

# PALAEONTOLOGICAL IMPACT ASSESSMENT

PHALA SOLAR POWER  
PLANT NEAR BELA-BELA,  
LIMPOPO PROVINCE  
2022

COMPILED FOR:  
ENVIRONAMICS ENVIRONMENTAL



Declaration of Independence

I, Elize Butler, declare that –

General declaration:

- I act as the independent palaeontological 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 favorable to the applicant
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting palaeontological impact assessments, 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 will take into account, to the extent possible, the matters listed in section 38 of the NHRA when preparing the application and any report relating to the application;
- 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;
- I will ensure that information containing all relevant facts in respect of the application is distributed or made available to interested and affected parties and the public and that participation by interested and affected parties is facilitated in such a manner that all interested and affected parties will be provided with a reasonable opportunity to participate and to provide comments on documents that are produced to support the application;
- I will provide the competent authority with access to all information at my disposal regarding the application, whether such information is favorable to the applicant or not
- All the particulars furnished by me in this form are true and correct;
- I will perform all other obligations as expected a palaeontological specialist in terms of the Act and the constitutions of my affiliated professional bodies; and
- I realize that a false declaration is an offense in terms of regulation 71 of the Regulations and is punishable in terms of section 24F of the NEMA.



**Disclosure of Vested Interest**

I do not have and will not have any vested interest (either business, financial, personal or other) in the proposed activity proceeding other than remuneration for work performed in terms of the Regulations.

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SIGNATURE:



The heritage impact assessment report has been compiled considering the National Environmental Management Act 1998 (NEMA) and Environmental Impact Regulations 2014 as amended, requirements for specialist reports, Appendix 6, as indicated in the table below.

*Table 1: Checklist for Specialist studies conformance with Appendix 6 of the EIA Regulations of 2014 (as amended)*

<b>Requirements of Appendix 6 – GN R326 EIA Regulations of 7 April 2017</b>	<b>Relevant section in report</b>	<b>Comment where not applicable.</b>
1.(1) (a) (i) Details of the specialist who prepared the report	Page ii and Section 3 of Report – Contact details and company and Appendix A	-
(ii) The expertise of that person to compile a specialist report including a curriculum vitae	Section 3 – refer to <b>Appendix A</b>	-
(b) A declaration that the person is independent in a form as may be specified by the competent authority	Page ii of the report	-
(c) An indication of the scope of, and the purpose for which, the report was prepared	Section 5 – Objective	-
(cA) An indication of the quality and age of base data used for the specialist report	Section 6 – Geological and Palaeontological history	-
(cB) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	Section 11	-
(d) The duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment		Desktop Assessment
(e) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used	Section 9 Approach and Methodology	-



Requirements of Appendix 6 – GN R326 EIA Regulations of 7 April 2017	Relevant section in report	Comment where not applicable.
(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;	Section 1 and 12	
(g) An identification of any areas to be avoided, including buffers	Section 6	No buffers or areas of sensitivity identified
(h) A map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	Section 6 – Geological and Palaeontological history	
(i) A description of any assumptions made and any uncertainties or gaps in knowledge;	Section 9.1 – Assumptions and Limitation	-
(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	Section 1-12	
(k) Any mitigation measures for inclusion in the EMPr	Section 1-12	
(l) Any conditions for inclusion in the environmental authorisation	Section 1-12	
(m) Any monitoring requirements for inclusion in the EMPr or environmental authorisation	Section 1-12	
(n)(i) A reasoned opinion as to whether the proposed activity, activities or	Section 1-12	



Requirements of Appendix 6 – GN R326 EIA Regulations of 7 April 2017	Relevant section in report	Comment where not applicable.
portions thereof should be authorised and		
(n)(iA) A reasoned opinion regarding the acceptability of the proposed activity or activities; and		
(n)(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 EMP, and where applicable, the closure plan	Section 1 and 12	-
(o) A description of any consultation process that was undertaken during the course of carrying out the study	N/A	
(p) A summary and copies if any comments that were received during any consultation process	N/A	
(q) Any other information requested by the competent authority.	N/A	
(2) Where a government notice 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.	Section 2 and 4	



## EXECUTIVE SUMMARY

Banzai Environmental was appointed by Environamics Environmental Consultants to conduct the **Palaeontological Desktop Assessment** (PDA) to assess the Phala Solar Power Plant near Bela-Bela, Limpopo Province. In accordance with the National Environmental Management Act 107 of 1998 (NEMA) and to comply with the National Heritage Resources Act (No 25 of 1999, section 38) (NHRA), this PIA is necessary to confirm if fossil material could potentially be present in the planned development area, to evaluate the potential impact of the proposed development on the Palaeontological Heritage and to mitigate possible damage to fossil resources.

The Phala Solar Power Plant is underlain by the Letaba Formation (Lebombo Group, Karoo Igneous Province) while the most northern portion of the connection corridor and Eskom Power lines are underlain by the Clarens Formation (Karoo Supergroup). The Palaeotechnical Report of the Limpopo Province (Groenewald et al, 2014) as well as the PalaeoMap of the South African Heritage Resources Information System (SAHRIS) (Almond *et al*, 2013; SAHRIS website) allocates a High Palaeontological Sensitivity to the Clarens Formation and a Low Palaeontological Sensitivity the Letaba Subgroup. However, the Palaeotechnical report of the Limpopo Province (Groenewald et al, 2014) indicates “very poor levels of surface exposure” and that most data were obtained from borehole cores.

A Low Palaeontological Significance has been allocated to the proposed Phala SPP development. It is therefore considered that the proposed development will not lead to detrimental impacts on the palaeontological resources of the area. The construction and operation of the project may be authorised, as the whole extent of the development footprint is not considered sensitive in terms of palaeontological heritage.

However, if fossil remains are discovered during any phase of construction, either on the surface or exposed by excavations the **Chance Find Protocol** must be implemented by the ECO/site manager in charge of these developments. These discoveries ought to be protected (if possible, *in situ*) and the ECO/site manager must report to SAHRA (Contact details: SAHRA, 111 Harrington Street, Cape Town. PO Box 4637, Cape Town 8000, South Africa. Tel: 021 462 4502. Fax: +27 (0)21 462 4509. Web: [www.sahra.org.za](http://www.sahra.org.za)) so that mitigation (recording and collection) can be carry out by a paleontologist.

Preceding any collection of fossil material, the specialist would need to apply for a collection permit from SAHRA. Fossil material must be curated in an accredited collection (museum or university collection), while all fieldwork and reports should meet the minimum standards for palaeontological impact studies suggested by SAHRA.



**Impact Summary**

<b>Environmental parameter</b>	<b>Issues</b>	<b>Rating prior to mitigation</b>	<b>Average</b>	<b>Rating post mitigation</b>	<b>Average</b>
Planning Stage	No Impact		No Impact		No Impact
Construction Stage Phala SPP	Destroy or permanently seal-in fossils at or below the surface that are then no longer available for scientific study	32	Negative Medium impact	16	Negative Low impact
Operational Phase Phala SPP	No Impact		No Impact		No Impact
Decommissioning Phase Phala SPP	No Impact		No Impact		No Impact
Construction Stage Power line Loss of fossil heritage	Destroy or permanently seal-in fossils at or below the surface that are then no longer available for scientific study	32	Negative Medium impact	16	Negative Low impact
Power line Operational Phase	No Impact		No Impact		No Impact
Power Line Decommissioning Phase	No Impact		No Impact		No Impact

It is therefore considered that the proposed Icarus SPP will not lead to detrimental impacts on the palaeontological reserves of the area. Thus, the construction of the development may be authorised in its whole extent.





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## Appendix A: CV



## 1 INTRODUCTION

Phala Solar Power Plant (RF) (PTY) LTD proposes the development of the Phala Solar Power Plant near Bela-Bela in the Limpopo Province is proposed (Figure 1-3).

Table 2: General site information

Description of affected farm portion	<u>Solar Power Plant</u> Remaining Extent of Portion 1 of the Farm Turfbult No. 494 Remaining Extent of Portion 2 of the Farm Turfbult No. 494 Portion 5 of the Farm Turfbult No. 494 Portion 7 of the Farm Turfbult No. 494  <u>Power Line</u> Remaining Extent of Portion 1 of the Farm Turfbult No. 494
Province	Limpopo
District Municipality	Bela-Bela District Municipality
Local Municipality	Waterberg Local Municipality
Ward numbers	9
Closest towns	The town of Bela-Bela is located approximately 2km north of the proposed development
21 Digit Surveyor General codes	<u>Solar Power Plant</u> Remaining Extent of Portion 1 of the Farm Turfbult No. 494 TOKR00000000049400001 Remaining Extent of Portion 2 of the Farm Turfbult No. 494 TOKR00000000049400002 Portion 5 of the Farm Turfbult No. 494 TOKR00000000049400005 Portion 7 of the Farm Turfbult No. 494 TOKR00000000049400007  <u>Power Line</u> Remaining Extent of Portion 1 of the Farm Turfbult No. 494 TOKR00000000049800001
Type of technology	Photovoltaic solar facility
Structure Height	Panels ~6m, buildings ~ 6m, power line ~32m and battery storage facility ~8m height
Battery storage	Within a 4-hectare area



Surface area to be covered (Development footprint)	Approximately 570ha
Laydown area dimensions (EIA footprint)	Assessed 812ha
Structure orientation	The panels will either be fixed to a single-axis horizontal tracking structure where the orientation of the panel varies according to the time of the day, as the sun moves from east to west or tilted at a fixed angle equivalent to the latitude at which the site is located in order to capture the most sun.
Generation capacity	Up to 350 MW (DC) and

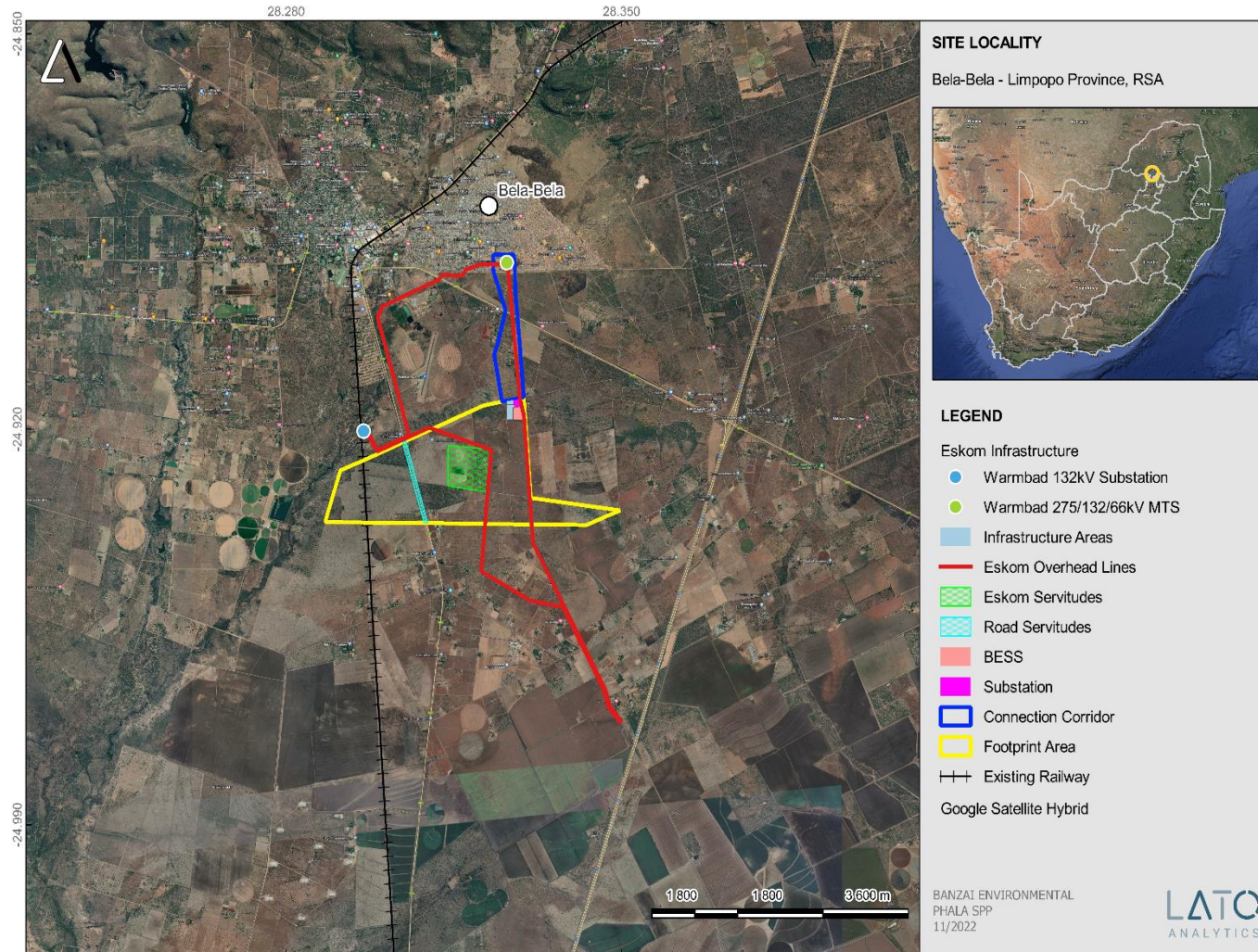


Figure 1: Regional locality of the proposed Phala Solar Power Plant near Bela-Bela, in Limpopo Province.

