HERITAGE BASELINE REPORT

For the Elandsfontein PV Cluster (Themeda PV and Aristida PV) , Lichtenburg, North-West Province

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Executive Summary

Beyond Heritage was appointed to conduct a Heritage Baseline Study for the Elandsfontein PV Cluster consisting of the Themeda PV and Aristida PV facilities and associated infrastructure:

The aim of the assessment was to determine the heritage potential of the facilities through a desktop study and a physical survey of the project. Key findings of the assessment include:

- The study area is characterised by agricultural activities including cultivation from the 1970's and more recently used for cattle grazing;
- Heritage finds were limited to Middle and Later Stone Age scatters exposed in gravel roads and on rocky outcrops;
- An assessment of the paleontological significance of the area (Bamford 2022) concluded that the project should be authorised from a paleontological point of view.

No fatal flaws were recorded although potential risks to the project is the occurrence of unrecorded cultural resources (of which graves and subsurface archaeological deposits are the highest risk). This can cause delays during construction, as well as additional costs involved in mitigation, and possible layout changes.

The following report outline the methodology, heritage background to the area and lastly management guidelines for further work required.

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Declaration of Independence

Specialist Name	Jaco van der Walt
Declaration of Independence	I declare, as a specialist appointed in terms of the National Environmental Management Act (Act No 108 of 1998) and the associated 2014 Environmental Impact Assessment (EIA) Regulations, that I: • I act as the independent 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 favourable to the applicant; • I declare that there are no circumstances that may compromise my objectivity in performing such work; • I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity; • I will comply with the Act, Regulations and all other applicable legislation; • I have no, and will not engage in, conflicting interests in the undertaking of the activity; • I 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; • All the particulars furnished by me in this form are true and correct; and • I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.
Signature	
Date	03/03/2022

a) Expertise of the specialist

Jaco van der Walt has been practising as a CRM archaeologist for 20 years. He obtained an MA degree in Archaeology from the University of the Witwatersrand focussing on the Iron Age in 2012 and is a PhD candidate at the University of Johannesburg focussing on Stone Age Archaeology with specific interest in the Middle Stone Age (MSA) and Later Stone Age (LSA). Jaco is an accredited member of ASAPA (#159) and have conducted more than 500 impact assessments in Limpopo, Mpumalanga, North West, Free State, Gauteng, KZN as well as he Northern and Eastern Cape Provinces in South Africa.

Jaco has worked on various international projects in Zimbabwe, Botswana, Mozambique, Lesotho, DRC Zambia, Guinea, Afghanistan and Tanzania. Through this he has a sound understanding of the IFC Performance Standard requirements, with specific reference to Performance Standard 8 – Cultural Heritage.

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ABBREVIATIONS

AIA: Archaeological Impact Assessment
ASAPA: Association of South African Professional Archaeologists
BGG Burial Ground and Graves
BIA: Basic Impact Assessment
CFPs: Chance Find Procedures
CMP: Conservation Management Plan
CRR: Comments and Response Report
CRM: Cultural Resource Management
DEA: Department of Environmental Affairs
EA: Environmental Authorisation
EAP: Environmental Assessment Practitioner
ECO: Environmental Control Officer
EIA: Environmental Impact Assessment*
EIA: Early Iron Age*
EIA Practitioner: Environmental Impact Assessment Practitioner
EMP: Environmental Management Programme
ESA: Early Stone Age
ESIA: Environmental and Social Impact Assessment
GIS Geographical Information System
GPS: Global Positioning System
GRP Grave Relocation Plan
HIA: Heritage Impact Assessment
LIA: Late Iron Age
LSA: Late Stone Age
MEC: Member of the Executive Council
MIA: Middle Iron Age
MPRDA: Mineral and Petroleum Resources Development Act
MSA: Middle Stone Age
NEMA National Environmental Management Act, 1998 (Act No. 107 of 1998)
NHRA National Heritage Resources Act, 1999 (Act No. 25 of 1999)
NID Notification of Intent to Develop
NoK Next-of-Kin
PRHA: Provincial Heritage Resource Agency
SADC: Southern African Development Community
SAHRA: South African Heritage Resources Agency

**Although EIA refers to both Environmental Impact Assessment and the Early Iron Age both are internationally accepted abbreviations and must be read and interpreted in the context it is used.*

GLOSSARY

Archaeological site (remains of human activity over 100 years old)
Early Stone Age (~ 2.6 million to 250 000 years ago)
Middle Stone Age (~ 250 000 to 40-25 000 years ago)
Later Stone Age (~ 40-25 000, to recently, 100 years ago)
The Iron Age (~ AD 400 to 1840)
Historic (~ AD 1840 to 1950)
Historic building (over 60 years old)

1 INTRODUCTION

Beyond Heritage was appointed to conduct a Heritage Baseline Study for the Elandsfontein PV Cluster Facility. The aim of the study is to identify cultural heritage sites, document, and assess their importance within local, provincial and national context. It serves to assess the impact of the proposed project on non-renewable heritage resources, and to submit appropriate recommendations with regard to the responsible cultural resources management measures that might be required to assist the developer in managing the discovered heritage resources in a responsible manner. It is also conducted to protect, preserve, and develop such resources within the framework provided by the National Heritage Resources Act of 1999 (Act 25 of 1999).

The report outlines the approach and methodology utilized before and during the survey, which includes Phase 1, a desktop study; Phase 2, the physical surveying of the study area on foot and by vehicle; Phase 3, reporting the outcome of the study.

General site conditions were recorded by means of photographs, GPS locations, and site descriptions. Possible impacts were identified, and mitigation measures are proposed in the following report.

1.1. Project Description

The proposed PV cluster is anticipated to comprise **two facilities** (up to 100 MW each) and will also include a self-build grid connection component to facilitate the connection of the facilities to Watershed MTS (assessed as part of a separate assessment). The solar PV facilities will comprise several arrays of PV panels and associated infrastructure and will have a contracted capacity of up to 100 MW.

Assessment areas of approximately 200 hectares each are assessed, and the infrastructure associated with the 100 MW facility includes:

- PV modules and mounting structures;
- Inverters and transformers;
- Battery Energy Storage System (BESS);
- Site and internal access roads (up to 8m wide);
- Auxiliary buildings (22kV or 33kV switch room, gate-house and security, control centre, office, warehouse, canteen & visitors centre, staff lockers etc.);
- Temporary and permanent laydown area;
- Cabling between the panels, to be laid underground where practical; and
- An on-site facility substation stepping up from 22kV or 33kV to 132kV, with an extent of up to 1ha to facilitate the connection between the solar PV facility and the grid connection solution.

The Themeda and Aristida PV facilities intends to connect to the National Grid via the Watershed Main Transmission Substation (MTS) (approximately 5 km east of the facility), however, the connection infrastructure associated with this grid solution is being assessed as part of a separate Environmental Application.

1.1.1 Location

The proposed project is situated within the Ditsobotla Local Municipality within the Ngaka Modiri Molema District Municipality on Portion 7 of Farm Elandsfontein 34 (Figure 1.1 to 1.3). The site is accessible via the R503, located southeast of the project area.

1.1.2. Environmental Setting

The study area falls within a Grassland Bioregion as described by Mucina *et al* (2006) with the vegetation described as Carltonville dolomite Grassland. Land use in the general area is characterized by agriculture, dominated by crops and cattle farming. The study area is characterised by deep sandy to loamy soils.

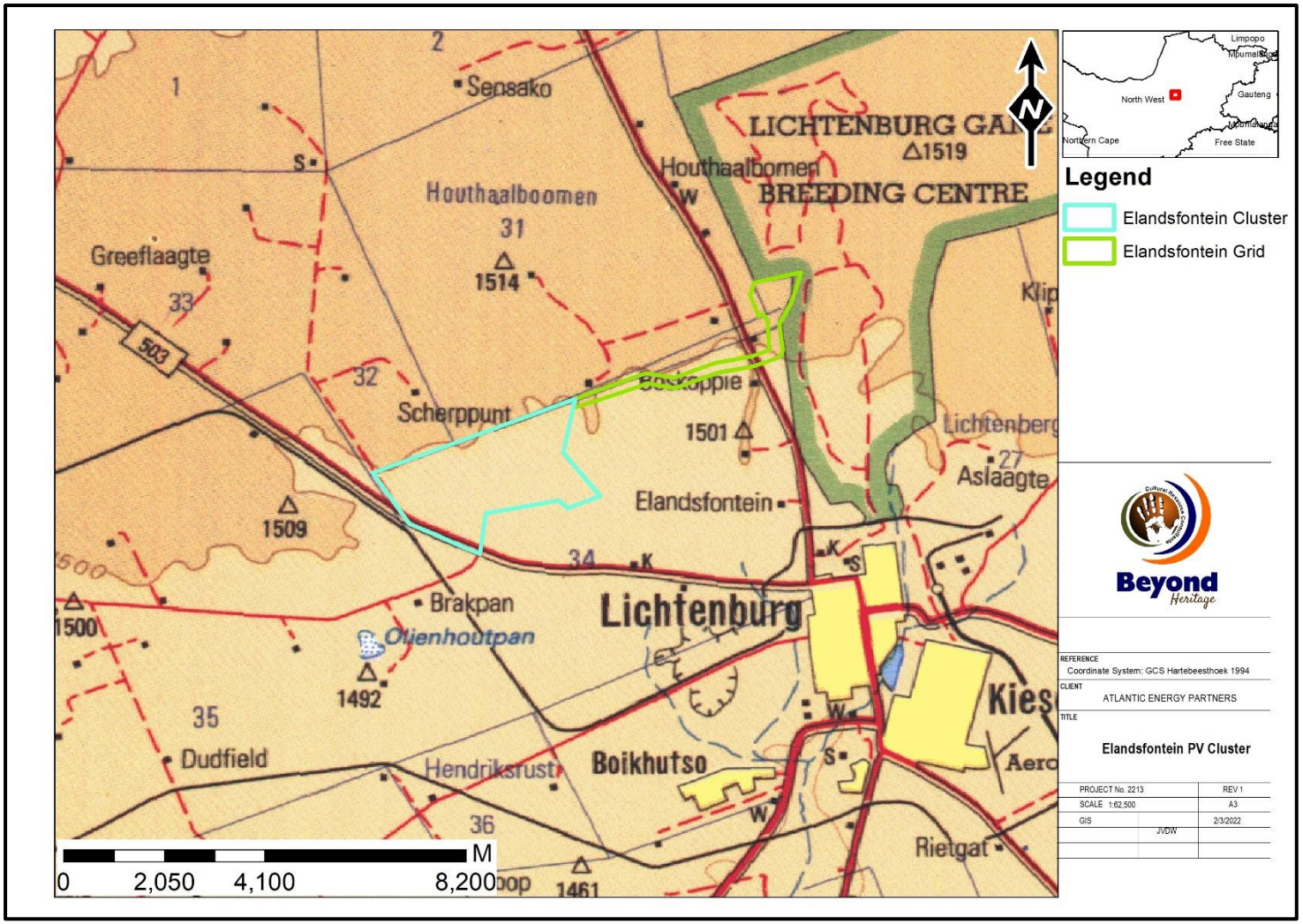

Figure 1.1: Regional setting of the project (1: 250 000 topographical map). Please note that the grid connection will be considered as part of a separate assessment and is included in the mapping for reference purposes only.

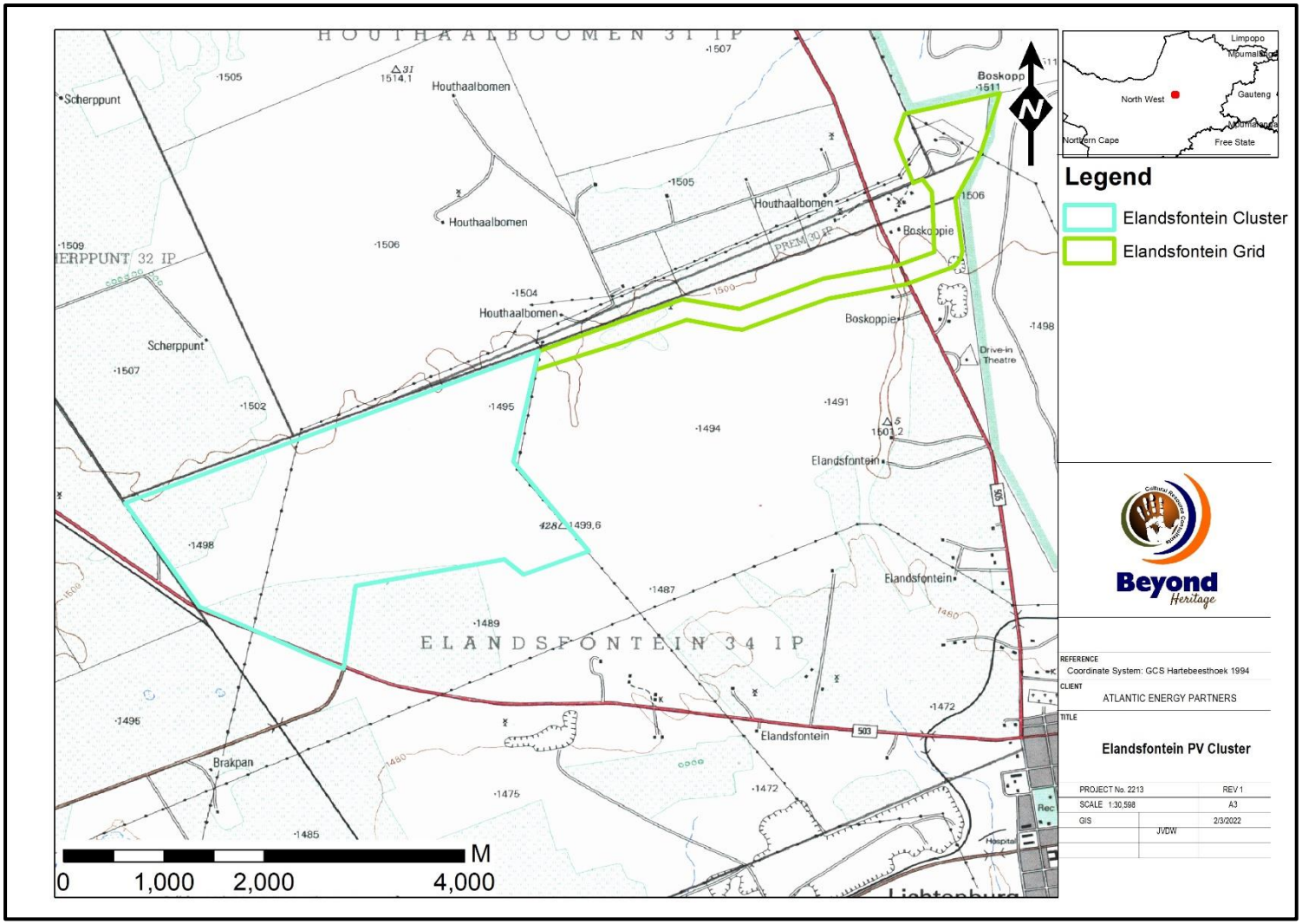

Figure 1.2. Local setting of the project (1:50 000 topographical map).

