UPGRADE ENERGY (PTY) LTD

Leeuwbosch 44 5MW Solar Photovoltaic (PV) Power Plant

Heritage Impact Report

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Executive Summary

PGS Heritage (Pty) Ltd (PGS) was appointed by SiVEST Environmental Division (SiVEST) to undertake a Heritage Impact Report that forms part of the Environmental Basic Assessment (BA) for Upgrade Energy (Pty) Ltd for the proposed construction of the 5MW Solar Photovoltic (PV) Power plant, on the farm Leeuwbosch 44, near Leeudoringstad, Maquassi Hills Local Municipality North West Province.

Heritage resources are unique and non-renewable and as such any impact on such resources must be seen as significant.

The fieldwork completed for the HIA in September 2016, identified 13 heritage resources. These resources can be grouped in to four clusters. Two clusters consist of the remains of labourer housing, while the other two consist of a cattle kraal and a cemetery. With acknowledgement of the suggested mitigation measures outlined below, the impact can be rated as low.

The design process and methodology followed by the developer for this project enabled the heritage assessment to provide input into the proposed layout before the impact assessment. This resulted in cognisance being taken of the positions of the heritage sites and thus the reduction of impacts at an early design phase. Analysis of the impact matrix tables will reflect this.

PV Plant

The comparative assessment of the alternatives has shown that an overall low impact on heritage is foreseen, as all the heritage resources identified are of a low to medium significance. **Table 2** groups the sites in relation to the four layout options.

Resources related to layout option

Leeudoring A	Leeudoring B	Leeudoring C	Leeudoring D
LD03, LD04, LD06	LD07, LD09	LD07, LD09, LD10, LD11, LD12	LD07, LD09, LD10, LD11,

Assessing the possible impacts by the layout options on the identified heritage resources the Leeudoring A and B will have the least direct impact on the heritage resources. However, with the implementation of the recommended management measures it is our opinion that all four alternatives will be acceptable for development.

Key

PREFERRED	The alternative will result in a low impact / reduce the impact
FAVOURABLE	The impact will be relatively insignificant
NOT PREFERRED	The alternative will result in a high impact / increase the impact
NO PREFERENCE	The alternative will result in equal impacts

Leeuwbosch PV Facility

Alternative	Preference	Reasons (incl. potential issues)
LAYOUT ALTERNATIVES		
Alternative A	**PREFERRED**	Assessing the possible impacts by the layout options on the identified heritage resources the Leeudoring A and B will have the least direct impact on the heritage resources. However, with the implementation of the recommended management measures it is our opinion that all four alternatives will be acceptable for development.
Alternative B	**PREFERRED**	
Alternative C	**FAVOURABLE**	However, with the implementation of the recommended management measures it is our opinion that all four alternatives will be acceptable for development.
Alternative D	**FAVOURABLE**	

Grid corridor

An assessment of the aerial photographs and historical imagery has revealed possible heritage features that will require further field investigation. The majority of the features is identified as ruins in various states of decay. The Leeudoringstad municipal cemetery is situated adjacent to the substation in the western end of the proposed corridor and should be avoided.

Management Measures

The management measures proposed are as follows:

Palaeontology

1. *No mitigation measures are required.*

Archaeological Sites

i. *A field assessment of the possible heritage resources as identified in the desktop assessment will need to be done to finalise this report as an impact assessment report.*
ii. *For sites LD01, LD03, LD04, LD05, LD06 and LD07, LD09, LD10, LD11 LD12. We recommend that further consultation with local communities on the previous inhabitants of these areas be initiated to determine the possibility of infant burials. In the event that such burial is confirmed a grave relocation process must be initiated.*
iii. *We further recommend that an archaeologist monitor the earth moving activities during construction.*
iv. *We recommend that the burial site LD02 be preserved and a buffer fence of 20 meters constructed around the site.*
v. *We recommend that site LD13 is demarcated with a 20 meter buffer during construction of the PV plant.*

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HERITAGE IMPACT REPORT

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1 INTRODUCTION

PGS Heritage (Pty) Ltd (PGS) was appointed by SiVEST Environmental Division (SiVEST) to undertake a Heritage Impact Report that forms part of the Environmental Basic Assessment (BA) for Upgrade Energy (Pty) Ltd for the proposed construction of the 5MW Solar Photovoltic (PV) Power plant, on the farm Leeuwbosch 44, near Leeudoringstad, Maquassi Hills Local Municipality North West Province.

1.1 Scope of the Study

The aim of the study is to identify possible heritage resources, sites, finds and sensitive areas that may occur in the study area for the BA study. The HIA aims to inform the BA in the development of a comprehensive EMPr to assist the developer in managing the discovered heritage resources in a responsible manner, in order to protect, preserve, and develop them within the framework provided by the National Heritage Resources Act of 1999 (Act 25 of 1999) (NHRA).

1.2 Assumptions and Limitations

Not detracting in any way from the comprehensiveness of the fieldwork undertaken, it is necessary to realise that the heritage resources located during the fieldwork do not necessarily represent all the possible heritage resources present within the development area. Various factors account for this, including the subterranean nature of some archaeological sites. As such, should any heritage features and/or objects not included in the present inventory be located or observed, a heritage specialist must immediately be contacted.

The grid corridor has not yet been field verified and if during the fieldwork any further heritage resources are discovered the HAI will be updated to reflect this.

1.3 Specialist Qualifications

PGS Heritage (PGS) compiled this Heritage Impact Report.

The staff at PGS has a combined experience of nearly 80 years in the heritage consulting industry. PGS and its staff have extensive experience in managing the HIA processes. PGS will only undertake heritage assessment work where they have the relevant expertise and experience to undertake that work competently.

Wouter Fourie, Project manager for this project, is registered as a Professional Archaeologist with the Association of Southern African Professional Archaeologists (ASAPA) and has CRM accreditation within the said organisation, as well as being accredited as a Professional

Heritage Practitioner with the Association of Professional Heritage Practitioners – Western Cape (APHP).

Jessica Angel, archaeologist and researcher for this report, has 5 years of experience in the industry and holds a Masters degree in Archaeology and is registered as a Professional Archaeologist with the Association of Southern African Professional Archaeologists (ASAPA).

1.4 Legislative Context

The identification, evaluation and assessment of any cultural heritage site, artefact or find in the South African context is required and governed by the following legislation:

i. National Environmental Management Act (NEMA), Act 107 of 1998
ii. National Heritage Resources Act (NHRA), Act 25 of 1999
iii. Mineral and Petroleum Resources Development Act (MPRDA), Act 28 of 2002

The following sections in each Act refer directly to the identification, evaluation and assessment of cultural heritage resources.

i. National Environmental Management Act (NEMA) Act 107 of 1998
    a. Basic Environmental Assessment (BEA) – Section (23)(2)(d)
    b. Environmental Scoping Report (ESR) – Section (29)(1)(d)
    c. Environmental Impact Assessment (EIA) – Section (32)(2)(d)
    d. Environmental Management Plan (EMP) – Section (34)(b)
ii. National Heritage Resources Act (NHRA) Act 25 of 1999
    a. Protection of Heritage Resources – Sections 34 to 36; and
    b. Heritage Resources Management – Section 38
iii. Mineral and Petroleum Resources Development Act (MPRDA) Act 28 of 2002
    a. Section 39(3)

The NHRA (Act 25 of 1999) stipulates that cultural heritage resources may not be disturbed without authorization from the relevant heritage authority. Section 34(1) of the NHRA (Act 25 of 1999) states that “no person may alter or demolish any structure or part of a structure which is older than 60 years without a permit issued by the relevant provincial heritage resources authority…” In addition, the NEMA (No 107 of 1998) and the GNR 982 (Government Gazette 38282, 14 December 2014) state that, “the objective of an environmental impact assessment process is to, … identify the location of the development footprint within the preferred site … focussing on the geographical, physical, biological, social, economic, cultural and heritage aspects of the environment” (GNR 982, Appendix 3(2)(c) emphasis added). In accordance with legislative requirements and EIA rating criteria, the regulations of SAHRA and ASAPA have also been incorporated to ensure that a comprehensive and legally compatible HIA report is compiled.

Refer to **Appendix A** for further discussions on heritage management and legislative frameworks

Table 1: Terminology

Acronyms	***Description***
AIA	Archaeological Impact Assessment
ASAPA	Association of South African Professional Archaeologists
CRM	Cultural Resource Management
DEA	Department of Environmental Affairs
EIA practitioner	Environmental Impact Assessment Practitioner
EIA	Environmental Impact Assessment
ESA	Early Stone Age
GPS	Global Positioning System
HIA	Heritage Impact Assessment
I&AP	Interested & Affected Party
LSA	Late Stone Age
LIA	Late Iron Age
MSA	Middle Stone Age
MIA	Middle Iron Age
NEMA	National Environmental Management Act
NHRA	National Heritage Resources Act
PHRA	Provincial Heritage Resources Agency
RoD	Record of Decision
SADC	Southern African Development Community
SAHRA	South African Heritage Resources Agency

Archaeological resources

This includes:

i. material remains resulting from human activity which are in a state of disuse and are in or on land and which are older than 100 years including artefacts, human and hominid remains and artificial features and structures;

ii. rock art, being any form of painting, engraving or other graphic representation on a fixed rock surface or loose rock or stone, which was executed by human agency and which is older than 100 years, including any area within 10m of such representation;

iii. wrecks, being any vessel or aircraft, or any part thereof, which was wrecked in South Africa, whether on land, in the internal waters, the territorial waters or in the maritime culture zone of the republic as defined in the Maritimes Zones Act, and any cargo, debris or artefacts found or associated therewith, which is older than 60 years or which SAHRA considers to be worthy of conservation;

iv. features, structures and artefacts associated with military history which are older than 75 years and the site on which they are found.

Cultural significance

This means aesthetic, architectural, historical, scientific, social, spiritual, linguistic or technological value or significance

Development

This means any physical intervention, excavation, or action, other than those caused by natural forces, which may in the opinion of the heritage authority in any way result in a change to the nature, appearance or physical nature of a place or influence its stability and future well-being, including:

i. construction, alteration, demolition, removal or change in use of a place or a structure at a place;
ii. carrying out any works on or over or under a place;
iii. subdivision or consolidation of land comprising a place, including the structures or airspace of a place;
iv. constructing or putting up for display signs or boards;
v. any change to the natural or existing condition or topography of land; and
vi. any removal or destruction of trees, or removal of vegetation or topsoil

Earlier Stone Age

The archaeology of the Stone Age, between 700 000 and 2 500 000 years ago.

Fossil

Mineralised bones of animals, shellfish, plants and marine animals. A trace fossil is the track or footprint of a fossil animal that is preserved in stone or consolidated sediment.

Heritage

That which is inherited and forms part of the National Estate (historical places, objects, fossils as defined by the National Heritage Resources Act 25 of 1999).

Heritage resources

This means any place or object of cultural significance, such as the caves with archaeological deposits identified close to both development sites for this study.

Holocene

The most recent geological time period which commenced 10 000 years ago.

Later Stone Age

The archaeology of the last 30 000 years associated with fully modern people.

Late Iron Age (Early Farming Communities)

The archaeology of the last 1000 years up to the 1800's, associated with iron-working and farming activities such as herding and agriculture.

Middle Stone Age

The archaeology of the Stone Age between 30 000-300 000 years ago, associated with early modern humans.

Palaeontology

Any fossilised remains or fossil trace of animals or plants which lived in the geological past, other than fossil fuels or fossiliferous rock intended for industrial use, and any site which contains such fossilised remains or trace.

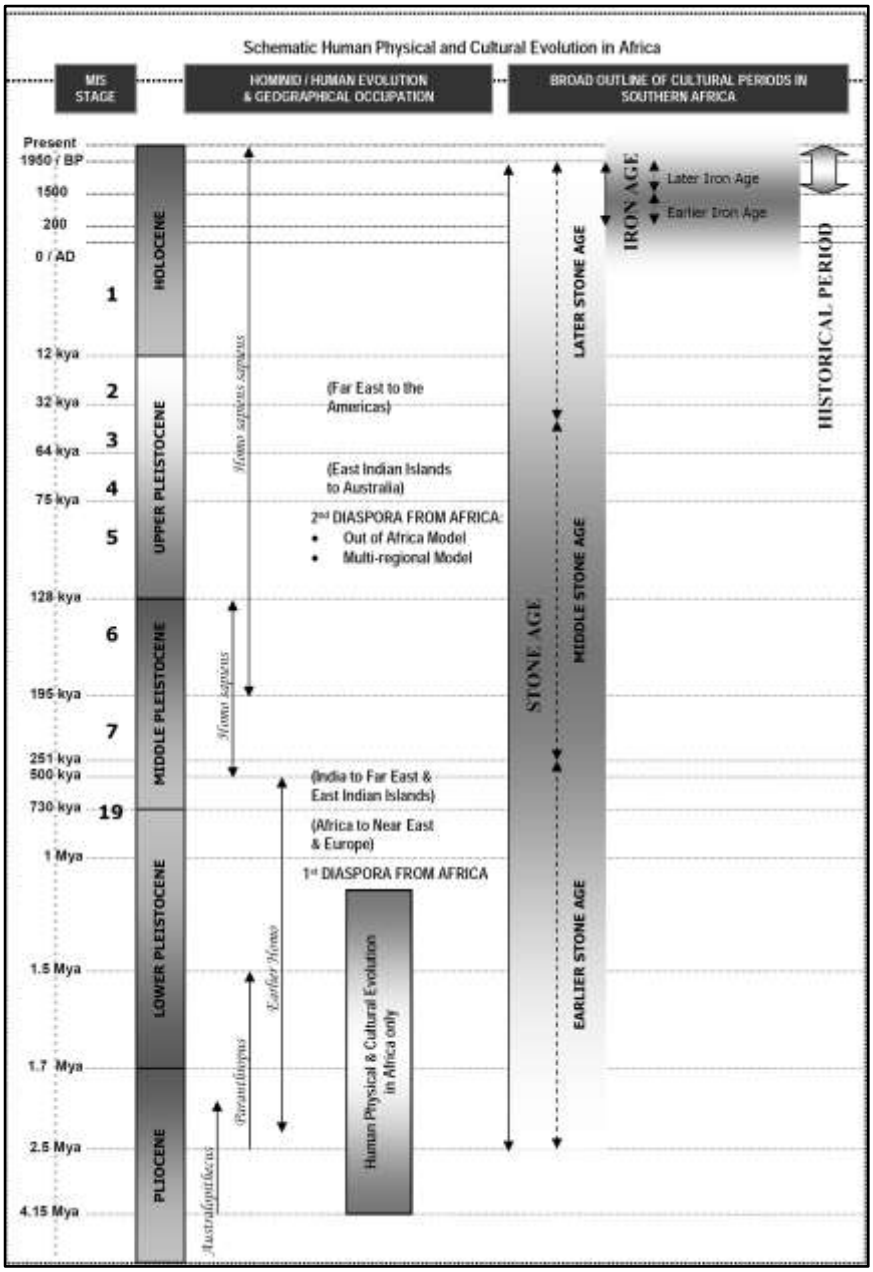

Figure 1: Human and Cultural Timeline in Africa (Morris, 2008)

2 TECHNICAL DETAILS OF THE PROJECT

2.1 Project Location

The proposed 5MW Solar Photovoltaic Power Plant on the farm Leeuwbosch 44 occurs approximately 6.5 km from the town Leeudoringstad, Maquassi Hills Local Municipality, North west Province.

