Jaco van der Walt
BA (Pret) BA (Hons) (Archaeology) [Wits], MA (Archaeology [Wits]

Cell: 082 373 8491.
E-mail: jaco@heritageconsultants.co.za
Website: www.heritageconsultants.co.za

Beyond Heritage (Pty) Ltd
Registration number:
2021/598485/07
VAT no. 4660218696
Private Bag X1049
Suite 34
Modimolle

12 May 2022

Attention: Ms. Natasha Higgitt

SAHRA Case Officer Northern Cape

South African Heritage Resources Agency (SAHRA)

Dear Ms Higgitt

Application for exemption from a Heritage Impact Assessment for the Proposed Development of a Solar PV Facility and Associated Infrastructure at the Sishen Iron Ore Mine

1. Introduction

Beyond Heritage was appointed by SLR Consulting (South Africa) to provide an assessment of the possible impacts on heritage resources by the proposed development of a Solar Photovoltaic (PV) Facility at the Sishen Iron Ore Mine (Sishen Mine). The Sishen Mine is an opencast mine located close to the town of Kathu in the Northern Cape Province. The proposed Project will be located on an existing waste rock dump (WRD) on portion 2 and the remaining extent of the Farm Sacha 468, and portion 1 of the Farm Sims 462 (Figure 1.1 – 1.3). The WRD have totally transformed the area and no heritage resources in terms of Section 38 of the National Heritage Resources Act (NHRA) will be impacted on.

Jaco van der Walt
BA (Pret) BA (Hons) (Archaeology) [Wits], MA (Archaeology [Wits]

Cell: 082 373 8491.
E-mail: jaco@heritageconsultants.co.za
Website: www.heritageconsultants.co.za

Beyond Heritage (Pty) Ltd
Registration number:
2021/598485/07
VAT no. 4660218696
Private Bag X1049
Suite 34
Modimolle

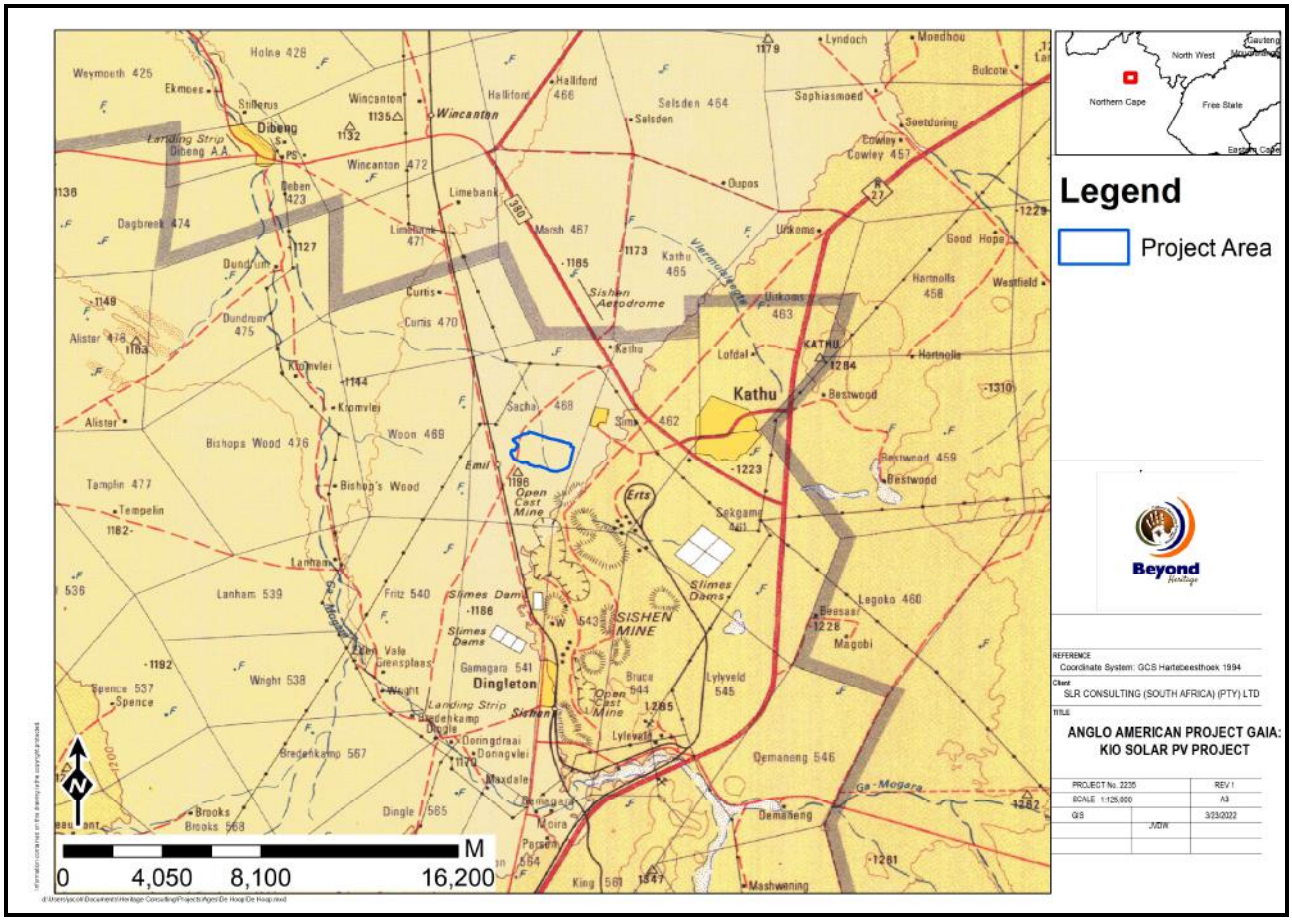

Figure 1.1. Regional setting of the Project (1: 250 000 topographical map).

Jaco van der Walt
BA (Pret) BA (Hons) (Archaeology) [Wits], MA (Archaeology [Wits]

Cell: 082 373 8491.
E-mail: jaco@heritageconsultants.co.za
Website: www.heritageconsultants.co.za

Beyond Heritage (Pty) Ltd
Registration number:
2021/598485/07
VAT no. 4660218696
Private Bag X1049
Suite 34
Modimolle

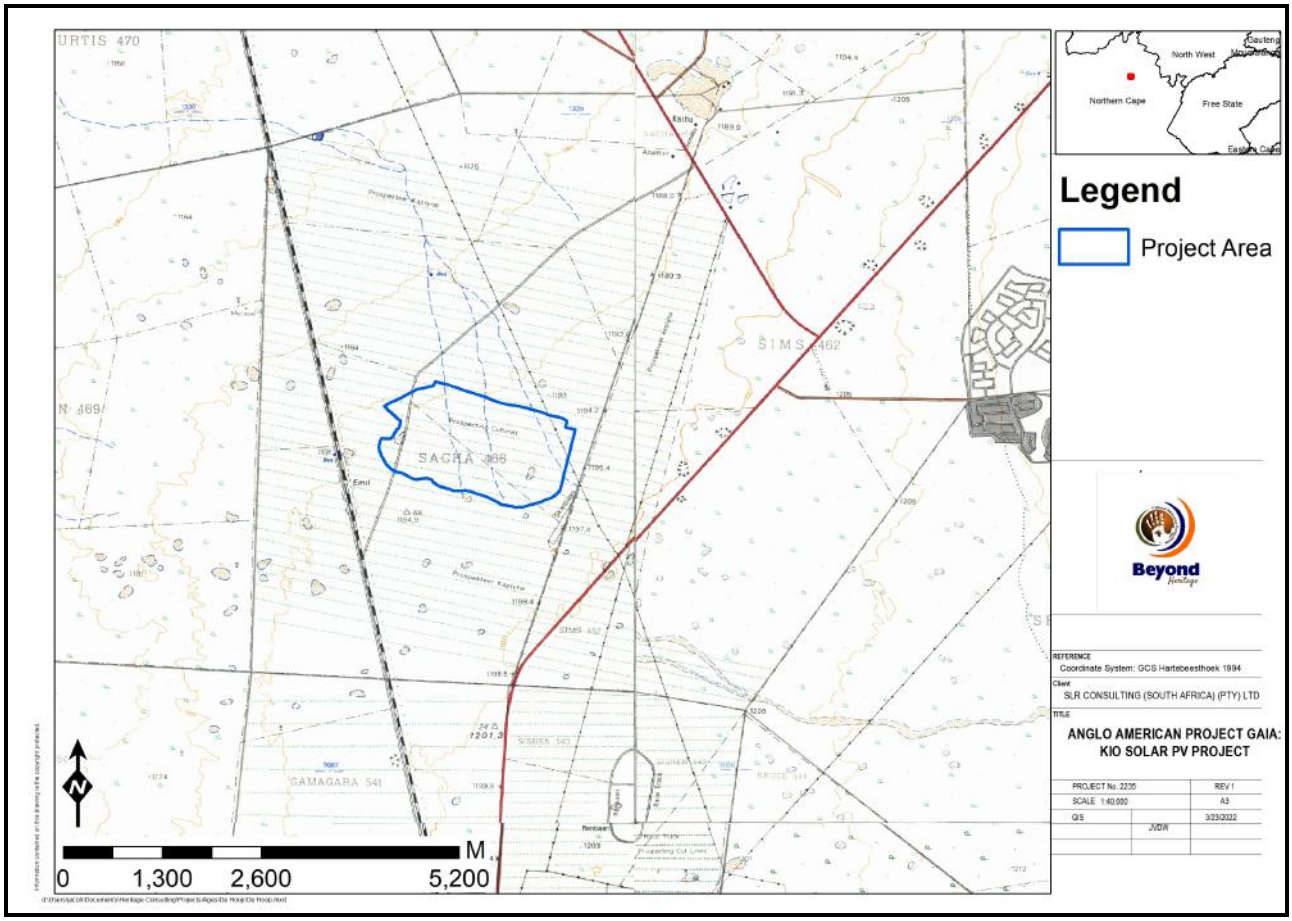

Figure 1.2. Local setting of the Project (1: 40 000 topographical map).

