GEOLOGICAL REPORT

SPECIALIST INPUT FOR THE SCOPING PHASE OF THE ENVIRONMENTAL IMPACT ASSESSMENT FOR THE PROPOSED UYEKRAAL WIND ENERGY FACILITY ON A SITE NEAR VREDENBURG, WESTERN CAPE PROVINCE

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List of abbreviations and definitions

The study area:	The area as delineated on **Figure 1**
EIA:	Environmental Impact Assessment
EMP:	Environmental Management Plan
WEF:	Wind Energy Facility
AMSL:	Above mean sea level
Ma:	Million years
Quaternary:	The geological period from 2Ma to present

1. INTRODUCTION

1.1. Background

Creative Renewable Energy Solutions (Pty) Ltd (CRENERSOL) is in the process of investigating the feasibility of a proposed Wind Energy Facility (WEF) on a site near Vredenburg in the Western Cape Province. The proposed activity is defined as the establishment of a WEF and associated infrastructure, including the following:

- Up to 22 wind turbines;
- A substation;
- A 132kV power line/s linking to the transmission grid at Eskom's existing Blouwater substation;
- Access roads;
- Maintenance/ control buildings.

1.2. Terms of reference

Savannah Environmental (Pty) Ltd has been appointed by the CRENERSOL to undertake the EIA process for the proposed activity. As part of the Scoping Phase, specialist geological input is required in order to identify potential environmental impacts on the geology and soil within the study area, with particular focus on erosion potential. Savannah Environmental has appointed Outeniqua Geotechnical Services to conduct a specialist geological report for the Scoping Phase.

The following broad scope of work has been given:

- Carry out a desk-top study of available information pertaining to the geology, soil types and physical aspects of the study area;
- Prepare a brief report which describes the location, physical characteristics and geology of the study area and identifies potential environmental impacts on the geological environment that are likely to be associated with the proposed activity.

1.3. Limitations

Information provided in this specialist report has been based on information provided by the developer, published scientific literature and maps. The study area was not visited and no detailed geotechnical investigation (trial pits, soil testing) or verification of the existing geological mapping was conducted. The information provided in this report is deemed adequate for the Scoping Phase of the EIA process.

1.4. Authors credentials & declaration of independence

The author of this report, Iain Paton of Outeniqua Geotechnical Services cc (OGS), is an professional engineering geologist registered with the South African Council for Natural and Scientific Professions (Pr Sci Nat # 400236/07) with 12 years experience in the construction, mining and petroleum industries and a member of the South African Institute of Engineering and Environmental Geologists (SAIEG). OGS shareholders and employees have no vested interest in the proposed activity and will not engage in conflicting activity associated with the project.

2. SITE DESCRIPTION

2.1. Location

The study area is located 10km southeast of Vredenburg, on the following farms:

- Langeberg 187/4
- Uyekraal 189/1

The study area is accessed via the R45 and then R27 from Vredenburg, which is the nearest major commercial centre (see **Figure 1**).