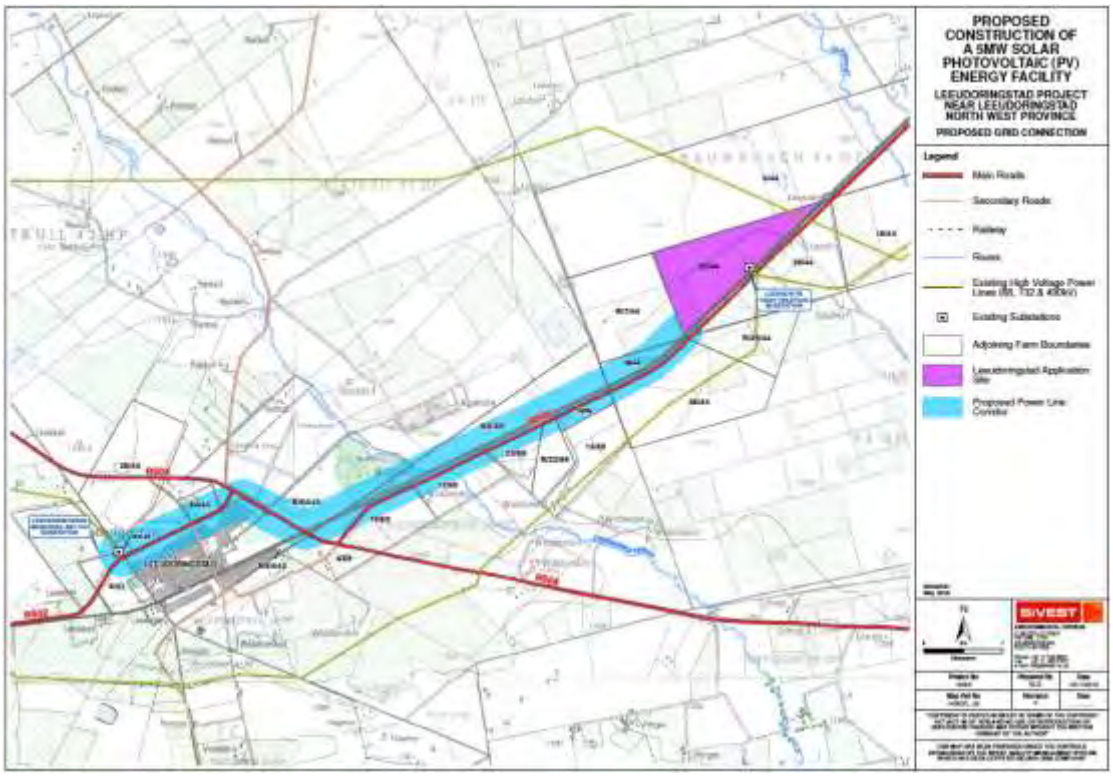

Figure 2: The proposed Solar PV Power Plant at Leeuwbosch 44 and proposed grid corridor construction (Image provided by SiVest)

2.2 Solar Power Plant Technical details

The proposed development will entail the construction of a 5MW Solar Photovoltaic (PV) Power Plant on farm Leeuwbosch 44, Leeudoringstad, Maquassi Hills Local Municipality, North West Province.

The following key components are to be constructed for the PV Power Plant:

- Solar PV Field
- PV solar panels and arrays PV Panel mountings
- DC-AC current inverters and transformers (10 x 500 kVA (2.5m x 1m) within the PV field)
- Mini Substations (3m x 2 m within the PV field)

The associated infrastructure for the proposed developments include:

- Coupling station (approximately 10m x 10m)
- Underground cabling (approximately 0,8 m x 0,6 wide)
- Small site office and storage facility (approximately 10m x 10m) - including security and associated facilities,
- Internal gravel roads (4m width)
- Site fencing

The proposed development is located directly west of the Harvard Substation, where existing supply is taken. The planned developments will link into Leeubos Traction Substation to be linked to the Leeuwbosch PV plant via the proposed grid corridor as indicated in **Figure 2**.

Four proposed layout are proposed for the project as shown in **Figure 3**.

2.1 No-go Alternative

The 'no-go' alternative is the option of not establishing the proposed Solar PV Power Plant. South Africa is currently under immense pressure to generate electricity to accommodate for the additional demand, which has been identified. With the current global focus on climate change, the government is exploring alternative energy sources in addition to coal-fired power stations. Although solar power is not the only solution to solving the energy crisis in South Africa, not establishing the proposed Solar PV Power Plant would be detrimental to the mandate that the government has set to promote the implementation of renewable power. It is a suitable sustainable solution to the energy crisis and this project would contribute to this solution. This project will aid in achieving South Africa's goals in terms of sustainability, energy security, mitigating energy cost risks, local economic development and national job creation.

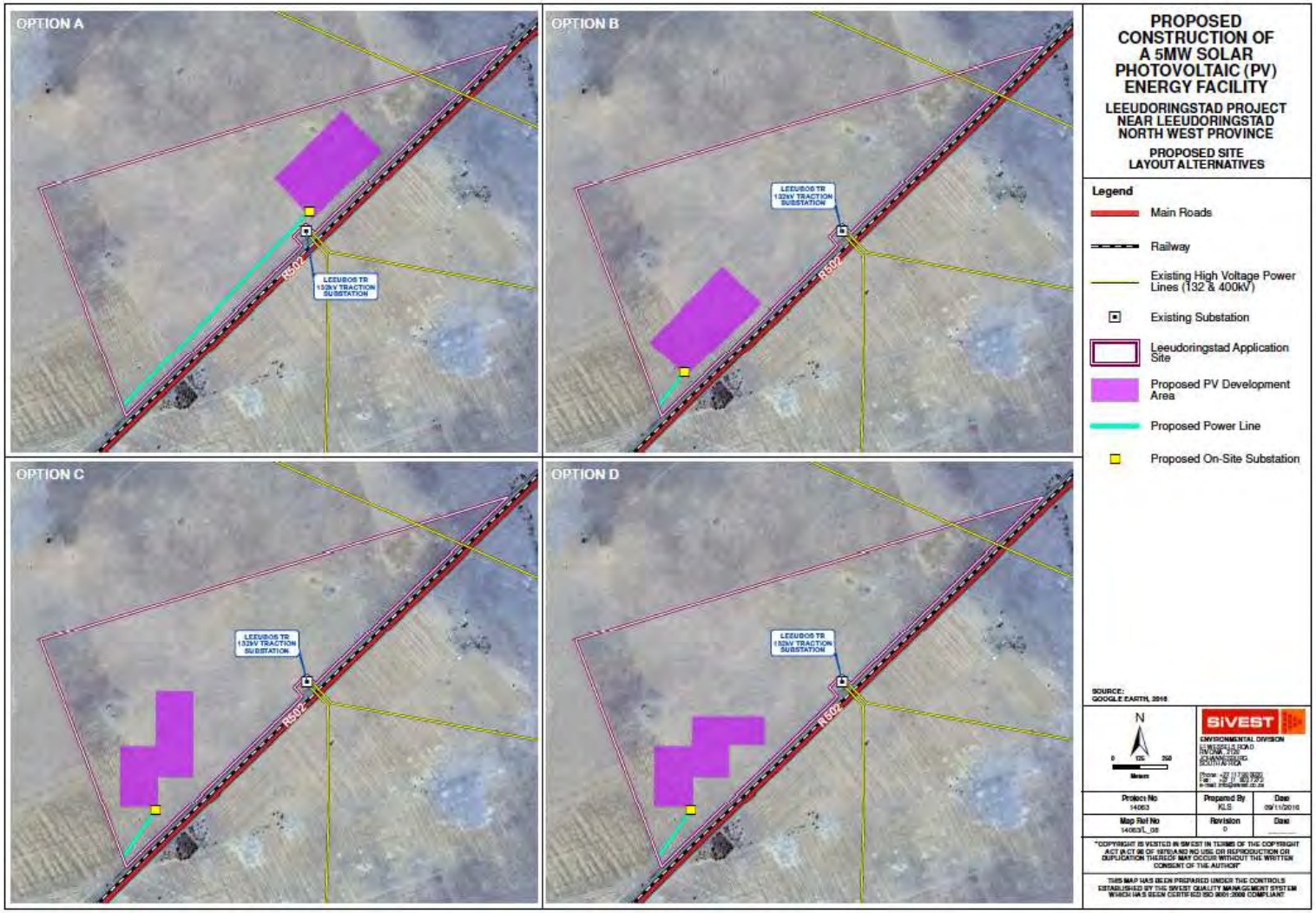

Figure 3: Proposed layout alternatives

3 ASSESSMENT METHODOLOGY

The section below outlines the assessment methodologies utilised in the study.

3.1 Methodology for Assessing Heritage Site significance

This HIA report was compiled by PGS for the proposed Leeuwbosch Solar PV Power Plant and grid corridor. The applicable maps, tables and figures, are included as stipulated in the NHRA (no 25 of 1999), the National Environmental Management Act (NEMA) (no 107 of 1998). The HIA process consisted of three steps:

3.1.1 Scoping Phase

Step I – Literature Review: The background information to the field survey relies greatly on the Heritage Background Research.

3.1.2 Impact Assessment Phase

Step II – Physical Survey: A physical survey was conducted on foot and by vehicle through the proposed project area by a qualified archaeologist, which aimed at locating and documenting sites falling within and adjacent to the proposed development footprint.

Step III – The final step involved the recording and documentation of relevant archaeological resources, the assessment of resources in terms of the HIA criteria and report writing, as well as mapping and constructive recommendations.

Appendix B outlines the HIA methodology, while **Appendix C** provides the guidelines for the impact assessment evaluation that will be done during the EIA phase of the project.

4 BACKGROUND RESEARCH

The examination of heritage databases, historical data and cartographic resources represents a critical additional tool for locating and identifying heritage resources and in determining the historical and cultural context of the study area. Therefore, an Internet literature search was conducted and relevant archaeological and historical texts were also consulted. Relevant topographic maps and satellite imagery were studied.

4.1 Previous Studies

Researching the SAHRIS online database (http://www.sahra.org.za/sahris), it was determined that a number of other archaeological or historical studies have been performed within the wider vicinity of the study area. Previous studies listed for the area in the APM Report Mapping Project included a number of surveys within the area listed in chronological order below:

Dreyer. C., 2007. *First phase archaeological and historical investigation of the proposed residential developments on the farm Kransdrift 243, Bothaville, Free State.* No archaeological or historical sites were located. This site occurs approximately 37 km SW from the present study area.

Kusel, U., 2007. *Cultural Heritage Resources Impact Assessment of Goedvooruitzicht 242 IP Hartbeesfontein, North West Province.* Late Iron Age settlements located. Approximately 50 km NW from the present study area.

Van der Walt, J., 2007. *AIA, Township development on Sub division of AH 19, Pretoriuskraal, Orkney, North West Province.* No sites located. Occurs approximately 46 km NE of present study area.

Coetzee, F. P., 2012. *Cultural Heritage Scoping (Predictive) Survey of the Proposed Kabi Witkop Solar PV Facility near Orkney, Dr Kenneth Kaunda District, North West Province.* No sites located. Approximately 46 Km NE from present study area.

Coetzee, F. P., 2012. *Cultural Heritage Survey of the Proposed Kabi Vaalkop Solar PV Facility near Orkney, Dr Kenneth Kaunda District, North West Province.* Two historical structures located. Approximately 46 Km NE from present study area.

Van Schalkwyk, J., 2013*. Heritage impact Assessment for the proposed development of a PV Power Plant on a portion of the farm Matjesspruit 145HP, Leeudoringstad Region, North West Province.* Graves, historical structures and stone age material located. Approximately 15 km E of present study area.

Pelser, A. J., 2015. *Phase 1 HIA report for the proposed Wolmaransstad extension 17 Township Development on the remaining extent of Portion 32 of the farm Wolmaransstad Town and Townlands 184HO, Wolmaransstad, Northwest Province.* Several historical structures and Stone Age material were located. Approximately 30 km W of the present study area.

Van der Walt, J.,2015. *Archaeological scoping report for the proposed Orkney, north West province.* No sites located. Approximately 30 km NE of present study area.

