HERITAGE IMPACT ASSESSMENT: PROPOSED KENHARDT PHOTO-VOLTAIC SOLAR POWER PLANT ON REMAINDER OF THE FARM KLEIN ZWART BAST 188, NORTHERN CAPE PROVINCE

(Assessment conducted under Section 38 (8) of the
National Heritage Resources Act 25 of 1999)

Prepared for:
Digby Wells Environmental
Private Bag X10046
Randburg, 2125.
Johan Nel
Tel: 011 789 9495
Cell: 072 288 5496
Email: johan.nel@digbywells.com

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Prepared by:

Lita Webley & David Halkett
ACO Associates
8 Jacobs Ladder
St James
7945

Phone (021) 650 2357
Fax (021) 650 2352

acoassociates@gmail.com
Lita@webleyonline.com

EXECUTIVE SUMMARY

ACO Associates cc was appointed by Digby Wells Environmental, on behalf of the client Orlight South Africa, to undertake an Impact Assessment for the construction of a 70MW solar facility on 350ha of land on the farm Klein Zwart Bast 188, in the Siyanda District Municipality, Northern Cape Province.

The proposed facility will be located to the north of the Kenhardt – Bossiekom District Road, opposite the Aries substation and some 40km west of Kenhardt.

This assessment forms part of the EIA process. The Notice of Intent to Develop and Scoping phase was undertaken by Digby Wells Environmental. The NID was submitted to SAHRA (SAHRA file number: 9/2/048/0001) in January 2012 and they have requested a palaeontological and archaeological impact assessment. They also asked that the "archaeological impact assessment should also assess whether the cumulative impact of the solar energy facilities proposed on the same property may compromise the cultural landscape and its archaeological significance".

Background research, including a review of two recent assessments conducted on adjoining properties, as well as fieldwork on the 19th and 20th April 2012, inform the following conclusions:

Heritage Findings:

Palaeontology:

- The palaeontological sensitivity of the rock units within the study area is generally low.

The Pre-colonial Archaeology:

- Archaeological sites are present in the form of stone artefact scatters from the Early Stone Age (ESA) and Middle Stone Age (MSA);
- Artefact scatters tend to be widespread rather than discrete and are found on extensive gravel pavements between scrub vegetation;
- The absence of associated organic material, and lack of discrete individual sites reduces the significance of the material overall;
- Thousands of square kilometres of Bushmanland are covered by these low density artefacts scatters;
- Further mitigation of the material is considered unnecessary in view of a collection which has already been made on the adjoining property of Olyven Kolk;
- A permit will be needed for the destruction of archaeological material.

The Built Environment:

- There are no buildings of heritage significance on the site.

Graves:

- A few cairns were identified. They could possibly be graves. Due care should be taken during construction of the site and if human remains are uncovered, work should stop in that area and SAHRA should be notified.

Cultural Landscape:

- The proposed solar plant is positioned opposite the Aries substation on district gravel road linking Kenhardt with Bossiekom in the Northern Cape. It is an isolated area and will not be visible from any scenic route;
- The cultural landscape of the surrounding area is a flat arid landscape utilised for the grazing of livestock; A number of solar facilities have been proposed for this area and the cumulative impact needs to be considered by the Visual Impact specialist.

The potential impacts resulting from the installation of a solar power plant on the heritage resources of the sites are considered to be of minor significance, and no mitigation is recommended.

SPECIALIST TEAM AND DECLARATION OF INDEPENDENCE

David Halkett (BA, BA Hons, MA (UCT)) is an Archaeologist and Member of the Association of Professional Archaeologists of Southern Africa (ASAPA) accredited with Principal Investigator status. He has been working in heritage management for 23 years and has considerable experience in impact assessment with respect to a broad range of archaeological and heritage sites including those in the Northern Cape. He is a member of the Archaeology, Palaeontology and Meteorites Committee and the Impact Assessment Committee of the Heritage Western Cape (HWC), the Provincial Heritage Resources Authority.

Lita Webley (BA, BA Hons, MA (Stellenbosch), PhD (UCT)) is an Archaeologist and member of ASAPA accredited with Principal Investigator status. She has been involved with heritage and archaeological impact assessments on a part-time basis since 1996 and full time since 2008. Her PhD thesis was concerned with the archaeology of the Namaqualand region of the Northern Cape and she is familiar with the heritage of the region.

John Pether (MSc. Pr. Sci. Nat.(Earth Sci)) is an independent consultant/researcher and authority on coastal-plain and continental-shelf palaeoenvironments.

Mr David Halkett, Dr Lita Webley and Mr John Pether are independent specialist consultants who are in no way connected, financially or otherwise, with the proponent, other than in the delivery of consulting services on the project.

Terminology

Archaeology: *Remains resulting from human activity which is 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.*

Crypto-crystalline silica (CCS): *Cryptocrystalline silicates include lithic materials such as chert or flint and were widely used by prehistoric peoples to manufacture stone tools*.

Early Stone Age: *The archaeology of the Stone Age between 700 000 and 2500 000 years ago***.**

Fossil: *Mineralised bones of animals, shellfish, plants and marine animals.*

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

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

Late Stone Age: *The archaeology of the last 20 000 years associated with fully modern people.*

Middle Stone Age: *The archaeology of the Stone Age between 20-300 000 years ago associated with early modern humans.*

National Estate: *The collective heritage assets of the Nation.*

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

SAHRA: *South African Heritage Resources Agency – the compliance authority which protects national heritage.*

Structure (historic): *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. Protected structures are those which are over 60 years old.*

Trace fossil: *The track or footprint of a fossil animal that is preserved in stone or consolidated sediment.*

Acronyms

BP	Before the Present
DEA	Department of Environmental Affairs
ESA	Early Stone Age
GPS	Global Positioning System
HIA	Heritage Impact Assessment
LSA	Late Stone Age
MSA	Middle Stone Age
NHRA	National Heritage Resources Act, No 25 of 1999
SAHRA	South African Heritage Resources Agency

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1. INTRODUCTION

ACO Associates cc was appointed by Digby Wells Environmental, on behalf of the client Orlight SA (Pty) Ltd, to undertake an Impact Assessment for the construction of a 70MW solar facility on 350ha of land on the Remainder and Portion 1 of the farm Klein Zwart Bast 188, in the Siyanda District Municipality, Northern Cape Province. This is to meet the growing demand for electricity generation and cleaner energy production in South Africa.

The proposed facility will be located to the north of the Kenhardt – Bossiekom District Road, opposite the Aries substation and some 40km west of Kenhardt.

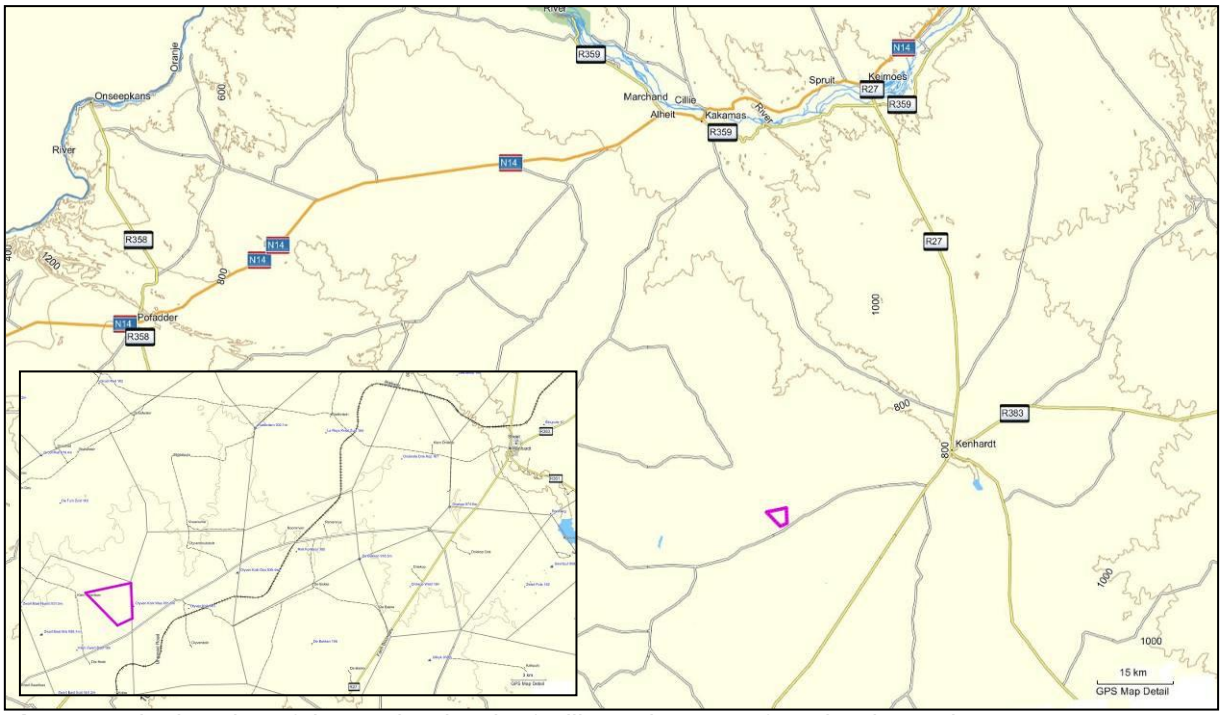

Figure 1: The location of the Kenhardt solar facility to the west of Kenhardt, Northern Cape.

2. DEVELOPMENT PROPOSALS

The Kenhardt project will have a generation capacity of 70MW resulting in the physical alteration of approximately 350ha of range land on the farm Klein Zwart Bast 188. Three alternative layout designs (Options A, B & C) have been suggested (Figure 2). They differ only marginally from each other in the position of the laydown areas and the substation. The facility will connect to the Aries substation via a 66kV or 132kV overhead powerline. Where possible the transmission route will be situated within, or parallel to, an existing servitude. The project will require the establishment of a ground mounting system, solar PV panels, inverters, switchboard and transformers. Access roads to the facility from the nearest public road onto the site will be required. Internal site roads will also be required to access the solar panels for maintenance purposes. The solar panel plant will be fenced off from the surrounding farms. The site will need to be cleared of vegetation.

The following associated infrastructure will be required:

- Temporary container homes during the construction phase
- Office and technical service buildings
- Electricity distribution lines (from substation to Eskom power line)

- A perimeter high security fence
- Roads within the development footprint

The “no go” option (no development of the site) will also be considered.

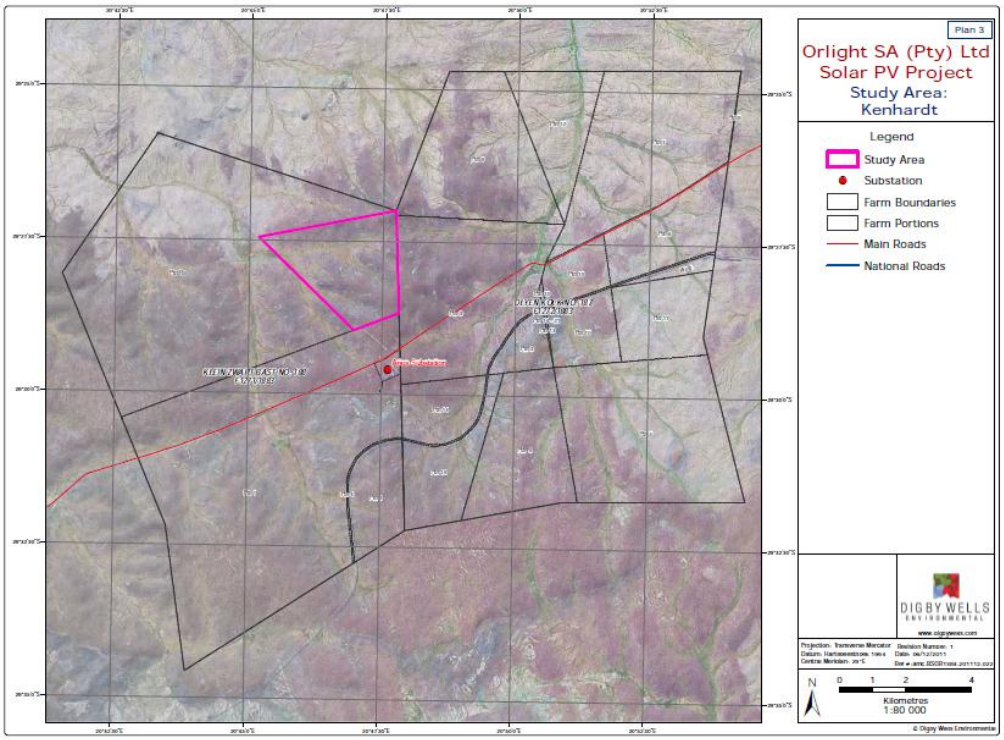

Figure 2: Map of the proposed facility in relation to the Aries substation and the District Road.

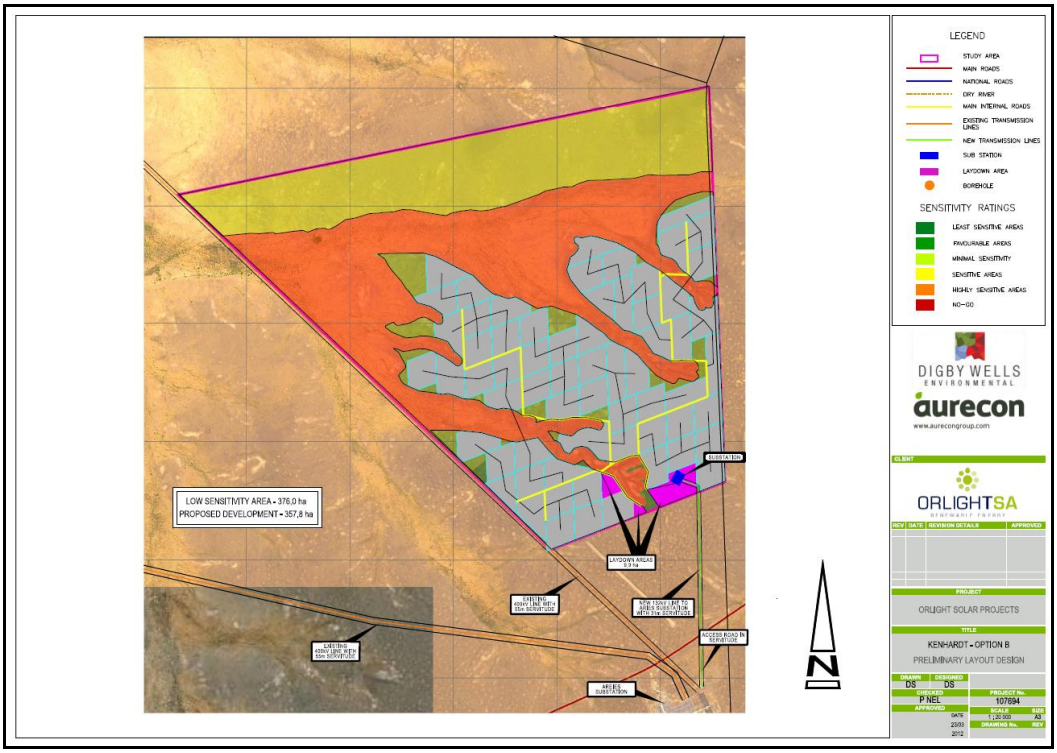

Figure 3: Preliminary layout design for Option B. Options A and C are similar except for the position of the substation and lay down areas.

3. TERMS OF REFERENCE

This assessment includes:

- A site visit and desk top study to determine the pre-history and history of the property;
- The rating of significance of heritage resources on the property;
- An assessment of whether the development of the property will result in a loss of significant heritage resources;
- Recommendations for mitigation if necessary.

4. LEGISLATION

The National Heritage Resources Act, No 25 of 1999 (Section 38 (1)) makes provision for a compulsory notification of the intent to development when any development exceeding 5000 m² in extent, or any road or linear development exceeding 300m in length is proposed.

The NHRA provides protection for the following categories of heritage resources:

- Cultural landscapes (Section 3(3))
- Buildings and structures greater than 60 years of age(Section 34)
- Archaeological sites greater than 100 years of age(Section 35)
- Palaeontological sites and specimens
- Shipwrecks and aircraft wrecks
- Graves and grave yards (Section 36).

Only the Western Cape and Kwa-Zulu Natal have functioning Provincial Heritage Authorities, and consequently SAHRA administers heritage in the remaining provinces particularly where archaeology and palaeontology are the dominant concerns. Heritage Northern Cape (Ngwao Boswa Kapa Bokoni) deals largely with built environment issues at this stage. Amongst other things the latter administers:

- World Heritage Sites
- Provincial Heritage Sites
- Heritage Areas
- Register Sites
- 60 year old structures
- Public monuments & memorials

Archaeology, including rock art, graves of victims of conflict and other graves not in formal cemeteries are administered by the national heritage authority, SAHRA.

Digby Wells Environmental submitted a cultural resources pre-assessment report or Notice of Intent to Develop to SAHRA in January 2012.

SAHRA (SAHRA file number: 9/2/048/0001) have requested a palaeontological and archaeological impact assessment. Further, they have asked that the archaeological impact assessment should also assess whether the cumulative impact of the solar energy facilities proposed on the same property may compromise the cultural landscape and its archaeological significance.

5. DESCRIPTION OF THE AFFECTED ENVIRONMENT

The town of Kenhardt is located about 115km south of Upington on the R27 which links Keimoes to Brandvlei in the Northern Cape. The study area is situated some 40km west of Kenhardt on the Kenhardt - Bossiekom District road. The Aries substation is situated 1km south of the study area (Figure 2).

Plate 1: View of the landscape.

According to the Draft Scoping Report (Digby & Wells Environmental 2012) the study area displays an elevation of between 910 and 940 mamsl. It is characterised by a relatively flat, slightly undulating surface bisected by a number of shallow drainage basins. The vegetation can be classified as Bushmanland Basin Shrubland comprising dwarf shrubland dominated by low sturdy and spiny shrubs. The knee high bushy vegetation is sparse and there is numerous bare gravel and rock covered pavements on which the archaeological material is found (Plate 3). The types of rock are variable but include grey quartzitic material in slabs often tilted vertically. Dolomite and banded ironstone are also present.

Plate 2: View of the shallow drainage channel which crosses the site from west to east. The drainage channel has been excluded from the proposed facility (see Figure 3). The transmission lines which cross the property are visible in the distance.

Stock farming is practiced on the farm. There is a small concrete reservoir and wind pump on the property and the property is fenced. The farm house of Klein Swartbas is located 1.3km to the west of the proposed facility. Access to the proposed facility will be from the local District Road.

In terms of visibility, the solar facility will be visible from the Kenhardt-Bossiekom District gravel road. There is an existing Cross Rope Suspension (CRS) 400kV transmission lines

which crosses the SW corner of the site and there is a service track which runs below the transmission line. The Aries substation is located on the opposite side of the road. The landscape has therefore already been subjected to some “industrialization”.

6. METHODOLOGY

The property was visited by Lita Webley and David Halkett. The locations of the proposed PV arrays were loaded onto handheld GPS receivers (set to the WGS84 datum) to facilitate the identification of the search area during field work undertaken on 17 & 18 April 2012. Walk paths and site locations were recorded with GPS and finds were photographed and described. The assessment was primarily concerned with palaeontology and archaeology (as per the recommendations of SAHRA), but consideration was also given to the built environment where appropriate.

Previous work done on adjoining properties such as Portions 14 and 15 of Olyven Kolk 187 (Halkett & Orton 2011) and on Portion 1 of Klein Swart Bast 118 (Pelser 2011), and in the wider region (Beaumont et al 1995), provides a good basis for comparison with our observations. Beaumont et al (1995) has described making collections of artefacts on Olyven Kolk but has not indicated the exact location of his sample, or whether it was ever analysed.

Based on the low sensitivity of the site determined by its geological context, the palaeontological study was limited to a desktop study. In preparing a palaeontological desktop study the potentially fossiliferous rock units (groups, formations *etc*) represented within the study area were determined from geological maps. The known fossil heritage within each rock unit was inventoried from the published scientific literature, previous palaeontological impact studies in the same region, and the author’s field experience.

An independent Visual Assessment forms part of the EIA.

6.1 Limitations

There were no significant physical limitations encountered when undertaking the field study and surface visibility was excellent. Although there are few roads across the property, the low shrub and the level topography meant that were able to access all areas of the proposed facility (Figure 4; Plate 1).

We have made certain assumptions about the archaeology based on the specific landscape characteristics of the site, and knowledge of the broader archaeological issues. The lack of significant landscape features such as rock outcrops, caves, pans etc, greatly reduces the likelihood of finding significant sites.

As with all archaeological surveys, it is not possible to be completely confident that all archaeological sites were identified during the fieldwork. Surface distributions give only a general indication of sub-surface remains. It is always possible that sub-surface archaeological sites may be present which were not identified during the survey

From a palaeontological point of view, the lack of any natural exposures of bedrock on the site have meant that conclusions are broad, based on existing literature and observations elsewhere.

7. BACKGROUND TO THE AREA

7.1 Palaeontology

The detailed palaeontological report is presented in Appendix 2. In summary, the study area is on the edge of the Karoo Supergroup and is underlain by the Dwyka Group, the lowermost unit of the Karoo Supergroup. To the north are ancient basement rocks of the Bushmanland Subprovince or terrane of the Namaqua Province. The Bushmanland terrane here consists of metasediments and metavolcanics, De Kruis gneisses and De Bakken granites. These are very old sediments and are not of palaeontological interest.

Quaternary sand is minimal and the thin stony soil has mainly formed from the weathering of the conglomerate Dwyka diamictites.

7.2 Archaeological Background

The archaeological background of the area is based on a single published and a number of unpublished reports. Beaumont et al. (1995:240), who undertook a surface collection of artefacts from the adjoining property of Olyven Kolk, have the following to say “the material separates out on the basis of abrasion state, into a fresh component, with advanced prepared cores, blades, and convergent points, that is ascribable to the Middle Stone Age, and a larger fraction of moderately to heavily weathered Early Stone Age. This is typified by the presence of long blades, Victoria West cores (mainly on dolerite) and an extremely low incidence of formal tools (handaxes and cleavers)…”

In his 2006 report, Morris indicates that the terrain in the vicinity of Olywen Kolk and **Klein Zwart Bast** is characterized by Dwyka tillite, known to be a favourite source of raw materials in Early Stone Age times.

At least two other recent CRM studies have been conducted in the immediate vicinity of the proposed facility, adjacent to the Aries substation, and they further inform our discussions and conclusions below.

Halkett & Orton (2011) undertook the HIA for the Olyven Kolk Solar Power Plant located to the south of the Aries substation and diagonally south of the proposed facility. They recorded a potential 50 “sites” although they describe these as: “gravel pavement, low density artefact scatter esa/msa gravel pavement”. These scatters of ESA and MSA material do not have discrete boundaries and it is not possible to talk of sites. Neither is it possible to record every artefact as there are thousands. They describe the material as including a few isolated large implements which resembled sub-classic bifaces (ESA) but the items were very weathered and observations remain equivocal and one clear biface of a size suggestive of Fauresmith type. Most of the material was ascribed to the Middle Stone Age and distinctive flakes were noted some of which some were retouched.

Pelser recorded both Early and Middle Stone artefact scatters on Portion 1 of Klein Zwart Bast, opposite the portion of the farm assessed in this report. He described the widespread distribution of material and emphasised in his report that “although GPS coordinates were taken on many locales (Sites), many more sites (scatters and concentrations of stone tools) were not recorded as it became clear during the assessment that most of the area is covered by Stone Age material and that it would be a near impossible task taking the scope and time-frame of the assessment into consideration to mark all the finds. The whole area can therefore be marked as a Stone Age site, with potentially millions of artefacts present”.

The Draft Scoping Assessment (Digby Wells Environmental) also describes that “Stone Age lithics were consistently noted along the drainage lines and the rim of the depression. Although no source material was found, both formal and informal tools were found, however these were surface scatters with little context”.

Pelser describes a small rocky outcrop with MSA/LSA tools (small flakes and tools) and ostrich eggshell as a potential Later Stone Age site. Similarly, Halkett & Orton (2011) have also recorded a single LSA site with an upside down grindstone. The Scoping Report points out that many of the informants that Lucy Lloyd and Wilhelm Bleek interviewed came from the Kenhardt area. Nevertheless, few Later Stone Age sites have to date been recorded from this part of Bushmanland.

Previous work therefore suggests that the study area would contain a widespread distribution of Early and Middle Stone Age material with perhaps a few Later Stone Age sites, depending on topography and proximity to water.

5.2 Historical Background

According to the Scoping Report, there were many skirmishes between Boers and San people in the area around Kenhardt. De Jong (2011) describes the arrival of the first Trekboers along the lower Orange River by 1730. The interior of Bushmanland was only settled much later. Even around the 1830’s missionaries such as Barnabas Shaw reported that large areas were deserted because of a lack of adequate grazing and water. This region was used after the summer rains, with many farmers moving seasonally between Namaqualand and Bushmanland. Shaw and later travellers described groups of “Basters” living in wagons around the pans on Bushmanland in the second half of the 19th century.

Increasing competition for land and resources between the Trekboers and Khoisan groups resulted in increasing tensions and ultimately to violence during the First Korana War of 1868-9. The Cape Colonial Government sent a special magistrate and border police force to the Kenhardt area in 1868 to serve as a buffer against the Koranas (a Khoekhoen group). For a long time it was the most remote white settlement in the North-Western Cape. The spread of white colonial settlement lead to the formal surveying and proclamation of farms, amongst them the farm Klein-Zwart-Bast. Many of these farms could only be settled permanently after the introduction of the wind pump after 1870.

Little is known about the history of Klein Zwart Bast. According to de Jong (2011), the farm was named after the occurrence of the bladder-nut or swartbas (*Diospyros whyteana*). The farm was formally surveyed in 1883 (SG 1271/1883). The “brakdak” farmhouse on Klein Swarbas probably dates to this period. De Jong speculates that the presence of a Martini-Henry cartridge case on the farm suggests that it was primarily used for hunting and seasonal grazing.

De Jong (2011) notes that the Anglo-Boer War (1899-1902) affected the Kenhardt region directly. By March 1900 Boer forces had taken Prieska, Kenhardt, Kakamas and Upington, attracting rebel support in the process. British columns were able to recapture the towns and the invasion had ended by June 1900. Local militias, including the Border Scouts (Upington), Bushmanland Borderers (Kenhardt) and Namaqualand Border Scouts (from the west) were established and patrolled the area. De Jong (2011) describes the remnants of a stone-walled structure on the farm adjoining the proposed facility, which resembles the type of military enclosures favoured for watch-keeping purposes, although their exact origin still must be established. Pelser (2011) in his survey report described a small semi-circle of packed stone as a possible Boer War structure or related to the 1st Koranna War. The structure in the photograph, however, closely resembles 20th century “skerms” used by local herdsmen and

an approximate date can only be determined from associated historic material (not described in the report).

The Scoping Report (Digby Wells Environmental) also contains references to the Anglo-Boer War, possibly because of comments by de Jong (2011).