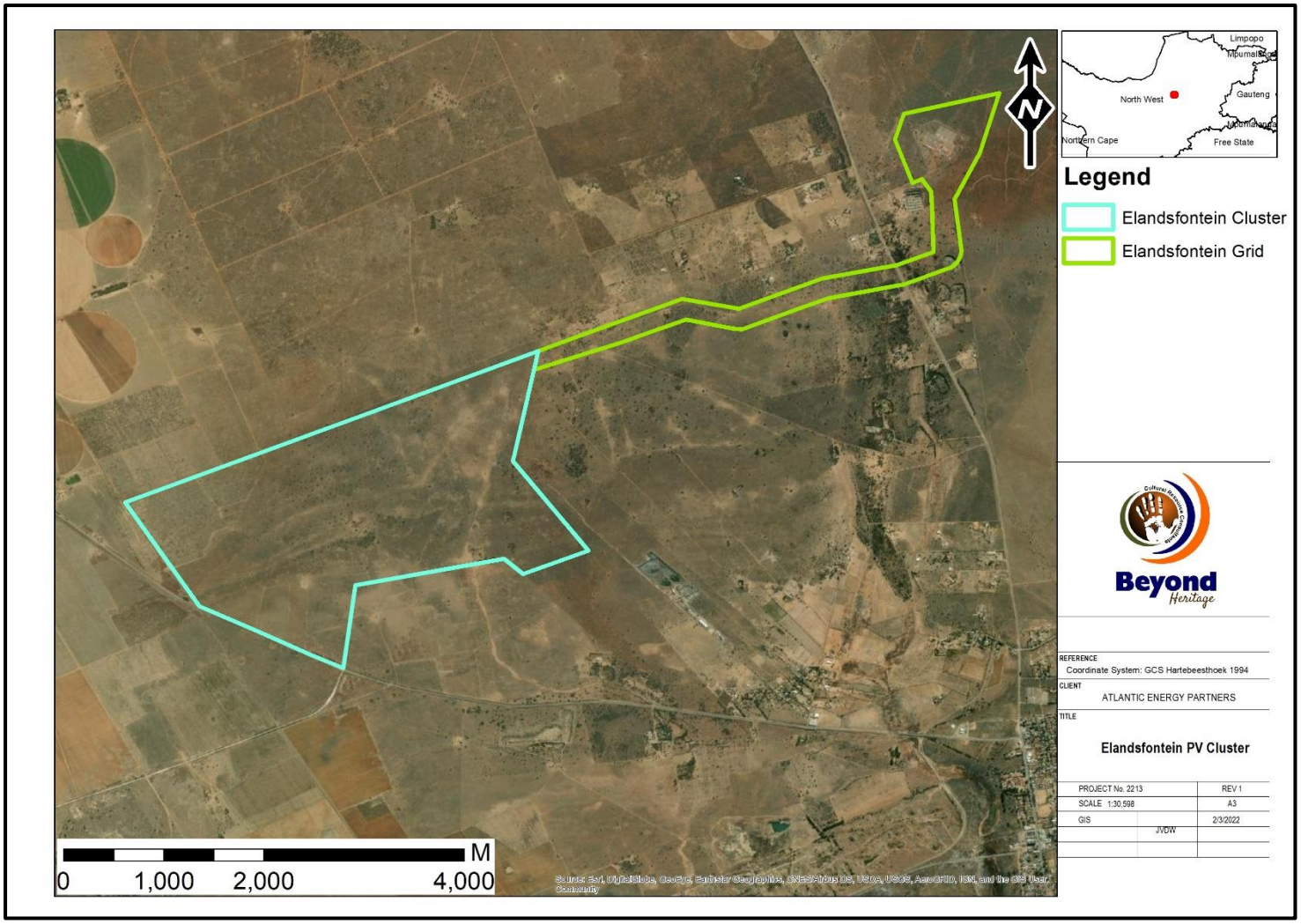

Figure 1.3. Aerial image of the study area.

2 Legislative Requirements

The HIA, as a specialist sub-section of the EIA, is required under the following legislation:

- National Heritage Resources Act (NHRA), Act No. 25 of 1999)
- National Environmental Management Act (NEMA), Act No. 107 of 1998 - Section 23(2)(b)

A Phase 1 HIA is a pre-requisite for development in South Africa as prescribed by SAHRA and stipulated by legislation. The overall purpose of heritage specialist input is to:

- Identify any heritage resources, which may be affected;
- Assess the nature and degree of significance of such resources;
- Establish heritage informants/constraints to guide the development process through establishing thresholds of impact significance;
- Assess the negative and positive impact of the development on these resources; and
- Make recommendations for the appropriate heritage management of these impacts.

The HIA should be submitted, as part of the impact assessment report or EMPr, to the PHRA if established in the province or to SAHRA. SAHRA will ultimately be responsible for the evaluation of Phase 1 HIA reports upon which review comments will be issued. 'Best practice' requires Phase 1 HIA reports and additional development information, as per the impact assessment report and/or EMPr, to be submitted in duplicate to SAHRA after completion of the study. SAHRA accepts Phase 1 HIA reports authored by professional archaeologists, accredited with ASAPA or with a proven ability to do archaeological work.

Minimum accreditation requirements include an Honours degree in archaeology or related discipline and 3 years post-university CRM experience (field supervisor level). Minimum standards for reports, site documentation and descriptions are set by ASAPA in collaboration with SAHRA. ASAPA is based in South Africa, representing professional archaeology in the SADC region. ASAPA is primarily involved in the overseeing of ethical practice and standards regarding the archaeological profession. Membership is based on proposal and secondment by other professional members.

Phase 1 HIA's are primarily concerned with the location and identification of heritage sites situated within a proposed development area. Identified sites should be assessed according to their significance. Relevant conservation or Phase 2 mitigation recommendations should be made. Recommendations are subject to evaluation by SAHRA.

Conservation or Phase 2 mitigation recommendations, as approved by SAHRA, are to be used as guidelines in the developer's decision-making process.

Phase 2 archaeological projects are primarily based on salvage/mitigation excavations preceding development destruction or impact on a site. Phase 2 excavations can only be conducted with a permit, issued by SAHRA to the appointed archaeologist. Permit conditions are prescribed by SAHRA and includes (as minimum requirements) reporting back strategies to SAHRA and deposition of excavated material at an accredited repository.

In the event of a site conservation option being preferred by the developer, a site management plan, prepared by a professional archaeologist and approved by SAHRA, will suffice as minimum requirement.

After mitigation of a site, a destruction permit must be applied for with SAHRA by the applicant before development may proceed.

Human remains older than 60 years are protected by the National Heritage Resources Act, with reference to Section 36. Graves older than 60 years, but younger than 100 years fall under Section 36 of Act 25 of 1999 (National Heritage Resources Act), as well as the Human Tissues Act (Act 65 of 1983) and are the

jurisdiction of SAHRA. The procedure for Consultation Regarding Burial Grounds and Graves (Section 36[5]) of Act 25 of 1999) is applicable to graves older than 60 years that are situated outside a formal cemetery administrated by a local authority. Graves in this age category, located inside a formal cemetery administrated by a local authority, require the same authorisation as set out for graves younger than 60 years, in addition to SAHRA authorisation. If the grave is not situated inside a formal cemetery, but is to be relocated to one, permission from the local authority is required and all regulations, laws and by-laws, set by the cemetery authority, must be adhered to.

Human remains that are less than 60 years old are protected under Section 2(1) of the Removal of Graves and Dead Bodies Ordinance (Ordinance No. 7 of 1925), as well as the Human Tissues Act (Act 65 of 1983) and are the jurisdiction of the National Department of Health and the relevant Provincial Department of Health and must be submitted for final approval to the office of the relevant Provincial Premier. This function is usually delegated to the Provincial MEC for Local Government and Planning; or in some cases, the MEC for Housing and Welfare. Authorisation for exhumation and reinternment must also be obtained from the relevant local or regional council where the grave is situated, as well as the relevant local or regional council to where the grave is being relocated. All local and regional provisions, laws and by-laws must also be adhered to. To handle and transport human remains, the institution conducting the relocation should be authorised under Section 24 of Act 65 of 1983 (Human Tissues Act).

3 METHODOLOGY

3.1 Literature Review

A brief survey of available literature was conducted to extract data and information on the area in question to provide general heritage context into which the development would be set. This literature search included published material, unpublished commercial reports and online material, including reports sourced from the South African Heritage Resources Information System (SAHRIS).

3.2 Genealogical Society and Google Earth Monuments

Google Earth and 1:50 000 maps of the area were utilised to identify possible places where sites of heritage significance might be located; these locations were marked and visited during the fieldwork phase. The database of the Genealogical Society was consulted to collect data on any known graves in the area.

3.3 Public Consultation and Stakeholder Engagement:

Stakeholder engagement is a key component of any EIA process and will be conducted by the EAP for this project. Stakeholders are provided with an opportunity to raise issues of concern. The aim of the public consultation process was to capture and address any issues raised by community members and other stakeholders during key stakeholder and public meetings conducted by the EAP. The process involved:

- Placement of advertisements and site notices
- Stakeholder notification (through the dissemination of information and meeting invitations);
- Stakeholder meetings undertaken with I&Aps where neccesary;
- Authority Consultation
- The compilation of a Scoping Report and an Environmental Impact Assessment Report (EIAR).

3.4 Site Investigation

The aim of the site survey was to:
a) survey the proposed project area to locate, identify, record, photograph and describe sites of archaeological, historical or cultural interest.
b) record GPS points of sites/areas identified as significant areas;
c) determine the levels of significance of the various types of heritage resources recorded in the project area.

3.5 Data Interpretation: Assessment of Significance and Impacts

The presence and distribution of heritage resources define a 'heritage landscape'. In this landscape, every site is relevant. In addition, because heritage resources are non-renewable, heritage surveys need to investigate an entire project area, or a representative sample, depending on the nature of the project. In the case of the proposed project the local extent of its impact necessitates a representative sample and only the farms earmarked for development was surveyed. In all initial investigations, however, the specialists are responsible only for the identification of resources visible on the surface.

This section describes the evaluation criteria used for determining the significance of archaeological and heritage sites. The following criteria were used to establish site significance:

- The unique nature of a site;
- The integrity of the archaeological/cultural heritage deposits;
- The wider historic, archaeological and geographic context of the site;
- The location of the site in relation to other similar sites or features;
- The depth of the archaeological deposit (when it can be determined/is known);
- The preservation condition of the sites; and
- Potential to answer present research questions.

Furthermore, NHRA distinguishes nine criteria for places and objects to qualify as 'part of the national estate' if they have cultural significance or other special value. These criteria are:

- Its importance in/to the community, or pattern of South Africa's history;
- Its possession of uncommon, rare or endangered aspects of South Africa's natural or cultural heritage;
- Its potential to yield information that will contribute to an understanding of South Africa's natural or cultural heritage;
- Its importance in demonstrating the principal characteristics of a particular class of South Africa's natural or cultural places or objects;
- Its importance in exhibiting particular aesthetic characteristics valued by a community or cultural group;
- Its importance in demonstrating a high degree of creative or technical achievement at a particular period;
- Its strong or special association with a particular community or cultural group for social, cultural or spiritual reasons;
- Its strong or special association with the life or work of a person, group or organisation of importance in the history of South Africa; and
- Sites of significance relating to the history of slavery in South Africa.

3.5.1 Field Rating of Sites

Site significance classification standards prescribed by SAHRA (2006), and acknowledged by ASAPA for the SADC region, were used for the purpose of this report.