4.2 Historical background

DATE	DESCRIPTION
2.5 million to 250,000 years ago	The Earlier Stone Age is the first and oldest phase identified in South Africa's archaeological history and comprises two technological phases. The earliest of these technological phases is known as Oldowan, which is associated with crude flakes, and hammer stones and dates to approximately 2 million years ago. The second technological phase in the Earlier Stone Age of Southern Africa is known as the Acheulean and comprises more refined and better made stone artefacts such as the cleaver and bifacial handaxe. The Acheulean phase dates back to approximately 1.5 million years ago. Prof. Revil Mason identified early Stone Age material along the banks of the Vaal River during an archaeological survey of the footprint of the Oppermansdrift Dam (Bloemhof Dam) in 1966. One of the sites (Munro's Site) identified during the survey was subsequently excavated (Mason, 1969).
250,000 to 40,000 years ago	The Middle Stone Age is the second oldest phase identified in South Africa's archaeological history. It is associated with flakes, points and blades manufactured by means of the prepared core technique.
40,000 years ago to the historic past	The Later Stone Age is the third phase in South Africa's Stone Age history. It is associated with an abundance of very small stone artefacts (microliths). The Munro Site found by Revil Mason during his survey of the Oppermansdrift Dam (see above) also included a Later Stone Age component. The Later Stone Age is also associated with rock engravings and rock paintings. Rock engravings are known from the direct and wider vicinity of the study area (Bergh, 1998). Dr. Benjamin Smith of the Rock Art Research Institute at the University of Witwatersrand indicates that two San rock engraving sites are located on the farm Kareeboom 228 HO (Smith, 2011). This farm is located approximately 30 km West of the present study area.
1500 – 1700	This period is associated with a Late Iron group referred to as the Olifantspoort facies of the Urewe Tradition. The Olifantspoort facies originated from the Icon facies (AD1300 – 1500) and led to the Thabeng facies (AD1700 – 1840) (Huffman, 2007). The Olifantspoort facies (with the Letsibogo facies in Botswana and the Madikwe facies in the area between Makapansgat and Botswana) represents the second phase in the development of Moloko and were represented by an absence of any stonewalling. Olifantspoort pottery is characterised by "*multiple bands of fine stamping or narrow incision separated by colour"* (Huffman, 2007:193).
1700 – 1820	This period is associated with the Late Iron Age group known as the Thabeng facies of the Urewe Tradition. As indicated above this facies followed on the

DATE	DESCRIPTION
	Olifantspoort facies as the third facies in the development of Moloko in this area. The Thabeng pottery is characterised by "*incised triangles, coloured chevrons and arcades*" (Huffman, 2007:197) whereas the settlements are stonewalled. Their layout conformed to Type Z settlements which can be described as "...*a loose circle of individual bilabial households surrounding the core...*" (Huffman, 2007:41).
1795	During this time Legassick (2010) indicates that the study area fell within the Rolong sphere of influence. Before this time the Rolong were mainly settled south of the Vaal River. Under their leader Tau (c. 1700 – 1760) they were a strong group with a vast sphere of influence and in control of strong trade networks. However, after his death the Rolong moved northward to settle along the headwaters of the Molopo River. The period after Tau's death saw fissures develop which (after the death of Tau's son Ratlou and in turn the death of his son Seitshiro) led to the division of the once united Rolong into at least five groups, namely the Rolong-Mariba, Rolong-Ratlou, Rolong-Tshidi, Rolong-Seleka and Rolong-Rapulana. In roughly 1790 the Rolong-Seleka, followed by the Rolong-Rapulana, left the Molopo River to settle at Thabeng near Klerksdorp (Legassick, 2010).
Early 1820s	During the early 1820s Burchell records the Tlhaping at Dithakong, the missionary Broadbent records the Rolong on top of the Platberg (at Thabeng) and the Kubung were associated with several localities in the Free State such as OMB1. These three groups form a South-western Sotho-Tswana cluster which can be associated with Thabeng pottery and Type Z walling (Huffman, 2007).
1823	As a result of increasing numbers of raiding groups crossing over the Vaal River from the south as part of the social dynamics of the Difaqane, the Rolong-Seleka abandoned their settlement at Thabeng and moved along the northern bank of the Vaal River in a western direction.
February 1823	The Methodist Reverends Samuel Broadbent and Thomas Hodgson (with their respective families) established a mission station on the farm Leeuwfontein a short distance east of Wolmaransstad (Oberholster, 1972) and 20 km NW of the present study. The two missionaries had met Chief Sefunelo of the Rolong-Seleka on his movement away from Thabeng, and asked him to settle in this vicinity (Legassick, 2010). It is worth noting that Breutz (1955) indicates that the Rolong-Seleka was already settled here when the missionaries arrived.

DATE	DESCRIPTION
	It is significant to note that the Broadbent mission station was the first one to be established north of the Vaal River (Oberholster, 1972). During 1824 Hodgson was instructed to return to Cape Town with the Reverend Archbell sent up to replace him. However, before Archbell could reach the mission station Broadbent left due to ill health. Although Hodgson rebuilt the mission station in 1826 he later abandoned it and moved to Boetsap (Oberholster, 1972).
January 1824	The Taung under their leader Moletsane attacked the Rolong-Seleka of Sefonela at their settlement in the vicinity of the Broadbent mission station. This attack was believed to have been in response to an earlier attack of the Rolong-Seleka on them. The Rolong-Seleka were forced to abandon their settlement, and eventually joined to the Rolong-Ratlou and Rolong-Tshidi at Phitsane on the Molopo River (Legassick, 2010). The mission station was also destroyed during the attack.
c. 1827	During this time the Taung under Moletsane crossed over the Vaal River from the south and settled along the Makwassie Stream. From here they undertook various attacks on the peripheral settlements and outposts of the Khumalo-Ndebele of Mzilikazi, who were established along the Magaliesberg Mountains further to the east (Bergh, 1998).
c. July 1829	The Khumalo-Ndebele attacked the Taung along the Makwassie Stream in response to an attack, which a combined Taung, Griqua and Koranna force had made the previous year on the Ndebele. The Taung were defeated and fled to the Modder River to the south (Bergh, 1998).
1839	In 1839 the town and district of Potchefstroom were established (Bergh, 1998). This followed on the arrival of the Voortrekkers in the wider landscape during 1836. The establishment of a Voortrekker town at Potchefstroom led to the increasing expansion of white farms toward the west. As a result, the 1840s saw the establishment of the first white farms along the Makwassie Stream. Some of the earliest farms on the eastern bank of the Makwassie Stream included Vlakfontein, Rietfontein, Zendelingsfontein and Goedvooruitzicht (Bergh, 1998). These farms are all located north of Wolmaransstad.
1841 - 1850	During this time the establishment of farms by Voortrekkers expanded from Potchefstroom and reached the Makwassie Stream (Bergh, 1998).

DATE	DESCRIPTION
April - June 1871	An arbitration commission held hearings in Bloemhof during this period. The commission was asked to provide an arbitrated solution to the exact position of the western boundary of the *Zuid-Afrikaansche Republiek*. It came as a result of increasing levels of disagreement and discontent between the Z.A.R. on the one hand, and the Rolong, Tlhaping and the Koranna (amongst others) on the other. The commission comprised the British magistrate at Klipdrif, John Campbell and the Z.A.R. magistrate of Wakkerstroom, A.A. O' Reilly. When the two individuals failed to reach an agreement, the Lieutenant-Governor of Natal, R.W. Keate, was asked to provide the final recommendations of the commission. In the vicinity of the study area the Keate Award (as Keate's findings are referred to) defined the western boundary of the Z.A.R. along the Makwassie Stream (Bergh, 1998). This means that the study area now fell outside of the Z.A.R.
1881	After the end of the Anglo-Transvaal War (also referred to the First Boer War), which terminated the two-year British annexation of the Z.A.R., the Pretoria Convention of 1881 redefined the western boundary of the Z.A.R. The recommendations of the convention were largely based on the investigations undertaken by Lieutenant-Colonel C.J. Moysey who had been appointed by the British government during the previous year to investigate the Keate Award of 1871 through map surveys and field assessments. According to the recommendations of the Pretoria Convention the western boundary of the Z.A.R. was moved from the Makwassie Spruit to roughly the Harts River. In 1884 the western boundary of the Z.A.R. was again moved further west as a result of the recommendations of the London Convention (Bergh, 1998).
19 August 1884	The government of the *Zuid-Afrikaansche Republiek* (Z.A.R.) provided permission for a town to be established in the Makwassie ward. This permission came as a result of the investigations undertaken by J.M.A. Wolmarans and Commandant Piet Cronjé of Potchefstroom. Although stands for the town were already being laid out in 1888, a dispute arose as to exactly where the new town should be established. The three disputed localities for the new town were Witpoort in the east, portions of the farms Rooderand and Vlakfontein in the centre and Leeufontein in the west. When President Paul Kruger heard of the dispute he paid a visit to the area and personally viewed each of the three possibilities. Before he returned to Pretoria he decided that the town would be laid out on the western bank of the Makwassie Stream on portions of the farms Rooderand and Vlakfontein. On 16 February 1891 the town of Wolmaransstad was officially proclaimed by the government of the Z.A.R (Van Zijl, 1966).
1899 – 1902	A number of significant events can be associated with the general vicinity of the study area during the South African War.

DATE	DESCRIPTION
	The town of Wolmaransstad was occupied by Republican forces at the beginning of 1901 and shortly thereafter a military court known as the *Militaire Hof voor de Westelijke Districten der ZAR* was established by the Boer authorities. The reason for the establishment of an almost permanent court in the town was due to the fact that Wolmaransstad was not connected to the railway system and as a result British forces only occupied the town for short periods of time. Although the court proceedings took place under difficult circumstances due to the effect of war and numerous attacks on the town, a large number of cases were tried. Of specific interest is that the court had jurisdiction in terms of Boer forces and men in both the Z.A.R. and Free State Republic. Boer general and later prime minister of South Africa, General Jan Smuts, referred to this court as the start of a united South Africa because of its jurisdiction over international boundaries between the Boer republics. However, the British viewed the court in a completely different light and after the war numerous attempts were made to have at least some members of the court charged with war crimes (Blake, 2010). During the war the nearby town of Wolmaransstad was attacked and occupied by the British on a number of occasions. One of these attacks took place on 5 March 1901 when a British column under Lord Methuen attacked the town. The column then turned south intending to assist the British garrison at Hoopstad. However, a skirmish developed with the local Boer commando between Wolmaransstad and the Vaal River. The British eventually managed to reach Commando Drift but found the river in flood and had to follow the bank of the river for almost 10 days before eventually reaching Fourteen Streams (Van Zijl, 1966). Two more attacks on Wolmaransstad took place on 17 December 1901 and 28 December 1901. On 10 February 1902 Lieutenant-Colonel Von Donop occupied the town again after receiving instructions to do so from Lord Methuen. He remained in town for roughly a month (Van Zijl, 1966).
c. 1910	The town of Makwassie (also known as Maquassi) was established during this time. The establishment of the town was as a result of the work undertaken by local shopkeeper Charles Cherrie. The first health committee of the town had Cherry as chairman and R. Reid, J. Lamont, H. Bloch as well as P. Quin as members. The secretary was Jack Wride (Van Zijl, 1966).
1911	The discovery and proclamation of an extensive diamond field at Mooifontein (north-west of Bloemhof) in 1911 attracted roughly 5,000 people to these diggings with other 1,200 fortune seekers setting their sights on the Bloemhof townlands. By the end of the year the two fields had yielded more than 37,000

DATE	DESCRIPTION
	carats, a yield that was maintained for the following two years as well (Van Onselen, 1996).
1914 - 1915	Even before the outbreak of the First World War in 1914, the Union of South Africa's responsibility to Britain in such a war was the subject of a heated debate for quite some time. With the outbreak of hostilities the South African Government of General Louis Botha notified Britain of their willingness to assist in the war effort. Many of the Afrikaans people found it intolerable that South Africa should assist their erstwhile enemy in her international conflicts and more so against a country with which they still had very strong ties. Subsequently many of them rose up in armed rebellion under the leadership of former Boer Generals such as Christiaan de Wet and J.C.G. Kemp. Another such a rebellion leader was Boer War leader General Christiaan Frederik Beyers who at the time was the commander of the Union Defence Force. After resigning his post he became one of the leaders of the rebellion. He instructed the members of his commando that they should never be the first to shoot at government troops. As a result he spent most of his time as rebel leader on the move to stay ahead of the government troops. Eventually his commando only comprised 25 men and they were chased without recourse from Kroonstad to the Vaal River. On the morning of 8 December 1914 government troops attacked the commando where they were camped in close vicinity to the Vaal River on the Free State farm Greyling's. In an attempt to allow their leader to escape, 23 members of the commando resisted while Beyers and Jan Pieterse tried to cross over the Vaal River on horseback. The river was however in flood and both men drowned (Van Zijl, 1966). As the South African government did not want to allow the family of General Beyers to bury him in Makwassie, he was buried in the Van Zijl family cemetery on the farm Oersonskraal 207 HO directly east of present-day Makwassie.. Pieterse was buried on the Free State side of the river (Möller, n.d.). Van Onselen (1996) indicates that on 1 November 1914 a skirmish took place between rebels under the command of P.J.K. van Vuuren and government troops on the farm Zoutpan 212 HO. Another skirmish took place shortly thereafter at the railway siding by the name of Kingswood.
October 1918	The Influenza Pandemic reached the general vicinity of the study area during this time. In his book *The Seed of Mine* Dr. Charles van Onselen (1996) relates how the crowded and unsanitary diamond diggings dotted across the wider

DATE	DESCRIPTION
	landscape, resulted in large numbers of fatalities. At the diggings on the farms Kameelkuil 88 HO and London 112 hundreds of people died. One eyewitness account reveals how dozens of corpses were buried in mass graves near these diggings. As people starting leaving the diggings out of fear of getting infected, they brought the disease to their homesteads, villages and farms. Many of these returning workers also died along the roads on their way home and were often buried where they died. The farms themselves were also not immune to the disease and many people died as a result of it on the farms as well (Van Onselen, 1996).
1920	The Town Leeudoringstad was established.
1922	The diamond diggings in the wider vicinity were expanded in 1922 with the proclamation of Kareepoort 210 HO (with a number of other farms in the district which appears to have included Oersonskraal, Boskuil and Kareepan) as alluvial diggings. Thousands of white and black unemployed flocked to these diggings. On the farm Kareepoort a number of informal 'locations' comprising clusters of makeshift shanties and cabins sprung up. These included Fly Camp, Velskoen, Vuilkantien and Rooistad (Van Onselen, 1996).
1925	The northern portion of the farm Oersonskraal 250 HO was proclaimed an alluvial diggings (URU, 767, 2348).
1932	17 July 1932 when a train carrying 320 to 330 tons of dynamite from the De Beers factory at Somerset West to the Witwatersrand exploded and flattened the town of Leeudoringstad.
1940	The ruins of the mission station, which had been established, by Broadbent and Hodgson was proclaimed a Historical Monument (Bergh, 1998).

4.3 Gid corridor analysis

An assessment of the aerial photographs and historical imagery for the grid corridor has revealed possible heritage features that will require further field investigation (**Figure 4**). The majority of the features is identified as ruins in various states of decay. The Leeudoringstad municipal cemetery is situated adjacent to the substation in the western end of the proposed corridor and should be avoided.

