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DRAFT ENVIRONMENTAL IMPACT REPORT AND ENVIRONMENTAL MANAGEMENT PLAN.

for

JORAM SOLAR DEVELOPMENT & GRID CONNECTION

on

Remainder of Portion 62 (Portion of Portion 9) of the farm Vaal Koppies, Upington, Northern Cape

In terms of the

National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended & Environmental Impact Regulations 2010

Prepared for Applicant: Joram Solar (Pty) Ltd.

By: *Cape EAPrac*

Report Reference: KHH/320/15

Department Reference: 14/12/16/3/3/2/713

Case Officer: Ms Thabile Sangweni

Date: 28 January 2015

APPOINTED ENVIRONMENTAL ASSESSMENT PRACTITIONER:

***Cape EAPrac* Environmental Assessment Practitioners**

PO Box 2070
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Tel: 044-874 0365
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Report written & compiled by: **Dale Holder** (Ndip Nat Con), who has 12 years' experience as an environmental practitioner..

PURPOSE OF THIS REPORT:

Departmental Compliance

APPLICANT:

Joram Solar (Pty) Ltd.

CAPE EAPRAC REFERENCE NO:

KHH/320/15

DEPARTMENT REFERENCE:

14/12/16/3/3/2/713

SUBMISSION DATE

28 January 2015

DRAFT ENVIRONMENT IMPACT REPORT AND ENVIRONMENTAL

in terms of the

National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended &
Environmental Impact Regulations 2010

Joram Solar Development

Remainder of Portion 62 (a portion of portion 9) of the farm Vaal Koppies, Upington.

and potential grid connections on:

Portion 66 of the farm 40, portion 9 of the farm 40 portion 7 of the farm 555, portion 52 of the farm 40, portion 3 of the farm 40, erf 73 and erf 19951.

Submitted for:

Departmental Review

Report Issued by:

Cape Environmental Assessment Practitioners

Tel: 044 874 0365
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PO Box 2070
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REPORT DETAILS

Title:	**DRAFT ENVIRONMENTAL IMPACT REPORT** **for proposed "JORAM SOLAR DEVELOPMENT"**
Purpose of this report:	This Draft Environmental Impact Report forms part of a series of reports and information sources that are being provided during the Environmental Impact Assessment (EIA) for the proposed JORAM Solar Development in the Northern Cape Province. In accordance with the EIA Regulations, the purpose of the Environmental Impact Report is to: • Provide a description of the proposed project, including a sufficient level of detail to enable stakeholders to identify relevant issues and concerns; • Describe the local environmental and developmental context within which the project is proposed, to assist further identifying issues and concerns; • Provide an overview of the process being followed in the Scoping Phase, in particular the public participation process • Undertake the Environmental Impact Assessment as contemplated in the Plan of Study for EIA; • Present the issues and concerns identified to date from the baseline specialist studies and the initial stakeholder engagement process, as well as an explanation of how these issues will be addressed through the EIA process. The Draft Scoping Report was made available to all stakeholders for a 40 day review & comment period, **28 August 2014 to 08 October 2014** Thes Final Scoping Report was made available for a further 21 Day comment period extending from **10 October 2014 – 30 October 2014**. This Draft Environmental Impact Report is made available for a 30 Day comment period extending from **28 January 2015 – 02 March 2015.**
Prepared for:	Joram Solar (Pty) Ltd.
Published by:	*Cape Environmental Assessment Practitioners (Pty) Ltd. (Cape EAPrac)*
Authors:	Mr Dale Holder
Reviewed by:	Ms Melissa Mackay
Cape EAPrac Ref:	KHH320/15
DEA Case officer & Ref. No:	**Ms Thabile Sangweni** 14/12/16/3/3/2/713
Date:	27 February 2014
To be cited as:	*Cape EAPrac,* 2014. Draft Environmental Impact Report for the proposed

	JORAM Solar Development. Report Reference: KHH320/15. George.

TECHNICAL CHECKLIST

The following technical checklist is included as a quick reference roadmap to the proposed project.

Company Details		
Company profile	Name and details of Developer	Joram Solar (Pty) Ltd is a renewable energy developer SPV established for the sole purpose of developing the proposed Joram Solar Development.
Site Details		
Size of the site	Description and Size in hectares of the affected property.	Remainder of portion 62 (portion of portion 9) of the farm Vaal Koppies. Total Property Size: 4695,8487.
Development Footprint	This includes the total footprint of PV panels, auxiliary buildings, onsite substation, inverter stations and internal roads.	Initial Study Area is 450Ha. The total footprint of JORAM Solar will not exceed 220ha
Technology Details		
Capacity of the facility	Capacity of facility (in MW	Net generating capacity (AC) of 75MW, Installed capacity (DC) of +/-90MW.
Solar Technology selection	Type of technology	PV and/or concentrated PV with fixed, single or double axis tracking technology.
	Capacity and dimensions of the PV field	75 MWp AC yield. Footprint of not more than 220ha .
	Structure height	Less than10 meters
	Surface area to be covered (including associated infrastructure such as roads)	Approximately 220 ha.
	Structure orientation	North-facing
	Laydown area dimensions	Approximately 2-5ha of laydown area will be required (the laydown areas will not exceed 5ha.)
Grid Connection Details **NOTE: Grid Connection may be removed from this environmental process and included in a separate process.**		
Grid connection	Substation to which project will connect.	Various grid connection options exist. All of the grid connections are planned to connect to the Gordonia substation. The facility will connect to the substation via own-built 132kV lines or by a "loop-in;loop-out" line to the existing Gordonia Kleinbegin 1 or to planned Ilanga CSP project 132 kV Powerlines. The servitude options for the Ilanga CSP Powerlines are illustrated in the layout report in Appendix C.
	Capacity of substation to connect facility	Still to be confirmed
Power line/s	Number of overhead power lines required	Various grid connection options exist. All of the grid connections are planned to connect to the Gordonia substation. The facility will connect to the substation via own-built 132kV lines or by a "loop-in;loop-out" line to the existing Gordonia Kleinbegin 1 or to planned Ilanga CSP project 132 kV Powerlines. The servitude options for the Ilanga CSP Powerlines are illustrated in the layout report in Appendix C.
	Route/s of power lines	Various scenarios and grid connection options exists. Please refer to layout report in appendix C.
	Voltage of overhead power lines	132kV expected.

	Height of the Power Line	<25m heights are expected for monopole steel structures.
	Servitude Width	32m or more.
Auxiliary Infrastructure		
Other infrastructure	Additional Infrastructure	Auxiliary buildings of approximately 2ha. The functions within these buildings include (but is not limited to) to ablution, workshops, storage areas and site offices. Perimeter Fencing not exceeding 5m
	Details of access roads	Access roads not exceeding 8m in width. The length of these access roads is dependent on the specific scenarios, as depicted within the layouts.
	Extent of areas required for laydown of materials and equipment	Approximately 2-5ha of laydown areas will be required, but will not exceed 5ha.

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Appendix D	:	Specialist Reports
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DRAFT ENVIRONMENTAL IMPACT REPORT - OVERVIEW

1 PROJECT OVERVIEW

Cape EAPrac has been appointed by **Joram Solar (Pty) Ltd.**, hereafter referred to as the Applicant, as the independent Environmental Assessment Practitioner EAP), to facilitate the Scoping & Environmental Impact Reporting (S&EIR) process required in terms of the National Environmental Management Act (NEMA, Act 107 of 1998) for the proposed development of the '**Joram Solar Development** near Upington in the Northern Cape.

Joram Solar (Pty) Ltd. have an option to sub-lease a portion of the Remainder of Portion 62 (Portion of Portion 9) of the farm Vaal Koppies from the landowner, Newhaven Trust, for the purposes of developing the proposed solar facility. A copy of a letter from Newhaven Trust providing consent for the continuation of the EIA is attached in Appendix E.

The total generation capacity of the solar facility will not exceed 75MW AC for input into the national Eskom grid.

