Environmental Impact Assessment Process
Amended EIA Report
Kai Garib CSP Tower Plant (previously known as Upington Solar Thermal Plant Two)
Northern Cape Province

September 2015

PART 1

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PROJECT DETAILS

DEA Reference Number	:	14/12/16/3/3/2/656
Title	:	Environmental Impact Assessment Process Amended EIA Report: Construction of the Kai Garib CSP Tower Plant (previously known as Upington Solar Thermal Plant Two), Northern Cape Province
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Client	:	Kai Garib CSP (RF) (Pty) Ltd (Abengoa Solar Power South Africa (Pty) Ltd)
Report Status	:	Amended EIA Report for submission to Department of Environmental Affairs
Date	:	September 2015

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PURPOSE OF THE AMENDED ENVIRONMENTAL IMPACT ASSESSMENT REPORT

Kai Garib CSP (RF) (Pty) Ltd (applicant was Abengoa Solar Power South Africa (Pty) Ltd) is proposing the construction and operation of a commercial solar thermal electricity generating facility (using power tower technology) and associated infrastructure near Upington, Northern Cape Province. The project is known as the Kai Garib CSP Tower Plant (previously referred to as the Upington Solar Thermal Plant Two)[1], and is one of three Abengoa Solar CSP facilities proposed to be established on Portion 3 of the farm McTaggarts Camp 453. The three Abengoa Solar facilities are as follows:

» Khi Solar One Solar Thermal Plant (a 50MW power tower technology), which is currently under construction (planned commercial operation date is end-2015);
» Proposed Upington Solar Thermal Plant Two (now officially called Kai Garib CSP Tower Plant) (up to 150MW using power tower technology), which is the subject of this EIA (DEA Ref Number 14/12/16/3/3/2/656); and
» Proposed Upington Solar Thermal Plant Three (up to 125MW using trough plant technology), which is authorised (DEA Ref Number 14/12/16/3/3/2/657).

Each project is located on a different area within Portion 3 of the Farm McTaggarts Camp 453, which lies approximately 20 km west of the town of Upington in the Northern Cape. It is the developer's intention to the CSP Facility under the Department of Energy's (DoE) Renewable Energy Independent Power Producer Procurement (REIPPP) Programme. The power generated from the CSP facility will be sold to Eskom through a 20-year power purchase agreement (PPA) and will feed into the national electricity grid. Ultimately, the project is intended to be a part of the renewable energy projects portfolio for South Africa. This EIA Report applies to the proposed Upington Solar Thermal Plant Two (i.e. now known as Kai Garib CSP Tower Plant) (DEA Reference Number: 14/12/16/3/3/2/656). It should be noted that the original project name (i.e. Upington Solar Thermal Plant Two) is still used in this report and the appendices.

As the project has the potential to impact on the environment, an Environmental Impact Assessment process is required to be completed in support of an application for environmental authorisation. 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 EIA Phase addresses that identified potential environmental impacts and benefits associated with all phases of the project including design, construction, operation and decommissioning and recommends appropriate mitigation measures for potentially significant environmental impacts. This amended final EIA report is submitted after taking account of feedback received from the Department of Environmental Affairs on the EIA report dated November 2014. This

[1] Kai Garib CSP Tower Plant is now the project's official name.

amended EIA report aims to provide the environmental authorities with sufficient information to make an informed decision regarding the proposed project.

The EIA process for the Upington Solar Thermal Plant Two commenced in 2013. A draft Environmental Impact Assessment Report was released for public review in August/September 2014. The Final EIA report was submitted to DEA (dated November 2014), and in May 2015 DEA requested:

» The EAP to amend the Final EIA report to address the requests for additional information and/or clarity, as per the DEA's correspondence dated 14 May 2015.
» Allow registered I&APS an opportunity to comment on the Amended EIA Report.
» Resubmit the Amended EIA report, together with any comments received from registered I&APs, to the DEA within a period of six months for final decision-making.

The Final EIA Report has been amended based on the request for clarification from the National Department of Environmental Affairs (DEA) dated the 14 May 2014. The Table below provides a summary of the points of clarification from the DEA, and indicates how the information requested and/or amendments have been included in this Amended EIA Report. This Amended EIA Report provides clarification of all the issues raised by the DEA. In addition the following amendments to the project information have been made:

a) A change to the project description, where the capacity of the facility has been changed from 125MW to 150MW. The change in the generating capacity the project would only change the generator to be used in the facility. There would be no change/increase in the development footprint of the facility, the height or nature of the infrastructure (i.e. tower and heliostats), the scope of the project and water volume required (remains at 400 000m^3 per annum).
b) A change to the project description, where the project name has been changed from Upington Solar Thermal Plant Two to *Kai Garib CSP Tower Plant* and the Applicant changed to *Kai Garib CSP (RF) (Pty) Ltd*.

In terms of Regulation 56(2), this amended EIA Report has been made available to registered interested and affected parties for comment.

KEY DIFFERENCES BETWEEN THE FINAL EIR (DATED NOVEMBER 2014) AND THE AMENDED EIR (DATED SEPTEMBER 2015)

Amendments and additional information provided within this Amended EIA report are

a) in response to the DEA's request for additional information and clarity as per the DEA correspondence dated 14 May 2015), and
b) to address the amendment to the project description, where the capacity of the facility changes been changed from 125MW to 150MW, and where the project name has been changed from Upington Solar Thermal Plant Two to *Kai Garib CSP Tower Plant* and the Applicant changed to *Kai Garib CSP (RF) (Pty) Ltd*.

The following summarises the key differences, and full details of the points of clarification requested by DEA and where each is addressed in this Amended report is included in Appendix B:

Points for Clarification	**Amendment to report**
Amendment to listed activities as applied for in the application form, including: • An amended application form with an indication of all the 2010 listed activities that are still listed; • An indication of all the similarly listed 2014 activities; • An indication if there are any new 2014 activities that are listed.	The application form has been amended and will be submitted to the DEA with the copy of the amended EIAr. The application has also been included in appendix B of the amended EIAr. All the similarly listed activities listed in the 2014 EIA Regulations have been included in Chapter 5, Table 5.1 of the Amended EIAr. All similar activities identifies in the 2014 EIA Regulations have been assessed in Chapter 7 of the Amended EIAr. It should be noted that no new listed activities under the 2014 Regulations have been triggered.
Assessment of each identified potential impact including cumulative impact that have been identified in accordance with Regulations 31 (l) of the EIA Regulations, 2010 for all the activities applied for.	The amended EIAr as well as the specialist studies adequately assesses all identified potential impact as well as the cumulative impacts in accordance with Regulations 31 (l) of the EIA Regulations, 2010 for all the activities applied for. Please refer to Chapter 7 and 8, and Appendix F to N (specialist studies) of the Amended EIAr.
Water resources: • Requirement for a non-binding water confirmation letter from the Department of Water and Sanitation as it is imperative that a reliable water source is secured for the	The Department of Water and Sanitation (DWS) have confirmed in a letter dated 29 May 2015 (refer to Appendix P) that, after due consideration of the water resource availability in the catchment area, it was found the

success of this project to ensure sustainability of the project. • Consideration of alternative water sources for the facility • Assessment of the cumulative impacts of all three solar facilities on the property on water resources in the area.	sufficient water is available to meet the water requirement of the project (~300 000 m3 per annum during construction and 400 000 m3 per annum during operation). CSP technologies function through the generation of steam to drive a conventional steam turbine and generator. Therefore, suitable and sufficient water resources are required. Water sources in this area of Northern Cape include a) water from the Gariep River (direct abstraction); b) water from a local municipality (who abstract from the Gariep River); or c) groundwater (direct abstraction). Groundwater resources are scarce, typically used by local farmers for livestock watering when available, and the water is brak. Groundwater is not considered a viable water source. Water will, therefore, be required to be abstracted from the Gariep River. The Department of Water and Sanitation (DWS) have confirmed in a letter dated 29 May 2015 (refer to Appendix P) that, after due consideration of the water resource availability in the catchment area, it was found the sufficient water is available to meet the water requirement of the project (~300 000 m3 per annum during construction and 400 000 m3 per annum during operation). The water source of direct abstraction from the Gariep River is therefore located a distance of less than 20km from the site, adjacent to the existing abstraction point for the Khi Solar One project (consolidating infrastructure at the existing abstraction embankment). No other water source/activity alternatives are available for assessment. The cumulative impact associated with the construction of the three CSP facilities have been addressed in Water Resources Study (Appendix I) as well as in Chapter 7 and of the Amended EIAr.
Avifauna: • Expansion of the avifaunal specialist study to include vantage point surveys as well as flight paths to consider how birds will move through approximately 2200 hectares of all	Eight vantage point surveys were conducted over a 10 day period, transects were conducted in the washes (riparian zones) and an investigation of the Khi Solar One solar field and tower complex which are constructed on the

three CSP's on the property. • Study to propose adequate mitigation measures to reduce the facilities impacts on avifauna frequenting the area, as well as mitigation measures to discourage birds from using the site. • Avifaunal assessment to be a separate/standalone specialist report.	site were undertaken. Adequate mitigation measures have been included to reduce the facilities impacts on avifauna frequenting the area. A separate Avifaunal report has been provided (refer to Appendix G).
Flora: Inclusion of a plant rescue plan.	A plant Search and Rescue Plan was compiled and has been included as part of the Draft Environmental Management Programme (refer to Appendix D of the Draft EMPr).
Dangerous good: Assessment and mitigation of impacts associated with the handling of a dangerous good	Impact associated with Item 13 of GNR 544 have been assessed in Chapter 7 of the amended EIAr.
Consideration of technology alternatives for the project, including an adequate motivation for the preferred technology.	The impacts associated with the Tower and the Trough technology have been comparatively assessed and their impacts weighted against each other. A clear motivation for the preferred alternative has been included (refer to Chapter 7, Section 7.1 of the Amended EIAr).
Detailed description of whether the proposed development is needed in the region and if the current proposed location is desirable for the proposed activity.	A detail motivation indicating whether the development is needed in the region and if the current proposed location is desirable for the proposed activity compared to other sites as been included in Chapter 3, Section 3.2 and in Chapter 4 Section 4.1 of the amended EIAr.
Assessment of cumulative impacts of the facility, taking into consideration the authorised two projects on site and alternative technologies.	The impacts associated with the Tower and the Trough technology have been comparatively assessed and their impacts weighted against each other. A clear motivation for the preferred alternative has been included (refer to Chapter 7, Section 7.1 of the Amended EIAr).
Inclusion of all copies of any representations, and comments received in connection with the application or the EIA report from interested and affected parties, and minutes of any meetings held by the EAP with interested and affected parties and other role players.	All representations and comments received from I&APs on the application are included in the public participation report. Refer to Appendix E5 for copies of comments received during the Scoping Phase. Copies of comments received during the EIA Phase are included in Appendix E3. All comments received and the responses to these comments are included in the Comments and Responses Report (refer to Appendix E1). No comments were received on the Final EIAR.

OPPORTUNITY FOR PUBLIC REVIEW OF THE AMENDED EIA REPORT

Interested and Affected Parties (I&APs) have been notified in terms of Regulation 56(2) and 56(3)(g) of the EIA Regulations of June 2010, of the availability of the Amended EIA Report. This Amended Final EIA Report has been released for a 30-day review period. The review period was from 03 August 2015 – 03 September 2015. Registered I&APs have been informed via letter (on 03 August 2015) that this amended Final EIA Report is available for comment, and that copies of the report can be requested from Savannah Environmental or downloaded from the website: www.savannahSA.com. The copy of the amended Final EIA report was placed at the Upington Public Library in Upington and at the Keimoes Public Library in Keimoes.

Comments were received through written submission via fax, post or e-mail. I&APs were also informed in writing that this Amended EIA Report has been prepared and submitted to DEA and is available from the website: www.savannahSA.com. Changes made to this Amended Report are underlined for ease of reference. Comments on this Amended Report should be submitted to DEA with a copy to Savannah Environmental. Relevant contact details are as follows:

National DEA **Mmamohale Kabasa** **Tel:** 012 399 9420 **Fax**: 012 320 7539 **Email:** MKabasa@environment.gov.za **Post:** Private Bag X 447, Pretoria, 0001	**Savannah Environmental(EAP):** **Gabriele Wood** **Tel:** 011 656 3237 **Fax:** 086 699 5796 **Email:** gabriele@savannahsa.com **Post:** P O Box 148 Sunninghill 2157

EXECUTIVE SUMMARY

Project Information

Kai Garib CSP (RF) (Pty) Ltd (Abengoa Solar Power South Africa (Pty) Ltd) is proposing the construction and operation of a commercial solar thermal electricity generating facility (using solar tower and heliostat technology) and associated infrastructure near Upington, Northern Cape Province. The project is known as the Kai Garib CSP Tower Plant (previously known as Upington Solar Thermal Plant Two, and is one of three Abengoa Solar Concentrating Solar Power (CSP) facilities proposed to be established on Portion 3 of the farm McTaggarts Camp 453 (with the Khi Solar One project currently under construction).

Each project is located on a different area within Portion 3 of the Farm McTaggarts Camp 453 (with a total extent of 2200ha), which lies approximately 20 km west of the town of Upington in the Northern Cape. The Upington Solar Thermal Plant Two is proposed to utilise power tower technology with a generation capacity of up to 150MW[2]. The facility will have a total development footprint of up to 700ha (within an 800ha portion identified within the larger farm) and will include the following associated infrastructure:

- Solar tower with central receivers and heliostat technology using superheated steam with dry cooling (700 hectares in extent).
- Power island which will include a steam turbine and generator; a dry cooled condenser; a generator transformer and substation; auxiliary fossil fuel and/or electric boilers and associated molten salt storage vessels and heat exchangers (approximately 200m x 500m in extent).
- Access roads (roads up to 6m wide).
- Plant substation (50m x 50m).
- 132 kV power line up to 4km in length to connect to Eskom's existing McTaggerts Substation, which is located on the same property as the proposed CSP Plant.
- Water abstraction point located at the Gariep River, filter station (20m x 30m) and water supply pipeline (up to 20km in length).
- Water storage reservoir and tanks (combined capacity up to 15 000m^3).
- Packaged water treatment plant (roughly 30m x 30 m).
- Up to 5 lined evaporation ponds (approximately 100m x 100m each).
- Workshop and office buildings (approximately 20m x 50m each).
- Mirror assembly facility (approximately 100m x 50m).

The purpose of the proposed facility is to add new capacity for generation of power from renewable energy to the

[2] Kai Garib CSP (RF) (Pty) Ltd increased the generating capacity from 125MW to 150MW. The RFP for the Expedited Round has been released, and the DoE has set the cap for CSP to 150MW. The change in the generating capacity the project would change the generator to be used in the facility. There would be no change/increase in the development footprint of the facility, the height or nature of the infrastructure (i.e. either trough, or tower and heliostats, the scope of the project and Water volume required.

national electricity supply (which is short of generation capacity to meet current and expected demand), and to aid in achieving the goal of a 30% share of all new power generation being derived from independent power producers (IPPs), as targeted by the Department of Energy (DoE). In response to the need, Abengoa Solar Power South Africa (Pty) Ltd, as an IPP, is proposing the construction and operation of this CSP facility. CSP is the only of the renewable technologies that utilise conventional steam generating equipment with operational and life expectancy similar to that of conventional power plants (i.e. 40 years vs 20 years for other renewable technologies). One advantage of concentrating solar power plants is their potential for storing solar thermal energy to use during non-solar periods and to dispatch electricity when it is needed most.

Environmental Impact Assessment

An EIA process, as defined in the NEMA EIA Regulations, is a systematic process of identifying, assessing, and reporting environmental impacts associated with an activity. The EIA process forms part of the planning of a project and informs the final design of a development. In terms of the EIA Regulations published in terms of Section 24(5) of the National Environmental Management Act (NEMA, Act No. 107 of 1998), Abengoa Solar Power South Africa requires authorisation from the National Department of Environmental Affairs (DEA) for the construction of the Upington Solar Thermal Plant Two facility. In terms of sections 24 and 24D of NEMA, as read with the EIA Regulations of GNR543, GNR544, GNR545; and GNR546, a Scoping and an EIA Phase have been undertaken for the proposed project. As part of this EIA process comprehensive, independent environmental studies have been undertaken in accordance with the EIA Regulations. The following key phases have been undertaken to date in the EIA Process.

» *Notification Phase* - organs of state, stakeholders, and interested and affected parties (I&APs) were notified of the proposed project using adverts, site notices, and stakeholder letters. Details of registered parties have been included within an I&AP database for the project.
» *Scoping Phase* – identification of potential issues associated with the proposed project and environmental sensitivities (i.e. over the broader project development site - entire extent of Portion 3 of the farm McTaggarts Camp 453), as well as the extent of studies required within the EIA Phase were defined.
» *EIA Phase* – potentially significant biophysical and social impacts[3] and identified feasible alternatives have been comprehensively assessed through specialist investigations. Appropriate mitigation measures have been recommended as part of a draft Environmental Management Programme (EMPr) (refer to Appendix T).

[3] Direct, indirect, cumulative that may be either positive or negative.

Evaluation of Impacts Associated with the Facility

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.

From the conclusions of the detailed EIA studies undertaken, sensitive areas within the development footprint area were identified and flagged for consideration and avoidance by the facility layout. Potential impacts which could occur as a result of the proposed project are summarised in the sections which follow. The most significant environmental impacts identified and assessed to be associated with the proposed Upington Solar Thermal Plant Two include:

» Local site-specific impacts
» Visual impacts due to the extent of the solar field and other associated infrastructure.

The areas of high ecological sensitivities of the site are presented in Figure 9.1 and include areas containing riparian vegetation along drainage lines: *Acacia mellifera – Cenchrus ciliaris* ephemeral drainage lines. These areas of high sensitivity also contain protected trees species (*Acacia erioloba* (Camelthorn) *and Boscia foetida* (Shepherds tree), *Boscia albitrunca (*Shepherds *tree).* The number of protected trees that could be destroyed by the development are estimated as follows:

» *Acacia erioloba:* less than 50 trees
» *Boscia albitrunca:* less than 50 trees

The areas of high ecological sensitivity amount to an area of ~11ha, and it is recommended that impact on these areas be avoided or minimised through considered placement of infrastructure in order to minimise the impact on vegetation and fauna. The areas of high ecological sensitivity amount to an area of ~11 hectares of the 800ha development footprint (i.e. ~1.3% of the development footprint for Upington Two).

Due to the nature of the power tower plant, total avoidance of the high ecological sensitivity may not be possible. Impacts to ephemeral riparian areas would be less than 1.3% of the total development footprint, and would be considered acceptable loss. However, mitigation would be required to ensure that water flow during high rainfall events is appropriately managed and does not result in erosion or scour (i.e. stormwater management is required).

Conclusions

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 CSP Plant 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 proposed development on the site will create a localised reduction of indigenous trees and shrubs, geophytes and other species of conservation concern, but not to a degree that the current conservation status of such species will be negatively affected. Due to the areas of high ecological sensitivity being avoided by the design and layout of the CSP Plant, the **ecological impacts** of the CSP plant will be of a medium acceptable significance.

» The threat to **fauna** communities would be from the loss of habitat, disturbance and/or any interaction of fauna with the facility, and is not anticipated to have a significant negative impact on fauna populations and communities in the area.

» » From the results of the expanded/additional study conducted and the literature reviewed it is likely that impacts on avifauna are likely to be very low. The threat to avifauna communities would be from the loss of habitat, disturbance, collisions with the overhead power line and/or any interaction with the facility infrastructure, and is not anticipated to have a significant negative impact on avifauna populations and communities in the area. Taking into account that the vast majority (over 80%) of the bird mortalities expected at a CSP facility are caused by collisions with heliostats, with the correct mitigation measures in place, the number of bird mortalities can probably be limited to 0.2 to 0.3 birds per week, which is approximately 10% of the number of birds killed per kilometre of road per week. One of the factors reducing the risk of mortality in avifauna species is the low average flight height of birds in the area, as most bird species will fly under the heliostats. The fact that many of the species of concern appear to be absent from the study area further reduces the likely impacts of the facility.

» 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 **soils** is medium to low due to the limited scale of the development and the scarcity of development in the immediate surrounding area.

» 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 other authorised and proposed CSP and solar projects adjacent to the site, however, these impacts are not considered to represent a fatal flaw, and in addition, there is no indication if (or when) other developments will take place.

» When considering these technical considerations, access Alternative 1 is nominated as the preferred access route alternative.

» The benefits of the project are expected to occur at a national, regional and local level. These benefits partially offset the localised environmental costs of the project.

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**.

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 impacts associated with the development of the Upington Solar Thermal Plant Two can be managed and mitigated to an acceptable level.

In terms of this conclusion, the EIA project team support the decision for environmental authorisation.

The following conditions would be required to be included within an authorisation issued for the project:

» As far as possible, the design and layout of the CSP Plant should consider and accommodate areas of high environmental sensitivity.

» 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 F to M to be implemented.

» The draft Environmental Management Programme (EMPr) as contained within Appendix T 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 EMPr 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.
- An ecological walk through survey for the CSP plant and associated infrastructure (such as pipeline, power line and access roads) must be undertaken prior to construction.
- A permit to be obtained for removal of protected trees and provincially protected flora that are affected.
- A walk-through survey be undertaken by an avifauna specialist for the route of the power line only to identify sections of line requiring collision mitigation.
- The relevant Water Use Licenses for water uses to be obtained from Department of Water and Sanitation (DWS).
- Applications for all other relevant and required permits required to be obtained by Abengoa Solar Power South Africa (Pty) Ltd must be submitted to the relevant regulating authorities. This includes permits for the transporting of all components (abnormal loads) to site, disturbance to any heritage sites, disturbance of protected vegetation and protected trees, and water uses.

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APPENDICES

ABBREVIATIONS AND ACRONYMS

BID	Background Information Document
CO_2	Carbon dioxide
CSP	Concentrated Solar Power
DENC	Department of Environment and Nature Conservation
DEA	National Department of Environmental Affairs
DoE	Department of Energy
DWS	Department of Water and Sanitation
EAP	Environmental Assessment Practitioner
EIA	Environmental Impact Assessment
EMPr	Environmental Management Programme
GDP	Gross Domestic Profit
GIS	Geographical Information Systems
GG	Government Gazette
GN	Government Notice
GHG	Greenhouse gases
GWh	Giga Watt Hour
I&AP	Interested and Affected Party
IDP	Integrated Development Plan
IPP	Independent Power Producer
km^2	Square kilometres
kV	Kilovolt
LUPO	Rezoning and Subdivision in terms of Land Use Planning Ordinance, Ordinance 15 of 1985
MAR	Mean Annual Rainfall
m^2	Square meters
MW	Megawatt
NEMA	National Environmental Management Act (Act No. 107 of 1998)
NERSA	National Energy Regulator of South Africa
NHRA	National Heritage Resources Act (Act No. 25 of 1999)
NGOs	Non-Governmental Organisations
NWA	National Water Act (Act No. 36 of 1998)
REIPPP	Renewable Energy Independent Power Producers Programme
SAHRA	South African Heritage Resources Agency
SANBI	South African National Biodiversity Institute
SANRAL	South African National Roads Agency Limited
SDF	Spatial Development Framework

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.

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.

Commercial Operation date: The date after which all testing and commissioning has been completed and is the initiation date to which the seller can start producing electricity for sale (i.e. when the project has been substantially completed).

Commence: The start of any physical activity, including site preparation and any other activity on site furtherance of a listed activity or specified activity, but does not include any activity required for the purposes of an investigation or feasibility study as long as such investigation or feasibility study does not constitute a listed activity or specified activity.

Commissioning: Commissioning commences once construction is completed. Commissioning covers all activities including testing after all components of the wind turbine are installed.

Construction: Construction means the building, erection or establishment of a facility, structure or infrastructure that is necessary for the undertaking of a listed or specified activity. Construction begins with any activity which requires Environmental Authorisation.

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.

Decommissioning: To take out of active service permanently or dismantle partly or wholly, or closure of a facility to the extent that it cannot be readily re-commissioned. This usually occurs at the end of the life of a facility.

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.

Emergency: An undesired/ unplanned event that results in a significant environmental impact and requires the notification of the relevant statutory body, such as a local authority.

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 programme: 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.

Hazardous waste: Any waste that contains organic or inorganic elements or compounds that may, owing to the inherent physical, chemical or toxicological characteristics of that waste, have a detrimental impact on health and the environment (Van der Linde and Feris, 2010;pg 185).

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 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.

Method statement: A written submission to the ECO and the site manager (or engineer) by the EPC Contractor in collaboration with his/her EO.

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/).

No-go areas: Areas of environmental sensitivity that should not be impacted on or utilised during the development of a project as identified in any environmental reports.

Pollution: A change in the environment caused by substances (radio-active or other waves, noise, odours, dust or heat emitted from any activity, including the storage or treatment or waste or substances.

Pre-construction: The period prior to the commencement of construction, this may include activities which do not require Environmental Authorisation (e.g. geotechnical surveys).

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.

Waste: Any substance, whether or not that substance can be reduced re-used, recycled and recovered; that is surplus, unwanted, rejected, discarded, abandoned or disposed of which the generator has no further use for the purposes of production. Any product which must be treated and disposed of, that is identified as waste by the minister of

Environmental affairs (by notice in the Gazette) and includes waste generated by the mining, medical or other sectors, but: A by-product is not considered waste, and portion of waste, once re-used, recycled and recovered, ceases to be waste (Van der Linde and Feris, 2010; p186).

INTRODUCTION CHAPTER 1

Kai Garib CSP (RF) (Pty) Ltd (applicant was Abengoa Solar Power South Africa (Pty) Ltd[4]) is proposing the construction and operation of a commercial solar thermal electricity generating facility (using power tower technology) and associated infrastructure near Upington, Northern Cape Province. The project is known as the Kai Garib CSP Tower Plant (previously referred to as the Upington Solar Thermal Plant Two)[5], and the Applicant is Kai Garib CSP (RF) (Pty) Ltd, a Special Purpose Vehicle (SPV) established by Abengoa Solar for this project[6]. The project is one of three Abengoa Solar CSP facilities proposed to be established on Portion 3 of the farm McTaggarts Camp 453. The three Abengoa Solar facilities are as follows:

» Khi Solar One Solar Thermal Plant (a 50MW power tower technology), which is currently under construction (planned commercial operation date is end-2015)
» Proposed Upington Solar Thermal Plant Two (now officially called Kai Garib CSP Tower Plant) (up to 150MW using power tower technology), which is the subject of this EIA (DEA Ref Number 14/12/16/3/3/2/656)
» Proposed Upington Solar Thermal Plant Three (up to 125MW using trough plant technology), which is authorised (DEA Ref Number 14/12/16/3/3/2/657).

Each project is located on a different area within Portion 3 of the Farm McTaggarts Camp 453, which lies approximately 20 km west of the town of Upington in the Northern Cape. It is the developer's intention to bid each CSP Facility under the Department of Energy's (DoE) Renewable Energy Independent Power Producer Procurement (REIPPP) Programme. The power generated from the CSP facilities will be sold to Eskom through a 20-year power purchase agreement (PPA) and will feed into the national electricity grid. Ultimately, the projects are intended to be a part of the renewable energy projects portfolio for South Africa. **This EIA Report applies to the Proposed Upington Solar Thermal Plant Two** (i.e. now known as Kai Garib CSP Tower Plant) **(DEA Reference Number: 14/12/16/3/3/2/656).** It should be noted that the original project name (i.e. Upington Solar Thermal Plant Two) is still used in this report and the appendices. Both project names refer to the same facility.

[4] The Special Purpose Vehicle (SPV) Kai Garib CSP (RF) (Pty) Ltd is the official Applicant for the project, although the project remains an Abengoa Solar project. Abengoa Solar is still referred to in this report as being the project developer.

[5] Kai Garib CSP Tower Plant is now the project's official name. The project name has been amended on the project application form submitted to DEA.

[6] The SPV Kai Garib CSP (RF) (Pty) Ltd is the official Applicant for the project, although the project remains an Abengoa Solar project. The applicant details have been amended on the project application form submitted to DEA.

As the project has the potential to impact on the environment, an Environmental Impact Assessment process is required to be completed in support of an application for Environmental Authorisation prior to the commencement of construction of the project. This Draft EIA Report assesses this proposed project and consists of ten chapters, which include:

» **Chapter 1** provides background to the proposed project and the environmental impact assessment, and an introduction to the rationale behind the selected site and technology proposed.
» **Chapter 2** outlines the strategic legal context for the energy planning and the proposed project.
» **Chapter 3** provides a description of the proposed project as well the need and desirability for the Kai Garib CSP Tower Plant (previously known as Upington Solar Thermal Plant Two project).
» **Chapter 4** provides details of the alternatives considered for the proposed project.
» **Chapter 5** outlines the process which was followed during the EIA process.
» **Chapter 6** describes the existing biophysical and socio-economic environment affected by the proposed project.
» **Chapter 7** provides a comparative assessment of the trough and tower and heliostats technologies, an assessment of the potential issues and impacts associated with the proposed CSP tower project, and presents recommendations for mitigation of significant impacts.
» **Chapter 8** provides an assessment of cumulative impacts.
» **Chapter 9** presents the conclusions and recommendations based on the findings of the EIA.
» **Chapter 10** provides references used to compile the EIA Report.

1.1. Purpose of the Amended Final EIA Report

The EIA process for the Kai Garib CSP Tower Plant commenced in 2013. A draft Environmental Impact Assessment Report was released for public review in August/September 2014. The Final EIA report was submitted to DEA (dated November 2014), and in May 2015 DEA requested:

» The EAP to amend the Final EIA report to address the requests for additional information and/or clarity, as per the DEA's correspondence dated 14 May 2015.
» Allow registered I&APS an opportunity to comment on the Amended EIA Report.
» Resubmit the Amended EIA report, together with any comments received from registered I&APs, to the DEA within a period of six months for final decision-making.

The Final EIA Report has been amended to address the request for clarification from the National Department of Environmental Affairs (DEA) dated the 14 May 2014. The following amendments have been made in this Amended EIA Report:

a) Provide clarification and/or assessment of all the issues raised by the DEA:
   The amendments include the results, impact predictions and recommendations (specifically avifauna, visual, flora and water resource specialists), and clarification of listed activities. Appendix B provides a tabled response as to how each point of clarification has been addressed.
b) A change to the project description, where the capacity of the facility has been changed from 125MW to 150MW:
   The change in the generating capacity of the project would only change the generator to be used in the facility. There would be no change/increase in the development footprint of the facility, the height or nature of the infrastructure (i.e. tower and heliostats), the scope of the project and water volume required (remains at 400 000m^3 per annum). The change in the capacity does not change any impacts or any impact significance ratings. Letters confirming that the change in capacity would not increase the level or nature of the potential impacts as determined in the 2014 specialist assessments are included in Appendix P.
c) A change to the project description, where the project name has been changed from Upington Solar Thermal Plant Two to *Kai Garib CSP Tower Plant* and the Applicant changed to *Kai Garib CSP (RF) (Pty) Ltd*.
   To alert the reader to the official name now given to the project. It should be noted that the original project name (i.e. Upington Solar Thermal Plant Two) is still used in this report and the appendices.

One of the key points for clarification raised by DEA was for the amended EIA report to consider impacts to avifauna in further detail through an expanded avifauna study including an additional avifauna survey. The primary objectives of the avifauna study were:

- Expand the study by means of vantage point surveys to be conducted to cover the full extent of the farm McTaggarts Camp (i.e. the 2200ha study area where Khi Solar One as well as the two other CSP plants are planned);
- Comment on and expand on mitigation measures as set out in the original assessment; and
- Provide detail on implementable mitigation measures for the proposed development/s.

The Amended Final EIA report has been now been compiled and is available for review by all stakeholders and registered I&APs.

1.2. Background to the Proposed Kai Garib CSP Tower Plant

The Kai Garib CSP Tower Plant is proposed to utilise solar tower and heliostats technology, using superheated steam, with a generation capacity of up to 150MW[7]. A locality map showing the proposed location of the Kai Garib CSP Tower Plant on Portion 3 of the Farm McTaggarts Camp 453 (and in relation to the Khi Solar One facility under construction, and the proposed Upington Solar Thermal Three facility) is included as Figure 1.1. The site falls within Ward 8 of the Kai !Garib Local Municipality but is physically closer to the town of Keimos and Upington.

Site selection: Why is this development proposed on portion 3 of McTaggarts Camp 453?

The Northern Cape has the best solar resource in the South Africa. Based on existing infrastructure, one of the best suited areas in the Northern Cape for solar energy facilities is close to and surrounding the town of Upington. The proposed location is in close proximity (within 10km) of this town.

The Khi Solar One plant located on Portion 3 of McTaggarts Camp 453 is one of the first CSP facilities awarded preferred bidder status by the Department of Energy, and commenced construction activities in 2012. The Khi Solar One facility only occupies a portion (less than 30%) of the total extent of the farm[8]. The construction of one CSP facility presents opportunities for other facilities to be constructed in the same location in order to benefit from infrastructure and services which have been established to service the first facility established. Abengoa Solar Power South Africa have identified these opportunities and now propose a further CSP facility on the same farm:

» The new Eskom McTaggerts Substation is located on the McTaggarts Camp property and Eskom's planned transmission grid expansion (by 2016) in close proximity provides a secure point of evacuation for the power to be generated at a new facility.

» A CSP plant requires water for the steam generation process and mirror cleaning. Water is only available from the Gariep River. To reduce the environmental impact on the river, existing abstraction points should be used. The Kai Garib CSP Tower Plant project will abstract water from an existing pool in the river, which currently supplies

[7] Abengoa Solar have increased the generating capacity of the facility from 125MW to 150MW. The RFP for the Expedited Round has been released, and the DoE has set the cap for CSP to 150MW. The change in the generating capacity of the project would change the generator to be used in the facility. There would be no change/increase in the development footprint of the facility, the height or nature of the infrastructure (i.e. either trough, or tower and heliostats, the scope of the project and water volume required.

[8] The full extent of the farm is owned by Abengoa Solar Power South Africa.

the Khi Solar One plant, therefore combining infrastructure and reducing the potential for impact.

» No natural ground water exists on the property. The land is not optimal for agricultural land use activities, and the use of the land for solar power production makes use of land that will not have otherwise contributed to development and sustainability.

» The gradient of the land is <1%, making it ideal for CSP construction, which requires a flat surface.

» The farm portion is not a greenfields site and has been disturbed through construction of the Khi Solar One facility in the southern portion of the site. In addition, old excavations and diggings are found in the northern portion of the site where tungsten was dug by hand during the Great Depression (1930 – 1935). The diggings were never rehabilitated.

» The Khi Solar One facility is the first solar tower plant to be constructed in South Africa, and Upington Solar Two would mirror this technology and be located on the same farm, consolidating the impacts to a single location.

Approximately 1200 people are currently being employed on the construction site of Khi Solar One, with a significant number coming from the nearby communities (Klippunt, Sesbrugge, Daysons Klip and others). Significant resources and expenses have been incurred by Abengoa Solar to train people in a variety of disciplines in the CSP industry. Developing this project at the same location will create sustainability in employment, in that workers can move from the one project to another.

Further, industries have been created in Upington and the surrounding communities to provide products and services to the Khi Solar One project. Developing the next phase on Portion 3 of the Farm McTaggarts Camp 453 will allow these businesses to continue trading and positively impact on the lives of the community.

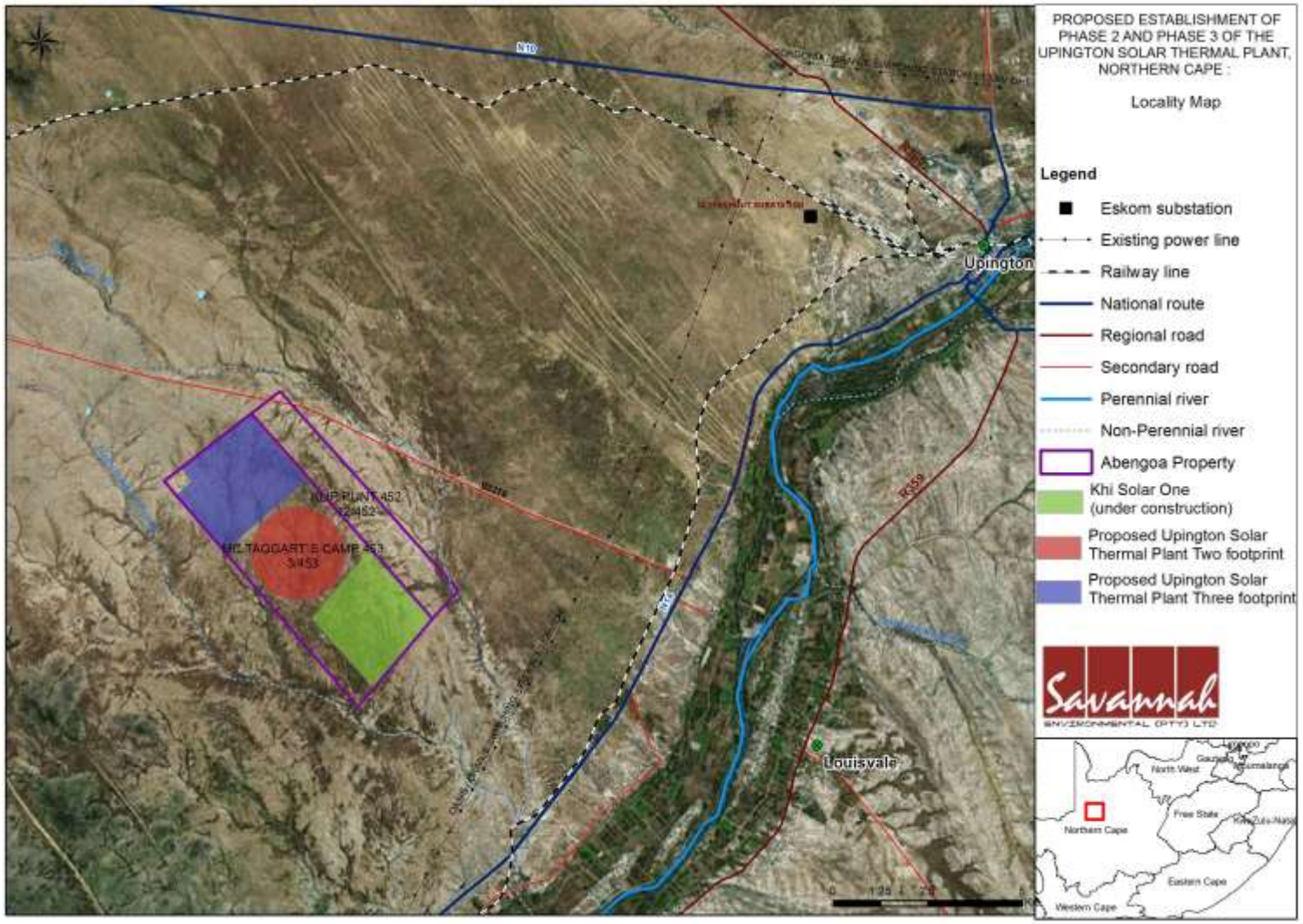

Figure 1.1: Locality map showing the proposed site for the construction of the Kai Garib CSP Tower Plant (previously known as Upington Solar Thermal Plant Two) (in relation to the Khi Solar One Solar Thermal Plant and proposed Upington Solar Thermal Plant Three) on Portion 3 of the farm McTaggarts Camp 453

Technology selection: Why consider CSP Tower Technology for the development?

Abengoa Solar is the only solar company that commercially implements all CSP technological solutions in projects worldwide. As such, projects are designed to most optimally suit the techno-economic needs of the specific situation or customer. The Khi Solar One project being developed by Abengoa Solar was limited to the available grid capacity, and no significant storage requirements were in place when the project was developed as part of Round 1 of the REIPPPP programme. As such a 50MW CSP steam tower, with steam storage was found as the optimal solution.

For Round 3 of the REIPPP Programme, the DOE provided an incentive for projects being able to contribute to peak power generation, specifically being able to generate between the hours of 16:30 and 21:30, i.e. requiring at least 5 hours of energy storage for electricity generation to continue after the sun has set (i.e. the primary energy source lost). It was further found that the grid upgrade by Eskom anticipated in 2016 would allow an additional 150MW to be fed into the grid in Upington.

Therefore, considering these factors, a 150MW solar tower and heliostat plant with molten salt energy storage represents an optimal technology choice to meet the requirements of the DOE for subsequent bidding Rounds and deliver the greatest value to the country as a whole through socio-economic development being created and least-cost impact on the electricity consumer. Therefore the proposed 150MW Upington Solar Thermal Plant Two is highly preferred from a technical, financial and socio-economic perspective. Environmental feasibility as well as potential impacts of the project is determined further in this EIA report.

Project details: What is proposed for the CSP Facility?

The Upington Solar Thermal Plant Two is proposed to utilise solar tower and heliostat technology with a generation capacity of up to 150MW, and energy storage of up to 6 hours (using molten salts technology). A solar tower system comprises of a heat collection system and a conventional generating plant portion. The heat collection system consists of **heliostats** (movable, flat reflective mirrors roughly 140m^2 which are oriented according to the sun's position in order to capture and reflect the solar radiation) and **receivers** (consisting of metal tubes which transfer the heat from the solar radiation to water or molten salt with the purpose of generating steam). The receivers are mounted on a 200m to 300m high **solar tower** that provides elevation and structurally supports the receivers. The collected energy in the power tower 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.

The Kai Garib CSP Tower Plant will have a development footprint of 700 ha, to be placed within a demarcated area of 800ha (which is located within a broader site of ~2200 ha) and will include the following associated infrastructure:

» Solar tower with central receivers and heliostat technology using superheated steam with dry cooling (700 hectares in extent).
» Power island which will include a steam turbine and generator; a dry cooled condenser; a generator transformer and substation; auxiliary fossil fuel and/or electric boilers and associated molten salt storage vessels and heat exchangers (approximately 200m x 500m in extent).
» Access roads (roads up to 6m wide).
» Plant substation (50m x 50m).
» 132 kV power line up to 4km in length to connect to Eskom's existing McTaggerts Substation, which is located on the same property as the proposed CSP Plant.
» Water abstraction point located at the Gariep River, filter station (20m x 30m) and water supply pipeline (up to 20km in length).
» Water storage reservoir and tanks (combined capacity up to 15 000m^3).
» Packaged water treatment plant (roughly 30m x 30 m).
» Up to 5 lined evaporation ponds (approximately 100m x 100m each).
» Workshop and office buildings (approximately 20m x 50m each).
» Mirror assembly facility (approximately 100m x 50m).

The scope of the proposed Kai Garib CSP Tower Plant, including details of all elements of the project (for the design/planning, construction, operation and decommissioning phases) is discussed in more detail in Chapter 2.

1.3. Details of the Environmental Assessment Practitioners and Specialist Team

Savannah Environmental was contracted as the independent EAP to undertake both Scoping and EIA Phases for the proposed project. Neither Savannah Environmental nor any of its specialist sub-consultants on this project are subsidiaries of, or are affiliated to Abengoa Solar Power South Africa (Pty) Ltd in any way. Furthermore, Savannah Environmental does not have any interests in secondary developments that could arise out of the authorisation of the proposed projects.

Savannah Environmental is a specialist environmental consulting company providing holistic environmental management services, including environmental impact assessments 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 have considerable experience in environmental impact assessments and environmental management, and have been actively involved in undertaking environmental studies, for a wide variety of projects throughout South Africa, including those associated with electricity generation.

- *Ravisha Ajodhapersadh*, principle author of this report, holds an Honours Bachelor of Science degree in Environmental Management and has 7 years of experience in environmental management. She has undertaken EIAs for various proposed solar energy facilities in South Africa and has been involved in other CSP projects in the Northern Cape.
- *Tebogo Mapinga,* of this report the co-author is a Senior Environmental Consultant, holds a BSc degree with 8 years of experience in the environmental field in both public and private sectors. Her competencies lie in environmental impact assessments, compliance monitoring and public participation for small and large scale projects. She is currently in the process of completing her honours degree in Environmental Management
- *Karen Jodas,* is a Professional Natural Scientist and holds a Master of Science degree and is the registered EAP on the proposed project. She has 17 years of experience consulting in the environmental field. Her key focus is on strategic environmental assessment and advice; management and co-ordination of environmental projects, which includes integration of environmental studies and environmental processes into larger engineering-based projects and ensuring compliance to legislation and guidelines; compliance reporting; the identification of environmental management solutions and mitigation/risk minimising measures; and strategy and guideline development. She is currently responsible for the project management of EIAs for several renewable energy projects across the country.

In order to adequately identify and assess potential environmental impacts associated with the proposed project, the following specialist sub-consultants have provided input into this EIA report:

- Ecology (flora, fauna and avifauna) – Marianne Strohbach and Blair Zoghby
- Soils and Agricultural Potential – Johann Lanz
- Heritage – David Morris
- Palaeontology - John Pether
- Visual - Bernard Oberholzer and Quinton Lawson
- Social – Tony Barbour
- Surface Water Assessment - Brian Colloty
- Noise - Morne De Jager

Refer to Appendix A for the curricula vitae for the EAPs and specialist sub-consultants.

2.1. National 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 2.1. 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 facility's development.

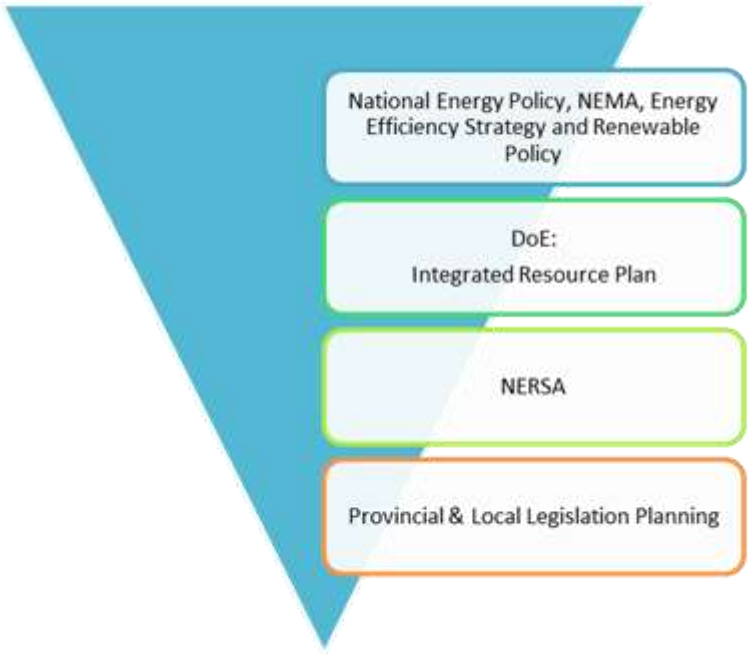

Figure 2.1: Hierarchy of electricity policy and planning documents

2.1.1 The National Energy Act (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)."

The National Energy Act aims 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 and interactions amongst economic sectors, as well as matters relating to renewable energy. The Act provides the legal framework which supports the development of renewable energy facilities for the greater environmental and social good.

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

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

As such, investment in renewable energy initiatives is supported, 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.

2.1.3 White Paper on the Renewable Energy Policy of the Republic of South Africa (2003)

The White paper on renewable energy supplements the Governments overarching policy on energy as set out in its White Paper on the Energy Policy of the republic of South Africa (DME, 1998). The White Paper on Renewable Energy Policy recognises the significance of the medium and long-term potential of renewable energy. The main aim of the policy is to create the conditions for the development and commercial implementation of renewable technologies. The White Paper on Energy Policy's position with respect to renewable energy is based on the integrated resource planning criterion of:

"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."

This White Paper on Renewable Energy (November, 2003) sets out Government's vision, policy principles, strategic goals and objectives for promoting and implementing renewable energy in South Africa. South Africa relies heavily on coal to meet its energy

needs because it is well-endowed with coal resources; in particular. However South Africa is endowed with renewable energy resources that can be sustainable alternatives to fossil fuels, so far these have remained largely untapped. The White Paper on Renewable Energy sets a target of generating 10 000GWh from renewable energy sources. Therefore the policy supports the investment in renewable energy facilities sources at ensuring energy security through the diversification of supply.

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) and more so when social and environmental costs are taken into account. In spite of this range of resources, the National Energy Policy acknowledges that the development and implementation of renewable energy applications has been neglected in South Africa.

Government policy on renewable energy is therefore 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 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*."

2.1.4 Final Integrated Resource Plan, 2010 - 2030

The Energy Act of 2008 obligates the Minister of Energy to develop and publish an integrated resource plan for energy. Therefore, the Department of Energy (DoE), together with the National Energy Regulator of South Africa (NERSA) has compiled the Integrated Resource Plan (IRP) for the period 2010 to 2030. The objective of the IRP is to develop a sustainable electricity investment strategy for generation capacity and transmission infrastructure for South Africa over the next twenty years. The IRP is intended to:

» Improve the long term reliability of electricity supply through meeting adequacy criteria over and above keeping pace with economic growth and development;
» Ascertain South Africa's capacity investment needs for the medium term business planning environment;

» Consider environmental and other externality impacts and the effect of renewable energy technologies; and
» Provide the framework for Ministerial determination of new generation capacity (inclusive of the required feasibility studies).

The objective of the IRP is to evaluate the security of supply, and determine the least-cost supply option by considering various demand side management and supply-side options. The IRP also aims to provide information on the opportunities for investment into new power generating projects.

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, and updated on 29 January 2010. The Department of Energy released the Final IRP in March 2011, which was accepted by Parliament at the end of the same month. This Policy-Adjusted IRP is recommended for adoption by Cabinet and subsequent promulgation as the final IRP. In addition to all existing and committed power plants (including 10 GW committed coal), the plan includes 9.6 GW of nuclear; 6.3 GW of coal; 17.8 GW of renewables (including 8.4GW solar); and 8.9 GW of other generation sources.

2.1.5 Electricity Regulation Act, 2006

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). NERSA has recently awarded electricity generation licences for new generation capacity projects under the REIPPP programme.

2.2. Provincial Policy and Planning Context

2.2.1 Northern Cape Provincial Growth and Development Strategy

The Northern Cape Provincial Growth and Development Strategy (NCPGDS) identified poverty as the most significant challenge in the Province. All other societal challenges that the Province faces emanate predominantly from the effects of poverty. The NCPGDS notes that the only effective way to reduce poverty is through long-term sustainable economic growth and development. The NCPGDS make reference to the need to ensure the availability of inexpensive energy. The document states 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 CSP Plant development is therefore in line with the Northern Cape Provincial Growth and Development Strategy.

2.2.2 Northern Cape Provincial Spatial Development Framework

The Northern Cape Provincial Spatial Development Framework (SDF) of 2012 lists a number of sectoral strategies and plans are to be read and treated as key components of the SDF. Of these there are a number that are relevant to the proposed CSP Plant. The SDF notes that various solar parks and CSP plants have been proposed in the Province, with the Upington area being the hub of such developments (NCPSDF, 2012). The SDF sets out the energy objectives for the Northern Cape Province which makes specific reference to renewable energy. Therefore the CSP facility falls within the key area of the Province ear-marked for solar energy developments.

2.3. Local Policy and Planning Context

2.3.1 Kai! Garib Local Municipality Integrated Development Plan

The Kai !Garib Local Municipality's IDP 2013-2014 identifies a number of Key Performance Areas (KPAs) for development within the municipality. The KPAs that are relevant to the proposed CSP project includes:

» KPA 1: Service Delivery and Infrastructure Development
» KPA 2: Local Economic Development

The renewable energy sector is also recognised as a key sector within the Municipality. The IDP notes that a number of new opportunities have opened up for the Kai !Garib municipal area since the need to facilitate the generation of sustainable energy was introduced in South Africa by Eskom and the South African government. The IDP notes that there are a number of solar projects proposed in the area and that the economic benefits from these projects are eagerly anticipated. Therefore the development of the CSP project is desirable by the local municipality.

2.3.2. //Khara Hais Local Municipality Integrated Development Plan

The //Khara Hais Local Municipality's (KHLM) IDP notes that the SDF identifies the establishment of the Upington Solar Park as a key anchor project. The Upington Solar Park is part of the South African government's policy to reduce the country's dependence on coal-based electricity by introducing renewable energy. Eskom made an undertaking to overcome a major constraint to the development of the solar park by constructing an additional 400kV transmission line to enable solar energy to be exported from the Solar Park. Other key potential developments that have a bearing on the proposed CSP plants include the Upington Industrial Development Zone. The Upington IDZ (± 400 ha) will be a purpose-built industrial estate linked to the Upington Airport. The IDZ will leverage fixed direct investments in value added and export-oriented manufacturing industries. Therefore the CSP project also fits in with the adjacent municipal development plans.

2.3.3. ZF Mgcawu (Siyanda) District Municipality Integrated Development Plan (IDP)

The development of the CSP Plant is aligned with the development goals and objectives listed in the ZF Mgcawu (formerly Siyanda) District Municipality's IDP, such as:

» To deliver a positive contribution to the sustainable growth and development within its boundaries and the rest of the Northern Cape.
» The creation of a healthy and environmentally friendly environment within and outside of the Councils" district boundaries, must be attempted;
» The promotion of human resources within and outside the organisation through training and the implementation of new technological aids.
» Promote the infrastructure development, including electricity.

2.3.4. ZF Mgcawu District Municipality Environmental Management Framework

The ZF Mgcawu (formerly Siyanda) District Municipality has compiled an Environmental Management Framework (EMF), in which environmental concerns and conservation priorities for all landscapes within the municipality are listed and mapped. According to the EMF, Bushmanland Arid Grasslands have a medium conservation priority and the proposed project area does not fall within areas earmarked for conservation.

Similarly, the proposed project area has been mapped as Zone 7 in the EMF Environmental Control Zones, indicating the threat that the area has relatively less sensitivity than other zones and no special protection or environmental management parameters or concerns, except those already implemented or required by law. This implies that there is no specific restriction on development of the area.

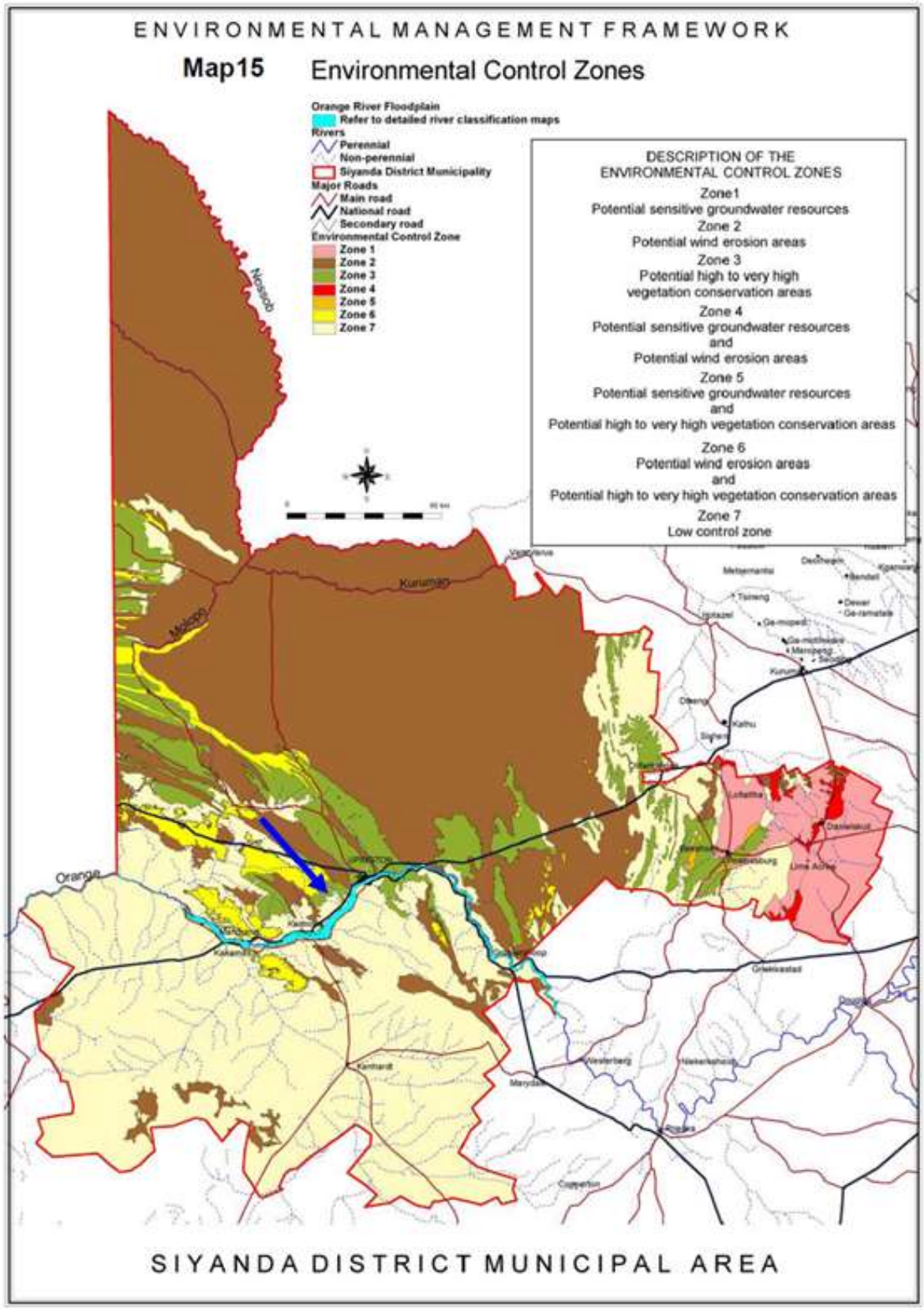

Figure 2.5: Map from the ZF Mgcawu (formerly Siyanda) EMF showing the environmental control zones. The proposed development location is indicated by the blue arrow

The Lower Gariep Alluvial Vegetation (which is located outside the site) on the banks of the Gariep River is regarded as a Critical Biodiversity Area, of which remaining sections have been listed as threatened ecosystems. These areas fall outside the proposed development footprint.

2.4. 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:

» *Department of Energy (DoE):* This Department is responsible for policy relating to all energy forms, including renewable energy, and is responsible for forming and approving the IRP (Integrated Resource Plan for Electricity).
» *National Energy Regulator of South Africa (NERSA):* This body is responsible for regulating all aspects of the electricity sector, and will ultimately issue licenses for solar energy developments to generate electricity.
» *Department of Environmental Affairs (DEA):* 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.
» *The South African Heritage Resources Agency (SAHRA):* SAHRA is a statutory organisation established under the National Heritage Resources Act, No 25 of 1999, as the national administrative body responsible for the protection of South Africa's cultural heritage.
» *National Department of Agriculture, Forestry, and Fisheries (DAFF):* This Department is responsible for activities pertaining to subdivision and rezoning of agricultural land. The forestry section is responsible for the protection of tree species under the National Forests Act (Act No 84 of 1998).
» *South African National Roads Agency (SANRAL):* This Agency is responsible for the regulation and maintenance of all national routes.
» *National Department of Water Affairs:* This Department is responsible for water resource protection, water use licensing and permits. Water uses within this area of the Northern Cape are not generally authorised by DWA, and so water use license applications are routed to the National Department for approval.
» *Eskom:* Commenting authority regarding Eskom infrastructure and grid connection.
» *Department of Science and Technology:* Land within a 3 kilometres radius of the centre of the Southern African large Telescope dome falls under the Sutherland Core Astronomy Advantage Area. The declaration also applies to the core astronomy

advantage area containing the MeerKAT radio telescope and the core of the planned Square Kilometre Array (SKA) radio telescope. Approval from SKA required for projects within the area/ the SKA project infrastructure.

At the Provincial Level, the main regulatory agencies are:

» *Provincial Government of the Northern Cape – Department of Environmental and Nature Conservation (NC DENC):* This Department is the commenting authority for the project.
» *Department of Transport and Public Works:* This Department is responsible for roads and the granting of exemption permits for the conveyance of abnormal loads on public roads.
» *Provincial Department of Water Affairs:* This Department is responsible for water resource protection, water use licensing and permits.
» *Ngwao Boswa ya Kapa Bokone (Northern Cape Heritage Authority):* This body is responsible for commenting on heritage related issues in the Northern Cape Province.
» *Northern Cape Department of Agriculture, Land Reform and Rural Development:* This Department is responsible for all matters which affect agricultural land.
» *Northern Cape Department of Mineral Resources (DMR):* Approval from the may be required to use land surface contrary to the objects of the Act in terms of Section 53 of the Mineral and Petroleum Resources Development Act (Act No 28 of 2002): In terms of the Act approval from the Minister of Mineral Resources is required to ensure that proposed activities do not sterilise a mineral resource that might occur on site.

At the 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 the local and district municipalities play a role. The local municipality is the Kai !Garib Local Municipality which forms part of the ZF Mgcawu District Municipality. There are also numerous non-statutory bodies such as environmental non-governmental organisations (NGOs) and community based organisations (CBO) working groups that play a role in various aspects of planning and environmental monitoring that will have some influence on proposed solar energy development in the area.

DESCRIPTION OF THE PROPOSED PROJECT CHAPTER 3

This chapter provides a description of the components and infrastructure which comprises the Kai Garib CSP Tower Plant, the need and desirability of the project and details the project scope which includes the planning/design, construction, operation and decommissioning activities. This chapter also explores site and technology alternatives as well as the 'do nothing' option. Lastly, it provides some insight to concentrating solar thermal facilities as a means for power generation.

3.1. Nature and extent of Kai Garib CSP Tower Plant project

The Upington Solar Thermal Plant Two (now known as the Kai Garib CSP Tower Plant) is proposed to utilise molten salt solar tower and heliostats technology, with a generation capacity of up to 150MW. The Concentrating Solar Power (CSP) facility will include the following associated infrastructure: solar tower, heliostats, a power island including a steam turbine generator, auxiliary boilers, salt or direct steam storage vessels, plant substation, power line, access roads, water abstraction point on the Gariep River and supply pipeline, water storage tanks, packaged water treatment plant, lined evaporation ponds, workshop, mirror assembly facility and office buildings. The Kai Garib CSP Tower Plant is proposed to be located in the Portion 3 of the Farm McTaggarts Camp 453, directly adjacent to and north of the existing Khi Solar One CSP Plant (also a tower plant) which is currently under construction.