Jaco van der Walt
BA (Pret) BA (Hons) (Archaeology) [Wits], MA (Archaeology [Wits]

Cell: 082 373 8491.
E-mail: jaco@heritageconsultants.co.za
Website: www.heritageconsultants.co.za

Beyond Heritage (Pty) Ltd
Registration number:
2021/598485/07
VAT no. 4660218696
Private Bag X1049
Suite 34
Modimolle

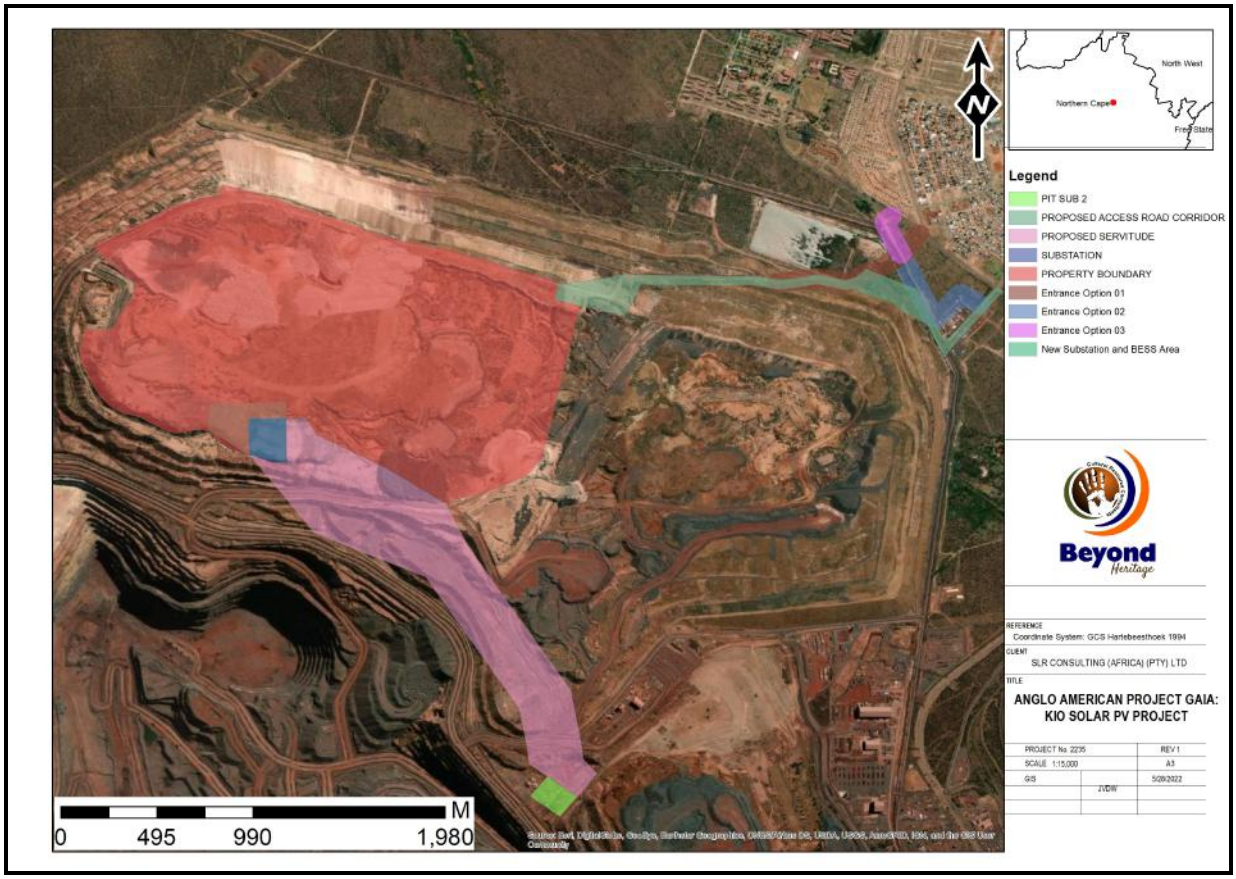

Figure 1.3. Aerial image of the study area.

1.1. Project Background

Sishen Iron Ore Company (SIOC), an Anglo American company, owns the opencast Sishen Iron Ore Mine (Sishen Mine). The Sishen Mine is located close to the town of Kathu in the Northern Cape Province. SIOC proposes to develop a 150 megawatt (MW) solar photovoltaic (PV) facility and associated infrastructure within the Mining Right area (the Project). The Project will be located on an existing waste rock dump (WRD) on portion 2 and the remaining extent (RE) of the Farm Sacha 468, and Portion 1 of the Farm Sims 462.

Project motivation

Anglo American is committed to being part of the solution to climate change and aim to play their part in maintaining global temperature rise to below 2℃ as called for by the Paris Agreement. South Africa is particularly vulnerable to climate change impacts and have developed a strategic response as set out in the Climate Change Bill (2018). Anglo American has committed to achieve carbon neutrality on Scope 1 and 2 emissions and to reduce their Scope 3 emissions by 50% by 2040, across their operations. One way to achieve this is through FutureSmart Mining™, an Anglo-American innovation-led approach to sustainable mining. Integral to FutureSmart Mining™ is their Sustainable Mine Plan, designed to tackle the most pressing environmental, social and governance challenges such as climate change. The Anglo American Green House Gas emission reduction ambitions are built on the following1:

Jaco van der Walt
BA (Pret) BA (Hons) (Archaeology) [Wits], MA (Archaeology [Wits]

Cell: 082 373 8491.
E-mail: jaco@heritageconsultants.co.za
Website: www.heritageconsultants.co.za

Beyond Heritage (Pty) Ltd
Registration number: 2021/598485/07
VAT no. 4660218696
Private Bag X1049
Suite 34
Modimolle

- Scope 1: Deployment of FutureSmart Mining™ is central to reducing energy demand and delivering the step-change innovation required for avoiding emissions, including the capture and use of fugitive methane.
- Scope 2: The procurement and rapid roll-out of renewable power supply, including through embedded generation where necessary.

As part of the Anglo group and in alignment with the Anglo "FutureSmart Mining" and "Carbon Neutrality Energy Strategy", Kumba has committed to reducing their carbon footprint. The development of the solar PV facility will allow for security of power supply, reduced costs of electricity and reduced carbon emissions. An added benefit to the development of the Project is the repurposing of otherwise unproductive land (WRD), into land which is economically productive again. Kumba sees this strategy as an enhancement to the disturbed area and an alternative vision for the closure of the WRD which will allow for a more constructive end land use.

Project components

The Sishen Mine currently receives power from Eskom, through the Ferrum substation. In an effort to reduce their operational carbon emissions, Kumba proposes to develop the 150 MW solar PV facility and associated infrastructure on the G80 WRD. The Project will cover an area of approximately 340 ha and includes the development of the following infrastructure:

- ground mounted solar PV panels;
- trackers or fixed tilt mounting structures;
- inverter stations;
- a switchyard;
- electrical cables;
- substations;
- battery energy storage system (BESS);
- transformer bays;
- transmission lines;
- operation and maintenance buildings;
- water storage and conservancy tanks;
- site camp and laydown area; and
- access and maintenance roads.

An estimated 300 000 PV panels will be ground mounted utilising either tracking or fixed-tilt technology. The height of the panels is not expected to exceed 8 m. Inverter stations will be developed and located within the area of the solar PV facility. Generated power will be transmitted by electrical cables for collection at an onsite substation of up to 190 MVA within the solar PV facility for distribution. The output capacity of the BESS will reach up to 100 MW and the storage capacity will reach 400 MWh (at 4 hours storage). The BESS will be located within the area of the substation with a total area of up to 8.7 ha.

All generated power will be transmitted via transmission lines up to a capacity of 132 kV (either overhead or underground) within a transmission corridor (area of 100 ha, approximately 4 km in length and 255 m wide) to the Pit Substation 2. Water required for the proposed Project will be sourced from the Sishen mining operations. The Project also includes the establishment of water storage and conservancy tanks for storage purposes.

Construction phase

The construction activities include (but is not limited to) the following:

Jaco van der Walt
BA (Pret) BA (Hons) (Archaeology) [Wits], MA (Archaeology [Wits]

Cell: 082 373 8491.
E-mail: jaco@heritageconsultants.co.za
Website: www.heritageconsultants.co.za

Beyond Heritage (Pty) Ltd
Registration number:
2021/598485/07
VAT no. 4660218696
Private Bag X1049
Suite 34
Modimolle

- earthworks (including foundations, trenches, and berms) in accordance with the approved civil/structural engineering drawings;
- establishment of access road; and
- the construction of a solar PV facility and BESS, substation, transmission lines and related support infrastructure (which includes the erection of associated structures such as the operation and maintenance buildings, site camp, fencing, concrete and steel work).

The duration of the construction phase of the Project is anticipated to be approximately 12 - 18 months. A staff complement of approximately 300 individuals would be required for the construction phase, hereby providing skilled and unskilled job opportunities. Procurement opportunities would be sourced locally, as far as possible.

Power for construction activities will be sourced from Eskom through the existing Sishen mining operations and supplemented by diesel generators where required. The construction phase will entail the establishment of ancillary infrastructure including a workshop, storage areas, temporary offices and ablution facilities for construction, permanent ablution facilities and a security hut at the entrance.

An existing access road, located to the north of the G80 rock dump will provide a separate, secure and dedicated access to the solar PV plant separate from the mine's main access. The road of approximately 5 km in length will require upgrading to a width of 50 m for the main access.

Operational phase

Typical activities will include the operation and maintenance of the facility. The duration of the operational phase of the Project is anticipated to be approximately 30 years. During operation, the facility will generate power for the Sishen operations and will create and maintain approximately 30 jobs.

Rehabilitation

Rehabilitation of the Project site will comprise of the following:

- Covering the dump with a layer of competent material e.g., calcrete on top of the clay layer of the WRD.
- On top of the competent layer, another thin layer of either topsoil or a type of gravel.
- Seeding of the entire area or topsoiled, for very light vegetation as it is on top of the WRD. It should be noted that seeding will only take place after the life of the solar PV facility.

Jaco van der Walt
BA (Pret) BA (Hons) (Archaeology) [Wits], MA (Archaeology [Wits]

Cell: 082 373 8491.
E-mail: jaco@heritageconsultants.co.za
Website: www.heritageconsultants.co.za

Beyond Heritage (Pty) Ltd
Registration number: 2021/598485/07
VAT no. 4660218696
Private Bag X1049
Suite 34
Modimolle

2. The Heritage Character of the Study area

2.1. 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).

2.2. Background to the general area

2.2.1. The Stone Age

South Africa has a long and complex Stone Age sequence of more than 2 million years. The broad sequence includes the Later Stone Age (LSA) , the Middle Stone Age (MSA) , and the Earlier Stone Age (ESA). Each of these phases contain sub-phases or industrial complexes, and within these we can expect regional variation regarding characteristics and time ranges. The three main phases can be divided as follows;

- LSA; associated with Khoi and San societies and their immediate predecessors. Recently to ~30 thousand years ago
- MSA; associated with *Homo sapiens* and archaic modern humans. 30-300 thousand years ago.
- ESA; associated with early Homo groups such as *Homo habilis* and *Homo erectus*. 400 000-> 2 million years ago.

The Northern Cape Province is rich in archaeological deposits depicting early hominin occupation as well as their concomitant stone tool technological changes. The area in and surrounding Kathu is referred to as the Kathu Complex which is comprised of several Stone Age sites of varying heritage significance. A series of 11 localities which have been exposed due to sinkhole formations belong to the Kathu Complex (Lukich et al 2019). The Kathu Pan forms an important aspect of the study of human evolution due to the expansive occupation within the region briefly outlined below.

Evidence of the oldest lithic assemblage of the Fauresmith industry, dating back 500 thousand years can be found at the site of Kathu Pan 1 (Wilkins and Chazan 2012). Lithic assemblages found at Kathu Pan 1 show continued hominin occupation throughout the ESA, MSA and LSA. Lithic technology at Kathu Pan 1 suggests of the earliest evidence for the use of spears for hunting and blade production (Wilkens and Chazan 2012).

To the east of the town of Kathu, a site called the Townlands was discovered in 1980 by the landowner. Excavations and analysis of the site discovered the densest Stone Age scatter with over a million artefacts being recovered therefrom (Chazan 2021). An in-situ quarry is speculated to have been made use of at Kathu Townlands, indicating the local procurement of materials as well as the local production of stone tools within the area (Walker et al 2014). The site itself spans roughly 12 hectares in size and is an important archaeological site pertaining to early human activity within the country. In 2013, the Kathu Townlands was declared a Grade 1 National Heritage site (Walker et al 2014).

Excavations at the Wonderwerk Cave situated in the Kuruman Hills yielded a deep deposit rich with Stone Age materials. The cave shows a long period of hominin occupation as the cave was used throughout the Stone Age. Rock engravings can also be found within the cave (Beaumont and Vogel 2006). Due to the importance of the finds, the cave has been registered as a National Heritage Site by SAHRA.