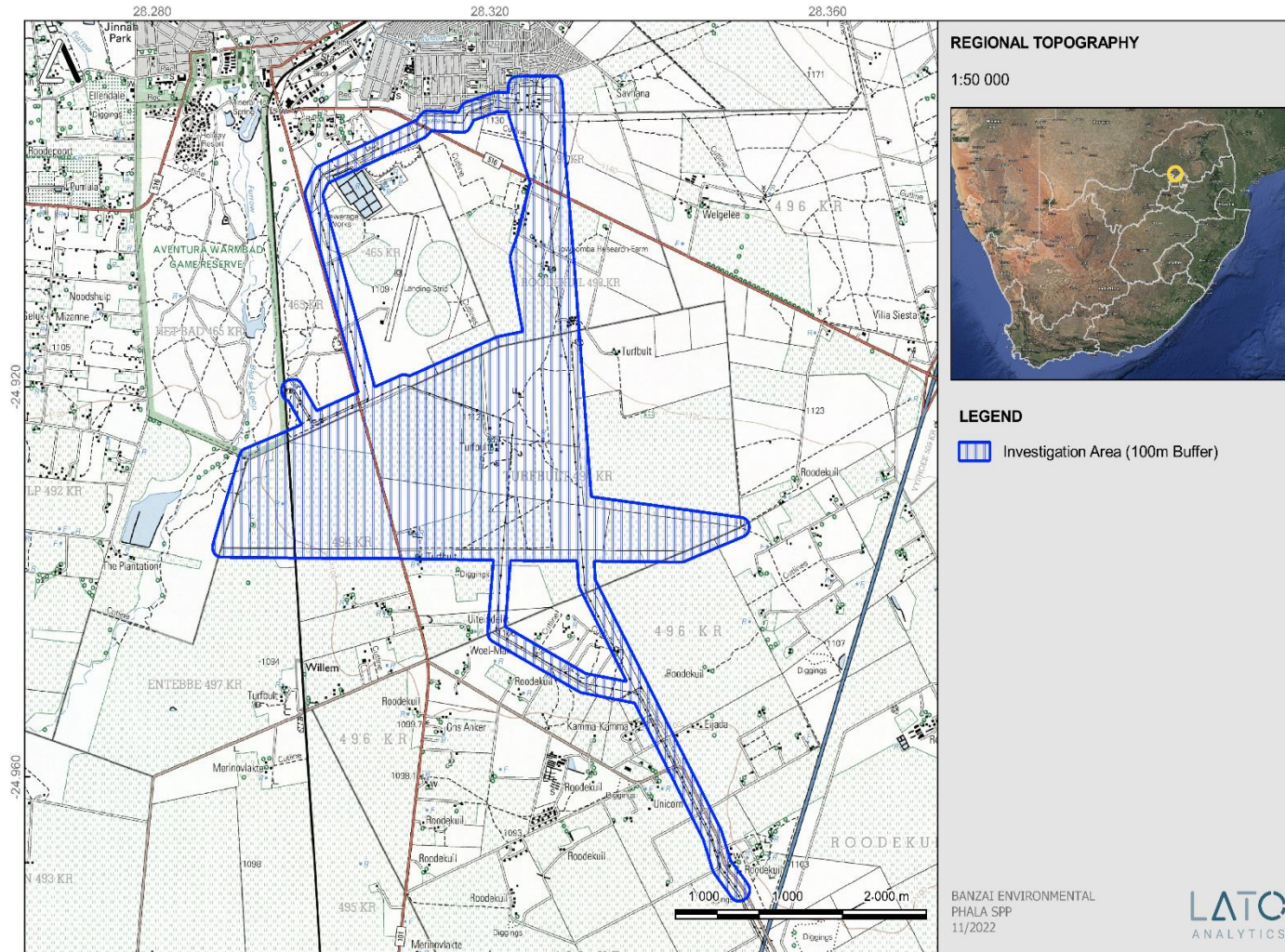


Figure 2: Locality of the proposed Phala Solar Power Plant near Bela-Bela in the Limpopo Province.



## 1.2 Technical Details

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 350MW, 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.

- **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. It is expected that generation from the facility will connect to the national grid via the existing Eskom Warmbad 275/132/66kV MTS Substation. The grid connection route will be assessed within a 200m wide (up to 550m wide in some instances) corridor. The Project will inject up to 300MW into the National Grid. The installed capacity will be approximately 350MW.

Refer to the Figure below.



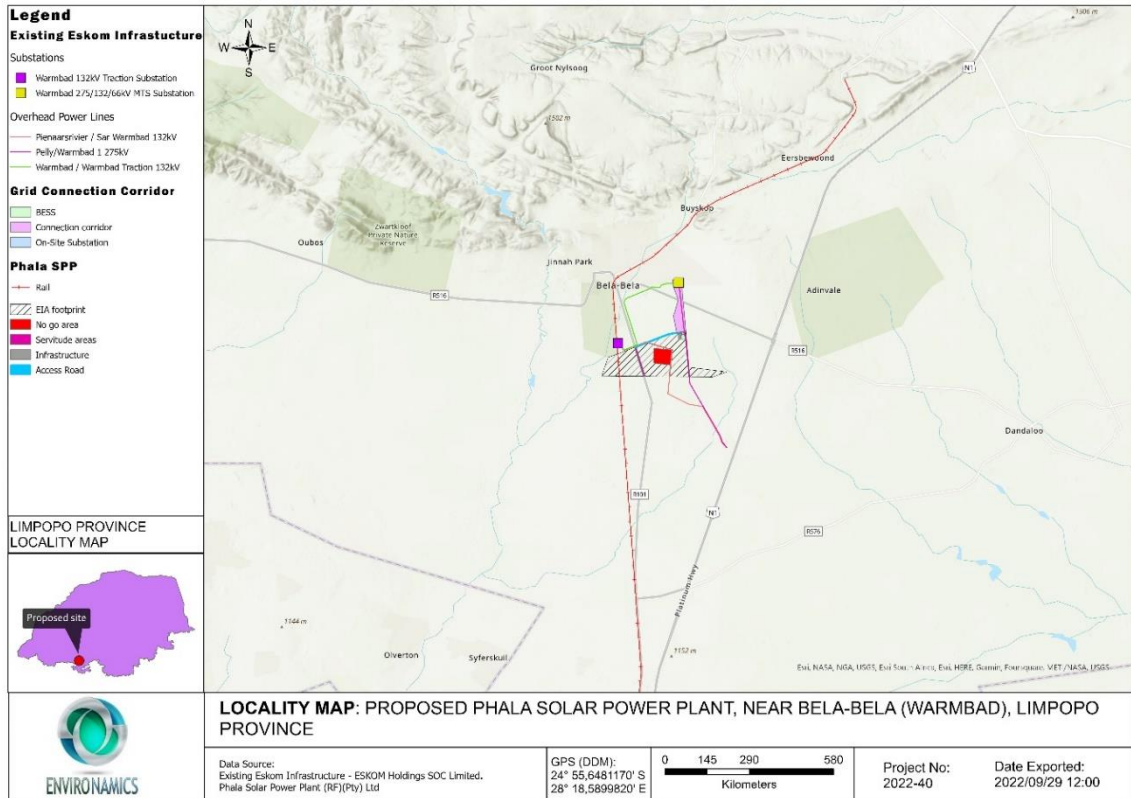


Figure 3: Power Line Corridor.

- **Electrical reticulation network**

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

- **Supporting Infrastructure**

The supporting infrastructure such as the auxiliary buildings will be situated in an area measuring up to 1.3 ha:

- **Battery storage**

A Battery Storage Facility with a maximum height of 8m and a maximum volume of 1,740 m<sup>3</sup> of batteries and associated operational, safety and control infrastructure.

- **Roads**

Access will be obtained via the R101 regional road to the west of the site. 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. Access Points: coordinates 24°55'19.96"S 28°18'18.58"E

- **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.



Table 3: Technical details

Component	Description / dimensions
Height of PV panels	6 meters
Area of PV Array	550 hectares (Development footprint)
Number of inverters required	Minimum 50
Area occupied by inverter / transformer stations / substations / BESS	Central inverters+ LV/MV trafo: 750 m <sup>2</sup> HV/MV substation with switching station: 15 000 m <sup>2</sup> BESS: 40 000 m <sup>2</sup>
Capacity of on-site substation	132kV
Capacity of the power line	132kV
Area occupied by both permanent and construction laydown areas	Total Footprint Area: 570 hectares Construction laydown area: within ~ 3.7 ha
Area occupied by buildings	Security Room: ~150 m <sup>2</sup> O&M laydown: Within 1.3 ha
Battery storage facility	Maximum height: 8m Maximum volume: 1740 m <sup>3</sup> Capacity: Up to 500 MW
Length of internal roads	Approximately 30 km
Width of internal roads	Between 4 to 6 meters
Proximity to grid connection	The grid connection route will be assessed within a 200m wide (up to 550m wide in some instances)
Grid connection corridor width	200m wide but up to 550m wide in some instances
Grid connection corridor length	± 2,6 km
Power line servitude width	15 - 25m
Height of fencing	Approximately 2.5 meters

### 1.3 Consideration Of Alternatives

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 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 the Remaining Extent of Portion 1, 2, 5 & 7 of the Farm Turfbult No. 494. 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 EIA proses.

#### **Technical alternatives: Powerlines**

Two grid connection options are available. It is expected that generation from the facility will tie in with the existing Eskom Pelly/Warmbad 1 275kV Overhead Line or Warmbad 275/132/66kV MTS substation. The project will inject up to 300MW into the National Grid. The installed capacity will be up to 350MW.

#### **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<sup>3</sup> 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.

## 2 LEGAL MANDATE AND PURPOSE OF THE REPORT

The National Environmental Management Act identifies listed activities (in terms of Section 24) which are likely to have an impact on the environment. These activities cannot commence without obtaining an EA from the relevant competent authority. Sufficient information is required by the competent authority to make an informed decision and the project is therefore subject to an environmental assessment process which can be either a Basic Assessment Process or a full Scoping and Environmental Impact Assessment process.

The EIA Regulations No. 324, 325, and 327 outline the activities that may be triggered and therefore require EA. The following listed activities with special reference to the proposed development is triggered:

**Table 4: Listed activities (SPPs)**

Relevant notice:	Activity No (s)	Description of each listed activity as per project description:
GNR. 327 (as amended in 2017)	Activity 11(i)	<ul style="list-style-type: none"> <li>• "The development of facilities or infrastructure for the transmission and distribution of electricity (i) outside urban areas or industrial complexes with a capacity of more than 33 but less than 275 kilovolts."</li> <li>• Activity 11(i) is triggered as the proposed photovoltaic solar facility will transmit and distribute electricity of 132 kilovolts outside an urban area.</li> </ul>



GNR. 327 (as amended in 2017)	Activity 24(ii)	<ul style="list-style-type: none"><li>• <i>"The development of a road (ii) with reserve wider than 13,5 meters, or where no reserve exists where the road is wider than 8 meters;</i></li><li>• Activity 24(ii) is triggered as the internal roads will vary between 6 and 12 meters in width.</li></ul>
GNR. 327 (as amended in 2017)	Activity 28(ii)	<ul style="list-style-type: none"><li>• <i>"Residential, mixed, retail, commercial, industrial or institutional developments where such land was used for agriculture or afforestation on or after 1998 and where such development (ii) will occur outside an urban area, where the total land to be developed is bigger than 1 hectare."</i></li><li>• Activity 28(ii) is triggered as portions of the affected farm has been previously used for grazing and the property will be re-zoned to "special" use.</li></ul>
GNR. 327 (as amended in 2017)	Activity 56 (ii)	<ul style="list-style-type: none"><li>• <i>Activity 56 (ii) is triggered since the existing access does not have a reserve and will need to be widened by more than 6 metres.</i></li></ul>
GNR. 325 (as amended in 2017)	Activity 1	<ul style="list-style-type: none"><li>• <i>"The development of facilities or infrastructure for the generation of electricity from a renewable resource where the electricity output is 20 megawatts or more."</i></li><li>• Activity 1 is triggered since the proposed photovoltaic solar facility will generate up to 150 megawatts electricity through the use of a renewable resource.</li></ul>
GNR. 325 (as amended in 2017)	Activity 15	<ul style="list-style-type: none"><li>• <i>"The clearance of an area of 20 hectares or more of indigenous vegetation."</i></li><li>• More than 20 hectares of indigenous vegetation will be cleared.</li></ul>

Being listed under Listing Notice 1 and 2 (GN.R. 327 & 325) implies that the development is considered as potentially having a significant impact on the environment. Based on the activities triggered, the Application for Environmental Authorisation is subject to the completion of full Scoping and EIA (S&EIA) process as described in Regulations 21-23. The Scoping and EIA process involves the identification and assessment of environmental impacts through specialist studies, the recommendation of appropriate mitigation measures as well as public participation.



