Power Corridor Option 3 is underlain by Abrahamskraal and Teekloof Formations. The Teekloof Formation is overlain by Quaternary alluvial deposits in parts of the southern section. • Perennial Groot River Traverses the southern section of Power Line Corridor Option 2. • Non-perennial drainage features traverse all three options. • Option 1 lies on a flat 0.9-2˚ slope, likely to be shallow, unstable transported soils. • Southern section of Option 2 lies on a flat 0-0.9˚ slope, likely to be shallow, unstable transported soils. The northern section lies on a flat to gentle slope of 0.9-8.7˚. • Option 3 lies on a slope of 0-3.6˚, likely to be shallow, unstable transported soils. • Option 1 is along to the road, easy access. No access roads for construction along Options 2 and 3, haulage distance to all locations are a potential constraint.
Power Line Corridor Option 2	**NO PREFERENCE**	
Power Line Corridor Option 3	**NO PREFERENCE**	
PROPOSED COLLECTOR SUBSTATIONS		
Collector Substation Alternative 1 (end of Corridor Option 2)	**NO PREFERENCE**	• Both Collector Substation Altenatives are underlain by the Abrahamskraal Formation. • Both alternatives do not traverse any drainage features. • Both alternatives lie on a flat slope of 0-0.4˚ • Collector Substation Alternative 1 is located approximately 500m west from the N12. • Collector Substation Alternative 2 is located approximately 3km west of the N12.
Collector Substation Alternative 2 (end of Corridor Option 3)	**NO PREFERENCE**	

10 CONCLUSIONS AND RECOMMENDATIONS

The foregoing report presents the findings concluded from a desktop study undertaken for the proposed Koup 1 Wind Energy Facility and associated grid infrastructure. The site is anticipated to be underlain by shallow bedrock conditions. It is recommended that the turbines be constructed on relatively flat to gentle, open areas (0-8.7˚ slopes) in areas with maximum wind exposure.

No fatal flaws, from a geotechnical perspective, were identified during this desktop study. Conclusions presented in this report will have to be more accurately confirmed during the detailed geotechnical investigation phase. The impact of the WEF was found to be "Negative low impact - The anticipated impact will have negligible negative effects and will require little to no mitigation." Given the amendments to the original layout, the site from a desktop level geotechnical study is considered suitable for the proposed WEF.

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 exploratory trial pits to determine founding conditions for the substation, the construction laydown area and the BESS. An investigation for determining the subgrade conditions for internal roads and a materials investigation (if required) is also recommended;
- Profiling rotary core to determine foundation conditions for the turbines.
- Geotechnical investigation for construction material – gravel and rock.
- 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 may be required depending on the soil profiles and imposed loads of the structures.

