DRAFT EIA REPORT

Scoping and Environmental Impact Assessment for the Proposed Development of a 100 MW Solar Photovoltaic Facility (SKEERHOK PV 2) on Portion 9 of Gemsbok Bult Farm 120, north-east of Kenhardt, Northern Cape Province

APPENDIX K:

Heritage Report

HERITAGE IMPACT ASSESSMENT: SCOPING AND ENVIRONMENTAL IMPACT ASSESSMENT FOR THE PROPOSED DEVELOPMENT OF THE SKEERHOK PV2 SOLAR ENERGY FACILITY ON GEMSBOKBULT 120/9, KENHARDT MAGISTERIAL DISTRICT, NORTHERN CAPE PROVINCE

SAHRA Case No.: 11819

Required under Section 38 (8) of the National Heritage Resources Act (No. 25 of 1999).

Report for:

CSIR – Environmental Management Services
P.O. Box 320, Stellenbosch, 7599
Tel: 021 8882432
Email: kstroebel@csir.co.za

On behalf of:

juwi Renewable Energies (Pty) Ltd

Dr Jayson Orton
ASHA Consulting (Pty) Ltd
40 Brassie Street, Lakeside, 7945
Tel: (021) 788 8425 | 083 272 3225
Email: jayson@asha-consulting.co.za

23 January 2018

Specialist declaration

environmental affairs

Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

DETAILS OF SPECIALIST AND DECLARATION OF INTEREST

	(For official use only)
File Reference Number:	12/12/20/ or 12/9/11/L
NEAS Reference Number:	DEA/EIA
Date Received:	

Application for integrated environmental authorisation and waste management licence in terms of the-

(1) National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended and the Environmental Impact Assessment Regulations, 2014; and

(2) National Environmental Management Act: Waste Act, 2008 (Act No. 59 of 2008) and Government Notice 921, 2013

PROJECT TITLE

HIA: Scoping and Environmental Impact Assessment for the proposed development of three 100 MW Solar Photovoltaic Facilities (Skeerhok PV 1, PV 2, & PV 3) & 132 kV overhead transmission line near Kenhardt in the Northern Cape Province

Specialist:	**ASHA Consulting (Pty) Ltd**		
Contact person:	**Dr Jayson Orton**		
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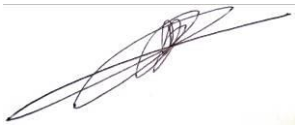
E-mail:	Kstroebel@csir.co.za		

4.2 The specialist appointed in terms of the Regulations_

I, Jayson Orton declare that -- General

declaration:

I act as the independent specialist in this application;
I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
I declare that there are no circumstances that may compromise my objectivity in performing such work;
I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
I will comply with the Act, Regulations and all other applicable legislation;
I have no, and will not engage in, conflicting interests in the undertaking of the activity;
I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
all the particulars furnished by me in this form are true and correct; and
I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.



Signature of the specialist:

ASHA Consulting (Pty) Ltd

Name of company (if applicable):

24 / 01 / 2018

Date:

EXECUTIVE SUMMARY

ASHA Consulting (Pty) Ltd was appointed by juwi Renewable Energies (Pty) Ltd to assess the potential impacts to heritage resources that might occur through the proposed construction of the 100 MW Skeerhok PV2 Solar Energy Facility, located some 39 km northeast of Kenhardt, !Kheis Local Municipality, Kenhardt Magisterial District, Northern Cape (S29° 03' 50" E21° 23' 18"). The project would be constructed on the farm Gemsbokbult 120, portion 9.

A survey of the area showed it to be flat with occasional gravel areas and generally light vegetation cover. Archaeological material was found to be very sparsely distributed across the study area but one site of low-medium significance was located within the proposed development footprint. Impacts in the development footprint are expected to be of moderate significance before mitigation and very low significance after mitigation. Palaeontological impacts are highly unlikely to occur and are of no concern. Impacts are expected to be of very low significance. Graves may be present but because of the very low likelihood of finding any the potential impact significance was rated as being very low. No other specific heritage resources were identified on site but the broader landscape carries a degree of heritage significance. Because of the already existing 'electrical layer' on this landscape and the fact that it has been identified for a hub of solar development, the significance of impacts to this landscape are considered to be low both before and after mitigation. Cumulative impacts are likely to be of essentially the same significance as the construction impacts because of the very low density of significant heritage resources on the broader landscape.

Because no highly significant impacts to heritage resources are envisaged, it is recommended that planning and construction of the proposed Skeerhok PV2 solar energy facility should be authorised but subject to the following conditions which should be incorporated into the Environmental Authorisation:

- The archaeological site at waypoint 836 (GBB2017/001) must be sampled if it cannot be avoided;
- Fencing around the facility is to be visually permeable;
- The use of white paint on structures should be minimised with earthy tones favoured;
- The archaeological site at SHK2017/003 should be cordoned off and all access to it prevented;
- A final archaeological walk down survey of both the facility footprint and any associated linear features must be carried out at least six months in advance of construction;
- Staff must be made aware of the small possibility of locating buried fossils and should this occur they must be left in place and immediately reported to the ECO and/or the heritage authorities; and
- If any archaeological material or human burials are uncovered during the course of development then work in the immediate area should be halted. The find would need to be reported to the heritage authorities and may require inspection by an archaeologist. Such heritage is the property of the state and may require excavation and curation in an approved institution.

Glossary

Background scatter: Artefacts whose spatial position is conditioned more by natural forces than by human agency.

Contact site: An archaeological site that is essentially Stone Age in character but which includes historical materials obtained via trade or exchange with, or wages from, Europeans.

Diagnostic: Artefacts bearing features identifying them to a particular period of time.

Early Stone Age: Period of the Stone Age extending approximately between 2 million and 200 000 years ago.

Hand-axe: A bifacially flaked, pointed stone tool type typical of the Early Stone Age.

Holocene: The geological period spanning the last approximately 10-12 000 years.

Hominid: a group consisting of all modern and extinct great apes (i.e. gorillas, chimpanzees, orangutans and humans) and their ancestors.

Hominin: a smaller group consisting of modern humans, extinct species of humans and all their immediate ancestors.

Later Stone Age: Period of the Stone Age extending over the last approximately 20 000 years.

Middle Stone Age: Period of the Stone Age extending approximately between 200 000 and 20 000 years ago.

Pleistocene: The geological period beginning approximately 2.5 million years ago and preceding the Holocene.

Abbreviations

APHP: Association of Professional Heritage Practitioners

ASAPA: Association of Southern African Professional Archaeologists

BAR: Basic Assessment Report

CSIR: Council for Scientific and Industrial Research

CRM: Cultural Resources Management

DEA: Department of Environmental Affairs

ECO: Environmental Control Officer

EIA: Environmental Impact Assessment

ESA: Early Stone Age

GPS: global positioning system

HIA: Heritage Impact Assessment

MSA: Middle Stone Age

LSA: Later Stone Age

NBKB: Ngwao-Boswa Ya Kapa Bokoni

NEMA: National Environmental Management Act (No. 107 of 1998)

NHRA: National Heritage Resources Act (No. 25) of 1999

NID: Notification of Intent to Develop

PPP: Public Participation Process

SAHRA: South African Heritage Resources Agency

SAHRIS: South African Heritage Resources Information System

SKA: Square Kilometre Array

Compliance with Appendix 6 of the 2014 EIA Regulations

Requirements of Appendix 6 – GN R326 (7 April 2017)	Addressed in the Specialist Report
1. (1) A specialist report prepared in terms of these Regulations must contain- a) details of- i. the specialist who prepared the report; and ii. the expertise of that specialist to compile a specialist report including a curriculum vitae;	Section 1.4 Appendix 1
b) a declaration that the specialist is independent in a form as may be specified by the competent authority;	Page ii (Preliminary Section of this report)
c) an indication of the scope of, and the purpose for which, the report was prepared;	Section 1.3
(cA) an indication of the quality and age of base data used for the specialist report;	Section 3
(cB) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	Sections 4, 5, 6, 7 and 8.2
d) the duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment;	Section 3.2
e) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used;	Section 3
f) details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying alternatives;	Section 1.1.1
g) an identification of any areas to be avoided, including buffers;	Section 10.2
h) a map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	Section 10.2
i) a description of any assumptions made and any uncertainties or gaps in knowledge;	Section 3.5
j) a description of the findings and potential implications of such findings on the impact of the proposed activity or activities;	Section 6
k) any mitigation measures for inclusion in the EMPr;	Section 9
l) any conditions for inclusion in the environmental authorisation;	Section 14
m) any monitoring requirements for inclusion in the EMPr or environmental authorisation;	Section 9
n) a reasoned opinion- i. whether the proposed activity, activities or portions thereof should be authorised; (iA) regarding the acceptability of the proposed activity and activities; and ii. if the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan;	Section 14
o) a description of any consultation process that was undertaken during the course of preparing the specialist report;	Section 12
p) a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	Please refer to Appendix G of the Draft EIAR for comments from SAHRA.
q) any other information requested by the competent authority.	Please refer to Appendix H of the Draft EIAR
2. Where a government notice gazetted by the Minister provides for any protocol of minimum information requirement to be applied to a specialist report, the requirements as indicated in such notice will apply	n/a

Contents

1. INTRODUCTION

ASHA Consulting (Pty) Ltd was appointed by juwi Renewable Energies (Pty) Ltd to assess the potential impacts to heritage resources that might occur through the proposed construction of the 100 MW Skeerhok PV2 Solar Energy Facility, located some 39 km northeast of Kenhardt, !Kheis Local Municipality, Kenhardt Magisterial District, Northern Cape (S29° 03' 50" E21° 23' 18"). The project would be constructed on the farm Gemsbokbult 120, portion 9 (Figures 1 & 2). Note that the grid connection for this project is being assessed in a separate Basic Assessment Report (BAR) process.

1.1. Project description

The project is being developed with a maximum possible installed capacity of 114 MWdc which produces 100 MWac of electricity. Generation is expected to continue for a period of at least 20 years. Although approximately 400 ha of land was assessed, the facility would require about 300 ha of land for the entire development footprint, panels and associated infrastructure. The project would include the following components:

- ≤250 ha PV array with panels up to about 5 m high and mounted via either free field single-axis trackers or fixed tilt PV solar module mounting structures comprised of galvanised steel and aluminium;
- Inverters, transformers, mini-substations and on-site collector substation;
- Below ground electrical cables linking the above components;
- A 32 m high telecommunications mast within the collector substation area;
- Site office and operations and maintenance buildings covering approximately 1 ha and including storage areas, parking, offices, ablution facilities, septic tank, water storage facility and central waste collection area;
- Permanent and temporary laydown areas covering approximately 1 ha;
- A battery storage facility up to 8 m high;
- ≤ 15 km of internal gravel access road ≤ 8 m wide linking the Transnet Service road to the site;
- ≤ 10 km of gravel service roads ≤ 8 m wide within the facility;
- ≤3.5 km length of water supply pipeline connecting existing boreholes to storage, alternatively water will supplied by the local municipality;
- Stormwater drainage; and
- Perimeter fencing 3m high with access gate and guard house.

In addition, the following temporary facilities would be required for the construction period only:
- ≤1 ha site office area;
- ≤ 10 ha laydown area; and
- ≤1 ha concrete batching plant

1.1.1. Aspects of the project relevant to the heritage study

All aspects of the proposed development are relevant since roads and excavations for foundations, cables or pipelines may impact on archaeological and/or palaeontological remains, while the above-ground aspects create potential visual (contextual) impacts to the cultural landscape and any significant heritage sites that might be visually sensitive.

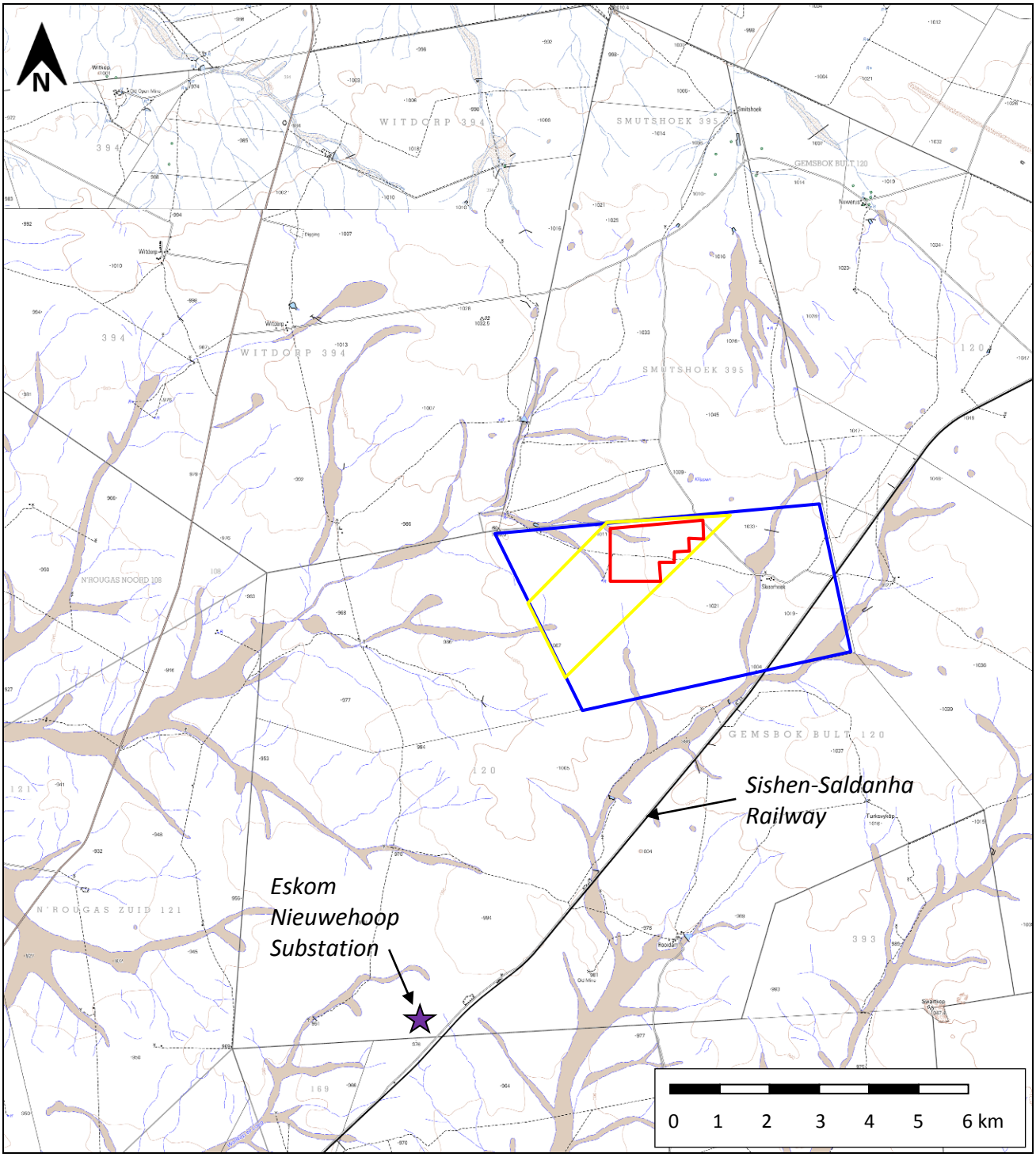


Figure 1: *Extract from 1:50 000 topographic maps 2821CD & 2921AB showing the location of the layout (red polygon), study area (yellow polygon) and farm portion (blue polygon). Source: Chief Directorate: National Geo-Spatial Information. Website: www.ngi.gov.za.*

