

ENVIRONMENTAL IMPACT ASSESSMENT PROCESS  
FINAL EIA REPORT

PROPOSED UPINGTON SOLAR THERMAL  
PLANT AND ASSOCIATED  
INFRASTRUCTURE  
NORTHERN CAPE

(DEA REF No: 12/12/20/1831)

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Prepared for:

!Khi CSP South Africa  
Lords Office Estates  
276 West Avenue  
Centurion

**!KHI CSP SOUTH AFRICA**

Prepared by:

*Savannah Environmental Pty Ltd*

UNIT 606, 1410 EGLIN OFFICE PARK  
14 EGLIN ROAD, SUNNINGHILL, GAUTENG  
PO BOX 148, SUNNINGHILL, 2157  
TEL: +27 (0)11 234 6621  
FAX: +27 (0)86 684 0547  
E-MAIL: [INFO@SAVANNAHSA.COM](mailto:INFO@SAVANNAHSA.COM)  
[WWW.SAVANNAHSA.COM](http://WWW.SAVANNAHSA.COM)



## PROJECT DETAILS

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<b>DEA Reference No.</b>	:	12/12/20/1831
<b>Title</b>	:	Environmental Impact Assessment Process Final Environmental Impact Assessment Report: Proposed Upington Solar Thermal Plant and associated infrastructure on a Site near Upington, Northern Cape
<b>Authors</b>	:	Savannah Environmental (Pty) Ltd Tammy Kruger Karen Jodas
<b>Sub-consultants</b>	:	Tony Barbour Environmental Consulting & Research Outeniqua Geotechnical Services Scherman, Colloty & Associates Agricultural Research Council David Hoare Consulting cc Sustainable Futures ZA Birdlife South Africa McGregor Museum MetroGIS MENCO
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## EXECUTIVE SUMMARY

Khi CSP South Africa (Pty) Ltd (!Khe CSP), an Independent Power Producer, proposes to establish a commercial solar energy facility and associated infrastructure to generate electrical power from solar radiation, a renewable form of energy, on a site near Upington. This proposed development is referred to as the **Upington Solar Thermal Plant**. The site that has been identified for the establishment of the facility is located approximately 20 km south-west of Upington in the Northern Cape and falls within the Kai !Gariep Local Municipality.

The proposed facility, which will be primarily contained within this identified farm portion, will have a developmental footprint of approximately 6 km<sup>2</sup>. The solar energy facility will have an overall maximum generating capacity of 110 MW and will be comprised of a combination of the following technologies (in any combination):

- » 50 MW trough plant (CSP system consisting of several rows of parabolic troughs)
- » 50 MW power tower plant (CSP system consisting of a field of heliostats/ mirrors positioned around a central receiver/power tower)
- » 10 MW PV plant (system consisting of several rows of photovoltaic (PV) panels)

The Renewable Energy Feed-in Tariff Process (criteria not yet finalised by the National Energy Regulator of South Africa), selection process (not finalised

by the Department of Energy, together with National Treasury) and the economics of the solar facility will be key in determining the final technology combination and the schedule of implementation for the facility.

The following associated infrastructural requirements will also be established within the developmental footprint of the proposed facility:

- » A **power island** which will include a steam turbine and generator; a generator transformer and substation; and an auxiliary steam boiler
- » An **overhead power line** feeding into the Eskom electricity network via a 'turn in and turn out' configuration to the existing Eskom Gordonia / Oasis 132 kV distribution line running approximately 4 km south of the site
- » An **abstraction point** on the Orange River; and associated water **supply pipeline; suspension reservoir; water storage reservoir**; and lined **evaporation ponds**
- » External and internal **access roads**
- » **Workshop, office and storage areas**

The nature and extent of this facility, as well as potential environmental impacts associated with the construction and operation of a facility of this nature are explored in more detail in this Environmental Impact Assessment (EIA) Report which consists of the following chapters:

**Chapter 1** provides background to the proposed facility and the environmental impact assessment process.

**Chapter 2** provides an overview of the proposed project.

**Chapter 3** provides an overview of the Regulatory and Legal Context for electricity generation projects

**Chapter 4** outlines the process which was followed during the EIA Phase, including the consultation program that was undertaken and input received from interested parties and stakeholders.

**Chapter 5** describes the existing biophysical and socio-economic environment.

**Chapter 6** presents the assessment of environmental impacts associated with the facility, its associated infrastructure.

**Chapter 7** presents the assessment of environmental impacts associated with the project alternatives.

**Chapter 8** presents the conclusions of the EIA process, as well as an impact statement on the proposed project

**Chapter 9** provides a list of references and information sources used in undertaking the studies for this EIA Report.

The Scoping Phase of the EIA process identified potential issues associated with the proposed project, and defined the extent of the studies required within the EIA Phase. The Scoping Phase also identified potentially sensitive areas within the study site which served to inform the placement of the facility through a funnel-down approach.

The EIA Phase addressed those identified potential environmental impacts and benefits (direct, indirect,

and cumulative impacts) associated with all phases of the project including design, construction, and operation. The EIA Phase recommends appropriate mitigation measures for potentially significant environmental impacts.

This Final EIA Report aims to provide sufficient information regarding the potential impacts and the acceptability of these impacts in order for the Competent Authority (i.e. the National Department of Environmental Affairs (DEA)) to make an informed decision regarding the proposed project.

The release of a Draft EIA Report provided stakeholders with an opportunity to verify that the issues they have raised through the EIA process had been captured and adequately considered. This Final EIA Report incorporates all issues and responses raised during the public review of the Draft EIA Report prior to submission to the DEA.

The conclusions and recommendations of this EIA Report are the result of the assessment of identified impacts by specialists, and the parallel process of public participation. The public consultation process has been extensive and every effort has been made to include representatives of all stakeholders in the study area.

The most significant environmental impacts associated with the proposed project, as identified through the EIA, include local site specific impacts, impacts on drainage lines; and visual



impacts. The findings of the specialist studies undertaken within this EIA to assess both the benefits and potential negative impacts anticipated resulting from the proposed project conclude that:

- » There are **no environmental fatal flaws** that should prevent the proposed solar energy facility and associated infrastructure from proceeding on the identified site, provided that the recommended mitigation and management measures are implemented, and given due consideration during the process of finalising the facility layout.
- » The most significant threat to **avifauna** communities would be from collisions with the overhead power line. The loss of habitat, disturbance, or any interaction with the facility is not anticipated to have a significant negative impact on bird communities in the area.
- » Very sparse **heritage resources** were found during the field survey undertaken for the site. From an archaeological perspective the observed heritage resources may be regarded as being of generally low significance. The **fossil record** from Kalahari deposits is very poor with respect to finds of fossil bones of vertebrates.
- » The cumulative significance of all the potential impacts on the **geological** environment is considered low due to the limited scale of the development and the scarcity of development in the immediate surrounding area. Furthermore, the

presence of calcrete and other minor occurrences of basement rock will have a significant reducing effect on the erosion potential on the south-eastern portion of the site.

- » The anticipated **visual** impact is not, considered to be a fatal flaw from a visual perspective, considering the low incidence of visual receptors in the region and the contained area of potential visual exposure.
- » The development will have both positive and negative **social** impacts. It will create employment and business opportunities for locals during both the construction and operational phases and represent an investment in clean, renewable energy infrastructure. The potential for cumulative impacts also exists due to the proximity of the proposed Eskom CSP to the east of the site, however, these impacts are not considered to represent a fatal flaw, and in addition, there is no indication if (or when) this development will take place.

The significance levels of the majority of identified negative impacts can generally be reduced by implementing the recommended mitigation measures. With reference to the information available at this planning approval stage in the project cycle, the **confidence** in the environmental assessment undertaken is regarded as **acceptable**.

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## ABBREVIATIONS AND ACRONYMS

BID	Background Information Document
CaBEERE	Capacity Building in Energy Efficiency and Renewable Energy
CO <sub>2</sub>	Carbon dioxide
CSP	Concentrating Solar Power
CPV	Concentrating Photovoltaic Power
DENC	Department of Environment & Nature Conservation
DEA	National Department of Environmental Affairs
DoE	Department of Energy
DM	District Municipality
DWA	Department of Water Affairs
EAP	Environmental Assessment Practitioner
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
EPC	Engineering, Procurement and Construction
FIT	Feed-in Tariffs
GDP	Gross Domestic Profit
GDPR	Gross Domestic Profit of the Region
GIS	Geographical Information Systems
GG	Government Gazette
GN	Government Notice
GHG	Green House Gases
GWh	Giga Watt Hour
I&AP	Interested and Affected Party
IDP	Integrated Development Plan
IPP	Independent Power Producer
km <sup>2</sup>	Square kilometres
km/hr	Kilometres per hour
kV	Kilovolt
LM	Local Municipality
LPG	Liquid Petroleum Gas
LUPO	Rezoning and Subdivision in terms of Land Use Planning Ordinance, Ordinance 15 of 1985
MA	Million years before present
MAR	Mean Annual Rainfall
m <sup>2</sup>	Square meters
m/s	Meters per second
MW	Mega Watt
NEMA	National Environmental Management Act (Act No. 107 of 1998)
NERSA	National Energy Regulator of South Africa
NGOs	Non-Governmental Organisations
NT	Not Threatened

NWA	National Water Act (Act No. 36 of 1998)
PES	Present Ecological State
REFIT	Renewable Energy Feed-in Tariffs
SAHRA	South African Heritage Resources Agency
SANBI	South African National Biodiversity Institute
SANRAL	South African National Roads Agency Limited
SDF	Spatial Development Framework
SWMP	Storm Water Management Plan
TPV	Tracking Photovoltaic Power
VAC	Visual Absorption Capacity
VU	Vulnerable

## DEFINITIONS AND TERMINOLOGY

**Alternatives:** Alternatives are different means of meeting the general purpose and need of a proposed activity. Alternatives may include location or site alternatives, activity alternatives, process or technology alternatives, temporal alternatives or the 'do nothing' alternative.

**Archaeological material:** Remains resulting from human activities which are in a state of disuse and are in or on land and which are older than 100 years, including artefacts, human and hominid remains and artificial features and structures.

**Article 3.1 (*sensu* Ramsar Convention on Wetlands):** "Contracting Parties "shall formulate and implement their planning so as to promote the conservation of the wetlands included in the List, and as far as possible the wise use of wetlands in their territory"".(Ramsar Convention Secretariat. 2004. Ramsar handbooks for the wise use of wetlands. 2nd Edition. Handbook 1. Ramsar Convention Secretariat, Gland, Switzerland.) (See <http://www.ramsar.org/>)

**Calcrete:** A soft sandy calcium carbonate rock related to limestone which often forms in arid areas.

**Clean development mechanism:** An arrangement under the Kyoto Protocol allowing industrialised countries with a greenhouse gas reduction commitment (called Annex 1 countries) to invest in projects that reduce emissions in developing countries as an alternative to more expensive emission reductions in their own countries. The most important factor of a CDM project is that it establishes that it would not have occurred without the additional incentive provided by emission reductions credits. The CDM allows net global greenhouse gas emissions to be reduced at a much lower global cost by financing emissions reduction projects in developing countries where costs are lower than in industrialised countries. The CDM is supervised by the CDM Executive Board (CDM EB) and is under the guidance of the Conference of the Parties (COP/MOP) of the United Nations Framework Convention on Climate Change (UNFCCC) (refer [http://unfccc.int/kyoto\\_protocol/mechanisms/items/2998.php](http://unfccc.int/kyoto_protocol/mechanisms/items/2998.php)).

**Concentrating solar power:** Solar generating facilities use the energy from the sun to generate electricity. CSP facilities collect the incoming solar radiation and concentrate it (by focusing or combining it) onto a single point, thereby increasing the potential electricity generation.

**Concentrating photovoltaic power:** Like CSP facilities, concentrating photovoltaic facilities operate on the same principle of concentrating the incoming solar radiation. The only different is that in this case photovoltaic panels are used.



**Cumulative impacts:** Impacts that result from the incremental impact of the proposed activity on a common resource when added to the impacts of other past, present or reasonably foreseeable future activities (e.g. discharges of nutrients and heated water to a river that combine to cause algal bloom and subsequent loss of dissolved oxygen that is greater than the additive impacts of each pollutant). Cumulative impacts can occur from the collective impacts of individual minor actions over a period and can include both direct and indirect impacts.

**Direct impacts:** Impacts that are caused directly by the activity and generally occur at the same time and at the place of the activity (e.g. noise generated by blasting operations on the site of the activity). These impacts are usually associated with the construction, operation or maintenance of an activity and are generally obvious and quantifiable

**'Do nothing' alternative:** The 'do nothing' alternative is the option of not undertaking the proposed activity or any of its alternatives. The 'do nothing' alternative also provides the baseline against which the impacts of other alternatives should be compared.

**Early stone age:** A very early period of human development dating between 300 000 and 2.6 million years ago.

**Endangered species:** Taxa in danger of extinction and whose survival is unlikely if the causal factors continue operating. Included here are taxa whose numbers of individuals have been reduced to a critical level or whose habitats have been so drastically reduced that they are deemed to be in immediate danger of extinction.

**Endemic:** An "endemic" is a species that grows in a particular area (is endemic to that region) and has a restricted distribution. It is only found in a particular place. Whether something is endemic or not depends on the geographical boundaries of the area in question and the area can be defined at different scales.

**Environment:** the surroundings within which humans exist and that are made up of:

- i. The land, water and atmosphere of the earth;
- ii. Micro-organisms, plant and animal life;
- iii. Any part or combination of (i) and (ii) and the interrelationships among and between them; and
- iv. The physical, chemical, aesthetic and cultural properties and conditions of the foregoing that influence human health and well-being.

**Environmental impact:** An action or series of actions that have an effect on the environment.

**Environmental impact assessment:** Environmental Impact Assessment (EIA), as defined in the NEMA EIA Regulations and in relation to an application to which scoping must be applied, means the process of collecting, organising, analysing, interpreting and communicating information that is relevant to the consideration of that application.

**Environmental management:** Ensuring that environmental concerns are included in all stages of development, so that development is sustainable and does not exceed the carrying capacity of the environment.

**Environmental management plan:** An operational plan that organises and co-ordinates mitigation, rehabilitation and monitoring measures in order to guide the implementation of a proposal and its ongoing maintenance after implementation.

**Feed-in tariffs:** Feed-in Tariffs have been set to promote socio-economic and environmentally sustainable growth. They are essentially guaranteed prices for electricity supply as opposed to conventional consumer tariffs. The basic economic principle underpinning the FIT is the establishment of a tariff that covers the cost of generation plus a "reasonable profit" to entice independent power producers to invest in generation projects.

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

**Heliostat:** Movable, flat reflective mirrors which are oriented according to the sun's position in order to capture and reflect the solar radiation.

**Heritage:** That which is inherited and forms part of the National Estate (Historical places, objects, fossils as defined by the National Heritage Resources Act of 2000).

**Indigenous:** All biological organisms that occurred naturally within the study area prior to 1800

**Indirect impacts:** Indirect or induced changes that may occur as a result of the activity (e.g. the reduction of water in a stream that supply water to a reservoir that supply water to the activity). These types of impacts include all the potential impacts that do not manifest immediately when the activity is undertaken or which occur at a different place as a result of the activity.

**Integrated energy plan:** A plan commissioned by the DME in response to the requirements of the National Energy Policy, in order to provide a framework in which specific energy policies, development decisions and energy supply trade-offs can be made on a project-by-project basis. The framework is intended to create a balance

between the energy demand and resource availability to provide low cost electricity for social and economic development, while taking into account health, safety, and environmental parameters.

**Integrated strategic electricity planning:** Eskom's planning process which provides strategic projections of supply-side and demand-side options to be implemented to deal with the energy management issues and meet long-term load forecasts.

**Interested and affected party:** Individuals or groups concerned with or affected by an activity and its consequences. These include the authorities, local communities, investors, work force, consumers, environmental interest groups, and the public.

**Kyoto protocol:** The Kyoto Protocol calls for developed countries to reduce their green house gas emissions during the commitment period (2008 - 2012) by 5.2% compared to 1990 levels. Developing countries, like South Africa, do not have a limit on their emissions.

**Late stone age:** In South Africa this period represents fully modern people who were the ancestors of southern African Khoekhoen and San groups (40 000 – 300 years ago).

**Middle stone age:** An early period in human history characterised by the development of early human forms into modern humans capable of abstract thought process and cognition 300 000 – 40 000 years ago.

**National integrated resource plan:** Commissioned by NERSA in response to the National Energy Policy's objective relating to affordable energy services, in order to provide a long-term, cost-effective resource plan for meeting electricity demand, which is consistent with reliable electricity supply and environmental, social, and economic policies.

**Natural properties of an ecosystem (*sensu* Convention on Wetlands):** Defined in Handbook 1 as the "...physical, biological or chemical components, such as soil, water, plants, animals and nutrients, and the interactions between them." (Ramsar Convention Secretariat. 2004. Ramsar handbooks for the wise use of wetlands. 2nd Edition. Handbook 1. Ramsar Convention Secretariat, Gland, Switzerland.) (See <http://www.ramsar.org/>)

**Optics:** Mirrors or lenses which are used to concentrate the solar radiation onto a photovoltaic cell.

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

**Parabolic trough:** A trough-shaped reflectors which focus the solar radiation onto a receiver at its focal point. It include a receiver tube/heat collection element (i.e. a metal absorber containing the heat transfer fluid surrounded by a glass envelope which absorbs the solar energy received from the parabolic trough), a sun-tracking system (i.e. an electronic control system and associated mechanical drive system used to focus the reflector onto the sun), and support structure (i.e. holds the parabolic trough in accurate alignment with incoming solar radiation while resisting the effects of the wind).

**Photovoltaic cell:** Semiconductors which absorb solar radiation to produce electricity

**Photovoltaic effect:** Electricity can be generated using photovoltaic panels (semiconductors) which are comprised of individual photovoltaic cells that absorb solar energy to produce electricity. The absorbed solar radiation excites the electrons inside the cells and produces what is referred to as the Photovoltaic Effect.

**Power tower:** A power tower forms part of the central receiver type solar electricity generating technology. The purpose of the tower, which may be up to 160 m high, is to structurally support the receiver. The receiver, consisting of metal tubes which transfer the heat from the solar radiation reflected on it by mirror fields, is used for generating the steam.

**Pleistocene:** A geological period (of 3 million – 20 000 years ago).

**Ramsar convention on wetlands:** "The Convention on Wetlands (Ramsar, Iran, 1971) is an intergovernmental treaty whose mission is "the conservation and wise use of all wetlands through local, regional, and national actions and international cooperation, as a contribution towards achieving sustainable development throughout the world." As of March 2004, 138 nations have joined the Convention as Contracting Parties, and more than 1300 wetlands around the world, covering almost 120 million hectares, have been designated for inclusion in the Ramsar List of Wetlands of International Importance." (Ramsar Convention Secretariat. 2004. Ramsar handbooks for the wise use of wetlands. 2nd Edition. Handbook 1. Ramsar Convention Secretariat, Gland, Switzerland.) (Refer <http://www.ramsar.org/>). South Africa is a Contracting Party to the Convention.

**Rare species:** Taxa with small world populations that are not at present Endangered or Vulnerable, but are at risk as some unexpected threat could easily cause a critical decline. These taxa are usually localised within restricted geographical areas or habitats or are thinly scattered over a more extensive range. This category was termed Critically Rare by Hall and Veldhuis (1985) to distinguish it from the more generally used word "rare."

**Red data species:** Species listed in terms of the International Union for Conservation of Nature and Natural Resources (IUCN) Red List of Threatened Species, and/or in terms of

the South African Red Data list. In terms of the South African Red Data list, species are classified as being extinct, endangered, vulnerable, rare, indeterminate, insufficiently known or not threatened (see other definitions within this glossary).

**Renewable energy feed-in tariff:** REFITs are used to promote renewable energy and have been adopted in over 36 countries worldwide. The establishment of the REFIT in South Africa provides the opportunity for an increased contribution towards the sustained growth of the renewable energy sector, and to promote competitiveness between renewable and conventional energies in the medium and long-term. Under the National Energy Regulator Act (Act No. 40 of 2004), the Electricity Regulation Act (Act No. 4 of 2006), and all subsequent relevant amendment acts, the National Energy Regulator of South Africa (NERSA) has the mandate to determine the prices at and conditions under which electricity must be supplied by licence.

**Significant impact:** An impact that by its magnitude, duration, intensity, or probability of occurrence may have a notable effect on one or more aspects of the environment.

**Sustainable utilisation (*sensu* Convention on Wetlands):** Defined in Handbook 1 as the "human use of a wetland so that it may yield the greatest continuous benefit to present generations while maintaining its potential to meet the needs and aspirations of future generations". (Ramsar Convention Secretariat. 2004. Ramsar handbooks for the wise use of wetlands. 2nd Edition. Handbook 1. Ramsar Convention Secretariat, Gland, Switzerland.) (Refer <http://www.ramsar.org/>).

**Structure (historic):** Any building, works, device, or other facility made by people and which is fixed to land, and includes any fixtures, fittings, and equipment associated therewith. Protected structures are those which are over 60 years old.

**Wise use (*sensu* Convention on Wetlands):** Defined in Handbook 1 (citing the third meeting of the Conference of Contracting Parties (Regina, Canada, 27 May to 5 June 1987) as "the wise use of wetlands is their sustainable utilisation for the benefit of humankind in a way compatible with the maintenance of the natural properties of the ecosystem".(Ramsar Convention Secretariat. 2004. Ramsar handbooks for the wise use of wetlands. 2nd Edition. Handbook 1. Ramsar Convention Secretariat, Gland, Switzerland.) (See <http://www.ramsar.org/>)

## INTRODUCTION

## CHAPTER 1

!Khi CSP is proposing the establishment of a commercial solar energy facility on Portion 3 of the Farm McTaggarts Camp 453, which lies approximately 20 km south-west of the town of Upington in the Northern Cape. Following an extensive site identification process undertaken by !Khi CSP, a 22 km<sup>2</sup> site which falls within the Kai !Gariep Local Municipality was identified for consideration within an Environmental Impact Assessment (EIA) process.

A sensitivity analysis was undertaken during the Scoping Phase wherein potentially sensitive areas which should be avoided within the broader 22 km<sup>2</sup> were identified. These sensitive areas included natural drainage lines, areas of increased gradient/slope, potential occurrence of Red Data Species, and areas previously disturbed through mining activities. As a result, the south-eastern portion of the site was identified as a preferred area for development of the solar thermal plant, based on the following characteristics:

- » Avoidance of key drainage lines
  - » This portion of the site exhibits the least diversity in term of riparian structure, with most species being ubiquitous within the region
  - » The presence of alluvial fans is limited
  - » Habitat complexity is low, e.g. no geomorphological changes such as rock outcrops were observed. There is little diversity regarding in-stream habitats and few refugia would be impacted upon.
  - » There is still sufficient space between the proposed footprint area and the significant mainstem riverbeds to institute suitable stormwater management structures (silt traps) and pollution containment areas.
- » Lower elevation
- » Proximity to a water abstraction point on the Orange (Gariep) River
- » Proximity to the existing grid for connection
- » Proximity to the N14 National Road for access
- » Proximity from areas previously disturbed through mining activities and potential heritage sites

The proposed facility, which will be primarily contained within this identified portion, will have a developmental footprint of approximately 6 km<sup>2</sup>. The solar energy facility is proposed to be comprised of Concentrating Solar Power (CSP) and Concentrating/Tracking Photovoltaic Power (CPV/TPV) components with an overall maximum generating capacity of 110 MW. The facility will be comprised of a combination of the following technologies (in any combination):

- » 50 MW trough plant (CSP system consisting of several rows of parabolic troughs)

- » 50 MW power tower plant (CSP system consisting of a field of heliostats/ mirrors positioned around a central receiver/power tower)
- » 10 MW PV plant (system consisting of several rows of photovoltaic (PV) panels)

The Renewable Energy Feed-in Tariff (REFIT) Process (criteria not yet finalised by the National Energy Regulator of South Africa (NERSA)), selection process (not finalised by the Department of Energy, together with National Treasury) and the economics of the solar facility will be key in determining the final technology combination and the schedule of implementation for the facility.

The following associated infrastructural requirements will also be established within the developmental footprint of the proposed facility:

- » A **power island** which will include:
  - » A **steam turbine** and **generator** typically housed within a 2-storey building
  - » A generator **transformer** and a small **substation** located outside and adjacent to the 2-storey building
  - » An **auxiliary steam boiler** and associated vessels (i.e. fossil fuel boiler/generator), proposed to be fired by either diesel fuel or liquid petroleum gas (LPG)
- » An **overhead power line** feeding into the Eskom electricity network via a 'turn in and turn out' configuration to the existing Eskom Gordonia / Oasis 132 kV distribution line running approximately 4 km south of the site
- » An **abstraction point** on the Orange (Gariep) River and an associated water **supply pipeline** to the facility
- » A **suspension reservoir** located approximately 0.6 km north-west of the raw water abstraction point (i.e. outside the boundaries of the identified site) to rid the raw water of particles in suspension (silt)
- » A **storage reservoir** located approximately 8.5 km west of the abstraction point (i.e. within the boundaries of the identified site). The water stored within the reservoir will be used during the steam generation process (boiler makeup), for washing of the heliostats/mirrors, troughs and PV panels, potable water supply and fire protection supply.
- » Lined **evaporation ponds** to allow for the evaporation of process waste water not to be re-used within the facility
- » **External access road** leading to the site (alternatives either from the N14 or from the existing D3276 secondary road)
- » **Internal access roads** for construction and maintenance purposes (including an internal asphalt access road (~6m wide) which will give direct access to the power island
- » **Workshop, office and storage areas**

The nature and extent of this facility, as well as potential environmental impacts associated with the construction of a facility of this nature is assessed in more detail in this Final EIA Report.

### ***1.1.1 Justification for Renewable Energy Projects***

Countries worldwide are being pressured to increase their share of renewable energy generation due to concerns related to climate change and the on-going, unsustainable exploitation of natural resources such as gas, oil, and coal. Grid connected renewable energy is currently the fastest growing sector in the global energy market. Targets for the promotion of renewable energy now exist in more than 58 countries, of which 13 are developing countries. The South African Government has recognised the country's high level of renewable energy potential and presently has in place targets of 10 000 GWh of renewable energy by 2013 (to be produced mainly from biomass, wind, solar and small-scale hydro). This amounts to approximately 4% (1 667 MW) of the total estimated electricity demand (41 539 MW) by 2013.

To contribute towards this target and towards socio-economic and environmentally sustainable growth, and to stimulate the renewable energy industry in South Africa, the need to establish an appropriate market based mechanism was identified, and Feed-in Tariffs (FIT) have been set. FITs are, in essence, guaranteed prices for electricity supply rather than conventional consumer tariffs. The basic economic principle underpinning the FITs is the establishment of a tariff (price) that covers the cost of generation plus a "reasonable profit" to entice investment. This is quite similar to the concept of cost recovery used in utility rate regulation based on the costs of capital. Feed-in tariffs to promote renewable energy have now been adopted in over 36 countries around the world. The establishment of the South African REFIT provides the opportunity for an increased contribution towards the sustained growth of the renewable energy sector locally, regionally and internationally. It also serves to promote competitiveness for renewable energy with conventional energies in the medium- and long-term. Under the National Energy Regulator Act, 2004 (Act No. 40 of 2004), the Electricity Regulation Act, 2006 (Act No. 4 of 2006) and all subsequent relevant Amendment Acts, NERSA has the mandate to determine the prices at and conditions under which electricity may be supplied by a generation licence.

Renewable energy is recognised internationally as a major contributor in protecting our climate, nature, and the environment as well as providing a wide range of environmental, economic, and social benefits that will contribute towards long-term global sustainability. It is considered viable that long-term benefits for the community and/or society in general can be realised should this site near Upington prove acceptable, from a technical and environmental perspective, for the establishment of a solar energy facility. In addition, the proposed project will aid in achieving the goal of a



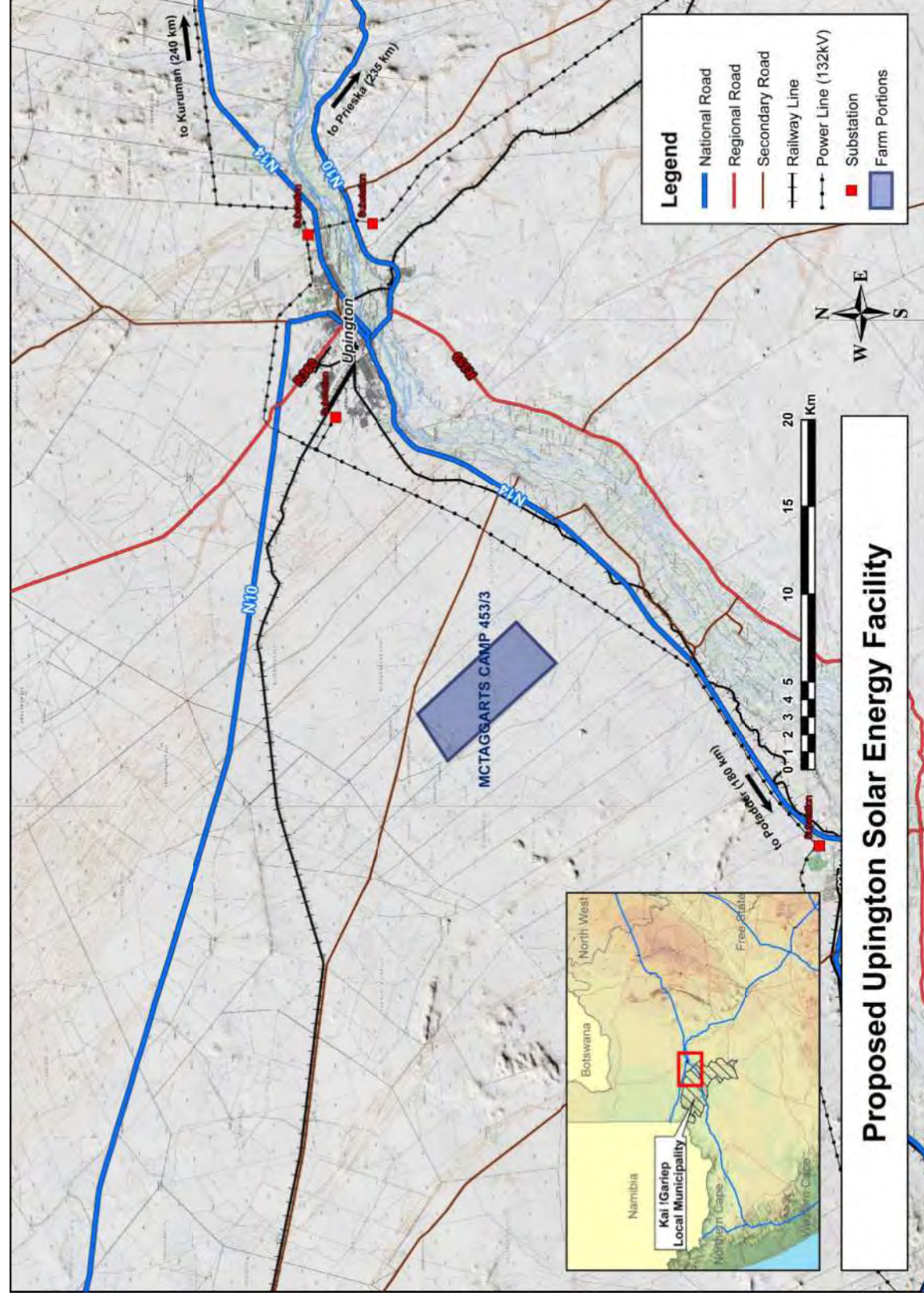
30% share of all new power generation being derived from independent power producers (IPPs).

## **1.1. Project Overview**

The proposed site being considered for the development of the Upington Solar Thermal Plant falls within the Kai !Gariep Local Municipality (i.e. that forms part of the Siyanda District Municipality) in the Northern Cape. The site is situated approximately 20 km south-west of Upington within quarter degree grid 2821AC and 2821CA, on Portion 3 of the Farm McTaggarts Camp 453 (refer to Figure 1.1).

This region of the Northern Cape consists primarily of rangeland for commercial livestock production. These regions have been commercially farmed as stock ranches for close to 100 years. Other agricultural practices such as viniculture (i.e. grape farming) also dominate the general land use character of this region. The site itself consists of natural vegetation however there is evidence of historic mining activities in the north-western corner.

The overarching objective for the proposed solar energy facility is to maximise electricity production through exposure to the solar resource, while minimising infrastructure, operational and maintenance costs, as well as social and environmental impacts. !Khi CSP undertook an extensive site selection process that identified McTaggarts Camp 453 as a suitable option for development. However, the micro siting of such a facility requires the assessment of environmental and planning issues in detail and as such these issues have now been considered within site-specific studies and assessments through the EIA process in the Scoping and EIA Phases. During the Scoping Phase, areas of sensitivity within the broader site were identified. This served to ultimately inform the general placement of the facility within the broader site (i.e. the south-eastern portion). The exact positioning or detailed layout of the facility's components within the boundaries of the broader site have been developed by taking cognisance of environmental sensitivities and technical constraints identified through the EIA Phase. This Final EIA Report documents the assessment of environmental impacts that may occur as a result of the establishment of the proposed facility. The scope of the proposed facility, including details of all elements of the project (for the construction, operation, and decommissioning phases) is discussed in more detail in Chapter 2.



**Figure 1.1:** Map indicating the farm portion identified for the proposed facility within the Upington area of the Northern Cape

## 1.2. Requirement for an Environmental Impact Assessment Process

The development of the proposed facility is subject to the requirements of the Environmental Impact Assessment Regulations (EIA Regulations) published in terms of Section 24(5) of the National Environmental Management Act (NEMA, No 107 of 1998). The EIA phase, which follows the Scoping phase, was conducted in accordance with the requirements of these regulations. This section provides a brief overview of EIA Regulations and their application to this project. !Khi CSP appointed Savannah Environmental to conduct the independent EIA process for the proposed Upington Solar Thermal Plant.

NEMA is the national legislation that provides for the authorisation of certain controlled activities known as 'listed activities'. In terms of Section 24(1) of NEMA, the potential impact on the environment associated with these listed activities must be considered, investigated, assessed and reported on to the competent authority (the decision-maker) charged by NEMA with granting of the relevant environmental authorisation. As this is a proposed electricity generation project (which is considered to be of national importance) the National Department of Environmental Affairs (DEA) is the competent authority for this project. An application for authorisation has been accepted by DEA (under application reference number **12/12/20/1831**). Through the decision-making process, the DEA will be supported by the Northern Cape Department of Environment and Nature Conservation (DENC).

The need to comply with the requirements of the EIA Regulations ensures that decision-makers are provided the opportunity to consider the potential environmental impacts of a project early in the project development process, and assess if environmental impacts can be avoided, minimised or mitigated to acceptable levels. Comprehensive, independent environmental studies are required to be undertaken in accordance with the EIA Regulations to provide the competent authority with sufficient information in order for an informed decision to be made.

An EIA is an effective planning and decision-making tool for the project proponent. It allows for the identification and management of environmental impacts/issues that may occur through the establishment and operation of such a facility. Furthermore, an EIA allows for resolution of the issue(s) reported on in the Scoping and EIA Reports as well as dialogue with affected parties.

In terms of sections 24 and 24D of NEMA, as read with Government Notices R385 (Regulations 27–36) and R387, a Scoping process and an EIA process are required to be undertaken for this proposed project as it includes the following activities listed in terms of GN R386 and R387 (GG No 28753 of 21 April 2006):

Relevant Notice	Activity	Description of listed activity
Government Notice R387 (21 April 2006)	1(a)	The construction of facilities or infrastructure, including associated structures or infrastructure, for the generation of electricity where (i) the electricity output is 20 megawatts or more; or (ii) the elements of the facility cover a combined area in excess of 1 hectare
Government Notice R387 (21 April 2006)	1(l)	The construction of facilities or infrastructure, including associated structures or infrastructure, for the transmission and distribution of above ground electricity with a capacity of 120 kV or more
Government Notice R387 (21 April 2006)	2	Any development, activity, including associated structures and infrastructure, where the total area of the developed area is, or is intended to be 20 ha or more
Government Notice R386 (21 April 2006)	1(m)	Any purpose in the one in ten year flood line of a river or stream, or within 32 metres from the bank of a river or stream where the flood line is unknown, excluding purposes associated with existing residential use, but including (i) canals; (ii) channels; (iii) bridges; (iv) dams; and (v) weirs
Government Notice R386 (21 April 2006)	7	The above ground storage of a dangerous good, including petrol, diesel, liquid petroleum gas or paraffin, in containers with a combined capacity of more than 30 cubic metres but less than 1 000 cubic metres at any one location or site
Government Notice R386 (21 April 2006)	12	The transformation or removal of indigenous vegetation of 3 hectares or more or of any size where the transformation or removal would occur within a critically endangered or an endangered ecosystem listed in terms of section 52 of the National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004)
Government Notice R386 (21 April 2006)	13	The abstraction of groundwater at a volume where any general authorisation issued in terms of the National Water Act, 1998 (Act No. 36 of 1998) will be exceeded
Government Notice R386 (21 April 2006)	14	The construction of masts of any material of type and of any height, including those used for telecommunications broadcasting and radio transmission, but excluding (a) masts of 15m and lower exclusively used by (i) radio amateurs; or (ii) for lightening purposes (b) flagpoles; and (c) lightening conductor poles
Government Notice R386 (21 April 2006)	15	The construction of a road that is wider than 4 m or that has a reserve wider than 6 m, excluding roads that fall within the ambit of another listed activity or which are access roads of less than 30 m long
Government Notice R386 (21 April 2006)	16(b)	The transformation of undeveloped, vacant or derelict land to residential mixed, retail, commercial, industrial or institutional use where such development does not constitute infill and where the total area to be transformed is bigger than 1 hectare

### 1.3. Objectives of the Environmental Impact Assessment Process

The Scoping Phase refers to the process of **identifying** potential impacts (i.e. positive and negative) associated with the proposed project, and defining the **extent of studies** required within the EIA phase. The Scoping Phase culminated in the identification of a preferred area for development within the broader 22 km<sup>2</sup> site (i.e. the south-eastern portion of the site). The Scoping Phase included input from the project proponent, specialists with experience in the study area as well as in EIAs for similar projects, as well as a public consultation process with key stakeholders that included both government authorities and interested and affected parties (I&APs).

The EIA Phase focuses on the preferred area for development identified during the Scoping Phase. It addresses identified environmental impacts (direct, indirect, and cumulative as well as positive and negative) associated with all phases of the project including design, construction, operation, and decommissioning. The EIA phase also recommends appropriate mitigation measures for potentially significant environmental impacts. The release of the Draft EIA Report provided stakeholders with an opportunity to verify that issues they have raised through the EIA process have been captured and adequately considered. This Final EIA Report incorporates all issues and responses raised during the public review of the Draft EIA Report prior to submission to DEA.

This EIA Report consists of the following sections:

**Chapter 1** provides background to the proposed facility and the environmental impact assessment process.

**Chapter 2** provides an overview of the proposed project.

**Chapter 3** provides an overview of the Regulatory and Legal Context for electricity generation projects

**Chapter 4** outlines the process which was followed during the EIA Phase, including the consultation program that was undertaken and input received from interested parties and stakeholders.

**Chapter 5** describes the existing biophysical and socio-economic environment.

**Chapter 6** presents the assessment of environmental impacts associated with the facility, its associated infrastructure.

**Chapter 7** presents the assessment of environmental impacts associated with the project alternatives.

**Chapter 8** presents the conclusions of the EIA process, as well as an impact statement on the proposed project

**Chapter 9** provides a list of references and information sources used in undertaking the studies for this EIA Report.

#### **1.4. Details of the Environmental Assessment Practitioner and Expertise to conduct the Scoping and EIA**

Savannah Environmental was contracted by !Khi CSP as the independent consultants to undertake an EIA process for the proposed project, as required by the NEMA EIA Regulations. Neither Savannah Environmental, nor any of its specialist sub-consultants on this project are subsidiaries of, or are affiliated to !Khi CSP. Furthermore, Savannah Environmental does not have any interests in secondary developments that may arise out of the authorisation of the proposed project.

Savannah Environmental is a specialist environmental consulting company providing a holistic environmental management service, including environmental assessment and planning to ensure compliance and evaluate the risk of development; and the development and implementation of environmental management tools. Savannah Environmental benefits from the pooled resources, diverse skills and experience in the environmental field held by its team.

The Savannah Environmental team has considerable experience in environmental assessment and environmental management and have been actively involved in undertaking environmental studies for a wide variety of projects throughout South Africa and neighbouring countries. Strong competencies have been developed in project management of environmental processes, as well as strategic environmental assessment and compliance advice, and the assessment of environmental impacts, the identification of environmental management solutions and mitigation/risk minimising measures.

Savannah Environmental has gained extensive knowledge and experience on potential environmental impacts associated with electricity generation projects through their involvement in related EIA processes. Savannah Environmental has completed the EIA process and received environmental authorisations for:

- » The Eskom Wind Energy Facility on the West Coast
- » The Umoya Energy Hopefield Wind Energy Facility in the Western Cape
- » The African Clean Energy Development Cookhouse Wind Energy Facility in the Eastern Cape

Savannah Environmental is currently undertaking the EIA process and reporting for *inter alia*:

- » The Renewable Energy Investments South Africa Kathu Solar Energy Facility in the Northern Cape
- » The VentuSA Energy Sishen Solar Energy Facility in the Northern Cape
- » The Thupela Energy Waterberg Photovoltaic Plant in the Limpopo Province
- » The VentuSA Energy Wag'nbiekiespan Solar Energy Facility in the Free State

- » The Noblesfontein Solar and Wind Energy Facility in the Northern Cape
- » The Moyeng Energy Suurplaat Wind Energy Facility in the Northern Cape

Savannah Environmental has developed a valuable understanding of impacts associated with the construction and operation of renewable energy facilities. Savannah Environmental has successfully managed and undertaken EIA processes for other power generation projects throughout South Africa. Curricula vitae for the Savannah Environmental project team consultants are included in Appendix A.

In order to adequately identify and assess potential environmental impacts, Savannah Environmental has appointed several specialist consultants to conduct specialist studies, as required. The curricula vitae for the EIA specialist consultants are also included in Appendix A.

## OVERVIEW OF THE PROPOSED PROJECT

## CHAPTER 2

Chapter 2 details the scope of the proposed facility (i.e. construction, operation and decommissioning), and explores alternatives, including the 'do nothing' option. This chapter also explores solar energy as a power generation technology and the need for such a facility in light of the country's energy requirements.

### 2.1. Consideration of Alternatives

The site for the proposed facility is regarded by !Khi CSP as preferential based on several site/region specific characteristics. Based on these preferences, no further siting alternatives have been considered in this EIA process.

#### ***Climatic conditions***

The economic viability of a solar facility is directly dependent on the annual direct solar irradiation values. The Northern Cape receives the highest average daily direct normal irradiation in South Africa while Upington has an average daily solar radiation of approximately 7.5 kWh/m<sup>2</sup> per day.

#### ***Water availability***

CSP facilities require water as the heat transfer medium for the generation of high temperature steam used to drive a conventional turbine and generator. Water will be extracted from an abstraction point located along the Orange (Gariep) River, the primary water source in the area.

#### ***Orography***

An area with favourable orography (flat terrain) facilitates the construction and maintenance of the solar thermal facility, and reduces the need for civil/earthworks. For example, parabolic troughs ideally require a level surface preferably with a slope of less than 1%.

#### ***Extent of the site***

Sufficient open space within an area is a restraining factor (for example a 50 MW parabolic trough system requires ~100 ha; a 10 MW PV installation (flat fixed panel) requires approximately 15 ha, a tracking PV installation of the same size roughly 60 ha (4 times) and a 50 MW heliostat/power tower system requires ~200 ha). The infrastructure for this proposed site is estimated to cover a total developmental footprint of 6 km<sup>2</sup>.



### ***Power transmission considerations***

The generated electricity will be sold to a single buyer entity (still to be finalised), as part of a power purchase agreement between this entity and !Khi CSP. Therefore the power will need to be evacuated into the Eskom grid. The site is located approximately 4 km north of an existing 132 kV distribution line which connects Eskom's Gordonia Distribution Substation (close to Upington) to the Oasis Distribution Substation (close to Keimoes). Based on discussions with Eskom, !Khi CSP intends to feed the generated electricity via a 'turn-in and turn out' configuration to this existing line.

### ***Existing site conditions***

The site is preferred due to the historic disturbance which has occurred on the site. Although comprising natural vegetation, the vegetation has been transformed through mining activities (i.e. tungsten diggings in the north-eastern portion of the site and isolated spots throughout the site) and grazing activities across the site.

### ***Proximity to other infrastructure***

The site is preferred due to its proximity to Upington (commercial and industrial), airport, and national roads infrastructures.

#### ***2.1.1 Site-specific / Layout Design Alternatives***

The overall aim of the layout is to maximise electricity production through exposure to the solar resource, while minimising infrastructure, operation, and maintenance costs, and social and environmental impacts. Through the process of determining constraining factors, the layout of the facility components within the broader site was planned with a preliminary layout being produced. In addition, feasible site alternative have been provided for the external access road and the powerline (refer to Figure 2.1).

#### ***External access road alternatives***

Two feasible alternative routes have been proposed for the external access road. Alternative A (i.e. the preferred route) runs in a north-westerly direction for approximately 3.2 km towards an existing gravel road which branches off the N14 (i.e. the D3276). Alternative B (i.e. the alternative route) runs in a southerly direction for approximately 6 km and joins directly with the N14 National Road. Alternative A is preferred from a technical perspective for the following reasons:

- » This route is shorter in distance
- » From a planning perspective, this route is simpler as the point of connection to the existing road is onto an existing Divisional Road (secondary gravel road), whereas Alternative B would need direct access onto a National Road (i.e. the N14) and SANRAL would be required to provide permission for this point of access, as the safety of the National road cannot be compromised by a private access road.

### ***Power line alternatives***

Two feasible alternative routes have been proposed for the power line. Alternative A (i.e. the preferred route of approximately 4.4 km in length) runs in a south-westerly direction for approximately 2.5 km then bends and travels south for a further distance of approximately 1.9 km towards the existing 132 kV distribution line. Alternative B (i.e. the alternative route of approximately 6.3 km in length) runs in a south-westerly direction for approximately 2.3 km until the south western corner of the farm portion and then travels south-east for approximately 4 km towards the existing 132 kV distribution line. Alternative A is preferred from a technical perspective as this route is shorter and therefore more cost effective.

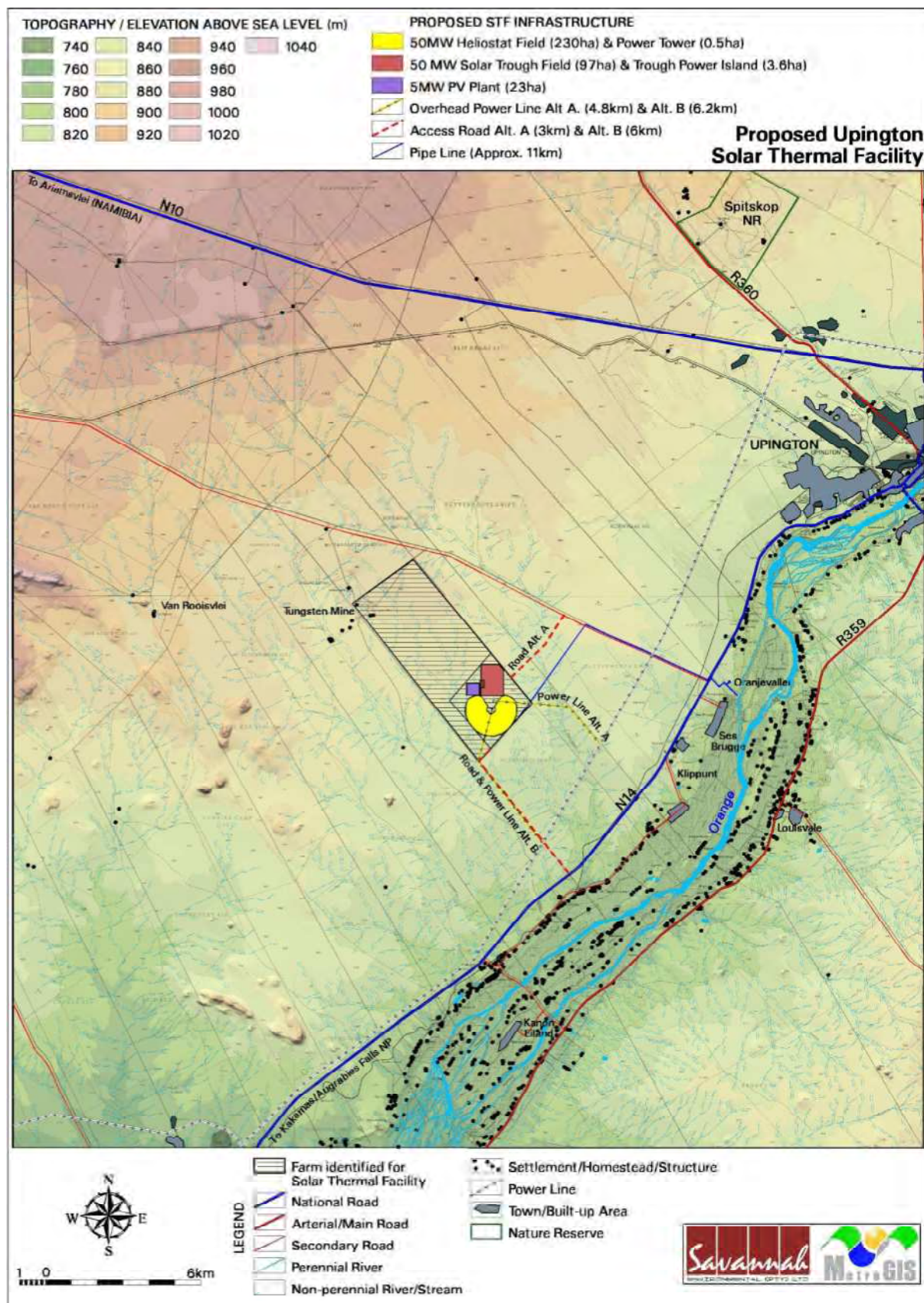
### ***Water supply pipeline and the location of the abstraction point and reservoirs***

Based on an extensive feasibility assessment, only one technically feasible abstraction point on the Orange River has been identified within an acceptable radius from the site. The most practical and technically feasible route for the water supply pipeline between this abstraction point and the site is proposed. No other technically feasible alternatives are available.

The proposed abstraction point on the Orange River is located on private property at an existing DWA embankment. The main considerations included abstraction pool depth consistency throughout the year, access to with no alteration to river flow and flood lines (20, 50, and 100 year). This is, therefore, the most technically feasible abstraction point, and is considered preferred as the construction of additional embankments in the flow of the river could lead to obstruction and higher water levels upstream.

Abstracted water will be pumped to a settlement reservoir (for de-gritting plant) located approximately 0.6 km north-west of the abstraction point. A second storage reservoir will be located approximately 8.5 km west of the abstraction point within the boundaries of the identified site. The water supply pipeline route between these points is preferred as:

- » It follows the shortest possible route
- » Allows for easy access to the pipeline for maintenance purposes
- » Follows an existing road reserve
- » Will be buried with about 1 m soil coverage



**Figure 2.1:** Preliminary layout for the solar infrastructure on the south east portion of the site, as well as associated linear infrastructure

### **2.1.2 The 'do-nothing' Alternative**

The 'do-nothing' alternative is the option of not constructing the proposed facility on the identified site near Upington.

However, the increasing electricity demand in South Africa is placing ever-increasing pressure on the existing power generation capacity. Therefore additional electricity generation options need to be developed throughout the country. The support for renewable energy policy is guided by a rationale that South Africa has a very attractive range of renewable resources, particularly solar and wind and that renewable applications are in fact the least-cost energy service in many cases - and more so when social and environmental costs are taken into account.

In South Africa the generation of electricity through renewable energy resources offers a range of socio-economic and environmental benefits. These benefits are explored in further detail in the South Africa Renewable Energy Feed-in Tariff (REFIT) Regulatory Guideline published by NERSA (March 2009), and include:

#### ***Increased energy security***

The current electricity crisis in South Africa highlights the significant role that renewable energy can play in terms of power supplementation. In addition, given that renewables can often be deployed in a decentralised manner close to consumers, they offer the opportunity for improving grid strength and supply quality, while reducing expensive transmission and distribution losses.

#### ***Resource saving***

Conventional coal fired plants are major consumers of water during their requisite cooling processes. It is estimated that the achievement of the targets in the Renewable Energy White Paper will result in water savings of approximately 16.5 million kilolitres, when compared with wet cooled conventional power stations; this translates into revenue savings of R26.6 million. As an already water-stressed nation, it is critical that South Africa engages in a variety of water conservation measures, particularly due to the detrimental effects of climate change on water availability.

#### ***Exploitation of our significant renewable energy resource***

At present, valuable national resources including biomass by-products, solar radiation and wind power remain largely unexploited. The use of these energy flows will strengthen energy security through the development of a diverse energy portfolio.

### ***Pollution reduction***

The release of by-products from the burning of fossil fuels for electricity generation has a particularly hazardous impact on human health, and contributes to ecosystem degradation.

### ***Climate friendly development***

The uptake of renewable energy offers the opportunity to address energy needs in an environmentally responsible manner, contributing to the mitigation of climate change through the reduction of greenhouse gas emissions. South Africa as a nation is estimated to be responsible for 1% of global GHG emissions and is currently ranked 9th worldwide in terms of per capita CO<sub>2</sub> emissions.

### ***Support for international agreements and enhanced status within the international community***

The effective deployment of renewable energy provides a tangible means for South Africa to demonstrate its commitment to its international agreements under the Kyoto Protocol, and for cementing its status as a leading player within the international community.

### ***Acceptability to society***

Renewable energy offers a number of tangible benefits to society including reduced pollution concerns, improved human and ecosystem health and climate friendly development.

### ***Support to a new industry sector***

The development of renewable energy offers the opportunity to establish a new industry within the South African economy. The sale, development, installation, maintenance, and management of renewable energy facilities have the potential for job creation in South Africa.

### ***Protecting the natural foundations of life***

The development of renewable energy projects can play an important role in reaching the target of 10 000 GWh renewable energy contributions to final energy consumption by 2013. The target is to be achieved primarily through the development of wind, biomass, solar and small-scale hydro. DoE's macroeconomic study of renewable energy, developed under the now completed Capacity Building in Energy Efficiency and Renewable Energy (CaBEERE) project, has established that the achievement of this target would provide a number of economic benefits, including increased government revenue amounting to R299 million, increased GDP of up to R1 billion per year and the creation of an estimated 20 500 new jobs. In addition, the development of renewable energy beyond the 10 000 GWh target holds further employment benefits and would maximise the number of jobs created per TWh (South Africa Renewable Energy Feed-in Tariff (REFIT) Regulatory Guideline published by NERSA (March 2009)).

Through research, the viability of a solar energy facility has been established, and !Khi CSP proposes that up to 110 MW can be generated from the proposed facility near Upington. The 'do nothing' alternative will not assist the South African government in reaching their set targets for renewable energy.

At present, South Africa is some way off from exploiting the diverse gains from renewable energy and from achieving a considerable market share in the renewable energy industry. South Africa's electricity supply remains heavily dominated by coal based power generation, with the country's significant renewable energy potential largely untapped to date.

This is, therefore, not a preferred alternative and not assessed in further detail.

### **2.1.3 Technology Alternatives**

The economics of a solar energy facility depend on the solar resource at the site. Detailed and reliable information about this resource is vital when considering the installation of such a facility and the type of technology to be installed. Several technologies exist including Concentrating Solar Power (CSP), Concentrating Photovoltaic Power (CPV), and Tracking Photovoltaic Power (TPV). The REFIT rules which have not yet been finalised by NERSA and the economics of the solar facility will be key in determining the final technology combination for the total facility. The selection of a preferred technology will be made from multifaceted decision-making framework. These include the outcome of the REFIT for solar technologies and the Engineering, Procurement, and Construction (EPC) partner whom !Khi CSP selects. However as it stands, the current technology options to be utilised on this site include:

- » Parabolic trough system
- » Heliostats and associated power tower
- » Photovoltaic panels

The details of these technologies are discussed further in Sections 2.3 and 2.4 below.

## **2.2. Solar Energy as a Power Generation Technology**

Solar energy facilities operate by converting solar energy into a useful form (i.e. electricity). The use of solar energy for electricity generation is a non-consumptive use of a natural resource and consumes no fuel for continuing operation. Solar power produces an insignificant quantity of greenhouse gases over its lifecycle as compared to conventional coal-fired power stations. The operational phase of a solar facility does not produce carbon dioxide, sulfur dioxide, mercury, particulates, or any other type of air pollution, as do fossil fuel power generation technologies.

Environmental pollution and the emission of CO<sub>2</sub> from the combustion of fossil fuels constitute a threat to the environment. The use of fossil fuels is reportedly responsible for approximately 70% of greenhouse gas emissions worldwide. The climate change challenge needs to include a shift in the way that energy is generated and consumed. Worldwide, many solutions and approaches are being developed to reduce emissions. However, it is important to acknowledge that the more cost effective solution in the short-term is not necessarily the least expensive long-term solution. This holds true not only for direct project cost, but also indirect project cost such as impacts on the environment. Renewable energy is considered a 'clean source of energy' with the potential to contribute greatly to a more ecologically, socially and economically sustainable future. The challenge now is ensuring solar energy projects are able to meet all economic, social, and environmental sustainability criteria.

## 2.3. Details of the functioning of a Solar Thermal Facility

### 2.3.1 *Parabolic Troughs*

A trough system is comprised of two component groups, firstly a heat collection system and secondly a conventional generating plant portion. The heat collection system is comprised of **parabolic collectors** (i.e. trough-shaped reflectors which focus the solar radiation onto a receiver at its focal point), a **receiver tube/heat collection element** (i.e. a metal absorber containing the heat transfer fluid surrounded by a glass envelope (maintaining a vacuum), which absorbs the solar energy received from the parabolic trough), a **sun-tracking system** (i.e. an electronic control system and associated mechanical drive system used to focus the reflector onto the sun), and support structure (i.e. holds the parabolic trough in accurate alignment with incoming solar radiation while resisting the effects of the wind). The collected energy in the heat transfer fluid is used to generate steam through a conventional heat exchanger system that is in turn used for electricity generation in a conventional steam turbine and generator.





**Figure 2.2:** CSP parabolic troughs (photograph courtesy of Abengoa Solar S.A.)

### **2.3.2 Heliostats and Power Tower**

A power tower system is also comprised of a heat collection system and a conventional generating plant portion. The heat collection system consists of **heliostats** (movable, flat reflective mirrors roughly 120 m<sup>2</sup> which are oriented according to the sun's position in order to capture and reflect the solar radiation) and a **receiver** (consisting of metal tubes which transfer the heat from the solar radiation to water with the purpose of generating steam). The receiver is mounted on a 160 – 180 m high **power tower** that provides elevation and structurally supports the receiver. In the generating portion the steam drives a turbine which is connected to a generator (in order to produce electricity, as stated before).

Power tower plants must be large to be economical. The heliostat field and the receiver are sized depending on the needs of the utility, for example, a 50 MW facility will require approximately 300 ha.

In a typical installation, solar energy collection occurs at a rate that exceeds the maximum required to provide steam to the turbine. Consequently, the thermal storage system can be charged at the same time that the plant is producing power at full capacity. The ratio of the thermal power provided by the heliostat field and receiver to



the peak thermal power required by the turbine generator is called the **solar multiple**. A power tower could potentially operate for 40 - 65% of the year (as from such storage, the system could provide energy, even in cloudy conditions or at night) without the need for a back-up fuel source. However, without energy storage, solar technologies are limited to annual capacity factors near 25%. Today, the most used solution is the usage of water/steam or molten salt storage tanks that store the energy to be then distributed when required. Determining the optimum storage size to meet power-dispatch requirements is an important part of the system design process. Storage tanks can be designed with sufficient capacity to power a turbine at for up to 6 - 8 hours.



**Figure 2.3:** CSP power tower (photograph courtesy of Abengoa Solar S.A.)

### **2.3.3 Functioning of CSP Facilities**

The following stages form part of the operating function of the CSP systems.

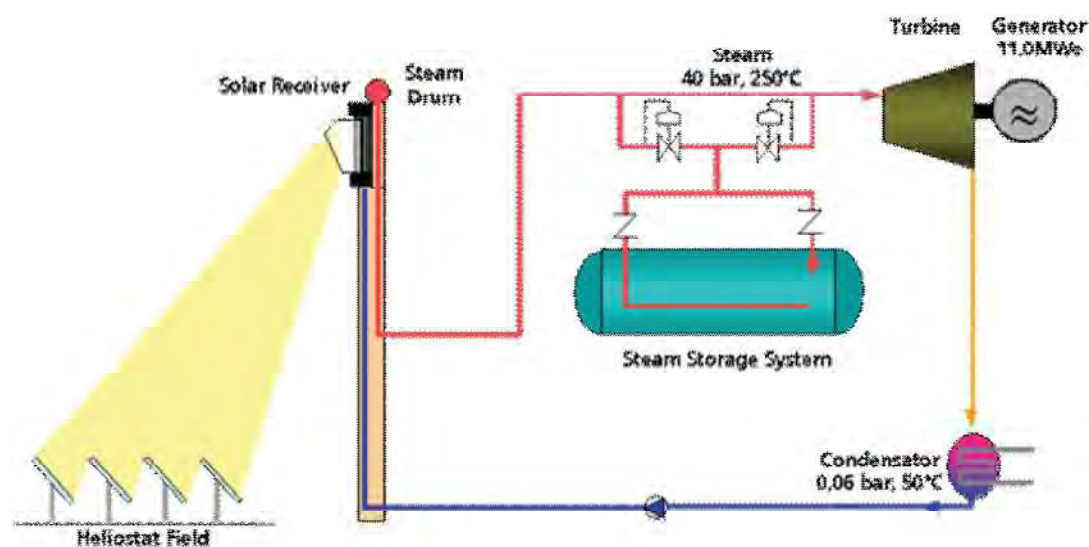
**Stage 1:** the water is pumped from low to high pressure and steam is extracted from the steam turbine generator and is used to pre-heat the water prior to entering the steam generator system (i.e. this increases overall cycle efficiency).

**Stage 2:** the high pressure working fluid enters the steam generator system where it is heated by the heat transfer fluid or receiver to become super heated steam.

**Stage 3:** The super heated steam expands through the high pressure section of the steam turbine turning the generator to produce electricity. This steam is then reheated in a re-heater that is part of the steam generator system and sent to the low pressure steam turbine. All sections of the steam turbine generator decrease the temperature and pressure of the steam with the low pressure section extracting the last available energy until the steam is operating under vacuum pressure.

**Stage 4:** the wet steam from the low pressure section of the steam turbine then enters the condenser where it is condensed back into a saturated liquid which is returned to stage 1. The solar field provides the heat input into stage 2 and for the re-heater in stage 3. As the heat transfer fluid or water is circulated through the solar field / power tower receiver, light from the sun reflects off the solar collectors (i.e. parabolic troughs / heliostats) and is concentrated on the heat collection elements located at the focal point of the parabolic troughs / receiver. Fluid flowing through these elements absorbs the heat and provides a high-temperature energy source for the entire cycle.

Low quality waste heat is rejected at stage 4. As the turbine exhaust is condensed, the heat is transferred to the cooling tower circulating water. The warm cooling tower circulating water carries the heat to the wet, mechanical draft cooling tower where the heat is rejected via evaporation and convection, returning cooled water to the condenser.



**Figure 2.4:** Illustration of the power tower operating system

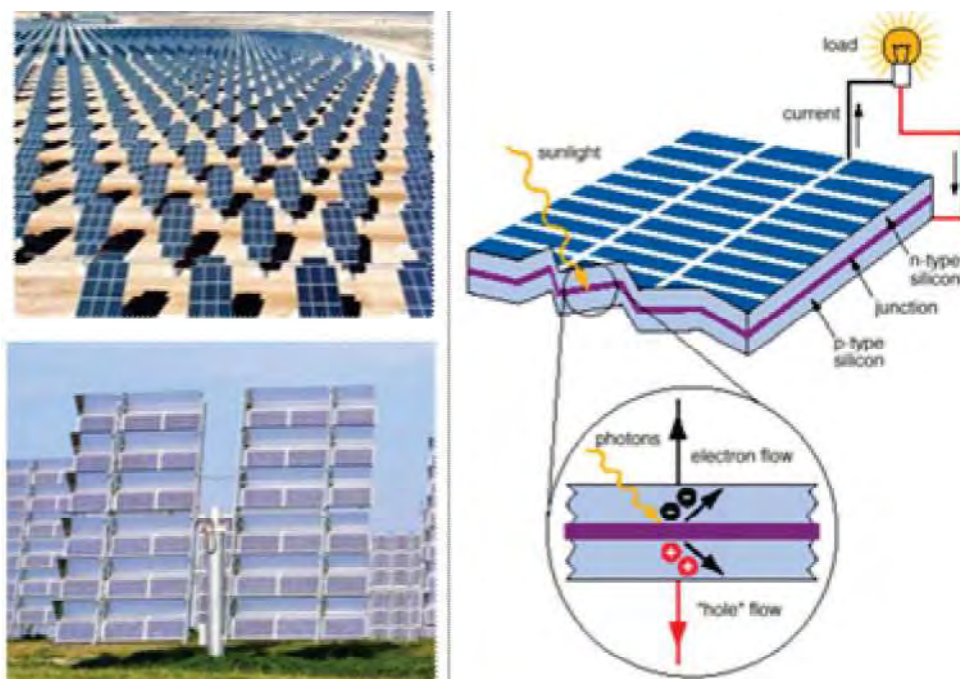
## 2.4. Details of the functioning of a Photovoltaic Facility

Photovoltaic (PV) facilities use semiconductors/PV cells which absorb solar energy to produce electricity through the "Photovoltaic Effect." This physical process was discovered in 1839 by Edmund Becquerel who found that certain materials (i.e. silicon) produce electric current when exposed to light. Sunlight is composed of photons or "packets" of energy and when these photons strike the PV cells, they may be reflected or

absorbed, or they may pass right through. When a photon is absorbed, its energy is transferred to an electron in an atom of the semiconductor). Thereafter, the electron is able to escape from its normal position associated with that atom to become part of the current in an electrical circuit. Special electrical properties of the solar cell provide the voltage needed to drive the current through an external load (i.e. a light bulb) (refer to Figure 2.5).

The **individual PV cells** are commonly constructed from silicon and are linked together and placed behind a protective glass sheet to operate in unison as a PV panel. A single PV cell is sufficient to power a small device such as an emergency telephone, however to produce 5 MW of power, the proposed plant will require numerous cells arranged in multiples/arrays which will be fixed to **support structures or mounts**. In order to maximise the electricity generated these mounts need to be angled in such a fashion so to receive the maximum amount of solar radiation throughout the year. The preferred angle of the panels (which is dependent on the latitude of the proposed facility) may be adjusted to optimise for summer or winter solar radiation characteristics. This is further optimised through the utilisation of tracking technology, whereby the PV panels are able to 'track' the sun during the day.

The generated power can then be stored or evacuated into a local electricity grid to meet the load requirements. In the case of the latter, the electricity is evacuated to either a substation or a switching station which houses an inverter. The **inverter** serve convert the electricity, which is produced as direct current, into alternating current which can be used by individuals drawing power from the national electricity grid.



**Figure 2.5:** Basic operational mechanism behind the Photovoltaic Effect

Four primary factors affect the efficiency of a PV cell, these include:

***The operational temperature of the PV cell***

Higher ambient temperatures reduce the performance of PV panels. For example standard silicon panels lose about 0.5% of efficiency for every 1 degree of temperature increase (calculated by assuming an efficiency at 25°C is 100%), so a 15% efficient panel at 25°C would turn in to a 13.5% panel at PV cells typically get significantly hotter than the ambient temperature (i.e. 25°C hotter under normal conditions).

***The intensity of the incoming solar radiation***

The PV cell performance is directly proportional to the solar intensity. Therefore the efficiency is affected by the intensity of the sunlight on an optimally oriented panel at the specific location, at the specific time. Clouds cover would cause a further decrease in efficiency.

***The orientation of the panels with respect to the angle of the sun***

For best performance, terrestrial PV systems aim to maximise the time they face the sun. Solar trackers aim to achieve this by moving PV panels to follow the sun. The increase can be by as much as 20% in winter and by as much as 50% in summer. Static mounted systems can be optimised by analysis of the sun's path. Panels are often set to latitude tilt, an angle equal to the latitude, but performance can be improved by adjusting the angle for summer or winter. In standard PV applications trackers are used to minimise the angle of incidence between the incoming light and the PV panel. This increases the amount of energy produced from a fixed installed power generating capacity. Various tracker technologies are available and include single axis trackers (i.e. have one degree of freedom that acts as an axis of rotation) or Dual Axis trackers (i.e. have two degrees of freedom that act as axes of rotation). Compared to a fixed mount, a single axis tracker increases annual output by approximately 30% and a dual axis tracker by an additional 6%.

***The I-V operation point***

The power a panel delivers depends on the load it is supplying. Modern PV systems use maximum power point trackers which change the input impedance of the load for the panels to match changes in the panels due to sun light changes. This means you have to have the right resistance that the panels are outputting into to get maximum power.

***2.4.1 Functioning of PV Facilities***

PV facilities, unlike CSP, do not require water as the photovoltaic effect does not generate electricity through a conventional steam driven turbine. Instead the electricity that is generated is evacuated directly to the on-site substation through an inverter system. (The inverter system might require additional cooling in warm climates.)

## 2.5. Project Construction Phase

The construction phase is expected to take up to two to three years in total and will entail a series of activities including:

- » The **pre-construction phase** will include conducting surveys; undertaking site preparation and transporting the required components and equipment to site.
- » The **construction phase** will include establishment of internal and external access roads; establishment of construction areas; construction of the power island (i.e. steam turbine and generator); establishment of the solar array; establishment of ancillary infrastructure (i.e. powerline, pipeline and reservoirs); and connection of the substation to the Eskom power grid.
- » The **post-construction phase** will include site remediation.

The construction phase is expected to create approximately between 300 and 600 employment opportunities, of which approximately 60% would be low skilled positions (i.e. construction labourers, security staff etc) and semi-skilled workers (i.e. drivers, equipment operators etc), and 40% would be available to skilled personnel (i.e. engineers, land surveyors, project managers etc). The majority of the employment opportunities, specifically the skilled and semi-skilled opportunities, are likely to be associated with the contractors appointed to construct the facility and associated infrastructure.

### 2.5.1 Conduct Surveys

Prior to initiating construction, a number of surveys will be required including, but not limited to, a geotechnical survey, a site survey and confirmation of the micro-siting footprint for the troughs, heliostats, power tower and PV panel, survey of power island and substation site, and survey of power line, water supply and road servitudes.

### 2.5.2 Establishment of Access Roads to the Site

The broader site will be accessed via an external access road (i.e. either a 3 km road from the D3267 or a 6 km road directly from the N14).

Within the site itself, access will be required from this existing secondary road to the individual facility components for construction purposes (and later limited access for maintenance). The amount of earthworks and compaction required in the establishment of the access roads will be established through the detailed geotechnical study to be conducted for the site.

Depending on the technology choices there will be one internal asphalt access road of approximately 6 m wide which provide direct access to the power island. Between the



heliostats/troughs/photovoltaic panels there will be a stabilised gravel track that would be used for maintenance purposes during the operational phase. The final layout of the access roads will be determined following the identification of site related sensitivities.

### ***2.5.3 Undertake Site Preparation***

Site preparation activities will include clearance of vegetation for the establishment of internal access roads and at the footprint of each project component. These activities will require the stripping of topsoil which will need to be stockpiled, backfilled and/or spread on site.

### ***2.5.4 Transport of Components and Equipment to Site***

The components for the proposed facility will be transported to site in sections by road. Some of the power station components (especially those associated with the power island) may be defined as abnormal loads in terms of the Road Traffic Act (Act No. 29 of 1989)<sup>1</sup> by virtue of the dimensional limitations (i.e. length and weight). Components of various specialised construction and lifting equipment are required (e.g. for the power tower) and will need to be transported to site. In addition to the specialised lifting equipment/cranes, the typical civil engineering construction equipment will need to be brought to the site (e.g. excavators, trucks, graders, compaction equipment, cement trucks, etc.) as well as components required for the establishment of the substation and power line.

The equipment will be transported to the site using appropriate National, Provincial and local roads, and then the dedicated access/haul road to the site itself.

### ***2.5.5 Establishment of Construction Camps and Laydown Areas***

Once the required equipment has been transported to site, a dedicated construction equipment camp will need to be established. The purpose of this camp is to confine activities and storage of equipment to one designated area to limit the potential ecological impacts associated with this phase of the project. The storage of fuel for the on-site construction vehicles and equipment will need to be secured in a temporary bunded facility so to prevent the possibility of leakages and soil contamination. A dedicated area for a batching plant will also need to be established (a batching plant is used to measure the quantities of different materials required to make a correct mix of concrete).

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<sup>1</sup> A permit will be required for the transportation of these abnormal loads on public roads.

Laydown and storage areas will be required for the typical construction equipment which will be required on site. Hard standing areas will also need to be established for the operation of any cranes to be used on the site.

### **2.5.6 Assemble and construct Solar Arrays**

The solar array components will be assembled on-site. The solar arrays will comprise the following components:

- » Parabolic troughs (~100 ha)
- » Heliostat field and Power Tower (~ 300 ha)
- » PV panels (over ~60 ha)
- » Cabling (underground)

The parabolic troughs plant will be established as numerous modules (i.e. each of approximately 12.5 m) which will be linked to form a collector of approximately 150 m. A trough loop will consist of 4 collectors in series of approximately 300 m in length. A total of 60 - 120 loops will be established which will function as a single unit for an output of 50 MW. Each collector module will be supported by pylons which will form part of a concrete foundation. The pylons will lift the troughs off the ground to a height of 5 m. A central pylon will be located between each collector.

Each heliostat mirror will be approximately 120 m<sup>2</sup> and will be supported on a 6 m high pedestal which will be supported by a concrete foundation. The heliostat field will be orientated mainly to the southern side of the power tower in order to reflect the sun's rays onto the central receiver. Approximately 4 000 – 5 000 heliostats will be used in a 50 MW plant.

Numerous PV panels will be linked together to form a single operating unit mounted on a sun tracker very similar to the heliostats described above. The PV plant is likely to comprise approximately 400 trackers each rated at about 25 kW. The "feet" of the support structure of the PV panels will also be placed on concrete foundations.

### **2.5.7 Construct Power Island and Substation**

The power island (with an approximate footprint of 20 000m<sup>2</sup>) and will include the following components:

- » The steam turbine generator and the associated heat exchangers
- » A water cooled condenser
- » Feed water pumps and heaters
- » A wet cooling tower
- » The substation

The construction of the power island and substation would require a survey of the site, site clearing and levelling and construction of access road/s (where required), construction of a level terrace and foundations, assembly, erection, installation and connection of equipment, and rehabilitation of any disturbed areas and protection of erosion sensitive areas.

### ***2.5.8 Establish Water Supply Pipeline and Associated Infrastructure***

Ancillary infrastructure includes a water supply pipeline to the facility from the abstraction point on the Orange (Gariep) River, a de-gritting and basic filtration facility at the abstraction point, a water treatment plant and water storage facilities on the site, and a blow down/evaporation pond (for wastewater from the generation process).

The establishment of these facilities will require the clearing of vegetation and levelling of the development site and the excavation of foundations prior to construction.

#### ***Water supply***

The proposed abstraction point on the Orange River is located on private property where existing infrastructure for the abstraction point exists. Ancillary infrastructure includes a water supply pipeline to the facility from the abstraction point, a de-gritting and basic filtration facility near the abstraction point, a water treatment plant and water storage facilities on the site, and a blow down/evaporation pond (for wastewater from the generation process). The establishment of these facilities will require the clearing of vegetation and levelling of the development site and the excavation of foundations prior to construction.

The abstraction point of the pump sets will be at the end of the culverts at the toe of the existing DWA embankment. The pump sets will be mounted on slides to move them up and down according to the water level of the river. The electrical switch gear will be installed at a point on the embankment above the 1:50 year flood line. The new embankment will be protected against erosion by gabions and stone pitching.

A PVC water supply pipeline will be constructed to convey the water to the facility. From the abstraction point pump set, the proposed delivery pipeline route will be at the toe of the existing embankment in a north-westerly direction at a point just outside the 1:50 year flood line. The pipeline route will then cross under the N14 and the existing railway line. From that point, the pipeline route will follow an alignment parallel to the road reserve of the D3267 gravel road to the facility.

A reservoir will be located approximately 0.6 km north-west of the abstraction point close to an existing gravel borrow pit and will be used as a de-gritting facility for the raw water abstracted from the Orange River (i.e. to rid the water of particles in suspension prior to pumping). It will have a storage capacity of approximately 5 000 m<sup>3</sup>. A second



reservoir will be located within the boundaries of the identified site at the plant. It will have a storage capacity of approximately 10 000m<sup>3</sup>."

### ***Water treatment***

A number of evaporation ponds are proposed within the development footprint to receive and store the wastewater generated from the electricity generation process as the proposed facility will be operated as a Zero Liquid Effluent Discharge (ZLED) facility. The evaporation ponds will be double-lined with a surface area of approximately 25 000 m<sup>2</sup>.

### ***2.5.9 Connect Substation to Power Grid***

An overhead power line utilising a monopole structure will be established to feed into the Eskom grid via a "turn in and turn out" configuration to the existing Eskom 132 kV distribution line running approximately 4 km south of the site. This line connects Eskom's Gordonia Distribution Substation (close to Upington) to the Oasis Distribution Substation (close to Keimoes).

### ***2.5.10 Undertake Site Remediation***

As construction is completed in an area, and as all construction equipment is removed from the site, the site must be rehabilitated where practical and reasonable. On full commissioning of the facility, any access points to the site which are not required during the operation phase will be closed and prepared for rehabilitation. The methodology for site remediation is included in the Draft Environmental Management Plan (EMP). The EMP will provide objectives for returning the site to the pre-establishment conditions and will provide measures to mitigate/manage the potential impacts expected during the construction phase.

## **2.6. Project Operation Phase**

The operations phase is discussed in more detail below.

### ***2.6.1 Solar Array***

The parabolic troughs and the heliostat field and power tower combination will receive the heat of the incoming solar radiation during daylight hours. This energy will be used to heat water for the production of steam in order to drive a conventional steam turbine generator.

### **2.6.2 Power Island**

The power island will be comprised of a steam turbine and generator (i.e. which will be established and housed within a 2-storey building), a generator transformer, a small substation, an auxiliary steam boiler and associated vessels.

The auxiliary steam boiler will be used to provide process steam to the facility (i.e. to supplement generation). The fuel (i.e. diesel or liquid petroleum gas (LPG)), sizing, and usage characteristics of the boiler will be dependent on the REFIT and the associated economics.

### **2.6.3 Water supply, use, and treatment**

Raw water will be pumped from an abstraction point on the Orange (Gariep) River. Abstracted water will be pumped to a settlement reservoir (for de-gritting plant) located approximately 0.6 km north-west of the abstraction point. A second storage reservoir will be located approximately 8.5 km west of the abstraction point within the boundaries of the identified site. The water use of the facility will include (refer to Table 2.1):

- » Makeup water for the circulating water system and cooling tower
- » Makeup water for the steam generator
- » Water for mirror washing
- » Service water
- » Potable water
- » Fire protection water

**Table 2.1:** Estimated water consumption for the proposed facility

<b>Description</b>	<b>Approximate daily use (m<sup>3</sup>/day)</b>
Raw water	3000
Cooling tower	2300
Plant use	600
Evaporation ponds	100

In order to reduce the overall water consumption and the requisite sizing of the evaporation ponds, service water will first be used as makeup to the cooling tower and circulating water system. Water conditioning chemicals may be fed into the makeup water to minimise corrosion and to inhibit mineral scale formation. The blow down from the circulating water will be continually treated by lime-softening clarification and filtration processes and then delivered to a clear well where the water will be treated by reverse osmosis prior to being used for other plant requirements. Prior to the reverse osmosis process, ion-exchange softeners will be used to remove any dissolved hardness minerals that remain after the clarifier. The discard brine stream will be delivered to the evaporation ponds.

Multiple evaporation ponds are proposed within the development footprint to receive and store the wastewater generated from the electricity generation process as the proposed facility will be operated as a Zero Liquid Effluent Discharge (ZLED) facility. The ponds are planned in order to allow plant operations to continue in event that a pond needs to be taken out of service for maintenance purposes. The surface area will be sufficient so that the evaporation rate will exceed the blow down rate from the generation process. The depth of the ponds will be selected so that residual solids will not need to be removed during the lifetime of the facility.

#### **2.6.4 Site Operation and Maintenance**

It is anticipated that a full-time security, maintenance, and control room staff will be required on site. The proposed facility will employ approximately 60 - 80 fulltime employees over a 30 year period. Each component within the facility will be operational except under circumstances of mechanical breakdown, unfavourable weather conditions, or maintenance activities.

### **2.7. Project Decommissioning Phase**

The facility is expected to have a lifespan of approximately 30 (with maintenance extendable to 50) and the power plant infrastructure would only be decommissioned once it has reached the end of its economic life. It is most likely that decommissioning activities of the infrastructure of the facility discussed in this EIA would comprise the disassembly and replacement of the individual components with more appropriate technology/infrastructure available at that time.

The following decommissioning activities will form part of the project scope.

#### **2.7.1. Site Preparation**

Site preparation activities will include confirming the integrity of the access to the site to accommodate the required equipment (e.g. lay down areas, construction platform) and the mobilisation of decommissioning equipment.

#### **2.7.2. Disassemble and Replace Existing Components**

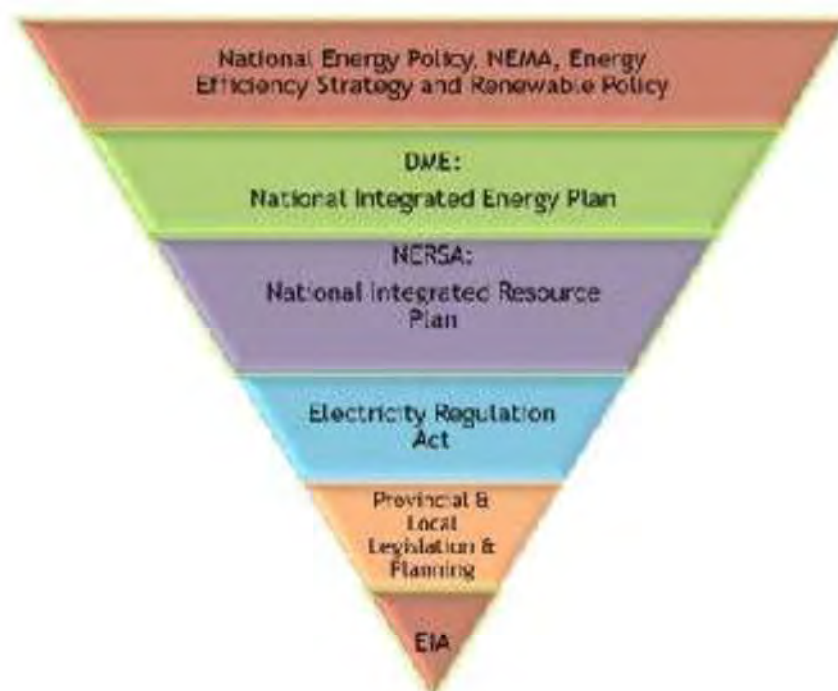
The components would be disassembled, and reused and recycled (where possible), or disposed of in accordance with regulatory requirements.

## REGULATORY AND LEGAL CONTEXT

## CHAPTER 3

### 3.1 Policy and Planning Context for Solar Energy Facility Development in South Africa

The need to expand electricity generation capacity in South Africa is based on **national policy** and informed by on-going strategic planning undertaken by the Department of Energy (DoE), the National Energy Regulator of South Africa (NERSA) and Eskom. The hierarchy of policy and planning documentation that support the development of renewable energy projects such as solar energy facilities is illustrated in Figure 3.1. These policies are discussed in more detail in the following sections, along with the provincial and local policies or plans that have relevance to the proposed solar energy facility's development.



**Figure 3.1:** Hierarchy of electricity policy and planning documents

#### 3.1.1 White Paper on the Energy Policy of the Republic of South Africa, 1998

Development within the energy sector in South Africa is governed by the White Paper on a National Energy Policy (the National Energy Policy), published by the Department of Minerals and Energy (DME) in 1998. This White Paper identifies key objectives for energy supply within South Africa, such as increasing access to affordable energy services, managing energy-related environmental impacts and securing energy supply through diversity.

Investment in renewable energy initiatives, such as the proposed solar energy facility, is supported by the White Paper on Energy Policy for South Africa. In this regard the document notes that government policy is based on an understanding that renewable energy sources have significant medium - long-term commercial potential and can increasingly contribute towards a long-term sustainable energy future in South Africa. The support for renewable energy policy is guided by a rationale that South Africa has a very attractive range of renewable resources, particularly **solar** and wind and that renewable applications are in fact the least cost energy service in many cases; more so when social and environmental costs are taken into account.

### **3.1.2 Renewable Energy Policy in South Africa, 1998**

The White Paper on Renewable Energy (DME, 2003) supplements the Energy Policy, and sets out Government's vision, policy principles, strategic goals, and objectives for promoting and implementing renewable energy in South Africa. The support for the Renewable Energy Policy is guided by a rationale that South Africa has a very attractive range of renewable resources, particularly solar and wind, and that renewable applications are, in fact, the least cost energy service in many cases from a fuel resource perspective (i.e. the cost of fuel in generating electricity from such technology); more so when social and environmental costs are taken into account. Government policy on renewable energy is therefore concerned with meeting economic, technical, and other constraints on the development of the renewable industry.

In order to meet the long-term goal of a sustainable renewable energy industry, the South African Government has set the following 10-year target for renewable energy: *"10 000 GWh (0.8 Mtoe) renewable energy contribution to final energy consumption by 2013 to be produced mainly from biomass, wind, solar and small-scale hydro. The renewable energy is to be utilised for power generation and non-electric technologies such as solar water heating and bio-fuels. This is approximately 4% (1 667 MW) of the estimated electricity demand (41 539 MW) by 2013"* (DME, 2003).

The White Paper on Renewable Energy states *"It is imperative for South Africa to supplement its existing energy supply with renewable energies to combat Global Climate Change which is having profound impacts on our planet."*

### **3.1.3 Integrated Energy Plan (IEP), 2003**

In response to the requirements of the National Energy Policy, the DME commissioned the Integrated Energy Plan (IEP) to provide a framework in which specific energy policies, development decisions and energy supply trade-offs can be made on a project-by-project basis. The framework is intended to create a balance between the energy demand and resource availability to provide low cost electricity for social and economic development, while taking into account health, safety, and environmental parameters.

The current IEP recognises that South Africa is likely to be reliant on coal for at least the next 20 years as the predominant source of energy. However, there is potential and a need to diversify energy supply through increased use of natural gas and new and renewable energies.

#### **3.1.4 National Integrated Resource Plan (NIRP), 2003/2004**

In response to the National Energy Policy's objective relating to affordable energy services, NERSA commissioned a National Integrated Resource Plan (NIRP) in order to provide a long-term (from 2003 to 2022), cost-effective resource plan for meeting electricity demand, which is consistent with reliable electricity supply and environmental, social and economic policies. The planning horizon for the study was from 2003 to 2022. The objective of the NIRP is to determine the least-cost supply option for the country, provide information on the opportunities for investment into new power generating projects, and evaluate the security of supply. The Long-term Electricity Planning goal is to ensure sustainable development considering technical constraints, economic constraints, social constraints, and externalities.

Various demand side management and supply-side options are considered in the NIRP process, prior to identifying the least cost supply options for South Africa. The outcome of the process confirmed that coal-fired options are still required over the next 20 years and that additional base load plants will be required from 2010.

The first and interim IRP was developed in 2009 by the Department of Energy. The initial four years of this plan was promulgated by the Minister of Energy on 31 December 2009, updated on 29 January 2010 (<http://www.doe-irp.co.za/>). The Department of Energy is currently revisiting and revising the IRP, with the IRP2010 expected to be published by end-October 2010.

#### **3.1.5 Electricity Regulation Act, 2006**

To contribute towards the renewable energy target set by the Government, socio-economic and environmentally sustainable growth, and kick start and stimulate the renewable energy industry in South Africa, Renewable Energy Feed-in Tariffs (REFIT) have been set by the National Energy Regulator of South Africa (NERSA). REFITs are, in essence, guaranteed prices for electricity supply rather than conventional consumer tariffs. The basic economic principle underpinning the REFITs is the establishment of a tariff (price) that covers the cost of generation plus a "reasonable profit" to induce developers to invest. This is quite similar to the concept of cost recovery used in utility rate regulation based on the costs of capital. Feed-in tariffs to promote renewable energy have now been adopted in over 36 countries around the world. The establishment of the Renewable Energy Feed-In Tariff (REFIT) in South Africa provides the opportunity for an increased contribution towards the sustained growth of the

renewable energy sector in the country, the region and internationally, and promote competitiveness for renewable energy with conventional energies in the medium- and long-term. Under the National Energy Regulator Act, 2004 (Act No 40 of 2004), the Electricity Regulation Act, 2006 (Act No 4 of 2006) and all subsequent relevant Acts of Amendment, NERSA has the mandate to determine the prices at and conditions under which electricity may be supplied by licence to Independent Power Producers (IPPs).

### 3.2. Regulatory Hierarchy for Energy Generation Projects

The South African energy industry is evolving rapidly, with regular changes to legislation and industry role-players. The regulatory hierarchy for an energy generation project of this nature consists of three tiers of authority who exercise control through both statutory and non-statutory instruments – that is National, Provincial and Local levels.

At National Level, the main regulatory agencies are:

<i>Department of Energy (formerly DME)</i>	This department is responsible for policy relating to all energy forms, including renewable energy. Solar energy is considered under the White Paper for Renewable Energy and the Department undertakes research in this regard. It is the controlling authority in terms of the Electricity Act (Act No 41 of 1987).
<i>National Energy Regulator of South Africa (NERSA)</i>	This body is responsible for regulating all aspects of the electricity sector, and will ultimately issue licenses for solar energy developments to generate electricity.
<i>Department of Environmental Affairs (DEA)</i>	This Department is responsible for environmental policy and is the controlling authority in terms of NEMA and the EIA Regulations. The DEA is the competent authority for this project, and charged with granting the relevant environmental authorisation.
<i>The South African Heritage Resources Agency (SAHRA)</i>	The National Heritage Resources Act (Act No 25 of 1999) and the associated provincial regulations provides legislative protection for listed or proclaimed sites, such as urban conservation areas, nature reserves and proclaimed scenic routes.
<i>Department of Transport - Civil Aviation Authority (CAA)</i>	This department is responsible for aircraft movements and radar, which are aspects that may influence solar energy development location and planning (i.e. in terms of the power tower).
<i>South African National Roads Agency (SANRAL)</i>	This department is responsible for all National road routes.

At Provincial Level, the main regulatory agencies are:

<i>Provincial Government of the Northern Cape – Department of Environmental and Nature Conservation (DENC)</i>	This Department is responsible for environmental policy and is the Provincial authority in terms of NEMA and the EIA Regulations. The DENC is the commenting authority for this project.
<i>Department of Transport and Public Works</i>	This department is responsible for roads and the granting of exemption permits for the conveyance of abnormal loads on public roads.

At Local Level the local and municipal authorities are the principal regulatory authorities responsible for planning, land use, and the environment. In the Northern Cape, both Municipalities and District Municipalities play a role. The local municipality is the *Kai !Gariep Local Municipality*, which forms part of the Greater *Siyanda District Municipality*.

- » In terms of the Municipal Systems Act (Act No 32 of 2000) it is compulsory for all municipalities to go through an Integrated Development Planning (IDP) process to prepare a five-year strategic development plan for the area under their control.
- » Bioregional planning involves the identification of priority areas for conservation and their placement within a planning framework of core, buffer, and transition areas. These could include reference to visual and scenic resources and the identification of areas of special significance, together with visual guidelines for the area covered by these plans.
- » By-laws and policies have been formulated by local authorities to protect visual and aesthetic resources relating to urban edge lines, scenic drives, special areas, signage, communication masts, etc.

There are also numerous non-statutory bodies and environmental lobby groups that play a role in various aspects of planning and the environment that will influence solar energy development.

### 3.3 Legislation and Guidelines that have informed the preparation of this EIA Report

The following legislation and guidelines have informed the scope and content of this EIA Report:

- » National Environmental Management Act (Act No 107 of 1998)
- » EIA Regulations, published under Chapter 5 of the NEMA (GN R543, GN R544 and GN R546 in Government Gazette 33306 of 18 June 2010)
- » Guidelines published in terms of the NEMA EIA Regulations, in particular:
  - \* Guideline 3: General Guide to Environmental Impact Assessment Regulations, 2006 (DEAT, June 2006)
  - \* Guideline 4: Public Participation in support of the Environmental Impact Assessment Regulations, 2006 (DEAT, May 2006)



- \* Guideline 5: Assessment of alternatives and impacts in support of the Environmental Impact Assessment Regulations, 2006 (DEAT, June 2006)

Acts, standards or guidelines which have informed the project process and the scope of issues assessed within this EIA are summarised in Table 3.1.

**Table 3.1:** Relevant legislative permitting requirements applicable to the solar energy facility

Legislation	Applicable Requirements	Relevant Authority	Compliance requirements
<b>National Legislation</b>			
National Environmental Management Act (Act No 107 of 1998)	<ul style="list-style-type: none"> <li>» EIA Regulations have been promulgated in terms of Chapter 5. Activities which may not commence without an environmental authorisation are identified within these Regulations.</li> <li>» In terms of S24(1) of NEMA, the potential impact on the environment associated with these listed activities must be considered, investigated, assessed and reported on to the competent authority (the decision-maker) charged by NEMA with granting of the relevant environmental authorisation.</li> <li>» In terms of GNR 387 of 21 April 2006, a scoping and EIA process is required to be undertaken for the proposed project.</li> </ul>	<ul style="list-style-type: none"> <li>» National Department of Environmental Affairs – lead authority</li> <li>» NC DENC - commenting authority</li> </ul>	<ul style="list-style-type: none"> <li>» This EIA Report is to be submitted to the DEA and Provincial Environmental Department in support of the application for authorisation.</li> </ul>
National Environmental Management Act (Act No 107 of 1998)	<ul style="list-style-type: none"> <li>» In terms of the Duty of Care provision in S28(1) the project proponent must ensure that reasonable measures are taken throughout the life cycle of this project to ensure that any pollution or degradation of the environment associated with this project is avoided, stopped or minimised.</li> <li>» In terms of NEMA, it has become the legal duty of a project proponent to consider a</li> </ul>	<ul style="list-style-type: none"> <li>» Department of Environmental Affairs (as regulator of NEMA)</li> </ul>	<ul style="list-style-type: none"> <li>» While no permitting or licensing requirements arise directly by virtue of the proposed project, this section will find application during the EIA phase and will continue to apply throughout the life cycle of the project.</li> </ul>

	project holistically, and to consider the cumulative effect of a variety of impacts.		
Environment Conservation Act (Act No 73 of 1989)	» National Noise Control Regulations (GN R154 dated 10 January 1992).	<ul style="list-style-type: none"> <li>» National Department of Environmental Affairs</li> <li>» NC DENC - commenting authority</li> <li>» Local Authorities</li> <li>» District &amp; Local Municipality</li> </ul>	» There is no requirement for a noise permit in terms of the legislation. Noise impacts may result from specific activities carried out during the construction phase of the project and could present an intrusion impact to the local community. Any such specific activities should be limited to 6:00am to 6:00pm Monday – Saturday (excluding public holidays). Should these specific activities need to be undertaken outside of these times, the surrounding communities will need to be notified and appropriate approval will be obtained from the DEA and the Local Municipality.
National Water Act (Act No 36 of 1998)	» Water uses must be licensed unless such water use falls into one of the categories listed in S22 of the Act or falls under the general authorisation.	» Department of Water Affairs	» The abstraction of water is regarded as a water use (as defined in terms of S21 of the NWA). A water use license is being applied for in parallel with the EIA process.
National Water Act (Act No 36 of 1998)	» In terms of S19, the project proponent must ensure that reasonable measures are taken throughout the life cycle of this	» Department of Water Affairs (as regulator of NWA)	» This section will apply throughout the life cycle of the project.

	project to prevent and remedy the effects of pollution to water resources from occurring, continuing, or recurring.		
Minerals and Petroleum Resources Development Act (Act No 28 of 2002)	<ul style="list-style-type: none"> <li>» A mining permit or mining right may be required where a mineral in question is to be mined (e.g. materials from a borrow pit) in accordance with the provisions of the Act.</li> <li>» Requirements for Environmental Management Programmes and Environmental Management Plans are set out in S39 of the Act.</li> </ul>	» Department of Minerals and Energy	» As no borrow pits are expected to be required for the construction of the facility, no mining permit or right is required to be obtained.
Atmospheric Pollution Prevention Act (Act No 45 of 1965)	<ul style="list-style-type: none"> <li>» In terms of S27, the Minister may declare certain areas dust control areas. (The project study area has not been declared a dust control area).</li> <li>» Part V of Act regulates pollution generated by vehicle fumes.</li> </ul>	» National Department of Environmental Affairs	» Although there is no legal obligation relating to the activities to be undertaken it is suggested that best practice means should be used to prevent dust generation from the roads and excavations during construction.
National Environmental Management: Air Quality Act (Act No 39 of 2004)	<ul style="list-style-type: none"> <li>» S18, S19, and S20 of the Act allow certain areas to be declared and managed as "priority areas."</li> <li>» Declaration of controlled emitters (Part 3 of Act) and controlled fuels (Part 4 of Act) with relevant emission standards.</li> </ul>	» National Department of Environmental Affairs	<ul style="list-style-type: none"> <li>» While no permitting or licensing requirements arise from this legislation, this act will find application during the operational phase of the project.</li> <li>» The Act provides that an air quality officer may require any person to submit an atmospheric impact report if there is reasonable suspicion that the person has failed to comply with</li> </ul>

<p>National Heritage Resources Act (Act No 25 of 1999)</p>	<ul style="list-style-type: none"> <li>» S38 states that Heritage Impact Assessments (HIAs) are required for certain kinds of development including <ul style="list-style-type: none"> <li>» The construction of a road, power line, pipeline, canal or other similar linear development or barrier exceeding 300 m in length;</li> <li>» Any development or other activity which will change the character of a site exceeding 5 000 m<sup>2</sup> in extent.</li> </ul> </li> <li>» The relevant Heritage Resources Authority must be notified of developments such as linear developments (such as roads and power lines), bridges exceeding 50 m, or any development or other activity which will change the character of a site exceeding 5 000 m<sup>2</sup>; or the re-zoning of a site exceeding 10 000 m<sup>2</sup> in extent. This notification must be provided in the early stages of initiating that development, and details regarding the location, nature and extent of the proposed development must be provided.</li> <li>» Stand alone HIAs are not required where an EIA is carried out as long as the EIA contains an adequate HIA component that fulfils the provisions of S38. In such cases only those components not addressed by the EIA should be covered by the heritage component.</li> </ul>	<ul style="list-style-type: none"> <li>» South African Heritage Resources Agency (SAHRA) – National heritage sites (grade 1 sites) as well as all historic graves and human remains</li> </ul>	<p>the Act.</p> <ul style="list-style-type: none"> <li>» A permit may be required should identified cultural/heritage sites on site be required to be disturbed or destroyed as a result of the proposed development.</li> <li>» S4 of the NHRA provides that within 14 days of receipt of notification the relevant Heritage Resources Authority must notify the proponent to submit an impact assessment report if they believe a heritage resource may be affected.</li> </ul>
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Nature Conservation Ordinance (Act 19 of 1974)	<ul style="list-style-type: none"> <li>» Article 63 prohibits the picking of certain fauna (including cutting, chopping, taking, and gathering, uprooting, damaging, or destroying).</li> <li>» Schedule 3 lists endangered flora and Schedule 4 lists protected flora.</li> <li>» Articles 26 to 47 regulate the use of wild animals.</li> </ul>	» National Department of Environmental Affairs	» Compliance requirements
National Environmental Management: Biodiversity Act (Act No 10 of 2004)	<ul style="list-style-type: none"> <li>» In terms of S57, the Minister of Environmental Affairs has published a list of critically endangered, endangered, vulnerable, and protected species in GNR 151 in Government Gazette 29657 of 23 February 2007 and the regulations associated therewith in GNR 152 in GG29657 of 23 February 2007, which came into effect on 1 June 2007.</li> <li>» In terms of GNR 152 of 23 February 2007: Regulations relating to listed threatened and protected species, the relevant specialists must be employed during the EIA phase of the project to incorporate the legal provisions as well as the regulations associated with listed threatened and protected species (GNR 152) into specialist reports in order to identify permitting requirements at an early stage of the EIA phase.</li> </ul>	» National Department of Environmental Affairs	<ul style="list-style-type: none"> <li>» As the applicant will not carry on any restricted activity, as is defined in Section 1 of the Act, no permit is required to be obtained in this regard.</li> <li>» Specialist flora and fauna studies are required to be undertaken as part of the EIA process. These studies have been undertaken as part of the previously EIAs undertaken for the power station site.</li> <li>» A permit may be required should any protected plant species on site be disturbed or destroyed because of the proposed development.</li> </ul>
Conservation of Agricultural Resources Act (Act No 43 of 1983)	» Regulation 15 of GNR1048 provides for the declaration of weeds and invader	» Department of Agriculture	» While no permitting or licensing requirements arise from this

1983)	plants, and these are set out in Table 3 of GNR1048. Weeds are described as Category 1 plants, while invader plants are described as Category 2 and Category 3 plants. These regulations provide that Category 1, 2 and 3 plants must not occur on land and that such plants must be controlled by the methods set out in Regulation 15E.		legislation, this Act will find application during the EIA phase and will continue to apply throughout the life cycle of the project. In this regard, soil erosion prevention and soil conservation strategies must be developed and implemented. In addition, a weed control and management plan must be implemented.
National Veld and Forest Fire Act (Act 101 of 1998)	<ul style="list-style-type: none"> <li>» In terms of Section 21 the applicant would be obliged to burn firebreaks to ensure that should a veldfire occur on the property, that it does not spread to adjoining land.</li> <li>» In terms of section 12 the applicant must ensure that the firebreak is wide and long enough to have a reasonable chance of preventing the fire from spreading, not causing erosion, and is reasonably free of inflammable material.</li> <li>» In terms of section 17, the applicant must have such equipment, protective clothing, and trained personnel for extinguishing fires.</li> </ul>	» Department of Water Affairs	» While no permitting or licensing requirements arise from this legislation, this act will find application during the operational phase of the project.
Aviation Act (Act No 74 of 1962) 13 <sup>th</sup> amendment of the Civil Aviation Regulations (CARS) 1997	» Any structure exceeding 45 m above ground level or structures where the top of the structure exceeds 150 m above the mean ground level, the mean ground level	» Civil Aviation Authority (CAA)	» While no permitting of licence requirements arise from the legislation, this act will find application during the operational

	<p>considered the lowest point in a 3km radius around such structure.</p> <p>» Structures lower than 45 m, which are considered as a danger to aviation shall be marked as such when specified.</p>		<p>phase of the project. Appropriate marking is required to meet the specifications as detailed in the CAR Part 139.01.33.</p>
<p>Hazardous Substances Act (Act No 15 of 1973)</p>	<p>» This Act regulates the control of substances that may cause injury, or ill health, or death because of their toxic, corrosive, irritant, strongly sensitising, or inflammable nature or the generation of pressure thereby in certain instances and for the control of certain electronic products. To provide for the rating of such substances or products in relation to the degree of danger; to provide for the prohibition and control of the importation, manufacture, sale, use, operation, modification, disposal or dumping of such substances and products.</p> <p>» Group I and II: Any substance or mixture of a substance that might by reason of its toxic, corrosive etc, nature or because it generates pressure through decomposition, heat or other means, cause extreme risk of injury etc., can be declared to be Group I or Group II hazardous substance;</p> <p>» Group IV: any electronic product;</p> <p>» Group V: any radioactive material.</p> <p>The use, conveyance, or storage of any hazardous substance (such as distillate fuel) is</p>	<p>» Department of Health</p>	<p>» It is necessary to identify and list all the Group I, II, III, and IV hazardous substances that may be on the site and in what operational context they are used, stored or handled. If applicable, a license is required to be obtained from the Department of Health.</p>



	prohibited without an appropriate license being in force.		
National Road Traffic Act (Act No 93 of 1996)	<ul style="list-style-type: none"> <li>» The Technical Recommendations for Highways (TRH 11): "Draft Guidelines for Granting of Exemption Permits for the Conveyance of Abnormal Loads and for other Events on Public Roads" outline the rules and conditions which apply to the transport of abnormal loads and vehicles on public roads and the detailed procedures to be followed in applying for exemption permits are described and discussed.</li> <li>» Legal axle load limits and the restrictions imposed on abnormally heavy loads are discussed in relation to the damaging effect on road pavements, bridges, and culverts.</li> <li>» The general conditions, limitations, and escort requirements for abnormally dimensioned loads and vehicles are also discussed and reference is made to speed restrictions, power/mass ratio, mass distribution, and general operating conditions for abnormal loads and vehicles. Provision is also made for the granting of permits for all other exemptions from the requirements of the National Road Traffic Act and the relevant Regulations.</li> </ul>	<p>Provincial Department of Transport (provincial roads)</p> <ul style="list-style-type: none"> <li>» South African National Roads Agency Limited (national roads)</li> </ul>	<ul style="list-style-type: none"> <li>» An abnormal load/vehicle permit may be required to transport the various components to site for construction. These include route clearances and permits will be required for vehicles carrying abnormally heavy or abnormally dimensioned loads.</li> <li>» Transport vehicles exceeding the dimensional limitations (length) of 22m.</li> <li>» Depending on the trailer configuration and height when loaded, some of the power station components may not meet specified dimensional limitations (height and width).</li> </ul>

Development Facilitation Act (Act No 67 of 1995)	<ul style="list-style-type: none"> <li>» Provides for the overall framework and administrative structures for planning throughout the Republic</li> <li>» Sections 2- 4 provide general principles for land development and conflict resolution.</li> </ul>	» Local Municipality, District Municipality	» The applicant must submit a land development application in the prescribed manner and form as provided for in the Act. A land development applicant who wishes to establish a land development area must comply with procedures set out in the DFA.
Subdivision of Agricultural Land Act (Act No 70 of 1970)	» Details land subdivision requirements and procedures. Applies for subdivision of all agricultural land in the province.	» Local Municipality, District Municipality	<ul style="list-style-type: none"> <li>» Subdivision will have to be in place prior to any subdivision approval in terms of Section 24 and 17 of LUPO.</li> <li>» Subdivision is required to be undertaken following the issuing of an environmental authorisation for the proposed project.</li> </ul>
National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008)	<ul style="list-style-type: none"> <li>» The Minister may by notice in the <i>Gazette</i> publish a list of waste management activities that have, or are likely to have, a detrimental effect on the environment.</li> <li>» The Minister may amend the list by— <ul style="list-style-type: none"> <li>(a) Adding other waste management activities to the list;</li> <li>(b) Removing waste management activities from the list; or</li> <li>(c) Making other changes to the particulars on the list.</li> </ul> </li> <li>» In terms of the Regulations published in terms of this Act (GN 718), A Basic</li> </ul>	National Department of Water and Environmental Affairs (hazardous waste and effluent) Provincial Department of Environmental Affairs (general waste)	<p>As no waste disposal site is to be associated with the proposed project, <b>no permit</b> is required in this regard.</p> <p>Waste handling, storage and disposal during construction and operation is required to be undertaken in accordance with the requirements of this Act, as detailed in the EMP.</p>

	<p>Assessment or Environmental Impact Assessment is required to be undertaken for identified listed activities.</p> <p>» Any person who stores waste must at least take steps, unless otherwise provided by this Act, to ensure that</p> <p>(a) the containers in which any waste is stored, are intact and not corroded or in any other way rendered unfit for the safe storage of waste;</p> <p>(b) adequate measures are taken to prevent accidental spillage or leaking;</p> <p>(c) the waste cannot be blown away;</p> <p>(d) nuisances such as odour, visual impacts and breeding of vectors do not arise; and</p> <p>(e) Pollution of the environment and harm to health are prevented.</p>		
Promotion of Access to Information Act (Act No 2 of 2000)	» All requests for access to information held by state or private body are provided for in the Act under S11.	» National Department of Environmental Affairs (DEA)	» No permitting or licensing requirements
Promotion of Administrative Justice Act (Act No 3 of 2000)	<p>» In terms of S3 the government is required to act lawfully and take procedurally fair, reasonable, and rational decisions.</p> <p>» Interested and affected parties have right to be heard.</p>	» National Department of Environmental Affairs (DEA)	» No permitting or licensing requirements
National Forests Act (Act No 84 of 1998)	» In terms of section 15(1) "no person may cut, disturb, damage or destroy any protected tree or possess, collect, remove, transport, export, purchase, sell	» National Department of Environmental Affairs (DEA)	» A permit would need to be obtained for any protected trees that are affected.

	donate or in any other manner acquire or dispose of any protected tree or any forest product derived from a protected tree, except under a license granted by the Minister to an (applicant and subject to such period and conditions as may be stipulated".		
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## APPROACH TO UNDERTAKING THE ENVIRONMENTAL IMPACT ASSESSMENT PHASE CHAPTER 4

An EIA process refers to the process dictated by the EIA Regulations which involves the identification of and assessment of direct, indirect, and cumulative environmental impacts associated with a proposed project. The EIA process comprises two phases: **Scoping Phase** and **EIA Phase**. The EIA process culminates in the submission of an EIA Report (including an environmental management plan (EMP)) to the competent authority for decision-making. The EIA process is illustrated below:



**Figure 4.1:** Phases within the EIA process

The EIA Phase for the proposed Upington Solar Thermal Plant has been undertaken in accordance with the EIA Regulations published in Government Notice 28753 of 21 April 2006, in terms of Section 24(5) of NEMA (Act No. 107 of 1998). The environmental studies for this proposed project were undertaken in two phases, in accordance with the EIA Regulations.

### 4.1. Phase 1: Scoping Study

The Scoping Study, which was completed in July 2010, provided interested and affected parties (I&APs) with the opportunity to receive information regarding the proposed project, to participate in the process and raise issues or concerns.

The Scoping Report aimed at detailing the nature and extent of the proposed facility, identifying potential issues associated with the proposed project, and defining the extent of studies required within the EIA Phase. This was achieved through an evaluation of the proposed project, involving the project proponent, specialist consultants, and a consultation process with key stakeholders that included both relevant government authorities and I&APs. In accordance with the requirements of the EIA Regulations, feasible project-specific alternatives were identified for consideration within the EIA process.

The Draft Scoping Report was made available the Khara Hais and Keimoes Public Libraries and on the Savannah Environmental website for I&AP review and comment. All the comments, concerns, and suggestions received during the Scoping Phase and the review period were included in the Final Scoping Report and Plan of Study for EIA. The Scoping Report was submitted to the National Department of Environmental Affairs (DEA) and the Northern Cape Department of Environment and Nature Conservation (DENC) in August 2010. The Final Scoping Report was accepted by the DEA, as the competent authority, on 28 September 2010. In terms of this acceptance, an EIA was required to be undertaken for the proposed project.

#### **4.2. Phase 2: Environmental Impact Assessment**

Through the Scoping Study, a number of issues requiring further study for all components of the project were highlighted. These issues have been assessed in detail within the EIA phase of the process.

The EIA Phase aims to achieve the following:

- » Provide an overall assessment of the social and biophysical environments affected by the proposed alternatives put forward as part of the project
- » Assess potentially significant impacts (direct, indirect, and cumulative, where required) associated with the proposed facility
- » Comparatively assess identified site layout alternatives put forward as part of the project
- » Identify and recommend appropriate mitigation measures for potentially significant environmental impacts
- » Undertake a fully inclusive public participation process to ensure that I&AP are afforded the opportunity to participate, and that their issues and concerns are recorded.

The EIA addresses potential environmental impacts and benefits associated with all phases of the project including design, construction, and operation and decommissioning, and aims to provide the environmental authorities with sufficient information to make an informed decision regarding the proposed project.

The EIA process followed for this project is described in detail below.

#### **4.3. Overview of the EIA Phase**

The EIA Phase has been undertaken in accordance with the EIA Regulations published in Government Notice 28753 of 21 April 2006, in terms of NEMA. Key tasks undertaken within the EIA phase included:

- » Consultation with relevant decision-making and regulating authorities (at National, Provincial and Local levels)
- » Undertaking a public participation process throughout the EIA process in accordance with Regulation 56 of Government Notice No R385 of 2006 in order to identify any additional issues and concerns associated with the proposed project
- » Preparation of a Comments and Response Report detailing key issues raised by I&APs as part of the EIA Process (in accordance with Regulation 59 of Government Notice No R385 of 2006)
- » Undertaking of independent specialist studies in accordance with Regulation 33 of Government Notice No R385 of 2006
- » Preparation of a Draft EIA Report in accordance with the requirements of the Regulation 32 Government Notice No R385 of 2006

These tasks are discussed in detail below.

#### **4.3.1 Authority Consultation**

The National DEA is the competent authority for this application. A record of all authority consultation undertaken prior to the commencement of the EIA Phase is included within the Scoping Report and this EIA Report. Consultation with the regulating authorities (i.e. DEA and DENC has continued throughout the EIA process). On-going consultation included the following:

- » Submission of a Final Scoping Report (August 2009) following a 30-day public review period (and consideration of stakeholder comments received)
- » Ad hoc discussions with DEA and DENC in order to clarify the findings of the Scoping Report and the issues identified for consideration in the EIA process.

The following will also be undertaken as part of this EIA process:

- » Submission of a Final Environmental Impact Assessment (EIA) Report following the 30-day public review period
- » A consultation meeting with the DEA and DENC in order to discuss the findings and conclusions of the EIA Report
- » Provision of an opportunity for DEA and DENC representatives to visit and inspect the proposed site, and the study area
- » Consultation with Organs of State that may have jurisdiction over the project, including:
  - \* Provincial and local government departments (including South African Heritage Resources Agency, Department of Water Affairs, South African National Roads Agency Limited, Department of Agriculture, etc)
  - \* Government Structures (including the Department of Public Works, Roads and Transport, etc)

- \* Kai !Gariep Local Municipality and Siyanda District Municipality
- \* Potentially affected and neighbouring landowners and tenants
- \* Local authorities (Upington Water User Association)
- \* Parastatals
- \* Conservation authorities (i.e. Wildlife and Environment Society of South Africa, etc)
- \* Industry and business (Enviro Water Services, Solar Northern Cape etc)
- \* Community Based Organisations and Non-governmental Organisations

A record of all authority consultation undertaken prior to the commencement of the EIA Phase is included within the Scoping Report. A record of the consultation in the EIA process is included within Appendix B.

#### **4.3.2 Public Involvement and Consultation**

The aim of the public participation process was primarily to ensure that:

- » Information containing all relevant facts in respect of the proposed project was made available to potential stakeholders and I&APs.
- » Participation by potential I&APs was facilitated in such a manner that all potential stakeholders and I&APs were provided with a reasonable opportunity to comment on the proposed project.
- » Comment received from stakeholders and I&APs was recorded and incorporated into the EIA process.

Through on-going consultation with key stakeholders and I&APs, issues raised through the Scoping Phase for inclusion within the EIA study were confirmed. All relevant stakeholder and I&AP information has been recorded within a database of affected parties (refer to Appendix C). While I&APs were encouraged to register their interest in the project from the onset of the process, the identification and registration of I&APs has been on-going for the duration of the EIA process and the project database has been updated on an on-going basis.

In order to accommodate the varying needs of stakeholders and I&APs, as well as ensure the relevant interactions between stakeholders and the EIA specialist team, the following opportunities were provided for I&APs issues to be recorded and verified through the EIA phase, including:

- » Focus group meetings (stakeholders invited to attend)
- » Public meeting (advertised in the local press)
- » Written, faxed or e-mail correspondence



In addition, during the EIA Phase, a **stakeholder meeting** was held in order to provide feedback of the findings of the EIA studies undertaken. Stakeholders were invited to attend the stakeholder meeting held on:

**Date:** 16 September 2010

**Time:** 18:00 – 20:00

**Venue:** Upington Protea Hotel

#### ***4.3.3 Identification and Recording of Issues and Concerns***

Issues and comments raised by I&APs over the duration of the EIA process have been synthesised into Comments and Response Reports (refer to Appendix D for the Comments and Response Report compiled from the EIA process thus far). In this case no additional comments were received following the submission of the Final Scoping Report.

The Comments and Response Reports include responses from members of the EIA project team and/or the project proponent. Where issues are raised that the EIA team considers beyond the scope and purpose of this EIA process, clear reasoning for this view is provided.

#### ***4.3.4 Assessment of Issues Identified through the Scoping Process***

Based on the findings of the Scoping Study, the following issues were identified as being of low significance, and therefore not requiring further investigation within the EIA:

##### ***Agricultural Potential***

Due mainly to the prevailing unfavourable climatic conditions for arable agriculture, as well as the prevalence of soils with limited depth, no further detailed soil investigation was required during the EIA Phase.

##### ***Noise***

The noise monitoring and modelling results undertaken during the scoping phase indicated that noise levels do not exceed specified limits. In addition, due to the lack of sensitive potential receptors in the area, no further detailed noise emission investigation was required during the EIA Phase.

Issues which require further investigation within the EIA phase, as well as the specialists involved in the assessment of these impacts are indicated in Table 4.1.

**Table 4.1:** Specialist studies undertaken within the EIA phase

Specialist	Area of Expertise	Appendix
David Hoare Consulting	Ecology, flora and fauna	Appendix E
Birdlife South Africa	Avifauna	Appendix F
Outeniqua Geotechnical Services cc	Geology, soil, and erosion potential	Appendix G
Scherman, Colloty and Associates	Water resources	Appendix H
McGregor Museum	Heritage	Appendix I
John Pether	Palaeontology	Appendix J
MetroGIS	Visual	Appendix K
Tony Barbour Environmental Consulting	Social	Appendix L

Specialist studies considered direct and indirect environmental impacts associated with the development of all components of the proposed Upington Solar Thermal Plant. Issues were assessed in terms of the following criteria:

- » The **nature**, a description of what causes the effect, what will be affected, and how it will be affected
- » The **extent**, wherein it is indicated whether the impact will be local (limited to the immediate area or site of development), regional, national or international. A score of between 1 and 5 is assigned as appropriate (with a score of 1 being low and a score of 5 being high)
- » The **duration**, wherein it is indicated whether:
  - \* The lifetime of the impact will be of a very short duration (0–1 years) – assigned a score of 1
  - \* The lifetime of the impact will be of a short duration (2-5 years) - assigned a score of 2
  - \* Medium-term (5–15 years) – assigned a score of 3
  - \* Long term (> 15 years) - assigned a score of 4
  - \* Permanent - assigned a score of 5
- » The **magnitude**, quantified on a scale from 0-10, where a score is assigned:
  - \* 0 is small and will have no effect on the environment
  - \* 2 is minor and will not result in an impact on processes
  - \* 4 is low and will cause a slight impact on processes
  - \* 6 is moderate and will result in processes continuing but in a modified way
  - \* 8 is high (processes are altered to the extent that they temporarily cease)
  - \* 10 is very high and results in complete destruction of patterns and permanent cessation of processes
- » The **probability of occurrence**, which describes the likelihood of the impact actually occurring. Probability is estimated on a scale, and a score assigned:
  - \* Assigned a score of 1–5, where 1 is very improbable (probably will not happen)
  - \* Assigned a score of 2 is improbable (some possibility, but low likelihood)

- \* Assigned a score of 3 is probable (distinct possibility)
- \* Assigned a score of 4 is highly probable (most likely)
- \* Assigned a score of 5 is definite (impact will occur regardless of any prevention measures)
- » The **significance**, which is determined through a synthesis of the characteristics described above (refer formula below) and can be assessed as low, medium or high
- » The **status**, which is described as either positive, negative or neutral
- » The degree to which the impact can be reversed
- » The degree to which the impact may cause irreplaceable loss of resources
- » The degree to which the impact can be mitigated

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

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

S = Significance weighting

E = Extent

D = Duration

M = Magnitude

P = Probability

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

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

As !Khi CSP has the responsibility to avoid or minimise impacts and plan for their management (in terms of the EIA Regulations), the mitigation of significant impacts is discussed. Assessment of impacts with mitigation is made in order to demonstrate the effectiveness of the proposed mitigation measures. A Draft EMP is included as Appendix M.

#### **4.3.5 Assumptions and Limitations**

The following assumptions and limitations are applicable to the studies undertaken within this EIA Phase:

- » All information provided by !Khi CSP and I&APs to the Environmental Team was correct and valid at the time it was provided.

- » It is assumed that the development site identified by !Khi CSP represents a technically suitable site for the establishment of a CSP and CPV facility.
- » Studies assume that any potential impacts on the environment associated with the proposed development will be avoided, mitigated, or offset.
- » This report and its investigations are project-specific, and consequently the environmental team did not evaluate any other power generation alternatives.

#### ***4.3.6 Public Review of Draft EIA Report and Feedback Meeting***

The **Draft EIA Report** was made available for public review from **15 October 2010 to 15 November 2010** at the following locations:

- » Khara Heis Library
- » Keimoes Library
- » [www.savannahsa.com](http://www.savannahsa.com)

All registered I&APs were notified of the availability of the report by letter.

#### ***4.3.7 Final EIA Report***

This final stage in the EIA Phase entails the capturing of responses from I&APs on the Draft EIA Report in order to refine it. It is this final report upon which the decision-making environmental authorities make a decision regarding the proposed project.

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## DESCRIPTION OF THE AFFECTED ENVIRONMENT

## CHAPTER 5

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This section of the EIA Report provides a description of the environment that may be affected by the proposed Upington Solar Thermal Plant. This information is provided in order to assist the reader in understanding the possible effects of the proposed project on the environment. Aspects of the biophysical, social, and economic environment that could directly or indirectly be affected by, or could affect, the proposed development have been described. This information has been sourced from both existing information available for the area as well as collected field data, and aims to provide the context within which this EIA is being conducted. A more detailed description of each aspect of the affected environment is included within the specialist reports contained within Appendices G - N.

### 5.1 Location of the Study Area

The identified site proposed for the Upington Solar Thermal Plant is situated approximately 20 km south-west of Upington on a portion of Portion 3 of the Farm McTaggart's Camp 453. The study site is located within the Kai Garib Local Municipality which forms part of the Siyanda District Municipality within the Northern Cape.

### 5.2 Regional Setting

The proposed site falls within the Kai Garib Local Municipality which has its administrative centre at Kakamas. This local municipality is one of 8 local municipalities that fall within the greater Siyanda District Municipality. The site can be accessed via the N14 and an existing farm road (D3276).

The entire site consists of natural vegetation however mining activities previously took place in an area in the north-western corner. This area of the Northern Cape consists primarily of farms used as rangeland for commercial livestock production. These regions have been commercially farmed as stock ranches for close to 100 years. Degradation of vegetation has been attributed to high stocking rates of domestic livestock in commercial farming areas.

### 5.3 Climatic Conditions

The study area is characterised by an arid climate with summer rainfall. The long-term average annual rainfall in this region of the Northern Cape is only 175 mm, of which 142 mm, or 81%, falls from November to April. Rainfall events are erratic, both locally and seasonally and therefore cannot be relied on for agricultural practices. The average evaporation is 2 375 mm per year, peaking at 11.2 mm per day in December.

Temperatures vary from an average monthly maximum and minimum of 35.0°C and 18.7°C for January to 20.8°C and 3.3°C for July respectively. Frost occurs most years on 6 days on average between mid-June and mid-August.

#### **5.4. Biophysical Characteristics of the Study Area and Surrounds**

##### **5.4.1 Topographical Profile**

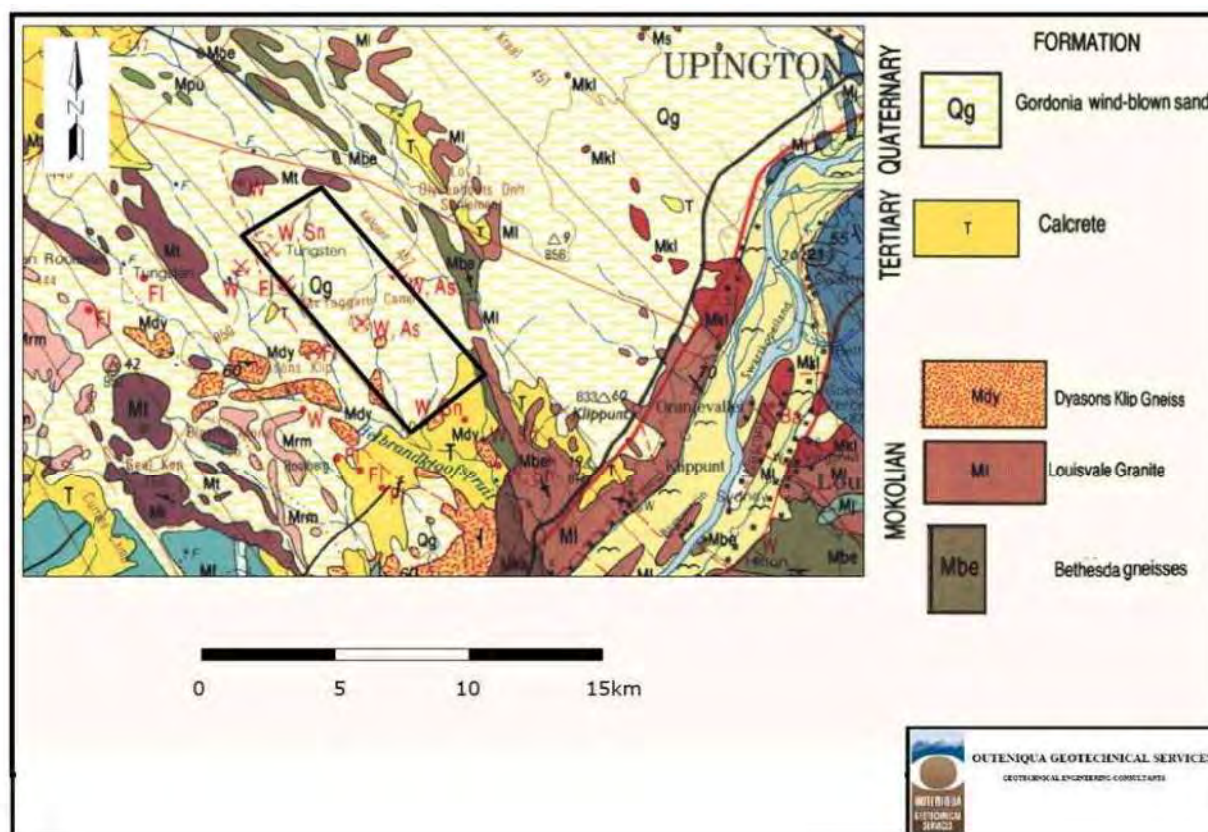
The study area is situated on the plains located to the north of the Orange (Gariep) River. The larger site has a flat to very gently sloping topography which ranges in altitude from 870 m in the north to 820 m amsl in the south, a gradient of approximately 1:150. Numerous ephemeral tributaries of the Helbrandkloofspruit drain the study site in a southerly direction towards the Gariep River.

##### **5.4.2 Geological profile**

The study area is located within the Namaqualand Metamorphic Belt which comprises very old and very highly deformed sedimentary and igneous rocks of the Mokolian Erathem (2100 - 1200Ma) that form part of the Southern African Basement Complex. The rocks of this complex have undergone both regional and contact metamorphism and the culminating deformation phase has been dated at about 1000 Ma.

The bedrock geology of the study area is covered by Quaternary red-brown wind-blown sands of the Gordonia Formation. Localised outcrops of Dyasons Klip gneisses of Mokolian age protrude through the sand cover in the southern portion of the study area. Other metamorphic rocks of Mokolian age in the near vicinity of the study area include Louisvale granite and Bethseda gneiss. A calcrete capping of Tertiary age also occurs in the southern portion of the study area. Rocky outcrops are likely to be very sparse and the majority of the study area is covered in Quaternary unconsolidated sands.

Inactive opencast mining operations in the study area include tungsten, tin, arsenic and fluoride. Fairly extensive diggings appear to have been carried out in the northwestern portion of the study area.



**Figure 5.1:** Geology of the study area

### 5.4.3 Ecological Profile

The study area falls within the Nama-Karoo Biome with four predominant vegetation types, of which two occur within the study site, namely Bushmanland Arid Grassland and Kalahari Karroid Shrubland. **Bushmanland Arid Grassland** occurs on extensive, relatively flat plains and is sparsely vegetated by tussock grasses and following good rains there are abundant displays of annual herbs (refer to Appendix E). There are no known endemics in this vegetation, but the vegetation contains endemics belonging to the Griqualand West or Gariep Centres of Endemism. At a national scale the Bushmanland Arid Grassland vegetation type has been transformed to a slight degree, with 27% conserved in Augrabies Falls National Park. It is, therefore, not considered to be a threatened vegetation type.

**Kalahari Karroid Shrubland** is a low karroid shrubland occurring on flat gravel plains with dominant species including small trees, shrubs, herbs and grasses (refer to Appendix E). There are no known endemics within this vegetation type; however, Catstail Vlei Grass (i.e. an endemic grass species) has its south-western distribution limit within this vegetation type. At a national scale this vegetation type has only been slightly transformed, however a quarter of the vegetation type is invaded by alien invasive species (i.e. *Prosopis* sp.). Although only a small amount is conserved in

Augrabies Falls National Park, it is not considered to be a threatened vegetation type and is officially classified as Least Threatened.

### ***Protected Trees***

There are several tree species protected under the National Forest Act that have a geographical distribution that includes the study area (refer to Appendix E). These species include Camel Thorn, Shepard's Tree, Grey Camel Thorn, and the Ebony Tree. Camel Thorn occurs in dry woodland along watercourses in arid areas where underground water is present as well as on deep Kalahari sands (mostly Bushmanland Arid Grassland) and is therefore relatively common in the study area. Grey Camel Thorn occurs on deep Kalahari sand between dunes or along dry watercourses within the Bushmanland Arid Grassland and occurs sparsely within the study area. Shepard's Tree occurs in semi-desert areas and bushveld, often on termitaria, but is common on sandy to loamy soils and calcrete soils mostly within Bushmanland Arid Grassland and is relatively common within the study area, primarily along secondary watercourses and areas adjacent to the primary watercourses. Ebony Tree occurs in semi-desert and desert areas, usually along watercourses and in depressions and *could* occur in the hills or on the flats within the study area (refer to Appendix E).

### ***Red Data Fauna Species***

No mammal, reptile, or amphibian species of conservation concern are likely to occur in available habitats in the study area. Six globally threatened bird species have a possibility of occurring in the study area, including Secretarybird (NT), Kori Bustard (V), Ludwig's Bustard (V), Lanner Falcon (NT), Martial Eagle (V), and Sclater's Lark (NT)<sup>2</sup>.

### ***Avifauna Species***

The most common bird species on-site are Sociable Weavers with several nest sites being located in the dry riverbeds across the site. These riverbeds appear to be higher in species density, abundance, and diversity than the adjacent plains which are relatively unproductive in terms of bird density and diversity. This habitat type is dominated by Spikeheeld Lark, Fawncoloured Lark, and Anteating Chats.

The six globally threatened bird species which have a distribution range which overlaps with the study area may not always be observed on site, it is possible for them to occur within the study area at some stage. These include the Secretarybird, Kori Bustard, Ludwig's Bustard, Lanner Falcon, Martial Eagle, and Sclater's Lark. Larger bodied species, such as the Martial Eagle, have extremely large home ranges and could very well be found on occasion within the study area.

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<sup>2</sup> NT – Not Threatened; V – Vulnerable



#### 5.4.4 Agricultural Potential

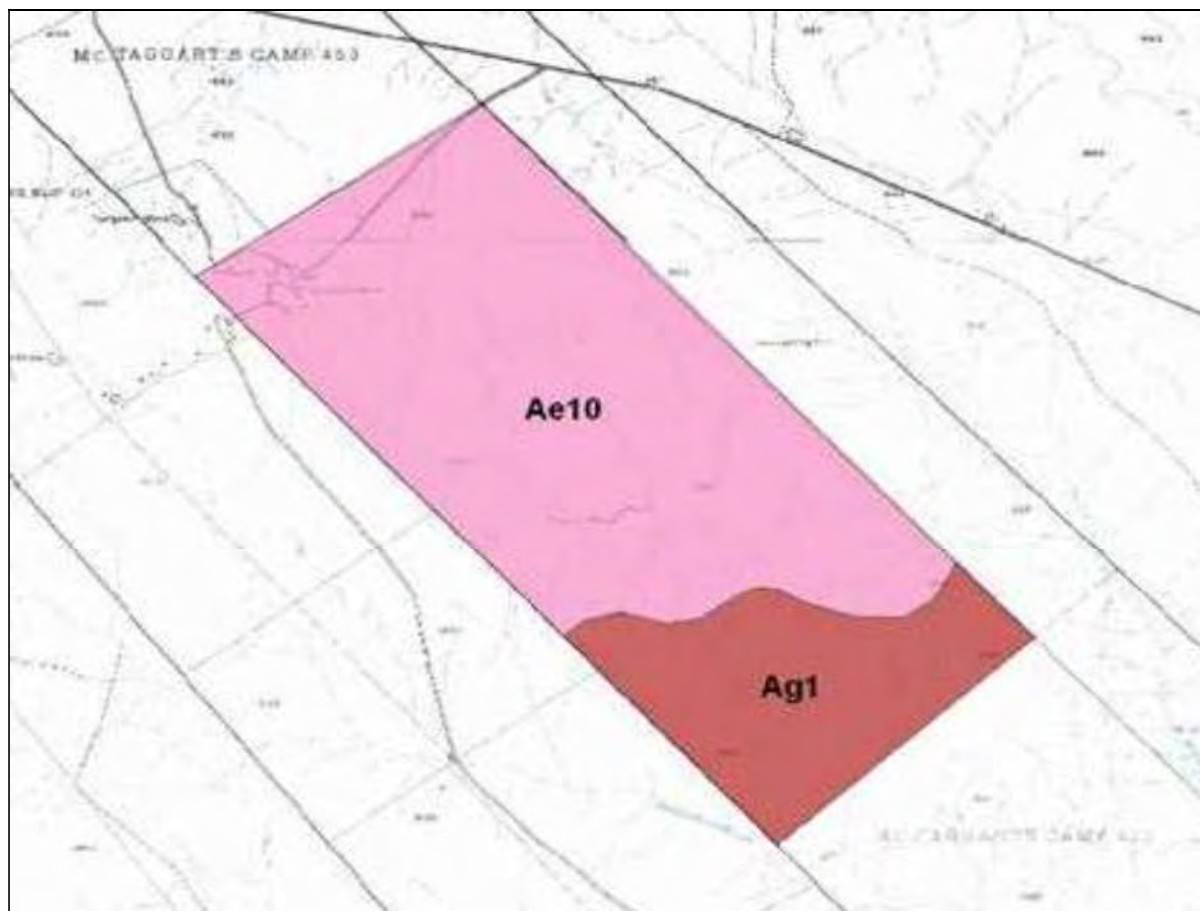
The study area is covered by only two land types, namely Ae10 (deep, red, freely-drained soils with a high base status), Ag1 (shallow red soils with a high base status).

Table 4.1: Soils types within the study area

Land Type	Dominant soils	Depth (mm)	Percent of land type	Characteristics	Potential (%) <sup>3</sup>
<b>Ae10</b>	Hutton 33/34	450-1000	42%	Red, sandy soils, occasionally on hardpan calcrete	High:0.0 Mod: 47.0 <b>Low: 53.0</b>
	Mispah 22	100-250	40%	Red-brown, sandy topsoils on hard rock and calcrete	
<b>Ag1</b>	Hutton 30/33/34	200-450	36%	Red, sandy topsoils on hard rock and calcrete	High:0.0 Mod: 15.0 <b>Low: 85.0</b>
	Mispah 10/12/20/22	100-250	20%	Red-brown, sandy topsoils on hard rock and calcrete	

Much of the study area comprises red, sandy soils, many of which are shallow to very shallow with only a limited portion of deep soils. The very low rainfall in the area means that the only means of cultivation would be by irrigation and aerial images show no signs of any agricultural infrastructure and none of irrigation. The climatic restrictions mean that this part of the Northern Cape is suited at best for grazing and here the grazing capacity is very low, around 40-50 ha/large stock unit.

<sup>3</sup> The distribution of soils with high, medium and low agricultural potential within each land type is also given, with the dominant class shown in **bold type**.



**Figure 5.2** Land types within the proposed study area

#### **5.4.5 Hydrological Characteristics**

The study area falls within the Lower Orange River System (i.e. defined as that stretch of the Orange River between the Orange-Vaal confluence and Alexander Bay or Oranjemund where the river meets the ocean).

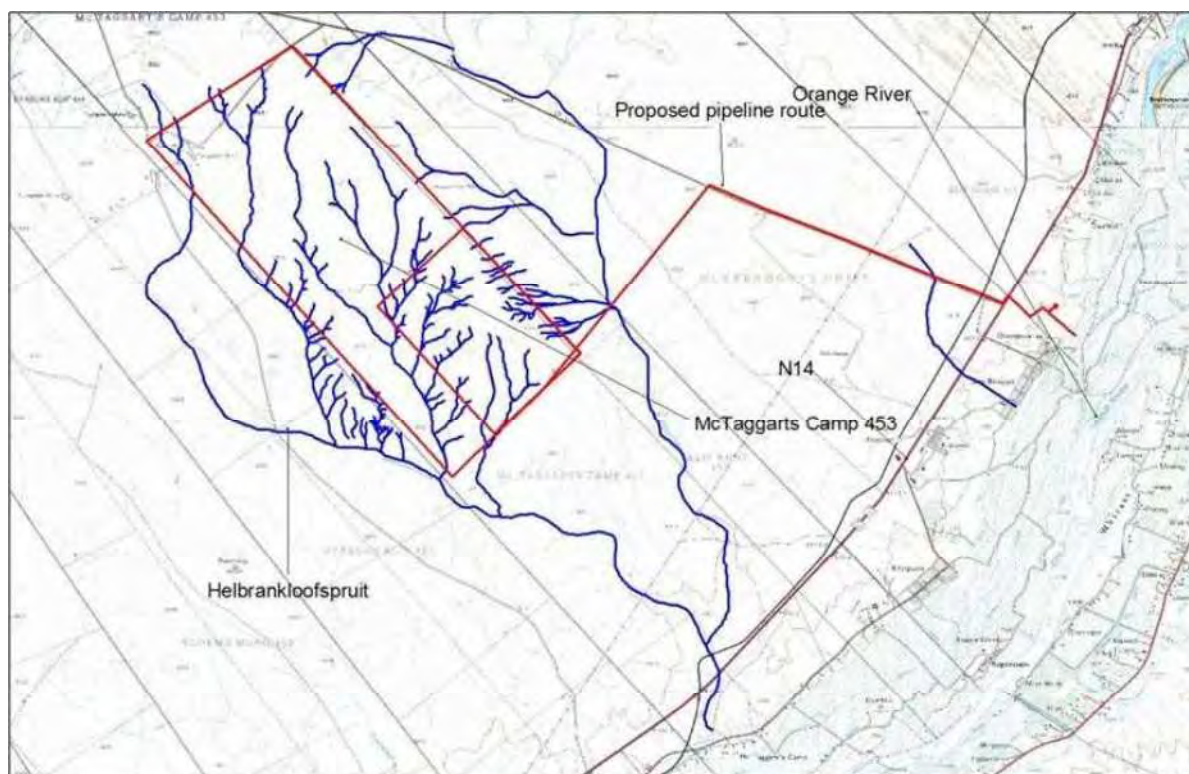
The Present Ecological State (PES) of the Orange River<sup>4</sup>, including fish and other biota (algae, vegetation, macro invertebrates), falls within a D Category. This means that the habitat integrity has been largely modified and a large loss of natural habitat, biota and basic ecosystem functions has occurred.

The study site is situated within quaternary catchment D73F and is dominated by highly ephemeral river systems that flow directly into the Gariep River. Potential runoff from the site would flow in a south-easterly direction towards the Gariep River. The primary drainage line, the Helbrandkloofspruit, typically flows once a year for no more than two

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<sup>4</sup> The Present Ecological State of a river represents the extent to which it has changed from the reference or near pristine condition (Category A) towards a highly impacted system where there has been an extensive loss of natural habitat and biota, as well as ecosystem functioning (Category E).

days at a time. Due to the nature of the soils and geomorphology, these systems are able to form various meanders or fans within the greater landscape (refer to Figure 5.3)



**Figure 5.3:** Figure illustrating the main rivers and river beds observed within the site, and along the pipeline route

## 5.5 Social Characteristics of the Study Area and Surrounds

The proposed project area is located within the Kai Garib Municipality (NC067) within the Northern Cape. This municipality is a category-B municipality<sup>5</sup>, which forms part of the greater Siyanda District Municipality (DC8, category-C municipality), and is located in the north-central portion of the Northern Cape, approximately 428 km west of the provincial capital of Kimberley.

This local municipality is largely rural and agricultural with three urban/semi-urban nodes at Kakamas, the designated administrative centre of the municipality Keimoes and Kenhardt. The municipality is approximately 7 445 km<sup>2</sup> in size (approximately 7.2% of the Siyanda District Municipality) and is bordered to the north, south and west by a District Management Area and in the east by the Khara Hais and Kheis Local Municipalities.

<sup>5</sup> A category-B municipality is defined as a municipality that shares executive and legislative authority in its area with a category- C municipality within whose area it falls

### **5.5.1. Heritage & Palaeontology**

#### **Later Stone Age**

Late Holocene Later Stone Age sites have been noted south/south-west of the study area and along the Gariep River. These are generally short-duration occupations by small groups of hunter-gatherers. In contrast, there are substantial herder encampments along the floodplain itself and in the hills north of Kakamas.

#### **Pleistocene: Middle and Earlier Stone Age**

A widespread low density stone artefact scatter of Pleistocene age has been noted across areas of Bushmanland to the south where raw materials, mainly quartzite cobbles, were derived from the Dwyka till. Similar occurrences have been noted north of Upington. Systematic collections of this material made at Olyvenkolk, south west of Kenhardt and Maans Pannen, and east of Gamoep, could be separated out by abrasion state into a fresh component of Middle Stone Age with prepared cores, blades and points, and a large aggregate of moderately to heavily weathered Earlier Stone Age.

The Earlier Stone Age included Victoria West cores on dolerite and quartzite (an example has been found at Hondeblaf north of Upington), long blades, and a very low incidence of hand axes and cleavers. The Middle (and perhaps in some instances Lower) Pleistocene occupation of the region that these artefacts reflect must have occurred at times when the environment was more hospitable than today. This is suggested by the known greater reliance of people in Acheulean times on quite restricted ecological ranges, with proximity to water being a recurrent factor in the distribution of sites.

#### **Palaeontology**

The Kalahari sediments and calcretes have low fossil potential, but possibility of fossils being encountered in diggings cannot be totally excluded. The fossils contexts are those of ephemeral watercourses and aeolian settings, particularly interdune areas where local ponding or pans developed.

Most of the fossils in the aeolianites are associated with particular contexts, particularly buried, stable surfaces (palaeosurfaces) where time has permitted bones to accumulate. The common fossils include shells of land snails, fossil tortoises, ostrich incl. egg fragments, sparsely scattered bones etc. "Blowout" erosional palaeosurfaces may carry fossils concentrated by the removal of sand by the wind. Hollows between dunes (interdune areas) are the sites of ponding of water seeping from the dunes, leading to the deposits of seeps and pans/vleis. Being water sources such may be richly fossiliferous. Most of fossils obtained from the Kalahari deposits have been from pans. Ephemeral watercourse deposits are poorly fossiliferous, but abraded bone fragments and loose teeth may occur sparsely in channel lags.

### **5.5.2 Social Characteristics**

#### **Northern Cape Province**

The proposed facility is located in the Northern Cape Province, which is the largest province in South Africa and covers an area of 361,830 km<sup>2</sup>, and constitutes approximately 30% of South Africa. The Province is divided into five district municipalities (DM), namely, Frances Baard, Karoo, Namakwa, Siyanda, and Kgalagadi DM, twenty-six Category B municipalities and five district management areas.

#### **Population Demographics**

Despite having the largest surface area, the Northern Cape has the smallest population (822 727 or 1.8% of the population) of South Africa. The population has declined by 2.1% from 1996 (840 321) to 2001 (822 727), resulting in a decrease in the population density, of an already sparsely populated Province, from 2.32 to 2.27 persons per km<sup>2</sup>. Of the five districts, Frances Baard has the largest population of 303 239. The other districts and their respective populations are Siyanda (209 889), Karoo (164 607), Kgalagadi (36 881) and Namakwa (108 111). The population within the Northern Cape can be classified as a young population with 57.7% of the population being younger than 30 years old. The female proportion makes up approximately 51.2% of the total with males making up the remaining 48.8%.

#### **Education**

In terms of education levels, 15.1% of the population has received no formal education, while 71.3% have primary or secondary education. Those with a higher educational qualification accounted for 3.7% of the population.

#### **Economy**

The Northern Cape Province has the third highest per capita income of all nine provinces; however, income distribution is extremely skewed, with a high percentage of the population living in extreme poverty. The Northern Cape's share of the country's Gross Domestic Product (GDP) in 2002 was 2%, the lowest contribution of the nine provinces. However, although the Northern Cape Province has the smallest economy of the nine provinces, Gross Domestic Product of the Region (GDPR) per capita is higher than the national average. In terms of economic activities, the economy of Northern Cape is heavily dependent on the primary sectors of the economy, which in 2002 made up 31.0% of GDPR. The largest sector is mining which has declined in contribution to the GDPR from 25.8% in 1996 to 23.7% in 2002. Agriculture, on the other hand, increased in its contribution from 6.2% to 7.3%.

#### **Employment**

Of the economically active population in the Northern Cape, 55.5% were employed while 26.1% could not find employment. This unemployment figure is lower than the national figure of 29.5%. Significant for this province, however, is that a third of the total

population is younger than 15 years old and approximately 45% of the potential labour force is younger than 30 years.

### **5.5.3 Kai !Gariep Municipality**

The proposed site falls within the Kai !Gariep Local Municipality (NC082) which is one of eight local municipalities within the greater Siyanda District Municipality (DC8).

#### **Population Demographics**

The population of the Kai !Gariep Local Municipality is estimated at 56 501 (2007), approximately 10% of the total population of the greater Siyanda District Municipality. The average population growth for the local municipality (2001-2007) is estimated at approximately 1.4%. The population is predominantly Coloured. The dominant language within the municipality is Afrikaans (78.8%) followed by Setswana, isiXhosa, and English.

#### **Education**

Approximately 14.7% of the population has no formal education, while approximately 42% have less than a Grade 7. When these totals are added to figures for people with no formal education they indicate that over half of people in the Kai !Gariep Local Municipality (approximately 58%) have less than a Grade 7 qualification. Only 11.1% of the population has a Matric qualification, while less than 4% have a tertiary qualification.

#### **Employment**

Approximately 57.8% of the population between 15 and 65 is employed in the formal sector and the unemployment rate is 12%. The agricultural sector provides approximately 28% of the formal employment, followed by the community services, wholesale and retail sectors which employ approximately 6% and 2% of the employed population in the area respectively. According to the 2001 Census data, the majority of employment is characterised as 'undetermined' (approximately 62%).

Approximately 48.8% of the population have no formal income and a majority 93.7% of the population earn less than R800 per month (this is the figure used by the South African Government as the official breadline figure). The low-income levels reflect the limited formal employment opportunities highlighted above. Approximately 22% of the population is dependent on social grants.

### **5.5.4 Kai !Gariep Municipality – Ward 8**

The proposed site is located within Ward 8 of the Kai !Gariep Local Municipality, which constitutes approximately 9.9% of the total area. Ward 8 is one of 8 administrative wards that make up the Kai !Gariep Local Municipality. The largest town within the ward is Kakamas.

### **Education**

Approximately 48.5% of the population of the Ward 8 aged 15 and older were estimated to be functionally illiterate/innumerate in 2001. Approximately 60% of the population have less than a Standard 5/Grade 7 education and 8.8% of the school going age population have a Matric qualification, while just fewer than 2% have a tertiary qualification. Given the strong correlation between education and skills levels, it may be assumed that a significant portion of the study area's working age population have only sufficient skills for elementary jobs.

### **Employment**

Employment statistics from 2001 indicates that approximately 67.2% of Ward 8's population was employed in 2001. The unemployment rate was relatively low, estimated at approximately 5%. Approximately 28% of the population is not economically active. The largest employer in Ward 8 is the agricultural sector which provides approximately 86% of the formal employment in the area. This sector is followed by the wholesale and retail trade sector and the community and social services sector, both of which provide 2.5% of the employment in the Ward. The other minor formal employment sector contributors are the construction sector (i.e. 1.4%) and the private households sector (i.e. 2.3%).

Census data on household income for 2001 indicates that the vast majority of households (i.e. 94%) in Ward 8 are living on less than the R1 600/ month minimum subsistence level. Significantly, the 'no formal income' category is the most pronounced at approximately 41%. Only 5% of household heads were earning an income clustered in the R800 - R3 200/ month range.

## **5.6. Site Specific Land-Use**

Portion 3 of the Farm McTaggarts Camp, which is owned by a single land owner will be affected by the establishment of the proposed facility (i.e. the solar array, power island, evaporation ponds, water storage reservoir). This farm portion is currently used for low density cattle farming and will be sold to the developer. The ancillary infrastructure will be located as follows:

- » The abstraction point and de-gritting reservoir will be located on Portion 17 of the Klipkraal 451. From the de-gritting reservoir the pipeline will follow the exiting road reserves to the proposed plant site, crossing Olyfinhoutsdrift 450 and Portion 12 of the Klippunt 452.
- » The preferred routing for the overhead power line will follow the existing boundary fence between Portion 1 of the McTaggarts Camp 453 and Portion 1 of the Klippunt 452 from the proposed plant site to the existing Eskom electricity network running approximately 4 km south of the site, via a 'turn in and turn out' configuration.

- » The preferred routing for the external access road will cross Olyfinhoutsdrift 450 and Klippunt 452 portion 12 (i.e. coming off the existing Lutzputs Road D3276).