### 3 QUALIFICATIONS AND EXPERIENCE OF THE AUTHOR

This study has been conducted by Mrs Elize Butler. She has conducted approximately 300 palaeontological impact assessments for developments in the Free State, KwaZulu-Natal, Eastern, Central, and Northern Cape, Northwest, Gauteng, Limpopo, and Mpumalanga. She has an MSc (*cum laude*) in Zoology (specializing in Palaeontology) from the University of the Free State, South Africa and has been working in Palaeontology for more than twenty-nine years. She has experience in locating, collecting, and curating fossils, including exploration field trips in search of new localities in the Karoo Basin. She has been a member of the Palaeontological Society of South Africa (PSSA) since 2006 and has been conducting PIAs since 2014.

### 4 LEGISLATION

#### National Heritage Resources Act (25 of 1999)

Cultural Heritage in South Africa, includes all heritage resources, is protected by the National Heritage Resources Act (Act 25 of 1999) (NHRA). Heritage resources as defined in Section 3 of the Act include **“all objects recovered from the soil or waters of South Africa, including archaeological and palaeontological objects and material, meteorites and rare geological specimens”**.

The identification, evaluation and assessment of any cultural heritage site, artefact or finds in the South African context is required and governed by the following legislation:

- National Environmental Management Act (NEMA) Act 107 of 1998
- National Heritage Resources Act (NHRA) Act 25 of 1999
- Notice 648 of the Government Gazette 45421- general requirements for undertaking an initial site sensitivity verification where no specific assessment protocol has been identified.

The next section in each Act is directly applicable to the identification, assessment, and evaluation of cultural heritage resources.

GNR 982 (Government Gazette 38282, 14 December 2014) promulgated under the National Environmental Management Act (NEMA) Act 107 of 1998

- Basic Assessment Report (BAR) – Regulations 19 and 23
- Environmental Impacts Assessment (EIA) – Regulation 23
- Environmental Scoping Report (ESR) – Regulation 21
- Environmental Management Programme (EMPr) – Regulations 19 and 23

National Heritage Resources Act (NHRA) Act 25 of 1999

- Protection of Heritage Resources – Sections 34 to 36
- Heritage Resources Management – Section 38

The NEMA (No 107 of 1998) states that an integrated EMP should (23:2 (b)) *“...identify, predict and evaluate the actual and potential impact on the environment, socio-economic conditions and cultural heritage”*.



In agreement with legislative requirements, EIA rating standards as well as SAHRA policies the following comprehensive and legally compatible PIA report have been compiled.

Palaeontological heritage is exceptional and non-renewable and is protected by the NHRA. Palaeontological resources and may not be unearthed, broken moved, or destroyed by any development without prior assessment and without a permit from the relevant heritage resources authority as per section 35 of the NHRA.

This Palaeontological Impact assessment forms part of the Heritage Impact Assessment (HIA) and adhere to the conditions of the Act. According to **Section 38 (1)**, an HIA is required to assess any potential impacts to palaeontological heritage within the development footprint where:

- the construction of a road, wall, power line, pipeline, canal or other similar form of linear development or barrier exceeding 300 m in length.
- the construction of a bridge or similar structure exceeding 50 m in length.
- any development or other activity which will change the character of a site—
- (Exceeding 5 000 m<sup>2</sup> in extent; or
- involving three or more existing erven or subdivisions thereof; or
- involving three or more erven or divisions thereof which have been consolidated within the past five years; or
- the costs of which will exceed a sum set in terms of regulations by SAHRA or a provincial heritage resources authority
- the re-zoning of a site exceeding 10 000 m<sup>2</sup> in extent.
- or any other category of development provided for in regulations by SAHRA or a Provincial heritage resources authority.

## **5 OBJECTIVE**

The objective of a Palaeontological Impact Assessment (PIA) is to determine the impact of the development on potential palaeontological material at the site.

According to the "SAHRA Archaeological, Palaeontological and Meteorite Unite (APM) Guidelines: Minimum Standards for the Archaeological and Palaeontological Components of Impact Assessment Reports" the aims of the PIA are: 1) to **identify** the palaeontological status of the exposed as well as rock formations just below the surface in the development footprint 2) to estimate the **palaeontological importance** of the formations 3) to determine the **impact** on fossil heritage; and 4) to recommend how the developer ought to protect or mitigate damage to fossil heritage.

The terms of reference of a PIA are as follows:



**General Requirements:**

- Adherence to the content requirements for specialist reports in accordance with Appendix 6 of the EIA Regulations 2014, as amended;
- Adherence to all applicable best practice recommendations, appropriate legislation and authority requirements;
- Submit a comprehensive overview of all appropriate legislation, guidelines;
- Description of the proposed project and provide information regarding the developer and consultant who commissioned the study,
- Description and location of the proposed development and provide geological and topographical maps
- Provide palaeontological and geological history of the affected area.
- Identification of sensitive areas to be avoided (providing shapefiles/kmls) in the proposed development;
- Evaluation of the significance of the planned development during the Pre-construction, Construction, Operation, Decommissioning Phases and Cumulative impacts. Potential impacts should be rated in terms of the direct, indirect and cumulative:
  - a. **Direct impacts** are impacts that are caused directly by the activity and generally occur at the same time and at the place of the activity.
  - b. **Indirect impacts** of an activity are indirect or induced changes that may occur as a result of the activity.
  - c. **Cumulative impacts** are impacts that result from the incremental impact of the proposed activity on a common resource when added to the impacts of other past, present or reasonably foreseeable future activities.
- Fair assessment of alternatives (infrastructure alternatives have been provided):
- Recommend mitigation measures to minimise the impact of the proposed development; and
- Implications of specialist findings for the proposed development (such as permits, licenses etc).

## **6 GEOLOGICAL AND PALAEONTOLOGICAL HISTORY**

The geology of the proposed Phala Solar Power Plant is depicted on the 1: 250 000 Nylstroom 2428 (1978) Geological Map (Council for Geosciences, Pretoria) (**Figure 4, Table 5**). According to this geological map the majority of the Phala SPP development is underlain by the Letaba Formation (Lebombo Group, Karoo Igneous Province) (J; purple red) while the most northern portion of the connection corridor and Eskom Power lines are underlain by the Clarens Formation (T<sub>R</sub>, pink) (Karoo Supergroup). The Phala SPP lies on the north-western margin of the Springbok Flats Basin (Ehlers and Du Toit, 2002).





The Palaeotechnical Report of the Limpopo Province (Groenewald et al, 2014) allocates a High Palaeontological Sensitivity to the Clarens Formation and a Low Palaeontological Sensitivity the Letaba Subgroup (**Table 6**). Updated geology (Council of Geosciences, Pretoria) is depicted in **Figure 5** and indicates that the Phala SPP is mostly underlain by the Letaba Subgroup with a very small northern portion underlain by the Clarens Formation (Karoo Supergroup). The PalaeoMap of the South African Heritage Resources Information System (SAHRIS) indicates that the Palaeontological Sensitivity of the Letaba Formation is Low while that of the Clarens Formation is High (**Figure 6**) (Almond et al, 2013; SAHRIS website).

The volcanic rocks of the Letaba Formation (Karoo Supergroup) are covered by Caenozoic superficial deposits that contain alluvium, calcrete hardpans and downwasted gravels.

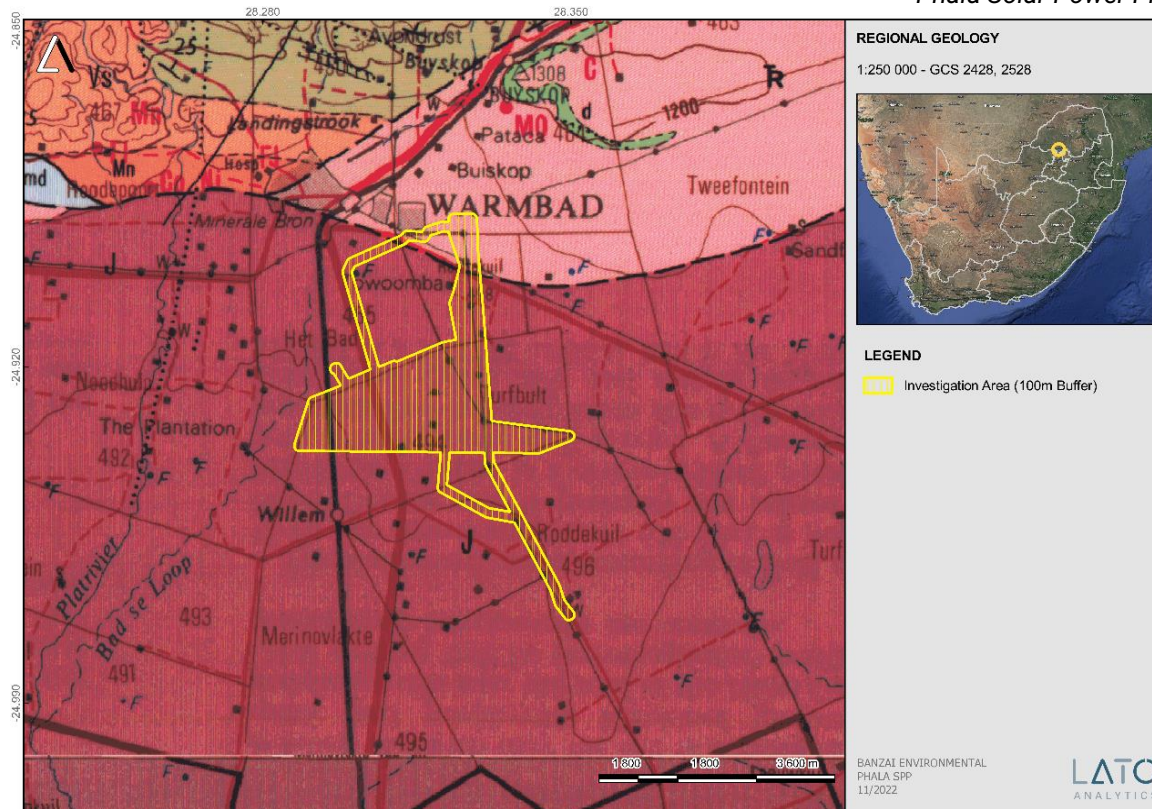
The Karoo igneous province (**Table 8**) is one of the worlds classic continental basalt (CFB) provinces. This province consists of intrusive and extrusive rocks that occur over a large area (Duncan et al, 2006). Generally, the flood basalts do not contribute to prominent volcanic structures, but instead are formed by successive eruptions from a set of fissures that form sub-horizontal lava flows (sills and dykes) varying in thickness. This lava caps the landscape on which they erupted. As the Karoo is an old flood basalt province it is today preserved as erosional fragments of a more extensive lava cap that covered much of southern Africa in the geological past. It is estimated that the Karoo lava outcrop currently covered at least 140 000 km<sup>2</sup> while it was larger in the past [ $\sim 2\,000\,000\text{ km}^2$  (Cox 1970, 1972)].

The Karoo Igneous Province contains a large volume of flood basalts as well as silicic volcanic rocks. These units are comprised of rhyodacite and rhyolitic magma and crops out along the Lebombo monocline. Individual units span up to 60 km and sometimes show massive pyroclastic structures and are thus classified as rheoignimbrites. The basal lavas lie conformable on the Clarens Formation but in specific localities sandstone erosion occurred before the volcanic eruptions took place. Lock et al (1974) found evidence in the Eastern Cape that in the early stages of volcanism magma interacted with ground water to produce volcanoclastic deposits as well as phreatic and phreatomagmatic diatremes. Eales et al (1984) also found evidence of aqueous environments during early volcanism by the existence of pillow lavas and associated hyaloclastite breccias and thin lenses of fluviatile sandstones interbedded with the lowermost magmas.

The Palaeotechnical report (Groenewald et al, 2014) describes the Lebombo Group (Early Jurassic in age,  $183 \pm 2\text{ Ma}$ ) as basic and acid lavas up to 13 km thick containing rare interbedded sandstones. These sedimentary layers could contain fossils (e.g., plants, traces, bones). The Karoo-Ferrar igneous intrusions are associated with the Early Jurassic global mass extinction event.