8. FINDINGS

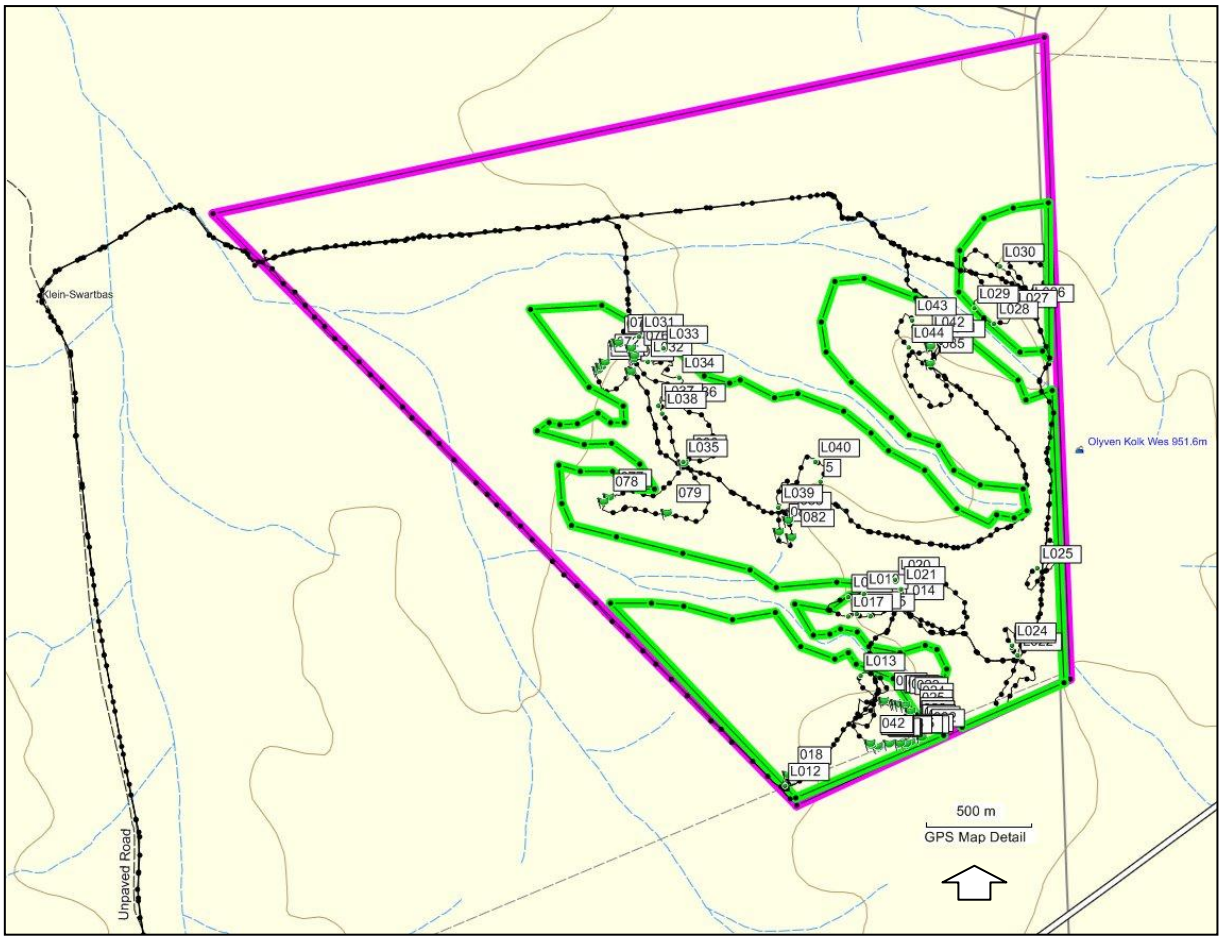

Figure 4: Map of tracks and sites recorded during field survey. The green lines indicate the boundaries of the proposed facility. Note the position of the farm house of Klein Swartbas to the west of the area.

8.1 Pre-Colonial Archaeology

Descriptions of the artefacts provided in the text, apply to the entire study area (Appendix 1). Numerous stone artefacts were recorded across the surface of the property on extensive gravel pavements (Plate 3). In fact there were only few areas where surface traces were absent, largely due to the surface being obscured by windblown sand. In some areas density appeared higher but it would be difficult to define individual sites and scatters. All observations are of the surface and there were no indicators that would suggest there would be deeply stratified material anywhere on the site. No associated organic remains (such as bone or ostrich eggshell) were noted with any of the stone scatters.

Plate 3: View of the gravel pavements where ESA and MSA artefacts occur in abundance. Many of the large cobbles have signs of being knapped.

A number of large implements were recovered which resembled classic bifaces (ESA). They are very weathered and occur in isolation (Plate 4). They are made on very weathered hornfels and while occasional flakes and cores may occur, there is no evidence of ESA knapping sites.

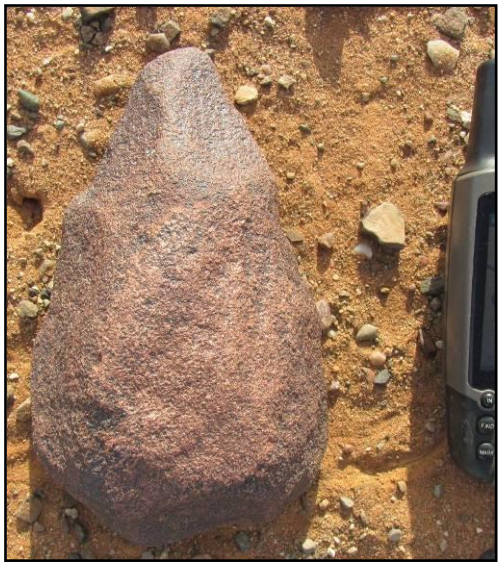

Plate 4: Large weathered handaxe; **Plate 5:** Large weathered flake (scale in centimetres).

Plate 6: Weathered flake; **Plate 7**: Handaxe on quartzite; **Plate 8**: Weathered flake and core.

Most of the material we observed can probably be ascribed to the Middle Stone Age (MSA) (Plates 10, 11). Flakes, blades, chunks and cores make up the majority of the scatters, and retouch was present on some items. The most predominant raw material was pale grey/white quartzite, although red quartzite, banded ironstone, quartz and agate lumps were also recorded.

Plate 9: Characteristic collection of grey quartzite cores, chunks and flakes with few diagnostic elements. **Plate 10:** Typical triangular MSA flakes with convergent flake scars on the dorsal surface.

Plate 11: Blade on red quartzite; **Plate 12:** Triangular grey quartzite flake.

Plates 13 & 14: Retouched pieces. The flake on the left has a more classic scraper retouch, while the artefact on the right has steep step flaking.

There is also some evidence of the knapping (flaking) of stone artefacts on site, from local sources of raw material. It was observed that some quartzite chunks, cores and flakes made on a particular shade of quartzite, occurred in close proximity. For example, there is a dense scatter of pink quartzite flakes within a 5m radius of the block of quartzite (Plate 15).

Plates 15 & 16: Block of pink quartzite (left) and grey quartzite (right), both with evidence of knapping of stone artefacts in the immediate vicinity.

No Later Stone Age artefact scatters were recorded.

8.2 Built Environment

Apart from a concrete reservoir and a wind pump, there are no elements of the built environment present on the property. The farm house complex of Klein Swartbas, which is located 1.3km to the west of the proposed facility, comprises a modern farmhouse as well as a fine example of a late 19th century "brakdak" farmhouse with decorative moulding and a Victorian verandah. This house is not threatened by the development as long as access to the facility is from the District road (as proposed).

8.3 Graves/Cairns

The proposed facility is some 1.3km from the farm house of Klein Swartbas. Due to the distance from the farm buildings, coupled with the rocky nature of the site in general, it was considered unlikely that graves would be found on site.

Plate 17: A few stone cairns were recorded in the study area.

While there is considerable evidence for stone age use of the area, formal burials have never been found in South Africa that date to the MSA, and while graves from the LSA are found from time to time, these tend to be found in softer soils, as would also have been the case in the colonial period. Although a few stone cairns were recorded, no typical surface grave markers were observed and we consider it highly unlikely that any graves are present on the site.

8.4 Cultural Landscape

The affected portions of Klein Zwart Bast 188 represent a very typical landscape in this area. It is flat and featureless with scrubby low vegetation and bare patches of gravel pavement. The farm continues to be used for small stock farming. Man-made features in the form of the Aries sub-station, an overhead powerline and an Eskom service road are the most visible features located within the site or in close proximity. The non-industrial built environment on the farm is marginal. The cultural landscape of the solar plant site is therefore considered to be of low significance.

9. IMPACT IDENTIFICATION AND ASSESSMENT

9.1 Palaeontology

The site of the proposed solar power plant is underlain by glacial-related sediments of the Dwyka Group that are generally of low palaeontological sensitivity. The fossil content of the

Dwyka Group is generally poor. Fossils are found mainly in interglacial, laminated mudrocks. These are trace fossils, organic-walled microfossils, rare marine shells, fish and plants. The scale of subsurface disturbance and exposure is quite limited, comprising mainly “post holes” to support the PV panel frames. These holes will mainly affect the weathered soil profile and regolith on the Dwyka outcrop.

Quaternary sediments as well as alluvial gravels, sands and calcretes of comparable age, all of low palaeontological sensitivity, are also represented within the study area.

The activities likely to result in impacts to surface and subsurface material include: site preparation, creation of roads, and construction of buildings and installation of cables. Installation of the solar panel frames will be secondary to the previous activities and so would the impacts would be minor. Drilling or screwing frames into place would however represent a possible threat to palaeontological resources if they existed on site.

9.2 Archaeology

The construction of the proposed facility will result in the physical disturbance and potential destruction of the context of surface and sub-surface archaeological material.

Scatters of ESA and MSA artefacts were recognised (Appendix 1), mainly on extensive gravel pavements. Some of the scatters (which lack discrete boundaries) will be impacted by construction and are likely to be disturbed. While some discrete knapping sites were recognised, the majority of the stone artefacts are probably not in original context, and not associated with organic remains such as bone, which could provide valuable information on prehistoric lifeways.

With respect to Olyven Kolk (the adjoining farm) Beaumont et al (1995:240) note that “thousands of square kilometres of Bushmanland are covered by a low density lithic scatter. The raw materials (mainly quartzite cobbles) are derived from the Dwyka till which is ubiquitous across this peneplain…” He indicates that these stone artefact scatters are common in this part of Bushmanland.

In addition, Beaumont et al have undertaken a systematic collection of material on the broader Olyven Kolk Farm (indicated as site 13 on their distribution map), although a precise location for the collection is unknown (1995:24). A collection of stone artefacts from this area therefore exists.

Construction (surface clearing, cables, frames, operation facilities and laydown areas) will be limited to a relatively small area of the total site and other areas will remain relatively undisturbed.

In general, the stone scatters are considered to be of low to medium significance. They have been given an “ungraded” rating. It is our opinion that the impact of disturbance of Stone Age material in the affected zones will be small.

Table 1: Summary of impacts to archaeological material

Nature of Impact: Impacts to archaeological material could involve destruction of material at solar panel footings, underground cabling, access roads, etc.		
	Pre- Mitigation	**Post- Mitigation**
Extent	Local	Local
Magnitude	On-site	On-site
Duration	Permanent	Permanent
Intensity	Negligible	Negligible

Probability	Definite	Definite
Significance	Low - Medium	Low - Medium
Mitigation: Although scatters of archaeological material will be impacted, the impact is considered Low. Lack of site boundaries or associated organic remains or reduces scientific value greatly. In the unlikely event that unmarked graves are present and found during the construction phase, work at that location must be halted, the feature should be cordoned off and the heritage authority (SAHRA) notified. They are likely to suggest mitigation in the form of exhumation. No mitigation has been suggested.		
Cumulative Impacts: The cumulative impact of several such facilities will result in the potential destruction of large scatter of archaeological material.		
Operational Phase: n/a		
Decommissioning Phase: n/a		

* Once archaeological material is destroyed, it cannot be renewed or replaced.

9.3 Built Environment

There are no buildings or structures on that portion of the property identified for the development of the facility. The impacts to the Built Environment are considered to be negligible.

9.4 Cultural Landscape

Table 2: Summary of impacts to Cultural Landscape

Nature of Impact: The proposed facility may have a limited visual impact on the cultural landscape and its archaeological significance		
	Pre- Mitigation	**Post- Mitigation**
Extent	Local	Local
Magnitude	Local	Local
Duration	Long term	Long term
Intensity	Medium	Medium
Probability	Definite	Definite
Significance	Low	Low
Mitigation: A Visual Impact Assessment by a specialist which considers the proposed impact of the development on the Cultural Landscape.		
Cumulative Impacts: The cumulative impact of several such facilities will result in "industrialization" of the landscape.		
Operational Phase: n/a		
Decommissioning Phase: n/a		

10. MITIGATION AND ASSESSMENT OF ALTERNATIVES

No Palaeontological mitigation will be required. The PIA report (Appendix 2) recommends that "an alert for the uncovering of fossil bone and implements be included in the construction EMP for the project".

No archaeological mitigation is proposed for the following reasons:

- Thousands of square kilometres of Bushmanland are covered by these low density artefacts scatters;
- A stone artefact collection has already been made by Beaumont et al (1995) from the adjoining property of Olyven Kolk;

- The lack of *in situ* archaeological surface sites or indications of stratified archaeological deposits means that the archaeological material on site has limited scientific value;
- We have photographed and recorded small collections of material across the solar plant site and believe that these are representative of the material as a whole;
- Further mitigation is unlikely to result in a greater understanding of the material and the various time periods, and as a result we do not believe further intervention from an archaeological point of view is necessary.

It is important to remember that a permit for the destruction of archaeological remains will have to be obtained from SAHRA.

In the event that human remains are uncovered beneath the soil surface during the construction of the facility, work in that location should stop, and the heritage authorities (SAHRA) should be notified. They may recommend exhumation.

There are no issues relating to the Built Environment (e.g. buildings or structures older than 60 years which are protected by the NHRA). There is a significant late 19th century "brakdak" farmhouse some 1.3km to the west of the proposed facility. If the proposed access road to the facility should be re-located in future to pass the house, then further studies of the Built Environment will be necessary. However, with regard current access plans, no mitigation is required.

SAHRA have requested that the assessment should whether the "cumulative impact of the solar energy facilities proposed on the same property may compromise the cultural landscape and its archaeological significance". There are no significant issues relating to the Cultural Landscape. The landscape comprises typical Bushmanland scrub. There are no prominent geological features such as hills or valleys. The farm is used for grazing livestock. The area has already been transformed by a substation and transmission lines.

The Visual Impact Specialist should consider the cumulative visual impact of several solar facilities in this area.

At least two other applications for solar energy facilities are proposed on the same property and the cumulative impact of several facilities may be high.

The "no-go" alternative would mean that the status quo is retained and that the heritage resources of the area are maintained in their current condition.

11. CONCLUSIONS

In conclusion, the following heritage indicators were considered:

Palaeontology:

- The bedrock under the property is unfossiliferous and of no palaeontological significance. The potential for fossils in the Quaternary sand cover is very low.

The Pre-colonial Archaeology:

- Stone artefacts scatters from the Early and Middle Stone Age are sparsely distributed across the study area and are found on gravel pavements between the vegetation;
- The absence of associated archaeological material, and lack of discrete individual sites reduces the significance of the material overall;

- The artefact scatters were given a low significance rating, with the knapping (factory) sites of low-medium significance;
- Thousands of square kilometres of Bushmanland are covered by these low density artefacts scatters;
- Further mitigation of sites is considered unnecessary in view of a collection which has already been made on the adjoining property of Olyven Kolk;
- A permit will be required for the destruction of archaeological material.

The Built Environment:

- There are no buildings of heritage significance on the site.

Graves:

- A few cairns were identified. They could possibly be graves. Due care should be taken during construction of the site and if human remains are uncovered, work should stop in that area and SAHRA should be notified.

Cultural Landscape:

- The proposed solar plant is positioned opposite the Aries substation on district gravel road linking Kenhardt with Bossiekom in the Northern Cape;
- A number of solar facilities have been proposed for this area and the cumulative impact needs to be considered;
- The cultural landscape of the surrounding area a flat arid landscape utilised for the grazing of livestock;

The potential impacts resulting from the installation of a solar power plant on the heritage resources of the sites are considered to be of minor significance, and no mitigation is recommended. However, the potential cumulative impact of a number of such facilities on the Cultural Landscape should be examined by the Visual Impact specialist.

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Appendix 1: Location of archaeological sites.

LABEL	LATITUDE (S) (dec deg)	LONGITUDE (E) (dec deg)	DESCRIPTION	SIGNIFICANCE
018	-29.48167000	20.78256800	Biface (quartzite) - part of general, low density, widespread artefact scatter	Low
019	-29.47854500	20.78752400	ESA/MSA quartzite artefacts as part of general widespread, low density, artefact scatter (sub-sample photographed)	Low
020	-29.47865600	20.78805600	Core	Low
021	-29.47864500	20.78813800	Core	Low
022	-29.47869100	20.78832500	Big flake	Low
023	-29.47873400	20.78859700	Big ESA core	Low
024	-29.47898700	20.78887900	Core	Low
025	-29.47926300	20.78885000	Big flake	Low
026	-29.47959300	20.78887200	Retouched flake	Low
027	-29.47972600	20.78893700	Flake	Low
028	-29.47972600	20.78893600	Big flake	Low
029	-29.47988700	20.78894600	Biface	Low
030	-29.47989600	20.78897700	Big core	Low
031	-29.47996700	20.78922600	Big core	Low
032	-29.48009100	20.78945500	Flake	Low
033	-29.48029000	20.78886900	Big core	Low
034	-29.48035900	20.78865200	Flake	Low
035	-29.48034600	20.78832700	Big retouched flake	Low
036	-29.48036200	20.78777300	Flake	Low
037	-29.48049800	20.78726600	Retouched flake	Low
038	-29.48049100	20.78722800	Retouched blade (NBK-like) - hornfels	Low
039	-29.48045700	20.78717300	Localised artefact scatter flakes and cores, , 1 retouched flake, of moderately higher density (subsample photographed)	Low-medium
040	-29.48042600	20.78685400	Big core	Low
041	-29.48034400	20.78683200	Flakes and cores - of same quartzite material (knapping area?)	Low-medium
042	-29.48034300	20.78680000	Flakes and cores - of same quartzite material (knapping area?)	Low-medium
043	gps error	gps error	Big single platform core	Low
044	gps error	gps error	Blade (retouched?), few cores and flakes	Low
045	gps error	gps error	Flak	Low
046	gps error	gps error	Big core	Low
047	gps error	gps error	Flakes, quartzite and banded ironstone	Low
048	gps error	gps error	Core	Low
049	gps error	gps error	Core	Low
050	gps error	gps error	Big retouched flake	Low
051	gps error	gps error	Big flake and big core	Low
052	gps error	gps error	Weathered flake	Low
053	gps error	gps error	Core and flake	Low
054	gps error	gps error	2 cores	Low
055	gps error	gps error	Localised artefact scatter flakes and cores, 1 retouched flake, of moderately higher density (sub-sample photographed). Quartzite fresh looking but also older weathered material	Low
056	gps error	gps error	Big single platform core, flakes, possible biface/core	Low
057	gps error	gps error	Fresh flake area (knapping?)	Low-medium
058	gps error	gps error	Core	Low
059	gps error	gps error	Core	Low
060	gps error	gps error	Flakes and cores	Low
061	gps error	gps error	Localised artefact scatter flakes and cores, 1 retouched flake, of moderately higher density (subsample photographed). Quartzite fresh looking but also older weathered material	Low
062	gps error	gps error	Localised artefact scatter flakes and cores, 1 retouched flake, of moderately higher density (subsample photographed). Quartzite fresh looking	Low

			but also older weathered material, some retouch	
063	gps error	gps error	Cores and flakes	Low
064	gps error	gps error	Very patinated biface, big retouched flake (scraper-like) and 2 cores	Low
065	gps error	gps error	Stone cairn (beacon/boundary marker?)	Low
066	gps error	gps error	Localised artefact scatter of flakes and cores incl retouched flake, of moderately higher density (subsample photographed). Butt preparation noted on occasional flakes	Low
067	gps error	gps error	Possible cairn (stones somewhat dispersed)	Low
068	-29.46410900	20.77458900	A number of quarried quartzite bedrock outcrops. A number of chunks of the material scattered about though little evidence of further knapping.	Low-medium
069	-29.46463800	20.77444200	Localised artefact scatter of patinated flakes and cores of moderately higher density (subsample photographed).	Low
070	-29.46457500	20.77275800	Fresh looking flakes and a number of quarried quartzite bedrock outcrops. Also patinated material.	Low
071	-29.46442900	20.77291400	Broken biface/core and some flakes	Low
072	-29.46424300	20.77310000	Patinated biface	Low
073	-29.46347900	20.77361000	Patinated flake showing signs of more recent re-use	Low
074	-29.46341200	20.77378900	A quarried quartzite bedrock outcrop. A number of flakes of the material scattered about the area	Low-medium
075	-29.46365100	20.77446200	Possible small biface	Low
076	-29.46397400	20.77461500	Small biface (Fauresmith?)	Low
077	-29.46994500	20.77331100	Large circular stone cairn (beacon/marker)	Low
078	-29.47013100	20.77303200	“Linear” cairn	Low
079	-29.47060500	20.77630100	Small knapping area with fresh looking quartzite flakes (same material and colour)	Low-medium
080	-29.46850500	20.77716300	Large chunks of surface rock scree in this area. “Bedrock” types are highly variable and include dolomite, ironstone, quartzite, dolerite?	Low
081	-29.47140900	20.78208900	Large chunk of banded ironstone	Low
082	-29.47164000	20.78272500	Localised artefact scatter of patinated flakes and cores of moderately higher density (subsample photographed).	Low
083	-29.47091800	20.78257500	Dolomite/ccs “bedrock”	Low
084	-29.46358000	20.78990800	Conglomerite “bedrock”	Low
085	-29.46429600	20.78989000	Small knapping area with fresh looking quartzite flakes (same material and colour)	Low-medium
L012	-29.48205440	20.78244660	Site under the transmission lines. Many artefacts including red jasper flake with retouch, large core, quartzite flakes with retouch, large blade with retouch, a single biface.	Low
L013	-29.47740350	20.78634620	On the slope overlooking a tributary of the river crossing the property. White/grey quartzite flakes very visible on the plains of black/dark rocks (igneous? Dolerite and dolomite). MSA	Low
L014	-29.47440740	20.78836170	On the other side of the tributary. 2 white/grey quartzite flakes and two reddish ones.	Low
L015	-29.47488760	20.78684810	2 white quartz chunks and 1 white quartzite flake. 2 very large quartzite flakes	Low
L016	-29.47479650	20.78614340	Very large quartzite cores and at least 7 flakes on red and white quartzite	Low
L017	-29.47490270	20.78570600	Quartzite cores and flakes	Low
L018	-29.47407980	20.78570730	Quartzite cores and flakes	Low
L019	-29.47394560	20.78651580	Quartzite cores and flakes	Low
L020	-29.47334920	20.78812380	3 white irregular quartzite cores and one flake. 8 white quartzite flakes (one small circular “scraper”).	Low
L021	-29.47374460	20.78843010	Another distribution of white quartzite cores and flakes.	Low
L022	-29.47655150	20.79445290	MSA (?) quartzite flake with retouch. 1 white quartzite flake with backing along one side and retouch on the other. Dolerite flake with flakes struck off radially (Levallois?).	Low
L023	-29.47623020	20.79414220	Collection of large white quartzite flakes and cores. A	Low

			collection of 9 (photo only has 6) flakes and cores of a green/brown quartzite, looks freshly struck. A knapping site.	
L024	-29.47612780	20.79416480	Red quartzite core	Low
L025	-29.47285970	20.79546040	1 very large quartzite core; 1 white quartzite flake. 1 red jasper core.	Low
L026	-29.46182880	20.79506730	Large white quartzite core and flake.	Low
L027	-29.46206920	20.79421250	Very large quartzite core.	Low
L028	-29.46253370	20.79322430	Very large red quartzite flake	Low
L029	-29.46187520	20.79221570	3 quartzite cores	Low
L030	-29.46011470	20.79353240	Grey quartzite flake with radial flakes removed (Levallois?).	Low
L031	-29.46308430	20.77491320	5 artefacts in a rubble area Very weathered handaxe (ESA) on a black dolerite (?) Collection of 6 white quartzite artefacts including 1 core	Low
L032	-29.46413740	20.77536370	1 large core and 3 flakes, one is a quartzite blade 5 quartzite cobbles, chunks and cores flaked Quartzite flake with retouch Typical MSA flake/blade with retouch	Low
L033	-29.46357210	20.77617160	1 very large quartzite core and only radial core	Low
L034	-29.46480390	20.77697960	2 types of flakes with retouch 1 well defined white quartzite MSA flake	Low
L035	-29.46837180	20.77718920	5 white quartzite flakes, one square with retouch along two margins 2 white flakes, one is a snapped blade	Low
L036	-29.46603100	20.77708860	Many white quartzite cores	Low
L037	-29.46600270	20.77591350	Factory site, on side of the hill, comprising a large outcrop of pink quartzite, which has had several large blocks removed, and many smaller flakes within a 5m radius of site.	Low-medium
L038	-29.46632960	20.77609730	Late 19th century green bottle glass, with base distributed in small area on top of the hill. No sign of retouch.	Low
L039	-29.47029760	20.78210800	1 large white quartzite core, 5 flakes, one being red quartzite. 1 MSA flake with prepared platform Several flakes with signs of retouch	Low
L040	-29.46836640	20.78401140	1 large quartzite blade 1 large triangular flake (typical MSA) with prepared platform 1 large, white quartzite scraper	Low
L041	-29.46333090	20.79049770	Quartzite flakes, cores, etc. One large squarish white quartzite flake with retouch along both margins. Pink quartzite core.	Low
L042	-29.46308600	20.78986950	Fine grained banded-ironstone core; very large weathered hornfels flake with retouch along one margin.	Low
L043	-29.46238920	20.78900210	Two MSA flakes on quartzite and one very weathered ironstone flake.	Low
L044	-29.46353540	20.78883150	MSA flake; large core, large group of white quartzite implements.	Low

Appendix 2: Brief Palaeontological Impact Assessment.

BRIEF PALAEONTOLOGICAL IMPACT ASSESSMENT

PROPOSED ORLIGHT SA DEVELOPMENT OF A SOLAR PHOTOVOLTAIC POWER PLANT NEAR KENHARDT, NORTHERN CAPE PROVINCE
Remaining Extent (RE) of Klein Zwart Bast 188 RD

By

John Pether, M.Sc., Pr. Sci. Nat. (Earth Sci.)
Geological and Palaeontological Consultant
P. O. Box 48318, Kommetjie, 7976
Tel./Fax (021) 7833023
Cellphone 083 744 6295
jpether@iafrica.com

Prepared at the Request of

Digby Wells & Associates (Pty) Ltd.
Fern Isle, Section 10, 359 Pretoria Ave, Randburg
Private Bag X10046, Randburg, 2125
Co. Reg. No. 1999/05985/07
Tel: 011 789 9495, Fax: 011 789 9498
johan.nel@digbywells.com, www.digbywells.com

For

ORLIGHT SA (PTY) LTD

24 April 2012

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CONTENTS

SUMMARY

Orlight SA (Pty) Ltd (Orlight SA) proposes to construct five new Solar Photovoltaic (PV) Power Plants in the Western Cape and Northern Cape Provinces. Three proposed sites for development of the Orlight SA Solar PV Power Plants are located in the Northern Cape Province near the towns of Aggeneys, Kenhardt and Loeriesfontein. Two proposed sites are in the Western Cape Province adjacent to the towns of Vanrhynsdorp and Graafwater. Digby Wells Environmental (Digby Wells) is appointed as the independent Environmental Assessment Practitioner (EAP) to conduct the Environmental Impact Assessment (EIA) processes for the proposed projects.