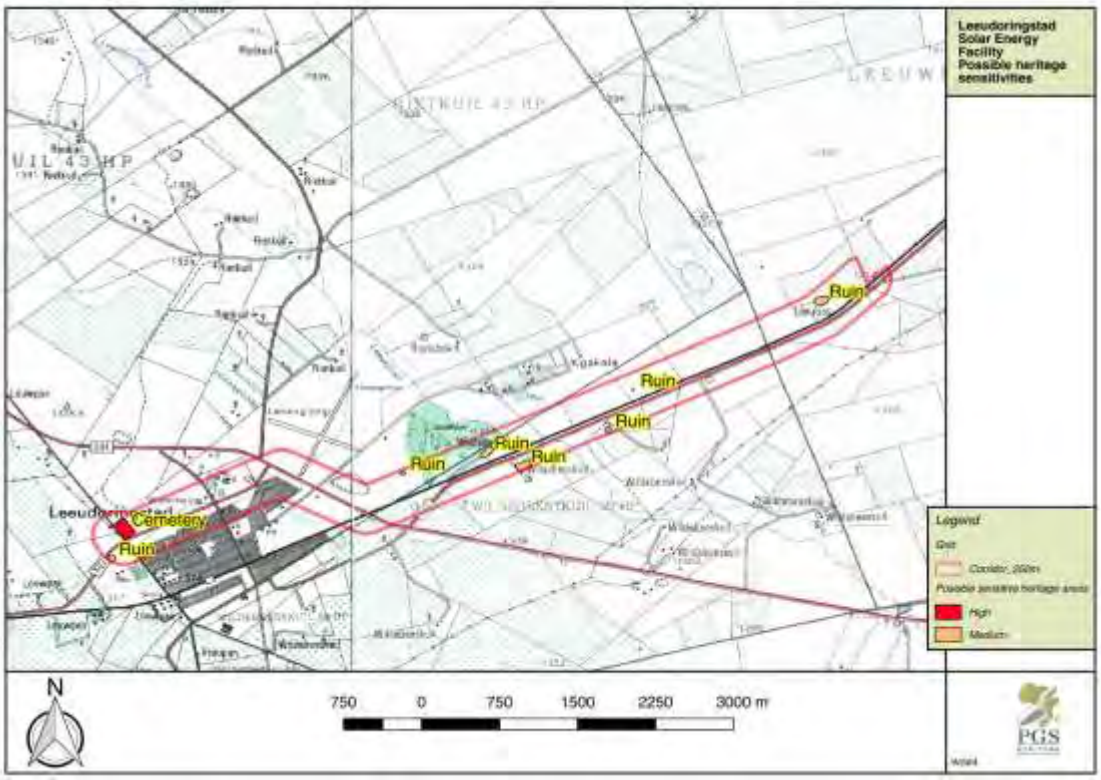

Figure 4: Possible heritage sensitive features in the corridor

5 FIELD WORK FINDINGS

5.1 Methodology

A selective survey of the study area was conducted on 13 September 2016. Due to the nature of cultural remains, with the majority of artefacts occurring below surface, an archaeologist from PGS conducted a vehicle and foot-survey that covered the study area. The fieldwork was logged with a GPS to provide a tracklog of the area covered (**Figure 5**).

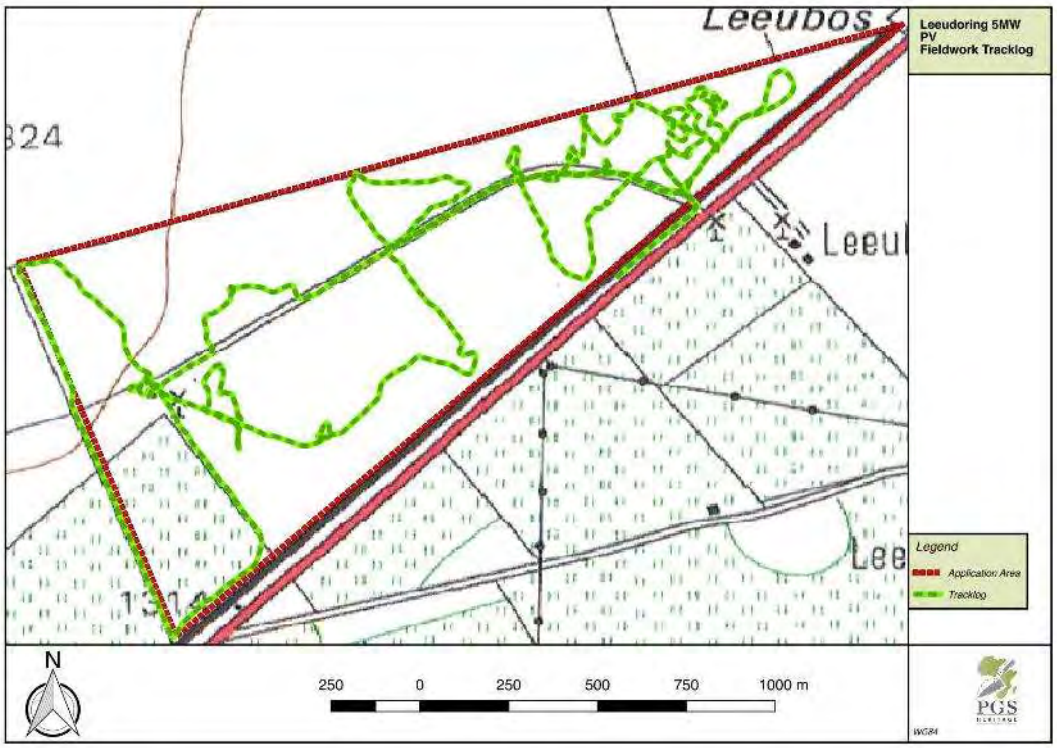

Figure 5: Track logs showing analysis of study area

The proposed study area is situated six kilometers northeast of Leeudoringstad on the R502 between Leeudoringstad and Orkney, in the North West Province.

The proposed site is generally flat, with s slight gradient from west to east. Vegetation on the site is predominantly grassland currently utilized for grazing.

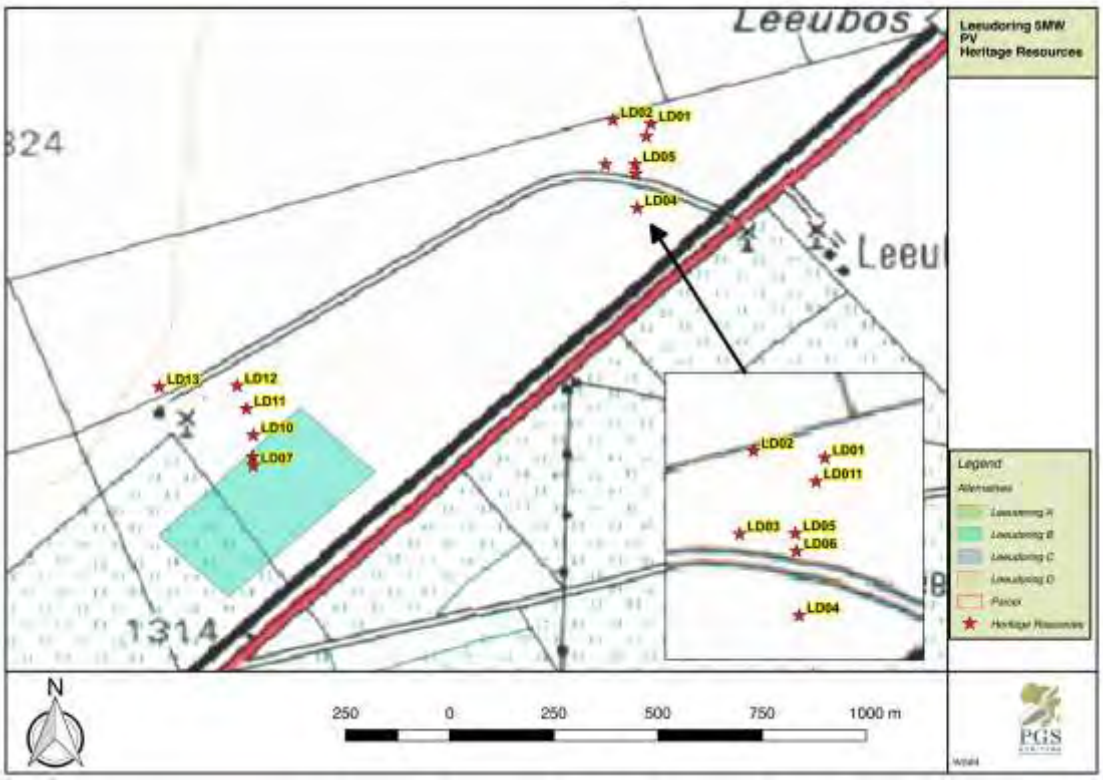

Figure 6: Position of heritage resources within the study area

Figure 7: View of north east section of site

Figure 8: View of south-western section of the site

The fieldwork identified 13 heritage resources. These resources can be grouped in to four clusters. **Table 2** groups the sites in relation to the four layout options. Two clusters consist of the remains of labourer housing, while the other two consist of a cattle kraal and a cemetery.

Table 2: Resources related to layout option

Leeudoring A	Leeudoring B	Leeudoring C	Leeudoring D
LD03, LD04, LD06	LD07, LD09	LD07, LD09, LD10, LD11, LD12	LD07, LD09, LD10, LD11,

5.2 Sites

Provides a description of the heritage resources identified in the study area.

Table 3 Heritage resources

Site Number	Lat	Lon	Type Find	Description	Significance	Heritage Rating
LD01 LD03 LD04 LD05 LD06	S27.19787° S27.19886° S27.19992° S27.19886° S27.19909°	E26.31093° E26.30983° E26.31060° E26.31055° E26.31057°	Heritage Resource	The concentration of structures is distributed of an area of 200x200 meters close to the north-eastern boundary of the study area. Most of the structures consist of a square single stone packed foundation. A single ash midden was identified close to LD06. The structures were most probably a concentration of labourer cottages. The cemetery at LD02 is in all probability associated with these structures. The structures in themselves are of low heritage significance, but the possibility of infant burials close to or in the remaining foundations as per African custom cannot be excluded. The resources are graded as having medium local heritage significance. It is recommended that further consultation with local communities on the previous inhabitants of these areas be initiated to determine the possibility of infant burials. In the event that such burial is confirmed a grave relocation process must be initiated. It is further recommended that an archaeologist monitor the earth moving activities during construction.	Medium to Low	4B

Site Number	Lat	Lon	Type Find	Description	Significance	Heritage Rating
 Figure 9: Foundation at LD01				 Figure 10: Foundation of kraal at LD03		
				 Figure 11: Paved entrance at LD05		
LD02	-29.842418	22.410477	Heritage Resource	The resource is a burial ground situated just south of the northern boundary fence of the study area. The burial ground consists of approximately 10 graves. All of the graves are aligned east-wet and are stone packed with no formal headstones. The graves are aligned in three rows in an area of approximately 10 x 10 meters. The heritage resource has of high local significance and is graded as 4A. It is recommended that the site be preserve and a buffer fence of 20 meters constructed around the site. Grave relocation must only be considered as last resort. A detailed relocation process must be followed and it is recommended that a experienced consultant be appointed to manage the relocation process.	High	4A

Site Number	Lat	Lon	Type Find	Description	Significance	Heritage Rating
 **Figure 12: View of LD02 from the east**				 **Figure 13: Close-up view of LD02**		
LD07 LD09 LD10 LD11 LD12	S27.20617° S27.20595° S27.20543° S27.20479° S27.20423°	E26.30130° E26.30128° E26.30130° E26.30113° E26.30090°	Heritage Resource	The concentration of structures is distributed of an area of 300x100 meters in the western section of the study area. Most of the structures consist of a square single stone packed foundation. A few small ash middens were identified close to each of the structures. The structures were most probably a concentration of labourer cottages. The structures in themselves are of low heritage significance, but the possibility of infant burials close to or in the remaining foundations as per African custom cannot be excluded. The resources are graded as having medium local heritage significance. It is recommended that further consultation with local communities on the previous inhabitants of these areas be initiated to determine the possibility of infant burials. In the event that such burial is confirmed a grave relocation process must be initiated.	Medium to Low	4B

Site Number	Lat	Lon	Type Find	Description	Significance	Heritage Rating
				It is further recommended that an archaeologist monitor the earth moving activities during construction.		
 **Figure 14: Foundation at LD07**				 **Figure 15: Foundation of kraal at LD09**		
LD13	S27.20426°	E26.29902°	Heritage Resource	The resource is a recent historic handling kraal. The site consists of a wind pump, cement water dam, feeding and water troughs, loading ramps and corner posts for a kraal. The site is dated to 1954, as a date inscription on one of the feeding troughs reads – "10-2-1954". The site is of medium local heritage significance and graded as 4B. The site is older than 60 years and protected under section 34 of the NHRA. It is recommended that the site be documented by means of a layout drawing and photographic documentation after which a destruction permit must be applied for from the North West Provincial Heritage Authority prior to destruction.	Medium	4B

Site Number	Lat	Lon	Type Find	Description	Significance	Heritage Rating

Figure 16: View of LD13 from the east

Figure 17: Loading ramp, with dam and wind pump in background

Figure 18: Date inscription on trough

5.3 Palaeontology

Banzai Environmental (Pty) Ltd, the appointed palaeontologist for this project, completed a desktop assessment contained in Appendix D.

The following section is extracted from their report.

The development footprint is underlain by the Allanridge Formation (Ventersdorp Supergroup). The Ventersdorp Supergroup characterise a major occurrence of igneous extrusion that is associated with fracturing of the Kaapvaal Craton approximately 2.7 Ga (billion years) ago. The Late Archaean Allanridge succession is almost fully composed of resistant-weathering, dark green lavas and associated pyroclastic rocks.