## ASSESSMENT OF IMPACTS: SOLAR THERMAL PLANT & ASSOCIATED INFRASTRUCTURE

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## CHAPTER 6

The generation of electricity from the proposed Upington Solar Thermal Plant will be achieved through the following solar technologies (in any combination):

- » **50 MW** to be generated from 60 – 120 loops of parabolic troughs (i.e. to cover a total extent of approximately 100 ha) with an approximate height of 5 m
- » **50 MW** to be generated from a field of heliostats/mirrors (i.e. approximately 4 000 – 5 000 mirrors each approximately 120 m<sup>2</sup>, positioned on approximately 6 m high pedestals) positioned around a approximately 200 m high power tower including the receiver (i.e. to cover a total extent of approximately 300 ha)
- » **10 MW** to be generated from several rows of PV panels (i.e. to cover a total extent of approximately 60 ha)

In conjunction with the abovementioned solar components, the following associated infrastructural requirements will also be established:

- » A **power island** which will include a steam turbine and generator (i.e. typically housed within a 2-storey building); a generator transformer and a small substation (i.e. located outside and adjacent to the 2-storey building); an auxiliary steam boiler and associated vessels (i.e. fossil fuel boiler/ generator), proposed to be fired by either diesel fuel or liquid petroleum gas (LPG)
- » An overhead **power line** feeding into the Eskom electricity network via a 'turn in and turn out' configuration to the existing Eskom Gordonia-Oasis 132 kV distribution line running approximately 4 km south of the site
- » **Water supply** infrastructure including an abstraction point on the Orange River; a suspension reservoir located approximately 0.6 km north-west of the raw water abstraction point; an associated water supply pipeline to the power island; a storage reservoir within the power island footprint; and evaporation ponds
- » **Access roads** including an external access road leading to the site (alternatives either from the N14 or from the existing D3276 secondary road); and internal access roads for construction and maintenance purposes (including an internal asphalt access road which will give direct access to the power island)
- » **Administrative areas** including a workshop, office and storage areas

The establishment of a solar energy facility project is comprised of several phases, including pre-construction, construction, operation, and decommissioning. The **construction activities** involved for the proposed Upington Solar Thermal Plant project will include the following:

- » Conduct pre-construction surveys

- » Establishment of access roads
- » Undertaking site preparation (i.e. including clearance of vegetation; and stripping of topsoil)
- » Transportation of solar components and equipment to site
- » Establishment of construction camps; laydown and hard standing areas (i.e. including storage facilities; batching facilities)
- » Assemble and construct solar arrays
- » Construct power island and substation
- » Establish abstraction point; pipeline; storage/treatment facilities and evaporation ponds
- » Connection of the on-site substation to the Eskom grid
- » Undertake site remediation

The **operational activities** will include the following:

- » The operation of the solar field (parabolic troughs, heliostats and associated power tower, and the PV panels)
- » The operation of the power island
- » The abstraction, treatment; pumping and storage of water for use in the CSP system
- » Site operation and maintenance

The **decommissioning activities** will include the following:

- » Removal of project infrastructure
- » Site rehabilitation

The construction and decommissioning activities have the potential to impact on the receiving environment in terms of habitat destruction, disturbance, and alteration; impacts on biodiversity; threatened fauna and flora species; protected tree species and ecological processes; soil degradation; erosion; and increased erosion potential; impacts on heritage sites; impacts on water resources and impacts on the visual aesthetics.

Environmental issues specific to the operation phase of a solar thermal plant include, amongst others visual impacts through the visual dominance of the power tower within the landscape; avian mortality through collisions/electrocutions with the power line; and water quality and quantity related issues.

These and other environmental issues were originally identified through a scoping evaluation of the proposed solar thermal plant. Potentially significant impacts have now been assessed during this EIA Phase. This EIA process has involved key input from specialist consultants, the project developer, and from key stakeholders and interested and affected parties. The significance of impacts associated with a facility of this nature is always project specific, and therefore impacts may vary significantly between facilities.

This chapter serves to assess the identified potentially significant environmental impacts associated with the development of the proposed facility, and to make recommendations for the management of these impacts for inclusion in the Draft EMP (Refer to Appendix M).

## 6.1 Methodology for the Assessment of Potentially Significant Impacts associated with the proposed Solar Thermal Plant

In order to assess the potential impacts associated with the proposed facility, it was necessary to understand the extent of the affected area. This affected area will include the area infrastructure (i.e. solar fields; power islands; abstraction point; water storage/treatment reservoirs) and linear infrastructure (i.e. the internal and external access roads; the water supply pipeline and the power line).

A broader site of 22 km<sup>2</sup> was originally identified by the project developer for the purpose of establishing the proposed facility, originally anticipated to cover an extent of approximately 6 km<sup>2</sup>. During the Scoping Phase assessment a preferred portion within the south-eastern region of the farm portion was identified based on reduced environmental sensitivities, in comparison to the remainder of the site. This smaller portion is likely to suffer disturbance, particularly during the construction phase, as the establishment and operation of a solar thermal plant generally results in whole-scale disturbance to significant portions of the affected site where infrastructure is located.

From the results of the facility layout determination, it is apparent that the effective utilised area within the identified farm portion is only approximately 4.7 km<sup>2</sup> in extent. This amount is less than 21% of the total 22 km<sup>2</sup> site originally earmarked for development (refer to Figure 6.1).

Permanently affected areas within and beyond the farm boundaries are summarised as follows.

Permanent Component –Within the facility	Approximate extent (in ha)
Parabolic troughs	100
Heliostats & power tower	300
PV panels	60
Power island	4
Internal access roads <sup>6</sup>	3
Water supply pipeline <sup>7</sup>	1
Water storage reservoir	0.5

<sup>6</sup> Assuming a length of 5 km and a width of 6 m

<sup>7</sup> Assuming a length of 3 km and a servitude of 3 m

Workshop and storage areas	1.5
<b>TOTAL (ha)</b>	<b>470</b> (of a total area of 22 km <sup>2</sup> ) <b>≈ 21% of site</b>

<b>Permanent Component –Outside the facility</b>	<b>Approximate extent (in ha)</b>
Water supply pipeline <sup>8</sup>	4.5
De-gritting reservoir	0.5
Abstraction point <sup>9</sup>	0.1
<b>TOTAL (ha)</b>	<b>5.1</b>

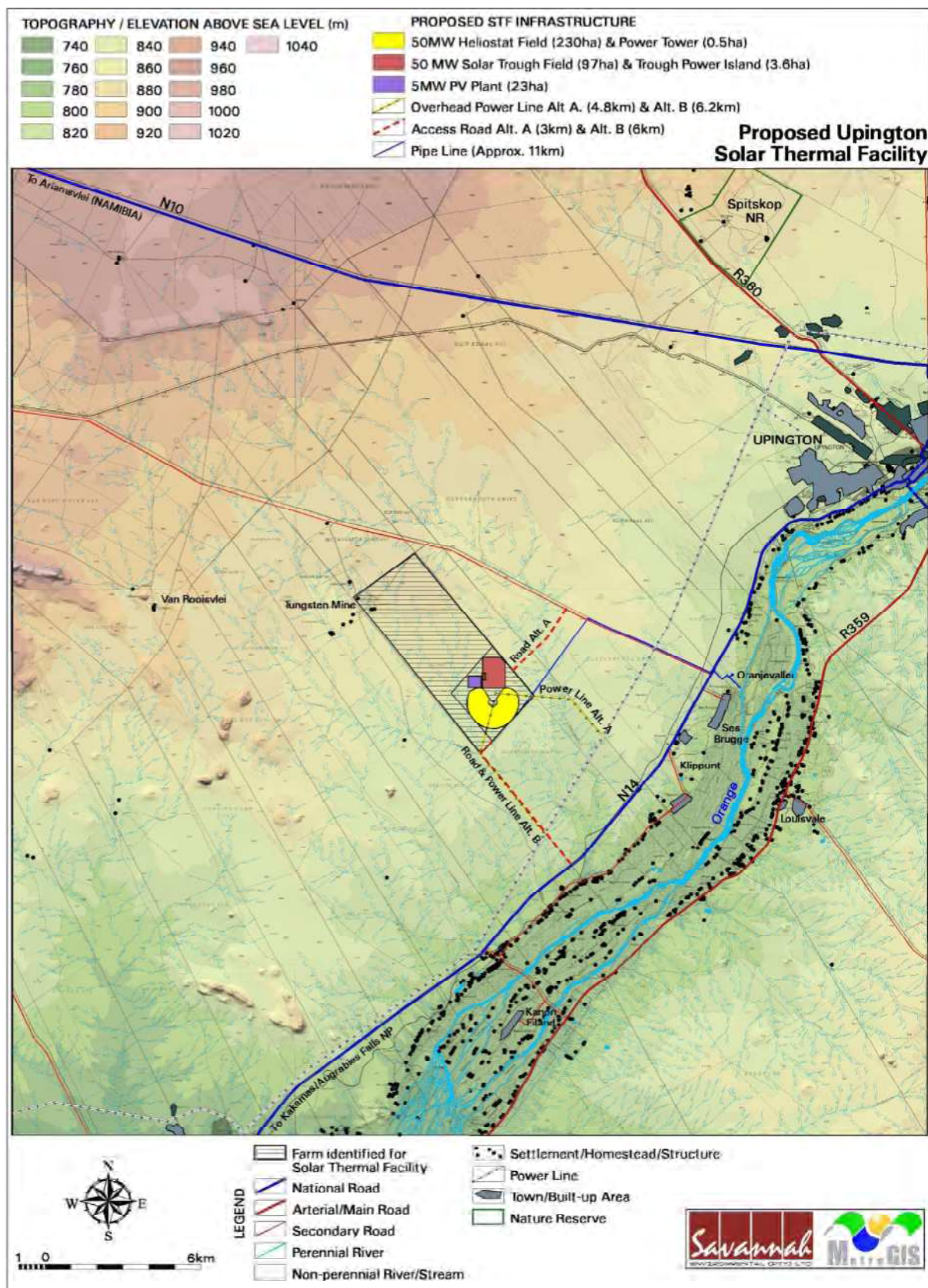
Temporarily affected areas within the identified farm portion comprise laydown areas for construction equipment, construction camps, temporary storage areas, and a batching plant area are summarised as follows:

<b>Facility Component -Temporary</b>	<b>Approximate area/extent (in ha)</b>
Laydown areas	1
Construction camps	0.5
Temporary storage areas	1
Batching plant	0.1
<b>TOTAL</b>	<b>2.6</b> (of a total area of 22 km <sup>2</sup> ) = <b>0.1% of site</b>

In order to assess the potential impacts that could occur, a site layout was produced, which is illustrated below in Figure 6.1.

<sup>8</sup> Assuming a length of 15 km and a servitude of 3 m

<sup>9</sup> Assuming dimensions of 50 m x 20 m



**Figure 6.1:** Layout map illustrating the provisional layout including the components within the preferred portion as well as the alternative routings for the power line and external access road (to be discussed in Chapter 7)

## **6.2 Assessment of the Potential Impacts associated with the Construction and Operation of the Proposed Solar Thermal Plant on the Identified Site in the Northern Cape**

The sections which follow provide a summary of the findings of the assessment undertaken for potential impacts associated with the construction and operation of the proposed solar thermal plant on the identified site. Issues were assessed in terms of the criteria detailed in Chapter 4. The nature of the potential impact is discussed; the significance is calculated with and without the implementation of mitigation measures. Recommendations are made regarding mitigation and management measures for potentially significant impacts and the possibility of residual and cumulative impacts are noted.

### **6.2.1 Potential Impacts on Ecology**

It was concluded that no mammal, reptile, or amphibian species of conservation concern that could occur in available habitats in the study area were present in the proposed development footprint. However, should any individuals occur they are likely to move away during construction and return to nearby natural habitats during operation. It is unlikely that construction of the solar facility will have a significant impact on fauna.

Impacts on vegetation may be both direct and indirect, with direct impacts occurring mostly during the construction phase, and indirect impacts during the operational phase. Clearing activities during the construction phase will lead to direct loss of vegetation which will in turn lead to localised or more extensive reduction in the overall extent of vegetation.

Plant species are especially vulnerable to infrastructure development because they cannot move out of the path of the construction activities. They are also affected by overall loss of habitat. Only the Quiver Tree which is classified as Vulnerable is considered a potential issue for this site. Only one individual of this species was recorded on the proposed development footprint.

Certain tree species are protected under the National Forests Act (Act No 84 of 1998)<sup>10</sup>. There are protected tree species that have a geographical distribution across the study area, including Camel Thorn, Shepard's Tree, Grey Camel Thorn, and the Ebony Tree. In terms of distribution within the study area, Camel Thorn is relatively common; Grey Camel occurs sparsely; Shepard's Tree is relatively common (i.e. primarily along secondary watercourses and areas adjacent to the primary watercourses); and Ebony

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<sup>10</sup> In terms of section 5(1) "no person may cut, disturb, damage or destroy any protected tree or possess, collect, remove, transport, export, purchase, sell donate or in any other manner acquire or dispose of any protected tree or any forest product derived from a protected tree, except under a license granted by the Minister to an (applicant and subject to such period and conditions as may be stipulated".

Tree *could* occur in the hills or on the flats within the study area. Shepard's Tree is relatively common on site and is associated primarily with secondary watercourses and areas adjacent to the primary watercourses. None of the other protected tree species that have the potential to occur on site were found, although drainage lines on site were considered suitable habitat for Grey Camel Thorn.

According to the National Water Act (No. 36 of 1998), the drainage lines on-site are classified as wetlands or water resources. These features provide important species habitat, for example these streambeds appear to be higher in species density, abundance, and diversity than the adjacent plains in terms of avifauna. From a sensitivity point of view, the higher order watercourse, including the main watercourse (i.e. the Helbrandkloofspruit which traverses to the centre/west of the site and on adjacent farm land) are more sensitive and, therefore, more important to protect than the low order ephemeral streams (i.e. in the south-eastern portion of the site where the facility is proposed to be located).

The health of the ecosystem may also be affected through the establishment and spread of alien invasive species due to disturbance activities in the construction phase. The site is not known to harbour alien plants in significant numbers, although some declared weeds (e.g. Tree tobacco) were found close to the previously mined areas in the north-western portion of the site, but in small numbers.

***Impact table summarising the significance of impacts on ecology during the construction and operation phases (with and without mitigation)***

<b><i>Nature: Impacts on indigenous natural vegetation</i></b>		
Direct permanent loss of vegetation will occur at the footprint of the solar fields; power island; evaporation ponds; storage and treatment reservoirs; internal access roads; and administrative offices and storage areas. The total footprint of the infrastructure is insignificant compared to the overall extent of Bushmanland Arid Grassland and Kalahari Karroid Shrubland.		
	<b><i>Without mitigation</i></b>	<b><i>With mitigation</i></b>
<b><i>Extent</i></b>	Local (1)	Local (1)
<b><i>Duration</i></b>	Permanent (5)	Permanent (5)
<b><i>Magnitude</i></b>	Moderate (6)	Low (4) - Moderate (6)
<b><i>Probability</i></b>	Probable (4) - Definite (5)	Probable (4) - Definite (5)
<b><i>Significance</i></b>	<b>Medium (36 - 60)</b>	<b>Medium (32 - 55)</b>
<b><i>Status (positive or negative)</i></b>	Negative	
<b><i>Reversibility</i></b>	Not reversible	
<b><i>Irreplaceable loss of resources</i></b>	Yes	
<b><i>Can impacts be mitigated</i></b>	To some extent	

<b><i>Nature: Impacts on threatened plant species</i></b>		
In terms of threatened species, only a single, relatively young Quiver Tree is expected to be affected (within the footprint of the solar field). The impact will be permanent since clearing of vegetation for construction purposes cannot be reversed and any plants destroyed will be permanently lost. Furthermore, loss of suitable habitat for this species means that it cannot become re-established within the transformed footprint of the facility.		
	<b><i>Without mitigation</i></b>	<b><i>With mitigation</i></b>
<b><i>Extent</i></b>	Local (1)	Local (1)
<b><i>Duration</i></b>	Permanent (5)	Permanent (5)
<b><i>Magnitude</i></b>	Low (2)	Low (1)
<b><i>Probability</i></b>	Definite (5)	Definite (5)
<b><i>Significance</i></b>	<b>Medium (40)</b>	<b>Medium (35)</b>
<b><i>Status (positive or negative)</i></b>	Negative	Negative
<b><i>Reversibility</i></b>	Not reversible	Not reversible
<b><i>Irreplaceable loss of resource</i></b>	Yes	Yes
<b><i>Can impacts be mitigated</i></b>	Yes	
<b><i>Mitigation:</i></b>		
» The plant should be rescued and planted at a suitable locality adjacent to the infrastructure where it will not be disturbed further.		
<b><i>Cumulative impacts:</i></b>		
» The potential loss of habitat, soil erosion, and alien invasions may lead to additional impacts that will exacerbate the impact on the Quiver Tree, potentially be through the destruction of potential habitat sites for new individuals.		
<b><i>Residual impacts:</i></b>		
» No likely residual impacts on threatened plant species have been identified.		

<b>Nature: Impacts on protected tree species</b>		
The impact will occur where an individual occurs within the developmental footprint. The impact will be permanent because clearing of vegetation for construction purposes cannot be reversed. The impact will only occur at the site of the proposed facility by affecting single individuals.		
	<b>Without mitigation</b>	<b>With mitigation</b>
<b>Extent</b>	Local (1)	Local (1)
<b>Duration</b>	Permanent (5)	Permanent (5)
<b>Magnitude</b>	Low (2) - Moderate (5)	Low (2) - Moderate (5)
<b>Probability</b>	Probable (3) - Definite (5)	Probable (3) - Definite (5)
<b>Significance</b>	<b>Low (24) - Medium (55)</b>	<b>Low (24) - Medium (55)</b>
<b>Status (positive or negative)</b>	Negative	
<b>Reversibility</b>	Not reversible	
<b>Irreplaceable loss of resources</b>	Yes	
<b>Can impacts be mitigated</b>	Yes	



**Mitigation:**

- » Obtain a permit for any protected trees that have to be destroyed in order to construct the facility.

**Cumulative impacts:**

- » Impacts due to alien invasions and damage to watercourses may possibly cause damage to habitat where protected trees could grow that may exacerbate the impact on protected tree species.

**Residual impacts:**

- » None likely.

**Nature: Impacts on ecology associated with drainage lines**

Construction of the solar array and ancillary infrastructure may lead to direct or indirect loss of or damage to the primarily lower order watercourses and/or to the catchment of these areas. This may affect the hydrology of the landscape or lead to loss of habitat for species that depend on this habitat type.

	<b>Without mitigation</b>	<b>With mitigation</b>
<b>Extent</b>	Local / surroundings (2)	Local / surroundings (2)
<b>Duration</b>	Medium (3) - Permanent (5)	Medium (3) - Permanent (5)
<b>Magnitude</b>	Moderate (5) - High (7)	Low (3) - Moderate (5)
<b>Probability</b>	Definite (5)	Definite (5)
<b>Significance</b>	<b>Medium (50) - High (70)</b>	<b>Medium (40) - High (60)</b>
<b>Status (positive or negative)</b>	Negative	
<b>Reversibility</b>	Reversible with effective rehabilitation	
<b>Irreplaceable loss of resource</b>	Yes	
<b>Can impacts be mitigated</b>	To some degree	

**Mitigation:**

- » Control stormwater and runoff water.
- » Obtain a permit from DWA to impact on any wetland or water resource.

**Cumulative impacts:**

- » Soil erosion, alien invasions may all lead to additional impacts on watercourses that will exacerbate the impact on the drainage lines.

**Residual impacts:**

- » It is expected that this impact will still occur to some degree.

**Nature: Impacts of the establishment and spread of alien invasive species**

The impact of alien invasive spread will be long-term unless alien plants are controlled. The impact will occur at the site of the proposed facility, but could spread into neighbouring areas.

	<b>Without mitigation</b>	<b>With mitigation</b>
<b>Extent</b>	Site & surroundings (2)	Site & surroundings (2)
<b>Duration</b>	Medium - Long-term (3 - 4)	Medium - Long-term (3 - 4)
<b>Magnitude</b>	Moderate (5)	Low (3)

<b>Probability</b>	Probable (3) – Define (5)	Improbable (2) – Define (5)
<b>Significance</b>	<b>Medium (33 - 50)</b>	<b>Low (18) – Medium (40)</b>
<b>Status (positive or negative)</b>	Negative	
<b>Reversibility</b>	Reversible	
<b>Irreplaceable loss of resources</b>	Yes	
<b>Can impacts be mitigated</b>	To a degree	
<b>Mitigation:</b> <ul style="list-style-type: none"><li>» Keep disturbance of indigenous vegetation to a minimum.</li><li>» Rehabilitate disturbed areas as quickly as practically possible following completion of construction activities in an area.</li><li>» Do not translocate soil stockpiles from areas with alien plants.</li><li>» Control any alien plants immediately to avoid establishment of a soil seed bank that would take decades to remove.</li><li>» Establish an ongoing monitoring programme to detect and quantify any aliens that may become established.</li></ul>		
<b>Cumulative impacts:</b> <ul style="list-style-type: none"><li>» Soil erosion, habitat loss, damage to wetlands and increased frequency of veld fires may all lead to additional impacts that will exacerbate the impact for the spread of alien invasive species.</li></ul>		
<b>Residual impacts:</b> <ul style="list-style-type: none"><li>» Residual impacts will probably be very low if control measures are effectively applied.</li></ul>		

### **Implications for Project Implementation**

- » The developmental footprint will not affect any botanical “no go” habitats or areas.
- » As there are no obvious concentrations of rare species or any especially threatened habitats or vegetation types on site, there are no areas of regionally high or very high ecological sensitivity demarcated within the project development footprint.
- » No mammal, reptile, or amphibian species of conservation concern that could occur within available habitats are in the study area and therefore the site is not considered sensitive in terms of faunal impacts (i.e. excluding avifauna).
- » A “Search and Rescue” Plan for the individual Quiver Tree should take place prior to construction.
- » A permit would need to be obtained for any protected trees that are affected.
- » A permit is required from (DWA) if there are expected impacts on any water resources (i.e. the drainage lines).
- » An on-going monitoring programme should be implemented to detect and quantify any aliens that may become established and provide information for the management of aliens.

### 6.2.2 Potential Impacts on Avifauna

On-site bird communities, particularly Red Data Species may be negatively affected due to habitat loss and disturbance (i.e. with the solar infrastructure). However, the loss of habitat and disturbance is unlikely to have any significantly negative impact on bird communities in the area.

#### **Impact tables summarising the significance of impacts on avifauna (with and without mitigation)**

<b>Nature: Impact of disturbance and habitat loss</b>		
Disturbance activities, which bird species are generally able to adapt and co exist with, would occur mainly during the construction period. Presuming these construction activities are limited to the developmental footprint, the extent of the impact will be local. Furthermore, the magnitude of this type of impact depends on the species concerned, the proportion of the study site affected, and the status of the habitat. Habitat loss would also occur primarily during the construction phase, primarily within the developmental footprint. The magnitude of habitat loss would vary depending on the species concerned, the proportion of the study site affected, and the status of the habitat currently on site (i.e. degraded or intact).		
	<b>Without mitigation</b>	<b>With mitigation</b>
<b>Extent</b>	Local (1)	Local (1)
<b>Duration</b>	Short term (2) – Long term (4)	Short term (2) – Long term (4)
<b>Magnitude</b>	Minor (2)	Minor (2) - Small (0)
<b>Probability</b>	Probable (3) - Highly probable (4)	Improbable (2) - Highly probable (4)
<b>Significance</b>	<b>Low (15 - 28)</b>	<b>Low (10 - 20)</b>
<b>Status (positive or negative)</b>	Negative	
<b>Reversibility</b>	Possible	
<b>Irreplaceable loss of resources</b>	None	
<b>Can impacts be mitigated</b>	Yes	
<b>Mitigation:</b>		
» The minimum amount of vegetation on site should be cleared outside of the development footprint.		
» The diversity and abundance of bird species is far greater in the drainage channels as opposed to the open plains where possible as much of this habitat should be kept intact.		
» The footprint of all construction activities and access roads should be restricted as much as practically possible.		
» If the nest of a large species is detected within the vicinity of the area to be disturbed then the relevant authorities need to be notified for potential nest removal, alternatively all attempts must be made to minimise the amount of disturbance of traffic near it.		
<b>Cumulative impacts:</b>		
» The loss of habitat on-site has the potential to add to the cumulative impacts that habitat		

loss in the region is having. However, 6 km <sup>2</sup> in the context of the amount of similar habitat in the region is a negligible amount.
<b>Residual impacts:</b>
» No residual impacts are expected.

### **Implications for Project Implementation**

- » No species of Special Concern were detected during the avifauna specialist site visit and none of the species detected are unduly shy or secretive species. Therefore it is not believed that the loss of habitat or disturbance will have any significant negative impact on bird communities in the area.
- » The incidences of birds interacting with the solar facility itself and subsequent mortalities are minimal.
- » Construction activities should be limited to the developmental footprint, and where possible, should be concentrated out of the drainage lines.
- » If the nest of a large species is detected within the vicinity of the area to be disturbed then the relevant authorities need to be notified for potential nest removal, alternatively all attempts must be made to minimise the amount of disturbance of traffic near it.

### **6.2.3 Assessment of Potential Impacts on Geology and Soils**

The impact of soil erosion and degradation during the construction phase (i.e. through stockpiling; mixing; wetting; filling; compaction; and pollution) is considered the most significant direct impact. Other negative indirect impacts include increased siltation.

#### **Impact tables summarising the significance of impacts on geology, soil, and erosion potential (with and without mitigation)**

<b>Nature: Soil degradation: removal of soil/rock; site clearing; soil mixing; cut-and-fill operations; soil compaction; stockpiling; and dumping of soil</b>		
The proposed activity is unlikely to have significant impact through the removal of soil/rock for foundations because the majority of the proposed structures will not involve excavations deeper than 1 – 2 m. Site clearing; soil mixing; cut-and-fill operations; soil compaction; stockpiling; and dumping of soil is likely to be limited to the construction phase.		
	<b>Without mitigation</b>	<b>With mitigation</b>
<b>Extent</b>	Local (1)	Local (1)
<b>Duration</b>	Medium (3) - Permanent (5)	Very short term (1) - Medium term (3)
<b>Magnitude</b>	Low (4) - Moderate (6)	Low (4)
<b>Probability</b>	Definite (4) - Highly Probable (4)	Definite (4) - Highly Probable (4)
<b>Significance</b>	<b>Moderate (32 - 48)</b>	<b>Low (24) - Moderate (32)</b>
<b>Status (positive or negative)</b>	Negative	

<b>Reversibility</b>	Partially reversible
<b>Irreplaceable loss of resources</b>	Yes
<b>Can impacts be mitigated</b>	Yes
<b>Mitigation:</b> <ul style="list-style-type: none"> <li>» Minimise size of disturbance areas.</li> <li>» Plan access roads according to minimise crossing of drainage lines.</li> <li>» Keep to existing roads/tracks, where practical, to minimise impact on undisturbed ground.</li> <li>» Topsoil can be replaced over foundations, if practical.</li> <li>» Plan soil embankments with max slope of 1:2 to allow for rehabilitation and or use erosion control measures where necessary.</li> <li>» Restrict temporary stockpiles to certain areas.</li> <li>» No permanent dumping on site other than approved filling operations.</li> <li>» Rehabilitate soil and vegetation in areas of activity where possible.</li> </ul>	
<b>Cumulative impacts:</b> <ul style="list-style-type: none"> <li>» The cumulative impact of topsoil removal and burial, and site clearing, soil mixing, etc is considered low due to the limited extent of the activity and the scarcity of development in the area.</li> <li>» The cumulative impact of stockpiling or dumping from all development in the area is considered low if mitigating measures are adopted.</li> </ul>	
<b>Residual impacts:</b> <ul style="list-style-type: none"> <li>» Residual impacts are expected to be minor due to the slow regeneration of topsoil.</li> </ul>	

<b>Nature: Soil degradation: pollution, salinisation, acidification or water-logging of natural soil</b>		
Soil pollution is expected to occur during the construction phase, predominantly because of the presence of vehicles and equipment.		
	<b>Without mitigation</b>	<b>With mitigation</b>
<b>Extent</b>	Local (1)	Local (1)
<b>Duration</b>	Medium term (3)	Short term (2)
<b>Magnitude</b>	Low (4)	Low (4)
<b>Probability</b>	Probable (3)	Probable (3)
<b>Significance</b>	<b>Low (24)</b>	<b>Low (21)</b>
<b>Status (positive or negative)</b>	Negative	Negative
<b>Reversibility</b>	Irreversible	Reversible
<b>Irreplaceable loss of resources</b>	Yes	Yes, minor
<b>Can impacts be mitigated</b>	Yes	
<b>Mitigation:</b>		
» Minimise disturbance areas.		
» Maintain good housekeeping practices in terms of spills remediation.		
» Implementation of a storm water management plan.		

**Cumulative impacts:**

- » Cumulative impact of soil pollution from all development in the area is considered low if mitigating measures are applied diligently

**Residual impacts:**

- » Minor negative residual impacts are expected due to the slow regeneration of vegetation and soil.

**Nature: Soil erosion**

The site has a low susceptibility to erosion, primarily due to the very dry climate. However, exceptional heavy rainfall can occur and therefore soil erosion concerns will be greatest along drainage lines where run-off is concentrated and hydraulic energy is potentially high. Areas where loose, unconsolidated sandy soils of low plasticity (i.e. Gordonia wind-blown sands) occur also tend to be more susceptible to erosion following heavy downpours, and this includes most of the proposed site. In addition to this, areas where vegetation is limited or has been disturbed or damaged due to construction activity will be more susceptible to erosion following heavy downpours. Localised occurrences of hard, resistant near-surface calcrete capping, or duricrust will, however, tend to limit erosion in areas where these outcrops are present. The most important indirect impacts are the increased siltation in drainage lines and downstream dams because of an increase in erosion from the site.

	<b>Without mitigation</b>	<b>With mitigation</b>
<b>Extent</b>	Local (1)	Local (1)
<b>Duration</b>	Medium term (3) - Permanent (5)	Very short term (1) - Permanent (5)
<b>Magnitude</b>	Moderate (6)	Low (4)
<b>Probability</b>	Highly probable (4) - Probable (3)	Probable (3)
<b>Significance</b>	<b>Moderate (36 - 40)</b>	<b>Low (18 - 30)</b>
<b>Status (positive or negative)</b>	Negative	
<b>Reversibility</b>	Irreversible	
<b>Irreplaceable loss of resources</b>	Yes	
<b>Can impacts be mitigated</b>	Yes	

**Mitigation:**

- » Restrict size of disturbance areas.
- » Minimise activity in high erosion-sensitive areas.
- » Implement effective erosion control measures.
- » Keep to existing roads, where practical, to minimise impact on undisturbed ground.
- » Ensure stable slopes of stockpiles/excavations to minimise slumping.
- » Minimise uncontrolled discharge of run-off.
- » Install anti-erosion measures such as silt fences in disturbance areas.

**Cumulative impacts:**

- » The cumulative impact of soil erosion from all development in the area is considered low if mitigating measures are adhered to.

***Residual impacts:***

- » The residual impacts are expected to be minor due to the localised movement of sediment and the slow regeneration of soil processes.

***Implications for Project Implementation***

- » Degradation of geo-sites is unlikely as none exist that would warrant special attention for preservation.
- » Soil erosion concerns will be greatest along drainage lines where run-off is concentrated and hydraulic energy is potentially high.
- » Uncontrolled discharge of run-off must be managed and anti-erosion measures such as silt fences should be installed in disturbance areas.
- » The preliminary geotechnical findings have highlighted certain constraints which should be considered in the design process. These constraints should be verified in a detailed geotechnical investigation which should be commissioned by the proponent before the design process is finalised. However, no insurmountable geotechnical problems were identified in this preliminary assessment and the site appears to be suitable for the development as planned.
- » The presence of calcrete and other minor occurrences of basement rock have a significant reducing effect on the erosion potential on the south-eastern portion of the site.
- » The cumulative significance of the potential impacts on the geological environment is considered low due to the limited scale of the development and the scarcity of development in the immediate surrounding area. With effective implementation of mitigating measures the impacts identified above can be reduced to a low level.
- » The proposed development layout indicates that some infrastructure and roads are sited near or across small drainage lines. These areas tend to be more sensitive in terms of erodibility potential and special engineering designs such as culverts, river training, etc. may have to be considered to minimise impact on these watercourses and to prevent obstructions in the site drainage.

***6.2.4 Assessment of Impacts on Water Resources***

From a habitat and ecosystem point of view, all the dry river beds and the associated riparian systems is rated as extremely sensitive to development, in particular the mainstem systems (i.e. Helbrandkloofspruit), which flows along the western boundary of the site. There is a moderate risk of impacts to the Orange River resulting from elevated sediment loads and polluted runoff from the facility reaching the river during site preparation and construction. The construction of infrastructure associated with the abstraction point also poses a moderate risk of impacting negatively on aquatic habitats and biota in the adjacent Orange River.

However, with suitable mitigation and implementation of the proposed layout, the development should have limited impact on the overall status of the riparian systems within the region. All impacts that were assessed as being of moderate significance could readily be reduced to low significance by appropriate mitigation, apart from the moderate impact of water abstraction from the Orange River.

<b>Nature: Loss of riparian systems</b>		
The physical removal of the narrow strips of woody riparian zones which will be replaced by hard engineered surfaces. This impact would however be localised, as a large portion of the remaining farm and the Helbrandkloofspruit catchment would remain intact.		
	<b>Without mitigation</b>	<b>With mitigation</b>
<b>Extent</b>	Local (1)	Local (1)
<b>Duration</b>	Long-term (4)	Long-term (4)
<b>Magnitude</b>	Moderate (6)	Low (4)
<b>Probability</b>	Definite (5)	Definite (5)
<b>Significance</b>	<b>High (55)</b>	<b>Medium (45)</b>
<b>Status (positive or negative)</b>	Negative	
<b>Reversibility</b>	Medium	
<b>Irreplaceable loss of resources</b>	No	
<b>Can impacts be mitigated</b>	Yes	
<b>Mitigation:</b>		
» The most significant form of mitigation would be to select a development area, which contained no drainage lines. However due to the nature of the site, this was not possible, thus an area with the least number of riparian systems was earmarked, i.e. the south eastern corner of the site. This area is also a significant distance from the main drainage systems, and is thus unlikely to be flooded or in itself pose a risk to the aquatic systems should there be any major spills.		
<b>Cumulative impacts:</b>		
» No cumulative impacts are expected.		
<b>Residual impacts:</b>		
» Possible impact on the remaining catchment due to changes in run-off characteristics in the development site.		

<b>Nature: Impact on dry riverbeds and localised drainage systems</b>		
The physical removal of narrow strips of woody riparian zones being replaced by hard engineered surfaces will alter the hydrological nature of the area, by increasing the surface run-off velocities, while reducing the potential for any run-off to infiltrate the soils. This impact would however be localised, as a large portion of the remaining farm and the Helbrandkloofspruit catchment would remain intact.		
	<b>Without mitigation</b>	<b>With mitigation</b>
<b>Extent</b>	Local (Low 1)	Local (Low 1)
<b>Duration</b>	Long-term (4)	Long-term (4)



<b>Magnitude</b>	Low (4)	Low (4)
<b>Probability</b>	Definite (5)	Probable (3)
<b>Significance</b>	<b>Medium (45)</b>	<b>Low (24)</b>
<b>Status (positive or negative)</b>	Negative	
<b>Reversibility</b>	High	
<b>Irreplaceable loss of resources</b>	No	
<b>Can impacts be mitigated</b>	Yes	
<b>Mitigation:</b>		
» Select a development area which contained no drainage lines. However due to the nature of the site, this was not possible, thus an area with the least number of riparian systems was earmarked, i.e. the south eastern corner of the site. Any stormwater within the site will be handled in a suitable manner, i.e. separate clean and dirty water streams around the plant, and install stilling basins to capture large volumes of run-off, trap sediments, and reduce flow velocities.		
<b>Cumulative impacts:</b>		
» The increase in surface run-off velocities and the reduction in the potential for groundwater infiltration are unlikely to occur, considering that the site is not near the main drainage channel, and the annual rainfall figures are low.		
<b>Residual impacts:</b>		
» Diversion of run-off away from downstream systems is unlikely to occur as the site is not near the main drainage channel and the annual rainfall figures are low.		

<b>Nature: Impact on riparian systems</b>		
This may occur through the possible increase in surface water runoff on riparian form and function.		
	<b>Without mitigation</b>	<b>With mitigation</b>
<b>Extent</b>	Local (Low 1)	Local (Low 1)
<b>Duration</b>	Long-term (4)	Long-term (4)
<b>Magnitude</b>	Low (2)	Low (2)
<b>Probability</b>	Definite (5)	Probable (3)
<b>Significance</b>	<b>Medium (35)</b>	<b>Low (19)</b>
<b>Status (positive or negative)</b>	Negative	
<b>Reversibility</b>	Medium	
<b>Irreplaceable loss of resources</b>	No	
<b>Can impacts be mitigated</b>	Yes	
<b>Mitigation:</b>		
» Any stormwater within the site will be handled in a suitable manner, i.e. separate clean and dirty water streams around the plant, and install stilling basins to capture large volumes of run-off, trap sediments, and reduce flow velocities (e.g. water used when washing the		

mirrors).
» The project should also try capture and recycle any form of run-off created by the daily operations. This would minimise the amount of water required by the project, but also serve to limit the downstream impacts on the riparian systems through an increase in run-off, a situation that these systems are currently unaccustomed too.
<b>Cumulative impacts:</b>
» Downstream alteration of hydrological regimes due to the increased run-off from the area.
<b>Residual impacts:</b>
» Possible impact on the remaining catchment due to changes in run-off characteristics in the development site.

Nature: Increase in sedimentation and erosion within the development footprint		
	Without mitigation	With mitigation
Extent	Local (Low 1)	Local (Low 1)
Duration	Long-term (4)	Long-term (4)
Magnitude	Low (1)	Low (1)
Probability	Definite (5)	Probable (3)
Significance	Medium (30)	Low (18)
Status (positive or negative)	Negative	
Reversibility	Medium	
Irreplaceable loss of resources	No	
Can impacts be mitigated	Yes	
Mitigation:		
» Any stormwater within the site will be handled in a suitable manner, i.e. separate clean and dirty water streams around the plant, and install stilling basins to capture large volumes of run-off, trap sediments, and reduce flow velocities (e.g. water used when washing the mirrors).		
Cumulative impacts:		
» Downstream erosion and sedimentation of the downstream wetland / dam area and canal system of the Naftali operations. During flood events, the unstable banks (eroded areas) and sediment bars (sedimentation downstream) already deposited downstream will then be washed into the Orange River.		
Residual impacts:		
» During flood events, the unstable banks (eroded areas) and sediment bars (sedimentation downstream) already deposited downstream will then be washed into the Orange River.		

<b>Nature: Physical disturbance by the supporting infrastructure (pump stations) on the riparian environment</b>		
The proposed pipeline route will have limited to no impact on the functioning of any riparian systems.		
	<b>Without mitigation</b>	<b>With mitigation</b>
<b>Extent</b>	Local (Low 1)	Local (Low 1)
<b>Duration</b>	Long-term (4)	Long-term (4)
<b>Magnitude</b>	Moderate (6)	Low (3)
<b>Probability</b>	Definite (5)	Probable (3)
<b>Significance</b>	<b>Medium (55)</b>	<b>Low (24)</b>
<b>Status (positive or negative)</b>	Negative	
<b>Reversibility</b>	Medium	
<b>Irreplaceable loss of resources</b>	No	
<b>Can impacts be mitigated</b>	Yes	
<b>Mitigation:</b>		
» The placement of pump inlets and the supporting infrastructure to prevent the potential for scour / erosion and downstream sedimentation of the Orange River. The current placement is within an area of dense reed growth ( <i>Phragmites australis</i> ), and would not be considered a severe impact. Care should however be taken that if any clearing is done, that this area is monitored for plant re-growth, firstly to prevent alien plant infestations and to ensure no erosion or scour takes place.		
<b>Cumulative impacts:</b>		
» Additional downstream erosion and sedimentation of the Orange River		
<b>Residual impacts:</b>		
» During flood events, the unstable banks (eroded areas) and sediment bars (sedimentation downstream) will further increase the suspended sediment loads within the Orange River system.		

### **Implications for Project Implementation**

- » The ecological functioning of the impacted reach of the Orange River could be seriously impacted by high sediment inputs associated with the proposed construction activities, particularly of the water abstraction facilities.
- » Any storm water within the site must be handled in a suitable manner, i.e. separate clean and dirty water streams around the plant, and install stilling basins to capture large volumes of run-off, trap sediments, and reduce flow velocities. Therefore a comprehensive Storm Water Management Plan (SWMP) which incorporates anti-erosion measures on site should be put in place.
- » Man-induced erosion and sedimentation in this area from intensive farming activities along the Orange River is expected to be unnaturally high. The cumulative impact on the Orange River could thus exceed the tolerances of the aquatic biota, including sensitive fish species.

- » Although the volume does not seem to be prohibitive, water use can be reduced by implementing alternative operational processes, e.g. dry cooling. However, this will have a significant economic impact as the current tariffs under the REFIT only cater for wet cooling and will affect the economic viability of the project.

### **6.2.5 Assessment of Potential Impacts on Heritage Sites**

The proposed site is unlikely to be rich in archaeological traces of major significance. Across most of the development footprint stone artefacts, which were by far the predominant heritage resource noted, were found to occur in extremely low densities of less than 1 per 10 m x 10 m area. However, artefact densities are greater closer to the Orange (Gariep) River along the water pipeline route and near the settlement reservoir (i.e. a maximum of 1 or 2 artefacts per square metre). It is not thought likely that any significant current intangible heritage values would be attached to the particular terrain in question.

Extremely sparse population and very limited material evidence of human activity even of the recent pre-colonial past together suggest that there are not likely to be any significant current intangible heritage values attached to the primary footprint development site on McTaggart's Camp.

#### **Impact tables summarising the significance of impacts on heritage resources (with and without mitigation)**

<b>Nature: Impacts on heritage resources</b>		
These potential impacts would tend to be direct, once-off events occurring during the initial construction period. In the long term, the proximity of operations in a given area could result in secondary indirect impacts resulting from the movement of people or vehicles in the immediate or surrounding vicinity. Certain activities would generally have a lower impact than others (i.e. power lines tend to be less destructive on Stone Age sites than access roads).		
	<b>Without mitigation</b>	<b>With mitigation</b>
<b>Extent</b>	Local (1)	Local (1)
<b>Duration</b>	Permanent (5)	Permanent (5)
<b>Magnitude</b>	Moderate (6)	Low (4)
<b>Probability</b>	Highly probable (4)	Probable (3)
<b>Significance</b>	<b>Moderate (48)</b>	<b>Low (30)</b>
<b>Status</b>	Negative	
<b>Reversibility</b>	No	
<b>Irreplaceable loss of resources</b>	Yes – but the archaeological resources are not of major significance	
<b>Can impacts be mitigated</b>	Yes – but not considered necessary in most instances	
<b>Mitigation:</b>		
» Artefact densities are low over most of the development footprint, so much so that mitigation measures are not considered necessary in most instances. A surface collection and record		

for an area which falls at the edge of the proposed main development footprint should be completed, and this could arguably reduce the 'magnitude' and the 'probability' criteria referred to above.
<b>Cumulative impacts:</b> » The impacts are once-off permanent destructive events.
<b>Residual impacts:</b> » No residual impacts are expected.

### **Implications for Project Implementation**

- » Very sparse heritage traces were found on the site and from an archaeological perspective the observed heritage resources may be regarded as being of generally low significance.
- » In the event of archaeological materials being present such activity would alter or destroy their context (even if the artefacts themselves are not destroyed, which is also obviously possible).
- » Destruction of the site of greater importance, (i.e. which falls at the edge of the proposed main development footprint) should be mitigated by way of a Phase 2 surface collection.
- » In the event that such resources are found, they are likely to be of a nature that potential impacts could be mitigated by documentation and/or salvage following approval and permitting by the South African Heritage Resources Agency and, in the case of any built environment features, by Ngwao Bošwa ya Kapa Bokone (the Northern Cape Heritage Authority).

### **6.2.6 Assessment of Potential Visual Impacts**

#### **Potential visual impacts associated with the construction phase**

The construction phase will last for approximately 2 – 3 years; however this is dependent on several external factors. During this time construction related traffic (i.e. in terms of traffic and construction workers) will frequent the area and may cause a visual nuisance to other road users and landowners in the area.

#### **Potential visual impacts associated with the operational phase**

During the operational phase, the facility (i.e. primarily the power tower) will be visible. Other ancillary infrastructure (i.e. the 2 story generator buildings, the substation, the settlement and storage reservoirs, the blow down pond, the internal roads, the office and the workshop) will generally be overshadowed by the much taller power tower). The results of the viewshed analyses in Figure 6.2 show the potential visual exposure of the facility. This figure illustrates the core area (primary visual catchment) of potentially uninterrupted exposure of the facility as contained within a 16 km buffer zone. It is envisaged that the proposed facility would be easily and comfortably visible, especially within a 16 km radius of the site; due to the relatively flat topography and the low visual

absorption capacity of the vegetation<sup>11</sup>, and the power tower in particular, would constitute a high visual prominence, potentially resulting in a moderate visual impact. The majority of potentially uninterrupted exposure will occur with the 0 – 4 km zone which equates to a short distance view where the solar facility (i.e. primarily the power tower) would dominate the frame of vision and constitute a very high visual prominence (refer to Figure 6.3). Visibility beyond the 16 km mark equates to a long distance exposure where the solar facility (i.e. primarily the power tower) would still be visible, though not as easily recognisable, this zone would constitute a medium visual prominence.

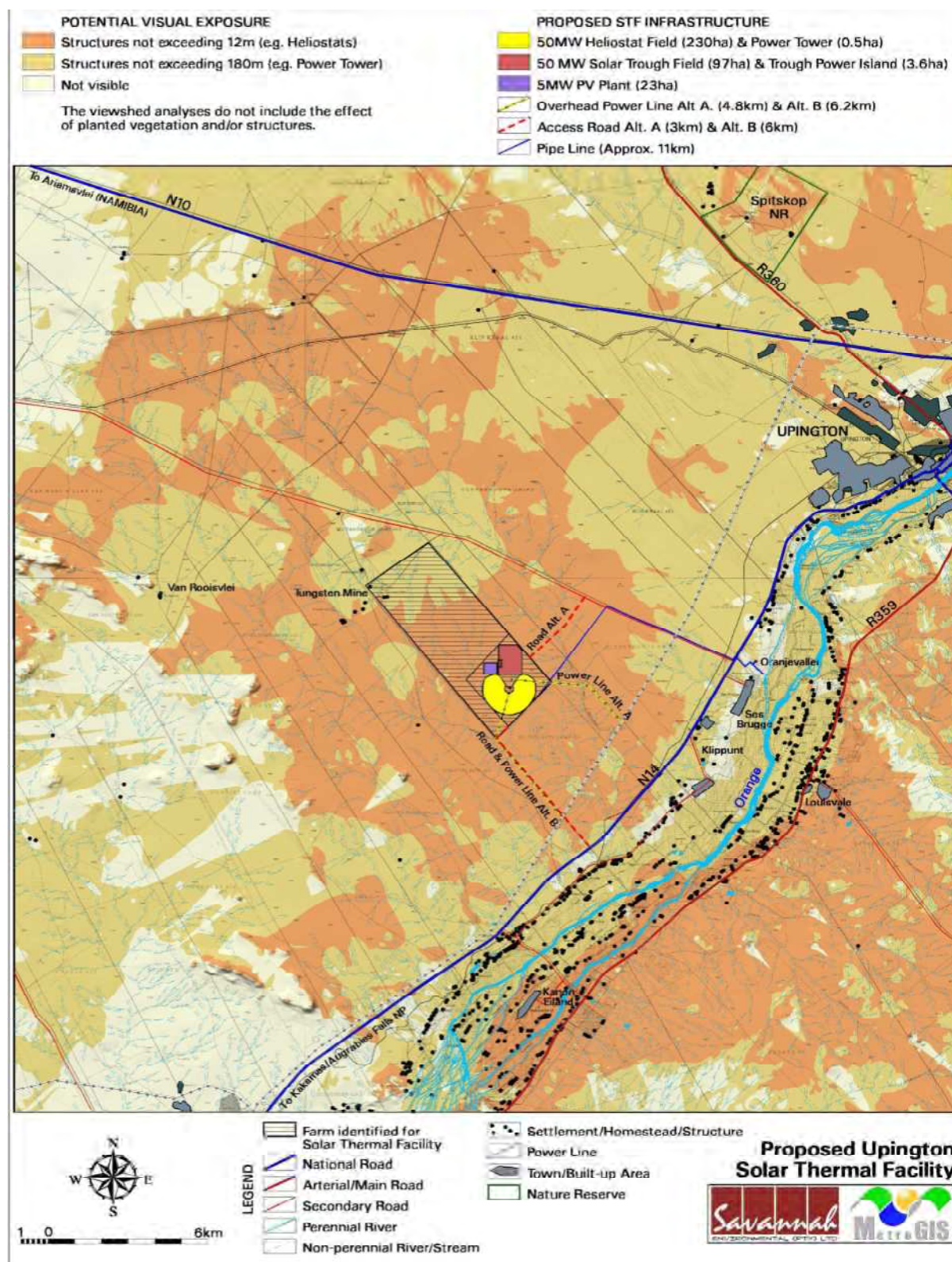
Upington, Oranjevallei, Louisvale, and Kanoneiland are expected to be exposed to medium to long distance views of the solar facility (i.e. primarily the power tower), and would therefore experience a moderate to low visual impact. Towns within 8 km of the proposed facility (i.e. Klippunt and Ses Brugge) will experience moderate to high visual impact. Many homesteads and settlements along the Orange River occur on the south east facing bank. In addition to being somewhat shielded by topography, most of these settlements lie beyond 8 km of the facility, and would therefore potentially be exposed to a low visual impact. This excludes those settlements along the R359 which will experience a moderate to high visual impact. Sparsely populated areas within a radius of 4 km of the facility, observers will potentially be exposed to high visual impact. Within this radius lies one settlement adjacent to the facility which will be exposed to very high visual impact. Beyond the 8 km radius, settlements such as Van Rooisvlei are expected to be exposed to moderate and low visual impact.

The power tower or parts of would be visible from the Spitskop Nature Reserve<sup>12</sup>, but these would be long distance views and visual impact would be low to very low. The other primary infrastructure (i.e. the heliostats, the PV panels or the troughs) or ancillary infrastructure will not be visible from this distance. Observers on corridors or roads in close proximity to the facility (i.e. within 4 km) would be exposed to a very high potential visual impact. This includes a section of secondary road bypassing the facility to the north. The secondary road is not of great concern as it is generally devoid of random observers and does not carry a large number of motorists. Both national and arterial roads between 4 km and 16 km of the site will be exposed to moderate to high visual impact, dropping to moderate in places. A small section of the N14 will experience high visual impact because of the power tower. Roads with a high potential visual impact include a section of the N14 south east of the site and a section of the secondary road north east of the site. At this distance (less than 8 km) the solar facility will be most prominent. Beyond 16 km away from the development the potential visual impacts along all the roads and built-up areas becomes low to very low or not visible.

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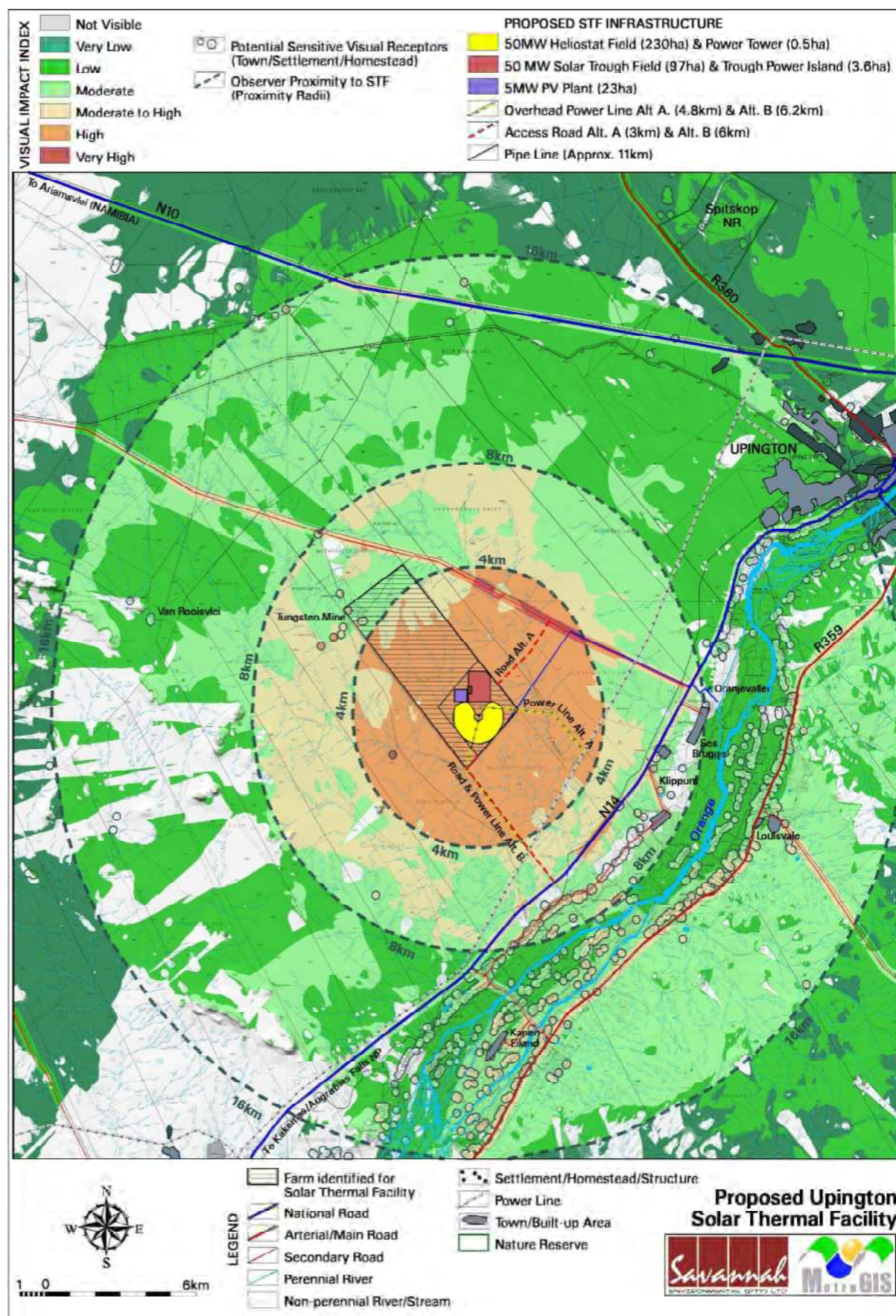
<sup>11</sup> Primarily Thicket, Bushland, and Shrubland which are on average only 2 m high.

<sup>12</sup> It should be noted that the Spitskop Nature Reserve is not a well developed tourist destination, and has little infrastructure at present.



**Figure 6.2:** Map illustrating the *theoretical* potential visual exposure of the solar plant. The pink shading indicates areas from where whole or parts of a single structure not exceeding 12 m could potentially be visible and the yellow shading indicate areas where **only** the power tower or a section thereof could be visible







From approximately **20 km away** from the facility the power tower will be visible in the far distance. However, the visual impact will be absorbed somewhat, by the industrial infrastructure and clutter of Upington Industria in the middle ground. It is not anticipated that the other primary infrastructure (i.e. the heliostats, the PV panels or the troughs) or ancillary infrastructure will be visible from this distance. This view is representative of a long distance visual experience that both residents of Upington as well as travellers utilising the N10 and Upington Airport will have of the proposed facility.

From approximately 10 km away the power tower will be visible in the **middle distance** landscape. It is not anticipated that the other primary infrastructure (i.e. the heliostats, the PV panels or the troughs) or ancillary infrastructure will be visible from this distance. This view is indicative of what will be seen from workers, residents, and potentially tourists utilising the area around Kanoneiland while moving between from the R359 and N14 roads and those moving in a northerly direction away from the Orange River.

From approximately 3 km away the power tower will be fully visible in the **short distance** landscape. The other primary infrastructure (i.e. the heliostats, the PV panels or the troughs) and the ancillary infrastructure may be discernable, but will not be apparent. This view is representative of a short distance visual experience of the proposed facility (refer to Figure 6.4). Other photo simulations are included within the visual impact assessment report (refer to Appendix K).



**Figure 6.4:** Photo simulation of the view from the road running along the north-eastern boundary of the facility, at a distance of approximately 2 to 3 km north (as the crow flies) of the proposed facility

The primary visual impact, namely the appearance and dimensions of the power tower is not possible to mitigate. The functional design of the approximately 200 m high structure cannot be changed to mitigate visual impacts.

**Impact table summarising the significance of visual impacts (with and without mitigation)**

<b>Nature: Visual impact on users of arterial roads and secondary roads in close proximity to the facility (i.e. within 8 km)</b>	
<b>Extent</b>	Local (4)
<b>Duration</b>	Long term (4)
<b>Magnitude</b>	High (4)
<b>Probability</b>	High (4)
<b>Significance</b>	High <b>(60)</b>
<b>Status (positive or negative)</b>	Negative
<b>Reversibility</b>	Recoverable (3)
<b>Irreplaceable loss of resources</b>	No
<b>Can impacts be mitigated during the operational phase</b>	No
<b>Mitigation:</b>	
» Decommissioning: removal of the solar facility structures and ancillary infrastructure after its economic life, 30 - 50 years.	
<b>Cumulative impacts:</b>	
» If considered in addition to the possible future construction of the proposed Eskom Solar Facility, the development of the solar facility and associated infrastructure will increase the cumulative visual impact within the region.	
<b>Residual impacts:</b>	
» None, the visual impact will be removed after decommissioning.	

<b>Nature: Visual impact on residents of towns, settlements, and homesteads in close proximity to the proposed facility (i.e. within 8 km)</b>	
<b>Extent</b>	Local (4)
<b>Duration</b>	Long term (4)
<b>Magnitude</b>	Moderate (3)
<b>Probability</b>	High (4)
<b>Significance</b>	Moderate <b>(56)</b>
<b>Status (positive or negative)</b>	Negative
<b>Reversibility</b>	Yes
<b>Irreplaceable loss of resources</b>	No
<b>Can impacts be mitigated during operational phase</b>	No
<b>Mitigation:</b>	
» Decommissioning: removal of the solar facility structures and ancillary infrastructure after its economic life, 30 - 50 years	
<b>Cumulative impacts:</b>	
» If considered in addition to the possible future construction of the proposed Eskom Solar Facility, the development of the solar facility and associated infrastructure will increase the cumulative visual impact within the region.	

**Residual impacts:**

- » None, the visual impact will be removed after decommissioning.

**Nature: Visual impact on residents of towns, settlements, and homesteads within the region (>16 km)**

<b>Extent</b>	Regional (3)
<b>Duration</b>	Long term (4)
<b>Magnitude</b>	Moderate (3)
<b>Probability</b>	High (4)
<b>Significance</b>	Moderate <b>(40)</b>
<b>Status (positive or negative)</b>	Negative
<b>Reversibility</b>	Recoverable (3)
<b>Irreplaceable loss of resources</b>	No
<b>Can impacts be mitigated during operational phase</b>	No
<b>Mitigation:</b>	
» Decommissioning: removal of the solar facility structures and ancillary infrastructure after its economic life, 30 - 50 years	
<b>Cumulative impacts:</b>	
» If considered in addition to the possible future construction of the proposed Eskom Solar Facility, the development of the solar facility and associated infrastructure will increase the cumulative visual impact within the region.	
<b>Residual impacts:</b>	
» None, the visual impact will be removed after decommissioning	

**Nature: Visual impact of the proposed solar facility on protected areas and eco-tourism along the Orange River**

<b>Extent</b>	Regional (3)
<b>Duration</b>	Long term (4)
<b>Magnitude</b>	Low (2)
<b>Probability</b>	High (4)
<b>Significance</b>	Moderate <b>(48)</b>
<b>Status (positive or negative)</b>	Negative
<b>Reversibility</b>	Recoverable (3)
<b>Irreplaceable loss of resources</b>	No
<b>Can impacts be mitigated during operational phase</b>	No
<b>Mitigation:</b>	
» Decommissioning: removal of the solar facility structures and ancillary infrastructure after its economic life, 30 - 50 years	

***Cumulative impacts:***

- » If considered in addition to the possible future construction of the Eskom Solar Facility, the development of the solar facility and associated infrastructure will increase the cumulative visual impact within the region.

***Residual impacts:***

- » None as the visual impact will be removed after decommissioning.

***Implications for Project Implementation***

- » The natural and relatively unspoiled wide-open views surrounding the site will be transformed for the entire operational lifespan (approximately 30 - 50 years) of the facility.
- » The facility further has a novel and futuristic design that invokes a curiosity factor not generally present with other conventional power generating plants. The advantage being that the solar facility can become an attraction or a landmark within the region that people would actually want to come and see. As it is impossible to hide the facility, the only option would be to promote it.
- » The solar facility would be visible for a large area that incorporates various sensitive visual receptors that should ideally not be exposed to industrial-type structures.
- » There are not many recommendations as to the mitigation of the visual impact of the core facility (power tower) as no amount of vegetation screening or landscaping would be able to hide structures of these dimensions.
- » The ancillary infrastructure must be properly planned with due cognisance of the topography, that all disturbed areas be properly rehabilitated, and that all infrastructure and the general surrounds are maintained in a neat and appealing way.
- » The placement of laydown areas and temporary construction camps should be carefully considered in order to not negatively influence the future perception of the facility.
- » Secondary visual impacts associated with the construction phase, such as the sight of construction vehicles, dust and construction litter must be managed to reduce visual impacts. The use of dust-suppression techniques on the access roads (where required) and the timely removal of rubble and litter will assist in doing this.
- » Proper planning and placement of light fixtures in order to reduce visual impacts associated with glare and light trespass is recommended.
- » Ancillary structures should, if possible, be placed underground to avoid additional visual clutter where possible and feasible.
- » Proper re-instatement and re-vegetation is recommended for the pipeline.

### **6.2.7            Assessment of Potential Social Impacts**

The key social issues associated with the **construction phase** include the following potential **positive** impacts:

- » Creation of employment, business opportunities, and the opportunity for skills development and on-site training

The key social issues associated with the **construction phase** also include the following potential **negative** impacts:

- » Impacts associated with the presence of construction workers on site
- » Increased risk of stock theft, poaching and damage to farm infrastructure associated with presence of construction workers on the site
- » Increased risk of veld fires associated with construction related activities
- » Threat to safety and security of farmers associated with the presence of construction workers in the area
- » Impact of heavy vehicles, including damage to roads, safety, noise and dust

The key social issues affecting the **operational phase** include the following potential **positive** impacts:

- » Creation of employment and business opportunities, and opportunities for skills development and training
- » The promotion of clean energy as an alternative energy source and establishment of Cleaner Development Mechanism (CDM) project

The key social issues affecting the **operational phase** include the following potential **negative** impacts:

- » The visual impacts and associated impact on sense of place (refer to the assessment of the visual impacts)
- » Impact on scarce water resources (refer to the assessment of the impact on water resources)

#### ***Impact tables summarising the significance of social impacts associated with the construction phase (with and without mitigation measures)***

##### ***Nature: Employment, business opportunities, and skills development***

The construction phase is expected to create approximately 300 - 600 employment opportunities where approximately 60% will be low skilled positions (i.e. construction labourers, security staff etc) and semi-skilled workers (i.e. drivers, equipment operators etc) and 40% will be available to skilled personnel (i.e. engineers, land surveyors, project managers etc). In terms of business opportunities for local companies, expenditure during the construction phase will create business

opportunities for the regional and local economy. However, given the technical nature of the project and high import content associated with solar energy facilities opportunities for the local Kai !Gariep economy and the towns of Keimoes and Kakamas are likely to be limited. However, opportunities are likely to exist for local contractors and engineering companies in Upington.

The potential opportunities for the local service sector would be linked to accommodation, catering, cleaning, transport and security, etc associated with the construction workers on the site. The majority of the construction workers will be accommodated in the nearest local towns, with Upington likely to be the most convenient due to its proximity to the site. This will create opportunities for local hotels, B&Bs, guest farms and people who want to rent out their houses. In addition, a proportion of the total wage bill earned by construction workers over the 2 – 3 year construction phase is also likely to be spent in the regional and local economy. The injection of income into the area in the form of rental for accommodation and wages will create opportunities for local businesses in towns such as Upington, Keimoes, and Kakamas. The benefits to the local economy will however be confined to the construction period (2 – 3 years).

In terms of training, the contractors are likely to provide on-site training and skills development opportunities. However, the majority of benefits are likely to accrue to personnel employed by the relevant contractors. The potential for meaningful skills development and training for members from the local communities are likely to be limited.

	<b><i>Without Mitigation<sup>13</sup></i></b>	<b><i>With Mitigation</i></b>
<b><i>Extent</i></b>	Local – Regional (2)	Local – Regional (4)
<b><i>Duration</i></b>	Short term (2)	Short term (2)
<b><i>Magnitude</i></b>	Low (4)	Moderate (6)
<b><i>Probability</i></b>	Highly probable (4)	Highly probable (4)
<b><i>Significance</i></b>	Medium (32)	Medium (48)
<b><i>Status (positive or negative)</i></b>	Positive	
<b><i>Reversibility</i></b>	N/A	
<b><i>Irreplaceable loss of resources</i></b>	N/A	
<b><i>Can impacts be Mitigated</i></b>	Yes	

***Mitigation/Enhancement:***

- » Where reasonable and practical, the turnkey EPC contractor should appoint local contractors, especially for semi and low-skilled job categories. However, due to the low skills levels in the area, the majority of skilled posts are likely to be filled by people from outside the area.
- » Prior to the construction phase the existence of a skills database for the area should be determined and if such as database exists it should be made available to the contractors appointed for the construction phase.
- » The local authorities, community representatives, and organisations on the I&AP database should be informed of the final decision regarding the project and the potential job opportunities for locals and the employment procedures that the turnkey EPC contractor intends following for the construction phase of the project.
- » Where applicable and feasible, training and skills development programmes for locals should

<sup>13</sup> With respect to positive impacts, mitigation is actually referring to the enhancement of impacts

<p>be initiated prior to the initiation of the construction phase.</p> <ul style="list-style-type: none"> <li>» The recruitment selection process should seek to promote gender equality and the employment of women wherever possible.</li> <li>» !Khi CSP should develop a database of local companies, specifically BEE companies, which qualify as potential service providers (e.g. construction companies, catering companies, waste collection companies, security companies etc.) prior to the commencement of the tender process for construction contractors.</li> <li>» The Kai !Gariep Municipality, in conjunction with the local Chamber of Commerce and representatives from the local hospitality industry, should identify strategies aimed at maximising the potential benefits associated with the project.</li> </ul>
<p><b>Cumulative impacts:</b></p> <ul style="list-style-type: none"> <li>» The opportunity exists to improve skills levels in the area. However, due to relatively small number of local employment opportunities this benefit is likely to be limited.</li> </ul>
<p><b>Residual impacts:</b></p> <ul style="list-style-type: none"> <li>» The improved pool of skills and experience in the local area is likely to be a residual impact. However, due to relatively small number of local employment opportunities this benefit is likely to be limited.</li> </ul>

<b>Nature: Stock theft, poaching and damage to farm infrastructure</b>		
The presence of construction workers on-site increases the potential risk of stock theft and poaching. The movement of construction workers on and off the site also poses a potential threat to farm infrastructure, such as fences and gates, which may be damaged. Stock and game losses may also result from gates being left open and/or fences being damaged. !Khi CSP and/or the turnkey EPC contractor will have the necessary management and control procedures in place for this.		
	<b>Without mitigation</b>	<b>With mitigation</b>
<b>Extent</b>	Local (4) (Rated as 4 due to potential severity of impact on local farmers)	Local (2)
<b>Duration</b>	Short term (2)	Short term (2)
<b>Magnitude</b>	Moderate (6) (Due to reliance on agriculture and livestock for maintaining livelihoods)	Low (4)
<b>Probability</b>	Probable (3)	Probable (3)
<b>Significance</b>	Medium (36)	Low (24)
<b>Status (positive or negative)</b>	Negative	
<b>Reversibility</b>	Yes	
<b>Irreplaceable loss of resources</b>	No	
<b>Can impacts be mitigated</b>	Yes	
<b>Mitigation:</b>		

<ul style="list-style-type: none"> <li>» Contractors should be held liable for damage to farm infrastructure that can be linked to construction workers (i.e. for all affected farm portions for the power line, pipe line and external access roads).</li> <li>» The EMP must outline procedures for managing and storing waste on site, specifically plastic waste that poses a threat to livestock if ingested.</li> <li>» Contractors should ensure that all workers are informed of the conditions contained on the Code of Conduct, specifically trespassing on adjacent farms.</li> <li>» The housing of construction workers on the site should be limited to essential and security personnel.</li> </ul>
<b>Cumulative impacts:</b> <ul style="list-style-type: none"> <li>» No cumulative impacts are expected.</li> </ul>
<b>Residual impacts:</b> <ul style="list-style-type: none"> <li>» Refer to cumulative impacts.</li> </ul>

**Nature: Potential impacts associated with the presence of construction workers**

The manner in which construction workers conduct themselves can affect the local community. In this regard the most significant negative impact is associated with the disruption of existing family structures and social networks. This risk is linked to the potential behaviour of male construction workers, including:

- » An increase in alcohol and drug use.
- » An increase in crime levels.
- » The loss of girlfriends and or wives to construction workers.
- » An increase in teenage and unwanted pregnancies.
- » An increase in prostitution.
- » An increase in sexually transmitted diseases (STDs).
- » Given the relatively large labour force of 300 – 600 during the construction phase, the potential risk to local family structures and social networks is regarded as high. This risk is heightened by the vulnerability of the residents of Oranjevallei, Kalksloot, Klippunt and Kanoneiland due to their low-income and education levels.

	<b>Without mitigation</b>	<b>With mitigation</b>
<b>Extent</b>	Local (4)	Local (2)
<b>Duration</b>	Short term for community as a whole (1) Long term-permanent for individuals who may be affected by STDs etc (5)	Short term for community as a whole (1) Long term-permanent for individuals who may be affected by STDs etc (5)
<b>Magnitude</b>	Moderate for the community as a whole (6) High-Very High for specific individuals who may be affected by STD's etc (10)	Low for community as a whole (4) High-Very High for specific individuals who may be affected by STD's etc (10)
<b>Probability</b>	Probable (3)	Probable (3)
<b>Significance</b>	Moderate for the community as a whole (33) Moderate-High for specific	Low for the community as a whole (21) Moderate-High for specific



	individuals who may be affected by STD's etc ( <b>57</b> )	individuals who may be affected by STD's etc ( <b>51</b> )
<b>Status (positive or negative)</b>	Negative	
<b>Reversibility</b>	No in the case of HIV and AIDS	
<b>Irreplaceable loss of resources</b>	Yes, if people contract HIV/AIDS as human capital plays a critical role in communities that rely on farming for their livelihoods	
<b>Can impacts be mitigated</b>	Yes, to some degree, however, the risk cannot be eliminated	
<b>Mitigation:</b>		
<ul style="list-style-type: none"><li>» Where reasonable and practical, the turnkey EPC contractor should appoint local contractors, especially for semi and low-skilled job categories as this could reduce the potential impact on local family and social networks.</li><li>» A code of good conduct should be developed for the construction phase which should identify what types of behaviour and activities by construction workers are not permitted.</li><li>» An HIV/AIDS awareness programme should be implemented for all construction workers at the outset of the construction phase.</li><li>» The movement of construction workers on and off the site should be closely managed and monitored by the contractors and the contractors should be responsible for making the necessary arrangements for transporting workers to and from site on a daily basis.</li><li>» Construction workers, with the exception of essential and security personnel, should not be permitted to overnight on the site.</li></ul>		
<b>Cumulative impacts</b>		
<ul style="list-style-type: none"><li>» Impacts on family and community relations may, in some cases, persist for a long period. Also in cases where unplanned / unwanted pregnancies occur, or members of the community are infected by an STD, specifically HIV and or AIDS, the impacts may be permanent and have long term to permanent cumulative impacts on the affected individuals and/or their families and the community.</li></ul>		
<b>Residual impacts</b>		
<ul style="list-style-type: none"><li>» As per the above cumulative impacts.</li></ul>		

**Nature: Increased risk of accidental veld fires**

The presence of construction workers and construction-related activities on the site poses an increased risk of veld fires that in turn pose a threat to the livestock, wildlife, and farmsteads in the area. In the process, farm infrastructure may also be damaged or destroyed and human lives threatened. Fires on the site may also pose a threat to the safety of the residents of Oranjevallei, Kalksloot, Klippunt, and Kanoneiland. The potential risk of veld fires is heightened by the windy conditions in the area, specifically during the dry, winter months. The majority of farms in the area farm cattle. As such, their livelihoods are dependent on grazing on their farms. Any loss of grazing due to a fire would therefore impact negatively on the affected farmers livelihoods. The risk of fire related damage is exacerbated by the distance to fire-fighting vehicles located in the nearest towns of Upington, Keimoes and Kakamas.

	<b>Without mitigation</b>	<b>With mitigation</b>
<b>Extent</b>	Local ( <b>4</b> )	Local ( <b>2</b> )
<b>Duration</b>	Short term ( <b>2</b> )	Short term ( <b>2</b> )
<b>Magnitude</b>	Moderate - High ( <b>8</b> )	Low-Moderate ( <b>6</b> )

<b>Probability</b>	Probable (3)	Probable (3)
<b>Significance</b>	Medium (42)	Low (30)
<b>Status (positive or negative)</b>	Negative	
<b>Reversibility</b>	Yes	
<b>Irreplaceable loss of resources</b>	No	
<b>Can impacts be mitigated</b>	Yes	
<b>Mitigation:</b> <ul style="list-style-type: none"><li>» The landowner should form part of the local fire protection agency if applicable.</li><li>» Contractor to ensure that open fires on the site for cooking or heating are not allowed except in designated areas.</li><li>» Contractor to ensure that construction related activities that pose a potential fire risk such as welding are properly managed and are confined to areas where the risk of fires has been reduced.</li><li>» Measures to reduce the risk of fires include clearing working areas and applying measures when working in high wind conditions when the risk of fires is greater.</li><li>» Special care should be taken during the high risk dry, windy winter months.</li><li>» Contractor to provide adequate fire fighting equipment on-site.</li><li>» Contractor to provide fire-fighting training to selected construction staff.</li></ul>		
<b>Cumulative impacts:</b> <ul style="list-style-type: none"><li>» No cumulative impacts are expected.</li></ul>		
<b>Residual impacts:</b> <ul style="list-style-type: none"><li>» Refer to cumulative impacts.</li></ul>		

#### **Nature: Impact of construction vehicles**

Road access to the proposed site will be via the N14 or the D3276. The movement of heavy construction vehicles during the construction phase may damage roads, create noise, dust, and safety impacts for other road users and local communities in the area, specifically the residents of Oranjevallei, Kalksloot, Klippunt, and Kanoneiland. The damage to gravel roads by heavy equipment can result in a number of potential negative impacts, including increased wear on vehicles owned by local farmers, impact on ease of access (e.g. time delays, detours) to stock posts, between neighbors and members of the farming community, as well as access to local towns (i.e. services, retail, socialising).

	<b>Without mitigation</b>	<b>With mitigation</b>
<b>Extent</b>	Local (3)	Local (2)
<b>Duration</b>	Short term (2)	Short term (2)
<b>Magnitude</b>	Low (4)	Minor (2)
<b>Probability</b>	Probable (3)	Probable (3)
<b>Significance</b>	Low (27)	Low (18)
<b>Status (positive or negative)</b>	Negative	
<b>Reversibility</b>	Yes	
<b>Irreplaceable loss of resources</b>	No	

<b>Can impacts be mitigated</b>	Yes
<b>Mitigation:</b> <ul style="list-style-type: none"> <li>» The contractor must ensure that damage caused to roads by the construction related activities, including heavy vehicles, is repaired before the completion of the construction phase.</li> <li>» The costs associated with repairs must be borne by the contractor.</li> <li>» Dust suppression measures must be implemented for heavy vehicles such as wetting of gravel roads on a regular basis and ensuring that vehicles used to transport sand and building materials are fitted with tarpaulins or covers when required by climatic conditions.</li> <li>» All vehicles must be road-worthy and drivers must be qualified, made aware of the potential road safety issues, and need for strict speed limits.</li> </ul>	
<b>Cumulative impacts:</b> <ul style="list-style-type: none"> <li>» If road damage is not repaired then this will affect the farming activities in the area and result in higher maintenance costs for vehicles of local farmers and other road users. The costs will be borne by road users who were no responsible for the damage.</li> </ul>	
<b>Residual impacts:</b> <ul style="list-style-type: none"> <li>» Refer to cumulative impacts</li> </ul>	

**Impact tables summarising the significance of social impacts associated with the operation phase (with and without mitigation measures)**

<p><b>Nature: Creation of employment and business opportunities</b></p> <p>The operation phase will employ approximately 60 - 80 full time employees over a 30 - 50 year period. Approximately 3 - 6% of the posts will be managerial, 12 - 18% engineers, 35 - 40% technicians and 40 - 50% craftsmen. The proposed facility will therefore create potential employment opportunities in the Northern Cape Province and the Kai !Gariep Municipality. However, given that the solar energy sector in South Africa is relatively new it may be necessary to import the required operational and maintenance skills from other parts of South Africa or even overseas. However, it will be possible to increase the local skills levels through the implementation of training programmes to local contractors contracted by the turnkey EPC contractor as applicable. Following construction, these skills will be available to following solar projects hence supporting the strategic goals of promoting local employment and skills development contained in the Kai !Gariep Integrated Development Plan.</p> <p>Given the location of the proposed facility the majority of permanent staff is likely to reside in the towns of Upington, Keimoes or Kakamas. In terms of accommodation options, a percentage of the permanent employees may purchase houses in one of these towns, while others may decide to rent. Both options would represent a positive economic benefit for the region. In addition, a percentage of the monthly wage bill earned by permanent staff would be spent in the regional and local economy which will benefit local businesses in these towns. The benefits to the local economy will extend over the 30 - 50 year operational lifespan of the project.</p> <p>The local hospitality industry in Upington, Keimoes, or Kakamas is also likely to benefit from the operational phase. These benefits are associated with site visits by company staff members and other professionals (engineers, technicians etc) who are involved in the company and the project but who are not linked to the day-to-day operations.</p>
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	<b><i>Without Mitigation<sup>14</sup></i></b>	<b><i>With Mitigation</i></b>
<b><i>Extent</i></b>	Local and Regional (2)	Local and Regional (3)
<b><i>Duration</i></b>	Long term (4)	Long term (4)
<b><i>Magnitude</i></b>	Low (4)	Moderate, due to the high unemployment and low-income levels in the area (6)
<b><i>Probability</i></b>	Probable (3)	Probable (3)
<b><i>Significance</i></b>	Moderate (30)	Moderate (39)
<b><i>Status (positive or negative)</i></b>	Positive	
<b><i>Reversibility</i></b>	N/A	
<b><i>Irreplaceable loss of resources</i></b>	No	
<b><i>Can impacts be enhanced</i></b>	Yes	
<b><i>Mitigation/Enhancement:</i></b>		
» The enhancement/mitigation measures listed in for the construction phase apply		
» The turnkey EPC contractor should consider training programmes to local contractors that have been contracted that will increase local skills levels.		
<b><i>Cumulative impacts:</i></b>		
» Cumulative impacts include creation of permanent employment, skills, and development opportunities for members from the local community and creation of additional business and economic opportunities in the area.		
<b><i>Residual impacts:</i></b>		
» See cumulative impacts		

***Nature: Potential impact on local tourism***

Sustainable utilisation of the natural resource base on which agriculture depends is critical in the Northern Cape with its fragile eco-systems and vulnerability to climatic variation. Due to the provinces exceptional natural and cultural attributes, it has the potential to become the preferred adventure and ecotourism destination in South Africa. Therefore caution must be taken to ensure that the development of large renewable energy projects, such as the proposed solar energy facility, do not affect the tourism potential of the province. However, the proposed facility is not likely to impact on the tourism sector in the area or the province. In some instances the plant may also attract tourists to the area as has happened in other countries where such facilities have been constructed. However, the significance of this potential benefit is also rated as low positive.

	<b><i>Without Mitigation<sup>15</sup></i></b>	<b><i>With Mitigation</i></b>
<b><i>Extent</i></b>	Local (2)	Local (3)
<b><i>Duration</i></b>	Long term (4)	Long term (4)
<b><i>Magnitude</i></b>	Low (2)	Low (2)
<b><i>Probability</i></b>	Probable (3)	Probable (3)

<sup>14</sup> With respect to positive impacts, mitigation is actually referring to the enhancement of impacts

<sup>15</sup> With respect to positive impacts, mitigation is actually referring to the enhancement of impacts

<b>Significance</b>	Low ( <b>24</b> ) (Applies to both negative and positive impacts)	Low ( <b>27</b> ) (Applies to both negative and positive impacts)
<b>Status (positive or negative)</b>	Both	
<b>Reversibility</b>	Yes	
<b>Irreplaceable loss of resources</b>	No	
<b>Can impacts be Mitigated</b>	Yes	
<b>Mitigation/Enhancement:</b>		
<ul style="list-style-type: none"><li>» In terms of mitigating the visual impacts, it is virtually impossible to hide the facility. The impact on the sense of place of the area cannot therefore be effectively mitigated.</li><li>» The Kai !Gariep Municipality and local tourism representatives should identify strategies aimed at maximising the potential benefits associated with the project.</li><li>» Kai !Gariep Municipality should investigate the option of establishing a renewable energy interpretation centre at entrance to the site.</li><li>» In order to maximise the benefits of an information board for the benefit of the broader community, it is recommended that the information be presented in the three languages of the Northern Cape Province, namely Afrikaans, English and Setswana.</li></ul>		
<b>Cumulative impacts:</b>		
<ul style="list-style-type: none"><li>» Cumulative impacts include potential benefit for tourism in the Kai !Gariep Municipality.</li></ul>		
<b>Residual impacts:</b>		
<ul style="list-style-type: none"><li>» See cumulative impacts.</li></ul>		

**Nature: Promotion of clean, renewable energy**

South Africa currently relies on coal-powered energy to meet more than 90% of its energy needs. The establishment of a clean, renewable energy facility will therefore reduce, albeit minimally, South Africa's reliance on coal-generated energy and the generation of carbon emissions into the atmosphere. The overall contribution to South Africa's total energy requirements of the proposed solar thermal plant is relatively small. However, the 110 MW produced will offset the total carbon emissions associated with energy generation in South Africa. Given South Africa's reliance on Eskom as a power utility, the benefits associated with an IPP based on renewable energy are regarded as significant.

	<b>Without Mitigation<sup>16</sup></b>	<b>With Mitigation</b>
<b>Extent</b>	Local, Regional and National ( <b>4</b> )	Local, Regional and National ( <b>4</b> )
<b>Duration</b>	Long term ( <b>4</b> )	Long term ( <b>4</b> )
<b>Magnitude</b>	High ( <b>8</b> )	Very High ( <b>10</b> )
<b>Probability</b>	Highly Probable ( <b>4</b> )	Highly Probable ( <b>4</b> )
<b>Significance</b>	<b>High (64)</b>	<b>High (72)</b>

<sup>16</sup> With respect to positive impacts, mitigation is actually referring to the enhancement of impacts

<b>Status (positive or negative)</b>	Positive
<b>Reversibility</b>	Yes
<b>Irreplaceable loss of resources</b>	No
<b>Can impacts be mitigated</b>	Yes
<b>Mitigation/Enhancement:</b>	
» Use the project to promote and increase the contribution of renewable energy to the national energy supply.	
» Maximise the public's exposure to the project via an extensive communication programme.	
<b>Cumulative impacts:</b>	
» Cumulative impacts include the reduction of carbon emissions via the use of renewable energy and associated benefits in terms of global warming and climate change.	
<b>Residual impacts:</b>	
» See cumulative impacts.	

### **Implications for Project Implementation**

- » The landowner who stands to be directly affected by the proposed facility supports the project.
- » The negative impacts associated with the proposed facility can be mitigated while the positive impacts can be enhanced with appropriate mitigation/enhancement measures.

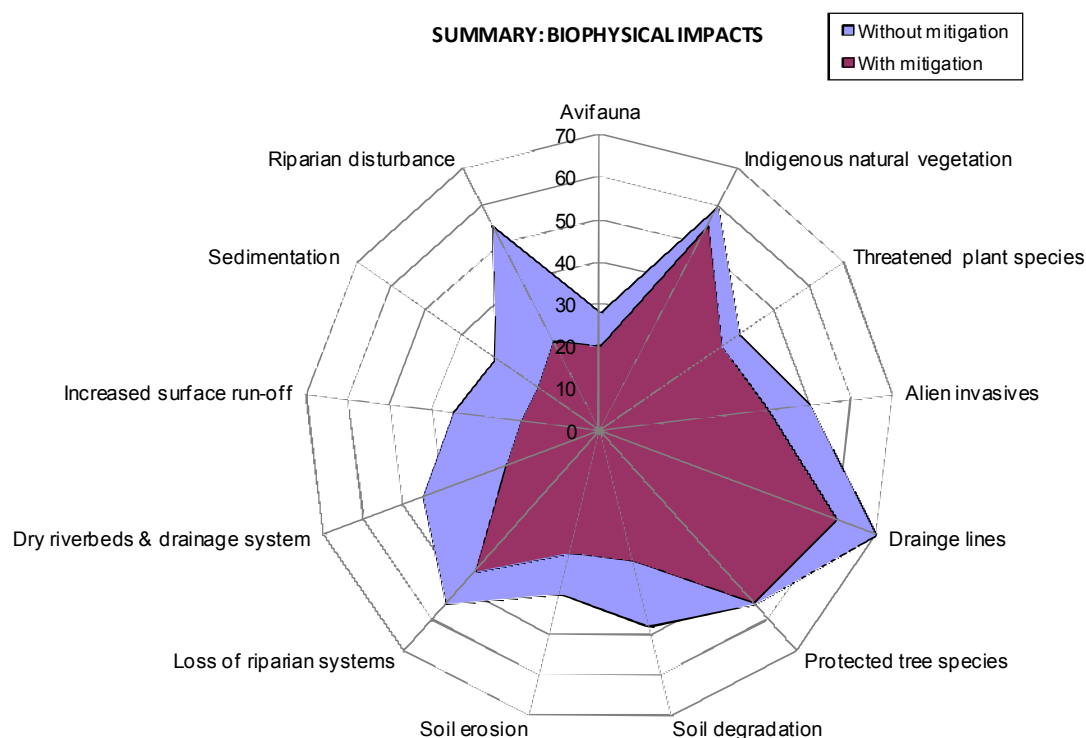
### **6.2.8 Summary of Impacts**

As a summary of the potential impacts identified and assessed through the EIA process, the following provide a diagrammatic representation of the significance ratings for the potential impacts.

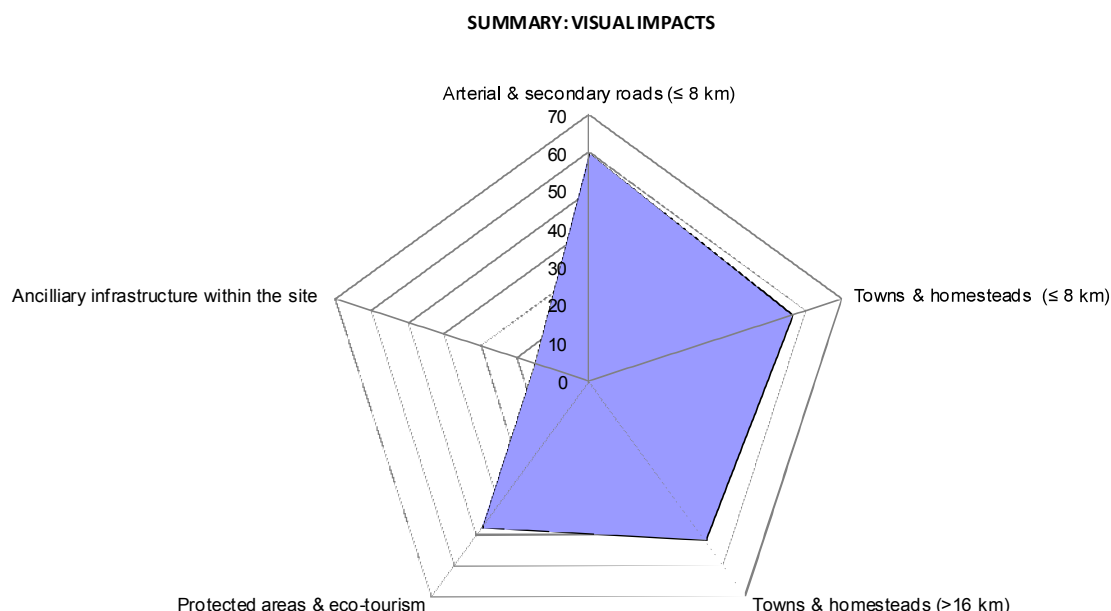
As indicated in Chapter 3, the significance weightings for potential impact have been rated as follows:

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

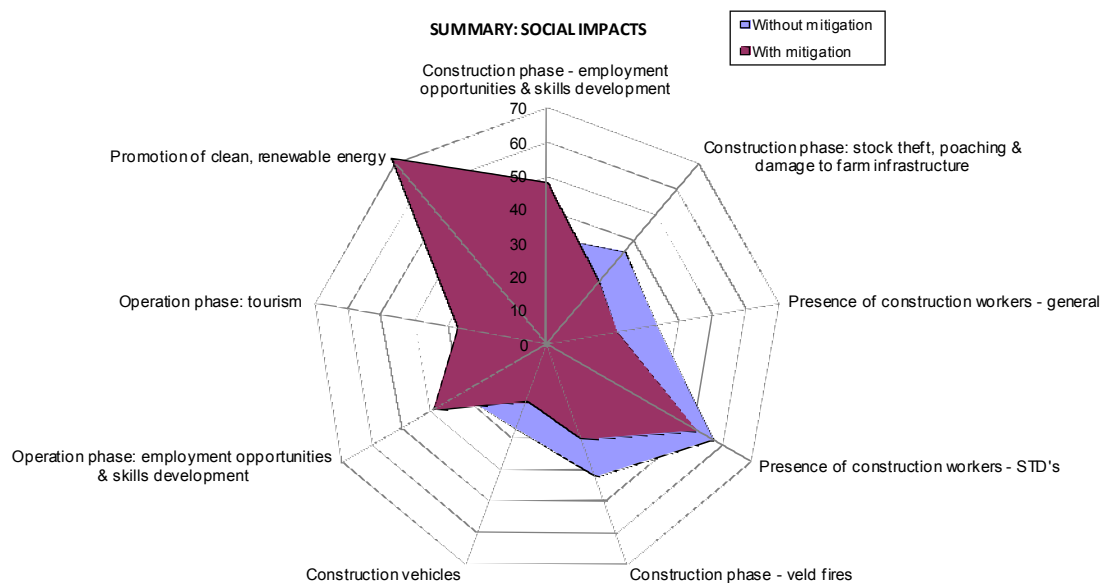
These ratings are illustrated on the axis of the graph. Impact ratings without mitigation are indicated in blue, and impact ratings with mitigation are indicated in purple.



*Biophysical impacts* in terms of the biophysical receiving environment (i.e. ecology, geology, avifauna, and water resources) are primarily of low to moderate significance without mitigation. With the implementation of mitigation measures, the impacts can be reduced.



*Visual impacts* are primarily low (i.e. in terms of the ancillary on-site infrastructure) to moderate (i.e. in terms of the power tower and heliostats). Mitigation measures are not regarded as a realistic measure with respect to the power tower and heliostats.



*Social impacts* that are experienced positively will be primarily moderate even with the implementation of enhancement measures. Those negative impacts that may occur are range significantly from low to very high (very high in the instance of the impact of STDs on local communities). Through the implementation of mitigation measures, those significance rating can be moderated to lower levels.

### 6.3. Assessment of Potential Cumulative Impacts Associated with the proposed Solar Thermal Plant

A cumulative impact, in relation to an activity, refers to 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 undertaking in the area<sup>17</sup>. The cumulative impacts associated with the proposed solar thermal plant primarily refer to those impacts associated with visual and water related impacts.

Potential cumulative visual impacts may occur with special reference to the possible future Eskom CSP facility (authorised in 2007), located on a site adjacent to the proposed development area for this facility. If the construction of this facility is considered in addition to the possible future construction of the Eskom CSP plant, there is a potentially cumulative visual impact within the region as a result of the construction of the two facilities.

Potential cumulative water related impacts may occur with special reference to downstream erosion and sedimentation of the Orange River; water abstraction from the

<sup>17</sup> Definition as provided by DEA in the EIA Regulations.



Orange River; the potential for chemical pollution; downstream alteration of hydrological regimes due to the increased run-off from the area and downstream erosion and sedimentation of the downstream wetland / dam area and canal system of the Naftali operations.

Cumulative effects have been considered within the detailed specialist studies, where applicable and are low (refer to Appendices G – N).

## ASSESSMENT OF IMPACTS: PROJECT ALTERNATIVES

## CHAPTER 7

This Chapter provides an assessment of the feasible and reasonable project alternatives considered through the EIA process, as required in terms of the EIA Regulations. The following alternatives have been considered:

1. The **'do nothing' alternative**: !Khi CSP does not establish a solar energy facility in the Northern Cape (i.e. maintain status quo).
2. **Site specific alternatives**: Relating to the layout of the solar components and associated infrastructure over the broader identified site of 22 km<sup>2</sup>.
3. **Alternative servitudes for power line routing**: a 132 kV power line is proposed to feed into the Eskom electricity network via a 'turn in and turn out' configuration to the existing Eskom Gordonia-Oasis 132 kV distribution line running approximately 4 km south of the site. Alternative routes for this proposed power line have been assessed in the EIA process.
4. **Access route alternatives**: Relating to the establishment of the external access road to provide access from the existing road network to the site.

The sections which follow provide a summary of the assessment of these project alternatives.

### 7.1 The 'do nothing' Alternative

Internationally there is increasing pressure on countries to increase their share of renewable energy generation due to concerns such as climate change and resource exploitation (i.e. coal and oil). The South African Government has set a ten year cumulative target for renewable energy generation of 10 000 GWh by 2013, to be produced mainly from biomass; wind; solar; and small scale hydro. This amounts to approximately 4 % (1 667 MW) of the total estimated electricity demand (41 539 MW) by 2013. In responding to the growing electricity demand within South Africa, as well as the country's targets for renewable energy, IPPs are being encouraged to develop renewable energy projects and contribute to these targets.

The 'do nothing' alternative translates to !Khi CSP not establishing a solar thermal plant on the identified site within the Northern Cape, that is, maintaining the status quo, with the following resultant impacts:

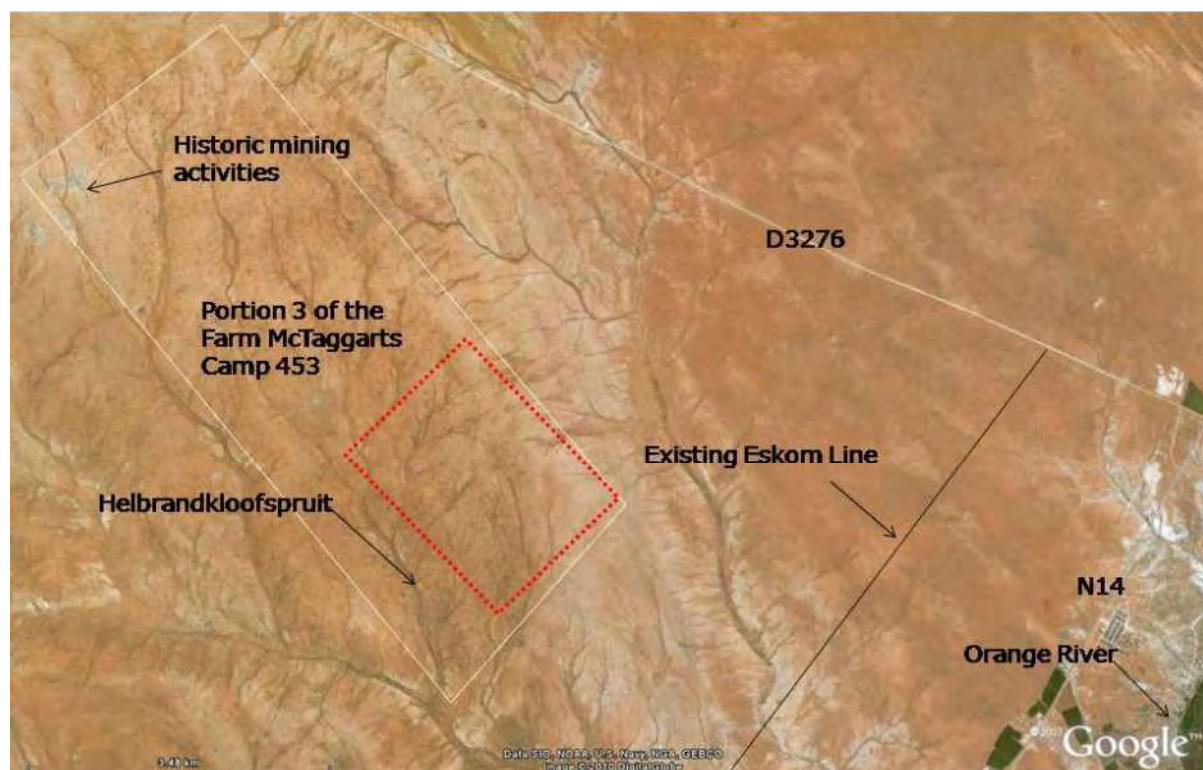
- » The project would not assist the South African Government in reaching their renewable energy targets as published in the Renewable Energy White Paper.
- » The potential to harness and utilise the excellent solar resources at the identified site would be lost.

- » The National electricity grid would not benefit from the additional power (i.e. a maximum of 110 MW) that could be received from the proposed facility. This is, therefore, not a preferred alternative.

## 7.2 Site Specific Alternatives in terms of Infrastructure Positioning

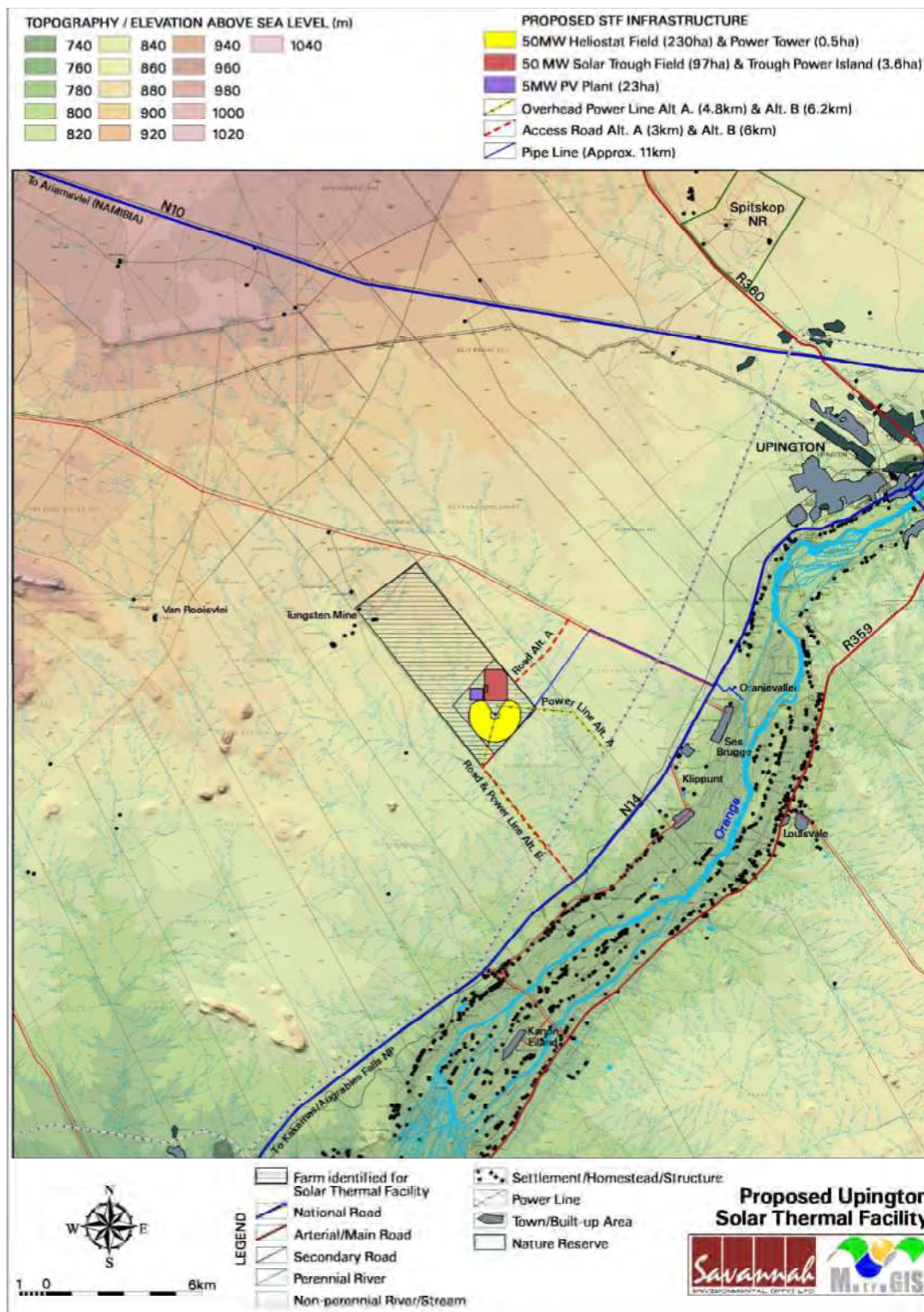
A sensitivity analysis was undertaken during the Scoping Phase wherein potentially sensitive areas which should be avoided within the broader 22 km<sup>2</sup> were identified. These sensitive areas included natural drainage lines, areas of increased gradient/slope, potential occurrence of Red Data Species, and areas previously disturbed through mining activities. As a result, the south-eastern portion of the site was identified as a preferred area for development of the solar thermal plant, based on the following characteristics (refer to Figure 7.1):

- » Avoidance of key drainage lines
- » Lower elevation
- » Proximity to a water abstraction point on the Orange (Gariep) River
- » Proximity to the existing grid for connection
- » Proximity to the N14 National Road for access
- » Proximity from areas previously disturbed through mining activities and potential heritage sites



**Figure 7.1:** Aerial image of the site providing an indication of the preferred south eastern portion of the site for the development of the facility (indicated by a red dashed line)

A detailed site layout has now been undertaken for this identified portion to effectively 'design' the solar facility. The overall aim was to maximise electricity production through exposure to the solar resource, while minimising infrastructure, operation, and maintenance costs, and social and environmental impacts (refer to Figure 7.2).



**Figure 7.2:** Preliminary layout for the solar infrastructure on the south-eastern portion of the site, as well as associated linear infrastructure

This micro-siting information informed the specialist impact assessments undertaken at the EIA phase. The layout has been considered in detail through the specialist studies and conclusions drawn as to where changes in site-specific footprints may be required in order to avoid potentially sensitive areas (as discussed in Chapter 6 and Chapter 8).

Layout design alternatives are to be finalised considering constraining environmental and technical factors. The environmental sensitivity identification process will inform the final layout design for the facility, avoiding sensitive areas, as far as possible.

### **7.3 Alternative Servitudes for Power Line Routing**

Two feasible alternative routes have been proposed for the power line. Alternative A (i.e. the technically and environmentally preferred route of approximately 4.4 km in length) runs in a south-westerly direction for approximately 2.5 km then bends and travels south for a further distance of approximately 1.9 km towards the existing 132 kV distribution line. Alternative B (i.e. the alternative route of approximately 6.3 km in length) runs in a south-westerly direction for approximately 2.3 km until the south western corner of the farm portion and then travels south-east for approximately 4 km towards the existing 132 kV distribution line. Alternative A is preferred from a technical perspective as this route is shorter and, therefore, more cost effective to construct and maintain.

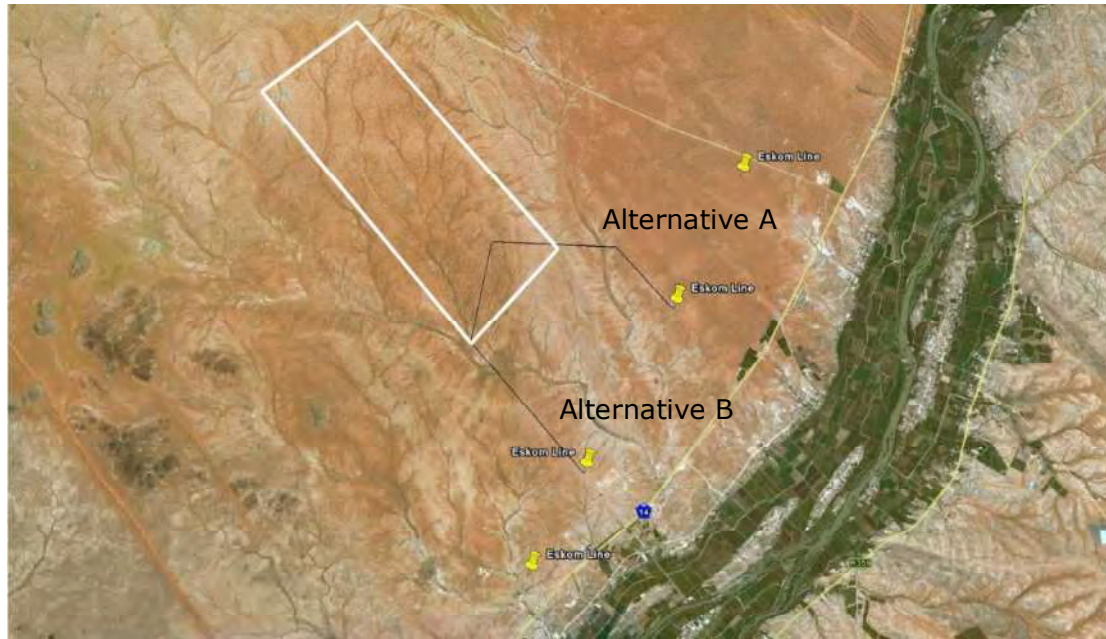
### **7.4 Alternative Servitudes for External Access Road**

Two feasible alternative routes have been proposed for the external access road. Alternative A runs in a north-westerly direction for approximately 3.2 km to join the existing gravel road (i.e. the DR3276) which branches off the N14. Alternative B runs in a southerly direction for approximately 6 km and joins directly with the N14 National Road.

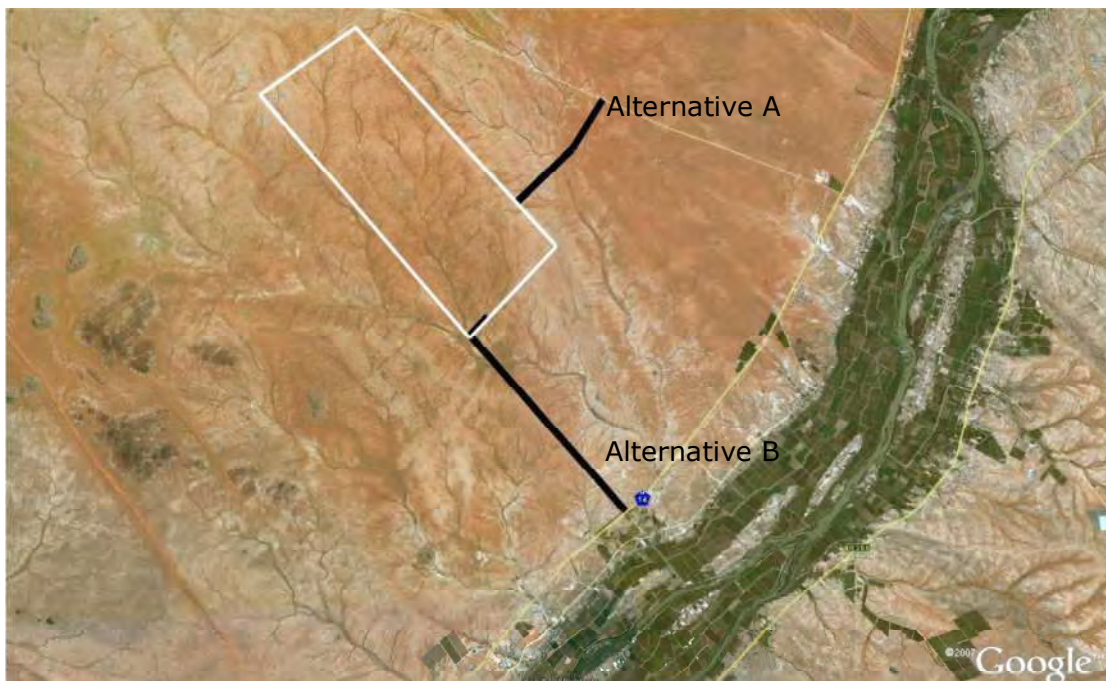
From a technical perspective, both routes are considered viable. The following are relevant considerations for both alternatives:

- » Alternative A: From a planning perspective, this route is potentially simpler as the point of connection to the existing road network is onto an existing Divisional Road (secondary gravel road). The route is shorter in distance, but the gravel road would require maintenance in the long-term.
- » Alternative B: There is an existing vehicle track between the property and the N14 access point, which is already used by the landowner. From a planning perspective, this route would need direct access onto a National Road (i.e. the N14) and SANRAL would be required to provide permission for this point of access, as the safety of the National road cannot be compromised by a private access road.





**Figure 7.3:** Aerial view illustrating the broader study site (i.e. outlined in white) and the two power line alternatives (i.e. the preferred route situated to the east and the alternative situated to the west)



**Figure 7.4:** Aerial view illustrating the broader study site (i.e. outlined in white) and the two access road alternatives (i.e. the preferred route situated to the east and the alternative situated to the west)

## **7.5 Assessment of the Potential Impacts associated with the Alternative Routes for the Power line and the External Access Road during the Construction and Operational Phases**

The sections which follow provide a summary of the findings of the assessment undertaken for potential impacts associated with the construction and operation of the alternative routes for the power line and external access roads. Issues were assessed in terms of the criteria detailed in Chapter 4. The nature of the potential impact is discussed; the significance is calculated with and without the implementation of mitigation measures. Recommendations are made regarding mitigation and management measures for potentially significant impacts and the possibility of residual and cumulative impacts are noted.

### **7.5.1 Potential Impacts on Ecology**

It was concluded that no mammal, reptile, or amphibian species of conservation concern that could occur in available habitats in the study area were present in the proposed development footprint. However, should any individuals occur they are likely to move away during construction and return to nearby natural habitats during operation.

Impacts on vegetation may be both direct and indirect, with direct impacts occurring mostly during the construction phase, and indirect impacts during the operational phase. Clearing activities during the construction phase will lead to direct loss of vegetation which will in turn lead to localised or more extensive reduction in the overall extent of vegetation.

Certain tree species are protected under the National Forests Act (Act No 84 of 1998)<sup>18</sup>. There are protected tree species that have a geographical distribution across the study area, including Camel Thorn, Shepard's Tree, Grey Camel Thorn, and the Ebony Tree. Shepard's Tree is relatively common on site and is associated primarily with secondary watercourses and areas adjacent to the primary watercourses. None of the other protected tree species that have the potential to occur on site were found, although drainage lines on site were considered suitable habitat for Grey Camel Thorn.

According to the National Water Act (No. 36 of 1998), the drainage lines on-site are classified as wetlands or water resources. These features provide important species habitat, for example these streambeds appear to be higher in species density, abundance, and diversity than the adjacent plains in terms of avifauna. From a sensitivity point of view, the higher order watercourse, including the main watercourse

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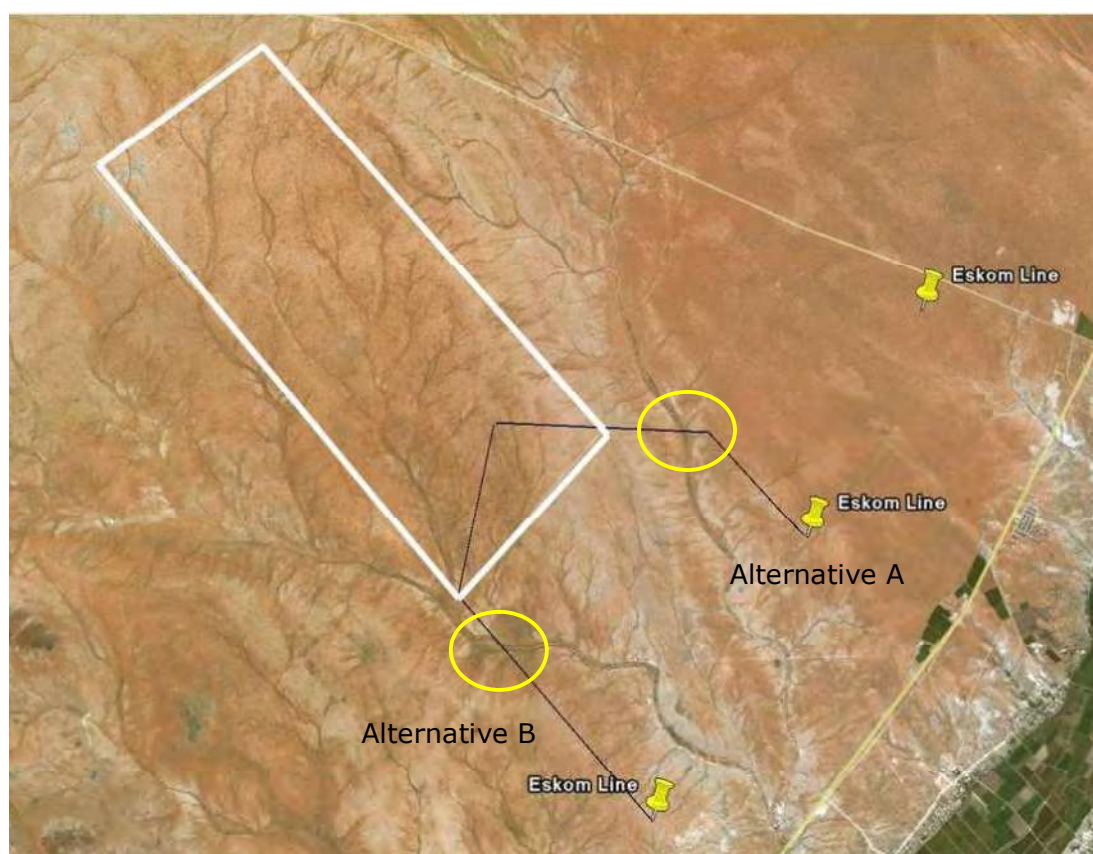
<sup>18</sup> In terms of section 5(1) "no person may cut, disturb, damage or destroy any protected tree or possess, collect, remove, transport, export, purchase, sell donate or in any other manner acquire or dispose of any protected tree or any forest product derived from a protected tree, except under a license granted by the Minister to an (applicant and subject to such period and conditions as may be stipulated".

(i.e. the Helbrandkloofspruit which traverses the west and to some extent the centre of the site) are more sensitive and, therefore, more important to protect than the low order ephemeral streams (i.e. in the south-western portion of the site where the facility is proposed to be located).

The health of the ecosystem may also be affected through the establishment and spread of alien invasive species due to disturbance activities in the construction phase. The site is not known to harbour alien plants in significant numbers, although some declared weeds (e.g. Tree tobacco) were found close to the previously mined areas in the north-western portion of the site, but in small numbers.

### **Power line alternatives**

Both alternative power line routes cross through similar habitat. They both also cross a non-perennial river at one point (refer to Figure 7.5). Alternative A follows an existing boundary fence while Alternative B is along an existing boundary where there is currently a vehicle track in use.



**Figure 7.5:** Aerial view illustrating the proposed power line routes in relation to existing drainage lines (i.e. areas outlined in yellow)

From an ecological point of view, both alternatives will have similar impacts on the drainage lines that they cross. The power line would span across the drainage line. However, construction activities may lead to some direct or indirect loss of or damage to



some of these areas and/or changes to their relative catchments. This may affect the hydrology of the landscape or lead to disturbance of/loss of habitat for species that depend on this habitat type. Dry river beds and drainage lines are an important habitat for a number of species in the study area, including those with a restricted distribution or species with an elevated conservation status.

Alternative B is marginally preferred, because it is aligned adjacent to an existing vehicle track (i.e. existing disturbance). There is also the option of the site access road (Alternative B) and the 132 kV power line along the same route, which would minimise the overall impact of the project through impact consolidation.

### ***Access road alternatives***

As per the power line routes, both alternative access road routes cross through similar habitat (i.e. they cross a non-perennial river at one point). Alternative B runs along an existing boundary where there is currently a vehicle track in use. Furthermore, the southern portion of this route is through a relatively disturbed area. Alternative A is aligned where there is currently no road, however the overall length of road required to be constructed is shorter than Alternative B. Alternative B is approximately 6 km long before it reaches the site, of which approximately 4 km is along an existing track and the remainder through disturbed areas.

Therefore from an ecological point of view, both alternatives will have similar impacts on habitats. Alternative B is marginally preferred, because it is aligned where there is an existing vehicle track and existing disturbance.

### ***Impact table summarising the significance of impacts on ecology (with and without mitigation)***

<b><i>Nature: Power line - impacts on indigenous natural vegetation</i></b>	
The total footprint of the overhead power line is insignificant compared to the overall extent of the two vegetation types in the study area. Impacts are therefore relevant only at a local scale and will be scored relative to the study area.	
	<b><i>Without &amp; mitigation</i></b>
<b><i>Extent</i></b>	local (1)
<b><i>Duration</i></b>	Permanent (5)
<b><i>Magnitude</i></b>	Low (2)
<b><i>Probability</i></b>	Definite (5)
<b><i>Significance</i></b>	<b>Medium (40)</b>
<b><i>Status (positive or negative)</i></b>	Negative
<b><i>Reversibility</i></b>	Not reversible
<b><i>Irreplaceable loss of resources</i></b>	Yes
<b><i>Can impacts be</i></b>	Yes, to some extent

<b>mitigated</b>	
<b>Mitigation:</b>	
» Avoid unnecessary impacts on natural vegetation surrounding infrastructure. Impacts should be contained, as much as possible, within the servitude of the power line.	
<b>Cumulative impacts:</b>	
» Soil erosion, alien invasions may lead to additional loss of habitat that will exacerbate this impact.	
<b>Residual impacts:</b>	
» Some loss of this vegetation type will occur, but this is insignificant relative to the total extent of the vegetation type.	

<b>Nature: Access road - impacts on indigenous natural vegetation</b>	
The total footprint of the access road is insignificant compared to the overall extent of the two vegetation types in the study area (i.e. Bushmanland Arid Grassland and Kalahari Karroid Shrubland). Impacts are therefore relevant only at a local scale and will be scored relative to the study area.	
	<b>Without mitigation</b>
<b>Extent</b>	Local (1)
<b>Duration</b>	Permanent (5)
<b>Magnitude</b>	Low (3)
<b>Probability</b>	Definite (5)
<b>Significance</b>	<b>Medium (45)</b>
<b>Status (positive or negative)</b>	Negative
<b>Reversibility</b>	Not reversible
<b>Irreplaceable loss of resources</b>	Yes
<b>Can impacts be mitigated</b>	To some extent
<b>Mitigation:</b>	
» Unnecessary impacts on natural vegetation surrounding the routing for the proposed access road should be avoided, where possible.	
<b>Cumulative impacts:</b>	
» Soil erosion and alien invasions may lead to additional loss of habitat that will exacerbate the potential impact of the external access roads on indigenous natural vegetation.	
<b>Residual impacts:</b>	
» Some loss of this vegetation type will occur because of the establishment of the external access roads, but this will be insignificant relative to the total extent of the vegetation type.	

<b>Nature: Power line and access road - impacts on threatened plant species</b>
Only the Quiver Tree, which is of conservation concern, is considered a potential issue. No individuals of this species were recorded along either alternative route of the proposed overhead power line. The impact will therefore not occur and is scored as zero.

<b>Nature: Power line - impacts on protected trees</b>	
The Shepard's Tree is relatively common on site and is associated primarily with secondary drainage lines and areas adjacent to the primary watercourses. None of the other species were found on site, although watercourses on site were considered suitable habitat for Camel Thorn.	
	<b>Without mitigation</b>
<b>Extent</b>	Local (1)
<b>Duration</b>	Permanent (5)
<b>Magnitude</b>	Low (2)
<b>Probability</b>	Improbable (2)
<b>Significance</b>	<b>Low (16)</b>
<b>Status (positive or negative)</b>	Negative
<b>Reversibility</b>	Not reversible
<b>Irreplaceable loss of resources</b>	Yes
<b>Can impacts be mitigated</b>	To some degree
<b>Mitigation:</b>	
» Obtain a permit for any protected trees that have to be destroyed in order to construct the power line.	
<b>Cumulative impacts:</b>	
» Impacts due to alien invasions and damage to watercourses may possibly cause damage to habitat where protected trees could grow that may exacerbate this impact.	
<b>Residual impacts:</b>	
» No residual impacts are likely.	

<b>Nature: Access road - impacts on protected trees</b>	
The Shepard's Tree is relatively common on site and is associated primarily with secondary watercourses and areas adjacent to the primary watercourses. None of the other species were found along the proposed access route, although watercourses on site were considered suitable habitat for Camel Thorn.	
	<b>Without mitigation</b>
<b>Extent</b>	Local (1)
<b>Duration</b>	Permanent (5)
<b>Magnitude</b>	Low (2)
<b>Probability</b>	Probable (3)
<b>Significance</b>	<b>Low (24)</b>
<b>Status (positive or negative)</b>	Negative
<b>Reversibility</b>	Not reversible
<b>Irreplaceable loss of resources</b>	Yes
<b>Can impacts be mitigated</b>	To some degree
<b>Mitigation:</b>	

» Obtain a permit for any protected trees that have to be destroyed in order to construct the access road.
<b>Cumulative impacts:</b>
» Impacts due to alien invasions and damage to watercourses may possibly cause damage to habitat where protected trees could grow that may exacerbate this impact.
<b>Residual impacts:</b>
» No residual impacts are likely.

<b>Nature: Power line - impacts on drainage lines</b>		
The 132 kV power line alternatives cross drainage lines in various places, although it is unlikely that power line towers will be positioned within wetlands.		
	<b>Without mitigation</b>	<b>With mitigation</b>
<b>Extent</b>	Local & surroundings (2)	Local & surroundings (2)
<b>Duration</b>	Permanent (5)	Medium-term (3)
<b>Magnitude</b>	Medium (4)	Low (1)
<b>Probability</b>	Probable (3)	Improbable (2)
<b>Significance</b>	<b>Medium (33)</b>	<b>Low (12)</b>
<b>Status (positive or negative)</b>	Negative	
<b>Reversibility</b>	Reversible with effective rehabilitation	
<b>Irreplaceable loss of resources</b>	Yes	
<b>Can impacts be mitigated</b>	Yes	
<b>Mitigation:</b>		
» Ensure towers are not positioned in or directly adjacent to watercourses.		
» Avoid unnecessary impacts on wetland areas and associated riparian areas.		
» Impacts should be contained, as much as possible, within the power line servitude.		
» Obtain a permit from DWA to impact on any wetland or water resource where required.		
» Rehabilitate any disturbed areas immediately to stabilise landscapes.		
<b>Cumulative impacts:</b>		
» No cumulative impacts are expected.		
<b>Residual impacts:</b>		
» Despite proposed mitigation measures, it is expected that this impact will still occur to some degree.		

<b>Nature: Access road - impacts on drainage lines</b>		
There is one main watercourse and various minor drainage lines that could potentially be affected by the proposed construction of the access road to the site (both alternatives).		
	<b>Without mitigation</b>	<b>With mitigation</b>
<b>Extent</b>	Local & surroundings (2)	Local & surroundings (2)
<b>Duration</b>	Permanent (5)	Permanent (5)
<b>Magnitude</b>	Medium (5)	Low (3)
<b>Probability</b>	Definite (5)	Highly probable (4)

<b>Significance</b>	<b>Medium (60)</b>	<b>Medium (40)</b>
<b>Status (positive or negative)</b>	Negative	
<b>Reversibility</b>	Reversible with effective rehabilitation	
<b>Irreplaceable loss of resources</b>	Yes	
<b>Can impacts be mitigated</b>	To some degree	
<b>Mitigation:</b> <ul style="list-style-type: none"><li>» Cross wetlands perpendicularly.</li><li>» Avoid unnecessary impacts on natural vegetation. Impacts should be contained, as much as possible, within the footprint of the proposed watercourse crossing.</li><li>» Obtain a permit from DWA to impact on any wetland or water resource where required.</li><li>» Rehabilitate any disturbed areas immediately to stabilise landscapes.</li><li>» Proper culvert and bridge structures are required for permanent roads.</li></ul>		
<b>Cumulative impacts:</b> <ul style="list-style-type: none"><li>» No cumulative impacts are expected.</li></ul>		
<b>Residual impacts:</b> <ul style="list-style-type: none"><li>» Despite proposed mitigation measures, it is expected that this impact will still occur to some degree.</li></ul>		

**Nature: Power line and access road – establishment and spread of declared weeds and alien invader plants**

The site is not known to harbour alien plants in significant numbers. Some declared weeds (e.g. Tobacco Tree) were found close to the previously mined areas, but in small numbers. There is therefore a weak potential for alien trees to spread or become established following disturbance on site. The presence of a diffuse disturbance over a wide area could, however, lead to the spread of species that are present in the area.

	<b><i>Without mitigation</i></b>	<b><i>With mitigation</i></b>
<b><i>Extent</i></b>	Site (2)	Site (2)
<b><i>Duration</i></b>	Long-term (4)	Long-term (4)
<b><i>Magnitude</i></b>	Moderate (5)	Low (3)
<b><i>Probability</i></b>	Probable (3)	Improbable (2)
<b><i>Significance</i></b>	<b>Medium (33)</b>	<b>Low (18)</b>
<b><i>Status (positive or negative)</i></b>	Negative	
<b><i>Reversibility</i></b>	Reversible	
<b><i>Irreplaceable loss of resources</i></b>	Yes	
<b><i>Can impacts be mitigated</i></b>	To some degree	
<b><i>Mitigation:</i></b>		
» Keep disturbance of indigenous vegetation to a minimum.		
» Rehabilitate disturbed areas as quickly as possible following completion of construction activities in an area.		
» Do not translocate soil stockpiles from areas with alien plants.		

- » Control any alien plants immediately to avoid establishment of a soil seed bank that would take decades to remove.
- » Establish an ongoing monitoring programme to detect and quantify any aliens that may become established.

**Cumulative impacts:**

- » Soil erosion, habitat loss, damage to wetlands and increased frequency of veld fires may all lead to additional impacts that will exacerbate this impact.

**Residual Impacts:**

- » Residual impacts will probably be very low if control measures are effectively applied.

### **Comparative Assessment Statement**

There is no significant difference in the potential impacts on ecology associated with the erection of a power line or the construction of an access road along the alternative routes identified. The routing of the power line and access road along Alternative B is marginally preferred over Alternative A, as there is the potential to consolidate the linear infrastructure and reduce the extent of impacts. As the access road Alternative B is aligned where there is an existing vehicle track and existing disturbance to the vegetation/habitats, **Alternative B** is nominated as the preferred option for the access road (and power line to consolidate impacts to a single corridor).

### **Implications for Project Implementation**

- » The developmental footprint for the power line and access road will not affect any botanical "no go" habitats or areas.
- » As there are no obvious concentrations of rare species or any especially threatened habitats or vegetation types on site, there are no areas of regionally high or very high ecological sensitivity demarcated within the footprint for the power line and access road.
- » No mammal, reptile or amphibian species of conservation concern occur within available habitats in the study area and therefore the site is not considered sensitive in terms of faunal impacts (i.e. excluding avifauna).
- » Impacts on drainage lines are potentially the most problematic due to the potential impact on downstream areas and the fact that important ecological processes in the landscape may be affected.
- » The external access road and power line are unlikely to have impacts of high significance on any ecological features primarily because they occupy a relatively small space in the landscape.
- » General disturbance due to construction activities could lead to the spread of alien plants, but this impact can be effectively controlled with suggested measures.
- » A permit would need to be obtained for any protected trees that are affected.
- » A permit is required from the Department of Water Affairs (DWA) if there are expected impacts on any water resources (i.e. the drainage lines).

- » An on-going monitoring programme should be implemented to detect and quantify any aliens that may become established and provide information for the management of aliens.

### **7.5.2 Potential Impacts on Avifauna**

#### **Power line**

The most significant threat to bird communities would be from collisions<sup>19</sup> with the power line. Secretarybird; Kori Bustard; and Ludwig's Bustard, all of which are threatened species possibly occurring within the study area, are susceptible to collision. The above mentioned species as well as Martial Eagle are susceptible to electrocution events<sup>20</sup>. The availability of nesting sites in terms of the proposed 132 kV power line could pose a problem as they have the potential to cause faults by creating an air gap intrusion. The faults created by nests can also result in veld fires due to the nesting material catching fire as well as surrounding veld.

Considering the two Alternatives A and B, Alternative A is preferred as it is a shorter route, and will reduce the potential for avifauna impacts associated with collisions.

#### **Access road**

Considering the two Alternatives A and B, from an avifauna point of view, both alternatives will have similar impacts on habitats. There is no strong preference for either alternative from an avifauna perspective.

#### **Impact tables summarising the significance of impacts on avifauna (with and without mitigation)**

<b>Nature: Impact of collisions events</b>		
The magnitude of this impact will be moderate to high due to the conservation status of the species which may potentially be involved in collision events. Ludwig's Bustard, which is a large species that inhabits open, arid country similar to that of the study area, is of particular concern. This species may be susceptible to collisions with the proposed power line, the consequences of which are significant.		
	<b>Without mitigation</b>	<b>With mitigation</b>
<b>Extent</b>	Local (1)	Local (1)
<b>Duration</b>	Long Term (4)	Long Term (4)
<b>Magnitude</b>	High (8)	Minor (2)
<b>Probability</b>	Highly probable (4)	Improbable (2)
<b>Significance</b>	<b>Medium (52)</b>	<b>Low (14)</b>

<sup>19</sup> It is generally accepted that birds can usually avoid the highly visible bundled conductors but often fail to see the thin earth wire.

<sup>20</sup> Electrocution events refer to scenarios whereby a bird perches on an electrical structure and causes an electrical short circuit by bridging the gap between live components and or live and earthed components.

<b>Status (positive or negative)</b>	Negative
<b>Reversibility</b>	Low
<b>Irreplaceable loss of resources</b>	None
<b>Can impacts be mitigated</b>	Yes
<b>Mitigation:</b> <ul style="list-style-type: none"> <li>» The line should be kept as low as possible taking into account engineering and legal requirements.</li> <li>» The span lengths should be kept as short as possible taking into account engineering and legal requirements.</li> <li>» Fitting the earth wire with a type of marker/bird diverter where required. The markers should preferably be placed on the earth wires as opposed to the conductors.</li> <li>» Placement of a sufficiently large form of marker which will increase the visibility of the wire</li> <li>» The marker should be placed with sufficient regularity (at least every 5-10m, if required).</li> </ul>	
<b>Cumulative impacts:</b> <ul style="list-style-type: none"> <li>» There are a number of power lines near Upington as well as throughout the Northern Cape. The length of the proposed power line is 4 km and therefore it is unlikely that this will add significantly to the cumulative impact of power line collisions in the region.</li> </ul>	
<b>Residual impacts:</b> <ul style="list-style-type: none"> <li>» No residual impacts are expected.</li> </ul>	

<b>Nature: Impact of electrocutions</b>		
The impact will be confined to the 4 km power line; however it will potentially have a regional impact on bird populations. The magnitude of this impact will be moderate due to the conservation status of the species which may be involved in electrocution events.		
	<b>Without mitigation</b>	<b>With mitigation</b>
<b>Extent</b>	Local (1)	Local (1)
<b>Duration</b>	Long Term (4)	Long Term (4)
<b>Magnitude</b>	Moderate (6)	Minor (2)
<b>Probability</b>	Highly probable (4)	Improbable (2)
<b>Significance</b>	<b>Medium (44)</b>	<b>Low (14)</b>
<b>Status (positive or negative)</b>	Negative	
<b>Reversibility</b>	No	
<b>Irreplaceable loss of resources</b>	No	
<b>Can impacts be mitigated</b>	Yes	
<b>Mitigation:</b>		
» Monopole bird-friendly structure will be utilised which will significantly minimise the number of electrocutions on the power lines.		
<b>Cumulative impacts:</b>		
» There are a number of power lines near Upington as well as throughout the Northern Cape.		



The length of the proposed power line is 4 km and it is unlikely to add significantly to the cumulative impact of electrocution events in the region.
<b>Residual impacts:</b> » The occurrence of residual impacts is not applicable in this case.

<b>Nature: Impact of bird pollution on the power line</b>		
The extent of the impact of a flashover event could be regional depending on the configuration of the power line grid.		
	<b>Without mitigation</b>	<b>With mitigation</b>
<b>Extent</b>	Local (1)	Local (1)
<b>Duration</b>	Long Term (4)	Long Term (4)
<b>Magnitude</b>	Moderate (6)	Low (4)
<b>Probability</b>	Highly probable (4)	Improbable (2)
<b>Significance</b>	<b>Medium (44)</b>	<b>Low (18)</b>
<b>Status (positive or negative)</b>	Negative	
<b>Reversibility</b>	No	
<b>Irreplaceable loss of resources</b>	No	
<b>Can impacts be mitigated</b>	Yes	
<b>Mitigation:</b> Monopole bird-friendly structure are proposed to be utilised, the design of which needs to incorporate perch deterrents in the area directly above the insulator strings to ensure that bird species are not given the opportunity to defecate on the string.		
<b>Cumulative impacts:</b> Cumulative impacts are not applicable in this case.		
<b>Residual impacts:</b> The occurrence of residual impacts is not applicable in this case.		

<b>Nature: Impact of nesting on the power line</b>		
Should there be any incidents of Species of Special Concern nesting on the facilities, then the magnitude of the impact would be greater.		
	<b>Without mitigation</b>	<b>With mitigation</b>
<b>Extent</b>	Local (1)	Local (1)
<b>Duration</b>	Long Term (4)	Long Term (4)
<b>Magnitude</b>	Minor (2)	Small (0)
<b>Probability</b>	Definite (5)	Probable (3)
<b>Significance</b>	<b>Medium (35)</b>	<b>Low (15)</b>
<b>Status (positive or negative)</b>	Negative	
<b>Reversibility</b>	No	
<b>Irreplaceable loss of resources</b>	No	
<b>Can impacts be</b>	Yes	

<b>mitigated</b>	
<b>Mitigation:</b>	
» A procedure for the removal of nests must be written into the Draft EMP for the operational phase of the facility. Depending on the bird species, permits may be required from the Northern Cape Provincial Department of Conservation for nest relocation (e.g. Sociable Weavers and White Browed Sparrow Weavers).	
<b>Cumulative impacts:</b>	
» Cumulative impacts are not applicable in this case.	
<b>Residual impacts:</b>	
» The occurrence of residual impacts is not applicable in this case.	

### **Comparative Assessment Statement**

There is no significant difference in the potential impacts on avifauna associated with the erection of a power line or the construction of an access road along the alternative routes identified. In terms of impacts arising from electrocution or disturbance, there is no significant difference in the potential impacts on avifauna associated with the power line alternatives, however, **Alternative A** is nominated as the preferred as the line is ~2.5 km shorter than Alternative B. There is **no preference** between the alternative access road routes.

### **Implications for Project Implementation**

- » There is a correlation between the size of the power line and the collision/electrocution risk potential with mortality increasing with voltage size. The smaller lines (i.e. 132 kV) and old designs (i.e. depending on the tower design) can be dangerous to birds.
- » In flattish landscapes, typical of the study area, large raptors will instinctively look for the highest vantage point on which to perch. Given that the towers will be the highest structures in the area, raptors will be landing on the structures and using them to survey the landscape or to nest on.
- » Species such as crows are often responsible for the different materials (such as pieces of wire) they collect which in turn can cause flashovers. The faults created by nests can also result in veld fires due to the nesting material catching fire as well as surrounding veld. Of even more concern is the possibility of species such as Sociable Weavers and White Browed Sparrow Weavers nesting on the infrastructure making up the solar facility.
- » Bird marking devices have proved to be extremely effective in preventing bird collisions by making the line more visible to birds. Bird flappers are susceptible to failure and have a life expectancy of three to five years.

### **7.5.3 Assessment of Potential Impacts on Geology and Soils**

The impact of soil erosion and degradation during the construction phase (i.e. through stockpiling; mixing; wetting; filling; compaction; and pollution) is considered the most significant direct impacts. Other negative indirect impacts include increased siltation.

Drainage lines tend to be more sensitive in terms of erodibility potential and the alternative routes for both the power line and access road cross areas of high erosion sensitivity (i.e. drainage lines) and therefore the only variable is the size or extent of the disturbance area.

#### **Power line**

Alternative A is of a shorter length which will potentially affect a smaller footprint area and as such it is preferred.

#### **Access road**

Alternative A is in closer proximity to an existing road, and therefore potentially less undisturbed ground will be impacted. Alternative B traverses a disturbed environment as there is an existing vehicle track. There is no strong preference for either alternative.

#### **Impact tables summarising the significance of impacts on geology relating to the power line and the access road (with and without mitigation)**

<b>Nature: Soil degradation: removal of soil/rock; site clearing; soil mixing; cut-and-fill operations; soil compaction; stockpiling; and dumping of soil</b>		
The proposed activity is unlikely to have significant impact through the removal of soil/rock for foundations because excavations for the power line structure will not be deeper than 1 – 2 m. Site clearing; soil mixing; cut-and-fill operations; soil compaction; stockpiling; and dumping of soil is likely to be limited to the construction phase.		
	<b>Without mitigation</b>	<b>With mitigation</b>
<b>Extent</b>	Local (1)	Local (1)
<b>Duration</b>	Medium term (3) - Permanent (5)	Very short term (1) - Medium term (3)
<b>Magnitude</b>	Low (4) - Moderate (6)	Low (4)
<b>Probability</b>	Definite (4) - Highly Probable (4)	Definite (4) - Highly Probable (4)
<b>Significance</b>	<b>Moderate (32 - 48)</b>	<b>Low (24) - Moderate (32)</b>
<b>Status (positive or negative)</b>	Negative	
<b>Reversibility</b>	Partially reversible	
<b>Irreplaceable loss of resources</b>	Yes	
<b>Can impacts be mitigated</b>	Yes	

**Mitigation:**

- » Minimise size of disturbance areas
- » Plan access roads according to minimise crossing of drainage lines
- » Keep to existing roads/tracks, where practical, to minimise impact on undisturbed ground
- » Topsoil can be replaced over foundations, if practical
- » Plan soil embankments with max slope of 1:2 to allow for rehabilitation and or use erosion control measures where necessary
- » Restrict temporary stockpiles to certain areas
- » No permanent dumping on site other than approved filling operations
- » Rehabilitate soil and vegetation in areas of activity

**Cumulative impacts:**

- » The cumulative impact of topsoil removal and burial, and site clearing, soil mixing, etc is considered low due to the limited extent of the activity and the scarcity of development in the area.
- » The cumulative impact of stockpiling or dumping from all development in the area is considered low if mitigating measures are adopted.

**Residual impacts:**

- » Residual impacts are expected to be minor due to the slow regeneration of topsoil.

**Nature: Soil degradation: pollution, salinisation, acidification or water-logging of natural soil**

Soil pollution is expected to occur during the construction phase, predominantly as a result of the presence of vehicles and equipment.

	<b>Without mitigation</b>	<b>With mitigation</b>
<b>Extent</b>	Local (1)	Local (1)
<b>Duration</b>	Medium term (3)	Short term (2)
<b>Magnitude</b>	Low (4)	Low (4)
<b>Probability</b>	Probable (3)	Probable (3)
<b>Significance</b>	<b>Low (24)</b>	<b>Low (21)</b>
<b>Status (positive or negative)</b>	Negative	
<b>Reversibility</b>	Irreversible	
<b>Irreplaceable loss of resources</b>	Yes	
<b>Can impacts be mitigated</b>	Yes	

**Mitigation:**

- » Minimise disturbance areas and rehabilitate soil and vegetation.
- » Use spoil from excavations for landscaping or run off site, spoil must not be dumped in piles.
- » Keep to existing roads, where practical, to minimise impacts on undisturbed ground.

**Cumulative impacts:**

- » Cumulative impact of soil pollution from all development in the area is considered low if mitigating measures are applied diligently.

**Residual impacts:**

- » Minor negative residual impacts are expected due to the slow regeneration of vegetation and soil.

<b>Nature: Soil erosion</b>		
The site has a low susceptibility to erosion, primarily due to the very dry climate. However, exceptional heavy rainfall can occur and therefore soil erosion concerns will be greatest along drainage lines where run-off is concentrated and hydraulic energy is potentially high. Areas where loose, unconsolidated sandy soils of low plasticity (i.e. Gordonia wind-blown sands) occur also tend to be more susceptible to erosion following heavy downpours, and this includes most of the proposed site. In addition to this, areas where vegetation is limited or has been disturbed or damaged due to construction activity will be more susceptible to erosion following heavy downpours. The most important indirect impacts are the increased siltation in drainage lines and downstream dams because of an increase in erosion from the site.		
	<b>Without mitigation</b>	<b>With mitigation</b>
<b>Extent</b>	Local (1)	Local (1)
<b>Duration</b>	Medium term (3) - Permanent (5)	Very short term (1) - Permanent (5)
<b>Magnitude</b>	Moderate (6)	Low (4)
<b>Probability</b>	Highly probable (4) - Probable (3)	Probable (3)
<b>Significance</b>	<b>Moderate (36 – 40)</b>	<b>Low (18 - 30)</b>
<b>Status (positive or negative)</b>	Negative	
<b>Reversibility</b>	Irreversible	
<b>Irreplaceable loss of resources</b>	Yes	
<b>Can impacts be mitigated</b>	Yes	
<b>Mitigation:</b>		
» Restrict size of disturbance areas.		
» Minimise activity in high erosion-sensitive areas.		
» Implement effective erosion control measures.		
» Keep to existing roads, where practical, to minimise impact on undisturbed ground.		
» Ensure stable slopes of stockpiles/excavations to minimise slumping.		
» Minimise uncontrolled discharge of run-off.		
» Install anti-erosion measures such as silt fences in disturbance areas.		
<b>Cumulative impacts:</b>		
» The cumulative impact of soil erosion from all development in the area is considered low if mitigating measures are adhered to.		
<b>Residual impacts:</b>		
» The residual impacts are expected to be minor due to the localised movement of sediment and the slow regeneration of soil processes.		

### **Comparative Assessment Statement**

There is **no distinct difference** between both alternatives for the power line and access road and therefore **no strong preference** for any alternative. However, as power line Alternative A is of a shorter length which will potentially affect a smaller footprint area, Alternative A is preferred for the power line alternative.

### ***Implication for Project Implementation***

- » No insurmountable geotechnical problems were identified in this preliminary assessment and the site appears to be suitable for the development as planned.
- » Certain constraints which have been identified could affect the design process, and therefore should be verified in a detailed geotechnical investigation before the design process is finalised.
- » Soil erosion concerns will be greatest along drainage lines where run-off is concentrated and hydraulic energy is potentially high.
- » Special engineering designs such as culverts, river training, etc. may have to be considered to minimise impact on these watercourses and to prevent obstructions in the site drainage.
- » Uncontrolled discharge of run-off must be managed and anti-erosion measures such as silt fences should be installed in disturbance areas.
- » The cumulative significance of the potential impacts on the geological environment is considered low due to the limited scale of the development and the scarcity of development in the immediate surrounding area.

### ***7.5.4 Assessment of Impacts on Water Resources***

From a habitat and ecosystem point of view, all the dry river beds are rated as extremely sensitive to development, in particular the mainstem systems (i.e. Helbrandkloofspruit), which flows along the western boundary of the site. There is a moderate risk of impacts to the Orange River resulting from elevated sediment loads and polluted runoff from the facility reaching the river during site preparation and construction. All impacts that were assessed as being of moderate significance could readily be reduced to low significance by appropriate mitigation, apart from the moderate impact of water abstraction from the Orange River.

### ***Impact tables summarising the significance of impacts on water resources with respect to the power line and access road (with and without mitigation)***

<b><i>Nature: Impact on riparian systems through the possible increase in surface water runoff on riparian form and function</i></b>		
	<b><i>Without mitigation</i></b>	<b><i>With mitigation</i></b>
<b><i>Extent</i></b>	Local (Low 1)	Local (Low 1)
<b><i>Duration</i></b>	Long-term (4)	Long-term (4)
<b><i>Magnitude</i></b>	Low (2)	Low (2)
<b><i>Probability</i></b>	Definite (5)	Probable (3)
<b><i>Significance</i></b>	<b>Medium (35)</b>	<b>Low (19)</b>
<b><i>Status (positive or negative)</i></b>	Negative	
<b><i>Reversibility</i></b>	Yes	

<b>Irreplaceable loss of resources</b>	No
<b>Can impacts be mitigated</b>	Yes
<b>Mitigation:</b> » Any stormwater within the site will be handled in a suitable manner, i.e. separate clean and dirty water streams around the plant, and install stilling basins to capture large volumes of run-off, trap sediments, and reduce flow velocities (e.g. water used when washing the mirrors).	
<b>Cumulative impacts:</b> » Downstream alteration of hydrological regimes due to the increased run-off from the area.	
<b>Residual impacts:</b> » Possible impact on the remaining catchment due to changes in run-off characteristics in the development site.	

<b>Nature: Increase in sedimentation and erosion</b>		
	<b>Without mitigation</b>	<b>With mitigation</b>
<b>Extent</b>	Local (Low 1)	Local (Low 1)
<b>Duration</b>	Long-term (4)	Long-term (4)
<b>Magnitude</b>	Low (1)	Low (1)
<b>Probability</b>	Definite (5)	Probable (3)
<b>Significance</b>	<b>Medium (30)</b>	<b>Low (18)</b>
<b>Status (positive or negative)</b>	Negative	
<b>Reversibility</b>	Medium	
<b>Irreplaceable loss of resources</b>	No	
<b>Can impacts be mitigated</b>	Yes	
<b>Mitigation:</b>		
» Measures should be implemented to control stormwater on road surface.		
» Aim to reduce flow velocities of stormwater to reduce sedimentation and erosion.		
<b>Cumulative impacts:</b>		
» Downstream erosion and sedimentation of the downstream wetland / dam area and canal system of the Naftali operations. During flood events, the unstable banks (eroded areas) and sediment bars (sedimentation downstream) already deposited downstream will then be washed into the Orange River.		
<b>Residual impacts:</b>		
» During flood events, the unstable banks (eroded areas) and sediment bars (sedimentation downstream) already deposited downstream will then be washed into the Orange River.		

### **Comparative Assessment Statement**

Neither the alternative route for power line nor for the access road will have a significant impact on drainage lines, the aquatic or riparian environment. There is **no distinct**

**difference** between both alternatives for the power line and access road and therefore **no strong preference** for any alternative.

### ***Implications for Project Implementation***

- » With suitable mitigation and implementation of the proposed layout, the development should have limited impact on the overall status of the riparian systems within the region.
- » A possible impact on the development of the Upington Solar Thermal Plant is in terms of the quantity of water required for operation of the facility. Although the volume does not seem to be prohibitive, the reduction of water use could be explored by the implementation of alternative operational processes. However, these alternatives would have financial (as tariffs proposed under the REFIT only cater for wet cooling) as well as efficiency implications on the overall development.

### ***7.5.5 Assessment of Potential Impacts on Heritage Sites***

Linear impacts are possible in the case of the power line, and access road. These potential impacts would tend to be direct, once-off events occurring during the initial construction period. In the long-term, the proximity of operations in a given area could result in secondary indirect impacts resulting from the movement of people or vehicles in the immediate or surrounding vicinity. Certain activities would generally have a lower impact than others (i.e. power lines tend to be less destructive on Stone Age sites than access roads).

The very low density of isolated stone artefacts across the various development areas provides no clear pointers for preferring one or another of the alternative routes for the power line or the external access road. It is recommended that in each case the preferred shorter routes be selected in that they would result in a lower loss or disturbance of the, albeit, low density artefact occurrences.

### ***Impact tables summarising the significance on heritage resources (with and without mitigation)***

<b>Nature: Impacts on heritage resources</b>		
These potential impacts would tend to be direct, once-off events occurring during the initial construction period. In the long term, the proximity of operations in a given area could result in secondary indirect impacts resulting from the movement of people or vehicles in the immediate or surrounding vicinity. Certain activities would generally have a lower impact than others (i.e. power lines tend to be less destructive on Stone Age sites than access roads)		
	<b><i>Without mitigation</i></b>	<b><i>With mitigation</i></b>
<b><i>Extent</i></b>	Local (1)	Local (1)
<b><i>Duration</i></b>	Permanent (5)	Permanent (5)
<b><i>Magnitude</i></b>	Moderate (6)	Low (4)
<b><i>Probability</i></b>	Highly probable (4)	Probable (3)



<b>Significance</b>	<b>Moderate (48)</b>	<b>Low (30)</b>
<b>Status</b>	Negative	
<b>Reversibility</b>	No	
<b>Irreplaceable loss of resources</b>	Yes – but the archaeological resources are not of major significance	
<b>Can impacts be mitigated?</b>	Yes – but not considered necessary in most instances	
<b>Mitigation:</b> » Artefact densities are low over most of the development footprint, so much so that mitigation measures are not considered necessary in most instances.		
<b>Cumulative impacts:</b> » The impacts are once-off permanent destructive events.		
<b>Residual impacts:</b> » No residual impacts are expected.		

### **Comparative Assessment Statement**

The **very low density** of isolated stone artefacts across the various development areas provides no clear pointers for preferring one or another of the alternative routes for the powerline or the external access road. It is recommended that in each case the **preferred shorter routes** (i.e. Alternative A) be selected in that they would result in a lower loss or disturbance of the, albeit, low density artefact occurrences.

### **Implications for Project Implementation**

- » Very sparse heritage traces were found on the site and from an archaeological perspective the observed heritage resources may be regarded as being of generally low significance.
- » In the event of archaeological materials being present such activity would alter or destroy their context (even if the artefacts themselves are not destroyed, which is also obviously possible).
- » In the event that such resources are found, they are likely to be of a nature that potential impacts could be mitigated by documentation and/or salvage following approval and permitting by the South African Heritage Resources Agency and, in the case of any built environment features, by Ngwao Bošwa ya Kapa Bokone (the Northern Cape Heritage Authority).

### **7.5.6 Assessment of Potential Visual Impacts**

#### **Power line**

Both proposed power line alternatives are new alignments and would therefore constitute a visual impact. Both alternatives are of similar length (Alternative A marginally shorter), and traverse similar terrain. Alternative B, however, coincides with an alternative access road alignment.

### **Access Road**

Two alternatives for the external access road are being considered. Alternative A will tee off a secondary road that bypasses the site in the north-east, while Alternative B will tee directly off the N14 south-west of the site. Although Alternative B is longer than Alternative A, it presents an opportunity to consolidate and localise impacts associated with ancillary infrastructure, as this alternative follows an already disturbed environment (access route).

### **Impact table summarising the significance of visual impacts (without mitigation)**

<b>Nature: Potential visual impact of the power line</b>	
<b>Extent</b>	Local (4)
<b>Duration</b>	Long term (4)
<b>Magnitude</b>	High (4)
<b>Probability</b>	Low (1)
<b>Significance</b>	<b>Low (15)</b>
<b>Status (positive or negative)</b>	Negative
<b>Reversibility</b>	Recoverable (3)
<b>Irreplaceable loss of resources</b>	No
<b>Can impacts be mitigated during operational phase</b>	No
<b>Mitigation:</b>	
» Decommissioning: removal of the solar facility structures and ancillary infrastructure after 30 to 50 years.	
<b>Cumulative impacts:</b>	
» No cumulative impacts are expected.	
<b>Residual impacts:</b>	
» No residual impacts are expected as the visual impact will be removed after decommissioning.	

<b>Nature: Potential visual impact of the external access road</b>	
<b>Extent</b>	Local (4)
<b>Duration</b>	Long term (4)
<b>Magnitude</b>	High (4)
<b>Probability</b>	Low (1)
<b>Significance</b>	<b>Low (15)</b>
<b>Status (positive or negative)</b>	Negative
<b>Reversibility</b>	Recoverable (3)
<b>Irreplaceable loss of</b>	No

<b>resources</b>	
<b>Can impacts be mitigated during the operational phase</b>	No
<b>Mitigation:</b> <ul style="list-style-type: none"> <li>» Consolidation of linear infrastructure.</li> <li>» Decommissioning: removal of the solar facility structures and ancillary infrastructure after 30 – 50 years.</li> </ul>	
<b>Cumulative impacts:</b> <ul style="list-style-type: none"> <li>» No cumulative impacts are expected.</li> </ul>	
<b>Residual impacts:</b> <ul style="list-style-type: none"> <li>» No residual impacts are expected as the visual impact will be removed after decommissioning</li> </ul>	

### **Comparative Assessment Statement**

There is **no distinct difference** between both alternatives for the power line and access road and therefore **no strong preference** for any alternative. However, as power line Alternative A is of a shorter length which will potentially result in a reduced visual impact, **Alternative A** is preferred for the power line alternative.