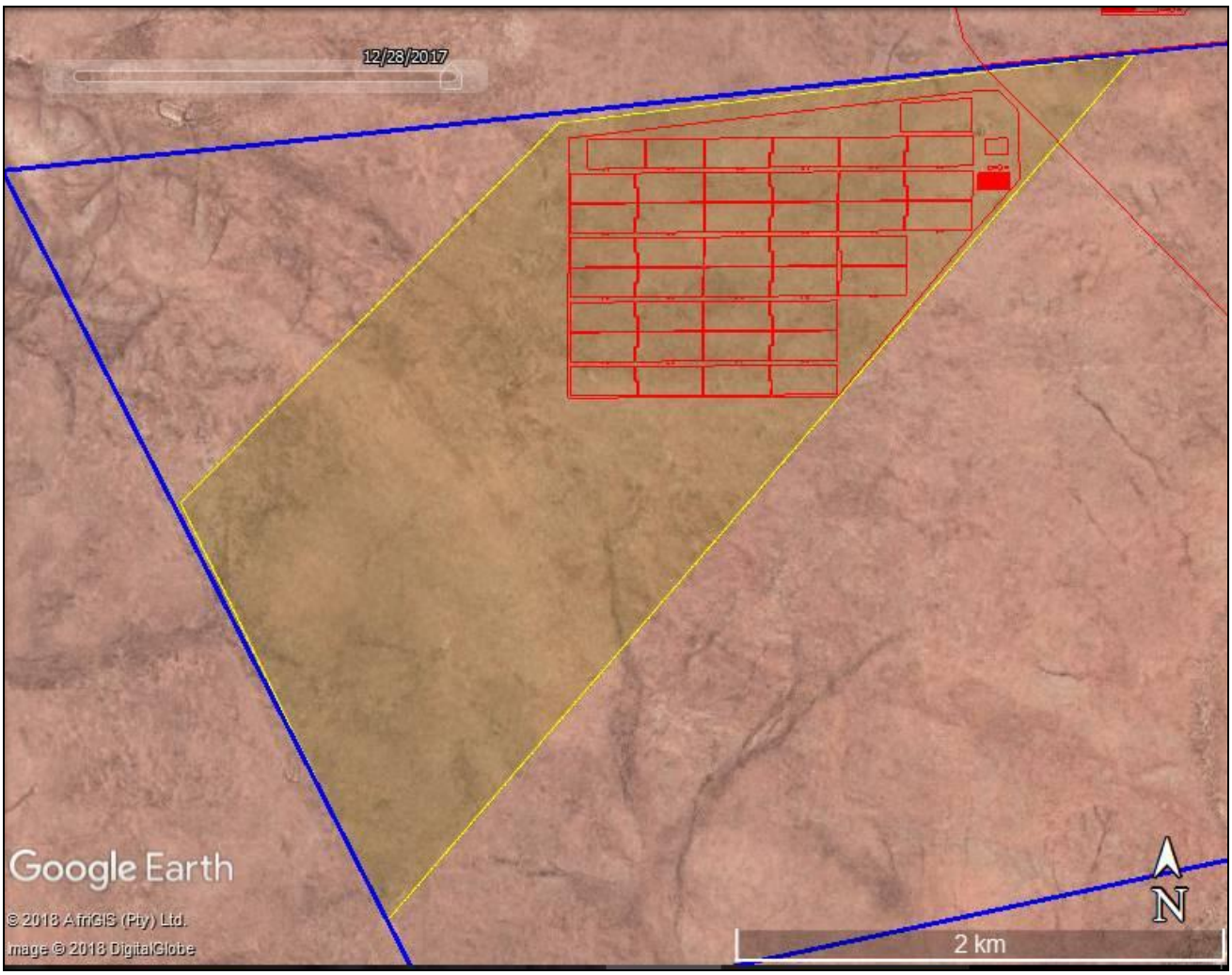


Figure 2: *Aerial view of the study area showing the proposed facility layout (red outlines), the assessed development area (yellow polygon) and the farm portion boundary (blue).*

1.2. Terms of reference

ASHA Consulting was asked to compile a heritage impact assessment (HIA) that included all relevant aspects of heritage, but particularly including palaeontology, archaeology and the cultural landscape which were seen as likely to be the most significant aspects.

The South African Heritage Resources Agency (SAHRA) was notified of the proposed project and the scoping report was submitted to them. SAHRA, in a letter dated 10 November 2017, requested the submission of a full HIA that included an assessment of the impacts to archaeology and palaeontology and also considered the potential visual impacts to heritage resources. This HIA is being submitted to SAHRA at the time of the release of the Draft EIAR for public comment.

It should also be noted, however, that following S.38(3) of the National Heritage Resources Act (No. 25 of 1999), even though certain specialist studies may be specifically requested, <u>all</u> heritage resources should be identified and assessed.

1.3. Scope and purpose of the report

A heritage impact assessment (HIA) is a means of identifying any significant heritage resources before development begins so that these can be managed in such a way as to allow the development to proceed (if appropriate) without undue impacts to the fragile heritage of South Africa. This HIA report aims to fulfil the requirements of the heritage authorities such that a comment can be issued for consideration by the National Department of Environmental Affairs (DEA) who will review the Environmental Impact Assessment (EIA) and grant or withhold authorisation. The HIA report will outline any management and/or mitigation requirements that will need to be complied with from a heritage point of view and that should be included in the conditions of authorisation should this be granted.

1.4. The author

Dr Jayson Orton has an MA (UCT, 2004) and a D.Phil (Oxford, UK, 2013), both in archaeology, and has been conducting Heritage Impact Assessments and archaeological specialist studies in South Africa (primarily in the Western Cape and Northern Cape provinces) since 2004 (please see curriculum vitae included as Appendix 1). He has also conducted research on aspects of the Later Stone Age in these provinces and published widely on the topic. He is an accredited heritage practitioner with the Association of Professional Heritage Practitioners (APHP; Member #43) and also holds archaeological accreditation with the Association of Southern African Professional Archaeologists (ASAPA) CRM section (Member #233) as follows:

- Principal Investigator: Stone Age, Shell Middens & Grave Relocation; and
- Field Director: Colonial Period & Rock Art.

2. HERITAGE LEGISLATION

The National Heritage Resources Act (NHRA) No. 25 of 1999 protects a variety of heritage resources as follows:

- Section 34: structures older than 60 years;
- Section 35: palaeontological, prehistoric and historical material (including ruins) more than 100 years old;
- Section 36: graves and human remains older than 60 years and located outside of a formal cemetery administered by a local authority; and
- Section 37: public monuments and memorials.

Following Section 2, the definitions applicable to the above protections are as follows:

- Structures: “any building, works, device or other facility made by people and which is fixed to land, and includes any fixtures, fittings and equipment associated therewith”;
- Palaeontological material: “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”;
- Archaeological material: a) “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”; b) “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"; c) "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 respectively in sections 3, 4 and 6 of the Maritime Zones Act, 1994 (Act No. 15 of 1994), 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"; and d) "features, structures and artefacts associated with military history which are older than 75 years and the sites on which they are found";

- Grave: "means a place of interment and includes the contents, headstone or other marker of such a place and any other structure on or associated with such place"; and
- Public monuments and memorials: "all monuments and memorials a) "erected on land belonging to any branch of central, provincial or local government, or on land belonging to any organisation funded by or established in terms of the legislation of such a branch of government"; or b) "which were paid for by public subscription, government funds, or a public-spirited or military organisation, and are on land belonging to any private individual."

While landscapes with cultural significance do not have a dedicated Section in the NHRA, they are protected under the definition of the National Estate (Section 3). Section 3(2)(c) and (d) list "historical settlements and townscapes" and "landscapes and natural features of cultural significance" as part of the National Estate. Furthermore, Section 3(3) describes the reasons a place or object may have cultural heritage value; some of these speak directly to cultural landscapes.

Section 38(8) of the NHRA states that if an impact assessment is required under any legislation other than the NHRA then it must include a heritage component that satisfies the requirements of S.38(3). Furthermore, the comments of the relevant heritage authority must be sought and considered by the consenting authority prior to the issuing of a decision. Under the National Environmental Management Act (No. 107 of 1998; NEMA), as amended, the project is subject to an EIA. The present report provides the heritage component. Ngwao-Boswa Ya Kapa Bokoni (Heritage Northern Cape; for built environment and cultural landscapes) and the South African Heritage Resources Agency (SAHRA for archaeology and palaeontology) are required to provide comment on the proposed project in order to facilitate final decision making by the DEA.

3. METHODS

3.1. Literature survey and information sources

A survey of available literature was carried out to assess the general heritage context into which the development would be set. This literature included published material, unpublished commercial reports and online material, including reports sourced from the South African Heritage Resources Information System (SAHRIS). The 1:50 000 map and historical aerial images were sourced from the Chief Directorate: National Geo-Spatial Information.

3.2. Field survey

The site was subjected to a detailed foot survey on 30 June and 3 July 2017. The survey was during mid-winter, although seasonality in this part of South Africa, where vegetation is minimal at all

times of the year, had no material effect on the fieldwork. During the survey the positions of finds were recorded on a hand-held Global Positioning System (GPS) receiver set to the WGS84 datum. Photographs were taken at times in order to capture representative samples of both the affected heritage and the landscape setting of the proposed development.

3.3. Impact assessment

For consistency, the impact assessment was conducted through application of a scale supplied by the CSIR. The impact assessment methodology used for this HIA can be found in Chapter 4 of the Draft EIAR.

3.4. Grading

Section 7 of the NHRA provides for the grading of heritage resources into those of National (Grade 1), Provincial (Grade 2) and Local (Grade 3) significance. Grading is intended to allow for the identification of the appropriate level of management for any given heritage resource. Grade 1 and 2 resources are intended to be managed by the national and provincial heritage resources authorities, while Grade 3 resources would be managed by the relevant local planning authority. These bodies are responsible for grading, but anyone may make recommendations for grading.

It is intended under S.7(2) that the various provincial authorities formulate a system for the further detailed grading of heritage resources of local significance but this is generally yet to happen. SAHRA (2007) has formulated its own system[1] for use in provinces where it has commenting authority. In this system sites of high local significance are given Grade IIIA (with the implication that the site should be preserved in its entirety) and Grade IIIB (with the implication that part of the site could be mitigated and part preserved as appropriate) while sites of lesser significance are referred to as having 'General Protection' and rated with an A (high/medium significance, requires mitigation), B (medium significance, requires recording) or C (low significance, requires no further action).

3.5. Assumptions and limitations

The study was carried out at the surface only and hence any completely buried archaeological sites or palaeontological occurrences will not be readily located. Similarly, it is not always possible to determine the depth of archaeological or palaeontological material visible at the surface. Due to the large size of the site (and others surveyed during the same project) it was impractical to cover the entire area in detail. This means that the results of the survey are indicative of the types of heritage resources likely to be present. It should be noted, however, that all obvious features such as pans and rocky hills were covered in greater detail such that the chances of having missed important heritage resources are very small. Because they were not available for study at the time of the survey, linear features such as the proposed access road alternatives and the water pipeline route were not examined in the field.

Cumulative impacts are assessed by adding expected impacts from this proposed development to existing and proposed developments with similar impacts within a 20 km radius. The existing and proposed developments that were taken into consideration for cumulative impacts include a total of twelve other PV plants (Figure 3), the already constructed Eskom Nieuwehoop Substation (Figure

[1] The system is intended for use on archaeological and palaeontological sites only.

3) and various associated power lines. However, it is notable that the DEA has issued a statement that a maximum of six PV facilities in this area will be issued with preferred bidder status due to the potential negative impacts on the Square Kilometre Array (SKA)

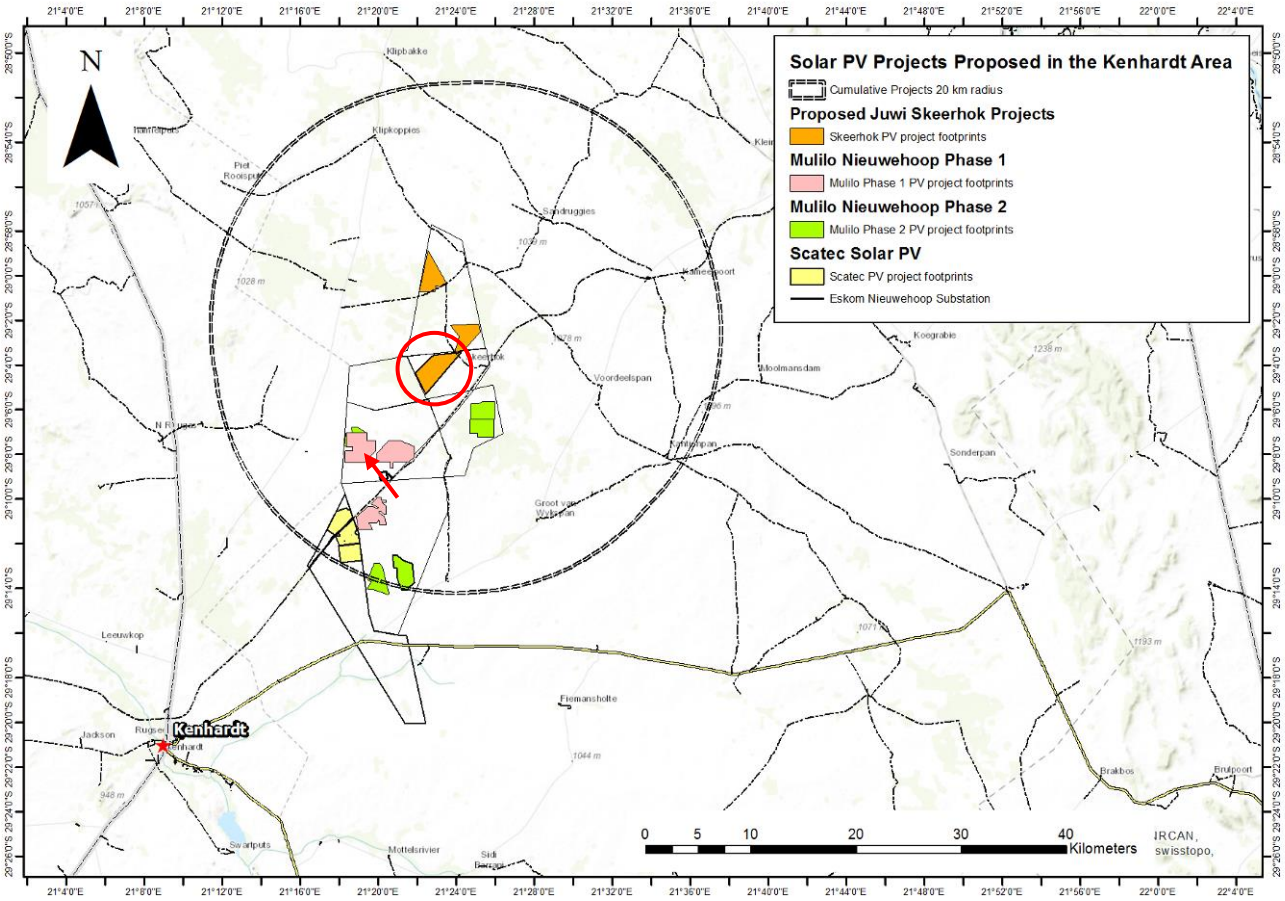


Figure 3: *Map of the broader area around the Nieuwehoop Substation (marked by a red arrow) showing the various solar energy facilities proposed. The present study area is ringed in red.*

3.6. Consultation processes undertaken

The NHRA requires consultation as part of an HIA but, since the present study falls within the context of an EIA which includes a public participation process (PPP), no dedicated consultation was undertaken as part of the HIA. Interested and affected parties would have the opportunity to provide comment on the heritage aspects of the project during the PPP.

Although not formal consultation, it is noted that contact was made with a local resident who knew the locations of some rock art sites. These sites were visited with the resident as part of the general background study but, owing to their distance from the study area, they have no direct relevance on the present assessment.

4. PHYSICAL ENVIRONMENTAL CONTEXT

4.1. Site context

The site is located in a rural area, some 43 km northeast of Kenhardt. However, the Sishen-Saldanha railway line transporting iron ore, its gravel service road, the large, new Eskom Nieuwehoop Substation and some power lines do occur in the general vicinity. The land is otherwise used for grazing of both small stock and wild game.

4.2. Site description

Like much of the broader landscape in this area, the site is very flat. Vegetation consists of grass and low bushes punctuated by occasional taller bushes, especially in ephemeral drainage lines (Figures 4 & 5). Rare quiver trees also occur in the vicinity. The surface is generally sandy, although some igneous bedrock was visible at the surface in places (Figure 6), while calcrete was occasionally noted beneath the surface and revealed in animal burrows. Weathered quartzite occurred as a surface gravel over one fairly large area in the central part of the study area (Figure 7). Rare quiver trees were also seen in the study area (Figure 8).