## Phala Solar Power Plant near Bela-Bela, Limpopo Province



**Figure 4:** Extract of the 1:250 000 Nylstroom 2428 (1978) and 2528 Pretoria Geological Map (Council for Geosciences, Pretoria) indicating the geology of the proposed Phala Solar Power plant near Bela-Bela in the Limpopo Province.

According to this geological map the majority of the Phala SPP development is underlain by the Letaba Formation (Karoo Supergroup) (J; purple red) while the most northern portion of the connection corridor and Eskom Power lines are underlain by the Clarens Formation (T<sub>R</sub>, pink) (Karoo Supergroup).



Table 5: Legend of the Nylstroom 2428 (1978) Geological Map (Council for Geoscience, Pretoria).

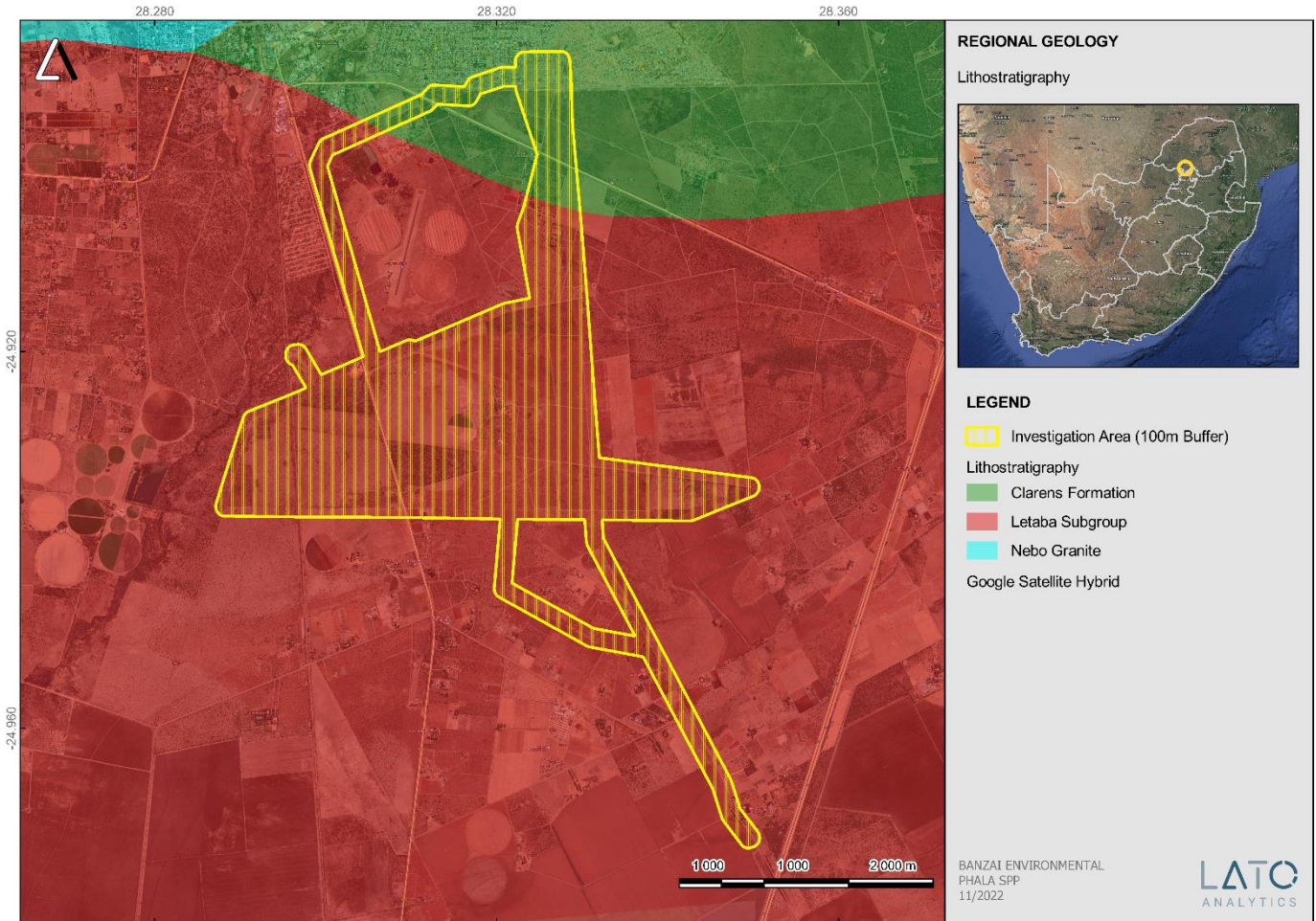
Relevant sediments are indicated in a blue square.

		FORMATION FORMASIE	SEDIMENTARY COLUMN/SEDIMENTÊRE KOLOM (INCLUDING VOLCANIC ROCKS/INSLUITENDE VULKANIESE GESTEENTES) LITHOLOGY/LITOLOGIE	IGNEOUS COLUMN/STOLLINGSKOLOM LITHOLOGY/LITOLOGIE
QUATERNARY KWATERNÊR		Alluvium Alluvium		
JURASSIC JURA	KAROO SEQUENCE OPEENVOLGING KAROO	Letaba	Volcanic rocks, sandstone Vulkaniese gesteentes, sandsteen	Diabase, dolerite, other basic to intermediate rocks of various ages verskeie ouderdomme Basalt, pyroclasts Basalt, piroklaste
TRIASSIC TRIAS		Clarens	Fine-grained red to cream sandstone Fynkorrelrige rooi tot roomkleurige sandsteen	
PERMIAN PERM		Irrigasia	Sandsteen, grintsteen, moddersteen, sliksteen, merrel, skalie, sporadiese sandlagies Sandsteen, grintsteen, moddersteen, sliksteen, merrel, sporadiese sandlagies	
		Ecca	Shale, shaly sandstone, grit, sandstone, conglomerate at base, in places coal near base and top Skalie, skalie-agtige sandsteen, grintsteen, sandsteen, konglomeraat aan basis, plek-plek steenkool naby basis en top	

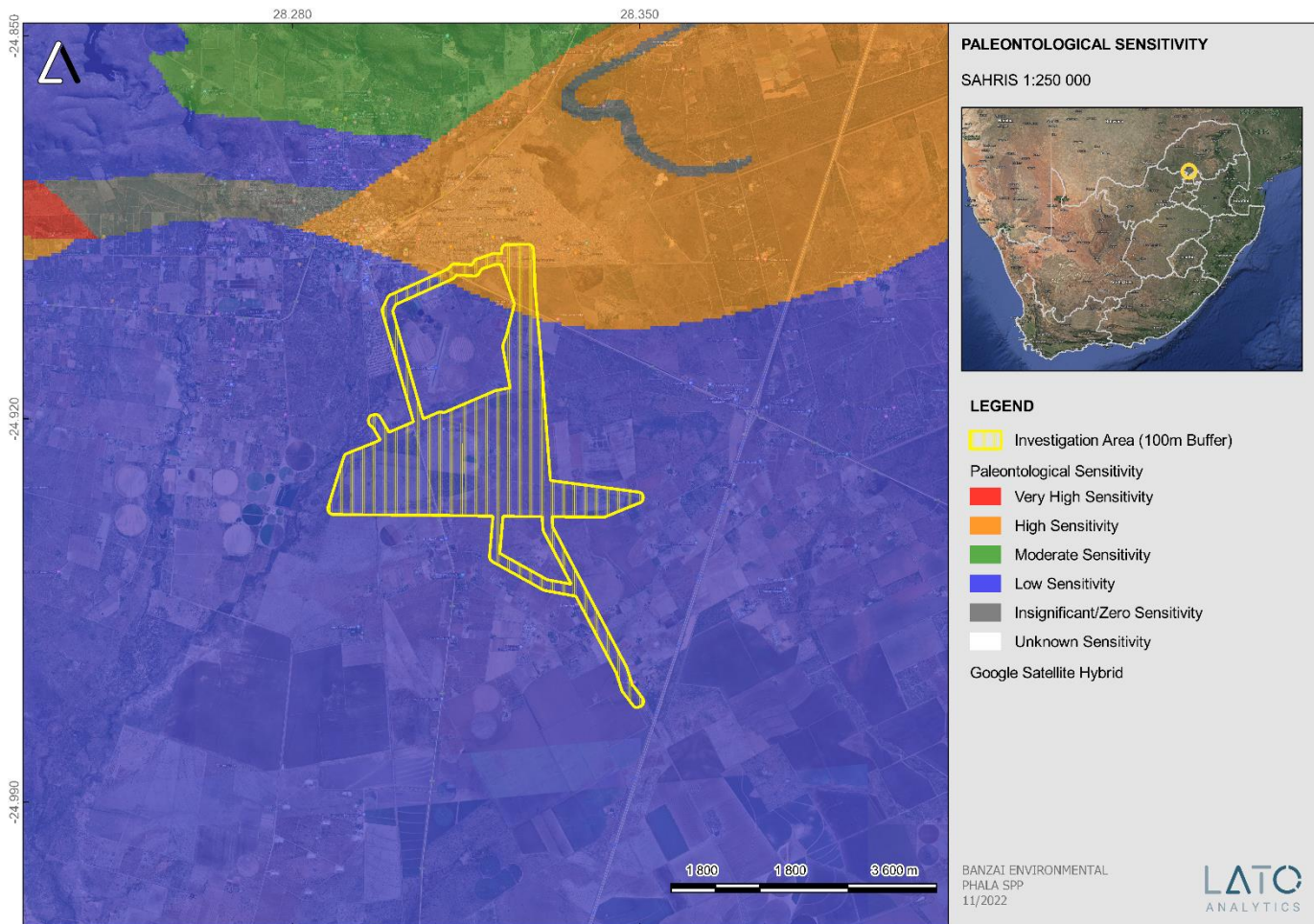


Table 6: Extract of the Palaeotechnical Report of the North West Province (Groenewald, et al., 2014).

KAROO DOLERITE (Jd)			Dolerite (Jd)		Dolerite intrusions Early Jurassic 183 ± 2 Ma	No fossils recorded	Karoo-Ferrar igneous intrusions associated with Early Jurassic global mass extinction event
LEBOMBO			Josini (Jj) Letaba & Sabi River (J; Jj; Jle)		Up to 13 km of volcanic rocks (basic and acid lavas) and rare interbedded sandstones. Early Jurassic 183 ± 2 Ma	Fossils might occur within thin sedimentary intervals (e.g. plants, traces, bones)	
		SPRINGBOKFLATS ELLISRAS	Clarens (TR; TRc; Jc)		Aeolian sandstones, minor ephemeral stream deposits	Dinosaur remains and trackways can be expected	Very poor levels of surface exposure (most data obtained from borehole cores)



**Figure 5:** Updated Geology (Council of Geosciences, Pretoria) of the proposed Phala Solar Power Plant indicates that the development is underlain by Letaba Subgroup as well as the Clarence Formation of the Karoo Supergroup.



**Figure 6:** Extract of the 1: 250 000 SAHRIS PalaeoMap map (Council of Geosciences) indicating the proposed Phala Solar development.

According to the SAHRIS Palaeosensitivity map (Figure 6) the proposed development is underlain by sediments with a High (orange) and Low (blue) Palaeontological Significance.



Table 7: Palaeontological Sensitivity according to the SAHRIS PalaeoMap (Almond et al, 2013; SAHRIS website)

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.

Table 8: Formal stratigraphic units of the Karoo Igneous Province.

