HERITAGE IMPACT ASSESSMENT FOR THE PROPOSED SOL INVICTUS 1 PV FACILITY, NAMAKWALAND MAGISTERIAL DISTRICT, NORTHERN CAPE

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

Report for:

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EXECUTIVE SUMMARY

ASHA Consulting (Pty) Ltd was appointed by Savannah Environmental (Pty) Ltd to conduct an assessment of the potential impacts to heritage resources that might occur through the proposed construction, operation and decommissioning of the Sol Invictus 1 PV facility. The project would be built on Portion 5 of the farm Ou Taaibosmond 66 which is located some 25 km to the west-southwest of Aggeneys and 75 km to the east-northeast of Springbok in the Northern Cape.

The development would comprise of an array of PV solar panels and associated infrastructure which would include access roads, foundations, cables, battery storage, onsite inverters and substation, batching plant and a laydown area.

The scoping study showed that significant palaeontological resources will not be impacted and these have therefore not been considered further. Within the footprint area the archaeological survey revealed a single quartz outcrop that had had a few flakes removed from it. It is of very low cultural significance. In addition a small scatter of rocks was noted that could represent a grave. However, the specific context of the rocks suggested a very low probability of a grave being present. The potential impacts have thus been rated as of low significance. The natural and cultural landscape, however, is a more important heritage resource and impacts to the landscape could be of medium significance before mitigation. However, with mitigation low significance impacts are expected. The site is 4 km from the N14 road and visibility of the proposed development will thus be low.

The impacts to heritage resources are thus of low significance and entirely manageable. No archaeological mitigation is required but a few other mitigation and management measures have been suggested to reduce the potential impacts to archaeology, graves and the landscape.

It is recommended from a heritage point of view that the proposed Sol Invictus 1 PV facility be authorised in its present footprint. The following conditions should be included in the environmental authorisation:

- 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;
- The construction footprint should be kept as small as possible with no activities allowed to occur outside of the authorised area;
- Where feasible, built elements should be painted in earthy colours; and
- Security lighting should be restricted as far as possible and directed downwards to reduce light pollution in the landscape.

Glossary

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

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

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

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.

Palimpsest: An archaeological site that has been occupied on multiple occasions but all the material remains of those occupations have been deposited on a single surface and are largely indistinguishable from one another.

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

Scraper: A stone tool with retouch along one or more margins that produces a working edge typically between about 30° and 60° but sometimes even steeper.

Abbreviations

APHP: Association of Professional Heritage Practitioners

ASAPA: Association of Southern African Professional Archaeologists

BAR: Basic Assessment Report

CCS: Crypto-crystalline silica

CRM: Cultural Resources Management

DEA: Department of Environmental Affairs

EIA: Environmental Impact Assessment

ESA: Early Stone Age

GPS: global positioning system

HIA: Heritage Impact Assessment

LSA: Later Stone Age

MSA: Middle Stone Age

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

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

NID: Notification of Intent to Develop

SAHRA: South African Heritage Resources Agency

SAHRIS: South African Heritage Resources Information System

Contents

1. INTRODUCTION

ASHA Consulting (Pty) Ltd was appointed by Savannah Environmental (Pty) Ltd to conduct an assessment of the potential impacts to heritage resources that might occur through the proposed construction, operation and decommissioning of the Sol Invictus 1 PV facility. The project would be built on Portion 5 of the farm Ou Taaibosmond 66 which is located some 25 km to the west-southwest of Aggeneys and 75 km to the east-northeast of Springbok in the Northern Cape (Figure 1). Portion 5 is 5000 ha in extent and the development would cover approximately 450 ha.

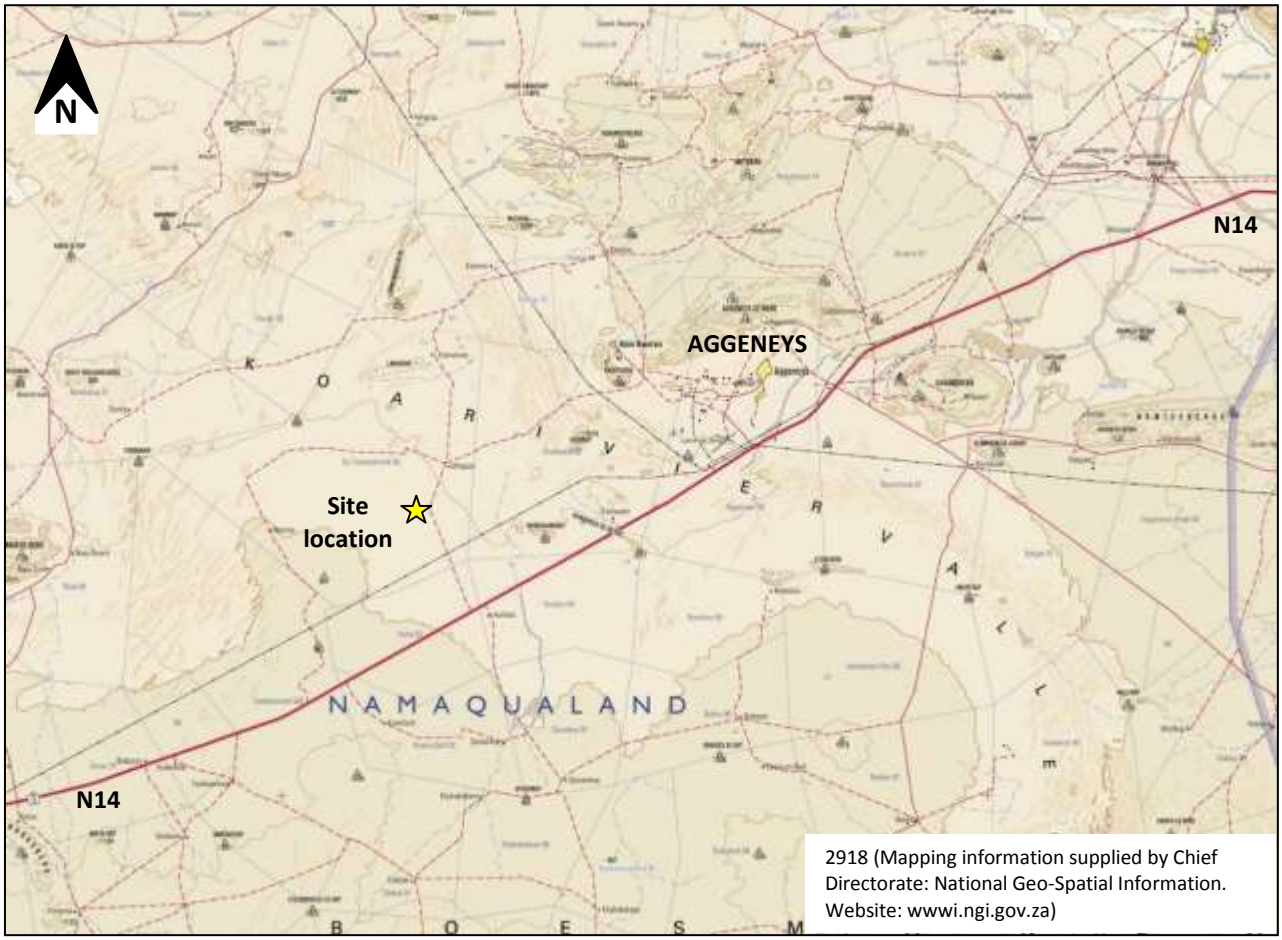

Figure 1: *Map showing the location of the site.*

1.1. Project description

The PV facility will include the following infrastructure:

- Arrays of PV panels with a capacity of up to 150 MW and covering up to 450 ha of land;
- Mounting structures to support the PV panels;
- Cabling between the project components, to be laid underground where practical;
- On-site inverters to convert the power from a direct current (DC) to an alternating current (AC) and an on-site substation to facilitate the connection between the solar energy facility and the Eskom electricity grid;
- Internal access roads, offices and workshop areas for maintenance and storage;
- Temporary laydown areas; and
- The associated infrastructure for the Sol Invictus 1 PV facility will include 33/220kV transformers and a new 220 kV double circuit line from the PV substation, the 220 kV double circuit line will loop in and loop out of the Aggeneis-Nama 220 kV power line, which runs along

the southern boundary of the project area to the Aggeneis Substation. A battery storage mechanism with a storage capacity of 300MWh will also be included for the PV facility.

An alternative of connecting the aforementioned PV facility via a 33 kV overhead line to a collector substation, as shared infrastructure, and then connecting to the Eskom Aggeneis Substation via a double circuit 132 kV overhead line will be assessed through a Basic Assessment Process (BAR).a separate application for environmental authorisation. This alternative is presented in Figure 2.

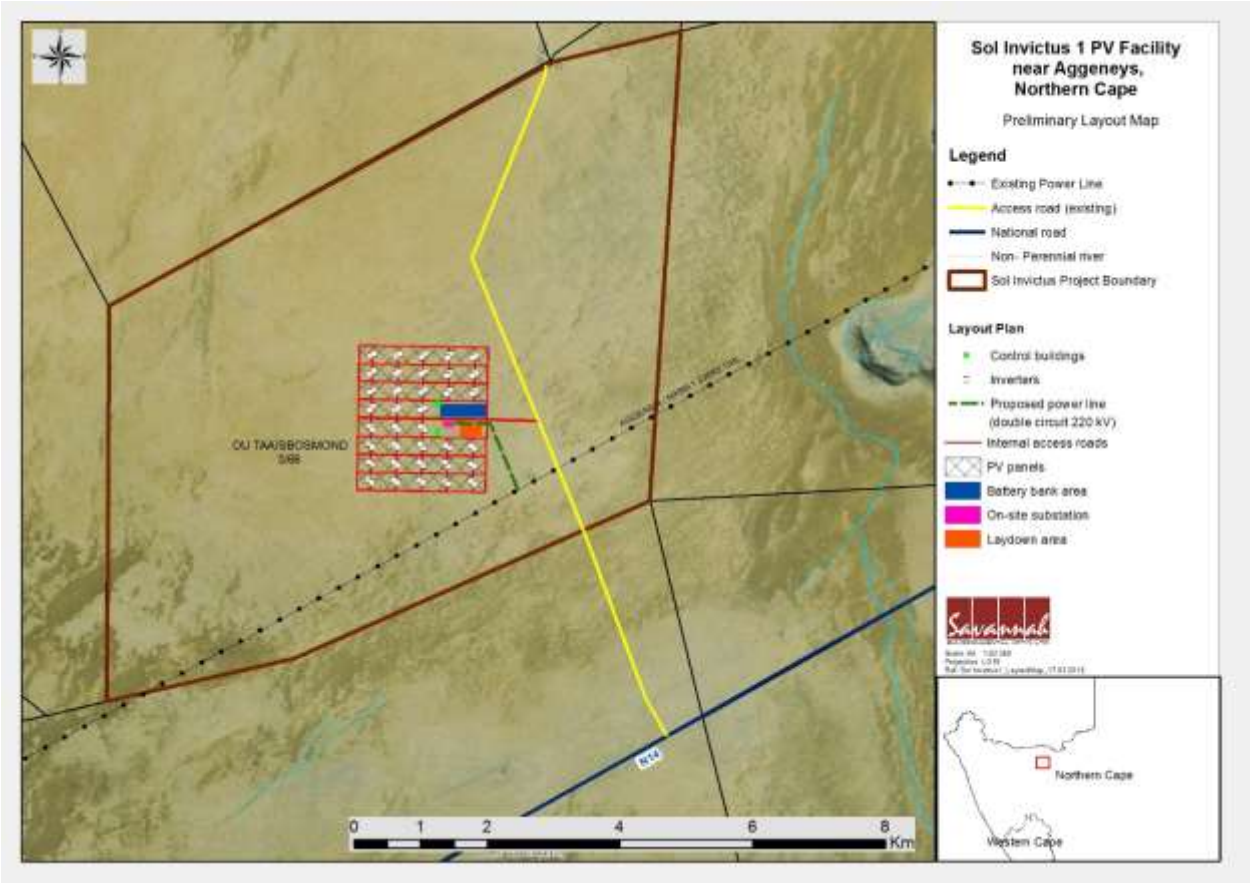

Figure 2: *Aerial view of the study area showing the Portion 5 of farm 66 (brown polygon), the proposed Sol Invictus 1 PV facility (red square), the proposed transmission line (green dashed line) and the existing access road (yellow line) leading north from the N14 (blue line).*