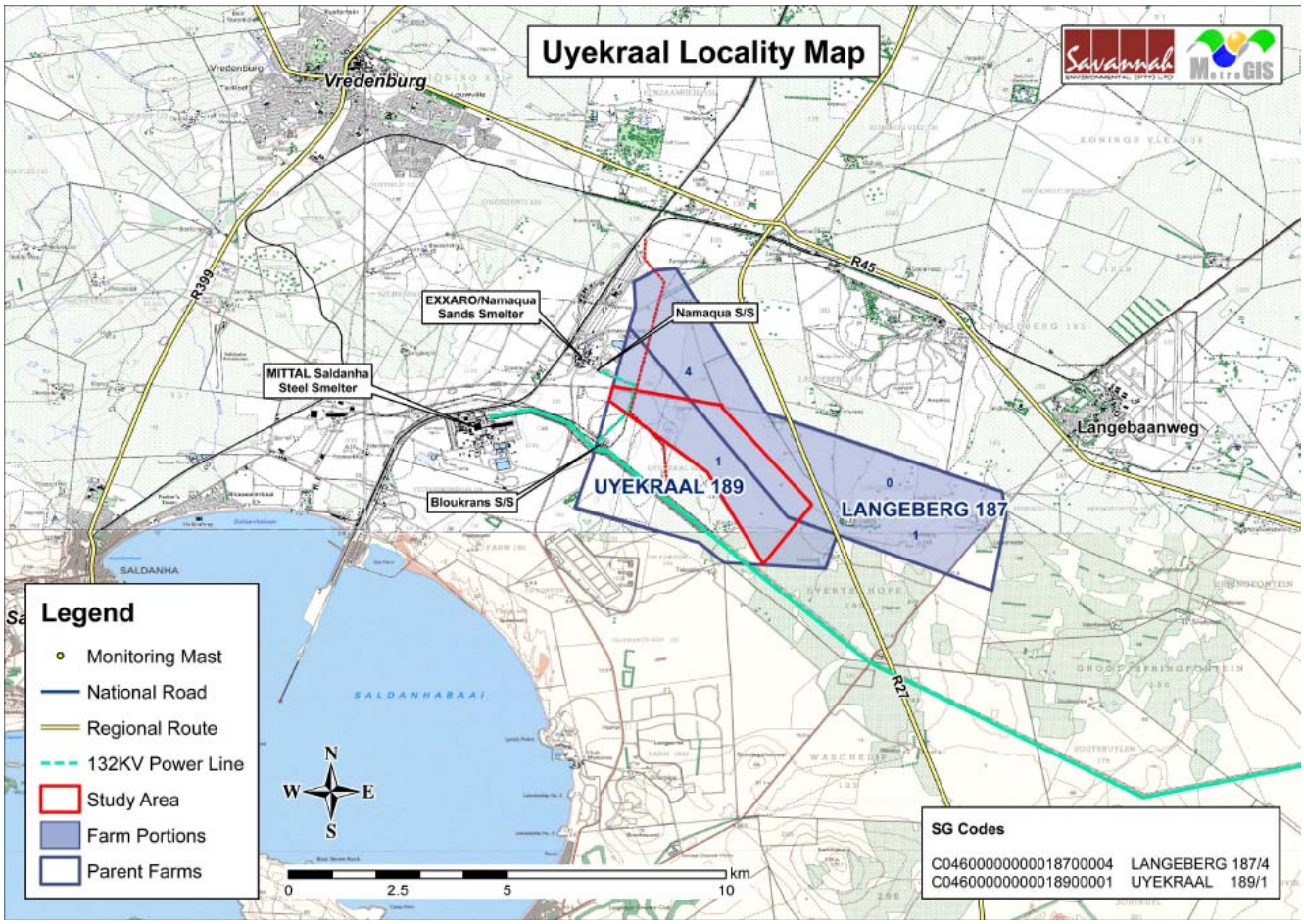

Figure 1: Locality and topography map of study area (red lines)

2.2. Topography, climate & vegetation cover

The study area is located approximately 2km southwest of the old Chemfos phosphate mine (now West Coast Fossil Park) in a lowland area with a very gently undulating topography at approximately 20m AMSL.

The nearby town of Vredenburg normally receives about 239mm of rain per year and because it receives most of its rainfall during winter it has a Mediterranean climate.[2]

The vegetation cover of the study area comprises agricultural croplands and indigenous West Coast Strandveld (coastal thicket and Fynbos).[6]