The ancient basement rocks, including the Allanridge Formation, are not known to be fossiliferous and thus there is no possibility that the rocks of the Allanridge Formation will contain any fossils. ***Thus, the construction and operation of the PV facility may be authorized as the whole extent of the development footprint is not considered as sensitive in terms of palaeontological resources.***

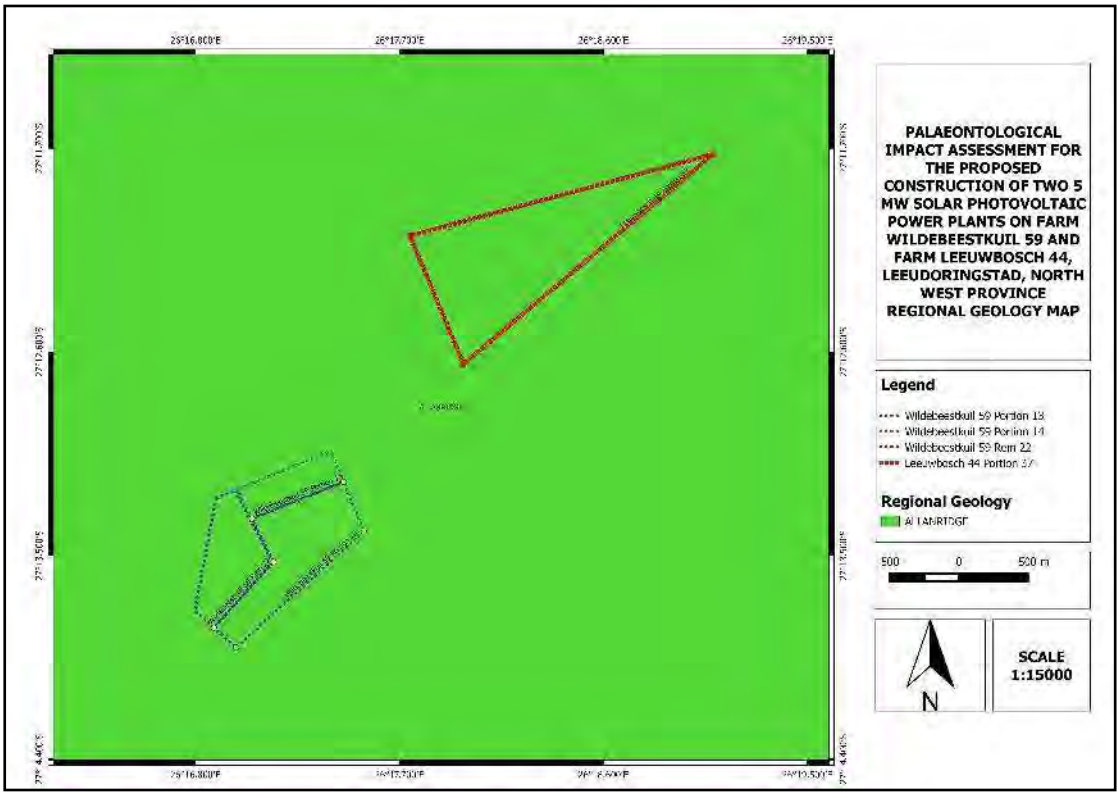

Figure 19: The surface geology of the proposed two 5 MW Solar Photovoltaic power plants on farm Wildebeestkuil 59 and farm Leeuwbosch 44, Leeudoringstad, Maquassi Hills Local Municipality, North West Province

6 IMPACT ASSESSMENT

The impact rating and analysis was done based on the methodology as explained and summarised in **Appendix C** of this report. The design process and methodology followed by the developer for this project enabled the heritage assessment to provide input into the proposed layouts before the impact assessment. This resulted in cognisance being taken of the positions of the heritage sites and thus the reduction of impacts at an early design phase. Analysis of the impact matrix tables will reflect this

6.1 Impact matrix

Table 4: Impact rating – Palaeontology

IMPACT TABLE	
Environmental Parameter	*Impact on the Palaeontology Heritage (fossils) of the development footprint*
Issue/Impact/Environmental Effect/Nature (E)	*The excavations and site clearance during the construction phase will involve substantial excavations into the superficial sediment cover as well as locally into the underlying bedrock. These excavations will modify the existing topography and may disturb, damage, destroy or permanently seal-in fossils at or below the ground surface that are then no longer available for scientific research.* *This impact is likely to occur only during the construction phase. No impacts are expected to occur during the operation phase.*
Extent	*The proposed 5MW Solar Photovoltaic (PV) Power Plants will be located on farm Leeuwbosch 44, Leeudoringstad, North West Province.* *The planned development is located directly west of the Harvard Substation, where present supply is taken.* *The proposed developments will link into Leeubos Traction Substation.* *A brief description of the area over which the impact will be expressed*
Probability	*The broader area near Leeudoringstad is underlain by the Allanridge Formation (Ventersdorp Supergroup). These ancient basement rocks* ***are not known to be fossiliferous*** *and thus there is no possibility that the rocks of the Allanridge Formation will contain any fossils.* *The probability of significant impacts on palaeontological heritage during the construction phase is insignificant.*
Reversibility	*Impacts on fossil heritage are generally irreversible. Well-documented records and further palaeontological studies of any fossils exposed during construction would represent a positive impact from a scientific perspective. The possibility of a negative impact on the palaeontological heritage of the area can be reduced by the implementation of adequate damage mitigation procedures. If damage mitigation is properly undertaken the benefit scale for the project will lie within the beneficial category* *No fossil Heritage is expected.*

Irreplaceable loss of resources	*The Allanridge Formation, are not known to be fossiliferous and thus irreplaceable loss of resources is rated as* ***insignificant***
Duration	*The expected duration of the impact is assessed as potentially permanent to* ***long term****. In the absence of mitigation procedures (should fossil material be present within the affected area) the damage or destruction of any palaeontological materials will be* ***permanent***
Cumulative effect	*Low Cumulative Impact* *The cumulative effect of the development area within the proposed location is considered to be low. The broader area near Leeudoringstad is underlain by the Allanridge Formation, which is not known to be fossiliferous.*
Intensity/magnitude	*Probable significant impacts on palaeontological heritage during the construction phase are high, but the intensity of the impact on fossil heritage is rated as low*
Significance Rating	*A brief description of the importance of an impact which in turn dictates the level of mitigation required*

	Pre-mitigation impact rating	Post mitigation impact rating
Extent	2	1
Probability	2	1
Reversibility	2	1
Irreplaceable loss	2	1
Duration	4	1
Cumulative effect	2	1
Intensity/magnitude	2	1
Significance rating	-28 (high negative)	-6 (low negative)
Mitigation measures	*Recommended mitigation of the inevitable damage and destruction of fossil within the proposed development area would involve the surveying, recording, description and collecting of fossils within the development footprint by a professional palaeontologist. This work should take place after initial vegetation clearance has taken place but before the ground is levelled for construction* *Impacts on fossil heritage are generally irreversible. Well-documented records and further palaeontological studies of any fossils exposed during construction would represent a positive impact from a scientific perspective. The possibility of a negative impact on the palaeontological heritage of the area can be reduced by the implementation of adequate damage mitigation procedures. If damage mitigation is properly undertaken the benefit scale for the project will lie within the beneficial category.* *Not deemed necessary, as the Allanridge Formation is unfosilliferous.*	

Table 5: Impact rating – Heritage resources

IMPACT TABLE		
Environmental Parameter	*Heritage structures*	
Issue/Impact/Environmental Effect/Nature	*The proposed development may impact on the identified structures and cemeteries.*	
Extent	*Localised and in most cases no more than 1000m^2*	
Probability	*Possible*	
Reversibility	*Heritage resources are non-renewable.*	
Irreplaceable loss of resources	*A brief description of the degree in which irreplaceable resources are likely to be lost*	
Duration	*Permanent*	
Cumulative effect	*Medium*	
Intensity/magnitude	*Low*	
Significance Rating	*Medium negative before mitigation and low negative after mitigation.*	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	2	2
Reversibility	4	4
Irreplaceable loss	2	2
Duration	4	4
Cumulative effect	3	3
Intensity/magnitude	1	1
Significance rating	-16 (low negative)	-16 (low negative)
Mitigation measures	1. *For sites LD01, LD03, LD04, LD05, LD06 and LD07, LD09, LD10, LD11 LD12. We recommend that further consultation with local communities on the previous inhabitants of these areas be initiated to determine the possibility of infant burials. In the event that such burial is confirmed a grave relocation process must be initiated.* 2. *We further recommend that an archaeologist monitor the earth moving activities during construction* 3. *We recommend that the burial site LD02 be preserved and a buffer fence of 20 meters constructed around the site.* 4. *We recommend that site LD13 is demarcated with a 20 meter buffer during construction of the PV plant.*	

6.2 Confidence in Impact Assessment

It is necessary to realise that the heritage resources located during the fieldwork do not necessarily represent all the possible heritage resources present within the area. Various factors account for this, including the subterranean nature of some heritage sites.

The impact assessment conducted for heritage sites assumes the possibility of finding heritage resources during the project life and has been conducted as such.

6.3 Cumulative Impacts

The cumulative impact that is foreseen is on the cultural landscape with the implementation of an additional solar project in the region. There are areas within the region with concentrations of archaeological remains such as Iron Age Sites or rock engravings. The historical buildings illustrate the specific culture of the area as well as further insight into the historical background of the areas development. Destruction of this historical landscape will dispossess the region of its heritage. However, the area is not seen as a major tourism zone, the archaeology is sporadic and many of the historical structures are in a state of disrepair.

6.4 Reversibility of Impacts

Although heritage resources are seen as non-renewable the mitigation of impacts on possible finds through scientific documentation will provided sufficient mitigation on the impacts on possible heritage resources.

6.5 Comparative Assessment of Alternatives

The comparative assessment of the alternatives has shown that an overall low impact on heritage is foreseen, as all the heritage resources identified are of a low to medium significance. **Table 2** groups the sites in relation to the four layout options.

Table 6: Resources related to layout option

Leeudoring A	Leeudoring B	Leeudoring C	Leeudoring D
LD03, LD04, LD06	LD07, LD09	LD07, LD09, LD10, LD11, LD12	LD07, LD09, LD10, LD11,

Assessing the possible impacts by the layout options on the identified heritage resources the Leeudoring A and B will have the least direct impact on the heritage resources. However, with the implementation of the recommended management measures it is our opinion that all four alternatives will be acceptable for development.

Key

PREFERRED	The alternative will result in a low impact / reduce the impact
FAVOURABLE	The impact will be relatively insignificant
NOT PREFERRED	The alternative will result in a high impact / increase the impact
NO PREFERENCE	The alternative will result in equal impacts

Leeuwbosch PV Facility

Alternative	Preference	Reasons (incl. potential issues)
LAYOUT ALTERNATIVES		
Alternative A	**PREFERRED**	Assessing the possible impacts by the layout options on the identified heritage resources the Leeudoring A and B will have the least direct impact on the heritage resources. However, with the implementation of the recommended management measures it is our opinion that all four alternatives will be acceptable for development.
Alternative B	**PREFERRED**	
Alternative C	**FAVOURABLE**	However, with the implementation of the recommended management measures it is our opinion that all four alternatives will be acceptable for development.
Alternative D	**FAVOURABLE**	

7 CONCLUSIONS AND RECOMMENDATIONS

PGS Heritage (Pty) Ltd was appointed by SiVEST Environmental Division to undertake a Heritage Impact Report that forms part of the Environmental Basic Assessment for Upgrade Energy (Pty) Ltd for the proposed construction of the 5MW Solar Photovoltic (PV) Power plant, on the farm Leeuwbosch 44, near Leeudoringstad, Maquassi Hills Local Municipality North West Province.

Heritage resources are unique and non-renewable and as such any impact on such resources must be seen as significant.

7.1 PV Plant

The fieldwork completed for the HIA in September 2016, identified 13 heritage resources. These resources can be grouped in to four clusters. Two clusters consist of the remains of labourer housing, while the other two consist of a cattle kraal and a cemetery. With acknowledgement of the suggested mitigation measures outlined below, the impact can be rated as low.

The design process and methodology followed by the developer for this project enabled the heritage assessment to provide input into the proposed layout before the impact assessment. This resulted in cognisance being taken of the positions of the heritage sites and thus the reduction of impacts at an early design phase. Analysis of the impact matrix tables will reflect this.

The comparative assessment of the alternatives has shown that an overall low impact on heritage is foreseen, as all the heritage resources identified are of a low to medium significance. **Table 2** groups the sites in relation to the four layout options.

Table 7: Resources related to layout option

Leeudoring A	Leeudoring B	Leeudoring C	Leeudoring D
LD03, LD04, LD06	LD07, LD09	LD07, LD09, LD10, LD11, LD12	LD07, LD09, LD10, LD11,

Assessing the possible impacts by the layout options on the identified heritage resources the Leeudoring A and B will have the least direct impact on the heritage resources. However, with the implementation of the recommended management measures it is our opinion that all four alternatives will be acceptable for development.

Key

PREFERRED	The alternative will result in a low impact / reduce the impact
FAVOURABLE	The impact will be relatively insignificant
NOT PREFERRED	The alternative will result in a high impact / increase the impact
NO PREFERENCE	The alternative will result in equal impacts

Leeuwbosch PV Facility

Alternative	Preference	Reasons (incl. potential issues)
LAYOUT ALTERNATIVES		
Alternative A	**PREFERRED**	Assessing the possible impacts by the layout options on the identified heritage resources the Leeudoring A and B will have the least direct impact on the heritage resources. However, with the implementation of the recommended management measures it is our opinion that all four alternatives will be acceptable for development.
Alternative B	**PREFERRED**	
Alternative C	**FAVOURABLE**	However, with the implementation of the recommended management measures it is our opinion that all four alternatives will be acceptable for development.
Alternative D	**FAVOURABLE**	

7.2 Grid corridor

An assessment of the aerial photographs and historical imagery has revealed possible heritage features that will require further field investigation. The majority of the features is identified as ruins in various states of decay. The Leeudoringstad municipal cemetery is situated adjacent to the substation in the western end of the proposed corridor and should be avoided.

7.3 Management Measures

The management measures proposed are as follows:

7.3.1 Palaeontology

i. No mitigation measures are required.

7.3.2 Archaeological Sites

vi. A field assessment of the possible heritage resources as identified in the desktop assessment will need to be done to finalise this report as an impact assessment report.

vii. For sites LD01, LD03, LD04, LD05, LD06 and LD07, LD09, LD10, LD11 LD12. We recommend that further consultation with local communities on the previous inhabitants of these areas be initiated to determine the possibility of infant burials. In the event that such burial is confirmed a grave relocation process must be initiated.

viii. We further recommend that an archaeologist monitor the earth moving activities during construction.

ix. We recommend that the burial site LD02 be preserved and a buffer fence of 20 meters constructed around the site.

x. We recommend that site LD13 is demarcated with a 20 meter buffer during construction of the PV plant.

8 REFERENCES

Bergh, J.S. 1999. *Geskiedenisatlas van Suid-Afrika: die Vier Noordelike Provinsies*. Van Schaik, Pretoria.

Blake, A. 2010. *Boereverraaier: Teregstellings tydens die Anglo-Boereoorlog*. Tafelberg Utigewers, Kaapsatad.

Breutz, P.J. 1955. *The Tribes of the Mafeking District*. Department of Native Affairs, Ethnological Publications No. 32, Pretoria.

