Appendix D: Specialist reports

Appendix D1	**Agricultural**
Appendix D2	**Biodiversity**
Appendix D3	**Heritage**
Appendix D3a	**Archaeological**
Appendix D3b	**Palaeontological**
Appendix D3c	**Visual**
Appendix D4	**Socio-Economic**

Appendix D1 Agricultural

TERRASOIL SCIENCE

BASIC ASSESSMENT LEVEL REPORT

SOIL, LAND USE, LAND CAPABILITY AND AGRICULTURAL POTENTIAL SURVEY:

PROPOSED KEIMOES KEREN SOLAR ENERGY FACILITY: KEIMOES, NORTHERN CAPE PROVINCE

March 14th, 2012

Compiled by:
J.H. van der Waals
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DECLARATION

I, Johan Hilgard van der Waals, declare that I –

- I act as the independent specialist in this application
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- all the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of Regulation 71 and is punishable in terms of Section 24F of the Act.

J.H. VAN DER WAALS
TERRA SOIL SCIENCE

» Good enough internal and external (out of profile) drainage if irrigation practices are considered. Drainage is imperative for the removal (leaching) of salts that accumulate in profiles during irrigation and fertilization.

In addition to soil characteristics, climatic characteristics need to be assessed to determine the agricultural potential of a site. The rainfall characteristics are of primary importance and in order to provide an adequate baseline for the viable production of crops rainfall quantities and distribution need to be sufficient and optimal. The combination of the above mentioned factors will be used to assess the agricultural potential of the soils on the site.

2.3 Survey Area Boundary

The site lies between 28° 41' 07" and 28° 41' 33" south and 20° 58' 36" and 20° 59' 08" east immediately north of the town of Keimoes in the Northern Cape Province (**Figure 1**).

2.4 Survey Area Physical Features

The survey area lies on relatively flat terrain between 760 and 780 m above mean sea level with a general south-westerly aspect. The geology of the area is comprised of migmatite, granite and gneiss with wind transported sands overlying lime pans.

3. SOIL, LAND CAPABILITY, LAND USE SURVEY AND AGRICULTURAL POTENTIAL SURVEY

3.1 Method of Survey

The Basic Assessment level soil, land capability, land use and agricultural potential surveys were conducted in three phases.

3.1.1 Phase 1: Land Type Data

Land type data for the site was obtained from the Institute for Soil Climate and Water (ISCW) of the Agricultural Research Council (ARC). The land type data is presented at a scale of 1:250 000 and entails the division of land into land types, typical terrain cross sections for the land type and the presentation of dominant soil types for each of the identified terrain units (in the cross section). The soil data is classified according to the Binomial System (MacVicar et al., 1977). The soil data was interpreted and re-classified according to the Taxonomic System (MacVicar, C.N. et al. 1991).

3.1.2 Phase 2: Aerial Photograph Interpretation and Land Use Mapping

The most up to date aerial photographs of the site were obtained from Google Earth. The image was used to interpret aspects such as land use and land cover.

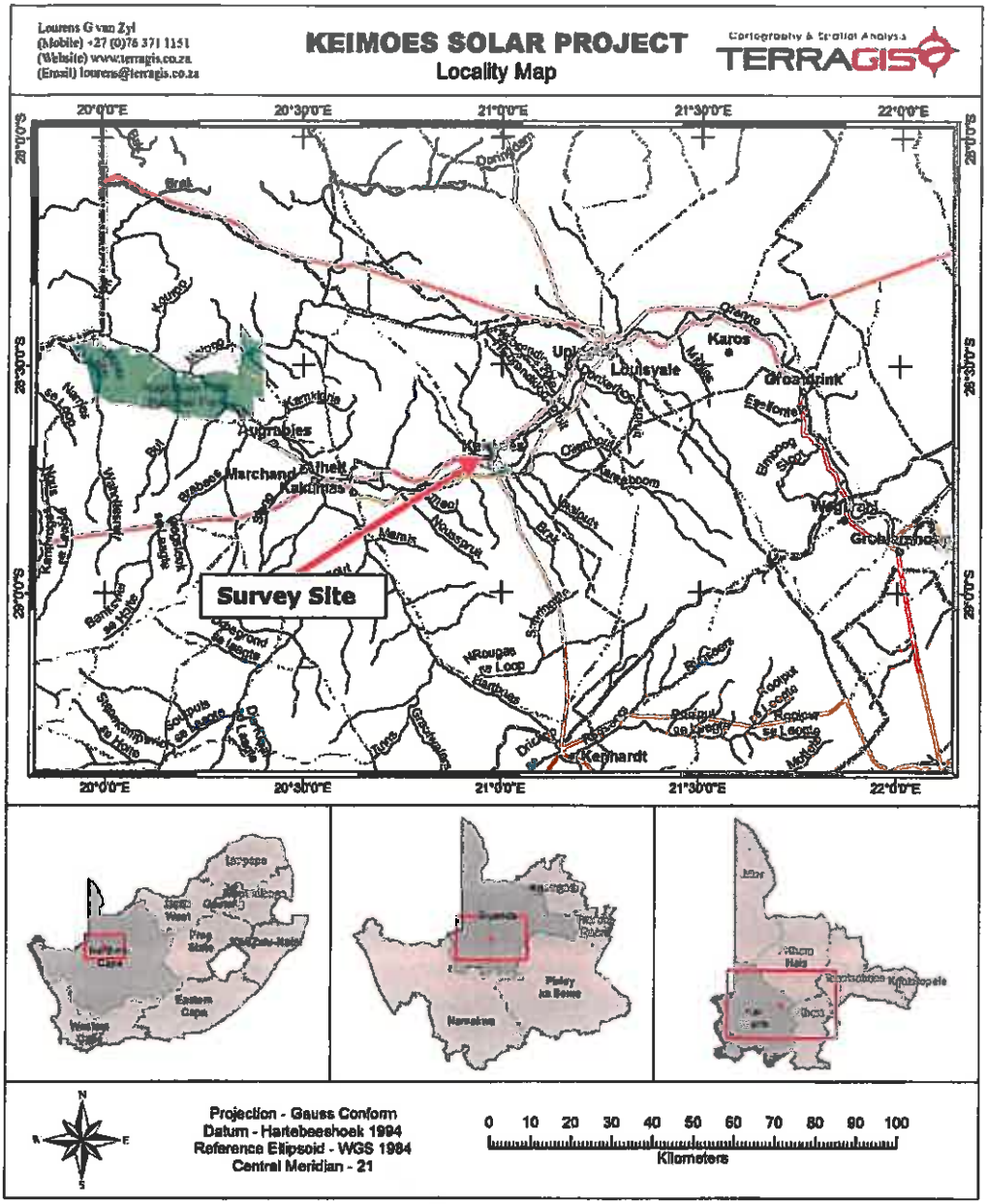

Figure 1 Locality of the survey site

3.1.3 Phase 3: Site Visit and Soil Survey

A site visit was conducted on the 24^{h} of November, 2011, during which a soil survey was conducted. The site was traversed on foot with the aim of ascertaining as much of the soil variability as possible. Soils were described and photographs were taken of pertinent soil, landscape and land use characteristics.

3.2 Survey Results

3.2.1 Phase 1: Land Type Data

The site falls into the **Ag1** land type (Land Type Survey Staff, 1972 - 2006). (Refer to **Figure 2** for the land type map of the area). Below follows a brief description of the land type in terms of soils, land capability, land use and agricultural potential.

Land Type Ag1
Soils: Predominantly shallow to moderately deep eutrophic soils (mainly red in colour) with extensive rock outcrops and rocky areas with occasional calcrete outcrops.
Land capability and land use: Exclusively extensive grazing due to climatic and soil constraints.
Agricultural potential: Very low potential due to the low rainfall (less than 100 mm per year – **Figure 3**) and shallow soils.

3.2.2 Phase 2: Aerial Photograph Interpretation and Land Use/Capability Mapping

The interpretation of aerial photographs yielded one dominant land use namely extensive grazing (**Figure 4**). The carrying capacity of the site is very low as rainfall and soils are limiting with regards to biomass production. Additional feeding of cattle and proper grazing management (camps) are imperative for the sustainable production of the cattle.

3.2.3 Phase 3: Site Visit and Soil Survey

The soil survey confirmed the land type data. A soil map of the site was not produced as the soils on the site are very homogenous and distinct soil units could therefore not be delineated meaningfully. The soils on the site are predominantly rocky with rock outcrops occurring throughout (**Figures 5** to **10**). Soils in drainage depressions are slightly deeper (**Figures 11** and **12**) but the distribution is very limited. Due to the limitation of the soils and the climate the only land use is extensive grazing. Distinction between the soil zones is visible in **Figure 11** where the drainage features (thin) follow water flow paths through areas with rocky soils and outcrops. The pattern is typical dendritic as water that flows off exposed areas transports sediment into lower lying depressions. The soils in the depressions do not exhibit any signs of wetness but do exhibit signs of episodic deposition in the form of coarser and finer material stratification. Additionally, the soils do not exhibit distinct signs of illuviation of clays (therefore they are considered pedologically young soils) and are therefore consistent with soils of arid environments.

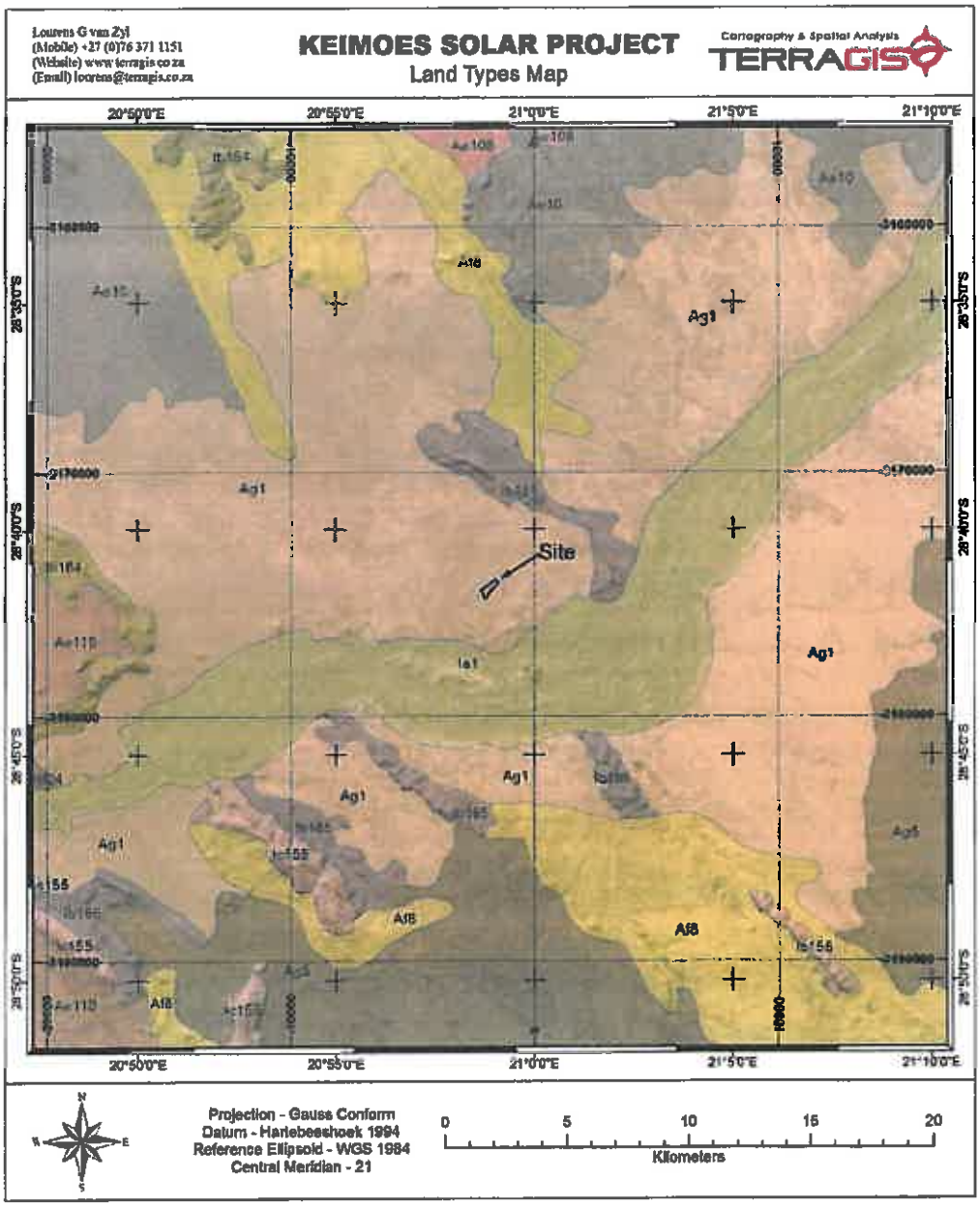

Figure 2 Land type map of the survey area

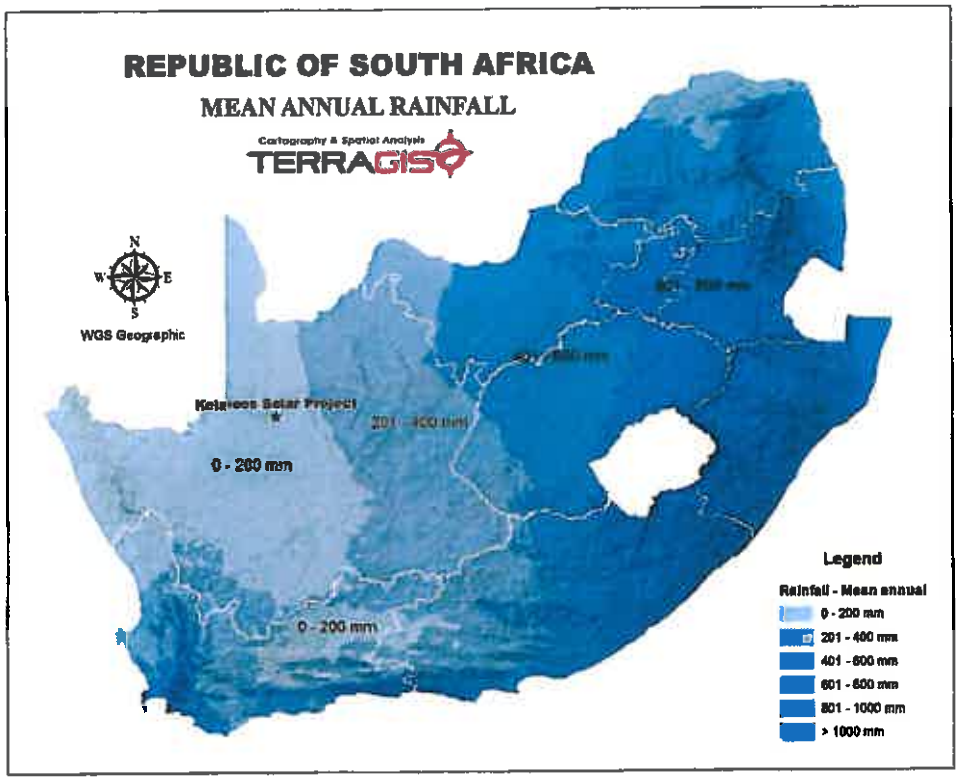

Figure 3 Rainfall map of South Africa indicating the survey site

4. INTERPRETATION OF SOIL, LAND CAPABILITY AND LAND USE SURVEY RESULTS

The interpretation of the land use and land capability results yielded a number of aspects that are of importance to the project.

4.1 Agricultural Potential

The agricultural potential of the site is determined mainly by the climate in that the rainfall effectively excludes any form of crop production. Additionally, the soils are not suited to crop production under irrigation in their current state and will require significant physical preparation before irrigated land uses are considered. The costs of these physical measures vary between R 150 000 and R 250 000 per hectare depending the extent of blasting required to break large boulders and rock. The site is therefore only suited to extensive grazing with a very low carrying capacity.

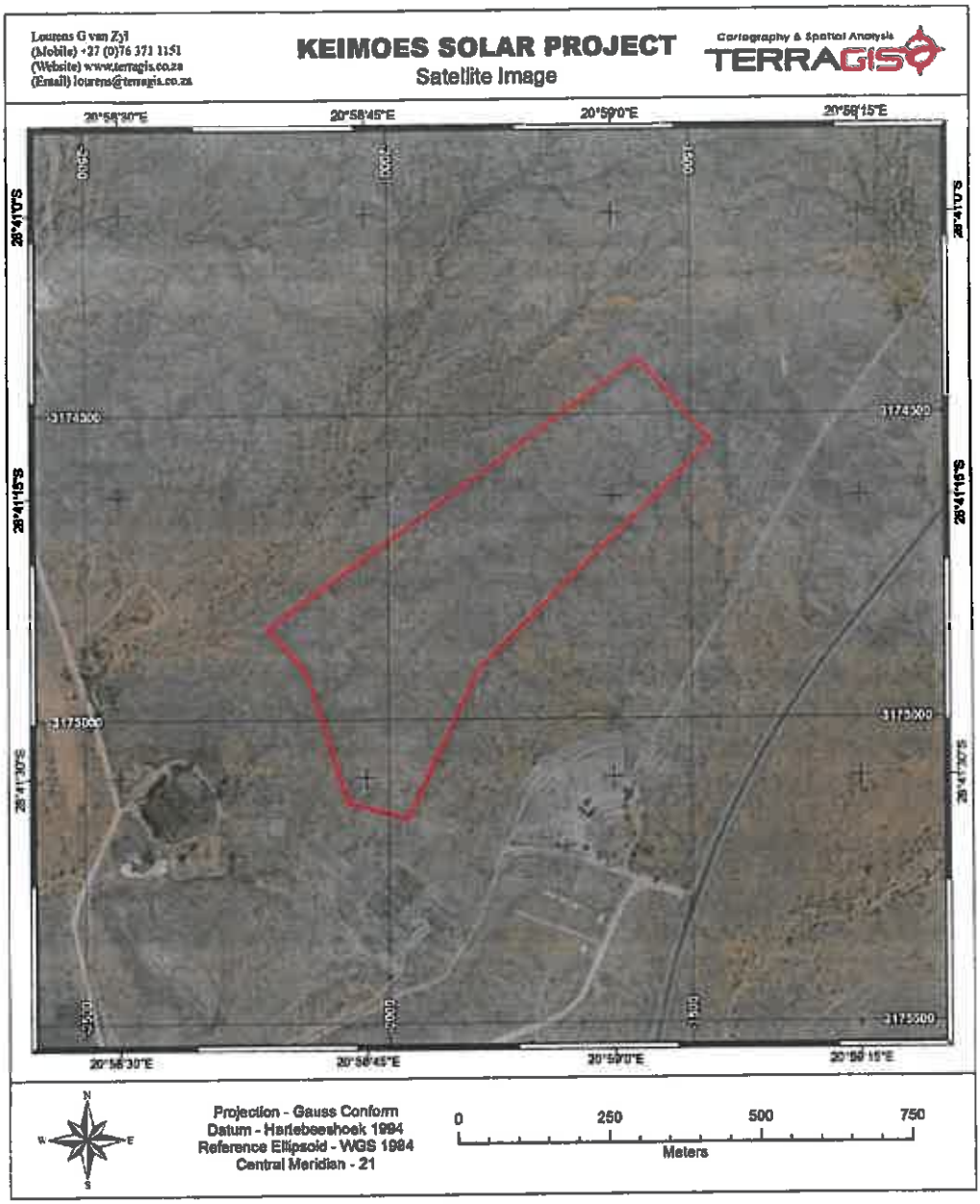

Figure 4 Satellite map of the general and the survey area

Figure 5 Shallow and rocky soils on the site

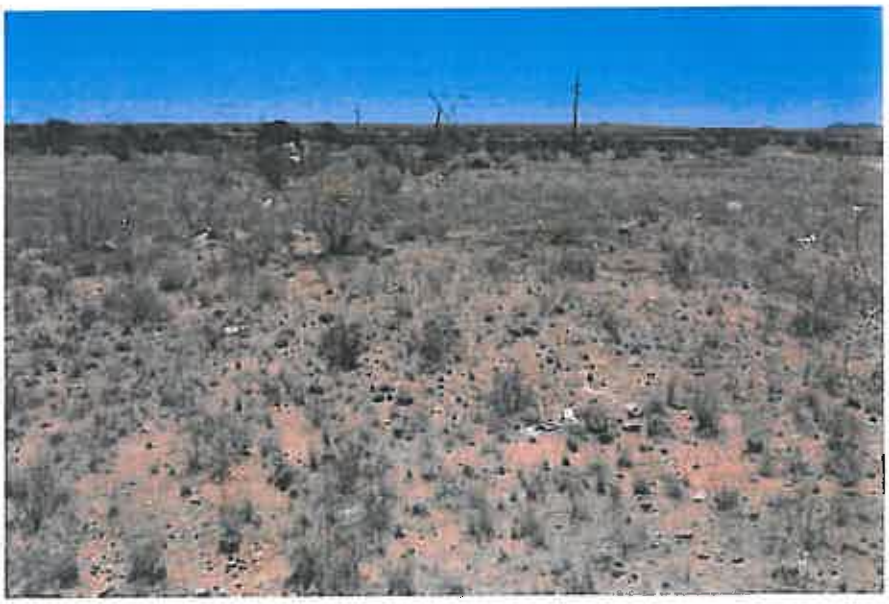

Figure 6 Shallow and rocky soils on the site

Figure 7 Shallow and rocky soils on the site

Figure 8 Shallow and rocky soils on the site

Figure 9 Shallow and rocky soils on the site

Figure 10 Shallow and rocky soils on the site

Figure 11 Alluvial soils in depressions

Figure 12 Alluvial soils in depressions

4.2 Overall Soil and Land Impacts

Due to the low agricultural potential of the site as well as the low rainfall the impacts on soils and agriculture is expected to be low – provided that adequate storm water management and erosion prevention measures are implemented. These measures should be included in the layout and engineering designs of the development.

5. ASSESMENT OF IMPACT

5.1 Assessment Criteria

The following assessment criteria (**Table 1**) will be used for the impact assessment.

Table 1 Impact Assessment Criteria

CATEGORY	DESCRIPTION OF DEFINITION
Direct, indirect and cumulative impacts	In relation to an activity, means the impact of an activity that in itself may not be significant but may become significant when added to the existing and potential impacts eventuating from similar or diverse activities or undertakings in the area.
Nature	A description of the cause of the effect, what will be affected and how it will be affected.
Extent (Scale) • 1 • 2 • 3 • 4 • 5	The area over which the impact will be expressed – ranging from local (1) to regional (5).
Duration • 1 • 2 • 3 • 4 • 5	Indicates what the lifetime of the impact will be. • Very short term: 0 – 1 years • Short-term: 2 – 5 years • Medium-term: 5 – 15 years • Long-term: > 15 years • Permanent
Magnitude • 2 • 4 • 6 • 8 • 10	This is quantified on a scale from 0-10, where 0 is small and will have no effect on the environment, 2 is minor and will not result in an impact on processes, 4 is low and will cause a slight impact on processes, 6 is moderate and will result in processes continuing but in a modified way, 8 is high (processes are altered to the extent that they temporarily cease), and 10 is very high and results in complete destruction of patterns and permanent cessation

CATEGORY	DESCRIPTION OF DEFINITION
	of processes.
Probability • 1 • 2 • 3 • 4 • 5	Describes the likelihood of an impact actually occurring. • Very Improbable • Improbable • Probable • Highly probable • Definite
Significance	The significance of an impact is determined through a synthesis of all of the above aspects. S = (E + D + M)*P S = Significance weighting E = Extent D = Duration M = Magnitude
Status • Positive • Negative • Neutral	Described as either positive, negative or neutral
Other	• Degree to which the impact can be reversed • Degree to which the impact may cause irreplaceable loss of resources • Degree to which the impact can be mitigated

5.2 List of Activities for the Site

Table 2 lists the anticipated activities for the site. The last two columns in the table list the anticipated forms of soil degradation and geographical distribution of the impacts.

5.3 Assessment of the Impacts of Activities

Many of the impacts are generic and their impacts will remain similar for most areas on the site. The generic activity will therefore be assessed. The impacts associated with the different activities have been assessed below for each activity. These impacts have been summarized in **Table 8**.
Note: The impacts listed below indicate that no mitigation is possible. It is important to note that any soil impact in the form of drastic physical disturbance (as with construction activities) is a permanent one and no mitigation is possible. The mitigation that can be applied is the restriction of off-site effects due to developments through adequate implementation of environmental management measures (discussed later in the report).

Table 2 List of activities and their associated forms of soil degradation

Activity	Form of Degradation	Geographical Extent	Comment (Section described)
Construction Phase			
Construction of solar panels and stands	Physical degradation (surface)	Two dimensional	Impact small due to localised nature (Section 5.3.1)
Construction of buildings and other infrastructure	Physical degradation (compound)	Two dimensional	(Section 5.3.2)
Construction of roads	Physical degradation (compound)	Two dimensional	(Section 5.3.3)
Construction and Operational Phase Related Effects			
Vehicle operation on site	Physical and chemical degradation (hydrocarbon spills)	Mainly point and one dimensional	(Section 5.3.4)
Dust generation	Physical degradation	Two dimensional	(Section 5.3.5)

5.3.1 Construction of Solar Panels and Stands

Table 3 presents the impact criteria and a description with respect to soils, land capability and land use for the construction of solar panels and stands.