### **Implications for Project Implementation**

- » Secondary visual impacts associated with the construction phase, such as the sight of construction vehicles, dust and construction litter must be managed to reduce visual impacts. The use of dust-suppression techniques on the access roads (where required), timely removal of rubble and litter, and the erection of temporary screening will assist in doing this.

### **7.5.7 Assessment of Potential Social Impacts**

The preference of the alternative routings for the power line and external access road is linked to the visual impact and associated impact on the sense of place and landscape character of the area.

<b>Nature: Stock theft, poaching and damage to farm infrastructure</b>		
The presence of construction workers on-site increases the potential risk of stock theft and poaching. The movement of construction workers on and off the site also poses a potential threat to farm infrastructure, such as fences and gates, which may be damaged. Stock and game losses may also result from gates being left open and/or fences being damaged.		
	<b>Without mitigation</b>	<b>With mitigation</b>
<b>Extent</b>	Local (4) (Rated as 4 due to potential severity of impact on local farmers)	Local (2)
<b>Duration</b>	Short term (2)	Short term (2)

<b>Magnitude</b>	Moderate (6) (Due to reliance on agriculture and livestock for maintaining livelihoods)	Low (4)
<b>Probability</b>	Probable (3)	Probable (3)
<b>Significance</b>	<b>Medium (36)</b>	<b>Low (24)</b>
<b>Status (positive or negative)</b>	Negative	
<b>Reversibility</b>	Yes	
<b>Irreplaceable loss of resources</b>	No	
<b>Can impacts be mitigated</b>	Yes	
<b>Mitigation:</b>		
<ul style="list-style-type: none"><li>» Contractors should be held liable for compensating farmers and communities in full for damage to farm infrastructure that can be linked to construction workers (i.e. for all affected farm portions for the power line, and external access roads)</li><li>» The EMP must outline procedures for managing and storing waste on site, specifically plastic waste that poses a threat to livestock if ingested</li><li>» Contractors should ensure that all workers are informed of the conditions contained on the Code of Conduct, specifically consequences of stock theft and trespassing on adjacent farms</li><li>» The housing of construction workers on the site should be limited to essential and security personnel</li></ul>		
<b>Cumulative impacts:</b>		
<ul style="list-style-type: none"><li>» No cumulative impacts are expected, provided losses (i.e. for all affected farm portions for the power line, and external access roads) are compensated for.</li></ul>		
<b>Residual impacts:</b>		
<ul style="list-style-type: none"><li>» Refer to cumulative impacts.</li></ul>		

**Nature: Increased risk of accidental veld fires**

Construction workers/activities pose an increased risk of veld fires that in turn pose a threat to the livestock, wildlife, and farmsteads in the area. In the process, farm infrastructure may also be damaged or destroyed and human lives threatened. Fires on the site may also pose a threat to the safety of the residents of Oranjevallei, Kalksloot, Klippunt, and Kanoneiland. The potential risk of veld fires is heightened by the windy conditions in the area, specifically during the dry, winter months. The majority of farms in the area farm cattle. As such, their livelihoods are dependent on grazing on their farms. Any loss of grazing due to a fire would therefore impact negatively on the affected farmers livelihoods. The risk of fire related damage is exacerbated by the distance to fire-fighting vehicles located in the nearest towns of Upington, Keimoes and Kakamas.

	<b>Without mitigation</b>	<b>With mitigation</b>
<b>Extent</b>	Local (4)	Local (2)
<b>Duration</b>	Short term (2)	Short term (2)
<b>Magnitude</b>	Moderate - High (8)	Low-Moderate (6)
<b>Probability</b>	Probable (3)	Probable (3)
<b>Significance</b>	<b>Medium (42)</b>	<b>Low (30)</b>

<b>Status (positive or negative)</b>	Negative
<b>Reversibility</b>	Yes, compensation paid for stock and crop losses etc
<b>Irreplaceable loss of resources</b>	No
<b>Can impacts be mitigated</b>	Yes
<b>Mitigation:</b> <ul style="list-style-type: none"> <li>» The landowner should form part of the local fire protection agency where relevant.</li> <li>» Contractor to ensure that open fires on the site for cooking or heating are not allowed except in designated areas.</li> <li>» Contractor to ensure that construction related activities that pose a potential fire risk such as welding are properly managed and are confined to areas where the risk of fires has been reduced.</li> <li>» Measures to reduce the risk of fires include clearing working areas and avoiding working in high wind conditions when the risk of fires is greater.</li> <li>» Special care should be taken during the high risk dry, windy summer months.</li> <li>» Contractor to provide adequate fire fighting equipment on-site.</li> <li>» Contractor to provide fire-fighting training to selected construction staff.</li> </ul>	
<b>Cumulative impacts:</b> <ul style="list-style-type: none"> <li>» No cumulative impacts are expected, provided losses are compensated for.</li> </ul>	
<b>Residual impacts:</b> <ul style="list-style-type: none"> <li>» Refer to cumulative impacts.</li> </ul>	

### **Comparative Assessment Statement**

The preference of the power line and access road is linked to the potential visual impact. There is **no distinct difference** between both alternatives for the power line and access road and therefore **no strong preference** for any alternative. However, as power line Alternative A is of a shorter length which will potentially result in a reduced visual impact, **Alternative A** is preferred for the power line alternative.

The social benefit associated with Alternative A for the access road is that construction related traffic will turn off the N14 and on to DR3276 before encountering the settlements of Oranjevallei, Kalksloot, Klippunt, and Kanoneiland (assuming travel from Upington). **Alternative A** therefore reduces the potential noise, and safety related impacts on these communities, and is nominated as the preferred alter

### **Implications for Project Implementation**

The following should be considered for all alternatives under consideration:

- » Minimal disturbance of natural vegetation during construction phase
- » Consultation with affected landowners with regard to actual siting of servitude, power line towers and access routes (construction and maintenance)

- » Consultation with affected landowners with regard to procedures to ensure that farming operations are not affected by maintenance visits (e.g. farm gates and gates between camps).

#### **7.5.8. Nomination of a Preferred Power Line and Access Road Alternative**

The findings of the specialist studies regarding preference of alternatives is summarised in Table 7.1 below. In general, from an environmental perspective, there is **no significant difference** in the potential impacts associated with the erection of a power line or the construction of an access road along either of the alternative routes identified.

- » **Power line:** From the results of the specialist investigations, Alternative A is favoured as the preferred **power line** alternative by the majority of specialist findings, primarily due to its shorter length. However, in terms of impacts arising from avifauna collision, electrocution or disturbance associated with power line infrastructure, **Alternative A** is nominated as the preferred as the line is ~2.5 km shorter than Alternative B. Alternative B is, however, also considered acceptable.
- » **Access road:** From the results of the specialist investigations, there is no significant difference between the two **access road** alternatives, and for the majority of specialist investigations, both alternatives are considered acceptable. However, **Alternative B** is marginally preferred, because this route is aligned where there is an existing vehicle track and existing disturbance.
- » These alternatives for the power line and access road meet the acceptance level for environmental impacts, and will ensure that impacts are minimised to an acceptable level which can be managed through the implementation of an Environmental Management Plan.

The technical considerations pertaining to the alternatives is summarised below:

- » **Power line:** Alternative A is preferred from a technical perspective as this route is shorter and, therefore, more cost effective to construct and maintain. As this route is shorter by roughly 2 km, the developer will incur a cost-saving of roughly R6 Million.
- » **Access road:** Either route is considered viable to construct. The preference based on technical factors is, however, Alternative B. This is based on the following considerations:
  - **Alternative A:** the point of connection for this route is to the existing Divisional Road (secondary gravel road). The route is shorter in distance, but the gravel road would require extensive maintenance over the life of the plant, or would require surfacing (at a significant cost) to avoid deterioration of a public road.
  - **Alternative B:** this route provides direct access to the national road. There is an existing vehicle track between the property and the N14 access point, which is already used by the landowner. From a planning perspective, this route would

need permission from SANRAL for the direct access onto a National Road (i.e. the N14) and SANRAL would stipulate specifications of this access point as the safety of the National road cannot be compromised by a private access road.

Therefore, the following is recommended in terms of preference for the alternatives assessed:

- » **Power line:** Alternative A
- » **Access road:** Alternative B

**Table 7.1:** Summary of the specialist preferences in terms of the power line and access road Alternatives A and B

	<b>Power line</b>	<b>Notes</b>	<b>Access road</b>	<b>Notes</b>
<b>Ecology</b>	Alternative B	Both alternatives will have similar impacts on habitats. Alternative B is marginally preferred, because it is aligned where there is an existing vehicle track and existing disturbance. There is also the option of having the access road (road alternative B) and the power line along the same route, which would minimise the overall impact of the project (i.e. through consolidation of linear impacts).	Alternative B	Both alternatives will have similar impacts on habitats. Alternative B is marginally preferred, because it is aligned where there is an existing vehicle track and existing disturbance. There is also the option of having the access road (road alternative B) and the power line along the same route, which would minimise the overall impact of the project (i.e. through consolidation of linear impacts).
<b>Avifauna</b>	Alternative A	There is no significant difference between the two alternatives. However, in terms of impacts arising from collision, electrocution or disturbance, Alternative A is nominated as the preferred as the line is approximately 2.5 km shorter than Alternative B.	No preference	There is no significant difference between the two alternatives.
<b>Geology</b>	No preference	There is no significant difference between the two alternatives.	No preference	There is no significant difference between the two alternatives.



	<b>Power line</b>	<b>Notes</b>	<b>Access road</b>	<b>Notes</b>
<b>Water resources</b>	No preference	There is no significant difference between the two alternatives.	No preference	There is no significant difference between the two alternatives.
<b>Heritage</b>	Alternative A	The very low density of isolated stone artefacts across the various development areas provides no clear pointers for preferring one or another of the alternative routes for the power line. There is no significant difference between the two alternatives. However, Alternative A is nominated as the preferred as the line is ~2.5 km shorter than Alternative B.	Alternative A	The very low density of isolated stone artefacts across the various development areas provides no clear pointers for preferring one or another of the alternative routes for the power line. There is no significant difference between the two alternatives. However, Alternative A is nominated as the preferred as the route is shorter than Alternative B.
<b>Visual</b>	Alternative A	Alternative A represents a potentially reduced visual impact by virtue of its shorter length.	No preference	There is no significant difference between the two alternatives.
<b>Social</b>	Alternative A	The social impacts are associated with the visual impacts. Alternative A represents a potentially reduced visual impact by virtue of its shorter length.	Alternative A	Alternative A is preferred as construction related traffic will turn off the N14 and on to DR3276 before encountering the settlements of Oranjevallei, Kalksloot, Klippunt, and Kanoneiland (i.e. reduces the potential noise, dust, and safety impacts on these communities).

## CONCLUSIONS AND RECOMMENDATIONS

## CHAPTER 8

Khi CSP South Africa (Pty) Ltd (!Khi CSP) is proposing the establishment of a commercial solar energy facility and associated infrastructure Portion 3 of the Farm McTaggarts Camp 453 near Upington in the Northern Cape.

A study area of approximately 22 km<sup>2</sup> was originally considered as the larger study area for the construction of the proposed facility. Following the Scoping Phase a preferred area for the development footprint (approximately 6 km<sup>2</sup>) located in the south-eastern portion of the larger site, was identified. This portion is preferred based on site sensitivities such as the presence of drainage lines; proximity to an existing power line (i.e. for the "turn in"); proximity to the N14 and proximity away from historic mining activities in the north-western portion of the site.

The primary components of the project (i.e. areas of activity) include the following:

- » The developmental footprint **within** the identified south-eastern portion including the solar collector fields; water storage reservoirs; evaporation ponds; the power island; internal access roads; workshops; offices; and storage areas.
- » The developmental footprint **outside** of the identified south-eastern portion including a power line; external access roads; an abstraction point on the Orange River; a suspension reservoir; and a water supply pipeline to the facility.

The EIA for the proposed facility has been undertaken in accordance with the EIA Regulations published in Government Notice 28753 of 21 April 2006, in terms of Section 24(5) of the National Environmental Management Act (NEMA; Act No 107 of 1998). The EIA Phase aimed to achieve the following:

- » Provide an overall assessment of the potential social and biophysical impacts that may occur as a result of the establishment of the proposed facility.
- » Assess potentially significant impacts (direct, indirect, and cumulative, where required) associated with the proposed facility.
- » Comparatively assess identified alternatives put forward as part of the project.
- » Nominate preferred power line and external access corridors for consideration by the decision-making authorities.
- » Identify and recommend appropriate mitigation measures for potentially significant environmental impacts.
- » Undertake a fully inclusive public involvement process to ensure that I&APs are afforded the opportunity to participate, and that their issues and concerns are recorded.

The conclusions and recommendations of this EIA are the result of the assessment of identified impacts by specialists, and the parallel process of public participation. The public consultation process has been extensive and every effort has been made to include representatives of all stakeholders in the study area.

## 8.1 Feedback from the Public Participation Process

During the review period for the Draft EIA Report, the affected landowner whose land the proposed water supply pipeline would cross brought to the Environmental Assessment Practitioner's attention that a land restitution claim exists against the property Klippunt 452, directly north-east of McTaggart's Camp. This constitutes a risk to the project and therefore a slight realignment of the proposed water supply pipeline will be required. The abstraction point and initial routing will remain as was originally proposed. However an additional section of pipeline north adjacent to the D3276 gravel road is proposed instead of the alignment traversing west to the facility across Klippunt 452. This additional section along the D3276 will terminate at the existing boundary fence of McTaggart's Camp where it will turn into the McTaggart's Camp itself and then travel south towards the power island.

The specialist sub consultants were notified of the proposed alignment changes and were requested to submit their comments regarding the environmental acceptability of this pipeline deviation (refer to the table below for a summary of the comments made).

	Specialist Field	Additional Comments
David Hoare Consulting cc	Ecology	The new alignment will have similar impacts to the original proposed alignment, although possibly slightly lesser impacts on some ecological features. For the original alignment, the two impacts with the highest significance were those on indigenous natural vegetation and on drainage lines (both rated as having medium significance). The current (new) alignment proposed here will probably have an impact of similar significance on indigenous natural vegetation and of lower significance on watercourses.
Martin Taylor of Birdlife South Africa	Avifauna	With regards to the avifauna on site and the proposed project, the most significant threat to bird communities would be from collisions with the overhead power line. It is not believed that the loss of habitat or the disturbance due to the realignment of the water pipe line will have any negative impact on bird communities in the area. The realignment of the pipeline will not affect any changes to the conclusions reached in the avifaunal assessment.
Iain Paton of	Geology, soil, and	The geology along the proposed new route does not

Outeniqua Geotechnical Services	erosion potential	differ significantly from that of the previous route and therefore we expect very similar impacts to those indicated in the original EIA Report. In terms of impacts on the geological environment, the newly proposed route can be followed.
David Morris of the McGregor Museum	Heritage	The heritage resources across a substantial part of the farm McTaggart's Camp in the vicinity of the new pipeline route can be predicted to have minimal archaeological traces, in line with the extremely low densities seen in immediately adjacent areas. These observations had been consistent with previous surveys in similar portions of the landscape near Upington. The terrain to be traversed by the pipeline does not differ significantly from areas previously examined.
Patsy Scherman of Scherman, Colloty and Associates	Water resources	The locality of the pump station and intake locality along the Orange River would not change, thus all impact ratings would remain unaltered. The impact of the initial pipeline on the riparian and dry rivers beds was assessed as low with mitigation. With the proposed new alignment the impact would even be lower, as the route now avoids one of the major river channels within the region.
Lourens du Plessis of MetroGIS	Visual aesthetics	Although no dedicated viewshed has been generated for the pipeline, it is expected that the area of potential visual exposure will lie within that of the primary infrastructure (i.e. specifically the power tower). The potential visual impact of the pipeline is expected to be low. The anticipated visual impact is not considered a fatal flaw from a visual perspective.
Tony Barbour Environmental Consultant and Researcher	Social issues	The social impacts associated with the revised route, as in the case of the original route, will be negligible and the significance of the impact is rated as low negative. The revised route is therefore supported. The revised pipeline route does not therefore have a bearing on the overall findings contained in the social impact assessment.

Refer to Appendix N for the specialist comments on the revised alignment.

The overall conclusion from the specialist sub consultants is that the impacts associated with the revised will not differ from those associated with the original pipeline alignment. Therefore, the revised alignment is considered acceptable from an environmental perspective and can be nominated as the preferred option for implementation.

## 8.2. Evaluation of the Proposed Project

The preceding chapters of this report together with the specialist studies contained within Appendices G - N provide a detailed assessment of the environmental impacts on the social and biophysical environment that may result from the proposed project. This chapter concludes the EIA Report by providing a summary of the conclusions of the assessment of the proposed site for the solar energy facility and the associated infrastructure. In so doing, it draws on the information gathered as part of the EIA process and the knowledge gained by the environmental consultants during the course of the EIA and presents an informed opinion of the environmental impacts associated with the proposed project.

- » The overall impact on the **ecology** is likely to be of a **moderate significance** prior to mitigation. This could be reduced to **moderate - low** negative following the implementation of mitigation measures. Areas of sensitivity include indigenous natural vegetation (i.e. impacts of medium significance), protected tree species (i.e. impacts of medium - low significance), threatened plant species (i.e. impacts of medium - low significance), drainage lines (i.e. impacts of high - medium significance), and the potential spread of alien invasive species (i.e. impacts of medium - low significance).
- » The overall impact on the **avifauna** is likely to be of a **moderate significance**. The primary concern will be collision/electrocution of birds with the power line. This impact on avifauna is potentially of moderate significance, but could be reduced to a **low significance** with the implementation of mitigation measures. Positioning of the power line is critical to avoid "high sensitivity" areas (i.e. drainage lines), where feasible.
- » The overall impact on the **geology, soils, and erosion potential** is likely to be of a **low significance**. The presence of calcrete and other minor occurrences of basement rock have a significant reducing effect on the erosion potential on the south-eastern portion of the site. The cumulative significance of all the potential impacts on the geological environment is considered low due to the limited scale of the development and the scarcity of development in the immediate surrounding area.
- » The overall impact on the **water resources** is likely to be of a **moderate significance**. These could readily be reduced to **low significance** by appropriate mitigation, apart from the moderate impact of water abstraction from the Orange River. Although the volume required (i.e. 1 million m<sup>3</sup> per annum, based on a wet cooling process, and pumping at 18hr/d at 70L/s), does not seem to be prohibitive, the reduction of water use could be explored by the implementation of alternative operational processes. However, these alternatives would have financial as well as

efficiency implications on the overall development, and are not considered further in light of the water resource required not being seen as a limiting factor at this time.

- » The overall impact on the **heritage resources** is likely to be of a **low significance**. Very sparse heritage traces were found during a field survey.
- » The overall **visual** impact is likely to be of a **low significance**. However, the potential visual impact on users of national, arterial, and secondary roads in close proximity of the solar facility will be of high significance. The potential visual impact on residents of towns, settlements, and homesteads in close proximity to the proposed solar facility and within the region, as well as on local protected areas will be of moderate significance. The proposed facility will transform the natural and relatively unspoiled wide-open views surrounding the site for the entire operational lifespan. This anticipated impact is not, however, considered a fatal flaw from a visual perspective, especially considering the low incidence of visual receptors in the region.
- » The overall **social** impact is likely to be of a **moderate significance** in terms of positive impacts, and a **low – high significance** in terms of the negative impacts. The development will create employment and business opportunities for locals during both the construction and operational phase of the project and represents an investment in clean, renewable energy infrastructure.

**No environmental fatal flaws** were identified with the establishment of the proposed Upington Solar Thermal Plant. However a number of issues requiring mitigation have been highlighted. Environmental specifications for the management of potential impacts are detailed within the Draft EMP included within Appendix M.

The most significant environmental impacts associated with the proposed project, as identified through the EIA, include:

#### ***Local site-specific impacts***

Local site-specific impacts as a result of physical disturbance/modification to the site with the establishment of the facility that may occur during the construction phase will include:

- » Impacts on biodiversity which includes any impacts on protected (i.e. Grey Camel Thorn, Shepard's Tree, Secretarybird, Martial Eagle, Kori Bustard, Lanner Falcon, Ludwig's Bustard and Sclater's Lark) or sensitive species (i.e. Quiver Tree), and on overall species richness
- » Impacts on sensitive habitats (i.e. drainage lines) that leads to direct or indirect loss of such habitat

- » Soil erosion induced or increased by human activity is termed “accelerated erosion” and is an integral element of global soil degradation

These impacts will be primarily limited to the preferred developmental area located within the south-eastern region of the broader site which was identified during the Scoping Phase.

### ***Impacts on drainage lines***

From a habitat and ecosystem point of view, all the dry river beds and the associated riparian systems would be rated as extremely sensitive to development, in particular the mainstem systems such as Helbrandkloofspruit, which flows along the western boundary of the site. Impacts include the following:

- » Impacts on the Orange River system due to water abstraction, and site-specific impacts on in-stream biota
- » Elevated sediment input into the Orange River during the establishment of the water abstraction facilities and associated elevated turbidity levels
- » Impacts on the drainage lines may lead to direct or indirect loss of such habitat
- » Disturbance of existing flood protection embankments
- » Inadequate erosion control or containment of sediment-laden runoff during site clearing and construction activities for infrastructure at both the abstraction points (e.g. pipelines and reservoirs) and at the solar plant site
- » Backwash water discharged from the sand filters could result in sediment laden water reaching the Orange River, with a resultant impact on habitat availability for in-stream biota
- » Poor planning and design of new abstraction infrastructure and new flood protection measures on the floodplain, resulting in bank erosion or slumping to occur during river flooding events

### ***Visual impacts***

The construction and operation of the proposed facility will have a visual impact on the natural scenic resources of this region. There are not many recommendations as to the mitigation of the visual impact of the solar collector field (i.e. power tower and heliostat field) as no amount of vegetation screening or landscaping would be able to hide structures of these dimensions. It is, however, recommended that the ancillary infrastructure be properly planned with due cognisance of the topography, that all disturbed areas be appropriately rehabilitated.

The facility further has a novel and futuristic design that invokes a curiosity factor not generally present with other conventional power generating plants. The advantage being that the solar facility can become an attraction or a landmark within the region that people would actually want to come and see. As it is impossible to hide the facility, the only option would be to promote it.

### 8.3. Overall Conclusion (Impact Statement)

Internationally there is increasing pressure on countries to increase their share of renewable energy generation due to concerns such as climate change and exploitation of resources. The South African Government has set a 10-year cumulative target for renewable energy of 10 000 GWh renewable energy contribution to final energy consumption by 2013, to be produced mainly from biomass, wind, solar and small-scale hydro. This amounts to approximately 4% (1 667 MW) of the total estimated electricity demand (41 539 MW) by 2013.

The viability of establishing a solar thermal plant with a maximum generating capacity of 110 MW on a site near Upington has been established by !Khi CSP. The positive implications of establishing a solar energy facility on the identified site within the Northern Cape include:

- » The project would assist the South African government in reaching their set targets for renewable energy
- » The potential to harness and utilise solar energy resources
- » The National electricity grid in the Northern Cape would benefit from the additional generated power.
- » Promotion of clean, renewable energy in South Africa
- » Positive impacts on the tourism economy of the area
- » Creation of local employment, business opportunities and skills development for the area

The findings of the specialist studies undertaken within this EIA to assess both the benefits and potential negative impacts anticipated from the proposed project conclude that:

- » There are **no environmental fatal flaws** that should prevent the proposed solar energy facility and associated infrastructure from proceeding on the identified site, provided that the recommended mitigation and management measures are implemented, and given due consideration during the process of finalising the facility layout.
- » The most significant threat to **avifauna** communities would be from collisions with the overhead power line. The loss of habitat, disturbance, or any interaction with the facility is not anticipated to have a significant negative impact on bird communities in the area.
- » Very sparse **heritage resources** were found during the field survey undertaken for the site. From an archaeological perspective the observed heritage resources may be regarded as being of generally low significance. The **fossil record** from Kalahari deposits is very poor with respect to finds of fossil bones of vertebrates.



- » The cumulative significance of all the potential impacts on the **geological** environment is considered low due to the limited scale of the development and the scarcity of development in the immediate surrounding area. Furthermore, the presence of calcrete and other minor occurrences of basement rock will have a significant reducing effect on the erosion potential on the south-eastern portion of the site.
- » The anticipated **visual** impact is not, considered to be a fatal flaw from a visual perspective, considering the low incidence of visual receptors in the region and the contained area of potential visual exposure.
- » The development will have both positive and negative **social** impacts. It will create employment and business opportunities for locals during both the construction and operational phases and represent an investment in clean, renewable energy infrastructure. The potential for cumulative impacts also exists due to the proximity of the proposed Eskom CSP to the east of the site, however, these impacts are not considered to represent a fatal flaw, and in addition, there is no indication if (or when) this development will take place.

The significance levels of the majority of identified negative impacts can generally be reduced by implementing the recommended mitigation measures. With reference to the information available at this planning approval stage in the project cycle, the **confidence** in the environmental assessment undertaken is regarded as **acceptable**.

The proposed power line alternatives are both considered to be acceptable from an environmental perspective, with **Alternative A** being considered as the preferred alternative (the shorter route reduces the potential for impacts arising from avifauna collision, electrocution or disturbance associated with power line infrastructure). The proposed access road alternatives are both considered acceptable from an environmental perspective, with **Alternative B** being considered as the preferred alternative (this route is aligned where there is an existing vehicle track and existing disturbance). The **revised pipeline route** recommended in response to comments received in the public review period of the draft EIA Report is considered acceptable and is nominated as the preferred option for implementation.

#### 8.4. Overall Recommendation

Based on the nature and extent of the proposed project, the local level of disturbance predicted as a result of the construction and operation of the facility and associated infrastructure, the findings of the EIA, and the understanding of the significance level of potential environmental impacts, it is the opinion of the EIA project team that the application for the proposed Upington Solar Thermal Plant can be mitigated to an acceptable level.

The following conditions would be required to be included within an authorisation issued for the project:

- » Alternative A for the proposed power line is considered acceptable from an environmental perspective and should be authorised as this shorter route reduces the potential for impacts arising from avifauna collision, electrocution or disturbance associated with power line infrastructure).
- » Alternative B for the proposed access road is considered acceptable from an environmental perspective and should be authorised as this route is aligned where there is an existing vehicle track and existing disturbance).
- » The revised water supply pipeline has been approved by all the specialist sub consultants and should be authorised.
- » As far as possible, any component of the facility which could potentially affect sensitive areas (i.e. primarily drainage line should be shifted in order to avoid these areas of high sensitivity (i.e. best practice is impact avoidance). Where this is not possible, alternative mitigation measures as detailed in this report must be implemented.
- » Disturbed areas should be rehabilitated as quickly as possible and an on-going monitoring programme should be established to detect and quantify any alien species.
- » During construction, unnecessary disturbance to habitats should be strictly controlled and the footprint of the impact should be kept to a minimum.
- » All mitigation measures detailed within this report and the specialist reports contained within Appendices G to N are implemented.
- » The Draft EMP as contained within Appendix M of this report should form part of the contract with the Contractors appointed to construct and maintain the proposed solar energy facility, and will be used to ensure compliance with environmental specifications and management measures. The implementation of this EMP for all life cycle phases of the proposed project is considered key in achieving the appropriate environmental management standards as detailed for this project.
- » A comprehensive stormwater management plan should be compiled for the developmental footprint prior to construction.
- » Applications for all other relevant and required permits required to be obtained by Khi CSP must be submitted to the relevant regulating authorities. This includes permits for the transporting of all components (abnormal loads) to site, disturbance to heritage sites, disturbance of protected vegetation, and disturbance to any drainage lines or riparian vegetation

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## **CURRICULUM VITAE**

**KAREN JODAS**

*Director : Savannah Environmental (Pty) Ltd*

*Environmental Scientist (MSc, Pr.Sci.Nat)*

### **SKILLS BASE AND CORE COMPETENCIES**

- Eleven years experience in the environmental management and impact assessment field.
- Nine years experience in Project Management.
- Project management of large environmental assessment & environmental management projects.
- Experienced in the identification & assessment of potential environmental impacts & benefits.
- Experienced in the development of practical & achievable mitigation measures & management plans, and evaluation of risk.
- Experienced in the formulation of environmental strategy, policy & guidelines.
- Working knowledge of environmental planning processes, policies, regulatory frameworks & legislation.
- Experienced in the compilation and review of the reports in accordance with all relevant environmental legislation.
- Wide range of experience for public and private sector projects - completed more than 50 environmental projects for a wide variety of Clients.
- Experienced in undertaking public participation processes for a variety of projects.
- Completed projects in all nine Provinces of South Africa, as well as Zambia and Lesotho.
- *Specialisation:* Strategic environmental assessment and advice; Project Management and coordination of environmental projects; Environmental Management; Environmental Impact Assessment; Integration of environmental studies and environmental processes into larger engineering-based projects and ensuring compliance to legislation and guidelines; Hydrology and Water Management; General Ecology.
- Registered Professional Natural Scientist (Registration No 400106/99).

### **TERTIARY EDUCATION**

- B.Sc Earth Sciences, majoring in Geography and Zoology, Rhodes University, Grahamstown, 1993.
- B.Sc Honours in Geography (in Environmental Water Management), Rhodes University, Grahamstown, 1994. Major subjects included Water Resources Management, Streams Ecology.
- Fluvial Geomorphology and Geographic Information Systems.
- M.Sc in Geography (Geomorphology), Rhodes University, Grahamstown, 1996.
- Water Quality Management, Potchefstroom University, 1998.
- Environmental Law Course, Aldo Leopold Institute, 2002.

### **EMPLOYMENT HISTORY**

- Nov 2006 – present: Savannah Environmental (Pty) Ltd: Director; Environmental Scientist.
- Oct 1997 – Oct 2005: Bohlweki Environmental (Pty) Ltd: Associate, Environmental Scientist.

### **SELECTED RELEVANT PROJECT EXPERIENCE**

- EIA and EMP for the proposed wind energy facility and associated infrastructure at a site

within the Western Cape (Eskom Generation) – project management & report compilation.

- Development of a comprehensive site-specific EMP for the construction and operation of the.
- Eskom Braamhoek Integration Project, Free State and KwaZulu-Natal Provinces (Eskom Transmission) - project management & report compilation.
- EIA and EMP for the proposed Steelpoort Integration Project, Mpumalanga & Limpopo Provinces (Eskom Transmission) – report compilation.
- Environmental Scoping Study for a new coal-fired power station in the Lephalale area, Limpopo Province (Eskom Generation) – report compilation.
- Detailed Environmental Scoping Study & public participation for the proposed Capacity Increase Project at Arnot Power Station, Mpumalanga Province (Eskom Generation) - report compilation.
- Numerous EIAs for various electricity sector projects (generation, transmission & distribution) in all nine provinces of South Africa.

## **CURRICULUM VITAE**

### **TAMMY KRUGER**

*Environmental Consultant: Savannah Environmental (Pty) Ltd*

*Environmental Scientist (MSc)*

#### **SKILLS BASE AND CORE COMPETENCIES**

- Project management
- Identification and assessment of potential negative environmental impacts and benefits through the review and manipulation of data and specialist studies
- Identification of practical and achievable mitigation and management measures and the development of appropriate management plans
- Compilation of environmental reports in accordance with relevant environmental legislative requirements
- External and peer review of environmental reports & compliance monitoring
- Formulation of environmental policies, strategies and guidelines
- Public participation processes for a variety of projects
- Strategic environmental advice to a wide variety of clients both in the public and private sectors
- Working knowledge of environmental planning processes, policies, regulatory frameworks and legislation

#### **EDUCATION AND PROFESSIONAL STATUS**

- B.Sc Zoology, University of the Witwatersrand, Johannesburg, 2004
- B.Sc Honours in Zoology, University of the Witwatersrand, Johannesburg, 2005
- M.Sc in Environmental Science, University of the Witwatersrand, Johannesburg, 2010

#### **EMPLOYMENT**

- Current: Environmental Consultant - Savannah Environmental (Pty) Ltd - Environmental Consultant
- October 2007 - September 2009: Prime Resources (Pty) Ltd - Environmental Consultant
- November 2006 - April 2007: Endangered Wildlife Trust - Field Researcher

#### **KEY RESPONSIBILITIES**

- Conducting and management of Environmental Impact Assessments (EIAs) and other environmental investigations according to the current legislation.
- Interpreting and applying Environmental Legislation.
- Development, planning, co-ordinating and facilitating Public Participation Process (PPP).
- Client and Authority liaison..
- Compiling, reviewing and approving project proposals and environmental reports .
- Developing and implementing Environmental Management Plans (EMP's).
- Provision of ongoing assistance and support to the Organisation's Directors and the environmental and engineering teams.

#### **SELECTED RELEVANT PROJECT EXPERIENCE**

- Basic Assessment team for proposed wind monitoring masts, Western Cape Province (for



South African General Investment and Trust Company Limited).

- Basic Assessment team for the proposed wind monitoring mast, Eastern Cape Province (for Just Energy).
- EIA team for the proposed wind energy facility, Eastern Cape Province (for Just Energy).
- Basic Assessment team for the proposed wind monitoring masts, Eastern and Western Cape Provinces (for VentuSA (Pty) Ltd).
- EIA team for the proposed wind energy facility, Eastern and Western Cape Provinces (for VentuSA (Pty) Ltd).
- EIA team for the proposed solar energy facility, Northern Cape Province (for VentuSA (Pty) Ltd).
- EIA team for the proposed solar energy facility, Northern Cape Province (for Abengoa Solar South Africa (Pty) Ltd).

**CURRICULUM VITAE**  
**LOURENS MARTINUS DU PLESSIS**

*MetroGIS (Pty) Ltd*

*Visual Assessment and Geographic Information Systems Specialist*

**SKILLS BASE AND CORE COMPETENCIES**

- More than 17 years experience in the application of Geographical Information Systems (GIS) in Environmental Planning and Management.
- Extensive practical knowledge in spatial analysis, environmental modelling and digital mapping.
- Experience in applying GIS in EIAs, State of the Environment Reports and Environmental Management Plans.

**TERTIARY EDUCATION**

- BA (University of Pretoria) Geography and Anthropology (Masters), 1993

**EMPLOYMENT HISTORY**

- 1999 - present: MetroGIS, Director
- 1997 - 1999: GISBS, Project Manager
- 1990 - 1997: GisLAB c, Project Manager / Member

**SELECTED RELEVANT PROJECT EXPERIENCE**

- Visual Impact Assessments and Viewshed Analysis for various types of developments, including telecommunications structures, mining activities and tourism accommodation in National Parks and other environmentally sensitive areas. Some recent and current projects include:
  - Proposed Altantis Open Cycle Gas Turbine power station.
  - Matimba B proposed coal-fired power station.
  - Zues to Mercury transmission line (comparative viewshed analysis)
  - Mercury-Ferrum-Garone transmission line intergration
  - Mmamambula (Botswana) transmission line and power station viewshed analysis Kynoch
  - Gypsum Tailings dam extension
  - N1 Western Bypass Shell service station
  - Coega regional hazardous waste processing facility.
  - Robinson Deep landfill extension
  - Concentrating Solar Power (CSP) plant
- EIAs for the utilisation of GIS based systems to determine and manage environmental impacts. Various projects in South Africa.

## **CURRICULUM VITAE**

### **TONY BARBOUR**

*Tony Barbour Environmental Consulting and Research  
Environmental Consultant and Researcher (MSc)*

#### **SKILLS BASE AND CORE COMPETENCIES**

- More than 18 years experience in the field of environmental management.
- Undertaken 20 Social Impact Assessments (SIA) for EIAs commissioned by the Department of Environmental Affairs and Development Planning (DEA&DP).
- Developed SIA guidelines for DWAF.
- Worked experience in South Africa, Botswana, Namibia, Zambia, Lesotho and Swaziland.

#### **TERTIARY EDUCATION**

- BSc (Geology and Economics) Rhodes, 1984
- BEcon (Hons) Rhodes, 1985
- MSc (Environmental Science) University of Cape Town, 1992

#### **EMPLOYMENT HISTORY**

- Private consultant: November 2004 – present
- UCT: August 1996- October 2004. Environmental Evaluation Unit, Senior Environmental Consultant and Researcher.
- 1991-1996: Ninham Shand Consulting, Cape Town. Senior Environmental Scientist
- 1996-2000; SRK Consulting, Associate Director, Cape Town
- 1990- Current: Lecturer, UCT and Cape Technikon, Environmental Economics, SIA, SEA, EIA and Waste Management.

#### **SELECTED RELAVANT PROJECT EXPERIENCE**

- SIA for the Darling Wind Farm, Western Capr (2001-2002).
- Portnet Saldanha, EIA for the expansion of a bulk iron ore exporting facility at the Port of Saldhana (2000).
- SIA for road upgrade between Gansbaai and Bredadorp (2005)
- SIA for Zeekoevlei Golf Estate, Somerset West (2005)
- SIA for Silwersand Golf and Resort Estate, Robertson, Western Cape (2003)
- Internal Review consultant for Golder Associates on Namakwa Sands Heavy Mineral Mining EIA (current).
- Review of EIA for Zeekoevlei Golf Course Estate, Somerset West (2005)
- Review of EIA for Oostenberg Waste Transfer Station, Brackenfell, Western Cape (2004)
- Review of EIA for N7 Road upgrade, Clanwilliam, Western Cape (2002).

**CURRICULUM VITAE  
MORNE DE JAGER**

*M2 Environmental Connections cc*

**SKILLS BASE AND CORE COMPETENCIES**

- Water monitoring programme design.
- Water Quality Analysis and Modelling.
- Environmental Auditing.
- Noise Monitoring, Modelling and Control.
- Biological Monitoring.
- Environmental Impact Assessment and Management.
- IT skills (software as well as hardware).
- Conflict resolution and stakeholder facilitation.

**TERTIARY EDUCATION**

- B.Eng (Chem) (University of Pretoria)

**EMPLOYMENT HISTORY**

- Department of Water Affairs and Forestry (1998 – 2001; Pollution Control Officer)
- EcoSat (2001 – 2002; Environmental Monitoring, Control and Management)
- Menco (2002 – current; See above)

**SELECTED RELEVANT PROJECT EXPERIENCE**

- Noise Impact Assessment for Skychrome (Pty) Ltd (A Ferro-chrome mine).
- Noise Impact Assessment for Mooiooi Chrome Mine (Western Chrome Mines).
- Noise Impact Assessment for Buffelsfontein East and West (Western Chrome Mines).
- Noise Impact Assessment for Elandsdrift (Sylvania).
- Noise Impact Assessment for Jagdlust Chrome Mine (Eastern Chrome Mines).
- Noise Impact Assessment Apollo Brick (Pty) Ltd (Clay mine and brick manufacturer).

**CURRICULUM VITAE**  
**IAIN PATON**

*Outeniqua Geotechnical Services*  
*Geologist*

**SKILLS BASE AND CORE COMPETENCIES**

Engineering and Geology

**TERTIARY EDUCATION**

- Rhodes University, Grahamstown, South Africa
- 1993: Bachelor of Science Degree in Geology and Economics
- 1994: Bachelor of Science with Honours Degree in Geology

**WORK EXPERIENCE**

- 1995 to 1996 Mine Geologist – Western Areas Gold Mine (JCI Limited), Johannesburg.
- 1996 to 1997 Senior Geologist – Western Areas Gold Mine (JCI Limited), Johannesburg.
- 1997 to 1998 Logging Geologist - Halliburton Energy Services (Drilling Systems), Aberdeen, Scotland.
- 2000 - 2006 Construction Site Manager – Progex, Knysna.
- 2006 to 2008 Engineering Geologist & Member - Siyakhula Lab cc, Knysna Civil Laboratory & Geotechnical Services.
- 2008 to date Engineering Geologist & Member - Outeniqua Geotechnical Services cc (Formerly Siyakhula Lab cc), Knysna.

## **CURRICULUM VITAE**

### **DAVID HOARE**

*David Hoare Consulting cc*

*Ecologist (PhD)*

#### **SKILLS BASE AND CORE COMPETENCIES**

Ecological consultant since 1995. Author of over 200 specialist ecological consulting reports. Wide experience in botanical studies within grassland, savanna and fynbos, as well as riparian, coastal and wetland vegetation.

#### **Main areas of specialization:**

- Vegetation ecology, primarily in grasslands, thicket, coastal systems, wetlands.
- Plant biodiversity and threatened species specialist.
- Remote sensing, analysis and mapping of vegetation.
- Specialist consultant for environmental management projects.

#### **TERTIARY EDUCATION**

- Matric - Graeme College, Grahamstown, 1984.
- B.Sc (majors: Botany, Zoology) - Rhodes University, 1991-1993.
- B.Sc (Hons) (Botany) - Rhodes University, 1994 with distinction.
- M.Sc (Botany) - University of Pretoria, 1995-1997 with distinction.
- PhD (in progress) – Nelson Mandela Metropolitan University, Port Elizabeth, "Patterns and determinants of plant biodiversity in temperate, mesic grasslands of South Africa" under supervision of Prof. Richard Cowling.

#### **EMPLOYMENT HISTORY**

- 1 February 1998 – 30 November 2004, Researcher, Agricultural Research Council, Range and Forage Institute, Private Bag X05, Lynn East, 0039. Duties: project management, general vegetation ecology, remote sensing image processing.
- 1 December 2004 – present, Member, David Hoare Consulting cc no. 2001/034446/23. Consultant, specialist consultant contracted to a number of existing companies and organisations.
- 1 January 2009 – 30 June 2009, Lecturer, University of Pretoria, Botany Dept.

#### **SELECTED RELEVANT PROJECT EXPERIENCE**

- Vegetation pattern in Pilanesberg National Park using digital photogrammetric data preparation techniques, 1 August – present.
- VegMap digital mapping and description of vegetation units of Eastern Cape for new national vegetation map (Dept. of Environmental Affairs and Tourism/National Botanical Institute) and contributions to text and vegetation descriptions in accompanying booklet.
- Classification and mapping of the savanna biome of South Africa using remote sensing techniques, 1 February 1998 – 20 November 1999.
- Natural resource survey of nodes O R Tambo and Maputoland, using remote sensing techniques, 1 November 2001 – December 2003.
- Field data collection for National Land Cover Change Project, Dec 2003 – March 2004.
- Vegetation survey of KwaMhlanaga Landcare site, March 2004.

- Scale physiognomic survey of Suikerbosrand Nature Reserve, 1 March 1998 – 1 April 1998.
- Natural resource survey of Mpumalanga, South Africa, using remote sensing techniques, 1 November 1998 – 2000.
- Vegetation of the corridor of the proposed ESKOM powerline from Port Elizabeth to Bedford. September 2000.
- National land cover change mapping and monitoring – development of guidelines, protocols and recommendations for a national mapping project, 1 June 2000 – 30 November 2000.

## **CURRICULUM VITAE**

### **MARTIN TAYLOR**

*Birdlife International*

*Zoology (M.Sc)*

#### **SKILLS BASE AND CORE COMPETENCIES**

- Project development and management, strategic environmental assessment , environmental assessments, ecological assessment and planning, community development, ecotourism development, proposal writing, institutional fundraising

#### **TERTIARY EDUCATION**

- BSc Biology with University Honours (4yr degree), Francis Marion University, USA.
- MSc Zoology (Masters in Conservation Ecology), University of Pretoria, South Africa

#### **EMPLOYMENT HISTORY**

- 2009 until present – Division manager for BirdLife South Africa - Avitourism division manager responsible for avitourism development within South Africa, project and financial management, proposal writing, route development, marketing, human resource management and managing various community and conservation projects.
- 2007 to 2009 –Project manager for BirdLife South Africa - Project manager of the Kruger to Canyons Birding Route project, a community and conservation orientated avitourism development project. Responsible for all aspects of project and financial management of the project.
- 2005 to 2007 –Senior environmental consultant for Coastal and Environmental Services
- Held the position of Senior Environmental Consultant dealing with various projects involving scoping reports, environmental impact assessments, risk assessments, ecological assessments, environmental impact assessment guideline documents and environmental monitoring projects.
- 2003 to 2005 – Martin Taylor and Associates - Formed Martin Taylor and Associates providing freelancing consulting services ranging from strategic environmental overviews, scoping reports, ecological assessments, vegetation assessments, and environmental management plans. Company was formed in order to supplement income whilst studying for my Masters degree.
- 2001 to 2003 – Environmental scientist for WSP Walmsley (Pty) Ltd - Held the position of Environmental Scientist and was involved in various projects involving scoping reports and environmental impact assessments, risk assessments, ecological assessments, environmental impact assessment, guideline documents and environmental monitoring projects.
- 1998-2004 – Conservation Ecology Unit, University of Pretoria - Held position of Research Assistant at Richards Bay Minerals Field Station. Involved in restoration ecology, various graduate research projects and the processing of collected data (vacational work)

#### **SELECTED RELAVANT PROJECT EXPERIENCE**

- Avifaunal Assessment of Transnet Capital Projects Nsezi Property, Richards Bay, KwaZulu Natal: Project management, field work and report writing
- Avifaunal Assessment of the Black Rock 132kV Powerline, Northern Cape:
- Project management, field work and report writing



- Ecological Assessment of the inundation of 200ha by the Nacala Dam, Northern Mozambique: Project management, field work and report writing.
- SAPP EIA Thermal Guidelines for Nexant (plc), Sub Saharan Africa. Data Collection on EIA Practice in Sub-Saharan Africa and report writing.
- Environmental Assessment for Additional Water Supply Options for the Kwale Mineral Sands Project, Kenya: Project management, data collection and report writing.
- Environmental Risk Report for the Dimbi Diamond Concession, Central African Republic: Project management and report writing.
- Environmental Assessment for El Burrullus Heavy Minerals Mine, Egypt: Project management, data collection and report writing.
- Strategic Environmental Overview of a Heavy Mineral Deposit, Malawi. - (Client and location confidential) Project management, data collection and report writing.
- Construction Environmental Action Plans for various components of the Kwale Mineral Sands Project, Kenya: Compilation of environmental action plans and document management
- EIA Guidelines for the Sectors of Roads, Transmission Lines, Telecom Masts, Filling Stations and Housing for the Department of Environmental Affairs and Tourism , South Africa. Data collection and report writing.
- Limpopo State of the Environment Report, South Africa: Biodiversity and Terrestrial Resource Use Sections: Data collection and report writing.

**CURRICULUM VITAE**  
**GARRY PATERSON**

*Agricultural Research Council*  
*Soil Scientist (MSc, Pr.Sci.Nat)*

**SKILLS BASE AND CORE COMPETENCIES**

- Soil classification and mapping
- Soil interpretations
- Soil survey project management
- Environmental assessment
- Soil survey and land capability course presentation
- Ground penetrating radar

**TERTIARY EDUCATION**

- Matriculated: 1976, Dalziel High School, Motherwell, Scotland
- BSc (Hons) Geography, 1980, University of Strathclyde, Glasgow, Scotland
- MSc (Soil Science) cum laude, 1998, University of Pretoria

**EMPLOYMENT HISTORY**

- 1981-1987: Soil Scientist: Soil and Irrigation Research Institute, Pretoria
- 1987-1992: Senior Soil Scientist: Soil and Irrigation Research Institute, Pretoria
- 1992-present: Senior Soil Scientist: ARC-Institute for Soil, Climate & Water

**PROFESSIONAL STATUS**

- Registered Natural Scientist (SA National Council for Natural Scientific Professions)
- Member of South African Soil Classification Working Group
- Member of Soil Science Society of South Africa (1982-present)
- President of Soil Science Society of South Africa (2005-2007)
- Council Member of South African Soil Survey Association (2002-2003)
- Scientific Referee, S.A. Journal for Plant and Soil
- External Examiner, University of Pretoria and University of Witwatersrand

**CURRICULUM VITAE**  
**PATSY SCHERMAN**

*Scherman, Colloty and Associates*

**SKILLS BASE AND CORE COMPETENCIES**

- Environmental water quality; riverine ecology; river health (bio)monitoring; ecological Reserve assessments for rivers; management of large environmental inter-disciplinary teams; development, implementation and management of environmental monitoring programmes.

**TERTIARY EDUCATION**

- Rhodes University, Grahamstown, South Africa:
- B. Sc in Microbiology and Zoology (1984-1986)
- B. Sc Hons in Microbiology, specializing in Biotechnology (1987)
- Ph.D in Biotechnology (1993)

**EMPLOYMENT HISTORY**

- 1992 – 1993 - Employed as Senior Technical Officer in the Institute for Water Research, Rhodes University, which included involvement on a number of projects. Duties included the maintenance of equipment, bacteriological and water quality analysis, data manipulation and interpretation.
- 1993 - During the period January to February participated in the World Ocean Current Experiment (WOCE) programme to Antarctica as an oceanic nutrient analyst using a Technico III autoanalyzer.
- 1994 – Feb 2002 - Employed as a Research Officer and Project Leader of the IWR, and Manager of the Centre for Aquatic Toxicology (CAT-IWR) since its inception in 1999.
- Mar 2002 – Feb 2005 - Employed as a Senior Environmental Consultant at Coastal and Environmental Services (CES), Grahamstown.
- Mar 2005 – Feb 2006 - Promoted to Principal Environmental Consultant at Coastal and Environmental Services, Grahamstown.
- Mar 2006 – Dec 2007 - Operations Director, Coastal and Environmental Services, Grahamstown.
- From Jan 2008 - Registered Scherman Consulting as a sole trader
- June 2009 - Registered Scherman Colloty & Associates: Environmental and Aquatic Management Consulting (CK 2009/112403/23)



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DEPARTMENT OF  
ENVIRONMENT AND NATURE CONSERVATION

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ISEBE LEZENDALO  
NOLONDOLOZO

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LEFAPHA LA ,TIKOLOGO  
LE TSHOMARELO YA TLHAGO

---

DEPARTEMENT VAN  
OMGEWING EN NATUUR BEWARING

---

90 Long Street  
Sasko Building  
Private Bag X6102  
KIMBERLEY  
8300

90 Long Street  
Sasko Building  
Inxowa yeposi X6102  
KIMBERLEY  
8300

90 Long Street  
Sasko Building  
Kgatsanaposo X6102  
KIMBERLEY  
8300

Long Street 90  
Privaatsak X6102  
KIMBERLEY  
8300

Tel: (053) 807 7430

Fax: (053) 831 3530

Enquiries : *Anga Yaphi*  
Dipatisilo :  
Navrae :  
Imibuzo :

Date : 29/07/2010  
Letlha :  
Datum :  
Umhla :

Reference :  
Tshupelo :  
Verwysing :  
Isalathiso :

**Att:** Tammy Kruger

**Fax no:** 086 684 0547

Dear Madam

**APPLICATION FOR ENVIRONMENTAL AUTHORISATION/ PROPOSED UPINGTON  
SOLAR THERMAL PLANT AND ASSOCIATED INFRASTRUCTURE, SIYANDA  
DISTRICT MUNICIPALITY, NORTHERN CAPE PROVINCE**

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The draft scoping report and plan of study for environmental impact assessment which was submitted by you in respect of the abovementioned application and received by the Department on 09 July 2010 has been reviewed by the Department. And the view is you may accordingly proceed with undertaking the environmental impact assessment in accordance with the tasks that are outlined in the plan of study for environmental impact assessment

The Environmental Assessment Practitioner (EAP) responsible for this application is furthermore reminded of the obligation to comply with Section 32 of the NEMA: EIA Regulations as published in GN R385 of 21 April 2006.

This Department has reviewed the document and the information provided is sufficient to allow an informed decision relating to the activity. This department thus has no objections for the above – mentioned activity being accepted and approved, subject to the conditions stipulated in chapter2 of the Scoping Report. And all mitigation measures be adhered to at all times.

Please contact this Department if you have any queries regarding the contents of this letter.

Yours faithfully

Anga Yaphi  
Principal Environmental Officer: Impact Management



## **environmental affairs**

Department:  
Environmental Affairs  
REPUBLIC OF SOUTH AFRICA

Private Bag X 447 · PRETORIA · 0001 · Fedsure Building · 315 Pretorius Street · PRETORIA Tel (+ 27 12) 310 3911  
Fax (+ 2712) 322 2682

**Reference:** 12/12/20/1831

**Enquiries:** Ms Gabisile Hlongwane

**Telephone:** (012) 310 3805 **Fax:** (012) 320 7539 **E-mail:** GabisileH@environment.gov.za

Ms. Tammy Kruger  
Savannah Environmental (Pty) Ltd  
PO Box 148  
**SUNNINGHILL**  
2157

Fax No.: 086 684 0547

Dear Ms Kruger,

### **ACCEPTANCE OF THE FINAL SCOPING REPORT AND THE PLAN OF STUDY FOR ENVIRONMENTAL IMPACT ASSESSMENT FOR THE PROPOSED ESTABLISHMENT OF THE UPINGTON SOLAR THERMAL PLANT AND ASSOCIATED INFRASTRUCTURE, NORTHERN CAPE PROVINCE**

The scoping report and plan of study for environmental impact assessment which was submitted by you in respect of the abovementioned application and received by the Department on 11<sup>th</sup> August 2010 has been accepted by the Department.

Please note the following for the submission of the Environmental Impact Assessment Report:

1. **Contents of EIA Report (EIR)**

You are hereby advised that the Environmental Impact Assessment Report (EIR) must contain all the information outlined in regulation 32 (2) of the Environmental Impact Assessment (EIA) regulations, omission of information may result in the EIA report being rejected.

2. **Specialist Assessments**

The Department notes the nine specialist studies/assessments identified during the scoping phase. When submitting the EIA Report, please ensure that all nine specialist reports except the Noise Impact Study, contains the details of the work done during the EIA phase and all the information specified in regulation 33 (2) of the EIA regulations. It is important that different maps included in the EIR are of acceptable quality and as a minimum, have the following attributes:

- Maps are relatable to one another;
- Cardinal points;
- Relatable and overlaid to the Northern Cape Biodiversity Conservation Plan (if any);
- Indicate the proposed plan and alternatives;
- Latest land cover;
- Vegetation types of the study area.

### 3. Alternatives

The Department notes the alternatives identified in the scoping report. You are now required to evaluate all alternatives and indicate the preferred option; reasons must be provided. You are hereby reminded that it is mandatory to investigate and assess the option of not proceeding with the proposed activity (i.o.w., the "no-go" option) in addition to other alternatives identified.

### 4. Public Participation

You are hereby reminded that the Public Participation process to be followed in the EIA phase must also comply with regulation 56 of the EIA regulations. Furthermore, when submitting the EIA Report, you are required to attach the written comments (copies of original letters) from all the relevant organs of state. Comments from Siyanda District Municipality, South African Heritage Resource Agency (SAHRA), Department of Water Affairs and Northern Cape Department of Environment and Nature Conservation. However, the public participation process should not be limited to the abovementioned Departments. All the interested and affected parties within your project area must be consulted during the EIR phase.

Your attention is also drawn to the fact that our Directorate: Biodiversity Planning has not yet commented, their comments will come after their review of the final Specialist Studies in the EIA Report. Also note that they may require additional studies or information depending on the information provided in the EIR.

### 5. Mandatory draft EMP

You are further reminded that a draft Environmental Management Plan ("EMP") that complies with regulation 34 of the EIA regulations must be compiled. The EMP must address the potential environmental impacts of the proposed power line deviation on the environment throughout the project life cycle, i.e. the EMP must address impacts in respect of the planning and design, pre-construction and construction activities, operation of the activity, rehabilitation of the environment and closure/decommissioning (if applicable).

You may now proceed with the environmental impact assessment process in accordance with the tasks outlined in the plan of study for environmental impact assessment.

Notwithstanding the above, your attention is drawn to the fact that the success of the application may be prejudiced by the information that is incomplete and not following the requirements of the NEMA Regulations, 2006.

You are hereby reminded that the activity may not commence prior to an environmental authorisation being granted by the Department.

Yours faithfully,



Ms Lize McCourt

**CHIEF DIRECTOR: ENVIRONMENTAL IMPACT MANAGEMENT**

Department of Environmental Affairs

Letter signed by: Mr. Dumisane Mthembu

Designation: Director: Environmental Impact Evaluation

Date: 28/09/2010

CC: Dr Louis van Heerden

Khi CSP South Africa (Pty) Ltd

Fax: 086 607 9286





REGISTRATION NO. 1998/009584/06

**Western Region**

Parc du Cap, Building 5, cor. Mispel Str & Willie van Schoor Avenue, Bellville, 7530  
Private Bag X19, Bellville, South Africa, 7530  
Tel +27 (0) 21 957 4600 Fax +27 (0) 21 946 1630

Head Office Tel +27 (0) 12 426 6000 Fax +27 (0) 12 362 2101 / 2116/2117

Offices in Menlyn - Pretoria, Pietermaritzburg, Port Elizabeth

<b>Reference:</b>	W11/2/1	<b>Fax Number:</b>	+27 (0) 21 946 1630
<b>Date:</b>	11 November 2010	<b>Direct Line:</b>	+27 (0) 21 957 4600
<b>Email:</b>	dekockr@nra.co.za	<b>Website:</b>	<a href="http://www.sanral.co.za">www.sanral.co.za</a>

Savannah Environmental (Pty) Ltd  
PO Box 148  
SUNNINGHILL  
2157

Dear Ms Kruger

**EIA FOR THE PROPOSED ESTABLISHMENT OF THE UPINGTON  
SOLAR THERMAL PLANT AND ASSOCIATED INFRASTRUCTURE,  
NORTHERN CAPE**

Thank you for your letter dated 18 October 2010.

The South African National Roads Agency Limited (SANRAL) has the following comments:

- (1) A permit needs to be obtained from the Provincial Government Northern Cape (PGNC) to transport abnormal loads on a national road.
- (2) A statutory building restriction of a 500m radius measured from an intersection on a national road or within 60 meters from the road reserve fence line is applicable on rural national roads.
- (3) SANRAL's approval is required for construction of any new access to a national road.

Yours faithfully

**René de Kock**  
**STATUTORY CONTROL**

Docs 423745

From the desk of Tammy Kruger  
E-mail: [tammy@savannahSA.com](mailto:tammy@savannahSA.com)

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**ENVIRONMENTAL IMPACT ASSESSMENT PROCESS: EIA PHASE**  
**PROPOSED ESTABLISHMENT OF THE UPINGTON SOLAR THERMAL PLANT,**  
**NORTHERN CAPE PROVINCE**  
**DEA Reference No. 12/12/20/1831**

03 December 2010

Good day

The abovementioned project refers.

The review period of for the Final Environmental Impact Assessment (EIA) Report has now passed and Savannah Environmental as the Environmental Assessment Practitioner has submitted the Final EIA Report to the National Department of Environmental Affairs as the competent authority.

Requests for comments have been made, however none have been received to date. Therefore can all comments be sent directly through to DEA marked for the attention of Gabisile Hlongwane, the authorised case officer for the project.

Sincerely,

A handwritten signature in black ink, appearing to read "Kruger".

Tammy Kruger

UNIT 606, 1410 EGLIN OFFICE PARK, 4 EGLIN ROAD, SUNNINGHILL, GAUTENG  
PO BOX 148, SUNNINGHILL, 2157, GAUTENG  
TEL: +27 (0)11 234 6621 • FAX: +27 (0)86 684 0547 • E-MAIL: [INFO@SAVANNAHSA.COM](mailto:INFO@SAVANNAHSA.COM)  
[WWW.SAVANNAHSA.COM](http://WWW.SAVANNAHSA.COM)

DIRECTORS: KM JODAS • J THOMAS • M MATSABU  
COMPANY REGISTRATION NO.: 2006/000127/07  
VAT REGISTRATION NO.: 4780226736

5. Appendix B2 Request for comment - DENC

From: Tammy Kruger [tammy@savannahsa.com]  
Sent: 30 November 2010 04:36 PM  
To: 'ayaphi@upprov.ncape.gov.za'  
Cc: 'ShawnJohnston'  
Subject: Upington Solar Thermal Plant (12/12/20/1830) - Comment on the Draft EIA Report (NC/NAT/EIA/SIY/UP11/2010)

Importance: High

Dear Anga,

We are looking to submit the Final EIA Report to the department of Environmental Affairs. Are you in a position to provide me with your comments on the report?

Thanks  
Tammy Kruger

Regards,  
Tammy Kruger  
MSc (Environmental Science)  
Savannah Environmental (Pty) Ltd  
  
Cell: 079 884 5123 / 074 101 6670  
Tel: 011 234 6621  
Fax: 086 684 0547  
Unit 606, 1410 Eglin Office Park, 14 Eglin Road, Sunninghill  
PO Box 148, Sunninghill, 2157  
<http://www.savannahsa.com/>

6. Appendix B2 Request for comment - LM and DM

From: Tammy Kruger [tammy@savannahsa.com]  
Sent: 30 November 2010 04:48 PM  
To: 'mackayj@kaigarib.co.za'  
Cc: 'mmakibi@siyanda.gov.za'  
Subject: Upington Solar Thermal Plant 12/12/20/1830

Importance: High

Good day,

Following the submission of a Draft EIA to both the local and district municipalities in which the above mentioned project falls, I would like to request your comments as we are looking to submit the Final EIA report to the National Department of Environmental Affairs.

Please contact me should you have any queries.

Regards,  
Tammy Kruger  
MSc (Environmental Science)  
Savannah Environmental (Pty) Ltd  
  
Cell: 079 884 5123 / 074 101 6670  
Tel: 011 234 6621  
Fax: 086 684 0547  
Unit 606, 1410 Eglin Office Park, 14 Eglin Road, Sunninghill  
PO Box 148, Sunninghill, 2157  
<http://www.savannahsa.com/>

7. Appendix B2 Request for comment - LM and DM answer

From: John Mac Kay [mackayj@kaigarib.co.za]  
Sent: 03 December 2010 11:39 AM  
To: 'Tammy Kruger'  
Cc: dngxanga@siyanda.gov.za; mmakibi@siyanda.gov.za  
Subject: RE: Upington Solar Thermal Plant 12/12/20/1830

Kindly, proceed with submission of the documents but keep us up to date.

Regards

Mac Kay

From: Tammy Kruger [mailto:tammy@savannahsa.com]  
Sent: 30 November 2010 04:48 PM  
To: mackayj@kaigarib.co.za  
Cc: mmakibi@siyanda.gov.za  
Subject: Upington Solar Thermal Plant 12/12/20/1830  
Importance: High

Good day,

Following the submission of a Draft EIA to both the local and district municipalities in which the above mentioned project falls, I would like to request your comments as we are looking to submit the Final EIA report to the National Department of Environmental Affairs.

Please contact me should you have any queries.

Regards,  
Tammy Kruger  
MSc (Environmental Science)  
Savannah Environmental (Pty) Ltd

Cell: 079 884 5123 / 074 101 6670  
Tel: 011 234 6621  
Fax: 086 684 0547

7. Appendix B2 Request for comment - LM and DM answer

Unit 606, 1410 Eglin Office Park, 14 Eglin Road, Sunninghill

PO Box 148, Sunninghill, 2157

<http://www.savannahsa.com/>

8. Appendix B2 Request for comment - DWA

From: Tammy Kruger [tammy@savannahsa.com]  
Sent: 30 November 2010 04:36 PM  
To: 'snyders@dwa.gov.za'  
Subject: Upington Solar Thermal Plant 12/12/20/1830

Importance: High

Dear Louis,

Apart from the comments you have already submitted to Savannah Environmental directly or through Shawn Johnston of Sustainable Futures ZA are there any further comments you would like to submit following your review of the Draft EIA Report?

Regards,  
Tammy Kruger  
MSc (Environmental Science)  
Savannah Environmental (Pty) Ltd

Cell: 079 884 5123 / 074 101 6670  
Tel: 011 234 6621  
Fax: 086 684 0547  
Unit 606, 1410 Eglin Office Park, 14 Eglin Road, Sunninghill  
PO Box 148, Sunninghill, 2157  
<http://www.savannahsa.com/>

9. Appendix B2 Request for comment - SAHRA

From: Tammy Kruger [tammy@savannahsa.com]  
Sent: 30 November 2010 04:50 PM  
To: 'mgalimberti@sahara.org.za'  
Subject: Upington Solar Thermal Plant 12/12/20/1830

Importance: High

Good day Mariagrazia,

The abovementioned project refers.

Are you in a position to provide me with any comments you may have on this project as we are looking to submit the Final EIA Report to the Department of Environmental Affairs for authorisation.

Please contact me should you have any queries.

Regards,  
Tammy Kruger  
MSc (Environmental Science)  
Savannah Environmental (Pty) Ltd  
  
Cell: 079 884 5123 / 074 101 6670  
Tel: 011 234 6621  
Fax: 086 684 0547  
Unit 606, 1410 Eglin Office Park, 14 Eglin Road, Sunninghill  
PO Box 148, Sunninghill, 2157  
<http://www.savannahsa.com/>



## UPINGTON SOLAR THERMAL PLANT, NORTHERN CAPE

### COMMENTS AND RESPONSE REPORT: I&APs & STAKEHOLDERS

#### Submitted as part of the Final Environmental Impact Assessment Report: Focus Group Meetings, Public Meeting & Written Comments

No.	Issue	Raised by	Response
<b><i>Khi CSP South Africa &amp; Partners</i></b>			
1.	Who are the shareholders of !Khi CSP South Africa? Whose farm is being used for this project?	Jaco Goussard, JCG Water Treatment, comments at public meeting, 06 July 2010.	The farm is McTaggart's Camp and it belongs to Piet van Schalkwyk. The directors include Dr Louis van Heerden and international persons.
2.	What is Eskom's connection to this project? Are they partners?	Ivan Pretorius, Beyond Elektries, comments at public meeting, 06 July 2010.	There is no partnership with Eskom on this project as it is a private project run by an independent developer.
3.	Are you also involved with the Kathu and Sishen PV plants?	Uwe Westphaeling, Solar Northern Cape, comments at public meeting, 06 July 2010.	Savannah Environmental is conducting the environmental impact assessments for those projects. !Khi CSP South Africa is not the project applicant.
<b><i>Procurement</i></b>			
4.	We are interested in transport, construction/erection, rigging, mechanical and electrical installation. We are a company that specialise in what we do therefore it would be very positive to be part of such a project which is environmentally friendly and technology advanced.	Johann van Deventer, Managing Director DRENCON Rigging, comment by e-mail, 30 June 2010.	!Khi CSP will look at an Engineering, Procurement and Construction (EPC) company to construct the plant. Local companies may be asked to contract for civil and minor components. The local market will be contracted by the ECP company. The project will have a local and international component during the construction phase. The provision of services required during the construction phase is yet to go to tender.
5.	I would be keen to get involved with the supply of the PV panels to projects in Northern Cape. We have a number of manufactures who could supply PV panels. Will you be using local	Uwe Westphaeling, Solar Northern Cape, comments at focus group meeting, 05 July 2010.	

No.	Issue	Raised by	Response
	suppliers for the PV panels? Will there be opportunities for local solar suppliers to get involved in a project of this nature?		
6.	We would be interested in providing the PV components to your project. What is the deadline for procurement of the different components?	Uwe Westphaeling, Solar Northern Cape, comments at public meeting, 06 July 2010.	No deadline has been set for procurement at this stage. Interested and affected parties have been requested to register on the project database in order to stay informed regarding project progress. The details of those parties wishing to tender will be passed on to the EPC company.
7.	What is the opportunity for engineering firms to be appointed as the EPC company?	Roberto Robertse, Aurecon, comments at public meeting, 06 July 2010.	<p>The EPC company could be any large construction company that can deal with the risk and can deliver the project on specification and in time. If such companies exist in South Africa they would be given the opportunity as part of the procurement process. The EPC company would need to comply with all conditions.</p> <p>Local companies may be asked to contract for civil and minor components as Khi CSP South Africa will be doing all the design work before procurement. The local market will be contracted by the EPC company. The project will have a local and international component during the construction phase.</p>
<b>Technology Selection</b>			
8.	What types of PV panels will be used? Will it be tracking or static panels?	Uwe Westphaeling, Solar Northern Cape, comments at focus group meeting, 05 July 2010.	It is not decided at this stage of the project what type of PV technology will be used on the site.
9.	What type of technology will be used in this project?	Siyanda District Municipality, comments at focus group meeting, 06 July 2010.	The proposed solar energy facility is proposed to accommodate up to 110 MW which will be comprised of a combination of the following technologies (in any combination) 50 MW trough plant (CSP); 50 MW power tower plant (CSP); 10 MW PV plant. The Renewable

No.	Issue	Raised by	Response
			Energy Feed-in Tariff Process (criteria not yet finalised by NERSA), selection process, IRP from government, and the economics of the solar facility will be key in determining the final technology combination and the schedule of implementation for the facility.
10.	What is the reason for including three different technologies for generating solar power? We have just submitted an application to do 200MW in the Kenhart area for solar power with PV only. So what is your reason for this mix plant?	Conrad Groenewald, Council for Geosciences Northern Cape, comment at public meeting, 06 July 2010.	The technology selection is based on international best practice and how industry is operating internationally. Each technology has its own pros and cons, and !Khi CSP South Africa is looking at limiting their risk profile by optimising the amount of power the plant can produce. Further to this, they have established a weather station on site recording the data that would be used in determining the approach with respect to the 3 types of technology. It will also depend on what the South African Government announces about the use of different types of technology. Tariffs for the different technologies would also have an impact on the technology selection. The decision regarding technology to be used on the site will be a combination of knowledge of site conditions and the REFIT conditions.
11.	I represent two German companies who represent excellent technology. How many Chinese companies are involved in the !Khi CSP South Africa project as they (the Chinese) have a very bad track record with respect to Human Rights Everyone is going to the Chinese for manufacturing of solar and wind energy equipment and forget about this. Will you visit the factories before signing with manufacturers?	Uwe Westphaeling, Solar Northern Cape, comments at public meeting, 06 July 2010.	There is no Chinese manufacturing involvement in this project. !Khi CSP South Africa will not construct the proposed facility and will look at an Engineering, Procurement, and Construction (EPC) company to construct the plant. That company would have to comply with the terms of reference relating to all aspects of the development.

No.	Issue	Raised by	Response
<b>Financing Options</b>			
12.	How do you intend financing your project? Will you speak to the World Bank and other international financing institutions as well?	Piet Du Plessis, Karstens Group, comments at focus group meeting, 05 July 2010.	!Khi CSP South Africa will consider several options through their partners and through a range of financial institutions. This process will run parallel to the environmental impact assessment process. This will be clarified <b>during the course of the project's</b> process.
13.	Who will finance the project? Are you looking for investors? Are you considering international loans?	Uwe Westphaeling, Solar Northern Cape, comments at public meeting, 06 July 2010.	The financing is still to be determined and secured. At this stage all possibilities are being considered.
<b>Heritage Resources</b>			
14.	Nonofho Ndobochani is now the Unit Manager of SAHRA Archaeology, Palaeontology & Meteorite (APM Unit). I have retired from the SAHRA APM Unit and have moved to the SAHRA Legal Office from 1 June for a period. In future you may send correspondence for the APM Unit to Nonofho Ndobochan.	Marie Leslie, South African Heritage Resources Agency Legal Office, comment by e-mail, 28 June 2010.	Correspondence was sent to Nonofho Ndobochan. However, he advised that Mariagrazia Galimberti is the correct contact person for this project. Ms. Galimberti has therefore been added to the I&AP database and all liaisons regarding Heritage Issues will be sent through to her.
15.	Request a Heritage Impact Assessment for the !Khi CSP South Africa's Upington Solar Thermal Plant.	Mariagrazia Galimberti APM Impact Assessor South African Heritage Resources Agency, comment by e-mail, 15 July 2010.	An email was sent to Ms. Galimberti on 15.07.2010 confirming that a full Phase 1 Heritage Impact Assessment will be undertaken for the proposed project during the EIA Phase by David Morris of the McGregor Museum. A formal letter was posted in this regard.

No.	Issue	Raised by	Response
16.	<p>Thank you for your indication that development is to take place. In terms of the National Heritage Resources Act, no 25 of 1999, heritage resources, including archaeological or palaeontological sites over 100 years old, graves older than 60 years, structures older than 60 years are protected. They may not be disturbed without a permit from the relevant heritage resource authority. This means that before such sites are disturbed by development it is incumbent on the developer to ensure that a Heritage Impact Assessment is done. This must include the archaeological component (Phase 1) and any other applicable heritage components. Appropriate (Phase 2) mitigation, which involves recording, sampling, and dating sites that are to be destroyed, must be done as required.</p> <p>In the Background Information Document, it is stated that possible impact on heritage resources will be assessed by specialist in the Scoping and EIA Phase Assessments. Therefore, SAHRA is looking forward to receiving a Heritage Impact Assessment for this project.</p> <p>The Phase 1 Impact Assessment Report will identify the archaeological sites and assess their significance. It should also make recommendations (as indicated in section 38) about the process to be followed. For example, there may need to be a mitigation phase (Phase 2) where the specialist will collect or excavate material and date the site. At the end of the process the heritage authority may give</p>	<p>Mariagrazia Galimberti APM Impact Assessor South African Heritage Resources Agency, comment by e-mail, 15 July 2010.</p>	<p>A full Phase 1 Heritage Impact Assessment will be undertaken during the EIA Phase by David Morris of the McGregor Museum. A statement regarding the palaeontological importance of the area will be included. The requirements of the National Heritage Resources Act will form part of the Environmental Management Plan that will be submitted with the EIA report, and will advise that heritage resources, including archaeological or palaeontological sites over 100 years old, graves older than 60 years, structures older than 60 years may not be disturbed without a permit from the relevant heritage resource authority. During the construction phase, should any heritage resources be discovered, appropriate Phase 2 mitigation measures will be required to be employed by the developer.</p>

No.	Issue	Raised by	Response
	<p>permission for destruction of the sites.</p> <p>A Palaeontological Desk Top study must be undertaken to assess whether or not the development will affect paleontological resources – or at least a letter of exemption from a Palaeontologist is needed to indicate that this is unnecessary. If the area is deemed sensitive, a full Phase 1 Palaeontological Impact Assessment will be required and if necessary a Phase 2 rescue operation might be necessary.</p> <p>Any other heritage resources that may be impacted such as built structures over 60 years old, sites of cultural significance associated with oral histories, burial grounds and graves, graves of victims of conflict, and cultural landscapes or views capes must also be assessed.</p>		
<b>Water Resources</b>			
17.	<p>There are 4 projects of specific interest to this office, i.e. Upington, Kathu, Sishen, and Boshof (Wagǃbietjiespan), all of which falls within the WMAs mentioned above. Our involvement is obviously around the water requirements, water availability, and potential of water resources pollution at the intended sites. While on the Upington project a lot of excellent work had been done on water resources assessment, we do not see that at the other intended projects yet.</p> <p>We are supportive of the solar energy drive and my officials will be involved in the stakeholder</p>	<p>Louis Snyders, Chief Director Northern Cape Region, Department of Water Affairs – Kimberley, comment by e-mail, 15 July 2010.</p>	<p>!Khi CSP is only associated with the proposed CSP facility at Upington.</p> <p>A Scoping assessment of the water resources to be used for the proposed facility has been undertaken. During the EIA Phase a detailed study will be undertaken which will include the following:</p> <ul style="list-style-type: none"> <li>» Assess the impact on water quality/quantity of the region in terms of physical, biophysical, and social impacts.</li> <li>» Assess the impact on water quantity of the region</li> <li>» Assess the impact on dry riverbeds and localised</li> </ul>

No.	Issue	Raised by	Response
	<p>meetings that we are aware of and later on in the water use authorisation process. I do however believe that we can have better and more focused interaction on an upfront bilateral basis. This should benefit both of us in ensuring streamlined processes when required and will prevent fragmented interaction with Water Affairs. My request is thus that you keep us informed about the progress on the projects as well as any new projects coming up in the mentioned WMAs. It would also be of value for your relevant members to visit our offices in Kimberley for discussions with respect to all water related issues.</p>		<p>drainage systems</p> <ul style="list-style-type: none"> <li>» Assess the impact on riparian systems (form and function) and on riverine and in stream habitats</li> <li>» Assess the impact on riparian systems (conservation and biodiversity) and on fish biodiversity and species of conservation concern.</li> </ul> <p>The I&amp;AP will be informed through the EIA process of the developments with respect to the potential impacts on water resources. Savannah Environmental, through their appointed water specialist, will liaise with the Kimberley branch of the Department of Water Aff</p>
18.	<p>One of the other ways of crossing the N14 Provincial Road would to align the pipeline (the proposed pipeline to carry the water from the de-gritting plant at the extraction point on the Orange River to the facility) with the existing culverts.</p> <p>What specific information do you require from me a key landowner in this area? What can I clarify for you?</p> <p>You would have to speak to the right person at the Steynsraad Irrigation Board and the Department of Water Affairs who would guide you in the application process for obtaining a water user licence.</p>	<p>Peu Bezuidenhout, Naftali Estate, comments at focus group meeting, 06 July 2010.</p>	<p>This information has been noted and may be considered during the EIA Phase as an alternative route for the pipeline.</p> <p>An understanding of how to deal with water access in the area is required. Further to this, a team of specialist consultants, who are looking at all aspects of water for the proposed project, have been contracted.</p> <p>Scherman, Colloty, and Associates (SCA) have been contracted by Savannah Environmental to undertake the specialist studies for the proposed project with respect to water resources. SCA will be advised to liaise with the Steynsraad Irrigation Board. SCA has liaised with the Department of Water Affairs.</p>

No.	Issue	Raised by	Response
	Please understand that access to water is very difficult due to the needs of existing users and the allocations for emerging farmers. You would have to spend some time clarifying all of these issues with the irrigation board and the Department of Water Affairs.		The complexities of the available water resources in the area as well as the requirements of surrounding landowners have been identified at the Scoping level through a desk-top study undertaken by SCA. During the EIA Phase, detailed specialist studies will identify potential water related issues and the impacts on surrounding land users.
<b>Site Specifics</b>			
19.	What is the extent of the study area?	Uwe Westphaeling, Solar Northern Cape, comments at public meeting, 06 July 2010.	The study area is six square kilometres. The components would be located within a portion of this larger site.
20.	What are the water requirements, and how will you access water? Have you applied to the Department of Water Affairs?	Ralph Damonse, comments at public meeting, 06 July 2010.	Approximately one million cubic litres are required annually for a 110 MW facility. A water specialist has been appointed to deal with the water study and the water use licence application with the Department of Water Affairs.
<b>Public Participation</b>			
21.	Please register me as an interested and affected party.	Frederick Ruppig, Environmental Health Officer, Siyanda District Municipality, comment by reply form, 06 July 2010	I&AP details have been recorded on the project database (refer to Appendix D). All registered I&APs will receive future correspondence pertaining to the EIA process for the project.
22.	Please register me as an interested and affected party.	Frederick Ruppig, Environmental Health Officer, Siyanda District Municipality, comment by reply form, 06 July 2010	



No.	Issue	Raised by	Response
23.	Please register me as an interested and affected party.	Patrick White, Beyond Electrical, comment reply form, 06 July 2010	I&AP details have been recorded on the project database (refer to Appendix D). All registered I&APs will receive future correspondence pertaining to the EIA process for the project.
24.	Please register me as an interested and affected party.	Gregory Present & Themba Makibi, Integrated Development Plan Managers, Siyanda District Municipality, comment at focus group meeting, 06 July 2010.	
25.	Please register me as an interested and affected party.	Jan Kruger, JA Kruger Electrical Services, comment at public meeting, 06 July 2010.	
26.	I will represent Macroplan, Town and Regional Planners, at the Public Meeting in Upington on the 6 of July 2010, in connection with the Solar Plant Development.	Bennie Scheepers, MACROPLAN, comment by e-mail, 05 July 2010.	
27.	We would like to be kept informed of the process.	Uwe Westphaeling, Solar Northern Cape, comments at focus group meeting, 05 July 2010.	
28.	Solar Northern Cape, (Upington) which is associated with Solarzone (Strand/CPT), Schuco/Germany and Signet Solar/ Germany wish to apply for this project. We require information and would like to be registered on the database.	Uwe Westphaeling, Solar Northern Cape, comment by e-mail, 17 June 2010.	
29.	Well we would welcome any future discussions and cooperation will be possible.	Piet Du Plessis, Karstens Group, comments at focus group meeting, 05 July 2010.	

No.	Issue	Raised by	Response
30.	Please send me information about the proposed plant. I am interested in solar power.	H.R. Penzhorn, Interested party, Rustenburg in Northwest Province, comment by e-mail, 19 July 2010.	I&AP details have been recorded on the project database (refer to Appendix D). All registered I&APs will receive future correspondence pertaining to the EIA process for the project.
31.	Please receive our business details and register us as an interested and affected party.	J. Goussard, JCG Water Treatment, comment by e-mail, 18 June 2010.	
32.	I refer to your advertisement in the Gemsbok dated 25/06/2010. Please register KV3 Engineers for the Upington Solar CSP project.	Chrisna Booysen, KV3 Engineers, comment by e-mail, 24 June 2010.	
33.	As per your advertisements in the Gemsbok, page 24 on 25 June 2010 regarding the Northern Cape. Is it possible to send me the project documentation in English?	Gawie Liebenberg, Global Sourcing South Africa, comment by e-mail, 05 July 2010.	
34.	I would like to suggest that in the near future, once you have more data and have completed a number of your studies on the project that you set up a meeting to brief senior officials and the entire Siyanda District Municipal Council.	Siyanda District Municipality, comments at focus group meeting, 06 July 2010.	Interested and affected parties, particularly organs of state and relevant municipalities will be corresponded with throughout the EIA process.

<b>General</b>			
35.	We at the Karstens Estate are quite excited about renewable energy development. Our Estate is currently looking at various options to reduce high energy overheads throughout our operations. We have just appointed an energy manager for the Karstens Group of companies. We would welcome your initiative to the area. As you might have discovered that we are dealing with a large amount of energy problems in the Northern Cape. Supply of power is our greatest problem, especially for a large company like ours. We are currently looking into a PV system for our packing operations at Little Pella where we process fruit and dates.	Piet Du Plessis, Karstens Group, comments at focus group meeting, 05 July 2010.	Noted
36.	Is this the only type of project you are looking at in the area?	Piet Du Plessis, Karstens Group, comments at focus group meeting, 05 July 2010.	!Khi CSP South Africa is only looking at the development of the Upington Solar Thermal Plant within the Upington area. However, other areas along the Lower Orange River are being looked at as potential sites for further developments. !Khi CSP South Africa will approach the Karstens Group at a later stage as these other developments may have a bearing on their operations in these areas.
37.	I have been in talks with two other developers about similar projects for my property. These have not materialised for various reasons. So I understand the technology and what your project is all about. I know of the proposed Eskom	Peu Bezuidenhout, Naftali Estate, comments at focus group meeting, 06 July 2010.	Noted

	project and the SolAfrica initiatives. These are a large number of groups talking to landowners like myself in the area.		
38.	I would suggest that we speak in the near future about access across my land for pipelines and other infrastructure needs once you have spoken to all the role-players and authorities.	Peu Bezuidenhout, Naftali Estate, comments at focus group meeting, 06 July 2010.	All registered interested and affected parties will be corresponded with throughout the duration of the EIA process.
39.	Is this the only solar project that is being launched in the Upington area? Are there other private companies? We are hearing that a large number of projects are being investigated.	Ivan Pretorius, Beyond Elektries, comments at public meeting, 06 July 2010.	The Eskom project already has an authorisation and a further project is proposed by Sol Africa which also in the Upington area. The government has announced the REFIT (renewable energy feed-in tariff) for renewable energy developments and a large number of independent power producers are looking to establish solar, wind and other forms of energy developments. This includes solar projects in the Northern Cape. Government need to <b>announce the criteria, set up a single buyer's office and</b> determine what percentage of power will be bought from independent power producers. Not all projects will qualify in terms of the criteria. This is a process !Khi CSP is waiting on and in the meantime they working on getting their environmental impact assessment and other applications ready to see whether they would qualify for what is being offered by Government.

40.	<p>Is this project a partnership with some of the other proposed solar projects in the area?</p> <p>I would like to see a project of this nature be linked into the Siyanda District Municipal Integrated Development Plan and Local Economic Development Plan and the Khai Garieb Municipal Integrated Development Plan and Local Economic Development Plan. Please ensure that you involve the Khai Garieb Municipality as well.</p>	<p>Siyanda District Municipality, comments at focus group meeting, 06 July 2010.</p>	<p>The project is proposed by a private South Africa venture called IKhi CSP South Africa who is the sole applicant for the proposed project.</p> <p>The Khai Garieb and Siyanda Municipalities have been actively involved during the Scoping Phase (i.e. through meetings) and copies of the Draft Scoping Report were couriered to the municipal managers). During the EIA Phase, the IDPs and LEDs of both the Siyanda District and the Khai Garieb Municipalities will be used to assess the potential social impacts associated with the project. The review of these documents will also enable the social impact study to deduce whether the proposed project fits with the aims and objectives of these documents.</p>
41.	<p>Who is the coordinating organisation for all of the solar energy projects to lobby together to Government?</p>	<p>Ralph Damonse, comments at public meeting, 06 July 2010.</p>	<p>Solar has been slower at establishing groupings than wind. There is a movement to get all solar technology developers together – this is through the South African Solar Thermal Association. There is also the Sustainable Energy Association of South Africa.</p>

## **ENVIRONMENTAL IMPACT ASSESSMENT REPORT:**

# Specialist ecological study on the potential impacts of the proposed Upington Solar Thermal Plant on a site near Upington, Northern Cape

Prepared by

David Hoare  
(M.Sc., Pr.Sci.Nat.)

David Hoare Consulting cc  
41 Soetdoring Ave  
Lynnwood Manor,  
Pretoria

for

Savannah Environmental (Pty) Ltd  
PO Box 148,  
Sunninghill,  
2197

on behalf of  
!Khi CSPKhi CSP South Africa (Pty) Ltd

15 October 2010



**David Hoare Consulting cc**

**Biodiversity Assessments, Vegetation Description / Mapping,  
Species Surveys**

## CONTROL SHEET FOR SPECIALIST REPORT

The table below lists the specific requirements for specialist studies, according to Regulation 33 of Government Notice No. R385 of 1996 EIA Regulations.

Activity	Yes	No	Comment
Details of: the person who prepared the report; and the expertise of that person to carry out the specialist study or specialised process	✓		
A declaration that the person is independent in a form as may be specified by the competent authority	✓		
An indication of the scope of, and the purpose for which, the report was prepared	✓		
A description of the methodology adopted in preparing the report or carrying out the specialised process	✓		
A description of any assumptions made and any uncertainties or gaps in knowledge	✓		
A description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives, on the environment	✓		
Recommendations in respect of any mitigation measures that should be considered by the applicant and the competent authority	✓		
A description of any consultation process that was undertaken during the course of carrying out the study	✓		
A summary and copies of any comments that were received during any consultation process	✓		
Any other information requested by the competent authority	✓		

## **REGULATIONS GOVERNING THIS REPORT**

This report has been prepared in terms the EIA Regulations promulgated under the *National Environmental Management Act* No. 107 of 1998 (NEMA) and is compliant with Regulation 385 Section 33 - Specialist reports and reports on specialized processes under the Act. Relevant clauses of the above regulation are quoted below and reflect the required information in the "Control sheet for specialist report" given above.

Regulation 33. (1): An applicant or the EAP managing an application may appoint a person who is independent to carry out a specialist study or specialized process.

Regulation 33. (2): A specialist report or a report on a specialized process prepared in terms of these Regulations must contain:

- (a) details of (i) the person who prepared the report, and
- (ii) the expertise of that person to carry out the specialist study or specialized process;
- (b) declaration that the person is independent in a form as may be specified by the competent authority;
- (c) indication of the scope of, and the purpose for which, the report was prepared;
- (d) description of the methodology adopted in preparing the report or carrying out the specialized process;
- (e) description of any assumptions made and any uncertainties or gaps in knowledge;
- (f) description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives, on the environment;
- (g) recommendations in respect of any mitigation measures that should be considered by the applicant and the competent authority;
- (h) description of any consultation process that was undertaken during the course of carrying out the study;
- (i) summary and copies of any comments that were received during any consultation process;
- (j) any other information requested by the competent authority.

### **Appointment of specialist**

David Hoare of David Hoare Consulting cc was commissioned by Savannah Environmental (Pty) Ltd to provide specialist consulting services for the Environmental Impact Assessment for the proposed Upington Solar Thermal Plant near Upington in the Northern Cape province. The consulting services comprise an assessment of potential impacts on the flora, fauna, vegetation and ecology in the study area by the proposed project.

### **Details of specialist**

Dr David Hoare  
David Hoare Consulting cc  
Postnet Suite no. 116  
Private Bag X025  
Lynnwood Ridge, 0040

Telephone: 012 804 2281  
Cell: 083 284 5111  
Fax: 086 550 2053  
Email: dhoare@lantic.net



## **Summary of expertise**

Dr David Hoare:

- Registered professional member of The South African Council for Natural Scientific Professions (Ecological Science, Botanical Science), registration number 400221/05.
- Founded David Hoare Consulting cc, an independent consultancy, in 2001.
- Ecological consultant since 1995.
- Conducted, or co-conducted, over 200 specialist ecological surveys as an ecological consultant.
- Published six technical scientific reports, 15 scientific conference presentations, seven book chapters and eight refereed scientific papers.
- Attended 15 national and international congresses & 5 expert workshops, lectured vegetation science / ecology at 2 universities and referee for 2 international journals.

## **Independence**

David Hoare Consulting cc and its Directors have no connection with Khi CSP South Africa (Pty) Ltd. David Hoare Consulting cc is not a subsidiary, legally or financially, of the proponent. Remuneration for services by the proponent in relation to this project is not linked to approval by decision-making authorities responsible for authorising this proposed project and the consultancy has no interest in secondary or downstream developments as a result of the authorisation of this project. David Hoare is an independent consultant to Savannah Environmental (Pty) Ltd and has no business, financial, personal or other interest in the activity, application or appeal in respect of which he 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 this specialist performing such work. The percentage work received directly or indirectly from the proponent in the last twelve months is zero.

## **Scope and purpose of report**

The scope and purpose of the report are reflected in the "Terms of reference" section of this report.

**Conditions relating to this report**

The findings, results, observations, conclusions and recommendations given in this report are based on the author's best scientific and professional knowledge as well as available information. David Hoare Consulting cc and its staff reserve the right to modify aspects of the report including the recommendations if and when new information may become available from ongoing research or further work in this field, or pertaining to this investigation.

This report must not be altered or added to without the prior written consent of the author. This also refers to electronic copies of this report which are supplied for the purposes of inclusion as part of other reports, including main reports. Similarly, any recommendations, statements or conclusions drawn from or based on this report must make reference to this report. If these form part of a main report relating to this investigation or report, this report must be included in its entirety as an appendix or separate section to the main report.

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## **INTRODUCTION**

### **Terms of reference and approach**

Savannah Environmental (Pty) Ltd. was appointed by Khi CSP South Africa (Pty) Ltd to undertake an application for environmental authorisation through an Environmental Impact Assessment (EIA) for the proposed "Upington Solar Thermal Plant." The project involves the establishment of a solar thermal plant for power generation and its associated infrastructure, including a sub-station, distribution powerlines, water supply lines and internal access roads. The purpose of the EIA is to identify environmental impacts associated with the project.

In April 2010 David Hoare Consulting cc was appointed by Savannah Environmental (Pty) Ltd to undertake an ecological assessment of the study area. The purpose of the EIA is to identify environmental impacts associated with the project.

In February 2010 David Hoare Consulting cc was appointed by Savannah Environmental (Pty) Ltd to undertake a fauna assessment of the study area. The specific terms of reference for the ecological study include:

- An indication of the methodology used in determining the significance of potential environmental impacts;
- A description of the environmental issues that were identified during the environmental impact assessment process;
- An assessment of the significance of direct, indirect and cumulative impacts in terms of standard criteria;
- A description and comparative assessment of all alternatives identified during the environmental impact assessment process;
- Recommendations regarding practical mitigation measures for potentially significant impacts, for inclusion in the Environmental Management Plan;
- An indication of the extent to which the issue could be addressed by the adoption of achievable mitigation measures;
- A description of any assumptions, uncertainties and gaps in knowledge;
- An environmental impact statement which contains
- A summary of the key findings of the environmental impact assessment,
- An assessment of the positive and negative implications of the proposed activity,
- A comparative assessment of the positive and negative implications of the distribution line alternatives,
- A comparative assessment of the positive and negative implications of the access road alternatives.

This report provides details of the results of the EIA phase. The findings of the study are based on a combination of a desktop assessment of the study area and fieldwork undertaken on site.

### **Study area**

At a regional level the study area falls within the Northern Cape Province to the south west of the town of Upington. A more detailed description of the study area is provided in a section below.

## **METHODOLOGY**

The project was to be undertaken in two phases, a Scoping phase and an Environmental Impact Assessment phase. The objective of the EIA phase was to assess the significance of potential impacts on fauna and flora patterns within the study area. This report contains all the descriptive information on flora and fauna that were presented in the Scoping report as well as a comprehensive assessment of potential impacts. The results of the EIA phase study are provided in this report.

### **Assessment philosophy**

Many parts of South Africa contain high levels of biodiversity at species and ecosystem level. At any single site there may be large numbers of species or high ecological complexity. Sites also vary in their natural character and uniqueness and the level to which they have been previously disturbed. Assessing the potential impacts of a proposed development often requires evaluating the conservation value of a site relative to other natural areas and relative to the national importance of the site in terms of biodiversity conservation. A simple approach to evaluating the relative importance of a site includes assessing the following:

- Is the site unique in terms of natural or biodiversity features?
- Is the protection of biodiversity features on site of national/provincial importance?
- Would development of the site lead to contravention of any international, national, or provincial legislation, policy, convention or regulation?

Thus, the general approach adopted for this type of study is to identify any critical biodiversity issues that may lead to the decision that the proposed project cannot take place, i.e. to specifically focus on red flags and/or potential fatal flaws. Biodiversity issues are assessed by documenting whether any important biodiversity features occur on site, including species, ecosystems or processes that maintain ecosystems and/or species. These can be organised in a hierarchical fashion, as follows:

#### **Species**

1. Threatened plant species
2. Protected trees
3. Threatened animal species

#### **Ecosystems**

1. Threatened ecosystems
2. Protected ecosystems
3. Critical biodiversity areas
4. Areas of high biodiversity
5. Centres of endemism

#### **Processes**

1. Corridors
2. Mega-conservancy networks
3. Rivers and wetlands
4. Important topographical features

It is not the intention to provide comprehensive lists of all species that occur on site, since most of the species on these lists are usually common or widespread species. Rare, threatened, protected and conservation-worthy species and habitats are considered to be the

highest priority, the presence of which are most likely to result in significant negative impacts on the ecological environment. The focus on national and provincial priorities and critical biodiversity issues is in line with National legislation protecting environmental and biodiversity resources, including, but not limited to the following which ensure protection of ecological processes, natural systems, and natural beauty as well as the preservation of biotic diversity in the natural environment:

1. Environment Conservation Act (Act no 73 of 1989)
2. National Environmental Management Act, 1998 (NEMA) (Act no 107 of 1998)
3. National Environmental Management Biodiversity Act, 2004. (Act no 10 Of 2004)

### **Plant and animal species of concern**

The purpose of listing Red Data plant and animal species was to provide information on the potential occurrence of species of special concern in the study area that may be affected by the proposed plant and its associated infrastructure. Species appearing on these lists could then be assessed in terms of their habitat requirements in order to determine whether any of them have a likelihood of occurring in habitats that may be affected by the proposed infrastructure.

Lists were compiled specifically for any species of conservation concern previously recorded in the area and any other species with potential conservation value. Historical occurrences of threatened plant species were obtained from the South African National Biodiversity Institute for the quarter degree squares within which the study area is situated. All threatened species for the Albany Centre of Endemism (as listed in Victor and Dold 2003) were also assessed to determine whether any had a distribution that co-incided with the study area.

Regulations published for the National Forests Act provide a list of protected tree species for South Africa. The species on this list were assessed in order to determine which protected tree species have a geographical distribution that coincides with the study area and habitat requirements that may be met by available habitat in the study area.

Lists of threatened animal and bird species that have a geographical range that includes the study area were obtained from literature sources (Barnes 2000, Branch 1988, 2001, Friedmann & Daly 2004, Mills & Hes 1997). The likelihood of any of them occurring was evaluated on the basis of habitat preference and habitat available. The three parameters used to assess the probability of occurrence for each species were as follows:

- *Habitat requirements*: most Red Data animals have very specific habitat requirements and the presence of these habitat characteristics within the study area were assessed;
- *Habitat status*: in the event that available habitat is considered suitable for these species, the status or ecological condition was assessed. Often, a high level of degradation of a specific habitat type will negate the potential presence of Red Data species (especially wetland-related habitats where water-quality plays a major role); and
- *Habitat linkage*: movement between areas used for breeding and feeding purposes forms an essential part of ecological existence of many species. The connectivity of the study area to these surrounding habitats and adequacy of these linkages are assessed for the ecological functioning Red Data species within the study area.

For all threatened organisms (flora and fauna) that occur in the general geographical area of the site, a rating of the likelihood of it occurring on site is given as follows:

- LOW: no suitable habitats occur on site / habitats on site do not match habitat description for species;
- MEDIUM: habitats on site match general habitat description for species (e.g. fynbos), but detailed microhabitat requirements (e.g. mountain fynbos on shallow soils overlying Table Mountain sandstone) are absent on the site or are unknown from the descriptions given in the literature or from the authorities;
- HIGH: habitats found on site match very strongly the general and microhabitat description for the species (e.g. mountain fynbos on shallow soils overlying Table Mountain sandstone);
- DEFINITE: species found in habitats on site.

## Sensitivity map

The purpose of producing a sensitivity map was to provide information on the location of potentially sensitive features in the study area. Various provincial, regional, or national level conservation planning studies have been undertaken in the area, e.g. the National Spatial Biodiversity Assessment (NSBA), and the mapped results from these were taken into consideration in compiling the sensitivity map.

## Assessment of impacts

Direct, indirect, and cumulative impacts of the issues identified through the scoping study, as well as all other issues identified in the EIA phase were assessed in terms of the following criteria:

- » The **nature**, which includes a description of what causes the effect, what will be affected and how it will be affected.
- » The **extent**, wherein it is indicated whether the impact will be local (limited to the immediate area or site of development) or regional, and a value between 1 and 5 was assigned as appropriate (with 1 being low and 5 being high):
- » The **duration**, wherein it was indicated whether:
  - \* the lifetime of the impact will be of a very short duration (0–1 years) – assigned a score of 1;
  - \* the lifetime of the impact will be of a short duration (2-5 years) - assigned a score of 2;
  - \* medium-term (5–15 years) – assigned a score of 3;
  - \* long term (> 15 years) - assigned a score of 4; or
  - \* permanent - assigned a score of 5;
- » The **magnitude**, quantified on a scale from 0-10, where 0 is small and will have no effect on the environment, 2 is minor and will not result in an impact on processes, 4 is low and will cause a slight impact on processes, 6 is moderate and will result in processes continuing but in a modified way, 8 is high (processes are altered to the extent that they temporarily cease), and 10 is very high and results in complete destruction of patterns and permanent cessation of processes.
- » The **probability of occurrence**, which describes the likelihood of the impact actually occurring. Probability was estimated on a scale of 1–5, where 1 is very improbable (probably will not happen), 2 is improbable (some possibility, but low likelihood), 3 is probable (distinct possibility), 4 is highly probable (most likely) and 5 is definite (impact will occur regardless of any prevention measures).
- » the **significance**, was determined through a synthesis of the characteristics described above and can be assessed as low, medium or high; and



- » the **status**, which was described as either positive, negative or neutral.
- » the degree to which the impact can be reversed.
- » the degree to which the impact may cause irreplaceable loss of resources.
- » the degree to which the impact can be mitigated.

The **significance** was calculated by combining the criteria in the following formula:

$$S=(E+D+M)P$$

S = Significance weighting

E = Extent

D = Duration

M = Magnitude

P = Probability

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

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

## Limitations

- Red List species are, by their nature, usually very rare and difficult to locate. Compiling the list of species that could potentially occur in an area is limited by the paucity of collection records that make it difficult to predict whether a species may occur in an area or not. The methodology used in this assessment is designed to reduce the risks of omitting any species, but it is always possible that a species that does not occur on a list may be located in an area where it was not previously known to exist.

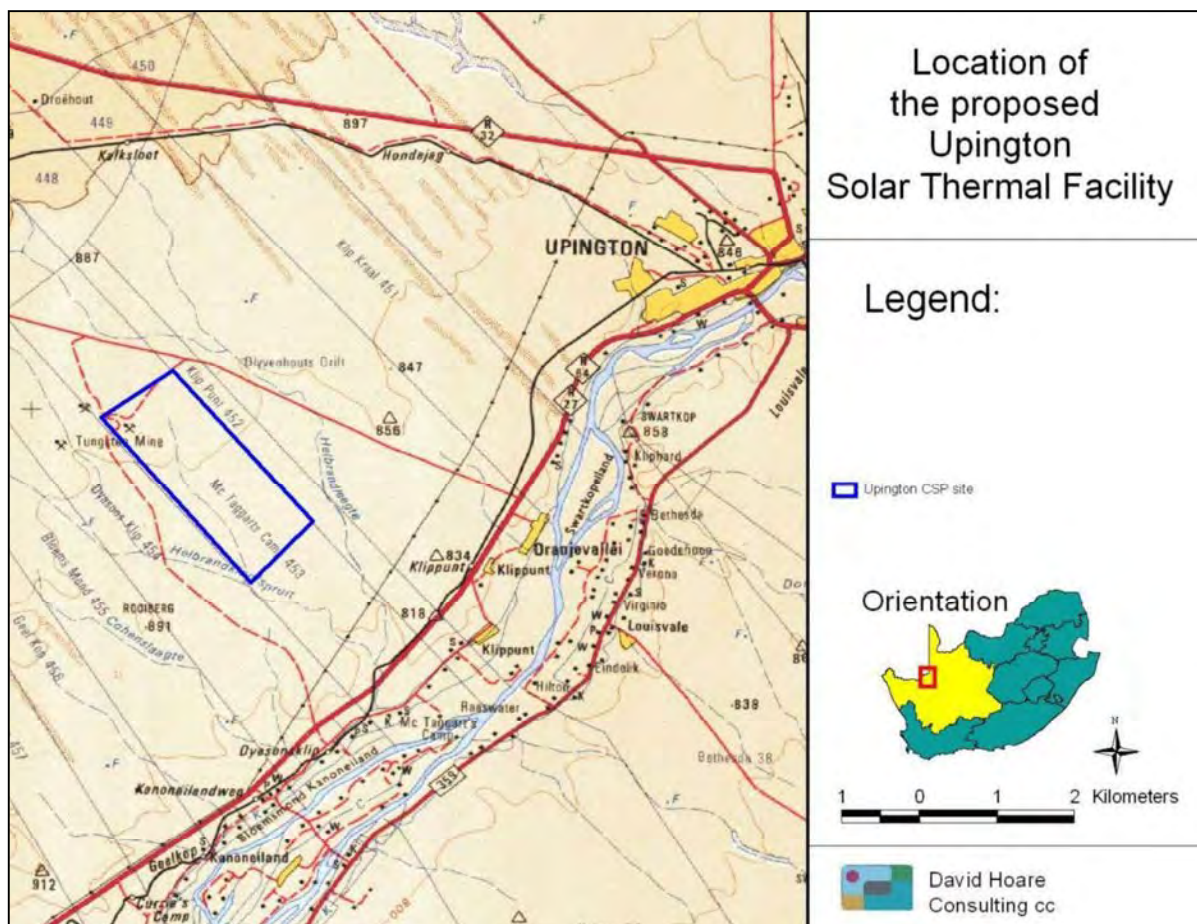
## DESCRIPTION OF STUDY AREA

### Location

The study site is situated approximately 19 km south west of the town of Upington within the Northern Cape (Figure 1). The site falls within the quarter degree grids 2821CA and 2824AC. It is situated north (within 7 km) of the Orange River. The proposed plant would be constructed on Portion 4 of the Farm McTaggart's Camp 453.

No alternative site is currently being considered for the proposed plant, however alternative alignments are proposed for the external access road and for the power line.

The study area is relatively accessible from Upington via the N14 which runs from Upington to Keimoes (between the site and the Orange River). There is a secondary road approximately 10 km outside Upington running northwards from the N14 towards Lutzputs. The farm access road to the site is approximately 12 km northwards along this road.



**Figure 1: Location of the proposed Upington Solar Thermal Plant.**

## Topography

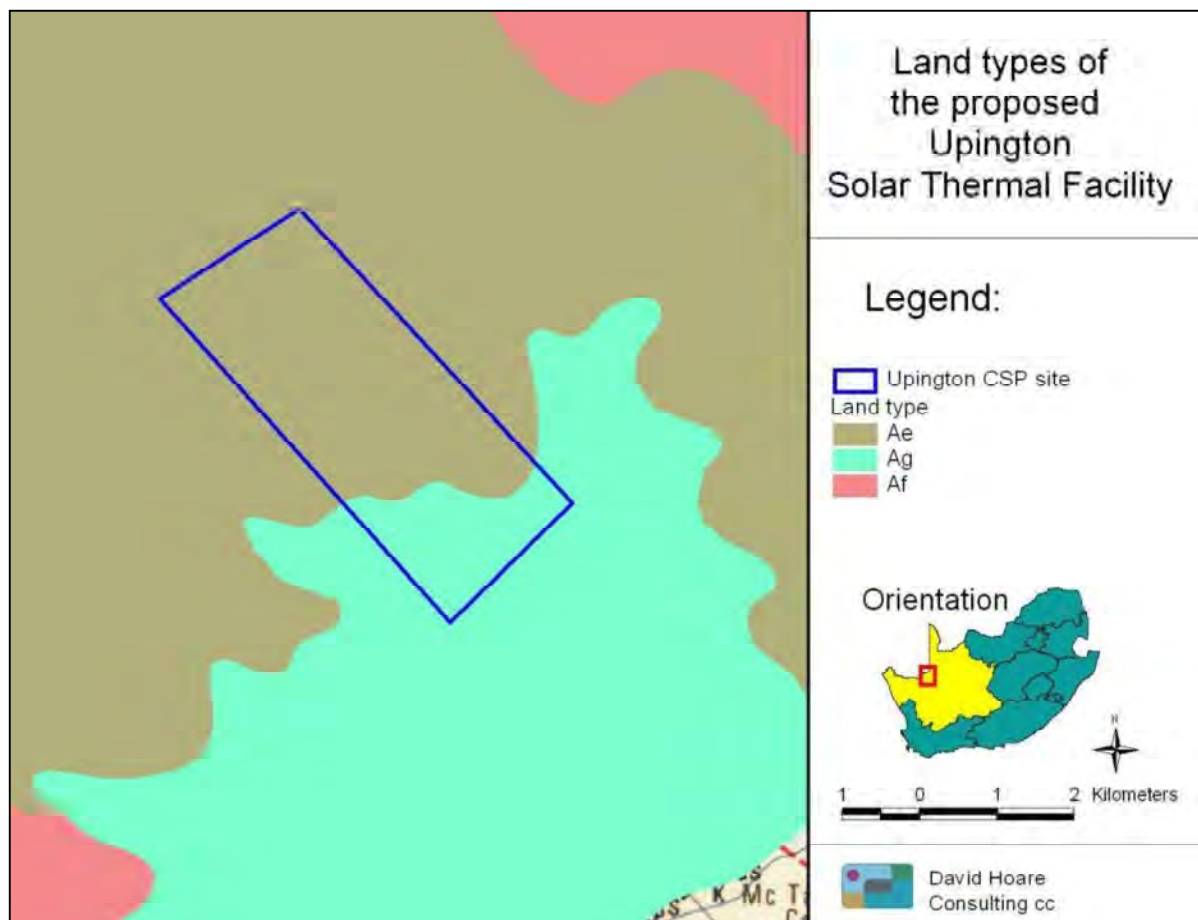
The study site is situated on the plains located to the north of the Orange River and slopes gently in a southerly direction. The elevation on site varies from 820 to 872 m above sea level over a distance of 8.07 km, with a gradient of approximately 1:150.

There are various drainage lines draining the study area, all non-perennial. These drain in primarily a southern direction towards the Orange River. The aggregation of these forms the non-perennial stream called the Helbrandkloofspruit.

## Soils

Detailed soil information is not available for broad areas of the country. As a surrogate, landtype data was used to provide a general description of soils in the study area (landtypes are areas with largely uniform soils, topography and climate). There are a variety of landtypes in the study area (Figure 2). The most common landtypes in the study area are Ae and Ag (Land Type Survey Staff, 1987).

The A-group of land types refer to yellow and red soils without water tables belonging to one or more of the following soil forms: Inanda, Kranskop, Magwa, Hutton, Griffin, Clovelly. The Ae landtype consists of red, high base status, > 300 mm deep soils and no dunes (MacVicar et al. 1974). These occur primarily in the northern half of the site. The Af landtype consists of red,



**Figure 2: Landtypes of the proposed Upington Solar Thermal Plant**

high base status, > 300 mm soils with dunes (MacVicar et al. 1974), These do not occur on site, but are found to the north and the south of the site. The Ag landtype consists of red, high base status soils, < 300 mm deep (MacVicar et al. 1974). These occur primarily in the southern half of the site.

## **Climate**

The climate is arid to semi-arid and rainfall occurs from November to April, but peaks in mid - to late summer (February / March). Mean annual rainfall is 140 to 170 mm per year. All areas with less than 400 mm rainfall are considered to be arid. The study area can therefore be considered to be arid to very arid.

## **Landuse and landcover of the study area**

A landcover map of the study area (Fairbanks et al. 2000) indicates that the entire site consists of natural vegetation. The Surveyor General's 1:50 000 topocadastral maps for the study area indicate an area in the north-western corner where significant mining previously took place. Other sources indicate that mining has also occurred in isolated spots throughout the property. Based on the two map sources, it is probable that the study area has not been impacted upon to a great degree, but it is possible that livestock farming has affected the vegetation.

This area of the country consists primarily of farms used as rangeland for commercial livestock production. Commercial farming systems are characterised by land stocked at economically sustainable levels. These regions have been commercially farmed as stock ranches for close to 100 years. Degradation of vegetation has been blamed on high stocking rates of domestic livestock in commercial farming areas. The study area is no exception and degradation due to overgrazing is likely.

## **Broad vegetation types of the region**

The study area falls within the Nama-Karoo Biome (Rutherford & Westfall 1986, Mucina & Rutherford 2006). The most recent and detailed description of the vegetation of this region is part of a national map (Mucina, Rutherford & Powrie, 2005; Mucina et al. 2006). This map shows four vegetation types occurring in the broad area, of which two occur within the study site, namely Kalahari Karroid Shrubland and Bushmanland Arid Grassland (Figure 3). These two vegetation types are described in more detail below.

### ***Bushmanland Arid Grassland***

This vegetation type occurs on extensive, relatively flat plains and is sparsely vegetated by tussock grasses, including *Stipagrostis ciliata*, *Aristida adscensionis*, *Aristida congesta*, *Enneapogon desvauxii*, *Eragrostis nindensis*, *Schmidtia kalahariensis* and *Stipagrostis obtusa*. In some years after good rains there are abundant displays of annual herbs (Mucina et al. 2006). There are no known endemics in this vegetation type (Mucina et al. 2006), but does contain endemics belonging to the Griqualand West or Gariep Centres of Endemism (van Wyk & Smith 2001), namely *Aizoon asbestinum*, *Maerua gilgii*, *Ruschia muricata* and *Aloe gariepensis*. The vegetation type also contains the protected tree species, *Acacia erioloba* (camel thorn), *Acacia haematoxylon* (grey camel thorn) and *Boscia albitrunca* (shepherd's bush). At a national scale this vegetation type has been transformed only a small amount and

27% is conserved in Augrabies Falls National Park; it is not therefore considered to be a threatened vegetation type (Mucina *et al.* 2006).

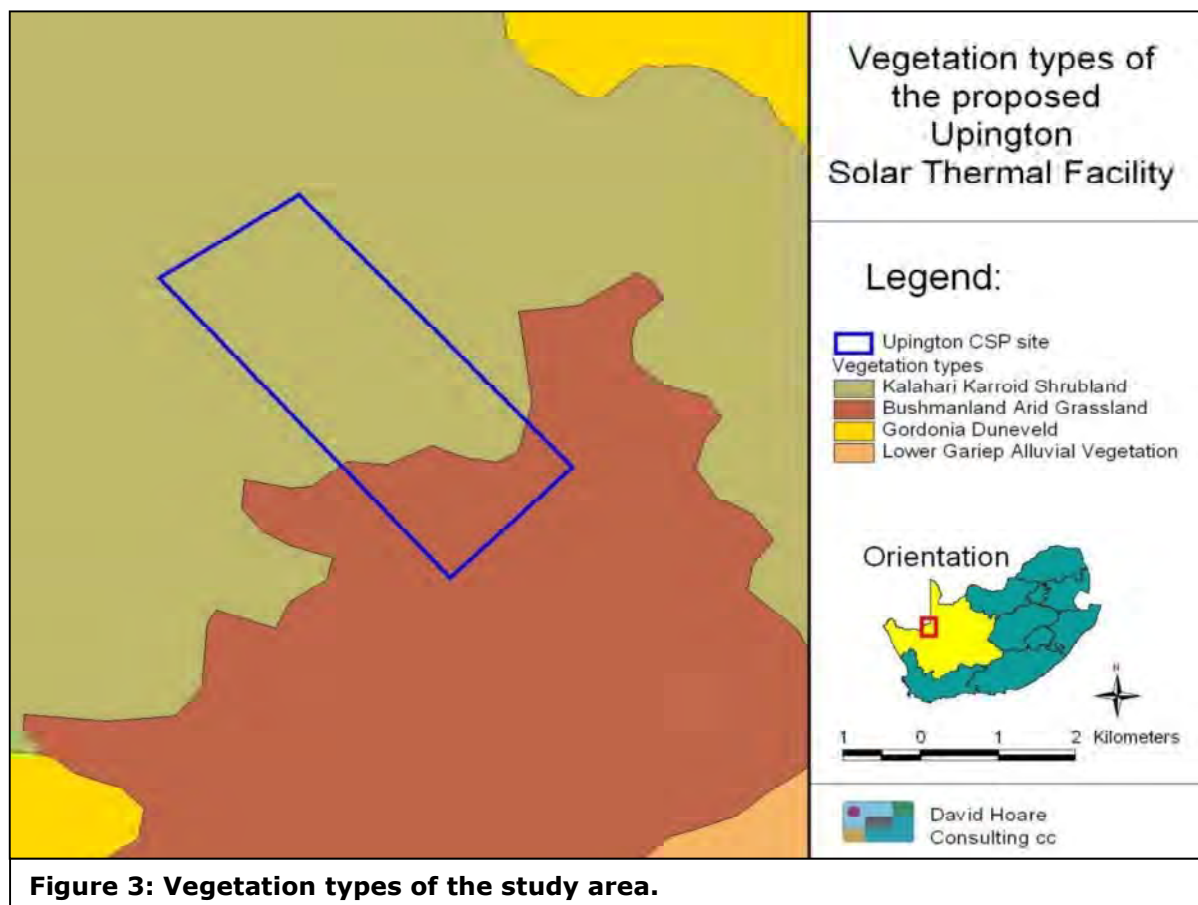
### **Kalahari Karroid Shrubland**

This is a low karroid shrubland occurring on flat gravel plains. Dominant species include the small trees, *Acacia mellifera*, *Parkinsonia africana* and *Boscia foetida*, the tall shrub, *Rhigozum trichotomum*, the low shrubs, *Hermannia spinosa* and *Phaeoptilum spinosum*, the herbs, *Dicoma capensis*, *Chamaesyce inaequilatera* and *Limeum aethiopicum*, and the grasses, *Aristida adscensionis*, *Enneapogon desvauxii*, *E. scaber*, *Stipagrostis obtusa* and *Aristida congesta*.

There are no known endemics in this vegetation type, but the grass *Dinebria retroflexa* has its south-western distribution limit in this vegetation type in this area (Mucina *et al.* 2006). At a national scale this vegetation type has been transformed only a small amount, but it contains the preferred routes of many roads and about a quarter of the vegetation type is invaded by *Prosopis* sp. Although only a small amount is conserved in Augrabies Falls National Park, it is not considered to be a threatened vegetation type (Mucina *et al.* 2006). This vegetation type is considered to be Least threatened (Table 2). None is conserved and 12% is transformed (Driver *et al.* 2005, Mucina *et al.* 2006).

### **Conservation status of broad vegetation types**

On the basis of a recently established approach used at national level by SANBI (Driver *et al.* 2005), vegetation types can be categorised according to their conservation status which is, in



turn, assessed according to the degree of transformation relative to the expected extent of each vegetation type. The status of a habitat or vegetation type is based on how much of its original area still remains intact relative to various thresholds. The original extent of a vegetation type is as presented in the recent national vegetation map (Mucina, Rutherford & Powrie 2005) and is the extent of the vegetation type in the absence of any historical human impact. On a national scale the thresholds are as depicted in Table 1, as determined by best available scientific approaches (Driver *et al.* 2005).

The level at which an ecosystem becomes Critically Endangered differs from one ecosystem to another and varies from 16% to 36% (Driver *et al.* 2005).

Both vegetation types occurring in the study area (Table 2) are classified as Least Threatened (Driver *et al.* 2005; Mucina *et al.*, 2006).

**Table 2: Conservation status of different vegetation types occurring in the study area, according to Driver *et al.* 2005 and Mucina *et al.* 2005.**

Vegetation Type	Target (%)	Conserved (%)	Transformed (%)	Conservation status
Bushmanland Arid Grassland	21	1	1	Least Threatened
Kalahari Karroid Shrubland	21	0	1	Least Threatened

### **Red List plant species of the study area**

Lists of plant species of conservation concern previously recorded in the quarter degree grids in which the study area is situated were obtained from the South African National Biodiversity Institute. These are listed in Appendix 1. Additional species that could occur in similar habitats, as determined from database searches and literature sources, but have not been recorded in these grids are also listed (i.e. there are six species on this list).

The species on this list were evaluated to determine the likelihood of any of them occurring on site on the basis of habitat suitability. Of the species that are considered to occur within the geographical area under consideration, there were four species of conservation concern recorded in the quarter degree grids that could occur in habitats that are available in the study area. According to IUCN Ver. 3.1 (IUCN, 2001) one of these is listed as Vulnerable and three as Declining. The one Vulnerable species was evaluated at the Scoping Phase as having a medium probability of occurring on site, but was recorded as occurring on the site. The three Declining plant species are of lower conservation concern and threats are related primarily to harvesting for medicinal purposes. Impacts on these three species will not be considered further for this impact assessment. The species of greatest concern is therefore the vulnerable species *Aloe dichotoma* subsp. *dichotoma* (quiver tree) (VU).

### **Red List animal species of the study area**

All vertebrates (mammals, reptiles, amphibians) of conservation concern that could occur in the study area are listed in Appendix 2. Those vertebrate species with a geographical distribution that includes the study area and habitat preference that includes habitats available in the study area are discussed further.

There are no mammal, reptile or amphibian species of conservation concern that could occur in available habitats in the study area.

### **Protected trees**

Tree species protected under the National Forest Act are listed in Appendix 3. Those that have a geographical distribution that includes the study area are *Acacia erioloba* (Camel Thorn, Kameeldoring), *Acacia haematoxylon* (Grey Camel Thorn, Vaalkameeldoring), *Boscia albitrunca* (Shepherd's Tree / Witgatboom / !Xhi) and *Euclea pseudobenus* (Ebony Tree, Ebbeboom).

The tree *Acacia erioloba* (Camel Thorn) occurs in dry woodland along watercourses in arid areas where underground water is present as well as on deep Kalahari sands (mostly Bushmanland Arid Grassland) and is relatively common in the study area. *Acacia haematoxylon* (Grey Camel Thorn) occurs on deep Kalahari sand between dunes or along dry watercourses (Bushmanland Arid Grassland) and occurs sparsely within the study area. *Boscia albitrunca* (Shepherd's Tree) occurs in semi-desert areas and bushveld, often on termitaria, but is common on sandy to loamy soils and calcrete soils (mostly Bushmanland Arid Grassland). This species is relatively common on site and is associated primarily with secondary watercourses and areas adjacent to the primary watercourses. *Euclea pseudobenus* (Ebony Tree) occurs in semi-desert and desert areas, usually along watercourses and in depressions and could occur in the hills or on the flats within the study area.

A table containing latitude-longitude positions of trees found on site in the area in and around the proposed infrastructure is attached as an addendum to this report (Appendix 5). No individuals of any of the other three species were found on site, although it is considered that the watercourses on site, especially the primary ones, are ideal habitat for *Acacia erioloba* (Camel Thorn).

### **Wetlands, riparian zones and watercourses**

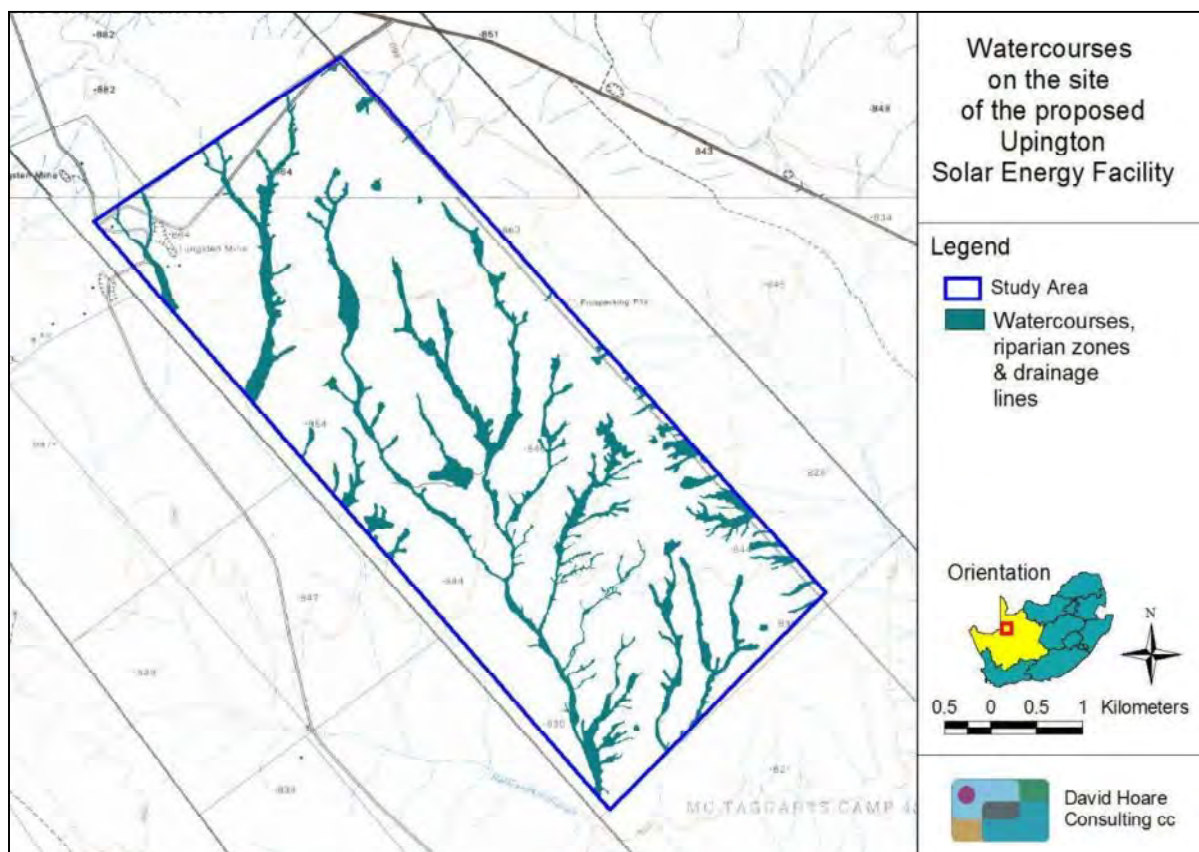


In terms of legislation, wetlands, riparian zones and watercourses are defined in the National Water Act as a water resource, and any activities that are contemplated that could affect the wetlands requires authorisation (Section 21 of the National Water Act No 36 of 1998). In addition they are also regarded as sensitive habitats in the National Environmental Management Act implying that they are afforded a higher level of protection. A "watercourse" in terms of the National Water Act means:

1. River or spring;
2. A natural channel in which water flows regularly or intermittently;
3. A wetland, lake or dam into which, or from which, water flows; and
4. Any collection of water which the Minister may, by notice in the gazette, declare to be a watercourse, and a reference to a watercourse includes, where relevant, its bed and banks.

The site contains primarily dry drainage lines and watercourses which drain into more significant riparian areas (i.e. the Heldbrandkloofspruit). The watercourses and riparian zones are all dry with a sandy bed, fringed by trees and shrubs, which constitute a defined riparian fringe zone. The distribution of wetlands, riparian zones, and watercourses in the study area are shown in Figure 4. The boundaries of these were obtained by mapping from aerial photographs and verifying the boundaries during the field survey.

Any developments contemplated in the sections of the site occupied by the wetlands, riparian zones and watercourses will have a direct negative impact on them as they are considered to be ecologically sensitive.



**Figure 4: Riparian areas, watercourses, and drainage lines on site.**

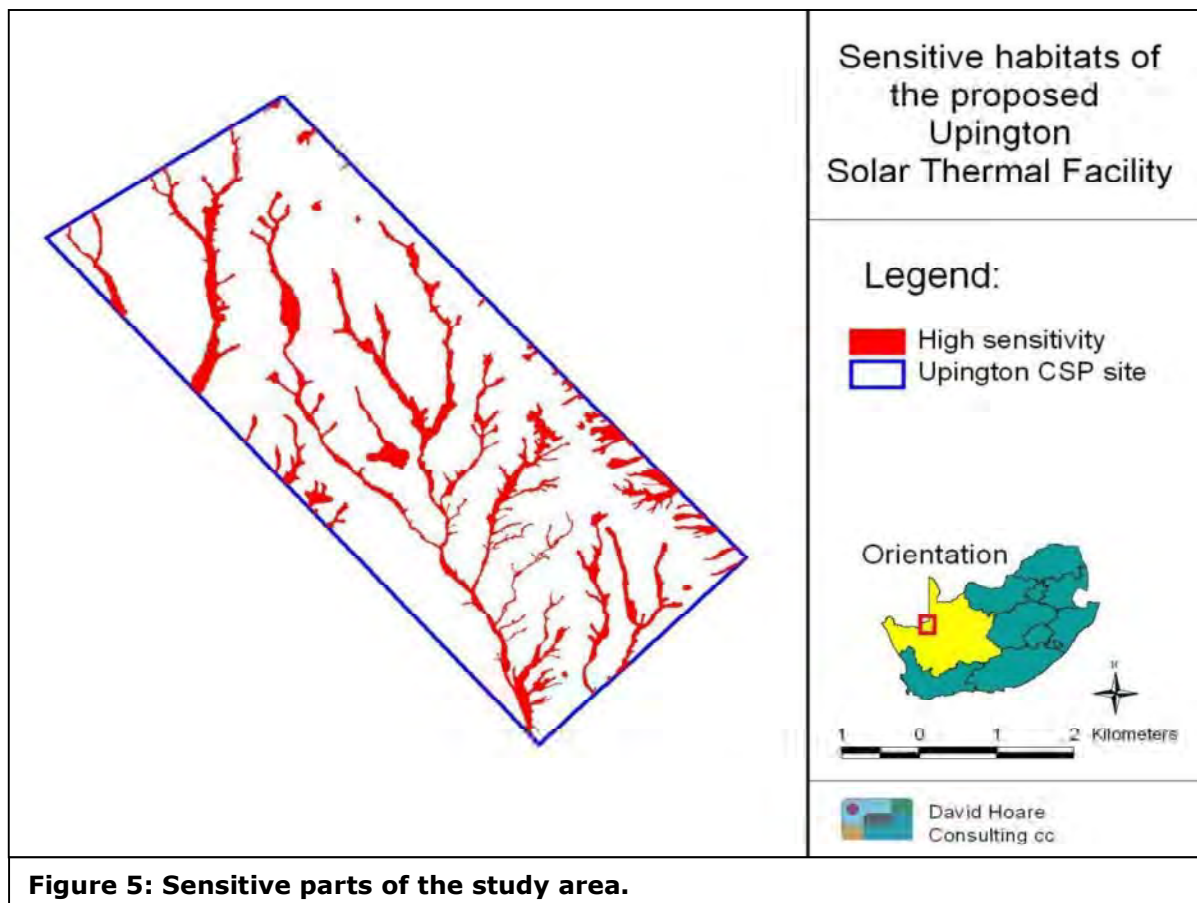


## Sensitivity assessment

The sensitivity assessment identifies those parts of the study area that could possibly have high conservation value or that may be sensitive to disturbance. Areas of potentially high sensitivity are shown in Figure 5 in red. Areas containing untransformed natural vegetation, high diversity, or habitat complexity, Red List organisms or systems vital to sustaining ecological functions are considered potentially sensitive. In contrast, any transformed area that has no importance for the functioning of ecosystems is considered to potentially have low sensitivity. The information provided in the preceding sections was used to compile a preliminary map of remaining natural habitats and areas important for maintaining ecological processes in the study area. There are a number of features that need to be taken into account in order to evaluate sensitivity in the study area. These include the following:

- Perennial and non-perennial rivers and streams: this represents a number of ecological processes including groundwater dynamics, hydrological processes, nutrient cycling and wildlife dispersal;
- Potential occurrence of populations of Red List organisms, including flora and fauna, and protected trees, that have been evaluated as having a high chance of occurring within natural habitats within the study area.

These factors have been taken into account in evaluating sensitivity within the study area. The watercourses and drainage lines are the only features on site mapped as sensitive (Figure 5). The watercourses and drainage lines shown in the sensitivity map have been mapped using a conservative mapping approach; if there is doubt about whether a feature is a drainage line or



not, then it is mapped as if it is one. From a sensitivity point of view, the higher order watercourses, including the main watercourse (i.e. the Heldbrandkloofspruit) in the centre of the site are more sensitive and therefore important to protect than the very ephemeral ones.

## RELEVANT LEGISLATIVE AND PERMIT REQUIREMENTS

Relevant legislation is provided in this section to provide a description of the key legal considerations of importance to the proposed project. The applicable legislation is listed below.

### Legislation

#### *National Environmental Management Act, Act No. 107 of 1998 (NEMA)*

NEMA requires, inter alia, that:

- "development must be socially, environmentally, and economically sustainable",
- "disturbance of ecosystems and loss of biological diversity are avoided, or, where they cannot be altogether avoided, are minimised and remedied.",
- "a risk-averse and cautious approach is applied, which takes into account the limits of current knowledge about the consequences of decisions and actions",

NEMA states that "the environment is held in public trust for the people, the beneficial use of environmental resources must serve the public interest and the environment must be protected as the people's common heritage."

#### *Environment Conservation Act No 73 of 1989 Amendment Notice No R1183 of 1997*

The ECA states that:

Development must be environmentally, socially and economically sustainable. Sustainable development requires the consideration of inter alia the following factors:

- that pollution and degradation of the environment is avoided, or, where they cannot be altogether avoided, are minimised and remedied;
- that the use and exploitation of non-renewable natural resources is responsible and equitable, and takes into account the consequences of the depletion of the resource;
- that the development, use and exploitation of renewable resources and the ecosystems of which they are part do not exceed the level beyond which their integrity is jeopardised; and
- that negative impacts on the environment and on peoples' environmental rights be anticipated and prevented, and where they cannot be altogether prevented are minimised and remedied.

The developer is required to undertake Environmental Impact Assessments (EIA) for all projects listed as a Schedule 1 activity in the EIA regulations in order to control activities which might have a detrimental effect on the environment. Such activities will only be permitted with written authorisation from a competent authority.

#### *National Forests Act (Act No 84 of 1998)*

##### *Protected trees*

According to this act, the Minister may declare a tree, group of trees, woodland or a species of trees as protected. The prohibitions provide that 'no person may cut, damage, disturb, destroy or remove any *protected tree*, or collect, remove, transport, export, purchase, sell, donate or in any other manner acquire or dispose of any protected tree, except under a licence granted by the Minister'.

##### *Forests*

Prohibits the destruction of indigenous trees in any natural forest without a licence.

#### *National Environmental Management: Biodiversity Act (Act No 10 of 2004)*

In terms of the Biodiversity Act, the developer has a responsibility for:

- The conservation of endangered ecosystems and restriction of activities according to the categorisation of the area (not just by listed activity as specified in the EIA regulations).

- Promote the application of appropriate environmental management tools in order to ensure integrated environmental management of activities thereby ensuring that all development within the area are in line with ecological sustainable development and protection of biodiversity.
- Limit further loss of biodiversity and conserve endangered ecosystems.

*Conservation of Agricultural Resources (Act No. 43 of 1983) as amended in 2001*

Declared Weeds and Invaders in South Africa are categorised according to one of the following categories:

- Category 1 plants: are prohibited and must be controlled.
- Category 2 plants: (commercially used plants) may be grown in demarcated areas providing that there is a permit and that steps are taken to prevent their spread.
- Category 3 plants: (ornamentally used plants) may no longer be planted; existing plants may remain, as long as all reasonable steps are taken to prevent the spreading thereof, except within the floodline of watercourses and wetlands.

*National Water Act (Act No 36 of 1998)*

Wetlands, riparian zones and watercourses are defined in the Water Act as a water resource and any activities that are contemplated that could affect the wetlands requires authorisation (Section 21 of the National Water Act of 1998). A "watercourse" in terms of the National Water Act (Act No 36 of 1998) means:

- River or spring;
- A natural channel in which water flows regularly or intermittently;
- A wetland, lake or dam into which, or from which, water flows; and

Any collection of water which the Minister may, by notice in the gazette, declare to be a watercourse, and a reference to a watercourse includes, where relevant, its bed and banks.

## DESCRIPTION OF INFRASTRUCTURE

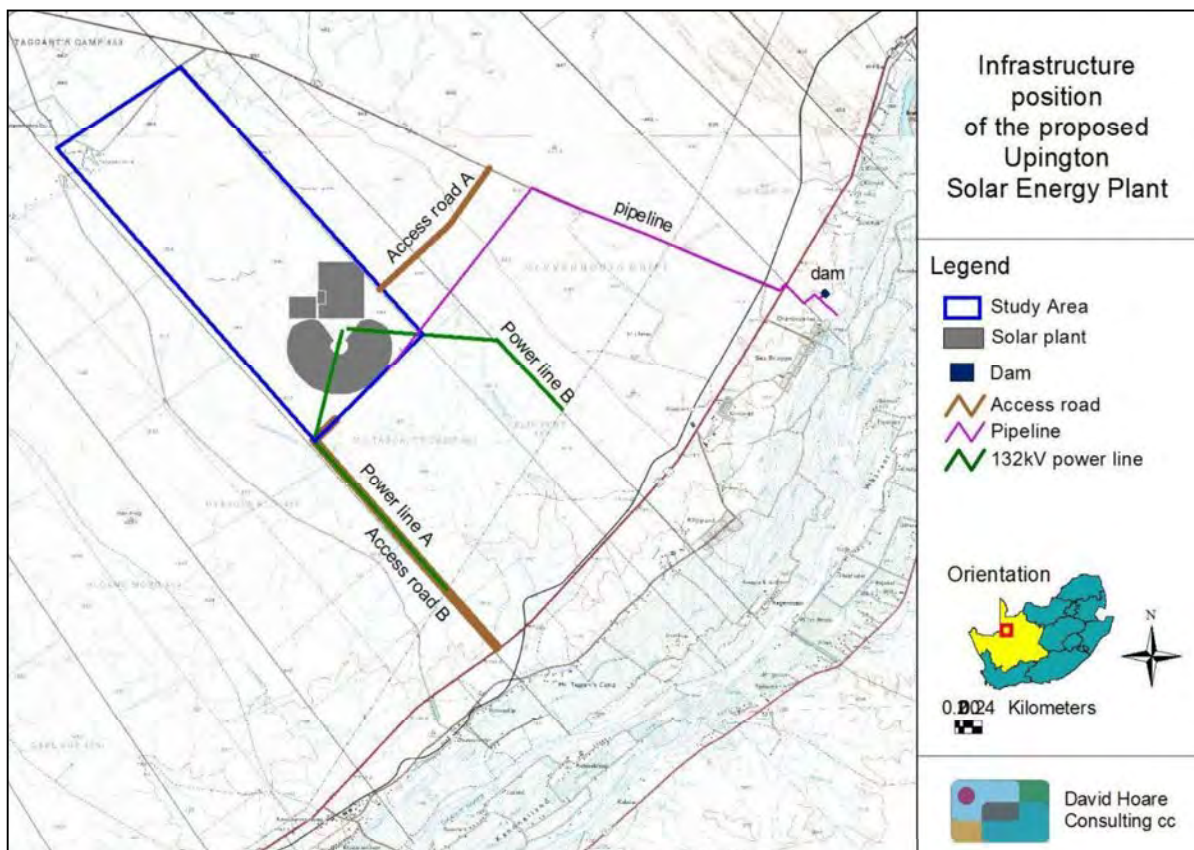
The plant is proposed to have a maximum generating capacity of 110 MW which will be achieved using the following technologies:

- » Parabolic troughs (concentrating solar power)
- » Power tower and heliostat field (concentrating solar power)
- » Photovoltaic panels

The ancillary infrastructure will include:

- A power island that will include a steam turbine and generator, a generator transformer and substation, an energy storage plant and vessels. This will be placed at the centre of the heliostat field;
- A new 132 kV overhead power line which will “turn-in” to an existing Eskom distribution line running approximately 4 km south of the site;
- Water supply pipeline to the plant; abstraction point on the Orange (Gariep) River and water storage / treatment facilities;
- Internal access roads and an external access road to the site from the main (N14) road. Two routes for the external access road are proposed, alternative A (the preferred route) and alternative B (the alternative route);
- Workshop, office and storage areas.

An indication of the location of infrastructure is given in Figure 6.



**Figure 6: Infrastructure positions in relation to site boundaries.**

## IDENTIFICATION OF RISKS AND POTENTIAL IMPACTS

Potential issues relevant to potential impacts on the ecology of the study area include the following:

- Impacts on biodiversity: this includes any impacts on populations of individual species of concern (flora and fauna), including protected species, and on overall species richness. This includes impacts on genetic variability, population dynamics, overall species existence, or health and on habitats important for species of concern.
- Impacts on sensitive habitats: this includes impacts on any sensitive or protected habitats, including wetland vegetation, that leads to direct or indirect loss of such habitat.
- Impacts on ecosystem function: this includes impacts on any processes or factors that maintain ecosystem health and character, including the following:
  - disruption to nutrient-flow dynamics;
  - impedance of movement of material or water;
  - habitat fragmentation;
  - changes to abiotic environmental conditions;
  - changes to disturbance regimes, e.g. increased or decreased incidence of fire;
  - changes to successional processes;
  - effects on pollinators;
  - increased invasion by alien plants.

Changes to factors such as these may lead to a reduction in the resilience of plant communities and ecosystems or loss or change in ecosystem function.

- Secondary and cumulative impacts on ecology: this includes an assessment of the impacts of the proposed project taken in combination with the impacts of other known projects for the area or secondary impacts that may arise from changes in the social, economic, or ecological environment.
- Impacts on the economic use of vegetation: this includes any impacts that affect the productivity or function of ecosystems in such a way as to reduce the economic value to users, e.g. reduction in grazing capacity, loss of harvestable products. It is a general consideration of the impact of a project on the supply of so-called ecosystem goods and services.

A number of direct risks to ecosystems would result from construction of the proposed solar thermal plant on site and linear infrastructure off-site, as follows:

- Clearing of land for construction
- Construction of access roads
- Construction of dams / storage reservoirs
- Placement of powerlines, cables and water pipelines
- Establishment of borrow and spoil areas
- Chemical contamination of the soil by construction vehicles and machinery
- Operation of construction camps
- Storage of materials required for construction

There are also risks associated with operation of the proposed plant, as follows:

- Water usage for cooling
- Maintenance of surrounding vegetation as part of management of the plant

## **Description of potential impacts**

Concentrating Solar Power Plants (CSP) and Concentrating or Standard Photovoltaic Plants (PV) typically require relatively large areas of land surface for placement of troughs/heliostats/photovoltaic panels and ancillary infrastructure. Depending on the technology used, they may require large amounts of water for cooling purposes, amounts which could be equivalent to coal power generation per GWh or electricity produced ([http://en.wikipedia.org/wiki/Solar\\_thermal\\_energy](http://en.wikipedia.org/wiki/Solar_thermal_energy), accessed on 2 April 2010). Once operational, the CSP/PV plants do not use fuel and there is a limited amount of vertical infrastructure that could potentially pose a hazard for birds. The power tower is the tallest structure in the plant (i.e. up to 180 m).

Major potential impacts are described briefly below. These are compiled from a generic list of possible impacts derived from previous projects of this nature and from a literature review of the potential impacts of CSP and PV facilities on the ecological environment. The major expected negative impact will be due to loss of habitat which may have direct or indirect impacts on individual organisms.

### ***Impact 1: Impacts on indigenous natural vegetation (terrestrial)***

Construction of infrastructure will lead to direct loss of vegetation. This will lead to localised or more extensive reduction in the overall extent of vegetation. There are factors that may aggravate this potential impact. For example, where this vegetation has already been stressed due to degradation and transformation at a regional level, the loss may lead to increased vulnerability (susceptibility to future damage) of the habitat and a change in the conservation status (current conservation situation). Consequences of the potential impact of loss of indigenous natural vegetation occurring may include:

- Negative change in conservation status of habitat (Driver et al. 2005);
- Increased vulnerability of remaining portions to future disturbance;
- General loss of habitat for sensitive species;
- Loss in variation within sensitive habitats due to loss of portions of it;
- General reduction in biodiversity;
- Increased fragmentation (depending on location of impact);
- Disturbance to processes maintaining biodiversity and ecosystem goods and services; and
- Loss of ecosystem goods and services.

It has been established that the most widespread vegetation types on site are Bushmanland Arid Grassland and Kalahari Karroid Shrubland, both of which are classified as Least Threatened. Transformation rates within both vegetation types are less than 2% of the overall extent of the vegetation type. Due to the low rates of transformation within these vegetation types and the large extent that they cover, it is not expected that regional impacts on these vegetation types due to the proposed solar plant will be significant.

### ***Impact 2: Impacts on threatened plants***

Plant species are especially vulnerable to infrastructure development due to the fact that they cannot move out of the path of the construction activities. They are, however, affected by overall loss of habitat.

Threatened species include those classified as critically endangered, endangered, or vulnerable. For any other species a loss of individuals or localised populations is unlikely to lead to a change in the conservation status of the species. However, in the case of threatened plant species, loss of a population or individuals could lead to a direct change in the conservation status of the species, possibly extinction. This may arise if the proposed

infrastructure is located where it will impact on such individuals or populations. Consequences may include:

- Fragmentation of populations of affected species;
- Reduction in area of occupancy of affected species; and
- Loss of genetic variation within affected species.

These may all lead to a negative change in conservation status of the affected species, which implies a reduction in the chance of survival of the species.

There are very few threatened species listed for the area surrounding the site. This is unfortunately due to the fact that this is an extremely undercollected area floristically speaking and the local flora is not well documented. There may, therefore, be a number of species that occur within this area for which there are no records. There are six known plant species of conservation concern that have a geographic distribution that includes the site, of which four could occur in available habitats in the study area. On the basis of the conservation status of the species concerned, only *Aloe dichotoma* subsp. *dichotoma* (quiver tree) (VU) is considered to be a potential issue on this site.

### **Impact 3: Impacts on protected tree species**

There are a number of tree species that are protected according to Government Notice no. 1012 under section 12(I)(d) of the National Forests Act, 1998 (Act No. 84 of 1998). In terms of section 15(1) of the National Forests Act, 1998 "no person may cut, disturb, damage or destroy any protected tree or possess, collect, remove, transport, export, purchase, sell donate or in any other manner acquire or dispose of any protected tree or any forest product derived from a protected tree, except under a license granted by the Minister to an (applicant and subject to such period and conditions as may be stipulated".

A number of species have a geographic distribution that includes the study area appear on this list, including the following: *Acacia erioloba*, *Acacia haematoxylon*, *Boscia albitrunca* and *Euclea pseudobenus*. *Boscia albitrunca* (Shepherd's Tree) is relatively common on site and is associated primarily with secondary watercourses and areas adjacent to the primary watercourses. None of the other species were found on site, although watercourses on site were considered to be good habitat for *Acacia erioloba* (Grey Camel Thorn).

### **Impact 4: Impacts on threatened animals**

Threatened animal species are indirectly affected primarily by the overall loss of habitat, since direct construction impacts can often be avoided due to movement of individuals from the path of construction. Animals are generally mobile and, in most cases, can move away from a potential threat.

Threatened species include those classified as critically endangered, endangered or vulnerable. For any other species a loss of individuals or localised populations is unlikely to lead to a change in the conservation status of the species. However, in the case of threatened animal species, loss of a population or individuals could lead to a direct change in the conservation status of the species. This may arise if the proposed infrastructure is located where it will impact on such individuals or populations or the habitat that they depend on. Consequences may include:

- Fragmentation of populations of affected species;
- Reduction in area of occupancy of affected species; and
- Loss of genetic variation within affected species.



These may all lead to a negative change in conservation status of the affected species, which implies a reduction in the chances of the species overall survival chances.

It has been evaluated that there are no mammal, reptile or amphibian species of conservation concern that could occur in available habitats in the study area. This impact is, therefore, not evaluated further for any component of the infrastructure.

**Impact 5: Impacts on drainage lines**

The site is in a very arid area. There are unlikely to be any wetlands on site, but there are clearly a number of dry stream beds and drainage areas. According to the National Water Act, these are classified as wetlands or water resources. Construction may lead to some direct or indirect loss of or damage to some of these areas and/or changes to the catchment of these areas. This may affect the hydrology of the landscape or lead to loss of habitat for species that depend on this habitat type. Dry river beds and drainage lines are an important habitat for a number of species in the study area, including those with a restricted distribution or species with an elevated conservation status.

**Impact 6: Establishment and spread of declared weeds and alien invader plants**

Major factors contributing to invasion by alien invader plants includes *inter alia* high disturbance (such as clearing for construction activities) and negative grazing practices (Zachariades *et al.* 2005). Exotic species are often more prominent near infrastructural disturbances than further away (Gelbard & Belnap 2003, Watkins *et al.* 2003). Consequences of this may include:

- Loss of indigenous vegetation;
- Change in vegetation structure leading to change in various habitat characteristics;
- Change in plant species composition;
- Change in soil chemical properties;
- Loss of sensitive habitats;
- Loss or disturbance to individuals of rare, endangered, endemic and/or protected species;
- Fragmentation of sensitive habitats;
- Change in flammability of vegetation, depending on alien species;
- Hydrological impacts due to increased transpiration and runoff; and
- Impairment of wetland function.

It is not known to what extent the site is vulnerable to invasion by alien plants. Potential weeds with a distribution centred on arid regions of the country include *Salsola kali*, *Atriplex lindleyi*, *Opuntia ficus-indica*, *Opuntia imbricata*, *Prosopis glandulosa*, *Prosopis velutina*, *Atriplex numularia*, and *Nicotiana glauca*. The shrub, *Prosopis glandulosa*, is potentially the most problematic, as this species invades riverbeds, riverbanks and drainage lines in semi-arid and arid regions and has been recorded near to the site. There is therefore the potential for alien plants to spread or invade following disturbance on site.

## ASSESSMENT OF IMPACTS

Impacts are assessed for each component of infrastructure for the proposed wind energy plant, as follows:

- solar array, power block and ancillary infrastructure;
- access roads to site;
- overhead power line (132kV);
- water supply pipeline, abstraction point, and associated infrastructure.

### Solar array, power block and ancillary infrastructure

#### ***Impact 1: Impacts on indigenous natural vegetation***

The most widespread vegetation type on site is Bushmanland Arid Grassland and Kalahari Karroid Shrubland, both of which are classified as Least Threatened. The locality of the solar and ancillary infrastructure is in an area near to the boundary of these vegetation types and contains floristic elements of both. The total footprint of the infrastructure is close to 6 km<sup>2</sup>, but this is insignificant compared to the overall extent of these two vegetation types. Impacts are therefore relevant only at a local scale and will be scored relative to the study area.

Duration: The impact will be permanent due to the fact that clearing of vegetation for construction purposes cannot be reversed.

Extent: The impact will occur at the site of the proposed plant.

Magnitude: At a regional scale, the potential magnitude of this impact will be small due to the small area of vegetation likely to be affected relative to the overall extent of the vegetation types concerned. At a local scale, the impact will be moderate to high.

Probability: It is definite that there will be impacts on natural vegetation.

Potential significance: The potential significance of this impact could potentially be of low significance at a regional scale and medium significance at a local scale.

Mitigation measures: Unnecessary impacts on surrounding natural vegetation must be avoided. The construction impacts must be contained to the footprint of the construction site.

<b><i>Nature: Loss of habitat within indigenous natural vegetation types</i></b>		
	<b>Without mitigation</b>	<b>With mitigation</b>
<b><i>Extent</i></b>	Local (1)	Local (1)
<b><i>Duration</i></b>	Permanent (5)	Permanent (5)
<b><i>Magnitude</i></b>	Medium (6)	Medium (5)
<b><i>Probability</i></b>	Definite (5)	Definite (5)
<b><i>Significance</i></b>	<b>Medium (60)</b>	<b>Medium (55)</b>
<b><i>Status (positive or negative)</i></b>	Negative	Negative
<b><i>Reversibility</i></b>	Not reversible	Not reversible
<b><i>Irreplaceable loss of resources?</i></b>	Yes	Yes
<b><i>Can impacts be mitigated?</i></b>	To some extent	
<b><i>Mitigation</i></b> : Avoid unnecessary impacts on natural vegetation surrounding infrastructure. Impacts should be contained, as much as possible, within the footprint of the construction site.		
<b><i>Cumulative impacts</i></b> :		

Soil erosion, alien invasions may lead to additional loss of habitat that will exacerbate this impact.

**Residual Impacts:**

Some loss of this vegetation type will occur, but this is insignificant relative to the total extent of the vegetation type.

\*Significance calculated as (magnitude+duration+extent) x probability. Significance: <30 = low, 30-60 = medium, >60 = high.

**Impact 2: Impacts on threatened plant species**

There is only one species of plant of conservation concern considered to be a potential issue for this site, namely *Aloe dichotoma* subsp. *dichotoma* (quiver tree). Despite a detailed search of the affected area within the site, only one individual of this species was recorded on site. It is possible, but unlikely, that more plants could occur on site. The species also occurs throughout similar habitats in the broader area surrounding the site and beyond. The footprint of the solar array is where this plant was found on site.

Duration: The impact will be permanent due to the fact that clearing of vegetation for construction purposes cannot be reversed and any plants destroyed will be permanently lost. More importantly, loss of suitable habitat for any of these species means that the plants cannot become re-established.

Extent: The impact will occur at the site of the proposed plant.

Magnitude: The potential magnitude of this impact will be low at a local scale for this vulnerable plant species due to the fact that only a single plant will be affected. The affected plant is also small and is therefore presumed to be relatively young. A detailed search of the affected part of the site did not reveal any additional plants. It is therefore unlikely that more than one individual plant will be affected.

Probability: It is definite that this impact will occur because one individual of this species was recorded within the footprint of the proposed solar array.

Significance: The potential significance of this impact emerges as being of medium significance at a local scale. This score is based purely on the fact that the impact is permanent and will definitely occur. In reality, the loss of a single individual of a widespread species, even though it is listed as Vulnerable, will not affect the conservation status of the species.

Mitigation measures: The plant should be rescued and planted at a suitable locality adjacent to the infrastructure, either in a natural area where it will not be disturbed further or as a horticultural subject somewhere within the development, for example, at the main entrance or in a garden.