11 REFERENCES

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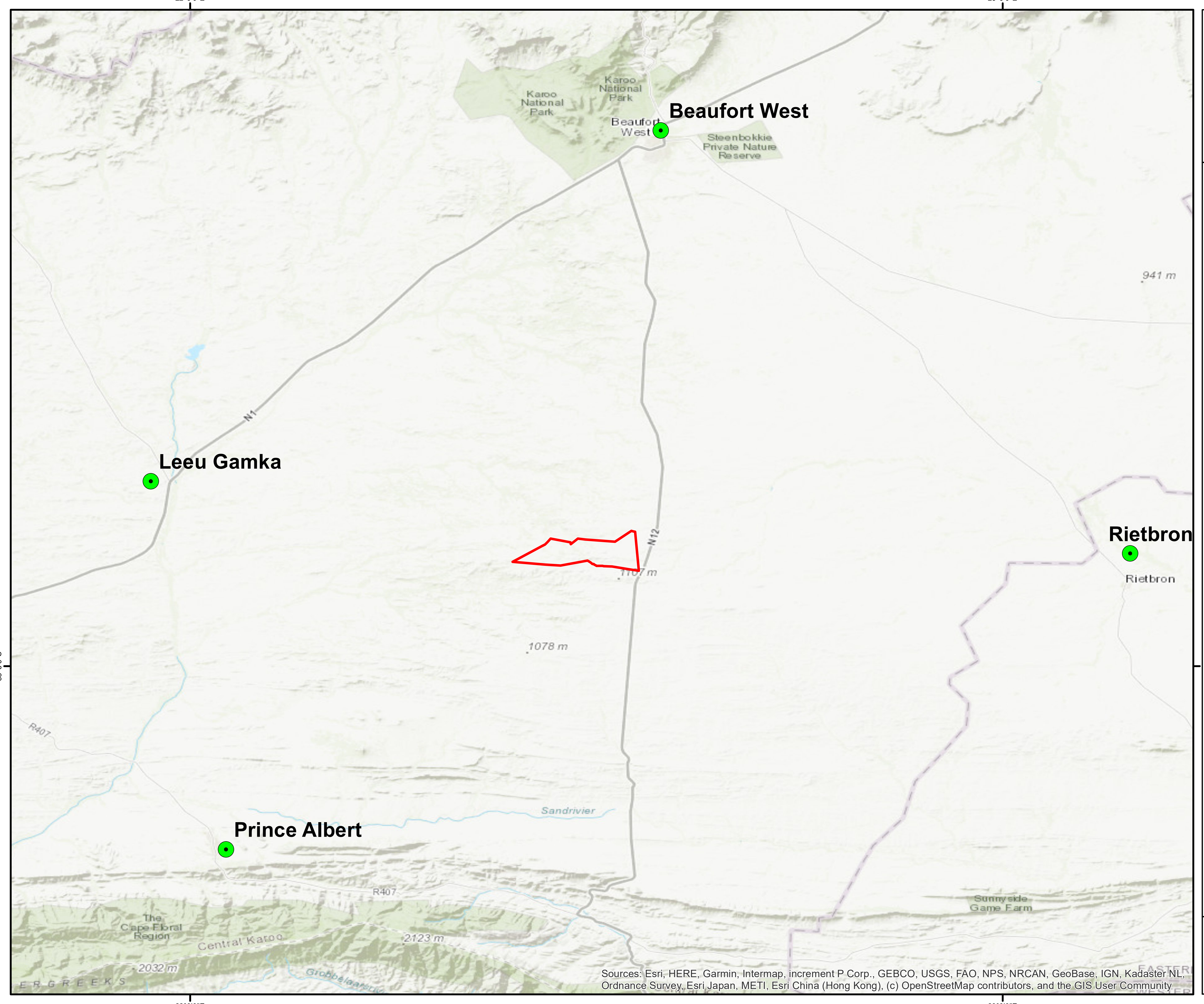
- 1: 3 000 000 Groundwater Harvest Potential of the Republic of South Africa. Published by the Department of Water Affairs and Forestry.

- 1: 1 000 000 Vegetation Map of South Africa, Lesotho and Swaziland. Published by South African National Biodiversity Institute.

