

PHASE 1 HERITAGE IMPACT ASSESSMENT FOR THE  
PROPOSED DEVELOPMENT OF HARVARD SOLAR FARM,  
SPES BONA NO. 2355, PORTION 8.

PROPOSED DEVELOPMENT OF SOLAR PHOTOVOLTAIC (PV) FACILITY ON THE FARM  
SPES BONA NO. 2355, PORTION 8 (HARVARD 1), BLOEMFONTEIN, MANGAUNG  
METROPOLITAN MUNICIPALITY, FREE STATE PROVINCE

**PREPARED FOR:**  
ENVIROAFRICA CC

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28 SEPTEMBER 2022

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**Declaration of independence:**

UBIQUE Heritage Consultants hereby confirm our independence as heritage specialists and declare that:

- we are suitably qualified and accredited to act as independent specialists in this application;
- we do not have any vested interests (either business, financial, personal or other) in the proposed development project other than remuneration for the heritage assessment and heritage management services performed;
- the work was conducted in an objective and ethical manner, in accordance with a professional code of conduct and within the framework of South African heritage legislation.



Signed:

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Date: 2022-09-28

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#### ARCHAEOLOGIST

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### HEIDI FIVAZ

#### CRM ARCHAEOLOGIST & OBJECT CONSERVATOR

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#### CRM ARCHAEOLOGIST

Jan Engelbrecht is accredited by the Cultural Resources Management section of the Association of Southern African Professional Archaeologists (ASAPA) to undertake Phase1 AIAs and HIAs in South Africa. He is also a member of the Association for Professional Archaeologists (ASAPA). Mr Engelbrecht holds an honours degree in archaeology (specialising in the history of early farmers in southern Africa (Iron Age) and Colonial period) from the University of South Africa. He has 12 years of experience in heritage management. He has worked on projects as diverse as the Zulti South HIA project of Richards Bay Minerals, research on the David Bruce heritage site at Ubombo in Kwa-Zulu Natal, and various archaeological excavations and historical projects. He has worked with many rural communities to establish integrated heritage and land use plans and speaks Zulu fluently. Mr Engelbrecht established Ubiqum Heritage Consultants in 2012. The company moved from KZN to the Northern Cape and is currently based at Askham in the Northern Cape within the Mier local municipality in the Kgalagadi region. He had a significant military career as an officer, whereafter he qualified as an Animal Health Technician at Technikon RSA and UNISA. He is currently studying for his MA Degree in Archaeology.

## EXECUTIVE SUMMARY

### Project description

UBIQUE Heritage Consultants were appointed by EnviroAfrica CC as independent heritage specialists in accordance with Section 38 of the NHRA and the National Environmental Management Act 107 of 1998 (NEMA) to conduct a cultural heritage assessment to determine the impact of the proposed solar PV facility (Harvard Solar 1), on the Farm Spes Bona no. 2355, Portion 8, Bloemfontein, Mangaung Metropolitan Municipality, Free State Province on any sites, features, or objects of cultural heritage significance.

### Findings and Impact on Heritage Resources

One occurrence of a low-density surface scatter of MSA/Early LSA alongside a piece of metal (SB01-001) was recorded on Spes Bona Portion 8 (Harvard 1). The sample size is small, without context, and of low significance; the impact is negligible.

A historical farmscape (SB01-020) with a barn, farming-related features, structural remains, and a livestock kraal (SB01-003) made out of Aloe plants is situated directly on the development footprint. Material such as brick, a wooden truss and a base of a milk glass material type bottle was recorded near the remains of a foundation. These heritage resources are of medium cultural and historical significance. The probability of impact is high.

The remains of a retaining wall were recorded southeast of the development footprint. No other structural features or material of cultural and historical significance were found near the retaining wall. It is unclear whether the remains of the retaining wall is older than 60 years. It is considered to be of low significance, with the probability of impact being negligible.

The proposed development area is largely underlain by the Balfour Formation of the Adelaide Subgroup (Beaufort Group, Karoo Supergroup) and only a small portion in the southwest is underlain by Jurassic Karoo dolerite. According to the PalaeoMap on the South African Heritage Resources Information System (SAHRIS) database, the Palaeontological Sensitivity of the Balfour Formation is Very High, and Jurassic Karoo dolerite is Zero as it is igneous in origin. Therefore, a site-specific field survey of the development footprint was conducted on foot and motor vehicle on 5 January 2022. During the site visit, no fossiliferous outcrops were identified. The scarcity of fossil heritage at the proposed development footprint indicates that the impact of the development footprint will be of low significance in palaeontological terms. It is therefore considered that the proposed development is deemed appropriate and will not lead to detrimental impacts on the palaeontological reserves of the area (Butler 2022 Appendix A).



## Recommendations

Based on the assessment of the potential impact of the development on the identified heritage, the following recommendations are made, taking into consideration any existing or potential sustainable social and economic benefits:

1. The historical farmscape with farming-related structures, features and structural remains, and the livestock (Aloe plant) kraal is situated directly on the development footprint. These heritage resources are of medium cultural and historical significance. These resources would require costly mitigation before destruction. It is, therefore, our recommendation that a buffer/safety zone should be implemented.
2. The two MSA/LSA Lithics and the piece of metal recorded at site SB01-001 to the southwest of the proposed development footprint is of low significance and will not be affected by the development.
3. The retaining wall is considered to be of low significance and will not be impacted by development. No further mitigation is recommended.
4. According to the PalaeoMap on the South African Heritage Resources Information System (SAHRIS) database, the Palaeontological Sensitivity of the Balfour Formation is Very High, and Jurassic Karoo dolerite is Zero as it is igneous in origin. However, no fossiliferous outcrops were identified during the site visit. If Palaeontological Heritage is uncovered during surface clearing and excavations, the Chance Find Protocol (Appendix A/12) must be implemented by the Environmental Control Officer (ECO) in charge of these developments. Fossil discoveries ought to be protected, and the ECO/site manager must report to SAHRA (Contact details: SAHRA, 111 Harrington Street, Cape Town. PO Box 4637, Cape Town 8000, South Africa. Tel: 021 462 4502. Fax: +27 (0)21 462 4509. Web: [www.sahra.org.za](http://www.sahra.org.za)) so that mitigation (recording and collection) can be carried out (Butler 2022).
5. Although all possible care has been taken to identify sites of cultural importance during the investigation of study areas, it is always possible that hidden or sub-surface sites could be overlooked during the assessment. If during construction, any evidence of archaeological sites or remains (e.g. remnants of stone-made structures, indigenous ceramics, bones, stone artefacts, ostrich eggshell fragments, charcoal and ash concentrations), fossils or other categories of heritage resources are found during the proposed development, SAHRA APM Unit (Natasha Higgitt/Phillip Hine 021 462 5402) must be alerted as per section 35(3) of the NHRA. If unmarked human burials are uncovered, the SAHRA Burial Grounds and Graves (BGG) Unit (Thingahangwi Tshivhase/Mimi Seetelo 012 320 8490), must be alerted immediately as per section 36(6) of the NHRA. A professional archaeologist or palaeontologist, depending on the nature of the finds, must be contacted as soon as possible to inspect the findings. If the newly discovered heritage resources prove to be of archaeological or palaeontological significance, a Phase 2 rescue operation may be required subject to permits issued by SAHRA. UBIQUE Heritage Consultants and its

personnel will not be held liable for such oversights or costs incurred as a result of such oversights.



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## ABBREVIATIONS

|         |  |
|---------|--|
| AIA:    | Archaeological Impact Assessment                         |
| ASAPA:  | Association of South African Professional Archaeologists |
| CRM:    | Cultural Resource Management                             |
| EIA:    | Early Iron Age   |
| EMP:    | Environmental Management Plan                            |
| ESA:    | Earlier Stone Age  |
| GPS:    | Global Positioning System                                |
| HIA:    | Heritage Impact Assessment                               |
| HWC:    | Heritage Western Cape                                    |
| IA:     | Iron Age   |
| IMP:    | Integrated Management Plan                               |
| LSA:    | Later Stone Age  |
| MIA:    | Middle Iron Age  |
| MSA:    | Middle Stone Age   |
| NBKB:   | Ngwao-Boswa Jwa Kapa Bokone (Northern Cape PHRA)         |
| NHRA:   | National Heritage Resources Act                          |
| PHRA:   | Provincial Heritage Resource Agency                      |
| SADC:   | Southern African Development Community                   |
| SAHRA:  | South African Heritage Resources Agency                  |
| SAHRIS: | South African Heritage Resources Information System      |

## GLOSSARY

|                     |   |
|---------------------|---|
| Archaeological:     | Material remains resulting from human activity in a state of disuse, older than 100 years, including artefacts, human and hominid remains and artificial features and structures.   |
| Historic building:  | Structures 60 years and older.  |
| Heritage:           | That which is inherited and forms part of the National Estate (historic places, objects, fossils as defined by the National Heritage Resources Act 25 of 1999).   |
| Heritage resources: | Valuable, finite, non-renewable and irreplaceable resources that provide evidence of the origins of South African society   |
| Mitigation:         | Anticipating and preventing adverse impacts and risks, then to minimise them, rehabilitate or repair impacts to the extent feasible.  |
| 'Public monuments:  | All monuments and memorials, erected on land belonging to any branch of central, provincial or local government, or on land belonging to any organisation funded by or established in terms of the legislation of such a branch of government; or<br>– which were paid for by public subscription, government funds, or a public-spirited or military organisation and are on land belonging to any private individual. |
| 'Structures!:       | Any building, works, device or other facility made by people, and which are fixed to land, and include any fixtures, fittings and equipment associated therewith.   |



## 1. INTRODUCTION

### 1.1 Scope of study

The project involves the proposed development of two separate solar photovoltaic (PV) facilities, developed including associated infrastructure on Portion 8 of Farm 2355 (referred to as Harvard 1), Bloemfontein, Mangaung Metropolitan Municipality, Free State Province. UBIQUE Heritage Consultants were appointed by EnviroAfrica CC as independent heritage specialists in accordance with the National Environmental Management Act 107 of 1998 (NEMA), and in compliance with Section 38 of the National Heritage Resources Act 25 of 1999 (NHRA), to conduct a cultural heritage assessment (AIA/HIA) of the development area.

The assessment aims to identify and report any heritage resources that may fall within the development footprint; to determine the impact of the proposed development on any sites, features, or objects of cultural heritage significance; to assess the significance of any identified resources; and to assist the developer in managing the documented heritage resources in an accountable manner, within the framework provided by the National Heritage Resources Act (Act 25 of 1999) (NHRA).

South Africa's heritage resources are rich and widely diverse, encompassing sites from all periods of human history. Resources may be tangible, such as buildings and archaeological artefacts, or intangible, such as landscapes and living heritage. Their significance is based on their aesthetic, architectural, historical, scientific, social, spiritual, linguistic, economic or technological values; their representation of a time or group; their rarity; and sphere of influence.

Natural (e.g. erosion) and human (e.g. development) activities can jeopardise the integrity and significance of heritage resources. In the case of human activities, a range of legislation exists to ensure the timeous and accurate identification and effective management of heritage resources for present and future generations.

The result of this investigation is presented within this heritage impact assessment report. It comprises the recording of heritage resources present/ absent and offers recommendations for managing these resources within the context of the proposed development.

Depending on SAHRA's acceptance of this report, the developer will receive permission to proceed with the proposed development, considering any proposed mitigation measures.



## 1.2 Assumptions and limitations

It is assumed that the description of the proposed project, as provided by the client, is accurate. Furthermore, it is assumed that the public consultation process undertaken as part of the Environmental Impact Assessment (EIA) is comprehensive and does not have to be repeated as part of the heritage impact assessment.

The significance of the sites, structures and artefacts is determined by means of their historical, social, aesthetic, technological and scientific value in relation to their uniqueness, condition of preservation and research potential. The various aspects are not mutually exclusive, and the evaluation of any site is done with reference to any number of these aspects. Cultural significance is site-specific and relates to the content and context of the site.

All possible care has been taken during the comprehensive field survey and intensive desktop study to identify sites of cultural importance within the development areas. However, it is essential to note that some heritage sites may have been missed due to their subterranean nature or dense vegetation cover. No subsurface investigation (i.e. excavations or sampling) was undertaken since a SAHRA permit is required for such activities. Therefore, should any heritage features and/or objects such as architectural features, stone tool scatters, artefacts, human remains, or fossils be uncovered or observed during construction, operations must be stopped, and a qualified archaeologist contacted for an assessment of the find. Observed or located heritage features and/or objects may not be disturbed or removed in any way until such time that the heritage specialist has been able to assess the significance of the site (or material) in question.



## 2. TERMS OF REFERENCE

### 2.1 Statutory Requirements

#### 2.1.1 General

The principle is that the environment should be protected for present and future generations by preventing pollution, promoting conservation and practising ecologically sustainable development. With regard to spatial planning and related legislation at national and provincial levels, the following legislation may be relevant:

- Physical Planning Act 125 of 1991
- Municipal Structures Act 117 of 1998
- Municipal Systems Act 32 of 2000
- Development Facilitation Act 67 of 1995 (DFA)

The identification, evaluation and management of heritage resources in South Africa are required and governed by the following legislation:

- National Environmental Management Act 107 of 1998 (NEMA)
- KwaZulu-Natal Heritage Act 4 of 2008 (KZNHA)
- National Heritage Resources Act 25 of 1999 (NHRA)
- Minerals and Petroleum Resources Development Act 28 of 2002 (MPRDA)

#### 2.1.2 National Heritage Resources Act 25 of 1999

The NHRA established the South African Heritage Resources Agency (SAHRA) together with its Council to fulfil the following functions:

- coordinate and promote the management of heritage resources at the national level;
- set norms and maintain essential national standards for the management of heritage resources in the Republic and to protect heritage resources of national significance;
- control the export of nationally significant heritage objects and the import into the Republic of cultural property illegally exported from foreign countries;
- enable the provinces to establish heritage authorities which must adopt powers to protect and manage certain categories of heritage resources; and
- provide for local authorities' protection and management of conservation-worthy places and areas.

#### 2.1.3 Heritage Impact Assessments/Archaeological Impact Assessments

Section 38(1) of the NHRA of 1999 requires **the responsible heritage resources authority to notify the person who intends to undertake a development that fulfils the following criteria to submit an impact assessment report if there is reason to believe that heritage resources will be affected by such event:**

- the construction of a road, wall, power line, pipeline, canal or other similar form of linear development or barrier exceeding 300m in length;
- the construction of a bridge or similar structure exceeding 50m in length;
- any development or other activity that will change the character of a site—
  - exceeding 5000m<sup>2</sup> in extent; or
  - involving three or more existing erven or subdivisions thereof; or
  - involving three or more erven or divisions thereof which have been consolidated within the past five years; or
  - the costs of which will exceed a sum set in terms of regulations by SAHRA or a provincial heritage resources authority;
- the rezoning of a site exceeding 10 000m<sup>2</sup> in extent; or
- any other category of development provided for in regulations by SAHRA or a provincial heritage resources authority.

### 2.1.5 Management of Graves and Burial Grounds

- **Graves younger than 60 years** are protected in terms of Section 2(1) of the Removal of Graves and Dead Bodies Ordinance 7 of 1925 as well as the Human Tissues Act 65 of 1983.
- **Graves older than 60 years, situated outside a formal cemetery administered by a local Authority** are protected in terms of Section 36 of the NHRA as well as the Human Tissues Act of 1983. Accordingly, such graves are the jurisdiction of SAHRA. The procedure for Consultation Regarding Burial Grounds and Graves (Section 36(5) of NHRA) is applicable to graves older than 60 years that are situated outside a formal cemetery administered by a local authority. Graves in the category located inside a formal cemetery administered by a local authority will also require the same authorisation as set out for graves younger than 60 years over and above SAHRA authorisation.

The **protocol for the management of graves older than 60 years situated outside a formal cemetery administered by a local authority** is detailed in Section 36 of the NHRA:

(3) (a) No person may, without a permit issued by SAHRA or a provincial heritage resources authority—

(a) destroy, damage, alter, exhume or remove from its original position or otherwise disturb the grave of a victim of conflict, or any burial ground or part thereof which contains such graves;

(b) destroy, damage, alter, exhume, remove from its original position or otherwise disturb any grave or burial ground older than 60 years which is situated outside a formal cemetery administered by a local authority; or

(c) bring onto or use at a burial ground or grave referred to in paragraph (a) or (b) any excavation equipment, or any equipment which assists in the detection or recovery of metals.

(4) SAHRA or a provincial heritage resources authority may not issue a permit for the destruction or damage of any burial ground or grave referred to in subsection (3)(a) unless it is satisfied that the applicant has made satisfactory arrangements for the exhumation and re-interment of the contents of such graves, at the cost of the applicant

and in accordance with any regulations made by the responsible heritage resources authority.

(5) SAHRA or a provincial heritage resources authority may not issue a permit for any activity under subsection (3)(b) unless it is satisfied that the applicant has, in accordance with regulations made by the responsible heritage resources authority—

- (a) made a concerted effort to contact and consult communities and individuals who by tradition have an interest in such grave or burial ground; and
- (b) reached agreements with such communities and individuals regarding the future of such grave or burial ground.

(6) Subject to the provision of any other law, any person who in the course of development or any other activity discovers the location of a grave, the existence of which was previously unknown, must immediately cease such activity and report the discovery to the responsible heritage resources authority which must, in cooperation with the South African Police Service and in accordance with regulations of the responsible heritage resources authority—

- (a) carry out an investigation for the purpose of obtaining information on whether or not such grave is protected in terms of this Act or is of significance to any community; and
- (b) if such grave is protected or is of significance, assist any person who or community which is a direct descendant to make arrangements for the exhumation and re-interment of the contents of such grave or, in the absence of such person or community, make any such arrangements as it deems fit.



## 3. STUDY APPROACH AND METHODOLOGY

### 3.1 Desktop study

The first step in the methodology was to conduct a desktop study of the heritage background of the area and the proposed development site. This entailed the scoping and scanning of historical texts/records as well as previous heritage studies and research around the study area.

The study area is contextualised by incorporating data from previous CRM reports in the area and an archival search. The objective of this is to extract data and information on the area in question, looking at archaeological sites, historical sites and graves in the area.

No archaeological site data was available for the project area. A concise account of the archaeology and history of the broader study area was compiled (sources listed in the bibliography).

#### 3.1.1 Literature review

A literature survey was undertaken to obtain background information regarding the area. Through researching the SAHRA APM Report Mapping Project records and the SAHRIS online database (<http://www.sahra.org.za/sahris>), it was determined that several other archaeological or historical studies had been performed within the broader vicinity of the study area. Sources consulted in this regard are indicated in the bibliography.

### 3.2 Field study

Phase 1 (AIA/HIA) requires the completion of a field study to establish and ensure the following:

#### 3.2.1 Systematic survey

A systematic survey of the proposed project area to locate, identify, record, photograph, and describe archaeological, historical or cultural interest sites were completed.

UBIQUE Heritage Consultants inspected the proposed development and surrounding areas on the 18<sup>th</sup> and 19<sup>th</sup> of November 2021 and completed a controlled-exclusive, pre-planned pedestrian and vehicular survey. We conducted an inspection of the ground's surface, wherever the surface was visible. This was done with no substantial attempt to clear brush, sand, deadfall, leaves or other material that may cover the surface and with no effort to look beneath the surface beyond the inspection of rodent burrows, cut banks and other exposures fortuitously observed.

The survey was tracked with a handheld Garmin global positioning unit (Garmin eTrex 10).

### 3.2.2 Recording significant areas

GPS points of identified significant areas were recorded with a handheld Garmin global positioning unit (Garmin eTrex 10). Photographs were taken with a Canon IXUS 185 20-megapixel camera. Detailed field notes were taken to describe observations. The layout of the area and plotted GPS points, tracks and coordinates, were transferred to Google Earth, and QGIS and maps were created.

### 3.2.3 Definitions of heritage resources

The NHRA defines a heritage resource as any place or object of cultural significance, i.e., aesthetic, architectural, historical, scientific, social, spiritual, linguistic, or technological value or significance. These include, but are not limited to, the following wide range of places and objects:

- living heritage as defined in the National Heritage Council Act No 11 of 1999 (cultural tradition; oral history; performance; ritual; popular memory; skills and techniques; indigenous knowledge systems; and the holistic approach to nature, society and social relationships);
- Ecofacts (non-artefactual organic or environmental remains that may reveal aspects of past human activity; definition used in KwaZulu-Natal Heritage Act 2008);
- places, buildings, structures and equipment;
- places to which oral traditions are attached or which are associated with living heritage;
- historical settlements and townscapes;
- landscapes and natural features;
- geological sites of scientific or cultural importance;
- archaeological and palaeontological sites;
- graves and burial grounds;
- public monuments and memorials;
- sites of significance relating to the history of slavery in South Africa;
- movable objects, but excluding any object made by a living person; and
- battlefields.



### 3.3 Determining significance

Heritage resources are considered of value if the following criteria apply:

- a. It is important in the community or pattern of South Africa's history;
- b. It has uncommon, rare or endangered aspects of South Africa's natural or cultural heritage;
- c. It has the potential to yield information that will contribute to an understanding of South Africa's natural or cultural heritage;
- d. It is vital in demonstrating the principal characteristics of a particular class of South Africa's natural or cultural places or objects;
- e. It exhibits particular aesthetic characteristics valued by a community or cultural group;
- f. It is essential in demonstrating a high degree of creative or technical achievement at a particular period;
- g. It has a strong or unique association with a particular community or cultural group for social, cultural or spiritual reasons;
- h. It has a strong or special association with the life or work of a person, group or organisation of importance in the history of South Africa;
- i. It is of significance relating to the history of slavery in South Africa.

Levels of significance of the various types of heritage resources observed and recorded are determined by the following criteria:

| CULTURAL & HERITAGE SIGNIFICANCE |  |
|----------------------------------|--|
| <b>LOW</b>                       | A cultural object found out of context, not part of a site or without any related feature/structure in its surroundings.   |
| <b>MEDIUM</b>                    | Any site, structure or feature is regarded as less important due to several factors, such as date, frequency and uniqueness. Likewise, any important object found out of context.                                |
| <b>HIGH</b>                      | Any site, structure or feature is regarded as important because of its age or uniqueness. Graves are always categorised as of a high importance. Likewise, any important object found within a specific context. |

Field Ratings or Gradings are assigned to indicate the level of protection required and who is responsible for national, provincial, or local protection.



| FIELD RATINGS & GRADINGS            |   |
|-------------------------------------|---|
| <b>National Grade I</b>             | Heritage resources with exceptional qualities to the extent that they are of national significance and should therefore be managed as part of the national estate.            |
| <b>Provincial Grade II</b>          | Heritage resources with qualities provincial or regional importance, although it may form part of the national estate, it should be managed as part of the provincial estate. |
| <b>Local Grade IIIA</b>             | Heritage resources are of local importance and worthy of conservation. Therefore, it should be included in the heritage register and not be mitigated (high significance).    |
| <b>Local Grade IIIB</b>             | Heritage resources are of local importance and worthy of conservation. Therefore, it should be included in the heritage register and mitigated (high/ medium significance).   |
| <b>General Protection Grade IVA</b> | The site/resource should be mitigated before destruction (high/ medium significance).   |
| <b>General protection Grade IVB</b> | The site/resource should be recorded before destruction (medium significance).  |
| <b>General protection Grade IVC</b> | Phase 1 is considered as sufficient recording, and it may be demolished (low significance).   |

### 3.3.1 Assessment of development impacts

A heritage resource impact may be defined broadly as the net change, either beneficial or adverse, between the integrity of a heritage site with and without the proposed development. Beneficial impacts occur wherever a proposed development actively protects, preserves, or enhances a heritage resource by minimising natural site erosion or facilitating non-destructive public use. More commonly, development impacts are of an adverse nature and can include:

- destruction or alteration of all or part of a heritage site;
- isolation of a site from its natural setting; and / or
- introduction of physical, chemical or visual elements out of character with the heritage resource and its setting.

Beneficial and adverse impacts can be direct or indirect and cumulative, as implied by the examples. Although indirect impacts may be more difficult to foresee, assess and quantify, they must form part of the assessment process. Therefore, the following assessment criteria have been used to assess the impacts of the proposed development on possible identified heritage resources:

| CRITERIA   | RATING SCALES | NOTES   |
|--|---------------|---|
| Nature   | POSITIVE      | An evaluation of the type of effect the construction, operation and management of the proposed development would have on the heritage resource.   |
|  | NEGATIVE      |   |
|  | NEUTRAL       |   |
| Extent   | LOW           | Site-specific affects only the development footprint.   |
|  | MEDIUM        | Local (limited to the site and its immediate surroundings, including the surrounding towns and settlements within a 10 km radius);  |
|  | HIGH          | Regional (beyond a 10 km radius) to national.   |
| Duration   | LOW           | 0-4 years (i.e. duration of construction phase).  |
|  | MEDIUM        | 5-10 years.   |
|  | HIGH          | More than 10 years to permanent.  |
| Intensity  | LOW           | Where the impact affects the heritage resource in such a way that its significance and value are minimally affected.  |
|  | MEDIUM        | Where the heritage resource is altered, and its significance and value are measurably reduced.  |
|  | HIGH          | Where the heritage resource is altered or destroyed to the extent that its significance and value cease to exist.   |
| Potential for impact on irreplaceable resources      | LOW           | No irreplaceable resources will be impacted.  |
|  | MEDIUM        | Resources that will be impacted can be replaced, with effort.   |
|  | HIGH          | There is no potential for replacing a particular vulnerable resource that will be impacted.   |
| Consequence  | LOW           | A combination of any of the following: <ul style="list-style-type: none"> <li>• Intensity, duration, extent and impact on irreplaceable resources are all rated low.</li> <li>• Intensity is low and up to two of the other criteria are rated medium.</li> <li>• - Intensity is medium, and all three other criteria are rated low.</li> </ul> |
|  | MEDIUM        | Intensity is medium, and at least two of the other criteria are rated medium.   |
|  | HIGH          | Intensity and impact on irreplaceable resources are rated high, with any combination of extent and duration.<br>Intensity is rated high, with all the other criteria being rated medium or higher.  |
| Probability (the likelihood of the impact occurring) | LOW           | It is highly unlikely or less than 50 % likely that an impact will occur.   |
|  | MEDIUM        | It is between 50 and 70 % certain that the impact will occur.   |

| CRITERIA   | RATING SCALES | NOTES  |
|--|---------------|--|
|  | HIGH          | It is more than 75 % certain that the impact will occur, or it is definite that the impact will occur. |
| Significance<br>(all impacts including potential cumulative impacts) | LOW           | Low consequence and low probability.   |
|  |               | Low consequence and medium probability.  |
|  |               | Low consequence and high probability.  |
|  | MEDIUM        | Medium consequence and low probability.  |
|  |               | Medium consequence and medium probability.   |
|  |               | Medium consequence and high probability.   |
|  |               | High consequence and low probability.  |
|  | HIGH          | High consequence and medium probability.   |
|  |               | High consequence and high probability.   |

### 3.4 Report

The desktop research and field survey results are compiled in this report. The identified heritage resources and anticipated direct, indirect, and cumulative impacts of the proposed project's development on the identified heritage resources will be presented objectively. Should any significant sites be impacted adversely by the proposed project, alternatives are offered. All efforts will be made to ensure that all studies, assessments, and results comply with the relevant legislation and the code of ethics and guidelines of the Association of South African Professional Archaeologists (ASAPA). The report aims to assist the developer in managing the documented heritage resources in a responsible manner and protecting, preserving, and developing them within the framework provided by the National Heritage Resources Act of 1999 (Act 25 of 1999).



## 4. PROJECT OVERVIEW

UBIQUE Heritage Consultants were appointed by EnviroAfrica CC as independent heritage specialists in accordance with Section 38 of the NHRA and the National Environmental Management Act 107 of 1998 (NEMA) to conduct a cultural heritage assessment to determine the impact of the proposed development (including associated infrastructure) of solar photovoltaic (PV) facility on the farm Spes Bona No. 2355, Portion 8 (referred to as Harvard 1), Bloemfontein, Mangaung Metropolitan Municipality, Free State Province.

The proposed project aims to develop two separate solar photovoltaic (PV) facilities, including associated infrastructure, one on Portion 8 of Farm 2355 (referred to as Harvard 1) and one on Portion 5 of Farm 2355 (referred to as Harvard 2). The envisaged Harvard Solar Farm is located approximately 11km West of Bloemfontein CBD. The combined size of the properties is 430 Ha. The Harvard Electrical Sub-Station is situated 2km to the north of the envisaged Harvard solar farm.

One of the following two photovoltaic solar panel technologies will be used:

- Single-axis tracking photovoltaic panels (on ground-mounted steel structures)
- Fixed axis photovoltaic panels (on ground-mounted steel structures)

The generating capacity of the two Harvard areas, are: Harvard 1 North 145 ha / 1.77 Ha/MW = 82 MW and Harvard 2 South 120 ha / 1.77 Ha/MW = 68 MW

The capacity of overhead power lines:

- Voltage: 132kV or higher
- Tower height: up to 25m typically
- Tower-type: Steel Monopole

The footprint of the switching station will be a 400m x 150m (typical) area in the middle of the Harvard Solar farm (Figure 3). The station will be constructed on an elevated flat area that protects the installation against stormwater damage. Stormwater channels can be seen around the elevated area. A perimeter fence protects the installation. The solar farm will also be fenced off.

Underground low voltage (0-1000V) electrical power lines (blue) transfer generates electricity from blocks of solar panels (approximately 8 ha) to inverter/transformer stations within the solar panel area. From these stations, the generated power of the solar block is conveyed through

underground medium voltage (1000-33000V) electrical power cables (orange) to the grid connection station (Figure 5).

There is a possibility that a small battery storage facility with a capacity of 4 x 2.5MW – 10MW will be constructed.

Water requirements during the construction and the operational phase of the solar energy facility will differ. The following water source(s) can be utilized after official approval application processes have been followed and official permission has been granted: Bloemwater which supplies portable water to the small holdings areas to the south of the Harvard solar farm through a water reticulation network (Figure 9); and Boreholes in the Harvard area.

The Construction phase and the operational phase will be treated differently in terms of sewer treatment. Wastewater and sewer will be treated on-site close to the operational offices using a small bio-filter type package plant. The treated/recycled water will be used for irrigation and maintenance of roads This plant will be sized according to the calculated load. The operational offices will be located next to the switch station in the centre of the solar area. Two registered solid waste sites will be used during construction and operational phases.

#### 4.1 Technical information

| PROJECT DESCRIPTION         |   |
|-----------------------------|---|
| Project name                | Phase 1 Heritage Impact Assessment for the Proposed Development of Harvard Solar Farm, Spes Bona No. 2355, Portion 8.   |
| Description                 | Proposed Development of Solar Photovoltaic (Pv) Facility on The Farm Spes Bona No. 2355, Portion 8 (Harvard 1), Bloemfontein, Mangaung Metropolitan Municipality, Free State Province |
| DEVELOPER                   |   |
| Keren Energy Group Holdings |   |
| Development type            | Development of Solar PV facilities and grid connection  |
| LANDOWNER                   |   |
|                             |   |
| CONSULTANTS                 |   |
| Environmental               | EnviroAfrica CC   |
| Heritage and archaeological | UBIQUE Heritage Consultants   |
| Paleontological             | Banzai Environmental  |
| PROPERTY DETAILS            |   |
| Province                    | Free State  |
| District municipality       | Mangaung Metropolitan Municipality  |
| Local municipality          | Mangaung Metropolitan Municipality  |
| Topo-cadastral map          | 1: 50 000 2926AA  |

|   |   |               |
|---|---|---------------|
| Farm name   | Portion 8 of Farm Spes Bona 2355          |               |
| Closest town  | Bloemfontein                              |               |
| GPS Co-ordinates  | 29° 07' 18.56" South, 26° 05' 51.69" East |               |
| PROPERTY SIZE   | 215.2342ha                                |               |
| DEVELOPMENT FOOTPRINT SIZE  | 210ha                                     |               |
| <b>LAND USE</b>   |   |               |
| Previous  | Agriculture/grazing                       |               |
| Current   | Agriculture/grazing                       |               |
| Rezoning required   | No  |               |
| Sub-division of land  | No  |               |
| <b>DEVELOPMENT CRITERIA IN TERMS OF SECTION 38(1) NHRA</b>  |   | <b>YES/NO</b> |
| Construction of a road, wall, power line, pipeline, canal or other linear forms of development or barrier exceeding 300m in length. |   | Yes           |
| Construction of bridge or similar structure exceeding 50m in length.  |   | No            |
| Construction exceeding 5000m <sup>2</sup> .   |   | Yes           |
| Development involving three or more existing erven or subdivisions.   |   | No            |
| Development involving three or more erven or divisions that have been consolidated within the past five years.                      |   | No            |
| Rezoning of site exceeding 10 000m <sup>2</sup> .   |   | No            |
| Any other development category, public open space, squares, parks, recreation grounds.  |   | No            |



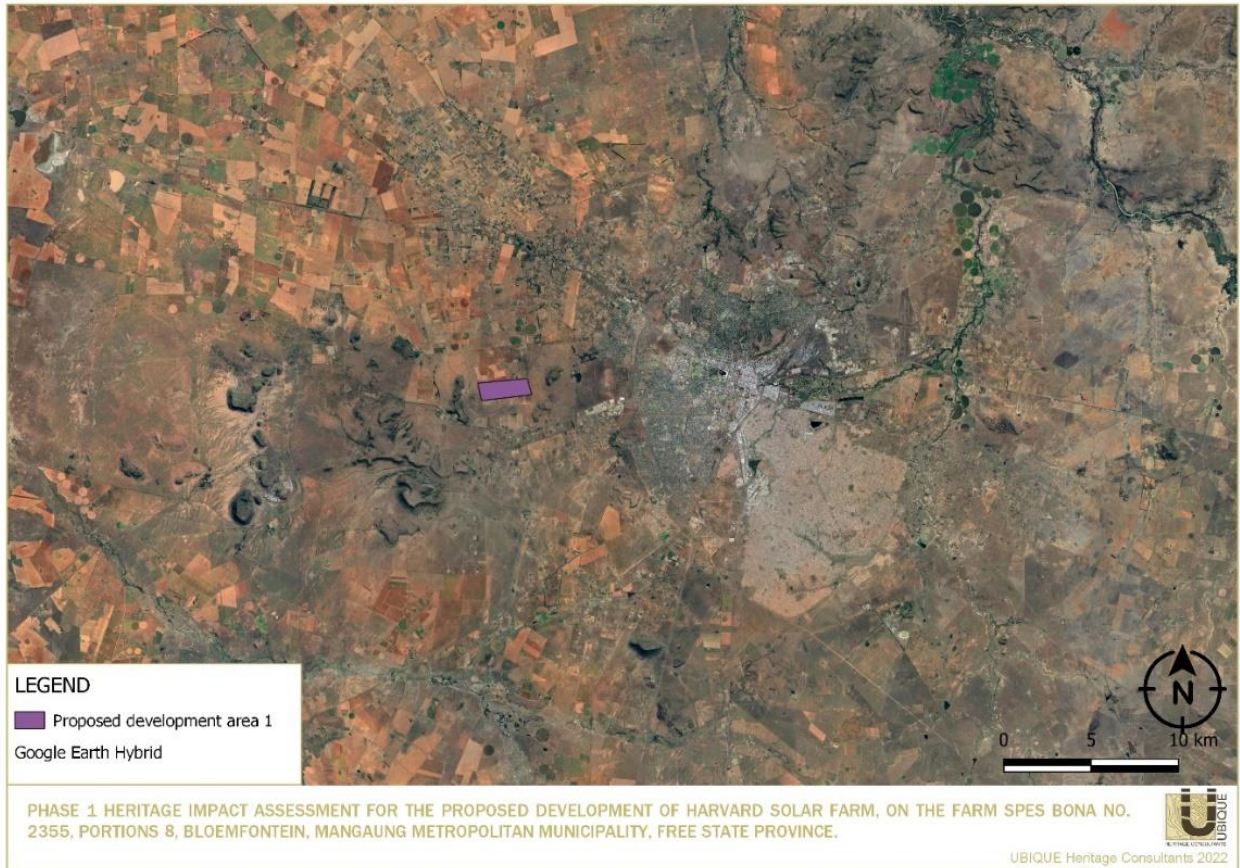


Figure 1 Regional locality of the development footprint, indicated on Google Earth Satellite imagery.