This desktop palaeontological assessment pertains to the Solar PV Plant near Kenhardt in the Siyanda District Municipality, Northern Cape, viz. on the Remaining Extent (RE) of the farm Klein Zwart Bast 188 RD (Figure 1)

The solar PV panels will be mounted on metal frames (Figure 2) which are anchored to the ground with either concrete or screw pile foundations. These footings will be either hammered into the earth or anchored in a 1.5 m deep concrete foundation.

The study area is on the edge of exposures of the Karoo Supergroup (Figure 4) and is underlain by the Dwyka Group, the lowermost unit of the Karoo Supergroup. The fossil content of the Dwyka group is overall poor. Fossils are found mainly in the interglacial, laminated mudrocks. These are trace fossils, organic-walled microfossils, rare marine shells, fish (sharks, palaeoniscoids) and plants (glossopterid leaves, lycopods) (Almond & Pether, 2008).

The scale of subsurface disturbance and exposure is quite limited, comprising mainly “post holes” to support the PV panel frames. These holes will mainly affect the weathered soil profile and regolith on the Dwyka outcrop. The fossil potential of the alluvium in the ephemeral drainages is low and PV arrays are not intended for these zones.

In view of the low fossil potential it is proposed that only a basic degree of mitigation is required. It is recommended that an alert for the uncovering of fossil bone and implements be included in the Construction Phase EMP for the project. Appendix 1 outlines monitoring by construction personnel and general Fossil Find Procedures. This is a general guideline, to be adapted to circumstances.

In the event of possible fossil and/or archaeological finds, the contracted archaeologist or palaeontologist must be contacted. For possible fossil finds, the palaeontologist will assess the information and liaise with the developer and the ECO and a suitable response will be established.

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The author, John Pether, is an independent consultant/researcher and is a recognized authority in the field of coastal-plain and continental-shelf palaeoenvironments and is consulted by exploration and mining companies, by the Council for Geoscience, the Geological Survey of Namibia and by colleagues/students in academia pursuing coastal-plain/shelf projects.

Expertise

- Shallow marine sedimentology.
- Coastal plain and shelf stratigraphy (interpretation of open-pit exposures and on/offshore cores).
- Marine macrofossil taxonomy (molluscs, barnacles, brachiopods).
- Marine macrofossil taphonomy.
- Sedimentological and palaeontological field techniques in open-cast mines (including finding and excavation of vertebrate fossils (bones).
- Analysis of the shelly macrofauna of modern samples e.g. for environmental surveys.

Membership of Professional Bodies

- South African Council of Natural Scientific Professions. Earth Science. Reg. No. 400094/95.
- Geological Society of South Africa.
- Palaeontological Society of Southern Africa.
- Southern African Society for Quaternary Research.
- Heritage Western Cape. Member, Permit Committee for Archaeology, Palaeontology and Meteorites.
- Accredited member, Association of Professional Heritage Practitioners, Western Cape.

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1 INTRODUCTION

Orlight SA (Pty) Ltd (Orlight SA) proposes to construct five new Solar Photovoltaic (PV) Power Plants in the Western Cape and Northern Cape Provinces. Orlight SA is the local company established by BSG Resources Limited (BSGR), an international natural resources company that operates in the fields of mining, energy and engineering services.

Three proposed sites for development of the Orlight SA Solar PV Power Plants are located in the Northern Cape Province near the towns of Aggeneys, Kenhardt and Loeriesfontein. Two proposed sites are in the Western Cape Province adjacent to the towns of Vanrhynsdorp and Graafwater. Digby Wells Environmental (Digby Wells) is appointed as the independent Environmental Assessment Practitioner (EAP) to conduct the Environmental Impact Assessment (EIA) processes for the proposed projects

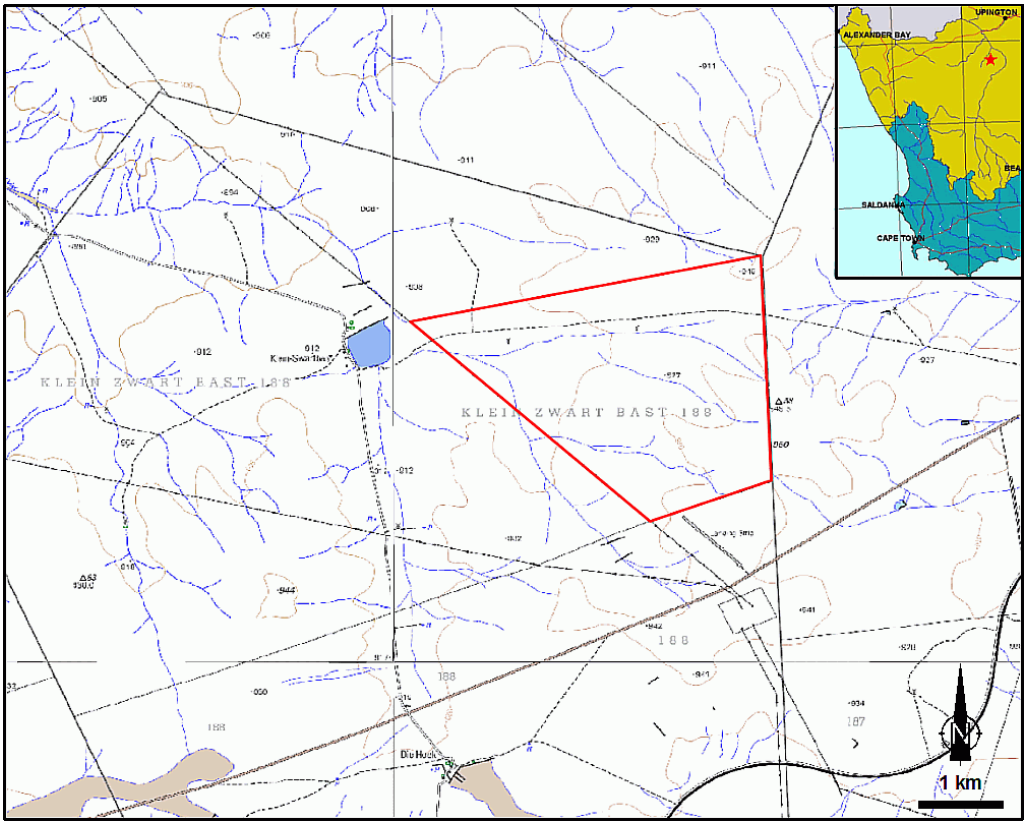

Figure 1. Location of the proposed Kenhardt Solar PV Plant. Extracts from 2920BC, BD, DA, DB_2003_ED2_GEO.TIF 1:50000 topo-cadastral maps. Chief Directorate: Surveys & Mapping.

This desktop palaeontological assessment pertains to the Solar PV Plant near Kenhardt in the Siyanda District Municipality, Northern Cape, viz. on the Remaining Extent (RE) of the farm Klein Zwart Bast 188 RD (Figure 1). The preliminary generation capacity of the proposed Kenhardt Solar PV Power Plant is ~70 MW, but may be up to 100 MW. During the EIA Phase, studies will be undertaken to determine the optimal generation capacity that can be

accommodated in the study area based on ecological, cultural and socio-economic characteristics and other technical factors.

The power plant infrastructure will consist of a ground mounting system, solar PV panels, cabling, inverters, switchboards and transformer/s and transmission lines to connect the proposed Solar PV Power Plant to an existing Eskom transmission line. Also involved are access roads and temporary construction-related laydown areas, temporary site offices and a workshop.

The solar PV panels will be mounted into metal frames (Figure 2) which are anchored to the ground with either concrete or screw pile foundations. These footings will be either hammered into the earth or anchored in a 1.5 m deep concrete foundation.

Figure 2. Example of a Solar PV installation (supplied by Digby Wells).

Figure 3. Simulated oblique view of the project area, looking north. From Google Earth.

2 GEOLOGICAL SETTING

The project area is situated on a gently sloping sandy plain (Figure 3) between ~900 m asl. in the northwest, rising to ~950 m asl. in the southeast. Ephemeral drainage lines extend northwest from the higher ground and are delineated by lighter-hued alluvium. This contrasts with the darker-hued, stony material exposed on the interfluves.

The study area is on the edge of exposures of the Karoo Supergroup (Figure 4) and is underlain by the Dwyka Group, the lowermost unit of the Karoo Supergroup. To the north are ancient basement rocks of the Bushmanland Subprovince or terrane of the Namaqua Province (Cornell *et al*., 2006). The Bushmanland terrane here consists of metasediments and metavolcanics (Brakwater Metamorphic Suite), De Kruis gneisses and De Bakken granites (*inter alia*). These very old rocks (>1000 Ma to 2000 Ma) are not of palaeontological interest.

The dark hue of the stony surface of the project area (Figure 3) contrasts with the lighter hues of the surficial cover formed on the gneisses to the north. Quaternary sand cover is minimal and the thin stony soil has evidently mainly formed by the weathering of the conglomeratic Dwyka diamictites.

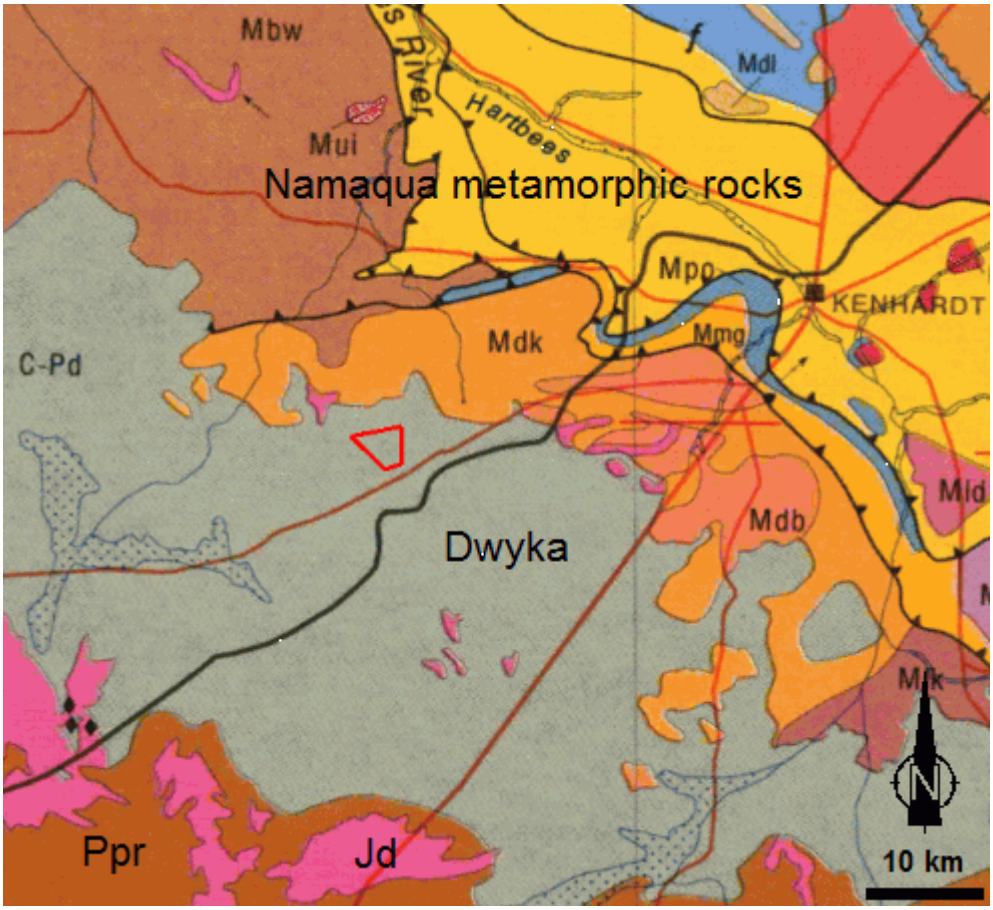

Figure 4. Geology of the study area. 1:1000000 Geological Map (CGS, 1997).

Mdb – De Bakken Granite.

Mdk – .De Kruis gneisses.
Mbw – Brakwater Metamorphic Suite.

3 EXPECTED PALAEONTOLOGY

The Dwyka Group was deposited when southern Africa was covered by large ice sheets and was located near the South Pole ~320-290 Ma. The typical deposits are called tillites (or diamictite), formed when mud, sand and rocks frozen in the ice melted out where the glaciers entered the sea. In places are interbedded mudstones and sandstones associated with phases of glacial retreat (warmer interglacials) (Johnson *et al*., 2006).

The fossil content of the Dwyka group is overall poor. Fossils are found mainly in the interglacial, laminated mudrocks. These are trace fossils, organic-walled microfossils, rare marine shells, fish (sharks, palaeoniscoids) and plants (glossopterid leaves, lycopods) (Almond & Pether, 2008).

The scale of subsurface disturbance and exposure is quite limited, comprising mainly “post holes” to support the PV panel frames. These holes will mainly affect the weathered soil profile and regolith on the Dwyka outcrop.

The fossil potential of the alluvium in the ephemeral drainages is low and PV arrays are not intended for these zones.

4 RECOMMENDATIONS

In view of the low fossil potential it is proposed that only a basic degree of mitigation is required.

It is recommended that an alert for the uncovering of fossil bone and implements be included in the construction EMP for the project.

Appendices 1 and 2 outline monitoring by construction personnel and general Fossil Find Procedures. This is a general guideline, to be adapted to circumstances.

In the event of possible fossil and/or archaeological finds, the contracted archaeologist or palaeontologist must be contacted. For possible fossil finds, the palaeontologist will assess the information and liaise with the developer and the ECO and a suitable response will be established.

5 APPLICATION FOR A PALAEONTOLOGICAL PERMIT

A permit from SAHRA is required to excavate fossils. The applicant should be the qualified specialist responsible for assessment, collection and reporting (palaeontologist). Should fossils be found that require rapid collecting, application for a palaeontological permit must be made to SAHRA immediately.

The application requires details of the registered owners of the sites, their permission and a site-plan map. All samples of fossils must be deposited at a SAHRA-approved institution.

6 REPORTING

Should fossils be found a detailed report on the occurrence/s must be submitted. This report is in the public domain and copies of the report must be deposited at SAHRA. The report must fulfil the reporting standards and data requirements of SAHRA.

7 REFERENCES

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8 GLOSSARY

~ (tilde): Used herein as “approximately” or “about”.

Aeolian: Pertaining to the wind. Refers to erosion, transport and deposition of sedimentary particles by wind. A rock formed by the solidification of aeolian sediments is an aeolianite.

AIA: Archaeological Impact Assessment.

Alluvium: Sediments deposited by a river or other running water.

Archaeology: 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.

asl.: above (mean) sea level.

Bedrock: Hard rock formations underlying much younger sedimentary deposits.

Calcrete: An indurated deposit (duricrust) mainly consisting of Ca and Mg carbonates. The term includes both pedogenic types formed in the near-surface soil context and non-pedogenic or groundwater calcretes related to water tables at depth.

Colluvium: Hillwash deposits formed by gravity transport downhill. Includes soil creep, sheetwash, small-scale rainfall rivulets and gullying, slumping and sliding processes that move and deposit material towards the foot of the slopes.

Coversands: Aeolian blanket deposits of sandsheets and dunes.

EIA: Environmental Impact Assessment.

EMP: Environmental Management Plan.

Fluvial deposits: Sedimentary deposits consisting of material transported by, suspended in and laid down by a river or stream.

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

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

HIA: Heritage Impact Assessment.

Palaeontology: The study of any fossilised remains or fossil traces of animals or plants which lived in the geological past and any site which contains such fossilised remains or traces.

Palaeosol: An ancient, buried soil whose composition may reflect a climate significantly different from the climate now prevalent in the area where the soil is found. Burial reflects the subsequent environmental change.

Palaeosurface: An ancient land surface, usually buried and marked by a palaeosol or pedocrete, but may be exhumed by erosion (*e.g*. wind erosion/deflation) or by bulk earth works.

Pedogenesis/pedogenic: The process of turning sediment into soil by chemical weathering and the activity of organisms (plants growing in it, burrowing animals such as worms, the addition of humus *etc.*).

Pedocrete: A duricrust formed by pedogenic processes.

PIA: Palaeontological Impact Assessment.

SAHRA: South African Heritage Resources Agency – the compliance authority, which protects national heritage.

8.1 GEOLOGICAL TIME SCALE TERMS

ka: Thousand years or kilo-annum (10^3 years). Implicitly means "ka ago" *i.e*. duration from the present, but "ago" is omitted. The "Present" refers to 1950 AD. Generally not used for durations not extending from the Present. Sometimes "kyr" is used instead.

Ma: Millions years, mega-annum (10^6 years). Implicitly means "Ma ago" *i.e.* duration from the present, but "ago" is omitted. The "Present" refers to 1950 AD. Generally not used for durations not extending from the Present.

Holocene: The most recent geological epoch commencing 11.7 ka till the present.

Pleistocene: Epoch from 2.6 Ma to 11.7 ka. Late Pleistocene 11.7–135 ka. Middle Pleistocene 135–781 ka. Early Pleistocene 781–2588 ka (0.78-2.6.Ma).

Quaternary: The current Period, from 2.6 Ma to the present, in the Cenozoic Era. The Quaternary includes both the Pleistocene and Holocene epochs.

Pliocene: Epoch from 5.3-2.6 Ma.

Miocene: Epoch from 23-5 Ma.

Oligocene: Epoch from 34-23 Ma.

Eocene: Epoch from 56-34 Ma.

Paleocene: Epoch from 65-56 Ma.

Cenozoic: Era from 65 Ma to the present. Includes Paleocene to Holocene epochs.

For more details, see www.stratigraphy.org.

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9 APPENDIX 1 - FOSSIL FIND PROCEDURES

A regular monitoring presence over the period during which excavations are made, by either an archaeologist or palaeontologist, is generally not practical.

The field supervisor/foreman and workers involved in digging excavations must be encouraged and informed of the need to watch for potential fossil and buried archaeological material. Workers seeing potential objects are to report to the field supervisor who, in turn, will report to the ECO. The ECO will inform the archaeologist and/or palaeontologist contracted to be on standby in the case of fossil finds.

In the context under consideration, it is improbable that fossil finds will require declarations of permanent "no go" zones. At most a temporary pause in activity at a limited locale may be required. The strategy is to rescue the material as quickly as possible.

The procedures suggested below are in general terms, to be adapted as befits a context. They are couched in terms of finds of fossil bones that usually occur sparsely. However, they may also serve as a guideline for other fossil material that may occur.

Bone finds can be classified as two types: isolated bone finds and bone cluster finds.

9.1 ISOLATED BONE FINDS

In the process of digging the excavations, isolated bones may be spotted in the hole sides or bottom, or as they appear on the spoil heap. By this is meant bones that occur singly, in different parts of the excavation. If the number of distinct bones exceeds 6 pieces, the finds must be treated as a bone cluster (below).

Response by personnel in the event of isolated bone finds

- **Action 1:** An isolated bone exposed in an excavation or spoil heap must be retrieved before it is covered by further spoil from the excavation and set aside.
- **Action 2:** The site foreman and ECO must be informed.
- **Action 3:** The responsible field person (site foreman or ECO) must take custody of the fossil. The following information to be recorded:
    - Position (excavation position).
    - Depth of find in hole.
    - Digital image of hole showing vertical section (side).
    - Digital image of fossil.
- **Action 4:** The fossil should be placed in a bag (*e.g.* a Ziplock bag), along with any detached fragments. A label must be included with the date of the find, position info., depth.
- **Action 5:** ECO to inform the developer, the developer contacts the standby archaeologist and/or palaeontologist. ECO to describe the occurrence and provide images asap. by email.

Response by Palaeontologist in the event of isolated bone finds
The palaeontologist will assess the information and liaise with the developer and the ECO and a suitable response will be established.

9.2 BONE CLUSTER FINDS

A bone cluster is a major find of bones, *i.e*. several bones in close proximity or bones resembling part of a skeleton. These bones will likely be seen in broken sections of the sides of the hole and as bones appearing in the bottom of the hole and on the spoil heap.

Response by personnel in the event of a bone cluster find

- **Action 1:** Immediately stop excavation in the vicinity of the potential material. Mark (flag) the position and also spoil that may contain fossils.
- **Action 2:** Inform the site foreman and the ECO.
- **Action 3:** ECO to inform the developer, the developer contacts the standby archaeologist and/or palaeontologist. ECO to describe the occurrence and provide images asap. by email.

Response by Palaeontologist in the event of a bone cluster find
The palaeontologist will assess the information and liaise with the developer and the ECO and a suitable response will be established. It is likely that a Field Assessment by the palaeontologist will be carried out asap.

It will probably be feasible to "leapfrog" the find and continue the excavation farther along, or proceed to the next excavation, so that the work schedule is minimally disrupted. The response time/scheduling of the Field Assessment is to be decided in consultation with developer/owner and the environmental consultant.

The field assessment could have the following outcomes:

- If a human burial, the appropriate authority is to be contacted (see AIA). The find must be evaluated by a human burial specialist to decide if Rescue Excavation is feasible, or if it is a Major Find.
- If the fossils are in an archaeological context, an archaeologist must be contacted to evaluate the site and decide if Rescue Excavation is feasible, or if it is a Major Find.
- If the fossils are in an palaeontological context, the palaeontologist must evaluate the site and decide if Rescue Excavation is feasible, or if it is a Major Find.

9.3 RESCUE EXCAVATION

Rescue Excavation refers to the removal of the material from the just the "design" excavation. This would apply if the amount or significance of the exposed material appears to be relatively circumscribed and it is feasible to remove it without compromising contextual data. The time span for Rescue Excavation should be reasonably rapid to avoid any or undue delays, *e.g*. 1-3 days and definitely less than 1 week.

In principle, the strategy during mitigation is to “rescue” the fossil material as quickly as possible. The strategy to be adopted depends on the nature of the occurrence, particularly the density of the fossils. The methods of collection would depend on the preservation or fragility of the fossils and whether in loose or in lithified sediment. These could include:

- On-site selection and sieving in the case of robust material in sand.
- Fragile material in loose/crumbly sediment would be encased in blocks using Plaster-of Paris or reinforced mortar.

If the fossil occurrence is dense and is assessed to be a “Major Find”, then carefully controlled excavation is required.

9.4 MAJOR FINDS

A Major Find is the occurrence of material that, by virtue of quantity, importance and time constraints, cannot be feasibly rescued without compromise of detailed material recovery and contextual observations.
A Major Find is not expected.

Management Options for Major Finds
In consultation with developer/owner and the environmental consultant, the following options should be considered when deciding on how to proceed in the event of a Major Find.

Option 1: Avoidance

Avoidance of the major find through project redesign or relocation. This ensures minimal impact to the site and is the preferred option from a heritage resource management perspective. When feasible, it can also be the least expensive option from a construction perspective.

The find site will require site protection measures, such as erecting fencing or barricades. Alternatively, the exposed finds can be stabilized and the site refilled or capped. The latter is preferred if excavation of the find will be delayed substantially or indefinitely. Appropriate protection measures should be identified on a site-specific basis and in wider consultation with the heritage and scientific communities.

This option is preferred as it will allow the later excavation of the finds with due scientific care and diligence.

Option 2: Emergency Excavation

Emergency excavation refers to the “no option” situation wherein avoidance is not feasible due to design, financial and time constraints. It can delay construction and emergency excavation itself will take place under tight time constraints, with the potential for irrevocable compromise of scientific quality. It could involve the removal of a large, disturbed sample by excavator and conveying this by truck from the immediate site to a suitable place for “stockpiling”. This material could then be processed later. Consequently, emergency excavation is not the preferred option for a Major Find.

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Appendix 3: Visual Impact Assessment.

VISUAL IMPACT ASSESSMENT

PROPOSED DEVELOPMENT OF FIVE SOLAR PV POWER PLANTS IN THE NORTHERN CAPE AND WESTERN CAPE PROVINCES

REPORT SUBMITTED TO:

ORLIGHT SA (PTY) LTD

8 MARCH 2012

SITE	*AFFECTED FARM*	*DEA REF. NO.*	*NEAS REF. NO.*
Aggeneys	Portion 1 of Aroams 57 RD	***12/12/20/2630***	***DEA/EIA/0000818/2011***
Kenhardt	Remaining Extent (RE) of Klein Zwart Bast 188 RD	***12/12/20/2631***	***DEA/EIA/0000813/2011***
Loeriesfontein	Portion 1 of Klein Rooiberg 227 RD	***12/12/20/2632***	***DEA/EIA/0000825/2011***
Vanrhynsdorp	Remaining Extent (RE) of Paddock 257 RD	***12/12/20/2633***	***DEA/EIA/0000822/2011***
Graafwater	Portion 1 of Graafwater 97 RD Remaining Extent (RE) of Bueroskraal 220 RD	***12/12/20/2636***	***DEA/EIA/0000828/2011***

Digby Wells & Associates (Pty) Ltd. Co. Reg. No. 1999/05985/07. Fern Isle, Section 10, 359 Pretoria Ave Randburg Private Bag X10046, Randburg, 2125, South Africa

Tel: +27 11 789 9495, Fax: +27 11 789 9498, info@digbywells.com, www.digbywells.com

Directors: AR Wilke, LF Koeslag, PD Tanner (British)*, AJ Reynolds (Chairman) (British)*, J Leaver*, GE Trusler (C.E.O)

*Non-Executive

DIGBY WELLS ENVIRONMENTAL

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Project Title: Visual Impact Assessment for the proposed development of five Solar Photovoltaic (PV) Power Plants in the Northern Cape and Western Cape Provinces

Project Number: BSG1384

Name	Responsibility	Signature	Date
Alice McClure *Environmental GIS Specialist*	Report Writer		02 March 2012
Bradly Thornton *Department Manager*	1st Review		02 March 2012
Mia Ackerman Project Manager	2nd Review		05 March 2012

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EXECUTIVE SUMMARY

In line with the growing need for electricity supply and cleaner energy production in South Africa, Orlight SA (Pty) Ltd (Orlight SA) is proposing the construction of five Solar Photovoltaic (PV) Power Plants in the Western Cape and Northern Cape Provinces.

Digby Wells Environmental (Digby Wells) has been appointed by Orlight SA as the independent Environmental Assessment Practitioner (EAP) responsible for undertaking the Environmental Impact Assessment (EIA) process for the proposed Solar PV Power Plants.

The five proposed Solar PV Power Plants will be situated near the towns of Aggeneys, Kenhardt and Loeriesfontein in the Northern Cape Province and Vanrhynsdorp and Graafwater in the Western Cape Province.

The study areas for and preliminary generation capacities of the proposed Solar PV Power Plants are listed below. Studies were undertaken to determine the optimal generation capacity that can be accommodated in each study area based on their ecological, cultural and socio-economic characteristics and other technical factors:

- Proposed 40 MW up to 150 MW generation capacity on Portion 1 of the farm Aroams 57 RD near Aggeneys in the Namakwa District Municipality, Northern Cape Province;
- Proposed 70 MW up to 100 MW generation capacity on the Remaining Extent (RE) of the farm Klein Zwart Bast 188 RD near Kenhardt in the Siyanda District Municipality. Northern Cape Province;
- Proposed 40 MW up to 150 MW generation capacity on Portion 1 of the farm Klein Rooiberg 227 RD near Loeriesfontein in the Namakwa District Municipality, Northern Cape Province;
- Proposed 20 MW up to 45 MW generation capacity on the RE of the farm Paddock 257 RD near Vanrhynsdorp in the West Coast District Municipality, Western Cape Province; and
- Proposed 35 MW up to 75 MW generation capacity on Portion 1 of the farm Graafwater 97 RD and the RE of the farm Bueroskraal 220 RD near Graafwater in the West Coast District Municipality, Western Cape Province.