1.1.1. Aspects of the project relevant to the heritage study

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

1.2. Terms of reference

ASHA Consulting was asked to produce a heritage impact assessment that included a field survey of the entire farm portion. Note that the palaeontological impacts were assessed by a separate specialist at the scoping level (Almond 2016) but all other aspects of heritage are considered here.

It should be noted, that following S.38(3) of the National Heritage Resources Act (No. 25 of 1999), all 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 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 the Western Cape and Northern Cape provinces of South Africa 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) 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.

1.5. Declaration of independence

ASHA Consulting (Pty) Ltd and its consultants have no financial or other interest in the proposed development and will derive no benefits other than fair remuneration for consulting services provided.

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 (2a) states that if there is reason to believe that heritage resources will be affected then an impact assessment report must be submitted. This report fulfils that requirement.

Under the National Environmental Management Act (No. 107 of 1998; NEMA), as amended, the project is subject to an EIA. 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 1:250 000 map and historical aerial photographs were sourced from the Chief Directorate: National Geo-Spatial Information. Recent aerial photography was also consulted to assist with planning the field survey.

3.2. Field survey

The site was surveyed on the 17th to the 19th February 2016. This was in late summer. In this dry area where ground visibility is always good, seasonality does not affect the outcomes of the report since heritage resources are never obscured by vegetation growth. The survey was conducted both on foot and by driving through the study area. Because of the large size of the area it was necessary to search it for the kinds of landscape features known to be archaeologically sensitive. These features were then examined in greater detail. During the survey the positions of finds were recorded on a hand-held 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 Savannah Environmental.

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 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. Heritage Western Cape (2012), however, uses a system in which resources of local significance are divided into Grade 3A, 3B and 3C. These approximately equate to high, medium and medium-low local significance, while sites of low or very low significance (and generally not requiring mitigation or other interventions) are referred to as ungradeable. For convenience, the Heritage Western Cape system is employed here.

3.5. Assumptions and limitations

The field study was carried out at the surface only and hence any completely buried archaeological sites will not be readily located. Similarly, it is not always possible to determine the depth of archaeological material visible at the surface, although in the present case most of the study area is underlain by bedrock very close to the surface and exposed in places. Because of the very large extent of the study area, it was not feasible to conduct a detailed foot survey of the entire area – that would have taken many weeks. Instead, the landscape survey approach outlined above was adopted and it is assumed that this would have resulted in the discovery of all significant heritage resources (the findings do appear to support this).

4. PHYSICAL ENVIRONMENTAL CONTEXT

4.1. Site context

The site is located in a very remote area 4 km from the N14 freeway and 25 km from the nearest town (Aggeneys). Farms in the area tend to be large and buildings are few and far between. The Eskom Aggeneis Substation lies at the eastern end of the proposed transmission line and a number of existing power lines cross the landscape towards this substation. One such powerline traverses the southern part of the study area. There is also a mining concern operating near the substation.

4.2. Site description

The project area (farm portion) is very flat with relief limited to a barely perceptible slope uphill towards the west. The bulk of the surface is covered in sand and fine gravel. Vegetation was minimal in the east (Figure 3 and 4), but grass was prevalent in the west where bushes and small trees were also to be found (Figures 5 and 6). In places small concentrations of bushes trapped wind-blown sand to form tiny 'dunes' of up to 30 cm high. In the south-western corner of the project site there were low, grass-covered dunes of deeper red sand, although these still had very fine gravel clasts on them. In hollows between these dunes the gneiss bedrock was exposed (Figure 7).

Figure 3: *Open plains with minimal vegetation in the eastern part of the PV study area.*

Figure 4: *Open plains with minimal vegetation in the eastern part of the PV study area.*

Figure 5: *Open, but grassy plains in the western part of the PV study area.*

Figure 6: *Grassy plain with scattered small trees and bushes in the western part of the PV study area.*

Figure 7: *Red dunes with grass and patches of exposed gneiss bedrock in the south-western part of the PV study area.*

5. CULTURAL HERITAGE 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 is found during the field survey 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. Palaeontology

The SAHRIS Palaeomap indicates that the project site lies in an area that is largely of 'moderate' palaeontological sensitivity (Figure 8). Almond (2015) notes in his desktop study that hard rocks – mainly gneisses, schists, quartzites and amphibolites – crop out at the surface only in the southwestern part of the study area. These are igneous and metamorphic rocks. The bulk of the study area, however, exhibits a range of unconsolidated to semi-consolidated superficial sediments. These are largely aeolian deposits of far more recent age than the underlying rocks.

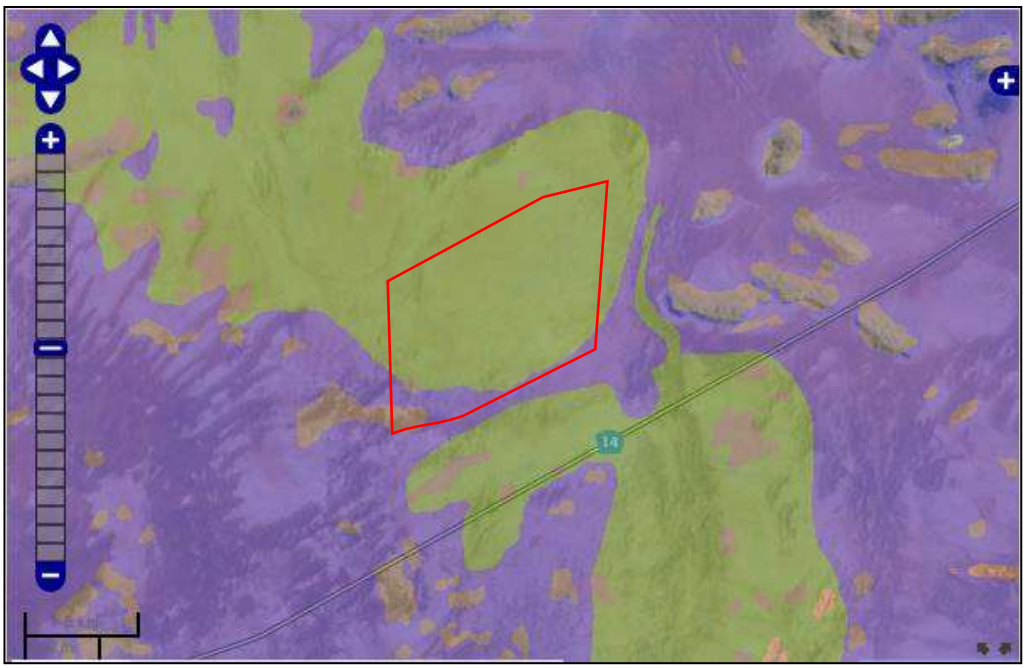

Figure 8: *Extract from the SAHRIS Palaeomap indicating the palaeontological sensitivity of the area. Green denotes moderate sensitivity, while blue denotes low sensitivity.*

No fossils are known to have been found within the study area. Although isolated examples of fossil sites are found in the broader region, for example at Bundu Pan near Copperton (Kibberd 2006), the fossil record of the Kalahari Group as a whole is sparse and limited in its diversity. While the basement rocks are unfossiliferous, the kinds of fossils that may be expected to occur in the sand deposits are of very low significance and would be sparsely distributed. Overall, the palaeontological sensitivity of the study area is thus considered to be low.

5.2. Archaeology

A number of surveys have been carried out in the Aggeneys area and have reported a variety of finds. Morris (2011b, 2011c) and Smith (2012) surveyed areas to the east of the present study area and, because of the sand cover, found only a small number of isolated quartz artefacts. Morris (2011b) does, however, note the presence of a rock painting on a boulder at Aggeneys, 17 km east of the present PV study area. The painting is a finger painting likely associated with the Khoekhoen. Similar art is found on granite outcrops throughout Namaqualand and elsewhere in Bushmanland but in very low densities (Orton 2013, 2016a). A later survey by Morris (2013) on one of the same farms yielded two important observations. He found bedrock grinding hollows and grooves with associated scatters of stone artefacts, pottery and ostrich eggshell in one area where a surface outcrop of bedrock occurred, and a set of artefact scatters associated with boulders at the foot of a mountain in another. These sites are 11 km east of the present PV study area. Orton and Webley (2012a, 2012b) also recorded sites with grinding hollows at Kangnas some 33 km to the west of the current study area and at a site to the southeast of Pofadder. To the northeast of Pofadder Orton (2015) located a number of LSA stone artefact scatters directly associated with very small surface rock outcrops. The outcrops had hollows in them that caught rainwater and attracted settlement. Bedrock grooves also occurred at some of these sites. Within the Ghaamsberg Inselberg 33 km to the east of the study area there are a variety of archaeological traces preserved. Scatters of Early Stone Age (ESA) artefacts occur in open, often eroding areas, while a small rock shelter preserves a *c.* 30 cm deep Later Stone Age (LSA) deposit and rock art is found in the kloof that drains the mountain (Orton 2014).

More generally, it can be noted that archaeological sites in the area tend to be more commonly encountered around the fringes of granite hills, on sand dunes or around pans (Beaumont *et*

al. 1995). Other surveys in the region support this contention (Halkett 2010; Morris 2011a, 2013; Orton & Webley 2012).

5.3. Other heritage

There is always the small possibility of encountering unmarked graves in sandy substrates. However, because of the envisaged low density of occupation sites the chance of locating such graves is deemed to be very small.

Some of the place names in the region reflect the living heritage of the Khoekhoen. Ghaamsberg (also Gamsberg), for example, derives from the Khoekhoen word meaning 'grassy spring' (Raper n.d.). There are unconfirmed historical reports that a massacre of Bushmen may have occurred in a kloof of the Ghaamsberg (Robinson 1978) but surveys have failed to yield any evidence.