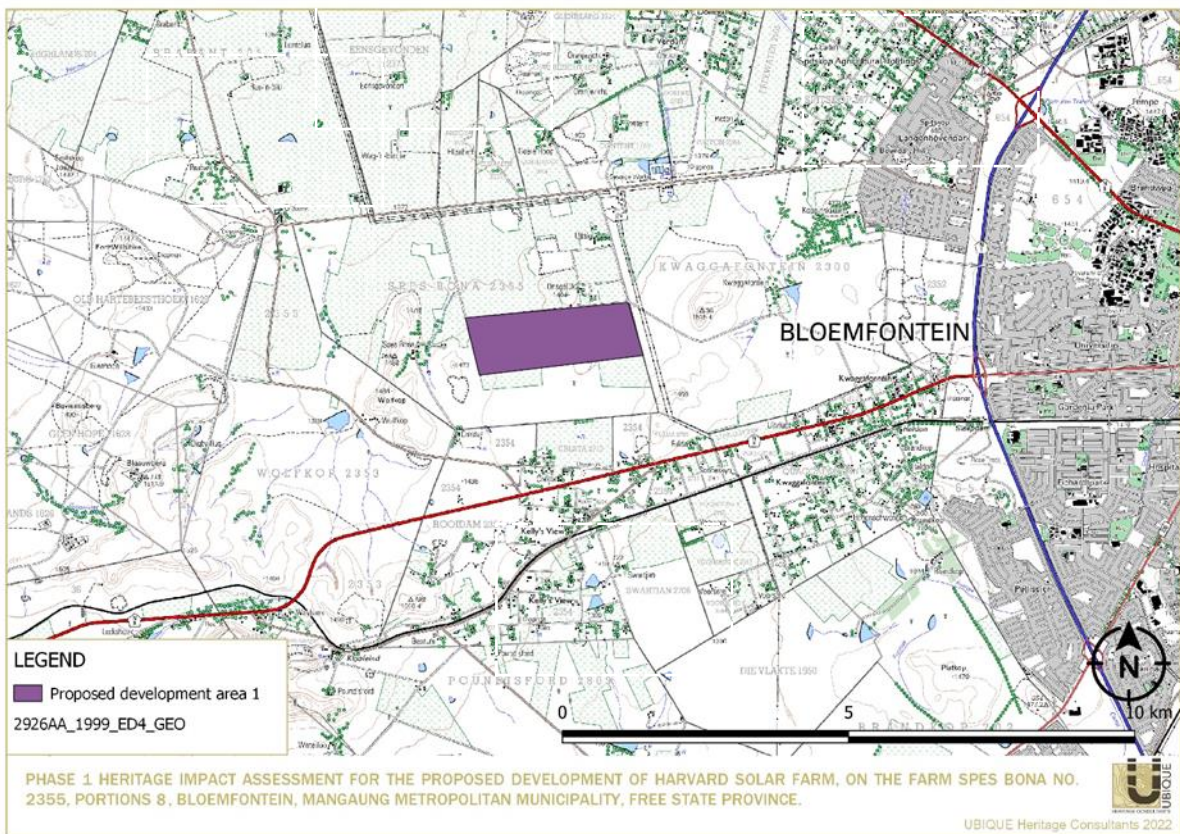
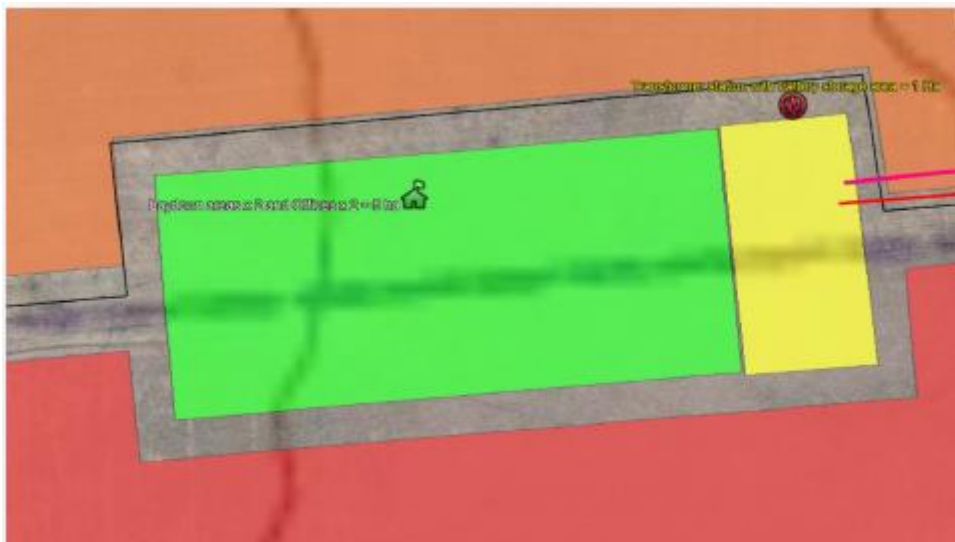
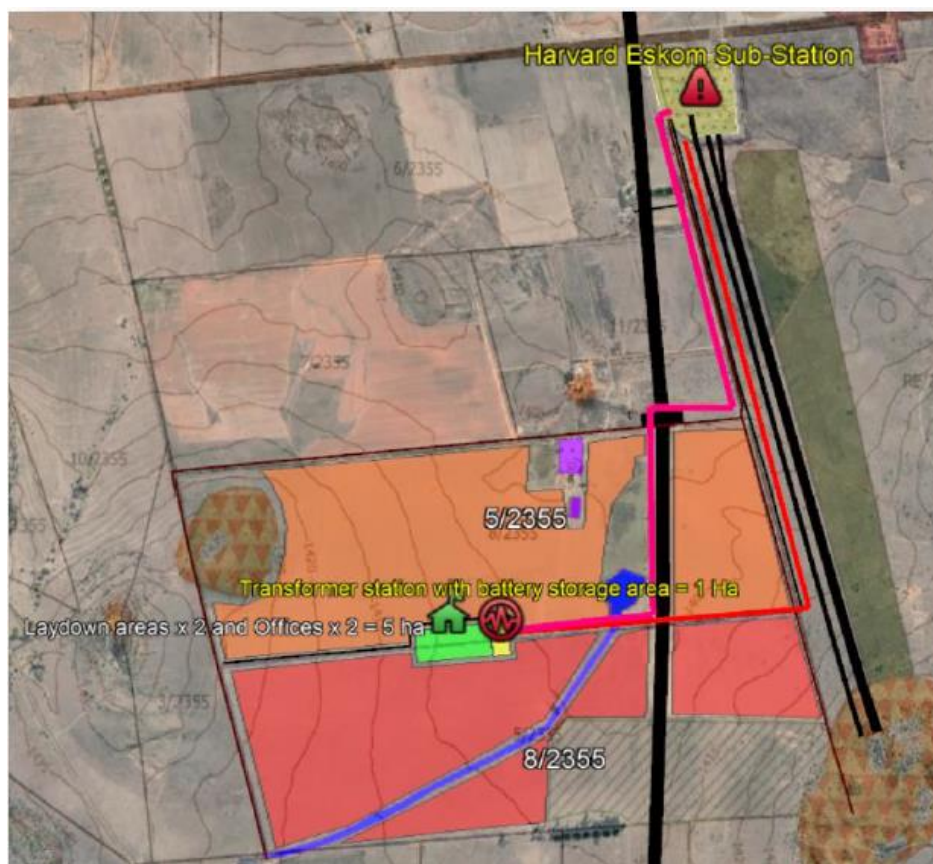


Figure 2 Locality of the development footprint, indicated on 1: 50 000 2926AA map.





**Figure 3** Footprint of grid connection station, offices and laydown/storage area. Image provided by client.



**Figure 4** Existing power lines as well as the route of the proposed power line connection from the solar farm to the Harvard Eskom Sub-Station. MV transmission line 1 (Black line); MV transmission line 1 (Brown line); Existing HV transmission lines (Black bold line); Proposed HV transmission line connection between Harvard Solar Farm and the Harvard Eskom Sub-Station (Red line); Proposed HV transmission line connection between Harvard Solar Farm and the Harvard Eskom Sub-Station (If Eskom does not approve the application to grant permission for a line in the Eskom servitude) (Pink line) . Image provided by client

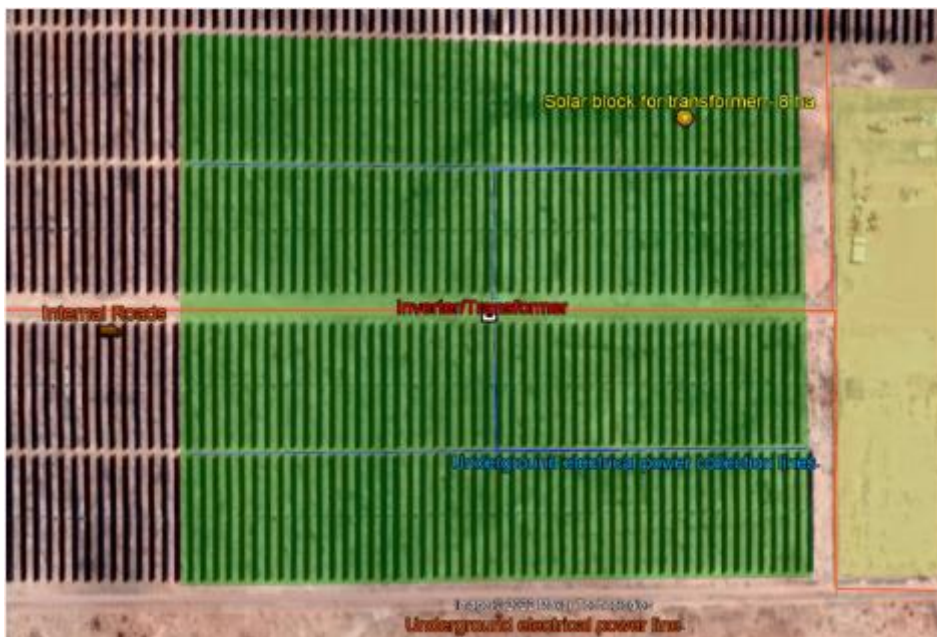


Figure 5 electrical cables between solar panels and inverters/transformers. Image provided by client

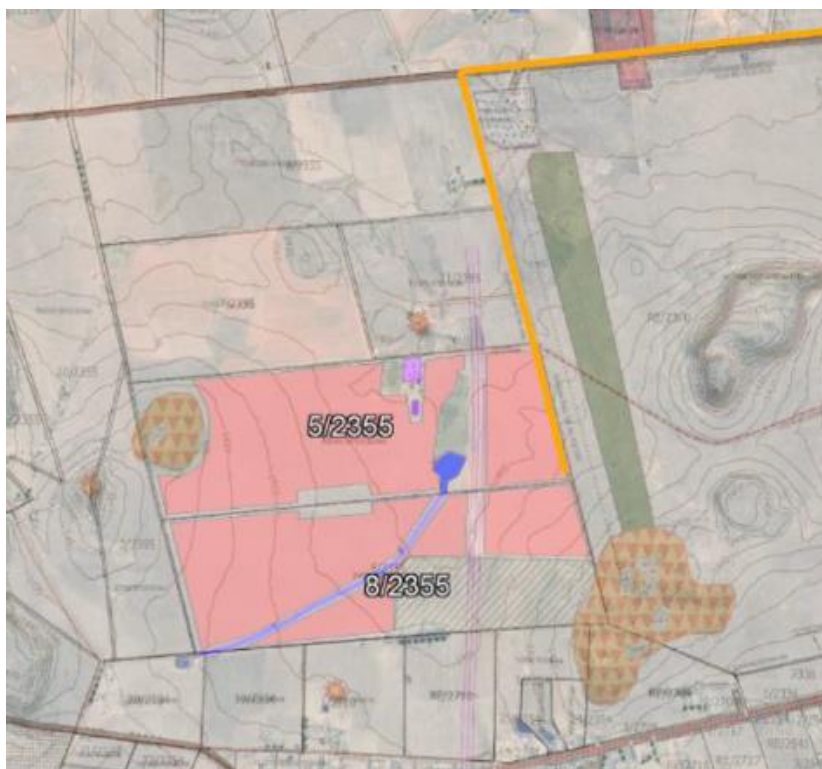


Figure 6 The current road from the North-East that gives access to the solar farm area is shown in gold on the Google image. Image provided by client

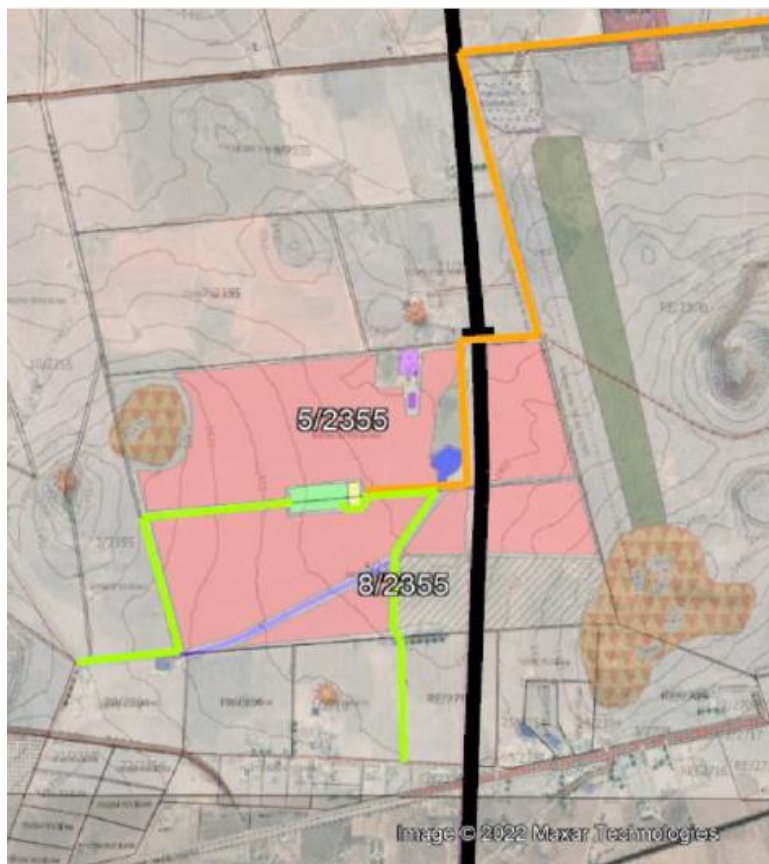
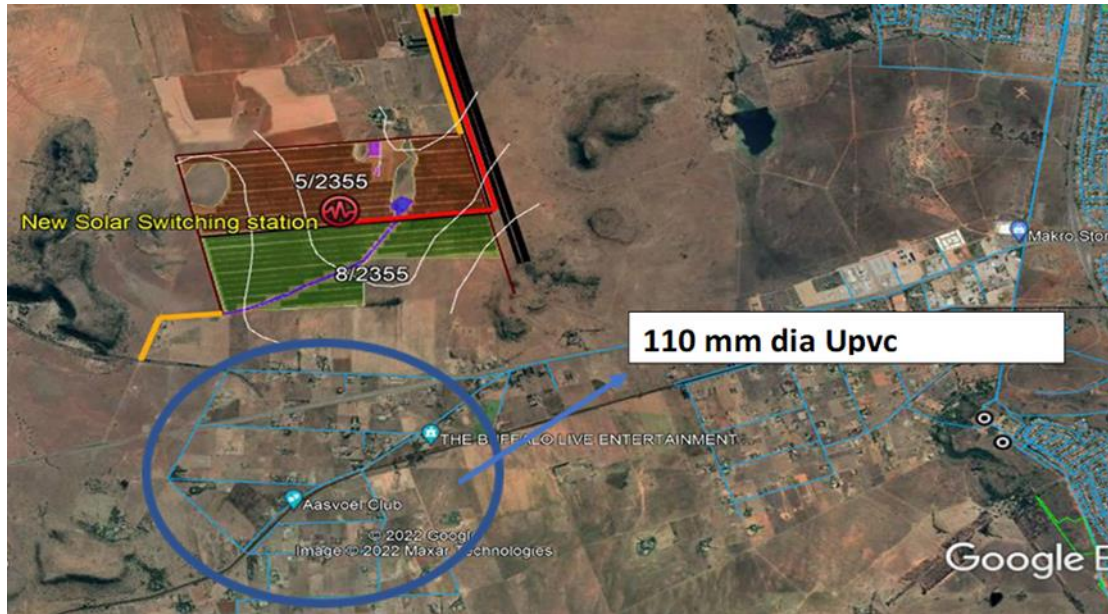


Figure 7 Proposed access roads (with alternatives) to the Harvard solar farm. Image provided by client.

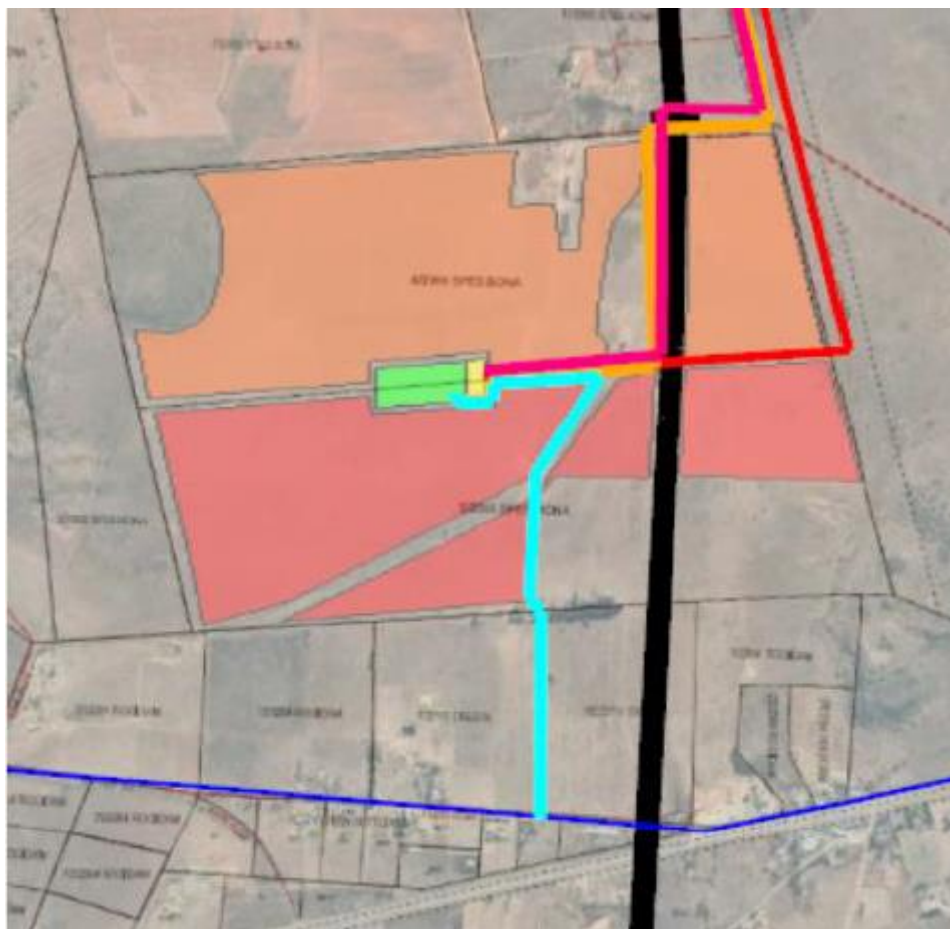


Figure 8 Internal roads. Image provided by client.





**Figure 9** Possible water supply will be from the 110mm diameter Bloemwater reticulation network to the south of Harvard solar farm. Image provided by client.



**Figure 10** Planned connection from Bloemwater reticulation network to the operational centre of Harvard solar farm. Image provided by client.

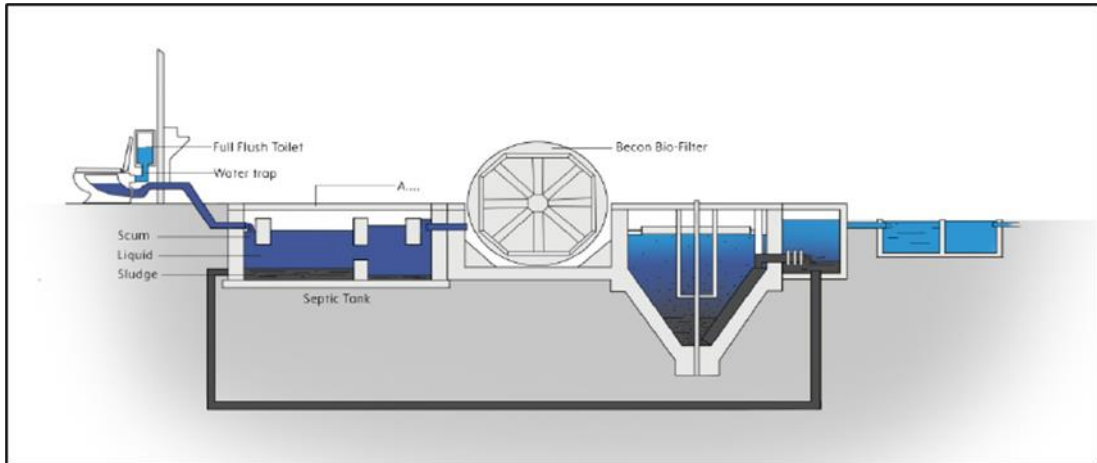


Figure 11 Plan of bio-filter type package plant. Image provided by client.

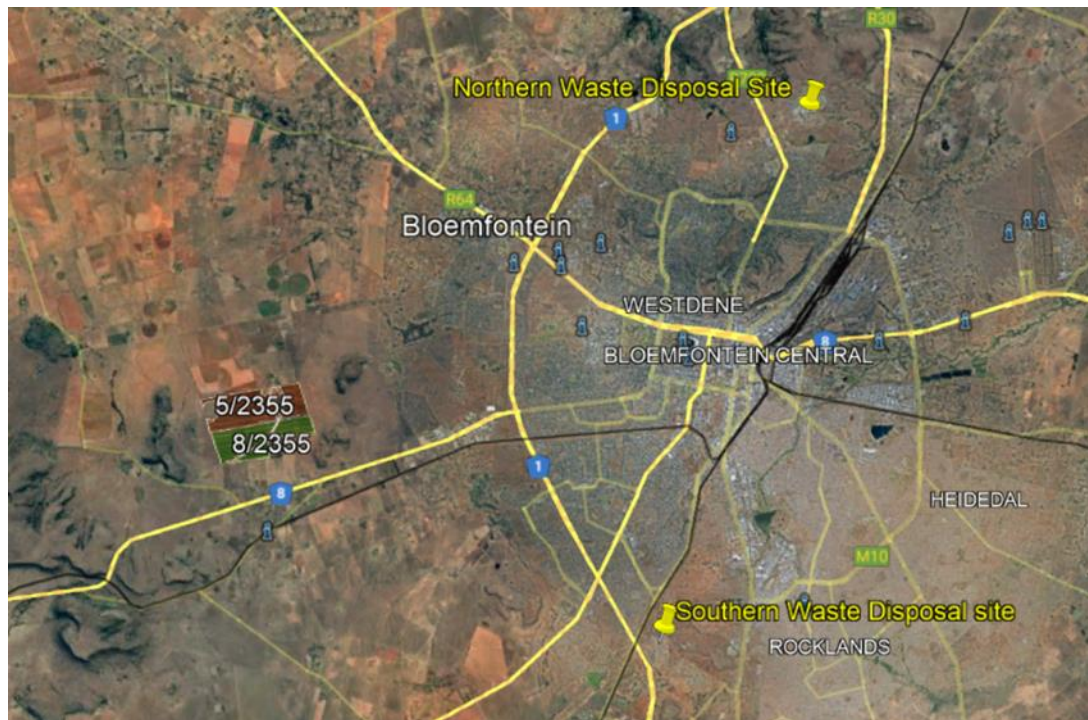


Figure 12 The two solid waste sites that will be used. Image provided by client.





Figure 13 Stormwater catchment area. Image provided by client.

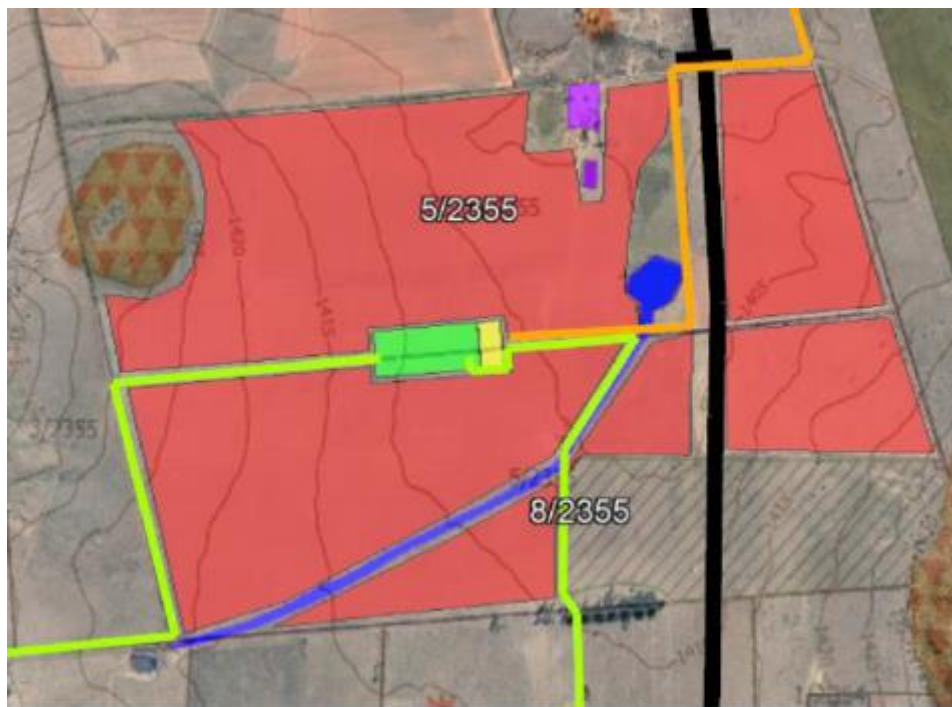


Figure 14 Contours and stormwater direction. Image provided by client.



## 5. HISTORICAL AND ARCHAEOLOGICAL BACKGROUND

### 5.1 Region: Free State

South Africa has a very long and varied history of human occupation (Deacon & Deacon 1999). This occupation has been dated to approximately 2mya (million years ago) (Mitchell 2002). Briefly, the archaeology of South Africa can be divided into three “major” periods, namely: the Stone Age, the Iron Age and the Historical period. Various archaeological and historical sites have been identified and documented throughout South Africa, including the Free State Province. The Free State Province has a rich and diverse history. The area was sparsely populated until the arrival of the Boers (Voortrekkers) by the end of the 18th century.

#### 5.1.1 Stone Age

The history of the Free State is reflected in a rich archaeological landscape, with a wealth of pre-colonial archaeological sites. Numerous sites have been identified and documented across the region. These sites have been dated to the Earlier, Middle and Later Stone Age.

In southern Africa, the Stone Age can be divided into three periods. It is, however, critical to note that dates are relative and only provide a broad framework for interpretation. The division of the Stone Age, according to Lombard et al. (2012), is as follows:

- Earlier Stone Age (ESA): >2 000 000 - >200 000 years ago
- Middle Stone Age (MSA): <300 000 - >20 000 years ago
- Later Stone Age (LSA): <40 000 - until the historical period

In short, the Stone Age refers to humans that mainly utilised stone as their technological marker. Each sub-division is formed by industries where the assemblages share attributes or common traditions (Lombard et al. 2012). The ESA is characterised by flakes produced from pebbles, cobbles and percussive tools, as well as objects created later during this period, such as large hand axes, cleavers and other bifacial tools (Klein 2000). The MSA is associated with small flakes, blades and points. The aforementioned is generally suggested to have been made and utilised for hunting activities and had numerous functions (Wurz 2013). Fine-grain quartzite, quartz, silcrete, chalcedony, and hornfels are common materials used for MSA stone artefacts (Binneman et al. 2011; Tomose 2013). MSA stone artefacts, including ESA artefacts, occur in secondary contexts for various reasons, such as natural events (erosion) or animal and human disruptions (Tomose 2013). Furthermore, the LSA is characterised by microlithic stone tools, scrapers and flakes (Binneman 1995; Lombard et al. 2012). The LSA is also associated with rock art.

The wider geological region of the Free State has been inhabited since the ESA onward. This interpretation is supported by the discovery of stone tools and lithics dating from the Early, Middle, and Late Stone Ages in various locations. However, according to Kruger (2018), these are



usually found near rivers, such as the Doring Spruit north of Kroonstad, the Vals River, and the Sand River south of Ventersburg. In the Free State, the earliest known industry of the ESA is the Victoria West Industry, which also spreads into the Northern Cape. The Victoria West Stone Industry can be found in the Free State area along the Vaal River basin. However, it is believed that the prepared cores of the Victoria West industry indicate a transitional period in the Stone Age industry from the Acheulian into the MSA. The Victoria West industry is often seen as an evolutionary step toward the Levallois Prepared Core Technique. This likely signifies the outwards spread of the Stone Age technology (Tomose 2013).

ESA stone artefacts and lithics in the Free State are commonly found as open-air surface scatters, either as individual occurrences or in vast numbers. ESA artefacts/occurrences can also, very rarely, be found in association with other archaeological heritage, plant, and material remains (Binneman et al. 2011). According to Binneman et al. (2011), South African exceptions include Wonderwerk in the Northern Cape near Kimberly, the Montagu Cave in the Western Cape Province, and Amanzi Springs near Uitenhage bone and plant material were discovered in situ associated with the stone artefacts.

The MSA artefacts eventually replaced the dominant large hand axes and cleavers that characterised the ESA. This transition or distinction in the archaeological record has been dated to around 250 000 years ago. Smaller artefacts dominate the archaeological record during this time period, with the flake and blade industry being the most prominent. This industry innovation is thought to have peaked about 120 000 years ago. Throughout southern Africa, archaeologists can generally find surface scatters from the blade and flake industries (Tomose 2013). The early MSA stone industry known as the Mangosia had a wide distribution and stretched across the Limpopo, the Qriqualand in Northern Cape, Natal, the Cape Point and the Free State (Binneman et al. 2011; Tomose 2013). Artefacts associated with the Mangosia industry in the Free State are known to have been produced from the indurate shale raw material (Binneman et al. 2011). The MSA tools include flakes, blades and points and mainly occur as surface scatters. Other industries within the MSA include are the Howieson's Poort which is known to have a wide distribution throughout southern Africa, including the Free State province, the Orangia (128 000 to 75 000 years ago) and the Florisbad (dominant in the Free State province) and Zeekoegat industries (between 64 000 and 32 000 years ago) (Tomose 2013).

The LSA archaeological record is often associated with the San hunter-gatherers. However, the LSA also included Khoekhoe pastoralists from about 2 000 years ago. In the Karoo (Northern Cape regions), the Free State Province, and Lesotho, dark or black fine-grained chalcedony would have been the preferred material. Smithfield settlement sites are more commonly found among hills and ridges. The LSA archaeology is rich and varied. Archaeologists often find stone artefacts, beads (ostrich eggshell beads are dominant), pottery, and rock art relating to the LSA. Rock art can be either in the form of paintings or engravings (Tomose 2013).

Most of the studies and surveys that have been conducted throughout the Free State have recorded Stone Age sites, and surface scatters of Stone Age artefacts (ranging from the ESA, MSA and LSA) (e.g. Fourie 2020; Morris 2014a and b; Orton 2015; 2016a, b, c, d and e). Several examples of stone tool "factory" sites have been found at, but not limited to, Ventershoek near

Wepener and Mooifontein near Zastron, at Spitzkop near Smithfield, and the Smithfield Townlands (Fourie 2020). Materials associated with the MSA/LSA have also been reported around the Vredefort Dome. Some of these materials (such as scrapers, blades, cores, flakes, hammerstones, and small microlithic tools that occur as scattered finds) have been found in open-air areas, especially near the Vaal River as well as in caves. They are associated with transhumance (Mlilo 2017). Stone tool open-air sites were discovered near Rouxville at Goedemoed, Weenkop, and Wesselsdal and in the Aliwal North District at Middelpaats Melkspruit Grassridge Farm. Grinding hollows and grooves have been recorded as well as boulders with cupules ground into it (Orton 2016 c and e).

### 5.1.2 Iron Age

The Iron Age (IA) is characterised by the use of metal (Coertze & Coertze 1996: 346). There is some controversy about the periods within the IA. Van der Ryst & Meyer (1999) have suggested that there are two phases within the IA, namely:

- Early Iron Age (EIA) 200 – 1000 A.D
- Late Iron Age (LIA) 1000 – 1850 A.D

However, Huffman (2007) suggests instead that there are three periods within the Iron Age, these periods are:

- Early Iron Age (EIA) 250 – 900 A.D
- Middle Iron Age (MIA) 900 – 1300 A.D
- Late Iron Age (LIA) 1300 – 1840 A.D

Thomas Huffman believes that the Middle Iron Age should be included within this period; his dates have been widely accepted in the IA field of archaeology.

The South African Iron Age is generally characterised by farming communities who had domesticated animals, cultivated plants, manufactured and made use of ceramics and beads, smelted iron for weapons and manufactured tools (Hall 1987). Iron Age people were often mixed farmers/agropastoralists. These agropastoralists generally chose to live in areas with sufficient water for domestic use along with arable soil that could be cultivated with an iron hoe. Most Iron Age (IA) settlements that were built by agropastoralists were permanent settlements (with a few exceptions, of course). They consisted of features such as houses, raised grain bins, storage pits and animal kraals/byres, which contrasts with the temporary camps of pastoralists and hunter-gatherers (Huffman 2007). It is evident in the archaeological record that IA groups had migrated with their material culture (Huffman 2002).

The EIA was a gradual spread or expansion of settlements of different indigenous people groups, which took place over a long period (Matenga 2019). Around 200 A.D., agriculturalist peoples arrived in southern Africa from West and East Africa, bringing with them settled agriculture,

metalworking, animal husbandry, pottery production, and social stratification, all in contrast to the Stone Age lifeways (Huffman 2007; Mlilo 2017). There are very few sites ascribed to the EIA in the country's central and western areas (Matenga 2019), which could be because IA communities appear to have favoured the country's eastern regions due to rainfall patterns. The summer rainfall climates were favourable for ploughing and growing crops like sorghum and millet. The first evidence of IA communities in the Free State has been recorded in the south-eastern region. The majority of current data regarding Iron Age cultures in the Free State dates from the 16th and 18th centuries when they passed over the Vaal River and came into contact with the San hunter-gatherers (Tomose 2013).