This Draft Environmental Impact Report is made available for a **30 day comment** period extending from **28 January 2015** – **02 March 2015**.

2 NEED AND DESIRABILITY

The supply of electricity in South Africa has become constrained, primarily because of insufficient generation capacity, but also due to constraints on the transmission and distribution of electricity. Considering this situation and the impact that carbon emissions from existing (and future) coal-fired power stations have on the environment (Climate Change), this renewable energy project will contribute to the generation of 'clean' or so-called 'green' renewable electricity for input into the national grid to augment Eskom's power supply.

The South African Government has set a 10 year cumulative target for renewable energy of 10 000 GWh renewable energy contribution to final energy consumption by 2013, to be produced mainly from biomass, wind, solar and small-scale hydro power (White Paper on Renewable Energy Policy, 2003). This amounts to approximately 4% (1667MW) of the total estimated electricity demand (41 539MW) by 2013. The majority of this power will be generated by Eskom. However, in order to meet the increasing power demand within the country, Eskom has set a target of 30% of all new power generation to be derived from independent power producers (IPPs).

Joram Solar (Pty) Ltd is one such IPP which intends to generate electricity from the proposed Joram Solar Development. This will contribute to South Africa's commitment to the Convention on Climate Change through emission-free generation of electricity and working towards an investor-friendly climate in the energy sector.

3 ENVIRONMENTAL REQUIREMENTS

The proposed solar energy facility project is subject to the requirements of the Environmental Impact Assessment Regulations (2010 EIA Regulations) in terms of the National Environmental Management Act (NEMA, Act 107 of 1998, as amended) This Act makes provision for the identification and assessment of activities that are potentially detrimental to the environment and which require authorisation from the competent authority (in this case, the national Department of

Environmental Affairs, DEA) based on the findings of an EIA. An application for authorisation has been accepted by the DEA (under the Application Reference number 14/12/16/3/3/2/713).

A Scoping and Environmental Impact Assessment process is required in terms of NEMA, 2010. The listed activities associated with the proposed development, as stipulation under Regulations 544, 545 and 546, where applied for as follows:

- Regulation 544 (Basic Assessment): 10(i), 11, 18(i) & 22(ii)
- Regulation 545 (Scoping & EIA): 1, 8, 15 and
- Regulation 546 (Basic Assessment): 4 &14

Before any of the above mentioned listed activities may be undertaken, authorisation must be obtained from the relevant authority, in this case, the National Department of Environmental Affairs (DEA).

5 SITE DESCRIPTION

The property is located in the ZF Mgcawu of the Northern Cape Province, within the jurisdiction area of the Khara Hais Local Municipality. The property is approximately 5695ha in size and is located approximately 15km east of Upington along the N10.

The proposed development site within the property is approximately 220ha in size.

The topography is generally flat and has low relief form. The slope gradient is between 0 and 2% with an undulating shape.

6 DEVELOPMENT PROPOSAL & ALTERNATIVES

The proposed Joram Solar Development is to consist of solar photovoltaic panels with a generation capacity of 75MW (megawatts), as well as associated infrastructure, which will include:

- On-site substation;
- Auxiliary buildings (administration / security, workshop, storage and ablution);
- Inverters, transformers and internal electrical reticulation (underground cabling);
- Access and internal road network;
- Overhead electrical transmission line (to connect to connect to the existing Gordonia substation);
- Rainwater tanks; and
- Perimeter fencing.

Various alternatives, in terms of sites, technology of the solar arrays, as well as layout for the solar arrays and associated infrastructure on the development site, have been considered. The alternatives are described in detail in this report.

In the event that the scoping/impact assessment process identify any other feasible/reasonable alternatives other than the above, such will be considered and incorporated as additional alternatives.

7 SPECIALIST STUDIES

The following aspects have been considered by specialists in order to determine the current status of the target development site, as well as to identify potential risks and impacts associated with the development of the renewable energy park. These are described in greater detail in the main report, while the full specialist reports are available in Appendix D.

The following baseline specialist studies have been undertaken and used to inform the Scoping Report as well as the project layout and concept:

- Agriculture potential;
- Biophysical (Fauna and Flora) scoping study;
- Heritage (archaeology)
- Engineering

A number of additional studies were done as part of this Environmental Impact Phase of the development. These are included in the following appendices to this report:

- Archaeology Impact Assessment – **Annexure D4;**
- Heritage Impact Assessment – **Annexure D3;**
- Paleontological Impact Assessment – **Annexure D5;**
- Botanical Impact Assessment – **Annexure D1;**
- Faunal Impact Assessment – **Annexure D2;**
- Visual Impact Assessment – **Annexure D6;**
- Storm water management Plan – **Annexure D8;**
- Transportation and Traffic Management Plan – **Annexure D9**
- Alien plant management plan – **Annexure G1**
- Re-vegetation and rehabilitation Plan – **Annexure G4**
- Plant Rescue and Protection Plan - **Annexure G3**
- Open Space Management Plan – **Annexure G2**

The issues and concerns identified through the baseline studies will be further investigated and assessed through detailed specialist impact assessments to follow in the Environmental Impact Reporting (EIR) phase in order to determine the significance of potential impacts possibly associated with the proposed project.

8 PLANNING CONTEXT

A planning specialist will be appointed for this project and will be responsible for undertaking the necessary applications.

9 AVOIDANCE APPROACH

A constraint map has been developed for the proposed Joram Solar Development site. This serves to identify possible contextual constraints for the target solar property as well as regional threshold criteria. The purpose of undertaking the constraints analysis is specifically to comply with the requirement of firstly avoidance of potential impacts, followed by minimisation and then mitigation of impacts. The constraints defined by the participating specialists have been used to develop the current preferred layout alternative that avoids all constraints as far as possible.

11 CONCLUSIONS & RECOMMENDATIONS

Cape EAPrac is of the opinion that the information contained in this Final Scoping Report and the documentation attached hereto is sufficient to allow registered I&AP's to gain a full understanding of potential impacts associated with the development and to provide informed comment within the comment period.

The Draft Scoping Report (DSR) was made available for stakeholder review and comment for a period of 40-days, extending from **28 October – 08 October 2014**. All comments received were responded to and are incorporated in this FSR.

The Final Scoping Report was made available to all registered I&AP's and stakeholders for **a 21 day comment period** extending from **10 October 2014 – 30 October 2014**.

This Draft Environmental Impact Report was made available for a 30 day comment period 28 January 2015 – 02 March 2015.

Comments on the DEIR must be submitted, in writing, to the following address before 02 March 2015

Cape Environmental Assessment Practitioners

Att: **Mr Dale Holder**

PO Box 2070, George, 6530

Fax: 044-874 0432 or Email: dale@cape-eaprac.co.za

DRAFT ENVIRONMENTAL IMPACT REPORT - MAIN REPORT

1 INTRODUCTION

Cape EAPrac has been appointed by **Joram Solar (Pty) Ltd**, hereafter referred to as the Applicant, as the independent Environmental Assessment Practitioner EAP), to facilitate the Scoping & Environmental Impact Reporting (S&EIR) process required in terms of the National Environmental Management Act (NEMA, Act 107 of 1998) for the proposed development of the '**Joram Solar Development** near Upington in the Northern Cape. This proposed development includes a grid connection between the proposed on site substation and the existing eskom Gordonia substation (potential loop in loop out options to existing power lines are also under investigation.)

Joram Solar (Pty) Ltd. have an option to sub-lease a portion of the remainder of portion 62 (portion of portion 9) of the farm Vaal Koppies 40 from the landowner, **Newhaven Trust**, for the purposes of developing the proposed solar facility. A copy of a letter from Newhaven Trust providing consent for the continuation of the EIA is attached in **Appendix E**. All other land owners where possible grid connection may take place were also notified and copies of these notifications are also included in **Appendix E**.

The total generation capacity of the photovoltaic **power generation facility** will not exceed **75 Megawatts** (MW) for input into the national Eskom grid.