Although the landscape itself does not carry any particular cultural significance, the N14 that runs to the south of the site can be deemed to be a scenic route because of the aesthetic qualities of the landscape through which it runs. However, as noted in the scoping study (Orton 2016b), the distance between the site and the road (> 3 km) suggests that the proposed development will be virtually invisible from the road and this aspect is thus of no further concern.

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 presents a list of all observations, while Figures 9 and 10 show their spatial distribution and the survey tracks. Note that all finds are included and described regardless of whether they were found within the Sol Invictus 1 PV development footprint along the transmission line alternatives or elsewhere on the farm portion. This is because there were generally very few heritage resources present and describing everything aids in a broader understanding of the heritage of the area.

Table 1: *List of all heritage occurrences recorded during the ground survey of the study area.*

Way-point	Co-ordinates	Description	Heritage Significance
005	S29 17 46.9 E18 37 02.0	20th century structure (in ruin) with a large ash heap alongside it. The material on the heap appears to all be 20th century.	Very low
006	S29 18 58.9 E18 36 40.4	Quartz outcrop that has been flaked as a source of stone material. The flaked edges are rounded from weathering (unusual) so it is an old quarry site.	Very low
007	S29 19 39.2 E18 39 47.5	Two crypto-crystalline silica flakes (one is edge-damaged) and a single ostrich eggshell fragment on the side of a large red dune.	Very low
008	S29 18 01.5 E18 46 03.9	20th century farm werf with two buildings and a reservoir. An ash dump contains only modern materials.	Very low
009	S29 18 13.0 E18 43 14.8	A pile of stones oriented roughly east-west and which may well be a grave. It is on a red sand dune but very close to the edge of the rocky hill.	If a grave then it would be of high significance.
010	S29 19 42.1 E18 39 43.0	Two quartz flakes on the side of the same red dune as 007 but 150 m to the WSW. There was also a large rock on the crest of the dune close to this point which was completely unused but must have been carried	Very low (if the rock is a grave then its

Way-point	Co-ordinates	Description	Heritage Significance
		there from the nearby mountain. There is a chance it represents a grave.	significance would be high)
011	S29 21 02.8 E18 36 50.1	Cement dam, two windmills and three gum trees (elements of the cultural landscape).	Very low
012	S29 20 16.8 E18 35 52.5	Quartz outcrop that has been minimally flaked as a source of stone material.	Very low
013	S29 20 57.4 E18 35 19.4	Collection of rocks that must be anthropogenic. It could be a historical grave that has become dispersed with time. The probability of the feature being a grave is considered to be very low.	High if a grave, otherwise no significance
014	S29 22 33.0 E18 32 53.4	Small pan with exposed gneiss bedrock. There is one grinding hollow and a light scattering of quartz artefacts around the area.	Very low
015	S29 22 43.2 E18 33 15.5	Small pan with fragments of a green bottle (20th century). Also a light scatter of quartz artefacts.	Very low
016	S29 22 42.2 E18 33 18.0	Small pan with exposed gneiss bedrock. Artefact scatter of quartz, quartzite, crypto-crystalline silica (CCS) and other rocks as well as a few fragments of green and pink bottle glass (20th century).	Low
017	S29 22 38.5 E18 33 13.9	Outcrop of gneiss boulders with some tins and green glass fragments around them. Also a few pieces of ostrich eggshell and some quartz flakes.	Very low
018	S29 22 34.5 E18 33 07.8	Eroding/deflating area with an ephemeral scatter of quartz artefacts.	Very low
019	S29 22 36.7 E18 33 00.3	Eroding/deflating area with an ephemeral scatter of quartz artefacts.	Very low
020	S29 22 32.0 E18 33 25.9	Outcrop of gneiss bedrock with at least seven grinding patches and shallow grooves on it. Surrounded by ephemeral quartz artefact scatter. Water would pool around the rock.	Low
021	S29 22 34.1 E18 33 25.5	Outcrop of gneiss bedrock with at least two grinding patches on it. Surrounded by ephemeral ostrich eggshell and quartz artefact scatter. Water would pool around the rock.	Low
022	S29 22 34.6 E18 33 25.5	Outcrop of gneiss bedrock with at least six grinding patches and shallow grooves on it. Surrounded by ephemeral quartz artefact scatter. Water would pool around the rock.	Low
023	S29 22 34.4 E18 33 24.9	Outcrop of gneiss bedrock with two grinding patches and shallow grooves on it. Surrounded by ephemeral quartz artefact scatter.	Low
024	S29 22 28.8 E18 33 28.5	Outcrop of gneiss bedrock with two grinding patches on it.	Very low
All observations from 025 to 050 are part of one large complex surrounding a pan of approximately 140 m diameter and with a very large amount of gneiss bedrock exposed. The entire complex is rated as having high heritage significance as a whole, although each individual recorded point has less importance on its own.			High
025	S29 22 29.1 E18 33 51.3	Outcrop of gneiss bedrock with nine grinding patches and shallow grooves on it. Surrounded by ephemeral quartz and CCS artefact scatter.	Low
026	S29 22 31.0 E18 33 51.8	Outcrop of gneiss bedrock with five grinding patches on it. Surrounded by lots of ostrich eggshell and some quartz and CCS artefacts.	Medium

Way-point	Co-ordinates	Description	Heritage Significance
027	S29 22 33.0 E18 33 54.2	Outcrop of gneiss bedrock with two grinding patches on it. Surrounded by lots of ostrich eggshell and some quartz and CCS artefacts.	Medium
028	S29 22 33.0 E18 33 53.6	Outcrop of gneiss bedrock with three grinding patches on it. Surrounded by some quartz and CCS artefacts.	Low
029	S29 22 32.8 E18 33 53.1	Outcrop of gneiss bedrock with one grinding groove on it. Surrounded by some quartz artefacts.	Low
030	S29 22 32.7 E18 33 52.7	Outcrop of gneiss bedrock with four grinding grooves on it. Surrounded by some quartz artefacts.	Low
031	S29 22 33.9 E18 33 52.7	Outcrop of gneiss bedrock with five grinding patches and grooves on it.	Low
032	S29 22 34.5 E18 33 53.6	Outcrop of gneiss bedrock with two grinding patches on it. Surrounded by some quartz artefacts.	Low
033	S29 22 35.0 E18 33 54.1	Scatter of ostrich eggshell and quartz and CCS stone artefacts.	Medium
034	S29 22 35.6 E18 33 54.6	Scatter of quartz, quartzite and CCS stone artefacts and some ostrich eggshell. Also a CCS adze noted.	Medium
035	S29 22 36.4 E18 33 55.0	Outcrop of gneiss bedrock with nine grinding patches and shallow grooves on it. Surrounded by a scatter of quartz and CCS artefacts and ostrich eggshell.	Medium
036	S29 22 36.4 E18 33 54.3	A dense scatter of ostrich eggshell fragments along with some artefacts in quartz, CCS and quartzite. There was also one large pottery sherd. A "Woodlot" type scraper in CCS was seen.	Medium-High
037	S29 22 35.9 E18 33 53.6	Outcrop of gneiss bedrock with two grinding patches on it. Surrounded by some quartz artefacts, ostrich eggshell fragments and some glass.	Low
038	S29 22 37.6 E18 33 53.2	Outcrop of gneiss bedrock with three grinding patches on it. Surrounded by some quartz and CCS artefacts and some ostrich eggshell fragments.	Low
039	S29 22 38.1 E18 33 52.1	Outcrop of gneiss bedrock with one grinding patch on it. Surrounded by some quartz artefacts.	Low
040	S29 22 38.3 E18 33 51.0	Outcrop of gneiss bedrock with two grinding patches on it. Surrounded by some quartz and CCS artefacts and some ostrich eggshell fragments.	Low
041	S29 22 38.7 E18 33 48.8	Outcrop of gneiss bedrock with four grinding patches on it. Surrounded by a dense artefact scatter in quartz, CCS and hornfels.	Medium-high
042	S29 22 38.7 E18 33 47.0	Outcrop of gneiss bedrock with nine grinding patches on it. Surrounded by a dense artefact scatter in quartz and CCS.	Medium-high
043	S29 22 37.0 E18 33 45.0	Outcrop of gneiss bedrock with two grinding patches on it. Surrounded by a quartz and CCS artefact scatter.	Low
044	S29 22 34.8 E18 33 43.9	Outcrop of gneiss bedrock with sixteen grinding patches and grooves on it. Surrounded by a quartz and CCS artefact scatter.	Medium
045	S29 22 35.2 E18 33 44.2	Outcrop of gneiss bedrock with two grinding patches on it. Surrounded by a quartz and CCS artefact scatter and some ostrich eggshell.	Low
046	S29 22 34.6 E18 33 47.8	Very large outcrop of gneiss bedrock with nine grinding patches on it. Surrounded by a quartz and CCS artefact scatter and some ostrich eggshell.	Low
047	S29 22 34.5 E18 33 48.8	Outcrop of gneiss bedrock with three grinding patches on it. Surrounded by a scatter of ostrich eggshell and some quartz and CCS artefacts.	Low

Way-point	Co-ordinates	Description	Heritage Significance
048	S29 22 35.7 E18 33 50.1	Scatter of quartz and CCS artefacts and some ostrich eggshell.	Low
049	S29 22 36.2 E18 33 52.6	Scatter of quartz and CCS artefacts and some ostrich eggshell as well as a fragment of mineralised bone.	Low
050	S29 22 31.2 E18 33 53.4	Outcrop of gneiss bedrock with four grinding patches and grooves on it. One is a very deep groove.	Low