The material and features recorded at IA sites throughout the Free State and southern Africa include stonewalled settlements, pottery, iron and metal implements, beads, rainmaking sites and features, spear sharpening grooves on rock surfaces and grindstones, among many other types of materials (Tomose 2013). The Free State's IA archaeology is distinguished by the widespread distribution of stonewalled sites over flat-topped ridges and hills. Stonewalls and stonewalled settlements are some of the many prominent features of the Iron Age people. Stonewalled settlements dating to the IA have been widely documented in parts of the Free State (Morris 2016). The Caledon River Valley, known to have been inhabited by the Fokeng (Sotho speakers), is one of the well-known and well-documented areas in the Free State region with evidence of Iron Age farmers. The Fokeng moved to Metlaeeng after living in the foothills of Ntsuana-tsatsi between Frankfort and Vrede (Tomose 2013). The site of Doornpoort in the Free State has two recent occupations that yield evidence for various usages of faunal material. The site has been associated with Sotho-Tswana speakers. Cattle dominate the faunal assemblages for the occupation, which dates back to about 1700 A.D. However, according to Badenhorst (2010: 94), few cattle remains were recovered from the late 19th to early 20th centuries, with caprines dominating the faunal assemblage. The Rinderpest disease, which killed large numbers of cattle herds, is most likely to blame for the shift in livestock usage and consumption. Moreover, the Afrikaner colonialism's influence in the former Orange Free State (OFS) can also be seen as a potential explanation for this change (Badenhorst 2010: 94).

The spatial organisation plays an essential role among IA communities. In general, it is characterised by the central position of the stock/cattle byres and placing the main swelling area on the perimeter of a settlement. The LIA is known for its massive stonewalled sites and the importance of livestock, personal status, kinship, social organisation, and males' and females' roles within their settlement patterns. The pottery styles associated with this settlement type are generally characterised by shallow line incisions in bands and triangles below the rim and on the shoulder, combined with straight or curved lines and areas of red ochre burnish on the body of clay vessels. Batswana groups such as the Rolong and Thlaping have been associated with sites with bilobial dwellings. The Kubung people have also been linked to such sites. According to oral tradition and radiocarbon dating, several sites were inhabited from the 16th and 17th centuries to the early 19th century in Ventersburg and from the 18th century to the early 19th century in Bothaville (Kruger 2018). The Later Iron Age (LIA) is commonly associated with the Sotho and Tswana, divided into a variety of facies based on ceramic studies (Huffman 2007). In the Kroonstad area, extensive stonewalled settlements have been discovered and possibly date from the 16th century. Elaborate LIA stonewall sites on the farm Middenspruit 151 adjacent to Bospoort have been reported by Dreyer (2006). The walls are in differing preservation and

deterioration states, with little evidence of wall-robbing, while some of the other structures are in good condition.

A single lower grinding stone was discovered next to one of the walls at one of the sites. On a southern portion of Middenspruit, he noted pottery, an upper grinding stone, and an unknown copper object (Kruger 2018). Interestingly, stonewalled sites in the Vrede Fort Dome have been associated with the Fokeng (Matenga 2019). The Askoppies site, located close to Vredefort Dome, is a large IA settlement with over 20 individual homesteads between 8 and 15 scalloped areas. Archaeological material recovered from the site includes seashells, pottery, ivory bangles, iron spears, a glass bead, hippo tusks, cuprous earrings, bone pendants, slag, smelting furnace remains, and tuyeres (Mlilo 2017). Researchers who have surveyed and studied the general area agree that the Vredefort Dome Conservancy area and its surroundings are rich in LIA dating from the 17th century to the early 19th century (Mlilo 2017). The Botanical Garden in the Free State is known to have been inhabited by IA Basotho dwellers. Pottery remains have been found here and are displayed in the Education Centre (SANBI 2021).

It is also believed that several IA communities north of the Vaal River (in the Limpopo Province) had practised the tradition of making rock art. Rock art is frequently connected to the later period in the IA when the farming communities had different encounters between other communities and the colonial settlers. The Makgabeng rock art is known for its depictions of conflict scenes associated with the Malebogo Wars (the war between Chief Malebogo of the Hananwa people and President Kruger of the Zuid Afrikaansche Republiek [ZAR]). In the Free State, rock art has also been linked to IA communities by association and is believed to have not been directly engraved or made by them. For instance, cattle paintings depict conflict scenes in the south-eastern Orange Free State (Tomose 2013). The figures include “hour-glass” Sotho shields, which has been argued to refer to the period of conflict and unrest known as the Difiqane/Mfecane (Binneman et al. 2011; Tomose 2013). Another known rock art site recorded in the Free State is on the Farm Kwartelfontein near Smithfield. Some rock art in the Free State depict cattle, sheep, and men walking with hunting dogs (Tomose 2013).

### 5.1.3 Historical period

The Historical/Colonial period generally refers to the last 500 years when European settlers and colonialism entered southern Africa (Binneman et al. 2011). It is believed that the historical period began with the arrival of Korana raiders in the area in the late 18th century. Soon after, in the 19th century, followed the arrival of traders, adventurers, and missionaries (Kruger 2018). The settlers were generally self-sufficient, surviving primarily on cattle/sheep farming and hunting (Van Schalkwyk 2014).

With the arrival of the Europeans, in the region north of the Orange River, by the end of the 18th century, the area was still sparsely populated. The bulk of the inhabitants seem to have been members of the Bechuana division of the Bantu speakers. Koranas were also in the Orange and Vaal valleys and Bushmen in the Drakensberg and western borders. The Griquas settled north of the Orange River in the early 19th century. Chief Mosilikatze (Mzilikazi) and his Matabele, between 1817 and 1831, ravaged the nation, and numerous large areas were depopulated. In

1824, Dutch farmers from the Cape Colony arrived in the country searching for pasture for their flocks. They were followed by the first parties of the Great Trek in 1836. The Voortrekkers had left Cape Colony for various reasons, but essentially to escape British sovereignty (Hillier and Cana 1911: 154).

When the Voortrekkers started on the Great Trek out of the Cape Colony, some settled just north of the Orange River, which formed the boundary between the Cape Colony and the rest of South Africa (SAHO 2019). They established several towns and farms there. However, they soon clashed with some of the indigenous groups of the country, especially the Basotho (SAHO 2019). The emigrants soon ran into Mzilikazi, who led Zulus (Matabele) raiding parties against Boer hunters who had crossed the Vaal without first receiving permission from the chieftain. Retaliation ensued, and in November 1837, Mzilikazi was decisively defeated by the Boers and fled northward. Meanwhile, another group of emigrants had arrived at Thaba'nchu, where the Wesleyans had a mission station for the BaRolong. Chief Moroko treated the emigrants with great kindness, and the Boers maintained good ties with the BaRolong (Hillier and Cana 1911: 154). The constitution of the Orange Free State was sanctioned on the 7th of April 1854, three weeks after the renunciation of British sovereignty. In 1853, the Boers proclaimed the region the Orange Free State (OFS), a Boer republic. In 1854, the Bloemfontein Convention recognised the OFS as an independent territory (SAHO 2019).

The Basotho were founded by Moshoeshoe (also referred to as Moshesh) after the Mfecane. The Voortrekkers had fought against Moshoeshoe and his Basotho countless times. The battles were brought on by arguments about who had a claim over which land as well as where the border lies between the OFS and the Basotho kingdom (SAHO 2019). It is said that Moshoeshoe requested British protection to defend his Kingdom during the lengthy Second Basotho War, which lasted from 1864 to 1868 (SAHO 2019). In 1868, Moshoeshoe and his country were placed under British protection (Hillier and Cana 1911: 156). The Basotho kingdom was designated as a British protectorate, and the thirty years of strife between the Boers and the Basotho had ended (Hillier and Cana 1911: 156; SAHO 2019). Trying to appease the Boers, the British had granted most of the Basotho's fertile land to the OFS. In turn, this created the current Lesotho borders along with the Free State (SAHO 2019).

The economy of South Africa, up until the 1860s, was primarily based on agriculture and trade. However, the discovery of diamonds led to the beginning of industrialisation in South Africa (SAHO 2019). Like their Transvaal neighbours, the Free State Boers had fallen into financial difficulties due to the conflicts with the Basothos. Paper money had been introduced, and the notes, known as "bluebacks", quickly fell to less than half their nominal value. Barter was the primary mode of exchange for goods and services, and many cases of bankruptcy occurred in the state. Nonetheless, just as British annexation rescued the Transvaal from ruin in 1877, so did the influx of British and other settlers to the diamond fields in the early 1870s returned public credit and individual wealth to the Free State's Boers. The diamond fields had a ready market for stock and agricultural products. Farmers started to make more money, and the public credit was restored. The government called in and redeemed the "bluebacks" after it regained par worth. The wealthiest diamond mine discovered in the Free State at the time was at Jagersfontein (Hillier and Cana 1911: 157). The Anglo-Boer War broke out in 1899. The OFS helped the ZAR to



fight against the British. This was a significant turning point in the history of South Africa and was the last full-scale war fought on South African soil. In 1902 the Boers had lost the war. As a consequence, their republics had become British colonies. The OFS was renamed the Orange River Colony. However, in 1910, it became one of the provinces of the new Union of South Africa and was renamed the OFS. Many years later, in 1995, after South Africa transitioned to democracy, the OFS was renamed the Free State (SAHO 2019; Britannica 2021). Interestingly, the Vaal River played an essential role during the Anglo-Boer War, forming a physical barrier that could only be crossed in a few areas. The ZAR forces burned the majority of the bridges in an attempt to hold the British at bay (Van Schalkwyk 2014). According to Van Schalkwyk (2014), the town of Vereeniging was where the peace negotiations had taken place between the Boer and British forces. However, the treaty was signed in Pretoria (Van Schalkwyk 2014).

In the Free State, there are various monuments, buildings (and their architectural styles) on farmsteads, statues and memorials associated with the various events that occurred during the Colonial/Historical period in the region (Tomose 2013). During the South African (Anglo-Boer) War (1899-1902), British forces were stationed near the Botanical Garden. The dam was constructed to keep water for their horses, and the stone wall can still be seen today. The Monk's Head beacon and an old stone wall commemorate a British patrol path used during the battle. Piles of horseshoes discovered near the nursery complex suggest that it was once home to a farrier's shop (SANBI 2021). Moreover, the south-eastern Free State is rich in historical encounters, tales, and material culture/remains from the Boer War. Binneman et al. (2011) remark that Bloemfontein's surroundings played an essential role in Boer War history. Colesburg is well-known for its historical events. In 1845, a skirmish between the Boers and the Griquas took place near Colesburg. Moreover, at Alleman's Drift near Colesburg, Adam Kok and many British individuals created a beacon proclaiming the whole nation from that point forward to be British territory, except areas in control by the Portuguese and native tribes (Binneman et al. 2011).



**Figure 15** Imperial Map of Bloemfontein and surrounds, with the wagon routes indicated. Image from UCT digital collections, <https://digitalcollections.lib.uct.ac.za/>

## 5.2 Local: Spes Bona 2355 and surrounds

Unfortunately, not much is known about the early history of the farm Spes Bona 2355. The early 1900s map above indicates farm boundaries, fences, farm names, divisional boundaries, roads, rivers, telegraph lines and railways in the Bloemfontein area. The map also indicates hills, pans (often dry), homesteads, cultivated land and trees. Upon closer inspection of the map, it would appear that Spes Bona 2355 was initially part of Quaggafontein (Kwaggafontein). Therefore, the history of Kwaggafontein and Bloemfontein may provide some insight into the local history. The majority of the history related to Kwaggafontein surrounds Sir Cornelis Hermanus Wessels. Wessels was a stock farmer who later became the second Administrator of the Orange Free State Province. He had purchased the farm in 1892. Kwaggafontein is believed to have initially belonged to a businessperson from Bloemfontein, named K.A Chapman. The farm was put on sale after Chapman's death. Wessels and his family had settled on the farm. However, Wessels and his family eventually moved to Aliwal Street (Bloemfontein) in the early 1900s (Dreyer 2013; Wikipedia 2021).

Bloemfontein was initially a gathering point for hunters and was referred to as Mangaung (place of the cheetahs). The origin of the name Bloemfontein appears to be a source of contention. According to one explanation, which appears to be the most widely recognised, the fountain was surrounded by flowers (*Bloem* in Dutch), and therefore it was named Bloemfontein, which translates to "fountain of flowers." Another story is that the name was suggested by one of Brits' (a family who resided in Bloemfontein) neighbours, Mr Griesel, who was inspired by Mrs Brits' garden. It is also said to have been named after a person with the surname Bloem or an ox with the same name (Raper 1987; SAHO 2018).

Bloemfontein was founded in 1846 by Major H D Warden on the farm Bloemfontein, which, according to Raper (1987), was formerly owned by a Griqua named Mauritz Pretorius. However, it is also believed that Warden purchased the property in the 1840s from Johannes Nicolas Brits. Nevertheless, it was founded as a British military outpost of the South African frontier known as the Transoranje region (Fourie 2013a and b; Rossouw 2007). Bloemfontein served as the capital of the Orange River Sovereignty (1848-1854) and afterwards as the capital of the erstwhile Orange Free State Republic (1854-1902). In 1880, Bloemfontein was granted municipal status. Bloemfontein hosted the Bloemfontein Conference in 1899 to negotiate a peaceful settlement between President Kruger of the Transvaal Republic and British High Commissioner Alfred Milner on the status of British migrant mine workers. However, the conference failed, and the South African War broke out (Britannica 2019; Fourie 2013 a and b; Raper 1987). The initial railway line, which connected Bloemfontein to Cape Town, was erected in 1890. This line was crucial to the British occupation of the city later in 1900 during the Anglo-Boer War (Rossouw 2007).

The Bloemfontein area is rich in history from the Anglo-Boer war (1899-1902). The area was central and important during the ABO, specifically the region south of Bloemfontein. Briefly, the Boer forces anticipated a British onslaught on Bloemfontein from the west along the Riet River in March 1900. However, the Boer defence was out-manoeuvred by Lord Roberts when they

approached from the south (Dreyer 2006). On 13 March 1900, Bloemfontein was seized, allowing Lord Roberts to prepare for the attack on Pretoria. Between March 15 and March 28, 1900, about 40 000 British troops arrived around Bloemfontein, putting further strain on the town's already overburdened infrastructure. By the end of June 1900, when the march to Pretoria began, the defence of Bloemfontein was no longer a priority (Dreyer 2006; 2015).

Bloemfontein was the capital of the Orange River Colony from 1902 to 1910, and it has since been the provincial capital of the erstwhile Orange Free State and contemporary Free State (Rossouw 2007).



The Heritage Screening tool (<https://screening.environment.gov.za/>) shows low to medium significance with locations of high sensitivity towards the east, northeast and southeast of the proposed project area(s).

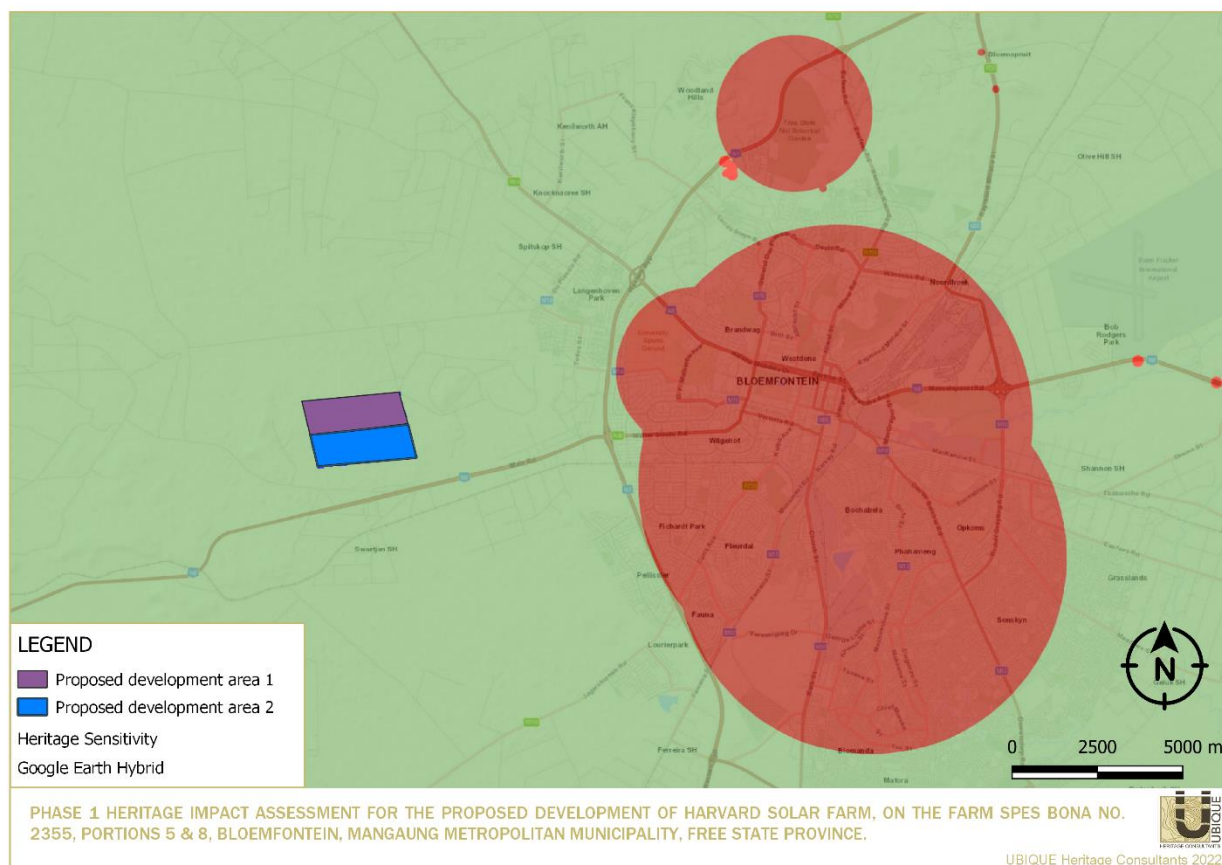


Figure 16 The Project area indicated on the Heritage Screening tool (<https://screening.environment.gov.za/>)

## 6.1 Summary of Local Heritage Resources: Spes Bona 2355 and surrounds

The desktop study revealed that several Impact Assessments had been done on several portions of Spes Bona 2355 and surrounding farms. Numerous reports have been done in and around Bloemfontein. However, due to the vast amount of impact assessments done in the wider region, the assessment zone focuses on farms directly surrounding Spes Bona 2355, such as WolfKop, Kwaggafontein, Picton, Eensgevonden, Brabant, Freewater, Rooidam, Cecilia, Donegal, and Glen Hope. The majority of the studies encountered minimal to no archaeological materials/remains (e.g. Dreyer 2007b, 2013; Rossouw 2014, 2015, 2016, 2018, Fourie 2013 a and b). Spes Bona 2355, and the wider region has mainly been disturbed by farming and industrial activities. However, some of the assessments reported on cultural material and features relating to the Iron Age and the Historical/Colonial era (e.g. Dreyer 2005, 2006, 2007a, c and d, 2015).

### 6.1.1 Stone Age

None of the reports done around Spes Bona 2355 recorded any stone tools, lithics or flakes. However, the Stone Age archaeological record around Bloemfontein dates between the early Middle Stone Age and Late Stone age periods (Rossouw 2018).

### 6.1.2 Rock Art

Several rock art sites have been documented on the SAHRA Database in the Free State province. The closest rock art sites are located (approximately 135km) to the east and southeast of the proposed development area.

#### HERITAGE SITES IN AND AROUND BLOEMFONTEIN DOCUMENTED ON THE SAHRA DATABASE:

| Site/Object Name                                      | Coordinates              | Archive Status    | Declaration Type         | Site type                         | Site Reference | Site ID |
|---|--------------------------|-------------------|--------------------------|-----------------------------------|----------------|---------|
| Rose Cottage Cave, Ladybrand District                 | -29.216091;<br>27.469661 |                   | Provincial Heritage Site | Archaeological, Rock Art, Deposit | 9/2/325/0006   | 32417   |
| Rock Paintings, Modderpoortspruit, Ladybrand District | -29.112431;<br>27.443938 | National monument | Provincial Heritage Site | Rock Art                          | 9/2/325/0010   | 26445   |
| Rock paintings, Ventershoek, Wepener District         | -29.746241;<br>27.072694 |                   | Provincial Heritage Site | Rock Art                          | 9/2/346/0003   | 26384   |

### 6.1.3 Iron Age

The Desktop study revealed that Iron Age sites are not uncommon in the area.

#### IRON AGE RESOURCES RECORDED IN A 10 KM RADIUS

| HIA/AIA     | SITE                   | COORDINATES             | HERITAGE RESOURCES   |
|-------------|------------------------|-------------------------|--|
|             |                        | PROXIMITY TO STUDY AREA |  |
| Dreyer 2005 | Stone-walled complex 1 | 29° 08' 08" S           | LIA stonewalled complex (1660-1810). Several ashy soil outcrops were visible near the stonewalls. No archaeological/cultural material was recorded on the surface. |
|             |                        | 26° 03' 01" E           |  |
|             |                        | 3.5 km W                |  |
| Dreyer 2005 | Stone-walled complex 2 | 29° 08' 16" S           | LIA stonewalled complex (1660-1810).   |
|             |                        | 26° 02' 59" E           |  |
|             |                        | 3.5km W                 |  |
| Dreyer 2005 | Stone-walled complex 3 | 29° 08' 17" S           | LIA stonewalled complex (1660-1810).   |
|             |                        | 26° 02' 57" E           |  |



### IRON AGE RESOURCES RECORDED IN A 10 KM RADIUS

| HIA/AIA      | SITE                  | COORDINATES             | HERITAGE RESOURCES  |
|--------------|-----------------------|-------------------------|---|
|              |                       | PROXIMITY TO STUDY AREA |   |
|              |                       | 3.7km W                 |   |
| Dreyer 2007c | Kwaggafontein - kraal | None provided for kraal | Base stones of a Kraal was recorded. Unfortunately, the walls have been robbed for their stone. |
|              |                       | Approx 2.5 km E         |   |

#### 6.1.4 Historical/Colonial period

Very few impact assessments reported on cultural material and sites associated with the Historical/Colonial Period. The wider vicinity is well known for Historical Period resources related to the ABO and colonial farming period, one example of ABO remains found in a 10km radius is included in the table below.

### HISTORICAL PERIOD RESOURCES RECORDED IN X KM RADIUS

| HIA/AIA      | SITE                             | COORDINATES             | HERITAGE RESOURCES  |
|--------------|----------------------------------|-------------------------|---|
|              |                                  | PROXIMITY TO STUDY AREA |   |
| Dreyer 2007d | Kwaggafontein residential house  | 29° 07' 37" S           | Old residence at Plot 38 Kwaggafontein dating from about 1926.  |
|              |                                  | 26° 09' 13" E           |   |
|              |                                  | 4.1 km E                |   |
| Dreyer 2007a | Erf 24722                        | 29° 07' 08" S           | Historical and cultural remains occur in the form of old corrugated iron buildings, concrete foundations, cement irrigation furrows, stone terrace walls, steps and pathways and the indications of several possible ash heaps.<br><br>The site appears to date as far back as 1939 or earlier. |
|              |                                  | 26° 12' 54" E           |   |
|              |                                  | Approx. 10km W          |   |
| Dreyer 2006  | Hill B3                          | 29° 10' 02" S           | Anglo-Boer war remains and a rectangular stonewall foundation was noted.  |
|              |                                  | 26° 12' 11" E           |   |
|              |                                  | 9.7 km SE               |   |
| Dreyer 2006  | EHRlich FOREST & HAMILTON FOREST | No coordinates provided | Dreyer (2006) noted that the Ehrlich and Hamilton Forests were mentioned by respondents. These were founded during the British occupation after the ABO.  |
|              |                                  | SE of study area        |   |

### HISTORICAL PERIOD RESOURCES RECORDED IN X KM RADIUS

| HIA/AIA     | SITE     | COORDINATES                                | HERITAGE RESOURCES   |
|-------------|----------|--|--|
|             |          | PROXIMITY TO STUDY AREA                    |  |
| Dreyer 2015 | Brandkop | 29° 11' 13" S<br>26° 09' 27" E<br>7.5km SE | <p>The farmyard contains several historic buildings, which date from about 1876, or even earlier. Other remains of previous farming activities occur in the form of corrugated iron buildings, concrete foundations, several water reservoir dams, irrigation furrows, stone steps and terrace walls.</p> <p>The farm used to be part of an important historical period in the history of Bloemfontein.</p> <p>The original house was erected in 1876 and was renovated and extended in 1919, with more alterations added through the years.</p> |

The Bloemfontein area has numerous National and provincial Monuments, ranging from places, buildings, battlefields, conservation areas and memorials, all of which are listed in this table below, which can also be found on the SAHRA Database:

### HERITAGE SITES IN AND AROUND NLOEMFONTEIN DOCUMENTED ON THE SAHRA DATABASE:

| Site/Object Name   | Coordinates             | Archive Status    | Declaration Type         | Site type         | Site Reference   | Site ID |
|--|-------------------------|-------------------|--------------------------|-------------------|------------------|---------|
| Historic tree-garden, President Brand Street, Bloemfontein                   | -29.116673<br>26.216538 | National monument | Provincial Heritage Site | Place             | 9/2/302/0001-001 | 26559   |
| First University Building, University of the Orange Free State, Bloemfontein | -29.112058<br>26.186284 | National monument | Provincial Heritage Site | Building          | 9/2/302/0001-005 | 26560   |
| Sannaspos Battlefield, Ahmetnagher, Bloemfontein District                    | -29.155606<br>26.532725 | National monument | Provincial Heritage Site | Battlefield       | 9/2/302/0002-001 | 26555   |
| President Brand Street Conservation Area, Bloemfontein                       | -29.114710<br>26.217760 | Conservation area | Provincial Heritage Site | Conservation area | 9/2/302/0003     | 26556   |
| The Original Archives Building, 37 Merriam                                   | 29.115826<br>26.214828  | National monument | Provincial Heritage Site | Building          | 9/2/302/0005     | 26557   |

## HERITAGE SITES IN AND AROUND NLOEMFONTEIN DOCUMENTED ON THE SAHRA DATABASE:

| Site/Object Name  | Coordinates             | Archive Status          | Declaration Type            | Site type | Site Reference   | Site ID |
|---|-------------------------|-------------------------|-----------------------------|-----------|------------------|---------|
| Makeba Street,<br>Bloemfontein  |                         |                         |                             |           |                  |         |
| Old Prison,<br>Bloemfontein   | -29.116667<br>26.216667 | Register                | Heritage register           | Building  | 9/2/302/0006     | 26558   |
| Old Presidency,<br>President Brand<br>Street,<br>Bloemfontein                           | -29.119636<br>26.215519 | National<br>monument    | Provincial<br>Heritage Site | Building  | 9/2/302/0007     | 26551   |
| Two Tower Church,<br>Charles Street,<br>Bloemfontein                                    | -29.115715<br>26.222264 | National<br>monument    | Provincial<br>Heritage Site | Building  | 9/2/302/0010     | 26552   |
| Military Museum<br>Fort Bloemfontein,<br>Church Street,<br>Bloemfontein                 | -29.124700<br>26.221567 | National<br>monument    | Provincial<br>Heritage Site | Building  | 9/2/302/0011     | 26553   |
| Fichardt House, 40<br>Elizabeth Street,<br>Bloemfontein                                 | -29.115508<br>26.215538 | National<br>monument    | Provincial<br>Heritage Site | Building  | 9/2/302/0013     | 26554   |
| Mapikela House,<br>1436 Maghoti<br>Street, Batho,<br>Bloemfontein                       | -29.137789<br>26.222761 | Provisional<br>monument | Provisional<br>Protection   | Building  | 9/2/302/0014     | 26549   |
| The Railway Bureau<br>Building, Maitland<br>Street,<br>Bloemfontein                     | -29.118670<br>26.225396 | National<br>monument    | Provincial<br>Heritage Site | Building  | 9/2/302/0016     | 26550   |
| City Hall, President<br>Brand Street,<br>Bloemfontein                                   | -29.114253<br>26.216682 | National<br>monument    | Provincial<br>Heritage Site | Building  | 9/2/302/0019     | 26546   |
| Cathedral of St<br>Andrew and St<br>Michael, St George<br>Street,<br>Bloemfontein       | -29.121105<br>26.219366 | National<br>monument    | Provincial<br>Heritage Site | Building  | 9/2/3<br>02/0022 | 26547   |
| Main Building,<br>Bloemfontein<br>Technical College,<br>Douglas Street,<br>Bloemfontein | -29.120689<br>26.221632 | National<br>monument    | Provincial<br>Heritage Site | Building  | 9/2/302/0023     | 26548   |
| Ramblers Club,<br>Aliwal Street,<br>Bloemfontein  | -29.111766<br>26.219862 | Register                | Heritage register           | Building  | 9/2/302/0024     | 26545   |
| Freshford House<br>Museum, 31<br>Kellner Street,<br>Bloemfontein                        | -29.111306<br>26.216250 | National<br>monument    | Provincial<br>Heritage Site | Building  | 9/2/3<br>02/0026 | 26542   |
| Vierde Raadsaal,<br>President Brand<br>Street,<br>Bloemfontein                          | -29.115772<br>26.217724 | National<br>monument    | Provincial<br>Heritage Site | Building  | 9/2/3<br>02/0027 | 26543   |
| Old Government<br>Building, President<br>Brand Street,<br>Bloemfontein                  | -29.116533<br>26.215925 | National<br>monument    | Provincial<br>Heritage Site | Building  | 9/2/302/0028     | 26544   |
| Anglo-Boer War<br>Blockhouse,<br>Riverford,<br>Bloemfontein                             | -29.400000<br>26.116667 | Provincial<br>Monument  | Provincial<br>protection    | Building  | 9/2/302/0029     | 26539   |

**HERITAGE SITES IN AND AROUND NLOEMFONTEIN DOCUMENTED ON THE SAHRA DATABASE:**

| Site/Object Name   | Coordinates             | Archive Status      | Declaration Type         | Site type             | Site Reference | Site ID |
|--|-------------------------|---------------------|--------------------------|-----------------------|----------------|---------|
| District   |                         |                     |                          |                       |                |         |
| Eerste Raadsaal, 95 St Georges Street, Bloemfontein                  | -29.120469<br>26.216674 | National monument   | Provincial Heritage Site | Building              | 9/2/302/0036   | 26540   |
| Hertzog House Museum, 19 Goddard Street, Bloemfontein                | -29.122791<br>26.218946 | National monument   | Provincial Heritage Site | Building              | 9/2/302/0037   | 26541   |
| Orange Free State Botanical Gardens, Bloemfontein                    | -29.052775<br>26.212410 | National monument   | Provincial Heritage Site | Building              | 9/2/302/0039   | 26536   |
| Conspiracy Tree, Onze Rust, Bloemfontein District                    | -29.276729<br>26.183050 | National monument   | Provincial Heritage Site | Natural, Place        | 9/2/302/0042   | 26537   |
| Arthur Nathan Swimming Pool Complex, Fairview Street, Bloemfontein   | -29.109039<br>26.222500 | National monument   | Provincial Heritage Site | Building              | 9/2/302/0043   | 26538   |
| Women's Memorial, Monument Road, Bloemfontein                        | -29.141587<br>26.208364 | National monument   | Provincial Heritage Site | Monuments & memorials | 9/2/302/0045   | 26534   |
| Elizabeth le Roux Hostel, 99 Aliwal Street, Bloemfontein             | -29.102484<br>26.220658 | National monument   | Provincial Heritage Site | Building              | 9/2/302/0049   | 26535   |
| Hoffman Square, Bloemfontein   | -29.118192<br>26.221833 | Provincial Monument | Provincial protection    | Place                 | 9/2/302/0051   | 26532   |
| Main Building and Hamilton Hall, Grey College, Bloemfontein          | -29.112654<br>26.197019 | National monument   | Provincial Heritage Site | Building              | 9/2/302/0056   | 26533   |
| Andrew Murray House, Grey College, Jock Meiring Street, Bloemfontein | -29.110684<br>26.193968 | National monument   | Provincial Heritage Site | Building              | 9/2/302/0057   | 26530   |
| Brill House, Grey College, Jock Meiring Street, Bloemfontein         | -29.111565<br>26.194668 | National monument   | Provincial Heritage Site | Building              | 9/2/302/0058   | 26531   |
| Tuck shop, Grey College, Jock Meiring Street, Bloemfontein           | -29.110816<br>26.195478 | National monument   | Provincial Heritage Site | Building              | 9/2/302/0059   | 26527   |
| Corrugated-Iron Building, School of Armour, Tempe, Bloemfontein      | -29.082889<br>26.184333 | National monument   | Provincial Heritage Site | Building              | 9/2/302/0061   | 139114  |
| Somerlust, 32 Whites Road, Waverley, Bloemfontein                    | -29.090152<br>26.227723 | Register            | Heritage Register        | Building              | 9/2/302/0063   | 26528   |
| Main Building, University of the Orange Free State,                  | -29.110660<br>26.186492 | National monument   | Provincial Heritage Site | Building              | 9/2/302/0064   | 26529   |

**HERITAGE SITES IN AND AROUND NLOEMFONTEIN DOCUMENTED ON THE SAHRA DATABASE:**

| Site/Object Name   | Coordinates             | Archive Status    | Declaration Type         | Site type               | Site Reference                      | Site ID |
|--|-------------------------|-------------------|--------------------------|-------------------------|-------------------------------------|---------|
| Bloemfontein   |                         |                   |                          |                         |                                     |         |
| Station Building, Sannaspos Railway Station, Bloemfontein District       | -29.160828<br>26.547184 | National monument | Provincial Heritage Site | Building                | 9/2/302/0065                        | 26526   |
| Edwardian House, 72 president Reitz Avenue, Westdene, Bloemfontein       | -29.108372<br>26.212602 | National monument | Provincial Heritage Site | Building                | 9/2/302/0072                        | 129906  |
| Green Lodge, 81 St Georges Street, Bloemfontein                          | -29.120208<br>26.217162 | National monument | Provincial Heritage Site | Building                | 9/2/302/0077                        | 26523   |
| White Horse Stone, Naval Hill, Bloemfontein                              | -29.100422<br>26.238832 | National monument | Provincial Heritage Site | Place                   | 9/2/302/0078                        | 26524   |
| Abraham Fischer House, University of the Orange Free State, Bloemfontein | -29.111767<br>26.185999 | National monument | Provincial Heritage Site | Building                | 9/2/302/0079                        | 26525   |
| Grave of Martha Moipone Motlhakwana, Phahameng Cemetery, Bloemfontein    | -29.154954<br>26.233313 |                   | Provincial Heritage Site | Burial Grounds & Graves | Grave of Martha Moipone Motlhakwana | 105604  |
| House of Martha Moipone Motlhakwana, 932 Gonyane Street, Bloemfontein    | -29.138088<br>26.231460 |                   | Provincial Heritage Site | Building                | House of Martha Moipone Motlhakwana | 105606  |
| Waaioek Wesleyan Church, Bloemfontein                                    | -29.123370<br>26.223759 |                   | National Heritage Site   | Building                | The Wesleyan Church                 | 93129   |

### 6.1.5 Graves/Burials

Several graves were recorded in the area around the development footprint.