The purpose of this ***Draft Environmental Impact Report*** is to describe the environment to be affected, the proposed project, the process followed to date. It also includes a detailed assessment of potential impacts to allow registered interested and affected parties the opportunity to provide informed comment on the potential impacts associated with the development of the Joram Solar Development and associated grid connection.

The Draft Scoping Report was available for review and comment for a period of 40 Days extending from: **28 August 2014 – 08 October 2014** and all comments received have been included in the Final Scoping Report that has been submitted to DEA.

The Final Scoping Report (FSR) was made available for a further **21 Day comment period** extending from **10 October 2014 – 30 October 2014**.

This Draft Environmental Impact Assessment Report is made available for a further **30 Day comment period** from **28 January 2015** – **02 March 2015**.

All comments on this report must be submitted to Cape EAPrac by no later than **02 March 2015**. Comments must be submitted to:

Cape Environmental Assessment Practitioners

Att: Mr Dale Holder

PO Box 2070, George, 6530

Fax: 044-874 0432 or Email: dale@cape-eaprac.co.za

1.1 OVERVIEW OF ALTERNATIVE ENERGY IN SOUTH AFRICA AND THE NORTHERN CAPE.

South Africa has for several years been experiencing considerable constraints in the availability and stability of electrical supply. Load shedding procedures have been applied since December 2005 due to multi-technical failures, as well as capacity and transmission constraints.

Eskom generates about 95% of South Africa's electricity supply, and has undertaken to increase capacity to meet growing demands. At the moment, the country's power stations are 90% coal-fired, and two huge new facilities are being built to add to this capacity. However, Eskom's plans to increase its national capacity by 40 000 megawatts in the period to 2025 have had to be scaled down due to the global economic recession (Northern Cape Business website).

International best-practice requires a 15% electricity reserve margin to deal with routine maintenance requirements and unexpected shutdowns in electricity supply systems. South Africa has historically enjoyed a large reserve margin (25% in 2002, 20% in 2004 and 16% in 2006), but that has declined over the recent past to 8% - 10%, as a result of robust economic growth and the associated demand for electricity. The spare power available to provide supply at any time of the day is known as the reserve capacity and the spare plant available when the highest demand of the year is recorded is known as the reserve margin (National Response to South Africa's Electricity Shortage, 2008). This has resulted in limited opportunities for maintenance and necessitated that power stations are run harder. This results in station equipment becoming highly stressed and an increase in unplanned outages and generator trips. The expected demand growth will rapidly erode this margin, as well as Eskom's ability to recover after it's already stressed systems shutdown.

This necessitates the additional generation of at least 3 000MW in the shortest possible time, to allow the reserve necessary to bring Eskom's system back into balance (*ibid*). This need can either be addressed from the *supply* or the *demand* side. Where the demand side interventions include short, medium and long term aspects of a national Power Conservation Programme to incentivise the public to use less electricity (as mentioned above), one of the supply side options (besides Eskom building new plants and returning old plants to service) is to allow **Independent Power Producers** (IPPs) to contribute electricity to the national grid (National Response Document, 2008). **Joram Solar (Pty) Ltd.** is one such body, which intends generating electricity from a renewable energy resource, namely solar.

In March 2011, the Cabinet approved South Africa's Integrated Resource Plan 2010, in terms of which energy from renewable sources will be expected to make up a substantial 42% of all new electricity generation in the country over the next 20 years. The government's New Growth Path for the economy also envisages up to 300 000 jobs being created in the "green" economy by 2020 (South Africa info website).

The Northern Cape is suggested by many to be the ideal location for various forms of alternative energy. This has resulted in a number of feasibility studies being conducted, not least of which an investigation by the Industrial Development Corporation in 2010 (R33-million spent) into potential for photo-voltaic, thermal, solar and wind power (Northern Cape Business website).

The area of the Northern Cape that borders on the Gariep (Orange) River and Namibia boasts the highest solar radiation intensity anywhere in southern Africa. Solar energy is therefore likely to be

the most viable alternative energy source for the Northern Cape, although wind-power potential is generally good along the coast (State of the Environment, S.A.)

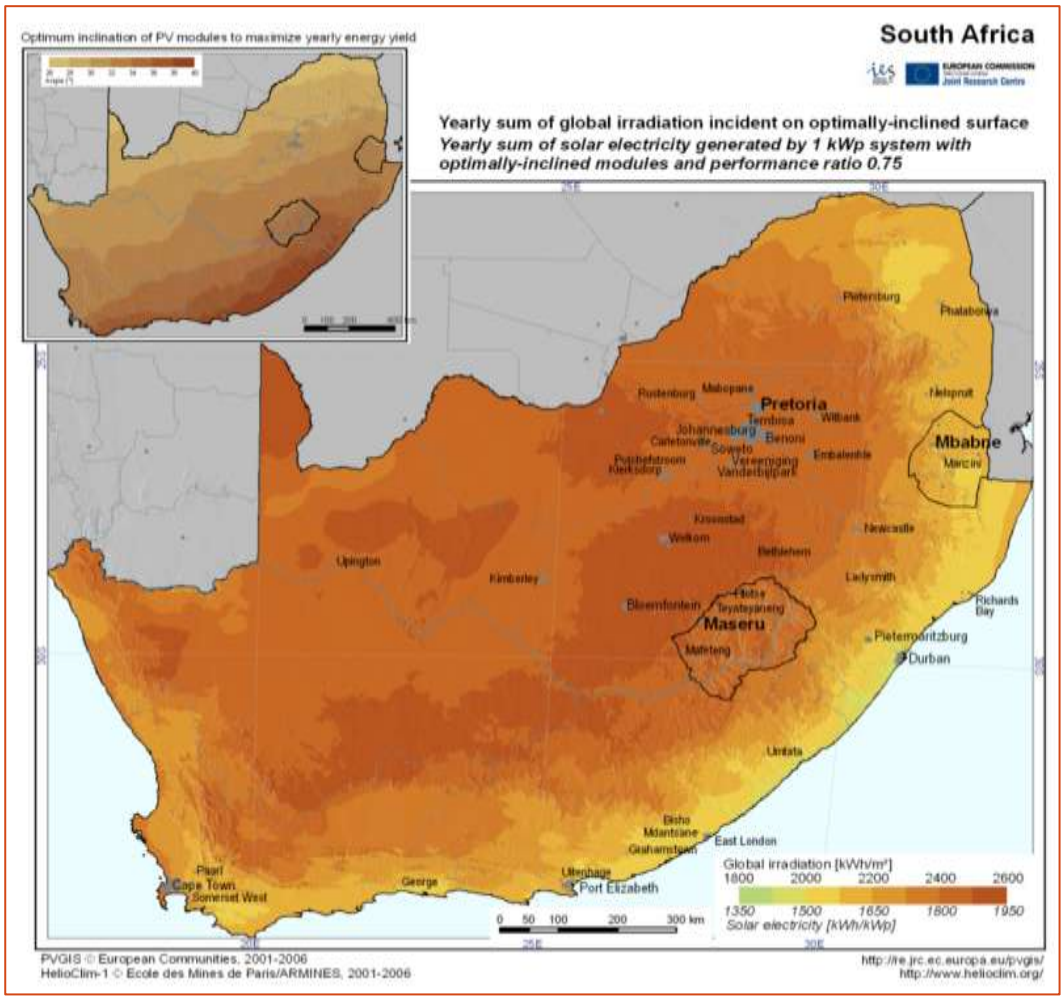

Figure 1: Solar radiation map for South Africa (Source: Solek Engineering Report, 2012).

The Northern Cape area is considered to have extremely favourable solar radiation levels over the majority of the year, making it ideal for the production of solar-power via Photovoltaic (fixed and tracking panels) and Concentrated (solar thermal) Solar systems. Several solar irradiation maps have been produced for South Africa, all of which indicate that the Northern Cape area **high solar irradiation**.