The Kai Garib CSP Tower Plant will have a total development footprint of 700 hectares (within an 800ha portion of the larger 2200 ha farm) and includes the following infrastructure (a layout map is shown in Figure 3.1):

- Solar tower with central receivers and heliostat technology using superheated steam with dry cooling (700 hectares in extent).
- Power island which will include a steam turbine and generator; a dry cooled condenser; a generator transformer and substation; auxiliary fossil fuel and/or electric boilers and associated molten salt storage vessels and heat exchangers (approximately 200m x 500m in extent).
- Access roads (roads up to 6m wide).
- Plant substation (50m x 50m).
- 132 kV power line up to 4km in length to connect to Eskom's existing McTaggerts Substation, which is located on the same property as the proposed CSP Plant.
- Water abstraction point located at the Gariep River, filter station (20m x 30m) and water supply pipeline (up to 20km in length; internal pipeline diameter <0.4m).
- Water storage reservoir and tanks (combined capacity up to 15 000m^3).
- Packaged water treatment plant (roughly 30m x 30 m).
- Up to 5 lined evaporation ponds (approximately 100m x 100m each).

» Workshop and office buildings (approximately 20m x 50m each).
» Mirror assembly facility (approximately 100m x 50m).

The proposed project will also require the construction of facilities or infrastructures for the storage of the following dangerous goods. The construction phase will require the handling and storage of materials including hydraulic oil, fuel, cement and fly ash (for use in concrete batching plant) with an estimated volume of 250 m^3 (cubic meters) at any one time. The operation phase will require the handling and storage of materials such as sodium hydroxide, hydrochloric acid, sulphuric acid, ferric chloride, lubrication oil, amine, phosphate, carbohydrazide, closed corrosion inhibitor with an approximate total of 140 m^3 (cubic meters) at any one time, fuel for the auxiliary steam boiler with an estimated total of 50 m^3 (cubic meters) at any one time[9]. Please refer to Appendix T- Facility illustration depicting the area were the Hazardous substance will be stored and Appendix Q- List of Hazardous substances).

[9] These estimates were obtained from the Abengoa Solar projects in South Africa and similar CSP projects in Spain.

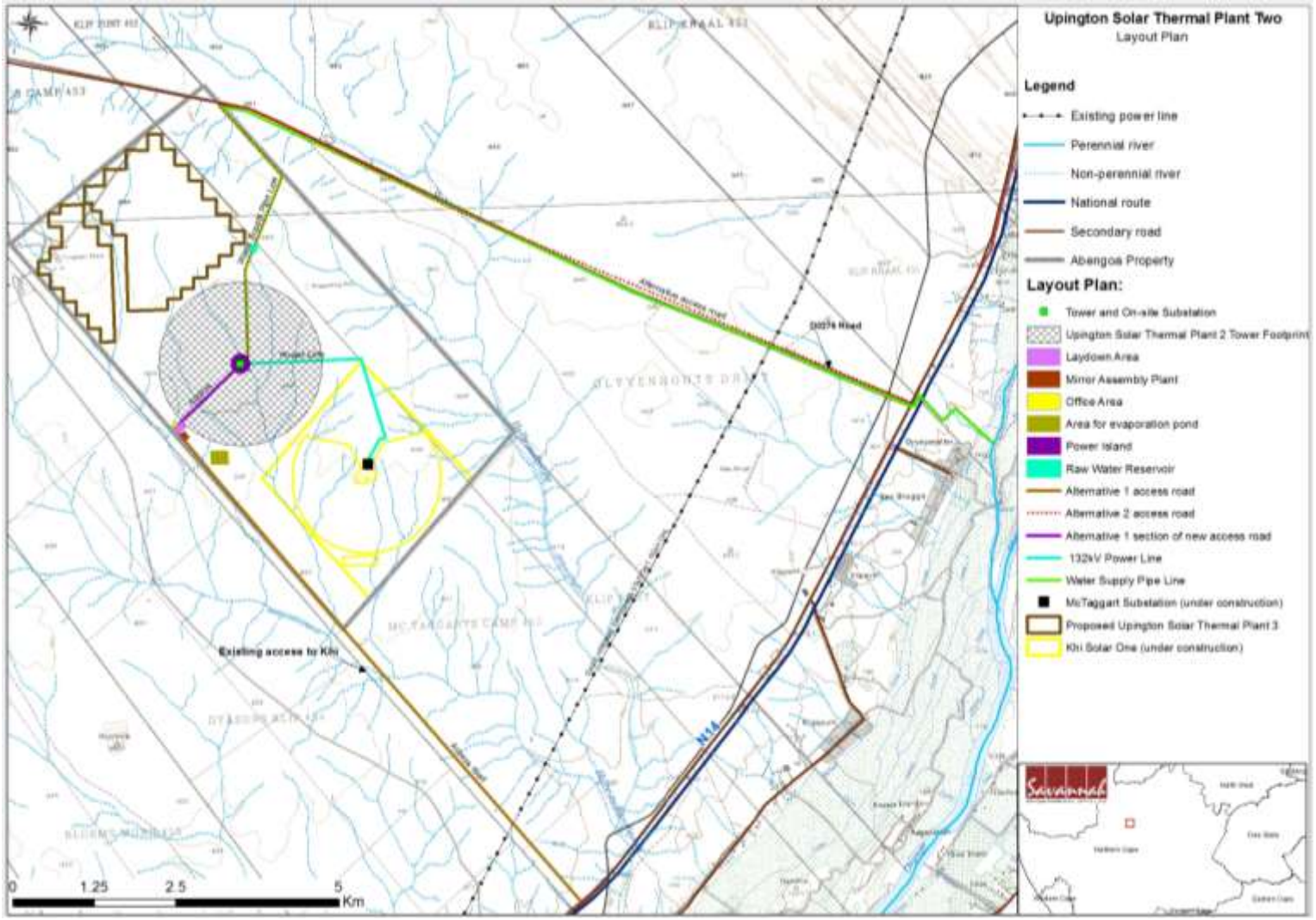

Figure 3.1: Layout map for the Kai Garib CSP Tower Plant (also showing the proposed Upington Plant Three and the Khi Solar One locations)

3.2. Need and desirability of the proposed project

According to the DEA Draft Guideline on Need and Desirability in terms of the Environmental Impact Assessment (EIA) Regulations, 2010 (October 2012) the need and desirability of a development must be measured against the contents of the Integrated Development Plan (IDP), Spatial Development Framework (SDF) and Environmental Management Framework (EMF) for an area, and the sustainable development vision, goals and objectives formulated in, and the desired spatial form and pattern of land use reflected in, the area's IDP and SDF.

3.2.1. Kai !Garib Local Municipality Integrated Development Plan

The Kai !Garib Local Municipality's IDP 2013-2014 identifies a number of Key Performance Areas (KPAs) for development within the municipality. The IDP notes that there are a number of solar projects proposed in the area and that the economic benefits from these projects are eagerly anticipated. Therefore the development of the CSP project is desirable by the local municipality and aligned with the IDP.

3.2.2. //Khara Hais Local Municipality Integrated Development Plan

The //Khara Hais Local Municipality's (KHLM) IDP notes that the SDF identifies the establishment of the Upington Solar Park as a key anchor project. The Upington Solar Park is part of the South African government's policy to reduce the country's dependence on coal-based electricity by introducing renewable energy. The CSP project also fit in to the adjacent municipal development plans.

3.2.3. Strategic Integrated Projects (SIPs)

In 2010, a National Development Plan was drafted to address socio economic issues affecting development in South Africa. These issues were identified and placed under 18 different Strategic Integrated Projects (SIPs) to address the spatial imbalances of the past by addressing the needs of the poorer provinces and enabling socio-economic development. Amongst these is the green energy in support of South African Economy i.e. SIP 8. The SIP aims at supporting sustainable green energy initiatives on national scale through a diverse range of clean energy options as envisaged in the Integrated Resource Plan (IRP, 2010). Abengoa Solar Power South Africa (Pty) Ltd is proposing the establishment of the CSP Plant for the purpose of reducing total carbon emissions and diversifying electricity supply. In the event of the projects being developed, it will contribute to the local electricity supply and increase the security of supply to consumers. In addition, the implementation of the proposed project will both economic stimulus to the local economy through the construction process and long term employment in site management and operation and maintenance of the facility.

Therefore should the proposed CSP Plant become a preferred bidder project, it could potentially become a SIP 8 project.

3.2.4. Renewable Energy Development Zones (REDZ)

The DEA has been mandated to undertake a Strategic Environmental Assessment (SEA) process. The wind and solar photovoltaic SEAs are being undertaken in order to identify geographical areas most suitable for the rollout of wind and solar photovoltaic energy projects and the supporting electricity grid network. The DEA and CSIR have released a map with focus areas best suited for the roll-out of wind and solar photovoltaic energy projects in South Africa. The aim of the assessment is to designate renewable energy development zones (REDZs) within which such development will be incentivised and streamlined. The proposed Upington Solar Thermal Plant Two project falls within the identified geographical areas / focus area most suitable for the rollout of the development of solar energy projects (called "Upington Solar priority area") within the Northern Cape Province, as shown in Figure 3.2.

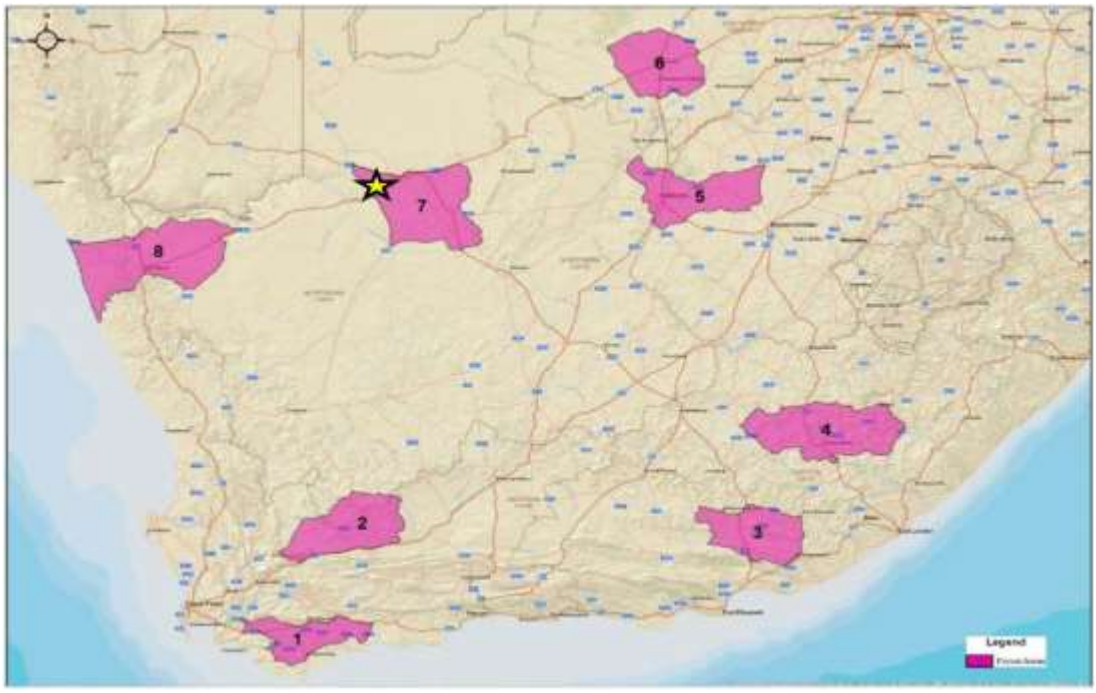

Figure 3.2: Renewable Energy Development Zones (REDZ) (CSIR 2014), the Upington Solar Thermal Plant Two Facility (shown by the yellow star) falls within REDZ 7.

Coupled to the Renewable Energy SEA, Eskom's Electricity Grid Infrastructure Strategic Environmental Assessment (SEA) is also underway. The area where the Upington Solar Thermal Plant Two is proposed is currently within the corridor planned to be strengthened by Eskom.

3.2.5. The Need for the CSP Plant

The need for harnessing renewable energy resources (such as solar energy for electricity generation) is linked to increasing pressure on countries to increase their share of renewable energy generation due to concerns such as exploitation of non-renewable resources and the rising cost of fossil fuels. In order to meet the long-term goal of a sustainable renewable energy industry, a target of 17.8 GW of renewables by 2030 has been set by the Department of Energy (DoE) within the Integrated Resource Plan (IRP) 2010 and incorporated in the Renewable Energy Independent Power Producer Procurement (REIPPP) Programme initiated by the DoE. This programme has been designed so as to contribute towards a target of 3725 MW to be generated from renewable energy sources, required to ensure the continued uninterrupted supply of electricity, towards socio-economic and environmentally sustainable growth, and to start and stimulate the renewable industry in South Africa. The energy procured through this programme will be produced mainly from wind, solar, biomass, and small-scale hydro (with wind and solar comprising the bulk of the power generation capacity). This 17,8GW of power from renewable energy amounts to ~42% of all new power generation being derived from renewable energy forms by 2030.

In responding to the growing electricity demand within South Africa, as well as the country's targets for renewable energy, Abengoa Solar Power South Africa (Pty) Ltd proposes the establishment of the Upington Solar Thermal Plant Two to add new capacity to the national electricity grid. The development of the project would benefit the local/regional/national community by developing a renewable energy project. Surrounding communities would also benefit from the development through job creation and spin-offs. In addition, according to Department of Energy (DoE) bidding requirements the developer must plan for a percentage of the profit per annum from the solar energy facility to go back into the community through a social beneficiation scheme. Therefore there is a potential for creation of employment and business opportunities, and the opportunity for skills development of for the local community.

The projects have the potential to contribute to the national electricity supply and to increase the security of supply to consumers as well as supporting South Africa's commitment to reducing greenhouse gas emissions. Over 90% of South Africa's electricity generation is currently coal-based, resulting in annual per capita carbon emissions of approximately 8.9 tons per person, according to 2008 World Bank estimates. According to the Carbon Dioxide Information Analysis Centre, South Africa is the 13th largest carbon dioxide emitting country, based on 2008 fossil-fuel CO_2 emissions. The nation is also the largest emitting country on the continent of Africa, pinpointing the importance of introducing greener solutions to the energy mix. Furthermore, it may provide both economic stimulus to the local economy through the construction process and long term employment (i.e. management and maintenance) during the operation phase of the project.

3.2.6. The Desirability of the CSP Plant

The use of solar irradiation for electricity generation is essentially a non-consumptive use of a natural resource. A solar energy facility also qualifies as a Clean Development Mechanism (CDM) project (i.e. a financial mechanism developed to encourage the development of renewable technologies) as it meets all international requirements in this regard. The proposed site was selected for the development of multiple CSP Plants based on its predicted climate (solar resource), suitable proximity in relation to the existing and available electricity grid, and minimum technical constraints from a construction and technical perspective. Studies of solar irradiation worldwide indicate that the Northern Cape shows great potential for the generation of solar power. The proposed project is located in an area of high irradiation generating up to 2240 kWh/m² annually, as shown in Figure 3.3 below.

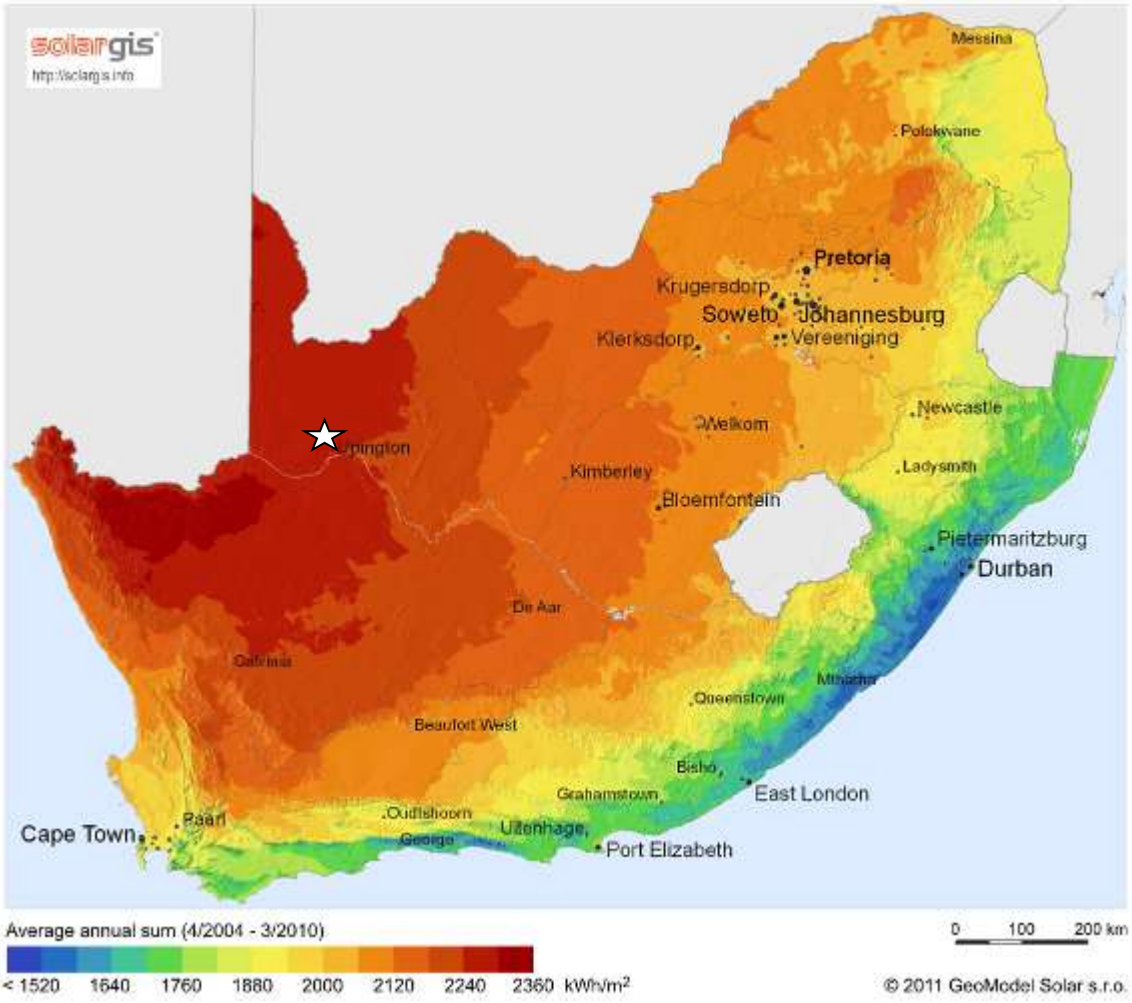

Figure 3.3: Solar irradiation map for South Africa (Source: GeoModel Solar, 2011). The study area is indicated by the white star.

Receptiveness of the site to CSP Development:

The Upington Solar Thermal Plant Two is proposed to be constructed outside of the Upington and Keimoes urban edge. Portion 3 of the Farm McTaggarts Camp 453 has not been considered for an alternative land use such as urban development, and has been rezoned for industrial use. The site is also located within an area which has become a node for renewable energy projects, with the following preferred bidder projects (PB) located directly adjacent to, or in close proximity to, the project development site: Khi Solar One (PB1) on the same farm portion, Rooipunt (PB3.5) directly north of the farm portion, Dyason's Klip 1 (PB4) directly west of the farm portion, Dyason's Klip 2 (PB4) directly west of the farm portion, and Sirius Solar One (PB4) directly south of the farm portion. In addition, the Eskom Tower Plant is to be constructed on the farm portion directly east of the site, and the CEF Solar Park is planned east of the Eskom site. This site is completely enclosed with preferred bidder projects, or projects to be constructed under a different programme.

Abengoa Solar Power South Africa (Pty) Ltd considers this area, and specifically the demarcated site on Portion 3 of the Farm McTaggarts Camp 453, to be highly preferred for the development of a solar energy facility. The reasons include:

» Extent of site: Availability of level land of sufficient area can be a restraining factor, as a 150 MW power tower system requires 500 ha of land space. The larger farm portion owned by the developer is approximately 22 km^2 in extent, and the portion of the farm which is allocated for the development of the tower plant is 800ha in extent, which is sufficient for the installation of the facility allowing for avoidance of site sensitivities.
» Power transmission considerations: An Eskom substation has been built on the site for the Khi Solar One CSP project, and allows for direct connection of the Upington Solar Thermal Plant Two to this new McTaggerts Substation (~4km of power line required).
» Site access: the site can be readily accessed via the N14 national road, or via the D3276. The Khi Solar One project has also established a formal access off the N14 for access to the McTaggarts Camp farm which could provide access for a portion of the distance to the site.
» Loss of current land use: There is no cultivated agricultural land in the study area or directly adjacent to it, which could be impacted upon by the proposed development.
» Climatic conditions: Climatic conditions determine the economic viability of a solar energy facility as it is directly dependent on the annual direct solar irradiation values for a particular area. The Northern Cape receives the highest average daily direct normal and global horizontal irradiation in South Africa which indicates that the regional location of the project is appropriate to a solar energy facility. Factors contributing to the location of the project include the relatively high number of daylight hours and the low number of rainy days experienced in this region. A Direct

Normal Irradiation (DNI)[10] of more than 2800 kWh/m²/year is relevant for the area in which the site is located.

» Topographic conditions: The site conditions are optimum for a development of this nature, with the project area being of a suitable gradient for a CSP project.
» Geographic location: The project site falls within the identified geographical areas / focus area most suitable for the rollout of the development of solar energy projects (i.e. Upington Solar priority area or REDZ 7). The site is also completely enclosed with preferred bidder projects, or projects to be constructed under a different programme, as explained above.

Technology choice:

CSP is the only of the renewable technologies that utilise conventional steam generating equipment with operational and life expectancy similar to that of conventional power plants (i.e. 40 years vs 20 years for other renewable technologies). One advantage of solar tower power plants is their potential for storing solar thermal energy to use during non-solar periods and to dispatch power when it is needed most. As a result, thermal energy storage allows solar tower power plants to achieve higher annual capacity factors — from 25% without thermal storage, up to 70% or more with it. CSP, through energy storage, can serve peaking and mid merit demand requirements and due to its conventional power station nature has significant socio-economic benefits.

Access to the Grid:

Ease of access into the Eskom electricity grid is vital to the viability of a solar energy facility. Projects which are in close proximity to a connection point and/or demand centre are favourable, and reduce the losses associated with power transmission. In addition, Eskom's '2040 Transmission Network Study' has drawn on various scenarios to determine the grid's development requirements, as well as to identify critical power corridors for future strategic development, of which the Northern corridor is one of these. The national power corridors have been refined and consolidated into five transmission power corridors of 100 km in width, which are being used by the Department of Environmental Affairs for a strategic environmental assessment (SEA) which will seek to identify environmentally acceptable routes over which long-term environmental impact assessment (EIA) approvals can be secured. The Upington Solar Thermal Plant Two site falls into the Northern corridor.

Benefits to local economy:

The long-term benefits for communities and/or society in general can be realised should the site prove acceptable (from a technical and environmental perspective), for the construction of two additional solar thermal plants. Each CSP solar facility will contribute to the economic and social development of surrounding local communities with job

[10] GHI is the total amount of shortwave radiation received from above by a surface horizontal to the ground. The value of particular interest to CSP installations is the Direct Normal Irradiance (DNI) as mirrors track the suns movements throughout the day.

creation in excess of a 1000 during construction (24 to 36 months) and 40 to 60 permanent jobs during the operational life of the plant (typically 30 to 40 years and extendible as with conventional plant). The knock-on effect could potentially add another 100 to 200 jobs in the support and service industries.

CSP technology, once economies of scale have kicked in through sustained roll out, can have a significant impact on local manufacture more so than any of the other renewable technologies. Case and point being the mirror manufacturing plant already established adjacent to the Upington Airport aiming to expand and serve more than just the Khi Solar One project and currently permanently employing more than 80 people.

The socio-economic benefit resulting from the project has been highlighted by the possibility to achieve high local content per MW installed, confirmed by actual data obtained from the construction of the Khi Solar One tower plant.

Specific support to the CSP industry (such as the Rioglass mirror manufacturing facility next to the airport, pipe and tank welding works located at Louisvale) was established in Upington to support the Khi Solar One and the Kaxu Solar One projects. Additional projects requiring these support services will ensure sustainability of these works and associated jobs, and be a continued benefit to the local economy.

3.2.7. How the principles of environmental management as set out in section 2 of NEMA have been taken into account in the planning for the proposed project

The principles of NEMA have been considered in this assessment through compliance with the requirements of the relevant legislation in undertaking the assessment of potential impacts, as well as through the implementation of the principle of sustainable development where appropriate mitigation measures have been recommended for impacts which cannot be avoided. In addition, the successful implementation and appropriate management of this proposed project will aid in achieving the principles of minimisation of pollution and environmental degradation.

The EIA process has been undertaken in a transparent manner and all effort has been made to involve interested and affected parties, stakeholders and relevant Organs of State such that an informed decision regarding the project can be made by the Regulating Authority.

The general objectives of Integrated Environmental Management have been taken into account for this EIA report by means of identifying, predicting and evaluating the actual and potential impacts on the environment, socio-economic conditions and cultural heritage component. The risks, consequences, alternatives as well as options for mitigation of activities have also been considered with a view to minimise negative

impacts, maximise benefits, and promote compliance with the principles of environmental management.

3.3. Solar Tower and Heliostats Technology proposed for the Kai Garib CSP Tower Plant

Solar power generating facilities use the energy from the sun to generate electricity. Concentrating Solar Power (CSP) collects the incoming solar radiation and concentrates it (focusing or combining it), on a single point, thereby increasing the potential electricity generation.

The proposed Kai Garib CSP Tower Plant will consist of a solar tower and heliostats system with a generation capacity of ~150MW. Infrastructure associated with the CSP Plant includes:

» Power Plant: Solar tower with central receivers and heliostat technology using superheated steam, including direct steam or salt storage with dry cooling.
» Associated infrastructure: power island with steam turbine generator, access roads, on-site substation, power line, water abstraction point and supply pipe line, water storage tanks, packaged waste treatment plant, lined evaporation ponds, salt or direct steam storage vessels, auxiliary fossil fuel boilers and workshop and office buildings.

A power tower system comprises of a heat collection system and a conventional generating plant portion. The heat collection system consists of **heliostats** (movable, flat reflective mirrors roughly 140 m^2 which are oriented according to the sun's position in order to capture and reflect the solar radiation) and **receivers** (consisting of metal tubes which transfer the heat from the solar radiation to water or molten salt with the purpose of generating steam). The receiver is mounted on a 200m to 300m high **solar 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).

A conceptual illustration showing the power tower operating system is shown in Figure 3.3.

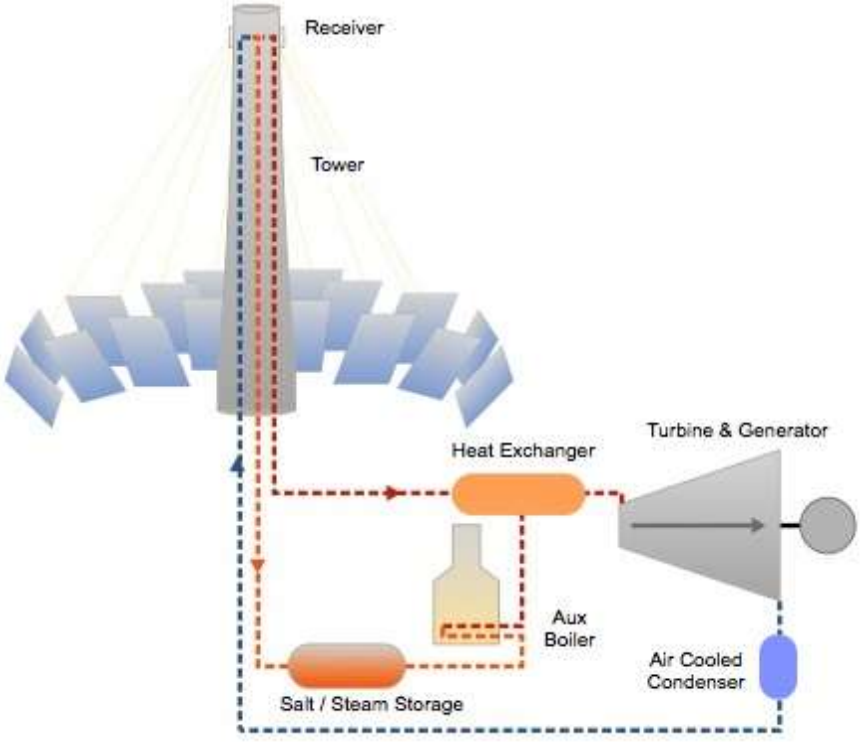

Figure 3.3: Illustration of the solar tower solar thermal system

Power tower plants must be large to be economical. The heliostat field and the receiver are sized depending on the needs of the utility. A 150 MW power tower plant requires an area of ~600 to 700 hectares.

In a typical installation, solar energy collection occurs at a rate that exceeds the maximum required to provide steam to the turbine. The thermal storage system can, therefore, 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% - 30%. Today, the most used solution is the usage of steam or molten salt storage vessels that store the energy to then be distributed when required. Determining the optimum storage size to meet power-dispatch requirements is an important part of the system design process. Storage vessels can be designed with sufficient capacity to power a turbine for up to 6 to 8 hours economically.

The Power tower plant will operate as a Zero Effluent Discharge (ZED) facility, with lined evaporation ponds for the power plant discard stream (boiler blow down and packaged waste treatment plant discard streams). The sand filter backwash stream at the abstraction point is proposed on private property next to the river, which will be used to irrigate adjacent existing crops. Material will be borrowed from the spoils heaps of a

worked out tungsten mine in the north-west corner of the property. The plant will connect to the existing Eskom McTaggerts Substation on the property. Critical staff will be housed on site during the construction phase.

Figure 3.4: Photographs illustrating one of Abengoa Solar's CSP solar tower plants, courtesy of Abengoa Solar S.A.

3.3.1. 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 to become superheated 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 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 through the solar field, light from the sun reflects off the solar collectors (i.e. Heliostats) and is concentrated on the heat collection elements located at

the focal point of the power tower. 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 air cooled condenser.

3.3.2. Dimensions of the main infrastructural components

Table 3.1 below described the dimensions of the main infrastructural components for one 150 MW power tower plant (the Kai Garib CSP Tower Plant).

Table 3.1: Dimensions of the main infrastructural components for a 150 MW power tower plant

Infrastructure	Footprint	Height
Power Tower	Approx. 50m in diameter (~10ha)	200m – 300m
Heliostat field	up to 700 ha	6m pedestal
Power island and steam turbine and generator	200m x 500m	40m
Molten salt storage tanks	4 tanks each 40m diameter	40 m
Auxiliary boilers	10m x 10m	5 m
Water storage reservoir and tanks (combined capacity up to 15 000m^3) and associated infrastructure	Tanks 15m to 20m diameter	Up to 30 m
Substation	50m x 50m	40 m
132 kV power line	32 m servitude, 4 km in length	25 - 35m towers
Workshop building (maintenance) and office buildings	20m x 50m each	20m
Packaged waste treatment plant	30m x 30m	10m
Lined evaporation ponds	5 ha - 5 ponds 100m x 100m each	1.8 m deep
Mirror assembly facility	100m x 50m	20m
Internal access roads	6m wide, 10km in length	n/a
Water abstraction point located at the Gariep River, filter station	20m x 30m	1 storey
Water supply pipeline	20km in length	± 1m depth (where practical)
Temporary laydown area and construction camp.	200m x 200m	10m
Concrete batching plant	112m x 80m	15m

3.4. Life-cycle Phases of the proposed Power Station

3.4.1. Construction Phase

In order to construct the solar thermal plant and associated infrastructure, a series of activities will need to be undertaken.

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, survey of substation site and survey of power line, water supply and road servitudes.

Establishment of Access Roads to the Site

The broader site can be accessed via a secondary road (i.e. D3276) or the Khi Solar One access road, both of which connect with the N14. Within the site itself, access will be required 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 surfaced access road of approximately 6m in width which will lead directly to the power island. Between the troughs 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.

Undertake Site Preparation

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

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 may be defined as abnormal loads in terms of the Road Traffic Act (Act No. 29 of 1989)[11] by virtue of the dimensional limitations (i.e. length and weight). Components of various specialised construction and lifting equipment are required and will need to be transported to site. In addition, 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.

[11] A permit will be required for the transportation of these abnormal loads on public roads.

Establishment of Laydown Areas on Site

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

Construct Power Island and Substation

A steam turbine and generator will be housed within a structure up to 40m in height (power island). A generator transformer and a small substation will be established outside the building. The position of the power island and substation within the site footprint will be informed by the final positioning of the solar generating components.

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.

Establishment of Ancillary Infrastructure

Ancillary infrastructure includes a water supply pipeline/s to the facility from the extraction point on the 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 or evaporation pond (for wastewater from the generation process). A workshop, storage areas as well as a contractor's equipment camp will also be required.

The establishment of these facilities/buildings will require the clearing of vegetation and levelling of the development site and the excavation of foundations prior to construction. A laydown area for building materials and equipment associated with these buildings will also be required.

Connect Substation to Power Grid

An overhead power line will feed into the McTaggerts Substation which is on the same property as the proposed facility (newly constructed for the Khi Solar One project). The proposed CSP project is intended to connect into this new McTaggerts Substation via a 132 kV overhead power line (up to 4 km in length).


Figure 3.5: Photographs of the newly constructed McTaggerts Substation located on Portion 3 of the farm McTaggarts Camp 453

Undertake Site Remediation

Once construction is completed and once all construction equipment is removed, 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 operational phase must be closed and prepared for rehabilitation.

3.4.2. Operation Phase

The operations phase is discussed in more detail below. A simplified flow chart of the general operation of a Solar Thermal Plant showing inputs and outputs of the process is shown in the table below.

Table 3.2: Process Flow for a Solar Thermal Plant – Operational Phase Only

Input	Process	Output
Solar energy	**Solar thermal energy generation process**	*Positive outputs:* Energy / electricity
Water		*Negative outputs:* Wastewater
Fossil fuel to start up		*Negative outputs:* Exhaust fumes / CO_2
Dosing chemicals for water treatment plant		*Negative outputs:* Wastewater/brine stream to evaporation ponds

Sourcing of water for the CSP facility

CSP technologies function through the generation of steam to drive a conventional steam turbine and generator. Therefore, suitable and sufficient water resources are required. Water sources in this area of Northern Cape include a) water from the Gariep River (direct abstraction); b) water from a local municipality (who abstract from the Gariep River); or c) groundwater (direct abstraction). Groundwater resources are scarce, typically used by local farmers for livestock watering when available, and the water is brak. Groundwater is not considered a viable water source. Water will, therefore, be required to be abstracted from the Gariep River. The Department of Water and Sanitation (DWS) have confirmed in a letter dated 29 May 2015 (refer to Appendix P) that, after due consideration of the water resource availability in the catchment area, it was found the sufficient water is available to meet the water requirement of the project (~300 000 m^3 per annum during construction and 400 000 m^3 per annum during operation). The water source of direct abstraction from the Gariep River is therefore located a distance of less than 20km from the site, adjacent to the existing abstraction point for the Khi Solar One project (consolidating infrastructure at the existing abstraction embankment). The water will be sourced through an extraction point on the Gariep River. Water supply pipelines will be constructed and the required volume of water treated and pumped to the facility. Potable water will also be required for on-site staff.

Water supply, use, and treatment

A water supply pipeline will be established from the extraction point on the Gariep River to the site. Infrastructure will include a water abstraction point located at the Gariep River, filter station (20m x 30m) and water supply pipeline (up to 20km in length; internal pipeline diameter <0.4m). Abstracted water will be pumped to a holding reservoir for supply buffering. A second storage reservoir will be located on the identified site itself. The water use of the facility for one 150MW CSP Plant will include:

» Makeup water for the steam generator;
» Water for mirror washing;
» Service water;
» Potable water; and
» Fire protection water.

Water treatment will be required to remove salts from the raw water, as well as blow down brine handling. The water treatment works infrastructure will include a primary treatment or basic sand filtration plant at the raw water supply source, as well as a reverse osmosis and deionisation packaged water treatment plant at the site.

Table 3.3: Estimated water consumption for the 150MW Kai Garib CSP Tower Plant and main water uses

Description: consumption	**Approximate annual use (m^3/year)**
Raw water consumption	Up to 400 000
Description: water uses	**Approximate annual use (m^3/year)**
Mirror washing	80 000
Boiler makeup	60 000
Potable and other	9 000
Evaporation losses	85 000
Wastewater to evaporation ponds	Up to 120 000 (typically 85 000)

In order to reduce the overall water consumption and the requisite sizing of the evaporation ponds, service water will first be used as circulating water makeup. 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 treated by reverse osmosis and ion-exchange softeners prior to being used for other plant requirements. Only the discard streams will be delivered to the evaporation ponds.

Evaporation Ponds

a. Technical Information about the evaporation ponds

Up to 5 evaporation ponds (5ha) will be required for the facility. The purpose of the evaporation ponds is to receive the water discard stream from the generation process. The evaporation ponds will be located on the site and within the development footprint. The proposed facility will be operated as a Zero Liquid Effluent Discharge (ZLED) facility; therefore no wastewater from the evaporation ponds will be permitted to be released into the environment or any water bodies. Each pond will have a surface area of approximately 1ha and be 1.8m deep including free board. A picture of a typical evaporation pond required for a CSP Plant is shown in Figure 3.6.

Figure 3.6: Photograph of a typical lined evaporation pond utilised for a CSP Plant

b. Evaporation Pond Management

The plant waste discard stream will be piped from the power island wastewater tank at ambient temperature to on-site dual lined surface evaporation ponds for de-watering. The ponds will be designed so that the residual solids will not require removal for the duration of the Project's operating life. If solids removal is necessary for pond maintenance reasons, the removed solids will be shipped to an appropriate off-site disposal facility.

Up to five evaporation ponds are planned for the CSP facility to allow plant operations to continue in the event that a pond needs to be taken out of service for maintenance purposes etc. Each pond will have enough surface area so that the evaporation rate exceeds the blow-down rate at maximum design conditions and at annual average climatic conditions. The planned pond depth (capacity), is therefore intended to avoid the need for residual solids removal during the life of the Project. The wastewater is not classified as hazardous, however, the ponds will be designed in accordance with international and local SANS (1526:2003 - Thermoplastics sheeting for use as a Geomembrane and installation guidelines; 10409:2004 - Design, selection and installation of Geomembranes) requirements and will incorporate suitable HDPE liners with a leachate (leak detection system) in order to ensure no ground contamination.

Typical evaporation ponds discard streams could have a total dissolved solids (TDS) of up to 60 000 ppm at a temperature of 40ºC and be roughly 85 000 m^3 per annum - obviously production and solar resource dependant. Should a leak be detected, the leaking pond in question would immediately be drained into adjacent ponds and repaired. In the case of a catastrophic failure of one of the ponds, the contaminated topsoil layer will be removed and treated in a remedial soil treatment area and disposed of at an appropriate off-site disposal facility.

The remaining residue within the evaporation ponds will be stored in the pond, until the end of the CSP Plant's lifespan, where the residue will be removed, and the evaporation pond sites will be remediated and rehabilitated.

Site Operation and Maintenance

It is anticipated that a full-time security, maintenance and control room staff will be required on site. Each component within the solar thermal plant will be operational except under circumstances of mechanical breakdown, unfavourable weather conditions or maintenance activities.

Non-hazardous solid wastes (maintenance-derived wastes) will be recycled to the extent practical. Those maintenance-derived wastes that cannot be recycled will be transported for disposal at an appropriate landfill.

3.4.3. Decommissioning Phase

The solar thermal plant is expected to have a design lifespan of approximately 35 years (extendable with appropriate refurbishment), 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.

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.

Disassemble and Replace Existing Components

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

PROJECT ALTERNATIVES CHAPTER 4

In terms of the Environmental Impact Assessment (EIA) Regulations, reasonable and feasible alternatives are required to be considered within the Environmental Impact Assessment process. All identified, feasible alternatives are required to be assessed in terms of social, biophysical, economic and technical factors.

A key challenge of the EIA process is the consideration of alternatives. Most guidelines use terms such as 'reasonable', 'practicable', 'feasible' or 'viable' to define the range of alternatives that should be considered. Essentially there are two types of alternatives:

» incrementally different (modifications) alternatives to the project; and
» fundamentally (totally) different alternatives to the project.

Fundamentally different alternatives are usually assessed at a strategic level, and EIA practitioners recognise the limitations of project-specific EIAs to address fundamentally different alternatives. Electricity generating alternatives have been addressed as part of the National Integrated Resource Plan (IRP) by the Department of Energy. In this regard, the need for renewable power generation has been identified. Abengoa Solar Power South Africa are therefore proposing the development of a power tower solar thermal plant.

Incrementally different alternatives relate specifically to the project under investigation. "Alternatives", in relation to a proposed activity, means different ways of meeting the general purposes and requirements of the activity, which may include alternatives to:

» The property on which, or location where, it is proposed to undertake the activity;
» The type of activity to be undertaken;
» The design or layout of the activity;
» The technology to be used in the activity; and
» The operational aspects of the activity.

These alternatives are discussed below.

4.1. Site Alternatives

No site alternatives are proposed for this project as the placement of the CSP facility is strongly dependent on several factors including climatic conditions, topography, grid connection, water supply, and the extent of the site. Portion 3 of the farm McTaggarts Camp 453 was identified by Kai Garib CSP (RF) (Pty) Ltd as being highly desirable for development of solar thermal plants in 2009 and are currently constructing one of the first CSP facilities in South Africa on the site. Portion 3 of the Farm McTaggarts Camp

453 has not been considered for an alternative land use such as urban development, and has been rezoned for industrial use. The site is also located within an area which has become a node for renewable energy projects, with the following preferred bidder projects (PB) located directly adjacent to, or in close proximity to, the project development site: Khi Solar One (PB1) on the same farm portion, Rooipunt (PB3.5) directly north of the farm portion, Dyason's Klip 1 (PB4) directly west of the farm portion, Dyason's Klip 2 (PB4) directly west of the farm portion, and Sirius Solar One (PB4) directly south of the farm portion. In addition, the Eskom Tower Plant is to be constructed on the farm portion directly east of the site, and the CEF Solar Park is planned east of the Eskom site. This site is completely enclosed with preferred bidder projects, or projects to be constructed under a different programme. The site is considered to be highly favourable for CSP development due to the following site characteristics:

» **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. Factors contributing to the location of the project include the relatively high number of daylight hours and the low number of rainy days experienced in this region. A Direct Normal Irradiation (DNI) of more than 2800 kWh/m²/year is relevant for the area in which the site is located.
» **Water availability**: CSP 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. Water sources in this area of Northern Cape include a) water from the Gariep River (direct abstraction); b) water from a local municipality (who abstract from the Gariep River); or c) groundwater (direct abstraction). Groundwater resources are scarce, typically used by local farmers for livestock watering when available, and the water is brak. Groundwater is not considered a viable water source. Water will, therefore, be required to be abstracted from the Gariep River. The Department of Water and Sanitation (DWS) have confirmed in a letter dated 29 May 2015 (refer to Appendix P) that, after due consideration of the water resource availability in the catchment area, it was found the sufficient water is available to meet the water requirement of the project (~300 000 m^3 per annum during construction and 400 000 m^3 per annum during operation). The water source of direct abstraction from the Gariep River is therefore located a distance of less than 20km from the site, adjacent to the existing abstraction point for the Khi Solar One project (consolidating infrastructure at the existing abstraction embankment).
» **Topography**: A surface area with favourable topography facilitates the work involved in construction and maintenance of the solar thermal facility.
» **Extent of site:** Availability of level land of sufficient area can be a restraining factor, as the power tower system requires ~700 ha of land space. The larger farm portion owned by the developer is approximately 22 km^2 in extent, which will be sufficient for

the installation of up to three CSP facilities on a single site (which also is key in consolidating impacts to a single node).

» **Power transmission considerations:** Eskom's planned transmission grid expansion (by 2016) in close proximity to the site provides a secure point of evacuation for the power to be generated at a new facility. A key factor in the siting of any project is that the project must have a viable grid connection. The selected project development site is adjacent to the proposed Eskom Upington MTS site (Eskom's strengthening of the grid in the Upington area) and within close proximity to other similar sites chosen through various programmes such as the CEF Solar Park, Eskom's CSP tower site and five preferred bidder projects from the DOE REIPPP Programme. The establishment of the Upington MTS allows the projects to connect to a major substation with minimal linear transmission impact, being less than 10km south. The principle to minimise associated infrastructure and the resulting impacts is also supported. Development on any other site, will result in a significant increase in disturbance, longer power lines and their associated impacts.

» **Site access**: The proposed site can be accessed via municipal roads (D3276), national roads (N14) and an international airport, and specific support industry which were established in Upington to support the Khi and Kaxu projects makes the site a preferred location from all aspects. Access to the site is currently via the D 3276, which links up with the N14 and runs along the eastern boundary of Portion 3 of the Farm McTaggarts Camp 453.

The whole of Portion 3 of the Farm McTaggarts Camp 453 was purchased by Abengoa Solar for development. The whole property has been rezoned for this intended use. In addition, due to the successful development and construction of the Khi Solar One project on the same site (Portion 3 of the Farm McTaggarts Camp 453), Abengoa Solar Power South Africa (Pty) Ltd is proposing two additional 150MW CSP projects on the remainder of the farm portion (more than 1500ha in extent). Based on these considerations, Abengoa Solar Power South Africa (Pty) Ltd considers the proposed site as *highly preferred* in terms of the development of two additional 150MW CSP projects (Upington Solar Thermal Plant Two and Three) and drawing on synergies. No site alternatives were considered for assessment.

4.2. Activity Alternatives

4.2.1. Power generation activity alternative

As it is the intention of the developer to develop renewable energy projects as part of the DoE's REIPPP Programme, only renewable energy technologies are being considered. Solar energy is considered to be the most suitable renewable energy technology for this site, based on the site location, ambient conditions and energy resource availability (i.e. solar irradiation).

Abengoa Solar is an international solar company that commercially implements all concentrated solar power (CSP) technological solutions worldwide. The activity which is selected for implementation (and therefore assessment) is the generation of electricity, using CSP technology.

CSP is the only one of the renewable technologies that utilises conventional steam generating equipment with operational and life expectancy similar to that of conventional power plants (i.e. 40 years vs 20 years for other renewable technologies). CSP, through energy storage, can serve peaking and mid merit demand requirements and due to its conventional power station nature has significant socio-economic benefits.

The CSP project has been developed in direct response to the DOE's efforts in obtaining additional *peak power generation* to support Eskom and the country's desperate energy need. CSP is currently *the only* renewable energy technology eligible to participate in the REIPPP programme capable of satisfying this peak power generation requirement, and as such no technology alternatives exist for the project.

A key factor in the siting of any project is the principle to minimise associated infrastructure and the resulting impacts. The selected project development site is adjacent to the proposed Eskom Upington MTS site and within close proximity to other similar sites chosen through various programs such as the Solar Park, Eskom's CSP site and other. The establishment of the Upington MTS allows the projects to connect to a major substation with minimal linear transmission impact, being less than 10km south. Development on any other site, will result in significant increase in disturbance, longer lines and their associated impacts.

Coupled with this, other infrastructure such as site access, ease of access from other centra through national roads and an international airport, and specific support industry which were established in Upington to support the Khi and Kaxu projects makes the site a preferred location from all aspects.

Due to the successful development and construction of the Khi Solar One project on the same site (Portion 3 of the Farm McTaggarts Camp 453), Abengoa Solar Power South Africa (Pty) Ltd is proposing two additional 125/150MW CSP projects on the farm portion. More than 1400ha remains available on Portion 3 of the Farm McTaggarts Camp 453, which is already owned by Abengoa Solar Power South Africa (Pty) Ltd, for development. Based on these considerations, Abengoa Solar Power South Africa (Pty) Ltd considers the proposed site as *highly preferred* in terms of the development of two additional 125/150MW CSP projects (Upington Solar Thermal Plant Two and Three) and drawing on synergies.

CSP specific support industry has development in Upington since the onset of the REIPPPP, examples are for instance the establishment of the Rioglass mirror

manufacturing facility next to the airport, pipe and tank welding works located at Louisvale etc., which makes it suited to support the CSP industry and ensure sustainability of these works and associated jobs.

The applicant has provided a letter of motivation regarding the consideration of CSP technology as the power generation alternative for the site, and this is included in Appendix R. No other power generation activity alternatives are available for assessment.

4.2.2. Water source/activity alternative

CSP technologies function through the generation of steam to drive a conventional steam turbine and generator. Therefore, suitable and sufficient water resources are required. Water sources in this area of Northern Cape include:

a) water from the Gariep River (direct abstraction);
b) water from a local municipality (who abstract from the Gariep River); or
c) groundwater (direct abstraction).

During the assessment for the Phase 1 project (i.e. the Khi Solar One project in 2010), various alternative water sources were debated and assessed between the project applicant, local engineers, the Municipality and the Department of Water and Sanitation. Local water users (irrigation schemes) were also consulted for the three phases (inclusive of Khi Solar One now under construction) and it was determined by Scherman Colloty and Associates (the specialist aquatic consultant) that the only viable source of water was from the Gariep River.

Groundwater resources are limited and scarce in some geological units, and are typically used by local farmers for livestock watering when available. The water is typically saline and not well-suited to use in a process which requires clean water. Groundwater is not considered a viable water source for a power generation project, as it would compromise the potential for other users to utilise groundwater resources. Other users or costs (e.g. pump water via a pipeline from the Upington WWTW) are prohibitive or would result in additional environmental impacts relating to the associated infrastructure.

Water will, therefore, be required to be abstracted from the Gariep River – either direct abstraction by the applicant, or via a Municipality's existing allocation for abstraction from the Gariep River. The Department of Water and Sanitation (DWS) have confirmed in a letter dated 29 May 2015 (refer to Appendix P) that, after due consideration of the water resource availability in the catchment area, it was found the sufficient water is available to meet the water requirement of the project (~300 000 m^3 per annum during construction and 400 000 m^3 per annum during operation). The water source of direct abstraction from the Gariep River is therefore located a distance of less than 20km from

the site, adjacent to the existing abstraction point for the Khi Solar One project (consolidating infrastructure at the existing abstraction embankment). No other water source/activity alternatives are available for assessment.

4.3. Alternative technologies to be used in the Activity

Abengoa Solar is the only solar company that commercially implements all CSP technological solutions in projects worldwide. As such, projects are designed to most optimally suit the techno-economic needs of the specific situation or customer Kai Garib CSP (RF) (Pty) Ltd considered two CSP technology types for implementation on the site near Upington in order to maximise the capacity and land available on the site, namely: heliostats and a power tower system (Solar Tower technology) and parabolic trough technology (Trough technology).

Both CSP technologies are based on the operating principle that the power gained from the sun can be maximised if the radiant energy of the sun is gathered and concentrated on a single point. By concentrating the sun's rays, CSP technologies maximise the amount of sunlight that can be converted into electricity, thereby reducing wastage and increasing output. Technological similarities between power tower and parabolic trough plants include:

» Both technologies operate on a steam turbine system to generate electricity.
» The energy can be stored to enhance despatchability for both technologies.

Technological differences between solar tower and parabolic trough plants include:

» Parabolic troughs are typically 8m to 10m in height and a heat transfer fluid is heated within the trough receiver tubes (i.e. has no 'central receiver', but rather a continuous loop at approximately 5m from ground level).
» Heliostats are mirrors (typically 10 m in height) which reflect the sunlight onto one 'central receiver' which is located on top of the power tower which is 200m to 300m in height.
» Both technologies result in a change in land use. Trough plants, however, require absolute levelling of the land as the troughs are required to be level (heat transfer fluid moves through the receiver tubes), therefore there the site is terraced and may have excessive cut-and-fill operations. A heliostat field does not require terracing, and has a lower impact as a result of direct footprint alteration.
» Molten salt towers have a 5% -10% overall efficiency advantage over parabolic troughs, with an associated *5% -10% less water consumed per MW generated* - estimated to be as much as 50 000 m^3 of water saved annually for a 150MW plant.

The two CSP technologies are shown in Figure 4.1. The Renewable Energy Independent Power Producer Procurement (REIPPP) Programme selection process (details of which are not yet finalised for future bidding rounds), IRP from Government, and the economics of the solar facility are key factors in determining the final technology combination and the

schedule of implementation for the facility. The preferred/optimal technology option (from a technical, financial and socio-economic perspective) for Kai Garib CSP Tower Plant located directly adjacent to the Khi Solar One project (a 50MW solar tower plant) on Portion 3 of the farm McTaggarts Camp 453 is considered by the Applicant to be *solar tower technology with molten salt energy storage*. The progress achieved by molten salt tower technology in recent years has resulted in Abengoa Solar to consider this technology choice a preferred technology for application in South Africa to meet the specific requirements as outlined by the DoE (and the REIPPP Programme).

Molten salt towers have become the CSP technology of choice for implementation in markets requiring *significant energy storage* by Abengoa and other CSP developers due to significant technology advances occurring over the last couple of years. This is illustrated in projects that are currently being developed and constructed in markets such as Chile, North Africa and the Middle East.

The molten salt tower technology provides an optimal techno socio-economic solution when considering CSP alternatives, highlighted by the salient indicators of higher efficiency, associated reduced water consumption per MW generated and lower direct footprint alteration (the heliostat field does not require absolute levelling of the land as trough plants do with the associated terracing and cut-and-fill operations).

The recent international preference for molten salt towers, prompted the National Renewable Energy Laboratory in the USA (NREL), to conduct a comparative analysis of molten salt tower and parabolic trough with storage technology and the findings in the study titled "Estimating the performance and economic value of multiple CSP technologies in a production cost model" dated December 2013, found that parabolic trough CSP-TES plants may require a higher capacity, at a greater expense, than a similar rated molten salt power tower to achieve the same annual output largely due to a larger seasonal variation in output, lower thermal efficiency, and greater storage losses, which support the findings as presented here.

Abengoa Solar South Africa's estimations indicate that molten salt tower plants will have a 5%-10% overall efficiency advantage over parabolic trough plants, with the associated 5%-10% less water consumed per MW generated, estimated to be as much as 50 000 m^3 annually for a 150MW plant. The socio-economic benefit resulting from the tower technology has been highlighted by the possibility to achieve a higher local content per MW installed of around 40%-60%, confirmed by actual data obtained from the construction of the Khi Solar One tower plant, compared to the Kaxu Solar One trough plant constructed in the Northern Cape (REIPPPP round 1 projects owned and operated by Abengoa Solar).
Kai Garib CSP (RF) (Pty) Ltd consider this technology choice to meet the requirements of the DOE and deliver the greatest value to the country as a whole through maximising electricity production utilising the available solar resource while minimising associated

infrastructure, O&M costs as well as social and environmental impacts. The applicant has provided a letter of motivation regarding the consideration of CSP tower technology as the power generation alternative for the site, and this is included in Appendix R. A comparative evaluation of tower and trough technology is provided in Section 7.1. These two technologies are thoroughly discussed and the impacts weighted. The preferred technology alterative for this project is solar tower technology with molten salt energy storage. No additional technology alternatives are assessed further in this report. The environmental feasibility as well as potential impacts of the proposed tower project is determined further in this EIA report (refer to Chapter 7 of this report).

4.4. Layout Design Alternatives

The 150 MW solar tower plant and associated infrastructure will have a development footprint of up to 700 ha, to be placed within a demarcated area of 800ha, located within a broader site of ~2200 ha. Therefore the Kai Garib CSP Tower Plant and its associated infrastructure can be appropriately located within the broader site (on Portion 3 of the Farm McTaggarts Camp 453). During the Scoping Phase potentially environmentally sensitive areas were identified for consideration in detail (through site-specific specialist studies) during this EIA Phase. The layout of the proposed facility occupies the full extent of areas of low ecological and heritage sensitivity. The layout plan provided by the developer is therefore considered to be the most optimal layout from an environmental perspective and the need to present further layout alternatives for the main facility is constrained on this basis. The environmental sensitivity identification process informed the layout design for the Kai Garib CSP Tower Plant, avoiding sensitive areas, as far as possible.

The power line which connects the facility to the McTaggerts Substation is designed to be the shortest route possible, while considering other infrastructure and environmental restrictions. The route is planned to the eastern farm boundary and then follows a common alignment to the McTaggerts Substation to avoid environmental sensitivities (minimise impact on drainage lines) and other infrastructure restrictions. The full extent of the power line is on Portion 3 of the Farm McTaggarts Camp 453.

The abstraction point and water pipeline from the Gariep River is designed to mirror the infrastructure which is currently in place for the Khi Solar One facility. The principle of consolidating impacts to a single alignment has been followed. The only deviation from the alignment of the existing pipeline is where the new pipeline would enter into the Upington Solar Thermal Plant Two development footprint, on the northern side of Portion 3 of the Farm McTaggarts Camp 453.

The primary access road to the site would be off the N14 via the existing Khi access road, or the D3276. These alternatives are explained in further detail in Section 4.5.

1. The Khi Solar One project has established a formal access off the N14 for access to the McTaggarts Camp farm which could provide access for a portion of the distance to the site; or
2. The site can be accessed via the D3276 to the northern boundary of Portion 3 of the Farm McTaggarts Camp 453, with access to the facility area then being from the north.

No other feasible layout alternatives are available for assessment.

4.5. Alternative access to site during construction and operation

The primary access road to the site would be off the N14 national road between Upington and Keimoes. Two reasonable and feasible alternatives have been considered (refer to Figure 4.2):

1. *Access Alternative 1- Access off the N14 via the existing Khi Solar One access road*. The Khi Solar One project has established a formal surfaced access road off the N14 for access to the McTaggarts Camp farm, and specifically the Khi Solar One project development site. The road is available to provide access for a portion of the distance to the site up to the Khi Solar One boundary (5.5km), with an additional 4.5km of road to then be constructed within the boundary of Portion 3 of the Farm McTaggarts Camp 453. This access road (total length of 10km) would provide direct access to the facility area from the south; or
2. *Access Alternative 2- Access off the N14 via the existing district road D3276.* The existing district road D3276 is a gravel road (and would be required to be surfaced). This road intersects with the northern boundary of Portion 3 of the Farm McTaggarts Camp 453 approximately 11 km from the N14. A section of road ~4km would be required to be constructed to access the facility area from the north. This access road (total length of 15km) would provide direct access to the facility area from the north.

Environmental feasibility as well as potential impacts of the two alternative access roads are assessed further in Chapter 7.