Figure 4: *View northwards across the site showing typical grass cover as well as taller bushes.*

Figure 5: *View north-eastwards across the site showing typical grass cover as well as taller bushes.*

Figure 6: *View westwards across the site showing an area of exposed igneous bedrock.*

Figure 7: *View northwards across the site showing a heavily weathered quartzite outcrop that has essentially turned to surface gravel.*

Figure 8: *View south-westwards across the site showing one of the few quiver trees noted on site.*

5. ARCHAEOLOGICAL AND HISTORICAL CONTEXT

This section of the report contains the desktop study and establishes what is already known about heritage resources in the vicinity of the study area. What was found during the field survey as presented below may then be compared with what is already known in order to gain an improved understanding of the significance of the newly reported resources.

5.1. Archaeological Aspects

Bushmanland is well known for the vast expanses of gravel that occur in places and which frequently contain stone artefacts in varying densities (Beaumont *et. al* 1995). Such material is often referred to as 'background scatter' and is generally of limited significance (Orton 2016i). At times, however, the scatter can become very dense and mitigation work is occasionally called for. The artefacts located in these contexts are largely Early Stone Age (ESA) and Middle Stone Age (MSA) and date to the middle to late Pleistocene. They are not associated with any other archaeological materials, since these would have long since decomposed and disappeared. Previous experience in the general vicinity suggests that such dense accumulations of background scatter artefacts are unlikely to occur in this part of Bushmanland.

Of potentially more significance, however, are Later Stone Age (LSA) sites which are commonly located along the margins of water features in Bushmanland. These features include both pans and ephemeral drainage lines. Such sites have been identified in the broader vicinity in association with pans but artefact scatters associated with drainage lines are rare (Orton 2014a, 2014b, 2014c, 2016b, 2016c, 2016d, 2016e, 2016f, 2016g, 2016h, 2016j, 2016k, 2016l). These sites would typically contain mostly stone artefacts, but fragments of ostrich eggshell (from eggs used as water containers and also as a food source) and pottery are also found at times, while bone is rare and likely confined to sites that are very recent. While no sites have ever been sampled in the vicinity of the present study area, excavations to the northeast of Pofadder at sites adjacent to small water holes demonstrate this pattern well (Orton 2016a). Similar LSA sites can also be found in association with rocky outcrops. Because of their positions along water courses and adjacent to rocky areas, many of these sites get avoided by development proposals because of the need to avoid the relevant natural features. Despite the increased likelihood of locating archaeology along streams, Morris (2009) noted that a search along the banks of the Hartebeest River close to Kenhardt, where he expected elevated frequencies of archaeological material, revealed virtually nothing. This is in contrast to a section of river bank some 42 km south of the present study area along which a dense concentration of LSA and historical sites (including contact sites) was found.

Another kind of archaeological site fairly commonly encountered in Bushmanland is small rock outcrops that have been quarried as a source of stone material for making stone tools. Several such occurrences – usually of quartz – have been seen in the general area but these are not significant sites.

A few rock engravings and paintings are known from the broader area (Louw Roux Bushmanland 2013). From the limited information available and from observations made along the Hartebeest River by the present author, the engravings tend to be naturalistic images produced by the Bushmen, while the paintings are geometric images, produced by the Khoekhoen. The latter are not well known from the area (Orton 2013), although examples have been seen in the region (David Morris, pers. comm. 2015; Orton 2016g). Painted art is also very rare but again, examples are known, particularly on large granite boulders like that recorded by Orton (2016g) some 15 km south of the present study area (Figure 9).

Figure 9: *View of the context of the one painted site known from within the vicinity of the study area. It is evident from the photograph that such contexts are rare in this very flat landscape.*

5.2. Historical Aspects

The Anglo-Boer War was fought across much of the Northern Cape interior, but information on the role of Kenhardt appears difficult to locate. The town was occupied by the Boers in late February 1900 after they convinced the magistrate that they had a large gun and would fire on the town if it did not surrender. They later surrendered to the British who occupied the town on 31st March 1900. By mid-1900 there were perhaps 100 Cape Rebels detained in a camp outside of Kenhardt (Grobler 2004). The British raised a local force known as the Border Scouts in Upington in May 1900. Many were mixed-race individuals, some local farmers, others Kalahari hunters, but all disliked the Boers. The scouts were responsible for a large area of the north-western Cape Colony centred on Upington and Kenhardt. They eventually numbered 786 by January 1901 and were under the command of Major John Birbeck (AngloBoerWar.com 2015; Rodgers 2011). At the beginning of 1902 there were 150 Border Scouts stationed at Kenhardt. Two boers, H.L. Jacobs and A.C. Jooste, were accused of treason and executed in the town on 24 July 1901 (Grobler 2004). A memorial stands there to their honour (Green Kalahari n.d.). Events around Kenhardt were likely not that important and this execution does not even feature in the Boer War timeline provided by Packenham (1993: 291-294).

No major action appears to have taken place around Kenhardt, although the Boers are known to have attacked a patrol on 17th May 1901, while the British attacked a Boer position on 25th June 1901 (AngloBoerWar.com 2015).

From an archaeological point of view the only material remains possibly related to occupation around the time of the Boer War are the series of contact period river bank scatters mentioned above. On one of these was a rusted pen knife handle with the portrait and name of Paul Kruger on it. This may indicate that a Boer commando had camped there (Orton 2016d).

5.3. Built Environment

The built environment is sparsely represented in rural Bushmanland because the farms tend to be so large. The vast majority of structures appear to be quite recent in age (20th century) and are of

very limited heritage significance. In any case, the development will not directly affect any buildings.

5.4. Graves

Graves are also very rare. Some older farm complexes have small graveyards located close to their farm buildings, while suspicious isolated rocks, perhaps planted upright, may mark historical graves of early mobile farmers (the so-called *trek boers*). An example has been seen some 19 km to the southwest (Orton 2016j). Unmarked pre-colonial graves can, in theory, be located anywhere, although they are generally more common in sandy areas where excavation of graves was easier and in more productive areas where population densities would have been higher.

6. FINDINGS OF THE HERITAGE STUDY

This section describes the heritage resources recorded in the study area during the course of the project. Table 1 provides a list of those resources recorded, identifying which are within the potential impact zone and which not. Figure 10 maps these finds.

Table 1: *List of findings made during the field survey. Note that sites located more than 30 m from the proposed project footprint are highlighted in grey. Such sites may be within the assessed area or in close proximity to it and could thus still be vulnerable to indirect impacts.*

Waypoint	Co-ordinates	Site name	Description	Significance (Mitigation)
836	S29 03 32.2 E21 23 54.3	GBB2017/001	Light scatter of MSA and LSA artefacts alongside a pan. Materials include quartzite, quartz, hornfels and CCS. The mid-section of a very thin, flat hornfels blade with unifacial flaking was seen. Variable weathering on the artefacts suggests variable age.	Medium-low (2 hours)
906	S29 03 40.1 E21 23 53.9	---	An isolated lower grindstone on dolerite and found face up alongside a very small pan. The background scatter did not appear to be any different or denser here to elsewhere.	Very low.
837	S29 03 42.1 E21 22 49.9	---	Low density scatter of MSA and LSA artefacts alongside a pan. Materials include quartzite, quartz, silcrete, 'other'. Variable weathering on the artefacts suggests variable age.	Low
838	S29 04 12.2 E21 21 56.6	---	Low density scatter of adiagnostic artefacts alongside a pan. Quartz and quartzite were present.	Very low
839	S29 04 13.2 E21 21 58.5	---	Low density scatter of adiagnostic artefacts alongside a pan. Quartz and quartzite were present.	Very low
840	S29 04 19.2 E21 22 01.4	GBB2017/002	Scatter of LSA and some older artefacts alongside a 'mini-pan'. Materials include quartz, quartzite and CCS.	Medium-low (2 hours)
841	S29 04 12.7 E21 22 17.8	GBB2017/003	A gneiss lower grindstone displaying ephemeral use as well as a low density scatter of quartz artefacts. Likely LSA in age.	Low
842	S29 04 18.6 E21 22 30.5	GBB2017/004	An old and quite extensive quartzite outcrop that has weathered to gravel and small blocks.	Very low

843	S29 04 19.5 E21 22 33.3		There are a fair number of quartzite flakes amongst the gravel. It is a greenish-coloured quartzite that I have seen in several places.	
844	S29 04 15.9 E21 22 36.5			

6.1. Archaeology

Archaeological resources were sparsely distributed across the study area with only a few areas found to have artefacts present in any quantity. Most were in the west, away from the development footprint (Figure 10). None of these was of great significance, but two areas revealed sites with some research value; only one lies inside the development footprint though (waypoint 836). There were, however, isolated background scatter artefacts found throughout the study area (Figures 11 & 12). A somewhat denser area of background scatter was located at waypoint 837

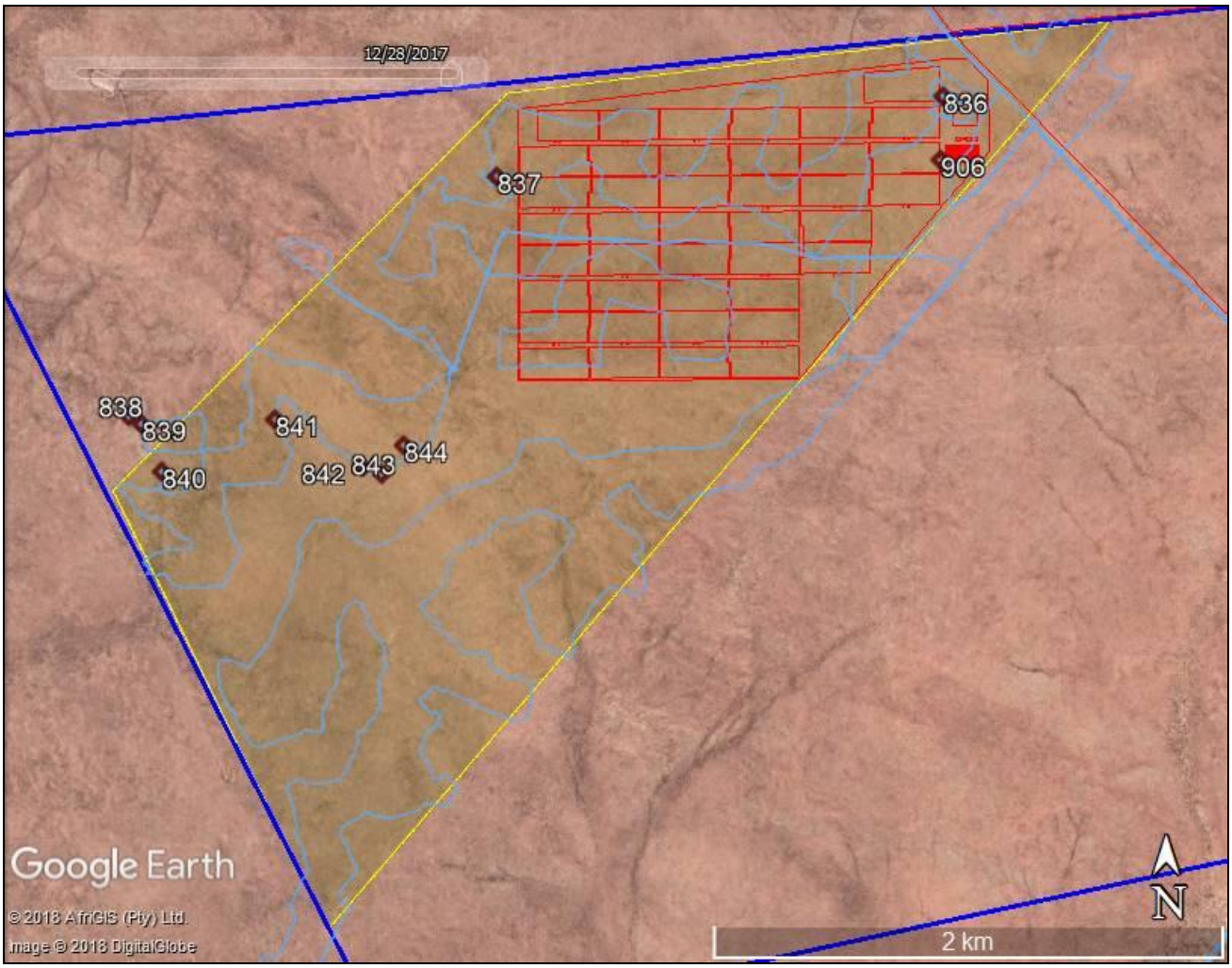


Figure 10: *Map showing the distribution of heritage resources (numbered symbols). The dark blue lines are the northern, western and southern edges of the farm portion, the yellow polygon is the study area, while the red polygons represent the proposed facility layout. Light blue lines denote the survey tracks.*

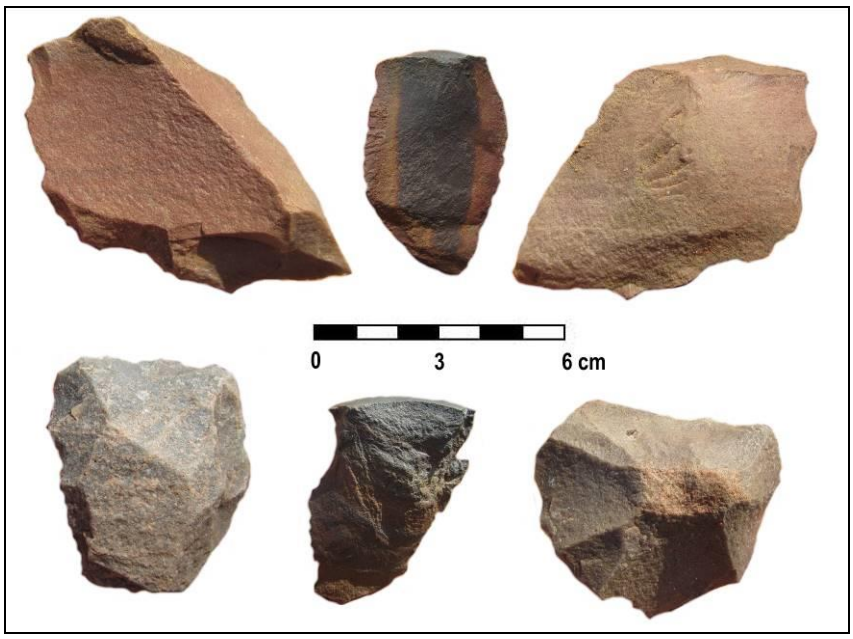


Figure 11: *Examples of isolated background scatter stone artefacts found across the study area. They are likely all MSA artefacts.*

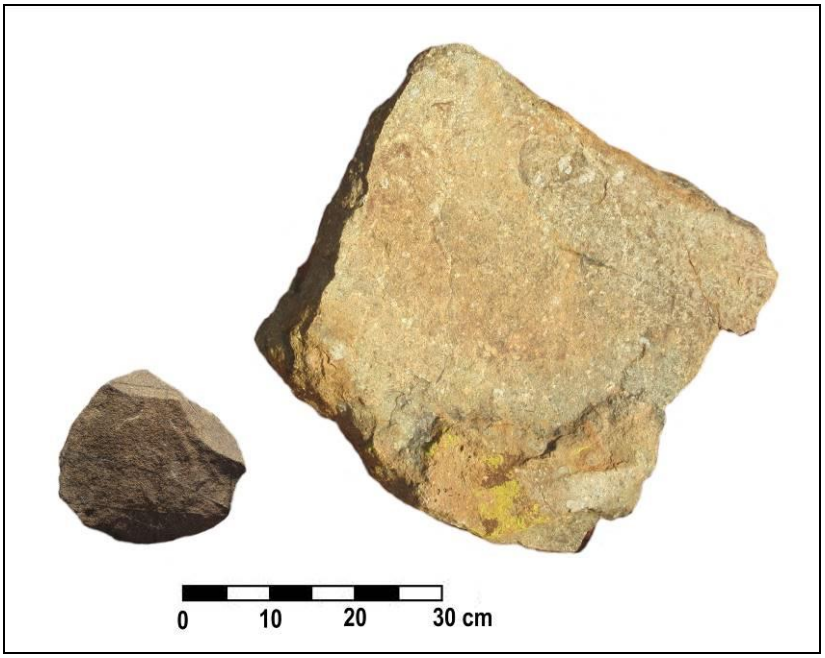


Figure 12: *A very large flake and a broken lower grindstone likely dating to the ESA and LSA respectively. The latter was found at waypoint 841.*

The two sites referred to above were both of fairly low density but had enough spatial integrity to be listed as sites rather than background scatter. Figure 13 shows artefacts from waypoint 836. A very weathered grey-green quartzite outcrop at waypoints 842-844 (Figure 7) provided a material source for flaking and a number of artefacts were seen among the naturally occurring quartzite debris (Figure 14).

