



PALAEONTOLOGICAL IMPACT ASSESSMENT

PROPOSED ACRUX SOLAR PV
PROJECT ONE NEAR
BLOEMFONTEIN, FREE STATE
PROVINCE

2023

COMPILED FOR:

BLUE CRANE 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:



This Palaeontological Impact Assessment report (as part of the Heritage Impact Assessment), 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).

Requirements of Appendix 6 – GN R326 EIA Regulations of 7 April 2017	The relevant section in the report	Comment where not applicable.
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 vita	Section 3 – refer to Appendix A	-
(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 4 – Methods and Terms of Reference	-
(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 10	-



Requirements of Appendix 6 – GN R326 EIA Regulations of 7 April 2017	The relevant section in the report	Comment where not applicable.
(d) The duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment	Section 1, 8 & 11	-
(e) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used	Section 5 – Methods and TOR	-
(f) details of an assessment of the specifically 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 & 11	-
(g) An identification of any areas to be avoided, including buffers	Section 1 & 11	-
(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 5. 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 & 11	-
(k) Any mitigation measures for inclusion in the EMPr	Section 12	-
(l) Any conditions for inclusion in the environmental authorisation	Section 1 & 11	-
(m) Any monitoring requirements for inclusion in the EMPr or environmental authorisation	Section 1 & 11	-



Requirements of Appendix 6 – GN R326 EIA Regulations of 7 April 2017	The relevant section in the report	Comment where not applicable.
(n)(i) A reasoned opinion as to whether the proposed activity, activities or portions thereof should be authorised and	Section 1 & 11	-
(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 & 11	-
(o) A description of any consultation process that was undertaken during the course of carrying out the study	N/A	Not applicable. A public consultation process was handled as part of the Environmental Impact Assessment (EIA) and Environmental Management Plan (EMP) process.
(p) A summary and copies of any comments that were received during any consultation process	N/A	Not applicable. To date, no comments



Requirements of Appendix 6 – GN R326 EIA Regulations of 7 April 2017	The relevant section in the report	Comment where not applicable.
		regarding heritage resources that require input from a specialist have been raised.
(q) Any other information requested by the competent authority.	N/A	Not applicable.
(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 4 compliance with SAHRA guidelines	



EXECUTIVE SUMMARY

Banzai Environmental was appointed by Blue Crane Environmental (Pty) Ltd to conduct the Palaeontological Impact Assessment (PIA) to assess the Acrux Solar PV Project One near Bloemfontein in the Free State. 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.

The proposed Acrux Solar PV Project One near Bloemfontein in the Free State is underlain by Jurassic dolerite, the Permian aged sediments of the Lower Stage of the Beaufort Group, Karoo Series as well as the Upper stage of the Ecca Group. Mantling these sediments is Quaternary superficial sediments. Two grid alternatives have been proposed for the Acrux Solar PV Project One. As the geology of the two layouts are the same there are no preference between the alternatives from a Palaeontological Perspective. Updated Geology compiled by the Council of Geosciences (Council for Geoscience, Pretoria) refines the geology and indicates that the proposed Acrux Solar PV Project One is underlain by Karoo Dolerite, the Balfour Formation (Adelaide Subgroup, Karoo Supergroup) as well alluvium, colluvium, eluvium and gravel. The PalaeoMap of the South African Heritage Resources Information System (SAHRIS) indicates that the Palaeontological Sensitivity of the Balfour Formation (Adelaide Subgroup) is Very High, while that of the Tierberg Formation (Ecca Group) is Moderate. Jurassic dolerite is igneous in origin, unfossiliferous and has a Zero Palaeontological Sensitivity (Almond and Pether, 2009; Almond *et al.*, 2013). The layout of the Acrux Solar PV Project One has been updated after specialist input. However, these layouts will not have an effect on the development from a Palaeontological point of view.

A site-specific field survey of the development footprint was conducted on foot and by motor vehicle on 15-16 March 2023. No fossiliferous outcrop was detected in the proposed development. This could be attributed to the lack of outcrops as well as the lush grassy vegetation in the area. Based on the site investigation as well as desktop research it is concluded that fossil heritage of scientific and conservational interest in the development footprint is rare. This is in contrast with the High Sensitivity allocated to the development area by the SAHRIS Palaeosensitivity Map and DFFE Screening Tool. **A medium Palaeontological Significance has been allocated for the construction phase of the PV development pre-mitigation and a low significance post mitigation.** The construction phase will be the only development phase impacting Palaeontological Heritage and **no significant impacts are expected to impact the Operational and Decommissioning phases.** As the No-Go Alternative considers the option of 'do nothing' and maintaining the status quo, it will have a Neutral impact on the Palaeontological Heritage of the development. The **Cumulative impacts of the**



development near Kroonstad is considered to be medium pre-mitigation and Low post mitigation and falls within the acceptable limits for the project. It is therefore considered that the proposed development will not lead to damaging impacts on the palaeontological resources of the area. **The construction of the development may thus be permitted in its whole extent, as the development footprint is not considered sensitive in terms of palaeontological resources.** It is consequently recommended that no further palaeontological heritage studies, ground truthing and/or specialist mitigation are required pending the discovery of newly discovered fossils.

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) 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

Environmental parameter	Issues	Rating prior to mitigation	Average	Rating post mitigation	Average
Planning Phase Acrux Solar PV One	No Impact	0	No Impact	0	No Impact
Construction Phase Acrux Solar PV One	Destroy or permanently seal-in fossils at or below the surface that are then no longer available for scientific study	60	Negative Medium impact	15	Negative Low impact
Operational Phase Acrux Solar PV One	No Impact	0	No Impact	0	No Impact
Decommissioning Phase Acrux Solar PV One	No Impact	0	No Impact	0	No Impact
Planning Phase Acrux Solar PV One Grid connection	No Impact	0	No Impact	0	No Impact
Construction Stage Acrux Solar PV One Grid connection	Destroy or permanently seal-in fossils at or below the surface that are then no longer available for scientific study	60	Negative Medium impact	15	Negative Low impact
Operational Phase Acrux Solar PV One	No Impact	0	No Impact	0	No Impact



Grid connection					
Decommissioning Phase Acrux Solar PV One Grid connection	No Impact	0	No Impact	0	No Impact

It is therefore considered that the proposed Acrux Solar PV Project One near Bloemfontein in the Free State Province is deemed appropriate and 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: Curriculum Vitae



1 INTRODUCTION

The Applicant, Acrux Solar PV Project One (Pty) Ltd, is proposing the construction of a photovoltaic (PV) solar energy facility (known as Acrux Solar PV Project One) located on the Remaining Extent of Portion 6 of the Farm Brabant No. 205, approximately 17 km west of the city of Bloemfontein in the Free State Province. The solar PV facility will comprise several arrays of PV panels and associated infrastructure and will have a contracted capacity of up to 200 MW. The development area is situated within the Mangaung Metropolitan Municipality.

Energy generated by the facility will be evacuated into the National Grid via a 132 kV gridline connecting to the existing Eskom Harvard Substation located approximately 8 km east of the site. The Environmental Impact Assessment (EIA) assessment footprint is approximately 428 hectares in extent. A 200 m wide and 8 km long grid connection corridor will be assessed for placement of the grid connection infrastructure.

The proposed Acrux Solar PV Project One will include the following infrastructure:

- PV modules and mounting structures
- Inverters and transformers
- Battery Energy Storage System (BESS)
- Site and internal access roads (up to 8 m wide)
- Supporting infrastructure such as operations and maintenance building/office, switch gear and relay room, staff lockers and changing room, security control, and offices.
- Temporary and permanent laydown areas
- Grid connection infrastructure, including:
 - 33 kV cabling between the project components and the facility substations;
 - Two facility substations up to 132 kV (one located on either side of the road);
 - A collector switching station up to 132kV;
 - A 132 kV single/double circuit overhead power line linking the two facility substations; and
 - A 132 kV single/double circuit overhead power line linking the facility substation / Eskom switching station to the existing Harvard Transmission Substation

The proposed Acrux Solar PV Project One is undergoing a Scoping and Environmental Impact Assessment (S&EIA) process.

2 PROJECT DESCRIPTION

2.1 Location of the Activity and Property Location



A development footprint of 320 ha (excluding linear components) has been identified within the Remaining extent of Portion 6 of the Farm Brabant No. 205 for the placement of the development footprint which will ultimately house the Acrux Solar PV Project One. The details of the location of the Acrux Solar PV Project One and Grid Connection Infrastructure are included in Table 2 below.

<i>Table 2: General site and location information</i>	
Description of affected farm portions	<p><u>Solar PV Facility:</u></p> <ul style="list-style-type: none"> Portion 6 of the Farm Brabant No. 205 <p><u>Grid Connection Corridor:</u></p> <ul style="list-style-type: none"> Portion 6 of Farm Brabant No. 205 Portion 2 of Farm Brabant No. 205 Portion 1 of Farm Brabant No. 205 Portion 1 of Farm Spes Bona No. 2355 Portion 13 of Farm Spes Bona No. 2355 Portion 14 of Farm Spes Bona No. 2355 Portion 10 of Farm Spes Bona No. 2355 Remaining Extent of Portion 6 of Farm Spes Bona No. 2355 Portion 7 of Farm Spes Bona No. 2355 Portion 11 of Farm Spes Bona No. 2355 Remainder of Farm Spes Bona No. 2355 Remainder of Farm Kwaggafontein No. 23000 <p><u>Access Road:</u></p> <ul style="list-style-type: none"> Portion 6 of the Farm Brabant No. 205
Province	Free State
Local Municipality	Mangaung Metropolitan Municipality
District Municipality	Mangaung Metropolitan Municipality
Ward numbers	48
Closest towns	The city of Bloemfontein is located approximately 17 km east of the proposed development
21 Digit Surveyor General codes	<p><u>Solar PV Facility:</u></p> <ul style="list-style-type: none"> Portion 6 of Farm Brabant No. 205 F0030000000020500006 <p><u>Grid Connection Corridor:</u></p> <ul style="list-style-type: none"> Portion 6 of Farm Brabant No. 205 F0030000000020500006



	<ul style="list-style-type: none"> • Portion 2 of Farm Brabant No. 205 F0030000000020500002 • Portion 1 of Farm Brabant No. 205 F0030000000020500001 • Portion 1 of Farm Spes Bona No. 2355 F00300000000235500001 • Portion 13 of Farm Spes Bona No. 2355 F00300000000235500013 • Portion 14 of Farm Spes Bona No. 2355 F00300000000235500014 • Portion 10 of Farm Spes Bona No. 2355 F00300000000235500010 • Remaining Extent of Portion 6 of Farm Spes Bona No. 2355 F00300000000235500006 • Portion 7 of Farm Spes Bona No. 2355 F00300000000235500007 • Portion 11 of Farm Spes Bona No. 2355 F00300000000235500011 • Remainder of Farm Spes Bona No. 2355 F00300000000230000000 • Remainder of Farm Kwaggafontein No. 23000 F00300000000230000000 <p><u>Access Road:</u></p> <ul style="list-style-type: none"> • Portion 6 of Farm Brabant No. 205 F0030000000020500006
Area under assessment	428 ha (excluding linear components)
Development footprint	320 ha (excluding linear components)

A development footprint of 320 ha (excluding linear components) has been defined based on the outcomes of the scoping phase (and results received from the independent specialists). A development layout has been produced and must be further assessed in the current EIA phase.

The properties on which the facility is to be constructed will be leased by Acrux Solar PV Project One (Pty) Ltd from the property owner for the life span of the project (minimum of 25 years).

The development footprint associated with Acrux Solar PV Project One and Grid Connection Corridor will include specific infrastructure that will be developed as part of the facility layout.



2.2 Details of Infrastructure proposed

The development footprint associated with Acrux Solar PV Project One and Grid Connection Corridor will include specific infrastructure that will be developed as part of the facility layout.

The infrastructure to be developed is specifically related to the preferred technology to be installed to generate electricity from the solar resource, which in this case is photovoltaic technology. Photovoltaic solar energy is obtained by converting sunlight into electricity using a technology based on the photoelectric effect¹. It is a type of renewable, inexhaustible and non-polluting energy that can be produced in installations ranging from small generators for self-consumption to large photovoltaic plants.

The design of the detailed layout has considered and adhered to the limitations of the development area and aspects such as environmentally sensitive areas, roads, fencing and servitudes on site. The total surface area proposed for the layout includes the PV panel arrays (spaced to avoid shadowing), access and maintenance roads and associated infrastructure (buildings, power inverters, power line, battery energy storage system, on-site substations, switching stations, perimeter fences and grid infrastructure).