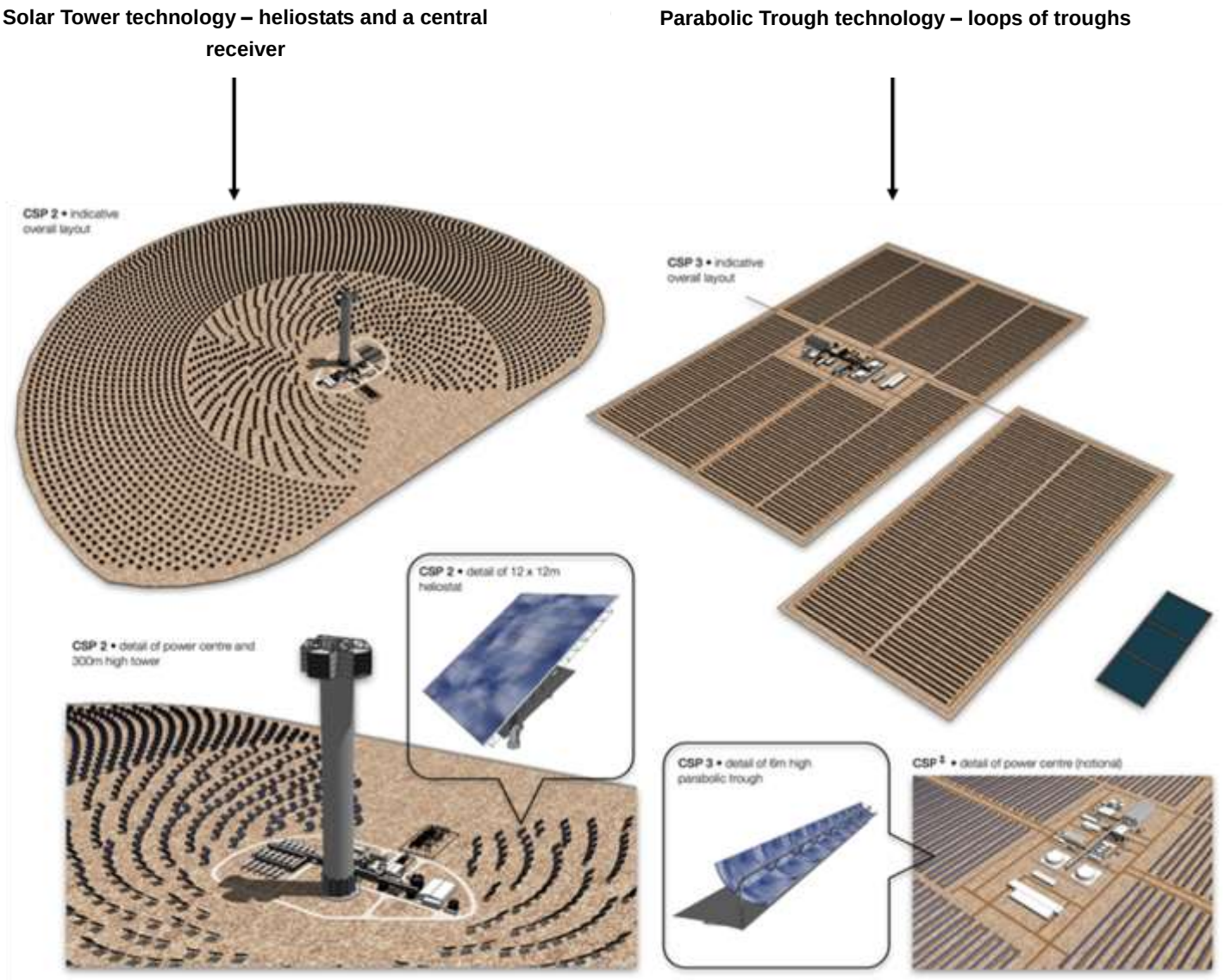

Figure 4.1: Images illustrating the two available CSP technologies considered for the Upington Solar Thermal Plant Two

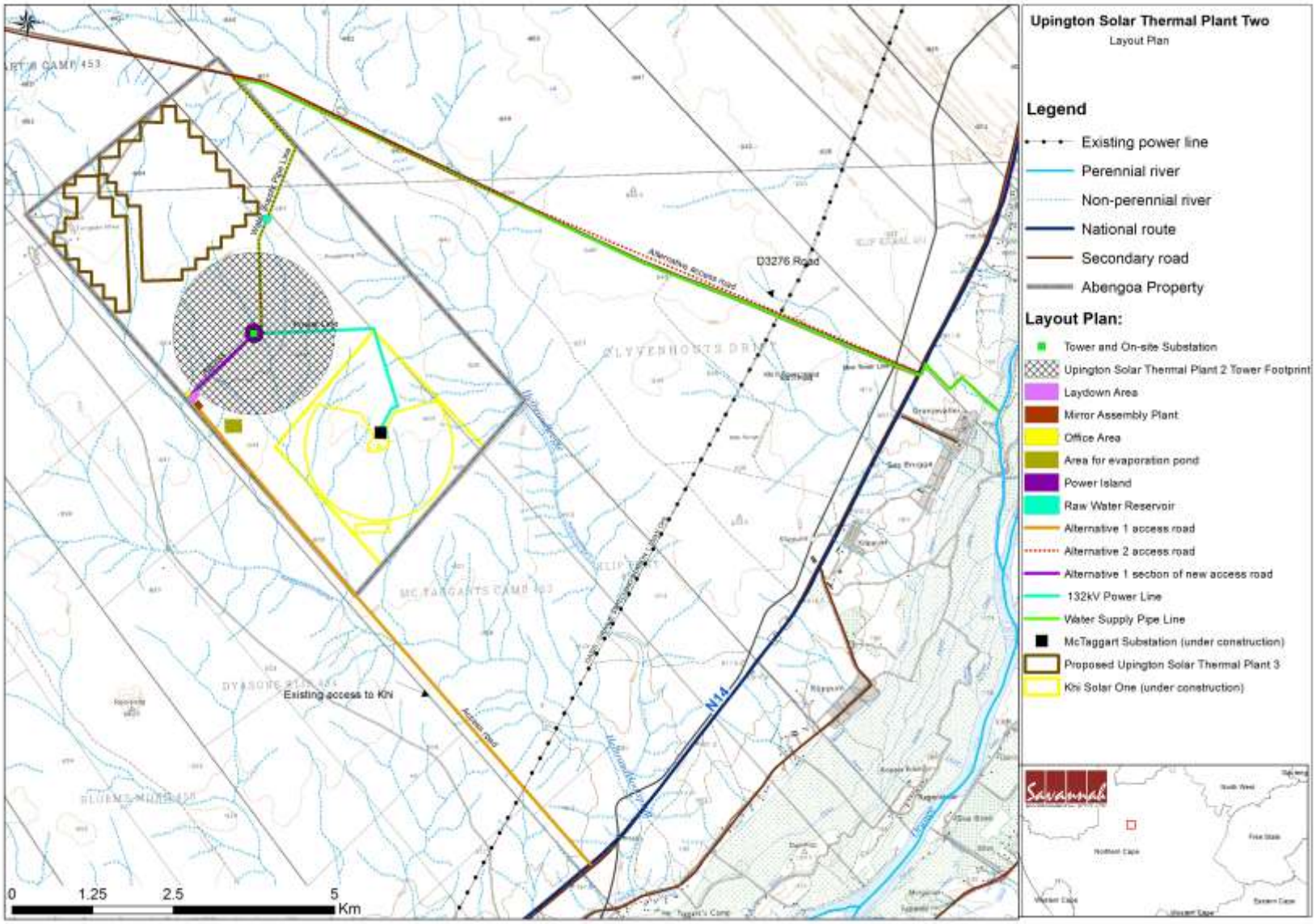

Figure 4.2: Map illustrating the two alternative access roads between the N14 and the Upington Solar Thermal Plant Two

4.6. The 'Do-Nothing' Alternative

The 'do-nothing' alternative is the option of not constructing the Upington Solar Thermal Plant Two. The no-go option would mean that the proposed CSP plant including all associated infrastructure would not be developed. Should this alternative be selected, there would be no direct impacts on the area designated for the construction of the CSP plant due to the associated construction and operation activities.

4.6.1. Land use considerations for the site

The predominant land use of Portion 3 of the Farm McTaggarts Camp 453 was historically grazing (albeit that the area has low carrying capacity) and some sections were mined by hand more than 60 years ago. Neither land use has proven to be commercially viable or profitable, nor had any major socio-economic benefits. The full extent of the farm portion has now been purchased by Abengoa Solar and historic land use practises have ceased. The new land use for the southern-most third of the property is renewable energy, with the construction of the Khi Solar One CSP facility. Rezoning has taken place. There are no unique benefits to be realised considering the land use potential of the site.

The study area is situated in the Nama-Karoo biome. The vegetation types dominating the study area are Bushmanland Arid Grassland and Kalahari Karroid Shrubland. Both vegetation types are regarded as least threatened. Although some species of conservation value do occur within the study area, the habitat is not considered to be unique for flora, terrestrial fauna or avifauna, and is repeated across the landscape. The implementation of the project would result in total loss of the development footprint, and the implementation of the do nothing alternative will allow for the natural grassland to persist (albeit that veld management practices will be required to be implemented). There are no unique benefits to be realised considering the habitat and ecology of the site.

4.6.2. Surrounding land uses

The region west of Upington and north of the Gariep River has received a considerable amount of attention with respect to renewable energy facility applications, and specifically planned CSP facilities. One CSP project (Khi Solar One) is under construction (to the south of the study site) and three large CSP facility applications have been authorised, including Eskom's CSP facility (located to the north and west of the study site). In addition, the proposed Upington Solar Thermal Plant Two falls within the DEA's identified geographical area/focus area considered most suitable for the rollout of the development of solar energy projects within the Northern Cape Province. It, therefore, follows that as the Upington Solar Thermal Plant Two falls in an identified renewable

energy node, and that projects of a similar nature are expected to be developed in this node and surround this site.

Therefore, it is considered likely that should this portion of the McTaggarts Farm not be developed for solar energy, it could be isolated through development of directly neighbouring portions.

While the no-go alternative will have limited socio-economic benefits at a local and regional scale, the extent of the physical impact in the area would be minimised by the number of projects developed in the Upington area. The do-nothing alternative will therefore likely result in minimising the cumulative impact on the land, although it is expected that pressure to develop the site for renewable energy purposes will be actively pursued due to the very factors which make the site a viable option for renewable energy development as discussed previously. Other developers will likely seek to develop the site for renewable energy purposes in order to realise targets for renewable energy in the country, the socio-economic and environmental benefits.

4.6.3. Benefits associated with the CSP Facility

A CSP facility of this extent has proven socio-economic spin-offs[12], most specifically during the construction phase (up to 3 years) but also during operation. Should the do nothing alternative be selected, then the benefits of this renewable energy facility will not be realised, as the generation of electricity from renewable energy resources can offer a range of socio-economic and environmental benefits for South Africa. These 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 and specifically CSP as it uses conventional steam generation coupled to storage which enhances despatchability i.e. being capable of supplying energy during the peak demand periods when it is most needed. In addition, renewables offer the opportunity for improving grid strength and supply quality, and result in generation facilities being deployed in a decentralised manner across the country (i.e. away from the dominant power house of the Mpumalanga coal fields).
» **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

[12] All socio-economic benefits and targets envisaged and set for Khi Solar One have all been achieved.

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 releases of by-products through the burning of fossil fuels for electricity generation have a particularly hazardous impact on human health and contribute to ecosystem degradation. The use of solar radiation for power generation is considered a non-consumptive use of a natural resource, which reduces greenhouse gas emissions.

» **Climate friendly development:** The uptake of renewable energy offers the opportunity to address energy needs in an environmentally responsible manner and thereby allows South Africa to contribute towards mitigating climate change through the reduction of greenhouse gas (GHG) emissions. South Africa is estimated to be responsible for ~1% of global GHG emissions and is currently ranked 9th worldwide in terms of per capita CO_2 emissions.

» **Support for international agreements:** 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[13]), and for cementing its status as a leading player within the international community.

» **Employment creation:** The sale, development, installation, maintenance and management of renewable energy facilities have significant potential for job creation in South Africa.

» **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.

[13] The second commitment period applies to emissions between 2013-2020. The protocol was amended in 2012 to accommodate the second commitment period, but this amendment has (as of January 2013) not entered into legal force.

APPROACH TO UNDERTAKING THE ENVIRONMENTAL IMPACT ASSESSMENT PHASE CHAPTER 5

The EIA process for the proposed Upington Solar Thermal Plant Two is regulated by the EIA Regulations of June 2010 (as amended), which involves the identification of and assessment of direct, indirect, and cumulative environmental impacts (both positive and negative) associated with a proposed project. The EIA process forms part of the feasibility studies for a project, and comprises a Scoping Phase and EIA Phase which culminates in the submission of an EIA Report together with an Environmental Management Programme (EMPr) to the competent authority for decision-making.

The EIA process for the proposed Kai Garib CSP Tower Plant has been undertaken in accordance with the EIA Regulations in terms of Sections 24 and 24D of NEMA, as read with the EIA Regulations of GNR543; GNR544; GNR545; and GNR546 of Section 24(5) of the National Environmental Management Act (NEMA Act No. 107 of 1998). In line with the EIA Regulations, an application for authorisation was lodged with the National DEA for the proposed Kai Garib CSP Tower Plant The Scoping Report, which considered both Kai Garib CSP Tower Plant as well as another phase of the project (the proposed Upington Solar Plant Three), was accepted by DEA in March 2014. In terms of this acceptance of scoping, an EIA phase study (resulting in a separate EIA report) was undertaken for each of the two CSP Projects.

A draft Environmental Impact Assessment Report was released for public review in August/September 2014. The Final EIA report was submitted to DEA (dated November 2014), and in May 2015 DEA requested:

» The EAP to amend the Final EIA report to address the requests for additional information and/or clarity, as per the DEA's correspondence dated 14 May 2015.
» Allow registered I&APS an opportunity to comment on the Amended EIA Report.
» Resubmit the Amended EIA report, together with any comments received from registered I&APs, to the DEA within a period of six months for final decision-making.

The Final EIA Report has been amended to address the request for clarification from the National Department of Environmental Affairs (DEA) dated the 14 May 2014. The following amendments have been made in this Amended EIA Report:

a) Provide clarification and/or assessment of all the issues raised by the DEA:
   The amendments include the results, impact predictions and recommendations (specifically avifauna, flora and water resource specialists).
b) A change to the project description, where the capacity of the facility has been changed from 125MW to 150MW:
   The change in the generating capacity of the project would only change the generator to be used in the facility. There would be no change/increase in the development

footprint of the facility, the height or nature of the infrastructure (i.e. tower and heliostats), the scope of the project and water volume required (remains at 400 000m^3 per annum). Letters confirming that the change in capacity would not increase the level or nature of the potential impacts as determined in the 2014 specialist assessments are included in Appendix O.

c) A change to the project description, where the project name has been changed from Upington Solar Thermal Plant Two to *Kai Garib CSP Tower Plant*.
To alert the reader to the official name now given to the project. It should be noted that the original project name (i.e. Upington Solar Thermal Plant Two) is still used in this report and the appendices.

The Amended Final EIA report has been compiled and was made available for review by all stakeholders and registered I&APs.

5.1. Relevant Listed Activities

The EIA Regulations were revised in December 2014 in terms of GNR 982 – 985. In terms of Sub-Regulations 53(2) and 53(3) of these Regulations) Transitional Arrangements):

" If a situation arises where an activity or activities, identified under the previous NEMA Notices, no longer requires environmental authorisation in terms of the current activities and competent authorities identified in terms of section 24(2) and 24D of the National Environmental Management Act, 1998 (Act No. 107 of 1998) or in terms of the National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008), and where a decision on an application submitted under the previous NEMA regulations is still pending, the competent authority will consider such application to be withdrawn".

and

"Where an application submitted in terms of the previous NEMA regulations, is pending in relation to an activity of which a component of the same activity was not identified under the previous NEMA notices, but is now identified in terms of section 24(2) of the Act, the competent authority must dispense of such application in terms of the previous NEMA regulations and may authorise the activity identified in terms of section 24(2) as if it was applied for, on condition that all impacts of the newly identified activity and requirements of these Regulations have also been considered and adequately assessed."

Therefore, similarly listed and additional activities relevant to the current application have been identified and are listed in the Table 5.1 below.

Table 5.1: Summary of the GN 544, 545 and 546, **listed activities** number and short description of the activities that require authorisation under NEMA

Number and date of the relevant notice	Activity No (in terms of the relevant notice)	Description of Listed Activity	Activity listed in GNR 983 - 985	Relevant Component(s) of Facility
GN 544, 18 June 2010	9 (ii)	The construction of facilities or infrastructure exceeding 1000 metres in length for the bulk transportation of water, sewage or storm water - (i) with an internal diameter of 0,36 metres or more; a. such facilities or infrastructure are for bulk transportation of water, sewage or storm water or storm water drainage inside a road reserve; or b. where such construction will occur within urban areas but further than 32 metres from a watercourse, measured from the edge of the watercourse.	***GN983, activity 9 (i)*** The development of infrastructure exceeding 1000 metres in length for the bulk transportation of water or storm water - (i) with an internal diameter of 0,36 metres or more;	***Ancillary infrastructure includes the construction of a water supply pipeline to the facility from the abstraction point at the Gariep (Orange) River.***
GN 544, 18 June 2010	10 (i)	The construction of facilities or infrastructure for the transmission and distribution of electricity – i. Outside urban areas or industrial complexes with a capacity of more than 33kv but less than 275kv	***GN983, activity 11 (i)*** The development of facilities or infrastructure for the transmission and distribution of electricity- (i) outside urban areas or industrial complexes with a capacity of more than 33 but less than 275 kilovolts***.***	***The proposed facility will be required to evacuate electricity into the national grid and include the construction of a distribution line of less than 275kV to McTaggerts Substation located on the site.***

GN 544, 18 June 2010	11	The construction of:÷ (iii) bridges; (x) buildings exceeding 50 square metres in size; or (xi) infrastructure or structures covering 50 square metres or more Where such construction occurs within a watercourse or within 32 metres of a watercourse, measures from the edge of a watercourse , excluding where such construction will occur behind the development setback line	***GN983, activity 12 (xii)(a)(c)*** The development of (xii) infrastructure or structures with a physical footprint of 100 square metres or more; where such development occurs- (a) within a watercourse; or (c) if no development setback exists, within 32 metres of a watercourse, measured from the edge of a watercourse;	***Bridges for access roads and cabling structures are required to cross the non-perennial stream traversing the site, and infrastructure exceeding 50m^2 are required to be constructed with 32 m of a watercourse.***
GN 544, 18 June 2010	12	The construction of facilities or infrastructure for the off-stream storage of water, including dams and reservoirs, with a combined capacity of 50000 cubic metres or more, unless such storage falls within the ambit of activity 19 of Notice 545 of 2010.	***GN983, activity 13*** The development of facilities or infrastructure for the off-stream storage of water, including dams and reservoirs, with a combined capacity of 50000 cubic metres or more, unless such storage falls within the ambit of activity 16 of Listing Notice 2 of 2014.	***Ancillary infrastructure includes water storage reservoir/s on the site and evaporation ponds (for clean water storage, wastewater from the generation process and water treatment plant). The combined capacity of these exceeds 50 000m^3.***
GN 544, 18 June 2010	13	The construction of facilities or infrastructure for the storage, or for the storage and handling, of a dangerous good, where such storage occurs in containers with a combined capacity of 80 but not exceeding 500 cubic metres.	***GN983, activity 13*** The development of facilities or infrastructure, for the storage, or for the storage and handling, of a dangerous good, where such storage occurs in containers with a combined capacity of 80 cubic metres or more but not exceeding 500 cubic metres.	***The facilities or infrastructure for the storage, or for the storage and handling, of a dangerous good will be required. The storage containers will have a combined capacity of 80 but not exceeding 500 cubic metres***
GN 544, 18 June 2010	18	The infilling or depositing of any material of more than 5 cubic metres into, or the dredging, excavation, removal or moving of soil, sand, shells, shell grit, pebbles or	***GN983, activity 19*** The infilling or depositing of any material of more than 5 cubic metres into, or the dredging, excavation, removal or moving	***The construction of the facility and/or associated infrastructure which crosses the ephemeral drainage line will require the infilling or excavation,***

		rock or more than 5 cubic metres from: i. A watercourse.	of soil, sand, shells, shell grit, pebbles or rock of more than 5 cubic metres from-(i) a watercourse	***removal or moving of any material into or from a watercourse.***
GNR 544, 18 June 2010	47 (ii)	The widening of a road by more than 6 metres, or the lengthening of a road by more than 1 kilometre (ii) where no reserve exists, where the existing road is wider than 8 metres – excluding widening or lengthening occurring inside urban areas.	***GN983, activity 56 (i)*** The widening of a road by more than 6 metres, or the lengthening of a road by more than 1 kilometre- (i) where the existing reserve is wider than 13,5 meters	***The development of the facility will require the widening or lengthening of the existing access road to the Khi Solar One site.***
GN 545, 18 June 2010	1	The construction of facilities or infrastructure, for the generation of electricity where the output is 20 megawatts or more.	***GN984, activity 1*** The development of facilities or infrastructure for the generation of electricity from a renewable resource where the electricity output is 20 megawatts or more	***The Facility will consist of a power tower and heliostats with a generation capacity of up to 150MW.***
GN 545, 18 June 2010	5	The construction of facilities or infrastructure for any process or activity which requires a permit or license in terms of national or provincial legislation governing the generation or release of emissions, pollution or effluent and which is not identified in Notice No. 544 of 2010 or included in the list of waste management activities published in terms of section 19 of the National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008) in which case that Act will apply.	***GN984, activity 6*** The development of facilities or infrastructure for any process or activity which requires a permit or license in terms of national or provincial legislation governing the generation or release of emissions, pollution or effluent excluding- Activities which are identified in Notice No. 544 of 2010 or included in the list of waste management activities published in terms of section 19 of the National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008) in which case the National Environmental Management: Waste Act, 2008 applies.	***The evaporation ponds require a water use licence for the release of pollution and effluents in a lined lagoon.***
GN 545, 18	15	Physical alteration of undeveloped, vacant	***GN983, activity 28 (ii)***	***The total area to be transformed will***

June 2010		or derelict land for residential, retail, commercial, recreational, industrial or institutional use where the total area to be transformed is 20 hectares or more.	Residential, mixed, retail, commercial, industrial or institutional developments where such land was used for agriculture or afforestation on or after 01 April 1998 and where such development: (ii) will occur outside an urban area, where the total land to be developed is bigger than 1 hectare	***be more than 20 hectares. The Facility will utilise tower technology (consisting a power tower and heliostats with a generation capacity of ~ 150MW and associated infrastructure) to be constructed over an area of 700ha.***
GN 546, 18 June 2010	2 (a) iii (bb)	The construction of reservoirs for bulk water supply with a capacity of more than 250 cubic metres in the Northern Cape in the Northern Cape outside urban areas in sensitive areas as identified in an environmental management framework as contemplated in chapter 5 of the Act and as adopted by the competent authority .	***GN985, activity 2 (a)(iii)(bb)*** The development of reservoirs for bulk water supply with a capacity of more than 250 cubic metres. (a) In the Northern Cape (iii) outside urban areas; (bb) in sensitive areas as identified in an environmental management framework as contemplated in chapter 5 of the Act and as adopted by the competent authority	***Ancillary infrastructure includes water storage reservoirs on the site in a sensitive area as identified in the Siyanda District Municipality's[14] environmental management framework (EMF). The EMF identifies the area the site is located within as an area of high conservation priority and the site is also demarcated as occurring in Zone 2 in the EMF – i.e. potentially high vegetation conservation areas.***
GN 546, 18 June 2010	4(a) ii (cc)	The construction of a road wider than 4 metres with a reserve less than 13,5 metres in the Northern Cape outside urban areas in sensitive areas as identified in an environmental management framework as contemplated in chapter 5 of the Act and as adopted by the competent authority	***GN985, activity 4 (a)(i)(cc):*** The development of a road wider than 4 metres with a reserve less than 13,5 metres. (a) in the Northern Cape i) Outside urban areas cc) sensitive areas as identified in an environmental management framework as contemplated in chapter 5 of the Act and as adopted by the competent authority	***A road wider than 4 m may need to be constructed in a sensitive area as identified in the Siyanda District Municipality's environmental management framework (EMF). The EMF identifies the area the site is located within as an area of high conservation priority and the site is also demarcated as occurring in Zone 2 in the EMF – i.e. potentially high vegetation conservation areas.***
GN 546, 18	10 (a) ii (cc)	The construction of facilities or	***GN985, activity 10(a)(ii)(cc)***	***Fuel to be used during construction***

[14] Note that the name of the Siyanda District Municipality has been changed to the ZF Mgcawu District Municipality.

June 2010		infrastructure for the storage, or storage and handling of a dangerous good, where such storage occurs in containers with a combined capacity of 30 but not exceeding 80 cubic metres in the Northern Cape, outside urban areas in sensitive areas as identified in an environmental management framework as contemplated in chapter 5 of the Act and as adopted by the competent authority.	The development of facilities or infrastructure for the storage, or storage and handling of a dangerous good, where such storage occurs in containers with a combined capacity of 30 but not exceeding 80 cubic metres (a) in the Northern Cape, (ii) outside urban areas in (cc) sensitive areas as identified in an environmental management framework as contemplated in chapter 5 of the Act and as adopted by the competent authority.	***will need to be stored on-site in a sensitive area as identified in the Siyanda District Municipality's environmental management framework (EMF). The EMF identifies the area the site is located within as an area of high conservation priority and the site is also demarcated as occurring in Zone 2 in the EMF – i.e. potentially high vegetation conservation areas.***
GN 546, 18 June 2010	13(c) ii (cc)	The clearance of an area of 1 hectare or more of vegetation where 75% or more of the vegetative cover constitutes indigenous vegetation in the Northern Cape, outside urban areas in (cc) Sensitive areas as identified in an environmental management framework as contemplated in chapter 5 of the Act and as adopted by the competent authority.	***GN985, activity 10(a)(ii)(cc)*** The clearance of an area of 300 square metres or more of indigenous vegetation except where such clearance of indigenous vegetation is required for maintenance purposes undertaken in accordance with a maintenance management plan.	***An area of 1 ha or more of indigenous vegetation cover (where 75% or more of the vegetative cover constitutes indigenous vegetation) may need to be cleared in a sensitive area as identified in the Siyanda District Municipality's environmental management framework (EMF). The EMF identifies the area the site is located within as an area of high conservation priority and the site is also demarcated as occurring in Zone 2 in the EMF – i.e. potentially high vegetation conservation areas.***
GN 546, 18 June 2010	14 (a) i	The clearance of an area of 5 hectares or more of vegetation where 75% or more of the vegetative cover constitutes indigenous vegetation in the Northern Cape, outside urban areas.	***GN985, activity 10(a)(ii)(cc)*** The clearance of an area of 300 square metres or more of indigenous vegetation except where such clearance of indigenous vegetation is required for maintenance purposes undertaken in accordance with a maintenance management plan.	***An area of 5 ha or more of indigenous vegetation cover (where 75% or more of the vegetative cover constitutes indigenous vegetation) will need to be cleared outside an urban area.***
GN 546, 18 June 2010	16(iii) & (iv) (a) (ii) (dd)	The construction of (iii) buildings with a footprint exceeding 10 square metres in	***GN 985, activity 14(xii)(a)(ii)(dd)*** The development of:	***Buildings and infrastructure larger than 10 m2 which occur within 32 m***

		size or (iv) infrastructure covering 10 square metres or more where such construction occurs within a watercourse or within 32 metres of a watercourse, measured from the edge of a watercourse, excluding where such construction will occur behind the development setback line. (a) In the Northern Cape, outside urban areas in sensitive areas as identified in an environmental management framework as contemplated in chapter 5 of the Act and as adopted by the competent authority.	(xii) infrastructure or structures with a physical footprint of 10 square metres or more. (a) in the Northern Cape (ii) Outside urban areas in dd) sensitive areas as identified in an environmental management framework as contemplated in chapter 5 of the Act and as adopted by the competent authority.	***of ephemeral drainage line or watercourse may will be required to be built in a sensitive area as identified in the Siyanda District Municipality's environmental management framework (EMF). The EMF identifies the area the site is located within as an area of high conservation priority and the site is also demarcated as occurring in Zone 2 in the EMF – i.e. potentially high vegetation conservation areas.***
GN R.546 -	Item 19 (a) (ii) (cc)	The widening of a road by more than 4 metres, or the lengthening of a road by more than 1 kilometre. (ii) Outside urban areas, in: (cc) sensitive areas as identified in an environmental management framework as contemplated in Chapter 5 of the Act and as adopted by the competent authority.	***GN 985, activity 18(xii)(a)(ii)(cc)*** The widening of a road by more than 4 metres, or the lengthening of a road by more than 1 kilometre. (a) In the Northern Cape (ii) Outside urban areas, in: (cc) sensitive areas as identified in an environmental management framework as contemplated in Chapter 5 of the Act and as adopted by the competent authority.	***The development of the facility will require the widening or lengthening of the existing access road to the Khi Solar One site, i.e. in a sensitive area as identified in the Siyanda District Municipality's environmental management framework (EMF). The EMF identifies the area the site is located within as an area of high conservation priority and the site is also demarcated as occurring in Zone 2 in the EMF – i.e. potentially high vegetation conservation areas.***

This EIA Report forms part of the EIA process for the Upington Solar Thermal Plant Two and was conducted in accordance with the requirements of the EIA Regulations of June 2010 and in terms of Section 24(5) of the National Environmental Management Act (NEMA; Act No 107 of 1998), in support of the application for environmental authorisation.

5.2. Scoping Phase

In accordance with the EIA Regulations, the main purpose of the Scoping Phase is to focus the environmental assessment in order to ensure that only potentially significant issues and reasonable and feasible alternatives are examined in the EIA Phase. The Draft Scoping Report provided stakeholders with an opportunity to verify that the issues they have raised through the process to date have been captured and adequately considered, and provides a further opportunity for additional key issues for consideration to be raised. This Final Scoping Report incorporated all issues and responses raised during the public review of the Draft Scoping Report prior to submission to DEA. The Final Scoping Report was accepted by DEA in March 2014 (refer to Appendix B).

The full extent of the project development site (i.e. Portion 3 of the Farm McTaggarts Camp 453) was evaluated within the Scoping phase of the EIA process.

The **potentially sensitive areas** which have been identified through the environmental scoping study are listed below. The scoping sensitivity map was a rough scale estimate of sensitivity on the site identified at a desk-top level. This map represents potentially sensitive areas identified through scoping within which more investigation is required. The map will be further refined in this EIA phase on the basis of these specialist studies, in order to inform the final design of the facility. These potentially sensitive areas already identified through the scoping study include:

» Areas along ephemeral drainage lines and seasonal pans – water resources
» Tributaries of the Heldbrandkloofspruit
» Areas previously disturbed through mining activities (25 hectares in extent)
» Heritage sites (a Middle Stone Age site near the Khi Solar One Plant, however *not* within the vicinity of the construction footprint for the Upington Solar Thermal Plant Two)
» Sensitive vegetation (Kalahari Karroid Shrubland vegetation)

With an understanding of which areas of the site are sensitive, Abengoa Solar Power South Africa (Pty) Ltd prepared infrastructure layouts for the Upington Solar Thermal Plant Two for consideration within this EIA Phase.

5.3. Environmental Impact Assessment Phase

The EIA Phase for the proposed Upington Solar Thermal Plant Two aims to achieve the following:

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

The EIA Report addresses potential direct, indirect, and cumulative[15] impacts (both positive and negative) associated with the proposed Kai Garib CSP Tower Plant including design, construction, operation and decommissioning. In this regard the EIA Report aims to provide the relevant authorities with sufficient information to make an informed decision regarding the proposed project.

5.3.1. Tasks completed during the EIA Phase

The EIA Phase for the proposed the proposed Kai Garib CSP Tower Plant has been undertaken in accordance with the EIA Regulations published in GN 33306 of 18 June 2010 (as amended), 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 54 of GN R543 of 2010 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 57 of GN R543 of 2010).
» Undertaking of independent specialist studies in accordance with Regulation 32 of GN R543 of 2010.
» Preparation of a Draft EIA Report in accordance with the requirements of the Regulation 31 of GN R543 of 2010.

[15] "Cumulative environmental change or cumulative effects may result from the additive effect of individual actions of the same nature or the interactive effect of multiple actions of a different nature" (Spaling and Smit, 1993).

» Prepare a Comments and Response Report detailing key issues raised by I&APs as part of the EIA Process (in accordance with Regulation 57 of GN R543 of 2010).
» Undertaking of independent specialist studies in accordance with Regulation 32 of GN R543 of 2010.
» Preparation of a Draft EIA Report in accordance with the requirements of the Regulation 31 of GN R543 of 2010.

5.3.2. Authority Consultation

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

» The Final Scoping Report for the proposed Upington Solar Thermal Plant Two and Three together with a Plan of Study for the EIA phase was submitted in December 2013. The Scoping Report was accepted by DEA in March 2014.
» A meeting had held with the Northern Cape Department of Environment and Nature Conservation on 8 January 2014 to inform the Department on the project and EIA process.

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

» Submission of a final EIA Report to DEA following a public review period for the draft EIA (30 days) and final EIA report.
» If required, an opportunity for DEA and NC DENC representatives to visit and inspect the proposed site, and the study area.
» Notification and 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.).

A record of consultation with DEA in the EIA process is included within **Appendix B**.

5.3.3. Public Involvement and Consultation

The aim of the public participation process is 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.
» Comments received from stakeholders and I&APs were recorded and incorporated into the EIA process.

In order to accommodate the varying needs of stakeholders and I&APs within the study area, as well as capture their inputs regarding the project, various opportunities for stakeholders and I&APs to be involved in the EIA Phase of the process have been provided, as follows:

» Focus group meetings (pre-arranged and stakeholders invited to attend) and a public meeting. A public meeting was held on 08 April 2014 at 18h00 at the Keimoes Hotel. Minutes of the meeting is attached to Appendix E4.
» Written, faxed or e-mail correspondence.
» The Draft EIA Report was released for a 30-day public review period from 26 August 2014 – 24 September 2014. The comments received from I&APs will be captured within a Comments and Response Report, which will be included within the Final EIA Report, for submission to the authorities for decision-making.
» I&APs were informed of the availability of the final EIA report prior to submission to DEA.
» The Amended EIA Report was released for a 30-day public review period from 03 August 2015– 03 September 2015. The comments received from I&APs have been captured within a Comments and Response Report, which have been included within the Amended EIA Report, for submission to the authorities for decision-making.

In terms of the requirement of Chapter 6 of the EIA Regulations of June 2010, the following public participation tasks have been undertaken:

» Distribution of Letters of Notification to I&APs to inform them on the project and planned EIA phase.
» Fixing a notice board at a place conspicuous to the public at the boundary or on the fence of—
    (i) the site where the activity to which the application relates is or is to be undertaken; and

(ii) any alternative site mentioned in the application;

» Giving written notice to:
  (i) the owner or person in control of that land if the applicant is not the owner or person in control of the land;
  (ii) the occupiers of the site where the activity is or is to be undertaken or to any alternative site where the activity is to be undertaken;
  (iii) Owners and occupiers of land adjacent to the site where the activity is or is to be undertaken or to any alternative site where the activity is to be undertaken;
  (iv) the municipal councillor of the ward in which the site or alternative site is situated and any organisation of ratepayers that represent the community in the area;
  (v) the municipality which has jurisdiction in the area;
  (vi) any organ of state having jurisdiction in respect of any aspect of the activity; and
  (vii) any other party as required by the competent authority.
» Placing an advertisement in:
  (i) one local newspaper; and
  (ii) in at least one provincial newspaper.
» Open and maintain a register/ database of interested and affected parties and organs of state.
» Release of a Draft Scoping Report, Draft EIA Report and Amended EIA Report for Public Review for a 30-day period.
» Hosting of a Public Meeting and Focus Group Meetings during the scoping phase and EIA phase by the EAP to discuss and share information on the project.
» Preparation of a Comments and Responses Report which document all the comments received and responses from the project team.
» Apart from the 30 day commenting period on the Amended EIA Report, in order to give effect to Regulation 56(2), registered Interested and Affected parties will be given access to, and an opportunity to comment on the final report before submitting the final environmental impact assessment report to the DEA.

A record of the documents relevant to the above-mentioned public participation process is contained within Appendix E.

Below is a summary of the key public participation activities conducted up to this point in the process.

» **Placement of Site Notices**
  Site notices have been placed on-site and at relevant public places and proof of this is included in Appendix D.

» **Identification of I&APs and establishment of a database**

Identification of I&APs was undertaken by Savannah Environmental through existing contacts and databases, recording responses to site notices and the newspaper advertisement, as well as through the process of networking. The key stakeholder groups identified include authorities, local and district municipalities, public stakeholders, Parastatals and Non-Governmental Organisations (refer to Table 5.1 below).

Table 5.1: Key stakeholder groups identified during the EIA Process

Stakeholder Group	Department
National and Provincial Authorities	» Northern Cape – Department of Environmental and Nature Conservation (DENC) » Northern Cape - Agriculture and Rural Development » Northern Cape - Public Works, Roads and Transport » Northern Cape - Water Affairs » South African Heritage Resources Agency » Department of Agriculture, Forestry and Fisheries » South African National Roads Agency » Department of Energy » Civil Aviation Authority » Square Kilometre Array (SKA) Project
Municipalities	» Kai !Garib Local Municipality » ZF Mgcawu District Municipality.
Public stakeholders	» Landowners, surrounding landowners, occupiers of land
Parastatals & service providers	» Eskom Transmission and Distribution » Ngwao Boswa ya Kapa Bokone (Northern Cape Provincial Heritage Authority)
NGOs	» Wildlife Environment Society of South Africa » BirdLife South Africa

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 undertaken by Savannah Environmental, the identification and registration of I&APs has been on-going for the duration of the EIA phase of the process.

» **Newspaper Advertisements**

A first round of newspaper adverts was placed to inform the public on the availability of the draft scoping report and first public meeting in the following newspapers:

* The Volksblad (30 October 2013)
* Gemsbok (30 October 2013)

A second round of newspaper adverts during the EIA phase was placed in March 2014 to advertise the public meeting details in the same newspapers (The Volksblad and Gemsbok).

A third round of newspaper adverts was placed in August 2014 to inform the public on the availability of the draft EIA Report for review in the same newspapers (The Volksblad and Gemsbok).

Refer to Appendix D for proof of advertisements which were placed.

» **Consultation**
In order to accommodate the varying needs of stakeholders and I&APs, the following opportunities have been provided for I&AP 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 and stakeholders invited to attend)
* Written, faxed or e-mail correspondence

In order to facilitate comments on the proposed project and to provide feedback on the findings of the EIA specialist studies, a public feedback meeting was held on 08 April 2014 at 18h00 at the Keimoes Hotel and registered interested and affected parties were invited to attend the public meeting. Details of the meeting were advertised in the Volksblad and Gemsbok newspapers for the benefit of the broader public. In addition, focus group meetings were held with 07 – 08 April 2014 (Kai !Garib Local Municipality and meeting with the Khoi San Chief).

Records of all consultation undertaken are included within **Appendix E**.

5.3.4. Identification and Recording of Issues and Concerns

Issues and comments raised by I&APs over the duration of the EIA process to date have been addressed and synthesised into an EIA Phase Comments and Response Report (refer to Appendix E). The Comments and Response Report includes 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.

During the review period for the DEIR, comments were received from organs of state and other stakeholders, including Department of Water Affairs, Department of Energy, Department of Rural Development and Land Reform, Department of Agriculture, Forestry and Fisheries, South African Civil Aviation Authority, Eskom, SANRAL and BirdLife South Africa, amongst others.

5.3.5. Assessment of Issues Identified through the Scoping Process

Issues which require investigation within the EIA Phase, as well as the specialists involved in the assessment of these impacts are indicated in Table 5.2 below.

Table 5.2: Specialist studies undertaken as part of the EIA process (including additional work to amend the EIA report)

Specialist Study Undertaken	Specialist	Appendix
Ecology, including flora, terrestrial fauna	Marianne Strohbach and Blair Zoghby of Savannah Environmental	Appendix F
Avifauna – expanded study	Adrian Hudson of Hudson Ecology	Appendix G
Soils and Agricultural potential	Johan Lanz	Appendix H
Water Resources	Brian Colloty of Scherman, Colloty and Associates	Appendix I
Visual assessment	Quinton Lawson and Bernard Oberhozer of Bernard Oberholzer Landscape Architects and MLB Architects	Appendix J and J1
Social assessment	Tony Barbour of Tony Barbour Consulting and Research	Appendix K
Heritage assessment	David Morris of the McGregor Museum	Appendix L
Palaeontological assessment	John Pether - Geological and Palaeontological Consultant	Appendix M
Noise assessment	Morne De Jager of Enviro-Acoustic Research cc	Appendix N

Specialist studies considered direct, indirect, cumulative, and residual environmental impacts associated with the development of the Upington Solar Plant Two. 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**, wh0ich 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 the developer 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 EMPr is included as **Appendix S**.

5.3.6. Assumptions and Limitations

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

» All information provided by the developer 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 the developer represents a technically suitable site for the establishment of the proposed solar facility.
» It is assumed correct that the proposed connection to the National Grid is correct in terms of viability and need.
» 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.

Refer to the specialist studies in **Appendices F – N** for specialist study specific limitations.

5.4 Legislation, Policies and Guidelines which have informed the EIA Process

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:
  * Companion to the National Environmental Management Act (NEMA) Environmental Impact Assessment (EIA) Regulations of 2010 (Draft Guideline; DEA, 2010).
  * Public Participation in the EIA Process (DEA, 2010).
» International guidelines – the Equator Principles

Several other acts, standards, or guidelines have also informed the project process and the scope of issues addressed and assessed in the EIA Report. A review of legislative requirements applicable to the proposed project is provided in the **Table 5.3.** .

Table 5.3: Relevant legislative permitting requirements applicable to the Upington Solar Thermal Plant Two

Legislation	Applicable Requirements	Relevant Authority	Compliance requirements
National Legislation			
National Environmental Management Act (Act No 107 of 1998)	» EIA Regulations have been promulgated in terms of Chapter 5. Activities which may not commence without an environmental authorisation are identified within these Regulations. » 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. » In terms of GNR 387 of 21 April 2006, a scoping and EIA process is required to be undertaken for the proposed project	» National Department of Environmental Affairs – lead authority » NC DENC - commenting authority	The listed activities triggered by the proposed solar energy facility have been identified and assessed in the EIA process being undertaken (i.e. Scoping and EIA). This EIA Report will be submitted to the competent and commenting authority in support of the application for authorisation.
National Environmental Management Act (Act No 107 of 1998)	» 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. » In terms of NEMA, it has become the legal duty of a project proponent to consider a project holistically, and to consider the cumulative effect of a variety of impacts.	» Department of Environmental Affairs (as regulator of NEMA)	While no permitting or licensing requirements arise directly by virtue of the proposed project, this section has found application during the EIA Phase through the consideration of potential impacts (cumulative, direct, and indirect). It will continue to apply throughout the life cycle of the project.
Environment Conservation Act (Act No 73 of 1989)	» National Noise Control Regulations (GN R154 dated 10 January 1992)	» National Department of Environmental Affairs » NC DENC » Local Authorities » District & Local Municipality	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.
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 and storage of water are regarded as a water uses (as defined in terms of S21 of the NWA). » A water use license (WUL) is required to be obtained if wetlands or drainage lines are impacted on, or if infrastructure lies within 500m of wetland features or the regulated area of a watercourse (being the riparian zone or the 1:100yr floodline whichever is greatest). » A water use license (WUL) is required to be obtained for the handling and storage of wastewater associated with the project. » A water use license application will be applied for in line with the DWA requirements, once the project has obtained preferred bidder status.
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 project to prevent and remedy the effects of pollution to water resources from occurring, continuing, or recurring.	» Department of Water Affairs (as regulator of NWA)	This section will apply throughout the life cycle of the project.
Minerals and Petroleum Resources Development Act (Act No 28 of 2002)	» 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. » Requirements for Environmental Management Programmes and Environmental Management Plans are set out in S39 of the Act.	» Department of Mineral Resources	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.

National Environmental Management: Air Quality Act (Act No 39 of 2004)	» S21 – Listed activities requiring an Air Emissions License. » Minimum emission standards are set for Listed Activities. » Measures in respect of dust control (S32) and National Dust Control Regulations of November 2013. » Measures to control noise (S34) - no regulations promulgated yet. » 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 the Act.	» National Department of Environmental Affairs » District Municipality	» While no permitting or licensing requirements arise from this legislation, this act will find application during the operational phase of the project. » 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 the Act.
National Heritage Resources Act (Act No 25 of 1999)	» Stipulates assessment criteria and categories of heritage resources according to their significance (S7). » Provides for the protection of all archaeological and palaeontological sites, and meteorites (S35). » Provides for the conservation and care of cemeteries and graves by SAHRA where this is not the responsibility of any other authority (S36). » Lists activities which require developers any person who intends to undertake to notify the responsible heritage resources authority and furnish it with details regarding the location, nature, and extent of the proposed development (S38). » Requires the compilation of a Conservation Management Plan as well as a permit from SAHRA for the presentation of archaeological sites as part of tourism attraction (S44).	South African Heritage Resources Agency and the Provincial Heritage Resources Agency	An HIA and PIA has been undertaken as part of the EIA Process to identify heritage sites (refer to Appendix L and M). Should a heritage resource be impacted upon, a permit may be required from SAHRA.

National Environmental Management: Biodiversity Act (Act No 10 of 2004)	» Provides for the MEC/Minister to identify any process or activity in such a listed ecosystem as a threatening process (S53) » A list of threatened and protected species has been published in terms of S 56(1) - Government Gazette 29657. » Three government notices have been published, i.e. GN R 150 (Commencement of Threatened and Protected Species Regulations, 2007), GN R 151 (Lists of critically endangered, vulnerable and protected species) and GN R 152 (Threatened or Protected Species Regulations). » Provides for listing threatened or protected ecosystems, in one of four categories: critically endangered (CR), endangered (EN), vulnerable (VU) or protected. The first national list of threatened terrestrial ecosystems has been gazetted, together with supporting information on the listing process including the purpose and rationale for listing ecosystems, the criteria used to identify listed ecosystems, the implications of listing ecosystems, and summary statistics and national maps of listed ecosystems (National Environmental Management: Biodiversity Act: National list of ecosystems that are threatened and in need of protection, (G 34809, GN 1002), 9 December 2011). » This Act also regulates alien and invader species.	Department of Environmental Affairs	Under this Act, a permit would be required for any activity which is of a nature that may negatively impact on the survival of a listed protected species. An ecological study has been undertaken as part of the EIA Phase. As such the potential occurrence of critically endangered, endangered, vulnerable, and protected species and the potential for them to be affected has been considered. This report is contained in Appendix F.
Conservation of Agricultural Resources Act (Act No 43 of 1983)	» Prohibition of the spreading of weeds (S5) » Classification of categories of weeds & invader plants (Regulation 15 of GN R1048) &	» Department of Agriculture	While no permitting or licensing requirements arise from this legislation, this Act will find application during the EIA

	restrictions in terms of where these species may occur. » Requirement & methods to implement control measures for alien and invasive plant species (Regulation 15E of GN R1048).		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 Forests Act (Act No. 84 of 1998)	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'.	National Department of Forestry	A licence is required for any removal of protected trees.
National Veld and Forest Fire Act (Act 101 of 1998)	In terms of S12 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. In terms of S17, the applicant must have such equipment, protective clothing, and trained personnel for extinguishing fires.	Department of Agriculture, Forestry and Fisheries (DAFF)	While no permitting or licensing requirements arise from this legislation, this Act will find application during the construction and operational phase of the project.
Aviation Act (Act No 74 of 1962) 13th 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 considered the lowest point in a 3km radius around such structure. » Structures lower than 45 m, which are considered as a danger to aviation shall be marked as such when specified.	» Civil Aviation Authority (CAA)	This act will find application during the operational phase of the project. Appropriate marking is required to meet the specifications as detailed in the CAR Part 139.01.33.

Hazardous Substances Act (Act No 15 of 1973)	» This Act regulates the control of substances that may cause injury, or ill health, or death by reason 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. » 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; » Group IV: any electronic product; » Group V: any radioactive material. The use, conveyance, or storage of any hazardous substance (such as distillate fuel) is prohibited without an appropriate license being in force.	» Department of Health	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.
National Road Traffic Act (Act No 93 of 1996)	» 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.	Provincial Department of Transport (provincial roads) » South African National Roads Agency Limited (national roads)	» 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. » Transport vehicles exceeding the dimensional limitations (length) of 22m.

	» 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. » 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.		» Depending on the trailer configuration and height when loaded, some of the power station components may not meet specified dimensional limitations (height and width).
Development Facilitation Act (Act No 67 of 1995)	» Provides for the overall framework and administrative structures for planning throughout the Republic » Sections 2- 4 provide general principles for land development and conflict resolution.	» 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	» Subdivision will have to be in place prior to any subdivision approval in terms of Section 24 and 17 of LUPO. » Subdivision is required to be undertaken following the issuing of an environmental authorisation for the proposed project.
National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008)	» The Minister may by notice in the *Gazette* publish a list of waste management activities that have, or are likely to have, a detrimental effect on the environment. » The Minister may amend the list by— *(a)* adding other waste management activities	National Department of Water and Environmental Affairs (hazardous waste and effluent) Provincial Department of Environmental Affairs (general	» As no waste disposal site is to be associated with the proposed project, no permit is required in this regard. » Waste handling, storage and disposal during construction and operation is required to be undertaken in

	to the list; *(b)* removing waste management activities from the list; or *(c)* making other changes to the particulars on the list. » A Basic Assessment or Environmental Impact Assessment is required to be undertaken for identified listed activities. » Any person who stores waste must at least take steps, unless otherwise provided by this Act, to ensure that *(a)* the containers in which any waste is stored, are intact and not corroded or in any other way rendered unlit for the safe storage of waste; *(b)* adequate measures are taken to prevent accidental spillage or leaking; *(c)* the waste cannot be blown away; *(d)* nuisances such as odour, visual impacts and breeding of vectors do not arise; and *(e)* pollution of the environment and harm to health are prevented	waste)	accordance with the requirements of this Act, as detailed in the EMPr.
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)	» In terms of S3 the government is required to act lawfully and take procedurally fair, reasonable and rational decisions » Interested and affected parties have right to be heard	» National Department of Environmental Affairs (DEA)	No permitting or licensing requirements
Astronomy Geographic Advantage Act (Act No. 21 of 2007)	» In terms of section 7(1) and 7(2) of this Act, the Minister declared core astronomy advantage areas on 20 August 2010 under Regulation No. 723 of Government Notice No.	» Department of Science and Technology	Approval from SKA required.

	33462. In this regard, all land within a 3 kilometres radius of the centre of the Southern African large Telescope dome falls under the Sutherland Core Astronomy Advantage Area. The declaration also applies to the core astronomy advantage area containing the MeerKAT radio telescope and the core of the planned Square Kilometre Array (SKA) radio telescope.		
Provincial Legislation			
Northern Cape Nature Conservation Act, Act No. 9 of 2009	This Act provides for the sustainable utilisation of wild animals, aquatic biota and plants; provides for the implementation of the Convention on International Trade in Endangered Species of Wild Fauna and Flora; provides for offences and penalties for contravention of the Act; provides for the appointment of nature conservators to implement the provisions of the Act; and provides for the issuing of permits and other authorisations. Amongst other regulations, the following may apply to the current project: » Boundary fences may not be altered in such a way as to prevent wild animals from freely moving onto or off of a property; » Aquatic habitats may not be destroyed or damaged; » The owner of land upon which an invasive species is found (plant or animal) must take the necessary steps to eradicate or destroy such species. » The Act provides lists of protected species for the Province.	Northern Cape Department of Environment and Nature Conservation	A collection/destruction permit must be obtained from Northern Cape Nature Conservation for the removal of any protected plant species found on site. .

DESCRIPTION OF THE RECEIVING ENVIRONMENT CHAPTER 6

This section of the EIA Report provides a description of the environment that may be affected by the proposed Upington Solar Thermal Plant Two. This chapter is also contains maps showing the Upington Solar Thermal Three, as both projects are located adjacent to each other Portion 3 of the Farm McTaggarts Camp 453. Information is provided in order to assist the reader in understanding the receiving environment within which the proposed facility is situated. Features 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 existing information available for the area, the Scoping and EIA Report for the Upington Solar Thermal Plant (known as the Khi Solar One Project, which is currently under construction), as well as collected field data from the EIA process, and aims to provide the context within which this EIA is being conducted.

6.1 Regional Setting: Location of the Study Area

The study site is proposed on Portion 3 of the farm McTaggarts Camp 453, which is located approximately 20 km south west of Upington. Portion 3 of the Farm McTaggarts Camp 453 has a total surface area of approximately 2200 ha (which includes the Khi Solar One development footprint), which is much larger than the development footprint required for development of a new 150MW CSP plant. The first Phase of the Upington Solar Thermal Plant referred to as the Khi Solar One project, is currently under construction and has a footprint of ~470 hectares and is located on the southern section of Portion 3 of the Farm McTaggarts Camp 453. The proposed Upington Solar Thermal Plant Two (a 150 MW power tower plant) is proposed adjacent to the Khi Solar One site and is planned to have development footprint of up to 700 ha.

The proposed site falls within Ward 8 of 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 ZF Mgcawu (formerly Siyanda) District Municipality. The site can be accessed via the N14 and an existing farm road (D3276). Existing gravel roads have been upgraded for the Khi Solar One project and will provide the main access point to the farm.

The current land-use in 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.

There are other solar energy facilities proposed in the broader study area, including Eskom's planned CSP Plant on the Farm Olyvenhouts Drift and the Khi Solar One CSP project which is currently under construction on Portion 3 of Farm McTaggarts Camp 453.

6.2 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 35.0ºC and 18.7ºC for January to 20.8ºC and 3.3ºC for July respectively. Frost occurs most years on 6 days on average between mid-June and mid-August.

6.3 Biophysical Characteristics of the Study Area

6.2.1 Conservation Planning

The ZF Mgcawu (formerly Siyanda) District Municipality has compiled an Environmental Management Framework (EMF), in which environmental concerns and conservation priorities for all landscapes within the municipality are listed and mapped. According to the EMF, Bushmanland Arid Grasslands have a medium conservation priority and the proposed project area does not fall within areas earmarked for conservation. Similarly, the proposed project area has been mapped as Zone 7 in the EMF Environmental Control Zones. The Lower Gariep Alluvial Vegetation (which is located outside the site) on the banks of the Gariep River is regarded as a Critical Biodiversity Area, of which remaining sections have been listed as threatened ecosystems. Although these areas fall outside the proposed development, the intermittent drainage lines on either side of the development site drain directly into the Gariep River.

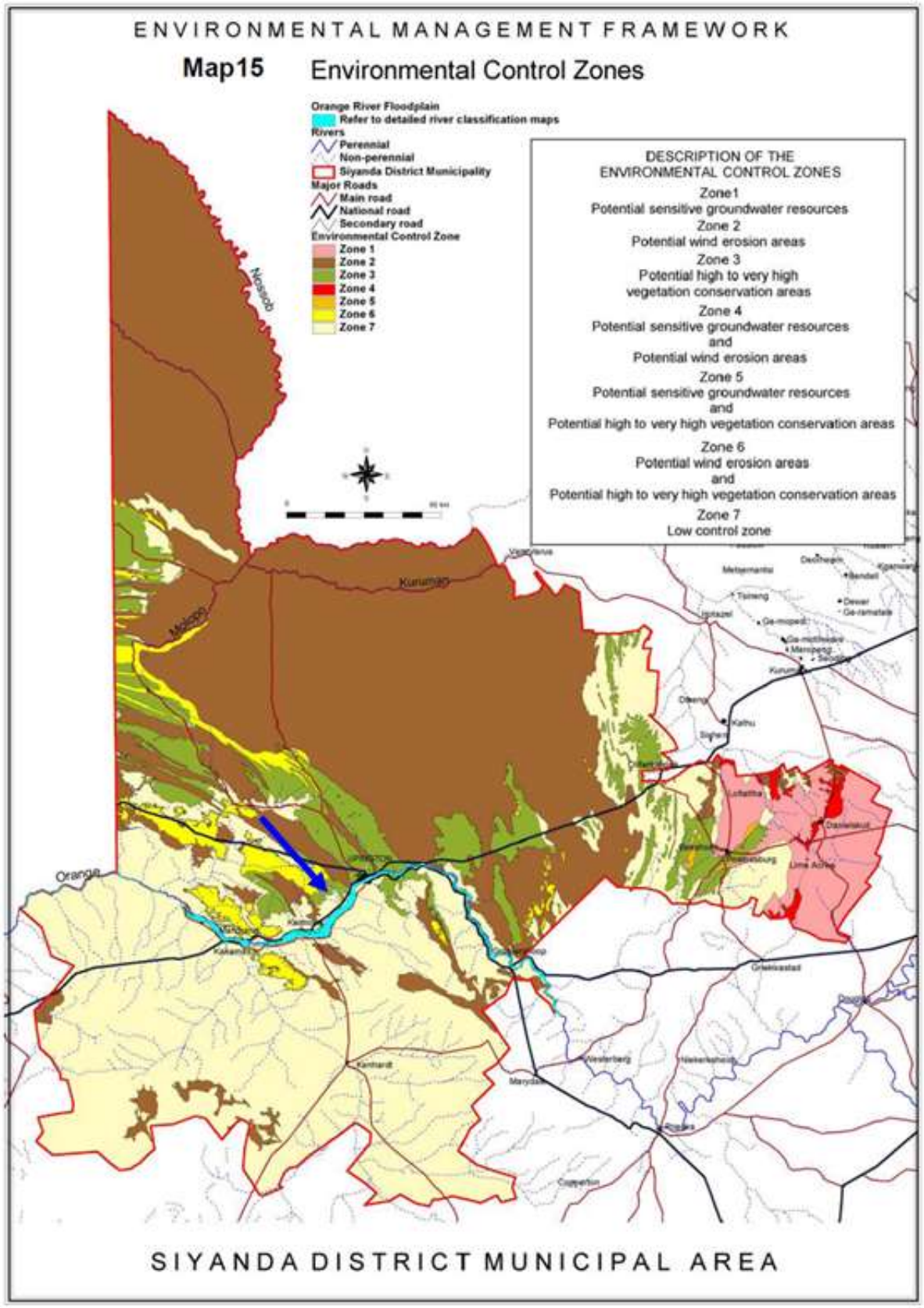

Figure 6.1: Map from the ZF Mgcawu (formerly Siyanda) EMF showing the environmental control zones. The proposed development location is indicated by the blue arrow.

6.2.2 Topographical Profile

The 22 km^2 (i.e 22 000 hectares) study area (including the Khi Solar One development footprint) is situated on the plains located to the north of the Gariep River. The study area 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.

6.2.3 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 north-western portion of the farm portion.

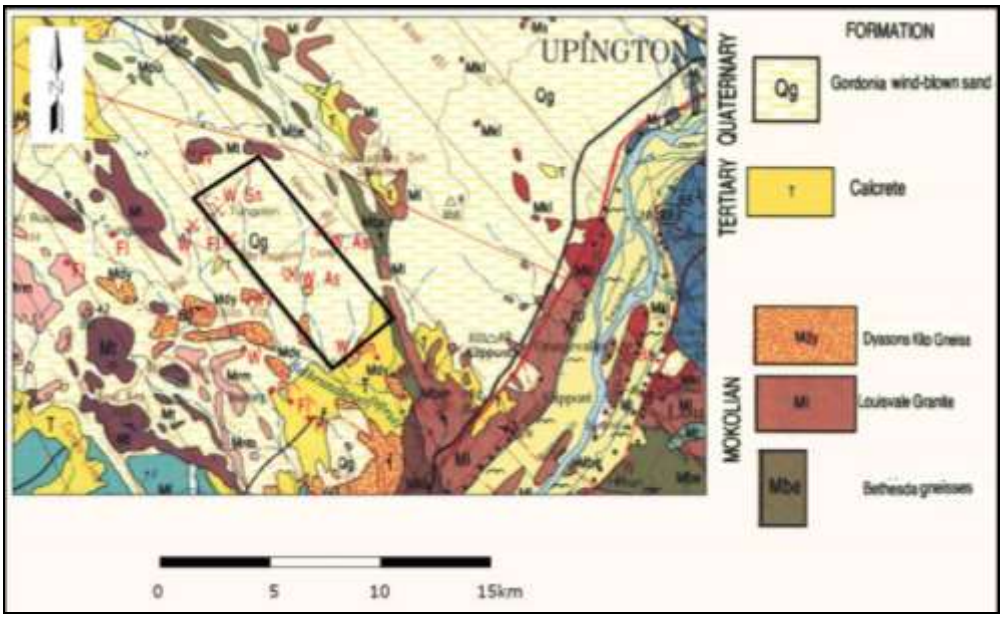

Figure 6.2: Geology of the study area

6.2.4 Soils and Agricultural Potential

a. Terrain, soils and agricultural capability

The proposed site extends inland to the north of the Orange River on almost flat ground with a south easterly aspect towards the river at a slope of approximately 1%. The land type classification is a nation-wide survey that groups areas of similar soil and terrain conditions into different land types. There are two land types across the full extent of the property, but the site for the new CSP Plant is entirely on the northern land type, Ae10 (refer to Figure 6.3). The soils of this land type are shallow to moderately deep, sandy soils on underlying hardpan carbonate or rock. The other land type, Ag1 occupies the southern part of the site where the existing project is located. The soils are also shallow, sandy soils predominantly on rock, and this land type has more rock outcrops on the surface.

Land capability is the combination of soil suitability and climate factors. The entire site (Portion 3 of the Farm McTaggarts Camp 453) has a land capability classification, on the 8 category scale, of Class 7 - non-arable, low potential grazing land. The land has a low to moderate water erosion hazard (class 5). The site is susceptible to wind erosion due to the sandy texture of the soil. Predominantly because of the aridity constraints, but also because of poor soils, agricultural land use is restricted to low intensity grazing only.

b. Land use and development at the site

The southern section of Portion 3 of Farm McTaggarts Camp 453 is already being used for the development of the Khi Solar One CSP Plant, and there is currently no agricultural activity or any agricultural infrastructure on the property (with the project developer of Khi Solar One being the landowner for the full extent of the farm portion). The site is within a sheep farming agricultural region. The natural grazing capacity is low, 31-40 hectares per animal unit across the site. Because of the aridity and soil constraints the only possible agricultural land use is grazing. There are no areas of agricultural sensitivity that should be avoided by the development. There has never been any cultivation or irrigation on the site. The north western corner of the site has been mined in the past for tungsten and old, un-rehabilitated mining excavations are still present in the area.