Karoo Igneous Province			
Drakensberg Group		Lebombo Group	
Formation	Rock Type	Formation	Rock Type
		Movene	Basalt
		Mbuluzi	Rholite
		Jozini	Rhyodacite
Lesotho	Basalt	Sabie River	Basalt
Barkley East	Basalt	Letaba	Picritic basalt
		Mashikri	Nephelinite



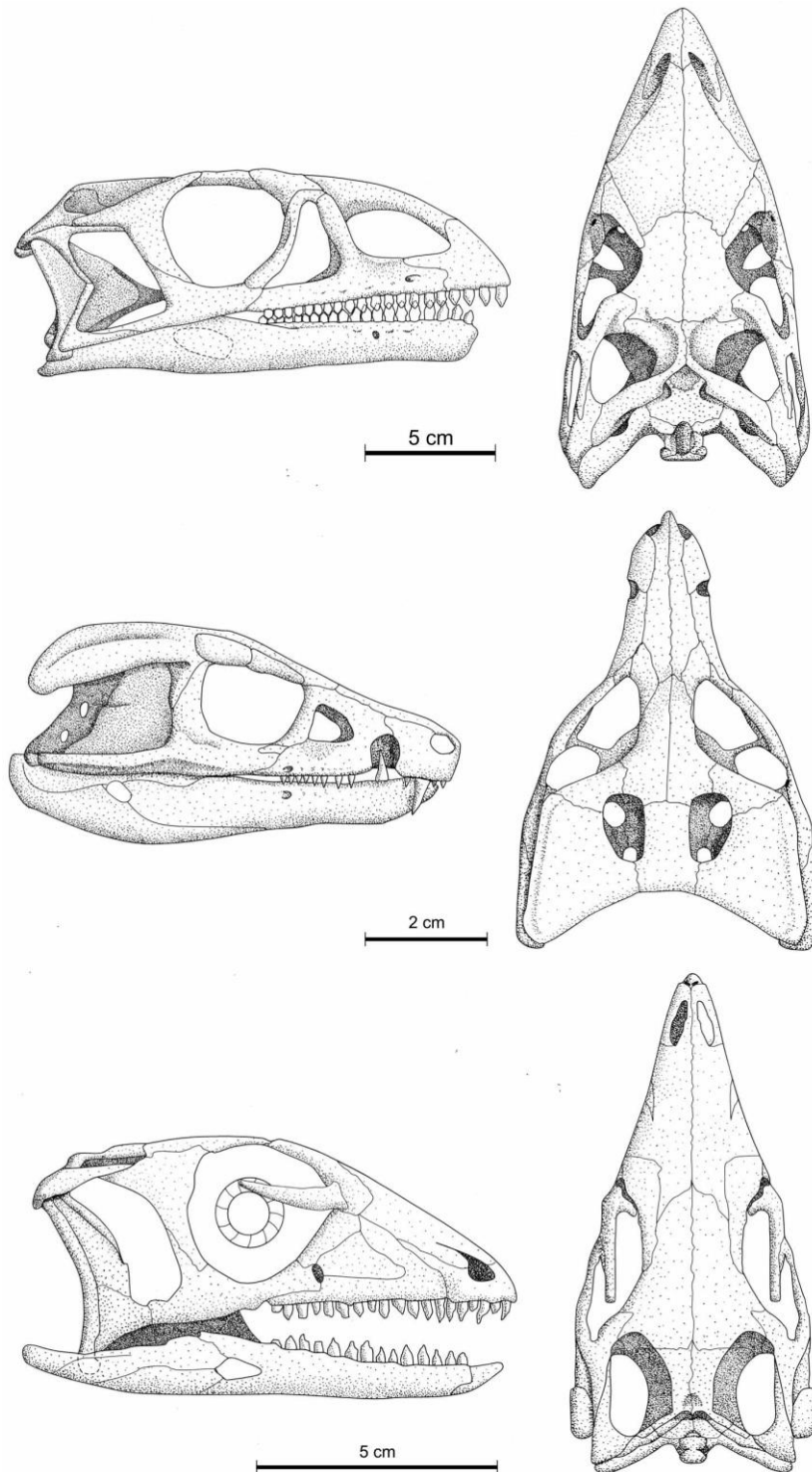
**Figure 7:** Lithostratigraphy, vertebrate biostratigraphy and geochronology of the Beaufort and Stormberg groups (Karoo Supergroup) in the Main Karoo Basin, South Africa.

Radiometric age determinations from; (A) Duncan et al. (1997), (B) Bordy et al. (2020), (C) Botha et al. (2020), (D) Gastaldo et al. (2015), (E) Rubidge et al. (2013), (F) Day et al. (2015), (G) Gastaldo et al. (2020). Dates prefaced by < are maximum depositional ages based on detrital zircon analyses. Wavy lines represent unconformities. Gp=Group, Subgp=Subgroup, Fm=Formation, M=Member. Figure taken from Smith et al., 2020

Age	Gp	West of 24° E	East of 24° E	Free State / KwaZulu-Natal	Vertebrate Assemblage Zones	Vertebrate Subzones	Radiometric dates	
JURASSIC	STORMBERG		Drakensberg Gp	Drakensberg Gp			← 183.0 Ma (A)	
			Clarens Fm	Clarens Fm	Massospondylus		← <187.5 Ma (B) ← <191.9 Ma (B)	
			upper Elliot Fm	upper Elliot Fm				
TRIASSIC	Tarkastad Subgp		lower Elliot Fm	lower Elliot Fm	Scalenodontoides		← <199.9 Ma (B) ← <204 Ma (B) ← <219 Ma (B)	
			Molteno Fm	Molteno Fm				
			Burgersdorp Fm	Driekoppen Fm	Cynognathus	Cricodon-Ufudocyclops Trirachodon-Kannemeyeria Langbergia-Gargainia		
			Katberg Fm	Verkykerskop Fm	Lystrosaurus declivis			
				Palingkloof M.				← 252.24 Ma (G) ← 251.7 Ma (C)
				Elandsberg M.	Harrismith M.			
				Ripplemead M.	Schoondraai M.	Daptocephalus	Lystrosaurus maccaigi-Moschorhinus	← 253.02 Ma (D)
				Daggaboersnek M.	Rooienekke M.		Dicynodon-Theriognathus	
				Oudeberg M.	Frankfort M.			
				Steenkampsvlaakte M.				← 255.2 Ma (E)
PERMIAN	BEAUFORT	Adelaide Subgp	Teekloof Fm					
			Oukloof M.				← 256.247 Ma (E)	
			Hoedemaker M.	Middleton Fm				← 259.262 Ma (E)
			Poortjie M.					← 260.259 Ma (F) ← 260.407 Ma (E)
			Abrahamskraal Fm	Koonap Fm	Volksrust Fm	Tapinocephalus	Eosimops-Glanosuchus	← 261.241 Ma (E)
						Eodicynodon		
ECCA			Waterford Fm	Waterford Fm				
			Tierberg/Fort Brown	Fort Brown				

The Beaufort and Stormberg Group is subdivided into a series of biostratigraphic units on the basis of its faunal content (Figure 7). The Jurassic Clarens Formation of the Stormberg Group is represented by the upper *Massospondylus* Assemblage Zone (MAZ). This Assemblage Zone is the youngest tetrapod biozone in the Karoo Basin and represents the oldest dinosaur dominated ecosystems in southern Gondwana. The main index taxon of the MAZ is the sauropodomorph *Massospondylus carinatus* cooccurring with the crocodylomorph *Protosuchus haughtoni* and the ornithischian *Lesothosaurus diagnosticus*.



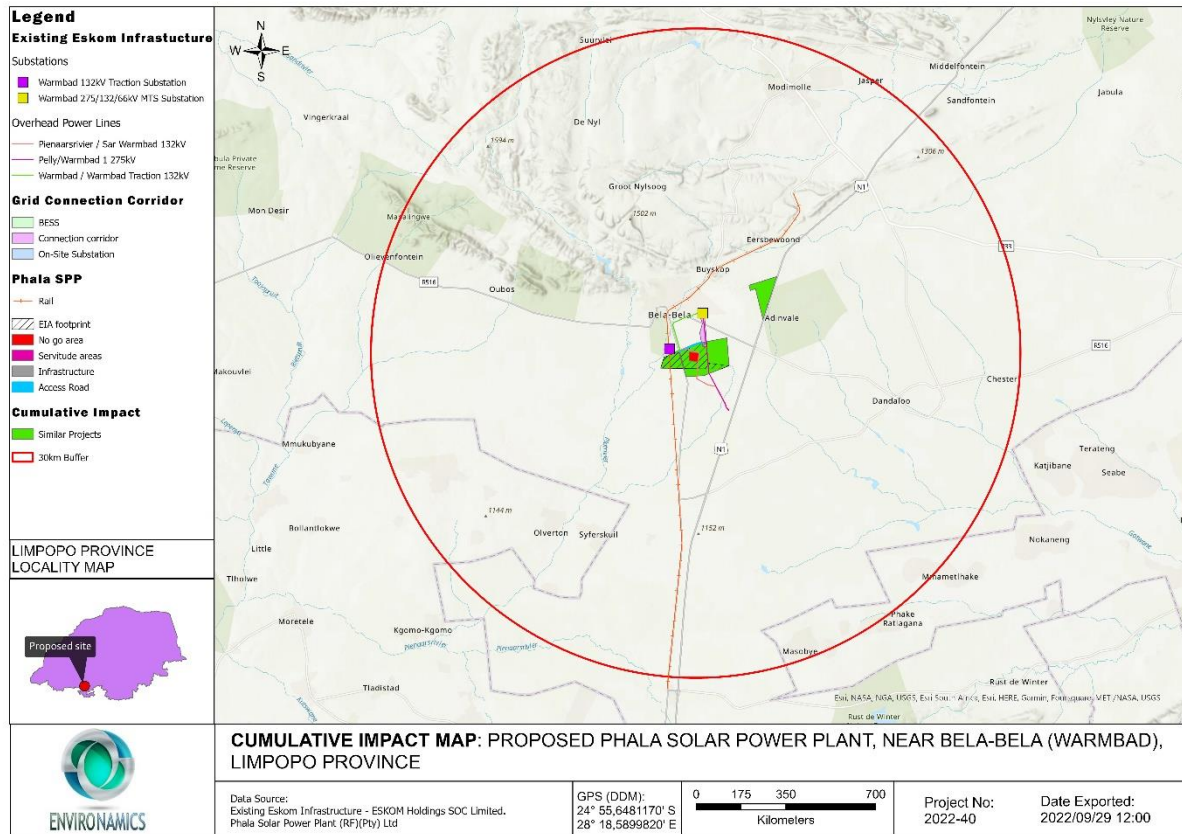


**Figure 8:** Lateral and dorsal skull views of the biozone defining fossils of the Massospondylus Assemblage Zone. (Top), *Massospondylus carinatus* (modified after Chapelle and Choiniere, 2018) (Middle), *Protosuchus haughtoni* (Modified after Gow, 2000). (Bottom), *Lesothosaurus diagnosticus* (Knoll et al., 2010). Image taken from Viglietti et al, 2020.



## 7 CUMMALATIVE EFFECTS

The geographic area of evaluation is the spatial boundary in which the cumulative effects analysis was undertaken. The spatial boundary evaluated in this cumulative effects analysis generally includes an area of a 30km radius surrounding the proposed development – refer to below.



**Figure 9: Phala SPP Geographic area of evaluation with utility-scale renewable energy generation sites and power lines.**

The geographic spread of PV solar projects, administrative boundaries and any environmental features (the nature of the landscape) were considered when determining the geographic area of investigation. It was argued that a radius of 30km would generally confine the potential for cumulative effects within this particular environmental landscape. The geographic area includes projects located within the Limpopo Province specific temporal or spatial impacts of a resource. For example, the socioeconomic cumulative analysis may include a larger area, as the construction workforce may draw from a much wider area. The geographic area of analysis is specified in the discussion of the cumulative impacts for that resource where it differs from the general area of evaluation described above.

A temporal boundary is the timeframe during which the cumulative effects are reasonably expected to occur. The temporal parameters for these cumulative effects analysis is the anticipated lifespan of the Proposed Project, beginning