Table 3 Construction of solar panels and stands

Criteria	**Description**	
Cumulative Impact	The cumulative impact of this activity will be small as it is constructed on land with low agricultural potential.	
Nature	This activity entails the construction of solar panels and stands with the associated disturbance of soils and existing land use.	
	Without Mitigation	With Mitigation
Extent	1 - Site: The impact is two dimensional but then limited to the immediate area that is being developed	1 - Site: The impact is two dimensional but then limited to the immediate area that is being developed
Duration	5 – Permanent (unless removed)	5 – Permanent (unless removed)
Magnitude	2	2
Probability	4 (highly probable due to inevitable changes in land use)	4 (highly probable due to inevitable changes in land use)
Significance of impact	S = (1 + 5 + 2)*4 = 32 (low)	S = (1 + 5 + 2)*4 = 32 (low)
Status	Negative	Negative
Mitigation	None possible. Limit footprint to the immediate development area	None possible. Limit footprint to the immediate development area

5.3.2 Construction of Buildings and Other Infrastructure

Table 4 presents the impact criteria and a description with respect to soils, land capability and land use for the construction of solar panels and stands.

Table 4 Construction of buildings and other infrastructure

Criteria	**Description**	
Cumulative Impact	The cumulative impact of this activity will be small as it is constructed on land with low agricultural potential.	
Nature	This activity entails the construction of buildings and other infrastructure with the associated disturbance of soils and existing land use.	
	Without Mitigation	With Mitigation
Extent	1 - Site: The impact is two dimensional but then limited to the immediate area that is being developed	1 - Site: The impact is two dimensional but then limited to the immediate area that is being developed
Duration	5 – Permanent (unless removed)	5 – Permanent (unless removed)

Magnitude	2	2
Probability	4 (highly probable due to inevitable changes in land use)	4 (highly probable due to inevitable changes in land use)
Significance of impact	S = (1 + 5 + 2)*4 = 32	S = (1 + 5 + 2)*4 = 32 (low)
Status	Negative	Negative
Mitigation	None possible. Limit footprint to the immediate development area	None possible. Limit footprint to the immediate development area

5.3.3 Construction of Roads

Table 5 presents the impact criteria and a description with respect to soils, land capability and land use for the construction of roads.

Table 5 Construction of roads

Criteria	**Description**	
Cumulative Impact	The cumulative impact of this activity will be small as it is linear and limited in geographical extent.	
Nature	This activity entails the construction of roads with the associated disturbance of soils and existing land use.	
	Without Mitigation	With Mitigation
Extent	1 - Site: The impact is two dimensional but then limited to the immediate area that is being developed along the road	1 - Site: The impact is two dimensional but then limited to the immediate area that is being developed along the road
Duration	5 – Permanent (unless removed)	5 – Permanent (unless removed)
Magnitude	2	2
Probability	4 (highly probable due to inevitable changes in land use)	4 (highly probable due to inevitable changes in land use)
Significance of impact	S = (1 + 5 + 2)*4 = 32 (low)	S = (1 + 5 + 2)*4 = 32 (low)
Status	Negative	Negative
Mitigation	None possible. Limit footprint to the immediate development area and keep to existing roads as far as possible	None possible. Limit footprint to the immediate development area and keep to existing roads as far as possible

5.3.4 Vehicle Operation on Site

It is assumed that vehicle movement will be restricted to the construction site and established roads. Vehicle impacts in this sense are restricted to spillages of lubricants and petroleum products. **Table 6** presents the impact criteria and a description with respect to soils, land capability and land use for the operation of vehicles on the site.

Significance of impact	S = (2 + 2 + 2)*4 = 24	S = (2 + 2 + 2)*2 = 12 (with mitigation and adequate management)
Status	Negative	Negative
Mitigation	Limit vehicle movement to absolute minimum, construct proper roads for access	Limit vehicle movement to absolute minimum, construct proper roads for access

Table 8 Summary of the impact of the development on agricultural potential and land capability

Nature of Impact	*Loss of agricultural potential and land capability owing to the development*	
	Without mitigation	With mitigation
Extent	Low (1) – Site	Low (1) – Site
Duration	Permanent (5)	Permanent (5)
Magnitude	Low (2)	Low (2)
Probability	Highly probable (4)	Highly probable (4)
Significance*	32 (Low)	32 (Low)
Status (positive or negative)	Negative	Negative
Reversibility	Medium	Medium
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	No	No
Mitigation: The loss of agricultural land is a long term loss and there are no mitigation measures that can be put in place to combat this loss.		
Cumulative impacts: Soil erosion may arise owing to increased surface water runoff. Adequate management and erosion control measures should be implemented.		
Residual Impacts: The loss of agricultural land is a long term loss. This loss extends to the post-construction phase. The agricultural potential is very low though.		

5.4 Environmental Management Plan

Tables 9 to **11** provide the critical aspects for inclusion in the EMP.

Table 9 Measures for erosion mitigation and control

Objective: Erosion control and mitigation		
Project components	Soil stabilisation, construction of impoundments and erosion mitigation structures	
Potential impact	Large scale erosion and sediment generation	
Activity / risk source	Poor planning of rainfall surface runoff and storm water management	
Mitigation: Target / Objective	Prevention of eroded materials and silt rich water running off the site	
Mitigation: Action/control	**Responsibility**	**Timeframe**
Plan and implement adequate erosion control measures	Construction team and engineer	Throughout project
Performance Indicator	Assessment of storm water structures and erosion mitigation measures. Measurement of actual erosion and sediment generation.	
Monitoring	Monitor and measure sediment generation and erosion damage	

Table 10 Measures for limiting vehicle operation impacts on site (spillages)

Objective: Erosion control and mitigation		
Project components	Maintenance of vehicles and planning of vehicle service areas	
Potential impact	Oil, fuel and other hydrocarbon pollution	
Activity / risk source	Poor maintenance of vehicles and poor control over service areas	
Mitigation: Target / Objective	Adequate maintenance and control over service areas	
Mitigation: Action/control	**Responsibility**	**Timeframe**
Service vehicles adequately	Construction team and engineer	Throughout project
Maintenance of service areas, regular cleanup	Construction team and engineer	Throughout project
Performance Indicator	Assessment number and extent of spillages on a regular basis.	
Monitoring	Monitor construction and service sites	

Table 11 Measures for limiting dust generation on site

Objective: Dust generation suppression		
Project components	Limit and address dust generation on site linked to construction activities	
Potential Impact	Large scale dust generation on site	
Activity / risk source	Inadequate dust control measures, excessive vehicle movement on unpaved roads	
Mitigation: Target / Objective	Minimise generation of dust	
Mitigation Action/Control	Responsibility	Timeframe
Implement dust control strategy including dust suppressants and tarring of roads	Construction team and engineer	Throughout project
Limit vehicle movement on unpaved areas to the absolute minimum	Construction team and engineer	Throughout project
Performance Indicator	Assessment of dust generated on site	
Monitoring	Monitor construction site and surrounds	

6. CONCLUSIONS AND RECOMMENDATIONS

It is concluded that the proposed development of a photovoltaic facility on the site will not have large impacts due to the low agricultural potential of the site. The low agricultural potential of the site is the result of a dominance shallow and rocky soils as well as the very low rainfall of the area.

It is imperative though that adequate storm water management measures be put in place as the soils on the site have no cohesion due to inherent soil properties as well as lack of plant roots. The main impacts that have to be managed on the site are:

1. Erosion must be controlled through adequate mitigation and control structures.
2. Impacts from vehicles, such as spillages of oil and hydrocarbons, should be prevented and mitigated.
3. Dust generation on site should be mitigated and minimised as the dust can negatively affect the quality of pastures as well as sheep production.

The impacts on the site need to be viewed in relation to the opencast mining of coal in areas of high potential soils – such as the Eastern Highveld. With this comparison in mind the impact of a solar energy facility is negligible compared to the damaging impacts of coal mining – for a similar energy output. Therefore, in perspective, the impacts of the proposed facility can be motivated as necessary in decreasing the impacts in areas where agriculture potential plays a more significant role.

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Appendix D2 Biodiversity

KEIMOES

KEREN ENERGY HOLDINGS

BIODIVERSITY ASSESSMENT & BOTANICAL SCAN

A preliminary Biodiversity Assessment (with botanical input) taking into consideration the findings of the National Spatial Biodiversity Assessment of South Africa.

March 9, 2012

PREPARED BY: PB Consult

PREPARED FOR: ENVIROAFRICA CC

REQUESTED BY: KEREN ENERGY HOLDINGS (Pty) Ltd

Peet Botes (Pr.Sci.Nat: 400184/05) Registered Professional Environmental and Ecological Scientist
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SUMMARY - MAIN CONCLUSIONS

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MAIN VEGETATION TYPES	**Bushmanland Arid Grassland** Described as an open, shrubby thornveld characterized by a dense shrub layer, often lacking a tree layer, with a sparse grass layer. **Least Threatened** But only 4% formally protected (Augrabies Falls National Park)
LAND USE AND COVER	The study area is situated on communal grazing land, with no development or agricultural practices (apart from some grazing) observed. Natural vegetation forms a sparse cover over the entire area of the study area. The Keimoes waste disposal site as well as cemetery are located to the north of the site. Sand mining activities were also observed in some of the non-perennial streams crossing the property (vicinity of the waste disposal site).
RED DATA PLANT SPECIES	None encountered or expected Protected Trees: *Acacia erioloba* (Camel thorn) are present to the north of the site (deeper sands next to main watercourses).
IMPACT ASSESSMENT	Development without mitigation: Sig. rating = 28% Development with mitigation Significance = 5% Where values of ≤15% indicate an insignificant environmental impact and values >15% constitute ever increasing environmental impact.

RECOMMENDATION

From the information available and the site visit, it is clear that the Keimoes final location was well chosen from a biodiversity viewpoint. No irreversible species loss, habitat loss, connectivity or associated impact can be foreseen from locating and operating the solar facility on the final proposed solar site. However, there is a significant difference between development **without** and development **with** mitigation. As a result it is recommended that all mitigating measures must be implemented in order to further minimise the impact of the construction and operation of the facility.

Although solar energy is presently not seen as a viable stand-alone technology for electricity production it will lighten the pressure on the fossil burning facilities of Eskom and in so doing will add to a more sustainable way of electricity production.

With the available information to the author's disposal it is recommended that the project be approved, but that all mitigation measures described in this document is implemented.

CONTENTS

INTRODUCTION

Renewable energy takes many forms, including biomass, geothermal, hydropower, wind and solar. Of these, solar may be the most promising: it can be used to generate electricity or to heat water, has little visual impact, and scales well from residential to industrial levels. Solar is the fastest growing energy source in the world. It offers a limitless supply of clean, safe, renewable energy for heat and power. And it's becoming ever more affordable, more efficient, and more reliable.

According to various experts (www.thesolarfuture.co.za), building solar plants is in many ways more financially viable and sustainable than erecting coal fired power stations. When a coal power plant has reached its life span, usually after 40 years depending on the technology, it must be demolished and rebuild (at a huge price tag). When panels of a solar plant reach their lifespan, you only need to replace the panels. Replacing panels is becoming cheaper and better in what they do as the technology is continuously improving. South Africa has abundant coal reserves, but its reserves of solar power are even greater, and unlike coal, solar power is inflation-proof and doesn't lead to large scale destruction of landscapes or the pollution of precious water. In addition South Africa is the world's best solar energy location after the Sahara and Australia.

The advantages of Solar and other renewable power sources are clear: greater independence from imported fossil fuels, a cleaner environment, diversity of power sources, relief from the volatility of energy prices, more jobs and greater domestic economic development. All over the world, solar energy systems have reduced the need to build more carbon-spewing fossil-fuelled power plants. They are critical weapons in the battle against global warming. As the cost of solar technologies has come down, solar is moving into the mainstream and growing worldwide at 40-50% annually (www.wikepedia.org).

In 2011, the International Energy Agency said that "the development of affordable, inexhaustible and clean solar energy technologies will have huge longer-term benefits. It will increase countries' energy security through reliance on an indigenous, inexhaustible and mostly import-independent resource, enhance sustainability, reduce pollution, lower the costs of mitigating climate change, and keep fossil fuel prices lower than otherwise. These advantages are global.

Keren Energy Holdings is proposing the establishment of a 10 MW concentrated photovoltaic solar energy facility near the town of Keimoes (Northern Cape Province, Kai iGarib Local Municipality). The facility will be established over an area of approximately 20 ha, on the remainder of the Farm 666, approximately 2 km north-east of Keimoes. The purpose of the proposed facility is to sell electricity to Eskom as part of the Renewable Energy Independent Power Producers Procurement Programme. This programme has been introduced by the Department of Energy to promote the development of renewable power generation facilities.

TERMS OF REFERENCE

EnviroAfrica (Pty) Ltd was appointed by Keren Energy Holdings as the independent Environmental Assessment Practitioner (EAP) to undertake the Scoping/Environmental Impact Assessment (EIA) Process for the proposed development. PB Consult was appointed by EnviroAfrica to conduct a Biodiversity Assessment of the proposed development area.

PB Consult was appointed within the following terms of reference:

- Evaluate the general location of the proposed site and make recommendations on a specific location for the 20
- The study must consider short- to long-term implications of impacts on biodiversity and highlight irreversible impacts or irreplaceable loss of species.

INDEPENDENCE & CONDITIONS

PB Consult is an independent consultant to Keren Energy Holdings and has no interest in the activity other than fair remuneration for services rendered. Remunerations for services are not linked to approval by decision making authorities and PB Consult have no interest in secondary or downstream development as a result of the authorization of this proposed project. There are no circumstances that compromise the objectivity of this report. The findings, results, observations and recommendations given in this report are based on the author's best scientific and professional knowledge and available information. PB Consult reserve the right to modify aspects of this report, including the recommendations if new information become available which may have a significant impact on the findings of this report.

DEFINITIONS & ABBREVIATIONS

DEFINITIONS

Environmental Aspect: Any element of any activity, product or services that can interact with the environment.

Environmental Impact: Any change to the environment, whether adverse or beneficial, wholly or partially resulting from any activity, product or services.

No-Go Area(s): Means an area of such (environmental/aesthetical) importance that no person or activity is allowed within a designated boundary surrounding this area.

ABBREVIATIONS

BGIS	Biodiversity Geographical Information System
DEA	Department of Environmental Affairs
DENC	Department of Environment and Nature Conservation (Northern Cape Province)
EAP	Environmental assessment practitioner

EIA	Environmental impact assessment
EMP	Environmental management plan
NEMA	National Environmental Management Act, Act 107 of 1998
NEM: BA	National Environmental Management Biodiversity Act, Act 10 of 2004
NSBA	National Spatial Biodiversity Assessment
SANBI	South African National Biodiversity Institute
SKEP	Succulent Karoo Ecosystem Project
WWTW	Wastewater Treatment Works

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PROJECT DESCRIPTION

Keren Energy Holdings is proposing the establishment of a 10 MW concentrated photovoltaic solar energy facility near the town of Keimoes (Northern Cape Province, Kai !Garib Local Municipality). The facility will be established over an area of approximately 20 ha, on the remainder of the Farm 666, approximately 2 km north-east of Keimoes.

The proposed facility will utilise Concentrated Photovoltaic (CPV) technology, which aims to concentrate the light from the sun, using Fresnel lenses, onto individual PV cells. This method increases the efficiency of the PV panels as compared to conventional PV technology. An inverter is then used to convert the direct current electricity produced into alternating current for connection into the Eskom grid. A single solar generator produces approximately 66kV. In order to produce 10 MW, the proposed facility will require a number of generators arranged in multiples/arrays. The CPV panels will be elevated (2 m above ground) by a support structure, and will be able to track the path of the sun during the day for maximum efficiency. Approximately 1.8 ha is required per installed MW. A 10 MW capacity facility will thus require a development footprint of approximately 20 ha (including associated infrastructure – ancillary infrastructure). Each panel will be approximately 22 m wide by 12.5 m high. When the panels are tracking vertically the structure will have a maximum height of approximately 15 m.

The site will be accessed from the N14, using existing secondary roads. However, additional temporary access roads will have to be established on site. Site preparation will include clearance of vegetation at the footprint of the following infrastructure:

- Support structures (approximately 148 units are proposed) (excavations of 1 m^2 by 5 m deep)
- Switchgear
- Inverters
- Workshops
- Trenches for the underground cabling

The activities may require the stripping of topsoil, which will need to be stockpiled, backfilled and/or spread on site. All in all, the proposed facility can be likened to light agriculture, with the exception that natural vegetation will be allowed to remain on all the non-disturbed areas. All surfaces not used for the facility and associated infrastructure will remain natural.

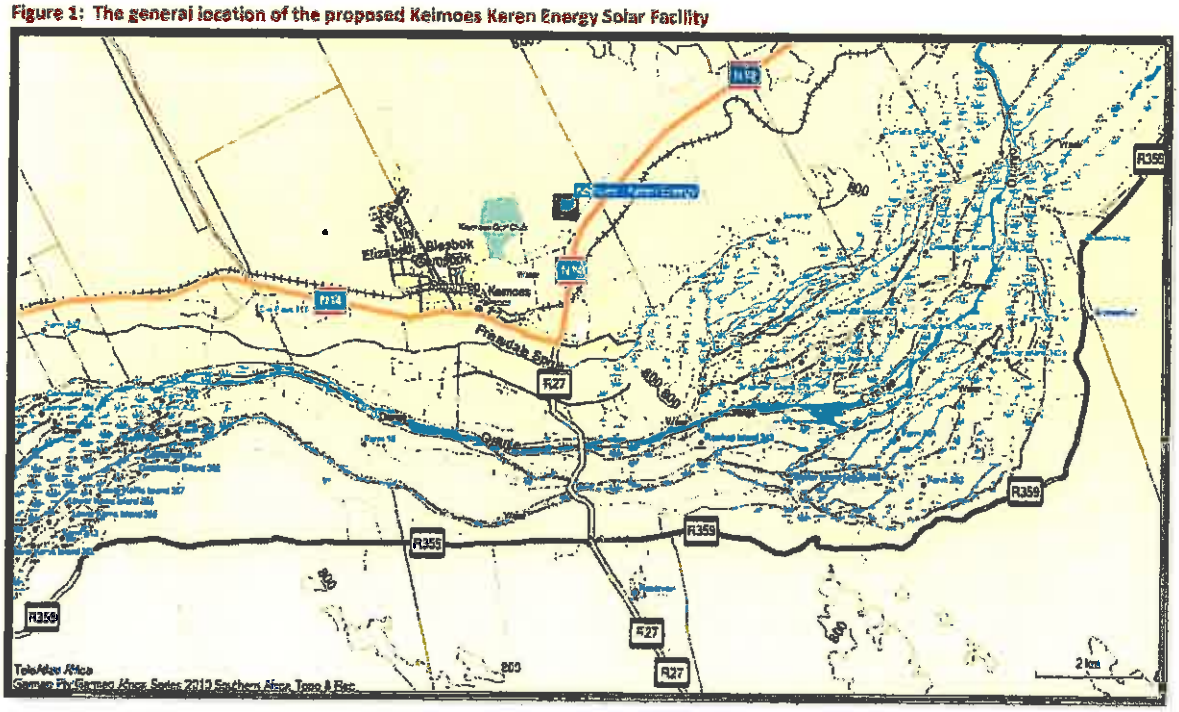
DESCRIPTION OF ENVIRONMENT

The aim of this description is to put the study area in perspective with regards to all probable significant biodiversity features which might be encountered within the study area. The study area has been taken as the proposed site and its immediate surroundings. During the desktop study any significant biodiversity features associated with the larger surroundings was identified, and were taken into account. The desktop portion of the study also informs as to the biodiversity status of such features as classified in the National Spatial Biodiversity Assessment (2004) as well as in the recent National list of ecosystems that are threatened and in need of protection (GN 1002, December 2011), promulgated in terms of the National Environmental Management Biodiversity Act (NEM: BA), Act 10 of 2004.

LOCATION & LAYOUT

Keimoes is located in the Northern Cape Province (Kai !Garib Local Municipality), just north of the N14 approximately 40 km west of Upington (Refer to Figure). The solar facility is proposed to be located approximately 2 km north-east of Keimoes (just east of the Keimoes Golf course) on a 20 ha potion of the Remainder of Farm 666 (refer to Figure 1).

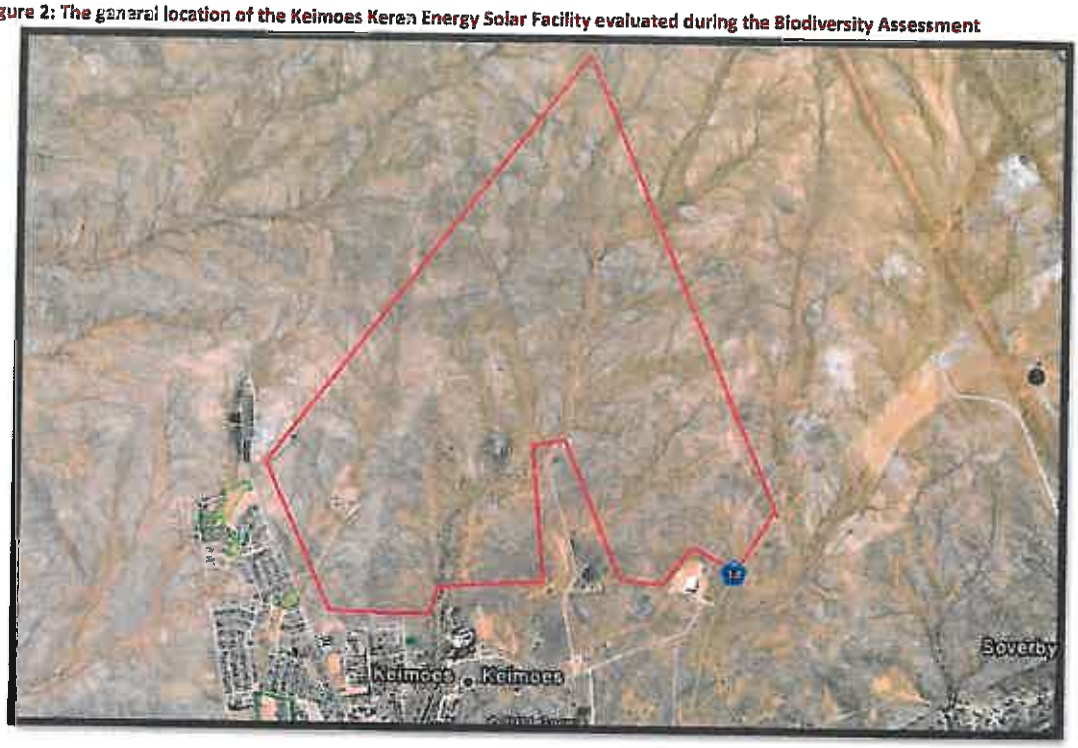
Figure 1: The general location of the proposed Keimoes Keren Energy Solar Facility



During the biodiversity assessment the following general location for the proposed site was evaluated (Refer to Figure 2).

Please note that this area is much larger than 20 ha and the purpose of the biodiversity assessment was to evaluate the larger site and then to choose a suitable area (within this larger site) on which the solar facility can be located, which will minimise significant biodiversity features.

Figure 2: The general location of the Keimoes Keren Energy Solar Facility evaluated during the Biodiversity Assessment



Biodiversity and other specialist inputs after the physical biodiversity assessment site visit was used to decide on the final proposed location for the solar facility (Refer to Figure 3).