-oOo-

Appendix A: Figures



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CONSTRUCTION OF THE KOUP 1 WIND ENERGY FACILITY

LOCALITY MAP

Legend

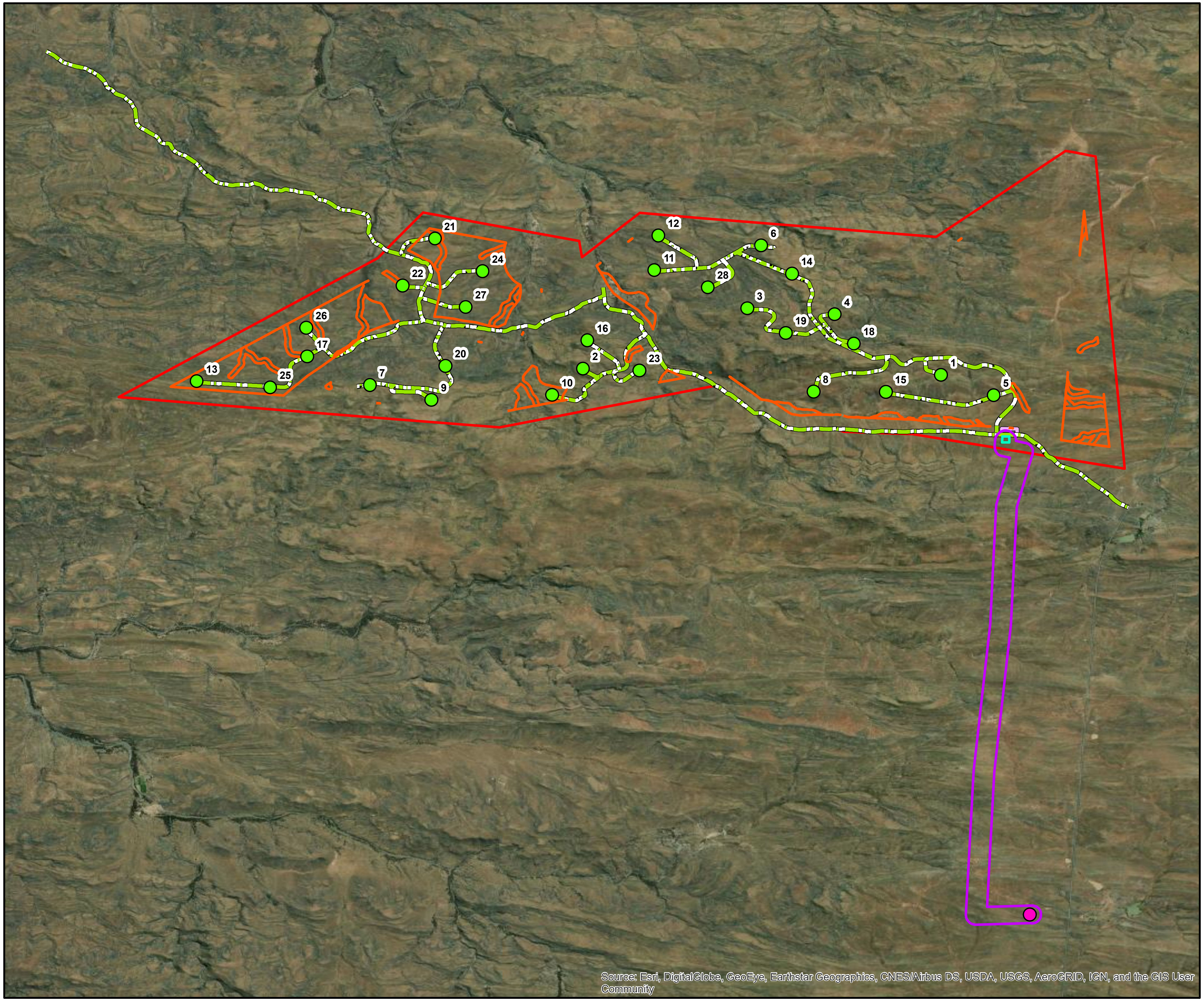
Study Area

0 5 10 20 km

N

Map No.: 01

1:500 000



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CONSTRUCTION OF THE KOUP 1 WIND ENERGY FACILITY

SITE MAP

Legend

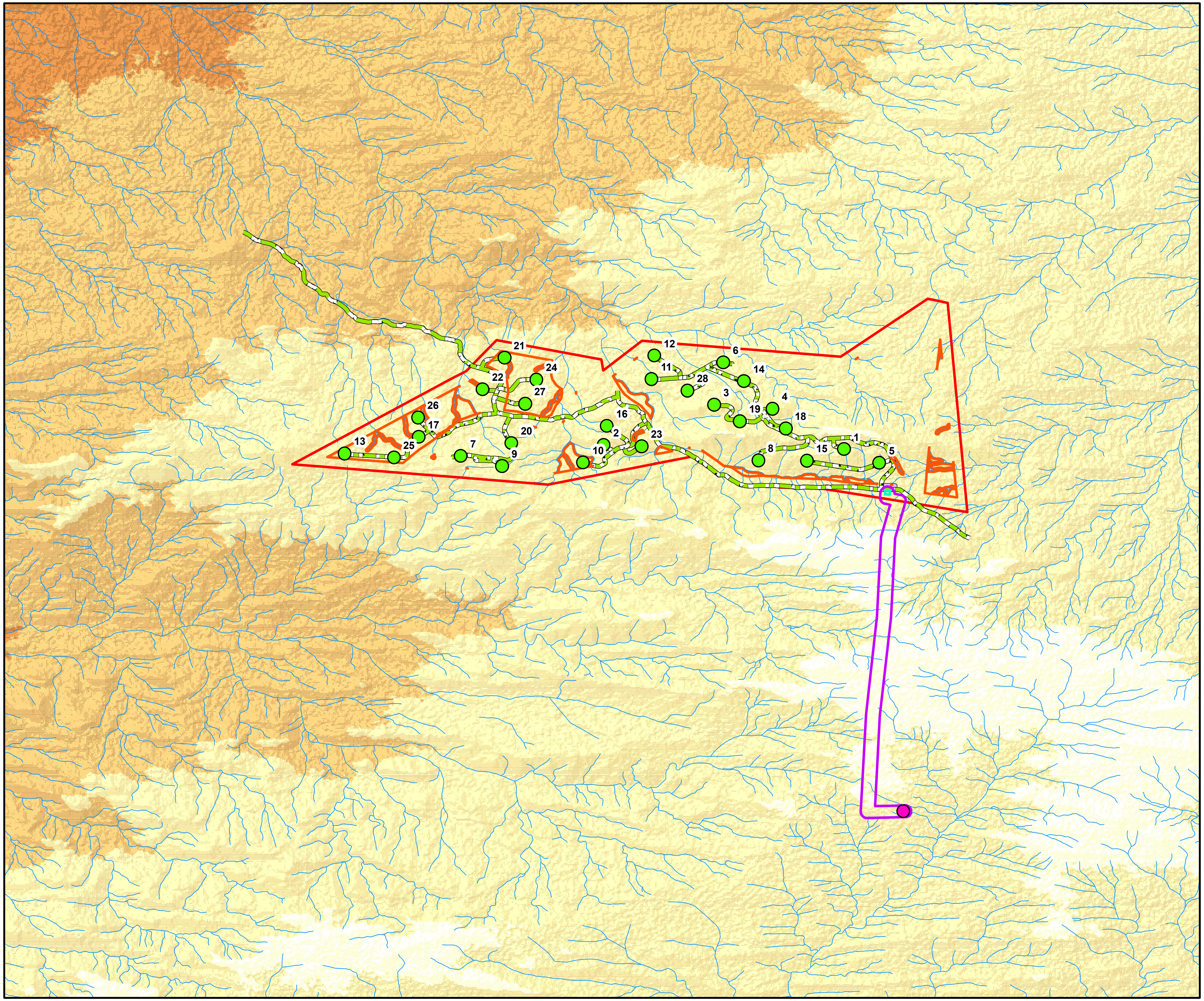
- 16017_K1_Turbines_08Nov2021
- Proposed Collector Substations
- 16017_K1_SubstationSite_Option1
- 16017_K1_BuildableArea_Preliminary
- 16017_K1_GridCorridor_Option2(Sub01)
- 16017_K1_InternalRoadNetwork
- 16017_K1_LaydownArea_Opt01
- 16017_K1_OuterBoundary

0 0.5 1 2 km

N

Map No.: 01

1:63 360



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CONSTRUCTION OF THE KOUP 1 WIND ENERGY FACILITY

ELEVATION AND WATERCOURSE MAP

Legend

- 16017_K1_Turbines_08Nov2021
- Proposed Collector Substations
- 16017_K1_SubstationSite_Option1
- 16017_K1_BuildableArea_Preliminary
- 16017_K1_GridCorridor_Option2(Sub01)
- 16017_K1_InternalRoadNetwork
- 16017_K1_LaydownArea_Opt01
- 16017_K1_OuterBoundary
- 3222_RIVER_LINE_2008_02