Potential impacts associated with the proposed Solar PV Power Plants were identified during a screening assessment undertaken for the project in December 2011. The five study areas were subsequently visited by the visual impact assessment (VIA) team in January 2012 to assess the landscape and visual contexts of each of the study areas. Viewshed and sensitivity analyses were performed in a Geographic Information System (GIS) and potential visual receptors were identified in order to determine the visibility of the proposed plant components.

The study areas were rated on a visual sensitivity scale that was developed in order to demarcate favourable areas for the development of the Solar PV Power Plant components,

construction lay-down yards and ancillary infrastructure, thereby mitigating visual impacts through the design process.

It is believed that if the potential infrastructure is constructed within the areas demarcated as having the lowest visual impact (based on the visual sensitivity scale), the visual impacts associated with the construction and operation of the Solar PV Power Plants at Aggeneys, Kenhardt, Loeriesfontein or Graafwater will not be significant. The visual impacts, associated with the construction and operation of a Solar PV Power Plant within the heritage and tourism landscape of Vanrhynsdorp, are likely to be more significant.

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TABLE OF ABBREVIATIONS

Abbreviation	**Meaning**
VIA	Visual impact assessment
EIA	Environmental impact assessment
EAP	Environmental assessment practitioner
PPP	Public participation process
I&AP	Interested and affected party
GIS	Geographic information system
PV	Photovoltaic
CV	Curriculum Vitae

1 INTRODUCTION

In line with the growing need for electricity supply and cleaner energy production in South Africa, Orlight SA (Pty) Ltd (Orlight SA) is proposing the construction of five Solar Photovoltaic (PV) Power Plants in the Western Cape and Northern Cape Provinces.

The five proposed Solar PV Power Plants will be situated near the towns of Aggeneys, Kenhardt and Loeriesfontein in the Northern Cape Province and Vanrhynsdorp and Graafwater in the Western Cape Province.

Digby Wells Environmental (Digby Wells) has been appointed by Orlight SA as the independent Environmental Assessment Practitioner (EAP) responsible for undertaking the Environmental Impact Assessment (EIA) process for the proposed Solar PV Power Plants.

The objective of the EIA process was to identify potential impacts associated with the project and thereafter, ensure that the development is undertaken in such a way as to promote the positive impacts (i.e. contribution to fulfilment of national electricity demand, training and skills development and creation of local employment opportunities) and to minimise the negative impacts (i.e. soil erosion, visual disturbance and ecological impacts) of the proposed project.

This report presents the findings of the Visual Impact Assessment (VIA) that was undertaken for the proposed project.

1.1 Expertise of the Specialists

The assessment was undertaken by Bradly Thornton and Alice McClure of Digby Wells Environmental. Bradly completed his Honours degree in Environmental Management and has been utilising GIS to aid in project decision making at Digby Wells for 5 years. He is the manager of the GIS department and has a number of years of experience in conducting Visual Impact Assessments. Alice completed her Masters in Conservation Planning using GIS and has been working with contemporary VIA methods, amongst other GIS functions, since she joined Digby Wells Environmental in January 2011. Please refer to Appendix B for an abridged Curricula Vitae (CVs) of the specialists.

1.2 Legislative and Policy Framework

The following international, national and regional legislative and policy documents form part of the legislative and policy framework of the VIA. The objective was to ensure that the assessments meet all stipulated requirements to ensure legal compliance and successful integration into the regional planning context.

1.2.1 International Conventions

The European Landscape Convention (ELC), created by the Council of Europe, was the first international convention to focus exclusively on landscapes (Berry, 2010). The purpose of

the convention is to promote effective management and planning of landscapes and was signed by the United Kingdom government in 2006 and became binding from 2007. Public documents that explore the impacts of large scale developments on any landscape should take into account the effects of these developments, such as wind farms or Solar PV Power Plants, as defined in the ELC. A landscape, as defined by the ELC, "means an area, as perceived by people, whose character is the result of the action and interaction of natural and/or human factors" (i.e. the natural, visual and subjectively perceived landscape) (Contesse 2011) (European Landscape Convention 2007).National Legislation and Policy

At a national level, the following legislative documents potentially apply to VIA;

Regulations in Chapter 5 (Integrated Environmental Management) of the National Environmental Management Act (Act No. 107 of 1998) (NEMA) and the Act in its entirety. The act states that "the State must respect, protect, promote and fulfil the social, economic and environmental right of everyone…" landscape is both moulded by, and moulds, social and environmental features;

The National Heritage Resources Act (Act No. 25 of 1999) (NHRA) in terms of the related provincial regulations – in some instances there are policies or legislative documents that give rise to the protection of listed sites. The heritage act states that it aims to promote "good management of the national estate, and to enable and encourage communities to nurture and conserve their legacy so that it may be bequeathed for future generations". A holistic landscape whose character is a result of the action and interaction and/or human factors has strong cultural associations as societies and the landscape in which they live are affected by one another in many ways;

Section 17 of the Protected Areas Act (Act 57 0f 2003) (PAA) which stipulates the protection of natural landscapes. Landscapes are defined by the natural, visual and subjectively perceived landscape (ELC); these aspects of a landscape are intertwined to form a holistic landscape context.

1.2.2 Regional Regulatory Context

In the Western Cape, visual and aesthetic resources, along with other natural resources, are protected by local authorities, such as the City of Cape Town, where policies and by-laws relating to urban edge lines, scenic drives, special areas, signage, communication masts, etc. have been formulated (Oberholzer, 2005).

2 STUDY AREAS

The study areas for and preliminary generation capacities of the proposed Orlight SA Solar PV Power Plants are listed below. Studies were undertaken to determine the optimal generation capacity that can be accommodated in each study area based on their ecological, cultural and socio-economic characteristics and other technical factors:

- Proposed 40 MW up to 150 MW generation capacity on Portion 1 of the farm Aroams 57 RD near Aggeneys in the Namakwa District Municipality, Northern Cape Province;

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- Proposed 35 MW up to 75 MW generation capacity on Portion 1 of the farm Graafwater 97 RD and the RE of the farm Bueroskraal 220 RD near Graafwater in the West Coast District Municipality, Western Cape Province.

The study areas are larger than the required footprint areas for the proposed Solar PV Power Plants, to provide adequate space for optimising site layout by avoiding ecological and archaeological sensitive areas. Please refer to Plan 1 in Appendix A for the regional setting of the proposed solar PV power projects.

Each of these study areas were described in the context of the visual environment (grouped into physical and human descriptions) and topographical aspects below.

2.1 Aggeneys

2.1.1 Physical Environment: Topography and Landscape

The Aggeneys study area is south facing and fairly flat, but is bordered by steep outcrops in the northern part. The study area falls within the Nama Karoo. The landscape and flora of the site and its surrounds are therefore typical of a dry climate. The area is sandy and rocky and is covered by low-lying vegetation (Figure 1). A drainage line, which spans approximately 50m in width, runs in a south-westerly direction through the study area.

The outcrops on the northern border of the study area are typical of the regional area in which the Aggeneys study site falls; a diversity of fauna and flora is supported by the unique ecologies on these arid inselbergs, outcrops and plains.

Figure 1: Aggeneys landscape, vegetation and topography

2.1.2 Human Elements, Aesthetic Value and Associations

The mining town of Aggeneys is located approximately 5 km from the study area and is therefore just visible from the northern border of the study area. The N14 is the most prominent man-made feature in the area and cuts through the study area in an east-west direction. Fences, a telecommunications tower, transmission lines and a picnic site on the side of the national road are the only notable man-made features. There are very few potential visual receptors in and around the area that will experience a visual impact from the project and there is already a mining operation taking place just outside the town; the aesthetic value and sense of place of the area as a whole has, therefore, already been somewhat altered from a pristine to a somewhat transformed landscape.

Figure 2: Fence lines on the north westerly boundary of the site - Aggeneys town just visible

2.2 Kenhardt

2.2.1 Physical Environment: Topography and Landscape

The Kenhardt study area is flat and north-easterly facing,. The study area falls within the Nama Karoo Biome and the vegetation composition is a result of a dry and hot climate. The landscape in and around the Kenhardt study area is mildly undulating (Figure 3). There are two main drainage lines within the study area.

Figure 3: Kenhardt landscape, vegetation and topography

2.2.2 Human Elements, Aesthetic Value and Associations

The Kenhardt study area is approximately 38 km away from the town of Kenhardt. In terms of man-made structures, there is a large Eskom substation about 1 km south of the study area, on the other side of a gravel road (Figure 4). The study area is surrounded by fences and two overhead transmission lines pass through the site to connect with the substation. Besides from the farmers that utilise the gravel road, it is expected that very few receptors will experience a visual impact from the proposed Solar PV Power Plant. The aesthetic value of the site and the surrounding areas is affected by presence of the substation and transmission lines.

Figure 4: Aries substation 1 km south of the study area

2.3 Loeriesfontein

2.3.1 Physical Environment: Topography and Landscape

The Loeriesfontein study area is positioned on the farm Kleine Rooiberg, after the name is representative of the landscape which displays outcropping areas that are reddish in colour and dominate the west and north of the study area (Figure 5). The study area itself is flat and slightly east-facing. The Loeriesfontein study area falls within the Succulent Karoo biome. The landscape is dominated by vegetation that is comprised of low-lying shrubs and succulents and rocky areas. A number of drainage lines that vary in size are evident throughout the study area of which the largest of the drainage lines is approximately 50 m wide

Figure 5: Landscape, vegetation and topography at Loeriesfontein study area

2.3.2 Human Elements, Aesthetic Value and Associations

The study area is situated 40 km to the north of the town of Loeriesfontein. It is nestled between steep outcrops and there is a gravel farm road that passes through site. Fences surround the western, eastern and southern boundaries of the site and transmission lines are visible to the north-east of the study area. The Helios substation is approximately 8 km north of the study area.

2.4 Vanrhynsdorp

2.4.1 Physical Environment: Topography and Landscape

The Vanrhynsdorp study area is flat to mildly sloping. The majority of the study area is north facing as the area forms a hill with the highest point approximately 1 third to the south. The study area is covered by low-lying grassy vegetation. The study area falls within the Succulent Karoo. The town of Vanrhynsdorp borders the site to the south and the large Matzikamma Mountain is visible on the other side of the town (Figure 6).

Figure 6: Topography, landscape and vegetation of Vanrhynsdorp study area in the fore-ground and Matzikmma Mountain in the background

2.4.2 Human Elements, Aesthetic Value and Associations

Since the study area is very close to the town itself, houses on the periphery of the town are visible from the study area and vice versa. The study area is surrounded by fences and the N7 national road runs along its western boundary (Figure 7). Due to the position of the study area from the town and the national road, there will be many visual receptors that will be impacted upon by the proposed Solar PV Power Plant.

Figure 7: View of Vanrhynsdorp study area from the N7

2.5 Graafwater

2.5.1 Physical Environment: Topography and Landscape

The Graafwater study area falls within the Fynbos Biome. The vegetation type that covers the study area is that of Sand Plain Fynbos and the Fynbos species on and around the study area grow up to 2 m high. Although the study area itself is fairly flat and is north facing, the topography of the general landscape of the area is much more mountainous (Figure 8).

Figure 8: Graafwater study area vegetation, landscape and topography with Graafwater town in the background

2.5.2 Human Elements, Aesthetic Value and Associations

The town of Graafwater is located 1.5 km to the north of the study area. The study area is divided by a gravel farm road and a railway line and is surrounded by fences. There is currently a small-scale quarry mining operation on the eastern side of the gravel road that runs through the study area. The proposed Solar PV Power Plant will be visible to people utilising the R346 provincial road which runs through the town of Graafwater and to a fair portion of the community members residing in the town. The proposed project will have an impact on the sense of place of the town itself and on its aesthetic value, as the town is currently a small farming town where Rooibos and potatoes are farmed commercially.

3 APPROACH AND METHODOLOGY

3.1 Approach to Visual Impact Assessment

Landscape and visual impacts, caused by any change to a region, are two closely related elements. A 'landscape' refers to the appearance of the land and takes into account its shape, texture and colours and the overall effect of the combination of these factors.

The four predominant groups of factors that contribute to landscape are:

- *Physical:* Geology, landform, drainage, soils, ecology and climate;
- *Human:* Archaeology, landscape history, land use/management, buildings and settlements;
- *Aesthetic:* Visual factors (i.e. views, viewers and visual amenity) and other senses (i.e. sounds, smells, tastes and touch); and
- *Associations:* Cultural and historical (Shetland Islands Council, 2006).

Impacts to the landscape are described as "…changes in the fabric, character, and quality of the landscape as a result of development," while visual impacts "…relate solely to the changes in views of the landscape, and the effect of those changes on people," (Shetland Islands Council, 2006).

VIAs are formalised assessments to quantify and describe both the landscape and visual impacts that a potential infrastructure development might have.

3.1.1 Requirements of Visual Impact Assessment

There are a number of elements that need to be included and considered when a VIA is carried out in order to address as many of the problematic queries that could arise (Fisher, 1996). In many cases, visual assessments are simply viewed as a "check-box" item in the EIA process, often not given as much weighting as other studies. For this reason, the methodology utilised during visual assessments is, in some cases, out-dated or not thorough or contemporary enough to produce optimal results and recommendations. When a VIA is undertaken under these conditions, many aspects of a comprehensive assessment are left out.

It is therefore important to carry out VIAs that take into account a full range of visual, aesthetic, cultural, natural and spiritual aspects of the specific environment, since they contribute to that area's sense of place and determine how different landscape elements interact with one another (Oberholzer, 2005). This calls for some level of subjectivity and sensitivity towards social contexts and issues, since visual and scenic resources are, by nature, difficult to quantify and assess using purely scientific methods.

A VIA should describe the potential effect of the proposed infrastructure on the holistic aesthetic and "feel" of a location. This is a complicated process and it is not sufficient to simply quantify where a structure will be seen from and where it will be hidden based on the topography. In some cases the proposed infrastructure might have the potential to add value to the visual or aesthetic quality of a landscape, depending on the current contextual cultural,

social and physical aspects of the proposed site. A VIA can be further complicated in some cases where the potential infrastructure traverses a mosaic of landscapes that differ in their physical and social composition. The outcome of a VIA is therefore highly site specific.

3.1.2 Visual Impact Assessment criteria

There are, however, a few criteria that should form the skeletal structure of all VIAs (Oberholzer 2005), these criteria are listed below. They may be adapted for site specific results and other criteria may be utilised if needs be (Oberholzer, 2005).

- *Visibility of the proposed structure:* Visibility of a proposed structure is defined by the topography of the area in which it will be situated and the height of the proposed structure. Theoretically, it is a quantifiable criterion and can be measured using a viewshed function in a Geographic Information System (GIS). There are, however, a number of other factors that might affect visibility - these either need to be included systematically in the study or mentioned in the results;
- *Visual exposure of the proposed structure:* Visual exposure is determined by the distance of the viewer from the proposed structure. This differs for different structures and is affected by the landscape character;
- *Visual sensitivity of the contextual area:* The sensitivity of a landscape is determined by its character, topography and how it has been utilised or populated. All of these factors will contribute towards determining how drastically the proposed development will alter the overall landscape;
- *Visual sensitivity of the potential receptors in the area:* The receptors that are included and analysed in a VIA are those locations where people inhabit or utilise land from where the proposed infrastructure will potentially be seen;
- *Visual absorption capacity (VAC) of the landscape:* The visual sensitivity of an area is fairly closely related to its VAC, depending on the current landscape and population situation and whether the proposed infrastructure will have the potential to 'blend in' with its surroundings (to an extent); and
- *Visual intrusion of the proposed structure:* VAC of a landscape is, in turn, related to the visual intrusion of the proposed structure. If the structure is not compatible with the qualities of an area (and is not easily 'absorbed') then the landscape integrity will be affected causing visual intrusion.

Many of these criteria are more qualitative than quantitative in nature. In order to define the status of each criterion for the proposed structure, a number of various current site-specific elements need to be taken into account and analysed using both quantitative and qualitative methods. By doing so, the current visual resource can be defined. It must be remembered that they are all affected by both natural physical and cultural attributes and are intertwined with one another.

Table 1 describes these elements and how each notion contributes towards a robust VIA (Theron, 2010; Oberholzer, 2005).

Table 1: Aspects that define and affect the visual and landscape character of a potential project site

Visual resource element	Description	Relevance to criteria
Landscape Character	All of the elements that a landscape is comprised of affect the landscape character (i.e. significant features, water bodies, terrain, vegetation type etc.). Landscape character is one of the more tangible aspects of a VIA and can therefore be quantified by viewing the particular landscape or photographs of it. However, in some cases the landscape character can be influenced by more intangible aspects, such as historical or cultural associations. These aspects therefore need to be considered when assessing or defining landscape character.	Relevant to all criteria
Scenic Value of the Landscape/ Landscape Quality	The "beauty" of a landscape is described by its scenic value. This is, again, a fairly difficult notion to define contextually since "beauty in things exists merely in the mind which contemplates them" (Hume, 1742). The scenic value of a place is therefore defined based on the context in which a landscape is viewed and the conceptual norms of aesthetic appeal and ecological integrity.	Relevant to visual sensitivity of the area and receptors, VAC and visual intrusion
Sense of Place	People who reside in the landscape, are familiar with it, or make use of it create a sense of place – it is created through cognitive and sensory experiences of these individuals or groups of people.	Relevant to visual sensitivity of the area and the potential receptors

3.1.3 Cultural and Heritage Associations

An important aspect of any VIA is the consideration of visual values of a place that are linked to cultural or heritage characteristics, as… “Culture changes landscapes and culture is embodied by landscapes,” (Nassauer, 1995). How a certain community or society has utilised a piece of land and, to an extent, the relationship that the community has had with the area over time can affect the landscape character. Land characters that have heritage or cultural associations can be defined as the following:

- *Designed Landscape:* A landscape that has been consciously designed by an urban designer, architect, engineer, landscape architect or any other persons that have used design principles or recognised styles or traditions;
- *Historic Site:* A landscape that is significant for its association with a historic event, activity or person;
- *Vernacular Landscape:* A landscape that has evolved through uses by people whose activities or occupancy has shaped the landscape. Through social or cultural attitudes of an individual, family or community the landscape reflects the physical, biological and cultural character of the everyday lives of the people living within it; and
- *Ethnographic Landscape:* A landscape containing a variety of natural and cultural resources that the associated people define as heritage resources.

Intangible heritage aspects are sensitive to visual impacts. Cultural landscapes (such as farm complexes) have the potential to change with the introduction of a new structure or infrastructure that subsequently becomes part of the landscape. It is important to identify areas or locations of archaeological and cultural significance in order to determine how the potential infrastructure might impact the sense of place or ambience of the landscape in which these locations exist. For example, if a homestead is recognised for its cultural or heritage significance, the introduction of a solar PV power plant could disrupt the visual and ambient landscape in which the homestead exists. Heritage and cultural landscapes are directly related to their visual environment and a negative impact on one leads to a negative impact on the other.

3.2 Objectives

The main objectives of the VIA are to quantify the potential impacts that the proposed Solar PV Power Plants will have on visual receptors and the landscape as a whole and to develop a site selection decision-making tool for the proposed projects. The specific objectives of the VIA were:

- To identify the current aspects of the study area/ landscape that are relevant to the VIA by carrying out a site visit and defining the various landscape units;
- To develop a model in GIS that provides a tool to aid decision-making in the selection of the placement of the potential infrastructure so that it will have the lowest negative visual impact on the surrounding environment;
- To run the model for each individual study area and create set of visual sensitivity maps;
- To advise the developers as to where the proposed solar PV infrastructure should be located in order to have the lowest negative visual impact, while ensuring the optimal utilisation of the study areas for electricity generation;
- To identify potential receptors that will be impacted on by the proposed Solar PV Power Plants;

- To identify the impacts that the proposed Solar PV Power Plants will have on the visual landscape and to rate the scale, duration, severity and probability of the impacts occurring; and
- To provide recommendations and mitigation measures so as to reduce the negative visual impacts that the proposed Solar PV Power Plants, transmission lines and substations will have.

3.3 Methodology

When dealing with the impact that a potential structure is going to have on the visual environment of a landscape, two important facets of a visual impact need to be considered, namely:

- The ability that the structure will have to alter the current landscape; and
- The impact that the structure will have on visual receptors (i.e. viewers).

The first consideration is based purely on the current landscape character which is a tangible aspect and is therefore easier to quantify. The latter is based on the perception of people that experience the visual impact and is therefore harder to quantify, necessitating a certain level of subjectivity. Aspects such as cultural and heritage associations, the current social, economic and even political characteristics of a community have the potential to influence or alter how visual receptors perceive the new infrastructure.

A number of different strategies were employed to ensure that all of the aspects of a comprehensive VIA were covered. These strategies comprise of subjective, objective, quantitative and qualitative decision-making tools.

3.3.1 Preliminary Risk Assessment

A preliminary risk assessment, or environmental screening, of the proposed project was undertaken in December 2011 with the objective of identifying the potential impacts of project activities on the visual environment. A summary of these impacts is provided in Table 2 and the assessment of the significance of these potential impacts will be the focus of the visual assessment.

Table 2: Potential impacts on the visual environment

Project activity	Potential impact	Knowledge gaps and proposed way forward
Construction phase		
Site clearance	Change in aesthetic characteristics	Conduct full visual impact assessment by carrying out the following activities; Carry out theoretical viewshed models using Geographic Information Systems. Ground-truth theoretical models and gather information about the visual sensitivity and characteristics of the proposed sites. Further identify potential receptors and attempt to quantify the extent of the visual impacts on these receptors. Synthesise viewshed model results, information gathered in the field and additional visual impact assessment research done to determine, as accurately as possible, the full range of visual impacts that the Solar PV Power Plants, and their respective construction / maintenance activities, will have on their surrounding visual environments.
Vehicular activity	Dust disturbance which affects visibility and visual nature of the areas	
Construction lay-down yard	Minor visual disturbance due to machinery and construction activities occurring	
Vehicle hard park and hydrocarbon management (fuel, oil and waste oil)	Minor visual impact due to introduction / presence of management tools and equipment	
On site-accommodation of construction workers	Minor visual impact due to introduction / presence of camps for workers	
Domestic waste and sewage management	Minor visual impact due to introduction / presence of sewage waste management tools and equipment	
Access control and fencing of site	Minor visual impact due to the erection of fencing and boom gates / access control centres	
Anchoring and installation of solar PV panels	Main visual impact due to the introduction and erection of large, reflective solar panels	

Project activity	Potential impact	Knowledge gaps and proposed way forward
Operational phase		
Operation of Solar PV Power Plants	Main visual impact due to the presence of large, reflective solar panels	Same as above
Access control and fencing of site	Minor visual impact due to the erection of fencing and boom gates / access control centres	Same as above

3.3.2 Assessing subjective visual sensitivity, scenic value and sense of place

In order to obtain the potential visual impact that a structure might have on a landscape, the intangible and physical aspects of the landscape need to be assessed. Site visits were carried out in order to document the tangible characteristics within the landscape such as topography, vegetation, man-made structures, etc. The intangible aspects of the areas, such as sense of place and the "feel" of the area could only truly be documented through observation and interaction with interested and affected parties (I&APs) and landowners. Public information sharing meetings were attended and the perceptions, ideas and issues that were raised by the public were recorded. These meetings and the opinions of the attendees, allowed for the general perceptions of the people within the community to be documented or at least experienced.

3.3.3 Viewshed analyses: Visibility of proposed structure

Systematic viewshed analyses were run in order to determine where the proposed Solar PV Power Plant components and ancillary infrastructure will be visible from. The viewshed analyses were carried out in the following way.

- A Digital Elevation Model (DTM) was created in a GIS using contours of the existing topography;
- Viewsheds (the total area that has a direct visual connection for the infrastructure) were modelled to establish the degree of visibility that the proposed preliminary infrastructure will have. A worst-case scenario of a 10 m height was factored into these viewshed analyses; and
- Viewsheds were assessed and compared in terms of intensity and spatial extent.

3.3.3.1 Methodological considerations

A visually sensitive area of concern of 5 km around each of the study areas was chosen to be assessed thoroughly in terms of the viewshed and overall visual sensitivity analyses. The viewshed models that are run in a GIS provide results that are relative to the topography layer that is used as an input in the model and can therefore extend as far as the topography layer extends. However, consideration of climate aspects which affect visibility and visual exposure were taken into account and real-world visual study area was defined in order to practically carry out the analyses for each of the five project study areas within time and monetary limitations.

3.3.4 Visual sensitivity and site selection

The site selection methodology was also a systematic process that utilised the viewshed analysis function.

Potential receptors were identified using aerial imagery within a 5 km radius of the proposed study areas. These receptors were grouped into the following:

- National roads (i.e. those people travelling on the National roads);

- Provincial roads (i.e. those people travelling on the Provincial roads);
- Gravel roads (i.e. those people travelling on the Gravel roads); and
- Towns (i.e. those people who reside in or are visiting the town).

A model was created in ArcGIS for the viewshed analyses to be run for each of these groups. The height of the proposed structure (absolute worst-case scenario) was factored into these viewshed analyses by assigning an "offset" height of the potential structure of 10 m. The model also converted the resultant raster viewshed layers for each group into polygon layers. The results of this model were 12 polygon viewshed layers for each receptor group for each site, denoting which points they would be seen from and, concurrently, which points in the landscape the persons within these receptor groups would be able to see.

Values were then assigned for the viewshed polygons based on the receptor group such that the areas visible by more sensitive visual receptors were given a higher value (i.e. the visibility areas for the towns and national roads are likely to be experienced more frequently/by a larger number of people). The values assigned were decided upon during a specialist meeting with two GIS specialists and are shown in Table 3.

Table 3: Potential receptor weightings

Receptor Type	Visual Impact Score
Gravel road	0.25
Provincial road	1
Town	3
National road	3

All of the viewshed polygons for all of the different receptor groups were then merged in order to obtain one comprehensive visual sensitivity layer. This merging process allowed both the number of receptors and the type of receptors to be factored into an all-inclusive visual sensitivity index that ranged from 0 (areas within the study site that are not visible from any of the identified receptors) to 7.25 (areas that are visible from a range of receptors, including the most sensitive receptors – towns and a national road).

These scores were then grouped into visual sensitivity ratings (Plans 8, 9, 10, 11 and 12) with red shading over areas that were rated as potentially having a very high visual impact, orange shading over areas that were deemed as having a potential high visual impact, yellow shading over areas that were depicted as having a potential significant visual impact, light green shading for areas that will potentially have a minor visual impact and dark green shading for the areas that would result in the lowest visual impact if the infrastructure were to be built on them. Based on the definition of the visual sensitivity scale, areas for potential construction that would lead to lower visual impacts were recommended.

3.3.5 Cultural and Heritage Associations

A Heritage Statement was compiled in order to identify sites of archaeological, cultural and heritage importance within and around the study areas at a desktop level. Co-ordinates of the relevant documented sites were researched and used to plot the sites as points on the viewshed analyses results maps in order to determine which of the sites could possibly be impacted by the change in visual landscape.

