Palaeontological Impact Assessment for the proposed construction of three Solar Photovoltaic (PV) Facilities (i.e. Vryburg Solar 1, Vryburg Solar 2 and Vryburg Solar 3) and associated electrical infrastructure, near Vryburg, in the North-West Province

Report prepared for:
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24 July 2018

SPECIALIST EXPERTISE

Dr Francois Durand is a palaeontologist and environmentalist and teaches at the University of Johannesburg. He specialises in the origin and evolution of mammals, early dinosaurs and cave fauna. He established cave and groundwater ecology research in South Africa and also does research on acid mine drainage in Gauteng.
He holds a PhD in Palaeontology and is a member of the Palaeontological Society of Southern Africa.

CV: DR. FRANCOIS DURAND

ACADEMIC CAREER:
BSc Botany & Zoology (Rand Afrikaans University: 1983)
BSc (Hons) Zoology (University of the Witwatersrand: 1984)
PhD Palaeontology (University of the Witwatersrand: 1990)
Post-graduate Diploma in Museology (University of Pretoria: 1993)
Higher Education Diploma (Rand Afrikaans University: 2001)

AFFILIATION TO PROFESSIONAL SOCIETIES AND BODIES:
Member of Research Committee of the Cancer Association of South Africa (2010-2011)
Member of the Suid-Afrikaanse Akademie vir Wetenskap en Kuns (1998-present)
Appointed by the Minister of the Department of Arts, Culture, Science and Technology to serve on the board of the Foundation for Education, Science & Technology (1996-1999)
Registered Professional Natural Scientist (Earth Science & Zoological Science) with the South African Council for Natural Scientific Professions
Palaeontological Society of Southern Africa (1986-present)

CAREER:
1988-1997: Palaeontologist at the Council for Geosciences.
1998-2004: Lecturer at the Rand Afrikaans University in the Zoology Department.
2005-Present: Senior Lecturer at the University of Johannesburg in the Zoology Department.

EXPERIENCE:
- Urban development in Cradle of Humankind World Heritage Site (Gauteng): Letamo, Honingklip, Windgat, Sundowners, Ekutheni
- Urban development at Goose Bay, Vereeniging, Gauteng
- Urban development on the farm Waterkloof, Rustenburg, North West Province
- Upgrade of R21 between N12 and Hans Strydom Drive, Gauteng
- Vele Colliery, Limpopo Province
- De Wildt 50 MW Solar Power Station, Gauteng
- 10 MW PV Plant Potchefstroom, North West Province
- Omega 342 50MW Solar Power Station, Viljoenskroon, Free State
- Springfontein wind and solar energy facility, Free State
- Solar power plant, Bethal, Mpumalanga
- Diamond mine on Endora, Limpopo Province
- Development at Tubatse Ext.15, Limpopo Province
- Manganese mine south of Hotazel, Northern Cape
- Wind energy facility at Cookhouse, Eastern Cape

- Energy facility at Noupoort, Northern Cape
- Fluorspar mine near Wallmannsthal, Gauteng
- ESKOM power line, Dumo, KwaZulu-Natal
- ESKOM Gamma-Omega 765KV transmission line, Western Cape
- ESKOM 44KV power line at Elandspruit near Middelburg, Mpumalanga
- ESKOM Makopane Substation, Limpopo Province
- ESKOM Platreef Substation and power lines to Borutho MTS Substation, Limpopo
- Solar energy facility at Prieska, Northen Cape.
- Marang B - a 3 x 500MVA 400/132kV Main Transmission Substation east of Rustenburg, North West Province
- Upgrading of storm water infrastructure in Valencia, Addo, Eastern Cape
- Development of a 10 MW Solar Energy facility on the Farm Liverpool 543 KQ Portion 2 at Koedoeskop, Limpopo Province
- Development of a fluorspar mine at Wallmannsthal, North of Pretoria
- Extension of limestone mine on the farms Buffelskraal 554 KQ Portion1 and Krokodilkraal 545 KQ, Limpopo Province
- Lesego Platinum Mine, Sekhukhune Area, Steelpoort, Limpopo Province
- Mine at Hotazel, Northern Cape
- Pollution control dams at Transalloys in Clewer, Emalahleni, Mpumalanga
- Erection of spill points on the Farm Kwikstaart 431 KQ Portion 2, Thabazimbi, Limpopo Province
- Construction of dam at Ethemba, Swaziland
- Construction of bridge at Busingatha, KwaZulu Natal
- Water Reticulation System - Kei Road and Berlin General, Eastern Cape
- Development at Kromdraai, COHWHS (Portion 26 of the Farm Kromdraai, West Rand Municipality)
- Construction of Nhlezi Bridge, KwaZulu Natal
- Erection of spill point and dam on the Farm Faure 72 KQ Portion 8, Makoppa near Thabazimbi, Limpopo Province
- Colliery on the Farm Goedehoop near Piet Retief, Mpumalanga
- Erection of spill points on the Farm Diepwater 302 KQ Portions 4 -8 near Thabazimbi, Limpopo Province
- Construction of 2 MW photovoltaic power plant on the farm De Hoek 32, Pixley ka Seme District Municipality, Northern Cape Province
- Road upgrade near Magogo, KwaZulu/Natal
- Construction of haul road & waste dump: Lylyveld, Sishen, Northern Cape
- Construction of 4 weirs and a road culvert on Portion 3 of the Farm Roodekrans 133JT, Dullstroom Area, Mpumalanga
- Construction of a solar energy facility on Blaubospan, Groblershoop, Northern Cape
- Construction of road from Macengeni to Macijo, KwaZulu/Natal
- Construction of the John Taole Gaetsewe school and hostels in Dithakgong, Northern Cape
- Development at Duduza Township, Gauteng
- Construction of roads near Ndanyana KwaZulu/Natal
- Development of colliery on the farm Goedehoop near Piet Retief, Mpumalanga
- Construction of Tiger Solar power plant near Windsorton, Northern Cape
- Development of Amandelbult Open Cast Mine near Thabazimbi, Limpopo
- Development at The Shed in the Cradle of Humankind World Heritage Site
- Development of 800 ha dry lands on Farm Hoylesdale 163 KQ portion 1, Makoppa, Thabazimbi Local municipality, Limpopo Province
- Construction of solar energy facility on Blauwpospan near Groblershoop, NC.

- Development of the Doornhoek Fluorspar Mine near Zeerust, Northwest.
- Development on the Farm Haakdoringdrift, 373 KQ Portion 3, Thabazimbi, Limpopo.
- Development of bulk sewer line, Motherwell, Eastern Cape.
- Erection of spill points on the Farm De Hoop, near Thabazimbi, Limpopo Province.
- Development of orchards on the Farm Kromdraai, near Thabazimbi, Limpopo.
- Upgrade of Section 3 and Section 4 of the National Route R75, Eastern Cape.
- Construction of Concentrated Power Plants at Olyvenhout Drift, Upington, NC.
- Borrow pit at New Payne in Mthatha, Eastern Cape.
- Borrow pit for rural road to Centuli Clinic, Eastern Cape.
- Juno Gromis 400kV power line (West Cape and North Cape).
- Barberton IAPS Waste Water Treatment Works, Barberton, Mpumalanga.
- Development of orchards on the Farm Kromdraai, Thabazimbi, Limpopo Province.
- Erection of spill points on the farm Knoppieskop, Limpopo Province.
- Development at O.R. Tambo International Airport, Gauteng.
- Development on Portion 12 of the Farm Tregaron, Sundays River Municipality, EC.
- Development of spill points and dam on the Farm Fairfield 306 KQ, Makoppa near Thabazimbi, Limpopo Province.
- Development at Erasmus Park (Waterkloof 378 JR), Pretoria, Gauteng.
- Development of shopping centre at Wright Park, Gauteng.
- Mining development on Thorncliffe and Helena Farms near Steelpoort, Sekhukhune District Municipality, Limpopo Province.
- Urban development at Pienaarspoort, Tshwane, Gauteng.
- Lydenburg-Merensky 132 kV Power Line within the Sekhukhune (Ward 31) and the Ehlanzeni (Wards 1, 5, 13) District Municipalities in the Limpopo and Mpumalanga Provinces.
- Mahikeng Main Transmission Substation and a 400kV Pluto-Mahikeng powerline, North West Province

Palaeontological research:

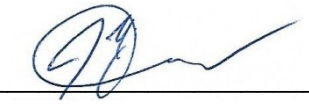
- Gauteng: Wonder Cave
- KwaZulu/Natal: Newcastle, Mooi River, Rosetta, Impendle, Himeville Underberg, Polela & Howick Districts, Sani Pass
- Eastern Cape: Cradock District, Algoa Basin
- Western Cape: Clanwilliam District
- Free State: Memel & Warden Districts
- Limpopo Province: Nyalaland (KNP), Vhembe Reserve, Pont Drift
- Zimbabwe: Sentinel Ranch, Nottingham

SPECIALIST DECLARATION

I, Jacobus Francois Durand as the appointed independent specialist, in terms of the 2014 EIA Regulations (as amended), hereby declare that I:

- I act as the independent specialist in this application;
- I perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- regard the information contained in this report as it relates to my specialist input/study to be true and correct, and do not have and will not have any financial interest in the undertaking of the activity, other than remuneration for work performed in terms of the NEMA, the Environmental Impact Assessment Regulations, 2014 (as amended) and any specific environmental management Act;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I have no vested interest in the proposed activity proceeding;
- 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 have ensured that information containing all relevant facts in respect of the specialist input/study was distributed or made available to interested and affected parties and the public and that participation by interested and affected parties was facilitated in such a manner that all interested and affected parties were provided with a reasonable opportunity to participate and to provide comments on the specialist input/study;
- I have ensured that the comments of all interested and affected parties on the specialist input/study were considered, recorded and submitted to the competent authority in respect of the application;
- all the particulars furnished by me in this specialist input/study are true and correct; and
- I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.