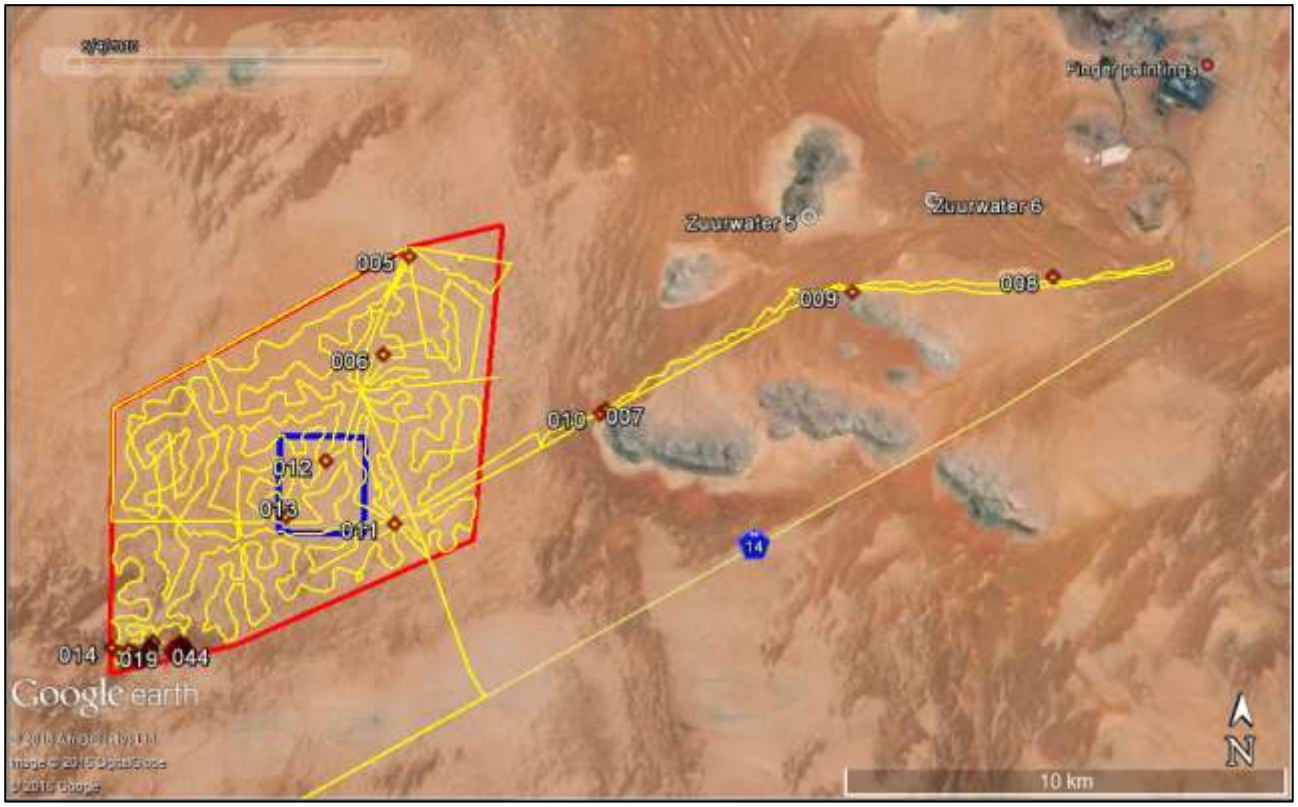

Figure 9: *Aerial view of the study area showing the site (red polygon), the proposed Sol Invictus 1 PV footprint (blue polygon), the survey tracks (yellow lines) and heritage finds (numbered symbols). Other archaeological sites on record to the northeast are marked.*

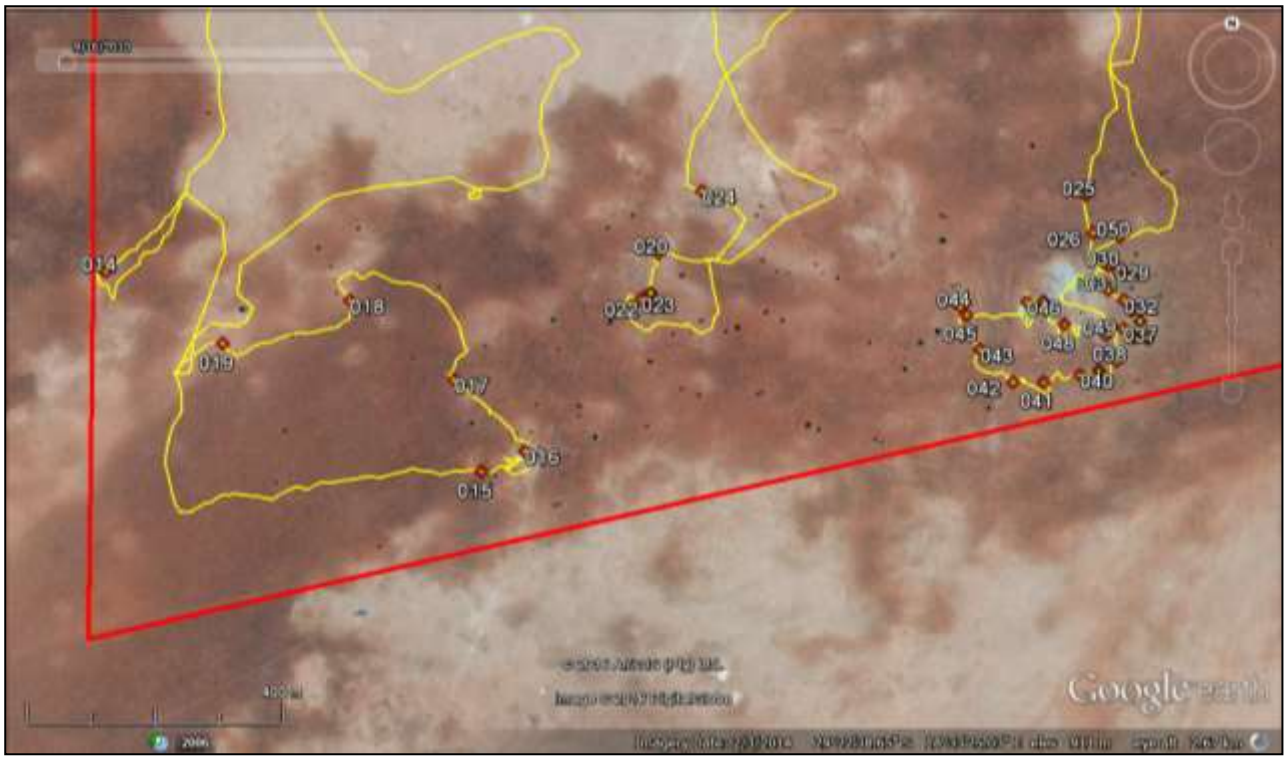

Figure 10: *Aerial view of the south-western part of the study area showing the survey tracks (yellow lines) and heritage finds (numbered symbols). The large cluster of points to the right represents the one very important archaeological site located in the study area.*

6.1. Palaeontology

Almond (2016) reports that the study area is underlain by igneous and metamorphic rocks that crop out at the surface only in the southwestern part of the study area. These rocks are unfosiliferous. Elsewhere the site is covered by Late Caenozoic-aged unconsolidated to semi-consolidated superficial sediments and red Quaternary-aged unconsolidated aeolian sands. The archaeological field assessment confirms the above observation of bedrock outcrops, although these rocks are largely covered by unconsolidated sand in the southwest. Elsewhere on the site quartz and quartzite outcrops were noted, along with exposures of calcrete. Almond (2016) reports that these semi- and unconsolidated sediments fall within the Gordonia Formation of the Kalahari Group and are regarded as being generally sparse in fossils with the species diversity being low. Minor fossils such as calcretised root casts, tortoise bones, land snails and ostrich eggshells may occur in dune sands, while freshwater snails and bivalves, ostracods, diatoms and stromatolites may occur in sediments association with old water courses and pans. These deposits are considered to be of low sensitivity. Calcretes may contain trace fossils, animal burrows and even trackways or occasional mammalian bones.

Because of the unfossiliferous bedrock, the low palaeontological sensitivity of the overlying sediments, and the very low likelihood that excavations will penetrate ancient alluvial deposits, Almond (2016) suggests that no further consideration palaeontological impacts is necessary.

It should be noted that the archaeological survey produced a single fragment of mineralised bone that was found on a Holocene-aged surface archaeological sites (Figure 15). Almond (pers. comm. 2016) notes that mineralised bone is best thought of as being at least Pleistocene in age, although in certain contexts, for example in association with calcrete, bones could mineralise faster.

Figure 11: *The outside (left) and inside (right) of the mineralised bone found at waypoint 049. The scale bar is in 1 cm intervals.*

6.2. Archaeology

The vast majority of the study area was found to be a flat, featureless plain that is completely unconducive to finding traces of Stone Age archaeological settlement. Even isolated artefacts attributable to the background scatter were very rarely encountered. This would be unusual in parts of Bushmanland, but is unsurprising here, given that the surface is either sandy or else, when rocks are present, they are totally unsuited to the production of stone artefacts. Those isolated artefacts that were found were all in quartz. It is also notable that many fragments of quartz were picked up and checked with many seeming similar to artefacts but revealed not to be on close inspection. No part of the broader study area seemed more likely to produce such isolated artefacts than any other. In terms of age, the majority are likely to date from the Middle Stone Age (MSA). No Early Stone Age (ESA) material was seen. The only place outside of the south-western part of the study area where a minor concentration of artefacts was found was at waypoints 007 and 010, both located atop a red sand dune within the transmission corridor. At 007 there were two CCS flakes and an ostrich eggshell fragment (Figure 12), while nearby at 010 there were two quartz flakes. These two points were 150 m apart from one another and are unlikely to be related. They are all Later Stone Age (LSA) artefacts.

Figure 12: *An ostrich eggshell fragment (left) and a CCS flake (right) from waypoint 007. The scale is in 1 cm intervals.*

All the important archaeology was found in the south-western corner of the study area in association with depressions in the sand body, usually with exposed gneiss in their bases. The majority were within one very large depression (Figures 10 & 13). A few sandy areas had low density scatters of artefacts, while a few smaller depressions with exposed gneiss contained low density versions of what the largest depression contained. As such, the finds from this largest depression serve to illustrate the kinds of things found in the broader area. This largest depression held standing water at the time of assessment and, after good summer rains, probably serves as a water source for several months. This would have attracted settlement around it. Although the periphery of the pan was not completely surveyed, it is likely that the majority of the archaeological occurrences scattered around it were recorded. Certainly, all the rock outcrops were visited.

Figure 13: *View across the pan where waypoints 025 to 050 were recorded.*

A large number of individual scatters were found and recorded. There is no doubt that they represent palimpsests, since people would have returned to this pan frequently during the last several thousand years. The artefact scatters contained a variety of materials, although the majority of artefacts were on quartz, which is widely available, and CCS which would likely have been sourced from the Orange River gravels. Quartzite, silcrete, hornfels and other less frequent rocks were all noted occasionally though. Also present, and sometimes in massive quantities, were fragments of ostrich eggshell. The eggs would have been used as food and, although the shells were sometimes subsequently used as water flasks or for making beads, no modified fragments were seen. Figure 14 shows a selection of artefacts and ostrich eggshell fragments from one of the scatters. Just one piece of pottery was found (at waypoint 036; Figure 15). Time did not allow a careful examination of all the stone artefacts but at one scatter a CCS scraper was noted. On close inspection it turned out to have lateral retouch along both margins (Figure 16). This is an unusual form normally only noted in early Holocene assemblages (when they are sometimes referred to as 'Woodlot scrapers') and normally they are far larger.

Figure 14 (left): Artefacts of quartz, CCS and quartzite and a number of ostrich eggshell fragments from waypoint 026. **Figure 15 (top right):** A pottery sherd from waypoint 036. **Figure 16 (bottom right):** A CCS scraper with lateral retouch from waypoint 036. All scales are in 1 cm intervals.

The most fascinating aspect of the archaeology in this area was the very large number of grinding patches and grooves evident in the gneiss. Most outcrops had at least one ground area evident on them. A pattern that was observed was that the ground patches tended to be towards the edges of the outcrops and not on the highest, central parts. More than 100 grinding patches and grooves were counted around the largest pan, but very few were noted on the largest rocks in the centre of the depression. The most prominent ground areas were deep grooves (Figure 17), while many patches were far more ephemeral and less easy to spot (Figure 18). Figure 19 shows a view of one of the gneiss outcrops with several grooves visible.