**GRAVES/BURIALS RECORDED IN 10 KM RADIUS**

| HIA/AIA      | SITE                 | COORDINATES                 | HERITAGE RESOURCES                |
|--------------|----------------------|-----------------------------|-----------------------------------|
|              |                      | PROXIMITY TO STUDY AREA     |                                   |
| Dreyer 2007c | Kwaggafontein graves | 29° 06' 47" S               | Approximately 30 graves recorded. |
|              |                      | 26° 08' 09" E               |                                   |
|              |                      | 2.6km E                     |                                   |
| Dreyer 2007c | Kwaggafontein        | No coordinates provided for | A cemetery near the farmhouse. It |



## GRAVES/BURIALS RECORDED IN 10 KM RADIUS

| HIA/AIA     | SITE     | COORDINATES                                     | HERITAGE RESOURCES  |
|-------------|----------|---|---|
|             |          | PROXIMITY TO STUDY AREA                         |   |
|             | cemetery | cemetery<br>Approx. 2.5 km E                    | consists of graves belonging to the former owner, his first wife and relatives.<br><br>The farm and cemetery farm belonged to Sir Cornelis Wessels, the second Administrator of the Free State. |
| Dreyer 2015 | Brandkop | 29° 11' 13"S<br>26° 09' 27"E<br>7.5km southeast | A graveyard near the farmhouse contains the burials of members of the Fichardt family, the first occupants, who were all prominent former citizens of Bloemfontein.                             |

## 7. IDENTIFIED RESOURCES AND HERITAGE ASSESSMENT

### 7.1 Surveyed area



The area surveyed for the impact assessment was dictated by the Google Earth map of the development footprints provided by the client. The proposed agricultural areas were surveyed by vehicle and on foot by a two-person team. The pedestrian survey was conducted in predominantly 30-50 m transects.

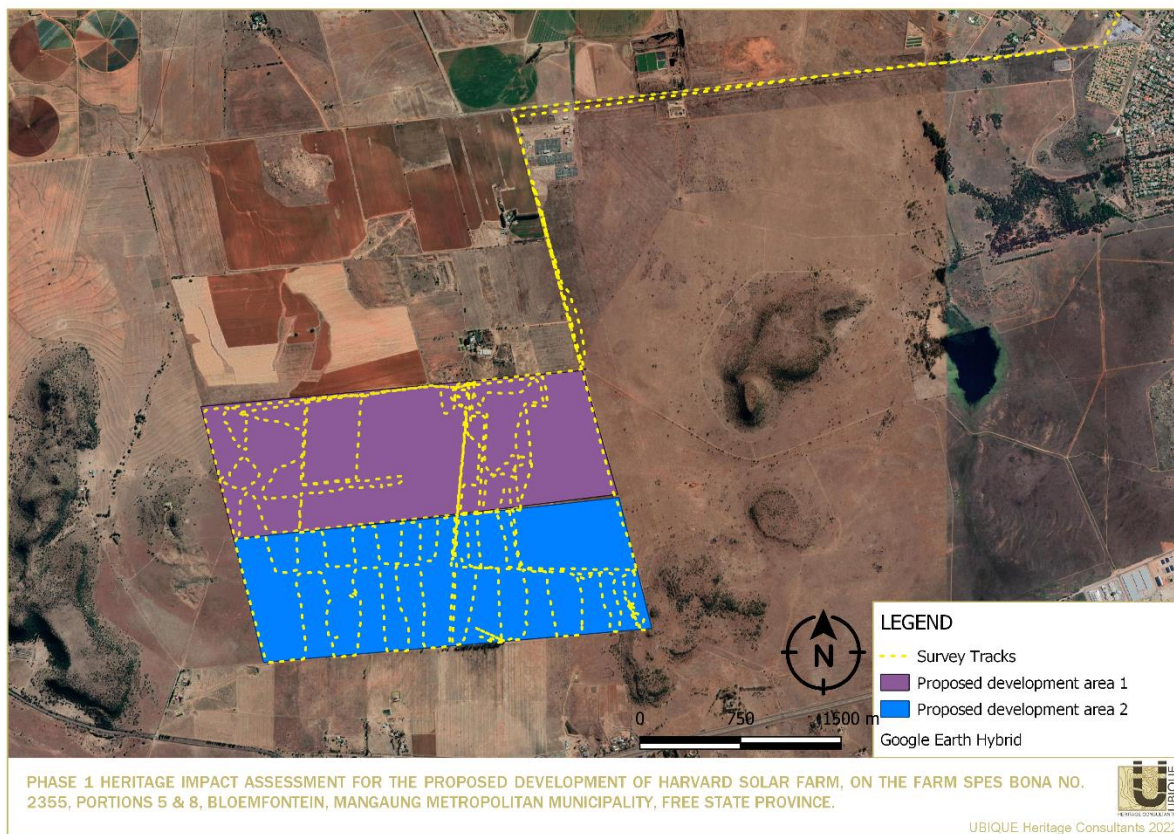


Figure 17 Survey tracks across the development footprint.

## 7.2 Description of the affected environment

The agricultural development area falls within the Winburg Grassy Shrubland vegetation type, with the larger area being surrounded by Bloemfontein dry grassland and Bloemfontein aroid Grassland (SANBI 2022). Mesas distinguish the landscape with solitary hills, slopes, and escarpments form a variety of habitats ranging from open grassland to shrubland. Tall shrubs and, in some cases, small trees are protected from frost throughout the winter months and veld fires that occur regularly from late winter to early spring. *Olea europaea subsp. africana*, *Euclea crispa subsp. crispa*, *Gymnosporia buxifolia*, *Diospyros lycioides*, *Rhus burchellii*, *R. ciliata*, *R. erosa* (mainly in the south), *Clusia pulchella* and *Grewia occidentalis* are present among the medium-height evergreen shrublands. Also common among this vegetation are trees such as *R. lancea*, *Celtis africana* and *Ziziphus mucronata* which are found in more deeply incised drainage lines (Mucina & Rutherford 2006).

According to Mucina and Rutherford (2006), the Winburg Grassy Shrubland's geology and soils are made up of large dolerite sills that form ridges, plateaus, and slopes of oppies. There are also

small escarpments that mark the erosion terraces. Furthermore, the dominant soil types are stony Mispah and gravel-rich Glenrosa derived from Jurassic dolerite (Mucina & Rutherford 2006).

The landscape has been severely disturbed by farming activities, specifically the central area of Harvard 1 and the easternmost portion of the proposed development area. A relatively small hill is located to the west of the study area, with several hills situated west outside of the development footprint. Neighbouring farm fences bound the development footprints to the east, north and west. Various two-track roads give access to the different development areas.



**Figure 18** Indication of the vegetation types in and around the study area (namely: Bloemfontein Karroid Grassland, Bloemfontein Dry Grassland, and Winburg Grassy Shrubland).





**Figure 19** Views of the affected development area.

## 7.3 Identified heritage resources

### 7.3.1. Stone Age Identified

| STONE AGE RESOURCES IDENTIFIED |                       |                              |         |                                |   |
|--------------------------------|-----------------------|------------------------------|---------|--------------------------------|---|
| SITE ID #                      | DESCRIPTION           |                              | PERIOD  | LOCATION                       | FIELD RATING/ SIGNIFICANCE/ RECOMMENDED MITIGATION                      |
| SB01-001                       | Type lithic/s         | Random                       | MSA/LSA | 29° 7'27.94"S<br>26° 5'14.13"E | Field Rating IV C<br><br>Low significance<br><br>No Mitigation Required |
|                                | Raw material          |                              |         |                                |   |
|                                | N in m <sup>2</sup> . | 2 in a 20m <sup>2</sup> area |         |                                |   |
|                                | Context               | Surface scatter              |         |                                |   |
|                                | Additional            |                              |         |                                |   |

### 7.3.2. Historical/Recent resources Identified

| HISTORICAL/RECENT RESOURCES IDENTIFIED |                     |  |                       |                                |  |
|--|---------------------|--|-----------------------|--------------------------------|--|
| SITE ID #                              | DESCRIPTION         |  | PERIOD                | LOCATION                       | FIELD RATING/ SIGNIFICANCE/ RECOMMENDED MITIGATION                                       |
| SB01-001                               | Type of site        | Open-air   | Historical/<br>Recent | 29° 7'27.94"S<br>26° 5'14.13"E | Field Rating IV C<br><br>Low significance<br><br>No Mitigation Required                  |
|  | Material            | metal  |                       |                                |  |
|  | N in m <sup>2</sup> | 1 in 20m <sup>2</sup> area   |                       |                                |  |
|  | Context             | Surface scatter, no context, random  |                       |                                |  |
|  | Additional          | Situated by 2 MSA stone tools  |                       |                                |  |
| SB01-002                               | Type of site        | Ruins of Foundation  | Historical            | 29° 7'3.90"S<br>26° 6'0.09"E   | Field rating Grade IVB<br><br>Medium Significance<br><br>Buffer/Safety zone recommended. |
|  | Style               | Brick  |                       |                                |  |
|  | N in m <sup>2</sup> |  |                       |                                |  |
|  | Context             | Historical farming-related feature   |                       |                                |  |
|  | Additional          | Foundation rubble consisting of brick and wood, as well as a base of a milk glass material type bottle |                       |                                |  |
| SB01-002                               | Type of site        | Barn   | Historical            | 29° 7'6.01"S<br>26° 6'2.94"E   | Field rating Grade IVB<br><br>Medium Significance<br><br>Buffer/Safety zone recommended. |
|  | Style               | Brick, stone and corrugated iron   |                       |                                |  |
|  | N in m <sup>2</sup> |  |                       |                                |  |
|  | Context             | Historical and recent farming-related material and features  |                       |                                |  |
|  | Additional          |  |                       |                                |  |
| SB01-002                               | Type of site        | Structural feature   | Historical            | 29° 7'9.76"S<br>26° 6'3.08"E   | Field rating Grade IVB<br><br>Medium Significance<br><br>Buffer/Safety zone recommended. |
|  | Style               | Brick, stone and cement  |                       |                                |  |
|  | N in m <sup>2</sup> |  |                       |                                |  |
|  | Context             | Historical and/or recent farming-related (water) feature   |                       |                                |  |
|  | Additional          |  |                       |                                |  |
| SB01-003                               | Type of site        | Kraal  | Historical/           | 29° 7'13.21"S                  | Field rating Grade IVB   |



### HISTORICAL/RECENT RESOURCES IDENTIFIED

| SITE ID # | DESCRIPTION         |  | PERIOD     | LOCATION                      | FIELD RATING/<br>SIGNIFICANCE/<br>RECOMMENDED<br>MITIGATION                                    |
|-----------|---------------------|--|------------|-------------------------------|--|
|           | Style               | Aloe Plant   | recent     | 26° 6'2.66"E                  | Medium Significance<br><br>Buffer/Safety zone recommended.                                     |
|           | N in m <sup>2</sup> |  |            |                               |  |
|           | Context             | Livestock kraal. No cultural material found.                     |            |                               |  |
|           | Additional          | It appears to not be in use.                                     |            |                               |  |
| SB01-002  | Type of site        | Structural ruins   | Historical | 29° 7'5.71"S<br>26° 6'0.45"E  | Field rating Grade IVB<br><br>Medium Significance<br><br>Buffer/Safety zone recommended.       |
|           | Style               | Brick and stone  |            |                               |  |
|           | N in m <sup>2</sup> |  |            |                               |  |
|           | Context             | Historical farming-related feature                               |            |                               |  |
|           | Additional          |  |            |                               |  |
| SB01-004  | Type of site        | Remains of a retaining wall                                      | Unknown    | 29° 7'22.97"S<br>26° 6'8.91"E | General protection Grade IVC<br><br>Low Significance<br><br>No further mitigation is required. |
|           | Style               | Stone  |            |                               |  |
|           | N in m <sup>2</sup> |  |            |                               |  |
|           | Context             | Area around it appears to be used as a grazing field for cattle. |            |                               |  |
|           | Additional          |  |            |                               |  |

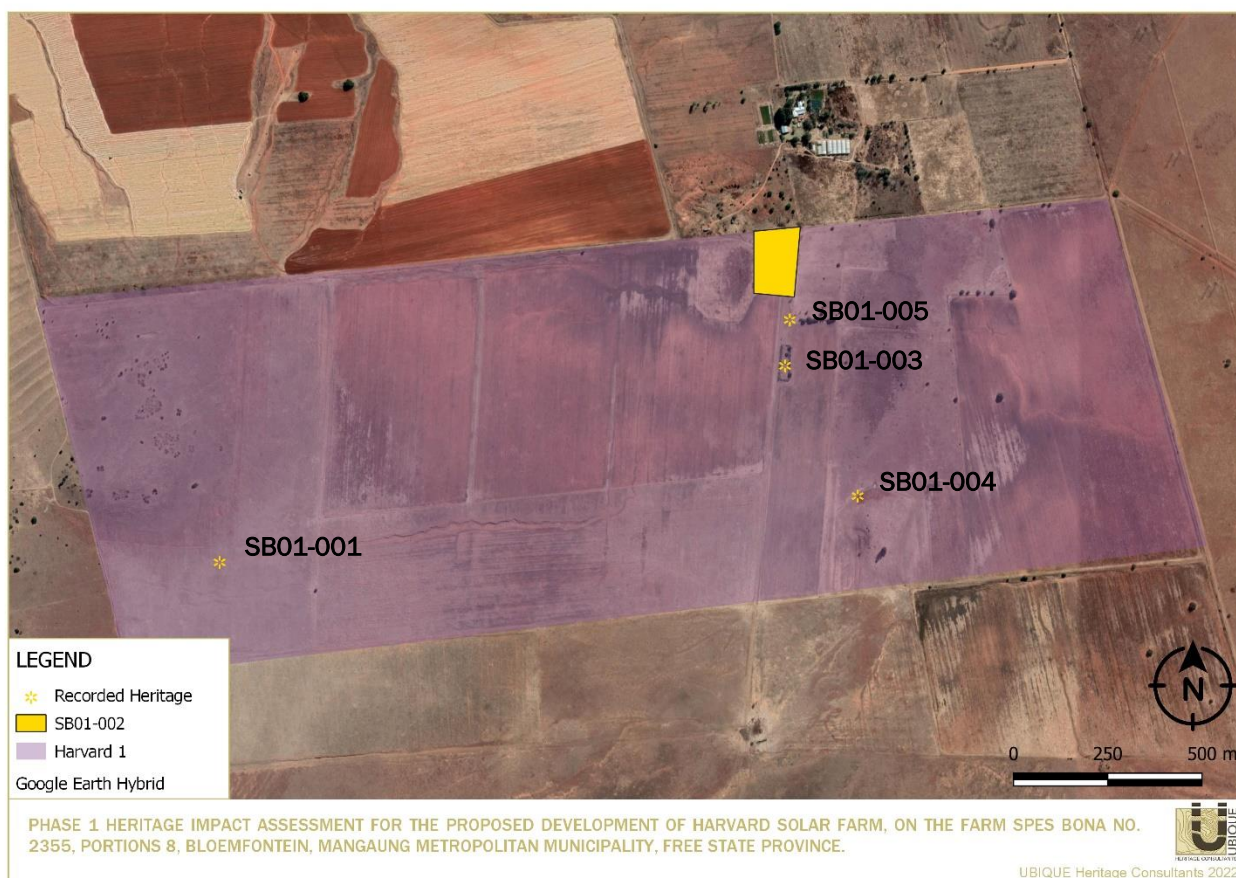


Figure 20 Distribution of identified heritage resources, Spes Bona 2355 Portion 8.

## 7.4 Discussion

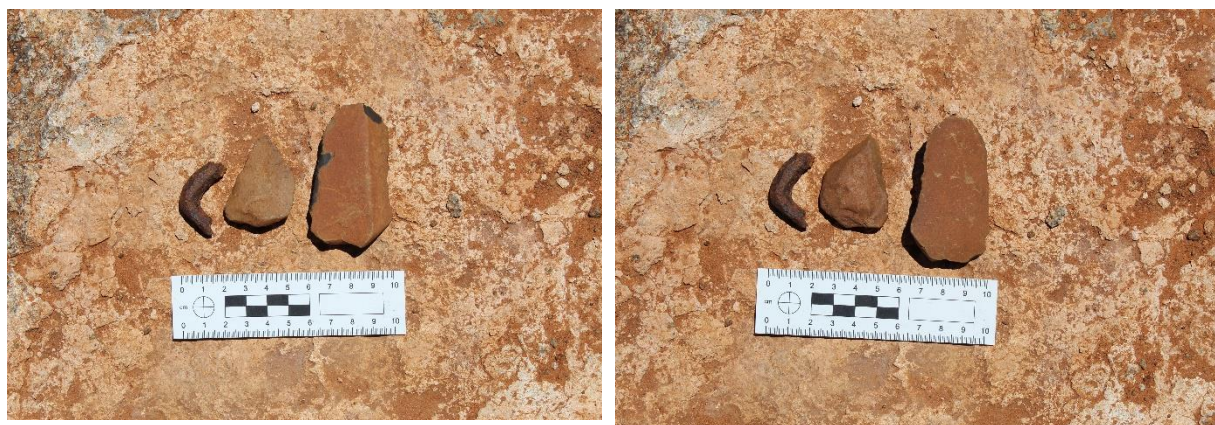
### 7.4.1. Archaeological features

#### 7.4.1.1. Prehistorical

Only one occurrence of lithic material was recorded outside to the southwest of the development footprint (SB01-001). The low-density surface scatter included a blade, a possible weathered scraper, and an unknown metal object.

The lithic material shows various degrees of weathering and is without substantial archaeological context or matrix and is therefore deemed of minor scientific importance and not conservation worthy (NCW).

The material is given a 'General' Protection C (Field Rating IV C). This means that it has been sufficiently recorded (in Phase 1). It requires no further action.



**Figure 21** The lithic material (and metal) recorded at Harvard 1.

#### 7.4.1.2. Historical/Recent

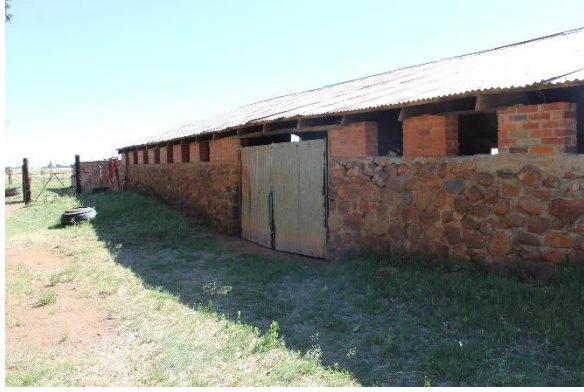
Historical structures, features, and associated material are present on the farmscape (SB01-002) at Harvard 1, Farm Spes Bona No. 2355, Portion 8. The farmscape (SB01-002) consists of ruins of possible farming-related features foundations. A base of a milkglass material type bottle was recorded near one of the ruins, among other material such as brick and a wooden truss. A barn is also present at site SB01-002, which is currently used for storage. The material found in and around the general area of the barn appears to be recent, consisting of glass and metal. It is constructed out of brick, stone, corrugated iron and cement. Site SB01-003 is a livestock kraal, made of Aloe plants. It does not appear to be in use anymore. Site SB01-004 are the remains of a retaining wall made from stone. No other cultural material or structural features were recorded near site SB01-004, thus it is challenging to identify the exact age of the retaining wall. The area where the retaining wall is also disturbed by animal grazing.



The material is given a **General' Protection C (Field Rating IV C)** This means that the retaining wall has been sufficiently recorded (in Phase 1). It requires no further action, and a **'General' Protection B (Field Rating IV B)** has been provided for the historical farmscape. The sites/resources should be recorded and mitigated before destruction.









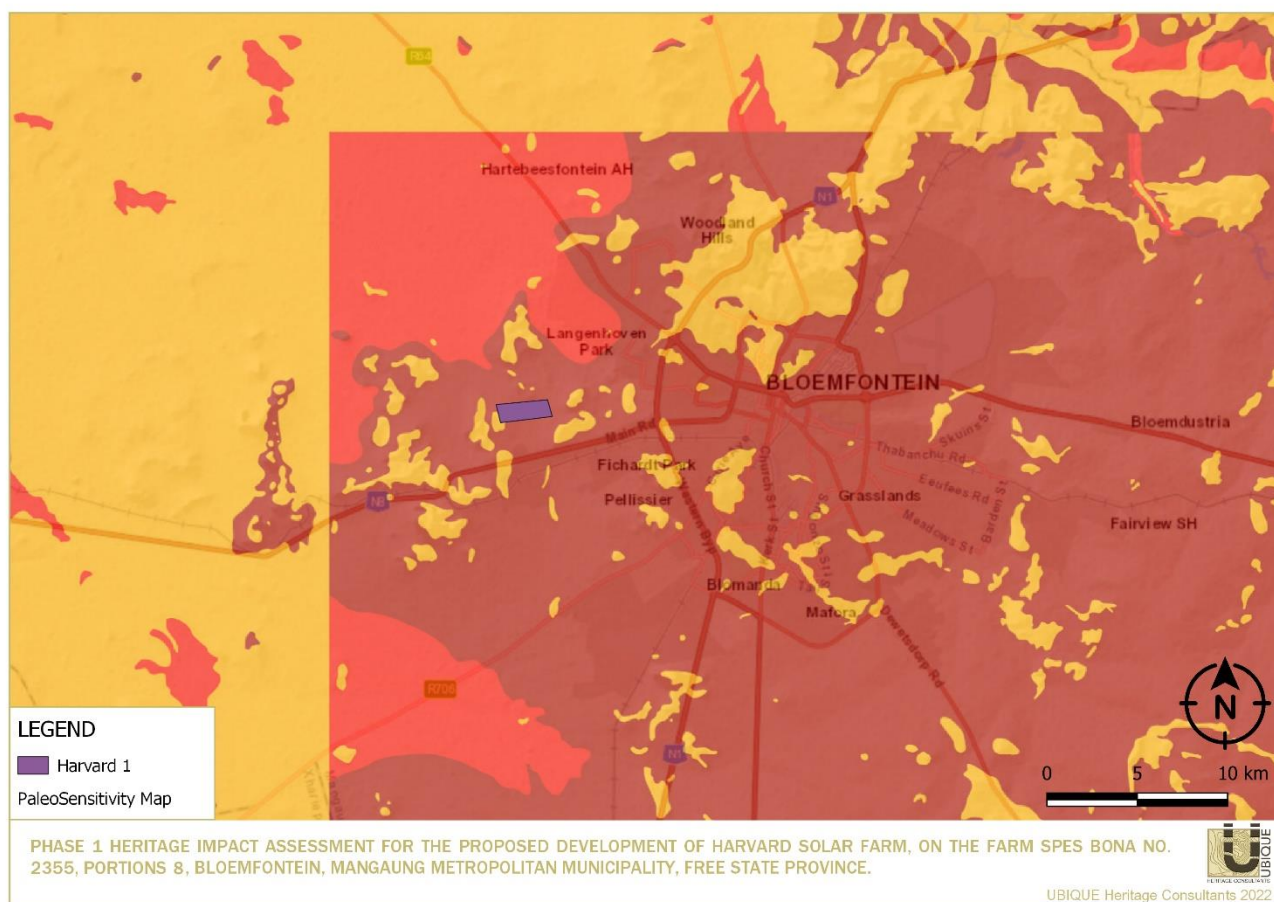






**Figure 22** Historical features and structures found at Harvard 1

### 7.4.2. Palaeontological resources



**Figure 23** The Heritage Paleo screening tool and SAHRIS PalaeoSensitivity Map, indicating Medium (yellow), High (Red), Very High (Dark red) palaeontological significance in the study area, (<https://screening.environment.gov.za/>; <https://sahr.sahra.org.za/map/palaeo>).

The proposed Harvard 1 Solar PV near Bloemfontein in the Free State is largely underlain by the Balfour Formation of the Adelaide Subgroup (Beaufort Group, Karoo Supergroup) and only a small portion in the south-west is underlain by Jurassic Karoo dolerite. According to the PalaeoMap on the South African Heritage Resources Information System (SAHRIS) database, the Palaeontological Sensitivity of the Balfour Formation is Very High, and that Jurassic Karoo dolerite is Zero as it is igneous in origin (Almond and Pether 2008, SAHRIS website). During the site visit, no fossiliferous outcrops were identified. The scarcity of fossil heritage at the proposed development footprint indicates that the impact of the development footprint will be of low significance in palaeontological terms. It is therefore considered that the proposed development is deemed appropriate and will not lead to detrimental impacts on the palaeontological reserves of the area. (Butler 2022 Appendix A).

Elize Butler from Banzai Environmental conducted a palaeontological field assessment for the development footprint (see Appendix A).

## 8. ASSESSMENT OF THE IMPACT OF THE DEVELOPMENT

| Description   | Development Impact                            | Mitigation | Field rating/ Significance  |   |
|---|---|------------|---|---|
| <b>Archaeological</b>   |   |            |   |   |
| 1. The one occurrence of lithic material and piece of metal on Harvard 1 (SB01-001) | Nature  | Neutral    | No mitigation required.   | Field Rating IV C<br>Low significance               |
|   | Extent  | Low        |   |   |
|   | Duration                                      | Low        |   |   |
|   | Intensity                                     | Low        |   |   |
|   | Potential of impact on irreplaceable resource | Low        |   |   |
|   | Consequence                                   | Low        |   |   |
|   | Probability of impact                         | Low        |   |   |
| 2. The structural features: The barn and related features (older than 60 years).    | Nature  | Negative   | Recording and mitigation required, before destruction. Buffer Zone recommended. | General protection Grade IVB<br>Medium significance |
|   | Extent  | Low        |   |   |
|   | Duration                                      | Medium     |   |   |
|   | Intensity                                     | Medium     |   |   |
|   | Potential of impact on irreplaceable resource | High       |   |   |
|   | Consequence                                   | High       |   |   |
|   | Probability of impact                         | High       |   |   |
| 3. Aloe Plant Kraal   | Nature  | Negative   | Recording and mitigation required, before destruction. Buffer Zone recommended. | Field rating of IV B<br>Medium significance         |
|   | Extent  | Low        |   |   |
|   | Duration                                      | Medium     |   |   |
|   | Intensity                                     | Medium     |   |   |
|   | Potential of impact on irreplaceable resource | Medium     |   |   |
|   | Consequence                                   | Medium     |   |   |
|   | Probability of impact                         | High       |   |   |
| 4. Retaining Wall   | Nature  | Neutral    | No mitigation required  | Field Rating of IV C<br>Low significance            |
|   | Extent  | Low        |   |   |
|   | Duration                                      | Low        |   |   |
|   | Intensity                                     | Low        |   |   |
|   | Potential of impact on irreplaceable resource | Low        |   |   |
|   | Consequence                                   | Low        |   |   |
|   | Probability of impact                         | Low        |   |   |
| <b>Paleontological</b>  | Nature  | Negative   | Chance Finds Protocol provided.   | N/A   |
|   | Extent  | Low        |   |   |
|   | Duration                                      | Medium     |   |   |
|   | Intensity                                     | High       |   |   |
|   | Potential of impact on irreplaceable resource | High       |   |   |
|   | Consequence                                   | High       |   |   |
|   |   |            |   |   |

|  |                       |      |  |  |
|--|-----------------------|------|--|--|
| will be of a low significance in palaeontological terms. | Probability of impact | High |  |  |
|  | Significance          | High |  |  |

The impact on the lithic material recorded at site SB01-001 is not conservation worthy, and therefore, the impact is negligible. The impact on the retaining wall at site SB01-004 is not conservation worthy, and therefore, the impact is considered negligible.

The sites associated with the historical farmscape situated on Portion 8 of Spes Bona 2355 are of Medium cultural and heritage significance. The probability of impact is high, and a buffer zone is recommended to ensure that the probability of impact will be low.

With regards to the impact on palaeontological resources, the scarcity of fossil heritage at the proposed development footprint indicates that the impact of the development footprint will be of low significance in palaeontological terms. Therefore, it is considered that the proposed development is deemed appropriate and feasible and will not lead to detrimental impacts on the palaeontological reserves of the area (Butler 2022).

## 9. RECOMMENDATIONS

Based on the assessment of the potential impact of the development on the identified heritage, the following recommendations are made, taking into consideration any existing or potential sustainable social and economic benefits:

1. The historical farmscape with farming-related structures, features and structural remains, and the livestock (Aloe plant) kraal is situated directly on the development footprint. These heritage resources are of medium cultural and historical significance. These resources would require costly mitigation before destruction. It is, therefore, our recommendation that a buffer/safety zone should be implemented.
2. The two MSA/LSA Lithics and the piece of metal recorded at site SB01-001 to the southwest of the proposed development footprint is of low significance and will not be affected by the development.
3. The retaining wall is considered to be of low significance and will not be impacted by development. No further mitigation is recommended.

4. According to the PalaeoMap on the South African Heritage Resources Information System (SAHRIS) database, the Palaeontological Sensitivity of the Balfour Formation is Very High, and Jurassic Karoo dolerite is Zero as it is igneous in origin. However, no fossiliferous outcrops were identified during the site visit. If Palaeontological Heritage is uncovered during surface clearing and excavations, the Chance Find Protocol (Appendix A/12) must be implemented by the Environmental Control Officer (ECO) in charge of these developments. Fossil discoveries ought to be protected, and the ECO/site manager must report to SAHRA (Contact details: SAHRA, 111 Harrington Street, Cape Town. PO Box 4637, Cape Town 8000, South Africa. Tel: 021 462 4502. Fax: +27 (0)21 462 4509. Web: [www.sahra.org.za](http://www.sahra.org.za)) so that mitigation (recording and collection) can be carried out (Butler 2022).
  
5. Although all possible care has been taken to identify sites of cultural importance during the investigation of study areas, it is always possible that hidden or sub-surface sites could be overlooked during the assessment. If during construction, any evidence of archaeological sites or remains (e.g. remnants of stone-made structures, indigenous ceramics, bones, stone artefacts, ostrich eggshell fragments, charcoal and ash concentrations), fossils or other categories of heritage resources are found during the proposed development, SAHRA APM Unit (Natasha Higgitt/Phillip Hine 021 462 5402) must be alerted as per section 35(3) of the NHRA. If unmarked human burials are uncovered, the SAHRA Burial Grounds and Graves (BGG) Unit (Thingahangwi Tshivhase/Mimi Seetelo 012 320 8490), must be alerted immediately as per section 36(6) of the NHRA. A professional archaeologist or palaeontologist, depending on the nature of the finds, must be contacted as soon as possible to inspect the findings. If the newly discovered heritage resources prove to be of archaeological or palaeontological significance, a Phase 2 rescue operation may be required subject to permits issued by SAHRA. UBIQUE Heritage Consultants and its personnel will not be held liable for such oversights or costs incurred as a result of such oversights.

## 10. CONCLUSION

This HIA has identified significant heritage resources: a historical farmscape that may be negatively impacted by the proposed development. The proposed development of solar photovoltaic (PV) facilities on Portion 8 of farm Spes Bona 2355 (Harvard 1), Bloemfontein, Mangaung Metropolitan Municipality, Free State Province, may continue, provided the recommendations stipulated within this report, and the subsequent decision by SAHRA, are followed.



## 11. BIBLIOGRAPHY

- Badenhorst, S. 2010. Descent of Iron Age Farmers on Southern Africa during the last 2000 years. *African Archaeological Review*, 27:87–106.
- Binneman, J. F. 1995. Symbolic construction of communities during the Holocene Later Stone Age in the South–Eastern Cape. Unpublished PhD thesis. Johannesburg: University of the Witwatersrand
- Binneman, J., Booth, C. and Higgitt, N. 2011. An Archaeological Desktop Study And Phase 1 Archaeological Impact Assessment (Aia) For The Proposed Clidet Data Cable between Bloemfontein, Orange Free State and Graaff Reinet, Eastern Cape Province; Colesberg, Orange Free State and Port Elizabeth, Eastern Cape Province; George, Western Cape Province and Port Elizabeth, Eastern Cape Province and; Aliwal North and East London, Eastern Cape Province. Unpublished report. Albany Museum: Grahamstown.
- Coertze, P.J. & Coertze, R.D. 1996. *Verklarende vak woordeboek vir Antropologie en Argeologie*. R.D. Coertze: Pretoria.
- Deacon, H.J. & Deacon, J. 1999. *Human Beginnings in South Africa: Uncovering the secrets of the Stone Age*. David Phillips Publishers: Cape Town.
- Dreyer, C. 2005. First Phase Heritage / Archaeological Assessment Of The Proposed Residential Developments At The Farm Wolfkop 2353, Bloemfontein. Unpublished report. Brandhof: Bloemfontein.
- Dreyer, C. 2006. First Phase Archaeological And Cultural Heritage Assessment Of The Proposed Developments At The Mangaung Integrated Housing Initiative, Hamilton, Bloemfontein. Unpublished report. Brandhof: Bloemfontein.
- Dreyer 2007a. First Phase Archaeological And Cultural Heritage Assessment Of The Proposed Business Developments On Erf 24722, Old Presidency, Bloemfontein. Unpublished report. Brandhof: Bloemfontein.
- Dreyer, C. 2007b. Archaeological And Historical Investigation of The Proposed Township Establishment On Portions Of The Farms Cecilia 2352, Kwaggafontein 2300 And Bloemfontein 654, Bloemfontein, Free State. Unpublished report. Brandhof: Bloemfontein.
- Dreyer, C. 2007c. First Phase Archaeological And Cultural Heritage Assessment Of The Proposed Residential Developments At Subdivision 3, Kwaggafontein 2300, Bloemfontein. Unpublished report. Brandhof: Bloemfontein.
- Dreyer, C. 2007d. First Phase Archaeological And Cultural Heritage Assessment Of The Proposed Light Industrial Developments At Plot 38 Kwaggafontein, Bloemfontein. Unpublished report. Brandhof: Bloemfontein.
- Dreyer, C. 2013. First Phase Archaeological & Heritage Assessment of The Proposed Solar Farm Developments At Spes Bona 2355, Bloemfontein. Unpublished report. Brandhof: Bloemfontein.
- Dreyer, C. 2015. First Phase Archaeological And Heritage Assessment Of The Proposed Mixed-Use Development On Portion 5 Of Brandkop 702, Bloemfontein, Free State. Unpublished report. Brandhof: Bloemfontein.