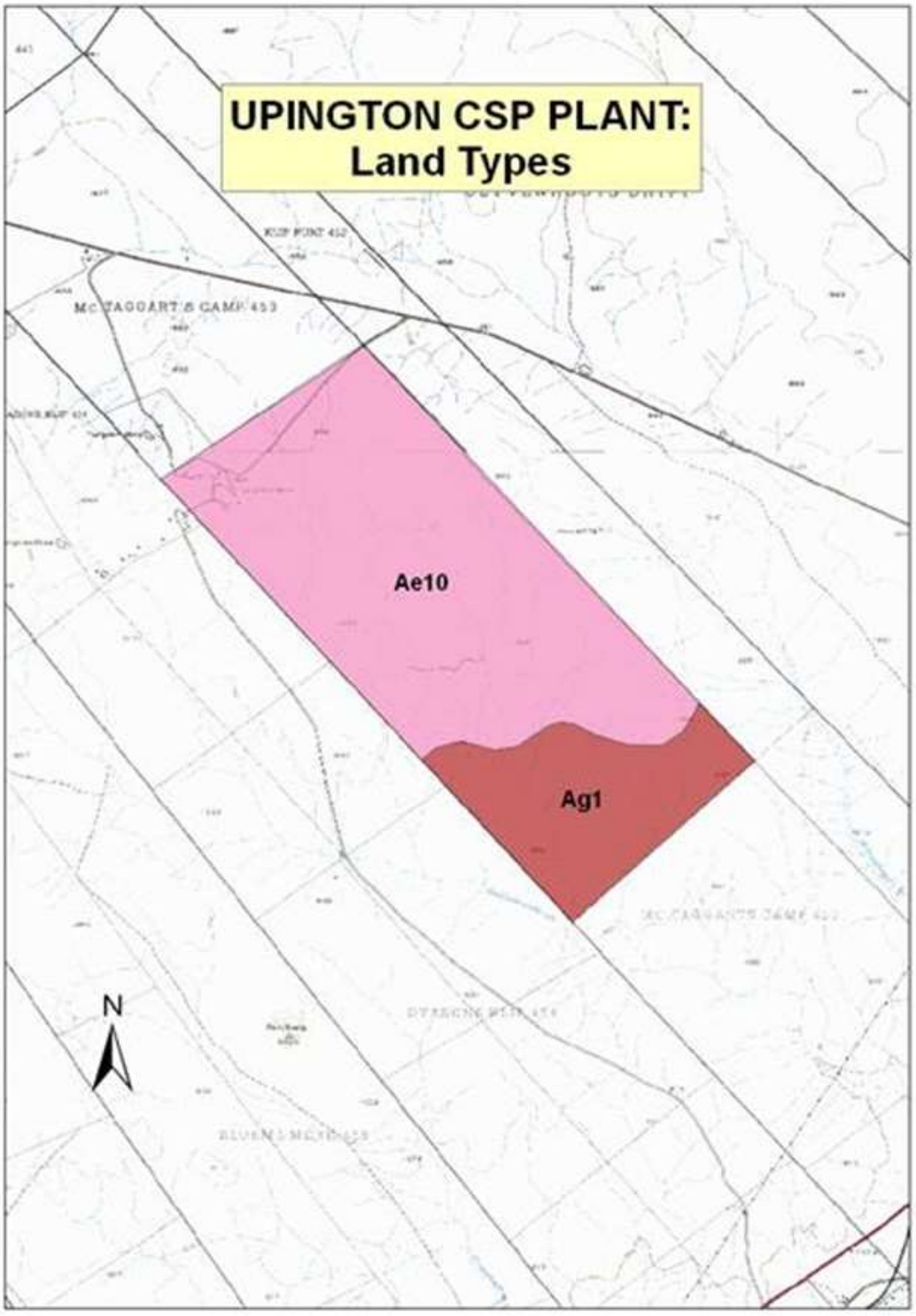

Figure 6.3: Land types within the proposed study area

6.2.5 Ecological Profile

a. Vegetation

The study area is situated in the Nama-Karoo biome. The vegetation types dominating the study area are Bushmanland Arid Grassland (NKb 3) and Kalahari Karroid Shrubland (NKb 5). Both vegetation types are regarded as least threatened. The Lower Gariep Alluvial Vegetation (AZa 3) occurs about 11-15 km beyond the main study area along the Gariep River and is the only vegetation type that has been listed as an endangered (Mucina & Rutherford 2006). This alluvial vegetation type will be minimally impacted by the construction of the pipeline associated with the proposed development.

The Bushmanland Arid Grassland landscapes consist of extensive or broken plains on a slightly sloping plateau. Vegetation density can vary annually from relatively sparse to higher densities, dominated by grasses of the genus *Stipagrostis.* Other prominent grass genera include *Enneapogon, Eragrostis,* and *Schmidtia*. A variable density of high shrubs can be found, dominated by *Acacia mellifera, Rhigozum trichotomum,* and *Boscia foetida* subsp *foetida*. Dwarf karroid shrubs are common, especially of the genera *Pentzia, Aptosimum, Pteronia,* and *Salsola*. The Bushmanland Arid Grassland vegetation is considered least threatened. A target of 21% has been earmarked for conservation, of which only a small portion is already protected in the Augrabies National Park. Overall, very little of the vegetation has been transformed, but extensive areas may be in various states of degradation due to grazing pressure.

Figure 6.4: Bushmanland Arid Grassland during the growing season on Portion 3 of the Farm McTaggarts Camp.

Within the study area, the Bushmanland Arid Grassland merges to some degree into mosaics of the Kalahari Karroid Shrubland. This shrubland vegetation typically occurs in narrow or restricted belts on calcrete outcrops or along gravelly scarps of intermittent rivers. It consists of a low karroid shrub layer, and grasses and shrubs more related to the sandy region of the Kalahari region. Small trees and tall shrubs are dominated by *Acacia mellifera, Rhigozum trichotomum*, *Parkinsonia africana,* and *Boscia foetida* subsp *foetida*. Dominant genera within the low shrub layer include *Hermannia, Aptosimum, Leucosphaera,* and *Monechma*. The grass layer is variable, consisting mostly of *Stipagrostis, Enneapogon, Eragrostis,* and *Schmidtia* species.

The Kalahari Karroid Shrubland vegetation is considered as least threatened. Of the 21% target for conservation, up to date only a small portion is protected in the Augrabies National Park. Many of the belts of this vegetation type have, in the past, been preferred for road construction, which has led to the introduction of several alien invasive species.

The Lower Gariep Alluvial Vegetation is situated on flat alluvial terraces and riverine islands along the lower Gariep River. The vegetation structure ranges from riparian thickets to reed beds or grasslands. Both reed beds and grasslands are subject to high levels of disturbance during periods of high flood. The riparian thickets are dominated by *Acacia karroo*, *Asparagus laricinus, Diospyros lycioides, Euclea pseudebenus, Gymnosporia linearis, Searsia lancea, Salix mucronata*, *Schotia afra, Tamarix usneoides*, and *Ziziphus mucronata*. Several more tree species can be found here, many having grown to immense sizes. Lower-lying terraces and islands, which get flooded more often, are covered with grasses or reeds that can regrow very rapidly after floods.

This vegetation type is most impacted by human disturbance. The usually narrow band of permanent woodland that is the major physical barrier to human movement into the floodplain, is often removed to improve access. It is also severely affected by regular burning of reed beds and thus highly susceptible to invasion by alien plants (ZF Mgcawu EMF). The construction of major dams upstream in the Gariep River has buffered the extent of seasonal floods, resulting in large expanses of this riparian vegetation to be cleared to gain access to the fertile soils for agricultural purposes. The lower Gariep Alluvial Vegetation is been listed as an endangered ecosystem, and all remaining intact sections of vegetation should not be disturbed further.

The vegetation types in relation to the study area are shown in Figure 6.5.

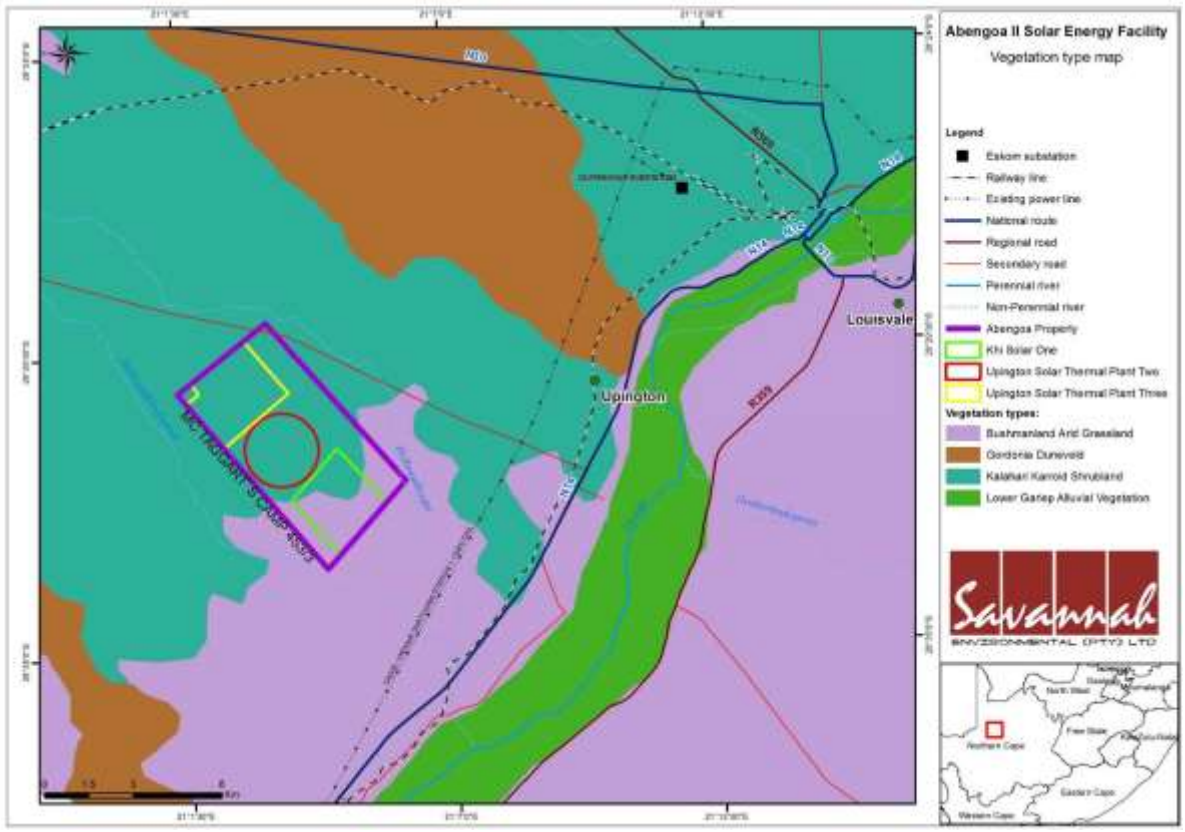

Figure 6.5: Vegetation types as mapped by Mucina and Rutherford (2006) for the study area

b. Results of the Ecological Survey

Vegetation of the study area consists of a transitions from Bushmanland Arid Grasslands to Kalahari Karroid Shrublands, with small areas of denser and higher riparian vegetation around washes and pans. Small-scale plant diversity and ecological state of the vegetation varies considerably across the entire farm portion, depending on soil surface rockiness, depth of soil and position in the landscape. Despite past disturbances such as gravel roads, farm tracks, a homestead, farming activities and small-scale mining (from the 1930s), the natural vegetation is relatively intact, with only a low presence of alien invasives. Geophytes could be observed during the survey, but none were in a flowering state. Likewise, there was a much lower presence of annual herbs than expected for the area. It can be expected that several additional species, mostly annuals and species resprouting from underground storage organs, can emerge throughout the study area during more favourable rainfall seasons. The 200 species that could be expected to be present in the study area is only a rough estimate and has been used as a comparative tool to help assess the conservation value and sensitivities of habitats. A list of species that has been recorded in the wider area on the SANBI database is provided in Ecological Impact Assessment Report which is attached to Appendix F.

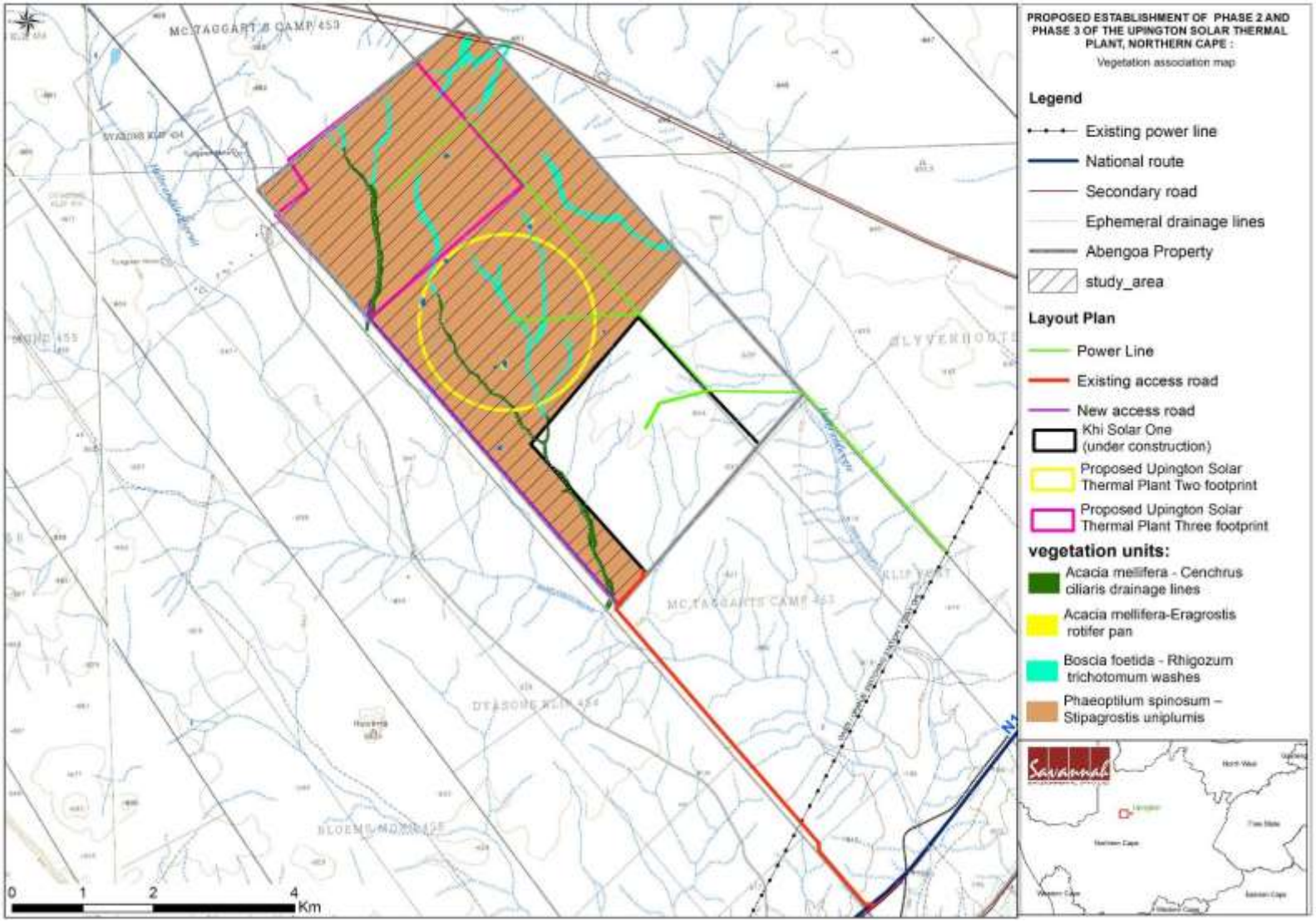

Figure 6.6: The vegetation associations as identified with a detailed field investigation of the study area

Vegetation units/associations identified during this studyare based on the overall similarity in species composition, vegetation structure and biophysical attributes that are part of an ecosystem, but smaller phytosociological differences within each vegetation unit are present. Vegetation associations occur in intricate mosaics throughout the study area, with edges of such associations generally relatively vague. There is also a large degree of species overlap between the mapped edges of vegetation associations identified.

The following vegetation associations occur on the site:

» Association 1: *Acacia mellifera – Cenchrus ciliaris* ephemeral drainage lines:
» Density, height and composition of the woody and herb layer vary immensely. Specimens of the protected *Acacia erioloba* and *Boscia foetida* as well as other tree and shrub species are scattered along the larger drainage lines on the south-west of the study area. Several of the large *Acacia erioloba* trees are currently 'occupied' by active social weavers' nests. Surface water in these drainage lines will be mostly ephemeral, but subsurface water reserves may persist for several weeks or months after sufficient rainfall.
» Association 2: *Acacia mellifera – Eragrostis rotifer* intermittent pans:
» These pans range from about 50 m to 100 m in diameter. Depending on the amount of silt and underlying rock of the central areas of these pans, they may be able to retain surface water or be waterlogged for one to three weeks after large rainfall events, seldom longer. They may also remain dry for several successive years. The central areas of the pans are covered only with a sparse herbaceous layer – if at all vegetated – and species here typically need or prefer occasionally waterlogged soils so be able to persist.
» Association 3: *Boscia foetida – Rhigozum trichotomum* washes:
» Larger washes with a distinct central sandy bed can be found throughout the study area. Their banks are vegetated with either a dense herbaceous layer of mostly perennial grasses or dense shrubs. These washes channel runoff during large rainfall events to lower-lying larger drainage lines, but surface water will most likely seep away within hours after a rainfall event. Drainage of moisture may continue underground to slowly percolate into ground water or downstream drainage lines. Peripheries of both this and association 2 are popular habitats for birds and burrowing vertebrates, whilst they also provide grazing, seeds and fruit to a variety of fauna.
» Association 4: *Phaeoptilum spinosum – Stipagrostis uniplumis* mixed shrublands:
» Covers the majority and remainder of the study area. Species composition is overall very diverse, but local forb and low shrub composition varies to a high degree from one locality to the next, depending on geology, soil depth, surface rockiness and slope. Similarly, the presence of grasses and annuals is driven by rainfall during the season and the abiotic characteristics of a specific locality. Occasional smaller trees of *Acacia erioloba* do occur. The area is generally prone to invasion by the indigenous *Acacia mellifera* subsp. *detinens* and *Rhigozum trichotomum*. This association, in a

highly disturbed form, also covers the road servitude up to the N14 (not specifically mapped due to the disturbed nature of this vegetation), in which the pipeline is proposed to be situated.

» The lowest section of the proposed pipeline route, between the N14 and the Orange River, traverses a more rocky area. The vegetation here has been highly disturbed in the past with a wide servitude that has been cleared for the Khi Solar One pipeline. As the vegetation here is not considered to be in a natural state any longer, it has not been specifically described.

c. Amphibians, Reptiles and Mammals

The study area was investigated during the vegetation survey for signs or the presence (observations) of amphibians, reptiles, and mammals. Species and signs of such sighted during the survey on and in the vicinity of the study area were the following:

Cape Hare (*Lepus capensis*)
Common (Grey) duiker (*Sylvicapra grimmia*)
Signs of Porcupine (*Hystrix africaeaustralis)*
Yellow Mongoose (*Cynictis penicillata*)
Cape Ground Squirrel (*Xerus inauris*)
Bat-eared Fox (*Otocyon megalotis*)
Aardvark (*Orycteropus afer)*
Ostrich (*Struthio camelus*)

Sightings during the development of Khi Solar one also includes Aardwolf (*Proteles cristatus*).

A full list of vertebrate species that could occur in the study area according to the ADU and SANBI databases, as well as Apps (2000) is presented in the ecology report (Appendix F). While fauna species are mobile and the impact of new structures does not destroy animals as it does plants, they do depend on specific habitats.
Another example would be the tree mouse (*Thallomys paedulcus*), which may occur in the area but needs large trees with holes to build its nests, and feeds on fruit and young shoots of tree and shrub species found in riparian woodlands.

The presence of the invertebrate tadpole shrimp (*Triops granaries)* has been noted in the small ephemeral pans close to Khi Solar One. These will only hatch in the pans if there is sufficient standing water for one to two consecutive weeks, during which they can complete their entire growing cycle, die off, and be present only as eggs until the next large rainfall event. The presence of the tadpole shrimp indicates that the small pans may on occasion be used by migratory Flamingo, as the latter feed on these and distribute their eggs (Beryl Wilson, personal communication).

d. Red data flora and fauna species

The following red data flora and fauna species have been recorded from the area (Grid 2821) according to the red data species list of SANBI and the ADU database:

Species	RD Status	Suitable Habitat	Possibility of being present	Threat
Plants				
Acacia erioloba	Declining, P	Sandy savannas	Confirmed	Habitat loss, wood harvesting
Boophone disticha	Declining, P	Savanna	Slight	Medicinal trade
Crinum bulbispermum	Declining, P	Plains with seasonally high moisture levels	Slight	Medicinal trade Habitat loss
Drimia sanguinea	NT, P	Sandy plains	Slight	Medicinal trade
Dinteranthus wilmotianus	NT, P	Gravel plains	Slight	Horticultural trade Habitat loss
Hoodia gordonii	DDD, P	Variable plains	Slight -Observed outside study area	Medicinal trade
Hoodia officinalis subsp. *officinalis*	NT, P	Variable plains	Slight	Medicinal trade
Terrestrial Vertebrates				
Dassie Rat ***Petromus typicus***	NT, P	Rocky areas on river edges	Slight	Habitat loss
African Wild Cat ***Felis silvestris***	VU	Variable	Roaming only	Habitat loss, cross-breeding with domestic cats

The following faunal species encountered on the study site are protected:

The Northern Cape Nature Conservation Act, Act No 9 of 2009
Schedule 1: Specially Protected Species
Fauna:
» Aardwolf (*Proteles cristatus*)
» Bat-eared Fox (*Otocyon megalotis*)
» Social Weavers and their nests

Flora:
» Ghaap: *Hoodia gordonii* *

* observed outside development area, could be present on development area

The Northern Cape Nature Conservation Act, Act No 9 of 2009
Schedule 2: Protected Species

Fauna:
Cape Hare (*Lepus capensis*)
Porcupine (*Hystrix africaeaustralis)*
Cape Ground Squirrel (*Xerus inauris*)
Yellow Mongoose (*Cynictis penicillata*)
Steenbok (*Raphicerus campestris*)
Common duiker (*Sylvicapra grimmia*)
Aardvark (*Orycteropus afer)*

Flora:
Acacia erioloba
Adenium oleifolium
*Aloe spp**
*Anacampseros sp**
Asclepias stellifera
Avonia albissima
*Babiana hypogaea**
Boscia albitrunca
Boscia foetida
*Euphorbia striata**
Fockea angustifolia
*Gethyllis sp**
Manulea nervosa
*Microloma sagittatum**
Moraea spp
Oxalis spp
*Psilocaulon coriarium**
Ruschia spinosa
*Tavaresia barklyi**
*Stapelia sp**

* observed outside development area, could be affected by access road, pipeline or other related activities, could be present on development area

National Forest Act (Act No. 84 of 1998)
» *Acacia erioloba*
» *Boscia albitrunca*

e. Alien invasive species

Current levels of alien invasive species are very low on the development area. The only species observed was *Prosopis glandulosa*. However, beyond the study area and along

major transport routes are several alien invasive species, most notably *Salsola kali* sp and *Nicotiana glauca*. There is a high risk of invasion of these and other alien invasive species onto the property and development area during and after construction, necessitating regular monitoring and eradication of such species as soon as observed.

6.2.6 Avifauna

The study area falls within the Nama Karoo Biome, which in terms of avifauna, is relatively species-poor and is mostly comprised of korhaans, larks, warblers and canaries as well as a variety of raptors. The highest species richness was recorded in the vicinity of the *Acacia mellifera – Cenchrus ciliaris* ephemeral drainage lines that occur to the south-west and west of the study area and do not fall within the demarcated site footprint. Here large *Acacia erioloba* and *Boscia foetida* as well as other tree and shrub species provide nesting and foraging habitats for birds. Social weaver's nests occur in large *Acacia erioloba* trees in most of the riparian areas.

Across the remainder of the study area, and within the demarcated site footprint, *Phaeoptilum spinosum – Stipagrostis uniplumis* mixed shrublands dominate and are largely unproductive and low in bird density and diversity. Here Spike-heeled Lark, Fawn-coloured Lark and Northern Black Korhaan make up the majority of the bird community present.

a. Avian diversity, endemism and red data species in the study area

Using a number of bird atlases and field guides (Harrison, et al., 1997; Sinclair, et al., 2002; Hockey, et al., 2005; Maclean, 1993; Hockey, et al., 2005) it was determined that 195 avifauna species occur in the region in which the development is located (Refer to Appendix 1 of the Avifauna specialist report in Appendix G. Of these species, 12 are endemic, 17 are listed on the regional or global Red Data Species lists, one was recorded as a vagrant species and one species is introduced.

Eight Species of Special Concern have been identified, based on distribution ranges and habitat requirements that are likely to occur within the study area. These species are listed below in the Table below:

Species of Special Concern that may occur within the study area

Common Name	Scientific Name	Conservation Status
Secretarybird	*Sagittarius serpentarius*	Near Threatened
Lanner Falcon	*Falco biarmicus*	Near Threatened
Sclater's Lark	*Spizocorys sclateri*	Near Threatened
Kori Bustard	*Ardeotis kori*	Vulnerable
Ludwig's Bustard	*Neotis ludwigii*	Vulnerable
Martial Eagle	*Polemaetus bellicosus*	Vulnerable

Secretarybird (*Sagittarius serpentarius*) – Near Threatened

This species is uncommon to locally fairly common, favouring open grasslands with scattered trees and shrubs. Although considered resident, it is not sedentary, with highly nomadic movements across their large home range (up to 230km^2). Local populations are thought to have decreased in South Africa, with the species being highly susceptible to being injured or killed by collisions with overhead power lines and telephone wires. 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. This species has the potential to occur within or pass through the study area due to its nomadic movements and wide ranging foraging patterns.

Lanner Falcon (*Falco biarmicus*) – Near Threatened

This species has a fairly high tolerance regarding habitat requirements, being found across southern Africa in 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 study area lacks any suitable mountainous areas which would serve as breeding sites. A breeding pair were recorded having taken residence in the central tower of the Khi Solar One CSP facility.

Sclater's Lark (*Spizocorys sclateri*) – Near Threatened

This species is endemic to South Africa and Southern Namibia, where its distribution is confined to the Nama Karoo biome - concentrated in the Northern Cape, slightly to the south of the study area. 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. Its preferred habitat is sparsely vegetated quartz gravel or stony plains, sometimes with some scattered grass tufts or scrubby bushes, on shales or clay. It is therefore not expected that this species occurs within the study area.

Kori Bustard (*Ardeotis kori*) - Vulnerable

This species is considered uncommon to locally common, favouring open savannah woodland, dwarf shrubland and occasionally grassland. Although a sedentary resident, this species is locally nomadic in response to rainfall and the subsequent flush of small invertebrates. The species has declined in South Africa due to habitat loss through transformation, collision with overhead power lines and poisoning. This species has the potential to occur within or pass through the study area due to the availability of suitable foraging habitat and the species nomadic movements.

Ludwig's Bustard (*Neotis ludwigii*) – Vulnerable

This species is a sparse to locally common near endemic nomad, favouring semi-arid dwarf shrubland, arid woodland and the arid western edge of the grassland biome. This species is highly susceptible to collisions with overhead power lines and telephone wires, with this single human-induced mortality factor considered the most important threat to this species. A study of 150 km of power line transects revealed approximately 600 carcasses comprising mainly of this species (± 45% of carcasses). This species has the potential to occur within or pass through the study area due to the availability of suitable foraging habitat and the species highly nomadic movements.

Martial Eagle (*Polemaetus bellicosus*) - Vulnerable
This species is widespread, although generally uncommon in South Africa, tolerating a wide range of habitat types, including open grassland, scrub and woodland. This species requires exceptionally large home ranges (in excess of 130 km^2), making use of large trees and electricity pylons to provide nest sites – which are often a limiting factor concerning this species. Population declines are largely the result of direct persecution due to the perceived threat posed to livestock, poisoning, electrocutions on electricity pylons and the reduction of its prey base as a result of habitat transformation. SABAP2 data shows records of this species in the vicinity of the study site. One individual was recorded to the north-east of the study area. Although not recorded in the study area, per se, this species has the potential to occur within or pass through the study area due to the availability of suitable foraging habitats.

b. Observed results for the Farm McTaggarts Camp

In order to expand on the original study for the Upington Two CSP facility, vantage point surveys were conducted in order to cover the entire 2200ha study area. The field conditions display homogeneity of the vegetation, topography and visibility across the area is good. The number of species and individuals recorded during the surveys gives a high degree of confidence in the vantage point surveys conducted. Transect surveys were conducted in the drainage lines or washes in order to determine the use of these areas as corridors by avifauna species. During the field surveys, time was also taken to investigate avifauna activity in the heliostat field and evaporation ponds and some time was spent investigating the tower, heliostats and other infrastructure that may impact upon avifauna species in the study area.

These surveys yielded results particularly pertinent to the project and there is high confidence in the understanding of the avifauna in the study area, the project and possible impacts upon each other gained during the study. The main pertinent observations made during the vantage point surveys can be summarised as follows:

Avifauna diversity - During the study a total of 44 species were recorded and a total of 2138 individual birds were recorded. Only two species of conservation importance were

recorded during the study namely, the Martial Eagle (*Polemaetus bellicosus*) and the Lanner Falcon (*Falco biarmicus*).

Avifauna behaviour – One of the main aspects of avifauna behaviour noted was that 80% of bird species, and 95% of individual birds, recorded during the study flew at an average height of 4m (rounded off to the closest meter) and were observed at an average minimum height of 0.4m and an average maximum height of 14.1m. When applied, to what was learned about the CSP facility, this means that most resident bird species usually fly below the height of the heliostats, this was confirmed during the vantage point surveys where most species were found to be active below the heliostats and very few species flew over them. Most of the birds that flew higher than these averages were recorded outside of the Khi Solar One CSP facility (including Martial Eagle, the three species of Korhaan and Pale Chanting Goshawk).

Another noteworthy observation was the lack of activity in the open field areas between 11:00 and 16:00 every day, during this time most species were found to be active in the riparian or wash areas traversing the study area. As was expected, at this time of the year, species activities were restricted to foraging and feeding or searching for food. No nesting or mating behaviour was observed.

During the study Secretarybird (*Sagittarius serpentarius*), Sclater's Lark, (*Spizocorys sclateri*), Kori Bustard (*Ardeotis kori*) and Ludwig's Bustard (*Neotis ludwigii*) appeared absent from the study area, all these species are likely to be resident species and the fact that they were not recorded does strongly suggest that they are in fact not present within the study area.

6.2.7 Hydrological Characteristics

This section provides information on the Gariep River system, as water supply is required for the CSP Plant, as well as riparian vegetation and fish fauna at the abstraction point and on-site. The following definitions apply:

- **Drainage line**: A drainage line is a lower category or order of watercourse that does not have a clearly defined bed or bank. It carries water only during or immediately after periods of heavy rainfall i.e. non-perennial, and riparian vegetation may or may not be present.
- **Perennial and non-perennial:** Perennial systems contain flow or standing water for all or a large proportion of any given year, while non-perennial systems are episodic or ephemeral and thus contain flows for short periods, such as a few hours or days in the case of drainage lines.
- **Riparian**: the area of land adjacent to a stream or river that is influenced by stream-induced or related processes. Riparian areas which are saturated or flooded for prolonged periods would be considered wetlands and could be described as riparian

wetlands. However, some riparian areas are not wetlands (e.g. an area where alluvium is periodically deposited by a stream during floods but which is well drained).

» **Wetland**: land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is periodically covered with shallow water, and which under normal circumstances supports or would support vegetation typically adapted to life in saturated soil (Water Act 36 of 1998); land where an excess of water is the dominant factor determining the nature of the soil development and the types of plants and animals living at the soil surface (Cowardin *et al*., 1979).

» **Watercourse**: as per the National Water Act means -
  - a 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

a. The Lower Gariep River System

The study area falls within the Lower Gariep River sub-basin, which comprises the Gariep River from the confluence with the Vaal River to the Gariep River Mouth. The major river systems that contribute to flows in the Gariep River include the Ongers and Sak rivers from the northern Karoo; the Kuruman and Molopo rivers from the Northern Cape Province, north of the Gariep River and the southern part of Botswana; and the Fish River from Namibia. Notably these rivers drain arid and semi-arid areas, which are bordered by the Upper Orange-Senqu and the Vaal sub-basins.

The study area site is situated within quaternary catchment D73F and is dominated by highly ephemeral river systems that flow directly into the Gariep River, which bisects this quaternary catchment. An ephemeral drainage line is defined as a drainage line or even larger river that will carry water only for very brief periods of time – as short as one hour to one or two days, and only after a larger rainfall event. It may typically have more below-ground water reserves supporting higher/denser vegetation, but soil does not remain saturated for long enough to support specially adapted flora. Note: Smaller ephemeral drainage lines may be referred to as waterwashes, or upper ephemeral tributaries of waterwashes or drainage lines.

Potential runoff from the site would flow in a south-easterly direction towards the Gariep River. The primary drainage line in close proximity to the site, the Helbrandkloofspruit, typically flows once a year for no more than two days at a time. Water bodies and rivers are of specific importance to a variety of Red Data species in this arid area. The perennial Gariep River is situated 10 - 13 km south-east of the proposed development

sites, and the river together with its surrounding vegetation along the river are regarded as Critical Biodiversity Areas, which should have a high conservation priority.

The Lower Gariep River can be defined as that stretch of the Gariep River between the Gariep-Vaal confluence and Alexander Bay or Oranjemund where the river meets the ocean. 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, 2013).

Land-use is primarily irrigation and mining, with the area highly dependent on water from the Gariep 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 Gariep 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 Gariep River catchments. Given the arid nature of the Lower Gariep River and the high potential evaporation, the evaporative losses result in an increase in concentrations along the length of the lower Gariep River (ORASECOM, 2013).

Water quality state can be summarised 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 Gariep Rivers but still remains good. There is an increase in Electrical Conductivity (EC) from Prieska to Vioolsdrift along the reaches of the lower Gariep River. This is due to irrigation return flows and evaporative losses along the river.
» Eutrophication is evident in localised areas along the Lower Gariep 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 Gariep River.

b. Flow distributions at Upington

Information on flows in the Lower Gariep 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. 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.

c. Fish fauna

The fish biodiversity in the Lower Gariep 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 Gariep River species. 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.

The recent IUCN 2010 Red List for the fish species found in the Lower Gariep 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 Gariep 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 Gariep.

Both these fish researchers feel that the Namaqua barb (*Barbus Hospes)* and the Rock catfish (*Austroglanis sclateri)* may be threatened in the Lower Gariep 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 Gariep 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 6.1: List of indigenous fish species found the Lower Gariep River within the Study Area, with the most recent IUCN (2013) 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 Gariep 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	*Anguilla mossambica*	Longfin eel		x	LC
Cyprinidae	*Mesobola brevianalis*	River sardine		x	LC
	Labeo capensis	Gariep River Mudfish	x		LC
	Labeo umbratus	moggel		x	LC

	Barbus hospes	Namaqua barb	x		LC*
	Barbus palidinosus	Straightfin barb		x	LC
	Barbus trimaculatus	Threespot barb			LC
	Labeobarbus kimberleyensis	Largemouth yellowfish	x		NT
	Labeobarbus aeneus	Smallmouth yellowfish	x		LC
Cichlidae	*Pseudocrenilabrus philander*	Southern mouthbrooder		x	LC
	Tilapia sparrmanii	Banded tilapia		x	LC
Clariidae	*Clarias gariepinus*	Sharptooth catfish		x	LC
Austroglanididae	*Austroglanis sclateri*	Rock catfish	x		LC*

The five endemic fish species present in the Lower Orange include:

» Largemouth yellowfish *Labeoarbus kimberleyensis*

» Namaqua barb *Barbus hospes*

» Smallmouth yellowfish *Labeobarbus aeneus*

» Gariep River Mudfish *Labeo capensis*

» Rock catfish *Austroglanis sclateri.*

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 Gariep 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 Gariep River, namely largemouth yellowfish (*Labeobarbus kimberleyensis)* and the Rock catfish (*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 catfish 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 (Gariep 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. *A. sclateri* was recorded in the ORASECOM (2011) assessment upstream and downstream of the study area.

d. Ecological Reserve Results: Lower Gariep River System

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 Gariep 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 Gariep 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 Catfish, appear to have been the most negatively impacted by these man-induced modifications.

Current ORASECOM assessment

The Reserve (or EFR / EWR) assessment 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 assessment of the sensitivity of biota and habitats has also informed the impact assessment.

e. Riparian vegetation on the site

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 the site was ground-truthed (in order to produce a GIS map of the site) as well as indicate any additional areas that may be impacted upon by the proposed development. This information was also then compared to the GIS databases such as the National Freshwater Ecosystems Priority Atlas data (NEFPA, Nel *et al*. 2011), 1:50 000 topo-cadastral data and available aerial photographs.

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 pseudebenus* (Ebony Tree), notably protected under the National Forest Act.

The only obligate wetland plants observed were those found in association with the man-made dams found at the confluence of the Helbrandkloofspruit and the Gariep River and along the Gariep River itself. Species observed included *Typha capensis, Phragmites australis, Prosopis glandulosa* and *Cyperus marginatus*. Notably the prevalence of *Prosopis* and alien invasive tree species had increased between 2010 and this survey within the sites that had been visited previously by this report author.

During the ORASECOM (2011) assessment, the following additional species were also observed within the study area between sites *OSAEH 26 17 and EFR 03:*

"Marginal Zone: Cobble and bedrock areas have a vibrant population of *Gomphostigma virgatum*. Other dominants however are *Salix mucronata*, *Phragmites australis*, *Cyperus marg inatus, Persecaria decipiens*, *P. lapathifolia* and *Cynodon dactylon*.

Lower Zone: Well wooded in places with *G. virgatum*, and S*. mucronata* mainly, but also with Acacia karroo recruits. Areas which are open (mainly cobble/boulder) or dominated by non-woody vegetation (*P. australis, Crinum bulbispermum, C. marginatus, Persecaria* and *C. dactylon* mainly) make up the mosaic.

Upper Zone: The right bank (RB) has extensive open areas (cobble or boulder) with *Tamarix usneoides* mainly. Otherwise the zone is predominantly woody with common species on both banks but the left bank (LB) mainly being *T. usneoides, Accacia karoo, Rhus pendulina, Ziziphus mucronata. Diospyros lycioides, Lycium hirsutum A. erioloba, Prosopis glandulosa* and *Prosopis velutina*). A single specimen of *Combretum erythrophyllum* was found."

f. Water Bodies on the Site (Portion 3 of the Farm McTaggarts Camp 453)

On either side portion 3 of the Farm McTaggarts Camp 453 larger ephemeral drainage lines occur, which merge further south and then flow into the Gariep River. These drainage lines may only flow once every couple of years after sufficient rainfall, but they do collect enough of the runoff from surrounding areas to support much denser and higher vegetation than on the surrounding plains, especially on the farm adjacent to the southern border of McTaggarts Camp. This higher vegetation creates numerous microhabitats.

No classified wetlands, other than the riparian systems found along the Gariep River, are shown on the national wetlands map. Seasonal pans and ephemeral waterwashes (also referred to as ephemeral drainage lines) occur on the site and drain into the Gariep River.

Dry river beds and riparian zones occur on the site. 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 Helbrandleegte and Helbrandkloofspruit, which flows through the site. The conservation importance of these systems (i.e. rare or protected plant species) was considered in the Ecological Impact Assessment (Savannah Environmental, 2014).

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 within the greater landscape.

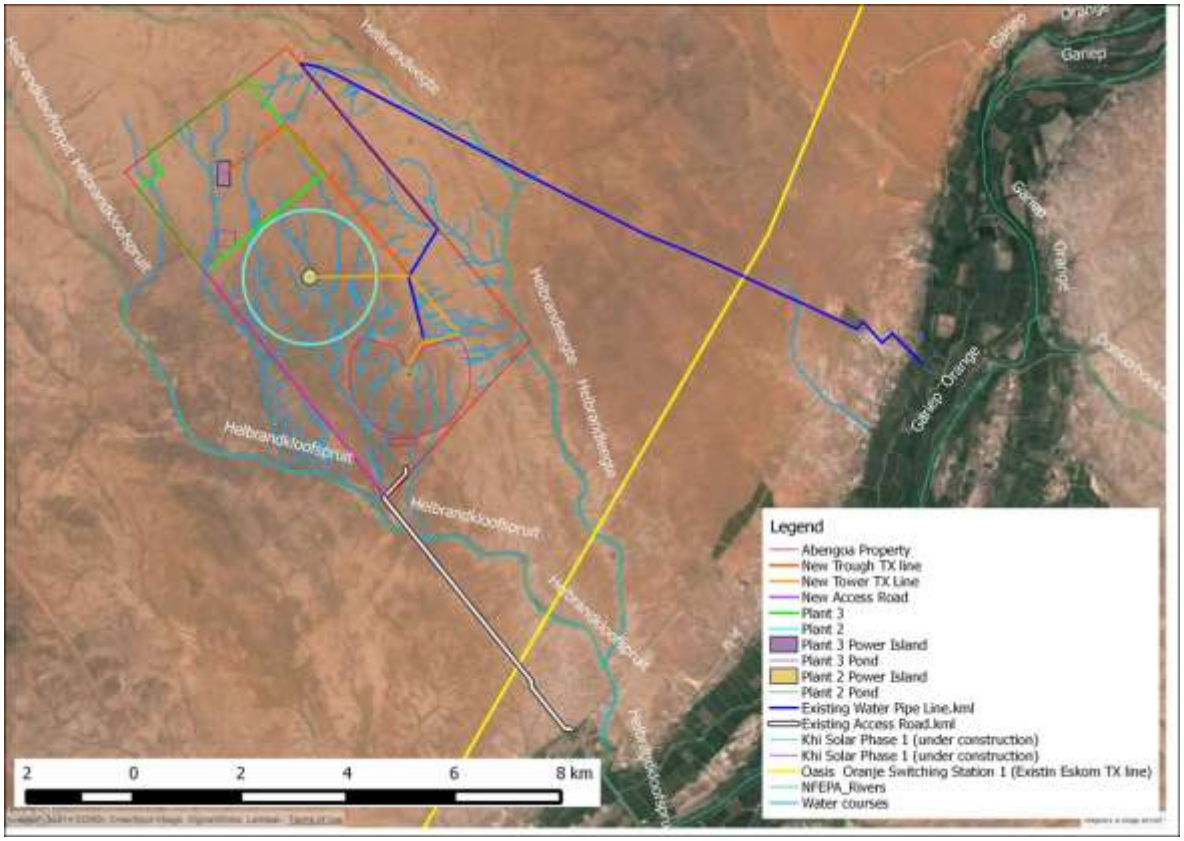

Figure 6.7: The water courses observed within the site and along the pipeline route

6.4 Social Characteristics of the Study Area and Surrounds

The proposed site for the CSP Plants is located within Ward 8 of the Kai !Garib Local Municipality (NC067) within the Northern Cape. This municipality is a category-B municipality[16], which forms part of the greater ZF Mgcawu 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. The nearest settlements to the site (in order of closest proximity) include: Louisvale, Kiemos, Upington and Kakamas). The majority of the study area is sparsely populated (less than 10 people per km^2) 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 Gariep River.

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^2 in size (~7.2% of the ZF Mgcawu 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. The Khi Solar One CSP Facility is under construction.

6.4.1 Demographic Profile

The population the Kai !Garib Local Municipality is estimated at 56 501 (2007), approximately 10% of the total population of the greater ZF Mgcawu District Municipality. The average population growth for the local municipality (2001-2007) is estimated at approximately 1.4%.

The population is 66.5% Coloured, 22.2% Black African, 7.8% White and 0.05% Asian. The dominant language within the municipality 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, 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 !Garib Local Municipality (~58%) have less than a Grade 7 qualification. Only 11.1% of the population have a matric qualification, while less than 4% have a tertiary qualification.

[16] 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.

6.4.2 Economic Profile

Employment data for Kai !Garib Local Municipality indicates that 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' (~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, of which 52% are child support grants and a total 2 706 households are subsidised by the services subsidy scheme (Kai !Garib Local Municipality IDP (2009).

6.4.3 Social and Noise Receptors

Portion 3 of the farm McTaggarts Camp 453 is owned by Abengoa Solar Power South Africa. No people live on the site. There are no potentially noise-sensitive receptors living within 2,000 meters from the proposed CSP Plant. There are landowners practicing agriculture in the broader study area.

6.5 Heritage

The McGregor Museum carried out a survey on Portion 3 of the farm McTaggarts Camp 453. The heritage artefacts on the site are well understood.

6.5.1. Colonial frontier

McTaggarts Camp derives its name from events during the Korana War of 1879-1880, when Captain McTaggart set up his military camp here (Van Vreeden 1961:431). It is not known exactly where this encampment was, though it seems most likely that it was close to the river, hence well away from the proposed solar facilities. The ephemeral nature of such an event is unlikely to have left much of a discernible archaeological 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 about100 km north-west of Upington. Mining took place at the north western-most part of McTaggarts Camp in the 1930s (Morris 2012).

6.5.2. Later Stone Age

Late Holocene Later Stone Age (LSA) sites are frequently noted in surveys south of and south west of the study areas and along the Gariep 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 Gariep 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 precolonial 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 (Morris 2011).

6.5.3. Pleistocene: Middle and Earlier Stone Age

A low density surface scatter of Middle Stone Age material was found on McTaggarts Camp (logged at the McGregor Museum as 2821CA003 McTaggarts Camp 1) in 2010, and this was sampled in Phase 2 mitigation (Morris 2012). It was focused around a bedrock exposure where water would be held for a time after good rain.

Figure 6.8: Google Earth Image Showing Middle Stone Age material was found on McTaggarts Camp

6.5.4. Results of the Heritage Survey

- Stone Age: The heritage survey found Stone Age traces which consist of wide scattered/isolated finds, none of those noted being of major heritage 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. Adjacent terrain, both on McTaggarts Camp and property alongside, surveyed by the McGregor Museum, has minimal Stone Age traces comprising widely scattered/isolated stone artefacts mainly based on jaspilite (banded ironstone) sourced from the banks and terraces of the Orange/Gariep River. Many of the stone artefacts found were based on banded ironstone, some on quartzite, the former most likely sourced from the Orange River gravels to the south; no tillites occur in the study area. There appear to be none of the features such as hills or rocky features (such as Spitskop north of Upington) which in other parts of this landscape provide shelters with traces of precolonial Stone Age occupation/activity.
- No shelters occur.
- Rock outcrops provide for temporary water pools after rain but any increased activity around these features in the CSP plants is not reflected in increased stone tool densities.
- 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. Recovery of stories and intangible heritage on this landscape would be difficult in the absence of residual long-term inhabitants.
- Apart from the remains of a tungsten mine, noted above, there appear not to be colonial era built environment features in the areas of proposed CSP plant.
- Several features of the tungsten mine were noted including ruins, an explosives magazine and, for the most part, trenches, pits and debris heaps associated with prospecting/mining.

6.5.5. Palaeontology

The fossil record from Kalahari deposits is very poor with respect to finds of fossil bones of vertebrates. 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.

ASSESSMENT OF IMPACTS: CHAPTER 7
PROPOSED UPINGTON SOLAR THERMAL PLANT TWO

The Upington Solar Thermal Plant Two is proposed to utilise solar tower technology with a generation capacity of up to 150MW, and energy storage of up to 6 hours (using molten salts technology). The Upington Solar Thermal Plant Two is proposed to be located in the Portion 3 of the Farm McTaggarts Camp 453, adjacent to and north-west of the existing Khi Solar One CSP Plant which is currently under construction. This chapter serves to assess the significance of the positive and negative environmental impacts (direct, indirect, and cumulative) expected to be associated with the development of the proposed facility (refer to **Figure 7.1**). This assessment has considered the construction of the Upington Solar Thermal Plant Two, with a total development footprint of up to 700 hectares (within a 800ha portion of the larger area), and includes the following associated infrastructure:

» Solar tower with central receivers and heliostat technology using superheated steam with dry cooling (700 hectares in extent).
» Power island which will include a steam turbine and generator; a dry cooled condenser; a generator transformer and substation; auxiliary fossil fuel and/or electric boilers and associated molten salt storage vessels and heat exchangers (approximately 200m x 500m in extent).
» Access roads (roads up to 6m wide).
» Plant substation (50m x 50m).
» 132 kV power line up to 4km in length to connect to Eskom's existing McTaggerts Substation, which is located on the same property as the proposed CSP Plant.
» Water abstraction point located at the Gariep River, filter station (20m x 30m) and water supply pipeline (up to 20km in length).
» Water storage reservoir and tanks (combined capacity up to 15 000m^3).
» Packaged water treatment plant (roughly 30m x 30 m).
» Up to 5 lined evaporation ponds (approximately 100m x 100m each).
» Workshop and office buildings (approximately 20m x 50m each).
» Hazardous substance storage area.
» Mirror assembly facility (approximately 100m x 50m).

The establishment of a solar energy facility project is comprised of various phases, including pre-construction, construction, operation, and decommissioning. The **construction activities** involved for the proposed CSP plant will include the following:

» Conduct pre-construction surveys.
» Establishment of access roads.
» Undertaking site preparation (i.e. including clearance of vegetation; and stripping and stockpiling of topsoil).

» Transportation of equipment to site and establishment of construction camps; laydown areas (i.e. including storage facilities, batching facilities and mirror assembly plant).
» Assemble and construct solar tower and heliostats.
» Construct power island and substation.
» Establish abstraction point; pipeline; water storage/treatment facilities and evaporation ponds.
» Construction of the 132kV power line to connect the on-site substation to the Eskom grid at McTaggerts Substation.
» Establish and implement a stormwater management plan.
» Undertake site remediation.

The construction phase is expected to take approximately 30 months.

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

» The operation of the solar facility (power tower plant).
» The operation of the power island.
» The abstraction, treatment; pumping and storage of water for use in the facility and wastewater handling.
» Site operation and maintenance.

The operational phase is expected to extend in excess of 40 years.

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

» Removal and disposal of project infrastructure
» Site rehabilitation

The majority of the environmental impacts associated with the facility will occur during the construction phase. Environmental issues associated with **construction and decommissioning** activities of the CSP Plant are similar and include, among others:

» Impact on ecology (flora, fauna and avifauna) and loss of protected species.
» Potential soil loss and change in land-use for the footprint of the facility.
» Impact on heritage resources.
» Social impacts (positive and negative).
» Visual impacts.

Environmental issues specific to the **operation** of the CSP Plant include, among others:

» Visual impacts (intrusion, negative viewer perceptions and visibility of the facility).
» Social impacts (positive and negative).

These and other environmental issues were originally identified through a scoping evaluation of the proposed CSP 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 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 Upington Solar Thermal Plant Two, and to make recommendations for the management of these impacts for inclusion in the draft Environmental Management Programme (refer to Appendix S).

7.1. Assessment of Alternative CSP Technologies

Abengoa Solar is the only solar company that commercially implements all CSP technological solutions in projects worldwide. As such, projects are designed to most optimally suit the techno-economic needs of the specific situation or customer. Abengoa Solar Power South Africa (Pty) Ltd has considered two CSP technology types for implementation on Portion 3 of the farm McTaggarts Camp 453 near Upington in order to maximise the capacity and land available on the site, namely: heliostats and a power tower system (Solar Tower technology) and parabolic trough technology (Trough technology). Abengoa Solar Power South Africa are currently constructing Khi Solar One tower plant (the only CSP tower facility in South Africa) on the site. At an early stage of the project development cycle, it was decided by Abengoa Solar to investigate a second tower plant directly adjacent to the first (under construction) and a trough plant to the north of the tower plants. That is, both technologies were considered on the farm portion.

Both CSP technologies are based on the operating principle that the power gained from the sun can be maximised if the radiant energy of the sun is gathered and concentrated on a single point. By concentrating the sun's rays, CSP technologies maximise the amount of sunlight that can be converted into electricity, thereby reducing wastage and increasing output. Technological similarities between power tower and parabolic trough plants include:

» Both technologies operate on a steam turbine system to generate electricity.
» The energy can be stored to enhance despatchability for both technologies.

Technological differences between solar tower and parabolic trough plants include:

» Parabolic troughs are typically 8m to 10m in height and a heat transfer fluid is heated within the trough receiver tubes (i.e. has no 'central receiver', but rather a continuous loop at approximately 5m from ground level).

» Heliostats are mirrors (typically 10 m in height) which reflect the sunlight onto one 'central receiver' which is located on top of the power tower which is 200m to 300m in height.
» Both technologies result in a change in land use. Trough plants, however, require absolute levelling of the land as the troughs are required to be level (heat transfer fluid moves through the receiver tubes), therefore there the site is terraced and may have excessive cut-and-fill operations. A heliostat field does not require terracing, and has a lower impact as a result of direct footprint alteration.
» Molten salt towers have a 5% -10% overall efficiency advantage over parabolic troughs, with an associated *5% -10% less water consumed per MW generated* - estimated to be as much as 50 000 m^3 of water saved annually for a 150MW plant.

7.1.1. Comparative evaluation of tower plant vs trough plant

The technologies were evaluated through a comparative evaluation in order to identify those impacts that have the greatest contribution towards identifying preferred alternative, considering environmental, economic and technical criteria.

There are two primary elements between the technologies against which environmental impacts must be considered in order understand the fundamental differences which the two technologies present.

1. Loss of land use and ecological functioning though the physical alteration for the footprint of the facility
   a. Ecological impacts, transformation and loss of habitat
   b. Surface hydrology - transformation and loss of habitat
   c. Soils and agricultural potential
   d. Loss of heritage resources
   e. Loss of palaeolontogical resources
   f. Change in land use (social considerations)
2. Differences in infrastructure or project components
   a. Visual exposure
   b. Avifauna mortality – risk of infrastructure
   c. Water consumption/ requirements from Gariep River

These are discussed against each environmental aspect in further detail below and assist in comprehending the need for trade-offs for the most sustainable technical solution.

1. Loss of land use and ecological functioning though the physical alteration for the footprint of the facility

a. Ecological impacts, transformation and loss of habitat

Tower Plant	Full extent of the area occupied by heliostats, tower complex, and power island considered as transformed. Area is required to be cleared (and subsequent loss of protected species), but not terraced, and so some opportunity for natural rehabilitation and unaided run-off. Area for evaporation ponds total loss.	Medium to high significance: Impacts considered as total transformation/loss
Trough Plant	Full extent of the area occupied by troughs and power island is to be transformed. The full extent of the area is required to be cleared (and subsequent loss of protected species) and terraced (level area required for trough plant), with large-scale cut-and-fill operations required. Limited opportunity for natural rehabilitation. All run-off from the site is diverted and managed. Area for evaporation ponds total loss.	Medium to high significance: Impacts considered as total transformation/loss

b. Surface hydrology - transformation and loss of habitat

Tower Plant	Full extent of the area occupied by heliostats, tower complex, and power island considered as transformed. Area is required to be cleared, but not terraced, and so some opportunity for natural rehabilitation and unaided run-off.	Low significance after mitigation: Impacts considered as total transformation/loss
Trough Plant	Full extent of the area occupied by troughs and power island is to be transformed. The full extent of the area is required to be cleared and terraced (level area required for trough plant), with large-scale cut-and-fill operations required. All run-off from the site is diverted and managed. Area for evaporation ponds total loss.	Low significance after mitigation: Impacts considered as total transformation/loss

c. Soils and agricultural potential

Tower Plant	The construction will result in a total loss of land. Full extent of the area occupied by heliostats, tower complex, and power island considered as transformed. The heliostat field will result in a lower direct footprint alteration, as it does not require absolute levelling of the land. Area is required to be cleared but not terraced, and so some opportunity for natural rehabilitation and unaided run-off. Area for evaporation ponds total loss.	Medium to low significance: Agricultural potential is low, but soils can be susceptible to erosion. Impacts considered as total transformation/loss

Trough Plant	The construction will result in a total loss of land. Full extent of the area occupied by troughs and power island is to be transformed. The full extent of the area is required to be cleared (and subsequent loss of protected species) and terraced (level area required for trough plant), with large-scale cut-and-fill operations required. Limited opportunity for natural rehabilitation. All run-off from the site is diverted and managed. Area for evaporation ponds total loss.	Medium to low significance: Agricultural potential is low, but soils can be susceptible to erosion. Impacts considered as total transformation/loss

d. Loss of heritage resources

Tower Plant	Full extent of the area occupied by heliostats, tower complex, and power island considered as transformed. Area is required to be cleared, but not terraced.	Low significance: Very sparse heritage traces (of low heritage value) were found during the field survey.
Trough Plant	Full extent of the area occupied by troughs and power island is to be transformed. The full extent of the area is required to be cleared and terraced (level area required for trough plant), with large-scale cut-and-fill operations required.	Low significance: Very sparse heritage traces (of low heritage value) were found during the field survey.

e. Loss of palaeolontogical resources

Tower Plant	Full extent of the area occupied by heliostats, tower complex, and power island considered as transformed. Area is required to be cleared, but not terraced.	Low significance. The fossil record from Kalahari deposits is very poor with respect to finds of fossil bones of vertebrates
Trough Plant	Full extent of the area occupied by troughs and power island is to be transformed. The full extent of the area is required to be cleared and terraced (level area required for trough plant), with large-scale cut-and-fill operations required.	Low significance: The fossil record from Kalahari deposits is very poor with respect to finds of fossil bones of vertebrates

f. Change in land use (social considerations)

Tower Plant	Full extent of the area occupied by heliostats, tower complex, and power island considered as transformed. Increased opportunity for socio-economic benefits during construction phase due to increased job opportunities. 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. From an	Medium significance in terms of positive impacts, and a low – medium significance in terms of the negative impacts

	economical perspective, the development of a tower facility development will create the least-cost impact on the electricity consumer. The socio-economic benefit resulting from the tower technology has been highlighted by the possibility to achieve a higher local content per MW installed of around 40-60%, confirmed through actual data obtained from the construction of the Khi Solar One tower plant, compared to the Kaxu Solar One trough plant constructed in the Northern Cape (REIPPPP round 1 projects by Abengoa Solar).	
Trough Plant	Full extent of the area occupied by troughs and power island is to be transformed. Increased opportunity for socio-economic benefits during construction phase due to increased job opportunities. 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. From an economical perspective, the development of a tower facility development will create the least-cost impact on the electricity consumer.	Medium significance in terms of positive impacts, and a low – medium significance in terms of the negative impacts

2. Differences in infrastructure or project components

a. Visual exposure

The Upington area has been identified for a number of solar energy projects and the area has been identified as a solar energy complex. Taking into consideration that the adjacent Khi Solar One already exists and the distance of from the planned new facility to the N14 route and the Gariep River, reduces the visual significance of the Upington Solar Thermal Plant Two facility.

Tower Plant	The tower would be visible over a large distance for up to 24km, but is a fairly slender form in the flat landscape. Although the tower would be visible over a large distance, the related heliostats, on their own, have a smaller viewshed than that of the trough type facility. The tower close to the Khi Solar One facility and forms part of the node which is already visually impacted, thereby reducing the significance of the impact.	Medium to high significance before mitigation, with limited opportunities for visual mitigation
Trough Plant	Trough plant facility would be visible over a distance of ~10km. The trough type facility has a larger viewshed that that of the heliostats associated with a tower plant.	Medium significance

b. Avifauna mortality – risk of infrastructure

Trough solar plants are generally *perceived* to have a lower impact on avifauna species. No peer reviewed studies have been conducted on avifauna deaths related to trough solar power generation, and there is therefore no data to scientifically support this theory. Possible impacts of tower and trough plants on avifauna species must be considered for the specific study area and the species using the area.

Tower Plant	From the results of the expanded/additional study conducted and the literature reviewed it is likely that avifauna impacts resultant from the Upington Two CSP tower facility are likely to be very low. One of the factors most likely to reduce the risk of mortality in avifauna species is the low average flight height of birds in the area, as most bird species will fly under the heliostats. The fact that many of the species of concern appear to be absent from the study area further reduces the likely impacts of the facility. Bird collisions against the heliostats were found to be the impact with the greatest probable magnitude – over 80% of fatalities at a plant. Due to the average flight height of birds in the study area to be only 4m above the ground, most resident bird species were observed flying unaffected between ground level and the heliostat mirrors. This was confirmed during the vantage point surveys where most species were found to be active below the heliostats and very few species flew over them.	Low significance
Trough Plant	Due to the average flight height of birds in the study area to be only 4m above the ground it is likely that this impact would be more significant through the use of trough technology. The parabolic mirrors create a focal point closer to the ground and therefore in closer proximity to the majority of birds occurring in the area, due to the flying height of the majority of birds. The focal point of the parabolic mirrors are concentrated on a pipe containing heated liquid (HTF or oil), these pipes are at the right height to be used as perches for the majority of the species occurring in the area, thus more likely to cause injury or death to birds than the focal point at the top of a tower. Trough plants comprise as many risks to birds as a tower plant, if not more, so in certain areas (such as the area in which the study area for the Upington Solar Two facility is proposed) a trough plant is a less desirable technology option.	Medium to low significance

c. Water consumption/ requirements from Gariep River

Tower Plant	400 000m^3 of water is required annually for the operation of the facility. Molten salt towers have a 5% - 10% overall efficiency advantage over parabolic troughs, with an associated 5% -10% less water consumed per MW generated - estimated to be as much as 50 000 m^3 of water saved annually for a 150MW plant	Medium significance
Trough Plant	440 000m^3 of water is required annually for the operation of the facility. Trough plants are between 5% - 10% less efficiency thank tower towers, with an associated 5% -10% more water consumed per MW generated - estimated to be as much as 50 000 m^3 of water annually for a 150MW plant. A trough plant is a less desirable technology option.	Medium significance

Table 7.1: Comparative assessment summary of the alternative CSP Technologies

Potential Impacts	**Heliostats and a power tower system (Solar Tower technology)- Significance Rating**	**Parabolic trough technology (Trough technology)- Significance Rating**
Loss of land use and ecological functioning though the physical alteration for the footprint of the facility		
Ecological impacts, transformation and loss of habitat	Medium to high	Medium to high
Surface hydrology - transformation and loss of habitat	Low	Low
Soils and agricultural potential	Medium to low	Medium to low
Loss of heritage resources	Low	Low
Loss of palaeolontogical resources	Low	Low
Change in land use (social considerations)	Medium-high-Positive impacts and Low-medium- negative impacts	Medium-Positive impacts and Low-medium- negative impacts
Differences in infrastructure or project components		
Visual exposure	Medium to high	Medium
Avifauna mortality – risk of infrastructure	Low	Medium to low
Water consumption/ requirements from Gariep River	Medium	Medium

7.1.2. Ranking Matrix

Environmental and Social Criteria

In order to nominate the preferred technology for full assessment in the environmental impact assessment phase, the identified alternative technologies were weighted against one another using a ranking matrix. The purpose of including a relative weighting of each environmental component in the ranking matrix is in order to ensure that due consideration is taken of the criteria which should, from an environmental perspective, have the greatest influence on the overall decision. The relative weighting is assigned to each criteria, and must total a score of 100.

Considering the two primary elements against which environmental impacts have been considered in Section 7.1.1. above, it is evident that all environmental criteria associated with 1) Loss of land use and ecological functioning though the physical alteration for the footprint of the facility are expected to result in impacts of the *same significance* regardless of technology implemented. In addition, all of these environmental criteria would be assigned the same relative weighting, as there is no difference between the significance ratings under each technology. Therefore, these have been excluded from the weighting matrix below as they will not influence the overall decision.