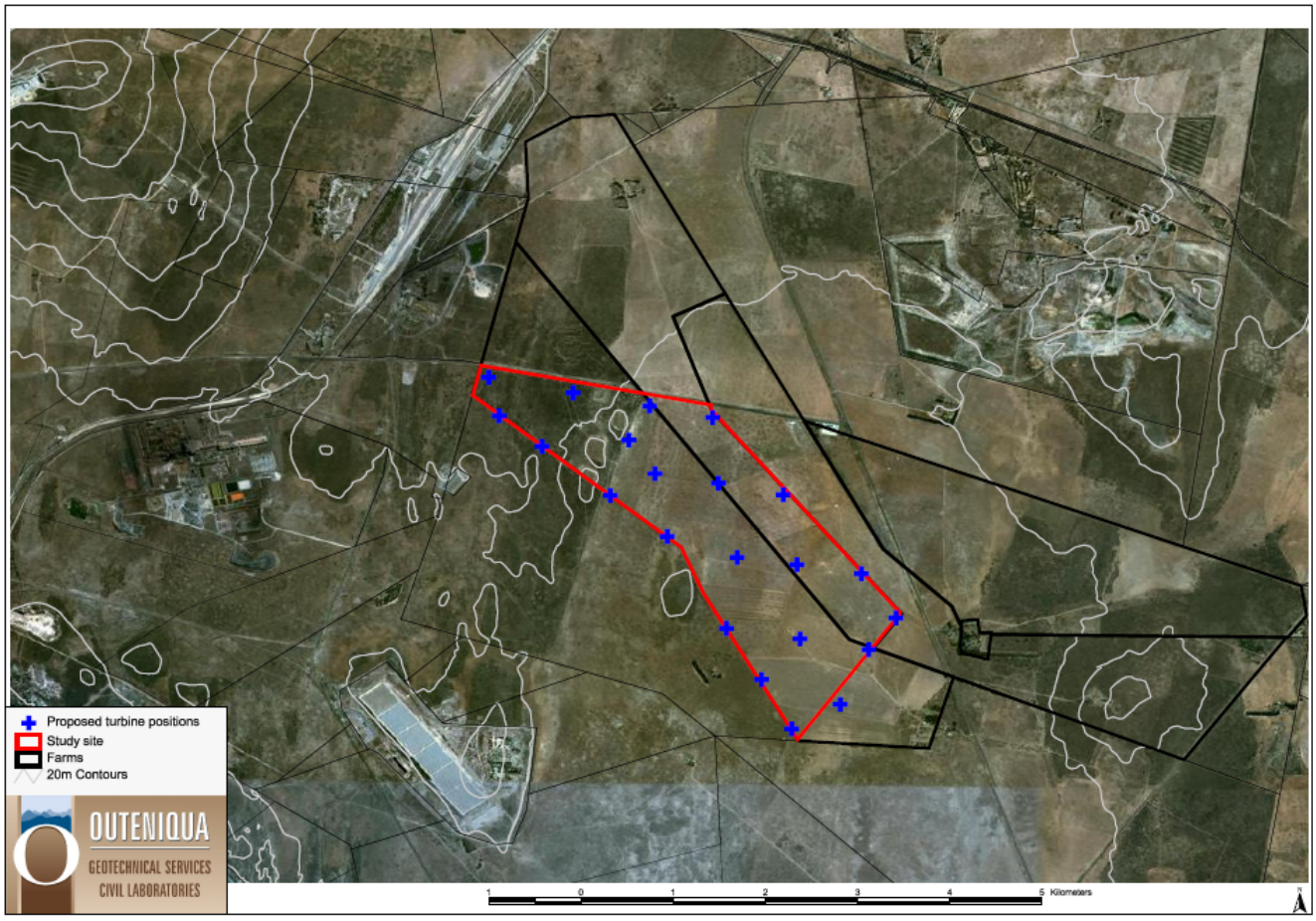

Figure 2: Aerial photo of the study area (red lines) with the proposed position of turbines (blue crosses)

2.3. Geology & soil types

The study area is underlain by the Quaternary Langebaan Formation unconsolidated calcareous sand to consolidated calcareous aeolianite and calc-arenite. The Langebaan Formation is underlain by the Quaternary Springfontein Formation which comprises fine to medium grained quartz sand of several meters in thickness. The Witzand Formation of Quaternary-Recent age overlies the Langebaan Formation to the west of the study area and forms the coastal dune cordons along the coast. [9.10]

The Langebaan Formation is a potentially unstable karstic formation, caused by the dissolution of calcium carbonate in calcareous sediments, resulting in the formation of voids, sinkholes or doline structures. Analysis of the aerial photography indicates some circular patterns in the northwestern portion of the site which appear similar to relict doline structures. The possibility of these structures occurring in the study area warrants further investigation.

There are no geological faults in the immediate vicinity of the study area, however the southwestern Cape is known to be a seismically active area. The anticipated seismic activity is rated as VII on the Modified Mercalli Scale but peak horizontal ground accelerations are typically less than 50cm/s with a 10% chance of being exceeded at least once in a 50 year period.