Although the location of the identified sites in relation to the study areas was determined, those that were within the visual study area (5 km radius around each of the sites) were not included in the overall visual sensitivity analyses for each of the sites. This is due to the fact that the significance of the visual landscape to each and every one of the sites has not been quantified; since the sites have merely been classified into groups and HIA. It is therefore difficult to quantify how a change in the visual environment will impact each of these cultural or heritage sites specifically. Detailed studies should be carried out during the phase 1 HIA in order to determine the significance of the visual environment to these sites, and how a change in the visual environment will impact their intangible heritage associations.

3.4 Impact Assessment Methodology

The methodology employed for the EIA is divided into two distinct phases, namely: (I) impact identification; and (ii) impact assessment.

3.4.1 Impact identification

Impact identification is performed by use of an input and output model, which serves to guide the assessor in assessing all the potential instances of ecological, socio-economic and cultural change, pollution and resource consumption that may be associated with the activities required during the construction, operational, closure and post-closure phases of the project.

Outputs may generally be described as any changes to the biophysical, socio-economic and cultural environments, both positive and negative in nature, and also include the product and waste produced by the activity.

During consultation with I&APs, perceived impacts were identified. These perceived impacts will become part of the impact assessment and significance rating in order to differentiate between probable impacts and perceived impacts.

A non-exhaustive list of activities that should be considered in the identification of potential positive and negative impacts via the input-output model is described in Table 2.

3.4.2 Impact significance assessment

The impact rating process is designed to provide a numerical rating of the various environmental impacts identified by use of the input and output model. The significance rating process follows the established impact/risk assessment formula:

Significance = Consequence x Probability

Where	Consequence	= Severity + Spatial Scale + Duration
And	Probability	= Likelihood of an impact occurring

The severity, spatial scale, duration and probability of an impact occurring are assigned a rating out of seven as indicated in Table 4. The matrix calculates an overall significance rating out of 147. Impacts are rated prior to mitigation and again after consideration of the mitigation measure proposed in the EMP.

The significance of an impact is determined by reference the significance rating to the probability consequence matrix shown in Table 5, after which it is categorised into one of four categories, as indicated in Table 6

Table 4: Impact assessment parameter ratings

Rating	Severity		Spatial scale	Duration	Probability
	Environmental	Social, cultural and heritage			
7	Very significant impact on the environment. Irreparable damage to highly valued species, habitat or eco system. Persistent severe damage.	Irreparable damage to highly valued items of great cultural significance or complete breakdown of social order.	International The effect will occur across international borders.	Permanent without mitigation No mitigation measures of natural process will reduce the impact after implementation.	Certain/definite The impact will occur regardless of the implementation of any preventative or corrective actions.
6	Significant impact on highly valued species, habitat or ecosystem.	Irreparable damage to highly valued items of cultural significance or breakdown of social order.	National Will affect the entire country.	Permanent with mitigation Mitigation measures of natural process will reduce the impact.	Almost certain/highly probable It is most likely that the impact will occur.
5	Very serious, long-term environmental impairment of ecosystem function that may take several years to rehabilitate.	Very serious widespread social impacts. Irreparable damage to highly valued items.	Provincial/regional Will affect the entire province or region.	Project life The impact will cease after the operational life span of the project.	Likely The impact may occur.
4	Serious medium term environmental effects. Environmental damage can be reversed in less than a year.	On-going serious social issues. Significant damage to structures/ items of cultural significance.	Municipal area Will affect the whole municipal area.	Long term 6 to 15 years.	Probable Has occurred here or elsewhere and could therefore occur.
3	Moderate, short-term effects but not affecting ecosystem functions. Rehabilitation requires intervention of external specialists and can be done in less than a month.	On-going social issues. Damage to items of cultural significance.	Local Local extending only as far as the development site area.	Medium term 1 to 5 years.	Unlikely Has not happened yet but could happen once in the lifetime of the project, therefore there is a possibility that the impact will occur.
2	Minor effects on biological or physical environment. Environmental damage can be rehabilitated internally with or without help of external consultants.	Minor medium-term social impacts on local population. Mostly repairable. Cultural functions and processes not affected.	Limited Limited to the site and its immediate surroundings.	Short term Less than 1 year,	Rare or improbable Conceivable, but only in extreme circumstances and/ or has not happened during lifetime of the project but has happened elsewhere. The possibility of the impact occurring is very low as a result of design, historic experience or implementation of adequate mitigation measures.
1	Limited damage to minimal area of low significance. Will have no impact on the environment.	Low-level repairable damage to commonplace structures.	Very limited Limited to specific isolated parts of the site.	Immediate Less than 1 month.	Highly unlikely Expected never to happen.

Table 5: Probability consequence matrix

Probability / Likelihood	Consequence (severity + scale + duration)								
	1	3	5	7	9	11	15	18	21
1	1	3	5	7	9	11	15	18	21
2	2	6	10	14	18	22	30	36	42
3	3	9	15	21	27	33	45	54	63
4	4	12	20	28	36	44	60	72	84
5	5	15	25	35	45	55	75	90	105
6	6	18	30	42	54	66	90	108	126
7	7	21	35	49	63	77	105	126	147

Table 6: Significance summary table

High	**108- 147**	
Medium-High	**73 - 107**	
Medium-Low	**36 - 72**	
Low	**0 - 35**	

3.5 Knowledge Gaps

The visual impact that the proposed structure will have on a landscape is, for the most part, dependent on the subject who is viewing it; visual impacts are rated based on social norms and the effect to the overall ecological integrity of the area, but for some people infrastructure may be an indication of urbanisation and, consequently, economic upliftment in the area. This would result in a positive visual impact for the viewer. For other receptors the construction of the Solar PV Power Plants might be a negative factor which could impede tourism in the area. Ideally the perceptions of people residing in each and every household, shop or restaurant that will potentially be affected would be included in the VIA, but this is impossible, especially for a project of this magnitude.

However, In the case of this VIA, the specialists carried out their field work in conjunction with the public participation process (PPP) specialists and therefore sat in on all of the PPP meetings that were held in each of the different towns. This was highly beneficial since the attendees included people from the local communities, government officials, landowners and other interested and affected parties (I&AP's). During the presentation that was given, the attendees were shown photos of other Solar PV Power Plants and were made aware of how the potential infrastructure will look and their reactions were noted by both the PPP and VIA

specialists. The PPP meetings also allowed the VIA specialists to get a feel for the 'sense of place' of each of the towns.

Because of the nature of the proposed project and the deliverables that were expected from the VIA, a novel and context specific approach was adopted to carry out the VIA. Although this was essential in order to achieve appropriate and defendable results, there is always potential for error when adopting original techniques as methods are refined through repetition.

A possible pitfall of the VIA, which is imperative to document, is the fact that the site visit was not carried out during the flowering season for the areas in which the sites are located. Both Loeriesfontein and Aggeneys are situated in the "Namakwa Land" (Plan 2), a tourist region known for its daisies and other flowers after the rainy season. Although Vanrhynsdorp falls outside of this region, after conversing with the local people in the different areas, it was established that Aggeneys does not experience the flowering daisies phenomenon, but, in fact, that Loeriesfontein and Vanrhynsdorp do. Documentation of the landscape character, scenic value and sense of place could change dramatically after a visit to the sites during the flowering season since the dry, barren landscapes become vibrant and colourful in some cases (Figure 9). The Namakwa is also known for its variety of succulents which, in some cases such as on the Vanrhynsdorp site, are also seasonal.

Figure 9: Namakwaland landscape when flowers are in bloom

4 RESULTS AND DISCUSSIONS

4.1 Landscape Character, Scenic Value and Sense of Place

4.1.1 Aggeneys

The Aggeneys study area (Northern Cape) is utilised for sheep grazing. The surrounding landscape is impressive with large, flat open spaces and contrasting large rocky outcrops. The dry landscape is somewhat dramatic with its contrasting features and has a rugged and stark beauty. There is definitely a sense of place within many of the small Karoo towns or "dorpies", however, Aggeneys is a mining town and was built during the 1970's; it therefore lacks a long standing social or cultural history. The study area evokes a sense of remoteness since it is about 5 km from the town and it is a semi-natural landscape that has only been utilised by people for livestock grazing. There is evidence for Stone Age use of the landscape. Consideration should thus be given to an archaeological sense of place, especially when interpreting Stone Age deposits. A Phase 1 Heritage Impact Assessment (HIA) will be conducted, wherein the Visual Impact Assessment will be reviewed to address specific heritage related issues, if any. The area does, however, have a sense of being transformed by people, not only because of the visibility of the town form the border of the study area, but also because a transmission lines runs through the study area and fences on the border of the property. The N14 also dissects the study area towards the south-eastern corner which adds to the aspect of the area being transformed.

4.1.2 Kenhardt

The Kenhardt study area falls within the Northern Cape. There are a few houses outside of the study area, but the study area itself is situated in open land approximately 37.5 km away from the town of Kenhardt and the sense of place, or remoteness, is therefore not influenced by present day social or cultural contexts. The historical sense of place may be affected. Many of Lucy Lloyd's and Wilhelm Bleek's San informants were originally from the Kenhardt region. Lloyd and Bleek compiled significant oral histories of the last /Xam San, Their information subsequently informed much later San rock art research and interpretation. Some of the /Xam recorded histories may in fact make reference to particular landscapes in the Kenhardt region. As such the character of the historical recorded landscape will be severely affected.

4.1.3 Loeriesfontein

The flat and barren Loeriesfontein study area falls within the Northern Cape and the areas has flat open plains which are contrasted by large, dramatic outcrops "rooiberge" or Red Mountains on its outskirts. These unusual "rooiberge" definitely add to the aesthetic value of the Loeriesfontein study area. The study area is situated approximately 40 km outside of the town of Loeriesfontein and there are no residences nearby it. The study area is surrounded by fences and high voltage overhead transmission lines are evident within and adjacent to the study area. Since the study area is nestled between mountains within a landscape that is not urbanised the sense of place on the site is not influenced by the present day social contexts that influence the sense of place within Loeriesfontein town. It has, instead a

"sense of remoteness". There is extensive evidence of Stone Age occupation and land use at Loeriesfontein. Similar to the Aggeneys site, the archaeological sense of place must be assessed during the Phase 1 HIA. There is furthermore evidence of a paleontological landscape, the effect of the proposed Solar PV Power Plants in terms of visual impacts on paleontological resources are unknown. Specialist opinion will be required by palaeontologists.

4.1.4 Vanrhynsdorp

The Vanrhynsdorp study area comprises a field-like area on the outskirts of the town of Vanrhynsdorp. There are a number of man-made footpaths evident amongst the dry, low-lying vegetation that was observed during the site visit in the dry season. The Matzikamma Mountain on the other side of the town contributes substantially to the scenic value of Vanrhynsdorp town is, which is home to a proud, close-knit community. The impacts on visual resources at this site are likely to be significant since the aesthetic appeal of the area is related to the arid plains (or Knersvlakte) and the historical aspects associated with the town.

The Knersvlakte is a semi-desert area within the Namakwaland that is renowned for its level of biodiversity richness (Haarmeyer 2009); the vast rolling plains that surround Vanrhynsdorp are characteristic of the Knersvlakte and accommodate a high level of succulent biodiversity. Vanrhynsdorp town itself has a high heritage and visual resource due to the origins and history (and consequently the architecture) that is associated with the town which was founded in 1887 (Van Tonder-Pieterse 2006, cited in Orton 2011). The project area is situated adjacently north of a more modern part of the town, the historical and vernacular landscape of the town and its surrounds is likely to be negatively affected if solar panels and other infrastructure, that is associated with the proposed Solar PV Power Plants, are erected. The N7 national road is a popular tourist route which passes near the outskirts of Vanrhynsdorp town and the provincial road connecting Nieuwoudtville, Vanrhynsdorp and Vredendal runs through the Vanrhyns Pass, which is an impressive natural feature of the landscape (Figure 10);

Figure 10: Vanrhyns Pass (travelling from Nieuwoudtville/Clanwilliam to Vanrhynsdorp)

The visual resource of the local area will experience a negative impact with the introduction of a Solar PV Power Plant which will, consequently, transform the current historical landscape and have a negative impact on the visual resource of the tourist route as a whole. A possible impact may also be on known and unknown rock shelters that may contain rock art and archaeological deposit. The location of such sites will need to be determined or affirmed during a Phase 1 HIA, and visual impacts reassessed.

4.1.5 Graafwater

The study area is on the outskirts of the town of Graafwater which is a farming town and does not have significant heritage or tourism associations.. The R364 is used by tourists travelling from Clanwilliam to Lamberts Bay but the scenic tourism resource of the area is not significant at a regional of even local scale. Two Grade II heritage sites (provincially protected) are known to exist on the farm Graafwater. These are a historical dovecote and Second Anglo-Boer blockhouse. The actual locations of these monuments are unknown and must be determined in a Phase 1 HIA. The visual impacts on these will be assessed in the HIA.

4.1.6 Summary

The descriptions of landscape character, scenic value and sense of place were based on the site visits that were carried out between 9 and 14 January 2012. An overall baseline landscape sensitivity score was given for each of the sites (Table 7); the study areas were rated from 1 to 5, with 5 being the highest sensitivity score and 1 being the lowest.

Table 7: Landscape sensitivity of the study areas

Study area	Overall Landscape Sensitivity Score (1 – 5)
Aggeneys	4
Kenhardt	3
Loeriesfontein	3.5
Vanrhynsdorp	4.5
Graafwater	3

4.2 Cultural and heritage associations

32 archaeological, cultural and heritage sites were identified during the Cultural Resources Pre-Assessment that was compiled in January 2012 (Appendix B). These sites included rock shelters, grave sites, structures, features and artefact scatters (Table 8).

Table 8: Relevant archaeological and heritage sites (adapted from Table A in the Cultural Resources Pre-Assessment, January 2012)

Site	Y Co-ordinate	X Co-ordinate	Type
1	-32.12572	18.6144	Rock Shelter
2	-31.526	18.6011	Rock Shelter
3	-31.52438	18.6038	Rock Shelter
4	Not available	Not available	Grave Site
5	-32.18675	18.69458	Structure
6	-32.18645	18.69563	Structure
7	-32.18608	18.69479	Grave Site
8	-32.18878	18.70195	Artefact Scatter
9	-32.19181	18.70758	Artefact Scatter
10	-32.19236	18.71142	Feature
11	-32.19236	18.71211	Artefact Scatter
12	-32.19371	18.71466	Rock Shelter
13	-32.14483	18.66613	Structure
14	-32.14619	18.6504	Artefact Scatter
15	-32.1445	18.65486	Structure
16	-32.18632	18.68391	Rock Shelter

17	-32.18647	18.68344	Rock Shelter
18	-32.14466	18.66463	Rock Shelter
19	-32.14433	18.66472	Rock Shelter
20	-32.18829	18.70008	Rock Shelter
21	-32.18801	18.70084	Rock Shelter
22	-32.17697	18.86717	Grave Site
23	-32.17852	18.84125	Rock Shelter
24	-29.25722	18.8033	Rock Shelter
25	-29.19952	18.9803	Artefact Scatter
26	-29.10232	19.39923	Artefact Scatter
27	-29.05551	19.4438	Structure
28	-28.97807	19.52695	Structure
29	-29.2303	18.89361	Feature
30	-29.2214	18.90597	Feature
31	-29.2229	18.90953	Feature
32	-29.4615	20.77483	Structure

Sites 29 and 31 are within the Aggeneys study area; the construction of the Solar PV Power Plant will therefore definitely have an impact on the visual landscape that might be associated with the sites. Both sites are described as natural features; both are rocky outcrops that hold potential for rock art. These sites need to be investigated further in the Phase 1 HIA. Site 25, which is a Late Stone Age lithic scatter, is located approximately 7. 3 km north east of the study area while site 24 (a rock shelter/boulder with rock art) is located approximately 7.6 km south west of the study area. They both fall outside of the area of high visual concern (the 5 km radius around the study area). The development of Solar PV Power Plants will significantly affect the sense of place connected with rock art, which are often imbued with ritual, symbolic and spiritual associations. Rock art is furthermore intrinsically linked with the landscape, making use of natural features to emphasise some of the motifs, designs and figures.

Site 32, which was identified on satellite imagery as possible stone feature falls within the Kenhardt study area but is within an area of non-visibility. The Loeriesfontein study area has evidence of Stone Age occupation and paleontological resources. In addition, These sites are just over 14 km north-west of the Vanrhynsdorp study area, both are defined as Stone Age rock shelters that contain a number of archaeological items including ostrich egg shell beads, decorated pottery, marine shell and others. A change in the visual environment could therefore potentially change their intangible heritage aspects if the structure is viewable from the rock shelters, or passed or visible when approaching these sites. The shelters are, however, in between two foothills of raised pieces of land, one of which is between the shelters and the Vanryhnsdorp study area. It is unlikely that the infrastructure will be viewable from these locations but the phase 1 heritage impact assessment that is to be carried out should investigate further.

Site 1 (a rock shelter containing lithics, pottery, worked bone and other items) and site 14 (an ephemeral artefact scatter on a rock shelf) are within the visual sensitivity study area.

Site 15 (an old road with dry stone embankments) is just outside of it. According to the viewshed analyses, the potential infrastructure will not be visible from site 1 but will be visible from site 14. The phase 1 heritage impact assessment needs to take heed how the potential infrastructure could impact the visual landscape associated with site 14 and determine whether site 15 will also be impacted.

The detailed Phase 1 HIA that will be undertaken should examine all of the identified sites, and other that are discovered, within the visual landscape. An attempt needs to be made to quantify, drawing on archaeological and heritage knowledge, the impact that the potential infrastructure might have on the intangible heritage aspects of the sites within the visual landscape.

5 QUANTITATIVE FINDINGS

5.1 Viewshed analyses

The results from the viewshed analyses, are depicted in Plans 3, 4, 5, 6 and 7, and summarised in Table 9. These plans illustrate the extent to which the proposed infrastructure will be visible within a 5 km radius of each of the study areas. The green areas are those that will experience a visual impact from the potential infrastructure while the pink areas will not experience a visual impact. The results are based on the topography of the current landscape and its ability to screen the potential infrastructure.

Table 9: Percentages of potential visibility and non-visibility of the Solar PV Power Plant infrastructure within a 5 km radius of the study areas

Site	% Visibility	% Non-visibility
Aggeneys	40.46	59.54
Kenhardt	47.14	52.86
Loeriesfontein	52.12	47.88
Vanrhynsdorp	57.33	42.67
Graafwater	61.84	38.16

The large outcrops and inselbergs to the north and east of the Aggeneys study area boundary shield the visibility of the potential infrastructure anywhere beyond these outcrops. There are also smaller outcrops that are scattered around the study area which also decrease visibility of the proposed infrastructure. The potential Solar PV Power Plant will therefore likely only be visible from less than half (40.46%) of the surrounding environment (within a 5 km radius of the site itself). The N14 national road, Aggeneys town and a number of gravel roads were identified as potential receptors within the 5 km radius around the Aggeneys study area.

The undulating topography of the Kenhardt study area region results in the potential infrastructure being likely visible within about half, or slightly less (47.14%), of the surrounding landscape within a 5 km radius. The infrastructure will potentially be visible mostly within areas to the north-west of the study area as there is a mild slope increase traveling from the north westerly corner to the south east corner of the study area. Only one gravel road was identified as a potential receptor within the radius of interest for the Kenhardt site.

There are fairly large outcrops ("rooiberge") to the west of the Loeriesfontein study area which results in the overall visibility within the 5 km radius being localised mostly within the eastern areas. These outcrops result in an overall lower area being exposed to visibility (47.88%) within the 5 km radius than that which is likely to experience visibility of the potential infrastructure (52.12%). Only one gravel road was identified as a potential receptor within the radius of interest for the Loeriesfontein site.

The topography of the Vanrhynsdorp site leads to a higher proportion of the area within the 5km radius around the study area likely to experience visibility (57.33%) than that area which will most probably not experience visibility of the proposed infrastructure (42,67%). Most of the land extending north and that which lies directly south of the study area will potentially experience visibility. A gentle slope downwards towards the "droe" river on the opposite side of the N7 (south west of the study area) leads to a lack of potential visibility within this region. Vanrhynsdorp town, the N7 national road, provincial roads and a number of gravel roads were all identified as potential visual receptors within the area.

A much larger area (61.84%) within the 5 km radius of the Graafwater is likely to experience visibility of the proposed infrastructure than that which is not (38.16%). The area that is likely not to experience visibility of the proposed infrastructure falls predominantly within the area that is south east of the study area, behind a very gentle slope that shields this region. Graafwater town, the R363 provincial road and a number of gravel roads were identified as potential visual receptors within the 5 km radius around the Graafwater study area.

Table 10: Potential receptors identified within a 5 km radius of the study areas

	Potential receptors			
Site	*Town*	*National road*	*Provincial road*	*Gravel road*
Aggeneys	X	X		X
Kenhardt				X
Loeriesfontein				X
Vanrhynsdorp	X	X	X	X
Graafwater	X		X	X

It is important to note where the potential receptors that were identified lie within the viewshed results displayed on Plans 3, 4, 5, 6 and 7.

The majority of the National road falls within the non-visibility area of the 5 km radius around the Aggeneys study area, while about a third of the town infrastructure also falls within this area. It is likely that the proposed infrastructure will be visible from the majority of the gravel roads that were identified.

The proposed infrastructure is unlikely to be visible from the gravel roads identified within the 5 km radius of the Kenhardt study area according to the viewshed analysis.

Half of the gravel road identified within the vicinity of the Loeriesfontein study area is likely to experience visual impacts.

More than half of the national road stretch and about two thirds of the actual town within the vicinity of Vanrhynsdorp is likely to experience visibility of the proposed infrastructure. Most of the provincial roads identified within the vicinity of the Vanrhynsdorp study area fall within the non-visibility areas, while more gravel roads fall within the visibility areas of the viewshed results.

Theoretically, most of the receptors identified within the vicinity of the Graafwater study area should experience visual impacts, including all of the town and most of the provincial road.

5.2 Visual Sensitivity

The results from the visual sensitivity model are depicted in Plans 8, 9, 10, 11 and 12. These plans show which areas, if developed, will have a higher visual impact than others, based purely on potential receptors that were identified. The results are illustrated on a relative visual impact scale; with areas that are shaded in orange or red depicting construction locations that would lead to a higher visual impact. It is favourable, based on visual impact concerns, to place infrastructure on areas that are green or yellow (i.e. infrastructure built on these areas will have a lower visual impact). A worst case scenario of 10 m high infrastructure was adopted during the visual impact and sensitivity methodologies in reaction to time and resource constraints. If the infrastructure height is less, the visual impact will be less, but the scale will still be relative.

Table 11: Percentages of visual sensitivity categories of the entire study area

Site	% Total Area				
	No Visual Impact	*Minor Visual Impact*	*Significant Visual Impact*	*High Visual Impact*	*Very High Visual Impact*
Aggeneys	X	24.13	62.85	X	13.02
Kenhardt	55.87	44.13	X	X	X
Loeriesfontein	7.75	92.25	X	X	X

Vanrhynsdorp	X	X	55.04	11.66	33.3
Graafwater	X	24.12	X	75.88	X

The Vanrhynsdorp site has the potential to have a high visual impact (Table 11) since all of the land falls either within the significant visual impact, high visual impact or very high visual impact categories (i.e. a high visual impact will be experienced no matter where the infrastructure is erected). From a visual perspective, it would be most favourable, in this situation to build on the areas demarcated as having a significant visual impact (comparatively). These high visual sensitivity results are a consequence of the proposed site being directly north of Vanrhynsdorp town itself and the fact that the N7 runs on the western border of the site.

From a visual perspective, the proposed infrastructure can be built anywhere within the Loeriesfontein and Kenhardt sites and the impact will be, at worst, only minor impacts (Table 11). This is due to the fact that there is only one, comparatively infrequently used gravel road (this is the case at both sites) that will receive the visual impact of the potential Solar PV Power Plants.

There are likely to be a higher number of potential receptors at the Aggeneys site which could experience a negative visual impact (Table 11) if the Solar PV Power Plant infrastructure (or part of it) is built on the red sections of the site (Plan 8). A lower visual impact will be experienced if the infrastructure is placed within the green sections on the map.

About three quarters of the Graafwater site is in a position to impose high visual impacts on receptors (in particular the town which is north of the site). Infrastructure should be placed within that quarter of land that is displayed as yellow on Plan 12 so that minor visual impacts will be experienced.

5.3 Summary

It is important to bear in mind that the mathematical models used to compute the viewshed and visual sensitivity results for the proposed Solar PV Power Plants are based purely on the topography of the landscape and do not take into account the vegetation, climate effects or man-made structures within the study areas. It is therefore important to synthesise the qualitative information gathered while visiting the site, the viewshed results and the visual sensitivity results in order to obtain comprehensive findings that are "real-world", contextual and can be applied practically.

Table 12 summarises the findings from the qualitative and quantitative visual impact methodologies that were adopted in order to determine the landscape character, scenic value and sense of place of the existing study areas and the respective towns, as well as the visibility and visual sensitivity of the potential Solar PV Power Plant infrastructure and its placement within the landscape and study area. The overarching and all-encompassing score given for three aforementioned visual aspects is the "overall landscape sensitivity rating". This is based on visits to the study areas (the visual aspects analysed and assessed) and interaction with people in the local communities.

The scores given for visibility and visual sensitivity of the potential infrastructure at each site (using mathematical and technical models) are based on the current topographical and contextual visual environment; these scores are derived from the percentage of areas that will be exposed to a visual impact created by the potential Solar PV Power Plants, and the receptors that were identified and recorded for the area. Lower scores indicate a lower impact.

The summary table also shows one final overarching score for the sensitivity of the entire visual environment for each of the sites. The score was derived by applying the equation below. This score was used as a basis for the impact assessments. Thus:

$$Overall\ visual\ sensitivity = \frac{(\text{overall landscape sensitivity} + \text{visibility} + \text{visual sensitivity})}{3}$$

Table 12: Summary table showing landscape sensitivity, visibility), visual sensitivity and the final comprehensive visual impact score

Site	Landscape sensitivity rating	Visibility rating	Visual sensitivity	Final visual impact score
Aggeneys	4	3.5	3.5	3.7
Kenhardt	3	0.5	1	1.5
Loeriesfontein	3.5	1	1	2
Vanrhynsdorp	4.5	4.5	4	4.3

Graafwater	3	3.5	3	3.2

6 IMPACT ASSESSMENT

This impact assessment considers two types of impacts, namely:

- Impacts which have the potential to alter/introduce elements into the landscape; and
- Impacts which alter sense of place of a landscape.

Both positive and negative impacts have been identified and considered in the impact matrices. Where positive impacts have the change to be enhanced, their "severity" is given a higher score. Since many of the activities that will be carried out have similar/the same visual impacts, a number of them have been grouped together – especially all of the visual impacts associated with construction since the different construction activities are usually experienced together as one visual impact.

6.1 Aggeneys

6.1.1 Construction phase

Nature: Potential impact on the aesthetics of the town of Aggeneys and surrounds

Accommodation of construction workers in the town of Aggeneys

The additional need for housing within Aggeneys to house workers during the construction phase might have an indirect impact on the aesthetics of the town and possibly, the surrounding area. The town might increase in size but that will not make a significant difference in the contextual landscape.

Parameters	**Without mitigation**	**With mitigation**
Severity	2 (Minor)	1 (Limited)
Spatial scale	2 (Limited)	1 (Very limited)
Duration	3 (Medium term)	3 (Medium term)
Probability	3 (Unlikely)	3 (Unlikely)
Significance	21 (Low)	15 (Low)
Status	Negative	Negative
Reversibility?	Yes	Yes
Irreplaceable loss of visual resources?	No	No

Can impacts be mitigated?	Yes
Residual impacts:	NA
Enhancement/mitigation	The additional housing that might be built should be constructed in line with the already existing housing infrastructure. If the dwellings are placed within an already existing urban or peri-urban context then there will not be a drastic change to the visual landscape of the town. Temporary housing can easily be disassembled after the Solar PV Power Plant has been built.