Figure 17: *A very prominent grinding groove located at waypoint 050. The scale bar is 10 cm long.*

Figure 18: *A fairly ephemeral ground patch located at waypoint 020. The scale bar is 20 cm long.*

Figure 19: *View of the gneiss outcrop at waypoint 035 showing several grooves and ground patches.*

Alongside a structure forming part of the farm complex on Portion 5 of Ou Taaibosmond 66 was a very large ash heap (waypoint 005). The buildings do not appear to be older than 100 years and it is thus expected that the ash heap would also not contain material in excess of 100 years of age (the legal age at which such material is considered archaeological). From aerial photography dating to 1961 it appears as though the structures were already present, although the image is not clear. From their style, however, they are likely to be from the first half of the 20th century. The ash heap is thus unlikely to be more than 100 years of age but is illustrated here for interest (Figure 20). It contained much animal bone and glass as well as various metal items and a large limpet shell (*Scutellastra barbara*). There was also much gravel present on it.

Figure 20: *View of the large ash heap at the southern end of the farm complex on Farm 66/5.*

6.3. Graves

On a large red sand dune, close to waypoint 010 (but not specifically recorded by GPS) was an isolated stone of about 30 cm length lying on the surface. It displayed no evidence of any use. Only after later recording of the two quartz flakes was it considered that it might represent a precolonial grave marker. A far more likely grave was located on another red sand dune further east along, but just outside of, the Alternative 1 transmission line corridor. It was very close to the foot of a rocky mountain and was comprised of a slightly elongated mound of rocks aligned in an east-west direction (Figure 21). Within the PV study area, a small collection of stones was noted at waypoint 013 (Figure 22). They would not ordinarily have attracted attention except that the ground surface in the area is devoid of rocks suggesting that these were all carried there for some purpose – to cover a grave seems the most likely, although the substrate is not generally suitable for the excavation of graves of any depth and there do not seem to be enough rocks present to cover a shallow grave. They may more likely have been unearthed by burrowing animals. Similar collections of stone are sometimes found along boundary lines, but the nearest farm track and fence is 120 m to the south of this point. Such isolated graves, when present, might relate to precolonial occupation of the area or could be from the early farmers ('trekboers') who colonised the area during the 19th century.

Figure 21: *East-west aligned mound of rocks waypoint 009 that is likely to be a grave.*

Figure 22: *Collection of rocks at waypoint 013. Although unlikely, it might be a grave.*

6.4. Built environment

No built structures are present within the proposed PV development footprint. Although the farm complex occurs in the far north of the study area, it will not be impacted and does not require further assessment. Its structures are all 20th century in age with two adjoining structures likely to be early to mid-20th century (Figure 23), and the other two likely to be from the 1940s (Figure 24) and 1950s (Figure 25). An aerial photograph from 1961 shows both the newest structures to be present, while that which visually appears oldest is not clear in the image, possibly due to its smaller size (Figure 26). There is some sort of disturbance of the natural surface, however, and this probably indicates the presence of the house.

Figure 23: *House forming part of the Ou Taaibosmond farm complex.*

Figure 24: *House forming part of the Ou Taaibosmond farm complex.*

Figure 25: *House forming part of the Ou Taaibosmond farm complex.*

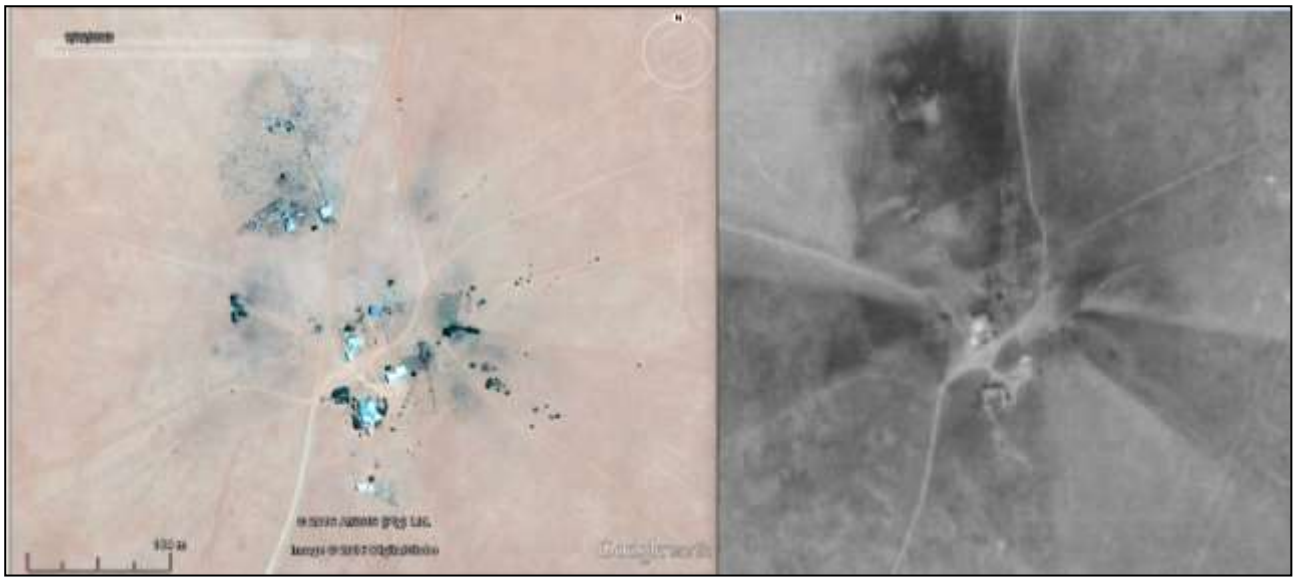

Figure 26: *Aerial photographs from 2014 (left) and 1961 (right) showing the Ou Taaibosmond farm complex.*

A small ruined farm complex was found along Alternative 1 transmission corridor at waypoint 008. The structures are in a state of disuse. Historical aerial photography shows it to have been present in 1962/63. The structures are widely dispersed with those furthest apart being 180 m from one another (Figures 27 & 28). They are not old, probably dating to the mid-20th century, and one of them appears to have been a cottage with an external hearth which may have housed farm labourers (Figure 29). There are three structures, a circular cement reservoir and a livestock loading ramp.

Figure 27: *View towards the east showing the widely dispersed farm complex at waypoint 008.*

Figure 28: *Aerial view of the farm complex at waypoint 008.*

Figure 29: *The cottage with external hearth at waypoint 008.*

6.5. Cultural landscape and scenic routes

The cultural landscape of the study area is related primarily to livestock grazing, although new layers related to electricity transmission and mining have been added in recent decades. The main elements of the landscape contributing to its character are the widely spaced farmsteads, the farm tracks and fences and occasional wind pumps, cement reservoirs and introduced trees. Figure 30 shows the Ou Taaibosmond farm complex hugging the ground; it is a typical Bushmanland farmstead. Another aspect of the cultural landscape is the wind pumps, reservoirs, introduced trees, fences and tracks commonly associated with livestock farming (Figures 31 to 33). Being so dry, this area has a limited carrying capacity and water-related infrastructure is sparse. The overall landscape character is natural, while a rural element results from the minimally developed cultural landscape.

Figure 30: *Long distance view of the Ou Taaibosmond farm complex.*

Figure 31: *View of the wind pumps and reservoir on Ou Taaibosmond 66/5.*

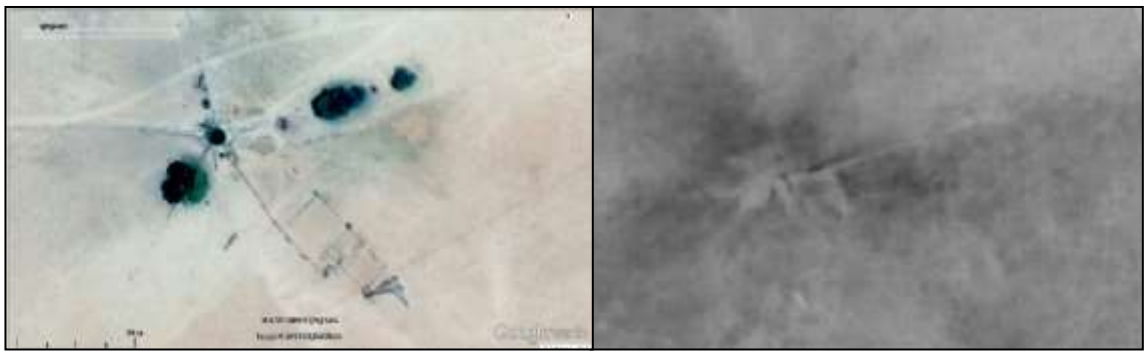

Figure 32: *Aerial views dating to 2014 (left) and 1961 (right) showing the features illustrated in Figure 31.*

Figure 33: *View east along a farm track and fence.*

The N14 can certainly be regarded as a scenic route through the area as it traverses large tracts of unspoilt landscape. The site is well set back from the N14, however, and the degree of visual intrusion from the proposed PV facility should be relatively minor because of the distance between it and the road. This means that although the cultural and natural landscapes would be altered through development, the impact would be fairly small in terms of visibility from the N14.

6.6. Statement of significance

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.

No palaeontological resources were encountered on site (with the exception of a single mineralised bone that may be archaeological) but the desktop study suggests that the cultural significance of any buried palaeontological resources would be low as nothing of scientific value is expected to be present.

The majority of archaeological resources are deemed to have low cultural significance for their scientific value, but the one large site encompassing waypoints 026 to 050 is considered to have high cultural significance. The only site within the development footprint has very low significance.

Graves are deemed to have high cultural significance for their social value.

The built heritage resources of the study area are neither particularly old, nor rare and are thus accorded low cultural significance for their architectural and technological value. They all occur outside of the development footprint.

The cultural landscape and scenic environment of the study area and surrounds have medium cultural significance for their aesthetic value.

6.7. Summary of heritage indicators and provisional grading

The main heritage indicators of concern are the archaeological resources in the south-western part of the project site, the few possible graves, and the broader landscape. The most important heritage resource is undoubtedly the large pan with its surrounding occupation debris and this site could be tentatively graded 3A. The remaining archaeological resources are ungradeable. The possible graves are of low heritage significance until proven to be graves and are thus suggested grade 3C (if human remains are found then the grave(s) should be managed as grade 3A resources). Those buildings greater than 60 years of age are worthy of no more than a 3C grading, while the landscape is rated 3B because it is a visually interesting scenic landscape that occurs over a relatively small area of South Africa. Palaeontological resources are ungradeable.

7. ASSESSMENT OF IMPACTS

The assessments presented below address only archaeology, graves and the landscape. Palaeontology is excluded from formal assessment because the scoping study showed that significant palaeontological resources would not occur on the site.