FIELD RATING	*GRADE*	*SIGNIFICANCE*	*RECOMMENDED MITIGATION*
National Significance (NS)	Grade 1	-	Conservation; national site nomination
Provincial Significance (PS)	Grade 2	-	Conservation; provincial site nomination
Local Significance (LS)	Grade 3A	High significance	Conservation; mitigation not advised
Local Significance (LS)	Grade 3B	High significance	Mitigation (part of site should be retained)
Generally Protected A (GP. A)	-	High/medium significance	Mitigation before destruction
Generally Protected B (GP. B)	-	Medium significance	Recording before destruction
Generally Protected C (GP.C)	-	Low significance	Destruction

Although Beyond Heritage surveyed the area as thoroughly as possible, it is incumbent upon the developer to stop operations and inform the relevant heritage agency should further cultural remains, such as graves, stone tool scatters, artefacts, bones or fossils, be exposed during the process of development (refer to the Chance Find Procedure that will be included in the Heritage Impact Assessment report).

4 BACKGROUND INFORMATION

4.1 Literature Review

A brief survey of available literature was conducted to extract data and information on the area in question to provide general heritage context into which the development would be set. This literature search included published material, unpublished commercial reports and online material, including reports sourced from the South African Heritage Resources Information System (SAHRIS).

Table 1. Studies consulted for this report.

Author	Year	Project	Findings
Küsel, U.S.	2008	Cultural Heritage Resources Impact Assessment of Portion 151 Of Lichtenburg Town And Townlands 27 Ip (Lichtenburg Extension 10) North West Province	None
van Schalkwyk, J.A.	2008	Proposed 88kv Power Line from Watershed Substation, Lichtenburg, to the Mmabatho Substation, North West Gauteng Province	Features dating to the historic period were identified as well as cemeteries.
van der Walt, J.	2013	Archaeological Impact Assessment Report, Watershed Solar facility	Low densities of MSA and LSA scatters. Single unmarked stone grave
van der Walt, J. & Almond, J.E.	2013	Archaeological Impact Assessment for the Proposed Hibernia Solar Project near the town of Lichtenburg in the North West Province of South Africa	MSA scatter and an informal cemetery
Levin, J.	2018	Heritage Impact Assessment for the development of the Lichtenburg 1PV Solar Energy Facility and Associated Infrastructure on a site near Lichtenburg, North West Province	Historic farmhouse
Miller, S.	2021	Phase I Heritage Impact Assessment of a 35 ha study area on portion 18 of the farm Dufield 35 IR, Lichtenburg district, North-western Province	None
van Schalkwyk, J.A.	2021	Phase 1 Cultural Heritage Impact Assessment: The Proposed Lerato Solar Power Plant Near Lichtenburg, North West Province.	Two informal burial sites, with 80 stone cairn graves in total.

4.2 Archaeological Background to the study area.

A brief summary of archaeological and historical events in South Africa is included in Figure 4.1 and the background to the study area is discussed below.

Published Stone Age and Iron Age archaeological sites are absent from the immediate study area. Stone Age lithic scatters occur near watercourses and some were exposed due to diamond mining in the wider area, suggesting that the landscape was used since the ESA. However, currently, published references only include Later Stone Age sites such as Jubilee and Holkrans rock shelters, which are ~ 200 km south-east of Lichtenburg, as well as rock art occurring at Driekuil and Gestoptefontein (e.g., Wadley 1989, 1996; Bradfield & Sadr 2011; Hollmann 2013).

Early Iron Age farmers settled at Broederstroom *ca*. 500 CE (Mason 1981), the oldest Iron Age site in the North-West Province. Agropastoral communities preferred open woodland areas with readily available access to water and cultivatable soils. Due to their particular homestead economy, farmers did not occupy the central highveld area of Lichtenburg. During the Late Iron Age when climatic conditions became more favourable people started to occupy areas previously considered unsuitable (Maggs 1994; Huffman 2007). The earliest Iron Age farmers who moved into the North-West Province were Tswana-speakers such as the BaRolong probably from the 18th century onwards. According to traditional history BaRolong king Tau died in 1760 CE, he was succeeded by his son Nôtô. During the reign of Nôtô it is said that they settled in the region of Molopo, while others say it was only during the time of Morara's kingship, son of Nôtô. However, during the early 1820s Methodist missionaries had contact with BaRolong communities as they fled from the chaos caused by the ongoing Mfecane, settling near Maquassi hills in modern-day Potchefstroom. Peace was short-lived and communities decided in 1833 to move towards Thaba Nchu under the protection of king Moshoshoe. The region was also a focal point for *Voortrekkers* such as Hendrik Potgieter and Sarel Cilliers, as they moved further towards the interior violent battles took place between local Sotho-Tswana, Ndebele and Zulu chiefdoms *(*Matthews 1945; Breutz 1957; Giliomee & Mbenga 2007).

The surrounding area of Lichtenburg was only occupied from the 1850s as resources were few and the town was established in 1873. During the South African War 1899-1902, a number of skirmishes took place in the larger region. The area included concentration camps and the famous battle of Mafikeng took place close-by. Lichtenburg is also home to the infamous General Koos de la Rey. The town was the seat of the local Senator, and he died in 1914 on his way home from a meeting in parliament about South Africa's participation in World War I. During the 1920s the town experienced a diamond rush that lasted 10 years. Today Lichtenburg is known for cattle and crop farming (e.g., Bergh 1998; Scholtz & Theron 2000; van der Walt 2013; Coetzee 2017). The project area nearby Lichtenburg was utilised for grazing or agricultural fields since the 1900s (van Schalkwyk 2021).

South Africa: A short chronology

Early Stone Age: 2 million - 250 000 BP. Hominins producing core and pebble tools, later stages includes handaxes and blades.

Middle Stone Age: 250 000 - 40 000 / 25 000 BP. *Homo Sapiens.* Prepared core techniques, formal tools, points, scrapers and backed artefacts. Occasionally includes bone points and ostrich eggshell fragments and grindstones.

Later Stone Age: 40 000 - 100 BP. Wide range of formal microlithic tools. Ostrich eggshell fragments, beads, rock art.

Ceramic Final Later Stone Age: 2000 BP. Wide range of formal microlithic tools, with thin-walled pottery, with some sites having faunal remains of ovicaprids.

Early Iron Age: 200 - 900 CE. Arrival of Bantu-speaking farmers who lived in sedentary settlements often located next to rivers. They kept livestock, cultivated sorghum, beans and cowpeas. Introduced metallurgy to the region and manufactured thick-walled pottery.

Middle Iron Age: 900 - 1300 CE. Confined to the modern-day Limpopo Province, and associated with early state formation, such as Mapungubwe and associated sites.

Late Iron Age: 1300 - 1840 CE. Marks the arrival of ancestral Eastern Bantu-speaking Nguni and Sotho-Tswana communities. Settlements are often located on or near hilltops for defensive purposes. The Iron Age as an archaeological period ends with the Mfecane, 1820s to 1840s CE. An event that caused major socio-political upheavel.

Historic events

1652: Dutch East India Company establishes refreshment station at modern-day Cape Town.

1658: First slave ships arrive at Table Bay.

1660 - 1793: Various armed conflicts between Khoisan and Europeans, several frontier wars between Europeans, Khoisan and Xhosa communities.

1795 - 1807: First British occupation of the Cape, the Dutch East India Company collapses, and slave trade is abolished.

1808 - 1820: Several frontier wars and first British Settlers arrive.

1820 - 1840: Onset of the Mfecane, abolishment of slavery and slaves are freed at the Cape. Dutch farmers started to migrate towards the interior of South Africa, what will become known as the 'Great Trek'.

1860 - 1880: Discovery of mineral wealth, diamons and gold. Establishment of the Zuid-Afrikaansche Republiek (ZAR).

1899 - 1902: The South African War.

1910 - 1945: Unifaction of South Africa, formation of the ANC, World War I and World War II.

BP - Before Present
CE - Common Era

Figure 4.1. Summary of archaeological and historical events in South Africa.

4.3 Genealogical Society and Google Earth Monuments

No graves are indicated for the proposed development area.

4.4 Results of Stakeholder engagements

Stakeholder engagement is facilitated by the EAP, and relevant results will be reported on in the Scoping Report and EIAr and if any heritage concerns are raised these will be addressed in the HIA.

4.5 Site investigation

Site investigation details are provided in Table 2 and tracklogs of survey paths are included in Figure 4.2.

Table 2: Site Investigation Details

	Site Investigation
Date	The week of 2 Feb 2022
Season	Summer. The study area was previously cultivated and is currently used for grazing marked by knee high grass cover that limited archaeological visibility. The area was however sufficiently covered to understand the heritage character of the area.

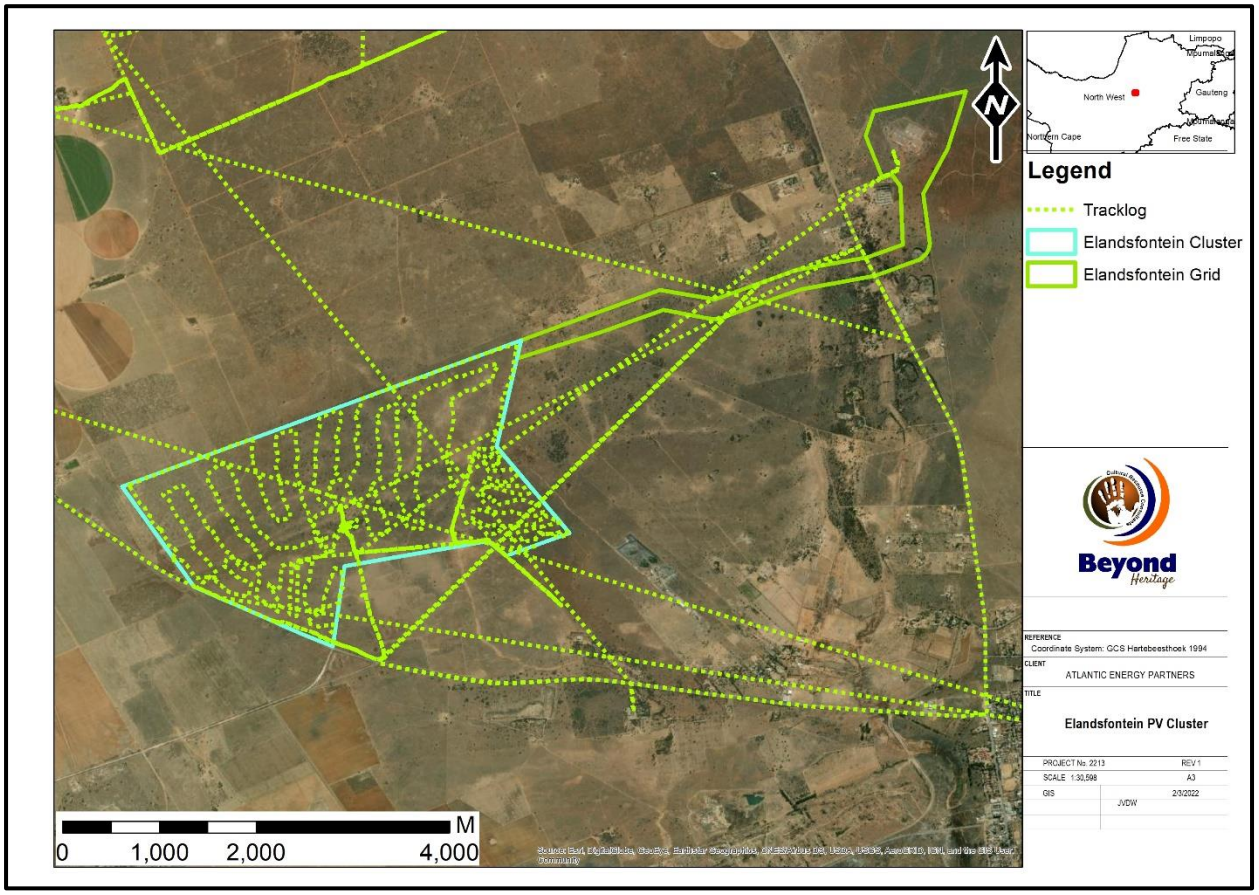

Figure 4.2. Tracklog of survey path.

5 BASELINE DESCRIPTION

The study area is situated approximately 6 km north of Lichtenburg and primarily used for cattle grazing with some camps having been cultivated in the past. These disused agricultural fields have been completely cleared of all surface rocks. A series of existing powerlines traverse the project area and are accessible through the various small gravel roads that are found throughout the study area. Most of these farm roads are overgrown. A thicket of trees is located on a small rocky ridge line aligned east to west across the

project area. Archaeological visibility is low due to thick grass cover while bushes and tall trees are sparse but scattered throughout the landscape. General site conditions are illustrated in Figure 5.1 to 5.4.

Figure 5.1. Southern portion of the study area with gravel road.

Figure 5.2. General site conditions in the western portion of the study area illustrating vegetation cover.

Figure 5.3. Thicket of trees on rocky ridge.

Figure 5.4. Powerline in the study area.

5.1 Cultural Landscape

The study area is located in a rural setting used for cultivation and grazing and remains largely undeveloped (Figure 5.13 to 5.14). The area is traversed by a powerline prior to 1972.

