

HERITAGE IMPACT ASSESSMENT FOR FOUR PROPOSED PHOTOVOLTAIC SOLAR ENERGY FACILITIES ON THE FARM ZUURWATER NEAR AGGENEYS, NORTHERN CAPE PROVINCE (EXPANDED SURVEY)

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1. Introduction: background

Previously, a phase 1 heritage impact assessment was carried out with respect to a photovoltaic energy generation facility on the farm Zuurwater 62 south west of Aggeneys and adjacent to the N14 between Springbok and Pofadder in the Northern Cape (Morris 2011, for SATO Energy Holdings). PVAfrica Development (Pty) Ltd is the new applicant for the Zuurwater project. The applicant has amended two of the originally authorised 7 phases, and has been granted the request for five of their seven authorised units to lapse. PVAfrica Development (Pty) Ltd is now making application for four replacement projects occupying the same land space, but with a new layout.

Each of the four phases of the proposed project will accommodate several arrays of photovoltaic (PV) panels and associated infrastructure. Each Phase is proposed to have stand-alone infrastructure, as each Phase will be developed separately. Each Phase will comprise the following typical infrastructure which is included in the scope of this EIA:

- » Arrays of either static or tracking, photovoltaic (PV) panels.
- » Mounting structures to be either rammed steel piles or piles with pre-manufactured concrete footings to support the PV panels.
- » Cabling between the project components, to be lain underground.
- » Power inverters between the PV arrays.
- » A new on-site substation and power lines to evacuate the power from each Phase into the Eskom grid via the Aggeneis MTS substation.
- » Internal access roads.
- » Water storage facilities
- » Office, workshop area for maintenance and storage.
- » During construction (temporary infrastructure) such as housing for workers and a laydown area will also be required.

The author was approached by Savannah Environmental (Pty) Ltd (PO Box 148, Sunninghill, 2157 <http://www.savannahsa.com/> attn Karen Jodas, E-mail:

karen@savannahSA.com; Cell: 082 655 1935; Tel: 011 656 3237; Fax: 086 684 0547) to revise the existing Heritage Impact Assessment (principally archaeology) based on observations made in 2011 and subject to ground-truthing prior to construction.

However, uncertainty about parts of the terrain not covered in the 2011 survey necessitated a return to the property to investigate the areas to be effected by a changed lay-out. This document is a revised version of the provisional desk-top report of February 2013 and reports on a proposed no-go area within the proposed Phase 4 layout.

1.1 Focus and Content of Specialist Report

The archaeology specialist study is focused on the development footprint of the proposed PV development areas.

This specialist study is a stand-alone report (as per the EIA Regulations) and incorporates the following information:

- » Introduction (1)
 - Focus and content of report (1.1)
 - Archaeology specialist (1.2)
- » Description of the affected environment (2)
 - Heritage features of the area (2.1)
 - Description and evaluation of environmental issues and potential impacts identified (2.2)
- » Methodology (3)
 - Assumptions and limitations (3.1)
 - Potentially significant impacts to be assessed (3.2)
 - Description and evaluation of environmental issues (3.3)
 - Determining archaeological significance (3.4)
- » Observations and assessment of impacts (4)
 - Fieldwork observations (4.1)
 - Characterising the archaeological significance (4.2)
 - Characterising the significance of impacts including a summary in tabular format together with Measures for inclusion in the draft EMP (4.3)
- » Conclusions (5)
- » References (6)

1.2 Archaeology/heritage Specialist

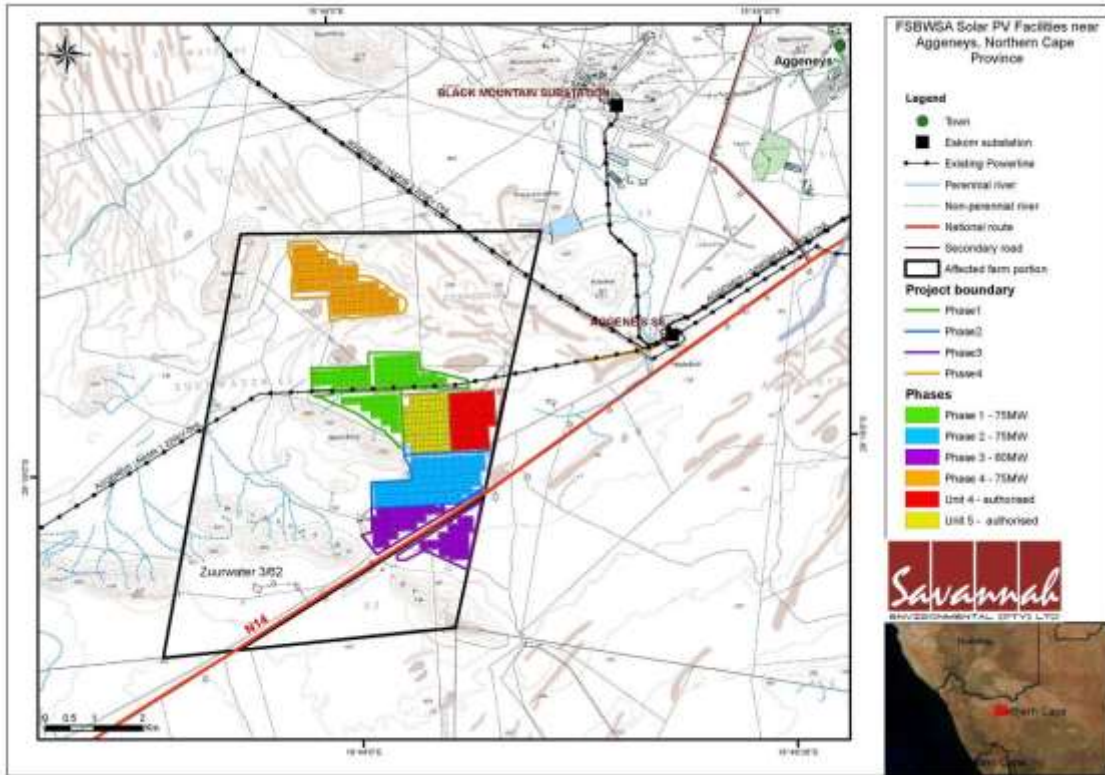
The author of this report is an archaeologist (PhD) accredited as a Principal Investigator by the Association of Southern African Professional Archaeologists. I have previously carried out surveys in the vicinity of the proposed activity (Morris 1999a-b, 2000a-c, 2001, 2010). In addition, the author has received UCT-accredited training in Architectural and Urban Conservation: researching and assessing local heritage environments (S. Townsend, UCT), and is familiar with the broad history of the Northern Cape.

I work independently of the organization commissioning this specialist input, and I provide these preliminary scoping observations within the framework of the National Heritage Resources Act (No 25 of 1999).

The National Heritage Resources Act no. 25 of 1999 (NHRA) protects heritage resources which include archaeological and palaeontological objects/sites older than 100 years, graves older than 60 years, structures older than 60 years, as well as intangible values attached to places. The Act requires that anyone intending to disturb, destroy or damage such sites, objects and/or structures may not do so without a permit from the relevant heritage resources authority. This means that a Heritage Impact Assessment should be performed, resulting in a specialist report as required by the relevant heritage resources authority/ies to assess whether authorisation may be granted for the disturbance or alteration, or destruction of heritage resources.