Name of Specialist: Jacobus Francois Durand

Signature of the specialist: 

Date: 24 July 2018

EXECUTIVE SUMMARY

The proposed development of the Vryburg Solar 1, Vryburg Solar 2 and Vryburg Solar 3 photovoltaic facility will take place in an area which is considered to have mostly a High Palaeontological Sensitivity for the PV facility sites, and areas of Medium, High and Very High Palaeontological Sensitivity within the corridor for the distribution power lines.

The central and western sections of the proposed Power Corridor fall in the Very High Palaeontological Sensitivity category due to the probability of finding stromatolites in this region. Even though no distinct outcrops of stromatolites were found during the field assessment, the chances of exposing stromatolites during construction are good and for this reason a Chance Find Procedure has been included in the Recommendations. Even though it is not essential to salvage every piece of stromatolite exposed because of its ubiquitous distribution in the dolomites of South Africa, it will be prudent not to destroy a major stromatolite find for scientific and heritage reasons.

The areas where the proposed Solar 1, 2 and 3 PV panels are to be installed fall in the High Palaeontological Sensitivity category because of the underlying Tertiary calcrete and Quaternary alluvium, sand and soils. The Chance Find Procedure should be followed if fossils are uncovered during construction in this section.

The eastern sections of the Power Corridor are situated on rocks with a Medium Palaeontological Sensitivity. The chances of finding fossils in the High to Medium Sensitivity sections are low however and the protocol that should be followed in the unlikely case of the discovery of fossils in this section is covered in the Chance Find Procedure.

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LIST OF ABBREVIATIONS

SAHRA: South African Heritage Resources Agency

Glossary

Definitions	
Fossiliferous	Rocks that contain fossils or which is particularly fossil-rich.
Stromatolite	Sedimentary structure which was formed by cyanobacteria that are approximately 2.2 Ga old in South Africa.

COMPLIANCE WITH THE APPENDIX 6 OF THE 2014 EIA REGULATIONS (AS AMENDED)

Requirements of Appendix 6 – GN R982	Addressed in the Specialist Report
1. (1) A specialist report prepared in terms of these Regulations must contain- a) details of- i. the specialist who prepared the report; and ii. the expertise of that specialist to compile a specialist report including a curriculum vitae;	Page 2 - 5
b) a declaration that the specialist is independent in a form as may be specified by the competent authority;	Page 5
c) an indication of the scope of, and the purpose for which, the report was prepared;	Section 1.1 Page 12
(cA) an indication of the quality and age of base data used for the specialist report;	Page 45-46
(cB) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	Page 35-42
d) the duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment;	Page 16
e) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used;	Page 16
f) details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternatives;	Page 22-34
g) an identification of any areas to be avoided, including buffers;	Page 20, 44
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;	Page 20
i) a description of any assumptions made and any uncertainties or gaps in knowledge;	Page 17
j) a description of the findings and potential implications of such findings on the impact of the proposed activity or activities;	Page 44
k) any mitigation measures for inclusion in the EMPr;	Page 45
l) any conditions for inclusion in the environmental authorisation;	Page 45
m) any monitoring requirements for inclusion in the EMPr or environmental authorisation;	Page 45
n) a reasoned opinion- i. whether the proposed activity, activities or portions thereof should be authorised; (iA) regarding the acceptability of the proposed activity or activities; and ii. if the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan;	Page 44-45
o) a description of any consultation process that was undertaken during the course of preparing the specialist report;	Page 22-34
p) a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	
q) any other information requested by the competent authority.	
(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.	Page 14-15

PALAEONTOLOGICAL IMPACT ASSESSMENT FOR THE PROPOSED CONSTRUCTION OF THREE SOLAR PHOTOVOLTAIC (PV) FACILITIES (I.E. VRYBURG SOLAR 1, VRYBURG SOLAR 2 AND VRYBURG SOLAR 3) AND ASSOCIATED ELECTRICAL INFRASTRUCTURE, NEAR VRYBURG, IN THE NORTH-WEST PROVINCE

This report presents the Palaeontological Impact Assessment that was prepared by Dr JF Durand as part of the Basic Assessment (BA) Process for the proposed construction of the Vryburg Solar Photovoltaic Facilities, in the North-West Province.

1. INTRODUCTION AND METHODOLOGY

The palaeontological heritage of South Africa is unsurpassed and can only be described in superlatives. The South African palaeontological record gives us insight in i.e. the origin of life, dinosaurs and humans. Fossils are also used to identify rock strata and determine the geological context of the geological formations and the chronostratigraphy of Southern Africa.

Some of the oldest evidence of life on Earth came from the rocks at Barberton which contain fossilized bacteria. Stromatolites in the dolomitic regions in South Africa were formed by shallow marine mats of cyanobacteria. The cyanobacteria, which were some of the first photosynthesising organisms, provided most of the oxygen in our atmosphere.

The National Heritage Resources Act (No. 25 of 1999) of South Africa stipulates that fossils and fossil sites may not be altered or destroyed. The purpose of the Field Assessment and this report are to detail the probability of finding fossils in the study area which may be impacted by the proposed development.

The sensitive palaeontological nature of the Study Area as determined by SAHRA necessitated a site visit to assess the potential palaeontological concerns that will arise during development.

1.1 Scope, Purpose and Objectives of this Specialist Report

The Field Assessment of the farms Frankfort, Retreat and Rosendal was done to assess the palaeontological nature of the areas demarcated for development.

The sites demarcated for the Solar 1 (Frankfort Farm 672 Portion 1), Solar 2 and Solar 3 (Retreat Farm 671 Portion 1) PV installations are in areas considered to be of High Palaeontological Sensitivity. The proposed Power Corridor is situated in areas that are considered to range from Very High Palaeontological Sensitivity to Medium Palaeontological Sensitivity.

This study serves to look at these potential impacts associated with the development proposed on study site and propose a mitigation protocol for the fossiliferous sites within the study area which would be impacted on by development.

1.2 Terms of Reference

- Review detailed information relating to the project description and precisely define the environmental risks to the palaeontology and fossil heritage, and consequences thereto.
- Conduct a review of available information pertaining to the study area.

- Draw on desktop information sources, the knowledge of local experts, information published in the scientific press and information derived from relevant EIAs and similar specialist studies previously conducted within the surrounding area.
- Prepare and undertake a desktop study on the palaeontology and fossil heritage within the proposed project area, based on:
    - a review of all relevant palaeontological and geological literature, including geological maps and previous reports;
    - location and examination of fossil collections from the study area (e.g. museums); and
    - data on the proposed development (e.g. location of footprint, depth and volume of bedrock excavation envisaged).
- Undertake a detailed field examination (i.e. fieldwork) of the palaeontological features within the development area.
- Describe the type and location of known palaeontology and fossil heritage sites in the study area, and characterize all items that may be affected by the proposed project.
- Describe the baseline environment and determine the status quo in relation to the specialist study.
- Note fossils and associated sedimentological features of palaeontological relevance (photos, maps, satellite images).
- Evaluate the potential for occurrence of palaeontology and heritage features within the study area.
- Incorporate relevant information from other specialist reports/findings if required.
- Identify and rate potential direct, indirect and cumulative impacts of the proposed project on the palaeontology and fossil heritage during the construction, operational and decommissioning phases of the project. Study the cumulative impacts of the project by considering the impacts of existing industries/solar PV plants within the area (as well as those PV plants that are proposed), together with the impact of the proposed project.
- Assessment of alternatives. Provide specialist input relating to the layout, design and the associated infrastructure in terms of impacts on the surrounding environment in relation to palaeontology and fossil heritage.
- Identify and rank the highlights and sensitivities to development of fossil heritage within study area.
- Provide recommendations and suggestions regarding fossil heritage management on site, including conservation measures, as well as promotion of local fossil heritage (e.g. for public education, schools) to ensure that the impacts are limited.
- Provide input to the EMPr, including mitigation and monitoring requirements to ensure that the impacts on the archaeological features and heritage features are limited.
- Provide specific recommendations for further palaeontological mitigation (if any).
- Compile an assessment report, for inclusion in the “Draft” and “Final” Basic Assessment Reports. Three final specialist reports must be completed (i.e. one for each Solar PV Facility, namely PV 1, PV 2 and PV 3). The specialist reports must comply with the requirements of the amended 2014 EIA Regulations (Appendix 6).
- Provide input to the Basic Assessment Report National DEA Template.
- Address all review comments made by the CSIR and the client.
- Address all comments raised by organs of state, interested and affected parties and the public (during the entire Public Participation Process), in relation to the specialist study. If necessary, an amended report must be submitted to the CSIR.
- Liaise with the relevant authority in order to obtain a letter of approval, comments or a Permit in terms of National Heritage Resources Act.
- Load the relevant documents on the South African Heritage Resources Information System (SAHRIS).