- Fourie, W. 2013 a. Proposed Construction Of The Sss1 5mw Solar Photovoltaic (Pv) Plant On The Eastern Part Of Portion 6 (Portion Of Portion 5) Of Farm Spes Bona 2355 Near Bloemfontein. Unpublished report. PGS Heritage and Grave Relocation Consultants: Totiusdal.
- Fourie, W. 2013 b. Proposed Construction Of The Sss2 5mw Solar Photovoltaic (Pv) Plant On The Western Part Of Portion 6 (Portion Of Portion 5) Of Farm Spes Bona 2355 Near Bloemfontein. Unpublished report. PGS Heritage and Grave Relocation Consultants: Totiusdal.
- Fourie, W. 2020. The Proposed Development Of The Eskom Melkspruit To Rouxville 132 Kv Overhead Powerline, Free State Province. Unpublished report. PSG Heritage.
- Hall, M. 1987. *The changing past: farmers, kings and traders in southern Africa. 200-1860*. Cape Town: David Philip.
- Hillier, A. P. and Cana, F. R. 1911. *Encyclopædia Britannica, Volume 20. 11th ed. Orange Free State* P:151-159.
- Huffman, T. 2002. Regionality in the Iron Age: the case of the Sotho-Tswana. *Southern African Humanities*, 14: 1-22.
- Huffman, T. 2007. Handbook to the Iron Age. Pietermaritzburg: University of Kwazulu-Natal Press.
- Klein, R. G. 2000. The Earlier Stone Age of Southern Africa. *The South African Archaeological Bulletin*, 27(172): 107-122.
- Kruger, N. 2018. Archaeological Impact Assessment (Aia) Of Demaracted Areas On A Portion Of The Remainder Of The Farm Bospoort 558 For The Proposed Bospoort Sand Mine Project In The Fezile Dabi District Municipality, Free State Province. Unpublished report. Exigo3 Sustainability.
- Lombard, M., Wadley, L., Deacon, J., Wurz, S., Parsons, I., Mohapi, M. Swart, J. & Mitchell, P. 2012. South African and Lesotho Stone Age sequence updated. *South African Archaeological Bulletin* 67: 123-144.
- Matenga, E. 2019. Phase I Heritage Impact Assessment (Including Palaeontological Assessment) Requested In Terms Of Section 38 Of The National Heritage Resources Act No 25/1999 For A Mining Right On Portion 4 Of The Farm Blaauwboschfontein 229, Boshof District, Free State Province. Unpublished report. Archaeological and Heritage Services Africa (Pty) Ltd. Pretoria
- Mitchell, P. 2002. *The archaeology of Southern Africa*. Cambridge: Cambridge University Press.
- Mlilo, T. 2017. Phase 1 Archaeological/Heritage Impact Assessment For Prospecting Rights To Prospect For Diamonds (Alluvial And Kimberlite) In Respect Of Remainder Of Kalkfontein A 13 Farm, Situated Within Boshof Local Municipality, Free State Province. Unpublished report. Integrated Specialist Services.
- Morris, D. 2014a. Proposed Boundary Solar Energy Facility On The Farm Karreeboom 1716, East Of Kimberley, In The Tokologo Local Municipality, Free State: Heritage Impact Assessment. Unpublished report. McGregor Museum: Bloemfontein.
- Morris, D. 2014 b. proposed Blackwood Solar Energy Facility On Portion 1 Of Pandamsfontein 1593, South East Of Kimberley, In The Tokologo Local Municipality, Free State: Scoping Phase Heritage Input. Unpublished report. McGregor Museum: Bloemfontein.
- Mucina, L. & Rutherford, M.C. (eds) 2006. *The vegetation of South Africa, Lesotho and Swaziland*. Strelitzia 19. SANBI: Pretoria.

- Orton, J. 2015. Heritage impact assessment for eleven Solar PV Facilities and Supporting Electrical Infrastructure near Dealesville in the Free State Province. Unpublished report. ASHA Consulting(Pty) Ltd.
- Orton, J. 2016 a. Heritage Impact Assessment: Scoping And Environmental Impact Assessment For The Proposed Development Of The Edison Pv 100 Mw Photovoltaic Facility Near Dealesville, Free State. Unpublished report. ASHA Consulting(Pty) Ltd.
- Orton, J. 2016 b. Heritage Impact Assessment: Scoping And Environmental Impact Assessment For The Proposed Development Of The Watt Pv 100 Mw Photovoltaic Facility Near Dealesville, Free State. Unpublished report. ASHA Consulting(Pty) Ltd.
- Orton, J. 2016 c. Heritage Impact Assessment: Scoping And Environmental Impact Assessment For The Proposed Development Of The Marconi Pv 100 Mw Photovoltaic Facility Near Dealesville, Free State. Unpublished report. ASHA Consulting(Pty) Ltd.
- Orton, J. 2016 d. Heritage Impact Assessment: Scoping And Environmental Impact Assessment For The Proposed Development Of The Faraday Pv 100 Mw Photovoltaic Facility Near Dealesville, Free State. Unpublished report. ASHA Consulting(Pty) Ltd.
- Orton, J. 2016 e. Heritage Impact Assessment: Scoping And Environmental Impact Assessment For The Proposed Development Of The Maxwell Pv 100 Mw Photovoltaic Facility Near Dealesville, Free State. Unpublished report. ASHA Consulting(Pty) Ltd.
- Raper, P. E. 1987. *Dictionary Of Southern African Place Names*. Head, Onomastic research Centre, HSRC.
- Rossouw, L. 2007. Phase 1 Archaeological Impact Assessment Of A 4000 M<sup>2</sup>, Portion Of Land Demarcated For Development By Coca Cola In Bloemfontein. Unpublished report. National Museum, Bloemfontein: Bloemfontein.
- Rossouw, L. 2014. Phase 1 Heritage Impact Assessment Of Remainder Of The Farm Cecilia 2352 And Farm Bloemfontein 654, Bloemfontein, Fs Province. Unpublished report. Paleo Field Services: Langenhovenpark.
- Rossouw, L. 2015. Phase 1 Heritage Impact Assessment Of The Remainder Of The Farm Cecilia 2352, Remainder Of The Farm Bloemfontein 654 And A Portion Of The Farm Kwaggafontein 9300, Bloemfontein, Fs Province. Unpublished report. Paleo Field Services: Langenhovenpark.
- Rossouw, L. 2016. Phase 1 Heritage Impact Assessment Of A Proposed New Residential Development On The Farm Brandkop 702 Near Bloemfontein, Fs Province. Unpublished report. National Museum, Bloemfontein: Bloemfontein.
- Rossouw, L. 2018. The Proposed Upgrading Of An Existing Diesel Depot On Portion 1 Of The Farm Roodam 2354, Bloemfontein, Free State Province. Unpublished report. National Museum, Bloemfontein: Bloemfontein.
- Tomose, N. G. 2013. A Phase 1 Heritage Impact Assessment Study For The Proposed Photovoltaic (Pv) Solar Energy Facilities, Near Excelsior, Free State Province. Unpublished report.
- Van der Ryst, M.M. & Meyer, A. 1999. *Die Ystertydperk. Bergh, J.S. (red.). Geskiedenisatlas van Suid-Afrika. Die vier noordelike provinsies*. Pretoria: J.L. van Schaik.
- Van Schalkwyk, J. 2014. Cultural Heritage Impact Assessment For The Proposed Resort Development On A Portion Of The Farm Damlaagte 229, Ngwathe Local Municipality, Free State Province. Unpublished report.

Wurz, S., 2013. Technological trends in the Middle Stone Age of South Africa between MIS 7 and MIS 3. *Current Anthropology*, 54(S8): S305-S319.

#### WEB

<https://sahris.sahra.org.za/declaredsites> (Accessed 15/01/2022).

<https://sahris.sahra.org.za/allsitesfinder> (Accessed 20/12/2021).

<https://screening.environment.gov.za/> (Accessed 20/12/2021).

[https://en.wikipedia.org/wiki/Cornelius\\_Hermanus\\_Wessels#cite\\_ref-1](https://en.wikipedia.org/wiki/Cornelius_Hermanus_Wessels#cite_ref-1) (Accessed 28/01/2022).

<https://www.sahistory.org.za/article/colonial-history-bloemfontein> (Accessed 28/01/2022).

<https://www.britannica.com/place/Bloemfontein> (Accessed 28/01/2022).

<https://www.sanbi.org/gardens/free-state/history/> (SANBI 2021) (Accessed 25/01/2022).

<https://www.sahistory.org.za/dated-event/bloemfontein-convention-signed> (Accessed 25/01/2022).

<https://www.sahistory.org.za/place/free-state-province> (Accessed 25/01/2022).

# APPENDIX A

PALAEONTOLOGICAL FIELD ASSESSMENT FOR THE PROPOSED CONSTRUCTION OF HARVARD 1 SOLAR PHOTOVOLTAIC (PV) FACILITY AND ASSOCIATED INFRASTRUCTURE, ON PORTION 8 OF FARM SPES BONA No 2355 IN THE MANGAUNG METROPOLITAN MUNICIPALITY IN THE FREE STATE.





**PALAEONTOLOGICAL FIELD ASSESSMENT FOR THE PROPOSED  
CONSTRUCTION OF HARVARD 1 SOLAR PHOTOVOLTAIC (PV)  
FACILITY AND ASSOCIATED INFRASTRUCTURE, ON PORTION 8  
OF FARM SPES BONA No 2355 IN THE MANGAUNG  
METROPOLITAN MUNICIPALITY IN THE FREE STATE**

Compiled for:

**UBIQUE Heritage Consultants**

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Prepared by  
Banzai Environmental  
February 2022

## **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.

**PALAEONTOLOGICAL CONSULTANT:**

Banzai Environmental (Pty) Ltd

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**SIGNATURE:**



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

Table 1 - NEMA Table

| <b>Requirements of Appendix 6 – GN R326 EIA Regulations of 7 April 2017</b>  | <b>Relevant section in report</b>  | <b>Comment where not applicable.</b> |
|--|--|--------------------------------------|
| 1.(1) (a) (i) Details of the specialist who prepared the report  | Page ii and Section 2 of Report – Contact details and company and Appendix A | -                                    |
| (ii) The expertise of that person to compile a specialist report including a curriculum vitae  | Section 2 – refer to <b>Appendix A</b>                                       | -                                    |
| (b) A declaration that the person is independent in a form as may be specified by the competent authority  | Page ii of the report  | -                                    |
| (c) An indication of the scope of, and the purpose for which, the report was prepared  | Section 4 – Objective  | -                                    |
| (cA) An indication of the quality and age of base data used for the specialist report  | Section 5 – 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   | -                                    |
| (d) The duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment   | Section 1 and 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 7 Approach and Methodology   | -                                    |
| (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 | Section 1 and 11   |                                      |



| <b>Requirements of Appendix 6 – GN R326 EIA Regulations of 7 April 2017</b>   | <b>Relevant section in report</b>                   | <b>Comment where not applicable.</b>          |
|---|---|---|
| alternative;  |   |   |
| (g) An identification of any areas to be avoided, including buffers   | Section 5   | No buffers or areas of sensitivity identified |
| (h) A map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;  | Section 5 – Geological and Palaeontological history |   |
| (i) A description of any assumptions made and any uncertainties or gaps in knowledge;   | Section 7.1 – 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 and 11                                    |   |
| (k) Any mitigation measures for inclusion in the EMPr   | Section 12  |   |
| (l) Any conditions for inclusion in the environmental authorisation   | Section 12  |   |
| (m) Any monitoring requirements for inclusion in the EMPr or environmental authorisation  | Section 12  |   |
| (n)(i) A reasoned opinion as to whether the proposed activity, activities or portions thereof should be authorised and  | Section 1 and 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 EMPr, and where applicable, the closure plan | Section 1 and 11                                    | -   |
| (o) A description of any consultation   | N/A   |   |

| Requirements of Appendix 6 – GN R326 EIA Regulations of 7 April 2017  | Relevant section in report                 | Comment where not applicable. |
|---|--|-------------------------------|
| process that was undertaken during the course of carrying out the study   |  |                               |
| (p) A summary and copies if any comments that were received during any consultation process   | N/A  |                               |
| (q) Any other information requested by the competent authority.   | N/A  |                               |
| (2) Where a government notice by the Minister provides for any protocol or minimum information requirement to be applied to a specialist report, the requirements as indicated in such notice will apply. | Section 3 compliance with SAHRA guidelines |                               |

## EXECUTIVE SUMMARY

Banzai Environmental was appointed by UBIQUE Heritage Consultants to conduct the Palaeontological Impact Assessment (PIA) to assess the proposed Harvard 1 Solar Photovoltaic (PV) facility on Portion 8 of Farm Spes Bona no 2355, Mangaung Metropolitan Municipality 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 and to mitigate possible damage to fossil resources.

The proposed Harvard 1 Solar PV near Bloemfontein in the Free State is largely underlain by the Balfour Formation of the Adelaide Subgroup (Beaufort Group, Karoo Supergroup) and only a small portion in the south-west is underlain by Jurassic Karoo dolerite. According to the PalaeoMap on the South African Heritage Resources Information System (SAHRIS) database, the Palaeontological Sensitivity of the Balfour Formation is Very High, and that Jurassic Karoo dolerite is Zero as it is igneous in origin (Almond and Pether 2008, SAHRIS website). The Very High Palaeontological Sensitivity triggered a site visit.

A site-specific field survey of the development footprint was thus conducted on foot and by motor vehicle on 26 January 2022. During the site visit no fossiliferous outcrops were identified. The scarcity of fossil heritage at the proposed development footprint indicates that the impact of the development footprint will be of a low significance in palaeontological terms. It is therefore considered that the proposed development is deemed appropriate and will not lead to detrimental impacts on the palaeontological reserves of the area.

### Recommendations:

- The ECO for this project must be informed that sediments of the Balfour Formation of the Adelaide Subgroup (Beaufort Group, Karoo Supergroup) have a **Very High Palaeontological Sensitivity**.
- If Palaeontological Heritage is uncovered during surface clearing and excavations the **Chance find Protocol** attached should be implemented immediately. Fossil discoveries ought to be protected and the ECO/site manager must report to SAHRA (Contact details: SAHRA, 111 Harrington Street, Cape Town. PO Box 4637, Cape Town 8000, South Africa. Tel: 021 462

4502. Fax: +27 (0)21 462 4509. Web: [www.sahra.org.za](http://www.sahra.org.za)) so that mitigation (recording and collection) can be carried out.

- Before any fossil material can be collected from the development site the specialist involved would need to apply for a collection permit from SAHRA. Fossil material must be housed in an official collection (museum or university), while all reports and fieldwork should meet the minimum standards for palaeontological impact studies proposed by SAHRA (2012).
- These recommendations should be incorporated into the Environmental Management Plan for the Harvard 1 PV Facility.



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**Appendix A: CV**

## 1 INTRODUCTION

Keren Renewable Energy (Pty) Ltd plans to develop the Harvard Solar PV facilities, associated infrastructure, and grid connection west of Bloemfontein in the Mangaung Metropolitan Municipality, Free State Province. EnviroAfrica cc has been commissioned to commence with a separate NEMA application procedure for Environmental Authorisation for each of the planned solar PV facilities (Harvard Solar 1 and Harvard Solar 2) and the grid connection (**Figure 1-12**).

UBIQUE Heritage Consultants was in turn appointed to conduct the Archaeological Impact Assessment (AIA) while Banzai Environmental was employed to conduct the Palaeontological Impact Assessment (PIA) as part of the Heritage Impact Assessment (HIA).

In this report the Palaeontological Heritage of **Harvard Solar 1 PV facility** and associated infrastructure will be investigated.

The construction of Harvard Solar 1 PV facility and associated infrastructure on Portion 8 of Farm Spes Bona no 2355 near Bloemfontein in the Free State is proposed (**Figure 1-12**). This PV facility will be approximately 210ha in extent.

The following Information was provided by EnviroAfrica CC

Due to proximity to the Eskom substation, consent use of land and other renewable energy developments/proposed developments, alternative sites do not exist. However, alternative options which include *inter alia* alternative PV technology, layout options and the option of not proceeding with the proposed development (the No-Go option) will be considered and assessed in the Environmental Impact Assessment Report (EIR). The EIR will include specialist reports and will undergo a further round of public participation.

### 1.1. TYPE OF SOLAR INSTALLATION

The solar installation type is as follows:

- Photovoltaic panels (on ground-mounted steel structures)
- Fixed axis and single-axis tracking (to be confirmed during detail design)





**Figure 24:** Type of solar installation.

## 1.2. ELECTRICITY

Generation capacity:

The generating capacity of the two Harvard areas, based on 2.5 Ha/MW are:

- Harvard 1 North 145 ha / 1.77 Ha/MW = 82 MW
- Harvard 2 South 120 ha / 1.77 Ha/MW = 68 MW

Capacity of overhead power lines

Voltage: 132kV or higher

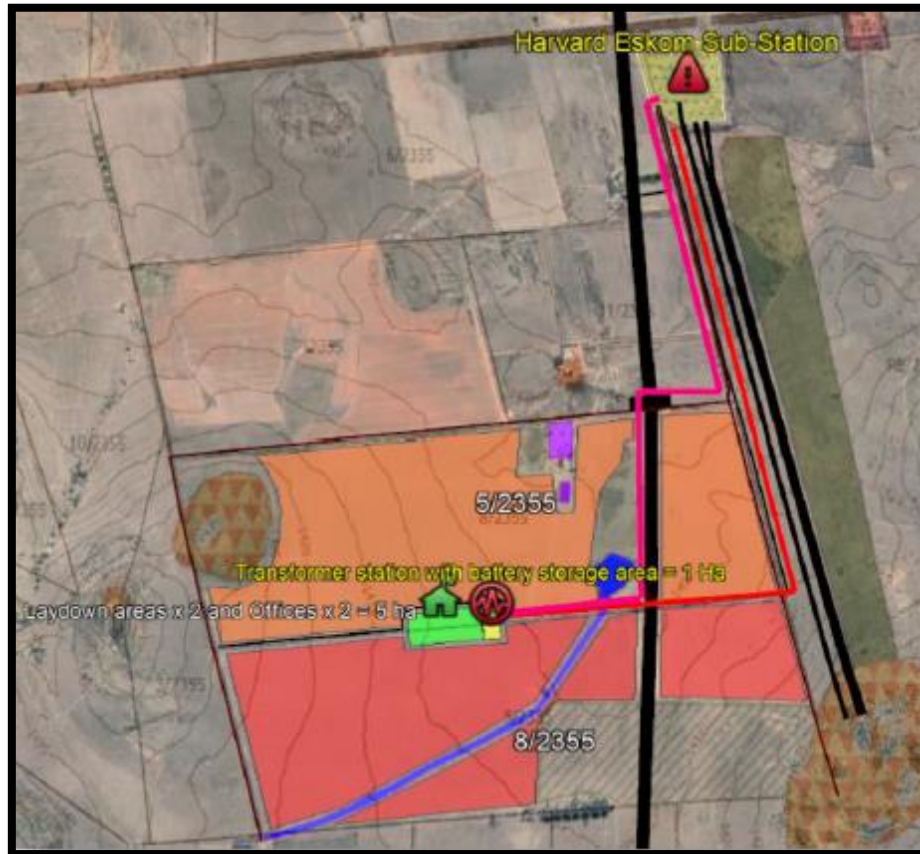
Tower height: up to 25m typically

Tower type: Steel Monopole

The Google image below shows the existing power lines as well as the route of the proposed power line connection from the solar farm to the Harvard Eskom Sub-Station.

- Existing MV transmission line 1
- Existing MV transmission line 1
- Existing HV transmission lines

- Proposed HV transmission line connection between Harvard Solar Farm and the Harvard Eskom Sub-Station
- Proposed HV transmission line connection between Harvard Solar Farm and the Harvard Eskom Sub-Station



**Figure 25:** Eskom power lines & proposed new power lines from the solar farm to Harvard Sub-Station

A 6 Ha (400m x 150m) (typical) area in the middle of the Harvard Solar farm is needed for this purpose.

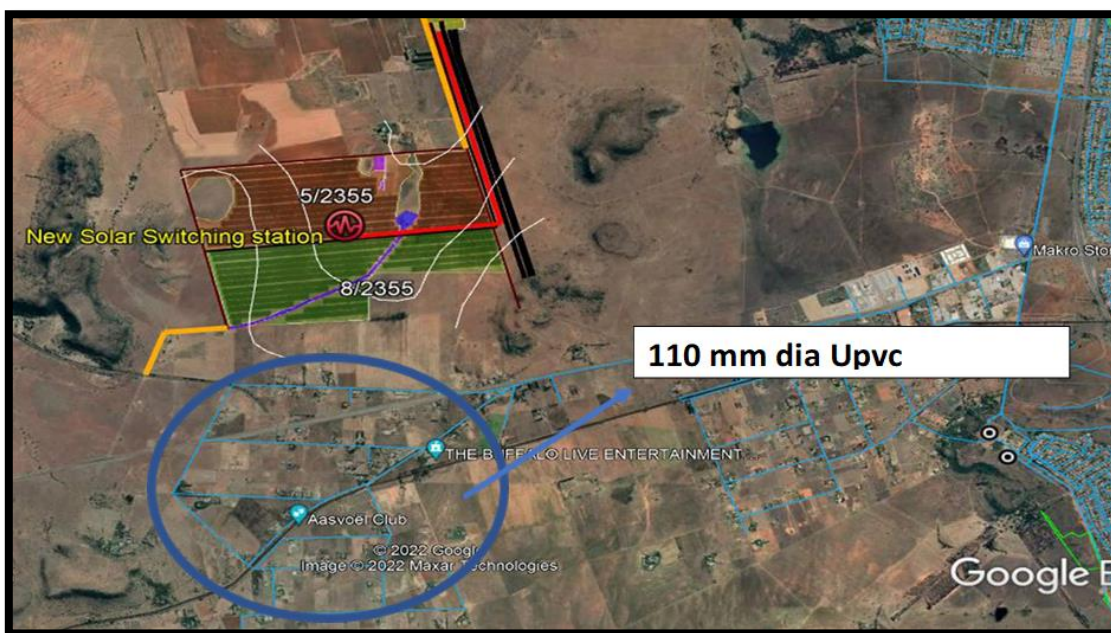


**Figure 26:** Footprint of grid connection station, offices, and laydown/storage area

### 1.3. WATER SUPPLY

Water requirements during the construction and the operational phase of the solar energy facility will differ.

Possible water supply will be from the 110mm diameter Bloemwater reticulation network to the south of Harvard solar farm shown on the Google image below:



**Figure 27:** Water supply

An official application must be submitted to Bloemwater. Water will mostly be utilized for drinking purposes and washing of solar panels every two or three months, or less. The diameter of the pipeline will be 75mm or smaller.

The proposed Harvard Solar Project will be located 11 km West of Bloemfontein's CBD in the Northern Cape Province. The area may have a groundwater occurrence of between 5 and 20 Litres/second.

The Developer will solicit the services of a consultant to undertake an assessment of groundwater resources that will include hydro-census and yield test studies.

The google image shows a possible connection from the water reticulation network to the Switching station.

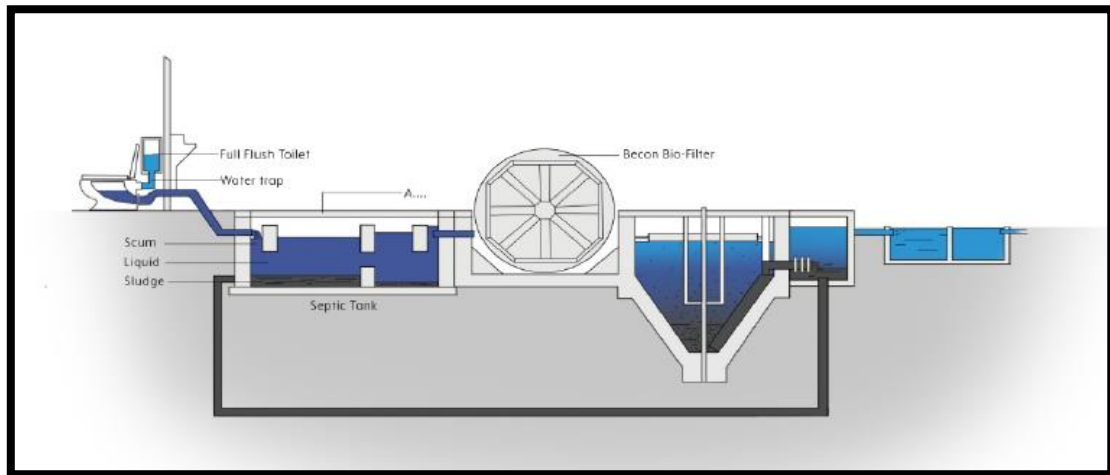


**Figure 28:** Planned connection from Bloemwater reticulation network to the operational centre of Harvard solar farm.

## 1.4. SEWER

The Construction phase and the operational phase will be treated differently in terms of sewer treatment.

Wastewater and sewer will be treated on-site close to the offices by using a small bio-filter type package plant sized according to the calculated load.

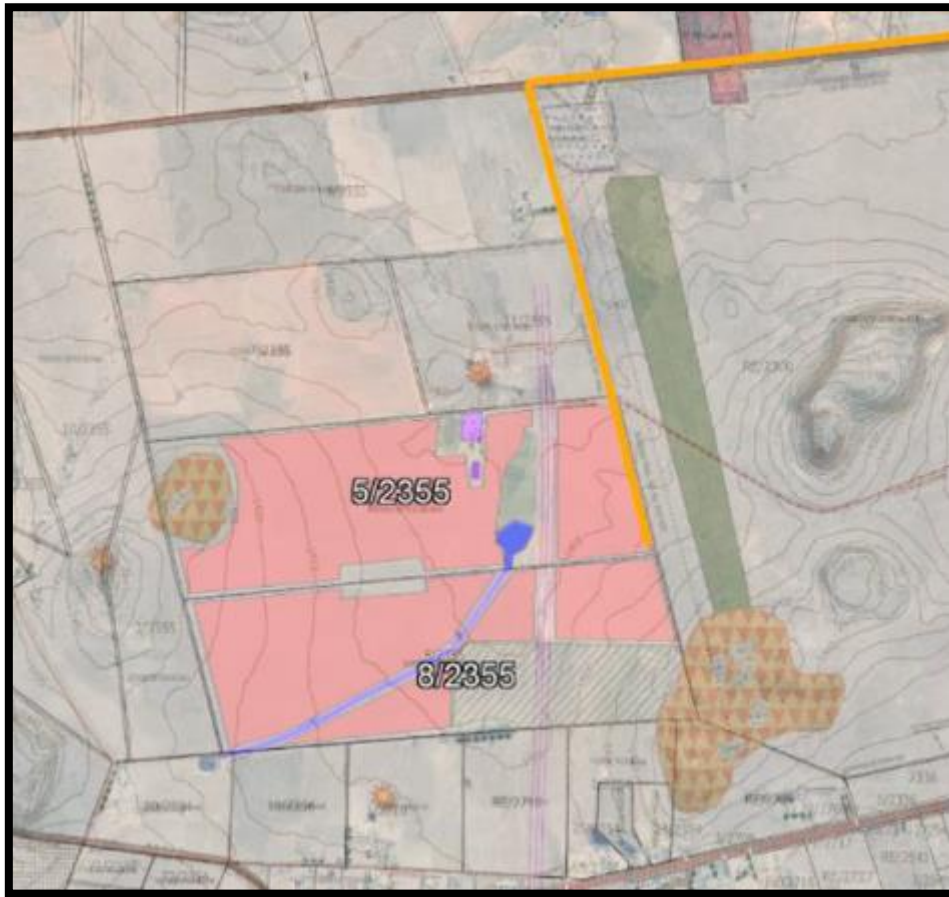


**Figure 29:** Sewer treatment

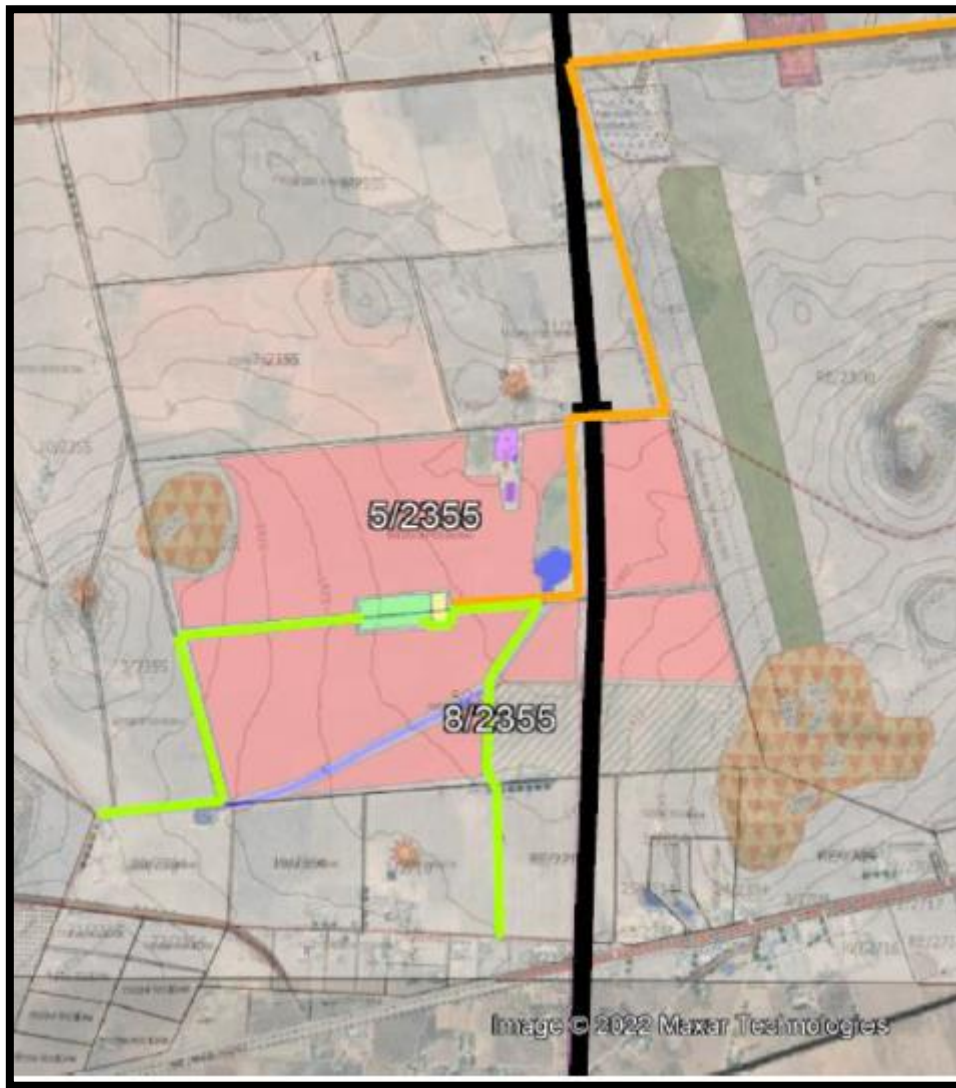
## 1.5. ROADS AND ACCESS

The current road from the north-east that gives access to the solar farm area are shown in gold on the Google image below.





**Figure 30:** Access roads



**Figure 31:** Proposed access roads (with alternatives) to the Harvard solar farm)



**Figure 32: Internal roads**

## **1.6. STORM WATER**

The contours on the Google map below shows that most of the drainage is overland with slopes that vary from 1:40 to 1:80.



**Figure 33: Storm water contours**

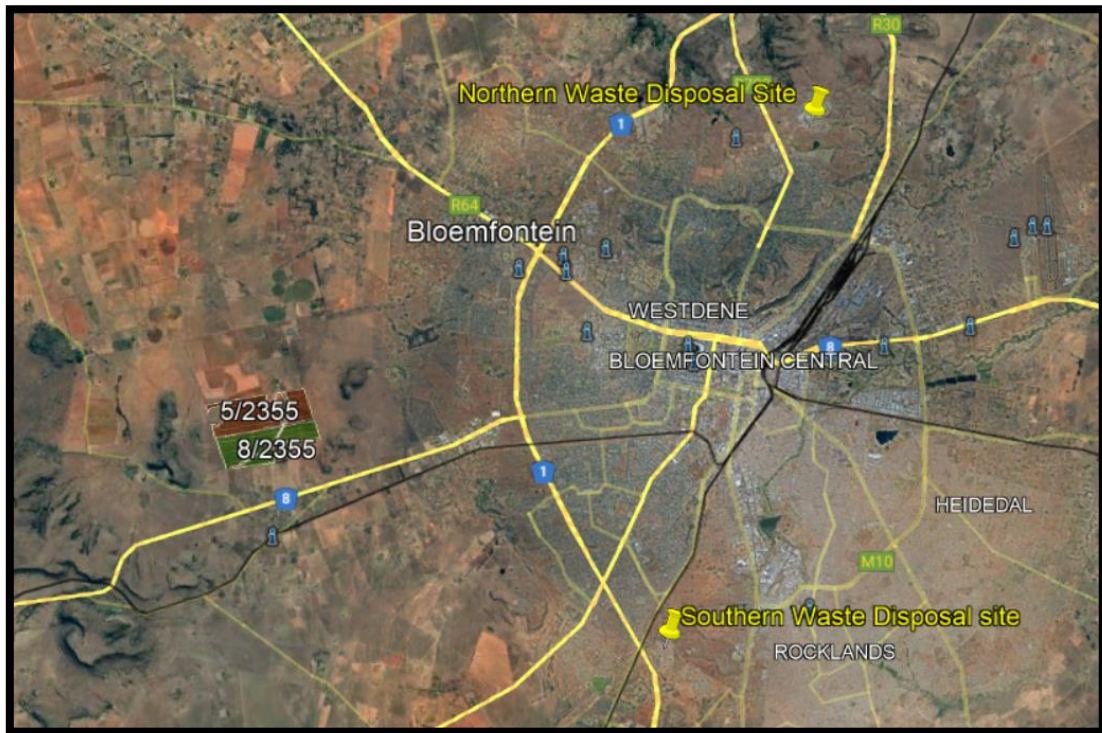


**Figure 34: Stormwater catchment area**

## 1.7. OFFICES

The operational offices will be located next to the switch station in the centre of the solar area.