2. DESCRIPTION OF THE AFFECTED ENVIRONMENT

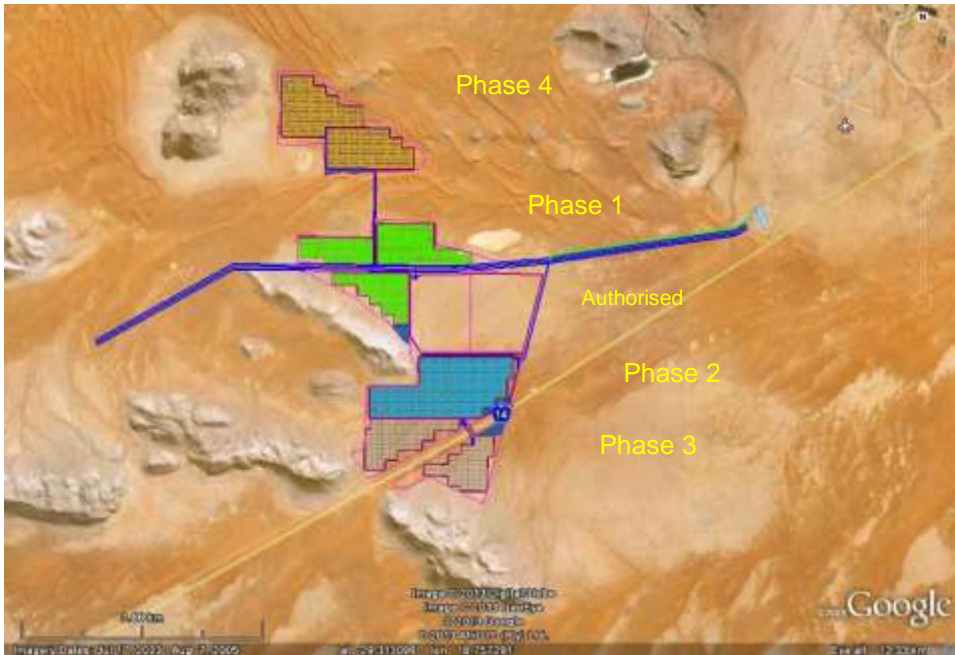
The environment in question is arid, comprising relatively flat drainage plains with inselbergs such as the Aggeneys Mountains, Black Mountain and Gamsberg rising above the plains in the wider landscape. In the immediate vicinity hills feature prominently, particularly the Windhoek se Berge, Skelmberg and Hoedkop. The landscape is sparsely vegetated, therefore making any surface archaeological traces highly visible. The area investigated includes parts of dune fields, generally deflated sandy plains and the lower slopes of hills strewn with scree gravitating down-slope.



Map of the area showing project area and proposed layout south west of Aggeneys.

The four phases proposed form part of a larger development of up to 370MW in capacity (comprising six units in total, the "Project"). The four phases to be considered, whose spatial extent is shown in the maps above and below, are as follows:

Unit Number	Output	Area(Hectares)	Coordinates for Central Point of the Unit	
			Latitude	Longitude
Unit 1	75MW	267ha	29°18'14.30"S	18°44'27.92"E
Unit 2	75MW	209ha	29°19'13.77"S	18°45'10.93"E
Unit 3	75MW	192ha	29°19'44.35"S	18°44'50.13"E
Unit 4	53MW	222ha	29°16'59.83"S	18°43'56.47"E

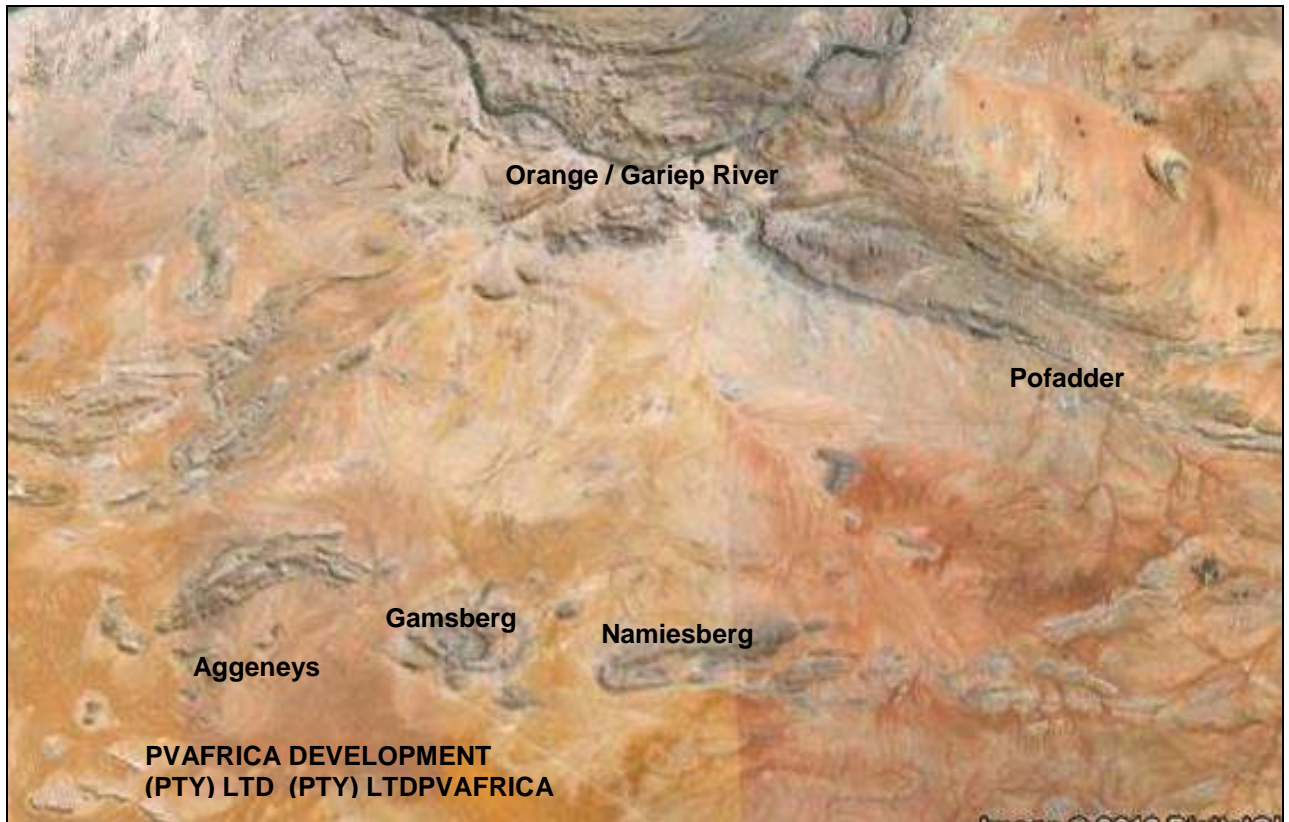


Proposed Phases 1-4 and already authorized units, with ancillary infrastructure including power line routes superimposed on Google Earth image

2.1 Description of heritage features of the region

2.1.1 Colonial frontier

As has been indicated in a similar survey of an area adjacent to Aggeneys (Morris 2011), the eighteenth- and nineteenth-century records for this region (Penn 2005) include the travelogues of George Thompson (1827) and E.J. Dunn (1931, Robinson 1978), who visited the area in 1824 and 1872 respectively. Place names were becoming fixed in this colonial frontier period (in a cadastral sense, on maps and in farm names), many such names having Khoe-San origins encapsulating vestiges of precolonial/indigenous social geography. A much more prominent appreciation is now emerging concerning the history of genocide against the Bushmen in this area (Anthing 1863), with certain mountainous areas (like Gamsberg and Namiesberg near Aggeneys) being likely massacre sites, referred to by Dunn in 1872 (Robinson 1978) and, more obliquely, by Anthing (1863; de Prada-Samper 2011).



Regional focus: the study area relative to Aggeneys and some other places mentioned.

2.1.2 Later Stone Age

Late Holocene Later Stone Age (LSA) sites are the predominant archaeological trace noted in past surveys in the Aggeneys-Pofadder region (Morris 1999a-b, 2000a-c, 2001, 2010, 2013). Beaumont *et al.* (1995) have shown, with reference to the LSA, that “virtually all the Bushmanland sites so far located appear to be ephemeral occupations by small groups in the hinterland on both sides of the [Orange] river” (1995:263). This was in sharp contrast to the substantial herder encampments along the Orange River floodplain itself (Morris & Beaumont 1990), which reflected the “much higher productivity and carrying capacity of these bottom lands.” “Given choice, the optimal exploitation zone for foragers would have been the Orange River.” The appearance of herders in the Orange River Basin, Beaumont *et al.* argue, led to competition over resources and ultimately to marginalisation of hunter-gatherers, some of whom then occupied Bushmanland, probably mainly in the last millennium, and focused their hunting and gathering activities around the limited

number of water sources in the region. Surveys have located signs of human occupation mainly in the shelter of granite inselbergs, on red dunes which provided clean sand for sleeping, or around the seasonal pans (Beaumont *et al.* 1995:264). Possibly following good rains, herders moved into the Orange River hinterland, as attested archaeologically at sites with ample pottery near Aggeneys and, east of Pofadder, at Schuitdrift South – Morris 1999a). However, Thompson (1824) refers to herder groups settled at the stronger springs such as Pella dispersing during periods of drought to smaller springs in the region, which could equally well account for the traces referred to here. At such times competition between groups over resources and stress within an already marginalised hunter-gatherer society, must have intensified.