The study area is used for cattle farming. Few rocky outcrops occur in this relatively flat area which is covered with natural grass and bush.

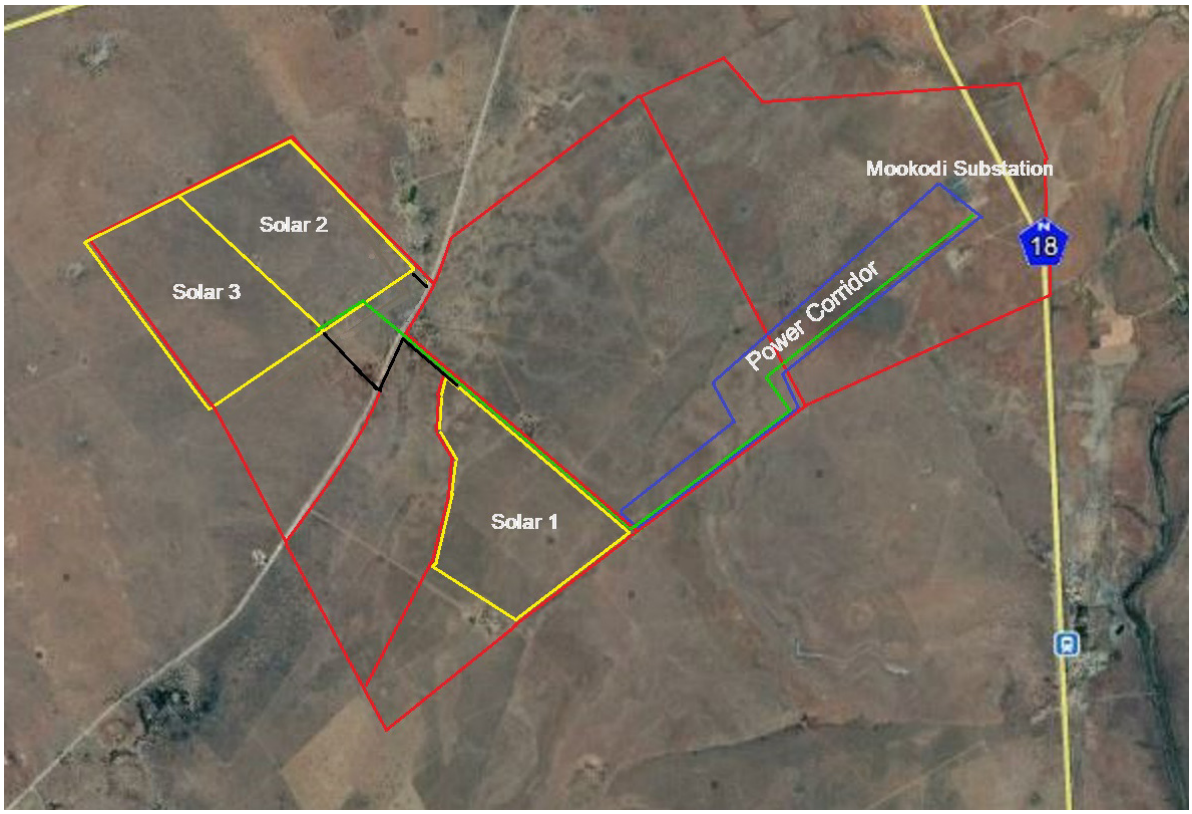


Figure 1: Google Earth photo indicating the study area

Relevant legislation and legal requirements:

According to the South African Heritage Resources Act (Act 25 of 1999) (Republic of South Africa, 1999), certain clauses are relevant to palaeontological aspects for a terrain suitability assessment.

- **Subsection 35(4)** No person may, without a permit issued by the responsible heritage resources authority-
- (a) destroy, damage, excavate, alter, deface or otherwise disturb any archaeological or palaeontological site or any meteorite;
- (b) destroy, damage, excavate, remove from its original position, collect or own any archaeological or palaeontological material or object or any meteorite;
- (c) trade in, sell for private gain, export or attempt to export from the republic any category of archaeological or palaeontological material or object, or any meteorite; or
- (d) bring onto or use at an archaeological or palaeontological site any excavation equipment or any equipment which assist with the detection or recovery of metals or archaeological material or objects, or use such equipment for the recovery of meteorites.
- **Subsection 35(5)** When the responsible heritage resources authority has reasonable cause to believe that any activity or development which will destroy, damage or alter any archaeological or palaeontological site is under way, and where no application for a permit has been submitted and no heritage resources management procedures in terms of section 38 has been followed, it may-
- (a) serve on the owner or occupier of the site or on the person undertaking such development an order for the development to cease immediately for such period as is specified in the order;
- (b) carry out an investigation for the purpose of obtaining information on whether or not an archaeological or palaeontological site exists and whether mitigation is necessary;

- (c) if mitigation is deemed by the heritage resources authority to be necessary, assist the person on whom the order has been served under paragraph (a) to apply for a permit as required in subsection (4); and
- (d) recover the costs of such investigation form the owner or occupier of the land on which it is believed an archaeological or palaeontological site is located or from the person proposing to undertake the development if no application for a permit is received within two weeks of the order being served.

South Africa's unique and non-renewable palaeontological heritage is protected in terms of the NHRA. According to this act, heritage resources may not be excavated, damaged, destroyed or otherwise impacted by any development without prior assessment and without a permit from the relevant heritage resources authority.

As areas are developed and landscapes are modified, heritage resources, including palaeontological resources, are threatened. As such, both the environmental and heritage legislation require that development activities must be preceded by an assessment of the impact undertaken by qualified professionals. Palaeontological Impact Assessments (PIAs) are specialist reports that form part of the wider heritage component of:

- Heritage Impact Assessments (HIAs) called for in terms of Section 38 of the National Heritage Resources Act, Act No. 25, 1999 by a heritage resources authority.
- Environmental Impact Assessment process as required in terms of other legislation listed in s. 38(8) of NHRA;
- Environmental Management Plans (EMPs) required by the Department of Mineral Resources.

HIAs are intended to ensure that all heritage resources are protected, and where it is not possible to preserve them in situ, appropriate mitigation measures are applied. An HIA is a comprehensive study that comprises a palaeontological, archaeological, built environment, living heritage, etc specialist studies. Palaeontologists must acknowledge this and ensure that they collaborate with other heritage practitioners. Where palaeontologists are engaged for the entire HIA, they must refer heritage components for which they do not have expertise on to appropriate specialists. Where they are engaged specifically for the palaeontology, they must draw the attention of environmental consultants and developers to the need for assessment of other aspects of heritage. In this sense, Palaeontological Impact Assessments that are part of Heritage Impact Assessments are similar to specialist reports that form part of the EIA reports.
The standards and procedures discussed here are therefore meant to guide the conduct of PIAs and specialists undertaking such studies must adhere to them.
The process of assessment for the palaeontological (PIA) specialist components of heritage impact assessments, involves:

Scoping stage in line with regulation 28 of the National Environmental Management Act (No. 107 of 1998) Regulations on Environmental Impact Assessment. This involves an **initial assessment** where the specialist evaluates the scope of the project (based, for example, on NID/BIDs) and advises on the form and extent of the assessment process. At this stage the palaeontologist may also decide to compile a **Letter of Recommendation for Exemption from further Palaeontological Studies**. This letter will state that there is little or no likelihood that any significant fossil resources will be impacted by the development. This letter should present a reasoned case for exemption, supported by consultation of the relevant geological maps and key literature.

A **Palaeontological Desktop Study** – the palaeontologist will investigate available resources (geological maps, scientific literature, previous impact assessment reports, institutional fossil collections, satellite images or aerial photos , etc) to inform an assessment of fossil heritage and/or exposure of potentially fossiliferous rocks within the study area. A Desktop studies will conclude whether a further field assessment is warranted or not. Where further studies are required, the desktop study would normally be an integral part of a field assessment of relevant palaeontological resources.

A **Phase 1 Palaeontological Impact Assessment** is generally warranted where rock units of high palaeontological sensitivity are concerned, levels of bedrock exposure within the study area are adequate; large-scale projects with high potential heritage impact are planned; and where the distribution and nature of fossil remains in the proposed project area is unknown. In the recommendations of Phase 1, the specialist will inform whether further monitoring and mitigation are necessary. The Phase 1 should identify the rock units and significant fossil heritage resources present, or by inference likely to be present, within the study area, assess the palaeontological significance of these rock units, fossil sites or other fossil heritage, comment on the impact of the development on palaeontological heritage resources and make recommendations for their mitigation or conservation, or for any further specialist studies that are required in order to adequately assess the nature, distribution and conservation value of palaeontological resources within the study area.