The full set of criteria considered in Section 7.1.1 are:

1. Loss of land use and ecological functioning though the physical alteration for the footprint of the facility
    a. Ecological impacts, transformation and loss of habitat
    b. Surface hydrology - transformation and loss of habitat
    c. Soils and agricultural potential
    d. Loss of heritage resources
    e. Loss of palaeolontogical resources
    f. Change in land use (social considerations)
2. Differences in infrastructure or project components
    a. Visual exposure
    b. Avifauna mortality – risk of infrastructure
    c. Water consumption/ requirements from Gariep River

The criteria considered in the ranking matrix (i.e. the criteria which would have a material influence on the technology selection) are:

Differences in infrastructure or project components

a. Visual exposure
b. Avifauna mortality – risk of infrastructure
c. Water consumption/ requirements from Gariep River

The objective of the matrix is to calculate a comparative score. The alternative with the greatest score is the more desirable technology alternative for consideration at the Upington Solar Thermal Plant Two site considering its spatial location.

Table 7.2: Environmental and social criteria weighted matrix

Environmental component	Weighting (a)	Alternative technologies			
		Tower Plant		Trough Plant	
		Significance (b)	(a) x (b)	Significance (b)	(a) x (b)
Visual exposure	20	1	20	2	40
Bird mortality – risk of infrastructure	40	4	160	3	120
Water consumption/ requirements from Gariep River	40	2	80	2	80
TOTAL	**100**	**260**		**240**	

(a) = Relative weighting of environmental component (Total 100)
(b) = Significance of technology on environmental component (scale 0 to 5, 0 being low and 5 being high in influencing the decision)

High	= score of 0
Medium to high	= score of 1
Medium	= score of 2
Medium to low	= score of 3
Low	= score of 4
None	= score of 5

The relative weighting for the environmental criteria considered the following:

» The site is located directly adjacent to an existing tower facility, which is an existing impact.
» Irreplaceable loss of resources has a more significant influence on the decision regarding technology

It should be noted that the specialist evaluations found no fatal flaws considering either technology at the site. The above matrix shows that there is only a small difference of score between the two technologies from an environmental and social perspective. According to the matrix tower and heliostat technology is considered to be the preferred technology for consideration at the Upington Solar Thermal Plant Two site considering its spatial location.

Technical and Economic Criteria

In order to provide a balanced approach to the site selection process, the technical and economic criteria which play a role in the selection of a technology for use on a site have been included within the overall evaluation. The inclusion of the technical and economic criteria in the site selection process stems from the BATNEEC (Best Available Techniques not entailing excessive costs) Principle. This principle introduces the need for a

development to be technically and economically feasible in addition to being environmentally feasible. In this way the site recommended is acceptable from all aspects of the environment, namely natural, social and economic environments, thereby ensuring that the project strives to embrace the principles of sustainable development.

The purpose of including a relative weighting of each technical component in the ranking matrix is in order to ensure that due consideration is taken of the criteria which should, from a technical and economic perspective, have the greatest influence on the overall decision. The relative weighting is assigned to each criteria, and must total a score of 100.

The objective of the matrix is to calculate a comparative score. The alternative with the greatest score is the more desirable technology alternative considering technical and economic criteria.

Table 7.3: Technical and Economic criteria weighted matrix

Technical component	Weighting (a)	Alternative technologies			
		Tower Plant		Trough Plant	
		Significance (b)	(a) x (b)	Significance (b)	(a) x (b)
Plant efficiency, performance and economic value	30	5	150	4	120
Annual output (MWs generated): considering seasonal variation in output, thermal efficiency, and storage losses	20	4	80	5	100
O&M costs	30	5	150	5	150
Water consumption/ requirements from Gariep River	20	5	100	5	100
TOTAL	**100**	**480**		**470**	

(a) = Relative weighting of environmental component (Total 100)

(b) = Influence on commercial decision (scale 0 to 5; 0 being low and 5 being high importance)

None	= score of 0
Low	= score of 1
Medium to low	= score of 2
Medium	= score of 3
Medium to high	= score of 4
High	= score of 5

7.1.3. Conclusion

The above matrices show that there is only a small difference of score between the two technologies from an environmental and social perspective as well as a technical and economic perspective. According to the results, tower and heliostat technology is considered to be the preferred technology for consideration at the Upington Solar Thermal Plant Two site considering its spatial location.

The Renewable Energy Independent Power Producer Procurement Programme selection process (details of which are not yet finalised for future bidding rounds), 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. The preferred/optimal technology option (from a technical, financial and socio-economic perspective) for Upington Solar Thermal Plant Two located adjacent to the Khi Solar One project (a 50MW solar tower plant) on Portion 3 of the farm McTaggarts Camp 453 is considered to be solar tower technology with molten salt energy storage. Abengoa Solar consider this technology choice to meet the requirements of the DOE and deliver the greatest value to the country as a whole through socio-economic development being created and least-cost impact on the electricity consumer. The tower plant is proposed to be located directly adjacent to a 50MW tower plant under construction.

Prior to this, commercial direct steam towers such as Khi Solar One, near Upington, were the preferred tower technology option. However, their limited storage capability (utilising large steam storage vessels), made them unsuitable for applications such as the provision of baseload or dispatchable power and the requirements of the DOE REIPPPP program. This unsuitability resulted in molten salt parabolic trough technology being the preferred technology option initially in South Africa to satisfy the requirements of the DOE's programme.

The progress achieved by molten salt tower technology has however resulted in a reconsideration of parabolic troughs with large-scale salt storage as the preferred technology for application in South Africa to meet the DOE requirements.

Environmental feasibility as well as potential impacts of the project is determined further in this EIA report.

7.2. Approach to the Assessment of Impacts associated with the proposed CSP Plant

In order to assess the potential impacts associated with the proposed Upington Solar Thermal Plant Two, it was necessary to understand the extent of the affected area. This affected area will include the area infrastructure (i.e. tower and heliostat solar field; power island; 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).

Portion 3 of the Farm McTaggarts Camp 453 is 22 km^2 (2200 ha) in extent. The farm was originally identified by the project developer for the purposed of establishing CSP facilities. The following 'no-go' zones apply to the larger farm portion:

» The development footprint of the Khi Solar One CSP Facility (which is currently under construction) and the development footprint for the other authorised phases of the Phase 1 project (~600 hectares).
» The mined out area on the north-western corner of the site (currently being rehabilitated under the Khi Solar One project due to safety risk associate with open excavations/ depressions) (~25 hectares).

Therefore, at least 625 ha of the 2200 ha farm portion is unavailable for further development. The remaining 1575 hectares is available land (which is owned by Abengoa Solar Power South Africa Pty Ltd), which has been put forward for consideration for the construction of two new CSP projects – known as Upington Solar Thermal Plant Two and Upington Solar Thermal Plant Three. This EIA report only considers Upington Solar Thermal Plant Two[17]. This phase of the development has been earmarked for an area approximately 700ha in extent located in the central portion of the farm portion.

From the results of the facility layout determination, the CSP Plant will have a total development footprint of up to 700 ha. This amounts to 32% of the total 1575 ha originally available for development (and ~75% of the 800ha area considered for the Upington Solar Thermal Plant Two), and is illustrated in the schematic in Figure 7.1 and 7.2.

[17] Note that a separate EIA report for the Upington Solar Thermal Plant Three has also been prepared by Savannah Environmental (DEA reference number: 14/12/16/3/3/2/657).

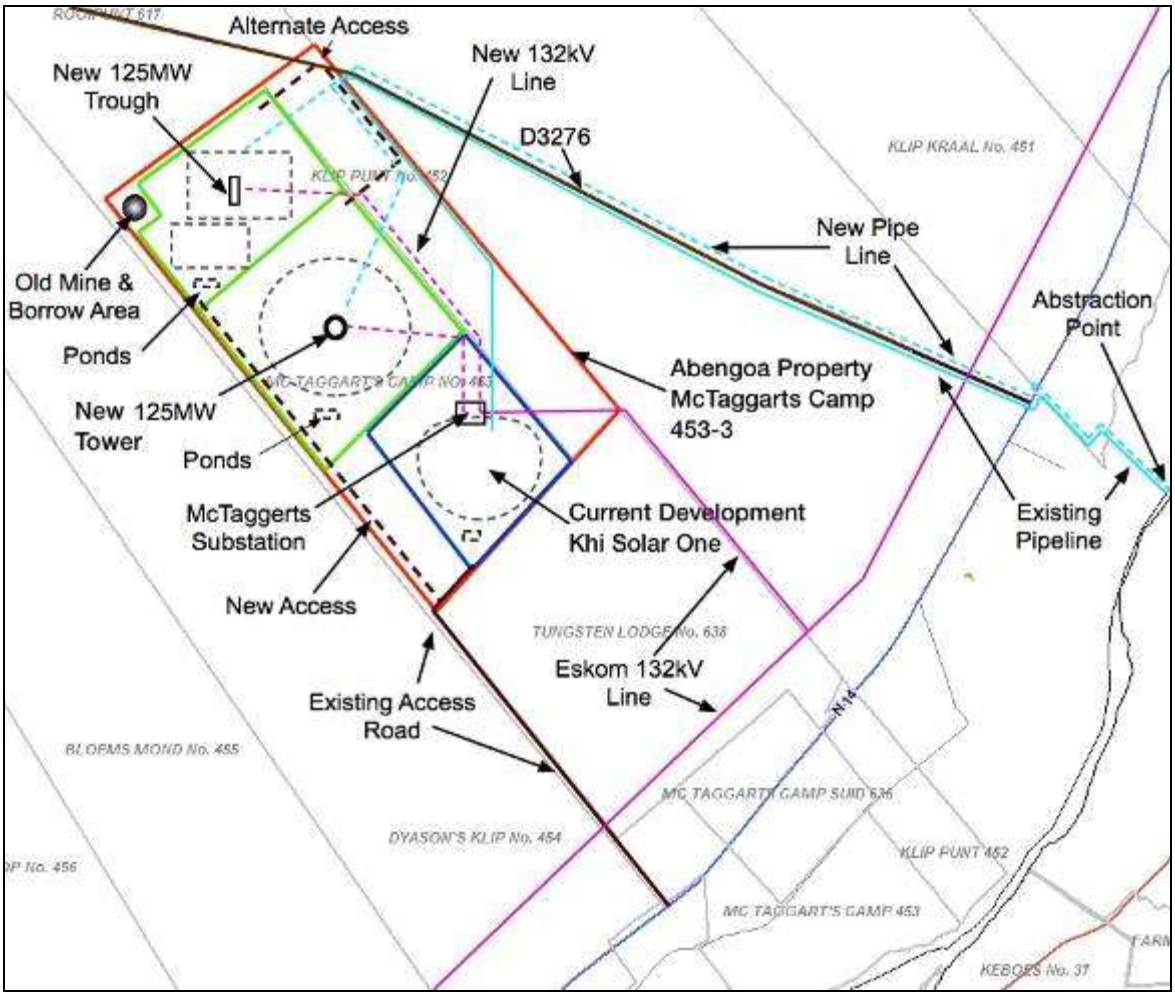

Figure 7.1: Schematic illustrating the relative locations of the Upington Solar Thermal Plant Two (the subject of this EIA), Upington Solar Thermal Plant Three (considered in a separate EIA), and the Khi Solar One project (under construction).

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 Upington Solar Thermal Plant Two on the identified site. This assessment has been informed by specialist studies contained in Appendix F – N. Issues were assessed in terms of the criteria detailed in Chapter 5. The nature of the potential impact is discussed; and 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.

7.3. Alternative access to site during construction and operation

The primary access road to the site would be off the N14 national road between Upington and Keimoes. Two reasonable and feasible alternatives are have been considered (refer to Figure 7.2):

1. *Access Alternative 1- Access off the N14 via the existing Khi Solar One access road*. The Khi Solar One project has established a formal surfaced access road off the N14 for access to the McTaggarts Camp farm, and specifically the Khi Solar One project development site. The road is available to provide access for a portion of the distance to the site up to the Khi Solar One boundary (5.5km), with an additional 4.5km of road to then be constructed within the boundary of Portion 3 of the Farm McTaggarts Camp 453. This access road (total length of 10km) would provide direct access to the facility area from the south; or
2. *Access Alternative 2- Access off the N14 via the existing district road D3276.* The existing district road D3276 is a gravel road (and would be required to be surfaced). This road intersects with the northern boundary of Portion 3 of the Farm McTaggarts Camp 453 approximately 11 km from the N14. A section of road ~4km would be required to be constructed to access the facility area from the north. This access road (total length of 15km) would provide direct access to the facility area from the north.

Potential impacts pertaining to access to the site is assessed in the sections below, and a comparative assessment of the two access alternatives is provided.

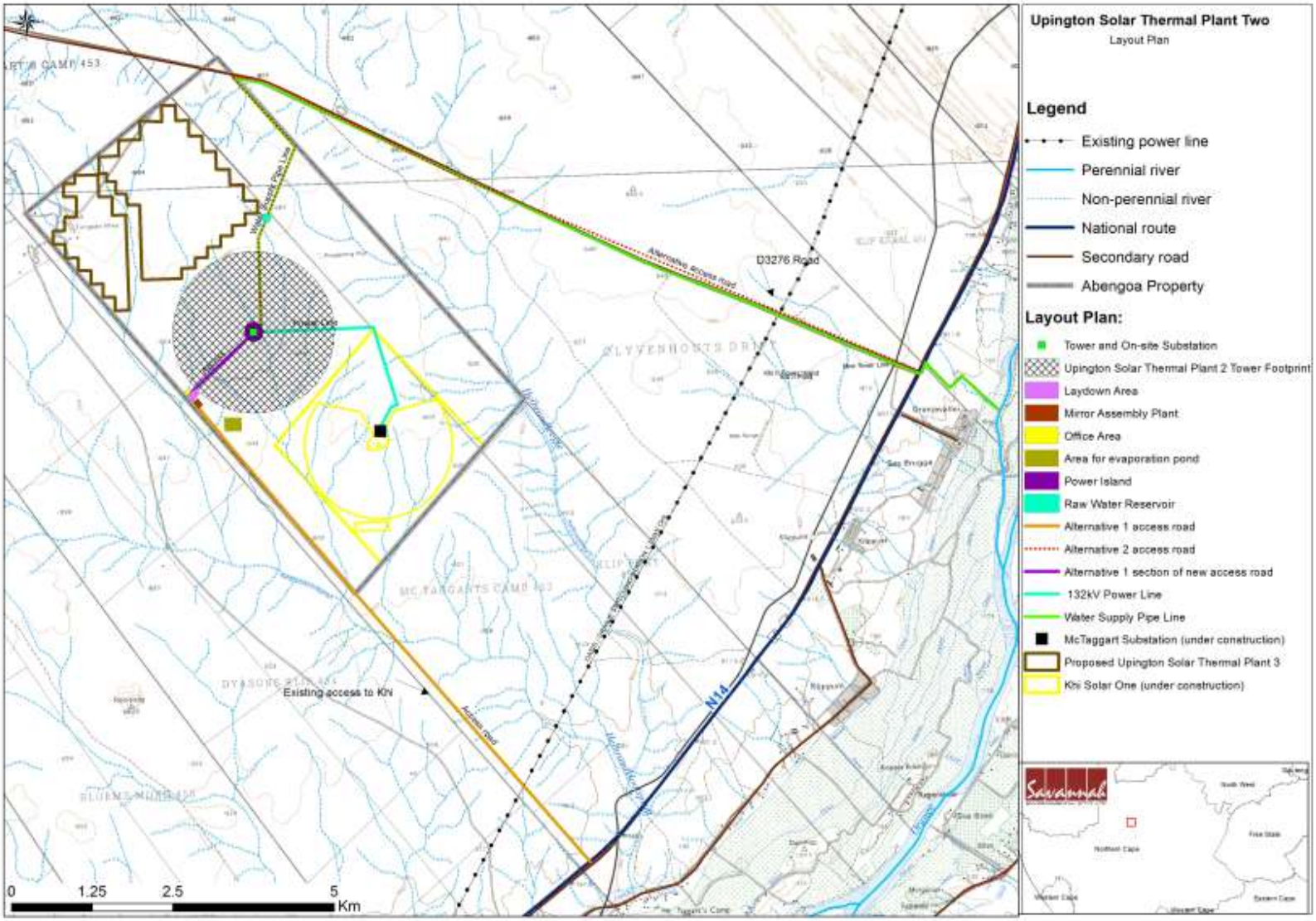

Figure 7.2: Map illustrating the layout and two alternative access roads between the N14 and the Upington Solar Thermal Plant Two

7.4. Potential Impacts on Ecology (Flora, Fauna and Ecosystems)

CSP facilities require relatively large areas of land for placement of infrastructure; this 150MW CSP facility requires 700 hectares. The expected negative impact will be due to loss of habitat which may have direct or indirect impacts on individual species. Potential impacts and the relative significance of the impacts are summarised below (refer to Appendix F - Ecology Report for more details).

7.4.1. Results of the Ecological Study

The study area is situated in the Nama-Karoo biome. The vegetation types dominating the study area are Bushmanland Arid Grassland and Kalahari Karroid Shrubland. Both vegetation types are regarded as least threatened. Vegetation of the study area consists of a transitions from Bushmanland Arid Grasslands to Kalahari Karroid Shrublands, with small areas of denser and higher riparian vegetation around washes and pans. Small-scale plant diversity and ecological state of the vegetation varies considerably across the entire farm portion, depending on soil surface rockiness, depth of soil and position in the landscape. Despite past disturbances such as gravel roads, farm tracks, a homestead, farming activities and small-scale mining (from the 1930s), and the development of the Kh Solar One facility on the southern portion of the farm, the natural vegetation is relatively intact, with only a low presence of alien invasives.

The site does not fall within any "protected areas" or "Critical biodiversity areas". However, protected trees occur on the site, as do other species which are protected at a Provincial level.

The ecological sensitivity assessment identifies those parts of the study area that have high conservation value or that may be sensitive to disturbance. This sensitivity assessment is based on a desktop study, detailed field evaluation of the site and detailed analysis of aerial photography. From this assessment, it has been concluded that the majority of the site is of low sensitivity associated with riparian areas. The areas of high and moderate ecological sensitivities of the site are presented in Figure 7.3 and include:

» **Areas containing riparian vegetation along drainage lines**: Due to the poorly developed nature of drainage lines at the site, the areas containing riparian vegetation along drainage lines are noted to be of importance (Vegetation Association 1: *Acacia mellifera – Cenchrus ciliaris* ephemeral drainage lines). Density, height and composition of the woody and herb layer vary immensely. Large specimens of the protected *Acacia erioloba* and *Boscia foetida* as well as other tree and shrub species are scattered along the larger drainage lines on the south-west and west of the study area. Some of the larger *Acacia erioloba* trees are currently 'occupied' by active social weavers' nests. Surface water in these drainage lines will be mostly

ephemeral, but subsurface water reserves may persist for several weeks or months after sufficient rainfall.

» **Pans**: There are intermittent pans situated within the northern section of the site. Intermittent Pans are described Vegetation Association 2- *Acacia mellifera – Eragrostis rotifer*. These pans range from ~50 to 100 m in diameter. Depending on the amount of silt and underlying rock of the central areas of these pans, they may be able to retain surface water or be waterlogged for one to three weeks after large rainfall events, seldom longer. They may also remain dry for several successive years. The central areas of the pans are covered only with a sparse herbaceous layer – if at all vegetated – and species here typically need or prefer occasionally waterlogged soils so be able to persist.

» **Areas containing protected trees species:** *Acacia erioloba* (Camelthorn), *Boscia foetida* (Shepherds tree), and *Boscia albitrunca (*Shepherds *tree).*

The areas of high ecological sensitivity amount to an area of ~11ha, and it is recommended that impact on these areas be avoided or minimised through considered placement of infrastructure in order to minimise the impact on vegetation and fauna.

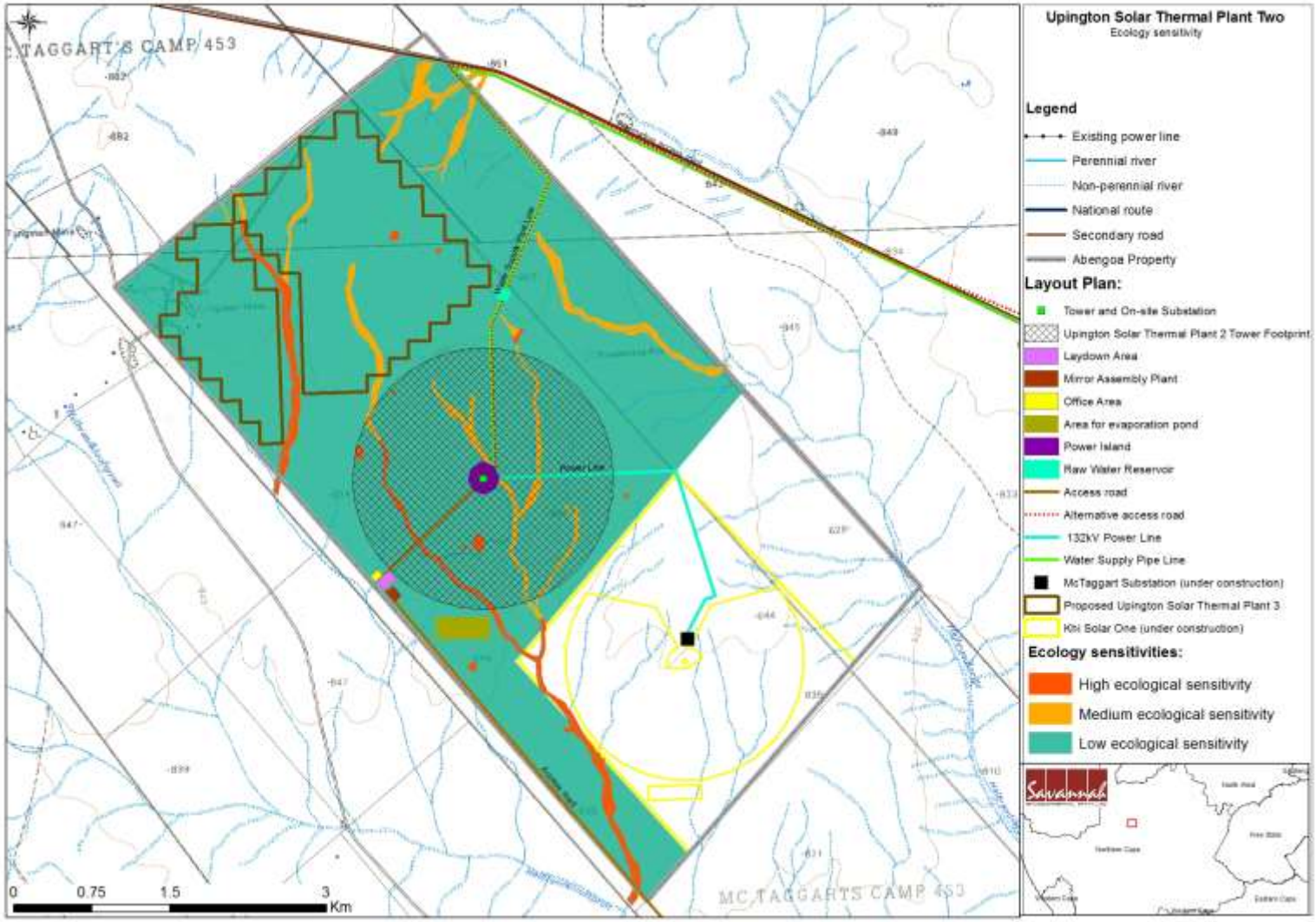

Figure 7.3: Ecological sensitivity map of the site for the Upington Solar Thermal Plant Two

7.4.2. Description of Ecological Impacts

- » Localised reduction of indigenous trees and shrubs, geophytes and other species of conservation concern, but not to a degree that the current conservation status of such species will be negatively affected. However, this effect is and will be further exacerbated by surrounding and regional developments (cumulative impacts).
- » A number of small intermittent pans and ephemeral washes will be permanently transformed. Due to the semi-arid nature of the environment, it is not expected that this will have a significant impact on downstream wetland hydrology or functionality with the implementation of mitigation measures. However, the functionality of the small intermittent pans and their resources to other biodiversity will be lost. This may create a localised loss of species, but not affect their conservation status.
- » Potentially significant negative impacts on the ecological environment could include soil degradation on and beyond the development area, loss of functional and productive topsoil, possible introduction of weeds and invasive plants, a long-term (more than 8 months) low or absent vegetation cover after construction and possible contamination of lower-lying ephemeral drainage and perennial wetland systems.
- » The impact on fauna is expected to be small for the development, but may become more of an issue if the cumulative impact of all surrounding developments is considered. Presence of indigenous terrestrial vertebrates within the study area is relatively low due to absence of permanent surface water. Animals that may be permanently present can be relocated or will move away during construction, and may resettle after construction, depending on safety specifications necessitated by the development. No restricted or specific habitat of vertebrates exists on the study area and will be affected by the proposed development; especially if the proposed development remains outside the more sensitive areas as recommended.

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

Nature: Upgrading and creation of site access and internal maintenance roads can cause loss of vegetation, increase in runoff and erosion, possible distribution and increased establishment of alien invasive species, possible disturbance and reduction of habitat or injury to burrowing vertebrates, possible rise of road-kill incidences of fauna, possible change of natural runoff and drainage patterns, possible loss of protected species, possible permanent loss of re-vegetation potential of soil surface, increase in dust levels.
Listed activities: GNR 544, 18 June 2010 Activity 47 (iii) GNR 546, 18 June 2010 Activity 4(a) ii

	Without mitigation	**With mitigation**
Extent	Local (2)	Local (1)
Duration	Long-term (4)	Long-term (4)
Magnitude	High (8)	Moderate (7)
Probability	Definite (5)	Definite (5)
Significance	**High (70)**	**Medium (60)**
Status (positive, neutral or negative)	Negative	Negative Notes: reduced impact on existing roads and tracks
Reversibility	Not reversible	Relatively reversible
Irreplaceable loss of resources?	Probable	Likely
Can impacts be mitigated?	Reasonably well	

Mitigation:

- » During construction: Create designated servitude areas and strictly prohibit any off-road driving or parking of vehicles and machinery outside designated areas.
- » Avoid or reduce impact on all pans, riparian vegetation around large intermittent rivers.
- » Ensure adequate drainage where the Helbrandskloofspruit tributaries are crossed.
- » Avoid pans as far as possible, maintaining a buffer zone of at least 32 m, preferably a minimum of 50 m from all pans that will not be within the solar development footprints.
- » Ensure that suitable stormwater management structures are in place.
- » Design the access route to go as far as possible along existing roads of the Khi Solar One access and other larger farm tracks.
- » Conduct an ecological walk through survey prior to construction to determine the full extent of protected fauna and flora that will be affected and compile a suitable photo record that can be used by EO/ECO/construction staff to identify the relevant species.
- » Protected geophytic plant species must be relocated.
- » Animal burrows: must be monitored by EO/ECO prior to construction for activity/presence of animal species. If detected, such animals must be removed and relocated by a qualified professional/contractor.
- » Amphibians or tadpole shrimps that may emerge in the small pans after larger rainfall events must be relocated to similar pans not affected by the development.
- » Should any mammals be injured during construction, they must be taken to a local

veterinarian for rehabilitation or humane euthanization.
» Create designated turning areas and strictly prohibit any off-road driving or parking of vehicles and machinery outside designated areas.
» Ensure that concrete, tar or other construction material is not spilled or discarded next to newly built roads or stormwater structures, but disposed of at a designated area.
» Keep the clearing of natural vegetation to a minimum.
» Dust levels must be controlled and minimised.
» If filling material is to be used, this should be sourced from areas free of invasive species:
  - Moderate volumes of spoil material have been created by the Khi Solar One development, which should be used as first option for filling material, after which more fill material will most likely become available from landscaping operations from the development.
  - The creation of any additional borrow pits should thus be avoided.
» Topsoil (the upper 25 cm of soil) is an important natural resource; where it must (and can) be stripped, never mix it with subsoil or any other material, store and protect it separately until it can be re-applied, minimise handling of topsoil.
» Topsoil and spoil material/subsoil storage areas must be delineated in the final layout plan.
» Combined final stockpiles may not exceed 4 m in height, preferably should not be higher than 1 m, and must be managed according to a strict landscaping, rehabilitation and soil erosion management plan until decommissioning.
» Reinforce portions of existing access routes that are prone to erosion, create structures or low banks to drain the access road rapidly during rainfall events, yet preventing erosion of the track and surrounding areas.
» Ensure that runoff from compacted or sealed surfaces is slowed down and dispersed sufficiently to prevent accelerated erosion from being initiated (erosion management plan required).
» Prevent leakage of oil or other chemicals or any other form of pollution, as this may infiltrate local groundwater reserves or end up in the Gariep River where it can affect all downstream users.
» Monitor the establishment of (alien) invasive species and remove as soon as detected, whenever possible before regenerative material can be formed.
» Strictly enforce a speed limit of 30 to 60 km/hour on all construction and access routes as appropriate and limit driving to daytime hours to try and prevent collisions with fauna, especially nocturnal mammals.
» After decommissioning, if access roads or portions thereof will not be of further use to other stakeholders, remove all foreign material, rip and treat the area to facilitate the establishment of vegetation, followed by a suitable re-vegetation program.

Cumulative impacts:

» Possible erosion of areas lower than the access road, possible contamination of

groundwater reserves due to oil or other spillage
» Possible spread and establishment of alien invasive species
» Increased transformed areas (together with surrounding developments) that will affect local fauna and flora population dynamics and runoff patterns
» Loss of small ephemeral pans and washes that could influence seasonal migration patterns of fauna

Residual impacts:
» Localised loss of vegetation
» Altered topsoil conditions
» Potential barren areas remaining after decommissioning
» Potential for erosion and invasion by weed or alien species
» Potential for increased dust and its impact on surrounding environments and biodiversity
» Potential permanent loss of small ephemeral pans and drainages that could influence seasonal migration patterns of fauna

Nature: Fencing area and CSP Plant may cause loss of habitat and mortality of fauna due to removal of vegetation, compaction of soils, creation of runoff zone, impact on protected species and impact on terrestrial vertebrates by restricting movement.

Listed activities:
GNR 546, 18 June 2010 Activity 13(c) ii
GNR 546, 18 June 2010 Activity 14 (a) i

	Without mitigation	**With mitigation**
Extent	Local (2)	Local (1)
Duration	Long-term (4)	Long term (4)
Magnitude	Low (4)	Minor (2)
Probability	Definite (5)	Highly Probable (4)
Significance	**Medium (50)**	**Low (28)**
Status (positive, neutral or negative)	Negative	Negative
Reversibility	Partially reversible	Reversible
Irreplaceable loss of resources?	Probable	Not likely
Can impacts be mitigated?	Reasonably well	

Mitigation:

- » All old/existing fencing must be checked routinely for and freed of snares; all staff need to be made aware that any form of poaching is a criminal offence and will be investigated.
- » During the design phase, the possible impact of burrowing vertebrates and rodents on the development must be determined, and fencing must be designed to either exclude such fauna if it will be detrimental or enable occasional migration of smaller vertebrates onto and across the site (which could be beneficial to small vertebrate populations).
- » Minimise area affected, especially during construction.
- » During construction strictly prohibit any off-road driving or parking of vehicles and machinery outside the footprint areas.
- » If the area will be used as fire-break as well, maintain a suitably low vegetation layer by regular mowing or appropriate plant species selection, but do not leave soil bare. Alternatively, ensure that the soil has a covering of gravel or small rock that prevents erosion.
- » The firebreak and fencing area will have to be kept clear of all weeds and indigenous invasive species to enable continued effective maintenance until decommissioning.
- » All ponds must be enclosed by 'Jackal-proof' fencing: a mesh fence of which the base is dug into the ground and lined with rock to ensure that not even small mammals can reach the ponds, as they will naturally attract fauna.

Cumulative impacts:

- » Possible erosion of cleared areas and associated accelerated erosion from surrounding areas.
- » Possible loss of ecosystem functioning due to increase in invasive species.
- » Increased habitat fragmentation and displacement of terrestrial vertebrates in the region.

Residual impacts:

- » Altered vegetation composition.
- » Compacted topsoils.
- » Possibility for erosion and invasion by alien and indigenous invasives.

Nature: Construction and operation of power tower and heliostat field will cause transformation of the land and ecosystem on an area of up to 700 hectares due to large scale removal of vegetation, transformation of soil surface and loss of microhabitats, compaction of soils, removal of topsoil.

Listed activities:

GNR 544, 18 June 2010 Activity 13
GNR 545, 18 June 2010 Activity 15

	Without mitigation	**With mitigation**
Extent	Local (5)	Local (3)
Duration	Long-term (4)	Long-term (4)
Magnitude	Very High (10)	High (8)
Probability	Definite (5)	Definite (5)
Significance	**High (95)**	**High (75)**
Status (positive, neutral or negative)	Negative	Negative
Reversibility	Low reversibility	Partially reversible
Irreplaceable loss of resources?	Highly Probable	Medium Probability
Can impacts be mitigated?	Reasonably but with limited full restoration potential	

Mitigation:

» Avoid all riparian vegetation around natural pans and larger intermittent drainage lines as far as practically possible.
» During the design phase, ensure that a buffer of at least 50 m is maintained around ephemeral pans and larger washes and drainage lines outside of the footprint area to maintain the species diversity and buffering capacity of these systems.
» Ensure that stormwater management structures do not negatively affect the above or pose any contamination risk of lower-lying larger ephemeral drainage lines, rivers and the Gariep (Orange) River.
» However, aim to channel runoff back into larger natural drainage lines to maintain seasonal moisture replenishment of these drainage lines beyond the development area to prevent the die-off of keystone species in drainage lines outside the development area.
» Conduct an ecological walk through survey prior to construction to determine the full extent of protected fauna and flora that will be affected and compile a suitable photo record that can be used by EO/ECO/construction staff to identify the relevant species.
» Keep areas affected to a minimum, strictly prohibit any disturbance outside the demarcated footprint area.
» Clear as little vegetation as possible, aim to maintain all indigenous vegetation where it will not interfere with the construction or operation of the development, rehabilitate an acceptable vegetation layer where permissible according to rehabilitation recommendations of the EMPr.
» Shred all shrubs and trees cleared and used the chips for dust and erosion control.
» Use only species that were part of the original non-invasive indigenous species

composition as listed in the specialist report for re-vegetation.

» Alternatively, soil surfaces where no re-vegetation seems possible will have to be covered with gravel or small rock fragments to increase porosity of the soil surface, slow down runoff and prevent wind- and water erosion.

» Remove all invasive vegetation, completely uproot and eradicate potentially resprouting high shrubs, especially *Rhigozum trichotomum, Phaeoptilum spinosum, Lycium* species and *Acacia mellifera.*

» Aim to cover all permanently bare areas either with a layer of gravel over sheets of weed-barrier sheeting, or porous asphalt.

» Continuously monitor the establishment of new invasive species and remove as soon as detected, whenever possible before regenerative material can be formed, up to decommissioning.

» Use excavated materials to fill up and close old mining pits.

» If filling material is to be used, this should be sourced from areas free of invasive species

- Moderate volumes of spoil material have been created by the Khi Solar One development, which should be used as first option for filling material, after which more fill material will most likely become available from landscaping operations from the development
- The creation of any additional borrow pits should thus be avoided

» Monitor the area below and around the heliostat field regularly after larger rainfall events to determine where erosion may be initiated and then mitigate accordingly.

» Runoff may have to be specifically channeled or stormwater adequately controlled to prevent localised rill and gully erosion.

» Prevent leakage of oil or other chemicals; strictly prohibit littering and spillages of any kind-

- Effective Micro-organisms can be used to treat any hydrocarbon spills – a clear method statement on hydrocarbon spill treatment, which also includes a list of at least three ready suppliers and/or firms doing bioremediation of hydrocarbon spills must be prepared prior to construction, updated regularly and kept on site at all times.

» The rehabilitation plan for all affected areas after decommissioning must aim to re-introduce all non-weed indigenous species listed in the specialist report as a minimum, taking the observed original cover percentages as a guideline of acceptable vegetation cover.

Cumulative impacts:

» If mitigation measures are not strictly implemented the following could occur:

- Loss of biodiversity across an extended area
- Possible accelerated erosion of areas around the panels and continued erosion of the development area with associated siltation and/or erosion of lower-lying wetlands
- possible contamination of drainage lines, lower-lying rivers or wetlands

- possible spread and establishment of invasive species

» Increased habitat fragmentation and displacement of terrestrial vertebrates in the region.
» Increased transformed areas (together with surrounding developments) that will affect local fauna and flora population dynamics and runoff patterns.
» A die-off of larger trees and shrubs and other species depending on higher soil moisture levels in downstream drainage lines due to the reduction of occasional floods as upper tributaries are removed from the system
» Possible creation of heat-island effects by the anticipated increased temperatures of large bare areas.

Residual impacts:

» ***Positive impact***: current old mine pits that are dangerous traps to fauna and man will be filled and covered and associated contaminants cleared
» Altered topsoil characteristics and some loss of functional topsoil
» Loss of and alteration of microhabitats, especially the loss of smaller ephemeral washes and pans and the alteration of ephemeral drainage lines
» Altered vegetation composition, lower vegetative cover and loss of species diversity
» Possible continued die-off of larger trees and shrubs and other species depending on higher soil moisture levels in downstream drainage lines due to the reduction of occasional floods as upper tributaries are obliterated
» Low functionality and productivity of large cleared areas that may remain susceptible to further degradation for many years after decommissioning
» Increased habitat fragmentation and displacement of terrestrial vertebrates
» Higher risk of the establishment by alien and indigenous invasive plant species

Nature: Construction of a power line as part of the grid connection to connect into the McTaggerts Substation. Alternative 1 is the shortest and environmentally most viable option, hence no other option is being considered. The power line will cause limited loss of vegetation, potential loss of individuals of keystone species and associated microhabitats, increase in runoff and erosion, disturbance of burrowing animals.

Listed Activities:
GNR 544, 18 June 2010 Activity 10

	Without mitigation	**With mitigation**
Extent	Local (2)	Local (1)
Duration	Long-term (4)	Long-term (4)
Magnitude	Minor (2)	Small (0)
Probability	Definite (5)	Highly Probable (4)
Significance	**Medium (40)**	**Low (20)**

Status (positive, neutral or negative)	Negative	Slightly negative
Reversibility	Partially reversible	Reversible
Irreplaceable loss of resources?	Probable	Not likely
Can impacts be mitigated?	Reasonably	

Mitigation:

- » Conduct an ecological walk through survey of the power line prior to construction.
- » Aim to minimise the destruction of indigenous large shrubs and trees.
- » Limit clearing of indigenous vegetation to pylon positions and access routes.
- » Shred all shrubs cleared and used the chips for dust and erosion control.
- » Monitor the establishment of invasive species along the power line route and remove as soon as detected, whenever possible before regenerative material can be formed.
- » Prevent spillage of construction material, oils or other chemicals, strictly prohibit other pollution
  - o Effective Micro-organisms can be used to treat any hydrocarbon spills – a clear method statement on hydrocarbon spill treatment, which also includes a list of at least three ready suppliers and/or firms doing bioremediation of hydrocarbon spills must be prepared prior to construction, updated regularly and kept on site at all times.

Cumulative impacts:

- » Possible erosion of surrounding areas if no mitigation is implemented, no major cumulative impact on flora or fauna expected

Residual impacts:

- » Localised alteration of soil surface characteristics
- » Localised loss of flora and displacement of fauna

Nature: Construction of an abstraction point and water pipeline to abstract water from the Gariep River will cause limited removal of vegetation, compaction of soils, temporary or permanent damage to animal burrows.

Listed Activities:
GNR 544, 18 June 2010 Activity 9

	Without mitigation	**With mitigation**
Extent	Local (2)	Local (1)
Duration	Long-term (4)	Long-term (4)

Magnitude	Low (4)	Small (1)
Probability	Definite (5)	Definite (5)
Significance	**Medium (50)**	**Medium (30)**
Status (positive, neutral or negative)	Negative	Slightly negative
Reversibility	Partially reversible	Reversible
Irreplaceable loss of resources?	Probable	Not likely
Can impacts be mitigated?	Reasonably	

Mitigation:

- Design the pipeline route to be positioned directly adjacent to the Khi Solar One pipeline servitude as far as possible; or as an alternative, within existing disturbed road servitudes.
- Avoid additional clearing of vegetation and rocky areas in the section between the N14 National Road and the Gariep River. Use overland pipelines in area where it is not feasible to bury the pipeline.
- If possible, share the same embankment for river access and cleared area for the pumping reservoir.
- Conduct an ecological walk through survey of the pipe line prior to construction to determine the full extent of protected fauna and flora that will be affected. And compile a suitable photo record that can be used by EO/ECO/construction.
- Aim to minimise the destruction of indigenous large shrubs and trees.
- During construction: create designated servitude areas and strictly prohibit any off-road driving or parking of vehicles and machinery outside designated areas.
- Remove and store topsoil and subsoil separately, store topsoil on the side of the excavation where it will not be affected by subsequent construction.
- Re-landscape and rehabilitate affected areas immediately after construction according to the general rehabilitation and re-vegetation plan.
- In areas where existing topsoil is very limited due to the presence of surface calcrete, a layer of topsoil sourced from the development footprints can be added over the re-landscaped sections to enable re-vegetation regrowth.
- Monitor the establishment of invasive species along the pipeline route and remove as soon as detected, whenever possible before regenerative material can be formed.

Cumulative impacts:

- Possible erosion of surrounding areas if no mitigation is implemented, no major cumulative impact on flora or fauna expected

Residual impacts:

- Localised alteration of soil surface characteristics

» Localised loss of flora and displacement of fauna

Nature: Construction of associated infrastructure, including buildings and other structures will result in loss of vegetation and/or species of conservation concern, loss of microhabitats, reduced vegetation cover, altered distribution of rainfall and resultant runoff patterns, increase in *concentrated* runoff from sealed surfaces and possibly higher accelerated erosion, reduction of habitat and resource availability for terrestrial fauna, possible pollution from permanent infrastructure and/or facilities etc.

Listed Activities:
GNR 544, 18 June 2010 Activity 12
GNR 544, 18 June 2010 Activity 39 (iii) & (v)
GNR 546, 18 June 2010 Activity 6(iii) & (iv)

	Without mitigation	**With mitigation**
Extent	Local (2)	Local (1)
Duration	Long-term (4)	Long-term (4)
Magnitude	Moderate (6)	Low (3)
Probability	Definite (5)	Definite (5)
Significance	**Medium (60)**	**Medium (40)**
Status (positive, neutral or negative)	Negative	Negative
Reversibility	Partially reversible	Reversible
Irreplaceable loss of resources?	Probable	Not likely
Can impacts be mitigated?	Reasonably	

Mitigation:

» Ensure that stormwater management structures do not negatively affect the above or pose any contamination risk of lower-lying larger ephemeral drainage lines, rivers and the Gariep River
» However, aim to channel runoff back into larger natural drainage lines to maintain seasonal moisture replenishment of these drainage lines beyond the development area to prevent the die-off of keystone species in drainage lines outside the development area
» Aim to minimise the destruction of indigenous large shrubs and trees.
» Conduct an ecological walk through survey of all infrastructure.
» During construction: stay within demarcated footprint areas and strictly prohibit any

off-road driving or parking of vehicles and machinery outside designated areas
» Prevent spillage of construction material and other pollutants, contain and treat any spillages immediately, strictly prohibit littering.
» Topsoil (the upper 25 cm of soil) is an important natural resource; where it must and can be stripped, never mix it with subsoil or any other material, store and protect it separately until it can be re-applied, minimise handling of topsoil.
» Temporarily stored topsoil must be re-applied within 6 months, topsoil stored for longer need to be managed according to a detailed topsoil management plan.
» Rehabilitate and re-vegetate all areas outside footprint area that have been disturbed.
» After decommissioning remove all foreign material prior to starting the rehabilitation.
» The rehabilitation plan for all temporarily affected areas and for the development area after decommissioning must aim to re-introduce all non-invasive indigenous species listed in the specialist report as a minimum, taking the observed original cover percentages as a guideline of acceptable vegetation cover
» Monitor the establishment of invasive species and remove as soon as detected, whenever possible before regenerative material can be formed.

Cumulative impacts:

» If mitigation measures are not strictly implemented the following could occur:
  - Erosion of areas around sealed surfaces and continued erosion of the development area with associated siltation and/or erosion of lower-lying water resource features
  - Contamination of ground water resources and possibly the Gariep River
  - Spread and establishment of invasive species
» Increased habitat fragmentation and displacement of terrestrial vertebrates in the region.
» Increased transformed areas (together with surrounding developments) that will affect local fauna and flora population dynamics.

Residual impacts:

» Altered topsoil characteristics.
» Loss of and alteration of microhabitats, especially the loss of smaller ephemeral washes and pans and the alteration of ephemeral drainage lines.
» Altered vegetation composition, lower vegetative cover and loss of species diversity.
» Low functionality and productivity of cleared areas that may remain susceptible to further degradation for many years after decommissioning.
» Increased habitat fragmentation and displacement of terrestrial vertebrates.
» Higher risk of the establishment by alien and indigenous invasive plant species.

Nature: Construction of evaporation ponds could cause environmental degradation and pollution of water bodies.

Listed Activities:
GNR 544, 18 June 2010 Activity 11
GNR 544, 18 June 2010 Activity 12
GNR 544, 18 June 2010 Activity 13
GNR 544, 18 June 2010 Activity 18
GNR 546, 18 June 2010 Activity10 (a) ii

	Without mitigation	**With mitigation**
Extent	Regional (5)	Minor (2)
Duration	Long-term (4)	Long-term (4)
Magnitude	High (8)	Low (4)
Probability	Definite (5)	Definite (5)
Significance	**High (85)**	**Medium (50)**
Status (positive, neutral or negative)	Negative	Negative
Reversibility	Partially reversible	Partially reversible
Irreplaceable loss of resources?	Probable	Not likely
Can impacts be mitigated?	Reasonably	

Mitigation:

- » Avoid all areas with a high occurrence of natural pans and larger intermittent drainage lines for the location of evaporation ponds.
- » During the design phase, ensure that a buffer of at least 150 m, preferably more, is maintained around all ephemeral pans and larger washes and drainage lines to eliminate any contamination risk of lower-lying pans, washes, drainage lines and rivers-
  - o Indicate all evaporation ponds on the final layout plan submitted prior to commencement of construction; and
  - o Ensure an appropriate management and response plan is in place to deal with accidental spillages or overflows which may result from extreme weather events or infrastructure breakages.
- » Ensure that all pons are fenced with 'jackal-proof' fencing: a meshed wire, with the base dug into the ground and there lined with large rocks to prevent access of even small mammals.
- » Monitor erosion of areas and control where necessary.
- » Continually monitor the infrastructure to detect any cracks or possible leakage early
- » Ensure that the evaporation ponds are lined.
- » Undertake monitoring of the evaporation ponds to check for leakages during the

operational phase.

Cumulative impacts:

» If mitigation measures are not strictly followed the following could occur:
  - Contamination of lower-lying wetlands and the Gariep river; and
  - Potential for increased chemical-laden dust and its impact on surrounding environments and biodiversity.

Residual impacts:

» Altered topsoil characteristics
» Altered vegetation composition, lower vegetative cover and loss of species diversity

Nature: Topsoil stockpiles that will be required during and after construction and large topsoil and subsoil volumes will be removed from the leveling of areas for the solar field which could cause soil loss, possible degradation of downstream habitats, possible excessive establishment and spread of weeds and invasive species (alien and indigenous) on disturbed areas, possible marginal increase in ambient temperatures in the immediate vicinity of the development due to hotter soil surface temperatures if stockpiles remain bare, possible excessive loss of topsoil resources, possible long term source of dust.

Listed Activities:
GNR 545, 18 June 2010 Activity 1
GNR 545, 18 June 2010 Activity 15

	Without mitigation	**With mitigation**
Extent	Local (2)	Local (1)
Duration	Permanent (5)	Long-term (4)
Magnitude	High (8)	Moderate (5)
Probability	Definite (5)	Definite (5)
Significance	**High (75)**	**Medium (50)**
Status (positive, neutral or negative)	Negative	Negative
Reversibility	Partially reversible	Partially reversible
Irreplaceable loss of resources?	Probable	Not likely
Can impacts be mitigated?	Reasonably	

Mitigation:

- » Indicate all stockpile areas and anticipated volumes of stored materials on the final layout plan prior to commencement of construction.
- » Ensure an appropriate management plan is in place for the construction, rehabilitation and erosion control of the stockpile areas prior to commencement of construction.
- » Minimise handling of topsoil, and aim to reduce double-handling of topsoil.
- » All areas utilised for topsoil stockpiles must be rehabilitated and alien vegetation cleared.
- » Topsoil (the upper 25 cm of soil) is an important natural resource; where it must and can be stripped, never mix it with subsoil or any other material, store and protect it separately until it can be re-applied.
- » Temporarily stored topsoil must be re-applied within 6 months, topsoils stored for longer need to be managed according to a detailed topsoil management plan.
- » After construction remove all foreign material prior to starting the rehabilitation
- » The rehabilitation plan for all temporarily affected areas must aim to re-introduce all non-weed indigenous species listed in the specialist report as a minimum, taking the observed original cover percentages as a guideline of acceptable vegetation cover.

Cumulative impacts:

- » If mitigation measures are not strictly followed the following could occur:
  - o Continued erosion of the altered surfaces with associated degradation of the site and surrounding areas
  - o Spread and establishment of invasive species
- » Increased transformed areas (together with surrounding developments) that will affect local fauna and flora population dynamics and runoff patterns.
- » Excessive loss of functional topsoil and associated loss of rangeland productivity and susceptibility of rangelands to degradation.

Residual impacts:

- » Altered topsoil characteristics
- » Loss of and alteration of microhabitats
- » Altered vegetation composition, lower vegetative cover and loss of species diversity
- » Potential for increased dust and its impact on surrounding environments and biodiversity
- » Higher risk of invasion by alien plant species

Nature: Construction and maintenance of facilities for the storage of dangerous goods, mostly hydrocarbons, in containers during and after construction.

Listed Activities:
GNR 544, 18 June 2010 Activity 13

	Without mitigation	**With mitigation**

Extent (E)	Regional (5)	Local (1)
Duration (D)	Moderate-term (3)	Short-term (2)
Magnitude (M)	Moderate (6)	Low (3)
Probability (P)	Definite (5)	Definite (5)
Significance (S = E+D+M)*P	**High (70)**	**Medium (30)**
Status (positive, neutral or negative)	Negative	Negative
Reversibility	Partially reversible	Reversible
Irreplaceable loss of resources?	Probable	Not likely
Can impacts be mitigated?	Reasonably	

Mitigation:

» Avoid all riparian vegetation around natural pans and larger intermittent drainage lines as far as practically possible-
  - Also avoid all areas found to be sensitive during the above survey as well as the pre-construction ecological foot-print investigation.

» Place infrastructure as far as possible on sites that have been disturbed by past development and mining activities already.

» During the design phase, ensure that a buffer of at least 500 m, preferably more, is maintained around all ephemeral pans and larger washes and drainage lines outside the footprint area to maintain the species diversity and buffering capacity of these systems and avoid spreading of spills into subsurface flow-regimes-
  - Ensure that stormwater management structures do not negatively affect the above or pose any contamination risk of lower-lying larger ephemeral drainage lines, rivers and the Orange River.

» Ensure all containers are placed onto a constructed, impermeable surface surrounded by a suitable containment wall, and that the area is also equipped with clearly marked fire-fighting equipment as well as spill-kits
  - Effective Micro-organisms can be used to treat any hydrocarbon spills – a clear method statement on hydrocarbon spill treatment, which also includes a list of at least three ready suppliers and/or firms doing bioremediation of hydrocarbon spills must be prepared prior to construction, updated regularly and kept on site at all times; and
  - Ensure that a thorough hazardous materials storage and - waste method statement is in place and strictly enforced by the Health and Safety Manager.

» Stay within demarcated temporary construction areas and strictly prohibit any off-road driving or parking of vehicles and machinery outside designated areas

- » Prevent spillage of construction material, especially concrete and cement, and other pollutants, contain and treat any spillages immediately, strictly prohibit any pollution/littering according to the relevant EMPr.
- » After construction remove all foreign material prior to starting the rehabilitation
  - o The rehabilitation plan for all temporarily affected areas must aim to re-introduce all non-weed indigenous species listed in the specialist report as a minimum, taking the observed original cover percentages as a guideline of acceptable vegetation cover; and
  - o Monitor the establishment of invasive species and remove as soon as detected, whenever possible before regenerative material can be formed.

Cumulative impacts:

- » If mitigation measures are not strictly implemented the following could occur:
  - o Considerable loss of biodiversity; and
  - o Contamination of ground water and the Orange River.
- » Increased transformed areas (together with surrounding developments) that will affect local fauna and flora population dynamics and runoff patterns.

Residual impacts:

- » Altered topsoil characteristics;
- » Loss of and alteration of microhabitats;
- » Altered vegetation composition;
- » Higher risk of invasion by alien plant species; and
- » Potential for increased dust and its impact on surrounding environments and biodiversity.

7.4.5. Comparative Assessment of Access Road Alternatives

Both routes will require new road construction within the boundaries of Portion 3 of the Farm McTaggarts Camp 453. New road construction should be in accordance with the mitigation as proposed for the removal of vegetation, transformation of soil surface and loss of microhabitats, compaction of soils, and removal of topsoil.

1. *Access Alternative 1- Access off the N14 via the existing Khi Solar One access road*. The Khi Solar One project has established a formal surfaced access road off the N14 for access to the McTaggarts Camp farm, and specifically the Khi Solar One project development site. The road is available to provide access for a portion of the distance to the site up to the Khi Solar One boundary (5.5km), with an additional 4.5km of road to then be constructed within the boundary of Portion 3 of the Farm McTaggarts Camp 453. This access road (total length of 10km) would provide direct access to the facility area from the south; or
2. *Access Alternative 2- Access off the N14 via the existing district road D3276.* The existing district road D3276 is a gravel road (and would be required to be surfaced). This road intersects with the northern boundary of Portion 3 of the Farm McTaggarts

Camp 453 approximately 11 km from the N14. A section of road ~4km would be required to be constructed to access the facility area from the north. This access road (total length of 15km) would provide direct access to the facility area from the north.

Both alternatives will result in disturbance to habitats (flora and fauna) and displacement of fauna. Both alternatives require additional earth works and construction activities. Alternative 1 is shorter route than Alternative 2. Considering the aridity of the area and the difficulty of new vegetation establishment, **Alternative 1** is preferred. The proposed Alternative 1 traverses the Helbrandskloofspruit tributary, which is less desirable from an ecological perspective, and would be recommended to be realigned.

7.4.6. Implications for Project Implementation

With the diligent implementation of mitigating measures by the developer, contractors, and operational staff, the severity of ecological impacts of the CSP plant can be significantly reduced or avoided. The Upington Solar Thermal Plant Two can be developed and ecological impacts managed by adhering to the following key actions:

» The areas of high ecological sensitivity amount to an area of ~11 hectares of the 800ha development footprint (i.e. ~1.3% of the development footprint for Upington Two).
» Where technically viable, the layout of the heliostats within the solar field should avoid the areas of high ecological sensitivities of the site as presented in the sensitivity map (Figure 7.3) in order to minimise the significance of impacts on these features.
» Design the access route to go as far as possible along existing roads of the Khi Solar One access and other larger farm tracks.
» An ecological walk through survey for the CSP plant and associated infrastructure (including the pipeline, power line and access roads) must be undertaken prior to construction.
» A permit to be obtained for removal of protected trees that are affected.
» Ensure adequate drainage where the Helbrandskloofspruit tributaries are traversed by any infrastructure.
» Avoid pans as far as possible, maintaining a buffer zone of at least 32 m, preferably a minimum of 50 m from all pans that will not be within the solar development footprint.
» A licence is required from DWS if there are impacts on any water resources (i.e. the drainage lines as well as the abstraction of water from the Gariep River).
» Ensure that suitable stormwater management structures are in place.
» All disturbed areas must be rehabilitated. Areas that can be re-vegetated must be determined during the construction phase.

7.5. Potential Impacts on Avifauna

One of the key points for clarification raised by DEA was for the amended EIA report to consider impacts to avifauna in further detail through an expanded avifauna study including an additional avifauna survey. The primary objectives of the avifauna study were:

- Expand the study by means of vantage point surveys to be conducted to cover the full extent of the farm McTaggarts Camp (i.e. the 2200ha study area where Khi Solar One as well as the two other CSP plants are planned);
- Comment on and expand on mitigation measures as set out in the original assessment; and
- Provide detail on implementable mitigation measures for the proposed development/s.

Due to the fact that this type of solar project and its impact on avifauna is new, poorly researched and poorly understood in South Africa, a detailed literature review consisted of the review of existing reports for the current projects, as well as relevant literature for similar projects worldwide in order to obtain a better understanding of the project, as well as the impacts on similar projects in other parts of the world. No guidelines for vantage point monitoring or analysis of data for a CSP facility are currently available.

The fieldwork consisted of a 10 day field study. During this period eight vantage point surveys were conducted, transects were conducted in the washes (riparian zones) and an investigation of the Khi Solar One solar field and tower complex which are constructed on the site were undertaken. The fact that the study was conducted on the site of the Khi Solar One solar complex gave a unique perspective on how natural behaviour would be affected, and the changes in behaviour, if any, could be observed first hand.

7.5.1. Results of the Avifauna survey

During the surveys a total of 44 species were recorded and a total of 2138 individual birds were recorded. Only two species of conservation importance were recorded during the study namely, the Martial Eagle (*Polemaetus bellicosus*) and the Lanner Falcon (*Falco biarmicus*). The Martial Eagle was recorded to the north-east of the study approximately 2km outside of the study area. The two Lanner Falcon recorded appear to have taken up residence in the tower complex of the Khi Solar One solar project.

During the avifauna surveys, data was collected on the number of species and abundance at each of the vantage point surveys. Due to the homogeneity of the vegetation throughout the study area there was no significant difference in the species richness or species diversity at any of the vantage points. Information pertinent to the study was also recorded, namely flight height, flight direction and behaviour.

a. Avifauna flight height

The average flight height data rounded to the nearest one decimal collected during the surveys is represented graphically in Figure 7.5. These averages are however skewed by a few species such as Egyptian Goose, Karoo Korhaan, Martial Eagle, Northern Black Korhaan, Pale Chanting Goshawk, Pied crow and Red-crested Korhaan. These are relatively uncommon species which fly very high such as in the case of the Martial Eagle, Pale Chanting Goshawk and Pied crow, or species that fly up to quite a height when flushed only to settle a short distance away again, such as the Korhaan species. If these species are removed from the dataset we found that the average heights decrease considerably (Figure 7.5). It can be noticed that most of the species recorded in the area fly at an average height of 4.0m, while the average minimum height is 0.4m and the average maximum height is 14.1m. Figure 7.6, shows the average minimum and maximum flight heights per species. What is noticeable is that the vast majority of species show and average flight height (based on the actual flying height excluding the ground level data) of below 10m. This is likely due to the vegetation being low shrubs and grass with few or no trees, all feeding, nesting and protection against predation thus occurs at very low altitudes.