Figure 3: Final proposed site location (approximately 20 ha)

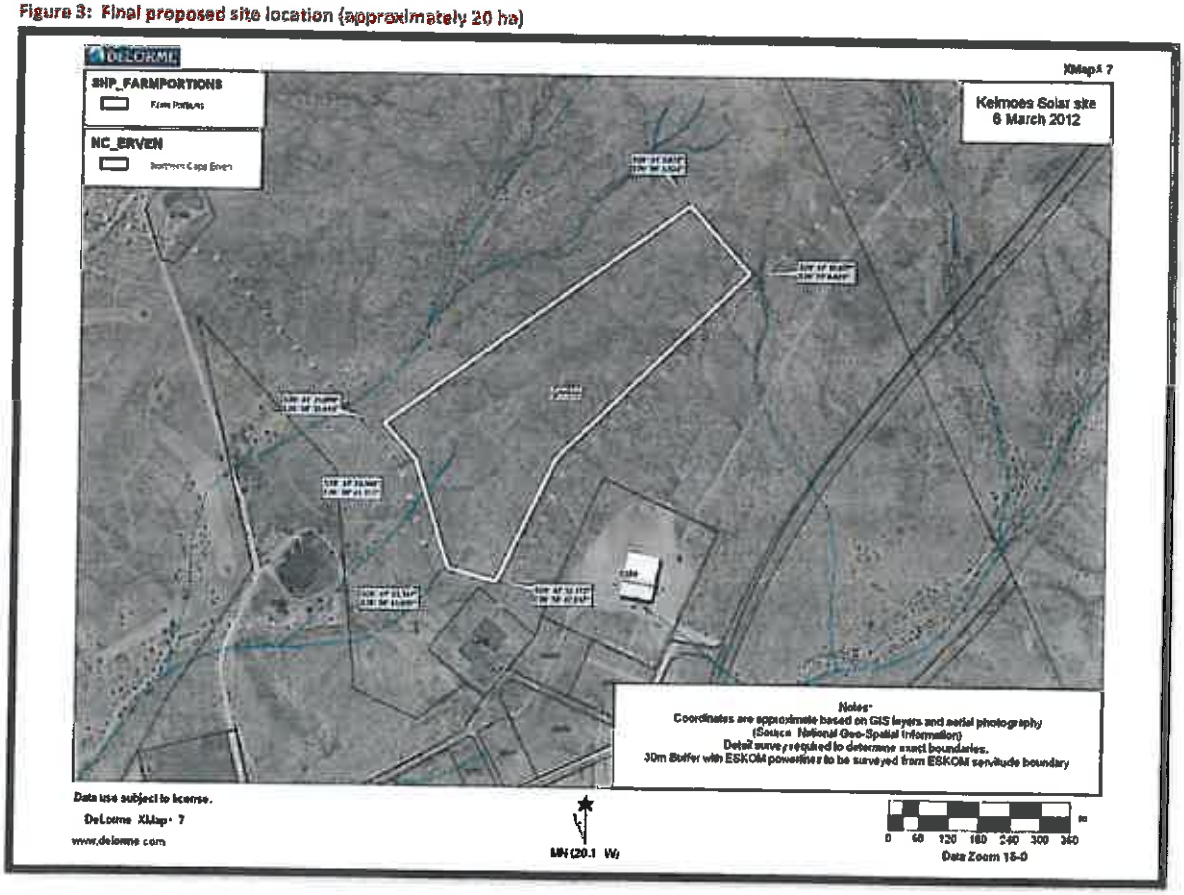


Table 1: GPS coordinates describing the approximate boundaries of the proposed final facility location (WGS 84 format)

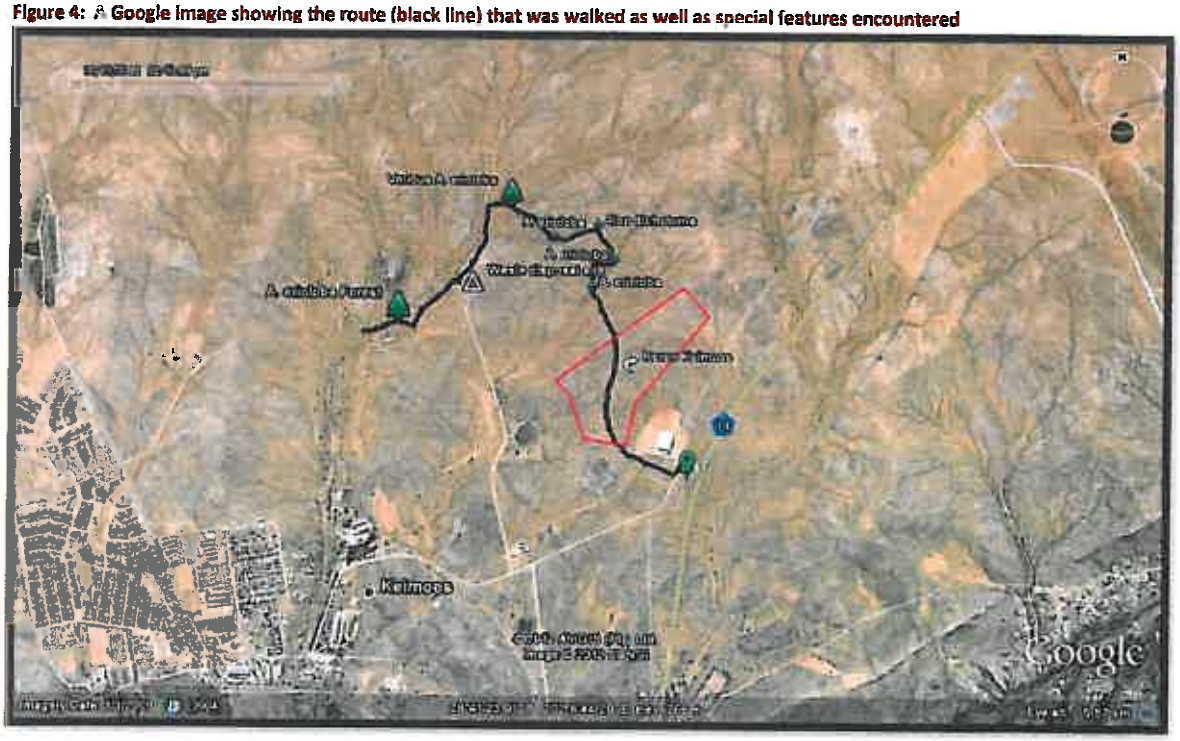
DESCRIPTION	LATITUDE AND LONGITUDE	ALTITUDE
North-west corner	S28 41 22.0 E20 58 39.0	766 m
North-east corner	S28 41 07.7 E20 59 01.5	777 m
South-east corner	S28 41 12.1 E20 59 06.0	775 m
South-west corner	S28 41 32.2 E20 58 51.7	766 m
Western boundary	S28 41 31.3 E20 58 43.9	764 m
Western boundary	S28 41 24.3 E20 58 41.4	765 m

METHODS

Various desktop studies were conducted, coupled by a physical site visit conducted in November 2011 and further desktop studies. The timing of the site visit was also reasonable in that essentially all perennial plants were identifiable and although the possibility remains that a few species may have been missed, the author is confident that a fairly good understanding of the biodiversity status in the area was obtained.

The survey was conducted by walking through the site (Refer to Figure 4) and examining, marking and photographing any area of interest. Confidence in the findings is high. During the site visit the author endeavoured to identify and locate all significant biodiversity features, including rivers, streams or wetlands, special plant species and or specific soil conditions which might indicate special botanical features (e.g. rocky outcrops or silcrete patches).

Figure 4: A Google image showing the route (black line) that was walked as well as special features encountered

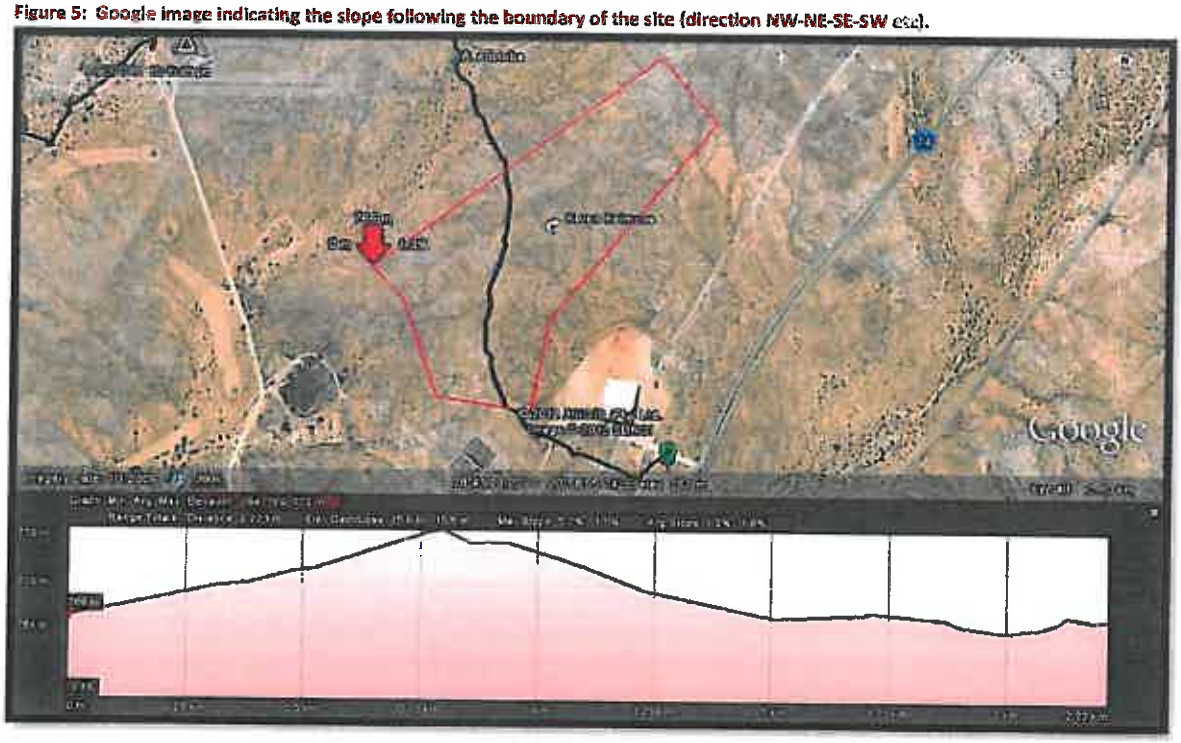


The site visit was also used to inform the client and EAP of potential conflicting areas (e.g. rivers/streams and plant species) in the larger site. This information together with engineering reasoning and other specialist studies was used to tweak the final proposed location indicated by the red block in Figure 4, above.

TOPOGRAPHY

The proposed final site is located on a relative flat area, which is shown in the elevation data given in Table 1 above as well as in Figure 1, which indicated an average slope of only 1.3% (with its highest point the north-east corner and its lowest point the south-west corner).

Figure 5: Google image indicating the slope following the boundary of the site (direction NW-NE-SE-SW etc).



CLIMATE

All regions with a rainfall of less than 400 mm per year are regarded as arid. This area normally receives about 106 mm of rain per year (the climate is therefore regarded as arid to very arid). Keimoes normally receives about 84mm of rain per year, with most rainfall occurring mainly during autumn. It receives the lowest rainfall (0 mm) in June and the highest (27 mm) in March. The monthly distribution of average daily maximum temperatures range from 19.8°C in June to 33°C in January. The region is the coldest during July when the mercury drops to 3°C on average during the night (www.saexplorer.co.za).

The graphs underneath indicate the average climate data for Kuruman (giving an average for the Northern Cape region) (Figure 6 to Figure 9).

Figure 6: Kuruman average minimum and maximum temperatures (www.weather-and-climate.com)

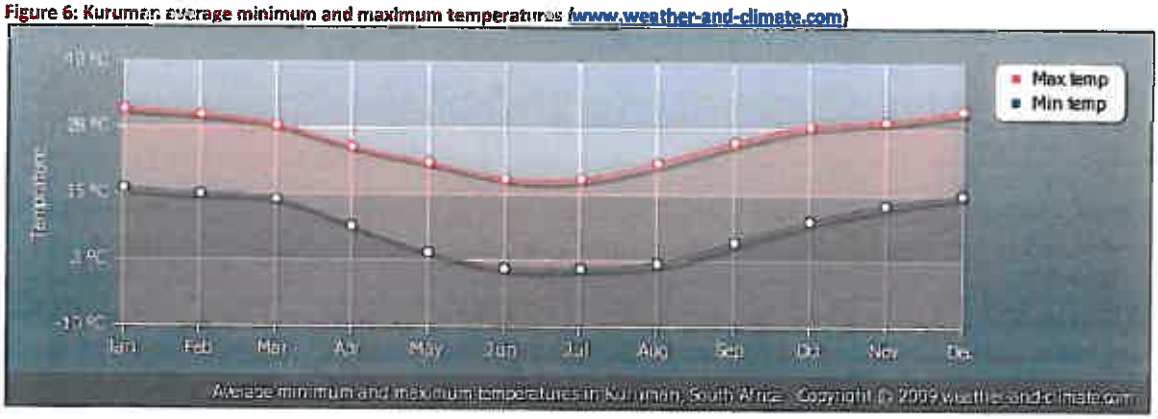


Figure 7: Kuruman average monthly precipitation over the year (www.weather-and-climate.com)

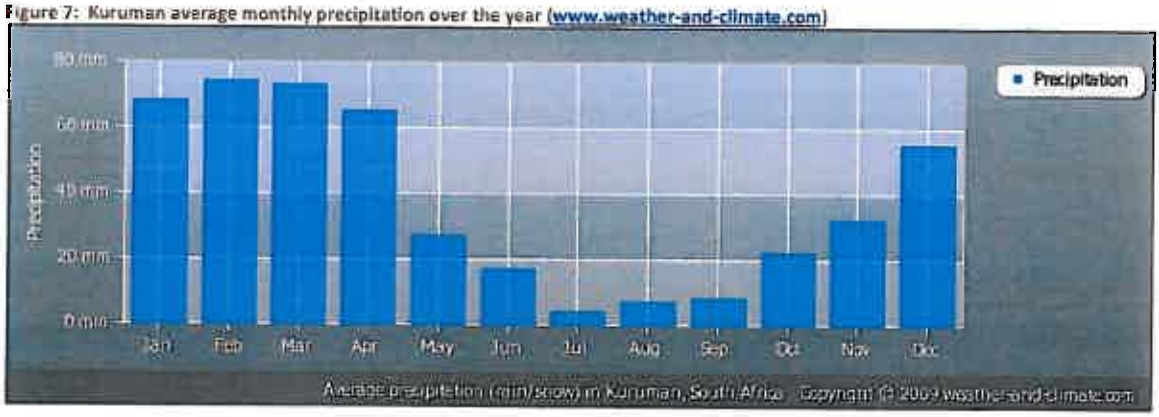


Figure 8: Kuruman average monthly hours of sunshine over the year (www.weather-and-climate.com)

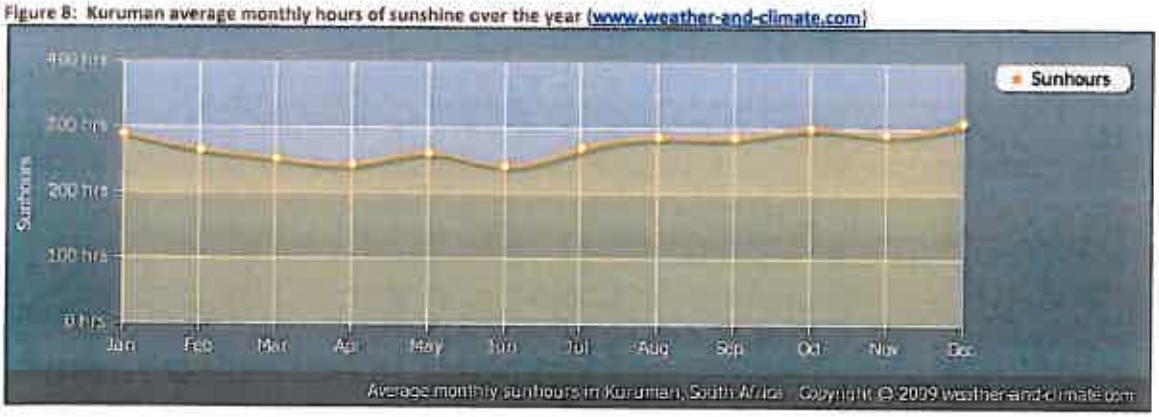
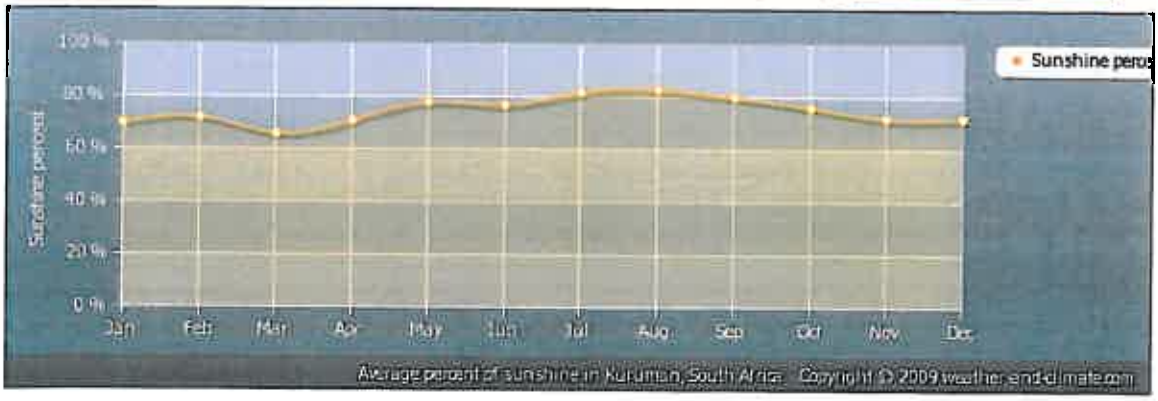


Figure 9: Kuruman average percent of sunshine over the year (mean % of sun hours during the day) (www.weather-and-climate.com)



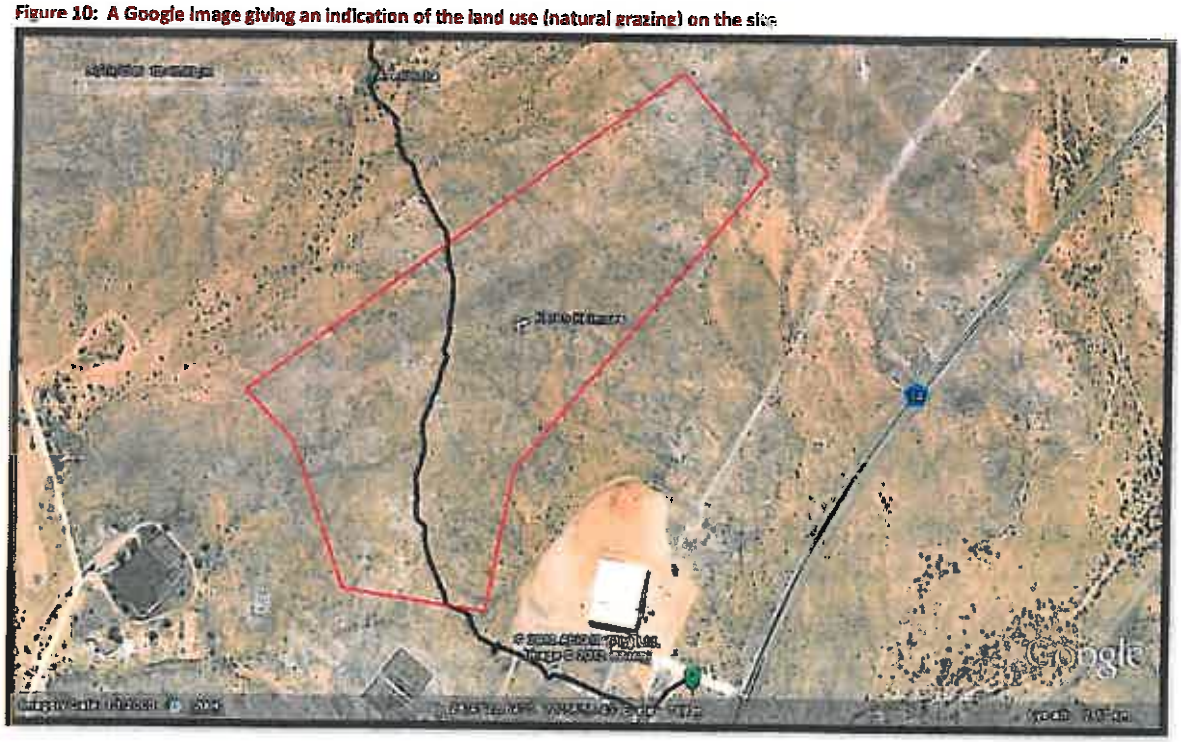
GEOLOGY & SOILS

Geology is dominated by mudstones and shales of the Ecca Group (Prince Albert and Volksrust Formations) and Dwyka tillites, both of the early Karoo age. About 20% of rock outcrops are formed by Jurassic intrusive dolerite sheets and dykes. Soils are described as soils with minimal development, usually shallow on hard or weathering rock, Glenrosa and Mispah forms, with lime generally present in the entire landscape (Fc land type) and, to a lesser extent, red-yellow apedal, freely drained soils with a high base status and usually <15% clay (Ah and Ai land types) are also found. The salt content in these soils is very high (Mucina & Rutherford, 2006).

LANDUSE AND COVER

The study area is situated on communal grazing land, with no development or agricultural practices (apart from some grazing) observed. Both the Keimoes waste disposal site as well as Cemetery are located to the north but in the vicinity of the larger study area. To the north of the site, sand mining activities was also observed in some of the non-perennial streams crossing the property. Natural vegetation forms a sparse cover over the entire area of the study area. Various non-perennial streams cross the property to the north of the final proposed study area (Refer to Figure 10). A number of smaller drainage channels are also present to the east of the proposed final site.

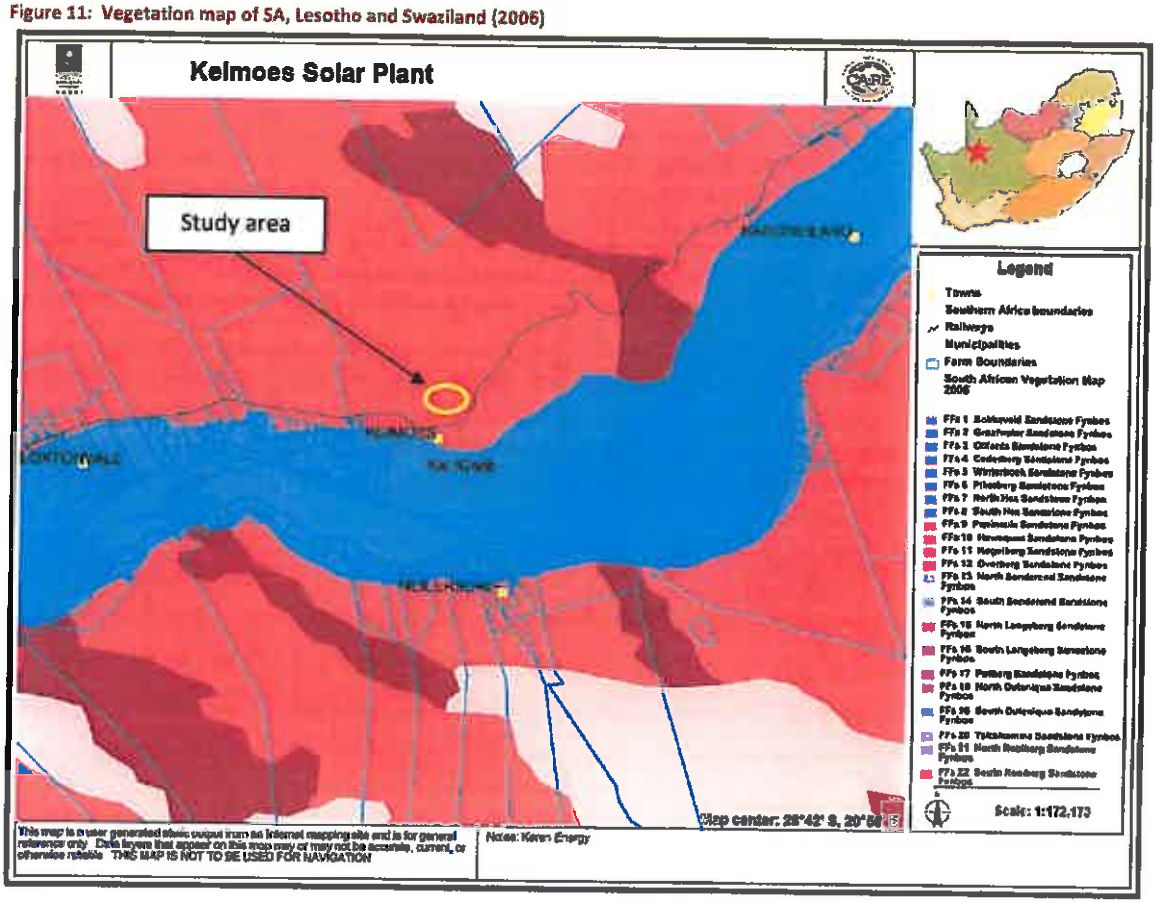
Figure 10: A Google image giving an indication of the land use (natural grazing) on the site



VEGETATION TYPES

In accordance with the 2006 Vegetation map of South Africa, Lesotho and Swaziland (Mucina & Rutherford, 2006) only one broad vegetation type is expected in the proposed area and its immediate vicinity, namely Bushmanland Arid Grassland (Light red in Figure 11). This vegetation type was classified as "Least Threatened" during the 2004 National Spatial Biodiversity Assessment (NSBA). More than 99% of this vegetation still remains in its natural state, but at present only 4% is formally protected (Augrabies Falls National Park) throughout South Africa. Recently the *National list of ecosystems that are threatened and in need of protection* (GN 1002, December 2011), was promulgated in terms of the National Environmental Management Biodiversity Act (NEM: BA), Act 10 of 2004. According to this National list, **Bushmanland Arid Grassland, remains classified as Least Threatened**.