A **Phase 2 Palaeontological Mitigation** involves planning the protection of significant fossil sites, rock units or other palaeontological resources and/or the recording and sampling of fossil heritage that might be lost during development, together with pertinent geological data. The mitigation may take place before and / or during the construction phase of development. The specialist will require a Phase 2 mitigation permit from the relevant Heritage Resources Authority before Phase 2 may be implemented.

A **'Phase 3' Palaeontological Site Conservation and Management Plan** may be required in cases where the site is so important that development will not be allowed, or where development is to co-exist with the resource. Developers may be required to enhance the value of the sites retained on their properties with appropriate interpretive material or displays as a way of promoting access of such resources to the public.

The assessment reports will be assessed by the relevant heritage resources authority, and depending on which piece of legislation triggered the study, a response will be given in the form of a Review Comment or Record of Decision (ROD). In the case of PIAs that are part of EIAs or EMPs, the heritage resources authority will issue a comment or a record of decision that may be forwarded to the consultant or developer, relevant government department or heritage practitioner and where feasible to all three.

1.3 Assessment Details

Type of Specialist Investigation	Palaeontological Impact Assessment
Date and Duration of Specialist Site Investigation	14 July 2018
Season	Winter
Relevance of Season	N/a

2. APPROACH AND METHODOLOGY

The site was visited and the relevant literature and geological maps for the region in which the development is proposed to take place, have been studied for a Palaeontological Impact Assessment.

The area in which the development is proposed to take place has been walked through in search of fossiliferous bedrock. A geological hammer was used to expose fresh rock in places.

2.1 Information Sources

The information that was used to prepare for the field assessment and the writing of the report includes the 1:250 000 geological maps: 2724 Christiana and 2624 Vryburg.

Descriptions of fossils in Tertiary calcretes are published in: Almond, J.E. & Pether, J. (2008) Palaeontological heritage of the Northern Cape. Interim SAHRA technical report, 124 pp.

A previous study (Almond, J.E. (2013) Palaeontological Heritage Assessment for the proposed PV Solar Facility on a portion of the farm Waterloo 992 near Vryburg, Naledi Local Municipality, North-West Province, SAHRA.) done on the neighbouring farm was consulted.

Descriptions of the regional geology were found in: Eriksson et al., 2009; Keyser & Du Plessis, 1993 and Schutte, 1994.

Descriptions of stromatolites in the vicinity of the study area were found in Almond, 2013; Keyser & Du Plessis, 2008 and Smit *et al*.,1991.

A Google Earth map with polygons of the proposed development was received from the CSIR.

The Palaeosensitivity Map was captured from the SAHRIS website.

2.2 Assumptions, Knowledge Gaps and Limitations

Palaeontological studies had been done on Retreat and Rosendal and the neighbouring farms Edinburgh to the south, Klondike to the north and Waterloo to the southeast of the study area previously. Although soil, sand and vegetation covered most of the bedrock in the study area, the geology of the area is well known and the geological formations described will be exposed once clearing of the area commences.

2.3 Consultation Processes Undertaken

The Palaeontological Impact Assessment (PIA) is undertaken as part of the Basic Assessment (BA) Process for the proposed Vryburg Solar projects. The BA process includes a public participation process (PPP), therefore no dedicated consultation was undertaken as part of the PIA. Interested and affected parties would have the opportunity to provide comment on the palaeontological aspects of the project during the PPP.

3. DESCRIPTION OF PROJECT ASPECTS RELEVANT TO PALAEONTOLOGICAL IMPACTS

The key aspects of the Solar PV project that are relevant to palaeontological impacts are:

- Excavations on the Solar PV sites for foundations for the panel arrays, burying of 33 kV lines (to 1 m depth maximum), building foundations and shallowly buried services could affect fossil-bearing rock formations.
- Excavations in the Distribution line corridor for foundations for pylons could affect fossil-bearing rock formations.
- Clearing, levelling and scraping of the surface could affect underlying fossil-bearing rock formations.

4. DESCRIPTION OF THE RECEIVING ENVIRONMENT

4.1 Baseline Environmental Description

The study area is used for cattle farming. Few rocky outcrops occur in this relatively flat area which is covered with natural grass and bush.

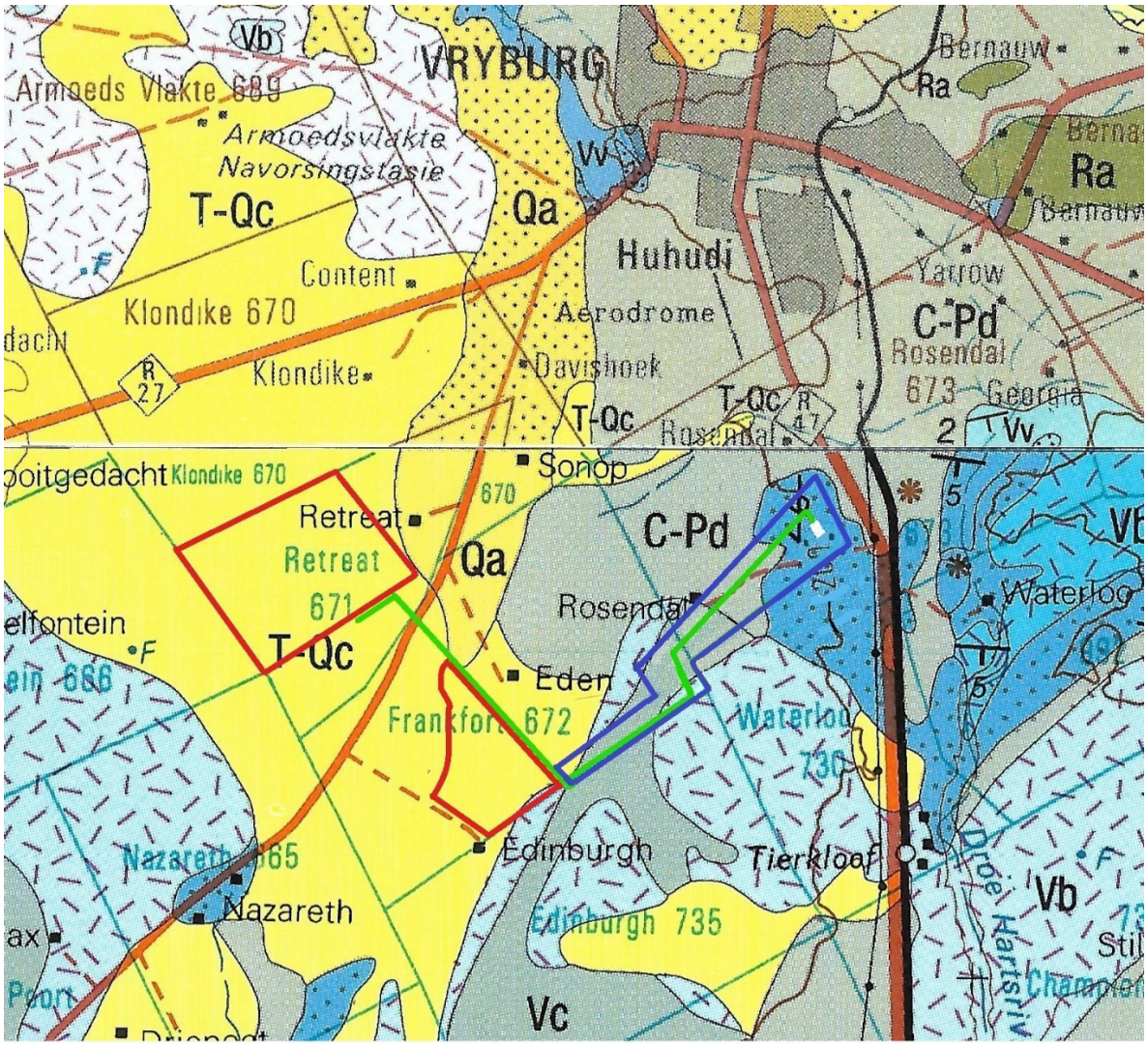


Figure 2: Geological Map of the study area and surroundings.
Adapted from the 2624 VRYBURG and 2724 CHRISTIANA 1:250 000 Geology Maps (Geological Survey, 1993; 1994)

LEGEND:

The study area is indicated with the green lines and blue and red polygons

	Lithology	Stratigraphy				Age
Qa	River terrace gravel.					Quaternary
T-Qc	Calcrete					Tertiary
C-Pd	Tillite, mudstone, shale, boulder shale and sandstone.	Dwyka Group			Karoo Supergroup	Carboniferous
Vc	Shale, siltstone with interbedded dolomite.	Clearwater Formation	Schmidts-drif Subgroup	Ghaap Group	Griqualand West Supergroup	Vaalian
Vb	Oolitic and stromatolitic dolomite, interbedded quartzite, shale and flagstone.	Boomplaas Formation				
Vv	Quartzite, flagstone, conglomerate, dolomite and shale. Andesitic lava.	Vryburg Formation				
Ra	Tholeiitic and calc-alkaline basalt and tuff.	Allanridge Formation			Ventersdorp Supergroup	Randium

The rocks on the eastern side of the study area resort under the Vryburg Formation which consists of quartzite, flagstone, conglomerate, dolomite, and andesitic lava (Keyser & Du Pessis, 1993; Schutte, 1994). Tabular-bedded, horizontally laminated quartzites of the lower Vryburg Formation are exposed at Site 8 (see Fig. 8). The lavas of this geological unit have been dated to 2.64 Ga (Eriksson et al., 2009)