Table below provides the technical details of the Acrux Solar PV Project One available at the EIA phase of the development.

<i>Table 3: Technical details of the proposed infrastructure for the proposed Acrux Solar PV Project One near Bloemfontein, Free State Province.</i>	
Component	Description / dimension
Type of technology	Photovoltaic solar facility
Generation capacity	Up to 200 MW
Area of the PV Array	Up to 310 ha
Structure orientation	<p>Monofacial or Bifacial PV panels will be utilised. The panels will either be fixed to a single-axis and/or double 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.</p> <p>PV panels with single axis tracking is preferred over fixed-axis or double axis tracking systems due to the potential to achieve higher annual energy yields whilst minimising the balance of system (BOS) costs, resulting in the lowest levelized cost of energy (LCOE). The development of the PV facility will take into consideration during the final design phase the use of either</p>

¹ The photoelectric effect is the emission of electrons or other free carriers when light shines on a material. Electrons emitted in this way can be called photo electrons.



	tracker vs fixed-tilt mounting structures. Both options are considered feasible for the site.
Structure Height	<ul style="list-style-type: none"> • Panels: up to 6 m • Buildings: up to 12 m • Power line: up to 30 m • Fencing: up to 3 m
Area of the Battery Storage	Within a 1 ha area of the development footprint and spread out within the facility next to the inverters and in between the panel arrays.
Capacity of the Battery Storage	Unspecified. To be confirmed prior to construction activity
Area of the facility substation and switching substation	<ul style="list-style-type: none"> • Facility substation at PV array 1: up to 1 ha • Facility substation at PV array 2: up to 1 ha • Eskom Switching Station: up to 1 ha
Capacity of the facility substation and switching substation	<ul style="list-style-type: none"> • Facility substation at PV array 1: up to 132 kV • Facility substation at PV array 2: up to 132 kV • Eskom Switching Station: up to 132 kV
Laydown area dimensions	Temporary laydown areas will occupy up to 2 hectares while 1 hectare will remain in place for the permanent laydown area as required for facility operation.
Area occupied by buildings	Operations and Maintenance Building/Office; switch gear and relay room; staff lockers and changing room; security control; and offices: Up to 1 ha
Length of grid connection corridor	Up to 8 km
Width of grid connection corridor	200 m
Width of the power line servitude	Up to 32 m
Width of internal roads	Up to 12 m wide
Length of internal roads	Up to 40 km in total

Table 4: General construction related information

Construction Phase Timeframe	Up to 20 months
Amount of construction employees	Up to a 500 people may be on site at a time
Number of employees during operation	Up to 25 permanent staff and additional contractors (number varies) for temporary ad hoc maintenance will be required



Current Land Use	Grazing
Current Land Use Zoning	Agriculture
Depth of excavation	Up to 900 mm trench depth

2.3 Consideration Of Alternatives

This section describes the alternatives under consideration for the Acrux Solar PV Project One. In terms of the Regulations only 'feasible' and 'reasonable' alternatives should be considered for development. The process undertaken by the Applicant for the identification of alternatives has been an iterative process and will continue to be an iterative process between the EAP and the Applicant in order to ensure that the preferred alternative proposed for authorisation is ultimately appropriate from a technical feasibility perspective as well as an environment perspective. Refer to Table 2.4 for an overview of the alternatives being considered.

Table 5: Summary of the alternatives considered

Alternatives considered	Description of the Alternative relating to the development
Site specific and Layout Alternatives	One preferred site / development area has been identified for the development of Acrux Solar PV Project One based on specific site characteristics such as the solar resource, land availability, topographical characteristics and environmental features. The development area of 320 ha (excluding linear components) is considered to be sufficient for the development of a solar facility with a contracted capacity of up to 200 MW.
Activity Alternatives	Only the development of a renewable energy facility is considered by Acrux Solar PV Project One (Pty) Ltd. Due to the location of the site / development area and the suitability of the solar resource, only the development of a solar PV facility is considered feasible considering the natural resources available to the area and the current land-use activities undertaken within the site (i.e., agricultural activities).
Technology Alternatives	Only the development of a photovoltaic solar facility is considered due to the characteristics of the site, including the natural resources available.
Grid Connection Alternatives	In order to evacuate the generated electricity into the national grid, the Applicant, Acrux Solar PV Project One (Pty) Ltd, proposes the construction of a 132 kV overhead powerline which will connect directly into the existing Eskom Harvard Substation. An 8 km long and 200 m wide grid corridor has been identified for assessment. The final grid



	route will be based on feedback provided by the Eskom Grid Access Unit as the process advances.
'Do-nothing Alternative	The option to not construct the Acrux Solar PV Project One. No impacts (positive or negative) are expected to occur on the social and environmental sensitive features or aspects located within or within the surrounding areas of the site. The opportunities associated with the development of the solar facility for the Bloemfontein area will however not be made available.

3 QUALIFICATIONS AND EXPERIENCE OF THE AUTHOR

Mrs. Elize Butler carried out this study. For developments in the Free State, KwaZulu-Natal, Eastern, Central, and Northern Cape, Northwest, Gauteng, Limpopo, and Mpumalanga, she has done roughly 500 palaeontological impact assessments. She has an MSc (cum laude) in Zoology with a focus in Palaeontology from the University of the Free State in South Africa, and she has more than 30 years of experience in the field. She has experience finding, gathering, and preserving fossils. This includes going on field expeditions to explore new areas in the Karoo Basin. She began conducting PIAs in 2014 and has been a member of the Palaeontological Society of South Africa (PSSA) since 2006.

A curriculum vitae is included in Appendix 1 of this specialist input report.

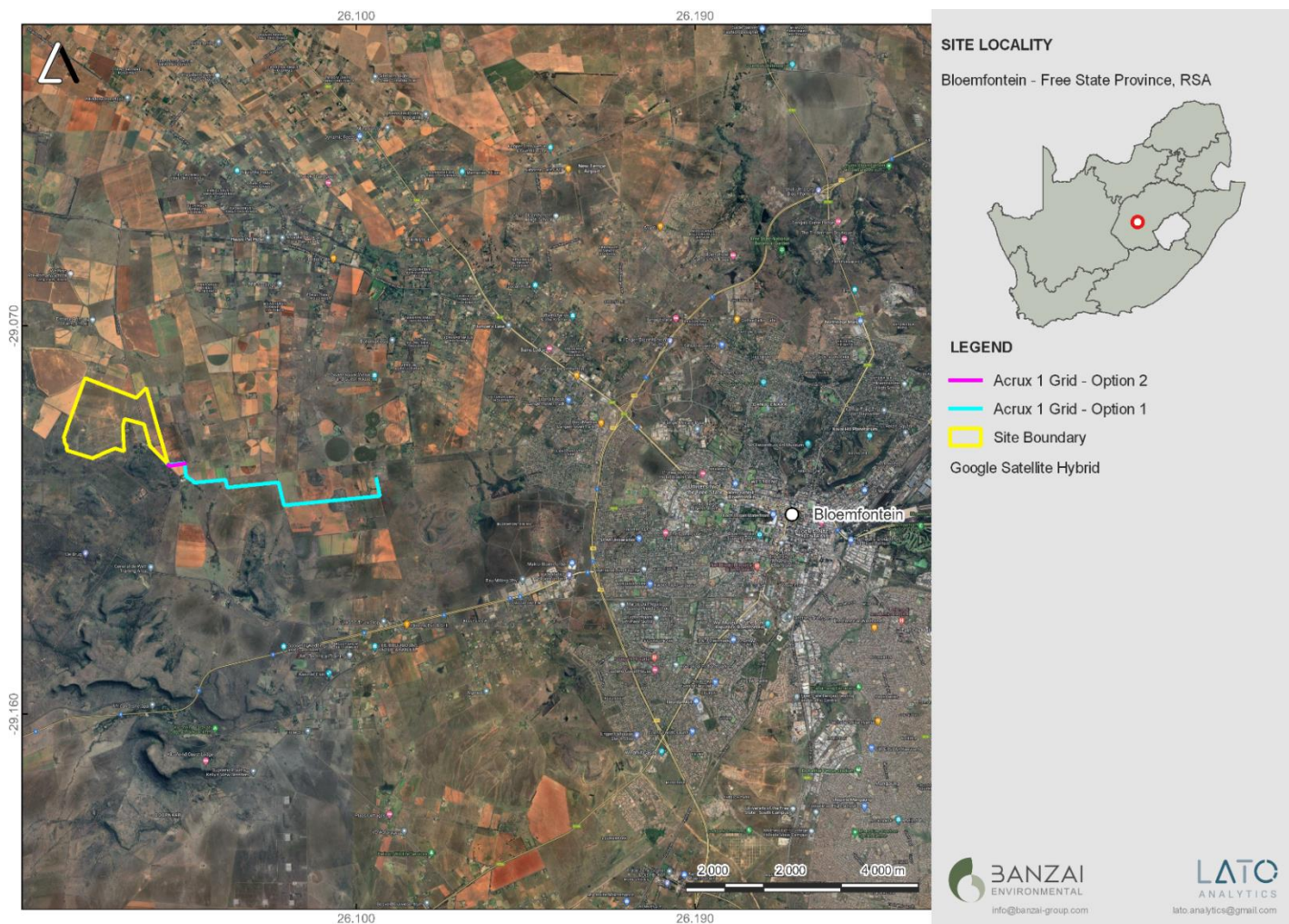


Figure 1: Regional locality of the Acrux Solar PV Project One and associated infrastructure near Bloemfontein in the Free State Province.

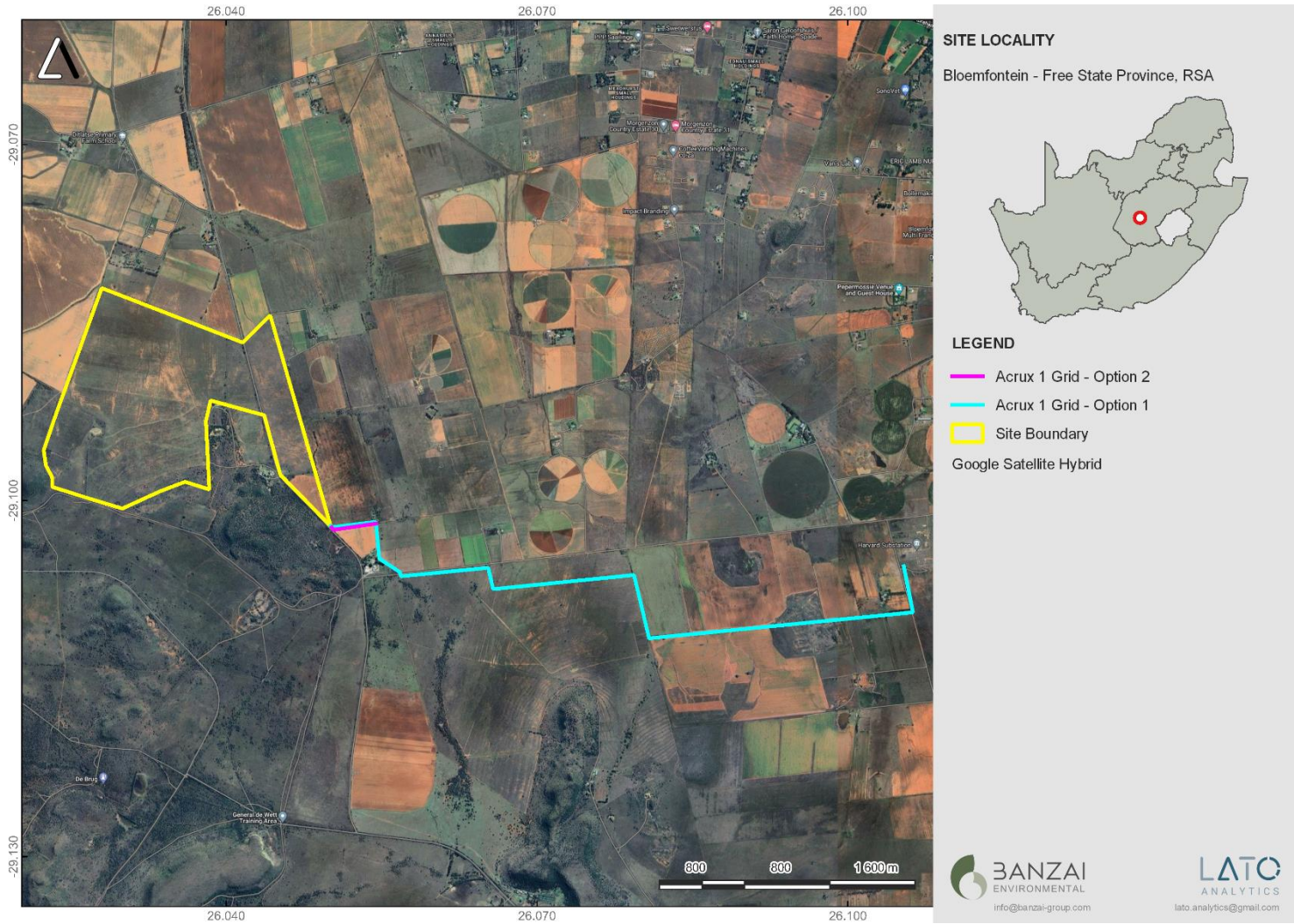


Figure 2: Close-up view of the proposed study area.