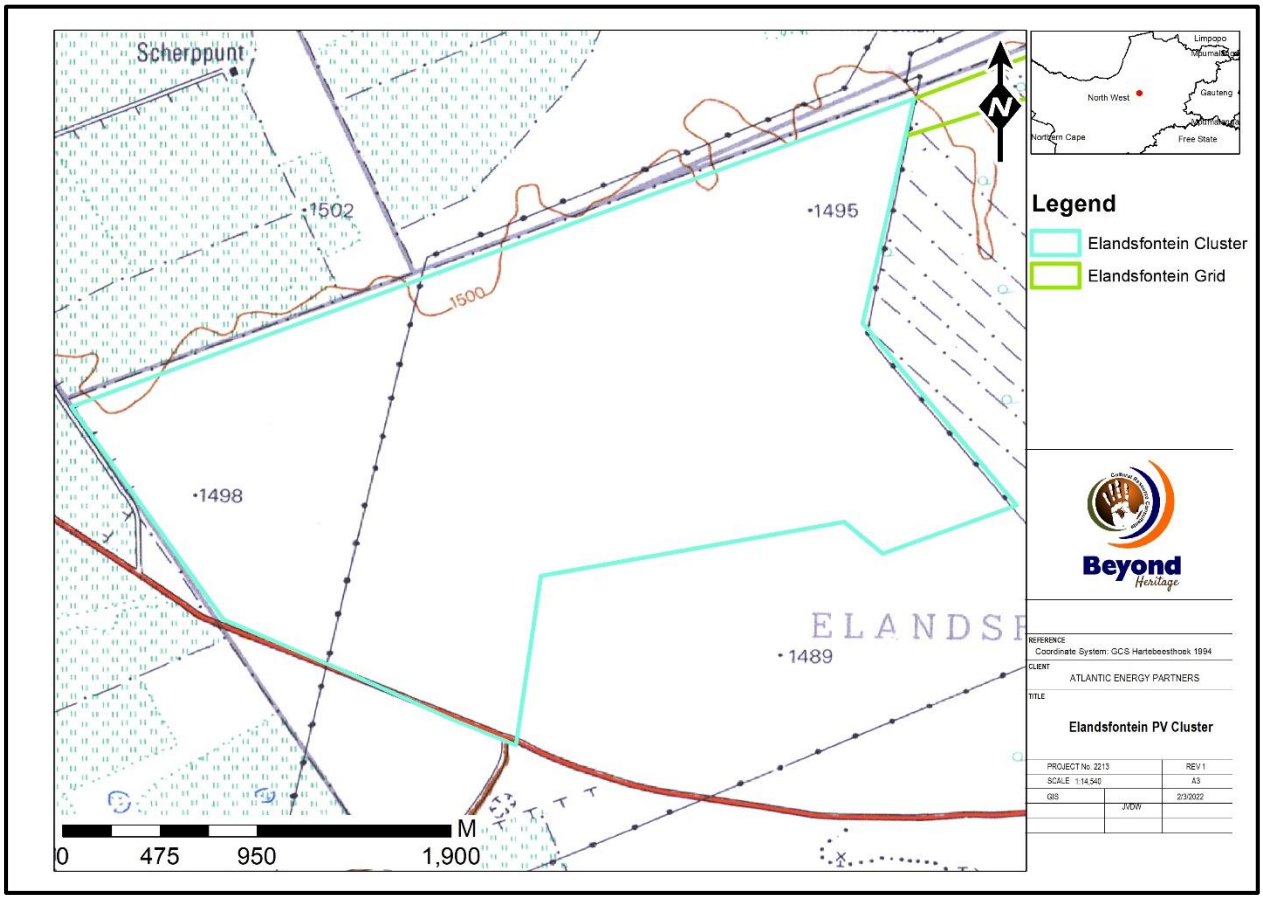

Figure 5.5. 1972 Topographic map of the impact area. A powerline traverses the site.

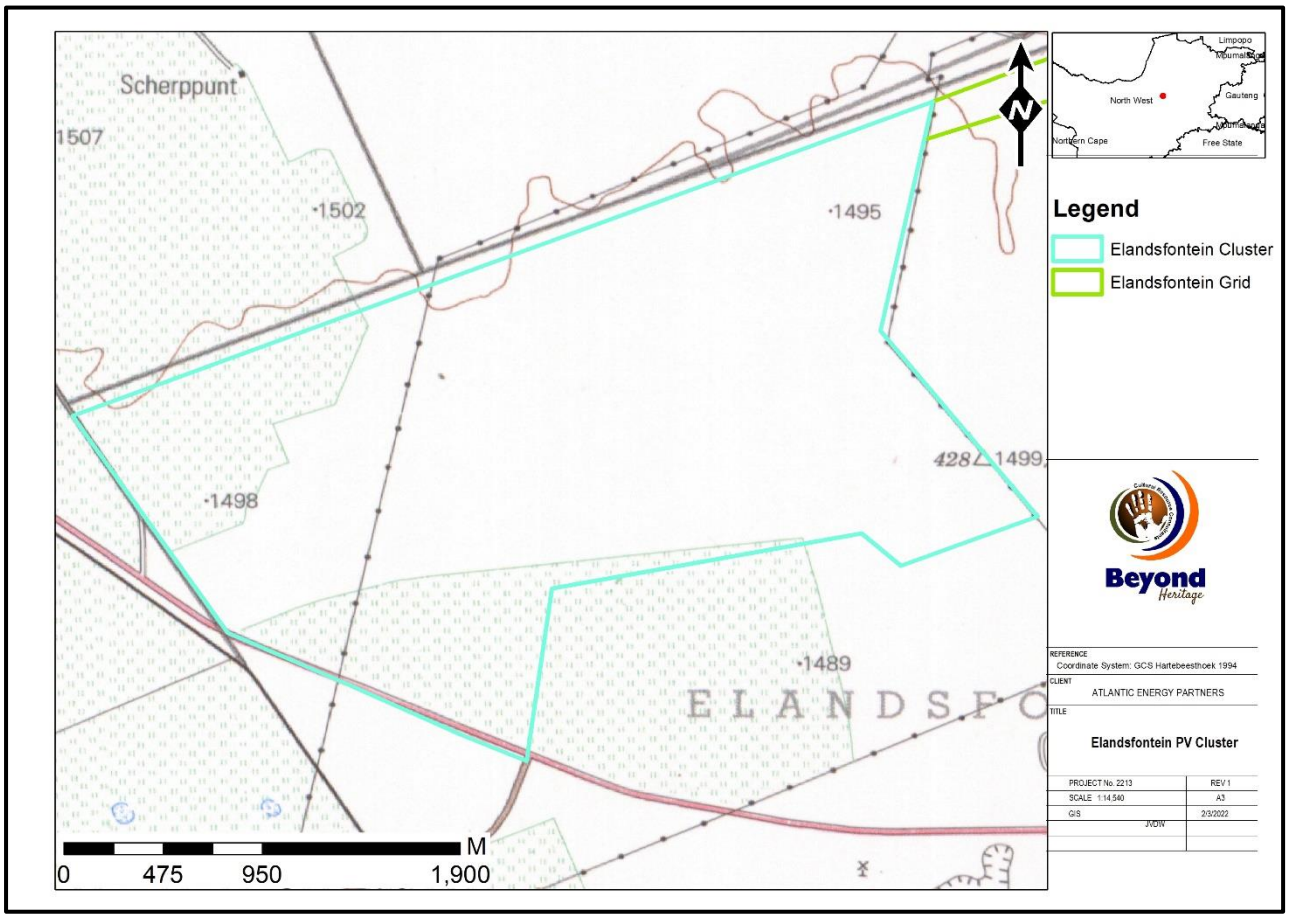

Figure 5.6. 1992 Topographic map of the study area. Some cultivated areas are visible as well as a powerline.

5.1 Heritage Resources

Based on the Department of Environmental Affairs (DEA) screening tool the heritage sensitivity of the study area is low (Figure 5.5). During the survey heritage resources were limited to low-density background scatters (Orton 2016) of MSA & LSA lithics. Scatters (between 3 - 5 artefacts per m²) was recorded as observation points of low significance. Scatters with densities less than 2 artefacts per m² were not recorded as they occur throughout the area. Individual occurrences were not point plotted within the recorded scatters however an attempt was made at determining site extent. GPS readings were taken roughly in the middle of each identified scatter. Recorded observations were labelled numerically with the Prefix EF for Elandsfontein and are briefly discussed below.

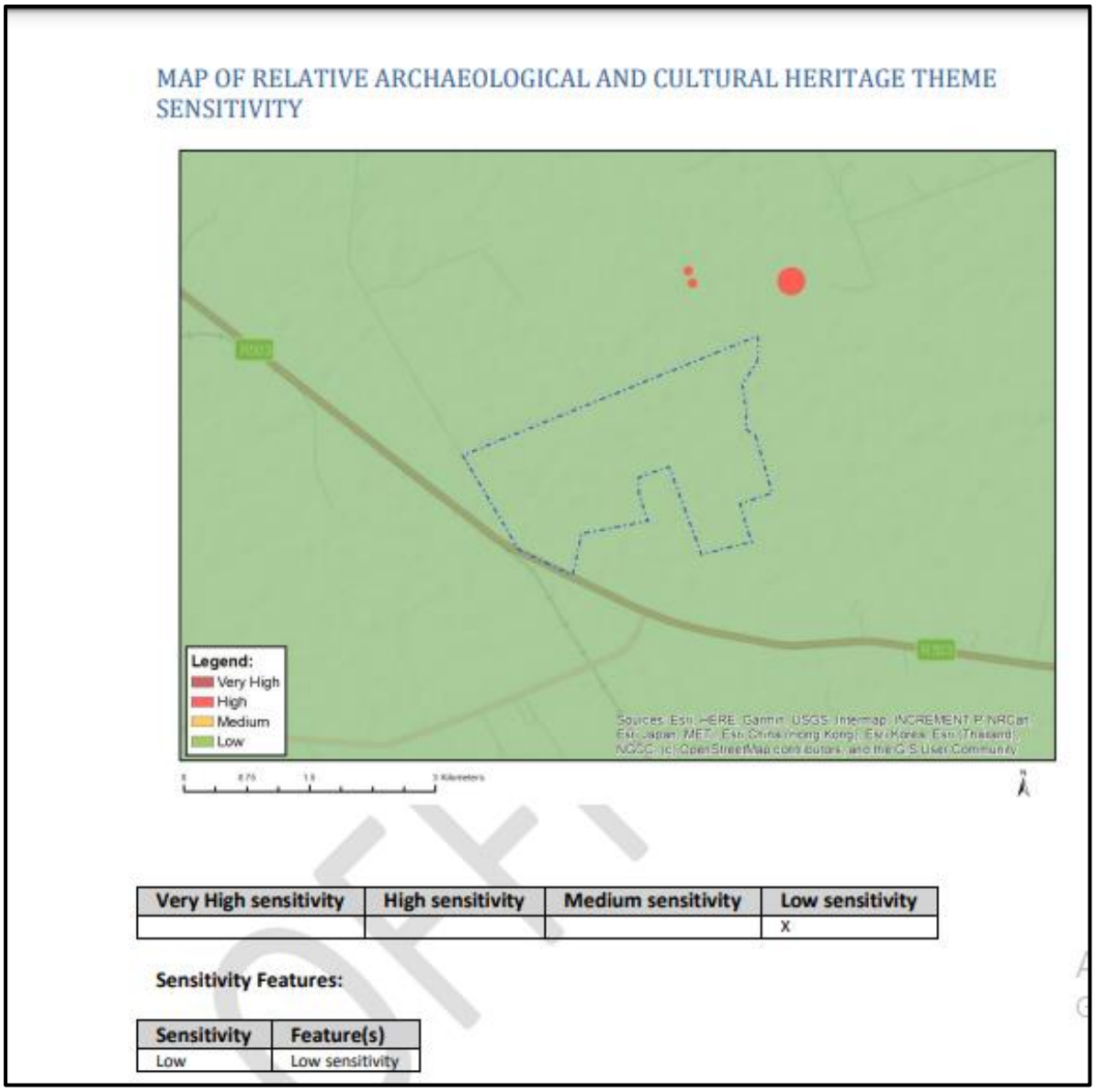

Figure 5.7. DEA Screening of the archaeological sensitivity of the study area.

The Stone Age artefacts date to the MSA and LSA and are made from fine grained material like chert and cryptocrystalline silica (CCS) and is exposed on rocky outcrops and cleared areas (Figure 5.6). No formal tools that can be attributed to an industry level were noted and artefacts consist of flakes without retouch, MSA blades and cores. Site locations are included in Table 3 and selected artefacts are illustrated in Figures 5.7 to 5.12.