7.1. Impacts to archaeological resources

Impacts are only expected to occur during the construction phase of the project. They would be direct impacts. Given the location of the proposed PV facility, the important archaeological site in the south-western part of the broader study area is not expected to be impacted by the proposed development. Only one archaeological site (at waypoint 012: Quartz outcrop that has been minimally flaked as a source of stone material) was recorded within the proposed PV footprint and it has very low (negligible) heritage significance. The site would be directly impacted and very likely destroyed by development (a permanent impact). However, because it has a very low heritage significance, the probability has been artificially lowered in order to arrive at an acceptable significance value (Low 12) for the impact (Table 2). This lower probability also reflects the chances of impacting other as yet undiscovered archaeological resources. Because of the very low heritage significance of the known site, no mitigation is suggested and there are no fatal flaws in terms of archaeology. Significant indirect impacts are highly unlikely to occur because the only important archaeological site is located right in the south-western corner of the project site, well away from the proposed PV footprint.

Table 2: *Assessment of impacts to archaeological resources during the construction phase.*

Nature: Archaeological sites may be damaged or destroyed during the construction phase of the project when earthmoving takes place or when heavy vehicles drive over such sites.		
	Without mitigation	**With mitigation**
Extent	Low (1)	Low (1)
Duration	Permanent (5)	Permanent (5)
Magnitude	Small (0)	Small (0)
Probability	Improbable (2)	Improbable (2)
Significance	**Low (12)**	**Low (12)**
Status (positive or negative)	Negative	Negative
Reversibility	Low	Low

Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes (but not necessary)	Yes (but not necessary)
Mitigation: No mitigation measures are suggested because the archaeological resources that would be impacted are of very low heritage significance and do not merit any mitigation being carried out. No new scientific data could be gained through implementation of mitigation measures.		
Residual impacts: Because no significant archaeological sites would be impacted and mitigated, no significant residual impacts are expected.		

7.2. Impacts to graves

Impacts might only occur during the construction phase of the project. One possible (but very unlikely) grave was recorded within the Sol Invictus 1 PV footprint (at waypoint 013). The site would be directly impacted and very likely destroyed by development. Because of the very small chance of the site actually being a grave, the probability of impacting human remains is deemed to be improbable. The significance before mitigation is calculated to be low (16), while if human remains were discovered, reported and successfully exhumed then the significance of impacts would be low (6). Table 3 summarises the impact ratings. There are no fatal flaws in terms of graves. Note that if the site is not a grave, which is entirely likely, then there would be no impacts to graves expected for the development.

Table 3: *Assessment of impacts to graves during the construction phase.*

Nature: Grave sites may be damaged or destroyed during the construction phase of the project when earthmoving takes place or when heavy vehicles drive over graves.		
	Without mitigation	**With mitigation**
Extent	Low (1)	Low (1)
Duration	Permanent (5)	Permanent (5)
Magnitude	Minor (2)	Small (0)
Probability	Improbable (2)	Improbable (1)
Significance	**Low (16)**	**Low (6)**
Status (positive or negative)	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes (if required)	Yes (if required)
Mitigation: The ECO should ensure that the construction team are aware of the possibility of encountering human remains and, if any are found, they should be cordoned off and protected in place and immediately reported to the site manager or ECO who should then report to an archaeologist or to SAHRA. This applies both to the vicinity of the collection of stones at waypoint 013 as well as to the rest of the site. Mitigation would then involve exhumation of the human remains and storage in an appropriate		

institution.
Residual Impacts: If no human remains are present or if a grave is successfully exhumed then there would be no residual impacts.

7.3. Impacts to the landscape

Impacts to the landscape (including the cultural landscape and impacts to scenic routes) are expected to occur during all three phases of the proposed development as a result of the addition of industrial elements to what is generally a natural landscape. However, because of the distance between the proposed development and the N14 (from which most viewers would be viewing the landscape) and the low degree of development of the cultural landscape, the impacts will be of low significance in heritage terms. The calculated significance of impacts is medium but this is a result of the long term nature of the impacts and their certainty of occurrence (Table 4). Mitigation measures would serve to slightly reduce the significance of the impacts. During the operation phase of the project the impacts to the landscape are expected to be of low significance because of the far reduced number of vehicles accessing the site. There are no fatal flaws in terms of landscape impacts.

Table 4: *Assessment of impacts to the landscape during the construction and decommissioning phases.*

Nature: Impacts to the landscape will result from the presence of construction vehicles and the PV facility itself in a landscape which currently has no industrial precedent. These elements will disrupt the visual qualities of the landscape.		
	Without mitigation	**With mitigation**
Extent	Low (2)	Low (1)
Duration	Long-term (4)	Long-term (4)
Magnitude	Minor (2)	Minor (1)
Probability	Definite (5)	Highly probable (4)
Significance	**Medium (40)**	**Low (24)**
Status (positive or negative)	Negative	Negative
Reversibility	High	High
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	Yes
Mitigation: Mitigation measures include keeping the construction footprint as small as possible, using earthy colours on built elements where possible and ensuring that security lighting is directed downwards so as to minimise night time light pollution.		
Residual Impacts: With proper rehabilitation of the site after decommissioning there would be virtually no residual impacts. At close range the landscape may well be rockier than before but from a distance no significant difference would be evident.		

Table 5: *Assessment of impacts to the landscape during the operation phases.*

Nature: Impacts to the landscape will result from the presence of the PV facility in a landscape which currently has no industrial precedent. This will disrupt the visual qualities of the landscape.		
	Without mitigation	**With mitigation**
Extent	Low (1)	Low (1)
Duration	Long-term (4)	Long-term (4)
Magnitude	Minor (1)	Minor (1)
Probability	Highly probable (4)	Probable (3)
Significance	**Low (24)**	**Low (18)**
Status (positive or negative)	Negative	Negative
Reversibility	High	High
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	Yes
Mitigation: Besides maintaining the site in a neat and tidy condition, there are no further mitigation measures to apply during operation, so long as the construction phase measures (particularly the security lighting) have been implemented successfully.		

7.4. Cumulative impacts

Cumulative impacts to archaeology, graves and the landscape are possible and are assessed in Tables 6 to 8 below. In general cumulative impacts are relatively insignificant because, aside from the landscape itself, heritage resources are sparsely distributed across the broader area.

Because no significant archaeological sites were located within the proposed development footprint, there will not be any difference in impact whether the Sol Invictus 1 PV facility is constructed or not. The majority of archaeological sites in the region are very ephemeral and do not provide much scientific data. For this reason the magnitude of impacts is considered to be minor throughout the region. In the event of more significant sites being found mitigation would retain the minor magnitude rating because scientific data would have been rescued.

Table 6: *Assessment of cumulative impacts to archaeology.*

Nature: Direct destruction of archaeological sites.		
	Cumulative Contribution of Proposed Project	**Cumulative Impact without Proposed Project**
Extent	Low (1)	Low (1)
Duration	Permanent (5)	Permanent (5)
Magnitude	Minor (2)	Minor (2)
Probability	Probable (3)	Probable (3)
Significance	**Low (24)**	**Low (24)**
Status (positive/negative)	Negative	Negative
Reversibility	Low	Low
Loss of resources?	Yes	Yes

Can impacts be mitigated?	Yes (but none required)	Yes (but none required)
Confidence in findings: High.		
Mitigation: Because of the very low cultural significance of the archaeological resources within the proposed PV footprint, no mitigation measures are required for the presently proposed facility. No significant scientific data will be lost during development of the site. There is a chance that other developments in the area could impact culturally significant archaeological sites and in such cases excavation and sampling may be required to rescue artefacts and data.		

Graves are often very difficult to identify and many of the features archaeologists record as possible graves are more than likely not graves. Despite the obvious importance of graves, the low probability of actually uncovering human remains on both the proposed project site and any other potential development areas means that the significance of impacts with and without the proposed Sol Invictus 1 PV facility are low.

Table 7: *Assessment of cumulative impacts to graves.*

Nature: Direct destruction of graves.		
	Cumulative Contribution of Proposed Project	**Cumulative Impact without Proposed Project**
Extent	Low (1)	Low (1)
Duration	Permanent (5)	Permanent (5)
Magnitude	Minor (2)	Minor (2)
Probability	Improbable (2)	Improbable (1)
Significance	**Low (16)**	**Low (8)**
Status (positive/negative)	Negative	Negative
Reversibility	Low	Low
Loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes	Yes
Confidence in findings: Medium.		
Mitigation: If any human remains are uncovered during any construction project, they should always be immediately reported so that appropriate action can be taken to rescue the remains. Any remains discovered should always be protected *in situ* until such time as they can be professionally removed.		

The broader landscape in this part of the Northern Cape has very few industrial-type facilities in it but to the east, near Aggeneys, there is a mine which has resulted in impacts to the landscape through both mining activities and the various buildings present. There are also various power lines in the area and an existing substation. There are no existing solar energy facilities in the immediate area, although others have been proposed so that the potential for cumulative impacts does exist. Although impacts would certainly occur if the various facilities are constructed, there is a relatively low probability that many would be built. The nature of the landscape and the proposed development is such that the cumulative impacts are considered to be of minor magnitude and low significance.

Table 8: *Assessment of cumulative impacts to the landscape.*

Nature: Degradation of the natural and cultural landscape through the addition of industrial elements.

	Cumulative Contribution of Proposed Project	Cumulative Impact without Proposed Project
Extent	Low (1)	Low (1)
Duration	Long term (4)	Long term (4)
Magnitude	Minor (2)	Minor (2)
Probability	Probable (3)	Improbable (2)
Significance	**Low (21)**	**Low (14)**
Status (positive/negative)	Negative	Negative
Reversibility	High	High
Loss of resources?	No	No
Can impacts be mitigated?	Yes	Yes
Confidence in findings: High.		
Mitigation: Minimise the disturbance footprint, minimise security lighting and ensure it does shine outwards, maintain a neat and tidy facility and ensure proper and prompt rehabilitation of land as required.		

8. INPUT TO THE ENVIRONMENTAL MANAGEMENT PROGRAMME

No managements measures are required for known archaeological resources within the project construction footprint because no significant impacts are expected anywhere within that area. However, although unlikely, secondary or indirect impacts may occur and will require management.

OBJECTIVE: Minimise the chances of impacting archaeological sites located outside of the development footprint, specifically in the southwest corner of the broader project site.	
Project component/s	n/a
Potential Impact	If construction vehicles stray outside of demarcated areas then archaeological sites located outside of the development footprint may be damaged and/or destroyed.
Activity/risk source	Risk of impact relates to construction vehicles not remaining within the designated and authorised areas where impacts are known to be minimal.
Mitigation: Target/Objective	All archaeological sites that will not be disturbed by the proposed development should be preserved *in situ*.

Mitigation: Action/control	Responsibility	Timeframe
All construction, operation and decommissioning activities should occur only within the authorised and demarcated footprint areas.	ECO & Facility manager	Throughout the project life.

Performance Indicator	No evidence of project-related activity should be found outside of project footprint.
Monitoring	Monitoring of activities on site should occur at appropriate intervals throughout the lifetime of the project to ensure that the project footprint is respected. During construction and decommissioning this may be every few days, while during operation this would likely be only during maintenance periods.

One site that may be a grave marker (very low probability) was located within the Sol Invictus 1 PV project footprint and it is always possible that other unmarked graves may occur. In general, however, this is deemed very unlikely given the nature of the substrate in the area.