Nature: Potential impact on the aesthetics and sense of place of the town of Aggeneys

Construction activities and the installation of the Solar PV Power Plant components might have an impact on the aesthetics and sense of place of the area.

Due to the active mining operation in the town of Aggeneys, large transportation trucks and other construction activities are not unusual in the area and will not introduce a significant novel visual impact.

Preparation of the site will involve flattening the landscape and removing vegetation and although this will alter the low-lying vegetation composition, the flat topography of the landscape will not be altered significantly. The erection of security fences will not introduce a significant new impact, as existing transmission lines, fences and even a telecommunications tower are visible on the site.

Transportation of infrastructure and building material to and from the site will also introduce dust plumes due to vehicular movement.

Parameters	**Without mitigation**	**With mitigation**
Severity	3 (Moderate)	2 (Minor)
Spatial scale	2 (Site and immediate surrounds)	2 (Site and immediate surrounds
Duration	3 (Medium-Term)	3 (Medium-Term)
Probability	7 (Certain)	6 (Likely)
Significance	56 (Medium-Low)	42 (Medium-Low)

Status	Negative	Negative
Reversibility?	Yes	Yes
Irreplaceable loss of visual resources?	No	No
Can impacts be mitigated?	Yes	
Enhancement/mitigation measures:	Recommendations about positioning of the Solar PV Power Plant components, based on the VIA and viewshed analyses that compare various options for placement within the study area was given. Although the study area straddles the N14, the visual impact of construction activities and the installation of the Solar PV Power Plant components will be reduced if activities are restricted within the recommended development areas.	
Residual impacts:	NA	

6.1.2 Operational phase

Nature: Potential impact on the aesthetics and sense of place of the town of Aggeneys The presence of the Solar PV Power Plant will introduce a negative visual impact to the current semi-remote landscape character of Aggeneys town and its surrounds.		
Parameters	**Without mitigation**	**With mitigation**
Severity	4 (Fairly serious and on-going)	2 (Moderate)
Spatial scale	2 (Site and immediate surrounds)	2 (Site and immediate surrounds)
Duration	5 (Project Life)	5 (Project Life)
Probability	7 (Certain)	6 (Almost Certain)
Significance	77 (Medium-Low)	54 (Medium-Low)
Status	Negative	Negative
Reversibility?	Yes	Yes
Irreplaceable loss of visual	No	No

resources?		
Can impacts be mitigated?	Yes	
Enhancement/mitigation measures:	Recommendations about positioning of the Solar PV Power Plant components, based on the VIA and viewshed analyses that compare various options for placement within the study area was given. Although the study area straddles the N14, the visual impact of the presence and operation of the Solar PV Power Plant will be reduced if development is restricted within the recommended development areas.	
Residual impacts:	Residual impacts will include a transformation of the landscape character as a whole during the project lifetime	

6.1.3 Decommissioning phase

Nature: Potential impact on the aesthetics of the landscape around the town of Aggeneys – demolition activities

The components of the plant will be disassembled after its expected lifetime (20 years) and removed once the life span of the Solar PV Power Plant has come to an end. The noisy and abrasive activities associated with demolition and decommissioning phase are likely to introduce a negative visual impact.

Parameters	**Without mitigation**	**With mitigation**
Severity	4 (Serious)	3 (Moderate)
Spatial scale	2 (Limited)	2 (Limited)
Duration	2 (Short Term)	2 (Short Term)
Probability	6 (Highly Likely)	6 (Highly Likely)
Significance	48 (Medium-Low)	42 (Medium-Low)
Status	Negative	Negative
Reversibility?	No	No
Irreplaceable loss of visual resources?	No	No

Can impacts be mitigated?	Yes
Enhancement/mitigation measures:	The infrastructure should be demolished and removed as quickly and efficiently as possible
Residual impacts:	NA

Nature: Potential impact on the aesthetics of the landscape around the town of Aggeneys – rehabilitation (outcome)

Removal of the Solar PV Power Plant and its associated structures will be a step towards rehabilitating the land to a state that it is in now. Visually, land that is being rehabilitated and returned to its natural state is normally aesthetically pleasing. After the abrasive demolition activities have been carried out, the outcome of rehabilitated land would be considered a positive impact. Rehabilitation activities always have the ability to be enhanced by best practices.

Parameters	**Without mitigation**	**With mitigation**
Severity	3 (Moderate)	2 (Minor)
Spatial scale	2 (Limited)	2 (Limited)
Duration	7 (Permanent)	7 (Permanent)
Probability	4 (Probable)	4 (Probable)
Significance	48 (Medium-Low)	44 (Medium-Low)
Status	Positive	Positive
Reversibility?	No	No
Irreplaceable loss of visual resources?	No	No
Can impacts be enhanced?	Yes	
Enhancement/mitigation measures:	Best practice rehabilitation methods should be adopted	
Residual impacts:	NA	

6.2 Kenhardt

6.2.1 Construction

Nature: Potential impact on the aesthetics and sense of place of Kenhardt Town

The current landscape will experience visual impacts associated with construction of the Solar PV Power Plants, building of roads and transportation of materials. Transportation of infrastructure and building material to and from the site will also introduce dust plumes due to vehicular movement.

Preparation of the site will involve flattening the landscape and removing vegetation and although this will alter the vegetation composition, the flat topography of the landscape will not be altered significantly. The erection of security fences will not introduce a significant new impact, as existing transmission lines and fences are visible on the site and there is a substation 1 km south of the study area.

The site is, however, being constructed outside of town – the likelihood of town residents and visitors to the town experiencing these visual impacts associated with construction activities is minimal,

Parameters	**Without mitigation**	**With mitigation**
Severity	2 (Minor)	1 (Limited)
Spatial scale	2 (Site and immediate surrounds)	1 (Very Limited)
Duration	3 (Medium-Term)	3 (Medium-Term)
Probability	4 (Probable)	4 (Probable)
Significance	28 (Low)	20 (Low)
Status	Negative	Negative
Reversibility?	Yes	Yes
Irreplaceable loss of visual resources?	No	No
Can impacts be mitigated?	Yes	
Enhancement/mitigation measures:	Recommendations about positioning of the Solar PV Power Plant components, based on the VIA and viewshed analyses that compare various options for placement within the study area was made. If these recommendations are followed, the visual impact associated with construction activities will be	

	reduced.
Residual impacts:	NA

6.2.2 Operational phase

Nature: Potential impact on the aesthetics and sense of place of Kenhardt Town The currently remote landscape will experience visual impacts associated with existence and operation of the Solar PV Power Plants. However, the site is being constructed fairly far outside of town and next to a road that is not likely to be utilised by tourists – the likelihood of town residents or visitors experiencing these visual impacts is minimal,		
Parameters	**Without mitigation**	**With mitigation**
Severity	2 (Minor)	1 (Limited)
Spatial scale	2 (Site and immediate surrounds)	1 (Very limited)
Duration	3 (Medium-term)	3 (Medium-term)
Probability	4 (Probable)	3 (Unlikely)
Significance	28 (Low)	15 (Low)
Status	Negative	Negative
Reversibility?	Yes	Yes
Irreplaceable loss of visual resources?	No	No
Can impacts be mitigated?	Yes	
Enhancement/mitigation measures:	Recommendations about positioning of the Solar PV Power Plant components, based on the VIA and viewshed analyses that compare various options for placement within the study area was made. If these recommendations are followed, the visual impact of the operational Solar PV Power Plant will be reduced since the visibility aspect will be reduced.	
Residual impacts:	Residual impacts will include a transformation of the landscape character as a whole during the project lifetime	

6.2.3 Decommissioning phase

Nature: Potential impact on the aesthetics of the landscape around the town of Kenhardt

The components of the plant will be disassembled after its expected lifetime (20 years) and removed once the life span of the Solar PV Power Plant has come to an end. The noisy and abrasive activities associated with the demolition phase are likely to introduce a negative visual impact, but the site will be located a substantial distance outside of Kenhardt town and very few potential receptors have been identified within the area – it is therefore unlikely that the impact associated with the activities will be experienced.

Parameters	**Without mitigation**	**With mitigation**
Severity	4 (Serious)	3 (Moderate)
Spatial scale	1 (Very limited)	1 (Very limited)
Duration	2 (Short term)	2 (Short term)
Probability	3 (Unlikely)	3 (Unlikely)
Significance	21 (Low)	18 (Low)
Status	Negative	Negative
Reversibility?	No	No
Irreplaceable loss of visual resources?	No	No
Can impacts be mitigated?	Yes	
Enhancement/mitigation measures:	The infrastructure should be demolished and removed as quickly and efficiently as possible	
Residual impacts:	NA	

Nature: Potential impact on the aesthetics of the landscape – rehabilitation (outcome)

Removal of the Solar PV Power Plant and its associated structures will be a step towards rehabilitating the land to a state that it is in now. Visually, land that is being rehabilitated and returned to its natural state is normally aesthetically pleasing. After the abrasive demolition activities have been carried out, the outcome of rehabilitated land would be considered a positive impact. Rehabilitation activities always have the ability to be enhanced by best practices.

Parameters	Without mitigation	With mitigation
Severity	3 (Moderate)	2 (Minor)
Spatial scale	2 (Limited)	2 (Limited)
Duration	7 (Permanent)	7 (Permanent)
Probability	4 (Probable)	4 (Probable)
Significance	48 (Medium-Low)	44 (Medium-Low)
Status	Positive	Positive
Reversibility?	No	No
Irreplaceable loss of visual resources?	No	No
Can impacts be enhanced?	Yes	
Enhancement/mitigation measures:	Best practice rehabilitation methods should be adopted	
Residual impacts:	NA	

6.3 Loeriesfontein

6.3.1 Construction

Nature: Potential impact on the aesthetics and sense of place of Loeriesfontein Town

Loeriesfontein will experience visual impacts associated with construction of the Solar PV Power Plants, building of roads and transportation of materials. Transportation of infrastructure and building material to and from the site will also introduce dust plumes due to vehicular movement. The site is, however, being constructed over 40km away from Loeriesfontein Town and the likelihood of town residents or visitors of the town experiencing these visual impacts is minimal.

Parameters	Without mitigation	With mitigation
Severity	2 (Minor)	1 (Limited)
Spatial scale	1 (Very Limited)	1 (Very Limited)

Duration	3 (Medium-Term)	3 (Medium-Term)
Probability	4 (Probable)	4 (Probable)
Significance	24 (Low)	20 (Low)
Status	Negative	Negative
Reversibility?	Yes	Yes
Irreplaceable loss of visual resources?	No	No
Can impacts be mitigated?	Yes	
Enhancement/mitigation measures:	Recommendations about positioning of the Solar PV Power Plant components, based on the VIA and viewshed analyses that compare various options for placement within the study area was made. If these recommendations are followed, the visual impact of the construction activities and Solar PV Power Plant will be reduced.	
Residual impacts:	NA	

6.3.2 Operational phase

Nature: Potential impact on the aesthetics and sense of place of Loeriesfontein Town The currently remote landscape will experience visual impacts associated with existence and operation of the Solar PV Power Plants. However, the site is being constructed 40km's outside of Loeriesfontein town, nestled between mountains, and next to a road that is not likely to be utilised by tourists – the likelihood of town residents or visitors experiencing these visual impacts is minimal,		
Parameters	**Without mitigation**	**With mitigation**
Severity	2 (Minor)	1 (Limited)
Spatial scale	1 (Very Limited)	1 (Very Limited)
Duration	5 (Project Life)	5 (Project Life)
Probability	3 (Unlikely)	3 (Unlikely)
Significance	24 (Low)	21 (Low)

Status	Negative	Negative
Reversibility?	Yes	Yes
Irreplaceable loss of visual resources?	No	No
Can impacts be mitigated?	Yes	
Enhancement/mitigation measures:	Recommendations about positioning of the Solar PV Power Plant components, based on the VIA and viewshed analyses that compare various options for placement within the study area was made. If these recommendations are followed, the visual impact of the construction activities and Solar PV Power Plant will be reduced.	
Residual impacts:	Residual impacts will include a transformation of the landscape character as a whole during the project lifetime	

6.3.3 Decommissioning phase

Nature: Potential impact on the aesthetics of the landscape around the town of Loeriesfontein

The components of the plant will be disassembled after its expected lifetime (20 years) and removed once the life span of the Solar PV Power Plant has come to an end. The noisy and abrasive activities associated with the demolition phase are likely to introduce a negative visual impact, but the site will be located a substantial distance outside of Loeriesfontein town and very few potential receptors have been identified within the area – it is therefore unlikely that the impact associated with the activities will be experienced.

Parameters	**Without mitigation**	**With mitigation**
Severity	4 (Serious)	3 (Moderate)
Spatial scale	1 (Limited)	1 (Limited)
Duration	2 (Short term)	2 (Permanent)
Probability	3 (Unlikely)	3 (Unlikely)
Significance	21 (Low)	15 (Low)
Status	Negative	Negative

Reversibility?	No	No
Irreplaceable loss of visual resources?	No	No
Can impacts be mitigated?	Yes	
Enhancement/mitigation measures:	The infrastructure should be demolished and removed as quickly and efficiently as possible	
Residual impacts:	NA	

Nature: Potential impact on the aesthetics of the landscape – rehabilitation (outcome)

Removal of the Solar PV Power Plant and its associated structures will be a step towards rehabilitating the land to a state that it is in now. Visually, land that is being rehabilitated and returned to its natural state is normally aesthetically pleasing. After the abrasive demolition activities have been carried out, the outcome of rehabilitated land would be considered a positive impact. Rehabilitation activities always have the ability to be enhanced by best practices.

Parameters	**Without mitigation**	**With mitigation**
Severity	3 (Moderate)	2 (Minor)
Spatial scale	2 (Limited)	2 (Limited)
Duration	7 (Permanent)	7 (Permanent)
Probability	4 (Probable)	4 (Probable)
Significance	48 (Medium-Low)	44 (Medium-Low)
Status	Positive	Positive
Reversibility?	No	No
Irreplaceable loss of visual resources?	No	No
Can impacts be enhanced?	Yes	
Enhancement/mitigation measures:	Best practice rehabilitation methods should be adopted	

Residual impacts:	NA

6.4 Vanrhynsdorp

6.4.1 Construction phase

Nature: Potential impact on the aesthetics and sense of place of Vanrhynsdorp Town While the Solar PV Power Plant is being constructed, a fair amount of activity will take place in and around the town, including fencing of the site and trucks transporting necessary equipment. Since the town of Vanrhynsdorp is rather small, construction activities will likely have an impact on the quaint "dorpie" and the tourism and cultural aspects associated with it. The N7 and R27 are fairly popular tourist routes and the likelihood of the impact being experienced is therefore high		
Parameters	**Without mitigation**	**With mitigation**
Severity	6 (Severe)	5 (Severe)
Spatial scale	3 (Local)	3 (Local)
Duration	3 (Medium Term)	3 (Medium Term)
Probability	7 (Certain)	7 (certain)
Significance	84 (Medium-High)	77 (Medium-High)
Status	Negative	Negative
Reversibility?	Yes	Yes
Irreplaceable loss of visual resources?	No	No
Can impacts be mitigated?	Yes	
Enhancement/mitigation measures:	Recommendations about positioning of the Solar PV Power Plant components, based on the VIA and viewshed analyses that compare various options for placement within the study area were made. If these recommendations are followed, the visual impact of the construction activities and the project will be reduced slightly.	

Residual impacts:	NA

6.4.2 Operational phase

Nature: Potential impact on the aesthetics and sense of place of Vanrhynsdorp Town and the surrounding landscape

The current landscape will experience visual impacts associated with the existence and operation of the Solar PV Power Plant. The potential site is situated in a visually sensitive area and the likelihood of both residents of the town and tourists experiencing the impacts is severe likely.

Parameters	**Without mitigation**	**With mitigation**
Severity	7 (Very Significant)	6 (Significant)
Spatial scale	4 (Municipal - tourism)	4 (Municipal - tourism)
Duration	5 (Project Life)	5 (Project Life)
Probability	7 (Definite)	7 (Definite)
Significance	112 (High)	105 (Medium-High)
Status	Negative	Negative
Reversibility?	Yes	Yes
Irreplaceable loss of visual resources?	No	No
Can impacts be mitigated?	Yes	
Enhancement/mitigation measures:	Recommendations about positioning of the Solar PV Power Plant components, based on the VIA and viewshed analyses that compare various options for placement within the study area was made. If these recommendations are followed, the visual impact of the construction activities and Solar PV Power Plant will be reduced very slightly.	
Residual impacts:	Residual impacts will include a transformation of the landscape character as a whole during the project lifetime	

6.4.3 Decommissioning phase

Nature: Potential impact on the aesthetics of the landscape around the town of Vanrhynsdorp

The components of the plant will be disassembled after its expected lifetime (20 years) and removed once the life span of the Solar PV Power Plant has come to an end. The noisy and abrasive decommissioning activities associated with the demolition of the infrastructure are likely to introduce a negative visual impact.

Parameters	**Without mitigation**	**With mitigation**
Severity	5 (Very Serious)	4 (Serious)
Spatial scale	2 (local)	2 (Local)
Duration	2 (Short Term	2 (Short term)
Probability	7 (Certain)	7 (Certain)
Significance	63 (Medium-High)	56 (Medium-Low)
Status	Negative	Negative
Reversibility?	No	No
Irreplaceable loss of visual resources?	No	No
Can impacts be mitigated?	Yes	
Enhancement/mitigation measures:	The infrastructure should be demolished and removed as quickly and efficiently as possible	
Residual impacts:	NA	

Nature: Potential impact on the aesthetics of the landscape – rehabilitation (outcome)

Removal of the Solar PV Power Plant and its associated structures will be a step towards rehabilitating the land to a state that it is in now. Visually, land that is being rehabilitated and returned to its natural state is normally aesthetically pleasing. After the abrasive demolition activities have been carried out, the outcome of rehabilitated land would be considered a positive impact. Rehabilitation activities always have the ability to be enhanced by best practices.

Parameters	**Without mitigation**	**With mitigation**

Severity	3 (Moderate)	2 (Minor)
Spatial scale	2 (Limited)	2 (Limited)
Duration	7 (Permanent)	7 (Permanent)
Probability	4 (Probable)	4 (Probable)
Significance	48 (Medium-Low)	44 (Medium-Low)
Status	Positive	Positive
Reversibility?	No	No
Irreplaceable loss of visual resources?	No	No
Can impacts be enhanced?	Yes	
Enhancement/mitigation measures:	Best practice rehabilitation methods should be adopted	
Residual impacts:	NA	

6.5 Graafwater

6.5.1 Construction phase

Nature: Potential impact on the aesthetics and sense of place of Graafwater Town		
Graafwater will experience visual impacts associated with construction of the Solar PV Power Plants, building of roads and transportation of materials which cannot be mitigated. Transportation of infrastructure and building material to and from the site will also introduce dust plumes due to vehicular movement. Graafwater is a farming town and does not have a significant tourism component. The significance of the activities will therefore not be very severe and the most likely receptors to experience the visual impact are residents within the town.		
Parameters	**Without mitigation**	**With mitigation**
Severity	3 (Moderate)	2 (Minor)
Spatial scale	2 (Site and immediate surrounds)	2 (Site and immediate surrounds)

Duration	3 (Medium-Term)	3 (Medium-Term)
Probability	7 (Certain)	6 (Almost Certain)
Significance	56 (Medium-Low)	42 (Medium-Low)
Status	Negative	Negative
Reversibility?	Yes	Yes
Irreplaceable loss of visual resources?	No	No
Can impacts be mitigated?	Yes	
Enhancement/mitigation measures:	Recommendations about positioning of the Solar PV Power Plant components, based on the VIA and viewshed analyses that compare various options for placement within the study area was made. If these recommendations are followed, the visual impact associated with the construction activities of the Solar PV Power Plant will be reduced since the visibility aspect will be reduced. .	
Residual impacts:	NA	

6.5.2 Operational phase

Nature: Potential impact on the aesthetics and sense of place of Graafwater Town and the surrounding landscape

The current landscape will experience visual impacts associated with the existence and operation of the Solar PV Power Plant. The visual sensitivity of the landscape is not extremely high since it is an agricultural landscape and does not have a significant tourism aspect.

Parameters	**Without mitigation**	**With mitigation**
Severity	4 (Serious)	3 (Moderate)
Spatial scale	2 (Limited)	2 (Limited)
Duration	5 (Project Life)	5 (Project Life)
Probability	7 (Definite)	6 (Probable)
Significance	77 (Medium-High)	60 (Medium-Low)

Status	Negative	Negative
Reversibility?	Yes	Yes
Irreplaceable loss of visual resources?	No	No
Can impacts be mitigated?	Yes	
Enhancement/mitigation measures:	Recommendations about positioning of the Solar PV Power Plant components, based on the VIA and viewshed analyses that compare various options for placement within the study area was made. If these recommendations are followed, the visual impact of the existence and operation of the solar PV power plant will be reduced.	
Residual impacts:	Residual impacts will include a transformation of the landscape character as a whole during the project lifetime	

6.5.3 Decommissioning phase

Nature: Potential impact on the aesthetics of the landscape around the town of Graafwater

The components of the plant will be disassembled after its expected lifetime (20 years) and removed once the life span of the Solar PV Power Plant has come to an end. The noisy and abrasive decommissioning activities associated with the demolition of the infrastructure are likely to introduce a negative visual impact.

Parameters	**Without mitigation**	**With mitigation**
Severity	3 (Moderate)	2 (Low)
Spatial scale	2 (Local)	2 (Local)
Duration	2 (Short-Term)	2 (Short-Term)
Probability	7 (Likely)	6 (Likely)
Significance	49 (Medium-Low)	55 (Medium-Low)
Status	Negative	Negative
Reversibility?	No	No
Irreplaceable loss of visual	No	No

resources?		
Can impacts be mitigated?	Yes	
Enhancement/mitigation measures:	The infrastructure should be demolished and removed as quickly and efficiently as possible	
Residual impacts:	NA	

Nature: Potential impact on the aesthetics of the landscape – rehabilitation (outcome)		
Removal of the Solar PV Power Plant and its associated structures will be a step towards rehabilitating the land to a state that it is in now. Visually, land that is being rehabilitated and returned to its natural state is normally aesthetically pleasing. After the abrasive demolition activities have been carried out, the outcome of rehabilitated land would be considered a positive impact. Rehabilitation activities always have the ability to be enhanced by best practices.		
Parameters	**Without mitigation**	**With mitigation**
Severity	3 (Moderate)	2 (Minor)
Spatial scale	2 (Limited)	2 (Limited)
Duration	7 (Permanent)	7 (Permanent)
Probability	4 (Probable)	4 (Probable)
Significance	48 (Medium-Low)	44 (Medium-Low)
Status	Positive	Positive
Reversibility?	No	No
Irreplaceable loss of visual resources?	No	No
Can impacts be enhanced?	Yes	
Enhancement/mitigation measures:	Best practice rehabilitation methods should be adopted	
Residual impacts:	NA	

7 CUMULATIVE IMPACTS

There is, at present, a lot of interest being expressed in the construction of renewable energy projects in the regions in which the five proposed Orlight Solar PV Power Plants will be located.

Table 13 is a comprehensive list of other proposed renewable energy projects (solar PV, concentrating solar power and wind energy) near the sites that have been assessed during this study. The impacts that have been identified and quantified are for the contextual current visual landscape and do not consider potential future developments. If the areas become hotspots for renewable energy project development, all of the landscapes that have been described will be altered drastically/completely. The sense of place of each landscape and the associated towns will change with the increase in renewable energy projects and their respective construction activities.

Table 13: Other proposed renewable energy projects within the areas of interest

Site / Area	Applicants	Size of proposed project (MW)
Aggeneys	Solar Capital Aurora Power Solutions	75 10
Kenhardt	Aurora Power Solutions Green Continent Energy Texforce - Cape Solar CC	10 75 40
Loeriesfontein	Solar Capital Mainstream - Wind Mainstream - Solar	5 X 75 100 50
Vanrhynsdorp	No competitors	
Graafwater	iNCA Energy	25

The size of the footprints of disturbed areas on which construction takes place definitely affects the magnitude of visual impacts. A single Solar PV Power Plant, surrounded by a natural landscape would have a smaller visual impact than an extensive landscape dominated by similar projects. Whether the sight of the solar PV panels extending into a landscape will have a negative or positive impact is dependent on the viewer – some might deem it as exciting and 'futuristic'.

The sense of place will, however, definitely be altered since the landscapes will be transformed from dramatic, vast expanses of open land, or small towns that have the 'in the middle of nowhere' charm. The alteration of a sense of place within communities and landscapes also leads to an impact on other aspects that are intertwined, such as the extraordinary heritage characteristics that a town, group of people, or even an archaeological site possesses. An archaeological site is a result of the cultural environment and landscape that surrounds it. It is therefore also very sensitive to changes in the cultural landscape or environment. The Gamsberg, which is located 2.5 km east of the proposed Solar PV Power Plant at Aggeneys has been identified as a possibly sensitive visual receptor of cumulative visual impacts if the area is transformed further (it has already been transformed by mining activities and the development of infrastructure such as transmission lines and roads) by renewable energy projects. Morris (2010) has discussed the importance of the Gamsberg as a potential "genocide site for the San"; the phase 1 HIA should therefore further explore the cumulative impacts of all of the possible renewable energy projects, along with the current and future mining activities, within the vicinity.

Future development of renewable energy projects in the regions will not only cause more side-spread visual impacts and changes to the landscape, but it will modify the sense of place (and remoteness around the Aggeneys, Kenhardt and Loeriesfontein study areas). The way in which the sense of place will be modified depends on the extent of the developments in the area, the way in which communities react to the developments and the relative successes of the first few projects that are initiated.

8 RECOMMENDATIONS

There are few mitigation measures that can be put in place in order to reduce the visual impacts that will be created by the infrastructure associated with the proposed Solar PV Power Plants.

The most important objective is to synthesise the current visual sensitivity data with the information collected from other environmental and cultural studies to delineate sensitive areas. A set of comprehensive sensitivity plans should play a role in the decision making process with regards to site layout of the proposed Solar PV Power Plants and its associated components. It is crucial that the relationship between the visual landscape and the archaeological and heritage sites that were identified during the cultural resources pre-assessment be explored thoroughly during the phase 1 HIA. The identified sites need to be described in detail and the occurrence/significance of visual impacts associated with the potential Solar PV Power Plant need to be quantified within the context of their intangible heritage aspects. Investigation and exploration of the study areas will determine whether there are other cultural and heritage resources within the area; if there are the visual impacts that might affect their intangible heritage aspects also need to be investigated.

The visual impacts associated with those study areas that could have potentially medium to high visual impacts when the infrastructure is built (Aggeneys, Vanrhynsdorp and Graafwater) could possibly be alleviated by carrying out the following actions;

- For the proposed Graafwater site, the natural vegetation that occurs on site has the capability to screen the proposed infrastructure. Existing natural vegetation should be retained between the Solar PV Power Plant and the road to the north that runs through the town of Graafwater to screen the infrastructure.
- Exotic tree species have been introduced in the town of Aggeneys along avenues. Planting of fast-growing species between receptors and the proposed Solar PV Power Plants is an option for visual screening; however it is not advised considering water scarcity and the threat of spreading of alien invasive species.