Figure 11: Vegetation map of SA, Lesotho and Swaziland (2006)

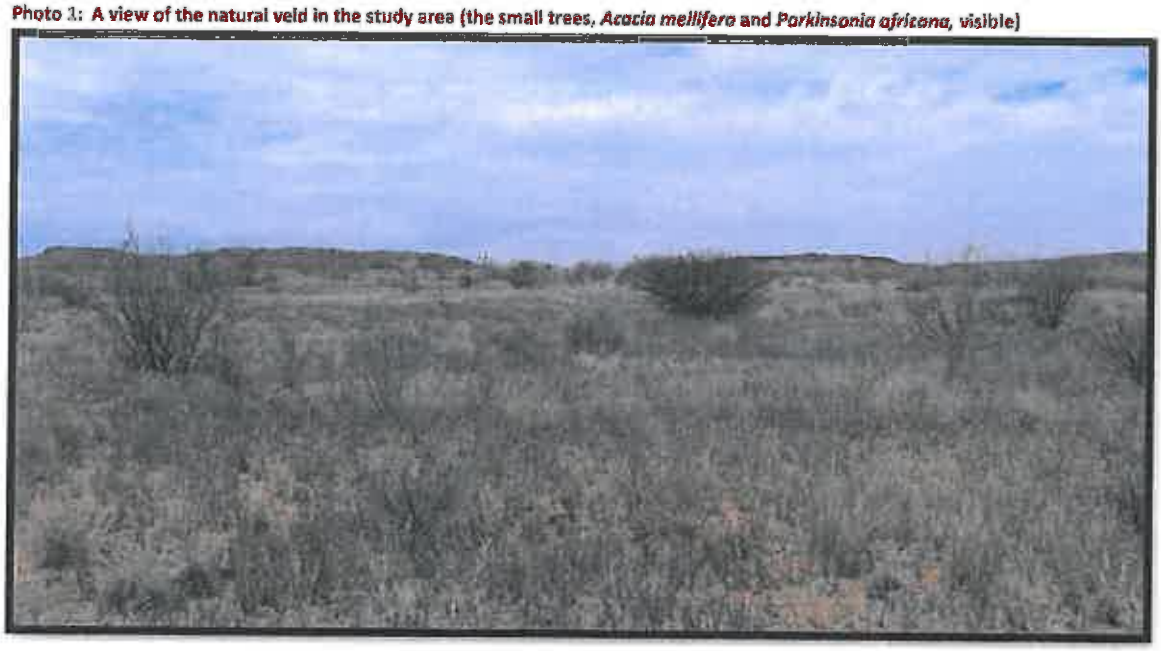


Bushmanland Arid Grassland is found in the Northern Cape Province spanning about one degree of latitude from around Aggeneys in the west to Prieska in the east. The southern border of the unit is formed by edges of the Bushmanland Basin while in the north-west this vegetation unit borders on desert vegetation (north-west of Aggeneys and Pofadder). The northern border (in the vicinity of Upington) and the eastern border (between Upington and Prieska) are formed with often intermingling units of Lower Gariep Broken Veld, Kalahari Karroid Shrubland and Gordonia Duneveld. Most of the western border is formed by the edge of the Namaqualand hills. Altitude varies from 600 – 1 200 m (Mucina & Rutherford, 2006).

BUSHMANLAND ARID GRASSLAND

Bushmanland Arid Grassland is described as extensive to irregular plains on a slightly sloping plateau sparsely vegetated by grassland dominated by white grasses (*Stipagrostis* species) giving this vegetation type the character of semi-desert "steppe". Sometimes low shrubs of *Salsola* change the vegetation structure. In years of abundant rainfall rich displays of annual herbs can be expected (Mucina & Rutherford, 2006). Acocks (1953) described this vegetation as Arid Karoo and Desert False Grassland or Orange River Broken Veld while Low & Rebelo (1996) described this vegetation as Orange River Nama Karoo.

Photo 1: A view of the natural veld in the study area (the small trees, *Acacia mellifera* and *Parkinsonia africana*, visible)



According to Mucina & Rutherford (2006) important taxa includes the following:

Graminoides: *Aristida adscensionis, A. congesta, Enneapogon desvauxii, Eragrostis nindensis, Schimdtia kalahariensis, Stipagrostis ciliate, S. Obtuse, Cenchrus ciliaris, Enneapogon scaber, Eragrostis annulata, E. porosa, E. procumbens, Panicum lanipes, Setaria verticillata, Sporobolus nervosus, Stipagrostis brevifolia, S uniplumis, Tragus berteronianus, T racemosus*

Small trees: *Acacia mellifera, Boscia foetida* subsp. *foetida*

Tall shrubs: *Lycium cinereum, Rhigozum trichotomum, Aptosimum spinescens, Hermannia spinosa, Pentzia spinescens, Aizoon asbestinum, Aizoon schellenbergii, Aptosimum elongatum, Aptosimum lineare, A marlothii, Barleria rigida, Berkheya annectens, Eriocephalus ambiguous, Eriocephalus spinescens, Limeum aethiopicum, Polygala seminuda, Pteronia leucoclada, Tetragonia arbuscula, Zygophyllum microphyllum*

Succulent Shrubs: *Kleinia longiflora, Lycium bosciifolium, Salsola tuberculata, S gabrescens.*

Herbs: *Acanthopsis hoffmannseggiana, Aizoon canariense, Amaranthus praetermissus, Dicoma capensis Lotononis platycarpa, Sesamum capense, Tribulus pterophorus* etc.

VEGETATION ENCOUNTERED

The sparse vegetation encountered conforms to that of Bushmanland Arid Grassland. Most of the larger study area was sparsely but fairly uniformly covered by the same vegetation composition and was also mostly associated with shallow soils in which rocky limestone outcrops were fairly frequently observed (Refer to Photo 2). The non-perennial streams, on the other hand, were mostly associated with deeper soils (red-yellow apedal soils) with denser, sometimes almost forming a thicket, stands of *Acacia mellifera*, in which *Acacia erioloba* was also frequently encountered (Refer to Photo 2).

The shallow soils (covering most of the proposed final location) support a distinct 2 stratum vegetation cover, with a grassy/shrub bottom layer and a short shrub/small tree over layer. The author did not spend time on the identification of the grass species (which include a number of Stipagrostis species etc.), but did make an effort to identify most of the shrub and tree species.

The grass bottom layer included a number of shrub species which includes: *Aptosimum* sp., *Aloe* sp., *Coton royenii, Eriocephalus* cf. *ambiquus, Euphorbia mauritanica, Thesium lineatum, Zygophyllum microphyllum.*

The top stratum was mostly dominated by *Acacia mellifera* (Swarthaak), and occasional individuals of *Boscia foetida* subsp. *foetida* and *Parkinsonia africana*, with mistletoe *Moquinella rubra* sometimes present in some of the trees or shrubs, while in the deeper sands along the dry river beds, *Acacia erioloba* are frequently (outside of the final proposed site). In some cases *Acacia mellifera* forms almost a thicket stand next to portions of the dry river beds. One individual of *Aloe* cf *pillansii* (Picture to the right) was also encountered to the north of final proposed solar site location (outside of the final proposed site).

Photo 2: General vegetation composition

Photo 3: Slightly denser vegetation next to stream

Photo 4: *Boscia foetida* subsp. *foetida*

Photo 5: *Euphorbia decepta*

ENDEMIC OR PROTECTED PLANT SPECIES

Endemic taxa which might be encountered include: *Dinteranthus pole-evansii, Larryleachia dinteri, L marlothii, Ruschia kenhardtensis, Lotononis oligocephala* and *Nemesia maxi.*

The following protected tree species in terms of the National Forest Act of 1998 (Act 84 of 1998) have a geographical distribution that may overlap with the broader study area.

SPECIES NAME	COMMON NAME	TREE NO.	DISTRIBUTION
Acacia erioloba	Camel Thorn Kameeldoring	168	In dry woodlands next to water courses, in arid areas with underground water and on deep Kalahari sand
Acacia haematoxylon	Grey Camel Thorn Vaalkameeldoring	169	In bushveld, usually on deep Kalahari sand between dunes or along dry watercourses.
Boscia albitrunca	Shepherds-tree Witgat/Matopie	130	Occurs in semi-desert and bushveld, often on termitaria, but is common on sandy to loamy soils and calcrete soils.

MAMMAL AND BIRD SPECIES

Mammal and bird species were not regarded, as the proposed activity should have very little permanent impact on these species. Small game is still expected and droppings have been observed. Some of the smaller game (e.g. klipspringers) found at the nearby Augrabies Falls National Park is also expected to still roam the larger area and surroundings of the proposed site.

At the nearby Augrabies Falls National Park, wildlife includes at least 46 mammal and 186 bird species, as well as a number of reptiles. Most show adaptations to the area's large temperature fluctuations – including smaller animals like slender mongooses, yellow mongooses, and rock dassies – which utilise what little shade there is, sheltering in burrows, rock crevices and fallen trees.

Larger mammals found at Augrabies include steenbok, springbok, gemsbok, kudu, eland and Hartmann's Mountain Zebra (*Equus hartmannae*). The giraffe found at Augrabies are said to be lighter in colour than those found in the regions to the east, allegedly as an adaptation to the extreme heat. One of the most common antelope is the klipspringer, pairs of which are often seen bounding across the rocks by keen-eyed walkers. The main mammalian predators found in Augrabies are black-backed jackals, caracals, bat-eared foxes, African wild cats and an elusive population of leopards.

One reptile here is of particular note: Broadley's flat lizard, locally known as the Augrabies flat lizard, is endemic to this area. It only occurs in an area that is within about 100km of the falls. This reptile is, however, not locally rare and on warm days, the brightly-coloured males can often be seen sparring and dancing for dominance.

Birds in the area includes: Augrabies the black stork and Verreaux's (black) eagles which both breed in the area, and also pygmy falcons. As is common in the Kalahari to the north, pale chanting goshawk is one of the more common raptors, whilst flocks of Namaqua sand grouse are also common. Other species includes peregrine and lanner falcons, and rock kestrels (www. sanparks.org.za/augrabies).

RIVERS AND WETLANDS

Rivers maintain unique biotic resources and provide critical water supplies to people. South Africa's limited supplies of fresh water and irreplaceable biodiversity are very vulnerable to human mismanagement. Multiple environmental stressors, such as agricultural runoff, pollution and invasive species, threaten rivers that serve the world's population. River corridors are important channels for plant and animal species movement, because they link different valleys and mountain ranges. They are also important as a source of water for human use. Vegetation on riverbanks needs to be maintained in order for rivers themselves to remain healthy, thus the focus is not just on rivers themselves but on riverine corridors.

Various non-perennial or dry watercourses and drainage lines have been observed, especially to the north of the final solar site location (which has been chosen specifically to avoid these features. Towards the south-eastern side of the final proposed site location a small stream is still present, but the activities are not expected to irreversibly impact on these drainage channels. With care permanent impact could be fully negated.

INVASIVE ALIEN INFESTATION

Most probably because of the aridity of the area, invasive alien rates are generally very low for most of this area. Problem areas are usually associated with river systems and other wetland areas. None have been observed in the study area.

BIODIVERSITY ASSESSMENT

Biological diversity, or biodiversity, refers to the variety of life on Earth. As defined by the United Nations Convention on Biological Diversity, it includes diversity of ecosystems, species and genes, and the ecological processes that supp ort them. Natural diversity in ecosystems provides essential economic benefits and services to human society—such as food, clothing, shelter, fuel and medicines—as well as ecological, recreational, cultural and aesthetic values, and thus plays an important role in sustainable development. Biodiversity is under threat in many areas of the world. Concern about global biodiversity loss has emerged as a prominent and widespread public issue.

The objective of this study was to evaluate the biological diversity associated with the study area in order to identify significant environmental features which should be avoided during development activities and or to evaluate short and long term impact and possible mitigation actions in context of the proposed development.

As such the report aim to evaluate the biological diversity of the area using the Ecosystem Guidelines for Environmental Assessment (De Villiers *et. al.*, 2005), with emphasis on:

- Significant ecosystems
  - Threatened or protected ecosystems
  - Special habitats
  - Corridors and or conservancy networks
- Significant species
  - Threatened or endangered species
  - Protected species

METHOD USED

During May 2001, Van Schoor published a formula for prioritizing and quantifying potential environmental impacts. This formula has been successfully used in various applications for determining the significance of environmental aspects and their possible impacts, especially in environmental management systems (e.g. ISO 14001 EMS's). By adapting this formula slightly it can also be used successfully to compare/evaluate various environmental scenario's/options with each other using a scoring system of 0-100%, where any value of 15% or less indicate an insignificant environmental impact while any value above 15% constitute ever increasing environmental impact.

Using Van Schoor's formula (adapted for construction with specific regards to environmental constraints and sensitivity) and the information gathered during the site evaluation the possible negative environmental impact of the activity was evaluated.

Underneath follows a short description of Van Schoor's formula. In the formula the following entities and values are used in order to quantify environmental impact.

$S = [(fd + int + sev + ext + loc) \times (leg + gcp + pol + ia + str) \times P]$ (as adapted for construction activities)

Where

S = Significance value

fd = frequency and duration of the impact

int = intensity of the impact

sev = severity of the impact

ext = extent of the impact

loc = sensitivity of locality

leg = compliance with legal requirements

gcp = conformance to good environmental practices

pol = covered by company policy/method statement

ia = impact on interested and affected parties

str = strategy to solve issue

P = probability of occurrence of impact

CRITERIA

The following numerical criteria for the above-mentioned parameters are used in the formula.

fd = frequency and duration of the impact					
low frequency ; low duration	1	medium frequency; low duration	1.5	high frequency ; low duration	2
low frequency; medium duration	1.5	medium frequency ; medium duration	2	high frequency ; medium duration	2.5
low frequency ; high duration	2	medium frequency ; high duration	2.5	high frequency ; high duration	3

int = intensity of the impact					
low probability of species loss; low physical disturbance	1	medium probability of species loss; low physical disturbance	1.5	high probability of species loss; low physical disturbance	2
low probability of species loss; medium physical disturbance	1.5	medium probability of species loss; medium physical disturbance	2	high probability of species loss; medium physical disturbance	2.5
low probability of species loss; high physical disturbance	2	medium probability of species loss; high physical disturbance	2.5	high probability of species loss; high physical disturbance	3

sev = severity of the impact	
changes immediately reversible	1
changes medium/long-term reversible	2
changes not reversible	3

ext = extent of the impact	
locally (on-site)	1
regionally (or natural/critical habitat affected)	2
globally (e.g. critical habitat or species loss)	3

loc = sensitivity of location	
not sensitive	1
moderate (e.g. natural habitat)	2
sensitive (e.g. critical habitat or species)	3

leg = compliance with legal requirements	
compliance	0
non-compliance	1

gcp = good conservation practices	
conformance	0
non-conformance	1

pol = covered by company policy	
covered in policy	0
not covered/no policy	1

ia = impact on interested and affected parties	
not affected	1
partially affected	2
totally affected	3

str = strategy to solve issue	
strategy in place	0
strategy to address issue partially	0.5
no strategy present	1

P = probability of occurrence of impact	
not possible (0% chance))	0
not likely, but possible (1 - 25% chance)	0.25
likely (26 - 50% chance)	0.50
very likely (51 - 75% chance)	0.75
certain (75 - 100% chance)	0.95

EVALUATION OF SIGNIFICANT ECOSYSTEMS

The main drivers in this dry ecosystem would be variations in soil type (e.g. soil depth, moisture capacity, rockiness, mineral composition and acidity), and could largely determine plant community composition and occurrence of rare species. Grazing, especially by small resident antelope may be an important factor in regulating competitive interaction between plants (*Acacia mellifera* encroachment is often a sign of overgrazing or bad veld management). Certain species can act as important "nursery" plants for smaller species and are also important for successional development after disturbance. Tortoises and mammals can be important seed dispersal agents.

Fire is not expected to have any major input in this very dry and sparsely populated vegetation type.

THREATENED OR PROTECTED ECOSYSTEMS

The vegetation itself is not considered to belong to a threatened or protected ecosystem. No special habitats were encountered on site (e.g. quartz patches or broken veld), which could sustain significant smaller ecosystems. However, various watercourses and drainage lines were observed within the larger area surrounding the proposed solar site location. Watercourses and drainage lines are particularly vulnerable to

alien plant invasion, agricultural transformation and or physical disturbance. In order to protect these features the final site location was chosen specifically to protect the dry watercourses and drainage lines of the larger area.

To the south-east of the final proposed site location a few drainage lines might still be affected, but it is felt that the impact on these drainage lines can be minimised (or negated) through placement of the pylons and good environmental control during the construction phase.

Overall the development of the 20 ha Keren Energy solar facility at Keimoes is not expected to a have a significant impact on threatened or protected ecosystems. The possibility of such an impact occurring is rated as low to very low.

SPECIAL HABITATS

The vegetation itself is not considered to belong to a threatened or protected ecosystem. No special habitats were encountered on site (e.g. quartz patches or broken veld), which could sustain significant smaller ecosystems.

Overall the development of the 20 ha Keren Energy solar facility at Keimoes is not expected to a have a significant impact on any special habitat. The possibility of such an impact occurring is rated as negligible.

CORRIDORS AND OR CONSERVANCY NETWORKS

Looking at the larger site and its surroundings it shows excellent connectivity with remaining natural veld in almost all directions. Corridors and natural veld networks are still relative unscathed (apart from through-road networks). Watercourses and drainage lines are still almost pristine (except for indicators of bush encroachment, sand mining and the road networks crossing the larger area).

Since such good connectivity exists over such a large area, the 20 ha Keren Energy solar facility development is not expected to a have a significant impact on connectivity of the remaining natural veld. The impact is rated as very low.

EVALUATION OF SIGNIFICANT SPECIES

The site visit during November 2011, co-insides with a relative dry spell in the Keimoes area (which normally receives some rain from October). As a result only the hardened drought resistant plant species were observed, herbs, bulbs and annuals were conspicuously absent. This might mean that some of the local

endemic species were not in growth or could not be identified. However, the author is of the opinion that in the larger context it will not constitute a significant contribution.

THREATENED OR ENDANGERED SPECIES

No threatened or endangered species are recorded for this vegetation type. However, a few local endemic species are associated with the broader vegetation type.

During the site visit no such species were observed and in the regional context the author is of the opinion that the development of the 20 ha solar facility will not lead to irreversible Species loss. With good environmental control (e.g. topsoil removal, storage and re-distribution) and rehabilitation after construction (leaving the remaining area as natural as possible) the possibility of such an impact occurring could be almost negated.

The possibility of such an impact occurring is rated as very low.

PROTECTED SPECIES

Three protected tree species have a distribution which could overlap with the general site location of the solar facility namely: *Acacia erioloba* (Camel thorn) *Boscia albitrunca* (Witgat) and *Acacia haematoxylon* (Grey camel thorn). Of these 3 species only *Acacia erioloba* was observed and then only associated with the deeper red sands next to the main dry watercourses. (All of the trees observed were referenced by GPS and are indicated on Figure 4). The final site location was specifically chosen to avoid these watercourses and as such also effectively avoid all the Camel thorns observed.

Since the site location was chosen to avoid any protected tree species, the possibility of such an impact occurring is rated as very low.

PLACEMENT AND CONSTRUCTION METHOD

A single solar generator produces approximately 66kV. In order to produce 10 MW, the proposed facility will require a number of generators arranged in multiples/arrays. The CPV panels will be elevated (2 m above ground) by a support structure, and will be able to track the path of the sun during the day for maximum efficiency. Approximately 1.8 ha is required per installed MW. A 10 MW capacity facility will thus require a development footprint of approximately 20 ha (including associated infrastructure – ancillary infrastructure). Each panel will be approximately 22 m wide by 12.5 m high. When the panels are tracking vertically the structure will have a maximum height of approximately 15 m. The excavation needed for each support structures (approximately 148 units are proposed) will be 1 m^2 by 5 m deep. It means that apart from the

associated structures, approximately 148 holes of 1 m^2 by 5 m deep will be excavated. Each hole must be at least 22 m from the next.

Photo 6: Typical layout of such a solar site (image courtesy of Amonix, a leading designer of CPV technology)

The activities will require the stripping of topsoil (for the pylon holes and access roads only, leaving the remainder as natural as possible), which will need to be stockpiled, backfilled and/or spread on site. All in all the proposed facility can be likened to light agriculture, with the exception that natural vegetation can be allowed to remain on all the non-disturbed areas. All surfaces not used for the facility and associated infrastructure can remain natural.

DIRECT IMPACTS

As the name suggest, direct impacts refers to those impacts with a direct impact on biodiversity features and in this case were considered for the potentially most significant associated impacts (some of which have already been discussed above).

Direct loss of vegetation type and associated habitat due to construction and operational activities.

- Loss of ecological processes (e.g. migration patterns, pollinators, river function etc.) due to construction and operational activities. (Refer to page 18).
- Loss of local biodiversity and threatened plant species (Refer to page 18)
- Loss of ecosystem connectivity (Refer to page 19)

LOSS OF VEGETATION AND ASSOCIATED HABITAT

One broad vegetation type is expected in the study area, namely Bushmanland Arid Grassland (Refer to Vegetation encountered on page 13). Bushmanland Arid Grassland was classified as "Least Threatened", but "Poorly Protected" during the 2004 National Spatial Biodiversity Assessment. Within the more recent *"National list of ecosystems that are threatened and in need of protection"* (GN 1002, December 2011), promulgated in terms of the National Environmental Management Biodiversity Act (NEM: BA), Act 10 of 2004, the status of Bushmanland Arid Grassland are still regarded as least threatened. Although only 0.4% of this

vegetation type is formally protected, more than 99% of this vegetation type is still found in a relative natural state. Thus the vegetation itself is not considered to belong to a threatened or protected ecosystem. No special habitats were encountered on site (e.g. quartz patches or broken veld), which could sustain significant smaller ecosystems.

Even if all of the 20 ha is transformed (such as for intensive cultivation), the impact on the specific vegetation type would most probably only be medium-low as a result of the status of the vegetation and the location of the final proposed solar location. However, with mitigation the impact could still be reduced much further.

Mitigation: The following is some mitigation which will minimise the impact of the solar plant location and operation.

- Pylons should be placed at least 32 m away from the main watercourses on the property. Care should also be taken to protect drainage lines (by controlling the pylons placement).
- All significant plant species should be identified (e.g. *Acacia erioloba*) and all efforts made to avoid damage to such species.
- Only existing access roads should be used for access to the terrain (solar site).
- The internal network of service roads (if needed) must be carefully planned to minimise the impact on the remaining natural veld on the site. The number of roads should be kept to the minimum and should be only two-track roads (if possible). If possible the construction of hard surfaces should be avoided.
- Access roads and the internal road system must be clearly demarcated and access must be tightly controlled (deviations must not be allowed).
- Indiscriminate clearing of areas must be avoided, only pylon sites and sites where associated infrastructure needs to be placed must be cleared (all remaining areas to remain as natural as possible).
- All topsoil (at all excavation sites) must be removed and stored separately for re-use for rehabilitation purposes. The topsoil and vegetation should be replaced over the disturbed soil to provide a source of seed and a seed bed to encourage re-growth of the species removed during construction.
- Once the construction is completed all further movement must be confined to the access tracks to allow the vegetation to re-establish over the excavated areas.

INDIRECT IMPACTS

Indirect impacts are impacts that are not a direct result of the main activity (construction of the solar facility), but are impacts still associated or resulting from the main activity. Very few indirect impacts are associated with the establishment of the solar facility (e.g. no water will be used, no waste material or pollution will be produced through the operation of the facility).

The only indirect impact resulting from the construction and use of the facility is a loss of movement from small game and other mammals, since the property will be fenced. However, it is not considered to result in any major or significant impact on the area as a whole.

CUMULATIVE IMPACTS

In order to comprehend the cumulative impact, one has to understand to what extent the proposed activity will contribute to the cumulative loss of this vegetation type and other biodiversity features on a regional basis. Bushmanland Arid Grassland was classified as "Least Threatened", but "Poorly Protected" during the 2004 National Spatial Biodiversity Assessment. Within the more recent *"National list of ecosystems that are threatened and in need of protection"* (GN 1002, December 2011), promulgated in terms of the National Environmental Management Biodiversity Act (NEM: BA), Act 10 of 2004, the status of Bushmanland Arid Grassland is still regarded as least threatened. Although only 0.4% of this vegetation type is formally protected, more than 99% of this vegetation type is still found in a relatively natural state. Thus the vegetation itself is not considered to belong to a threatened or protected ecosystem. No special habitats were encountered on site (e.g. quartz patches or broken veld), which could sustain significant smaller ecosystems.

Even if all of the 20 ha is transformed (such as for intensive cultivation), the impact on the regional status of this vegetation type and associated biodiversity features would likely still be only medium-low. No irreversible species-loss, habitat-loss, connectivity or associated impact can be foreseen from locating and operating the solar facility on the final proposed solar site. However, all mitigation measures should still be implemented in order to further minimise the impact of the construction and operation of the facility.

THE NO-GO OPTION

During the impact assessment only the final proposed site (which was identified after inputs from the various appointed specialists) as described in Figure 3 and Table 1 is discussed. From the above, the "No-Go alternative" does not signify significant biodiversity gain or loss especially on a regional basis. In this case the no-go options will only ensure that the status quo remains, but it is expected that urban creep will anyway impact on the proposed final solar site location over time.

The site visit and desktop studies described and evaluated in this document led to the conclusion that the "No-Go Alternative" alternative will not result in significant gain in regional conservation targets, the conservation of rare & endangered species or gain in connectivity. At the best the No-Go alternative will only support the "status quo" of the region. On the other hand the pressure on Eskom facilities, most of which are currently still dependant on fossil fuel electricity generation, will remain. Solar power is seemingly a much cleaner and more sustainable option for electricity production.

QUANTIFICATION OF ENVIRONMENTAL IMPACTS

Taking all of the above discussions into account and using Van Schoor's formula for impact quantification, impacts of the following can be quantified as follows:

NO DEVELOPMENT

The no development scenario can only take regional biodiversity into account. In this instance national biodiversity (and even possibly global diversity) may, however, show significant gain over time, if for instance fossil burning electricity generation could be reduced and or replaced by cleaner energy production methods. Although solar energy is presently not seen as a viable stand-alone technology for electricity production it will lighten the pressure on the fossil burning facilities of Eskom and in so doing will add to a more sustainable way of electricity production.