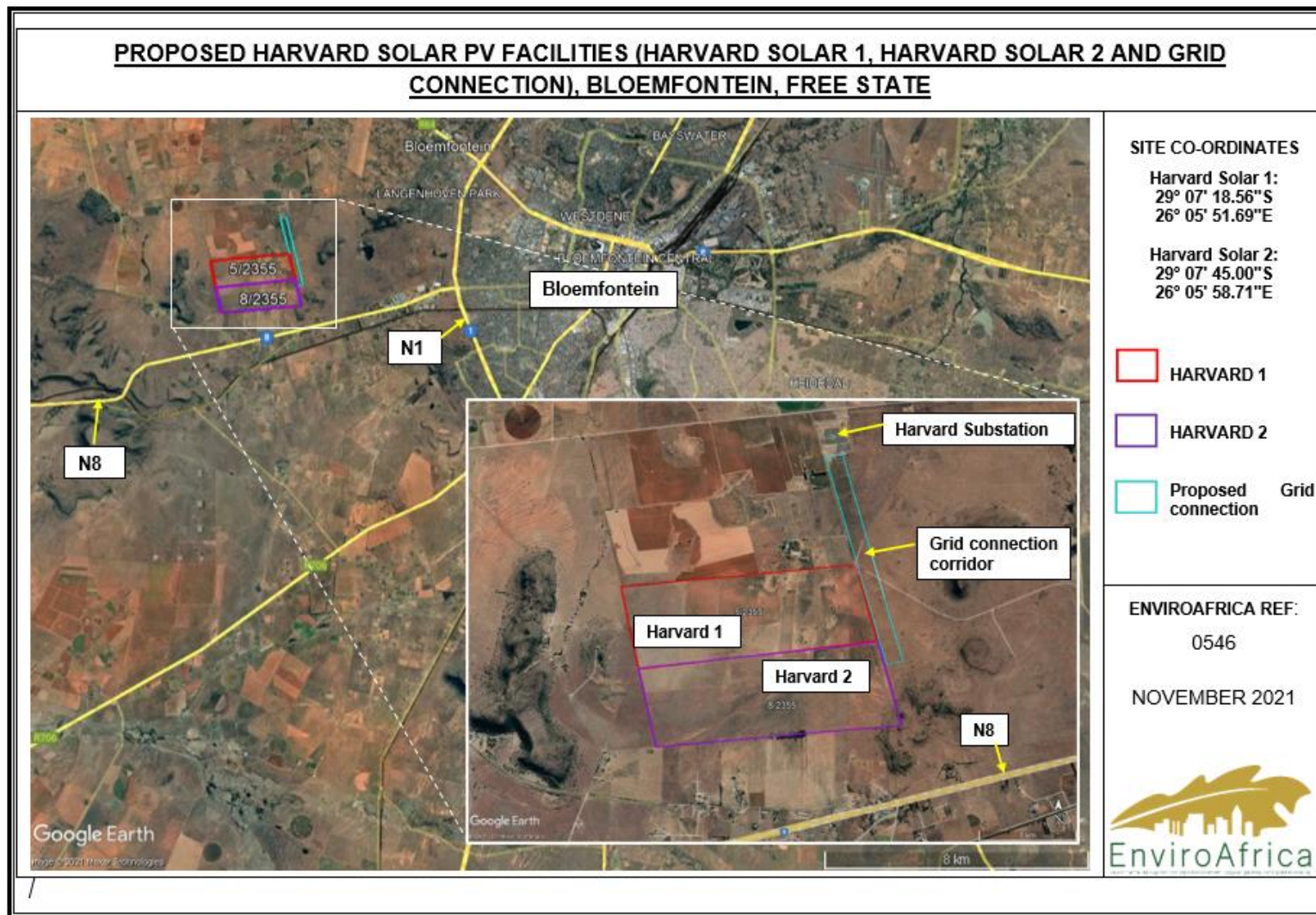


**Figure 35:**Locality map

## **2. QUALIFICATIONS AND EXPERIENCE OF THE AUTHOR**

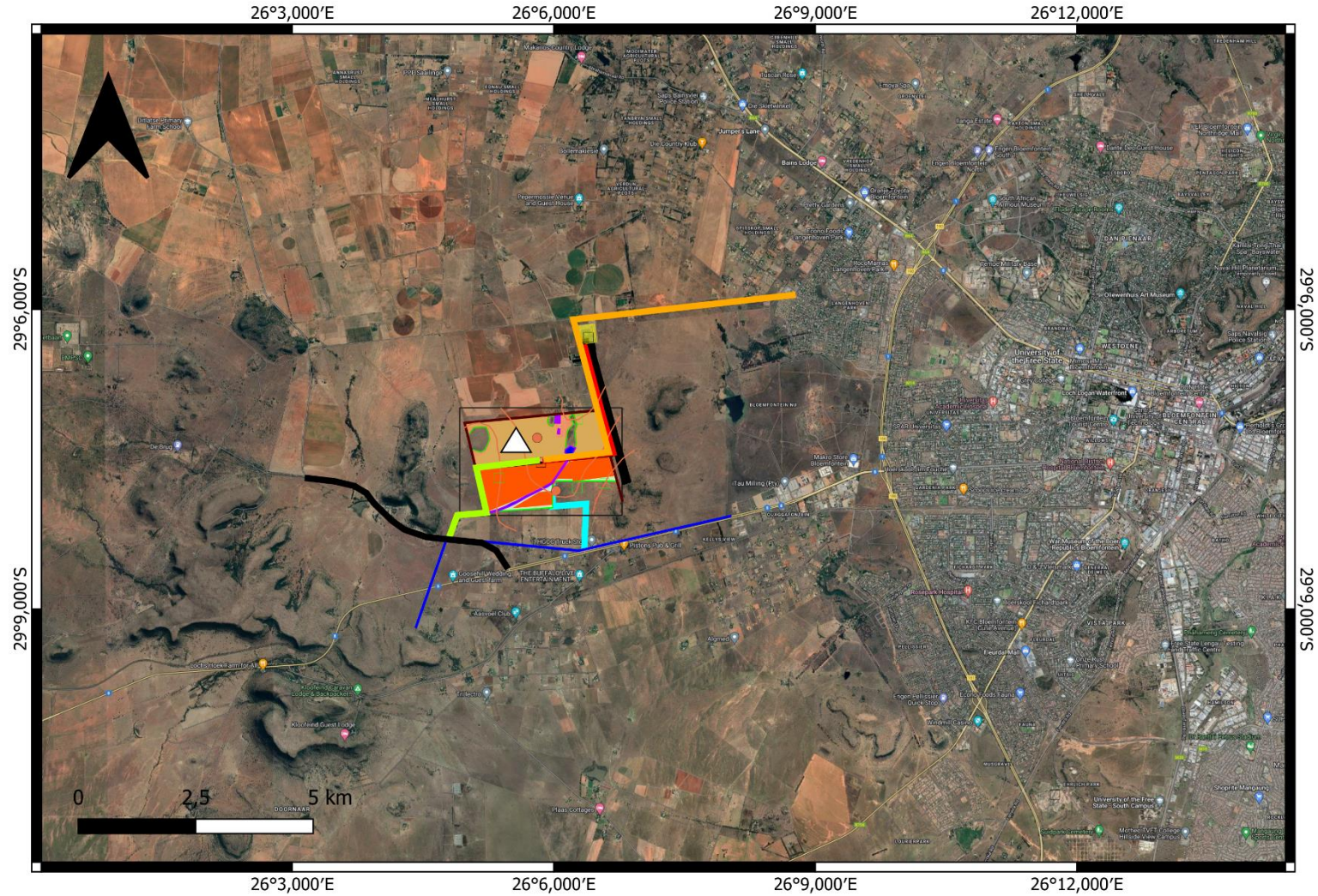
This present study has been conducted by Mrs Elize Butler. She has conducted approximately 300 palaeontological impact assessments for developments in the Free State, KwaZulu-Natal, Eastern, Central, and Northern Cape, Northwest, Gauteng, Limpopo, and Mpumalanga. She has an MSc (*cum laude*) in Zoology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





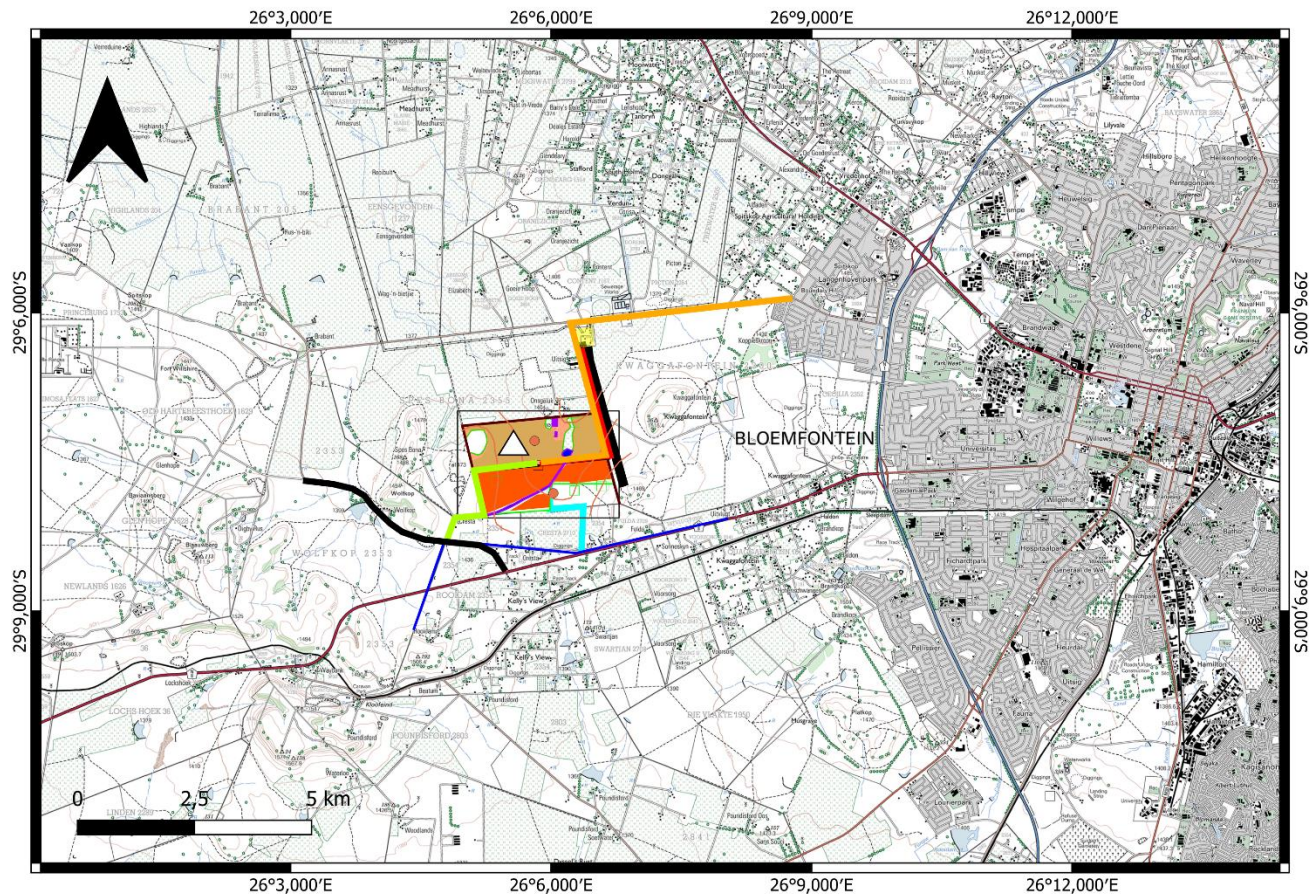
**Figure 36:** Proposed Harvard Solar PV facilities near Bloemfontein in the Free State Province.





**Figure 37:** Google Earth (2022) Image of the proposed Harvard Solar 1 PV facility and associated infrastructure (white triangle) on Portion 8 of Farm Spes Bona no 2355, Mangaung Metropolitan Municipality in the Free State.





**Figure 38:** Extract of the 1:50 000 topographical map [2926AA] indicating the location (white triangle) of the Harvard Solar 1 PV facility and associated infrastructure on Portion 8 of Farm Spes Bona no 2355, Mangaung Metropolitan Municipality in the Free State.

### 3. LEGISLATION

#### 3.1. 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 m<sup>2</sup> in extent; or
- involving three or more existing erven or subdivisions thereof; or
- involving three or more erven or divisions thereof which have been consolidated within the past five years; or
- the costs of which will exceed a sum set in terms of regulations by SAHRA or a provincial heritage resources authority
- the re-zoning of a site exceeding 10 000 m<sup>2</sup> in extent.
- or any other category of development provided for in regulations by SAHRA or a Provincial heritage resources authority.

#### 4. OBJECTIVE

The aim of a Palaeontological Impact Assessment (PIA) is to decrease the effect of the development on potential fossils at the development site.

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.

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.

Mitigation usually precede 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 as possible because our knowledge of local palaeontological heritage may be increased

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 sensitive areas to be avoided (providing shapefiles/kml's) 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** 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. GEOLOGICAL AND PALAEOLOGICAL HISTORY

The geology of the proposed Harvard 1 PV Facility is indicated on the 1:250 000 Bloemfontein 2926 Geological Map (1966) (Council of Geoscience, Pretoria) (**Figure 16, Table 2**). The proposed development is largely underlain by the Balfour Formation of the Adelaide Subgroup (Beaufort Group, Karoo Supergroup) with a small portion in the south-west underlain by Jurassic dolerite. The Shape files (obtained from the Council of Geosciences, Pretoria) indicates that the proposed development is primarily underlain by the Balfour Formation (**Figure 17**). According to the PalaeoMap on the South African Heritage Resources Information System (SAHRIS) database, the Palaeontological Sensitivity of the Balfour Formation is Very High while that of the Karoo Dolerite is Zero as it is igneous in nature (Almond and Pether 2008, SAHRIS website).

The **Jurassic dolerite** present in the development form part of the Karoo Igneous Province that is one of the worlds classic continental flood basalts (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 covered at least 140 000 km<sup>2</sup> while it was larger in the past [ $\sim 2\,000\,000\text{ km}^2$  (Cox 1970, 1972)]. The Karoo Igneous Province 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 rheognimbrites. The basal lavas lie conformable on the Clarens Formation but in specific localities sandstone erosion occurred before the volcanic eruptions took place. Lock *et al* (1974) found evidence in the Eastern Cape that in the early stages of volcanism magma interacted with ground water to produce volcanoclastic deposits as well as phreatic and phreatomagmatic diatremes. Eales *et al* (1984) also found evidence of aqueous environments during early volcanism by the existence of pillow lavas and associated hyaloclastite breccias and thin lenses of fluvial sandstones interbedded with the lowermost magmas.

The planned development is underlain by mudstones, sandstones, and shales, which were deposited under fluvial environments of the **Adelaide Subgroup**. The Adelaide Subgroup forms part of the Beaufort Group. The Beaufort Group is the third of the main subdivisions of the Karoo Supergroup. This group overlays the Ecca 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. The Beaufort Group was deposited on land through alluvial processes. This Group covers a total land surface area of approximately 200 000 km<sup>2</sup> in South Africa and is the first fully continental sequence in the Karoo Supergroup. The Beaufort Group is divided into the Adelaide 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 (Johnson *et al* 2006).

In the south eastern portion of the Karoo Basin the Adelaide Subgroup consists of the Koonap, Middleton and Balfour Formations. West of 24° the Adelaide Subgroup is represented by the Abrahamskraal and Teekloof Formations and in the north the Group is represented by the Palaeontological Impact Assessment for the proposed Harvard 1 Solar PV facility on Portion 8 of Farm Spes Bona No 2355, Mangaung Metropolitan Municipality in the Free State



Normandien Formation. The Adelaide Subgroup is approximately 5 000 m thick in the southeast, but this decreases to about 800m in the centre of the basin which thins out to about 100 to 200m in the north. The Balfour Formation is approximately 200 m thick, while the Abrahamskraal Formation is about 2 500 m thick and the Teekloof Formation 1 000 m. The Normandien Formation is only about 320 m thick.

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. The **Balfour formation** in the development footprint comprise of greenish- to bluish-grey and greyish-red mudstone, siltstone, subordinate sandstone. In the northern Normandien formation the basin consists of course to very coarse sandstones and granulostones. Coarsening-upward cycles are present in the lower part of the Normandien Formation while the mudrocks and sandstone units usually form fining-upward cycles. These cycles are positioned on erosion surfaces which is overlain by thin intraformational mud-pellet conglomerate and vary in thickness from a few meters to tens of meters. Singular sandstone units could vary from 6 meters to 60 meters in the south thinning northwards, but thick sandstone units are also present in the northern Normandien Formation (Groenewald 1989, 1990).

The 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 massive beds, while ripple lamination is usually confined to thin sandstones towards the top of the thicker units. The mudrocks of the Adelaide Subgroup usually has massive and blocky weathering apart from in the Normandien and Daggaboersnek Member (Groenewald 1989, 1990). 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 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 (**Figure 18**) (Kit ching 1977, 1978; Keyser *et al*, 1977, Rubidge 1995, Smith *et al*, 2020; Viglietti 2020). 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 (**Figure 18**) (Viglietti, 2020).

The *Daptocephalus* Assemblage Zone (AZ) expands into the lower Palingkloof of the Upper Balfour Formation. This Zone is characterized by the occurrence of the two therapsids namely *Dicynodon* and *Theriognathus* (**Figure 19-20**). The *Daptocephalus* AZ 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 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 (**Figure 18**). Vertebrate fossils are mostly found in the mudrock units between channel sandstones in the *Lystrosaurus declivis* Assemblage Zone (**Figure 21-22**). Specimens are well preserved and articulated skull and skeleton specimens have been abundantly found. Several bonebeds have been recorded. A common fossil taxon to the floodplain bonebeds is juvenile *Lystrosaurus declivis* that most probably died due to severe drought conditions (Smith and Botha, 2005, Viglietti et al., 2013, Smith and Botha-Brink, 2014). Numerous positively identified skeletons have been identified in burrows in this Assemblage Zone (Bordy et al., 2011; Botha-Brink, 2017, Damiani et al., 2003, Kitching, 1977; Modesto and Botha-Brink, 2010; Smith and Botha-Brink, 2014). Synchrotron scanning made it possible for Fernandez, et al., 2013 to describe a burrow cast from the Early Triassic of the Karoo (**Figure 23**). This scan depicts a unique mixed-species association of an injured temnospondyl amphibian (*Broomistega*) sheltering in a burrow inhabited by an aestivating *Thrinaxodon*.

West of the proposed development is an area underlain by the Tierberg Formation (K2u), of the Eccca Group (Karoo Supergroup) while Quaternary superficial deposits are present north of the proposed development (**Figure 15**).

The Quaternary deposits reveal palaeoclimatic changes in the different geological formations (Hunter et al., 2006). The climatic fluctuations in the Cenozoic Era were responsible for the formation of most geomorphologic features in southern Africa (Maud, 2012). Various warming

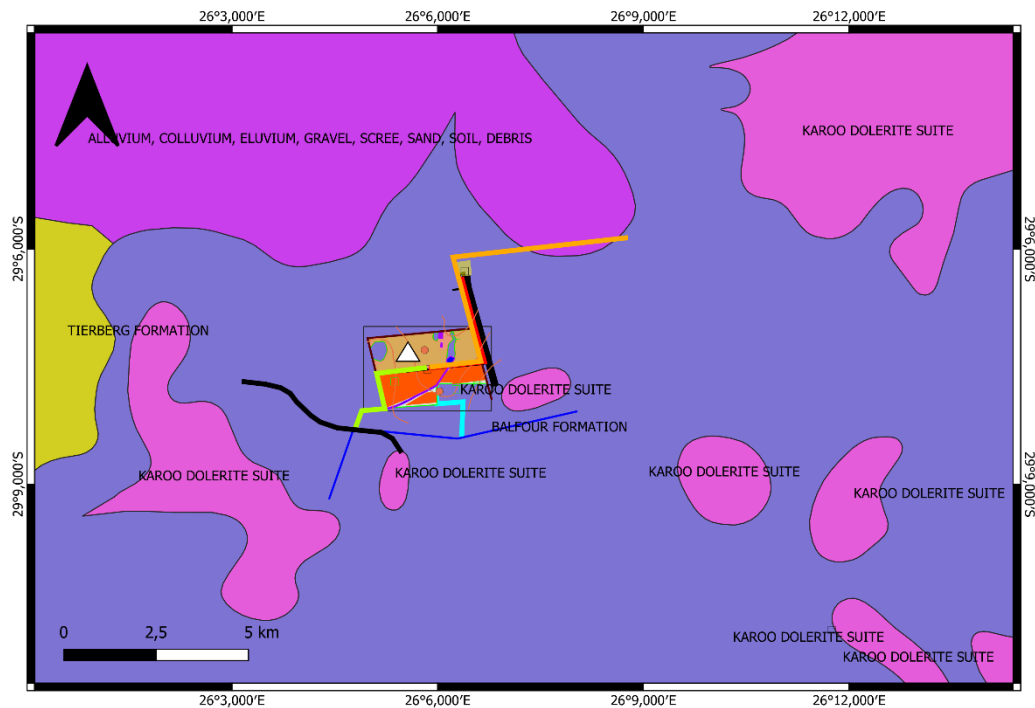
and cooling events occurred in the Cenozoic but climatic changes during the Quaternary, specifically the last 1.8 Ma, were the most drastic climate changes relative to all climate variations in the past Barnosky (2005). Climate in the Quaternary Period were both drier and wetter than the present and resulted in changes in river flow patterns, sedimentation processes and vegetation variation (Tooth et al., 2004). The fossil assemblages of this Group are generally very low in diversity but locally High and occur over a wide range. These fossils represent terrestrial plants and animals with a close resemblance to living forms. Fossil assemblages include bivalves, diatoms, gastropod shells, ostracods and trace fossils. The palaeontology of the Quaternary superficial deposits has been relatively neglected in the past. Late Cenozoic calcrete may comprise of bones, horn corns as well as mammalian teeth. Tortoise remains have also been uncovered as well as trace fossils which includes termite and insect's burrows and mammalian trackways. Amphibian and crocodile remains have been uncovered where the depositional settings in the past were wetter.

The majority of the Tierberg Formation 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.



**Figure 39:** Extract of the 1:250 000 Bloemfontein 2926 Geological Map (1966) (Council of Geoscience, Pretoria) indicating the surface geology of the proposed development (indicated by the white triangle). The development is underlain by the Balfour Formation of the Adelaide Subgroup of the Karoo Supergroup.





**Figure 40:** Surface Geology of the proposed development (Shape files obtained from the Council of Geoscience, Pretoria) indicates that site is underlain by the Balfour Formation of the Adelaide Group (Beaufort Group, Karoo Supergroup)

Table 2: Legend of the Bloemfontein 2926 Geological Map (1966) (Council of Geoscience, Pretoria)

|    | Age        | Group/Formation   |  | Lithology  | Palaeontological Sensitivity |
|----|------------|-------------------|--|--|------------------------------|
| Q  | Quaternary |                   |  | Alluvium, Colluvium, Eluvium, gravel, scree, sand, soil and debris | High                         |
| Jd | Jurassic   |                   |  | Dolerite   | Zero                         |
| Pa | Permian    | Adelaide Subgroup |  | Grey and brownish-red mudstone,                                    | Very High                    |

|                 |          |                    |                               |   |           |
|-----------------|----------|--------------------|-------------------------------|---|-----------|
|                 |          |                    | Beaufort Group                | subordinate sandstone                     |           |
| T <sub>RT</sub> | Triassic | Tarkastad Subgroup | Karoo Supergroup              | Brownish-red and grey mudstone, sandstone | Very High |
| K2U             |          | Tierberg Formation | Ecca Group (Karoo Supergroup) | Mudstone, Shale                           | High      |

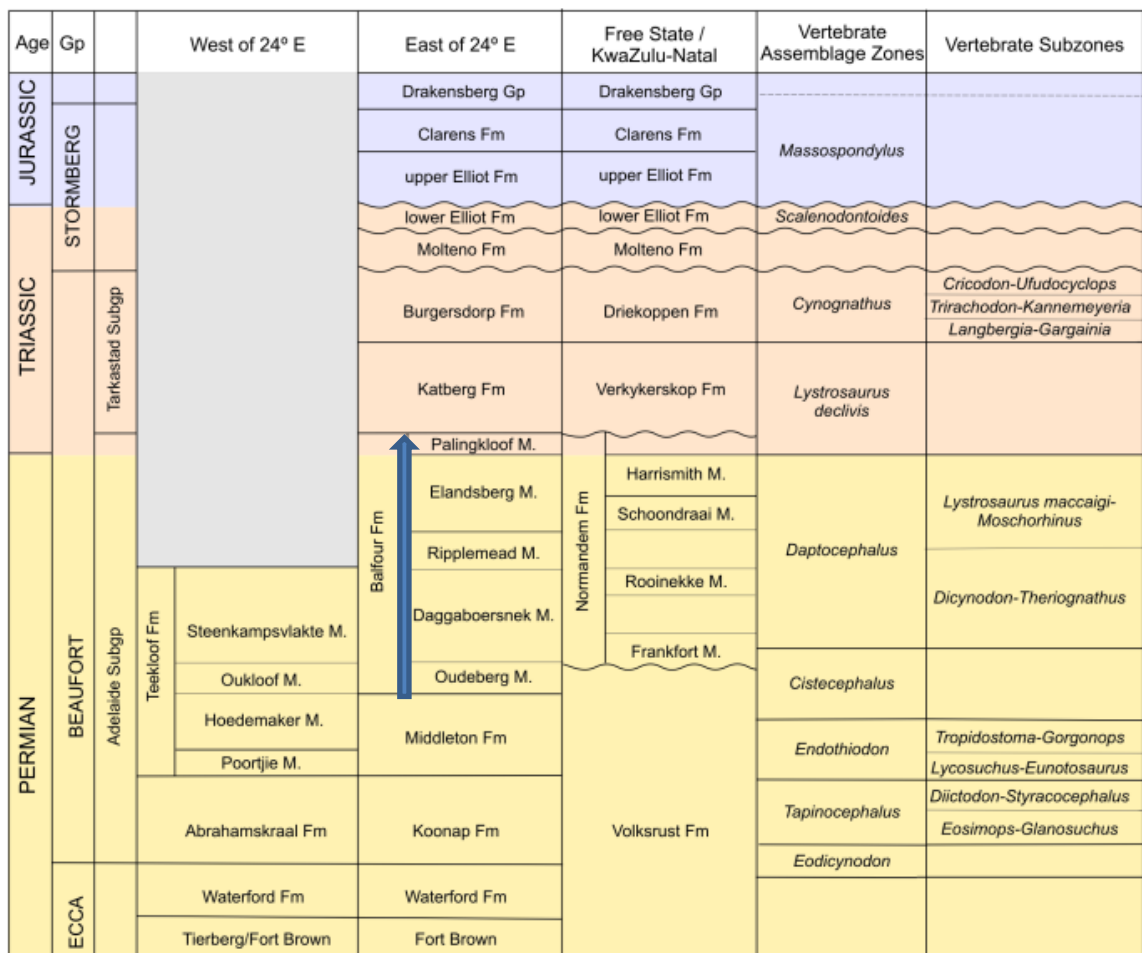
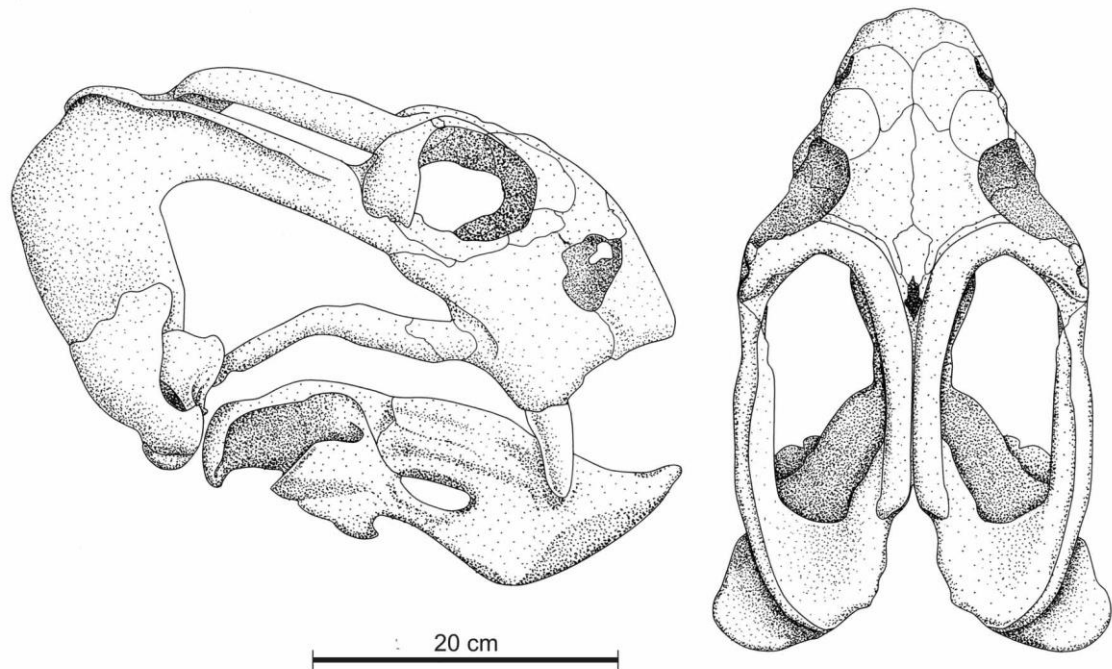


Figure 41: Vertebrate biozonation range chart for the Main Karoo Basin of South Africa.

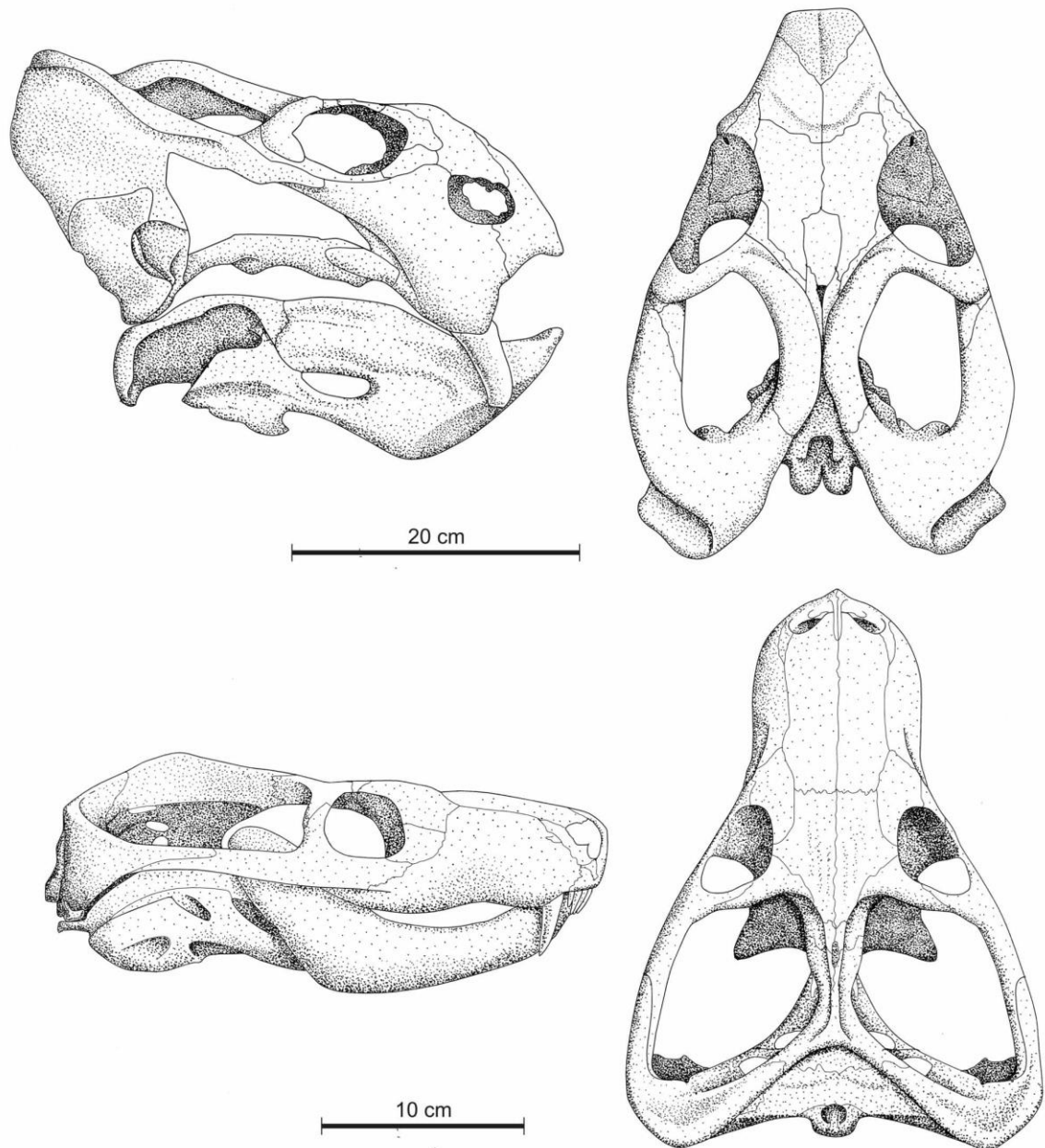
Solid lines indicate known ranges, dotted lines indicate suspected but not confirmed ranges, single dot represents the stratigraphic position of the taxa that have only been recovered from a single bed.

Wavy lines indicate unconformities. (PLYCSR=Pelycosauria and MAMMFMES+Mammaliaformes. Gp=group, Subgp-Subgroup, Fm=Formation, M=Member)

The proposed cemetery development is indication by the blue arrow

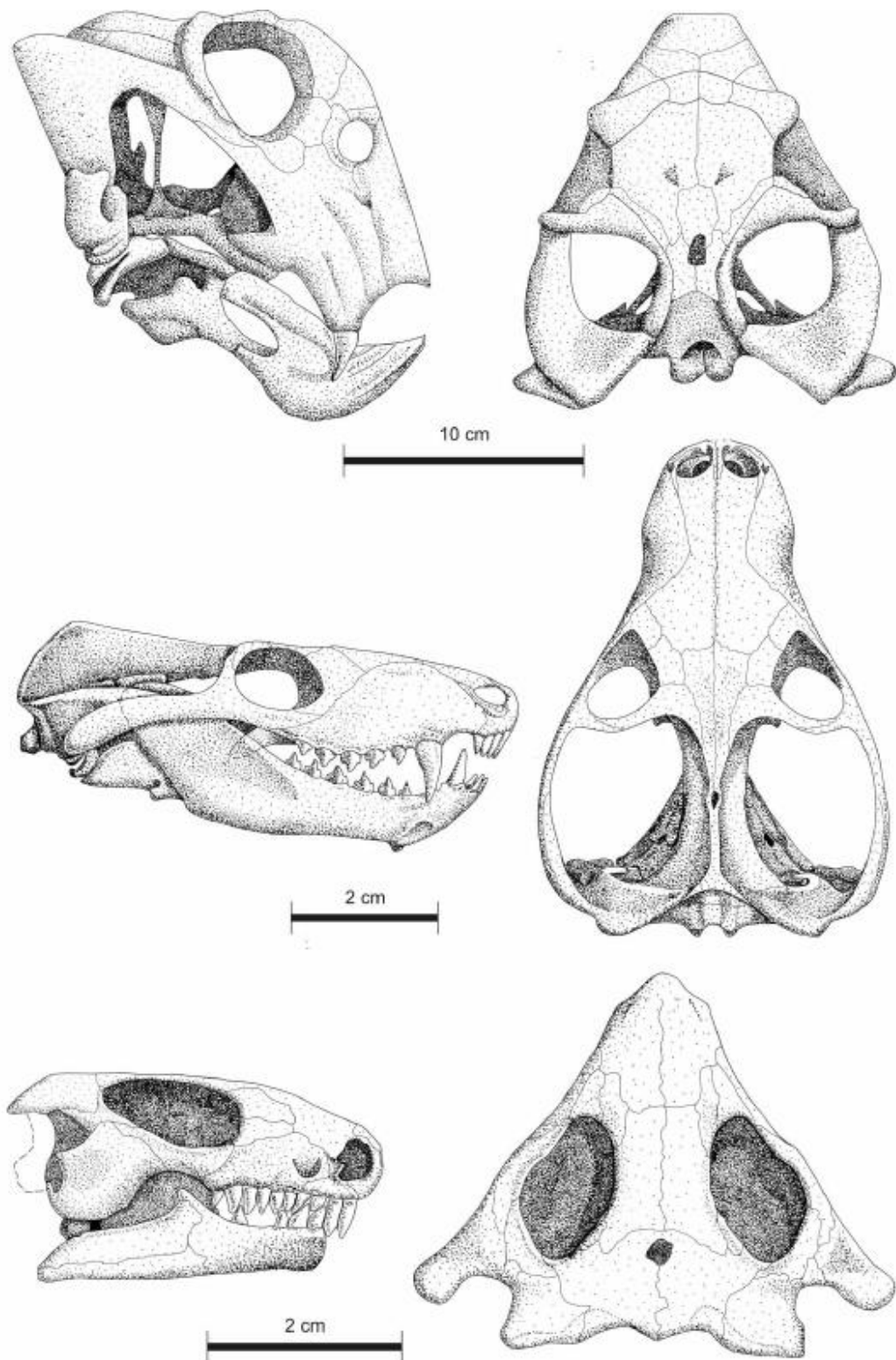


**Figure 42:** Lateral and dorsal views of skull of the dicynodont *Daptocephalus leoniceps*, the main *Daptocephalus* AZ defining fossil (Image taken from Viglietti, 2020).