Grinding grooves have been found on rock outcrops in the Aggeneys/Gamsberg area (Morris 2011) and rock paintings are known from a boulder site alongside the Aggeneys/Black Mountain aggregate quarry (Morris 2011). More recently, important engraved cupule sites have been identified at two sites on Black Mountain Mining property, Aggeneys and at the foot of the Swartberg on Zuurwater 62 (Morris 2013).

2.1.3 Pleistocene: Middle and Earlier Stone Age

Beaumont *et al.* (1995:240-1) note a widespread low density stone artefact scatter of Pleistocene age across areas of Bushmanland to the south where raw materials, mainly quartzite cobbles, were derived from the Dwyka till. Systematic collections of this material made at Olyvenkolk, south west of Kenhardt and Maans Pannen, and east of Gamoep, could be separated out by abrasion state into a fresh component of Middle Stone Age (MSA) with prepared cores, blades and points, and a large aggregate of moderately to heavily weathered Earlier Stone Age (ESA).

Beaumont *et al.* have shown that “substantial MSA sites are uncommon in Bushmanland” (1995:241): and those that have been documented thus far have generally yielded only small samples (Morris & Beaumont 1991; Smith 1995).

The ESA included Victoria West cores on dolerite, long blades, and a very low incidence of handaxes and cleavers. The Middle (and perhaps in some instances Lower) Pleistocene occupation of the region that these artefacts reflect must have

occurred at times when the environment was more hospitable than today. This is suggested by the known greater reliance of people in Acheulean times on quite restricted ecological ranges, with proximity to water being a recurrent factor in the distribution of sites.

No substantial sites have been found previously in the survey area. Only very sparse localized scatters of stone tools have been seen in places, with limited traces in the hills (e.g. an MSA site at the top of Gamsberg) or at the bases of hills. ESA including a Victoria West core on quartzite has been noted within the Gamsberg basin (Morris 2010).

2.2 Description and evaluation of environmental issues and potential impacts identified

Heritage resources including archaeological sites are in each instance unique and non-renewable resources. Developments such as those envisaged can have a permanent destructive impact on these resources. The objective of an EIA would be to assess the sensitivity of such resources where present to assess the significance of potential impacts on these resources and to recommend no-go areas and measures to mitigate or manage said impacts.

Area impacts are possible in the case of the Zuurwater PV development and associated infrastructure, if heritage traces occur.

2.2.1 Direct, indirect and cumulative impacts (in terms of nature, magnitude and extent)

The destructive impacts that are possible in terms of heritage resources would tend to be direct, once-off events occurring during the initial construction period. In the long term, the proximity of operations in a given area could result in secondary indirect impacts resulting from the movement of people or vehicles in the immediate or surrounding vicinity.

3. METHODOLOGY

A site visit was necessary to inspect various parts of the terrain on foot, focusing on areas of expected impact. Heritage traces would be evaluated in terms of their archaeological significance (see tables below).

3.1 Assumptions and limitations

It was assumed that, by and large in this landscape, with its sparse vegetation and shallow soil profiles, some sense of the archaeological traces to be found in the area would be readily apparent from surface observations (including assessment of places of erosion or past excavations that expose erstwhile below-surface features). It was not considered necessary to conduct excavations as part of the EIA to establish the potential of sub-surface archaeology. Dunes may mask sub-surface traces, but a number of erosion and deflation areas afforded opportunities to assess this possibility.

A proviso is routinely given, that should sites or features of significance be encountered during construction (this could include an unmarked burial, an ostrich eggshell water flask cache, or a high density of stone tools, for instance), specified steps are necessary (cease work, report to heritage authority).

3.2 Predictions

There was no explicit scoping phase to this particular heritage input other than the review given above on the colonial and precolonial history of the area. It was expected that features such as rock outcrops or the immediate footslopes of hills might be places where Stone Age and probably also colonial era traces would occur, if present. Previous experience has shown that the flat plains away from such features are almost entirely bereft of heritage traces. The dunes may also have been a focus of past human activity.

3.3 Potentially significant impacts to be assessed in the EIA process

Any area or linear, primary and secondary, disturbance of surfaces in the development locales could have a destructive impact on heritage resources, where present. In the event that such resources are found, they are likely to be of a nature that potential impacts could be mitigated by documentation and/or salvage following approval and permitting by the South African Heritage Resources Agency and, in the case of any built environment features, by Ngwao Bošwa ya Kapa Bokone (the Northern Cape Heritage Authority). Although unlikely, there may be some that could

require preservation *in situ* and hence modification of intended placement of development features.

Disturbance of surfaces includes any construction including any *clearance* of, or *excavation* into, a land surface. In the event of archaeological materials being present such activity would alter or destroy their context (even if the artefacts themselves are not destroyed, which is also obviously possible). Without context, archaeological traces are of much reduced significance. It is the contexts as much as the individual items that are protected by the heritage legislation.

3.4 Determining archaeological significance

In addition to guidelines provided by the National Heritage Resources Act (Act No. 25 of 1999), a set of criteria based on Deacon (nd) and Whitelaw (1997) for assessing archaeological significance has been developed for Northern Cape settings (Morris 2000a). These criteria include estimation of landform potential (in terms of its capacity to contain archaeological traces) and assessing the value to any archaeological traces (in terms of their attributes or their capacity to be construed as evidence, given that evidence is not given but constructed by the investigator).

Estimating site potential

Table 1 (below) is a classification of landforms and visible archaeological traces used for estimating the potential of archaeological sites (after J. Deacon nd, National Monuments Council). Type 3 sites tend to be those with higher archaeological potential, but there are notable exceptions to this rule, for example the renowned rock engravings site Driekopseiland near Kimberley which is on landform L1 Type 1 – normally a setting of lowest expected potential. It should also be noted that, generally, the older a site the poorer the preservation, so that sometimes *any* trace, even of only Type 1 quality, can be of exceptional significance. In light of this, estimation of potential will always be a matter for archaeological observation and interpretation.

Assessing site value by attribute

Table 2 is adapted from Whitelaw (1997), who developed an approach for selecting sites meriting heritage recognition status in KwaZulu-Natal. It is a means of judging a site's archaeological value by ranking the relative strengths of a range of attributes (given in the second column of the table). While aspects of this matrix remain qualitative, attribute assessment is a good indicator of the general archaeological significance of a site, with Type 3 attributes being those of highest significance.

Table 1. Classification of landforms and visible archaeological traces for estimating the potential for archaeological sites (after J. Deacon, National Monuments Council).

Class	Landform	Type 1	Type 2	Type 3
L1	Rocky surface	Bedrock exposed	Some soil patches	Sandy/grassy patches
L2	Ploughed land	Far from water	In floodplain	On old river terrace
L3	Sandy ground, inland	Far from water	In floodplain or near feature such as hill	On old river terrace
L4	Sandy ground, Coastal	>1 km from sea	Inland of dune cordon	Near rocky shore
L5	Water-logged deposit	Heavily vegetated	Running water	Sedimentary basin
L6	Developed urban	Heavily built-up with no known record of early settlement	Known early settlement, but buildings have basements	Buildings without extensive basements over known historical sites
L7	Lime/dolomite	>5 myrs	<5000 yrs	Between 5000 yrs and 5 myrs
L8	Rock shelter	Rocky floor	Sloping floor or small area	Flat floor, high ceiling
Class	Archaeological traces	Type 1	Type 2	Type 3
A1	Area previously excavated	Little deposit remaining	More than half deposit remaining	High profile site
A2	Shell or bones visible	Dispersed scatter	Deposit <0.5 m thick	Deposit >0.5 m thick; shell and bone dense
A3	Stone artefacts or stone walling or other feature visible	Dispersed scatter	Deposit <0.5 m thick	Deposit >0.5 m thick

Table 2. Site attributes and value assessment (adapted from Whitelaw 1997)

Class	Attribute	Type 1	Type 2	Type 3
1	Length of sequence/context	No sequence Poor context Dispersed distribution	Limited sequence	Long sequence Favourable context High density of arte/ecofacts
2	Presence of exceptional items (incl regional rarity)	Absent	Present	Major element
3	Organic preservation	Absent	Present	Major element
4	Potential for future archaeological investigation	Low	Medium	High
5	Potential for public display	Low	Medium	High
6	Aesthetic appeal	Low	Medium	High

7	Potential for implementation of a long-term management plan	Low	Medium	High

4. OBSERVATIONS AND ASSESSMENT OF IMPACTS

The manner in which archaeological and other heritage traces or values might be affected by the proposed development may be summed up in the following terms: it would be any act or activity that would result immediately or in the future in the destruction, damage, excavation, alteration, removal or collection from its original position, any archaeological material or object (as indicated in the National Heritage Resources Act (No 25 of 1999)). The most obvious impact in this case would be land surface disturbance associated with infrastructure construction.