4 LEGISLATION

4.1 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
- Minerals and Petroleum Resources Development Act (MPRDA) Act 28 of 2002
- 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

MPRDA Regulations of 2014

Environmental reports to be compiled for application of mining right – Regulation 48

- Contents of scoping report – Regulation 49
- Contents of environmental impact assessment report – Regulation 50
- Environmental management programme – Regulation 51



- Environmental management plan – Regulation 52

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 m² 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 m² in extent.
- or any other category of development provided for in regulations by SAHRA or a Provincial heritage resources authority.

5 METHODS AND TERMS OF REFERENCE

The present field-based PIA assesses the potential impacts on Fossil Heritage on the development. This study forms part of the Heritage Impact Assessment Report. According to the “SAHRA APM Guidelines: Minimum Standards for the Archaeological and Palaeontological Components of Impact Assessment Reports” the purpose of the PIA is: 1) to identify the palaeontological importance of the rock formations



in the footprint; 2) to evaluate the palaeontological magnitude of the formations; 3) to clarify the **impact** on fossil heritage; and 4) to suggest how the developer might protect and lessen possible damage to fossil heritage.

The palaeontological status of each rock section is calculated as well as the possible impact of the development on fossil heritage by a) the palaeontological importance of the rocks, b) the type of development and c) the quantity of bedrock removed.

All possible information is consulted to compile a scoping report, and this includes the following: Provisional DFFE Screening Tool, SAHRIS Palaeosensitivity map, all Palaeontological Impact Assessment reports in the same area; aerial photos and Google Earth images, topographical and geological maps as well as scientific articles of specimens from the development area and Assemblage Zones. When the development footprint has a moderate to high palaeontological sensitivity a field-based assessment is necessary. The desktop and the field survey of the exposed rock determine the impact significance of the planned development and recommendations for further studies or mitigation are made. Destructive impacts on palaeontological heritage usually only occur during the construction phase while the excavations will change the current topography and destruct or permanently seal-in fossils at or below the ground surface. Fossil Heritage will then no longer be accessible for scientific research.

During a site investigation the palaeontologist does not only survey the development but also tries to determine the density and diversity of fossils in the development area. This is confirmed by examining representative exposures of fossiliferous rocks (sedimentary rocks contain fossil heritage whereas igneous and metamorphic rocks are mostly unfossiliferous). Rock exposures that are investigated usually contains a large portion of the stratigraphic unit, can be accessed easily and comprise of unweathered (fresh) exposed rock. These exposures may be natural (rocky outcrops in stream or river banks, cliffs, dongas) but could also be artificial (quarries, open building excavations and even railway and road cuttings). It is common practice for palaeontologist to log well-preserved fossils (GPS, and stratigraphic data) during field assessment studies.

Mitigation usually precedes construction or may occur during construction when potentially fossiliferous bedrock is exposed. Mitigation comprises the collection and recording of fossils. Preceding excavation of any fossils, a permit from SAHRA must be obtained and the material will have to be housed in a permitted institution. When mitigation is applied correctly, a positive impact is possible as knowledge of local palaeontological heritage may be increased.

The fossil potential of the Arcus Solar PV Project One development area was determined by criss-crossing the development footprint and by physically investigating all bedrock outcrops to determine the lithology and fossil content of the outcrops. Fossils occurring at the surface is very unpredictable and a representative sample size of the area has been investigated. However, it is important to note that the



absence of fossils in a development footprint does not necessarily mean that palaeontological significant material is not present on site (on or beneath ground surface).

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).

5.1 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.

6 GEOLOGICAL AND PALAEOLOGICAL HISTORY

The proposed Acrux Solar PV Project One near Bloemfontein in the Free State is depicted on the 1:250 000 Bloemfontein 2926 Geological map (1966) (Council of Geoscience, Pretoria) (**Figure 3; Table 5**). This map indicates that the PV study area is underlain by the Permian aged sediments of the Eccca (K2u, Upper Stage) in the north while the southern portion of the PV development is underlain by the Lower Stage (K3l) of the Beaufort Group, Karoo Series. The south-east margins of the PV development are underlain by Post-Karoo Dolerite. The two grid alternatives are underlain by the Lower Stage (K3l) of the Beaufort Group, Karoo Series with the western portion of both alternatives are underlain by the Post-Karoo Dolerite (red). The PalaeoMap of the South African Heritage Resources Information System (SAHRIS) (**Figure 4, Table 6**) indicates that the Palaeontological Sensitivity of the Jurassic Dolerite is Zero as it is igneous in origin and thus unfossiliferous, while that of the Adelaide Subgroup (Beaufort Group) is Very High (Almond and Pether, 2009; Almond *et al.*, 2013, Groenewald *et al.* 2014). As elsewhere in the country, the underlying sediments is mantled by Quaternary superficial sediments not mapped on the 1:250 000 Geological Map. This geological map and terminology are outdated. Updated geology (Council for Geoscience, Pretoria) refined the geology of the 1966 geological map and indicates (**Figure 5**) that the proposed development is underlain by the Karoo Dolerite, the Balfour Formation (Adelaide Subgroup, Karoo Supergroup) as well alluvium, colluvium, eluvium and gravel.

The Lower Beaufort Group (Adelaide Subgroup) near Bloemfontein is not assigned to specific formations but, current mapping of the Main Karoo Basin has assigned this area to the *Daptocephalus* Assemblage Zone (previously *Dicynodon* Assemblage Zone) (Smith *et al.* 2020, Viglietti 2020).

The Jurassic dolerite present in the development form part of the Karoo Igneous Province is one of the worlds classic continental flood basalt (CFB) provinces. This Suite was formed approximately 183 million years ago and 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 dikes) 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 covering at least 140 000 km², was larger in the past [$\sim 2\,000\,000\text{ km}^2$ (Cox 1970, 1972)]. The Karoo Igneous Province can be divided into the Lebombo and the Drakensberg Groups. This Igneous Province contains a large volume of flood basalts as well as silicic volcanic rocks. These units consist of hyodacite 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 conformably on the Clarens Formation but in specific localities, sandstone erosion occurred before the volcanic eruptions took place. Lock *et al* (1974) described 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 proposed development is underlain by a series of Karoo sandstones, mudstones, and shales, deposited under fluvial environments of the Adelaide Subgroup that forms part of the Beaufort Group (**Figure 6**). The Beaufort Group is the third of the main subdivisions of the Karoo Supergroup. The Beaufort group overlies the Ecca Group and consists essentially of sandstones and shales, deposited in the Karoo Basin from the Middle Permian to the early part of the Middle Triassic periods and was deposited on land through alluvial processes. The Beaufort Group covers a total land surface area of approximately 200 000 km² in South Africa and is the first fully continental sequence in the Karoo Supergroup and is divided into the Adelaide subgroup and the overlying Tarkastad subgroup. The Adelaide subgroup rocks are deposited under a humid climate that allowed for the establishment of wet floodplains with high water tables and are interpreted to be fluvio-lacustrine sediments. The Adelaide Subgroup is approximately 5 000m thick in the southeast, but this decreases to about 800m in the centre of the basin which decreases to about 100 to 200m in the north.

The Adelaide Subgroup contains alternating greyish-red, bluish-grey, or greenish grey mudrocks in the southern and central parts of the Karoo Basin with very fine to medium-grained, grey lithofeldspathic sandstones. Thicker sandstones of the Adelaide are usually multi-storey and usually have cut-and-fill features. The sandstones are characterized internally by horizontal lamination together with parting lineation and less frequent trough crossbedding as well as current ripple lamination. The bases of the sandstone units are extensive beds, while ripple lamination is usually confined to thin sandstones towards the top of the thicker units. The mudrocks of the Adelaide Subgroup usually have massive and blocky weathering. Sometimes desiccation cracks and impressions of raindrops are present. In the mudstones of the Beaufort Group calcareous nodules and concretions occur throughout.

The flood plains of the Beaufort Group (Karoo Supergroup) are internationally renowned for the early



Figure 3. Extract of the 1:250 000 Bloemfontein 2926 Geological map (1966) (Council of Geoscience, Pretoria) indicating the geology of the Acruz Solar PV Project One and associated grid infrastructure near Bloemfontein in the Free State. The development is underlain by the Upper Stage of the Ecca Series (K2u), the Lower Stage (K3l) of the Beaufort System as well as dolerite in the south-east of the development.



Table 6: Legend to the 1:250 000 Bloemfontein 2926 Geological map (1966) (Council of Geoscience, Pretoria)

GEOLOGICAL LEGEND		GEOLOGIESE LEGENDE	
	Surface-limestone Oppervlakkalksteen		Recent Resent
	Kimberlite dyke Kimberlietgang		Cretaceous? Krvt?
	Diatreme Diatrema		Post-Karoo Na-Karoo
	Volcanic neck Vulkaniese pyp		
	Dolerite, overprinted on geological formations Doleriet, oorgedruk op geologiese formasies		
	Basaltic lava Basaltiese lawa	Drakensberg Stage Etage Drakensberg	Stormberg Series Serie Stormberg
	Massive sandstone, thin shale Massiewe sandsteen, dun skalie	Cave Sandstone Stage Etage Holkranssandsteen	
	Purple shale and mudstone; thin sandstone Pers skalie en moddersteen; dun sandsteen	Red Beds Stage Etage Rooilae	
	Feldspathic sandstone and grit, green shale Veldspatiese sand- en grintsteen, groen skalie	Molteno Stage Etage Molteno	
	Purple and green shale, thick sandstone beds Pers en groen skalie, dik sandsteenae	Upper Stage Boonste Etage	Beaufort Series Serie Beaufort
	Sandstone, shale and mudstone Sandsteen, skalie en moddersteen	Middle Stage Middelste Etage	
	Sandstone, shale and mudstone Sandsteen, skalie en moddersteen	Lower Stage Onderste Etage	
	Mudstone, shale Moddersteen, skalie	Upper Stage Boonste Etage	Ecca Series Serie Ecca
	Strike and dip of strata Strekking en helling van lae		KARROO SYSTEM SISTEEM KAROO
	Fault with downthrow indicated Verskuiwing met valkant aangetoon		
	Fossil locality (see list below) Fossilvindplek (kyk lvs hieronder)		
Economic Data		Ekonomiese Gegewens	
CS	Brick-clay Baksteenklei	Da	Diamonds Diamante