DEVELOPMENT WITHOUT MITIGATION

The purpose of this scenario is to illustrate, using Van Schoor's formula, the loss should development be allowed without any mitigation measures. It is assumed that the 20 ha will be totally developed into hard surfaces, but still in context of the regional importance of the biodiversity associated with the area.

$$S = [(fd + int + sev + ext + loc) \times (leg + gcp + pol + ia + str) \times P] \text{ (as adapted)}$$

$$S = [(1.5 + 1.5 + 1 + 1 + 1) \times (1 + 1 + 1 + 1 + 1) \times 0.95] = 28\ \%$$

In the above any value of 15% or less indicates an insignificant environmental impact, while any value above 15% constitutes ever increasing environmental impact.

DEVELOPMENT WITH MITIGATION

The purpose of this scenario is to illustrate, using Van Schoor's formula, the environmental gain should development be allowed with all proposed mitigation measures implemented. It is assumed that the 20 ha will be developed, but that all areas not directly impacted by infrastructure placement will remain as natural as possible.

$$S = [(fd + int + sev + ext + loc) \times (leg + gcp + pol + ia + str) \times P] \text{ (as adapted)}$$

$$S = [(1.5 + 1 + 1 + 1 + 1) \times (0 + 0 + 0 + 1 + 0) \times 0.95] = 5\ \%$$

In the above any value of 15% or less indicates an insignificant environmental impact, while any value above 15% constitutes ever increasing environmental impact.

RECOMMENDATIONS & IMPACT MINIMIZATION

From the information discussed in this document it is clear to see that the Keimoes final location was well chosen from a biodiversity viewpoint. Even if all of the 20 ha is transformed (such as for intensive cultivation), the impact on the regional status of this vegetation type and associated biodiversity features would likely still be only medium-low. No irreversible species-loss, habitat-loss, connectivity or associated impact can be foreseen from locating and operating the solar facility on the final proposed solar site.

The site visit and desktop studies described and evaluated this document led to the conclusion that the "No-Go Alternative" alternative will not result in significant gain in regional conservation targets, the conservation of rare & endangered species or gain in connectivity. At the best the No-Go alternative will only support the "status quo" of the region. On the other hand the pressure on Eskom facilities, most of which is currently still dependant on fossil fuel electricity generation, will remain. Solar power is seemingly a much cleaner and more sustainable option for electricity production. However, the No-Go scenario can only take regional biodiversity into account. In this instance national biodiversity (and even possibly global diversity) may show significant gain over time, if for instance fossil burning electricity generation could be reduced and or replaced by cleaner energy production methods. Although solar energy is presently not seen as a viable stand-alone technology for electricity production it will lighten the pressure on the fossil burning facilities of Eskom and in so doing will add to a more sustainable way of electricity production.

Finally, when quantifying the development options, the Van Schoor's formula for impact quantification still shows a significant difference between development **without** and development **with** mitigation. As a result it is recommended that all mitigating measures must be implemented in order to further minimise the impact of the construction and operation of the facility.

With the available information at the author's disposal it is recommended that the project be approved, but that all mitigation measures described in this document is implemented.

IMPACT MINIMIZATION

GENERAL

- All construction must be done in accordance with an approved construction and operational phase Environmental Management Plan (EMP), which must be developed by a suitably experienced Environmental Assessment Practitioner.
- A suitably qualified Environmental Control Officer must be appointed to monitor the construction phase of the solar plant in terms of the EMP and the Biodiversity study recommendations as well as any other conditions which might be required by the Department of Environmental Affairs.
- An integrated waste management system must be implemented during the construction phase.

- All rubble and rubbish (if applicable) must be collected and removed from the site to a suitable registered waste disposal site.
- All alien vegetation should be removed from the property, as is legally required (if applicable)
- Adequate measures must be implemented to ensure against erosion.

SITE SPECIFIC

- Pylons should be placed at least 32 m away from any of the main watercourses on the property. Care should also be taken to protect drainage lines (by controlling the pylon placement).
- All significant plant species should be identified (e.g. *Acacia erioloba*) and all efforts made to avoid damage to such species.
- Only existing access roads should be used for access to the terrain (solar site).
- The internal network of service roads (if needed) must be carefully planned to minimise the impact on the remaining natural veld on the site. The number of roads should be kept to the minimum and should be only two-track/ twee-spoor roads (if possible). If possible the construction of hard surfaces should be avoided.
- Access roads and the internal road system must be clearly demarcated and access must be tightly controlled (deviations must not be allowed).
- Indiscriminate clearing of areas must be avoided, only pylon sites and sites where associated infrastructure needs to be placed must be cleared (all remaining areas to remain as natural as possible).
- All topsoil (the top 15-20 cm at all excavation sites), must be removed and stored separately for re-use for rehabilitation purposes. The topsoil and vegetation should be replaced over the disturbed soil to provide a source of seed and a seed bed to encourage re-growth of the species removed during construction.
- Once the construction is completed all further movement must be confined to the access tracks to allow the vegetation to re-establish over the excavated areas.

Appendix D3a Archaeological

ARCHAEOLOGICAL IMPACT ASSESSMENT THE PROPOSED KEREN ENERGY KEIMOES SOLAR FARM ON ERF 666 KEIMOES NORTHERN CAPE PROVINCE

Prepared for:

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On behalf of:

KEREN ENERGY KEIMOES (PTY) LTD

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MARCH
2012

Executive summary

The Agency for Cultural Resource Management was requested to conduct an Archaeological Impact Assessment (AIA) for the proposed construction and operation of a 10 Mega Watt (MW) commercial Concentrated Photovoltaic (CPV) Energy Generation Facility on Erf 666 in Keimoes in the Northern Cape Province.

Keimoes is situated alongside the Orange River, about 40 kms west of Upington. The site for the proposed solar farm is located north of the N14 and just to the east of the Keimoes Golf Course. The land is owned by the Kai Garib local municipality and is currently zoned for Agriculture use. The proposed site is fairly flat, but does slope gently toward the N14 and is very exposed and covered in rocks and stone with sparse natural vegetation covering the 20 ha footprint area.

In terms of Section 38 (1) (c) (iii) of the National Heritage Resources Act 1999 (Act 25 of 1999), an Archaeological Impact Assessment of the proposed project is required if the footprint area of the proposed development is more than 5000 m².

The AIA forms part of the Environmental Basic Assessment process that is being conducted by EnviroAfrica cc.

The aim of the study is to locate and map archaeological sites/remains that may be impacted by the proposed project, to assess the significance of the potential impacts and to propose measures to mitigate the impacts.

A 1 day, foot survey of the proposed footprint area was undertaken by the archaeologist on 2 March 2012, in which the following observations were made:

- More than 100 stone artefacts were mapped with a hand held GPS unit. Most of the tools are assigned to the Later Stone Age, but tools belonging to the Middle Stone Age were also counted. Only two Early Stone Age implements were found, including a large biface and one handaxe. More than 90% of the tools are in banded ironstone, with the remainder in indurated shale, quartzite, silcrete and quartz. Banded ironstone is fairly prolific on the site and was clearly the preferred raw material for making tools. Banded ironstone is known to have been a favoured and desirable raw material for making stone artefacts and occurs on a number of sites that have been documented by the archaeologist and others throughout the Northern Cape. Most of the tools are spread very thinly and unevenly over the surrounding landscape, but a low density scatter of tools was documented near the Eskom servitude. However, no evidence of any factory or workshop site, or the result of any human settlement was identified. No organic remains such as bone, pottery, or ostrich eggshell were found.

  The majority of the lithics comprise flakes, flake blades and chunks most of which are utilised and/or retouched, testament to the flaking qualities and sharp cutting edges of the preferred raw material. At least 18 cores or minimal cores/flaked chunks were also counted, indicating a fairly high level of stone fabrication on the site. The ratio of cores to flakes suggests that many of the final retouched or flaked artefacts were removed from the site by the toolmakers. Frequencies of formal retouched tools are very low, but the numbers of miscellaneous retouched tools (nearly 50%) is quite high. Of the formal retouched tools; only one convex

scraper, one side scraper, one possible end scraper, and two step retouched flakes (possible utilitarian adzes) were counted. No hammerstones were found and only one manuport was counted.

As archaeological sites are concerned, the occurrences are lacking in context as no organic remains such as bone, pottery or ostrich eggshell was found. There is no spatial patterning to the distribution of finds, but it was noted that some of the lithics tended to cluster around the south western portion of the proposed site near the Eskom servitude. Overall, however, the fairly small numbers and isolated context in which they were found means that the archaeological remains on Erf 666 have been rated as having low archaeological (Grade 3C) significance.

There are no graves on the affected property.

In terms of the built environment, the area has no significance, as there are no old buildings, structures, or features, old equipment, public memorial or monuments in the footprint area.

It is maintained that the study has captured good information on the archaeological heritage present and that the study has identified no significant impacts to pre-colonial archaeological material that will need to be mitigated prior to proposed development activities.

The results of the study indicate that the proposed development of the Keren Energy Keimoes Solar Farm on Erf 666 will not have an impact of great significance on these and potentially other archaeological remains.

Indications are that in terms of archaeological heritage, the proposed activity (i. e. the construction of a solar energy farm) is viable and no fatal flaws have been identified.

With regard to the proposed development of the Keren Energy Keimoes Solar Farm on Erf 666 in Keimoes, the following recommendations are made:

1. No further archaeological mitigation is required.

2. Should any unmarked human burials/remains or ostrich eggshell water flask caches be uncovered, or exposed during construction activities, these must immediately be reported to the archaeologist (Jonathan Kaplan 082 321 0172), or the South African Heritage Resources Agency (SAHRA) (Att Ms Mariagrazia Galimberti 021 462 4502). Burials, etc must not be removed or disturbed until inspected by the archaeologist.

Table of Contents

1. INTRODUCTION

1.1 Background and brief

Keren Energy Keimoes (Pty) Ltd, commissioned the Agency for Cultural Resource Management to conduct an Archaeological Impact Assessment (AIA) for the proposed construction and operation of a 10 MW Concentrated Photovoltaic (CPV) Energy Generation Facility on Erf 666 near Keimoes in the Northern Cape (Figures 1 & 2). The proposed development is situated within the Kai Garib municipality. Erf 666 is zoned for Agriculture and is owned by the local authority.

The Northern Cape has the highest levels of Solar Irradiance in South Africa, which makes the location of the proposed development ideal for solar energy generation. The renewable energy industry is currently experiencing an explosive growth worldwide. In South Africa, while such energy sources are not expected to replace the country's traditional reliance and dependency on coal-generated power, the National Energy Regulator of South Africa (NERSA) has published a favourable feed-in tariff structure for renewable energy that allows for independent clean energy producers to invest in renewable energy resources. The growing alternative energy industry is considered to be of national importance in anticipation of its contribution to electricity supply and reduced reliance of non-renewable energy sources.

It is in this context that the applicant proposes to construct a solar energy facility in Keimoes. The proposed activity entails the construction of about 140 CPV solar panels covering an area of about 20 ha. The CPV panels will be mounted on pedestals drilled and set into the ground. Extensive bedrock excavations are not envisaged, but some vegetation will need to be cleared from the site. Associated infrastructure includes single track internal access roads, trenches for underground cables, transformer pads, a switching station, a maintenance shed, and a temporary construction camp. The electricity generated from the project will be fed directly into the national grid at the Eskom Oasis substation which is situated alongside the subject property.

The AIA forms part of the Environmental Basic Assessment process that is being conducted by EnviroAfrica cc.

The aim of the study is to locate and map archaeological sites/remains that may be impacted by the proposed project, to assess the significance of the potential impacts and to propose measures to mitigate the impacts.

2. HERITAGE LEGISLATION

The National Heritage Resources Act (Act No. 25 of 1999) makes provision for a compulsory Heritage Impact Assessment (HIA) when an area exceeding 5000 m² is being developed. This is to determine if the area contains heritage sites and to take the necessary steps to ensure that they are not damaged or destroyed during development.

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

- Landscapes, cultural or natural (Section 3 (3))

- Buildings or structures older than 60 years (Section 34);
- Archaeological sites, palaeontological material and meteorites (Section 35);
- Burial grounds and graves (Section 36);
- Public monuments and memorials (Section 37);
- Living heritage (defined in the Act as including cultural tradition, oral history, performance, ritual, popular memory, skills and techniques, indigenous knowledge systems and the holistic approach to nature, society and social relationships) (Section 2 (d) (xxi)).

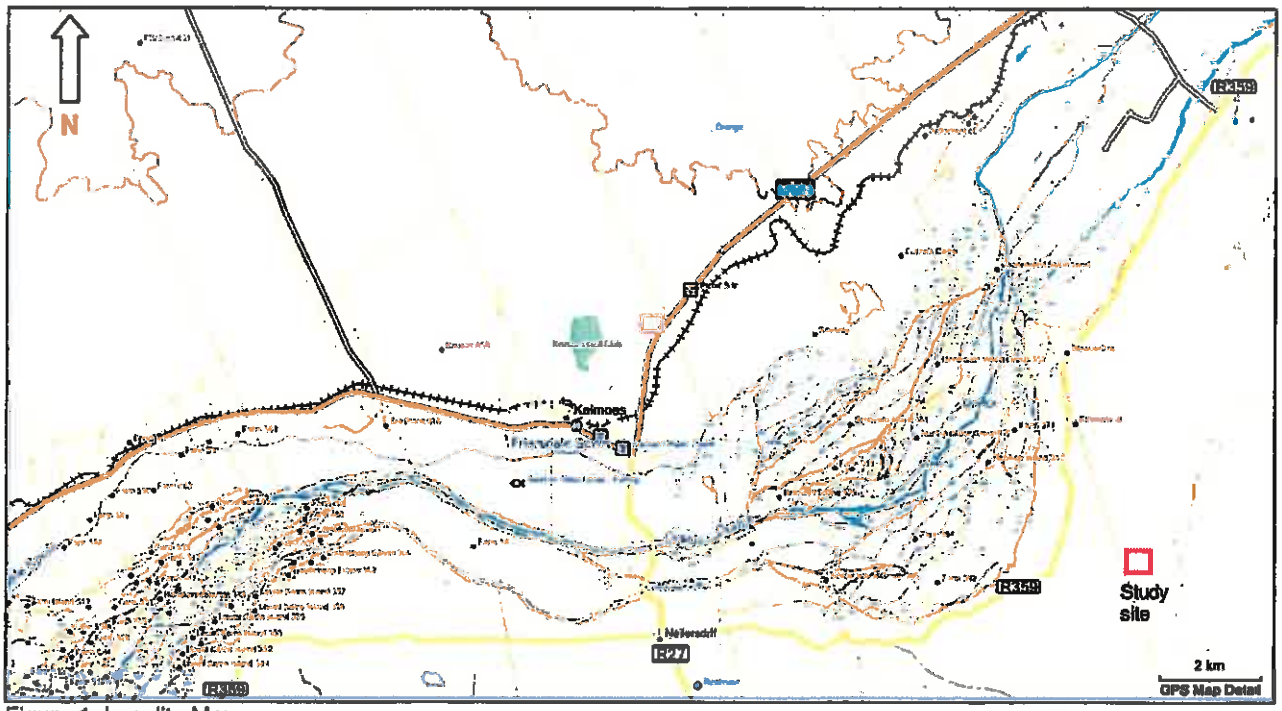

Figure 1. Locality Map

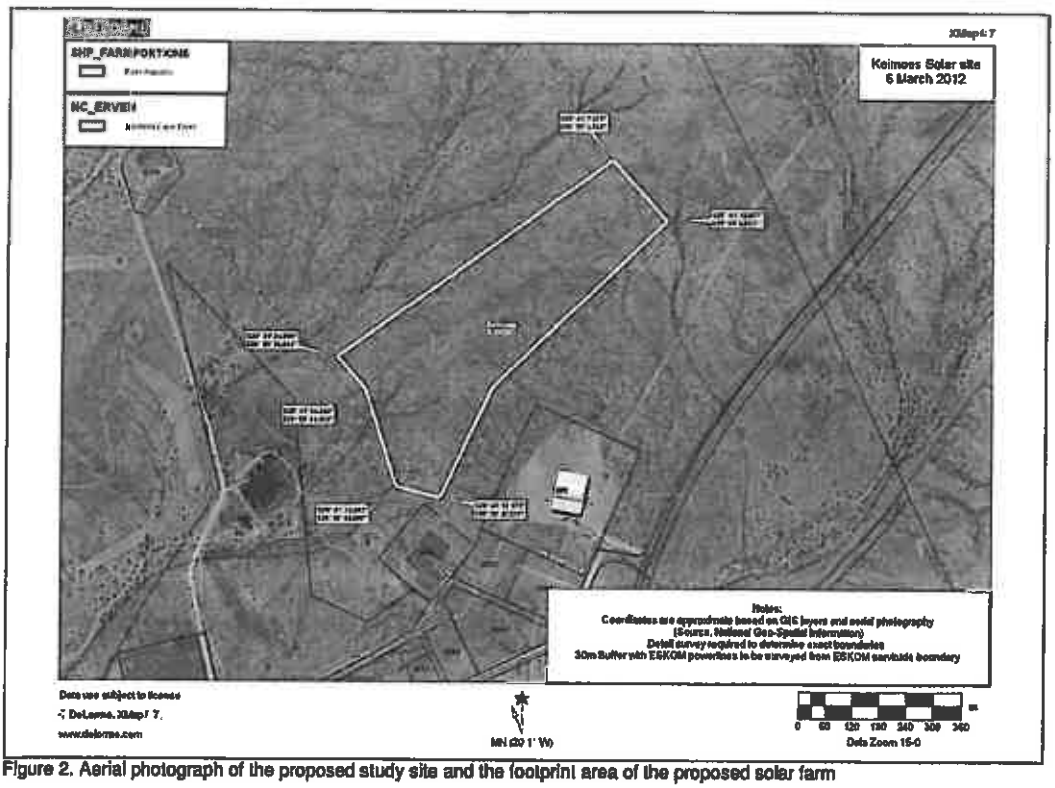

Figure 2. Aerial photograph of the proposed study site and the footprint area of the proposed solar farm

3. TERMS OF REFERENCE

The terms of reference for the study were to.

- Determine whether there are likely to be any important archaeological resources that may potentially be impacted by the proposed project, including the erection of the solar panels, internal access roads, trenches for underground cables, and any other associated infrastructure;
- Indicate any constraints that would need to be taken into account in considering the development proposal;
- Identify potentially sensitive archaeological areas, and
- Recommend any further mitigation action.

4. DESCRIPTION OF THE AFFECTED ENVIRONMENT

An aerial photograph indicating the location site of the proposed Keren Energy Keimoes Solar Farm is illustrated in Figure 3.

The proposed site (Erf 666) is located just north of the N14 and about 2 kms before entering the town of Keimoes on the right hand side of the road. Keimoes is located about 40 kms west of Upington. The proposed site, which is to the east of the Keimoes Golf Course, is fairly flat, but slopes gently toward the N14. The site is very rocky and stony with sparse vegetation covering the ± 20 ha footprint area (Figure 4). A few sporadic trees occur in places. Several drainage channels (non-perennial streams) intersect the site while there are several small hillocks located alongside an, Eskom powerline servitude. The vegetation alongside the drainage channels is quite dense. The Eskom Oasis sub-station is located directly west of the proposed solar energy farm. There is no other infrastructure on the proposed site. A large food packaging factory (Sun Foods) is located directly alongside the proposed site and the N14. Immediate surrounding land use is the Sun Food processing factory, the Keimoes Golf Course, Waste Water Treatment Works, the N14, and large tracts of vacant, communal grazing land.

There are no old buildings, structures or features or any old equipment on the proposed site.

There are no public memorials or monuments on the site.

There are no visible graves on the proposed site, or within the proposed footprint area of the proposed solar farm.

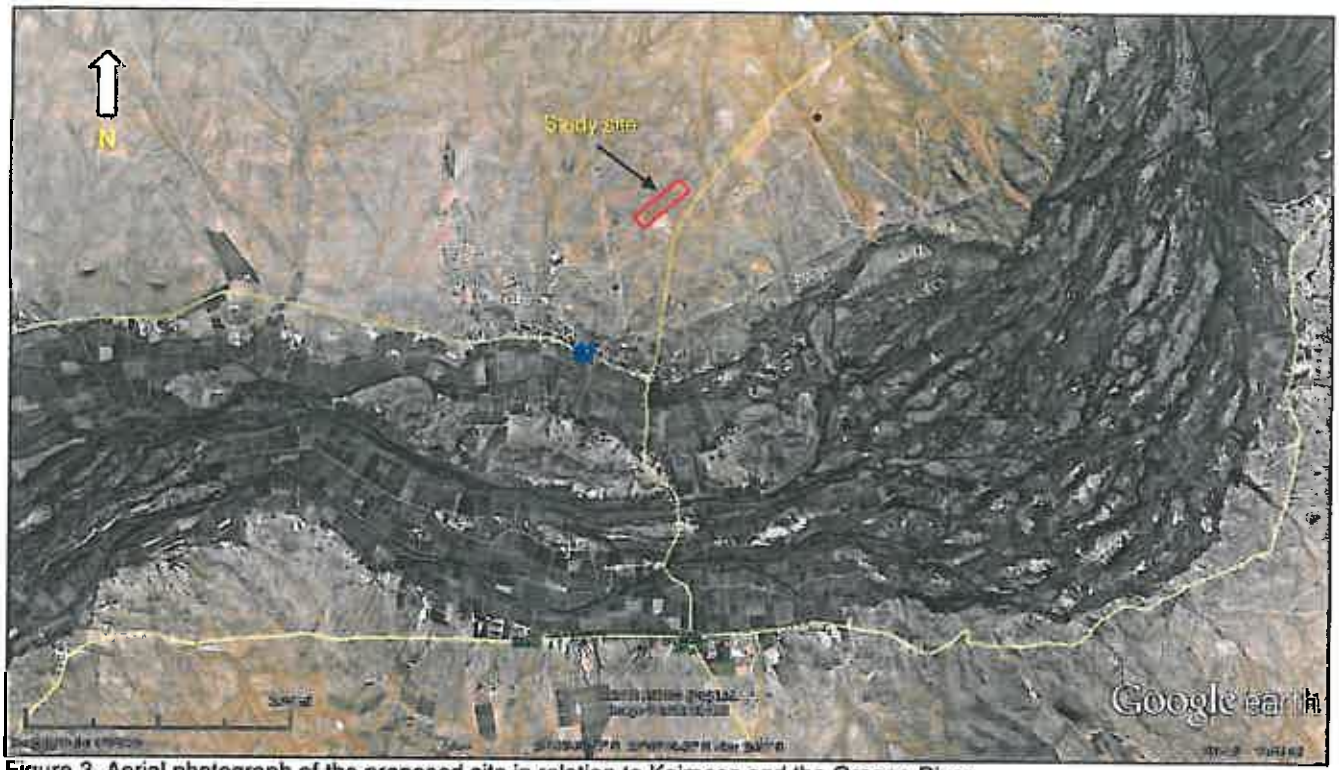

Figure 3. Aerial photograph of the proposed site in relation to Keimoes and the Orange River

Figure 4. View of the proposed site facing west. The Sun Foods factory can be seen in the left of the plate

5. STUDY APPROACH

5.1 Method of survey

A survey of the proposed footprint area was undertaken by J Kaplan on 02 March, 2012. This survey was undertaken on foot and most of the footprint area was covered in a series of transects. The ± 20 m wide, Eskom powerline servitude was not searched. A GPS track path of the survey was created (refer to Figure 13 in Appendix I). All archaeological occurrences documented during the study were mapped in-situ using a hand-held Garmin Oregon 300 GPS unit set on the map datum WGS 84. A collection of tools were also photographed, including the context in which some of the artefacts were found. A desk top study was also done and archaeologist David Morris of the McGregor Museum was consulted.

5.2 Constraints and limitations

There were no constraints or limitations associated with the study. Apart from the drainage channels which have some vegetation growing alongside its banks, there is very little natural vegetation covering the site, and only a few sporadic trees occurring in places. As a result, archaeological visibility was very good.

5.3 Identification of potential risks

Pre-colonial archaeological heritage (i. e. stone implements) will be impacted by the proposed development, but it is maintained that the study has captured a good record of the archaeological heritage present in the proposed footprint area. Apart from trenches for underground cabling, limited bedrock excavations are envisaged. The solar panels will be raised about 2 m above ground and mounted on small footings drilled and set into the ground. The excavations for the footings are about 1-1.5 m in diameter and so the actual ground disturbance will be quite limited and contained.

5.4 Results of the desk top study

The archaeology of the Northern Cape is rich and varied covering long spans of human history. According to Beaumont et al (1995:240) "thousands of square kilometres of Bushmanland are covered by a low density lithic scatter". No previous archaeological work has been done in Keimoes, but an AIA for a proposed solar farm in Kakamas, about 40 kms west of Keimoes documented small numbers of LSA lithics in banded ironstone (Kaplan 2012). Banded ironstone implements were also documented during a survey for a water pipeline between Kakamas and Kenhardt (Kaplan 2008) while Orton (2012) recently recorded very low density scatters of LSA and MSA tools in quartz, indurated shale and banded ironstone for a proposed solar farm near the Augrabies Falls National Park. A number of sites (including open scatters and shelters) are also described by Orton (2012) in the Augrabies area, but these are located many kilometres away from Keimoes. The archaeologist also consulted with David Morris of the McGregor Museum in Kimberly with regard to the presence of archaeological sites in Keimoes, but at the time of writing up this report, Mr Morris had not yet communicated to the archaeologist.