4.1 Fieldwork observations

The proposed development footprint areas on the farm Zuurwater 62 (Portion 3) were visited on 6 December 2011, and further parts of the property in May 2013. In summary the findings can be reported in relation to predictions made in Section 3.2 above.

4.1.1 Reduced archaeological visibility away from landscape features such as hills and rock outcrops:

This notion was not contradicted in the areas surveyed. What was found on the sandy plains was an extremely low incidence of any form of artefact whatsoever, whether Stone Age or colonial in age, other than those associated with a) the 'old' twentieth century gravel road (Springbok-Aggeneys) – including remains of bottles and cans thrown from passing traffic (testimony to de facto drinking and driving!) – and periodic old cast cement 'milestones'; and b) late twentieth century encampments of fencing teams.



The plains are veneered with sand, an unconsolidated layer generally thinly spread on a harder older crust of sand. Red dunes of Aeolian sand with occasional deflation zones occur in the vicinity. Almost no artefacts were found in association. On the plains, then, extremely minimal traces were found. A single quartz flake was noted at in an erosion feature at 29.32997° S 18.74865° E; and, intriguingly, a single quartz biface (ESA) was found in a deflation area at 29.33123° S 18.74606° E. No other artefacts or notable features were found in association with these.



Deflation hollow – handaxe in foreground.

Such completely isolated single-artefact finds could not be considered as constituting “sites” in a conventional archaeological or heritage sense.



A completely isolated flake found at 29.32997° S 18.74865° E
This place is designated Zuurwater Site 1



Isolated handaxe at 29.33123° S 18.74606° E.
This find is designated as Zuurwater 2.



'Milestone' on old gravel road at 29.31522° S 18.76377° E, designated as Zuurwater 3.



Late twentieth/early twenty-first century fencing team camp site at 29.2756° S 18.7188° E, designated as Zuurwater 4.

4.1.2 Higher archaeological visibility at or around landscape features such as hills and rock outcrops:

This expectation was confirmed in a few notable instances (4.1.2.1 and 4.1.2.2 below), although in most instances on the property examined the foot-slopes of hills turned out to be inhospitably rugged, comprising broken scree with angular cobbles gravitating towards the plain. These latter places lack the kinds of substantial boulders or outcrops of rock that would provide shelter or !goras (hollows where water would pool following rains) that might have attracted past human inhabitation.



Unlike the situation at the nearby Black Mountain locale (see 2.1.2 above, Morris 2013), there were no large boulders such as support a single finger painting site there or the engraved cupules identified at the foot of Swartberg (at the northern end of Zuurwater); nor were there the kinds of gently sloping bedrock exposures bearing LSA grinding surfaces, as noted at Black Mountain, Aggeneys and Bloemhoek east and north east from Zuurwater (Morris 2010, 2011, 2013).

4.1.2.1 Sites at foot of Hoedkop

A cluster of sites, here designated as Zuurwater 5, was found at the southwestern foot of Hoedkop, in the vicinity of 29.28827° S 18.71053° E, is situated clear of the proposed solar panel array relating to Phase 4 of the proposed project. The sites occur in the shadow or and between large boulders and consist of surface scatters of stone artefacts based on quartz and ostrich eggshell fragments. On a flat surface on one of the boulders a narrow grinding groove was found, similar to those found on several other sites in the region (Morris 2013). The sites are not likely to be impacted directly by the proposed development, but management of construction and operational phases needs to ensure that there are no secondary impacts at these places.



Large boulders at the foot of Hoedkop providing sheltered locales used in Later Stone Age times.

4.1.2.2 Site on 'Sandkop'

A rocky outcrop at the crest of what is locally called 'Sandkop', situated between 29.28490° S 18.73832° E and 29.28517° S 18.74018° E, was found to represent a remarkable wealth of Ceramic Later Stone Age remains, together with numerous grinding grooves, and evidence of utilisation of the outcrop in the colonial era. This site is designated in this report as Zuurwater 6. At the western end of the outcrop a !gora occurs, where water would pool after rains, and in the immediate vicinity are several grinding grooves. Similar grinding grooves occur on all the major outcrops extending about 15 m eastwards from this point. At the eastern-most end, an upper grindstone was found alongside one of the grinding grooves. Particularly in a sandy saddle, but scattered along the entire length of the outcrop is a fairly dense scatter of stone tools (quartz as well as fine-grained crypto-crystalline silicates probably derived from the Orange River north of here), with ostrich eggshell fragments (probably mainly from water flasks), and fine grint-tempered pot-sherds.



!Gora in foreground (29.28494° S 18.73893° E); Hoedkop in the distance.



Numerous grinding grooves and ground surfaces, and upper grindstone (white stone at centre of image) alongside (see also below),
at 29.28511° S 18.74023° E





Potsherd in situ: the sandy saddle between outcrops (below, at 29.28511° S 18.73961° E) has a high density of Later Stone Age artefacts, pottery and ostrich eggshell fragments.





Sheltered areas below the outcrops have concentrations of artefacts, testimony to use of these places that afford shade.

In addition to the traces of Later Stone Age occupation of this rocky outcrop, there are indications of stones being packed to create a rectangular structure (photo below), very likely a feature from the early colonial history of the area. Alongside the walling is a hollow in the rock, with a stone placed to block access, indicative of utilisation of this feature for storage/hiding of possessions or provisions.





Plan view of the packed-stone feature (above), at 29.28527° S 18.73977° E, and hollow in wall with stone for closing it as storage space (below).



This is one of the richest such Later Stone Age sites documented thus far in the area, with added significance in terms of colonial era utilisation of the landscape, and it should be regarded as off-limits for development in relation to the present project. It is recommended that

this locale (situated between 29.28490° S 18.73832° E and 29.28517° S 18.74018° E) should be avoided in terms of PV array layout for Phase 4, and that a buffer zone be established to prevent encroachment closer than 100 m from the edges of the rock outcrops at this site.

4.2 Characterising the archaeological significance (Refer to 3.4 above)

4.2.1 Sandy plains

In terms of the significance matrices in Tables 1 and 2 under 3.4 above, the archaeological observations made over most of the property examined (with the notable exception of sites 5 and 6, the observations noted under paragraphs 4.1.2.1 & 4.1.2.2) fall under Landform L3 Type 1. In terms of archaeological traces on areas of proposed development all Table 1 ascriptions reflect poor contexts and likely low significance for these criteria.

For site attribute and value assessment (Table 2), most of the observations noted (including sites 1-4) fall under Type 1 for Classes 1-7, again reflecting low significance, low potential and absence of contextual and key types of evidence.