Huffman, T.N. 2007. *Handbook to the Iron Age*. University of KwaZulu-Natal Press, Scottsville.

Legassick, M. 2010. *The politics of a South African frontier: the Griqua, the Sotho-Tswana and the missionaries, 1780 – 1840*. Basler Afrika Bibliographien, Basel.

Mason, R.J. 1969. *The Oppermansdrif Dam Archaeological Project: Vaal Basin* in The South African Archaeological Bulletin, Vol. 24, No. 95/96, pp. 182-192.

Oberholster, J.J. 1970. *The Historical Monuments of South Africa*. National Monuments Council, Cape Town.

Van Onselen, C. 1996. *The Seed is Mine: the life of Kas Maine*. David Philip, Cape Town.

Van Zijl, P.H.S. 1966. *Die Geskiedenis van Wolmaransstad*. Die Wolmaransstadse Kultuurvereniging,

Unpublished References

Smith, B. 2011. Unpublished letter on information contained in the database of the Rock Art Research Institute, University of the Witwatersrand.

Previous heritage reports (SAHRIS)

Dreyer. C., 2007. First phase archaeological and historical investigation of the proposed residential developments on the farm Kransdrift 243, Bothaville, Free State

Kusel, U., 2007. Cultural Heritage Resources Impact Assessment of Goedvooruitzicht 242 IP Hartbeesfontein, North west Province.

Van der Walt, J., 2007. AIA, Township development on Sub division of AH 19, Pretoriuskraal, Orkney, North West Province

Morris, D. 2008. Archaeological and Heritage Phase 1, Impact Assessment for proposed upgrading of Sishen Mine Diesel Depot Storage Capacity at Kathu, Northern Cape. Kimberley: McGregor Museum.

Coetzee, F. P., 2012. Cultural Heritage Scoping (Predictive) Survey of the Proposed Kabi Witkop Solar PV Facility near Orkney, Dr Kenneth Kaunda District, North West Province.

Coetzee, F. P., 2012. Cultural Heritage Survey of the Proposed Kabi Vaalkop Solar PV Facility near Orkney, Dr Kenneth Kaunda District, North West Province

Van Schalkwyk, J., 2013. Heritage impact Assessment for the proposed development of a PV Power Plant on a portion of the farm Matjesspruit 145HP, Leeudoringstad Region, North West Province.

Pelser, A. J., 2015. Phase 1 HIA report for the proposed Wolmaransstad extension 17 Township Development on the remaining extent of Portion 32 of the farm Wolmaransstad Town and Townlands 184HO, Wolmaransstad, Northwest Province.

Van der Walt, J.,2015. Archaeological scoping report for the proposed Orkney, north West province.

Internet References

www.wikipedia.org

Appendix A

LEGISLATIVE PRINCIPLES

LEGISLATIVE REQUIREMENTS – TERMINOLOGY AND ASSESSMENT CRITERIA

3.1 General principles

In areas where there has not yet been a systematic survey to identify conservation worthy places, a permit is required to alter or demolish any structure older than 60 years. This will apply until a survey has been done and identified heritage resources are formally protected.

Archaeological and palaeontological sites, materials, and meteorites are the source of our understanding of the evolution of the earth, life on earth and the history of people. In the new legislation, permits are required to damage, destroy, alter, or disturb them. People who already possess material are required to register it. The management of heritage resources are integrated with environmental resources and this means that before development takes place heritage resources are assessed and, if necessary, rescued.

In addition to the formal protection of culturally significant graves, all graves, which are older than 60 years and are not in a cemetery (such as ancestral graves in rural areas), are protected. The legislation protects the interests of communities that have interest in the graves: they may be consulted before any disturbance takes place. The graves of victims of conflict and those associated with the liberation struggle will be identified, cared for, protected and memorials erected in their honour.

Anyone who intends to undertake a development must notify the heritage resource authority and if there is reason to believe that heritage resources will be affected, an impact assessment report must be compiled at the developer's cost. Thus, developers will be able to proceed without uncertainty about whether work will have to be stopped if an archaeological or heritage resource is discovered.

According to the National Heritage Act (Act 25 of 1999 section 32) it is stated that:
An object or collection of objects, or a type of object or a list of objects, whether specific or generic, that is part of the national estate and the export of which SAHRA deems it necessary to control, may be declared a heritage object, including –

- objects recovered from the soil or waters of South Africa, including archaeological and palaeontological objects, meteorites and rare geological specimens;
- visual art objects;
- military objects;
- numismatic objects;
- objects of cultural and historical significance;
- objects to which oral traditions are attached and which are associated with living heritage;
- objects of scientific or technological interest;
- books, records, documents, photographic positives and negatives, graphic material, film or video or sound recordings, excluding those that are public records as defined in section 1 (xiv) of the National Archives of South Africa Act, 1996 (Act No. 43 of 1996), or in a provincial law pertaining to records or archives; and
- any other prescribed category.

Under the National Heritage Resources Act (Act No. 25 of 1999), provisions are made that deal with, and offer protection, to all historic and pre-historic cultural remains, including graves and human remains.

3.2 Graves and cemeteries

Graves younger than 60 years fall 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 reinterment 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. In order 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).

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 the South African Heritage Resource Agency (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 the category located inside a formal cemetery administrated by a local authority will also require the same authorisation as set out for graves younger than 60 years over and above 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.

Appendix B

Heritage Assessment Methodology

The section below outlines the assessment methodologies utilised in the study.

The Heritage Impact Assessment (HIA) report to be compiled by PGS Heritage (PGS) for the proposed Leeudooringstad 5MW PV Plant will assess the heritage resources found on site. This report will contain the applicable maps, tables and figures as stipulated in the NHRA (no 25 of 1999), the National Environmental Management Act (NEMA) (no 107 of 1998) and the Minerals and Petroleum Resources Development Act (MPRDA) (28 of 2002). The HIA process consists of three steps:

- Step I – Literature Review: The background information to the field survey leans greatly on the Heritage Scoping Report completed by PGS for this site.

- Step II – Physical Survey: A physical survey was conducted on foot and by vehicle through the proposed project area by a qualified archaeologist, aimed at locating and documenting sites falling within and adjacent to the proposed development footprint.

- Step III – The final step involved the recording and documentation of relevant archaeological resources, as well as the assessment of resources in terms of the heritage impact assessment criteria and report writing, as well as mapping and constructive recommendations

The significance of heritage sites was based on four main criteria:

- **site integrity** (i.e. primary vs. secondary context),
- **amount of deposit, range of features** (e.g., stonewalling, stone tools and enclosures),
    - Density of scatter (dispersed scatter)
        - Low - <10/50m^2
        - Medium - 10-50/50m^2
        - High - >50/50m^2
- **uniqueness** and
- **potential** to answer present research questions.

Management actions and recommended mitigation, which will result in a reduction in the impact on the sites, will be expressed as follows:

A - No further action necessary;
B - Mapping of the site and controlled sampling required;
C - No-go or relocate pylon position
D - Preserve site, or extensive data collection and mapping of the site; and
E - Preserve site

Site Significance

Site significance classification standards prescribed by the South African Heritage Resources Agency (2006) and approved by the Association for Southern African Professional Archaeologists (ASAPA) for the Southern African Development Community (SADC) region, were used for the purpose of this report.

Table 8: Site significance classification standards as prescribed by SAHRA

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)	Grade 4A	High / Medium Significance	Mitigation before destruction
Generally Protected B (GP.B)	Grade 4B	Medium Significance	Recording before destruction
Generally Protected C (GP.A)	Grade 4C	Low Significance	Destruction

Appendix C

Impact Assessment Methodology to be utilised during EIA phase

1 ENVIRONMENTAL IMPACT ASSESSMENT METHODOLOGY

The EIA Methodology assists in evaluating the overall effect of a proposed activity on the environment. The determination of the effect of an environmental impact on an environmental parameter is determined through a systematic analysis of the various components of the impact. This is undertaken using information that is available to the environmental practitioner through the process of the environmental impact assessment. The impact evaluation of predicted impacts was undertaken through an assessment of the significance of the impacts.

1.1 Determination of Significance of Impacts

Significance is determined through a synthesis of impact characteristics which include context and intensity of an impact. Context refers to the geographical scale i.e. site, local, national or global whereas Intensity is defined by the severity of the impact e.g. the magnitude of deviation from background conditions, the size of the area affected, the duration of the impact and the overall probability of occurrence. Significance is calculated as shown in Table 3.

Significance is an indication of the importance of the impact in terms of both physical extent and time scale, and therefore indicates the level of mitigation required. The total number of points scored for each impact indicates the level of significance of the impact.

1.2 Impact Rating System

Impact assessment must take account of the nature, scale and duration of effects on the environment whether such effects are positive (beneficial) or negative (detrimental). Each issue / impact is also assessed according to the project stages:

- planning
- construction
- operation
- decommissioning

Where necessary, the proposal for mitigation or optimisation of an impact should be detailed. A brief discussion of the impact and the rationale behind the assessment of its significance has also been included.

1.2.1 Rating System Used To Classify Impacts

The rating system is applied to the potential impact on the receiving environment and includes an objective evaluation of the mitigation of the impact. Impacts have been consolidated into one rating. In

assessing the significance of each issue the following criteria (including an allocated point system) is used:

NATURE		
Include a brief description of the impact of environmental parameter being assessed in the context of the project. This criterion includes a brief written statement of the environmental aspect being impacted upon by a particular action or activity.		
GEOGRAPHICAL EXTENT		
This is defined as the area over which the impact will be expressed. Typically, the severity and significance of an impact have different scales and as such bracketing ranges are often required. This is often useful during the detailed assessment of a project in terms of further defining the determined.		
1	Site	The impact will only affect the site
2	Local/district	Will affect the local area or district
3	Province/region	Will affect the entire province or region
4	International and National	Will affect the entire country
PROBABILITY		
This describes the chance of occurrence of an impact		
1	Unlikely	The chance of the impact occurring is extremely low (Less than a 25% chance of occurrence).
2	Possible	The impact may occur (Between a 25% to 50% chance of occurrence).
3	Probable	The impact will likely occur (Between a 50% to 75% chance of occurrence).
4	Definite	Impact will certainly occur (Greater than a 75% chance of occurrence).
REVERSIBILITY		
This describes the degree to which an impact on an environmental parameter can be successfully reversed upon completion of the proposed activity.		
1	Completely reversible	The impact is reversible with implementation of minor mitigation measures
2	Partly reversible	The impact is partly reversible but more intense mitigation measures are required.
3	Barely reversible	The impact is unlikely to be reversed even with intense mitigation measures.
4	Irreversible	The impact is irreversible and no mitigation measures exist.
IRREPLACEABLE LOSS OF RESOURCES		

This describes the degree to which resources will be irreplaceably lost as a result of a proposed activity.		
1	No loss of resource.	The impact will not result in the loss of any resources.
2	Marginal loss of resource	The impact will result in marginal loss of resources.
3	Significant loss of resources	The impact will result in significant loss of resources.
4	Complete loss of resources	The impact is result in a complete loss of all resources.
DURATION		
This describes the duration of the impacts on the environmental parameter. Duration indicates the lifetime of the impact as a result of the proposed activity		
1	Short term	The impact and its effects will either disappear with mitigation or will be mitigated through natural process in a span shorter than the construction phase (0 – 1 years), or the impact and its effects will last for the period of a relatively short construction period and a limited recovery time after construction, thereafter it will be entirely negated (0 – 2 years).
2	Medium term	The impact and its effects will continue or last for some time after the construction phase but will be mitigated by direct human action or by natural processes thereafter (2 – 10 years).
3	Long term	The impact and its effects will continue or last for the entire operational life of the development, but will be mitigated by direct human action or by natural processes thereafter (10 – 50 years).
4	Permanent	The only class of impact that will be non-transitory. Mitigation either by man or natural process will not occur in such a way or such a time span that the impact can be considered transient (Indefinite).
CUMULATIVE EFFECT		
This describes the cumulative effect of the impacts on the environmental parameter. A cumulative effect/impact is an effect which in itself may not be significant but may become significant if added to other existing or potential impacts emanating from other similar or diverse activities as a result of the project activity in question.		
1	Negligible Cumulative Impact	The impact would result in negligible to no cumulative effects
2	Low Cumulative Impact	The impact would result in insignificant cumulative effects
3	Medium Cumulative impact	The impact would result in minor cumulative effects
4	High Cumulative Impact	The impact would result in significant cumulative effects

INTENSITY / MAGNITUDE		
Describes the severity of an impact		
1	Low	Impact affects the quality, use and integrity of the system/component in a way that is barely perceptible.
2	Medium	Impact alters the quality, use and integrity of the system/component but system/ component still continues to function in a moderately modified way and maintains general integrity (some impact on integrity).
3	High	Impact affects the continued viability of the system/component and the quality, use, integrity and functionality of the system or component is severely impaired and may temporarily cease. High costs of rehabilitation and remediation.
4	Very high	Impact affects the continued viability of the system/component and the quality, use, integrity and functionality of the system or component permanently ceases and is irreversibly impaired (system collapse). Rehabilitation and remediation often impossible. If possible rehabilitation and remediation often unfeasible due to extremely high costs of rehabilitation and remediation.

SIGNIFICANCE

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

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

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

Points	Impact Significance Rating	Description
6 to 28	Negative Low impact	The anticipated impact will have negligible negative effects and will require little to no mitigation.

6 to 28	Positive Low impact	The anticipated impact will have minor positive effects.
29 to 50	Negative Medium impact	The anticipated impact will have moderate negative effects and will require moderate mitigation measures.
29 to 50	Positive Medium impact	The anticipated impact will have moderate positive effects.
51 to 73	Negative High impact	The anticipated impact will have significant effects and will require significant mitigation measures to achieve an acceptable level of impact.
51 to 73	Positive High impact	The anticipated impact will have significant positive effects.
74 to 96	Negative Very high impact	The anticipated impact will have highly significant effects and are unlikely to be able to be mitigated adequately. These impacts could be considered "fatal flaws".
74 to 96	Positive Very high impact	The anticipated impact will have highly significant positive effects.