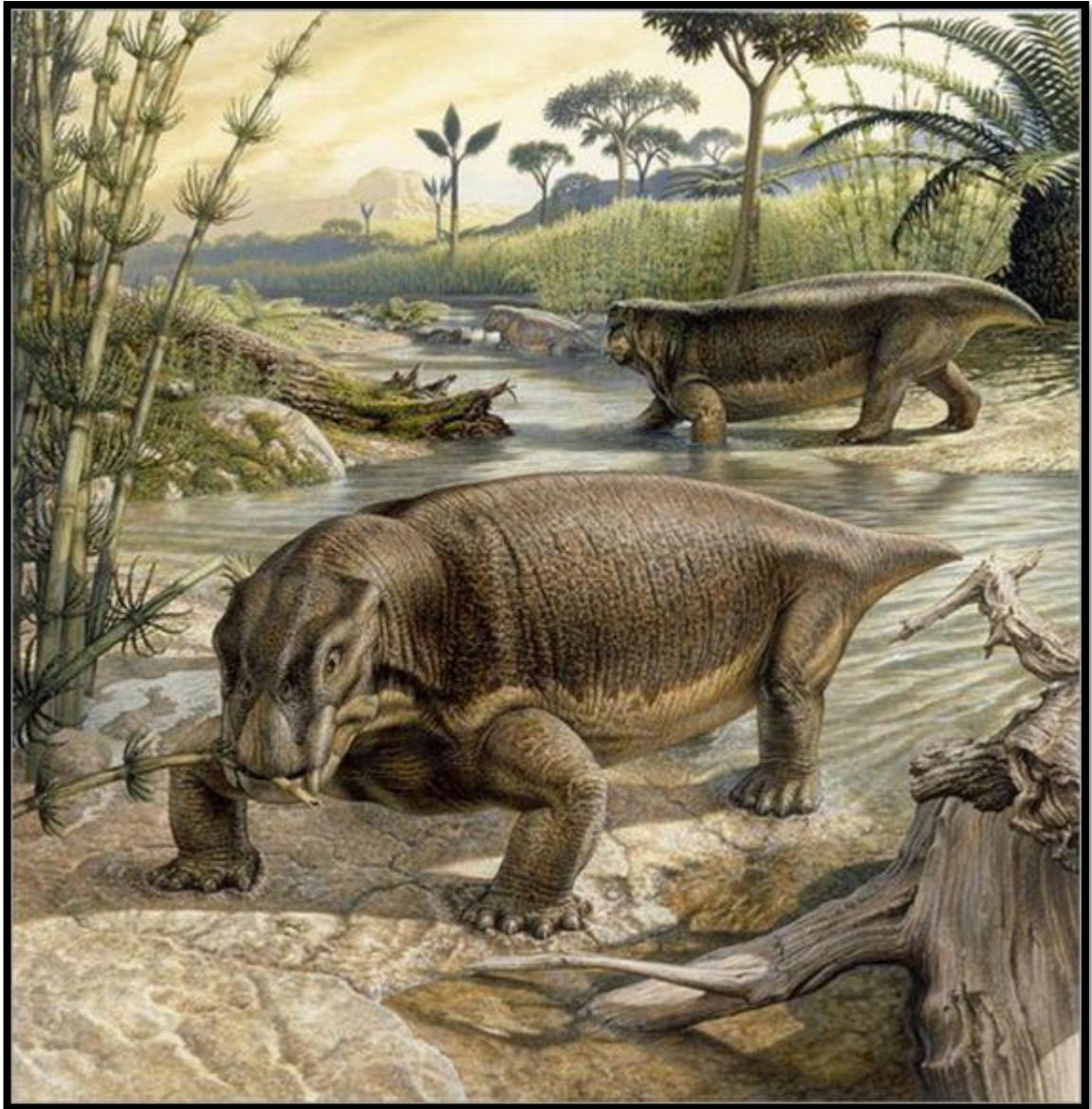


**Figure 43:** Skulls of the biozone defining fossils of the *Dicynodon-Theriognathus* Subzone in lateral and dorsal views. *Dicynodon lacerticeps* (top), *Theriognathus microps* (bottom) (Image taken from Viglietti, 2020).





**Figure 44:** Lateral and dorsal views of the index taxa defining the *Lystrosaurus declivis* Assemblage Zone. (top) *Lystrosaurus declivis*, (centre) *Thrinaxodon liorhinus*, (bottom) *Procolophon trigoniceps*.

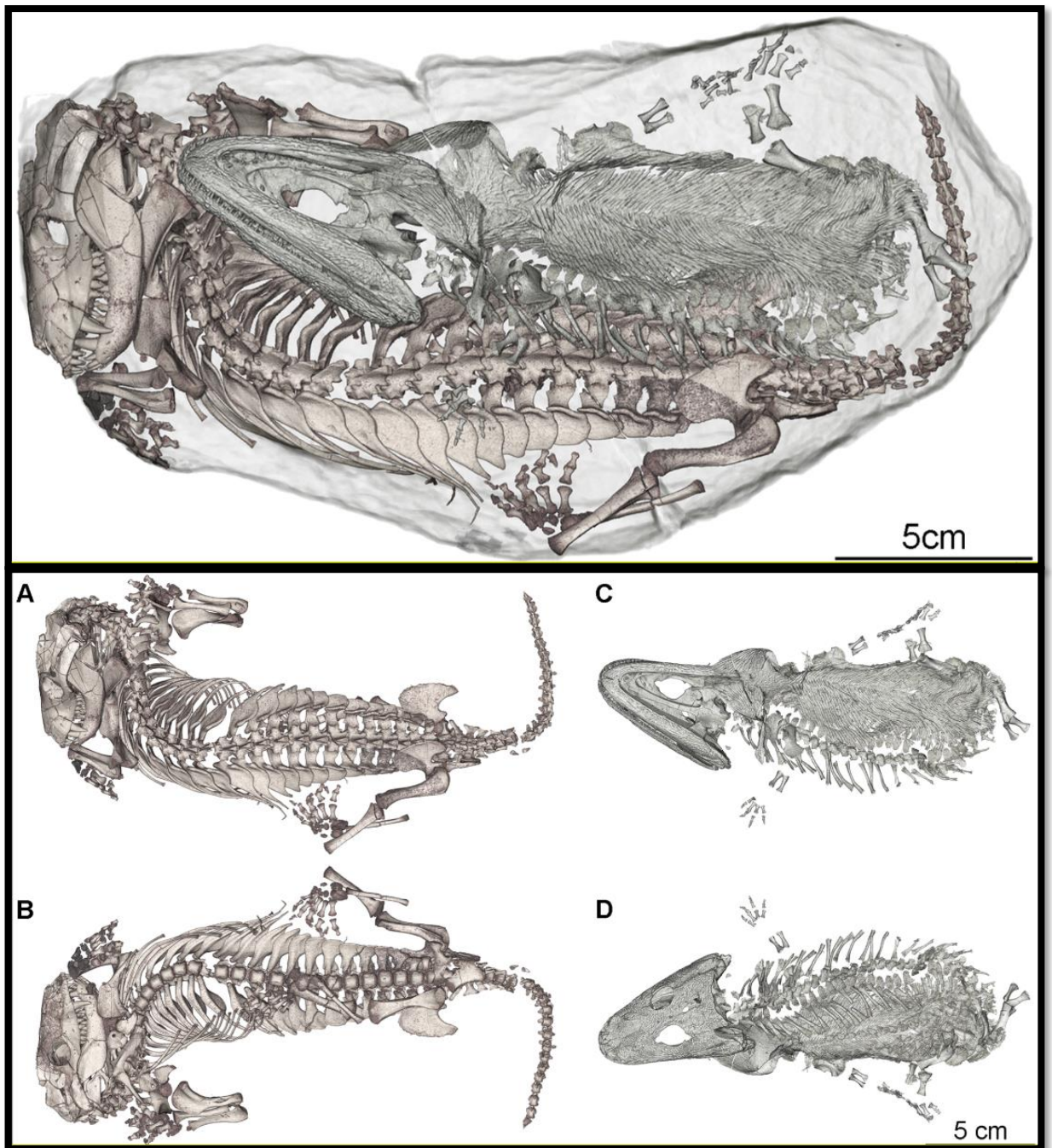


**Figure 45:** Reconstruction of *Lystrosaurus*

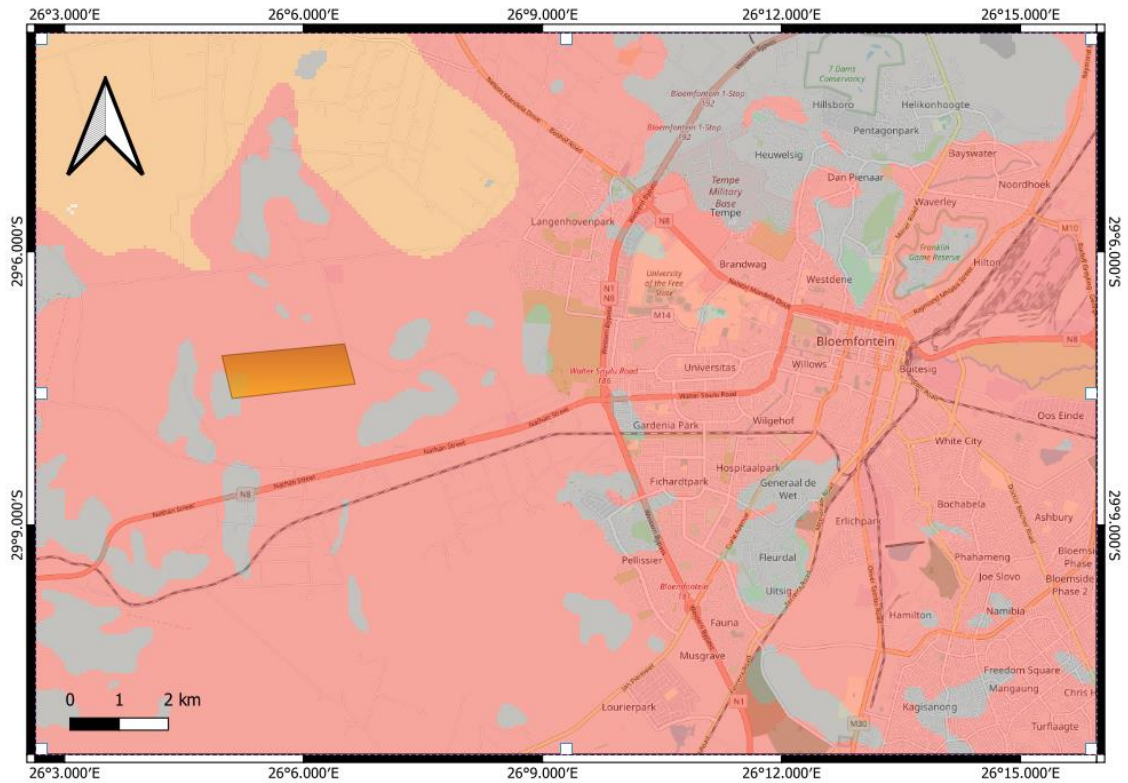
<https://i.pinimg.com/564x/ac/7b/13/ac7b132d1d9882e6d9f9af804820a21e.jpg>

*Lystrosaurus* sp





**Figure 46:** Synchrotron scan of a burrow cast from the Early Triassic indicates an injured temnospondyl amphibian (*Broomistega*) that sheltered in a burrow occupied by an aestivating therapsid (*Thrinaxodon*) Image taken from Fernandez, et al., 2013.



**Figure 47:** Extract of the 1 in 250 000 SAHRIS PalaeoMap map (Council of Geosciences) indicating the proposed development in orange.

According to the SAHRIS Palaeosensitivity map (Figure 24) the proposed development is underlain by sediments with a Very High (red), and Zero (grey) Palaeontological Sensitivity.

Table 3: Palaeontological Sensitivity on SAHRIS

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

## 6. GEOGRAPHICAL LOCATION OF THE SITE

The proposed Harvard 1 Solar PV facility on Portion 8 of Farm Spes Bona no 2355 in the Mangaung Metropolitan Municipality is about 5km west of Bloemfontein (Figure1-3). This Power Facility will connect to the present Harvard substation north of the Harvard 1 Solar PV facility via an approximately 2,3km long 275kV overhead grid connection line situated on the western edge of Remainder of Farm 2300 (separate application). The Harvard 1 Solar PV facility will be approximately 210ha in extent.

Table 4: Location of the proposed Harvard 1 Solar PV facility and associated infrastructure.

|                          |                                 |                              |
|--------------------------|---------------------------------|------------------------------|
| <b>Study Area</b>        | <b>Northern western border:</b> | <b>North-eastern border:</b> |
| <b>GPS Coordinates -</b> | -29.119116° 26.082996°          | -29.116973° 26.108446°       |



|  |   |   |
|--|---|---|
|  | <b>South -western border:</b><br>-29.127075° 26.085119° | <b>South -eastern border:</b><br>-29.124316° 26.110675° |
|--|---|---|

## 7. METHODS

The aim of a desktop study is to evaluate the risk to palaeontological heritage in the proposed development. This includes all trace fossils and fossils. All available information is consulted to compile a desktop study and includes Palaeontological impact assessment reports in the same area, aerial photos, and Google Earth images, topographical as well as geological maps.

### 7.1. Assumptions and Limitations

When conducting a PIA several factors can affect the accuracy of the assessment. The focal point of geological maps is the geology of the area, and the sheet explanations were not meant to focus on palaeontological heritage. Many inaccessible regions of South Africa have not been reviewed by palaeontologists and data is generally based on aerial photographs. 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 used to provide information on the existence of fossils in an area which was not yet been documented. When similar Assemblage Zones and geological formations for Desktop studies is used it is generally **assumed** that exposed fossil heritage is present within the footprint.

## 8. 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)
- 1:250 000 Bloemfontein 2926 Geological Map (1966) (Council of Geoscience, Pretoria)
- A Google Earth map with polygons of the proposed development was obtained from EnviroAfrica.

## 9. SITE VISIT

A site-specific field survey of the development footprint was conducted on foot and by motor vehicle on 26 January 2022. No visible dolerite outcrops were identified on this development. **Although no surface outcrops were identified in the development footprint, fossil heritage could be embedded within rocks beneath the surface.** It is thus possible that fossil heritage could be present in the development footprint and thus a Chance Find Protocol is included in this report. The following photographs were taken during the site visit to the proposed development.



**Figure 48:** View from the northern border overlooking Harvard Solar 1 development.

GPS coordinates -29.116944, 26.108333



**Figure 49:** View from the southern border overlooking the proposed Harvard Solar 1 development. The flat topography and lush vegetation are depicted.

GPS coordinates -29.125000 26.104167





**Figure 50:** Development was utilized for agricultural



## 10. IMPACT ASSESSMENT METHODOLOGY

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 following project phases:

- Construction.
- Operation; and
- 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 5: The rating system

|   |                            |   |
|---|----------------------------|---|
| <b>NATURE</b>   |                            |   |
| The Nature of the Impact is the possible destruction of fossil heritage   |                            |   |
| <b>GEOGRAPHICAL EXTENT</b>  |                            |   |
| This is defined as the area over which the impact will be experienced.  |                            |   |
| 1   | Site                       | The impact will only affect the site.   |
| 2   | Local/district             | Will affect the local area or district.   |
| 3   | Province/region            | Will affect the entire province or region.  |
| 4   | International and National | Will affect the entire country.   |
| <b>PROBABILITY</b>  |                            |   |
| This describes the chance of occurrence of an impact.   |                            |   |
| 1   | Unlikely                   | The chance of the impact occurring is extremely low (Less than a 25% chance of occurrence).   |
| 2   | Possible                   | The impact may occur (Between a 25% to 50% chance of occurrence).   |
| 3   | Probable                   | The impact will likely occur (Between a 50% to 75% chance of occurrence).   |
| 4   | Definite                   | Impact will certainly occur (Greater than a 75% chance of occurrence).  |
| <b>DURATION</b>   |                            |   |
| This describes the duration of the impacts. Duration indicates the lifetime of the impact as a result of the proposed activity. |                            |   |
| 1   | Short term                 | The impact will either disappear with mitigation or will be mitigated through natural processes in a span shorter than the construction phase (0 – 1 years), or the impact will last for the period of a relatively short construction period and a limited recovery time after construction, thereafter it will be entirely negated (0 – 2 years). |
| 2   | Medium term                | The impact will continue or last for some time after the  |

|  |           |  |
|--|-----------|--|
|  |           | construction phase but will be mitigated by direct human action or by natural processes thereafter (2 – 10 years).   |
| 3  | Long term | The impact and its effects will continue or last for the entire operational life of the development but will be mitigated by direct human action or by natural processes thereafter (10 – 30 years).   |
| 4  | Permanent | The only class of impact that will be non-transitory. Mitigation either by man or natural process will not occur in such a way or such a time span that the impact can be considered indefinite.   |
| <b>INTENSITY/ MAGNITUDE</b>  |           |  |
| Describes the severity of an impact.   |           |  |
| 1  | Low       | Impact affects the quality, use and integrity of the system/component in a way that is barely perceptible.   |
| 2  | Medium    | Impact alters the quality, use and integrity of the system/component but system/component still continues to function in a moderately modified way and maintains general integrity (some impact on integrity).   |
| 3  | High      | Impact affects the continued viability of the system/component, and the quality, use, integrity and functionality of the system or component is severely impaired and may temporarily cease. High costs of rehabilitation and remediation.   |
| 4  | Very high | <b>Impact affects the continued viability of the system/component, and the quality, use, integrity and functionality of the system or component permanently ceases and is irreversibly impaired. Rehabilitation and remediation often impossible. If possible rehabilitation and remediation often unfeasible due to extremely high costs of rehabilitation and remediation.</b> |
| <b>REVERSIBILITY</b>   |           |  |
| This describes the degree to which an impact can be successfully reversed upon completion of the |           |  |

|   |                               |  |
|---|-------------------------------|--|
| proposed activity.  |                               |  |
| 1   | Completely reversible         | The impact is reversible with implementation of minor mitigation measures.         |
| 2   | Partly reversible             | The impact is partly reversible but more intense mitigation measures are required. |
| 3   | Barely reversible             | The impact is unlikely to be reversed even with intense mitigation measures.       |
| 4   | Irreversible                  | The impact is irreversible, and no mitigation measures exist.                      |
| <b>IRREPLACEABLE LOSS OF RESOURCES</b>  |                               |  |
| This describes the degree to which resources will be irreplaceably lost as a result of a proposed activity.   |                               |  |
| 1   | No loss of resource           | The impact will not result in the loss of any resources.                           |
| 2   | Marginal loss of resource     | The impact will result in marginal loss of resources.                              |
| 3   | Significant loss of resources | The impact will result in significant loss of resources.                           |
| 4   | Complete loss of resources    | The impact is result in a complete loss of all resources.                          |
| <b>CUMULATIVE EFFECT</b>  |                               |  |
| This describes the cumulative effect of the impacts. A cumulative impact is an effect which in itself may not be significant but may become significant if added to other existing or potential impacts emanating from other similar or diverse activities as a result of the project activity in question. |                               |  |
| 1   | Negligible cumulative impact  | The impact would result in negligible to no cumulative effects.                    |
| 2   | Low cumulative impact         | The impact would result in insignificant cumulative effects.                       |
| 3   | Medium cumulative impact      | The impact would result in minor cumulative effects.                               |
| 4   | High cumulative impact        | The impact would result in significant cumulative effects                          |
| <b>SIGNIFICANCE</b>   |                               |  |



Significance is determined through a synthesis of impact characteristics. Significance is an indication of the importance of the impact in terms of both physical extent and time scale, and therefore indicates the level of mitigation required. The calculation of the significance of an impact uses the following formula:

**[(Extent + probability + reversibility + irreplaceability + duration + cumulative effect] x magnitude/intensity.**

The summation of the different criteria will produce a non-weighted value. By multiplying this value with the magnitude/intensity, the resultant value acquires a weighted characteristic which can be measured and assigned a significance rating.

| Points   | Impact significance rating | Description  |
|----------|----------------------------|--|
| 6 to 28  | Negative low impact        | The anticipated impact will have negligible negative effects and will require little to no mitigation.   |
| 6 to 28  | Positive low impact        | The anticipated impact will have minor positive effects.   |
| 29 to 50 | Negative medium impact     | The anticipated impact will have moderate negative effects and will require moderate mitigation measures.  |
| 29 to 50 | Positive medium impact     | The anticipated impact will have moderate positive effects.  |
| 51 to 73 | Negative high impact       | The anticipated impact will have significant effects and will require significant mitigation measures to achieve an acceptable level of impact.                      |
| 51 to 73 | Positive high impact       | The anticipated impact will have significant positive effects.   |
| 74 to 96 | Negative very high impact  | The anticipated impact will have highly significant effects and are unlikely to be able to be mitigated adequately. These impacts could be considered "fatal flaws". |
| 74 to 96 | Positive very high impact  | The anticipated impact will have highly significant positive   |

## 10.1. Summary of Impact Tables

Table 6: Impact Summary

|                 | Extent | Probability | Duration | Magnitude | Reversibility | Irreplaceable | Cumulative | Significance | Impact |
|-----------------|--------|-------------|----------|-----------|---------------|---------------|------------|--------------|--------|
| Pre-mitigation  | 1      | 4           | 4        | 3         | 4             | 4             | 2          | 57           | High   |
| Post Mitigation | 1      | 4           | 4        | 1         | 4             | 4             | 2          | 19           | Low    |

Loss of fossil heritage will be a negative impact. Only the site will be affected by the proposed development. The expected duration of the impact is assessed as potentially permanent to long term. In the absence of mitigation procedures, the damage or destruction of any palaeontological materials will be permanent. Impacts on palaeontological heritage during the construction phase could potentially occur. A negative High Significance has been allocated to the proposed development pre-mitigation while a LOW significance has been allocated post mitigation.

## 11. FINDINGS AND RECOMMENDATIONS

The proposed Harvard 1 Solar PV near Bloemfontein in the Free State is largely underlain by the Balfour Formation of the Adelaide Subgroup (Beaufort Group, Karoo Supergroup) and only a small portion in the south-west is underlain by Jurassic Karoo dolerite. According to the PalaeoMap on the South African Heritage Resources Information System (SAHRIS) database, the Palaeontological Sensitivity of the Balfour Formation is Very High, and that Jurassic Karoo dolerite is Zero as it is igneous in origin (Almond and Pether 2008, SAHRIS website).

A site-specific field survey of the development footprint was thus conducted on foot and by motor vehicle on 5 January 2022. During the site visit no fossiliferous outcrops were identified. The scarcity of fossil heritage at the proposed development footprint indicates that the impact of the development footprint will be of a low significance in palaeontological terms. It is therefore considered that the

proposed development is deemed appropriate and will not lead to detrimental impacts on the palaeontological reserves of the area.

#### **Recommendations:**

- The ECO for this project must be informed that sediments of the Balfour Formation of the Adelaide Subgroup (Beaufort Group, Karoo Supergroup) have a **Very High Palaeontological Sensitivity**.
- If Palaeontological Heritage is uncovered during surface clearing and excavations the **Chance find Protocol** attached should be implemented immediately. Fossil discoveries ought to be protected and the ECO/site manager must report to SAHRA (Contact details: SAHRA, 111 Harrington Street, Cape Town. PO Box 4637, Cape Town 8000, South Africa. Tel: 021 462 4502. Fax: +27 (0)21 462 4509. Web: [www.sahra.org.za](http://www.sahra.org.za)) so that mitigation (recording and collection) can be carried out.
- Before any fossil material can be collected from the development site the specialist involved would need to apply for a collection permit from SAHRA. Fossil material must be housed in an official collection (museum or university), while all reports and fieldwork should meet the minimum standards for palaeontological impact studies proposed by SAHRA (2012).
- These recommendations should be incorporated into the Environmental Management Plan for the Harvard 1 PV Facility.

## **12. CHANCE FINDS PROTOCOL**

A following procedure will only be followed if fossils are uncovered during excavation.

### **12.1. Legislation**

Cultural Heritage in South Africa (includes all heritage resources) is protected by the **National Heritage Resources Act (Act 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.

## 12.2. Background

A fossil is the naturally preserved remains (or traces) of plants or animals embedded in rock. These plants and animals lived in the geologic past 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.

## 12.3. Introduction

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.

## 12.4. Chance Find Procedure

- If a chance find is made the person responsible for the find must immediately **stop working** and all work that could impact that finding must cease in the immediate vicinity of the find.
- The person who made the find must immediately **report** the find to his/her direct supervisor which in turn must report the find to his/her manager and the ESO or site manager. The ESO or site manager must report the find to the relevant Heritage Agency (South African Heritage Research Agency, SAHRA). (Contact details: SAHRA, 111 Harrington Street, Cape Town. PO Box 4637, Cape Town 8000, South Africa. Tel: 021 462 4502. Fax: +27 (0)21 462 4509. Web: [www.sahra.org.za](http://www.sahra.org.za)). The information to the Heritage Agency must include photographs of the find, from various angles, as well as the GPS co-ordinates.

- A preliminary report must be submitted to the Heritage Agency within **24 hours** of the find and must include the following: 1) date of the find; 2) a description of the discovery and a 3) description of the fossil and its context (depth and position of the fossil), GPS co-ordinates.
- Photographs (the more the better) of the discovery must be of high quality, in focus, accompanied by a scale. It is also important to have photographs of the vertical section (side) where the fossil was found.

Upon receipt of the preliminary report, the Heritage Agency will inform the ESO (or site manager) whether a rescue excavation or rescue collection by a palaeontologist is necessary.

- The site must be secured to protect it from any further damage. **No attempt** should be made to remove material from their environment. The exposed finds must be stabilized and covered by a plastic sheet or sand bags. The Heritage agency will also be able to advise on the most suitable method of protection of the find.
- In the event that the fossil cannot be stabilized the fossil may be collected with extreme care by the ESO (site manager). 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 Heritage Agency has issued the written authorization, the developer may continue with the development on the affected area.

### 13. BIBLIOGRAPHY

Almond, J., Pether, J, and Groenewald, G. 2013. South African National Fossil Sensitivity Map. SAHRA and Council for Geosciences. Schweitzer *et al.* (1995) pp p288.

Almond, J.E. & Pether, J. 2009. Palaeontological heritage of the Northern Cape. Interim SAHRA technical report, 124 pp. Natura Viva cc., Cape Town.

Backwell, L.R., T. S. McCarthy, L. Wadley, Z. Henderson, C. M. Steininger, B. De Klerk, M. Barré, M. Lamothe, B. M. Chase, S. Woodbourne, G.J. Susino, M.K. Bamford, C. Sievers, J.S. Brink, L. Rossouw, L. Pollarolo, G. Trower, L. Scott, F. D’errico. 2014. Multiproxy record of late Quaternary climate change and Middle Stone Age human occupation at Wonderkrater, South Africa. *Quaternary Science Reviews*. 99: 42–59.

Barnosky, A.D. 2005. Effects of Quaternary Climatic Change on Speciation in Mammals. *Journal of Mammalian Evolution*. 12:247-264

Bordy, E.M., Sztanó, O., Rubidge, B.S. and Bumby, A., 2011. Early Triassic vertebrate burrows from the Katberg Formation of the south-western Karoo Basin, South Africa. *Lethaia*, 44, 33-45.

Botha, J., and Smith, R.M.H., 2006. Rapid vertebrate recuperation in the Karoo Basin of South Africa following the end-Permian extinction. *Journal of African Earth Sciences*, 45, 502-514.

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- Botha, J., and Smith, R.M.H., 2007. *Lystrosaurus* species composition across the Permo-Triassic boundary of South Africa. *Lethaia*, 40, 125-137.
- Botha, J., Huttenlocker, A.K., Smith, R.M.H., Prevec, R., Viglietti, P. And Modesto, S., 2020. New geochemical and palaeontological data from the Permo-Triassic boundary in the South African Karoo Basin test the synchrony of terrestrial and marine extinctions. *Palaeogeography, Palaeoclimatology, Palaeoecology*, DOI: 10.1016/j.palaeo.2019.109467
- Botha, J., 2020. Biostratigraphy of the *Lystrosaurus declivis* Assemblage Zone (Beaufort Group, Karoo Supergroup), South Africa. *South African Journal of Geology*: 123(2):207-216.
- Botha-Brink, J., 2017. Burrowing in *Lystrosaurus*: preadaptation to a post extinction environment? *Journal of Vertebrate Paleontology*, 37, (5): e1365080.
- BRINK, J.S. 2012. The post-1.0 Ma evolution of large mammal endemism in southern Africa in relation to East Africa and subsequent biogeographic isolation of the Cape coastal region. *Quaternary International* vol. 279–280: 69.
- Brink, J.S. 2016. Faunal evidence for mid- and late Quaternary environmental change in southern Africa. In: Knight, J. and Grab, S.W. (eds) *Quaternary environmental change in southern Africa: physical and human dimensions*. Cambridge University Press, pp. 286-307
- Broom, R., 1906. On the Permian and Triassic faunas of South Africa. *Geological Magazine*, 5, 29-30.
- Cowan, R., 1995. *History of Life*. 2nd Edition. Blackwell Scientific Publications, Boston. 462pp.
- Damiani, R., Modesto, S., Yates, A. and Neveling, J., 2003. Earliest evidence of cynodont burrowing. *Proceedings of the Royal Society London B*, 270, 1747-1751.
- Damiani, R.J., Neveling, J., Hancox, P.J. and Rubidge B.S., 2000. First trematosaurid temnospondyl from the *Lystrosaurus* Assemblage Zone of South Africa and its biostratigraphic implications. *Geological Magazine* 137, 659-665.
- De Wit, M.C.J., Marshall, T.R. & Partridge, T.C. 2000. Fluvial deposits and drainage evolution. In: Partridge, T.C. & Maud, R.R. (Eds.) *The Cenozoic of southern Africa*, pp.55-72. Oxford University Press, Oxford.
- Dingle, R.V., Siesser, W.G. & Newton, A.R. 1983. *Mesozoic and Tertiary geology of southern Africa*. viii + 375 pp. Balkema, Rotterdam.
- Du Toit, A. 1954. *The geology of South Africa*. xii + 611pp, 41 pls. Oliver & Boyd, Edinburgh.
- Du Toit, A.L., 1918. The zones of the Karoo System and their distribution. *Proceedings of the Geological Society of South Africa*, 21, 17-37.

Duncan, R.A., Hooper, P.R., Rehacek, J., Marsh J.S. and Duncan, A.R., 1997. The timing and duration of the Karoo igneous event, southern Gondwana. *Journal of Geophysical Research*, 102, 18127-18138.

Eales, H.V., Marsh, J.S. and Cox, K.G. (1984). The Karoo Igneous Province: an introduction. In: Erlank, A.J. (Ed.), *Petrogenesis of the Volcanic Rocks of the Karoo Province*. Spec. Publ. Geol. Soc. S. Afr., 13, 1-26

Fernandez, V., Abdala, F., Carlson, K.J., Cook, D.C., Rubidge, B.S., Yates, A. and Tafforeau, P., 2013. Synchrotron reveals Early Triassic odd couple: Injured amphibian and aestivating therapsid share burrow. *PLoS ONE* 8, e64978. doi:10.1371/journal.pone.0064978.

Gastaldo, R.A., Kamo, S.L., Neveling, J., Geissman, W., Looy, C.V. and Martini, A.M., 2020. The base of the Lystrosaurus Assemblage Zone, Karoo Basin, predates the end-Permian marine extinction. *Nature Communications* 11, 1428. doi.org/10.1038/s41467-020-15243-7

Groenewald, G.H. and Kitching, J.W., 1995. Biostratigraphy of the Lystrosaurus Assemblage Zone. *South African Committee for Stratigraphy. Biostratigraphic Series* 1, 35-39.

Hunter, D.R., Johnson, M.R., Anhaeusser, C. R. and Thomas, R.J. 2006. Introduction. (*In: Johnson, M.R., Anhaeusser, C.R. and Thomas, R.J. (Eds), The Geology of South Africa*. Geological Society of South Africa, Johannesburg/Council for Geoscience, Pretoria, 585-604.)

Johnson, M.R., Visser, J.N.J., et al.2006. Sedimentary rocks of the Karoo Supergroup In Johnson, M.R., Anhaeusser, C.R. & Thomas, R.J. (eds). *The geology of South Africa*. 691 pp. Geological Society of South Africa, Johannesburg and Council for Geoscience, Pretoria.

Kent, L. E., 1980. Part 1: Lithostratigraphy of the Republic of South Africa, South West Africa/Namibia and the Republics of Bophuthatswana, Transkei, and Venda. SACS, Council for Geosciences.

Keyser, A.W. and Smith, R.H.M., 1979. Vertebrate biozonation of the Beaufort Group with special reference to the Western Karoo Basin. *Annals Geological Survey South Africa*, 12, 1-36.

Keyser, A.W., 1979. A review of the biozonation of the Beaufort Group in the Karoo basin of South Africa. *Geological Society of South Africa, Abstracts 1979 Geological Congress* 2, 13-31.

Kitching, J.W., 1970. A short review of the Beaufort zoning in South Africa. In: S.H. Haughton (Editor), *I.U.G.S., 2nd Gondwana Symposium Proceedings and Papers*, 309-312.

Kitching, J.W., 1977. The distribution of the Karoo vertebrate fauna. *Bernard Price Institute for Palaeontological Research Memoir* 1, 1-131.

Kitching, J.W., Collinson, J.W., Elliot, D.H. and Colbert, E.H., 1972. Lystrosaurus Zone (Triassic) fauna from Antarctica. *Science*, 175, 524-527.

Klein, R.G. 1984. The large mammals of southern Africa: Late Pliocene to Recent. In: Klein, R.G. (Ed.) *Southern African prehistory and paleoenvironments*, pp 107-146. Balkema, Rotterdam.

- Lewis, Patrick J.; Brink, James S.; Kennedy, Alicia M.; Campbell, Timothy L. (2011). "Examination of the Florisbad microvertebrates". *South African Journal of Science*. 107(7/8). MACRAE, C. 1999. Life etched in stone. Fossils of South Africa. 305 pp. The Geological Society of South Africa, Johannesburg.
- Lock, B.E., Paverd, A.L. and Broderick, T.J. (1974). Stratigraphy of the Karroo volcanic rocks of the Barkly East District. *Trans. Geol. Soc. S. Afr.*, 77, 117–129
- Lucas, S.G., 1998. Global Triassic tetrapod biostratigraphy and biochronology. *Palaeogeography, Palaeoclimatology, Palaeoecology*, 143, 347-384.
- Macrae, C. 1999. Life etched in stone. Fossils of South Africa. 305 pp. The Geological
- Marchetti, L., Klein, H., Buchwitz, M., Ronchi, A., Smith, R.M.H., De Klerk, E., Sciscio, L. and Groenewald, G., 2019. Ichnoassociations of Permian and Triassic tetrapod footprints in the Karoo Basin of South Africa. *Gondwana Research* 72,139-168.
- Maud, R. 2012. Macroscale Geomorphic Evolution. (*In* Holmes, P. and Meadows, M. Southern Africa Geomorphology, New trends and new directions. Bloemfontein: Sun Press. p. 7- 21)
- McCarthy, T. & Rubidge, B. 2005. The story of Earth and life: a southern African perspective on a 4.6-billion-year journey. 334pp. Struik, Cape Town
- Michaelsen, P., 2002. Mass extinction of peat-forming plants and the effect on fluvial styles across the Permian-Triassic boundary, northern Bowen Basin, Australia, *Palaeogeography Palaeoclimatology Palaeoecology*, 179, 173-188.
- Modesto, S.P. and Botha-Brink, J., 2010. A burrow cast with *Lystrosaurus* skeletal remains from the Lower Triassic of South Africa. *Palaios*, 25, 274-281.
- Neveling, J., 2004. Stratigraphic and sedimentological investigation of the contact between the *Lystrosaurus* and *Cynognathus* Assemblage Zones (Beaufort Group: Karoo Supergroup). *Council for Geoscience Bulletin* 137, 1-165.
- Neveling, J., Hancox, P.J. and Rubidge, B.S., 2004. Biostratigraphy of the lower Burgersdorp Formation (Beaufort Group; Karoo Supergroup) of South Africa – implications for the stratigraphic ranges of Early Triassic tetrapods. *Palaeontologia africana*, 41, 81-87.
- Nicolas, M.V.M., 2007. Tetrapod Biodiversity through the Permo Triassic Beaufort Group (Karoo Supergroup) of South Africa. Unpublished PhD thesis, University of the Witwatersrand, Johannesburg. 356pp
- Partridge, T.C. & Scott, L. 2000. Lakes and pans. In: Partridge, T.C. & Maud, R.R. (Eds.) *The Cenozoic of southern Africa*, pp.145 - 161. Oxford University Press, Oxford.