Jaco van der Walt
BA (Pret) BA (Hons) (Archaeology) [Wits], MA (Archaeology [Wits]

Cell: 082 373 8491.
E-mail: jaco@heritageconsultants.co.za
Website: www.heritageconsultants.co.za

Beyond Heritage (Pty) Ltd
Registration number:
2021/598485/07
VAT no. 4660218696
Private Bag X1049
Suite 34
Modimolle

On the farm Sims 462 Kathu Pan 6, 8, 9, 10, and 11 are found within a sinkhole that was caused by sediment collapse. Artefacts found on the farm Sims are associated with the Middle and Late Stone Age. Excavations on the farm Sacha recovered Acheulean to Late Stone Age material from Kathu Pan 1. Stone tools recovered from the excavations are stored at the McGregor Museum (Beaumont 2000). The closest graded site from the project area is approximately 4 km to the north (Figure 2.1).

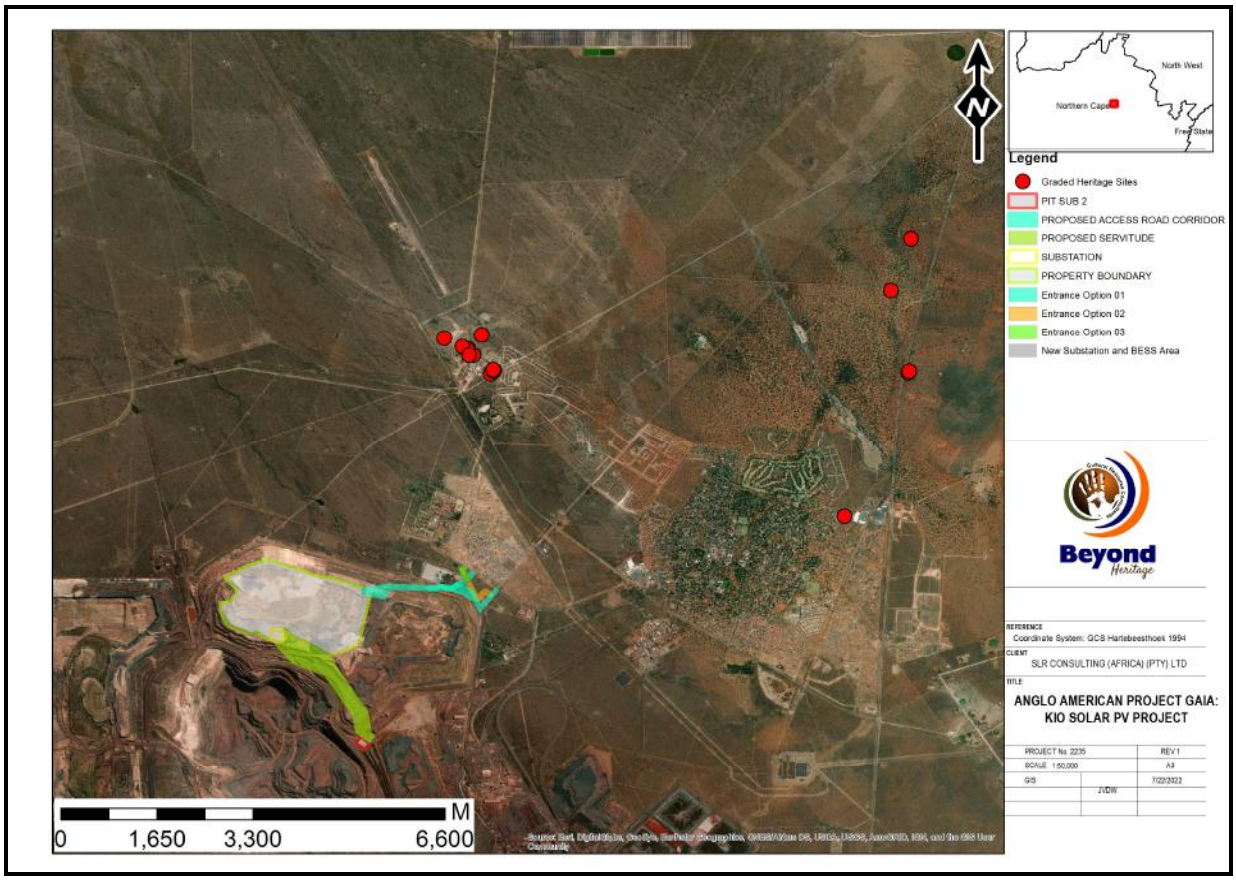

Figure 2.1. Graded sites in relation to the proposed project.

2.2.2. The Iron Age

The Iron Age as a whole represents the spread of Bantu speaking people and includes both the pre-Historic and Historic periods. It can be divided into three distinct periods:

- The Early Iron Age: Most of the first millennium AD.
- The Middle Iron Age: 10th to 13th centuries AD
- The Late Iron Age: 14th century to colonial period.

The Iron Age is characterised by the ability of these early people to manipulate and work iron ore into implements that assisted them in creating a favourable environment to make a better living. Low density ceramic scatters along with other Iron Age artefacts have been found within the Kathu Complex but there is no evidence of any significant Iron Age sites within the area (Beaumont 2000)

Jaco van der Walt
BA (Pret) BA (Hons) (Archaeology) [Wits], MA (Archaeology [Wits]

Cell: 082 373 8491.
E-mail: jaco@heritageconsultants.co.za
Website: www.heritageconsultants.co.za

Beyond Heritage (Pty) Ltd
Registration number:
2021/598485/07
VAT no. 4660218696
Private Bag X1049
Suite 34
Modimolle

2.2.3. Cultural Resource Management (CRM) reports

Several unpublished CRM projects were conducted in the general study area (Van der Walt 2021, Beaumont 2000; 2004; 2005; 2006; 2007; 2008a; 2008b, Dreyer 2008, Van Schalkwyk 2010, Morris 2005; 2008, Kaplan 2008, Walker et al 2013). These surveys and excavations found an array of stone tool scatters from the ESA, MSA, and LSA.

Table 1. Studies consulted for this project include:

Author	Year	Project	Findings
Van der Walt, J.	2021	Heritage Baseline Report for the AMDA Bestwood PV 1 Facility, Northern Cape Province	Stone Age scatters
Morris, D.	2005	Report on a Phase 1 Archaeological Assessment of Proposed Mining Areas on the Farms Bruce, Mokaning and Parson, between Postmasburg and Kathu, Northern Cape	Stone Age artefacts
Beaumont, P. B.	2006	Phase 1 Heritage Impact Assessment on ERF 1439, Remainder of ERF 2974, Remainder of Portion 1 of Farm Uitkoms 463, and Farms Kathu 465 and Sims 462 at and near Kathu in the Northern Cape Province.	Single artefact

2.2.4. Society and Google Earth Monuments

No known grave sites are indicated close to the study area.

2.3. Cultural Landscape

The Sishen Mine has been in operation since 1953 and is the largest iron ore mine found within the Gamagara Municipality. The town of Sishen consisted of buildings associated with the mine. In 1970, the town of Kathu was formally established as a direct result of the Sishen mining activities which allowed the town to expand. During 1970's the Project area used to be fallow land targeted for prospecting and by 2000 partial development for mining activities occurred in the Project area. The site has been completely transformed into a mining landscape during the last 20 years (Figure 2.2 – 2.5).

Jaco van der Walt
BA (Pret) BA (Hons) (Archaeology) [Wits], MA (Archaeology [Wits]

Cell: 082 373 8491.
E-mail: jaco@heritageconsultants.co.za
Website: www.heritageconsultants.co.za

Beyond Heritage (Pty) Ltd
Registration number:
2021/598485/07
VAT no. 4660218696
Private Bag X1049
Suite 34
Modimolle

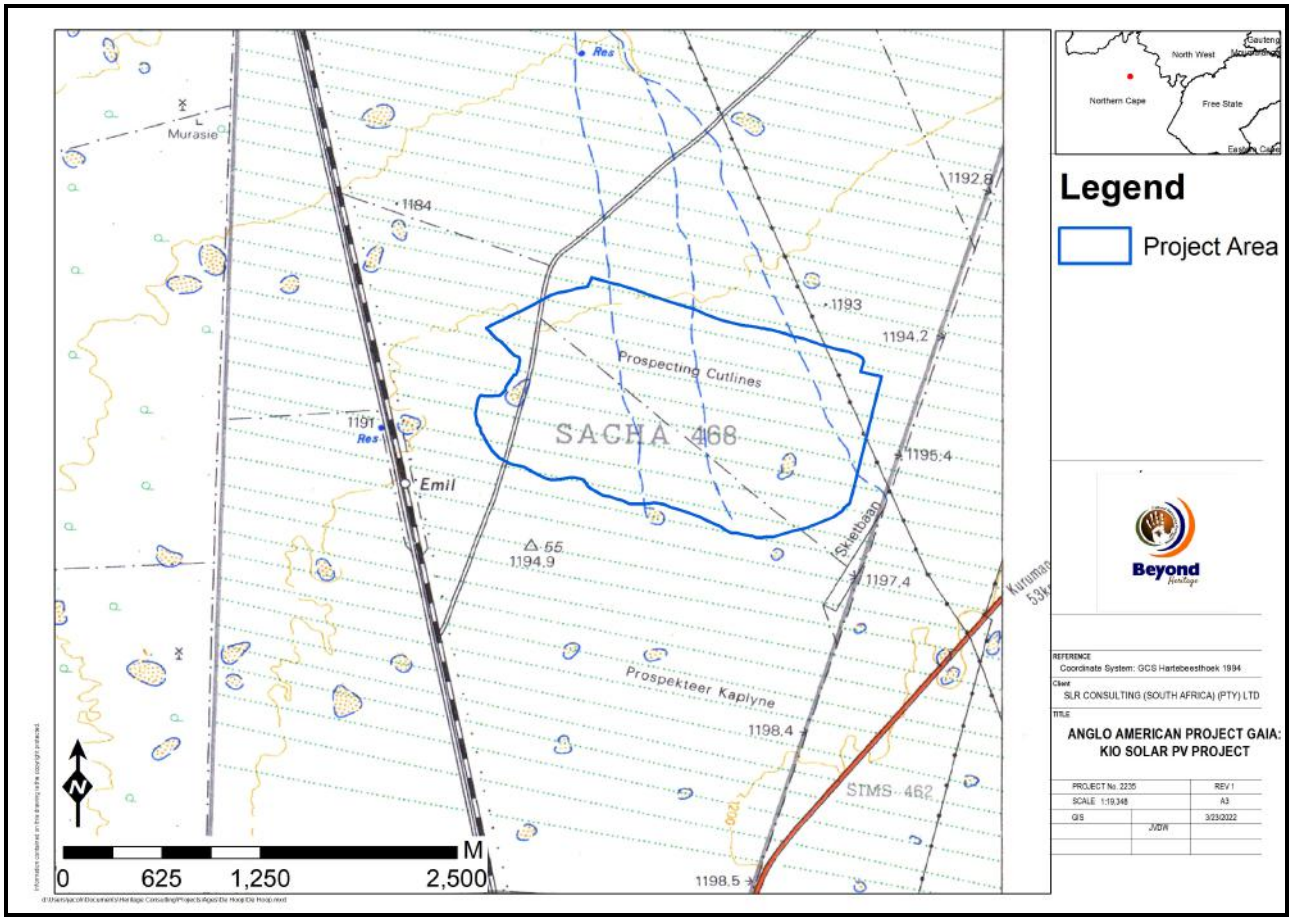

Figure.2.2. 1974 Topographical map of the Project area and surrounds. Prospecting cutlines as well as roads and tracks are indicated, but no structures. A shooting range is indicated just outside the impact area.