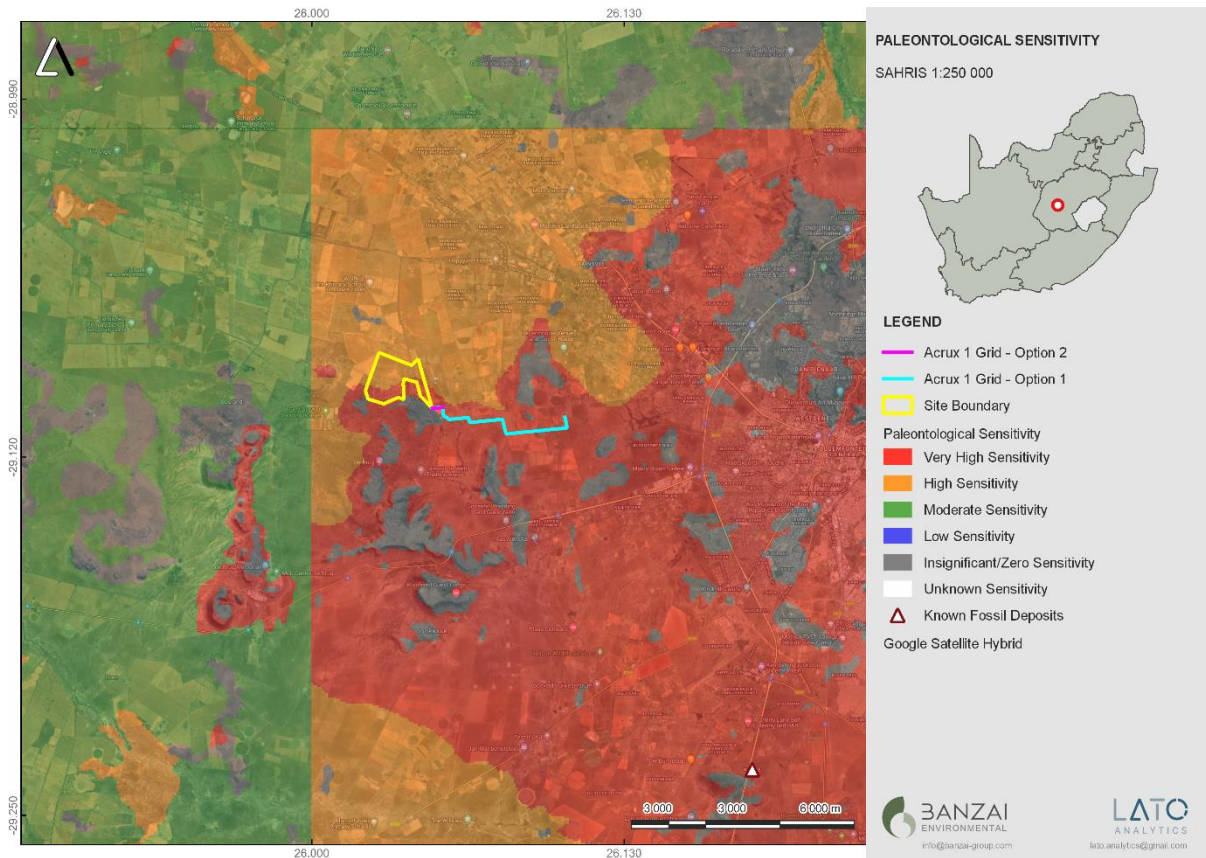


Figure 4: Extract of the SAHRIS PalaeoMap (Council of Geosciences) indicating that Acruz Solar PV Project One is underlain by sediments with a High (orange), Very High (red) and Zero (grey) Palaeontological Sensitivity.



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.

The colors on the PalaeoMap indicate the following degrees of sensitivity: red = very highly sensitive; orange/yellow = high; green = moderate; blue = low; grey = insignificant/zero.

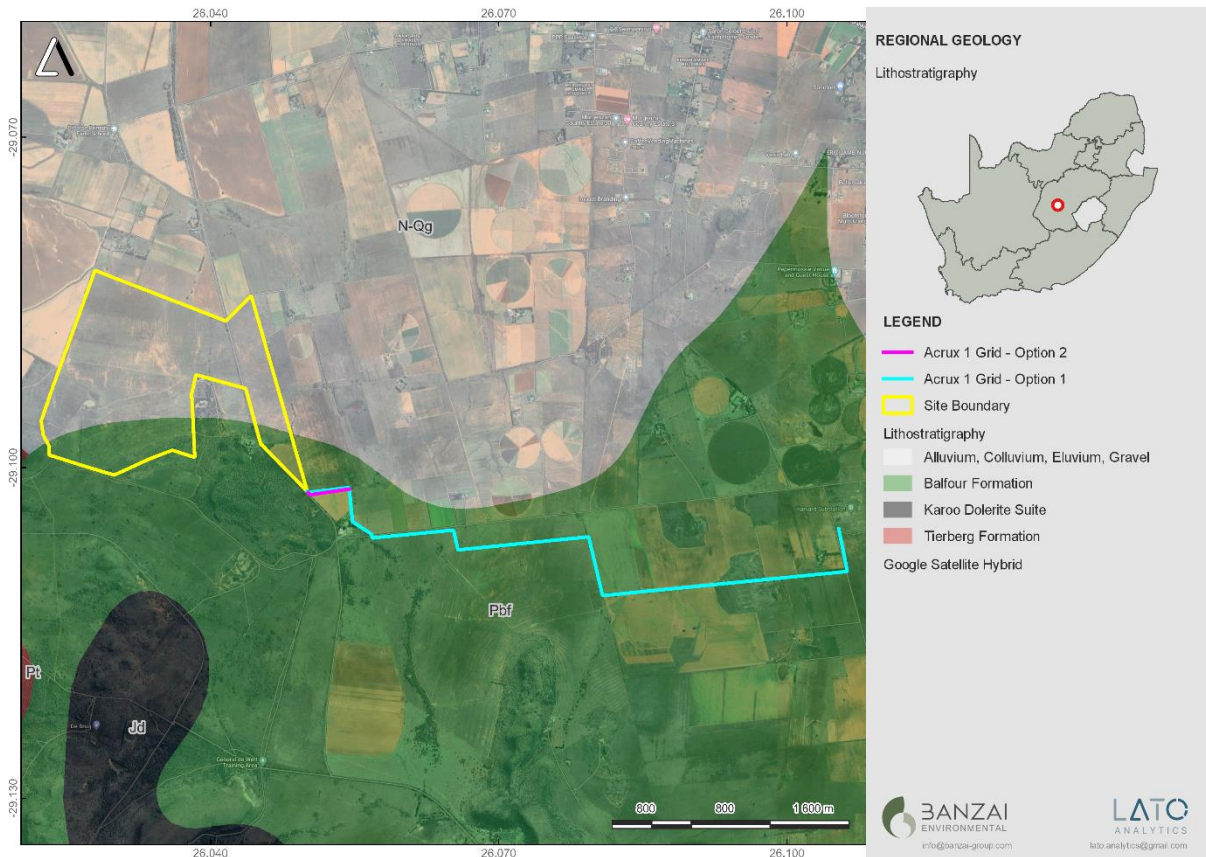


Figure 5: Updated Geology compiled by the Council of Geosciences (Council for Geoscience, Pretoria) indicates that the proposed Acrux Solar PV Project One is underlain by Karoo Dolerite, the Balfour Formation (Adelaide Subgroup, Karoo Supergroup) as well alluvium, colluvium, eluvium and gravel.

diversification of land vertebrates and provide the worlds’ most complete transition from early “reptiles” to mammals. The Beaufort Group is subdivided into a series of biostratigraphic units based on its faunal content (Kitching1977, 1978; Keyser *et al*, 1977, Rubidge 1995, Smith *et al*, 2020; Viglietti 2020). The south-western portion of the proposed development is underlain by the Balfour Formation which is divided in the *Daptocephalus* (DAZ) which in turn is divided in the upper (younger) *Lystrosaurus maccaigi* - *Moschorhinus* and lower (older) *Dicynodon-Theriognathus* Subzones (Viglietti, 2020).

The dicynodont, *Daptocephalus leoniceps* (Figure 7) is the main biozone defining fossil of the *Daptocephalus* Assemblage Zone. The *Daptocephalus* Assemblage Zone (DaAZ) is characterised by the co-occurrence of the dicynodontoid *Daptocephalus leoniceps*, the therocephalian *Theriognathus microps*, and the cynodont *Procynosuchus delaharpeae*. The DaAZ comprise of two subzones representing the two distinct faunal assemblages in this assemblage zone. The *Dicynodon* - *Theriognathus* Subzone (in co-occurrence with *Daptocephalus*) is present in the lower *Daptocephalus* Assemblage Zone while the *Lystrosaurus maccaigi* – *Moschorhinus kitchingi* Subzone is present in the upper DaAZ. The defining taxa of the latter subzone is *L. maccaigi*, *Daptocephalus* and *Moschorhinus* (Figure 9). This Zone is characterized by the co-occurrence of the two therapsids namely *Dicynodon* and



Theriongnathus (Figure 8). The *Daptocephalus* Assemblage Zone of the Beaufort Group shows the greatest vertebrate diversity and includes numerous well-preserved genera and species of dicynodonts, biarmosuchians, gorgonopsian, therocephalian and cynodont therapsid Synapsida. Captorhinid Reptilia are also present while eosuchian Reptilia, Amphibia and Pisces are rarer in occurrence. Trace fossils of vertebrates and invertebrates as well as *Glossopteris* flora plants have also been described.

The *Daptocephalus* Assemblage Zone (AZ) expands into the lower Palingkloof of the Upper Balfour Formation (Figure 6). The lower Palingkloof Member is of special importance as it precedes the Permo-Triassic Extinction Event which destroyed the vertebrate fauna and extinguished the diverse glossopterid plants. The lower *Lystrosaurus declivis* AZ forms part of the Katberg Formation. Fauna and flora from this assemblage zone is rare as few genera survived the Permo-Triassic Extinction Event. The *Lystrosaurus declivis* AZ is characterized by the dicynodont, *Lystrosaurus* (Figure 9-10), and captorhinid reptile, *Procolophon*, biarmosuchian and gorgonopsian Therapsida that did not survive into the *Lystrosaurus* Assemblage Zone although the therocephalian and cynodont Therapsida are present in moderate quantities. Captorhinid Reptilia is reduced, but this interval is characterised by a unique diversity of oversize amphibians while fossil fish, millipedes and diverse trace fossils have also been recorded.

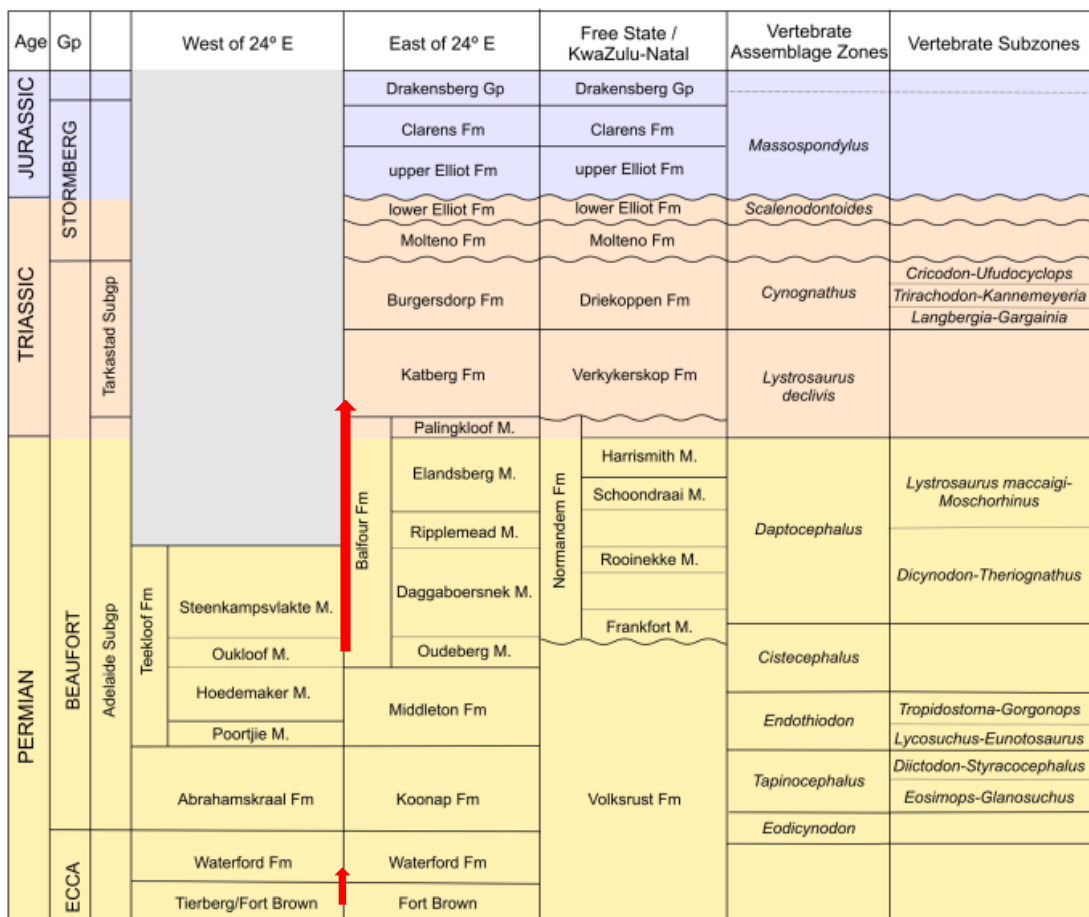


Figure 6: Vertebrate biozonation range chart for the Main Karoo Basin of South Africa.