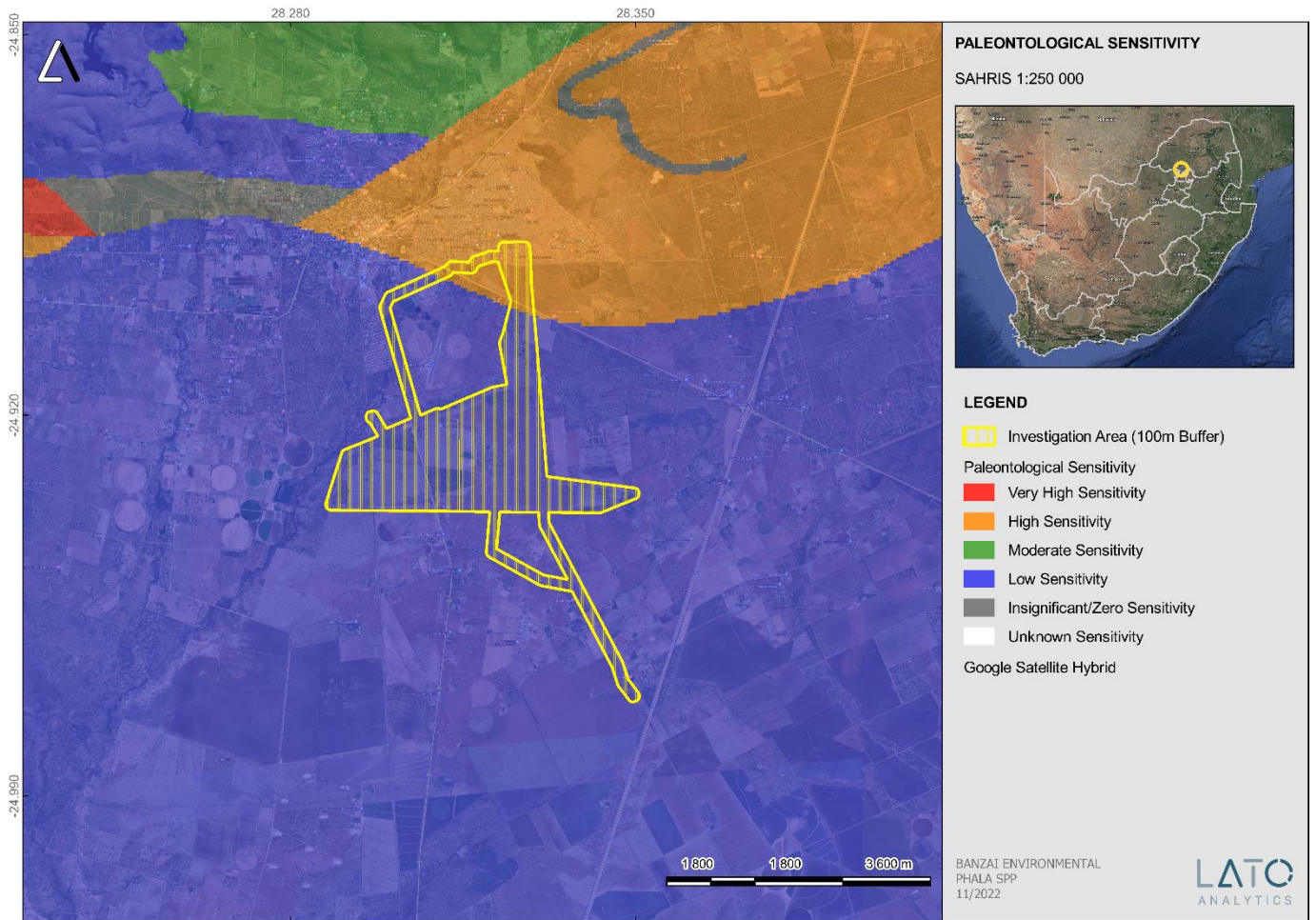


in 2024 and extending out at least 20 years, which is the minimum expected project life of the proposed project. Where appropriate, particular focus is on near-term cumulative impacts of overlapping construction schedules for proposed projects in the area of evaluation.

Table 9:A summary of related facilities, that may have a cumulative impact, in a 30 km radius of the Phala SPP.

Site Name	Distance from Study Area	Proposed generating capacity	DEFF Reference	EIA Process	Project status
Portion 67 of Tweefontein Farm 462 KR	9km	30 MW	12/12/20/2130	Scoping and EIA	Approved
Gihon Solar Energy Facility	0km	75 MW	14/12/16/3/3/2/576	Scoping and EIA	Approved
Portion 67 of Tweefontein Farm 462 KR	9km	75 MW	14/12/16/3/3/2/6	Scoping and EIA	Approved

In general, development activity in the area is focused on agriculture. It is quite possible that future solar farm developments may take place within the general area.



**Figure 10:** General Palaeontological Sensitivity of the Bela-Bela area.

The general Palaeontological Sensitivity of the area is Low to High (see SAHRIS Palaeomap (**Figure 11**)). However, it is important to note that the quality of preservation of these different sites will most probably vary and it is thus difficult to allocate a Cumulative Sensitivity to the projects. If all the mitigation measures are carried out, a conservative estimate of the Cumulative impacts on fossil Heritage will vary between Low and Medium.



## 8 GEOGRAPHICAL LOCATION OF THE SITE

The proposed Phala SPP is located on the following farms and farm portions:

Remaining Extent of Portion 1 of the Farm Turfbult No. 494

Remaining Extent of Portion 2 of the Farm Turfbult No. 494

Portion 5 of the Farm Turfbult No. 494

Portion 7 of the Farm Turfbult No. 494

While the Power line is located on the Remaining Extent of Portion 1 of the Farm Turfbult No. 494 (**Figure 1-3**).

## 9 METHODS

The aim of a desktop study is to evaluate the possible risk to palaeontological heritage in the proposed development. This includes all trace fossils as well as all fossils in the proposed footprint. All possible information is consulted to compile a desktop study, and this includes the following: all Palaeontological Impact Assessment reports in the same area; aerial photos and Google Earth images, topographical as well as geological maps.

### 9.1 Assumptions and Limitations

The focal point of geological maps is the geology of the area and the sheet explanations of the Geological Maps were not meant to focus on palaeontological heritage. Many inaccessible regions of South Africa have never been reviewed by palaeontologists and data is generally based on aerial photographs alone. Locality and geological information of museums and universities databases have not been kept up to date or data collected in the past have not always been accurately documented.

Comparable Assemblage Zones in other areas is also used to provide information on the existence of fossils in an area which has not documented in the past. When using similar Assemblage Zones and geological formations for Desktop studies it is generally **assumed** that exposed fossil heritage is present within the footprint. A field-assessment will thus improve the accuracy of the desktop assessment.

## 10 ADDITIONAL INFORMATION CONSULTED

In compiling this report the following sources were consulted:

- Geological map 1:100 000, Geology of the Republic of South Africa (Visser 1984)
- A Google Earth map with polygons of the proposed development was obtained from Environamics.
- 1: 250 000 Nylstroom 2428 (1978) Geological Map (Council for Geosciences, Pretoria)
- Palaeotechnical report of the Limpopo Province (Groenewald et al, 2014)

## 11 IMPACT ASSESSMENT METHODOLOGY

The environmental assessment aims to identify the various possible environmental impacts that could results from the proposed activity. Different impacts need to be evaluated in terms of its significance and in doing so highlight the most critical issues to be addressed.



Significance is determined through a synthesis of impact characteristics which include context and intensity of an impact. Context refers to the geographical scale i.e., site, local, national or global whereas intensity is defined by the severity of the impact e.g., the magnitude of deviation from background conditions, the size of the area affected, the duration of the impact and the overall probability of occurrence. Significance is calculated as shown in Table 4.1.

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

### Impact Rating System

Impact assessment must take account of the nature, scale and duration of impacts on the environment whether such impacts are positive or negative. Each impact is also assessed according to the project phases:

- planning
- construction
- operation
- decommissioning

Where necessary, the proposal for mitigation or optimisation of an impact should be detailed. A brief discussion of the impact and the rationale behind the assessment of its significance should also be included. The rating system is applied to the potential impacts on the receiving environment and includes an objective evaluation of the mitigation of the impact. In assessing the significance of each impact, the following criteria is used:

<i>Table 10: The rating system.</i>		
<b>NATURE</b>		
Loss of fossil heritage.		
<b>GEOGRAPHICAL EXTENT</b>		
This is defined as the area over which the impact will be experienced.		
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.
<b>PROBABILITY</b>		
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).
<b>DURATION</b>		
This describes the duration of the impacts. Duration indicates the lifetime of the impact as a result of the proposed activity.		
1	Short term	The impact will either disappear with mitigation or will be mitigated through natural processes in a span shorter than the construction phase (0 – 1 years), or the impact 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 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 – 30 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 indefinite.
<b>INTENSITY/ MAGNITUDE</b>		
Describes the severity of an impact.		
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. Rehabilitation and remediation often impossible. If possible rehabilitation and remediation often unfeasible due to extremely high costs of rehabilitation and remediation.
<b>REVERSIBILITY</b>		
This describes the degree to which an impact 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.
<b>IRREPLACEABLE LOSS OF RESOURCES</b>		
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.
<b>CUMULATIVE EFFECT</b>		
This describes the cumulative effect of the impacts. A cumulative impact is an effect which in itself may not be significant but may become significant if added to other existing or potential impacts emanating from other similar or diverse activities as a result of the project activity in question.		
1	Negligible cumulative impact	The impact would result in negligible to no cumulative effects.
2	Low cumulative impact	The impact would result in insignificant cumulative effects.
3	Medium cumulative impact	The impact would result in minor cumulative effects.
4	High cumulative impact	The impact would result in significant cumulative effects
<b>SIGNIFICANCE</b>		
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. The calculation of the significance of an impact uses the following formula: (Extent + probability + reversibility + irreplaceability + duration + cumulative effect) 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
6 to 28	Negative low impact	The anticipated impact will have negligible negative effects and will require little to no mitigation.
6 to 28	Positive low impact	The anticipated impact will have minor positive effects.
29 to 50	Negative medium impact	The anticipated impact will have moderate negative effects and will require moderate mitigation measures.
29 to 50	Positive medium impact	The anticipated impact will have moderate positive effects.
51 to 73	Negative high impact	The anticipated impact will have significant effects and will require significant mitigation measures to achieve an acceptable level of impact.
51 to 73	Positive high impact	The anticipated impact will have significant positive effects.
74 to 96	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".
74 to 96	Positive very high impact	The anticipated impact will have highly significant positive effects.

**Table 11: Summary of Impacts**  
 (Extent + probability + reversibility + irreplaceability + duration + cumulative effect) x magnitude/intensity

	Extent	Duration	Magnitude	Reversibility	Irreplicable loss	Cumulative effect	Impact
Pre-Mitigation	1	4	2	4	4	3	32
Post-Mitigation	1	4	1	4	4	3	16



## 12 FINDINGS AND RECOMMENDATIONS

The Phala Solar Power Plant is underlain by the Letaba Formation (Lebombo Group, Karoo Igneous Province) while the most northern portion of the connection corridor and Eskom Power lines are underlain by the Clarens Formation (Karoo Supergroup). The Palaeotechnical Report of the Limpopo Province (Groenewald et al, 2014) as well as the PalaeoMap of the South African Heritage Resources Information System (SAHRIS) (Almond et al, 2013; SAHRIS website) allocates a High Palaeontological Sensitivity to the Clarens Formation and a Low Palaeontological Sensitivity the Letaba Subgroup. However, the Palaeotechnical report of the Limpopo Province (Groenewald et al, 2014) indicates “very poor levels of surface exposure” and that most data were obtained from borehole cores.

A Low Palaeontological Significance has been allocated to the proposed Phala SPP development. It is therefore considered that the proposed development will not lead to detrimental impacts on the palaeontological resources of the area. The construction and operation of the project may be authorised, as the whole extent of the development footprint is not considered sensitive in terms of palaeontological heritage.

However, if fossil remains are discovered during any phase of construction, either on the surface or exposed by excavations the **Chance Find Protocol** must be implemented by the ECO/site manager in charge of these developments. These discoveries ought to be protected (if possible, *in situ*) and the ECO/site manager must report to SAHRA (Contact details: SAHRA, 111 Harrington Street, Cape Town. PO Box 4637, Cape Town 8000, South Africa. Tel: 021 462 4502. Fax: +27 (0)21 462 4509. Web: [www.sahra.org.za](http://www.sahra.org.za)) so that mitigation (recording and collection) can be carry out by a paleontologist.

Preceding any collection of fossil material, the specialist would need to apply for a collection permit from SAHRA. Fossil material must be curated in an accredited collection (museum or university collection), while all fieldwork and reports should meet the minimum standards for palaeontological impact studies suggested by SAHRA.



## 13 CHANCE FINDS PROTOCOL

The following procedure will only be followed if fossils are uncovered during the excavation phase of the development.

### 13.1 Legislation

Cultural Heritage in South Africa (includes all heritage resources) is protected by the **National Heritage Resources Act (Act No 25 of 1999) (NHRA)**. According to Section 3 of the Act, all Heritage resources include **“all objects recovered from the soil or waters of South Africa, including archaeological and palaeontological objects and material, meteorites and rare geological specimens”**.

Palaeontological heritage is unique and non-renewable and is protected by the NHRA and are the property of the State. It is thus the responsibility of the State to manage and conserve fossils on behalf of the citizens of South Africa. Palaeontological resources may not be excavated, broken, moved, or destroyed by any development without prior assessment and without a permit from the relevant heritage resources authority as per section 35 of the NHRA.

A fossil is the naturally preserved remains (or traces thereof) of plants or animals embedded in rock. These organisms lived millions of years ago. Fossils are extremely rare and irreplaceable. By studying fossils, it is possible to determine the environmental conditions that existed in a specific geographical area millions of years ago.

This informational document is intended for workmen and foremen on construction sites. It describes the actions to be taken when mining or construction activities accidentally uncovers fossil material.

It is the responsibility of the Environmental Site Officer (ESO) or site manager of the project to train the workmen and foremen in the procedure to follow when a fossil is accidentally uncovered. In the absence of the ESO, a member of the staff must be appointed to be responsible for the proper implementation of the chance find protocol as not to compromise the conservation of fossil material.

### 13.2 Chance Find Procedure

- If a chance find is made the person responsible for the find must immediately **stop working** and all work that could impact that finding must cease in the immediate vicinity of the find.
- The person who made the find must immediately **report** the find to his/her direct supervisor which in turn must report the find to his/her manager and the ESO or site manager. The ESO or site manager must report the find to the relevant Heritage Agency (South African Heritage Research Agency, SAHRA).