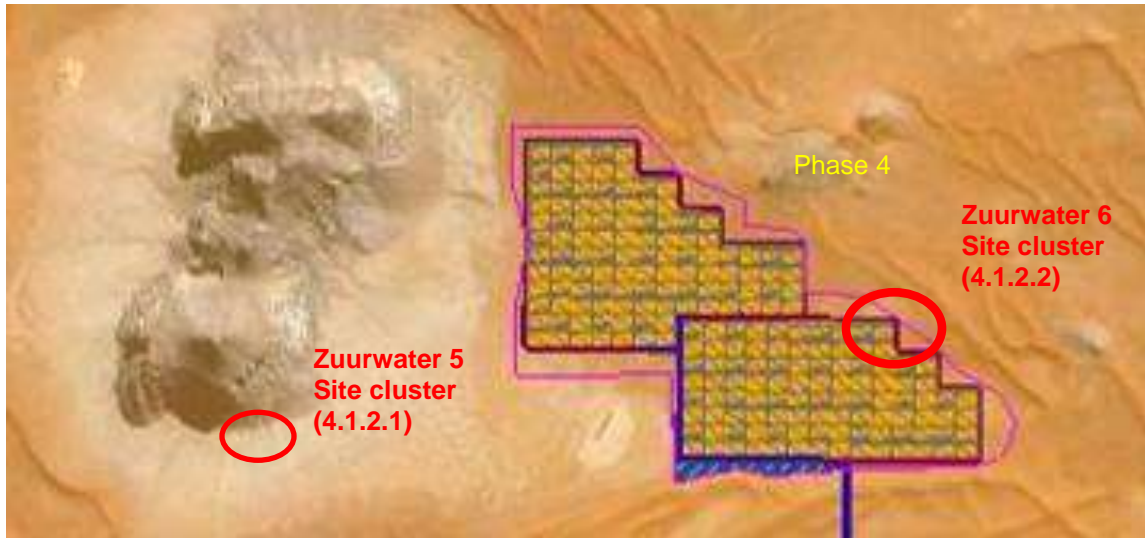
See Impact Assessment Significance Matrix for Phases 1-3 at 4.3.1 below.

4.2.2 Near rock outcrops

In terms of the significance matrices in Tables 1 and 2 under 3.4 above, the archaeological observations made in proximity to rocky places in the landscape and where large boulders afford shelter, suggest that the sites 5 and 6 noted under paragraphs 4.1.2.1 & 4.1.2.2 (affecting the area designated as Phase 4 in this development) fall under Landform L3 Type 2 and Class A3 Type 2. For site attribute and value assessment (Table 2), the observations noted for these sites fall under Type 2 or 3 (reflecting medium to high significance and potential).

In the case of the area designated as Phase 4 in this development (see Google Earth maps on next page), therefore, a site of high significance (site 6 described in section 4.1.2.2) is identified. It is recommended that this locale (situated between 29.28490° S 18.73832° E and 29.28517° S 18.74018° E) should be avoided in terms of PV array layout, and that a buffer zone be established to prevent encroachment closer than 100 m from the edges of the rock outcrops at this site.

The site cluster (site 5) identified in paragraph 4.1.2.1 in this report is at the southern foot of Hoedkop, well to the west of the development: but care should be taken that no secondary impacts extend to this vicinity.



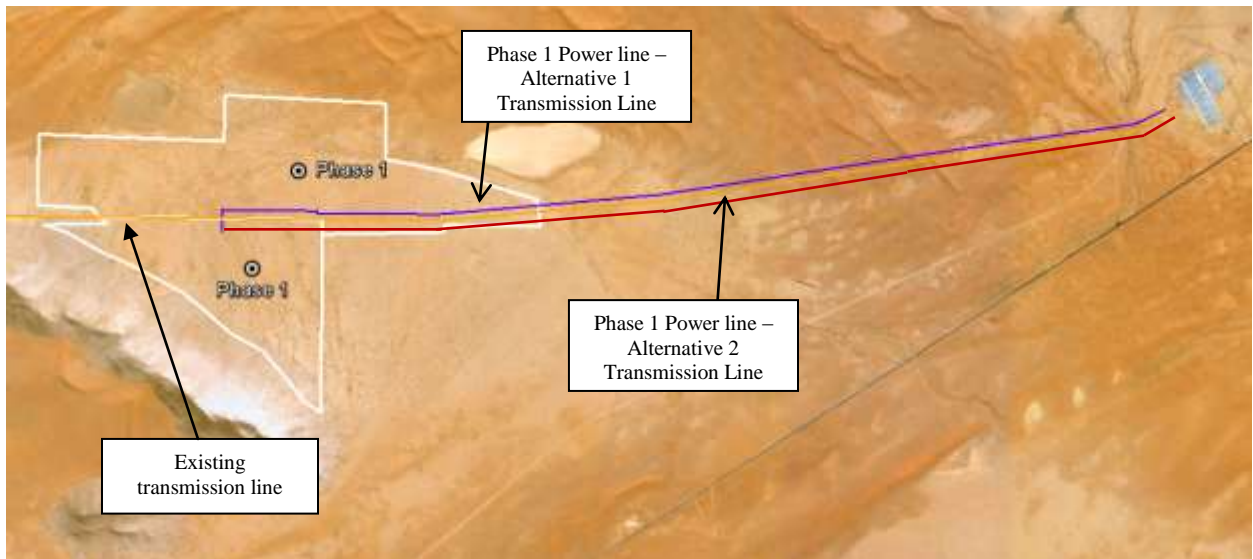
The site cluster Zuurwater 6 described in paragraph 4.1.2.2 is identified relative to the Phase 4 PV array layout plan. Situated at the northern edge of the array, it is recommended that layout be adjusted to avoid impacting on the locale.

See Impact Assessment Significance Matrix for Phase 4 at 4.3.2 below.

4.2.3 Powerline route alternatives

Phase 1

The Phase 1 Powerline route alternatives 1 and 2 both would run parallel with the existing powerline that traverses the property west to east, as shown in the map below.



With regard to magnitude and extent of the potential impacts of powerlines, it has been noted that their erection, with non-permanent 'twee-spoor' access tracks, generally has a relatively small impact on Stone Age sites. Sampson's (1985) observations show this from surveys beneath power lines in the Karoo (actual modification of the landscape tends to be limited to the footprint of each pylon). A more permanent road would tend to be far more destructive (modification of the landscape surface within a continuous strip), albeit relatively limited in spatial extent, i.e. width.

On archaeological grounds there is no reason to prefer one or another of the alternative routes for Phase 1.

See Impact Assessment Significance Matrix for Powerline alternative routes for Phase 1 at 4.3.3 below.

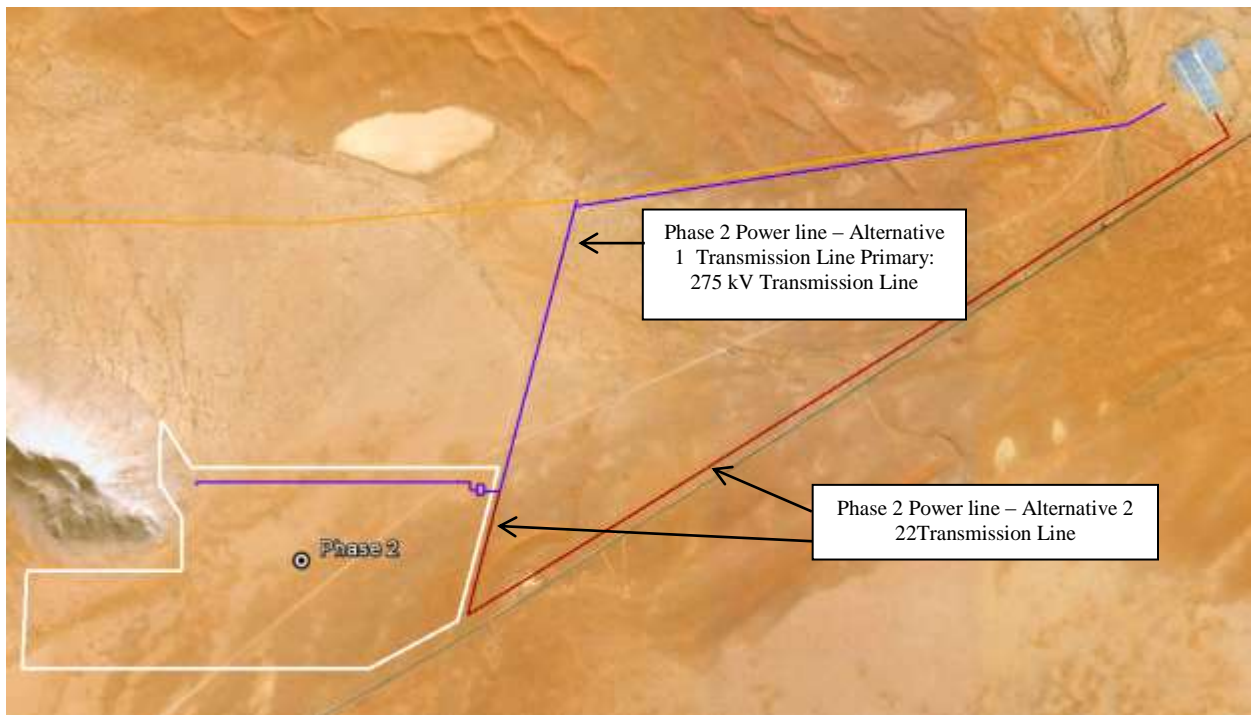
Phase 2

The Phase 2 Powerline route alternative 1 would run parallel with the existing transmission line before swinging south and then west towards the anticipated Phase 2 PV array; whereas route alternative 2 would run parallel with the N14 road from

the substation near Aggeneys, then north and then west to the Phase 2 PV array, as shown in the map below.