Elevation

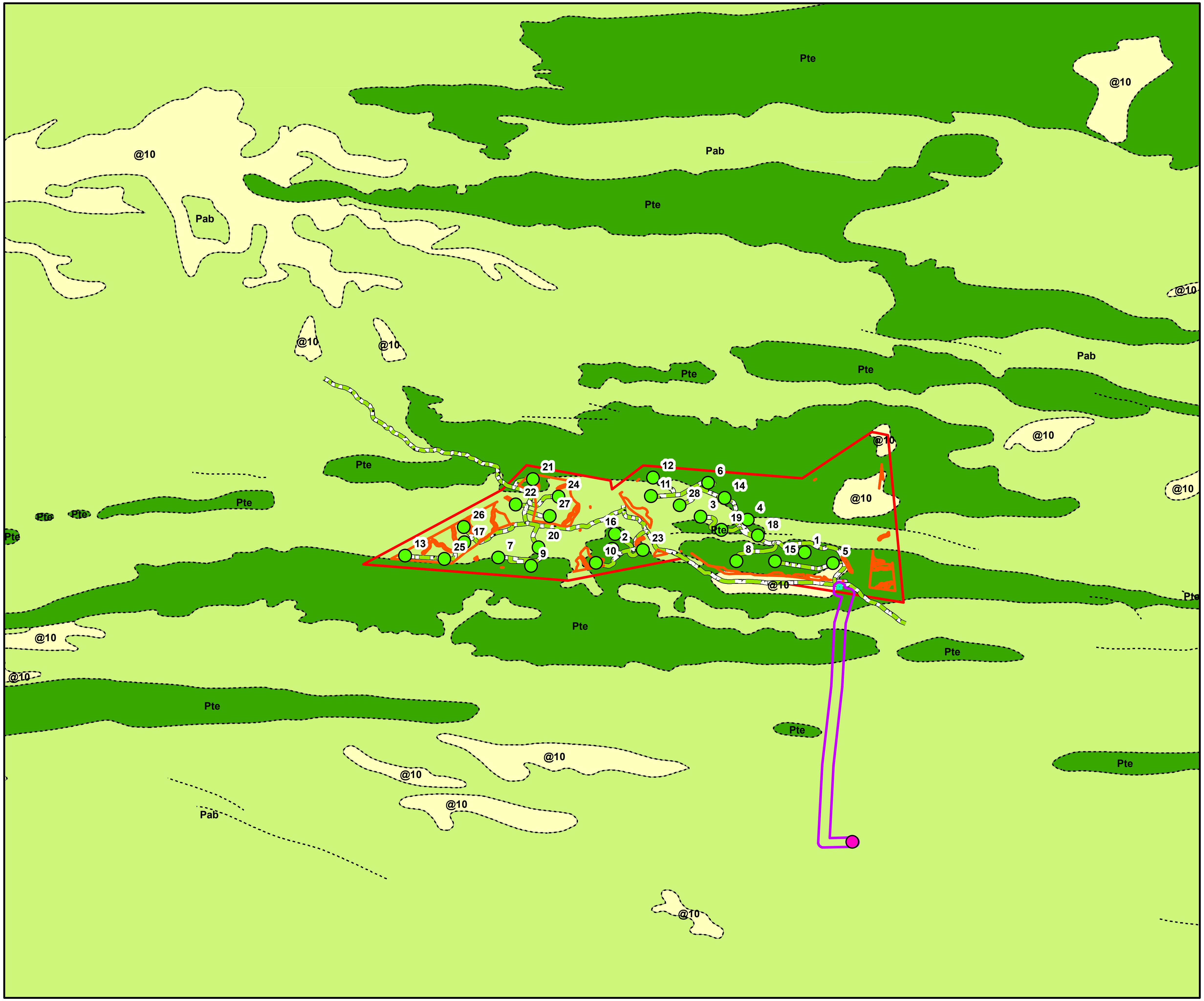
- 495 - 685.3647059
- 685.364706 - 800.7372549
- 800.737255 - 921.8784314
- 921.8784315 - 1 054.556863
- 1 054.556864 - 1 216.078431
- 1 216.078432 - 1 389.137255
- 1 389.137256 - 1 539.121569
- 1 539.12157 - 1 677.568627
- 1 677.568628 - 1 966

0 1 2 4 km

N

Map No.: 01

1:94 437



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CONSTRUCTION OF THE KOUP 1 WIND ENERGY FACILITY

GEOLOGY MAP
MAP

Legend

- 16017_K1_Turbines_08Nov2021
- Proposed Collector Substations
- Beaufort West_3222_Geological_Lines
- 16017_K1_SubstationSite_Option1
- 16017_K1_BuildableArea_Preliminary
- 16017_K1_GridCorridor_Option2(Sub01)
- 16017_K1_InternalRoadNetwork
- 16017_K1_LaydownArea_Opt01
- 16017_K1_OuterBoundary