Solid lines indicate known ranges, dotted lines indicate suspected but not confirmed ranges, single dot represents the stratigraphic position of the taxa that have only been recovered from a single bed. Wavy lines indicate unconformities. (PLYCSR=Pelycosauria and MAMMMFES+Mammaliaformes. Gp=group, Subgp-Subgroup, Fm=Formation, M=Member. The biozones present in the proposed Solar development is indicated by the red arrows

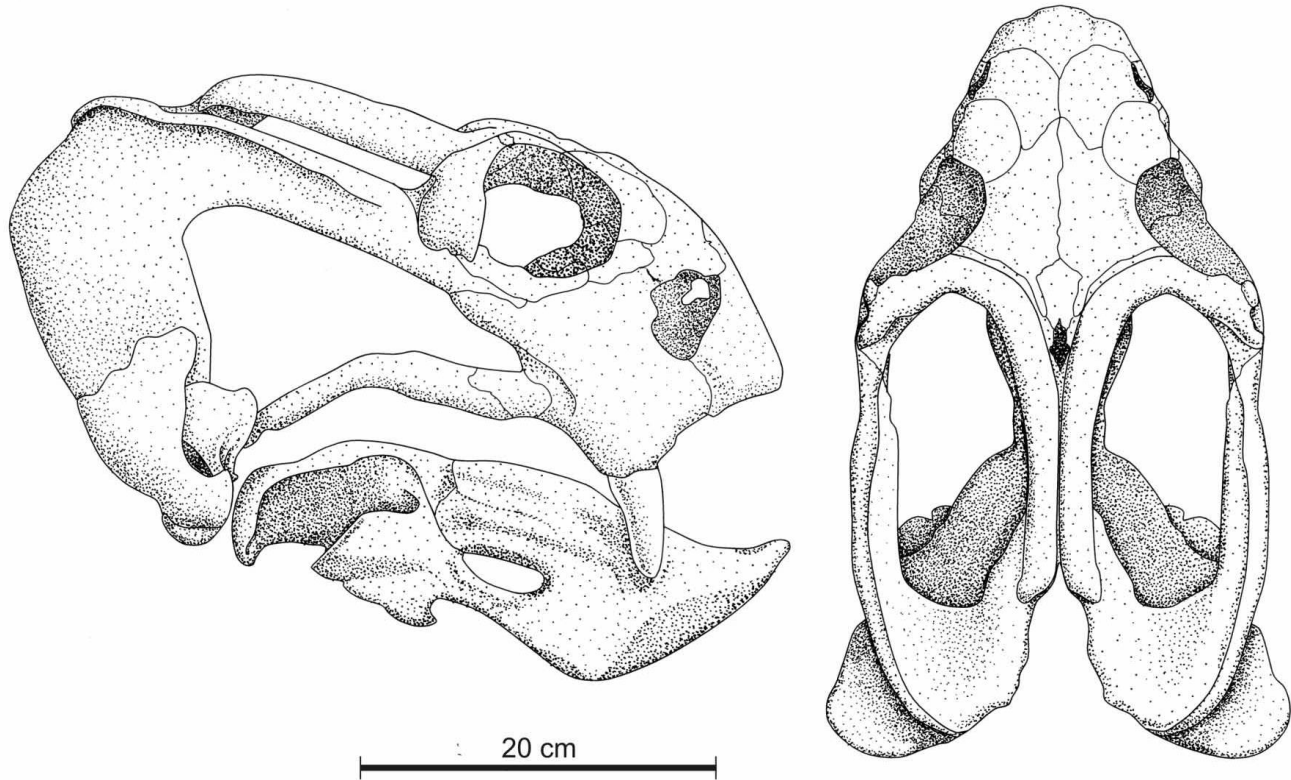


Figure 7: Lateral and dorsal views of skull of the dicynodont *Daptocephalus leoniceps*, the main biozone defining fossil and dorsal views (Image taken from Viglietti, 2020).

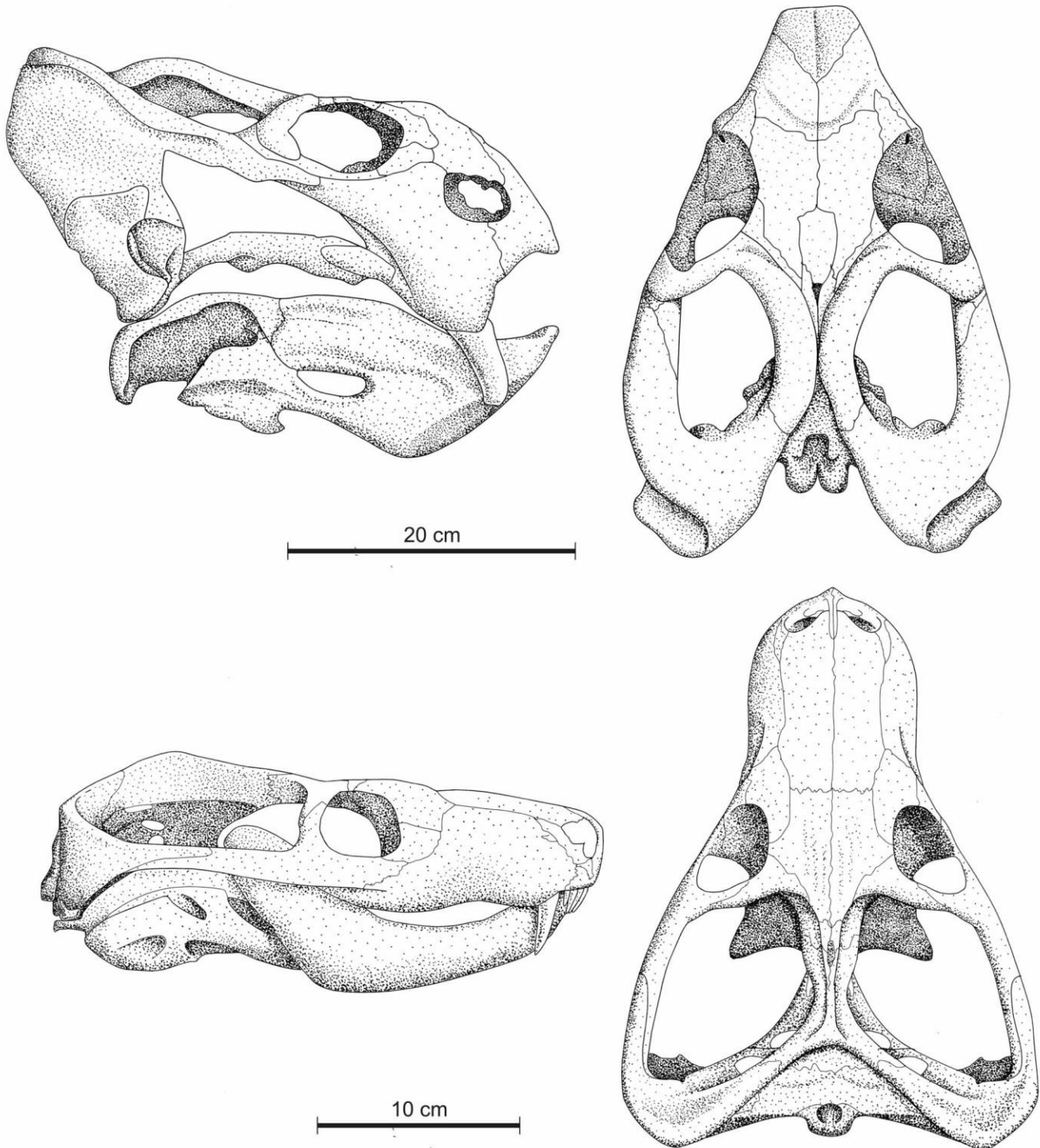


Figure 8: Skulls of the biozone defining fossils of the *Dicynodon-Theriognathus* Subzone in lateral and dorsal views. *Dicynodon lacerticeps* (top), *Theriognathus microps* (bottom) (Image taken from Viglietti, 2020).

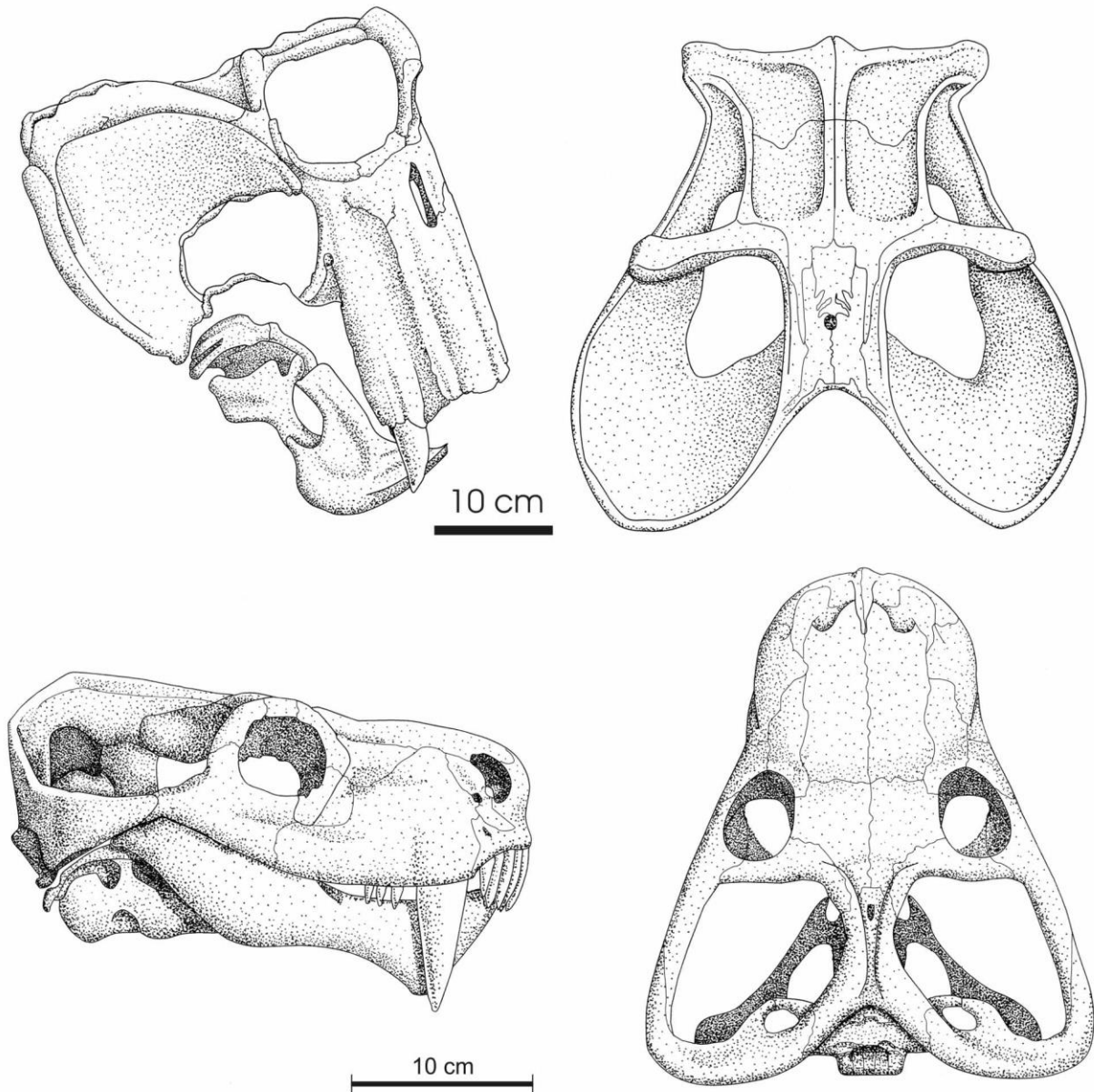


Figure 9: Biozone defining fossils of the *Lystrosaurus maccaigi*-*Moschorhinus* Subzone. The skulls of the *Lystrosaurus maccaigi* (top) and *Moschorhinus kitchingi* (bottom) in lateral