A solar-investment conference was held in November 2010 at Upington and was attended by 400 delegates from all over the world. Dipuo Peters, the previous national Minister of Energy, outlined the competitive advantages of the Northern Cape, over and above its extremely high irradiation levels, amongst others:

- relative closeness to the national power grid compared to other areas with comparable sunshine;
- water from the Orange River;
- access to two airports; and
- good major roads and a flat landscape (Northern Cape Business website – solar power).

The Northern Cape is not too dusty, the land is flat and sparsely populated, and there are little to no geological or climate risks, meaning that the sun can be used year-round (BuaNews online). An

advantage that the Northern Cape has over the Sahara Desert is the relatively wind-free environment that prevails in the province. A Clinton Climate Initiative (CCI) pre-feasibility study has found that South Africa has one of the best solar resources on the planet (Northern Cape Business website – solar power).

To take advantage of this potential for the Northern Cape to become a national renewable-energy hub, the groundwork is being done on a mega-project that has the capacity to fundamentally change the structure of South Africa's power sector: to build a massive solar park that will generate an eighth of the country's electricity needs – 5 000MW – in the Northern Cape near Upington. Sixteen square kilometres of land (thousands of hectares) have been identified and Eskom is looking for private partners. The park, which will cost more than R150-billion, will generate 1 000MW in its first phase. A full feasibility study will now be conducted with the support of the Central Energy Fund and the Development Bank of Southern Africa (Northern Cape Business website – solar power). Significant job creation, lucrative private-sector investments, local industry development and a cleaner, more secure power supply are among the benefits of a large-scale park such as this (BuaNews online).

Indeed this potential for solar energy generation plants has resulted in the emergence of smaller solar energy projects throughout the Northern Cape. The previous Energy Minister, Dipuo Peters announced in February 2012 that 16 of the initial 28 preferred projects identified by the Department of Energy (DoE) under the renewable energy independent power producer (IPP) programme were located in the sun-drenched province (Creamer, Feb. 2012). Mining companies in the Northern Cape are looking to concentrating solar power (CSP) to provide power for their operations. Engineering company Group Five announced in 2011 that they were investigating the construction of a 150MW plant near Kathu. The Industrial Development Corporation (IDC) is supporting a number of projects in the province. These include a 100MW plant conceived by Abengoa Solar, a Spanish company with a global presence, and a Solafrica scheme to spend more than R3-billion on a Concentrated Solar Plant at Groblershoop (Northern Cape Business website – solar power).

The Joram Solar Development. is one such IPP solar project which intends to generate 75MW of electricity from solar-energy for inclusion into the National grid. The Joram solar development site is considered ideal, primarily due to:

- The flat topography of the proposed development site and it's the availability for use for an alternative energy generation facility;
- The grid connection potential based in proximity to existing transmission & Existing Gordonia sub station; and
- Its proximity to other Alternative Energy Facilities under consideration (eg Ilanga CSP project)

The Renewable Energy Independent Power Producer Programme has made 3725 MW of power available to be generated as part of a first phase initiative, after which a number of phases would follow. So far, the first two bidding windows have taken up 2459.4 MW of this target. The Department of Energy (DoE) has set a number of dates for the submission of bid documents for private companies to apply for a licence to generate electricity. The bidding deadlines for the first two stages were as follow:

- 1st Bid Submission: 4 November 2011.
- 2nd Bid Submission: 5 March 2012.
- 3rd Bid submission: 19th of August 2013.

- 4th Bid submission: 18 August 2014.
- 5th Bid Submission: To be confirmed.

NOTE: It is the intention that the **Joram** solar development will submit their Bid for the **5th bidding window.**

2 LEGISLATIVE AND POLICY FRAMEWORK

The legislation that is relevant to this study is briefly outlined below. These environmental requirements are not intended to be definitive or exhaustive, but serve to highlight key environmental legislation and responsibilities only.

2.1 THE CONSTITUTION OF THE REPUBLIC OF SOUTH AFRICA

The Constitution of the Republic of South Africa (Act 108 of 1996) states that everyone has a right to a non-threatening environment and that reasonable measure are applied to protect the environment. This includes preventing pollution and promoting conservation and environmentally sustainable development, while promoting justifiable social and economic development.

2.2 NATIONAL ENVIRONMENTAL MANAGEMENT ACT (NEMA)

The current assessment is being undertaken in terms of the **National Environmental Management Act** (NEMA, Act 107 of 1998)[1] . This Act makes provision for the identification and assessment of activities that are potentially detrimental to the environment and which require authorisation from the competent authority (in this case, the national Department of Environmental Affairs, DEA) based on the findings of an Environmental Assessment.

The proposed scheme entails a number of listed activities, which require a **Scoping & Environmental Impact Reporting (S&EIR) process**, which must be conducted by an independent environmental assessment practitioner (EAP). Cape EAPrac has been appointed to undertake this process. Figure 2 below depicts a summary of the S&EIR process.

[1] On 18 June 2010 the Minister of Water and Environmental Affairs promulgated new regulations in terms of Chapter 5 of the National Environmental Management Act (NEMA, Act 107 of 1998), viz, the Environmental Impact Assessment (EIA) Regulations 2010. These regulations came into effect on 02 August 2010 and replace the EIA regulations promulgated in 2006.

Figure 2: Summary of Scoping & EIR Process

The listed activities associated with the proposed development, as stipulation under 2010 Regulations **544, 545 & 546** are as follows:

Table 1: NEMA 2010 listed activities for the Joram Solar Development

Listed activity as described in GN R.544, 545 and 546	**Description of project activity that triggers listed activity – if activities in GN R. 546 are triggered, indicate the triggering criteria as described in the second column of GN R. 543**
GN R544 Item 10: *The construction of facilities or infrastructure for the* ***transmission and distribution or electricity*** *–* ***(i)*** *outside urban areas or industrial complexes with a capacity of more than 33kV, but less than 275kV.*	Construction of a **new 132kV overhead power line** linking the on-site substation to the existing Eskom Gordonia Substation.
GN R544 Item 11: *The construction of:* ***(x)*** *buildings exceeding 50 square metres in size;* ***(xi)*** *infrastructure or structures covering 50 square metres or more* *where such construction occurs within a*	Potentially for the construction of solar related infrastructure (buildings, cables, overhead lines etc.) and access roads **in proximity to seasonal washes**. The relevance and extent of this activity will be determined after completion of the baseline

watercourse or within 32m of a watercourse, measured from the edge of a watercourse, excluding where such construction will occur behind the development setback line.	studies.
GN R544 Item 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 rock of more than 5 cubic metres from:* ***(i)*** *a watercourse.*	The possible **construction of roads / tracks & PV arrays across any minor drainage lines and seasonal washes**. The relevance and extent of this activity will be determined during the baseline studies.
GN R544 Item 22: *The **construction of a road**, **outside urban areas**,* ***(i)*** *with a reserve wider than 13.5m or,* ***(ii)*** *where no reserve exists where the road is wider than 8m.*	Construction of **access and internal roads** for the solar facility for construction and operation phases outside the urban edge of Upington.
GN R545 Item 1: *The construction of facilities or infrastructure for the **generation of electricity** where the electricity output is **20MW or more**.*	Construction of the Jorum Solar Development with a maximum generation capacity **of 75MW.**
***GN R545 Item 15: Physical alteration of undeveloped, vacant or derelict land** to residential, retail, commercial, recreational, industrial or institutional use where the total area to be transformed is **20ha or more**.*	Development of the Jorum Solar Development on private land, of approximately **250ha**, outside of the urban edge Upington.
GN R546 Item 4: *The construction of a road wider than 4 metres with a reserve less than 13.5m.* ***(a)*** *In Northern Cape:* ***(ii)*** *All areas outside urban areas.*	Construction of **access and internal roads wider than 4 metres** for solar facility, outside the urban edge of Upington. The extent and relevance of this activity will be determined by the baseline studies.
GN R546 Item 14: *The **clearance of an area of 5ha or more of vegetation** where 75% or more of the vegetative cover constitutes indigenous vegetation, except where such removal of vegetation is required for:* ***(3)*** *the undertaking of a linear activity falling below the thresholds mentioned in Listing 1 in terms of GN R.544 of 2010.* ***(a)*** *In Northern Cape:* ***(i)*** *All areas outside urban areas.*	**Vegetation clearing** for the Solar Panels and Associated Infrastructure: access roads, cable trenches and on-site substation & auxiliary buildings etc. The extent and relevance of this activity will be determined by the baseline studies.
GN R546 Item 16: *The construction of:* ***(iii)*** *buildings with a footprint exceeding 10 square metres in size; or* ***(iv)*** *infrastructure covering 10 square metres or more,* *where such construction occurs within a*	Possible crossing of **washes / seepage lines** by access or internal road network, as well as PV Solar infrastructure: outside of the urban edge of Upington.