Analysis of the geological maps and aerial photography indicates that hard rock outcrops are unlikely to occur in the study area and the Quaternary sand cover, which may be semi-lithified, is likely to be several meters thick.

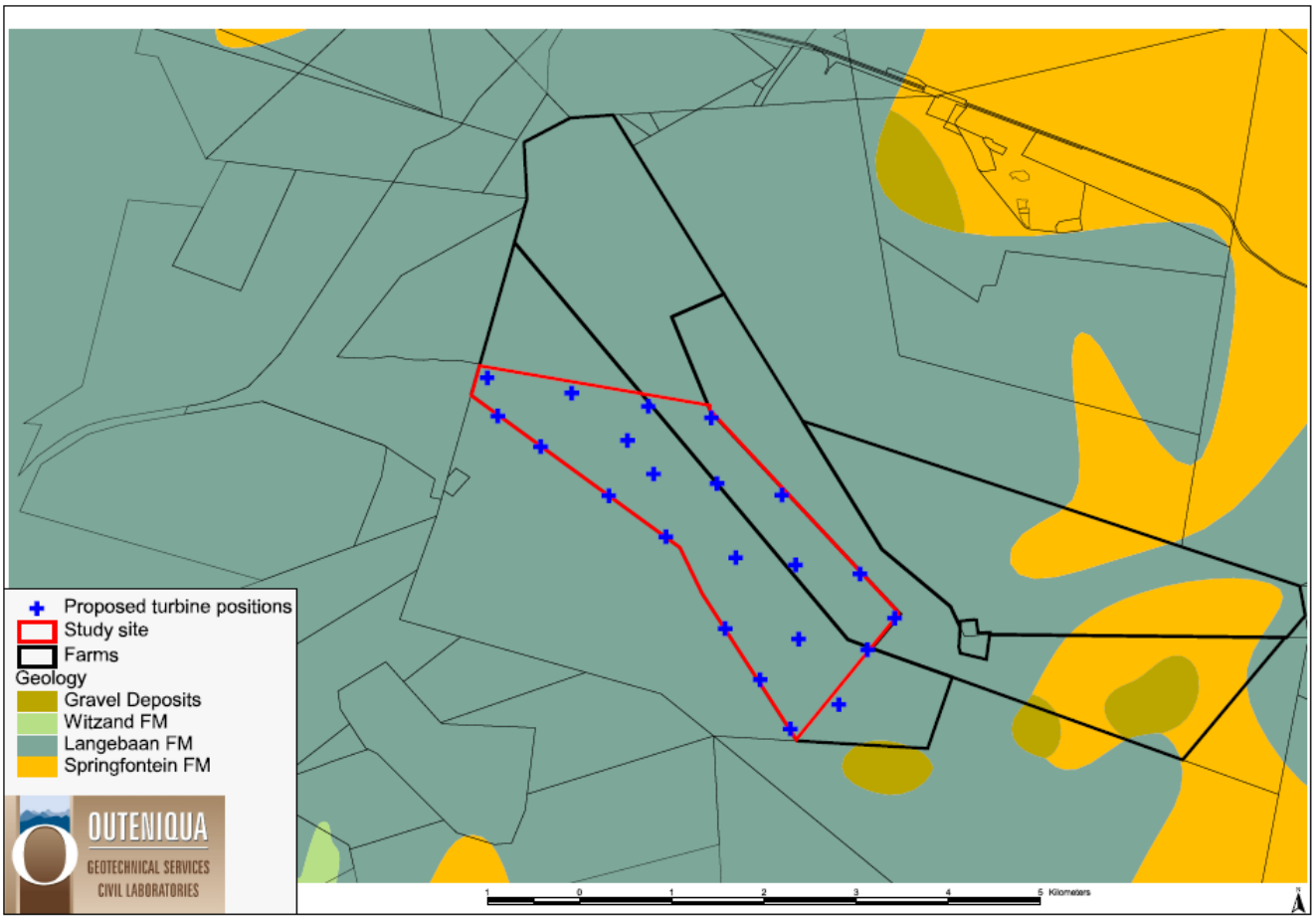

Figure 3: Geology of the study area.