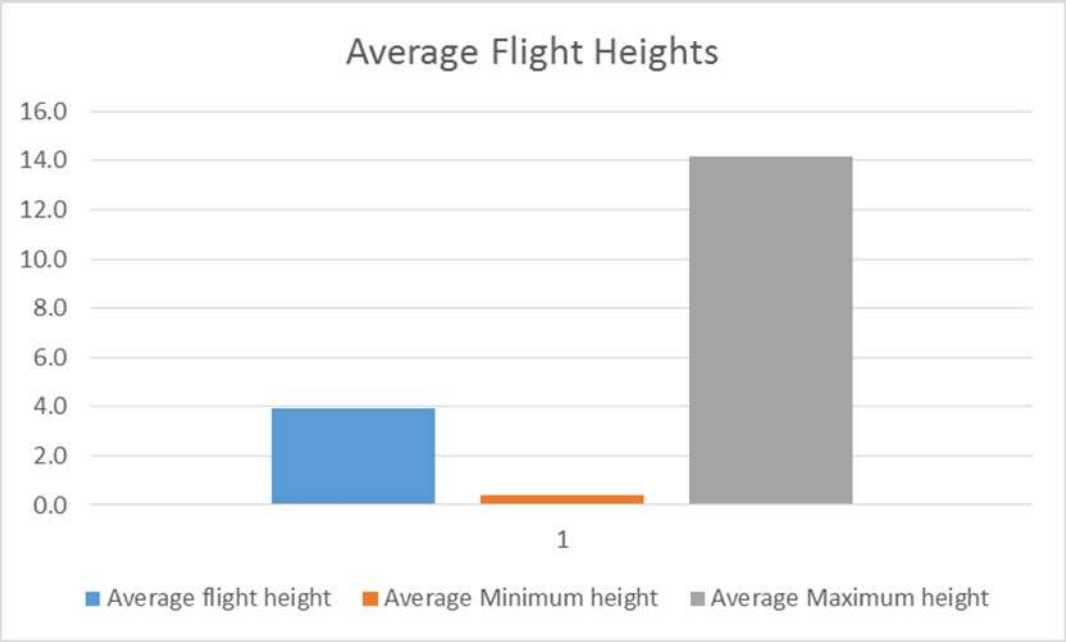

Figure 7.4: Average flights heights of birds after removal of the rare outliers

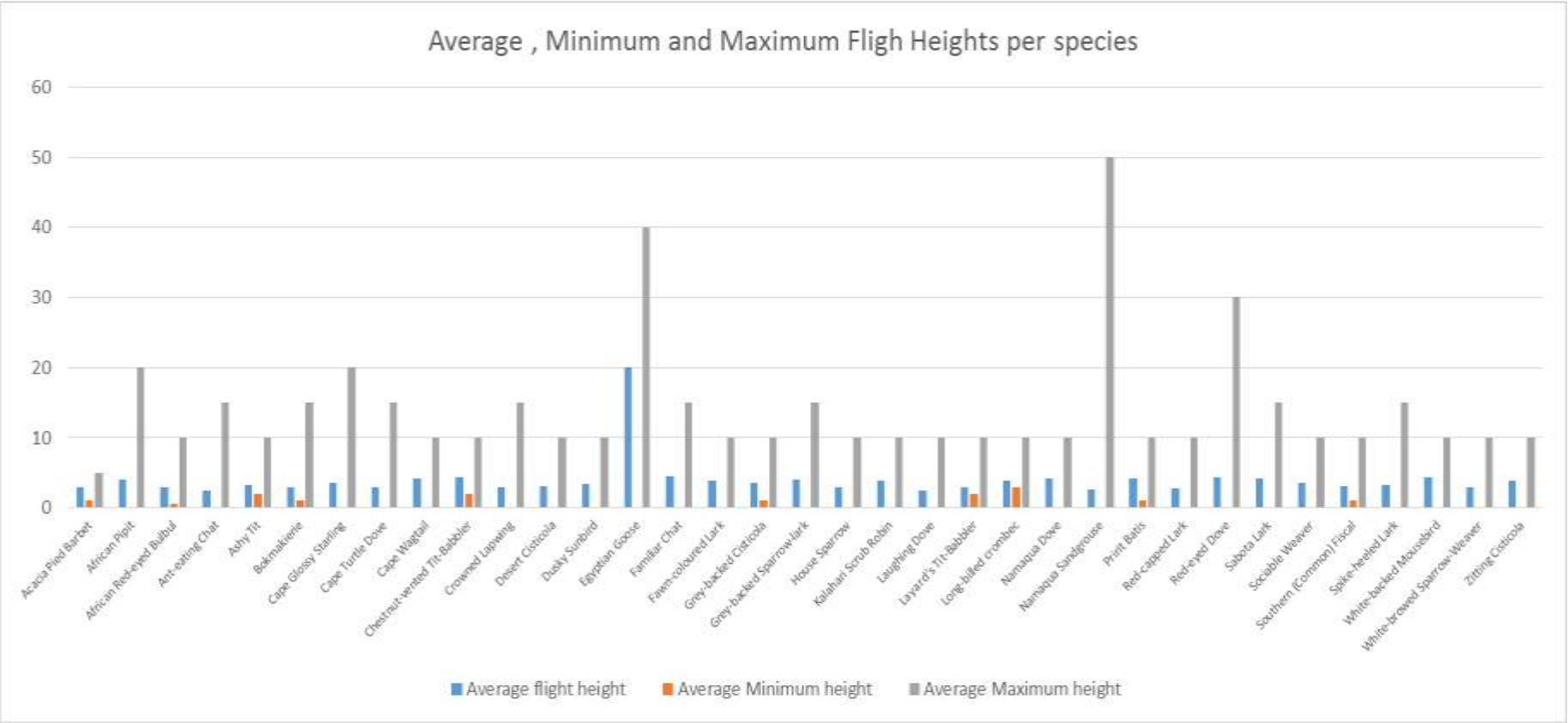

Figure 7.5: Average, minimum and maximum flight heights by species

b. Avifauna flight direction

Figure 7.6 shows the flight directions recorded. From the data recorded there does not appear to be any preferred or prevalent direction in which birds tend to fly. This may be due to the fact that there is no significant migration at this time of the year and that all the birds recorded are locally resident.

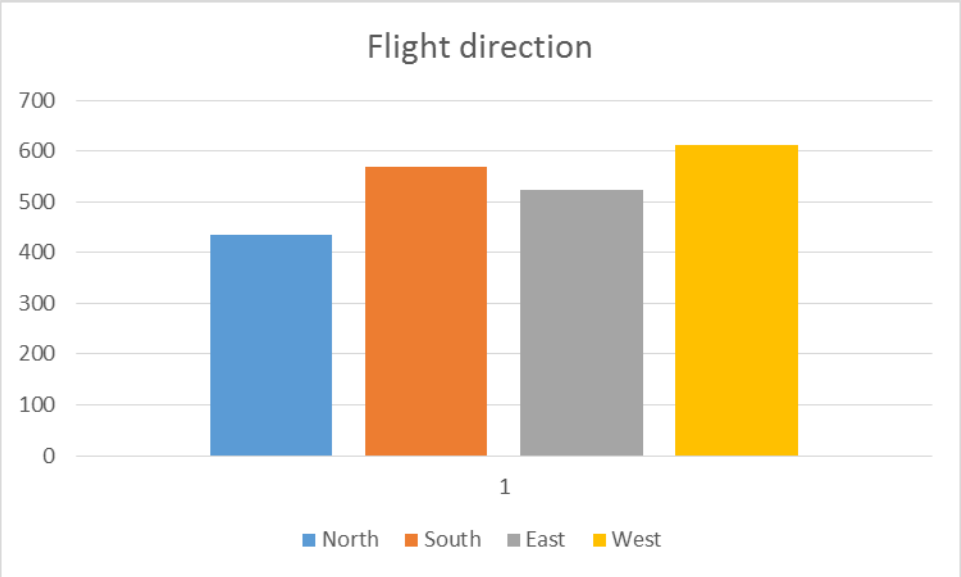

Figure 7.6: Indicates the flight directions recorded. From the data recorded there does not appear to be any preferred or prevalent direction in which birds tend to fly. This may be due to the fact that there is no significant migration at this time of the year and that all the birds recorded are locally resident

c. Avifauna behaviour

Bird activity was restricted to flying, feeding perching and soaring in search of food (for the predatory birds), as expected during a survey at this time of the year.

A substation is currently under construction on the site for the Khi Solar One CSP project and the proposed project is intended to connect into this new McTaggerts Substation via a 132 kV overhead power line (up to 4km in length).

Commercial-scale solar technologies are relatively new, with a limited number of significant developments worldwide. Some studies have been conducted on the effects of CSP facilities on avifauna, most notably The Solar One plant in the Mojave Desert in the United States (McCrary, et al., 1986).

Although there may be considerable impact due to the clearing of vegetation and the large footprint required for commercial-scale energy production, which would refer to the habitat loss and disturbance created during the construction phase of the facility, birds are the most mobile of vertebrate species and there is considerable amount of the same

vegetation in adjacent areas to which avifauna will move. Furthermore, in this case, the vegetation of the area is very low and with revegetation the area of the heliostat field, thereby recovering some of the lost vegetation. Secondary impacts relate to the operation of the facility and include avian mortality due to direct interactions with the facilities and their associated infrastructure.

Based on the information gathered, several impacts have been identified and will be quantified in sections below:

- Impact on local bird community due to habitat loss;
- Impact on local bird community due to disturbance;
- Impact on birds attracted to solar thermal plant infrastructure;
- Birds may be singed or killed flying into the focal point;
- Collision of birds with infrastructure associated with the CSP facilities;
- Collision of birds with the associated power line; and
- Electrocution of birds on associated power line tower structures.

These impacts were quantified using the data collected during the site visit.

7.5.2. Impact tables summarising the significance of impacts on avifauna (with and without mitigation)

Impact on local bird community due to habitat loss

Nature: In order for solar energy facilities to be commercially viable, they require large tracts of land, in this case ±700ha. It can therefore be assumed that a habitat will be lost during the establishment of the facility and its associated infrastructure (including clearing for access roads and power lines). Habitat loss reduces the carrying capacity of a habitat, often resulting in localised population declines. Such habitat loss can impact on local as well as, to a lesser degree, migratory species. The general nature of the study area (already relatively disturbed, and extremely uniform throughout wider area) means that this is not likely to impact significantly on the avifauna of the area.

Extent: The north western portion of the site would be the area within the broader site that would be disturbed by the proposed facility. This area is largely composed of unproductive plains, where bird density and diversity is low. Numerous small washes occur within the area, although their influence on bird density and diversity was negligible. The impact of habitat loss would therefore be local.

Duration: The loss of habitat will have a permanent impact for the life of the project. Rehabilitation of the habitat is possible, however due to the long term nature of this project, it is unlikely that the habitat lost through the construction of the facility, will be restored in the near future. Based on this, the loss of habitat and the 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 on site (i.e. degraded or intact). For instance, if Species of Special Concern were adversely affected by the habitat loss on site, then the impact would be high. No Species of Special Concern were however detected on site and the density and diversity of bird species was fairly low. The amount of habitat that would be lost (±700ha) would not be significant. For this reason, the magnitude is minor.

Probability: Habitat will be lost if the construction of the facility takes place and therefore, regardless of any prevention or mitigation measures that are put in place, an impact will occur. The impact will be definite.

Mitigation measures: The following mitigation measures are recommended:

- Minimise vegetation clearing;
- Avoid clearing vegetation in drainage channels or washes, where bird density and diversity has the potential to be higher;
- If possible, the servitude of the power line exiting the site should follow existing roads and not cut across habitat; and
- 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.

Nature: Impact on local bird community due to habitat loss from the construction of the CSP plant and associated infrastructure including power lines.		
Listed activities: GNR 545, 18 June 2010 Activity 1 GNR 544, 18 June 2010 Activity 47 (iii) GNR 545, 18 June 2010 Activity 15 GNR 546, 18 June 2010 Activity 13		
	Without mitigation	**With mitigation**
Extent	Local (1)	Local (1)
Duration	Long Term (4)	Long Term (3)
Magnitude	Minor (2)	Minor (2)
Probability	Highly Probable (4)	Highly Probable(4)
Significance	**Low (28)**	**Low (20)**
Status	Negative	Negative
Reversibility	Possible	Possible
Irreplaceable loss of resources	None	None
Can impacts be mitigated	Yes	Yes

Mitigation measures:

» Where possible, avoid clearing vegetation in drainage channels or washes, where bird density and diversity has the potential to be higher (although this higher diversity was not recorded during the site visit).
» If possible, the servitude of the power line exiting the site should follow existing roads and not cut across habitat.
» All construction and maintenance activities must be undertaken in accordance with Eskom's Environmental Best Practise Standards.
» The construction footprint and access roads should be restricted to within the development footprint.
» All social weavers nests that may be affected by the development must be moved by a qualified contractor or with the assistance of the relevant qualified persons; other bird nests in trees/higher shrubs need to be monitored and only removed if not used for breeding.

Cumulative impacts:

The loss of habitat on-site has the potential to add to the cumulative impacts that habitat loss in the region is having on avifauna. However, ±700ha in the context of the amount of similar habitat in the region is a negligible amount.

Residual impacts:

Localised loss or displacement of avifauna species.

Impact on local bird communities due to disturbance

Nature: Disturbance from human activity, during the construction and operational phase, has the potential to modify bird behaviour on site. For shy and sensitive species, this may result in displacement or exclusion.

Construction and maintenance activities associated with the power facility as well as the power line impact on birds through disturbance, particularly during the breeding season. Certain bird species could also choose to nest on the towers of the proposed power line. In this arid and largely treeless landscape any form of available nesting substrate will probably be utilised by medium sized raptors, crows and the Sociable Weaver. The proposed power line is likely to be built on a monopole structure, which does not present the most conducive structure for nesting.

Extent: It is assumed that all new construction, and subsequent operational activities, will be limited mainly to the ±700ha area demarcated in the north west of the property. Based on this, the impact will be local.

Duration: Disturbance will mainly occur during the construction phase of the development, and to a lesser extent, during operation. Over time, bird species are able to adapt to 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 by the potential outcome should certain individuals in the bird community present on site be unduly disturbed and affected by the construction and operation of the facility. No Species of Special Concern were detected during the site visit. In addition, none of the species detected on site are unduly shy or secretive species and particularly sensitive to disturbance. The magnitude of the impact will therefore be minor.

Probability: There is a distinct possibility of this impact occurring.

Mitigation: The additional disturbance will be minimal and it not expected to have a particularly significant impact on the local bird community. However:

- Contractors need to minimise the amount of disturbance during the construction phase of the facility, by staying within the demarcated ±700ha 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 near it.

Nature: Impact on local bird community due to disturbance on site and in surrounding area.		
Listed activities: GNR 545, 18 June 2010 Activity 1 GNR 544, 18 June 2010 Activity 47 (iii) GNR 545, 18 June 2010 Activity 15 GNR 546, 18 June 2010 Activity 13		
	Without mitigation	**With mitigation**
Extent	Local (1)	Local (1)
Duration	Short Duration (2)	Short Duration (2)
Magnitude	Minor (2)	Minor (2)
Probability	Distinct Possibility (3)	Distinct Possibility (3)
Significance	**Low (15)**	**Low (15)**
Status	Negative	Negative
Reversibility	Possible	Possible
Irreplaceable loss of resources	None	None
Can impacts be mitigated	Yes	Yes
Mitigation measures: » Contractors need to minimise the amount of disturbance during the construction phase of the facility, by staying within the demarcated ±700ha 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 near it. Removal of the nest may		

require a permit from DENC.
Cumulative impacts: Development of multiple solar energy facilities in this region near Upington may have cumulative impacts on birds, however limited due to the species which occur in the area. Each CSP plant will have to individually assess if mitigation measures are required to protect avifauna.
Residual impacts: Localised loss or displacement of avifauna species.

Impact on birds attracted to the solar thermal infrastructure

Nature: The facility will cover an area of ±700ha and will include a series of heliostats/mirrors which will reflect sunlight. Infrastructure at the Khi Solar One site was investigated in order to determine the possible impacts on avifauna. The current infrastructure was investigated keeping in mind the findings of the Solar One study by McCrary et al. (1986) as well as the avian species and behaviour recorded during the vantage point surveys conducted. In order to reduce the possible impacts of the development on avian species the infrastructure of the development should be made as unattractive as possible for avian species.

» Openings at either end of the horizontal rotating cylinder - The first aspect of the development at the Khi Solar One CSP development that should be addressed are the openings at either end of the horizontal rotating cylinder of the heliostats. These openings would be ideal nesting sites for sparrow species, as well as any other structure nesting species. This may not necessarily be a negative impact, but certain factors need to be taken into account. In order to make the development as unattractive for avifauna species, possible nesting sites need to be limited to as few as possible, with two opening in each heliostats these openings could provide more than 3400 nesting sites, with two birds per nest this can cause an influx of 6800 birds to the area. Species most likely to be attracted to these nesting sites are sparrows and doves which, in turn, act as prey species for larger raptors, thus being likely to attract more of these species to the area as well. Furthermore, if nests are built in these openings, the eggs or chicks could roll out of the nests as the cylinder rotates. In the long term this could lead to a lower local fecundity of species using these openings as breeding sites.
» Heliostats in the vertical position - The heliostats themselves, when in a static position (horizontal to the grade) or focused position (at an angle to the grade are visible very visible and thus unlikely to cause avifauna collisions. Mirrors placed in the cleaning position (perpendicular to the ground), give the illusion of a continuation of the heliostat field and are very likely to cause collisions, due to birds trying to continue to fly through the heliostat field which appears to be continuing in the mirrors. Collisions with heliostats were found to be the impact with the greatest probable magnitude related to the CSP facility in the study by McCrary et al (1986).

- Flat surfaces at the base of the tower - Any elevated flat surfaces are seen by many avian species as potential nesting sites, including smaller and larger raptor species, pigeons and doves. The tower itself has many flat surfaces including ledges near the base of the tower, the ledges of the focal cavities and the ledges at the top of the tower. These ledges will attract many species of birds which will use them as nesting places, but these birds may in turn attract raptor species which prey on the species using the ledges as nesting sites.
- Opening at the top of the tower - Not only will the opening at the top of the tower will allow structure nesting species access into the tower to build nests in what appears to be suitable nesting area for them, but to some species the visual similarity of the tower to a grain silo may be a distal factor that may attract them to the tower. The opening at the top of the tower may cause them to approach the tower in order to investigate the contents of the tower.
- Flat surfaces under the cavities - Under each of the cavities there are flat surfaces bisected by steel girders, these flat surfaces may be seen as suitable nesting places for bird species that often build their nests under cliff overhangs, bridges or other manmade structures, including swallows and swifts.
- Colour of the tower cavities - At present the tower cavities are painted white. Because white light reflects ultraviolet light it is likely that the white cavity areas will attract insects, which in turn will attract aerial insectivores such as swallows, swifts and martins (the same species which were found to be most susceptible to being burned to death during the Solar One study (McCrary, et al., 1986).
- Spider-frame at the top of the tower - The spider frame and other infrastructure at the top of the tower may attract raptor species, including larger raptors such as eagles as perches from which to hunt prey.
- Focusing the heliostats above the tower during maintenance - Information about the operation of the CSP indicated that, during maintenance, the heliostats may be focused above the tower in order to allow for maintenance in the cavities. This practice may produce a sudden, invisible "hotspot" above the tower which will not give any warning to birds, such as a gradual increase in temperature around the cavities, due to reflection of some of the heat, may allow during operation. This undetectable sudden "hotspot' may increase the possibility of birds being burned, as was proposed by McCrary, et al. (1986). The radiation from the cavities will cause a gradually increasing "heat bubble" around the cavity which will be sensed by most birds before it is potentially fatal allowing birds to take evasive action. This radiating heat bubble will be a lot less distinct when the focal point is above the tower and this focal point may be perceived as a more sudden, potentially fatal, hotspot, thus not allowing birds to take evasive action in time.
- Evaporation ponds - Possible toxicity of the water in the evaporation ponds will need to be monitored in order to prevent poisoning of avifauna species. In arid areas any water sources will be utilised by many species, and a toxic water source will have a considerable effect on species in the area. Egyptian geese have already started to utilise these ponds.

Extent: This would be limited to the immediate area of the facility containing the heliostats. 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 order to measure 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 birds will be attracted to the facility and if so, to what extent they would interact with the facility. While this phenomenon cannot be ruled out, evidence to date from other installed facilities (including the adjacent Khi Solar One facility) have shown that the magnitude is low due to the type of birds resident in the area.

Probability: The probability of this occurring is relatively probable before mitigation.

Mitigation:

» Openings at either end of the horizontal rotating cylinder – The simplest way to mitigate this impact would be to seal the openings at each end of the cylinder. This can be done by tack-welding appropriately sized discs onto either end.
» Heliostats in the vertical position – the heliostats should be limited to being in the vertical position for as short a time as possible. The trucks which clean the heliostats should follow each other as close as possible and the heliostats returned to a static (horizontal) or focussed position as soon as possible after cleaning.
» Flat surfaces at the base of the tower – all ledges should be built or panelled so that they slope at an angle downwards to the outside to prevent nesting on these ledges.
» Opening at the top of the tower – netting can be placed across the tower near the top of the tower in order to prevent birds from entering the tower. If the correct strength netting is used this can also serve as a safety net.
» Flat surfaces under the cavities – Chicken wire or similar fine mesh steel wire mesh can placed over the girders in order to prevent access to the flat surfaces so that birds cannot build mud nests on these surfaces.
» Colour of the tower cavities – a neutral brown, concrete colour or grey would prevent the reflection of UV light and thus mitigate the possible impact of the white tower.
» Spider-frame at the top of the tower – measures need to be put in place in order to prevent birds using the spider frame and other infrastructure as perches. Investigating the option of a timed release of steam at the top of the tower would also be an audible and visual deterrent to birds at the top of the tower.
» Focusing the heliostats above the tower during maintenance – ideally the heliostats should be in one of three positions vertical (washing position – for as short a time as possible), static position or focussed in order to prevent the undetectable "hotspot" above the tower.

» Evaporation ponds - toxicity levels of the water in the evaporation ponds will need to be monitored and maintained in order to prevent poisoning of species that may utilise the ponds. In a study of avian species on tailings storage facilities Hudson and Bowman (2008) found that, although the area was avoided by many species, a number of waders were noted to be feeding on insects on the water surface.

Nature: Impact on of birds attracted to the solar thermal infrastructure		
Listed activities: GNR 545, 18 June 2010 Activity 1 GNR 544, 18 June 2010 Activity 47 (iii) GNR 545, 18 June 2010 Activity 15 GNR 546, 18 June 2010 Activity 13		
	Without mitigation	**With mitigation**
Extent	Local (1)	Local (1)
Duration	Long Term (4)	Permanent (5)
Magnitude	Low (3)	Negligible (1)
Probability	Probable (2)	Very Improbable (1)
Significance	**Low (16)**	**Low (7)**
Status	Negative	Negative
Reversibility	Possible	Possible
Irreplaceable loss of resources	None	None
Can impacts be mitigated	Yes	Yes
Mitigation measures:	» Openings at either end of the horizontal rotating cylinder – The simplest way to mitigate this impact would be to seal the openings at each end of the cylinder. This can be done by tack-welding appropriately sized discs onto either end. » Heliostats in the vertical position – the heliostats should be limited to being in the vertical position for as short a time as possible. The trucks which clean the heliostats should follow each other as close as possible and the heliostats returned to a static (horizontal) or focussed position as soon as possible after cleaning. » Flat surfaces at the base of the tower – all ledges should be built or panelled so that they slope at an angle downwards to the outside to prevent nesting on these ledges. » Opening at the top of the tower – netting can be placed across the tower near the top of the tower in order to prevent birds from entering the tower. » Flat surfaces under the cavities – Chicken wire or	

	similar fine mesh steel wire mesh can placed over the girders in order to prevent access to the flat surfaces so that birds cannot build mud nests on these surfaces. » Colour of the tower cavities – a neutral brown, concrete colour or grey would prevent the reflection of UV light and thus mitigate the possible impact of the white tower. » Spider-frame at the top of the tower – measures need to be put in place in order to prevent birds using the spider frame and other infrastructure as perches. Investigating the option of a timed release of steam at the top of the tower would also be an audible and visual deterrent to birds at the top of the tower » Focusing the heliostats above the tower during maintenance – ideally the heliostats should be in one of three positions vertical (washing position – for as short a time as possible), static position or focussed in order to prevent the undetectable "hotspot" above the tower. » Evaporation ponds - toxicity levels of the water in the evaporation ponds will need to be monitored and maintained in order to prevent poisoning of species that may use the ponds.
Cumulative impacts:	A tower plant is under construction on the adjacent Khi Solar One site. The proximity of the two facilities will result in an increased area of heliostats, increasing the potential for disorientation for specific bird species. The consolidation of impacts is preferred, localising the impact to an area where the risk to birds is considered low. In addition, the spacing between the two facilities is sufficient to provide a corridor for avifauna movement.
Residual impacts:	Localised loss or displacement of avifauna species.

Collision of birds with infrastructure associated with the development, most specifically the power line

Nature: Collisions are one of the biggest single threat posed by overhead power lines to birds in southern Africa. In South Africa, bird collisions with power lines are a major form of unnatural mortality, affecting several threatened species as well as other species. The majority of species that are susceptible to collisions tend to be long-lived, slow reproducing species such as bustards, cranes, korhaans and various water bird species who are not the most agile flyers. Due to the slow reproductive nature of many of the susceptible species, long-term mortalities caused by collisions may result in future population's abilities to sustain themselves. Birds usually avoid the highly visible bundled

conductors, but often fail to see the thin ground wires, with typical injuries resulting from collisions including broken necks and legs. Threatened species that have the potential to occur in the study area and that may be involved in collision events include:

- Secretarybirds *Sagittarius serpentarius* – Near Threatened
- Kori Bustard *Ardeotis kori* – Vulnerable
- Ludwig's Bustard *Neotis ludwigii* – Vulnerable

While the aforementioned species only included endangered species, all korhaan and bustard populations are currently under pressure. Birdlife SA lists the collision of large terrestrial birds with power lines as one of the highest mortality factors for these particular birds in South Africa – with this single mortality factor leading to the decline of Ludwig's Bustard *Neotis ludwigii*. For species such as Northern Black Korhaan *Afrotis afraoides* and Karoo Korhaan *Eupodoptis vigorsii* which occur on site, collision mortalities would probably not have a hugely significant impact on their regional populations. Ongoing mortalities on a large-scale may however result in long term effects on these species and as such, an effort should be made to minimise the impacts upon these populations.

Susceptible species to collisions with power lines utilise waterways as flyways and the proximity of the Gariep (Orange) River accentuates the likelihood of interactions with power lines.

Duration: The impact would cover the lifespan of the facility and will be long-term.

Extent: The extent will be confined to the study area (i.e. the demarcated site for the facility as well as the extent of the power line). 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 have the potential to be involved in collision events. Ludwig's Bustard is of particular concern based on its biology and known incidences of collision events. This species may therefore be susceptible to collisions with the proposed power line, the consequences of which would be significant.
Probability: Bird species susceptible to collisions with power lines occur in the area and some, in large numbers. Northern Black Korhaan and Karoo Korhaan were both recorded on site, both of which are large, heavy bodied, low flying species, susceptible to collisions. There is therefore 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 involved in possible collision events). The significance of this impact can however be reduced through mitigation measures.

Mitigation: The incidences of birds interacting with the solar facility itself and subsequent mortalities are minimal. It is however recommended that appropriate bird deterrents are placed at power line locations around the facility to reduce this impact. Mitigation measures regarding the power line include:

- Install anti bird collision line marking devices on high risk sections of power line;
- Conduct avifaunal walk through to identify these high risk area;s
- 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 bird flappers as markers on the earth wire, which will increase the visibility of the power line;
- Markers should be placed with sufficient regularity (at least every 5-10m). Eagle eye devices may be used, if feasible to deter birds from the CSP plant area/ solar field; and
- Regular monitoring and assessment and improvement of mitigation factors.

Nature: <u>Impact on local bird communities due to the power line due to collision by the overhead power lines.</u>

Listed activities:
GNR 544, 18 June 2010 Activity 47 (iii)
GNR 545, 18 June 2010 Activity 1
GNR 545, 18 June 2010 Activity 15
GNR 546, 18 June 2010 Activity 13

	Without mitigation	**With mitigation**
Extent	Low (1)	Low (1)
Duration	Long term (4)	Long term (4)
Magnitude	High8)	Low (4)
Probability	Highly Probable (4)	Improbable (2)
Significance	**Medium (52)**	**Low (18)**
Status	Negative	Negative
Reversibility	No	No
Irreplaceable loss of resources	Yes – bird fatalities	Yes – bird fatalities
Can impacts be mitigated	Yes	Yes

Mitigation measures:

» 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 is reasonable.
» Placement of bird flappers as markers on the earth wire, which will increase the visibility of the power line.

» Markers should be placed with sufficient regularity (at least every 5-10m). » Eagle eye devices may be used, if feasible to deter birds from the CSP plant area/ solar field.
Cumulative impacts: There are a number of power lines in the vicinity of Upington as well as throughout the Northern Cape. Power lines that cross remote areas should be fitted with bird diverters (diurnal and nocturnal) to reduce the high incidence of collisions. As the number of power lines increase so the number of deaths of bustards and other birds will increase. With mitigation, it is considered unlikely that the addition of the proposed length of power line will significantly add to the cumulative impact of collision events in the region.
Residual impacts: Localised loss or displacement of avifauna species.

Electrocution of birds on associated power line tower structures

Nature: The design has allowed for a 132kV overhead power line, which runs parallel to the farm boundary of Portion 3 of McTaggarts Camp 453, feeding into the Eskom network at the newly constructed McTaggerts Substation (a distance of approximately 4km). Power lines have a range of bird related impacts, one of which is electrocution events, which occur when 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 (220kV to 765kV) are not a threat to large raptors and other birds which are vulnerable to electrocutions – often proving to be beneficial by providing roosting and nesting sites. The smaller distribution lines, such as the 132kV proposed for the development, can however be dangerous to birds. Birds that are typically at risk are those with large wingspans which can bridge the gaps between lines, such as raptors, bustards and storks. Threatened species that have the potential to occur in the study area and that may be involved in electrocution events include:

- Secretarybird *Sagittarius serpentarius* – Near Threatened
- Kori Bustard *Ardeotis kori* – Vulnerable
- Ludwig's Bustard *Neotis ludwigii* – Vulnerable
- Martial Eagle *Polemaetus bellicosus* - Vulnerable

In flat 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, there is a high probability that raptors will be landing on the structures and using them to survey the surrounding habitat or to nest on.

Electrocution is possible on 132kV lines such as those proposed, depending on the exact pole structure used. Since the developer have not yet committed to a tower structure, this impact cannot be fully assessed. The minimum phase – phase and phase – earth clearance of 2000mm should be adhered to for whichever structure is used, in order to mitigate for electrocution.

Extent: The impact will be confined to the length of the power line. It will however, 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, including endangered species. The probability of such events can be minimised through mitigation measures.

Mitigation: It has been indicated that mono pole bird friendly tower structures will be utilised in the development. This will significantly minimise the number of electrocutions.

Nature: The electrification of birds on associated power line tower structures.		
Listed activities: GNR 544, 18 June 2010 Activity 10		
	Without mitigation	**With mitigation**
Extent	Low (1)	Low (1)
Duration	Long term (4)	Long term (4)
Magnitude	Moderate (6)	Minor (2)
Probability	Highly probable (4)	Improbable (2)
Significance	**Medium (44)**	**Low (14)**
Status	Negative	Negative
Reversibility	Yes	Yes
Irreplaceable loss of resources	Yes – bird fatalities	Yes- Bird fatalities
Can impacts be mitigated	Yes	Yes
Mitigation measures: » Where feasible, monopole bird friendly tower structures will be utilised in the development. This will significantly minimise the number of electrocutions.		
Cumulative impacts: There are a number of power lines in the vicinity of Upington as well as throughout the Northern Cape. Power lines that cross remote areas should be fitted with bird guards to reduce the incidence of perching on towers. With mitigation, it is considered unlikely that the addition of the proposed length of power line will significantly add to the cumulative impact of electrocution events in the region.		
Residual impacts: Localised loss or displacement of avifauna species.		

7.5.3. Comparative Assessment of Access Road Alternatives

Both routes will require new road construction within the boundaries of Portion 3 of the Farm McTaggarts Camp 453. In terms of impacts arising from disturbance and displacement as a result of construction activities, there is **no significant** difference in the potential impacts associated with the two access road routes. Therefore, there is **no preference** between the alternatives.

7.5.4. Implications for Project Implementation

From the results of the expanded/additional study conducted and the literature reviewed it is likely that avifauna impacts resultant from the Upington Two CSP tower facility are likely to be very low. One of the factors most likely to reduce the risk of mortality in avifauna species is the low average flight height of birds in the area, as most bird species will fly under the heliostats. The fact that many of the species of concern appear to be absent from the study area further reduces the likely impacts of the facility.

In order to deter avian species from the CSP facility, the CSP facility needs to be as unsuitable for avian biological requirements as possible, as avifauna tend to avoid areas that are not suitable for their requirements. Biological requirements of avian species include:

» Food sources;
» Water sources;
» Nesting sites;
» Perching sites; and
» Reduced competition.

During the study the following factors were providing these requirements for local avifauna and it is needed that these factors be mitigated in order to reduce the number of birds likely to occupy the CSP facility (i.e. deter birds from using the area by making it as unsuitable for meeting avian biological requirements as possible, and therefore less attractive to birds):

» Openings at either end of the horizontal rotating cylinder of heliostats – provide nesting sites;
» Opening at the top of the tower – provide access to nesting sites and can be mistaken for a food source;
» Flat surfaces at the base of the tower – provide possible nesting and perching sites for a large number of species;
» Flat surfaces under the cavities – provide nesting sites for swallows and swifts;
» Colour of the tower cavities – attract insects, which are a food source for insectivorous avifauna; and
» Spider-frame at the top of the tower – provides perching sites for raptors.

Further issues at the CSP facility that were identified for mitigation were:

» Mirrors in cleaning position – very high risk for avian collisions;
» Focusing the heliostats above the tower during maintenance – increase the possibility of incineration of birds as opposed to being defocussed or focussed on the cavity;
» Evaporation ponds – in a dry region like this they are likely to be utilised and increased toxicity levels in the water could be fatal to species using the ponds.

In order to mitigate any possible impacts even further, the following measures are recommended to be implemented:

» Openings at either end of the horizontal rotating cylinder on the heliostat should be sealed
» Heliostats in the vertical position – the heliostats should be limited to being in the vertical position for as short a time as possible, or at night, and the heliostats returned to a static (horizontal) or focussed position as soon as possible after cleaning
» Flat surfaces at the base of the tower – all ledges should be built or panelled so that they slope at an angle downwards to the outside to prevent nesting on these ledges;
» Opening at the top of the tower – netting can be placed across the tower near the top of the tower in order to prevent birds from entering the tower
» Flat surfaces under the cavities – Chicken wire or similar fine mesh steel wire mesh can placed over the girders in order to prevent access to the flat surfaces so that birds cannot build mud nests on these surfaces
» Colour of the tower cavities – a neutral brown, concrete colour or grey would prevent the reflection of UV light
» Spider-frame at the top of the tower – measures need to be put in place in order to prevent birds using the spider frame and other infrastructure as perches. Investigating the option of a timed release of steam at the top of the tower would also be an audible and visual deterrent to birds at the top of the tower;
» Focusing the heliostats above the tower during maintenance – ideally the heliostats should be in one of three positions: vertical (washing position – for as short a time as possible), static position; or focussed in order to prevent the undetectable "hotspot" above the tower;
» Evaporation ponds - toxicity levels of the water in the evaporation ponds will need to be monitored and maintained in order to prevent poisoning of species that may use the ponds.

The following measures are recommended to be implemented for the power line:

» Placement of bird flappers as markers on the earth wire of overhead power lines, which will increase the visibility of the power line.
» Monopole bird friendly tower structures to be utilised where feasible.

7.6. Assessment of Impacts on Surface and Ground Water Resources

7.6.1 Results of the Surface and Ground Water Resources Assessment

The study area falls within the Lower Gariep River sub-basin and the site is situated within quaternary catchment D73F. The site dominated by highly ephemeral river systems that flow directly into the Gariep River, which bisects this quaternary catchment. The primary drainage line in close proximity to the site, the Helbrandkloofspruit, typically flows once a year for no more than two days at a time. Water bodies and rivers are of specific importance to a variety of Red Data species in this arid area. The perennial Gariep River is situated 10 - 13 km south-east of the proposed development sites.

Fish fauna:

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 CSP Plant. These include:

- Largemouth yellowfish *Labeoarbus kimberleyensis*
- Largemouth yellowfish *Labeoarbus kimberleyensis*
- Smallmouth yellowfish *Labeobarbus aeneus*
- Gariep River Mudfish *Labeo capensis*
- Rock catfish *Austroglanis sclateri*

The three other endemic fish species present in the Study Area (Gariep River Mudfish, smallmouth yellowfish and Namaqua barb) were found to be well represented.

Present Ecological Status of the Lower Gariep River

The LORMS (2005) study found that the overall Present Ecological Status (PES) of the Lower Gariep 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.

Riparian Vegetation on the development footprint (Portion 3 of the Farm McTaggarts Camp 453)

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 pseudebenus* (Ebony Tree), notably protected under the National Forest Act. The only obligate wetland plants observed were those found in association with the man-made dams found at the confluence of the Helbrandkloofspruit and the Gariep River and along the Gariep River itself. Species observed included *Typha capensis, Phragmites australis, Prosopis*

glandulosa and *Cyperus marginatus*. The prevalence of *Prosopis* and alien invasive tree species had increased between a survey undertaken in 2010 and now in 2014.

Water Bodies on the Site (Portion 3 of the Farm McTaggarts Camp 453)

Figure 7.7 illustrates the watercourses observed within the site and along the pipeline route. No classified wetlands, other than the riparian systems found along the Gariep River, are shown on the national wetlands map. However, season pans and ephemeral waterwashes (also referred to as ephemeral drainage lines) occur on the site and drain into the Gariep River.

On either side of Portion 3 of the Farm McTaggarts Camp 453 larger ephemeral drainage lines occur, which merge further south and then flow into the Gariep River. These drainage lines may only flow once every couple of years after sufficient rainfall, but they do collect enough of the runoff from surrounding areas to support much denser and higher vegetation than on the surrounding plains, especially on the farm adjacent to the southern border of McTaggarts Camp. This higher vegetation creates numerous microhabitats.

Dry river beds and riparian zones occur on the site. 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 Helbrandleegte and Helbrandkloofspruit, which flows through the site. Due to the nature of the soils and geomorphology, these systems are able to form various meanders within the greater landscape.

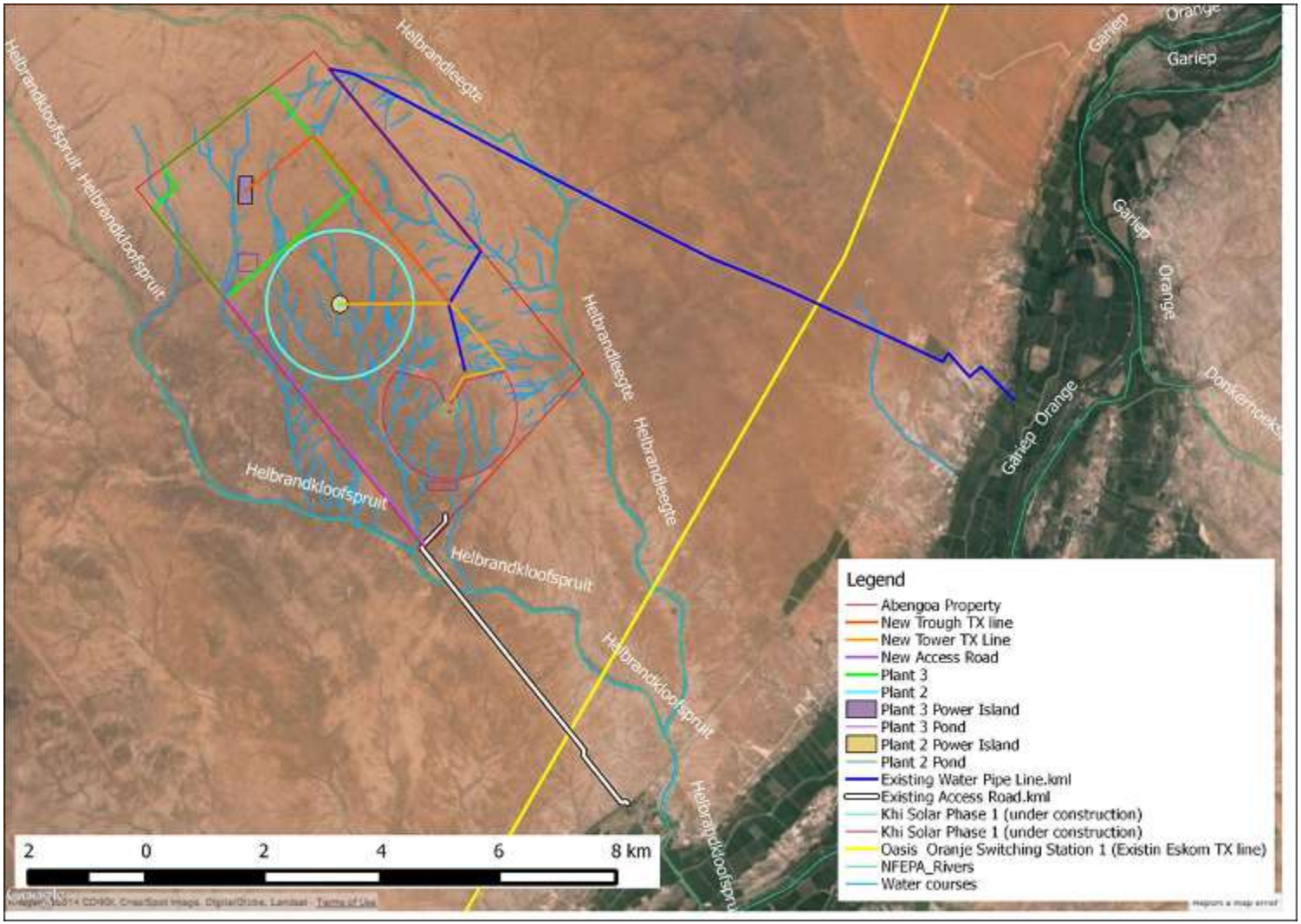

Figure 7.7: Map illustrating the ephemeral watercourses observed within the site and along the pipeline route

The impact assessment on surface water resources deals with three separate components, i.e. flow and water quality impacts, riparian vegetation and fish fauna impacts. In generic terms, many of the potential environmental impacts on the Gariep 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.

7.6.2 Sensitivity Assessment

From a habitat and ecosystem point of view, all the dry river beds and the associated riparian systems which occur on the site would be rated as extremely sensitive to development, in particular the mainstem systems such as Helbrandleegte and Helbrandkloofspruit systems, which flow within the site. However from a riparian and aquatic standpoint, the CSP Plant and the associated infrastructure are suitable for the proposed site, for the following reasons:

» The areas where the Upington Solar Thermal Plant Two is proposed 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 sufficient space between the proposed footprint areas of the 150MW CSP project and the significant mainstem riverbeds (Helbrandleegte and Helbrandkloofspruit) to institute suitable stormwater management structures (silt traps) and pollution containment areas.

7.6.3 Flow and Water Quality Impacts

General Surface Water Impacts: Sedimentation and Elevated Turbidity

Causes:
Although relatively far from the river itself, sediment-laden runoff from the proposed CSP plant could occur, particularly if flash floods occur during the site clearing and construction phases of the project. Sediment mobilisation could result from, among others:

» 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 Gariep River, with a resultant impact on habitat availability for instream biota.

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 Gariep River could be seriously impacted by high sediment inputs associated with the proposed construction activities, particularly of the water abstraction facilities.

General Surface Water Impacts: 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. During operations, various other chemicals will be used and significant spillage if these chemicals could contaminate water resources.

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 and invertebrates, 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.

Most of the chemicals used in the operational phase will be stored and or utilised in areas that will be disjoint from and surface water run-off, thus the probability is low of these elements reaching any aquatic ecosystems. Secondly the development site is mostly near dry river beds, therefore the chances of any spills reaching the Gariep River are low.

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.

7.6.4 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. Impacts on riparian vegetation due to the development of the CSP Plant includes:

» Loss of riparian systems.
» Impact on dry riverbeds and localised drainage systems.

» Impact on riparian systems through the possible increase in surface water runoff on riparian form and function.
» Increase in sedimentation and erosion.

Considering riparian areas, the CSP facility and the associated infrastructure are acceptable on this proposed site as:

» The area where the Upington Solar Thermal Plant Two is proposed 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.

Due to the nature of the aquatic environment within the study area, together with the high number of drainage lines, selecting a development site that avoids any of these areas is not entirely possible. Therefore any stormwater within the site must be handled in a suitable manner. These impacts on riparian zones will occur as the CSP Plant will require removal of riparian vegetation. Within the power island no vegetation cover will remain. There is riparian vegetation that occurs along drainage lines (refer to ecological sensitivity map contained in Figure 7.3), and where these areas cannot be avoided by the CSP plant these will be completely transformed. Physical impacts on the Helbrandleegte /Helbrandkloofspruit catchment would be limited, and these spruits will remain intact.

7.6.5 Impact table summarising the significance of impacts on riparian zones during the construction and operation phases (with and without mitigation)

Nature: 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 Helbrandleegte and Helbrandkloofspruit catchment would remain intact.		
Listed Activities: GNR 545, 18 June 2010 Activity 1 GNR 544, 18 June 2010 Activity 11 GNR 544, 18 June 2010 Activity 12 GNR 544, 18 June 2010 Listed Activity 13 GNR 544, 18 June 2010 Activity 18		
	Without mitigation	**With mitigation**
Extent	Local (1)	Local (1)

Duration	Long-term (4)	Long-term (4)
Magnitude	Moderate (6)	Low (4)
Probability	Definite (5)	Definite (5)
Significance	**Medium (55)**	**Medium (45)**
Status (positive or negative)	Negative	Negative
Reversibility	Medium	Medium
Irreplaceable loss of resources	No	No
Can impacts be mitigated	Yes	

Mitigation:

Due to the nature of the aquatic environment within the study area, together with the high number of drainage lines, selecting a development site that avoids any of these areas is not entirely possible. Therefore any stormwater within the site must be handled in a suitable manner such as:

» Separate clean and dirty water streams around the plant
» Install stilling basins to capture large volumes of run-off
» Trap sediments and reduce flow velocities.
» Monitor riparian zones for erosion and is erosion occurs, utilise erosion control measures to stabilise soils.

Cumulative impacts:

None

Residual impacts:

Possible impact on the remaining catchment due to changes in run-off characteristics in the development site.

Nature: 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 Helbrandleegte /Helbrandkloofspruit catchment would remain intact.

Listed Activities:

GNR 545, 18 June 2010 Activity 1
GNR 544, 18 June 2010 Activity 11
GNR 544, 18 June 2010 Activity 12
GNR 544, 18 June 2010 Listed Activity 13
GNR 544, 18 June 2010 Activity 18

	Without mitigation	**With mitigation**
Extent	Local (1)	Local (1)
Duration	Long-term (4)	Long-term (4)

Magnitude	Low (4)	Low (4)
Probability	Definite (5)	Probable (3)
Significance	**Medium (45)**	**Low (24)**
Status (positive or negative)	Negative	Negative
Reversibility	High	High
Irreplaceable loss of resources	No	No
Can impacts be mitigated	Yes	

Mitigation:

Due to the nature of the aquatic environment within the study area, together with the high number of dry riverbeds and localised drainage system, selecting a development site that avoids any of these areas is not entirely possible. Therefore any stormwater within the site must be handled in a suitable manner such as:

» Separate clean and dirty water streams around the plant
» Install stilling basins to capture large volumes of run-off
» Trap sediments and reduce flow velocities.
» Monitor dry riverbeds and drainage lines for erosion and is erosion occurs, utilise erosion control measures to stabilise soils.

Cumulative impacts:

The increase in surface run-off velocities and the reduction in the potential for groundwater infiltration is likely to occur, considering that the site is near the main drainage channels and however the annual rainfall figures are low. When considering the other 14 potential projects within the adjacent / nearby farms the potential for changes to the surrounding hydrological habitat could be significant especially during the operational phases (hard surfaces and stormwater management). It is however assumed, together with the low mean annual run-off that with suitable stormwater management the impacts could however be mitigated.

Residual impacts:

Diversion of run-off away from downstream systems is unlikely to occur as the annual rainfall figures are low.

Nature: Impact on riparian systems through the possible increase in surface water runoff on riparian form and function

Listed Activities:

GNR 545, 18 June 2010 Activity 1
GNR 544, 18 June 2010 Activity 11
GNR 544, 18 June 2010 Activity 12
GNR 544, 18 June 2010 Activity 18

	Without mitigation	**With mitigation**

Extent	Local (1)	Local (1)
Duration	Long-term (4)	Long-term (4)
Magnitude	Low (2)	Low (2)
Probability	Definite (5)	Probable (3)
Significance	**Medium (35)**	**Low (19)**
Status (positive or negative)	Negative	Negative
Reversibility	Medium	Medium
Irreplaceable loss of resources	No	No
Can impacts be mitigated	Yes	

Mitigation:

Any stormwater within the site must be handled in a suitable manner such as:

» Separate clean and dirty water streams around the plant
» Install stilling basins to capture large volumes of run-off
» Trap sediments and reduce flow velocities.
» Monitor on riparian zones for erosion and is erosion occurs, utilise erosion control measures to stabilise soils.
» Attempt to capture and recycle any form of run-off created by the daily operations of the CSP Plant. 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.

Cumulative impacts:

Downstream alteration of hydrological regimes due to the increased run-off from the area. When considering the other 14 potential projects within the adjacent / nearby farms within a 10-15 km radius the potential for changes to the surrounding hydrological habitat could be significant especially during the operational phases (hard surfaces and stormwater management). It is however assumed that any such changes would be detrimental to the various projects owners (erode areas around mirrors) together with the low mean annual run-off and suitable stormwater management the impacts could however be mitigated.

Residual impacts:

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 of the CSP Plant (up to 500 hectares).

Listed Activities:
GNR 545, 18 June 2010 Activity 1
GNR 544, 18 June 2010 Activity 11
GNR 544, 18 June 2010 Activity 12
GNR 544, 18 June 2010 Activity 18

	Without mitigation	**With mitigation**
Extent	Local (1)	Local (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	Negative
Reversibility	Medium	Medium
Irreplaceable loss of resources	No	No
Can impacts be mitigated	Yes	

Mitigation:
Any stormwater within the site must be handled in a suitable manner such as:
» Separate clean and dirty water streams around the plant.
» Install stilling basins to capture large volumes of run-off.
» Trap sediments and reduce flow velocities (e.g. water used when washing the mirrors).
» If erosion occurs, utilise erosion control measures to stabilise soils.

Cumulative impacts:
Downstream erosion and sedimentation of the downstream systems and farming operations. During flood events, the unstable banks (eroded areas) and sediment bars (sedimentation downstream) already deposited downstream will then be washed into the Gariep River. When considering the other 14 potential projects within the adjacent / nearby farms the potential for changes to the surrounding hydrological habitat could be significant especially during the operational phases (hard surfaces and stormwater management). It is however assumed that any such changes would be detrimental to the various projects owners (erode areas around mirrors) together with the low mean annual run-off and suitable stormwater management the impacts could however be mitigated.

Residual impacts:
During flood events, the unstable banks (eroded areas) and sediment bars (sedimentation downstream) already deposited downstream will then be washed into

the Gariep River.

7.6.6 Impact assessment: Gariep 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 Gariep River system. The distance of the proposed facility from the Gariep River (approximately 3 km) will reduce the risk of contaminated run-off polluting the Gariep River. However the well-defined drainage lines or ephemeral streams such as the Helbrandleegte and Helbrandkloofspruit within the site would increase this risk during rainstorms and local flash floods which normally occur during the summer months.

7.6.7 Impact assessment: Gariep River – Fish fauna (biotic study)

The fish fauna component focuses on the impact of the CSP Plant's development on the biota of the water resources of the area, i.e. the Gariep River as the water source for the development. Water is intended to be abstracted from the Gariep River. The water will be sourced through an extraction point on the Gariep River. Water supply pipelines will be constructed and the required volume of water treated and pumped to the facility. Potable water will also be required for on-site staff. Approximately 400 000 m^3 of water per year[18] is required for operation of one 150MW CSP Plant. Water is required for generation of steam to drive a conventional steam turbine and generator, mirror washing, potable purposes and for fire-fighting.

There is a moderate risk of impacts to the Gariep River resulting from elevated sediment loads and polluted runoff from the facility reaching the river during site preparation and construction, if appropriate mitigation is not implemented at the abstraction point. The construction of infrastructure associated with the abstraction point also poses a moderate risk of impacting negatively on aquatic habitats and biota in the immediate area within the Gariep River without appropriate mitigation being implemented.

The proposed constant abstraction of water from the Gariep River during the operation of the CSP Plant (400 000 m^3/a) could reduce present day flows at the abstraction point only and impact negatively on the local aquatic biota. This impact would be more evident in summer months 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 (EWR), this impact is not possible to quantify. Reserve determination assessments are undertaken by the DWS (as seasonal and long-term data is required) and this information forms part of the

[18] A volume of 400 000m3 per annum was previously stated, but actual measurement on operating plants (Kaxu) as well as refined calculations based on current available technology have confirmed that 400 000m3 per annum will be required.

DWS decision-making process when considering a Water Use License application (WULA). For this project's water requirement, the Department of Water and Sanitation (DWS) have confirmed in a letter dated 29 May 2015 (refer to Appendix P) that, after due consideration of the water resource availability in the catchment area, it was found the sufficient water is available to meet the water requirement of the project (~300 000 m^3 per annum during construction and 400 000 m^3 per annum during operation). The Gariep River 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, and this is undertaken by the DWS.

Impacts on the Gariep 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 could affect the site, although release patterns are re-evaluated every year to provide for irrigators and is therefore well known. A 280 million m^3/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 Gariep 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).

7.6.8 Impact table summarising the significance of impacts on the Gariep River during the construction and operation phases (with and without mitigation)

Nature: Sediment input into the Gariep River Vegetation clearing and earthmoving operations at the site during pre-construction and construction of the infrastructure (including access roads and ponds etc.) will increase the risk of soil erosion and sediment being washed into the Gariep River during heavy rains.		
Listed Activities: GNR 544, 18 June 2010 Activity 9 GNR 544, 18 June 2010 Activity 11 GNR 544, 18 June 2010 Activity 18		
	Without mitigation	**With mitigation**
Extent	Site (2)	Local (1)
Duration	Short-term (2)	Short-term (2)

Magnitude	Moderate (6)	Minor (2)
Probability	Highly probable (4)	Improbable (2)
Significance	**Medium (40)**	**Low (10)**
Status (positive or negative)	Negative	Negative
Reversibility	Medium	Low
Irreplaceable loss of resources	Yes (medium)	Yes (low)
Can impacts be mitigated	Yes (high)	

Mitigation:

» 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.

» Comprehensive Storm Water Management Plan (SWMP) incorporating anti-erosion measures on site should be put in place. Any stormwater 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 (e.g. water used when washing the mirrors). The outcome of this plan together with monitoring should be that no net changes occur to any water courses downstream of the site.

» All surface run-off should be discharge via detention dams to allow sediment to settle out before leaving the site.

Cumulative impacts:

Man-induced erosion and sedimentation in this area from intensive farming activities along the Gariep River is expected to be unnaturally high. The cumulative impact on the Gariep River could thus exceed the tolerances of the aquatic biota, including sensitive fish species. When considering the other 14 potential projects within the adjacent / nearby farms within a 10-15 km radius the potential for changes to the surrounding hydrological habitat could be significant especially during the operational phases (hard surfaces and stormwater management). It is however assumed that any such changes would be detrimental to the various projects owners (erode areas around mirrors) together with the low mean annual run-off and suitable stormwater management the impacts could however be mitigated.

Residual Impacts:

Residual Impacts should be minimal with appropriate mitigation.

Nature: Chemicals and other pollutants causing contamination of the water in the Gariep 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 Gariep 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 Gariep River. The operations also include several chemicals listed in this report that are harmful to the aquatic environment and can only be disposed of at a hazardous waste site. The design and management of the plants has addressed this to ensure that no spills could occur and if so that they are rapidly contained.

Listed Activities:
GNR 545, 18 June 2010 Activity 1
GNR 544, 18 June 2010 Activity 9
GNR 544, 18 June 2010 Activity 11
GNR 544, 18 June 2010 Activity 13
GNR 544, 18 June 2010 Activity 18

	Without mitigation	**With mitigation**
Extent	Site (2)	Local (1)
Duration	Short-term (2)	Short-term (2)
Magnitude	Moderate (6)	Minor (2)
Probability	Probable (3)	Improbable (2)
Significance	**Medium (30)**	**Low (10)**
Status (positive or negative)	Negative	Negative
Reversibility	Yes (high)	Yes (high)
Irreplaceable loss of resources	Yes (medium)	Yes (low)
Can impacts be mitigated	Yes (high)	

Mitigation:

» Appropriate ablution facilities should be provided for construction workers during construction and on-site staff during the operation of the facility.
» Strict use and management of all hazardous materials used on site.
» Strict management of potential sources of pollution (e.g. litter, hydrocarbons from vehicles and machinery, cement during construction, etc.).
» Containment of all contaminated water by means of careful run-off management on the development site.
» Strict control over the behaviour of construction workers.
» Working protocols incorporating pollution control measures (including approved method statements by the contractor) should be clearly set out in the Environmental Management Programme (EMPr) for the project and strictly enforced. This should be carried over to the Operational Phase, where various chemicals are used in the processes.

Cumulative impacts:
The widespread use of chemicals in farming activities (fertilizers, insecticides, herbicides, etc.) means that any chemical pollution from the CSP plant will have a marked cumulative impact on aquatic biota. When considering the other 14 potential projects within the adjacent / nearby farms it is assumed that they will all have proactive measures and monitoring plans to safe the guard the surrounding environment from spills as has been done for this project.

Residual impacts:
Residual impacts will be negligible after appropriate mitigation.

Nature: Abstraction of water from the Gariep River impact on water flow: timing and volume

The proposed constant abstraction of water from the Gariep River during the operation of the CSP Plant (400 000 m^3/a) could reduce present day flows at the abstraction point only and impact negatively on the local aquatic biota. This impact would be more evident in summer months 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 (EWR), this impact is not possible to quantify. Reserve determination assessments are undertaken by the DWS (as seasonal and long-term data is required) and this information forms part of the DWS decision-making process when considering a Water Use License application (WULA). For this project's water requirement, the Department of Water and Sanitation (DWS) have confirmed in a letter dated 29 May 2015 (refer to Appendix P) that, after due consideration of the water resource availability in the catchment area, it was found the sufficient water is available to meet the water requirement of the project (~300 000 m^3 per annum during construction and 400 000 m^3 per annum during operation). The Gariep River 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, and this is undertaken by the DWS.

A letter from the Department of Water and Sanitation has been received from the Lower Orange Water Management Area regional office, confirming that there is water available for the project for the required construction and operation volumes (refer to Appendix P). .

Listed Activities:
GNR 544, 18 June 2010 Activity 9
GNR 544, 18 June 2010 Activity 11
GNR 544, 18 June 2010 Activity 3
GNR 544, 18 June 2010 Activity 18

	Without mitigation	**With mitigation**
Extent	Region (3)	n/a
Duration	Long-term (4)	n/a
Magnitude	Low (4)	n/a
Probability	Improbable (2)	n/a
Significance	**Low (22)**	n/a
Status (positive or negative)	Negative	n/a

Reversibility	High	n/a
Irreplaceable loss of resources	Yes	n/a
Can impacts be mitigated	Yes	

Mitigation:

» If possible, optimise the design or technology of the facility to reduce consumptive water requirements as possible.

» Adapt the water abstraction regime to meet the EWR and requirements of other users where required.

Cumulative impacts:

Note that the water use required by this project is relatively small in a regional context and compared to other water users, such as agriculture. DWS will, however, need to assess the water availability during the Water Use Licencing process in conjunction with the other projects which may seek to abstract from the Gariep River. At present the Khi Solar One site holds a WUL (300 000m^3 per annum). The other preferred bidder projects (one of which is a CSP tower) still need to secure their water source, and several are taking water from the local municipalities.

Residual impacts: No residual impacts expected if mitigation possible.

Nature: Operation of the water reservoir and high pressure sand filtration plant
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 Gariep River.

Listed Activities:
GNR 544, 18 June 2010 Activity 2

	Without mitigation	**With mitigation**
Extent	Site (2)	Local (1)
Duration	Long-term (4)	Very short (1)
Magnitude	Minor-low (3)	Minor (2)
Probability	Highly probable (4)	Improbable (2)
Significance	**Medium (36)**	**Low (8)**
Status (positive or negative)	Negative	Negative
Reversibility	Yes (high)	Yes (high)
Irreplaceable loss of resources	Yes	Yes
Can impacts be mitigated	Yes	

Mitigation:

» 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.

Cumulative impacts:

This will be a cumulative impact as it will add to the already elevated sediment load into the river due to agricultural activities.

Residual impacts:
Residual impacts should not be apparent if mitigation is correctly carried out.

7.6.9 Comparative Assessment of Access Road Alternatives

Both access road routes will require new road construction within the boundaries of Portion 3 of the Farm McTaggarts Camp 453. New road construction should be cognisant of impacts to ephemeral drainage lines.

The proposed layout includes a crossing of the Helbrandskloofspruit tributary by Alternative 1. Alternative 2 crosses the Helbrandleegte. Alternative 1 is a shorter route than Alternative 2. Therefore considering the aridity of the area and the difficulty of new vegetation establishment, **Alternative 1** is preferred.

7.6.10 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. This assessment of the potential impacts of the facility on the fish biota of Gariep River also did not reveal any significant impacts on the fish fauna and associated aquatic habitats, provided the appropriate mitigation measures are taken. A possible impact on the development would be the quantity of water to be abstracted from the Gariep River required for operation of the facility. All impacts that were assessed as being of moderate significance which could readily be reduced to low significance by appropriate mitigation, apart from the moderate impact of water abstraction from the Gariep River.

During the assessment of the Phase 1 project, various alternative water sources were discussed with the proponent, local engineers, the Municipality and the Department of Water and Sanitation. Local water users (irrigation schemes) were also consulted for the three phases (inclusive of Khi Solar One now under construction) and it was determined that the only viable source of water was from the Gariep River. Other users or costs (e.g. pump water via a pipeline from the Upington WWTW) were prohibitive or would result in additional environmental impacts relating to the associated infrastructure.

The following actions are required:

» Any stormwater 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 Stormwater Management Plan incorporating anti-erosion measure on site should be put in place.

» Working protocols incorporating emergency response and pollution control measures (including approved method statements by the contractor) should be clearly set out in the EMPr for the project and strictly enforced.
» 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.
» The relevant Water Use Licenses for water uses (abstraction and impacting of water courses) to be obtained from the Department of Water Affairs and Sanitation (DWS). DWS will, however, need to assess the water availability during the Water Use Licencing process in conjunction with the 14 other projects which may seek to abstract from the Gariep River. At present the Khi Solar One site holds a WUL (300 000m^3 per annum). The other preferred bidder projects (one of which is a CSP tower) still need to secure their water source, and several are taking water from the local municipalities.

7.7. Assessment of Potential Impacts on Heritage Sites

7.7.1 Results of the Heritage Survey

» Stone Age: The heritage survey found Stone Age traces which consist of wide scattered/isolated finds, none of those noted being of major heritage significance. Many of the stone artefacts found were based on banded ironstone, some on quartzite, the former most likely sourced from the Gariep River gravels to the south; no tillites occur in the study area. There appear to be none of the features such as hills or rocky features (such as Spitskop north of Upington) which in other parts of this landscape provide shelters with traces of pre-colonial Stone Age occupation/activity.
» No shelters occur.
» Rock outcrops provide for temporary water pools after rain but any increased activity around these features in the CSP plants is not reflected in increased stone tool densities.
» 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.
» Apart from the remains of a tungsten mine, noted above, there appear not to be colonial era built environment features in the areas of proposed CSP plant.
» Several features of the tungsten mine were noted including ruins, an explosives magazine and, for the most part, trenches, pits and debris heaps associated with prospecting/mining.
» The Kalahari sediments and calcretes have low fossil potential, but possibility of fossils being encountered in diggings cannot be totally excluded.

» Archaeological (Stone Age traces) and cultural (mining) heritage observations made were assessed as being of low heritage significance.
» No graves were found on the site.

During the construction phase deep excavations could result in loss/ find of heritage resources and impacts including:

» Disturbance of heritage resources.
» Impacts on cultural landscape and sense of place.