Figure 13: *A selection of artefacts from the site at waypoint 836. Scale in cm.*

Figure 14: *A selection of quartzite artefacts from the weathered outcrop at waypoints 842 to 844. Scale in cm.*

Because SAHRA requested that the visual impact on heritage resources be considered, it is pertinent to note that the only visually sensitive archaeological site known to the author in the broader area is a rock art site located 7.5 km south of the footprint area. This is the site on the boulder depicted in Figure 9.

6.2. Palaeontology

Although the SAHRIS Palaeosensitivity Map (Figure 22) shows the study area to be largely of moderate sensitivity, the nature of the area in terms of palaeontology is such that a full palaeontological study was not deemed necessary by the appointed specialist. Nevertheless, because SAHRA had requested an evaluation of the palaeontological impacts, a desktop study was compiled for the greater project and is briefly summarised here.

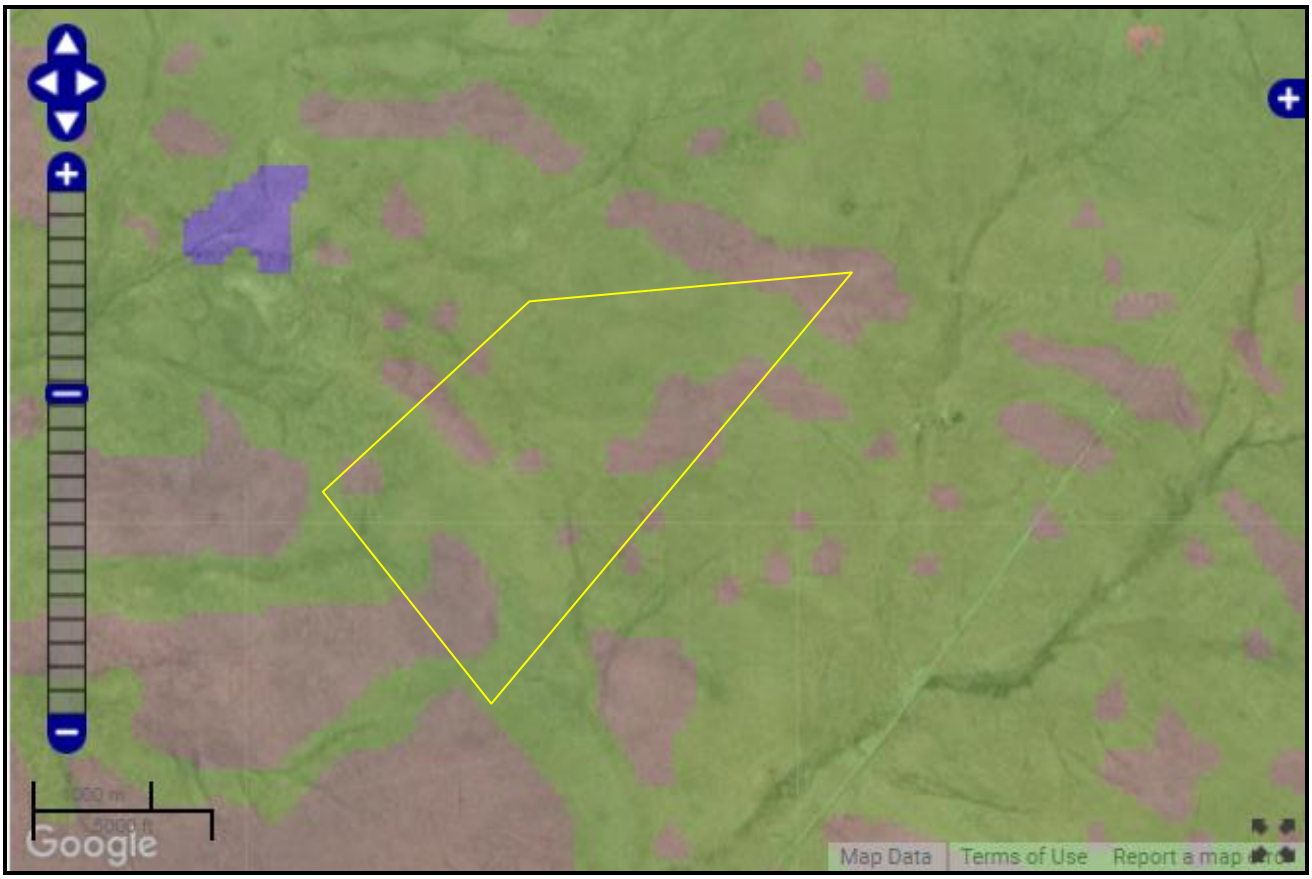


Figure 22: *Extract from the SAHRIS Palaeosensitivity map showing the study area to be of generally moderate palaeontological sensitivity (green shading) but with some areas regarded as zero sensitivity (grey shading).*

The broader area is underlain by metamorphic rocks that are entirely unfossiliferous. The overlying Late Cenozoic superficial sediments are generally of low palaeontological sensitivity, although small, isolated pockets of high sensitivity can be found when fossils are trapped within alluvium related to pans and river terraces along larger water courses (Almond 2017).

Almond (2017) has listed the possible fossils that might be found in the area, although he notes that none have been found there to date. Isolated bones and teeth (e.g. of mammals, fish, amphibians), ostrich eggshell fragments, freshwater molluscs, crabs, trace fossils (e.g. burrows), petrified wood, stromatolites, diatoms and pollen are all possible finds but deemed highly unlikely.

6.3. Graves

No graves were found within the study area, although this does not rule out the possibility that graves could occur due to the great difficulty in spotting them, or at least the stone 'features' thought to be graves.

6.4. Built environment

No built environment features were found within the study area. No structures were visible from the study area with the nearest house being 1.5 km to the southeast of the PV layout area. This is

the landowner's residence. The structures are 20th century in age and are of low significance. Only one structure was present in 1945 (Figure 23). It was not visited during the field assessment. The farm complex would not be affected in any way, although one of the access road alternatives passes about 130 m north of the complex.

Figure 23: *Aerial views of the Skeerhok Farm Complex dating to 1945 (Job 083, strip 4, photograph 02372) and 2013 (Google Earth). The only structure present in 1945 is ringed in green in both images.*

6.5. Cultural landscape and visual concerns

The cultural and natural landscape is also of concern. However, the cultural landscape is very poorly developed in this area with fences, water troughs and wind pumps being the primary anthropogenic features. The primary sense of place is one of remoteness rather than of a farming landscape. This remoteness has already been impacted upon by the presence of the railway line, Nieuwehoop Substation and all associated power lines. The natural landscape lacks visually interesting and sensitive features. In addition, the proposed site is a long distance from any important roads (it is 23 km from the R27) and is highly unlikely to be visible to anyone other than local residents making use of the gravel road along the railway line. Solar PV facilities are not very tall and, if an earthy coloured paint is used for the buildings where feasible, they can be almost invisible from as little as 1 km away.

A pan 6.5 km northeast of the study area was cultivated during the mid-20th century (Figure 24). This shows the low intensity, opportunistic subsistence agriculture practiced in a pan when sufficient rain had fallen. All other activities in the broader area relate to small stock grazing.

It is notable that the landscape in the vicinity of the study area already has an electrical layer comprised of a large substation and several power lines (Figure 25). It is because of the substation that the development location has been chosen.

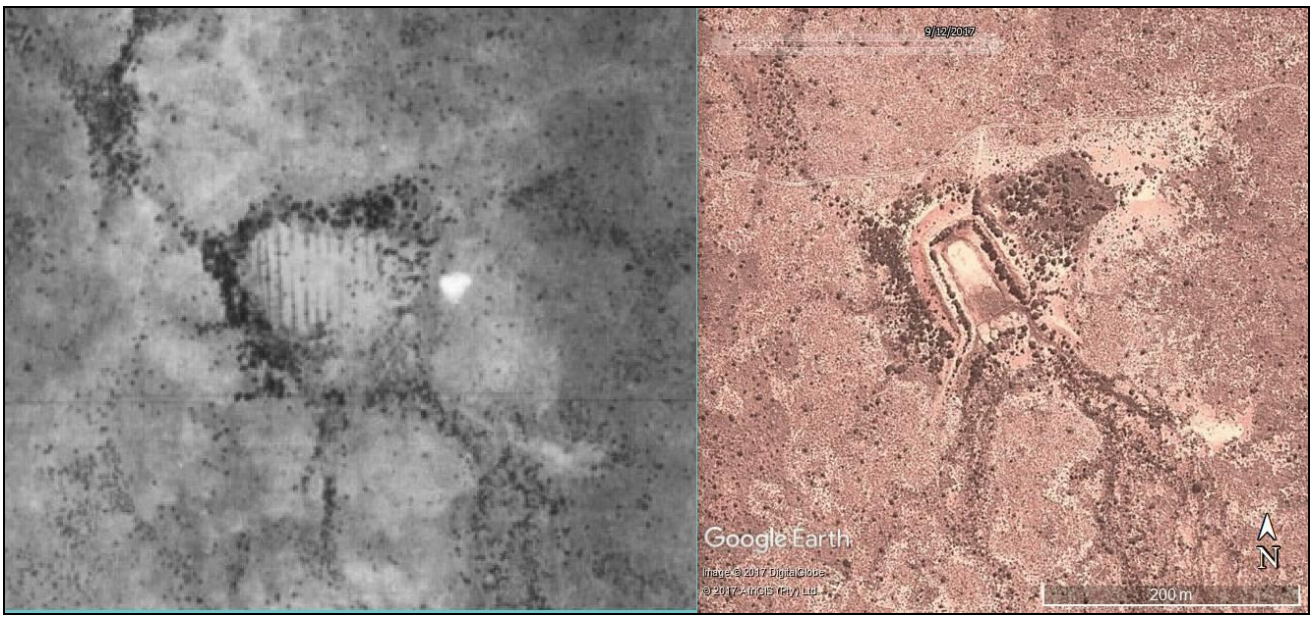


Figure 24: *1944 (Job 83, strip 001, photograph 02633) and modern (Google Earth) aerial photographs showing the pan to have been under cultivation during the mid-20th century but excavated out to facilitate water catchment by the late 20th century.*

Figure 25: *Evening view of the large Eskom substation located some 16 km south of the proposed project.*

6.6. Summary of heritage indicators

The primary indicator of concern here is archaeological sites. Although no highly significant sites were located within the proposed development footprint, the chance still exists that one could occur there and be damaged or destroyed by the proposed development. The survey has ensured, however, that no large and potentially highly significant sites would be impacted. Graves could also occur, but again, the chances are small. The chances of impacting on significant palaeontological resources are considered minimal. The single visually sensitive heritage site in the area, a rock art site, is located well far enough away to be of no concern here. The only other issue is visual impacts to the cultural landscape but this issue is unavoidable and of little heritage concern.

6.7. Statement of significance and provisional grading

Section 38(3)(b) of the NHRA requires an assessment of the significance of all heritage resources. In terms of Section 2(vi), ''cultural significance'' means aesthetic, architectural, historical, scientific, social, spiritual, linguistic or technological value or significance.

The archaeological resources within the development footprint are deemed to have low cultural significance for their scientific value (provisional grade: General Protection B).

Graves are deemed to have high cultural significance for their social value, but none have been located within the site to date. Any graves present would be assigned a grading of IIIA.

The cultural landscape is of fairly low significance because it is extensive and quite monotonous. This makes it fairly well-suited to the proposed development because there are no strong cultural features to it that would be irreversibly harmed by it. Furthermore, there is an electrical layer already present with the potential for this to be expanded.

7. ISSUES, RISKS AND IMPACTS

7.1. Summary of issues identified during the Scoping Phase

The main heritage issues identified during the scoping phase were:

- The potential damage to or destruction of archaeological sites;
- The potential damage to or destruction of palaeontological materials; and
- The potential visual or contextual impacts to the cultural landscape.

On submission of the scoping report to SAHRA, they responded as follows:

> *SAHRA Archaeology, Palaeontology and Meteorites (APM) Unit notes that a Heritage Scoping Input has been submitted, and therefore awaits the pending Heritage Impact Assessment (HIA) as part of the draft EIA Phase.*
>
> *The pending HIA must assess all heritage resources as defined in section 3(2) of the National Heritage Resources Act, Act 25 of 1999 (NHRA) and the report must comply with section 38(3) of the NHRA. The Archaeological and Palaeontological components of the HIA must comply with the SAHRA 2006 Minimum Standards for Archaeological and Palaeontological Components of Impact Assessments and the 2012 Minimum Standards: Palaeontological Components of Heritage Impact Assessments. Additionally, the Visual Impact of the proposed development on heritage resources and any comments provided by the public regarding heritage resources must be taken into consideration. The Scoping report appendices, the draft EIA with all appendices must be submitted along with the heritage reports in order for further comments to be issued.*

The present HIA meets the requirements of SAHRA in that it assesses all relevant aspects of heritage and aims to satisfy Section 38(3) of the NHRA. The archaeological and palaeontological components have been prepared by specialists, while visual impacts to heritage resources are also considered (note that a separate visual impact assessment is also available as part of the overall EIA). No other heritage-related comments were received during the public participation process (PPP) for the scoping report.

7.2. Identification of potential impacts/risks

Based on both fieldwork and desktop research as well as the concerns of SAHRA, the potential heritage-related impacts identified during the EIA assessment are:

Construction Phase
- Potential direct impacts to archaeological resources
- Potential direct impact to palaeontological resources
- Potential direct impacts to graves
- Potential direct and visual impacts to the cultural landscape
- Potential visual impacts to all visually sensitive heritage resources

Operational Phase
- Potential direct and visual impacts to the cultural landscape
- Potential visual impacts to all visually sensitive heritage resources

Decommissioning Phase
- Potential direct and visual impacts to the cultural landscape
- Potential visual impacts to all visually sensitive heritage resources

Cumulative impacts
- Potential direct impacts to archaeological resources
- Potential direct impact to palaeontological resources
- Potential direct impacts to graves
- Potential direct and visual impacts to the cultural landscape
- Potential visual impacts to all visually sensitive heritage resources

8. IMPACT ASSESSMENT

Note that although SAHRA identified the need to assess the impacts to visually sensitive heritage resources, none were found to occur within the study area or near enough to be of any concern. This aspect is thus not considered further in this section although impacts to the cultural landscape are visual in nature and are assessed.

Note also that linear aspects such as the water pipeline and access road are subsumed within the assessments below because the level of impacts expected would at all times be less than or equal to that for the PV facility. Furthermore, these alignments were not surveyed in the field because their locations were only available during the impact assessment phase of the project.

8.1. Direct Impacts

8.1.1. Construction Phase

Construction phase impacts are assessed in Table 2.

Potential impacts to archaeology

Archaeological resources are sparsely distributed on the landscape with important sites being rare. Nevertheless, direct impacts in the form of destruction of or damage to sites and materials may occur if construction machinery operates outside of the demarcated areas, if the single site worthy of further research is not mitigated, or if further as yet undiscovered archaeological sites are present. Because of the high likelihood of damaging significant archaeological resources in the proposed development footprint (one such site does occur in the footprint), the overall impacts to archaeology are expected to be moderate before mitigation. Potential mitigation measures include conducting a final footprint survey and then excavating or sampling any important archaeological material found to occur within the footprint including the already known site. The chances of further such material being found, however, are considered to be very small. After mitigation, the overall impact significance would likely be very low.

Potential impacts to palaeontology

The desktop study showed that the probability of finding and damaging or destroying significant palaeontological material during development is extremely unlikely. As such, the potential impacts to palaeontology are considered to be very low. The only measure that needs to be put in place is to ensure that the environmental control officer is alerted if any fossil material is found and that such material gets reported to SAHRA. A palaeontologist may need to inspect the find or conduct further research. The impact significance after mitigation remains very low.

Potential impacts to graves

The probability of uncovering graves during construction is extremely unlikely. Despite their importance, the significance of potential impacts to graves is thus assessed to be very low. Mitigation in the event that a grave was found would include following the appropriate exhumation process that should include a public consultation process if the grave is suspected to be historical. The impact significance after mitigation remains very low.