(Contact details: SAHRA, 111 Harrington Street, Cape Town. PO Box 4637, Cape Town 8000, South Africa. Tel: 021 462 4502. Fax: +27 (0)21 462 4509. Web: [www.sahra.org.za](http://www.sahra.org.za)). The information to the Heritage Agency must include photographs of the find, from various angles, as well as the GPS co-ordinates.

- A preliminary report must be submitted to the Heritage Agency within **24 hours** of the find and must include the following: 1) date of the find; 2) a description of the discovery and a 3) description of the fossil and its context (depth and position of the fossil), GPS co-ordinates.
- Photographs (the more the better) of the discovery must be of high quality, in focus, accompanied by a scale. It is also important to have photographs of the vertical section (side) where the fossil was found.
- Upon receipt of the preliminary report, the Heritage Agency will inform the ESO (or site manager) whether a rescue excavation or rescue collection by a palaeontologist is necessary.
- The site must be secured to protect it from any further damage. **No attempt** should be made to remove material from their environment. The exposed finds must be stabilized and covered by a plastic sheet or sand bags. The Heritage agency will also be able to advise on the most suitable method of protection of the find.
- If the fossil cannot be stabilized the fossil may be collected with extreme care by the ESO. Fossils finds must be stored in tissue paper and in an appropriate box while due care must be taken to remove all fossil material from the rescue site.
- Once the Heritage Agency has issued the written authorization, the developer may continue with the development on the affected area.

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## Appendix A – Elize Butler CV

PROFESSION:	Palaeontologist
YEARS' EXPERIENCE:	29 years in Palaeontology
EDUCATION:	B.Sc Botany and Zoology, 1988 University of the Orange Free State
	B. Sc (Hons) Zoology, 1991 University of the Orange Free State
	Management Course, 1991 University of the Orange Free State
	M. Sc. <i>Cum laude</i> (Zoology), 2009 University of the Free State

**Dissertation title:** The postcranial skeleton of the Early Triassic non-mammalian Cynodont *Galesaurus planiceps*: implications for biology and lifestyle

### MEMBERSHIP

Palaeontological Society of South Africa (PSSA) 2006-currently

### EMPLOYMENT HISTORY

Part-time Laboratory assistant	Department of Zoology & Entomology University of the Free State Zoology 1989-1992
Part-time laboratory assistant	Department of Virology University of the Free State Zoology 1992
Research Assistant	National Museum, Bloemfontein 1993 – 1997
Principal Research Assistant and Collection Manager	National Museum, Bloemfontein 1998–currently

### TECHNICAL REPORTS

**Butler, E. 2014.** Palaeontological Impact Assessment of the proposed development of private dwellings on portion 5 of farm 304 Matjesfontein Keurboomstrand, Knysna District, Western Cape Province. Bloemfontein.

**Butler, E. 2014.** Palaeontological Impact Assessment for the proposed upgrade of existing water supply infrastructure at Noupoort, Northern Cape Province. 2014. Bloemfontein.



**Butler, E. 2015.** Palaeontological impact assessment of the proposed consolidation, re-division, and development of 250 serviced erven in Nieu-Bethesda, Camdeboo local municipality, Eastern Cape. Bloemfontein.

**Butler, E. 2015.** Palaeontological impact assessment of the proposed mixed land developments at Rooikraal 454, Vrede, Free State. Bloemfontein.

**Butler, E. 2015.** Palaeontological exemption report of the proposed truck stop development at Palmiet 585, Vrede, Free State. Bloemfontein.

**Butler, E. 2015.** Palaeontological impact assessment of the proposed Orange Grove 3500 residential development, Buffalo City Metropolitan Municipality East London, Eastern Cape. Bloemfontein.

**Butler, E. 2015.** Palaeontological Impact Assessment of the proposed Gonubie residential development, Buffalo City Metropolitan Municipality East London, Eastern Cape Province. Bloemfontein.

**Butler, E. 2015.** Palaeontological Impact Assessment of the proposed Ficksburg raw water pipeline. Bloemfontein.

**Butler, E. 2015.** Palaeontological Heritage Impact Assessment report on the establishment of the 65 mw Majuba Solar Photovoltaic facility and associated infrastructure on portion 1, 2 and 6 of the farm Witkoppies 81 HS, Mpumalanga Province. Bloemfontein.

**Butler, E. 2015.** Palaeontological Impact Assessment of the proposed township establishment on the remainder of portion 6 and 7 of the farm Sunnyside 2620, Bloemfontein, Mangaung metropolitan municipality, Free State, Bloemfontein.

**Butler, E. 2015.** Palaeontological Impact Assessment of the proposed Woodhouse 1 photovoltaic solar energy facilities and associated infrastructure on the farm Woodhouse729, near Vryburg, North West Province. Bloemfontein.

**Butler, E. 2015.** Palaeontological Impact Assessment of the proposed Woodhouse 2 photovoltaic solar energy facilities and associated infrastructure on the farm Woodhouse 729, near Vryburg, North West Province. Bloemfontein.

**Butler, E. 2015.** Palaeontological Impact Assessment of the proposed Orkney solar energy farm and associated infrastructure on the remaining extent of Portions 7 and 21 of the farm Wolvehuis 114, near Orkney, North West Province. Bloemfontein.

**Butler, E. 2015.** Palaeontological Impact Assessment of the proposed Spectra foods broiler houses and abattoir on the farm Maiden Manor 170 and Ashby Manor 171, Lukhanji Municipality, Queenstown, Eastern Cape Province. Bloemfontein.

**Butler, E. 2016.** Palaeontological Impact Assessment of the proposed construction of the 150 MW Noupoot concentrated solar power facility and associated infrastructure on portion 1 and 4 of the farm Carolus Poort 167 and the remainder of Farm 207, near Noupoot, Northern Cape. Prepared for Savannah Environmental. Bloemfontein.

**Butler, E. 2016.** Palaeontological Impact Assessment of the proposed Woodhouse 1 Photovoltaic Solar Energy facility and associated infrastructure on the farm Woodhouse 729, near Vryburg, North West Province. Bloemfontein.



- Butler, E. 2016.** Palaeontological Impact Assessment of the proposed Woodhouse 2 Photovoltaic Solar Energy facility and associated infrastructure on the farm Woodhouse 729, near Vryburg, North West Province. Bloemfontein.
- Butler, E. 2016.** Proposed 132kV overhead power line and switchyard station for the authorised Solis Power 1 CSP project near Upington, Northern Cape. Bloemfontein.
- Butler, E. 2016.** Palaeontological Impact Assessment of the proposed Senqu Pedestrian Bridges in Ward 5 of Senqu Local Municipality, Eastern Cape Province. Bloemfontein.
- Butler, E. 2016.** Recommendation from further Palaeontological Studies: Proposed Construction of the Modderfontein Filling Station on Erf 28 Portion 30, Founders Hill, City of Johannesburg, Gauteng Province. Bloemfontein.
- Butler, E. 2016.** Recommendation from further Palaeontological Studies: Proposed Construction of the Modikwa Filling Station on a Portion of Portion 2 of Mooihoek 255 Kt, Greater Tubatse Local Municipality, Limpopo Province. Bloemfontein.
- Butler, E. 2016.** Recommendation from further Palaeontological Studies: Proposed Construction of the Heidedal filling station on Erf 16603, Heidedal Extension 24, Mangaung Local Municipality, Bloemfontein, Free State Province. Bloemfontein.
- Butler, E. 2016.** Recommended Exemption from further Palaeontological studies: Proposed Construction of the Gunstfontein Switching Station, 132kv Overhead Power Line (Single or Double Circuit) and ancillary infrastructure for the Gunstfontein Wind Farm Near Sutherland, Northern Cape Province. Savannah South Africa. Bloemfontein.
- Butler, E. 2016.** Palaeontological Impact Assessment of the proposed Galla Hills Quarry on the remainder of the farm Roode Krantz 203, in the Lukhanji Municipality, division of Queenstown, Eastern Cape Province. Bloemfontein.
- Butler, E. 2016.** Chris Hani District Municipality Cluster 9 water backlog project phases 3a and 3b: Palaeontology inspection at Tsomo WTW. Bloemfontein.
- Butler, E. 2016.** Palaeontological Impact Assessment of the proposed construction of the 150 MW Noupoot concentrated solar power facility and associated infrastructure on portion 1 and 4 of the farm Carolus Poort 167 and the remainder of Farm 207, near Noupoot, Northern Cape. Savannah South Africa. Bloemfontein.
- Butler, E. 2016.** Palaeontological Impact Assessment of the proposed upgrading of the main road MR450 (R335) from Motherwell to Addo within the Nelson Mandela Bay Municipality and Sunday's River valley Local Municipality, Eastern Cape Province. Bloemfontein.
- Butler, E. 2016.** Palaeontological Impact Assessment construction of the proposed Metals Industrial Cluster and associated infrastructure near Kuruman, Northern Cape Province. Savannah South Africa. Bloemfontein.
- Butler, E. 2016.** Palaeontological Impact Assessment for the proposed construction of up to a 132kv power line and associated infrastructure for the proposed Kalkaar Solar Thermal Power Plant near Kimberley, Free State and Northern Cape Provinces. PGS Heritage. Bloemfontein.
- Butler, E. 2016.** Palaeontological Impact Assessment of the proposed development of two burrow pits (DR02625 and DR02614) in the Enoch Mgijima Municipality, Chris Hani District, Eastern Cape.



**Butler, E. 2016.** Ezibeleni waste Buy-Back Centre (near Queenstown), Enoch Mgijima Local Municipality, Eastern Cape. Bloemfontein.

**Butler, E. 2016.** Palaeontological Impact Assessment for the proposed construction of two 5 Mw Solar Photovoltaic Power Plants on Farm Wildebeestkuil 59 and Farm Leeuwbosch 44, Leeudoringstad, North West Province. Bloemfontein.

**Butler, E. 2016.** Palaeontological Impact Assessment for the proposed development of four Leeuwberg Wind farms and basic assessments for the associated grid connection near Loeriesfontein, Northern Cape Province. Bloemfontein.

**Butler, E. 2016.** Palaeontological impact assessment for the proposed Aggeneys south prospecting right project, Northern Cape Province. Bloemfontein.

**Butler, E. 2016.** Palaeontological impact assessment of the proposed Motuoane Ladysmith Exploration right application, KwaZulu Natal. Bloemfontein.

**Butler, E. 2016.** Palaeontological impact assessment for the proposed construction of two 5 MW solar photovoltaic power plants on farm Wildebeestkuil 59 and farm Leeuwbosch 44, Leeudoringstad, North West Province. Bloemfontein.

**Butler, E. 2016:** Palaeontological desktop assessment of the establishment of the proposed residential and mixed-use development on the remainder of portion 7 and portion 898 of the farm Knopjeslaagte 385 Ir, located near Centurion within the Tshwane Metropolitan Municipality of Gauteng Province. Bloemfontein.

**Butler, E. 2017.** Palaeontological impact assessment for the proposed development of a new cemetery, near Kathu, Gamagara local municipality and John Taolo Gaetsewe district municipality, Northern Cape. Bloemfontein.

**Butler, E. 2017.** Palaeontological Impact Assessment of The Proposed Development of The New Open Cast Mining Operations on The Remaining Portions Of 6, 7, 8 And 10 Of the Farm Kwaggafontein 8 In the Carolina Magisterial District, Mpumalanga Province. Bloemfontein.

**Butler, E. 2017.** Palaeontological Desktop Assessment for the Proposed Development of a Wastewater Treatment Works at Lanseria, Gauteng Province. Bloemfontein.

**Butler, E. 2017.** Palaeontological Scoping Report for the Proposed Construction of a Warehouse and Associated Infrastructure at Perseverance in Port Elizabeth, Eastern Cape Province.

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**Butler, E., 2020.** Palaeontological Desktop Assessment of the Proposed Okapi Diamonds (Pty) Ltd Mining Right of Diamonds Alluvial (Da) & Diamonds General (D) Combined with a Waste Licence Application on the Remaining Extent of Portion 9 (Wouter) of the Farm Lanyon Vale 376; Registration Division: Hay; Northern Cape Province. Banzai Environmental (Pty) Ltd, Bloemfontein.

**Butler, E., 2020.** Palaeontological Field Assessment of the Proposed Prospecting Right Application for the Prospecting of Diamonds (Alluvial & General) between Douglas and Prieska on Portion 12, Remaining Extent of Portion 29 (Portion of Portion 13) and Portion 31 (Portion of Portion 29) on the Farm Reads Drift 74, Registration Division; Herbert, Northern Cape Province. Banzai Environmental (Pty) Ltd, Bloemfontein.