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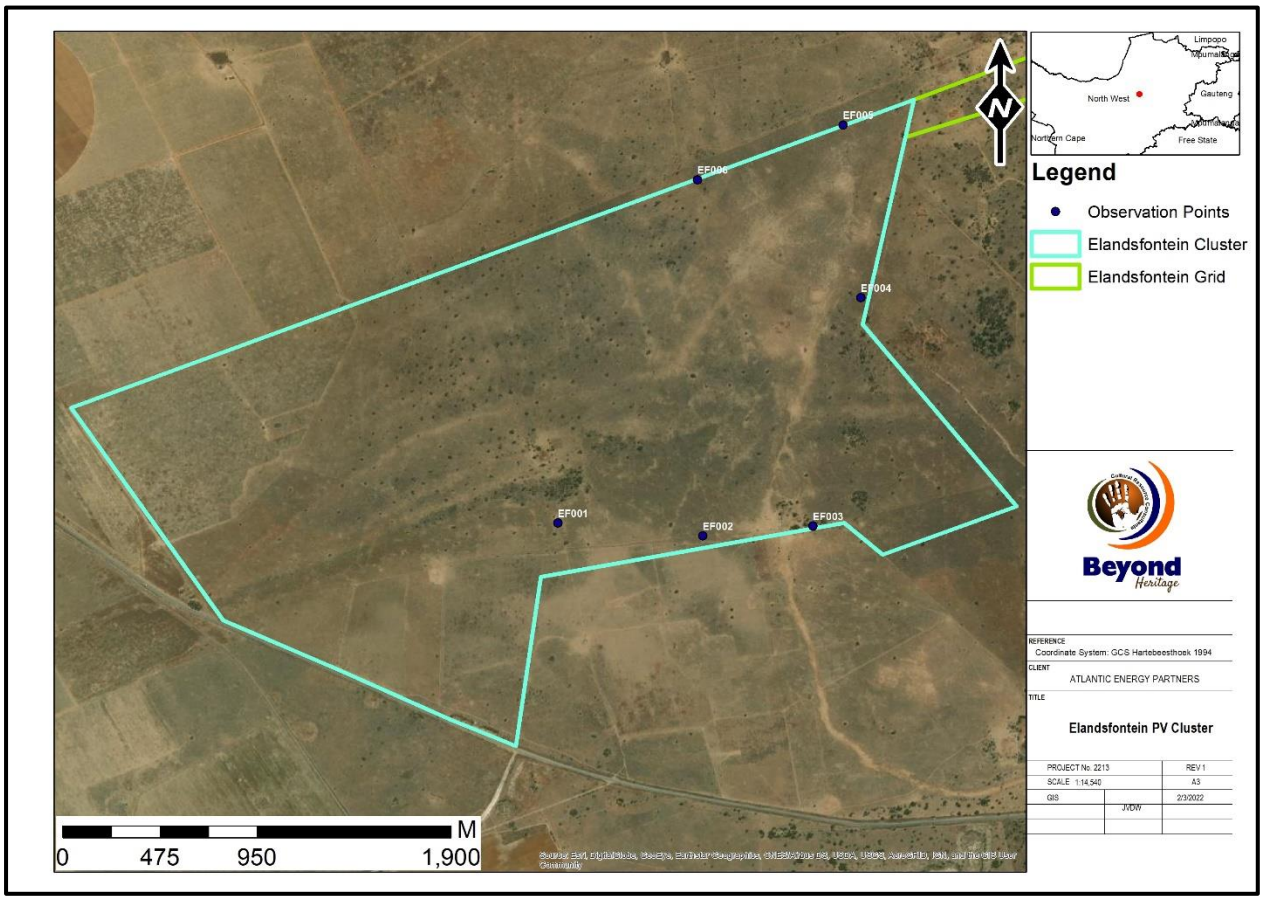


Figure 5.8. Recorded features in relation to the proposed PV Facility.

Figure 5.9. MSA cores and chunks at EF001

Figure 5.10. Dorsal view of MSA artefacts at EF002

Figure 5.11. Collection of artefacts noted at EF003

Figure 5.12. Collection of artefacts at EF004.

Figure 5.13. Flakes on CCS at EF005

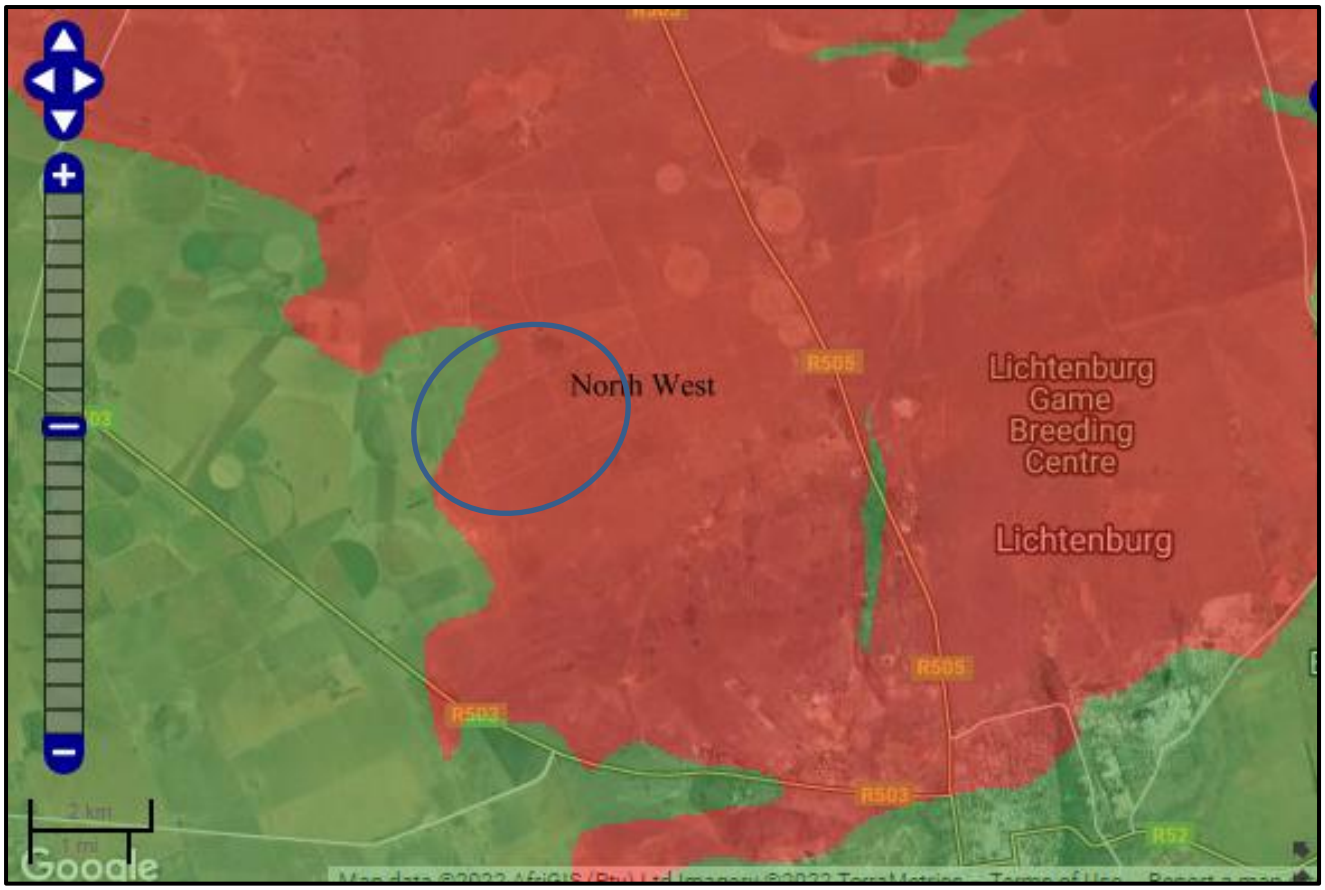
Figure 5.14. Single MSA blade at EF006.

Table 3. Recorded observations in the study area.

Label	Longitude	Latitude	Description	Significance	Elevation
EF001	26° 05' 30.7823" E	26° 07' 42.2581" S	Small scatter of MSA lithics located on a small gravel road running from the entrance of the farm to the cement water reservoir.	Low Significance GP C	1502,568
EF002	26° 05' 53.7611" E	26° 07' 44.2955" S	Small scatter of MSA flakes and chunks in a small gravel road where the top soil has been scraped away.	Low Significance GP C	1504,565
EF003	26° 06' 11.1852" E	26° 07' 42.7080" S	Small scatter of lithic artefacts found in a gravel road on a rocky outcrop.	Low Significance GP C	1494,04
EF004	26° 06' 18.7884" E	26° 07' 06.5280" S	Small scatter of artefacts located on a small gravel road on a rocky outcrop.	Low Significance GP C	1498,397
EF005	26° 06' 15.9839" E	26° 06' 39.1573" S	Small scatter of artefacts located near a gravel road.	Low Significance GP C	1498,78
EF006	26° 05' 52.8972" E	26° 06' 47.8368" S	Isolated MSA blade located near a small gravel road.	Low Significance GP C	1500,441

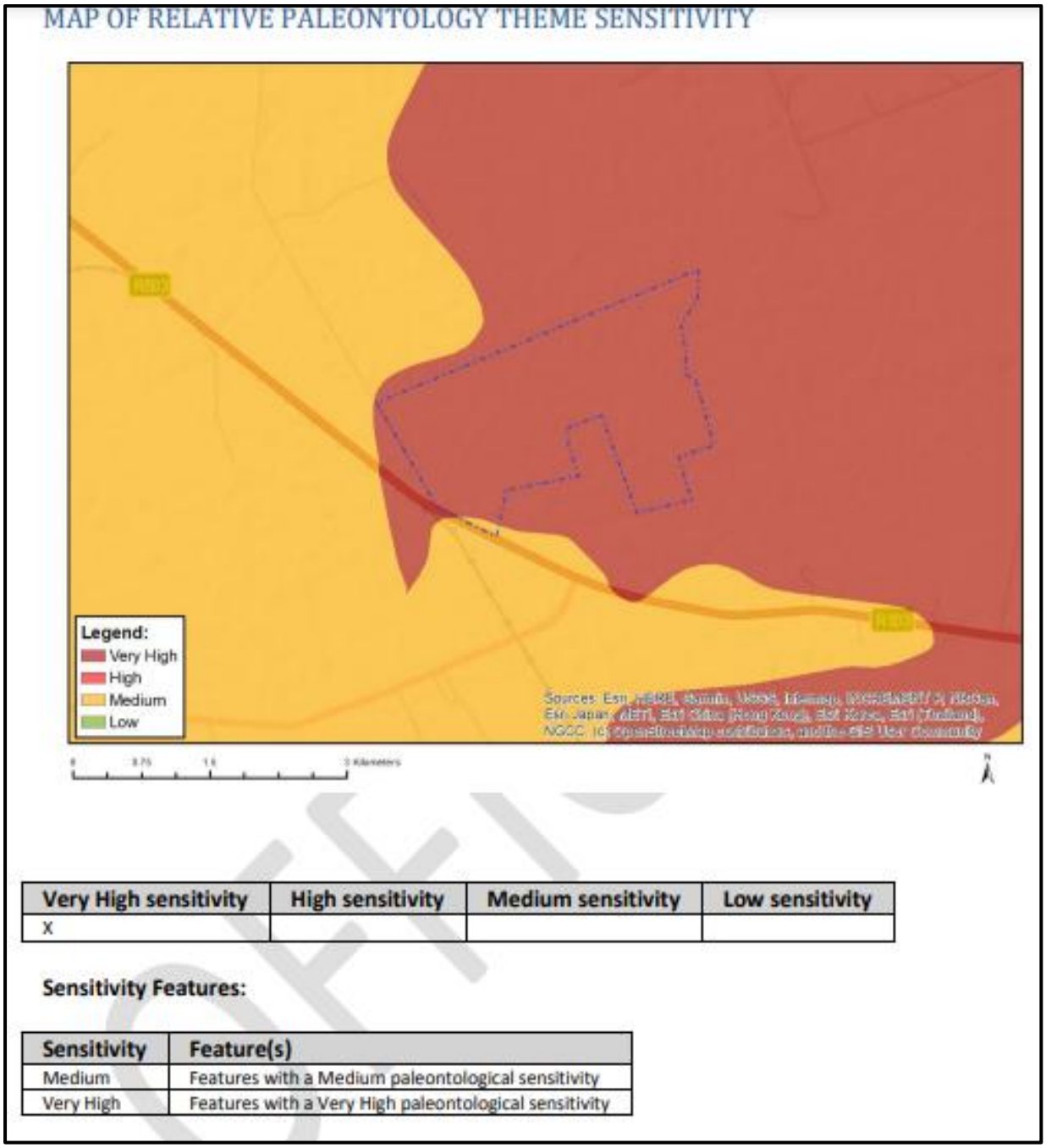
5.2 Paleontological Resources

Based on the SAHRA sensitivity map the area is of high sensitivity, this concurs with the DEA Screening Tool that indicated the area of very high paleontological sensitivity. An independent study for this aspect was conducted by Prof Marion Bamford (2022) as appended, the study found that the proposed site lies on the potentially very highly fossiliferous rocks of the Malmani Subgroup, (Chuniespoort Group, Transvaal Supergroup), particularly the Oaktree Formation. The site visit and walkthrough found that there were good exposures of dolomite but no stromatolites were present. Nonetheless, a Fossil Chance Find Protocol should be added to the EMPr.



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.

Figure 5.15. Paleontological sensitivity for the approximate study area (blue polygon) as indicated by SAHRA.



Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
X			

Sensitivity Features:

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

Figure 5.16. DEA screening of the paleontological sensitivity of the study area.

6 KNOWLEDGE GAPS

The authors acknowledge that the brief literature review is not exhaustive on the literature of the area. Due to the subsurface nature of archaeological artefacts the possibility exists that some features or artefacts may not have been discovered/recorded during the survey. The possible occurrence of graves can also not be excluded. This study did not assess the impact on medicinal plants and intangible heritage as it is assumed that these components would have been highlighted through the public consultation process if relevant. It is possible that new information could come to light in future, which might change the results of this Impact Assessment. Sand and vegetation cover in the study area limited archaeological visibility.