Potential impacts to the cultural landscape

Although impacts to the cultural landscape, in the form of the addition of features not considered generally compatible with a rural landscape, would definitely occur, the very limited heritage significance of this landscape and the current existence of a large substation and power lines means that the consequence is only seen as moderate. Although minimising the surface footprint and the amount of white structures visible would reduce impacts, they are considered to be of low significance both before and after mitigation.

8.1.2. Operation Phase

Operation phase impacts are assessed in Table 3. Because no changes to the substrate are expected during operation, impacts relate solely to the presence of the facility in the landscape.

Potential impacts to the cultural landscape

Although impacts would definitely occur if the facility is constructed, because the cultural landscape is only weakly developed and of low heritage significance, the overall impact significance is rated as

being low. The only reason they are not seen as very low is because of the long duration over which the impact would occur. After construction there is nothing that can be done by way of mitigation measures to further reduce impacts so no change to the significance assessment is required.

8.1.3. Decommissioning Phase

Decommissioning phase impacts are assessed in Table 4. Because no changes to undisturbed substrate are expected during decommissioning, impacts relate solely to the removal of the facility from the landscape and the subsequent rehabilitation period.

Potential impacts to the cultural landscape

The visual impact of the proposed solar energy facility would remain static until decommissioning. At this time, however, there would be an increased visual impact due to the equipment brought onto site to dismantle the plant and the rehabilitation work which would result in much dust. These impacts would, however, be temporary. After the decommissioning is complete, the landscape would then also be scarred but allowed to recover with time. The cleared but scarred landscape would result in less impacts than the actual dismantling of the plant so the assessment in Table 4 reflects the dismantling activities. While minimising the time taken to effect the decommissioning and employing dust suppression measures are appropriate mitigation measures, they are unlikely to result in any change in significance to the impact ratings. The impacts are deemed to be of low significance.

8.1.4. Cumulative impacts

Cumulative phase impacts are assessed in Table 5. They are effectively all the same impacts as would be experienced during the construction phase of the proposed project.

Potential impacts to archaeology

Archaeological resources are sparsely distributed on the wider landscape with important sites being rare. Nevertheless, direct impacts in the form of destruction of or damage to sites and materials may occur at any of the proposed facilities in the area, especially if construction machinery operates outside of the demarcated areas or if further as yet undiscovered archaeological sites are present. Because of the low likelihood of finding further significant archaeological resources in the relevant areas proposed for development and the generally low density of sites in the wider landscape the overall impacts to archaeology are expected to be of low significance before mitigation, even though one site of low-medium heritage significance does occur within the present project footprint. Potential mitigation measures include conducting final footprint surveys and then excavating or sampling any important archaeological material found to occur within the footprints, including the already known site affected by the present project. The chances of further such material being found, however, are considered to be small, even across multiple development areas. After mitigation, the overall impact significance would likely be very low. It is considered unlikely that the cumulative impacts to archaeological resources would differ if six or fourteen solar energy facilities were constructed in the area.

Potential impacts to palaeontology

The desktop study showed that the probability of finding and damaging or destroying significant palaeontological material during the constriction of renewable energy facilities in this area is extremely

unlikely. Areas in and along water course tend to be of slightly higher sensitivity but such areas are routinely avoided anyway during the formulation of development proposals. As such, the potential impacts to palaeontology are considered to be very low. The only measure that generally needs to be put in place is to ensure that the environmental control officer is alerted if any fossil material is found and that such material gets reported to SAHRA. A palaeontologist may need to inspect the find or conduct further research. The impact significance after mitigation remains very low. It is considered unlikely that the cumulative impacts to palaeontological resources would differ if six or fourteen solar energy facilities were constructed in the area.

Potential impacts to graves

The probability of uncovering graves during construction anywhere in the surrounding landscape is extremely unlikely. Despite their importance, the significance of potential impacts to graves is thus assessed to be very low. Mitigation in the event that a grave was found would include following the appropriate exhumation process that should include a public consultation process if the grave is suspected to be historical. The impact significance after mitigation remains very low. It is considered unlikely that the cumulative impacts to archaeological resources would differ much if six or fourteen solar energy facilities were constructed in the area. Given the difficulty in identifying graves, there is a small chance that a slightly greater impact could be experienced if fourteen facilities are built.

Potential impacts to the cultural landscape

Although impacts to the cultural landscape, in the form of the addition of features not considered generally compatible with a rural landscape, would definitely occur, the very limited heritage significance of this landscape means that the consequence is only seen as moderate. Although minimising the surface footprint and the amount of white structures visible would reduce impacts, they are considered to be of low significance both before and after mitigation. It is considered unlikely that the cumulative impacts to the cultural landscape would differ much if six or fourteen solar energy facilities were constructed in the area. This is mainly due to the quite isolated location of the Nieuwehoop Substation and the various projects proposed around it.

8.2. Levels of acceptable change

Any impact to an archaeological or palaeontological resource or a grave is deemed unacceptable until such time as the resource has been inspected and studied further if necessary. Impacts to the landscape are difficult to quantify but in general a development that visually dominates the landscape from many vantage points is undesirable. Because of the height of the majority of the proposed development, such an impact is not envisaged.

Table 2: Impact assessment summary table – Construction Phase direct impacts.

Aspect/ Impact pathway	Nature of potential impact/risk	Status	Spatial Extent	Duration	Consequence	Probability	Reversibility of impact	Irreplaceability of receiving environment/resource	Potential mitigation measures	Significance of impact/risk = consequence x probability		Ranking of impact/risk	Confidence level
										Without mitigation /management	With mitigation /management (residual risk/impact)		
Clearing of site and excavation of foundations and construction of the facility	**Loss of / damage to archaeological sites**	Negative	Site	Permanent	Severe	Very likely	Non-reversible	High	Final footprint survey, excavation if needed	Moderate	Very low	5	High
	Loss of / damage to palaeontological materials	Negative	Site	Permanent	Severe	Extremely unlikely	Non-reversible	High	Chance finds procedure	Very low	Very low	5	High
	Loss of / damage to graves	Negative	Site	Permanent	Extreme	Extremely unlikely	Non-reversible	High	Exhumation process	Very low	Very low	5	Medium
	Impacts to the cultural landscape	Negative	Local	Short term	Moderate	Very likely	High (rehabilitation after decommissioning)	High	Minimise footprint, minimise white-painted surfaces	Low	Low	4	High

Table 3: Impact assessment summary table – Operation Phase direct impacts.

Aspect/ Impact pathway	Nature of potential impact/risk	Status	Spatial Extent	Duration	Consequence	Probability	Reversibility of impact	Irreplaceability of receiving environment/resource	Potential mitigation measures	Significance of impact/risk = consequence x probability		Ranking of impact/risk	Confidence level
										Without mitigation /management	With mitigation /management (residual risk/impact)		
Presence of the solar energy facility on the landscape and occasional access by maintenance vehicles	**Impacts to the cultural landscape**	Negative	Local	Long term	Moderate	Very likely	High (rehabilitation after decommissioning)	High	None	Low	Low	4	High

Table 4: Impact assessment summary table – Decommissioning Phase direct impacts.

Aspect/ Impact pathway	Nature of potential impact/risk	Status	Spatial Extent	Duration	Consequence	Probability	Reversibility of impact	Irreplaceability of receiving environment/resource	Potential mitigation measures	Significance of impact/risk = consequence x probability		Ranking of impact/risk	Confidence level
										Without mitigation /management	With mitigation /management (residual risk/impact)		
Presence of the solar energy facility on the landscape, frequent access by construction vehicles, creation of dust and landscape scarring	**Impacts to the cultural landscape**	Negative	Local	Short term	Moderate	Very likely	High (rehabilitation after decommissioning)	High	Minimise work time, Use dust suppression measures	Low	Low	4	High

Table 5: Impact assessment summary table – Cumulative impacts

Aspect/ Impact pathway	Nature of potential impact/risk	Status	Spatial Extent	Duration	Consequence	Probability	Reversibility of impact	Irreplaceability of receiving environment/resource	Potential mitigation measures	Significance of impact/risk = consequence x probability		Ranking of impact/risk	Confidence level
										Without mitigation /management	With mitigation /management (residual risk/impact)		
Clearing of sites, excavation of foundations and construction of the facilities	**Loss of / damage to archaeological sites**	Negative	Site	Permanent	Severe	Very unlikely	Non-reversible	High	Final footprint survey, excavation if needed	Low	Very low	5	High
	Loss of / damage to palaeontological materials	Negative	Site	Permanent	Severe	Extremely unlikely	Non-reversible	High	Chance finds procedure	Very low	Very low	5	High
	Loss of / damage to graves	Negative	Site	Permanent	Extreme	Extremely unlikely	Non-reversible	High	Exhumation process	Very low	Very low	5	Medium
	Impacts to the cultural landscape	Negative	Local	Short term	Moderate	Very likely	High (rehabilitation after decommissioning)	High	Minimise footprint, minimise white-painted surfaces	Low	Low	4	High

9. LEGISLATIVE AND PERMIT REQUIREMENTS

Once Environmental Authorisation has been granted there are no further legal requirements that the developer has to meet so long as all conditions stipulated by the heritage authority have been complied with. If there is any archaeological mitigation work to be carried out then the appointed archaeologist would need to apply for and be granted a permit to allow them to carry out the work. This permit would be issued in the name of the archaeologist and it remains their responsibility to ensure that they have met the requirements that may be imposed on them as conditions on the permit. The permit application process allows the heritage authorities to ensure that a suitably qualified and experienced archaeologist undertakes the work and that the proposed excavation/sampling methodology is acceptable. The final comment issued by the heritage authority in response to the permit report would, however, still be needed by the developer to prove compliance with the heritage-related authorisation conditions.

In the event of any archaeological or palaeontological material or graves being exposed during construction it may be necessary for a specialist to apply for a permit as described above in order to effect rescue of the relevant material.

10. ENVIRONMENTAL MANAGEMENT PROGRAMME INPUTS

The EMPr should include all mitigation and management actions suggested in this report as well as make provision for further actions that may become necessary after a final 'walkdown' survey of the various project component footprints. Monitoring would entail the ECO ensuring that any protected sites remain undisturbed throughout the duration of the construction period.

10.1. Mitigation requirements

At this point there is just one archaeological site that would require mitigation prior to construction because it falls within the proposed development footprint and will very likely not be avoidable (Figure 26). No other significant sites were located within the project footprint. However, because it was not practical to conduct a comprehensive survey of the entire study area and the linear feature layouts were not available for field study, it is suggested that a pre-construction walk down survey be carried out during the design phase. The ECO will need to ensure that this survey is commissioned at least 6 months in advance of construction in order to allow for the mitigation process to be carried out as necessary.

10.2. Monitoring requirements

At this point there are no significant archaeological sites that would require *in situ* conservation during development. This means that no specific monitoring requirements can be posed. However, whenever the ECO is on site they should be aware of any potential heritage material that may still be undiscovered. Graves are the main potential issue here. Any such material found would require immediate *in situ* preservation and reporting to SAHRA.

Although the chances of locating palaeontological material are extremely small, the ECO should make staff aware of this possibility and ensure that a reporting procedure is followed. The 'Chance

Fossil Finds Procedure' include in the palaeontological specialist study (see Appendix 2) should be followed.

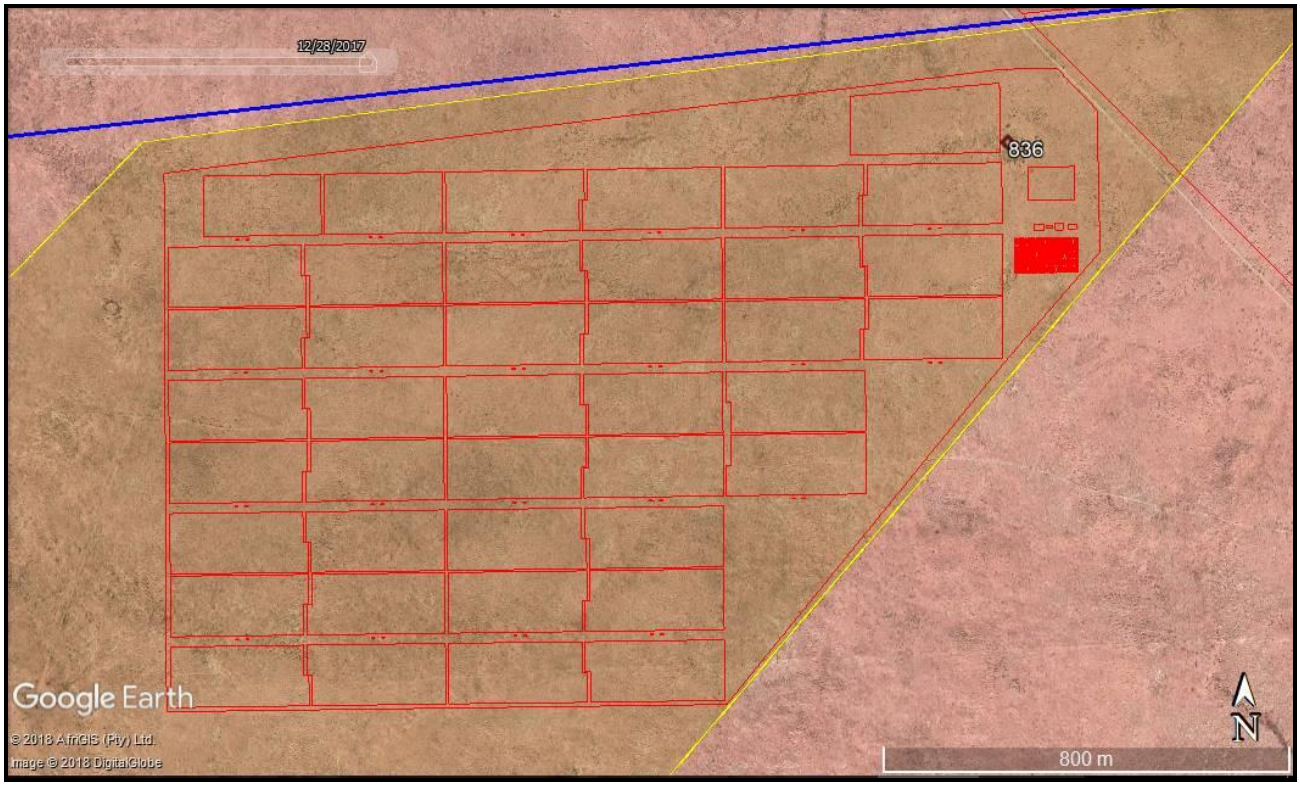


Figure 26: *Aerial view of the proposed development footprint (red outlines) showing the single heritage site requiring mitigation (waypoint 836). This is site GBB2017/001.*

11. EVALUATION OF IMPACTS RELATIVE TO SUSTAINABLE SOCIAL AND ECONOMIC BENEFITS

Section 38(3)(d) of the NHRA requires an evaluation of the impacts on heritage resources relative to the sustainable social and economic benefits to be derived from the development.

The provision of electricity is important to South Africa in terms of both growing the economy to provide jobs and providing electricity to households. Because no highly significant heritage resources would be impacted by the proposed development it is considered that the social and economic benefits outweigh any minor impacts to heritage, including those to the known site of low-medium heritage significance.

12. CONSULTATION WITH HERITAGE CONSERVATION BODIES

No formal consultation was carried out as part of this HIA because the report would be part of the legislated public participation process (PPP) that will be carried out as part of the EIA (see section 3.6 above).

13. CONCLUSIONS

Only one significant heritage resource has been identified in the vicinity of the proposed solar energy development. This is an archaeological site associated with a pan that has in the past been excavated deeper to improve its water catchment ability (Figure 25). The excavation has revealed ESA, MSA and LSA stone artefacts from beneath the surface of the pan. This site will need *in situ* conservation. Aside from this site, so long as a final walk down survey is carried out there are no reasons to prevent development of this site from proceeding. There is no favoured alternative in terms of access roads.