<b>Nature: Destruction/permanent loss of individuals of threatened plant species</b>		
	<b>Without mitigation</b>	<b>With mitigation</b>
<b>Extent</b>	Local (1)	Local (1)
<b>Duration</b>	Permanent (5)	Permanent (5)
<b>Magnitude</b>	Low (2)	Low (1)
<b>Probability</b>	Definite (5)	Definite (5)
<b>Significance</b>	<b>Medium (40)</b>	<b>Medium (35)</b>
<b>Status (positive or negative)</b>	Negative	Negative
<b>Reversibility</b>	Not reversible	Not reversible
<b>Irreplaceable loss of resources?</b>	Yes	Yes

<b>Can impacts be mitigated?</b>	Partially	
<b>Mitigation:</b> Rescue the single plant that will be affected and plant it in adjacent habitat where it will not be disturbed further.		
<b>Cumulative impacts:</b> Loss of habitat, soil erosion, alien invasions may all lead to additional impacts that will exacerbate this impact.		
<b>Residual Impacts:</b> None likely		

\*Significance calculated as (magnitude+duration+extent) x probability. Significance: <30 = low, 30–60 = medium, >60 = high.

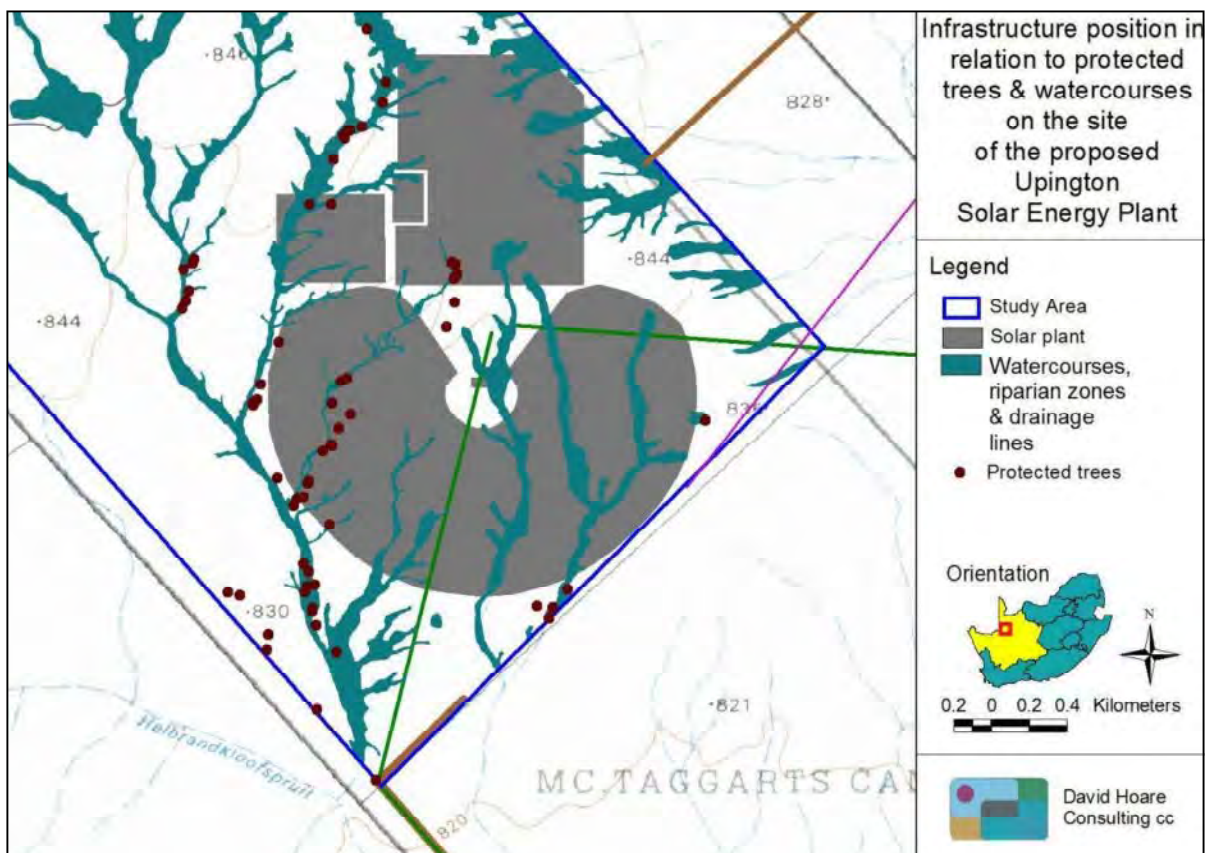
### **Impact 3: Impacts on protected trees**

*Boscia albitrunca* (Shepherd's Tree) is relatively common on site and is associated primarily with secondary watercourses and areas adjacent to the primary watercourses. None of the other protected tree species that have the potential to occur on site were found, although watercourses on site were considered suitable habitat for *Acacia erioloba* (Camel Thorn).

Duration: The impact will be permanent because clearing of vegetation for construction purposes cannot be reversed. Any loss of individual trees will therefore be irreversible.

Extent: The impact will occur at the site of the proposed plant. It may affect single individuals of protected species.

Magnitude: The potential magnitude of this impact will be moderate, due to the number of trees that will be affected. There are 19 trees that fall directly in the footprint of the solar



**Figure 7: Solar array position in relation to protected trees & watercourses.**

plant and another 16 within 200 m (Figure 7). This approximately half of the individual trees within this southern part of the site. The pattern of occurrence of protected trees on site does, however, reflect the general distribution pattern of these species in the Upington area. Similar concentrations of protected trees are likely to occur anywhere within similar habitat in close proximity to the Orange River.

Probability: It is definite that there will be protected trees affected.

Significance: The impact will be of medium significance. However, a permit would need to be obtained for any protected trees that are affected, so a legal obligation remains to determine the presence of protected trees irrespective of the significance of the impact.

<b>Nature: Loss of individuals of protected trees</b>		
	<b>Without mitigation</b>	<b>With mitigation</b>
<b>Extent</b>	Local (1)	Local (1)
<b>Duration</b>	Permanent (5)	Permanent (5)
<b>Magnitude</b>	Medium (5)	Medium (5)
<b>Probability</b>	Definite (5)	Definite (5)
<b>Significance</b>	<b>Medium (55)</b>	<b>Medium (55)</b>
<b>Status (positive or negative)</b>	Negative	Negative
<b>Reversibility</b>	Not reversible	Not reversible
<b>Irreplaceable loss of resources?</b>	Yes	Yes
<b>Can impacts be mitigated?</b>	Not necessary	
<b>Mitigation:</b> Obtain a permit for any protected trees that have to be destroyed in order to construct the plant.		
<b>Cumulative impacts:</b> Impacts due to alien invasions and damage to watercourses may possibly cause damage to habitat where protected trees could grow that may exacerbate this impact.		
<b>Residual Impacts:</b> None likely		

\*Significance calculated as (magnitude+duration+extent) x probability. Significance: <30 = low, 30-60 = medium, >60 = high.

#### **Impact 4: Impacts on threatened animal species**

There are no threatened animal species that are likely to occur on site. The significance of this impact is therefore scored as zero.

#### **Impact 5: Impacts on drainage lines**

There are a number of non-perennial watercourses on site with associated riparian zones that could potentially be affected by the proposed construction of the solar array and ancillary infrastructure (Figure 8). These are primarily lower order watercourses.

Duration: The impact will be permanent due to the fact that clearing of land for construction purposes cannot be reversed.

Extent: The impact will occur at the site of the proposed plant, but could have downstream impacts. The extent of the potential impact is therefore on the site and surroundings.

Magnitude: The potential magnitude of this impact will be high at a local scale.

**Probability:** Due to the fact that drainage lines occur within the footprint of the proposed solar array on site, it is definite that drainage lines will be affected.

**Potential significance:** The significance of this impact is rated as high at a scale of local and surroundings before mitigation.

**Mitigation measures:** Stormwater and runoff water must be controlled and managed to avoid impacts on watercourses. A permit from the Department of Water Affairs (DWA) is required if there are expected to be any impacts on any wetland or water resources.

<b>Nature: Damage to watercourses and drainage lines</b>		
	<b>Without mitigation</b>	<b>With mitigation</b>
<b>Extent</b>	Local and surroundings (2)	Local and surroundings (2)
<b>Duration</b>	Permanent (5)	Permanent (5)
<b>Magnitude</b>	High (7)	Medium (5)
<b>Probability</b>	Definite (5)	Definite (5)
<b>Significance</b>	<b>High (70)</b>	<b>Medium (60)</b>
<b>Status (positive or negative)</b>	Negative	Negative
<b>Reversibility</b>	Reversible with effective rehabilitation	Reversible
<b>Irreplaceable loss of resources?</b>	Yes	Yes
<b>Can impacts be mitigated?</b>	To some degree	
<b>Mitigation:</b> Control stormwater and runoff water and obtain a permit from DWA to impact on any wetland or water resource.		
<b>Cumulative impacts:</b> Soil erosion, alien invasions may all lead to additional impacts on watercourses that will exacerbate this impact.		
<b>Residual Impacts:</b> Despite proposed mitigation measures, it is expected that this impact will still occur to some degree.		

\*Significance calculated as (magnitude+duration+extent) x probability. Significance: <30 = low, 30–60 = medium, >60 = high.

#### **Impact 6: Establishment and spread of declared weeds and alien invader plants**

The site is not known to harbour alien plants in significant numbers. Some declared weeds (e.g. *Nicotiana glauca*) were found close to the previously mined areas, but in small numbers. There is therefore a weak potential for alien trees to spread or become established following disturbance on site. The presence of a diffuse disturbance over a wide area could, however, lead to the spread of species that are present in the area. Watercourses are especially vulnerable to such impacts.

**Duration:** The impact will be long-term unless alien plants are controlled.

**Extent:** The impact will occur at the site of the proposed plant, but could spread into neighbouring areas.

**Magnitude:** The potential magnitude of this impact is potentially moderate for local ecosystems.

**Probability:** There is a moderate likelihood that alien species will spread on site in the absence of control measures.

**Potential significance:** The impact could potentially be of moderate to high significance. Standard control measures, if put in place, would adequately control this impact and reduce the significance to low.

**Mitigation measures:** Disturbance of indigenous vegetation must be kept to a minimum. Where disturbance is unavoidable, disturbed areas should be rehabilitated as quickly as possible. Soil stockpiles should not be translocated from areas with alien plants into the site and within the site alien plants on stockpiles must be controlled so as to avoid the development of a soil seed bank of alien plants within the stock-piled soil. Any alien plants must be immediately controlled to avoid establishment of a soil seed bank that would take decades to remove. An ongoing monitoring programme should be implemented to detect and quantify any aliens that may become established and provide information for the management of aliens.

<b>Nature: Establishment and spread of declared weeds and alien invader plants</b>		
	<b>Without mitigation</b>	<b>With mitigation</b>
<b>Extent</b>	Site & surroundings (2)	Site & surroundings (2)
<b>Duration</b>	Long-term (4)	Long-term (4)
<b>Magnitude</b>	Moderate (5)	Low (3)
<b>Probability</b>	Probable (3)	Improbable (2)
<b>Significance</b>	<b>Medium (33)</b>	<b>Low (18)</b>
<b>Status (positive or negative)</b>	Negative	Negative
<b>Reversibility</b>	Reversible	Reversible
<b>Irreplaceable loss of resources?</b>	Yes	Yes
<b>Can impacts be mitigated?</b>	To some degree	
<b>Mitigation:</b> (1) Keep disturbance of indigenous vegetation to a minimum (2) Rehabilitate disturbed areas as quickly as possible following completion of construction activities in an area (3) Do not translocate soil stockpiles from areas with alien plants (4) Control any alien plants immediately to avoid establishment of a soil seed bank that would take decades to remove (5) Establish an ongoing monitoring programme to detect and quantify any aliens that may become established		
<b>Cumulative impacts:</b> Soil erosion, habitat loss, damage to wetlands and increased frequency of veld fires may all lead to additional impacts that will exacerbate this impact.		
<b>Residual Impacts:</b> Will probably be very low if control measures are effectively applied		

\*Significance calculated as (magnitude+duration+extent) x probability. Significance: <30 = low, 30–60 = medium, >60 = high.

## **Access road to site**

There are two alternative access roads to site. The assessment of impacts is identical for both alternatives, except where specifically indicated.

### **Impact 1: Impacts on indigenous natural vegetation**

The most widespread vegetation type on site is Bushmanland Arid Grassland and Kalahari Karroid Shrubland, both of which are classified as Least Threatened. The locality of the solar array and ancillary infrastructure is in an area near to the boundary of these vegetation types and contains floristic elements of both. The total footprint of the access road is insignificant compared to the overall extent of these two vegetation types. Impacts are therefore relevant only at a local scale and will be scored relative to the study area.

Duration: The impact will be permanent due to the fact that clearing of vegetation for construction purposes cannot be reversed.

Extent: The impact will occur at the site of the proposed plant.

Magnitude: At a regional scale, the potential magnitude of this impact will be small due to the small area of vegetation likely to be affected relative to the overall extent of the vegetation types concerned. At a local scale, the impact will be moderate.

Probability: It is definite that there will be impacts on natural vegetation.

Potential significance: The potential significance of this impact could potentially be of low significance at a regional scale and medium significance at a local scale.

Mitigation measures: Unnecessary impacts on surrounding natural vegetation must be avoided. The construction impacts must be contained to the footprint of the project.

<b>Nature: Loss of habitat within indigenous natural vegetation types</b>		
	<b>Without mitigation</b>	<b>With mitigation</b>
<b>Extent</b>	Local (1)	Local (1)
<b>Duration</b>	Permanent (5)	Permanent (5)
<b>Magnitude</b>	Low (4)	Low (3)
<b>Probability</b>	Definite (5)	Definite (5)
<b>Significance</b>	<b>Medium (50)</b>	<b>Medium (45)</b>
<b>Status (positive or negative)</b>	Negative	Negative
<b>Reversibility</b>	Not reversible	Not reversible
<b>Irreplaceable loss of resources?</b>	Yes	Yes
<b>Can impacts be mitigated?</b>	To some extent	
<b>Mitigation:</b> Avoid unnecessary impacts on natural vegetation surrounding infrastructure. Impacts should be contained, as much as possible, within the footprint of the construction site.		
<b>Cumulative impacts:</b> Soil erosion, alien invasions may lead to additional loss of habitat that will exacerbate this impact.		
<b>Residual Impacts:</b> Some loss of this vegetation type will occur, but this is insignificant relative to the total extent of the vegetation type.		

\*Significance calculated as (magnitude+duration+extent) x probability. Significance: <30 = low, 30-60 = medium, >60 = high.

### **Impact 2: Impacts on threatened plant species**

There is only one species of plant of conservation concern considered to be a potential issue for this site, namely *Aloe dichotoma* subsp. *dichotoma* (quiver tree). Despite a detailed search of the affected area within the site, only one individual of this species was recorded on site. It is possible, but unlikely, that more plants could occur on site. The species also occurs throughout similar habitats in the broader area surrounding the site and beyond. No individuals of this species were recorded along the route of either proposed external access road. The impact will therefore not occur and is scored as zero.

### **Impact 3: Impacts on protected trees**

*Boscia albitrunca* (Shepherd's Tree) is relatively common on site and is associated primarily with secondary watercourses and areas adjacent to the primary watercourses. None of the



other protected tree species that have the potential to occur on site were found, although watercourses on site were considered suitable habitat for *Acacia erioloba* (*Camel Thorn*).

**Duration:** The impact will be permanent due to the fact that clearing of vegetation for construction purposes cannot be reversed. Any loss of individual trees will therefore be irreversible.

**Extent:** The impact will occur at the site of the proposed access road. It may affect single individuals of protected species.

**Magnitude:** The potential magnitude of this impact will be low, due to the small number of trees that will be affected.

**Probability:** It is probable that there will be protected trees affected.

**Significance:** The impact will be of low significance. However, a permit would need to be obtained for any protected trees that are affected, so a legal obligation remains to determine the presence of protected trees irrespective of the significance of the impact.

<b>Nature: Loss of individuals of protected trees</b>		
	<b>Without mitigation</b>	<b>With mitigation</b>
<b>Extent</b>	Local (1)	Local (1)
<b>Duration</b>	Permanent (5)	Permanent (5)
<b>Magnitude</b>	Low (2)	Low (2)
<b>Probability</b>	Probable (3)	Probable (3)
<b>Significance</b>	<b>Low (24)</b>	<b>Low (24)</b>
<b>Status (positive or negative)</b>	Negative	Negative
<b>Reversibility</b>	Not reversible	Not reversible
<b>Irreplaceable loss of resources?</b>	Yes	Yes
<b>Can impacts be mitigated?</b>	To a small extent	
<b>Mitigation:</b> Obtain a permit for any protected trees that have to be destroyed in order to construct the plant.		
<b>Cumulative impacts:</b> Impacts due to alien invasions and damage to watercourses may possibly cause damage to habitat where protected trees could grow that may exacerbate this impact.		
<b>Residual Impacts:</b> None likely		

\*Significance calculated as (magnitude+duration+extent) x probability. Significance: <30 = low, 30-60 = medium, >60 = high.

#### **Impact 4: Impacts on threatened animal species**

There are no threatened animal species that are likely to occur on site. The significance of this impact is therefore scored as zero.

#### **Impact 5: Impacts on drainage lines**

There is one main watercourse and various minor drainage lines that could potentially be affected by the proposed construction of the access road to the site (both alternatives).

**Extent:** The impact will be local and surrounding areas, although downstream areas could be affected.

Duration: The impact will be of permanent duration, because the vegetation will be permanently cleared in order to construct the infrastructure.

Magnitude: The potential magnitude of the impact could be medium at a local scale, due to the complete clearing of vegetation required.

Probability: According to the current position of the proposed access roads, it is definite that the impact will occur.

Mitigation measures: Stormwater and runoff water must be controlled and managed to avoid impacts on watercourses. A permit from DWA is required if there are expected to be any impacts on any wetland or water resources. Proper bridge and/or culvert structures must be put in place to prevent hydrological impacts on downstream areas.

<b>Nature: Damage to wetland areas.</b>		
	<b>Without mitigation</b>	<b>With mitigation</b>
<b>Extent</b>	Local and surroundings (2)	Local and surroundings (2)
<b>Duration</b>	Permanent (5)	Permanent (5)
<b>Magnitude</b>	Medium (5)	Low (3)
<b>Probability</b>	Definite (5)	Highly probable (4)
<b>Significance</b>	<b>Medium (60)</b>	<b>Medium (40)</b>
<b>Status (positive or negative)</b>	Negative	Negative
<b>Reversibility</b>	Reversible with effective rehabilitation	Reversible
<b>Irreplaceable loss of resources?</b>	Yes	Yes
<b>Can impacts be mitigated?</b>	To some degree	
<b>Mitigation:</b> (1) Cross wetlands perpendicularly (2) Avoid unnecessary impacts on natural vegetation. Impacts should be contained, as much as possible, within the footprint of the proposed watercourse crossing (3) Obtain a permit from DWA to impact on any wetland or water resource (4) Rehabilitate any disturbed areas immediately to stabilise landscapes (5) Proper culvert and bridge structures are required for permanent roads		
<b>Cumulative impacts:</b> Will exacerbate impacts due to solar plant infrastructure.		
<b>Residual Impacts:</b> Despite proposed mitigation measures, it is expected that this impact will still occur to some degree.		

\*Significance calculated as (magnitude+duration+extent) x probability. Significance: <30 = low, 30–60 = medium, >60 = high.

#### **Impact 6: Establishment and spread of declared weeds and alien invader plants**

The site is not known to harbour alien plants in significant numbers. Some declared weeds (e.g. *Nicotiana glauca*) were found close to the previously mined areas, but in small numbers. There is therefore a weak potential for alien trees to spread or become established following disturbance on site. The presence of a diffuse disturbance over a wide area could, however, lead to the spread of species that are present in the area.

Duration: The impact will be long-term unless alien plants are controlled.

Extent: The impact will occur at the site of the proposed plant, but could spread into neighbouring areas.

Magnitude: The potential magnitude of this impact is potentially moderate for local ecosystems.

**Probability:** There is a moderate likelihood that alien species will spread on site in the absence of control measures.

**Potential significance:** The impact could potentially be of moderate to high significance. Standard control measures, if put in place, would adequately control this impact and reduce the significance to low.

**Mitigation measures:** Disturbance of indigenous vegetation must be kept to a minimum. Where disturbance is unavoidable, disturbed areas should be rehabilitated as quickly as possible. Soil stockpiles should not be translocated from areas with alien plants into the site and within the site alien plants on stockpiles must be controlled so as to avoid the development of a soil seed bank of alien plants within the stock-piled soil. Any alien plants must be immediately controlled to avoid establishment of a soil seed bank that would take decades to remove. An ongoing monitoring programme should be implemented to detect and quantify any aliens that may become established and provide information for the management of aliens.

<b><i>Nature: Establishment and spread of declared weeds and alien invader plants</i></b>		
	<b>Without mitigation</b>	<b>With mitigation</b>
<b>Extent</b>	Site & surroundings (2)	Site & surroundings (2)
<b>Duration</b>	Long-term (4)	Long-term (4)
<b>Magnitude</b>	Moderate (5)	Low (3)
<b>Probability</b>	Probable (3)	Improbable (2)
<b>Significance</b>	<b>Medium (33)</b>	<b>Low (18)</b>
<b>Status (positive or negative)</b>	Negative	Negative
<b>Reversibility</b>	Reversible	Reversible
<b>Irreplaceable loss of resources?</b>	Yes	Yes
<b>Can impacts be mitigated?</b>	To some degree	
<b>Mitigation:</b> (1) Keep disturbance of indigenous vegetation to a minimum (2) Rehabilitate disturbed areas as quickly as possible following completion of construction activities in an area (3) Do not translocate soil stockpiles from areas with alien plants (4) Control any alien plants immediately to avoid establishment of a soil seed bank that would take decades to remove (5) Establish an ongoing monitoring programme to detect and quantify any aliens that may become established		
<b>Cumulative impacts:</b> Soil erosion, habitat loss, damage to wetlands and increased frequency of veld fires may all lead to additional impacts that will exacerbate this impact.		
<b>Residual Impacts:</b> Will probably be very low if control measures are effectively applied		

\*Significance calculated as (magnitude+duration+extent) x probability. Significance: <30 = low, 30–60 = medium, >60 = high.

## **Overhead power line**

There are two alternative power lines to site. The assessment of impacts is identical for both alternatives, except where specifically indicated.

### **Impact 1: Impacts on indigenous natural vegetation**

The most widespread vegetation type on site is Bushmanland Arid Grassland and Kalahari Karroid Shrubland, both of which are classified as Least Threatened. The total footprint of the

overhead power lines is insignificant compared to the overall extent of these two vegetation types. Impacts are therefore relevant only at a local scale and will be scored relative to the study area.

Duration: The impact will be permanent due to the fact that clearing of vegetation for construction purposes cannot be reversed.

Extent: The impact will occur at the site of the proposed power line. It must be emphasized that not the whole servitude is cleared, only an approximately 8 m wide strip for stringing purposes.

Magnitude: At a regional scale, the potential magnitude of this impact will be small due to the small area of vegetation likely to be affected relative to the overall extent of the vegetation types concerned. At a local scale, the impact will be of low to moderate magnitude.

Probability: It is definite that there will be impacts on natural vegetation.

Potential significance: The potential significance of this impact could potentially be of low significance at a regional scale and medium significance at a local scale.

Mitigation measures: Unnecessary impacts on surrounding natural vegetation must be avoided. The construction impacts must be contained to the servitude of the power line.

<b>Nature: Loss of habitat within indigenous natural vegetation types</b>		
	<b>Without mitigation</b>	<b>With mitigation</b>
<b>Extent</b>	local (1)	Local (1)
<b>Duration</b>	Permanent (5)	Permanent (5)
<b>Magnitude</b>	Low (2)	Low (2)
<b>Probability</b>	Definite (5)	Definite (5)
<b>Significance</b>	<b>Medium (40)</b>	<b>Medium (40)</b>
<b>Status (positive or negative)</b>	Negative	Negative
<b>Reversibility</b>	Not reversible	Not reversible
<b>Irreplaceable loss of resources?</b>	Yes	Yes
<b>Can impacts be mitigated?</b>	To some extent	
<b>Mitigation:</b> Avoid unnecessary impacts on natural vegetation surrounding infrastructure. Impacts should be contained, as much as possible, within the servitude of the power line.		
<b>Cumulative impacts:</b> Soil erosion, alien invasions may lead to additional loss of habitat that will exacerbate this impact.		
<b>Residual Impacts:</b> Some loss of this vegetation type will occur, but this is insignificant relative to the total extent of the vegetation type.		

\*Significance calculated as (magnitude+duration+extent) x probability. Significance: <30 = low, 30-60 = medium, >60 = high.

### **Impact 2: Impacts on threatened plant species**

There is only one species of plant of conservation concern considered a potential issue for this site, namely *Aloe dichotoma* subsp. *dichotoma* (quiver tree). No individuals of this species were recorded along the route of either proposed overhead power line. The impact will therefore not occur and is scored as zero.

### **Impact 3: Impacts on protected trees**

*Boscia albitrunca* (Shepherd's Tree) is relatively common on site and is associated primarily with secondary watercourses and areas adjacent to the primary watercourses. None of the other protected tree species that have the potential to occur on site were found, although watercourses on site were considered suitable habitat for *Acacia erioloba* (Camel Thorn).

Duration: The impact will be permanent due to the fact that clearing of vegetation for construction purposes cannot be reversed. Any loss of individual trees will therefore be irreversible.

Extent: The impact will occur at the site of the proposed plant. It may affect single individuals of protected species.

Magnitude: The potential magnitude of this impact will be low, due to the small number of trees that will be affected.

Probability: It is probable that there will be protected trees affected.

Significance: The impact will be of low to medium significance. However, a permit would need to be obtained for any protected trees that are affected, so a legal obligation remains to determine the presence of protected trees irrespective of the significance of the impact.

<b>Nature: Loss of individuals of protected trees</b>		
	<b>Without mitigation</b>	<b>With mitigation</b>
<b>Extent</b>	local (1)	Local (1)
<b>Duration</b>	Permanent (5)	Permanent (5)
<b>Magnitude</b>	Low (2)	Low (2)
<b>Probability</b>	Improbable (2)	Improbable (2)
<b>Significance</b>	<b>Low (16)</b>	<b>Low (16)</b>
<b>Status (positive or negative)</b>	Negative	Negative
<b>Reversibility</b>	Not reversible	Not reversible
<b>Irreplaceable loss of resources?</b>	Yes	Yes
<b>Can impacts be mitigated?</b>	Not necessary	
<b>Mitigation:</b> (1) Obtain a permit for any protected trees that have to be destroyed in order to construct the plant.		
<b>Cumulative impacts:</b> Impacts due to alien invasions and damage to watercourses may possibly cause damage to habitat where protected trees could grow that may exacerbate this impact.		
<b>Residual Impacts:</b> None likely		

\*Significance calculated as (magnitude+duration+extent) x probability. Significance: <30 = low, 30-60 = medium, >60 = high.

### **Impact 4: Impacts on threatened animal species**

There are no threatened animal species that are likely to occur on site. The significance of this impact is therefore scored as zero.

### **Impact 5: Impacts on drainage lines**

The 132kV power line (both alternatives) crosses wetlands and watercourses in various places, although it is unlikely that power line towers will be positioned within wetlands. The impact is assessed assuming that drainage lines will be spanned.

Extent: The impact will be local and surrounding areas, although downstream areas could be affected.

Duration: The impact will be of permanent duration, because the vegetation will be permanently cleared in order to erect the tower.

Magnitude: The potential magnitude of the impact could be medium to low at a local scale.

Probability: According to the current position of the power line alternatives, it is possible that the impact will occur, but it is considered highly unlikely that towers will be placed within drainage lines.

Mitigation measures: Power line towers must not be positioned in drainage lines. Stormwater and runoff water around tower bases must be controlled and managed to avoid impacts on watercourses. A permit from DWA is required if there are expected to be any impacts on any wetland or water resources.

<b>Nature: Damage to wetland areas resulting in hydrological impacts</b>		
	<b>Without mitigation</b>	<b>With mitigation</b>
<b>Extent</b>	local and surroundings (2)	Local and surroundings (2)
<b>Duration</b>	Permanent (5)	Medium-term (3)
<b>Magnitude</b>	Medium (4)	Low (1)
<b>Probability</b>	Improbable (2)	Improbable (2)
<b>Significance</b>	<b>Low (22)</b>	<b>Low (12)</b>
<b>Status (positive or negative)</b>	Negative	Negative
<b>Reversibility</b>	Reversible with effective rehabilitation	Reversible
<b>Irreplaceable loss of resources?</b>	Yes	Yes
<b>Can impacts be mitigated?</b>	To some degree	
<b>Mitigation:</b> (1) Ensure towers are not positioned in watercourses. (2) Avoid unnecessary impacts on wetland areas. Impacts should be contained, as much as possible, within the power line servitude. Obtain a permit from DWA to impact on any wetland or water resource. (3) Rehabilitate any disturbed areas immediately to stabilise landscapes		
<b>Cumulative impacts:</b> None		
<b>Residual Impacts:</b> Despite proposed mitigation measures, it is expected that this impact will still occur to some degree.		

\*Significance calculated as (magnitude+duration+extent) x probability. Significance: <30 = low, 30-60 = medium, >60 = high.

#### **Impact 6: Establishment and spread of declared weeds and alien invader plants**

The site is not known to harbour alien plants in significant numbers. Some declared weeds (e.g. *Nicotiana glauca*) were found close to the previously mined areas, but in small numbers. There is therefore a weak potential for alien trees to spread or become established following disturbance on site. The presence of a diffuse disturbance over a wide area could, however, lead to the spread of species that are present in the area.

Duration: The impact will be long-term unless alien plants are controlled.

**Extent:** The impact will occur at the site of the proposed power line plant, but could spread into neighbouring areas.

**Magnitude:** The potential magnitude of this impact is potentially moderate for local ecosystems.

**Probability:** There is a moderate likelihood that alien species will spread on site in the absence of control measures.

**Potential significance:** The impact could potentially be of moderate to high significance. Standard control measures, if put in place, would adequately control this impact and reduce the significance to low.

**Mitigation measures:** Disturbance of indigenous vegetation must be kept to a minimum. Where disturbance is unavoidable, disturbed areas should be rehabilitated as quickly as possible once construction in the area is complete. Soil stockpiles should not be translocated from areas with alien plants into the servitude. Any alien plants must be immediately controlled to avoid establishment of a soil seed bank that would take decades to remove. An ongoing monitoring programme should be implemented to detect and quantify any aliens that may become established and provide information for the management of aliens.

<b>Nature: Establishment and spread of declared weeds and alien invader plants</b>		
	<b>Without mitigation</b>	<b>With mitigation</b>
<b>Extent</b>	site & surroundings (2)	site & surroundings (2)
<b>Duration</b>	long-term (4)	long-term (4)
<b>Magnitude</b>	moderate (5)	low (3)
<b>Probability</b>	probable (3)	improbable (2)
<b>Significance</b>	<b>medium (33)</b>	<b>low (18)</b>
<b>Status (positive or negative)</b>	negative	negative
<b>Reversibility</b>	Reversible	Reversible
<b>Irreplaceable loss of resources?</b>	Yes	Yes
<b>Can impacts be mitigated?</b>	To some degree	
<b>Mitigation:</b> (1) keep disturbance of indigenous vegetation to a minimum (2) rehabilitate disturbed areas as quickly as possible following completion of construction activities in an area (3) do not translocate soil stockpiles from areas with alien plants (4) control any alien plants immediately to avoid establishment of a soil seed bank that would take decades to remove (5) establish an ongoing monitoring programme to detect and quantify any aliens that may become established		
<b>Cumulative impacts:</b> Soil erosion, habitat loss, damage to wetlands and increased frequency of veld fires may all lead to additional impacts that will exacerbate this impact.		
<b>Residual Impacts:</b> Will probably be very low if control measures are effectively applied		

\*Significance calculated as (magnitude+duration+extent) x probability. Significance: <30 = low, 30–60 = medium, >60 = high.

## Water pipeline and associated infrastructure

**Impact 1: Impacts on indigenous natural vegetation**

The most widespread vegetation type on site is Bushmanland Arid Grassland and Kalahari Karroid Shrubland, both of which are classified as Least Threatened. The locality of the pipeline and ancillary infrastructure is in an area near to the boundary of these vegetation types and contains floristic elements of both. The total footprint of the pipeline is insignificant compared to the overall extent of these two vegetation types. It is also mostly along the edge of an existing road. The reservoir is sited within an old borrow pit. Impacts are therefore relevant only at a local scale.

Duration: The impact will be permanent due to the fact that clearing of vegetation for construction purposes cannot be reversed.

Extent: The impact will occur at the site of the proposed pipeline.

Magnitude: At a regional scale, the potential magnitude of this impact will be small due to the small area of vegetation likely to be affected relative to the overall extent of the vegetation types concerned. At a local scale, the impact will be low.

Probability: It is probable that there will be impacts on natural vegetation.

Potential significance: The potential significance of this impact could potentially be of low significance at a regional scale and medium significance at a local scale.

Mitigation measures: Unnecessary impacts on surrounding natural vegetation must be avoided. The construction impacts must be contained to the servitude of the pipeline. Disturbed areas must be rehabilitated as quickly as possible.

<b>Nature: Loss of habitat within indigenous natural vegetation types</b>		
	<b>Without mitigation</b>	<b>With mitigation</b>
<b>Extent</b>	local (1)	local (1)
<b>Duration</b>	permanent (5)	permanent (5)
<b>Magnitude</b>	low (3)	low (2)
<b>Probability</b>	probable (4)	probable (4)
<b>Significance</b>	<b>medium (36)</b>	<b>medium (32)</b>
<b>Status (positive or negative)</b>	negative	negative
<b>Reversibility</b>	Not reversible	Not reversible
<b>Irreplaceable loss of resources?</b>	Yes	Yes
<b>Can impacts be mitigated?</b>	To some extent	
<b>Mitigation:</b> (1) Avoid unnecessary impacts on natural vegetation surrounding infrastructure. Impacts should be contained, as much as possible, within the servitude of the infrastructure.		
<b>Cumulative impacts:</b> Soil erosion, alien invasions may lead to additional loss of habitat that will exacerbate this impact.		
<b>Residual Impacts:</b> Some loss of this vegetation type will occur, but this is insignificant relative to the total extent of the vegetation type.		

\*Significance calculated as (magnitude+duration+extent) x probability. Significance: <30 = low, 30-60 = medium, >60 = high.

**Impact 2: Impacts on threatened plant species**

There is only one species of plant of conservation concern considered to be a potential issue for this site, namely *Aloe dichotoma* subsp. *dichotoma*. No individuals of this species were



recorded along the route of the pipeline. The impact will therefore not occur and is scored as zero.

### **Impact 3: Impacts on protected trees**

*Boscia albitrunca* (Shepherd's Tree) is relatively common on site and is associated primarily with secondary watercourses and areas adjacent to the primary watercourses. None of the other protected tree species that have the potential to occur on site were found, although watercourses on site were considered suitable habitat for *Acacia erioloba* (Camel Thorn).

Duration: The impact will be permanent because clearing of vegetation for construction purposes cannot be reversed. Any loss of individual trees will therefore be irreversible.

Extent: The impact will occur at the site of the proposed plant. It may affect single individuals of protected species.

Magnitude: The potential magnitude of this impact will be low, due to the small number of trees that will be affected.

Probability: It is probable that there will be protected trees affected.

Significance: The impact will be of low significance. However, a permit would need to be obtained for any protected trees that are affected, so a legal obligation remains to determine the presence of protected trees irrespective of the significance of the impact.

<b>Nature: Loss of individuals of protected trees</b>		
	<b>Without mitigation</b>	<b>With mitigation</b>
<b>Extent</b>	Local (1)	Local (1)
<b>Duration</b>	Permanent (5)	Permanent (5)
<b>Magnitude</b>	Low (2)	Low (2)
<b>Probability</b>	Probable (3)	Probable (3)
<b>Significance</b>	<b>Low (24)</b>	<b>Low (24)</b>
<b>Status (positive or negative)</b>	Negative	Negative
<b>Reversibility</b>	Not reversible	Not reversible
<b>Irreplaceable loss of resources?</b>	Yes	Yes
<b>Can impacts be mitigated?</b>	Not necessary	
<b>Mitigation:</b> (1) Obtain a permit for any protected trees that have to be destroyed in order to construct the pipeline and reservoir.		
<b>Cumulative impacts:</b> Impacts due to alien invasions and damage to drainage lines may possibly cause damage to habitat where protected trees could grow that may exacerbate this impact.		
<b>Residual Impacts:</b> None likely.		

\*Significance calculated as (magnitude+duration+extent) x probability. Significance: <30 = low, 30-60 = medium, >60 = high.

### **Impact 4: Impacts on threatened animal species**

There are no threatened animal species that are likely to occur on site. The significance of this impact is therefore scored as zero.

**Impact 5: Impacts on drainage lines**

There is one main watercourse and various minor watercourses that will be affected by the proposed construction of the pipeline (between the site of the plant and the gravel secondary road). Once the pipeline reaches the gravel road, it runs adjacent to this for the remainder of its length. At the slopes overlooking the Orange River, the habitat is disturbed.

Extent: The impact will be local and surrounding areas, although downstream areas could be affected.

Duration: The impact will be of medium-term duration, because the river bed will recover quickly once the pipeline is buried and the riparian vegetation (if not severely disturbed) will recover relatively quickly.

Magnitude: The potential magnitude of the impact could be medium at a local scale, due to the clearing of vegetation required.

Probability: According to the current alignment of the proposed pipeline, it is definite that the impact will occur.

Mitigation measures: Stormwater and runoff water must be controlled and managed to avoid impacts on watercourses. A permit from DWA is required if there are expected to be any impacts on any wetland or water resources. Disturbed areas must be rehabilitated as quickly as possible. If the access road A is selected as the preferred alternative, the pipeline servitude should run adjacent to this, and not along its own servitude. Impacts on drainage lines can then be contained to single crossings of each watercourse.

<b>Nature: Damage to wetland areas.</b>		
	<b>Without mitigation</b>	<b>With mitigation</b>
<b>Extent</b>	Local and surroundings (2)	Local and surroundings (2)
<b>Duration</b>	Medium-term (3)	Medium-term (3)
<b>Magnitude</b>	Medium (5)	Low (3)
<b>Probability</b>	Definite (5)	Definite (5)
<b>Significance</b>	<b>Medium (50)</b>	<b>Medium (40)</b>
<b>Status (positive or negative)</b>	Negative	Negative
<b>Reversibility</b>	Reversible with effective rehabilitation	Reversible
<b>Irreplaceable loss of resources?</b>	Yes	Yes
<b>Can impacts be mitigated?</b>	To some degree	
<b>Mitigation:</b> (1) Cross wetlands or drainage lines perpendicularly. (2) Avoid unnecessary impacts on natural vegetation. Impacts should be contained, as much as possible, within the footprint of the proposed watercourse crossing. (3) Obtain a permit from DWA to impact on any wetland or water resource. (4) Rehabilitate any disturbed areas immediately to stabilise landscapes (5) Proper culvert and bridge structures are required for permanent roads.		
<b>Cumulative impacts:</b> None		
<b>Residual Impacts:</b> Despite proposed mitigation measures, it is expected that this impact will still occur to some degree.		

\*Significance calculated as (magnitude+duration+extent) x probability. Significance: <30 = low, 30-60 = medium, >60 = high.

**Impact 6: Establishment and spread of declared weeds and alien invader plants**

The site is not known to harbour alien plants in significant numbers. Some declared weeds (e.g. *Nicotiana glauca*) were found close to the previously mined areas, but in small numbers. There is therefore a weak potential for alien trees to spread or become established following disturbance on site. The presence of a diffuse disturbance over a wide area could, however, lead to the spread of species that are present in the area.

Duration: The impact will be long-term unless alien plants are controlled.

Extent: The impact will occur at the site of the proposed plant, but could spread into neighbouring areas.

Magnitude: The potential magnitude of this impact is potentially moderate for local ecosystems.

Probability: There is a moderate likelihood that alien species will spread on site in the absence of control measures.

Potential significance: The impact could potentially be of moderate to high significance. Standard control measures, if put in place, would adequately control this impact and reduce the significance to low.

Mitigation measures: Disturbance of indigenous vegetation must be kept to a minimum. Where disturbance is unavoidable, disturbed areas should be rehabilitated as quickly as possible. Soil stockpiles should not be translocated from areas with alien plants into the site and within the site alien plants on stockpiles must be controlled so as to avoid the development of a soil seed bank of alien plants within the stockpiled soil. Any alien plants must be immediately controlled to avoid establishment of a soil seed bank that would take decades to remove. An ongoing monitoring programme should be implemented to detect and quantify any aliens that may become established and provide information for the management of aliens.

<b>Nature: Establishment and spread of declared weeds and alien invader plants</b>		
	<b>Without mitigation</b>	<b>With mitigation</b>
<b>Extent</b>	Site & surroundings (2)	Site & surroundings (2)
<b>Duration</b>	Long-term (4)	Long-term (4)
<b>Magnitude</b>	Moderate (5)	Low (3)
<b>Probability</b>	Probable (3)	Improbable (2)
<b>Significance</b>	<b>Medium (33)</b>	<b>Low (18)</b>
<b>Status (positive or negative)</b>	Negative	negative
<b>Reversibility</b>	Reversible	Reversible
<b>Irreplaceable loss of resources?</b>	Yes	Yes
<b>Can impacts be mitigated?</b>	To some degree	
<b>Mitigation:</b> (1) Keep disturbance of indigenous vegetation to a minimum (2) Rehabilitate disturbed areas as quickly as possible following completion of construction activities in an area (3) Do not translocate soil stockpiles from areas with alien plants (4) Control any alien plants immediately to avoid establishment of a soil seed bank that would take decades to remove (5) Establish an ongoing monitoring programme to detect and quantify any aliens that may become established		
<b>Cumulative impacts:</b> Soil erosion, habitat loss, damage to wetlands may all lead to additional impacts that will exacerbate this impact.		
<b>Residual Impacts:</b>		

Will probably be very low if control measures are effectively applied

\*Significance calculated as (magnitude+duration+extent) x probability. Significance: <30 = low, 30-60 = medium, >60 = high.

## DISCUSSION AND CONCLUSIONS

There are two major vegetation types that occur in the study area, namely Bushmanland Arid Grassland and Kalahari Karroid Shrubland. Both of these vegetation types are classified as Least Threatened and also have a wide distribution and extent. The natural vegetation on site is therefore not considered to have high conservation status.

Most of the study area appears to be in a natural condition, although small parts of the northern portions of the site are degraded due to previous mining activities on site and there are localities within the study area where over-grazing has reduced the value of the natural vegetation of the full extent of the site. Highly degraded areas on site are classified as having low sensitivity and conservation value, whereas natural areas of vegetation are classified as having medium sensitivity. The southern part of the property, where the infrastructure is planned to be located, is in a natural state and is therefore classified as having medium sensitivity.

Other factors that may lead to parts of the study area having high ecological sensitivity are the presence of drainage lines on site and the potential presence of various plant and animal species of conservation concern. Drainage lines and watercourses represent particularly vital natural corridors as they function both as wildlife habitat, providing resources needed for survival, reproduction and movement, and as biological corridors, providing for movement between habitat patches. The drainage lines provide this function because they have dense and tall vegetation relative to surrounding areas and therefore provide protection and habitat for fauna. Drainage lines and watercourses are protected under national legislation (National Wetlands Act). Any impacts on these areas would require a permit from the relevant National Department.

There are four protected tree species that occur in the area. One of these, the Shepherd's Tree (*Boscia albitrunca*), was widespread on site. Geographic co-ordinates of all individuals encountered on site were recorded (Appendix 5). A permit will be required to destroy/move any of these individuals. It was evaluated that at least one other protected tree species, the Camel Thorn (*Acacia erioloba*) has a high probability of occurring on site, but no individuals of this species was found within the footprint of the proposed infrastructure.

There are four plant species of conservation concern that have a high likelihood of occurring in available habitats in the study area. This includes one species classified as Vulnerable and three as Declining. The three species classified as Declining are considered to be of low risk and conservation concern and the proposed project will not have an impact on the survival of any of these species or their conservation classification. Only the vulnerable plant species (a threatened category) was considered in terms of impacts associated with the proposed project. One individual of this species (*Aloe dichotoma* subsp. *dichotoma*, Quiver Tree) was recorded on site and it will be destroyed by the proposed project. It is proposed that this plant is moved into adjacent habitat and an attempt made to ensure its survival. It is not usually considered viable to translocate affected plants due to the array of biological problems associated with such measures, but in this case it is considered an exception. The fact that it is a single, young plant and the surrounding habitat for extensive distances around the site harbour the same species indicates that translocation could be successfully achieved without adverse effects on the recipient habitat and the species concerned.

There are no mammal, reptile or amphibian species of conservation concern that could occur in available habitats in the study area.

A risk assessment was undertaken which identified seven main potential negative impacts on the ecological receiving environment. The significance of these impacts was assessed during this EIA phase after collection of relevant field data. The identified potential impacts are the following:

- Impacts on indigenous natural vegetation
- Impacts on threatened plants
- Impacts on protected tree species
- Impacts on threatened animals
- Impacts on wetlands
- Change in runoff and drainage patterns
- Establishment and spread of declared weeds and alien invader plants

Impacts were assessed separately for the solar plant and ancillary infrastructure, access road, overhead power lines and the water pipeline. A summary of impacts, as evaluated, is provided in the table below (Table 3).

The solar plant (including pv panels, heliostat field, power tower and parabolic troughs) has the greatest impact on ecological systems. This is due to the size of these components and the fact that the footprint will be cleared of vegetation during construction. It will lead to local impacts on vegetation, impacts on a single individual of a plant species classified as threatened (*Aloe dichotoma* subsp. *dichotoma*), a number of individuals of a protected trees species (*Boscia albitrunca*, Shepherd's Tree) and impacts on drainage lines. The impacts on the drainage lines are potentially the most problematic due to the potential impact on downstream areas and the fact that important ecological processes in the landscape may be affected.

The main access road, overhead power line and the water pipeline (including reservoir and extraction point) are unlikely to have impacts of high significance on any ecological features. This is primarily because they occupy a relatively small space in the landscape.

Disturbance due to construction of any infrastructure could lead to the spread of alien plants, but this impact can be effectively controlled with suggested measures.

## **Evaluation of alternatives**

### **132 kV power line**

Both alternative power line routes are through similar habitat. They both also cross a large non-perennial river at one point. Alternative A is along an existing boundary where there is currently a vehicle track in use. Alternative B is aligned where there is currently no road (see Figure 6).

From an ecological point of view, both alternatives will have similar impacts on habitats. Alternative A is marginally preferred, because it is aligned where there is an existing vehicle track and existing disturbance. There is also the option of having the access road (road alternative B) and the 132 kV power line along the same route, which would minimise the overall impact of the project.

### **Access road to site**

Both alternative routes for the access road to the site are through similar habitat (see Figure 6 for position of alternatives). They both cross a large non-perennial river at one point. Alternative B is along an existing boundary where there is currently a vehicle track in use. The

south-eastern portion of this road (Alternative B) is through a relatively disturbed area, but the overall length of road required to be constructed is longer than Alternative A. Alternative B is approximately 5.52 km long before it reaches the site, of which 4.34 km is along an existing track and the remainder through disturbed areas. Alternative A is aligned where there is currently no road. It is approximately 3.25 km long. Alternative A connects to an existing gravel road before connecting to the N14, whereas alternative B connects directly to the N14.

From an ecological point of view, both alternatives will have similar impacts on habitats. Alternative B is marginally preferred, because it is aligned where there is an existing vehicle track and existing disturbance. There is also the option of having the access road and 132 kV power line along the same route, which would minimise the overall impact of the project.

## **Conclusion**

The overall impacts of the proposed project have been assessed as being of low or medium significance (see Table 3 below). The exception is the potential impact of the solar plant infrastructure on watercourses. Figure 5 provides a sensitivity map of the entire property. This indicates that watercourses are the primary sensitive feature on site. If mitigation measures are put in place to manage impacts, then most potential impacts can be reduced to having low or medium significance, including those on watercourses.

The proposed project is therefore considered to be acceptable in terms of potential impacts on flora, fauna and watercourses and it is recommended that it should be permitted to go ahead.

## **Recommendations**

The following recommendations are made to reduce impacts or provide additional information that can lead to reduction or control of impacts:

- Alien invasive plants should be controlled on site. Currently, the site contains very little alien vegetation. It is important to maintain this situation and not allow alien species to become established on site.
- A permit is required for removal of protected trees. A large number of the protected Shepherd's Tree (*Boscia albitrunca*) occurs on site.
- A permit (water-use license) is required to impact on any watercourse. Watercourses should be avoided, where possible, and measures taken to reduce impacts where it is not possible to avoid watercourses.
- A single individual of a threatened plant species (Quiver tree, *Aloe dichotoma* subsp. *dichotoma*) occurs on site. This small (juvenile) tree should be translocated to a suitable area outside the footprint of the proposed development.

**Table 3: Summary of the significance of impacts for different infrastructure components before and after mitigation.**

Impact on:	Solar array and ancillary infrastructure		Access road		Overhead powerline		Water pipeline	
	Without mitigation	With mitigation	Without mitigation	With mitigation	Without mitigation	With mitigation	Without mitigation	With mitigation
<b>1. vegetation</b>	medium (60)	medium (55)	medium (50)	medium (45)	medium (40)	medium (40)	medium (36)	medium (32)
<b>2. threatened plants</b>	medium (40)	medium (35)	low (0)	low (0)	low (0)	low (0)	low (0)	low (0)
<b>3. protected trees</b>	medium (55)	medium (55)	low (24)	low (24)	low (16)	low (16)	low (24)	low (24)
<b>4. threatened animals</b>	zero (0)	zero (0)	zero (0)	zero (0)	zero (0)	zero (0)	zero (0)	zero (0)
<b>5. watercourses</b>	high (70)	medium (60)	medium (60)	medium (40)	low (22)	low (12)	medium (50)	medium (40)
<b>6. alien plants</b>	medium (33)	low (18)	medium (33)	low (18)	medium (33)	low (18)	medium (33)	low (18)

\*Significance: <30 = low, 30–60 = medium, >60 = high.




## MANAGEMENT PLAN

Control measures are only proposed for those impacts where mitigation measures are proposed to reduce the significance of impacts, i.e. some impacts are of low significance and thus no mitigation measures are proposed or no mitigation measures are possible or required.

OBJECTIVE: Control alien invasive plants	
Project component/s	Any infrastructure or activity that will result in disturbance to natural areas
Potential Impact	Invasion of natural vegetation surrounding the site by declared weeds or invasive alien species
Activity/risk source	Construction, environmental management
Mitigation: Target/Objective	Target: no alien plants within project control area Time period: construction, operation

Mitigation: Action/control	Responsibility	Timeframe
(1) Avoid creating conditions in which alien plants may become established: <ol style="list-style-type: none"> <li>Keep disturbance of indigenous vegetation to a minimum</li> <li>Rehabilitate disturbed areas as quickly as possible</li> <li>Do not import soil from areas with alien plants</li> </ol> (2) Establish an ongoing monitoring programme to detect and quantify any alien species that may become established and identify the problem species (as per Conservation of Agricultural Resources Act) (3) Immediately control any alien plants that become established using registered control methods	Construction team, management (environmental officer)	Construction, Operation

Performance Indicator	For each alien species: number of plants and aerial cover of plants within project area and immediate surroundings
Monitoring	<ul style="list-style-type: none"> <li>Ongoing monitoring of area by environmental control officer during construction</li> <li>Ongoing monitoring of area by environmental manager during operation</li> <li>Annual audit of project area and immediate surroundings by qualified botanist. If no species are detected, then this can be stated. If any alien invasive species are detected then the distribution of these should be mapped (GPS co-ordinates of plants or concentrations of plants), number of individuals (whole site or per unit area), age and/or size classes of plants and aerial cover of plants. The results should be interpreted in</li> </ul>



terms of the risk posed to sensitive habitats within and surrounding the project area. The environmental manager should be responsible for driving this process. Reporting frequency depends on legal compliance framework

**OBJECTIVE:** Relocate threatened tree

Project component/s	Solar array
Potential Impact	Loss of single individual of protected tree, <i>Aloe dichotoma</i> subsp. <i>dichotoma</i> (quiver tree).
Activity/risk source	Construction
Mitigation:	Target: rescue of protected tree
Target/Objective	Time period: construction

Mitigation: Action/control	Responsibility	Timeframe
(1) Dig out affected tree with the use of suitable equipment that will allow removal of entire root structure. Plant tree in open natural veld nearby that has similar ecological attributes as current position of tree, i.e. similar slope, aspect and topographical position. Alternatively, plant tree as a horticultural subject on site. A horticulturalist should be consulted to ensure that measures taken maximize the chances of the tree surviving, e.g. whether to water the tree or not, use of fertilizer and/or compost and possible treatment of tree during translocation.	Construction team, management (environmental officer)	Construction

Performance Indicator	Successful transplanting of affected tree
Monitoring	<ul style="list-style-type: none"> <li>None required</li> </ul>

**OBJECTIVE:** Control loss of/disruption to indigenous vegetation

<b>Project component/s</b>	Any infrastructure or activity that will result in disturbance to natural areas
<b>Potential Impact</b>	Loss of indigenous natural vegetation due to construction activities
<b>Activity/risk source</b>	Construction
<b>Mitigation:</b>	Target: minimal loss of natural vegetation
<b>Target/Objective</b>	Time period: construction

<b>Mitigation: Action/control</b>	<b>Responsibility</b>	<b>Timeframe</b>
(2) The construction impacts must be contained to the footprint of the infrastructure (3) Limit unnecessary impacts on surrounding natural vegetation, e.g. driving around in the veld, use access roads only	Construction team, management (environmental officer)	Construction

<b>Performance Indicator</b>	Minimum loss of natural vegetation outside of the exact footprint of the proposed project
<b>Monitoring</b>	<ul style="list-style-type: none"> <li>Before construction, demarcate footprint of proposed infrastructure and construction area and ensure that construction impacts are contained within this area.</li> <li></li> </ul>

**OBJECTIVE: Limit damage to watercourses**

<b>Project component/s</b>	Any infrastructure or activity that will result in disturbance to watercourses
<b>Potential Impact</b>	Damage to watercourses by any means that will result in hydrological changes (includes erosion, siltation, dust, direct removal of soil of vegetation, dumping of material within wetlands). The focus should be on the functioning of the watercourse as a natural system
<b>Activity/risk source</b>	Construction, operation
<b>Mitigation:</b>	Target: no unnecessary damage to watercourses within project area
<b>Target/Objective</b>	Time period: construction, operation

Mitigation: Action/control	Responsibility	Timeframe
(1) For any new construction, cross watercourses perpendicularly to minimise disturbance footprints (2) Rehabilitate any disturbed areas as quickly as possible (3) Control stormwater and runoff water (4) Obtain a permit from DWA to impact on any wetland or water resource.	Construction team, management, environmental control officer	Construction, Operation

<b>Performance Indicator</b>	No impacts on water quality, water quantity, wetland vegetation, natural status of watercourses outside of footprint of infrastructure
<b>Monitoring</b>	<ul style="list-style-type: none"> <li>Habitat loss in watercourses should be monitored before and after construction</li> <li>The environmental manager should be responsible for driving this process</li> <li>Reporting frequency depends on legal compliance framework</li> </ul>

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**Appendix 1: Plant species of conservation importance (Threatened, Near Threatened and Declining) that have historically been recorded in the study area.**

Sources: South African National Biodiversity Institute in Pretoria.

Family	Taxon	Status	Habitat	Likelihood of occurrence on site
FABACEAE	<i>Acacia erioloba</i>	Declining	Savanna, semi-desert and desert areas, deep sandy soils and along drainage lines in very arid areas, sometimes in rocky outcrops.	HIGH
ASPHODALACEAE	<i>Aloe dichotoma</i> subsp. <i>dichotoma</i>	VU	North-facing rocky slopes (particularly dolomite) in the south of its range. Rocky areas in Bushmanland Arid Grassland	DEFINITE, occurs on site
FABACEAE	<i>Caesalpinia bracteata</i>	VU	This species is only known from below the Augrabies Falls near the Orange River and Klein Pella on granite. Blouputs Karroid Thornveld.	LOW, nearest locality is 70 km away
AMARYLLIDACEAE	<i>Crinum bulbispermum</i>	Declining	Scattered from the Northern Cape on the banks of the Orange River eastwards through the Free State, Lesotho to Mpumalanga and KwaZulu-Natal. Recorded in the drainage basins of the Orange and Vaal Rivers practically throughout their lengths, and also in the catchment areas of the Pongola and the Tugela Rivers. Near rivers, streams, seasonal pans and in damp depressions.	MEDIUM
MESEMBRYANTHEACEAE	<i>Dinteranthus wilmotianus</i>	NT	Orange river basin, from Augrabies to Eendoorn area near Warmbad in southern Namibia. Alluvial gravel soils.	LOW, no suitable habitat on site
APOCYNACEAE	<i>Hoodia gordonii</i>	Declining	Wide variety of arid habitats	HIGH

\* Conservation Status Category assessment according to IUCN Ver. 3.1 (IUCN, 2001), as evaluated by the Threatened Species Programme of the South African National Biodiversity Institute in Pretoria. \*IUCN (3.1) Categories: VU = Vulnerable, EN = Endangered, CR = Critically Endangered, NT = Near Threatened.



## Appendix 2: Threatened vertebrate species with a geographical distribution that includes the current study area.

### MAMMALS

Common name	Taxon	Habitat	Status <sup>1</sup>	Likelihood of occurrence
Black rhinoceros	Diceros bicornis bicornis	Wide variety of habitats, but currently only occurs in game reserves.	CR Protected (NEMBA)	<b>NONE</b> , only occurs in game reserves

<sup>1</sup>Status according to IUCN 2010. IUCN Red List of Threatened Species. Version 2010.3. ([www.iucnredlist.org](http://www.iucnredlist.org)). Downloaded on 11 September 2010.

### AMPHIBIANS

Common name	Species	Habitat	Status <sup>2</sup>	Likelihood of occurrence
Giant Bullfrog	Pyxicephalus adspersus	Widely distributed in southern Africa, mainly at higher elevations. Inhabits a variety of vegetation types where it breeds in seasonal, shallow, grassy pans in flat, open areas; also utilises non-permanent vleis and shallow water on margins of waterholes and dams. Prefer sandy substrates although they sometimes inhabit clay soils.	NT <sup>1</sup> LC <sup>2</sup> Protected (NEMBA)	<b>LOW</b> , on edge of known distribution range and no suitable habitat on site.

<sup>1</sup>Status according to Minter et al. 2004.

<sup>2</sup>Status according to IUCN 2010. IUCN Red List of Threatened Species. Version 2010.3. ([www.iucnredlist.org](http://www.iucnredlist.org)). Downloaded on 11 September 2010.

### REPTILES

Common name	Species	Habitat	Status <sup>3</sup>	Likelihood of occurrence
Black spitting cobra	Naja nigricollis woodi	Favours rocky terrain and dry rocky watercourses.	RARE <sup>3</sup> , (no entry on IUCN list)	<b>LOW</b> , overall geographical distribution includes this area but no suitable habitat on site.

<sup>3</sup>Status according to Branch 1988.

### BIRDS

Common name	Species	Habitat	Status	Importance of site for species
Martial Eagle	Polemaetus bellicosus	The Martial Eagle is widespread but uncommon throughout South Africa and neighbouring countries. It tolerates a wide range of vegetation types, being found in open grassland, scrub, Karoo and woodland. It relies on large trees (and electricity pylons) to provide nest sites. It is found typically in flat country and is rarer in mountains and forests. One of the main reason it is declining is because of persecution on private land. This species has been recorded from the study area and many surrounding areas.	VU <sup>1</sup> NT <sup>2</sup> Protected (NEMBA)	LOW, breeding, MEDIUM, foraging

Kori Bustard	<i>Ardeotis kori</i>	Semi-arid regions, within the 100 - 600 mm rainfall isohyet. Also occurs throughout dryer west, particularly in the Nama-Karoo. Diet consists of insects, reptiles, rodents and vegetable matter. Breeding peaks from October to January. In the semi-arid western parts of South Africa, favours tree-lined watercourses.	VU <sup>1</sup> LC <sup>2</sup> Protected (NEMBA)	MEDIUM, breeding, MEDIUM, foraging
Ludwig's Bustard	<i>Neotis ludwigii</i>	This is a near-endemic to southern Africa, with its range centred on the Nama Karoo and Succulent Karoo biomes. It occurs in western grasslands of the Eastern Cape, but supposedly as a nonbreeding visitor. The most important threat to this species is collisions with overhead powerlines and telephone wires. It inhabits the open plains of the semi-arid Karoo and especially in areas where extensive sheep farming is prevalent.	VU <sup>1</sup> EN <sup>2</sup> Protected (NEMBA)	MEDIUM, breeding, MEDIUM, foraging

<sup>1</sup>Status according to Barnes 2000.

<sup>2</sup>Status according to IUCN 2010. IUCN Red List of Threatened Species. Version 2010.3. ([www.iucnredlist.org](http://www.iucnredlist.org)).  
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### Appendix 3: List of protected tree species (National Forests Act).

<i>Acacia erioloba</i>	<i>Acacia haematoxylon</i>
<i>Adansonia digitata</i>	<i>Afzelia quanzensis</i>
<i>Balanites</i> subsp. <i>maughamii</i>	<i>Barringtonia racemosa</i>
<i>Boscia albitrunca</i>	<i>Brachystegia spiciformis</i>
<i>Breonadia salicina</i>	<i>Bruguiera gymnorhiza</i>
<i>Cassipourea swaziensis</i>	<i>Catha edulis</i>
<i>Ceriops tagal</i>	<i>Cleistanthus schlechteri</i> var. <i>schlechteri</i>
<i>Colubrina nicholsonii</i>	<i>Combretum imberbe</i>
<i>Curtisia dentata</i>	<i>Elaeodendron</i> (Cassine) <i>transvaalensis</i>
<i>Erythrophysa transvaalensis</i>	<i>Euclea pseudebenus</i>
<i>Ficus trichopoda</i>	<i>Leucadendron argenteum</i>
<i>Lumnitzera racemosa</i> var. <i>racemosa</i>	<i>Lydenburgia abottii</i>
<i>Lydenburgia cassinoides</i>	<i>Mimusops caffra</i>
<i>Newtonia hildebrandtii</i> var. <i>hildebrandtii</i>	<i>Ocotea bullata</i>
<i>Ozoroa namaensis</i>	<i>Philenoptera violacea</i> ( <i>Lonchocarpus capassa</i> )
<i>Pittosporum viridiflorum</i>	<i>Podocarpus elongatus</i>
<i>Podocarpus falcatus</i>	<i>Podocarpus henkelii</i>
<i>Podocarpus latifolius</i>	<i>Protea comptonii</i>
<i>Protea curvata</i>	<i>Prunus africana</i>
<i>Pterocarpus angolensis</i>	<i>Rhizophora mucronata</i>
<i>Sclerocarya birrea</i> subsp. <i>caffra</i>	<i>Securidaca longependunculata</i>
<i>Sideroxylon inerme</i> subsp. <i>inerme</i>	<i>Tephrosia pondoensis</i>
<i>Warburgia salutaris</i>	<i>Widdringtonia cedarbergensis</i>
<i>Widdringtonia schwarzii</i>	

*Acacia erioloba*, *Acacia haematoxylon*, *Boscia albitrunca*, *Euclea pseudebenus* have a geographical distribution that coincides with the study area.

#### **Appendix 4: Checklist of plant species recorded during previous botanical surveys in the study area and surrounds.**

\**Azolla filiculoides*  
\**Phalaris canariensis*  
\**Prosopis glandulosa* var. *glandulosa*  
\**Prosopis glandulosa* var. *torreyana*  
\**Prosopis velutina*  
\**Salsola kali*  
\**Setaria italica*  
\**Verbesina encelioides* var. *encelioides*  
*Acacia mellifera* subsp. *detinens*  
*Adenium oleifolium*  
*Adenolobus garipensis*  
*Aloe claviflora*  
*Aloe hereroensis* var. *hereroensis*  
*Amellus tridactylus* subsp. *arenarius*  
*Anacampseros baeseckei*  
*Anacampseros filamentosa* subsp. *filamentosa*  
*Anacampseros filamentosa* subsp. *namaquensis*  
*Anacampseros filamentosa* subsp. *tomentosa*  
*Antheophora pubescens*  
*Aptosimum lineare* var. *lineare*  
*Aptosimum procumbens*  
*Aptosimum spinescens*  
*Arctotis leiocarpa*  
*Aristida congesta* subsp. *congesta*  
*Aristida vestita* var. *vestita*  
*Atriplex semibaccata* var. *typica*  
*Augea capensis*  
*Avonia albissima*  
*Babiana flabellifolia*  
*Barleria lichtensteiniana*  
*Barleria rigida* Nees  
*Blepharis mitrata*  
*Brachiaria glomerata*  
*Cenchrus ciliaris*  
*Centropodia glauca*  
*Colchicum melanthoides* subsp. *melanthoides*  
*Commiphora gracilifrondosa*  
*Cotyledon orbiculata* var. *dactyloopsis*  
*Crassula muscosa* var. *muscosa*  
*Crinum bulbispermum*  
*Cyperus usitatus*  
*Dicoma capensis*  
*Dimorphotheca polyptera*  
*Dinteranthus wilmotianus*  
*Dipcadi gracillimum*  
*Echinochloa stagnina*  
*Enneapogon desvauxii*  
*Enneapogon scaber*  
*Eragrostis annulata*  
*Eragrostis biflora*

Eragrostis brizantha  
Eragrostis porosa  
Eragrostis procumbens  
Eragrostis rotifer  
Eriocephalus ambiguus  
Eriospermum bakerianum subsp. bakerianum  
Eriospermum roseum  
Felicia muricata Nees subsp. muricata  
Ferraria variabilis  
Galenia sarcophylla  
Geigeria filifolia  
Geigeria ornativa  
Geigeria pectidea  
Geigeria pectidea  
Gisekia africana var. africana  
Gnidia polycephala  
Grielum humifusum var. humifusum  
Gymnosporia linearis subsp. lanceolata  
Helichrysum micropoides  
Heliophila minima  
Heliophila trifurca  
Hermannia abrotanoides  
Hermannia bicolor  
Hermannia minutiflora  
Hermannia spinosa  
Hirpicium echinus  
Hoodia gordonii  
Jamesbrittenia integerrima  
Kedrostis capensis  
Kohautia cynanchica  
Lapeirousia littoralis subsp. caudata  
Leucosphaera bainesii  
Lotononis rabenaviana  
Lycium pumilum  
Manulea schaeferi  
Melinis repens  
Mesembryanthemum crystallinum  
Mesembryanthemum guerichianum  
Monechma genistifolium subsp. australe  
Monechma spartioides  
Monsonia luederitziana  
Nerine laticoma  
Nymania capensis  
Ornithoglossum vulgare  
Oxalis lawsonii  
Oxygonum alatum var. alatum  
Parkinsonia africana  
Peliostomum leucorrhizum  
Phaeoptilum spinosum  
Polygala seminuda  
Portulaca hereroensis  
Prenia tetragona  
Psilocaulon articulatum

*Psilocaulon coriarium*  
*Psilocaulon subnodosum*  
*Pteronia leucoclada*  
*Pteronia mucronata*  
*Requienia sphaerosperma*  
*Rhigozum obovatum*  
*Rhigozum trichotomum*  
*Ruschia canonotata*  
*Ruschia griquensis*  
*Ruschia vulvaria*  
*Salix mucronata* subsp. *mucronata*  
*Salsola barbata*  
*Salsola tuberculata*  
*Schmidtia kalahariensis*  
*Searsia lancea*  
*Searsia pendulina*  
*Selago divaricata*  
*Selago paniculata*  
*Senecio consanguineus*  
*Senna italica* subsp. *arachoides*  
*Sericocoma avolans*  
*Sida rhombifolia* subsp. *rhombifolia*  
*Solanum burchellii*  
*Stipagrostis amabilis*  
*Stipagrostis ciliata* var. *capensis*  
*Stipagrostis obtusa*  
*Stipagrostis uniplumis* var. *uniplumis*  
*Suaeda caespitosa*  
*Tamarix usneoides* x *T. ramosissima*  
*Tapinanthus oleifolius*  
*Tephrosia dregeana* var. *dregeana*  
*Thesium hystricoides*  
*Tragus berteronianus* Schult.  
*Tribulus pterophorus*  
*Tribulus zeyheri* subsp. *zeyheri*  
*Triraphis ramosissima*  
*Wahlenbergia denticulata* var. *denticulata*  
*Zygophyllum dregeanum*  
*Zygophyllum simplex*

**Appendix 5: Co-ordinates of protected tree species (National Forests Act) that occur within the footprint of proposed infrastructure or nearby.**

<b>Species</b>	<b>South</b>	<b>East</b>
<i>Boscia albitrunca</i>	-28.54956284	21.08060533
<i>Boscia albitrunca</i>	-28.54961556	21.08133313
<i>Boscia albitrunca</i>	-28.55013976	21.08115677
<i>Boscia albitrunca</i>	-28.55760293	21.07296019
<i>Boscia albitrunca</i>	-28.55435083	21.07015477
<i>Boscia albitrunca</i>	-28.55156997	21.06777439
<i>Boscia albitrunca</i>	-28.55088139	21.06784639
<i>Boscia albitrunca</i>	-28.54905372	21.06648299
<i>Boscia albitrunca</i>	-28.53159254	21.05074689
<i>Boscia albitrunca</i>	-28.53034690	21.04739262
<i>Boscia albitrunca</i>	-28.54876060	21.08202581
<i>Aloe dichotoma subsp. dichotoma</i>	-28.53662227	21.07630147
<i>Boscia albitrunca</i>	-28.52287737	21.07252207
<i>Boscia albitrunca</i>	-28.52531718	21.07341986
<i>Boscia albitrunca</i>	-28.52626626	21.07328072
<i>Boscia albitrunca</i>	-28.52737954	21.07228243
<i>Boscia albitrunca</i>	-28.52756554	21.07172168
<i>Boscia albitrunca</i>	-28.52757945	21.07159579
<i>Boscia albitrunca</i>	-28.52789998	21.07148464
<i>Boscia albitrunca</i>	-28.52780761	21.07138783
<i>Boscia albitrunca</i>	-28.52891863	21.07094669
<i>Boscia albitrunca</i>	-28.53097689	21.06978764
<i>Boscia albitrunca</i>	-28.53097429	21.07082222
<i>Boscia albitrunca</i>	-28.53352230	21.06431853
<i>Boscia albitrunca</i>	-28.53369615	21.06425064
<i>Boscia albitrunca</i>	-28.53397753	21.06382476
<i>Boscia albitrunca</i>	-28.53498595	21.06408108
<i>Boscia albitrunca</i>	-28.53543489	21.06395384
<i>Boscia albitrunca</i>	-28.53579590	21.06378310
<i>Boscia albitrunca</i>	-28.53733339	21.06835425
<i>Boscia albitrunca</i>	-28.53733884	21.06833690
<i>Boscia albitrunca</i>	-28.53930967	21.06749804
<i>Boscia albitrunca</i>	-28.54002457	21.06730786
<i>Boscia albitrunca</i>	-28.54013646	21.06710384
<i>Boscia albitrunca</i>	-28.54027074	21.06713301
<i>Boscia albitrunca</i>	-28.54459061	21.06921432
<i>Boscia albitrunca</i>	-28.54492396	21.06903897
<i>Boscia albitrunca</i>	-28.54449975	21.06952445
<i>Boscia albitrunca</i>	-28.54389005	21.06974531
<i>Boscia albitrunca</i>	-28.54376918	21.06977197
<i>Boscia albitrunca</i>	-28.54238608	21.07044654
<i>Boscia albitrunca</i>	-28.54208450	21.07081593
<i>Boscia albitrunca</i>	-28.54133734	21.07117401
<i>Boscia albitrunca</i>	-28.54015147	21.07086765
<i>Boscia albitrunca</i>	-28.53915696	21.07129991
<i>Boscia albitrunca</i>	-28.53902880	21.07156075
<i>Boscia albitrunca</i>	-28.54066754	21.07176066

<i>Boscia albitrunca</i>	-28.54212130	21.07086430
<i>Boscia albitrunca</i>	-28.54237846	21.07044730
<i>Boscia albitrunca</i>	-28.54579660	21.07077352
<i>Boscia albitrunca</i>	-28.55168773	21.07108231
<i>Boscia albitrunca</i>	-28.55043631	21.07011613
<i>Boscia albitrunca</i>	-28.54980122	21.06995386
<i>Boscia albitrunca</i>	-28.54967960	21.06992645
<i>Boscia albitrunca</i>	-28.54892690	21.06957231
<i>Boscia albitrunca</i>	-28.54863136	21.06969142
<i>Boscia albitrunca</i>	-28.54856765	21.07005989
<i>Boscia albitrunca</i>	-28.54794320	21.06976518
<i>Boscia albitrunca</i>	-28.54760952	21.06949889



**SPECIALIST AVIFAUNAL ASSESSMENT FOR THE  
PROPOSED UPINGTON SOLAR THERMAL PLANT,  
NORTHERN CAPE**



**COMPILED FOR:**

**SAVANNAH ENVIRONMENTAL (PTY) LTD  
UNIT 606, 1410 EGLIN OFFICE PARK  
14 EGLIN ROAD  
SUNNINGHILL**

**ON BEHALF OF**

**KHI CSP SOUTH AFRICA (PTY) LTD  
SEPTEMBER 2010**

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## **1. INTRODUCTION AND TERMS OF REFERENCE**

BirdLife South Africa was appointed by Savannah Environmental (Pty) Ltd to undertake an avifaunal specialist study for the proposed establishment of the Upington Solar Thermal Plant, to be located on Portion 3 of the Farm McTaggarts Camp 453, which falls within the Khai-Garib Local Municipality, Northern Cape.

## **2. THE PROPOSED ACTIVITY**

### **2.1 Location of the activity**

The Upington Solar Thermal Plant is proposed to be developed on Portion 3 of the Farm McTaggarts Camp 453, which falls within the Khai-Garib Local Municipality, Northern Cape. The site lies approximately 8km to the north west of the Orange River and 20km to the south west of the town of Upington. The larger site covers an area of approximately 22 km<sup>2</sup>



**Figure 2-1: Portion 3 of Farm McTaggarts Camp 453, Northern Cape**

## **2.2 Proposed project and infrastructure requirements**

The facility is proposed to accommodate up to 110 MW which will be comprised of a combination of the following technologies (in any combination):

- 50 MW trough plants
- 50 MW power tower plants
- 10 MW CPV plants

The first two technology options will also include the associated infrastructural requirements:

- A steam turbine and generator housed within a 2-storey building
- A generator transformer and a small substation outside the building
- An auxiliary steam boiler and associated vessels
- An overhead power line feeding into the Eskom electricity network via a “turn in and turn out” configuration to an existing distribution line running 4 km south of the site
- Water supply pipeline/s to the facility and extraction point on the Orange River
- Water treatment plant and water storage facilities
- Blow down pond (for wastewater from the generation process)
- Access roads to the site from the main road, as well as access roads within the site
- Workshop and storage areas

## **3. METHODS**

A two day site visit was conducted by Martin Taylor on the 14-15th September 2010. The purpose of the site visit was to complete an on-site avifaunal assessment site in order to identify Species of Special Concern (SSC) and assess the likely impacts of the construction and operational phases on the resident avifaunal communities present on site. Additional data was compiled by means of a desktop study utilising several sources including feasibility reports, literature and past environmental reports.

### **3.1 Onsite avifaunal assessment**

Given that the vegetation within the study area was fairly homogenous (with the exception of the dry drainage lines), the MacKinnon List Method was utilised. This is a rapid avifaunal assessment technique, used to collect bird community data. All species seen or heard were grouped into consecutive lists of equal length (n=10) and a species accumulation curve was generated from adding those species not recorded on any previous list to the total species number (Colwell, Nao and Chang 2004). Saturation was defined as the point where the rate of species accumulation over five sample intervals fell below 0.10 (O' Dea, Watson and Whittaker 2004). At this point the study area was deemed to have been adequately surveyed with the likelihood of further species being detected being negligible to the amount of survey effort required. For the purposes of this study, aerial species such as Martins, Swallows, and Swifts were excluded from the data set. These species forage over an extremely wide area and in site specific surveys they are excluded unless known to be roosting on site. The occurrence of Sociable Weavers was weighted to a maximum number of 15 so as not to skew the accumulation curve.

### **3.2 Desktop data compilation**

Data was compiled by means of a desktop study utilising several sources including feasibility reports, literature and past environmental reports. The purpose of the literature review was to identify:

- A baseline bird community as well as Species of Special Concern
- Previous means of predicting bird mortality (and other impacts) of solar energy facilities affecting birds in groups similar to those in the study area.
- Accounts of avian mortality at solar facilities and associated infrastructure
- Information on the status, in Upington, Northern Cape and globally, of bird groups most likely to be affected

### **3.3 Methods for determining the significance of impacts and assumptions**

The consultant was provided with a document setting out the standardised method for evaluating impacts identified during the EIA phase of the study. A copy of this document is included in Appendix B.

## **4. BASELINE DESCRIPTION OF RECEIVING ENVIRONMENT**

### **4.1 Vegetation**

The site falls predominantly within the Kalahari Karroid Shrubland vegetation type. This vegetation type is characterised by sparsely scattered individuals of Camel thorn (*Acacia erioloba*), with Shepard's Bush (*Boscia albitrunca*) found in areas where sand has accumulated. The shrub layer is moderately developed consisting of species such as *Salsola tuberculata*, *Eriocephalus spinescens*, *Rosenia humilis*, and *Eriocephalus pubescens*. The grass layer is sparse, consisting of species such as *Stipagrostis obtusa*, *Stipagrostis ciliata*, *Enneapogon desvauxii*, *Eragrostis annulata*, *Eragrostis porosa*, *Eragrostis homomalla*, *Tragus racemosus*, and *Schmidtia kalihariensis*.



**Figure 4-1: Typical habitat occurring on site**

The habitat type and extent required by a bird species depends on a species food preferences, foraging strategies, and nest site requirements. A key factor in the composition of a bird community is also the quality of habitat. Stock farming is a primary activity in this area and overstocking has degraded vegetation on the property.





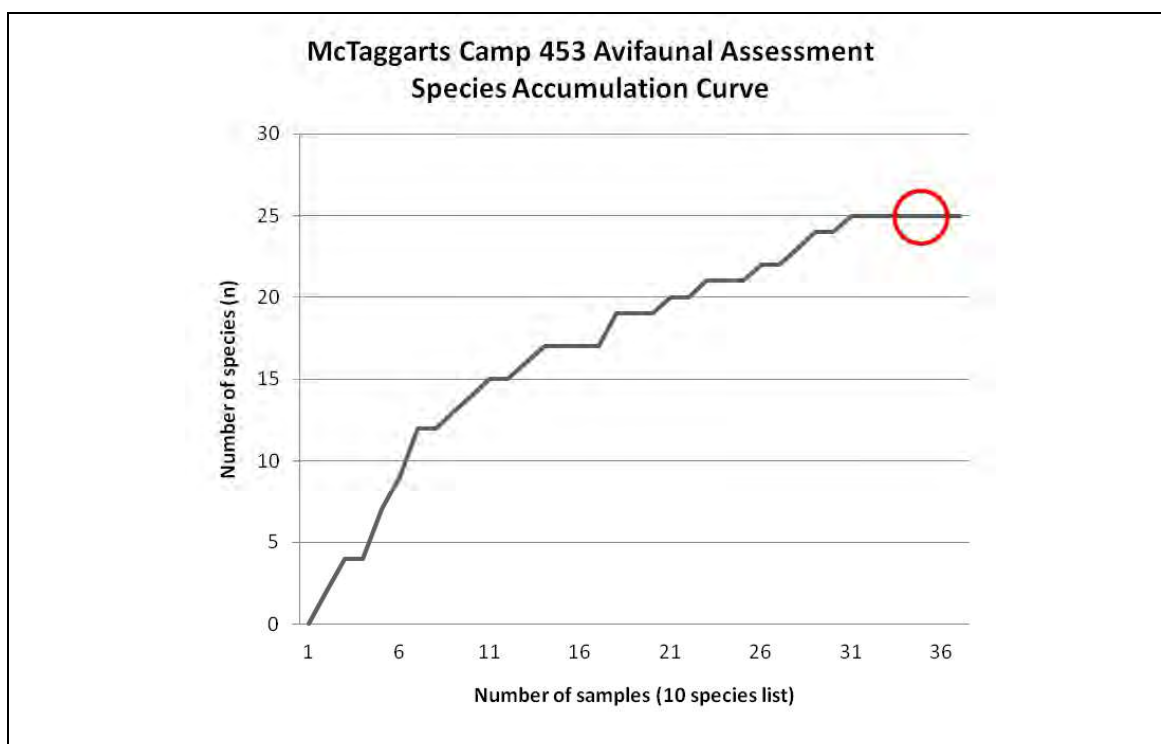
**Figure 4-2: Vegetation typical of the drainage lines present onsite**

#### **4.2 Regional overview of bird species occurring in the Northern Cape**

Approximately 445 bird species occur within the Northern Cape across a wide range of different biomes and habitat types. This includes ocean and coastal dwelling species such as albatrosses, petrels and so forth found on the western borders of the Province and which do not occur in the interior. Fifty six of these species are endemic to South Africa meaning that they do not occur outside of South Africa's borders with a further forty two being classified as near endemics i.e. their distribution reaches just outside of our borders into neighbouring countries. Of the 445 bird species occurring in the Northern Cape, fifty two (or 11.5%) are listed in *The Eskom Red Data Book of Birds of South Africa, Lesotho, and Swaziland*, meaning that to a certain degree their existence as a species is threatened.

#### **4.3 Bird community assemblage within the study area**

Bird taxa are appropriate indicators for monitoring ecosystem health as individual bird species are associated with particular habitats and groups of bird species (or assemblages) can be used to develop associations with habitats that are predictive of the relative level of anthropogenic disturbance (Canterbury, et al. 2000). The results of the avifaunal assessment are depicted in Figure 4-3. Twenty five species were detected within the study area. This figure was lower than expected and certainly lower than the more species rich areas to the east of the site. The accumulation curve in the graph below shows an initial high rate of species accumulation during the early stages of the sampling program. As sampling progressed, fewer new species were being recorded which explains the slowdown in the rate of accumulation up until an asymptote is reached after 36 sampling units. Figure 4-3 indicates that the sampling effort for the study area was saturated meaning that for additional sampling effort it was unlikely that any additional new species would be detected.



**Figure 4-3: Species accumulation curve for the McTaggarts Camp 453 Avifaunal Assessment**

The most common species recorded were the Sociable weavers. A number of their nests were encountered in the dry drainage lines that cross the site from north east to south west. These streambeds were noted as being higher in species density, abundance, and diversity than the adjacent plains. The plains in the vicinity of the demarcated site footprint were fairly unproductive and low in bird density and diversity. This habitat type was dominated by Spikeheeled Lark, Fawncoloured Lark, and Anteating Chats. No Species of Special Concern were detected during the site visit. In addition to the site visit, a number of the pentads (SABAP2 database) in the immediate vicinity of the study site were analysed and a composite list of what species might occur on site has been compiled. This list, as well as a list of the species detected in the site visit, is contained in Appendix G.

#### 4.4 Avifaunal Species of Special Concern

As mentioned above, of the 445 bird species occurring in the Northern Cape, 52 (or 11.5%) are listed in *The Eskom Red Data Book of Birds of South Africa, Lesotho and Swaziland* meaning, that to a certain degree, their existence as a species is threatened. A data set of the total number of species that occurred within the Northern Cape was compiled and is contained in Appendix H. Species that would not occur within the area or for which the habitat would be unsuitable, i.e. pelagic species such as albatrosses which are oceanic, were removed. The remaining species which may possibly occur on site are recorded in Table 4-1 below.

**Table 4-1: Globally threatened species possibly occurring within the study area**

Common name	Scientific name	Biome	Red Data Book status	Habitat
Secretarybird	<i>Sagittarius serpentarius</i>	S, G	Near-threatened	Grassland
Kori Bustard	<i>Ardeotis kori</i>	NK	Vulnerable	Grassland/Thornveld
Ludwig's Bustard	<i>Neotis ludwigii</i>	NK	Vulnerable	Savannah
Lanner Falcon	<i>Falco biarmicus</i>	NK, S	Near-threatened	Varied
Martial Eagle	<i>Polemaetus bellicosus</i>	NK, S	Vulnerable	Varied
Sclater's Lark	<i>Spizocorys sclateri</i>	Uncommon	Near-threatened	Stony desert scrub

##### 4.4.1 Secretarybird (*Sagittarius serpentarius*)

In 2000, the Secretarybird was classified as Near-threatened (Barnes 2000). Secretarybirds are endemic to Sub-Saharan Africa and are non-migratory, though they may follow food sources. Secretarybirds prefer open grasslands and savannas which assist their foraging habits. It is sensitive to habitat degradation due to overgrazing, bush encroachment, disturbance, and loss of habitat to afforestation and crop cultivation.

Recent data has seen a constriction of its range and lower reporting rates which is cause for concern.

#### **4.4.2 Kori Bustard (*Ardeotis kori*)**

The Kori Bustard is listed as Vulnerable in South Africa due to declines in population numbers (Barnes 2000). Throughout its range the species is common to uncommon and unevenly distributed with the Northern Cape being a stronghold for this species. The main threats to current populations are habitat loss through overgrazing and conversion of grasslands as well as collisions with power lines. A more recent threat is that of foreign falconers targeting this species.

#### **4.4.3 Ludwig's Bustard (*Neotis ludwigii*)**

Ludwig's Bustard has a large range centred on the dry biomes of the Karoo and Namib in southern Africa, being found in the extreme south-west of Angola, western Namibia and in much of South Africa. The global population has been previously estimated at 56,000 to 81,000 individuals. However, this estimate is now approximately 20 years old and is unreliable. This species is listed as Vulnerable as recent research has suggested that the population has undergone a very rapid population decline due to collisions with power lines, a trend which is set to continue into the future as successful mitigation measures are yet to be implemented. Collision rates on high voltage transmission lines in the De Aar area of the Karoo may exceed one Ludwig's Bustard per kilometre per year (Anderson 2001). Given that the extent of power lines in the Karoo is vast and expanding, with already over 250,000 km of lines in place, it is estimated that such collisions alone are already enough to cause a rapid decline in the population and may increase in the future. This threat may be exacerbated as males are more prone to power line collisions than females, which may lead to a reduced effective population size. Habitat on site is suitable for Ludwig's Bustard although none were detected during the site visit.

#### **4.4.4 Lanner Falcon (*Falco biarmicus*)**

The Lanner Falcon is listed as Near Threatened in South Africa. It has fairly high tolerance in terms of its habitat requirements, being found across southern Africa in just about most habitat types excluding forest. The Lanner Falcon is generally a cliff nester and its distribution is closely associated with mountainous areas. However, and especially in the Karoo, the increasing number of pylon towers has offered alternative nesting opportunities for this species. The site lacks any suitable mountainous areas

which would be suitable for it to find breeding sites. It is extremely unlikely that this species will occur within the study area.

#### **4.4.5 Martial Eagle (*Polemaetus bellicosus*)**

The Martial Eagle is listed as Vulnerable in South Africa (Barnes 2000). The SABAP2 provisional distribution map shows records in a pentad in the vicinity of the study site. As mentioned above the area is extremely lacking in terms of atlas records and this may not reflect accurately the distribution of the species. The Martial Eagle inhabits open woodland, wooded savanna, bushy grassland, thornbush and, in southern Africa, more open country and even sub desert, from sea level to 3,000 m but mainly below 1,500 m (Ferguson-Lees & Christie 2001). The availability of nests sites is often a limiting factor concerning this species. The species suffers from direct persecution (shooting and trapping) by farmers, indirect poisoning (these two threats by far the most important causes of losses), drowning in sheer-walled reservoirs, electrocution on power poles, and habitat alteration and degradation (BirdLife International Factsheet 2010). Poisoning is largely carried out by a few large-scale commercial farmers, but is also a problem in tribal small-stock farming communities. Reduction in natural prey may lead to an increase in predation on domestic animals which may in turn lead to increased persecution by farmers. As mentioned this species has been recorded as occurring in the vicinity of the study site in the last SABAP1 project. This species was not recorded on site.

#### **4.4.6 Sclater's Lark (*Spizocorys sclateri*)**

Sclater's Lark is listed as Near Threatened (Barnes 2000). This species is endemic to South Africa and Southern Namibia, its distribution being confined to the Nama Karoo where it is concentrated in the Northern Cape slightly to the south of the study area (Barnes 2000). Although this species has been reported to move substantially it appears to move within in its core Bushmanland distribution. This species was not detected during the site visit but is notoriously nomadic responding to rainfall events. Sclater's Lark preferred habitat is arid to semi-arid gravely and stony plains with scattered shrubs and grasses on shale soils, and sparse dwarf shrublands on clays.

### **5. ISSUES IDENTIFIED DURING THE SCOPING PROCESS**

Very little research has been conducted on the impacts of solar energy facilities on birds as opposed to the well documented impacts that wind energy facilities have. The primary impact on bird species and communities is mainly due to the large footprint

required for commercial-scale energy production. This would refer to the habitat loss and disturbance created during the construction phase of the facility. The second group of impacts relate to the operation of the facility. In terms of avian mortality due to direct interaction with the facilities, it seems as if these are low with the exception of interactions with power lines. Based upon the information that we could gather in the scoping phase we identified several impacts that needed to be further quantified during the EIA Phase namely:

- Impact on local bird communities due to habitat loss
- Impact on local bird community due to disturbance
- Impacts on birds attracted to the solar panels
- Collision of birds with facilities associated with the development
- Electrocution of birds on the power line tower structures
- Impacts of bird species upon the facilities
  - Bird pollution (Streamers and faeces build up) and power lines
  - Bird nests on tower structures

These impacts were quantified using the data collected during the site visit and according to criteria set out by Savannah Environmental (Appendix B).

## **6. ASSESSMENTS OF IMPACTS ON AVIFAUNA DUE TO THE PROPOSED DEVELOPMENT**

### **6.1 Impact on local bird community due to habitat loss**

**Nature:** To produce clean power cost-effectively, solar energy facilities often cover a sizeable land area, in this case 6km<sup>2</sup>. A certain amount of habitat will be lost during the establishment of the solar farm and the associated infrastructure (including the clearing of land for access roads and the powerline). In the simplest terms, when habitat is destroyed, the plants, animals, and other organisms that occupied the habitat have a reduced carrying capacity so that populations decline and extinction becomes more likely. 82% of endangered bird species are significantly threatened by habitat loss (Temple and Cary 1988). Whilst impacting greatly on endangered bird species, habitat loss can also have an impact on existing bird communities within the study area i.e. the problem of common birds becoming less common. Habitat loss can impact on local as well as, to a lesser degree, migratory species.

**Extent:** The south eastern portion of the site (Portion 3) would be the area within the broader site that would be disturbed by the proposed facility. This area has some natural

drainage lines where the bird density and diversity seemed to be at its highest. It is noted that the proposed construction plans avoid the majority of the drainage lines. Habitat loss would be limited to the development site area and the extent of the impact would therefore be **local**.

**Duration:** The loss of habitat will have a permanent impact for the life of the project. At times it is reversible through actions such as rehabilitation. However, the nature of this project is long term and it is unlikely that the habitat that will be lost through the construction of the facility would be restored in the near future. For this reason the loss of habitat and subsequent impact on local bird communities will be **long term**.

**Magnitude:** The magnitude of this type of impact could be low to high, depending on the species concerned, the proportion of the study site affected and the current status of the habitat currently on site (i.e. degraded or intact). For instance, if habitat loss adversely impacted on any Sclater's Lark individuals on site then the impact would be high. During the avifaunal assessment no Species of Special Concern were detected and the density and diversity of bird species was fairly low. The amount of habitat that would be lost (6km<sup>2</sup>) would not be significant. For this reason the magnitude is **minor**.

**Probability:** Habitat will be lost if the construction of the facility takes place. In light of this the impact will occur regardless of any prevention or mitigation measures that are put in place. The impact will be **definite**.

**Mitigation measures:** The following mitigation measures are recommended:

- With regards to the two alternative access roads and the amount of habitat loss. There is a minimal amount of difference in terms of impact on bird communities and therefore it is recommended that alternative A, the shorter route, be preferred.
- The minimum amount of vegetation on site will be cleared.
- The diversity and abundance of bird species was far greater in the drainage channels as opposed to the open plains. Where possible as much of this habitat should be kept intact.
- If possible the servitude of the powerline exiting the site should follow existing roads where possible and should not cut across habitat.
- All construction and maintenance activities must be undertaken in accordance with Eskom Transmission's Environmental Best Practise Standards. All construction activities and access roads should be restricted as much as possible.

**Table 6-1: Summary impact significance table for habitat loss**

<b>Nature: Impact on local bird community due to habitat loss</b>		
	<b>Without mitigation</b>	<b>With mitigation</b>
<b>Extent</b>	1 - local	1 - local
<b>Duration</b>	4 – long term >15 years	4 – long term >15 years
<b>Magnitude</b>	2 - minor	0 - small
<b>Probability</b>	4 – highly probable	4 – highly probable
<b>Significance</b>	28 - Low	20 - Low
<b>Status</b>	Negative	Negative
<b>Reversibility</b>	Possible	Possible
<b>Irreplaceable loss of resources</b>	None	None
<b>Can impacts be mitigated</b>	Yes	Yes
<b>Mitigation measures:</b>	Included above	
<b>Cumulative impacts:</b>	The loss of habitat on-site has the potential to add to the cumulative impacts that habitat loss in the region is having. However, 6km <sup>2</sup> in the context of the amount of similar habitat in the region is a negligible amount.	
<b>Residual impacts:</b>	None	

## **6.2 Impact on local bird communities due to disturbance**

**Nature:** The Upington Solar Thermal Plant will consist of the solar components as well as associated infrastructure. At an individual level, disturbance from human activity may modify bird foraging behaviour (Burger and Gochfield 1998) and even more seriously reproduction (Giese 1996). For shy and sensitive species this may result in negative impacts especially during the breeding season.

**Extent:** It is presumed that construction, and subsequently, operational activities will be limited mainly to the 6km<sup>2</sup> area in the south eastern portion of the property and that no other disturbance will take place on the property. Based upon this the extent of the impact will be **local**.

**Duration:** Disturbance would occur mainly during the construction period and then, to a lesser extent, through ongoing maintenance. Over time bird species are able to adapt and co-exist with certain disturbances. The duration of the impact will be of a **short duration**.



**Magnitude:** The magnitude of the impact is measured as to what would be the conservation outcome should certain individuals in the present bird community be unduly disturbed and affected by the construction and operation of the facility. No Species of Special Concern were detected during the site visit. None of the species detected during the on site assessment are unduly shy or secretive species or be sensitive to disturbance. Given this the magnitude of the impact will be **minor**.

**Probability:** There is a **distinct possibility** of this impact occurring.

**Mitigation:** The additional disturbance created through the construction and ongoing maintenance will be minimal and should not have any significant impact upon the local bird community.

- Contractors need to minimise the amount of disturbance during the construction phase by staying within the boundaries of the 6km<sup>2</sup> construction area
- If the nest of a large species is detected within the vicinity of the area to be disturbed then the Northern Cape Department needs to be notified and all attempts made to minimise the amount of disturbance of traffic near it.

**Table 6-2: Impact significance table for disturbance**

<b>Nature: Impact on local bird community due to disturbance</b>		
	<b>Without mitigation</b>	<b>With mitigation</b>
<b>Extent</b>	1 - local	1 - local
<b>Duration</b>	2 – short duration	2 – short duration
<b>Magnitude</b>	2 - minor	2 - minor
<b>Probability</b>	3 – distinct possibility	2 – distinct possibility
<b>Significance</b>	15 - Low	15 - Low
<b>Status</b>	Negative	Negative
<b>Reversibility</b>	Possible	Possible
<b>Irreplaceable loss of resources</b>	None	None
<b>Can impacts be mitigated</b>	Yes	Yes
<b>Mitigation measures:</b>	Provided above	
<b>Cumulative impacts:</b>	N/A	
<b>Residual impacts:</b>	N/A	

### 6.3 Impact on birds attracted to the solar panels

**Nature:** The facility will cover an area of 6km<sup>2</sup> and will include a series of mirrors of heliostats/toughs panels which will reflect sunlight. Ornithologists in the past have recorded instances of birds being attracted to wet runways and have concluded that the birds have mistaken these features for water bodies i.e. young flamingos have been recorded sitting on wet runways that they have mistaken as a water body (T Anderson pers. comm.). Birds, and especially Lesser Flamingos, mistaking the panel field as a water body can cause negative interactions between themselves and the panels through collisions. The phenomenon was discussed with Mr Dave Allen of the Durban Natural History Museum, Mr Doug Harebottle, Coordinator of SABAP2 and Mr Mark Anderson of BirdLife South Africa. Whilst this phenomenon may occur, it is unlikely that it will have any long term impacts.

**Extent:** This would be limited to the immediate area of the facility containing the panels. The extent of the impact would therefore be **local**.

**Duration:** The impact would exist for the life of the facility and would therefore be **long term**.

**Magnitude:** In measuring the magnitude of this impact one has to measure what impact the facility may have on birds attracted to the facility. It is uncertain as to whether species such as Lesser Flamingo will be attracted to the facility and if they were to be attracted, then to what extent would they interact with the facility. Based upon discussions with different ornithologists it is felt that the magnitude is **minor** and will not result in an impact on processes.

**Probability:** The probability of this occurring is fairly **improbable** i.e. it will probably not happen.

**Mitigation measures:** None required.

**Table 6-3: Impact significance table for the impact of birds being attracted to the solar panels**

<b>Nature: Impact on of birds being attracted to the solar panels</b>		
	<b>Without mitigation</b>	<b>With mitigation</b>
<b>Extent</b>	1 - local	1 - local
<b>Duration</b>	4 – long term	4 – long term
<b>Magnitude</b>	2 - minor	2 - minor
<b>Probability</b>	1 – very improbable	1 – very improbable
<b>Significance</b>	7 - Low	7 - Low
<b>Status</b>	Negative	Negative
<b>Reversibility</b>		
<b>Irreplaceable loss of resources</b>	None	None
<b>Can impacts be mitigated</b>	No	No
<b>Mitigation measures:</b>	None required	
<b>Cumulative impacts:</b>	N/A	
<b>Residual impacts:</b>	N/A	

#### **6.4 Collision of birds with infrastructure associated with the development**

**Nature:** There are two types of collision events that may occur with regards to the proposed facility, namely collisions with the PV panels, heliostats, parabolic troughs and power tower and collisions with the overhead power line. The Upington Solar Thermal Plant will have approximately 50 MW trough plants, 50 MW power tower plants, 10 MW PV panels, and 4 km of powerline. There is a scarcity of information relating to bird collisions with solar panels. At a study site in Nevada (McCrary, et al. 1986) the estimated mortality rate was 1.9-2.2 birds per week of which 57 birds (81%) of 20 species died due to collisions with structures, mainly the mirrored surfaces of heliostats whilst 13 birds (19%) of 7 species died from burns received by flying through “standby points”. The conclusion was that the impact of this mortality on the local bird population was minimal. However, the same cannot be said of power lines. In South Africa, bird collisions with power lines are a major form of unnatural mortality amongst several threatened species as well as other species (Jenkins, Smallie and Diamond 2010). Unfortunately, the majority of species that are susceptible to collision tend to be long lived, slow reproducing species such as bustards, cranes, korhaans, and different species of waterbird. All of these species utilise waterways as flyways and the proximity of the Orange River exacerbates the likelihood of interaction with power lines. Due to the

slow reproductive nature of the species most likely to be collision suspects, long-term mortalities caused by collisions with power lines could have a high likelihood on future population's abilities to be able to sustain themselves. It is generally accepted that birds can usually avoid the highly visible bundled conductors but often fail to see the thin ground wires. Typical injuries that result from collisions are impact injuries such as broken necks and legs. Research indicates that there is a correlation between the size of the power line and the collision risk potential with mortality increasing with voltage size. The size of the power lines associated with this project will be 132kV. Species that may possibly occur in the area and that may be involved in collision events are included in Table 6-4.

**Table 6-4: Endangered species within the study area that may be collision suspects**

Common name	Scientific name	Bio m e	Red Data Book status	Habitat
Secretarybird	<i>Sagittarius serpentarius</i>	S, G	Near-threatened	Grassland
Kori Bustard	<i>Ardeotis kori</i>	NK	Vulnerable	Grassland/Thornveld
Ludwig's Bustard	<i>Neotis ludwigii</i>	NK	Vulnerable	Savannah

Whilst the above table lists only endangered species, all korhaan and bustard populations are currently under pressure. According to Anderson (2001), the collision of large terrestrial birds with the wires of utility structures and especially power lines, has been determined to be one of the highest mortality factors for this group of birds in South Africa. It is possible that the populations of two southern Africa endemic species namely Ludwig's Bustard (*Neotis ludwigi*) and the Blue Crane (*Anthropoides paradiseus*) may be in decline due to this single mortality factor (Anderson 2001). For species such as Northern Black Korhaan (*Eupoditis afraoides*) which occur on site, collision mortalities would probably not have a hugely significant impact on their regional populations. Ongoing mortalities on a large scale could however have long term affects on Northern Black Korhaan and as such an effort should be made to minimise the impacts upon these populations.

**Duration:** The impact would cover the lifespan of the facility and will be **long term**.

**Extent:** The impact will be confined to the study area (i.e. area that the facility and the powerlines cover). The extent is therefore **local**.

**Magnitude:** The magnitude of this impact will be **moderate** to **high** due to the conservation status of the species which may potentially be involved in collision events. Ludwig's Bustard is of particular concern based upon what is known of its biology: it is a large, heavily bodied species which inhabits open, arid country similar to that of the study area and lives and moves in loose flocks. This species is highly nomadic, flying long distances in the Karoo in response to rainfall events and feeding sources (Allan 2005). This species may be susceptible to collisions with the proposed 4km powerline, the consequences of which are significant.

**Probability:** Birds which consistently appear in list of taxa that are susceptible to collisions, such as waterbirds which habitually congregate at wetlands and commute in between food sources and the wetlands in flocks, occur in the area and in large numbers (Jenkins, Smallie and Diamond 2010). In addition, Karoo and Northern Black Korhaan were both recorded on site, both of which are large, heavy bodied, low flying species. All of these species are collision suspects. There is a **high possibility** of collision events and subsequent impacts on local bird populations. The probability of events can be minimised through the implementation of mitigation measures.

**Significance:** The significance of this impact will be **moderate** to **high** due to the conservation status of the species which may be involved in collision events. The significance of this impact can be mitigated for which will reduce the significance to **low** i.e. this impact would not have a direct influence on the decision to develop in the area.

**Mitigation:** The incidences of birds interacting with the solar facility itself and subsequent mortalities are minimal. It is however recommended that an appropriate bird deterrent device is placed at locations around the facility to lessen this impact. Additional mitigation options considered included reviewing the placement of proposed new lines, removing the earth-wire, or else fitting the wire with a type of marker.

- With regards to the two different alternatives proposed by the project proponent there is no significant difference (in terms of impact on birds) between the two. It would therefore be recommended to go with the shorter line.
- The line should be kept as low as possible taking into account engineering and legal requirements
- The span lengths should be kept as short as possible

- Placement of a sufficiently large form of marker which will increase the visibility of the wire. There remains considerable uncertainty about the best performing marking device. Bird marking devices have proved to be extremely effective in preventing bird collisions by making the line more visible to birds. The two most commonly used marking devices in South Africa are Bird Flight Diverters and Bird Flappers. Bird Flight Diverters (BFD) were developed in Europe and have shown to have been able to reduce the collision rate of birds significantly (in certain cases up to 60%) by increasing the visibility of the powerline (Alonso and Alonso 1999). BFD are static and typically require less maintenance. Bird flappers are a South African invention and, if applied correctly, have proven to be more effective than the Bird Flight Diverter in comparative experiments. It has largely replaced the BFD as a mitigation device for bird collisions within South Africa. Bird flappers are susceptible to failure and have a life expectancy of three to five years.
- The marker should be placed with sufficient regularity (at least every 5-10m)
- The markers should preferably be placed on the earth wires as opposed to the conductors.

**Table 6-5: Impact significance table for the collision of birds with the facility and infrastructure**

<b>Nature: Impact on local bird community due to collision with the facility</b>		
	<b>Without mitigation</b>	<b>With mitigation</b>
<b>Extent</b>	1 - Low	1 - Low
<b>Duration</b>	4 - Low	4 - Low
<b>Magnitude</b>	8 - High	4 - Low
<b>Probability</b>	4 - Highly probable	2 - Improbable
<b>Significance</b>	52 - Medium	10 - Low
<b>Status</b>	Negative	Negative
<b>Reversibility</b>		
<b>Irreplaceable loss of resources</b>	None	None
<b>Can impacts be mitigated</b>	Yes	N/A
<b>Mitigation measures:</b>	Included above	
<b>Cumulative impacts:</b>	There are a number of powerlines in the vicinity of Upington as well as throughout the Northern Cape. The length of the proposed powerline is 4km. It is unlikely that this will add significantly to the cumulative impact of	

	powerlines collisions in the region.
<b>Residual impacts:</b>	None

## 6.5 Electrocution of birds on the power line tower structures

Nature: **The design has allowed for a 132kV overhead powerline feeding into the electricity network via a “turn in and turn out” configuration to line running 4 km south of the site. Two alternatives have been which, are shown in the map included in Control Sheet in line with Regulation 33 of Government Notice No. R385 of 1996 EIA Regulations**

Activity	Yes	No	Comment
Details of: I: the person who prepared the report; and II: the expertise of that person to carry out the specialist study	✓		Appendix D
A declaration that the person is independent in a form as may be specified by the competent authority	✓		Appendix E
An indication of the scope of, and the purpose for which the report was prepared	✓		
A description of the methodology adopted in preparing the report or carrying out the specialised process	✓		
A description of any assumptions made and any uncertainties or gaps in knowledge	✓		
A description of the findings and potential implications of such findings on the impact of the proposed activity including identified alternatives, on the environment	✓		
Recommendations in respect of any mitigation measures that should be considered by the applicant and the competent authority	✓		
A description of any consultation process that was undertaken during the course of carrying out the study	✓		
A summary and copies of any comments that were		✓	

received during the consultation process			
<b>Any other information requested by the competent authority</b>			None requested as of yet



## **Appendix B – Criteria for Evaluating Impacts**

## ASSESSMENT OF IMPACTS

Direct, indirect, and cumulative impacts of the issues identified through the Scoping Study, as well as other issues identified in the EIA Phase must be assessed in terms of the following criteria.

» The **nature**, which shall include a description of what causes the effect, what will be affected, and how it will be affected.

» The **extent**, wherein it will be indicated whether the impact will be local (limited to the immediate area or site of development) or regional:

- local extending only as far as the development site area – assigned a score of 1;
- limited to the site and its immediate surroundings (up to 10 km) – assigned a score of 2;
- will have an impact on the region – assigned a score of 3;
- will have an impact on a national scale – assigned a score of 4; or
- will have an impact across international borders – assigned a score of 5.
- 

» The **duration**, wherein it will be indicated whether:

- the lifetime of the impact will be of a very short duration (0–1 years) – assigned a score of 1;
- the lifetime of the impact will be of a short duration (2-5 years) - assigned a score of 2;
- medium-term (5–15 years) – assigned a score of 3;
- long term (> 15 years) - assigned a score of 4; or
- permanent - assigned a score of 5.

» The **magnitude**, quantified on a scale from 0-10, where a score is assigned:

- 0 is small and will have no effect on the environment;
- 2 is minor and will not result in an impact on processes;
- 4 is low and will cause a slight impact on processes;
- 6 is moderate and will result in processes continuing but in a modified way;
- 8 is high (processes are altered to the extent that they temporarily cease); and
- 10 is very high and results in complete destruction of patterns and permanent cessation of processes.

» The **probability of occurrence**, which shall describe the likelihood of the impact actually occurring. Probability will be estimated on a scale, and a score assigned:

- Assigned a score of 1–5, where 1 is very improbable (probably will not happen);
- Assigned a score of 2 is improbable (some possibility, but low likelihood);
- Assigned a score of 3 is probable (distinct possibility);
- Assigned a score of 4 is highly probable (most likely); and
- Assigned a score of 5 is definite (impact will occur regardless of any prevention measures).

- » the **significance**, which shall be determined through a synthesis of the characteristics described above (refer formula below) and can be assessed as low, medium or high.
- » the **status**, which will be described as either positive, negative or neutral.
- » the degree to which the impact can be reversed.
- » the degree to which the impact may cause irreplaceable loss of resources.
- » the *degree* to which the impact can be *mitigated*.

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

**S= (E+D+M) P**; where  
 S = Significance weighting  
 E = Extent  
 D = Duration  
 M = Magnitude  
 P = Probability

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

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

Appendix C. Powerlines have a range of bird related impacts one of which is electrocution events. Electrocution events refer to scenarios whereby a bird perches on an electrical structure and causes an electrical short circuit by bridging the gap between live components and or live and earthed components. The larger transmission lines from 220kV to 765kV upwards are not a threat to large raptors and other birds which are vulnerable to electrocution and in a number of cases have proved to be beneficial by providing roosting and nesting sites. However, the smaller lines (such as a 132kV line (older designs) and depending on the tower design) can be dangerous to birds. Birds that are typically the cause of this are the larger species with corresponding large wingspans which can bridge the gaps, such as raptors and storks. Endangered species which could occur within the area is included in Table 6-6.

**Table 6-6: Endangered species possibly occurring within the study area capable of electrocution events**

Common name	Scientific name	Bio m e	Red Data Book status	Habitat
Secretarybird	<i>Sagittarius serpentarius</i>	S, G	Near-threatened	Grassland
Kori Bustard	<i>Ardeotis kori</i>	NK	Vulnerable	Grassland/Thornveld
Martial Eagle	<i>Polemaetus bellicosus</i>	NK, S	Vulnerable	Varied
Ludwig's Bustard	<i>Neotis ludwigii</i>	NK	Vulnerable	Savannah

In flattish landscapes, typical of the study area, large raptors will instinctively look for the highest vantage point on which to perch. Given that the towers will be the highest structures in the area, raptors will be landing on the structures and using them to survey the landscape or to nest on.

**Extent:** The impact will be confined to the 4km powerline. However it will potentially have a **regional** impact on bird populations.

**Duration:** The impact will cover the lifespan of the facility and will be **long term**.

**Magnitude:** The magnitude of this impact will be **moderate** to **high** due to the conservation status of the species which may be involved in electrocution events.

**Probability:** There is a **distinct possibility** of electrocution events and subsequent impacts on local bird communities as well as endangered species. The probability of events can be minimised through mitigation measures.

**Mitigation:** Discussions with the representative from Khi CSP indicated that it is planned to utilise the mono pole bird friendly structure which will significantly minimise the number of electrocutions on the powerlines.

**Table 6-7: Impact significance table for the electrocution of birds**

<b>Nature: Impact on local bird communities due to electrocution events</b>		
	<b>Without mitigation</b>	<b>With mitigation</b>
<b>Extent</b>	1 - Low	1 - Low
<b>Duration</b>	4 – Long term	4 – Long term
<b>Magnitude</b>	6 - Moderate	2 - Minor
<b>Probability</b>	4 – Distinct possibility	2 - Improbable
<b>Significance</b>	44 - Medium	14 - Low
<b>Status</b>	Negative	Negative
<b>Reversibility</b>		
<b>Irreplaceable loss of resources</b>	None	None
<b>Can impacts be mitigated</b>	Yes	
<b>Mitigation measures:</b>	Included above	
<b>Cumulative impacts:</b>	There are a number of powerlines in the vicinity of Upington as well as throughout the Northern Cape. The length of the proposed powerline is 4km and it is unlikely that this will add significantly to the cumulative impact of electrocution events in the region.	
<b>Residual impacts:</b>	N/A	

## **6.6 Impacts of bird species upon the Upington Solar Plant**

### **6.6.1 Bird pollution (Streamers and faeces build up) and powerlines**

**Nature:** A streamer is when a bird defecates and releases a stream of faeces which creates an air gap intrusion between the conductor and the earthed structure. The fault appears to flash across the air gap (i.e. between the live conductor and the tower steelwork which is earthed) and does not follow an insulator creepage as observed on

pollution faults. Species which create streamers large enough to create this type of situation are typically large species such as vultures, raptors, and herons.

**Table 6-8: Species that may impact on the powerline through pollution events**

Common name	Scientific name	Biom e	Red Data Book status	Habitat
Ludwig's Bustard	<i>Neotis ludwigii</i>	NK	Vulnerable	Savannah
Secretarybird	<i>Sagittarius serpentarius</i>	S, G	Near-threatened	Grassland
Kori Bustard	<i>Ardeotis kori</i>	NK	Vulnerable	Grassland/Thornveld
Martial Eagle	<i>Polemaetus bellicosus</i>	NK, S	Vulnerable	Varied

A flashover occurs when an insulator string becomes coated with pollutant which then causes the insulator to function incorrectly. When the pollutant is wet, the coating becomes conductive, insulation breaks down, and a flashover occurs. This is created by a build-up of bird faeces over a period on a line. Species that occur on site that could possibly impact upon the powerline are included in Table 6-8.

**Extent:** The extent of the impact that a flashover event could be **regional** depending on the configuration of the powerline grid.

**Duration:** The impact will cover the lifespan of the facility and will be **long term**.

**Magnitude:** The magnitude is **moderate** and will result in the process continuing albeit in a modified manner. With the implementation of different measures, such as selecting the correct tower structure design, the impacts that these events can have can be mitigated.

**Probability:** There is a **high probability** that these types of events may occur. With the correct mitigation measures it is possible to eliminate the chances of these events occurring.

**Mitigation:** ! !Khi CSP has indicated that it intends to utilise the Eskom mono pole bird-friendly structure. The design of the tower needs to incorporate perch deterrents in the area directly above the insulator strings to ensure that bird species are not given the opportunity to defecate on the string.

**Table 6-9: Impact significance table for the impact of bird pollution (Streamers and faeces build up) and powerlines**

<b>Nature: Impact of bird pollution (streamers and faces build up) an powerlines</b>		
	<b>Without mitigation</b>	<b>With mitigation</b>
<b>Extent</b>	1 - Low	1 - Low
<b>Duration</b>	4 – Long term	4 – Long term
<b>Magnitude</b>	6 - Moderate	4 - Moderate
<b>Probability</b>	4 - Highly probable	2 - Improbable
<b>Significance</b>	44 - Medium	18 - Low
<b>Status</b>	Negative	Negative
<b>Reversibility</b>	Yes	
<b>Irreplaceable loss of resources</b>	None	None
<b>Can impacts be mitigated</b>	Yes	
<b>Mitigation measures:</b>	Included above	
<b>Cumulative impacts:</b>	N/A	
<b>Residual impacts:</b>	N/A	

#### **6.6.2 Birds nesting on the tower structures**

**Nature:** As mentioned above, certain structures have proven to be beneficial to certain raptors by providing roosting and nesting sites in areas where natural alternatives are scarce. In the case of the proposed facility, there are two area of concern namely of species nesting on transmission tower structures and then nesting on the solar infrastructure itself. This is especially true in the Northern Cape where there is a lack of suitable sites. Species, such as Martial Eagle, are known to be restricted by suitable nesting opportunities and are known to utilise tower structures.

**Table 6-10: Species capable of nesting on the tower power line structure**

<b>Common name</b>	<b>Scientific name</b>	<b>Biome</b>
Secretarybird	<i>Sagittarius serpentarius</i>	S, G
Martial Eagle	<i>Polemaetus bellicosus</i>	NK, S
Kori Bustard	<i>Ardeotis kori</i>	NK
Sociable Weaver	<i>Philetairus socius</i>	NK
Pied Crow	<i>Corvus albus</i>	NK
White-necked Raven	<i>Corvus albicollis</i>	NK

White-browed Sparrow-Weaver	<i>Plocepasser mahali</i>	S, NK
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Whilst the larger towers can be beneficial the smaller power lines can pose a problem. The construction of bird nests on the smaller power lines has the potential to cause faults by creating an air gap intrusion. Species such as crows are famous for the different materials (such as pieces of wire) they collect which in turn can cause flashovers. The faults created by nests can also result in veld fires due to the nesting material catching fire as well as surrounding veld. Of even more concern is the possibility of species such as Sociable Weavers and White Browed Sparrow Weavers nesting on the infrastructure making up the solar facility.

**Extent:** The impact will be limited to the immediate area i.e. the site to be developed. The impact will therefore be **local**.

**Duration:** The lifetime of the impact will be for **long term**.

**Magnitude:** The magnitude of this impact will be **minor**. Should there be any incidents of Species of Special Concern nesting on the facilities then the magnitude of the impact would be greater.

**Probability:** Both species which will have the highest likelihood of nesting on the structures (Sociable Weavers and White browed Sparrow Weavers) are fairly abundant species and there are numerous examples of these species taking advantage of man-made structures to construct their nests upon. There is a **definite possibility** that these species will attempt to construct nests on either the solar panels or associated infrastructure. Mitigation measures will need to be applied to prevent these species from impacting on the facility.

**Mitigation measures:** A procedure for the removal of nests must be written into the operating manual for the facility. In the event of the need to remove a nest the project proponent will be required to apply to the Northern Cape Provincial Department for a permit in order to relocate the nests of Sociable Weavers and White Browed Sparrow Weavers.

**Table 6-11: Impact significance table for species nesting on infrastructure**

<b>Nature: Species capable of nesting on the infrastructure</b>
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<sup>1</sup> Species highlighted in red indicate a high likelihood of nesting on infrastructure associated with the development



	Without mitigation	With mitigation
<b>Extent</b>	1 - Low	1 - Low
<b>Duration</b>	4 – Long term	4 – Long term
<b>Magnitude</b>	2 - Minor	0 - Small
<b>Probability</b>	5 - Definite	3 - Probable
<b>Significance</b>	35 - Medium	15 - Low
<b>Status</b>	Negative	Negative
<b>Reversibility</b>	Yes	
<b>Irreplaceable loss of resources</b>	None	None
<b>Can impacts be mitigated</b>	Yes	Yes
<b>Mitigation measures:</b>	Included above	
<b>Cumulative impacts:</b>	N/A	
<b>Residual impacts:</b>	N/A	

## 7. A DESCRIPTION OF ANY ASSUMPTIONS, UNCERTAINTIES AND GAPS IN KNOWLEDGE

In a study such as this, it is not possible to carry out sampling over an extended period. In order to obtain a full avifaunal record it would be better to sample the area frequently throughout the year to record birds as they migrate during seasons of activity. A rapid avifaunal assessment technique was utilised (Mackinnon List) and proved statistically that A) the study area was saturated, and B) the gains in terms of detecting new species for further sampling effort was negligible. This technique provides a snapshot of what occurs on-site at a certain moment in time. Additional species may occur from time to time or may not have been detected in the survey. However, as far as possible utilising valid scientific measures, the study area was saturated and the birds that were detected are representative of the community occurring on site.

## 8. INPUT FOR THE ENVIRONMENTAL MANAGEMENT PLAN

OBJECTIVE: Minimise the impact on habitat on site during the construction phase of the project

<b>Project component/s</b>	Clearing of the site for placement of the solar panels, location of office infrastructure, steam turbine and generator, energy storage plant and vessels, powerline and pipeline servitudes and access roads
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<b>Potential Impact</b>	Impact on local bird community due to habitat loss
<b>Activity/risk source</b>	Habitat will be lost during the establishment of the solar farm and the associated infrastructure (including the clearing of land for access roads and the powerline). When habitat is destroyed the birds that occupied the habitat are compromised.
<b>Mitigation: Target/Objective</b>	All construction and maintenance activities should be carried out in a manner so as to minimise the amount of habitat loss on site

<b>Mitigation: Action/control</b>	<b>Responsibility</b>	<b>Timeframe</b>
<p>All construction activities should be carried out according to generally accepted environmental best practices.</p> <p>No additional habitat destruction should take place beyond the site boundaries or powerline and/or road servitudes</p> <p>Existing roads should be used during construction and maintenance</p>	<p>Engineering contractor</p> <p>Eskom contractor</p> <p>Environmental Control Officer</p>	Construction

<b>Performance Indicator</b>	A minimum amount of habitat clearance
<b>Monitoring</b>	ECO to monitor the extent of the disturbance and habitat clearance on a weekly basis during construction and a monthly basis during operation

OBJECTIVE: Minimise the amount of disturbance to birds on site during the construction and operational phases of the project

<b>Project component/s</b>	Activities during construction such as the placement of the solar panels, location of office infrastructure, steam turbine and generator, energy storage plant and vessels, powerline and pipeline servitudes and access roads as well as ongoing operational activities on site
<b>Potential Impact</b>	Impact on local bird community due to disturbance
<b>Activity/risk</b>	Undue disturbance by construction and operational staff can

<b>source</b>	impact on bird species. Disturbance from human activity may modify bird foraging behaviour and, even more seriously, reproduction. For shy and sensitive species this may result in negative impacts especially during the breeding season.
<b>Mitigation: Target/Objective</b>	All construction and operational activities should be carried out in a manner so as to minimise the amount of disturbance to bird species on site

<b>Mitigation: Action/control</b>	<b>Responsibility</b>	<b>Timeframe</b>
<p>All construction and maintenance should be carried out according to generally accepted environmental best practices.</p> <p>Contractors need to minimise the amount of disturbance during the construction phase by staying within the boundaries of the 6km<sup>2</sup> construction area</p> <p>If the nest of a large species is detected within the vicinity of then the Northern Cape Department needs to be notified and all attempts made to minimise the amount of disturbance of traffic or activity near it.</p>	<p>Engineering contractor</p> <p>Eskom contractor</p> <p>Environmental Control Officer</p>	<p>Construction and operation</p>

<b>Performance Indicator</b>	A minimal amount of disturbance to bird species beyond the extent of the site, powerline or road servitudes boundaries
<b>Monitoring</b>	ECO to monitor the extent of the disturbance

OBJECTIVE: Minimise the amount of interaction between birds and the solar panels	
<b>Project component/s</b>	Operation of solar panels
<b>Potential Impact</b>	Impacts on birds attracted to the solar panels

<b>Activity/risk source</b>	Ornithologists in the past have recorded instances of birds being attracted to wet runways and similar facilities which reflect light. Birds may subsequently interact with the solar facility.
<b>Mitigation: Target/Objective</b>	Birds must be prevented from interacting with the solar panels

<b>Mitigation: Action/control</b>	<b>Responsibility</b>	<b>Timeframe</b>
The ECO must monitor any events of interactions with the solar farm and birds. Based upon observations and an identified need the appropriate interventions need to be decided upon and incorporated into the Environmental Management Plan.	ECO	Operation

<b>Performance Indicator</b>	A minimal amount of interaction between bird species and the solar panels.
<b>Monitoring</b>	ECO to monitor the extent of interaction on a weekly basis.

OBJECTIVE: Minimise the impact of the power lines on resident bird communities	
<b>Project component/s</b>	Operation of power line exiting the facility
<b>Potential Impact</b>	Collision of birds with facilities associated with the development
<b>Activity/risk source</b>	Two types of collision events may occur with regards to the proposed facility, namely collisions with the PV panels, heliostats, parabolic troughs and power tower and collisions with the overhead power line.
<b>Mitigation: Target/Objective</b>	To minimise the number of collisions by birds with the power lines

<b>Mitigation: Action/control</b>	<b>Responsibility</b>	<b>Timeframe</b>
Mitigation options considered included reviewing the placement of proposed new lines, removing the earth-wire, or else fitting the wire with a type of	Eskom contractor Environmental Control Officer	Operation

marker.		
With regards to the two different alternatives proposed by the project proponent there is no significant difference (in terms of impact on birds) between the two. It would therefore be recommended to go with the shorter line.		
The line should be kept as low as possible taking into account engineering and legal requirements		
The span lengths should be kept as short as possible		
Placement of a sufficiently large form of marker which will increase the visibility of the wire.		
The marker should be placed with sufficient regularity (at least every 5-10m)		
The markers should preferably be placed on the earth wires as opposed to the conductors.		

<b>Performance Indicator</b>	Ideally there should be zero collisions.
<b>Monitoring</b>	ECO to monitor the number of collisions on a monthly basis

OBJECTIVE: Minimise the number of electrocution events	
<b>Project</b>	Operation of power line exiting the facility

<b>component/s</b>	
<b>Potential Impact</b>	Electrocution of birds on the power line structures
<b>Activity/risk source</b>	Electrocution events occur when bird perches on an electrical structure and causes an electrical short circuit by bridging the gap between live components and or live and earthed components
<b>Mitigation: Target/Objective</b>	To minimise the number of electrocution events on the power lines exiting the site

<b>Mitigation: Action/control</b>	<b>Responsibility</b>	<b>Timeframe</b>
Utilise the Eskom mono pole bird friendly structure which will significantly minimise the number of electrocutions on the power line	Eskom contractor Environmental Control Officer	Construction (design) and operation

<b>Performance Indicator</b>	Ideally there should be zero electrocution events
<b>Monitoring</b>	ECO to monitor the number of electrocution on a monthly basis

OBJECTIVE: Minimise the amount of bird pollution on the facilities	
<b>Project component/s</b>	Operation of the facility
<b>Potential Impact</b>	The build up of bird pollution, in the forms of streamers and faeces build up, will impact on the functioning of the solar panels and the power lines
<b>Activity/risk source</b>	A streamer is when a bird defecates and releases a stream of faeces which creates an air gap intrusion between the conductor and the earthed structure. A flashover occurs when an insulator string becomes coated with pollutant which then causes the insulator to function incorrectly. When the pollutant is wet, the coating becomes conductive, insulation breaks down, and a flashover occurs. This is created by a build-up of bird faeces over a period on a line.
<b>Mitigation:</b>	To minimise the number of bird pollution related events on the

<b>Target/Objective</b>	power lines exiting the site
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<b>Mitigation: Action/control</b>	<b>Responsibility</b>	<b>Timeframe</b>
Utilise the Eskom mono pole bird friendly structure which will significantly minimise the number of electrocutions on the power line. The design of the tower needs to incorporate perch deterrents in the area directly above the insulator strings to ensure that bird species are not given the opportunity to defecate on the string.	Eskom Environmental Control Officer	Operation

<b>Performance Indicator</b>	Zero incidents caused by the build up of bird faeces or flashovers
<b>Monitoring</b>	ECO to monitor the amount of pollution on the lines on a monthly basis

OBJECTIVE: Minimise the number of bird nests on infrastructure	
<b>Project component/s</b>	Operation of the facility
<b>Potential Impact</b>	Impact of bird nests on infrastructure
<b>Activity/risk source</b>	Structures similar to those on site have proven to be beneficial to certain bird species by providing roosting and nesting sites in areas where natural alternatives are scarce. There are two area of concern namely of species nesting on transmission tower structures and then nesting on the solar infrastructure itself.
<b>Mitigation: Target/Objective</b>	To minimise the number of bird nests on infrastructure

<b>Mitigation: Action/control</b>	<b>Responsibility</b>	<b>Timeframe</b>
All possible attempts should be made to prevent nests from being established	Environmental Control Officer	Operation

on infrastructure.		
All removal of bird nests should be carried out according to generally accepted environmental best practices.		
The ECO will be required to apply to the Northern Cape Provincial Department for a permit in order to relocate the nests of Sociable Weavers and White Browed Sparrow Weavers.		

<b>Performance Indicator</b>	Zero nests established on infrastructure
<b>Monitoring</b>	ECO to monitor nesting events on a weekly basis

## 9. ENVIRONMENTAL IMPACT STATEMENT

A rapid avifaunal assessment of the study area was completed, the results of which are in Section 4.3 of the report. In addition to this, a full desktop study was undertaken in which the likelihood of Species of Special Concern occurring within the study area was identified. This has been completed in Section 4.3 of the report. Based upon this baseline data the possible impacts that the development would have on local bird communities and Species of Special Concern was assessed. This has been completed in section 6 of the report. The most significant threat to bird communities would be from collisions with the overhead power line. An ideal situation would be that no species would be injured or killed due to an interaction with the solar facility, electricity infrastructure or that power was not interrupted due to an electrocution event. Unfortunately, this is not the case and these types of interactions are inevitable and will happen. What is important is to ensure that the correct measures are put in place to minimise the number of interactions. It is not believed that the loss of habitat, disturbance, or any interaction with the facility will have any negative impact on bird communities in the area.



In this document, recommendations have been made regarding practical mitigation measures for potentially significant impacts, for inclusion in the Environmental Management Plan (EMP). Provided the recommended mitigation measures are employed, BirdLife South Africa does not consider that the construction and operation of the solar plant will have a negative impact upon local bird communities or Species of Special Concern occurring in the region.

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## **Appendix A – Control sheet for Specialist Study**

**Control Sheet in line with Regulation 33 of Government Notice No. R385 of 1996**  
**EIA Regulations**

<b>Activity</b>	<b>Yes</b>	<b>No</b>	<b>Comment</b>
Details of: I: the person who prepared the report; and Ii: the expertise of that person to carry out the specialist study	√		Appendix D
A declaration that the person is independent in a form as may be specified by the competent authority	√		Appendix E
An indication of the scope of, and the purpose for which the report was prepared	√		
A description of the methodology adopted in preparing the report or carrying out the specialised process	√		
A description of any assumptions made and any uncertainties or gaps in knowledge	√		
A description of the findings and potential implications of such findings on the impact of the proposed activity including identified alternatives, on the environment	√		
Recommendations in respect of any mitigation measures that should be considered by the applicant and the competent authority	√		
A description of any consultation process that was undertaken during the course of carrying out the study	√		
A summary and copies of any comments that were received during the consultation process		√	
<b>Any other information requested by the competent authority</b>			None requested as of yet

## **Appendix B – Criteria for Evaluating Impacts**

## ASSESSMENT OF IMPACTS

Direct, indirect, and cumulative impacts of the issues identified through the Scoping Study, as well as other issues identified in the EIA Phase must be assessed in terms of the following criteria.

» The **nature**, which shall include a description of what causes the effect, what will be affected, and how it will be affected.

» The **extent**, wherein it will be indicated whether the impact will be local (limited to the immediate area or site of development) or regional:

- local extending only as far as the development site area – assigned a score of 1;
- limited to the site and its immediate surroundings (up to 10 km) – assigned a score of 2;
- will have an impact on the region – assigned a score of 3;
- will have an impact on a national scale – assigned a score of 4; or
- will have an impact across international borders – assigned a score of 5.
- 

» The **duration**, wherein it will be indicated whether:

- the lifetime of the impact will be of a very short duration (0–1 years) – assigned a score of 1;
- the lifetime of the impact will be of a short duration (2-5 years) - assigned a score of 2;
- medium-term (5–15 years) – assigned a score of 3;
- long term (> 15 years) - assigned a score of 4; or
- permanent - assigned a score of 5.

» The **magnitude**, quantified on a scale from 0-10, where a score is assigned:

- 0 is small and will have no effect on the environment;
- 2 is minor and will not result in an impact on processes;
- 4 is low and will cause a slight impact on processes;
- 6 is moderate and will result in processes continuing but in a modified way;
- 8 is high (processes are altered to the extent that they temporarily cease); and
- 10 is very high and results in complete destruction of patterns and permanent cessation of processes.

» The **probability of occurrence**, which shall describe the likelihood of the impact actually occurring. Probability will be estimated on a scale, and a score assigned:

- Assigned a score of 1–5, where 1 is very improbable (probably will not happen);
- Assigned a score of 2 is improbable (some possibility, but low likelihood);
- Assigned a score of 3 is probable (distinct possibility);
- Assigned a score of 4 is highly probable (most likely); and
- Assigned a score of 5 is definite (impact will occur regardless of any prevention measures).

- » the **significance**, which shall be determined through a synthesis of the characteristics described above (refer formula below) and can be assessed as low, medium or high.
- » the **status**, which will be described as either positive, negative or neutral.
- » the degree to which the impact can be reversed.
- » the degree to which the impact may cause irreplaceable loss of resources.
- » the *degree* to which the impact can be *mitigated*.

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

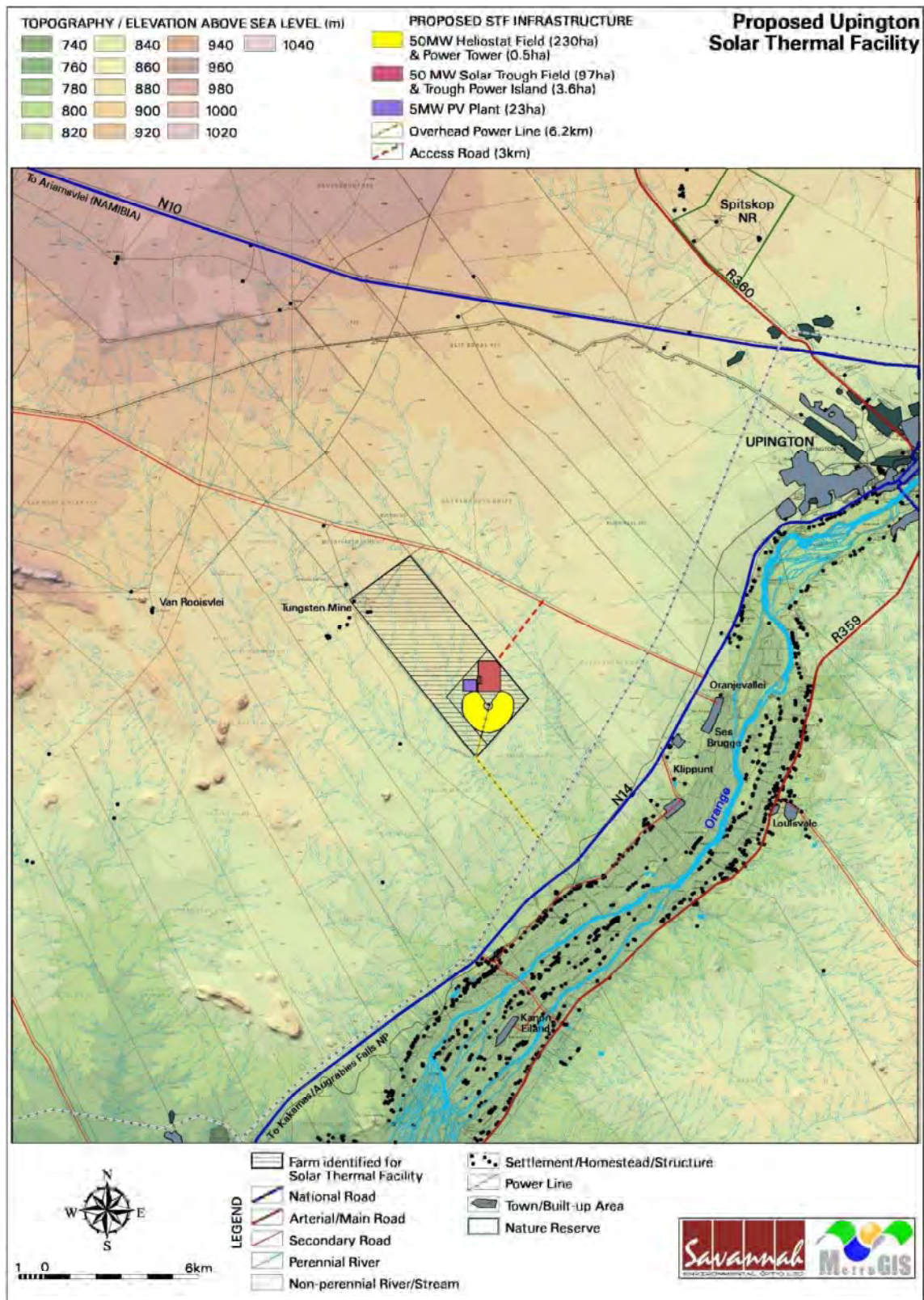
**S= (E+D+M) P**; where  
 S = Significance weighting  
 E = Extent  
 D = Duration  
 M = Magnitude  
 P = Probability

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

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



## **Appendix C – Map of the Study Area**



## **Appendix D – photograph illustrating the proposed 132kV Mono Pole Design**



## **Appendix E – Declaration of Independence**





[www.birdlife.org.za](http://www.birdlife.org.za)

Lewis House 239 Barkston Drive, Blairgowrie • P O Box 515 Randburg 2125 South Africa

Tel 0861 BIRDER / (011) 789 1122 • Fax (011) 789 5188 • e-mail [secretary@birdlife.org.za](mailto:secretary@birdlife.org.za) •

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To whom it may concern,

26 May 2010

**Declaration of Independence**

BirdLife South Africa is an independent entity and has no business, financial, personal or other interest in the activity, application or appeal in respect of which they were appointed other than fair remuneration for work performed in connection with the activity, application or appeal. BirdLife South Africa is not a subsidiary, legally or financially of Khi CSP South Africa (Pty) Ltd. Remuneration for services by the proponent in relation to this project is not linked to approval by decision making authorities responsible for authorising this proposed project. BirdLife South Africa has no interest in secondary or downstream developments as a result of the authorisation of this project. There are no circumstances that compromise the objectivity of the specialist performing such work. The percentage work received directly or indirectly from the proponent in the last 12 months is approximately 0% of BirdLife South Africa's turnover.

Yours faithfully

Mark Anderson  
Executive Director  
BirdLife South Africa

## **Appendix F – Curriculum Vitae of the Consultant**

# CURRICULUM VITAE– MARTIN TAYLOR

<b>Name</b>	<b>Martin Russell Taylor</b>
<b>Year of Birth</b>	1979
<b>Nationality</b>	South African (British passport holder)
<b>Languages</b>	English and Afrikaans
<b>Residence</b>	1a Tudor Road, Gillitts, KZN
<b>Key areas</b>	Project development and management, strategic environmental assessment , environmental assessments, ecological assessment and planning, community development, ecotourism development, proposal writing, institutional fundraising
<b>Professional experience in</b>	South Africa, Central African Republic, Lesotho, Egypt, Kenya, Malawi and Mozambique
<b>Qualifications</b>	BSc Biology with University Honours (4yr degree), Francis Marion University, USA. MSc Zoology (Masters in Conservation Ecology), University of Pretoria, South Africa
<b>Additional courses</b>	WSP Environmental Internal Environmental Management Systems Auditor Course
<b>Professional Associations</b>	Member of the South African Wildlife Management Association Pri Sci Nat (in progress)
<b>Awards and honours</b>	2005 – Recipient – Second place in the Graduate Research Award, South African Wildlife Management Association Conference, Magoebeskloof.  2004-2005 – Awarded a National Research Foundation Bursary to conduct research on coastal dune forest bird communities  2001 and 2003 – Recipient – Presidents Undergraduate Research Award, Francis Marion University. (Work done on a project initiated in



2001)

2001– Recipient – Second place in the Frank C. Brooks Undergraduate Research Award at Association of South-Eastern Biologists meeting – New Orleans.

2001 – Recipient – Biology Research Award, Francis Marion University.

1998-2000 – Deans List for Academic Achievement, Francis Marion University.

1998-1999 – Academic Honours Roll for the Peach Belt Athletics Conference

#### **Career History**

##### ***2010 until present – Editor: Red Data Books for Birds of South Africa, Swaziland and Lesotho***

Responsible for managing the revision of the Eskom Red data Book for Birds of South Africa, Swaziland and Lesotho. This includes project management and text revision.

##### ***2009 until 2010 – Division manager for BirdLife South Africa***

Avitourism division manager responsible for avitourism development within South Africa, project and financial management, proposal writing, route development, marketing, human resource management and managing various community and conservation projects.

##### ***2007 to 2009 –Project manager for BirdLife South Africa***

Project manager of the Kruger to Canyons Birding Route project, a community and conservation orientated avitourism development project. Responsible for all aspects of project and financial management of the project.

##### ***2005 to 2007 –Senior environmental consultant for Coastal and Environmental Services***

Held the position of Senior Environmental Consultant dealing with various projects involving scoping reports, environmental impact assessments, risk assessments, ecological assessments, environmental impact assessment guideline documents and environmental monitoring projects.

##### ***2003 to 2005 – Martin Taylor and Associates***

Formed Martin Taylor and Associates providing freelancing consulting services ranging from strategic environmental overviews, scoping reports, ecological assessments, vegetation assessments, and environmental management plans. Company was formed in order to supplement income whilst studying for my Masters degree.

**2001 to 2003 – Environmental scientist for WSP Walmsley (Pty) Ltd**

Held the position of Environmental Scientist and was involved in various projects involving scoping reports and environmental impact assessments, risk assessments, ecological assessments, environmental impact assessment, guideline documents and environmental monitoring projects.

**1998-2004 – Conservation Ecology Unit, University of Pretoria**

Held position of Research Assistant at Richards Bay Minerals Field Station. Involved in restoration ecology, various graduate research projects and the processing of collected data (vacational work)

**Environmental  
Project  
Experience**

**Avifaunal Assessment of Transnet Capital Projects Nsezi Property, Richards Bay, KwaZulu Natal:** Project management, field work and report writing

**Avifaunal Assessment of the Black Rock 132kV Powerline, Northern Cape:**

Project management, field work and report writing

**Avifaunal Assessment of the inundation of 200ha by the Nacala Dam, Northern Mozambique:** Project management, field work and report writing.

**SAPP EIA Thermal Guidelines for Nexant (plc), Sub Saharan Africa.** Data

Collection on EIA Practice in Sub-Saharan Africa and report writing.

**Environmental Assessment for Additional Water Supply Options for the Kwale Mineral Sands Project, Kenya:** Project management, data collection and report writing.

**Environmental Risk Report for the Dimbi Diamond Concession, Central**

**African Republic:** Project management and report writing.

**Environmental Assessment for El Burrullus Heavy Minerals Mine, Egypt:** Project management, data collection and report writing.

**Strategic Environmental Overview of a Heavy Mineral Deposit, Malawi.**

(Client and location confidential) Project management, data collection and report writing.

**Construction Environmental Action Plans for various components of the**

**Kwale Mineral Sands Project, Kenya:** Compilation of environmental action plans and document management

**EIA Guidelines for the Sectors of Roads, Transmission Lines, Telecom Masts, Filling Stations and Housing for the Department of Environmental Affairs and Tourism , South Africa.** Data collection and report writing.

**Limpopo State of the Environment Report, South Africa:** Biodiversity and Terrestrial Resource Use Sections: Data collection and report writing

**Environmental Assessment for the Knysna N2 Upgrade, South Africa:** Project management and report writing

**Rehabilitation and Closure Plan for the Coega Kop Quarry, South Africa:** Project management and report writing

**Zandriverspoort Pre-Feasibility Study for Kumba Resources (plc), South Africa.** Data collection, risk assessment, identification of alternatives and report writing.

**Environmental Assessment for RBC Distributors (Pty) Ltd Bulk Material Handling and Storage Facility, South Africa.** Data collection, impact assessment and report writing.

**Environmental Assessment for Kingsburgh 132/11/32kV substation for Durban Metro Electricity.** Project management and report writing.

**Baseline Study for Platreef Resources.** Synthesis of specialist reports and final report compilation.

**Environmental Assessment of Ferro Furnaces (Pty) Ltd.** Project management and report writing.

**Professional review of the Van Ryn Mine EMPR.** Data review and report writing.

Various Environmental Management Plans for road upgrade applications in the Limpopo Province

Various smaller EMPR's for borrow pits in the Limpopo province.

Various Environmental Due Diligence Assessments on various properties throughout South Africa.

Various Ecological Assessments for a variety of different projects and clients.

**Ecological  
research  
experience**

**Small mammal trapping - Richards Bay Minerals Ecological Monitoring Program.** Field work, grid maintenance, trap maintenance and data entry

**Vegetation surveys - Richards Bay Minerals Ecological Monitoring**

**Program.** Field work and data entry

**Herpetological surveys at Francis Marion University and surrounding**

**areas, Florence, USA.** Field work and data entry.

**Small mammal museum specimen preparation at Francis Marion University, Florence, USA.** Specimen collection and preparation.

**Bird surveys - Richards Bay Minerals Ecological Monitoring Program.** Field work, data entry, data analysis and reporting

**Acacia kosiensis seed bank trials – Richards Bay Minerals Ecological**

**Monitoring Program.** Field work, data entry and reporting

**Mastomys competition trials – University of Pretoria.** Field work.

**Assistance in African Buffalo TB Research Program at Kruger National Park:** Field assistant

**Publications,  
Technical  
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Presentations**

Wassenaar, T.D and Taylor, M.R. (2004). Seed germination rates of *Acacia kosiensis*- CERU 22. Internal technical report. Conservation Ecology Research Unit. University of Pretoria.