Jaco van der Walt
BA (Pret) BA (Hons) (Archaeology) [Wits], MA (Archaeology [Wits]

Cell: 082 373 8491.
E-mail: jaco@heritageconsultants.co.za
Website: www.heritageconsultants.co.za

Beyond Heritage (Pty) Ltd
Registration number:
2021/598485/07
VAT no. 4660218696
Private Bag X1049
Suite 34
Modimolle

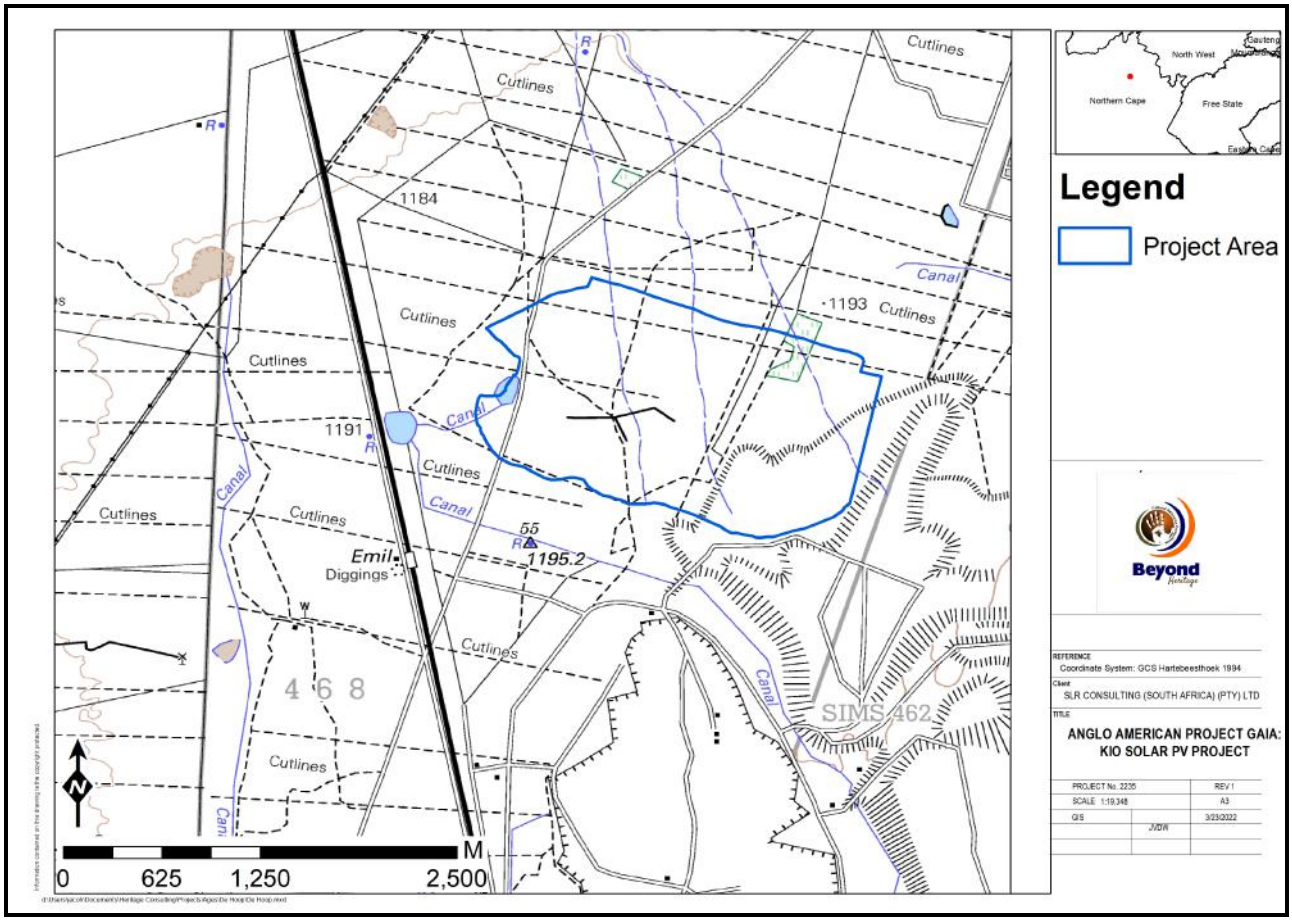

Figure 2.3. 2001 Topographical map of the impact area indicating extensive excavations and cutlines within the impact areas.

Jaco van der Walt
BA (Pret) BA (Hons) (Archaeology) [Wits], MA (Archaeology [Wits]

Cell: 082 373 8491.
E-mail: jaco@heritageconsultants.co.za
Website: www.heritageconsultants.co.za

Beyond Heritage (Pty) Ltd
Registration number:
2021/598485/07
VAT no. 4660218696
Private Bag X1049
Suite 34
Modimolle

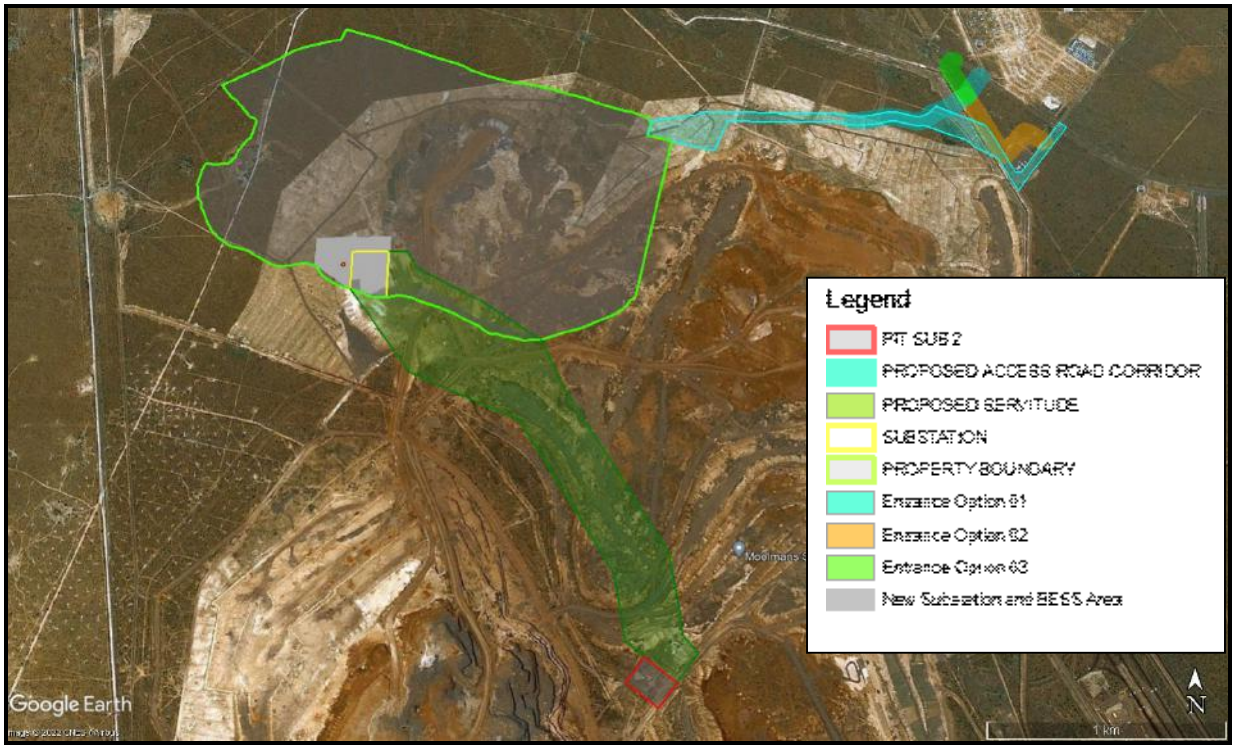

Figure 2.4. 2006 Google image of the study area prior to expansion of the waste rock dump of the mine. Most of the area is visibly transformed by mining activities.

Jaco van der Walt
BA (Pret) BA (Hons) (Archaeology) [Wits], MA (Archaeology [Wits]

Cell: 082 373 8491.
E-mail: jaco@heritageconsultants.co.za
Website: www.heritageconsultants.co.za

Beyond Heritage (Pty) Ltd
Registration number:
2021/598485/07
VAT no. 4660218696
Private Bag X1049
Suite 34
Modimolle

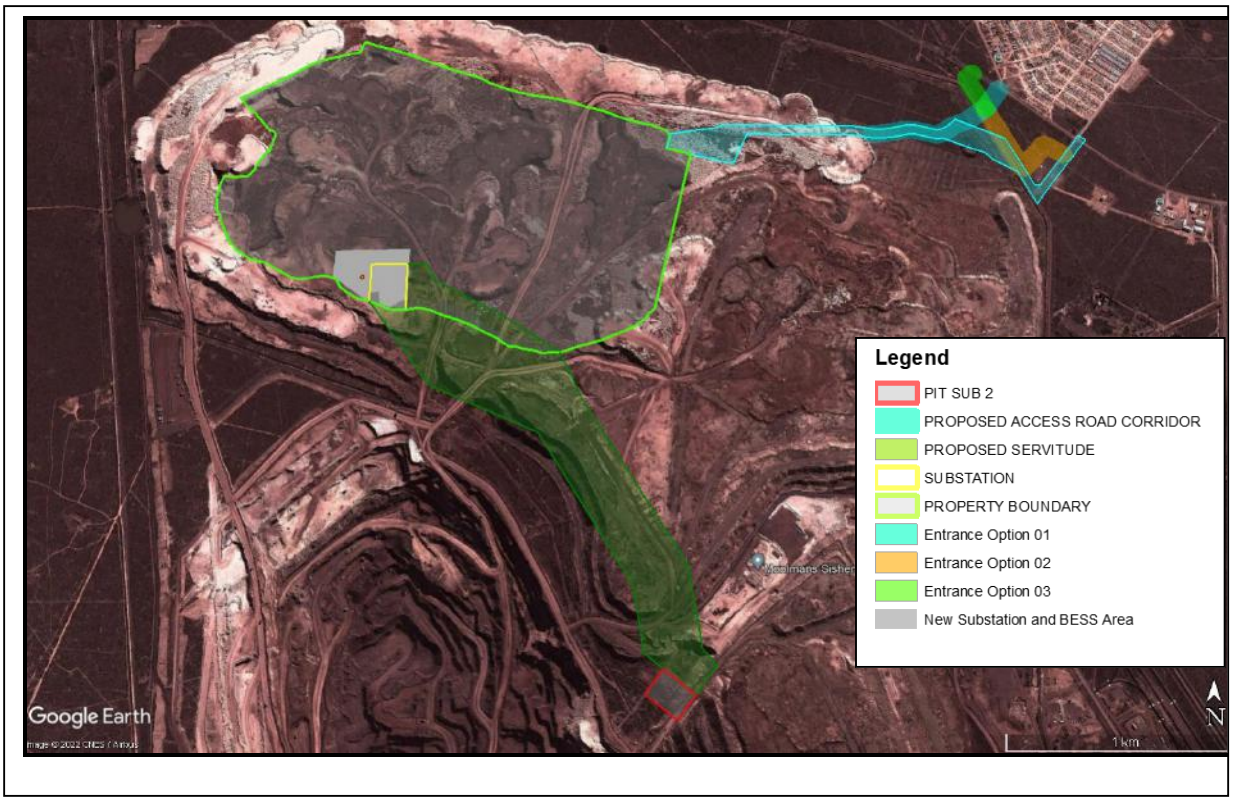

Figure 2.5. 2011 Google image of the study area indicating the complete transformation of the area through mining activities.