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

Nature: Construction activities could result in loss of heritage resources (archaeology and fossils) Activities resulting in disturbance of surfaces and/or sub-surfaces containing heritage / paleontological artefacts resulting in the destruction, damage, excavation, alteration, removal or collection from its original position, of any archaeological material or object.		
Listed Activities: GNR 545, 18 June 2010 Activity 1 GNR 544, 18 June 2010 Activity 47 (iii) GNR 545, 18 June 2010 Activity 15 GNR 546, 18 June 2010 Activity 13		
	Without mitigation	**With mitigation**
Extent	1	n/a
Duration	5	n/a
Magnitude	2	n/a
Probability	2	n/a
Significance	**Low (16)**	**n/a**
Status (positive or negative)	Negative	n/a
Reversibility	No	n/a
Irreplaceable loss of resources?	Yes	n/a
Can impacts be mitigated?	Yes – but not considered necessary.	n/a
Mitigation:: Mitigation measures are not considered necessary, however should any heritage resources, actions will be required for inclusion in the EMPr including: » Development an on-going heritage monitoring procedure for the construction and operational phase which must also provide guidelines on what to do in the event of any major heritage feature being encountered during any phase of development of		

the CSP Plant. » The ECO must monitor if any accidental disturbance of previously undetected heritage features occurs. » In the event of any archaeological deposits or features (such as a grave or an ostrich eggshell cache) being encountered, relevant personnel should halt work and notify SAHRA immediately (Tel: 021 462 4502. Fax: 021 462 4509; 111 Harrington Street, Cape Town. PO Box 4637, Cape Town 8000) to allow for investigation and possible mitigation.
Cumulative impacts: where any archaeological contexts occur the impacts are once-off permanent destructive events.
Residual Impacts: None

7.7.3 Comparative Assessment of Access Road Alternatives

The scattered/isolated finds during the field survey are not noted to be of major heritage significance. In terms of impacts arising from disturbance and loss as a result of the access roads, there is **no significant** difference in the potential impacts. Therefore, there is **no preference** between the alternatives.

7.7.4 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).
» The EMPr should contain an on-going heritage monitoring procedure for the construction and operational phase which must also provide guidelines on what to do in the event of any major heritage feature being encountered during any phase of development of the CSP Plant.
» During construction, the ECO must monitor if any accidental disturbance of previously undetected heritage features occurs.
» In the event of any archaeological deposits or features (such as a grave or an ostrich eggshell cache) being encountered, relevant personnel should halt work and notify SAHRA immediately (Tel: 021 462 4502. Fax: 021 462 4509; 111 Harrington Street, Cape Town. PO Box 4637, Cape Town 8000) to allow for investigation and possible mitigation.

7.8. Impacts on Soils, Land-Use and Agricultural Potential

7.8.1 Results of the Soils Survey

The soils and agricultural potential study revealed the following:

» The proposed site extends inland to the north of the Gariep River on almost flat ground with a south easterly aspect towards the river at a slope of approximately 1%.
» The site of the new CSP Plant is entirely on the northern land type, Ae10. The soils of this land type are shallow to moderately deep, sandy soils on underlying hardpan carbonate or rock.
» The entire site (Portion 3 of the Farm McTaggarts Camp 453) has a land capability classification, on the 8 category scale, of Class 7 - non-arable, low potential grazing land. The land has a low to moderate water erosion hazard (class 5).
» The site is susceptible to wind erosion due to the sandy texture of the soil. Predominantly because of the aridity constraints, but also because of poor soils, agricultural land use is restricted to low intensity grazing only.
» A section of the site (Portion 3 of Farm McTaggarts Camp 453) is already being used for the development of the Khi Solar One CSP Plant, and there is currently no agricultural activity or any agricultural infrastructure on the property.
» There are no areas of agricultural sensitivity that should be avoided by the development. There has never been any cultivation or irrigation on the site.
» The north western corner of the site has been mined in the past for tungsten and old, un-rehabilitated mining excavations occur. The mined out areas is ~25 hectares in total and is currently being rehabilitated under the Khi Solar One project (due to safety risk associate with open excavations/depressions). The previously mined area is considered a no-go area for development.

7.8.2 Impacts on Soils

The components of the project that can impact on soils, agricultural resources and productivity are:

» Construction activities that disturb the soil profile and vegetation, for example for levelling, excavations, blasting (if required), drilling and so forth.
» Long term use of the land for the CSP Plant which will result in bare areas devoid of vegetation and hardened surfaces.
» Spills or contamination from dangerous goods or hazardous fuels utilised on the site during construction or operation.

The following impacts will occur:

» Change in land-use from agricultural land to a CSP Plant (700 hectares in extent).
» Loss of topsoil.

» Soil loss and soil erosion.

The significance of all agricultural impacts is influenced by the fact that the proposed site is on land of extremely limited agricultural potential that is only suitable as non-arable, low potential grazing land.

7.8.3 Impact tables summarising the significance of impacts on soils and land use (with and without mitigation)

Nature: Loss of topsoil due to construction activities
Caused by: poor topsoil management (burial, erosion, etc.) during construction related soil profile disturbance (levelling, excavations, disposal of spoils from excavations etc.)
And having the effect of: loss of soil fertility on disturbed areas after rehabilitation.

Listed Activities:
GNR 545, 18 June 2010 Activity 1
GNR 545, 18 June 2010 Activity 10
GNR 544, 18 June 2010 Activity 47 (iii)
GNR 545, 18 June 2010 Activity 15
GNR 546, 18 June 2010 Activity 13

	Without mitigation	**With mitigation**
Extent	Low (1) - Site	Low (1) - Site
Duration	Long term (4)	Long term (4)
Magnitude	Minor (3)	Minor (2)
Probability	Probable (3)	Very improbable (1)
Significance	**Low (24)**	**Low (7)**
Status	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	

Mitigation:
» Strip and stockpile topsoil from all areas where soil will be disturbed.
» After cessation of disturbance, re-spread topsoil over the surface.
» Dispose of any sub-surface spoils from excavations where they will not impact on agricultural land, or where they can be effectively covered with topsoil.
» Topsoil (the upper 25 cm of soil) is an important natural resource; where it must and

can be stripped, never mix it with subsoil or any other material, store and protect it separately until it can be re-applied, minimise handling of topsoil.
» Topsoil and spoil material/subsoil storage areas must be delineated in the final layout plan.
» Combined final stockpiles may not exceed 4 m in height, preferably should not be higher than 1m, and must be managed according to a strict landscaping, rehabilitation and soil erosion management plan until decommissioning.
» Temporarily stored topsoil must be re-applied within 6 months, topsoil stored for longer need to be managed according to a detailed topsoil management plan.

Cumulative impacts:
The development of multiple solar projects in the area can have cumulative impact on soil; however this can be managed to acceptable levels.

Residual impacts: None

Nature: Loss of agricultural land and change in land use
Caused by: direct occupation of land by solar energy facility infrastructure; and having the effect of: taking the entire property out of agricultural production.

Listed Activities:
GNR 545, 18 June 2010 Activity 1
GNR 544, 18 June 2010 Activity 47 (iii)
GNR 545, 18 June 2010 Activity 15
GNR 546, 18 June 2010 Activity 13

	Without mitigation	**With mitigation**
Extent	Low (1) - Site	Low (1) - Site
Duration	Permanent (5)	Permanent (5)
Magnitude	Small (1)	Small (1)
Probability	Definite (5)	Definite (5)
Significance	**Medium (35)**	**Medium (35)**
Status	Negative	Negative
Reversibility	High	High
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	No	

Cumulative impacts: The overall loss of agricultural land in the region due to other developments. The significance is low due to the extremely limited agricultural potential

of the area.

Residual impacts: No mitigation possible so same as impacts without mitigation

Nature: Soil Erosion
Caused by: alteration of run-off characteristics due to hard surfaces and access roads;
And having the effect of: loss and deterioration of soil resources.

Listed Activities:
GNR 545, 18 June 2010 Activity 1
GNR 545, 18 June 2010 Activity 10
GNR 544, 18 June 2010 Activity 47 (iii)
GNR 545, 18 June 2010 Activity 15
GNR 546, 18 June 2010 Activity 13

Comment: There is low risk of erosion due to the very gentle slopes.

	Without mitigation	**With mitigation**
Extent	Low (1) - Site	Low (1) - Site
Duration	Long term (4)	Long term (4)
Magnitude	Low (4)	Minor (3)
Probability	Probable (3)	Very improbable (1)
Significance	**Low (27)**	**Low (8)**
Status	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	

Mitigation:
» Implement an effective system of run-off control, where it is required, that collects and disseminates run-off water from hardened surfaces and prevents potential down slope erosion. This should be in place and maintained during all phases of the development.
» Develop an erosion management plan (within EMPr).
» Monitor the site for erosion areas.
» Utilise soil stabilisation/ erosion control measures, should erosion occur.

Cumulative impacts: None

Residual impacts: Low

7.8.4 Implications for Project Implementation

» The development of the CSP Plant will have low to medium negative impacts on soils, agricultural resources and productivity.
» The significance of all agricultural impacts is influenced by the fact that the site has extremely limited agricultural potential, with a land capability of class 7, non-arable, low potential grazing land.
» Soils are red, sandy soils on underlying rock and calcrete, varying from very shallow to moderately deep.
» The major limitations to agriculture are the aridity and lack of access to water, as well as the shallow soils. The land is only suitable for low intensity grazing.
» Three potential negative impacts of the development on agricultural resources and productivity were identified as:
  * Loss of agricultural land use caused by direct occupation of land by the energy facility footprint (medium significance with and without mitigation).
  * Soil Erosion caused by alteration of the surface run-off characteristics (low significance with and without mitigation).
  * Loss of topsoil in disturbed areas, causing a decline in soil fertility (low significance with and without mitigation).
» There are no fatal flaws associated with the soils on the site and the project can be developed with the use of good soil management measures during all phases of development of the project.

7.9. Assessment of Potential Visual Impacts

7.9.1 Visual Character of the landscape

» Vegetation Cover and Land Use: The southern portion of the study area, where the Khi Solar One is located, is characterised by arid grassland and the remainder as karroid shrubland. The vegetation is sparse and of low heights, and has been disturbed by grazing and mining. Vineyards occur largely along the Gariep River terraces. Abandoned mines in the form of shallow trenches and a few deep pits occur in the north-west corner of the McTaggart Camp property, as well as scattered trenches in the surrounding area. Farming in the area consists of sheep, goats, cattle and horses although the grazing potential is low in the arid landscape. Wildlife still inhabits the area.
» Existing Infrastructure: The Khi Solar One Power Tower CSP Plant is being constructed on the farm portion directly adjacent to the site. An existing Eskom 132 kV power line runs between the site and the N14. An existing rail line runs almost parallel with the N14 but appears to have not been in use for some time. A number of buildings, such as a substation, and a water supply pipeline from the Gariep River have recently been constructed as part of the Khi Solar One project.

» Visual Significance: The visual significance of Upington are largely on the Gariep River for settlements, farmsteads and recreation, along with extensive vineyards, wineries and guesthouses, forming part of the area's tourism potential. The N14 is an important tourist route to Augrabies Falls National Park, and the N10 to the Kgalagadi Transfrontier Park and Namibia. The Spitskop Nature Reserve, some 16 km away, is one of the few protected areas, while the Upington airport provides a gateway to the region.
» Opportunities and Constraints: The region, with its long sunshine hours, has already been identified as having opportunity for the production of solar energy, with the proposed solar facilities tending to be located on the semi-arid plains, away from the Gariep River settlements and farmlands. The wilderness and rural qualities, including the vineyards, that contribute to the area's sense of place, along with the main tourist routes, are some of the major visual constraints.

7.9.2 Visual Assessment

The methodology for the visual impact assessment involves both quantitative and qualitative criteria to determine potential visual impacts. These are rated to determine both the expected level and significance of the visual impacts. To determine the nature and degree of potential visual impacts, the following criteria have been used:

» **Viewpoints:** Viewpoints were selected based on prominent viewing positions in the area, where uninterrupted views of the proposed CSP Plant could be obtained, including potentially sensitive viewpoints. The proposed CSP Plant would be potentially visible from the outskirts of Upington, from numerous settlements and farmsteads along the Gariep River, from the N14 and N10 National Routes, and even from Upington Airport 23 km away. Refer to Figure 7.8 for the viewpoints utilised for the visual assessment.
» **Visibility:** Visibility tends to be determined by distance between the proposed CSP Plant and the viewer. Distance radii are shown in Figure 7.8 to assist in quantifying visibility of the proposed power tower plant.

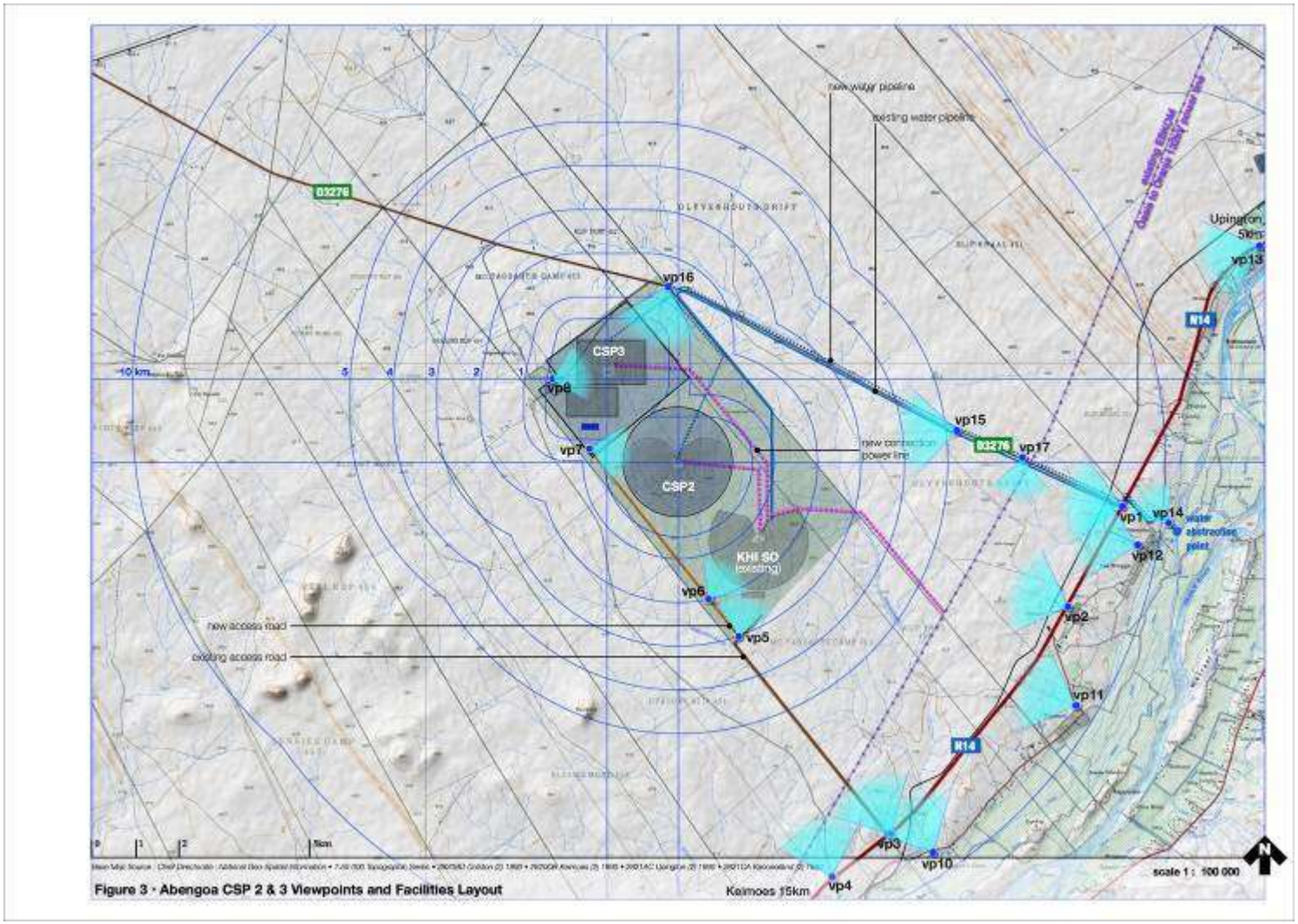

Figure 7.8: Viewpoints selected in the study area

Table 7.1: Potential Visibility of the CSP Plant

ABU CSP Viewpoints	**Location**	**Distance from the Solar Tower Plant**	**Visibility**
vp1	N14 / D3276 Intersection	9.1 km	Moderate
vp2	N14 Klippunt	8.4 km	Moderate
vp3	N14 Khi Solar 1 Entrance	8.6 km	Moderate
vp4	N14 Dyason's Klip	8.9 km	Moderate
vp5	Start of New Access Road	3.1 km	High
vp6	New Access Road opposite Khi Solar 1	1.9 km	High
vp7	CSP 3 SW Boundary	994 m	High
vp8	Old Tungsten Mine	2.3 km	High
vp9	Kanoneiland Settlement	13.4 km	Moderate
vp10	Mc Taggert's Camp Settlement	9.5 km	Moderate
vp11	Klippunt Settlement	9.5 km	Moderate
vp12	Ses Brugge Settlement	9.6 km	Moderate
vp13	Upington western outskirts	13.1 km	Moderate
vp15	Road crest on D3276	5.1 km	High
vp16	NE Boundary on D3276	3.5 km	High
vp18	R360 at Spitskop Nature Reserve	16.6 km	Marginal
vp14	Pump station	284 m	High
vp17	D3276 at ESKOM Power Line	60 m	High

» **Visual Exposure:** Visual exposure is determined by the 'viewshed' or 'view catchment', being the geographic area within which the project would be visible. The viewshed for the power tower is shown in in Figure 7.9. The viewshed for the heliostats is shown in Figure 7.10. The viewshed boundary tends to follow ridgelines and high points in the landscape. Some areas within the view catchment area fall within a view shadow, and would therefore not be affected by the proposed energy facilities. Given the flatness of the landscape and the height of the Khi Solar One Plant, there are few view shadows.

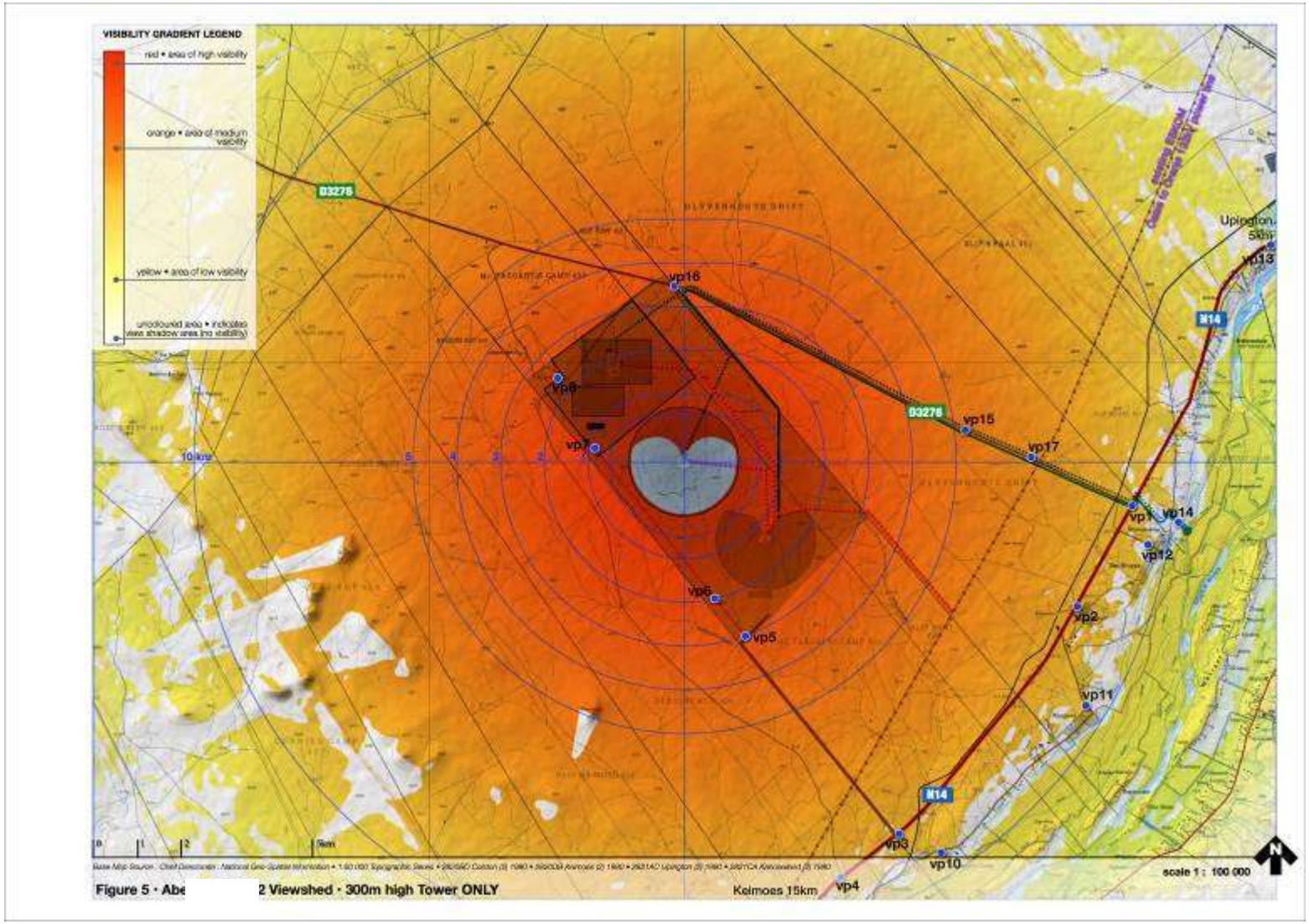

Figure 7.9: Viewshed for the Upington Solar Thermal Plant Two Power Tower only (height of up to 300m)

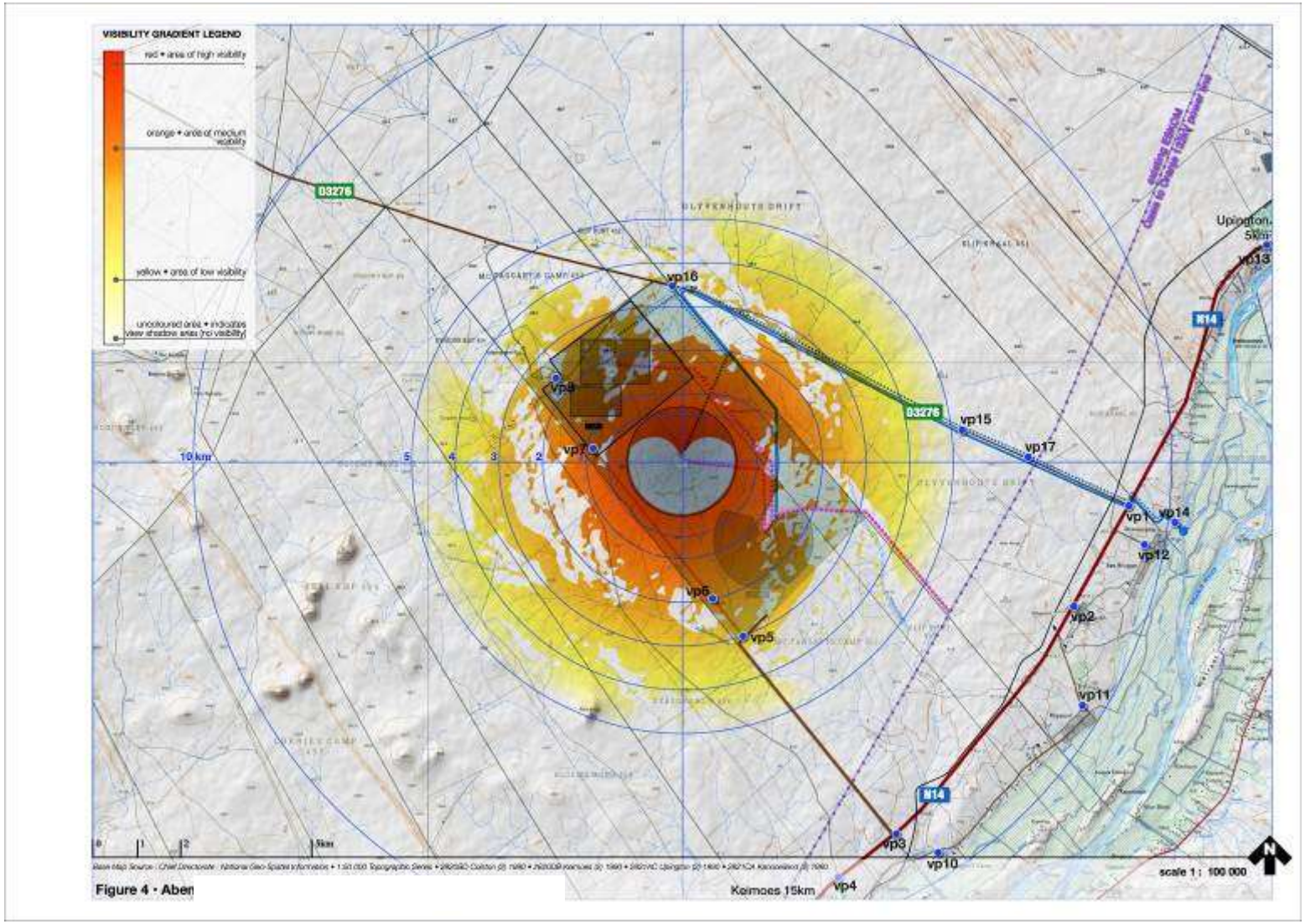

Figure 7.10: Viewshed for the Upington Solar Thermal Plant Two (heliostats only at 6m in height)

A photomontage showing the Upington Solar Thermal Plant Three is shown in Figure 7.9

Figure 7.11: Photo simulation showing the Upington Solar Thermal Plant Two within the current landscape

» **Landscape Integrity**

Visual quality is enhanced by the scenic-ness or intactness of the landscape, and lack of other visual intrusions. The existing Khi Solar One project and Eskom 132 kV power line and other industrial type sheds or structures are some of the existing visual intrusions. The surrounding landscape has a generally rural quality, but other energy facilities are proposed in the area, which need to be taken into account

» **Cultural Landscape**: Besides natural attributes, landscapes have a cultural value, enhanced by the presence of historical settlements, old routes, graves and farmsteads.

» **Visual Absorption Capacity**: This is the potential to screen the project. Given the scale of the proposed facility, both in terms of footprint and height, along with the open nature of the landscape, there is little opportunity for screening.

» **Cumulative Visual Impact**: This is the accumulation of visual impacts in the area, particularly in relation to the Khi Solar One CSP Plant and other proposed energy projects and industrial-type facilities in the area.

The criteria above are considered in combination to give an indication of the nature and degree of the potential visual impacts, as outlined in **Table 7.2** below.

Table 7.2: Nature and Degree of Potential Visual Impacts / Benefits

Criteria	Comments	Phase 2 power tower	Connecting power lines	Pump house and pipeline at Gariep R.
Visibility of facilities Distance from selected viewpoints	Views of CSP facilities from the N14 tend to be the most significant, but are some 8 km distant. Settlements are from 9 or more km distance.	Medium-high	Low	Low
Visibility of lights at night	Depends on CAA requirements for navigation lights on the tower, and amount of security lighting at the substation and other facilities.	Medium-high	n/a	Low
Visual exposure Zone of visual influence or view catchment	The power tower viewshed is extensive as a result of the height of the structure.	High	Low-medium	Low
Visual sensitivity Effect on landscape features and scenic value	A visually exposed landscape. The tower would create a distinctive feature in the semi-arid landscape. The Khi Solar One tower is already visible. Sparsely populated area.	Medium-high	Medium	Medium
Landscape	Industrial-type facilities would	Medium-high	Medium	Medium

integrity Effect on character of the area	contrast with rural / wilderness landscape. However precedent already exists for similar facilities – Khi Solar One is already constructed.			
Visual absorption capacity (VAC) Lack of concealment	Low potential of open landscape to visually absorb CSP facilities. Tower would be visible on the skyline. Phases 2 would be partly screened by Khi Phase One.	Medium-high	Medium	Low-medium
Cumulative impacts Accumulation of impacts in the area	Other solar energy facilities are proposed within a 30km radius. Adds to footprint of Khi Solar One.	Medium-high	Medium	Medium-low

- The Phase 2 power tower CSP Plant requires a 200m – 300m power tower which will be highly visible, and would therefore have a medium- high visual impact as due to the height of the power tower (200m to 300m in height) and heliostats (6m in height).
- Although the proposed power tower would be highly visible in the relatively flat, open landscape, and would therefore have a 'high' visual rating, the fact that the adjacent Khi Solar One already exists means that the Phase 2 plant, further from the N14 Route and the Gariep River, would have a reduced significance. In addition, the surrounding area has been identified for a number of solar energy projects, so that the Proposed Phase 2 Power Tower would essentially form part of a larger solar energy complex.
- Potential visual impacts for associated infrastructure include the connecting power lines, which are rated as medium significance before mitigation, with little opportunity for mitigation.
- The water abstraction facilities at the Gariep River would be fairly localised with a potential visual impact of medium-low before mitigation and could be partly mitigated to low significance, including rehabilitation/re-vegetation. All pipelines and power lines related to water abstraction should be located underground where possible.
- The construction phase of the project would include the use of cranes and a batching plant, both of which have visual implications, but these would be temporary, and were therefore not considered to have an important effect on the overall visual impact significance ratings.
- The decommissioning phase of the projects, at the end of their useful life, would involve the dismantling and removal (recycling) of the structures, although concrete foundations would probably remain in the landscape.
- The area has been generally identified for the location of solar energy plants, no fatal flaws are expected in terms of potential visual impacts.

» The assessment indicates that visual impacts of the facility would be of an acceptable level provided the mitigation measures are implemented.

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

Nature of impacts: Visual impact of the Upington Solar Thermal Plant Three (power tower technology)		
Listed Activities: GNR 545, 18 June 2010 Activity 1		
	Without mitigation	**With Mitigation**
Extent	Medium (3)	n/a
Duration	Long Term (4)	n/a
Magnitude	High (8)	n/a
Probability	Highly Probable (4)	n/a
Significance	**High (60)**	n/a
Status *(positive/negative)*	Negative	n/a
Reversibility	Low	n/a
Irreplaceable loss of resources?	Yes	n/a
Can impacts be mitigated?	Marginally	n/a
Mitigation: » Ensure a compact layout of facilities to minimise sprawl of buildings in the landscape. » Use earth berms for visual screening. » Use natural colours for buildings. » All structures to be removed in the decommissioning phase, and the landscape rehabilitated/ re-vegetated. » The entrance gate facilities to be set back a min. 200 m from the N14. » Signage to be controlled, and should not break the skyline.		
Cumulative impacts: Would add to the footprint of existing first phase Khi Solar One on the site. Will add to other solar projects envisioned around Upington.		
Residual impacts: Industrial-type facility in a rural area. Concrete foundations would probably remain after decommissioning.		

Nature of impacts: Visual impact of the power line		
Listed Activities: GNR 545, 18 June 2010 Activity 10		
	Without mitigation	**With Mitigation**
Extent	Low (2)	Low (2)
Duration	Long Term (4)	Long Term (4)

Magnitude	Low (4)	Low (4)
Probability	Highly Probable (4)	Highly Probable (4)
Significance	**Medium (36)**	**Medium (36)**
Status *(positive/negative)*	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	No	No
Mitigation: None		
Cumulative impacts: Would add to footprint of existing first phase Khi Solar One powerlines and the existing Eskom 132 kV power line.		
Residual impacts: Powerlines could be visually prominent in the exposed landscape. Concrete foundations would probably remain after decommissioning.		

Nature of impacts: Visual impact of the Pumphouse and Pipeline at Gariep River		
Listed Activities: GNR 545, 18 June 2010 Activity 9 GNR 546, 18 June 2010 Activity 2		
	Without mitigation	**With Mitigation**
Extent	Low (2)	Low (2)
Duration	Long Term (4)	Long Term (4)
Magnitude	Low (4)	Low (2)
Probability	Probable (3)	Probable (3)
Significance	**Low (27)**	**Low (21)**
Status *(positive/negative)*	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes	

Mitigation:

» All pipelines and powerlines at the Gariep water abstraction site to be located underground where possible, and the water tanks painted dark green. Above-ground structures to be screened by berms and tree planting.

» Cluster new facilities with existing ones to minimise scatter of structures in the landscape. Areas exposed by excavations or fill to be regraded and re-vegetated to restore the natural landscape.

» All structures, above-ground pipelines and powerlines to be removed in the decommissioning phase and the disturbed areas rehabilitated/re-vegetated.

Cumulative impacts: Would add to footprint of existing first phase Khi Solar One pump house, pipeline and water tanks.

Residual impacts: Above-ground pipeline and water tanks could be visually intrusive in the rural landscape. Concrete foundations would probably remain after decommissioning.

7.9.4 Comparative Assessment of Access Road Alternatives

Both access road routes will require new road construction within the boundaries of Portion 3 of the Farm McTaggarts Camp 453. In terms of visual impacts as a result of construction of the road, there is **no significant** difference in the potential impacts associated with the two access road routes. Therefore, there is **no preference** between the alternatives.

7.9.5 Implications for Project Implementation

» Given that the proposed CSP plant would be even further away from receptors than the Khi Solar One, and that the area has been generally identified for the location of solar energy plants, no fatal flaws are expected in terms of potential visual impacts.
» Pipelines at the Gariep water abstraction site to be located underground where possible, and the water tanks painted dark green. Above-ground structures to be screened by berms and tree planting.
» Disturbed areas rehabilitated/re-vegetated after construction has been completed/ should the facility be decommissioned.

7.10. Noise Impacts

A noise study was undertaken by an acoustic specialist to determine is noise was an issue related to the development of the CSP Plant. Excluding single noise events from the N14 (traffic), there are no noise sources of significance in the area and relative low ambient sound levels are expected, especially at night. Excluding contractors busy with

the construction of the Khi Solar One facility working on the property there are no potentially noise-sensitive receptors living within 2 000 m from the proposed facility.

7.10.1 Construction Phase Noise Impacts

Potential Noise Sources during the construction phase include:

» Construction equipment: The equipment likely to be required to complete the above tasks will typically include: excavators/graders, bulldozer(s), dump trucks(s), vibratory roller, bucket loader, rock breaker(s), drill rig, flatbed truck(s), pile drivers, TLB, concrete truck(s), crane(s), fork lift(s) and various 4WD and service vehicles.
» Construction Vehicles: This will include trucks transporting equipment, aggregate and cement as well as various components used to develop the facility.
» Construction workers.

Construction activities are highly dependent on the final operational layout. A number of different noise-generating activities might take in the area. It has assumed that the existing Khi Solar One plant will be operational when construction of the CSP Plant will commence. The cumulative impact will therefore be considered simultaneously with the various construction activities.

The following construction activities are assumed to take place simultaneously for the construction of a 150 MW CSP Plant:

» Area where the new 150 MW Conventional Electrical Power Generation Plant will be situated, together with supporting services. Construction activities modelled included: General noise, digging trenches (excavator), cement truck offloading, crane operating, portable electrical generator (diesel - noisy).
» Site preparation for the construction of the power tower and heliostats. Construction activities modelled included: Digging trenches (excavator), portable electric generator (diesel – noisy), grader, water dozing.
» Road traffic: An average of five vehicles per hour on the access roads travelling between the various areas at speeds of 60 km/h, with three of these being heavy vehicles.

There will be a number of smaller equipment, but the addition of the general noise source (at each point) covers most of these noise sources. It is assumed that all equipment would be operating under full load (generate the most noise) at a number of locations and that atmospheric conditions would be ideal for sound propagation. This is likely the worst case scenario that can occur during the construction of the facility.

Even though construction activities are projected to take place only during day time, it might be required at times that these activities take place during the night (particularly for a large project). Construction activities that might occur during night time include:

» Concrete pouring: Large portions of concrete do require pouring and vibrating to be completed once started, and work is sometimes required until the early hours of the morning to ensure a well-established concrete foundation. However the work force working at night for this work will be considerably smaller than during the day.
» Working late due to time constraints: Weather plays an important role in time management in construction. A spell of bad weather can cause a construction project to fall behind its completion date. Therefore, it is hard to judge beforehand if a construction team would be required to work late at night.

The scenario was modelled using the layout for the CSP Plant. The impact assessment for the various construction activities that may impact on the surrounding environment is presented in the table below.

Nature: Numerous simultaneous construction activities that could cause noise and impact on receptors.	
Listed Activities: GNR 545, 18 June 2010 Activity 1	
Acceptable Rating Level	Rural district (excluding construction traffic): 45 dBA outside during day. Use of $L_{Req,D}$ of 45 dBA for rural areas Ambient sound level = 20 dBA
Extent ($\Delta L_{Aeq,D}$>7dBA)	**Local** – Assuming a uniformly 20 dBA ambient sound level over the study area, ambient sound levels could extend further than 1,000 meters from activities **(3)**
Duration	**Short** – Noisy activities in the vicinity of the receptors would last the duration of the construction period **(2)**
Magnitude	Noise Rating Levels (at receptors) < Rating Level – **Low (2)**
Probability	While it is possible that the closest receptors may hear construction activities at some time during the construction period (ideal sound propagation conditions), it is definite that it will not impact on them. **Unlikely (1)**
Significance	**Low (7)**
Status	Negative.
Reversibility	High
Irreplaceable loss of resources?	n/a
Comments	Modelling considered a worse-case scenario with significant activities taking place for 16 hours each day
Can impacts be mitigated?	Mitigation not required.
Mitigation:	Not required.

Cumulative impacts: This impact is cumulative with existing ambient sound as well as other noisy activities conducted in the same area.
Residual Impacts: This impact will only disappear once construction activities cease.

7.10.2 Operational Phase Noise Impacts

The main noise source associated with the operation of the CSP Plant relates to the fans used to assist with the condensing of the steam/water used in the power generation circuit. The following noise sources will be evaluated during the operational phase:

- Noises from the conventional electrical power generating plant (steam generation, steam storage, steam turbine and cooling system).
- Plant-generated traffic (maintenance crew, cleaning crew(s), etc.)
- Ancillary equipment such as pumps and pressure release valves.
- Possible general noise from the maintenance/workshop.
- With the steam turbine and generators situated within a building (that will significantly reduce the noise generation from these sources) noises from the fans will be the dominating noise in the area. The impact assessment therefore would focus on the noise generated by the fans and no other equipment.

The noise study therefore considers the worse-case scenario and illustrates the noise rating contours from 35 dBA (rural night-time acceptable rating level) upwards. Figure 7.7 illustrates the projected *cumulative* noise rating levels due to the operation of three proposed CSP facilities (Khi Solar One, Upington Solar Thermal Plant Two and the Upington Solar Thermal Plant Three). It does not consider potential cumulative impacts due to existing ambient sound levels and assumes a very quiet background sound level.

Nature: Noise due to fans related to the CSP Plants and others solar plants operating simultaneously	
Acceptable Rating Level	Rural district (excluding construction traffic): 45 and 35 dBA outside during day and night respectively. Use of $L_{Req,D}$ of 45 dBA and $L_{Req,N}$ of 35 dBA for rural areas Ambient sound level = 20 dBA
Extent ($\Delta L_{Aeq,n}$>7dBA)	**Local** – Impact could extend further than 1,000 meters from activity **(3)**
Duration	**Long** – Facility will operate for a number of years **(4)**
Magnitude	Noise Rating Levels (at receptors) <Rating Level – **Low (2)**
Probability	While it is possible that the closest receptors may hear construction activities at some time during the construction period (ideal sound propagation conditions), it is definite that

	it will not impact on them. **Unlikely (1)**
Significance	**Low (16)**
Status	Negative.
Reversibility	High.
Irreplaceable loss of resources?	*Not relevant.*
Can impacts be mitigated?	Not required.
Mitigation: None	
Cumulative impacts: This impact is cumulative with existing ambient background noises.	
Residual Impacts: This impact will only disappear once the operation of the facility stops, or the sensitive receptor no longer exists.	

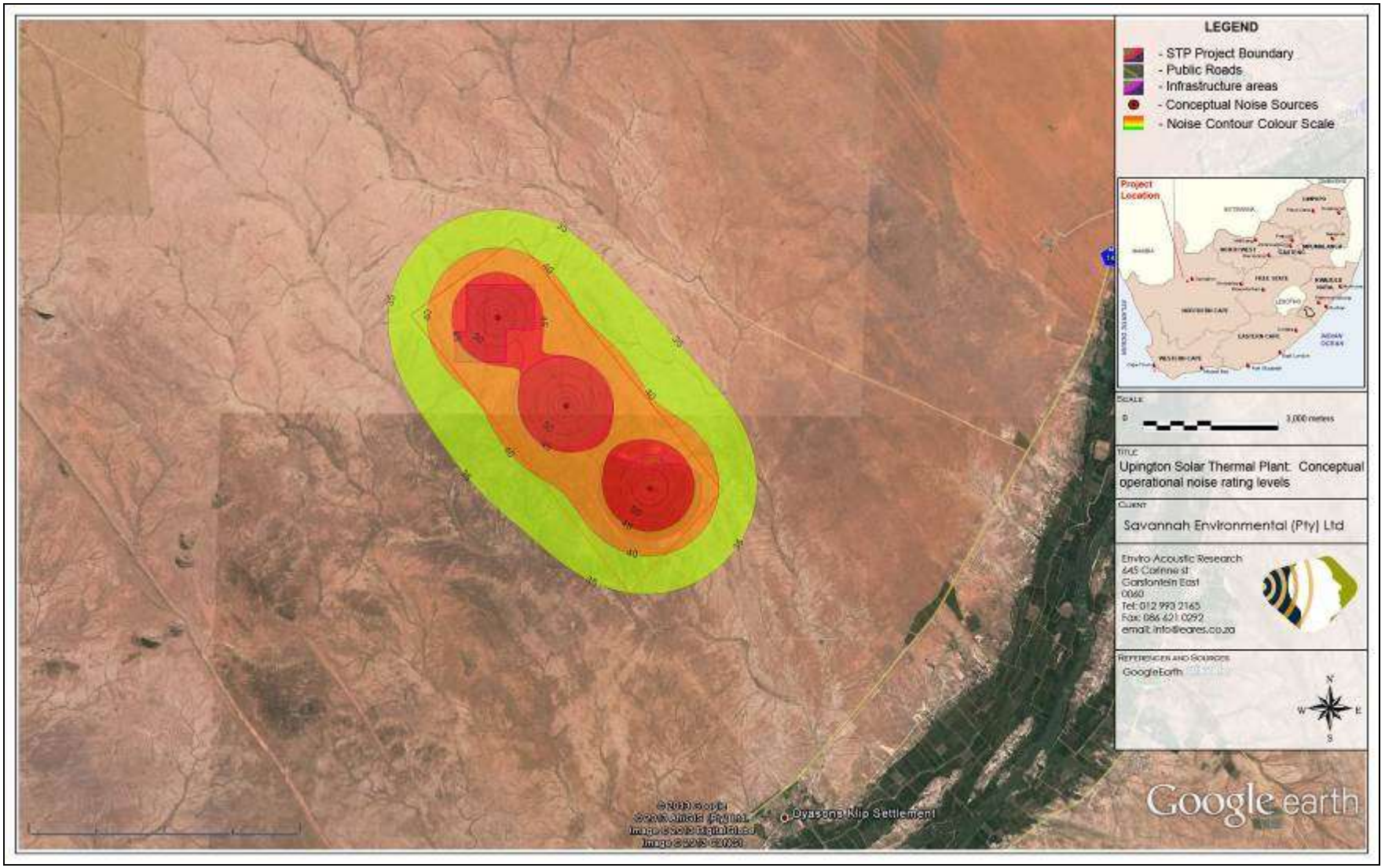

Figure 7.7: Projected Noise Rating Levels; Contours of constant sound levels due to the cumulative operation of three CSP Plants on Portion 3 of the Farm McTaggarts Camp 453

7.10.3Implications for Project Implementation

» The noise study utilised the noise emission characteristics of equipment expected to be used at the CSP plant. With the input data as used, this assessment indicated that the potential noise impact would be insignificant during both the construction and operational phases.
» No routine noise measurements are recommended before the construction starts or during the operational phase. However, if a valid and reasonable noise complaint is registered (relating to the operation of the facility) additional noise monitoring should be conducted by an acoustic consultant. Noise monitoring must be continued as long when noise complaints are registered.
» The developer should re-evaluate the noise study if the layout is changed (where any noise-generating equipment are moved closer or added within 1,000 meters from any potential noise-sensitive receptor).
» With its potential for environmental and economic advantages, solar power generation has significant potential to become a large industry in South Africa. Though it poses a very low noise risk to surrounding communities, the fans does generate noise. If constructed close to potential sensitive receptors, consideration must be given to ensuring a compatible co-existence where the potential noise-sensitive receptors are not adversely affected.
» The developer must implement a method of communication for lodgings of noise complaints.

7.11. Assessment of Potential Social Impacts

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

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

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

» Impacts associated with the presence of construction workers on site.
» Threat to safety and security of farmers 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.
» Impact of heavy vehicles, including damage to roads, safety, noise and dust.
» Potential loss of grazing land associated with construction-related activities.

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

» Creation of employment and business opportunities. The operational phase will also create opportunities for skills development and training.
» Benefits associated with the establishment of a Community Trust.
» The establishment of renewable energy infrastructure.

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

» The visual impacts and associated impact on sense of place.

The Social Impact Assessment Report (SIA) contains a detailed assessment of social impacts, which is summarised in the impact tables below. The findings of the SIA indicate that the development of the proposed Upington Solar Thermal Plant Two will create employment and business opportunities for locals during both the construction and operational phase of the project. The enhancement measures listed in the report should be implemented in order to enhance these benefits. In addition, the proposed establishment of a number of other renewable energy facilities in the area will create significant socio-economic opportunities for the local municipalities in the area, which, in turn, will result in a positive social benefit.

The establishment of a Community Trust funded by revenue generated from the sale of energy from the proposed project also creates an opportunity to support local economic development in the area. Given the size of the CSP Plant (150MW) this will represent a significant social benefit for an area where there are limited opportunities. 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. In addition, no affected or adjacent landowner or local community has objected to the development of the CSP Plant during the public participation process undertaken by Savannah Environmental. The establishment of the proposed Upington Solar Thermal Plant Two is therefore supported by the findings of the SIA.

7.11.1Impact tables summarising the significance of social impacts associated with the construction phase (with and without mitigation measures)

Nature: Creation of 300 – 600 employment and business opportunities during the construction phase.

Listed Activities:
GNR 545, 18 June 2010 Activity 1

	Without Mitigation	**With Enhancement**
Extent	Local – Regional (2)	Local – Regional (4)
Duration	Short Term (2)	Short Term (2)
Magnitude	Low (4)	Moderate (6)
Probability	Highly probable (4)	Definite (5)
Significance	**Medium (32)**	**High (60)**
Status	Positive	Positive
Reversibility	N/A	N/A
Irreplaceable loss of resources?	N/A	N/A
Can impact be enhanced?	Yes	

Enhancement:

Employment

» Where reasonable and practical the contractors appointed by the proponent 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 contactors that are compliant with Broad Based Black Economic Empowerment (BBBEE) criteria;
» Before the construction phase commences the proponent and its contractors should meet with representatives from the Kai !Garib Local Municipality (KGLM) and bordering //Khara Hais Local Municipality(KHLM) to establish the existence of a skills database for the area. 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 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 the proponent intends following for the construction phase.
» 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

» The proponent should seek to develop a database of local companies, specifically Broad Based Black Economic Empowerment (BBBEE) 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.

» The proponent, in consultation with the KGLM and KHLM and the local Chamber of Commerce, 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.

Cumulative impacts: Opportunity to up-grade and improve skills levels in the area.

Residual impacts: Improved pool of skills and experience in the local area.

Nature: Potential impacts on family structures and social networks associated with the presence / disturbances by construction workers.

Listed Activities:
GNR 545, 18 June 2010 Activity 1

	Without Mitigation	**With Mitigation**
Extent	Local (2)	Local (1)
Duration	Medium Term for community as a whole (3)	Medium Term for community as a whole (3)
Magnitude	Low for the community as a whole (4)	Low for community as a whole (4)
Probability	Probable (3)	Probable (3)
Significance	Low for the community as a whole (27)	Low for the community as a whole (24)
Status	Negative	Negative
Reversibility	No in case of HIV and AIDS	No in case of HIV and AIDS
Irreplaceable loss of resources?	Yes, if people contract HIV/AIDS. Human capital plays a critical role in communities that rely on farming	

	for their livelihoods	
Can impact be mitigated?	Yes, to some degree. However, the risk cannot be completely eliminated.	

Mitigation:

» Where possible, the proponent should make it a requirement for contractors to implement a 'locals first' policy for construction jobs, specifically semi and low-skilled job categories.
» Provide forums to communicate matters regarding environmental management.
» The proponent and the contractors should 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.
» The proponent 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 necessary arrangements to enable 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 non-local construction workers to local family structures and social networks.
» The contractor should make the necessary arrangements for ensuring that all non-local construction workers are transported back to their place of residence once the construction phase is completed. This would reduce the risk posed by non-local construction workers to local family structures and social networks.
» With the exception of security personnel, no construction workers should be permitted to stay overnight on the site.

Cumulative impacts: Impacts on family and community relations that 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. The development of other solar energy projects in the area may exacerbate these impacts.

Residual impacts: Community members affected by STDs etc. and associated impact on local community and burden services etc.

Nature: Potential loss of livestock, poaching and damage to farm infrastructure

associated with the presence of construction workers on site		
Listed Activities: GNR 545, 18 June 2010 Activity 1		
	Without Mitigation	**With Mitigation**
Extent	Local (2)	Local (1)
Duration	Medium Term (3)	Medium Term (3)
Magnitude	Moderate (6)	Low (4)
Probability	Probable (3)	Probable (3)
Significance	**Medium (33)**	**Low (24)**
Status	Negative	Negative
Reversibility	Yes, compensation paid for stock losses etc.	Yes, compensation paid for stock losses etc.
Irreplaceable loss of resources?	No	No
Can impact be mitigated?	Yes	Yes
Mitigation: » Provide forums to communicate matters regarding environmental management. » The proponent should hold contractors liable for compensating any impacted farmer and communities for any stock losses and/or damage to farm infrastructure that can be linked to construction workers. This should be contained in tender documents for contractors and the Code of Conduct to be signed between the proponent, the contractors and neighbouring landowners. The agreement should also cover loses and costs associated with fires caused by construction workers or construction related activities (see below); » The EMPr must outline procedures for managing and storing waste on site, specifically plastic waste that poses a threat to livestock if ingested. » Contractors appointed by the proponent 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 the proponent should ensure that construction workers who are found guilty of stealing livestock, poaching and/or damaging farm infrastructure should be charged as per the conditions 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.		
Cumulative impacts: No**,** provided losses are compensated for.		
Residual impacts: Not applicable if losses are compensated for.		

Nature: Potential loss of livestock, crops and houses, damage to farm infrastructure and threat to human life associated with increased incidence of veld fires

Listed Activities:
GNR 545, 18 June 2010 Activity 1

	Without Mitigation	**With Mitigation**
Extent	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)
Duration	Short Term (2)	Short Term (2)
Magnitude	Moderate due to reliance on livestock for maintaining livelihoods (6)	Low (4)
Probability	Probable (3)	Probable (3)
Significance	**Medium (36)**	**Low (24)**
Status	Negative	Negative
Reversibility	Yes, compensation paid for stock and losses and damage etc.	
Irreplaceable loss of resources?	No	No
Can impact be mitigated?	Yes	

Mitigation:

» Contractor should ensure that open fires on the site for cooking or heating are not allowed except in designated areas.
» No smoking on the site, except in designated areas should be permitted.
» Contractor should 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 should provide adequate fire fighting equipment on-site.
» Contractor should provide fire-fighting training to selected construction staff.
» As per the conditions of the Code of 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.

» The developer should also ensure that they join the local fire protection agency.

Cumulative impacts: No, provided losses are compensated for.

Residual impacts: Potential loss of income and impact on livelihoods and economic viability of affected farms.

Nature: Potential noise, dust and safety impacts associated with movement of construction related traffic to and from the site and construction related activities

Listed Activities:
GNR 545, 18 June 2010 Activity 1
GNR 544, 18 June 2010 Activity 47 (iii)

	Without Mitigation	**With Mitigation**
Extent	Local-Regional (2)	Local-Regional (1)
Duration	Medium Term (3)	Medium Term (3)
Magnitude	Moderate (6)	Low (4)
Probability	Probable (3)	Probable (3)
Significance	**Medium (33)**	**Low (24)**
Status	Negative	Negative
Reversibility	Yes	
Irreplaceable loss of resources?	No	No
Can impact be mitigated?	Yes	

Mitigation:

» The proponent should ensure that damage to the D3276 is repaired on a regular basis and that the road is returned to its original state once the construction phase is completed.

» Drivers should be made aware of the potential risk posed to school children and other local residents. All drivers must ensure that speed limit of 60 km per hour is enforced along the section of the N14 that runs past residential units.

» Abnormal loads along the N14 should be timed to avoid times of the year when traffic volumes are likely to be higher, such as start and end of school holidays, long weekends and weekends in general etc.

» The contractor must ensure that all damage caused to the internal access road 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, made aware of the potential road safety issues, and need for strict speed limits.
» Construction should be done in phases so that the area cleared is kept to a minimum. This will also allow for progressive rehabilitation of disturbed areas during the 24 month construction phase.

Cumulative impacts: 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.

Residual impacts: Reduced quality of road surfaces and impact on road users

Nature: The activities associated with the construction phase, such as establishment of access roads and the construction camp, movement of heavy vehicles and preparation of CSP Plant, pipe line, roads and power lines will damage farmlands and result in a loss of farmlands for future farming activities.

Listed Activities:
GNR 545, 18 June 2010 Activity 1
GNR 544, 18 June 2010 activity 9

	Without Mitigation	**With Mitigation**
Extent	Local (1)	Local (1)
Duration	Long term-permanent if disturbed areas are not effectively rehabilitated or compensation is not paid (5)	Medium Term if damaged areas are rehabilitated (3)
Magnitude	Low (4)	Low (4)
Probability	Probable (3)	Probable (3)
Significance	**Low (28)**	**Low (28)**
Status	Negative	Negative
Reversibility	Yes, disturbed areas can be rehabilitated	Yes, disturbed areas can be rehabilitated
Irreplaceable	Yes, loss of farmland. However,	Yes, loss of farmland. However,

loss of resources?	disturbed areas can be rehabilitated	disturbed areas can be rehabilitated
Can impact be mitigated?	Yes, however, loss of farmland cannot be avoided	Yes, however, loss of farmland cannot be avoided

Mitigation:

» The footprint associated with the construction related activities (access roads, construction platforms, workshop etc.) should be kept to a minimum.
» The installation of the components should be phased so that the area cleared is kept to a minimum. This will also allow for progressive rehabilitation of disturbed areas during the construction phase.
» An Environmental Control Officer (ECO) should be appointed to monitor 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 a suitably qualified person/s.
» The implementation of the Rehabilitation Programme should be monitored by the ECO.

Cumulative impacts: Overall loss of farmland could affect the livelihoods of the affected farmer, and the workers on the farm and their families. However, disturbed areas can be rehabilitated and loses would be off-set by compensation

Residual impacts: Land would be available for farming once rehabilitation has been completed.

7.11.2Impact tables summarising the significance of social impacts associated with the operational phase (with and without mitigation measures)

Nature: Creation of ~80 employment and business opportunities associated with the operational phase

Listed Activities:
GNR 545, 18 June 2010 Activity 1

	Without Mitigation	**With Enhancement**
Extent	Local and Regional (1)	Local and Regional (2)
Duration	Long term (4)	Long term (4)
Magnitude	Moderate (6)	Moderate (6)
Probability	Probable (3)	Highly Probable (4)

Significance	**Medium (33)**	**Medium (48)**
Status	Positive	Positive
Reversibility	N/A	
Irreplaceable loss of resources?	No	
Can impact be enhanced?	Yes	
Enhancement: The proponent 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 locals employed during the operational phase of the project.		
Cumulative impacts: 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		
Residual impacts: Creation of pool of people with experience in field of CSP Plants.		

Nature: Establishment of a Community Trust funded by revenue generated from the sale of energy. The revenue can be used to fund local community development		
Listed Activities: GNR 545, 18 June 2010 Activity 1		
	Without Mitigation	**With Enhancement**
Extent	Local and Regional (2)	Local and Regional (3)
Duration	Long term (4)	Long term (4)
Magnitude	Moderate (6)	Moderate (6)
Probability	Probable (3)	Definite (5)
Significance	**Medium (36)**	**High (65)**
Status	Positive	Positive
Reversibility	N/A	
Irreplaceable loss of resources?	No	
Can impact be enhanced?	Yes	
Enhancement: » The proponent in consultation with the KGLM and KHLM should establish criteria for		

identifying and funding community projects and initiatives in the area. The criteria should be aimed at maximising the benefits for the community as a whole and not individuals within the community; » The proponent in consultation with the KGLM and KHLM should ensure that strict financial management controls, including annual audits, should be implemented to ensure that the funds generated for the Community Trust are managed for benefit of the community as a whole and not individuals within the community.
Cumulative impacts: Promotion of social and economic development and improvement in the overall well-being of the community
Residual impacts: Investment in local economic development in the area that would benefit the community post operational phase

Nature: Promotion of clean, renewable energy		
Listed Activities: GNR 545, 18 June 2010 Activity 1		
	Without Mitigation	**With Mitigation** (The provision of renewable energy infrastructure is in itself a mitigation measure)
Extent	Local, Regional and National (4)	Local, Regional and National (4)
Duration	Long term (4)	Long term (4)
Magnitude	Low (4)	Low (4)
Probability	Highly Probable (4)	Highly Probable (4)
Significance	**Medium (48)**	**Medium (48)**
Status	Positive	Positive
Reversibility	Yes	
Irreplaceable loss of resources?	Yes, impact of climate change on ecosystems	
Can impact be mitigated?	Yes	
Enhancement: » Use the project to promote and increase the contribution of renewable energy to the national energy supply; » 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.
Cumulative impacts: Reduce carbon emissions via the use of renewable energy and associated benefits in terms of global warming and climate change.
Residual impacts: Not applicable after decommissioning

7.11.3Impact tables summarising the significance of social impacts associated with the decommissioning phase (with and without mitigation measures)

Nature: Social impacts associated with retrenchment including loss of jobs, and source of income should the CSP Plant be decommissioned.		
Listed Activities: GNR 545, 18 June 2010 Activity 1		
	Without Mitigation	**With Mitigation**
Extent	Local and regional (3)	Local and regional (2)
Duration	Medium Term (2)	Very Short Term (1)
Magnitude	Moderate (6)	Low (4)
Probability	Highly Probable (4)	Highly Probable (4)
Significance	**Medium (44)**	**Low (16)**
Status	Negative	Negative-Neutral
Reversibility	Yes, assumes retrenchment packages are paid to all affected employees	
Irreplaceable loss of resources?	No	
Can impact be mitigated?	Yes	
» **Mitigation:** » The proponent 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. » The proponent should investigate the option of establishing 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 20 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.
Cumulative impacts: Loss of jobs and associated loss of income etc. can impact on the local economy and other businesses. However, decommissioning can also create short term, temporary employment opportunities associated with dismantling etc.
Residual impacts: See cumulative impacts

7.11.4Comparative Assessment of Access Road Alternatives

Consolidation of the impacts to a single corridor (Khi Solar One and Upington Two) is supported, as Alternative 1 makes use of the purpose-built access for Khi Solar One, reduces the need for using the gravel public road for access, and keeps all construction traffic limed to a single corridor. **Alternative 1** is considered the preferred alternative. Where Alternative 2 is used, the proponent would be required to ensure that damage to the D3276 is repaired on a regular basis (the D3276 is a public road which is currently a gravel road), and that the road is returned to its original state once the construction phase is completed.

7.11.5Implications for Project Implementation

- The findings of the SIA undertaken for the proposed Upington Solar Thermal Plant Two indicate that the development will create employment and business opportunities for locals during both the construction and operational phase of the project.
- The establishment of a Community Trust will also create an opportunity to support local economic development in the area.
- The development of renewable energy has also been identified as key growth sector by the local municipality and 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.
- Where reasonable and practical the contractors appointed by the proponent 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.
- A skills development and training programme to be developed for the construction and operational phases.
- Any negative social impacts during construction and operational of the plant can be managed to acceptable levels.
- It is therefore recommended that the Upington Solar Thermal Plant Two can be developed, subject to the implementation of the recommended enhancement and mitigation measures contained in the EMPr.

7.12. Impacts Related to the Storage and Handling of Dangerous Goods

During the construction and operation phase, the CSP plant will require the storage of materials which may be considered to be dangerous goods.

"Dangerous goods" is defined under the Listing Notices that deal with the storage, or storage and handling, of dangerous goods. "Dangerous goods" are defined in the Listing Notices as:

"Goods containing any of the substances as contemplated in South African National Standard No. 10234, supplement 2008 1.00: designated "List of classification and labelling of chemicals in accordance with the Globally Harmonized Systems (GHS)" published by Standards South Africa, and where the presence of such goods, regardless of quantity, in a blend or mixture, causes such blend or mixture to have one or more of the characteristics listed in the Hazard Statements in section 4.2.3, namely physical hazards, health hazards or environmental hazards".

The above definition makes specific reference to SANS 10234. South Africa has implemented the Globally Harmonized System of Classification and Labelling of Chemicals by issuing this national standard.