watercourse or within 32m of a watercourse, measured from the edge of a watercourse, excluding where such construction will occur behind the development setback line. ***(a)** In Northern Cape:* ***(ii)** Outside urban areas, in:*	
***GN R546 Item19:** The widening of a road by more than 4 metres or the lengthening of a road by more than 1 kilometre.* ***(a)** In Northern Cape:* ***(ii)** All areas outside urban areas.*	Construction of **access and internal roads** for solar park, outside of urban edge of Upington.

It must be noted that these activities are all to be considered at the scoping phase, but certain of the activities listed above may no longer be relevant after the outcome of the specialist studies. In this case, these activities will be excluded from further assessment and the Department will be notified accordingly.

Before any of the above mentioned listed activities can be undertaken, authorisation must be obtained from the relevant authority, in this case the National Department of Environmental Affairs (DEA). Should the Department approve the proposed activity, the Environmental Authorisation does not exclude the need for obtaining relevant approvals from other Authorities who has a legal mandate.

NOTE: This Application was undertaken in terms of the NEMA 2010 EIA regulations. In order to comply with transitional arrangements, the similarly listed 2014 EIA regulations were also considered.

2.2.1 Exemptions and Deviations

The following deviations from the public participation process were applied for in terms of Regulation 54(5) of GN R. 543.

GN R.543 I 54 (2)(a)(i&ii):

The person conducting a public participation process must take into account any guidelines applicable to public participation as contemplated in section 24J of the Act and must give notice to all potential interested and affected parties of the application which is subjected to public participation by – (a) 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, (ii) any alternative site mentioned in the application.

The boundary fence of the site is set back from the N10 highway and thus will be inconspicuous to the public past it. Site Notices have been placed at the entrance to the proposes facility on the farm, but off the N10.

No alternative properties / sites are to be considered for this application.

GN R.543 Item 54 (1)(b)(ii)&(iii):

Giving written notice to – (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, or (iii) 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.

Potentially affected landowners and adjacent landowners have been / will be requested (via notification) to inform any labourers / tenants / occupiers residing on their properties of the proposal and their right to register as I&APs.

GN R. 543.10 (2)(d)

Advertising the environmental decision in a newspaper.

Registered I&APs will be directly notified of the environmental decision directly.

2.3 NATIONAL ENVIRONMENTAL MANAGEMENT: BIODIVERSITY (ACT 10 OF 2004)

The National Environmental Management: Biodiversity Act (Act 10 of 2004) (NEMBA) provides for listing threatened or protected ecosystems, in one of four categories: critically endangered (CR), endangered (EN), vulnerable (VU) or protected. The Draft National List of Threatened Ecosystems (Notice 1477 of 2009, Government Gazette No 32689, 6 November 2009) has been gazetted for public comment.

The list of threatened terrestrial ecosystems supersedes the information regarding terrestrial ecosystem status in the NSBA 2004. In terms of the EIA regulations, a basic assessment may be required for the transformation or removal of indigenous vegetation in a critically endangered or endangered ecosystem regardless of the extent of transformation that will occur. **However, all of the vegetation types on both the study sites are classified as Least Threatened.**

NEMBA also deals with endangered, threatened and otherwise controlled species. The Act provides for listing of species as threatened or protected, under one of the following categories:

- **Critically Endangered**: any indigenous species facing an extremely high risk of extinction in the wild in the immediate future.
- **Endangered**: any indigenous species facing a high risk of extinction in the wild in the near future, although it is not a critically endangered species.
- **Vulnerable**: any indigenous species facing an extremely high risk of extinction in the wild in the medium-term future; although it is not a critically endangered species or an endangered species.
- **Protected species**: any species which is of such high conservation value or national importance that it requires national protection. Species listed in this category include, among others, species listed in terms of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES).

Certain activities, known as Restricted Activities, are regulated by a set of permit regulations published under the Act. These activities may not proceed without environmental authorization.

According to the national vegetation map (Mucina & Rutherford 2006), the entire development site is restricted to the Kalahari Karroid Shrubland vegetation type, with Bushmanland Arid Grassland being the other major vegetation type present in the wider area. In terms of the conservation status of the various vegetation types of the area, only **Lower Gariep Alluvial Vegetation is of concern and is listed as Endangered**. This vegetation type is however associated with the alluvium along the Orange River and **would not be impacted by the current development** which is some distance from the river itself.

2.4 NATIONAL PROTECTED AREA EXPANSION STRATEGY (NPAES) FOR S.A. 2008 (2010)

Considering that South Africa's protected area network currently falls far short of sustaining biodiversity and ecological processes, the NPEAS aims to achieve cost-effective protected area expansion for ecological sustainability and increased resilience to Climate Change. Protected areas, recognised by the National Environmental Management: Protected Areas Act (Act 57 of 2003), are considered formal protected areas in the NPAES. The NPAES sets targets for expansion of these protected areas, provides maps of the most important protected area expansion, and makes recommendations on mechanisms for protected area expansion.

The NPAES identifies 42 focus areas for land-based protected area expansion in South Africa. These are large intact and un-fragmented areas suitable for the creation or expansion of large protected areas. **There are no NPAES expansion areas that have been identified in close proximity to the site**.

2.5 CRITICAL BIODIVERSITY AREAS.

According the South African National Biodiversity Institute Biodiversity Geographic Information System (SANBI BGIS) and the Ecological Specialist, Mr Simon Todd, there are no fine-scale conservation planning has been conducted for the region and as a result, **no Critical Biodiversity Areas have been defined for the study area.**

2.6 NATIONAL FORESTS ACT (NO. 84 OF 1998):

The National Forests Act provides for the protection of forests as well as specific tree species, quoting directly from the Act: "*no person may cut, disturb, damage or destroy any protected tree or possess, collect, remove, transport, export, purchase, sell, donate or in any other manner acquire or dispose of any protected tree or any forest product derived from a protected tree, except under a licence or exemption granted by the Minister to an applicant and subject to such period and conditions as may be stipulated".*

The ecological specialist, Mr Simon Todd, confirmed that two species protected in terms of the National Forest Act may occur on site, namely *Acacia erioloba* and *Boscia albitrunca*.

The Department of Agriculture, Forestry and Fisheries requested that the potential presence of these on site be confirmed.

The ecologist, Mr Simon Todd has confirmed the likely presence of a small number of protected species during his field work. There are also likely to be present which are either protected under the National Forests Act such as *Boscia albitrunca* or protected under the Northern Cape Nature Conservation Act of 2009, which includes all *Mesembryanthemacea, Boscia foetida*, all species within the *Euphorbiaceae*. *Oxalidaceae, Iridaceae*, all species within the genera *Nemesia* and *Jamesbrittenia.*

The results of the field assessment indicated that it is likely that about **30 - 50 Acacia erioloba trees would be impacted**, which is not considered highly significant in the context of the large local population of this species in the area, which is clearly not in decline as is apparently the case in some areas.

Please refer to the Ecological Impact Assessment Report in Appendix D, Annexure D1 for a detailed description of the botanical component of the site.