3. Findings

The Project footprint measures approximately 340 hectares in size. The project area is completely transformed through initial iron ore mining activities (Figure 2.5), with subsequent growth of the WRD over time. These developments would have destroyed surface indicators of heritage resources if any were present in the area. Areas within the farm Sims 462 and farm Sacha have been previously excavated in the 1980s by Peter Beaumont and as such any artefacts of heritage value have already been removed and preserved that could relate to Stone Age sites impacted on by the mine development. The extensive disturbance of the site and the fact that no in-situ deposit will be disturbed by the Project means that the study area is considered to be of low heritage potential.

Jaco van der Walt
BA (Pret) BA (Hons) (Archaeology) [Wits], MA (Archaeology [Wits]

Cell: 082 373 8491.
E-mail: jaco@heritageconsultants.co.za
Website: www.heritageconsultants.co.za

Beyond Heritage (Pty) Ltd
Registration number:
2021/598485/07
VAT no. 4660218696
Private Bag X1049
Suite 34
Modimolle

Based on the SAHRA paleontological map the Project area is of high senstivity (Figure 3.1). An independent assessment by Bamford (2022) concluded that the proposed site lies on the waste rock dumps which lie on the potentially moderately fossiliferous Tertiary surface limestone. The entire area is highly disturbed and the waste rock is likely to be non-fossiliferous banded iron of the Kuruman Formation. The chance of finding fossils is extremely low. Nonetheless, a Fossil Chance Find Protocol should be added to the Environmental Management Programme (EMPr).

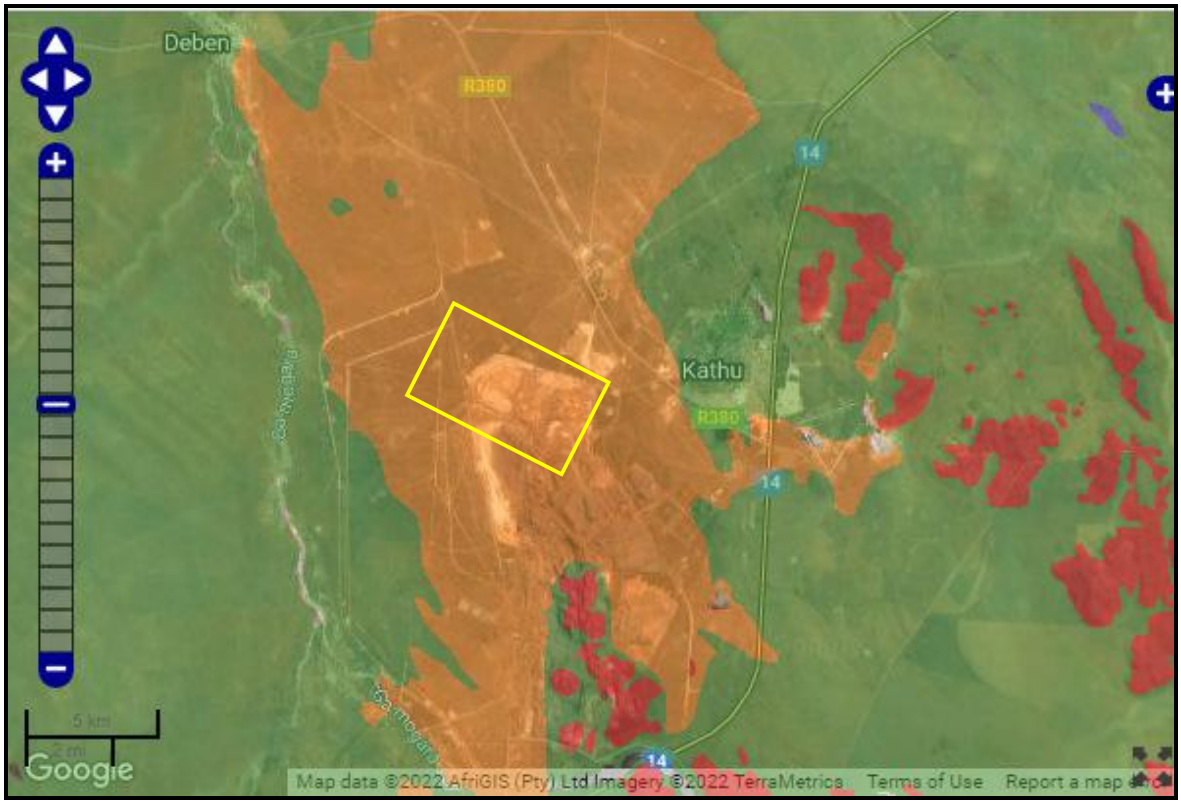

Figure 3.1. Paleontological sensitivity of the approximate study area (yellow polygon) as indicated on the SAHRA Paleontological Map (Key below)

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.

Jaco van der Walt
BA (Pret) BA (Hons) (Archaeology) [Wits], MA (Archaeology [Wits]

Cell: 082 373 8491.
E-mail: jaco@heritageconsultants.co.za
Website: www.heritageconsultants.co.za

Beyond Heritage (Pty) Ltd
Registration number: 2021/598485/07
VAT no. 4660218696
Private Bag X1049
Suite 34
Modimolle

4. Conclusion

The Project area is completely transformed, firstly by initial iron ore mining activities, with further disturbance marked by an existing WRD (Figure 2.5). Since the Project area is highly disturbed and transformed, and that no in-situ deposit will be affected by the Project, it is unlikely that the solar PV facility would disturb any heritage resources. Access road alternatives also occur in highly disturbed areas apart from option1 that traverses a small section of approximately 140 m in a greenfield area, but unlikely to disturb a site of major significance considering the transformed nature of the surrounding area and all three alternatives are acceptable from a heritage point of view. Isolated artefacts are of low significance in these areas since better preserved sites within the farm Sims 462 and farm Sacha have been previously excavated in the 1980s by Peter Beaumont and as such any artefacts of heritage value have already been removed and preserved. In terms of the visual impact of the project on the cultural landscape with specific reference to the Grade 1 Heritage Sites at Kathu and Bestwood is low since impacts already occurred with the existing mining operations. As such with the implementation of a chance find protocol as detailed below, an application for exemption from further heritage studies is supported for the PV footprint and a pre-construction heritage walkdown of the access roads as a condition of the EMPr.

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 commence, the rocks and must be given a cursory inspection by the environmental officer or designated person. Any fossiliferous material (plants, insects, bone, or coal) 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. This information will be built into the EMPr'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 WRDs 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 studies. 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 permit conditions.

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.

Jaco van der Walt
BA (Pret) BA (Hons) (Archaeology) [Wits], MA (Archaeology [Wits]

Cell: 082 373 8491.
E-mail: jaco@heritageconsultants.co.za
Website: www.heritageconsultants.co.za

Beyond Heritage (Pty) Ltd
Registration number: 2021/598485/07
VAT no. 4660218696
Private Bag X1049
Suite 34
Modimolle

Any further queries can be forwarded to Jaco van der Walt on Cell: +27 82 373 8491 or to jaco@heritageconsultants.co.za.

Jaco van der Walt
BA (Pret) BA (Hons) (Archaeology) [Wits], MA (Archaeology [Wits]

Cell: 082 373 8491.
E-mail: jaco@heritageconsultants.co.za
Website: www.heritageconsultants.co.za

Beyond Heritage (Pty) Ltd
Registration number:
2021/598485/07
VAT no. 4660218696
Private Bag X1049
Suite 34
Modimolle

5. References

Beaumont, P.B. 2000. Archaeological Scoping Survey for the Purpose of an EMPR for the Sishen Iron Ore Mine.

Beaumont, P.B. & Vogel, J.C. 2006. On a timescale for the past million years of human history in central South Africa.

Chazan, M. 2021. Early hominin group size: A perspective from Bestwood 1, Northern Cape Province, South Africa. *Quaternary International*. In Press.

Lukich, V., Porat, N., Faershtein, G., Cowling, S. & Chazan, M. 2019. New chronology and stratigraphy for Kathu Pan 6, South Africa. *Journal of Paleolithic Archaeology*, *2*(3): 235-257.

Walker, S.J., Lukich, V. & Chazan, M. 2014. Kathu Townlands: a high density Earlier Stone Age locality in the interior of South Africa. *PLoS One*, *9*(7): p.e103436.

Wilkins, J. & Chazan, M. 2012. Blade production 500 thousand years ago at Kathu Pan 1, South Africa: support for a multiple origins hypothesis for early Middle Pleistocene blade technologies. *Journal of Archaeological Science* 39:1883-1900

Palaeontological Impact Assessment for the proposed development of a Solar Photovoltaic (PV) Facility and Associated Infrastructure at the Sishen Iron Ore Mine

Desktop Study (Phase 1)

For

Beyond Heritage

13 May 2022

Prof Marion Bamford
Palaeobotanist
P Bag 652, WITS 2050
Johannesburg, South Africa
Marion.bamford@wits.ac.za

Expertise of Specialist

The Palaeontologist Consultant: Prof Marion Bamford
Qualifications: PhD (Wits Univ, 1990); FRSSAf, mASSAf
Experience: 33 years research and lecturing in Palaeontology
25 years PIA studies and over 300 projects completed

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 Sishen Mine Solar PV Facility which is located west of Kathu and north of Sishen towns, Northern Cape Province. The proposed Project will be located on an existing waste rock dump (WRD) on portions 2 and the remaining extent of the Farm Sacha 468, and portion 1 of the Farm Sims 462.

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 desktop Palaeontological Impact Assessment (PIA) was completed for the proposed development.

The proposed site lies on the waste rock dump which lie on the potentially moderately fossiliferous Tertiary surface limestone. The entire area is highly disturbed and the waste rock is likely to be non-fossiliferous banded iron of the Kuruman Formation. The chance of finding fossils is extremely low. Nonetheless, a Fossil Chance Find Protocol should be added to the Environmental Management Programme (EMPr). Based on this information it is recommended that no further palaeontological impact assessment is required unless fossils are found by the contractor, environmental officer or other designated responsible person once excavations for foundations and infrastructure have commenced.

Taking account of the defined criteria, the rating is very low (pre- and post-mitigation), the consequence is very low (pre- and post-mitigation) and the significance is insignificant (pre and post-mitigation).

Table of Contents

1. Background

Sishen Iron Ore Company (SIOC), an Anglo American company, owns the opencast Sishen Iron Ore Mine (Sishen Mine). The Sishen Mine is located close to the town of Kathu in the Northern Cape Province. SIOC proposes to develop a 150 megawatt (MW) solar photovoltaic (PV) facility and associated infrastructure within the Mining Right area (the Project). The Project will be located on an existing waste rock dump (WRD) on portion 2 and the remaining extent (RE) of the Farm Sacha 468, and Portion 1 of the Farm Sims 462.