Appendix D

Palaeontological Desktop Assessment

PALAEONTOLOGICAL IMPACT ASSESSMENT FOR THE PROPOSED CONSTRUCTION OF TWO 5 MW SOLAR PHOTOVOLTAIC POWER PLANTS ON FARM WILDEBEESTKUIL 59 AND FARM LEEUWBOSCH 44, LEEUDORINGSTAD, NORTH WEST PROVINCE

Prepared for:

PSG Heritage

27 September 2016

Prepared by

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EXECUTIVE SUMMARY

Banzai Environmental was appointed by PSG Heritage to conduct the EIA Report for the proposed construction of two 5 MW Solar Photovoltaic (PV) Power Plants on farm Wildebeestkuil 59 and farm Leeuwbosch 44, Leeudoringstad, North West Province. According to the National Heritage Resources Act (Act No 25 of 1999, section 38), a palaeontological impact assessment is required to detect the presence of fossil material within the proposed development footprint and to assess the impact of the construction and operation of the Solar Photovoltaic Power Plants on the palaeontological resources.

The development footprint is underlain by the Allanridge Formation (Ventersdorp Supergroup). The Ventersdorp Supergroup characterise a major occurrence of igneous extrusion that is associated with fracturing of the Kaapvaal Craton approximately 2.7 Ga (billion years) ago. The Late Archaean Allanridge succession is almost fully composed of resistant-weathering, dark green lavas and associated pyroclastic rocks.

The ancient basement rocks, including the Allanridge Formation, are not known to be fossiliferous and thus there is no possibility that the rocks of the Allanridge Formation will contain any fossils. Thus, the construction and operation of the PV facility may be authorized as the whole extent of the development footprint is not considered as sensitive in terms of palaeontological resources.

It is therefore recommended that no further palaeontological heritage studies, ground truthing and/or specialist mitigation are required for the commencement of this development as the impact of the PV Solar Farm will be of low significance.

CONTENTS

1 INTRODUCTION

Upgrade Energy appointed SiVEST, as the independent Environmental Assessment Practitioner (EAP), to undertake the required Basic Assessment processes for the proposed construct of two 5MW Solar Photovoltaic (PV) Power Plants on Farm Wildebeestkuil 59 and Farm Leeuwbosch 44, Leeudoringstad, Maquassi Hills Local Municipality, North West Province.

The following key components are to be constructed for each PV Power Plant: (information provided By PSG Heritage)

- Solar PV Field
- PV solar panels and arrays PV Panel mountings
- DC-AC current inverters and transformers (10 x 500 kVA (2.5m x 1m) within the PV field)
- Mini Substations (3m x 2 m within the PV field)

The associated infrastructure for the proposed developments, include

- Coupling station (approximately 10m x 10m)
- Underground cabling (approximately 0,8 m x 0,6 wide)
- Small site office and storage facility (approximately 10m x 10m) - including security and associated facilities,
- Internal gravel roads (4m width)
- Site fencing

The proposed development is located directly west of the Harvard Substation, where existing supply is taken. The planned developments will link into Leeubos Traction Substation.

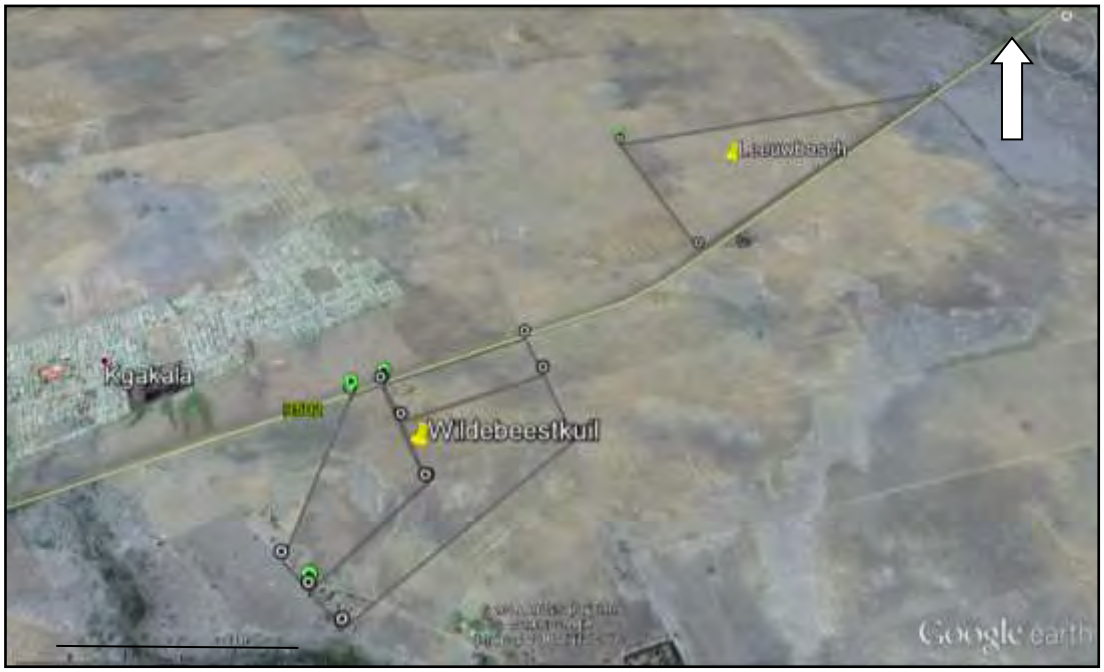

Figure 1. Google Earth image (2016) of the proposed location of the 5 MW Solar Photovoltaic Power Plants on farm Wildebeestkuil 59 and farm Leeuwbosch 44, Leeudoringstad, North West Province.

Figure 2. Flat topography of the propsed developmentarea near Leeudoringstad, North West Province. (Photo by W.Fourie).

2 LEGISLATION

2.1 General Management Guidelines

1. The National Heritage Resources Act (Act 25 of 1999) states that, any person who intends to undertake a development categorised as-

(a) the construction of a road, wall, transmission line, pipeline, canal or other similar form of linear development or barrier exceeding 300m in length;

(b) the construction of a bridge or similar structure exceeding 50m in length;

(c) any development or other activity which will change the character of a site-

  (i) exceeding 5 000 m^2 in extent; or

  (ii) involving three or more existing erven or subdivisions thereof; or

  (iii) involving three or more erven or divisions thereof which have been consolidated within the past five years; or

  (iv) the costs of which will exceed a sum set in terms of regulations by SAHRA.SAHRA;

(d) the re-zoning of a site exceeding 10 000 m^2 in extent; or

(e) any other category of development provided for in regulations by SAHRA or a provincial heritage resources authority, must at the very earliest stages of initiating such a development, notify the responsible heritage resources authority and furnish it with details regarding the location, nature and extent of the proposed development.

Cultural Heritage in South Africa is governed by the National Heritage Resources Act (Act 25 of 1999). This Palaeontological Environmental Impact Assessment forms part of the Heritage Impact Assessment (HIA) and complies with the requirements of the above mentioned Act. In accordance with Section 38, an HIA is required to assess any potential impacts to palaeontological heritage within the development footprint.

3 SECTION 35 OF THE NATIONAL HERITAGE RESOURCES ACT 25 OF 1999

- The protection of archaeological and palaeontological sites and material and meteorites is the responsibility of a provincial heritage resources authority.
- All archaeological objects, palaeontological material and meteorites are the property of the State.
- Any person who discovers archaeological or palaeontological objects or material or a meteorite in the course of development or agricultural activity must immediately report the find to the responsible heritage resources authority, or to the nearest local authority offices or museum, which must immediately notify such heritage resources authority.

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

3.1 Objective

According to the SAHRA APM Guidelines: Minimum Standards for the Archaeological and Palaeontological Components of Impact Assessment Reports' the aims of the palaeontological impact assessment are:

- to identify exposed and subsurface rock formations that are considered to be palaeontologically significant;
- to assess the level of palaeontological significance of these formations;
- to comment on the impact of the development on these exposed and/or potential fossil resources; and
- To make recommendations as to how the developer should conserve or mitigate damage to these resources.

The objective is thus to conduct a Palaeontological Impact Assessment, which forms of part of the Heritage Impact Assessment (HIA) and the EIA Report, to determine the impact of the development on potential palaeontological material at the site.

When a palaeontological desktop/scoping study is conducted, the potentially fossiliferous rocks (i.e. groups, formations, members, etc.) represented within the study area are determined from geological maps. The known fossil heritage within each rock unit is collected from published scientific literature; fossil sensitivity map; consultations with professional colleagues, previous palaeontological impact studies in the same region and the databases of various institutions may be consulted. This data is then used to assess the palaeontological sensitivity of each rock unit of the study area on a desktop level. The likely impact of the proposed development on local fossil heritage is subsequently established on the basis of the palaeontological sensitivity of the rocks and the nature and scale of the development itself (extent of new bedrock excavated).

If rocks of moderate to high palaeontological sensitivity are present within the study area, a Phase 1 field-based assessment by a professional palaeontologist is necessary. Generally, damaging impacts on palaeontological heritage occur during the construction phase. These excavations will modify the existing topography and may disturb damage, destroy or permanently seal-in fossils at or below the ground surface that are then no longer available for scientific study.

When specialist palaeontological mitigation is suggested, it may take place prior to construction or, even more successfully, during the construction phase when new, potentially fossiliferous bedrock is still exposed and available for study. Mitigation usually involves the careful sampling, collection and recording of fossils as well as relevant data concerning the surrounding sedimentary matrix. Excavation of the fossil heritage will require a permit from SAHRA and the material must be housed in a permitted institution. With appropriate mitigation, many developments involving bedrock excavation will have a *positive* impact on our understanding of local palaeontological heritage.

4 GEOLOGICAL AND PALAEONTOLOGICAL HISTORY

The development footprint is underlain by the Allanridge Formation (Ventersdorp Supergroup) (Fig. 3.). The Ventersdorp Supergroup characterise a major occurrence of igneous extrusion that is associated with fracturing of the Kaapvaal Craton approximately 2.7 Ga (billion years) ago. At the top of the Ventersdorp succession are the greyish-green amydaloidal and porphyritic lavas, mainly basaltic andesites, of the Allanridge Formation. The Late Archaean Allanridge succession is almost entirely composed of resistant-weathering, dark green lavas and associated pyroclastic rocks (Van der Westhuizen and De Bruiyn, 2006).

The ancient basement rocks, including the Allanridge Formation, are not known to be fossiliferous.

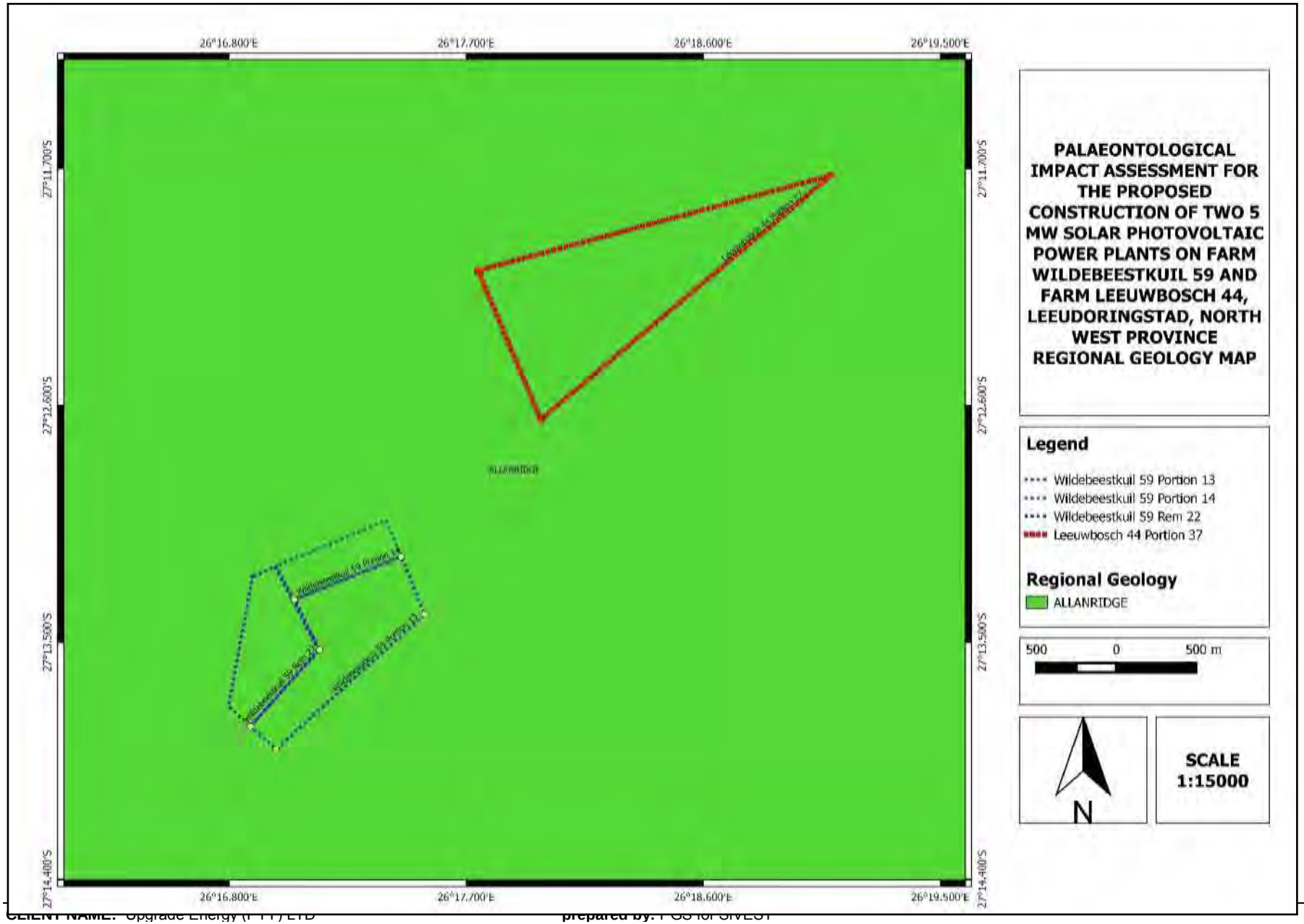

Figure 3. The surface geology of the proposed two 5 MW Solar Photovoltaic power plants on farm Wildebeestkuil 59 and farm Leeuwbosch 44, Leeudoringstad, Maquassi Hills Local Municipality, North West Province.

5 GEOGRAPHICAL LOCATION OF THE SITE

5.1 Project Location

The proposed two 5MW Solar Photovoltaic Power Plants will be located on Farm Wildebeestkuil 59 and Farm Leeuwbosch 44, approximately 15km east of Leeudoringstad, North West Province. The proposed PV Plants are located within the Maquassi Hills Local Municipality. The planned development is located directly west of the Harvard Substation, where present supply is taken. The proposed developments will link into Leeubos Traction Substation.