7 CONCLUSIONS

The study area was assessed both on desktop level and by a non-intrusive pedestrian field survey. No significant heritage sites were recorded within the PV footprint, although Stone Age scatters were noted alluding to Stone Age occupation of the area. *In-situ* deposits could occur below the surface and the significance of higher density clusters will have to be further investigated during the EIA phase.

Based on the Department of Environmental Affairs screening tool the heritage sensitivity of the study area is low. The findings of the baseline study confirmed this rating. The DEA Screening Tool and the SAHRA paleontological map indicated the study area to be of very high palaeontological sensitivity and this was independently assessed by Bamford (2022). The study concluded that it is extremely unlikely that any fossils would be preserved in the overlying soils and sands of the Quaternary. There is a very small chance that fossils may occur in below the ground surface in the dolomites of the Malmani Subgroup (Chuniespoort Group, Transvaal Supergroup) so a Fossil Chance Find Protocol should be added to the EMPr.

No fatal flaws were recorded, and the project can proceed but in order to comply with the National Heritage Resources Act (Act 25 of 1999) it is recommended that a Phase 1 Heritage Impact Assessment must be undertaken for the study area. During the HIA the potential impact on heritage resources will be determined as well as levels of significance of recorded heritage resources. The HIA will also provide management and mitigation measures should any significant sites be impacted upon, ensuring that all the requirements of the SAHRA are met.

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Appendix A – Palaeontological study

Palaeontological Impact Assessment for the proposed Elandsfontein Energy Cluster, Lichtenburg, North West Province

Site Visit Report (Phase 2)

For

Beyond Heritage

05 February 2022

Prof Marion Bamford
Palaeobotanist
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Johannesburg, South Africa
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Expertise of Specialist

The Palaeontologist Consultant: Prof Marion Bamford
Qualifications: PhD (Wits Univ, 1990); FRSSAf, ASSAf
Experience: 33 years research; 25 years PIA studies

Declaration of Independence

This report has been compiled by Professor Marion Bamford, of the University of the Witwatersrand, sub-contracted by Beyond Heritage, Modimolle, South Africa. The views expressed in this report are entirely those of the author and no other interest was displayed during the decision making process for the Project.

Specialist: Prof Marion Bamford

Signature: 

Executive Summary

A Palaeontological Impact Assessment was requested for the proposed Elandsfontein Energy Cluster that comprises two PV facilities, the Aristida and the Themeda PVs. The site is northwest of Lichtenburg and the grid connection is planned to the Watershed Substation at the Lichtenburg Game Breeding Farm, in the Northwest West Province.

To comply with the regulations of the South African Heritage Resources Agency (SAHRA) in terms of Section 38(8) of the National Heritage Resources Act, 1999 (Act No. 25 of 1999) (NHRA), a site visit (Phase 2) Palaeontological Impact Assessment (PIA) was completed for the proposed development.

The proposed site lies on the potentially very highly fossiliferous rocks of the Malmani Subgroup, (Chuniespoort Group, Transvaal Supergroup), particularly the Oaktree Formation. The site visit and walkthrough by the archaeologists for this project found that there were good exposures of dolomite but no stromatolites were present. Nonetheless, a Fossil Chance Find Protocol should be added to the EMPr. Based on this information it is recommended that no further palaeontological impact assessment is required unless fossils are found by the developer/ environmental officer/ other designated responsible person once excavations/drilling activities have commenced. As far as the palaeontology is concerned, the project should be authorised.

Table of Contents

1. Background

A proposal has been put forward to develop two solar energy clusters on Farm Elandsfontein 34, the so called Aristida PV and the Themeda PV. The farm is located northwest of Lichtenburg, on the R503, North West Province (Figures 1-2). A grid connection to the existing Watershed Substation, adjacent to the Lichtenburg Game Breeding Centre is also part of this project (Figure 3).

A Palaeontological Impact Assessment was requested for the Elandsfontein Energy Cluster because the site and grid route lie on potentially very highly sensitive rocks of the Oaktree Formation (Malmani Subgroup, Chuniespoort Group, Transvaal Supergroup). To comply with the regulations of the South African Heritage Resources Agency (SAHRA) in terms of Section 38(8) of the National Heritage Resources Act, 1999 (Act No. 25 of 1999) (NHRA), a site visit and walkthrough (Phase 2) Palaeontological Impact Assessment (PIA) was completed for the proposed development and is reported herein.

Table 1: Specialist report requirements in terms of Appendix 6 of the EIA Regulations (amended 2017)

	A specialist report prepared in terms of the Environmental Impact Regulations of 2017 must contain:	**Relevant section in report**
ai	Details of the specialist who prepared the report	Appendix B
aii	The expertise of that person to compile a specialist report including a curriculum vitae	Appendix B
b	A declaration that the person is independent in a form as may be specified by the competent authority	Page 1
c	An indication of the scope of, and the purpose for which, the report was prepared	Section 1
ci	An indication of the quality and age of the base data used for the specialist report: SAHRIS palaeosensitivity map accessed – date of this report	Yes
cii	A description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change	Section 5
d	The date and season of the site investigation and the relevance of the season to the outcome of the assessment	N/A
e	A description of the methodology adopted in preparing the report or carrying out the specialised process	Section 2
f	The specific identified sensitivity of the site related to the activity and its associated structures and infrastructure	Section 4
g	An identification of any areas to be avoided, including buffers	N/A

	A specialist report prepared in terms of the Environmental Impact Regulations of 2017 must contain:	**Relevant section in report**
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;	N/A
i	A description of any assumptions made and any uncertainties or gaps in knowledge;	Section 5
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 4
k	Any mitigation measures for inclusion in the EMPr	Section 8, Appendix A
l	Any conditions for inclusion in the environmental authorisation	N/A
m	Any monitoring requirements for inclusion in the EMPr or environmental authorisation	Section 8, Appendix A
ni	A reasoned opinion as to whether the proposed activity or portions thereof should be authorised	Section 6
nii	If the opinion is that the proposed activity 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	Sections 6, 8
o	A description of any consultation process that was undertaken during the course of carrying out the study	N/A
p	A summary and copies if any comments that were received during any consultation process	N/A
q	Any other information requested by the competent authority.	N/A

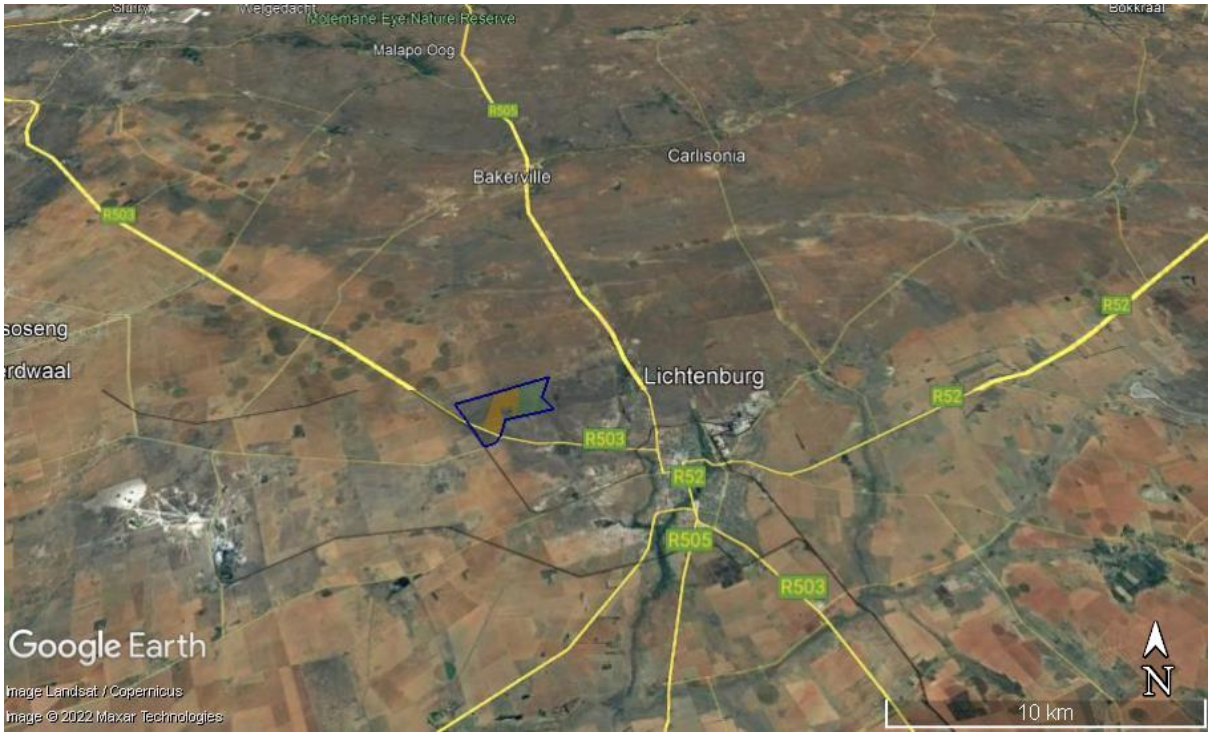

Figure 1: Google Earth map of the proposed development showing the relevant land marks.

Figure 2: Google Earth map of the proposed Elandsfontein Energy Cluster shown within the Blue outline with the Aristida PV to the west (orange) and the Themeda PV to the east (gree).

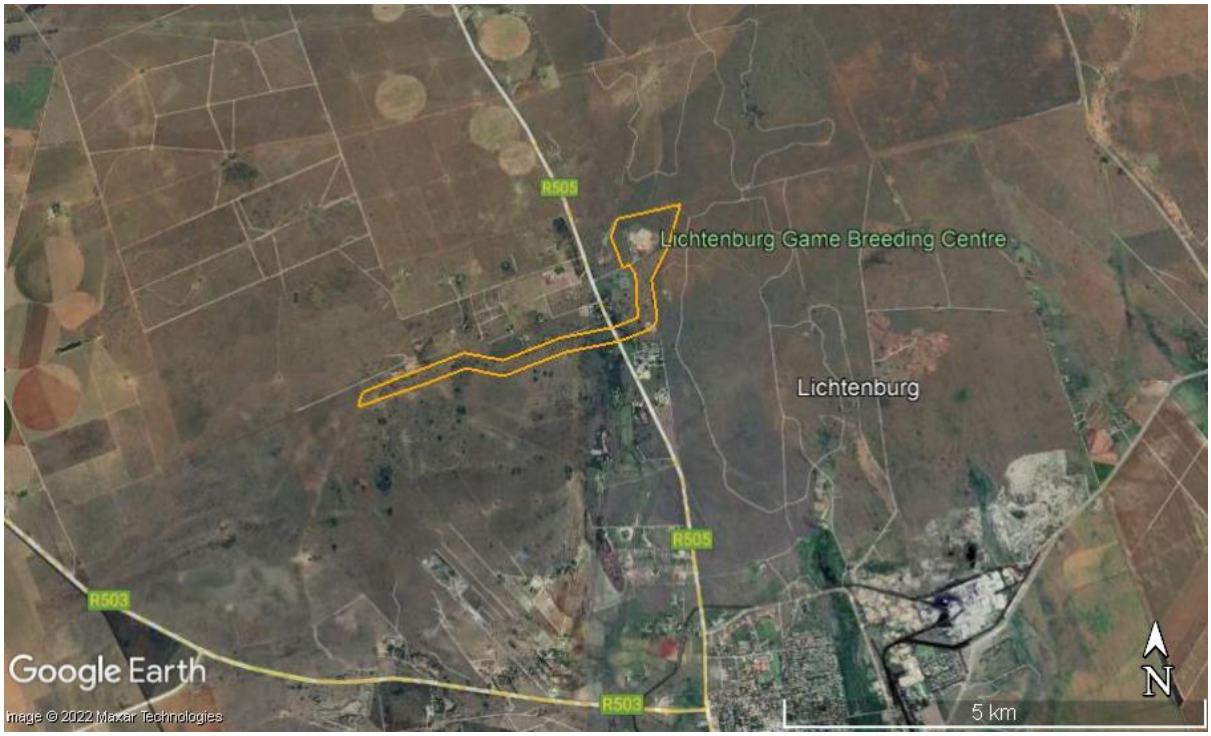

Figure 3: Google Earth Map of the proposed grid connection from the Elandsfontein Energy Cluster to the Watershed Substation adjacent to the Lichtenburg Game Breeding Centre.

2. Methods and Terms of Reference

The Terms of Reference (ToR) for this study were to undertake a PIA and provide feasible management measures to comply with the requirements of SAHRA.
The methods employed to address the ToR included:

1. Consultation of geological maps, literature, palaeontological databases, published and unpublished records to determine the likelihood of fossils occurring in the affected areas. Sources included records housed at the Evolutionary Studies Institute at the University of the Witwatersrand and SAHRA databases;
2. Where necessary, site visits by a qualified palaeontologist to locate any fossils and assess their importance, as is the case here;
3. Where appropriate, collection of unique or rare fossils with the necessary permits for storage and curation at an appropriate facility (*not applicable to this assessment*); and
4. Determination of fossils' representivity or scientific importance to decide if the fossils can be destroyed or a representative sample collected (*not applicable to this assessment*).