The nature of visual impacts is such that the impact is highest when first experienced, but as receptors become used to the site and the new landscape aspects become part of the sense of place and the landscape itself, the visual impact is reduced.

9 STUDY SUMMARY AND CONCLUSION

The proposed Orlight SA Solar PV Power Plants is an exciting opportunity for South Africa to adopt a "greener" technology in terms of energy production. The VIA aims to objectively report on the possible visual impacts that the people living within a certain radius to the proposed Solar PV Power Plants and those people passing through the environment of interest might experience. The VIA also aims to suggest favourable options for the construction of the Solar PV Power Plants so that the lowest possible visual impacts will be experienced.

Many of the landscapes of interest are open and are more natural than urbanised – the potential infrastructure does, therefore, have the ability to alter the current landscape character and scenic value of all of the sites.

The Loeriesfontein and Kenhardt study areas lie at least 35 km from the towns themselves and the landscapes will definitely be transformed should the projects take place. However, there will be few to no people experiencing a negative visual impact as there are very few identified potential receptors and the construction of Solar PV Power Plants might even bring about positive visual impacts. This positive visual impact could be introduced if the Solar PV Power Plants are constructed in a responsible manner that takes into account all of the aspects of visual (and ecological) sensitivity since the construction and presence of the infrastructure could introduce a sense of progress and opportunity to local and impoverished communities.

The Aggeneys study area is close to the town, but it is a mining town and existing construction and mining related activities contribute to the landscapes' already existing industrial character. The landscape type will therefore not be completely transformed by the proposed Solar PV Power Plant.

The Graafwater study area is situated very close to the town and consequently, a number of receptors have been identified within the visual study area. However, the landscape is already transformed due to agricultural activities, transmission lines and the borrow pit and therefore has a higher visual absorption capacity. The tourism aspect of the area is not highly significant and should not be a limiting factor when considering the impacts associated with the construction of the Solar PV Power Plant.

The visual sensitivity of the Vanrhynsdorp area is very high due to tourism and cultural aspects associated with the old and quaint 'dorpie' and the ecological landscape that surrounds it. The likelihood of the visual impact being experienced is high due to the positioning of the town in relation to the N7 and the route connecting Nieuwoudtville, Vanrhynsdorp and Vredendal.

It was evident that very few I&APs perceive the proposed Solar PV Power Plants to have a negative visual impact. In fact, some opinions were voiced that the proposed projects would have a positive visual impact in terms of attaching a "green energy" sense to the town.

It is believed that the identified visual impacts associated with the construction and operation of the proposed Solar PV Power Plants, will not be too severe at the Aggeneys, Kenhardt, Loeriesfontein, or the Graafwater sites, provided that the developments take place within the

low visual sensitivity areas that were delineated through the course of this assessment. The visual impacts associated with the heritage and tourism landscape of Vanrhynsdorp are likely to be more severe.

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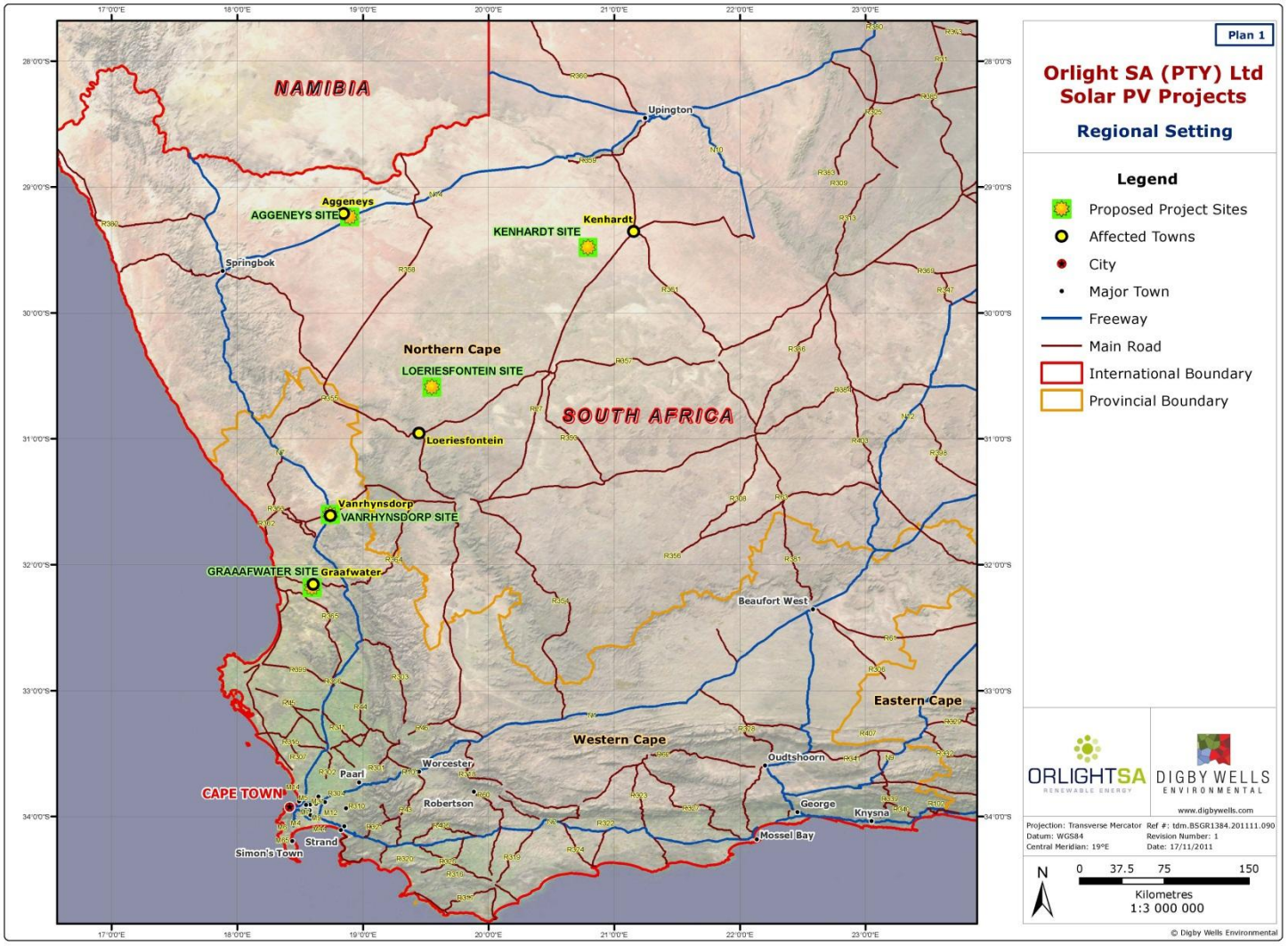
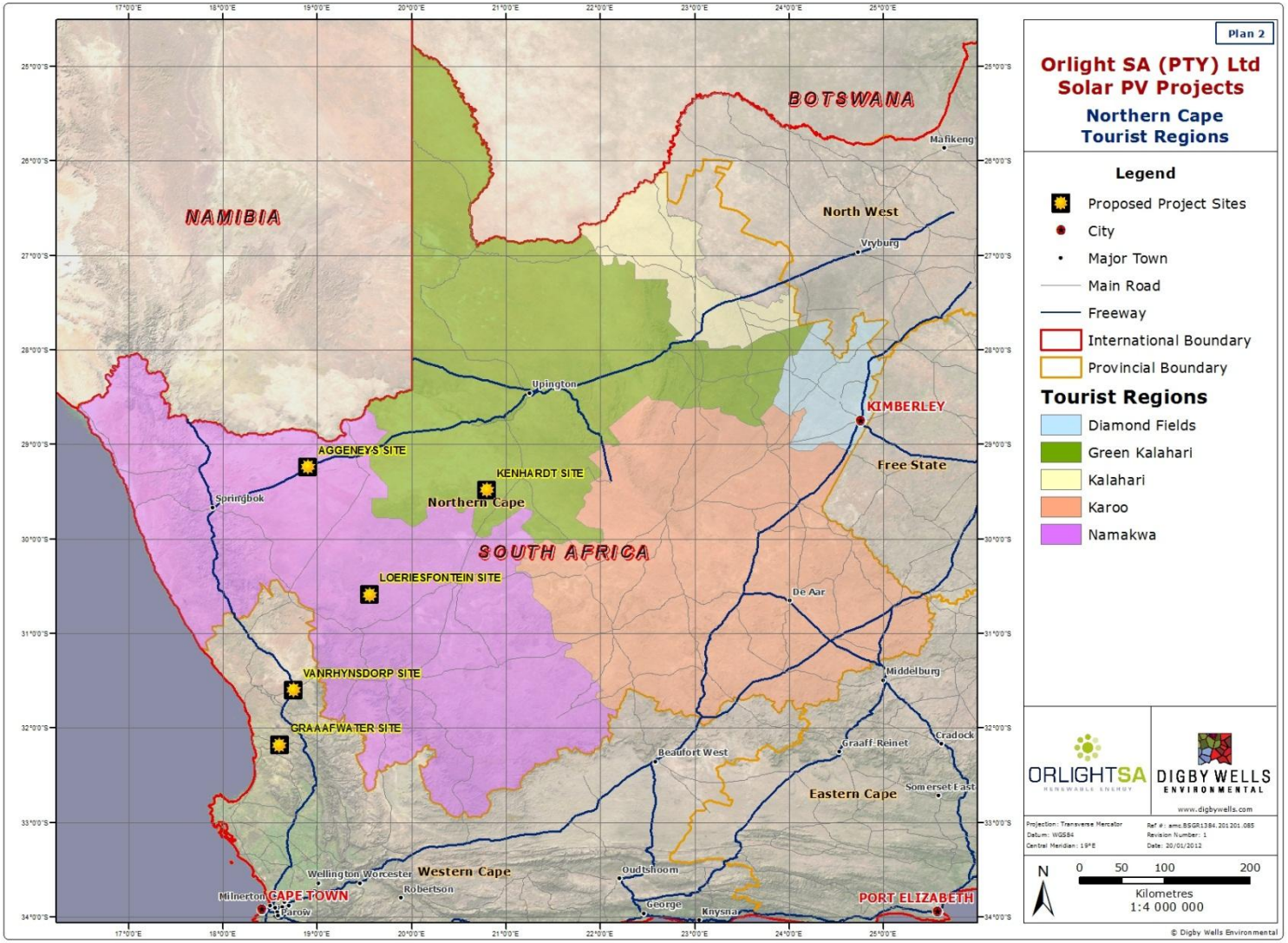
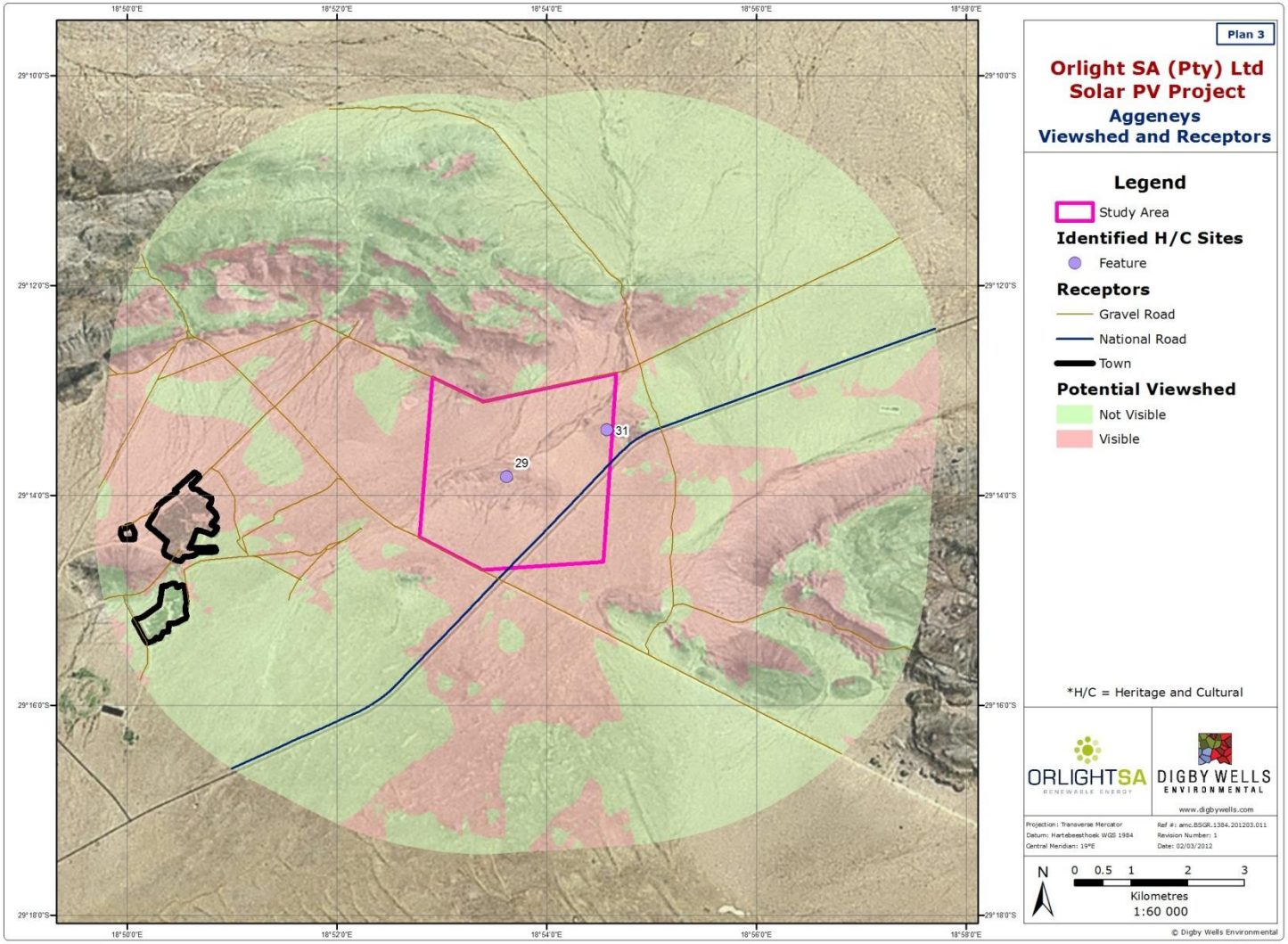
Appendix A: Plans



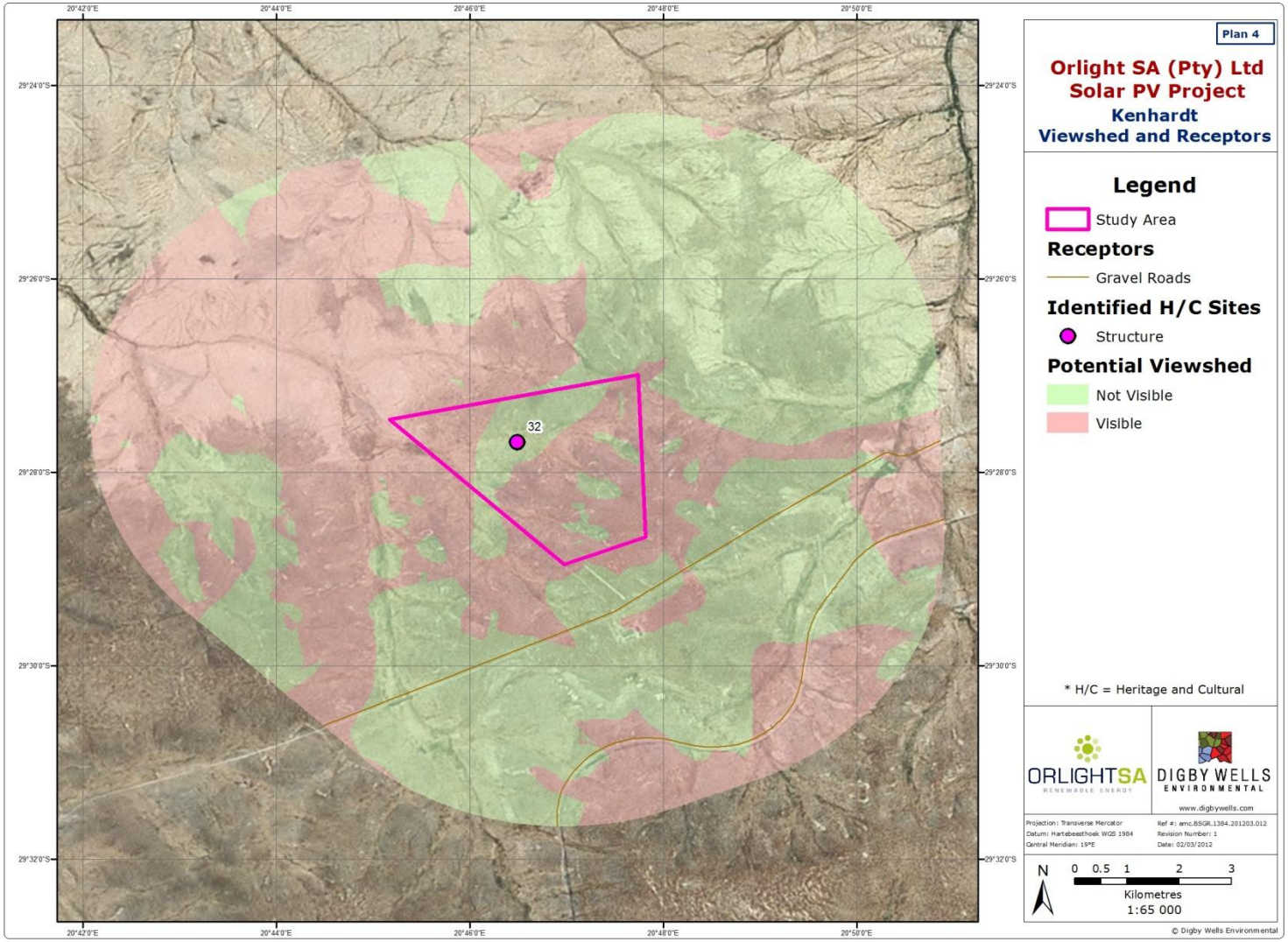
Plan 1: Regional study area



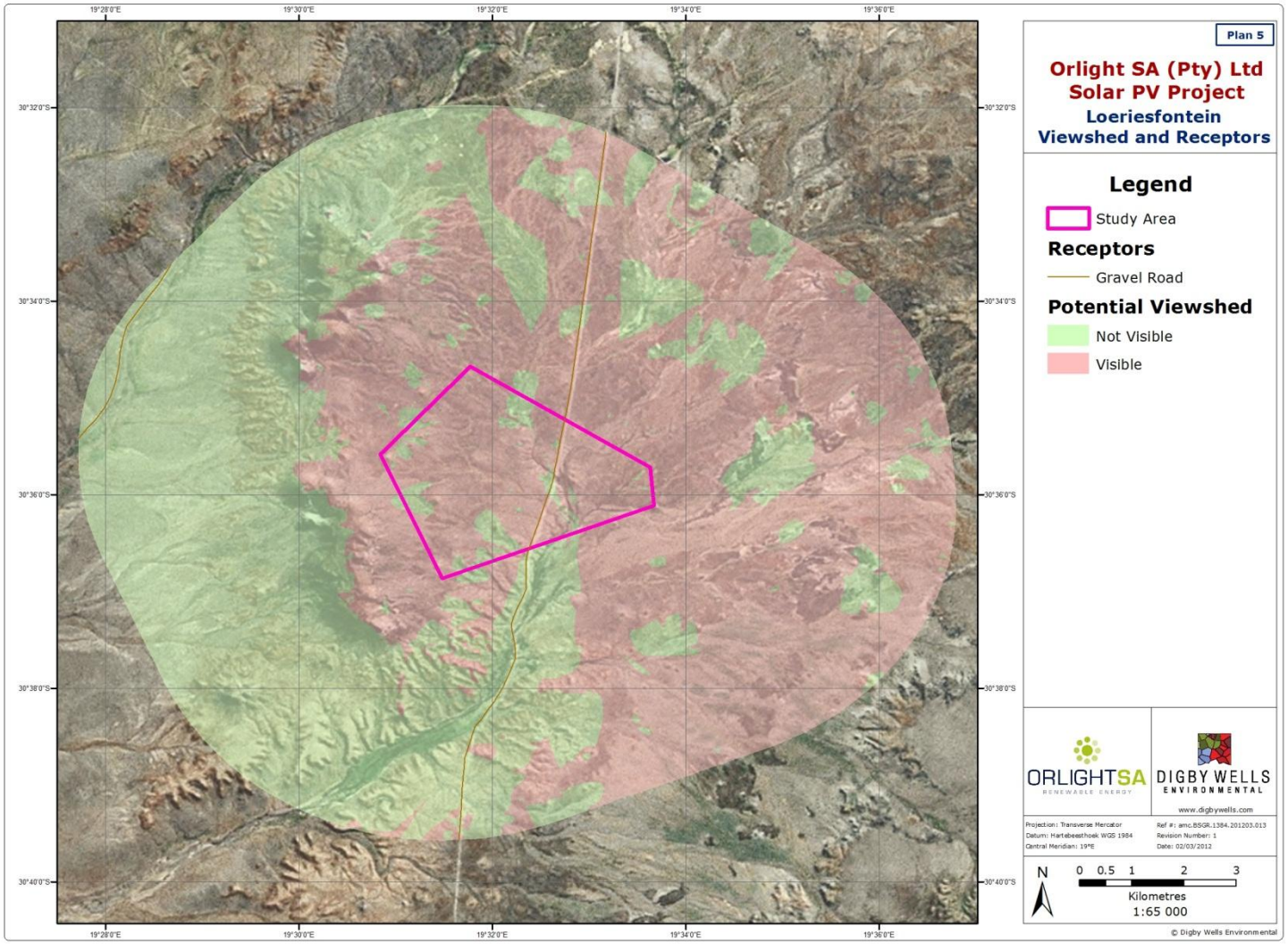
Plan 2: Tourism regions within the Northern Cape



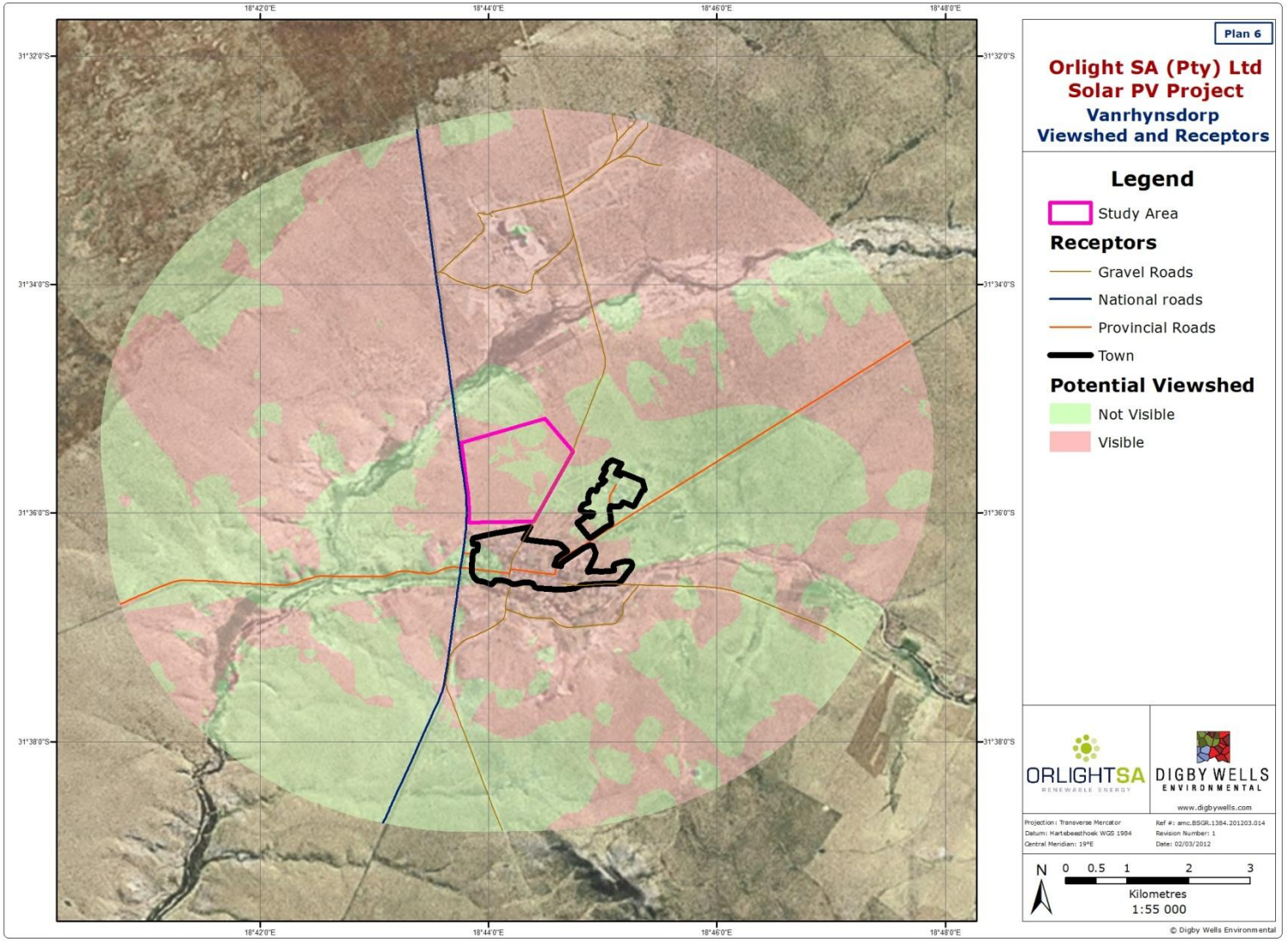
Plan 3: Aggeneys study area viewshed results