The same observation as was noted above with regard to the impact of powerlines (Sampson 1985) applies.

On archaeological grounds there is no reason to prefer one or another of the alternative routes for Phase 2. However in terms of visual impact (although the author is not a specialist qualified to pronounce on visual impacts) it may be preferable to opt for alternative 1.



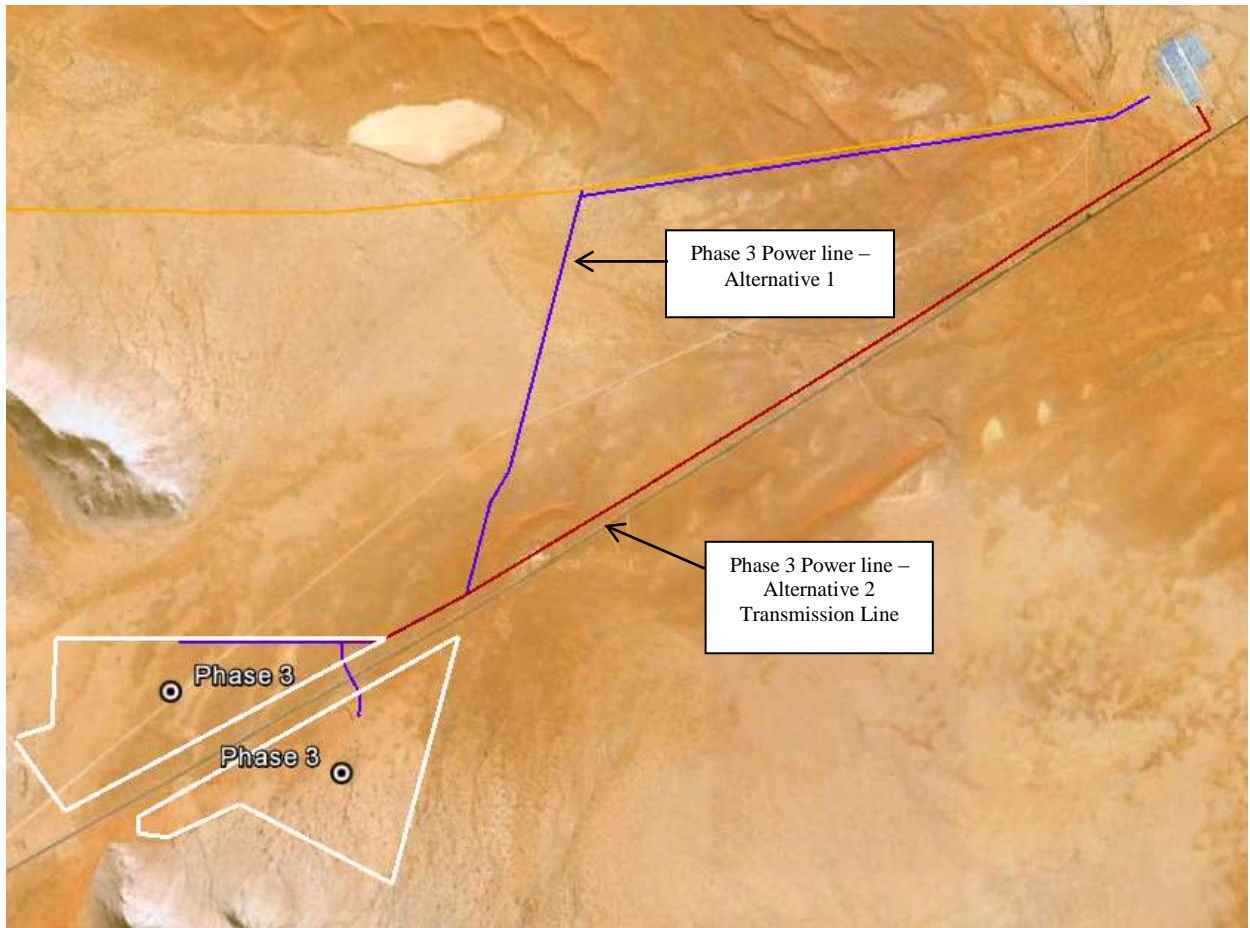
See Impact Assessment Significance Matrix for Powerline alternative routes for Phase 2 at 4.3.4 below.

Phase 3

The Phase 3 Powerline route alternative 1 would run parallel with the existing transmission line before swinging south (parallel with alternative 1 in Phase 2) and then south-westwards/southwards towards the anticipated Phase 3 PV arrays; whereas route alternative 2 would run parallel with the N14 road from the substation near Aggeneys (parallel with alternative 2 in Phase 2), towards the Phase 3 PV arrays, as shown in the map below.

The same observation as was noted above with regard to the impact of powerlines (Sampson 1985) applies.

On archaeological grounds, again, there is no reason to prefer one or another of the alternative routes for Phase 3, but in terms of visual impact it may be preferable to opt for alternative 1.



See Impact Assessment Significance Matrix for Powerline alternative routes for Phase 3 at 4.3.5 below.

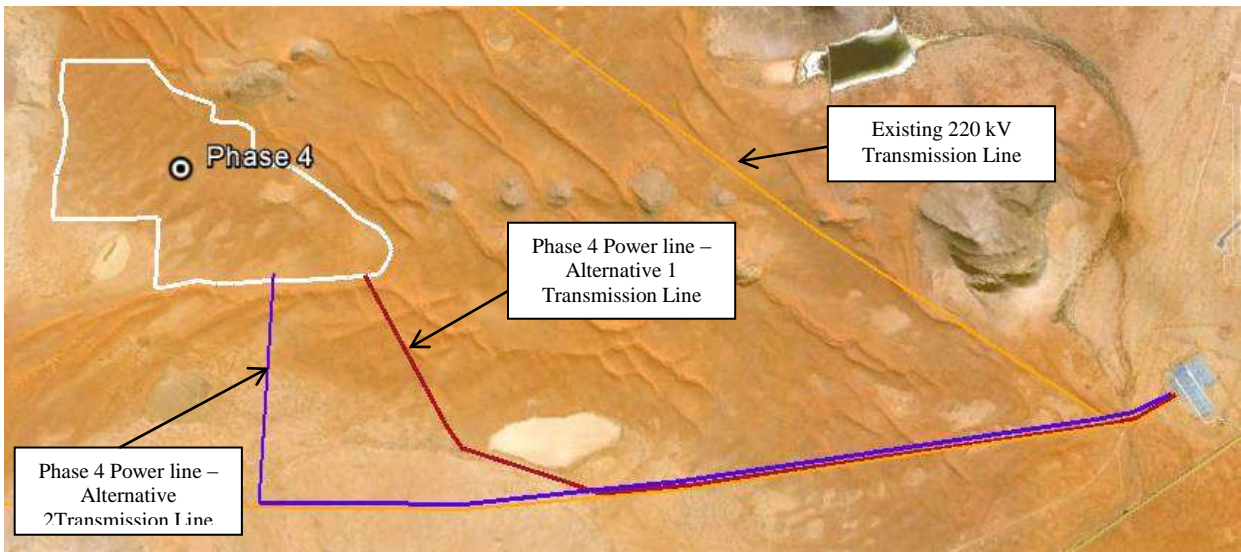
Phase 4

The Phase 4 Powerline route alternative 1 would run parallel with the existing transmission line before swinging north towards the anticipated Phase 4 PV arrays;

whereas route alternative 2 would follow the same route but swinging sooner, north westwards, towards the Phase 4 PV arrays, as shown in the map below.

