SITE SENSITIVITY VERIFICATION: PROPOSED NGWEDI SOLAR POWER PLANT (PART OF THE AUTHORISED PALESO SOLAR POWER PLANT) NEAR VILJOENSKROON, IN THE FREE STATE

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1. INTRODUCTION

Ngwedi Solar Power Plant (RF) (Pty) Ltd proposes the development of the Ngwedi Solar Plant and Power Line which forms part of the authorised Paleso Solar Powerplant near Viljoenskroon in the Free State. This Solar Power Plant forms part of the authorised Paleso Solar Power Plant that includes the following projects:

- Noko Solar Power Plant near Viljoenskroon, Free State Province
- Ngwedi Solar Power Plant near Viljoenskroon, Free State Province
- Noko Solar Power Plant near Orkney, North West Province
- Power line as part of the Paleso solar Power Plant near Viljoenskroon, Free State Province

The Ngwedi Solar Powerplant is located on Portion 23 of the Farm Pretorius Kraal No. 53 while the associated powerline is located on the Remaining Extent of Portion 24 and 27 of the Farm Pretorius Kraal no 53 in the Fezile Dabi District Municipality, Moqhaka Local Municipality.

The term photovoltaic describes a solid-state electronic cell that produces direct current electrical energy from the radiant energy of the sun through a process known as the Photovoltaic Effect. This refers to light energy placing electrons into a higher state of energy to create electricity. Each PV cell is made of silicon (i.e. semiconductors), which is positively and negatively charged on either side, with electrical conductors attached to both sides to form a circuit. This circuit captures the released electrons in the form of an electric current (direct current). The key components of the proposed project are described below:

- PV Panel Array - To produce up to 150MW, the proposed facility will require numerous linked cells placed behind a protective glass sheet to form a panel. Multiple panels will be required to form the solar PV arrays which will comprise the PV facility. The PV panels will be tilted at a northern angle in order to capture the most sun, or using one-axis tracker structures to follow the sun to increase the Yield.

- Wiring to Inverters - Sections of the PV array will be wired to inverters. The inverter is a pulse width mode inverter that converts direct current (DC) electricity to alternating current (AC) electricity at grid frequency.

- Connection to the grid - Connecting the array to the electrical grid requires transformation of the voltage from 480V to 33kV to 132kV. The normal components and dimensions of a distribution rated electrical substation will be required. Output voltage from the inverter is 480V and this is fed into step up transformers to 132kV. An onsite substation will be required on the site to step the voltage up to 132kV, after which the power will be evacuated into the national grid via the proposed power line. Whilst Ngwedi Solar Power Plant (RF) (Pty) Ltd. has not yet received a cost estimate letter from Eskom, it is expected that generation from the facility will tie in with the existing Vaal Reefs Nine Substation. The Project will inject up to 100MW into the National Grid. The installed capacity will be approximately 150MW.

  A grid connection corridor, with a width of ~100m but up to 150m, has been identified for the assessment and placement of the power line. The corridor is located to the east of the SPP site and is ~1.6km in length. Refer to the Figure below.

- Electrical reticulation network – An internal electrical reticulation network will be required and will be lain ~2-4m underground as far as practically possible.

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

  - Office (~200m²);

  - Switch gear and relay room (~400m²);

- Staff lockers and changing room (~200m²); and

- Security control (~60m²)

- Battery storage – A Battery Storage Facility with a maximum height of 8m and a maximum volume of 1,740 m^3 of batteries and associated operational, safety and control infrastructure.
- Roads – Access will be obtained via the Stokkiesdraai Road off the R30 Regional Route. An internal site road network will also be required to provide access to the solar field and associated infrastructure. The access and internal roads will be constructed within a 25-meter corridor.
- Fencing - For health, safety and security reasons, the facility will be required to be fenced off from the surrounding farm. Fencing with a height of 2.5 meters will be used.