2.7 CONSERVATION OF AGRICULTURAL RESOURCES ACT – CARA (ACT 43 OF 1983):

CARA provides for the regulation of control over the utilisation of the natural agricultural resources in order to promote the conservation of soil, water and vegetation and provides for combating weeds and invader plant species. The Conservation of Agricultural Resources Act defines different categories of alien plants:

- Category 1 - prohibited and must be controlled;
- Category 2 – must be grown within a demarcated area under permit; and
- Category 3 - ornamental plants that may no longer be planted, but existing plants may remain provided that all reasonable steps are taken to prevent the spreading thereof, except within the flood lines of water courses and wetlands.

The abundance of alien plant species on the Joram Solar site is very low, which can be ascribed mainly to the aridity of the site.

In terms of soil and water resources, the main drainage channels and several pans highlighted as sensitive. Caution would need to be exercised if any development were to take place within these areas.

The Department of Agriculture, Land Reform and Rural Development is guided by Act 43 of 1983.

In their preliminary comment on the development they have advised that the developer must take care of the following:

Article 7.(3)b of Regulation 9238: CONSERVATION OF AGRICULTURE RESOURCES, 1983 (Act 43 of 1983)

Utilisation and protection of vleis, marshes, water sponges and water courses

- 7.(1) “no land user shall utilize the vegetation in a vlei, marsh or water sponge or within the flood area of a water course or within 10 meters horizontally outside such flood area in a manner that causes or may cause the deterioration of or damage to the natural agriculture resources.”
- (3)(b) “cultivate any land on his farm unit within the flood area of a water course or within 10 meters horizontally outside the flood area of a water course”

The ecological specialist has considered these requirements in detail during his study.

Comment was received from the Northern Cape Department of Agriculture, Land Reform and Rural Development on the Draft Scoping Report. In their comment, they confirmed that they foresee no issues with the proposed Joram Solar Development on condition that Act 43 of 1983 (CARA) is adhered to.

2.8 NORTHERN CAPE NATURE CONSERVATION ACT, NO. 9 OF 2009:

The Northern Cape Nature Conservation Act provides inter alia for the sustainable utilisation of wild animals, aquatic biota and plants as well as permitting and trade regulations regarding wild fauna and flora within the province. In terms of this act the following section may be relevant with regards to any security fencing the solar development may require.

Manipulation of boundary fences: *19. No Person may –*

(a) erect, alter, remove or partly remove or cause to be erected, altered, removed or partly removed, any fence, whether on a common boundary or on such person’s own property, in

such a manner that any wild animal which as a result thereof gains access or may gain access to the property or a camp on the property, cannot escape or is likely not to be able to escape therefrom.

It is recommended that the perimeter fencing around the solar development site will be constructed in a manner which allows for the passage of small and medium sized mammals: The biodiversity specialist will make recommendations with regard to the specific fencing configuration during the EIA phase of this project.

There are also likely to be present which are either protected under the National Forests Act such as *Boscia albitrunca* or protected under the Northern Cape Nature Conservation Act of 2009, which includes all *Mesembryanthemacea, Boscia foetida*, all species within the *Euphorbiaceae*. *Oxalidaceae, Iridaceae*, all species within the genera *Nemesia* and *Jamesbrittenia*.

Apart from the above species there may also be other listed species present as the area has probably not been well sampled in the past. Further detailed of protected species on site have been provided by the Ecological Specialist, Mr Simon Todd. Please also refer to the **Ecological Impact Assessment Report** attached in **Annexure D1.**

2.9 NATURE AND ENVIRONMENTAL CONSERVATION ORDINANCE (19 OF 1974)

This legislation was developed to protect both animal and plant species within the various provinces of the country which warrant protection. These may be species which are under threat or which are already considered to be endangered. The provincial environmental authorities are responsible for implementing the provisions of this legislation, which includes the issuing of permits etc. In the Northern Cape, the Department of Environment and Nature Conservation fulfils this mandate as per the Northern Cape Nature Conservation Act as described above.

2.10 NATIONAL HERITAGE RESOURCES ACT

The protection and management of South Africa's heritage resources are controlled by the National Heritage Resources Act (Act No. 25 of 1999). South African National Heritage Resources Agency (SAHRA) is the enforcing authority in the Northern Cape, and is registered as a Stakeholder for this environmental process.

In terms of Section 38 of the National Heritage Resources Act, SAHRA will comment on the detailed Heritage Impact Assessment (HIA) where certain categories of development are proposed. Section 38(8) also makes provision for the assessment of heritage impacts as part of an EIA process.

The National Heritage Resources Act requires relevant authorities to be notified regarding this proposed development, as the following activities are relevant:

- *the construction of a road, wall, power line, pipeline, canal or other similar form of linear development or barrier exceeding 300m in length;*
- *any development or other activity which will change the character of a site exceeding 5 000 m² in extent;*
- *the re-zoning of a site exceeding 10 000m^2 in extent.*

Furthermore, in terms of Section 34(1), no person may alter or demolish any structure or part of a structure, which is older than 60 years without a permit issued by the SAHRA, or the responsible resources authority.

Nor may anyone destroy, damage, alter, exhume or remove from its original position, or otherwise disturb, any grave or burial ground older than 60 years, which is situated outside a formal cemetery administered by a local authority, without a permit issued by the SAHRA, or a provincial heritage authority, in terms of Section 36 (3).

In terms of Section 35 (4), no person may destroy, damage, excavate, alter or remove from its original position, or collect, any archaeological material or object, without a permit issued by the SAHRA, or the responsible resources authority.

Mr Stefan de Kock, of Perception Heritage Planning, undertook an **integrated heritage impact assessment** for the proposed Joram Solar Development. This integrated heritage study included an **Archaeological Impact Assessment** undertaken by Dr Peter Nilssen as well as a **Paleontological Desktop Assessment** to be undertaken by Dr John Almond. These specialist studies are included in **Annexures D3, D4 and D5** respectively.

These Specialist Impact Assessments have been uploaded to the SAHRIS system and final comment is awaited from SAHRA.

2.11 NATIONAL WATER ACT, NO 36 OF 1998

Section 21c & i of the National Water Act (NWA) requires the Applicant to apply for authorisation from the Department of Water Affairs for an activity in, or in proximity to any watercourse. Such an application may be required for any access road that may crosses the drainage channel. The actual footprint of the solar panels is to be developed to avoid the main drainage channel crossing the property.

Water required for the construction and operation of the Joram Solar development may also require authorisation in terms of the National Water Act as it may to be sourced from boreholes on the property. Should water be sourced from the Khara Hais Garib municipality, it is expected that an additional authorisation in terms of the National Water Act will not be required. Please see the **Engineering Report** in **Annexure D7** for additional information in this regard.

Solek renewable energy engineers are in the process of compiling the relevant applications in terms of the National Water Act. These applications will be submitted to the Northern Cape Department of Water Affairs prior to the submission of the Final Environmental Impact Report.

2.12 SUSTAINABILITY IMPERATIVE

The norm implicit to our environmental law is the notion of sustainable development ("SD"). SD and sustainable use and exploitation of natural resources are at the core of the protection of the environment. SD is generally accepted to mean development that meets the needs of the present generation without compromising the ability of future generations to meet their own needs. The evolving elements of the concept of SD *inter alia* include the right to develop; the pursuit of equity in the use and allocation of natural resources (the principle of intra-generational equity) and the need to preserve natural resources for the benefit of present and future generations. Economic development, social development and the protection of the environment are considered the pillars of SD (the triple bottom line).

"*Man-land relationships require a holistic perspective, an ability to appreciate the many aspects that make up the real problems. Sustainable planning has to confront the physical, social, environmental and economic challenges and conflicting aspirations of local communities. The imperative of sustainable planning translates into notions of striking a balance between the many competing interests in the ecological, economic and social fields in a planned manner. The 'triple*

bottom line' objectives of sustainable planning and development should be understood in terms of economic efficiency (employment and economic growth), social equity (human needs) and ecological integrity (ecological capital)."