3. Geology and Palaeontology

i. Project location and geological context

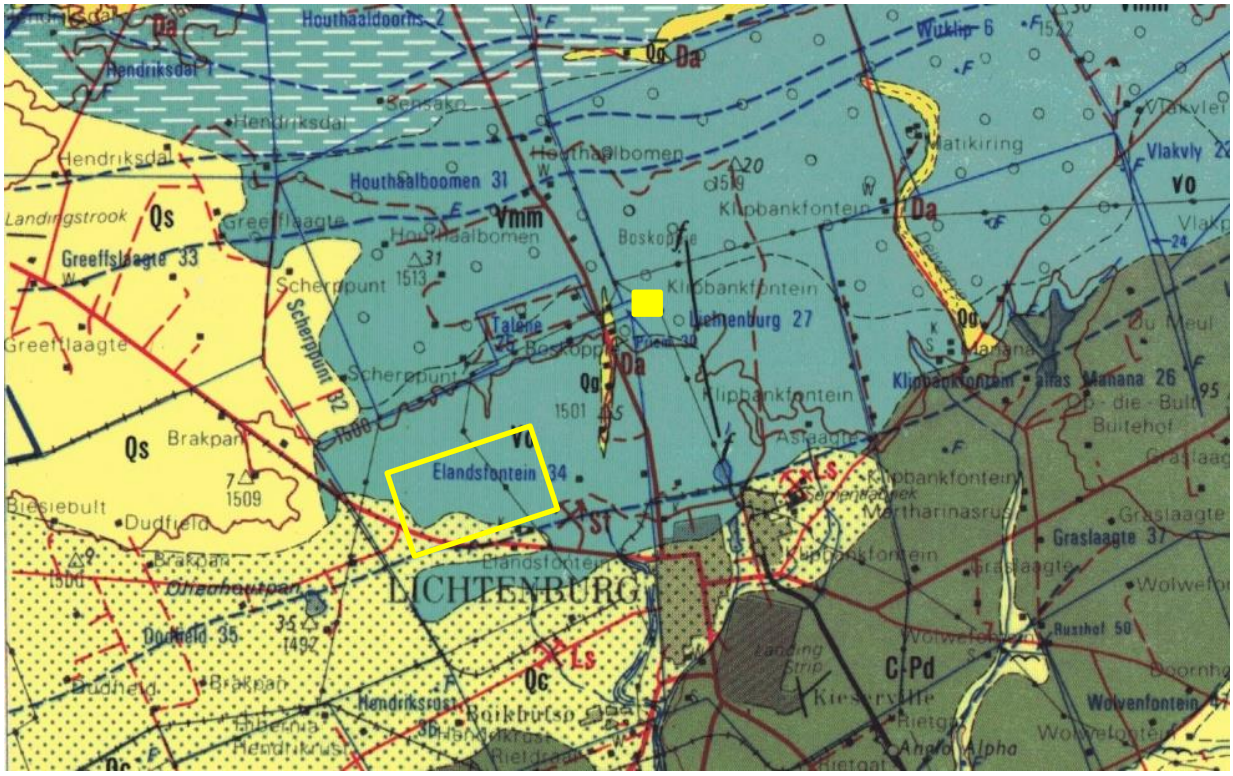

Figure 4: Geological map of the area around Lichtenburg and the proposed Elandsfontein Energy cluster (clear yellow block) and the Watershed Substation (solid yellow block).

Abbreviations of the rock types are explained in Table 2. Map enlarged from the Geological Survey 1: 250 000 map 2626 West Rand.

Table 2: Explanation of symbols for the geological map and approximate ages (Eriksson et al., 2006).. SG = Supergroup; Fm = Formation; Ma = million years; grey shading = formations impacted by the project.

Symbol	Group/Formation	Lithology	Approximate Age
Qs	Quaternary	Alluvium, sand, calcrete	Neogene, ca 2.5 Ma to present
Qc	Quaternary calcrete	Calcrete, sand	Neogene, ca 2.5 Ma to present
C-Pd	Dwyka Group	Diamictites, tillites, mudstones, shales,	Early Permian, Middle Ecca, ca 280-270 Ma
Vml	Littleton Fm, Malmani Subgroup, Chuniespoort Group, Transvaal SG	Dark chert-poor dolomite	Ca 2585 – 2480 Ma
Vmm	Monte Christo Fm, Malmani Subgroup, Chuniespoort Group, Transvaal SG	Chert-rich dolomite; circles = oolitic	Ca 2585 – 2480 Ma
Vo	Oaktree Fm, Malmani Subgroup, Chuniespoort Group, Transvaal SG	Dark chert-free dolomite	Ca 2585 – 2480 Ma
Vbr	Black Reef Fm, Transvaal SG	Quartzite, conglomerate, shale	<2618 Ma

The Late Archaean to early Proterozoic Transvaal Supergroup is preserved in three structural basins on the Kaapvaal Craton (Eriksson et al., 2006). In South Africa are the Transvaal and Griqualand West Basins, and the Kanye Basin is in southern Botswana. The Griqualand West Basin is divided into the Ghaap Plateau sub-basin and the Prieska sub-basin. Sediments in the lower parts of the basins are very similar but they differ somewhat higher up the sequences. Several tectonic events have greatly deformed the south western portion of the Griqualand West Basin between the two sub-basins

The Transvaal Supergroup comprises one of world's earliest carbonate platform successions (Beukes, 1987; Eriksson et al., 2006; Zeh et al., 2020). In some areas there are well preserved stromatolites that are evidence of the photosynthetic activity of blue green bacteria and green algae. These microbes formed colonies in warm, shallow seas.

In the Transvaal Basin the Transvaal Supergroup is divided into two Groups, the lower Chuniespoort Group and the upper Pretoria Group (with ten formations; Eriksson et al., 2006). The Chuniespoort Group is divided into the basal Malmani Subgroup that comprises dolomites and limestones and is divided into five formations based on chert content, stromatolitic morphology, intercalated shales and erosion surfaces. The top of the Chuniespoort Group has the Penge Formation and the Duitschland Formation.

The Malmani Subgroup is up to 2000m thick and has been divided into five formations based on the composition of cherts, stromatolites, limestones and shales. At the base, overlying the Black Reef Formation, is the base is the **Oaktree Formation** that represents a transition from siliciclastic sedimentation to platform carbonates (Eriksson et al., 2006). It is composed of carbonaceous shales, stromatolitic dolomites and locally developed quartzites. Next is the **Monte Christo Formation** that has an erosive breccia base and continues with stromatolitic and oolitic platformal dolomites. Above that is the Lyttleton Formation that is composed of shales, quartzites and stromatolitic dolomites. The overlying Eccles Formation includes a series of cherty dolomites and erosion breccias that locally contain gold deposits. This mineralisation has been attributed to hydrothermal remobilisation of fluids by the Bushveld complex (Eriksson et al., 2006). The topmost formation is the Frisco Formation that is composed mainly of stromatolitic dolomites but these become more shale rich towards the top of the sequence because of the deepening depositional environment.

ii. Palaeontological context

The palaeontological sensitivity of the area under consideration is presented in Figure 5, with the Monte Christo and Oaktree Formations of the Malmani Subgroup indicated as very highly sensitive (red) because of the potential of finding trace fossils, in particular stromatolites.

Stromatolites are the trace fossils that were formed by colonies of green algae and blue-green algae (Cyanobacteria) that grew in warm, shallow marine settings. These algae were responsible for releasing oxygen via the photosynthetic process where atmospheric carbon dioxide and water, using energy from the sun, are converted into carbon chains and compounds that are the building blocks of all living organisms. The released carbon

dioxide initially was taken up by the abundant reducing minerals to form oxides, e.g. iron oxide. Eventually free oxygen was released into the atmosphere and some was converted into ozone by the bombardment of cosmic rays. The ozone is critical for the filtering out of harmful ultraviolet rays.

Stromatolites are the layers upon layers of inorganic materials that were deposited during photosynthesis, namely calcium carbonate, magnesium carbonate, calcium sulphate and magnesium sulphate. These layers can be in the form of flat layers, domes or columns depending on the environment where they grew (Beukes, 1987). Some environments did not form stromatolites, just layers of limestone that later was converted to dolomite. The algae that formed the stromatolites are very rarely preserved, and they are microscopic so they can only be seen from thin sections studies under a petrographic microscope.

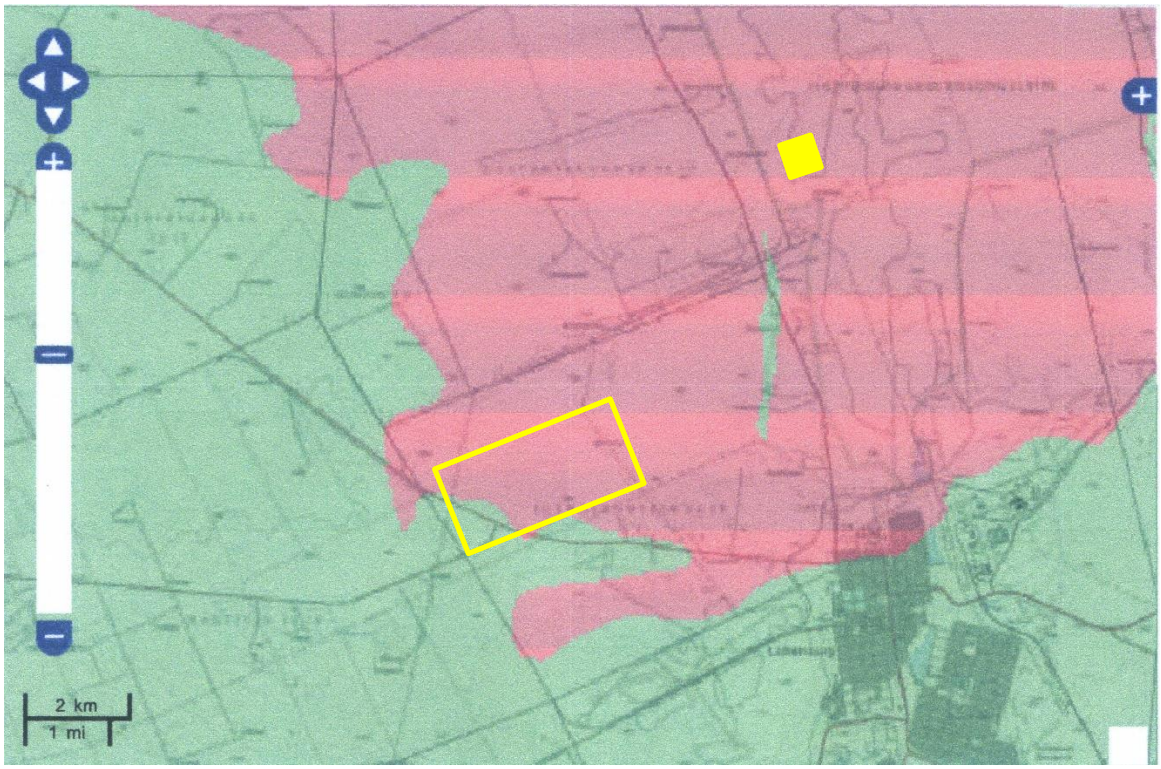

Figure 5: SAHRIS palaeosensitivity map for the site for the proposed Elandsfontein Energy Cluster shown within the yellow rectangle. Background colours indicate the following degrees of sensitivity: red = very highly sensitive; orange/yellow = high; green = moderate; blue = low; grey = insignificant/zero.

iii. Site visit observations

The site was visited on 03 February by the archaeologist and walked through, looking for dolomite and stromatolites.

Figure 6

Figure 7

Figure 6: Elandsfontein Energy Cluster site photographs, Aristida PV area. A – the topography is generally flat and covered in grasses, including *Aristida* sp., But outcrops of dolomite are fairly common. B – undisturbed dolomite. C – D – piles of dolomite that have been removed from the field but none contains any stromatolites.

Figure 7: Elandsfontein Energy Cluster site photographs, Themeda PV area. A – pile of dolomite that has been removed from the fields. B – D – in situ dolomite. B – typical elephant-skin texture of the dolomite. C – remnant of very weathered cryptalgal structures. Note there are no stromatolites.

Summary of observations

The site was visited in summer so the grass cover is good. Nonetheless, the outcrops of dolomite were clearly seen. None of them, however, had preserved any trace fossils such as stromatolites.