The DEAT 2006 guidelines on 'assessment of alternatives and impacts' proposes the consideration of four types of alternatives namely, the no-go, location, activity, and design alternatives. It is however, important to note that the regulation and guidelines specifically state that only 'feasible' and 'reasonable' alternatives should be explored. It also recognizes that the consideration of alternatives is an iterative process of feedback between the developer and EAP, which in some instances culminates in a single preferred project proposal. An initial site assessment was conducted by the developer the affected properties and the farm portions were found favorable due to its proximity to grid connections, solar radiation, ecology and relative flat terrain. These factors were then taken into consideration and avoided as far as possible.

The following alternatives were considered in relation to the proposed activity and all specialists should also make mention of these:

No-go alternative

This alternative considers the option of 'do nothing' and maintaining the status quo. The site is currently zoned for agricultural and mining land uses. Should the proposed activity not proceed, the site will remain unchanged and will continue to be used for agricultural and mining purposes. The potential opportunity costs in terms of alternative land use income through rental for energy facility and the supporting social and economic development in the area would be lost if the status quo persist.

Location alternatives

No other possible sites were identified on Portion 23 of the Farm Pretorius Kraal No. 53. This site is referred to as the preferred site. Some limited sensitive features occur on the site. The size of the site makes provision for the exclusion of any sensitive environmental features that may arise through the BA proses.

Technical alternatives: Powerlines

It is expected that generation from the facility will tie in with the existing Vaal Reefs Nine Substation. The preferred power line route is located east of the project footprint. It is proposed that from the onsite

substation one power line will be constructed to connect the project to the Vaal Reefs Nine Substation located approximately 1.6 kilometres east of the site. Due to the proposed power line route, as assessed within the wider grid connection corridor, being the shortest possible route to connect the SPP to the national grid no other routes are being assessed.

Battery storage facility

It is proposed that a nominal up to 500 MWh Battery Storage Facility for grid storage would be housed in stacked containers, or multi-storey building, with a maximum height of 8m and a maximum volume of 1,740m^3 of batteries and associated operational, safety and control infrastructure. Three types of battery technologies are being considered for the proposed project: Lithium-ion, Sodium-sulphur or Vanadium Redox flow battery. The preferred battery technology is Lithium-ion.

Battery storage offers a wide range of advantages to South Africa including renewable energy time shift, renewable capacity firming, electricity supply reliability and quality improvement, voltage regulation, electricity reserve capacity improvement, transmission congestion relief, load following and time of use energy cost management. In essence, this technology allows renewable energy to enter the base load and peak power generation market and therefore can compete directly with fossil fuel sources of power generation and offer a truly sustainable electricity supply option.

Design and layout alternatives

Design alternatives will be considered throughout the planning and design phase and specialist studies are expected to inform the final layout of the proposed development.

Technology alternatives

There are several types of semiconductor technologies currently available and in use for PV solar panels. Two, however, have become the most widely adopted, namely crystalline silicon (Mono-facial and Bi-facial) and thin film. The technology that (at this stage) proves more feasible and reasonable with respect to the proposed solar facility is crystalline silicon panels, due to it being non-reflective, more efficient, and with a higher durability. However, due to the rapid technological advances being made in the field of solar technology the exact type of technology to be used, such as bifacial panels, will only be confirmed at the onset of the project.