2.4. Hydrology

There are no major drainage lines traversing the site due to low terrain gradients, high permeability and infiltration rates.

3. GEOLOGICAL SCOPING ASSESSMENT

The proposed activity may have certain impacts on the geological environment, and this needs to be assessed as an integral part of the broader EIA study. The geological environment includes the parent rock and the soil overburden. Important or prominent geological features (geosites) that contribute to the aesthetic scenery or geological interest in the area, such as fossil sites, prominent rock outcrops or features, must also be considered in the impact study. Geological features, such as caves, addits, middens, worship rocks, etc. which are important from historical, cultural, archaeological or religious heritage standpoint are not covered in this report as they are covered in the Heritage Impact Assessment. Geohydrological assessments also do not form part of this study.

3.1. Geo-sites

The area around Langebaanweg is known as a rich vertebrate fossil site and the nearby Fossil Park was established at the old phosphate mine. However, these fossils are hosted in Tertiary Varswater Formation which is overlain by Langebaan Formation sediments in the study area. Apart from the possibility of encountering fossils in excavations for turbine foundations, there are no other known important or interesting geological phenomena that need to be addressed.

3.2. Rock degradation

There is no hard bedrock in the study area and therefore there will be no negative impacts associated with this.

3.3. Soil degradation

Soil degradation is the removal, alteration or damage to soil and soil-forming processes which can be due to natural processes, such as erosion, or human influence during construction activity. The preservation of the natural soil is important to maintain environmental *status quo*.

Potential negative impacts relating to soil degradation are anticipated for the proposed activity. Such impacts include excavation, displacement or importation of soil, stockpiling, mixing, wetting, compaction and pollution of soil, soil erosion and sedimentation.

Soil erosion is the process of the lowering of the natural ground level by wind or water and may occur as a result of, *inter alia*, chemical processes and/or physical transport on the land surface[1]. Soil erodibility potential is the likelihood that erosion will occur when soils are exposed to water (and/or wind) during or as a result of land-disturbing activities. Erodibility potential is increased where low-plasticity, fine-grained soils occur, such as Quaternary and Recent sediments, which occur in this study area (see **Figure 3**). Where slopes exceed 2°, water erosion potential is increased. The Erosion Index for South Africa[3] indicates that the site is located within an area that is ranked between 7 and 11 on a scale from 1 (highest potential) to 19 (lowest). This means that the erodibility potential is moderate. This indication is primarily based on slope gradients and geology.

No severe water erosion features are mapped on the 1:50 000 topography maps or are visible on the aerial photographs. However, moderate levels of erosion can be expected along minor drainage lines. The severity of erosion is also affected by, *inter alia*, vegetation cover and the thickness, texture and consistency of the soil.

It is estimated that 100% of the study area is underlain by moderately erodible soils but the high soil permeability and low slope gradients results in high infiltration and low run-off, thus resulting in low erosion levels. The low mean annual precipitation also contributes to the low erosion levels. However, construction activity may alter the factors affecting run-off and thus induce erosion, particularly in areas stripped of vegetation. A more detailed site investigation (to be undertaken during the EIA phase of the project) will provide more accurate sensitivity mapping

which will facilitate the identification of areas where severe erosion has taken place or is likely to take place.

3.4. Preliminary assessment of potential impacts

The proposed activity will involve minor earthworks for underground services (electrical ducting), access roads and foundations for structures (turbines, substations, workshops, etc.).

The most important issues are the direct impacts of soil degradation which includes soil removal, soil alteration, soil pollution and specifically, soil erosion from the area of activity.

The main direct potential impacts are identified and tabulated in **Table 1** below.

Impact:	Nature:	Extent:
Soil removal	Removal of soil due to excavations for foundations, underground services and access roads	Local
Soil alteration	Alteration of soil texture, density, structure and chemistry due to soil mixing, wetting, stockpiling and compaction	Local
Soil pollution	Pollution of *in situ* soil due to spillage of hazardous substances such as fuel, oil and cement	Local
Soil erosion	Loss of soil by water or wind erosion	Local

Table 1: Main direct impacts

Indirect potential impacts include increased deposition downstream or downwind caused by accelerated water or wind erosion from the site.