14. RECOMMENDATIONS

Because no highly significant impacts to heritage resources are envisaged, it is recommended that planning and construction of the proposed Skeerhok PV2 solar energy facility should be authorised but subject to the following conditions which should be incorporated into the Environmental Authorisation:

- The archaeological site at waypoint 836 (GBB2017/001) must be sampled if it cannot be avoided;
- Fencing around the facility is to be visually permeable;
- The use of white paint on structures should be minimised with earthy tones favoured;
- The archaeological site at SHK2017/003 should be cordoned off and all access to it prevented;
- A final archaeological walk down survey of both the facility footprint and any associated linear features must be carried out at least six months in advance of construction;
- Staff must be made aware of the small possibility of locating buried fossils and should this occur they must be left in place and immediately reported to the ECO and/or the heritage authorities; and
- If any archaeological material or human burials are uncovered during the course of development then work in the immediate area should be halted. The find would need to be reported to the heritage authorities and may require inspection by an archaeologist. Such heritage is the property of the state and may require excavation and curation in an approved institution.

15. REFERENCES

AngloBoerWar.com. 2015. South African Units: Border Scouts. Website accessed at http://www.angloboerwar.com/unit-information/south-african-units/301-border-scouts?showall=1&limitstart= on 6th November 2015.

Beaumont, P.B., Smith, A.B. & Vogel, J.C. 1995. Before the Einiqua: the archaeology of the frontier zone. In: Smith, A.B. (ed.) *Einiqualand: studies of the Orange River frontier*: 236-264. Cape Town: University of Cape Town Press.

Green Kalahari. n.d. Kenhardt attractions. Website accessed at http://www.greenkalahari.co.za/index.php/kenhardt/kenhardt-attractions on 6th November 2013.

Grobler, J.E.H. 2004. *The War Reporter*. Jeppestown: Jonathan Ball Publishers.

Heritage Western Cape. 2012. A short guide to and policy statement on grading. Version 6, 30th May 2012.

Louw Roux Bushmanland. 2013. Website accessed at http://www.bushmanland.co.za/Attractions.htm on 26th October 2015

Morris, D. 2009. Archaeological Specialist Input with regard to the proposed Aries-Garona Eskom Transmission Power Line, Northern Cape: Inspection along the transect between Tower Positions 1 and 146. Unpublished report prepared for Tswelopele Environmental. Kimberley: McGregor Museum.

Orton, J. 2013. Geometric rock art in western South Africa and its implications for the spread of early herding. *South African Archaeological Bulletin* 68: 27-40.

Orton, J. 2014a. Heritage impact assessment for the proposed Boven Solar PV1 Facility, Kenhardt Magisterial District, Northern Cape. Unpublished report prepared for the CSIR. Muizenberg: ASHA Consulting (Pty) Ltd.

Orton, J. 2014b. Heritage impact assessment for the proposed Gemsbok Solar PV1 Facility, Kenhardt Magisterial District, Northern Cape. Unpublished report prepared for the CSIR. Muizenberg: ASHA Consulting (Pty) Ltd.

Orton, J. 2014c. Heritage impact assessment for the proposed Gemsbok Solar PV2 Facility, Kenhardt Magisterial District, Northern Cape. Unpublished report prepared for the CSIR. Muizenberg: ASHA Consulting (Pty) Ltd.

Orton, J. 2016a. Archaeological mitigation for the proposed Konkoonsies II Solar Energy Facility, Kenhardt Magisterial District, Northern Cape. Unpublished report prepared for Ramizone (RF) (Pty) Ltd. Muizenberg: ASHA Consulting (Pty) Ltd.

Orton, J. 2016b. Heritage Impact Assessment Environmental Impact Assessment for the Proposed Development of a 75 MW Solar Photovoltaic Facility (Boven Solar PV2) on Gemsbok Bult 120/8, northeast of Kenhardt, Northern Cape Province. Unpublished report prepared for CSIR. Muizenberg: ASHA Consulting (Pty) Ltd.

Orton, J. 2016c. Heritage Impact Assessment Environmental Impact Assessment for the Proposed Development of a 75 MW Solar Photovoltaic Facility (Boven Solar PV3) on Gemsbok Bult 120/8, northeast of Kenhardt, Northern Cape Province. Unpublished report prepared for CSIR. Muizenberg: ASHA Consulting (Pty) Ltd.

Orton, J. 2016d. Heritage Impact Assessment Environmental Impact Assessment for the Proposed Development of a 75 MW Solar Photovoltaic Facility (Boven Solar PV4) on Gemsbok Bult

120/8, northeast of Kenhardt, Northern Cape Province. Unpublished report prepared for CSIR. Muizenberg: ASHA Consulting (Pty) Ltd.

Orton, J. 2016e. Heritage Impact Assessment Environmental Impact Assessment for the Proposed Development of a 75 MW Solar Photovoltaic Facility (Gemsbok Solar PV3) on Gemsbok Bult 120/8, northeast of Kenhardt, Northern Cape Province. Unpublished report prepared for CSIR. Muizenberg: ASHA Consulting (Pty) Ltd.

Orton, J. 2016f. Heritage Impact Assessment Environmental Impact Assessment for the Proposed Development of a 75 MW Solar Photovoltaic Facility (Gemsbok Solar PV4) on Gemsbok Bult 120/8, northeast of Kenhardt, Northern Cape Province. Unpublished report prepared for CSIR. Muizenberg: ASHA Consulting (Pty) Ltd.

Orton, J. 2016g. Heritage Impact Assessment Environmental Impact Assessment for the Proposed Development of a 75 MW Solar Photovoltaic Facility (Gemsbok Solar PV5) on Gemsbok Bult 120/8, northeast of Kenhardt, Northern Cape Province. Unpublished report prepared for CSIR. Muizenberg: ASHA Consulting (Pty) Ltd.

Orton, J. 2016h. Heritage Impact Assessment Environmental Impact Assessment for the Proposed Development of a 75 MW Solar Photovoltaic Facility (Gemsbok Solar PV6) on Gemsbok Bult 120/8, northeast of Kenhardt, Northern Cape Province. Unpublished report prepared for CSIR. Muizenberg: ASHA Consulting (Pty) Ltd.

Orton, J. 2016i. Prehistoric cultural landscapes in South Africa: a typology and discussion. *South African Archaeological Bulletin* 71: 119-129.

Orton, J. 2016j. Scoping and Environmental Impact Assessment for the proposed development of a 75 Mw Solar Photovoltaic Facility (Kenhardt PV 1) on the Remaining Extent of Onder Rugzeer Farm 168, North-East Of Kenhardt, Northern Cape Province: EIA Report - Heritage Impact Assessment. Unpublished report prepared for CSIR. Muizenberg: ASHA Consulting (Pty) Ltd.

Orton, J. 2016k. Scoping and Environmental Impact Assessment for the proposed development of a 75 Mw Solar Photovoltaic Facility (Kenhardt PV 2) on the Remaining Extent of Onder Rugzeer Farm 168, North-East Of Kenhardt, Northern Cape Province: EIA Report - Heritage Impact Assessment. Unpublished report prepared for CSIR. Muizenberg: ASHA Consulting (Pty) Ltd.

Orton, J. 2016l. Scoping and Environmental Impact Assessment for the proposed development of a 75 Mw Solar Photovoltaic Facility (Kenhardt PV 3) on the Remaining Extent of Onder Rugzeer Farm 168, North-East Of Kenhardt, Northern Cape Province: EIA Report - Heritage Impact Assessment. Unpublished report prepared for CSIR. Muizenberg: ASHA Consulting (Pty) Ltd.

Packenham, T. 1993. *The Boer War: illustrated edition.* Johannesburg: Jonathan Ball Publishers.

Rodgers, K. 2011. Cloth notes result of Boer War. *Bank Note Reporter* 2011.

APPENDIX 1 – Curriculum Vitae

Curriculum Vitae

Jayson David John Orton

ARCHAEOLOGIST AND HERITAGE CONSULTANT

Contact Details and personal information:

Address: 40 Brassie Street, Lakeside, 7945
Telephone: (021) 780 1219
Cell Phone: 083 272 3225
Email: jayson@asha-consulting.co.za

Birth date and place: 22 June 1976, Cape Town, South Africa
Citizenship: South African
ID no: 760622 522 4085
Driver's License: Code 08
Marital Status: Married to Carol Orton
Languages spoken: English and Afrikaans

Education:

SA College High School	Matric	1994
University of Cape Town	B.A. (Archaeology, Environmental & Geographical Science)	1997
University of Cape Town	B.A. (Honours) (Archaeology)*	1998
University of Cape Town	M.A. (Archaeology)	2004
University of Oxford	D.Phil. (Archaeology)	2013

*Frank Schweitzer memorial book prize for an outstanding student and the degree in the First Class.

Employment History:

Spatial Archaeology Research Unit, UCT	Research assistant	Jan 1996 – Dec 1998
Department of Archaeology, UCT	Field archaeologist	Jan 1998 – Dec 1998
UCT Archaeology Contracts Office	Field archaeologist	Jan 1999 – May 2004
UCT Archaeology Contracts Office	Heritage & archaeological consultant	Jun 2004 – May 2012
School of Archaeology, University of Oxford	Undergraduate Tutor	Oct 2008 – Dec 2008
ACO Associates cc	Associate, Heritage & archaeological consultant	Jan 2011 – Dec 2013
ASHA Consulting (Pty) Ltd	Director, Heritage & archaeological consultant	Jan 2014 –

Professional Accreditation:

Association of Southern African Professional Archaeologists (ASAPA) membership number: 233
CRM Section member with the following accreditation:

- Principal Investigator: Coastal shell middens (awarded 2007)
  Stone Age archaeology (awarded 2007)
  Grave relocation (awarded 2014)
- Field Director: Rock art (awarded 2007)
  Colonial period archaeology (awarded 2007)

Association of Professional Heritage Practitioners (APHP) membership number: 43

- Accredited Professional Heritage Practitioner

➢ *Memberships and affiliations:*

South African Archaeological Society Council member	2004 – 2016
Assoc. Southern African Professional Archaeologists (ASAPA) member	2006 –
UCT Department of Archaeology Research Associate	2013 –
Heritage Western Cape APM Committee member	2013 –
UNISA Department of Archaeology and Anthropology Research Fellow	2014 –
Fish Hoek Valley Historical Association	2014 –
Kalk Bay Historical Association	2016 –
Association of Professional Heritage Practitioners member	2016 –

Fieldwork and project experience:

Extensive fieldwork and experience as both Field Director and Principle Investigator throughout the Western and Northern Cape, and also in the western parts of the Free State and Eastern Cape as follows:

Feasibility studies:

- Heritage feasibility studies examining all aspects of heritage from the desktop

Phase 1 surveys and impact assessments:

- Project types
  - Notification of Intent to Develop applications (for Heritage Western Cape)
  - Desktop-based Letter of Exemption (for the South African Heritage Resources Agency)
  - Heritage Impact Assessments (largely in the Environmental Impact Assessment or Basic Assessment context under NEMA and Section 38(8) of the NHRA, but also self-standing assessments under Section 38(1) of the NHRA)
  - Archaeological specialist studies
  - Phase 1 archaeological test excavations in historical and prehistoric sites
  - Archaeological research projects
- Development types
  - Mining and borrow pits
  - Roads (new and upgrades)
  - Residential, commercial and industrial development
  - Dams and pipe lines
  - Power lines and substations
  - Renewable energy facilities (wind energy, solar energy and hydro-electric facilities)

Phase 2 mitigation and research excavations:

- ESA open sites
  - Duinefontein, Gouda, Namaqualand
- MSA rock shelters
  - Fish Hoek, Yzerfontein, Cederberg, Namaqualand
- MSA open sites
  - Swartland, Bushmanland, Namaqualand
- LSA rock shelters
  - Cederberg, Namaqualand, Bushmanland
- LSA open sites (inland)
  - Swartland, Franschhoek, Namaqualand, Bushmanland
- LSA coastal shell middens
  - Melkbosstrand, Yzerfontein, Saldanha Bay, Paternoster, Dwarskersbos, Infanta, Knysna, Namaqualand
- LSA burials
  - Melkbosstrand, Saldanha Bay, Namaqualand, Knysna
- Historical sites
  - Franschhoek (farmstead and well), Waterfront (fort, dump and well), Noordhoek (cottage), variety of small excavations in central Cape Town and surrounding suburbs
- Historic burial grounds
  - Green Point (Prestwich Street), V&A Waterfront (Marina Residential), Paarl

Awards:

Western Cape Government Cultural Affairs Awards 2015/2016: Best Heritage Project.

APPENDIX 2 – Palaeontological study

PALAEONTOLOGICAL HERITAGE DESKTOP INPUT:

Kenhardt PV Solar Energy Facility, Farms Gemsbok Bult 120 and 120/9 near Kenhardt, Northern Cape and associated powerline to the existing Nieuwehoop Substation

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December 2017

1. GEOLOGICAL CONTEXT

The study area for the proposed Kenhardt PV Solar Energy Facility on Gemsbok Bult Farm 120 and Farm 120/9, located some 40 km northeast of Kenhardt, is situated at an elevation of *c*. 1000 m amsl. in semi-arid, flat-lying terrain of the Bushmanland region of the Northern Cape (Northern Cape Pan Veld geomorphic region of Partridge *et al.* 2010). The region is drained by a dendritic network of shallow, southwesterly-flowing tributary streams of the Hartbeesrivier such as the Rugseersrivier and other unnamed drainage lines. The geology of the study area is shown on adjoining 1: 250 000 geology sheets 2920 Kenhardt and 2820 Upington (Council for Geoscience, Pretoria) (Figure 1). The entire area is underlain at depth by a variety of Precambrian basement rocks that are *c*. 2 billion years old and are assigned to the **Namaqua-Natal Province**. These ancient igneous and high-grade metamorphic rocks - mainly granites and gneisses of the **Keimoes Suite** (granitoids) *plus* high grade metasediments of the **Jacobmynspan Group** (*e.g.* gneisses of the **Sandnoute Formation**) – are listed in the legend to Figure 1. The various basement rock units are described in the Kenhardt and Upington 1: 250 000 sheet explanations by Slabbert *et al.* (1999) and Moen (2007) respectively and are placed in the context of the Namaqua-Natal Province by Cornell *et al.* (2006). They generally crop out as scattered, low surface exposures rather than elevated *koppies*. The Precambrian crustal rocks are transected by the NW-SE trending Boven Rugzeer Shear Zone which trends NW-SE to the southwest of the core solar development study area and will be transected by the associated powerline connection to Nieuwehoop Substation (Figure 2). The shear zone is a band of large-scale tectonic deformation which separates two major crustal blocks in Bushmanland known as the Kakamas Terrane and Areachap Terrane (Cornell *et al.* 2006, their fig. 18).

A large proportion of the basement rock outcrop in the PV Solar Energy Facility project area is mantled by a range of superficial sediments of Late Caenozoic age, some of which are included within the **Kalahari Group**. These predominantly thin, unconsolidated deposits include small patches of calcretes (soil limestones), gravelly to sandy river alluvium, pan sediments along certain watercourses, surface gravels as well as – especially – Quaternary to Recent aeolian (wind-blown) sands of the **Gordonia Formation** (**Kalahari Group**). The geology of the Late Cretaceous to Recent Kalahari Group is reviewed by Thomas (1981), Dingle *et al.* (1983), Thomas & Shaw (1991), Haddon (2000) and Partridge *et al.* (2006). The thickness of the unconsolidated Kalahari sands in the Bushmanland area is variable and often uncertain. The Gordonia Formation dune sands were previously considered to range in age from the Late Pliocene/Early Pleistocene to Recent, dated in part from enclosed Middle to Late Stone Age stone artefacts (Dingle *et al*., 1983, p. 291). Following the recent extension of the Pliocene - Pleistocene boundary from 1.8 Ma back

to 2.588 Ma the older Gordonia Formation sands are now dated to the Pleistocene Epoch. A number of older Kalahari formations underlie the young wind-blown surface sands in the main Kalahari depository to the north of the study area. However, at the latitude of the study area near Kenhardt (*c*. 29° S) Gordonia Formation sands less than 30 m thick are likely to be the main, or perhaps only, Kalahari sediments present (*cf* isopach map of the Kalahari Group, Figure 6 *in* Partridge *et al*., 2006). These unconsolidated sands will be locally underlain by thin subsurface gravels along the buried palaeosurface and also perhaps by calcretes of Pleistocene or younger age.