Geology

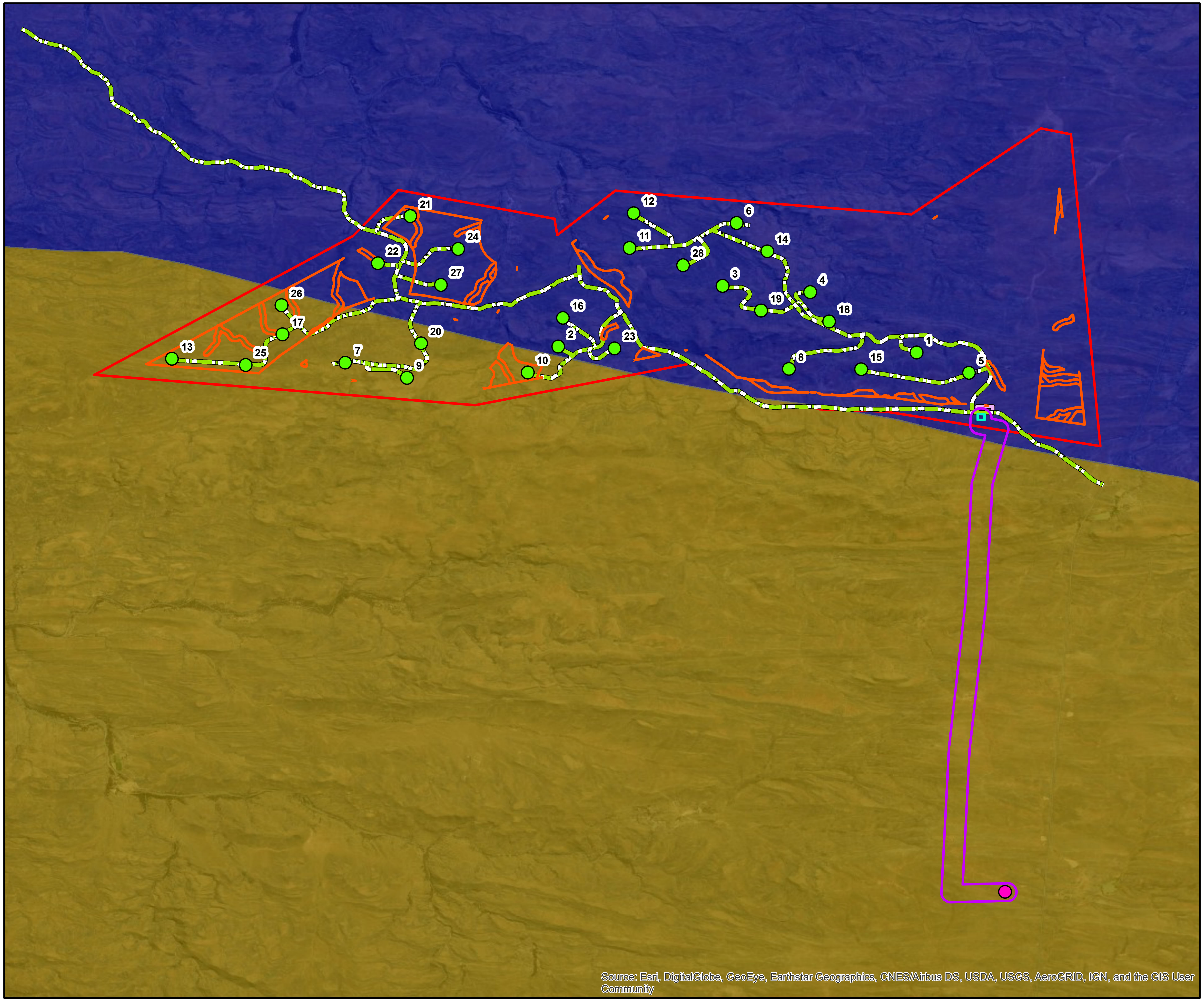
- @10 - Alluvial slope deposits
- Pab - Mudstone (generally greenish-grey), subordinate sandstone
- Pte - Brownish-red and greenish-grey mudstone, subordinate siltstone and sandstone
- Beaufort West_3222_Tectonic_Lines