The operation of the CSP Plant requires fuel for start-up, diesel and other chemicals. The facilities or infrastructure for the storage, or storage and handling of a dangerous good in containers will have a combined capacity of up to / not exceeding 500m^3 (cubic metres). These chemicals will be stored on-site in appropriate storage vessels in bunded areas/ on impervious services. A designated storage and dangerous good handling area is considered as part of the facility design. The storage and handling of dangerous goods has the potential to result in soil and/or water contamination should any spillages/leakages occur. This is considered to be the most significant risk (other than a direct risk to personnel on site, which is an occupational health and safety issue and is considered in line with the OH&S Act). While not all materials to be stored on site are considered to be hazardous (or have a hazard rating), materials such as fuel and oils are flammable and also have the potential to cause fires, explosions, damage to infrastructure, as well as injuries of staff.

The proposed project will require the construction of facilities or infrastructures for the storage of the following dangerous goods. The construction phase will require the handling and storage of materials including hydraulic oil, fuel, cement and fly ash (for use in concrete batching plant) with an estimated volume of 250 m^3 at any one time. The operation phase will require the handling and storage of materials such as:

» Sodium hydroxide, hydrochloric acid, sulphuric acid, ferric chloride, lubrication oil, amine, phosphate, carbohydrazide, closed corrosion inhibitor with an approximate total of 140 m^3 at any one time.
» Fuel for the auxiliary steam boiler with an estimated total of 50 m^3 at any one time

The combined volumes of dangerous good stored or handled on the site at any one time[19] are:

» Construction phase: approximately 250 m^3
» Operations phase: approximately 190 m^3

The facility illustration provided in Appendix T indicates the bunded and enclosed dedicated storage area. A list of dangerous good and hazardous substances which may be used at the facility is included in Appendix Q.

Molten salts are specific to the operation of power tower plant with storage. The molten salt to be utilised in the CSP Plant is made up of a blend of Sodium Nitrate (approximately 60%) and Potassium Nitrate (approximately 40%). Neither is listed under Annex A of SANS 10234 supplement 2008 1.00: designated "List of classification and labelling of chemicals in accordance with the Globally Harmonized Systems (GHS)" published by Standards South Africa. Molten salt therefore does not qualify as a dangerous good in terms of the definition under NEMA EIA Regulations. It is, however, superheated when being used for thermal energy storage.

[19] These estimates were obtained from the Abengoa Solar projects in South Africa and similar CSP projects in Spain.

Nature: Soil and water contamination due to the handling and storage of dangerous goods during the construction and operational phases.

Listed Activities:
GNR 544, 18 June 2010 Listed Activity 13

	Without mitigation	**With mitigation**
Extent	Local (5)	Local (5)
Duration	Short (2)	Short (1)
Magnitude	High (8)	Low (4)
Probability	Probable (3)	Improbable (2)
Significance	**Medium (45)**	**Low (20)**
Status (positive or negative)	Negative	Negative
Reversibility	Irreversibility	Irreversibility
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	Yes

Mitigation::

» Any spillages of dangerous substances must be contained, and remedial and clean-up actions initiated immediately.
» Regular inspections of the permanent bunded areas for storage of dangerous goods must be undertaken.
» Maintenance vehicles must have access to spill kits.
» An emergency spill response plan must be developed for implementation during the construction and the operational phase.
» A fire management plan must be developed for implementation during the construction and the operational phase.
» Store flammable substances in enclosed containers away from heat, sparks, open flames, or oxidizing materials.
» Develop and implement a procedure for handling and clean-up of the chemical spill
» Develop a monitoring and leak detection procedure for monitoring of the chemical spillages.

Cumulative impacts:
The development of the CSP plant and its proximity to the Khi Solar One Plant will increase the cumulative environmental risk of contamination due to the storage and handling of chemicals and flammable substances.

Residual Impacts:
None

Nature: Operation of the CSP Plant including: possible release of toxic substances and associated contamination of soil and groundwater and downstream wetlands, possible contamination and damage to terrestrial fauna, possible rapid establishment of weeds or invasive species within solar fields and source of regenerative material of such species, possible increase of dust levels.

Listed Activities:
GNR 544, 18 June 2010 Listed Activity 13

	Without mitigation	**With mitigation**
Extent	Regional (4)	Local (1)
Duration	Long-term (4)	Long-term (4)
Magnitude	Low (4)	Small (0)
Probability	Definite (5)	Probable (3)
Significance	**Medium (60)**	**Low (15)**
Status (positive, neutral or negative)	Negative	Negative
Reversibility	Partially reversible	Reversible
Irreplaceable loss of resources?	Probable	Not likely
Can impacts be mitigated?	Reasonably	

Mitigation:

» No polluting chemicals may be used in mirror wash water.
» Routinely checks for chemical spillages.
» Prior to construction and up to decommissioning, clear method statements must be drafted and available on site at all times on how spillages will be contained and remediated.

Cumulative impacts:

» Possible pollution of surrounding areas and downstream rivers and wetlands if no mitigation is implemented

Residual impacts:

» None expected if mitigation measures are implemented

7.13. Assessment of the Do Nothing Alternative

The 'Do-Nothing' alternative is the option of not constructing the proposed Upington Solar Thermal Plant Two. Should this alternative be selected, there would be no environmental impacts on the site due to the construction and operation activities of a solar energy facility. Currently, the southern portion of the site is utilised for the Khi Solar One CSP project – the first CSP facility constructed in the Upington area. Abandoned mines in the form of shallow trenches and a few deep pits occur in the north-west corner of the McTaggart Camp property, as well as scattered trenches in the surrounding area. Some wildlife occurs on the broader farm portion. Should the current land use activities continue, degradation of the site vegetation will need to be managed through a site-specific management strategy to manage the potential for degradation of vegetation on site. Abengoa Solar South Africa own the whole farm portion. It is not their intention to continue with livestock or farming practises on the portion of the farm not occupied by a CSP facility.

In addition, the project is proposed on the same property/site as the Khi Solar One tower plant, which includes a new Eskom substation (the Eskom Distribution McTaggerts Substation). The construction of the Khi facility has included vegetation clearance on the portion of the land where the facility is situated, several access roads, as well as a power line. The new substation will be utilised for connection of new and additional renewable facilities proposed in the area until Eskom's new Transmission substation is constructed on their site for their planned CSP plant.

Approximately 1200 people are currently being employed on the construction site of Khi Solar One, with a significant number coming from the nearby communities (Klippunt, Sesbrugge, Daysons Klip and others). Significant resources and expenses have been incurred by Abengoa Solar to train people in a variety of disciplines in the CSP industry. Developing this project at the same location will create sustainability in employment, in that workers can move from the one project to another.

Further, industries have been created in Upington and the surrounding communities to provide products and services to the Khi Solar One project. Developing the next phase on Portion 3 of the Farm McTaggarts Camp 453 will allow these businesses to continue trading and positively impact on the lives of the community.

At a local and regional level, the new employment opportunities created through the construction of the Khi Solar One project will not be continued in terms of transfer of skills to people in terms of the construction and operation of the solar energy facility. The landowner and developer would have lost an opportunity of using the land in a sustainable manner. Furthermore, the community would lose the opportunity to improve and uplift their infrastructures through the additional community trust to be put in place.

At a broader scale, the benefits of additional capacity to the electricity grid and those associated with the introduction of renewable energy would not be realised. The Northern Cape has the best solar resource in the South Africa. Based on existing infrastructure, one of the best suited areas in the Northern Cape for solar energy facilities is close to and surrounding the town of Upington. Although the facility is only proposed to contribute 150 MW to the grid capacity, this would assist in meeting the growing electricity demand throughout the country and would also assist in meeting the government's goal for renewable energy. The generation of electricity from renewable energy resources offers a range of potential socio-economic and environmental benefits for South Africa. These benefits 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 releases of by-products through the burning of fossil fuels for electricity generation have a particularly hazardous impact on human health and contribute to ecosystem degradation.

» **Climate friendly development:** The uptake of renewable energy offers the opportunity to address energy needs in an environmentally responsible manner and thereby allows South Africa to contribute towards mitigating climate change through the reduction of greenhouse gas (GHG) emissions. South Africa is estimated to be responsible for ~1 % of global GHG emissions and is currently ranked 9th worldwide in terms of per capita CO_2 emissions.

» **Support for international agreements:** 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.

» **Employment creation:** The sale, development, installation, maintenance and management of renewable energy facilities have significant potential for job creation in South Africa.

» **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 'do nothing' alternative will do little to influence the macro-level renewable energy targets set by government due to competition in the sector, and the number of renewable energy projects being bid to the DoE, specifically around the Upington area. However, as the site experiences some of the best irradiation in the country and optimal grid connection opportunities are available, not developing the project would see such an opportunity being lost. The loss of the land to this project is, therefore, not considered significant. In addition the Northern Cape grid will be deprived of an opportunity to benefit from the additional generated power being evacuated directly into the Province's grid. The "Do Nothing" alternative is therefore not preferred as South Africa needs to diversify electricity generation sources, to which this project will contribute.

ASSESSMENT OF POTENTIAL CUMULATIVE IMPACTS CHAPTER 8

Cumulative impacts in relation to an activity are defined in the Environmental Impact Assessment Regulations (GN R543) as meaning "the impact of an activity that in itself may not be significant, but may become significant when added to the existing and potential impacts eventuating from similar or diverse activities or undertakings in the area".

There has been a steady increase in renewable energy developments recently in South Africa as legislation is evolving to facilitate the introduction of Independent Power Producers (IPPs) and renewable energy into the electricity generation mix. The Department of Energy has, under the REIPPP Programme released requests for proposals to contribute towards Government's renewable energy target of 3725 MW and to stimulate the industry in South Africa.

In a parallel process, a Strategic Environmental Assessment process is underway in order to identify geographical areas most suitable for the rollout of wind and solar photovoltaic energy projects and the supporting electricity grid network. Although CSP technology has not been specifically considered in the SEA, it follows that all solar technologies would be focussed in similar areas. The aim of the assessment is to designate renewable energy development zones (REDZs) within which such development will be incentivised and streamlined. The proposed Upington Solar Thermal Plant Two falls within the identified geographical areas / focus area most suitable for the rollout of the development of solar energy projects within the Northern Cape Province. Coupled to the Renewable Energy SEA, Eskom's Electricity Grid Infrastructure Strategic Environmental Assessment (SEA) is also underway. The area where the Upington Solar Thermal Plant Two is proposed is currently within the corridor planned to be strengthened by Eskom. It, therefore, follows that as the Upington Solar Thermal Plant Two falls in an identified renewable energy node, that projects of a similar nature are expected to be developed in this node.

Due to the growth in interest in renewable energy developments in South Africa, it is important to follow a precautionary approach in accordance with NEMA to ensure that the potential for cumulative impacts are considered and minimised where required and possible. This chapter considers whether the proposed CSP project's potential impacts become more significant when considered in combination with the other known or proposed solar energy facility projects within the area.

8.1 Assessment of Potential Cumulative Impacts

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[20].

Significant cumulative impacts that could occur due to the development of the solar energy facilities and its associated infrastructure in proximity to each other include impacts such as:

» Visual impacts
» Socio-economic impacts
» Loss of vegetation and impacts on ecology
» Impacts to soil
» Impacts on heritage resources
» Impacts related to abstraction of water from the Gariep River/ water resources.

The cumulative effect or impacts are presented as follows:

» Cumulative impacts potentially occurring due to the cumulative effects of the Kai Garib CSP Tower Plant added to all other renewable energy facilities under construction in the Upington area. These impacts will be registered throughout the Upington area requiring mitigation through planning at a regional level.
» Cumulative impacts potentially occurring due to the cumulative effects of the Kai Garib CSP Tower Plant, the proposed Upington Solar Thermal Plant Three and the Khi Solar One under construction, which are all proposed to be located on different areas within Portion 3 of the Farm McTaggarts Camp 453. These impacts will be registered within the boundaries of the greater farm portion.

8.2 Cumulative Impacts of Renewable Energy Facilities in the Region

The surrounding Upington area has been identified for a number of solar energy projects, with the proposed Kai Garib CSP Tower Plant forming part of a larger solar energy complex. The Kai Garib CSP Tower Plant is situated in the middle of Upington Solar Thermal Plant Three which has been authorised by the DEA and the Khi Solar One which is under construction. There are more than ten projects that are proposed in the area. Authorised projects relevant to the Upington Solar Thermal Plant Two include:

[20] Definition as provided by DEA in the EIA Regulations.

Project Name	Location	Project Status
1. Eskom CSP Facility	Farm Olyvenhouts Drift	Received Authorisation
2. Abengoa Solar 50MW Khi CSP facility (power tower technology)	Portion 3 of the farm McTaggarts Camp 453	Construction underway
3. Upington CSP Facility Three	Portion 3 of the Farm McTaggarts Camp 453	Received Authorisation
4. Solar Reserve CSP project	Remaining extent of Farm Rooipunt 617	Received Authorisation- Preferred bidder round 3.5
5. Sasol New Energy Project Solis (CSP Plant) Phase 1 and 2	Portions 443 to 450 of Van Roois Vley Farm	Received Authorisation
6. Sirius Solar Energy Facility (2 X 75MW PV projects)	Remaining Extent of the Farm Tungsten Lodge	Received Authorisation- Preferred bidder round 4
7. S-Kol photovoltaic plant near Keimoes	Farm Geelkop 456	Received Authorisation
8. Ofir ZX PV Facility	Remaining extent of Farm 616	Received Authorisation
9. Sonneberg PV Facility	Portion 11 of Farm Baviaanz Kranz 474	Received Authorisation
10. AEP Bloemsmond Solar PV Phase 1 and 2	Portion 5 and 14 of Farm Bloemsmond 455	EIA process underway
11. Dyasons Klip Solar 1	Dysons Klip 454	Preferred bidder round 4
12. Dyasons Klip Solar 2	Dysons Klip 454	Preferred bidder round 4

These projects were identified using the Department of Environmental Affairs Geographic Information System digital data developed by the CSIR[21]. A map showing the other relevant solar projects (both CSP as well as PV technology) in the study area is shown in Figure 8.1. Only the Khi Solar One Project is under construction by the same developer for the Upington Solar Thermal Plant Two i.e. Abengoa Solar Power South Africa (Pty) Ltd. There are at least 12 authorised solar projects in the immediate vicinity.

In addition, The Central Energy Fund (CEF) proposes a Solar Park on the Farm Klip Kraal 451 which is located adjacent to Eskom's CSP Plants site (on Farm Olyvenhouts Drift). The CEF Solar Park is proposed to comprise of a 1 GW of solar electricity generating plant consisting of a mix of solar technologies including PV, CPV, parabolic trough and central receiver/solar tower CSP technologies.

[21] It must be noted that the accuracy of this data has not been confirmed by DEA.

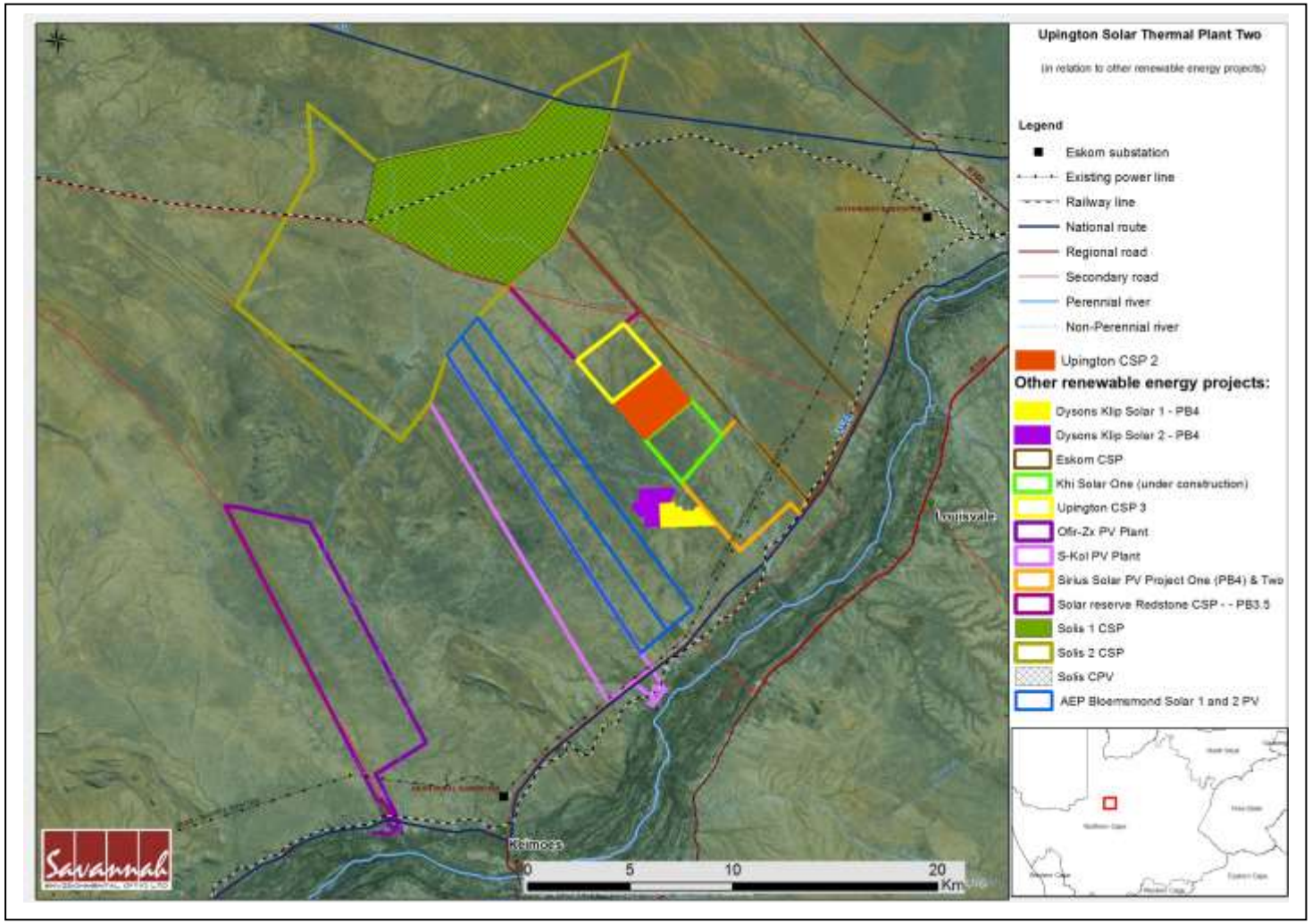

Figure 8.1: Map showing other projects in the study area. These projects were identified using the Department of Environmental Affairs Geographic Information System digital data developed by the CSIR

8.2.1. Visual impacts

The cumulative impacts associated with CSP and PV facilities are largely linked to the visual impact on the areas sense of place and landscape character. The construction of the Kai Garib CSP Tower Plant and the other CSP plants in close proximity to one other will increase the cumulative visual impact of industrial type infrastructure within the region. This is especially relevant in light of the other CSP facilities proposed adjacent to the site.

Considering the authorised CSP facilities, the addition of the proposed Kai Garib CSP Tower Plant will contribute to the cumulative visual impact within the region. Of note is that should enough alternative energy facilities exist within a region, it begins to be defined by such. Therefore, considering those facilities already in possession of an Environmental Authorisation, the anticipated cumulative impact on the visual quality of the landscape and the sense of place of the region will be of medium-high significance. Given the vastness of the area, the significance of the impact on the areas sense place and character is likely to be moderate. The cumulative impact on the areas landscape character will also be reduced by the concentration of a number of solar energy facilities in one area as opposed to being spread out over a larger area.

8.2.2. Socio-economic impacts

The proposed Kai Garib CSP Tower Plant together with the establishment of the other solar projects in the area also have the potential to result in significant positive cumulative socio-economic impacts for the local municipalities in the area (Kai !Garib Local Municipality, //Khara Hais Local Municipality and the ZF Mgcawu District Municipality). Positive cumulative impacts include creation of employment, skills development and training opportunities (construction and operational phase), creation of downstream business opportunities and stimulation of the local property market. The significance of this impact is rated as a high positive with enhancement.

However, the establishment of a large number of solar energy facilities in the area will also create a number of potential challenges for the local and district municipalities. These challenges are linked to provision of services and infrastructure. These challenges will need to be addressed by the municipalities to ensure that the benefits associated with the renewable energy sector are maximised for the benefit of the broader community.

8.2.3. Ecological Processes (flora and fauna)

The solar energy developments in the area are largely outside of the National Protected Areas Expansion Strategy 2008 (NPAES) focus areas, suggesting that the affected areas are not likely to be considered highly sensitive from a broad-scale conservation perspective. This agrees with observations from the area which suggests that the relatively flat topography of the area and relatively homogenous vegetation are factors which are likely to reduce the overall cumulative impact on the area to a relatively low level in terms of the potential of the high local development intensity to disrupt broad scale ecological processes. The cumulative loss of habitat resulting from the current and as well as the other developments in the area are not likely to impact the country's ability to meet conservation targets and objectives as the affected vegetation types are widespread and have been little impacted by transformation to date. Cumulative ecological impacts include:

» Excessive clearing of slow growing trees, especially *Boscia albitrunca* and *Acacia erioloba* could significantly impact local and regional population dynamics, as well as microhabitats and resources associated with these species available to other fauna and flora species. Clearing of such trees, must be kept to the absolute minimum, and large vigorous specimens should be a priority for conservation and exclusion from development footprints.
» Excessive clearing of vegetation and landscaping will influence runoff and stormwater flow patterns and dynamics, which could cause excessive accelerated erosion of plains, small ephemeral to larger intermittent drainage lines, rivers and this could also have detrimental effects on the lower lying Gariep River.
» Rehabilitation and re-vegetation of all surfaces disturbed or altered during construction is desirable. Runoff from sealed surfaces or surfaces that need to be kept clear of vegetation to facilitate operation of a development needs to be monitored regularly to ensure that erosion control and stormwater management measures are adequate to prevent the degradation of the surrounding environment.
» Large-scale disturbance of indigenous vegetation creates a major opportunity for the establishment of invasive species and the uncontrolled spread of alien invasives into adjacent rangelands.

Cumulative negative impacts on ecology related to transformation of land, disturbance and habitat loss may occur during construction as well as impacts on fauna and flora. The significance of this impact is expected to be of a medium significance with mitigation for each project, through sound environmental management during construction and operation and by formal conservation and active management of the natural areas on site. This will result in the negative impacts on ecosystems on each site being managed to acceptable levels, with acceptable loss, and therefore in keeping with the principles of sustainable development. With the implementation of good environmental management

practise during the life cycle of each project, cumulative impacts on ecology as a result of the establishment of similar facilities will be to an acceptable level.

8.2.4. Cumulative impacts on Avifauna

From the results of the expanded/additional study conducted and the literature reviewed it is likely that avifauna impacts resultant from the Upington Two CSP tower facility are likely to be very low.

Taking into account that the vast majority (over 80%) of the bird mortalities expected at a CSP facility are caused by collisions with heliostats, with the correct mitigation measures in place, the number of bird mortalities can probably be limited to 0.2 to 0.3 birds per week per facility, which is approximately 10% of the number of birds killed per kilometre of road per week. The cumulative impact on birds of three facilities is therefore considered to be low.

One of the factors most likely to reduce the risk of mortality in avifauna species for this area is the low average flight height of birds in the area, as most bird species will fly under the heliostats. The fact that many of the species of concern appear to be absent from the study area further reduces the likelihood of impacts.

A tower plant is under construction on the adjacent Khi Solar One site. The consolidation of impacts is preferred, localising the impact to an area where the risk to birds is considered low.

8.2.5. Cumulative impacts on Soil

The impact of the proposed project on soil and the loss of agricultural land available to grazing is of low to medium significance. The cumulative impact is offset by major limitations to agriculture in the area due to the aridity and lack of access to water, as well as the shallow soils prevailing in the area. Generally, land is only suitable for low intensity small stock farming and the cumulative impact is therefore expected to be low.

8.2.6. Cumulative Heritage Impacts

Archaeological sites are non-renewable and impact on any archaeological context or material will be permanent and destructive. Very sparse heritage and fossil traces were found on the site and from an archaeological perspective the observed heritage resources may be regarded as being of generally low significance. It still remains important for each facility to observe mitigation measures and to incorporate any sensitive heritage features into the layout plans where possible.

8.2.7. Cumulative effects on Water Resources

Potential cumulative water related impacts may occur with special reference to downstream erosion and sedimentation of the Gariep River; water abstraction from the Gariep 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 downstream of the Gariep River. Volumes of water to be abstracted from the Gariep River are controlled by the DWS, who will determine if sufficient reserves exist for the Lower Gariep River Catchment. All applicants will have to apply to DWS for a water use licence for abstraction of water from the Gariep River.

The relevant Water Use Licenses for all water uses (including abstraction and impacting on watercourses) are required to be obtained from the Department of Water and Sanitation (DWS). DWS will, however, need to assess the water availability during the Water Use Licencing process in conjunction with the 14 other projects which may seek to abstract from the Gariep River. At present the Khi Solar One site holds a WUL (for 300 000m3 per annum). The other preferred bidder projects (one of which is a CSP tower) still need to secure their water source, and several are taking water from the local municipalities.

The abstraction of water from the Gariep River during the operation of the CSP Plant (400 000 m^3/a) as well as at other abstraction points could reduce present day flows and impact negatively on the local aquatic biota. This impact would be more evident in summer months 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 (EWR), this impact is not possible to quantify. Reserve determination assessments are undertaken by the DWS (as seasonal and long-term data is required) and this information forms part of the DWS decision-making process when considering a Water Use License application (WULA). Considering of the Reserve would be undertaken by DWS on receipt of each WULA where water is to abstracted form a system. This would not be restricted to water for power generation, but also for other activities, such as agricultural activities (which are common on the banks of the Gariep River). For this project's water requirement, the Department of Water and Sanitation (DWS) Lower Orange Water Management Area regional office have confirmed in a letter dated 29 May 2015 (refer to Appendix P) that, after due consideration of the water resource availability in the catchment area, it was found the sufficient water is available to meet the water requirement of the project (~300 000 m^3 per annum during construction and 400 000 m^3 per annum during operation). This would have considered the WUL already issued to Khi Solar one on the same farm. The Gariep River system is also highly regulated (i.e. many dams upstream in the system), however, it is anticipated that constant pumping during drought periods may impact on drought flow requirements needed to meet the EWR. Cognisance will have to be taken of other user requirements, and this is undertaken by the DWS.

8.3 Cumulative impacts of adding two additional 125/150MW CSP projects on Portion 3 of the Farm McTaggarts Camp 453

The potential cumulative impacts over the Portion 3 of the Farm McTaggarts Camp 453, should the development of two additional 125/150MW CSP Plants be realised, are likely to be largely contained to within the boundaries of the farm, and with the application of the necessary mitigation measures, contained within each of the respective plant areas. This is deduced based on the following:

» The development footprints of the two new proposed 125/150MW CSP projects are aligned with areas of low ecological sensitivity and largely outside of the identified high to very high sensitive areas (which are in limited extent on the site).
» Stone Age material is found on the greater farm, but is of low heritage significance.
» Visual impacts of developing 2 new 125/150MW plants will be of medium significance.
» The development of up to three CSP plants on the same farm portion means that each plant will require water. Water quantity may be affected; however volumes of water to be abstracted from the Gariep (Orange) River are controlled by the DWA, who will determine if sufficient reserves exist for the Lower Orange River Catchment. All applicants will have to apply to DWA for a water use licence for abstraction of water from the Gariep River.
» The development of up to three CSP plants may impact on public roads during construction. However, this impact can be managed, primarily through the selection of the primary access to the sites.
» Shared infrastructure between Kai Garib CSP Tower Plant and Upington Solar Thermal Plant Three, and Khi Solar One could include a shared access road and sharing of the McTaggerts Substation. This is favourable.
» Social – benefit to people in the area and increased opportunities for employment and spin-offs may occur. This is favourable.

Based on the above, the cumulative impacts associated with the construction and operation of two additional 125/150MW CSP Plants the Portion 3 of the Farm McTaggarts Camp 453 are considered to be acceptable provided that environmental impacts are mitigated to suitable standards by strict control and implementation of EMPrs for each project.

A map showing the potential for cumulative environmental sensitivities for Portion 3 of the Farm McTaggarts Camp 453 (considering the three CSP facilities) is provided in Figure 8.2.

8.4 Conclusion regarding Cumulative Impacts

Cumulative impacts and benefits on various environmental and social receptors will occur to varying degrees with the development of several renewable energy facilities in South Africa. The degree of significance of these cumulative impacts is difficult to predict without detailed studies based on more comprehensive data/information on each of the receptors and the site specific developments. This however, is beyond the scope of this study.

The alignment of renewable energy developments with South Africa's National Energy Response Plan and the global drive to move away from the use of non-renewable energy resources and to reduce greenhouse gas emissions is undoubtedly positive. The economic benefits of renewable energy developments at a local, regional and national level have the potential to be significant.

The surrounding Upington area has been identified for a number of solar energy projects, with the proposed Kai Garib CSP Tower Plant forming part of a larger solar energy complex. The Kai Garib CSP Tower Plant is situated in the middle of Upington Solar Thermal Plant Three which has been authorised by the DEA and the Khi Solar One which is under construction. There are more than more than ten projects are being proposed in the area. This implies that projects of the same nature will be consolidated in one area creating a node, and ultimately aiming to reduce the potential for cumulative impacts associated with such developments when spatially fragmented.

It is also important to note that it is unlikely that all proposed renewable energy facilities proposed in the area will be constructed in the short-term due to capacity constraints on the Eskom grid and the limits placed on renewable energy targets. Considering the findings of the specialist assessments undertaken for the project, the cumulative impacts for the proposed Kai Garib CSP Tower Plant are considered to be of **moderate significance.**

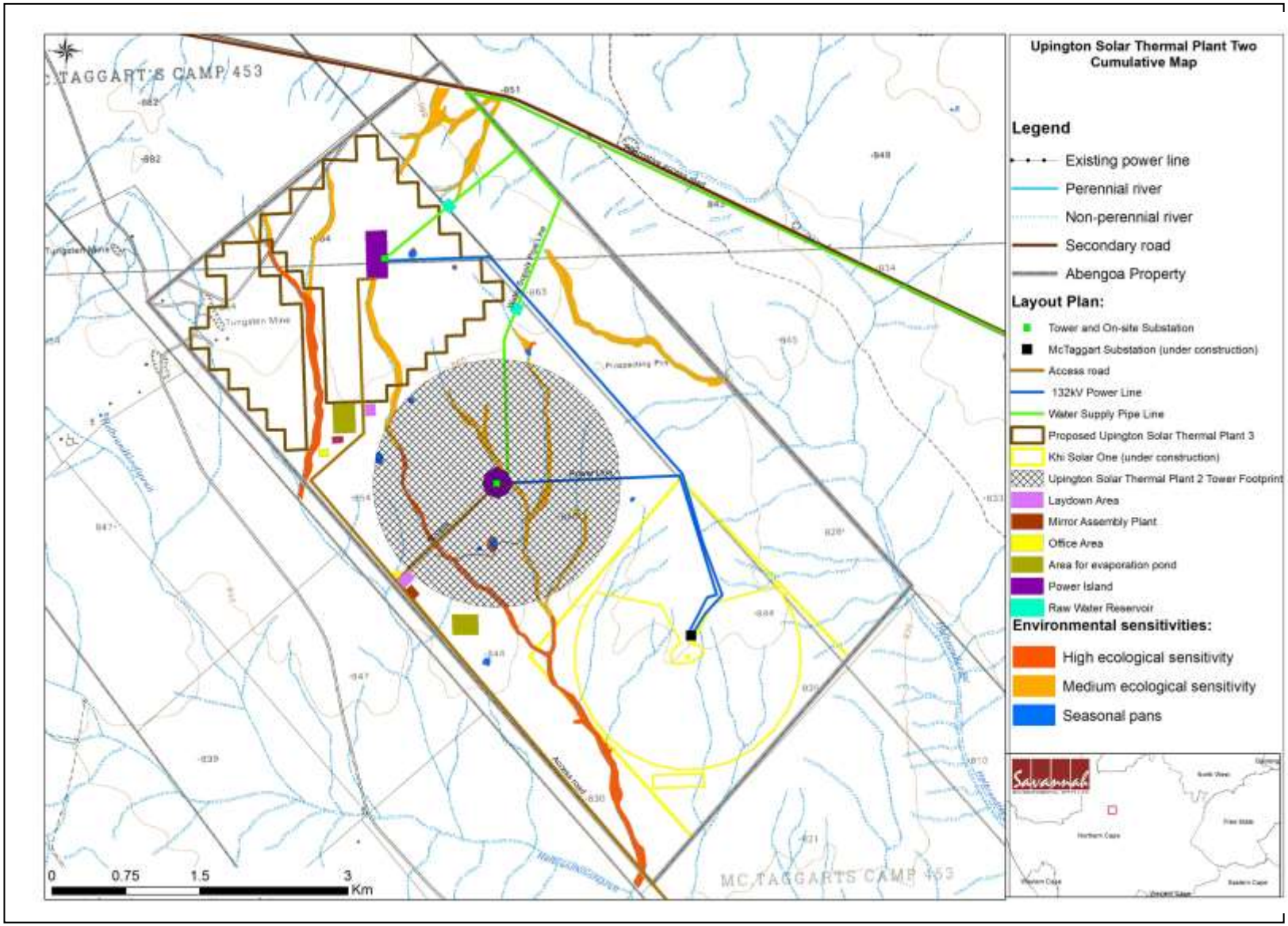

Figure 8.2: Map showing the potential for cumulative environmental sensitivities for Portion 3 of the Farm McTaggarts Camp 453 (considering the three CSP facilities)

CONCLUSIONS AND RECOMMENDATIONS CHAPTER 9

Kai Garib CSP (RF) (Pty) Ltd (Abengoa Solar Power South Africa (Pty) Ltd) is proposing the construction and operation of a commercial solar thermal electricity generating facility (using solar tower technology) and associated infrastructure near Upington, Northern Cape Province. The project is known as the Kai Garib CSP Tower Plant (previously known as Upington Solar Thermal Plant Two), and is one of three Abengoa Solar Concentrating Solar Power (CSP) facilities proposed to be established on Portion 3 of the farm McTaggarts Camp 453 (with the Khi Solar One project currently under construction).

Each project is located on a different area within Portion 3 of the Farm McTaggarts Camp 453 (with a total extent of 2200ha), which lies approximately 20 km west of the town of Upington in the Northern Cape. The Kai Garib CSP Tower Plant is proposed to utilise power tower technology with a generation capacity of up to 150MW[22]. The facility will have a total development footprint of up to 700ha (within an 800ha portion identified within the larger farm) and will include the following associated infrastructure:

» Solar tower with central receivers and heliostat technology using superheated steam with dry cooling (700 hectares in extent).
» Power island which will include a steam turbine and generator; a dry cooled condenser; a generator transformer and substation; auxiliary fossil fuel and/or electric boilers and associated molten salt storage vessels and heat exchangers (approximately 200m x 500m in extent).
» Access roads (roads up to 6m wide).
» Plant substation (50m x 50m).
» 132 kV power line up to 4km in length to connect to Eskom's existing McTaggerts Substation, which is located on the same property as the proposed CSP Plant.
» Water abstraction point located at the Gariep River, filter station (20m x 30m) and water supply pipeline (up to 20km in length).
» Water storage reservoir and tanks (combined capacity up to 15 000m^3).
» Packaged water treatment plant (roughly 30m x 30 m).
» Up to 5 lined evaporation ponds (approximately 100m x 100m each).
» Workshop and office buildings (approximately 20m x 50m each).
» Mirror assembly facility (approximately 100m x 50m).

[22] Kai Garib CSP (RF) (Pty) Ltd increased the generating capacity from 125MW to 150MW. The RFP for the Expedited Round has been released, and the DoE has set the cap for CSP to 150MW. The change in the generating capacity the project would change the generator to be used in the facility. There would be no change/increase in the development footprint of the facility, the height or nature of the infrastructure (i.e. either trough, or tower and heliostats, the scope of the project and Water volume required.

The purpose of the proposed facility is to add new capacity for generation of power from renewable energy to the national electricity supply (which is short of generation capacity to meet current and expected demand), and to aid in achieving the goal of a 30% share of all new power generation being derived from independent power producers (IPPs), as targeted by the Department of Energy (DoE). In response to the need, Abengoa Solar Power South Africa (Pty) Ltd, as an IPP, is proposing the construction and operation of this CSP facility. CSP is the only of the renewable technologies that utilise conventional steam generating equipment with operational and life expectancy similar to that of conventional power plants (i.e. 40 years vs 20 years for other renewable technologies). One advantage of the solar tower power plants is their potential for storing solar thermal energy to use during non-solar periods and to dispatch electricity when it is needed most.

An EIA process, as defined in the NEMA EIA Regulations, is a systematic process of identifying, assessing, and reporting environmental impacts associated with an activity. The EIA process forms part of the planning of a project and informs the final design of a development. In terms of the EIA Regulations published in terms of Section 24(5) of the National Environmental Management Act (NEMA, Act No. 107 of 1998), Abengoa Solar Power South Africa requires authorisation from the National Department of Environmental Affairs (DEA) for the construction of the Kai Garib CSP Tower Plant facility. In terms of sections 24 and 24D of NEMA, as read with the EIA Regulations of GNR543, GNR544, GNR545; and GNR546, a Scoping and an EIA Phase have been undertaken for the proposed project. As part of this EIA process comprehensive, independent environmental studies have been undertaken in accordance with the EIA Regulations. The following key phases have been undertaken in the EIA Process.

» *Notification Phase* - organs of state, stakeholders, and interested and affected parties (I&APs) were notified of the proposed project using adverts, site notices, and stakeholder letters. Details of registered parties have been included within an I&AP database for the project.
» *Scoping Phase* – identification of potential issues associated with the proposed project and environmental sensitivities (i.e. over the broader project development site - entire extent of Portion 3 of the farm McTaggarts Camp 453), as well as the extent of studies required within the EIA Phase were defined.
» *EIA Phase* – potentially significant biophysical and social impacts[23] and identified feasible alternatives have been comprehensively assessed through specialist investigations. Appropriate mitigation measures have been recommended as part of a draft Environmental Management Programme (EMPr) (refer to Appendix T).

Amended EIA Report - potentially significant biophysical and social impacts and identified feasible alternatives have been comprehensively assessed through specialist investigations. Appropriate mitigation measures have been recommended as part of a

[23] Direct, indirect, cumulative that may be either positive or negative.

draft Environmental Management Programme (EMPr) (refer to Appendix T). The EIAr report also addressed the concerns raised by the DEA in the rejection letter dated the 14 May 2015.

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. A summary of the recommendations and conclusions for the proposed Kai Garib CSP Tower Plant facility project is provided in this Chapter.

The purpose of this Amended Final EIA Report is to include the results, impact predictions and recommendations of the pre-construction bird monitoring programme as well as updating the project information where necessary and to address all issue raised by the DEA in the rejection letter dated 14 May 2015.

9.1. Evaluation of the Proposed Project

The preceding chapters of this report together with the specialist studies contained within Appendices F - M provide a detailed assessment of the environmental impacts on the social and biophysical environment that may result from the proposed CSP project. This chapter concludes the Draft EIA Report by providing a summary of the conclusions of the assessment of the proposed site for the CSP Plant 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.

From the conclusions of the detailed EIA studies undertaken, sensitive areas within the development footprint area were identified and flagged for consideration by the facility layout (refer to Figure 9.1). Potential impacts which could occur as a result of the proposed project are summarised in the sections which follow. The most significant environmental impacts identified and assessed to be associated with the proposed Kai Garib CSP Tower Plant include:

» Local site-specific impacts - loss of land use and ecological functioning though the physical alteration for the footprint of the facility
» Visual impacts due to the extent of the solar field and other associated infrastructure
» Avifauna mortality – risk of infrastructure
» Water consumption/ requirements from Gariep River

Local site-specific impacts: impacts on ecology, drainage lines and pans, and soils

Local site-specific impacts as a result of physical disturbance/modification to the site (700 hectares) with the establishment of a power tower CSP plant that may occur during the construction phase will include:

» Impacts on biodiversity which includes any impacts on protected, red data or sensitive plant species and on overall species richness due to transformation of the land and loss of vegetation cover. The site does not fall within any "protected areas" or "Critical biodiversity areas". However, protected trees occur on the site, as do other species which are protected at a Provincial level. The ecological specialist recommended that the layout should be refined to avoid the riparian vegetation / high sensitivity zones. However, due to the nature of the power tower plant, total avoidance of the riparian vegetation is not possible.
» Localised reduction of indigenous trees and shrubs, geophytes and other species of conservation concern, but not to a degree that the current conservation status of such species will be negatively affected. However, this effect is and will be further exacerbated by surrounding and regional developments (cumulative impacts).
» A number of small intermittent pans and ephemeral washes will be permanently transformed. Due to the semi-arid nature of the environment, it is not expected that this will have a significant impact on downstream hydrology or functionality with the implementation of mitigation measures. However, the functionality of the small intermittent pans and their resources to other biodiversity will be lost. This may create a localised loss of species, but not affect their conservation status.
» Soil degradation on and beyond the development area, loss of functional and productive topsoil, possible introduction of weeds and invasive plants, a long-term (more than 8 months) low or absent vegetation cover after construction and possible contamination of lower-lying ephemeral drainage and perennial wetland systems.
» Soil erosion induced or increased by human activity.

These impacts will be limited to the development site (~700 ha) located within the portion of Portion 3 of the Farm McTaggarts Camp 453.

Visual impacts

Visual quality is enhanced by the intact nature of a landscape, and lack of other visual intrusions. The existing Khi Solar One project on the same farm portion and Eskom 132kV power line and other industrial type structures in the area are existing visual intrusions. The surrounding landscape has a generally rural quality, but other energy facilities are already constructed, to be constructed, or proposed in the area, which need to be taken into account. Given the scale of the proposed facility, both in terms of footprint and height, along with the open nature of the landscape, there is little opportunity for screening.

- The power tower CSP Plant has a high visual impact as due to the height (200m – 300m) of the power tower and the extent of the heliostats. Potential visual impacts would be of medium to high significance.
- Potential visual impacts for associated infrastructure include the connecting power lines, which are rated as medium significance before mitigation, with little opportunity for mitigation.
- The water abstraction facilities at the Gariep River would be localised with a potential visual impact of medium-low before mitigation, and could be mitigated to low significance, including rehabilitation/re-vegetation.
- The construction phase of the project would include the use of cranes and a batching plant, both of which have visual implications, but these would be temporary, and were therefore not considered to have an important effect on the overall visual impact significance ratings.
- The decommissioning phase of the projects, at the end of their useful life, would involve the dismantling and removal (recycling) of the structures, although concrete foundations would probably remain in the landscape.
- Given that the proposed CSP plant would be even further away from receptors than the Khi Solar One, and that the area has been generally identified for the location of solar energy plants, no fatal flaws are expected in terms of potential visual impacts.
- The assessment indicates that visual impacts would be of an acceptable level provided the mitigation measures are implemented.

Avifauna mortality – risk of infrastructure

From the results of the expanded/additional study conducted and the literature reviewed it is likely that impacts on avifauna are likely to be very low. The threat to avifauna communities would be from the loss of habitat, disturbance, collisions with the overhead power line and/or any interaction with the facility infrastructure, and is not anticipated to have a significant negative impact on avifauna populations and communities in the area. Taking into account that the vast majority (over 80%) of the bird mortalities expected at a CSP facility are caused by collisions with heliostats, with the correct mitigation measures in place, the number of bird mortalities can probably be limited to 0.2 to 0.3 birds per week, which is approximately 10% of the number of birds killed per kilometre of road per week. One of the factors reducing the risk of mortality in avifauna species is the low average flight height of birds in the area, as most bird species will fly under the heliostats. The fact that many of the species of concern appear to be absent from the study area further reduces the likely impacts of the facility.

Water consumption/ requirements from Gariep River

CSP technologies function through the generation of steam to drive a conventional steam turbine and generator. Therefore, suitable and sufficient water resources are required. Water sources in this area of Northern Cape include a) water from the Gariep River (direct abstraction); b) water from a local municipality (who abstract from the Gariep River); or c) groundwater (direct abstraction). Groundwater resources are scarce,

typically used by local farmers for livestock watering when available, and the water is brak. Groundwater is not considered a viable water source. Water will, therefore, be required to be abstracted from the Gariep River. The Department of Water and Sanitation (DWS) have confirmed in a letter dated 29 May 2015 (refer to Appendix P) that, after due consideration of the water resource availability in the catchment area, it was found the sufficient water is available to meet the water requirement of the project (~300 000 m^3 per annum during construction and 400 000 m^3 per annum during operation). The water source of direct abstraction from the Gariep River is therefore located a distance of less than 20km from the site, adjacent to the existing abstraction point for the Khi Solar One project (consolidating infrastructure at the existing abstraction embankment). The water will be sourced through an extraction point on the Gariep River. Water supply pipelines will be constructed and the required volume of water treated and pumped to the facility.

Molten salt towers have a 5% -10% overall efficiency advantage over parabolic troughs, with an associated *5% -10% less water consumed per MW generated* - estimated to be as much as 50 000 m^3 of water saved annually for a 150MW plant.

Summary

In summary, the environmental impacts associated with the proposed project, as identified through the EIA, can be summarised as follows:

» The overall impact on the **ecology (including flora and fauna)** is likely to be of a medium to high significance prior to mitigation. This could be reduced to **medium** negative significance following the implementation of mitigation measures. Areas of sensitivity include riparian vegetation, occurrence of protected and red data plant species, drainage lines and pans.
» The overall impact on the **avifauna** is likely to be of a **low significance**. One of the factors most likely to reduce the risk of mortality in avifauna species is the low average flight height of birds in the area, as most bird species will fly under the heliostats. The fact that many of the species of concern appear to be absent from the study area further reduces the likely impacts of the facility.
» The overall impact on the **soils, land-use and agricultural potential** is likely to be of a **low to medium significance**. The significance of all agricultural impacts is influenced by the fact that the site has extremely limited agricultural potential, with a land capability of class 7, non-arable, low potential grazing land. Soils are red, sandy soils on underlying rock and calcrete, varying from very shallow to moderately deep. The major limitations to agriculture are the aridity and lack of access to water, as well as the shallow soils. The land is only suitable for low intensity grazing.
» The overall impact on the **water resources** is of a **moderate significance**. These impacts are reduced to **low significance** through mitigation, apart from the moderate impact of water abstraction from the Gariep River. The development should have limited impact on the overall status of the riparian systems within the

region. Impacts are related to the quantity of water to be abstracted from the Gariep River (400 000m^3/a) required for operation of the facility, and impacts to ephemeral drainage lines. The mainstem system (known as the Helbrandkloofspruit) flows along the western boundary of the site and is avoided by the development footprint, and only tributaries to this ephemeral system are impacted by the development footprint. The relevant Water Use Licenses for water uses (abstraction and impacting of water courses) are required to be obtained from DWA.

» The overall impact on the **heritage resources** is likely to be of a **low significance** as very sparse heritage traces (of low heritage value) were found during the field survey. The **fossil record** from Kalahari deposits is very **poor** with respect to finds of fossil bones of vertebrates.

» The overall **visual** impact is likely to be of a **medium-high significance**. The proposed CSP facility will transform the natural 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 and the existence of the newly constructed Khi Solar One solar tower project on the same site.

» The overall **social** impact is likely to be of a **medium significance** in terms of positive impacts, and a **low – medium 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 Kai Garib CSP Tower Plant. However a number of issues requiring mitigation have been highlighted. Areas of environmental sensitivity are discussed under Section 9.1. Environmental specifications for the management of potential impacts are detailed within the draft Environmental Management Programme (EMPr) included within Appendix T.

9.2. Assessment of Potential Cumulative Impacts

Cumulative impacts and benefits on various environmental and social receptors will occur to varying degrees with the development of several renewable energy facilities in South Africa. The degree of significance of these cumulative impacts is difficult to predict without detailed studies based on more comprehensive data/information on each of the receptors and the site specific developments. This however, is beyond the scope of this study. The alignment of renewable energy developments with South Africa's National Energy Response Plan and the global drive to move away from the use of non-renewable energy resources and to reduce greenhouse gas emissions is undoubtedly positive. The economic benefits of renewable energy developments at a local, regional and national level have the potential to be significant.

The Kai Garib CSP Tower Plant facility falls within the identified geographical area most suitable for the rollout of the development of solar energy projects within the Northern Cape Province. This implies that projects of the same nature will be consolidated in one area creating a node, and ultimately aiming to reduce the potential for cumulative impacts associated with such developments when spatially fragmented. It is also important to note that it is unlikely that all proposed renewable energy facilities located in the region will be built due to capacity constraints on the Eskom grid and the limits placed on renewable energy targets. The site is located in close proximity to the Khi Solar One facility, which is currently under construction. The cumulative impacts for the proposed Kai Garib CSP Tower Plant have been assessed to be acceptable.

9.3 Comparison of Access Road Alternatives

The primary access road to the site would be off the N14 national road between Upington and Keimoes. Two reasonable and feasible alternatives have been considered:

3. *Access Alternative 1- Access off the N14 via the existing Khi Solar One access road*. The Khi Solar One project has established a formal surfaced access road off the N14 for access to the McTaggarts Camp farm, and specifically the Khi Solar One project development site. The road is available to provide access for a portion of the distance to the site up to the Khi Solar One boundary (5.5km), with an additional 4.5km of road to then be constructed within the boundary of Portion 3 of the Farm McTaggarts Camp 453. This access road (total length of 10km) would provide direct access to the facility area from the south; or
4. *Access Alternative 2- Access off the N14 via the existing district road D3276.* The existing district road D3276 is a gravel road (and would be required to be surfaced). This road intersects with the northern boundary of Portion 3 of the Farm McTaggarts Camp 453 approximately 11 km from the N14. A section of road ~4km would be required to be constructed to access the facility area from the north. This access road (total length of 15km) would provide direct access to the facility area from the north.

In terms of the specialist studies undertaken, the following conclusions were made regarding the preferred access road alternative:

	Access Alternative 1	**Access Alternative 2**
Ecology	Preferred	Longer length of road, therefore less preferred.
Avifauna	No significant difference in impacts - no preference	No significant difference in impacts - no preference
Surface water resources	Preferred	Longer length of road, therefore less preferred.
Soils and agricultural potential	No preference	No preference

Visual	No significant difference in impacts – no preference	No significant difference in impacts – no preference
Heritage & palaeontology	No preference	No preference
Social	Preferred	Less preferred, as it is a public road

There are no impacts of unacceptably high significance associated with either access road alternative assessed for the proposed project. In addition, there is little or no difference between the impacts associated with the two access road alternatives as both routes partially exist. Alternative 1 is the sorter length of access road and follows the existing access road to the Khi Solar One site. From a technical perspective, Alternative 1 is preferred as it allows for the developer to utilise infrastructure which has already been purpose-built (i.e. the portion of the access road off the N14 to the entrance for the Khi Solar One site). This is also a private road, and so impacts on the public D3276 would be avoided. In addition, the developer would be responsible for the upkeep of the road surface. When considering technical and environmental considerations, access Alternative 1 is nominated as the preferred access route alternative.

9.4. Environmental Sensitivity Mapping

The areas of high ecological sensitivities of the site are presented in Figure 9.1 and include areas containing riparian vegetation along drainage lines: *Acacia mellifera – Cenchrus ciliaris* ephemeral drainage lines. These areas of high sensitivity also contain protected trees species (*Acacia erioloba* (Camelthorn) *and Boscia foetida* (Shepherds tree), *Boscia albitrunca (*Shepherds *tree).* The number of protected trees that could be destroyed by the development are estimated as follows:

- *Acacia erioloba:* less than 50 trees
- *Boscia albitrunca:* less than 50 trees

The areas of high ecological sensitivity amount to an area of ~11ha, and it is recommended that impact on these areas be avoided or minimised through considered placement of infrastructure in order to minimise the impact on vegetation and fauna. The areas of high ecological sensitivity amount to an area of ~11 hectares of the 800ha development footprint (i.e. ~1.3% of the development footprint for Kai Garib CSP Tower Plant).

Due to the nature of the power tower plant, total avoidance of the high ecological sensitivity may not be possible. Impacts to ephemeral riparian areas would be less than 1.3% of the total development footprint, and would be considered acceptable loss. However, mitigation would be required to ensure that water flow during high rainfall events is appropriately managed and does not result in erosion or scour (i.e. stormwater management is required).

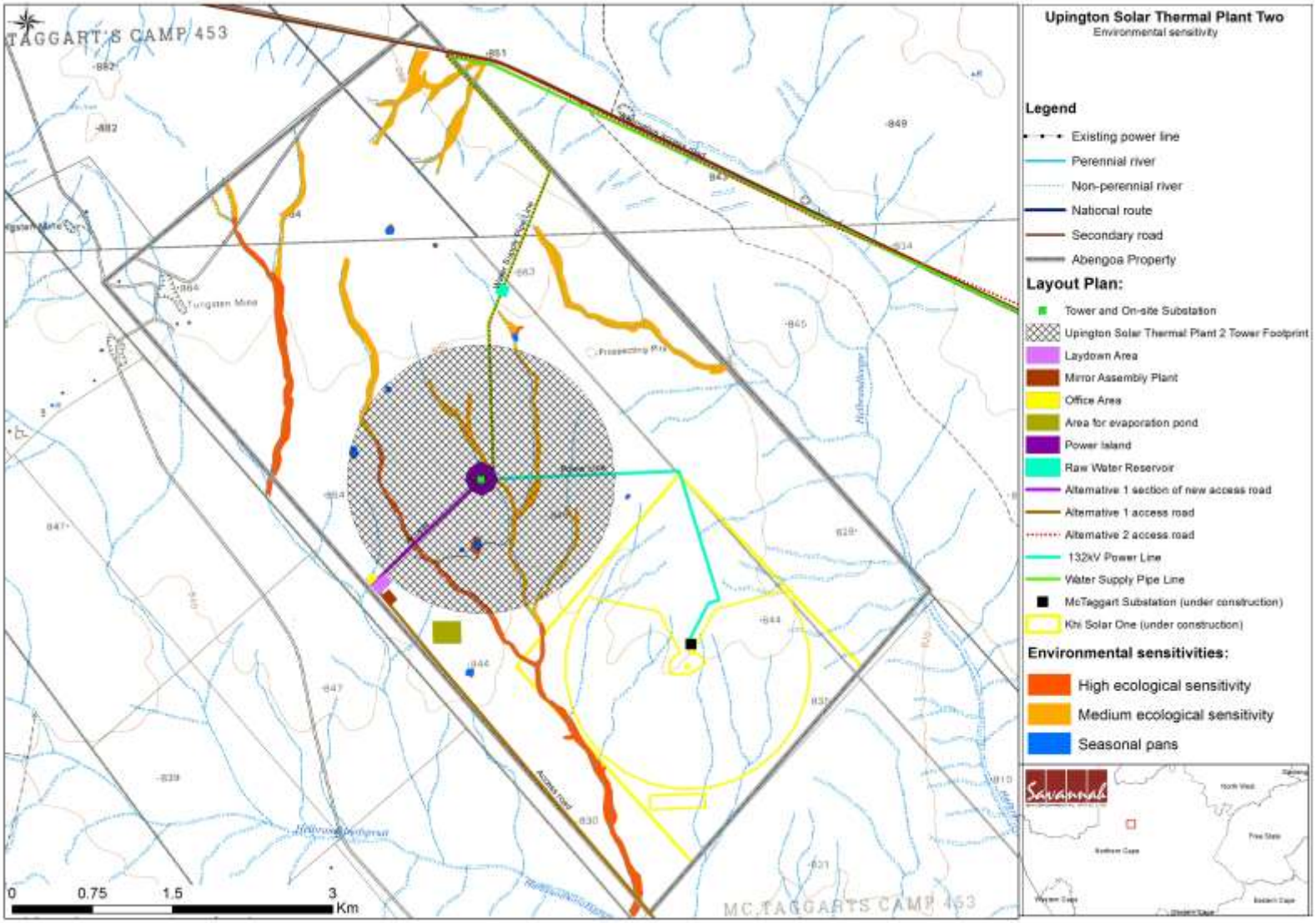

Figure 9.1: Combined Layout and Environmental Sensitivity Map for the Kai Garib CSP Tower Plant

9.5 Environmental Costs of the Project versus Benefits of the Project

Environmental (natural environment, economic and social) costs can be expected to arise from the project proceeding. This could include:

» Direct loss of biodiversity, flora, fauna and soils due to the clearing of land for the construction and utilisation of land for the CSP project (which is limited to the development footprint of 700 hectares). The cost of loss of biodiversity has been minimised on the site through the careful location of the development to avoid key areas supporting biodiversity of particularly high conservation importance.
» Visual impacts associated with the facility and power line. The cost of loss of visual quality to the area is reduced due to the area already been visually impacted by the Khi Solar One facility, and power lines and surrounding infrastructure associated with agriculture.

These costs are expected to occur at a local and site level and are considered acceptable as long as the mitigation measures as outlined in the EMPr are adhered to.

Benefits of the project include the following:

» The project is poised to bring about important economic benefit at the local and regional scale through job creation, procurement of materials and provision of services and other associated downstream economic development. These will transpire during the preconstruction/ construction and operational phases.
» The project serves to diversify the economy and electricity generation mix of South Africa by addition of solar energy to the mix.
» South Africa's per capita greenhouse gas emissions being amongst the highest in the world due to reliance on fossil fuels, the proposed project will contribute to South Africa achieving goals for implementation of non-renewable energy and 'green' energy. Greenhouse gas emission load is estimated to reduce by 0.86% for a 500MW coal-fired power station compared to a similar MW PV project, on a like for like basis.

The benefits of the project are expected to occur at a national, regional and local level. These benefits partially offset the localised environmental costs of the project.

9.5. Overall Conclusion (Impact Statement)

The viability of establishing a power tower CSP Plant with a maximum generating capacity of 150MW on a site near Upington has been established by Kai Garib CSP (RF) (Pty) Ltd. The positive implications of establishing a CSP Plant on the identified site within the Northern Cape include:

» The potential to harness and utilise solar energy resources within the Province
» The project will assist the South African government in reaching their set targets for renewable energy.
» The project will assist the South African government in the implementation of its green growth strategy and job creation targets.
» The project will assist the district and local municipalities in reducing level of unemployment through the creation of jobs and supporting local business
» The National electricity grid in the Northern Cape Province will benefit from the additional generated power.
» Promotion of clean, renewable energy in South Africa
» 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 CSP Plant 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 proposed development on the site will create a localised reduction of indigenous trees and shrubs, geophytes and other species of conservation concern, but not to a degree that the current conservation status of such species will be negatively affected. Due to the areas of high ecological sensitivity being avoided by the design and layout of the CSP Plant, the **ecological impacts** of the CSP plant will be of a medium acceptable significance.
» The threat to **fauna** communities would be from the loss of habitat, disturbance and/or any interaction of fauna with the facility, and is not anticipated to have a significant negative impact on fauna populations and communities in the area.
» From the results of the expanded/additional study conducted and the literature reviewed it is likely that impacts on **avifauna** are likely to be very low. The threat to avifauna communities would be from the loss of habitat, disturbance, collisions with the overhead power line and/or any interaction with the facility infrastructure, and is not anticipated to have a significant negative impact on avifauna populations and

communities in the area. Taking into account that the vast majority (over 80%) of the bird mortalities expected at a CSP facility are caused by collisions with heliostats, with the correct mitigation measures in place, the number of bird mortalities can probably be limited to 0.2 to 0.3 birds per week, which is approximately 10% of the number of birds killed per kilometre of road per week. One of the factors reducing the risk of mortality in avifauna species is the low average flight height of birds in the area, as most bird species will fly under the heliostats. The fact that many of the species of concern appear to be absent from the study area further reduces the likely impacts of the facility.

» 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 **soils** is medium to low due to the limited scale of the development and the scarcity of development in the immediate surrounding area.
» 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, as well as the existence of the Khi Solar One facility on the sae farm portion (consolidation of impacts).
» 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 other authorised and proposed CSP and solar projects adjacent to the site, however, these impacts are not considered to represent a fatal flaw, and in addition, there is no indication if (or when) other developments 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**.

9.6. Overall Recommendation

Global climate change is widely recognised as being one of the greatest environmental challenges facing the world today. How a country sources its energy plays a big part in tackling climate change. As a net off-setter of carbon, renewable energy technologies can assist in reducing carbon emissions, and can play a big part in ensuring security of energy supply, as other sources of energy are depleted or become less accessible. 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 of carbon emissions. With the aim of reducing South Africa's dependency on coal generated energy, and to address climate change concerns, the South African Government has set a target, through the Integrated Resource Plan (IRP) for electricity to develop 17.8 GW of renewables (including 8.4GW solar) within the period 2010 – 2030.

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 impacts associated with the development of the Kai Garib CSP Tower Plant can be managed and mitigated to an acceptable level. In terms of this conclusion, the EIA project team support the decision for environmental authorisation. The layout plan as presented is acceptable.

The following conditions would be required to be included within an authorisation issued for the project:

» As far as possible, the design and layout of the CSP Plant should consider and accommodate areas of high environmental sensitivity.
» 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 F to M to be implemented.
» The draft Environmental Management Programme (EMPr) as contained within Appendix T 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 EMPr 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.
» An ecological walk through survey for the CSP plant and associated infrastructure (such as pipeline, power line and access roads) must be undertaken prior to construction.
» A permit to be obtained for removal of protected trees and provincially protected flora that are affected.
» A walk-through survey be undertaken by an avifauna specialist for the route of the power line only to identify sections of line requiring collision mitigation.

- A detailed avifauna monitoring plan should be compiled prior to operation and implemented in order to constantly monitor the CSP facility and all associated infrastructure, including the power lines.
- The relevant Water Use Licenses for water uses to be obtained from DWS.
- Applications for all other relevant and required permits required to be obtained by Kai Garib CSP (RF) (Pty) Ltd must be submitted to the relevant regulating authorities. This includes permits for the transporting of all components (abnormal loads) to site, disturbance to any heritage sites, disturbance of protected vegetation and protected trees, and water uses.

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