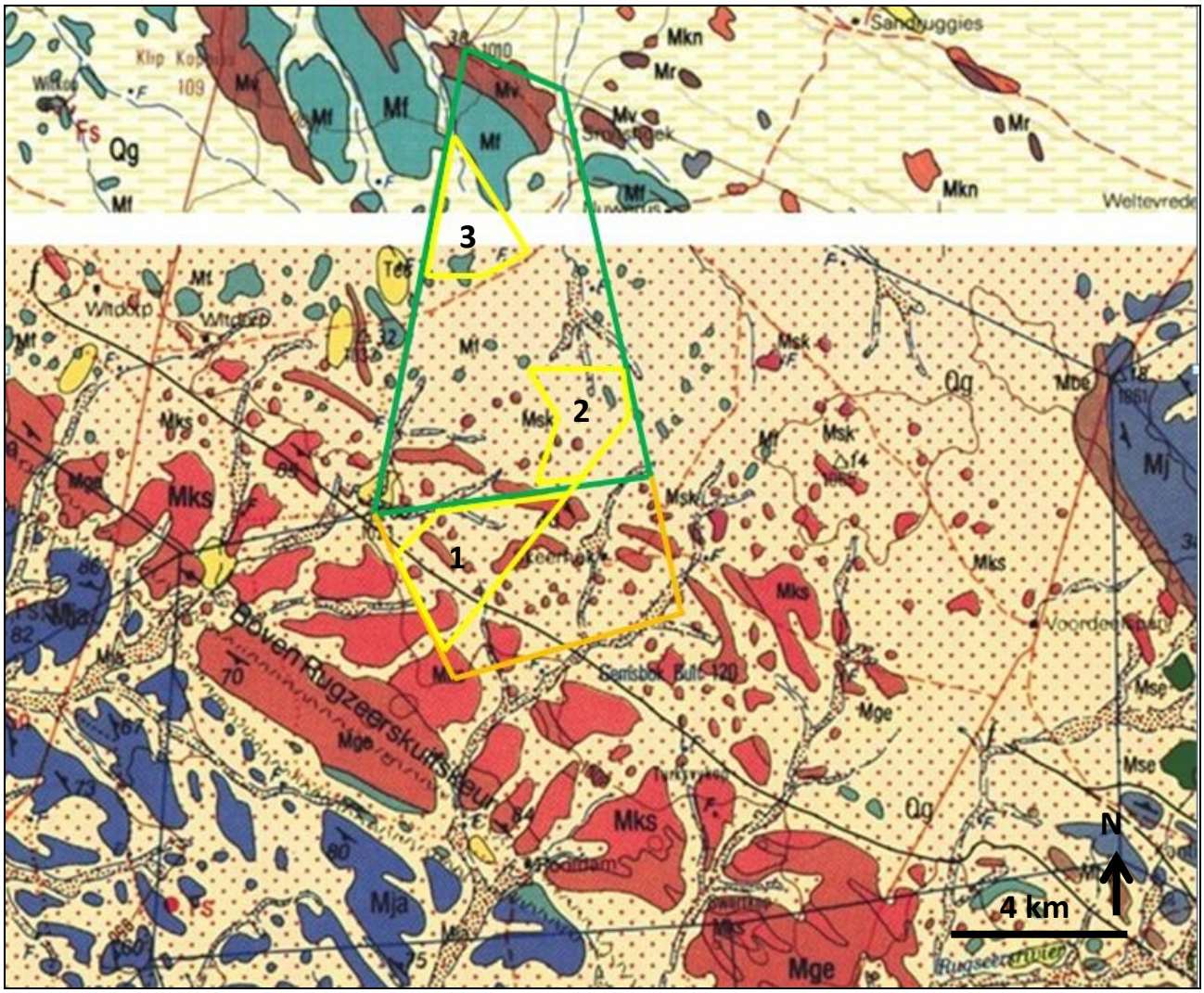

Figure 1. Extract from adjoining 1: 250 000 scale geological map sheets 2920 Kenhardt (below) and 2820 Upington (above) (Council for Geoscience, Pretoria) showing the geology of the Kenhardt PV Solar Energy Facility study area on Gemsbok Bult 120 (green polygon) and Gemsbok Bult 120/9 (orange polygon), situated *c*. 40 km to the NE of Kenhardt, Northern Cape. The three solar development areas under consideration (1, 2 and 3) are indicated by the small yellow polygons. The main geological units represented within the broader project area include:

PRECAMBRIAN BASEMENT ROCKS

KEIMOES SUITE

- **Brown (Mge) = Gemsbokbult Granite**

- **Dark brown (Mv) = Vaalputs Granite**
- **Red (Mks) = Klipkoppies Granite**
- **Red (Msk) = Skierhoek Granite**
- **Blue-grey (Mf) =Friersdale Charnockite**

JACOBMYNS PAN GROUP

- **Dark blue (Mja) = Jacobmyns Pan Group**

LATE CAENOZOIC SUPERFICIAL SEDIMENTS

- **Pale yellow with sparse red stipple or dashed ornament (Qg) = aeolian sands of the Gordonia Formation (Kalahari Group)**
- **Pale yellow with dense black stipple = alluvial and pan sediments**
- **Dark yellow (Tec) = calcrete**

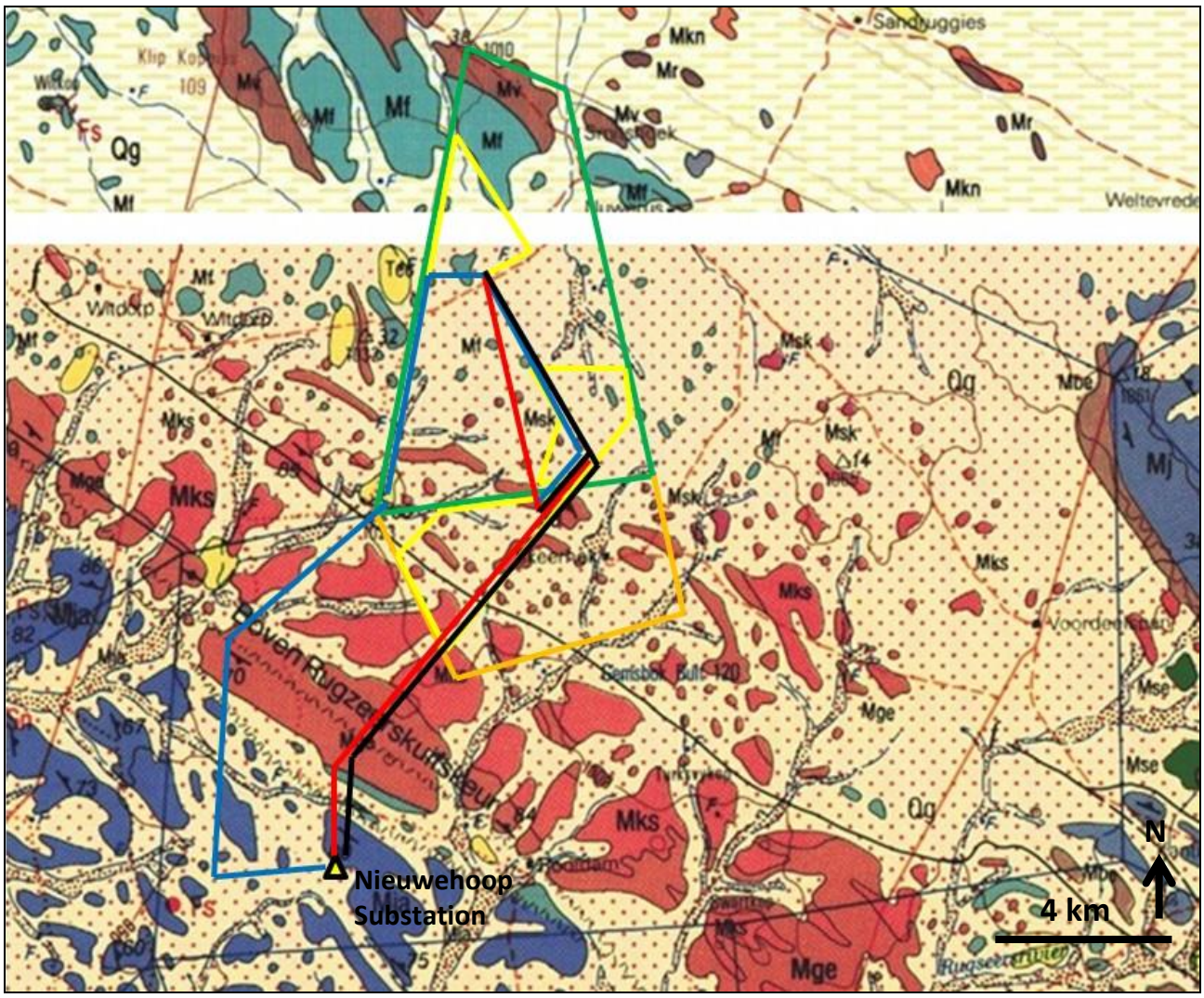

Figure 2. Extract from adjoining 1: 250 000 scale geological map sheets 2920 Kenhardt (below) and 2820 Upington (above) (Council for Geoscience, Pretoria) showing the geology of the study areas for the three power line route options (1- black; 2 – red; 3 – blue) between the Kenhardt PV solar development areas and the existing Nieuwehoop Substation. See legend to Figure 1 for a list of the relevant rock units.

2. PALAEONTOLOGICAL HERITAGE

The Precambrian basement rocks of the **Namaqua-Natal Province** represented within the study area are igneous and high grade metamorphic rocks that were last metamorphosed some 1 billion years ago and are entirely unfossiliferous.

The fossil record of the **Kalahari Group** as a whole is generally sparse and low in diversity; no fossils are recorded here in the Kenhardt and Upington geology sheet explanations by Slabbert *et al.* (1999) and Moen (2007). The Gordonia Formation dune sands were mainly active during cold, drier intervals of the Pleistocene Epoch that were inimical to most forms of life, apart from hardy, desert-adapted species. Porous dune sands are not generally conducive to fossil preservation. However, mummification of soft tissues may play a role here and migrating lime-rich groundwaters derived from underlying lime-rich bedrocks may lead to the rapid calcretisation of organic structures such as burrows and root casts. Occasional terrestrial fossil remains that might be expected within this unit include calcretized rhizoliths (root casts) and termitaria (*e.g. Hodotermes*, the harvester termite), ostrich egg shells (*Struthio*), tortoise remains and shells of land snails (*e.g. Trigonephrus*) (Almond in Macey *et al.* 2011, Almond & Pether 2008). Other fossil groups such as freshwater bivalves and gastropods (*e.g. Corbula, Unio*), ostracods (seed shrimps), charophytes (stonewort algae), diatoms (microscopic algae within siliceous shells) and stromatolites (laminated microbial limestones) are associated with local watercourses and pans. Microfossils such as diatoms may be blown by wind into nearby dune sands. These Kalahari fossils (or subfossils) can be expected to occur sporadically but widely, and the overall palaeontological sensitivity of the Gordonia Formation is therefore considered to be low. Underlying calcretes might also contain trace fossils such as rhizoliths, termite and other insect burrows, or even mammalian trackways. Mammalian bones, teeth and horn cores (also tortoise remains, and fish, amphibian or even crocodiles in wetter depositional settings) may be occasionally expected within Kalahari Group sediments and calcretes, notably those associated with ancient alluvial gravels. The younger (Pleistocene to Recent) fluvial and alluvial sands and gravels within the proposed development area are unlikely to contain many, if any, substantial fossil or subfossil remains.

It is concluded that both the Precambrian bedrocks and the Late Caenozoic superficial sediments underlying the study area are generally of ZERO to LOW palaeontological sensitivity, although isolated, and largely unpredictable, pockets of high sensitivity (*e.g.* mammalian remains) may occur sporadically (Table 1). Note that, to the author's knowledge, there are no fossil records from the broader Kenhardt PV Solar Energy Facili**ty** project area itself and no palaeontological fieldwork has been undertaken here.

Table 1: Fossil heritage recorded from the major rock units that are represented within the PV Solar Energy Facility study area near Kenhardt

GEOLOGICAL UNIT	ROCK TYPES AND AGE	FOSSIL HERITAGE	PALAEONT-OLOGICAL SENSITIVITY
LATE CAENOZOIC SUPERFICIAL SEDIMENTS, **especially** **ALLUVIAL AND PAN SEDIMENTS**	**fluvial, pan, lake and terrestrial sediments, including diatomite (diatom deposits), pedocretes (*e.g.* calcrete), colluvium (slope deposits such as scree), aeolian sands (Gordonia Formation, Kalahari Group)** **LATE TERTIARY, PLEISTOCENE TO RECENT**	**bones and teeth of wide range of mammals (*e.g.* mastodont proboscideans, rhinos, bovids, horses, micromammals), fish, reptiles (crocodiles, tortoises), ostrich egg shells, fish, freshwater and terrestrial molluscs (unionid bivalves, gastropods), crabs, trace fossils (*e.g.* calcretised termitaria, horizontal invertebrate burrows, stone artefacts), petrified wood, leaves, rhizoliths, stromatolites, diatom floras, peats and palynomorphs.**	**GENERALLY LOW BUT LOCALLY HIGH** **(*e.g.* Tertiary alluvium associated with large old river courses)**
Basement granites and gneisses **NAMAQUA-NATAL PROVINCE**	**Highly-metamorphosed sediments, intrusive granites** **PRECAMBRIAN / MID-PROTEROZOIC (*c.*1- 2 billion years old)**	**None**	**ZERO**

3. CONCLUSIONS

- **Solar Development Areas**

Area 1: The area is underlain at depth by unfossiliferous Precambrian basement rocks of the Namaqua-Natal Province (*e.g.* Klipkoppies and Gemsbokbult Granites) as well as Late Caenozoic superficial sediments (Kalahari sands, alluvium, surface gravels) that are, at most, very sparsely fossiliferous (Fig. 1). The palaeontological sensitivity of the area is accordingly VERY LOW, as is the impact significance of the proposed small-scale PV solar development. Pending the discovery of fossil material within the development footprint before or during the development phase (See appended Fossil Chance Finds Procedure), no further specialist palaeontological studies or mitigation are recommended for this project.

Area 2: The area is underlain at depth by unfossiliferous Precambrian basement rocks of the Namaqua-Natal Province (*e.g.* Skierhoek Granite, Friersdale Charnockite) as well as Late Caenozoic superficial sediments (Kalahari sands, alluvium, surface gravels) that are, at most, very sparsely fossiliferous (Fig. 1). The palaeontological sensitivity of the area is accordingly VERY LOW, as is the impact significance of the proposed small-scale PV solar development. Pending the

discovery of fossil material within the development footprint before or during the development phase (See appended Fossil Chance Finds Procedure), no further specialist palaeontological studies or mitigation are recommended for this project.

Area 3: The area is underlain at depth by unfossiliferous Precambrian basement rocks of the Namaqua-Natal Province (*e.g.* Friersdale Charnockite) as well as Late Caenozoic superficial sediments (Kalahari sands, alluvium, surface gravels) that are, at most, very sparsely fossiliferous (Fig. 1). The palaeontological sensitivity of the area is accordingly VERY LOW, as is the impact significance of the proposed small-scale PV solar development. Pending the discovery of fossil material within the development footprint before or during the development phase (See appended Fossil Chance Finds Procedure), no further specialist palaeontological studies or mitigation are recommended for this project.

- **Powerline route options**

All three powerline route options traverse broadly similar geological terrain comprising a range a Precambrian igneous and metamorphic rocks of the Namaqua-Natal Province that are extensively mantled by Late Caenozoic superficial sediments such as Kalahari sands, alluvium and surfacegravels. The palaeontological sensitivity of all the powerline route option corridors underconsideration is equally VERY LOW, as is the impact significance of the proposed small-scale powerline development. There is no preference on fossil heritage grounds for any particular route option. Pending the discovery of fossil material within the development footprint before or during the development phase (See appended Fossil Chance Finds Procedure), no further specialist palaeontological studies or mitigation are recommended for this project.

Cumulative impact significance

Several previous desktop palaeontological heritage studies submitted for alternative energy projects in the area northeast of Kenhardt have concluded that the impact significance of developments in this area is negligible to very low as far as fossil heritage is concerned (See reports by Almond under references). The potentially-fossiliferous Late Caenozoic sedimentary units represented here are generally of widespread occurrence in Bushmanland. It is concluded that the anticipated cumulative impact of the proposed new solar PV projects in the context of other alternative energy developments in the region is of LOW significance.

REFERENCES

ALMOND, J.E. 2008a. Fossil record of the Loeriesfontein sheet area (1: 250 000 geological sheet 3018). Unpublished report for the Council for Geoscience, Pretoria, 32 pp.