The main indirect potential impacts are identified and tabulated in **Table 2** below.

Impact:	Nature:	Extent:
Siltation downstream/ downwind	Alteration of soil processes due to abnormal siltation arising from accelerated erosion	Regional

Table 2: Main indirect impacts

Other impacts may come to light as the study proceeds into the EIA phase.

Although the proposed activity is relatively small-scale compared to the mining and processing industries (old SAMANCOR Phosphate mine, Exxaro Mineral Processing Plant, MITTAL Sladanha Steel Smelter) that exist in the area, it is a minor contributor in the overall significant cumulative impact on natural soil is the area.

The potential significance of the impacts that have been identified is likely to be low to moderate due to the localised extent of the activity within the study area and the low to moderate erosion potential. The limited scale of earthworks also generally points towards a short critical period where soils are loosened and exposed to erosion, and this can be managed successfully.

More in-depth analysis of these impacts should be carried with a site reconnaissance for the EIA phase of the project.

3.5. Mitigation of impacts

Construction activity will have negative impacts on the natural soil profile but this is generally restricted to the construction site footprint located within the boundary of the study area (only a portion of the study area will be utilised) and the activity within this footprint (the disturbance area) can be regulated to mitigate the impacts successfully. The following mitigation measures should be considered for the framework for the Environmental Management Plan (EMP):

- Construction activities should be kept to restricted areas and activities should be kept to a minimum as far as possible (limit unnecessary earthworks, double handling, etc.);
- Excavation processes should be monitored to prevent over-excavation and the correct placement of soil in controlled stockpiles (slope stability must be ensured);
- Rehabilitation of disturbed areas should be undertaken as soon as possible and properly monitored;
- Correct use of hazardous substances should be controlled;
- The wetting of soil and the discharge of construction grey water across natural soil should be controlled;
- Erosion control measures (e.g.: silt fences, sand bags, anti-erosion geosynthetics, etc.) should be installed where necessary and maintained;
- Where significant pedestrian and / or vehicular traffic is predicted during construction, such areas should be surfaced with a temporary gravel wearing course to reduce erosion of the *in situ* soil and to prevent dust;
- The handling of natural construction materials, such as filling soil and gravels will require dust management, particularly near sensitive areas;
- Rehabilitation will involve the replacement of suitable and adequate topsoil and the encouragement of indigenous local vegetation to stabilise the soil.

4. PLAN OF STUDY FOR EIA

The following methodology will be adopted for the EIA phase study:

- Conduct a site visit to confirm the physical and geological information used in this report and to collect visual information pertaining to the soil types and their geotechnical engineering properties;
- Assess the present state of erosion, identify critical areas in terms of erosion and produce a map identifying these areas;
- Prepare a specialist report detailing the environmental issues and potential impacts pertaining to soil degradation and erosion;
- Assess the potential direct and indirect impacts using a weighting system that assigns a value to the categories (extent, duration, magnitude, probability) and arrives at a total which depicts the significance of the particular impact;
- Assess the contribution of the proposed activity in the cumulative impact of the development in the area;

- Comparatively assess any feasible alternatives (if any);
- Provide mitigating measures to input into the Environmental Management Plan (EMP).

5. CONCLUSIONS

The study has identified that degradation of the natural soil, in various manners, is the main geological impact associated with the proposed activity. However, the strict implementation of the EMP can mitigate the impacts successfully. Wind and water erosion, is deemed to be of importance due to the presence of fine unconsolidated sands in the area. An overview of the geology and physical characteristics of the site has revealed that approximately 100% of the study area is underlain by potentially sensitive or erodible Quaternary sandy soils but the texture and thickness of the soils, state of consolidation and lithification, the slope gradients and the vegetation cover are the controlling factors in determining the severity. The significance of the main direct impacts that have been identified is considered low to medium but further investigations on site can provide more details with regards to the spatial distribution of potentially erodible soils and lithified sands. To this end, a visual assessment of the study area should be undertaken in the EIA phase. Simultaneously, a basic geotechnical engineering assessment of the site should also be undertaken in the EIA phase to determine the constraints on the development which may affect the positioning of the facilities. The possibility of unstable karstic landforms associated with the Langebaan Formation will require more investigation.

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