The same observation as was noted above with regard to the impact of powerlines (Sampson 1985) applies.

On archaeological grounds, again, there is no reason to prefer one or another of the alternative routes for Phase 4, while the visual impact may also be approximately the same for each.



See Impact Assessment Significance Matrix for Powerline alternative routes for Phase 4 at 4.3.6 below.

4.2 Characterising the significance of impacts

Specific observations of heritage sites may be tabulated as follows, using SAHRA significance grading:

Heritage Site	Location (GPS co-ordinates)	Grading	Which Phase does the site affect/ is located on/ near by	Implication For Project Implementation
Zuurwater 1	29.32997° S 18.74865° E	III C (lowest)	On Phase 2 layout	No mitigation required. No permit regarded as necessary.

Zuurwater 2	29.33123° 18.74606° E	S	III C (lowest)	On Phase 2 layout	No mitigation required. No permit regarded as necessary.
Zuurwater 3	29.31522° 18.76377° E	S	N/A	On Phase 2 layout	No mitigation required. No permit needed.
Zuurwater 4	29.2756° 18.7188° E	S	N/A	On Phase 2 layout	No mitigation required. No permit needed.
Zuurwater 3	Between 29.28490° 18.73832° E and 29.28517° 18.74018° E	S S	III A	On Phase 4 layout	Avoid disturbance by repositioning layout in the vicinity of this site.
Zuurwater 4	29.28827° 18.71053° E	S	III B	Near to but clear of Phase 4	Site is beyond the project lay- out.

The following criteria are used in this Environmental Impact Assessment to characterise the significance of direct, indirect and cumulative impacts (Jodas 2010):

- » The **nature**, which shall include a description of what causes the effect, what will be affected, and how it will be affected.
- » The **extent**, wherein it will be indicated whether the impact will be local (limited to the immediate area or site of development) or regional:
 - * local extending only as far as the development site area – assigned a score of 1;
 - * limited to the site and its immediate surroundings (up to 10 km) – assigned a score of 2;
 - * will have an impact on the region – assigned a score of 3;
 - * will have an impact on a national scale – assigned a score of 4; or
 - * will have an impact across international borders – assigned a score of 5.
- » The **duration**, wherein it will be indicated whether:
 - * the lifetime of the impact will be of a very short duration (0–1 years) – assigned a score of 1;
 - * the lifetime of the impact will be of a short duration (2–5 years) - assigned a score of 2;
 - * medium-term (5–15 years) – assigned a score of 3;
 - * long term (> 15 years) - assigned a score of 4; or
 - * permanent - assigned a score of 5.
- » The **magnitude**, quantified on a scale from 0–10, where a score is assigned:
 - * 0 is small and will have no effect on the environment;

- * 2 is minor and will not result in an impact on processes;
 - * 4 is low and will cause a slight impact on processes;
 - * 6 is moderate and will result in processes continuing but in a modified way;
 - * 8 is high (processes are altered to the extent that they temporarily cease); and
 - * 10 is very high and results in complete destruction of patterns and permanent cessation of processes.
- » The **probability of occurrence**, which shall describe the likelihood of the impact actually occurring. Probability will be estimated on a scale, and a score assigned:
- * Assigned a score of 1–5, where 1 is very improbable (probably will not happen);
 - * Assigned a score of 2 is improbable (some possibility, but low likelihood);
 - * Assigned a score of 3 is probable (distinct possibility);
 - * Assigned a score of 4 is highly probable (most likely); and
 - * Assigned a score of 5 is definite (impact will occur regardless of any prevention measures).
- » the **significance**, which shall be determined through a synthesis of the characteristics described above (refer formula below) and can be assessed as low, medium or high.
- » the **status**, which will be described as either positive, negative or neutral.
- » the degree to which the impact can be reversed.
- » the degree to which the impact may cause irreplaceable loss of resources.
- » the *degree* to which the impact can be *mitigated*.

The **significance** is determined by combining the criteria in the following formula:

S = (E+D+M) P; where

S = Significance weighting

E = Extent

D = Duration

M = Magnitude

P = Probability

The **significance weightings** for each potential impact are as follows:

- » < 30 points: Low (i.e. where this impact would not have a direct influence on the decision to develop in the area),
- » 30-60 points: Medium (i.e. where the impact could influence the decision to develop in the area unless it is effectively mitigated),
- » > 60 points: High (i.e. where the impact must have an influence on the decision process to develop in the area).

Impact tables summarising the significance of impacts (with and without mitigation)

4.3.1 Significance matrix for Zuurwater PV array layout for phases 1 to 3.

Nature: Acts or activities resulting in disturbance of surfaces and/or sub-surfaces containing artefacts (causes) resulting in the destruction, damage, excavation, alteration, removal or collection from its original position (consequences), of any archaeological material or object (what affected).		
	Without mitigation	With mitigation
Extent	1	1
Duration	5	5
Magnitude	2	2
Probability	2	2
Significance	16	16
Status (positive or negative)		
Reversibility	No	No
Irreplaceable loss of resources?	Yes, where present – but occurrence is generally extremely low density and of low significance.	Not regarded as necessary
Can impacts be mitigated?	Yes – but not considered necessary.	Not regarded as necessary
Mitigation: Mitigation Measures: Artefact densities are very low over the development footprint areas in question. Unlike biological processes, heritage destruction generally has a once-off permanent impact and in view of this the figures given in the “Without mitigation” column err on the side of caution. Even so, the criteria for significance indicated in this matrix give a Low significance weighting (<30 points). Mitigation measures are not considered necessary.		
Cumulative impacts: Cumulative Impacts: where any archaeological contexts occur the impacts are once-off permanent destructive events.		
Residual Impacts: The aesthetic impact would be a lasting impact on a property that has been used for film-making recently.		

4.3.2 Significance matrix for Zuurwater PV array layout for Phase 4.

Nature: Acts or activities resulting in disturbance of surfaces and/or sub-surfaces containing artefacts (causes) resulting in the destruction, damage, excavation, alteration, removal or collection from its original position (consequences), of any archaeological material or object (what affected).		
	Without mitigation	With mitigation
Extent	3	1
Duration	5	5
Magnitude	10	2
Probability	5	2
Significance	90	16
Status (positive or negative)	Negative	Neutral
Reversibility	No	N/A

Irreplaceable loss of resources?	Yes, where present. A high significance archaeological locale is identified in this report.	On condition that the layout is altered to avoid the locale, and the important archaeological site cluster would be preserved.
Can impacts be mitigated?	Yes – recommendation that the locale in question be regarded as a no-go zone, with buffer of 100 m from edge of rock outcrop (as indicated above).	Mitigate by declaring development no go for the archaeological locale identified. No secondary impacts to occur on this high point in the local landscape.
Mitigation: Mitigation Measures: As recommended above, a no-go space be left at and surrounding the locale between 29.28490° S 18.73832° E and 29.28517° S 18.74018° E), with a 100 m buffer zone measured from the edges of the rock outcrop.		
Cumulative impacts: Cumulative Impacts: where any archaeological contexts occur the impacts are once-off permanent destructive events.		
Residual Impacts: The aesthetic impact would be a lasting impact on a property that has been used for film-making recently.		

4.3.3 Significance matrix for Zuurwater Powerline route alternatives 1 and 2 for Phase 1.

Nature: Acts or activities resulting in disturbance of surfaces and/or sub-surfaces containing artefacts (causes) resulting in the destruction, damage, excavation, alteration, removal or collection from its original position (consequences), of any archaeological material or object (what affected).		
	Without mitigation	With mitigation
Extent	1	
Duration	5	
Magnitude	2	
Probability	2	
Significance	16	
Status (positive or negative)		
Reversibility	No	
Irreplaceable loss of resources?	Yes, where present. But occurrence is generally extremely low density and of low significance.	
Can impacts be mitigated?	Yes – but not considered necessary. On aesthetic grounds choice of Alternative Route 1 may be preferable.	Not regarded as necessary.
Mitigation: Mitigation Measures: Artefact densities are very low over the development footprint areas in question. Unlike biological processes, heritage destruction generally has a once-off permanent impact and in view of this the figures given in the “Without mitigation” column err on the side of caution. Even so, the criteria for significance indicated in this matrix give a Low significance weighting (<30 points). Mitigation measures are not considered necessary.		
Cumulative impacts: Cumulative Impacts: where any archaeological contexts occur the impacts are once-off permanent destructive events.		