6. FINDINGS

More than 100 stone artefacts were mapped and counted with a hand held GPS unit.

A description of the archaeological finds located during the study is presented in Table A in Appendix I.

The majority of finds located during the study are assigned to the Later Stone Age (LSA), but at least 16 Middle Stone Age artefacts were also counted. Only two Early Stone Age implements were found, including a large biface (113) and one handaxe (060). More than 90% of the tools are in banded ironstone, with the remainder in indurated shale and quartzite. Only two 'silcrete' flakes, one limestone flake and one quartz core, were found. Banded ironstone is known to have been a favoured raw material for making stone artefacts and occurs on a number of sites that have been documented by the archaeologist and others throughout the Northern Cape. It occurs fairly widely over the site and was clearly a desirable raw material which was targeted by LSA people for its superior flaking qualities.

Most of the archaeological remains are spread very thinly and unevenly over the surrounding landscape, but one small, low density scatter of tools (105) was documented not far from the Eskom servitude. This included a mix of LSA and MSA tools including several chunks, a weathered broken limestone flake, several burnished retouched and utilised flakes, a burnished core, and an unworked quartzite cobble/manuport on a large patch of stony ground. However, no evidence of any factory or workshop site, or the result of any human settlement was identified. Spatially, a number of the occurrences tend to cluster around the south western portion of the proposed footprint area near the Eskom servitude but no organic remains such as bone, pottery, or ostrich eggshell were found.

Most of the lithics comprise flakes, flake blades and chunks of which many are utilised and/or retouched, testament to the superior flaking qualities and sharp cutting edges of the banded iron stone. A number of the tools are also abraded or weathered suggesting that they have lain on the surface for many years. At least 18 cores/ minimal cores/flaked chunks (or about 20 % of the stone artefact assemblage) were also counted, indicating a fairly high level of stone fabrication. Five of the cores are made on cobbles of indurated shale. The ratio of cores to flakes on the ground may indicate that many of the formal tools/artefacts were removed from the site by the toolmakers.

Frequencies of formal retouched tools are very low, but the numbers of miscellaneous retouched tools (almost 50%) is quite high. Of the formal retouched tools; one convex scraper, one side scraper, one possible end scraper, two step retouched flakes (possible adzes) were counted. No hammerstone were found and only one manuport was counted.

No colonial heritage resources were noted during the study.

A collection of tools documented during the study and the context in which some of them were found are illustrated in Figures 5-12.

Figure 5. Core and flakes. Scale is in cm

Figure 6. Core and pointed retouched flakes (MSA). Scale is in cm

Figure 7. Collection of stone tools. Scale is in cm

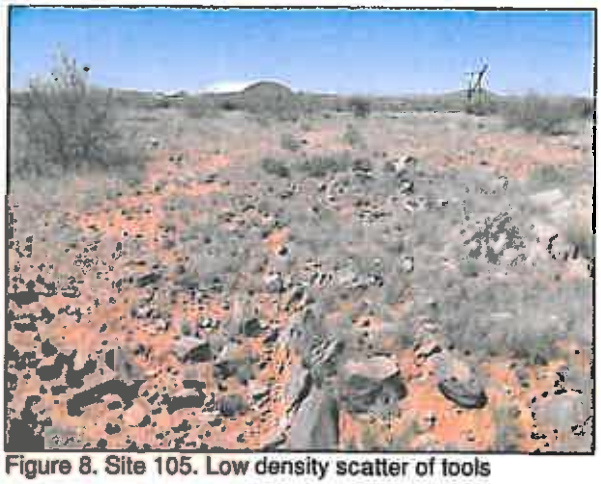

Figure 8. Site 105. Low density scatter of tools

Figure 9. Collection of tools. Scale is in cm

Figure 10. Collection of tools. Scale is in cm

Figure 11. ESA Handaxe (060) scale is in cm

Figure 12. ESA biface (060) scale is in cm

6.1 Significance of the archaeological remains

Most of the stone implements documented during the study comprise isolated occurrences that are spread thinly and unevenly over the surrounding landscape, although one low density scatter of tools (105) was recorded in the western portion of the proposed footprint area. However, no evidence of any factory or workshop site, or the result of any human settlement was identified.

As archaeological sites are concerned, the occurrences are lacking in context as no organic remains such as bone, pottery or ostrich eggshell was found. There is no spatial patterning to the distribution of finds, but it was noted that some of the lithics tended to cluster around the south western portion of the proposed site near the Eskom servitude (refer to Figure 13). Overall, however, the fairly small numbers and isolated context in which they were found means that the archaeological remains on Erf 666 have been rated as having low archaeological (Grade 3C) significance.

7. ASSESSMENT OF IMPACTS

In the case of the proposed Keren Energy Keimoes Solar Energy Farm it is expected that some archaeological impacts will occur during the construction phase of the proposed project, but that the overall impact on important archaeological resources will be low (Table 1).

Potential impacts on archaeological heritage	
Extent of impact:	Site specific
Duration of impact;	Permanent
Intensity	Low
Probability of occurrence:	Probable
Significance without mitigation	Low
Significance with mitigation	Negative
Confidence:	High

Table 1. Assessment of archaeological impacts.

8. CONCLUSION

Development of the proposed Keren Energy Keimoes solar energy facility will have a very limited impact on archaeological heritage resources.

It is maintained that the study has captured good information on the archaeological heritage present and has identified no significant impacts to pre-colonial archaeological material that will need to be mitigated prior to development activities commencing.

The project should be allowed to proceed with no further archaeological input required.

Indications are that in terms of archaeological heritage, the proposed activity is viable and no fatal flaws have been identified.

9. RECOMMENDATIONS

With regard to the proposed construction and operation of a 10 MW solar energy facility on Erf 666 near Keimoes in the Northern Cape, the following recommendations are made:

1. No further archaeological mitigation is required.

2. Should any unmarked human burials/remains or ostrich eggshell water flask caches be uncovered, or exposed during construction activities, these must immediately be reported to the archaeologist (Jonathan Kaplan 082 321 0172), or the South African Heritage Resources Agency (SAHRA) (Att Ms Mariagrazia Galimberti 021 462 4502). Burials must not be removed or disturbed until inspected by the archaeologist.

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Appendix I

Name of Site	Name of Farm	Lat/Long	Finds
	Erf 666 Keimoes		
042		S28 41.502 E20 59.038	Crude **quartzite** misc retouched flake **?MSA**
043		S28 41.495 E20 59.051	Thick pointed flake blade & small chunk – misc retouch
044		S28 41.489 E20 59.041	Cobble chunk; green chert flake (**MSA**), and misc retouched flake & chunk
045		S28 41.290 E20 59.143	Small nicked chunk and misc retouch
046		S28 41.289 E20 59.144	**Indurated shale** cobble **core**
047		S28 41.258 E20 59.168	Large weathered pointed **MSA** flake, with some retouch along dorsal edge
048		S28 41.192 E20 59.201	**Indurated shale** cobble **core**
049		S28 41.103 E20 59.139	Core reduced flake with utilization damage and misc retouch; chunk/pebble; small misc retouch chunk
050		S28 41.058 E20 59.106	Possible **side scraper** & chunk
051		S28 41.129 E20 59.131	Chunk/**core** on cobble; round quartz chunk/minimal **core**
052		S28 41.205 E20 59.176	Flake & flake with step flaking (? **Adze**)
053		S28 41.229 E20 59.193	Misc retouch flake
054		S28 41.288 E20 59.193	Large flake, side retouched
055		S28 41.312 E20 59.183	Round cobble **core**, with cortex
056		S28 41.412 E20 59.094	Large indurated shale cobble **core**
057		S28 41.426 E20 59.083	Large burnished flake (**?MSA**) retouched and utilized
058		S28 41.430 E20 59.079	Burnished chunk with 1-2 retouch
059		S28 41.471 E20 59.050	Burnished chunk/pebble
060		S28 41.438 E20 59.024	Large quartzite biface (**ESA**)
061		S28 41.415 E20 59.044	Chunk with misc retouch
062		S28 41.227 E20 59.174	Burnished chunk
063		S28 41.223 E20 59.175	Burnished pebble chunk; small **pointed retouched flake**
064		S28 41.227 E20 59.145	Double sided retouched flake
065		S28 41.229 E20 59.143	Chunk with 1-2 retouch
066		S28 41.239 E20 59.136	Retouched chunk
067		S28 41.243 E20 59.131	Broken retouched flake & a retouched (high edge) possible **end scraper**
068		S28 41.246 E20 59.128	Burnished chunk
069		S28 41.262 E20 59.112	**Indurated shale** cobble – manuport
070		S28 41.345 E20 59.023	Miscellaneous retouched flake
071		S28 41.347 E20 59.020	Miscellaneous retouched flake
072		S28 41.375 E20 58.997	Round **core** and 2 flakes
073		S28 41.380 E20 58.995	Cortex chunk/**core**
074		S28 41.242 E20 59.108	Burnished broken flake in servitude
075		S28 41.207 E20 59.119	Flake
076		S28 41.346 E20 58.943	**Indurated shale** flake (weathered) **?MSA**
077		S28 41.407 E20 58.882	Burnished retouched flake **?MSA**
078		S28 41.450 E20 58.864	Burnished flake
079		S28 41.465 E20 58.856	Chunk; end retouched & utilised flake & burnished retouched flake
080		S28 41.483 E20 58.848	Chunk
081		S28 41.510 E20 58.832	Misc utilized chunk; misc retouched flake
082		S28 41.514 E20 58.831	Misc retouched flake
083		S28 41.519 E20 58.826	**Core** and flake

084		S28 41.531 E20 58.815	Misc. retouched flake; cobble flake (cortex)
085		S28 41.492 E20 58.808	**Indurated shale core**/chunk (cortex)
086		S28 41.466 E20 58.819	Single flake with step flake retouch & **end scraper** retouch
087		S28 41.457 E20 58.821	Burnished flake with retouch on ventral surface
088		S28 41.424 E20 58.838	Quartzite **MSA** flake
089		S28 41.421 E20 58.842	Large retouched flake (broken); **core**/chunk
090		S28 41.336 E20 58.903	Retouched chunky flake
091		S28 41.236 E20 59.032	Broken **quartzite** flake
092		S28 41.220 E20 59.053	Chunk/**core** and broken retouched **MSA** flake
093		S28 41.147 E20 59.138	Round **core**
094		S28 41.149 E20 59.128	Misc retouched chunky **MSA** flake
095		S28 41.188 E20 59.062	Red banded agate lump/chunk
096		S28 41.214 E20 59.018	Burnished chunky, retouched **MSA** flake; burnished chunk with misc retouch; burnished chunk with utilization damage and misc retouch
097		S28 41.230 E20 58.995	Chunk
098		S28 41.311 E20 58.916	Large burnished **Indurated shale core ?MSA**
099		S28 41.338 E20 58.900	Double sided retouched chunky flake **?MSA**
100		S28 41.354 E20 58.886	Chunk
101		S28 41.387 E20 58.860	Small chunk with misc retouch
102		S28 41.398 E20 58.851	Pebble core; **pointed** triangular shaped flake with retouch on 1 end; flake with retouch on ventral surface
103		S28 41.430 E20 58.827	Chunk with misc retouch
104		S28 41.439 E20 58.820	Chunk; large wide burnished blade; large round burnished **indurated shale** chunk/min **core** – large flake scars **?MSA**
105		S28 41.446 E20 58.809	**Low density scatter** – x 4 chunks, 1 weathered broken **limestone** flake, burnished retouched flake, burnished **core, MSA** retouched flake, **quartzite** cobble manuport, on large patch stony ground
106		S28 41.479 E20 58.791	Chunk and misc retouched flake
107		S28 41.487 E20 58.777	Chunk and retouched cortex flake with some end retouch and utilized damage on ventral surface
108		S28 41.487 E20 58.777	Chunky burnished indurated shale flake blade **?MSA**
109		S28 41.434 E20 58.783	Multiple retouched flake
110		S28 41.433 E20 58.788	Chunky side retouched flake
111		S28 41.427 E20 58.792	Round **quartzite** cobble core/chunk
112		S28 41.428 E20 58.767	Broken chunk/cobble cortex with scraper retouch
113		S28 41.439 E20 58.756	**ESA quartzite biface**
114		S28 41.505 E20 58.698	Large green silcrete side struck flake **?MSA**
115		S28 41.437 E20 58.753	Cortex flake misc retouch and utilized
116		S28 41.421 E20 58.758	Weathered/burnished chunk
117		S28 41.398 E20 58.788	Flat **quartzite** utilised flake; several flakes and chunk
118		S28 41.358 E20 58.811	Snapped **quartzite MSA** flake
119		S28 41.176 E20 58.968	? **adze** and 1 min retouched convex shaped

			flake ?scraper blank
120		S28 41.167 E20 58.970	Cortex cobble chunk/min **core**
121		S28 41.138 E20 59.000	Burnished chunk
122		S28 41.105 E20 59.034	**MSA** utilised flake blade broken tip
123		S28 41.068 E20 59.089	Chunk
124		S28 41.091 E20 59.104	Small chunky **side scraper**
125		S28 41.097 E20 59.120	Burnished flake
126		S28 41.089 E20 59.059	Burnished flake
127		S28 41.138 E20 58.988	Green silcrete flake
128		S28 41.150 E20 58.974	Small snapped retouched flake
129		S28 41.346 E20 58.772	Large chunk
130		S28 41.333 E20 58.789	X 2 step retouch chunks
131		S28 41.322 E20 58.804	Flake
132		S28 41.201 E20 58.973	Utilised and retouched flake blade
133		S28 41.201 E20 58.975	**MSA** quartzite flake
134		S28 41.086 E20 59.069	Flake
135		S28 41.130 E20 59.143	Double sided retouched flake & chunk
136		S28 41.197 E20 59.152	Large flat **core** in road
137		S28 41.262 E20 59.216	Weathered **MSA indurated shale** flake
138		S28 41.315 E20 59.219	Snapped retouched and double sided utilised **pointed flake**
139		S28 41.320 E20 59.217	Chunk
140		S28 41.442 E20 59.101	Utilised cobble cortex flake
141		S28 41.462 E20 59.088	Small chunky weathered utilised flake

Table A. Spreadsheet of waypoints and description of archaeological finds. Unless otherwise stated, all implements are in locally available banded iron stone which is prolific over the study area and surrounding farms

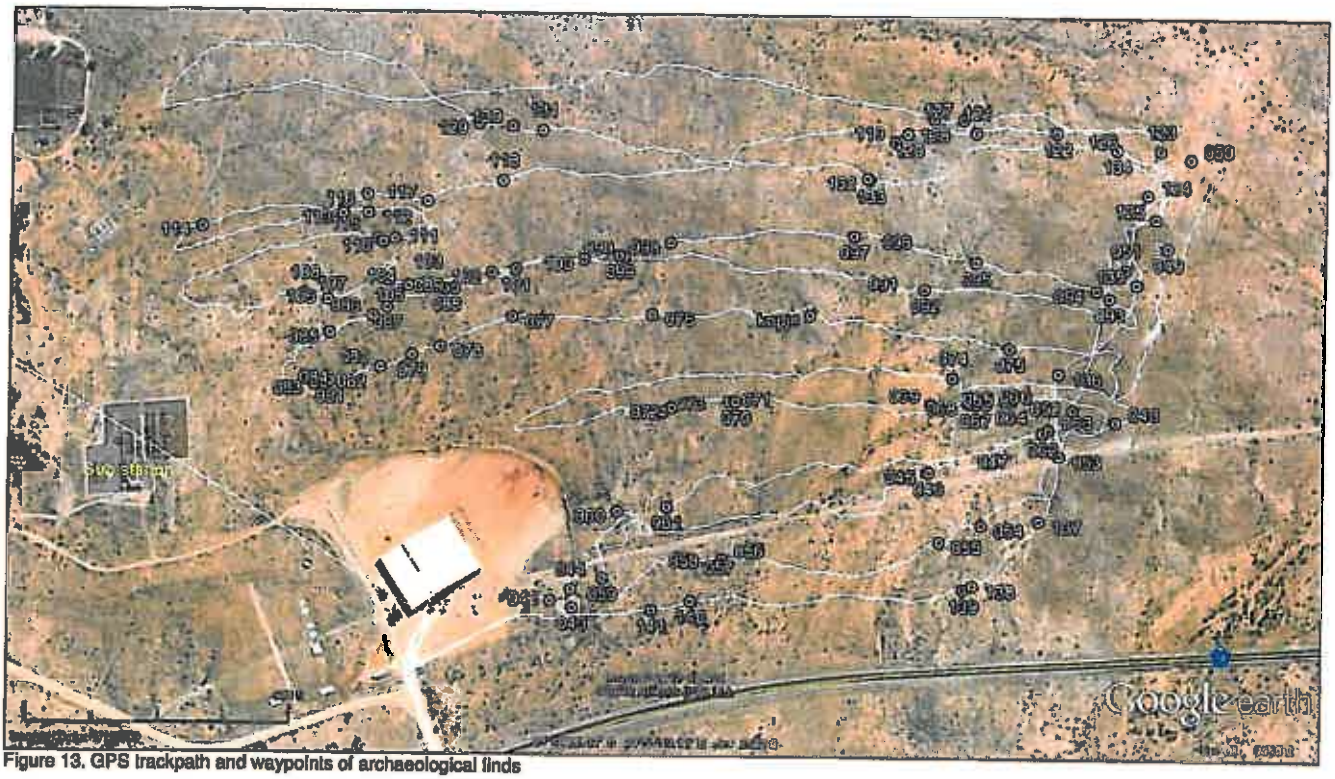

Figure 13. GPS trackpath and waypoints of archaeological finds

Appendix D3b Palaeontological

RECOMMENDED EXEMPTION FROM FURTHER PALAEONTOLOGICAL STUDIES & MITIGATION:

PROPOSED KEREN ENERGY KEIMOES SOLAR PLANT ON ERF 666 KEIMOES, KAI GARIB MUNICIPALITY, NORTHERN CAPE

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March 2012

1. OUTLINE OF DEVELOPMENT

Keren Energy Keimoes (Pty) Ltd is proposing to construct a 10 MW Concentrating Photovoltaic (CPV) Energy Generation Facility on Erf 666 near Keimoes, Kai Garib Municipality, in the Northern Cape (Fig. 2). Erf 666 is currently zoned for agriculture and is owned by the local authority.

The proposed activity entails the construction of about 140 CPV solar panels with a footprint of about 20 ha. The CPV panels will be mounted on pedestals drilled and set into the ground. Extensive bedrock excavations are not envisaged, but some vegetation will need to be cleared from the site. Associated infrastructure includes single track internal access roads, trenches for underground cables, transformer pads, a switching station, a maintenance shed, and a temporary construction camp. The electricity generated from the project will be fed directly into the national grid at the Eskom Oasis substation which is situated alongside the subject property.

The present palaeontological heritage comment has been commissioned by EnviroAfrica cc, Somerset West as part of a comprehensive Heritage Impact Assessment of the proposed development (Contact details: Mr Bernard de Witt, EnviroAfrica cc, P. O. Box 5367, Helderberg, 7135; 29 St James St, Somerset West; mobile: +27 82 4489991; tel: +27 21 851 1616; fax: 086203308).

2. GEOLOGICAL BACKGROUND

The proposed solar plant study area is situated on flat-lying, arid, rocky terrain at 760-780m amsl on the north-eastern outskirts of the town of Keimoes, some 2 km north of the Orange River (Fig. 2). The N14 trunk road runs 400m to the southeast.

The geology of the study area near Keimoes is shown on the 1: 250 000 geology map 2820 Upington (Council for Geoscience, Pretoria; Fig. 1 herein). A comprehensive sheet explanation for this map has been published by Moen (2007).

According to the 1: 250 000 geology map the study area of the proposed Keimoes solar plant is largely underlain by a range of ancient Precambrian basement rocks – largely high grade metamorphic rocks (*e.g.* charnockites, metaquartzites) and intrusive granitoids – that belong to the **Namaqua-Natal Province** of Mid Proterozoic (Mokolian) age (Cornell *et al.* 2006, Moen 2007). These basement rocks are approximately two to one billion years old and entirely unfossiliferous (Almond & Pether 2008).

The Precambrian basement rock within the study area are mantled with a spectrum of other coarse to fine-grained **superficial deposits** such as rocky soils, downwasted gravels, colluvium (slope deposits), sheet wash, calcrete hardpans and alluvium of the numerous intermittently flowing streams. These deposits are generally young (Quaternary to Recent) and largely unfossiliferous. Some sectors of the study area may be covered by fine-grained aeolian (wind-blown) sands of the **Gordonia Formation (Qg)**, the youngest, Pleistocene to Recent, subunit of the **Kalahari Group** (Haddon 2000).

The study site is over 2 km away from the present course of the Orange River and elevated perhaps 30 to 50m or more higher that this above mean sea level. According to Moen (2007) ancient river terrace gravels occur "all along the river" within 2km of the present banks and at elevations of up to 45 m (rarely as high as 85m) above the present flood plain. However, it is considered unlikely that significant deposits of Late Tertiary **Orange River alluvial gravels** are present within this area, and none are mapped here on the 1: 250 000 Upington geology sheet.

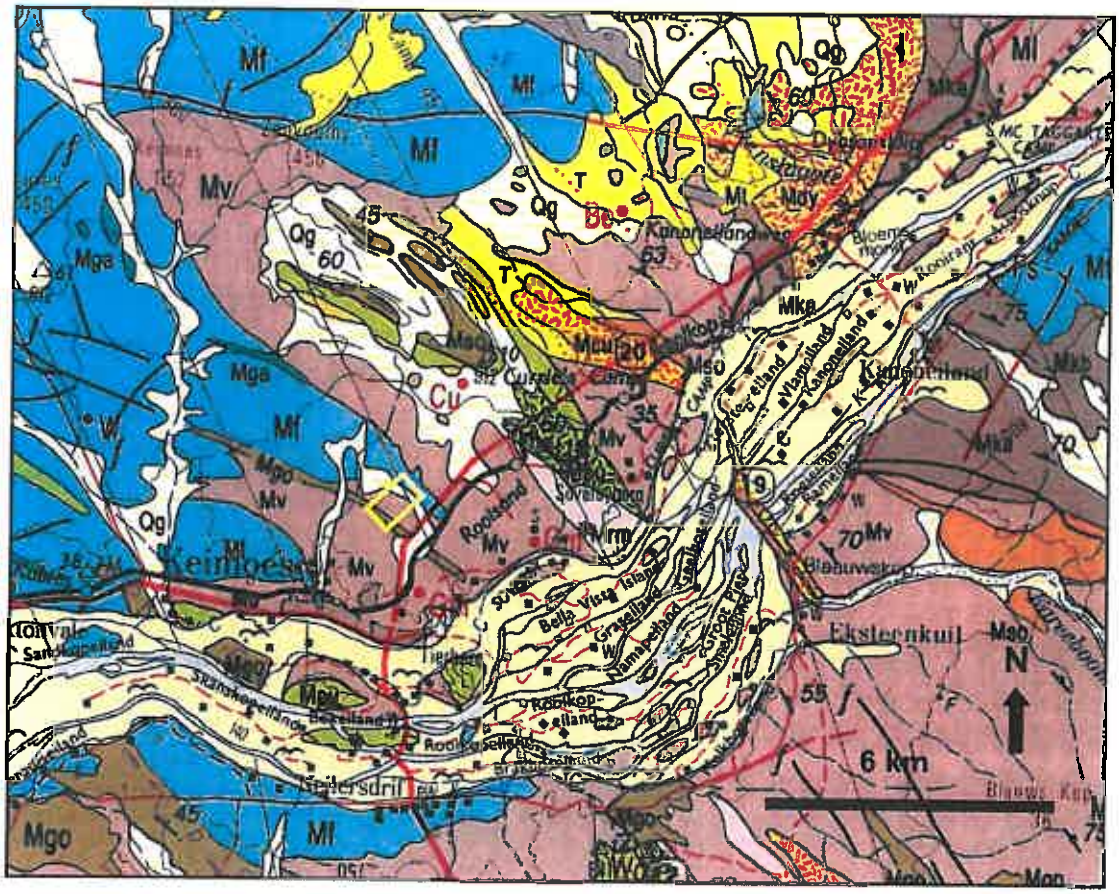

Fig. 1. Extract from 1: 250 000 geological map 2820 Upington (Council for Geoscience, Pretoria) showing approximate location of proposed Keimoes Solar Plant study area on the north-eastern outskirts of Keimoes, Northern Cape Province (small yellow rectangle). Major rock units mapped within the study area include:

Qg (white with yellow stripes) = red aeolian (wind-blown) sand of the Gordonia Formation (Kalahari Group)

The remaining area is underlain by a range of unfossiliferous Precambrian (Middle Proterozoic / Mokolian) basement rocks of the Namaqua-Natal Metamorphic Province, including various highly metamorphosed sediments and intrusive igneous rocks (*e.g.* Mv Vaalputs Granite, Mgo Goedehoop Formation metaquartzites, Mf Friersdale Charnockite).