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Dr Adrian Shrader  
Lecturer – Wildlife Conservation Management Unit  
University of KwaZulu Natal  
Cell: +27 845686640  
Email: shrader@ukzn.ac.za

Jonathan Stacey  
Director – Rio Tinto / BirdLife International Partnership  
Cell: +44 779064264  
Email: Jonathan.Stacey@birdlife.org

## Contact details

Martin Taylor  
Cell: +27 722777254  
Email: taita@birdlife.org.za

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## **Appendix G - Species List for the Study Site**

# McTaggart's Camp 453 Avifaunal Assessment – Bird species Possibly Occurring on Site May 2010

Common Name	Scientific Name	Site survey
Acacia Pied Barbet	<i>Tricholaema leucomelas</i>	Yes
African Black Duck	<i>Anas sparsa</i>	
African Darter	<i>Anhinga rufa</i>	
African Fish-Eagle	<i>Haliaeetus vocifer</i>	
African Hoopoe	<i>Upupa africana</i>	
African Palm-Swift	<i>Cypsiurus parvus</i>	
African Pied Wagtail	<i>Motacilla aguimp</i>	
African Pipit	<i>Anthus cinnamomeus</i>	Yes
African Red-eyed Bulbul	<i>Pycnonotus nigricans</i>	Yes
African Reed-Warbler	<i>Acrocephalus baeticatus</i>	
African Sacred Ibis	<i>Threskiornis aethiopicus</i>	
Anteater Chat	<i>Myrmecocichla formicivora</i>	Yes
Ashy Tit	<i>Parus cinerascens</i>	
Barn Swallow	<i>Hirundo rustica</i>	
Black-chested Prinia	<i>Prinia flavicans</i>	
Black-eared Sparrowlark	<i>Eremopterix australis</i>	
Black-headed Heron	<i>Ardea melanocephala</i>	
Black-shouldered Kite	<i>Elanus caeruleus</i>	
Blacksmith Lapwing	<i>Vanellus armatus</i>	
Black-throated Canary	<i>Crithagra atrogularis</i>	
Black-winged Stilt	<i>Himantopus himantopus</i>	
Bokmakierie	<i>Telophorus zeylonus</i>	Yes
Brown-throated Martin	<i>Riparia paludicola</i>	
Brubru	<i>Nilaus afer</i>	
Burchell's Coucal	<i>Centropus burchellii</i>	
Cape Glossy Starling	<i>Lamprotornis nitens</i>	Yes
Cape Robin-Chat	<i>Cossypha caffra</i>	
Cape Sparrow	<i>Passer melanurus</i>	
Cape Turtle-Dove	<i>Streptopelia capicola</i>	Yes
Cape Wagtail	<i>Motacilla capensis</i>	
Capped Wheatear	<i>Oenanthe pileata</i>	
Cattle Egret	<i>Bubulcus ibis</i>	
Chestnut-vented Tit-Babbler	<i>Parisoma subcaeruleum</i>	Yes
Common Fiscal	<i>Lanius collaris</i>	Yes
Common Waxbill	<i>Estrilda astrild</i>	
Crested Barbet	<i>Trachyphonus vaillantii</i>	
Crowned Lapwing	<i>Vanellus coronatus</i>	
Diderick Cuckoo	<i>Chrysococcyx caprius</i>	
Dusky Sunbird	<i>Cinnyris fuscus</i>	Yes
Eastern Clapper Lark	<i>Mirafrasciolata</i>	
Egyptian Goose	<i>Alopochen aegyptiacus</i>	

European Bee-eater	<i>Merops apiaster</i>	
Familiar Chat	<i>Cercomela familiaris</i>	Yes
Fawn-coloured Lark	<i>Calendulauda africanoides</i>	Yes
Fiscal Flycatcher	<i>Sigelus silens</i>	
Giant Kingfisher	<i>Megaceryle maximus</i>	
Goliath Heron	<i>Ardea goliath</i>	
Greater Striped Swallow	<i>Hirundo cucullata</i>	
Grey-backed Sparrowlark	<i>Eremopterix verticalis</i>	
Hadedda Ibis	<i>Bostrychia hagedash</i>	Yes
Hamerkop Hamerkop	<i>Scopus umbretta</i>	
House Sparrow	<i>Passer domesticus</i>	
Icterine Warbler	<i>Hippolais icterina</i>	
Karoo Korhaan	<i>Eupodotis vigorsii</i>	Yes
Karoo Scrub-Robin	<i>Cercotrichas coryphoeus</i>	
Karoo Thrush	<i>Turdus smithi</i>	
Laughing Dove	<i>Streptopelia senegalensis</i>	Yes
Layard's Tit-Babbler	<i>Parisoma layardi</i>	Yes
Lesser Swamp-Warbler	<i>Acrocephalus gracilirostris</i>	
Little Bittern	<i>Ixobrychus minutus</i>	
Little Egret	<i>Egretta garzetta</i>	
Little Swift	<i>Apus affinis</i>	
Long-billed Crombec	<i>Sylvietta rufescens</i>	
Mountain Wheatear	<i>Oenanthe monticola</i>	
Namaqua Dove	<i>Oena capensis</i>	
Namaqua Sandgrouse	<i>Pterocles namaqua</i>	Yes
Namaqua Warbler	<i>Phragmacia substriata</i>	
Northern Black Korhaan	<i>Afrotis afraoides</i>	Yes
Orange River White-eye	<i>Zosterops pallidus</i>	
Pied Kingfisher	<i>Ceryle rudis</i>	
Pied Starling	<i>Spreo bicolor</i>	
Pirit Batis	<i>Batis pririt</i>	Yes
Purple Heron	<i>Ardea purpurea</i>	
Red-billed Quelea	<i>Quelea quelea</i>	
Red-billed Teal	<i>Anas erythrorhyncha</i>	
Red-eyed Dove	<i>Streptopelia semitorquata</i>	
Reed Cormorant	<i>Phalacrocorax africanus</i>	
Rock Martin	<i>Hirundo fuligula</i>	
Rufous-cheeked Nightjar	<i>Caprimulgus rufigena</i>	
Rufous-eared Warbler	<i>Malcorus pectoralis</i>	Yes
Sabota Lark	<i>Calendulauda sabota</i>	Yes
Scaly-feathered Finch	<i>Sporopipes squamifrons</i>	
Short-toed Rock-Thrush	<i>Monticola brevipes</i>	
Sociable Weaver	<i>Philetairus socius</i>	Yes
South African Shelduck	<i>Tadorna cana</i>	
Southern Grey-headed Sparrow	<i>Passer diffusus</i>	
Southern Masked-Weaver	<i>Ploceus velatus</i>	
Southern Pale Chanting Goshawk	<i>Melierax canorus</i>	Yes
Southern Red Bishop	<i>Euplectes orix</i>	



Speckled Pigeon	<i>Columba guinea</i>	
Spike-heeled Lark	<i>Chersomanes albofasciata</i>	Yes
Spotted Flycatcher	<i>Muscicapa striata</i>	
Spur-winged Goose	<i>Plectropterus gambensis</i>	
Swallow-tailed Bee-eater	<i>Merops hirundineus</i>	
Three-banded Plover	<i>Charadrius tricollaris</i>	
Wattled Starling	<i>Creatophora cinerea</i>	
White-backed Mousebird	<i>Colius colius</i>	
White-breasted Cormorant	<i>Phalacrocorax carbo</i>	
White-browed Sparrow-Weaver	<i>Plocepasser mahali</i>	Yes
White-faced Duck	<i>Dendrocygna viduata</i>	
White-throated Swallow	<i>Hirundo albigularis</i>	
Wood Sandpiper	<i>Tringa glareola</i>	
Yellow Canary	<i>Crithagra flaviventris</i>	

\*Data derived from Southern African Bird Atlas Project 2

## **Appendix H - Red Data Species Occurring within the Northern Cape**

## Red Data Bird Species List for the Northern Cape

Common name	Scientific name	Status	Red Data Book status	Habitat
Saddle-billed Stork	<i>Ephippiorhynchus senegalensis</i>	Uncommon	Endangered	Water
Damara Tern	<i>Sterna balaenarum</i>	Rare	Endangered	Ocean
Southern Giant-Petrel	<i>Macronectes giganteus</i>	Common	Near-threatened	Ocean
Northern Giant-Petrel	<i>Macronectes halli</i>	Common	Near-threatened	Ocean
White-chinned Petrel	<i>Procellaria aequinoctialis</i>	Common	Near-threatened	Ocean
Great White Pelican	<i>Pelecanus onocrotalus</i>	Common	Near-threatened	Water
Cape Cormorant	<i>Phalacrocorax capensis</i>	Common	Near-threatened	Ocean
Crowned Cormorant	<i>Phalacrocorax coronatus</i>	Uncommon	Near-threatened	Ocean
Black Stork	<i>Ciconia nigra</i>	Rare	Near-threatened	Water
Marabou Stork	<i>Leptoptilos crumeniferus</i>	Uncommon	Near-threatened	Game Reserves
Yellow-billed Stork	<i>Mycteria ibis</i>	Uncommon	Near-threatened	Water
Greater Flamingo	<i>Phoenicopterus ruber</i>	Common	Near-threatened	Water
Lesser Flamingo	<i>Phoenicopterus minor</i>	Common	Near-threatened	Water
Secretarybird	<i>Sagittarius serpentarius</i>	Uncommon	Near-threatened	Grassland
Pallid Harrier	<i>Circus macrourus</i>	Uncommon	Near-threatened	Grassland
Black Harrier	<i>Circus maurus</i>	Uncommon	Near-threatened	Grassland
Peregrine Falcon	<i>Falco peregrinus</i>	Rare	Near-threatened	Cliffs
Lanner Falcon	<i>Falco biarmicus</i>	Uncommon	Near-threatened	Varied
Blue Korhaan	<i>Eupodotis caerulea</i>	Common	Near-threatened	Grassland
African Black Oystercatcher	<i>Haematopus moquini</i>	Common	Near-threatened	Ocean
Chestnut-banded Plover	<i>Charadrius pallidus</i>	Uncommon	Near-threatened	Wetlands, Pans
Caspian Tern	<i>Sterna caspia</i>	Common	Near-threatened	Water
Eastern Long-billed Lark	<i>Certhilauda semitorquata</i> [c.]	Common	Near-threatened	Farmlands
Short-clawed Lark	<i>Certhilauda chuana</i>	Uncommon	Near-threatened	Thornveld
Sclater's Lark	<i>Spizocorys sclateri</i>	Uncommon	Near-threatened	Stony desert scrub
Red-billed Oxpecker	<i>Buphagus erythrorhynchus</i>	Rare	Near-threatened	Savanna
Eastern Long-billed Lark	<i>Certhilauda semitorquata</i> [c.]	Common	Near-threatened	Farmlands
Egyptian Vulture	<i>Neophron percnopterus</i>	Rare	Regionally extinct	Grassland
Lappet-faced Vulture	<i>Torgos tracheliotus</i>	Rare	Vuln. / Threat	Grassland
African Penguin	<i>Spheniscus demersus</i>	Common	Vulnerable	Ocean
Indian Yellow-nosed Albatross	<i>Thalassarche carteri</i>	Uncommon	Vulnerable	Ocean
Pink-backed Pelican	<i>Pelecanus rufescens</i>	Uncommon	Vulnerable	Water
Cape Gannet	<i>Morus capensis</i>	Common	Vulnerable	Ocean
Bank Cormorant	<i>Phalacrocorax neglectus</i>	Common	Vulnerable	Ocean
White-backed Night-Heron	<i>Gorsachius leuconotus</i>	Uncommon	Vulnerable	Water
Hooded Vulture	<i>Necrosyrtes monachus</i>	Uncommon	Vulnerable	Grassland
White-backed Vulture	<i>Gyps africanus</i>	Uncommon?	Vulnerable	Grassland
White-headed Vulture	<i>Trigonoceps occipitalis</i>	Uncommon	Vulnerable	Grassland
Tawny Eagle	<i>Aquila rapax</i>	Uncommon	Vulnerable	Thornveld
Martial Eagle	<i>Polemaetus bellicosus</i>	Uncommon	Vulnerable	Varied
Bateleur	<i>Terathopius ecaudatus</i>	Uncommon	Vulnerable	Savanna
African Marsh-Harrier	<i>Circus ranivorus</i>	Uncommon	Vulnerable	Marshlands
Blue Crane	<i>Anthropoides paradisea</i>	Common	Vulnerable	Grassland
Corn Crake	<i>Crex crex</i>	Uncommon	Vulnerable	Grassland
Kori Bustard	<i>Ardeotis kori</i>	Uncommon	Vulnerable	Grassland
Ludwig's Bustard	<i>Neotis ludwigii</i>	Uncommon	Vulnerable	Savanna
Red Lark	<i>Certhilauda burra</i>	Common	Vulnerable	Shrubland, dunes
Cape Vulture	<i>Gyps coprotheres</i>	Uncommon	Vulnerable / Threat	Grassland



# **GEOLOGICAL REPORT**

## **SPECIALIST INPUT FOR THE ENVIRONMENTAL IMPACT ASSESSMENT FOR THE PROPOSED UPINGTON SOLAR THERMAL PLANT NEAR UPINGTON, NORTHERN CAPE**

**Technical Report No: OGS2010-09-07-2**

**September 2010**

**PREPARED BY:**

**OUTENIQUA GEOTECHNICAL SERVICES  
PO BOX 3186  
GEORGE INDUSTRIA  
6536**



**PREPARED FOR:**

**SAVANNAH ENVIRONMENTAL (PTY) LTD  
PO BOX 148  
SUNNINGHILL  
2157**



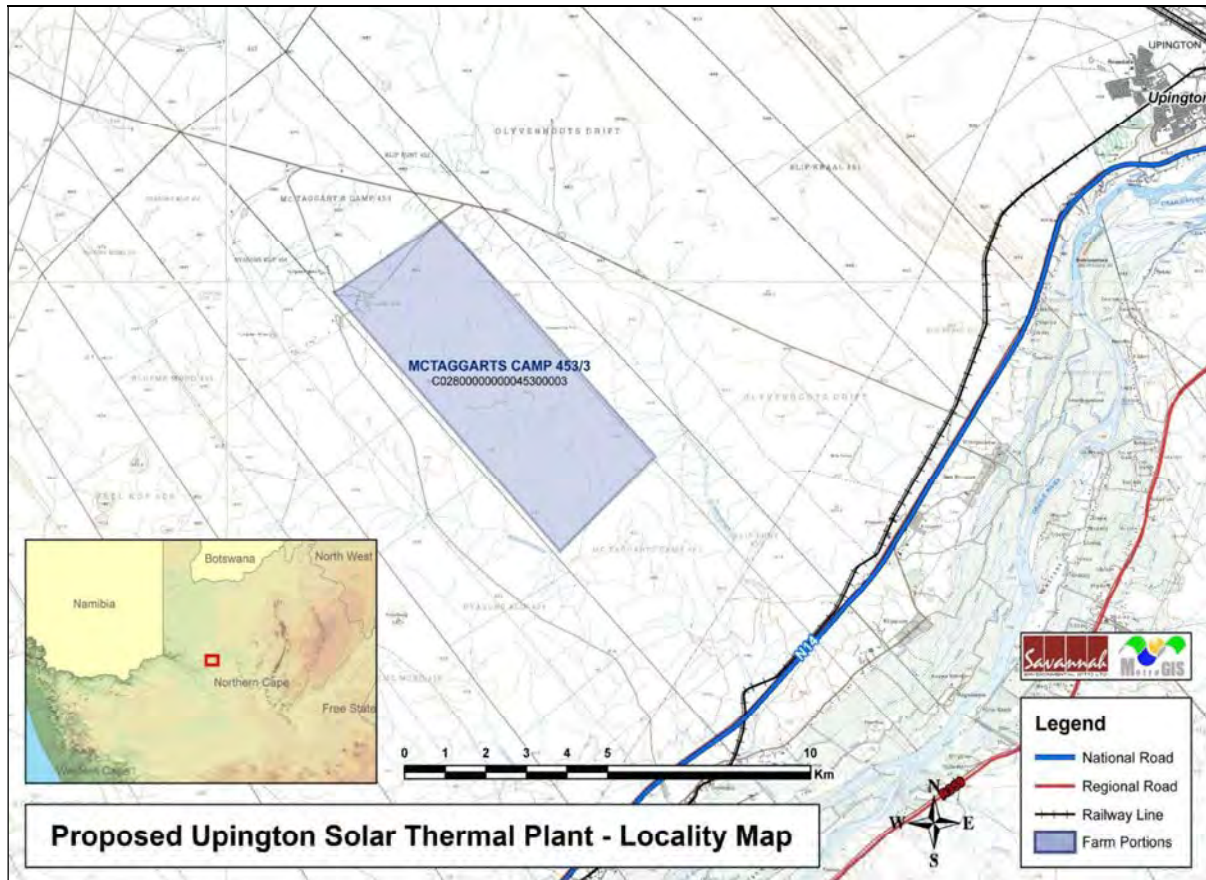
### **List of abbreviations and definitions**

The study area:	The area as delineated on <b>Figure 1</b>
EIA:	Environmental Impact Assessment
EMP:	Environmental Management Plan
AMSL:	Above mean sea level
NGL:	Natural Ground Level
ECO:	Environmental Control Officer
Ma:	Million years before present

## 1. INTRODUCTION

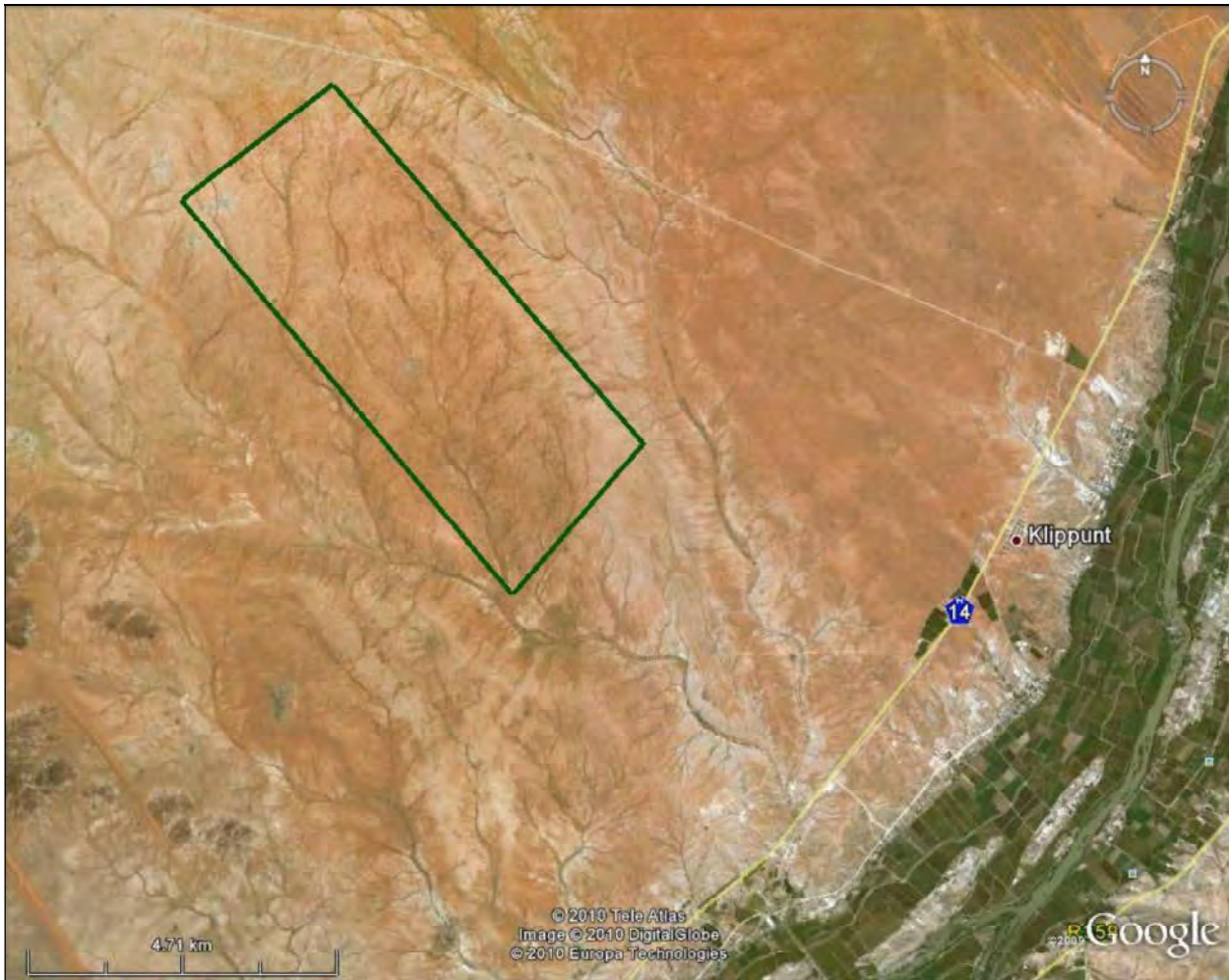
### 1.1. Background information and location

Savannah Environmental (Pty) Ltd is conducting an Environmental Impact Assessment (EIA) on behalf of Khi CSP South Africa (Pty) Ltd (!Khi CSP) for the proposed Upington Solar Thermal Plant. The facility is proposed on Portion 3 of the Farm McTaggart's Camp 453, which is approximately 20km southwest of Upington in the Northern Cape Province. The study area is accessible via the N14 from Upington, which is the nearest major commercial centre.



**Figure 1:** Locality and topography map of study area (purple-shaded)

The proposed facility is expected to have a development footprint (i.e. the area which will be disturbed during the operational phase), of approximately 6 km<sup>2</sup> within the broader farm portion which is approximately 22 km<sup>2</sup> (refer to Figure 2 for an aerial photo of the farm portion).



**Figure 2:** Aerial photo of the study area (green line)

### **1.2. Description of the proposed activity**

The proposed solar thermal plant will have a maximum generating capacity of 110 MW which will be achieved using the following technologies (in any combination):

- » Parabolic troughs (concentrating solar power)
- » Power tower and heliostat field (concentrating solar power)
- » Photovoltaic panels

The ancillary infrastructural requirements will include:

#### ***A steam turbine & generator***

Concentrating solar power facilities require water as the heat transfer medium for the generation of high temperature steam which is used to drive a conventional turbine and generator. This turbine and generator will be housed within a 2-storey building on-site. It is envisioned that the water will be extracted from the Orange (Gariep) River (the preferred abstraction point is discussed below).



### ***A generator transformer and a small substation outside the building***

This infrastructure would form part of the power island.

### ***Energy storage plant and vessels***

An auxiliary steam boiler (i.e. fossil fuel boiler / generator) will be included on the power island and will be fired by diesel fuel or LPG. The boiler will be able to provide steam to the process, freeze protection heat exchangers, steam turbine seal system, and other critical plant components while the solar plant is offline or during night time or cloud covered days, or when the grid connection is not available.

### ***Power line***

The generated power will be evacuated into the Eskom electricity grid. An overhead power line of 132 kV will be constructed and connected via a 'turn in and turn out' configuration to an existing Eskom distribution line running approximately 4 km south of the site. This power line connects Eskom's Gordonia Distribution Substation (close to Upington) to its Oasis Distribution Substation (close to Keimoes). Two alternative corridors/routes are proposed for the power line and include:

- » Alternative A (see **Figure 3**).
- » Alternative B (see **Figure 3**).

### ***Pipeline***

A water supply pipeline will be constructed and the required volume of water will be treated and pumped to the facility. A water supply pipeline to the facility and extraction point on the Orange (Gariep) River is proposed. Based on an extensive feasibility assessment, one alternative route has been provided for the proposed pipeline (see **Figure 3**). This route is preferred by virtue of:

- » Shortest pipeline route
- » Minimum impact on the environment
- » Easy access to the pipeline for maintenance purposes
- » Getting out of the flood lines as soon as possible
- » An agreement has been reached to establish an abstraction point on the property of Mr. Conrad Geldenhuys
- » The identified routing will follow an existing road reserve

### ***Water treatment***

Water that has been abstracted from the Orange River will be pumped to a settlement reservoir located approximately 0.6 km north-west of the abstraction point to get rid of particles in suspension. A second storage reservoir will be located approximately 8.5 km west of the abstraction point within the boundaries of the identified site.

### ***Blow down pond***

A blow down pond will be established to receive wastewater from the generation process.

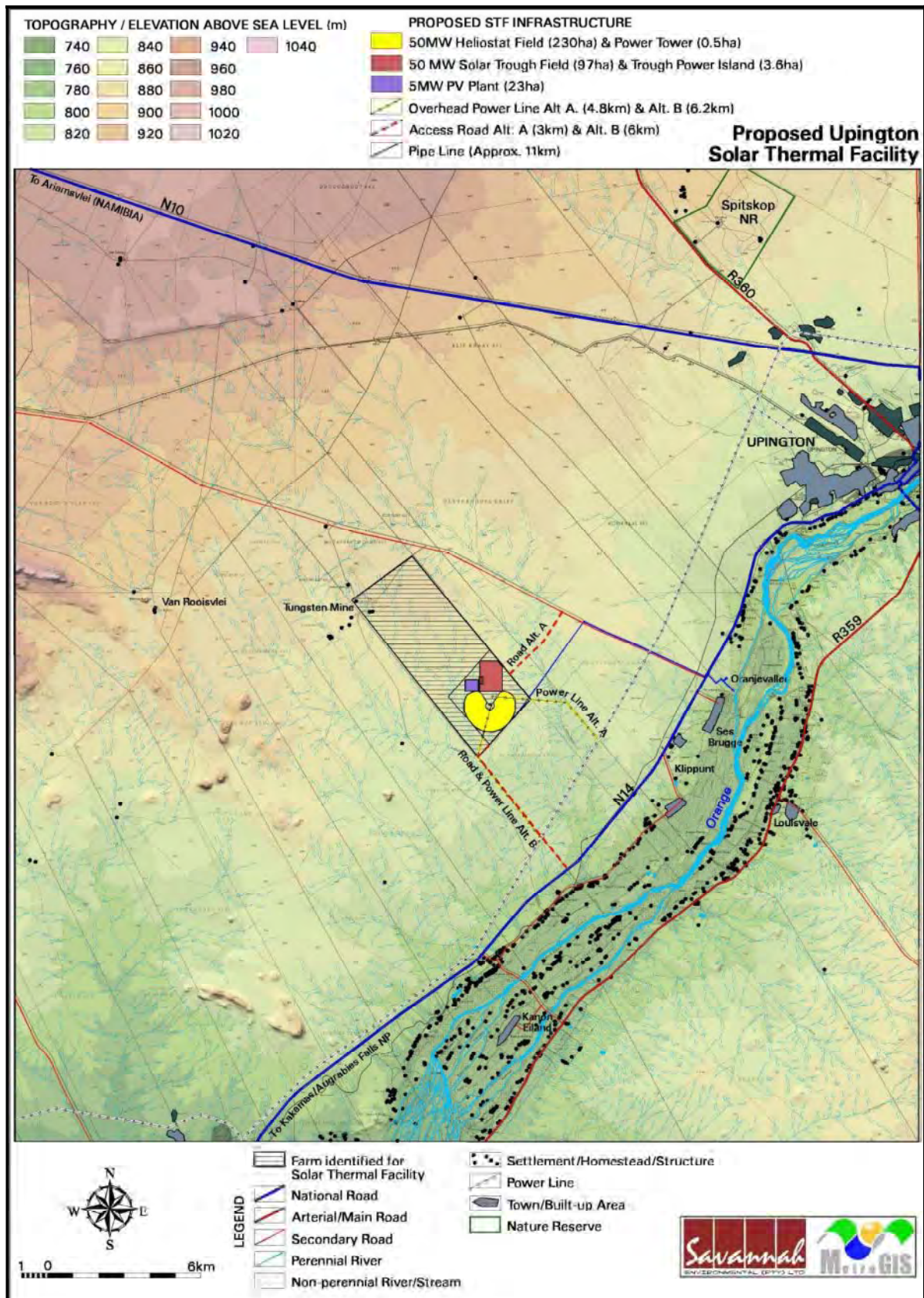
***Access roads***

An external access road to the site will be established from the main road (i.e. N14), which runs approximately 5.2 km south-east of the site. Internal access roads will also be established for construction and maintenance purposes. Depending on the technology selection there will be one internal asphalt access road of approximately 6 m wide which will lead directly to the power island. Between the heliostats/troughs/photovoltaic panels there will be a stabilised gravel track that would be used for maintenance purposes during the operational phase. Two routes for the external access road are proposed and are as follows:

- » Alternative A (see **Figure 3**).
- » Alternative B (see **Figure 3**).

***Workshop, office, and storage areas***

These areas would be located within the boundaries of the overall site.



**Figure 3:** Topographical terrain map showing layout of proposed facility and associated infrastructure

### **1.3. Applicable legislation**

In terms of the EIA regulations published in terms of Section 24(5) of the National Environmental Management Act (NEMA, No 107 of 1998), the applicant requires an Environmental Authorisation from the National Department of Environmental Affairs (DEA) (in consultation with the Provincial Department) for the undertaking of the proposed project. This specialist study fulfils the requirements under section 33 of the EIA regulations i.t.o. NEMA, published in Government Gazette R385 of 2006.

### **1.4. Terms of reference**

Savannah Environmental has been appointed by the applicant to carry out the EIA process for the proposed activity. Specialist geological input is required in order to assess the environmental impacts on the geology and soil profile over the study area. Savannah Environmental appointed Outeniqua Geotechnical Services to conduct a specialist geological study of the study area.

The following broad scope of work has been given:

- Carry out a desk-top study of available information pertaining to the geology and soil types of the study area and the environmental impacts on the geological environment that are likely to be associated with the proposed activity.
- Conduct a brief site visit to collect visual data pertaining to the geology, soil types and potential soil degradation issues.
- Prepare a report on the findings of the study including an assessment of the potential impacts.

The following aspects are covered in this report:

- A description of the proposed activity
- A description of the environment that may be affected by the activity (the study area)
- A description of the geology and soil types in the study area
- An assessment of the potential environmental impacts on the soil profile and other geological features (with emphasis on erosion and soil degradation)
- Guidelines for mitigating measures to be included in the EMP
- A preliminary indication of potential geotechnical constraints on the proposed project that may impact on the civil engineering design

### **1.5. Limitations**

Information provided in this specialist report has been based on information provided by !Khi CSP South Africa, published scientific literature and maps. The study area was visited briefly but no detailed soil investigation (trial pits, soil testing), geomorphological or geohydrological assessment or verification of the existing geological mapping was conducted. The information provided in this report is deemed adequate for the EIA process and preliminary

planning phase but further geotechnical information may be required for the detailed design phase.

### **1.6. Authors credentials and declaration of independence**

The author of this report, Iain Paton of Outeniqua Geotechnical Services cc (OGS), is a professional engineering geologist registered with the South African Council of Natural and Scientific Professions (Pr Sci Nat # 400236/07) with 12 years experience in the mining, petroleum and construction industries and is a member of the South African Institute of Engineering and Environmental Geologists. Iain Paton declares that he does not have any financial interest in the undertaking of the activity, other than remuneration for work performed in the compilation of this specialist report.

## **2. DESCRIPTION OF THE ENVIRONMENT**

### **2.1. Topography, climate, and vegetation cover**

The study area has a gently undulating topography which falls from an altitude of 870m in the north to 820m AMSL in the south. Numerous ephemeral tributaries of the Helbrandkloofspruit drain the area in a south-southeast direction towards the Orange River.

The Weinert Climatic N-number<sup>7</sup> for the area, which is between 40 and 50, indicates that the climate is extremely arid and mechanical weathering processes are dominant. Mean annual precipitation for this region is less than 200mm and the annual potential evaporation is in excess of 2500mm. In 1950, 500mm of rainfall was recorded and in three separate occasions since 1960, annual rainfall exceeded 300mm.<sup>2</sup>

Vegetation cover is predominantly Kalahari Karroid Shrubland and Bushmanland Arid Grassland.<sup>6</sup>

### **2.3. Geology and soil types**

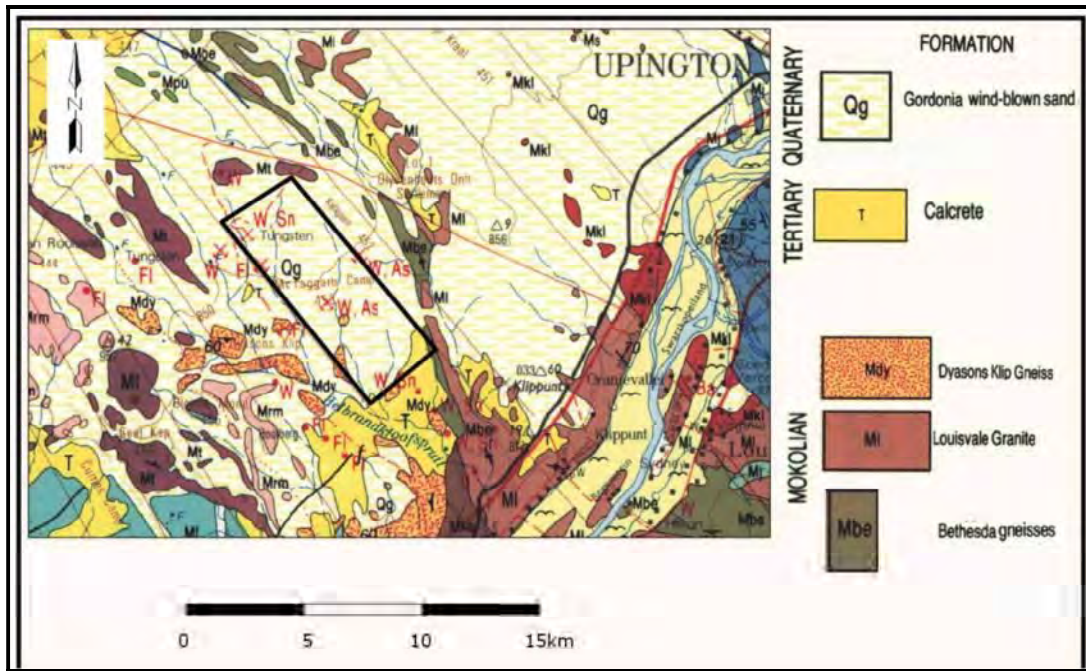
The study area is located within the Namaqualand Metamorphic Belt which comprises very old and very highly deformed sedimentary and igneous rocks of the Mokolian Erathem (2100-1200Ma) that form part of the Southern African Basement Complex. The rocks of this complex have undergone both regional and contact metamorphism and the culminating deformation phase has been dated at about 1000Ma<sup>4</sup>.

The bedrock geology of the study area is covered by Quaternary red-brown wind-blown sands of the Gordonia Formation. Localised outcrops of Dyasons Klip gneisses of Mokolian age (Mdy in **Figure 4**) protrude through the sand cover in the southern portion of the study area. Other metamorphic rocks of Mokolian age in the near vicinity of the study area include Louisvale granite (MI in **Figure 4**) and Bethseda gneiss (Mbe in **Figure 4**). A calcrete capping of Tertiary age also occurs in the southern portion of the study area.



Inactive opencast mining operations in the study area include tungsten, tin, arsenic and fluoride, mapped in **Figure 4** as W, Sn, As and Fl respectively. Fairly extensive diggings appear to have been carried out in the northwestern corner of the study area.

Basement rock outcrops are sparse and the majority of the study area is covered in Quaternary unconsolidated sands and pedogenic calcrete capping. The thickness of the sands is unknown at this stage, but is thought to be approximately 10-20m.



**Figure 4:** Geology of the study area

## 2.4. Hydrology

Mean annual precipitation for the study area is less than 200mm which is exceptionally low but heavy downpours are known to occur in the region, albeit infrequently. The expected infiltration is likely to be high over most of the study area which is underlain by Quaternary aeolian sandy soils (Qg in **Figure 4**). In the southern portion of the site where a hard calcrete capping occurs on surface or basement rocks protrude through Quaternary sand cover, ground infiltration will be relatively low and higher run-off can be expected and this may negatively affect erosion potential in downstream areas where soil is thicker. Analysis of aerial photography indicates a well-defined dendritic drainage pattern which drains the site into the Helbrandkloofspruit which feeds into the Orange (Gariep) River.

Hydrology plays an important role in the erosion potential. Rainfall, if not intercepted by vegetation or by artificial surfaces, falls on the earth where it may evaporate, infiltrate, lie in depression storage, or end up as surface run-off. The permeability of the ground influences the percentage of rainfall which infiltrates. Where soil cover is thin or impermeable, infiltration will tend to be lower and vice versa. Surface run-off is generally inversely proportional to infiltration, ceteris paribus. Rainfall intensity, infiltration, and slope gradient influence the volume, velocity and energy of the surface run-off. The energy of the hydraulic

system and the soil texture and consistency are the main determining factors of the erosion potential. The presence of vegetation and other erosion inhibitors will tend to reduce the energy of the hydraulic system as well as providing an anchoring effect on the soil mass.

In this particular study area, the Quaternary soil cover is moderately to highly permeable and the slope gradients are low which means that under normal conditions, run-off and subsequent erosion is likely to be low. However, the existence of a well-defined drainage pattern is an indication that exceptional heavy downpours do occur, during which time, a significant proportion ends up as run-off, and this results in erosion along the drainage lines.

### **3. GEOLOGICAL IMPACT ASSESSMENT**

The geological impact assessment aims to assess the impact that the proposed development will have on the geological environment which includes the bedrock and the overlying natural soil profile. The impact on the natural soil profile is generally considered most important as it is crucial for the sustainability of ecosystems. Important or prominent geological features (geosites) that contribute to the aesthetic scenery or academic interest in the area, such as prominent rock outcrops or features or fossil sites, are also considered in the impact study. Geological features, such as caves, addits, middens, worship rocks, etc. which are important from historical, cultural, archaeological or religious heritage standpoint are not assessed in this report as they are covered in the Heritage Impact Assessment. Geohydrological impact assessments also do not form part of this study.

#### **3.1. Soil degradation**

Soil degradation is the removal, alteration, or damage to soil and associated soil forming processes, usually related to human activities. The stripping of vegetation or disturbance to the natural ground level over disturbance areas will negatively affect soil formation, natural weathering processes, moisture levels, soil density, soil chemistry, and biological activity. Soil degradation includes erosion (due to water and wind), salinisation, acidification, crusting, water-logging, pollution, soil excavation, removal or burial (as in the case of cut-and-fill operations) and soil compaction.

The proposed construction activities will include excavation, loosening or displacement of soil, stockpiling, mixing, wetting, filling and compaction of soil and soil pollution with chemicals (such as fuel, oil and cement) and these activities carry potential negative direct impacts contributing to soil degradation and possibly accelerated erosion. These activities could also cause negative indirect impacts such as increased siltation in other areas away from the site causing negative impact on water sources and agriculture with potential socio-economic repercussions. The severity or significance of the various impacts is largely dependent on the nature and scope of the activity. There are no known positive impacts relating to the geological environment and the impacts are generally related to the construction phase only with very little additional impacts in the post construction and decommissioning phases.

Soil erosion is a natural process whereby the ground level is lowered by wind or water action and may occur as a result of, *inter alia* chemical processes and/or physical transport on the

land surface<sup>1</sup>. Soil erosion induced or increased by human activity is termed “accelerated erosion” and is an integral element of global soil degradation. Accelerated soil erosion is generally considered the most important geological impact in any development due to its potential impact on a local and regional scale (i.e. on and off site) and as a potential threat to agricultural production.

Soil erodibility potential is the likelihood that erosion will occur when soils are exposed to water and/or wind as a result of land-disturbing activities. This is a complex phenomenon, not only because it depends on soil chemistry, texture, and characteristics, but because it varies with time and other variables. However, the geology of the site, soil texture, and topography are the main considerations. The Erosion Index for South Africa<sup>4</sup> indicates that the area where the site is located has a low susceptibility to erosion, primarily due to the very dry climate. However, exceptional heavy rainfall can occur and therefore soil erosion concerns will be greatest along drainage lines where run-off is concentrated and hydraulic energy is potentially high. Areas where loose, unconsolidated sandy soils of low plasticity (i.e. Gordonia wind-blown sands) occur also tend to be more susceptible to erosion following heavy downpours, and this includes most of the proposed site. In addition to this, areas where vegetation is limited or has been disturbed or damaged due to construction activity will be more susceptible to erosion following heavy downpours. Localised occurrences of hard, resistant near-surface calcrete capping, or duricrust will, however, tend to limit erosion in areas where these outcrops are present. **Table 1** outlines the site-sensitivity in terms of erosion susceptibility.

**Table 1:** Erosion sensitivity

Sensitivity Level	Area/Terrain	Comments/Recommendations
High	Natural drainage lines/watercourses	Thick fine-grained alluvial soil. Erosion is currently taking place - No-go areas without special mitigating measures being implemented
Moderate	Areas underlain by Gordonia wind-blown sands (see <b>Figure 4</b> )	Erosion of loosened, exposed sand is likely to occur during heavy downpours or due to concentrated discharge of construction water. The presence of shallow calcrete rock will have limiting effect.
Low	Areas underlain by calcrete and other rock types (see <b>Figure 4</b> )	

The proposed development layout indicates that some infrastructure and roads are sited near or across small drainage lines. These areas tend to be more sensitive in terms of erodibility potential and special engineering designs such as culverts, river training, etc. may have to be considered to minimise impact on these watercourses and to prevent obstructions in the site drainage.



### **3.2. Degradation of bedrock**

The proposed activity is unlikely to have any significant impact on bedrock due to the limited extent of excavations.

### **3.3. Degradation of geo-sites**

Geo-sites are interesting or academically important geological exposures or features that require protection for obvious reasons and the environmental impact process needs to cater for these aspects, if they occur within the site. The occurrence of these sites is not always apparent unless the particular feature is well known (such as a prominent rock feature like the Maltese Cross in the Cederberg). Geo-sites that are less well-known or that have local significance are usually brought to light during the public participation process. Following a site visit, it was concluded that there are no geo-sites that warrant special attention for preservation.

### **3.4. Assessment of impacts**

Direct impacts are impacts on the environment that may occur as a direct result of activity within a specific area. Indirect impacts are impacts on the environment that may occur away from the site where the activity is occurring but are related to the activity. The cumulative impact is the combined, incremental effects over time of all development that has occurred or is going to occur within an area. Impacts are assessed in terms of the following criteria:

- The nature of the impact - what causes the impact, what will be impacted and how it will be impacted;
- The extent of the impact - whether it is local (limited to the immediate area or site of the development) or regional (on a scale of 1 to 5).
- The duration of the impact – whether it will be very short (less than 1 year), short (1-5 years), medium (5-15 years), long (>15 years) or permanent (on a scale of 1 to 5, respectively).
- The magnitude, quantified on a scale of 0-10, where 0 is small and will have no impact on the environment, 2 is minor and will not result in an impact on processes, 4 is low and will have a slight impact on processes, 6 is moderate and will result in processes continuing, but in a modified way, 8 is high and processes are altered the extent that they temporarily cease, and 10 is very high and results in complete destruction of patterns and permanent cessation of processes.
- The probability of occurrence, which describes the likelihood of the impact actually occurring (on a scale of 1 to 5 – very improbable to definite).
- The significance, which is determined through a synthesis of the characteristics described above and is assessed as low, medium or high.
- The status, which is described as positive, negative or neutral.
- The degree to which the impact can be reversed.
- The degree to which the impact may cause the irreplaceable loss of resources.
- The degree to which the impact can be mitigated.

- The possibility of significant cumulative impacts of a number of individual areas of activity.
- The possibility of residual impacts existing after mitigating measures have been put in place

The significance is calculated by combining the criteria in the following formula:

$$S = (E+D+M)P$$

Where:

S = Significance weighting

E = Extent

D = Duration

M = Magnitude

P = Probability

The significance weightings for each potential impact are as follows:

<30 points: Low (i.e. where this impact would not have a direct influence on the decision to develop in the area);

30-60 points: Moderate (i.e. where the impact could influence the decision to develop in the area unless it is effectively mitigated);

>60 points: High (i.e. where the impact will influence the decision to develop in the area).

### 3.4.1. Direct impacts

The most important direct impact is soil degradation including erosion from the area of construction activity. An assessment of the individual direct potential impacts associated with the proposed activity is outlined in **Table 2**.

**Table 2:** Assessment of potential direct impacts

<b>Nature: Soil and/or rock degradation</b> – Removal of soil and/or rock for foundations and roads affecting soil forming processes and/or local geology		
	<b>Without mitigation</b>	<b>With mitigation</b>
<b>Extent</b>	Local (1)	Local (1)
<b>Duration</b>	Permanent (5)	Medium term (3)
<b>Magnitude</b>	Moderate (6)	Low (4)
<b>Probability</b>	Definite (4)	Definite (4)
<b>Significance</b>	<b>Moderate (48)</b>	<b>Moderate (32)</b>
<b>Status</b>	Negative	Negative
<b>Reversibility</b>	Partially reversible	Partially reversible
<b>Irreplaceable loss of resources?</b>	Yes	Yes, low
<b>Can impacts be mitigated?</b>	Yes, to a certain extent.	
<b>Mitigation:</b>	<ul style="list-style-type: none"> <li>• Topsoil can be replaced over foundations, if practical</li> <li>• Keep to existing roads/tracks, where practical, to minimise impact on</li> </ul>	

	undisturbed ground
<b>Cumulative impacts:</b>	The cumulative impact of topsoil removal and burial is considered low due to the limited extent of the activity and the scarcity of development in the area
<b>Residual impacts:</b>	Minor – slow regeneration of topsoil

**Nature: Soil degradation** – Site clearing, soil mixing, cut-and-fill operations, and compaction for construction platforms and road embankments affecting soil forming processes, resources and erosion potential.

	<b>Without mitigation</b>	<b>With mitigation</b>
<b>Extent</b>	Local (1)	Local (1)
<b>Duration</b>	Long term (4)	Medium term (3)
<b>Magnitude</b>	Moderate (6)	Low (4)
<b>Probability</b>	Definite (4)	Definite (4)
<b>Significance</b>	<b>Moderate (44)</b>	<b>Moderate (32)</b>
<b>Status</b>	Negative	Negative
<b>Reversibility</b>	Partially reversible	Partially reversible
<b>Irreplaceable loss of resources?</b>	Yes	Yes, minor
<b>Can impacts be mitigated?</b>	Yes, to a certain extent	
<b>Mitigation:</b>	<ul style="list-style-type: none"> <li>Plan access roads according to minimise crossing of drainage lines</li> <li>Minimise size of disturbance areas</li> <li>Restrict activity within disturbance areas</li> <li>Plan soil embankments with max slope of 1:2 to allow for rehabilitation and or use erosion control measures where necessary</li> <li>Keep to existing roads, where practical, to minimise impact on undisturbed ground</li> </ul>	
<b>Cumulative impacts:</b>	The cumulative impact of site clearing, soil mixing, etc. is considered low due to the limited extent of the activity and the dearth of development in the area.	
<b>Residual impacts:</b>	Minor – slow regeneration of topsoil.	

**Nature: Soil degradation** – Pollution, salinisation, acidification or water-logging of natural soil in construction areas affecting soil formation processes.

	<b>Without mitigation</b>	<b>With mitigation</b>
<b>Extent</b>	Local (1)	Local (1)
<b>Duration</b>	Medium term (3)	Short term (2)
<b>Magnitude</b>	Low (4)	Low (4)
<b>Probability</b>	Probable (3)	Probable (3)
<b>Significance</b>	<b>Low (24)</b>	<b>Low (21)</b>
<b>Status</b>	Negative	Negative
<b>Reversibility</b>	Irreversible	Reversible
<b>Irreplaceable loss of resources?</b>	Yes	Yes, minor
<b>Can impacts be mitigated?</b>	Yes	

<b>Mitigation:</b>	<ul style="list-style-type: none"> <li>• Minimise disturbance areas</li> <li>• Rehabilitate soil and vegetation</li> <li>• Use spoil from excavations for landscaping or run off site, spoil must not be dumped in piles</li> <li>• Stage earthworks in phases across site so that exposed areas are minimised.</li> <li>• Keep to existing roads, where practical, to minimise impacts on undisturbed ground</li> </ul>
<b>Cumulative impacts:</b>	Cumulative impact of soil pollution from all development in the area is considered low if mitigating measures are applied diligently
<b>Residual impacts:</b>	Minor negative – slow regeneration of vegetation & soil

<b>Nature: Soil degradation –</b> Stockpiling or dumping of soil and/or rock on site affecting soil formation processes.		
	<b>Without mitigation</b>	<b>With mitigation</b>
<b>Extent</b>	Local (1)	Local (1)
<b>Duration</b>	Medium term (3)	Very short term (1)
<b>Magnitude</b>	Low (4)	Low (4)
<b>Probability</b>	Highly Probable (4)	Highly Probable (4)
<b>Significance</b>	<b>Moderate (32)</b>	<b>Low (24)</b>
<b>Status</b>	Negative	Negative
<b>Reversibility</b>	Partially reversible	Partially reversible
<b>Irreplaceable loss of resources?</b>	Yes, moderate	Yes, minor
<b>Can impacts be mitigated?</b>	Yes, to a certain extent	
<b>Mitigation:</b>	<ul style="list-style-type: none"> <li>• Restrict temporary stockpiles to certain areas</li> <li>• No permanent dumping on site other than approved filling operations</li> <li>• Rehabilitate soil and vegetation in areas of activity</li> </ul>	
<b>Cumulative impacts:</b>	The cumulative impact of stockpiling or dumping from all development in the area is considered low if mitigating measures are adopted	
<b>Residual impacts:</b>	Minor negative – slow regeneration of topsoil	

<b>Nature: Soil degradation –</b> Increased erosion due to construction activity		
	<b>Without mitigation</b>	<b>With mitigation</b>
<b>Extent</b>	Local (1)	Local (1)
<b>Duration</b>	Medium term (3)	Very short term (1)
<b>Magnitude</b>	Moderate (6)	Low (4)
<b>Probability</b>	Highly probable (4)	Probable (3)
<b>Significance</b>	<b>Moderate (40)</b>	<b>Low (18)</b>
<b>Status</b>	Negative	Negative
<b>Reversibility</b>	Irreversible	Irreversible
<b>Irreplaceable loss of resources?</b>	Yes, moderate	Yes, minor

<b>Can impacts be mitigated?</b>	Yes
<b>Mitigation:</b>	<ul style="list-style-type: none"> <li>• Restrict size of authorised disturbance areas</li> <li>• Minimise activity in high erosion-sensitive areas</li> <li>• Implement effective erosion control measures</li> <li>• Stage construction in phases to minimise exposed ground</li> <li>• Keep to existing roads, where practical, to minimise impact on undisturbed ground.</li> <li>• Ensure stable slopes of stockpiles/excavations to minimise slumping</li> </ul>
<b>Cumulative impacts:</b>	The cumulative impact of soil erosion from all development in the area is considered low if mitigating measures are adhered to
<b>Residual impacts:</b>	Minor – Localised movement of sediment. Slow regeneration of soil processes

### 3.4.2. Indirect impacts

The most important indirect impacts are the increased siltation in drainage lines and downstream dams as a result of an increase in erosion from the site.

An assessment of the indirect potential impacts associated with the proposed activity is outlined in **Table 3** below.

**Table 3:** Assessment of potential indirect impacts

<b>Nature: Soil degradation</b> - Deposition down-slope affecting soil forming processes and siltation of downstream drainage lines and dams		
	<b>Without mitigation</b>	<b>With mitigation</b>
<b>Extent</b>	Local (1)	Local (1)
<b>Duration</b>	Permanent (5)	Permanent (5)
<b>Magnitude</b>	Moderate (6)	Low (4)
<b>Probability</b>	Probable (3)	Probable (3)
<b>Significance</b>	<b>Moderate (36)</b>	<b>Low (30)</b>
<b>Status</b>	Negative	Negative
<b>Reversibility</b>	Irreversible	Irreversible
<b>Irreplaceable loss of resources?</b>	Yes	Yes, minor
<b>Can impacts be mitigated?</b>	Yes, to a certain degree	
<b>Mitigation:</b>	<ul style="list-style-type: none"> <li>• Minimise size of disturbance areas</li> <li>• Minimise uncontrolled discharge of run-off</li> <li>• Install anti-erosion measures such as silt fences in disturbance areas</li> </ul>	
<b>Cumulative impacts:</b>	The cumulative impact of siltation from all development in the area is considered low if mitigating measures are applied diligently	
<b>Residual impacts:</b>	Minor localised movement of soil across site	

### **3.4.3. Impact statement**

The presence of calcrete and other minor occurrences of basement rock have a significant reducing effect on the erosion potential on the south-eastern portion of the site. The cumulative significance of all the potential impacts on the geological environment is considered low due to the limited scale of the development and the scarcity of development in the immediate surrounding area. With effective implementation of mitigating measures the impacts identified above can be reduced to a low level and therefore there is no compelling reason, from a geological perspective, why environmental authorisation for the proposed activity should not be granted.

### **3.4.4. Alternatives**

There are two proposed alternative access roads to the site and two proposed power lines connecting to the Gordonia-Oasis line (see **Figure 3**). All the alternatives cross areas of high erosion sensitivity (drainage lines) and therefore the only variable is the size or extent of the disturbance area.

#### ***Access roads***

Alternative A is preferred due to its closer proximity to the existing road and therefore less undisturbed ground will be impacted.

#### ***Power lines***

Alternative A is preferred due to its shorter length which will therefore affect a smaller footprint area. However, if the outcome of the EIA process is that the Alternative B access road is preferred, then Alternative B power line will be preferred as this route will already be disturbed in the road construction process (i.e. consolidation of linear infrastructure).

### 3.5. Mitigating measures

Negative impacts can be mitigated to a large degree by the implementation of an appropriate and effective EMP.

The objectives, impacts, risks, and mitigating measures that are required for inclusion in the EMP are outlined in **Table 4** below:

#### OBJECTIVE: Soil and rock degradation and erosion control

The natural soil on the site needs to be preserved as far as possible to minimise impacts on the environment. Soil degradation including erosion (by wind and water) and subsequent deposition elsewhere is of a concern across the entire site which is underlain by fine grained soil which can be mobilised when disturbed, even on relatively low slope gradients (accelerated erosion). Uncontrolled run-off relating to construction activity (excessive wetting, uncontrolled discharge, etc.) will also lead to accelerated erosion. Degradation of the natural soil profile due to excavation, stockpiling, compaction, pollution and other construction activities will affect soil forming processes and associated ecosystems. Degradation of parent rock is considered low as there are no deep excavations envisaged.

A set of strictly adhered mitigation measures are required to effectively limit the impact on the environment. The disturbance areas where human impact is likely are the focus of the mitigation measures laid out below.

**Table 4:** EMP guidelines

Project components	PV array modules, power tower and heliostat field and parabolic troughs
	Access roads
	Substation
	Offices and workshops
	Underground and overhead pipes and power cabling
	Abstraction point, storage and treatment reservoirs
	Power line
Potential Impact	Soil and rock degradation
	Soil erosion
	Increased deposition of soil into drainage systems
	Increased run-off over the site
Activities/risk sources	Construction activity – removal of vegetation, excavation, stockpiling, compaction and pollution of soil
	Rainfall - water erosion of disturbed areas
	Wind erosion of disturbed areas
	Concentrated discharge of water from construction activity
Mitigation:	To minimise extent of disturbance areas

Target/Objective	To minimise activity within disturbance areas
	To minimise soil degradation (mixing, wetting, compaction, etc)
	To minimise soil erosion
	To minimise deposition of soil into drainage lines
	To minimise instability of embankments/excavations

Mitigation: Action/control	Responsibility	Timeframe
Identify disturbance areas and restrict construction activity to these areas	ECO/Contractor	Before and during construction
Restrict construction activity within disturbance areas	ECO/Contractor	Before and during construction
Access roads to be carefully planned and constructed to minimise the impacted area and prevent unnecessary excavation, placement and compaction of soil	Engineer/ECO/ Contractor	Before and during construction
Dust control on construction site: wetting of denuded areas	Contractor	During construction
Minimise removal of vegetation which adds stability to soil	ECO/Contractor	During construction
Rehabilitate disturbance areas as soon as an area is vacated	Contractor	During and after construction
Soil conservation: Stockpile topsoil for re-use in rehabilitation phase, protect stockpile from erosion	Contractor	Before and during construction
Erosion control measures: Run-off attenuation on slopes (sand bags, logs), silt fences, stormwater catch-pits, shade nets, or temporary mulching over denuded areas	Contractor/ECO	Erection: Before construction Maintenance: Duration of contract
Where access roads cross natural drainage lines, culverts must be designed to allow free flow and regular maintenance must be carried out	Engineer/ECO/ Contractor	Before construction and maintenance over duration of contract
Control depth of excavations and stability of cut faces/sidewalls	Engineer/ECO/ Contractor	Before construction and maintenance over duration of contract

Performance Indicator	<ul style="list-style-type: none"> <li>No activity outside disturbance areas</li> <li>Acceptable level of activity within disturbance areas, as determined by ECO</li> <li>Acceptable level of soil erosion around site, as determined by ECO</li> </ul>
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	<ul style="list-style-type: none"> <li>• Acceptable level of increased siltation in drainage lines, as determined by ECO</li> <li>• Acceptable level of soil degradation, as determined by ECO</li> <li>• Acceptable state of excavations, as determined by ECO</li> <li>• No activity in restricted areas</li> </ul>
Monitoring	<ul style="list-style-type: none"> <li>• Fortnightly inspections of the site</li> <li>• Fortnightly inspections of sediment control devices</li> <li>• Fortnightly inspections of surroundings, including drainage lines</li> <li>• Immediate reporting of ineffective sediment control systems</li> <li>• An incident reporting system will record non-conformances</li> </ul>

#### 4. GEOTECHNICAL CONSTRAINTS

A basic preliminary assessment of the geotechnical nature of the study area affords the opportunity to identify any potential fatal flaws with the proposed site, in terms of the suitability of the site for development. A basic assessment of the main geotechnical constraints that may impact on the civil engineering design is given in **Table 5**.

**Table 5:** Geotechnical constraints on the proposed development

Geotechnical Constraint	Effect on the proposed development	Severity	Comment & recommendations
Collapsible & compressible soil	Soil horizons with a potentially collapsible and/or compressible fabric hazardous to foundations	High	Unconsolidated wind-blown sands are potentially compressible and collapsible under load. Conventional compaction of soil will be adequate for light structures
Differential settlement (DS)	Foundations placed across different soil types or rock may settle differentially	Medium	Recommend found individual structures on same soil types
Bearing capacity	Soils with low in situ bearing capacity resulting in high settlements of structures if not engineered properly	Medium	Transported sands: 50-80kPa, depending on level of consolidation. Rock: >250kPa* (*check calcrete for thickness, consistency)
Saturated soils, groundwater problems, perched or permanent water tables	Seepage from sidewalls of excavations affecting stability or dewatering of trenches necessary	Low	No groundwater problems expected in shallow excavations
Active soil	Heaving clays affecting foundation stability	Low	No active clay expected
Excavations	Boulders or rock affecting excavations	Low-medium	Difficult shallow excavations (into rock) expected in southern portions and along the water pipeline route, nearer to the Orange River
	Unstable excavations requiring shoring	High	Sidewalls of excavations exceeding 1m in unconsolidated sandy soils will be unstable. Temporary slopes to be battered to 1:2
Slope stability	Geological instability causing damage to structures founded on slopes	Low	No unstable slopes in development footprint

<b>Geotechnical Constraint</b>	<b>Effect on the proposed development</b>	<b>Severity</b>	<b>Comment &amp; recommendations</b>
Seismic activity	Structures at risk of damage due to seismicity	Low	Uppington area has a low seismic activity
Flood potential or storm water damage	Low lying areas affected by poor drainage.	Low	Site is well drained
	Steep slopes affected by uncontrolled run-off	Low	No steep slopes which could be unstable
Unconsolidated fill	Unconsolidated fill material affecting foundations	Low	
Availability of local construction material	Large distances to nearest quarry for sources of suitable construction material negatively affect construction costs	Medium	Nearest major centre is Uppington (20km). Potential local sources of construction material (on site) are restricted to selected fill (sand)
Mining Activity	Past, present or future mining activity which may affect development of the site	Low-Medium	Several small-scale diggings on the site. Extent of the excavations is unknown but is unlikely to seriously affect the proposed activity

The above classification highlights some basic potential constraints, none of which are considered insurmountable. A detailed geotechnical investigation should be undertaken before the engineering design phase to provide more information. Geotechnical supervision or input is recommended during construction.

## 5. CONCLUSIONS

The majority of the site is underlain by aeolian sands and the soil erosion potential for the site is moderate. However, the topography and climate is favourable and as a result there is no sign of significant erosion on the site, apart from along drainage lines. This will change during construction and the envisaged impacts will carry a moderate significance which can be mitigated to a resultant low significance through effective implementation of the EMP.

A basic assessment of the potential geotechnical constraints on the project indicates no insurmountable problems or "fatal flaws" which have may have an impact on the design and construction processes.

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## **UPINGTON SOLAR THERMAL PLANT**

### **ENVIRONMENTAL IMPACT ASSESSMENT – SPECIALIST STUDY: WATER RESOURCES ASSESSMENT STUDY**

#### **Prepared for:**

Savannah Environmental (Pty) Ltd.  
PO Box 148  
SUNNINGHILL  
2157

#### **Prepared by:**

PA Scherman, BM Colloty & A Bok  
Scherman Colloty & Associates  
22 Somerset Street  
GRAHAMSTOWN  
6139



*Scherman Colloty and Associates cc*

*Environmental and Aquatic Management Consulting  
(CK 2009/112403/23)*

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## **EXECUTIVE SUMMARY**

### **Background**

This Water Resources Study was commissioned by Savannah Environmental (Pty) Ltd for Khi CSP South Africa (Pty) Ltd. (!Khe CSP) as part of the Environmental Impact Assessment (EIA) being conducted for the proposed Upington Solar Thermal Facility in the Upington area (McTaggart's Camp 453, Portion 4) of the Northern Cape.

### **Methods / Approach**

The following approach was taken during the Water Resources Study:

- » A desktop assessment of available information, including an evaluation of the study area using available maps and databases.
- » A ground truthing survey in April 2010, including riparian vegetation surveys and gathering of fish information, particularly in terms of available fish habitats and the ecological integrity of the Orange River within the Study Area.
- » Liaison with the national office of the Department of Water Affairs (DWA) regarding water availability.
- » Meetings with stakeholders (e.g. Steynsvoor Irrigation Board) and DWA in Upington in April 2010 and the collection of data.
- » A meeting with the Regional Office of DWA for the Northern Cape in Kimberley in October 2010 regarding water availability.

### **Description of the affected environment**

The Lower Orange River can be defined as that stretch of the Orange River between the Orange-Vaal confluence and Alexander Bay or Oranjemund. Land-use is primarily irrigation and mining, with the area highly dependent on water from the Orange River. Water quality between Boegoeberg and Onseepkans is generally good despite extensive irrigation and settlements in the Upington area, although eutrophication is evident in localised areas and salt loads are increasing. The fish biodiversity in the Lower Orange River within the Study Area (i.e. from Upington to Onseepkans) is relatively high compared to the entire river system, with a total of 13 indigenous species being recorded, including five of the six endemic Orange River species. The Lower Orange River Management Strategy (2005) study found that the overall present state of the Lower Orange River is in a *D category*, i.e. Largely modified. These results are being verified by the current ORASECOM Ecological Flow Requirements study.

### **Sensitivity assessment**

From a habitat and ecosystem point of view, all the dry river beds and the associated riparian systems would be rated as extremely sensitive to development, in particular the mainstem systems such as Helbrandkloofspruit, which flows along the western boundary of the site.

### **Impact statement**

With suitable mitigation and implementation of the proposed layout, the development should have limited impact on the overall status of the riparian systems within the

region. Impacts on the Orange River system due to water abstraction, and site-specific impacts on instream biota are difficult to quantify due to the number of unknowns and the highly regulated nature of the system. The desktop assessment of the potential impacts of the proposed facility on the fish biota of Orange River also did not reveal any significant impacts on the fish fauna and associated aquatic habitats, provided the appropriate mitigation measures are taken. All impacts that were assessed as being of moderate significance could readily be reduced to low significance by appropriate mitigation, apart from the moderate impact of water abstraction from the Orange River. Although the volume does not seem to be prohibitive, water use can be reduced by implementing alternative operational processes, e.g. dry cooling, as requested by DWA. Note that this impact may represent a **significant financial implication** to the development, as tariffs proposed under the REFIT only cater for wet cooling.

Consideration of alternative routes for power lines and access roads were as follows:

- » Alternative routes for power lines: no impact on the aquatic or riparian environment
- » Alternative routes for access roads: no significant impact on the aquatic or riparian environment, although there is a preference for entry to the site from the south-eastern corner, i.e. access road III.

In conclusion therefore, the facility is deemed to have a limited potential impact on the aquatic environment, considering the number of unknowns and the highly regulated nature of the Orange River system. The only significant risk is the water use license not being granted by DWA unless water use is reduced.

## ACRONYMS

CD: RDM	Chief Directorate: Resource Directed Measures
CEMP	Construction Environmental Management Plan
CSP	Concentrated Solar Power
D: NWRP	Directorate: National Water Resource Planning
DWA	Department of Water Affairs
EFR	Ecological Flow Requirements
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
EWR	Ecological Water Requirements
GIS	Geographical Information Systems
LOHEPS	Lower Orange Hydroelectrical Power Scheme
LORMS	Lower Orange River Management Strategy
MRU	Management Resource Unit
ORASECOM	Orange Senqu River Commission
PES	Present Ecological State
PV	Photovoltaic
RDM	Resource Directed Measures
REC	Recommended Ecological Category
RFP	Request for Proposals
SC&A	Scherman Colloty & Associates
SANBI	South African National Biodiversity Institute
SWMP	Storm Water Management Plan
WULA	Water Use License Application



## **1. INTRODUCTION**

This Water Resources Study was commissioned by Savannah Environmental (Pty) Ltd for Khi CSP South Africa (Pty) Ltd. (!Khi CSP) as part of the Environmental Impact Assessment (EIA) being conducted for the proposed Upington Solar Thermal Facility in the Upington area (McTaggarts Camp 453, Portion 4) of the Northern Cape. The farm is situated approximately 20 km south west of Upington, and within 10 km of the Orange River. At present there are two general branches within solar technology, in both cases the electricity produced can be used locally or supplied to the grid.

- 1) Concentrated solar power (CSP) technology utilises the energy from solar radiation in the form of heat. This heat can then be used to run a conventional steam power cycle.
- 2) Photovoltaic (PV) technology directly converting solar radiation into electricity using semiconductors and the photovoltaic effect

## **2. PROJECT DESCRIPTION**

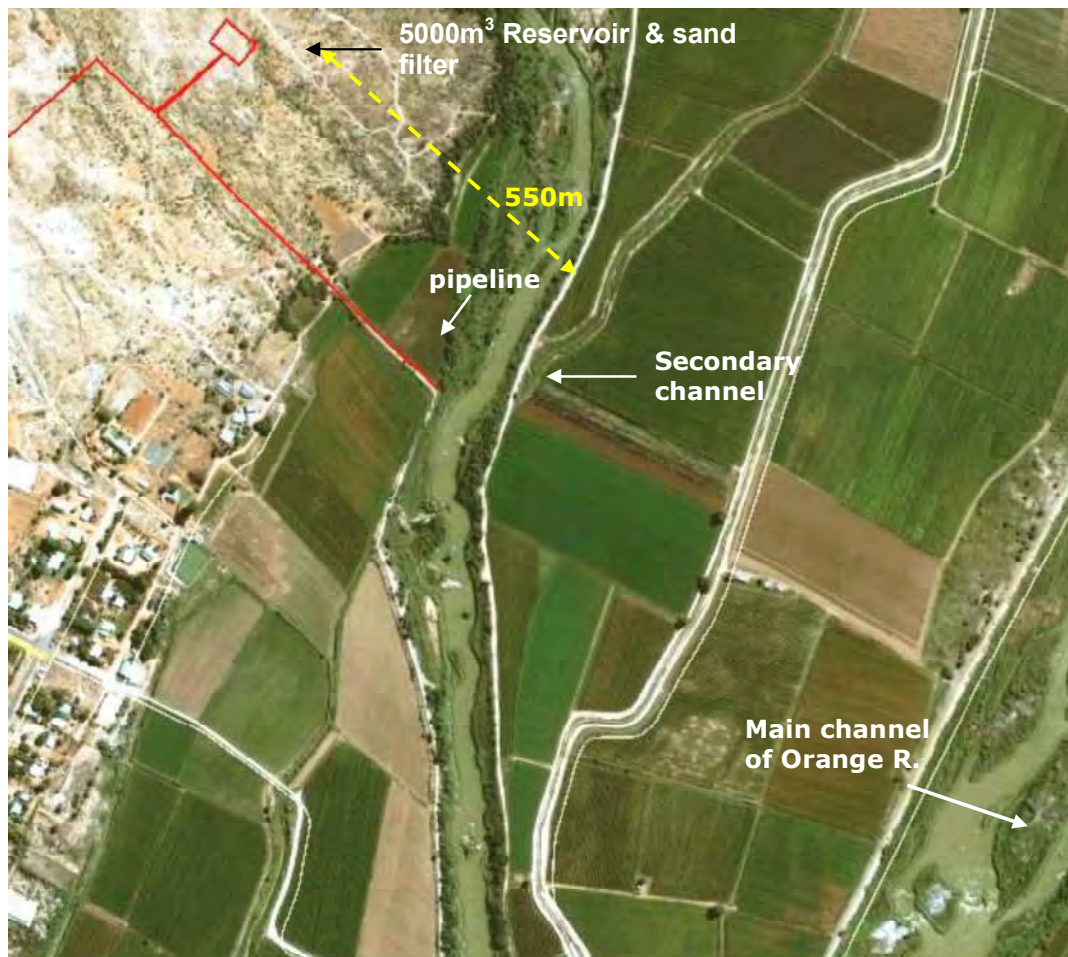
The proposed facility is expected to have a development footprint of approximately 6 km<sup>2</sup> within the broader site of 22 km<sup>2</sup>. The facility is proposed to have a maximum generating capacity of 110 MW which will be achieved using the following technologies (in any combination):

- » 50 MW parabolic trough plant
- » 50 MW power tower plant
- » 10 MW photovoltaic panels

The troughs or heliostats reflect solar energy (sunlight) onto a receiver tube or tower-mounted receiver. The heat is then transferred using a heat transfer fluid in the case of troughs or directly to steam in the case of a tower to a nearby power block which then drives conventional steam turbines to produce electricity.

Water requirements for the operation of the facility are estimated at approximately 1 million m<sup>3</sup> per annum, based on a wet cooling process, and pumping at 18hr/d at 70L/s. No return flows to the Orange River from the solar power plant is envisaged, and this is considered a non-polluting activity. Water that has been abstracted from the Orange River will be pumped to a settlement reservoir located approximately 0.6 km north-west of the abstraction point to rid the supply water of particles in suspension. This storage reservoir and high pressure sand filter will be located about 550 m from the right bank of the Orange River. The proposed automatic backwash system at the filtration works will discharge backwash water (containing fines) into an existing natural storm water drainage furrow which empties into the Orange River (Figure 1). A second storage reservoir will be located approximately 8.5 km west of the abstraction point within the boundaries of the identified site, and will provide raw water for on-site use. Both reservoirs will be covered with floating lids. The water treatment works will therefore include a primary treatment plant at the supply source and a small purification

plant at the site. Deionized water is required for the cleaning of mirrors (approximately every 2 weeks), which takes place using high pressure spray washers. Run-off will evaporate and dissipate into the ground. Potable water will also be required at the plant for staff etc.



**Figure 1:** The storage reservoir and sand filter along the abstraction pipeline.

A blow down pond will be established on site to receive wastewater from the generation process. This pond will contain brine and will be cleaned out at the termination of the project. Brine will need to be removed by a reputable waste management company and to an appropriate waste site. The pond will be lined and covered with mesh for safety purposes.

### 3. SCOPE OF WORK

The activity for the EIA is the proposed construction and operation of a solar thermal plant and associated infrastructure for power generation purposes, including the construction of a power island (i.e. substation, turbine generator etc), power line, water supply pipeline, and access roads. It is proposed to make use of troughs, power tower and heliostats, as well as photovoltaic technology for the site. No alternative site or alternative water supply pipeline routes were considered during the EIA. A detailed water supply study was done by !Khi CSP and an abstraction point and routing defined that looked at all possibilities along the river close to the proposed plant. Pipeline routing will mainly follow the existing road reserves where practicable. Two power line routes and external access routes are being considered for access and evacuation of generated power into the Eskom electricity grid.

The following Scope of Work was provided for the Water Resources Assessment study. Task 1 is the focus of this report, with specialist areas covered being *water resources and water availability* (Scherman), *riparian vegetation* (Colloty) and *fish* (Bok). Tasks 2 and 3 will be conducted subsequent to Task 1.

- **Task 1:** Identification and assessment of potential impacts of the development on the water resources of the area. This task will include an assessment of impacts on the water resource to be used as source for the development. Specific tasks for the **riparian vegetation assessment** were as follows:
  - Assess the current structure and status of any wetland or riparian systems found within the site, as well as areas adjacent to the proposed site that may be impacted upon by the development.
  - Supply a sensitivity map indicating observed wetland and riparian habitats.
- **Task 2:** Preparation of the Water Use License Application (WULA) for the development for submission to DWA.
- **Task 3:** Preparation of the Reserve template and necessary documentation (i.e. letter for the region and maps required by the Chief Directorate Resource Directed Measures (CD: RDM) of the Department of Water Affairs (DWA)) needed to complete the water use license for the development.

Note that Task 3 can only be dealt with once the outcomes of the Ecological Flow Requirements (EFR) study currently being conducted for the Orange Senqu River Commission (ORASECOM) are available. The EFR study (or Ecological Water Requirements (EWR) or Ecological Reserve) assesses the present state of the system and defines the Recommended Ecological Category (REC) for the various river reaches, based on the flow and quality requirements of the biota components of the system (i.e. fish, macroinvertebrates, diatoms, and riparian vegetation). The outcome of the study is therefore the flow and quality requirements that will satisfy the Ecological Reserve, which needs to be defined before water available for other users can be determined. This information will go into the strategic planning for the system, conducted by the DWA, as is captured in a Reserve template which forms part of the documentation required during the WULA process. The text box below

provides some information and Reserve terminology (modified from Scherman, 2010a).

**Reserve:** The quantity and quality of water needed to sustain basic *human needs* and *ecosystems* (e.g. estuaries, rivers, lakes, groundwater and wetlands) to ensure ecologically sustainable development and utilisation of a water resource. The **Ecological Reserve** pertains specifically to aquatic ecosystems.

**Reserve requirements:** The quality, quantity and reliability of water needed to satisfy the requirements of basic human needs and the Ecological Reserve.

**Ecological Reserve determination study:** The study undertaken to determine Ecological Reserve requirements.

**Licensing applications:** Water users are required (by legislation) to apply for licenses prior to extracting water resources from a water catchment.

**Ecological Water (or Flow) Requirements:** This is the quality and quantity of water flowing through a natural stream course that is needed to sustain instream functions and ecosystem integrity at an acceptable level as determined during an EWR or EFR study.

**Water allocation process (compulsory licensing):** This is a process where all existing and new water users are requested to reapply for their licenses, particularly in stressed catchments where there is an over-allocation of water or an inequitable distribution of entitlements.

**Present Ecological State** is a term for the current ecological condition of the resource. This is assessed relative to the deviation from the Reference State.

**Reference State/Condition** is the natural or pre-impacted condition of the system. The reference state is not a static condition, but refers to the natural dynamics (range and rates of change or flux) prior to development.

**EcoStatus** is the overall PES or current state of the resource. It represents the totality of the features and characteristics of a river and its riparian areas that bear upon its ability to support an appropriate natural flora and fauna and its capacity to provide a variety of goods and services. The EcoStatus value is an integrated ecological state made up of a combination of various PES findings from component EcoStatus assessments (such as for invertebrates, fish, riparian vegetation, geomorphology, hydrology and water quality).

#### 4. SPECIALIST TEAM

Scherman Colloty & Associates (SC&A) is a specialist consulting firm based in Grahamstown in the Eastern Cape. The two partners have more than 27 years combined experience in the environmental management and aquatic assessment fields, with a diverse suite of clients based nationally and internationally. Key team members will be Patsy Scherman and Brian Colloty, assisted by Anton Bok, an associate of SC&A.

Dr. Patsy Scherman has a Ph.D in Biotechnology and has been actively involved in a number of Reserve determination projects over the years, having been the project technical team manager or water quality specialist on a number of these projects. The management includes the co-ordination of technical teams, including socio-economics, wetland, groundwater, estuary and river teams. She has also developed and managed integrated environmental and water quality monitoring programmes; and conducts water specialist studies for EIAs. Patsy has providing training and specialist water quality services to the Chief Directorate Resource Directed Measures, DWA, for the past few years, and is currently the water quality specialist on the Orange-Senqu River Commission (ORASECOM) project.

Dr. Brian Colloty has a PhD in wetland ecology and importance rating, and has conducted wetland and riverine / estuarine assessments for projects throughout Africa. Brian has produced more than 54 wetland studies in the last 5 years, part of which includes the production of GIS related sensitivity maps with site-specific Environmental Management Plan (EMP) recommendations with regard construction and operational phases of developments.

Dr Anton Bok (of Anton Bok Aquatic Consultants cc., and an associate of SC&A) is a fish specialist who will assess the potential impacts on fish populations or habitats with regard the locality of any pump stations, with particular reference to the Orange River.

## **5. APPROACH / METHODS**

Due to the large amount of research and information available for the Uptington area of the Lower Orange River catchment, the following approach was followed for Task 1 of the Water Resources Assessment study:

- » A desktop assessment of available information, including an evaluation of the study area using SANBI (South African National Biodiversity Institute) wetland maps and the DWA Rivers Database. Maps and Geographical Information Systems (GIS) were employed to ascertain which portions of the proposed development would have the greatest impact on the riverine areas or associated habitats.
- » A ground truthing survey in April 2010
- » Although no fish sampling was undertaken during the field survey, valuable information on available fish habitat and the ecological integrity of the Orange River within the Study Area was obtained. Communication with fish specialists with extensive knowledge of the Study Area and/or have undertaken recent fish surveys in the Lower Orange (Ben Benade and Dr. Piet Kotzé) provided further fish data. Although catch data on the fish species present in the Lower Orange River specifically at the proposed water abstraction sites were not available, the fish likely to be present can be inferred from catch data from adjacent areas and the riverine habitats found at the sites under review.
- » Riparian vegetation areas were assessed on the following basis:
  - Vegetation type: verification of type and state or condition-based, supported by species identification using Germishuizen and Meyer (2003) and Vegmap (Mucina and Rutherford, 2006 as amended).
  - Plant species were further categorised as follows:
    - Terrestrial: species not directly related to any surface or groundwater base-flows and persist solely on rainfall.
    - Facultative: species usually found in wetlands (inclusive of riparian systems) (67 – 99% of occurrences), but occasionally found in terrestrial systems (non wetland) (DWAF, 2005).

- Obligate: species that are only found within wetlands (>99% of occurrences) (DWAF, 2005).
- » Liaison with the national office of the DWA regarding water availability.
- » Meetings with stakeholders (e.g. Steynsvoor Irrigation Board) and DWA in Uppington in April 2010 and the collection of data, e.g. water quality data collected by Rekopane Estates twice annually for intake water from the canals before irrigation.
- » A meeting with the Regional Office for the Northern Cape in Kimberley in October 2010.

## **6. DESCRIPTION OF THE AFFECTED ENVIRONMENT: NATIONAL, REGIONAL, LOCAL AND SITE-SPECIFIC CONTEXT**

The focus of the study is at a range of levels, i.e. 1) the impact of abstraction from the Orange River for the study, 2) potential on-site impacts, and 3) impacts related to infrastructure such as the water pipeline. This section of the report provides information on the Orange River system, as water supply is critical to the solar facility, as well as riparian vegetation and fish fauna at the abstraction point and on-site.

### **6.1. The Lower Orange River System**

The Lower Orange River can be defined as that stretch of the Orange River between the Orange-Vaal confluence and Alexander Bay or Oranjemund where the river meets the ocean (Figure 2). The area is hot and dry with rainfall varying from 400mm in the east to 50mm on the west coast and large parts of the catchment considered desert with annual precipitation dropping to below 25mm in some areas (ORASECOM, 2007).

Land-use is primarily irrigation and mining, with the area highly dependent on water from the Orange River. Sheep and goat farming is practised over most of the area, with large parts falling within conservation areas. Cultivation is restricted to isolated patches where somewhat higher rainfall occurs, and extensive irrigation is practised in the fertile alluvial soils along the Orange River valley. This irrigation is supplied with releases from Vanderkloof Dam. The water quality in the Lower Orange WMA is affected by upstream activities in the Vaal and Orange River catchments. Given the arid nature of the Lower Orange River and the high potential evaporation, the evaporative losses result in an increase in concentrations along the length of the lower Orange River (ORASECOM, 2007).

A number of developments are currently planned for the Lower Orange River, including the NamPower 100 MW run-of-river Lower Orange Hydroelectrical Power Scheme (LOHEPS). The scheme would entail the development of up to nine small hydroelectric power stations, ranging from 6 MW to 12 MW, along the Lower Orange river, which has an estimated power generation potential of between 80 MW and 120 MW. The power utility noted that LOHEPS would be used to divert the flow of the river through canals and tunnels into water turbines to produce electricity.



**Figure 2:** Major rivers and transfer schemes in the Lower Orange sub-basin (From Hatfield (2009) after UNDP/GEF 2008, and cited in ORASECOM, 2007).

Water quality state can be summarized as follows (ORASECOM, 2009 and Golder Associates, 2009, as cited in Scherman, 2010b):

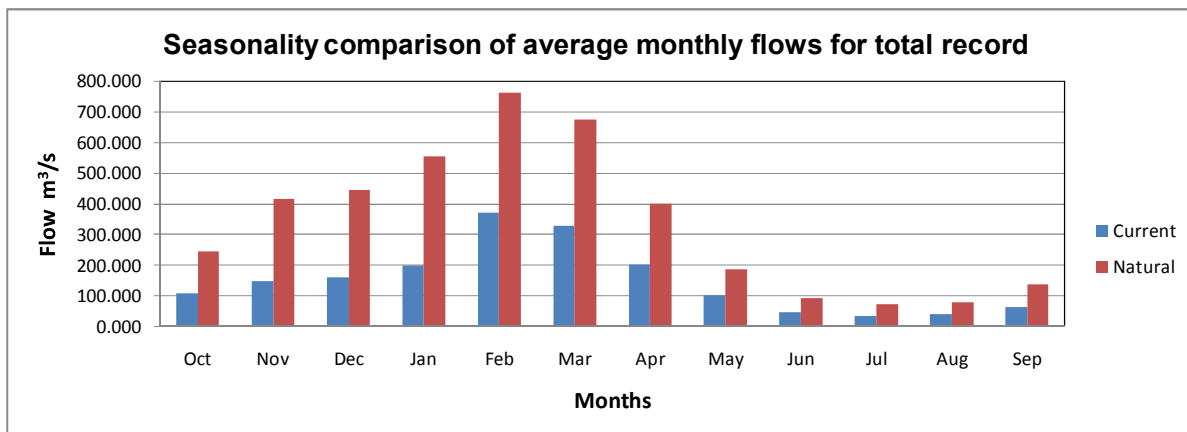
- Water quality between Boegoeberg and Onseepkans is generally good despite extensive irrigation and settlements in the Upington area.
- The salinity deteriorates downstream of the confluence of the Vaal and Orange rivers but still remains good. There is an increase in Electrical Conductivity (EC) from Prieska to Vioolsdrift along the reaches of the lower Orange River. This is due to irrigation return flows and evaporative losses along the river.
- Eutrophication is evident in localised areas along the Lower Orange River; intermittent blooms of toxic algae have been reported in the Upington area.
- Some of the water withdrawn for irrigation is returned to the river environment for reuse, but its quality is seriously degraded with considerably higher salts and nutrient concentrations which contribute significantly to the salts load in the Orange River.



### 6.1.1. Flow distributions at Upington

Information on flows in the Lower Orange River are taken from the current ORASECOM EFR study for EFR site O2 at Boegoeberg (below Boegoeberg Dam), i.e. the most upstream site from the abstraction point at Upington. Site details are shown in Section 7.2 of this report. Data from hydrological gauging weir D7H008 (real time gauge downstream of Boegoeberg Dam) was used for the assessment. The length of the hydrological record is 1932 – 2007 (on the database, but data recordings to present day).

The distribution of flow is still similar to the natural seasonal distribution, but much lower in the wet season and a little bit lower in the dry season. The reason for the difference is the large dams upstream and highly regulated flows from Vanderkloof Dam. Figure 3 is a seasonality representation of average monthly flows for the total flow record (WRP Consulting, pers. comm., September 2010, for the ORASECOM EFR study).



**Figure 3:** Average monthly flows for the total flow record of gauging weir D7H008

### 6.1.2. Water availability

The determination of water availability for the project was approached in the following way:

- 1) Liaison with Mr Seef Rademeyer of the national DWA office (D: National Water Resource Planning (D: NWRP)) in February 2010, who advised that the D: NWRP has incorporated the use of water for alternative energy technologies as a potential future water use for the small surplus of water (44 million m<sup>3</sup>/a (Rademeyer, DWA, pers. comm., February 2010) that is available in the system.
- 2) Consultation was held with members of the DWA, stakeholders and the Steynsvoor Irrigation Board in the Upington area during the field survey of April 2010. DWA, Upington commented that the water requirement for the project seemed high in a local context and that water use alternatives should be considered. Note that the requirement is minimal in contrast to other users, e.g. irrigation.



- 3) Further consultation was held with the Regional Director, Mr Louis Snyders, and Mr Abe Abrahams, Director: Water Regulation and Use, of the Regional Northern Cape DWA Office in Kimberley during October 2010. This meeting also formed the Pre-application Consultation Meeting of the WULA process. At this meeting Mr Snyders confirmed DWA's principle of reduce, reuse and recycle, and requested that the project consider alternatives to reduce water use, e.g. dry cooling.

## 6.2. Abstraction point near Upington

From aerial photographs it is apparent that the proposed abstraction point is located on a relatively small secondary channel of about 40 – 45 m wide, which joins the main Orange River about 2.4 km downstream (see Figure 4). There is road bridge and low instream weir about 900 to 950 m downstream of the abstraction point. The instream habitat at the abstraction point appears to be slow deep habitat (deep pools), with the river banks and channel margins densely lined with reeds (probably *Phragmites*). In terms of preferred fish habitat, this locality does not appear to be unusually valuable or sensitive.



**Figure 4:** The proposed water abstraction point for the Upington thermal solar facility. Note dense stands of reeds (probably *Phragmites australis*).

## 6.3. On-site data

### 6.3.1. Riparian vegetation

This assessment was based on a broad evaluation of the natural vegetation found within the region and how localised surface and groundwater systems functioned in the formation of any recognisable riparian systems. During the site visit these areas were

ground truthed, in order to produce a GIS map of the study site, as well as indicate any additional areas that may be impacted upon by the proposed development.

Eighteen woody plant species were found associated with the riparian systems within the study site. Although none of these were obligate or facultative river/wetland species, they do show a preference for riparian soil conditions. Species within the site were dominated by *Acacia erioloba* (Camel Thorn, Kameeldoring), *Acacia haematoxylon* (Grey Camel Thorn), *Boscia foetida* (Stink Shepard's Tree) and *Euclea pseudobenus* (Ebony Tree), notably protected under the National Forest Act.

Few grass or forbs species were successfully identified due to the prevailing dry conditions and the intensity of grazing observed.

The only obligate wetland plants observed were those found in association with the man-made dam found at the confluence of the Helbrandkloofspruit and the Orange River and along the Orange River itself. Species observed included *Typha capensis*, *Phragmites australis* and *Cyperus latifolius*.

The Ecological Impact Assessment should be referred to for a complete assessment of the importance and status of the plant species observed within the study site.

### **6.3.2. Fish fauna**

The fish biodiversity in the Lower Orange River within the Study Area (i.e. from Upington to Onseepkans) is relatively high compared to the entire river system, with a total of 13 indigenous species being recorded, including five of the six endemic Orange River species (see Table 1). The endemic Namaqua barb, *Barbus hospes* only occurs below the Augrabies Falls, as does an isolated population of the indigenous river sardine, *Mesobola brevianalis*. The nearest adjacent population of river sardine occurs in the Okavango system.

As seen in Table 1, the recent IUCN 2010 Red List for the fish species found in the Lower Orange River includes only largemouth yellowfish (*Labeobarbus kimberleyensis*) as "Near Threatened" (Impson and Swartz, 2007), with the remaining fish listed as of "Least Concern". However, correspondence with local fish experts, who have been involved with recent fish studies in the Lower Orange River (pers. comm. Ben Benade 30/08/2010; pers. comm. Piet Kotzé, 31/08/2010), consider that this IUCN Red Listing is not applicable to the endemic fish populations in the Lower Orange.

Both these fish researchers feel that the Namaqua barb (*Barbus Hospes*) and the rock catlet (*Austroglanis sclateri*) may be threatened in the Lower Orange and recommend that these species require further studies to establish their true conservation status in this locality. In this regard, the Namaqua barb (*Barbus hospes*) was IUCN listed as Near Threatened in 1996 (Swartz and Impson, 2007), and the rock catfish (*A. sclateri*) as Data Deficient in 1996 (Swartz et al., 2007). The other two endemic fish species, Smallmouth Yellowfish (*Labeobarbus aeneus*) and Orange River mudfish (*Labeo capensis*) are fairly

abundant. However, the conservation status of these two species are also of some concern due to the deterioration of their habitat in the Lower Orange (LORMS, 2005), as discussed below.

**Table 1:** List of indigenous fish species found the Lower Orange River within the Study Area, with the most recent IUCN (2010) Red listing for the various species. The IUCN fish species Red List category marked with an \* (and shaded) are considered to be “near threatened” or even “vulnerable” in the Lower Orange River by local fish experts - see text. LC = least concern; NT = near threatened; E = endemic; I = indigenous.

FAMILY	SPECIES		STATUS		
	Scientific Name	Common Name	E	I	Red List
Anguillidae	<i>Anguilla mossambica</i>	Longfin eel		x	LC
Cyprinidae	<i>Mesobola brevianalis</i>	River sardine		x	LC
	<i>Labeo capensis</i>	Orange River Mudfish	x		LC
	<i>Labeo umbratus</i>	moggel		x	LC
	<i>Barbus hospes</i>	Namaqua barb	x		LC*
	<i>Barbus palidinosus</i>	Straightfin barb		x	LC
	<i>Barbus trimaculatus</i>	Threespot barb			LC
	<i>Labeobarbus kimberleyensis</i>	Largemouth yellowfish	x		NT
	<i>Labeobarbus aeneus</i>	Smallmouth yellowfish	x		LC
Cichlidae	<i>Pseudocrenilabrus philander</i>	Southern mouthbrooder		x	LC
	<i>Tilapia sparrmanii</i>	Banded tilapia		x	LC
Clariidae	<i>Clarias gariepinus</i>	Sharptooth catfish		x	LC
Austroglanididae	<i>Austroglanis sclateri</i>	Rock catfish	x		LC*

A brief description of the habitat requirements and abundance of the five endemic fish species present in the Lower Orange is therefore of relevance to the present investigation in terms of potential impacts of the proposed solar power facilities.

- Largemouth yellowfish *Labeobarbus kimberleyensis* is the largest yellowfish species in South Africa reaching over 800 mm in length and over 22 kg in weight. This species was listed as Vulnerable by Skelton (2003) due to a decline in numbers and distribution throughout its natural range. The adults (fish over 300 mm in length) are piscivorous and prefer flowing water in deep channels. This species matures at about 6 -8 years of age and breeds in mid to late summer over clean, silt-free gravel beds in running water, often below rapids (Skelton, 2003).
- Namaqua barb *Barbus hospes* is a small barb that attains about 75 mm in length and prefers open water in the mainstream and backwaters where it feeds on zooplankton and aquatic insects (Skelton, 2003). Little is known about its breeding biology, but it probably spawns in running water in riffles. This is one of the few species that may have benefited from the regulated flows in the Lower Orange (Skelton, 2003), but more data is needed to confirm this suggestion.

- Smallmouth yellowfish *Labeobarbus aeneus* reaches about 500 mm in length and is widely distributed in large numbers throughout the Orange-Vaal system. Its preferred riverine habitat is clear, fast-flowing waters with sandy to gravel substrates, but this species also flourishes in large impoundments. It migrates upstream to spawn over clean gravel substrates in spring to mid-summer after the first post-winter floods or high flows.
- Orange River Mudfish *Labeo capensis* attains 500 mm in length and prefers running waters in large rivers, but appears to do well in a variety of habitats including large impoundments, grazing on firm surfaces of rocks and plants. This species breeds in summer in shallow water over cobbles and rapids and possibly on flooded vegetation. The numbers of this species were reported to be declining in the Lower Orange River by Benade (1993 vide LORMS 2005).
- Rock catfish *Austroglanis sclateri* is a medium-sized species reaching 300 mm and prefers rocky habitats in flowing water, favouring rapids, where breeding is also thought to take place. This species appears sensitive to poor water quality and numbers have declined in areas subject to siltation and deterioration in water quality (Benade 1992 vide LORMS 2005; Pieter Kotze pers. comm., 31/08/2010).

Environmental impacts affecting the spawning habitats of riverine fish can threaten the survival of vulnerable species with specific spawning requirements. The above description of the breeding requirements of the endemic fish in the Lower Orange River emphasises the importance of suitable river flows in summer and the presence of clean, silt-free gravel or cobble spawning areas in flowing water habitats. Altered river flows and increased sediment input are impacts that could theoretically be associated with the proposed solar thermal facilities, as discussed later.

Vulnerable fish species requiring specific environmental conditions such as good quality water flowing over clean rocks and gravel substrate for feeding and particularly for breeding, include the two most important fish species of concern in the Lower Orange River, namely largemouth yellowfish (*Labeobarbus kimberleyensis*) and the rock catlet (*Austroglanis sclateri*). It is therefore of particular concern that recent fish surveys in the lower Orange in May 2010 have captured very few of these two species (pers. comm., Pieter Kotzé, 31 August 2010). In addition, the rock catlet is considered the best indicator species to use when determining instream flow requirements when designing future water projects due to its specific habitat requirements related to river flow and water quality (ORASECOM, 2007).

The three other endemic fish species present in the Study Area (Orange River Mudfish, smallmouth yellowfish and Namaqua barb) were found to be well represented in the May 2010 survey catches by Kotzé (pers. com. 31/08/2010) and appear to be relatively tolerant of the habitat alteration that has occurred.

## **7. RESERVE RESULTS: LOWER ORANGE RIVER SYSTEM**

### **7.1. Historical assessments**

The Present Ecological State (PES) of a river represents the extent to which it has changed from the reference or near pristine condition (Category A) towards a highly impacted system where there has been an extensive loss of natural habit and biota, as well as ecosystem functioning (Category E). The LORMS (2005) study found that the overall PES of the Lower Orange River, including fish and the other biota (algae, vegetation, macroinvertebrates), to be in a *D Category*. This is defined as where the habitat integrity has been largely modified and where a large loss of natural habitat, biota and basic ecosystem functions has occurred.

In addition, the LORMS (2005) study found fish in the Lower Orange to be on a negative trajectory of change with the PES dropping to D/E in 20 years unless the current impacts are reduced or reversed. In terms of fish, the main negative impacts are related to changes in river flow and deterioration in water quality.

The absence of scouring floods due to the large upstream dams and lack of the natural seasonal flow variations can have major negative impacts on fish biota. The resultant impacts on fish habitat and environmental conditions include, among others:


- » Absence of spring floods (i.e. the November or December freshets) required to trigger and synchronise fish spawning and flush out silt from the gravel and cobble fish spawning habitat.
- » Invasion of rapids, riffles, and gravel spawning areas by the reed *Phragmites australis*, which when established in turn traps more sediment, resulting in further colonisation of preferred fish habitat by *Phragmites* reeds. During recent fish surveys (May 2010) in the Lower Orange River, P. Kotzé (pers. comm., 31/08/2010) found areas in the channel colonized by reeds to be “dead zones” that do not appear to provide adequate or preferred habitat for fish. These reed-dominated areas were found to be largely devoid of fish.


The above habitat modifications appear to have reduced the availability of suitable clean riffle and gravel habitats used for fish spawning and feeding. Sensitive fish species most reliant on these habitats and environmental conditions, such as the largemouth yellowfish and rock catlet, appear to have been the most negatively impacted by these man-induced modifications.

### **7.2. Current ORASECOM assessment**

The Reserve (or EFR / EWR) assessment currently being conducted will supersede all previous reserves conducted for the system. The results of assessments at the EFR site at Boegoeberg in quaternary catchment D73C, i.e. EFR site O2, will inform the Water Use License Application (WULA) process (Louw, 2010). The results of the downstream EFR

site O3, at Augrabies, will also be considered. The preliminary assessment of the sensitivity of biota and habitats also informed the impact assessment.

<i>EFR no. &amp; name</i>	EFR O2 Boegoeberg	
<i>River</i>	Orange	
<i>Previous IFR site</i>	-	
<i>National RHP site</i>	-	
<i>Decimal Degrees</i>	-29.0055, 22.16225	
<i>EcoRegion (Level II)</i>	26.05	
<i>Geozone</i>	Lowland	
<i>Altitude (m)</i>	871	
<i>RU</i>	MRU Orange D	
<i>Quaternary</i>	D73C	
<i>Farm name</i>	Blinkfontein 10	
<i>Hydrological gauge</i>	D7H008	

<i>EFR no. &amp; name</i>	EFR O3 Augrabies	
<i>River</i>	Orange	
<i>Previous IFR site</i>	-	
<i>National RHP site</i>	-	
<i>Decimal Degrees</i>	-28.42867, 19.9983	
<i>EcoRegion (Level II)</i>	28.01	
<i>Geozone</i>	Lowland	
<i>Altitude (m)</i>	434	
<i>RU</i>	MRU Orange E	
<i>Quaternary</i>	D81B	
<i>Farm name</i>	Oranjestroom 386	
<i>Hydrological gauge</i>	D7H014	

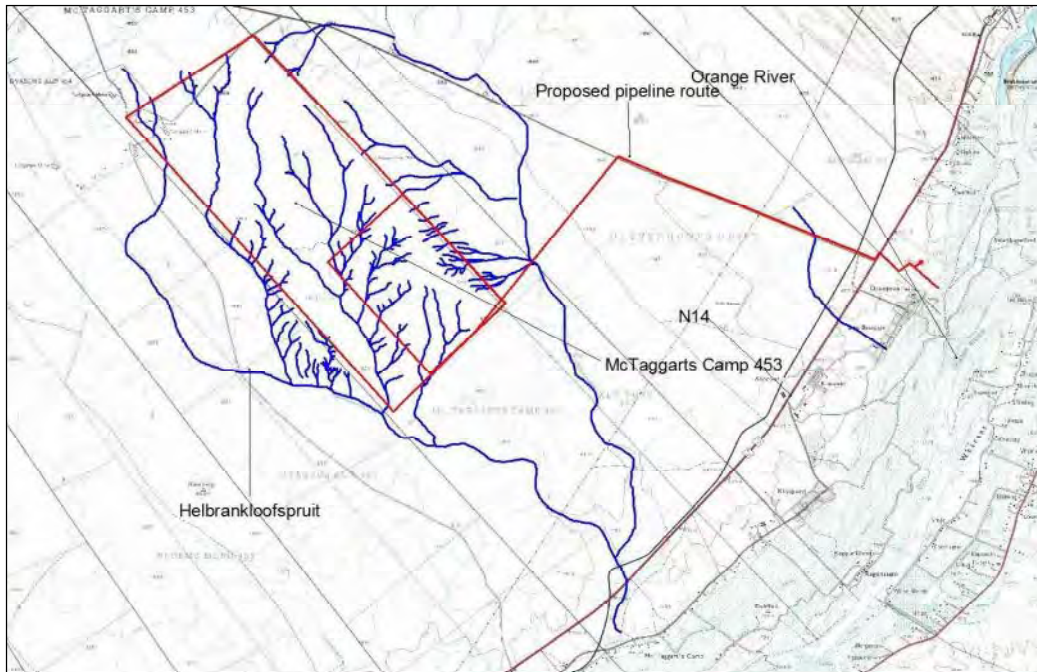
## 8. SENSITIVITY ASSESSMENT

In the compilation of this report, a number of sensitive areas within and adjacent to the proposed site were identified. From an aquatic systems point of view most were associated with dry river beds and riparian zones. The conservation importance of these systems (i.e. rare or protected plant species) was considered in the Ecological Impact Assessment (Hoare, 2010).

Thus from a habitat and ecosystem point of view, all the dry river beds and the associated riparian systems (Figure 5) would be rated as extremely sensitive to development, in particular the mainstem systems such as Helbrandkloofspruit, which flows along the western boundary of the site. The developer was thus advised during the Scoping Phase to avoid the western boundary of the site, so to minimise any direct impacts on the Helbrandkloofspruit.

When mapping these systems, it became evident that the active channel could not be used to define the lateral extent of the river system. Due to the nature of the soils and geomorphology, these systems are able to form various meanders or fans (Figure 6) within the greater landscape. Placing a buffer of, for example 100 m onto such a system, would still not capture the entire system and therefore not adequately ensure the protection of the riparian zone.





**Figure 5:** The main rivers and river beds observed within the site, and along the pipeline route.



**Figure 6:** An example of active channel (indicated by white line) versus alluvial fans observed on site.

The south-eastern portion of the site was found suitable for the development, for the following reasons:

- This portion of the site exhibited the least diversity in term of riparian structure, with most species being ubiquitous within the region.
- The presence of alluvial fans is limited.
- Habitat complexity is low, e.g. no geomorphological changes such as rock outcrops were observed. There is little diversity regarding instream habitats and few refugia would be impacted upon.
- There is still sufficient space between the proposed footprint area and the significant mainstem riverbeds to institute suitable stormwater management structures (silt traps) and pollution containment areas.

## **9. IMPACT ASSESSMENT**

This impact assessment deals with three separate components, i.e. riparian vegetation, flow and quality, and fish fauna (Sections 9.2 – 9.4). Section 9.1 provides general information on impacts.

### **9.1 Generic impacts**

In generic terms, many of the potential environmental impacts on the Orange River due to construction activities associated with the water abstraction infrastructure on the banks and riparian zones are similar, and will be applicable to any construction activity in or adjacent to rivers. A general description of the possible causes of these common impacts on aquatic habitats and biota (particularly on the fish fauna), as well as a description of their ecological consequences, is provided below.

#### **9.1.1. Sedimentation and Elevated Turbidity**

##### **Potential causes**

There is a risk of elevated sediment input into the Orange River during the establishment of the water abstraction facilities on the banks and floodplains of the Orange River. In addition, although relatively far from the river itself, sediment-laden runoff from the proposed sites of the solar power facility could possibly occur, particularly if flash floods occur during the site clearing and construction phases of the project. Sediment mobilisation could result from, among others:

- » Disturbance of existing flood protection embankments.
- » Inadequate erosion control or containment of sediment-laden runoff during site clearing and construction activities for infrastructure at both the abstraction points (e.g. pipe lines and reservoirs) and at the solar plant site.
- » Backwash water discharged from the sand filters could result in sediment laden water reaching the Orange River, with a resultant impact on habitat availability for instream biota.
- » Poor planning and design of new abstraction infrastructure and new flood protection measures on the floodplain, resulting in bank erosion or slumping to occur during river flooding events.



## **Consequences**

Increased siltation and sedimentation has been described as one of the biggest threats facing some rivers in South Africa and could result in a number of negative impacts, including:

- » Reducing the depth of pools in the river channel causing these sanctuary habitats to become too shallow during low flows to support fish life or other aquatic biota.
- » Fine sediment could be washed downstream and smother important fish spawning areas, such as gravel and cobble riffles used by Largemouth yellowfish and rock catfish.
- » Sediment deposits would further encourage reed invasion in the river channel and thus degrade preferred fish habitats.

Elevated turbidity levels associated with increased sediment washing into the river has a number of negative impacts on aquatic biota, including fish. These include.

- » The whole food web can be disrupted due to reduced light penetration and photosynthesis, resulting in reduced primary production, a reduction in submerged plant life, including phytoplankton.
- » Reduced number of bottom organisms (e.g. benthic algae, crabs, small aquatic invertebrates) due to smothering by layers of silt.
- » The smothering of incubating eggs (fish, tadpoles, etc.) and larval fish.
- » Clogging, abrading and damage to fish gills, leading to reduced oxygen absorption, damage to gill filaments, resulting in increased stress, disease and even death, (Whitfield and Paterson 1995).
- » Reduced feeding efficiency – a major impact on visual predators such as largemouth yellowfish, as they are unable to see and find enough food in the turbid water.

The above impacts could eliminate sensitive species from the affected areas and cause fish species and other biota to vacate the area. Fish species such as the near threatened largemouth yellowfish that require silt-free gravel and/or cobble habitats for spawning, would be particularly affected by elevated sediment inputs.

Thus the ecological functioning of the impacted reach of the Orange River could be seriously impacted by high sediment inputs associated with the proposed construction activities, particularly of the water abstraction facilities.

### **9.1.2 Water pollution**

#### **Potential causes**

During both pre-construction and construction activities, chemical pollutants (hydrocarbons from equipment and vehicles, cleaning fluids, cement powder, wet cement, shutter-oil, etc.) associated with site-clearing machinery and construction activities could wash into the rivers. In addition, washing soap, faeces, and other waste material from workers, particularly those working near the river, could contaminate surface run-off and pollute the river water.

## Consequences

These pollutants could be harmful to aquatic biota, particularly during low flows when dilution is reduced, and could pose a health risk to locals using the river water for domestic purposes. Larval fish, which often utilise shallow productive habitats near the river bank as nursery areas, are usually more sensitive than adult fish to poor water quality. In addition, the important and rare rock catfish is thought to be particularly sensitive to poor water quality.

Lime-containing (high pH) construction materials such as concrete, cement, grouts, etc., deserve a special mention, as they are highly toxic to fish and other aquatic biota. If dry cement powder or wet uncured concrete is exposed to surface run-off or river water, these compounds can elevate the pH to lethal levels. Thus extreme care should be taken when these hazardous compounds are used near water. For fish, pH levels of over 10 are considered toxic.

### 9.2. Impact assessment: Riparian zones

The riparian zone component includes the functional or ecosystem services importance of the dry river beds and riparian zones on site and how the proposed development would affect the riparian environment. At this point the development footprint has been positioned in the south eastern corner of the proposed site to avoid the majority of the drainage lines as per the conclusions of the scoping study (Figure 7).



**Figure 7:** Locality map indicating the CSP layout within Portion 3 of the Farm McTaggarts Camp 453

During the impact assessment study a number of potential key issues / impacts were identified and these were assessed based on the methodology supplied by Savannah Environmental. Two main issues are highlighted and these are listed below, together with related impacts that have the potential to arise should the project go-ahead.

Issue – Biological environment (e.g. vegetation)

Impact 1: Loss of riparian systems

Issue - Physical environment

Impact 2: Impact on dry riverbeds and localised drainage systems

Impact 3: Impact on riparian systems through the possible increase in surface water runoff on riparian form and function

Impact 4: Increase in sedimentation and erosion

Impact 5: Physical disturbance by the supporting infrastructure (pipe lines and pump stations) on the riverine environment

The impacts were assessed as follows:

<b>Nature:</b> Impact 1 - Loss of riparian systems		
The physical removal of the narrow strips of woody riparian zones, being replaced by hard engineered surfaces. This biological impact would however be localised, as a large portion of the remaining farm and the Helbrandkloofspruit catchment would remain intact.		
	<b>Without mitigation</b>	<b>With mitigation</b>
<b>Extent</b>	Local (1)	Local (1)
<b>Duration</b>	Long-term (4)	Long-term (4)
<b>Magnitude</b>	Moderate (6)	Low (4)
<b>Probability</b>	Definite (5)	Definite (5)
<b>Significance</b>	<b>High (55)</b>	<b>Medium (45)</b>
<b>Status (positive or negative)</b>	Negative	Negative
<b>Reversibility</b>	Medium	Medium
<b>Irreplaceable loss of resources</b>	No	No
<b>Can impacts be mitigated</b>	Yes	
<b>Mitigation:</b>		
The most significant form of mitigation would be to select a development area, which contained no drainage lines. However due to the nature of the site, this was not possible, thus an area with the least number of riparian systems was earmarked, i.e. the south eastern corner of the site. This area is also a significant distance from the main drainage systems, and is thus unlikely to be flooded or in itself pose a risk to the aquatic systems should there be any major spills (coolants).		
<b>Cumulative impacts:</b>		
None		
<b>Residual impacts:</b>		
Possible impact on the remaining catchment due to changes in run-off characteristics in the development site.		

<b>Nature:</b> Impact 2 - Impact on dry riverbeds and localised drainage systems		
The physical removal of narrow strips of woody riparian zones being replaced by hard engineered surfaces will alter the hydrological nature of the area, by increasing the surface run-off velocities, while reducing the potential for any run-off to infiltrate the soils. This impact would however be localised, as a large portion of the remaining farm and the Helbrandkloofspruit catchment would remain intact.		
	<b>Without mitigation</b>	<b>With mitigation</b>
<b>Extent</b>	Local (1)	Local (1)
<b>Duration</b>	Long-term (4)	Long-term (4)
<b>Magnitude</b>	Low (4)	Low (4)
<b>Probability</b>	Definite (5)	Probable (3)
<b>Significance</b>	<b>Medium (45)</b>	<b>Low (24)</b>
<b>Status (positive or negative)</b>	Negative	Negative
<b>Reversibility</b>	High	High
<b>Irreplaceable loss of resources</b>	No	No
<b>Can impacts be mitigated</b>	Yes	
<b>Mitigation:</b> The most significant form of mitigation would be to select a development area which contained no drainage lines. However due to the nature of the site, this was not possible, thus an area with the least number of riparian systems was earmarked, i.e. the south eastern corner of the site. Any stormwater within the site will be handled in a suitable manner, i.e. separate clean and dirty water streams around the plant, and install stilling basins to capture large volumes of run-off, trap sediments and reduce flow velocities.		
<b>Cumulative impacts:</b> The increase in surface run-off velocities and the reduction in the potential for groundwater infiltration is unlikely to occur, considering that the site is not near the main drainage channel and the annual rainfall figures are low.		
<b>Residual impacts:</b> Diversion of run-off away from downstream systems is unlikely to occur as the site is not near the main drainage channel and the annual rainfall figures are low.		

<b>Nature:</b> Impact 3 - Impact on riparian systems through the possible increase in surface water runoff on riparian form and function		
	<b>Without mitigation</b>	<b>With mitigation</b>
<b>Extent</b>	Local (1)	Local (1)
<b>Duration</b>	Long-term (4)	Long-term (4)
<b>Magnitude</b>	Low (2)	Low (2)
<b>Probability</b>	Definite (5)	Probable (3)
<b>Significance</b>	<b>Medium (35)</b>	<b>Low (19)</b>
<b>Status (positive or negative)</b>	Negative	Negative
<b>Reversibility</b>	Medium	Medium
<b>Irreplaceable loss of resources</b>	No	No

<b>Can impacts be mitigated</b>	Yes	
<b>Mitigation:</b> Any stormwater within the site will be handled in a suitable manner, i.e. separate clean and dirty water streams around the plant, and install stilling basins to capture large volumes of run-off, trap sediments, and reduce flow velocities (e.g. water used when washing the mirrors).  The project should also try capture and recycle any form of run-off created by the daily operations. This would minimise the amount of water required by the project, but also serve to limit the downstream impacts on the riparian systems through an increase in run-off, a situation that these systems are currently unaccustomed too.		
<b>Cumulative impacts:</b> Downstream alteration of hydrological regimes due to the increased run-off from the area.		
<b>Residual impacts:</b> Possible impact on the remaining catchment due to changes in run-off characteristics in the development site.		

<b>Nature:</b> Impact 4 - Increase in sedimentation and erosion within the development footprint		
	<b>Without mitigation</b>	<b>With mitigation</b>
<b>Extent</b>	Local (1)	Local (1)
<b>Duration</b>	Long-term (4)	Long-term (4)
<b>Magnitude</b>	Low (1)	Low (1)
<b>Probability</b>	Definite (5)	Probable (3)
<b>Significance</b>	<b>Medium (30)</b>	<b>Low (18)</b>
<b>Status (positive or negative)</b>	Negative	Negative
<b>Reversibility</b>	Medium	Medium
<b>Irreplaceable loss of resources</b>	No	No
<b>Can impacts be mitigated</b>	Yes	
<b>Mitigation:</b> Any stormwater within the site will be handled in a suitable manner, i.e. separate clean and dirty water streams around the plant, and install stilling basins to capture large volumes of run-off, trap sediments and reduce flow velocities (e.g. water used when washing the mirrors).		
<b>Cumulative impacts:</b> Downstream erosion and sedimentation of the downstream wetland / dam area and canal system of the Naftali operations. During flood events, the unstable banks (eroded areas) and sediment bars (sedimentation downstream) already deposited downstream will then be washed into the Orange River.		
<b>Residual impacts:</b> During flood events, the unstable banks (eroded areas) and sediment bars (sedimentation downstream) already deposited downstream will then be washed into the Orange River.		

<b>Nature:</b> Impact 5 - Physical disturbance by the supporting infrastructure (pump stations) on the riparian environment		
The proposed pipeline route will have limited to no impact on the functioning of any riparian systems.		
	<b>Without mitigation</b>	<b>With mitigation</b>
<b>Extent</b>	Local (1)	Local (1)
<b>Duration</b>	Long-term (4)	Long-term (4)
<b>Magnitude</b>	Moderate (6)	Low (3)
<b>Probability</b>	Definite (5)	Probable (3)
<b>Significance</b>	<b>Medium (55)</b>	<b>Low (24)</b>
<b>Status (positive or negative)</b>	Negative	Negative
<b>Reversibility</b>	Medium	Medium
<b>Irreplaceable loss of resources</b>	No	No
<b>Can impacts be mitigated</b>	Yes	
<b>Mitigation:</b> The placement of pump inlets and the supporting infrastructure so as to prevent the potential for scour / erosion and downstream sedimentation of the Orange River. The current placement is within an area of dense reed growth ( <i>Phragmites australis</i> ), and would not be considered a severe impact. Care should however be taken that if any clearing is done, that this area is monitored for plant re-growth, firstly to prevent alien plant infestations and to ensure no erosion or scour takes place.		
<b>Cumulative impacts:</b> Additional downstream erosion and sedimentation of the Orange River.		
<b>Residual impacts:</b> During flood events, the unstable banks (eroded areas) and sediment bars (sedimentation downstream) will further increase the suspended sediment loads within the Orange River system.		

### 9.3. Impact assessment: Orange River - Flow and quality issues

The flow and quality component focuses on the impact of the development on the availability of the water resources of the area, particularly from the regional context of the Lower Orange River system.

The distance of the proposed solar facility on the Farm McTaggart's Camp 453-3 from the Orange River (approximately 8 km) will reduce the risk of contaminated run-off from the solar facility polluting the Orange River. However the well defined drainage lines or ephemeral streams such as the Helbrandkloofspruit adjacent to the site would increase this risk during rainstorms and local flash floods which normally occur during the summer months.

### 9.4. Impact assessment: Orange River – Fish fauna (biotic study)

The fish fauna component focuses on the impact of the development on the biota of the water resources of the area, i.e. the Orange River as the water source for the development.

Note that the impact assessment for 9.3 and 9.4 are dealt with together. As the outcomes of the Ecological Flow Requirement (EFR) study currently being conducted for ORASECOM are not yet available, the impact assessment is based on the preliminary present state and sensitivity of the system. This is particularly relevant when assessing the potential impact of water abstraction from the Orange River.

There is a moderate risk of impacts to the Orange River resulting from elevated sediment loads and polluted runoff from the solar thermal facility reaching the river during site preparation and construction, if appropriate mitigation is not taken. The construction of infrastructure associated with the abstraction point also poses a moderate risk of impacting negatively on aquatic habitats and biota in the adjacent Orange River, unless appropriate mitigation is taken. These impacts are assessed in detail below.

<b>Nature:</b> Impact 1 - Sediment input into the Orange River		
Vegetation clearing and earthmoving operations at the site during pre-construction and construction of the infrastructure (including access roads, water pipelines, reservoirs, etc.) will increase the risk of soil erosion and sediment being washed into the Orange River during heavy rains.		
	<b>Without mitigation</b>	<b>With mitigation</b>
<b>Extent</b>	Site (2)	Local (1)
<b>Duration</b>	Short-term (2)	Short-term (2)
<b>Magnitude</b>	Moderate (6)	Minor (2)
<b>Probability</b>	Highly probable (4)	Improbable (2)
<b>Significance</b>	<b>40 (medium)</b>	<b>10 (low)</b>
<b>Status (positive or negative)</b>	Negative	Negative
<b>Reversibility</b>	Medium	Low
<b>Irreplaceable loss of resources</b>	Yes (medium)	Yes (low)
<b>Can impacts be mitigated</b>	Yes (high)	
<b>Mitigation:</b>		
<ul style="list-style-type: none"> <li>» Site clearing and preparation for the construction of the solar facility should take steps to avoid surface run-off and storm-water erosion of cleared areas where practicable.</li> <li>» A comprehensive Storm Water Management Plan (SWMP) incorporating anti-erosion measures on site should be put in place.</li> <li>» All surface run-off should be discharge via detention dams to allow sediment to settle out before leaving the site</li> </ul>		
<b>Cumulative impacts:</b>		
Man-induced erosion and sedimentation in this area from intensive farming activities along the Orange River is expected to be unnaturally high. The cumulative impact on the Orange River could thus exceed the tolerances of the aquatic biota, including sensitive fish species.		
<b>Residual Impacts:</b>		
Residual Impacts should be minimal with appropriate mitigation.		

<b>Nature:</b> Impact 2 - Chemical and other pollutants into the Orange River
During both preconstruction, construction and operational activities, chemical pollutants (hydrocarbons from equipment and vehicles, cleaning fluids, cement powder, wet cement, shutter-oil, etc.) associated with site-clearing machinery and construction activities could be washed downslope via the ephemeral streams into the Orange River.
During the operational phase, spills and leaks from the evaporation or blow down ponds could be washed by stormwater run-off via the natural drainage lines into the Orange River.

Appropriate ablution facilities should be provided for construction workers during construction and on-site staff during the operation of the facility.

This impact is particularly important as McTaggart's Stream draining the site flows into an irrigation balancing dam on Naftali Farm downstream, where high irrigation quality water is essential as the fruit crop (grapes) is exported to Europe (Rekopane Estates).

	Without mitigation	With mitigation
<b>Extent</b>	Site (2)	Local (1)
<b>Duration</b>	Short-term (2)	Short-term (2)
<b>Magnitude</b>	Moderate (6)	Minor (2)
<b>Probability</b>	Probable (3)	Improbable (2)
<b>Significance</b>	<b>30 (medium)</b>	<b>10 (low)</b>
<b>Status (positive or negative)</b>	Negative	Negative
<b>Reversibility</b>	Yes (high)	Yes (high)
<b>Irreplaceable loss of resources</b>	Yes (medium)	Yes (low)
<b>Can impacts be mitigated</b>	Yes (high)	
<b>Mitigation:</b> <ul style="list-style-type: none"> <li>» Strict use and management of all hazardous materials used on site.</li> <li>» Strict management of potential sources of pollution (e.g. litter, hydrocarbons from vehicles &amp; machinery, cement during construction, etc.).</li> <li>» Containment of all contaminated water by means of careful run-off management on the development site.</li> <li>» Strict control over the behaviour of construction workers.</li> <li>» Working protocols incorporating pollution control measures (including approved method statements by the contractor) should be clearly set out in the Construction Environmental Management Plan (CEMP) for the project and strictly enforced.</li> </ul>		
<b>Cumulative impacts:</b> The widespread use of chemicals in farming activities (fertilizers, insecticides, herbicides, etc.) means that any chemical pollution from the solar thermal facility will have a marked cumulative impact on aquatic biota.		
<b>Residual impacts:</b> Residual impacts will be negligible after appropriate mitigation.		

**Nature:** Impact 3 - Abstraction of water from the Orange River: timing and volume

The proposed constant abstraction of large volumes of water from the Orange River (ca 1 million m<sup>3</sup>/a) may reduce present day flows and impact negatively on aquatic biota. This impact would be particularly evident in summer when high river flows are required for fish spawning migrations and egg incubation. However, without detailed data on present-day flows, volumes abstracted by other users or Ecological Water Requirements, this impact is difficult to quantify. The system is also highly regulated (i.e. many dams upstream in the system), making an assessment more difficult. However, it is anticipated that constant pumping during droughts may impact on drought flow requirements needed to meet the EWR. Cognisance will have to be taken of other user requirements.

	Without mitigation	With mitigation
<b>Extent</b>	Region (3)	n/a
<b>Duration</b>	Long-term (4)	n/a
<b>Magnitude</b>	Low (4)	n/a
<b>Probability</b>	Probable (3)	n/a
<b>Significance</b>	<b>33 (medium)</b>	n/a
<b>Status (positive or negative)</b>	Negative	n/a
<b>Reversibility</b>	High	n/a



<b>Irreplaceable loss of resources</b>	Yes (low)	n/a
<b>Can impacts be mitigated</b>	Low/none	
<b>Mitigation:</b> Mitigation measures may be difficult and expensive. The only mitigation is the consideration of alternative sources of water, which are not considered feasible at this time (Smit, Abengoa Solar, pers. comm., October 2010). However, the possible measures to reduce volumes of water abstracted from the Orange River could include the following: <ul style="list-style-type: none"> <li>» Optimise the design or technology of the solar power facility to reduce consumptive water requirements as possible.</li> <li>» Use water from another source, such as the final effluent from the Upington WWTW; however not practically possible.</li> <li>» Adapt the abstraction regime to meet the EWR and requirements of other users where required.</li> </ul> <p><u>Note:</u> The above assessment was undertaken assuming realistic mitigation is NOT feasible and that wet cooling would be undertaken at the solar facility.</p>		
<b>Cumulative impacts:</b> Cumulative impacts due to water abstraction in the Lower Orange River are already considered to be high and will be exacerbated by the abstractions for this project. Note that the water use required by this project is relatively small in a regional context.		
<b>Residual impacts:</b> No residual impacts expected if mitigation possible.		

Note that Impact 3 may represent a **significant financial implication** to the development in terms of the required licensing from DWA. DWA has requested that options be considered to reduce the water use for the solar thermal facility, e.g. by instituting dry cooling (Snyders, DWA Northern Cape, pers. comm., October 2010). The tariffs proposed under the REFIT however, only caters for wet cooling.

<b>Nature:</b> Impact 4 - Water abstraction facility on Mr. Conrad Geldenhuys's Farm – Sediment input due to erosion and river bank damage  Increased sediment input could result from: <ul style="list-style-type: none"> <li>» Disturbance of existing flood protection embankments at Orange River.</li> <li>» Inadequate erosion control or containment of sediment-laden runoff during site clearing and construction activities for infrastructure at the abstraction points (e.g. pipelines and reservoirs).</li> <li>» Poor planning and design of new abstraction infrastructure and new flood protection measures on the floodplain, resulting in bank erosion or slumping to occur during river flooding events.</li> </ul>		
	<b>Without mitigation</b>	<b>With mitigation</b>
<b>Extent</b>	Site (2)	Local (1)
<b>Duration</b>	Medium-term (3)	Medium-term (3)
<b>Magnitude</b>	Low (4)	Minor (1)
<b>Probability</b>	Highly probable (4)	Improbable (2)
<b>Significance</b>	<b>36 (medium)</b>	<b>10 (low)</b>
<b>Status (positive or negative)</b>	Negative	Negative
<b>Reversibility</b>	Yes (medium)	Yes (high)
<b>Irreplaceable loss of resources</b>	Yes (low)	Yes (low)
<b>Can impacts be mitigated</b>	Yes (high)	
<b>Mitigation:</b> Mitigation measures can readily be implemented and include: <ul style="list-style-type: none"> <li>» Appropriate hard-engineered bank erosion protection structures.</li> <li>» Careful rehabilitation using natural riparian vegetation to stabilize the riverbanks and all</li> </ul>		

<p>disturbed areas in the riparian zone</p> <ul style="list-style-type: none"> <li>» Stormwater drains should be correctly located and designed with appropriate erosion-control features to ensure local stormwater run-off over the flood embankments and natural riverbanks do not cause erosion and subsequent bank slumping.</li> <li>» During construction, adjacent riparian habitats outside the “footprint” of the new infrastructure should be declared sensitive habitats and out of bounds for all construction activities and for all construction workers.</li> <li>» Construction work should preferably take place in the dry winter months to avoid storm-water erosion of cleared areas and damage due to untimely river flooding.</li> </ul>
<p><b>Cumulative impacts:</b></p> <p>Cumulative impacts due to artificial elevation of the river banks, embankment construction and earthmoving activities in the floodplain of the Orange River has severely impacted on ecological functioning of the system. Further manipulation will exacerbate these impacts, but to a very limited degree with a localised impact.</p>
<p><b>Residual impacts:</b></p> <p>There will be a low residual impact due to the alteration of the river banks at the abstraction point.</p>

<p><b>Nature:</b> Impact 5 - Operation of the reservoir and high pressure sand filtration plant</p> <p>The discharge of sediment-laden backwash water from the sand filter into a natural drainage line about 500 m from river could have a potential impact by discharging into and raising the turbidity of the Orange River.</p>		
	<b>Without mitigation</b>	<b>With mitigation</b>
<b>Extent</b>	Site (2)	Local (1)
<b>Duration</b>	Long-term (4)	Very short (1)
<b>Magnitude</b>	Minor-low (3)	Minor (2)
<b>Probability</b>	Highly probable (4)	Improbable (2)
<b>Significance</b>	<b>36 (medium)</b>	<b>8 (low)</b>
<b>Status (positive or negative)</b>	Negative	Negative
<b>Reversibility</b>	Yes (high)	Yes (high)
<b>Irreplaceable loss of resources</b>	Yes (low)	Yes (low)
<b>Can impacts be mitigated</b>	Yes (high)	
<p><b>Mitigation:</b></p> <p>Mitigation measures could be readily applied and include the following:</p> <ul style="list-style-type: none"> <li>» The backwash water should be directed into a suitably designed retention pond to allow most of the sediment to settle out before the clear water is allowed to flow back to the river.</li> </ul>		
<p><b>Cumulative impacts:</b></p> <p>This will be a cumulative impact as it will add to the already elevated sediment load into the river due to agricultural activities.</p>		
<p><b>Residual impacts:</b></p> <p>Residual impacts should not be apparent if mitigation is correctly carried out.</p>		

## 9. ENVIRONMENTAL MANAGEMENT PLAN MEASURES

<b>Project component/s</b>	Site selection with regard minimising the overall impact on the functioning of the riparian environment	
<b>Potential impact</b>	Loss of important habitat and fragmentation of the riverine systems	
<b>Activity risk source</b>	Site selection and incorrect placement of the development footprint	
<b>Mitigation: Target / Objective</b>	Minimise the loss of riparian systems - incorrect footprint / site selection	
<b>Mitigation: Action/control</b>	<b>Responsibility</b>	<b>Timeframe</b>
Select a favourable site having the least impact or within an area that is least sensitive, i.e. the south-eastern portion of the site.	Developer	Planning and design phase
<b>Performance indicator</b>	N/A	
<b>Monitoring</b>	N/A	

<b>Project component/s</b>	Site selection with regard minimising the overall impact on the functioning of the riparian environment	
<b>Potential impact</b>	Loss of important habitat and fragmentation of the riverine systems	
<b>Activity risk source</b>	Placement of hard engineered surfaces	
<b>Mitigation: Target / Objective</b>	Select a favourable site, having the least impact or within an area that is least sensitive, i.e. the south eastern portion of the site	
<b>Mitigation: Action/control</b>	<b>Responsibility</b>	<b>Timeframe</b>
Minimise the loss of riparian habitat – physical removal and replacement by hard surfaces	Developer	Planning and design phase
<b>Performance indicator</b>	N/A	
<b>Monitoring</b>	N/A	

<b>Project component/s</b>	Alteration of sandy substrata into hard surfaces impacting on the local hydrological regime	
<b>Potential impact</b>	Poor stormwater management and the alteration hydrological regime	
<b>Activity risk source</b>	Placement of hard engineered surfaces	
<b>Mitigation: Target / Objective</b>	The most significant form of mitigation would be to select a development area that contained no drainage lines. However due to the nature of the site, this was not possible, thus an area, with the least number of riparian systems was earmarked, i.e. the south eastern corner of the site. Any stormwater within the site will be handled in a suitable manner, i.e. clean and dirty water streams around the plant and install stilling basins to capture large volumes of run-off, trapping sediments and reduce flow velocities.	
<b>Mitigation: Action/control</b>	<b>Responsibility</b>	<b>Timeframe</b>
Reduce the potential increase in surface flow velocities and the impact on dry riverbeds and the localised drainage systems	Developer / Operator	Planning, design and operation phase
<b>Performance indicator</b>	Water quality and quantity management - "Water Use Licence Conditions"	
<b>Monitoring</b>	Surface water monitoring plan	

<b>Project component/s</b>	Poor stormwater management and the alteration of the hydrological regime	
<b>Potential impact</b>	Risk of river system erosion and downstream sedimentation	
<b>Activity risk source</b>	Placement of hard engineered surfaces	
<b>Mitigation: Target / Objective</b>	Any stormwater within the site will be handled in a suitable manner, i.e. clean and dirty water streams around the plant and install stilling basins to capture large volumes of run-off, trapping sediments and reduce flow velocities. (e.g. water used when washing the mirrors).	
<b>Mitigation: Action/control</b>	<b>Responsibility</b>	<b>Timeframe</b>
Minimise the potential impact by the supporting infrastructure on the riparian systems	Developer / Operator	Planning, design and operation phase
<b>Performance indicator</b>	Water quality and quantity management – "Water Use Licence Conditions"	
<b>Monitoring</b>	Surface water monitoring plan	

<b>Project component/s</b>	Placement of access roads, pipelines and dams off-site	
<b>Potential impact</b>	Risk of river system erosion and downstream sedimentation	
<b>Activity risk source</b>	Placement of hard engineered surfaces	
<b>Mitigation: Target / Objective</b>	The placement of pump inlets and the supporting infrastructure so as to prevent the potential for scour / erosion and downstream sedimentation of the Orange River. The current placement is within an area of dense reed growth ( <i>Phragmites australis</i> ), and would not be considered a severe impact. Care should however be taken that if any clearing is done, that this area is monitored for plant re-growth, firstly to prevent alien plant infestations and to ensure no erosion or scour takes place.	
<b>Mitigation: Action/control</b>	<b>Responsibility</b>	<b>Timeframe</b>

Minimise the potential Increase in sedimentation and erosion	Developer / Operator	Planning, design and operation phase
<b>Performance indicator</b>	Water quality and quantity management – “Water Use Licence Conditions”	
<b>Monitoring</b>	Surface water monitoring plan	

<b>Project component/s</b>	Placement of access roads, pipelines and dams off-site	
<b>Potential impact</b>	<p>There is a high risk of elevated sediment input into the Orange River during the establishment of the water abstraction facilities on the banks and floodplains of the Orange River.</p> <ul style="list-style-type: none"> <li>• Backwash water discharged from the sand filters could result in sediment laden water reaching the Orange River.</li> <li>• Poor planning and design of new abstraction infrastructure and new flood protection measures on the floodplain, resulting in bank erosion or slumping to occur during river flooding events.</li> </ul>	
<b>Activity risk source</b>	Design, placement and operation of water abstraction infrastructure	
<b>Mitigation: Target / Objective</b>	<p>The risk of erosion and bank slumping or collapse during both pre-construction, construction work can readily be prevented by careful design and planning. Mitigation measures include:</p> <ul style="list-style-type: none"> <li>• Appropriate hard-engineered bank erosion protection structures.</li> <li>• Careful rehabilitation using natural riparian vegetation to stabilize the riverbanks and all disturbed areas in the riparian zone.</li> <li>• Local stormwater run-off over the flood embankments and natural riverbanks could potentially cause erosion and subsequent bank slumping, unless stormwater drains are correctly located and designed with appropriate erosion-control features.</li> <li>• During construction, adjacent riparian habitats outside the “footprint” of the new infrastructure should be declared sensitive habitats and out of bounds for all construction activities and for all construction workers.</li> <li>• Construction work (including site clearing and preparation for the solar power plants) should only take place in the dry winter months to avoid storm-water erosion of cleared areas and damage due to untimely river flooding.</li> </ul>	
<b>Mitigation: Action/control</b>	<b>Responsibility</b>	<b>Timeframe</b>
Minimise the potential impact elevated turbidity and sedimentation in the Orange River	Developer / Operator	Planning, design and operation phase
<b>Performance indicator</b>	Water quality and quantity management – “Water Use Licence Conditions”	
<b>Monitoring</b>	Surface water monitoring plan – elevated turbidity in the irrigation canals and Orange River	

<b>Project component/s</b>	The use of chemicals and hazardous substances during construction and operation	
<b>Potential impact</b>	<p>These pollutants could be harmful to aquatic biota, particularly during low flows when dilution is reduced, and could also pose a health risk to locals using the river water for domestic purposes.</p> <p>Lime-containing (high pH) construction materials such as concrete, cement, grouts, etc., deserve a special mention, as they are highly toxic to fish and other aquatic biota. If dry cement powder or wet uncured concrete comes into contact with surface run-off or river water, these compounds can elevate the pH to lethal levels. Thus extreme care should be taken when these hazardous compounds are used near water. For fish, pH levels of over 10 are considered toxic.</p>	
<b>Activity risk source</b>	Design, placement and operation of water abstraction infrastructure	
<b>Mitigation: Target / Objective</b>	<p>Management actions that are applicable to all the construction sites (particularly at the abstraction points) include:</p> <ul style="list-style-type: none"> <li>• Strict use and management of all hazardous materials used on site.</li> <li>• Strict management of potential sources of pollution (hydrocarbons from vehicles and machinery, cement during construction, etc.).</li> <li>• Containment of all contaminated water, which includes any 'backwash' or process water that could be released back into the Orange River.</li> <li>• Strict control over the behaviour of construction workers.</li> <li>• Any current erosion or destabilization of the river banks due to existing structures in the vicinity of the abstraction sites should be repaired and stabilized as part of the present project.</li> <li>• All areas adjacent to the hard-engineered erosion-control structures provided for this project, which are (accidentally) disturbed and where riparian vegetation was destroyed during the construction activities, should to be rehabilitated using appropriate indigenous vegetation.</li> </ul>	
<b>Mitigation: Action/control</b>	<b>Responsibility</b>	<b>Timeframe</b>
Minimise the potential impact of pollutants entering the Orange River	Developer / Operator	Planning, design and operation phase
<b>Performance indicator</b>	Water quality and quantity management - "Water Use Licence Conditions"	
<b>Monitoring</b>	Surface water monitoring plan - elevated turbidity in the irrigation canals and Orange River	

## 10. CONCLUDING COMMENTS/IMPACT STATEMENT

With suitable mitigation and implementation of the proposed layout, the development should have limited impact on the overall status of the riparian systems within the region. This desktop assessment of the potential impacts of the proposed Upington Solar Thermal Plant on the fish biota of Orange River also did not reveal any significant impacts on the fish fauna and associated aquatic habitats, provided the appropriate mitigation measures are taken. All impacts that were assessed as being of moderate significance could readily be reduced to low significance by appropriate mitigation, apart from the moderate impact of water abstraction from the Orange River. However, in this case the precautionary principle was applied due the lack of data on the Ecological Water Requirements of the Orange River in this locality.

Impacts on the Orange River system due to water abstraction, and site-specific impacts on instream biota are difficult to quantify due to the number of unknowns and the highly regulated nature of the system. Releases from Vanderkloof Dam would affect the site, although release patterns are re-evaluated every year to provide for irrigators and is therefore well known. Eskom requirements also play a role in release strategies. A 280 million m<sup>3</sup>/a release for the estuary is also made as variable base flows over 12 months, although it is unknown as to whether this water actually reaches the estuary. Operating losses and requirements (such as to top up the upstream Boegoeberg Dam after draining it for cleaning) are also included in this allocation. Note that Boegoeberg Dam (upstream of Upington) is not used to operate flows into the river, but rather as a diversion weir for the canal systems. The only flows from this dam into the Orange River are spills and when bottom releases are made (approximately once a year) to clean the dam (WRP Consulting, pers. comm., September 2010, for the ORASECOM EFR study).

A possible impact on the development of the Upington Solar Thermal Plant is in terms of the quantity of water required for operation of the facility. Although the volume does not seem to be prohibitive, water use can be reduced by implementing alternative operational processes, e.g. dry cooling, as requested by DWA. The following alternatives or recommendations are therefore presented for consideration. Comments are shown alongside in *italics*:

- 1) Use of groundwater and on-site treatment. *Due to the quality of groundwater and the on-site requirement for deionized water for cleaning of mirrors, the costs of treating groundwater are probably prohibitive. Furthermore, no such resources exist on the site.*
- 2) Reduce water requirement. *This can be undertaken through a range of design optimisations, but will however, have to take into account cost implications. Refer to point 4.*
- 3) Consider feasibility of further re-cycling/re-using cooling water. This option has been *considered and incorporated into the design.*
- 4) Consider dry cooling. *This will have a significant economic impact as the current tariffs under the REFIT only cater for wet cooling and will impact the economic viability of the project (Smith, Abengoa Solar, pers. comm., October 2010).*
- 5) Consider the use of grey water, e.g. output from Upington Wastewater Treatment Works (WWTW). *The distance between the facilities will increase operational costs significantly.*

Consideration of alternative routes for power lines and access roads were as follows:

- » Alternative routes for power lines: no impact on the aquatic or riparian environment
- » Alternative routes for access roads: no significant impact on the aquatic or riparian environment, although there is a preference for entry to the site from the south-eastern corner, i.e. access road III.

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# **McGregor Museum Department of Archaeology**



## **UPINGTON SOLAR THERMAL PLANT**

### **Archaeology**

**Specialist Input for the Environmental  
Impact Assessment Phase and  
Environmental Management Plan for the  
proposed Upington Solar Thermal Plant,  
Northern Cape Province**

David Morris  
September 2010

## **UPINGTON SOLAR THERMAL PLANT**

### **SPECIALIST INPUT FOR THE ENVIRONMENTAL IMPACT ASSESSMENT PHASE AND ENVIRONMENTAL MANAGEMENT PLAN FOR THE PROPOSED UPINGTON SOLAR THERMAL PLANT, NORTHERN CAPE PROVINCE**

#### **ARCHAEOLOGY**

David Morris, McGregor Museum, Kimberley  
P.O. Box 316 Kimberley 8300  
Tel 082 2224777 email mmkarchaeology@yahoo.co.uk  
September 2010

#### **1. INTRODUCTION**

A scoping phase evaluation of the full site on the Farm McTaggarts Camp 453, portion 3, which is located approximately 20 km south west of Upington in the Southern Kalahari, Northern Cape, narrowed the choice of site for the proposed development to a development footprint of approximately 6 km<sup>2</sup> in the south eastern portion of the site within the broader site of 22 km<sup>2</sup>. The development footprint is the area which will be disturbed during the operational phase.

##### **1.1 Focus and Content of Specialist Report: Archaeology**

The archaeology specialist study (commissioned by Savannah Environmental (Pty) Ltd), is focused on the development footprint of the proposed facility and its ancillary infrastructure including steam turbine and generator, generator transformer and substation, overhead power lines, water supply line to the facility and an abstraction point on the Gariep / Orange River, water storage / treatment reservoirs, an evaporation pond, workshops, storage areas and access roads.

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

- » Introduction to the Specialist in terms of qualifications, accreditation and experience to undertake the study (1.2, below)
- » Description of the affected environment (2)
- » Description of heritage features of the region (2.1)
- » Description of issues identified during the Scoping process (2.2)
- » Methodology of determining the significance of the impacts and assumptions as well as scoping phase predictions (3)
- » Observations and Assessment of impacts, including a summary in tabular format (4)

- » Comparative assessment of alternatives (4.3.2)
- » Recommended measures for draft Environmental Management Plan and site-specific mitigation (5)
- » Conclusions (6)

## **1.2 Archaeology Specialist**

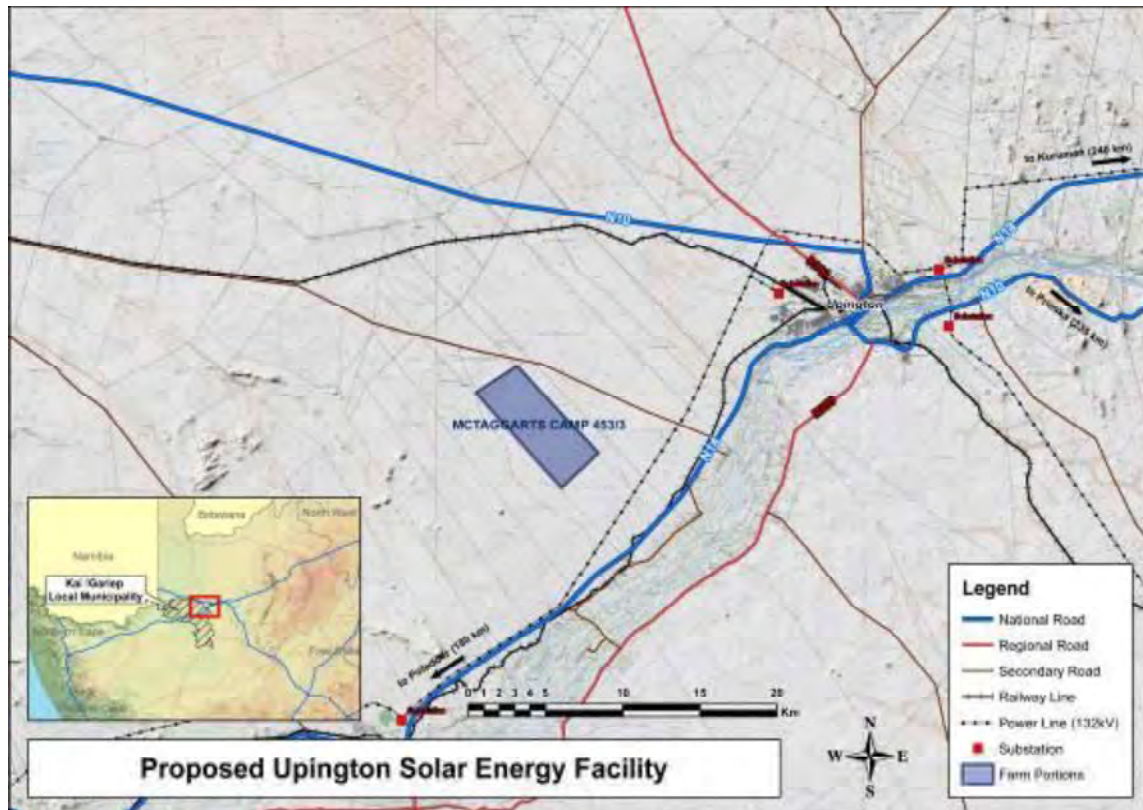
The author of this report is a qualified archaeologist (MA cum laude, PhD candidate, University of the Western Cape) accredited as a Principal Investigator by the Association of Southern African Professional Archaeologists. The author has worked as a museum archaeologist in the Northern Cape since 1985 and has since the late 1980s carried out surveys in the general area of Upington (Morris 2002, 2005, 2006; Morris & Beaumont 1991; Morris & Seliane 2006).

The author is independent of the organisation commissioning this specialist input, and provides this Specialist Report within the framework of the National Heritage Resources Act (No 25 of 1999).

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

## **2. DESCRIPTION OF THE AFFECTED ENVIRONMENT**

The environment in question is arid, comprising relatively flat drainage plains stretching up to 15 km north-west of the Orange River. The landscape is sparsely vegetated, with shallow soils, therefore making any surface archaeological traces highly visible.



**Figure 1:** The location of the site identified for the proposed Solar Thermal Plant, located south west of Upington and north-west of the Gariep (Orange) River in the Northern Cape.

## 2.1 Description of heritage features of the region

No previous archaeological survey work had been carried out in the vicinity of the farm McTaggart's Camp 453. The scoping report therefore referred to heritage features of the broader region as background to the Environmental Impact Assessment Phase.

### 2.1.1 Colonial frontier

The eighteenth- and nineteenth-century records for this region (Penn 2005) pertain mainly to the areas south of and along the Orange River. The travellers Wikar and Gordon followed the river as far as and beyond this region in the 1770s, describing communities living along the river (see Morris & Beaumont 1991 for a summary). Dunn and others describe the situation a century later (Robinson 1978). Frontiersmen such as the colourful Stephanos can be linked with particular places in the landscape (Morris 2002). None of these accounts refer to the specific area of the proposed development.

McTaggart's Camp derives its name from the fact that Captain McTaggart set up his military camp here during the Koranna War of 1879-1880 (Van Vreeden 1961:431). It is not known exactly where this encampment was on the property and it is questionable whether its ephemeral nature would have left any material trace.

There was further military activity in the area in the early twentieth century in relation to Jacob Marengo, shot dead on 20 September 1907 near Eensaamheid Pan where, in an incident of "severe overkill," 5000 rounds were fired to exterminate the resistance leader, five other armed Nama and two accompanying women (Masson 1995). Eensaamheid is located about 100 km north-west of Upington.

Tungsten mining took place at the north western-most portion of the McTaggart's Camp property in the 1930's. Because the traces of previous mining, including an old explosives magazine, are greater than 60 years old they could be considered as themselves potentially conservation-worthy.

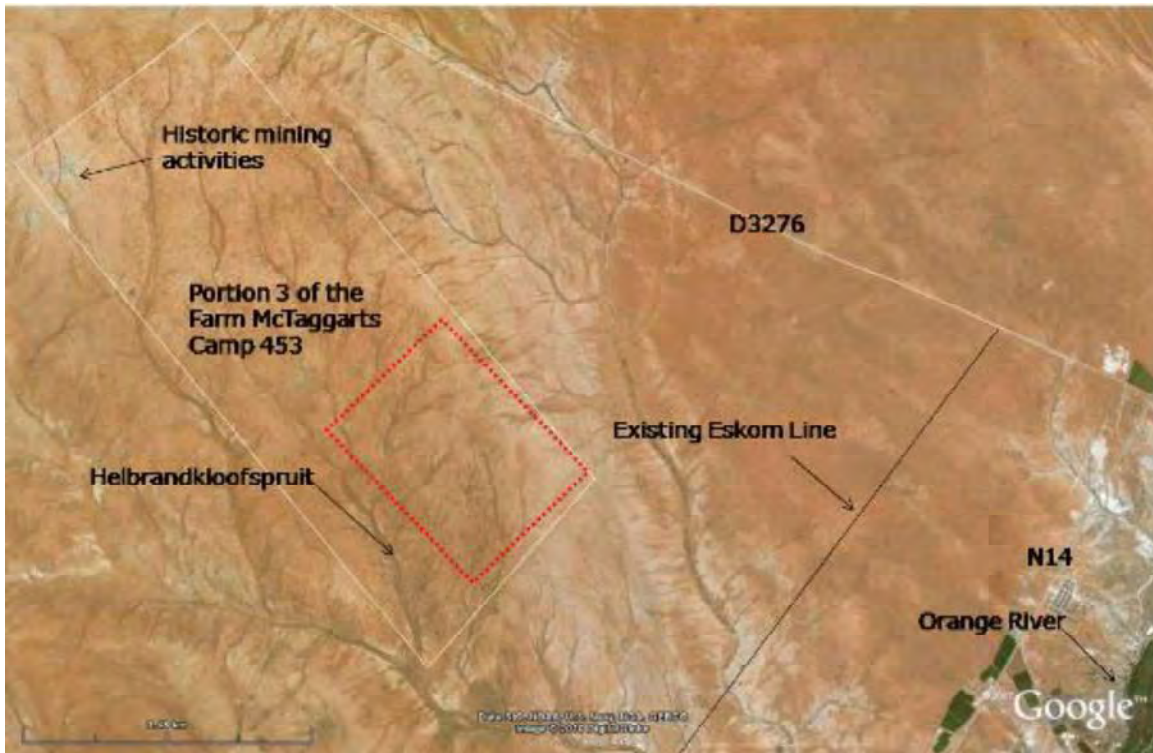
### **2.1.2 Later Stone Age**

Late Holocene Later Stone Age (LSA) sites are frequently noted in surveys south of and south west of the region of proposed development and along the Orange River (e.g. Morris & Beaumont 1991; Beaumont *et al.* 1995). These are generally short-duration occupations by small groups of hunter-gatherers. In contrast, there are substantial herder encampments along the Orange River floodplain itself (Morris & Beaumont 1991) and in the hills north of Kakamas (Parsons 2003). In a range of hills north east of Keimoes, on Zovoorby, a rock shelter and specularite working (a sparkling mineral with known cosmetic and ritual use in the pre-colonial past) has been excavated (Smith 1995). LSA sites are usually focused on a particular feature in the landscape such as a hill or rocky outcrop and in relation to resources like water and associated habitats richer in animals and plant foods.

### **2.1.3 Pleistocene: Middle and Earlier Stone Age**

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

The ESA included Victoria West cores on dolerite and quartzite (a fine example has been found at Hondeblaf north of Upington), long blades, and a very low incidence of handaxes and cleavers. The Middle (and perhaps in some instances Lower) Pleistocene occupation of the region that these artefacts reflect must have occurred at times when the environment was more hospitable than today. This is suggested by the known greater reliance of people in Acheulean times on quite restricted ecological ranges, with proximity to water being a recurrent factor in the distribution of sites.



**Figure 2:** The sparsely vegetated drainage plain, otherwise largely featureless is apparent in this Google Earth image, with property boundary and key features indicated. The red dotted line shows the proposed development footprint in the south eastern part of the property.

## **2.2 Description and evaluation of environmental issues and potential impacts identified in the scoping phase**

Heritage resources including archaeological sites are in each instance unique and non-renewable resources. Area and linear developments such as those envisaged can have a permanent destructive impact on these resources. The objective of an EIA would be to assess the sensitivity of such resources where present, to evaluate the significance of potential impacts on these resources and, if and where

appropriate, to recommend no-go areas and measures to mitigate or manage said impacts.

Area impacts are possible in the case of the Uppington Solar Thermal Plant itself; the proposed substation; the power lines, water supply lines and access roads would represent linear impacts.

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

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

With respect to the magnitude and extent of potential impacts, it has been noted that the erection of power lines would have a relatively small impact on Stone Age sites, in light of Sampson's (1985) observations during surveys beneath power lines in the Karoo (actual modification of the landscape tends to be limited to the footprint of each pylon), whereas a road or a water supply pipeline would tend to be far more destructive (modification of the landscape surface would be within a continuous strip), albeit relatively limited in spatial extent, i.e. width (Sampson compares such destruction to the pulling out of a thread from an ancient tapestry). The water pipeline could traverse more sensitive terrain, i.e. affecting a potentially greater density of archaeological sites.

### ***2.2.2 Other issues identified during the scoping process – choice of the south eastern portion of site as preferred development locale***

Considering areas of potential sensitivity identified on the site during the scoping phase, the south eastern portion of the site has been identified as the preferred area for the proposed solar thermal plant development on Portion 3 of the Farm McTaggart's Camp 453.

The following points (with additional remarks) have been made in this respect (Savannah Environmental, 2010):

- » *Areas along natural drainage lines – water resources and ecology:* Various considerations summarised in the Scoping Report prepared by Savannah

Environmental have suggested that the development footprint not be directly on or near the main drainage channels (e.g. the Helbrandkloofspruit); that, rather, the development footprint be located in the south eastern portion of the proposed site. (To the extent that archaeological traces may tend to be more prevalent near to the more significant water courses, this scoping phase recommendation is endorsed from a heritage perspective).

- » *Areas of increased gradient/slope:* Development of such areas could result in erosion and increased potential for storm water runoff. (This would have a potential negative impact on any archaeological/heritage resources where present).
- » *Potential occurrence of populations of Red List organisms:* This includes flora and fauna, and protected trees that have been evaluated as having a high chance of occurring within remaining natural habitats within the study area. (Richer habitats would have been magnets for past human activity).
- » *Areas previously disturbed through mining activities and potential heritage sites:* While the area previously disturbed through mining activities in the 1930s would be least sensitive in terms of ecological conservation value, those areas in the northern portion of the site degraded from previous mining activities on site could present a stability risk to the development. In addition, the heritage value/quality of the previous activities, being greater than 60 years old, could preclude these areas from future development.

Favourable aspects of the preferred locale in the south eastern part of McTaggart's Camp include:

- » *Avoidance of key drainage lines*
- » *Lower elevation*
- » *Proximity to the extraction point on the Orange (Gariep) River,* minimising length of water supply pipeline, in turn reducing potential for resource (including heritage resource) disturbance by the pipeline.
- » *Proximity to the grid connection point,* minimising the length of power line linking the proposed facility with the existing Eskom distribution line, in turn reducing the potential for linear disturbance associated with the power line.
- » *Proximity to the N14 National Road for access,* minimising the length of access road and hence reducing the potential for linear disturbance of any heritage resources present.



### **3. METHODOLOGY**

A site visit was necessary to inspect various parts of the terrain on foot, focusing on areas of expected impact (construction of solar plant, power island, and secondary infrastructure such as roads, pipelines, and power lines). Heritage traces would be evaluated in terms of their archaeological significance (see tables below). A set of Scoping phase predictions were made which the study would test with observations made in the field.

#### **3.1 Assumptions and limitations**

It was assumed that, largely in this landscape, with its sparse vegetation and shallow soil profiles, some sense of the archaeological traces to be found in the area would be readily apparent from surface observations (including assessment of places of erosion or past excavations that expose erstwhile below-surface features). It was not considered necessary to conduct excavations as part of the EIA to establish the potential of sub-surface archaeology.

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

With regard to fossils, a preliminary assessment of the likelihood fossils occurring in this area has been provided by a palaeontologist.

#### **3.2 Scoping phase predictions**

During the Scoping phase it was predicted that:

- » Based on previous experience in the area, the terrain on which the Uppington Solar Thermal Plant would be located is likely *not* to be rich in archaeological traces of major significance.
- » Should there be local sources of Dwyka tillite, these may have served as raw materials often drawn upon in Pleistocene times. If not, it might be expected that any archaeological traces would be sparse.
- » There appear to be none of the features such as hills or rocky features which in other parts of this landscape provide shelters with traces of pre-colonial Stone Age occupation/activity.
- » Nineteenth- and twentieth-century cultural history and intangible heritage values attached to places may be difficult to recover owing to the sparse population. It

is not thought likely that any significant intangible heritage values would be attached to the particular terrain in question.

### **3.3 Potentially significant impacts to be assessed in the EIA process**

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

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

Some of the activities indicated here have a generally lower impact than others. For example, Sampson (1985) has shown that powerlines tend to be less destructive on Stone Age sites than roads since access along the route of the line during construction and maintenance tends to be by way of a 'twee-spoor' temporary roadway (not scraped, the surface not significantly modified). Individual tower positions might be of high archaeological significance (e.g. a grave, or an engraving). The impact of a 'twee-spoor' could be far greater on Iron Age sites in other parts of South Africa, where stone walling might need to be breached.

### **3.4 Determining archaeological significance**

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

### *Estimating site potential*

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

### *Assessing site value by attribute*

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

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

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

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

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

#### **4. OBSERVATIONS AND ASSESSMENT OF IMPACTS**

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

##### **4.1 Fieldwork observations**

The proposed development footprint area and ancillary infrastructure locales were visited on 26 September 2010. In summary the findings can be reported in relation to predictions made in the scoping report (see 3.2 above):

##### **4.1.1 Richness of archaeological traces:**

*That the development footprint is likely not to be rich in archaeological traces of major significance.*

This was found to be the case. As a rule, over almost all the primary development footprint site and along the two alternative powerline and access road routes and the water pipeline route, stone artefacts (by far the predominant heritage resource noted) were found to occur in extremely low densities of less than 1 per 10 x 10 m area. Closer to the Orange River, along the water pipeline route and in the vicinity of the settlement reservoir approximately 0.6 km from the Orange River, however, artefact densities are greater. Here up to a maximum of 1 or 2 artefacts per square metre were found, widely distributed, i.e. low density and not easily construed in any instance as a readily definable "site". Typologically, artefacts noted generally had features such as faceted butts, characteristic of the Middle Stone Age. No scatters were seen that included ostrich eggshell pieces, which often co-occur with stone tools of the Later Stone Age in this region.



**Figure 3:** Two isolated flakes found in an area about 20 x 20 m within development footprint for the proposed Solar Thermal Plant.

#### **4.1.2 Raw material availability:**

*That, should there be local sources of Dwyka tillite, these may have served as raw materials often drawn upon in Pleistocene times. If not, it might be expected that any archaeological traces would be sparse.*

Dwyka tillite was not in evidence in the areas investigated and, as predicted, Stone Age archaeological traces are sparse. The raw materials used for stone tool manufacture are exotic to the local environment, carried in by Stone Age people and consisting predominantly of jaspilite (banded ironstone) derived from the gravels along the Orange River. It seems possible that the extremely dispersed individual artefacts reflect opportunistic off-site flaking from nodules of favoured raw materials by hunter-gatherers during foraging excursions over long periods.



**Figure 4:** The landscape setting of the development footprint, featureless with shallow soil profile and minimal vegetation

#### **4.1.3 Landscape features:**

*That there appear to be none of the features such as hills or rocky features which in other parts of this landscape provide shelters with traces of pre-colonial Stone Age occupation/activity.*

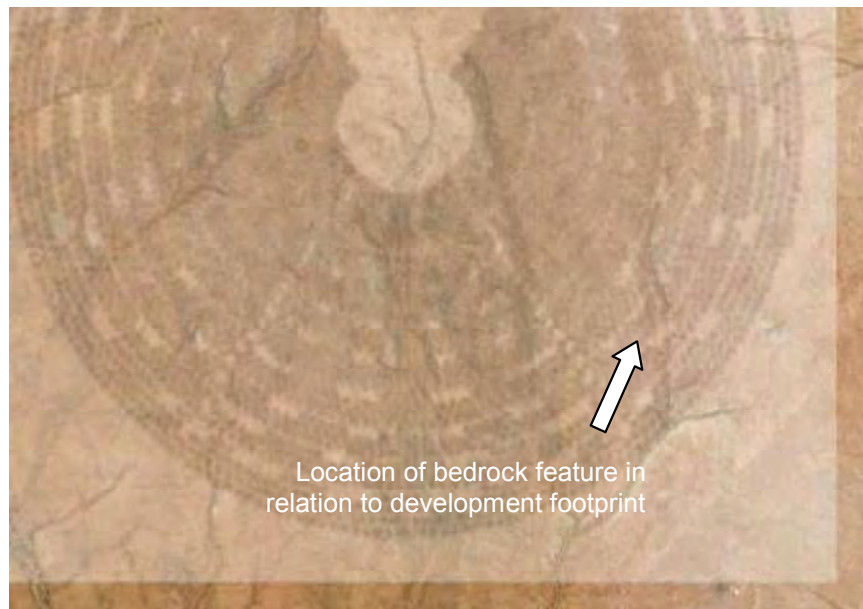
The relatively featureless landscape provides few of the kinds of landscape nodes that typically contain sites elsewhere in the region.