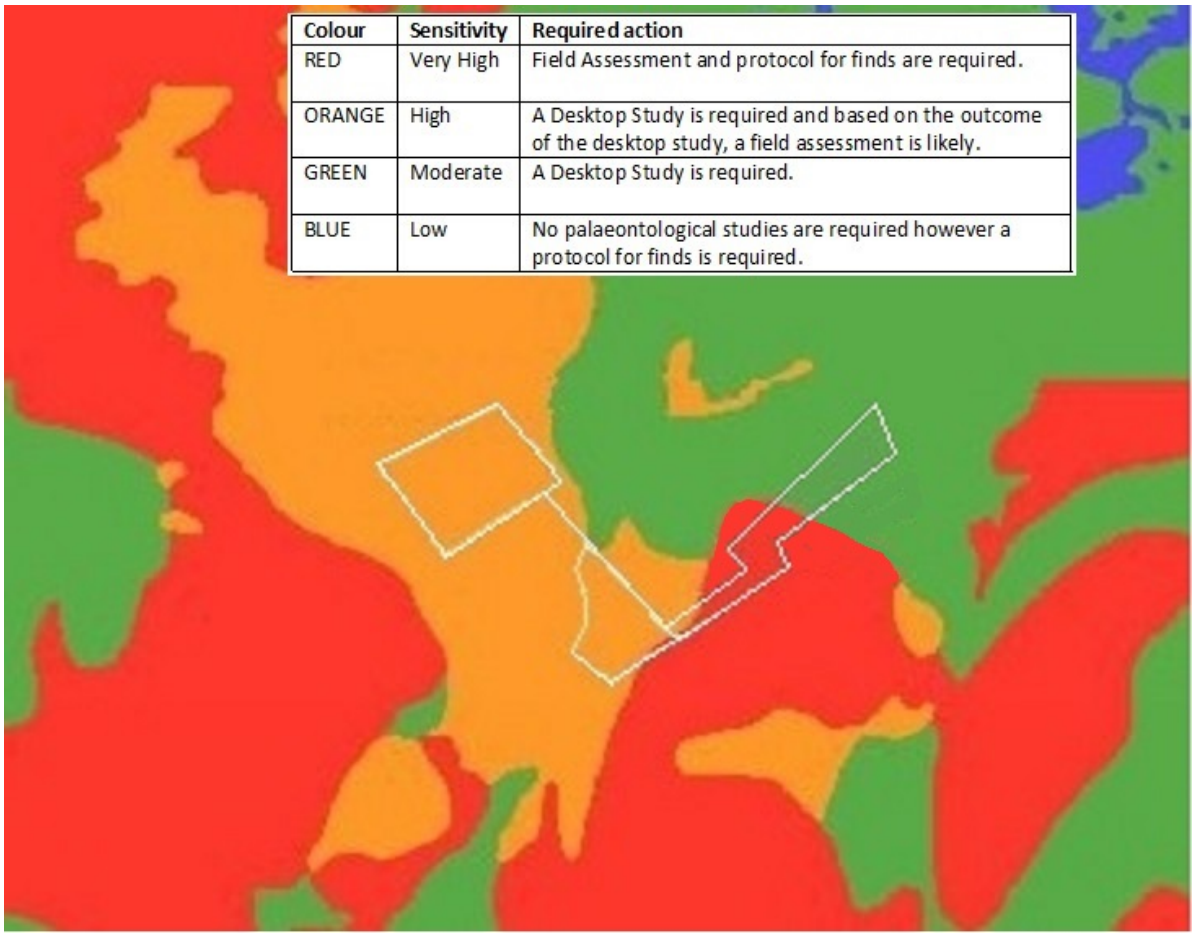
The eastern section of the study area is underlain by rocks of the Ghaap Group of the Griqualand West Supergroup. This geological unit forms the most basal part of the Late Archaean to Early Proterozoic Griqualand West Supergroup. The rock strata of the Ghaap Group in this section of the study area are subdivided into the Boomplaas and Clearwater Formations of the Schmidtsdrif Subgroup (Eriksson et al., 2009) (see Fig. 2).

The Boomplaas Formation consists of grey dolomites which weather reddish-brown giving the soil in the area its characteristic red colour. Subordinate layers of limestone which weathers blue-grey, quartzite, flagstone and shale occur in between thicker layers of oolitic and stromatolitic dolomite.

The Clearwater Formation overlies the Boomplaas Formation and consists of grey to khaki coloured mudrocks and subordinate layers of stromatolitic dolomite, flagstone, tuffites and cherts.

The western and largest part of the study area which is demarcated for the Solar 1, 2 and 3 photovoltaic development is underlain by Tertiary-aged calcrete (see Figs. 2 & 23). Vast areas of hundreds of square kilometres of calcrete occur in the Northwest and are prevalent in the Vryburg area. The calcretes are associated with recent prehistoric (Tertiary to Quaternary) drainage lines and pans where evaporation and or the loss of CO_2 caused the precipitation of calcite from the water in the sands and soils of that area. During this cementation phase rocks and bones and even stone tools in the superficial sediments were trapped as part of the calcrete that formed.

4.1. Identification of Environmental Sensitivities



(The study area is indicated with the white polygon)

Figure 3: Palaeontological sensitivity of the region (SAHRA, 2018)

During the field assessment special attention was given to the areas demarcated as having a high palaeontological sensitivity (red). These areas are underlain by dolomite and chert. Sections that are demarcated as having a high palaeontological sensitivity (orange) were also visited. These areas are underlain mostly by Quaternary aged calcrete, gravel, sand and soil.

The sections of the study area which are demarcated as having a High Palaeontological Sensitivity are underlain by calcrete (see Fig. 3). Calcrete underlies the areas for the proposed Solar 1, 2 and 3 solar panels. There are rare occurrences of fossils in Tertiary calcrete and Quaternary soil, sand and alluvium reported from other localities (Almond & Pether, 2008).

Parts of the proposed Power Corridor is underlain by rocks of the Schmidtsdrif Formation which is considered to have a Very High Palaeontological Sensitivity due to the probability of finding stromatolites (see Fig. 3). The southern margin of the Power Corridor also touches the Boomplaas Formation which has yielded many kinds and sizes of stromatolites on the neighbouring farm Waterloo (Almond, 2013).

The eastern sections of the proposed Power Corridor (which includes the power station) is situated on rocks of the Vryburg Formation which is considered to have a Moderate Palaeontological Sensitivity

(see Fig. 3). Microbial stromatolites have been reported form the Vryburg Formation some 40 km south of Vryburg (Smit et al., 1991).

5. ISSUES, RISKS AND IMPACTS

5.1 Summary of Issues identified during the Project Notification Phase

The key issues have been identified through the experience of the specialist in similar projects and available databases. The public consultation process is still to be undertaken where the Draft BA Report is released for 30 days public comment.

5.2 Identification of Potential Impacts/Risks

The proposed development will take place in areas which have been demarcated by SAHRA as having a Moderate, High to Very High Palaeontological Sensitivity as depicted in Fig.2.

With the necessary mitigation protocols the impact on the fossil sites will be minimized on the one hand while new fossil sites which are important to science will be discovered and samples be donated to museums.

The potential impacts identified during the BA are:

Construction Phase
- Destruction of fossils

Operational Phase
- Destruction of fossils

Decommissioning Phase
- Destruction of fossils

Cumulative Impacts
- Destruction of fossils

6. SITE VISIT

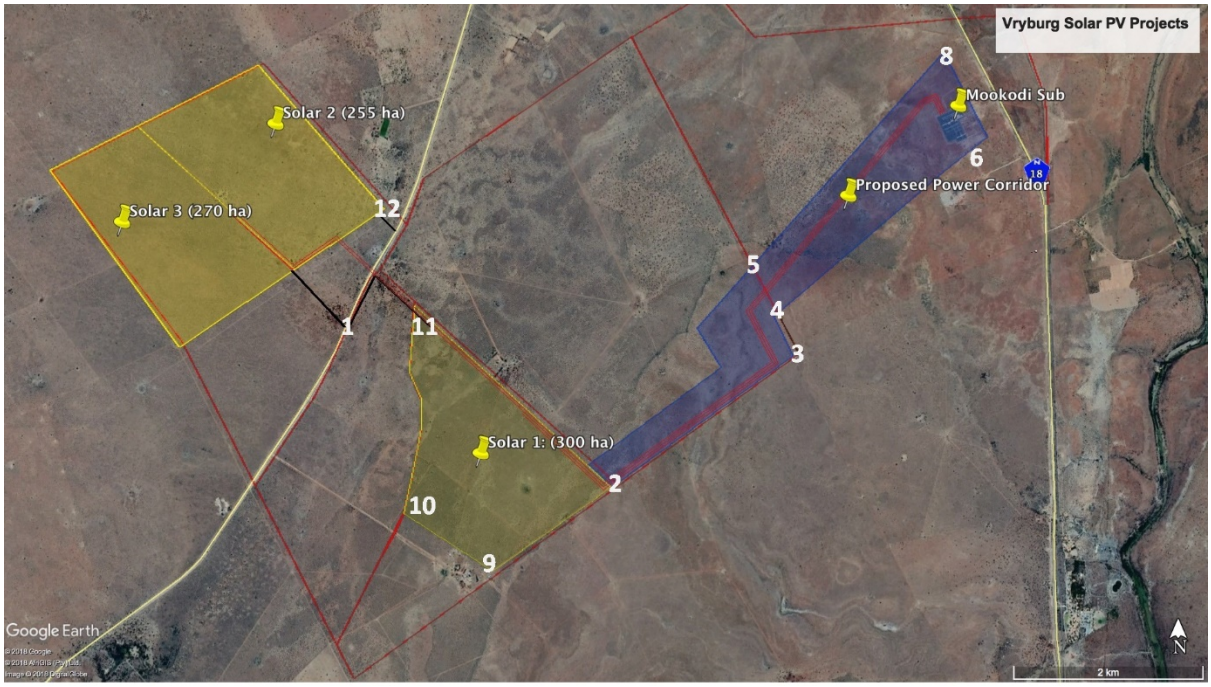


Figure 4: Site map showing picture vantage points for orientation purposes (see discussion)