As was pointed out by the Constitutional Court, SD does not require the cessation of socio-economic development but seeks to regulate the manner in which it takes place. The idea that developmental and environmental protection must be reconciled is central to the concept of SD - it implies the accommodation, reconciliation and (in some instances) integration between economic development, social development and environmental protection. It is regarded as providing a "conceptual bridge" between the right to social and economic development, and the need to protect the environment.

Our Constitutional Court has pointed out that the requirement that environmental authorities must place people and their needs at the forefront of their concern so that environmental management can serve their developmental, cultural and social interests, can be achieved if a development is sustainable. "*The very idea of sustainability implies continuity. It reflects the concern for social and developmental equity between generations, a concern that must logically be extended to equity within each generation. This concern is reflected in the principles of inter-generational and intra-generational equity which are embodied in both section 24 of the Constitution and the principles of environmental management contained in NEMA.*" [Emphasis added.]

In terms of NEMA sustainable development requires the integration of the relevant factors, the purpose of which is *to ensure that development serves present and future generations.*[2]

It is believed that the proposed 75MW Joram Solar development supports the notion of sustainable development by presenting a reasonable and feasible alternative to the existing vacant land use type, which has limited agricultural potential due the lack of water and infrastructure.

Furthermore the proposed alternative energy project (reliant on a natural renewable resource – solar energy) is in line with the national and global goal of reducing reliance on fossil fuels, thereby providing long-term benefits to future generations in a sustainable manner.

3 ACTIVITY

Joram Solar (Pty) Ltd is a Solar Energy Facility Independent Power Producer (IPP), is proposing the establishment of a commercial solar energy facility on a site within the Northern Cape to be known as Joram Solar Development. The project is planned to be located on the remainder of portion 62 (a portion of portion 9) of the farm Vaal Koppies 40, with a planned installed electrical capacity of 75 MW. Remainder of Portion 62 (a portion of portion 9) of the farm Vaal Koppies, Upington.

Potential grid connections are also being investigated on Portion 66 of the farm 40, portion 9 of the farm 40 portion 7 of the farm 555, portion 52 of the farm 40, portion 3 of the farm 40, erf 73 and erf 19951.

The proposed facility has a planned peak capacity of be 75 MW.AC with an estimated footprint between 200 and 220ha.

The estimated portion of land each component of the facility will typically occupy is summarised in the table below (with the average area is taken as 200ha):

[2] See definition of "sustainable development" in section 1 of NEMA.

Table 2: Component sizes of the proposed Joram Solar Development (Solek, 2014)

Component	Estimated extent of 75 MW plant	Percentage of selected area (± 200 ha)	Percentage of whole farm (±4695.8587 ha)
PV or CPV modules	180 ha (1.8 km^2)	90%	3.8%
Internal roads-6m width	18 ha (0.27 km^2)	9%	0.38%
Auxiliary buildings	2 ha (0.02 km^2)	1%	less than 0.1%

The proposed infrastructure that is planned to be constructed includes **CPV modules**, or a series of solar **PV arrays**, **inverters**, **internal electrical reticulation**, and an **internal road network**. It will also be necessary to construct an **onsite substation** which would typically include a **transformer** to allow the generated power to be connected to Eskom's electricity grid. **Auxiliary buildings**, including **ablution**, **workshops**, **storage areas** and **fencing** are planned to be erected. A distribution line will also be required to distribute the generated electricity from the site to the Eskom substation and grid.

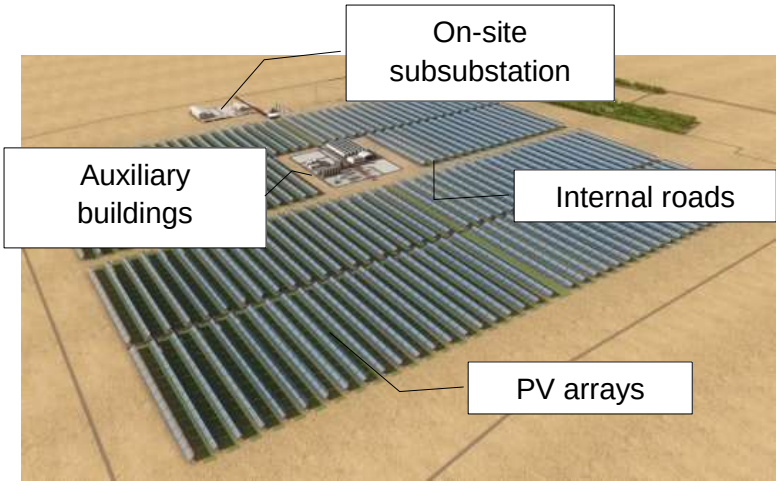

Figure 3: Typical Layout of a solar PV Plant (Solek, 2014)

Determining the optimal layout is a costly process which would normally take place once an REIPP tender has been awarded to the bidder. For the purpose of the environmental impact assessment, a typical layout will be discussed, alternatives will be investigated and a preliminary high level layout will be drafted – This typical layout will include a maximum environmental footprint that will be assessed in the environmental process. The final layout design that will be done after bidding will take into account the site constraints identified and recommendations made by the various EIA specialists. With the actual construction, the **final plant layout will stay the same in terms of footprint size and height**, as assessed in the environmental process, but the exact location of the different components may change within the footprint.

It must be noted that a **larger total study site** is under consideration during the scoping phase for this development. The **preferred footprint** within the study site will be determined once the participating specialists have undertaken their studies and **defined constraints** – The final preferred layout followed a **risk adverse** approach to avoid all highly sensitive features as far as possible. This preferred layout has been presented in the Draft Environmental Impact Report.

Various layout alternatives for the abovementioned components are under consideration. The preferred alternative (to avoid constraints defined by the specialists) will be determined during the

EIR phase of the project. Details regarding the consideration of alternatives are included in the section below.

Please see the **layout report** attached in **Appendix C** for additional supplementary information.

4 LAYOUT PROGRESSION & CONSIDERATION OF ALTERNATIVES

A number of alternatives, including activity, layout and technological alternatives were considered for the proposed Joram Solar Development. The consideration of these alternatives is detailed below. Please also refer to the Layout report compiled by Solek Renewable Energy Engineers attached in Appendix C.

In terms of the requirements relating to the assessment of alternatives, a number of alternatives have been considered as part of this environmental process, these include:

- Layout Alternatives,
- Technology Alternatives,
- Grid Connection Alternatives, and
- Access Road Alternatives.

4.1 LAYOUT ALTERNATIVES

Since project inception, the layout of the facility underwent multiple changes in order to come out with the best practicable environmental option. The initial facility layout was included within the draft scoping report and progressed to this latest layout report submitted with the draft environmental impact report. This portion of the layout report elaborates on the layout progression since inception.

4.1.1 Preliminary Study Site

As part of the scoping layout report different locations within an identified study site for the proposed facility were investigated. A preliminary study site of 450 ha was identified as part of this scoping phase of the Joram Solar (Pty) Ltd. Solar Development project.

The preliminary study site was selected due to initial project planning of multiple solar facilities and therefore the reason for the large area. During the planning stages the possible higher sensitive areas within the preliminary study site have already been excluded to inform the preferred Layout.

In addition the land is considered to have a low agriculture potential, with limited carrying capacity, as per the Agriculture Potential specialist report. The usage of this low agricultural potential land is believed to have little effect on food security and the corresponding production of food. The low concentration of nutrients in the soil also means that vegetation is not very dense or high, eliminating the chances of casting shadows on the solar arrays or having an effect on food security.

The 450 ha area was also identified because of its level surface, road access alternatives, and distance to the Gordonia Eskom substation.

The identified 450 ha study area is referred to as the “Preliminary Study Site”. Please refer to the engineering report (Annexure D7) for more details regarding the Preferred Layout and corresponding expected infrastructure. The infrastructure includes components such as frames, solar modules, roads, workshop and admin office area, laydown area, and an onsite substation.