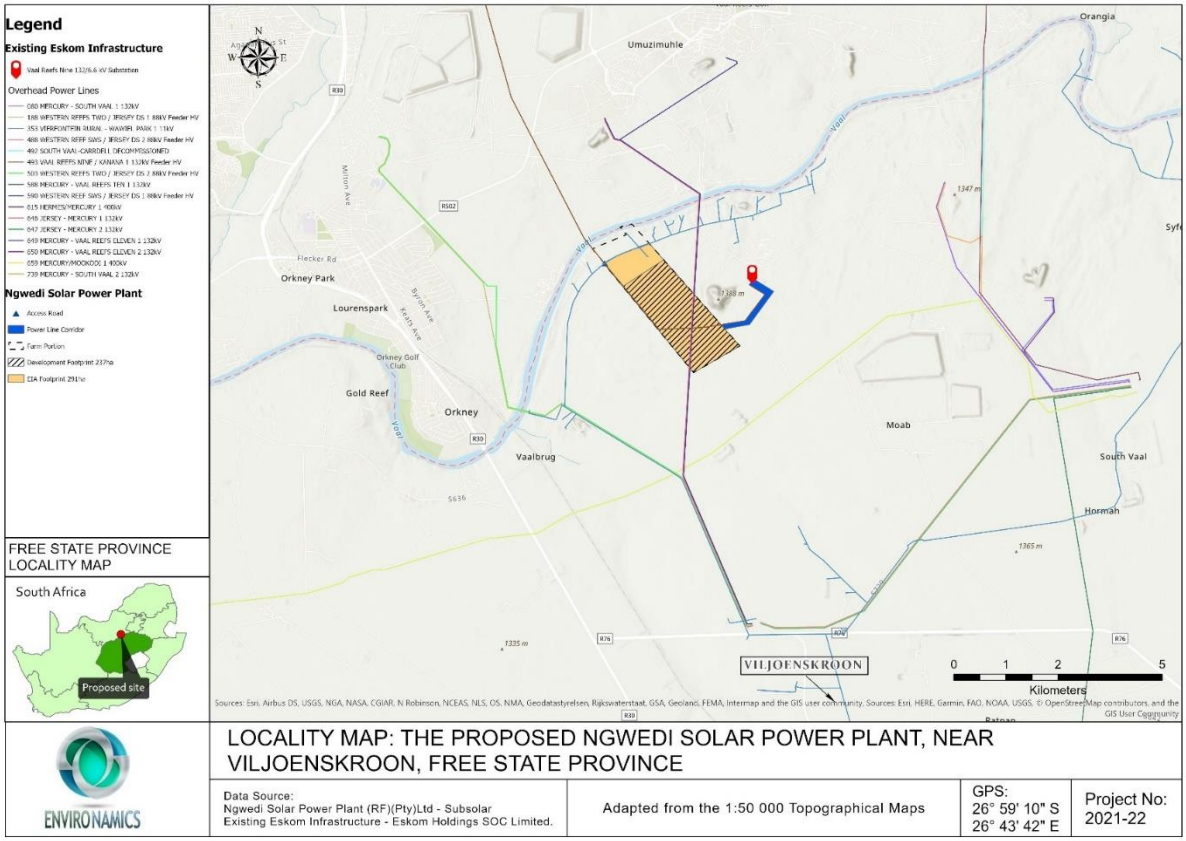

Figure 1: Locality of the proposed Ngwedi Solar Power Plant and grid connection near Viljoenkroon in the Free State

2. SITE SENSITIVITY VERIFICATION METHODOLOGY

The Palaeontology Sensitivity Verification was undertaken by the following methodology:

- Desktop analysis of satellite imagery to determine the topography of the area and to identify possible fossiliferous outcrops.
- Desktop analysis of the development footprint by mapping the site on the relevant Geological Map to determine the undelaying geology of the development.
- Desktop analysis of the development footprint on the SAHRIS PalaeoMap to establish the Sensitivity of the proposed development and establishing if a site investigation is necessary.
- Conducting extensive fieldwork on foot and by motor vehicle to identify any fossiliferous outcrop in the proposed development.

3. OUTCOME OF SITE SENSITIVITY VERIFICATION

The proposed development is mostly underlain by Precambrian dolomites and associated marine sedimentary rocks that are allocated to the Malmani (Chuniespoort Group, Transvaal Supergroup) while

the most northern portion is underlain by Quaternary alluvium. According to the PalaeoMap of SAHRIS the Palaeontological Sensitivity of the Malmani Subgroup is Very High while that of the Quaternary alluvium is moderate (Almond *et al*, 2013; SAHRIS website).