ALMOND, J.E. 2009. Contributions to the palaeontology and stratigraphy of the Alexander Bay sheet area (1: 250 000 geological sheet 2816), 117 pp. Unpublished technical report prepared for the Council for Geoscience by Natura Viva cc, Cape Town.

ALMOND, J.E. 2011. Proposed Solar Cape Photovoltaic Electricity Generation Facility near Kenhardt, Northern Cape Province. Palaeontological impact assessment: desktop study, 18 pp. Natura Viva cc, Cape Town.

ALMOND, J.E. 2014a. Proposed Exheredo CSP and PV solar energy facilities on the farm Styns Vley 280 near Kenhardt, Northern Cape Province. Palaeontological heritage assessment: desktop study, 28 pp. Natura Viva cc, Cape Town.

ALMOND, J.E. 2014b. Proposed Exheredo CSP and PV solar energy facilities near Kenhardt, Northern Cape Province. Palaeontological heritage assessment: combined desktop & field-based study, 61 pp. Natura Viva cc, Cape Town.

ALMOND, J.E. 2014c. Proposed Gemsbok Solar PV1 Solar Energy Facility near Kenhardt, Northern Cape Province. Desktop study, 21 pp. Natura Viva cc, Cape Town.

ALMOND, J.E. 2014d. Proposed Boven Solar PV1 Solar Energy Facility near Kenhardt, Northern Cape Province. Desktop study, 21 pp. Natura Viva cc, Cape Town.

ALMOND, J.E. 2016a. Palaeontological impact assessment: Environmental Impact Assessment for the Proposed Development of a 75 MW Solar Photovoltaic Facility (GEMSBOK SOLAR PV3) on Portion 3 of Gemsbok Bult Farm 120, north-east of Kenhardt, Northern Cape Province, 23 pp. Natura Viva cc, Cape Town.

ALMOND. J.E. 2016b. Proposed AMDA Charlie Solar PV development on Portion 1 of N'rougas Zuid No 121, Kenhardt Registration Division, Northern Cape. Recommended exemption from further palaeontological studies, 7 pp. Natura Viva cc, Cape Town.

ALMOND, J.E. & PETHER, J. 2008. Palaeontological heritage of the Northern Cape. Interim SAHRA technical report, 124 pp. Natura Viva cc., Cape Town.

BAMFORD, M.K. 2000. Cenozoic macro-plants. In: Partridge, T.C. & Maud, R.R. (Eds.) The Cenozoic of southern Africa, pp.351-356. Oxford University Press, Oxford.

BAMFORD, M.K. & DE WIT, M.C.J. 1993. Taxonomic description of fossil wood from Cainozoic Sak River terraces, near Brandvlei, Bushmanland, South Africa. Palaeontologia africana 30: 71-80.

BENDER, P.A. & BRINK, J.S. 1992. A preliminary report on new large mammal fossil finds from the Cornelia-Uitzoek site. South African Journal of Science 88: 512-515.

BOUSMAN, C.B. et al. 1988. Palaeoenvironmental implications of Late Pleistocene and Holocene valley fills in Blydefontein Basin, Noupoort, C.P., South Africa. Palaeoecology of Africa 19: 43-67.

BRINK, J.S. 1987. The archaeozoology of Florisbad, Orange Free State. Memoirs van die Nasionale Museum 24, 151 pp.

BRINK, J.S. *et al.* 1995. A new find of *Megalotragus priscus* (Alcephalini, Bovidae) from the Central Karoo, South Africa. Palaeontologia africana 32: 17-22.

BRINK, J.S. & ROSSOUW, L. 2000. New trial excavations at the Cornelia-Uitzoek type locality. Navorsinge van die Nasionale Museum Bloemfontein 16, 141-156.

BUTZER, K.W., HELGREN, D.M., FOCK, G. & STUCKENRATH, R. 1973. Alluvial terraces of the Lower Vaal River, South Africa: a re-appraisal and re-investigation. Journal of geololgy 81, 341-362.

CHURCHILL, S.E. et al. 2000. Erfkroon: a new Florisian fossil locality from fluvial contexts in the western Free State, South Africa. South African Journal of Science 96: 161-163.

COOKE, H.B.S. 1949. Fossil mammals of the Vaal River deposits. Memoirs of the geological Survey of South Africa 35, 1-117.

CORNELL, D.H., THOMAS, R.J., MOEN, H.F.G., REID, D.L., MOORE, J.M. & GIBSON, R.L. 2006. The Namaqua-Natal Province. In: Johnson, M.R., Anhaeusser, C.R. & Thomas, R.J. (Eds.) The geology of South Africa, pp. 461-499. Geological Society of South Africa, Marshalltown.

DE WIT, M.C.J. 1990. Palaeoenvironmental interpretation of Tertiary sediments at Bosluispan, Namaqualand. Palaeoecology of Africa and the surrounding islands 21: 101-118.

DE WIT, M.C.J. 1993. Cainozoic evolution of drainage systems in the north-western Cape. Unpublished PhD thesis, University of Cape Town, Cape Town, 371 pp.
DE WIT, M.C.J. 1999. Post-Gondwana drainage and the development of diamond placers in western South Africa. Economic Geology 94: 721-740.

DE WIT, M.C.J. & BAMFORD, M.K. 1993. Fossil wood from the Brandvlei area, Bushmanland as an indication of palaeoenvironmental changes during the Cainozoic. Palaeontologia africana 30: 81-89.

DE WIT, M.C.J., MARSHALL, T.R. & PARTRIDGE, T.C. 2000. Fluvial deposits and drainage evolution. In: Partridge, T.C. & Maud, R.R. (Eds.) The Cenozoic of southern Africa, pp.55-72. Oxford University Press, Oxford.

DINGLE, R.V., SIESSER, W.G. & NEWTON, A.R. 1983. Mesozoic and Tertiary geology of southern Africa. viii + 375 pp. Balkema, Rotterdam.

DU TOIT, A. 1954. The geology of South Africa. xii + 611pp, 41 pls. Oliver & Boyd, Edinburgh.

HADDON, I.G. 2000. Kalahari Group sediments. In: Partridge, T.C. & Maud, R.R. (Eds.) The Cenozoic of southern Africa, pp. 173-181. Oxford University Press, Oxford.

HELGREN, D.M. 1977. Geological context of the Vaal River faunas. South African Journal of Science 73, 303-307.

KIBERD, P. 2006. Bundu Farm: a report on archaeological and palaoenvironmental assemblages from a pan site in Bushmanland, Northern Cape, South Africa. South African Archaeological Bulletin 61, 189-201.

KLEIN, R. 1980. Environmental and ecological implications of large mammals from Upper Pleistocene and Hoocene sites in southern Africa. Annals of the South African Museum 81, 223-283.

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

KLEIN, R. 2000. The Earlier Stone Age in southern Africa. The South African Archaeological Bulletin 40, 107-122.

MACEY, P.H., SIEGFRIED, H.P., MINNAAR, H., ALMOND, J. AND BOTHA, P.M.W. 2011. The geology of the Loeriesfontein Area. Explanation to 1: 250 000 Geology Sheet 3018 Loeriesfontein, 139 pp. Council for Geoscience, Pretoria.

MACRAE , C. 1999. Life etched in stone. Fossils of South Africa. 305 pp. The Geological Society of South Africa, Johannesburg.

MEADOWS, M.E. & WATKEYS, M.K. 1999. Palaeoenvironments. In: Dean, W.R.J. & Milton, S.J. (Eds.) The karoo. Ecological patterns and processes, pp. 27-41. Cambridge University Press, Cambridge.

MOEN, H.F.G. 2007. The geology of the Upington area. Explanation to 1: 250 000 geology Sheet 2820 Upington, 160 pp. Council for Geoscience, Pretoria.

ORTON, J. 2012. Heritage impact assessment for a proposed solar energy facility on the farm Hoekplaas near Copperton, Northern Cape, 32 pp. Archaeology Contracts Office, University of Cape Town, Cape Town.

PARTRIDGE, T.C. & SCOTT, L. 2000. Lakes and Pans. In: Partridge, T.C. & Maud, R.R. (Eds.) The Cenozoic of southern Africa, pp.145-161. Oxford University Press, Oxford.

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

PARTRIDGE, T.C., DOLLAR, E.S.J., MOOLMAN, J. & DOLLAR, L.H. 2010. The geomorphic provinces of South Africa, Lesotho and Swaziland: a physiographic subdivision for earth and environmental scientists. Transactions of the Royal Society of South Africa 65, 1-47.

PICKFORD, M. & SENUT, B. 2002. The fossil record of Namibia. 39 pp. The Geological Survey of Namibia.

ROSSOUW, L. 2006. Florisian mammal fossils from erosional gullies along the Modder River at Mitasrust Farm, Central Free State, South Africa. Navorsinge van die Nasionale Museum Bloemfontein 22, 145-162.

SAHRA 2013. Minimum standards: palaeontological component of heritage impact assessment reports, 15 pp. South African Heritage Resources Agency, Cape Town.

SCHNEIDER, G. & MARAIS, C. 2004. Passage through time. The fossils of Namibia. 158 pp. Gamsberg MacMillan, Windhoek.

SCOTT, L. 2000. Pollen. In: Partridge, T.C. & Maud, R.R. (Eds.) The Cenozoic of southern Africa, pp.339-35. Oxford University Press, Oxford.

SENUT, B., PICKFORD, M., WARD, J., DE WIT, M., SPAGGIARI, R. & MORALES, J. 1996. Biochronology of the Cainozoic sediments at Bosluis Pan, Northern Cape Province, South Africa. South African Journal of Science 92: 249-251.

SIEBRITS, L.B. 1989. Die geologie van die gebied Sakrivier. Explanation of 1: 250 000 geology sheet 3020, 19 pp. Council for Geoscience, Pretoria.

SKEAD, C.J. 1980. Historical mammal incidence in the Cape Province. Volume 1: The Western and Northern Cape, 903pp. Department of Nature and Environmental Conservation, Cape Town.

SLABBERT, M.J., MOEN, H.F.G. & BOELEMA, R. 1999. Die geologie van die gebied Kenhardt. Explanation to 1: 250 000 geology Sheet 2920 Kenhardt, 123 pp. Council for Geoscience, Pretoria.

SMITH, A.B. 1999. Hunters and herders in the Karoo landscape. Chapter 15 in Dean, W.R.J. & Milton, S.J. (Eds.) The Karoo; ecological patterns and processes, pp. 243-256. Cambridge University Press, Cambridge.

THOMAS, M.J. 1981. The geology of the Kalahari in the Northern Cape Province (Areas 2620 and 2720). Unpublished MSc thesis, University of the Orange Free State, Bloemfontein, 138 pp.

THOMAS, R.J., THOMAS, M.A. & MALHERBE, S.J. 1988. The geology of the Nossob and Twee Rivieren areas. Explanation for 1: 250 000 geology sheets 2520-2620. 17pp. Council for Geoscience, Pretoria.

THOMAS, D.S.G. & SHAW, P.A. 1991. The Kalahari environment, 284 pp. Cambridge University Press.

WELLS, L.H. 1964. The Vaal River 'Younger Gravels" faunal assemblage: a revised list. South African Journal of Science 60, 92-94.

QUALIFICATIONS & EXPERIENCE OF THE AUTHOR

Dr John Almond has an Honours Degree in Natural Sciences (Zoology) as well as a PhD in Palaeontology from the University of Cambridge, UK. He has been awarded post-doctoral research fellowships at Cambridge University and in Germany, and has carried out palaeontological research in Europe, North America, the Middle East as well as North and South Africa. For eight years he was a scientific officer (palaeontologist) for the Geological Survey / Council for Geoscience in the RSA. His current palaeontological research focuses on fossil record of the Precambrian - Cambrian boundary and the Cape Supergroup of South Africa. He has recently written palaeontological reviews for several 1: 250 000 geological maps published by the Council for Geoscience and has contributed educational material on fossils and evolution for new school textbooks in the RSA.

Since 2002 Dr Almond has also carried out palaeontological impact assessments for developments and conservation areas in the Western, Eastern and Northern Cape, Limpopo, Gauteng, KwaZulu-Natal, Mpumalanga, Northwest and Free State under the aegis of his Cape Town-based company *Natura Viva* cc. He has been a long-standing member of the Archaeology, Palaeontology and Meteorites Committee for Heritage Western Cape (HWC) and an advisor on palaeontological conservation and management issues for the Palaeontological Society of South Africa (PSSA), HWC and SAHRA. He is currently compiling technical reports on the provincial palaeontological heritage of Western, Northern and Eastern Cape for SAHRA and HWC. Dr Almond is an accredited member of PSSA and APHP (Association of Professional Heritage Practitioners – Western Cape).

Declaration of Independence

I, John E. Almond, declare that I am an independent consultant and have no business, financial, personal or other interest in the proposed project, application or appeal in respect of which I was appointed other than fair remuneration for work performed in connection with the activity, application or appeal. There are no circumstances that compromise the objectivity of my performing such work.

Dr John E. Almond
Palaeontologist
Natura V

<table>
<tr><td colspan="3">CHANCE FOSSIL FINDS PROCEDURE: Kenhardt PV Solar Energy Facility, Farms Gemsbok Bult 120 and 120/9 near Kenhardt, Northern Cape and associated powerline to the existing Nieuwehoop Substation</td></tr>
<tr><td>Province & region:</td><td colspan="2">NORTHERN CAPE, KENHARDT DISTRICT</td></tr>
<tr><td>Responsible Heritage Resources Authority</td><td colspan="2">SAHRA, 111 Harrington Street, Cape Town. PO Box 4637, Cape Town 8000, South Africa.
Phone: +27 (0)21 462 4502. Fax: +27 (0)21 462 4509. Web: www.sahra.org.za</td></tr>
<tr><td>Rock unit(s)</td><td colspan="2">Kalahari Group (esp. Gordonia Formation sands, alluvial and pan deposits, calcretes)</td></tr>
<tr><td>Potential fossils</td><td colspan="2">bones and teeth of mammals, fish, reptiles, ostrich egg shells, fish, freshwater and terrestrial molluscs, crabs, trace fossils (e.g. calcretised termitaria, horizontal invertebrate burrows, stone artefacts), petrified wood, leaves, rhizoliths, stromatolites, diatom floras, peats and palynomorphs.</td></tr>
<tr><td rowspan="4">ECO protocol</td><td colspan="2">1. Once alerted to fossil occurrence(s): alert site foreman, stop work in area immediately (N.B. safety first!), safeguard site with security tape / fence / sand bags if necessary.</td></tr>
<tr><td colspan="2">2. Record key data while fossil remains are still in situ:
• Accurate geographic location – describe and mark on site map / 1: 50 000 map / satellite image / aerial photo
• Context – describe position of fossils within stratigraphy (rock layering), depth below surface
• Photograph fossil(s) in situ with scale, from different angles, including images showing context (e.g. rock layering)</td></tr>
<tr><td>3. If feasible to leave fossils in situ:
• Alert Heritage Resources Authority and project palaeontologist (if any) who will advise on any necessary mitigation
• Ensure fossil site remains safeguarded until clearance is given by the Heritage Resources Authority for work to resume</td><td>3. If not feasible to leave fossils in situ (emergency procedure only):
• Carefully remove fossils, as far as possible still enclosed within the original sedimentary matrix (e.g. entire block of fossiliferous rock)
• Photograph fossils against a plain, level background, with scale
• Carefully wrap fossils in several layers of newspaper / tissue paper / plastic bags
• Safeguard fossils together with locality and collection data (including collector and date) in a box in a safe place for examination by a palaeontologist
• Alert Heritage Resources Authority and project palaeontologist (if any) who will advise on any necessary mitigation</td></tr>
<tr><td colspan="2">4. If required by Heritage Resources Authority, ensure that a suitably-qualified specialist palaeontologist is appointed as soon as possible by the developer.</td></tr>
</table>

	5. Implement any further mitigation measures proposed by the palaeontologist and Heritage Resources Authority
Specialist palaeontologist	Record, describe and judiciously sample fossil remains together with relevant contextual data (stratigraphy / sedimentology / taphonomy). Ensure that fossils are curated in an approved repository (e.g. museum / university / Council for Geoscience collection) together with full collection data. Submit Palaeontological Mitigation report to Heritage Resources Authority. Adhere to best international practice for palaeontological fieldwork and Heritage Resources Authority minimum standards.