OBJECTIVE: Minimise the chances of impacting human remains	
Project component/s	All earthworks for access roads, PV foundations and cable trenches could potentially disturb human remains.
Potential Impact	If human remains are not protected and reported immediately after discovery then graves could be completely destroyed and the remains damaged and/or destroyed.
Activity/risk source	Risk of impact relates to workers not being observant during earthworks and/or not reporting any human remains that might be revealed during construction.
Mitigation: Target/Objective	The aim is to ensure that any human remains uncovered are protected and reported immediately so that appropriate action can be taken to remove the remains.

Mitigation: Action/control	**Responsibility**	**Timeframe**
Ensure that all workers on site are aware of the possibility of encountering human remains and are aware of the procedure to follow if any are found.	Site manager/foreman & ECO	Throughout the construction phase.

Performance Indicator	Human remains are reported promptly on discovery and no graves are disturbed more than is necessary for their discovery.
Monitoring	No specific monitoring required, but site manager/foreman should report to ECO.

Although impacts to the landscape will be of very low significance, some management measures are also required.

OBJECTIVE: Minimise the disturbance and degradation of land that will not be developed.	
Project component/s	All construction, operation and decommissioning activities.
Potential Impact	The landscape could be degraded more than is necessary for construction purposes.
Activity/risk source	Careless work on site could result in disturbance outside of the authorised construction footprint.
Mitigation: Target/Objective	The aim would be to ensure that all land outside of the authorised construction footprint remains undisturbed and in its present state.

Mitigation: Action/control	**Responsibility**	**Timeframe**
All construction, operation and decommissioning activities should be restricted to within the authorised and demarcated footprint areas.	ECO & Facility manager	Throughout the project life.

Performance Indicator	No evidence of project-related activity should be found outside of project footprint.
Monitoring	Monitoring of activities on site should occur at appropriate intervals throughout the lifetime of the project to ensure that the project footprint is respected. During construction and decommissioning this

	may be every few days, while during operation this would likely be during maintenance periods only.

OBJECTIVE: Keep the facility neat and tidy at all times and ensure rehabilitation of undeveloped areas and the entire site after decommissioning.	
Project component/s	All activities on site.
Potential Impact	Un-rehabilitated land and uncontained waste could degrade the landscape.
Activity/risk source	Any areas that are not rehabilitated and any uncontained waste could result in a visual impact to the landscape.
Mitigation: Target/Objective	The site should be maintained in a neat and tidy state and no disturbed land should be left unrehabilitated.

Mitigation: Action/control	Responsibility	Timeframe
All waste should be responsibly disposed of and any disturbed land that will not be developed must be rehabilitated at the earliest opportunity. On decommissioning the entire site should be rehabilitated.	ECO, site manager/foreman & facility manager	Throughout the lifetime of the project.

Performance Indicator	No waste is found outside of demarcated disposal areas and all undeveloped land is rehabilitated at the earliest opportunity.
Monitoring	Monitoring should aim to ensure that the site is maintained in a neat and tidy state and that unsightly disturbances to the land are rehabilitated quickly.

9. CONCLUSIONS

This study has found that there will be no significant impacts to heritage resources if the proposed Sol Invictus 1 PV facility is developed. Just one archaeological site was located within the project footprint but it is of very low cultural significance. A cluster of stones may represent a grave but the probability of this is deemed to be very low. The landscape is of medium cultural significance but because of the distance between the proposed development and the N14 road the impacts will be of low significance. In addition, a number of other electrical facilities (power lines and a substation) occur in the area and a mining concern operates at Aggeneys to the east of the site.

The impacts to archaeology and graves are of low significance and the probability of the latter being present on site is considered to be low. Although the landscape is of medium cultural significance, impacts to it are of low significance because of the distance between the site and the N14 from which most viewers would be seeing the landscape.

The proposed development is thus deemed feasible from a heritage point of view and there are no fatal flaws. A number of mitigation measures have been proposed to assist with reducing the already limited impacts.

10. RECOMMENDATIONS

It is recommended from a heritage point of view that the proposed Sol Invictus 1 PV facility be authorised in its proposed footprint. The following conditions should be included in the environmental authorisation:

- 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;
- The construction footprint should be kept as small as possible with no activities allowed to occur outside of the authorised area;
- Where feasible, built elements should be painted in earthy colours; and
- Security lighting should be restricted as far as possible and directed downwards to reduce light pollution in the landscape.

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APPENDIX 1 – Curriculum Vitae

Curriculum Vitae

Jayson David John Orton

ARCHAEOLOGIST AND HERITAGE CONSULTANT

Contact Details and personal information:

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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 –

Memberships and affiliations:

South African Archaeological Society Council member 2004 –
Assoc. Southern African Professional Archaeologists (ASAPA) member 2006 –
ASAPA Cultural Resources Management Section member 2007 –
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 –

Professional Accreditation:

ASAPA membership number: 233, CRM Section member

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)

Fieldwork and project experience:

Extensive fieldwork 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:

Phase 1 surveys and impact assessments:

- Project types
  - Notification of Intent to Develop applications (for Heritage Western Cape)
  - 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 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
- 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

APPENDIX 2 – Palaeontological scoping study

PALAEONTOLOGICAL HERITAGE DESKTOP ASSESSMENT:

PROPOSED SOL INVICTUS SOLAR PV DEVELOPMENT ON PORTION 5 OF FARM OU TAAISBOSMOND 66 NEAR AGGENEYS, NORTHERN CAPE PROVINCE

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November 2015

GEOLOGICAL CONTEXT

The proposed Sol Invictus 1, Sol Invictus 2, Sol Invictus 3 and Sol Invictus 4 PV Facilities (hereafter referred to as the Sol Invictus Solar PV development) on farm Ou Taaibosmond 66 is situated in fairly flat-lying terrain (*c.* 750-950 m amsl) within a very arid desert region to the south of the River Orange. There are several scattered Inselberge (island mountains) of resistant-weathering basement rocks to the north and wesVt surrounded by a sea of wind-blown Kalahari dune sands (orange on satellite images) and other superficial deposits such as braided stream sediments, sheet wash, calcrete and surface gravels (Figure 1). Rocky outcrops within the study area itself are small and mainly restricted to the southwestern corner, while there are no major drainage lines here.

The geology of the Sol Invictus PV study area is shown on 1: 250 000 geological map 2918 Pofadder (Council for Geoscience, Pretoria; Agenbacht 2007) (Figure 2). The region is underlain at depth by a range of resistant-weathering igneous and high grade metamorphic rocks of Late Precambrian (Mokolian / Mid-Proterozoic) age. The various rock units - mainly gneisses, schists, quartzites and amphibolites – crop out at surface in the southwestern corner of the area and are listed in the legend to the geological map. They include representatives of the **Gladkop Metamorphic Suite** (**Koeipoort Gneiss**) and **Little Namaqualand Suite** (**Konkyp Gneiss**). These metamorphic basement rocks are assigned to the **Namaqua-Natal Province** and are approximately two to one billion years old (Cornell *et al.* 2006, Agenbacht 2007, Almond & Pether 2008).

The great majority of the study area – including those portions that are likely to be directly affected by the proposed solar PV development - are underlain by a range of unconsolidated to semi-consolidated superficial sediments of Late Caenozoic age. These include **Quaternary to Recent sands and gravels** of probable fluvial or sheet wash origin (**Q-s_2** in Figure 2) that are locally overlain, and perhaps also underlain, by unconsolidated aeolian (*i.e.* wind-blown) sands of the Quaternary **Gordonia Formation** (**Kalahari Group**) (**Q-s_1** in Figure 2; orange dunes on satellite images, Figure 1). All these sediments can be subsumed into the Late Cretaceous to Recent **Kalahari Group**, the geology of which is reviewed by Partridge *et al.* (2006). The Gordonia dune sands are considered to range in age from the Late Pliocene / Early Pleistocene to Recent, dated in part from enclosed Middle to Later Stone Age stone tools. Note that the recent extension of the Pliocene - Pleistocene boundary from 1.8 Ma back to 2.588 Ma would place the Gordonia Formation almost entirely within the Pleistocene Epoch. A south-north trending drainage line with associated alluvial deposits is mapped outside and just to the east of the study area and is transected by the transmission line corridor to Aggenys Substation. It might be associated with Pleistocene or older fluvial deposits at depth.

Small **uranium deposits** (U) are mapped in the study area – probably associated with surface calcrete – as well as Creatceous **kimberlites** of the Gordonia Province (diamond symbol) (Agenbacht 2007, pp. 76-77)

PALAEONTOLOGICAL HERITAGE

To the author's knowledge, there are no previously recorded fossil sites within the present study area. The Mid-Proterozoic basement rocks of the **Namaqua-Natal Province** are entirely unfossiliferous and will therefore not be considered further here (*cf* Almond & Pether 2008, Almond 2012, Almond 2013).

The various younger superficial deposits of the Bushmanland and Karoo regions of South Africa, including aeolian sands, alluvium, calcretes and pan deposits, have been comparatively neglected in palaeontological terms. However, they may occasionally contain important fossil biotas, notably the bones, teeth and horn cores of mammals as well as remains of reptiles like tortoises. Good examples are the Pleistocene mammal faunas at Florisbad, Cornelia and Erfkroon in the Free State and elsewhere (*e.g.* Cooke 1974, Skead 1980, Klein 1984, Brink, J.S. 1987, Bousman *et al.* 1988, Bender & Brink 1992, Brink *et al*. 1995, MacRae 1999, Churchill *et al*. 2000, Brink & Rossouw 2000, Rossouw 2006). In Bushmanland important fossil mammalian remains assigned to the Florisian Mammal Age (*c*. 300 000 – 12 000 BP; MacRae 1999) have recently been documented from stratigraphic units designated Group 4 to Group 6 (*i.e.* calcrete hardpan and below) at Bundu Pan, some 22 km northwest of Copperton (Kiberd 2006 and refs. therein).

Other late Caenozoic fossil biotas from these arid-region superficial deposits include non-marine molluscs (bivalves, gastropods), ostrich egg shells, trace fossils (*e.g.* calcretised termitaria, coprolites), and plant remains such as peats or palynomorphs (pollens, spores) in organic-rich alluvial horizons (Scott 2000) and siliceous diatoms in pan sediments. Calcrete hardpans might also contain trace fossils such as rhizoliths, termite nests and other insect burrows, or even mammalian trackways. Solution hollows within well-developed calcrete horizons may have acted as fossil traps in the past, as seen in Late Caenozoic limestones near the coast and Precambrian carbonate successions of the Southern African interior. Dense concentrations of vertebrate remains (*e.g.* small mammals, reptiles) or terrestrial molluscs, for example, are a possibility here. In Quaternary deposits, fossil remains may be associated with human artefacts such as stone tools and are also of archaeological interest. Stone artefacts of Pleistocene and younger age may additionally prove useful in constraining the age of superficial deposits such as gravelly alluvium and pedocretes within which they are occasionally embedded.