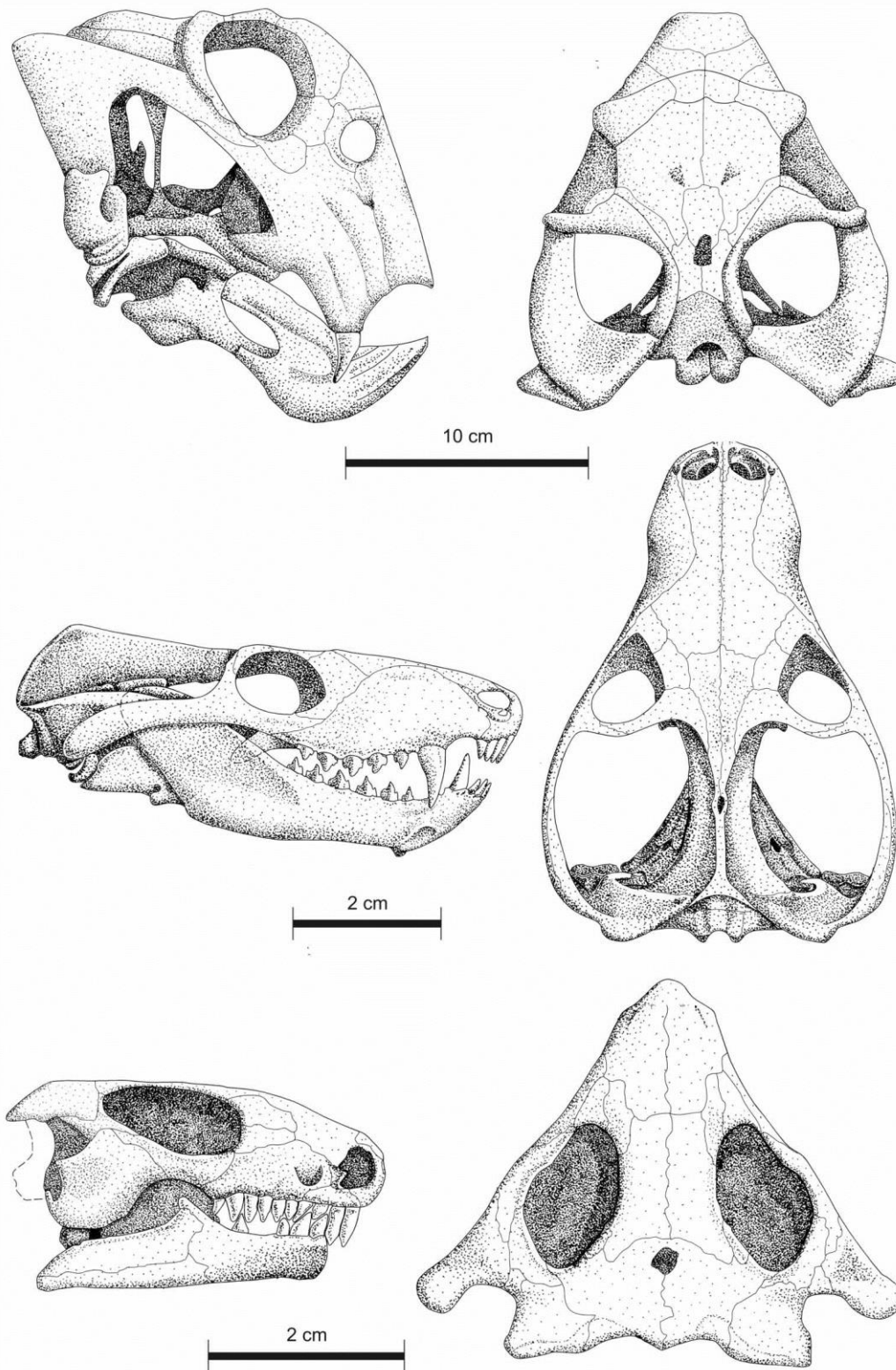


Figure 10: Lateral and dorsal views of the index taxa defining the *Lystrosaurus declivis* Assemblage Zone. (top) *Lystrosaurus declivis*, (centre) *Thrinaxodon liorhinus*, (bottom) *Procolophon trigoniceps* (Image taken from Botha and Smith, 2020).

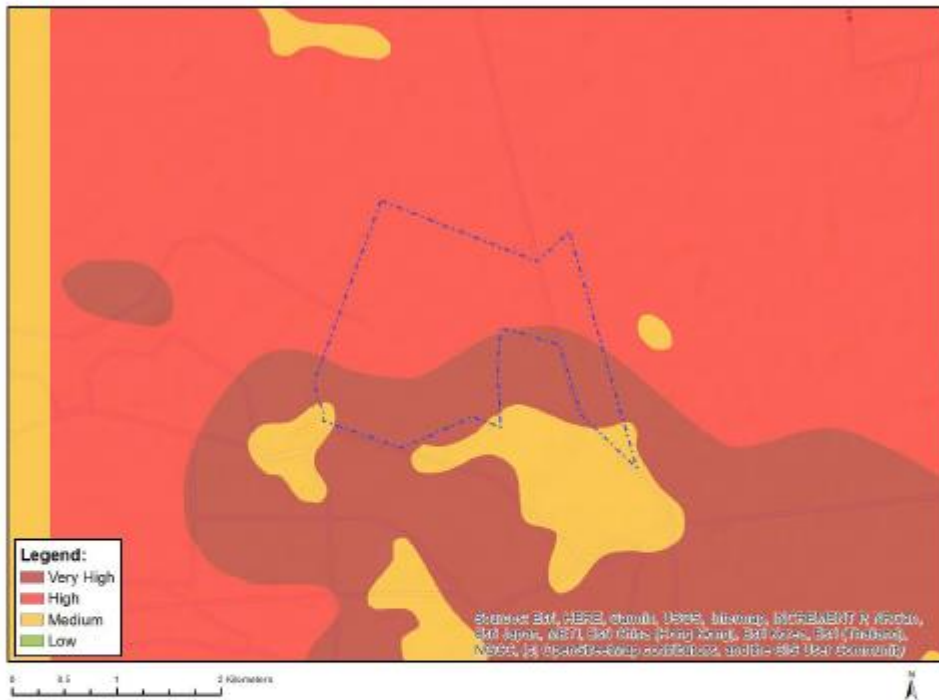


The majority of the Tierberg Formation (Ecca Group; Karoo Supergroup) comprises of well-laminated, dark grey to black shale (Johnson et al 2006). Some yellowish tuffaceous beds up to 10cm thick occur in the lower part of the succession along the western and northern margins of the Basin. Calcareous concretions are common towards the top of the formation. Clastic rhythmites occur at various levels in the sequence (Cole, 2005). This formation is considered to be a deep-water deposit associated with event beds. The Tierberg formation is known for its rare trace fossils assemblages. Vascular plants (including petrified wood) and palynomorphs of *Glossopteris* flora have been found while crustaceans, shelly marine invertebrates, insects, and fish fossils as well as microfossils have been identified.

As elsewhere in the country superficial deposits mantle underlying sediments but is not always indicated on the 1:250 000 geological maps. Superficial sediments are represented by the Pleistocene to Recent superficial deposits and comprise of alluvium, downwasted surface gravels, pedocretes, and sandy soils. These sediments are most probably of Low Palaeontological Significance but could contain mammalian teeth, bones and horn cores, reptile skeletons and fragments of ostrich eggs. Microfossils, non-marine mollusc shells are also known from Quaternary deposits. Plant material such as foliage, wood, pollens, and peats are recovered as well as trace fossils like vertebrate tracks, burrows, termitaria (termite heaps/mounds) and rhizoliths (root casts). Reworked Stone Age artifacts have been found in Quaternary alluvium.



MAP OF RELATIVE PALEONTOLOGY THEME SENSITIVITY



Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
x			

Sensitivity Features:

Sensitivity	Feature(s)
High	Features with a High paleontological sensitivity
Medium	Features with a Medium paleontological sensitivity
Very High	Features with a Very High paleontological sensitivity

Figure 11: Palaeontological Sensitivity of the Acrux Solar PV facility by the National Environmental Web-based Screening Tool.

The National Environmental Web-based Screening Tool indicates that the Palaeontological Sensitivity of the development is Very High (dark red).



The geographic area of evaluation is the spatial boundary in which the cumulative effects analysis was undertaken. The spatial boundary evaluated in these cumulative effects analysis generally includes the area within a 30 km radius surrounding the proposed development.

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 25 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.

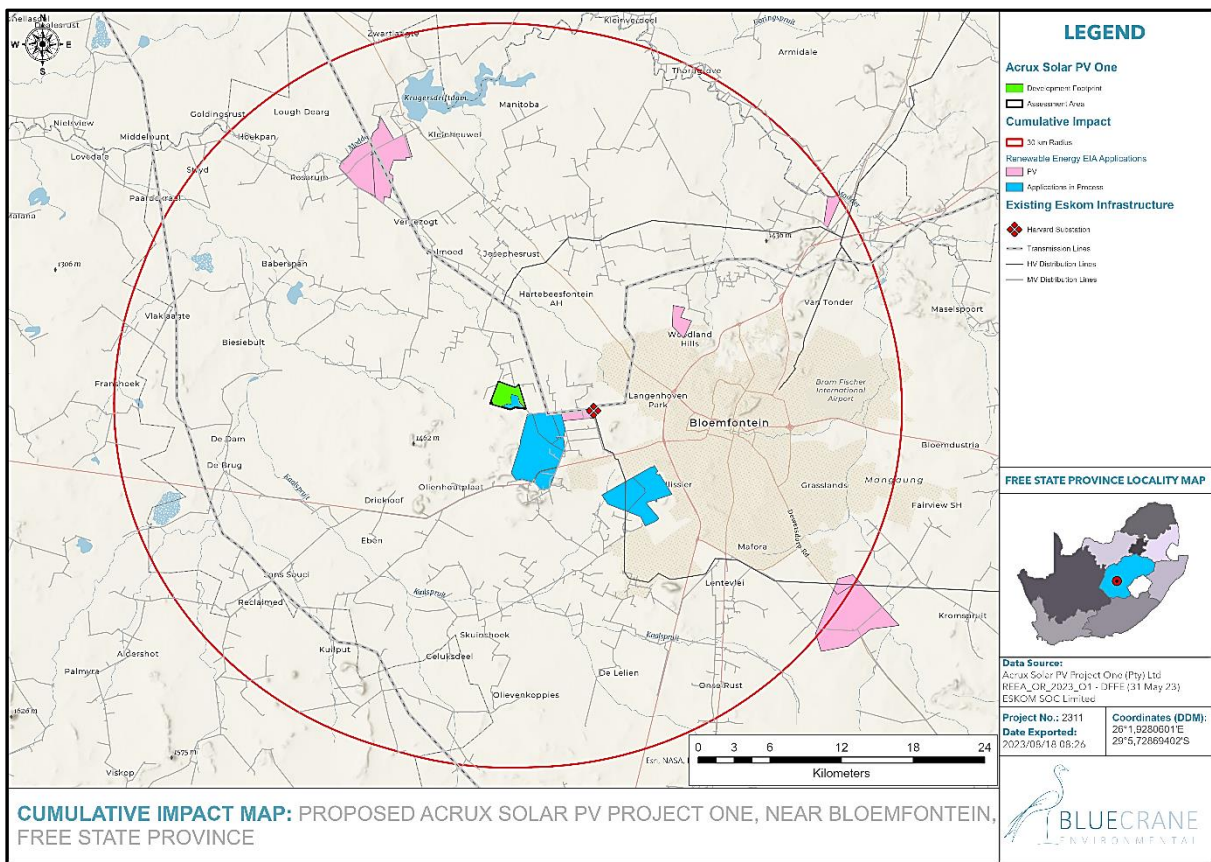


Figure 12: Acruz Solar PV Project one Geographic area of evaluation with utility-scale renewable energy generation sites and power lines



Existing projects and projects that are proposed within the geographical area of evaluation is indicated in Table 9.

Table 8: A summary of related facilities that may have a cumulative impact, in a 30 km radius of Acrux Solar PV Project One.

Project name	Distance from study area	Proposed generating capacity (MW)	DFFE reference	EIA process	Project status
Projects included in the REEA database (May 2023)					
Jedwater Solar Power Facility	18 km	164	12/12/20/1972	Scoping and EIA	Approved
SSS1 5MW Solar PV Power Plant	2.7 km	5	14/12/16/3/3/1/1092	BAR	Approved
SSS1 5MW Solar PV Power Plant	2.7 km	5	14/12/16/3/3/1/1093	BAR	Approved
Solaire Direct Glen Thorne Solar PV Facility	14 km	10	14/12/16/3/3/1/455	BAR	In process
Farm Mara No. 2571 PV Solar Facility	29 km	15	14/12/16/3/3/1/564	BAR	Approved
Portion 1 and Portion 9 Spes Bona PV Solar Facility	0.7 km	75	14/12/16/3/3/2/641	Scoping and EIA	Approved
Sonneblom photovoltaic solar energy facility	29 km	84	14/12/16/3/3/2/673	Scoping and EIA	Approved
Serurubele photovoltaic solar energy facility	30 km	84	14/12/16/3/3/2/675	Scoping and EIA	Approved
Projects not included in REEA database or Applications in process					



Acrux Solar PV Project Two	< 1 km	650	14/12/16/3/3/2/2390	Scoping and EIA	In process
Mira Solar PV Project One	10 km	TBC	TBC	Scoping and EIA	In process

It is unclear whether other projects not related to renewable energy is or has been constructed in this area, and whether other projects are proposed. In general, development activity in the area is focused on agricultural activity. It is quite possible that future solar farm developments may take place within the general area.