Partridge, T.C., Botha, G.A. & Haddon, I.G. 2006. Cenozoic deposits of the interior. In: Johnson, M.R., Anhaeusser, C.R. & Thomas, R.J. (Eds.) *The geology of South Africa*, pp. 585-604. Geological Society of South Africa, Marshalltown.

Rubidge B.S., 1995 *Biostratigraphy of the Beaufort Group (Karoo Supergroup)*. South African Committee for Stratigraphy Biostratigraphic Series 1: 1-46 Pretoria South African Committee for Stratigraphy and Biostratigraphy

S.A.C.S. (South African Committee for Stratigraphy), 1980. *Stratigraphy of South Africa. Part 1. Lithostratigraphy of the Republic of South Africa, South West Africa/Namibia, and the Republics of Bophuthatswana, Transkei, and Venda*. Handbook of the Geological Survey of South Africa, 8, 690pp

Scott, L. & J.S. Brink. 1992. Quaternary palynology, palaeontology and palaeoenvironments in central South Africa. *South African Geographer* 19: 22-34.

SG 2.2 SAHRA APMHOB Guidelines, 2012. Minimum standards for palaeontological components of Heritage Impact Assessment Reports, Pp 1-15.

Smith R.M.H., 1990. A review of stratigraphy and sedimentary environments in the Karoo Basin of South Africa. *Journal of African Earth Sciences*, 10, 117-137

Smith, R.M.H. and Botha-Brink, J., 2011. Anatomy of an extinction: End-Permian drought induced die-off in the Karoo Basin, South Africa. Abstracts SVP Annual Meeting Las Vegas *Journal Vertebrate Palaeontology*, SVP Program and Abstracts Book, 2011, 196.

Smith, R.M.H. and Botha-Brink, J., 2014. Anatomy of an extinction: Sedimentological and taphonomic evidence for drought-induced die-offs during the Permo-Triassic mass extinction in the main Karoo Basin, South Africa. *Palaeogeography, Palaeoclimatology, Palaeoecology*, 396, 99-118.

Smith, R.M.H. and Ward, P.D., 2001. Pattern of vertebrate extinctions across an event bed at the Permian–Triassic boundary in the Karoo Basin of South Africa. *Geological Society of America Bulletin*, 29, 1147-1150.

Smith, R.M.H., 1995. Changing fluvial environments across the Permian–Triassic boundary in the Karoo Basin, South Africa, and possible causes of the extinctions. *Palaeogeography, Palaeoclimatology, Palaeoecology*, 117, 81-104.

Smith, R.M.H., Rubidge, B.S. and van der Walt, M., 2012. Therapsid biodiversity patterns and paleoenvironments of the Karoo Basin, South Africa. In: A. Chinsamy (Editor), *The forerunners of mammals: radiation, histology, and biology*. Indiana University Press, Bloomington, 31-62.

Smith, R.M.H., Rubidge, B.S., Day, M.O., Botha; J. 2020. Introduction to the tetrapod biozonation of the Karoo Supergroup. *South African Journal of Geology* 123 (2): 131–140. Doi: <https://doi.org/10.25131/sajg.123.0009>.

Tankard, A.J., Jackson, M.P.A., Eriksson, K.A., Hobday, D.K., Hunter, D.R. & Minter, W.E.L. 1982. Crustal evolution of southern Africa – 3.8 billion years of earth history, xv + 523pp. Springer Verlag, New York.

Thomas, M.J. 1981. The geology of the Kalahari in the Northern Cape Province (Areas 2620)

Tooth, S. Brandt, D., Hancox P.J. And Mccarthy, T. S. 2004. Geological controls on alluvial river behaviour: a comparative study of three rivers in the South African Highveld. *Journal of African Earth Sciences*, 38(2004): 79-97, 15 Aug.

Van Zyl, W., S. Badenhorst & J.S. Brink. 2016. Pleistocene Bovidae from X Cave on Bolt's Farm in the Cradle of Humankind in South Africa. *Annals of the Ditsong National Museum of Natural History* 6: 39–73.

Viglietti P.A., Smith R.M.H. and Compton J.S., 2013. Origin and palaeoenvironmental significance of Lystrosaurus bonebeds in the earliest Triassic Karoo Basin, South Africa. *Palaeogeography, Palaeoecology, Palaeoclimatology*, 392, 9-21.

Viglietti P.A., 2020. The Daptocephalus Assemblage Zone (Lopingian), South Africa: A proposed biostratigraphy based on a new compilation of stratigraphic ranges. *South African Journal of Geology* 123 (2): 191-206. DOI: [10.1016/j.jafrearsci.2015.10.011](https://doi.org/10.1016/j.jafrearsci.2015.10.011)

Visser, D.J.L. (ed) 1984. Geological Map of South Africa 1:100 000. South African Committee for Stratigraphy, Council for Geoscience, Pretoria.

Visser, D.J.L. (ed) 1989. *Toeligting: Geologiese kaart (1:100 000). Die Geologie van die Republieke van Suid Afrika, Transkei, Bophuthatswana, Venda, Ciskei en die Koningkryke van Lesotho en Swaziland.* South African Committee for Stratigraphy. Council for Geoscience, Pretoria, Pp 494.



**APPENDIX A – ELIZE BUTLER CV**  
**ELIZE BUTLER**

**PROFESSION:** Palaeontologist  
**YEARS' EXPERIENCE:** 26 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 National Museum, Bloemfontein  
and Collection Manager 1998–currently

## TECHNICAL REPORTS

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

**Butler, E. 2016.** Palaeontological Impact Assessment of the proposed Woodhouse 2 Photovoltaic Solar Energy facility and associated infrastructure on the farm Woodhouse 729, near Vryburg, North West Province. Bloemfontein.

**Butler, E. 2016.** Proposed 132kV overhead power line and switchyard station for the authorised Solis Power 1 CSP project near Upington, Northern Cape. Bloemfontein.

**Butler, E. 2016.** Palaeontological Impact Assessment of the proposed Senqu Pedestrian Bridges in Ward 5 of Senqu Local Municipality, Eastern Cape Province. Bloemfontein.

**Butler, E. 2016.** Recommendation from further Palaeontological Studies: Proposed Construction of the Modderfontein Filling Station on Erf 28 Portion 30, Founders Hill, City of Johannesburg, Gauteng Province. Bloemfontein.

**Butler, E. 2016.** Recommendation from further Palaeontological Studies: Proposed Construction of the Modikwa Filling Station on a Portion of Portion 2 of Mooihoek 255 Kt, Greater Tubatse Local Municipality, Limpopo Province. Bloemfontein.

**Butler, E. 2016.** Recommendation from further Palaeontological Studies: Proposed Construction of the Heidedal filling station on Erf 16603, Heidedal Extension 24, Mangaung Local Municipality, Bloemfontein, Free State Province. Bloemfontein.

**Butler, E. 2016.** Recommended Exemption from further Palaeontological studies: Proposed Construction of the Gunstfontein Switching Station, 132kv Overhead Power Line (Single or Double

Circuit) and ancillary infrastructure for the Gunstfontein Wind Farm Near Sutherland, Northern Cape Province. Savannah South Africa. Bloemfontein.

**Butler, E. 2016.** Palaeontological Impact Assessment of the proposed Galla Hills Quarry on the remainder of the farm Roode Krantz 203, in the Lukhanji Municipality, division of Queenstown, Eastern Cape Province. Bloemfontein.

**Butler, E. 2016.** Chris Hani District Municipality Cluster 9 water backlog project phases 3a and 3b: Palaeontology inspection at Tsomo WTW. Bloemfontein.

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

**Butler, E. 2016.** Palaeontological Impact Assessment of the proposed upgrading of the main road MR450 (R335) from Motherwell to Addo within the Nelson Mandela Bay Municipality and Sunday's River valley Local Municipality, Eastern Cape Province. Bloemfontein.

**Butler, E. 2016.** Palaeontological Impact Assessment construction of the proposed Metals Industrial Cluster and associated infrastructure near Kuruman, Northern Cape Province. Savannah South Africa. Bloemfontein.

**Butler, E. 2016.** Palaeontological Impact Assessment for the proposed construction of up to a 132kv power line and associated infrastructure for the proposed Kalkaar Solar Thermal Power Plant near Kimberley, Free State and Northern Cape Provinces. PGS Heritage. Bloemfontein.

**Butler, E. 2016.** Palaeontological Impact Assessment of the proposed development of two burrow pits (DR02625 and DR02614) in the Enoch Mgijima Municipality, Chris Hani District, Eastern Cape.

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

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

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

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

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

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

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

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

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

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

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

**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.

**Butler, E. 2017.** Palaeontological Impact Assessment for the Development of the Proposed Ventersburg Project-An Underground Mining Operation near Ventersburg and Henneman, Free State Province. Bloemfontein.

**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.

**Butler, E. 2017.** Palaeontological 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 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 10 in the Albert Luthuli Local Municipality, Gert Sibande District Municipality, Mpumalanga Province. Bloemfontein.

**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 Lephalale coal and power project, Lephalale, 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 Lephalale Coal and Power Project, Lephalale, 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 H<sub>2</sub> 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 decommissioning 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 Delportshoop 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



**Butler, E., 2019.** Palaeontological Field Assessment for Heuningspruit PV 1 Solar Energy Facility near Koppies, Ngwathe Local Municipality, Free State Province.

**Butler, E., 2019.** Palaeontological Field Assessment for the Moeding Solar Grid Connection, North West Province.

**Butler, E., 2019.** Recommended Exemption from further Palaeontological studies for the Proposed Agricultural Development on Farms 1763, 2372 And 2363, Kakamas South Settlement, Kai! Garib Municipality, Mgcawu District Municipality, Northern Cape Province.

**Butler, E., 2019.** Recommended Exemption from further Palaeontological studies: of Proposed Agricultural Development, Plot 1178, Kakamas South Settlement, Kai! Garib Municipality

**Butler, E., 2019.** Palaeontological Desktop Assessment for the Proposed Waste Rock Dump Project at Tshipi Borwa Mine, near Hotazel, Northern Cape Province:

**Butler, E., 2019.** Palaeontological Exemption Letter for the proposed DMS Upgrade Project at the Sishen Mine, Gamagara Local Municipality, Northern Cape Province

**Butler, E., 2019.** Palaeontological Desktop Assessment of the proposed Integrated Environmental Authorisation process for the proposed Der Brochen Amendment project, near Groblershoop, Limpopo

Butler, E., **2019.** Palaeontological Desktop Assessment of the proposed updated Environmental Management Programme (EMPr) for the Assmang (Pty) Ltd Black Rock Mining Operations, Hotazel, Northern Cape

**Butler, E., 2019.** Palaeontological Desktop Assessment of the proposed Kriel Power Station Lime Plant Upgrade, Mpumalanga Province

**Butler, E., 2019.** Palaeontological Impact Assessment for the proposed Kangala Extension Project Near Delmas, Mpumalanga Province.

**Butler, E., 2019.** Palaeontological Desktop Assessment for the proposed construction of an iron/steel smelter at the Botshabelo Industrial area within the Mangaung Metropolitan Municipality, Free State Province.

**Butler, E., 2019.** Recommended Exemption from further Palaeontological studies for the proposed agricultural development on farms 1763, 2372 and 2363, Kakamas South settlement, Kai! Garib Municipality, Mgcawu District Municipality, Northern Cape Province.

**Butler, E., 2019.** Recommended Exemption from further Palaeontological Studies for Proposed formalisation of Gamakor and Noodkamp low-cost Housing Development, Keimoes, Gordonia Rd, Kai !Garib Local Municipality, ZF Mgcawu District Municipality, Northern Cape Province.

**Butler, E., 2019.** Recommended Exemption from further Palaeontological Studies for proposed formalisation of Blaauwskop Low-Cost Housing Development, Kenhardt Road, Kai !Garib Local Municipality, ZF Mgcawu District Municipality, Northern Cape Province.

**Butler, E., 2019.** Palaeontological Desktop Assessment of the proposed mining permit application for the removal of diamonds alluvial and diamonds kimberlite near Windsorton on a certain portion of Farm Zoelen's Laagte 158, Registration Division: Barkly Wes, Northern Cape Province.

**Butler, E., 2019.** Palaeontological Desktop Assessment of the proposed Vedanta Housing Development, Pella Mission 39, Khâi-Ma Local Municipality, Namakwa District Municipality, Northern Cape.

**Butler, E., 2019.** Palaeontological Desktop Assessment for The Proposed 920 KWP Groenheuwel Solar Plant Near Augrabies, Northern Cape Province

**Butler, E., 2019.** Palaeontological Desktop Assessment for the establishment of a Super Fines Storage Facility at Amandelbult Mine, Near Thabazimbi, Limpopo Province

**Butler, E., 2019.** Palaeontological Impact Assessment for the proposed Sace Lifex Project, Near Emalahleni, Mpumalanga Province

**Butler, E., 2019.** Palaeontological Desktop Assessment for the proposed Rehau Fort Jackson Warehouse Extension, East London

**Butler, E., 2019.** Palaeontological Desktop Assessment for the proposed Environmental Authorisation Amendment for moving 3 Km of the Merensky-Kameni 132KV Powerline

**Butler, E., 2019.** Palaeontological Impact Assessment for the proposed Umsobomvu Solar PV Energy Facilities, Northern and Eastern Cape

**Butler, E., 2019.** Palaeontological Desktop Assessment for six proposed Black Mountain Mining Prospecting Right Applications, without Bulk Sampling, in the Northern Cape.

**Butler, E., 2019.** Palaeontological field Assessment of the Filling Station (Rietvlei Extension 6) on the Remaining Portion of Portion 1 of the Farm Witkoppies 393JR east of the Rietvleidam Nature Reserve, City of Tshwane, Gauteng

**Butler, E., 2019.** Palaeontological Desktop Assessment of The Proposed Upgrade of The Vaal Gamagara Regional Water Supply Scheme: Phase 2 And Groundwater Abstraction

**Butler, E., 2019.** Palaeontological Desktop Assessment of The Expansion of The Jan Kempdorp Cemetery on Portion 43 Of Farm Guldenskat 36-Hn, Northern Cape Province

**Butler, E., 2019.** Palaeontological Desktop Assessment of the Proposed Residential Development on Portion 42 Of Farm Geldunskat No 36 In Jan Kempdorp, Phokwane Local Municipality, Northern Cape Province

**Butler, E.,** 2019. Palaeontological Impact Assessment of the proposed new Township Development, Lethabo Park, on Remainder of Farm Roodepan No 70, Erf 17725 And Erf 15089, Roodepan Kimberley, Sol Plaatjies Local Municipality, Frances Baard District Municipality, Northern Cape

**Butler, E.,** 2019. Palaeontological Protocol for Finds for the proposed 16m WH Battery Storage System in Steinkopf, Northern Cape Province

**Butler, E.,** 2019. Palaeontological Exemption Letter of the proposed 4.5WH Battery Storage System near Midway-Pofadder, Northern Cape Province

**Butler, E.,** 2019. Palaeontological Exemption Letter of the proposed 2.5ml Process Water Reservoir at Gloria Mine, Black Rock, Hotazel, Northern Cape

**Butler, E.,** 2019. Palaeontological Desktop Assessment for the Establishment of a Super Fines Storage Facility at Gloria Mine, Black Rock Mine Operations, Hotazel, Northern Cape:

**Butler, E.,** 2019. Palaeontological Desktop Assessment for the Proposed New Railway Bridge, and Rail Line Between Hotazel and the Gloria Mine, Northern Cape Province

**Butler, E.,** 2019. Palaeontological Exemption Letter of The Proposed Mixed Use Commercial Development on Portion 17 of Farm Boegoeberg Settlement Number 48, !Kheis Local Municipality in The Northern Cape Province. Banzai Environmental (Pty) Ltd, Bloemfontein.

**Butler, E.,** 2019. Palaeontological Desktop Assessment of the Proposed Diamond Mining Permit Application Near Kimberley, Sol Plaatjies Municipality, Northern Cape Province. Banzai Environmental (Pty) Ltd, Bloemfontein.

**Butler, E.,** 2019. Palaeontological Desktop Assessment of the Proposed Diamonds (Alluvial, General & In Kimberlite) Prospecting Right Application near Postmasburg, Registration Division; Hay, Northern Cape Province. Banzai Environmental (Pty) Ltd, Bloemfontein.

**Butler, E.,** 2019. Palaeontological Desktop Assessment of the proposed diamonds (alluvial, general & in kimberlite) prospecting right application near Kimberley, Northern Cape Province. Banzai Environmental (Pty) Ltd, Bloemfontein.

**Butler, E.,** 2019. Palaeontological Phase 1 Impact Assessment of the proposed upgrade of the Vaal Gamagara regional water supply scheme: Phase 2 and groundwater abstraction. Banzai Environmental (Pty) Ltd, Bloemfontein.

**Butler, E.,** 2019. Palaeontological Desktop Assessment of the proposed seepage interception drains at Duvha Power Station, Emalahleni Municipality, Mpumalanga Province. Banzai Environmental (Pty) Ltd, Bloemfontein.

**Butler, E.**, 2019. Palaeontological Desktop Assessment letter for the Proposed PV Solar Facility at the Heineken Sedibeng Brewery, near Vereeniging, Gauteng. Banzai Environmental (Pty) Ltd, Bloemfontein.

**Butler, E.**, 2019. Palaeontological Phase 1 Assessment letter for the Proposed PV Solar Facility at the Heineken Sedibeng Brewery, near Vereeniging, Gauteng. Banzai Environmental (Pty) Ltd, Bloemfontein.

**Butler, E.**, 2019. Palaeontological field Assessment for the Proposed Upgrade of the Kolomela Mining Operations, Tsantsabane Local Municipality, Siyanda District Municipality, Northern Cape Province, Northern Cape. Banzai Environmental (Pty) Ltd, Bloemfontein.

**Butler, E.**, 2019. Palaeontological Desktop Assessment of the proposed feldspar prospecting rights and mining application on portion 4 and 5 of the farm Rozynen 104, Kakamas South, Kai! Garib Municipality, Zf Mgcawu District Municipality, Northern Cape. Banzai Environmental (Pty) Ltd, Bloemfontein.

**Butler, E.**, 2019. Palaeontological Phase 1 Field Assessment of the proposed Summerpride Residential Development and Associated Infrastructure on Erf 107, Buffalo City Municipality, East London. Banzai Environmental (Pty) Ltd, Bloemfontein.

**Butler, E.**, 2019. Palaeontological Desktop Impact Assessment for the proposed re-commission of the Old Balgay Colliery near Dundee, KwaZulu Natal.

**Butler, E.**, 2019. Palaeontological Phase 1 Impact Assessment for the Proposed Re-Commission of the Old Balgay Colliery near Dundee, KwaZulu Natal. Banzai Environmental (Pty) Ltd, Bloemfontein.

**Butler, E.**, 2019. Palaeontological Desktop Assessment for the Proposed Environmental Authorisation and Amendment Processes for Elandsfontein Colliery. Banzai Environmental (Pty) Ltd, Bloemfontein.

**Butler, E.**, 2019. Palaeontological Impact Assessment and Protocol for Finds of a Proposed New Quarry on Portion 9 (of 6) of the farm Mimosa Glen 885, Bloemfontein, Free State Province. Banzai Environmental (Pty) Ltd, Bloemfontein.

**Butler, E.**, 2019. Palaeontological Impact Assessment and Protocol for Finds of a proposed development on Portion 9 and 10 of the Farm Mimosa Glen 885, Bloemfontein, Free State Province. Banzai Environmental (Pty) Ltd, Bloemfontein.

**Butler, E.**, 2019. Palaeontological Exemption Letter for the proposed residential development on the Remainder of Portion 1 of the Farm Strathearn 2154 in the Magisterial District of Bloemfontein, Free State. Banzai Environmental (Pty) Ltd, Bloemfontein.

**Butler, E.,** 2019. Palaeontological Field Assessment for the Proposed Nigel Gas Transmission Pipeline Project in the Nigel Area of the Ekurhuleni Metropolitan Municipality, Gauteng Province. Banzai Environmental (Pty) Ltd, Bloemfontein.

**Butler, E.,** 2019. Palaeontological Desktop Assessment for five Proposed Black Mountain Mining Prospecting Right Applications, Without Bulk Sampling, in the Northern Cape. Banzai Environmental (Pty) Ltd, Bloemfontein.

**Butler, E.** 2019. Palaeontological Desktop Assessment for the Proposed Environmental Authorisation and an Integrated Water Use Licence Application for the Reclamation of the Marievale Tailings Storage Facilities, Ekurhuleni Metropolitan Municipality - Gauteng Province. Banzai Environmental (Pty) Ltd, Bloemfontein.

**Butler, E.,** 2019. Palaeontological Impact Assessment for the Proposed Sace Lifex Project, near Emalaheni, Mpumalanga Province. Banzai Environmental (Pty) Ltd, Bloemfontein.

**Butler, E.,** 2019. Palaeontological Desktop Assessment for the proposed Golfview Colliery near Ermelo, Msukaligwa Local Municipality, Mpumalanga Province

**Butler, E.,** 2019. Palaeontological Desktop Assessment for the Proposed Kangra Maquasa Block C Mining development near Piet Retief, in the Mkhondo Local Municipality within the Gert Sibande District Municipality. Banzai Environmental (Pty) Ltd, Bloemfontein.

**Butler, E.,** 2019. Palaeontological Desktop Assessment for the Proposed Amendment of the Kusipongo Underground and Opencast Coal Mine in Support of an Environmental Authorization and Waste Management License Application. Banzai Environmental (Pty) Ltd, Bloemfontein.

**Butler, E.,** 2019. Palaeontological Exemption Letter of the Proposed Mamatwan Mine Section 24g Rectification Application, near Hotazel, Northern Cape Province. Banzai Environmental (Pty) Ltd, Bloemfontein.

**Butler, E.,** 2020. Palaeontological Field Assessment for the Proposed Environmental Authorisation and Amendment Processes for Elandsfontein Colliery. Banzai Environmental (Pty) Ltd, Bloemfontein.

**Butler, E.,** 2020. Palaeontological Desktop Assessment for the Proposed Extension of the South African Nuclear Energy Corporation (Necsa) Pipe Storage Facility, Madibeng Local Municipality, North West Province. Banzai Environmental (Pty) Ltd, Bloemfontein.

**Butler, E.,** 2020. Palaeontological Field Assessment for the Proposed Piggery on Portion 46 of the Farm Brakkefontien 416, Within the Nelson Mandela Bay Municipality, Eastern Cape. Banzai Environmental (Pty) Ltd, Bloemfontein.

**Butler, E.,** 2020. Palaeontological field Assessment for the proposed Rietfontein Housing Project as part of the Rapid Land Release Programme, Gauteng Province Department of Human



Settlements, City of Johannesburg Metropolitan Municipality. Banzai Environmental (Pty) Ltd, Bloemfontein.

**Butler, E., 2020.** Palaeontological Desktop Assessment for the Proposed Choje Wind Farm between Grahamstown and Somerset East, Eastern Cape. Banzai Environmental (Pty) Ltd, Bloemfontein.

**Butler, E., 2020.** Palaeontological Desktop Assessment of the Proposed Prospecting Right Application for the Prospecting of Diamonds (Alluvial, General & In Kimberlite), Combined with A Waste License Application, Registration Division: Gordonia and Kenhardt, Northern Cape Province. Banzai Environmental (Pty) Ltd, Bloemfontein.

**Butler, E., 2020.** Palaeontological Impact Assessment for the Proposed Clayville Truck Yard, Ablution Blocks and Wash Bay to be Situated on Portion 55 And 56 Of Erf 1015, Clayville X11, Ekurhuleni Metropolitan Municipality, Gauteng Province. Banzai Environmental (Pty) Ltd, Bloemfontein.

**Butler, E., 2020.** Palaeontological Desktop Assessment for the Proposed Hartebeesthoek Residential Development. Banzai Environmental (Pty) Ltd, Bloemfontein.

**Butler, E., 2020.** Palaeontological Desktop Assessment for the Proposed Mooiplaats Educational Facility, Gauteng Province. Banzai Environmental (Pty) Ltd, Bloemfontein.

**Butler, E., 2020.** Palaeontological Impact Assessment for the Proposed Monument Park Student Housing Establishment. Banzai Environmental (Pty) Ltd, Bloemfontein.

**Butler, E., 2020.** Palaeontological Field Assessment for the Proposed Standerton X10 Residential and Mixed-Use Developments, Lekwa Local Municipality Standerton, Mpumalanga Province. Banzai Environmental (Pty) Ltd, Bloemfontein.

**Butler, E., 2020.** Palaeontological Field Assessment for the Rezoning and Subdivision of Portion 6 Of Farm 743, East London. Banzai Environmental (Pty) Ltd, Bloemfontein. Banzai Environmental (Pty) Ltd, Bloemfontein.

**Butler, E., 2020.** Palaeontological Field Assessment for the Proposed Matla Power Station Reverse Osmosis Plant, Mpumalanga Province. Banzai Environmental (Pty) Ltd, Bloemfontein.

**Butler, E., 2020.** Palaeontological Desktop Assessment of the Proposed Prospecting Right Application Without Bulk Sampling for the Prospecting of Diamonds Alluvial near Bloemhof on Portion 3 (Portion 1) of the Farm Boschpan 339, the Remaining Extent of Portion 8 (Portion 1), Portion 9 (Portion 1) and Portion 10 (Portion 1) and Portion 17 (Portion 1) of the Farm Panfontein 270, Registration Division: Ho, North West Province. Banzai Environmental (Pty) Ltd, Bloemfontein.

**Butler, E., 2020.** Palaeontological Desktop Assessment of the Proposed Prospecting Right Application Combined with a Waste Licence Application for the Prospecting of Diamonds Alluvial,

Diamonds General and Diamonds near Wolmaransstad on the Remaining Extent, Portion 7 and Portion 8 Of Farm Rooibult 152, Registration Division: HO, North West Province. Banzai Environmental (Pty) Ltd, Bloemfontein.

**Butler, E.,** 2020. Palaeontological Desktop Assessment of the Proposed Prospecting Right Application With Bulk Sampling combined with a Waste Licence Application for the Prospecting of Diamonds Alluvial (Da), Diamonds General (D), Diamonds (Dia) and Diamonds In Kimberlite (Dk) near Prieska On Portion 7, a certain Portion of the Remaining Extent of Portion 9 (Wouter), Portion 11 (De Hoek), Portion 14 (Stofdraai) (Portion of Portion 4), the Remaining Extent of Portion 16 (Portion Of Portion 9) (Wouter) and the Remaining Extent of Portion 18 (Portion of Portion 10) of the Farm Lanyon Vale 376, Registration Division: Hay, Northern Cape. Banzai Environmental (Pty) Ltd, Bloemfontein.

**Butler, E.,** 2020. Palaeontological Desktop Assessment of the Proposed Prospecting Right Area and Mining Permit Area near Ritchie on the Remaining Extent of Portion 3 (Anna's Hoop) of the Farm Zandheuvel 144, Registration Division: Kimberley, Northern Cape Province. Banzai Environmental (Pty) Ltd, Bloemfontein.

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

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

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

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

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

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

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

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

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

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

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

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

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

**Butler.** 2020. Part 2 Environmental Authorisation (EA) Amendment Process for the Kudusberg Wind Energy Facility (WEF) near Sutherland, Western and Northern Cape Provinces- Palaeontological Impact Assessment. Banzai Environmental (Pty) Ltd, Bloemfontein.

**Butler, E.,** 2020. Palaeontological Desktop Assessment Proposed for the Construction and Operation of the Battery Energy Storage System (BESS) and Associated Infrastructure and inclusion of Additional Listed Activities for the Authorised Droogfontein 3 Solar Photovoltaic (PV) Energy Facility Located near Kimberley in the Sol Plaatje Local Municipality, Francis Baard District Municipality, in the Northern Cape Province of South Africa. Banzai Environmental (Pty) Ltd, Bloemfontein.

**Butler, E.,** 2020. Palaeontological Impact Assessment for the Proposed Development of a Cluster of Renewable Energy Facilities between Somerset East and Grahamstown in the Eastern Cape. Banzai Environmental (Pty) Ltd, Bloemfontein.

**Butler, E.,** 2021. Palaeontological Desktop Assessment for the Proposed Amaoti Secondary School, Pinetown, eThekweni Metropolitan Municipality KwaZulu Natal. Banzai Environmental (Pty) Ltd, Bloemfontein.

**Butler, E.,** 2021. Palaeontological Impact Assessment for the Proposed an Inland Diesel Depot, Transportation Pipeline and Associated Infrastructure on Portion 5 of the Farm Franshoek No. 1861, Swinburne, Free State Province. Banzai Environmental (Pty) Ltd, Bloemfontein.

**Butler, E.,** 2021. Palaeontological Impact Assessment for the proposed erosion control gabion installation at Alpine Heath Resort on the farm Akkerman No 5679 in the Bergville district Kwazulu-Natal. Banzai Environmental (Pty) Ltd, Bloemfontein.

**Butler, E.,** 2021. Palaeontological Impact Assessment for the proposed Doornkloof Residential development on portion 712 of the farm Doornkloof 391 Jr, City of Tshwane Metropolitan Municipality in Gauteng, South Africa. Banzai Environmental (Pty) Ltd, Bloemfontein.

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

**Butler, E.,** 2021. Palaeontological Desktop Assessment for De Beers Consolidated Mines: Proposed Drilling on Portion 6 of Scholtzfontein 165 and Farm Arnotsdale 175, Herbert District in the Northern Cape. Banzai Environmental (Pty) Ltd, Bloemfontein.

**Butler, E.,** 2021. Palaeontological Desktop Assessment for De Beers Consolidated Mines: Proposed Drilling on the Remaining Extent of Biessie Laagte 96, and Portion 2 and 6 of Aasvogel Pan 141, Near Hopetown in the Northern Cape. Banzai Environmental (Pty) Ltd, Bloemfontein.

**Butler, E.,** 2021. Palaeontological Desktop Assessment for De Beers Consolidated Mines: Proposed Drilling in the North West Province: on Portions 7 (RE) (of Portion 3), 11, 12 (of Portion 3), 34 (of Portion 30), 35 (of Portion 7) of the Farm Holfontein 147 IO and Portions 1, 2 and the RE) of the Farm Kareeboschbult 76 Ip and Portions 1, 2, 4, 5, 6, (of Portion 3), 7 (of Portion 3), 13, 14, and the Re of the farm Oppaslaagte 100IP and portions 25 (of Portion 24) and 30 of the farm Slypsteen 102 IP. Banzai Environmental (Pty) Ltd, Bloemfontein.

**Butler, E., 2021.** Palaeontological Desktop Assessment for the Proposed Expansion of the Cavalier Abattoir on farm Oog Van Boekenhoutskloof of Tweefontein 288 JR, near Cullinan, City of Tshwane Metropolitan Municipality, Gauteng. Banzai Environmental (Pty) Ltd, Bloemfontein.

**Butler, E., 2021.** Palaeontological Impact Assessment for the Proposed Doornkloof Residential Development on Portion 712 of the Farm Doornkloof 391 JR, City of Tshwane Metropolitan Municipality in Gauteng, South Africa. Banzai Environmental (Pty) Ltd, Bloemfontein.

**Butler, E., 2021.** Palaeontological Desktop Assessment for the proposed High Density Social Housing Development on part of the Remainder of Portion 171 and part of Portion 306 of the farm Derdepoort 326 JR, City of Tshwane. Banzai Environmental (Pty) Ltd, Bloemfontein.

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

**Butler, E., 2021.** Palaeontological Desktop Assessment for the proposed Mixed-use Development on a Part of Remainder of Portion 171 and Portion 306 of the farm Derdepoort 326 JR, City of Tshwane. Banzai Environmental (Pty) Ltd, Bloemfontein.

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

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

**Butler, E., 2021.** Palaeontological Impact Assessment for the establishment of a mixed-use development on Portion 0 the of Erf 700, Despatch, Nelson Mandela Bay Municipality, Eastern Cape. Banzai Environmental (Pty) Ltd, Bloemfontein.

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

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

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



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

**Butler, E., 2021. Palaeontological Impact Assessment** for the Noko Solar Power Plant and power line which forms part of the authorised Paleso Solar Powerplant near Orkney in the North West. Banzai Environmental (Pty) Ltd, Bloemfontein.

**Butler, E., 2021. Palaeontological Impact Assessment** for the Proposed Power Line as part of the Paleso Solar Power Plant near Viljoenskroon in the Free State. Banzai Environmental (Pty) Ltd, Bloemfontein.

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

**Butler, E., 2020. Palaeontological Desktop Assessment** for the proposed Farming Expansions on Portions 50 of the Farm Rooipoort 555 JR, Portion 34 of the Farm Rooipoort 555 JR, Portions 20 and 49 of the Farm Rooipoort 555 JR and Portion 0(RE) of the Farm Oudou Boerdery 626 JR, Tshwane Metropolitan Municipality, Gauteng Province. Banzai Environmental (Pty) Ltd, Bloemfontein.

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

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

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

**Butler, E., 2021. Palaeontological Desktop Assessment** for the proposed Black Rock Mining Operations (BRMO) new rail loop and stacker reclaimer Project at Gloria Mine near Hotazel in the Northern Cape. Banzai Environmental (Pty) Ltd, Bloemfontein.

**Butler, E., 2020. Palaeontological Desktop Assessment** for the proposed Nchwaning Rail Balloon Turn Outs at Black Rock Mine Operations (BRMO) near Hotazel in the John Taolo Gaetsewe District Municipality in the Northern Cape.

**Butler, E., 2021.** Palaeontological Impact Assessment for the proposed utilization of one Borrow Pit for the planned Clarkebury DR08034 Road Upgrade, Engcobo Local Municipality, Eastern Cape. Banzai Environmental (Pty) Ltd, Bloemfontein.

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

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

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

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

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

**Butler, E., 2021.** Palaeontological Impact Assessment for the proposed development of 177 new units in the northern section of Mpongo Park in the Eastern Cape. Banzai Environmental (Pty) Ltd, Bloemfontein.

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

**Butler, E., 2021.** Palaeontological Desktop Assessment for the proposed Raphuti Settlement Project on Portions of the Farm Weikrans 539KQ in the Waterberg District Municipality of the Limpopo Province. Banzai Environmental (Pty) Ltd, Bloemfontein.

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

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

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

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

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

**Butler, E., 2021.** Palaeontological Impact Assessment for the proposed Victoria West water augmentation project in the Northern Cape. Banzai Environmental (Pty) Ltd, Bloemfontein.

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

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

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

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

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

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

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

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

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

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

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

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

**Butler, E., 2022.** Palaeontological Desktop Assessment for the Construction of the ESKOM Mesong 400kV Loop-In Loop-Out Project, Ekurhuleni Municipality, Gauteng Province. Banzai Environmental (Pty) Ltd, Bloemfontein.