Project motivation

Anglo American is committed to being part of the solution to climate change and aim to play their part in maintaining global temperature rise to below 2°C as called for by the Paris Agreement. South Africa is particularly vulnerable to climate change impacts and have developed a strategic response as set out in the Climate Change Bill (2018). Anglo American has committed to achieve carbon neutrality on Scope 1 and 2 emissions and to reduce their Scope 3 emissions by 50% by 2040, across their operations. One way to achieve this is through FutureSmart MiningTM, an Anglo American innovation-led approach to sustainable mining. Integral to FutureSmart MiningTM is their Sustainable Mine Plan, designed to tackle the most pressing environmental, social and governance challenges such as climate change. The Anglo American Green House Gas emission reduction ambitions are built on the following :

- Scope 1: Deployment of FutureSmart Mining™ is central to reducing energy demand and delivering the step-change innovation required for avoiding emissions, including the capture and use of fugitive methane.
- Scope 2: The procurement and rapid roll-out of renewable power supply, including through embedded generation where necessary.

As part of the Anglo group and in alignment with the Anglo "FutureSmart Mining" and "Carbon Neutrality Energy Strategy", Kumba has committed to reducing their carbon footprint. The development of the solar PV facility will allow for security of power supply, reduced costs of electricity and reduced carbon emissions. An added benefit to the development of the Project is the repurposing of otherwise unproductive land (WRD), into land which is economically productive again. Kumba sees this strategy as an enhancement to the disturbed area and an alternative vision for the closure of the WRD which will allow for a more constructive end land use.

Project components

The Sishen Mine currently receives power from Eskom, through the Ferrum substation. In an effort to reduce their operational carbon emissions, Kumba proposes to develop the 150 MW solar PV facility and associated infrastructure on the G80 WRD. The Project will cover an area of approximately 340 ha and includes the development of the following infrastructure:

- ground mounted solar PV panels;
- trackers or fixed tilt mounting structures;
- inverter stations;
- a switchyard;
- electrical cables;

- substations;
- battery energy storage system (BESS);
- transformer bays;
- transmission lines;
- operation and maintenance buildings;
- water storage and conservancy tanks;
- site camp and laydown area; and
- access and maintenance roads.

An estimated 300 000 PV panels will be ground mounted utilising either tracking or fixed-tilt technology. The height of the panels is not expected to exceed 8 m. Inverter stations will be developed and located within the area of the solar PV facility. Generated power will be transmitted by electrical cables for collection at an onsite substation of up to 190 MVA within the solar PV facility for distribution. The output capacity of the BESS will reach up to 100 MW and the storage capacity will reach 400 MWh (at 4 hours storage). The BESS will be located within the area of the substation with a total area of up to 8.7 ha.

All generated power will be transmitted via transmission lines up to a capacity of 132 kV (either overhead or underground) within a transmission corridor (area of 100 ha, approximately 4 km in length and 255 m wide) to the Pit Substation 2. Water required for the proposed Project will be sourced from the Sishen mining operations. The Project also includes the establishment of water storage and conservancy tanks for storage purposes.

Construction phase
The construction activities include (but is not limited to) the following:

- earthworks (including foundations, trenches, and berms) in accordance with the approved civil/structural engineering drawings;
- establishment of access road; and
- the construction of a solar PV facility and BESS, substation, transmission lines and related support infrastructure (which includes the erection of associated structures such as the operation and maintenance buildings, site camp, fencing, concrete and steel work).

The duration of the construction phase of the Project is anticipated to be approximately 12 - 18 months. A staff complement of approximately 300 individuals would be required for the construction phase, hereby providing skilled and unskilled job opportunities. Procurement opportunities would be sourced locally, as far as possible.

Power for construction activities will be sourced from Eskom through the existing Sishen mining operations and supplemented by diesel generators where required. The construction phase will entail the establishment of ancillary infrastructure including a workshop, storage areas, temporary offices and ablution facilities for construction, permanent ablution facilities and a security hut at the entrance.

An existing access road, located to the north of the G80 rock dump will provide a separate, secure and dedicated access to the solar PV plant separate from the mine's main access.

The road of approximately 5 km in length will require upgrading to a width of 50 m for the main access.

Operational phase
Typical activities will include the operation and maintenance of the facility. The duration of the operational phase of the Project is anticipated to be approximately 30 years. During operation, the facility will generate power for the Sishen operations and will create and maintain approximately 30 jobs.

Rehabilitation
Rehabilitation of the Project site will comprise of the following:

- Covering the dump with a layer of competent material e.g., calcrete on top of the clay layer of the WRD.
- On top of the competent layer, another thin layer of either topsoil or a type of gravel.
- Seeding of the entire area or topsoiled, for very light vegetation as it is on top of the WRD. It should be noted that seeding will only take place after the life of the solar PV facility.

The proposed development requires an Environmental Authorisation (EA) from the Northern Cape Department of Agriculture, Environmental Affairs, Rural Development and Land Reform as the Competent Authority. Given that the Project triggers listed activities and due to the location of the Project on "existing infrastructure" (WRD). The definition of existing infrastructure was defined by the Department of Forestry, Fisheries, and the Environment (DFFE) as attached in Appendix 12.

The project will exceed a generation capacity threshold of more than 20 MW of electricity from a renewable resource as stipulated in Activity 1 of the EIA Regulations Listing Notice 2 of 2014. However, due to the interpretation of existing infrastructure (Appendix 12), the Project is excluded from a full Scoping and EIA process as stipulated in terms of the National Environmental Management Act (No 107 of 1998) (as amended) (NEMA) and Environmental Impact Assessment (EIA) Regulations (GNR 982, as amended) (EIA Regulations, 2014). As such, the environmental assessment will comprise of a Basic Assessment (BA) process as stipulated in terms of the NEMA and the EIA Regulations (2014).

In terms of the National Water Act, 1998 (No. 36 of 1998) and the Regulations Regarding the Procedural Requirements for Water Use Licence (WUL) Applications and Appeals (GNR 267 of March 2017), a General Authorisation process must be followed with the Department of Water and Sanitation (DWS) as the Competent Authority.

A Palaeontological Impact Assessment was requested for the Sishen Mine Solar PV Project. 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 desktop Palaeontological Impact Assessment (PIA) was completed for the proposed development and is reported herein.

Table 1: National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA) and Environmental Impact Assessment (EIA) Regulations, 2014 (as amended) - Requirements for Specialist Reports (Appendix 6).

	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
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

	A specialist report prepared in terms of the Environmental Impact Regulations of 2017 must contain:	Relevant section in report
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 of 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 gazetted 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.	N/A

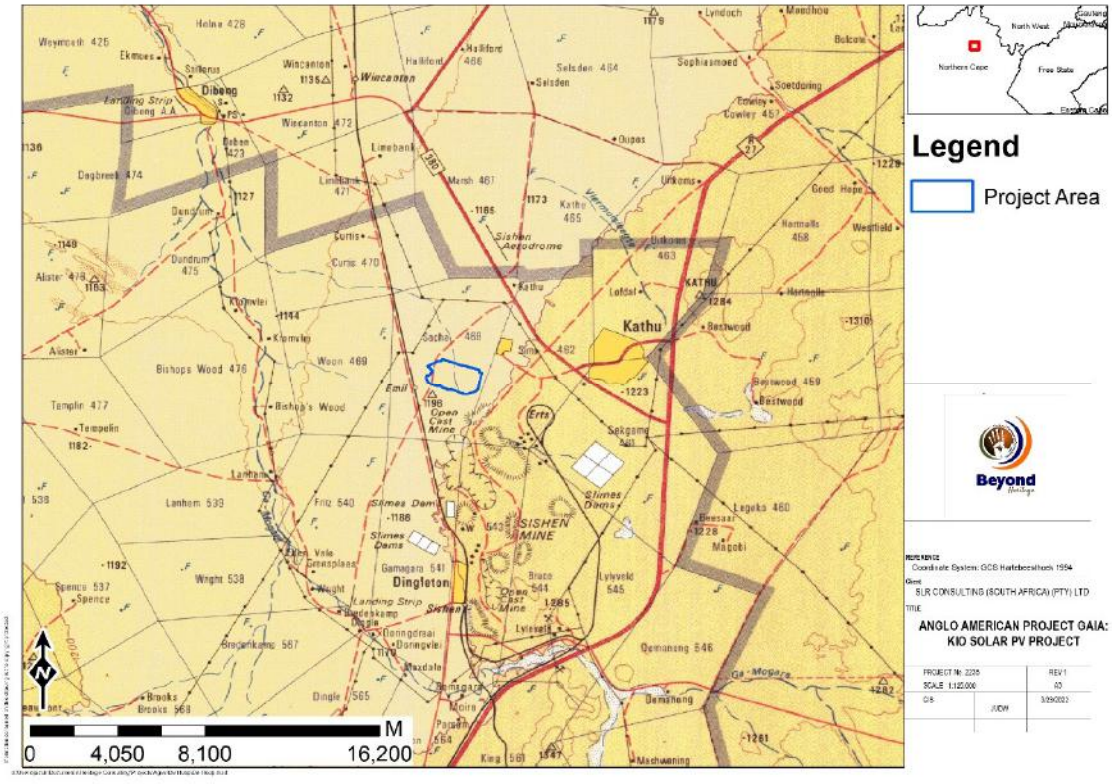

Figure 1: Regional map of the general area to show the relative land marks. The Sishen Mine Solar PV Project is shown by the blue polygon.

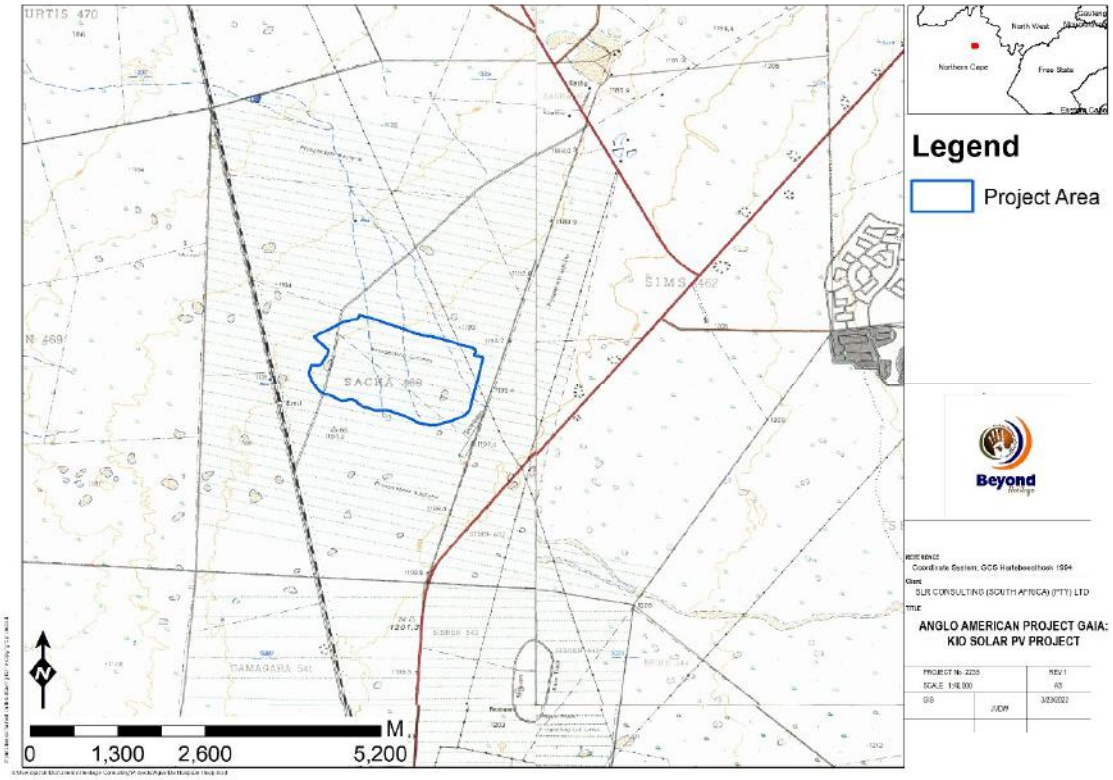

Figure 2: Local Map of the proposed Sishen Mine Solar PV Project area shown by the blue polygon.