The dry watercourses constitute one exception, although artefact densities were not noticeably greater in areas examined along watercourses.

One other exception noted, where artefact density was markedly greater, was at a low rocky outcrop, where water evidently collects after rains, at 28.54109° S 21.08842° E (refer to figures below). Here there were up to 3 or 4 artefacts per m<sup>2</sup> with a greater variety of raw materials, predominantly banded ironstone but also quartzite and quartz. The artefacts can be characterised as Middle Stone Age. No ostrich eggshell pieces were noted. Bedrock grinding grooves sometimes found at such exposures in Bushmanland, south of the Orange River, and usually also associated with herder pottery, were also not seen.



**Figure 5:** Bedrock outcrop with higher density of artefacts based on banded ironstone as well as other raw materials, all exotic to the local environment.





#### **4.1.4 Intangible heritage values:**

*That nineteenth- and twentieth-century cultural history and intangible heritage values attached to places may be difficult to recover owing to the sparse population. It is not thought likely that any significant current intangible heritage values would be attached to the particular terrain in question.*

Extremely sparse population and very limited material evidence of human activity even of the recent pre-colonial past together suggest that there are not likely to be any significant current intangible heritage values attached to the primary footprint development site on McTaggart's Camp.

#### **4.2 Characterising the archaeological significance (Refer to 3.4 above)**

In terms of the significance matrices in Tables 1 and 2 under 3.4 above, most of the archaeological observations fall under Landforms L1 and L3 Type 1 with some L1 Type 2 settings and L3 Type 3 adjacent to the river. In terms of archaeological traces they all fall under Class A3 Type 1. All of these ascriptions (Table 1) reflect poor contexts and likely low significance for these criteria.

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

On archaeological grounds, therefore, the occurrences can be said to be of low significance.

#### **4.3 Characterising the significance of impacts**

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

- » The **nature**, which shall include a description of what causes the effect, what will be affected, and how it will be affected.
- » The **extent**, wherein it will be indicated whether the impact will be local (limited to the immediate area or site of development) or regional:
  - \* local extending only as far as the development site area – assigned a score of 1;
  - \* limited to the site and its immediate surroundings (up to 10 km) – assigned a score of 2;
  - \* will have an impact on the region – assigned a score of 3;

- \* will have an impact on a national scale – assigned a score of 4; or
- \* will have an impact across international borders – assigned a score of 5.
- » The **duration**, wherein it will be indicated whether:
  - \* the lifetime of the impact will be of a very short duration (0–1 years) – assigned a score of 1;
  - \* the lifetime of the impact will be of a short duration (2-5 years) - assigned a score of 2;
  - \* medium-term (5–15 years) – assigned a score of 3;
  - \* long term (> 15 years) - assigned a score of 4; or
  - \* permanent - assigned a score of 5.
- » The **magnitude**, quantified on a scale from 0-10, where a score is assigned:
  - \* 0 is small and will have no effect on the environment;
  - \* 2 is minor and will not result in an impact on processes;
  - \* 4 is low and will cause a slight impact on processes;
  - \* 6 is moderate and will result in processes continuing but in a modified way;
  - \* 8 is high (processes are altered to the extent that they temporarily cease); and
  - \* 10 is very high and results in complete destruction of patterns and permanent cessation of processes.
- » The **probability of occurrence**, which shall describe the likelihood of the impact actually occurring. Probability will be estimated on a scale, and a score assigned:
  - \* Assigned a score of 1–5, where 1 is very improbable (probably will not happen);
  - \* Assigned a score of 2 is improbable (some possibility, but low likelihood);
  - \* Assigned a score of 3 is probable (distinct possibility);
  - \* Assigned a score of 4 is highly probable (most likely); and
  - \* Assigned a score of 5 is definite (impact will occur regardless of any prevention measures).
- » the **significance**, which shall be determined through a synthesis of the characteristics described above (refer formula below) and can be assessed as low, medium or high.
- » the **status**, which will be described as either positive, negative or neutral.
- » the degree to which the impact can be reversed.
- » the degree to which the impact may cause irreplaceable loss of resources.
- » the *degree* to which the impact can be *mitigated*.

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

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

S = Significance weighting

E = Extent

D = Duration  
M = Magnitude  
P = Probability

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

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

#### ***4.3.1 Impact table summarising the significance of impacts (with and without mitigation)***

The following table considers the development footprint of the proposed facility with its ancillary infrastructure.

<b>Nature:</b> Acts or activities resulting in disturbance of surfaces and/or sub-surfaces containing artefacts (causes) resulting in the destruction, damage, excavation, alteration, removal or collection from its original position (consequences), of any archaeological material or object (what affected).		
	<b>Without mitigation</b>	<b>With mitigation</b>
<b>Extent</b>	1	1
<b>Duration</b>	5	5
<b>Magnitude</b>	6	4
<b>Probability</b>	4	3
<b>Significance</b>	<b>48</b>	<b>30</b>
<b>Status (positive or negative)</b>	Negative	
<b>Reversibility</b>	No	
<b>Irreplaceable loss of resources</b>	Yes – but the archaeological resources are not of major significance	
<b>Can impacts be mitigated</b>	Yes – but not considered necessary in most instances	See above.
<b>Mitigation:</b> Artefact densities are low over most of the development footprint, so much so that mitigation measures are not considered necessary in most instances. Although the criteria for significance given in this matrix give a Medium significance weighting (unlike biological processes, heritage destruction generally has a once-off permanent impact), it has been shown that the archaeological significance of the materials observed may be regarded as low. As indicated above (in this table), it would be worth carrying out a surface collection and record of the site at 28.54109° S 21.08842° E, which falls at the edge of the proposed main development footprint, and this could arguably reduce the		

'magnitude' and the 'probability' criteria referred to above.
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<b>Cumulative impacts:</b> The impacts are once-off permanent destructive events.
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#### 4.3.2 Comparative assessment of alternatives

The very low density of isolated stone artefacts across the various development areas provides no clear pointers for preferring one or another of the alternative routes for the powerline or the external access road. It is recommended that in each case the preferred shorter routes be selected in that they would result in a lower loss or disturbance of the, albeit, low density artefact occurrences.

### 5. MEASURES FOR INCLUSION IN THE DRAFT ENVIRONMENTAL MANAGEMENT PLAN

OBJECTIVE: Limit impacts to the primary activities associated with the development and hence to limit secondary impacts during the medium and longer term working life of the facility.

<b>Project component/s</b>	Any road construction over and above what is necessary and any extension of other components addressed in this EIA.
<b>Potential Impact</b>	Archaeological or other heritage materials occurring in the path of any surface or sub-surface disturbances associated with any aspect of the development are highly likely to be subject to destruction, damage, excavation, alteration, or removal. The potential impact is that wider areas or extended linear developments may result in further destruction, damage, excavation, alteration, removal or collection of heritage objects from their current context on the site.
<b>Activity/risk source</b>	Activities which could impact on achieving this objective include deviation from the planned lay-out of road/s and infrastructure without taking heritage impacts into consideration.
<b>Mitigation: Target/Objective</b>	<ul style="list-style-type: none"> <li>A facility environmental management plan that takes cognisance of heritage resources in the event of any future extensions of roads or other infrastructure.</li> <li>The impact assessment set out in 4.3.1 provides a recommendation that a surface collection and characterisation of the archaeological site at 28.54109° S 21.08842° E be carried out. The work associated with this task should be achievable within a period of not more than two days.</li> </ul>

Mitigation: Action/control	Responsibility	Timeframe
Provision for on-going heritage monitoring in a facility environmental management	Environmental management	Environmental management plan to be in

plan which also provides guidelines on what to do in the event of any major heritage feature being encountered during any phase of development or operation.	provider with on-going monitoring role set up by the developer.	place before commencement of development.
Phase 2 (mitigation) surface collection and characterisation of the archaeological site at 28.54109° S 21.08842 ° E as a salvage operation ahead of the development of the facility.	An accredited archaeologist, in terms of a permit issued by SAHRA.	It is anticipated that this task could be completed in no more than two days, and this should take place before development of the facility commences.

<b>Performance Indicator</b>	<ul style="list-style-type: none"> <li>• A report describing the completion of the Phase 2 mitigation work described above</li> <li>• Inclusion of further heritage impact consideration in any future extension of infrastructural elements</li> <li>• Immediate reporting to relevant heritage authorities of any heritage feature discovered during any phase of development or operation of the facility</li> </ul>
<b>Monitoring</b>	<ul style="list-style-type: none"> <li>• Officials from relevant heritage authorities (National and Provincial) to be permitted to inspect the operation at any time in relation to the heritage component of the management plan.</li> </ul>

## 6. CONCLUSIONS

Very sparse heritage traces were found during the EIA Phase of this study and these have proven to be consistent with predictions made during the Scoping Phase.

From an archaeological perspective the observed heritage resources may be regarded as being of generally low significance. Criteria used here for impact significance assessment rate the impacts as medium (mainly because for heritage traces, unlike biological processes, impacts tend to be irreversible, of permanent duration and high magnitude).

It has been recommended that destruction of one site of greater note in a setting of otherwise generally extremely low density should be mitigated by way of a Phase 2 surface collection.

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**BRIEF PALAEONTOLOGICAL IMPACT ASSESSMENT**

**(Desktop Study)**

**PROPOSED UPINGTON SOLAR THERMAL PLANT**

**Portion 3 of the Farm McTaggarts Camp 453**

**Gordonia District, Northern Cape**

**By**

**John Pether, M.Sc., Pr. Sci. Nat. (Earth Sci.)**

Geological and Palaeontological Consultant

P. O. Box 48318, Kommetjie, 7976

Tel./Fax (021) 7833023

Cellphone 083 744 6295

jpether@iafrica.com

**Prepared at the Request of**

**Savannah Environmental (Pty) Ltd**

PO Box 148

Sunninghill, 2157

Tel: +2711 234-6621

Fax: +2786 684 0547

Cell: 084 300 0660

[www.savannahSA.com](http://www.savannahSA.com)

**For**

**Khi CSP South Africa (Pty) Ltd**

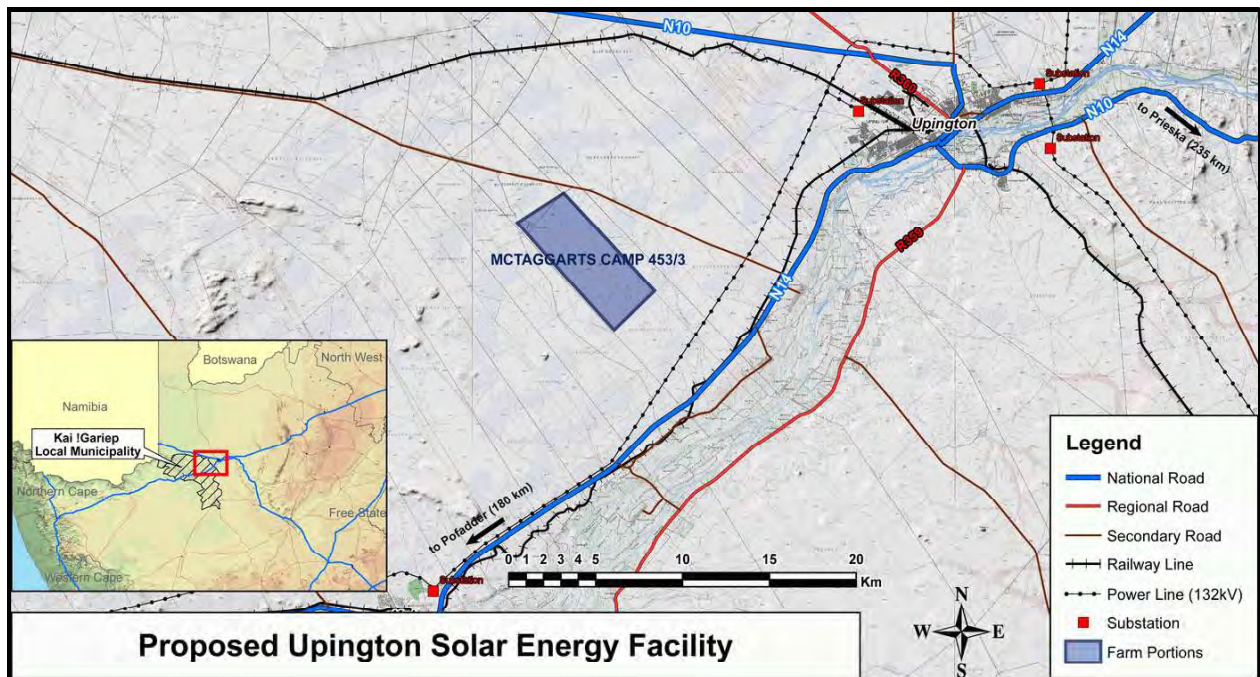
14 October 2010



## 1. INTRODUCTION

This assessment has been prepared at the request of Savannah Environmental (Pty) Ltd. It is the part of the Heritage Impact Assessment in the EIA process being undertaken by Savannah Environmental for their client, Khi CSP South Africa (Pty) Ltd (!Khi CSP).

!Khi CSP is proposing the establishment of a solar electricity generating facility on Portion 3 of the Farm McTaggart's Camp 453, west of the town of Upington in the Northern Cape (Figure 1).



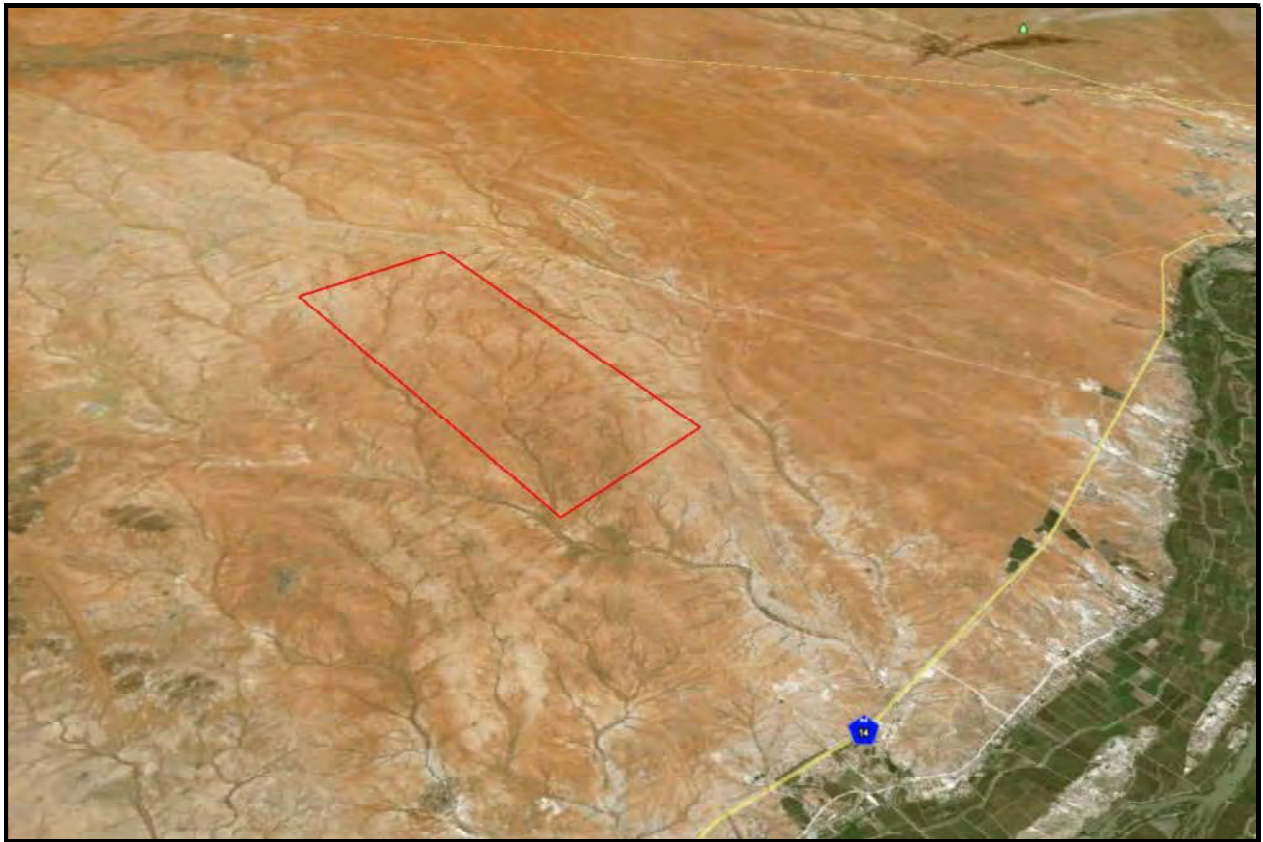
**Figure 1:** Location of the proposed Upington Solar Thermal Plant

The proposed project, known as the Upington Solar Thermal Plant, will use both Concentrating Solar Power (CSP) and Photovoltaic (PV) technologies to deliver 110 MW. The footprint of the facility entails approximately 6 km<sup>2</sup> of the 22 km<sup>2</sup> property. A combination of CSP parabolic troughs, CSP tower and tracking mirrors (heliostats) and PV (with tracking/concentrating), is to be installed.

Associated infrastructure involves a steam turbine, generator generator transformer, overhead power line feeding into the grid, water supply pipeline/s from the Orange River, water treatment plant and storage facilities, workshop, office and storage areas, access roads and internal roads.

This Palaeontological Impact Assessment (PIA) assesses the probability of palaeontological materials (fossils) being uncovered in the subsurface and being disturbed or destroyed in the process of making excavations. The main purposes are to:

- Outline the nature of possible palaeontological heritage resources in the subsurface of the affected area.
- Suggest the mitigatory actions to be taken with respect to the occurrence of fossils during the construction phase.



**Figure 2:** Simulated oblique aerial view of the setting of the proposed Upington Solar Thermal Plant, looking from the south (Upington outskirts in upper RH corner)

## **2. APPROACH AND METHODOLOGY**

### **2.1 Available Information**

The main information sources consulted are the 1:1 000 000 CGS Geological Map of South Africa and the relevant chapters in "The Geology of South Africa" (Johnson *et al.*, (eds.), 2006). Other references are cited in the normal manner and included in the References section. Specific details of geological sections of the the bedrock-mantling deposits in the

area are not readily available. No subsurface geotechnical investigation reports of the site are available.

## **2.2 Assumptions and Limitations**

It is not possible to predict the buried fossil content of an area other than in general terms. In particular, the important fossil bone material is generally sparsely scattered in most deposits and much depends on spotting this material as it is uncovered during digging (i.e. by monitoring excavations).

Details of bulk earth works required for the installations are not available.

## **2.3. Palaeontological Heritage Management**

The rescue of fossils or sampling of fossil content (palaeontological mitigation) cannot usually be done prior to the commencement of excavations for infrastructure and foundations. Palaeontological interventions happen once the EIA process is done, the required approvals have been obtained, and excavation of the bulk earth works is proceeding. The intent of palaeontological mitigation is to sample the *in situ* fossil content and describe the exposed, pristine stratigraphic sections.

The action plans and protocols for palaeontological mitigation must therefore be included in the Environmental Management Plan (EMP) for the Construction Phase of the project.

## **4. GEOLOGICAL SETTING**

### **4.1. Local Geology**

The project area is situated between 50 to 100 metres above the local level of the Gariep (Orange) River, at 820-870 m above sea level, on very low gradients sloping mainly to the southwest (Figure 2).

The geological setting is the Namaqua-Natal Metamorphic Province, Namaqua Sector, Areachap Terrane, where metasediments, gneisses and granites, ranging in age from 2000-1000 Ma, comprise an unfossiliferous bedrock (Figure 3). This bedrock is exposed beneath Kalahari Group sedimentary deposits, where the latter has been eroded away along drainages.

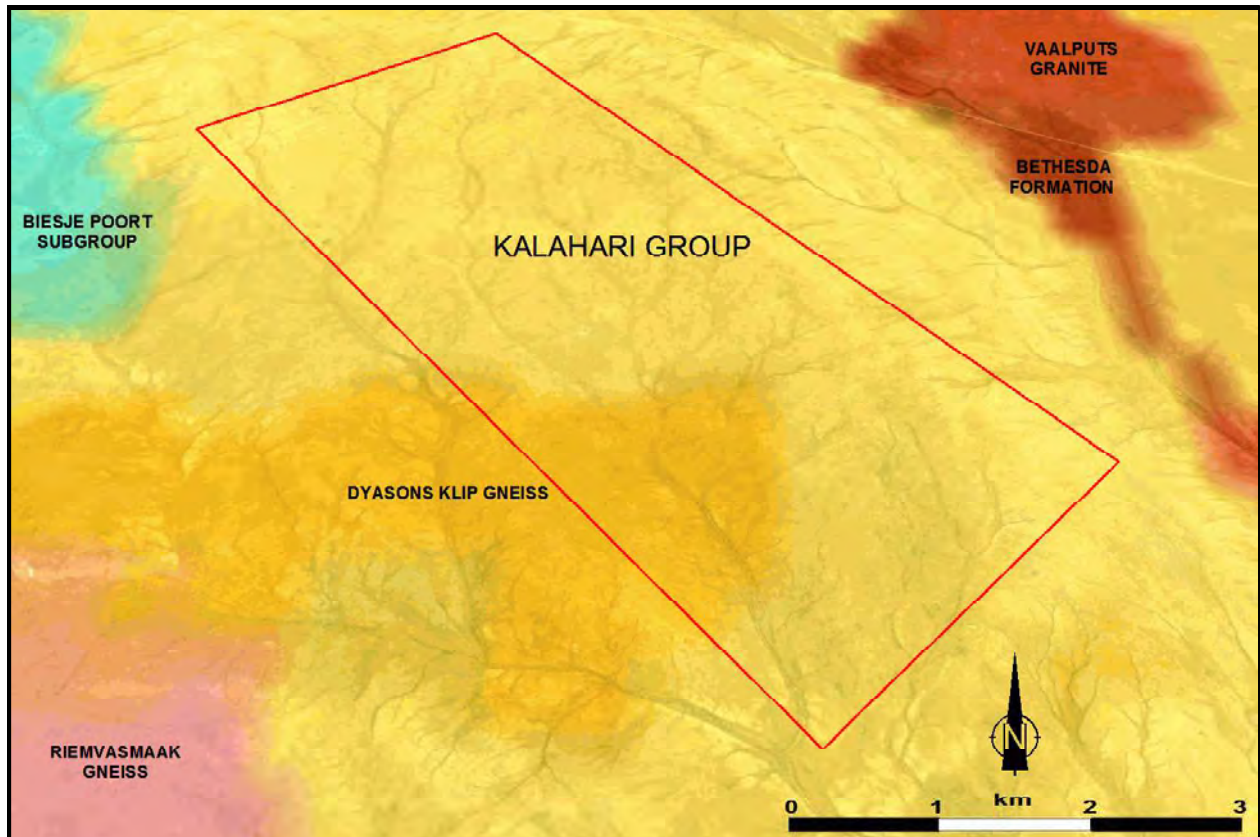
The area is on the edge of the Kalahari Basin where the Kalahari Group sedimentary deposits are thin. Basal pebbly sands of the Eden Formation, deposited in braided streams, may overlie the bedrock.

Calcretes of the Mokalanen Formation are widely developed and have formed in a variety of sediments such as the deposits of ephemeral streams, pans, colluvium and windblown



sands. The calcrete thickness is sometimes considerable and represents polyphase development, mainly since the late Miocene/early Pliocene ~5 Ma.

Overlying the calcretes are red aeolian sands classic of the Kalahari, now termed the Gordonia Formation. In places there are deposits accumulated in pans, beneath and within the aeolian sequence.



**Figure 3:** Simulated oblique aerial view of the setting of the proposed Uppington Solar Thermal Plant, looking from the south (Google Earth with overlain geology from ZAF CGS 1:1M Bedrock Lithostratigraphy)

**KALAHARI GROUP:** Basal gravels, sandy and pebbly calcretes and overlying aeolian sands.

**VAALPUTS GRANITE:** Grey, well-foliated, medium-grained, locally porphyritic adamellitic granite with abundant xenoliths.

**DYASONS KLIP GNEISS:** Brown-weathering porphyroblastic to megacrystic gneiss (intrusive).

**RIENVASMAAK GNEISS:** Pink-weathering granular or augen quartz-feldspar gneiss.

**BETHESDA FORMATION:** Biotite-rich and pelitic gneisses, muscovite-biotite schist, subordinate amphibolite and calc-silicate rocks.

**BIESJE POORT SUBGROUP:** Quartzite, quartz-feldspar gneiss, calc-silicate rocks, kinzigite, subordinate marble, amphibolite and aluminous gneiss.

#### **4.2. Expected Palaeontology**

The Kalahari sediments and calcretes have low fossil potential, but possibility of fossils being encountered in diggings cannot be totally excluded. The fossils contexts are those of ephemeral watercourses and aeolian settings, particularly interdune areas where local ponding or pans developed.

Most of the fossils in the aeolianites are associated with particular contexts, particularly buried, stable surfaces (palaeosurfaces) where time has permitted bones to accumulate. The common fossils include shells of land snails, fossil tortoises, ostrich incl. egg fragments, sparsely scattered bones etc. "Blowout" erosional palaeosurfaces may carry fossils concentrated by the removal of sand by the wind. Hollows between dunes (interdune areas) are the sites of ponding of water seeping from the dunes, leading to the deposits of seeps and pans/vleis. Being water sources, such may be richly fossiliferous. Most of fossils obtained from the Kalahari deposits have been from pans. Ephemeral watercourse deposits are poorly fossiliferous, but abraded bone fragments and loose teeth may occur sparsely in channel lags.

#### **5. APPLICABLE LEGISLATION**

The National Heritage Resources Act (NHRA No. 25 of 1999) protects archaeological and palaeontological sites and materials, as well as graves/cemeteries, battlefield sites and buildings, structures and features over 60 years old. The South African Heritage Resources Agency (SAHRA) administers this legislation nationally, with Heritage Resources Agencies acting at provincial level.

According to the Act (Sect. 35), it is an offence to destroy, damage, excavate, alter or remove from its original place, or collect, any archaeological, palaeontological and historical material or object, without a permit issued by the South African Heritage Resources Agency (SAHRA) or applicable Provincial Heritage Resources Agency, viz. Heritage Western Cape (HWC).

Notification of SAHRA or the applicable Provincial Heritage Resources Agency is required for proposed developments exceeding certain dimensions (Sect. 38).

#### **6. THRESHOLDS**

The areal scale of subsurface disturbance and exposure exceeds 300 m in linear length and 5000 m<sup>2</sup> (NHRA 25 (1999), Section 38 (1)). It has therefore been assessed for heritage impacts (an HIA) that includes assessment of potential palaeontological heritage (a PIA).

For the evaluation of the palaeontological impact it is the extent/scale of the deeper excavations to be made that are the main concern, such as the foundations for the CSP

central tower, foundation trenches for buildings, the trenches for connecting piping and cabling and water storage dams.

Plans showing the extent and depths of bulk earth works are not available yet. Notwithstanding, it is likely that significant sub-surface volumes will be disturbed and exposed.

## **7. SIGNIFICANCE**

The fossil record from Kalahari deposits is very poor with respect to finds of fossil bones of vertebrates. Thus fossils finds will be of considerable scientific interest. Mitigation during the construction phase of the proposed project has the potential for discoveries that stand to have heritage/scientific benefits.

The significance of fossils that may be found involves:

- Significance for the history of the Kalahari deposits.
- Significance for the history of past climatic changes.
- Significance in the history of past biota and environments. Rescuing of fossil bones is very important. These may not necessarily represent species that we would expect nowadays. Modern analytical techniques such as stable isotopic analyses can reveal indications of diets and environmental conditions of the past.
- Associations of fossils with buried archaeological material and human prehistory.
- For radiometric and other dating techniques.
- Preservation of materials for the application of yet unforeseen investigative techniques.

## **8. NATURE OF THE IMPACT OF DEVELOPMENT EXCAVATIONS ON FOSSILS**

Fossils are rare objects, often preserved due to unusual circumstances. This is particularly applicable to vertebrate fossils (bones), which tend to be sporadically preserved and have high value w.r.t. palaeoecological and biostratigraphic (dating) information. Such fossils are non-renewable resources. Provided that no subsurface disturbance occurs, the fossils remain sequestered there.

When excavations are made they furnish the “windows” into the past that would not otherwise exist and thereby provide access to the hidden fossils. The impact is positive for palaeontology, provided that efforts are made to watch out for and rescue the fossils. Fossils and significant observations will be lost in the absence of management actions to

mitigate such loss. This loss of the opportunity to recover them and their contexts when exposed at a particular site is irreversible.

The status of the potential impact for palaeontology is not neutral or negligible.

Although terrestrial coversands are not generally very fossiliferous, it is quite possible that fossiliferous material could occur. The very scarcity of fossils makes for the added importance of them being sought.

There remains a medium to high risk of valuable fossils being lost in spite of management actions to mitigate such loss. Machinery involved in excavation may damage or destroy fossils, or they may be hidden in "spoil" of excavated material. Worse, they may simply be ignored as "Just another bone".

## **9. RECOMMENDATIONS**

In view of the low fossil potential, monitoring of bulk earth works by a specialist is not justified.

Notwithstanding, the sporadic fossil occurrences are then particularly important and efforts made to spot them are often rewarded.

In order to spot the rare occurrences, it is very desirable to have the co-operation of the people "on the ground". By these are meant personnel in supervisory/inspection roles, such as engineers, surveyors, site foremen, etc., who are willing and interested to look out for occurrences of fossils. These personnel are also critical in informing excavator operators and manual workmen, whom being close to the sediments, would be more likely to spot smaller fossils.

It is recommended that a requirement to be alert for possible fossils be included in the EMP for the Construction Phase. This should include guidelines for potential finds and a reporting/action protocol for when finds are uncovered.

There is a local branch of the CGS (Geological Survey) in Upington. A local CGS geologist could be involved to inspect excavations and liaise with the ECO and an advising palaeontologist, in the event of possible finds.

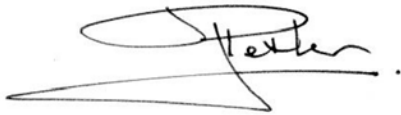
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A handwritten signature in black ink, appearing to read 'John Pether', with a stylized flourish underneath.

John Pether

14 October 2010



**PROPOSED UPINGTON SOLAR THERMAL PLANT,  
NORTHERN CAPE PROVINCE**

**VISUAL ASSESSMENT**

**Produced for:**  
**!Khi CSP South Africa (Pty) Ltd**

**Produced by:**  
MetroGIS (Pty) Ltd.  
PO Box 384, La Montagne, 0184  
Tel: (012) 349 2884/5 Fax: (012) 349 2880  
E-mail: lourens@metrogis.co.za Web: www.metrogis.co.za



**On behalf of:**  
Savannah Environmental (Pty) Ltd.  
PO Box 148, Sunninghill, 2157  
Tel: (011) 234 6621 Fax: 086 684 0547  
E-mail: info@savannahSA.co.za Web: www.savannahSA.com



**- October 2010 -**

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MetroGIS (Pty) Ltd, specialising in visual assessment and Geographic Information Systems, undertook this visual assessment in collaboration with V&L Landscape Architects CC.

Lourens du Plessis, the lead practitioner undertaking the assessment, has been involved in the application of Geographical Information Systems (GIS) in Environmental Planning and Management since 1990.

The team undertaking the visual assessment has extensive practical knowledge in spatial analysis, environmental modeling and digital mapping, and applies this knowledge in various scientific fields and disciplines. The expertise of these practitioners is often utilised in Environmental Impact Assessments, State of the Environment Reports and Environmental Management Plans.

The visual assessment team is familiar with the "Guidelines for Involving Visual and Aesthetic Specialists in EIA Processes" (Provincial Government of the Western Cape: Department of Environmental Affairs and Development Planning) and utilises the principles and recommendations stated therein to successfully undertake visual impact assessments. Although the guidelines have been developed with specific reference to the Western Cape province of South Africa, the core elements are more widely applicable.

Savannah Environmental (Pty) Ltd appointed MetroGIS (Pty) Ltd as an independent specialist consultant to undertake the visual impact assessment for the proposed Upington Solar Thermal Plant. Neither the author, MetroGIS or V&L Landscape Architects will benefit from the outcome of the project decision-making.

## **1. INTRODUCTION**

**!Khi CSP South Africa (Pty) Ltd** (!Khi CSP) is proposing the establishment of a solar thermal plant within the Kai !Garib Local Municipality in the Northern Cape Province. The proposed site is located approximately 12km south-west of Upington and at a distance of approximately 5.5km of the N14 national road.

Solar thermal energy is a technology for harnessing solar energy for thermal energy (heat).

!Khi CSP identified this region as a suitable location for a solar facility as it complies with the minimum Direct Normal Radiation (DNR) required by international standards to viably operate a solar facility.

The proposed facility is expected to have a development footprint of approximately 6 km<sup>2</sup> within the broader site of 22 km<sup>2</sup> and is proposed to have a maximum generating capacity of 110 MW which will be achieved using the following technologies (in any combination):

- **50 MW trough plant:** This is a Concentrated Solar Power (CSP) system which makes use of curved, mirrored troughs which reflect direct solar radiation onto a glass tube containing a fluid (also called a receiver, absorber or collector) running the length of the trough, and positioned at the focal point of the reflectors.
- **50 MW power tower plant:** This CSP system, also known as 'central receiver' power plants or 'heliostat' power plants, is a type of solar furnace using a tower to receive the focused sunlight. It uses an array of flat, movable mirrors (called heliostats) to focus the sun's rays upon a collector tower (the target).

- **10 MW photovoltaic plant:** Photovoltaics (PV) is a method of generating electrical power by converting solar radiation into direct current electricity using semiconductors that exhibit the photovoltaic effect. PV power generation employs solar panels comprising a number of cells containing a PV material (i.e. silicon).

Primary infrastructure for the solar facility will include the following:

- Trough field (97 ha)
- Heliostat field (230 ha) and Power Tower (0.5 ha)
- PV panels (23 ha)
- Power Island (3.6 ha)

The power tower will consist of a 180 m high concrete structure with a receiver perched on top of the concrete structure, in a cavity. This central receiver will appear white hot during daytime operations but the brightness is comparable to only a 400 W light bulb when viewed from a distance of 1 km.

Approximately 3000 heliostats will be arranged around the power tower over an approximate surface area of 230 ha. The troughs and the PV panels will be roughly the same scale as the heliostats.

The photographs below show infrastructure similar to the proposed solar facility:



**Figure 1:** Trough plant which is part of Abengoa Solar's Solúcar Platform in Sanlúcar la Mayor, Seville (Spain)<sup>1</sup>.

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<sup>1</sup> Picture courtesy of Savannah Environmental (Pty) Ltd.



**Figure 2:** Power tower and heliostat field which is part of Abengoa Solar's Solúcar Platform in Sanlúcar la Mayor, Seville (Spain) <sup>2</sup>.



**Figure 3:** PV plant which is part of Abengoa Solar's Solúcar Platform in Sanlúcar la Mayor, Seville (Spain) <sup>3</sup>.

The ancillary infrastructural requirements will include:

- A steam turbine & generator housed within a **2-storey building** on-site.
- A generator **transformer and a small substation** outside the building, as part of the power island.
- A **132 kV power line** to evacuate the generated power into the Eskom electricity grid via an existing Eskom distribution line running approximately 4 km south of the site. This power line connects Eskom's

<sup>2</sup> Picture courtesy of Savannah Environmental (Pty) Ltd.

<sup>3</sup> Picture courtesy of Savannah Environmental (Pty) Ltd.

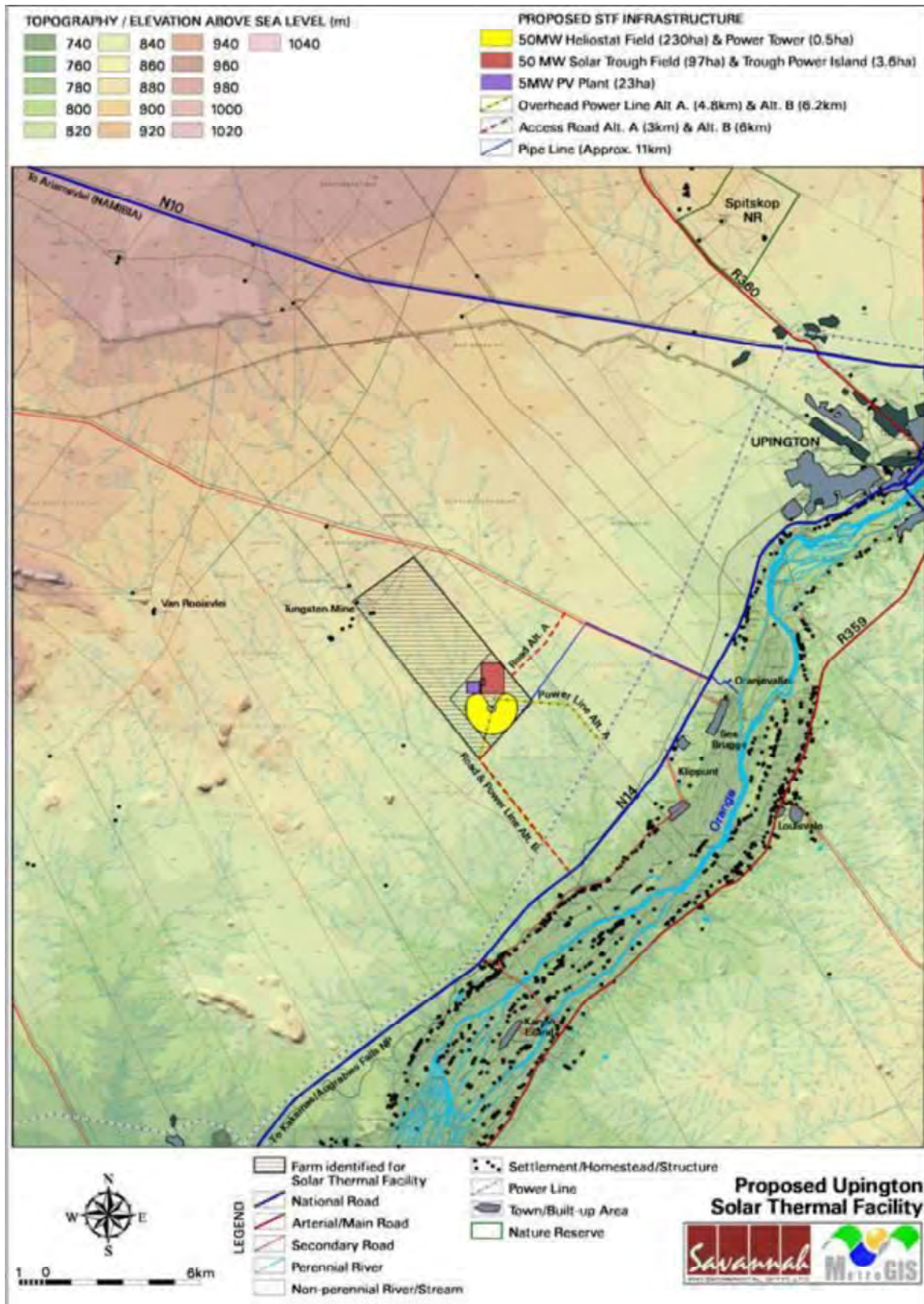
Gordonia Distribution Substation (close to Upington) to its Oasis Distribution Substation (close to Keimoes). Two alternative corridors/routes are proposed for the power line.

- A **water supply pipeline** to the facility and extraction point on the Orange (Gariep) River along an existing road reserve.
- Water that has been abstracted from the Orange River will be pumped to a **settlement reservoir** located approximately 0.6 km north-west of the abstraction point to get rid of particles in suspension.
- A second **storage reservoir** will be located approximately 8.5 km west of the abstraction point within the boundaries of the identified site.
- A **blow down pond** will be established to receive wastewater from the generation process.
- An **external access road** to the site will be established from the main road (i.e. N14), which runs approximately 5.2 km south-east of the site. Two routes for the external access road are proposed.
- **Internal access roads** will also be established for construction and maintenance purposes. Depending on the technology selection there will be one internal asphalt access road of approximately 6 m wide which will lead directly to the power island. Between the heliostats/troughs/photovoltaic panels there will be a stabilised gravel track that would be used for maintenance purposes during the operational phase.
- **Workshop, office, and storage areas** located within the boundaries of the overall site.

A layout of the solar facility is shown on **Map 1**.

The construction phase of the proposed facility is expected to be 2 to 3 years whilst the lifespan of the facility is approximated at 20 to 30 years.





**Map 1:** Locality map and proposed layout of the solar facility showing a proposed 50MW Heliostat Field, 50MW Parabolic Trough Field and 5MW PV Plant.



## **2. SCOPE OF WORK**

The study area for the visual assessment encompasses a geographical area of 1,339km<sup>2</sup> and includes a minimum 16km buffer zone from the proposed development area.

It includes the town of Upington as well as sections of the N14 and N10 national roads, the R359 and R360 arterial roads and a few secondary (local) roads. Other built up areas include Oranjevallei, Ses Brugge, Louisvale, Klippunt, and Kanoneiland.

The scope of work includes the determination of the potential visual impacts in terms of nature, extent, duration, magnitude, probability, and significance of the construction and operation of the proposed infrastructure.

In this regard specific issues related to the visual impact were identified during a site visit to the affected environment. Issues related to the proposed solar facility include:

- The visibility of the facility to, and potential visual impact on, observers travelling along major routes in the area (i.e. the N10/N14 roads to Augrabies Falls National Park, Kgalagadi Transfrontier Park and Namibia) as well as the arterial roads (R359 and R360) and secondary roads within the study area.
- The visibility of the facility to, and visual impact on, not only the larger built-up centres or populated places (the town of Upington, Oranjevallei, Ses Brugge, Louisvale, Klippunt, and Kanon Eiland) but also individual/isolated landowners/homesteads identified within the study area (primarily located along the Orange River).
- Potential cumulative visual impacts (or alternately, consolidation of visual impacts) with special reference to the possible future Eskom CSP plant located adjacent to the proposed development area.
- The potential visual exposure of the facility to protected areas in the vicinity of the proposed facility (i.e. the Spitskop Nature Reserve).
- The potential visual impact of operational, safety and security lighting of the facility at night on observers residing in close proximity of the facility.
- The visual absorption capacity of the natural vegetation (if applicable).
- Potential visual impacts associated with the construction phase.
- The potential to mitigate visual impacts.

## **3. METHODOLOGY**

The study was undertaken using Geographic Information Systems (GIS) software as a tool to generate viewshed analyses and to apply relevant spatial criteria to the proposed facility. A detailed Digital Terrain Model (DTM) for the study area was created from 20m interval contours supplied by the Surveyor General.

Site visits were undertaken to source information regarding land use, vegetation cover, topography and general visual quality of the affected environment. It further served the purpose of verifying the results of the spatial analyses and to identify other possible mitigating/aggravating circumstances related to the potential visual impact.

The approach utilised to identify issues related to the visual impact included the following activities:

- The creation of a detailed digital terrain model (DTM) of the potentially affected environment
- The sourcing of relevant spatial data. This included cadastral features, vegetation types, land use activities, topographical features, site placement, etc
- The identification of sensitive environments upon which the proposed facility could have a potential impact
- The creation of viewshed analyses from the proposed development area in order to determine the visual exposure and the topography's potential to absorb the potential visual impact. The viewshed analyses take into account the dimensions of the proposed structures.

This report (visual impact assessment) sets out to identify and quantify the possible visual impacts related to the proposed solar facility and related infrastructure mentioned above, as well as offer potential mitigation measures, where required.

The following methodology has been followed for the assessment of visual impact:

- **Determine Potential visual exposure**

The visibility or visual exposure of any structure or activity is the point of departure for the visual impact assessment. It stands to reason that if the proposed solar facility and associated infrastructure were not visible, no impact would occur.

Viewshed analyses of the proposed solar facility and the related infrastructure, based on a 20 m interval digital terrain model of the study area, indicate the potential visibility.

- **Determine Visual Distance/Observer Proximity to the facility**

In order to refine the visual exposure of the facility on surrounding areas/receptors, the principle of reduced impact over distance is applied in order to determine the core area of visual influence for each type of structure.

Proximity radii for the proposed development site are created in order to indicate the scale and viewing distance of the facility and to determine the prominence of the structures in relation to their environment.

The visual distance theory and the observer's proximity to the facility are closely related, and especially relevant, when considered from areas with a high viewer incidence and a predominantly negative visual perception of the proposed facility.

- **Determine Viewer Incidence/Viewer Perception**

The number of observers and their perception of a structure determine the concept of visual impact. If there are no observers or if the visual perception of the structure is favourable to all the observers, there would be no visual impact.

It is therefore necessary to identify areas of high viewer incidence and to classify certain areas according to the observer's visual sensitivity towards the proposed solar facility and its related infrastructure. It would be

impossible not to generalise the viewer incidence and sensitivity to some degree, as there are many variables when trying to determine the perception of the observer; regularity of sighting, cultural background, state of mind, and purpose of sighting which would create a myriad of options.

- **Determine the Visual Absorption Capacity of the natural vegetation**

This is the capacity of the receiving environment to absorb the potential visual impact of the proposed facility. The VAC is primarily a function of the vegetation, and will be high if the vegetation is tall, dense and continuous. Conversely, low growing sparse and patchy vegetation will have a low VAC.

- **Determine the Visual impact index**

The results of the above analyses are merged in order to determine where the areas of likely visual impact would occur. These areas were further analysed in terms of the previously mentioned issues (related to the visual impact) and in order to judge the severity of each impact.

#### **4. THE AFFECTED ENVIRONMENT**

The identified site for the proposed facility is situated approximately 12 km south-west of Upington on the farm McTaggart's Camp 453 portion 3, refer to **Map 3**. Distance by road is approximately 20km.

This farm is located south west of a possible future Eskom CSP facility (indicated on **Map 2**). Eskom applied in 2006 for the construction of a power tower consisting of a power tower and approximately 3000 heliostats over an identified area of 230 ha.

Access to the proposed solar facility is afforded by means of an 8 km stretch of secondary (gravel) road that joins the N14 national road near the small town of Oranjevallei. Other small towns and settlements along the Orange River include Ses Brugge, Louisvale, Klippunt and Kanoneiland.

The N14, N10, R360 and R359 are the primary roads in the region and are the main link between Gauteng and Namibia, the Augrabies Falls National Park and the Kgalagadi Trans-frontier National Park.

The topography of the region is relatively homogenous and is described predominantly as *lowlands with hills, dune hills and irregular or slightly irregular plains*. Relatively prominent hills occur towards the south-west of the study area. See **Map 2** for the shaded relief/topography map of the study area.

The terrain surrounding the farm is predominantly flat with an even south-eastern slope towards the Orange River valley that forms a distinct hydrological feature in the region.

The Orange River has, to a large degree, dictated the settlement pattern in this arid region by providing a source of perennial water for the cultivation of grapes. This and the associated production of wine is the primary agricultural activity of this district.

Cattle and game farming practises also occur, although are less intensive. Other land-use activities include conservation and nature oriented tourism in the form

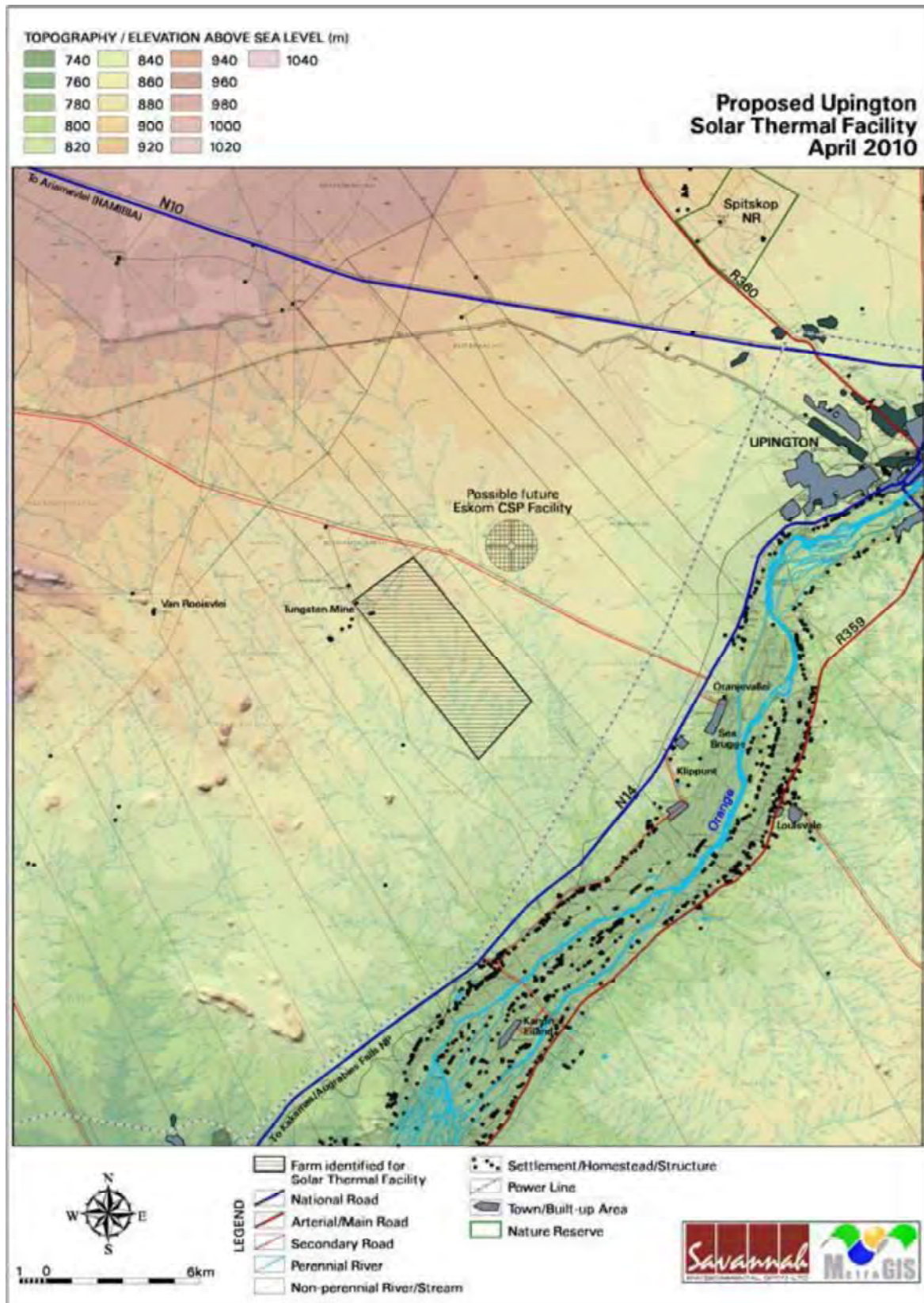
of the Spitskop Nature Reserve located north-west of Upington (along the R360) and the Augrabies Falls National Park (approximately 120 km west of Upington).

The majority of the study area is sparsely populated (less than 10 people per km<sup>2</sup>) and consists of a landscape of wide-open expanses and vast desolation. The scarcity of water and other natural resources has strongly influenced settlement within this region - the population distribution is concentrated along the Orange River.

Vegetation cover in this semi-desert region is restricted to *thicket*, *bushland*, *shrubland*, and *grassland*. Planted vegetation in the form of vineyards and cotton fields is found along the Orange River floodplain. See **Map 3** for the broad land cover types map of the study area.

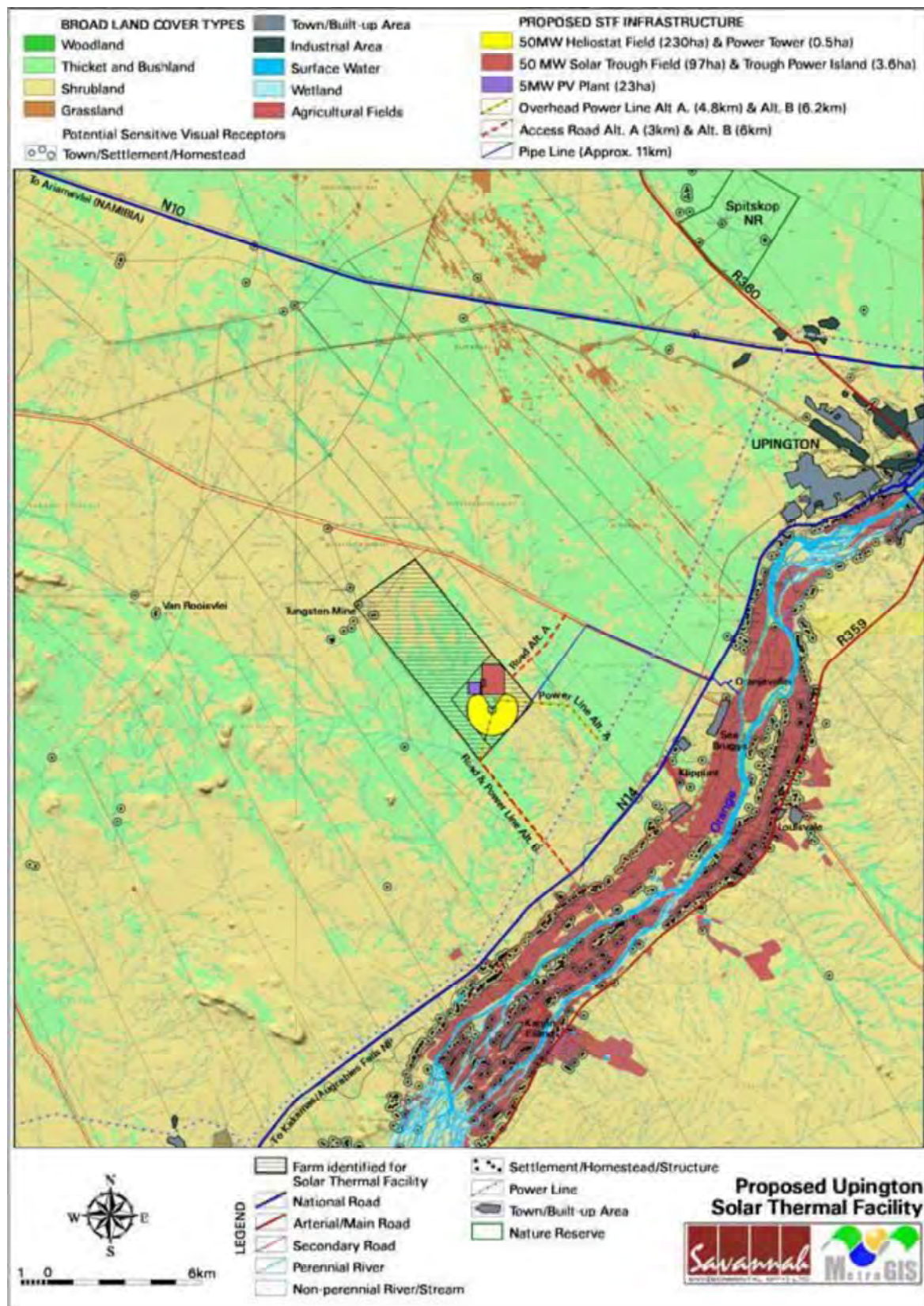
The Spitskop Nature Reserve is a provincial nature reserve. It is located in the north east of the study area and is the only statutory protected area within the study area.

It should be noted that the Spitskop Nature Reserve is not a well developed tourist destination, and has little infrastructure at present.



**Map 2:** Shaded relief map of the broader study area (indicating the location of the proposed solar facility, the possible Eskom CSP facility and the topography and elevation above sea level).





**Map 3:** Land types and vegetation cover of the broader study area.

The photograph below of the area identified for the solar facility footprint gives a good indication of the wide-open expanse and unrestricted vistas afforded by the terrain.



**Figure 4:** Photograph of the proposed site taken from the access road (looking north).

*Sources: DEAT (ENPAT Eastern Cape), NBI (Vegetation Map of South Africa, Lesotho and Swaziland) and NLC2000 (ARC/CSIR).*

## **5. RESULTS**

### **5.1 Potential Visual Exposure**

The potential visual exposure analysis was undertaken from actual positions as set out in the layout of the facility. The heights of the power tower (180m) and heliostats (12m) were used during the generation of the viewshed, as these represent the largest and potentially the most visibly prominent infrastructure within the proposed facility. The potential visual exposure of the PV panels and the troughs, which are similar in size to the heliostats, are also accommodated within the heliostat field viewshed.

The ancillary infrastructure (i.e. the 2 storey generator building, the power line, the substation, the reservoirs, the blow down pond, the access roads and the workshops and offices) are all smaller than the power tower, and will thus fall within this structure's viewshed.

The joint visual exposure of the power tower and the heliostats are indicated on **Map 4**. The darker shading indicates areas from which the power tower, the heliostats, the PV panels, the parabolic troughs and the ancillary infrastructure would potentially be visible. The lighter shading indicates areas from which only the larger power tower would be visible.

It is clear from this viewshed analysis that the facility (especially the power tower) would be exposed to a large geographical area within this region due to the relatively flat topography.

It is anticipated that the power tower, as well as some of the smaller infrastructure (i.e. the heliostats, the PV panels, the parabolic troughs and the larger buildings) will be visible from some of the northern parts of Upington as well as the smaller towns of Kanoneiland, and Louisvale.

The entire facility may also be partially visible from limited sections of the N10 and the N14, and from longer stretches of the R359 east of the Orange River. Interrupted sections of secondary roads and a few settlements on the eastern bank of the Orange River will be potentially visually affected.

In addition to the above, the power tower as an isolated entity will be exposed to most of the towns along the river. These include Oranjevallei, Ses Brugge, and Klippunt as well as most of the settlements/homesteads along the river.

The power tower is also expected to be visible from most of the length of the national roads (including the N14 and N10), the arterial roads (including the R360 and the R359), and the secondary roads traversing the study area.

The solar facility is likely to be visible from parts of the Spitskop Nature Reserve, and the power tower will be visually exposed to the entire reserve.

It should be noted that the Spitskop Nature Reserve is not a well developed tourist destination, and has little infrastructure at present.

It is envisaged that the proposed facility would be easily and comfortably visible, especially within a 16km radius of the site and the power tower in particular, would constitute a high visual prominence, potentially resulting in a moderate visual impact. It should be noted, however that the nature of the impact is subjective.

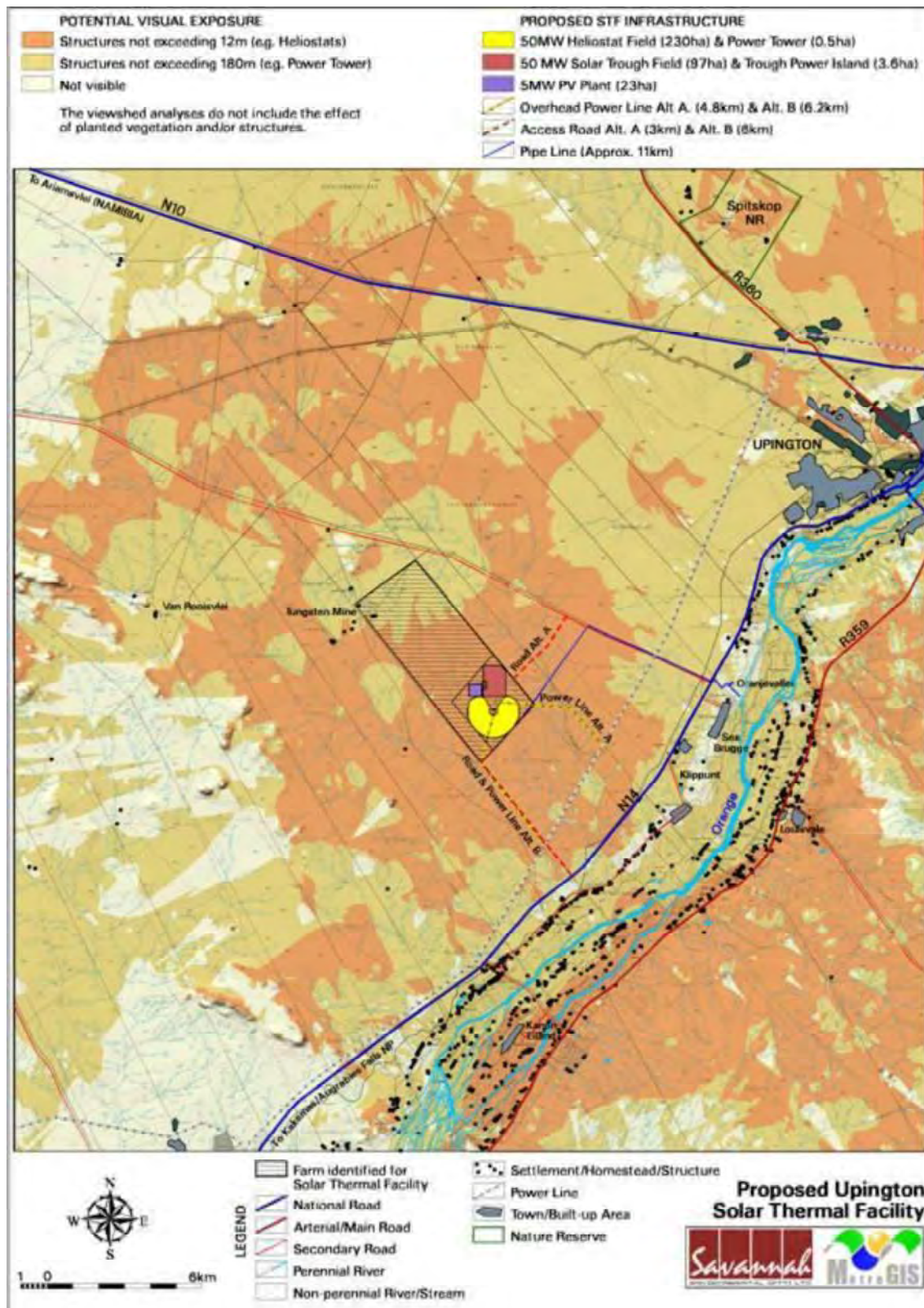
## **5.2 Visual Distance/Observer Proximity to the facility**

MetroGIS determined the proximity radii based on the anticipated visual experience of the observer over varying distances. The distances are adjusted upwards for larger facilities and downwards for smaller facilities (i.e. depending on the size and nature of the proposed infrastructure. MetroGIS developed this methodology in the absence of any known and/or acceptable standards for South African solar energy facilities.

The proximity radii (calculated from the boundary lines of the farm selected for the solar facility) are shown on **Map 5** and are as follows:

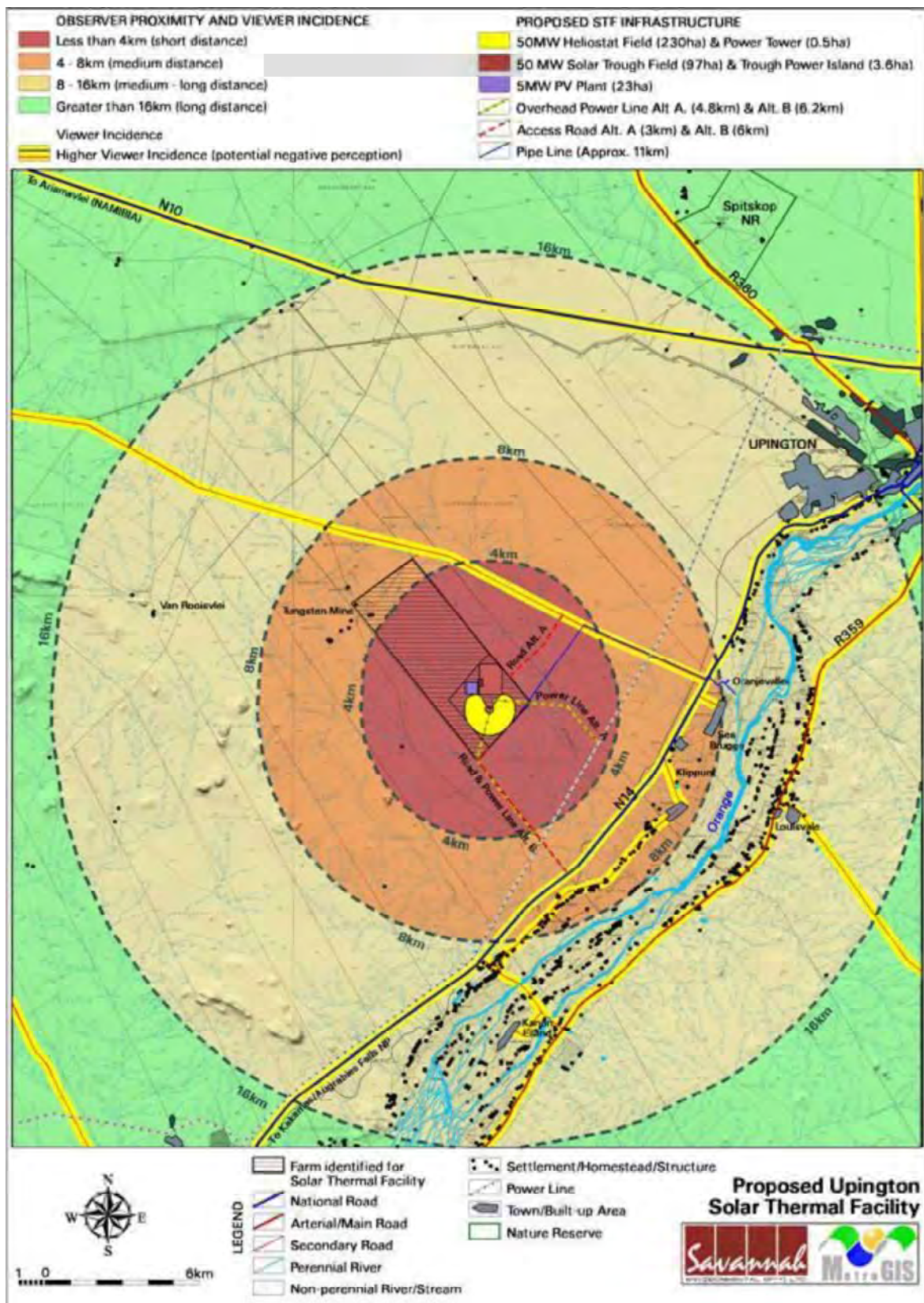
- 0 - 4 km - Short distance view where the solar facility (i.e. primarily the power tower and heliostats) would dominate the frame of vision and constitute a very high visual prominence.
- 4 - 8 km - Medium distance view where the solar facility (i.e. primarily the power tower and heliostats) would be easily and comfortably visible and constitute a high visual prominence.
- 8 - 16 km - Medium to longer distance view where the solar facility (i.e. primarily the power tower and heliostats) would become part of the visual environment, but would still be visible and recognisable. This zone constitutes a high to medium visual prominence.
- Greater than 16 km - Long distance view of the facility where the solar facility (i.e. primarily the power tower and heliostats) would still be visible though not as easily recognisable. This zone constitutes a medium visual prominence for the facility.





**Map 4** Potential visual exposure of the solar facility.





**Map 5:** Observer proximity to the proposed solar facility and areas of high viewer incidence.

### 5.3. Viewer Incidence/Viewer Perception

For the purpose of this study, five categories were identified as having differing observer incidences and/or perceptions. These are indicated on **Map 5**.

- The **first** category of high viewer incidence and potential negative perception includes the built-up areas within the study area. These include Upington, Louisvale Road, Oranjevallei, Ses Brugge, Louisvale, Klippunt, and Kanoneiland. Observers residing in these areas are accustomed to the wide natural expanses and vistas afforded by this rural region, although storage and chiller plants are visible intermittently. Developments of the scale of the power tower (180m tall) may constitute a negative visual impact.

The industrial areas surrounding Upington are not likely to be negatively impacted upon due to the nature of the activities and facilities already present here.

*It must be noted that no complaints pertaining to potential visual impact of the construction and operation of the proposed solar facility, as far as the author is aware, were received from individual landowners in the study area during the public participation process or otherwise.*

- The **second** category with medium observer incidence and potentially negative viewer perception encompasses the cultivated areas adjacent to the Orange River. This zone consists mainly of vineyards and activities related to the cultivation of grapes. It is perceived that it would have fewer observers but could still evoke potentially negative perceptions of the facility. This is due to the existing rural context to which the viewers are accustomed.

The gentle slopes toward the river offer some visual protection from the smaller infrastructure (heliostats, troughs and PV panels), but not from the power tower.

- Areas that are greatly devoid of random observers make up the **third** category with low observer incidence and/or a predominantly neutral perception of the facility. This area includes large tracts of sparsely populated land (*thicket and bushland, shrubland and grassland*).
- The **fourth** category that could potentially experience a negative visual impact due to land use conflict are the protected areas (Spitskop Provincial Nature Reserve) and nature based tourism destinations (Orange River). It should be noted that the Spitskop Nature Reserve is not a well developed tourist destination, and has little infrastructure at present.
- The **fifth** and final category comprises corridors along the main roads in the area. These areas include 200m buffer zone along the national, arterial, and secondary roads, and are expected to support a higher frequency of observers. These buffers represent the area with the highest potential sightings of the solar facility.

### 5.4. Visual Absorption Capacity of the natural vegetation

The vegetation units present in the study area surrounding the solar facility (predominantly *Ticket and Bushland* and *Shrubland*) are on average only 2 m high. This, coupled with the sparse distribution of the plant species, the

dimensions of the facility and height of structures, it was determined that the Visual Absorption Capacity (VAC) is low to negligible for virtually the entire study area.

### **5.5. Visual impact index**

The combined results of the visual exposure, viewer incidence/perception and visual distance of the proposed solar facility are displayed on **Map 6**.

Here the weighted impact and the likely areas of impact are indicated as a visual impact index. Values were assigned for each potential visual impact per data category and merged in order to calculate the visual impact index.

An area with short distance, high frequency of visual exposure to the proposed facility, a high viewer incidence and a predominantly negative perception would therefore have a higher value (greater impact) on the index. This helps in focussing the attention to the critical areas of potential impact when evaluating the issues related to the visual impact.

#### ***Category 1 – residential areas/built up areas***

Upington, as well as the towns of Oranjevallei, Louisvale, and Kanoneiland are expected to be exposed to medium to long distance views of the power tower. It is not anticipated that the other primary infrastructure (i.e. the heliostats, the PV panels or the troughs) or ancillary infrastructure will be visible from this distance.

These observers will experience a **moderate to low** visual impact. Towns within 8km (short to medium distance view) of the proposed facility (such as Klippunt and Ses Brugge) will experience **moderate to high** visual impact.

It should be noted that the visual impact index does not take into account visual clutter and structures that obstruct long distance views within built-up areas. For this reason it can be assumed that the solar facility would not be visible from all areas within the towns, but have a higher visual incidence from the outskirts.

#### ***Category 2 – cultivated areas along the Orange River***

Many homesteads and settlements along the Orange River occur on the south east facing bank. In addition to being somewhat shielded by topography, most of these settlements lie beyond 8km (medium to long distance view) from the proposed facility, and would thus potentially be exposed to a **low** visual impact as a result of the power tower. This excludes those settlements along the R359 which will experience a **moderate to high** visual impact.

It is not anticipated that the other primary infrastructure (i.e. the heliostats, the PV panels or the troughs) or ancillary infrastructure will be visible from this distance.

#### ***Category 3 – sparsely populated areas***

Within a radius of 4km (short distance view) of the solar facility, observers will potentially be exposed to **high** visual impact as a result of both the power tower, and the smaller infrastructure (i.e. the heliostats, the PV panels, the troughs and the ancillary infrastructure). Within this radius lies one settlement adjacent to the facility which will be exposed to **very high** visual impact.

Beyond the 8km radius, settlements such as Van Rooisvlei are expected to be exposed to **moderate** and **low** visual impact as a result of the power tower.

It is not anticipated that the other primary infrastructure (i.e. the heliostats, the PV panels or the troughs) or ancillary infrastructure will be visible from this distance.

***Category 4 – protected areas***

The power tower would be visible from the Spitskop Nature Reserve, but these would be long distance views and visual impact would be **low** to **very low**.

It is not anticipated that the other primary infrastructure (i.e. the heliostats, the PV panels or the troughs) or ancillary infrastructure will be visible from this distance.

***Category 5: – corridors/roads***

Observers in close proximity to the facility (i.e. within 4 km) would be exposed to a **very high** potential visual impact as a result of the power tower. This includes a section of secondary road bypassing the facility to the north. The secondary road is not of great concern as it is generally devoid of random observers and does not carry a large number of motorists. The other primary infrastructure (i.e. the heliostats, the PV panels or the troughs) and the ancillary infrastructure may be discernable, but will not be apparent.

Both national and arterial roads between 4km and 16km of the site will be exposed to views of the power tower, and thus to **moderate to high** visual impact, dropping to **moderate** in places. A small section of the N14 will experience **high** visual impact as a result of the power tower.

It is not anticipated that the other primary infrastructure (i.e. the heliostats, the PV panels or the troughs) or ancillary infrastructure will be visible from this distance.

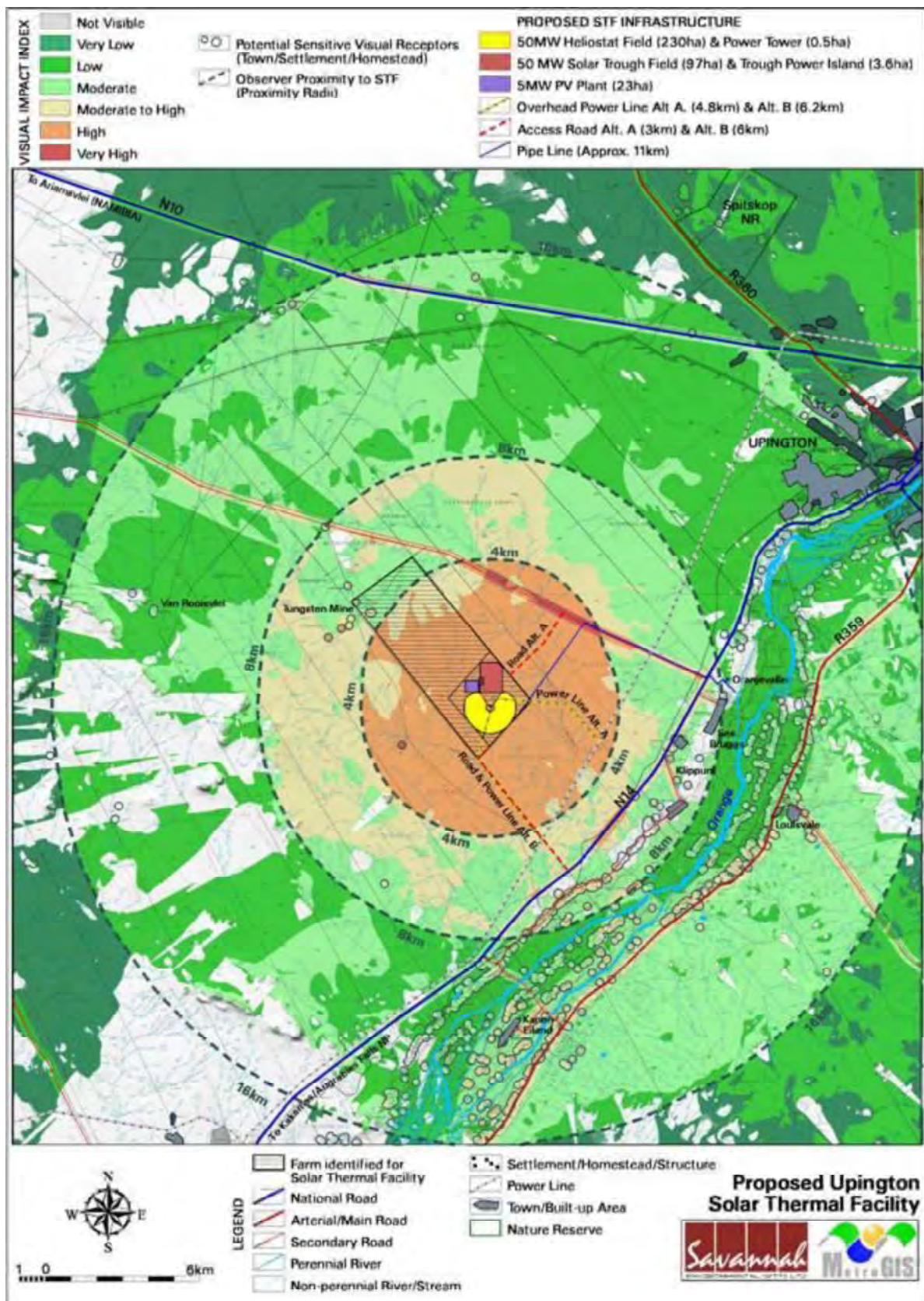
Of significance is that these roads are the primary tourist routes in a region where Upington functions as a gateway and activity hub to a host of eco-tourism destinations.

Roads with a **high** potential visual impact include a section of the N14 south east of the site and a section of the secondary road north east of the site. At this distance (less than 8km) the solar facility will be most prominent. It is anticipated that the power tower will be visible from this distance. The other primary infrastructure (i.e. the heliostats, the PV panels or the troughs) and the ancillary infrastructure may be discernable, but will not be apparent.

Beyond 16km away from the development the potential visual impacts along all the roads and built-up areas becomes **low** to **very low** or **not visible**.

It is not anticipated that the other primary infrastructure (i.e. the heliostats, the PV panels or the troughs) or ancillary infrastructure will be visible from this distance.





**Map 6:** Visual impact index of the proposed solar facility.

## 5.6 Visual impact assessment

The previous section of the report identified specific areas where likely visual impacts would occur. This section will attempt to quantify these potential visual impacts in their respective geographical locations and in terms of the identified issues (see Chapter 2: SCOPE OF WORK) related to the visual impact.

The methodology for the assessment of potential visual impacts states the **nature** of the potential visual impact (e.g. the visual impact on users of major roads in the vicinity of the proposed solar facility) and includes a table quantifying the potential visual impact according to the following criteria:

- **Extent** - site only (very high = 5), local (high = 4), regional (medium = 3), national (low = 2) or international (very low = 1)
- **Duration** - very short (0-1 yrs = 1), short (2-5 yrs = 2), medium (5-15 yrs = 3), long (>15 yrs = 4), and permanent (= 5)
- **Magnitude** - None (= 0), minor (= 1), low (= 2), medium/moderate (= 3), high (= 4) and very high (= 5)
- **Probability** - none (= 0), improbable (= 1), low probability (= 2), medium probability (= 3), high probability (= 4) and definite (= 5)
- **Status** (positive, negative or neutral)
- **Reversibility** - reversible (= 1), recoverable (= 3) and irreversible (= 5)
- **Significance** - low, medium or high

The **significance** of the potential visual impact is equal to the **consequence** multiplied by the **probability** of the impact occurring, where the consequence is determined by the sum of the individual scores for magnitude, reversibility, duration and extent (i.e. **significance = consequence (magnitude + reversibility + duration + extent) x probability**).

The significance weighting for each potential visual impact (as calculated above) is as follows:

- <30 points: Low (where the impact would not have a direct influence on the decision to develop in the area)
- 31-60 points: Medium/moderate (where the impact could influence the decision to develop in the area)
- >60: High (where the impact must have an influence on the decision to develop in the area)

*Please note that due to the declining visual impact over distance, the **extent** (or spatial scale) rating is reversed (i.e. a localised visual impact has a higher value rating than a national or regional value rating). This implies that the visual impact is highly unlikely to have a national or international extent, but that the local or site-specific impact could be of high significance.*

No mitigation measures (e.g. painting the structures a sky blue colour) is proposed as the colour scheme and lighting fixtures are legally required by the Civil Aviation Authority, and cannot be altered.

### 5.6.1 The Solar Facility

#### Potential visual impact on users of national, arterial and secondary roads in close proximity of the solar facility.

Potential visual impact on the major roads within close proximity to the proposed solar facility (i.e. within 8km) is expected to be **high**.

The table below illustrates this impact assessment.

**Table 1** Impact table summarising the significance of visual impacts on users of national, arterial and secondary roads in close proximity of the solar facility.

<b>Nature of Impact:</b> Potential visual impact on users of arterial and secondary roads in close proximity of the solar facility	
<b>Extent</b>	Local <b>(4)</b>
<b>Duration</b>	Long term <b>(4)</b>
<b>Magnitude</b>	High <b>(4)</b>
<b>Probability</b>	High <b>(4)</b>
<b>Significance</b>	High <b>(60)</b>
<b>Status (positive or negative)</b>	Negative
<b>Reversibility</b>	Recoverable <b>(3)</b>
<b>Irreplaceable loss of resources?</b>	No
<b>Can impacts be mitigated during operational phase?</b>	No
<b>Mitigation:</b> Decommissioning: removal of the solar facility structures and ancillary infrastructure after 30 years	
<b>Cumulative impacts:</b> If the construction of this facility is considered in addition to the possible future construction of the Eskom CSP plant, there is a potentially cumulative visual impact within the region as a result of the construction of the two facilities.  The development of the primary infrastructure over 2 to 3 years may create the impression of a cumulative visual impact on uninformed observers (i.e. observers who are not aware of the total extent of the facility).	
<b>Residual impacts:</b> None. The visual impact will be removed after decommissioning	



**Potential visual impact on residents of towns, settlements and homesteads in close proximity to the proposed solar facility.**

The visual impact of the proposed solar facility on built-up areas and settlements within 8km of the site is found to be **moderate**.

The table below illustrates this impact assessment.

**Table 2** Impact table summarising the significance of visual impacts on residents of towns, settlements and homesteads in close proximity to the proposed solar facility

<b>Nature of Impact:</b> Potential visual impact on residents of towns, settlements and homesteads in close proximity (0-8km) to the proposed solar facility	
<b>Extent</b>	Local <b>(4)</b>
<b>Duration</b>	Long term <b>(4)</b>
<b>Magnitude</b>	Moderate <b>(3)</b>
<b>Probability</b>	High <b>(4)</b>
<b>Significance</b>	Moderate <b>(56)</b>
<b>Status (positive or negative)</b>	Negative
<b>Reversibility</b>	Recoverable <b>(3)</b>
<b>Irreplaceable loss of resources?</b>	No
<b>Can impacts be mitigated during operational phase?</b>	No
<b>Mitigation:</b> Decommissioning: removal of the solar facility structures and ancillary infrastructure after 30 years	
<b>Cumulative impacts:</b> If the construction of this facility is considered in addition to the possible future construction of the Eskom CSP plant, there is a potentially cumulative visual impact within the region as a result of the construction of the two facilities.  The development of the primary infrastructure over 2 to 3 years may create the impression of a cumulative visual impact on uninformed observers (i.e. observers who are not aware of the total extent of the facility).	
<b>Residual impacts:</b> None. The visual impact will be removed after decommissioning	

**Potential visual impact on residents of towns, settlements and homesteads within the region.**

The visual impact of the proposed solar facility on built-up areas and settlements beyond 8km of the site is found to be **moderate**.

The table below illustrates this impact assessment.

**Table 3** Impact table summarising the significance of visual impacts on residents of towns, settlements and homesteads within the region

<b>Nature of Impact:</b> Potential visual impact on residents of towns, settlements, and homesteads within the region (>16km)	
<b>Extent</b>	Regional <b>(3)</b>
<b>Duration</b>	Long term <b>(4)</b>
<b>Magnitude</b>	Moderate <b>(3)</b>
<b>Probability</b>	High <b>(4)</b>
<b>Significance</b>	Moderate <b>(52)</b>
<b>Status (positive or negative)</b>	Negative
<b>Reversibility</b>	Recoverable <b>(3)</b>
<b>Irreplaceable loss of resources?</b>	No
<b>Can impacts be mitigated during operational phase?</b>	No
<b>Mitigation:</b> Decommissioning: removal of the solar facility structures and ancillary infrastructure after 30 years	
<b>Cumulative impacts:</b> If the construction of this facility is considered in addition to the possible future construction of the Eskom CSP plant, there is a potentially cumulative visual impact within the region as a result of the construction of the two facilities.  The development of the primary infrastructure over 2 to 3 years may create the impression of a cumulative visual impact on uninformed observers (i.e. observers who are not aware of the total extent of the facility).	
<b>Residual impacts:</b> None. The visual impact will be removed after decommissioning	

### Potential visual impact of the proposed solar facility on protected areas and eco-tourism

The potential visual impact of the proposed solar facility on the Spitskop Nature Reserve and on eco-tourism along the Orange River is expected to be **moderate**.

The table below illustrates this impact assessment.

**Table 4** Impact table summarising the significance of visual impacts on protected areas and eco-tourism

<b>Nature of Impact:</b> Potential visual impact of the proposed solar facility on protected areas and eco-tourism	
<b>Extent</b>	regional <b>(3)</b>
<b>Duration</b>	Long term <b>(4)</b>
<b>Magnitude</b>	Low <b>(2)</b>
<b>Probability</b>	High <b>(4)</b>
<b>Significance</b>	Moderate <b>(48)</b>
<b>Status (positive or negative)</b>	Negative
<b>Reversibility</b>	Recoverable <b>(3)</b>
<b>Irreplaceable loss of resources?</b>	No
<b>Can impacts be mitigated during operational phase?</b>	No
<b>Mitigation:</b> Decommissioning: removal of the solar facility structures and ancillary infrastructure after 30 years	
<b>Cumulative impacts:</b> If the construction of this facility is considered in addition to the possible future construction of the Eskom CSP plant, there is a potentially cumulative visual impact within the region as a result of the construction of the two facilities.  The development of the primary infrastructure over 2 to 3 years may create the impression of a cumulative visual impact on uninformed observers (i.e. observers who are not aware of the total extent of the facility).	
<b>Residual impacts:</b> None. The visual impact will be removed after decommissioning	

### 5.6.2 Ancillary infrastructure

#### Potential visual impact of the external access road.

Two alternatives for the external access road are being considered. Alternative A tees off a secondary road that bypasses the site in the north east, while Alternative B tees directly off the N14 to the south west of the site. Alternative B is also somewhat longer than Alternative A.

In terms of potential visual impact, the shorter access road which tees off a lower order road would constitute a lesser impact. Therefore, Alternative A is recommended from a visual perspective.

Although no dedicated viewshed has been generated for the external access road, it is expected that the area of potential visual exposure of this road will lie within that of the primary infrastructure (i.e. specifically the power tower, heliostats, PV panels and troughs). The potential visual impact of this access road is expected to be **low**.

The table below illustrates this impact assessment.

**Table 5** Impact table summarising the significance of visual impact of the external access road.

<b>Nature of Impact:</b> Potential visual impact of the external access road	
<b>Extent</b>	Local <b>(4)</b>
<b>Duration</b>	Long term <b>(4)</b>
<b>Magnitude</b>	High <b>(4)</b>
<b>Probability</b>	Low <b>(1)</b>
<b>Significance</b>	Low <b>(15)</b>
<b>Status (positive or negative)</b>	Negative
<b>Reversibility</b>	Recoverable <b>(3)</b>
<b>Irreplaceable loss of resources?</b>	No
<b>Can impacts be mitigated during operational phase?</b>	No
<b>Mitigation:</b> Decommissioning: removal of the solar facility structures and ancillary infrastructure after 30 years	
<b>Cumulative impacts:</b> None.	
<b>Residual impacts:</b> None. The visual impact will be removed after decommissioning	

### Potential visual impact of the power line.

Two alternatives are also being considered for the overhead power line connecting the solar facility to the main Eskom power line. Alternative A runs in an easterly direction for about 3km before swinging to the south east to link with the Eskom line. Alternative B runs due south to the boundary of the solar facility site, and then swings to the south east to link with the Eskom line.

Both power line alternatives are new alignments and would thus constitute a visual impact. Both alternatives traverse similar terrain, but Alternative A is somewhat shorter. Alternative B coincides with an alternative access road alignment.

All other factors being equal, it is recommended that Alternative A be favoured for the power line as it represents a reduced impact by virtue of its shorter length. Alternative B would only be viable if the access road Alternative B was also recommended.

Although no dedicated viewshed has been generated for the power line, it is expected that the area of potential visual exposure will lie within that of the primary infrastructure (i.e. specifically the power tower). The potential visual impact of this power line is expected to be **low**.

The table below illustrates this impact assessment.

**Table 6** Impact table summarising the significance of visual impact of the power line.

<b>Nature of Impact:</b> Potential visual impact of the power line	
<b>Extent</b>	Local <b>(4)</b>
<b>Duration</b>	Long term <b>(4)</b>
<b>Magnitude</b>	High <b>(4)</b>
<b>Probability</b>	Low <b>(1)</b>
<b>Significance</b>	Low <b>(15)</b>
<b>Status (positive or negative)</b>	Negative
<b>Reversibility</b>	Recoverable <b>(3)</b>
<b>Irreplaceable loss of resources?</b>	No
<b>Can impacts be mitigated during operational phase?</b>	No
<b>Mitigation:</b> Decommissioning: removal of the solar facility structures and ancillary infrastructure after 30 years	
<b>Cumulative impacts:</b> None.	
<b>Residual impacts:</b> None. The visual impact will be removed after decommissioning	

### Potential visual impact of other ancillary infrastructure.

Other ancillary infrastructure (i.e. the 2 story generator building, the substation, the settlement and storage reservoirs, the blow down pond, the internal roads, the office and the workshop) will be located within the development footprint, and will generally be overshadowed by the much taller power tower as well as the heliostats, PV panels and troughs.

Visual impacts related to the proposed pipe line relate to vegetation that will be removed during the construction phase. If left unrehabilitated, this servitude could remain as a visual scar in the landscape. In addition, unrehabilitated areas are vulnerable to erosion over time. The effects of erosion also represent a potential visual impact to observers.

Although no dedicated viewshed has been generated for this ancillary infrastructure, it is expected that the area of potential visual exposure will lie within that of the primary infrastructure (i.e. specifically the power tower). The potential visual impact of this ancillary infrastructure is expected to be **low**.

The table below illustrates this impact assessment.

**Table 7** Impact table summarising the significance of visual impact of other ancillary infrastructure.

<b>Nature of Impact:</b> Potential visual impact of other ancillary infrastructure	
<b>Extent</b>	Local <b>(4)</b>
<b>Duration</b>	Long term <b>(4)</b>
<b>Magnitude</b>	High <b>(4)</b>
<b>Probability</b>	Low <b>(1)</b>
<b>Significance</b>	Low <b>(15)</b>
<b>Status (positive or negative)</b>	Negative
<b>Reversibility</b>	Recoverable <b>(3)</b>
<b>Irreplaceable loss of resources?</b>	No
<b>Can impacts be mitigated during operational phase?</b>	No
<b>Mitigation:</b> Decommissioning: removal of the solar facility structures and ancillary infrastructure after 30 years	
<b>Cumulative impacts:</b> None.	
<b>Residual impacts:</b> None. The visual impact will be removed after decommissioning	

## **5.7. Secondary visual impacts**

### **5.7.1. Lighting impacts**

The area earmarked for the placement of the solar facility has a relatively small number of populated places (towns, settlements and farmsteads).

The power tower glows white hot during the day but the effect will be low, in the context of daylight.

Although these are not densely populated areas, the light trespass and glare from the security and after-hours operational lighting will have some significance. Furthermore, the sense of place and cultural ambiance of the local area increases its sensitivity to such lighting intrusions.

A second source of light pollution stemming from the solar facility will be in the form of 'glare light', which is not as intense as flood lighting. The source of this lighting is the aircraft warning lights mounted on top of the power tower. These lights are less aggravating due to the toned-down red colour, but have the potential to be visible from a great distance. The Civil Aviation Authority (CAA) prescribes these warning lights and the potential to mitigate their visual impact is low. Only the power tower will require such lights, which means the impact of these should also be low.

Last is the potential lighting impact known as sky glow. Sky glow is the condition where the night sky is illuminated when light reflects off particles in the atmosphere such as moisture, dust, or smog. The sky glow intensifies with the increase in the amount of light sources. Each new light source, especially upwardly directed lighting, contributes to the increase in sky glow. The solar facility may contribute to the effect of sky glow in an otherwise dark environment.

This issue is also relevant in context of other nearby infrastructure (i.e. a crusher plant to the north west of the site just off the N10) which may already be causing sky glow. The addition of this facility could contribute to the accumulation of this impact.

### **5.7.2. Potential visual impacts associated with the construction phase**

The construction phase of a project potentially causes the most disturbances within the receiving environment. During this time there will be a noticeable increase in heavy vehicles utilising the roads to the development site that may cause, at the very least, a visual nuisance to other road users and land owners in the area.

## **5.8. The potential to mitigate visual impacts**

- The primary visual impact, namely the appearance of the facility (including the primary and ancillary infrastructure), is not possible to mitigate. The largest structure, being the power tower, will be impossible to hide. The heliostats (with a footprint area of about 130m<sup>2</sup> each) as well as the PV panels and the troughs are also large, and their functional design cannot be changed in order to reduce visual impacts. All other structures and infrastructure will fall within the viewshed of the larger structures.

Considering the topography of the land and the VAC of the vegetation, very little can be done to mitigate the visual impacts caused by these structures. Furthermore, the functional design of these structures and the

dimensions of the facility cannot be changed in order to reduce visual impacts. Therefore, the potential for mitigation is low.

However, the visual impact of ancillary structures such as the pipe line can be successfully mitigated by placing the pipe underground, and rehabilitating the vegetation within the pipeline servitude. This has the further advantage of negating possible visual impacts associated with vegetation clearing and potential unsightly erosion scarring.

The mitigation of secondary visual impacts caused by security and functional lighting, and construction activities may be mitigated through careful planning and management.

- A land use conflict exists with regard to the Spitskop Nature Reserve. This land use conflict extends to the Orange River itself, which holds potential for ecotourism development within the region. The visual impact represented by the solar facility will impose some limitation on conservation based development and tourism opportunities in the future. This impact is not possible to mitigate.

It should be noted, however that the current status of the Spitskop Reserve is such that it is not a well known tourist destination, and very little if any tourism infrastructure exists.

- The secondary visual impact associated with the power line and the access road is not possible to mitigate.
- Mitigation of lighting impacts includes the pro-active design, planning, and specification lighting for the facility. The correct specification and placement of lighting and light fixtures for the infrastructure will go far to contain rather than spread the light. Additional measures include the following:
  - Shielding the sources of light by physical barriers (walls, vegetation, or the structure itself)
  - Limiting mounting heights of lighting fixtures, or alternatively using foot-lights or bollard level lights
  - Making use of minimum lumen or wattage in fixtures
  - Making use of down-lighters, or shielded fixtures
  - Making use of Low Pressure Sodium lighting or other types of low impact lighting
  - Making use of motion detectors on security lighting. This will allow the site to remain in relative darkness, until lighting is required for security or maintenance purposes.
- Visual impacts associated with the construction phase, albeit temporary, should be managed according to the following principles:
  - Reduce the construction period, if possible, through careful planning and productive implementation of resources.
  - Restrict the activities and movement of construction workers and vehicles to the immediate construction site.
  - Ensure that the general appearance of construction activities, construction camps (if required) and lay-down areas are maintained by means of the timely removal of rubble and disused construction materials.
  - Restrict construction activities to daylight hours, as per the requirements of the Environment Conservation Act, in order to negate or reduce the visual impacts associated with lighting.



## 6. PHOTO SIMULATIONS

Photo simulations were done (in addition to the above spatial analyses) in order to illustrate the potential visual impact of the completed solar facility within the receiving environment.

The simulations are based on the facility dimensions (specifically the power tower and heliostats) and layout as indicated on Map 1 and illustrate the visual significance of the alteration of the landscape from various sensitive visual receptors and over varying distances.

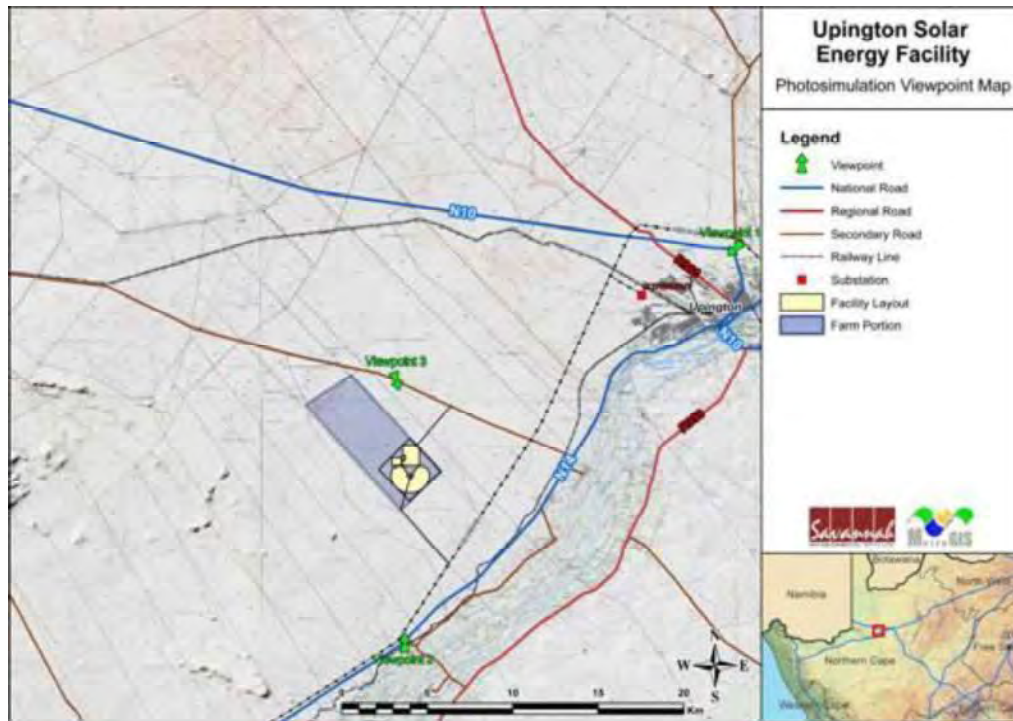
The simulated power tower and heliostats, as shown on the photographs, were adapted to the atmospheric conditions present when the original photographs were taken. This implies that factors such as haze and solar glare were also simulated in order to realistically represent the observer's potential view of the facility.

The photograph positions are indicated on **Map 7** and should be referenced with the photo simulation being viewed in order to place the observer in spatial context.

The simulated views show the placement of the solar facility during the longer-term operational phase of the facility's lifespan. It is assumed that the necessary post-construction phase rehabilitation and mitigation measures, as proposed by the various specialists in the environmental impact assessment report, were done.

These photographs should be seen as an ideal operational scenario (from a visual impact point of view). The ancillary infrastructure (i.e. the power lines, the access road, the 2 story generator building, the substation, the settlement and storage reservoirs, the blow down pond, the internal roads, the office and the workshop) associated with the facility are not included in the photo simulations, as these will not be discernable at this scale. Only the power tower (180m high) has been indicated.

Each photographic simulation is preceded by a panoramic overview of the landscape from the specified viewpoint being discussed. The panoramic overview allows for a more realistic viewer scale that would be representative of the distance over which the facility may be viewed. Each panoramic overview indicates the section that was enlarged to show a more detailed view of the solar facility.



**Map 7:** Photograph positions for Photo Simulations

## 6.1 South-westerly view

### View 1 (long distance view)

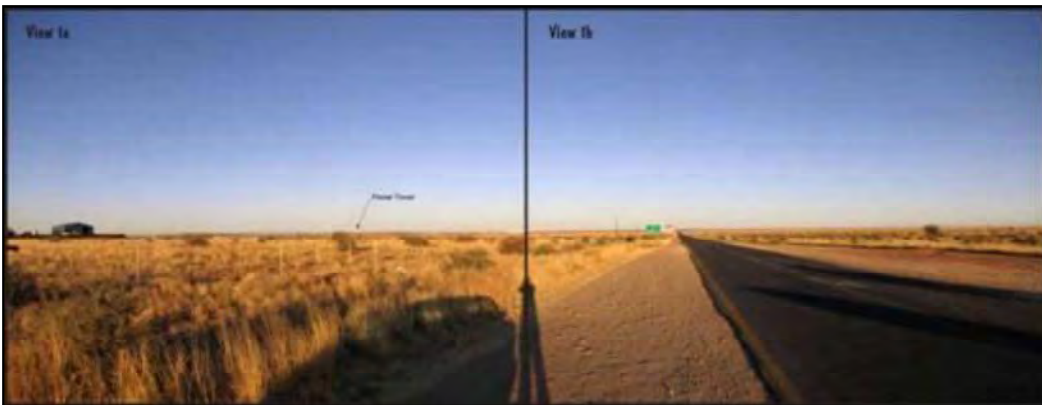
Viewpoint 1 is located at the junction of the N10 and the road that leads to Upington Airport. This position is approximately 20 km away from the facility and is indicative of what will be seen by residents and commuters using the airport or exiting Upington on the N10

The viewing direction is south-westerly and the power tower of proposed Upington Solar Energy Facility can be seen in the far distance. From this view it is clear that the visual impact is absorbed somewhat, by the industrial infrastructure and clutter of Upington Industria in the middle ground. This view is representative of a long distance visual experience that both residents of Upington as well as travellers utilising the N10 and Upington Airport will have of the proposed facility.

It is not anticipated that the other primary infrastructure (i.e. the heliostats, the PV panels or the troughs) or ancillary infrastructure will be visible from this distance.



**Figure 5a:** Pre-construction panoramic overview from Viewpoint 1, approximately 20km from the proposed facility.



**Figure 5b:** Post-construction panoramic overview from Viewpoint 1 (showing photo sections).



**Figure 5c:** View 1a (enlarged photograph section from Viewpoint 1).



**Figure 5d:** View 1b (enlarged photograph section from Viewpoint 1).

## 6.2. Northerly view

### View 2 (Middle distance view)

Viewpoint 2 is located on the junction of the N14 and the road that links this to the R359 and is approximately 10km south (as the crow flies) of the proposed Upington Solar Energy Facility. This view is indicative of what will be seen from workers, residents and possible tourists moving in a northerly direction away from the Orange River.

The viewing direction is northerly and the power tower will be visible in the middle distance landscape. This view is representative of a middle to short distance visual experience that residents, farmers and potential tourists utilising the area around Kanoneiland will have while moving between from the R359 and N14 roads.

It is not anticipated that the other primary infrastructure (i.e. the heliostats, the PV panels or the troughs) or ancillary infrastructure will be visible from this distance.



**Figure 6a:** Pre-construction panoramic overview from Viewpoint 2.



**Figure 6b:** Post-construction panoramic overview from Viewpoint 2 (showing photo sections).





**Figure 6c:** View 2a (enlarged photograph section from Viewpoint 2).



**Figure 6d:** View 2b (enlarged photograph section from Viewpoint 2).

### 6.3. South-south-easterly view

#### View 3 (short distance view)

Viewpoint 3 is located along the road running along the north-eastern boundary of the Upington Solar Energy Facility and is approximately 2 to 3km north (as the crow flies) of the proposed facility.

This view is indicative of what will be seen from the road side close to the facility. The viewing direction is south-south-easterly and the power tower will be fully visible in the landscape. This view is representative of a short distance visual experience of the proposed facility.

The other primary infrastructure (i.e. the heliostats, the PV panels or the troughs) and the ancillary infrastructure may be discernable, but will not be apparent.



**Figure 7a:** Pre-construction panoramic overview from Viewpoint 3.



**Figure 7b:** Post-construction panoramic overview from Viewpoint 3 (showing photo sections).



**Figure 7c:** View 3a (enlarged photograph section from Viewpoint 3).



**Figure 7d:** View 3b (enlarged photograph section from Viewpoint 3).



## **7. CONCLUSIONS AND RECOMMENDATIONS**

The construction and operation of the Uppington Solar Thermal Plant (primarily the power tower) will have a visual impact on the natural scenic resources of this region.

However, the author is of the opinion that the solar facility has an advantage over other more conventional power generating plants (e.g. coal-fired power stations). The facility utilises a renewable source of energy (considered as an international priority) to generate power and is therefore generally perceived in a positive light. It does not emit any harmful by-products or pollutants and is therefore not negatively associated with possible health risks to observers.

The facility further has a novel and futuristic design that invokes a curiosity factor not generally present with other conventional power generating plants. The advantage being that the solar facility can become an attraction or a landmark within the region that people would actually want to come and see. As it is impossible to hide the facility, the only option would be to promote it.

This opinion should however not distract from the fact that the power tower would be visible for a large area that incorporates various sensitive visual receptors that should ideally not be exposed to industrial-type structures.

There are not many recommendations as to the mitigation of the visual impact of the facility (including the primary and ancillary infrastructure), but especially the power tower.

It is however recommended that all disturbed areas are properly rehabilitated, and that all infrastructure and the general surrounds are maintained in a neat and appealing way.

In addition, Alternative A should be favoured for both the power line and the external access road, as these both represent the lowest potential visual impact.

Furthermore, the visual impact of ancillary structures such as the pipe line can be successfully mitigated by placing the pipe underground, and rehabilitating the vegetation within the pipeline servitude.

The construction phase of the facility should be sensitive to potential observers near the construction site. The placement of lay-down areas and temporary construction camps should be carefully considered in order to not negatively influence the future perception of the facility.

Secondary visual impacts associated with the construction phase, such as the sight of construction vehicles, dust and construction litter must be managed to reduce visual impacts. The use of dust-suppression techniques on the access roads (where required), timely removal of rubble and litter, and the erection of temporary screening will assist in doing this.

The planning and proper placement of light fixtures will also reduce visual impacts associated with glare and light trespass.

The facility should be dismantled upon decommissioning and the site and surrounding area should be rehabilitated to its original (current) visual status.

## **8. IMPACT STATEMENT**

In light of the results and findings of the Visual Impact Assessment undertaken for the proposed Upington Solar Thermal Plant, it is acknowledged that the natural and relatively unspoiled rural views surrounding the site will be impacted upon, primarily by the power tower, for the entire operational lifespan (approximately 30 years) of the facility.

The potential visual impact on users of national, arterial and secondary roads in close proximity of the solar facility will be of high significance and the potential visual impact on residents of towns, settlements and homesteads in close proximity to the proposed solar facility and within the region, as well as on protected areas and eco-tourism will be of moderate significance.

In terms of the ancillary infrastructure, the potential visual impact is low, and much of this will be overshadowed by the much taller power tower as well as the heliostats, PV panels and troughs.

This anticipated visual impact is not, however, considered to be a fatal flaw from a visual perspective, considering the low incidence of visual receptors in the region and the contained area of potential visual exposure.

It is therefore recommended that the facility as proposed be supported, subject to the recommended mitigation measures (chapter 7) and management actions (chapter 9).

## **9. MANAGEMENT PLAN**

The management plan tables aim to summarise the key findings of the visual impact report and to suggest possible management actions in order to mitigate the potential visual impacts. The management plan primarily focuses on the mitigation and management of potential secondary visual impacts, due to the fact that the primary visual impact (i.e. the power tower and heliostats) has very low or limited mitigation potential.

**Table 8:** Management plan – Upington Solar Thermal Plant

OBJECTIVE: The mitigation and possible negation of the additional visual impacts associated with the construction of the Upington Solar Thermal Facility.

Project component/s	Construction site, access road and power line		
Potential Impact	Potential scarring and erosion due to the unnecessary removal of vegetation		
Activity/risk source	The viewing of the abovementioned by observers on or near the site		
Mitigation: Target/Objective	Minimal disturbance to vegetation cover in close vicinity to the proposed roads		
Mitigation: Action/control	Responsibility	Timeframe	
Adopt responsible construction practices aimed at containing the construction activities to specifically demarcated areas thereby limiting the removal of natural vegetation to the minimum.	!Khi CSP /contractors	During construction	
Limit access to the construction sites to existing access roads.	!Khi CSP /contractors	Construction / operational phases	
Rehabilitate all disturbed areas to acceptable visual standards.	!Khi CSP /contractors	Construction / operational phases	
Maintain the general appearance of the facility in an aesthetically pleasing way.	!Khi CSP	Operational phase	
Performance Indicator	Vegetation cover that remains intact with no erosion		
Monitoring	Monitoring of vegetation clearing during the construction phase		

**Table 9:** Management plan - Lighting impacts

OBJECTIVE: The mitigation and possible negation of the potential visual impact of lighting at the solar facility

Project component/s	Solar facility lighting fixtures.		
Potential Impact	The potential night time visual impact of lighting fixtures on observers in proximity to the site		
Activity/risk source	The effects of glare and light trespass on motorists and observers		
Mitigation: Target/Objective	The containment of light emitted in order to eliminate the risk of additional night time visual impacts		
	Minimal usage of security and other lighting		
Mitigation: Action/control	Responsibility	Timeframe	
Ensure that proper planning is undertaken regarding the placement of lighting structures and that light fixtures only illuminate areas inside the substation sites. Undertake regular maintenance of light fixtures.	!Khi CSP /lighting engineer	Construction/Operation	
Performance Indicator	The effective containment of the light on the site and no complaints from observers.		
Monitoring	The monitoring of the condition and functioning of the light fixtures during the operational phase of the project		

## **10. REFERENCES/DATA SOURCES**

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**SOCIAL IMPACT ASSESSMENT  
UPINGTON SOLAR THERMAL PLANT  
NORTHERN CAPE PROVINCE**

**OCTOBER 2010**

**Prepared for**

**SAVANNAH ENVIRONMENTAL (Pty) Ltd**

**By**

**Tony Barbour and Daniel Rogatschnig**

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**Tony Barbour**

**ENVIRONMENTAL CONSULTANT AND RESEARCHER**

P O Box 1753, Sun Valley, 7975, South Africa

(Tel) 27-21-789 1112 - (Fax) 27-21-789 1112 - (Cell) 082 600 8266

(E-Mail) [tbarbour@telkomsa.net](mailto:tbarbour@telkomsa.net)

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# EXECUTIVE SUMMARY

## INTRODUCTION AND LOCATION

Savannah Environmental (Pty) Ltd was appointed by Khi CSP South Africa (Pty) Ltd (!Khi CSP) as the lead consultants to manage the Environmental Impact Assessment (EIA) process for the establishment of the proposed Upington Solar Thermal Plant and associated infrastructure on the farm McTaggart's Camp 453, portion 3, near the town of Upington in the Northern Cape Province, South Africa.

Tony Barbour Consulting was appointed by Savannah Environmental (Pty) Ltd to undertake a specialist Social Impact Assessment (SIA) as part of the EIA process. The terms of reference for the study include a scoping level assessment followed by a detailed assessment of the social issues as part of the EIA phase. This report contains the findings of the Draft SIA undertaken as part of the EIA phase.

## DESCRIPTION OF THE PROPOSED SOLAR THERMAL PLANT

The proposed Upington Solar Thermal Plant is expected to produce up to 110 MW of power with using parabolic troughs, power tower and associated heliostat field, and photovoltaic panels. In addition to the above components the proposed facility will also include:

**A steam turbine and generator:** The turbine and generator will be housed within a 2-storey building on-site. The water will be abstracted from the Orange (Gariep) River (the preferred abstraction point is discussed below).

**A generator transformer and a small substation outside the building:** This infrastructure would form part of the power island.

**Energy storage plant and vessels:** An auxiliary steam boiler (i.e. fossil fuel boiler / generator) will be included on the power island and will be fired by diesel fuel or LPG (liquid petroleum gas). The boiler will be able to provide steam to the process, freeze protection heat exchangers, steam turbine seal system, and other critical plant components while the solar plant is offline or during night time or cloud covered days, or when the grid connection is not available.

**Powerline:** An overhead power line of 132 kV will be constructed and connected via a 'turn in and turn out' configuration to an existing Eskom distribution line running approximately 4 km south of the site. This power line connects Eskom's Gordonina Distribution Substation (close to Upington) to its Oasis Distribution Substation (close to Keimoes). Two alternative corridors/routes are proposed for the power line, namely where Alternative A is preferred by the developer by virtue of it being a shorter distance.

**Water supply pipeline:** A water supply pipeline from the abstraction point is proposed. Based on an extensive feasibility assessment, one alternative route has been provided for the proposed pipeline.

**Water treatment:** Water abstracted from the Orange / Gariep River will be pumped to a settlement reservoir located approximately 0.6 km north-west of the abstraction

point to get rid of particles in suspension. A second storage reservoir will be located approximately 8.5 km west of the abstraction point within the boundaries of the identified site.

**Blow down pond:** A blow down pond will be established to receive wastewater from the generation process.

**Access roads:** An external access road to the site will be established from the main road (i.e. N14), which runs approximately 5.2 km south-east of the site. Internal access roads will also be established for construction and maintenance purposes. Depending on the technology selection there will be one internal asphalt access road of approximately 6 m wide, which will lead directly to the power island. Between the heliostats/troughs/photovoltaic panels there will be a stabilised gravel track that would be used for maintenance purposes during the operational phase. Two routes for the external access road are proposed where Alternative A is preferred route by virtue of it being a shorter distance.

**Workshop, office, and storage areas:** These areas would be located within the boundaries of the overall site.

## **APPROACH TO THE STUDY**

The approach to the SIA study is based on the Western Cape Department of Environmental Affairs and Development Planning Guidelines for Social Impact Assessment (February 2007). These guidelines are based on international best practice and have been endorsed by the Department of Water and Environmental Affairs (DWEA). The key activities in the SIA process embodied in the guidelines include:

- Describing and obtaining an understanding of the proposed intervention (type, scale, location), the communities likely to be affected and determining the need and scope of the SIA
- Collecting baseline data on the current social environment and historical social trends
- Identifying and collecting data on the Social Impact Assessment variables and social change processes related to the proposed intervention. This requires consultation with affected individuals and communities
- Assessing and documenting the significance of social impacts associated with the proposed intervention
- Identifying alternatives and mitigation measures

In this regard the study involved:

- Review of demographic data from the 2001 Census Survey
- Review of relevant planning and policy frameworks for the area
- Site specific information collected during the site visit to the area and interviews with key stakeholders
- Review of information from similar projects
- Identification of social issues associated with the proposed project

Due to the requirements for the generation of solar energy, no alternative sites were identified within the area. As such, the EIA does not assess any additional site alternatives for the project.

## **SUMMARY OF KEY FINDINGS**

The key findings of the study are summarised under the following sections:

- Fit with policy and planning
- Construction phase impacts
- Operational phase impacts
- Cumulative Impacts
- Decommissioning phase impacts
- No-development option

The potential health impacts associated with solar thermal plants are also discussed.

### **Policy and planning issues**

The key documents reviewed included:

- The National Energy Act (2008)
- The White Paper on the Energy Policy of the Republic of South Africa (December 1998)
- The White Paper on Renewable Energy (November 2003)
- Northern Cape Provincial Growth and Development Strategy (2004-2014)
- The Kai! Garib Local Municipality Integrated Development Plan (2009)

The findings of the review indicated that solar energy is strongly supported at a national, provincial, and local level. Based on this it is reasonable to assume that the establishment of the proposed Upington solar thermal plant is supported.

### **Construction phase**

The key social issues associated with the construction phase include:

#### **Potential positive impacts**

- Creation of employment and business opportunities, and the opportunity for skills development and on-site training

Based on the information provided by the client the construction phase is expected to extend over a period of 24 months and create approximately 400 - 600 employment opportunities. It is anticipated that approximately 60 % (240 - 360) of the employment opportunities will be available to low skilled (construction labourers, security staff etc) and semi-skilled workers (drivers, equipment operators etc) and 40% (160 - 240) to skilled personnel (engineers, land surveyors, project managers etc). The majority of the employment opportunities, specifically the skilled and semi-skilled opportunities, are likely to be associated with the contractors appointed to construct the facility and associated infrastructure. In this regard the majority of contractors tend to use their own staff and this will limit the potential for direct employment opportunities for locals during the construction phase. In addition, the low education and skills levels in the area will hamper potential opportunities for local communities. However, members of the local community are likely to benefit from the low skilled employment opportunities associated with the project. In this regard the majority of the beneficiaries are likely to be historically disadvantaged members of the community.

Based on information from wind energy facilities the total wage bill for the 24 month construction phase will be in the region of R 160 million. The injection of income into



the area in the form of rental for accommodation and wages will create opportunities for local businesses in towns such as Upington, Keimoes, and Kakamas. The sector of the local economy that is most likely to benefit from the proposed development is the local service industry. The potential opportunities for the local service sector would be linked to accommodation, catering, cleaning, transport and security, etc associated with the construction workers on the site. The client has indicated that the majority of the construction workers will be accommodated in the nearest local towns, with Upington likely to be the most convenient due to its proximity to the site. This will create opportunities for local hotels, B&Bs, guest farms and people who want to rent out their houses. The benefits to the local economy will however be confined to the construction period (24 months).

In terms of training, the contractors are likely to provide on-site training and skills development opportunities. However, the majority of benefits are likely to accrue to personnel employed by the relevant contractors. In the absence of specific commitments from the developer to employ local contractors the potential for meaningful skills development and training for members from the local communities are likely to be limited.

#### **Potential negative impacts**

- Influx of construction workers employed on the project
- Increased risk of stock theft, poaching and damage to farm infrastructure associated with construction workers
- Increased risk of veld fires associated with construction related activities
- Impact of heavy vehicles, including damage to roads, safety, noise and dust
- Loss of agricultural land associated with construction related activities

The significance of the potential negative impacts with mitigation was assessed to be of Low Significance. The majority of the potential negative impacts can therefore be effectively mitigated if the recommended mitigation measures are implemented. However, the impact on individuals who are directly impacted on by construction workers and or job seekers (i.e. contract HIV/ AIDS) was assessed to be of Medium-High Significance. In addition, due to the relatively large size of the labour force (400 - 600) the potential risk to local family structures and social networks is regarded as Highly Significant. This risk is heightened by the vulnerability of the residents of Oranjevallei, Kalksloot, Klippunt and Kanoneiland due to their low-income levels and education levels. The movement of construction workers on and off the site during the construction phase will therefore need to be carefully managed.

Table 1 summarises the significance of the impacts associated with the construction phase.

**Table 1:** Summary of social impacts during construction phase

<b>Impact</b>	<b>Significance No Mitigation</b>	<b>Significance With Mitigation</b>
<b>Creation of employment and business opportunities</b>	Medium (Positive impact)	Medium (Positive impact)
<b>Presence of construction workers and potential impacts on family</b>	Low (Negative impact for community as a whole)	Low (Negative impact for community as a whole)

<b>structures and social networks</b>	Medium-High (Negative impact of individuals)	Medium-High (Negative impact of individuals)
<b>Risk of stock theft, poaching and damage to farm infrastructure</b>	Medium (Negative impact)	Low (Negative impact)
<b>Risk of veld fires</b>	Medium (Negative impact)	Low (Negative impact)
<b>Impact of heavy vehicles and construction activities</b>	Low (Negative impact)	Low (Negative impact)
<b>Loss of farmland</b>	High (Negative impact)	Low (Negative impact)

### **Operational phase**

The key social issues affecting the operational phase include:

#### **Potential positive impacts**

- Creation of employment and business opportunities during the operational phase will also create opportunities for skills development and training
- Impact on tourism and the creation of potential tourist opportunities (Impact on tourism may also be negative in some instances)
- The establishment of infrastructure to generate renewable energy and establishment of Clean Development Mechanism (CDM) project

Given the location of the proposed facility the majority of permanent staff is likely to reside in Upington, Keimoes and Kakamas. In terms of accommodation options, a percentage of the permanent employees may purchase a house in one of these two towns, while others may decide to rent. Both options would represent a positive economic benefit for the region. In addition, a percentage of the monthly wage bill earned by permanent staff would be spent in the local economy. The benefits to the local economy will extend over the 25 - 30 year operational lifespan of the project.

The proposed development also represents an investment in infrastructure for the generation of clean, renewable energy, which, given the challenges created by climate change, represents a positive High social benefit for society as a whole.

#### **Potential negative impacts**

- The visual impacts and associated impact on sense of place and the landscape

The visual impacts on landscape character associated with large renewable energy facilities, such as solar thermal plants, are highlighted in the research undertaken by Warren and Birnie (2009). In the South African context, the majority of South Africans have a strong connection with and affinity for the large, undisturbed open spaces that are characteristic of the South African landscape. The impact of large, solar thermal plants on the landscape is therefore likely to be a key issue in South Africa, specifically given South African's strong attachment to the land and the growing number of solar facility applications.

The significance of the impacts associated with the operational phase are summarised in Table 2.

**Table 2:** Summary of social impacts during operational phase

<b>Impact</b>	<b>Significance No Mitigation</b>	<b>Significance With Mitigation</b>
<b>Creation of employment and business opportunities</b>	Medium (Positive impact)	Medium (Positive impact)
<b>Impact on tourism</b>	Low (Positive and Negative)	Low (Positive and Negative)
<b>Promotion of renewable energy projects</b>	Medium (Positive impact)	High (Positive impact)
<b>Visual impact and impact on sense of place</b>	Medium (Negative impact)	Medium (Negative impact)

The findings of the SIA also indicate the proposed plant will consume relative large volumes of water (approximately 4 522 m<sup>3</sup> and 2 611 m<sup>3</sup> of water per day during the summer and winter months respectively). The allocation of such large volumes of water to a single user raises potential issues related to equity and efficiency in terms of allocating the water for other uses, such as food security. The potential conflict between supporting renewable energy and conserving water is an issue that authorities will need to consider in South Africa.

#### **Power line and access road options**

Alternative A for both the power line and road access options is the preferred option.

#### **Cumulative impacts**

The cumulative impacts associated with large, renewable energy facilities, are largely linked to the impact on sense of place and visual impacts. Due to the proximity of the proposed Eskom CSP to the site the significance of the potential cumulative social impacts, specifically the impact on the landscape, associated with the proposed facility was rated to be medium

However, it is recommended that the environmental authorities consider the overall cumulative impact on the rural character and the areas sense of place before a final decision is taken with regard to the optimal number of solar thermal plants in the area. In addition, the siting and number of individual components of the plant should be informed by findings of the relevant VIAs, specifically with respect to the visual impact on farmsteads and important roads in the area.

#### **Potential health impacts**

The potential health risks associated with solar thermal plants are linked to the hazardous materials used in the process and stored on site. These include liquids such as oils or molten salts that may be hazardous, and present spill risks. In addition, various fluids are commonly used in most industrial facilities, such as hydraulic fluids, coolants, and lubricants. These fluids may in some cases be hazardous, and present a spill-related risk. PV panels may also contain hazardous materials, and although they are sealed under normal operating conditions, there is the potential for environmental contamination if they were damaged or improperly disposed upon decommissioning.

However, the findings of a detailed health assessment undertaken as part of the assessment of the Genesis solar plant in California found that the proposed facility

would not present a significant health risk to the public. In addition, proper planning and good maintenance and management practices can mitigate the potential risks and impacts.

### **No-Development Option**

The No-Development option would represent a lost opportunity for South Africa to supplement its current energy needs with clean, renewable energy. Given South Africa's position as one of the highest per capita producer of carbon emissions in the world, this would represent a High negative social cost.

The no-development option also represents a lost opportunity in terms of the employment and business opportunities (construction and operational phase) associated with the proposed facility. The loss of potential employment and business opportunities would also represent a negative social cost.

### **Decommissioning phase**

Typically, the major social impacts associated with the decommissioning phase are linked to the loss of jobs and associated income. This has implications for the households who are directly affected, the communities within which they live, and the relevant local authorities. However, in the case of the proposed facility, the decommissioning phase is likely to involve the disassembly and replacement of the existing components with more modern technology. This is likely to take place in the 25 - 30 years post commissioning. The decommissioning phase is therefore likely to create additional, construction type jobs, as opposed to the jobs losses typically associated with decommissioning.

When and if the proposed facility is finally decommissioned, the impacts are likely to be limited due to the relatively small number of permanent employees (60 - 80) affected. The potential impacts associated with the decommissioning phase can also be effectively managed with the implementation of a retrenchment and downscaling programme. With mitigation, the impacts are assessed to be of a Low Significance.

!Khi CSP should also establish an Environmental Rehabilitation Trust Fund to cover the costs of decommissioning and rehabilitation of disturbed areas. The Trust Fund should be funded by a percentage of the revenue generated from the sale of energy to the national grid over the 25 - 30 year operational life of the facility. The rationale for the establishment of a Rehabilitation Trust Fund is linked to the experiences with the mining sector in South Africa and failure of many mining companies to allocate sufficient funds during the operational phase to cover the costs of rehabilitation and closure.

## **RECOMMENDATIONS**

The findings of the SIA indicate that the landowner who stands to be directly affected by the proposed facility supports the project. The findings of the SIA also indicate that the development will create employment and business opportunities for locals during both the construction and operational phase of the project. In order to enhance the local employment and business opportunities the mitigation measures listed in the report should be implemented. !Khi CSP, in consultation with the Kai-Garib Municipality, should also investigate the opportunities for establishing a Community Trust. The revenue for the trust would be derived from the income generated from the sale of energy from the plant. The establishment of a Community Trust does not only create potential benefits for local communities, but also addresses the issue of impact equity. In the case of the majority of renewable energy facilities, such as the Uppington solar facility, the directly affected landowner is compensated for the loss of land, while the adjacent landowners and communities bear the external costs associated with the visual impacts on the sense of place and the landscape character of the area.

The mitigation measures listed in this report to address the potential negative impacts during the construction phase should also be implemented.

The proposed development also represents an investment in clean, renewable energy infrastructure, which, given the challenges created by climate change, represents a positive social benefit for society as a whole. The establishment of the proposed facility is therefore supported by the findings of the SIA.

However, the potential impacts associated with large solar facilities on an areas sense of place and landscape cannot be ignored. These impacts are an issue that will need to be addressed by the relevant environmental authorities, specifically given the large number of applications for solar facilities that have been submitted over the last 12 months. The water demand associated with the operational phase of large, solar thermal plants is also an issue that will need to be addressed by the relevant authorities.

## **IMPACT STATEMENT**

The findings of the SIA undertaken for the proposed Uppington Solar Thermal Plant indicate that the development will create employment and business opportunities for locals during both the construction and operational phase of the project. The proposed development also represents an investment in clean, renewable energy infrastructure, which, given the challenges created by climate change, represents a positive social benefit for society as a whole. However, the visual impacts associated with facility will impact on the areas rural sense of place and landscape character. This impact will be for the entire operational lifespan (approximately 30 years) of the facility. The potential for cumulative impacts also exists due to the proximity of the proposed Eskom CSP to the east of the site. However, these impacts are not considered to represent a fatal flaw. It is therefore recommended that the facility as proposed be supported, subject to the implementation of the recommended mitigation measures and management actions contained in the report.

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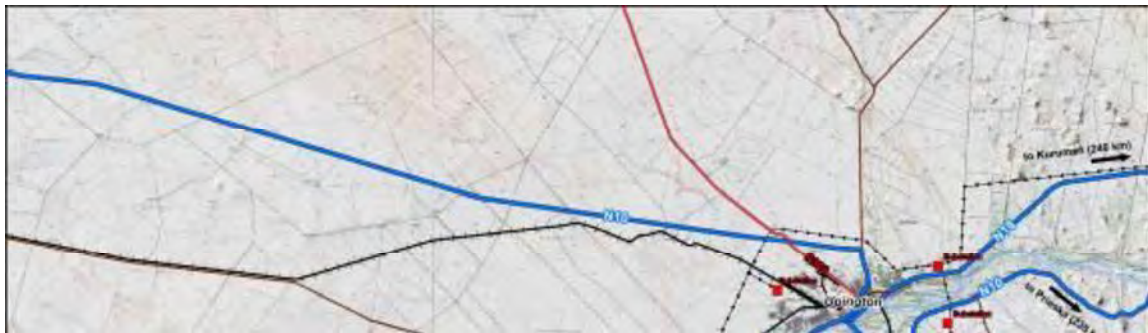
## SECTION 1: INTRODUCTION

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### 1.1 INTRODUCTION

Savannah Environmental (Pty) Ltd was appointed by Khi CSP South Africa (Pty) Ltd (!Khi CSP) as the lead consultants to manage the Environmental Impact Assessment (EIA) process for the establishment of the proposed Upington Solar Thermal Plant and associated infrastructure on the farm McTaggarts Camp 453, portion 3, near the town of Upington in the Northern Cape Province, South Africa (Figure 1.1).

Tony Barbour Consulting was appointed by Savannah Environmental (Pty) Ltd to undertake a specialist Social Impact Assessment (SIA) as part of the EIA process. The terms of reference for the study include a scoping level assessment followed by a detailed assessment of the social issues as part of the EIA. This report contains the findings of the Draft SIA undertaken as part of the EIA process.



**Figure 1.1:** Location of the proposed facility within the Kai Garib Local Municipality (MetroGIS, 2010)



## **1.2 TERMS OF REFERENCE**

The terms of reference for the SIA require:

- A description of the environment that may be affected by the activity and the manner in which the environment may be affected by the proposed facility
- A description and assessment of the potential social issues associated with the proposed facility
- Identification of enhancement and mitigation aimed at maximising opportunities and avoiding and or reducing negative impacts

## **1.3 PROJECT LOCATION**

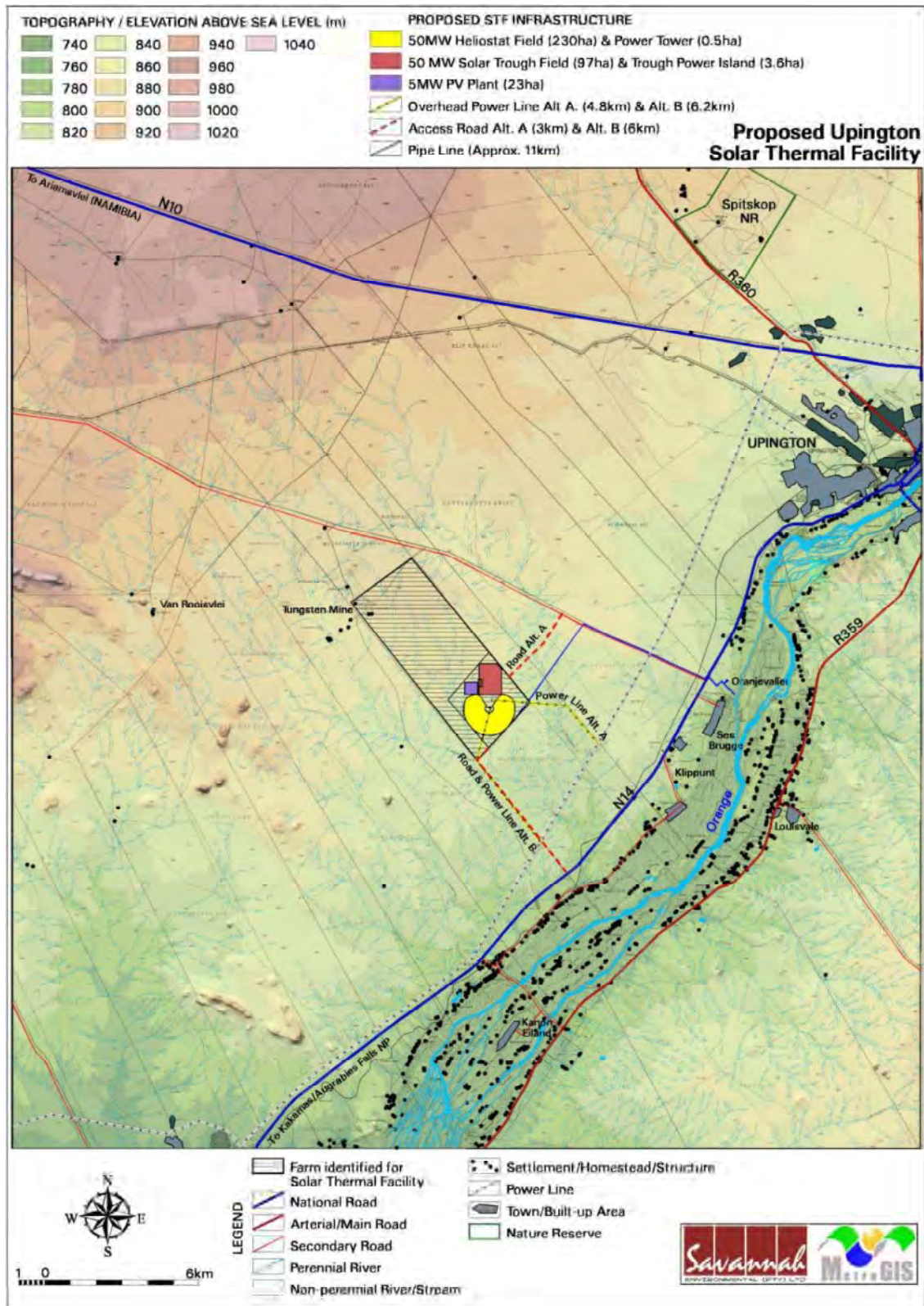
The proposed facility is located on the northern banks of the Orange / Gariep River, on the farm McTaggarts Camp 453, portion 3, in the Northern Cape Province (Figure 1.1). The nearest towns to the site are Upington (approximately 25 km north east of the site), Keimoes (approximately 43 km south west of the site), and Kakamas (approximately 83 km south west of the site). The proposed layout of the facility (Figure 1.2) is located in the eastern corner of the proposed site.

The proposed site falls within the Kai! Garib Local Municipality (NC082), which has its administrative centre at Kakamas. The Kai! Garib Local Municipality is one of 8 local municipalities that fall within the greater Siyanda District Municipality (DC8). Road access to the proposed site is mainly from the N14 to the south and south-east.

## **1.4 PROJECT DESCRIPTION**

The proposed Upington Solar Thermal Plant will be developed by !Khi CSP, an Independent Power Producer (IPP) and is expected to have a generating capacity of up to 110 MW. A description of the components to form part of the facility is provided below.

The exact proportion of the total output ascribed to each of these technologies has not been finalised. In order to evacuate the power, an overhead powerline will exit from the facility's on-site substation and will connect to an existing Eskom distribution line that runs south of the site. External and internal access roads will be developed. An abstraction point on the Orange River, a water supply pipeline and water storage / treatment reservoirs will be required. Alternative routes for the external access road and the powerline have been assessed as part of the EIA phase.



**Figure 1.2:** Proposed layout and alternatives proposed for the facility

Based on the information provided by the client construction phase is expected to extend over a period of 24 months and create approximately 400 - 600 employment opportunities. The total wage bill for the 24 month construction phase will be in the region of R 160 million. The operational phase will employ between 60 and 80 people full time for a period of up to 30 years. Based on the information provided by the client the proposed facility will consume approximately 4 522 m<sup>3</sup> and 2 611 m<sup>3</sup> of water per day during the summer and winter months respectively.

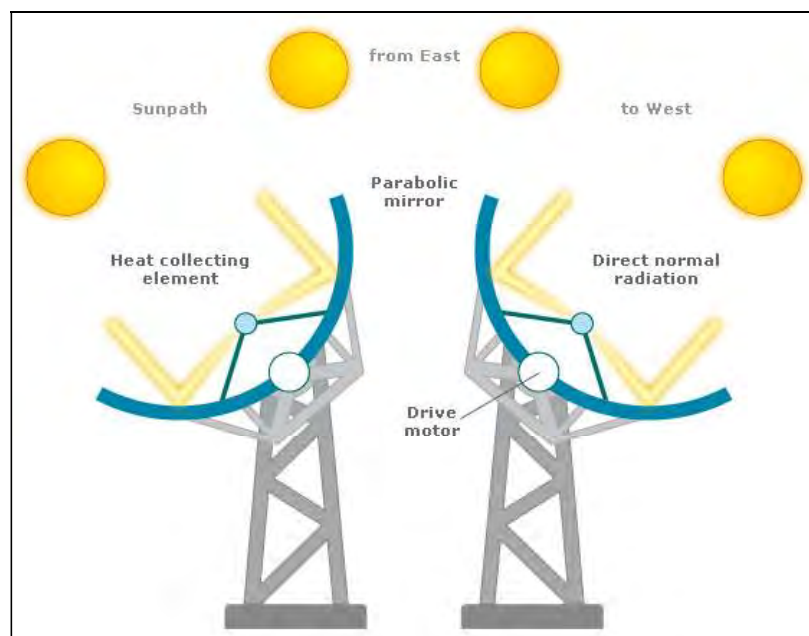
#### 1.4.1 Components of the proposed facility

##### Parabolic Trough (Concentrating Solar Power)

A parabolic trough (Figure 1.3) is a large, curved mirror that sits on a motorised base, allowing it to follow the movement of the sun throughout the day. The mirror's unique parabolic shape is designed to gather a great deal of sunlight and then reflect that light onto a single point, concentrating the solar power (Abengoa Solar S.A., 2008).

A receiver tube sits at the point where the mirror concentrates all the sunlight. The tube is filled with synthetic heat transfer oil, heated by the mirror's light to around 750 F (400 C). This superheated oil is then pumped from the solar field to a nearby power block, where the oil's heat is converted to high-pressure steam in a series of heat exchangers. This steam pushes a conventional steam turbine, creating electricity (Abengoa Solar S.A., 2008).

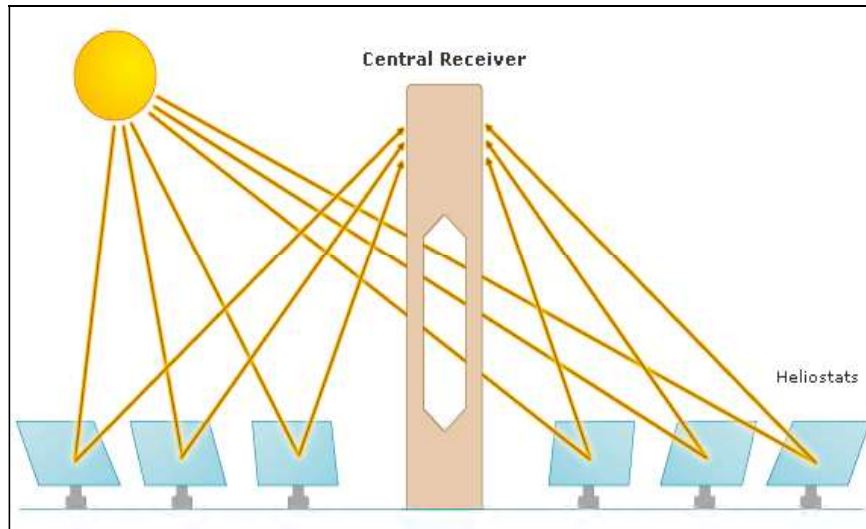
Parabolic trough technology is the most developed CSP technology, and Abengoa Solar is currently operating and deploying parabolic troughs at the Solúcar Platform outside of Seville, Spain and at numerous international locations. (Abengoa Solar S.A., 2008).



**Figure 1.3:** Parabolic trough and associated technology (source: Abengoa Solar S.A., 2008)

### **Power Tower & Heliostat Field (Concentrating Solar Power)**

A power tower systems (Figure 1.4), consist of a heliostat field of movable mirrors oriented according to the solar position in order to reflect the solar radiation and concentrate it up to 600 times on a receptor located on the upper part of a power tower (i.e. up to 180 m high). This heat is transferred to a fluid with the purpose of generating steam that expands on a turbine that is coupled to a generator to produce electricity (Abengoa Solar S.A., 2008).



**Figure 1.4:** Solar power tower system and associated technology (source: Abengoa Solar S.A., 2008)

### **Photovoltaic Panels**

Photovoltaic (PV) use semiconductors, which absorb solar energy to produce electricity through the "Photovoltaic Effect." Since the photovoltaic effect produces direct current (DC), an inverter must be used to change it to alternating current (AC). Concentrating PV systems use lenses or mirrors to concentrate sunlight onto a PV cell. Since concentration greatly reduces the size of the solar cells needed, more expensive semiconductors are used to maximize performance. Tracking PV maximises the electricity generation whereby the panels are able to 'track' the sun during the day.





**Figure 1.5:** Concentrating and tracking PV (source: Abengoa Solar S.A., 2008)

#### **1.4.2 Additional components and infrastructure**

Based on information provided by !Khi CSP, the basic infrastructure associated with the establishment of the proposed facility would include:

##### **A steam turbine and generator**

Concentrating solar power facilities require water as the heat transfer medium for the generation of high temperature steam which is used to drive a conventional turbine and generator. The turbine and generator will be housed within a 2-storey building on-site. It is envisioned that the water will be extracted from the Orange / Gariep River (the abstraction point is discussed below).

##### **A generator transformer and a small substation outside the building**

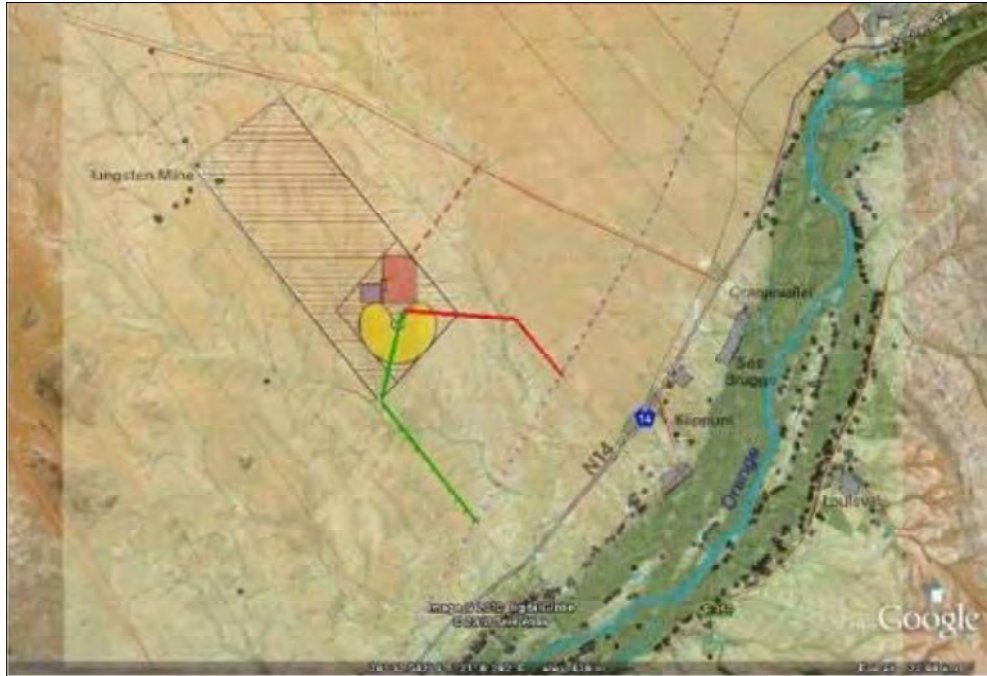
This infrastructure would form part of the power island.

##### **Energy storage plant and vessels**

An auxiliary steam boiler (i.e. fossil fuel boiler / generator) will be included on the power island and will be fired by diesel fuel or LPG. The boiler will be able to provide steam to the process, freeze protection heat exchangers, steam turbine seal system, and other critical plant components while the solar plant is offline or during night time or cloud covered days, or when the grid connection is not available.

##### **Power line**

The generated power will be evacuated into the Eskom electricity grid. An overhead power line of 132 kV will be constructed and connected via a 'turn in and turn out' configuration to an existing Eskom distribution line running approximately 4 km south of the site. This power line connects Eskom's Gordonia Distribution Substation (close to Upington) to its Oasis Distribution Substation (close to Keimoes). Two alternative corridors/routes are proposed for the power line where Alternative A is preferred by the developer by virtue of it being a shorter distance



**Figure 1.6:** Power line alternatives A (-) and B (-)

### Pipe Line

A water supply pipeline to the facility and an abstraction point on the Gariep River is proposed. Based on an extensive feasibility assessment, one alternative route has been provided for the proposed pipeline. This route is preferred by virtue of the following:

- Shortest pipeline route
- Minimum impact on the environment
- Easy access to the pipeline for maintenance purposes
- Getting out of the flood lines as soon as possible
- An agreement has been reached to establish an abstraction point on the property of Mr. Conrad Geldenhuys
- The identified routing will follow an existing road reserve



**Figure 1.7:** Pipeline routing (marked by the blue line)

### **Water treatment**

Water abstracted from the Orange / Gariep River will be pumped to a settlement reservoir located approximately 0.6 km north-west of the abstraction point to get rid of particles in suspension. A second storage reservoir will be located approximately 8.5 km west of the abstraction point within the boundaries of the identified site.

### **Blow down pond**

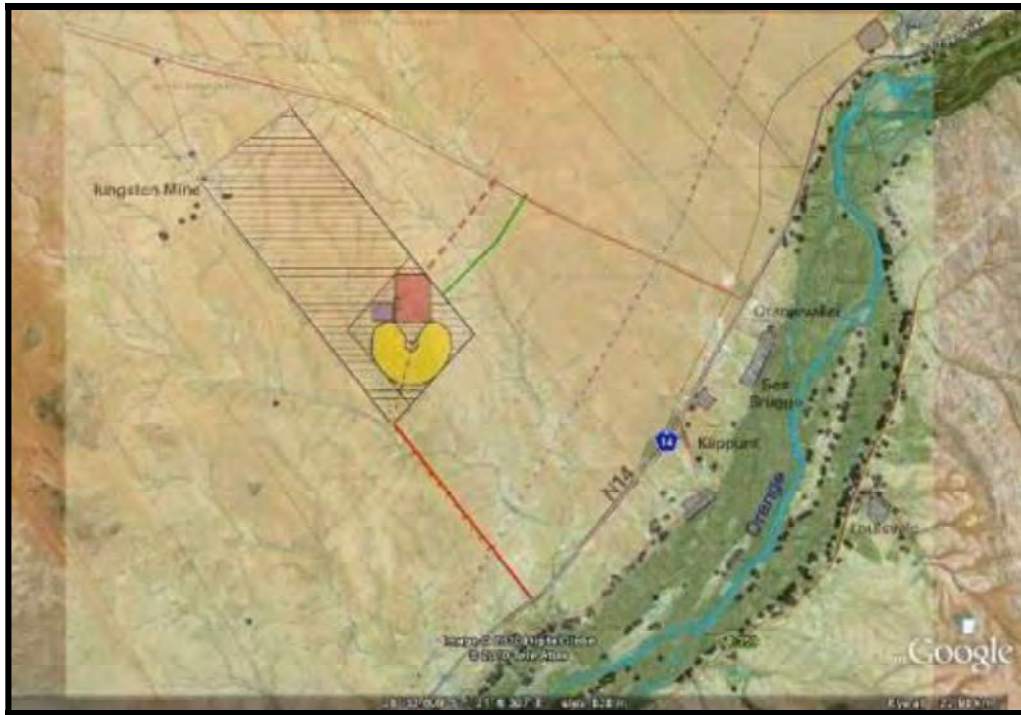
A blow down pond will be established to receive wastewater from the generation process.

### **Access roads**

An external access road to the site will be established from the main road (i.e. N14), which runs approximately 5.2 km south-east of the site. Internal access roads will also be established for construction and maintenance purposes. Depending on the technology selection there will be one internal asphalt access road of approximately 6 m wide, which will lead directly to the power island. Between the heliostats/troughs/photovoltaic panels there will be a stabilised gravel track that would be used for maintenance purposes during the operational phase. Two routes for the external access road are proposed where Alternative A is the preferred route by virtue of it being a shorter distance.

### Workshop, office, and storage areas

These areas would be located within the boundaries of the overall site.



**Figure 1.8:** Access road alternatives A (marked in green) and B (marked in red)

## 1.5 APPROACH TO STUDY

The approach to the SIA study is based on the Western Cape Department of Environmental Affairs and Development Planning Guidelines for Social Impact Assessment (February 2007). These guidelines are based on international best practice and have been endorsed by the Department of Environment and Water Affairs (DEWA). The key activities in the SIA process embodied in the guidelines include:

- Describing and obtaining an understanding of the proposed intervention (type, scale, location), the settlements and communities likely to be affected by the proposed project
- Collecting baseline data on the current social and economic environment;
- Identifying the key potential social issues associated with the proposed project. This requires a site visit to the area and consultation with affected individuals and communities. As part of the process a basic information document was prepared and made available to key interested and affected parties. The aim of the document was to inform the affected parties of the nature and activities associated with the construction and operation of the proposed development so as to enable them to better understand and comment on the potential social issues and impacts
- Assessing and documenting the significance of social impacts associated with the proposed intervention
- Identifying alternatives and mitigation measures



In this regard the study involved:

- Review of demographic data from the 2001 Census Survey;
- Review of relevant planning and policy frameworks for the area;
- Site specific information collected during the site visit to the area and interviews with interested and affected parties;
- Review of information from similar studies, including the EIAs undertaken for other renewable energy projects, including wind energy facilities;
- Identification and assessment of the social issues associated with the proposed project.

The identification of potential social issues associated with proposed facility is based on observations during the project site visit, review of relevant documentation, experience with similar projects and the area. Annex A contains a list of the secondary information reviewed and interviews conducted. Annex B contains a copy of the background information document made available to interested and affected parties. Annex C summarises the assessment methodology used to assign significance ratings to the assessment process.

### **1.5.1 Definition of social impacts**

Social impacts can be defined as “The consequences to human populations of any public or private actions (these include policies, programmes, plans and/or projects) that alter the ways in which people live, work, play, relate to one another, organise to meet their needs and generally live and cope as members of society. These impacts are felt at various levels, including individual level, family or household level, community, organisation or society level. Some social impacts are felt by the body as a physical reality, while other social impacts are perceptual or emotional” (Vanclay, 2002).

When considering social impacts it is important to recognise that social change is a natural and on-going process (Burdge, 1995). However, it is also important to recognise and understand that policies, plans, programmes, and/or projects implemented by government departments and/or private institutions have the potential to influence and alter both the **rate** and **direction** of social change. Many social impacts are not in themselves “impacts” but change process that may lead to social impacts (Vanclay, 2002). For example the influx of temporary construction workers is in itself not a social impact. However, their presence can result in range of social impacts, such as increase in antisocial behaviour. The approach adopted by Vanclay stresses the importance of understanding the processes that can result in social impacts. It is therefore critical for social assessment specialists to think through the complex causal mechanisms that produce social impacts. By following impact pathways, or causal chains, and specifically, by thinking about interactions that are likely to be caused, the full range of impacts can be identified (Vanclay, 2002).

An SIA should therefore enable the authorities, project proponents, individuals, communities, and organisations to understand and be in a position to identify and anticipate the potential social consequences of the implementation of a proposed policy, programme, plan, or project. The SIA process should alert communities and individuals to the proposed project and possible social impacts, while at the same time allowing them to assess the implications and identify potential alternatives. The assessment process should also alert proponents and planners to the likelihood and

nature of social impacts and enable them to anticipate and predict these impacts in advance so that the findings and recommendations of the assessment are incorporated into and inform the planning and decision-making process.

However, the issue of social impacts is complicated by the way in which different people from different cultural, ethnic, religious, gender, and educational backgrounds etc view the world. This is referred to as the "social construct of reality". The social construct of reality informs people's worldview and the way in which they react to changes.

### **1.5.2 Timing of social impacts**

Social impacts vary in both time and space. In terms of timing, all projects and policies go through a series of phases, usually starting with initial planning, followed by implementation (construction), operation, and finally closure (decommissioning). The activities, and hence the type and duration of the social impacts associated with each of these phases are likely to differ.

## **1.6 ASSUMPTIONS AND LIMITATIONS**

### **1.6.1 Assumptions**

#### **Strategic importance of the project and no-go option**

It is assumed that the strategic importance of promoting renewable energy, including solar energy, is supported by the national and provincial energy policies.

#### **Technical suitability**

It is assumed that the development site identified by !Khe CSP, represents a technically suitable site for the establishment of a solar thermal plant.

#### **Fit with planning and policy requirements**

Legislation and policies reflect societal norms and values. The legislative and policy context therefore plays an important role in identifying and assessing the potential social impacts associated with a proposed development. In this regard a key component of the SIA process is to assess the proposed development in terms of its fit with key planning and policy documents. As such, if the findings of the study indicate that the proposed development in its current format does not conform to the spatial principles and guidelines contained in the relevant legislation and planning documents, and there are no significant or unique opportunities created by the development, the development cannot be supported.

However, the study recognises the strategic importance of solar energy and the technical, spatial and land use constraints required for such facilities.

### **1.6.2 Limitations**

#### **Demographic data**

The demographic data used in the study is largely based on the 2001 Census. While this data does provide useful information on the demographic profile of the affected area, the data are dated and should be treated with care. Where possible reference is made to the latest demographic data contained in local Integrated Development Plans and other documents.