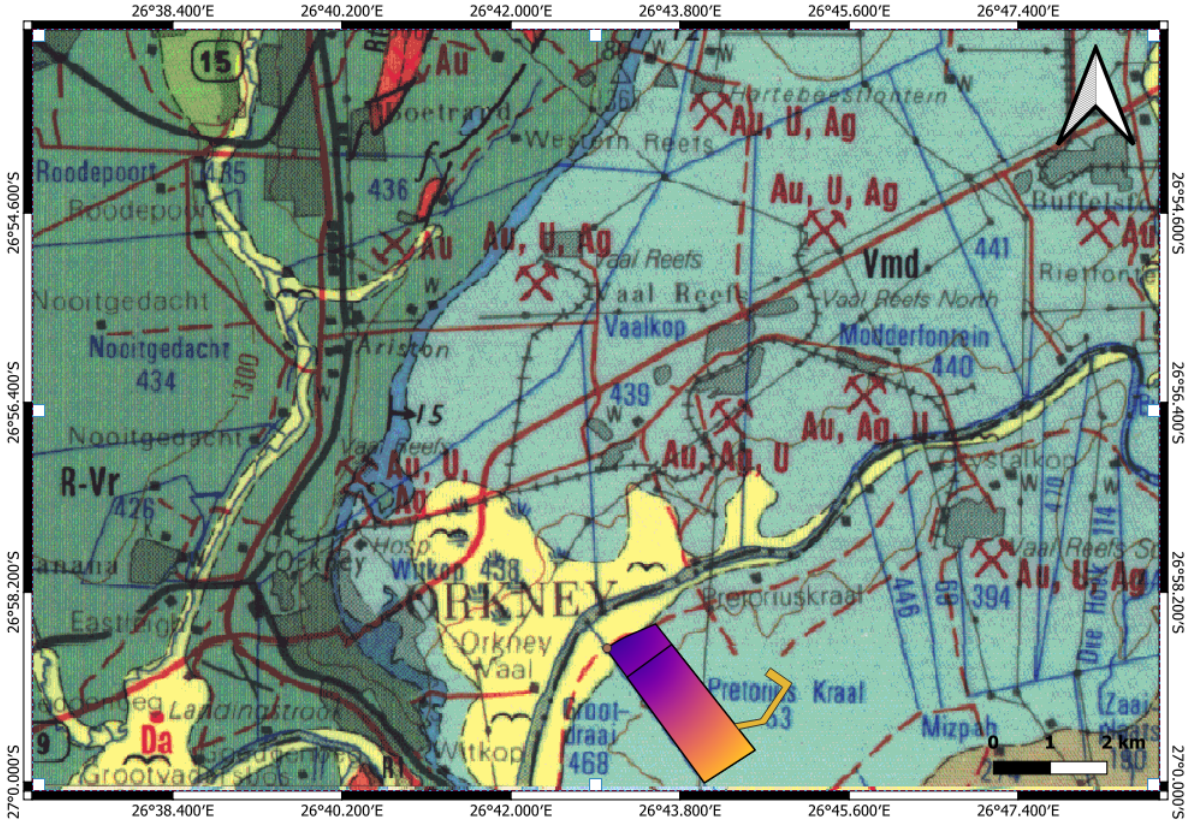

Figure 2. Extract of the 1:250 000 2626 Wes-Rand (1986) Geological Map (Council for Geosciences, Pretoria) indicating the proposed Ngwedi Solar Powerplant and power line. The proposed development is mostly underlain by Precambrian dolomites and associated marine sedimentary rocks allocated to the Malmani Subgroup (blue-green - Vmd) (Chuniespoort Group, Transvaal Supergroup) while the most northern portion is underlain by Quaternary alluvium (yellow single bird figure).

Table 1: Legend to Map and short explanation of the development and surrounding sediments (Modified from the 1:250 000 ***2626*** Wes-Rand Geological Map (1986) (Council of Geoscience, Pretoria).

Synbol	Group/Formation	Lithology
Q		**Alluvium surface deposits**
Vmd	**Chuniespoort Group, Malmani Subgroup**	**Dolomite, chert**
R-Vr	Rietgat Formation, Platberg Group, Ventersdorp Supergroup	Amagdaloidal lava, agglomerate, tuff