Figure 5: Site 1 facing southeast

Figure 6: Site 2 facing west

Figure 7: Site 2 facing north

Figure 8: Eroded dolomite and chert between Site 2 and Site 3

Figure 9: Site 3 facing northwest

Figure 10: Site 3 facing northeast

Figure 11: Site 4 facing west

Figure 12: Site 4 facing east

Figure 13: Site 4 facing northeast

Figure 14: Site 5 facing southwest

Figure 15: Site 5 facing east

Figure 16: Site 6 facing north

Figure 17: Site 6 facing west

Figure 18: Site 6 facing south

Figure 19: Site 8 facing southwest

Figure 20: Site 9 facing north

Figure 21: Site 10 facing southeast

Figure 22: Calcrete eroding out in area demarcated for Solar 1

Figure 23: Site 11 facing south

Figure 24: Site 12 facing west

Discussion:

The study area is covered in natural vegetation with grass and shrubs and trees and is used for cattle farming. The soil cover in the study area is relatively thin and the underlying eroded bedrock is exposed in places (see Figs. 8 & 23). No distinct or remarkable fossils were found on this field trip. This however does not imply that Tertiary-aged fossils or stromatolites would not be discovered once the grass and soil are cleared and it is highly probable that they will be discovered in the study region as soon as excavations commence. Stromatolites of various kinds and sizes were found on the neighbouring farm Waterloo (Almond, 2013).

Figure 26: Example of stromatolites at Sterkfontein Caves

Stromatolites are very important from an evolutionary, environmental, ecological and geological perspective. Stromatolites were formed approximately 2.2 Ga ago when mats of cyanobacteria covered the sea floor up to a certain depth which allowed them to photosynthesize. The slimy surface caused fine grained mud and precipitates to adhere to them after which cyanobacterial strands consisting of chains of bacterial cells would continue to extend by means through the sediment in order to get enough light to photosynthesize. Very thin layers of sediments were set down during this process. In time these sedimentary layers were petrified and turned into columns of rock. Some of these columns which are stacked closely together are as thin as pencils, while others formed mushroom-like scallops (see Figs. 26 & 27) and others formed bigger domes (see Fig. 28) and even megadomes which are meters across. Keyser and Du Plessis (1993) have reported stromatolite domes of up to 2 m across in the Vryburg Map area and Almond (2013) discovered similar sized stromatolites on the farm Waterloo immediately to the east of the study site. When the soil and underlying eroded rock stratum are removed, it is expected that these domal structures will be exposed in places in the study site. When stromatolites are uncovered a palaeontologist must be appointed to assist in the evaluation of the importance of the conservation of these structures before construction continues, following the Chance Find Procedures.

These bacteria were amongst the first photosynthesizing organisms and it is thought that the chloroplast found in plants has evolved from a cyanobacterial ancestor. Cyanobacteria released oxygen as a by-product of photosynthesis in such quantities that it irrevocably changed the atmosphere from a reducing to an oxidizing atmosphere which had a devastating effect to most bacteria which were and still are anoxic. On the other hand, higher organisms such as fungi, plants and animals would not have been able to exist without the oxygen in the atmosphere and would therefore not have evolved if it were not for cyanobacteria.

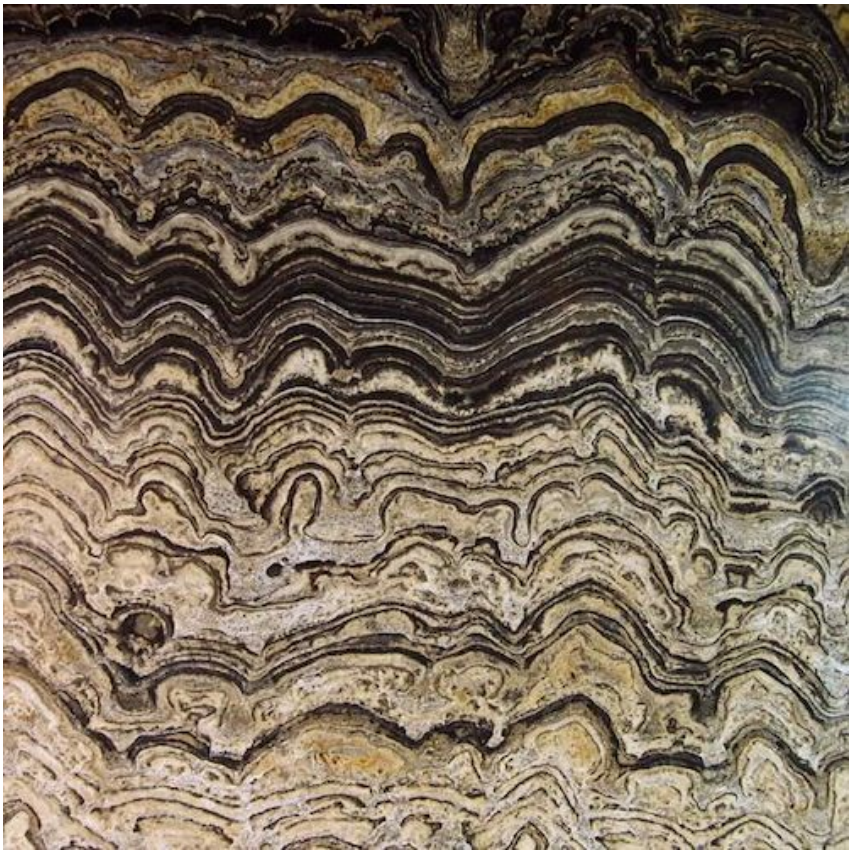


Figure 27: Polished vertical section through stromatolites

(from: https://www.google.co.za/imgres?imgurl=http%3A%2F%2Fwww.therockgallery.co.uk%2Fekmps%2Fshops%2Ftherockgallery%2Fimages%2Fstromatolite-large-polished-slice-100-million-years-old-andes-mountains-bolivia-%5B4%5D-1997-p.jpg&imgrefurl=http%3A%2F%2Fwww.therockgallery.co.uk%2Fstromatolite-large-polished-slice----100-million-years-old----andes-mountains-bolivia-1997p. asp&docid=2vFkg_vqTH0I5M&tbnid=FQcixxQGdtBUFM%3A&vet=10ahUKEwinl8rfwqjcAhUGsKQKHf8wBy0QMwgsKAYwBg..i&w=500&h=500&bih=918&biw=1280&q=stromatolites&ved=0ahUKEwinl8rfwqjcAhUGsKQKHf8wBy0QMwgsKAYwBg&iact=mrc&uact=8)

Figure 28: Domal structures of stromatolites seen from above

(from: https://www.google.co.za/imgres?imgurl=http%3A%2F%2Fwww.kidsdiscover.com%2Fwp-content%2Fuploads%2F2015%2F04%2FBacteria_2.jpg&imgrefurl=http%3A%2F%2Fwww.kidsdiscover.com%2Fspotlight%2Fbacteria%2F%3Fmc_cid%3D97b6810d71%26mc_eid%3Df31cca173c&docid=jpZALMrhmI6d1M&tbnid=6zCWRFeJArwpQM%3A&vet=10ahUKEwioiMq6z6jcAhWisqQKHTkzCSoQMwhCKAMwAw..i&w=1000&h=683&bih=344&biw=553&q=Bacteria_2%20stromatolites&ved=0ahUKEwioiMq6z6jcAhWisqQKHTkzCSoQMwhCKAMwAw&iact=mrc&uact=8)

6.1 Potential Impacts during the Construction Phase

Sites for Solar 1, 2 and 3 PV installation

Aspect/Activity	Site preparation
Type of Impact (i.e. Impact Status)	Direct
Potential Impact	Site preparation and construction may have a negative impact on fossils which will be destroyed in the process. But on the other hand, new fresh fossiliferous material could be exposed after the removal of soil and eroded rock on the surface. Fossils in calcrete are exceptionally sparse and the chances of finding any at the study site are small.
Status	Negative if destroyed but positive if discovered and salvaged
Mitigation Required	The ECO should follow the Chance Find Procedure
Impact Significance (Pre-Mitigation)	Low (Level 4)
Impact Significance (Post-Mitigation)	Very Low (Level 5)
I&AP Concern	None (all fossils belong to the State)