Residual Impacts: The aesthetic impact would be a lasting impact on a property that has been used for film-making recently. Visual considerations make powerline alternative route 1 preferable.

4.3.4 Significance matrix for Zuurwater Powerline route alternatives 1 and 2 for Phase 2.

Nature: Acts or activities resulting in disturbance of surfaces and/or sub-surfaces containing artefacts (causes) resulting in the destruction, damage, excavation, alteration, removal or collection from its original position (consequences), of any archaeological material or object (what affected).		
	Without mitigation	With mitigation
Extent	1	
Duration	5	
Magnitude	2	
Probability	2	
Significance	16	
Status (positive or negative)		
Reversibility	No	
Irreplaceable loss of resources?	Yes, where present. But occurrence is generally extremely low density and of low significance.	
Can impacts be mitigated?	Yes – but not considered necessary. On aesthetic grounds choice of Alternative Route 1 may be preferable.	Not regarded as necessary.
Mitigation: Mitigation Measures: Artefact densities are very low over the development footprint areas in question. Unlike biological processes, heritage destruction generally has a once-off permanent impact and in view of this the figures given in the “Without mitigation” column err on the side of caution. Even so, the criteria for significance indicated in this matrix give a Low significance weighting (<30 points). Mitigation measures are not considered necessary.		
Cumulative impacts: Cumulative Impacts: where any archaeological contexts occur the impacts are once-off permanent destructive events.		
Residual Impacts: The aesthetic impact would be a lasting impact on a property that has been used for film-making recently. Visual considerations make powerline alternative route 1 preferable.		

4.3.5 Significance matrix for Zuurwater Powerline route alternatives 1 and 2 for Phase 3.

Nature: Acts or activities resulting in disturbance of surfaces and/or sub-surfaces containing artefacts (causes) resulting in the destruction, damage, excavation, alteration, removal or collection from its original position (consequences), of any archaeological material or object (what affected).		
	Without mitigation	With mitigation
Extent	1	

Duration	5	
Magnitude	2	
Probability	2	
Significance	16	
Status (positive or negative)		
Reversibility	No	
Irreplaceable loss of resources?	Yes, where present. But occurrence is generally extremely low density and of low significance.	
Can impacts be mitigated?	Yes – but not considered necessary. On aesthetic grounds choice of Alternative Route 1 may be preferable.	Not regarded as necessary.
Mitigation: Mitigation Measures: Artefact densities are very low over the development footprint areas in question. Unlike biological processes, heritage destruction generally has a once-off permanent impact and in view of this the figures given in the “Without mitigation” column err on the side of caution. Even so, the criteria for significance indicated in this matrix give a Low significance weighting (<30 points). Mitigation measures are not considered necessary.		
Cumulative impacts: Cumulative Impacts: where any archaeological contexts occur the impacts are once-off permanent destructive events.		
Residual Impacts: The aesthetic impact would be a lasting impact on a property that has been used for film-making recently. Visual considerations make powerline alternative route 1 preferable.		

4.3.6 Significance matrix for Zuurwater Powerline route alternatives 1 and 2 for Phase 4.

Nature: Acts or activities resulting in disturbance of surfaces and/or sub-surfaces containing artefacts (causes) resulting in the destruction, damage, excavation, alteration, removal or collection from its original position (consequences), of any archaeological material or object (what affected).		
	Without mitigation	With mitigation
Extent	1	
Duration	5	
Magnitude	2	
Probability	2	
Significance	16	
Status (positive or negative)		
Reversibility	No	
Irreplaceable loss of resources?	Yes, where present. But occurrence is generally extremely low density and of low significance.	
Can impacts be mitigated?	Yes – but not considered necessary. On aesthetic grounds choice of Alternative Route 1 may be preferable.	Not regarded as necessary.
Mitigation: Mitigation Measures: Artefact densities are very low over the development footprint areas in question. Unlike biological processes, heritage destruction generally has		

a once-off permanent impact and in view of this the figures given in the “Without mitigation” column err on the side of caution. Even so, the criteria for significance indicated in this matrix give a Low significance weighting (<30 points). Mitigation measures are not considered necessary.

Cumulative impacts: Cumulative Impacts: where any archaeological contexts occur the impacts are once-off permanent destructive events.

Residual Impacts: The aesthetic impact would be a lasting impact on a property that has been used for film-making recently. Visual considerations for both powerline alternative routes appear to be approximately equal.

MEASURES FOR INCLUSION IN A DRAFT ENVIRONMENTAL MANAGEMENT PLAN

OBJECTIVE: Archaeological or other heritage materials that occur in the path of any surface or sub-surface disturbances associated with any aspect of the development are highly likely to be subject to destruction, damage, excavation, alteration, or removal. The objective should be to limit such impacts to the primary activities associated with the development and hence to limit secondary impacts during the medium and longer term working life of the facility.

Project component/s	Any surface disturbance, road or other spatial or linear construction over and above what is necessary and any spatial extension of other components addressed in an EIA.
Potential Impact	The potential impact if this objective is not met is that wider areas or extended linear developments may result in destruction, damage, excavation, alteration, removal or collection of heritage objects from their current context on the site.
Activity/risk source	Activities which could impact on achieving this objective include deviation from the planned/ revised* lay-out of infrastructure without taking heritage impacts into consideration. * Current Phase 4 PV array needs to be revised in light of this study.
Mitigation: Target/Objective	A facility environmental management plan that takes cognizance of heritage resources in the event of any future extensions of any infrastructure.

Mitigation: Action/control	Responsibility	Timeframe
Revised PV array layout for Phase 4 in order to preserve the high significance site (4.1.2.2 above). Provision for on-going heritage monitoring in a facility environmental management plan which should also provide guidelines on what to do in the event of any major heritage feature being encountered during any phase of development or operation.	Environmental management provider with on-going monitoring role set up by the developer.	Environmental management plan to be in place before commencement of development.

Performance Indicator	Inclusion of further heritage impact consideration in any future extension of infrastructural elements.
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	Immediate reporting to relevant heritage authorities of any heritage feature discovered during any phase of development or operation of the facility.
Monitoring	Officials from relevant heritage authorities (National and Provincial) to be permitted to inspect the operation at any time in relation to the heritage component of the management plan.

5. CONCLUSIONS

A high significance cluster of sites within the anticipated layout of the Phase 4 PV array was identified which necessitates a revision of the planned layout.

Across the remainder of the Phase 4 array and the development footprint areas for Phases 1-3 and associated ancillary infrastructure including powerline routes, generally very sparse to zero heritage traces were found.

Excepting for the site cluster identified within the Phase 4 area, other impacts, if any, would be local. Impacts on heritage and archaeological resources may be mitigated and hence classed as 'short term' but the original in situ context is usually altered in a 'permanent' way. If the archaeological or heritage significance of the resources in question is considered to be low – which is the case here for areas other than the site cluster referred to above – then the significance of the permanent loss is low. Archaeological and heritage resources being non-renewable, the intensity of any direct impact would be high by definition but this evaluation would again be ameliorated by the significance attached to the particular resources in question – which (for most of the terrain) is extremely low given the general absence of such resources. With regard to this project the probability of impacts on heritage including archaeological resources is generally Improbable. Subject to pre-construction ground-truthing, no 'Phase 2' mitigation work is regarded as necessary in terms of present development layout – on condition that the planned layout for Phase 4 is revised to exclude any impacts on the significant heritage site identified in paragraph 4.1.2.2, above.

In the event that any heritage feature (which may be sub-surface, such as an unmarked grave) is encountered during the development or operational life of the facility, work is to be halted immediately and contact made with SAHRA (Ms C. Scheermeyer at 021-4624502) and/or the Northern Cape Heritage Authority Ngwao Bošwa jwa Kapa Bokone (Mr A. Timothy) who would arrange for the evaluation of the find for possible mitigation.

From an archaeological perspective the observed heritage resources are in most instances of very low significance (low occurrence). One site of high significance requires a change in the planned PV array layout in Phase 4.

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