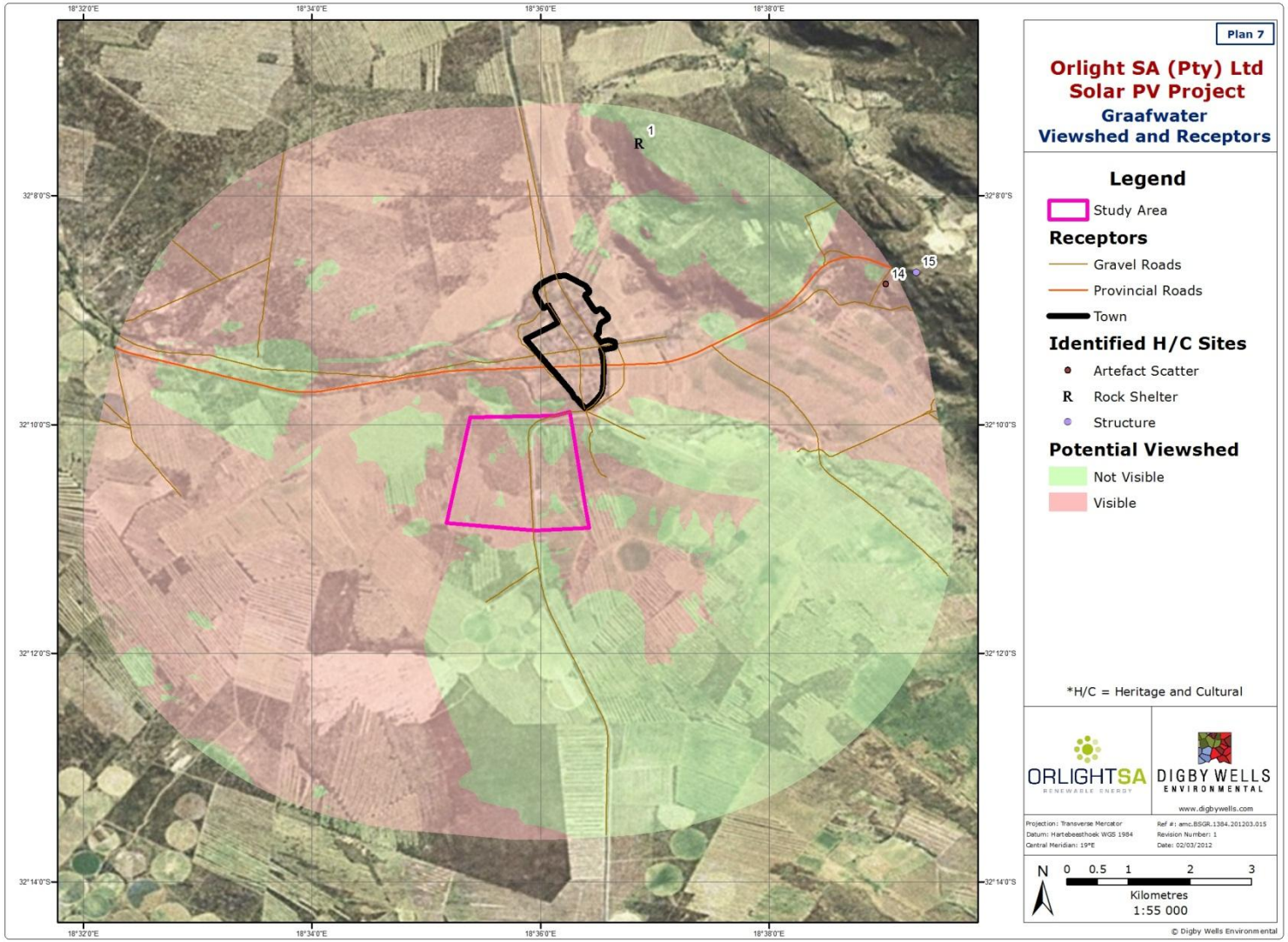
Plan 4: Kenhardt study area viewshed results



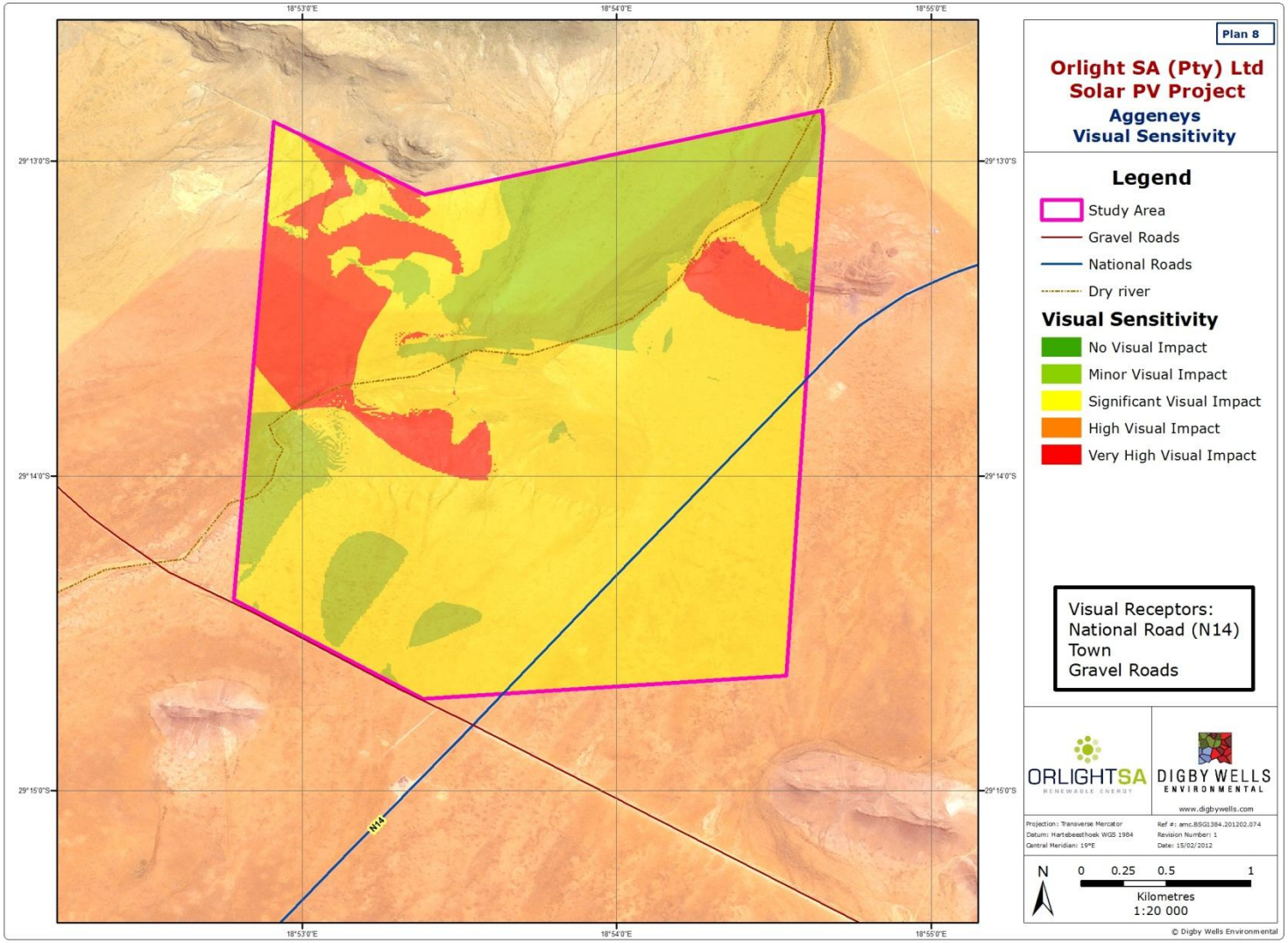
Plan 5: Loeriesfontein study area viewshed results



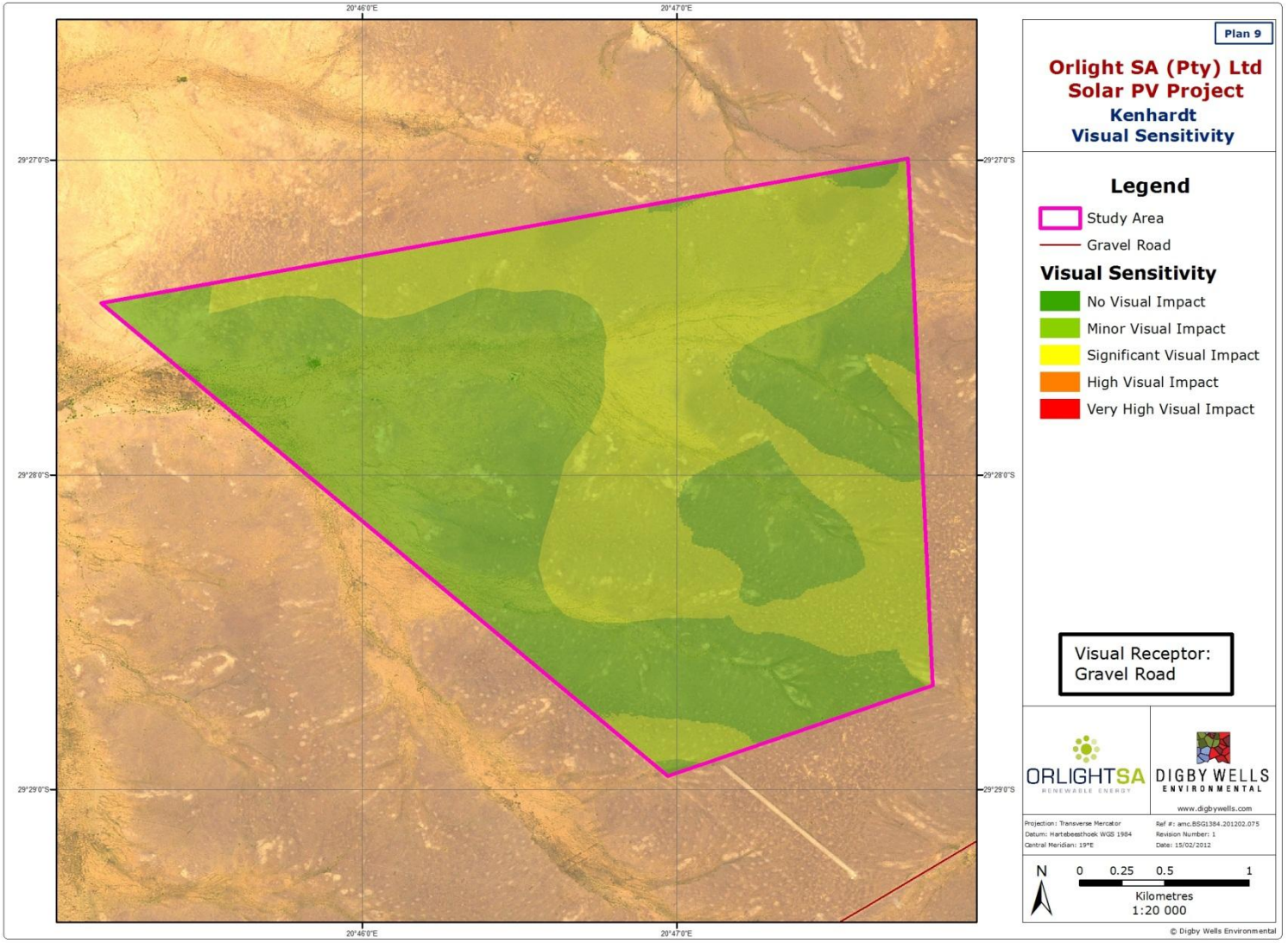
Plan 6: Vanrhynsdorp study area viewshed results



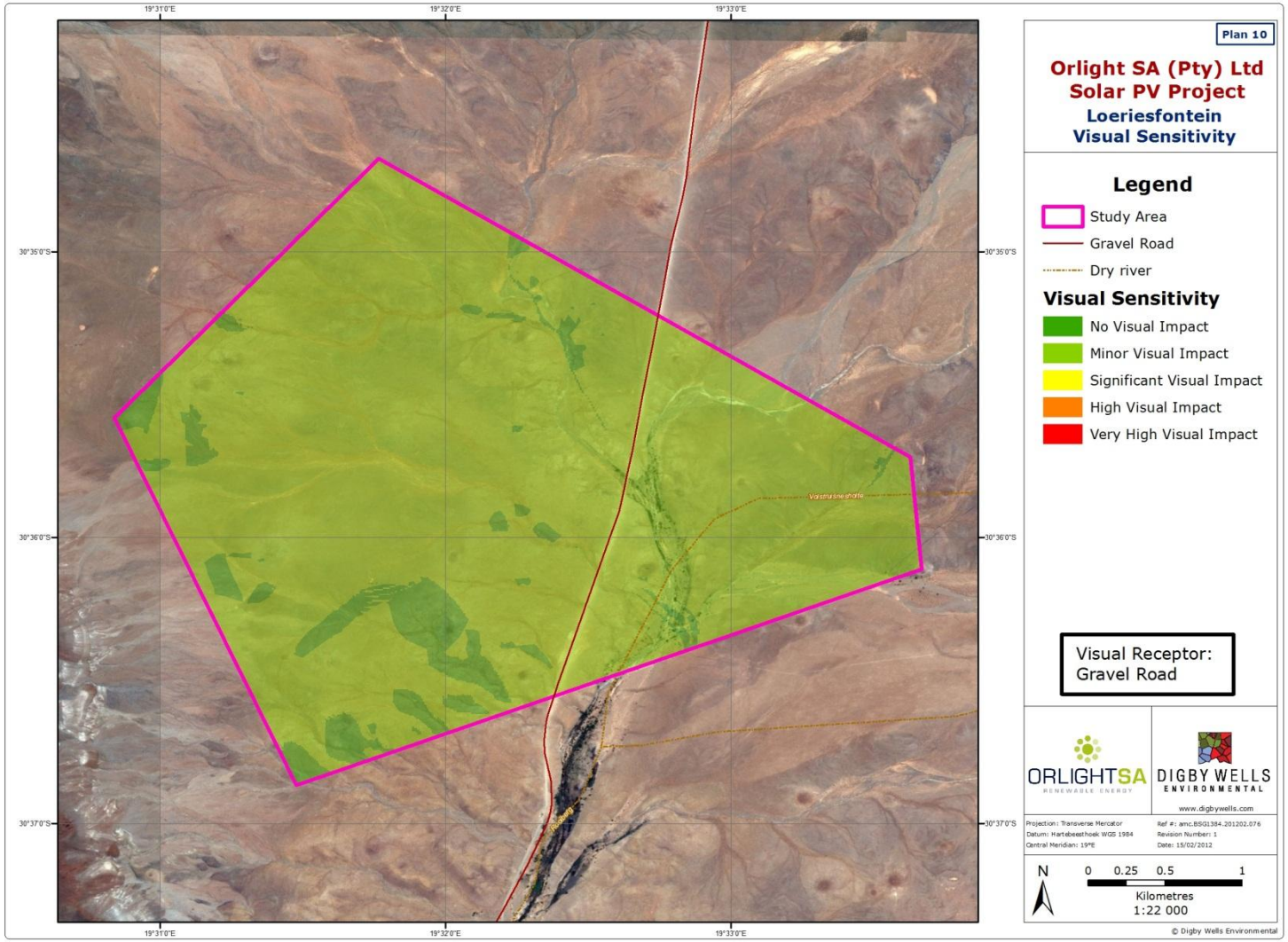
Plan 7: Graafwater study area viewshed results



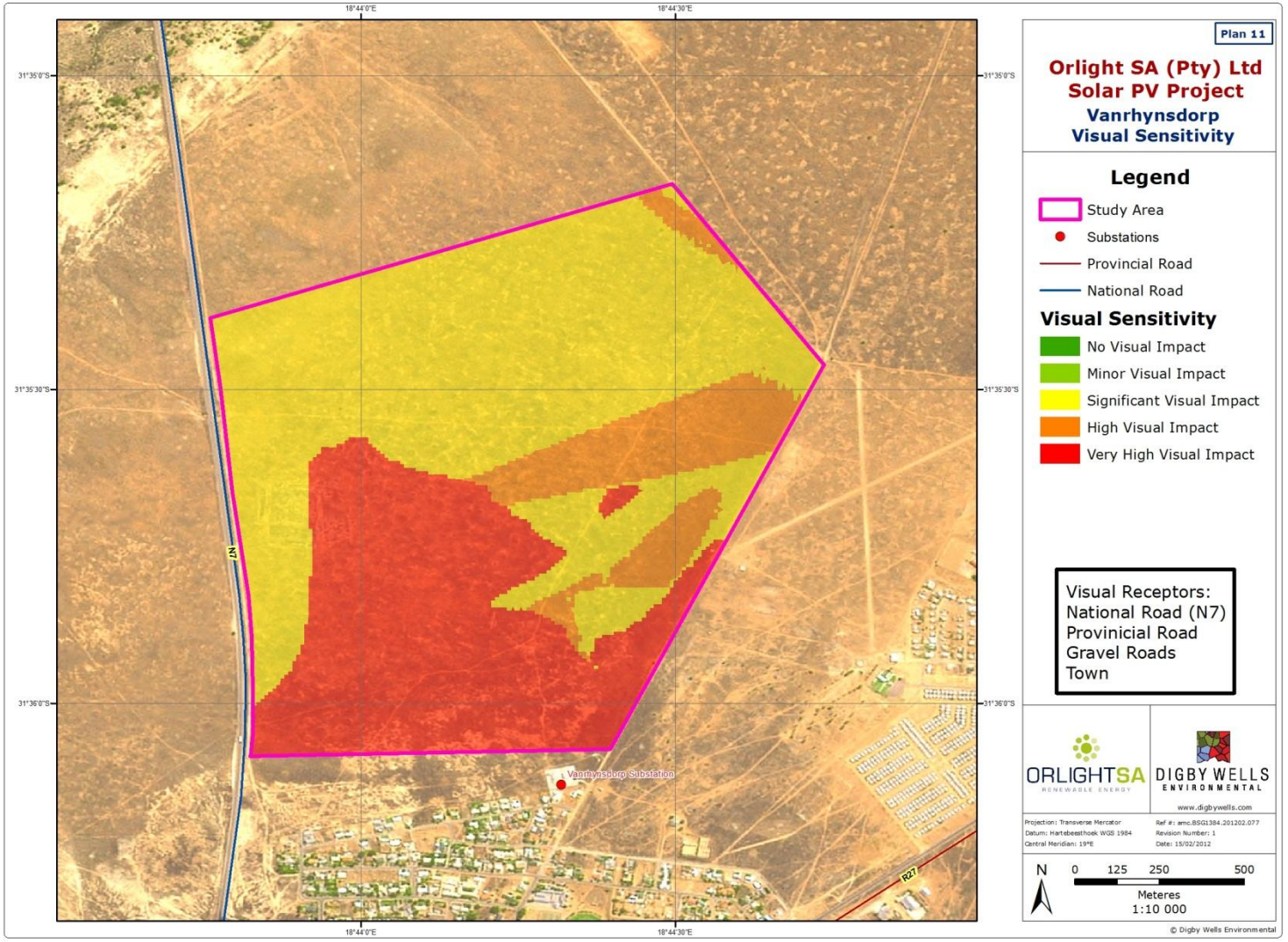
Plan 8: Aggeneys overall visual sensitivity



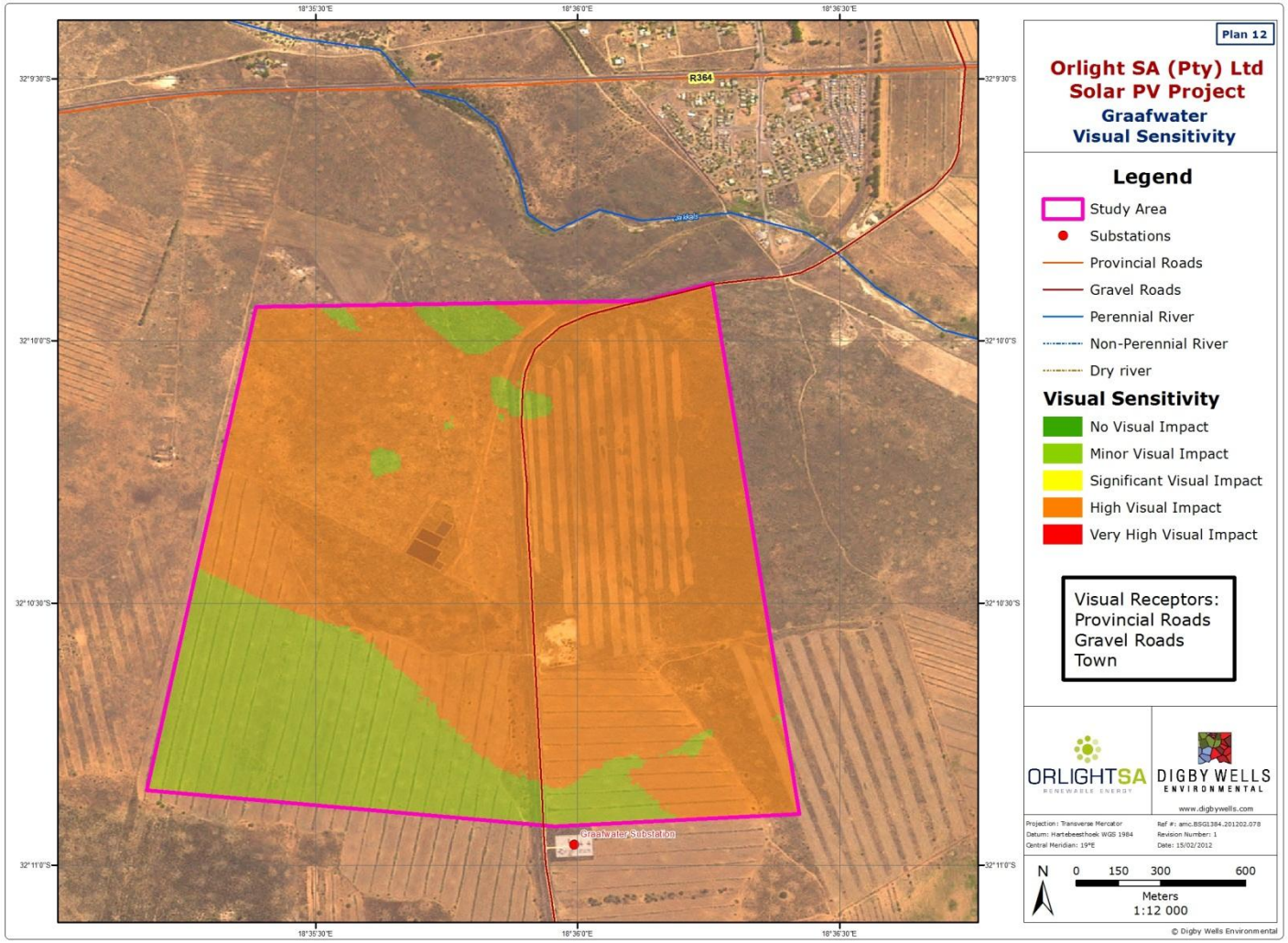
Plan 9: Kenhardt overall visual sensitivity



Plan 10: Loeriesfontein overall visual sensitivity



Plan 11: Vanrhynsdorp overall visual sensitivity



Plan 12: Graafwater overall visual sensitivity

Appendix B: Curriculum vitae’s and declarations of independence of specialists

CURRICULUM VITAE OF REPORT WRITER/GIS SPECIALIST

Miss Alice McClure

Specialist: Geographic Information Systems (GIS) & Air Quality

GIS & Air Quality Department

Digby Wells Environmental

Education

2005 - 2007: B.Sc. Environmental Sciences: Majored in Environmental Science and Entomology (Rhodes University)

2008: B.Sc. (Hons) Environmental Sciences: Courses in Conservation Planning, Rehabilitation Ecology, Non-timber Forest Product Uses, Geographic Information Systems (GIS), Environmental Impact Assessment (EIA) and a short course in statistics (Rhodes University)

2009 – 2010: M.Sc. Environmental Sciences: Proactive conservation planning with a strong social focus using GIS

Language Skills

English, Afrikaans and limited Zulu

Employment

March 2011 to present Digby Wells Environmental

January 2009 – August 2010 Eden to Addo Corridor Initiative

Experience

GIS specialist in the Geographic Information Systems (GIS) and Air Quality Department. Graduated with an MSc in Environmental Sciences. The research associated with my master's degree was carried out while I was employed at Eden to Addo and was utilised practically to begin the systematic design of a conservation corridor between Addo Elephant National Park and Tsitsikamma National Park. Special consideration was given to the high social sensitivity of the area and the controversy surrounding conservation in the area. I used GIS to explore the effect and outcomes of incorporating social data into systematic conservation planning using least-cost corridor models. Since employment at Digby Wells, my expertise in ArcGIS processes has grown exponentially and techniques to solve spatial, temporal and analytical problems have been refined.

Responsibilities at Digby Wells Environmental currently include but are not limited to:

Generation of maps for company projects;

Compilation of Visual Impact Assessments;

Assist in the completion of Biodiversity Assessments;

Assist in the completion of Due Diligence Reports

Assist in the development of a systematic and efficient tree-relocation plan;

Assist in the maintenance of the GIS database by storing all electronic files in a well organised structure

Assist in the completion of Closure Cost Assessments by solving the spatial and analytical queries involved

Assist in the design and completion of Rehabilitation Plans

Assist in carrying out air quality assessments

Produce spatial information in map format; and

Application of GPS technology, aerial photo and satellite images

Professional affiliations

Geographic Information Society of South Africa (GISSA)

International Association for Impact Assessment (IAIA)

DECLARATION OF INDEPENDANCE OF REPORT WRITER AND GIS SPECIALIST

I, **Alice McClure**, declare that I –

- Act as the independent specialist for the undertaking of a specialist section for the proposed project: **Visual Impact Assessment for BSGR Resources**;
- Do not have and will not have any financial interest in the undertaking of the activity, other than remuneration for work performed in terms of the Environmental Impact Assessment Regulations, 2006;
- Do no have nor will have a vested interest in the proposed activity proceeding;
- Have no, and will not engage in, conflicting interests in the undertaking of the activity;
- Undertake to disclose, to the competent authority, any information that have or may have the potential to influence the decision of the competent authority or the objectivity of any report, plan or document required in terms of the Environmental Impact Assessment Regulations, 2006;

Alice McClure

Name of specialist

Signature of the specialist

Digby Wells Environmental

Name of company

2012/03/05

Date

CURRICULUM VITAE OF GIS SPECIALIST

Mr. Error! Reference source not found.

Department Manager: Geographic Information Systems (GIS) & Air Quality

GIS & Air Quality Department

Digby Wells Environmental

Education

2000 – 2002: BSc Natural Sciences: Majored in Geology, Geography & Environmental Management (Rand Afrikaans University).

2003: B.Sc. (Hons) Geography and Environmental Management: Strong focus on Geographic Information Systems (GIS), Environmental Management and Physical Geography (Rand Afrikaans University).

2007: Introduction to ArcGIS (GIMS)

2008: Advanced Analysis with ArcGIS (GIMS)

2008: Flood Hydrology (University of Stellenbosch)

Language Skills

English & Afrikaans

Employment

March 2007 to present	Digby Wells Environmental
May 2003 – April 2006	Fernridge Consulting
April 2006 – February 2007	OPSI Systems

Experience

Department manager of the Geographic Information Systems (GIS) and Air Quality department. Graduated with a BSc (Hons) in the field of Geography and Environmental Management. Several years of experience in using GIS techniques for solving spatial and temporal problems within the human and natural environments. After inaugurating GIS technology at Digby Wells, expertise has further developed in the areas of Aerial Photographic and Satellite Remote Sensing applications, topographical and three dimensional (3D) data modelling, statistical analytics and digital cartographic applications. Has a keen interest in identifying natural and social relationships which lends itself to a better understanding of the environment and enhancing informed decision making.

Responsibilities at Digby Wells Environmental currently include but are not limited to:

Management of the GIS & Air Quality Department;

Technological development of GIS and Remote Sensing solutions;

Expanding and improving GIS databases by identifying gaps and sources of additional mapping data;

The production of spatial information in map format;

Application of GPS technology, Aerial photo and satellite images.

Professional affiliations

Geographic Information Society of South Africa (GISSA)

DECLARATION OF INDEPENDANCE OF REPORT WRITER AND GIS SPECIALIST

I, **Bradly Thornton**, declare that I –

- Act as the independent specialist for the undertaking of a specialist section for the proposed project: **Visual Impact Assessment for BSGR Resources**;
- Do not have and will not have any financial interest in the undertaking of the activity, other than remuneration for work performed in terms of the Environmental Impact Assessment Regulations, 2006;
- Do no have nor will have a vested interest in the proposed activity proceeding;
- Have no, and will not engage in, conflicting interests in the undertaking of the activity;
- Undertake to disclose, to the competent authority, any information that have or may have the potential to influence the decision of the competent authority or the objectivity of any report, plan or document required in terms of the Environmental Impact Assessment Regulations, 2006;

Bradly Thornton

Name of specialist

Signature of the specialist

Digby Wells Environmental

Name of company

2012/03/05

Date