The fossil record of the **Kalahari Group** as a whole is generally sparse and low in diversity; no fossils are recorded here in the recent Pofadder geology sheet explanation by Agenbacht (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 the underlying 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*) and shells of land snails (*e.g. Trigonephrus*) (Almond 2008, Almond & Pether 2008). Other fossil groups such as freshwater bivalves and gastropods (*e.g. Corbula, Unio*) and snails, 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. Subsurface or exposed 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. Any younger fluvial and alluvial sands and gravels within the proposed development area are unlikely to contain any substantial fossil or subfossil remains.

CONCLUSIONS & RECOMMENDATIONS

The overall impact significance of the proposed Sol Invictus Solar PV development on fossil heritage is considered to be VERY LOW because:

- Most of the study area is underlain by unfossiliferous metamorphic basement rocks (gneisses *etc*) or mantled by superficial sediments of low palaeontological sensitivity;
- Most fossils within the superficial deposits are likely to be of widespread occurrence (*i.e.* not unique), with the exception of rare vertebrate remains;
- Extensive, deep excavations into older alluvial deposits are unlikely to be involved in this solar park project.

It is therefore recommended that exemption from further specialist palaeontological studies and mitigation be granted for this solar plant development.

Should substantial fossil remains be exposed during construction, however, the ECO should safeguard these, preferably *in situ*, and alert SAHRA as soon as possible so that appropriate action (*e.g.* recording, sampling or collection) can be taken by a professional palaeontologist.

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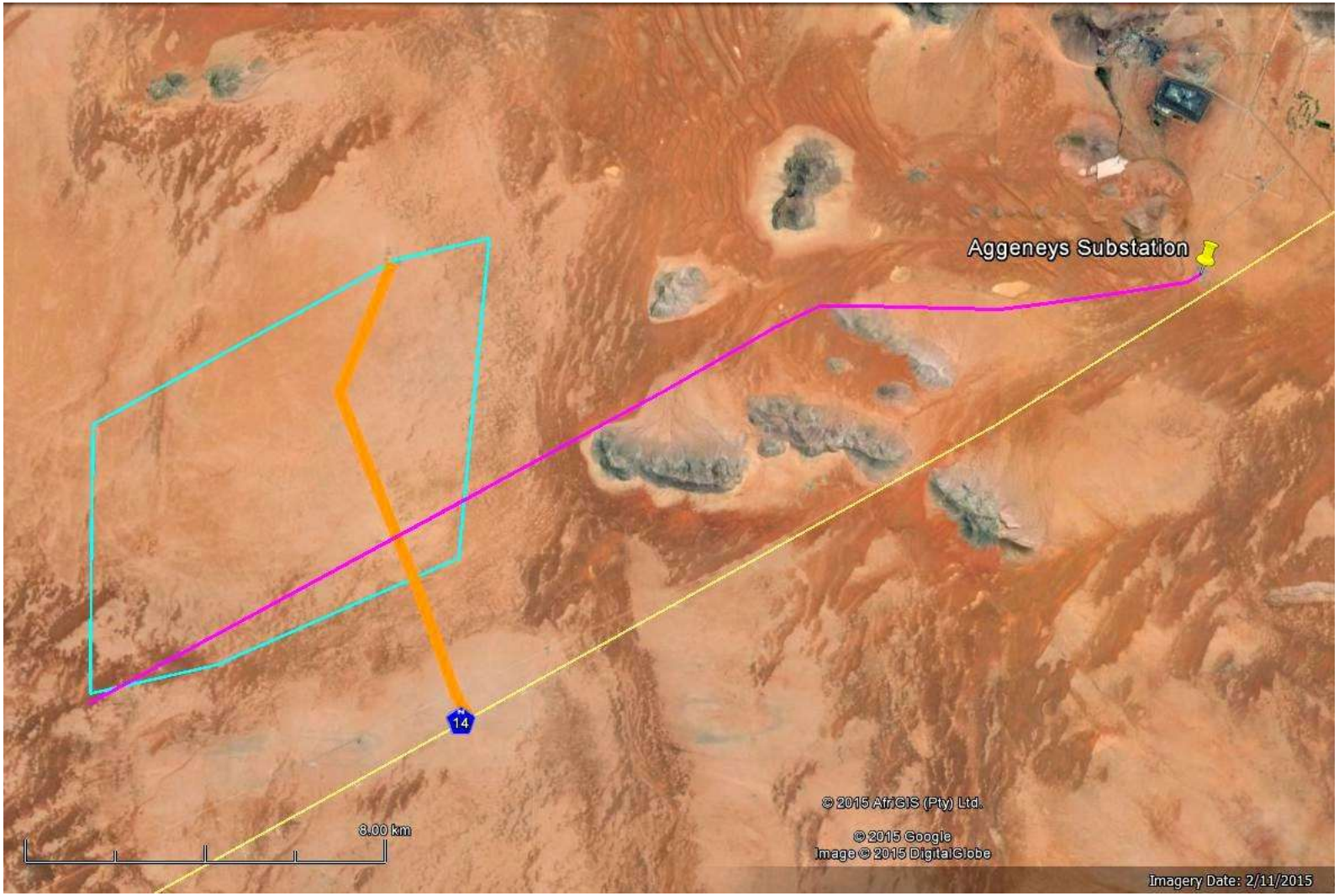

Figure 1. Google earth© satellite image of the study area for the Sol Invictus 600 MW Solar PV development on Portion 5 of Farm Ou Taaisbosmond located *c.* 35 km west-southwest of Aggeneys, Northern Cape Province showing scattered small Inselberge of Precambrian basement rocks to the southwest of the Black Mountain (grey) surrounded by a sea of wind-blown Kalahari sands (orange) and paler alluvial and sheet wash deposits (pale flesh-coloured, calcretised in much of the area). The pink line shows the proposed 132 kV overhead power line connection to Eskom's Aggeneys Substation. The existing access road from the N14 trunk road to the south is shown in orange.

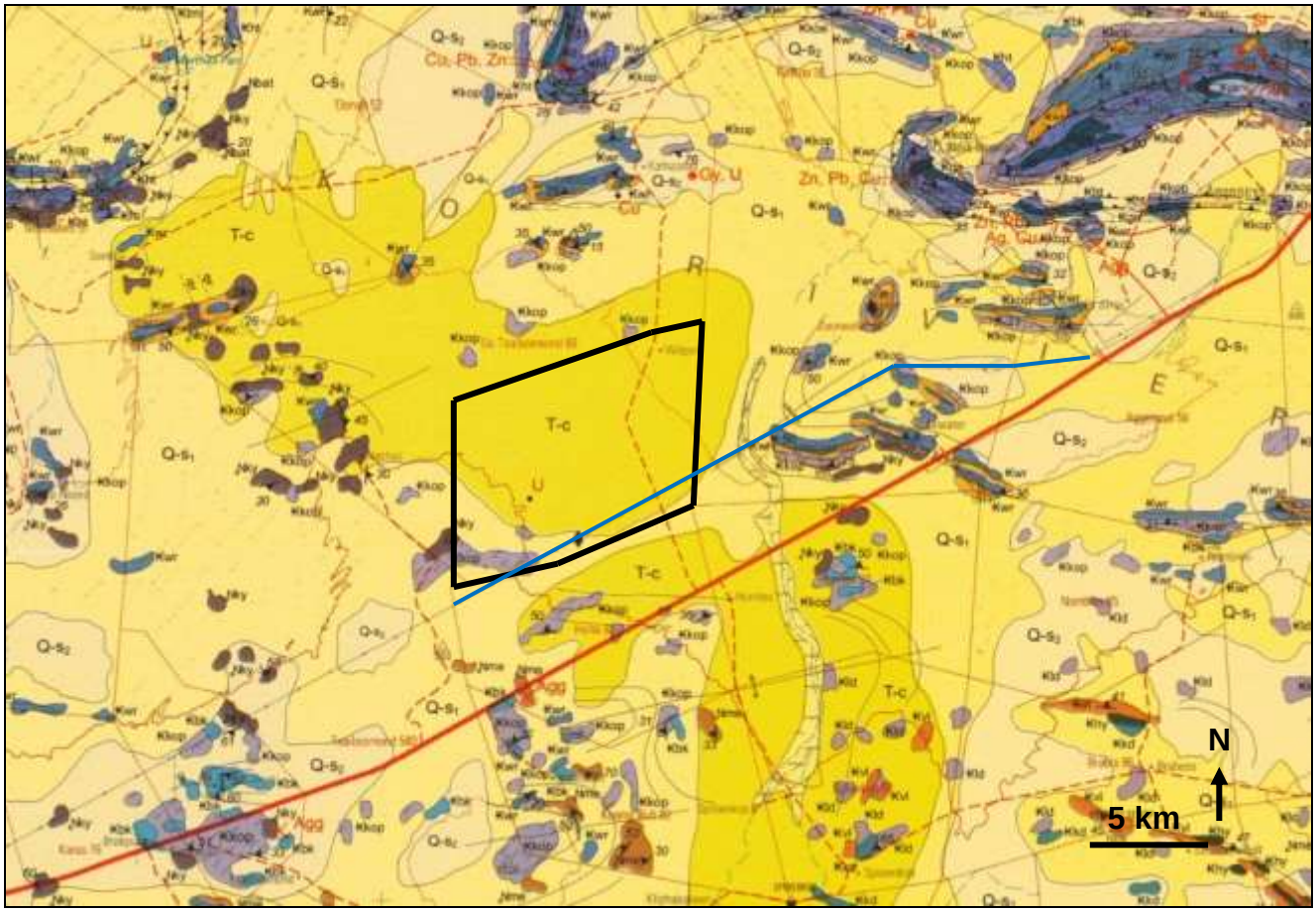

Figure 2. Extract from 1: 250 000 geological map 2918 Pofadder (Council for Geoscience, Pretoria) showing approximate location (black polygon) of the study area for the proposed Sol Invictus 600 MW Solar PV development on Portion 5 of Farm Ou Taaisbosmond 66 situated *c*. 35 km WSW of Aggeneys, Northern Cape. The blue line indicates the proposed 132 kV transmission line connection to Aggenys Substation.

Geological units mapped in the study area include:

(a) Mid Proterozoic (Mokolian) igneous and metamorphic basement rocks

Kwr (blue-grey & buff) = Wortel Formation (Bushmanland Group)
Kkop (grey) = Koeipoort Gneiss (Gladkop Metamorphic Suite)
Nky (brown) = Konkyp Gneiss (Little Namaqualand Suite)

(b) Late Caenozoic superficial sediments

Q-s_1 (medium yellow) = red aeolian sands of the Gordonia Formation (Kalahari Group) and Q-s_2 (pale yellow) = sand, scree, rubble and sandy soil
T-C (dark yellow) = Tertiary / Quaternary calcrete

(c) Mineral occurrences

U = uranium deposit
Diamond symbol = kimberlite

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 and Madagascar. 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 numerous palaeontological impact assessments for developments and conservation areas in the Western, Eastern and Northern Cape, Free State, Northwest, Mpumalanga and Gauteng under the aegis of his Cape Town-based company *Natura Viva* cc. He was 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 APHAP (Association of Professional Heritage Assessment 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 development 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 Viva* cc**