Western and central part of the Power Corridor

Aspect/Activity	Site preparation
Type of Impact (i.e. Impact Status)	Direct
Potential Impact	Site preparation and construction may have a negative impact on fossils which will be destroyed in the process. But on the other hand, new fresh fossiliferous material could be exposed after the removal of soil and eroded rock on the surface. The chances of discovering stromatolites and new fossil sites are very big in this area and site preparation has to commence with care in this area.
Status	Negative if destroyed but positive if discovered and conserved
Mitigation Required	The ECO should follow the Chance Find Procedure
Impact Significance (Pre-Mitigation)	Very high (Level 1)
Impact Significance (Post-Mitigation)	Low (Level 4)
I&AP Concern	None

Eastern part of the Power Corridor

Aspect/Activity	Site preparation
Type of Impact (i.e. Impact Status)	Direct
Potential Impact	The fossils in this area are small and difficult to collect and conserve. The fossils are not unique to the study site and hundreds of cubic kilometres of the geological layer in which they occur exist elsewhere.
Status	Negative
Mitigation Required	The ECO should follow the Chance Find Procedure if exceptional fossils are discovered.
Impact Significance (Pre-Mitigation)	Low (Level 4)
Impact Significance (Post-Mitigation)	Very Low (Level 5)
I&AP Concern	None

6.2 Potential Impacts during the Operational Phase

Sites for Solar 1, 2 and 3 PV installation

Aspect/Activity	Operational Phase
Type of Impact (i.e. Impact Status)	Direct
Potential Impact	Maintenance of the PV installation may have some moderate effect on the underlying rocky, potentially fossiliferous surface but no major problem is foreseen.
Status	Moderately negative
Mitigation Required	Fossiliferous areas may be enclosed to prevent people from damaging them.
Impact Significance (Pre-Mitigation)	Low (Level 4)
Impact Significance (Post-Mitigation)	Very Low (Level 5)
I&AP Concern	None (all fossils belong to the State)

Western and central part of the Power Corridor

Aspect/Activity	
Type of Impact (i.e. Impact Status)	Direct
Potential Impact	Maintenance of the power lines and underground cables, if any, may have some moderate effect on the underlying rocky, potentially fossiliferous surface but no major problem is foreseen.
Status	Moderately negative
Mitigation Required	Fossiliferous areas may be enclosed to prevent people from damaging them.
Impact Significance (Pre-Mitigation)	Moderate (Level 3)
Impact Significance (Post-Mitigation)	Low (Level 2)
I&AP Concern	None (all fossils belong to the State)

Eastern part of the Power Corridor

Aspect/Activity	
Type of Impact (i.e. Impact Status)	Direct
Potential Impact	Maintenance of the power lines and underground cables, if any, may have some moderate effect on the underlying rocky, potentially fossiliferous surface but no major problem is foreseen.
Status	None – very little negative impact
Mitigation Required	None
Impact Significance (Pre-Mitigation)	Very Low (Level 5)
Impact Significance (Post-Mitigation)	Very Low (Level 5)
I&AP Concern	None (all fossils belong to the State)

6.3 Potential Impacts during the Decommissioning Phase

Sites for Solar 1, 2 and 3 PV installation

Aspect/Activity	Operational Phase
Type of Impact (i.e. Impact Status)	Direct
Potential Impact	Potentially no major problem is foreseen.
Status	Moderately negative
Mitigation Required	Fossiliferous areas may be enclosed to prevent people from damaging them.
Impact Significance (Pre-Mitigation)	Low (Level 4)
Impact Significance (Post-Mitigation)	Very Low (Level 5)
I&AP Concern	None (all fossils belong to the State)

Western and central part of the Power Corridor

Aspect/Activity	
Type of Impact (i.e. Impact Status)	Direct
Potential Impact	No major problem is foreseen.
Status	Moderately negative
Mitigation Required	Fossiliferous areas may be enclosed to prevent people from damaging them.
Impact Significance (Pre-Mitigation)	Moderate (Level 3)
Impact Significance (Post-Mitigation)	Low (Level 2)
I&AP Concern	None (all fossils belong to the State)

Eastern part of the Power Corridor

Aspect/Activity	
Type of Impact (i.e. Impact Status)	Direct
Potential Impact	No major problem is foreseen.
Status	None – very little negative impact
Mitigation Required	None
Impact Significance (Pre-Mitigation)	Very Low (Level 5)
Impact Significance (Post-Mitigation)	Very Low (Level 5)
I&AP Concern	None (all fossils belong to the State)

6.4 Cumulative Impacts

Sites for Solar 1, 2 and 3 PV installation

Aspect/Activity	Operational Phase
Type of Impact (i.e. Impact Status)	Direct
Potential Impact	Potentially no major problem is foreseen.
Status	Moderately negative
Mitigation Required	Care should be given when development occurs in this area. Fossils may be salvaged and fossiliferous areas may be avoided during development, construction and maintenance.. .
Impact Significance (Pre-Mitigation)	Low (Level 4)
Impact Significance (Post-Mitigation)	Very Low (Level 5)
I&AP Concern	None (all fossils belong to the State)

Western and central part of the Power Corridor

Aspect/Activity	
Type of Impact (i.e. Impact Status)	Direct
Potential Impact	No major problem is foreseen.
Status	Moderately negative
Mitigation Required	SAHRA may be approached for a permit if stromatolite formations needs to be destroyed during the clearing and construction phase, otherwise highly fossiliferous areas should be avoided.
Impact Significance (Pre-Mitigation)	Very High (Level 5)
Impact Significance (Post-Mitigation)	Moderate (Level 3)
I&AP Concern	None (all fossils belong to the State)

Eastern part of the Power Corridor

Aspect/Activity	
Type of Impact (i.e. Impact Status)	Direct
Potential Impact	No major problem is foreseen.
Status	None – very little negative impact
Mitigation Required	None
Impact Significance (Pre-Mitigation)	Very Low (Level 5)
Impact Significance (Post-Mitigation)	Very Low (Level 5)
I&AP Concern	None (all fossils belong to the State)

7. IMPACT ASSESSMENT TABLES

Table 1: Impact Assessment Summary Table for the Construction Phase

Sites for Solar 1, 2 and 3 PV installation

Construction Phase												
Direct Impacts												
Aspect/ Impact Pathway	**Nature of Potential Impact/ Risk**	**Status**	**Spatial Extent**	**Duration**	**Consequence**	**Probability**	**Reversibility of Impact**	**Irreplaceability**	**Potential Mitigation Measures**	**Significance of Impact and Risk**		**Ranking of Residual Impact/ Risk**	**Confidence Level**
										Without Mitigation/ Management	**With Mitigation/ Management (Residual Impact/ Risk)**		
Clearing of vegetation of 300 ha for Solar 1, 255 ha for Solar 2 and 270 ha for Solar 3	Destruction of fossils	Negative	Site	Long-Term	Substantial	Not likely	Irreversible	Moderate	Follow Chance Find Procedures and salvage fossils	Moderate	Low	2.5	Medium
Service road beneath 132 kV power line for western part of Power Corridor	Destruction of fossils	Negative	Site	Long-Term	Substantial	Very likely	Irreversible	Moderate	Follow Chance Find Procedures and conserve stromatolite formations in situ.	Very High	Moderate	4	High
Service road beneath 132 kV line for eastern part of Power Corridor	Destruction of fossils	Negative	Site	Long-Term	Moderate	Not Likely	Irreversible	Moderate	Follow Chance find Procedures and report any new fossil site finds.	Low	Very low	1.5	Medium

Table 2: Impact Assessment Summary Table for the Operational Phase

Operational Phase													
Direct Impacts													
Aspect/ Impact Pathway	**Nature of Potential Impact/ Risk**	**Status**	**Spatial Extent**	**Duration**	**Consequence**	**Probability**	**Reversibility of Impact**	**Irreplaceability**	**Potential Mitigation Measures**	**Significance of Impact and Risk**		**Ranking of Residual Impact/ Risk**	**Confidence Level**
										Without Mitigation/ Management	**With Mitigation/ Management (Residual Impact/ Risk)**		
Clearing of vegetation of 300 ha for Solar 1, 255 ha for Solar 2 and 270 ha for Solar 3	Destruction of fossils	Negative	Site	Long-Term	Substantial	Not likely	Irreversible	Moderate	Follow Chance Find Procedures and salvage fossils	Low	Very Low	1.5	Medium
Maintenance of cleared area (300 m) beneath the 132 kV power line for western part of Power Corridor	Destruction of fossils	Negative	Site	Long-Term	Substantial	Very likely	Irreversible	Moderate	Follow Chance Find Procedures and conserve stromatolite formations in situ.	Moderate	Low	2.5	High
Maintenance of cleared area beneath the 132 kV line for eastern part of Power Corridor	Destruction of fossils	Negative	Site	Long-Term	Moderate	Not Likely	Irreversible	Moderate	Follow Chance find Procedures and report any new fossil site finds.	Very Low	Very low	1	Medium