The general Palaeontological Sensitivity of the area is Low to High (see SAHRIS Palaeomap, **Figure 4**). 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 Zero and Very High.

7 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 Blue Crane Environmental.
- 1:250 000 Bloemfontein 2926 Geological map (1966) (Council of Geoscience, Pretoria).
- Shape files produced by the Council of Geosciences, Pretoria.

8 SITE INVESTIGATION

A site-specific field survey of the development footprint was conducted on foot and by motor vehicle on 15-16 March 2023. No fossiliferous outcrops were identified during the site visit. This could be attributed to the lack of outcrops as well as the lush grassy vegetation in the area. The area has been utilized for agriculture over the past years.



Figure 13: General view over the proposed development indicates lush vegetation with a lack of outcrops.



Figure 14: Dolerite koppie mantled by quaternary sediments and lush vegetation.



Figure 15: Lush grassy vegetation with no outcrops visible.



9 UPDATED LAYOUT

After specialist studies were concluded the layout of the Acrux Solar PV Project One was updated to avoid any sensitive areas. The new updated layout is indicated in Figures below.

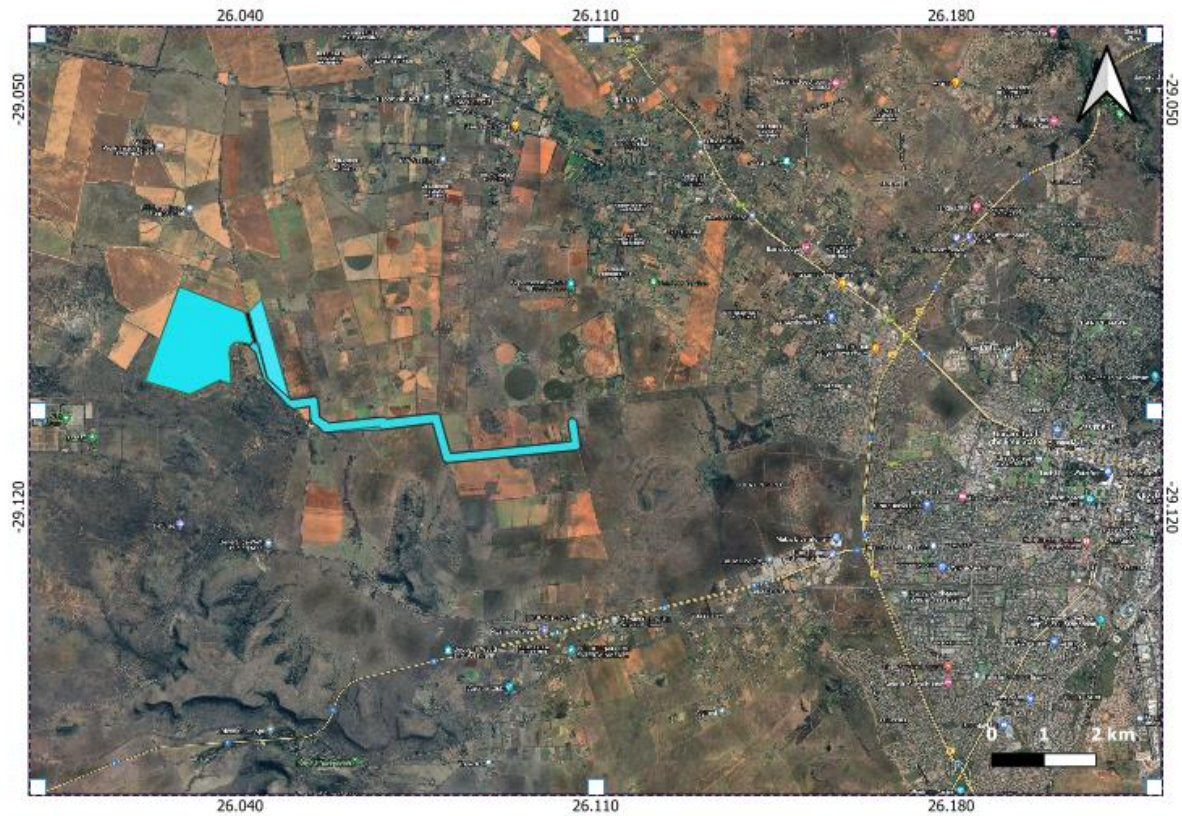


Figure 16: Google Earth image of the updated layout.

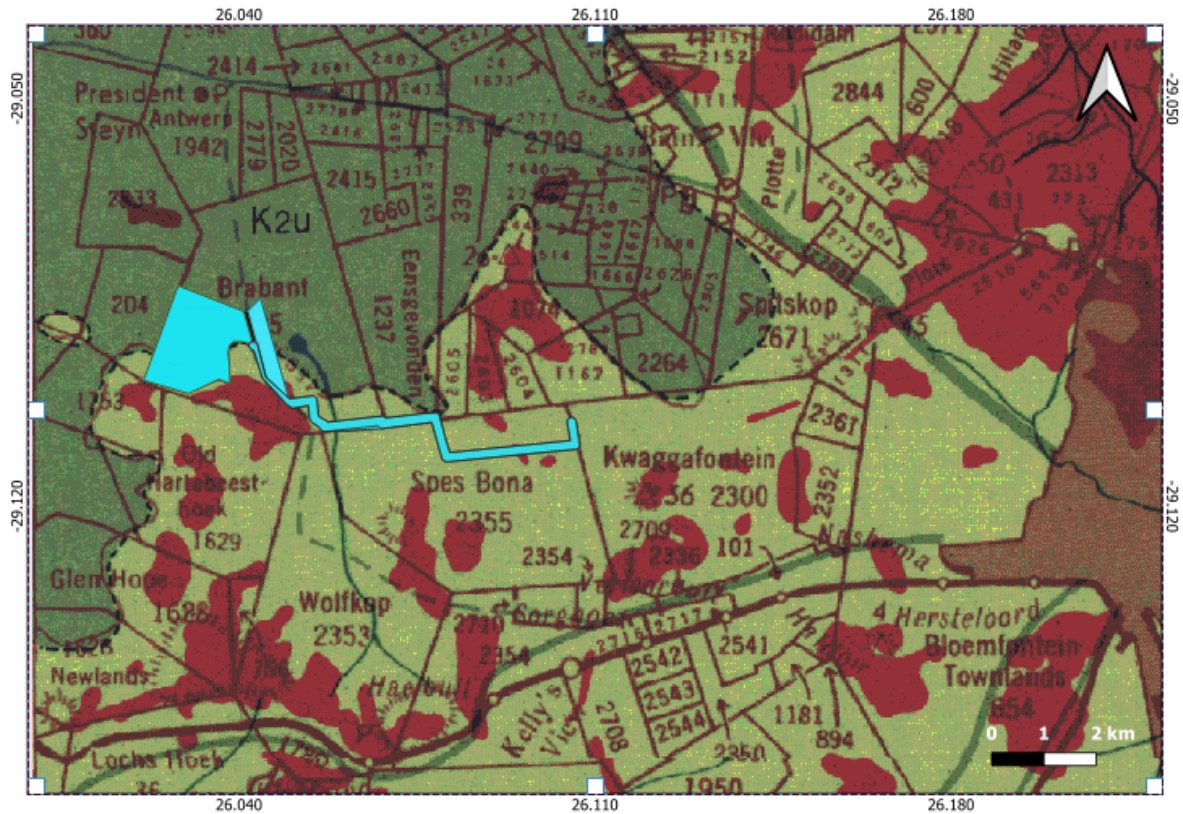


Figure 17: Regional Geology of the updated layout indicates that the development is underlain by the Upper Stage of the Ecca Series (K2u), the Lower Stage (K3l) of the Beaufort System with the grid corridor intersecting with dolerite south-east of the PV Facility.

From a Palaeontological point of view the updated layout will not impact the Palaeontological Heritage of the area.

10 ASSESSMENT METHODOLOGY

10.1 Method of Environmental Assessment

The environmental assessment aims to identify the various possible environmental impacts that could result 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 10.



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.

10.2 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:



Table 9: The rating system

NATURE		
Loss of Fossil Heritage.		
GEOGRAPHICAL EXTENT		
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.
PROBABILITY		
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).
DURATION		
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.
INTENSITY/ MAGNITUDE		
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.
REVERSIBILITY		
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.
IRREPLACEABLE LOSS OF RESOURCES		
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.
CUMULATIVE EFFECT		
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
SIGNIFICANCE		
<p>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.</p> <p>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.</p>		



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.

(Extent + probability + reversibility + irreplaceability + duration + cumulative effect) x magnitude/intensity



Table 10: Summary of Impacts

Impacts	Extent	Duration	Magnitude	Reversibility	Irreplaceable loss	Cumulative effect	Impact
	Site	Permanent	Very High	Irreversible	Complete	Medium	Negative High
Pre-mitigation Acrux Solar PV	1	4	4	4	4	2	60
Post-mitigation	1	4	1	4	4	2	15

11 FINDINGS AND RECOMMENDATIONS

The proposed Acrux Solar PV Project One near Bloemfontein in the Free State is underlain by Jurassic dolerite, the Permian aged sediments of the Lower Stage of the Beaufort Group, Karoo Series as well as the Upper stage of the Ecca Group. Mantling these sediments is Quaternary superficial sediments. Two grid alternatives have been proposed for the Acrux Solar PV Project One. As the geology of the two layouts are the same there are no preference between the alternatives from a Palaeontological Perspective. Updated Geology compiled by the Council of Geosciences (Council for Geoscience, Pretoria) refines the geology and indicates that the proposed Acrux Solar PV Project One is underlain by Karoo Dolerite, the Balfour Formation (Adelaide Subgroup, Karoo Supergroup) as well alluvium, colluvium, eluvium and gravel. The PalaeoMap of the South African Heritage Resources Information System (SAHRIS) indicates that the Palaeontological Sensitivity of the Balfour Formation (Adelaide Subgroup) is Very High, while that of the Tierberg Formation (Ecca Group) is Moderate. Jurassic dolerite is igneous in origin, unfossiliferous and has a Zero Palaeontological Sensitivity (Almond and Pether, 2009; Almond *et al.*, 2013). The layout of the Acrux Solar PV Project One has been updated after specialist input. However, these layouts will not have an effect on the development from a Palaeontological point of view.

A site-specific field survey of the development footprint was conducted on foot and by motor vehicle on 15-16 March 2023. No fossiliferous outcrop was detected in the proposed development. This could be attributed to the lack of outcrops as well as the lush grassy vegetation in the area. Based on the site investigation as well as desktop research it is concluded that fossil heritage of scientific and conservational interest in the development footprint is rare. This is in contrast with the High Sensitivity



allocated to the development area by the SAHRIS Palaeosensitivity Map and DFFE Screening Tool. **A High Palaeontological Significance has been allocated for the construction phase of the PV development pre-mitigation and a low significance post mitigation.** The construction phase will be the only development phase impacting Palaeontological Heritage and **no significant impacts are expected to impact the Operational and Decommissioning phases.** As the No-Go Alternative considers the option of 'do nothing' and maintaining the status quo, it will have a Neutral impact on the Palaeontological Heritage of the development. The **Cumulative impacts of the development is considered to be medium pre- mitigation and Low post mitigation and falls within the acceptable limits for the project.** It is therefore considered that the proposed development will not lead to damaging impacts on the palaeontological resources of the area. **The construction of the development may thus be permitted in its whole extent, as the development footprint is not considered sensitive in terms of palaeontological resources.** It is consequently recommended that no further palaeontological heritage studies, ground truthing and/or specialist mitigation are required pending the discovery of newly discovered fossils.

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) 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.

12 CHANCE FINDS PROTOCOL

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

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.

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. 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 2

CURRICULUM VITAE

PROFESSION: Palaeontologist

YEARS' EXPERIENCE: 30 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. *Cum laude* (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 1998–2022

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 Noupoot, 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.
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- 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.
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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.

Butler, E. 2017. Palaeontological Desktop Assessment for the Proposed Establishment of a Diesel Farm and a Haul Road for the Tshipi Borwa mine Near Hotazel, In the John Taolo Gaetsewe District Municipality in the Northern Cape Province. Bloemfontein.

Butler, E. 2017. Palaeontological Desktop Assessment for the Proposed Changes to Operations at the UMK Mine near Hotazel, In the John Taolo Gaetsewe District Municipality in the Northern Cape Province. Bloemfontein.

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Butler, E. 2017. Palaeontological desktop assessment of the proposed development of a 3000 MW combined cycle gas turbine (CCGT) in Richards Bay, Kwazulu-Natal. Bloemfontein.

Butler, E. 2017. Palaeontological Impact Assessment for the Development of the Proposed Revalidation of the lapsed General Plans for Elliotdale, Mbhashe Local Municipality. Bloemfontein.