0 2.5 5 km

N

Map No.: 01

1:118 000



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CONSTRUCTION OF THE KOUP 1 WIND ENERGY FACILITY

GEOHYDROLOGY MAP

Legend

- 16017_K1_Turbines_08Nov2021
- Proposed Collector Substations
- 16017_K1_SubstationSite_Option1
- 16017_K1_BuildableArea_Preliminary
- 16017_K1_GridCorridor_Option2(Sub01)
- 16017_K1_InternalRoadNetwork
- 16017_K1_LaydownArea_Opt01
- 16017_K1_OuterBoundary

b2, Fractured 0.1 - 0.5 l/s

b3, Fractured 0.5 - 2.0 l/s

0 0.5 1 2 km

N

Map No.: 01

1:63 360

Appendix B: SiVEST Impact Assessment Methodology

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 8-1: Geotechnical Impact Assessment Matrix

KOUP 1 WIND ENERGY FACILITY																					
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																					
Removal of subsoils (soil, rock)	Displacement of natural earth material and overlying vegetation. 1) Increase stormwater velocity. 2) Increase in soil and wind erosion due to clearing of vegetation. 2) Construction and earthmoving vehicles may displace soil during operations. 3) Creation of drainage paths along access tracks. 4) Potential oil spillages from heavy plant. 5) Sedimentation of non-perennial features and excessive dust. 6) Potential groundwater and drainage feature contamination.	1	4	2	2	2	2	22	-	Low Impact	Identify protected areas prior to construction. 1) Construction of temporary berms and drainage channels to divert surface water. 2) Minimize earthworks and fills. 3) Use existing road network and access tracks. 4) Rehabilitation of affected areas (such as regrassing, mechanical stabilization). 5) Correct engineering design and construction of gravel roads and water crossings. 6) Correct construction methods for foundation installations and cut to fill configurations. 7) Vehicle repairs to be undertaken in designated areas. 8) Control stormwater flow	1	2	2	1	4	2	20	-	Low Impact	
Operational Phase																					

KOUP 1 WIND ENERGY FACILITY																				
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
Removal of subsoils (soil, rock)	Displacement of natural earth material. 1) Increase in soil erosion. 2) Potential oil spillages from maintenance vehicles. 3) Sedimentation of non-perennial features caused by soil erosion.	1	2	2	2	3	1	10	-	Low Impact	1) Use of existing roads and tracks where feasible. 2) Rehabilitation of affected areas (such as erosion control mats). 3) Correct engineering design and construction of roads and water crossings. 4) Vehicle repairs to be undertaken in designated areas. 5) Maintenance of stormwater system.	1	3	2	2	3	2	22	-	Low Impact
Decommissioning Phase																				
Removal of subsoils (soil, rock)	Decommissioning of the structure will disturb the geological environment. 1) Increase in soil and wind erosion due to clearance of structures. 2) Construction and earthmoving vehicles will displace the soil. 3) Creation of drainage paths. 4) Potential oil spillages from vehicles. 5) Excessive sediments in non-perennial features.	1	4	2	1	1	3	27	-	Low Impact	1) Use of temporary berms and drainage channels to divert surface water were feasible. 2) Minimize earthworks and demolish footprints. 3) Use of existing roads and tracks were feasible. 4) Rehabilitation of affected areas (such as regrassing). 5) Develop a chemical spill response plan. 6) Develop dust and demolition fly suppression plan. 7) Vehicle repairs to be undertaken in designated areas. 8) Reinstate channelized drainage features.	1	3	4	2	2	2	24	-	Low Impact
Cumulative																				

KOUP 1 WIND ENERGY FACILITY																					
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
Removal of subsoils (soil, rock)	None							0			None							0		

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

Proposed Construction of the Koup 2 Wind Energy Facility and Associated Grid Infrastructure, Near Beaufort West, Western Cape Province, South Africa

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			
Professional affiliation/registration:	Cand Sci Nat			
Physical address:	06 Pin Oak Avenue, Hilton, Pietermaritzburg			
Postal address:				
Postal code:	3245	Cell:		
Telephone:	033 343 6700	Fax:		
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:

11/06/2021
____
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.

K.Bulala.

Signature of the Specialist

JG AFRIKA (Pty) Ltd

Name of Company

11/06/2021

Date

DJBurg.

Signature of the Commissioner of Oaths

COMMISSIONER OF OATHS
DAWN JANET BURGIN
9/1/8/2 (R/O) KZN (PIETERMARITZBURG)
6 PIN OAK AVENUE, HILTON

11/06/2021

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 Years*
Years with Firm	*4.5 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. Since returning to the office she has been involved with a number of small to medium 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

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

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 m^3. 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