Table 3: Impact Assessment Summary Table for the Decommissioning Phase

Decommissioning Phase												
Direct Impacts												
Aspect/ Impact Pathway	**Nature of Potential Impact/ Risk**	**Status**	**Spatial Extent**	**Duration**	**Consequence**	**Probability**	**Reversibility of Impact**	**Irreplaceability**	**Potential Mitigation Measures**	**Significance of Impact and Risk**		**Ranking of Residual Impact/ Risk**	**Confidence Level**
										Without Mitigation/ Management	**With Mitigation/ Management (Residual Impact/ Risk)**		
Rehabilitation of cleared areas of 300 ha for Solar 1, 255 ha for Solar 2 and 270 ha for Solar 3	Destruction of fossils	Negative	Site	Long-Term	Substantial	Not likely	Irreversible	Moderate	Follow Chance Find Procedures and salvage fossils	Low	Very Low	1.5	Medium
Rehabilitation of cleared area beneath western part of Power Corridor	Destruction of fossils	Negative	Site	Long-Term	Substantial	Very likely	Irreversible	Moderate	Follow Chance Find Procedures and conserve stromatolite formations in situ.	Moderate	Low	2.5	High
Rehabilitation of cleared area beneath for eastern part of Power Corridor	Destruction of fossils	Negative	Site	Long-Term	Moderate	Not Likely	Irreversible	Moderate	Follow Chance find Procedures and report any new fossil site finds.	Very Low	Very low	1	Medium

Table 4: Cumulative Impact Assessment Summary Table

Cumulative Impacts (Construction, Operational and Decommissioning Phases)													
Direct Impacts													
Aspect/ Impact Pathway	**Nature of Potential Impact/ Risk**	**Status**	**Spatial Extent**	**Duration**	**Consequence**	**Probability**	**Reversibility of Impact**	**Irreplaceability**	**Potential Mitigation Measures**	**Significance of Impact and Risk**		**Ranking of Residual Impact/ Risk**	**Confidence Level**
										Without Mitigation/ Management	**With Mitigation/ Management (Residual Impact/ Risk)**		
Clearing of vegetation of 300 ha for Solar 1, 255 ha for Solar 2 and 270 ha for Solar 3	Destruction of fossils	Negative	Site	Long-Term	Substantial	Not likely	Irreversible	Moderate	Follow Chance Find Procedures and salvage fossils	Low	Very Low	1.5	Medium
Clearing of vegetation for 3m service road beneath 132 kV line for western part of Power Corridor	Destruction of fossils	Negative	Site	Long-Term	Substantial	Very likely	Irreversible	Moderate	Follow Chance Find Procedures and conserve stromatolite formations in situ.	Very High	Moderate	4	High
Clearing of vegetation for 3 m service road under 132 kV line for eastern part of Power Corridor	Destruction of fossils	Negative	Site	Long-Term	Moderate	Not Likely	Irreversible	Moderate	Follow Chance find Procedures and report any new fossil site finds.	Very Low	Very low	1	Medium

7.1 Impact Assessment Summary

Table 5a: Overall Impact Significance (Post Mitigation) for Solar 1, 2 and 3 PV Sites

Phase	**Overall Impact Significance**
Construction	Low
Operational	Very Low
Decommissioning	Very Low
Nature of Impact	**Overall Impact Significance**
Cumulative - Construction	Low
Cumulative - Operational	Very Low
Cumulative - Decommissioning	Very Low

Table 5b: Overall Impact Significance (Post Mitigation) for Central and Western part of the Power Corridor

Phase	**Overall Impact Significance**
Construction	Very High
Operational	Moderate
Decommissioning	Low
Nature of Impact	**Overall Impact Significance**
Cumulative - Construction	Very High
Cumulative - Operational	Moderate
Cumulative - Decommissioning	Low

Table 5c: Overall Impact Significance (Post Mitigation) for eastern part of the Power Corridor

Phase	**Overall Impact Significance**
Construction	Low
Operational	Very Low
Decommissioning	Very Low
Nature of Impact	**Overall Impact Significance**
Cumulative - Construction	Low
Cumulative - Operational	Very Low
Cumulative - Decommissioning	Very Low

8. LEGISLATIVE AND PERMIT REQUIREMENTS

A qualified palaeontologist should be appointed to handle the mitigation procedure in conjunction with the ECO upon the discovery of fossils during construction.

A permit should be applied for by a qualified palaeontologist from SAHRA and issued by SAHRA to either salvage material or to destroy fossiliferous beds during construction.

9. ENVIRONMENTAL MANAGEMENT PROGRAMME INPUTS

The ECO should be aware of the palaeontological sensitivity of each of the sites where development is taking place and should familiarise themselves with the Chance Find Procedure which should be followed upon the discovery of a fossil site.

10. CONCLUSION AND RECOMMENDATIONS

Although stromatolites are considered to be fossils, there are hundreds of square kilometres of stromatolites in South Africa and it is not considered to be so scarce that every stromatolite has to be preserved. In the event of the discovery of an exceptional stromatolite formation it is advised that it should on principle not be destroyed if an alternative position for the placing of a specific pylon, pipe, service road or building can be found.

Rocks of the Schmidsdrif Formation occur in the central and western part of the proposed Power Corridor and therefore there is a very high probability of uncovering stromatolites in this section. When stromatolites are discovered at construction sites the Chance Find Procedure should be followed by the ECO.

There is a low likelihood that the Quaternary alluvium and aeolian sand and Tertiary calcrete in the study area may contain fossils. Elsewhere rare fossils of root casts, burrows, ostrich egg shells, mollusc shells, isolated bones, root casts, burrows and termitaria were found in Tertiary and Quaternary deposits (Almond & Pether 2008) and the possibility of finding similar fossils in the study area cannot be excluded.

In the unlikely event of fossils being discovered in the sands, soils, calcrete or dolomite formations in the study area, the ECO should follow the Chance Find Procedure. Although disturbed fossils should be collected and stored safely until it can be inspected by a palaeontologist, no attempt should be made to remove such accidentally discovered fossils from the rock by an unqualified person.

11. FINAL SPECIALIST STATEMENT AND AUTHORISATION RECOMMENDATION

Mitigation measures which should be followed upon the discovery of fossils:

PROCEDURE FOR CHANCE PALAEONTOLOGICAL FINDS

Extracted and adapted from the National Heritage Resources Act, 1999 Regulations Reg No. 6820, GN: 548.

The following procedure must be considered in the event that previously unknown fossils or fossil sites are exposed or found during the life of the project:

1. Surface excavations should continuously be monitored by the ECO and any fossil material be unearthed the excavation must be halted.

2. If fossiliferous material has been disturbed during the excavation process it should be put aside to prevent it from being destroyed.

3. The ECO then has to take a GPS reading of the site and take digital pictures of the fossil material and the site from which it came.

4. The ECO then should contact a palaeontologist and supply the palaeontologist with the information (locality and pictures) so that the palaeontologist can assess the importance of the find and make recommendations.

5. If the palaeontologist is convinced that this is a major find an inspection of the site must be scheduled as soon as possible in order to minimise delays to the development.

6. From the photographs and/or the site visit the palaeontologist will make one of the following recommendations:

    a. The material is of no value so development can proceed, or:

    b. Fossil material is of some interest and a representative sample should be collected and put aside for further study and to be incorporated into a recognised fossil repository after a permit was obtained from SAHRA for the removal of the fossils, after which the development may proceed, or:

    c. The fossils are scientifically important and the palaeontologist must obtain a SAHRA permit to excavate the fossils and take them to a recognised fossil repository, after which the development may proceed.

7. If any fossils are found then a schedule of monitoring will be set up between the developer and palaeontologist in case of further discoveries.

11.1 EA Condition Recommendations

The proposed development of the Vryburg Solar 1, Vryburg Solar 2 and Vryburg Solar 3 photovoltaic facility will take place in an area which is considered to have mostly a High Palaeontological Sensitivity for the PV facility sites, and areas of Medium, High and Very High Palaeontological Sensitivity within the corridor for the distribution power lines.

The central and western sections of the proposed Power Corridor fall in the Very High Palaeontological Sensitivity category due to the probability of stromatolites occurring in this region. The chances of exposing stromatolites during construction are good and for this reason a Chance Find Procedure has been included in the Recommendations. Even though it is not essential to salvage every piece of stromatolite exposed because of its ubiquitous distribution in the dolomites of South Africa, it will be prudent not to destroy a major stromatolite find for scientific and heritage reasons.

The areas where the proposed Solar 1, 2 and 3 PV panels are to be installed fall in the High Palaeontological Sensitivity category because of the underlying Tertiary calcrete and Quaternary alluvium, sand and soils. The Chance Find Procedure should be followed if fossils are uncovered during construction in this section.

The eastern sections of the Power Corridor are situated on rocks with a Medium Palaeontological Sensitivity. The chances of finding fossils in the High to Medium Sensitivity sections are low however and the protocol that should be followed in the unlikely case of the discovery of fossils in this section is covered in the Chance Find Procedure.

12. REFERENCES

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13. APPENDICES

(none required)