4. Impact assessment

An assessment of the potential impacts to possible palaeontological resources considers the criteria encapsulated in Table :

Table 3a: Criteria for assessing impacts

PART A: DEFINITION AND CRITERIA		
Criteria for ranking of the SEVERITY/NATURE of environmental impacts	**H**	Substantial deterioration (death, illness or injury). Recommended level will often be violated. Vigorous community action.
	M	Moderate/ measurable deterioration (discomfort). Recommended level will occasionally be violated. Widespread complaints.
	L	Minor deterioration (nuisance or minor deterioration). Change not measurable/ will remain in the current range. Recommended level will never be violated. Sporadic complaints.
	L+	Minor improvement. Change not measurable/ will remain in the current range. Recommended level will never be violated. Sporadic complaints.
	M+	Moderate improvement. Will be within or better than the recommended level. No observed reaction.
	H+	Substantial improvement. Will be within or better than the recommended level. Favourable publicity.
Criteria for ranking the DURATION of impacts	**L**	Quickly reversible. Less than the project life. Short term
	M	Reversible over time. Life of the project. Medium term
	H	Permanent. Beyond closure. Long term.
	L	Localised - Within the site boundary.
	M	Fairly widespread – Beyond the site boundary. Local

Criteria for ranking the SPATIAL SCALE of impacts	**H**	Widespread – Far beyond site boundary. Regional/ national
PROBABILITY (of exposure to impacts)	**H**	Definite/ Continuous
	M	Possible/ frequent
	L	Unlikely/ seldom

Table 3b: Impact Assessment

PART B: Assessment		
SEVERITY/NATURE	**H**	-
	M	Quaternary soils and sands do not preserve plant fossils; Malmani Subgroup dolomites might preserve trace fossils such as stromatolites. The site visit confirmed that there were no stromatolites.. The impact would be negligible.
	L	-
	L+	-
	M+	-
	H+	-
DURATION	**L**	-
	M	-
	H	Where manifest, the impact will be permanent.
SPATIAL SCALE	**L**	Since the only possible fossils within the area would be trace fossils such as stromatolites, the spatial scale will be localised within the site boundary.
	M	-
	H	-
PROBABILITY	**H**	**-**
	M	**-**
	L	The site visit showed that there are no surface stromatolites, but they might be present below the surface. Therefore, a Fossil Chance Find Protocol should be added to the eventual EMPr.

Based on the nature of the project, surface activities may impact upon the fossil heritage if preserved in the development footprint. The geological structures suggest that the rocks are the correct age and type to preserve fossils. The site visit and walk through confirmed that there were NO FOSSILS in the project footprint. Furthermore, the material to be excavated is soils and sand and these do not preserve fossils. Since there is an extremely small chance that trace fossils may occur below ground and be disturbed, a Fossil Chance Find Protocol has been added to this report. Taking account of the defined criteria, the potential impact to fossil heritage resources is extremely low.

5. Assumptions and uncertainties

Based on the geology of the area and the palaeontological record as we know it, it can be assumed that the formation and layout of the dolomites, sandstones, shales and sands are typical for the country and do contain trace fossils such as stromatolites. The site visit and walk through on 03 February by the archaeologist confirmed that there are NO FOSSILS such as stromatolites in the project footprint, in the solar collecting area or along the proposed grid connection.. The sands of the Quaternary period would not preserve fossils.

6. Recommendation

Based on the fossil record but confirmed by the site visit and walk through there are NO FOSSILS such as stromatolites in the exposed dolomites, even though fossils have been recorded from rocks of a similar age and type in South Africa. It is extremely unlikely that any fossils would be preserved in the overlying soils and sands of the Quaternary. There is a very small chance that fossils may occur in below the ground surface in the dolomites of the Malmani Subgroup (Chuniespoort Group, Transvaal Supergroup) so a Fossil Chance Find Protocol should be added to the EMPr. If fossils are found by the environmental officer, or other responsible person once excavations and drilling have commenced, then they should be rescued and a palaeontologist called to assess and collect a representative sample.

7. References

Beukes, N.J., 1987. Facies relations, depositional environments and diagenesis in a major early Proterozoic stromatolitic carbonate platform to basinal sequence, Campbellrand Subgroup, Transvaal Supergroup, southern Africa. Sedimentary Geology 54, 1-46.

Eriksson, P.G., Altermann, W., Hartzer, F.J., 2006. The Transvaal Supergroup and its pre-cursors. 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. pp 237-260

Plumstead, E.P., 1969. Three thousand million years of plant life in Africa. Geological Society of southern Africa, Annexure to Volume LXXII. 72pp + 25 plates.

8. Chance Find Protocol

Monitoring Programme for Palaeontology – to commence once the excavations / drilling activities begin.

1. The following procedure is only required if fossils are seen on the surface and when drilling/excavations commence.
2. When excavations begin the rocks and must be given a cursory inspection by the environmental officer or designated person. Any fossiliferous material (trace fossils, fossils of plants, insects, bone or coalified material) should be put aside in a suitably protected place. This way the project activities will not be interrupted.
3. Photographs of similar fossils must be provided to the developer to assist in recognizing the fossil plants, vertebrates, invertebrates or trace fossils in the shales and mudstones (for example see Figure 8). This information will be built into the EMP's training and awareness plan and procedures.
4. Photographs of the putative fossils can be sent to the palaeontologist for a preliminary assessment.
5. If there is any possible fossil material found by the developer/environmental officer then the qualified palaeontologist sub-contracted for this project, should visit the site to inspect the selected material and check the dumps where feasible.
6. Fossil plants or vertebrates that are considered to be of good quality or scientific interest by the palaeontologist must be removed, catalogued and housed in a suitable institution where they can be made available for further study. Before the fossils are removed from the site a SAHRA permit must be obtained. Annual reports must be submitted to SAHRA as required by the relevant permits.
7. If no good fossil material is recovered then no site inspections by the palaeontologist will be necessary. A final report by the palaeontologist must be sent to SAHRA once the project has been completed and only if there are fossils.
8. If no fossils are found and the excavations have finished then no further monitoring is required.

9. Appendix A – Examples of fossils from the Malmani Subgroup

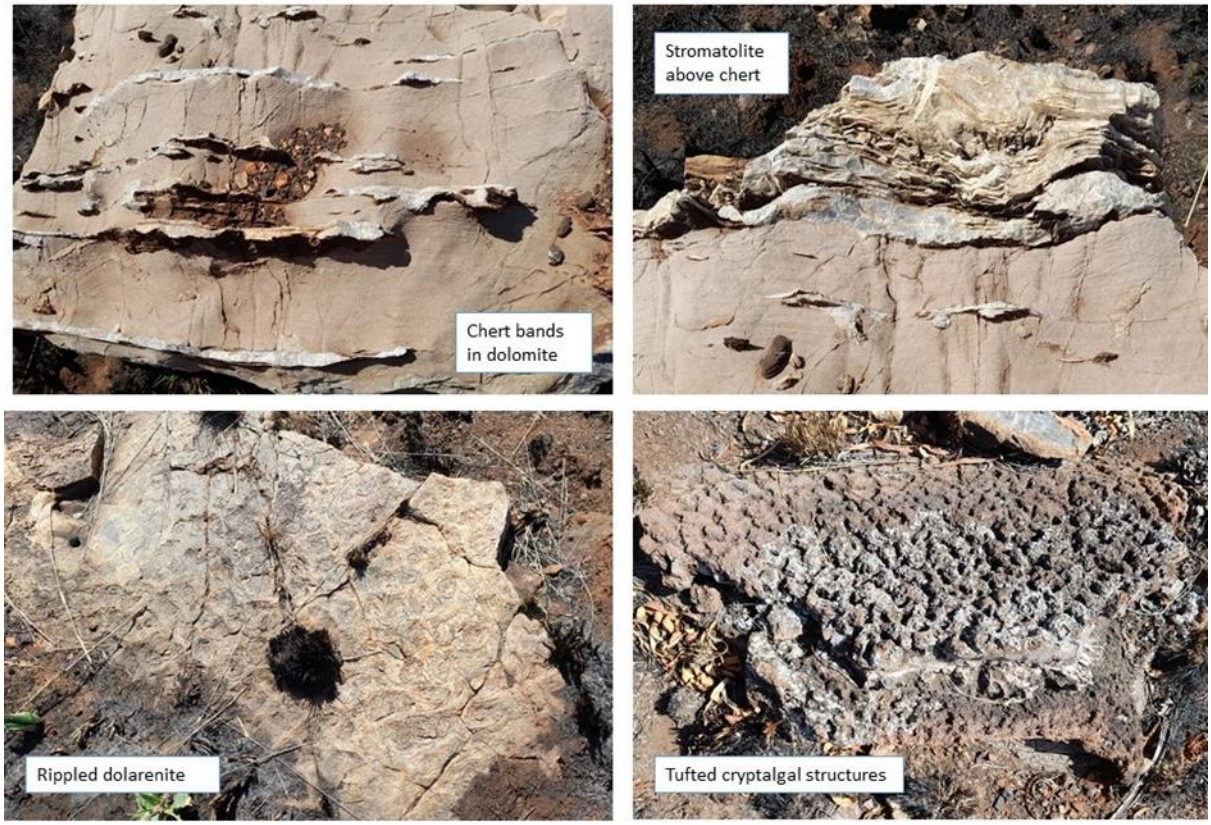

Figure 8: Photographs of different types of stromatolites in dolomite.

10. Appendix B – Details of specialists

Marion Bamford (PhD)

Short CV for PIAs – Jan 2022

I) **Personal details**

Present employment: Professor; Director of the Evolutionary Studies Institute. Member Management Committee of the NRF/DST Centre of Excellence Palaeosciences, University of the Witwatersrand, Johannesburg, South Africa

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Fax : +27 11 717 6694
Cell : 082 555 6937
E-mail : marion.bamford@wits.ac.za ; marionbamford12@gmail.com

ii) **Academic qualifications**

Tertiary Education: All at the University of the Witwatersrand:
1980-1982: BSc, majors in Botany and Microbiology. Graduated April 1983.

1983: BSc Honours, Botany and Palaeobotany. Graduated April 1984.
1984-1986: MSc in Palaeobotany. Graduated with Distinction, November 1986.
1986-1989: PhD in Palaeobotany. Graduated in June 1990.

iii) **Professional qualifications**
Wood Anatomy Training (overseas as nothing was available in South Africa):
1994 - Service d'Anatomie des Bois, Musée Royal de l'Afrique Centrale, Tervuren, Belgium, by Roger Dechamps
1997 - Université Pierre et Marie Curie, Paris, France, by Dr Jean-Claude Koeniguer
1997 - Université Claude Bernard, Lyon, France by Prof Georges Barale, Dr Jean-Pierre Gros, and Dr Marc Philippe

iv) **Membership of professional bodies/associations**
Palaeontological Society of Southern Africa
Royal Society of Southern Africa - Fellow: 2006 onwards
Academy of Sciences of South Africa - Member: Oct 2014 onwards
International Association of Wood Anatomists - First enrolled: January 1991
International Organization of Palaeobotany – 1993+
Botanical Society of South Africa
South African Committee on Stratigraphy – Biostratigraphy - 1997 - 2016
SASQUA (South African Society for Quaternary Research) – 1997+
PAGES - 2008 –onwards: South African representative
ROCEEH / WAVE – 2008+
INQUA – PALCOMM – 2011+onwards

vii) **Supervision of Higher Degrees**
All at Wits University

Degree	Graduated/completed	Current
Honours	11	0
Masters	12	4
PhD	11	4
Postdoctoral fellows	12	2

viii) **Undergraduate teaching**
Geology II – Palaeobotany GEOL2008 – average 65 students per year
Biology III – Palaeobotany APES3029 – average 25 students per year
Honours – Evolution of Terrestrial Ecosystems; African Plio-Pleistocene Palaeoecology; Micropalaeontology – average 12 - 20 students per year.

ix) **Editing and reviewing**
Editor: Palaeontologia africana: 2003 to 2013; 2014 – Assistant editor
Guest Editor: Quaternary International: 2005 volume
Member of Board of Review: Review of Palaeobotany and Palynology: 2010 –
Associate Editor: Cretaceous Research: 2018-2020
Associate Editor: Royal Society Open: 2021 -
Review of manuscripts for ISI-listed journals: 25 local and international journals

x) **Palaeontological Impact Assessments**

Selected from recent project only – list not complete:

- Mala Mala 2017 for Henwood
- Modimolle 2017 for Green Vision
- Klipoortjie and Finaalspan 2017 for Delta BEC
- Ledjadja borrow pits 2018 for Digby Wells
- Lungile poultry farm 2018 for CTS
- Olienhout Dam 2018 for JP Celliers
- Isondlo and Kwasobabili 2018 for GCS
- Kanakies Gypsum 2018 for Cabanga
- Nababeep Copper mine 2018
- Glencore-Mbali pipeline 2018 for Digby Wells
- Remhoogte PR 2019 for A&HAS
- Bospoort Agriculture 2019 for Kudzala
- Overlooked Quarry 2019 for Cabanga
- Richards Bay Powerline 2019 for NGT
- Eilandia dam 2019 for ACO
- Eastlands Residential 2019 for HCAC
- Fairview MR 2019 for Cabanga
- Graspan project 2019 for HCAC
- Lieliefontein N&D 2019 for Enviropro
- Skeerpoort Farm Mast 2020 for HCAC
- Vulindlela Eco village 2020 for 1World
- KwaZamakhule Township 2020 for Kudzala
- Sunset Copper 2020 for Digby Wells
- McCarthy-Salene 2020 for Prescali
- VLNR Lodge 2020 for HCAC
- Madadeni mixed use 2020 for Enviropro
- Frankfort-Windfield Eskom Powerline 2020 for 1World
- Beaufort West PV Facility 2021 for ACO Associates
- Copper Sunset MR 2021 for Digby Wells
- Sannaspos PV facility 2021 for CTS Heritage
- Smithfield-Rouxville-Zastron PL 2021 for TheroServe
- Glosam Mine 2021 for AHSA

Xi) **Research Output**

Publications by M K Bamford up to January 2022 peer-reviewed journals or scholarly books: over 160 articles published; 5 submitted/in press; 10 book chapters.
Scopus h-index = 30; Google Scholar h-index = 36; -i10-index = 95
Conferences: numerous presentations at local and international conferences.