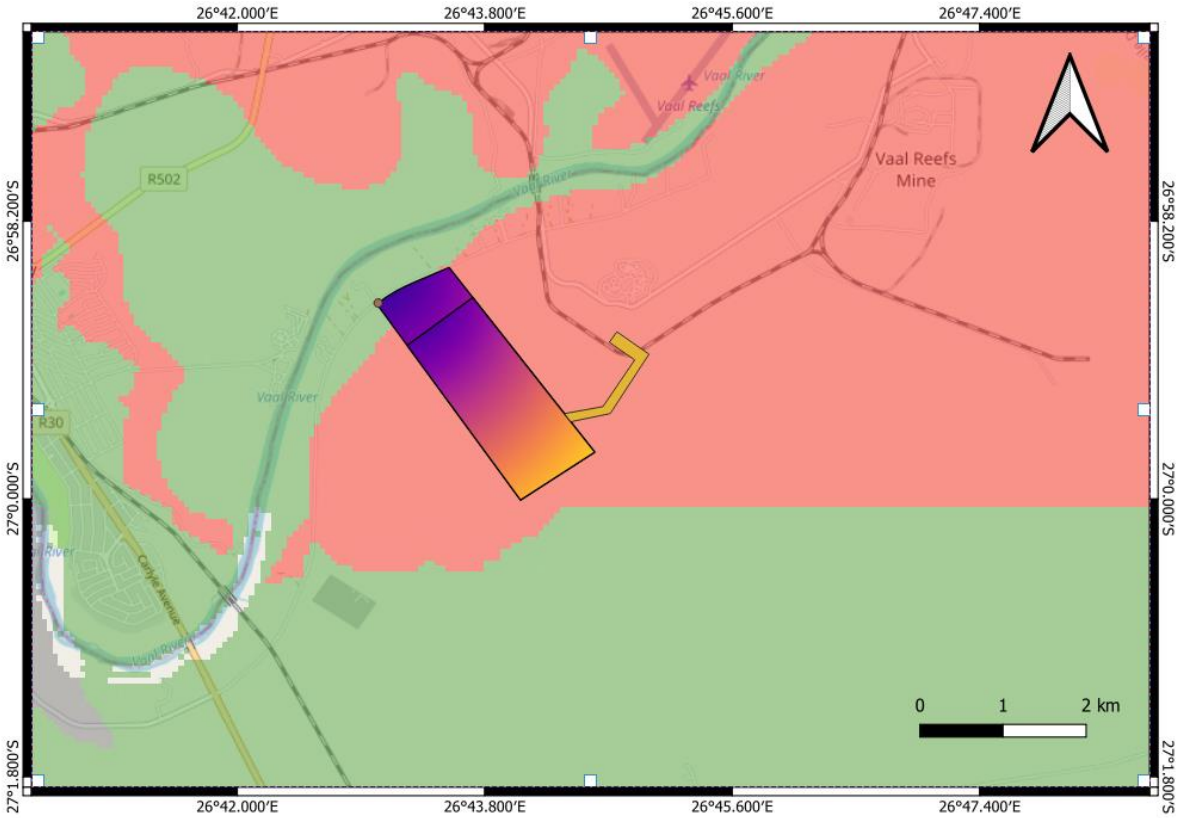

Figure 3: Extract of the 1 in 250 000 SAHRIS PalaeoMap map (Council of Geosciences). Proposed development is indicated in colours. According to the SAHRIS Palaeosensitivity map the proposed development is underlain by sediments with a Very High (red) and Moderate (green) Palaeontological Significance.

Colour	Sensitivity	Required Action
RED	**VERY HIGH**	**field assessment and protocol for finds is required**
ORANGE/YELLOW	HIGH	desktop study is required and based on the outcome of the desktop study; a field assessment is likely
GREEN	**MODERATE**	**desktop study is required**
BLUE	LOW	no palaeontological studies are required however a protocol for finds is required
GREY	INSIGNIFICANT/ZERO	no palaeontological studies are required
WHITE/CLEAR	UNKNOWN	these areas will require a minimum of a desktop study. As more information comes to light, SAHRA will continue to populate the map.