## **1.7 SPECIALIST DETAILS**

The lead author of this report is an independent specialist with 20 years experience in the field of environmental management. His qualifications include a BSc, BEcon (Hons) and an MSc in Environmental Science. In terms of SIA experience Tony Barbour has undertaken in the region of 80 SIA's and is the author of the Guidelines for Social Impact Assessments for EIA's adopted by the Department of Environmental Affairs and Development Planning (DEA&DP) in the Western Cape in 2007. These guidelines have also been endorsed by DWEA.

Daniel Rogatshnig has an MSc in Environmental Science and has five years experience as an environmental consultant. He has also worked on a number of SIAs with Tony Barbour.

## **1.8 DECLARATION OF INDEPENDENCE**

This confirms that Tony Barbour and Daniel Rogatschnig, the specialist consultants responsible for undertaking the study and preparing the Draft SIA Report, are independent and do not have vested or financial interests in the proposed Upington Solar Thermal Plant being either approved or rejected.

## **1.9 REPORT STRUCTURE**

The report is divided into five sections, namely:

- Section 1: Introduction
- Section 2: Overview of the study area
- Section 3: Summary of key policy and planning documents relating to solar energy and the area in question
- Section 4: Identification and assessment of key social issues
- Section 5: Summary of key findings and recommendations

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## SECTION 2: DESCRIPTION OF STUDY AREA

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### 2.1 INTRODUCTION

Section 2 provides an overview of:

- The provincial context;
- The policy and planning environment affecting the proposed solar thermal plant;
- The local socio-economic environment;
- Surrounding land uses.

### 2.2 PROVINCIAL CONTEXT

The proposed solar energy facility is located in the Northern Cape Province, which is the largest province in South Africa and covers an area of 361,830 km<sup>2</sup> and constitutes approximately 30% of South Africa. The province is divided into five district municipalities (DM), namely, Frances Baard, Karoo, Namakwa, Siyanda, and Kgalagadi DM, twenty-six Category B municipalities and five district management areas. The site itself is located in the Kai! Garib Local Municipality (LM) (NC082), which is one of eight local municipalities that fall within the greater Siyanda District Municipality (DC8).

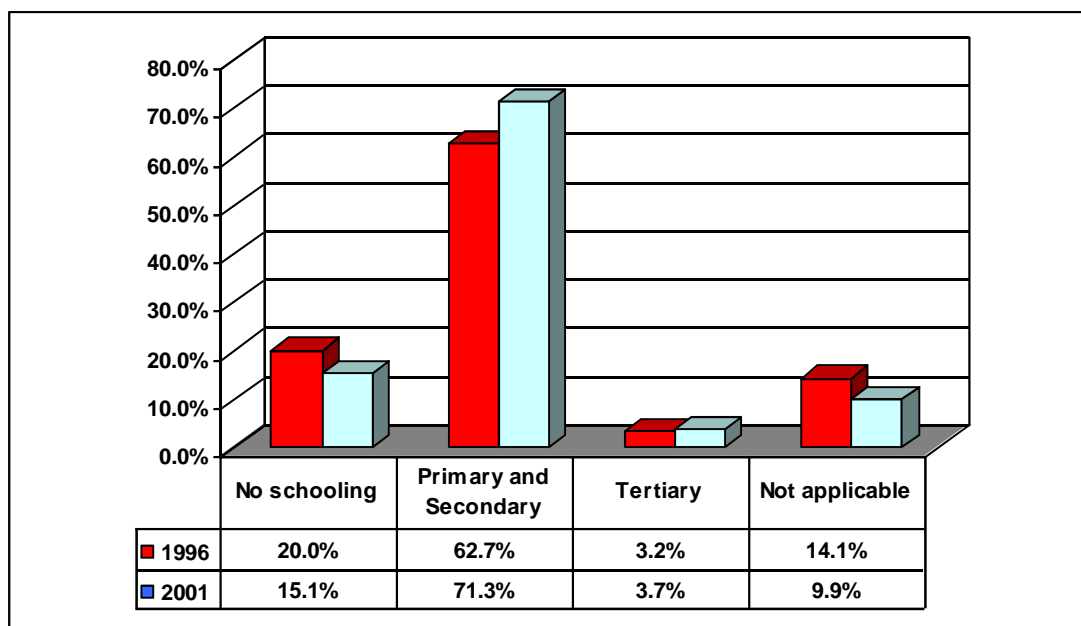
#### Population

Despite having the largest surface area, the Northern Cape has the smallest population of 822 727 (Census 2001) or 1.8% of the population of South Africa. The population has declined by 2.1% from 1996 (840 321) to 2001 (822 727), resulting in a decrease in the population density, of an already sparsely populated province, from 2.32 to 2.27 persons per km<sup>2</sup>. Of the five districts, Frances Baard has the largest population of 303 239. The other districts and their respective populations are Siyanda (209 889), Karoo (164 607), Kgalagadi (36 881) and Namakwa (108 111). The population can be classified as a young population with 57.7% of the population being younger than 30 years old. The female proportion makes up approximately 51.2% of the total with males making up the remaining 48.8%. The 2001 Census data indicates a significant shift in the 20 – 24 cohort occurs, which can possibly be attributed to, amongst others, people in this age group moving to other provinces in search of better career and job opportunities and tertiary education. Research indicates that approximately 36% of the migrants from the Northern Cape moved to the Western Cape, while 19.4% moved to the North West (19.4%), 18.5% to Gauteng and 12.8% to the Free State (12.8%). In addition, there has also been an increase in migration from the rural areas to the larger towns in the province over the last five years. This movement is in response to the improved access to opportunities and services within the larger urban centers. This trend is reflected in the increase in the proportion of people living in urban areas from 75.2% in 1996 to 82.7% in 2001.

## Education

In terms of education levels 15.1% of the population had no education at all, while 71.3% have primary or secondary education. Those with a higher educational qualification accounted for 3.7% of the population (Figure 2.1). These figures indicate an increase in all categories since 1996, except for the no schooling category, which decreased by 4.9% indicating a higher percentage of people attending school.

The information contained in Figure 2.1, indicates that, in general, there has been an improvement in the educational qualifications of the labour force in the Northern Cape. There has also been an increase in the proportion of the labour force that has a secondary and tertiary education. This would appear to be the result of an increase in access to education since 1994, in particular, amongst new entrants to the labour force.



**Figure 2.1:** Percentage of people by level of education for 1996 and 2001 (*Source: Northern Cape Province PGDS*)

## Economic development

The Human Development Index<sup>1</sup> (HDI) for the province, which covers four indexed factors – life expectancy, adult literacy, GDP per capita (adjusted for real income) and education attainment, for the Northern Cape as a whole is 0.58, which is substantially below the South African figure of 0.72.

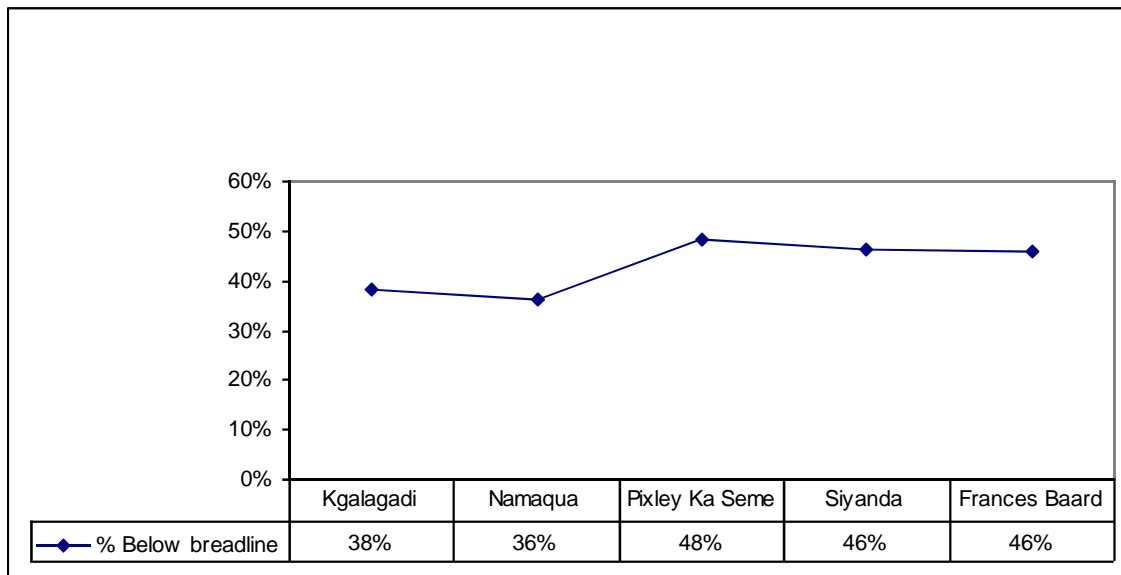
For the Northern Cape, the areas of lowest Human Development Index include the South Eastern region (Noupoort and Richmond) and the hinterland of Kimberley (Griekwastad, Campbell and Douglas) – for these areas the HDI varies between 0.47

<sup>1</sup> The closer the HDI to 1.0, the higher the level of “living condition”. For example, Sweden has an index of 0.91 defined as high, South Africa at 0.72 is defined as middle and Lesotho at 0.47 is defined as low.

to 0.51. Over the past 8 years there has been little to no variance in the HDI figures, indicating no increase or decrease in the overall standard of living. In contrast, the Kimberley and Springbok areas have the highest HDI of 0.63 to 0.62 respectively, primarily due to the broader economic opportunities and access to services such as infrastructure, schools, and health facilities. Similarly, there has been no significant change over the past 8 years.

The above trend is unlikely to change in the foreseeable future, mainly due to the marginal economic base of the poorer areas, and the consolidation of the economic base in the relatively better off areas.

In terms of per capita income, the Northern Cape Province has the third highest per capita income of all nine provinces, however, income distribution is extremely skewed, with a high percentage of the population living in extreme poverty. The measure used in the PGDS document to measure poverty is the percentage of people living below the poverty line or breadline is used<sup>2</sup>. The poverty line indicates a lack of economic resources to meet basic food needs. Figure 2.2 indicates the percentage of household income below the poverty breadline of R800 in the Northern Cape Province, the highest being Karoo at 48% and the lowest being Namakwa at 36%.



**Figure 2.2:** Percentage of household income below the poverty breadline by district  
(Source: Northern Cape PGDS)

### Economic sectors

In terms of economic importance, the Northern Cape's share of the country's Gross Domestic Product (GDP) in 2002 was 2%, the lowest contribution of the nine provinces. However, although the Northern Cape Province has the smallest economy of the nine provinces, Gross Domestic Product of the Region (GDPR) per capita is higher than the national average. In terms of economic activities, the economy of Northern Cape is heavily dependent on the primary sectors of the economy, which in 2002 made up 31.0% of GDPR. The largest sector is mining which has declined in

<sup>2</sup> In terms of the poverty line, a person is considered poor if his or her consumption or income level falls below some minimum level necessary to meet basic needs. The minimum level is usually called the poverty line. In South Africa the poverty income level is set at R800/month.

contribution to the GDP from 25.8% in 1996 to 23.7% in 2002. Agriculture, on the other hand, increased in its contribution from 6.2% to 7.3%.

A worrying characteristic of the economy is the limited amount of processing of the primary commodity output in mining and agriculture that takes place in the Northern Cape. This is reflected in the fact that manufacturing contributes only 4.2% towards GDP. All the industries in the secondary sector have decreased in their contribution to the GDP, with electricity and water sector showing the greatest decrease of 0.7% and the construction industry making the lowest contribution of 1.9% to the GDP of the Northern Cape. At the same time the contribution to regional GDP by industries in the tertiary sector increased, with the exception of the wholesale and retail industry, which decreased by 1.1%. Figure 2.3 illustrates the percentage contribution of the various economic sectors to the GDP of the Northern Cape

### **Employment**

Of the economically active population in the Northern Cape, 55.5% were employed while 26.1% could not find employment. This unemployment figure is lower than the national figure of 29.5%. Significant for this province, however, is that a third of the total population is younger than 15 years old and approximately 45% of the potential labour force is younger than 30 years. At the same time, unemployment is the highest among the youth with unemployment rates of 54% and 47% in the 15 - 19 and 20 - 24 year-old age groups. There has been an increase in the economically active population from 35.9% in 1996 to 38.1% in 2001. The unemployment rate for the same period has increased from 28.3% to 33.4%. In terms of employment there has been a decrease in the number of people that are formally employed from 196 219 in 1996 to 193 980 in 2001. The largest decrease was in the private household sector, showing a loss of 4 859 jobs.

The most important sectors in terms of employment in 2002 were agriculture, hunting, forestry and fishing (28.4%), community, social and personal services (19.8%), wholesale and retail trade (12.7%) and private households (11.4%) (Figure 2.3).

**Table 2.3:** Formal employment by sector (*Source: Northern Cape PGDS*)

Sectors	1996	1996 % of persons employed per sector	2001	2001 % of persons employed per sector
<b>Primary</b>				
Agriculture, hunting; forestry and fishing	48646	24.8	55016	28.4
Mining and quarrying	18556	9.5	15493	8.0
<b>Secondary</b>				
Manufacturing	8812	4.5	10598	5.5
Electricity; gas and water supply	2397	1.2	1385	0.7
Construction	10402	5.3	8971	4.6
<b>Tertiary</b>				
Wholesale and retail trade	23099	11.8	24671	12.7
Transport; storage and communication	9963	5.1	6366	3.3
Financial, insurance, real estate and business services	7733	3.9	10989	5.7
Community, social and personal services	39724	20.2	38463	19.8
Private Households	26887	13.7	22028	11.4
<b>Total</b>	<b>196219</b>		<b>193980</b>	

## 2.3 SOCIO-ECONOMIC OVERVIEW OF THE PROPOSED PROJECT AREA

### 2.3.1 Kai! Garib Municipality

The proposed facility is located in the Kai! Garib Municipality (Figure 2.4), a category-B municipality<sup>3</sup>, which forms part of the greater Siyanda District Municipality (DC8, category-C municipality). The municipality is located in the north-central portion of the Northern Cape, approximately 428 km west of the provincial capital of Kimberley.

The municipality is approximately 7 445 km<sup>2</sup> in size (~7.2% of the Siyanda District Municipality) and is bordered to the north, south and west by a District Management Area (NCDMA08) and in the east by the //Khara Hais and !Kheis Local Municipalities. In terms of land use, the Kai! Garib Local Municipality is largely rural and agricultural with three urban/semi-urban nodes at Kakamas, the designated administrative centre of the municipality Keimoes and Kenhardt (Kai! Garib IDP, 2009).

<sup>3</sup> A category-B municipality is defined as a municipality that shares executive and legislative authority in its area with a category- C municipality within whose area it falls.





**Figure 2.4:** The location of the Kai !Garib Local Municipality with respect to the towns of Kakamas, Keimoes, Kanoneiland and Upington. The location of the site for the proposed facility is outlined in white (Source: Municipal Demarcation Board, Garmin, Google Earth)

The population the Kai !Garib Municipality is estimated at 56 501 (2007), which makes up approximately 10% of the total population of the greater Siyanda District Municipality (238 063 [2007]). The average population growth for the local municipality (2001-2007) is estimated at ~1.4% (Community Survey, 2007).

The majority of the population is Coloured (66.5%), followed by Black Africans (22.2%) and Whites (7.8%). The dominant language is Afrikaans (78.8%) followed by Setswana (20.2%) with the remainder made up of isiXhosa (0.4%), English (0.2%) and other African languages (0.2%).

In terms of education levels, based on the data from Census 2001, approximately 14.7% of the population has no formal education, while approximately 42% have less than a Grade 7 (standard 5). When these totals are added to figures for people with no formal education they indicate that over half of people in the Kai !Garib Local Municipality (~58%) have less than a Grade 7 (standard 5) qualification. Only 11.1% of the population have a matric qualification, while less than 4% having a tertiary qualification.

Employment data for Kai !Garib Local Municipality indicates that 57.8% of the population between the economically active ages of 15 and 65 are employed in the formal sector and the unemployment rate is 12%. The agricultural sector provides ~28% of the formal employment, followed by the community services, wholesale

and retail sectors which employ ~6% and ~2% of the employed population in the area respectively. According to the 2001 Census data, the majority of employment is characterised as 'undetermined' (~62%).

Based on the data from the 2001 Census, 48.8% of the population have no formal income and 93.7% of the population earn less than R 800 per month (This is the figure used by the South African Government as the official breadline figure). The low-income levels reflect the limited formal employment opportunities highlighted above. According the Kai! Garib Local Municipality IDP (2009), 22% of the population is dependent on social grants, of which 52% are child support grants. A total 2 706 households are subsidised by the services subsidy scheme.

### 2.3.2 Kai! Garib Local Municipality – Ward 8

The proposed site is located within Ward 8 of the Kai! Garib Local Municipality, which constitutes ~9.9% (737.1 km<sup>2</sup>) of the total area of the Municipality (7 445 km<sup>2</sup>). Ward 8 is one of 8 administrative wards that make up the Kai! Garib local Municipality. The largest town within the ward is Kakamas.

#### Population

According to Census 2001 data, the total population of Ward 8 was 11 698. It is assumed that the population would have increased marginally given the low positive population growth rate (1.4%) within the Kai! Garib Local Municipality between 2001 and 2007 (Community Survey, 2007).

**Table 2.1:** Ward 8 - Population figures

Population Group	Kai! Garib LM Ward 8 (%)
Black African	32.8
Coloured	60.8
Indian or Asian	-
White	6.3
Total	100

**Source: Census 2001**

Table 2.1 above indicates that the Coloured population group is the dominant population group in the ward, accounting for 60.8% of the total population. The Black African population group represents a significant ~32.8% of the total population and is made up of primarily Setswana-speaking individuals. The White population group constitutes a minority 6.3%.

#### Age distribution

Table 2.2 below shows that the <15 years age bracket in Ward 8 is relatively high at ~23.5%. The post retirement cohort (>64) is moderate at ~5%. The dependency ratio<sup>4</sup> is 0.4, which means that 2 working individuals support 1 non-working/unemployed individual.

<sup>4</sup> The dependency ratio is calculated as the number of 0 to 14-year olds, plus the number of 65-year olds and older, divided by the number of people in the 15 to 64-year old age cohort. This is to give a rough indication of dependency.

**Table 2.2:** Ward 8 - Age distribution

Age Group	Kai !Garib LM Ward 8 (number)
0-4	947
5-9	888
10-14	912
[Youthful dependents]	[2747]
15-19	1212
20-24	1430
25-29	1292
30-34	1105
35-39	910
40-44	695
45-49	539
50-54	484
55-59	401
60-64	291
65-69	228
70-74	150
75-79	101
80 and over	113

**Source: Census 2001**

### Education levels

Table 2.3 below shows that, based on 2001 Census data, approximately 48.5% (corresponding to an absolute total of 3 751 people) of the population of in Ward 8 aged 15 and older are estimated to be functionally illiterate/innumerate in 2001.

Approximately 60% of the population have less than a Standard 5/Grade 7 education and 8.8% of the school going age population have a matric qualification, while just fewer than 2% have a tertiary qualification. Given the strong correlation between education and skills levels, it may be assumed that a significant portion of the study area's working age population have only sufficient skills for elementary jobs.

**Table 2.3:** Ward 8 - Education levels

Description	Kai !Garib LM Ward 8 (number)
No schooling	994
Some primary	2757
[% functional illiteracy/ innumeracy] <sup>5</sup>	48.5% [3751]
Complete primary	978
Some secondary	2194
Std 10/Grade 12	681
Higher	135

**Source: Census 2001**

### Employment levels

The employment statistics (2001) presented in Table 2.4 below indicates that 67.2% of Ward 8's population was employed in 2001. The unemployment rate was relatively low, estimated at ~5%. Approximately 28% of the population is not economically active<sup>6</sup>.

**Table 2.4:** Ward 8 - Employment levels (15 – 64 age group)

Description	Kai !Garib LM Ward 8 (%)
Employed <sup>7</sup>	67.2
Unemployed	4.8
Not Economically Active	27.9

**Source: Census 2001**

### Sectoral employment

Table 2.5 below provides an overview of proportional employment per economic sector by head of household for Ward 8 within the Kai! Garib Local Municipality. The largest employer in Ward 8 is the Agricultural sector which provides ~86% of the formal employment in the area. This sector is followed by the Wholesale and Retail trade sector and the Community and Social Services sector, both of which provide 2.5% of the employment in the Ward. The other minor formal employment sector contributors are the Construction sector (1.4%) and the Private Households sector (2.3%).

<sup>5</sup> In the South African context, having obtained a primary qualification (i.e. having successfully passed Grade 7) is generally held as the absolute minimum requirement for functional literacy/ numeracy. The National Department of Education's ABET (Adult Basic Education and Training) programme provides education and training up to the equivalent of Grade 9. In this more onerous definition, Grade 9 is required as the minimum qualification for having obtained a basic education ([www.abet.co.za](http://www.abet.co.za)).

<sup>6</sup> The term "not economically active" refers to people of working age not actively participating in the economy, such as early retirees, students, the disabled and home-makers.

<sup>7</sup> Census 2001 official definition of *an unemployed person*: "A person between the ages of 15 and 65 with responses as follows: 'No, did not have work'; 'Could not find work'; 'Have taken active steps to find employment'; 'Could start within one week, if offered work'." ([www.statssa.gov.za](http://www.statssa.gov.za)).

**Table 2.5:** Ward 8 - Sectoral contribution to employment

Description	Kai! Garib LM Ward 8 (%)
Agriculture, hunting, forestry and fishing	86.1
Mining and quarrying	0.1
Manufacturing	0.7
Electricity, gas and water supply	0.1
Construction	1.4
Wholesale and retail trade	2.5
TransportsStorage and communication	0.2
Finance, real estate and business services	0.7
Community, social and personal services	2.5
Other and not adequately defined	3.4
Private households <sup>8</sup>	2.3

**Source: Census 2001****Household income**

Census data on household income for 2001 (Table 2.6) indicates that the vast majority of households (~94%) in Ward 8 are living on less than the R1 600/ month minimum subsistence level. Significantly, the 'no formal income' category is the most pronounced at ~41%. Only ~5% of household heads were earning an income clustered in the R800-R3 200/ month range.

**Table 2.6:** Ward 8 - Household income (by head of household)

Income per month	Kai! Garib LM Ward 8 (%)
No formal income	41.5
R 1 – R 400	18.2
R 401 – R 800	31.5
R 801 - R 1 600	2.6
[% households below minimum subsistence level]	[93.9]
R1 601 - R 3 200	2.3
R 3 201 – R 6 400	2.2
R 6 401 – R 12 800	1.2
R 12 801 – R 25 600	0.3
R 25 601 and higher	0.2

**Source: Census 2001**

<sup>8</sup> This category mainly comprises domestic workers and gardeners.

### 2.3.3 Upington (Ward 1-8, // Khara Hais Local Municipality)

While the town of Upington falls outside of the Kai !Garib Local Municipality, it is located only ~25km east of the proposed site and is likely to be exposed to both the potential impacts and opportunities associated with the proposed site.

Upington is the administrative center of the //Khara Hais Local Municipality which, along with the Kai! Garib Local Municipality is one of 6 Local Municipalities and one DMA that fall within the greater Siyanda District Municipality. The //Khara Hais Local Municipality is made up of 12 administrative wards. Wards 1-8 constitute the greater Upington area.

#### Population

According to Census 2001 data, the total population of Ward 1-8 was 56 400. It is assumed that the population would have increased substantially given the large positive population growth rate (33.4%) within the //Khara Hais Local Municipality between 2001 and 2007<sup>9</sup> (Community Survey, 2007)

**Table 2.7:** Ward 1-8 - Population figures

Population Group	//Khara Hais LM Ward 1-8 (%)
Black African	22.0
Coloured	64.6
Indian or Asian	0.1
White	13.3
Total	100

**Source: Census 2001**

Table 2.7 indicates that the Coloured population group make the dominant population group within the wards, accounting for ~65% of the total population. The Black African population group represents a sizable 22% of the total population while White population group constitutes a minority 13.3%. The Asian population group accounts for only 0.1% of the total population in Wards 1-8.

#### Age distribution

Table 2.8 indicates that the <15 years age bracket in Ward 1-8 is relatively high at ~32%. The post retirement cohort (>64) is moderate at 5.5%. The dependency ratio<sup>10</sup> is 0.6, which means that approximately 2 working individuals support 1 non-working/unemployed individual.

<sup>9</sup> According to the StatsSA Community Survey of 2007, the population of the //Khara Hais Local Municipality increased from 75 671 in 2001 to 100 920 in 2007.

<sup>10</sup> The dependency ratio is calculated as the number of 0 to 14-year olds, plus the number of 65-year olds and older, divided by the number of people in the 15 to 64-year old age cohort. This is to give a rough indication of dependency.

**Table 2.8:** Ward 1-8 - Age distribution

Age Group	//Khara Hais LM Ward 1-8 (number)
0-4	5767
5-9	6135
10-14	6193
[Youthful dependents]	[18095]
15-19	6579
20-24	4731
25-29	4289
30-34	4273
35-39	3896
40-44	3396
45-49	2686
50-54	2152
55-59	1664
60-64	1518
65-69	1194
70-74	787
75-79	548
80 and over	592

**Source: Census 2001**

### Education levels

Table 2.9 indicates that, based on 2001 Census data, 28% (corresponding to an absolute total of 8 895 people) of the population of in Ward 1-8 aged 15 and older are estimated to be functionally illiterate/innumerate in 2001.

Approximately 36% of the population have less than a Standard 5/Grade 7 education and 22.1% of the school going age population have a matric qualification, while just over 6% have a tertiary qualification. Given the strong correlation between education and skills levels, it may be assumed that a significant portion of the study area's working age population have only sufficient skills for elementary jobs. However, with relatively high Matric and tertiary education qualifications a significant portion of the population will be employed in more skilled position with respect to the proposed facility.

**Table 2.9:** Ward 1-8 - Education levels

Description	//Khara Hais LM Ward 1-8 (number)
No schooling	3717
Some primary	5178
[% functional illiteracy/innumeracy] <sup>11</sup>	28% [8895]

<sup>11</sup> In the South African context, having obtained a primary qualification (i.e. having successfully passed Grade 7) is generally held as the absolute minimum requirement for functional literacy/ numeracy. The National Department of Education's ABET (Adult Basic Education and Training) programme provides education and training up to the equivalent of Grade 9. In this more onerous definition, Grade 9 is required as the minimum qualification for having obtained a basic education ([www.abet.co.za](http://www.abet.co.za)).



Complete primary	2621
Some secondary	11244
Std 10/Grade 12	7000
Higher	1967

**Source: Census 2001**

### Employment levels

The employment statistics (2001) presented in Table 2.10 below indicates that 36.6% of Ward 1-8's population was employed. The unemployment rate was relatively high, estimated at ~23%. Approximately 40% of the population is not economically active<sup>12</sup>. According to StatsSA the unemployment figure for South Africa (4<sup>th</sup> Quarter 2009) is currently estimated at 24.3%.

**Table 2.10:** Ward 1-8 - Employment levels (15 – 64 age groups)

Description	//Khara Hais LM Ward 1-8 (%)
Employed <sup>13</sup>	36.6
Unemployed	23.1
Not Economically Active	40.3

**Source: Census 2001**

### Sectoral employment

Table 2.11 below provides an overview of proportional employment per economic sector by head of household for Ward 1-8 within the //Khara Hais Local Municipality. The largest employer in Ward 1-8 is the Community and Social Services sector which provides ~27% of the formal employment in the area. This sector is followed by the Wholesale and Retail trade sector (21.3%), Private Households (10%), the Financial, Real Estate and Business Services sector (8.9%), the Manufacturing sector (8.1%), the Transport, Storage and Communication sector (5.7%) and the Construction sector (5.4%). Agriculture, while a dominant activity in the //Khara Hais Local Municipality, accounts for only 3.7% of the employment opportunities in Wards 1-8.

**Table 2.11:** Sectoral contribution to employment

Description	//Khara Hais LM Ward 1-8 (%)
Agriculture, hunting, forestry and fishing	3.7
Mining and quarrying	0.4
Manufacturing	8.1
Electricity, gas and water supply	0.7
Construction	5.4
Wholesale and retail trade	21.3

<sup>12</sup> The term "not economically active" refers to people of working age not actively participating in the economy, such as early retirees, students, the disabled and home-makers.

<sup>13</sup> Census 2001 official definition of *an unemployed person*: "A person between the ages of 15 and 65 with responses as follows: 'No, did not have work'; 'Could not find work'; 'Have taken active steps to find employment'; 'Could start within one week, if offered work'." ([www.statssa.gov.za](http://www.statssa.gov.za)).



Transport, storage and communication	5.7
Finance, real estate and business services	8.9
Community, social and personal services	27.4
Other and not adequately defined	8.5
Private households <sup>14</sup>	10

**Source: Census 2001**

### Household income

Census data on household income for 2001 (Table 2.12) indicates that the vast majority of households (~87%) in Ward 1-8 were living on less than the R800/ month minimum subsistence level. Significantly, the 'no formal income' category is the most pronounced at ~65%. Only 12% of household heads were earning an income clustered in the R800-R3200/ month range.

**Table 2.12:** Ward 1 - 8 - Household income (by head of household)

Income per month	//Khara Hais LM Ward 1-8 (%)
No formal income	64.5
R 1 – R 400	4.4
R 401 – R 800	12.3
R 801 - R 1 600	6.1
[% households below minimum subsistence level]	[87.3]
R1 601 - R 3 200	5.9
R 3 201 – R 6 400	4.1
R 6 401 – R 12 800	1.8
R 12 801 – R 25 600	0.4
R 25 601 and higher	0.5

**Source: Census 2001**

## 2.4 SURROUNDING LAND USES

The proposed site is located on the farm McTaggart's Camp in the Kai! Garib Local Municipality. The N14 is located to the south of the site and the closest large towns to the site are Upington (25 km north-east of the site), Keimoes (43km south-west of the site) and Kakamas (83km south-west of the site). Road access to the proposed site is mainly from the N14 to the south and south-east. The towns of Keimoes and Kakamas are typical small, rural South African towns (Photograph 2.1).

The Kai! Garib Municipality is characterised by semi-arid plains, rolling hills and the Gariep River (Photograph 2.2 and 2.3), which bisects the Municipality from the

<sup>14</sup> This category mainly comprises domestic workers and gardeners.

east to the north-west. Road access to the proposed site is site is mainly from the N14 and the D3276 (Photograph 2.4).



**Photograph 2.1:** Keimoes



**Photograph 2.2:** Gariep River near Kakamas



**Photograph 2.3:** View towards the site taken from the D3276



**Photograph 2.4:** Junction of the D3276 and the N14 (left)

There are no farmsteads within and/or bordering the proposed project site. However, there are a few communities located to the east of the site, between the N14 to the north and the Orange / Gariep River to the south. Figure 1.14 below illustrates the location of the communities of Oranjevallei, Kalksloot, Klippunt, and Kanoneiland relative to the proposed project site.

All of these communities are low-income communities housed in low-income and informal housing (Photograph 2.5). The residents of these communities are employed largely by the local agricultural sector, specifically the viticulture and fruit farms, and associated manufacturing facilities. Employment opportunities are therefore largely seasonal.



Source: MetroGIS, Google Earth

**Figure 1.14:** The location of nearby communities relative to the proposed Solar Thermal Plant



**Photograph 2.5:** Low income housing in Kalksloot

The Orange / Gariep River supports well-developed, intensive irrigation agriculture (Photograph 2.6), with key crops including grapes (wine grapes, table grapes and raisins), as well as lucerne, cotton, corn, and nuts (Kai! Garib IDP, 2009).



**Photograph 2.6:** Vineyards located adjacent to the N14

Small-scale stock farming is also practiced inland of the fertile banks of the Gariep River (Kai! Garib IDP, 2009). In this regard the land use on the proposed site, McTaggart's Camp 453, is beef cattle farming (Photograph 2.7).



**Photograph 2.7:** Beef cattle herd on McTaggart's Camp 453

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## **SECTION 3: POLICY AND PLANNING CONTEXT**

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### **3.1 INTRODUCTION**

Section 3 provides an overview of the policy and planning environment affecting the proposed solar thermal plant. For the purposes of the meeting the objectives of the EIA the following policy and planning documents were reviewed, namely:

- The National Energy Act (2008)
- The White Paper on the Energy Policy of the Republic of South Africa (December 1998)
- The White Paper on Renewable Energy (November 2003)
- Northern Cape Provincial Growth and Development Strategy (2004-2014)
- Kai! Garib Local Municipality IDP (2009)

The section also provides a summary of some of the key social issues associated with solar facilities based on international experience.

### **3.2 NATIONAL LEVEL ENERGY POLICY**

#### **3.2.1 NATIONAL ENERGY ACT (ACT No 34 OF 2008)**

The National Energy Act was promulgated in 2008 (Act No 34 of 2008). One of the objectives of the Act was to promote diversity of supply of energy and its sources. In this regard, the preamble makes direct reference to renewable resources, including solar:

"To ensure that diverse energy resources are available, in sustainable quantities, and at affordable prices, to the South African economy, in support of economic growth and poverty alleviation, taking into account environmental management requirements (...); to provide for (...) increased generation and consumption of renewable energies..." (Preamble).

#### **3.2.2 White Paper on the Energy Policy of the Republic of South Africa**

Investment in renewable energy initiatives, such as the proposed solar thermal plant, is supported by the White Paper on Energy Policy for South Africa (December 1998). In this regard the document notes:

"Government policy is based on an understanding that renewables are energy sources in their own right, are not limited to small-scale and remote applications, and have significant medium and long-term commercial potential".

"Renewable resources generally operate from an unlimited resource base and, as such, can increasingly contribute towards a long-term sustainable energy future".



The support for renewable energy policy is guided by a rationale that South Africa has a very attractive range of renewable resources, particularly **solar** and wind and that renewable applications are in fact the least cost energy service in many cases; more so when social and environmental costs are taken into account.

Government policy on renewable energy is thus concerned with meeting the following challenges:

- Ensuring that economically feasible technologies and applications are implemented;
- Ensuring that an equitable level of national resources is invested in renewable technologies, given their potential and compared to investments in other energy supply options; and,
- Addressing constraints on the development of the renewable industry.

The White Paper also acknowledges that South Africa has neglected the development and implementation of renewable energy applications, despite the fact that the country's renewable energy resource base is extensive and many appropriate applications exist.

The White Paper also notes that renewable energy applications have specific characteristics that need to be considered. Advantages include:

- Minimal environmental impacts in operation in comparison with traditional supply technologies;
- Generally lower running costs, and high labour intensities.

Disadvantages include:

- Higher capital costs in some cases
- Lower energy densities
- Lower levels of availability, depending on specific conditions, especially with sun and wind based systems

### **3.2.3 White Paper on Renewable Energy**

This White Paper on Renewable Energy (November, 2003) (further referred to as the White Paper) supplements the *White Paper on Energy Policy*, which recognises that the medium and long-term potential of renewable energy is significant. This Paper sets out Government's vision, policy principles, strategic goals and objectives for promoting and implementing renewable energy in South Africa.

The White Paper notes, that while South Africa is well-endowed with renewable energy resources that have the potential to become sustainable alternatives to fossil fuels, these have thus far remained largely untapped. As signatory to the Kyoto Protocol, Government is determined to make good the country's commitment to reducing greenhouse gas emissions. To this purpose, Government has committed itself to the development of a framework in which a national renewable energy framework can be established and operate.

Apart from the reduction of greenhouse gas emissions, the promotion of renewable energy sources is aimed at ensuring energy security through the diversification of supply (in this regard, also refer to the objectives of the National Energy Act).

Government's long-term goal is the establishment of a renewable energy industry producing modern energy carriers that will offer in future years a sustainable, fully non-subsidised alternative to fossil fuels. The medium-term (10-year) target set in the White Paper is:

*10 000 GWh (0.8 Mtoe) renewable energy contribution to final energy consumption by 2013, to be produced mainly from biomass, wind, solar and small-scale hydro. The renewable energy is to be utilised for power generation and non-electric technologies such as solar water heating and bio-fuels. This is approximately 4% (1667 MW) of the projected electricity demand for 2013 (41539 MW) (Executive Summary, ix).*

### **3.3 PROVINCIAL AND LOCAL LEVEL POLICY AND PLANNING**

#### **3.3.1 Northern Cape Province Provincial Growth and Development Strategy**

The Provincial Growth and Development Strategy (PGDS) notes that the most significant challenge that the government and its partners in growth and development are confronted with is the **reduction of poverty**. All other societal challenges that the province faces emanate predominantly from the effects of poverty. The PGDS notes that the only effective way to reduce poverty is through long-term sustainable economic growth and development. The sectors where economic growth and development can be promoted include:

- Agriculture and Agro-processing
- Fishing and Mariculture
- Mining and mineral processing
- Transport
- Manufacturing
- Tourism

However, the PGDS also notes that economic development in these sectors also requires:

- Creating opportunities for lifelong learning
- Improving the skills of the labour force to increase productivity
- Increasing accessibility to knowledge and information

The achievement of these primary development objectives depends on the achievement of a number of related objectives that, at a macro-level, describe necessary conditions for growth and development. These are:

- Developing requisite levels of human and social capital
- Improving the efficiency and effectiveness of governance and other development institutions
- Enhancing infrastructure for economic growth and social development

Of specific relevance to the SIA the NCPGDS make reference to the need to ensure the availability of inexpensive energy. The section notes that in order to promote economic growth in the Northern Cape the availability of electricity to key industrial users at critical localities at rates that enhance the competitiveness of their industries must be ensured. At the same time, the development of new sources of



energy through the promotion of the adoption of energy applications that display a synergy with the province's natural resource endowments must be encouraged. In this regard the NCPGDS notes "the development of energy sources such as **solar energy**, the natural gas fields, bio-fuels, etc, could be some of the means by which new economic opportunity and activity is generated in the Northern Cape". The NCPGDS also highlights the importance of close co-operation between the public and private sectors in order for the economic development potential of the Northern Cape to be realised.

The NCPGDS also highlights the importance of enterprise development, and notes that the current levels of private sector development and investment in the Northern Cape are low. In addition, the province also lags in the key policy priority areas of SMME Development and Black Economic Empowerment. The proposed solar energy facility therefore has the potential to create opportunities to promote private sector investment and the development of SMMEs in the Northern Cape Province.

In this regard care will need to be taken to ensure that the proposed solar thermal plant and other renewable energy facilities do not negatively impact on the regions natural environment. In this regard the NCPGDS notes that the sustainable utilisation of the natural resource base on which agriculture depends is critical in the Northern Cape with its fragile eco-systems and vulnerability to climatic variation. The document also indicates that due to the provinces exceptional natural and cultural attributes, it has the potential to become the preferred adventure and ecotourism destination in South Africa. Care therefore needs to be taken to ensure that the development of large renewable energy projects, such as the proposed solar energy facility, do not affect the tourism potential of the province.

The NCPGDS also notes that the Northern Cape Provincial Government will promote the preservation of agricultural biodiversity and the sustainable use of soil and water through the application of legislation and related regulations where this is necessary. In this regard the proposed solar thermal plant will consume relatively large volumes of water, which is a scarce resource in the area. The water required for the project may also impact on the provincial government's commitment to land reform through the allocation of water rights to emerging black farmers. .

### **3.3.2 Kai! Garib Local Municipality Integrated Development Plan (2009)**

The Constitution of South Africa ascribes major developmental responsibilities to Local Municipalities to ensure that the quality of life for its citizens is improved through the provision of basic services, creation of jobs, promotion democracy and a culture of accountability as well as the accountability and eradication of poverty. The Integrated Development Plan (IDP) enables Local Municipalities like the Kai! Garib Municipality to manage and measure their progress in fulfilling their developmental responsibilities.

The Kai! Garib Local Municipality IDP (2009) identifies 6 Key Priority Areas (KPA) in line with the National standards to address the municipality's development objectives:

- KPA 1: Spatial Development
- KPA 2: Service Delivery
- KPA 3: Economic Development and LED
- KPA 4: Financial Viability

- KPA 5: Institutional Arrangements and PMS
- KPA 6: Good Governance and Public Participation

With focus on these KPAs an analysis of the status quo across numerous sectors within the Municipality was undertaken highlighting 8 priority issues and their related or contributing factors. Those priority issues that are relevant to the proposed facility include:

- Poverty alleviation employment and capacity building
- Health and HIV/AIDS (specifically relevant to the potential impact of construction workers on local communities during the construction phase)
- Infrastructure development (including electricity, water and roads) and service delivery

In terms of these issues, the IDP sets out some specific critical targets that are summarised below:

- Poverty alleviation employment and capacity building:
  - Provide permanent employment for 100 people per annum over the next 5 years across all sectors (60 youth, 20 women, 10 disabled, 10 community)
  - Provide skills development/training for at least 100 people per annum over the next 5 years across all sectors
  - Provide land and improve infrastructure on farms for 100 emerging farmers over the next 5 years
- Health and HIV/AIDS:
  - Update the existing policy and implement accordingly by June 2010
  - Establish a Forum to develop a plan for the Kai !Garib area by June 2010
  - Facilitate awareness campaigns by Department of Health in all communities of Kai !Garib by 2010
  - Facilitate the upgrading of health services and facilities by dept of Health in all 8 wards in Kai !Garib by 2014
- Infrastructure development (including electricity, water and roads) and service delivery:
  - Ensure that all households in Kai !Garib have access to basic water services by 2011/12
  - Ensure that all households have access to basic sanitation by 2011/12
  - Ensure that all households in Kai !Garib have access to electricity by 2011/12
  - Ensure that all communities in Kai !Garib can access refuse removal services by 2011/12
  - Eradicate the bucket system in Kai !Garib

The exploitation of the region's high rates of insolation for the generation of energy through solar technology has been identified as a potential driver for economic growth within the Local Municipality.

### **3.4 INTERNATIONAL EXPERIENCE WITH SOLAR ENERGY PLANTS**

#### **3.4.1 Introduction**

All renewable energy technologies are not appropriate to all applications or locations, however. As with conventional energy production, there are environmental issues to

be considered. Solar energy facilities reduce the environmental impacts of combustion used in fossil fuel power generation such as green house gas and other air pollution emissions. However, concerns have been raised over land disturbance, visual impacts, and the use of potentially hazardous materials in some systems.

The section below provides a summary of potential issues, including social issues typically associated with solar energy facilities. The key issues listed below are largely sourced from the Solar Energy Development Programmatic Environmental Impact Statement (PEIS) being prepared by the U.S. Department of Energy, Energy Efficiency and Renewable Energy Program and the U.S. Department of the Interior, Bureau of Land Management (the Agencies) in order to assess environmental impacts associated with the development and implementation of agency-specific programs that would facilitate environmentally responsible utility-scale solar energy development in six western states (Arizona, California, Colorado, New Mexico, Nevada, and Utah) (<http://solareis.anl.gov/guide/environment/index.cfm>). The findings of the literature review also indicated that there do not appear to be any national or international guidelines for the siting and establishment of solar energy plants.

### **3.4.2 Health and safety issues**

Materials used in some solar systems can create health and safety hazards for workers and anyone else encountering them. In particular, the manufacturing of PV cells often requires hazardous materials such as arsenic and cadmium. Even relatively inert silicon, a major material used in solar cells, can be hazardous to workers if it is breathed in as dust. Workers involved in manufacturing photovoltaic modules and components must consequently be protected from exposure to these materials. However, none of these potential hazards is much different in quality or magnitude from the innumerable hazards people face routinely in an industrial society. Through effective regulation, the dangers can very likely be kept at a very low level.

### **3.4.3 Land disturbance and land use impacts**

Large, utility-scale solar power plants require approximately one square kilometer of land for every 20-60 megawatts (MW) generated. The large arrays of solar collectors may interfere with natural sunlight, rainfall, and drainage, which could have a variety of effects on plants and animals. Solar facilities may interfere with existing land uses, such as grazing. In some instances homesteads may be affected, which in turn may require the affected parties to be relocated. Proper siting decisions can help to avoid land disturbance and land use impacts. In addition, new solar installation sites are often levelled, sprayed with weed control chemicals, and shaded. Each one of these steps will change the dynamics of the original function of the land with respect to plant and animal inhabitants. This in turn may have potential impacts on the overall long-term productivity of the land.

However, it is important to bear in mind that these impacts are not unique to solar power plants. Coal-fired or nuclear plants usually require as much, or more land per unit of energy delivered if the land lost to mining is taken into account.

### **3.4.4 Visual impacts**

Due to their size (i.e. a power tower can be up to 180 m high), and the presence of numerous highly geometric and sometimes highly reflective surfaces, solar energy

facilities may create visual impacts. However, being visible does not necessarily imply that they are visually intrusive. Aesthetic issues are by their nature highly subjective. Proper siting decisions can help to reduce the aesthetic impacts on the landscape.

#### **3.4.5 Hazardous materials**

PV panels may contain hazardous materials, and although they are sealed under normal operating conditions, there is the potential for environmental contamination if they were damaged or improperly disposed upon decommissioning. Concentrating solar power systems may also employ liquids such as oils or molten salts that may be hazardous, and present spill risks. In addition, various fluids are commonly used in most industrial facilities, such as hydraulic fluids, coolants, and lubricants. These fluids may in some cases be hazardous, and present a spill-related risk. The potential risks and impacts can, however, be mitigated by proper planning and good maintenance and management practices.

#### **3.4.6 Impact on water resources**

Parabolic trough and power tower systems typically use conventional steam turbines to generate electricity, which commonly consume water for cooling. In arid settings, the increased water demand could strain available water resources and other water users. . If the cooling water was contaminated through an accident, pollution of water resources could occur, although the risk can be minimized by good operating practices. The developers of the proposed Uppington facility have indicated that there will be no effluent discharges associated with the facility.

#### **3.4.7 Carbon Footprint**

The primary environmental, health, and safety issues associated with solar energy involve how they are manufactured, installed, and ultimately disposed of. Energy is required to manufacture and install solar components, and any fossil fuels used for this purpose will generate emissions. It is therefore important to compare how much fossil energy input is required for solar systems compared to the fossil energy consumed by comparable conventional energy systems. Although this varies depending upon the technology and climate, studies have found that the energy balance for solar energy facilities is generally favourable and is improving with each successive generation of technology.

#### **3.4.8 Other concerns raised in the literature**

Concentrating Solar Power (CSP) systems can potentially cause interference with aircraft operations if reflected light beams become misdirected into aircraft pathways. Operation of solar energy facilities, especially CSP facilities involves high temperatures that may also pose an environmental or safety risk to workers. Like all electrical generating facilities, solar facilities produce electric and magnetic fields that can interfere with communication equipment, TVs and radios. Construction and decommissioning of utility-scale solar energy facilities would involve a variety of possible impacts normally encountered in construction/decommissioning of large-scale industrial facilities. If new electric transmission lines or related facilities were needed to service a new solar energy development, construction, operation, and decommissioning of the transmission facilities could also cause a variety of environmental impacts.

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## **SECTION 4: ASSESSMENT OF KEY SOCIAL ISSUES**

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### **4.1 INTRODUCTION**

Section 4 identifies the key social issues identified during the SIA study. The identification of social issues was based on:

- The Social Scoping Report prepared for the Scoping Report (Tony Barbour, March, 2010)
- Review of project related information, including other specialist studies
- Interviews with key interested and affected parties
- Experience of the authors of the area and the local conditions
- Experience with similar projects, including renewable energy projects such as wind farms

In identifying the key issues the following assumption is made:

- The area identified for the proposed solar thermal plant meets the technical criteria required for such facilities.

### **4.2 IDENTIFICATION OF KEY SOCIAL ISSUES**

The key social issues identified during the SIA can be divided into:

- The policy and planning related issues
- Local, site-specific issues

The local site-specific issues can in turn be divided into construction and operational related issues. These issues are discussed and assessed below. The potential impacts associated with the associated infrastructure (access road, pipeline and power line routes\_ are also assessed.

### **4.3 POLICY AND PLANNING ISSUES**

As indicated in Section 1.6, legislative and policy context plays an important role in identifying and assessing the potential social impacts associated with a proposed development. In this regard a key component of the SIA process is to assess the proposed development in terms of its fit with key planning and policy documents.

The review of the relevant planning and policy documents was undertaken as a part of the SIA. The key documents reviewed included:

- The National Energy Act (2008)
- The White Paper on the Energy Policy of the Republic of South Africa (December 1998)

- The White Paper on Renewable Energy (November 2003)
- Northern Cape Provincial Growth and Development Strategy (2004-2014)
- The Kai! Garib Local Municipality Integrated Development Plan (2009)

The findings of the review indicated that solar energy was strongly supported at a national and local level. At a national level the White Paper on Energy Policy (1998) notes:

- Renewable resources generally operate from an unlimited resource base and, as such, can increasingly contribute towards a long-term sustainable energy future;
- The support for renewable energy policy is guided by a rationale that South Africa has a very attractive range of renewable resources, particularly **solar** and wind and that renewable applications are in fact the least cost energy service in many cases; more so when social and environmental costs are taken into account.

At a provincial level the NCPGDS notes that availability of inexpensive energy is a key requirement in order to promote economic growth in the Northern Cape. The NCPGDS goes on to indicate that "the development of energy sources such as **solar energy**, the natural gas fields, bio-fuels, etc, could be some of the means by which new economic opportunity and activity is generated in the Northern Cape".

Based on this it is reasonable to assume that the establishment of solar thermal plants is supported. However, the NCPGDS also states that the sustainable utilisation of the natural resource base on which agriculture depends is critical in the Northern Cape with its fragile ecosystems and vulnerability to climatic variation. The document also indicates that due to the Province's exceptional natural and cultural attributes, it has the potential to become the preferred adventure and ecotourism destination in South Africa. Care therefore needs to be taken to ensure that the development of large renewable energy projects, such as the proposed solar energy facility, do not impact on the tourism potential of the Province. However, the representative from WESSA NC (T. Andersen) indicated that provided the project was located in a habitat of low significance and due consideration was given to the potential impact on red listed plants, birds and animals and well as the impact of the heliostat reflection and the potential collision impact with the power tower on birds, WESSA would have little objection noting that "solar is the way to go." The potential impact on birds has been addressed in the avifauna specialist study.

The NCPGDS also notes that the Northern Cape Provincial Government will promote the preservation of agricultural biodiversity and the sustainable use of soil and water through the application of legislation and related regulations where this is necessary. In this regard the proposed solar thermal plant will consume relatively large volumes of water, which is a scarce resource in the area.

At the local level the Kai! Garib Municipality IDP indicates that the exploitation of the region's high rates of insolation for the generation of energy through solar technology has been identified as a potential driver for economic growth within the Local Municipality.

The findings of the review of the relevant policies and documents pertaining to the energy sector therefore indicate that solar energy and the establishment of solar thermal plants are supported at a national, provincial, and local level. It is therefore the opinion of the authors that the establishment of a solar thermal plant on the

proposed site is supported by national, provincial and local policies and planning guidelines.

#### **4.4 SOCIAL IMPACTS ASSOCIATED WITH THE CONSTRUCTION PHASE**

The key social issues associated with the construction phase include:

##### **Potential positive impacts**

- Creation of employment and business opportunities,
- Opportunity for skills development and on-site training

##### **Potential negative impacts**

- Impacts associated with the presence of construction workers on site
- Increased risk of stock theft, poaching and damage to farm infrastructure associated with presence of construction workers on the site
- Increased risk of veld fires associated with construction-related activities
- Threat to safety and security of farmers associated with the presence of construction workers on site
- Impact of heavy vehicles, including damage to roads, safety, noise and dust
- Potential loss of grazing land associated with construction-related activities.

Annexure D contains the management plan for addressing social impacts.

##### **4.4.1 Creation of employment and business opportunities**

Based on the information provided by the client, the construction phase is expected to extend over a period of 24 months and create approximately 400 - 600 employment opportunities, depending on the final design. The work associated with the construction phase will be undertaken by contractors and will include the establishment of the solar thermal plant and the associated components, including, access roads, services, power line, abstraction point on and pipe line from the Orange / Gariep River.

It is anticipated that approximately 60% (240 - 360) of the employment opportunities will be available to low (construction labourers, security staff etc) and semi-skilled (drivers, equipment operators etc) and 40% (160 - 240) to skilled personnel (engineers, land surveyors, project managers etc). The majority of the employment opportunities, specifically the skilled and semi-skilled opportunities, are likely to be associated with the contractors appointed to construct the proposed solar thermal plant and associated infrastructure. In this regard the majority of contractors tend to use their own staff and this will limit the potential for direct employment opportunities for locals during the construction phase. The low education and skills levels in the area will also hamper potential opportunities for local communities. However, members of the local community are likely to benefit from the low skilled employment opportunities associated with the project. In this regard the majority of the beneficiaries are likely to be historically disadvantaged (HD) members of the community.

Due to issues relating to commercial sensitivity the client was not in a position to provide information on the capital expenditure associated with the construction phase. However, based on information from wind energy facilities it is safe to assume that the capital expenditure would be in excess of R 1 billion. In terms of

business opportunities for local companies, the expenditure of these sums during the construction phase will create business opportunities for the regional and local economy. However, given the technical nature of the project and high import content associated with solar thermal plants opportunities for the local Kai! Garib economy and the towns of Upington, Keimoes and Kakamas are likely to be limited. However, opportunities are likely to exist for local contractors and engineering companies in Upington. Implementing the enhancement measures listed below can enhance these opportunities.

The implementation of the proposed enhancement measures listed below would enable the establishment of the proposed solar thermal plant to support co-operation between the public and private sectors in order for the economic development potential of the Northern Cape to be realised. In this regard the NCPGDS highlights the importance of enterprise development, and notes that the current levels of private sector development and investment in the Northern Cape are low. The proposed solar energy facility therefore has the potential to create opportunities to promote private sector investment and the development of SMMEs in the Northern Cape Province.

The sector of the local economy that is most likely to benefit from the proposed development is the local service industry. The potential opportunities for the local service sector would be linked to accommodation, catering, cleaning, transport and security, etc associated with the construction workers on the site. The client has indicated that the majority of the construction workers will be accommodated in the nearest local towns, with Upington likely to be the most convenient due to its proximity to the site. This will create opportunities for local hotels, B&Bs, guest farms and people who want to rent out their houses. In addition, a proportion of the total wage bill earned by construction workers over the 24 month construction phase is also likely to be spent in the regional and local economy. Based on information from other renewable energy facilities, the total wage bill for the 24 month construction phase will be in the region of R 160 million. The injection of income into the area in the form of rental for accommodation and wages will create opportunities for local businesses in towns such as Upington, Keimoes, and Kakamas. The benefits to the local economy will however be confined to the construction period (24 months).

In terms of training, the contractors are likely to provide on-site training and skills development opportunities. However, the majority of benefits are likely to accrue to personnel employed by the relevant contractors. In the absence of specific commitments from the developer to employ local contractors the potential for meaningful skills development and training for members from the local communities are likely to be limited.

The hospitality industry in the local towns is also likely to benefit from the provision of accommodation and meals for professionals (engineers, quantity surveyors, project managers, product representatives etc.) and other (non construction) personnel involved on the project. Experience from other large construction projects indicates that the potential opportunities are not limited to on-site construction workers but also to consultants and product representatives associated with the project.



**Table 4.1:** Impact assessment of employment and business creation opportunities during the construction phase

<b>Nature:</b> Creation of employment and business opportunities during the construction phase		
	<b>Without Mitigation</b>	<b>With Enhancement</b>
<b>Extent</b>	Local – Regional (2) (Rated as 2 due to potential opportunities for local communities and businesses)	Local – Regional (4) (Rated as 4 due to potential opportunities for local communities and businesses)
<b>Duration</b>	Short term (2)	Short term (2)
<b>Magnitude</b>	Low (4)	Moderate (64)
<b>Probability</b>	Highly probable (4)	Highly probable (4)
<b>Significance</b>	Medium (32)	Medium (48)
<b>Status</b>	Positive	Positive
<b>Reversibility</b>	N/A	N/A
<b>Irreplaceable loss of resources?</b>	N/A	N/A
<b>Can impact be enhanced?</b>	Yes	
<b>Enhancement :</b> See below		
<b>Cumulative impacts:</b> Opportunity to up-grade and improve skills levels in the area. However, due to relatively small number of local employment opportunities this benefit is likely to be limited.		
<b>Residual impacts:</b> Improved pool of skills and experience in the local area. However, due to relatively small number of local employment opportunities this benefit is likely to be limited.		

### Assessment of No-Go option

There is no impact as it maintains the current status quo. The potential employment and economic benefits associated with the proposed solar thermal plant would therefore be forgone. The potential opportunity costs in terms of the capital expenditure, employment, skills development, and opportunities for local business are therefore regarded as a negative.

### Recommended enhancement measures

In order to enhance local employment and business opportunities associated with the construction phase the following measures should be implemented:

#### Employment

- Where reasonable and practical, !Khe CSP should appoint local contractors and implement a 'locals first' policy, especially for semi and low-skilled job categories. However, due to the low skills levels in the area, the majority of skilled posts are likely to be filled by people from outside the area.
- Where feasible, efforts should be made to employ local contractors that are compliant with Black Economic Empowerment (BEE) criteria;
- Before the construction phase commences !Khe CSP should meet with representatives from the Kai! Garib Municipality to establish the existence of a skills database for the area. If such a database exists it should be made available to the contractors appointed for the construction phase.

- The local authorities, community representatives, and organisations on the interested and affected party database should be informed of the final decision regarding the project and the potential job opportunities for locals and the employment procedures that !Khe CSP intends following for the construction phase of the project.
- Where feasible, training and skills development programmes for locals should be initiated prior to the initiation of the construction phase.
- The recruitment selection process should seek to promote gender equality and the employment of women wherever possible.

### **Business**

- !Khe CSP should seek to develop a database of local companies, specifically BEE companies, which qualify as potential service providers (e.g. construction companies, catering companies, waste collection companies, security companies etc.) prior to the commencement of the tender process for construction contractors. These companies should be notified of the tender process and invited to bid for project-related work;
- Where possible, !Khe CSP should assist local BEE companies to complete and submit the required tender forms and associated information.
- The Kai! Garib Municipality, in conjunction with the local Chamber of Commerce and representatives from the local hospitality industry, should identify strategies aimed at maximising the potential benefits associated with the project.

Note that while preference to local employees and companies is recommended, it is recognised that a competitive tender process may not guarantee the employment of local labour for the construction phase.

#### **4.4.2 Presence of construction workers in the area**

In terms of affected farmsteads, there are a relatively small number of farmsteads that will be affected and it would appear that very few of the farmers live on their farms. In this regard there appear to be no farmsteads within and/or bordering the proposed plant site. However, there are a number of potentially vulnerable farming activities, specifically cattle farming. The potential threat to farming activities is discussed below. In addition, the presence of construction workers also poses a potential risk to family structures and social networks in the area. The most vulnerable communities include Oranjevallei, Kalksloot, Klippunt and Kanoneiland, all of which are low-income communities housed in low-income and informal housing. The main source of income is employment on the farms that flank the Orange / Gariep River.

While the presence of construction workers does not in itself constitute a social impact, the manner in which construction workers conduct themselves can impact on the local community. In this regard the most significant negative impact is associated with the disruption of existing family structures and social networks. This risk is linked to the potential behaviour of male construction workers, including:

- An increase in alcohol and drug use
- An increase in crime levels
- The loss of girlfriends and or wives to construction workers
- An increase in teenage and unwanted pregnancies
- An increase in prostitution
- An increase in sexually transmitted diseases (STDs)

Given the relatively large labour force of 400 – 600 during the construction phase, the potential risk to local family structures and social networks is regarded as high. This risk is heightened by the vulnerability of the residents of Oranjevallei, Kalksloot, Klippunt and Kanoneiland due to their low-income levels and education levels.

Employing members from the local community to fill the low-skilled job categories can help to reduce the risk and mitigate the potential impacts on the local communities. These workers will be from the local community and form part of the local family and social network and, as such, the potential impact will be low. The use of local residents to fill the low skilled job categories will also reduce the need to house construction workers on the site. However, due to the potential mismatch of skills and low education levels, the potential employment opportunities for the members from these local communities are likely to be low. However, initial indications are that the majority of the construction workers will be accommodated in the towns of Upington, Keimoes and Kakamas. This would reduce the potential risks to the residents of Oranjevallei, Kalksloot, Klippunt, and Kanoneiland. However, the movement of construction workers on and off the site is an issue of concern and will need to be carefully managed.

The majority of construction workers that fall within the semi and skilled category and are likely to be housed in the nearby towns of Upington, Keimoes and Kakamas where they will be accommodated in local B&B's and houses.

**Table 4.2:** Assessment of impact of construction workers on local communities

<b>Nature:</b> Potential impacts on family structures and social networks associated with the presence of construction workers		
	<b>Without Mitigation</b>	<b>With Mitigation</b>
<b>Extent</b>	Local (4) (Rated as 4 due to potential severity of impact on local communities)	Local (2) (Rated as 1 due to potential severity of impact on local communities)
<b>Duration</b>	Short term for community as a whole (1) Long term-permanent for individuals who may be affected by STD's etc (5)	Short term for community as a whole (1) Long term-permanent for individuals who may be affected by STD's etc (5)
<b>Magnitude</b>	Moderate for the community as a whole (6) High-Very High for specific individuals who may be affected by STD's etc (10)	Low for community as a whole (4) High-Very High for specific individuals who may be affected by STD's etc (10)
<b>Probability</b>	Probable (3)	Probable (3)
<b>Significance</b>	Moderate for the community as a whole (33) Moderate-High for specific individuals who may be affected by STD's etc (57)	Low for the community as a whole (21) Moderate-High for specific individuals who may be affected by STD's etc (51)
<b>Status</b>	Negative	Negative
<b>Reversibility</b>	No in case of HIV and AIDS	No in case of HIV and AIDS
<b>Irreplaceable loss of</b>	Yes, if people contract HIV/AIDS. Human capital plays a critical role in	

<b>resources?</b>	communities that rely on farming for their livelihoods	
<b>Can impact be mitigated?</b>	Yes, to some degree. However, the risk cannot be eliminated	
<b>Mitigation:</b> See below		
<b>Cumulative impacts:</b> Impacts on family and community relations that may, in some cases, persist for a long period of time. Also in cases where unplanned / unwanted pregnancies occur or members of the community are infected by an STD, specifically HIV and or AIDS, the impacts may be permanent and have long term to permanent cumulative impacts on the affected individuals and/or their families and the community.		
<b>Residual impacts:</b> See cumulative impacts.		

### Assessment of No-Go option

There is no impact as it maintains the current status quo. The potential positive impacts on the local economy associated with the additional spending by construction workers in the local economy will also be lost.

### Recommended mitigation measures

The potential risks associated with construction workers can be mitigated. The aspects that should be covered include:

- Where possible, !Khi CSP should make it a requirement for contractors to implement a 'locals first' policy for construction jobs, specifically semi and low-skilled job categories. This will reduce the potential impact that this category of worker could have on local family and social networks;
- !Khi CSP should consider the establishment of a Monitoring Forum (MF) for the construction phase which should be established before the construction phase commences and should include key stakeholders, including representatives from the local community, local councillors, farmers, and the contractor. The role of the MF would be to monitor the construction phase and the implementation of the recommended mitigation measures. The MF should also be briefed on the potential risks to the local community associated with construction workers;
- !Khi CSP and the contractor should, in consultation with representatives from the MF, develop a code of conduct for the construction phase. The code should identify what types of behaviour and activities by construction workers are not permitted. Construction workers that breach the code of good conduct should be dismissed. All dismissals must comply with the South African labour legislation;
- !Khi CSP and the contractor should implement an HIV/AIDS awareness programme for all construction workers at the outset of the construction phase;
- The movement of construction workers on and off the site should be closely managed and monitored by the contractors. In this regard the contractors should be responsible for making the necessary arrangements for transporting workers to and from site on a daily basis;
- The contractor should make the necessary arrangements for allowing workers from outside the area to return home over weekends and or on a regular basis during the 24 month construction phase. This would reduce the risk posed by construction workers to local family structures and social networks;
- It is recommended that no construction workers, with the exception of security personnel, should be permitted to stay overnight on the site. This will make it possible to manage the potential impacts effectively.

#### 4.4.3 Increased risk of stock theft, poaching and damage to farm infrastructure

The presence of construction workers on the site increases the potential risk of stock theft and poaching. The movement of construction workers on and off the site also poses a potential threat to farm infrastructure, such as fences and gates, which may be damaged. Stock and game losses may also result from gates being left open and/or fences being damaged. !Khi CSP has entered into an agreement with the affected landowners whereby the company will compensate for damages to farm property and disruptions to farming activities. This includes losses associated with stock theft and damage to property etc.

**Table 4.3:** Assessment of impact of stock theft and damage to farm infrastructure

<b>Nature:</b> Potential loss of livestock, poaching and damage to farm infrastructure associated with the presence of construction workers on site		
	<b>Without Mitigation</b>	<b>With Mitigation</b>
<b>Extent</b>	Local (4) (Rated as 4 due to potential severity of impact on local farmers)	Local (2)
<b>Duration</b>	Short term (2)	Short term (2)
<b>Magnitude</b>	Moderate (6) (Due to reliance on agriculture and livestock for maintaining livelihoods)	Low (4)
<b>Probability</b>	Probable (3)	Probable (3)
<b>Significance</b>	Medium (36)	Low (24)
<b>Status</b>	Negative	Negative
<b>Reversibility</b>	Yes, compensation paid for stock losses etc	Yes, compensation paid for stock losses etc
<b>Irreplaceable loss of resources?</b>	No	No
<b>Can impact be mitigated?</b>	Yes	Yes
<b>Mitigation:</b> See below		
<b>Cumulative impacts:</b> No, provided losses are compensated for		
<b>Residual impacts:</b> See cumulative impacts.		

#### Assessment of No-Go option

There is no impact as it maintains the current status quo.

#### Recommended mitigation measures

The mitigation measures that can be considered to address the potential impact on livestock, game, and farm infrastructure include:

- !Khi CSP should investigate need to establish a MF (see above) that includes local farmers and develop a Code of Conduct for construction workers. Should such a MF be required it should be established prior to commencement of the

construction phase. The Code of Conduct should be signed by !Khi CSP and the contractors before the contractors move onto site;

- !Khi CSP should hold contractors liable for compensating farmers and communities in full for any stock losses and/or damage to farm infrastructure that can be linked to construction workers. This should be contained in the Code of Conduct to be signed between !Khi CSP, the contractors and neighbouring landowners. The agreement should also cover losses and costs associated with fires caused by construction workers or construction related activities (see below);
- The EMP must outline procedures for managing and storing waste on site, specifically plastic waste that poses a threat to livestock if ingested;
- Contractors appointed by !Khi CSP should ensure that all workers are informed at the outset of the construction phase of the conditions contained on the Code of Conduct, specifically consequences of stock theft and trespassing on adjacent farms.
- Contractors appointed by !Khi CSP should ensure that construction workers who are found guilty of stealing livestock, poaching and/or damaging farm infrastructure are dismissed and charged. This should be contained in the Code of Conduct. All dismissals must be in accordance with South African labour legislation;
- The housing of construction workers on the site should be limited to security personnel.

#### 4.4.4 Increased risk of veld fires

The presence of construction workers and construction-related activities on the site poses an increased risk of veld fires that in turn pose a threat to the livestock, wildlife, and farmsteads in the area. In the process, farm infrastructure may also be damaged or destroyed and human lives threatened. Fires that start on the site that spread to neighbouring farms and areas may also pose a threat to the safety of the residents of Oranjevallei, Kalksloot, Klippunt, and Kanoneiland.

- The potential risk of veld fires is heightened by windy conditions in the area, specifically during the dry, winter months.
- The majority of farms in the area farm cattle. As such, their livelihoods are dependent on grazing on their farms. Any loss of grazing due to a fire would therefore impact negatively on the affected farmers livelihoods;
- The risk of fire related damage is exacerbated by the distance to fire-fighting vehicles located in the nearest towns of Upington, Keimoes and Kakamas.

**Table 4.4:** Assessment of impact of increased risk of veld fires

<b>Nature:</b> Potential loss of livestock, crops and houses, damage to farm infrastructure and threat to human life associated with increased incidence of veld fires		
	<b>Without Mitigation</b>	<b>With Mitigation</b>
<b>Extent</b>	Local (4) (Rated as 4 due to potential severity of impact on local farmers)	Local (2) (Rated as 2 due to potential severity of impact on local farmers)
<b>Duration</b>	Short term (2)	Short term (2)
<b>Magnitude</b>	Moderate-High due to reliance on livestock for maintaining	Low-Moderate (6)

	livelihoods (8)	
<b>Probability</b>	Probable (3)	Probable (3)
<b>Significance</b>	Medium (42)	Low (30)
<b>Status</b>	Negative	Negative
<b>Reversibility</b>	Yes, compensation paid for stock and crop losses etc	
<b>Irreplaceable loss of resources?</b>	No	No
<b>Can impact be mitigated?</b>	Yes	
<b>Mitigation:</b> See below		
<b>Cumulative impacts:</b> No, provided losses are compensated for.		
<b>Residual impacts:</b> See cumulative impacts.		

### Assessment of No-Go option

There is no impact as it maintains the current status quo.

### Recommended mitigation measures

As indicated above, !Khe CSP has entered into an agreement with the affected landowners whereby the company will compensate for damages. This includes losses associated veld fires. In addition, the potential increased risk of veld fires can be effectively mitigated. The detailed mitigation measures are outlined in the EMP for the construction and operation phases. The aspects that should be covered include:

- Contractor to ensure that open fires on the site for cooking or heating are not allowed except in designated areas;
- Contractor to ensure that construction related activities that pose a potential fire risk, such as welding, are properly managed and are confined to areas where the risk of fires has been reduced. Measures to reduce the risk of fires include clearing working areas and avoiding working in high wind conditions when the risk of fires is greater. In this regard special care should be taken during the high risk dry, windy winter months;
- Contractor to provide adequate fire fighting equipment on-site;
- Contractor to provide fire-fighting training to selected construction staff;
- As per the conditions of the Code of Good Conduct, in the advent of a fire being caused by construction workers and or construction activities, the appointed contractors must compensate farmers for any damage caused to their farms. The contractor should also compensate the fire fighting costs borne by farmers and local authorities.

In addition the landowner should also ensure that they join the local fire protection agency.

#### 4.4.5 Impact of construction vehicles

The movement of heavy construction vehicles during the construction phase will damage roads and create noise, dust, and safety impacts for other road users and local communities in the area, specifically the residents of Oranjevallei, Kalksloot, Klippunt, and Kanoneiland. In terms of access, rRoad access to the proposed site

will be via the N14 and/or D3276. Two routes for the external access road are proposed, namely Alternative A and Alternative B. Access via Alternative A will from D3276 which is located to the east of the site, while access via Alternative B will be from the N14 which is located to the south of the site. Based on the findings of the SIA (see below) Alternative A is the preferred alternative. The major social benefit associated with Alternative A is that construction related traffic will turn off the N14 and on to D3276 before encountering the settlements of Oranjevallei, Kalksloot, Klippunt, and Kanoneiland. Alternative A therefore reduces the potential noise, dust, and safety impacts on these communities.

The potential damage to D3276 by heavy equipment can result in a number of potential negative impacts, including increased wear on vehicles owned by local farmers, impact on ease of access (e.g. time delays, detours) to stock posts, between neighbors and members of the farming community, as well as access to local towns (services, retail, socialising). However, the findings of the SIA indicate that the current road use frequency is low.

**Table 4.5:** Assessment of the impacts associated with construction vehicles

<b>Nature:</b> Potential noise, dust and safety impacts associated with movement of construction related traffic to and from the site		
	<b>Without Mitigation</b>	<b>With Mitigation</b>
<b>Extent</b>	Local (3) (Rated as 2 due to potential severity of impact on local farmers)	Local (2)
<b>Duration</b>	Short term (2)	Short term (2)
<b>Magnitude</b>	Low (4)	Minor (2)
<b>Probability</b>	Probable (3)	Probable (3)
<b>Significance</b>	Low (27)	Low (18)
<b>Status</b>	Negative	Negative
<b>Reversibility</b>	Yes	
<b>Irreplaceable loss of resources?</b>	No	No
<b>Can impact be mitigated?</b>	Yes	
<b>Mitigation:</b> See below		
<b>Cumulative impacts:</b> If damage to roads is not repaired then this will affect the farming activities in the area and result in higher maintenance costs for vehicles of local farmers and other road users. The costs will be borne by road users who were no responsible for the damage.		
<b>Residual impacts:</b> See cumulative impacts		

#### Assessment of No-Go option

There is no impact as it maintains the current status quo.

#### Recommended mitigation measures

!Khi CSP have entered into an agreement with the affected landowners whereby the company will compensate for damages. This includes losses associated with damage



to local internal farm roads that are affected by the site . In addition, the potential impacts associated with heavy vehicles and dust can be effectively mitigated. The aspects that should be covered include:

- The contractor must ensure that damage caused to roads by the construction related activities, including heavy vehicles, is repaired before the completion of the construction phase. The costs associated with the repair must be borne by the contractor;
- Dust suppression measures must be implemented for heavy vehicles such as wetting of gravel roads on a regular basis and ensuring that vehicles used to transport sand and building materials are fitted with tarpaulins or covers;
- All vehicles must be road-worthy and drivers must be qualified and made aware of the potential road safety issues and need for strict speed limits.

#### 4.4.6 Damage to and loss of farmland

The activities associated with the construction phase has the potential to damage farmlands and result in a loss of land available for grazing.

The significance of the impacts is to some extent mitigated by the fact that the farming activities in the area are confined to cattle farming as opposed to crops. In addition, only one landowners is affected and the section of his farm that is affected has been purchased by !Khi CSP. The loss of production farmland has therefore been offset by the purchase price of the property in question. In addition, the final disturbance footprint can also be reduced by careful site design and placement of components. The impact on farmland associated with the construction phase can therefore be mitigated by minimising the footprint of the construction related activities and ensuring that disturbed areas are fully rehabilitated on completion of the construction phase. Recommended mitigation measures are outlined below.

Mr. van Schalkwyk (the only landowner) has been farming in the area for 22 years and indicated that he felt that the construction activities would have potentially posed a disruption to his usual farming activities. However, the location of the proposed site in the corner of his property will limit such disruptions. In addition, he indicated that the facility would act as a buffer between his cattle and residents of the nearby Kalksloot informal settlement.

**Table 4.6:** Assessment of impact on farmland due to construction related activities

<b>Nature:</b> The activities associated with the construction phase, such as establishment of access roads and the construction camp, movement of heavy vehicles and preparation of foundations for the solar plant, water pipeline and power lines will damage farmlands and result in a loss of farmlands for future farming activities.		
	<b>Without Mitigation</b>	<b>With Mitigation</b>
<b>Extent</b>	Local (3)	Local (1)
<b>Duration</b>	Long term-permanent if disturbed areas are not effectively rehabilitated (5)	Short term if damaged areas are rehabilitated (1)
<b>Magnitude</b>	Moderate, due to importance of farming in terms of local livelihoods (4)	Minor (2)

<b>Probability</b>	Definite (5)	Highly Probable (4)
<b>Significance</b>	High (60)	Low (16)
<b>Status</b>	Negative	Negative
<b>Reversibility</b>	No, in case of footprint associated with solar thermal plant	No, in case of footprint associated with solar thermal plant
<b>Irreplaceable loss of resources?</b>	Yes, loss of farmland. However, disturbed areas can be rehabilitated	Yes, loss of farmland. However, disturbed areas can be rehabilitated
<b>Can impact be mitigated?</b>	Yes, however, loss of farmland cannot be avoided	Yes, however, loss of farmland cannot be avoided
<b>Mitigation:</b> See below		
<b>Cumulative impacts:</b> Overall loss of farmland could affect the livelihoods of the affected farmers, their families, and the workers on the farms and their families. However, disturbed areas can be rehabilitated.		
<b>Residual impacts:</b> See cumulative impacts.		

### Assessment of No-Go option

There is no impact as it maintains the current status quo.

### Recommended mitigation measures

The potential impacts associated with damage to and loss of farmland can be effectively mitigated. The aspects that should be covered include:

- The footprint associated with the construction related activities (access roads, , construction platforms, workshop etc) should be minimised
- An Environmental Control Officer (ECO) should be appointed to monitor the establishment phase of the construction phase
- All areas disturbed by construction related activities, such as access roads on the site, construction platforms, workshop area etc, should be rehabilitated at the end of the construction phase
- The implementation of a rehabilitation programme should be included in the terms of reference for the contractor/s appointed. The specifications for the rehabilitation programme should be drawn up the Environmental Consultants appointed to undertake the EIA (Savannah Environmental)
- The implementation of the Rehabilitation Programme should be monitored by the ECO

## 4.5 SOCIAL IMPACTS ASSOCIATED WITH OPERATIONAL PHASE

The key social issues affecting the operational phase include:

### Potential positive impacts

- Creation of employment and business opportunities. The operational phase will also create opportunities for skills development and training;
- Impact on tourism and the creation of potential tourist opportunities (This can also be regarded as a negative impact);
- The establishment of renewable energy infrastructure

### Potential negative impacts

- Impact of the proposed solar thermal plant on the current farming activities, specifically the potential loss of productive farm land;
- The visual impacts and associated impact on sense of place;
- Impact on scarce water resources

Annexure D contains the management plan for the addressing social impacts.

#### 4.5.1 Creation of employment and business opportunities

Based on information provided by the client the proposed solar thermal plant will employ approximately 60 - 80 full time employees over a 30 year period. Approximately 3 - 6% of the posts will be managerial, 12 - 18% engineers, 35 - 40% technicians and 40 - 50% craftsmen. The proposed facility will therefore create potential employment opportunities in the Northern Cape Province and the Kai! Garib Municipality. However, given that the solar energy sector in South Africa is relatively new, it may be necessary to import the required operational and maintenance skills from other parts of South Africa or even overseas. However, it will be possible to increase the number of local employment opportunities through the implementation of a skills development and training programme linked to the operational phase. Such a programme would support the strategic goals of promoting local employment and skills development contained in the Kai! Garib IDP.

Given the location of the proposed facility the majority of permanent staff is likely to reside in the towns of Upington, Keimoes or Kakamas. In terms of accommodation options, a percentage of the permanent employees may purchase houses in one of these towns, while others may decide to rent. Both options would represent a positive economic benefit for the region. In addition, a percentage of the monthly wage bill earned by permanent staff would be spent in the regional and local economy, which will benefit local businesses in these towns. The benefits to the local economy will extend over the 30-year operational lifespan of the project.

The local hospitality industry in Upington, Keimoes, or Kakamas is also likely to benefit from the operational phase. These benefits are associated with site visits by company staff members and other professionals (engineers, technicians etc) who are involved in the company and the project but who are not linked to the day-to-day operations.

The Kai !Garib Municipal Manager (MM) (Mr McKay) indicated that the development represented a positive investment in the local Municipality, and as such, it was fully supported. The Kalksloot Ward Councillor (Ousis Koloi) also indicated that she supported the development and felt that the project would create employment opportunities and support training and skills development initiatives both in the ward and the broader municipality.

**Table 4.7:** Impact assessment of employment and business creation opportunities

<b>Nature:</b> Creation of employment and business opportunities associated with the operational phase		
	<b>Without Mitigation</b>	<b>With Enhancement</b>
<b>Extent</b>	Local and Regional (2)	Local and Regional (3)
<b>Duration</b>	Long term (4)	Long term (4)

<b>Magnitude</b>	Low (4)	Moderate (6)
<b>Probability</b>	Probable (3)	Probable (3)
<b>Significance</b>	Medium (30)	Medium (39)
<b>Status</b>	Positive	Positive
<b>Reversibility</b>	N/A	
<b>Irreplaceable loss of resources?</b>	No	
<b>Can impact be enhanced?</b>	Yes	
<b>Enhancement:</b> See below		
<b>Cumulative impacts:</b> Creation of permanent employment and skills and development opportunities for members from the local community and creation of additional business and economic opportunities in the area		
<b>Residual impacts:</b> See cumulative impacts		

### Assessment of No-Go option

There is no impact as it maintains the current status quo. However, the potential opportunity costs in terms of the loss of employment and skills and development training would be lost which would also represent a negative impact.

### Recommended enhancement measures

The enhancement measures listed in Section 3.2.1, i.e. to enhance local employment and business opportunities during the construction phase, also apply to the operational phase.

In addition:

- !Khi CSP should implement a training and skills development programme for locals during the first 5 years of the operational phase. The aim of the programme should be to maximise the number of South African's and locals employed during the operational phase of the project;
- !Khi CSP, in consultation with the Kai! Garib Municipality, should investigate the opportunities for establishing a Community Trust. The revenue for the trust should be derived from the income generated from the sale of energy from the plant. The communities that should benefit from the trust include Oranjevallei, Kalksloot, Klippunt and Kanoneiland. The establishment of a Community Trust does not only create potential benefits for local communities, but also addresses the issue of impact equity. In the case of the majority of renewable energy facilities, such as the Uppington solar facility, the directly affected landowner is compensated for the loss of land, while the adjacent landowners and communities bear the external costs associated with the visual impacts on the sense of place and the landscape character of the area.

### 4.5.2 Impact on tourism

The NCPGDS notes that the sustainable utilisation of the natural resource base on which agriculture depends is critical in the Northern Cape with its fragile ecosystems and vulnerability to climatic variation. The document also indicates that due to the

provinces exceptional natural and cultural attributes, it has the potential to become the preferred adventure and ecotourism destination in South Africa. Therefore caution must be taken to ensure that the development of large renewable energy projects, such as the proposed solar energy facility, do not affect the tourism potential of the Province. However, based on the findings of the site visit, the proposed facility is not likely to impact on the tourism sector in the area or the Province. The significance of this issue is therefore rated as low negative. In some instances the plant may also attract tourists to the area. However, the significance of this potential benefit is also rated as low positive.

**Table 4.8:** Impact on tourism

<b>Nature:</b> Potential impact of the solar thermal plant on local tourism		
	<b>Without Mitigation</b>	<b>With Enhancement / Mitigation</b>
<b>Extent</b>	Local (2)	Local (3)
<b>Duration</b>	Long term (4)	Long term (4)
<b>Magnitude</b>	Low (2)	Low (2)
<b>Probability</b>	Probable (3)	Probable (3)
<b>Significance</b>	Low (24) (Applies to both – and +)	Low (27) (Applies to both – and +)
<b>Status</b>	Positive (Potential to attract people to the area) Negative (Potential to distract from the tourist experience of the area)	Positive (Potential to attract people to the area) Negative (Potential to distract from the tourist experience of the area)
<b>Reversibility</b>	Yes	
<b>Irreplaceable loss of resources?</b>	No	
<b>Can impact be enhanced?</b>	Yes	
<b>Enhancement:</b> See below		
<b>Cumulative impacts:</b> Potential benefit for tourism in the Kai! Garib Municipality Area.		
<b>Residual impacts:</b> See cumulative impacts		

#### **Assessment of No-Go option**

The No-Development option would represent a lost opportunity to create a facility that has the potential to attract visitors to the area. This would represent a negative opportunity cost.

#### **Recommended enhancement measures**

In terms of mitigating the visual impacts, it is virtually impossible to hide the facility. The impact on the sense of place of the area cannot therefore be effectively mitigated. In terms of efforts to enhance the proposed benefits to tourism:

- !Khi CSP should liaise with representatives from the Kai! Garib Municipality and local tourism representatives to raise awareness of the proposed facility;

- !Khi CSP should investigate the option of establishing a renewable energy interpretation centre at entrance to the site. The centre should include a viewing area where passing visitors can stop and view the site.
- In order to maximise the benefits of the interpretation centre to the broader community, it is recommended that the information on the project and solar energy be presented in the three main languages of the Northern Cape Province, namely Afrikaans, English and Setswana.

#### 4.5.3 Development of clean, renewable energy infrastructure

South Africa currently relies on coal-powered energy to meet more than 90% of its energy needs. As a result South Africa is one of the highest per capita producers of carbon emissions in the world and Eskom, as an energy utility, has been identified as the world's second largest producer carbon emissions (Cape Times, 15 November 2007).

The establishment of a clean, renewable energy facility will therefore reduce, albeit minimally, South Africa's reliance on coal-generated energy and the generation of carbon emissions into the atmosphere.

The overall contribution to South Africa's total energy requirements of the proposed solar thermal plant is relatively small. However, the 110 MW produced will offset the total carbon emissions associated with energy generation in South Africa. Given South Africa's reliance on Eskom as a power utility, the benefits associated with an IPP based on renewable energy are regarded as significant.

**Table 4.9:** Development of clean, renewable energy infrastructure

<b>Nature:</b> Promotion of clean, renewable energy		
	<b>Without Mitigation</b>	<b>With Mitigation</b>
<b>Extent</b>	Local, Regional and National (4)	Local, Regional and National (4)
<b>Duration</b>	Long term (4)	Long term (4)
<b>Magnitude</b>	Moderate (6)	High (8)
<b>Probability</b>	Highly Probable (4)	Highly Probable (4)
<b>Significance</b>	Medium (56)	High (64)
<b>Status</b>	Positive	Positive
<b>Reversibility</b>	Yes	
<b>Irreplaceable loss of resources?</b>	Yes, impact of climate change on ecosystems	
<b>Can impact be mitigated?</b>	Yes	
<b>Enhancement:</b> See below		
<b>Cumulative impacts:</b> Reduce carbon emissions via the use of renewable energy and associated benefits in terms of global warming and climate change.		
<b>Residual impacts:</b> See cumulative impacts		

#### Assessment of No-Go option

The No-Development option would represent a lost opportunity for South Africa to supplement its current energy needs with clean, renewable energy. This would represent a negative opportunity cost.

#### **Recommended mitigation measures**

The establishment of the proposed facility is a mitigation measure in itself. In order to maximise the benefits of the proposed project !Khi CSP should:

- Use the project to promote and increase the contribution of renewable energy to the national energy supply;
- Maximise the public's exposure to the project via an extensive communication and advertising programme;
- Implement a training and skills development programme for locals during the first 5 years of the operational phase. The aim of the programme should be to maximise the number of South African's employed during the operational phase of the project;
- Investigate the opportunities for establishing a Community Trust. The revenue for the trust should be derived from the income generated from the sale of energy from the plant.

#### **4.5.4 Visual impact and impact on sense of place**

The components associated with the proposed facility will have a visual impact and, in so doing, impact on the landscape and rural sense of the place of the area. As indicated previously, the NCPGDS does indicate that the province does have the potential to become the preferred adventure and ecotourism destination in South Africa. Care therefore needs to be taken to ensure that the development of large renewable energy projects not impact on visual character and sense of place of the landscape.

The key findings of the specialist visual impact assessment (VIA) (MetroGIS, September, 2010) note that it is clear from the viewshed analysis that the facility (especially the power tower) would be exposed to a large geographical area within this region due to the relatively flat topography. The specific findings of the VIA are listed below.

#### **Potential visual impact on users of national, arterial and secondary roads in close proximity of the solar facility**

Potential visual impact on the major roads within close proximity to the proposed solar facility (i.e. within 8km) is expected to be **high**.

#### **Potential visual impact on residents of towns, settlements and homesteads in close proximity to the proposed solar facility**

The visual impact of the proposed solar facility on built-up areas and settlements within 8km of the site is found to be **moderate**.

#### **Potential visual impact on residents of towns, settlements and homesteads within the region**

The visual impact of the proposed solar facility on built-up areas and settlements beyond 8km of the site is found to be **moderate**.

#### **Potential visual impact of the proposed solar facility on protected areas and eco-tourism**

The potential visual impact of the proposed solar facility on the Spitskop Nature Reserve and on eco-tourism along the Orange River is expected to be **moderate**

In conclusion the VIA notes that the construction and operation of the Upington Solar Thermal Plant (primarily the power tower) will have a visual impact on the natural scenic resources of this region. The VIA also indicates that the facility has a novel and futuristic design that invokes a curiosity factor not generally present with other conventional power generating plants. The advantage being that the solar facility can become an attraction or a landmark within the region that people would actually want to come and see. As it is impossible to hide the facility, the only option would be to promote it. However, the VIA goes on to state that this should not distract from the fact that the power tower would be visible for a large area that incorporates various sensitive visual receptors that should ideally not be exposed to industrial-type structures. In terms of potential mitigation measures, the VIA indicates that there are not many recommendations as to the mitigation of the visual impact of the facility (including the primary and ancillary infrastructure), especially the power tower.

**Table 4.11:** Visual impact and impact on sense of place

<b>Nature:</b> Visual impact associated with the proposed solar facility and the potential impact on the areas rural sense of place.		
	<b>Without Mitigation</b>	<b>With Mitigation</b>
<b>Extent</b>	Local (3)	Local (3)
<b>Duration</b>	Long term (4)	Long term (4)
<b>Magnitude</b>	Minor (2)	Minor (2)
<b>Probability</b>	Highly Probable (4)	Highly Probable (4)
<b>Significance</b>	Medium (56)	Medium (56)
<b>Status</b>	Negative	Negative
<b>Reversibility</b>	Yes, solar facility can be removed.	
<b>Irreplaceable loss of resources?</b>	No	
<b>Can impact be mitigated?</b>	Yes	
<b>Enhancement:</b> See below		
<b>Cumulative impacts:</b> Potential impact on current rural sense of place		
<b>Residual impacts:</b> See cumulative impacts		

#### **Assessment of No-Go option**

There is no impact as it maintains the current status quo.

#### **Recommended mitigation measures**

The recommendations contained in the VIA should be implemented.



#### **4.5.5 Impact on scarce water resources**

The NCPGDS notes that the Northern Cape Provincial Government will promote the preservation of agricultural biodiversity and the sustainable use of soil and water through the application of legislation and related regulations where this is necessary. In this regard, the proposed facility will consume relatively large volumes of water, which is a scarce resource in the area. Based on the information provided by the client the proposed facility will consume approximately 4 522 m<sup>3</sup> and 2 611 m<sup>3</sup> of water per day during the summer and winter months respectively. These represent large volumes of water being allocated to a single user and raise potential issues related to equity and efficiency in terms of allocating the water for other uses, such as food security. However, it is assumed that the provincial and national Department of Water Affairs has been informed of the proposed development and that !Khe CSP has followed the required procedures for obtaining a water use licence for the operation.

The issue of impact on water resources is raised in an assessment of a solar thermal plant in California (Genesis Solar Energy Facility). The findings of the assessment undertaken by the US Bureau of Land Management and the California Energy Commission (March, 2010) indicate that while the state of California has a strong interest in developing its solar energy resources, the construction and operation of solar energy facilities requires the use of water, which state policy also protects. In this regard the report states that the Energy Commission must balance the state's interest in promoting solar energy development with its interest in conserving and protecting the state's water resources. In this regard the report notes that several solar projects currently proposed in the Mojave and Colorado deserts of California would use water for power plant cooling, which staff believes is contrary to the state's long term interest in maximising solar power generation and minimising adverse environmental impacts. The potential for the same conflict to arise in South Africa exists and needs to be borne in mind by the authorities.

As a potential mitigation measure the authorities in California recommended consideration of air-cooled condenser (ACC) systems rather than the cooling towers proposed for the Genesis project. Based on the information provided by the client no such alternative is being considered for the proposed facility. However, based on information provided by Savannah Consulting the REFIT tariff does not make allowance for dry cooled CSP. While DWAF are aware of this situation, it appears to be an oversight given that water is one of South Africa's scarcest resources.

#### **4.6 ASSESSMENT POWER LINE OPTIONS**

The proposed facility includes the establishment of an overhead powerline of 132 kV which will connect via a 'turn in and turn out' configuration to an existing Eskom distribution line running approximately 4 km south of the site. This power line connects Eskom's Gordonia Distribution Substation (close to Upington) to its Oasis Distribution Substation (close to Keimoes). Two alternative corridors/routes are proposed for the power line where Alternative A is the preferred route by the developer by virtue of it being a shorter distance.

The findings of the SIA indicate that the social impacts associated with both Alternative A and B are linked to the visual impact and associated impact on the sense of place and landscape character of the area. However, the significance of the

impact is rated as low negative. Alternative A is therefore supported. The findings of the VIA also support Alternative A.

**Table 4.12:** Assessment of transmission line options

<b>Nature:</b> Potential visual impact and impact on sense of place associated with power lines		
	<b>Without Mitigation</b>	<b>With Mitigation</b>
<b>Extent</b>	Local (2)	Local (1)
<b>Duration</b>	Long term (4)	Long term (4)
<b>Magnitude</b>	Minor (2)	Minor (2)
<b>Probability</b>	Probable (3)	Probable (3)
<b>Significance</b>	Low (24)	Low (21)
<b>Status</b>	Negative	Negative
<b>Reversibility</b>	Yes	
<b>Irreplaceable loss of resources?</b>	No	
<b>Can impact be mitigated?</b>	Yes	
<b>Enhancement:</b> See below		
<b>Cumulative impacts:</b> Limited visual and impact on sense of place		
<b>Residual impacts:</b> See cumulative impacts		

#### **Assessment of No-Go option**

There is no impact as it maintains the current status quo.

#### **Recommended mitigation measures**

The recommendations contained in the VIA should be implemented. The measures listed above to address the potential impacts associated with the construction phase also apply to the construction of the power line.

### **4.7 ASSESSMENT OF ACCESS ROAD OPTIONS**

An external access road to the site will be established from the main road (i.e. N14), which runs approximately 5.2 km south-east of the site. Two routes for the external access road are proposed, namely:

- Alternative A (the preferred route): this alternative is preferred by virtue of it being a shorter distance
- Alternative B (the alternative route): this alternative is located to the west of the preferred alternative

Access via Alternative A will be from D3276 which is located to the east of the site, while access via Alternative B will be from the N14 which is located to the south of the site. Based on the findings of the SIA (see below) Alternative A is the preferred alternative. The major social benefit associated with Alternative A is that construction and operational related traffic will turn off the N14 and on to D3276 before

encountering the settlements of Oranjevallei, Kalksloot, Klippunt, and Kanoneiland. Alternative A therefore reduces the potential noise, dust, and safety impacts on these communities. The findings of the VIA also support Alternative A.

**Table 4.12:** Assessment of access roads

<b>Nature:</b> Potential noise, dust and safety impacts associated with traffic		
	<b>Without Mitigation</b>	<b>With Mitigation</b>
<b>Extent</b>	Local (2)	Local (1)
<b>Duration</b>	Long term (4)	Long term (4)
<b>Magnitude</b>	Minor (2)	Minor (2)
<b>Probability</b>	Probable (3)	Probable (3)
<b>Significance</b>	Low (24)	Low (21)
<b>Status</b>	Negative	Negative
<b>Reversibility</b>	Yes	
<b>Irreplaceable loss of resources?</b>	No	
<b>Can impact be mitigated?</b>	Yes	
<b>Enhancement:</b> See below		
<b>Cumulative impacts:</b> Limited increase in safety, noise and dust risks to local communities.		
<b>Residual impacts:</b> See cumulative impacts		

#### **Assessment of No-Go option**

There is no impact as it maintains the current status quo.

#### **Recommended mitigation measures**

Alternative A should be developed. The recommendations contained in the VIA should be implemented. The measures listed above to address the potential impacts associated with the construction phase also apply to the construction of the access road.

### **4.8 ASSESSMENT PIPELINE ROUTE OPTIONS**

The proposed facility requires the establishment of a water supply pipeline linking the facility to an abstraction point on the Orange (Gariep) River. Based on an extensive feasibility assessment, only one alternative route has been provided for the proposed pipeline. This route is preferred by virtue of the following:

- Shortest pipeline route
- Minimum impact on the environment
- Easy access to the pipeline for maintenance purposes
- Getting out of the flood lines as soon as possible
- An agreement has been reached to establish an abstraction point on the property of Mr. Conrad Geldenhuys
- The identified routing will follow an existing road reserve

The findings of the SIA indicate that the social impacts associated with the proposed route are negligible and the significance of the impact is rated as low negative. The route identified is therefore supported.

**Table 4.13:** Assessment of pipeline options

<b>Nature:</b> Potential visual impact and impact on sense of place associated with pipelines if they are established above ground. Disturbance to the land during the construction phase		
	<b>Without Mitigation</b>	<b>With Mitigation</b>
<b>Extent</b>	Local (2)	Local (1)
<b>Duration</b>	Long term (4)	Long term (4)
<b>Magnitude</b>	Minor (2)	Minor (2)
<b>Probability</b>	Probable (3)	Probable (3)
<b>Significance</b>	Low (24)	Low (21)
<b>Status</b>	Negative	Negative
<b>Reversibility</b>	Yes	
<b>Irreplaceable loss of resources?</b>	No	
<b>Can impact be mitigated?</b>	Yes	
<b>Enhancement:</b> See below		
<b>Cumulative impacts:</b> Limited visual and impact on sense of place		
<b>Residual impacts:</b> See cumulative impacts		

#### Assessment of No-Go option

There is no impact as it maintains the current status quo.

#### Recommended mitigation measures

The recommendations contained in the VIA should be implemented. The measures listed above to address the potential impacts associated with the construction phase also apply to the construction of water pipelines.

## 4.9 POTENTIAL HEALTH IMPACTS

The potential health risks associated with solar thermal plants are linked to the hazardous materials used in the process and stored on site. These include liquids such as oils or molten salts that may be hazardous, and present spill risks. In addition, various fluids are commonly used in most industrial facilities, such as hydraulic fluids, coolants, and lubricants. These fluids may in some cases be hazardous, and present a spill-related risk. Photovoltaic panels may also contain hazardous materials, and although they are sealed under normal operating conditions, there is the potential for environmental contamination if they were damaged or improperly disposed upon decommissioning.

However, the findings of a detailed health assessment undertaken as part of the assessment of the Genesis solar plant in California found that the proposed facility would not present a significant health risk to the public. In addition, proper planning and good maintenance and management practices can mitigate the potential risks and impacts.

#### 4.10 ASSESSMENT OF NO-DEVELOPMENT OPTION

As indicated above, South Africa currently relies on coal-powered energy to meet more than 90% of its energy needs. As a result South Africa is one of the highest per capita producers of carbon emissions in the world and Eskom, as an energy utility, has been identified as the world's second largest producer carbon emissions (Cape Times, 15 November 2007).

The No-Development option would represent a lost opportunity for South Africa to supplement its current energy needs with clean, renewable energy. Given South Africa's position as one of the highest per capita producer of carbon emissions in the world, this would represent a High negative social cost.

**Table 4.14:** Assessment of no-development option

<b>Nature:</b> The no-development option would result in the lost opportunity for South Africa to supplement its current energy needs with clean, renewable energy		
	<b>Without Mitigation</b>	<b>With Mitigation</b>
<b>Extent</b>	Local-International (5)	Local-International (5)
<b>Duration</b>	Long term (4)	Long term (4)
<b>Magnitude</b>	Moderate (6)	Moderate (6)
<b>Probability</b>	Highly Probable (4)	Highly Probable (4)
<b>Significance</b>	High (60)	High (60)
<b>Status</b>	Negative	Positive
<b>Reversibility</b>	Yes	
<b>Irreplaceable loss of resources?</b>	Yes, impact of climate change on ecosystems	
<b>Can impact be mitigated?</b>	Yes	
<b>Enhancement:</b> See below		
<b>Cumulative impacts:</b> Reduce carbon emissions via the use of renewable energy and associated benefits in terms of global warming and climate change.		
<b>Residual impacts:</b> See cumulative impacts		

#### Recommended enhancement measures

The proposed facility should be developed and the mitigation and enhancement measures identified in the SIA and other specialist studies should be implemented. However, the impact of large solar facilities on the sense of place and landscape are issues need to be addressed in the location, design and layout of the proposed plant.

#### 4.11 ASSESSMENT OF CUMULATIVE IMPACTS

Although there appear to be no guidelines for solar facilities, the Australian Wind Farm Development Guidelines (Draft, July 2010) indicate that the cumulative impact of multiple wind farm facilities is likely to become an increasingly important issue for wind farm developments in Australia. This finding is also likely to apply to solar thermal plants and is also likely to be the case in South Africa. The key concerns in terms of cumulative impacts are, as in the case of wind farms, also likely to be linked to visual impacts and the impact on rural, undeveloped landscapes.

The Scottish Natural Heritage (2005) describes a range of potential cumulative landscape impacts associated with wind farms on landscapes. These issues raised in these guidelines as to what defines a cumulative impact are also regarded as pertinent to solar facilities, specifically given that the key issue of concern is likely to relate to the impact on rural, undeveloped landscapes. The relevant issues raised in the by Scottish Natural Heritage include:

- Combined visibility (whether two or more wind farms (solar facilities) will be visible from one location).
- Sequential visibility (e.g. the effect of seeing two or more wind farms (solar facilities) along a single journey, e.g. road or walking trail).
- The visual compatibility of different wind farms (solar facilities) in the same vicinity.
- Perceived or actual change in land use across a character type or region.
- Loss of a characteristic element (e.g. viewing type or feature) across a character type caused by developments across that character type.

The guidelines also note that cumulative impacts need to be considered in relation to dynamic as well as static viewpoints. The experience of driving along a tourist road, for example, needs to be considered as a dynamic sequence of views and visual impacts, not just as the cumulative impact of several developments on one location. The viewer may only see one wind farm (solar facility) at a time, but if each successive stretch of the road is dominated by views of a wind farm (solar facility), then that can be argued to be a cumulative visual impact (National Wind Farm Development Guidelines, DRAFT - July 2010). It is reasonable to assume that these issues will also apply to solar thermal plants.

Research on wind farms undertaken by Warren and Birnie (2009) also highlights the visual and cumulative impacts on landscape character. The paper notes that given that aesthetic perceptions are a key determinant of people's attitudes, and that these perceptions are subjective, deeply felt and diametrically contrasting, it is not hard to understand why the arguments become so heated. Because landscapes are often an important part of people's sense of place, identity and heritage, perceived threats to familiar vistas have been fiercely resisted for centuries. The paper also identifies two factors that important in shaping people's perceptions of wind farms' landscape impacts. The first of these is the cumulative impact of increasing numbers of wind farms (Campbell, 2008). The research found that if people regard a region as having 'enough' wind farms already, then they may oppose new proposals. The second factor is the cultural context. This relates to peoples perception and relationship with the landscape. In the South African context, the majority of South Africans have a strong connection with and affinity for the large, undisturbed open spaces that are characteristic of the South African landscape. This concerns raised with regard to wind farms and the impact on landscapes are also likely to apply to solar facilities.

The impact of solar facilities on the landscape is therefore likely to be a key issue in South Africa, specifically given South African's strong attachment to the land and the growing number of solar plant applications. With regard to the area, a proposed solar facility is located immediately to the east of the site. The constriction of the proposed Upington and Eskom sites in such close proximity to each other will result in a cumulative impact on the landscape and the areas rural sense of place. This finding is supported by the findings of the VIA.

**Table 4.15:** Cumulative impacts on sense of place and the landscape

<b>Nature:</b> Visual impacts associated with the establishment of more than one solar thermal plant and the potential impact on the areas rural sense of place and character of the landscape.		
	<b>Without Mitigation</b>	<b>With Mitigation</b>
<b>Extent</b>	Local and regional (2)	Local and regional (2)
<b>Duration</b>	Long term (4)	Long term (4)
<b>Magnitude</b>	Low (4)	Low (4)
<b>Probability</b>	Probable (3)	Probable (3)
<b>Significance</b>	Medium (30)	Medium (30)
<b>Status</b>	Negative	Negative
<b>Reversibility</b>	Yes. Solar thermal plant components and other infrastructure can be removed.	
<b>Irreplaceable loss of resources?</b>	No	
<b>Can impact be mitigated?</b>	Yes	
<b>Enhancement:</b> See below		
<b>Cumulative impacts:</b> Impact on other activities whose existence is linked to linked to rural sense of place and character of the area, such as tourism, bird watching, and hunting.		
<b>Residual impacts:</b> See cumulative impacts		

### Assessment of No-Go option

There is no impact as it maintains the current status quo.

### Recommended mitigation measures

The establishment of more than one large solar facility in an area is likely to have a negative cumulative impact on the areas sense of place and the landscape. The environmental authorities should consider the overall cumulative impact on the rural character and the areas sense of place before a final decision is taken with regard to the optimal number of such plants in an area.

## 4.12 ASSESSMENT OF DECOMMISSIONING PHASE

Typically, the major social impacts associated with the decommissioning phase are linked to the loss of jobs and associated income. This has implications for the households who are directly affected, the communities within which they live, and

the relevant local authorities. However, in the case of the proposed facility the decommissioning phase is likely to involve the disassembly and replacement of the existing components with more modern technology. This is likely to take place in the 25 - 30 years post commissioning. The decommissioning phase is therefore likely to create additional, construction type jobs, as opposed to the jobs losses typically associated with decommissioning.

In addition, the social impacts associated with final decommissioned are likely to be limited due to the relatively small number of permanent employees (60 - 80) affected. The potential impacts associated with the decommissioning phase can also be effectively managed with the implementation of a retrenchment and downscaling programme. With mitigation, the impacts are assessed to be Low (negative).

### **Recommended mitigation measures**

The following mitigation measures are recommended:

- !Khi CSP should investigate the option of relocating employees to other solar facilities when the Uppington plant is decommissioned;
- !Khi CSP should ensure that retrenchment packages are provided for all staff who stand to lose their jobs when the plant is decommissioned;
- All structures and infrastructure associated with the proposed facility should be dismantled and transported off-site on decommissioning;
- !Khi CSP should establish an Environmental Rehabilitation Trust Fund to cover the costs of decommissioning and rehabilitation of disturbed areas. The Trust Fund should be funded by a percentage of the revenue generated from the sale of energy to the national grid over the 30 year operational life of the facility.



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## SECTION 5: KEY FINDINGS AND RECOMMENDATIONS

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### 5.1 INTRODUCTION

Section 5 lists the key findings of the study and recommendations. These findings are based on:

- A review of the issues identified during the Scoping Process
- A review of key planning and policy documents pertaining to the area
- Semi-structured interviews with interested and affected parties
- A review of social and economic issues associated with similar developments
- A review of selected specialist studies undertaken as part of the EIA
- A review of relevant literature on social and economic impacts
- The experience of the authors with other wind energy projects in South Africa

### 5.2 SUMMARY OF KEY FINDINGS

The key findings of the study are summarised under the following sections:

- Fit with policy and planning
- Construction phase impacts
- Operational phase impacts
- Cumulative Impacts
- Decommissioning phase impacts
- No-development option

The section also comments on the potential health impacts associated with solar facilities.

#### 5.2.1 Policy and planning issues

The key documents reviewed included:

- The National Energy Act (2008)
- The White Paper on the Energy Policy of the Republic of South Africa (December 1998)
- The White Paper on Renewable Energy (November 2003)
- Northern Cape Provincial Growth and Development Strategy (2004-2014)
- The Kai! Garib Local Municipality Integrated Development Plan (2009)

The findings of the review indicated that solar energy is strongly supported at a national, provincial, and local level. Based on this it is reasonable to assume that the establishment of the proposed Upington Solar Thermal Plant is supported.

#### 5.2.2 Construction phase

The key social issues associated with the construction phase include:

### **Potential positive impacts**

- Creation of employment and business opportunities, and the opportunity for skills development and on-site training.

The construction phase is expected to extend over a period of 24 months and create approximately 400 - 600 employment opportunities. It is anticipated that approximately 60 % (240 - 360) of the employment opportunities will be available to low skilled (construction labourers, security staff etc) and semi-skilled workers (drivers, equipment operators etc) and 40% (160-240) to skilled personnel (engineers, land surveyors, project managers etc). The majority of the employment opportunities, specifically the skilled and semi-skilled opportunities, are likely to be associated with the contractors appointed to construct the facility and associated infrastructure. In this regard the majority of contractors tend to use their own staff and this will limit the potential for direct employment opportunities for locals during the construction phase. In addition, the low education and skills levels in the area will hamper potential opportunities for local communities. However, members of the local community are likely to benefit from the low skilled employment opportunities associated with the project. In this regard the majority of the beneficiaries are likely to be historically disadvantaged (HD) members of the community.

Based on information from wind energy facilities the total wage bill for the 24 month construction phase will be in the region of R 160 million. The injection of income into the area in the form of rental for accommodation and wages will create opportunities for local businesses in towns such as Upington, Keimoes, and Kakamas. The sector of the local economy that is most likely to benefit from the proposed development is the local service industry. The potential opportunities for the local service sector would be linked to accommodation, catering, cleaning, transport and security, etc associated with the construction workers on the site. The client has indicated that the majority of the construction workers will be accommodated in the nearest local towns, with Upington likely to be the most convenient due to its proximity to the site. This will create opportunities for local hotels, B&Bs, guest farms and people who want to rent out their houses. The benefits to the local economy will however be confined to the construction period (24 months).

In terms of training, the contractors are likely to provide on-site training and skills development opportunities. However, the majority of benefits are likely to accrue to personnel employed by the relevant contractors. In the absence of specific commitments from the developer to employ local contractors the potential for meaningful skills development and training for members from the local communities are likely to be limited.

### **Potential negative impacts**

- Influx of construction workers employed on the project;
- Increased risk of stock theft, poaching and damage to farm infrastructure associated with construction workers;
- Increased risk of veld fires associated with construction related activities;
- Impact of heavy vehicles, including damage to roads, safety, noise and dust;
- Loss of agricultural land associated with construction related activities.

The significance of the potential negative impacts with mitigation was assessed to be of Low significance. The majority of the potential negative impacts can therefore be effectively mitigated if the recommended mitigation measures are implemented.

However, the impact on individuals who are directly impacted on by construction workers and or job seekers (i.e. contract HIV/ AIDS) was assessed to be of Medium-High negative significance. In addition, due to the relatively large size of the labour force (400-600) the potential risk to local family structures and social networks is regarded as high. This risk is heightened by the vulnerability of the residents of Oranjevallei, Kalksloot, Klippunt and Kanoneiland due to their low-income levels and education levels. The movement of construction workers on and off the site during the construction phase will therefore need to be carefully managed.

Table 5.1 summarises the significance of the impacts associated with the construction phase.

**Table 5.1:** Summary of social impacts during construction phase

<b>Impact</b>	<b>Significance No Mitigation</b>	<b>Significance With Mitigation</b>
<b>Creation of employment and business opportunities</b>	Medium (Positive impact)	Medium (Positive impact)
<b>Presence of construction workers and potential impacts on family structures and social networks</b>	Low (Negative impact for community as a whole) Medium-High (Negative impact of individuals)	Low (Negative impact for community as a whole) Medium-High (Negative impact of individuals)
<b>Risk of stock theft, poaching and damage to farm infrastructure</b>	Medium (Negative impact)	Low (Negative impact)
<b>Risk of veld fires</b>	Medium (Negative impact)	Low (Negative impact)
<b>Impact of heavy vehicles and construction activities</b>	Low (Negative impact)	Low (Negative impact)
<b>Loss of farmland</b>	High (Negative impact)	Low (Negative impact)

### 5.2.3 Operational phase

The key social issues affecting the operational phase include:

#### **Potential positive impacts**

- Creation of employment and business opportunities. The operational phase will also create opportunities for skills development and training;
- Impact on tourism and the creation of potential tourist opportunities (Impact on tourism may also be negative in some instances);
- The establishment of infrastructure to generate renewable energy and establishment of Cleaner Development Mechanism (CDM) project

Given the location of the proposed facility the majority of permanent staff is likely to reside in Uptington, Keimoes and Kakamas. In terms of accommodation options, a percentage of the permanent employees may purchase a house in one of these two towns, while others may decide to rent. Both options would represent a positive economic benefit for the region. In addition, a percentage of the monthly wage bill

earned by permanent staff would be spent in the local economy. The benefits to the local economy will extend over the 25-30 year operational lifespan of the project.

The proposed development also represents an investment in infrastructure for the generation of clean, renewable energy, which, given the challenges created by climate change, represents a positive High social benefit for society as a whole.

### Potential negative impacts

- The visual impacts and associated impact on sense of place and the landscape

The visual impacts on landscape character associated with large renewable energy facilities, such as solar thermal plants, are highlighted in the research undertaken by Warren and Birnie (2009). In the South African context, the majority of South Africans have a strong connection with and affinity for the large, undisturbed open spaces that are characteristic of the South African landscape. The impact of large, solar thermal plants on the landscape is therefore likely to be a key issue in South Africa, specifically given South African's strong attachment to the land and the growing number of solar energy applications.

The significance of the impacts associated with the operational phase are summarised in Table 5.2.

**Table 5.2:** Summary of social impacts during operational phase

Impact	Significance No Mitigation	Significance With Mitigation
<b>Creation of employment and business opportunities</b>	Medium (Positive impact)	Medium (Positive impact)
<b>Impact on tourism</b>	Low (Positive and Negative)	Low (Positive and Negative)
<b>Promotion of renewable energy projects</b>	Medium (Positive impact)	High (Positive impact)
<b>Visual impact and impact on sense of place</b>	Medium (Negative impact)	Medium (Negative impact)

The findings of the SIA also indicate the proposed plant will consume relative large volumes of water (approximately 4 522 m<sup>3</sup> and 2 611 m<sup>3</sup> of water per day during the summer and winter months respectively). The allocation of such large volumes of water to a single user raises potential issues related to equity and efficiency in terms of allocating the water for other uses, such as food security. The potential conflict between supporting renewable energy and conserving water is an issue that authorities will need to consider in South Africa.

### 5.2.4 Assessment of cumulative impacts

The cumulative impacts associated with large, renewable energy facilities, such as the proposed Upington solar thermal plant, are largely linked to the impact on sense of place and visual impacts. The significance of the potential cumulative social impacts, specifically the impact on the landscape, associated with the proposed Upington solar thermal plant was rated to be low.

However, it is recommended that the environmental authorities consider the overall cumulative impact on the rural character and the areas sense of place before a final decision is taken with regard to the optimal number of solar thermal plants in the area. In addition, the siting and number of individual components of the plant should be informed by findings of the relevant VIAs, specifically with respect to the visual impact on farmsteads and important roads in the area.

#### **5.2.5 Transmission line options**

The findings of the SIA indicate that Alternative A is the preferred option.

#### **5.2.6 Access road options**

The findings of the SIA indicate that Alternative A is the preferred option.

#### **5.2.7 Pipeline options**

The findings of the SIA indicate that the social impacts associated with the proposed route are negligible and the significance of the impact is rated as low negative. The route identified is therefore supported.

#### **5.2.8 Potential health impacts**

The potential health risks associated with solar thermal plants are linked to the hazardous materials used in the process and stored on site. These include liquids such as oils or molten salts that may be hazardous, and present spill risks. In addition, various fluids are commonly used in most industrial facilities, such as hydraulic fluids, coolants, and lubricants. These fluids may in some cases be hazardous, and present a spill-related risk. Photovoltaic panels may also contain hazardous materials, and although they are sealed under normal operating conditions, there is the potential for environmental contamination if they were damaged or improperly disposed upon decommissioning.

However, the findings of a detailed health assessment undertaken as part of the assessment of the Genesis solar plant in California found that the proposed facility would not present a significant health risk to the public. In addition, proper planning and good maintenance and management practices can mitigate the potential risks and impacts.

#### **5.2.9 Assessment of no-development option**

The No-Development option would represent a lost opportunity for South Africa to supplement its current energy needs with clean, renewable energy. Given South Africa's position as one of the highest per capita producer of carbon emissions in the world, this would represent a High negative social cost.

The no-development option also represents a lost opportunity in terms of the employment and business opportunities (construction and operational phase) associated with the proposed solar thermal plant. This also represents a negative social cost.

### **5.2.10 Decommissioning phase**

Typically, the major social impacts associated with the decommissioning phase are linked to the loss of jobs and associated income. This has implications for the households who are directly affected, the communities within which they live, and the relevant local authorities. However, in the case of the solar thermal plants decommissioning phase is likely to involve the disassembly and replacement of the existing components with more modern technology. This is likely to take place in the 25-30 years post commissioning. The decommissioning phase is therefore likely to create additional, construction type jobs, as opposed to the jobs losses typically associated with decommissioning.

When and if the proposed solar thermal plant is finally decommissioned, the impacts are likely to be limited due to the relatively small number of permanent employees (60-80) affected. The potential impacts associated with the decommissioning phase can also be effectively managed with the implementation of a retrenchment and downscaling programme. With mitigation, the impacts are assessed to be Low (negative).

Khi CSP South Africa (Pty) Ltd should also establish an Environmental Rehabilitation Trust Fund to cover the costs of decommissioning and rehabilitation of disturbed areas. The Trust Fund should be funded by a percentage of the revenue generated from the sale of energy to the national grid over the 25-30 year operational life of the facility. The rationale for the establishment of a Rehabilitation Trust Fund is linked to the experiences with the mining sector in South Africa and failure of many mining companies to allocate sufficient funds during the operational phase to cover the costs of rehabilitation and closure.

## **5.3 RECOMMENDATIONS**

The findings of the SIA indicate that the development will create employment and business opportunities for locals during both the construction and operational phase of the project. In order to enhance the local employment and business opportunities the mitigation measures listed in the report should be implemented. !Khe CSP, in consultation with the Kai! Garib Municipality, should also investigate the opportunities for establishing a Community Trust. The revenue for the trust would be derived from the income generated from the sale of energy from the plant. The establishment of a Community Trust does not only create potential benefits for local communities, but also addresses the issue of impact equity. In the case of the majority of renewable energy facilities, such as the Upton solar facility, the directly affected landowner is compensated for the loss of land, while the adjacent landowners and communities bear the external costs associated with the visual impacts on the sense of place and the landscape character of the area.

The mitigation measures listed in the report to address the potential negative impacts during the construction phase should also be implemented.

The proposed development also represents an investment in clean, renewable energy infrastructure, which, given the challenges created by climate change, represents a positive social benefit for society as a whole. The establishment of the proposed Upton solar thermal plant is therefore supported by the findings of the SIA.

However, the potential impacts associated with large, solar facilities on an areas sense of place and landscape cannot be ignored. These impacts are an issue that will need to be addressed by the relevant environmental authorities, specifically given the large number of applications for solar facilities that have been submitted over the last 12 months. The water demand associated with the operation phase of large, solar thermal plants is also an issue that will need to be addressed by the relevant authorities.

#### **5.4 IMPACT STATEMENT**

The findings of the SIA undertaken for the proposed Upington Solar Thermal Plant indicate that the development will create employment and business opportunities for locals during both the construction and operational phase of the project. The proposed development also represents an investment in clean, renewable energy infrastructure, which, given the challenges created by climate change, represents a positive social benefit for society as a whole. However, the visual impacts associated with facility will affect the areas rural sense of place and landscape character. This impact will be for the entire operational lifespan (approximately 30 years) of the facility. The potential for cumulative impacts also exists due to the proximity of the proposed Eskom CSP to the east of the site. However, these impacts are not considered to represent a fatal flaw. It is therefore recommended that the facility as proposed be supported, subject to the implementation of the recommended mitigation measures and management actions contained in the report.

## ANNEXURE A

### REFERENCES

#### Interviews

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- Mr J. MacKay, Kai !Garib LM Municipal Manager, 07/09/2010;
- Mr G. Present, Siyanda DM IDP Officer, 06/09/2010;
- Ms. C. Titus, Kai !Garib LM IDP Officer, 06/09/2010;
- Tanya Andersen, WESSA NC, 06/09/2010.

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#### Internet sources

- [www.demarcation.org.za](http://www.demarcation.org.za) (Census 2001 data).
- Google Earth 2009.



## ANNEXURE B

### METHODOLOGY FOR THE ASSESSMENT OF POTENTIAL IMPACTS

Direct, indirect and cumulative impacts of the above issues, as well as all other issues identified will be assessed in terms of the following criteria:

- The **nature**, which shall include a description of what causes the effect, what will be affected and how it will be affected.
- The **extent**, where it will be indicated whether the impact will be local (limited to the immediate area or site of development), regional, national or international. A score between 1 and 5 will be assigned as appropriate (with a score of 1 being low and a score of 5 being high).
- The **duration**, where it will be indicated whether:
  - \* the lifetime of the impact will be of a very short duration (0–1 years) – assigned a score of 1;
  - \* the lifetime of the impact will be of a short duration (2-5 years) - assigned a score of 2;
  - \* medium-term (5–15 years) – assigned a score of 3;
  - \* long term (> 15 years) - assigned a score of 4; or
  - \* permanent - assigned a score of 5.
- The **magnitude**, quantified on a scale from 0-10, where a score is assigned:
  - \* 0 is small and will have no effect on the environment;
  - \* 2 is minor and will not result in an impact on processes;
  - \* 4 is low and will cause a slight impact on processes;
  - \* 6 is moderate and will result in processes continuing but in a modified way;
  - \* 8 is high (processes are altered to the extent that they temporarily cease); and
  - \* 10 is very high and results in complete destruction of patterns and permanent cessation of processes.
- The **probability of occurrence**, which shall describe the likelihood of the impact actually occurring. Probability will be estimated on a scale, and a score assigned:
  - \* Assigned a score of 1–5, where 1 is very improbable (probably will not happen);
  - \* Assigned a score of 2 is improbable (some possibility, but low likelihood);
  - \* Assigned a score of 3 is probable (distinct possibility);
  - \* Assigned a score of 4 is highly probable (most likely); and
  - \* Assigned a score of 5 is definite (impact will occur regardless of any prevention measures).
- The **significance**, which shall be determined through a synthesis of the characteristics described above (refer formula below) and can be assessed as low, medium or high.
- The **status**, which will be described as either positive, negative or neutral.
- The *degree* to which the impact can be *reversed*.
- The *degree* to which the impact may cause *irreplaceable loss of resources*.
- The *degree* to which the impact can be *mitigated*.

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

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

S = Significance weighting

E = Extent

D = Duration

M = Magnitude

P = Probability

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

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

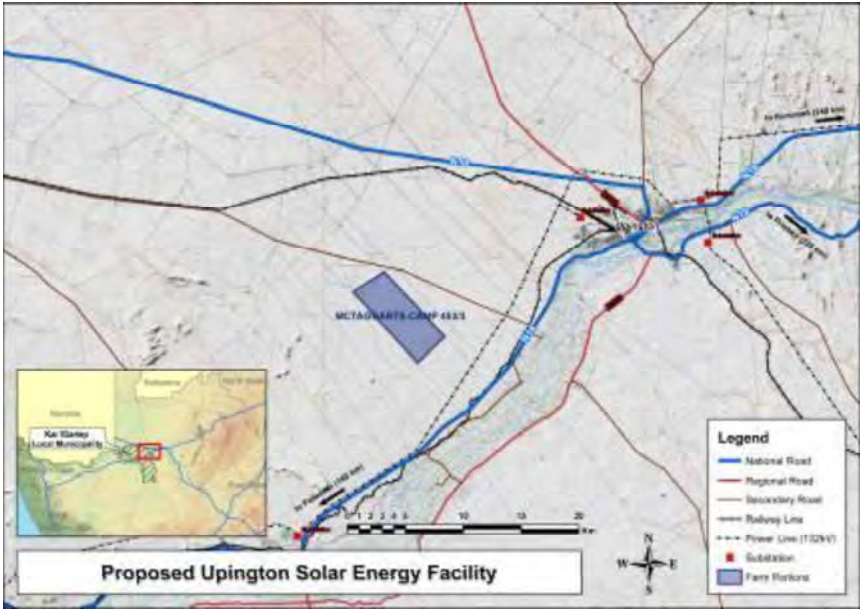
## ANNEXURE C

### BACKGROUND INFORMATION DOCUMENT

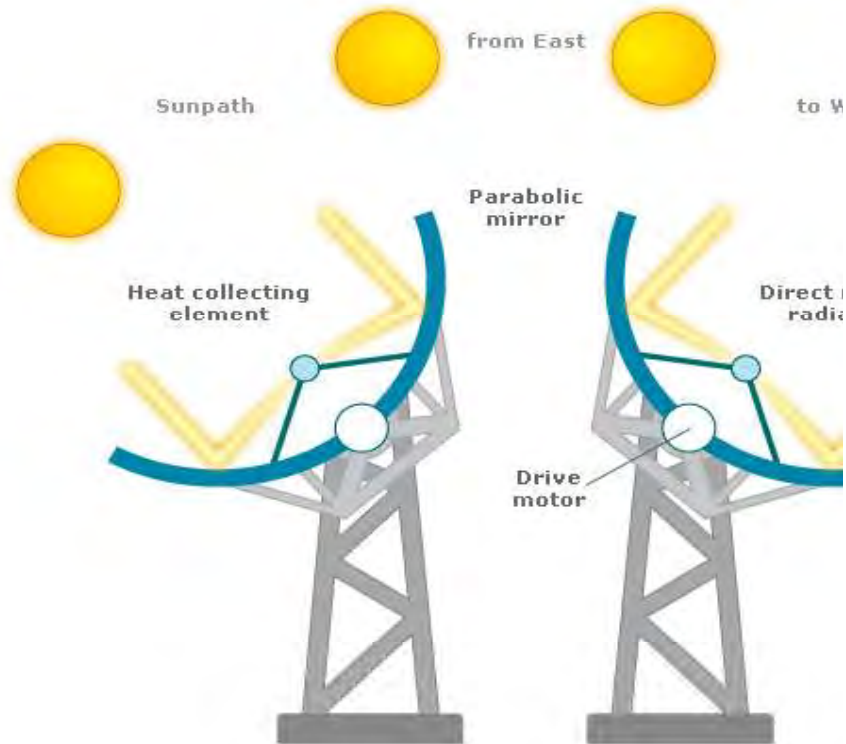
**Tony Barbour**  
**ENVIRONMENTAL CONSULTANT AND RESEARCHER**

P O Box 1753, Sun Valley, 7975, South Africa  
 (Tel) 27-21-789 1112 - (Fax) 27-21-789 1112 - (Cell) 082 600 8266  
 (E-Mail) [tbarbour@telkomsa.net](mailto:tbarbour@telkomsa.net)

### BACKGROUND INFORMATION DOCUMENT FOP SOCIAL IMPAACT ASSESSMENT

<b>Project Name</b>	Upington Solar Thermal Plant (STP)
<b>Project Developer</b>	!Khi CSP South Africa (!Khi CSP)
<b>Location/nearest Town(s)</b>	Upington and Keimoes, Northern Cape Province, South Africa
<b>Local Authority</b>	Kai! Garib Local Municipality (Kakamas) & Siyanda District Municipality (Upington)
<b>Locality Map</b>	
<b>Brief project description</b>	!Khi CSP has identified the potential to establish a Solar Thermal Plant using Concentrated Solar Power (CSP) and Concentrating or nTracking Photovoltaic Power (PV) technology

	on the farm McTaggarts <i>Camp 453, portion 3</i> near the towns of Keimoes and Upington in the Northern Cape.
<b>Typical Infrastructure Associated with a Solar Thermal Plant using CSP technology</b>	<p>The identified site which is being considered for the construction of the Solar Thermal Plant covers a total extent of 22 km<sup>2</sup>. The facility will consist of an unspecified number of parabolic troughs, heliostats and associated power tower photovoltaic panels as well as the associated infrastructure.</p> <p>The facility is proposed to accommodate up to 110MW which will be comprised of a combination of the following technologies (in any combination):</p> <ul style="list-style-type: none"> <li>» 50MW trough plants (CSP)</li> <li>» 50 MW power tower plants (CSP)</li> <li>» 10MW PV plants</li> </ul> <p><b>Parabolic Trough</b></p> <p>A parabolic trough (Figure 1.1) is a large, curved mirror that sits on a motorized base, allowing it to follow the movement of the sun throughout the day. The mirror's unique parabolic shape is designed to gather a great deal of sunlight and then reflect that light onto a single point, concentrating the solar power (Abengoa Solar S.A., 2008).</p> <p>A receiver tube sits at the point where the mirror concentrates all the sunlight. The tube is filled with synthetic heat transfer oil, heated by the mirror's light to around 750 F (400 C). This superheated oil is then pumped from the solar field to a nearby power block, where the oil's heat is converted to high-pressure steam in a series of heat exchangers. This steam pushes a conventional steam turbine, creating electricity (Abengoa Solar S.A., 2008).</p> <p>Parabolic trough technology is the most developed CSP technology, and Abengoa Solar is currently operating and deploying parabolic troughs at the Solúcar Platform outside of Seville, Spain and at numerous international locations. (Abengoa Solar S.A., 2008).</p>



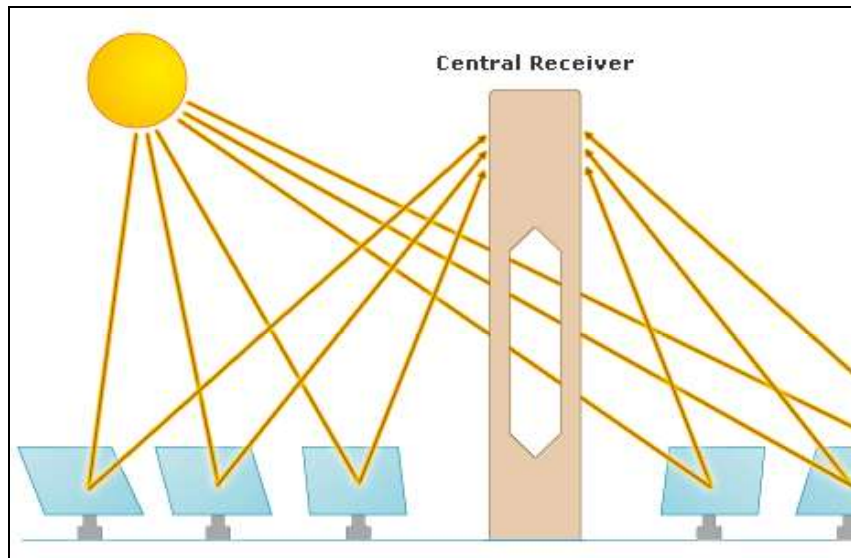
**Figure 1.1: Parabolic trough and associated technology**  
(source: Abengoa Solar S.A., 2008)

The Parabolic Trough components specified by Abengoa include:

- **Parabolic trough reflectors** are cylindrical in shape and reflect incident sunlight from its surface onto the receiver at the focal point. Typically, the reflector is made of thick glass silver mirrors formed into the shape of a parabola. Alternatively, mirrors can be made from thin glass, plastic films or polished metals.
- **Receiver tube or heat collection elements** consist of a metal absorber surrounded by a glass envelope. The absorber is coated with a selective coating to maximise energy collection and to minimise heat loss. The glass envelope is used to insulate the absorber from heat loss, and is typically coated with an anti-reflective surface to increase the transmittance of light through the glass to the absorber. For high temperature Solar Thermal Plant applications, the space between the absorber and glass tube is evacuated to form a vacuum.
- A **sun-tracking system** is an electronic control system and associated mechanical drive system is used to focus the reflector onto the sun as it moves during daylight hours.
- The **Support structure** is typically made of metal and holds the mirrors in accurate alignment while resisting the effects of the wind.

### Solar Power Tower

Solar Power tower systems (Figure 1.2), are comprised of a heliostat field of movable mirrors oriented according to the solar position in order to reflect the solar radiation and concentrating it up to 600 times on a receptor located on the upper part of a power tower. This heat is transferred to a fluid with the purpose of generating steam that expands on a turbine that is coupled to a generator to produce electricity (Abengoa Solar S.A., 2008).



**Figure 1.2: Solar power tower system and associated technology (source: Abengoa Solar S.A., 2008)**

The solar power tower components specified by Abengoa include:

- **Heliostats** have the function to capture solar radiation and direct it to the receiver. They are composed of a reflective surface, a supporting structure and mechanisms used to orientate them, following the sun's movement (which involves the necessary systems for the heliostat movement as well as control systems). The most used reflective surfaces today are glass mirrors.

**The receiver**, which transfers received heat to an operating fluid (which could be water, molten salts, etc.). This fluid is responsible for transmitting heat to other parts of the C.S.P. plant, generally to a water deposit, obtaining high temperature steam to produce electricity through the action of a turbine. Latest advances and research are centred to obtain high temperature towers, with heat transporting fluids, such as air, salts, etc.

- **The tower** acts as support for the receiver which should be located at a certain height above the heliostats level to avoid, or at least reduce, shades and blockings.

### Concentrated Photovoltaics

Concentrated Photovoltaic (CPV) systems use lenses or mirrors to concentrate sunlight on a PV cell. Since concentration greatly reduces the size of the solar cells needed, more expensive semiconductors are used to maximize performance.

CPV plants can be described as either low concentration or high concentration (Figure 1.4). While Low concentration PV plants often use mirrors to concentrate solar radiation onto a PV cell, high concentration PV plants use optical technology and lenses to concentrate solar radiation up to 500 times.



**Figure 1.3: Low (left) and high (right) concentration PV plant trackers (source: Abengoa Solar S.A., 2008)**

The typical CPV components specified by Abengoa include:

- **2-axis tracking heliostats:** Heliostats that track the sun on 2 axes are the structure upon which mirrors and PV cells are supported. 2-axis tracking PV yields 35% to 48% more energy production than fixed PV systems.
- **Concentrators:** Concentrators are used to direct solar radiation onto a PV cell. Often, these concentrators are mirrors manufactured with a silicone-covered metal. The orientations of mirrors on a concentrating PV module differ depending on their dimension, inclination angle, and module design.
- **Photovoltaic cells:** PV cells are what convert solar radiation into electricity. Low concentration PV cells are often made from single-crystalline silicon semiconductors. This technology has an efficiency of roughly 12%.
- **Inverter:** Since the photovoltaic effect produces direct current (DC), an inverter must be used to change it to alternating current (AC).

	<p>The proposed Upington Solar Thermal Plant is expected to produce approximately 110MW of power with parabolic troughs contributing ~50MW each, Power Tower ~50MW and Concentrated Photovoltaics ~10MW. The exact proportion of the total output ascribed to each of these technologies is subject to change.</p> <p>The exact number and placement of the facility components will be investigated in more detail during the EIA phase of the study. The power line for the facility will connect to existing Eskom transmission line that runs to the south of the proposed site. The proposed Solar Thermal Plant is therefore an Independent Power Producer (IPP) project. In addition, a water pipeline will be required to abstract from the Orange River. Alternative routes for these will be assessed as part of the EIA.</p> <p>Based on information provided by !Khi CSP South Africa, the basic infrastructure associated with the establishment of the proposed facility would include:</p> <ul style="list-style-type: none"> <li>• An access road to the site from the main road/s within the area. In the case of the proposed Upington site, access is likely to be from the N14 (which runs to the south and south east of the Solar Thermal Plant site) and/ or existing gravel and access roads.</li> <li>• An internal access road that links the facility components and associated infrastructure on the site;</li> <li>• A generator transformer and a small substation outside the building;</li> <li>• An overhead power line feeding into the Eskom electricity network via a "turn in and turn out" configuration to an existing distribution line running ~ 4 km south of the site;;</li> <li>• A steam turbine and generator housed within a 2-storey building;</li> <li>• Water supply pipeline/s to the facility and extraction point on the Orange River;</li> <li>• Water treatment plant and water storage facilities;</li> <li>• Blow down pond (for wastewater from the generation process);</li> <li>• Access roads to the site from the main road, as well as access roads within the site;</li> <li>• Workshop, office and storage areas.</li> </ul>
<b>Typical construction phase activities</b>	<p>The construction phase of the Solar thermal Plant will take approximately 24 months. In order to construct the proposed solar energy facility and associated infrastructure, a series of activities will need to be undertaken. They are as follows:</p> <ul style="list-style-type: none"> <li>• Conduct surveys e.g. geotechnical survey, site survey etc;</li> <li>• Establishment of access roads to the site;</li> <li>• Undertake site preparation e.g. clearance of vegetation, the establishment of internal access roads and terracing;</li> <li>• Construct solar field foundation and steelworks;</li> <li>• Transport of components and equipment to site;</li> </ul>



	<ul style="list-style-type: none"> <li>• Establishment of Laydown Areas on Site for the storage of Plant components etc.;</li> <li>• Plant infrastructure</li> <li>• Construct substation on site ;</li> <li>• Establishment of ancillary infrastructure i.e. office, solar field assembly facility, contractor's equipment camp etc.;</li> <li>• Connection of Plant to the substation;</li> <li>• Connect substation to power Grid via transmission lines; and</li> <li>• Undertake site remediation i.e. all construction equipment is removed from the site, the site rehabilitated where practical and reasonable.</li> </ul> <p>The number of construction personnel involved in the construction phase will be between 400 and 600 depending on the design of the Plant. It is estimated that 60% of the workforce will be low-skilled/unskilled while the remaining 40% will be skilled. The exact number of jobs (and the nature of the skills required) will be determined during the Impact Assessment Phase of the Environmental Impact Assessment Process undertaken by Savannah Environmental (Pty) Ltd (<a href="http://www.savannahsa.com/">http://www.savannahsa.com/</a>) on behalf of the project developer.</p>
<b>Typical operation phase activities</b>	<p>During the operational phase the operations workforce will include management, supervisors, plant operators, engineering and maintenance staff, skilled labor, and unskilled labour. Operational procedures will guide the major part of maintenance operations ensuring the correct functioning of all sections of the power plant from the basic components of the solar field to the main equipment of the power block (i.e. conventional steam turbine and generator), including access roads and internal road tracks. All these features will be under close supervision of a well trained management team which will not only control the daily operation and maintenance of the power plant but will also be searching for continuous improvements and will be responsible for procuring all spares, equipment components and consumables as required. There will also be a specialized team involved in the performance monitoring of the plant with the aim of optimizing plant production. A financial team, responsible for the daily accounting and cost control measures, will receive feedback from all management sections and report as required.</p> <p>Approximately 60-10 people will be employed during the operational phase. The approximate breakdown (%) of employment categories is as follows:</p> <ul style="list-style-type: none"> <li>• Managers 3 - 6%</li> <li>• Engineers 12 - 18%</li> <li>• Technicians 35 - 40%</li> <li>• Craftsmen 40 - 50%</li> </ul>
<b>Decommissioning</b>	The Solar thermal Plant infrastructure is expected to have a

	<p>lifespan of approximately 30 years (with maintenance). Equipment associated with this facility would only be decommissioned once it has reached the end of its economic life. It is most likely that decommissioning activities of the infrastructure of the Plant would comprise the disassembly and replacement of operating Plant components with more appropriate technology/infrastructure available at that time.</p>
<p><b>Questions to Consider</b></p>	<p>The typical social issues associated with solar energy facilities include:</p> <p><b>Construction phase</b></p> <ul style="list-style-type: none"> <li>• Impacts associate with construction related activities, such as noise, dust, traffic and presence of construction workers;</li> <li>• Disruption of farming activities and potential increased risk of veld fires;</li> <li>• Creation of employment opportunities</li> </ul> <p><b>Operational phase</b></p> <ul style="list-style-type: none"> <li>• Visual impact on the landscape;</li> <li>• Impact on tourism in the area, positive and negative.</li> </ul> <div style="border: 2px solid black; padding: 10px; margin: 10px 0;"> <p><b>In your view, would these impacts apply to the proposed facility in your area?; and</b></p> <p><b>Do you think there are any other key social impacts that might occur?</b></p> </div> <p><b>NOTES</b></p> <p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p>

## ANNEXURE D

### ENVIRONMENTAL MANAGEMENT PLAN: SIA

#### CONSTRUCTION PHASE

#### Creation of employment and business opportunities

**OBJECTIVE: Maximise local employment and business opportunities associated with the construction phase.**

<b>Project component/s</b>	Construction and establishment activities associated with the establishment of the solar thermal plant, including infrastructure etc.	
<b>Potential Impact</b>	The opportunities and benefits associated with the creation of local employment and business should be maximised.	
<b>Activity/risk source</b>	The employment of outside contractors to undertake the work and who make use of their own labour will reduce the employment and business opportunities for locals. Employment of local labour will maximise local employment opportunities.	
<b>Mitigation: Target/Objective</b>	Khi CSP South Africa (Pty) Ltd (!Khi CSP), in discussions with the Kai! Garib Municipality, should aim to employ a minimum of 80% of the low-skilled workers from the local area. This should also be made a requirement for all contractors. !Khi CSP should also develop a database of local BEE service providers	
<b>Mitigation: Action/control</b>	<b>Responsibility</b>	<b>Timeframe</b>
<ul style="list-style-type: none"> <li>• Attempt to employ a minimum of 80% of the low-skilled workers are sourced from the local area;</li> <li>• Where required, implement appropriate training and skills development programmes prior to the initiation of the construction phase to ensure that 80% target is met.</li> <li>• Skills audit to be undertaken to determine training and skills development requirements;</li> <li>• Develop a database of local BEE service providers and ensure that they are informed of tenders and job opportunities;</li> <li>• Identify potential</li> </ul>	<ul style="list-style-type: none"> <li>• !Khi CSP &amp; contractors</li> <li>• !Khi CSP</li> <li>• !Khi CSP</li> <li>• !Khi CSP</li> <li>• !Khi CSP</li> </ul>	<ul style="list-style-type: none"> <li>• Employment and business policy document that sets out local employment targets to be in place before construction phase commences.</li> <li>• Where required, training and skills development programmes to be initiated prior to the initiation of the construction phase.</li> <li>• Skills audit to determine need for training and skills development programme undertaken within 1 month of commencement of construction phase commences.</li> <li>• Database of potential local BEE services providers to be completed before</li> </ul>

opportunities for local businesses	construction phase commences.
<b>Performance Indicator</b>	<ul style="list-style-type: none"> <li>• Employment and business policy document that sets out local employment and targets completed before construction phase commences;</li> <li>• 80% of semi and unskilled labour locally sourced.</li> <li>• Database of potential local BEE services providers in place before construction phase commences.</li> <li>• Skills audit to determine need for training and skills development programme undertaken within 1 month of commencement of construction phase.</li> </ul>
<b>Monitoring</b>	<ul style="list-style-type: none"> <li>• !Khi CSP and or appointed ECO must monitor indicators listed above to ensure that they have been met for the construction phase.</li> </ul>

## Impact associated with presence of construction workers

**OBJECTIVE: Avoid the potential impacts on family structures and social networks associated with presence of construction workers from outside the area**

<b>Project component/s</b>	Construction and establishment activities associated with the establishment of the solar thermal plant, including infrastructure etc.	
<b>Potential Impact</b>	The presence of construction workers who live outside the area and who are housed in local towns can affect family structures and social networks.	
<b>Activity/risk source</b>	The presence of construction workers can impact negatively on family structures and social networks, especially in small, rural communities.	
<b>Mitigation: Target/Objective</b>	To avoid and or minimise the potential impact of construction workers on the local community. This can be achieved by maximising the number of locals employed during the construction phase and minimising the number of workers housed on the site.	
Mitigation: Action/control	Responsibility	Timeframe
<ul style="list-style-type: none"> <li>• Attempt to ensure that a minimum of 80% of the low-skilled workers are sourced from the local area. This should be included in the tender documents. Construction workers should be recruited from the local area in and around the towns of Upington, Keimoes, and Kakamas.</li> <li>• Local construction workers should be able to provide proof of having lived in the</li> </ul>	<ul style="list-style-type: none"> <li>• !Khi CSP and contractors</li> <li>• !Khi CSP</li> </ul>	<ul style="list-style-type: none"> <li>• Identify suitable local contractors prior to the tender process for the construction phase.</li> <li>• Tender documents for contractors include conditions set out in SIA, including transport of workers home over weekends, transportation of workers home on completion of construction phase, establishment of MF etc,</li> </ul>

<p>area for five years or longer.</p> <ul style="list-style-type: none"> <li>Identify local contractors who are qualified to undertake the required work.</li> <li>Consider establishing a Monitoring Forum (MF) consisting of representatives from the local community, local police, local farming community and the contractor prior to the commencement of the construction phase.</li> <li>Develop a Code of Conduct to cover the activities of the construction workers housed on the site.</li> <li>Ensure that construction workers housed attend a brief session before they commence activities. The aim of the briefing session is to inform them of the rules and regulations governing activities on the site as set out in the Code of Conduct.</li> <li>Ensure that all workers are informed at the outset of the construction phase of the conditions contained on the Code of Conduct.</li> <li>Ensure that construction workers who are found guilty of breaching the Code of Conduct are dismissed. All dismissals must be in accordance with South African labour legislation.</li> <li>Provide opportunities for workers to go home over weekends. The cost of transporting workers home over weekends and back to the site should be borne by the contractors.</li> <li>On completion of the construction phase all construction workers must be transported back to their place of origin within two days of their contract</li> </ul>	<ul style="list-style-type: none"> <li>!Khi CSP</li> <li>!Khi CSP</li> <li>!Khi CSP and contractors</li> <li>!Khi CSP and contractors</li> <li>Contractors</li> <li>Contractors</li> <li>Contractors</li> <li>Contractors</li> </ul>	<ul style="list-style-type: none"> <li>MF established before construction phase commences.</li> <li>Code of Conduct drafted before construction phase commences.</li> <li>Briefing session for construction workers held before they commence work on site.</li> </ul>
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ending. The costs of transportation must be borne by the contractor.		
Performance Indicator	<ul style="list-style-type: none"> <li>• Employment policy and tender documents that sets out local employment and targets completed before construction phase commences;</li> <li>• 80% of semi and unskilled labour locally sourced;</li> <li>• Local construction workers employed have proof that they have lived in the area for five years or longer;</li> <li>• Tender documents for contractors include recommendations for construction camp;</li> <li>• MF set up prior to implementation of construction phase;</li> <li>• Code of Conduct drafted before commencement of construction phase;</li> <li>• Briefing session with construction workers held at outset of construction phase;</li> </ul>	
Monitoring	<ul style="list-style-type: none"> <li>• !Khi CSP and or appointed ECO must monitor indicators listed above to ensure that they have been met for the construction phase.</li> </ul>	

### Safety, poaching, stock theft and damage to farm infrastructure

**OBJECTIVE: To avoid and or minimise the potential impact of the activities during the construction on the safety of local communities and the potential loss of stock and damage to farm infrastructure.**

Project component/s	Construction and establishment activities associated with the establishment of the solar thermal plant, including infrastructure etc.	
Potential Impact	Impact on safety of farmers and communities (increased crime etc) and potential loss of livestock due to stock theft by construction workers and also damage to farm infrastructure, such as gates and fences.	
Activity/risk source	The presence of construction workers on the site can pose a potential safety risk to local farmers and communities and may also result in stock thefts. The activities of construction workers may also result in damage to farm infrastructure.	
Mitigation: Target/Objective	To avoid and or minimise the potential impact on local communities and their livelihoods.	
Mitigation: Action/control	Responsibility	Timeframe
<ul style="list-style-type: none"> <li>• The housing of construction workers on the site should be limited to security personnel.</li> <li>• Consider establishing a MF with the adjacent farmers and develop a Code of Conduct for construction</li> </ul>	<ul style="list-style-type: none"> <li>• !Khi CSP and contractors</li> <li>• !Khi CSP</li> </ul>	<ul style="list-style-type: none"> <li>• Establish MF before construction phase commences.</li> <li>• Develop Code of Conduct prior to commencement of construction phase. The Code of Conduct should be signed by Khi CSP and the</li> </ul>

<p>workers.</p> <ul style="list-style-type: none"> <li>• Inform all workers of the conditions contained in the Code of Conduct.</li> <li>• Dismiss all workers that do not adhere to the code of conduct for workers. All dismissals must be in accordance with South African labour legislation.</li> <li>• Compensate farmers / community members at full market related replacement cost for any losses, such as livestock, damage to infrastructure etc.</li> </ul>	<ul style="list-style-type: none"> <li>• !Khi CSP and contractor</li> <li>• Contractors</li> <li>• Contractors</li> </ul>	<p>contractors before the contractors move onto site;</p> <ul style="list-style-type: none"> <li>• Inform all construction workers of Code of Conduct requirements before construction phase commences.</li> <li>• Compensate farmers / community members within 1 month of claim being verified by Khi CSP and or Contractor/s.</li> </ul>
Performance Indicator	<ul style="list-style-type: none"> <li>• Community MF in place before construction phase commences.</li> <li>• Code of Conduct developed and approved prior to commencement of construction phase.</li> <li>• All construction workers made aware of Code of Conduct within first week of being employed.</li> <li>• Compensation claims settled within 1 month of claim being verified by Community MF.</li> </ul>	
Monitoring	<ul style="list-style-type: none"> <li>• Khi CSP and or appointed ECO must monitor indicators listed above to ensure that they have been met for the construction phase.</li> </ul>	

## Increase risk of veld fires

**OBJECTIVE: To avoid and or minimise the potential risk of increased veld fires during the construction phase.**

Project component/s	Construction and establishment activities associated with the establishment of solar thermal plant, including infrastructure etc.	
Potential Impact	Veld fires can pose a personal safety risk to local farmers and communities, and their homes, crops, livestock and farm infrastructure, such as gates and fences.	
Activity/risk source	The presence of construction workers and their activities on the site can increase the risk of veld fires.	
Mitigation: Target/Objective	To avoid and or minimise the potential risk of veld fires on local communities and their livelihoods.	
Mitigation: Action/control	Responsibility	Timeframe
<ul style="list-style-type: none"> <li>• Ensure that open fires on the site for cooking or heating are not allowed except in designated areas.</li> <li>• Provide adequate fire</li> </ul>	<ul style="list-style-type: none"> <li>• !Khi CSP and contractors</li> <li>• !Khi CSP and</li> </ul>	<ul style="list-style-type: none"> <li>• Ensure that these conditions are included in the Construction Phase EMP.</li> <li>• Ensure that designated areas for fires are identified on site</li> </ul>

fighting equipment onsite. • Provide fire-fighting training to selected construction staff. • Compensate farmers / community members at full market related replacement cost for any losses, such as livestock, damage to infrastructure etc. • fpa	contractors • Contractors  • Contractors	at the outset of the construction phase. • Ensure that fire fighting equipment and training is provided before the construction phase commences. • Compensate Farmers within 1 month of claim being verified by MF.
Performance Indicator	• Conditions contained in the Construction EMP. • Designated areas for fires identified on site at the outset of the construction phase. • Fire fighting equipment and training provided before the construction phase commences. • Compensation claims settled within 1 month of claim being verified by Community MF.	
Monitoring	• !Khi CSP and or appointed ECO must monitor indicators listed above to ensure that they have been met for the construction phase.	

## Impact of dust and noise due to heavy vehicles and damage to roads

**OBJECTIVE: To avoid and or minimise the potential impacts of safety, noise and dust and damage to roads caused by construction vehicles during the construction phase.**

Project component/s	Construction and establishment activities associated with the establishment of the solar thermal plant, including infrastructure etc.	
Potential Impact	Heavy vehicles can generate noise and dust impacts. Movement of heavy vehicles can also damage roads.	
Activity/risk source	The movement of heavy vehicles and their activities on the site can result in noise and dust impacts and damage roads.	
Mitigation: Target/Objective	To avoid and or minimise the potential noise and dust impacts associated with heavy vehicles, and minimise damage to roads.	
Mitigation: Action/control	Responsibility	Timeframe
• Implement dust suppression measures for heavy vehicles such as wetting roads on a regular basis and ensuring that vehicles used to transport sand and building materials are fitted with tarpaulins or covers. • Ensure that all vehicles are road-worthy, drivers are	• Contractors     • Contractors	• Ensure that these conditions are included in the Construction Phase EMP. • Ensure that dust suppression measures are implemented for all heavy vehicles that require such measures during the construction phase commences. • Ensure that drivers are made



<p>qualified and are made aware of the potential noise, dust and safety issues.</p> <ul style="list-style-type: none"> <li>• Ensure that drivers adhere to speed limits. Vehicles should be fitted with recorders to record when vehicles exceed the speed limit.</li> <li>• Ensure that damage to roads is repaired before completion of construction phase.</li> </ul>	<ul style="list-style-type: none"> <li>• Contractors</li> <li>• Contractors</li> </ul>	<p>aware of the potential safety issues and enforcement of strict speed limits when they are employed.</p> <ul style="list-style-type: none"> <li>• Fit all heavy vehicles with speed monitors before they are used in the construction phase.</li> <li>• Assess road worthy status of heavy vehicles at the outset of the construction phase and on a monthly basis thereafter;</li> <li>• Ensure that damage to roads is repaired before completion of construction phase.</li> </ul>
Performance Indicator	<ul style="list-style-type: none"> <li>• Conditions included in the Construction Phase EMP.</li> <li>• Dust suppression measures implemented for all heavy vehicles that require such measures during the construction phase commences.</li> <li>• Drivers made aware of the potential safety issues and enforcement of strict speed limits when they are employed.</li> <li>• All heavy vehicles equipped with speed monitors before they are used in the construction phase.</li> <li>• Road worthy certificates in place for all heavy vehicles at outset of construction phase and up-dated on a monthly basis.</li> </ul>	
Monitoring	<ul style="list-style-type: none"> <li>• !Khi CSP and or appointed ECO must monitor indicators listed above to ensure that they have been met for the construction phase.</li> </ul>	

## Impact on farming activities

**OBJECTIVE: To avoid and or minimise the potential impact on current and future farming activities during the construction phase.**

Project component/s	Construction phase activities associated with the establishment of the solar thermal plant and associated infrastructure.	
Potential Impact	The footprint of the solar energy plant and associated infrastructure will result in a loss of land that will impact on farming activities on the site.	
Activity/risk source	The footprint taken up by the solar energy plant and associated infrastructure.	
Mitigation: Target/Objective	To minimise the loss of land taken up by the solar thermal plant and associated infrastructure and to enable farming activities to continue where possible, specifically grazing.	
Mitigation: Action/control	Responsibility	Timeframe
<ul style="list-style-type: none"> <li>• Minimise the footprint of the solar thermal plant and the</li> </ul>	<ul style="list-style-type: none"> <li>• Savannah Environmental</li> </ul>	<ul style="list-style-type: none"> <li>• Footprint for solar thermal plant should be defined in</li> </ul>

	associated infrastructure. • Rehabilitate disturbed areas on completion of the construction phase. Details of the rehabilitation programme should be contained in the EMP. • Investigate the possibility of allowing farmers in the area to continue to use the site for grazing, or the option of leasing the land for grazing to other local farmers and possibly emerging farmers.	and !Khi CSP • ECO and Contractors  • !Khi CSP	the Construction EMP before construction phase commences. • Rehabilitation should be on-going and completed within 3 months of the completion of the construction phase. • Meeting/s with local farmers to discuss lease options should take place during the construction phase.
Performance Indicator	• Footprint of solar thermal plant included in the Construction Phase EMP. • Meeting/s held with farmers during construction phase.		
Monitoring	• ECO must monitor indicators listed above to ensure that they have been met for the construction phase.		