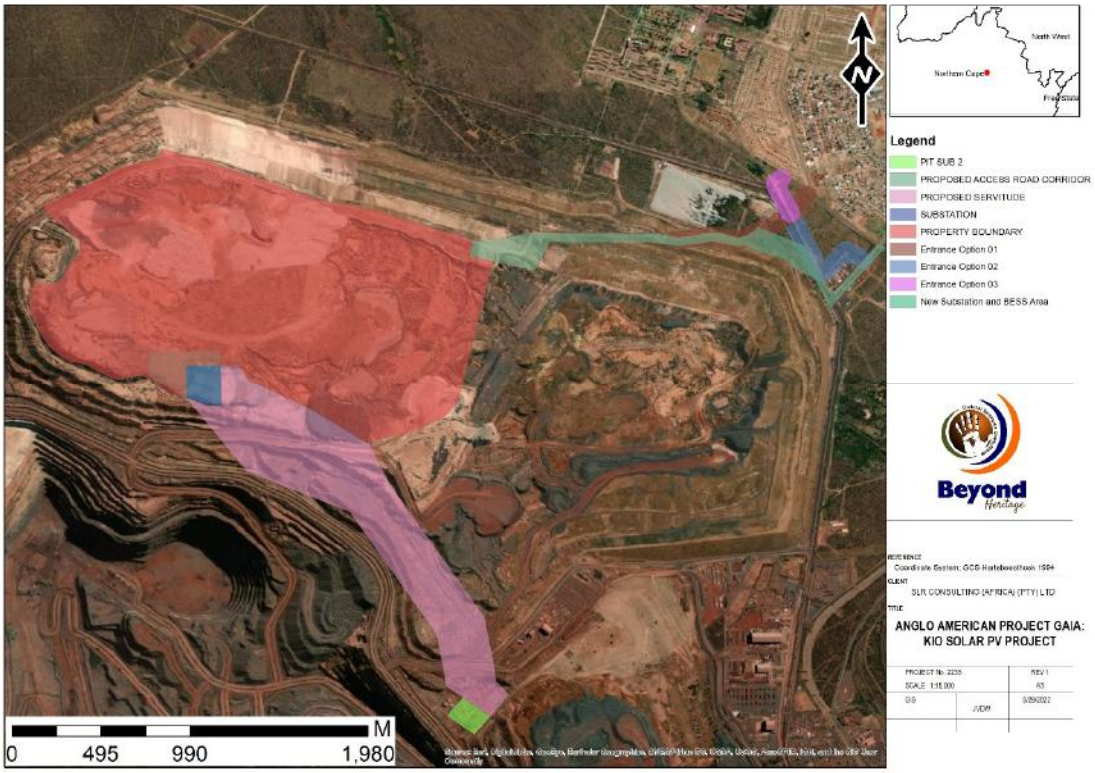

Figure 3: Aerial map of the outline and components of the Sishen Mine Solar PV Project with the different features as indicated in the legend.

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 (*not applicable to this assessment*);
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

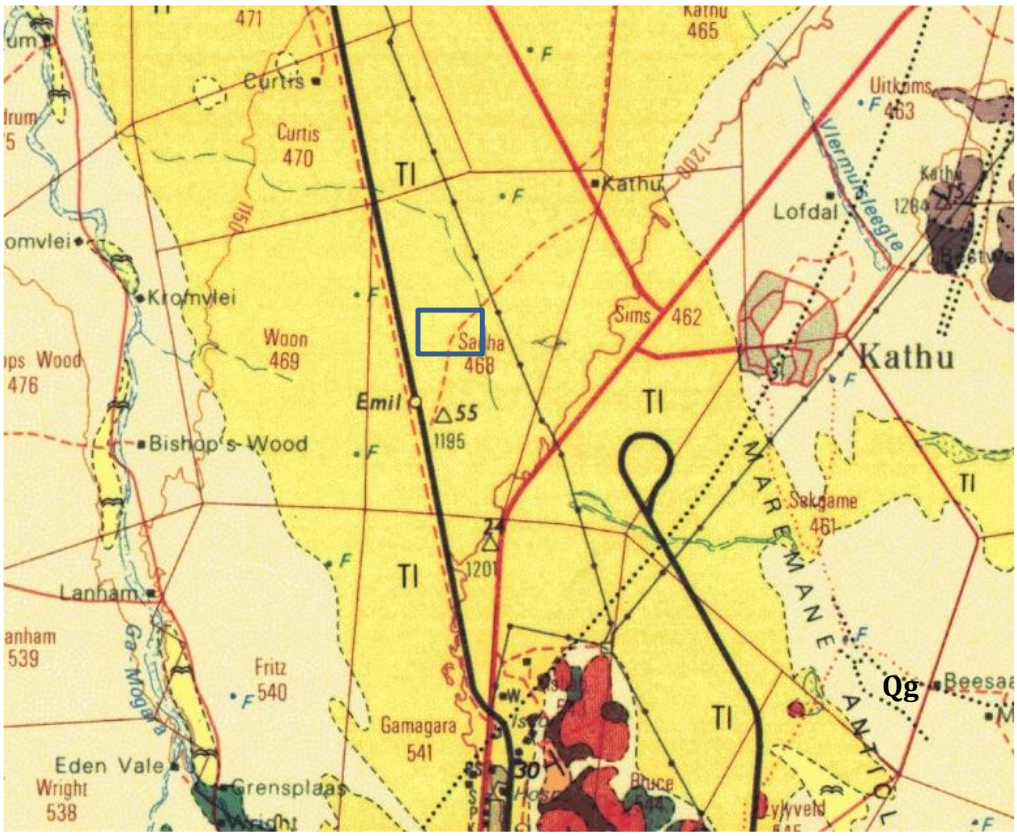

Figure 4: Geological map of the area around the Sishen Mine with proposed Project as indicated within the blue rectangle. Abbreviations of the rock types are explained in Table 2. Map enlarged from the Geological Survey 1: 250 000 map Kuruman 2722.

Table 2: Explanation of symbols for the geological map and approximate ages (Eriksson et al., 2006. Partridge et al., 2006; Schröder et al., 2016). SG = Supergroup; Fm = Formation; Ma = million years; grey shading = formations impacted by the Project; ca = circa (=approximately).

Symbol	Group/Formation	Lithology	Approximate Age
Qs	Kalahari Group	Aeolian sand,	Quaternary ca 2.5 Ma to present
Tl	Tertiary limestone	Sand and limestone	Quaternary ca 2.5 Ma to present
Vo	Ongeluk Fm, Postmasburg Group, Griqualand West Basin, Transvaal SG	Lava	Palaeoproterozoic, Ca 2222 Ma
Vad	Danielskuil Fm, Asbestos Hills Subgroup, Ghaap Group,	Banded or massive jaspilite or crocidilite	Ca 2440 -2460 Ma

Symbol	Group/Formation	Lithology	Approximate Age
	Griqualand West Sequence, Transvaal SG		
Vak	Kuruman Fm, Asbestos Hills Subgroup, Ghaap Group, Griqualand West Sequence, Transvaal SG	Banded iron formation	Ca 2440 -2460 Ma

The Project lies in the north-eastern margin of the Griqualand West Sequence of Neoarchaean intrusive rocks, in the Prieska Subbasin of the Transvaal Basin that is filled with the Griqualand West sequence of the Transvaal Supergroup. Outcrops of the two main iron and manganese-bearing rocks are exposed to the east of the mine, but below the Kalahari sands are layers of banded iron formation (BIF) that is in primary context in the Kuruman Formation, and reworked in the overlying Danielskuil Formation (Beukes et al., 2016). These ancient rocks are the target of the mining operation but they are non-fossiliferous so will not be considered any further in this palaeontological report.

Overlying much of the area are the Kalahari Group sands. This is the largest and most extensive palaeo-erg in the world (Partridge et al., 2006) and is composed of extensive aeolian and fluvial sands, sand dunes, calcrete, scree and colluvium. Periods of aridity have overprinted the sands, and calcrete and silcrete are common.

ii. Palaeontological context

The palaeontological sensitivity of the area under consideration is presented in Figure 5. The site for development was by Tertiary calcrete and surface limestone. Some of this is covered by aeolian Kalahari sands that were derived from farther to the northwest (Goudie and Wells, 1995) and finally deposited in this region during the Quaternary. Since they are windblown the sands are not in primary context, nor do they preserve any fossils.

Fossils can only be preserved if there are palaeo-spring or palaeo-pan deposits where wood, plants or bones can be entrapped and preserved in the calcrete or silcrete that occasionally forms in such settings. No such deposits have been recorded from around this site and it is not known what lies below the waste rock. The Google Earth imagery does not show any pan or spring deposits. According to Goudie and Wells (1995) three factors are required for the formation of pans, namely a setting where the fluvial system is not fully integrated, and where salt weathering and aeolian deflation occur. The latter two conditions apply to this environmental setting, but the first does not as the site is on a slope and is far from any major river or drainage system. Therefore, it is extremely unlikely that there are or were any pans in the site or any fossils in the sands. Since most of the area has been disturbed by previous mining operations it is unlikely that any pan or spring features remain (Figure 5). The waste rock, probably reworked banded iron from the Kuruman or Danielskuil Formations, does not preserve fossils.

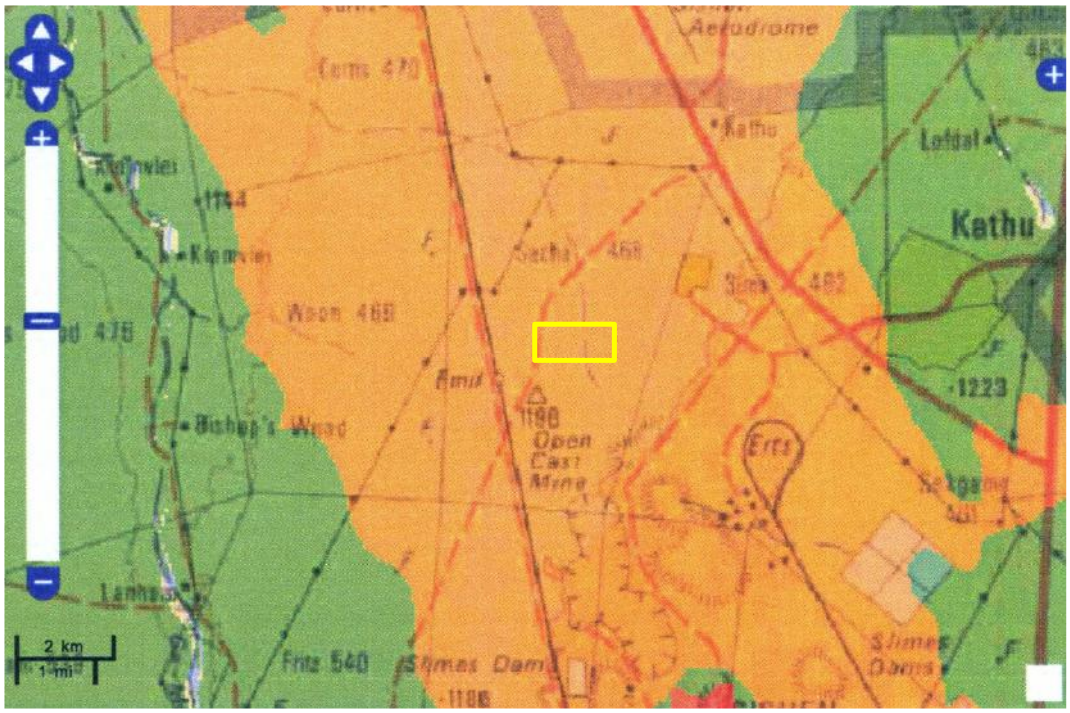

Figure 5: SAHRIS palaeosensitivity map for the site for the proposed Sishen Mine Solar PV facility shown within the yellow rectangle. Background colours indicate the following degrees of sensitivity: red = very highly sensitive; orange/yellow = high; green = moderate; blue = low; grey = insignificant/zero.