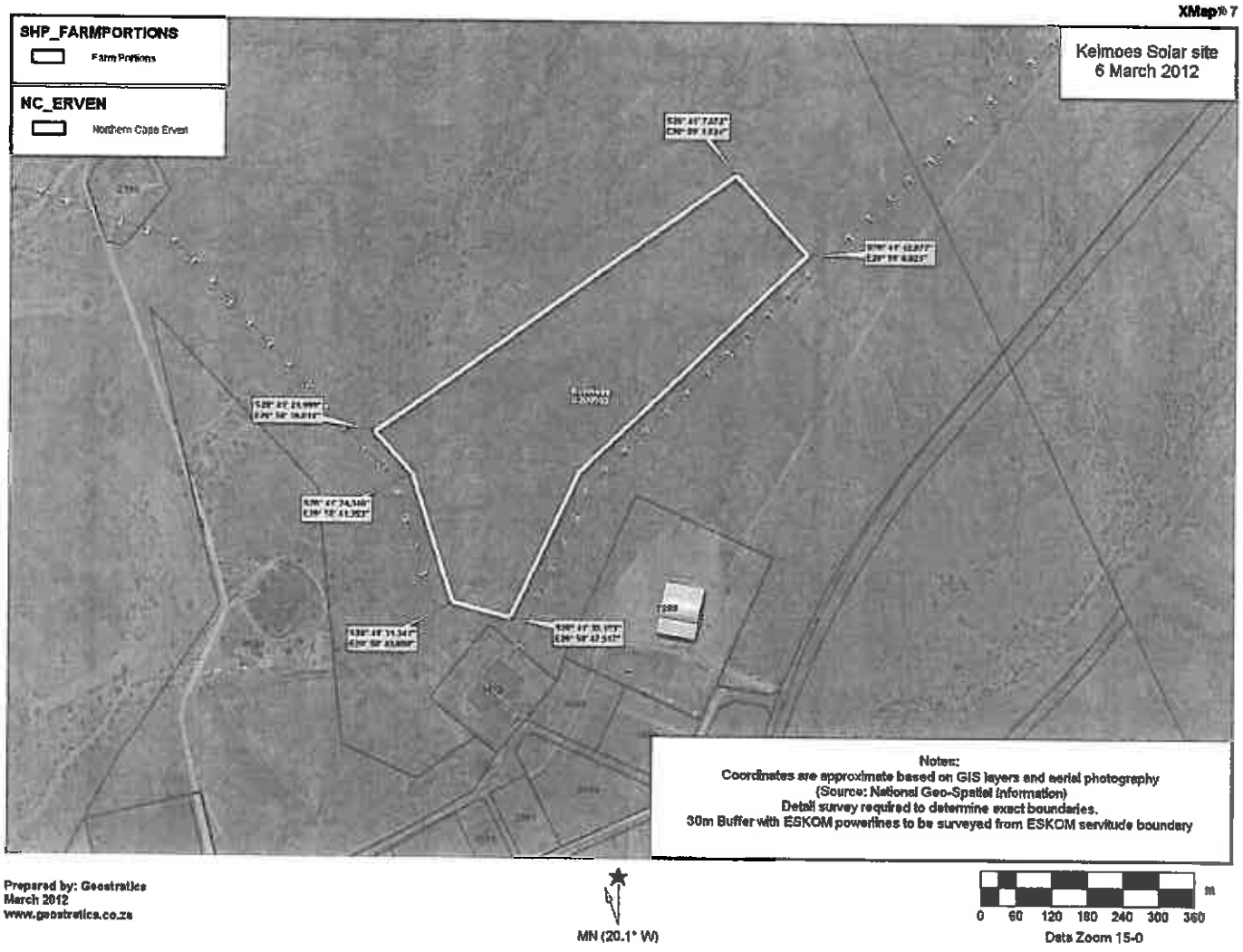

Fig. 2. Satellite image showing the study area for the Keren Keimoes solar farm on Erf 666 on the north-eastern outskirts of Keimoes, Northern Cape (Image prepared by Geostratics 2012). The N14 trunk road runs across the right hand side of the image.

3. PALAEONTOLOGICAL HERITAGE

The Precambrian metamorphic and igneous basement rocks in the study area are entirely unfossiliferous.

The fossil record of the **Kalahari Group** is generally sparse and low in diversity (Almond & Pether 2008). The **Gordonia Formation** dune sands were mainly active during cold, drier intervals of the Pleistocene Epoch that were inimical to most forms of life, apart from hardy, desert-adapted species. Porous dune sands are not generally conducive to fossil preservation. However, mummification of soft tissues may play a role here and migrating lime-rich groundwaters derived from the underlying rocks may lead to the rapid calcretisation of organic structures such as burrows and root casts. Occasional terrestrial fossil remains that might be expected within this unit include calcretized rhizoliths (root casts) and termitaria (*e.g. Hodotermes*, the harvester termite), ostrich egg shells (*Struthio*) and shells of land snails (*e.g. Trigonephrus*) (Almond 2008, Almond & Pether 2008). Other fossil groups such as freshwater bivalves and gastropods (*e.g. Corbula, Unio*) and snails, ostracods (seed shrimps), charophytes (stonewort algae), diatoms (microscopic algae within siliceous shells) and stromatolites (laminated microbial limestones) are associated with local watercourses and pans. Microfossils such as diatoms may be blown by wind into nearby dune sands (Du Toit 1954, Dingle *et al.*, 1983). These Kalahari fossils (or subfossils) can be expected to occur sporadically but widely, and the overall palaeontological sensitivity of the Gordonia Formation is therefore considered to be low.

Late Caenozoic calcretes may also contain trace fossils such as rhizoliths, termite and other insect burrows, or even mammalian trackways. Mammalian bones, teeth and horn cores (also tortoise remains, and fish, amphibian or even crocodiles in wetter depositional settings) may be expected occasionally expected within Kalahari Group sediments and calcretes, notably those associated with ancient alluvial gravels and pans (*cf* Almond 2008). However, these fossil assemblages are generally sparse, low in diversity, and occur over a wide geographic area, so the palaeontological sensitivity of the calcretes within the study area is rated as low. This applies equally to the thin veneer of other surface deposits (rocky scree, stream alluvium *etc*) within this highly arid region.

Alluvial gravels of the Orange River of Miocene and younger age are locally highly fossiliferous (*e.g.* Hendy 1984, Schneider & Marias 2004, Almond 2009 and extensive references therein) but, as argued above, these are not mapped within the study area.

The palaeontological sensitivity of the Keimoes solar plant study area is assessed as LOW.

4. CONCLUSIONS & RECOMMENDATIONS

The overall impact significance of the proposed Keimoes solar plant development is considered to be LOW because:

- Most of the study area is underlain by unfossiliferous igneous and metamorphic basement rocks (granites, gneisses *etc*) or mantled by superficial sediments of low palaeontological sensitivity;
- Extensive, deep excavations are unlikely to be involved in this sort of solar park project.

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

Should any substantial fossil remains (*e.g.* vertebrate bones and teeth) be encountered during excavation, however, these should be reported to SAHRA for possible mitigation by a professional palaeontologist.

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6. QUALIFICATIONS & EXPERIENCE OF THE AUTHOR

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

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

Declaration of Independence

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

John E. Almond

Dr John E. Almond
Palaeontologist
***Natura Viva* cc**

Appendix D3c Visual

VISUAL ASSESSMENT

Draft Report Version 1

Prepared by:
S.C. Lategan

For consideration in the Basic Assessment for Keimoes solar facility

March2012

CONTENT

Tables:

Figures:

1 TERMS OF REFERENCE

The applicant intends the development of a solar farm on a portion of Erf 666, commonage in Keimoes. The site gain access off the N14.

The objective of the Visual Impact assessment is to determine the significance of any visual impact. This assessment will indicate whether from a visual perspective the development constitute and acceptable level of change and if so what potential mitigation measures can reduce any visual impact as to limit

To determine the potential extent of the VIA required the following broad criteria are considered.

Areas with protection status, e.g. nature reserves	None
Areas with proclaimed heritage sites or scenic routes	None.
Areas with intact wilderness qualities, or pristine ecosystems	None.
Areas with intact or outstanding rural or townscape qualities	None
Areas with a recognized special character or sense of place	None
Areas with sites of cultural or religious significance	None
Areas of important tourism or recreation value	The site is in a region where such elements exists and are important in the Green Kalahari tourist route
Areas with important vistas or scenic corridors	To assess.
Areas with visually prominent ridgelines or skylines.	None

Table 1: Requirements for visual assessment

High intensity type projects including large-scale infrastructure	yes
A change in land use from the prevailing use	Yes, from vacant to utility/infrastructure
A use that is in conflict with an adopted plan or vision for the area	No
A significant change to the fabric and character of the area	Potentially
A significant change to the townscape or streetscape	Potentially
Possible visual intrusion in the landscape	Potentially
Obstruction of views of others in the area	Potentially

Table 2: Nature of intended development

From the above it is clear that the receiving environment holds certain visual elements which may be impacted upon by development of the site.

It is thus clear that the potential exist that development of the site may have a visual impact. In order to assist authorities thus to make an informed decision, the input of a specialist is required to assist in the project design and assess the visual impact of the preferred project proposal.

The term visual and aesthetic is defined to cover the broad range of visual, scenic, cultural, and spiritual aspects of the landscape. The terms of reference for the specialist is to:

- Provide the visual context of the site with regard to the broader landscape context and site specific characteristics.
- Provide input in compiling layout alternatives.
- To describe the affected environment and set the visual baseline for assessment
- Identify the legal, policy and planning context
- Identifying visual receptors
- Predicting and assessing impacts
- Recommending management and monitoring actions

2 Methodology and principles

2.1 Methodology

Table 4: Summary of methodology

Task undertaken	Purpose	Resources used
A screening of the site and environment	To obtain an understanding of the site and area characteristics and potential visual elements	Photographs Site visits
Identify visual receptors	To assess visual impact from specific view points	Photographs, profiles
Contextualize the site within the visual resources	To present an easy to understand context of the site within the visual resource baseline	Specialist: S Lategan Graphic presentation Superimposed photo's Model in case of high significance
Propose possible mitigation measures	To present practical guidelines to reduce any potential negative impacts.	Specialist: S. Lategan

Throughout the evaluation the following fundamental criteria applied:

- An awareness that "visual' implies the full range of visual, aesthetic, cultural and spiritual aspects of the environment that contribute to the area's sense of place.
- Consideration of both the natural and cultural (urban) landscape, and their inter-connectivity.
- The identification of all scenic resources, protected areas and sites of special interest, as well as their relative importance in the region.
- Understanding of the landscape processes, including geological, vegetation and settlements patterns which give the landscape its particular character or scenic attributes.
- The inclusion of both quantitative criteria, such as visibility and qualitative criteria, such as aesthetic value or sense of place.
- The incorporation of visual input as an integral part of the project planning and design process, so that the findings and recommended mitigation measures can inform the final design and quality of the project.
- To test the value of visual/aesthetic resources through public involvement.

2.1.1 Principles

The following principles to apply throughout the project:

- The need to maintain the integrity of the landscape within a changing land use process
- To preserve the special character or 'sense of place' of the area
- To minimize visual intrusion or obstruction of views
- To recognize the regional or local idiom of the landscape.

2.1.2 Fatal flaw statement

A potential fatal flaw is defined as an impact that could have a "no-go" implication for the project. A "no-go" situation could arise if the proposed project were to lead to (Oberholzer, 2005):

1. Non-compliance with Acts, Ordinance, By-laws and adopted policies relating to visual pollution, scenic routes, special areas or proclaimed heritage sites.
2. Non-compliance with conditions of existing Records of Decision.
3. Impacts that may be evaluated to be of high significance and that are considered by the majority of stakeholders and decision-makers to be unacceptable.

The screening of the site and initial project intentions did not reveal any of the above issues which may result in a fatal flaw.

2.2 Legal Framework, Guidelines and policies

2.2.1 National Environmental Management Act, 107, 1998 and relevant Guidelines:

An assessment in terms of any activity that required an EIA or Basic Assessment may be subjected to a specialist visual assessment in order to determine the significance of the potential impacts to result from a proposed activity.

The National Dept has subsequently determined that all applications for solar farms are subject to a visual impact assessment.

2.2.2 Northern Cape PSDF

The NCPSDF identified various use zones.
The PSDF provides guidance to ensure that

- development is of a quality that promotes environmental integrity.
- based upon the principles of 'critical regionalism" which promotes a return to the development of high-quality settlements.
- remised upon "The Big Five" principles that guide the planning, design and management of development namely sense of place, sense of history, sense of nature, sense of craft and sense of limits.

2.2.3 Green Kalahari tourism

The Green Kalahari tourist plan is an initiative to promote tourism in the region. Of importance to this specific application is the identification of the N14 as an important route and thus proposals that the entrances to town along the route be improved. The R359 has also been identified as an alternative tourist route. The protection of cultural and heritage resources as well as the active involvement and empowerment of local communities through tourism is a core theme through the tourism plan.

3 DEVELOPMENT PROPOSAL

3.1 General Description

Construction of Solar energy production facility ("Solar Farm") with a 10Megawatt capacity, consisting of 140 tracking CPV units, on approximately 20ha. Each unit have approximately 30m tracker clearance zone. Units are typically positioned in rows with access roads between every second row. Unit spacing typically varies between 43x37 and 33x30m.

Figure 2: Typical CPV Unit

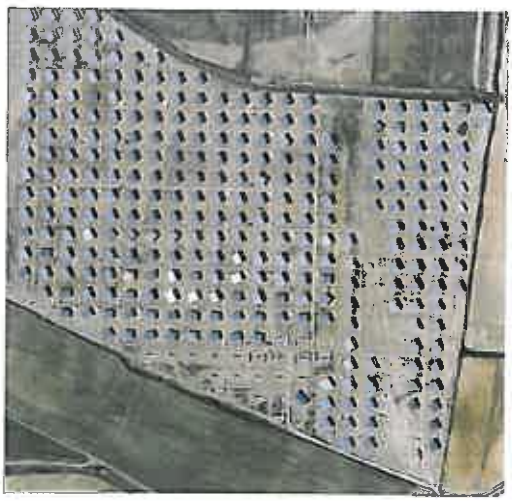


Figure 1: Typical Solar Farm layout

The Solar Farm include supportive infrastructure which consists of 2 -4 concrete transformer pads approximately 20x15m respectively, a fence construction staging area, maintenance shed and a switch panel for connection to the grid and transmission line from the transformers to the closest ESKOM substation.

3.2 Project Elements
3.2.1 Extent and layout

The Solar farm will occupy approximately 20ha. The nature of the tracking CPV units are such that the property has to be leveled to less than 1:5 gradient in order to prevent the units to touch the ground when turning on the pedestal. CPV units are positioned in a grid with the active panel side facing north. The units will rotate from east (morning) to west (afternoon). Back of units facing south. Units are position in rows of two with an access roads in between.

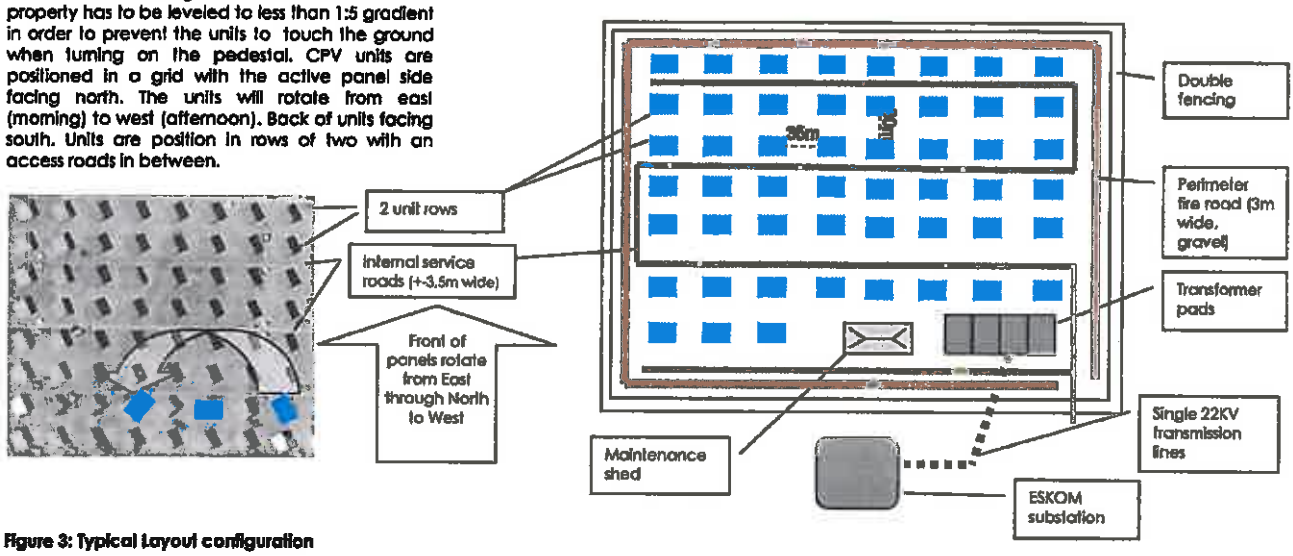


Figure 3: Typical Layout configuration

3.2.2 Tracking CPV Units

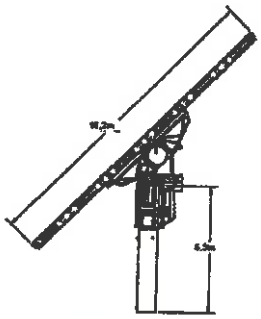
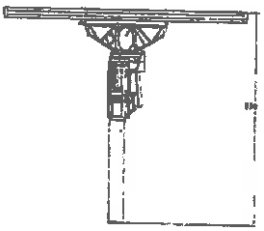


Figure 5: Typical Operational position



In stow: >28 mph. > 10 sec. Out of stow : <26 mph. >300 sec.

Figure 4: Storm Stow position

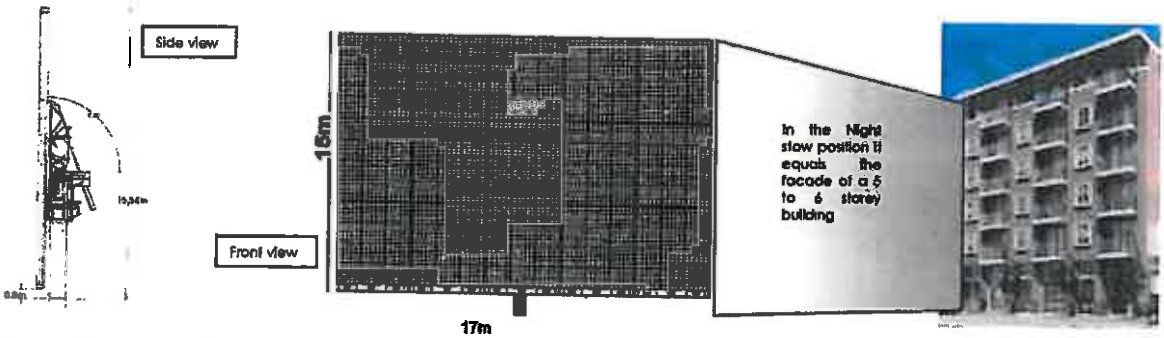


Figure 6: Night stow position

3.2.3 Project perimeter

Double fencing with inner fence consisting of galvanized palisade fence and outer an electrified fence of 2,4m in height.

Figure 7: Typical electrical fence

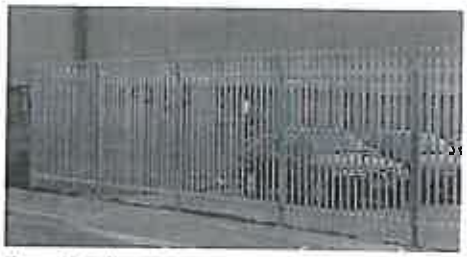


Figure 8: Typical galvanized palisade fence

3.2.4 Supportive infrastructure

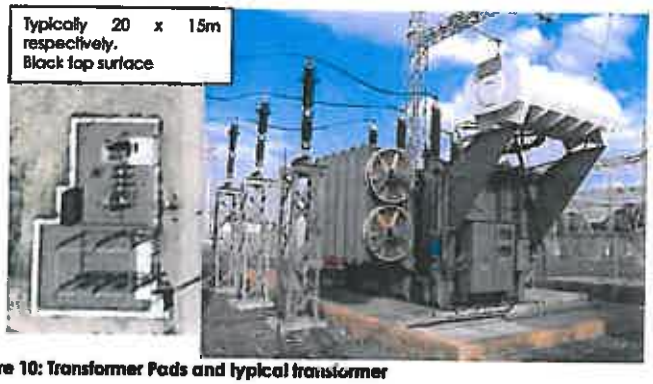


Figure 10: Transformer Pads and typical transformer

3.2.5 Operational elements

A pressure washer on a water truck with a de-ionizing nozzle is sufficient for most washes

Figure 12: High Pressure spray truck

An occasional (~1/year) deep clean scrub may be necessary to clean the lenses

Once a year, cleaning teams will access the site and physically clean the panels. This is done either by rope access or the use of "cherry pickers"

Figure 11: Annual physical cleaning

3.3 Construction elements

Groundwork: Level site, Pedestal foundation

High lift equipment / cranes

Transport trucks for delivery of units

Figure 13: Construction Elements

4 RECEIVING VISUAL ENVIRONMENT

4.1 Description

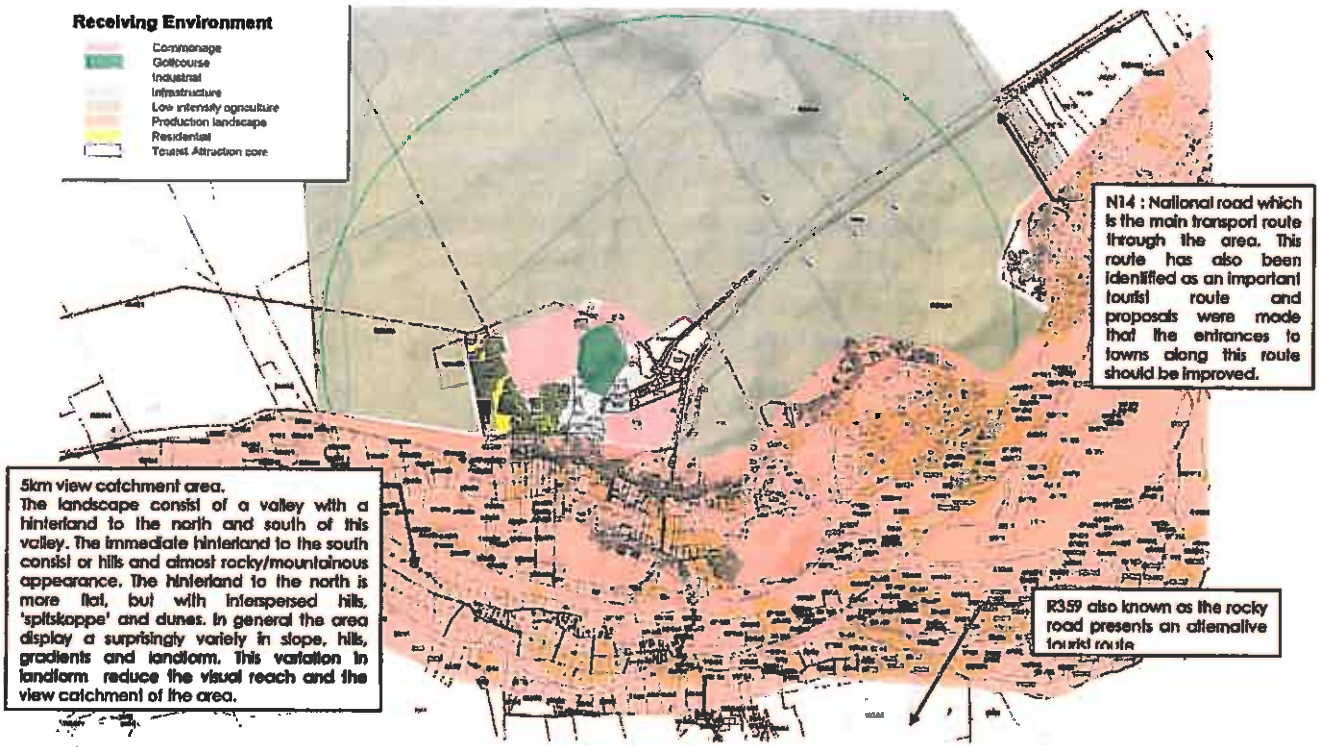


Figure 14: Catchment area

Prepared by: SC Lategan
March 2012

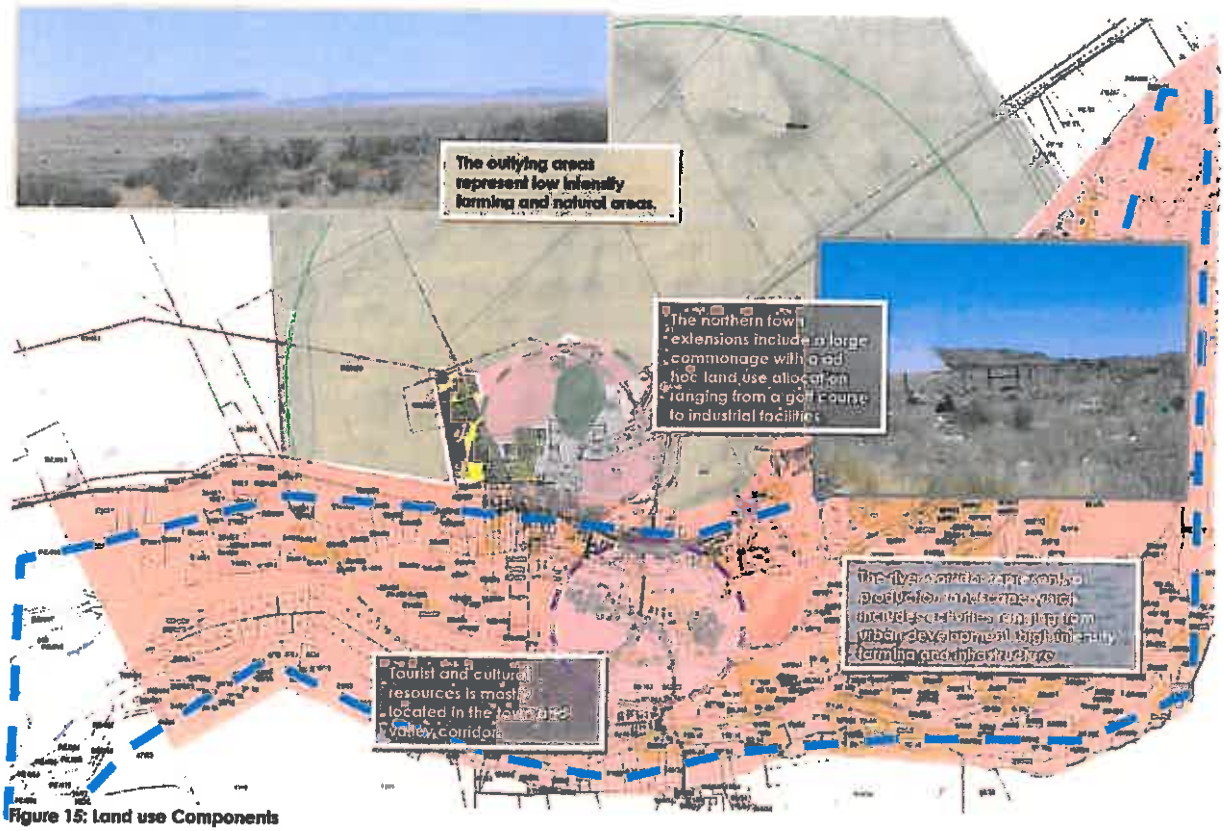


Figure 15: Land use Components

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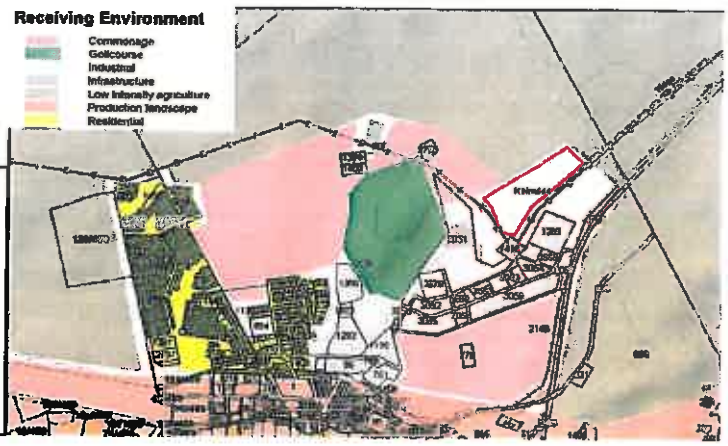
March 2012

Figure 16: Land use continuum



The site is situated in the northern extension of the town on commonage. It is surrounded by infrastructure which include High voltage power lines, electrical substation, sewage works, landfill, railway line and gravel streets.
Other use in the area include industrial buildings, small holding type of residential-industrial mix and large vacant land. The golf course is situated almost in the centre of this large area. Residential neighbourhoods are located west of this area.
The area thus do not a have a well defined character and reflects a lack a sense of place.