The Sensitivity of rocks in the development is indicated in bold. The colours on the PalaeoMap indicate the following degrees of sensitivity: red = very highly sensitive; orange/yellow = high; green = moderate; blue = low; grey = insignificant/zero

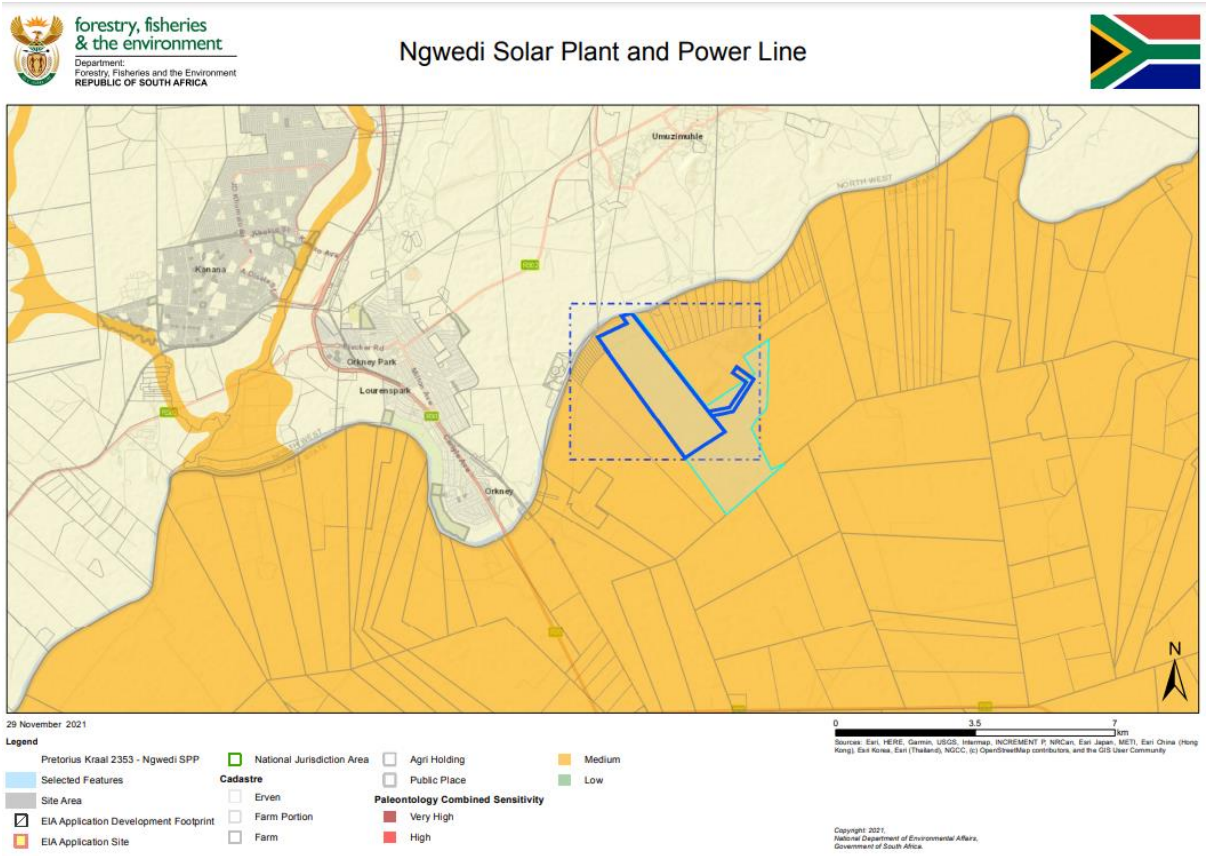

Figure 4: Palaeontological Sensitivity generated by the DFFE Screening

According to the DFFE Screening tool the Sensitivity of the proposed Ngwedi Solar Power Plant and associated infrastructure near Viljoenskroon in the Free State is Medium (orange).

A thorough site-specific field survey of the proposed development development was conducted on foot and by motor vehicle where fossiliferous outcrops was found.

4. CONCLUSION

The DFFE Screening tool indicates that the Sensitivity of the development footprint is Medium. The SAHRIS PalaeoMap in turn indicates that the Sensitivities varies between Moderate to Very High. During a site visit well-preserved fossiliferous outcrops were identified. **Mitigation measures were included in the report.**