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Butler, E. 2017. Palaeontological Impact Assessment of the proposed mining of the farm Zandvoort 10 in the Albert Luthuli Local Municipality, Gert Sibande District Municipality, Mpumalanga Province. Bloemfontein.

Butler, E. 2017. Palaeontological Desktop Assessment for the proposed Lanseria outfall sewer pipeline in Johannesburg, Gauteng Province. Bloemfontein.

Butler, E. 2017. Palaeontological Desktop Assessment of the proposed development of open pit mining at Pit 36W (New Pit) and 62E (Dishaba) Amandelbult Mine Complex, Thabazimbi, Limpopo Province. Bloemfontein.

Butler, E. 2017. Palaeontological impact assessment of the proposed development of the sport precinct and associated infrastructure at Merrifield Preparatory school and college, Amathole Municipality, East London. PGS Heritage. Bloemfontein.

Butler, E. 2017. Palaeontological impact assessment of the proposed construction of the Lehae training and fire station, Lenasia, Gauteng Province. Bloemfontein.

Butler, E. 2017. Palaeontological Desktop Assessment of the proposed development of the new open cast mining operations of the Impunzi mine in the Mpumalanga Province. Bloemfontein.

Butler, E. 2017. Palaeontological Desktop Assessment of the construction of the proposed Viljoenskroon Munic 132 KV line, Vierfontein substation and related projects. Bloemfontein.

Butler, E. 2017. Palaeontological Desktop Assessment of the proposed rehabilitation of 5 ownerless asbestos mines. Bloemfontein.

Butler, E. 2017. Palaeontological Desktop Assessment of the proposed development of the Lephale coal and power project, Lephale, Limpopo Province, Republic of South Africa. Bloemfontein.

Butler, E. 2017. Palaeontological Impact Assessment of the proposed construction of a 132KV powerline from the Tweespruit distribution substation (in the Mantsopa local municipality) to the Driedorp rural substation (within the Naledi local municipality), Free State province. Bloemfontein.

Butler, E. 2017. Palaeontological Desktop Assessment of the proposed development of the new coal-fired power plant and associated infrastructure near Makhado, Limpopo Province. Bloemfontein.



- Butler, E. 2017. Palaeontological Impact Assessment of the proposed construction of a Photovoltaic Solar Power station near Collett substation, Middelburg, Eastern Cape. Bloemfontein.
- Butler, E. 2017. Palaeontological Impact Assessment for the proposed township establishment of 2000 residential sites with supporting amenities on a portion of farm 826 in Botshabelo West, Mangaung Metro, Free State Province. Bloemfontein.
- Butler, E. 2017. Palaeontological Desktop Assessment for the proposed prospecting right project without bulk sampling, in the Koa Valley, Northern Cape Province. Bloemfontein.
- Butler, E. 2017. Palaeontological Desktop Assessment for the proposed Aroams prospecting right project, without bulk sampling, near Aggeneys, Northern Cape Province. Bloemfontein.
- Butler, E. 2017. Palaeontological Impact Assessment of the proposed Belvior aggregate quarry II on portion 7 of the farm Maidenhead 169, Enoch Mgijima Municipality, division of Queenstown, Eastern Cape. Bloemfontein.
- Butler, E. 2017. PIA site visit and report 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. 2017. Palaeontological Impact Assessment of the proposed construction of Tina Falls Hydropower and associated power lines near Cumbu, Mthlontlo Local Municipality, Eastern Cape. Bloemfontein.
- Butler, E. 2017. Palaeontological Desktop Assessment of the proposed construction of the Mangaung Gariep Water Augmentation Project. Bloemfontein.
- Butler, E. 2017. Palaeontological Impact Assessment of the proposed Belvoir aggregate quarry II on portion 7 of the farm Maidenhead 169, Enoch Mgijima Municipality, division of Queenstown, Eastern Cape. Bloemfontein.
- Butler, E. 2017. Palaeontological Impact Assessment of the proposed construction of the Melkspruit-Rouxville 132KV Power line. Bloemfontein.
- Butler, E. 2017. Palaeontological Desktop Assessment of the proposed development of a railway siding on a Portion of portion 41 of the farm Rustfontein 109 is, Govan Mbeki local municipality, Gert Sibande district municipality, Mpumalanga Province. Bloemfontein.
- Butler, E. 2017. Palaeontological Impact Assessment of the proposed consolidation of the proposed Ilima Colliery in the Albert Luthuli local municipality, Gert Sibande District Municipality, Mpumalanga Province. Bloemfontein.
- Butler, E. 2017. Palaeontological Desktop Assessment of the proposed extension of the Kareerand Tailings Storage Facility, associated borrow pits as well as a storm water drainage channel in the Vaal River near Stilfontein, North West Province. Bloemfontein.
- Butler, E. 2017. Palaeontological Desktop Assessment of the proposed construction of a filling station and associated facilities on the Erf 6279, district municipality of John Taolo Gaetsewe District, Ga-Segonyana Local Municipality Northern Cape. Bloemfontein.
- Butler, E. 2017. Palaeontological Desktop Assessment of the proposed of the Lephallale Coal and Power Project, Lephallale, Limpopo Province, Republic of South Africa. Bloemfontein.
- Butler, E. 2017. Palaeontological Desktop Assessment of the proposed Overvaal Trust PV Facility, Buffelspoort, North West Province. Bloemfontein.
- Butler, E. 2017. Palaeontological Impact Assessment of the proposed development of the H₂ Energy Power Station and associated infrastructure on Portions 21; 22 And 23 of the farm Hartebeestspruit in the Thembisile Hani Local Municipality, Nkangala District near Kwamhlanga, Mpumalanga Province. Bloemfontein.
- Butler, E. 2017. Palaeontological Impact Assessment of the proposed upgrade of the Sandriver Canal and Klippan Pump station in Welkom, Free State Province. Bloemfontein.
- Butler, E. 2017. Palaeontological Impact Assessment of the proposed upgrade of the 132kv and 11kv power line into a dual circuit above ground power line feeding into the Urania substation in Welkom, Free State Province. Bloemfontein.
- Butler, E. 2017. Palaeontological Desktop Assessment of the proposed Swaziland-Mozambique border patrol road and Mozambique barrier structure. Bloemfontein.
- Butler, E. 2017. Palaeontological Impact Assessment of the proposed diamonds alluvial & diamonds general prospecting right application near Christiana on the remaining extent of portion 1 of the farm Kaffraria 314, registration division HO, North West Province. Bloemfontein.
- Butler, E. 2017. Palaeontological Desktop Assessment for the proposed development of Wastewater Treatment Works on Hartebeesfontein, near Panbult, Mpumalanga. Bloemfontein.



- Butler, E. 2017. Palaeontological Desktop Assessment for the proposed development of Wastewater Treatment Works on Rustplaas near Piet Retief, Mpumalanga. Bloemfontein.
- Butler, E. 2018. Palaeontological Impact Assessment for the Proposed Landfill Site in Luckhoff, Letsemeng Local Municipality, Xhariep District, Free State. Bloemfontein.
- Butler, E. 2018. Palaeontological Impact Assessment of the proposed development of the new Mutsho coal-fired power plant and associated infrastructure near Makhado, Limpopo Province. Bloemfontein.
- Butler, E. 2018. Palaeontological Impact Assessment of the authorisation and amendment processes for Manangu mine near Delmas, Victor Khanye local municipality, Mpumalanga. Bloemfontein.
- Butler, E. 2018. Palaeontological Desktop Assessment for the proposed Mashishing township establishment in Mashishing (Lydenburg), Mpumalanga Province. Bloemfontein.
- Butler, E. 2018. Palaeontological Desktop Assessment for the Proposed Mlonzi Estate Development near Lusikisiki, Ngquza Hill Local Municipality, Eastern Cape. Bloemfontein.
- Butler, E. 2018. Palaeontological Phase 1 Assessment of the proposed Swaziland-Mozambique border patrol road and Mozambique barrier structure. Bloemfontein.
- Butler, E. 2018. Palaeontological Desktop Assessment for the proposed electricity expansion project and Sekgame Switching Station at the Sishen Mine, Northern Cape Province. Bloemfontein.
- Butler, E. 2018. Palaeontological field assessment of the proposed construction of the Zonnebloem Switching Station (132/22kV) and two loop-in loop-out power lines (132kV) in the Mpumalanga Province. Bloemfontein.
- Butler, E. 2018. Palaeontological Field Assessment for the proposed re-alignment and de-commissioning of the Firham-Platrand 88kv Powerline, near Standerton, Lekwa Local Municipality, Mpumalanga province. Bloemfontein.
- Butler, E. 2018. Palaeontological Desktop Assessment of the proposed Villa Rosa development In the Buffalo City Metropolitan Municipality, East London. Bloemfontein.
- Butler, E. 2018. Palaeontological field Assessment of the proposed Villa Rosa development In the Buffalo City Metropolitan Municipality, East London. Bloemfontein.
- Butler, E. 2018. Palaeontological desktop assessment of the proposed Mookodi – Mahikeng 400kV line, North West Province. Bloemfontein.
- Butler, E. 2018. Palaeontological Desktop Assessment for the proposed Thornhill Housing Project, Ndlambe Municipality, Port Alfred, Eastern Cape Province. Bloemfontein.
- Butler, E. 2018. Palaeontological desktop assessment of the proposed housing development on portion 237 of farm Hartebeestpoort 328. Bloemfontein.
- Butler, E. 2018. Palaeontological desktop assessment of the proposed New Age Chicken layer facility located on holding 75 Endicott near Springs in Gauteng. Bloemfontein.
- Butler, E. 2018 Palaeontological Desktop Assessment for the development of the proposed Leslie 1 Mining Project near Leandra, Mpumalanga Province. Bloemfontein.
- Butler, E. 2018. Palaeontological field assessment of the proposed development of the Wildealskloof mixed use development near Bloemfontein, Free State Province. Bloemfontein.
- Butler, E. 2018. Palaeontological Field Assessment of the proposed Megamor Extension, East London. Bloemfontein
- Butler, E. 2018. Palaeontological Impact Assessment of the proposed diamonds Alluvial & Diamonds General Prospecting Right Application near Christiana on the Remaining Extent of Portion 1 of the Farm Kaffraria 314, Registration Division HO, North West Province. Bloemfontein.
- Butler, E. 2018. Palaeontological Impact Assessment of the proposed construction of a new 11kV (1.3km) Power Line to supply electricity to a cell tower on farm 215 near Delpoortshoop in the Northern Cape. Bloemfontein.
- Butler, E. 2018. Palaeontological Field Assessment of the proposed construction of a new 22 kV single wood pole structure power line to the proposed MTN tower, near Britstown, Northern Cape Province. Bloemfontein.
- Butler, E. 2018. Palaeontological Exemption Letter for the proposed reclamation and reprocessing of the City Deep Dumps in Johannesburg, Gauteng Province. Bloemfontein.
- Butler, E. 2018. Palaeontological Exemption letter for the proposed reclamation and reprocessing of the City Deep Dumps and Rooikraal Tailings Facility in Johannesburg, Gauteng Province. Bloemfontein.
- Butler, E. 2018. Proposed Kalabasfontein Mine Extension project, near Bethal, Govan Mbeki District Municipality, Mpumalanga. Bloemfontein.



- Butler, E. 2018. Palaeontological Desktop Assessment for the development of the proposed Leslie 1 Mining Project near Leandra, Mpumalanga Province. Bloemfontein.
- Butler, E. 2018. Palaeontological Desktop Assessment of the proposed Mookodi – Mahikeng 400kV Line, North West Province. Bloemfontein.
- Butler, E. 2018. Environmental Impact Assessment (EIA) for the Proposed 325mw Rondekop Wind Energy Facility between Matjiesfontein and Sutherland in the Northern Cape Province.
- Butler, E. 2018. Palaeontological Impact Assessment of the proposed construction of the Tooverberg Wind Energy Facility, and associated grid connection near Touws River in the Western Cape Province. Bloemfontein.
- Butler, E. 2018. Palaeontological impact assessment of the proposed Kalabasfontein Mining Right Application, near Bethal, Mpumalanga.
- Butler, E., 2019. Palaeontological Desktop Assessment of the proposed Westrand Strengthening Project Phase II.
- Butler, E., 2019. Palaeontological Field Assessment for the proposed Sirius 3 Photovoltaic Solar Energy Facility near Upington, Northern Cape Province
- Butler, E., 2019. Palaeontological Field Assessment for the proposed Sirius 4 Photovoltaic Solar Energy Facility near Upington, Northern Cape Province
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