## OPERATIONAL PHASE

### Creation of employment and business opportunities

**OBJECTIVE: Maximise local employment and business opportunities associated with the operational phase.**

<b>Project component/s</b>	Day to day operational activities associated with the solar thermal plant, including maintenance etc.	
<b>Potential Impact</b>	The opportunities and benefits associated with the creation of local employment and business should be maximised	
<b>Activity/risk source</b>	The operational phase of the solar thermal plant will create approximately 30 full time employment opportunities.	
<b>Mitigation: Target/Objective</b>	In the medium to long term employ as many locals as possible to fill the 30 full time employment opportunities.	
<b>Mitigation: Action/control</b>	<b>Responsibility</b>	<b>Timeframe</b>
<ul style="list-style-type: none"> <li>The entire workforce of 60 - 80 permanent staff will be based in local towns of Upington, Keimoes and Kakamas. Khi CSP should commit to implementing a 5-year training and skills development and training programme. The initial local content target is 30%, however, after 5 years the objective is to have all the employment opportunities taken up by locals.</li> <li>Identify local members of the community who are suitably qualified or who have the potential to be employed full time.</li> </ul>	<ul style="list-style-type: none"> <li>!Khi CSP</li> <li>!Khi CSP</li> </ul>	<ul style="list-style-type: none"> <li>Develop 5 year training and skills development programme during the construction phase</li> <li>Identify local members of the community who are suitably qualified or who have the potential to be employed full time during the construction phase.</li> </ul>
<b>Performance Indicator</b>	<ul style="list-style-type: none"> <li>5 year training and skills development programme developed and designed before construction phase completed.</li> <li>Potential locals identified before construction phase completed.</li> </ul>	
<b>Monitoring</b>	<ul style="list-style-type: none"> <li>Khi CSP must monitor indicators listed above to ensure that they have been met for the operational phase.</li> </ul>	

## Impact on tourism and highlight benefits of renewable energy projects

**OBJECTIVE:** Maximise the potential tourism opportunities during the operational phase. In addition, highlight the benefits of renewable energy projects.

Project component/s	Operational phase of the project.		
Potential Impact	The proposed solar thermal plant has the potential to provide Kai! Garib Municipality with an attraction that would improve its attraction to tourists. The development also has the potential to promote the benefits of renewable energy projects.		
Activity/risk source	The establishment of a solar thermal plant has the potential to create and attraction for visitors to the area. The development also has the potential to promote the benefits of renewable energy projects.		
Mitigation: Target/Objective	To enhance the potential tourism and renewable energy opportunities associated with the proposed solar thermal plant.		
Mitigation: Action/control	Responsibility	Timeframe	
<ul style="list-style-type: none"><li>• Liaise with representatives from the Kai! Garib Municipality and tourism organizations to raise awareness of the proposed solar thermal plant;</li><li>• Establish a renewable energy interpretation centre at the site. The centre should be equipped with information boards that provide visitors with information on the project and other relevant information. Information should also be provided on renewable energy and its benefits.</li><li>• Information should be presented in the main languages in the Northern Cape Province, namely Afrikaans, Setswana and English</li></ul>	<ul style="list-style-type: none"><li>• !Khe CSP</li><li>• !Khe CSP</li><li>• !Khe CSP</li></ul>	<ul style="list-style-type: none"><li>• Set up meeting with Kai! Garib Municipality and local tourism organisations during the construction phase.</li><li>• Establish interpretation centre at the outset of the construction phase. This will create an opportunity to provide tourists with information on both the construction and operational phases of the project.</li></ul>	
Performance Indicator	<ul style="list-style-type: none"><li>• Meeting with Kai! Garib Municipality and local tourism organisations during the construction phase.</li><li>• Establishment of interpretation centre at the outset of the construction phase.</li></ul>		
Monitoring	<ul style="list-style-type: none"><li>• !Khe CSP must monitor indicators listed above to ensure that they have been met for the operational phase.</li></ul>		

## DECOMMISSIONING PHASE

### Impact of decommissioning

**OBJECTIVE: To avoid and or minimise the potential impacts associated with the decommissioning phase.**

Project component/s	Decommissioning phase of the solar thermal plant		
Potential Impact	Decommissioning will result in job losses, which in turn can result in a number of social impacts, such as reduced quality of life, stress, depression etc. However, the number of people affected (60-80) is relatively small. Decommissioning is also similar to the construction phase in that it will also create temporary employment opportunities.		
Activity/risk source	Decommissioning of the solar thermal plant		
Mitigation: Target/Objective	To avoid and or minimise the potential social impacts associated with decommissioning phase of the solar thermal plant.		
Mitigation: Action/control	Responsibility	Timeframe	
<ul style="list-style-type: none"><li>Retrenchments should comply with South African Labour legislation of the day</li></ul>	<ul style="list-style-type: none"><li>Khi CSP</li></ul>	<ul style="list-style-type: none"><li>When solar thermal plant is decommissioned</li></ul>	
Performance Indicator	<ul style="list-style-type: none"><li>South African Labour legislation relevant at the time</li></ul>		
Monitoring	<ul style="list-style-type: none"><li>!Khi CSP and Department of Labour</li></ul>		

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# **PROPOSED UPINGTON SOLAR THERMAL PLANT, NORTHERN CAPE PROVINCE**

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## **CONSTRUCTION & OPERATION DRAFT ENVIRONMENTAL MANAGEMENT PLAN FOR THE UPINGTON SOLAR THERMAL PLANT PROJECT:**

**Submitted as part of the Final Environmental Impact Assessment Report  
December 2010**

**Prepared for**  
!Khi CSP South Africa  
Lords Office Estates  
276 West Avenue  
Centurion

**Prepared by**  
Savannah Environmental (Pty) Ltd  
PO Box 148  
Sunninghill  
2175



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## PROJECT DETAILS

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<b>DEA Reference No.</b>	: 12/12/20/1831
<b>Title</b>	: Draft Environmental Management Plan for the proposed Upington Solar Thermal Plant
<b>Authors</b>	: Savannah Environmental (Pty) Ltd Tammy Kruger & Karen Jodas
<b>Specialists</b>	: Tony Barbour Environmental Consulting & Research Outeniqua Geotechnical Services Scherman, Colloty & Associates David Hoare Consulting cc Birdlife South Africa McGregor Museum MetroGIS
<b>Client</b>	: Khi CSP South Africa (Pty) Ltd
<b>Report Status</b>	: Draft Environmental Management Plan submitted as part of the Final Environmental Impact Assessment Report for public review

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## DEFINITIONS AND TERMINOLOGY

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**Alternatives:** Alternatives are different means of meeting the general purpose and need of a proposed activity. Alternatives may include location or site alternatives, activity alternatives, process or technology alternatives, temporal alternatives or the 'do nothing' alternative.

**Concentrating solar power:** Solar generating facilities use the energy from the sun to generate electricity. Concentrating Solar Power facilities collect the incoming solar radiation and concentrate it (by focusing or combining it) onto a single point, thereby increasing the potential electricity generation.

**Cumulative impacts:** Impacts that result from the incremental impact of the proposed activity on a common resource when added to the impacts of other past, present or reasonably foreseeable future activities (e.g. discharges of nutrients and heated water to a river that combine to cause algal bloom and subsequent loss of dissolved oxygen that is greater than the additive impacts of each pollutant). Cumulative impacts can occur from the collective impacts of individual minor actions over a period and can include both direct and indirect impacts.

**Direct impacts:** Impacts that are caused directly by the activity and generally occur at the same time and at the place of the activity (e.g. noise generated by blasting operations on the site of the activity). These impacts are usually associated with the construction, operation, or maintenance of an activity and are generally obvious and quantifiable.

**'Do nothing' alternative:** The 'do nothing' alternative is the option of not undertaking the proposed activity or any of its alternatives. The 'do nothing' alternative also provides the baseline against which the impacts of other alternatives should be compared.

**Endangered species:** Taxa in danger of extinction and whose survival is unlikely if the causal factors continue operating. Included here are taxa whose numbers of individuals have been reduced to a critical level or whose habitats have been so drastically reduced that they are deemed to be in immediate danger of extinction.

**Endemic:** An "endemic" is a species that grows in a particular area (is endemic to that region) and has a restricted distribution. It is only found in a particular place. Whether something is endemic or not depends on the geographical boundaries of the area in question and the area can be defined at different scales.

**Environment:** the surroundings within which humans exist and that are made up of:



- i. The land, water and atmosphere of the earth;
- ii. Micro-organisms, plant and animal life;
- iii. Any part or combination of (i) and (ii) and the interrelationships among and between them; and
- iv. The physical, chemical, aesthetic and cultural properties and conditions of the foregoing that influence human health and well-being.

**Environmental impact:** An action or series of actions that have an effect on the environment.

**Environmental impact assessment:** Environmental Impact Assessment, as defined in the NEMA EIA Regulations and in relation to an application to which scoping must be applied, means the process of collecting, organising, analysing, interpreting and communicating information that is relevant to the consideration of that application.

**Environmental management:** Ensuring that environmental concerns are included in all stages of development, so that development is sustainable and does not exceed the carrying capacity of the environment.

**Environmental management plan:** An operational plan that organises and co-ordinates mitigation, rehabilitation and monitoring measures in order to guide the implementation of a proposal and its ongoing maintenance after implementation.

**Indigenous:** All biological organisms that occurred naturally within the study area prior to 1800

**Indirect impacts:** Indirect or induced changes that may occur because of the activity (e.g. the reduction of water in a stream that supply water to a reservoir that supply water to the activity). These types of impacts include all the potential impacts that do not manifest immediately when the activity is undertaken or which occur at a different place because of the activity.

**Interested and affected party:** Individuals or groups concerned with or affected by an activity and its consequences. These include the authorities, local communities, investors, work force, consumers, environmental interest groups, and the public.

**Photovoltaic effect:** Electricity can be generated using photovoltaic panels (semiconductors) which are comprised of individual photovoltaic cells that absorb solar energy to produce electricity. The absorbed solar radiation excites the electrons inside the cells and produces what is referred to as the Photovoltaic Effect.

**Power tower:** A Power Tower forms part of the central receiver type solar electricity generating technology. The purpose of the tower, which may be up to 200 m high, is to

structurally support the receiver. The receiver, consisting of metal tubes which transfer the heat from the solar radiation reflected on it by mirror fields, is used for generating the steam.

**Natural properties of an ecosystem (*sensu* convention on wetlands):** Defined in Handbook 1 as the "...physical, biological or chemical components, such as soil, water, plants, animals and nutrients, and the interactions between them." (Ramsar Convention Secretariat 2004. Ramsar handbooks for the wise use of wetlands. 2nd Edition. Handbook 1. Ramsar Convention Secretariat, Gland, Switzerland.) (See <http://www.ramsar.org/>).

**Ramsar convention on wetlands:** "The Convention on Wetlands (Ramsar, Iran, 1971) is an intergovernmental treaty whose mission is "the conservation and wise use of all wetlands through local, regional, and national actions and international cooperation, as a contribution towards achieving sustainable development throughout the world." As of March 2004, 138 nations have joined the Convention as Contracting Parties, and more than 1300 wetlands around the world, covering almost 120 million hectares, have been designated for inclusion in the Ramsar List of Wetlands of International Importance." (Ramsar Convention Secretariat. 2004. Ramsar handbooks for the wise use of wetlands. 2nd Edition, Handbook 1. Ramsar Convention Secretariat, Gland, Switzerland.) (Refer <http://www.ramsar.org/>). South Africa is a Contracting Party to the Convention.

**Rare species:** Taxa with small world populations that are not at present Endangered or Vulnerable, but are at risk as some unexpected threat could easily cause a critical decline. These taxa are usually localised within restricted geographical areas or habitats or are thinly scattered over a more extensive range. This category was termed Critically Rare by Hall and Veldhuis (1985) to distinguish it from the more generally used word "rare."

**Red data species:** Species listed in terms of the International Union for Conservation of Nature and Natural Resources (IUCN) Red List of Threatened Species, and/or in terms of the South African Red Data list. In terms of the South African Red Data list, species are classified as being extinct, endangered, vulnerable, rare, indeterminate, insufficiently known or not threatened (see other definitions within this glossary).

**Significant impact:** An impact that by its magnitude, duration, intensity, or probability of occurrence may have a notable effect on one or more aspects of the environment.

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## PURPOSE & OBJECTIVES OF THE EMP

## CHAPTER 1

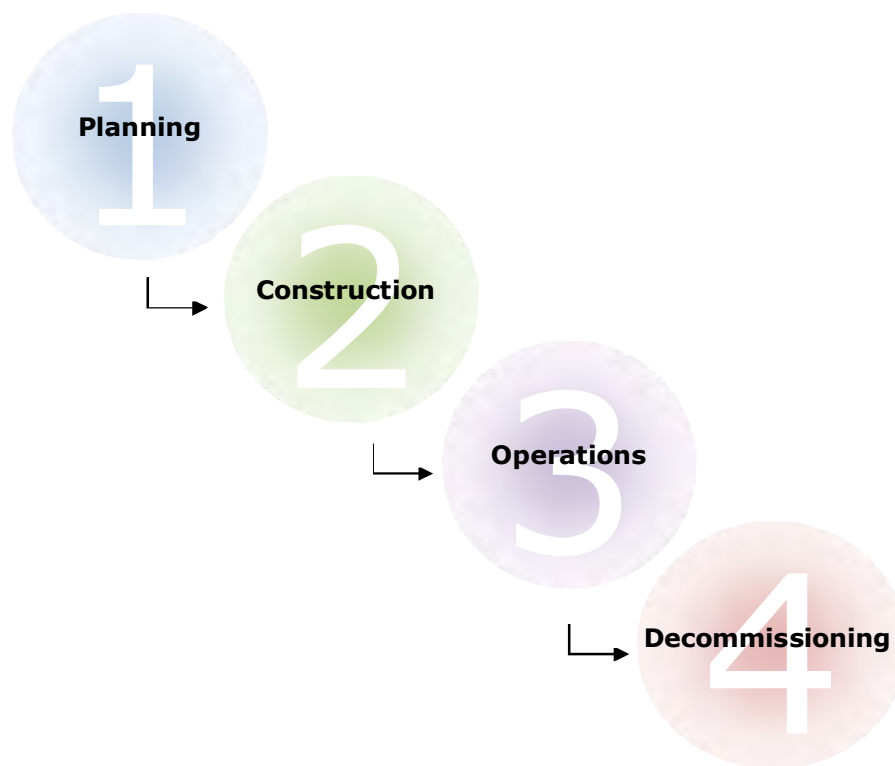
An Environmental Management Plan (EMP) is defined as “an environmental management tool used to ensure that undue or reasonably avoidable adverse impacts of the construction, operation and decommissioning of a project are prevented or mitigated, and that the positive benefits of the projects are enhanced”<sup>1</sup>. The objective of this EMP is to provide consistent information and guidance for implementing the management and monitoring measures established in the permitting process and help achieve environmental policy goals. The purpose of an EMP is to ensure continuous improvement of environmental performance, reducing negative impacts and enhancing positive effects during the construction and operation of the facility. An effective EMP is concerned with both the immediate outcome as well as the long-term impacts of the project.

The EMP provides specific environmental guidance for the construction and operation phases of a project, and is intended to manage and mitigate construction and operation activities so that unnecessary or preventable environmental impacts do not result. These impacts range from those incurred during start up (i.e. site clearing and site establishment), during the construction activities themselves (i.e. erosion, noise, dust, and visual impacts), during site remediation (i.e. soil stabilisation, re-vegetation), during operation and decommissioning (i.e. similar to construction phase activities).

The EMP has been developed as a set of environmental specifications (i.e. principles of environmental management), which are appropriately contextualised to provide clear guidance in terms of the on-site implementation of these specifications (i.e. on-site contextualisation is provided through the inclusion of various monitoring and implementation tools. During its lifecycle, a project journeys through four distinctive phases, as presented in Figure 1.1. The EMP is accordingly separated into measures dealing with the various project phases.

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<sup>1</sup> Provincial Government Northern Cape, Department of Environmental Affairs and Development Planning: *Guideline for Environmental Management Plans*. 2005



**Figure 1:** The four phases that form part of the development of a project and which are represented within this EMP

This EMP has the following objectives:

- » Outline mitigation measures and environmental specifications which are required to be implemented for the planning, construction and rehabilitation, operation, and decommissioning phases of the project in order to manage and minimise the extent of potential environmental impacts associated with the facility
- » Ensure that all the phases of the project do not result in undue or reasonably avoidable adverse environmental impacts, and ensure that any potential environmental benefits are enhanced
- » Identify entities responsible for the implementation of the measures and outline functions and responsibilities
- » Propose mechanisms and frequency for monitoring compliance, and preventing long-term or permanent environmental degradation
- » Facilitate appropriate and proactive responses to unforeseen events or changes in project implementation that was not considered in the EIA process

The management and mitigation measures identified within the Environmental Impact Assessment (EIA) process are systematically addressed in this EMP, and ensure the minimisation of adverse environmental impacts to an acceptable level.

Khi CSP South Africa (Pty) Ltd (!Khi CSP) must ensure that the implementation of the project complies with the requirements of all environmental authorisations, permits, and obligations emanating from other relevant environmental legislation. This obligation is partly met through the development and the implementation of this EMP through its integration into the contract documentation. Since this EMP is part of the EIA process it is important that this guideline document be read in conjunction with the Scoping Report (August 2010) and EIA Report (October 2010). This will contextualise the EMP and enable a thorough understanding of its role and purpose in the integrated environmental management process. This EMP has been compiled in accordance with Section 34 of the EIA Regulations and will be further developed in terms of specific requirements listed in any authorisations issued for the proposed project.

In order to achieve effective environmental management, it is important that Contractors are aware of the responsibilities in terms of the relevant environmental legislation and the contents of this EMP. The Contractor is responsible for informing employees and sub-contractors of their environmental obligations in terms of the environmental specifications, and for ensuring that employees are adequately experienced and properly trained in order to execute the works in a manner that will minimise environmental impacts. The Contractor's obligations in this regard include the following:

- » Employees must have a basic understanding of the key environmental features of the construction site and the surrounding environment.
- » A copy of the EMP must be easily accessible to all on-site staff members.
- » Employees must be familiar with the requirements of this EMP and the environmental specifications as they apply to the construction of the proposed facility.
- » Prior to commencing any site works, all employees and sub-contractors must have attended an environmental awareness training course which must provide staff with an appreciation of the project's environmental requirements, and how they are to be implemented.
- » Staff will be informed of environmental matters as deemed necessary by the ECO.



## PROJECT DETAILS

## CHAPTER 2

!Khi CSP is proposing the establishment of a commercial solar energy facility on Portion 3 of the Farm McTaggarts Camp 453, which lies approximately 20 km south-west of the town of Upington in the Northern Cape (Refer to Figure 2.1). Following an extensive site identification process undertaken by !Khi CSP, a 22 km<sup>2</sup> site which falls within the Kai !Gariep Local Municipality was identified for consideration within an EIA process.

A sensitivity analysis was undertaken during the Scoping Phase which identified potentially sensitive areas which should be avoided within the broader 22 km<sup>2</sup> site. These sensitive areas include natural drainage lines, areas of increased gradient/slope, potential occurrence of Red Data Species, and areas previously disturbed through mining activities. As a result, the south-eastern portion of the site was identified as a preferred area for development of the solar thermal plant, based on the following characteristics:

- » *Avoidance of key drainage lines:* the development footprint is not directly on or near the 'main channel' (i.e. the Helbrandkloofspruit), and would therefore present the least risk in terms of disturbance to natural hydrological regimes.
- » *Lower elevation:* the south-eastern portion of the site is located lower in the landscape (i.e. at a slightly lower elevation) than the northern portion of the site and therefore would present a lower risk in terms of erosion potential and potential for visual exposure.
- » *Proximity to the extraction point on the Orange (Gariep) River:* being in closer proximity to the point of abstraction will minimise the length of the water supply pipeline that is required between the raw water abstraction point and the proposed facility (i.e. approximately 10 km). In turn, this would reduce the potential for habitat disturbance by the pipeline.
- » *Proximity to the grid connection point:* being in closer proximity to the point of connection to the grid will minimise the length of the power line that is required between the proposed facility and the proposed 'turn in and turn out' configuration at the existing Eskom distribution line (i.e. approximately 4 km). In turn, this would reduce the potential for the linear disturbance associated with the power line including the potential for impacts on avifauna species.
- » *Proximity from areas previously disturbed through mining activities and potential heritage sites:* While the area previously disturbed through mining activities in the 1930s would be least sensitive in terms of ecological conservation value, those areas in the northern portion of the site degraded from previous mining activities on site could present a stability risk to the development. In addition, the heritage value/quality of the previous activities could preclude these areas from future development.

The proposed facility, which will be primarily contained within this identified portion, will have a developmental footprint of approximately 6 km<sup>2</sup>. The facility is proposed to be comprised of Concentrating Solar Power (CSP) and Concentrating/Tracking Photovoltaic Power (CPV) components with an overall maximum generating capacity of 110 MW. The facility will be comprised of a combination of the following technologies (in any combination):

- » 50 MW trough plant (CSP system consisting of several rows of parabolic troughs).
- » 50 MW power tower plant (CSP system consisting of a field of heliostats/ mirrors positioned around a central receiver/power tower).
- » 10 MW PV (CPV system consisting of several rows of photovoltaic (PV) panels).

The Renewable Energy Feed-in Tariff (REFIT) Process (criteria not yet finalised by the National Energy Regulator of South Africa (NERSA)), selection process (not finalised by the Department of Energy, together with National Treasury), and the economics of the solar facility will be key in determining the final technology combination and the schedule of implementation for the facility.

The following associated infrastructural requirements will also be established within the developmental footprint of the proposed facility:

- » A **power island** which will include:
  - » A **steam turbine** and **generator** typically housed within a 2-storey building.
  - » A generator **transformer** and a small **substation** located outside and adjacent to the 2-storey building.
  - » An **auxiliary steam boiler** and associated vessels (i.e. fossil fuel boiler/generator), proposed to be fired by either diesel fuel or liquid petroleum gas (LPG).
- » An **overhead power line** feeding into the Eskom electricity network via a 'turn in and turn out' configuration to the existing Eskom distribution line running approximately 4 km south of the site (i.e. the Eskom Gordonia / Oasis 132 kV distribution line) (Refer to the footnote below and to Figure 2.2).
- » An **abstraction point** on the Orange / Gariep River and an associated water **supply pipeline** to the facility.
- » A **suspension reservoir** located approximately 0.6 km north-west of the raw water abstraction point (i.e. outside the boundaries of the identified site) to rid the raw water of particles in suspension.
- » A **storage reservoir** located approximately 8.5 km west of the abstraction point (i.e. within the boundaries of the identified site). The water stored within the reservoir will be used during the steam generation process (boiler makeup), for washing of the heliostats/mirrors, troughs and PV panels, potable water supply and fire protection supply.

- » Lined **evaporation ponds** to allow for the evaporation of water not to be re-used within the facility.
- » **External access road** leading to the site, either from the N14 or from the existing D3276 <sup>2</sup>(Refer to the footnote below and to Figure 2.2).
- » **Internal access roads** for construction and maintenance purposes<sup>3</sup>.
- » **Workshop, office, and storage areas.**

In terms of the findings of the EIA Report, various planning, construction, and operation-related environmental impacts were identified, including:

- » Disturbance of the ecological environment (i.e. flora and fauna).
- » Impacts on avifauna (i.e. particularly on Red Data Species).
- » Impacts on water resources (i.e. in terms of quantity and quality).
- » Impacts on the visual aesthetics and sensitive receptors.
- » Impacts on the underlying geology (i.e. in terms soil disturbance and erosion).
- » Impacts on heritage resources.
- » Socio-economic impacts.

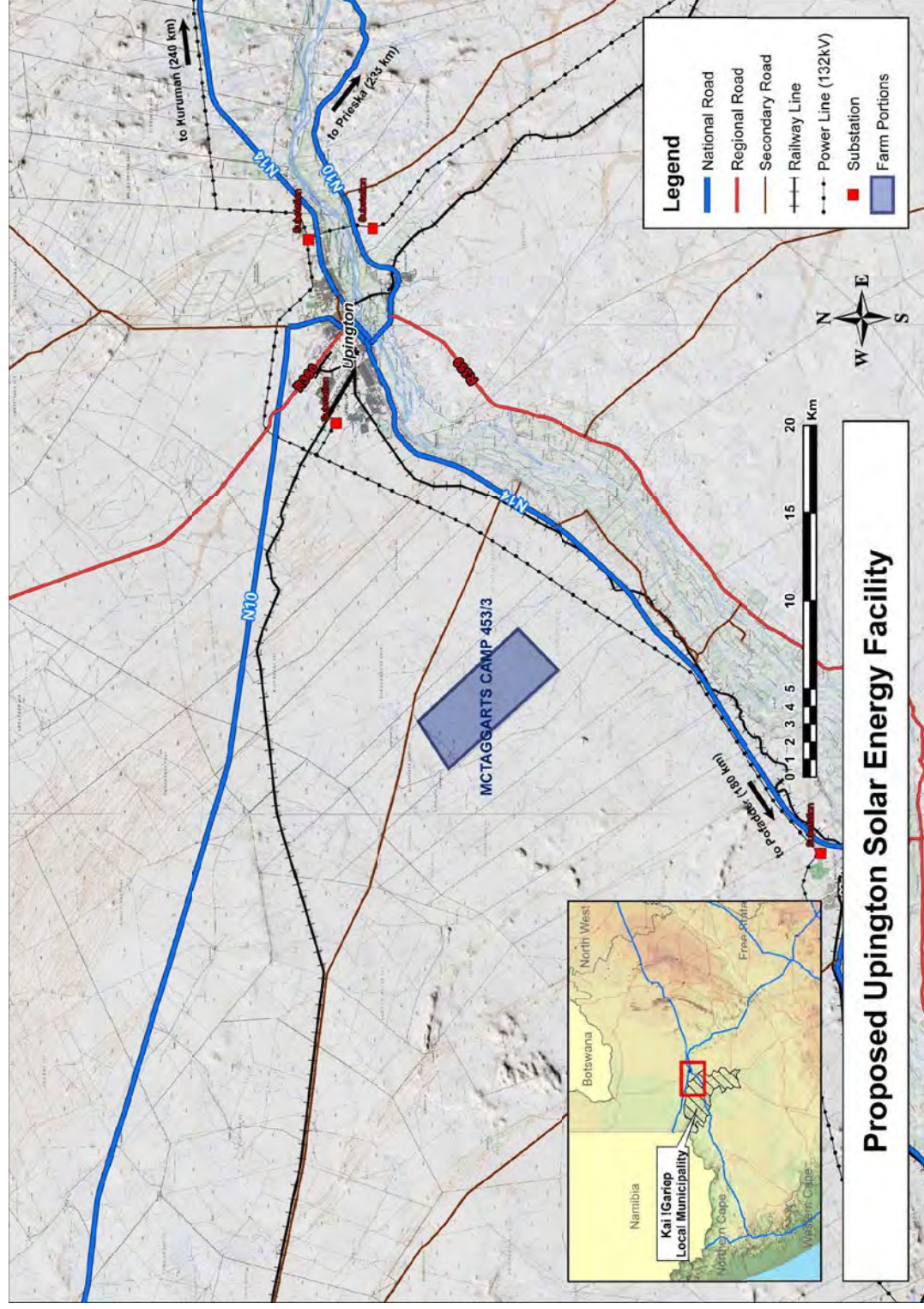
**The specialist studies undertaken in the EIA Phase did not identify any absolute no go areas for the proposed facility.** However, the following potentially sensitive areas within the preferred south-eastern portion of the project area were identified:

- » Areas of **ecological** sensitivity (i.e. drainage lines, areas with remaining natural vegetation and protected tree species, potential habitat for various red data species, and activities which lead to the proliferation of alien invasive plants).
- » Sensitivity in terms of **water resources** (i.e. in terms of drainage lines and riverine areas along the Orange River at the abstraction point).
- » Issues regarding **avifaunal** sensitivity (i.e. potential impacts on red data species through collision or electrocution events with the overhead power line and the solar infrastructure).
- » Areas of **geological** sensitivity (i.e. drainage lines on-site which may be more susceptible to erosion).
- » **Visual** sensitivity (i.e. the visibility of sensitive receptors along major routes, arterial, and secondary roads in the area, built-up centres or populated places and on individual/isolated landowners/homesteads identified within the study area).

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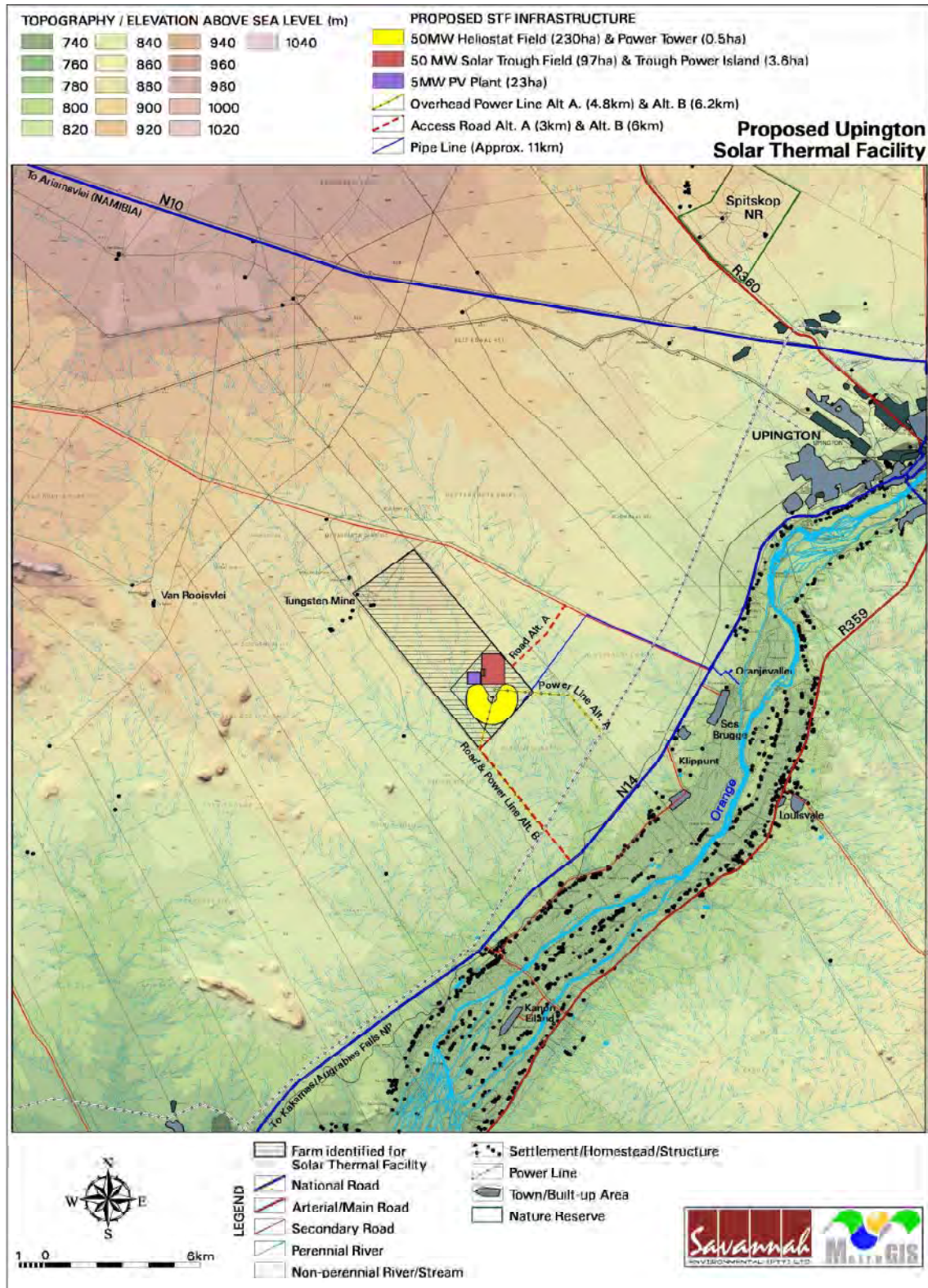
<sup>2</sup> Alternative A (the preferred route): this alternative is preferred by virtue of it being a shorter distance  
Alternative B (the alternative route): this alternative is longer than the preferred route

<sup>3</sup> Depending on the technology selection, there will be one internal asphalt access road of approximately 6 m wide which will lead directly to the power island



**Figure 2.1:** Map indicating the farm portion identified for the proposed facility near Upington, Northern Cape





**Figure 2.2:** Map indicating the potential layout including the solar array, and the alternative routes for the power line and the external access road.

The site identified during the Scoping Phase (i.e. the south-eastern portion) is not devoid of sensitive areas as it is still traversed by drainage lines. However the higher order drainage lines, including the main watercourse (i.e. the Helbrandkloofspruit) in the centre of the site are regarded more sensitive and therefore more important to protect than the ephemeral ones located within the south-eastern portion.

Generalised recommendations, in terms of the layout and/or technical characteristics of the proposed facility as made by the specialists are described below.

In order to reduce/avoid impacts on **avifauna** the following has been suggested:

- » The diversity and abundance of bird species is greater in the drainage channels as opposed to the open plains, and therefore as much of this habitat should be kept intact, where possible. The servitude of the power line should follow existing roads where possible and should not cut across habitat (i.e. as per Alternative B).
- » The power line should be kept as low as possible and the span lengths of the power line should be kept as short as possible taking into account engineering and legal requirements.<sup>4</sup>

In order to reduce/avoid impacts the **visual** impacts the following has been suggested:

- » The siting of ancillary infrastructure needs to be properly planned with due cognisance of the topography.
- » Alternative B for both the proposed external access road and the power line are favoured, since this routing may allow for impact consolidation.
- » The placement of lay-down areas and temporary construction camps should be carefully considered in order to not negatively influence the future perception of the facility.
- » The placement of light fixtures should be planned in order to reduce visual impacts associated with glare and light trespass.
- » Ancillary structures (i.e. water supply pipeline) should, if possible, be placed underground to avoid additional visual clutter.

This EMP has been developed based on the findings of the EIA Phase, and must be implemented to protect sensitive features (i.e. both on and off-site) through controlling construction and operation activities that could have a detrimental effect on the environment, and avoiding or minimising potential impacts.

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<sup>4</sup> Due to the low skills levels in the area, the majority of skilled posts are likely to be filled by people from outside the area.

## 2.1 Activities and Components associated with the Upington Solar Thermal Plant

The main activities/components associated with the Upington Solar Thermal Plant are detailed below in Table 2.1.

**Table 2.1:** Activities associated with Planning, Construction, Operation, and Decommissioning of the facility

Main Activity/Project Component	Components of Activity	Details
<b>Planning</b>		
Conduct technical surveys	<ul style="list-style-type: none"> <li>» Geotechnical survey by geotechnical engineering company.</li> <li>» Site survey and confirmation of the micro-siting footprint for the solar arrays and associated infrastructure.</li> <li>» Survey of power line, external access road, and water supply pipeline servitudes.</li> </ul>	<ul style="list-style-type: none"> <li>» All surveys are to be undertaken prior to initiating construction.</li> </ul>
Conduct environmental surveys (environmental specialists)	<ul style="list-style-type: none"> <li>» Heritage surveys.</li> </ul>	<ul style="list-style-type: none"> <li>» A surface collection and characterisation of the archaeological site at 28.54109° S 21.08842 ° E be carried out (i.e. the work associated with this task should be achievable within a period of not more than two days).</li> </ul>
<b>Construction</b>		
Establishment of access roads	<ul style="list-style-type: none"> <li>» Establish external access road.</li> <li>» Establish internal access road (i.e. one internal asphalt access road of approximately 6 m wide which will lead directly to the power island for use during construction and operation phase).</li> </ul>	<ul style="list-style-type: none"> <li>» Access roads will be constructed in advance of any components being delivered to site, and will remain in place after completion for future access and possibly access for replacement of parts if necessary.</li> <li>» Existing access roads to the site will be utilised, and upgraded where required.</li> <li>» Special haul roads may need to be constructed to and within the site to accommodate abnormally loaded vehicle access and circulation.</li> <li>» The internal service road alignment will be informed by the</li> </ul>

Main Activity/Project Component	Components of Activity	Details
Undertake site preparation	<ul style="list-style-type: none"> <li>» Site establishment of offices/workshop with ablutions, storage areas, and a contractor's yard.</li> <li>» Clearance of vegetation at the footprint of the power block, storage areas, power tower, and parabolic troughs.</li> </ul>	<p>final micro-siting/positioning of the solar array and the power island.</p> <ul style="list-style-type: none"> <li>» These activities will require the stripping of topsoil, which will need to be appropriately stockpiled for use in rehabilitation.</li> <li>» A temporary construction area is needed for containers, toilets, and equipment.</li> <li>» Requires the clearing of vegetation and levelling of the development site.</li> <li>» A lay down area for building materials and equipment associated with these buildings will also be required.</li> </ul>
Construct foundations for the power tower, power island and workshops, offices, and storage areas	<ul style="list-style-type: none"> <li>» Excavations for foundations (final dimensions to be defined by final design and EPC contractor).</li> </ul>	<ul style="list-style-type: none"> <li>» Foundation holes will be excavated as required.</li> <li>» Shoring and safety barriers will be erected.</li> <li>» Aggregate and cement to be transported from the closest centre to the development, with the establishment of a small concrete batching plant close to the activities (i.e. this would most likely be a movable plant).</li> </ul>
Transport of components and equipment to site	<ul style="list-style-type: none"> <li>» Flatbed trucks will be used to transport all components to site.</li> <li>» The normal civil engineering construction equipment for the civil works (e.g. excavators, trucks, graders, compaction equipment, cement mixers, etc).</li> <li>» The components required for the establishment of the substation (including transformers).</li> <li>» Components required for the establishment of the power line</li> </ul>	<ul style="list-style-type: none"> <li>» The solar arrays will be brought to site by the supplier in sections to be established on-site in a designated building</li> <li>» Individual components <i>may</i> be defined as abnormal loads in terms of the Road Traffic Act (Act No 29 of 1989) by virtue of the dimensional limitations.</li> <li>» The dimensional requirements of the load during the construction phase (length/height) may require alterations to the existing road infrastructure (widening on corners, removal of traffic islands), accommodation of street furniture (electricity, street lighting, traffic signals, telephone lines etc.), and protection of road-related structures (bridges, culverts, portal culverts, retaining walls etc) as a result of</li> </ul>



Main Activity/Project Component	Components of Activity	Details
	<ul style="list-style-type: none"> <li>(including monopole towers and cabling).</li> <li>» Ready-mix cement trucks for power tower, power block, and workshop/storage area foundations.</li> </ul>	<ul style="list-style-type: none"> <li>» abnormal loading.</li> <li>» The equipment will be transported to the site using appropriate National and Provincial routes, and the dedicated access/haul road to the site itself.</li> </ul>
Construct power island and ancillary infrastructure	<ul style="list-style-type: none"> <li>» Steam turbine and generator.</li> <li>» Generator transformer.</li> <li>» Small substation.</li> <li>» An auxiliary steam boiler and associated vessels (i.e. fossil fuel boiler/ generator), proposed to be fired by either diesel fuel or liquid petroleum gas (LPG).</li> <li>» Substation and associated components.</li> <li>» Security fencing around high-voltage (HV) yard.</li> </ul>	<ul style="list-style-type: none"> <li>» The substation will be constructed with a high-voltage (HV) yard footprint of up to 50 m x 50 m.</li> <li>» The substation would be constructed in the following simplified sequence: <ul style="list-style-type: none"> <li>* <u>Step 1:</u> Survey of the site;</li> <li>* <u>Step 2:</u> Site clearing and levelling and construction of access road to substation site;</li> <li>* <u>Step 3:</u> Construction of terraces and foundations;</li> <li>* <u>Step 4:</u> Assembly, erection and installation of equipment (including transformers);</li> <li>* <u>Step 5:</u> Connection of conductors to equipment; and</li> <li>* <u>Step 6:</u> Rehabilitation of any disturbed areas and protection of erosion sensitive areas.</li> </ul> </li> </ul>
Connection of the PV panels and the steam turbine and generator to the substation	<ul style="list-style-type: none"> <li>» CSP infrastructure.</li> <li>» 11/15/22 kV underground electrical cabling connecting the steam turbine and generator or PV panels to the substation.</li> </ul>	<ul style="list-style-type: none"> <li>» The installation of these cables will require the excavation of trenches, approximately 1 m in depth within which these cables can then be laid.</li> <li>» The underground cables would follow the internal access roads as far as reasonably possible.</li> </ul>
Connect substation to the power grid	<ul style="list-style-type: none"> <li>» One 132 kV power line connecting to the "Oasis/Gordonia" 132 kV distribution line.</li> </ul>	<ul style="list-style-type: none"> <li>» The nominated preferred route for the power line will be assessed, surveyed, and pegged prior to construction.</li> <li>» Servitude of approximately 35 m will be required for the power line.</li> </ul>
Commissioning of the facility	<ul style="list-style-type: none"> <li>» Solar energy facility commissioning</li> </ul>	<ul style="list-style-type: none"> <li>» Prior to the start-up of solar component, a series of checks and tests will be carried out, including both static and</li> </ul>

Main Activity/Project Component	Components of Activity	Details
Undertake site remediation	<ul style="list-style-type: none"> <li>» Remove all construction equipment from the site.</li> <li>» Rehabilitation of temporarily disturbed areas where practical and reasonable.</li> </ul>	<p>dynamic tests to make sure it is working within appropriate limits.</p> <ul style="list-style-type: none"> <li>» Grid interconnection and unit synchronisation will be undertaken to confirm the performance.</li> <li>» On full commissioning of the facility, any access points to the site which are not required during the operation phase will be closed and prepared for rehabilitation.</li> </ul>
<b>Operation</b>		
Operation	<ul style="list-style-type: none"> <li>» Operation of power tower and heliostat field; parabolic troughs; and PV panels within the solar energy facility.</li> </ul>	<ul style="list-style-type: none"> <li>» Once operational, the solar energy facility will be monitored and maintained by a staff complement of approximately 60 - 80 full time employees combined total, for all plants.</li> <li>» All the solar components will be operational, except under circumstances of mechanical breakdown, extreme weather conditions, or maintenance activities.</li> </ul>
Maintenance	<ul style="list-style-type: none"> <li>» Oil and grease – moving components of the solar arrays.</li> <li>» Oil (i.e. heat transfer fluid) for the parabolic troughs.</li> <li>» Diesel or LPG for the auxiliary boiler.</li> <li>» Transformer oil – substation.</li> <li>» Waste product disposal.</li> </ul>	<ul style="list-style-type: none"> <li>» The solar components will be subject to periodic maintenance and inspection.</li> <li>» Any waste products (e.g. used oil etc.) will be disposed of in accordance with relevant waste management legislation (OHS Act).</li> <li>» The solar infrastructure is expected to have a lifespan of approximately 30 years, with maintenance expandable to 50 years.</li> </ul>
<b>Decommissioning</b>		
Site preparation	<ul style="list-style-type: none"> <li>» Confirming the integrity of the access to the site to accommodate required equipment.</li> <li>» Preparation of the site.</li> <li>» Mobilisation of construction</li> </ul>	<ul style="list-style-type: none"> <li>» Equipment associated with this facility would only be decommissioned once it has reached the end of its economic life.</li> <li>» It is most likely that decommissioning activities of the infrastructure of the facility would comprise the disassembly</li> </ul>

Main Activity/Project Component	Components of Activity	Details
Disassemble and replace existing solar components	<p>equipment.</p> <ul style="list-style-type: none"> <li>» General construction equipment will be required to replace components of the solar facility.</li> </ul>	<p>and replacement of the solar infrastructure with more appropriate technology/infrastructure available at that time.</p> <ul style="list-style-type: none"> <li>» Components would be reused, recycled, or disposed of in accordance with regulatory requirements.</li> <li>» The hours of operation for noisy construction activities are guided by the Environment Conservation Act (noise control regulations)</li> <li>» If the project requires .construction work outside of the designated hours, regulatory authorities, and affected stakeholders will be consulted and subsequent negotiations will be made to ensure the suitability of the revised activities.</li> </ul>

## STRUCTURE OF THIS EMP

## CHAPTER 3

The first two chapters provide background to the EMP and the proposed project, while the chapters which follow consider the following:

- » Planning and design activities;
- » Construction activities;
- » Operation activities; and
- » Decommissioning activities.

These chapters set out the procedures necessary for !Khi CSP to achieve environmental compliance. For each of the phases of implementation for the solar energy facility project, an over-arching environmental **goal** is stated. In order to meet this goal, a number of **objectives** are listed. The management programme has been structured in table format in order to show the links between the goals for each phase and their associated objectives, activities/risk sources, mitigation actions, monitoring requirements and performance indicators. A specific environmental management programme table has been established for each environmental objective. The information provided within the EMP table for each objective is illustrated below:

**OBJECTIVE: Description of the objective, which is necessary in order to meet the overall goals; these take into account the findings of the EIA specialist studies**

<b>Project Component/s</b>	List of project components affecting the objective.
<b>Potential Impact</b>	Brief description of potential environmental impact if objective is not met.
<b>Activity/Risk Source</b>	Description of activities which could affect achieving objective.
<b>Mitigation: Target/Objective</b>	Description of the target; include quantitative measures and/or dates of completion.

<b>Mitigation: Action/Control</b>	<b>Responsibility</b>	<b>Timeframe</b>
List specific action(s) required to meet the mitigation target/objective described above.	Who is responsible for the measures?	Time periods for implementation of measures

<b>Performance Indicator</b>	Description of key indicator(s) that track progress/indicate the effectiveness of the management programme.
<b>Monitoring</b>	Mechanisms for monitoring compliance; the key monitoring actions required to check whether the objectives are being achieved, taking into

consideration responsibility, frequency, methods and reporting.

The objectives and EMP tables are required to be reviewed and possibly modified whenever changes, such as the following, occur:

- » Planned activities change (i.e. in terms of the components and/or layout of the facility);
- » Modification to or addition to environmental objectives and targets;
- » Relevant legal or other requirements are changed or introduced; and
- » Significant progress has been made on achieving an objective or target such that it should be re-examined to determine if it is still relevant, should be modified, etc.

### 3.1. Project Team

This Draft EMP was compiled by:

	<b>Name</b>	<b>Company</b>
<b>EMP Compilers:</b>	Tammy Kruger – Environmental Assessment Practitioner (EAP) Karen Jodas – EAP	Savannah Environmental
<b>Specialists:</b>	David Hoare – Impacts on Fauna, Flora & Ecological Environment	David Hoare Consulting
	David Morris – Impacts on Heritage Resources	McGregor Museum
	Martin Taylor - Ornithologist	Birdlife South Africa
	Iain Paton – Impacts on Geology, Soils & Erosion Potential	Outeniqua Geotechnical Services
	Lourens du Plessis – Impacts on Visual Aesthetics	MetroGIS
	Patsy Scherman & Brian Colloty – Impacts on Water Resources	Scherman, Colloty & Associates
	Tony Barbour - Social Impacts	Tony Barbour Environmental Consulting & Research

The Savannah Environmental team have extensive knowledge and experience in EIA and environmental management, having been involved in EIA processes over the past ten (10) years. They have managed and drafted EMPs for other power generation projects throughout South Africa, including numerous wind and solar energy facilities.

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## MANAGEMENT PROGRAMME FOR SOLAR ENERGY FACILITY: CHAPTER 4 PLANNING & DESIGN

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### 4.1. Goal for Planning and Design

**Overall Goal for Planning and Design:** Undertake the planning and design phase of the solar energy facility in a way that:

- » Ensures that the design of the facility responds to the identified environmental constraints and opportunities.
- » Ensures that adequate regard has been taken of any landowner concerns and that these are appropriately addressed through design and planning (where appropriate).
- » Ensures that the best environmental options are selected for the project, including the power line alignment and substation site.
- » Enables the solar energy facility construction activities to be undertaken without significant disruption to other land uses in the area.

In order to meet this goal, the following objectives have been identified, together with necessary actions and monitoring requirements.

### 4.2. Objectives

**OBJECTIVE: Ensure the design of the facility responds to the identified environmental constraints and opportunities**

From the specialist investigations undertaken for the proposed solar energy facility development site, no absolute 'no go' areas were identified. However, a number of potentially sensitive areas were identified to be associated with the proposed project.

In order to minimise impacts associated with the construction and operation of the solar energy facility and associated infrastructure, the following surveys are required to be undertaken during the final design phase of the facility:

- » Geotechnical survey; and
- » A storm-water management plan that details how storm-water off hard surfaces will be managed to reduce velocities and volumes of water that could lead to erosion of surfaces.

<b>Project Component/s</b>	Project components affecting the objective: » Power tower and heliostat field, parabolic troughs, and PV panels; » Power island; » Access roads; » Substation; and » Power line.
<b>Potential Impact</b>	Design fails to respond optimally to the environmental consideration
<b>Activities/Risk Sources</b>	Positioning of solar components and access roads; Positioning of substation; and Alignment of power line.
<b>Mitigation: Target/Objective</b>	Ensure that the design of the facility responds to the identified environmental constraints and opportunities

<b>Mitigation: Action/Control</b>	<b>Responsibility</b>	<b>Timeframe</b>
Undertake pre-construction surveys.	Specialists	Design phase
Consider design level mitigation measures recommended, especially with respect to visual aesthetics, flora, water resources and associated ecology, avifauna, and heritage, as detailed within the EIA report.	EPC Contractor !Khi CSP	Design review stage
Access roads to be carefully planned to minimise the impacted area and prevent unnecessary over compaction of soil.	EPC Contractor !Khi CSP	Design phase
A detailed geotechnical investigation is required for the design phase.	!Khi CSP	Design phase
Compile a comprehensive storm water management plan for hard surfaces (e.g. substation and power island footprints) as part of the final design of the project.	EPC Contractor !Khi CSP	Design phase
A sustainable design approach should be considered in finalising the design of key elements.	EPC Contractor !Khi CSP	Tender design and design review stage

<b>Performance Indicator</b>	Design meets objectives and does not degrade the environment. Design layouts etc respond to the mitigation measures and recommendations in the EIA report.
<b>Monitoring</b>	Ensure that the design implemented meets the objectives and mitigation measures in the EIA report through review of the design by the Project Manager, and ECO prior to the commencement of construction.

**OBJECTIVE: Ensure selection of best environmental option for alignment/design of the 132 kV power line, substation and associated access roads**

One 132 kV power line is proposed to connect the substation within the power island to the electricity network/grid, a distance of approximately 4 km. Alternative routes/corridors for the power line were identified and assessed in the EIA phase. From the conclusions of the specialist studies undertaken within the EIA, the preferred power line alternative is Alternative B as it represents an opportunity for the consolidation of impacts with Alternative B for the external access road (refer to Figure 2.2):

<b>Project Component/s</b>	Power line; and Substation.
<b>Potential Impact</b>	Route that degrades environment unnecessarily, particularly with respect to visual aesthetics, loss of indigenous flora, erosion. Substation site that degrades environment unnecessarily, particularly with respect to visual aesthetics, loss of indigenous flora, erosion.
<b>Activities/Risk Sources</b>	Alignment of power line within corridor. Construction of substation.
<b>Mitigation: Target/Objective</b>	To ensure selection of best environmental option for alignment for the power line and site for the substation.

<b>Mitigation: Action/Control</b>	<b>Responsibility</b>	<b>Timeframe</b>
Select an alignment that curtails environmental impacts and enhances environmental benefits.	EPC Contractor !Khi CSP	Prior to submission of Final EIA
Consider design level mitigation measures recommended, especially with respect to visual aesthetics, flora, ecology (i.e. drainage lines), avifauna, and heritage, as detailed within the EIA report.	EPC Contractor !Khi CSP	Design phase
Plan new access roads according to contour lines to minimise cutting and filling operations.	EPC Contractor !Khi CSP	Design phase
Use bird-friendly power line tower and conductor designs.	EPC Contractor !Khi CSP	Design phase
The most sensitive landscape features for planning purposes in the study area will be the presence of drainage lines, and areas of indigenous natural vegetation.	EPC Contractor !Khi CSP	Design phase
In the case of Alternative B being selected for the power line and the external access road, they should be routed as close as possible.	EPC Contractor !Khi CSP	Design phase

<b>Performance</b>	Power line alignments meet environmental objectives.
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<b>Indicator</b>	Selected power line alignments that minimises any negative environmental impacts and maximises any benefits.
<b>Monitoring</b>	Ensure that the design implemented meets the objectives and mitigation measures in the EIA report through review of the design by the Project Manager, and the ECO prior to the commencement of construction.

## MANAGEMENT PROGRAMME FOR SOLAR ENERGY FACILITY: CHAPTER 5 CONSTRUCTION

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### 5.1. Overall Goal for Construction

**Overall Goal for Construction:** Undertake the construction phase of the solar energy facility in a way that:

- » Ensures that construction activities are properly managed in respect of environmental aspects and impacts.
- » Enables construction activities to be undertaken without significant disruption to other land uses in the area, in particular concerning noise impacts, farming practices, traffic and road use, and effects on local residents.
- » Minimises the impact on the indigenous natural vegetation, protected tree species, and habitats of ecological value (i.e. drainage lines).
- » Minimises impacts on avifauna and other fauna using the site.
- » Minimises the impact on the heritage and historical value of the site.
- » Establishes an environmental baseline during construction activities on the site, where possible, particularly with regard to priority bird species using the site.

### 5.2. Objectives

In order to meet this goal, the following objectives have been identified, together with necessary actions and monitoring requirements.

**OBJECTIVE: Environmentally sensitive location of construction equipment camps on site**

It is expected that all construction workers will be accommodated within existing accommodation within the study area as far as possible. No construction workers will be accommodated on site. In addition, construction equipment may need to be stored at an appropriate location on the site, along the power line routes and at the substation site for the duration of the construction period.

Project Component/s
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Project components affecting the objective:
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- |   |
|---|
| <ul style="list-style-type: none"><li>» Heliostat field and power tower;</li><li>» Parabolic troughs;</li><li>» PV panels;</li><li>» Power islands;</li><li>» Power line; and</li></ul> |
|---|

	» Access roads.
<b>Potential Impact</b>	Damage to indigenous natural vegetation; Damage to and/or loss of topsoil; Compacting of ground; and Impacts on the surrounding environment due to inadequate sanitation and waste removal facilities.
<b>Activities/Risk Sources</b>	Bush clearing and levelling of equipment storage area/s; and Access to and from the equipment storage area/s.
<b>Mitigation: Target/Objective</b>	To minimise impacts on the social and biophysical environment; and To limit equipment storage to within the demarcated site.

<b>Mitigation: Action/Control</b>	<b>Responsibility</b>	<b>Timeframe</b>
Before construction commences, representatives from the local authority and community-based organisations (e.g. residents associations), as well as neighbouring residents should be informed of the details of the construction company, size of the workforce and construction schedules.	EPC Contractor !Khi CSP	Pre-construction
The siting of the construction equipment camp will take cognisance of any sensitive areas identified by the EIA studies. The location of this construction equipment camp shall be approved by the project ECO.	EPC Contractor !Khi CSP	Pre-construction
As far as possible, minimise vegetation clearing and levelling for equipment storage areas.	EPC Contractor	Erection: Site establishment Maintenance: contract duration
Rehabilitate all disturbed areas at the construction equipment camp as soon as construction is complete within an area.	EPC Contractor	Duration of Contract

<b>Performance Indicator</b>	No visible erosion scars once construction in an area is completed. No claims regarding damage due to unauthorised removal of vegetation. All damaged areas successfully rehabilitated one year after completion. No damage to drainage lines and/or riverine areas. Appropriate waste management.
<b>Monitoring</b>	Regular audits of the construction camps and areas of construction on site. An incident reporting system should be used to record non-conformances to the EMP.

## OBJECTIVE: Securing the site and site establishment

The EPC Contractor must take all reasonable measures to ensure the safety of the public in the surrounding area. Where the public could be exposed to danger by any of the works or site activities, the EPC Contractor must, as appropriate, provide suitable flagmen, barriers and/or warning signs in English, Afrikaans and any other relevant local languages, all to the approval of the Site Manager.

All unattended open excavations shall be adequately demarcated and/or fenced (fencing shall consist of a minimum of three strands of wire wrapped with danger tape). Adequate protective measures must be implemented to prevent unauthorised access to the working area and the internal access/haul routes.

<b>Project Component/s</b>	Project components affecting the objective: » Heliostat field and power tower; » Parabolic troughs; » PV panels; » Power island; » Power line; » Access roads; and » Pipeline and abstraction point.
<b>Potential Impact</b>	Hazards to landowners and public; Security of materials; and Substantially increased damage to adjacent sensitive vegetation, due largely to ignorance of where such areas are located.
<b>Activities/Risk Sources</b>	Open excavations (foundations and cable trenches); and Movement of construction vehicles in the area and on-site.
<b>Mitigation: Target/Objective</b>	To secure the site against unauthorised entry; and To protect members of the public/landowners/residents.

<b>Mitigation: Action/Control</b>	<b>Responsibility</b>	<b>Timeframe</b>
Secure site, working areas and excavations in an appropriate manner, as agreed with the ECO.	EPC Contractor	Erection: during site establishment Maintenance: duration of contract
Where necessary to control access, fence and secure area.	EPC Contractor	Erection: during site establishment Maintenance: duration of contract

Mitigation: Action/Control	Responsibility	Timeframe
Fence and secure EPC Contractor's equipment camp.	EPC Contractor	Erection: during site establishment Maintenance: duration of contract
All development footprints for roads, buildings, underground cables, laydown areas should be fenced off with two strand wire and clearly indicated with flags and/or danger tape strips. There is to be no disturbance outside these demarcated areas, at least not without the permission of the ECO.	EPC Contractor	Erection: during site establishment Maintenance: duration of contract
Establish the necessary ablution facilities with chemical toilets and provide adequate sanitation facilities and ablutions for construction workers (1 toilet per every 15 workers) at appropriate locations on site.	EPC Contractor	Erection: during site establishment Maintenance: duration of contract
Ablution or sanitation facilities should not be located within 100 m from a 1:100 year flood line including water courses, wetlands or within a horizontal distance of less than 100 m, whichever is applicable	EPC Contractor	During site establishment, construction, & maintenance
Supply adequate waste collection bins at site where construction is being undertaken.	EPC Contractor	Erection: during site establishment Maintenance: duration of contract within a particular area
Dispose of all solid waste collected at an appropriately registered waste disposal site. Waste disposal shall be in accordance with all relevant legislation. Under no circumstances may waste be burnt on site.	EPC Contractor	Erection: during site establishment Maintenance: duration of contract within a particular area
Where a registered waste site is not available close to the construction site, provide a method statement with regard to waste management.	EPC Contractor	Site establishment

<b>Performance Indicator</b>	Site is secure and there is no unauthorised entry; and No members of the public/ landowners injured.
<b>Monitoring</b>	An incident reporting system will be used to record non-conformances to the EMP. ECO to monitor all construction areas on a continuous basis until all

construction is completed; immediate report backs to site manager.

**OBJECTIVE: Maximise local employment and business opportunities associated with the construction phase**

The construction phase is expected to create approximately 300 - 500 employment opportunities over a two - three year period where approximately 60% will be low skilled positions (i.e. construction labourers, security staff etc) and semi-skilled workers (i.e. drivers, equipment operators etc) and 40% will be available to skilled personnel (i.e. engineers, land surveyors, project managers etc). EPC Contractors typically make use of their own skilled and semi-skilled staff. Direct employment opportunities to members of local communities are therefore likely to be limited to low skilled opportunities.

<b>Project Component/s</b>	Construction and establishment activities associated with the establishment of the facility, including infrastructure etc.
<b>Potential Impact</b>	The opportunities and benefits associated with the creation of local employment and business should be maximised where possible.
<b>Activities/Risk Sources</b>	The employment of outside EPC Contractors to undertake the work and who make use of their own labour will reduce the employment and business opportunities for locals.
<b>Mitigation: Target/Objective</b>	In discussions with the Kai !Gariep Municipality, !Khi CSP and all EPC Contractors should aim to employ as many as possible of the low-skilled workers from the local area.

<b>Mitigation: Action/Control</b>	<b>Responsibility</b>	<b>Timeframe</b>
Ensure that as many as possible of the low-skilled workers are sourced from the local area.	!Khi CSP EPC Contractors	Before construction phase commences.
Where required, implement appropriate training and skills development programmes prior to the initiation of the construction phase.	EPC Contractor !Khi CSP	Where required, training and skills development programmes to be initiated prior to the initiation of the construction phase
Skills audit to be undertaken to determine training and skills development requirements.	EPC Contractor !Khi CSP	Skills audit to determine need for training & skills development (i.e. within 1 month of commencement of construction phase

Mitigation: Action/Control	Responsibility	Timeframe
		commences
Identify potential opportunities for local businesses.	EPC Contractor !Khi CSP	

<b>Performance Indicator</b>	Employment and business policy document that sets out local employment and targets completed before construction phase commences. Semi and unskilled labour locally sourced. Skills audit to determine need for training and skills development programme undertaken within 1 month of commencement of construction phase.
<b>Monitoring</b>	!Khi CSP and or appointed ECO must monitor indicators listed above to ensure that they have been met for the construction phase.

**OBJECTIVE: Avoid potential impacts on family structures and social networks associated with presence of construction workers from outside the area**

The presence of construction workers poses a potential risk to family structures and social networks. While the presence of construction workers does not in itself constitute a social impact, the manner in which construction workers conduct themselves can affect local communities. The most significant negative impact is associated with the disruption of existing family structures and social networks. This risk is linked to potentially risky behaviour of male construction workers, including:

- » An increase in alcohol and drug use.
- » An increase in crime levels.
- » The loss of girlfriends and or wives to construction workers.
- » An increase in teenage and unwanted pregnancies.
- » An increase in prostitution.
- » An increase in sexually transmitted diseases (STDs).
- »

<b>Project Component/s</b>	Construction and establishment activities associated with the establishment of the solar energy facility, including infrastructure etc.
<b>Potential Impact</b>	The presence of construction workers who live outside the area and who are housed in local towns can impact on family structures and social networks.
<b>Activities/Risk Sources</b>	The presence of construction workers can impact negatively on family structures and social networks, especially in small, rural communities.
<b>Mitigation: Target/Objective</b>	To avoid and or minimise the potential impact of construction workers on the local community which can be achieved by maximising the number of locals employed during the construction phase and minimising the number of workers housed on the site.

Mitigation: Action/Control	Responsibility	Timeframe
Ensure that a portion of the low-skilled workers is sourced from the local area. Construction workers should be recruited from the local area in and around the towns of Upington, Keimoes, and Kakamas where possible.	!Khi CSP EPC Contractor	Identify suitable local contractors prior to the tender process for the construction phase
Identify local Contractors who are qualified to undertake the required work.	!Khi CSP	Before construction phase commences
Develop a Code of Conduct to cover the activities of the construction workers.	!Khi CSP EPC Contractors	
Ensure that construction workers attend a briefing session before they commence activities, the aim of the briefing session is to inform them of the rules, and regulations governing activities on the site as set out in the Code of Conduct.	!Khi CSP EPC Contractors	
Ensure that all workers are informed at the outset of the construction phase of the conditions contained on the Code of Conduct.	EPC Contractors	
On completion of the construction phase all construction workers must leave the site within one week of their contract ending.	EPC Contractors	

<b>Performance Indicator</b>	Employment policy and tender documents that sets out local employment and targets completed before construction phase commences. Portion of semi and unskilled labour locally sourced. Code of Conduct drafted before commencement of construction phase; Briefing session with construction workers held at outset of construction phase.
<b>Monitoring</b>	!Khi CSP and or appointed ECO must monitor indicators listed above to ensure that they have been met for the construction phase.

**OBJECTIVE: Avoid and or minimise potential impacts of the activities during the construction on the safety of local communities and the potential loss of stock and damage to farm infrastructure**

<b>Project Component/s</b>	Construction and establishment activities associated with the establishment of the solar thermal plant, including infrastructure etc.
<b>Potential Impact</b>	Impact on safety of farmers and communities (increased crime etc) and potential loss of livestock and also damage to farm infrastructure, such as



	gates and fences.
<b>Activities/Risk Sources</b>	The presence of construction workers on the site can pose a potential safety risk to local farmers and communities and may result in stock losses. The activities of construction workers may also result in damage to farm infrastructure.
<b>Mitigation: Target/Objective</b>	To avoid and or minimise the potential impact on local communities and their livelihoods.

<b>Mitigation: Action/Control</b>	<b>Responsibility</b>	<b>Timeframe</b>
The housing of construction workers on the site should be limited to security and essential personnel.	!Khi CSP EPC Contractor	Before construction phase commences
Develop a Code of Conduct for construction workers.	!Khi CSP EPC Contractor	Develop Code of Conduct prior to commencement of construction phase. The Code of Conduct should be signed by Khi CSP and the EPC Contractors before the EPC Contractors move onto site
Inform all workers of the conditions contained in the Code of Conduct.	EPC Contractor	Inform all construction workers of Code of Conduct requirements before construction phase commences
Manage non-adherence to the code of conduct for workers in accordance with South African labour legislation and disciplinary procedures.	EPC Contractors	As above

<b>Performance Indicator</b>	Code of Conduct developed and approved prior to commencement of construction phase. All construction workers made aware of Code of Conduct within first week of being employed.
<b>Monitoring</b>	Khi CSP and or appointed ECO must monitor indicators listed above to

ensure that they have been met for the construction phase.

**OBJECTIVE: Avoid and or minimise the potential risk of veld fires during the construction phase**

<b>Project Component/s</b>	Construction and establishment activities associated with the establishment of solar thermal plant, including infrastructure etc.
<b>Potential Impact</b>	Veld fires can pose a risk to local farmers and communities, and their livestock and farm infrastructure, such as gates and fences.
<b>Activities/Risk Sources</b>	The presence of construction workers and their activities on the site can increase the risk of veld fires.
<b>Mitigation: Target/Objective</b>	To avoid and or minimise the potential risk of veld fires on local communities and their livelihoods.

<b>Mitigation: Action/Control</b>	<b>Responsibility</b>	<b>Timeframe</b>
Ensure that open fires on the site for cooking or heating are not allowed except in designated areas.	EPC Contractors	Ensure that these conditions are included in the Construction Phase EMP.
Provide adequate fire fighting equipment onsite.	EPC Contractors	Ensure that designated areas for fires are identified on site at the outset of the construction phase.
Provide fire-fighting training to selected construction staff.	EPC Contractors	Ensure that fire fighting equipment and training is provided before the construction phase commences.
<b>Performance Indicator</b>	Designated areas for fires identified on site at the outset of the construction phase. Fire fighting equipment and training provided before the construction phase commences.	
<b>Monitoring</b>	!Khi CSP and or appointed ECO must monitor indicators listed above to ensure that they have been met for the construction phase.	

**OBJECTIVE: Avoid and or minimise potential impacts of safety, noise and dust and damage to roads caused by construction vehicles**

<b>Project Component/s</b>	Construction and establishment activities associated with the establishment of the solar thermal plant, including infrastructure etc.
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<b>Potential Impact</b>	Heavy vehicles can generate dust impacts, and can damage roads.
<b>Activities/Risk Sources</b>	The movement of heavy vehicles and their activities on the site can result in dust impacts and damage to roads.
<b>Mitigation: Target/Objective</b>	To avoid and or minimise the potential dust impacts associated with heavy vehicles, and minimise damage to roads.

<b>Mitigation: Action/Control</b>	<b>Responsibility</b>	<b>Timeframe</b>
Implement dust suppression measures for heavy vehicles such as wetting roads on a regular basis and ensuring that vehicles used to transport sand and building materials are fitted with tarpaulins or covers if wind conditions necessitate such.	EPC Contractors	Construction phase
Ensure that all vehicles are road-worthy; drivers are qualified and are made aware of the potential noise, dust and safety issues.	EPC Contractors	Construction phase
Ensure that drivers adhere to speed limits.	EPC Contractors	Construction phase
Ensure that damage to roads is repaired before completion of construction phase.	EPC Contractors	Construction phase

<b>Performance Indicator</b>	Conditions included in the Construction Phase EMP. Dust suppression measures implemented for all heavy vehicles that require such measures during the construction phase. Drivers made aware of the potential safety issues and enforcement of strict speed limits when they are employed. Road worthy certificates in place for all heavy vehicles at outset of construction phase.
<b>Monitoring</b>	!Khi CSP and/or appointed ECO must monitor indicators to ensure that they have been met for the construction phase.

**OBJECTIVE: Avoid and or minimise potential impacts on current and future farming activities during the construction phase**

<b>Project Component/s</b>	Construction phase activities associated with the establishment of the solar thermal plant and associated infrastructure.
<b>Potential Impact</b>	The footprint of the solar energy plant and associated infrastructure will result in a loss of land that will impact on farming activities on the site.
<b>Activities/Risk Sources</b>	The footprint taken up by the solar energy plant and associated infrastructure.
<b>Mitigation: Target/Objective</b>	To minimise the loss of land taken up by the solar facility and associated infrastructure and to enable farming activities to continue where possible, specifically grazing.

<b>Mitigation: Action/Control</b>	<b>Responsibility</b>	<b>Timeframe</b>
Minimise the footprint of the facility and the associated infrastructure.	!Khi CSP EPC Contractors	Duration of construction
Rehabilitate disturbed areas on completion of the construction phase.	EPC Contractor	Duration of construction

<b>Performance Indicator</b>	Footprint of solar thermal plant included in the Construction Phase EMP.
<b>Monitoring</b>	ECO must monitor indicators listed above to ensure that they have been met for the construction phase.

**OBJECTIVE: Management of dust and air emissions**

During the construction phase, limited gaseous or particulate emissions are anticipated from exhaust emissions from construction vehicles and equipment on-site, as well as vehicle entrained dust from the movement of vehicles on the main and internal access roads.

<b>Project Component/s</b>	Construction and establishment activities associated with the establishment of the solar energy facility and associated infrastructure.
<b>Potential Impact</b>	Dust and particulates from vehicle movement to and on-site, foundation excavation, road construction activities, road maintenance activities, temporary stockpiles, and vegetation clearing affecting the surrounding residents and visibility. Release of minor amounts of air pollutants (for example NO <sub>2</sub> , CO and SO <sub>2</sub> ) from vehicles and construction equipment.
<b>Activities/Risk</b>	Clearing of vegetation and topsoil.

<b>Sources</b>	Excavation, grading, scraping, levelling, digging, drilling. Transport of materials, equipment, and components on internal access roads. Re-entrainment of deposited dust by vehicle movements. Wind erosion from topsoil and spoil stockpiles and unsealed roads and surfaces. Fuel burning vehicle and construction engines.
<b>Mitigation: Target/Objective</b>	To ensure emissions from all vehicles and construction engines are minimised, where possible, for the duration of the construction phase. To minimise nuisance to the community from dust emissions and to comply with workplace health and safety requirements for the duration of the construction phase as contained in the OHS Act.

<b>Mitigation: Action/Control</b>	<b>Responsibility</b>	<b>Timeframe</b>
Roads must be maintained to a manner that will ensure that nuisance to the community from dust emissions from road or vehicle sources is not visibly excessive Ensure that damage to roads is repaired before completion of construction phase.	EPC Contractor	Site establishment  Duration of construction
Appropriate dust suppressant must be applied on all exposed areas and stockpiles as required to minimise/control airborne dust.	EPC Contractor	Duration of contract
Haul vehicles moving outside the construction site carrying material that can be wind-blown must be covered with tarpaulins if required by the wind conditions.	EPC Contractor	Duration of contract
Speed of construction vehicles must be restricted, as defined by the ECO.	EPC Contractor	Duration of contract
Dust-generating activities or earthworks may need to be rescheduled or the frequency of application of dust control/suppressant increased during periods of high winds if visible dust is blowing toward nearby residences.	EPC Contractor	Duration of contract
Strictly control vibration pollution from compaction plant or excavation plant.	EPC Contractor	Duration of contract
Disturbed areas must be re-vegetated as soon as practicable.	EPC Contractor	Completion of the construction phase
Vehicles and equipment must be maintained in a road-worthy condition at all times.	EPC Contractor	Duration of contract
If monitoring results or complaints indicate inadequate performance against the criteria indicated, then the source of the problem must be identified, and existing procedures or equipment modified to ensure the problem is rectified.	EPC Contractor	Duration of contract

Mitigation: Action/Control	Responsibility	Timeframe
<b>Performance Indicator</b>	<p>No complaints from affected residents or community regarding dust or vehicle emissions.</p> <p>Dust suppression measures implemented for all heavy vehicles that require such measures during the construction phase commences.</p> <p>Drivers made aware of the potential safety issues and enforcement of strict speed limits when they are employed.</p> <p>Road worthy certificates in place for all heavy vehicles at outset of construction phase.</p>	
<b>Monitoring</b>	<p>Monitoring must be undertaken to ensure emissions are not exceeding the prescribed levels via the following methods:</p> <p>Immediate reporting by personnel of any potential or actual issues with nuisance dust or emissions to the Site Manager.</p> <p>A complaints register must be maintained, in which any complaints from residents/the community will be logged, and thereafter complaints will be investigated and, where appropriate, acted upon.</p> <p>An incident reporting system must be used to record non-conformances to the EMP.</p>	

#### OBJECTIVE: Control loss of indigenous vegetation

<b>Project Component/s</b>	Any infrastructure or activity that will result in disturbance to natural areas.
<b>Potential Impact</b>	Loss of indigenous natural vegetation due to construction activities.
<b>Activity/Risk Source</b>	<p>Vegetation clearing.</p> <p>Construction of access roads.</p> <p>Placement of power line and cables.</p> <p>Construction/placement of water pipeline, storage/treatment reservoirs.</p> <p>Establishment of borrow and spoil areas.</p> <p>Chemical contamination of the soil by construction vehicles &amp; machinery.</p> <p>Operation of construction camps.</p> <p>Storage of materials required for construction.</p>
<b>Mitigation: Target/Objective</b>	<p>To retain natural vegetation in the highly sensitive areas the site.</p> <p>To minimise footprints of disturbance of vegetation/habitats on-site.</p> <p>To minimise loss of indigenous vegetation.</p> <p>No loss of species of conservation concern.</p>

Mitigation: Action/Control	Responsibility	Timeframe
The construction impacts must be contained to the footprint of the infrastructure.	EPC Contractor	Construction phase
Limit unnecessary impacts on surrounding natural vegetation must be avoided, e.g. driving around in the veld, use access roads only.	EPC Contractor	Construction phase

Mitigation: Action/Control	Responsibility	Timeframe
<b>Performance Indicator</b>	Loss of natural vegetation equivalent to the exact footprint of the proposed project.	
<b>Monitoring</b>	<p>Before construction, determine required number of hectares to accommodate footprint of proposed infrastructure.</p> <p>After construction, determine amount of natural vegetation lost due to construction.</p>	

**OBJECTIVE: Control the establishment and spread of alien invasive plants**

<b>Project Component/s</b>	Any infrastructure or activity that will result in disturbance to natural areas.
<b>Potential Impact</b>	Invasion of natural vegetation surrounding the site by declared weeds or invasive alien species.
<b>Activities/Risk Sources</b>	Construction, environmental management.
<b>Mitigation: Target/Objective</b>	There is a target of no alien plants within project control area during the construction and operation phases.

Mitigation: Action/Control	Responsibility	Timeframe
Avoid creating conditions in which alien plants may become established: » Keep disturbance of indigenous vegetation to a minimum. » Rehabilitate disturbed areas as quickly as possible. » Do not import soil from areas with alien plants.	EPC Contractor	Construction phase Operational phase
Establish an ongoing monitoring programme to detect and quantify any alien species that may become established and identify the problem species (as per Conservation of Agricultural Resources Act).	EPC Contractor ECO	Construction phase Operational phase
Immediately control any alien plants that become established using registered control methods.	EPC Contractor ECO	Construction phase Operational phase

<b>Performance Indicator</b>	For each alien species: number of plants and aerial cover of plants within project area and immediate surroundings.
<b>Monitoring</b>	<p>Ongoing monitoring of area by ECO during construction.</p> <p>Ongoing monitoring of area by environmental manager during operation.</p> <p>Annual audit of project area and immediate surroundings by qualified botanist.</p> <p>If any alien invasive species are detected then the distribution of these</p>

	<p>should be mapped (GPS co-ordinates of plants or concentrations of plants), number of individuals (whole site or per unit area), age and/or size classes of plants and aerial cover of plants.</p> <p>The results should be interpreted in terms of the risk posed to sensitive habitats within and surrounding the project area.</p> <p>The environmental manager should be responsible for driving this process.</p> <p>Reporting frequency depends on legal compliance framework.</p>
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**OBJECTIVE: Limit damage to drainage lines in terms of ecology**

<b>Project Component/s</b>	Any infrastructure or activity that will result in disturbance to watercourses.
<b>Potential Impact</b>	<p>Damage to watercourses by any means that will result in hydrological changes (includes erosion, siltation, dust, direct removal of soil of vegetation, dumping of material within wetlands).</p> <p>The focus should be on the functioning of the watercourse as a natural system.</p>
<b>Activity/Risk Source</b>	Construction & operation of the facility.
<b>Mitigation: Target/Objective</b>	No unnecessary damage to watercourse areas within project area.

<b>Mitigation: Action/Control</b>	<b>Responsibility</b>	<b>Timeframe</b>
For any new construction, cross watercourses perpendicularly to minimise disturbance footprints.	EPC Contractor	Construction phase Operational phase
Rehabilitate any disturbed areas as quickly as possible.	EPC Contractor	Construction phase Operational phase
Control storm water and runoff water.	EPC Contractor	Construction phase Operational phase
Obtain a permit from DWA to impact on any wetland or water resource.	EPC Contractor	Construction phase Operational phase

<b>Performance Indicator</b>	No impacts on water quality, wetland vegetation, natural status of watercourses outside of footprint of infrastructure.
<b>Monitoring</b>	Habitat loss in watercourses should be monitored before and after



construction.

The environmental manager should be responsible for driving this process.  
Reporting frequency depends on legal compliance framework.

## OBJECTIVE: Soil and rock degradation and erosion control

The natural soil on the site needs to be preserved as far as possible to minimise impacts on the environment. Soil degradation including erosion (by wind and water) and subsequent deposition elsewhere is of a concern across the entire site which is underlain by fine grained soil which can be mobilised when disturbed, even on relatively low slope gradients (accelerated erosion). Uncontrolled run-off relating to construction activity (excessive wetting, uncontrolled discharge, etc.) will also lead to accelerated erosion. Degradation of the natural soil profile due to excavation, stockpiling, compaction, pollution and other construction activities will affect soil forming processes and associated ecosystems. Degradation of parent rock is considered low as there are no excessively deep excavations envisaged.

<b>Project Component/s</b>	Heliostat field and power tower, parabolic troughs, and PV panels Power island Power line Water pipeline and water storage/treatment reservoirs Offices and workshops
<b>Potential Impact</b>	Soil and rock degradation. Soil erosion. Increased deposition of soil into drainage systems. Increased run-off over the site.
<b>Activities/Risk Sources</b>	Construction activity – removal of vegetation, excavation, stockpiling, compaction, and pollution of soil. Rainfall - water erosion of disturbed areas. Wind erosion of disturbed areas. Concentrated discharge of water from construction activity.
<b>Mitigation: Target/Objective</b>	To minimise extent of disturbance areas. To minimise activity within disturbance areas. To minimise soil degradation (mixing, wetting, compaction, etc). To minimise soil erosion. To minimise deposition of soil into drainage lines. To minimise instability of embankments/excavations.

<b>Mitigation: Action/Control</b>	<b>Responsibility</b>	<b>Timeframe</b>
Identify disturbance areas and restrict construction activity to these areas.	ECO EPC Contractor	Before construction During

Mitigation: Action/Control	Responsibility	Timeframe
		construction
Restrict construction activity within disturbance areas.	ECO EPC Contractor	Before construction During construction
Access roads to be carefully planned and constructed to minimise the impacted area and prevent unnecessary excavation, placement, and compaction of soil.	ECO EPC Contractor	Before c
Dust control on construction site: wetting of denuded areas.	EPC Contractor	During construction
Minimise removal of vegetation which adds stability to soil.	EPC Contractor	During construction
Rehabilitate disturbance areas as soon practicable when an area is vacated.	EPC Contractor	During construction After construction
Soil conservation: Stockpile topsoil for re-use in rehabilitation phase, protect stockpile from erosion.	EPC Contractor	Before construction During construction
Erosion control measures: Run-off attenuation on slopes (sand bags, logs), silt fences, storm water catch-pits, shade nets, or temporary mulching over denuded area as required.	EPC Contractor	Before construction Maintenance: duration of contract
Where access roads cross natural drainage lines, culverts must be designed to allow free flow and regular maintenance must be carried out.	EPC Contractor	Before construction Maintenance duration of contract
Control depth of excavations and stability of cut faces/sidewalls.	EPC Contractor	Before construction Maintenance Duration of contract

<b>Performance Indicator</b>	<p>No activity outside disturbance areas.</p> <p>Acceptable level of activity within disturbance areas, as determined by ECO.</p> <p>Acceptable level of soil erosion around site, as determined by ECO.</p> <p>Acceptable level of increased siltation in drainage lines, as determined by ECO.</p> <p>Acceptable level of soil degradation, as determined by ECO.</p> <p>Acceptable state of excavations, as determined by ECO.</p> <p>No activity in restricted areas.</p>
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<b>Monitoring</b>	<p>Monthly inspections of the site.</p> <p>Monthly inspections of sediment control devices.</p> <p>Monthly inspections of surroundings, including drainage lines.</p> <p>Immediate reporting of ineffective sediment control systems.</p> <p>An incident reporting system will record non-conformances.</p>
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**OBJECTIVE: Minimise the loss of riparian systems**

<b>Project Component/s</b>	Site selection with regard minimising the overall impact on the functioning of the riparian environment.
<b>Potential Impact</b>	Loss of important habitat and fragmentation of the riverine systems.
<b>Activities/Risk Sources</b>	Site selection and incorrect placement of the development footprint.
<b>Mitigation: Target/Objective</b>	Minimise the loss of riparian systems - incorrect footprint / site selection.

<b>Mitigation: Action/Control</b>	<b>Responsibility</b>	<b>Timeframe</b>
Select a favourable site having the least impact or within an area that is least sensitive, i.e. the south-eastern portion of the site.	!Khi CSP	Planning phase Design phase

<b>Performance Indicator</b>	N/A
<b>Monitoring</b>	N/A

**OBJECTIVE: Minimising the overall impact on the functioning of the riparian environment**

<b>Project Component/s</b>	Site selection with regard minimising the overall impact on the functioning of the riparian environment.
<b>Potential Impact</b>	Loss of important habitat and fragmentation of the riverine systems.
<b>Activities/Risk Sources</b>	Placement of hard engineered surfaces.
<b>Mitigation: Target/Objective</b>	Minimise the loss of riparian habitat – physical removal and replacement by hard surfaces.

<b>Mitigation: Action/Control</b>	<b>Responsibility</b>	<b>Timeframe</b>
Select a favourable site, having the least impact or within an area that is least sensitive, i.e. the south	!Khi CSP	Planning phase Design phase

Mitigation: Action/Control	Responsibility	Timeframe
eastern portion of the site.		

<b>Performance Indicator</b>	N/A
<b>Monitoring</b>	N/A

#### OBJECTIVE: Minimising alteration of the hydrological regime

<b>Project Component/s</b>	Alteration of sandy substrata into hard surfaces affecting the local hydrological regime.
<b>Potential Impact</b>	Poor stormwater management and the alteration hydrological regime.
<b>Activities/Risk Sources</b>	Placement of hard engineered surfaces.
<b>Mitigation: Target/Objective</b>	Reduce the potential increase in surface flow velocities and the impact on dry riverbeds and the localised drainage systems.

Mitigation: Action/Control	Responsibility	Timeframe
The most significant form of mitigation would be to select a development area that contained no drainage lines. However due to the nature of the site, this was not possible, thus an area, with the least number of riparian systems was earmarked, i.e. the south eastern corner of the site.  Any stormwater within the site will be handled in a suitable manner, i.e. clean and dirty water streams separated around the plant, install stilling basins to capture large volumes of run-off, trapping sediments, and reduce flow velocities.	!Khi CSP EPC Contractor	Planning, design and operation phase

<b>Performance Indicator</b>	Water quality and quantity management - "Water Use Licence Conditions."
<b>Monitoring</b>	Surface water monitoring plan.

#### OBJECTIVE: Minimise river system erosion and downstream sedimentation

<b>Project Component/s</b>	Poor stormwater management and the alteration of the hydrological regime. Placement of access roads, pipelines, and dams off-site.
<b>Potential Impact</b>	Risk of river system erosion and downstream sedimentation.

<b>Activities/Risk Sources</b>	Placement of hard engineered surfaces.
<b>Mitigation: Target/Objective</b>	Minimise the potential impact by the supporting infrastructure on the riparian systems.

<b>Mitigation: Action/Control</b>	<b>Responsibility</b>	<b>Timeframe</b>
Any stormwater within the site will be handled in a suitable manner, i.e. clean and dirty water streams separated around the plant, install stilling basins to capture large volumes of run-off, trapping sediments, and reduce flow velocities (i.e. water used when washing the mirrors). The placement of pump inlets and the supporting infrastructure to prevent the potential for scour / erosion and downstream sedimentation of the Orange River. The current placement is within an area of dense reed growth ( <i>Phragmites australis</i> ), and would not be considered a severe impact. Care should however be taken that if any clearing is done, that this area is monitored for plant re-growth, firstly to prevent alien plant infestations and to ensure no erosion or scour takes place.	!Khi CSP EPC Contractor	Planning, design and operation phase

<b>Performance Indicator</b>	Water quality and quantity management – “Water Use Licence Conditions.”
<b>Monitoring</b>	Surface water monitoring plan.

**OBJECTIVE: Minimise river system erosion and downstream sedimentation**

<b>Project Component/s</b>	Placement of access roads, pipelines, and dams off-site.
<b>Potential Impact</b>	There is a high risk of elevated sediment input into the Orange River during the establishment of the water abstraction facilities on the banks and floodplains. Backwash water discharged from the sand filters could result in sediment laden water reaching the Orange River. Poor planning and design of new abstraction infrastructure and new flood protection measures on the floodplain, resulting in bank erosion or slumping to occur during river flooding events.
<b>Activities/Risk Sources</b>	Design, placement, and operation of water abstraction infrastructure.
<b>Mitigation:</b>	Minimise the potential impact by the supporting infrastructure on the

**Target/Objective** riparian systems.

Mitigation: Action/Control	Responsibility	Timeframe
<p>The risk of erosion and bank slumping or collapse during both pre-construction, construction work can readily be prevented by careful design and planning. Mitigation measures include:</p> <ul style="list-style-type: none"> <li>» Appropriate hard-engineered bank erosion protection structures.</li> <li>» Careful rehabilitation using natural riparian vegetation to stabilise the riverbanks and all disturbed areas in the riparian zone.</li> </ul> <p>Local stormwater run-off over the flood embankments and natural riverbanks could potentially cause erosion and subsequent bank slumping, unless stormwater drains are correctly located and designed with appropriate erosion-control features.</p> <p>During construction, adjacent riparian habitats outside the "footprint" of the new infrastructure should be declared sensitive habitats and out of bounds for all construction activities and for all construction workers.</p>	!Khi CSP EPC Contractor	Planning, design, and operation phase

<b>Performance Indicator</b>	Water quality and quantity management – "Water Use Licence Conditions"
<b>Monitoring</b>	Surface water monitoring plan

## OBJECTIVE: Protection of heritage resources

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

<b>Project Component/s</b>	Excavation activities, construction of access roads and establishment of water supply pipeline and transmission pylons.
<b>Potential Impact</b>	Wider areas or extended linear developments may result in further destruction, damage, excavation, alteration, removal, or collection of heritage objects from their current context on the site.
<b>Activity/Risk Source</b>	Activities which could affect achieving this objective include deviation from the planned lay-out of road/s and infrastructure without considering heritage impacts.

<b>Mitigation:</b>	A facility EMP that takes cognisance of heritage resources in the event of any future extensions of roads or other infrastructure.		
<b>Target/Objective</b>			
<b>Mitigation: Action/control</b>	<b>Responsibility</b>	<b>Timeframe</b>	
Provision for on-going heritage monitoring which provides guidelines on what to do in the event of any major heritage feature being encountered during any phase of development or operation.	!Khi CSP ECO	EMP to be in place before commencement of development	
Phase 2 (mitigation) surface collection and characterisation of the archaeological site at 28.54109° S 21.08842 ° E as a salvage operation as part of the pre-construction phase.	An accredited archaeologist, in terms of a permit issued by SAHRA	Prior to construction	

<b>Performance Indicator</b>	<p>A report describing the completion of the Phase 2 mitigation work described above.</p> <p>Inclusion of further heritage impact consideration in any future extension of infrastructural elements.</p> <p>Immediate reporting to relevant heritage authorities of any heritage feature discovered during any phase of development or operation of the facility.</p>
<b>Monitoring</b>	Officials from relevant heritage authorities (National and Provincial) to be permitted to inspect the operation on agreement with the EPC Contractor to the heritage component of the EMP.

**OBJECTIVE: Minimisation of visual impacts associated with construction and operational phases**

During the construction phase heavy vehicles, components, equipment and construction crews will frequent the area and may cause, at the very least, a visual nuisance to landowners and residents in the area as well as road users. The placement of lay-down areas and temporary construction camps should be carefully considered in order to not negatively influence the future perception of the facility. Secondary visual impacts associated with the construction phase, such as the sight of construction vehicles, dust and construction litter must be managed to reduce visual impacts. The use of dust-suppression techniques on the access roads (where required), timely removal of rubble and litter, and the erection of temporary screening will assist in doing this.

During the operational phase, mitigation of the appearance of the facility is not possible. The largest structure, being the power tower, will be impossible to hide. The 4000 – 6000 heliostats (i.e. 120 m<sup>2</sup> surface areas) and their functional design cannot be changed in order to reduce visual impacts. Considering the topography of the land and the visual absorption capacity of the vegetation, very little can be done to mitigate the visual impacts caused by these structures. Furthermore, the functional design of these

structures and the dimensions of the facility cannot be changed in order to reduce visual impacts. Therefore the potential for mitigation is low.

<b>Project Component/s</b>	Construction site, access road, and power line.
<b>Potential Impact</b>	The potential scarring of the landscape due to the creation of new access roads/tracks or the unnecessary removal of vegetation.
<b>Activity/Risk Source</b>	The viewing of the abovementioned visual scarring by observers near the solar facility.
<b>Mitigation: Target/Objective</b>	Minimal disturbance to vegetation cover in close vicinity to the proposed solar facility and its related infrastructure.

<b>Mitigation: Action/Control</b>	<b>Responsibility</b>	<b>Timeframe</b>
Implement an environmentally responsive planning approach to roads and infrastructure to limit cut and fill requirements.	!Khi CSP EPC Contractors	During construction
Adopt responsible construction practices aimed at containing the construction activities to specifically demarcated areas thereby limiting the removal of natural vegetation to the minimum.	!Khi CSP EPC Contractors	During construction
Limit access to the construction sites (during both construction and operational phases) along existing access roads.	EPC Contractors	Construction and, operational phases
Rehabilitate all disturbed areas to acceptable visual standards.	EPC Contractors	Construction, and operational phases
Maintain the general appearance of the facility in an aesthetically pleasing way.	!Khi CSP	Operational phase

<b>Performance Indicator</b>	Vegetation cover that remains intact with unnecessary access roads or erosion scarring in close proximity of the solar facility.
<b>Monitoring</b>	Monitoring of vegetation clearing during the construction phase.

**OBJECTIVE: The mitigation of potential visual impacts caused by the unnecessary removal of vegetation cover for the power line servitude**

<b>Project Component/s</b>	Distribution power line servitude.
<b>Potential Impact</b>	The potential scarring of the landscape due to the creation of cleared cut-lines and new roads/tracks.
<b>Activity/Risk Source</b>	The viewing of the abovementioned cut lines/roads by observers.



<b>Mitigation:</b>	Minimal disturbance to vegetation cover in close vicinity to the proposed
<b>Target/Objective</b>	distribution power line.

<b>Mitigation: Action/Control</b>	<b>Responsibility</b>	<b>Timeframe</b>
Avoid the unnecessary removal of vegetation for the distribution power line servitudes and limit access to the servitudes (during both construction and operational phases) along existing access roads.	!Khi CSP EPC Contractors	Construction, and operational phases

<b>Performance Indicator</b>	Vegetation cover that remains intact with no visible cut lines, access roads or erosion scarring in and around the power line servitude.
<b>Monitoring</b>	The monitoring of vegetation clearing during the construction and operational phases of the project.

**OBJECTIVE: The mitigation and possible negation of the potential visual impact of lighting at the solar facility**

<b>Project Component/s</b>	Solar facility lighting fixtures.
<b>Potential Impact</b>	The potential night time visual impact of lighting fixtures on observers.
<b>Activity/Risk Source</b>	The effects of glare and light trespass on motorists.
<b>Mitigation: Target/Objective</b>	The containment of light emitted in order to eliminate the risk of additional night time visual impacts. Minimal usage of security and other lighting.

<b>Mitigation: Action/Control</b>	<b>Responsibility</b>	<b>Timeframe</b>
Ensure that proper planning is undertaken regarding the placement of lighting structures Undertake regular maintenance of light fixtures.	!Khi CSP EPC Contractor	Construction, and operational phases

<b>Performance Indicator</b>	The effective containment of the light on the site.
<b>Monitoring</b>	The monitoring of the condition and functioning of the light fixtures during the operational phase of the project.

**OBJECTIVE: Traffic management and transportation of equipment and materials to site**

The construction phase of the project will be the most significant in terms of generating traffic impacts; resulting from the transport of equipment (including solar components) and materials and construction crews to the site and the return of the vehicles after delivery of materials. Potential impacts associated with transportation and access relate to works within the site boundary and external works outside the site boundary.

Existing national roads (i.e. the N14) will be used to access the sites in conjunction with the proposed access road during construction and operational phases.

<b>Project Component/s</b>	Heliostat field and power tower; Parabolic troughs; PV panels; Power island; Power line; and Construction vehicles.
<b>Potential Impact</b>	Traffic congestion, particularly on narrow roads or on road passes where overtaking is not permitted. Risk of accidents. Deterioration of road pavement conditions (both surfaced and gravel road) due to abnormal loads.
<b>Activity/Risk Source</b>	Traffic congestion increase. Site preparation and earthworks. Foundations or plant equipment installation. Transportation of ready-mix cement from off-site batching plant to the site. Mobile construction equipment movement on-site. Power line and substation construction activities.
<b>Mitigation: Target/Objective</b>	To minimise impact of traffic associated with the construction of the facility on local traffic. To minimise potential for negative interaction between pedestrians or sensitive users and traffic associated with the facility construction. To ensure all vehicles are roadworthy and all materials/equipment are carried appropriately and within any imposed permit/licence conditions.

<b>Mitigation: Action/Control</b>	<b>Responsibility</b>	<b>Timeframe</b>
All relevant permits for abnormal loads must be applied for from the relevant authority.	EPC Contractor	Pre-construction
A designated access to the proposed site must be created to ensure safe entry and exit.	EPC Contractor	Pre-construction
No deviation from approved transportation routes must be allowed, unless roads are closed for whatever reason	EPC Contractor	Duration of contract

Mitigation: Action/Control	Responsibility	Timeframe
outside the control of the EPC Contractor.		
Appropriate road management strategies must be implemented on external and internal roads with all employees and EPC Contractors required to abide by standard road and safety procedures.	EPC Contractor	Pre-construction
Appropriate dust suppression techniques must be used to minimise dust emissions on un-surfaced roads.	EPC Contractor	Duration of contract
Times for arrival and departure of heavy vehicles must be co-ordinated to minimise congestion as is possible.	EPC Contractor	Duration of contract
Any traffic delays as a result of construction traffic must be co-ordinated with the appropriate authorities.	EPC Contractor	Duration of contract
The movement of all vehicles within the site must be on designated roadways.	EPC Contractor	Duration of contract
Signage must be established at appropriate points warning of turning traffic and the construction site (all signage to be in accordance with prescribed standards).	EPC Contractor	Duration of contract
Appropriate maintenance of all vehicles of the EPC Contractor must be ensured.	EPC Contractor	Duration of contract
All vehicles of the EPC Contractor travelling on public roads must adhere to the specified speed limits and all drivers must be in possession of an appropriate valid driver's license.	EPC Contractor	Duration of contract
Keep hard road surfaces as narrow as possible.	EPC Contractor	Duration of contract
Prevent damage to roads by construction vehicles.	EPC Contractor	Duration of contract

<b>Performance Indicator</b>	<p>No traffic incidents involving !Khe CSP personnel or appointed EPC Contractors.</p> <p>Appropriate signage in place.</p> <p>No complaints resulting from traffic congestion, delays or driver negligence associated with construction of the solar energy facility.</p>
<b>Monitoring</b>	<p>Visual monitoring of dust produced by traffic movement.</p> <p>Visual monitoring of traffic control measures to ensure they are effective.</p> <p>A complaints register will be maintained, in which any complaints from the community will be logged.</p> <p>Complaints will be investigated and, if appropriate, acted upon.</p> <p>An incident reporting system will be used to record non-conformances to the EMP.</p>

**OBJECTIVE: Appropriate handling/storage of chemicals, hazardous substances and waste**

The construction phase will involve the storage and handling of a variety of chemicals including adhesives, abrasives, oils and lubricants, paints and solvents. The main wastes expected to be generated by the construction of the facility will include general solid waste, hazardous waste and liquid waste.

Comprehensive fire and emergency procedures must be established for use during construction and operational phases of the project. Personnel must be trained to respond to veld fires in order to control them as quickly as possible.

<b>Project Component/s</b>	Storage and handling of chemicals, hazardous substances, and waste.
<b>Potential Impact</b>	Release of contaminated water from contact with spilled chemicals. Generation of contaminated wastes from used chemical containers. Inefficient use of resources resulting in excessive waste generation. Litter or contamination of the site or water through poor waste management practices. Pollution of water and soil resources.
<b>Activity/Risk Source</b>	Vehicles associated with site preparation and earthworks. Power line construction activities. Substation construction activities. Packaging and other construction wastes. Hydrocarbon use and storage. Spoil material from excavation, earthworks, and site preparation.
<b>Mitigation: Target/Objective</b>	To ensure that the storage and handling of chemicals and hydrocarbons on-site does not cause pollution to the environment or harm to persons. To ensure that the storage and maintenance of machinery on-site does not cause pollution of the environment or harm to persons. To comply with waste management guidelines. To minimise production of waste. To ensure appropriate waste storage and disposal. To avoid environmental harm from waste disposal.

<b>Mitigation: Action/Control</b>	<b>Responsibility</b>	<b>Timeframe</b>
Spill kits must be made available on-site for the clean-up of spills and leaks of contaminants.	EPC Contractor	Duration of contract
Corrective action must be undertaken immediately if a complaint is made, or potential/actual leak or spill of polluting substance identified. This includes stopping the contaminant from further escaping, cleaning up the affected environment as much as practically possible and implementing	EPC Contractor	Duration of contract

Mitigation: Action/Control	Responsibility	Timeframe
preventive measures.		
In the event of a major spill or leak of contaminants, the relevant administering authority must be immediately notified as per the notification of emergencies/incidents.	EPC Contractor	Duration of contract
Spilled cement must be cleaned up as soon as possible and disposed of at a suitably licensed waste disposal site.	EPC Contractor	Duration of contract
Any contaminated/polluted soil removed from the site must be disposed of at a licensed hazardous waste disposal facility.	EPC Contractor	Duration of contract
Routine servicing and maintenance of vehicles must not to take place on-site (except for emergencies). If repairs of vehicles must take place, an appropriate drip tray must be used to contain any fuel or oils.	EPC Contractor	Duration of contract
All stored fuels to be maintained within a bund and on a sealed surface.	EPC Contractor	Duration of contract
Fuel storage areas must be inspected regularly to ensure bund stability, integrity, and function.	EPC Contractor	Duration of contract
Construction machinery must be stored in an appropriately sealed area.	EPC Contractor	Duration of contract
Oily water from bunds at the substations must be removed from site by licensed EPC Contractors.	EPC Contractor	Duration of contract
The storage of flammable and combustible liquids such as oils will be in designated areas which are appropriately bunded, and stored in compliance with MSDS files.	EPC Contractor	Duration of contract
Any storage and disposal permits/approvals which may be required must be obtained, and the conditions attached to such permits and approvals will be complied with.	EPC Contractor	Duration of contract
Transport of all hazardous substances must be in accordance with the relevant legislation and regulations	EPC Contractor	Duration of contract
Construction EPC Contractors must provide specific detailed waste management plans to deal with all waste streams.	EPC Contractor	Duration of contract
Specific areas must be designated on-site for the temporary management of various waste streams, i.e. general refuse, construction waste (wood and metal scrap), and contaminated waste as required. Location of such areas must seek to minimise the potential for impact on the surrounding environment, including prevention of contaminated runoff, seepage, and vermin control.	EPC Contractor	Duration of contract

Mitigation: Action/Control	Responsibility	Timeframe
Where practically possible, construction and general wastes on-site must be reused or recycled. Bins and skips must be available on-site for collection, separation, and storage of waste streams (such as wood, metals, general refuse etc.).	EPC Contractor	Duration of contract
Disposal of waste must be in accordance with relevant legislative requirements, including the use of licensed EPC Contractors.	EPC Contractor	Duration of contract
Hydrocarbon waste must be contained and stored in sealed containers within an appropriately bunded area.	EPC Contractor	Duration of contract
Waste and surplus dangerous goods must be kept to a minimum and must be transported by approved waste transporters to sites designated for their disposal.	EPC Contractor	Duration of contract
Documentation (waste manifest) must be maintained detailing the quantity, nature, and fate of any regulated waste. Waste disposal records must be available for review at any time.	EPC Contractor	Duration of contract
An incident/complaints register must be established and maintained on-site.	ECO EPC Contractor	Duration of contract
The sediment control and water quality structures used on-site must be monitored and maintained in a fully operational state at all times.	ECO EPC Contractor	Duration of contract
Upon the completion of construction, the area must be cleared of potentially polluting materials.	EPC Contractor	Completion of construction

<b>Performance Indicator</b>	<p>No chemical spills outside of designated storage areas.</p> <p>No water or soil contamination by spills.</p> <p>No complaints received regarding waste on site or indiscriminate dumping.</p> <p>Internal site audits ensuring that waste segregation, recycling and reuse is occurring appropriately.</p> <p>Provision of all appropriate waste manifests for all waste streams.</p>
<b>Monitoring</b>	<p>Observation and supervision of chemical storage and handling practices and vehicle maintenance throughout construction phase.</p> <p>A complaints register must be maintained, in which any complaints from the community will be logged.</p> <p>Observation and supervision of waste management practices throughout construction phase.</p> <p>Waste collection will be monitored on a regular basis.</p> <p>Waste documentation completed.</p> <p>A complaints register will be maintained, in which any complaints from the community will be logged.</p> <p>Complaints will be investigated and, if appropriate, acted upon.</p> <p>An incident reporting system will be used to record non-conformances to the EMP.</p>

**OBJECTIVE: Ensure disciplined conduct of on-site EPC Contractors and workers**

In order to minimise impacts on the surrounding environment, EPC Contractors must be required to adopt a certain Code of Conduct and commit to restricting construction activities to areas within the development footprint. EPC Contractors and their sub-Contractors must be familiar with the conditions of the Environmental Authorisation (once issued), the EIA Report, and this EMP, as well as the requirements of all relevant environmental legislation.

<b>Project Component/s</b>	Heliostat field and power tower; Parabolic troughs; PV panels; Power island; Power line; and All associated infrastructure.
<b>Potential Impact</b>	Pollution/contamination of the environment. Disturbance to the environment.
<b>Activity/Risk Source</b>	EPC Contractors are not aware of the requirements of the EMP, leading to unnecessary impacts on the surrounding environment.
<b>Mitigation: Target/Objective</b>	To ensure appropriate management of actions by on-site personnel in order to minimise impacts to the surrounding environment.

<b>Mitigation: Action/Control</b>	<b>Responsibility</b>	<b>Timeframe</b>
The terms of this EMP and the Environmental Authorisation (once issued) will be included in all tender documentation and EPC Contractors contracts.	!Khi CSP	Tender process
An ECO must be on site throughout the road construction, cable laying, and foundation excavation periods, and at other times should visit the site at least once a week.	!Khi CSP	Duration of construction
EPC Contractors must use chemical toilets/ablation facilities situated at designated areas of the site; no ablation activities will be permitted outside the designated area. These facilities must be regularly serviced by appropriate Contractors. A minimum of one toilet shall be provided per 15 persons at each working area such as the Contractor's camp.	EPC Contractor Sub-Contractor/s	Duration of contract
Cooking/meals must take place in a designated area No firewood or kindling may be gathered from the site or surrounds.	EPC Contractor Sub-Contractor/s	Duration of contract
All litter must be deposited in a clearly marked,	EPC Contractor	Duration of

Mitigation: Action/Control	Responsibility	Timeframe
closed, animal-proof disposal bin in the construction area. Particular attention needs to be paid to food waste.	Sub-Contractor/s	contract
No one other than the ECO or personnel authorised by the ECO must disturb flora or fauna outside of the demarcated construction area/s.	EPC Contractor Sub-Contractor/s	Duration of contract
EPC Contractors appointed by !Khi CSP must ensure that all workers are informed at the outset of the construction phase of the conditions contained on the Code of Conduct, specifically consequences of stock theft and trespassing on adjacent farms.	EPC Contractor Sub-Contractor/s	Construction
Provide opportunities for workers to go home over weekends where required and practically possible.	EPC Contractor Sub-Contractor/s	Construction
On completion of the construction phase all construction workers must leave the site within one week of their contract ending.	EPC Contractor Sub-Contractor/s	Construction

<b>Performance Indicator</b>	<p>Compliance with specified conditions of Environmental Authorisation, EIA report and EMP.</p> <p>No complaints regarding EPC Contractor behaviour or habits.</p> <p>Fire fighting equipment and training provided before the construction phase commences.</p> <p>Code of Conduct drafted before commencement of construction phase</p> <p>Briefing session with construction workers held at outset of construction phase.</p>
<b>Monitoring</b>	<p>Observation and supervision of EPC Contractor practices throughout construction phase.</p> <p>A complaints register will be maintained, in which any complaints from the community will be logged.</p> <p>Complaints will be investigated and, if appropriate, acted upon.</p> <p>An incident reporting system will be used to record non-conformances to the EMP.</p>

**OBJECTIVE: Fencing of development footprints in sensitive areas is in order to minimise disturbance to adjacent sensitive areas**

<b>Project Component/s</b>	<p>Heliostat field and power tower;</p> <p>Parabolic troughs;</p> <p>PV panels;</p> <p>Power island;</p> <p>Power line;</p>
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	Water supply pipeline and water storage/treatment reservoirs; and All associated infrastructure.
<b>Potential Impact</b>	Unnecessary damage to indigenous natural vegetation. Loss of threatened plant species and protected tree species.
<b>Activity/Risk Source</b>	EPC Contractors are not aware of the requirements of the EMP, leading to unnecessary impacts on the surrounding environment.
<b>Mitigation: Target/Objective</b>	No loss of or damage to sensitive vegetation in areas outside immediate development footprint. Less than 1 ha of construction related disturbance in sensitive areas outside fenced footprints; measured monthly during duration of construction.

<b>Mitigation: Action/Control</b>	<b>Responsibility</b>	<b>Timeframe</b>
Two strand wire fencing around all development footprints in areas of natural vegetation as determined by the ecological specialist. The wire to be inter-threaded with danger tape, and signage saying "Sensitive Area – Keep Out" placed on fences every 50 m.	EPC Contractor !Khi CSP ECO	To be completed prior to construction activities

<b>Performance Indicator</b>	No damage to surrounding natural vegetation.
<b>Monitoring</b>	ECO to monitor all construction areas until all construction is completed. An incident reporting system will be used to record non-conformances to the EMP.

#### OBJECTIVE: Search and rescue of all indigenous plants from development footprints

<b>Project Component/s</b>	Heliostat field and power tower; Parabolic troughs; PV panels; Power island; Power line; Water supply pipeline and water storage/treatment reservoirs; and All associated infrastructure.
<b>Potential Impact</b>	Unnecessary damage to indigenous natural vegetation. Loss of threatened plant species.
<b>Activity/Risk Source</b>	EPC Contractors are not aware of the requirements of the EMP, leading to unnecessary impacts on the surrounding environment.
<b>Mitigation: Target/Objective</b>	No loss of or damage to sensitive vegetation in areas outside immediate development footprint. Less than 1 ha of construction related disturbance in sensitive areas outside fenced footprints, measured monthly during duration of

construction.

Mitigation: Action/Control	Responsibility	Timeframe
Search and Rescue to be completed in all areas of natural vegetation prior to any construction related activities in these areas. General items that can be considered for rescue are all bulbs and tuberous species (including Haemanthus, Brunsvigia, Babiana, Trachyandra, Albuca, Veltheimia, Arctopus, etc.), plus selected specimens of succulents such as Ruschia and Lampranthus species. Material to be bagged up or stored in suitable conditions; to be replanted in areas requiring rehabilitation following cessation of all construction related disturbance in particular area.	!Khi CSP ECO EPC Contractor	To be completed prior to construction activities

Performance Indicator	No damage to surrounding natural vegetation.
Monitoring	ECO to monitor and conduct search and rescue until construction is completed. An incident reporting system will be used to record non-conformances to the EMP.

### 5.3. Institutional Arrangements: Roles and Responsibilities for the Construction Phase of the Solar Energy Facility

As the proponent, !Khi CSP must ensure that the implementation of the solar energy facility complies with the requirements of any and all environmental authorisations and permits, and obligations emanating from other relevant environmental legislation. This obligation is partly met through the development of the EMP, and the implementation of the EMP through its integration into the contract documentation. !Khi CSP will retain various key roles and responsibilities during the construction of the solar energy facility. These are outlined below.

**OBJECTIVE: To establish clear reporting, communication, and responsibilities in relation to environmental incident**

Formal responsibilities are necessary to ensure that key procedures are executed. Specific responsibilities of the Project Manager; Site Manager; Safety, Health and Environment Representative; Environmental Control Officer (ECO) and EPC Contractor for the construction phase of this project are as detailed below.

The **Project Manager** will:

- » Ensure of all specifications and legal constraints specifically with regards to the environment are highlighted to the EPC Contractor(s) so that they are aware of these.
- » Ensure that the EPC Contractor(s) are made aware of all stipulations within the EMP.
- » Ensure that the EMP is correctly implemented throughout the project by means of site inspections and meetings. This will be documented as part of the site meeting minutes.
- » Be fully conversant with the EIA for the project, the EMP, the conditions of the Environmental Authorisation (once issued), and all relevant environmental legislation.

The **Site Manager** (!Khi CSP's on-site Representative) will:

- » Be fully knowledgeable with the contents of the EIA.
- » Be fully knowledgeable with the contents and conditions of the Environmental Authorisation (once issued).
- » Be fully knowledgeable with the contents of the EMP.
- » Be fully knowledgeable with the contents of all relevant environmental legislation, and ensure compliance with these.
- » Have overall responsibility of the EMP and its implementation.
- » Conduct audits to ensure compliance to the EMP.
- » Ensure there is communication with the Project Manager, the ECO, and relevant discipline engineers on matters concerning the environment.
- » Ensure that no actions are taken which will harm or may indirectly cause harm to the environment, and take steps to prevent pollution on the site.
- » Confine activities to the demarcated construction site.

The **ECO** will be responsible for monitoring, reviewing, and verifying compliance by the EPC Contractor with the environmental specification and accordingly will:

- » Be fully knowledgeable with the contents with the EIA.
- » Be fully knowledgeable with the contents with the conditions of the Environmental Authorisation (once issued).
- » Be fully knowledgeable with the contents with the EMP.
- » Be fully knowledgeable with the contents with all relevant environmental legislation, and ensure compliance with them.
- » Ensure that the contents of this document are communicated to the EPC Contractor site staff and that the Site Manager and EPC Contractor are constantly made aware of the contents through discussion.
- » Ensure that the compliance of the EMP is monitored through regular and comprehensive inspection of the site and surrounding areas.

- » Ensure that if the EMP conditions or specifications are not followed then appropriate measures are undertaken to address this.
- » Monitoring and verification must be implemented to ensure that environmental impacts are kept to a minimum, as far as possible.
- » Ensure that the Site Manager has input into the review and acceptance of construction methods and method statements.
- » Ensure that activities on site comply with all relevant environmental legislation.
- » Ensure that a removal is ordered of any person(s) and/or equipment responsible for any contravention of the specifications of the EMP.
- » Ensure that the compilation of progress reports for submission to the Project Manager, with input from the Site Manager, takes place on a regular basis, including a final post-construction audit.
- » Ensure that there is communication with the Site Manager regarding the monitoring of the site.
- » Ensure that any non-compliance or remedial measures that need to be applied are reported.

**EPC Contractors and Service Providers:** All EPC Contractors (including sub-Contractors and staff) and service providers are ultimately responsible for:

- » Ensuring adherence to the environmental management specifications.
- » Ensuring that Method Statements are submitted to the Site Manager (and ECO) for approval before any work is undertaken.
- » Any lack of adherence to the above will be considered as non-compliance to the specifications of the EMP.
- » Ensuring that any instructions issued by the Site Manager on the advice of the ECO are adhered to.
- » Ensuring that a report is tabled at each site meeting, which will document all incidents that have occurred during the period before the site meeting.
- » Ensuring that a register is kept in the site office, which lists all transgressions issued by the ECO.
- » Ensuring that a register of all public complaints is maintained.
- » Ensuring that all employees, including those of sub- Contractors receive training before the commencement of construction in order that they can constructively contribute towards the successful implementation of the EMP (i.e. ensure their staff are appropriately trained as to the environmental obligations).

#### 5.4. Detailing Method Statements

**OBJECTIVE: Ensure all construction activities/practices/procedures are undertaken with the appropriate level of environmental awareness to minimise environmental risk, in line with the specifications of the EMP**

The environmental specifications are required to be underpinned by a series of Method Statements, within which the EPC Contractors and Service Providers are required to outline how any identified environmental risks will practically be mitigated and managed for the duration of the contract, and how specifications within this EMP will be met. That is, the EPC Contractor will be required to describe how specified requirements will be achieved through the submission of written Method Statements to the Site Manager and ECO.

A Method Statement is defined as "a written submission by the EPC Contractor in response to the environmental specification or a request by the Site Manager, setting out the plant, materials, labour and method the EPC Contractor proposes using to conduct an activity, in such detail that the Site Manager is able to assess whether the EPC Contractor's proposal is in accordance with the Specifications and/or will produce results in accordance with the Specifications". The Method Statement must cover applicable details with regard to:

- » Construction procedures.
- » Materials and equipment to be used.
- » Getting the equipment to and from site.
- » How the equipment/material will be moved while on-site.
- » How and where material will be stored.
- » The containment (or action to be taken if containment is not possible) of leaks or spills of any liquid or material that may occur.
- » Timing and location of activities.
- » Compliance/non-compliance with the Specifications.
- » Any other information deemed necessary by the Site Manager.

The EPC Contractor may not commence the activity covered by the Method Statement until it has been approved, except in the case of emergency activities and then only with the consent of the Site Manager. Approval of the Method Statement will not absolve the EPC Contractor from their obligations or responsibilities in terms of their contract.

## 5.5. Awareness and Competence: Construction Phase of the Solar Energy Facility

**OBJECTIVE: To ensure all construction personnel have the appropriate level of environmental awareness and competence to ensure continued environmental due diligence and on-going minimisation of environmental harm**

To achieve effective environmental management, it is important that EPC Contractors are aware of the responsibilities in terms of the relevant environmental legislation and the contents of this EMP. The EPC Contractor is responsible for informing employees and sub- Contractors of their environmental obligations in terms of the environmental specifications, and for ensuring that employees are adequately experienced and properly trained in order to execute the works in a manner that will minimise environmental impacts. The EPC Contractors obligations in this regard include the following:

- » Employees must have a basic understanding of the key environmental features of the construction site and the surrounding environment.
- » Ensuring that a copy of the EMP is readily available on-site, and that all site staff are aware of the location and have access to the document.
- » Employees will be familiar with the requirements of the EMP and the environmental specifications as they apply to the construction of the facility.
- » Ensuring that, prior to commencing any site works, all employees and sub-EPC Contractors have attended an Environmental Awareness Training course.
- » The course should be sufficient to provide the site staff with an appreciation of the project's environmental requirements, and how they are to be implemented.
- » Awareness of any other environmental matters, which are deemed necessary by the ECO.
- » Ensuring that employee information posters, outlining the environmental "do's" and "don'ts" (as per the environmental awareness training course) are erected at prominent locations throughout the site.
- » Records must be kept of those that have completed the relevant training.
- » Refresher sessions must be held to ensure the EPC Contractor staff are aware of their environmental obligations as practically possible.

## 5.6. Monitoring Programme: Construction Phase of the Solar Energy Facility

**OBJECTIVE: To monitor the performance of the control strategies employed against environmental objectives and standards**

A monitoring programme must be in place not only to ensure conformance with the EMP, but also to monitor any environmental issues and impacts which have not been accounted for in the EMP that are, or could result in significant environmental impacts for which corrective action is required. The period and frequency of monitoring will be stipulated by the Environmental Authorisation (once issued). Where this is not clearly dictated, !Khi CSP will determine and stipulate the period and frequency of monitoring required in consultation with relevant stakeholders and authorities. The Project Manager will ensure that the monitoring is conducted and reported.

The aim of the monitoring and auditing process would be to routinely monitor the implementation of the specified environmental specifications, in order to:

- » Monitor and audit compliance with the prescriptive and procedural terms of the environmental specifications.
- » Ensure adequate and appropriate interventions to address non-compliance.
- » Ensure adequate and appropriate interventions to address environmental degradation.
- » Provide a mechanism for the lodging and resolution of public complaints.
- » Ensure appropriate and adequate record keeping related to environmental compliance.
- » Determine the effectiveness of the environmental specifications and recommend the requisite changes and updates based on audit outcomes, in order to enhance the efficacy of environmental management on site.
- » Aid communication and feedback to authorities and stakeholders.

The ECO will ensure compliance with the EMP, will conduct monitoring activities, and will report any non-compliance or where corrective action is necessary to the Site Manager and/or any other monitoring body stipulated by the regulating authorities. The ECO must have the appropriate experience and qualifications to undertake the necessary tasks.

## MANAGEMENT PROGRAMME FOR SOLAR ENERGY FACILITY: CHAPTER 6 REHABILITATION OF DISTURBED AREAS

### 6.1. Overall Goal for the Rehabilitation of Disturbed Areas

**Overall Goal for the Rehabilitation of Disturbed Areas:** Undertake the rehabilitation measures in a way that:

- » Ensures rehabilitation of disturbed areas following the execution of the works, such that residual environmental impacts are remediated or curtailed.

### 6.2. Objectives

In order to meet this goal, the following objective, actions and monitoring requirements are relevant:

**OBJECTIVE:** To ensure appropriate rehabilitation of disturbed areas following the execution of the works, such that residual environmental impacts are remediated or curtailed

Areas requiring rehabilitation will include all areas disturbed during the construction phase and that are not required for regular operation and maintenance operations. Rehabilitation should be undertaken in an area as soon as possible after the completion of construction activities within that area.

The main areas requiring rehabilitation will be the disturbed areas around the footprint of the solar array and the power island, any cable routings where these fall outside the above-mentioned areas, and disturbed areas around the substation and maintenance building, disturbed areas associated with the power line tower foundations, water supply pipeline and associated water storage/treatment reservoirs, and access roads.

<b>Project Component/s</b>	Components of the solar energy facility (including temporary access roads and construction areas). Power island and associated service roads. Water supply pipeline and water storage/treatment reservoirs. Power line servitude.
<b>Potential Impact</b>	Environmental integrity of site undermined resulting in reduced visual aesthetics, erosion, compromised land capability and the requirement for on-going management intervention
<b>Activity/Risk Source</b>	Temporary construction areas. Temporary access roads/tracks.



	Other disturbed areas/footprints.
<b>Mitigation:</b>	To ensure and encourage site rehabilitation of disturbed areas.
<b>Target/Objective</b>	To ensure that the site is appropriately rehabilitated following the execution of the works, such that residual environmental impacts (including erosion) are remediated or curtailed.

<b>Mitigation: Action/Control</b>	<b>Responsibility</b>	<b>Timeframe</b>
All temporary facilities, equipment, and waste materials must be removed from site.	EPC Contractor	Following execution of the works
All temporary fencing and danger tape must be removed once the construction phase has been completed.	EPC Contractor	Following completion of construction activities in an area
Necessary drainage works and anti-erosion measures must be installed, where required, to minimise loss of topsoil and control erosion.	EPC Contractor	Following completion of construction activities in an area
A rehabilitation plan should be drawn up that specifies the rehabilitation process and should be approved by the ECO.	EPC Contractor, !Khe CSP and ECO	Pre-construction
Disturbed areas must be rehabilitated/re-vegetated with appropriate natural vegetation and/or local seed mix. Re-use of native/indigenous plant species removed from disturbance areas in the rehabilitation phase to be determined by a botanist as applicable.	EPC Contractor in consultation with rehabilitation specialist	Following completion of construction activities in an area
Re-vegetated areas may have to be protected from wind erosion and maintained until an acceptable plant cover has been achieved.	!Khe CSP in consultation with rehabilitation specialist	Post-rehabilitation
Erosion control measures should be used in sensitive areas such as steep slopes, hills, and drainage lines is necessary.	!Khe CSP in consultation with rehabilitation specialist	Post-rehabilitation
On-going alien plant monitoring and removal must be undertaken on all areas of natural vegetation on an annual basis.	!Khe CSP in consultation with rehabilitation specialist	Post-rehabilitation

<b>Performance Indicator</b>	All portions of site, including construction equipment camp and working areas, cleared of equipment and temporary facilities. Topsoil replaced on all areas and stabilised where practicable or required after construction and temporally utilised areas. Disturbed areas rehabilitated and acceptable plant cover achieved on rehabilitated sites.
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	Completed site free of erosion and alien invasive plants.
<b>Monitoring</b>	<p>On-going inspection of rehabilitated areas in order to determine effectiveness of rehabilitation measures implemented during the operational lifespan of the facility.</p> <p>On-going alien plant monitoring and removal should be undertaken on an annual basis.</p>

## MANAGEMENT PROGRAMME FOR SOLAR ENERGY FACILITY: CHAPTER 7 OPERATION

### 7.1. Overall Goal for Operation

**Overall Goal for Operation:** To ensure that the operation of the solar energy facility does not have unforeseen impacts on the environment and to ensure that all impacts are monitored and the necessary corrective action taken in all cases. In order to address this goal, it is necessary to operate the solar energy facility in a way that:

- » Ensures that operation activities are properly managed in respect of environmental aspects and impacts.
- » Enables the solar energy facility operation activities to be undertaken without significant disruption to other land uses in the area, in particular with regard to farming practices, traffic and road use, and effects on local residents.
- » Minimises impacts on birds and other fauna using the site.
- » Monitors and evaluates the impacts of the solar energy facility on birds that frequent the area, in particular monitoring of bird collisions and interactions with the facility, electrocutions and nesting activities.
- » Establishes an environmental baseline for solar energy facility sites in South Africa, particularly with regard to priority bird species using the site.

### 7.2. Objectives

In order to meet this goal, the following objectives have been identified, together with necessary actions and monitoring requirements.

#### OBJECTIVE: Protection of indigenous natural vegetation

Indirect impacts on vegetation during operation could result from maintenance activities and the movement of people and vehicles on site.

<b>Project component/s</b>	Components of the solar energy facility; Power island and associated service roads; Water supply pipeline and water storage/treatment reservoirs; and Power line servitude.
<b>Potential Impact</b>	Disturbance to or loss of vegetation and/or habitat
<b>Activity/Risk Source</b>	Movement of employee vehicles within and around site
<b>Mitigation:</b>	To maintain minimised footprints of disturbance of vegetation/habitats on-

<b>Target/Objective</b>	<p>site.</p> <p>To ensure and encourage plant regrowth in non-operational areas of post-construction rehabilitation.</p>
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<b>Mitigation: Action/Control</b>	<b>Responsibility</b>	<b>Timeframe</b>
Vehicle movements must be restricted to designated roadways.	!Khi CSP	Operation
Existing roads must be maintained to ensure limited erosion and impact on areas adjacent to roadways.	!Khi CSP	Operation
An on-going weed monitoring and eradication programme must be implemented, where necessary.	!Khi CSP	Operation
An environmental manager must be appointed during operation whose duty it will be to minimise impacts on surrounding sensitive habitats.	!Khi CSP	Operation

<b>Performance Indicator</b>	<p>No further disturbance to vegetation.</p> <p>Continued improvement of rehabilitation efforts.</p>
<b>Monitoring</b>	<p>Observation of vegetation on-site by Site Manager and environmental manager.</p> <p>Regular inspections to monitor plant regrowth/performance of rehabilitation efforts and weed infestation compared to natural/undisturbed areas.</p>

#### OBJECTIVE: Maintenance of rehabilitated areas

In order to ensure the long-term environmental integrity of the site following construction, maintenance of the areas rehabilitated post-construction must be undertaken until these areas have successfully re-established. Fire breaks should be established, where appropriate, to limit both incoming and outgoing veld fires.

<b>Project Component/s</b>	<p>Components of the solar energy facility;</p> <p>Power island and associated service roads;</p> <p>Water supply pipeline and water storage/treatment reservoirs; and</p> <p>Power line servitude.</p>
<b>Potential Impact</b>	<p>Environmental integrity of site undermined resulting in reduced visual aesthetics, erosion, compromised land capability and the requirement for on-going management intervention.</p>
<b>Activity/Risk Source</b>	<p>Constructions areas.</p> <p>Access roads.</p> <p>Other disturbed areas.</p>
<b>Mitigation: Target/Objective</b>	<p>To ensure and encourage site rehabilitation of disturbed areas.</p>

Mitigation: Action/Control	Responsibility	Timeframe
A botanist familiar with the vegetation of the area should monitor the rehabilitation success and alien plant removal on an annual basis.	!Khi CSP in consultation with a botanist	Annual monitoring until successful re-establishment of vegetation in an area
Fire breaks should be established, where appropriate and applicable.	!Khi CSP	Operation
Appoint an environmental manager during operation whose duty it will be to minimise impacts on surrounding sensitive habitats.	!Khi CSP	Operation

<b>Performance Indicator</b>	Successful rehabilitation of disturbed areas.
<b>Monitoring</b>	On-going alien plant monitoring and removal should be undertaken on an annual basis.

## OBJECTIVE: Protection of terrestrial fauna and habitats

Indirect impacts on terrestrial fauna during operation could include disturbance and further habitat destruction because of maintenance activities and the movement of people and vehicles on site, and direct fatalities from vehicle movements on-site.

<b>Project Component/s</b>	Solar energy facility (including access roads); Power island; and Power line, pipeline, and access road servitudes.
<b>Potential Impact</b>	Disturbance to or loss of fauna and/or habitat. Direct mortalities.
<b>Activity/Risk Source</b>	Movement of vehicles within and around site. Power line, water supply pipeline and access roads.
<b>Mitigation: Target/Objective</b>	To keep number of vehicle movements to a minimum. To maintain minimised footprints of disturbance of vegetation/habitats on-site. To ensure and encourage site rehabilitation.

Mitigation: Action/Control	Responsibility	Timeframe
Vehicle movements restricted to designated roadways.	!Khi CSP	Operation
Appoint an environmental manager during operation whose duty it will be to minimise impacts on	!Khi CSP	Operation

surrounding sensitive habitats.		
Adherence to reduced vehicle speeds (as prescribed by the environmental manager) by any vehicles moving on the site to reduce potential for direct mortalities.	!Khi CSP	Operation

<b>Performance Indicator</b>	No further disturbance to faunal populations on the site. Continued improvement of faunal protection efforts.
<b>Monitoring</b>	Observation and recording of mortalities associated with the solar energy facility

### OBJECTIVE: Protection of avifauna and priority bird species

During the operation of the facility, the threat of collision of avifauna with the power line is the biggest potential threat to avifauna, particularly sensitive, collision prone species that may occur on the site. The threat of electrocution while perching on the power line and associated infrastructure serves as a threat to certain sensitive species.

Due to the low overall significance of the potential impacts on avifauna, the implementation of a monitoring programme, such as the type required for a wind energy facility, would not be required.

<b>Project Component/s</b>	Power line
<b>Potential Impact</b>	Collision and electrocution events with the overhead power line.
<b>Activities/Risk Sources</b>	Overhead power line.
<b>Mitigation: Target/Objective</b>	To maintain a low number of collision and electrocution events.

<b>Mitigation: Action/Control</b>	<b>Responsibility</b>	<b>Timeframe</b>
Fit the earth wire with bird marking/deterrent devices (i.e. in defined problem areas) which have proved to be extremely effective in preventing bird collisions by making the line more visible.	!KHi CSP EPC Contractor	Construction
The power line should be kept as low as possible taking into account engineering and legal requirements.	EPC Contractor	Construction
The span lengths should be kept as short as possible taking into account engineering and legal requirements.	EPC Contractor	Construction
Notes of electrocution and collision events must be sent to a qualified Ornithologist for the recommendation of further mitigation measures.	!KHi CSP	Operation

<b>Performance Indicator</b>	Zero collision or electrocution events.
<b>Monitoring</b>	Observation of electrocution or collision events with the power line Monitor power line servitude for dead birds.

#### OBJECTIVE: Minimisation of visual impacts

The placement of the solar energy facility and its associated infrastructure will have a visual impact on the natural scenic resources and rural character of this region. The rural and relatively unspoilt wide-open vistas surrounding the solar energy facility will be transformed for the entire operational lifespan (approximately 30 years plus any extensions) of the plant.

The primary visual impact, namely the appearance and dimensions of the solar energy facility (i.e. mainly the power tower) is not possible to mitigate to any significant extent within this landscape. The functional design of the structures and the dimensions of the facility cannot be changed in order to reduce visual impacts. Due to the nature of the area within which the facility is planned, there are only a few potentially sensitive receptors.

Other impacts include impacts associated with lighting of the substation and the operational, security and safety lighting fixtures of the proposed solar energy facility will have some impact surrounding observers.

<b>Project Component/s</b>	Solar energy facility; Power island and associated infrastructure; Water supply pipeline and water storage/treatment reservoirs; Power line; and Operational, security and safety lighting fixtures.
<b>Potential Impact</b>	Risk to aircraft in terms of the potential for collision. Enhanced visual intrusion. Impact on ambient lighting conditions.
<b>Activity/Risk Source</b>	Size/scale of power tower. Substation, operational, and security associated lighting. Access roads. Power line, pipeline, and water storage/treatment reservoirs. Other associated infrastructure.
<b>Mitigation: Target/Objective</b>	To minimise potential for visual impact. To ensure that the facility complies with Civil Aviation Authority requirements for the visibility of the power tower to aircraft. Minimise contrast with surrounding environment and visibility of the

	associated infrastructure. The containment of light emitted from the facility in order to eliminate the risk of additional night-time visual impacts.
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Mitigation: Action/Control	Responsibility	Timeframe
Ensure that proper planning is undertaken regarding the placement of lighting structures.	!Khi CSP EPC Contractor	Construction, operation and maintenance
Care must be taken in the planning and placement of light fixtures in order to reduce visual impacts associated with glare and light trespass.	!Khi CSP EPC Contractor	Erection and maintenance
Maintain the general appearance of the facility in an aesthetically pleasing way.	!Khi CSP	Operation and maintenance
Undertake regular maintenance of light fixtures.	!Khi CSP	Operation and maintenance
Limit access to the solar energy facility site, power line, water supply pipeline and associated infrastructure.	!Khi CSP	Operation and maintenance
Avoid the unnecessary removal of vegetation for the distribution power line servitude and limit access to the servitudes (during both construction and operational phases) along existing access roads.	!Khi CSP	Operation and maintenance

<b>Performance Indicator</b>	Minimised visual intrusion on surrounding areas. Appropriate visibility of infrastructure to aircraft. The effective containment of light.
<b>Monitoring</b>	Ensure that aviation warning lights or other measures are installed before construction is completed. Ensure that aviation warning lights or other measures are functional at all times. The monitoring of the condition and functioning of the light fixtures during the operational phase of the project.

**OBJECTIVE: To ensure the implementation of an appropriate fire management plan during the operation phase**

The vegetation in the study area may be at risk of fire, particularly the parabolic troughs which are situated closer to the ground. The increased presence of people on the site could increase the risk of veld fires, particularly in the dry season.

<b>Project Component/s</b>	Operation and maintenance of the solar energy facility and associated infrastructure.
<b>Potential Impact</b>	Veld fires can pose a personal safety risk to local farmers and



	communities, and their homes, crops, livestock and farm infrastructure, such as gates and fences. In addition, fire can pose a risk to the solar energy facility infrastructure.
<b>Activities/Risk Sources</b>	The presence of operation and maintenance personnel and their activities on the site can increase the risk of veld fires.
<b>Mitigation: Target/Objective</b>	To avoid and or minimise the potential risk of veld fires on local communities and their livelihoods.

<b>Mitigation: Action/Control</b>	<b>Responsibility</b>	<b>Timeframe</b>
Provide adequate fire fighting equipment onsite.	EPC Contractor	Duration of construction
Provide fire-fighting training to selected operation and maintenance staff.	EPC Contractor	Duration of construction
Ensure that appropriate communication channels are established to be implemented in the event of a fire.	!Khi CSP	Pre-construction

<b>Performance Indicator</b>	Fire fighting equipment and training provided before the construction phase commences.
<b>Monitoring</b>	!Khi CSP must monitor indicators listed above to ensure that they have been met for the construction phase.

## OBJECTIVE: Appropriate handling and management of hazardous substances and waste

The operation of the solar energy facility will involve the generation of limited waste products. The main wastes expected to be generated by the operation activities includes general solid waste, hazardous waste and liquid waste.

<b>Project Component/s</b>	Parabolic troughs (i.e. oil); Operation and maintenance staff; and Workshop.
<b>Potential Impact</b>	Inefficient use of resources resulting in excessive waste generation. Litter or contamination of the site or water through poor waste management practices.
<b>Activity/Risk Source</b>	Transformers and switchgear – substation. Parabolic troughs. Water storage tank. Fuel and oil storage. Maintenance building.
<b>Mitigation: Target/Objective</b>	To comply with waste management guidelines. To minimise production of waste. To ensure appropriate waste disposal. To avoid environmental harm from waste disposal.

Mitigation: Action/Control	Responsibility	Timeframe
Hazardous substances (such as used/new transformers) must be stored in sealed containers within a clearly demarcated designated area.	!Khi CSP	Operation
Storage areas for hazardous substances must be appropriately sealed and bunded.	!Khi CSP	Operation
All structures and/or components replaced during maintenance activities must be appropriately disposed of at an appropriately licensed waste disposal site or sold to a recycling merchant for recycling.	!Khi CSP	Operation
Care must be taken to ensure that spillage of oils and other hazardous substances are limited during maintenance. Handling of these materials should take place within an appropriately sealed and bunded area. Should any accidental spillage take place, it will be cleaned up according to specified standards regarding bioremediation.	!Khi CSP	Operation and maintenance
Waste handling, collection, and disposal operations must be managed and controlled by a waste management contractor.	!Khi CSP Waste management contractor	Operation
Used oils and chemicals: » Appropriate disposal must be arranged with a licensed facility in consultation with the administering authority. » Waste must be stored and handled according to the relevant legislation and regulations.	!Khi CSP	Operation
General waste must be recycled where possible or disposed of at an appropriately licensed landfill.	!Khi CSP	Operation
Hazardous waste (including hydrocarbons) and general waste must be stored and disposed of separately.	!Khi CSP	Operation
Disposal of waste must be in accordance with relevant legislative requirements, including the use of licensed contractors.	!Khi CSP	Operation

<b>Performance Indicator</b>	No complaints received regarding waste on site or indiscriminate dumping. Internal site audits identifying that waste segregation recycling and reuse is occurring appropriately. Provision of all appropriate waste manifests. No contamination of soil or water.
<b>Monitoring</b>	Waste collection must be monitored on a regular basis. Waste documentation must be completed and available for inspection on request. An incidents/complaints register must be maintained, in which any

complaints from the community must be logged.  
Complaints must be investigated and, if appropriate, acted upon.  
Regular reports on exact quantities of all waste streams exiting the site must be compiled by the waste management contractor and monitored by the ECO  
All appropriate waste disposal certificates accompany the monthly reports.

## MANAGEMENT PROGRAMME FOR SOLAR ENERGY FACILITY: CHAPTER 8 DECOMMISSIONING

The solar infrastructure which will be utilised for the proposed solar energy facility is expected to have a lifespan of 30 years and eventual extensions (i.e. with maintenance or refurbishment / replacement). Equipment associated with this facility would only be decommissioned once it has reached the end of its economic life. It is most likely that decommissioning activities of the infrastructure of the facility would comprise the disassembly and replacement of the solar infrastructure with more appropriate technology/infrastructure available at that time.

*The mitigations contained under the construction section should be applied during decommissioning and this is not repeated in this section.*

### 8.1. Site Preparation

Site preparation activities will include confirming the integrity of the access to the site to accommodate required equipment, preparation of the site (e.g. lay down areas, construction platform) and the mobilisation of construction equipment.

### 8.2 Disassemble and Replace Infrastructure

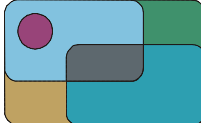
Disassembled components will be reused, recycled, or disposed of in accordance with regulatory requirements.

**OBJECTIVE: To avoid and or minimise the potential impacts associated with the decommissioning phase**

<b>Project Component/s</b>	Decommissioning phase of the solar energy facility.
<b>Potential Impact</b>	Decommissioning will result in job losses, which in turn can result in a number of social impacts, such as reduced quality of life etc. (i.e. 60 -80 people). Decommissioning is similar to the construction phase in that it will also create temporary employment opportunities.
<b>Activity/Risk Source</b>	Decommissioning of the solar energy facility.
<b>Mitigation: Target/Objective</b>	To avoid and or minimise the potential social impacts associated with decommissioning phase of the solar energy facility.

<b>Mitigation: Action/control</b>	<b>Responsibility</b>	<b>Timeframe</b>
Retrenchments should comply with current South African Labour Legislation.	!Khi CSP	Decommissioning

<b>Performance Indicator</b>	Relevant South African Labour Legislation.
<b>Monitoring</b>	No occurrences of dismissals not in-line with South African Labour Legislation.



**David Hoare Consulting cc**

CC 2001/034446/23

**Environmental & Natural  
Resource Consultants**

41 Soetdoring Avenue  
Lynnwood Manor,  
0041  
Pretoria  
Gauteng  
SOUTH AFRICA

Postnet Suite #116  
Private Bag X025  
Lynnwood Ridge, 0040  
tel: (012) 804 2281  
fax: 086 550 2053  
cellular: 083 284 5111  
e-mail: dhoare@lantic.net

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26 November 2010

Tammy Kruger  
Savannah Environmental (Pty) Ltd  
P O Box 148  
Sunninghill, 2157

Dear Tammy

**Re: Re-alignment of water pipeline for the proposed Upington Solar Thermal Plant**

The proposed re-alignment of the water pipeline, as described in a letter sent to me on 24 November 2010, has reference. I undertook the ecological specialist study for the proposed Upington Solar Thermal Plant. The assessment of this proposed project included an assessment of potential impacts of the water pipeline from the Orange River extraction point to the site.

The proposed new alignment is along the boundary of the property northwards to the access road to the mining area. On reaching the northern corner of the site, the pipeline runs next to an existing access road and then along an existing gravel regional road back towards the original alignment. The previous alignment (assessed in the EIA) cut across natural vegetation, including a drainage line, whereas the alignment proposed here does not affect such features to the same extent.

In my opinion, this new alignment will have similar impacts to the original proposed alignment, possibly slightly lesser impacts on some ecological features. For the original alignment, the two impacts with the highest significance were those on indigenous natural vegetation and on drainage lines (both rated as having medium significance). The current (new) alignment proposed here will probably have an impact of similar significance on indigenous natural vegetation and of lower significance on watercourses.

In conclusion, I approve of the new alignment and consider it a better option than the alignment assessed in the EIA report. I also approve submission of the Final EIA Report to the DEA with the revised pipeline route.

Yours faithfully

Dr David Hoare  
PhD (Botany / Ecology)



[www.birdlife.org.za](http://www.birdlife.org.za)

Lewis House 239 Barkston Drive, Blairgowrie • P O Box 515 Randburg 2125 South Africa  
Tel 0861 BIRDER / (011) 789 1122 • Fax (011) 789 5188 • e-mail [secretary@birdlife.org.za](mailto:secretary@birdlife.org.za) •  
Nonprofit Registration Number 001-298 NPO • Public Benefit Organisation Exemption No 930 004 518

To whom it may concern,

01/12/2010

**Upington Solar Plant – Realignment of water pipeline for the Upington Solar  
Thermal Power Plant McTaggart's Camp 453-3**

My involvement in the project to this point has been that of an avifaunal specialist responsible for the compilation of a specialist avifaunal assessment of the site and possible impacts that the project may pose to avifauna in the region. My current position in BirdLife South Africa is that of project manager for the 2012 Red Data Book for Birds of South Africa, Lesotho and Swaziland. My qualifications include an Msc Zoology, which focussed on different bird survey methods, and I am in the process of registering a PhD thesis focusing on Red Data species and species prioritisation methods.

Savanna Environmental (Pty) Ltd has informed BirdLife South Africa of the need to realign the water pipe line feeding the proposed facility. This is due to unforeseen circumstances. With regards to the avifauna on site and the proposed project, the most significant threat to bird communities would be from collisions with the overhead power line. It is not believed that the loss of habitat or the disturbance due to the realignment of the water pipe line will have any negative impact on bird communities in the area. The realignment of the pipeline will not affect any changes to the conclusions reached in the avifaunal assessment.

In conclusion, BirdLife South Africa has no objection to Savanna Environmental (Pty) Ltd submitting the final EIA report to the DEA with the revised pipeline route included.

Regards

Martin Taylor

# OUTENIQUA GEOTECHNICAL SERVICES cc

Reg. No. 1999/062743/23

## GEOTECHNICAL ENGINEERING CONSULTANTS



26 Cove St Knysna

PO Box 3186 George Industria 6536

044 3820502(T) 044 3820503(F)

iaian@outeniqua.co.za

25<sup>th</sup> November 2010

Tammy Kruger  
Savannah Environmental

### **RE: REALIGNMENT OF PROPOSED PIPELINE – UPINGTON SOLAR THERMAL FACILITY**

The documentation from the developer regarding the realignment of the proposed pipeline for the above project has reference.

This company has been involved in the EIA process for the project as an independent geological specialist and has the following comments on the proposed realignment:

- The geology along the proposed new route does not differ significantly from that of the previous route and therefore we expect very similar impacts to those indicated in our original EIA report (refer to Technical Report No. OGS2010-09-07-2).
- There is no reason, in terms of impacts on the geological environment, why the newly proposed route should not be followed.

Regards

Iain Paton Pr. Sci. Nat. MSAIEG

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Outeniqua Geotechnical Services is affiliated to Outeniqua Lab (Pty) Ltd Civil Engineering Laboratories

Members: Dennis McDonald Reg.Eng.Tech MSAICE  
Llewelyn Heathcote BTech (Civ.Eng) MSAICE

Iain Paton Pr.Sci.Nat (Geol) MSAICE MSAIEG  
Avasheni Govender

Associates: Alan Cook Pr. Eng. MSAICE





# McGregor Museum

5 Atlas Street  
Herlear  
Kimberley  
8301

PO Box 316  
Kimberley 8300  
Tel. +27 (0) 53 839 2700  
Fax. +27 (0) 53 842 1433

## Archaeology Department

Your Ref: Upington Solar Plant  
Our Ref: MMK 14  
Date: 26 November 2010

Tel +27-53 839 2706  
Mobile +27-82 2224777  
dmorris@museumsnc.co.za  
www.museumsnc.co.za

### **Proposed Upington Solar Thermal Plant: proposed change in water supply pipeline route.**

#### **Comment by David Morris, Archaeologist.**

##### Role

I am a qualified and professionally accredited archaeologist who provided the archaeology and heritage assessment for the proposed development of the Upington Solar Thermal Plant in question.

##### Assessment of the deviation

It has been brought to my attention that the route of the proposed water supply pipeline has needed to be changed owing to a land claim on a portion of the terrain across which it was originally planned to be constructed.

Having assessed the heritage resources across a substantial part of the farm McTaggarts Camp, the vicinity which the new pipeline would cross can be predicted to have minimal archaeological traces, in line with the extremely low densities seen in immediately adjacent areas. These observations had been consistent with previous surveys in similar portions of the landscape near Upington. The terrain to be traversed by the pipeline does not differ significantly from areas previously examined.

The proviso given previously, that in the unlikely event of any significant heritage traces being encountered during development, steps be taken to report the find immediately and seek advice on possible mitigation procedures.

##### Conclusion

Given these observations, I would support submission of the Final EIA Report to DEA with the revised pipeline route included.

David Morris: McGregor Museum, Kimberley, 26 November 2010





26 November 2010

Tammy Kruger  
Savannah Environmental (Pty) Ltd.  
PO Box 148  
Sunninghill  
2157

Dear Tammy

**Uppington CSP aquatic impact assessment of new pipeline alignment**

After reviewing the design information provided on the new pipeline alignment proposed by the developer, and of our impact assessment, we have found that no changes to the impact assessment would be required based on the following:

- The locality of pump station and intake locality along the Orange River would not change, thus all impact ratings would remain unaltered.
- The impact of the initial pipeline on the riparian and dry rivers beds was assessed as LOW with mitigation. With the proposed new alignment the impact would even be lower, as the route now avoids one of the major river channels within the region.
- Cumulative and residual impacts would remain similar should all the conditions in the Environmental Management Plan be upheld.

We would thus support the proposed new alignment in terms of the above assessment.

Yours sincerely

**Dr Brian Colloty**

Riparian and wetland specialist and co-author of the water resources impact assessment report, with 13 years experience in river and wetland impact assessments following a Ph.D in conservation rating methods.

30 November 2010

Savannah Environmental (Pty) Ltd

To Whom in May Concern

**VIA commentary on realigned supply pipeline for the Proposed Upington Solar Thermal Plant**

Further to the comments received by Savannah Environmental on the draft EIR for the above project, and the subsequent decision to realign the water supply pipeline, the following:

- Savannah Environmental (Pty) Ltd appointed MetroGIS (Pty) Ltd as an independent specialist consultant to undertake the visual impact assessment for the proposed Upington Solar Thermal Plant. MetroGIS undertook the visual assessment in October 2010.

Lourens du Plessis, the lead practitioner undertaking the assessment, has been involved in the application of Geographical Information Systems (GIS) in Environmental Planning and Management since 1990. The team undertaking the visual assessment has extensive practical knowledge in spatial analysis, environmental modeling and digital mapping, and applies this knowledge in various scientific fields and disciplines.

- Ancillary infrastructure for the proposed project still includes a water supply pipeline to the facility along an existing road reserve, although the revised alignment is longer than the original proposal.

Anticipated visual impacts related to the proposed pipe line remain unchanged in terms of the nature of the visual impact - vegetation will be removed during the construction phase, and if left un-rehabilitated, the pipeline servitude may remain as a visual scar in the landscape. In addition, un-rehabilitated areas are vulnerable to erosion over time. The effects of erosion also represent a potential visual impact to observers.

The potential visual impact of the pipe line can be successfully mitigated by placing the pipe underground, and rehabilitating the vegetation within the pipeline servitude. Provided the servitude is properly rehabilitated, this measure has the further advantage of negating possible visual impacts associated with vegetation clearing and potential unsightly erosion scarring.

Although no dedicated viewshed has been generated for the pipeline, it is expected that the area of potential visual exposure will lie within that of the primary infrastructure (i.e. specifically the power tower). The potential visual impact of the pipeline is expected to be low.

- In terms of the realigned pipeline, the anticipated visual impact is not considered to be a fatal flaw from a visual perspective. It is therefore recommended that the Upington Solar Thermal Plant as proposed be supported, subject to the recommended mitigation measures (chapter 7 of the VIA) and management actions (chapter 9 of the VIA).

I trust the above is in order. Please do not hesitate to contact me should you require any further clarification or information.

Yours sincerely

Lourens du Plessis  
MetroGIS

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# **Tony Barbour**

## **ENVIRONMENTAL CONSULTANT AND RESEARCHER**

P O Box 1753, Sun Valley, 7975, South Africa  
(Tel) 27-21-789 1112 - (Fax) 27-21-789 1112 - (Cell) 082 600 8266  
(E-Mail) [tbarbour@telkomsa.net](mailto:tbarbour@telkomsa.net)

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Attention  
Karen Jodas  
Savannah Environmental (Pty) Ltd  
PO Box 148  
Sunninghill  
2157

30 November 2010

### **UPINGTON SOLAR PLANT SOCIAL IMPACT ASSESSMENT: REVISED PIPELINE ROUTE**

This letter serves to confirm that I was the lead author for the Social Impact Assessment (SIA) for the Upington Solar Energy Facility proposed by Khi CSP South Africa (Pty) Ltd. My qualifications include a BSc, BEcon (Hons) and an MSc in Environmental Science. In terms of SIA experience I have undertaken in the region of 100 SIA's and am the author of the Guidelines for Social Impact Assessments for EIA's adopted by the Department of Environmental Affairs and Development Planning (DEA&DP) in the Western Cape in 2007. These guidelines have also been endorsed at a national level by the DEA.

This letter also serves to confirm that I have considered the revised route for the water pipeline. In this regard the social impacts associated with the revised route, as in the case of the original route, will be negligible and the significance of the impact is rated as low negative. The revised route is therefore supported. The revised pipeline route does not therefore have a bearing on the overall findings contained in the SIA. The revised pipeline route can therefore be included in the Final EIR.

Regards

Tony Barbour