4. Impact assessment

The SLR criteria for the impact assessment are provided in Table 3 below.

Table 3: Impact Assessment Criteria

Criteria	Rating	Description
Criteria for ranking of the INTENSITY (SEVERITY) of environmental impacts	ZERO TO VERY LOW	Negligible change, disturbance, or nuisance. The impact affects the environment in such a way that natural functions and processes are not affected. People / communities are able to adapt with relative ease and maintain pre-impact livelihoods.
	LOW	Minor (slight) change, disturbance, or nuisance. The impact on the environment is not detectable or there is no perceptible change to people's livelihood.
	MEDIUM	Moderate change, disturbance, or discomfort. Where the affected environment is altered, but natural functions and processes continue, albeit in a modified way. People/communities are able to adapt with some difficulty and maintain pre-impact livelihoods but only with a degree of support.

Criteria	Rating	Description
	HIGH	Prominent change, disturbance, or degradation. Where natural functions or processes are altered to the extent that they will temporarily or permanently cease. Affected people/communities will not be able to adapt to changes or continue to maintain-pre impact livelihoods.
Criteria for ranking the DURATION of impacts	SHORT TERM	< 5 years.
	MEDIUM TERM	5 to < 15 years.
	LONG TERM	> 15 years, but where the impact will eventually cease either because of natural processes or by human intervention.
	PERMANENT	Where mitigation either by natural processes or by human intervention will not occur in such a way or in such time span that the impact can be considered transient.
Criteria for ranking the EXTENT / SPATIAL SCALE of impacts	LOCAL	Impact is confined to project or study area or part thereof, e.g. limited to the area of interest and its immediate surroundings.
	REGIONAL	Impact is confined to the region, e.g. coast, basin, catchment, municipal region, etc.
	NATIONAL	Impact is confined to the country as a whole, e.g. South Africa, etc.
	INTERNATIONAL	Impact extends beyond the national scale.
Criteria for determining the PROBABILITY of impacts	IMPROBABLE	Where the possibility of the impact to materialise is very low either because of design or historic experience, i.e. ≤ 30% chance of occurring.
	POSSIBLE	Where there is a distinct possibility that the impact would occur, i.e. > 30 to ≤ 60% chance of occurring.
	PROBABLE	Where it is most likely that the impact would occur, i.e. > 60 to ≤ 80% chance of occurring.
	DEFINITE	Where the impact would occur regardless of any prevention measures, i.e. > 80% chance of occurring.
Criteria for determining the DEGREE OF CONFIDENCE of the assessment	LOW	≤ 35% sure of impact prediction.
	MEDIUM	> 35% and ≤ 70% sure of impact prediction.
	HIGH	> 70% sure of impact prediction.
Criteria for the DEGREE TO WHICH IMPACT CAN BE MITIGATED - the degree to which an impact can be reduced / enhanced	NONE	No change in impact after mitigation.
	VERY LOW	Where the significance rating stays the same, but where mitigation will reduce the intensity of the impact.
	LOW	Where the significance rating drops by one level, after mitigation.
	MEDIUM	Where the significance rating drops by two to three levels, after mitigation.
	HIGH	Where the significance rating drops by more than three levels, after mitigation.

Criteria	Rating	Description
Criteria for LOSS OF RESOURCES - the degree to which a resource is permanently affected by the activity, i.e. the degree to which a resource is irreplaceable	LOW	Where the activity results in a loss of a particular resource but where the natural, cultural, and social functions and processes are not affected.
	MEDIUM	Where the loss of a resource occurs, but natural, cultural, and social functions and processes continue, albeit in a modified way.
	HIGH	Where the activity results in an irreplaceable loss of a resource.

DETERMINING CONSEQUENCES

Consequence attempts to evaluate the importance of a particular impact, and in doing so incorporate extent, duration, and intensity. The ratings and description for determining consequence are provided below.

Rating	Description
VERY HIGH	Impacts could be EITHER: of *high intensity* at a *regional level* and endure in the *long term*; OR of *high intensity* at a *national level* in the *medium term*; OR of *medium intensity* at a *national level* in the *long term.*
HIGH	Impacts could be EITHER: of *high intensity* at a *regional level* and endure in the *medium term*; OR of *high intensity* at a *national level* in the *short term*; OR of *medium intensity* at a *national level* in the *medium term;* OR of *low intensity* at a *national level* in the *long term*; OR of *high intensity* at a *local level* in the *long term*; OR of *medium intensity* at a *regional level* in the *long term.*
MEDIUM	Impacts could be EITHER: of *high intensity* at a *local level* and endure in the *medium term*; OR of *medium intensity* at a *regional level* in the *medium term*; OR of *high intensity* at a *regional level* in the *short term*; OR of *medium intensity* at a *national level* in the *short term*; OR of *medium intensity* at a *local level* in the *long term*; OR of *low intensity* at a *national level* in the *medium term;* OR of *low intensity* at a *regional level* in the *long term.*
LOW	Impacts could be EITHER of *low intensity* at a *regional level* and endure in the *medium term*; OR of *low intensity* at a *national level* in the *short term*; OR of *high intensity* at a *local level* and endure in the *short term*; OR of *medium intensity* at a *regional level* in the *short term*; OR of *low intensity* at a *local level* in the *long term*; OR of *medium intensity* at a *local level* and endure in the *medium term.*
VERY LOW	Impacts could be EITHER of *low intensity* at a *local level* and endure in the *medium term*; OR of *low intensity* at a *regional level* and endure in the *short term*; OR of *low to medium intensity* at a *local level* and endure in the *short term.*

	OR Zero to very low intensity with any combination of extent and duration.

DETERMINING SIGNIFICANCE
The consequence rating is considered together with the probability of occurrence in order to determine the overall significance using the table below.

		PROBABILITY			
		IMPROBABLE	POSSIBLE	PROBABLE	DEFINITE
CONSEQUENCE	VERY LOW	INSIGNIFICANT	INSIGNIFICANT	VERY LOW	VERY LOW
	LOW	VERY LOW	VERY LOW	LOW	LOW
	MEDIUM	LOW	LOW	MEDIUM	MEDIUM
	HIGH	MEDIUM	MEDIUM	HIGH	HIGH
	VERY HIGH	HIGH	HIGH	VERY HIGH	VERY HIGH

In certain cases, it may not be possible to determine the significance of an impact. In these instances, the significance is UNKNOWN.

Table 4: Impact assessment for the Sishen Solar PV Project

Criteria	Pre-mitigation	Post-mitigation = removal of any fossils found.
Intensity/Severity	Very low	Zero to very low
Duration	Short	Short
Scale/Extent	Local	Local
Probability	Possible	Improbable
Degree of confidence	High	High
Degree of mitigation effect	High	high
Loss of Resources	Low	Low
Rating	Very low	Very low
Consequence	Very low	Very low
Significance	Insignificant	Insignificant

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 either the wrong age or wrong type to preserve fossils. No traps such as palaeo-pans or palaeo-springs are present. Furthermore, the material to be excavated is waste rock and this does not preserve fossils. Since there is an extremely small chance that fossils from below the waste rock dump may be disturbed a Fossil Chance Find Protocol has been added to this report. Taking account of the defined criteria, the rating is very

low (pre- and post-mitigation), the consequence is very low (pre- and post-mitigation) and the significance is insignificant (pre and post-mitigation).

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 not contain fossil plant, insect, invertebrate and vertebrate material. The sands of the Quaternary period would not preserve fossils unless there were fossil traps.

6. Recommendation

Based on experience and the lack of any previously recorded fossils from the area, it is extremely unlikely that any fossils would be preserved in the aeolian sands of the Quaternary or trapped in the Tertiary surface limestone because there are no palaeo-pans or palaeo-springs present. No fossils would occur in the waste rock material. There is a very small chance that fossils may occur below the dump 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 for foundations and infrastructure have commenced then they should be rescued and a palaeontologist called to assess and collect a representative sample. The significance of the Project for the palaeontological heritage is insignificant, therefore, the Project should be authorised.

7. References

Anderson, J.M., Anderson, H.M., 1985. Palaeoflora of Southern Africa: Prodromus of South African megafloras, Devonian to Lower Cretaceous. A.A. Balkema, Rotterdam. 423 pp.

Beukes, N.J., Swindell, E.W.P., Wabo, H., 2016. Manganese Deposits of Africa. Episodes, 39(3), 1-33. DOI: 10.18814/epiiugs/2016/v39i2/95779

Goudie, A.S., Wells, G.L., 1995. The nature, distribution and formation of pans in arid zones. Earth Science Reviews 38, 1-69.

Johnson, M.R., van Vuuren, C.J., Visser, J.N.J., Cole, D.I., Wickens, H.deV., Christie, A.D.M., Roberts, D.L., Brandl, G., 2006. Sedimentary rocks of the Karoo Supergroup. 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 461 – 499.

Partridge, T.C., Botha, G.A., Haddon, I.G., 2006. Cenozoic deposits of the interior. 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 585-604.

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.

Schröder, S., Beukes, N.J., Armstrong, R.A., 2016. Detrital zircon constraints on the tectonostratigraphy of the Paleoproterozoic Pretoria Group, South Africa. Precambrian Research 278, 362 – 393.

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 discard must be given a cursory inspection by the environmental officer or designated person. Any fossiliferous material (plants, insects, bone or trace fossils) 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 6). This information will be built into the EMPr'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 WRDs 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 studies. 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 permit conditions.
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 Quaternary deposits

Figure 6: Photographs of fossils found in the field in Cenozoic and Quaternary settings. Note the fragmentary nature.

10. Appendix B – Details of specialist

Curriculum vitae (short) - Marion Bamford PhD
January 2022

I) Personal details

Surname	:	**Bamford**
First names	:	**Marion Kathleen**
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
Telephone	:	+27 11 717 6690
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.
NRF Rating: C-2 (1999-2004); B-3 (2005-2015); B-2 (2016-2020); B-1 (2021-2026)

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	13	0
Masters	11	3
PhD	11	6
Postdoctoral fellows	15	1

viii) Undergraduate teaching
Geology II – Palaeobotany GEOL2008 – average 65 students per year
Biology III – Palaeobotany APES3029 – average 45 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 Open Science UK: 2021 -
Review of manuscripts for ISI-listed journals: 30 local and international journals

Reviewing of funding applications for NRF, PAST, NWO, SIDA, National Geographic, Leakey Foundation

x) Palaeontological Impact Assessments

Selected from the past five years 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

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 = 35; -i10-index = 92
Conferences: numerous presentations at local and international conferences.