6 METHODS

A Palaeontological Scoping study was conducted on a desktop level to assess the potential risk to palaeontological material (fossil and trace fossils) within the site proposed for development. The author's experience, aerial photos (using Google Earth, 2015), topographical and geological maps and other reports from the same area were used to assess the site proposed for the development.

6.1 Assumptions and Limitations

The accuracy and reliability of desktop Palaeontological Impact Assessments as components of heritage impact assessments are normally limited by the following restrictions:

- Old fossil databases that have not been kept up-to-date or are not computerised. These databases do not always include relevant locality or geological information. South Africa has a limited number of professional palaeontologists that carry out fieldwork and most development study areas have never been surveyed by a palaeontologist
- The accuracy of geological maps where information may be based solely on aerial photographs and small areas of significant geology have been ignored. The sheet explanations for geological maps are inadequate and little to no attention is paid to palaeontological material.
- Impact studies and other reports (*e.g.* of commercial mining companies) - is not readily available for desktop studies.

Large areas of South Africa have not been studied palaeontologically. Fossil data collected from different areas but in similar Assemblage Zones might however provide insight on the possible occurrence of fossils in an unexplored area. Desktop studies of this nature therefore usually assume the presence of unexposed fossil heritage within study areas of similar geological formations. Where considerable exposures of bedrocks or potentially

fossiliferous superficial sediments are present in the study area, the reliability of a Palaeontological Impact Assessment may be significantly improved through field-survey by a professional palaeontologist.

7 IMPACT ASSESSMENTS

An assessment of the impact significance of the proposed construction of two 5 MW Solar Photovoltaic power plants and associated infrastructure on local fossil heritage is presented here:

7.1 Nature of the impact

The excavations and site clearance will involve substantial excavations into the superficial sediment cover as well as locally into the underlying bedrock. These excavations will modify the existing topography and may disturb damage, destroy or permanently seal-in fossils at or below the ground surface that are then no longer available for scientific research. According to the Geology of the development site there is not a possibility of finding fossils.

7.2 Sensitive areas

The broader area, including the site proposed for the solar farms, is underlain by the Allanridge Formation at the top of the Ventersdorp Supergroup. The Ventersdorp Supergroup consists of igneous extrusions dated approximately 2.7 Ga (billion years) ago. The ancient basement rocks, including the Allanridge Formation, are not known to be fossiliferous and thus the sensitivity associated with the development of the Solar Farms is considered to be of a very low significance.

7.3 Geographical extent of impact

The impact on fossil materials and thus palaeontological heritage will be limited to the construction phase when new excavations into fresh potentially fossiliferous bedrock take place. The extent of the area of potential impact is thus restricted to the project site and therefore categorised as local.

7.4 Duration of impact

The expected duration of the impact is assessed as potentially permanent to long term.

7.5 Potential significance of the impact

The ancient basement rocks, including the Allanridge Formation, are not known to be fossiliferous and thus the significance is considered to be very low.

7.6 Severity / benefit scale

The proposed project is potentially beneficial on not only a local level, but regional and national levels as well. The solar farms will provide a long term benefit to the community in terms of the provision of electricity from a renewable energy resource to a progressively stressed national electricity grid

7.7 Intensity

The intensity of the impact on fossil heritage is rated as very low.

7.8 Probability of the impact occurring

The ancient basement rocks, including the Allanridge Formation, are not known to be fossiliferous. Probable significant impacts on palaeontological heritage during the construction phase are rated as moderate, and the intensity of the impact on fossil heritage is rated as very low.

7.9 DAMAGE MITIGATION, REVERSAL AND POTENTIAL IRREVERSIBLE LOSS

7.9.1 Mitigation

There is no possibility that the rocks of the Allanridge Formation will contain any fossil resources and therefore no mitigation measures are recommended.

7.9.2 Degree of irreversible loss

The Allanridge Formation, are not known to be fossiliferous and thus irreplaceable loss of resources is rated as insignificant.

7.9.3 Degree to which the impact may cause irreplaceable loss of resources

The Allanridge Formation, are not known to be fossiliferous and thus irreplaceable loss of resources is rated as insignificant.

8 CUMULATIVE IMPACTS

The cumulative effect of the development of the proposed construction of two 5 MW Solar Photovoltaic power plants is considered to be low. This is as a result of the broader Leeudoringstad area not being considered as highly fossiliferous.

9 FINDINGS AND RECOMMENDATIONS

The broader area near Leeudoringstad is underlain by the Allanridge Formation (Ventersdorp Supergroup). The Ventersdorp Supergroup characterise a major occurrence of igneous extrusion that is associated with fracturing of the Kaapvaal Craton approximately 2.7 Ga (billion years) ago. The Late Archaean Allanridge succession is almost entirely composed of resistant-weathering, dark green lavas and associated pyroclastic rocks (Van der Westhuizen and De Bruiyn, 2006 and references therein). A summary of the findings is provided in the Table 1 below.

The ancient basement rocks, including the Allanridge Formation, are not known to be fossiliferous and thus there is no possibility that the rocks of the Allanridge Formation will contain any fossils. Thus, the construction and operation of the PV facility may be authorised as the whole extent of the development footprint is not considered as sensitive in terms of palaeontological resources.

Table 1: Geological summary of the area.

Geological Unit	Rock types and age	Fossil heritage	Palaeontological sensitivity	Recommended mitigation
Allanridge Formation Ventersdorp Supergroup	Lavas and pyroclastics with minor siliciclastic lenses Late Archaean (C. 2.7 GA)	No Fossil heritage is known from this Formation -	Insensitive	None recommended

IMPACT TABLE

NATURE		
Include a brief description of the impact of environmental parameter being assessed in the context of the project. This criterion includes a brief written statement of the environmental aspect being impacted upon by a particular action or activity.		
GEOGRAPHICAL EXTENT		
This is defined as the area over which the impact will be expressed. Typically, the severity and significance of an impact have different scales and as such bracketing ranges are often required. This is often useful during the detailed assessment of a project in terms of further defining the determined.		
1	Site	The impact will only affect the site
2	Local/district	Will affect the local area or district
3	Province/region	Will affect the entire province or region
4	International and National	Will affect the entire country
PROBABILITY		
This describes the chance of occurrence of an impact		
1	Unlikely	The chance of the impact occurring is extremely low (Less than a 25% chance of occurrence).
2	Possible	The impact may occur (Between a 25% to 50% chance of occurrence).
3	Probable	The impact will likely occur (Between a 50% to 75% chance of occurrence).
4	Definite	Impact will certainly occur (Greater than a 75% chance of occurrence).
REVERSIBILITY		
This describes the degree to which an impact on an environmental parameter can be successfully reversed upon completion of the proposed activity.		
1	Completely reversible	The impact is reversible
2	Partly reversible	The impact is partly reversible but more intense mitigation measures are required.
3	Barely reversible	The impact is unlikely to be reversed even with intense mitigation measures.
4	Irreversible	The impact is irreversible and no mitigation measures exist.
IRREPLACEABLE LOSS OF RESOURCES		
This describes the degree to which resources will be irreplaceably lost as a result of a proposed activity.		
1	No loss of resource.	The impact will not result in the loss of any resources.
2	Marginal loss of resource	The impact will result in marginal loss of resources.

3	Significant loss of resources	The impact will result in significant loss of resources.
4	Complete loss of resources	The impact is result in a complete loss of all resources.
DURATION		
This describes the duration of the impacts on the environmental parameter. Duration indicates the lifetime of the impact as a result of the proposed activity		
1	Short term	The impact and its effects will either disappear with mitigation or will be mitigated through natural process in a span shorter than the construction phase (0 – 1 years), or the impact and its effects will last for the period of a relatively short construction period and a limited recovery time after construction, thereafter it will be entirely negated (0 – 2 years).
2	Medium term	The impact and its effects will continue or last for some time after the construction phase but will be mitigated by direct human action or by natural processes thereafter (2 – 10 years).
3	Long term	The impact and its effects will continue or last for the entire operational life of the development, but will be mitigated by direct human action or by natural processes thereafter (10 – 50 years).
4	Permanent	The only class of impact that will be non-transitory. Mitigation either by man or natural process will not occur in such a way or such a time span that the impact can be considered transient (Indefinite).
CUMULATIVE EFFECT		
This describes the cumulative effect of the impacts on the environmental parameter. A cumulative effect/impact is an effect which in itself may not be significant but may become significant if added to other existing or potential impacts emanating from other similar or diverse activities as a result of the project activity in question.		
1	Negligible Cumulative Impact	The impact would result in negligible to no cumulative effects
2	Low Cumulative Impact	The impact would result in insignificant cumulative effects
3	Medium Cumulative impact	The impact would result in minor cumulative effects
4	High Cumulative Impact	The impact would result in significant cumulative effects
INTENSITY / MAGNITUDE		
Describes the severity of an impact		
1	Low	Impact affects the quality, use and integrity of the system/component in a way that is barely perceptible.

2	Medium	Impact alters the quality, use and integrity of the system/component but system/ component still continues to function in a moderately modified way and maintains general integrity (some impact on integrity).
3	High	Impact affects the continued viability of the system/component and the quality, use, integrity and functionality of the system or component is severely impaired and may temporarily cease. High costs of rehabilitation and remediation.
4	Very high	Impact affects the continued viability of the system/component and the quality, use, integrity and functionality of the system or component permanently ceases and is irreversibly impaired (system collapse). Rehabilitation and remediation often impossible. If possible rehabilitation and remediation often unfeasible due to extremely high costs of rehabilitation and remediation.

SIGNIFICANCE

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

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

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

Points	Impact Significance Rating	Description
6 to 28	Negative Low impact	The anticipated impact will have negligible negative effects and will require little to no mitigation.
6 to 28	Positive Low impact	The anticipated impact will have minor positive effects.
29 to 50	Negative Medium impact	The anticipated impact will have moderate negative effects and will require moderate mitigation measures.
29 to 50	Positive Medium impact	The anticipated impact will have moderate positive effects.
51 to 73	Negative High impact	The anticipated impact will have significant effects and will require significant mitigation measures to achieve an acceptable level of impact.

51 to 73	Positive High impact	The anticipated impact will have significant positive effects.
74 to 96	Negative Very high impact	The anticipated impact will have highly significant effects and are unlikely to be able to be mitigated adequately. These impacts could be considered "fatal flaws".
74 to 96	Positive Very high impact	The anticipated impact will have highly significant positive effects.

Table 1. Impact Assessment.

IMPACT TABLE	
Environmental Parameter	*Impact on the Palaeontology Heritage (fossils) of the development footprint*
Issue/Impact/Environmental Effect/Nature (E)	The excavations and site clearance during the construction phase will involve substantial excavations into the superficial sediment cover as well as locally into the underlying bedrock. These excavations will modify the existing topography and may disturb, damage, destroy or permanently seal-in fossils at or below the ground surface that are then no longer available for scientific research. This impact is likely to occur only during the construction phase. No impacts are expected to occur during the operation phase.
Extent	The proposed two 5MW Solar Photovoltaic (PV) Power Plants will be located on Farm Wildebeestkuil 59 and Farm Leeuwbosch 44, Leeudoringstad, North West Province. The planned development is located directly west of the Harvard Substation, where present supply is taken. The proposed developments will link into Leeubos Traction Substation. *A brief description of the area over which the impact will be expressed*
Probability	The broader area near Leeudoringstad is underlain by the Allanridge Formation (Ventersdorp Supergroup).These ancient basement rocks are not known to be fossiliferous and thus there is no possibility that the rocks of the Allanridge Formation will contain any fossils. The probability of significant impacts on palaeontological heritage during the construction phase is insignificant.
Reversibility	Impacts on fossil heritage are generally irreversible. Well-documented records and further palaeontological studies of any fossils exposed during construction would

	represent a positive impact from a scientific perspective. The possibility of a negative impact on the palaeontological heritage of the area can be reduced by the implementation of adequate damage mitigation procedures. If damage mitigation is properly undertaken the benefit scale for the project will lie within the beneficial category *No fossil Heritage is expected*	
Irreplaceable loss of resources	The Allanridge Formation, are not known to be fossiliferous and thus irreplaceable loss of resources is rated as insignificant	
Duration	The expected duration of the impact is assessed as potentially permanent to long term. In the absence of mitigation procedures (should fossil material be present within the affected area) the damage or destruction of any palaeontological materials will be permanent	
Cumulative effect	Low Cumulative Impact The cumulative effect of the development area within the proposed location is considered to be low. The broader area near Leeudoringstad is underlain by the Allanridge Formation which is not known to be fossiliferous.	
Intensity/magnitude	Probable significant impacts on palaeontological heritage during the construction phase are high, but the intensity of the impact on fossil heritage is rated as low	
Significance Rating	*A brief description of the importance of an impact which in turn dictates the level of mitigation required*	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	2	1
Probability	2	1
Reversibility	2	1
Irreplaceable loss	2	1
Duration	4	1
Cumulative effect	2	1
Intensity/magnitude	2	1
Significance rating	-28 (high negative)	-6 (low negative)
Mitigation measures	Recommended mitigation of the inevitable damage and destruction of fossil within the proposed development area would involve the surveying, recording, description and collecting of fossils within the development footprint by a	

	professional palaeontologist. This work should take place after initial vegetation clearance has taken place but *before* the ground is levelled for construction Impacts on fossil heritage are generally irreversible. Well-documented records and further palaeontological studies of any fossils exposed during construction would represent a positive impact from a scientific perspective. The possibility of a negative impact on the palaeontological heritage of the area can be reduced by the implementation of adequate damage mitigation procedures. If damage mitigation is properly undertaken the benefit scale for the project will lie within the beneficial category. Not deemed necessary as the Allanridge Formation is unfossiliferous.

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

10 REFERENCES

Johnson, M.R, Anhausser, C.R and Thomas, R.J. (eds) (2006). *The Geology of South Africa.* Geological Society of South Africa: Johannesburg: Council for Geoscience, Pretoria: Geological Society of South Africa, 691pp.

MCCARTHY, T., and RUBIDGE, B. (2005). *The story of Earth and life: a southern African perspective on a 4.6-billion-year journey*. 334pp. Struik, Cape Town.

Mac Rae, C. (1999). *Life etched in stone: fossils of South Africa.* The Geological Society of South Africa, Johannesburg, pp 305.