Figure 17: Immediate Environment

4.2 Findings

The proposed site is situated within the urban edge zone of Keimoes in an area characterized buy little urban coherence nor rural, agricultural or wilderness sentiments. The larger area reflects the characteristics of a production to urban landscape and the site is situated within the land use continuum.
The valley area with its higher range of elements have a high visual absorption rate. The valley wall zones are not steep and therefore urban and infrastructure has developed on the areas. Due to their gradient they too reflect a high rate of visual absorption. Moving out of the valley area above the valley walls into the deep hinterland, the absorption rate reduces where the landscape is flat, but in areas with more gradient variation the absorption rate is still medium.

Statement 1: The nature and extent of the proposed development is such that it would not change the nature of land use of the area it is situated in.
Statement 2: Due to the medium to high absorption capacity of the landscape, the development will easily be absorbed into the existing visual structure.

5 VISUAL RECEPTORS

Label	Latitude	Longitude	Comment
Blucuso tourist accommodation	-28.65	20.98	Hillock in front of facility screen direct view.
N14 direction Keimoes	-28.68	21	Site visible from most western dune all the way until it is screened by the warehouse.
Golfcourse	-28.69	20.97	Partially visible
Red Sun Dried fruit warehouse	-28.69	20.98	Direct view. Industrial facility.
Industrial properties	-28.7	20.98	Partially screened by substation. Industrial facilities
Orangeriver Wine cellar	-28.7	20.97	Partially screened by substation, old sewage works and landscape features (gradient).
N14 direction Upington	-28.7	20.96	Substation and warehouse largely screen site. Visible for a brief moment as you cross the bridge leaving town.
N14 direction Upington, bridge	-28.7	20.96	Topography and infrastructure provide only glimpses of site.
R359 highest point	-28.74	20.93	Potential brief glimpse of site in distance

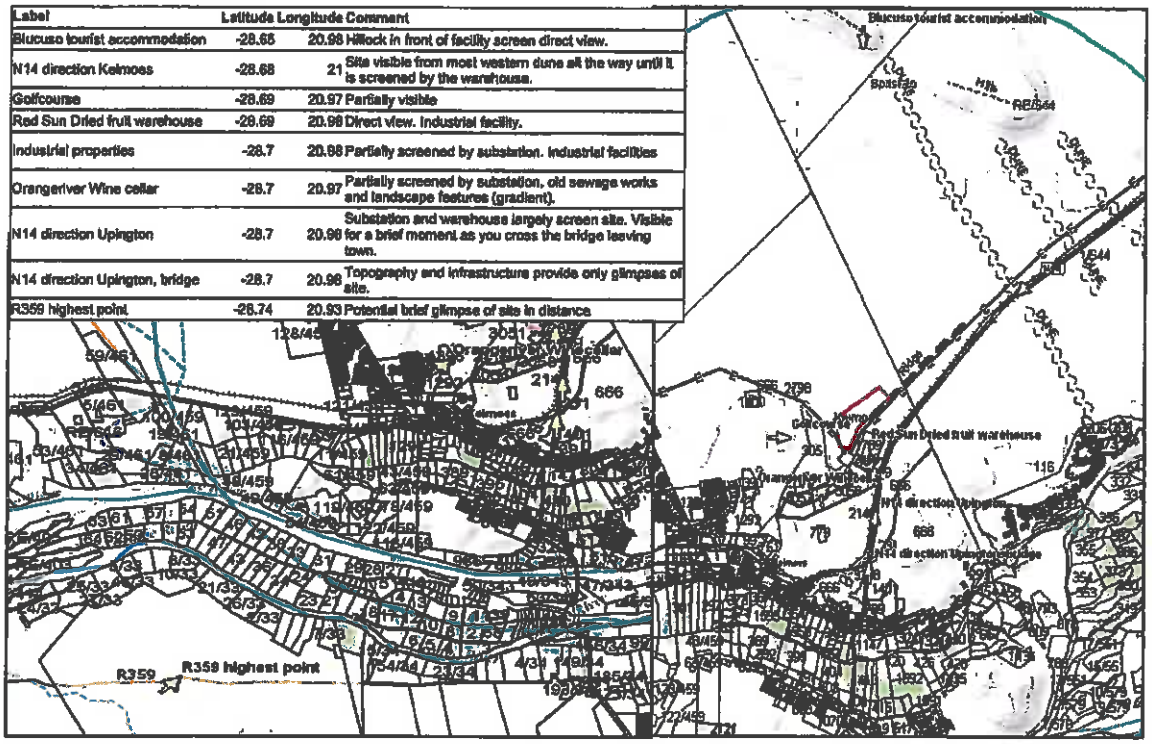


Figure 18: Identified visual receptors

Prepared by: SC Lategan
March 2012

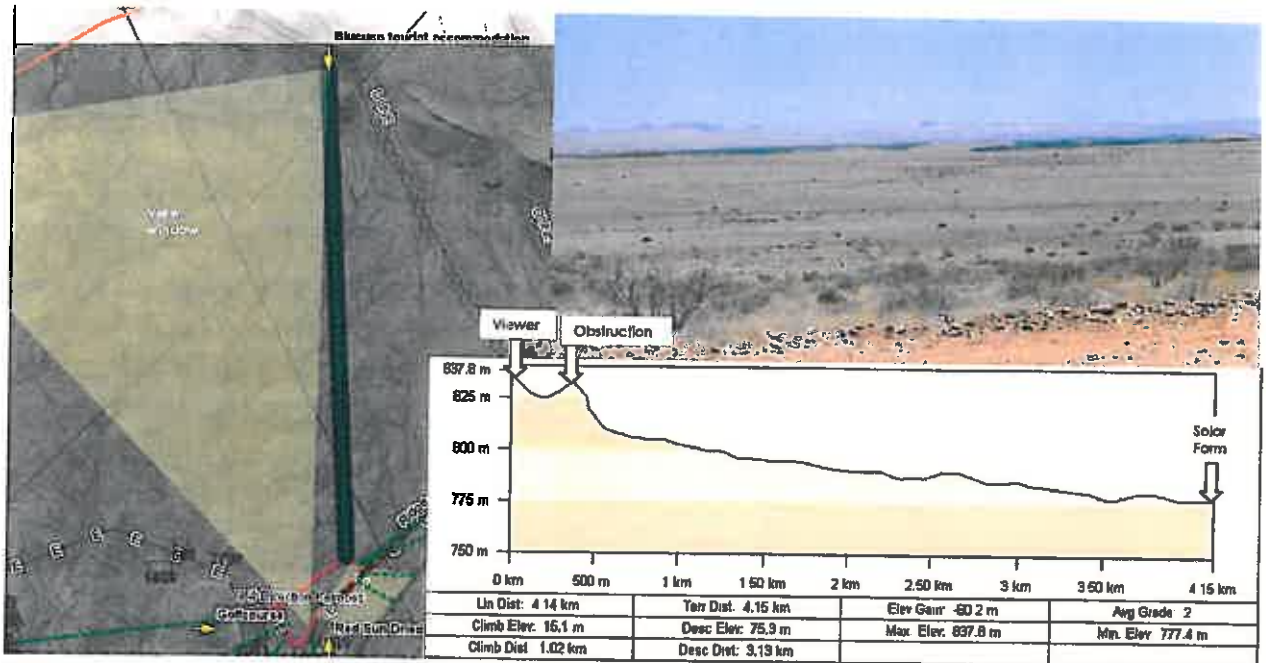


Figure 19: Visual Receptor - Blucuso tourist facility

Criteria	High	Moderate	Low
Exposure	dominant, clearly visible	recognizable to the viewer	not particularly noticeable to the viewer
Sensitivity		sporting, recreational, places of work	industrial, mining, degraded areas
Intrusion/Obstructive	noticeable change, discordant with surroundings	Partially fits but clearly visible	minimal change or blends with surroundings

Table 3 : Visual Impact - Blucuso

Prepared by: SC Lategan
March 2012

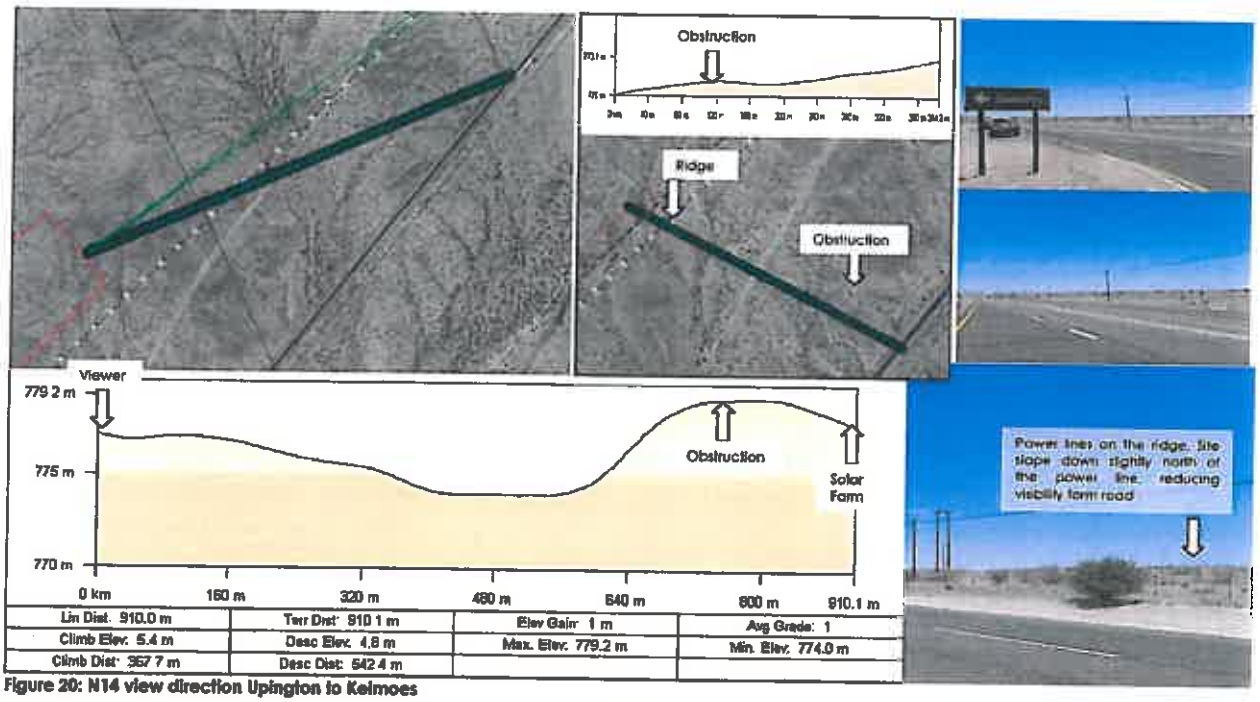


Figure 20: N14 view direction Upington to Keimoes

Criteria	High	Moderate	Low
Exposure	dominant, clearly visible	recognizable to the viewer	not particularly noticeable to the viewer
Sensitivity		sporting, recreational, places of work	industrial, mining, degraded areas
Intrusion/Obstructive	noticeable change, discordant with surroundings	Partially fits but clearly visible	minimal change or blends with surroundings

Table 4: N14 Upington to Keimoes view assessed

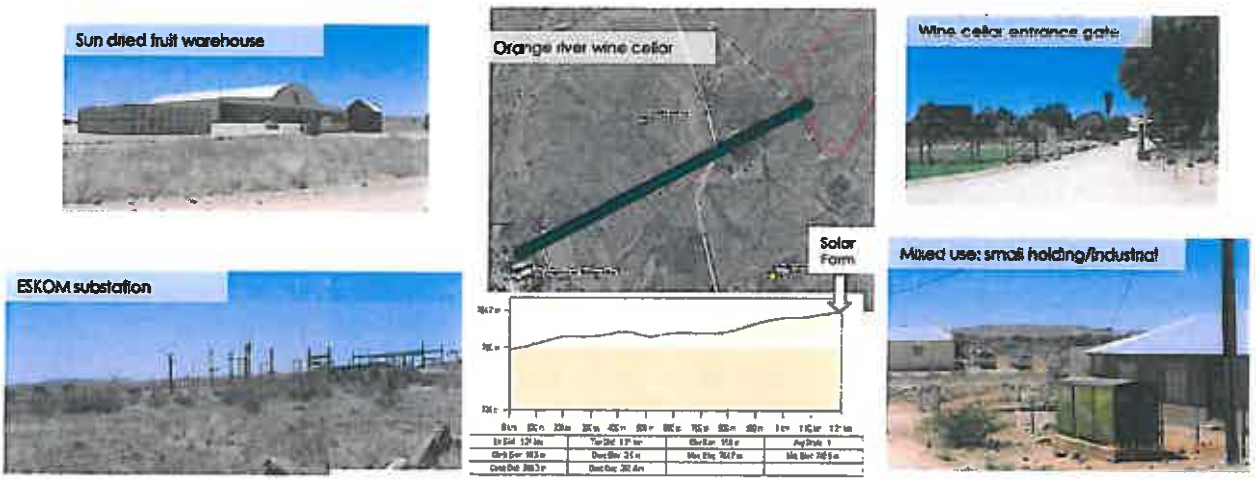


Figure 21: Commonage precinct as receptor

Criteria	High	Moderate	Low
Exposure		recognizable to the viewer	not particularly noticeable to the viewer
Sensitivity	residential, nature reserves, scenic routes	sporting, recreational places of work	industrial, mining, degraded areas
Intrusion/Obstructive	noticeable change, discordant with surroundings	Partially fits but clearly visible	minimal change or blends with surroundings

Table 5: Commonage as receptor

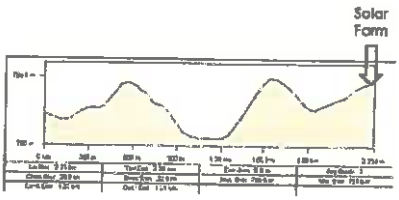


Figure 22: Residential area to the west

Residential area to the west: Various landscape and topographical features screen the residential area from the site. This area is thus not a visual receptor although within the view catchment. No significant impact identified.

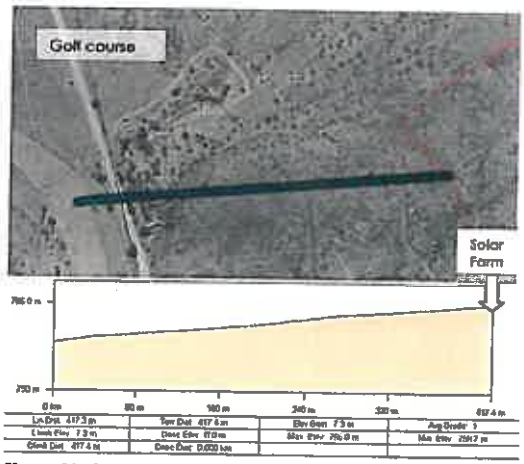
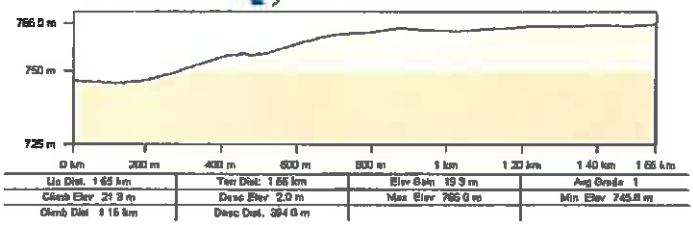


Figure 23: Golf course as visual receptor

Criteria	High	Moderate	Low
Exposure	dominant, clearly visible	recognizable to the viewer	not particularly noticeable to the viewer
Sensitivity	residential, nature reserves, scenic routes	sporting recreational places of work	industrial, mining, degraded areas
Intrusion/Obstructive	noticeable change, discordant with surroundings	Partially fits but clearly visible	minimal change or blends with surroundings

Table 6: Golf course as receptor

View from most of the golf course is obscured by landscape elements and the topography. The site is significantly higher than the golf course and therefore any development on the site is above the view level of viewers. Glimpses from different areas on the golf course is possible, but these would be brief.



Travelling on the N14 out of Keimoes, direction Upington, the bridge lift the road for a brief moment above the landscape. From this point the site would be visible for a brief moment before the road slopes down again and the site disappear behind landscape elements and the traveller pass the site.

Figure 24: N14 direction Upington

Criteria	High	Moderate	Low
Exposure	dominant, clearly visible	recognizable to the viewer	not particularly noticeable to the viewer
Sensitivity		sporting, recreational, places of work	industrial, mining, degraded areas
Intrusion/Obstructive	noticeable change, discordant with surroundings	Partially fits but clearly visible	minimal change or blends with surroundings

Table 7: N14 direction Upington as receptor

The R359 between Keimoes and Kakamas to the south of the river, has been identified as an alternative tourist route and is known as the "rockery" road. The road is more than 7km from the site. The profile indicates that the road at its highest point is lower than the site and thus the traveller on the R359 would see the valley wall on the other side of the valley but the site is above the viewers line of site .

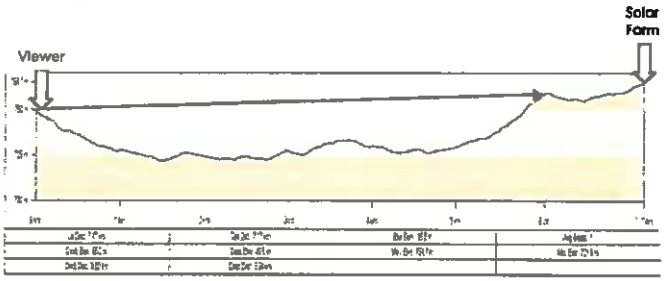


Figure 25: R359 as visual receptor

Criteria	High	Moderate	Low
Exposure	dominant, clearly visible	recognizable to the viewer	not particularly noticeable to the viewer
Sensitivity		sporting, recreational, places of work	industrial, mining, degraded areas
Intrusion/Obstructive	noticeable change, discordant with surroundings	Partially fits but clearly visible	minimal change or blends with surroundings

Table 8: R359 as receptor

Label	Latitude	Longitude	Comment	Exposure	Sensitivity of receptor	Intrusion	Finding
Blucuso tourist accommodation	-28.65	20.98	Hillock in front of facility screen direct view.	The receptor is more than 4kmfrom the site. Due to the size of the solar farm, the distance diminish the impact to a large extent. Rate: Moderate	Tourist facilities are sensitive to landscape changes as they rely on the surrounding recourses to "sell" an experience. Rate: High	The position of the tourist facility is such that view is partially blocked by hillock. The distance to the development also reduce impact. The Solar Farm would thus not result in a significant change in the view landscape Rate: Low	No significant impact.
N14 direction Keimoes	-28.68	21	Site visible from most western dune all the way until it is screened by the warehouse.	The site becomes visible after the road crosses the most western dune. The road is however lower than the site and thus partially disappear below the low ridge and then get screened by the warehouse. Rate: Moderate	The N14 has been identified as an important tourist route especially entrances to towns Rate: High	Due to the other infrastructure such as electrical power lines and the substation the site fits into the current land use of the immediate environment. Rate: Low	No significant impact.
Golf course	-28.69	20.97	Partially visible	Only glimpses to the site visible Rate: Moderate	Recreational facility Rate: Moderate	Grouped with the electrical substation, behind the powerline, the solar farm will fit with the existing land use Rate: Low	No significant impact
Red Sun Dried fruit warehouse	-28.69	20.98	Direct view. Industrial facility.	The site is visible from various places on the property. Directly behind the dried fruit warehouse it is dominant. The Orange river wine cellar on the other hand is sheltered through gradient variations Rate: High to moderate	Industrial related land use not sensitive to addition of utility use. Rate: Moderate	grouped with the electrical substation and industrial uses it fits with its immediate environment Rate: Low	No significant impact
Industrial properties	-28.7	20.98	Partially screened by substation. Industrial facilities				
Orangeriver Wine cellar	-28.7	20.97	Partially screened by substation, old sewage works and landscape features (gradient).				
N14 direction Upington	-28.7	20.98	Substation and warehouse largely screen site. Visible for a brief moment as you cross the bridge leaving town.	The site is briefly visible from the bridge, but is then screened by landscape element Rate: Moderate	The N14 has been identified as an important tourist route especially entrances to towns Rate: High	Due to the other infrastructure such as electrical power lines and the substation the site fits into the current land use of the immediate environment. Rate: Low	No significant impact
N14 direction Upington, bridge	-28.7	20.98	Topography and infrastructure provide only glimpses of site.				
R359 highest point	-28.74	20.93	Potential brief glimpse of site in distance	The road is more than 7km from the site. The road at its highest point is lower than the site, thus the traveller on the R359 would see the valley wall on the other side of the valley but the site is above the viewers line of Rate: Low	The R359 between Keimoes and Kakamas to the south of the river, has been identified as an alternative tourist route and is known as the "rockery" road Rate: High	Rate: Low	No significant impact

Table 9: Summary of Visual Receptor assessment

6 CONSTRUCTION

During construction, various large earth moving equipment and equipment will be transported to the site and work on the site. This will impact on the general experience of viewers. This impact is however temporary and not uncommon during construction of infrastructure. Communities have fairly high tolerance levels for such activities if it contribute to the infrastructure of the area.
Rating: Low

7 FINDINGS

The site is situated in an area of little coherence and ad hoc position of a range of industrial and utility land uses. The site has a high absorption capacity due to the presence of existing land use and topographical variation.

The sensitive receptors namely the N14 and R359 is situated such that the exposure to the site and the intrusion is low.

The proposal does not present an unacceptable level of change to the visual environment and therefore the development can be recommended.

8 MITIGATION MEASURES

The level of visual impact is of such level that no mitigation to the proposed development elements are recommended. The impact can however be used as a resource by providing a tourist interpretation centre/facility to raise awareness amongst local residents and visitors to the site. Such facility can also serve as a practical demonstration of the region's commitment to sustainable development and responsible tourism.