**Butler, E., 2020.** Palaeontological Desktop Assessment for the Proposed Mining Permit Application Combined with a Waste License Application for the Mining of Diamonds (Alluvial) Near Schweitzer-Reneke on a certain Portion of Portion 12 (Ptn of Ptn 7) of the Farm Doornhoek 165, Registration Division: HO, North West Province. Banzai Environmental (Pty) Ltd, Bloemfontein.

**Butler, E., 2020.** Palaeontological Desktop Assessment for Black Mountain Koa South Prospecting Right Application, Without Bulk Sampling, in the Northern Cape. Banzai Environmental (Pty) Ltd, Bloemfontein.

**Butler, E., 2020.** Palaeontological Impact Assessment of the Proposed AA Bakery Expansion, Sedibeng District Municipality, Gauteng. Banzai Environmental (Pty) Ltd, Bloemfontein.

**Butler, E., 2020.** Palaeontological Desktop Assessment for the Proposed Boegoeberg Township Expansion, !Kheis Local Municipality, ZF Mgcawu District Municipality, Northern Cape Province. Banzai Environmental (Pty) Ltd, Bloemfontein.

**Butler, E., 2020.** Palaeontological Desktop Assessment for the Proposed Gariiep Township Expansion, !Kheis Local Municipality, ZF Mgcawu District Municipality, Northern Cape Province. Banzai Environmental (Pty) Ltd, Bloemfontein.

**Butler, E., 2020.** Palaeontological Desktop Assessment for the Proposed Groblershoop Township Expansion, !Kheis Local Municipality, Zf Mgcawu District Municipality, Northern Cape Province. Banzai Environmental (Pty) Ltd, Bloemfontein.

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**Butler, E., 2020.** Palaeontological Exemption Letter for the Proposed Opwag Township Expansion, !Kheis Local Municipality, ZF Mgcawu District Municipality, Northern Cape Province. Banzai Environmental (Pty) Ltd, Bloemfontein.

**Butler, E., 2020.** Palaeontological Exemption Letter for the Proposed Topline Township Expansion, !Kheis Local Municipality, ZF Mgcawu District Municipality, Northern Cape Province. Banzai Environmental (Pty) Ltd, Bloemfontein.

**Butler, E., 2020.** Palaeontological Desktop Assessment for the Proposed Wegdraai Township Expansion, !Kheis Local Municipality, Zf Mgcawu District Municipality, Northern Cape Province. Banzai Environmental (Pty) Ltd, Bloemfontein.

**Butler, E., 2020.** Palaeontological field Assessment for the Proposed Establishment of an Emulsion Plant on Erf 1559, Hardustria, Harrismith, Free State. Banzai Environmental (Pty) Ltd, Bloemfontein.



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**Butler, E.,** 2021. Palaeontological Desktop Assessment for the Proposed Expansion of the Square *Kilometre* Array (SKA) Meerkat Project, on the Farms Mey's Dam RE/68, Brak Puts RE /66, Swartfontein RE /496 & Swartfontein 2/496, in the Kareeberg Local Municipality, Pixley Ka Seme District Municipality, and the Farms Los Berg 1/73 & Groot Paardekloof RE /74, in the Karoo Hoogland Local Municipality, Namakwa District Municipality, Northern Cape Province. Banzai Environmental (Pty) Ltd, Bloemfontein.

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**Butler, E., 2021.** Palaeontological Desktop Assessment for the proposed Red Rock Mountain Farm activities on Portions 2, 3 and 11 of the Farm Buffelskloof 22, near Calitzdorp in the Western Cape. Banzai Environmental (Pty) Ltd, Bloemfontein.

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**Butler, E., 2021.** Palaeontological Impact Assessment for the Proposed Realignment of the D 2809 Provincial Road as well as the Mining Right Application for the Glisa and Paardeplaats Sections of the NBC Colliery (NBC) near Belfast (eMakhazeni), eMakhazeni Local Municipality, Nkangala District Municipality, Mpumalanga Province. Banzai Environmental (Pty) Ltd, Bloemfontein.

**Butler, E., 2021.** Palaeontological Desktop Assessment for the proposed construction of Whittlesea Cemetery within Enoch Mqijima Local Municipality area, Eastern Cape. Banzai Environmental (Pty) Ltd, Bloemfontein.

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**Butler, E., 2021.** Palaeontological Desktop Assessment for the proposed East Orchards Poultry Farm, Delmas/Botleng Transitional Local Council, Mpumalanga. Banzai Environmental (Pty) Ltd, Bloemfontein.

**Butler, E., 2021.** Palaeontological Impact Assessment for the proposed East Orchards Poultry Farm, Delmas/Botleng Transitional Local Council, Mpumalanga. Banzai Environmental (Pty) Ltd, Bloemfontein.

**Butler, E., 2021.** Palaeontological Desktop Assessment to assess the proposed Gariep Road upgrade near Groblershoop, Northern Cape Province. Banzai Environmental (Pty) Ltd, Bloemfontein.

**Butler, E., 2021. Palaeontological Impact Assessment** for the Ngwedi Solar Plant which forms part of the authorised Paleso Solar Powerplant near Viljoenskroon in the Free State. Banzai Environmental (Pty) Ltd, Bloemfontein.

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**Butler, E., 2020.** Palaeontological Desktop Assessment for the proposed Saselamani CBD on the Remainder of Tshikundu's Location 262 MT, and the Remainder of Portion 1 of Tshikundu's Location 262 MT, Collins Chabane Local Municipality, Limpopo Province. Banzai Environmental (Pty) Ltd, Bloemfontein.

**Butler, E., 2021.** Palaeontological Impact Assessment for the proposed expansions of the existing Molare Piggery infrastructure and related activities on Portion 0(Re) of the farm Arendsfontein 464 JS, Portion 0(Re) of the farm Wanhoop 443 JS, Portion 0(Re) of the farm Eikeboom 476 JS and Portions 2 & 7 of the farm Klipbank 467 JS within the jurisdiction of the Steve Tshwete Local Municipality, Mpumalanga Province. Banzai Environmental (Pty) Ltd, Bloemfontein.

**Butler, E., 2021.** Palaeontological Desktop Assessment for the proposed Nchwaning Rail Balloon Turn Outs at Black Rock Mine Operations (BRMO) near Hotazel in the John Taolo Gaetsewe District Municipality in the Northern Cape. Banzai Environmental (Pty) Ltd, Bloemfontein.

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**Butler, E., 2021.** Palaeontological Desktop Assessment for the proposed Kappies Kareeboom Prospecting Project on Portion 1 and the Remainder of the farm Kappies Kareeboom 540, the Remainder of Farm 544, Portion 5 of farm 534 and Portion 1 of the farm Putsfontein 616, ZF Mgcawu District Municipality, Northern Cape Province. Banzai Environmental (Pty) Ltd, Bloemfontein.

**Butler, E., 2021.** Palaeontological Desktop Assessment for the proposed Kameel Fontein Prospecting Project on the Remainder of the farm Kameel Fontein 490, a portion of the farm Strydfontein 614 and the farm Soetfontein 606, ZF Mgcawu District Municipality, Northern Cape Province. Banzai Environmental (Pty) Ltd, Bloemfontein.

**Butler, E., 2021.** Palaeontological Desktop Assessment for the proposed Lewis Prospecting Project on Portions of the Farms Lewis 535, Spence 537, Wright 538, Symthe 566, Bredenkamp 567, Brooks 568, Beaumont 569 and Murray 570, John Taolo Gaetsewe District Municipality in the Northern Cape Province. Banzai Environmental (Pty) Ltd, Bloemfontein.



**Butler, E., 2021.** Palaeontological Desktop Assessment for the Construction of the Ganspan Pering 132kV Powerline, Phokwane Local Municipality, Frances Baard District Municipality in the Northern Cape. Banzai Environmental (Pty) Ltd, Bloemfontein.

**Butler, E., 2021.** Palaeontological Desktop Assessment for the Longlands Prospecting Project on a Portion of the farm Longlands 350, Frances Baard District Municipality, Northern Cape Province. Banzai Environmental (Pty) Ltd, Bloemfontein.

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**Butler, E., 2021.** Palaeontological Desktop Assessment for the proposed Qhumanco Irrigation Project, Chris Hani District Municipality Eastern Cape. Banzai Environmental (Pty) Ltd, Bloemfontein.

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**Butler, E., 2021.** Palaeontological Impact Assessment for the Senqu Rural Project, Joe Gqabi District Municipality, Senqu Local Municipality, in the Eastern Cape Province. Banzai Environmental (Pty) Ltd, Bloemfontein.

**Butler, E., 2021.** Palaeontological Impact Assessment for the proposed new Township development on portion of the farm Klipfontein 716 and farm Ceres 626 in Bloemfontein, Mangaung Metropolitan Municipality, Free State. Banzai Environmental (Pty) Ltd, Bloemfontein.

**Butler, E., 2021.** Palaeontological Desktop Assessment for the ECDOT Borrow Pits and WULA near Sterkspruit, Joe Gqabi District Municipality in the Eastern Cape Province. Banzai Environmental (Pty) Ltd, Bloemfontein.

**Butler, E., 2021.** Palaeontological Desktop Assessment for the proposed SANRAL Stone Crescent Embankment Stabilisation Works along the N2 on the farm Zyfer Fonteyn 253 (Portion 0, 11 and 12RE) and Palmiet Rivier 305 (Portion 34, 36) near Grahamstown in the Eastern Cape. Banzai Environmental (Pty) Ltd, Bloemfontein.

**Butler, E., 2021.** Palaeontological Impact Assessment for the Klein Rooipoort Trust Citrus Development, in the Eastern Cape. Banzai Environmental (Pty) Ltd, Bloemfontein.

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**Butler, E., 2021.** Palaeontological Desktop Assessment for the proposed Campbell Sewer, Internal Reticulation, Outfall Sewer Line and Oxidation Ponds, located on ERF 1, Siyancuma Local Municipality in the Northern Cape. Banzai Environmental (Pty) Ltd, Bloemfontein.

**Butler, E., 2021.** Palaeontological Desktop Assessment for the proposed Development and Upgrades within the Great Fish River Nature Reserve, Eastern Cape Province. Banzai Environmental (Pty) Ltd, Bloemfontein.

**Butler, E., 2021.** Palaeontological Desktop Assessment for proposed Parsons Power Park a portion of Erf 1. within the Nelson Mandela Bay Municipality in the Eastern Cape. Banzai Environmental (Pty) Ltd, Bloemfontein.

**Butler, E., 2021.** Palaeontological Desktop Assessment for the proposed expansion of the farming operations on part of portions 7 and 8 of farm Boerboonkraal 353 in the Greater Tubatse Local Municipality of Sekhukhune District, Limpopo Province. Banzai Environmental (Pty) Ltd, Bloemfontein.



**Butler, E., 2021.** Palaeontological Desktop Assessment to assess the proposed low-level pedestrian bridge, in Heilbron, Free State. Banzai Environmental (Pty) Ltd, Bloemfontein.

**Butler, E., 2021.** Palaeontological Desktop Assessment to assess the proposed township developments in Hertzogville, Malebogo, in Heilbron, Free State. Banzai Environmental (Pty) Ltd, Bloemfontein.

**Butler, E., 2021.** Palaeontological Impact Assessment for the proposed construction of Malangazana Bridge on Farm No.64 Nkwenkwana, Engcobo Local Municipality, Eastern Cape. Banzai Environmental (Pty) Ltd, Bloemfontein.

**Butler, E., 2021.** Palaeontological Impact Assessment to assess the proposed Construction of Middelburg Integrated Transport Control Centre on Portion 14 of Farm 81 Division of Middelburg, Chris Hani District Municipality in the Eastern Cape. Banzai Environmental (Pty) Ltd, Bloemfontein.

**Butler, E., 2021.** Palaeontological Desktop Assessment for the Witteberge Sand Mine on the remainder of farm Elandskrag Plaas 269 located in the Magisterial District of Laingsburg and Central Karoo District Municipality in the Western Cape. Banzai Environmental (Pty) Ltd, Bloemfontein.

**Butler, E., 2021.** Palaeontological Impact Assessment (PIA) to assess the proposed Agrizone 2, Dube Trade Port in KwaZulu Natal Province. Banzai Environmental (Pty) Ltd, Bloemfontein.

**Butler, E., 2021.** Palaeontological Desktop Assessment assessing the proposed Prospecting Right application without bulk sampling for the prospecting of Chrome ore and platinum group metals on the Remaining Extent of the farm Doornspruit 106, Registration Division: HO; North West Province. Banzai Environmental (Pty) Ltd, Bloemfontein.

**Butler, E., 2022.** Palaeontological Desktop Assessment for the proposed Ennerdale Extension 2 Township Establishment on the Undeveloped Part of Portion 134 of the Farm Roodepoort 302IQ, City of Johannesburg Metropolitan Municipality, Gauteng Province. Banzai Environmental (Pty) Ltd, Bloemfontein.

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