Figure 4: Initial Scoping area (Preliminary Study Site)

4.1.2 Layout Alternative 1 - Initial Layouts (Scoping Phase)

During the scoping phase, two alternative layouts were considered. The following two figures depict these proposed layouts (as detailed in the Final Scoping Reports).

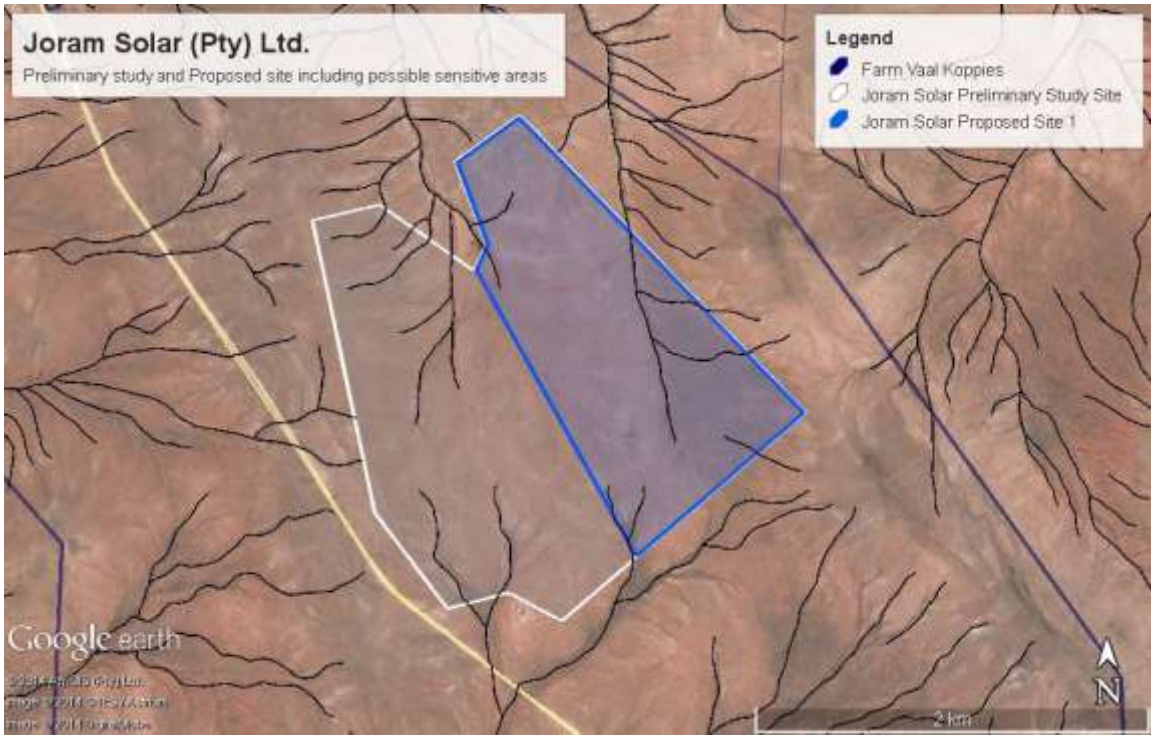

Figure 5: Scoping phase (initial) proposed site layout

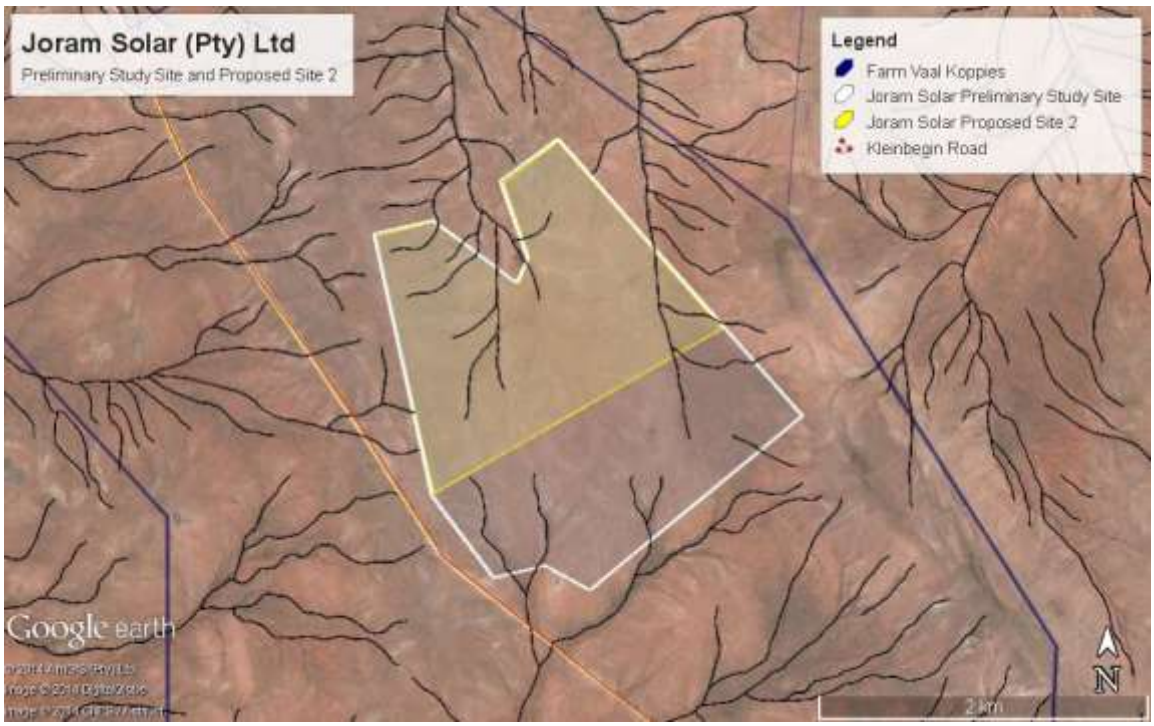

Figure 6: Scoping phase proposed site alternative layout

The major points which lead to these initial layouts during the scoping phase, as illustrated above are the following:

- Area of approximately 220 ha , to ensure the project would be economically viable, allowing for exclusions of environmental sensitive areas;
- Minimal disturbance to water washes and highly sensitive areas.
- Road access to the site with regard to distance and minimal disturbance to sensitive areas
- Grid connection taking into consideration distance and minimal disturbance to sensitive areas.

4.1.3 Layout progression after scoping phase

Within the impact assessment phase various specialist reports was obtained and incorporated in order to develop the preferred / mitigated layouts. These preferred layouts as discussed below incorporated the various constraints as identified by participating specialists. These were as follows:

4.1.3.1 Visual specialist input

The feedback received from the visual specialist (Visual Resource Management Africa, Stephen Stead) was that there are visual constraints on the study site, based on a worst case height of 10m for CPV technology.

A visual “setback line” was recommended by the visual specialist to offset this change in visual classification for the area.

4.1.3.2 Ecological specialist input

The feedback received from the ecology specialist (Simon Todd Consulting, Simon Todd) was that there were sensitive areas to take cognisance of in terms of the design. After collaborating and discussing the identified sensitive areas with Simon Todd, the very high sensitive areas and some of the high sensitive areas was excluded and used to inform the alternative and preferred layout.

The recommended exclusion areas by Simon Todd include the mountainous area on the western side of the site as well as an area to the east of the site (east of an existing wash) due to presence of protected species.

The alternative layout and the preferred layout were mainly influenced by the visual specialist study and the ecology specialist study as no other constraints were identified by the remaining specialists. All of these constraints were taken into account and used to inform these layouts.

4.1.4 Layout Alternative 2 - Alternate Layout

An Alternative Layout to the Preferred Layout has been selected within the Preliminary Study Site as part of the impact assessment phase. This Alternative Layout is illustrated in the figure below.

The main reason for this Alternative Layout is the size and Layout type that could benefit the commercial side of developing an additional project in future REIPPP rounds. The very high sensitive areas have been excluded and mitigation measures have been taken into account as recommended in the Ecological Impact Assessment.

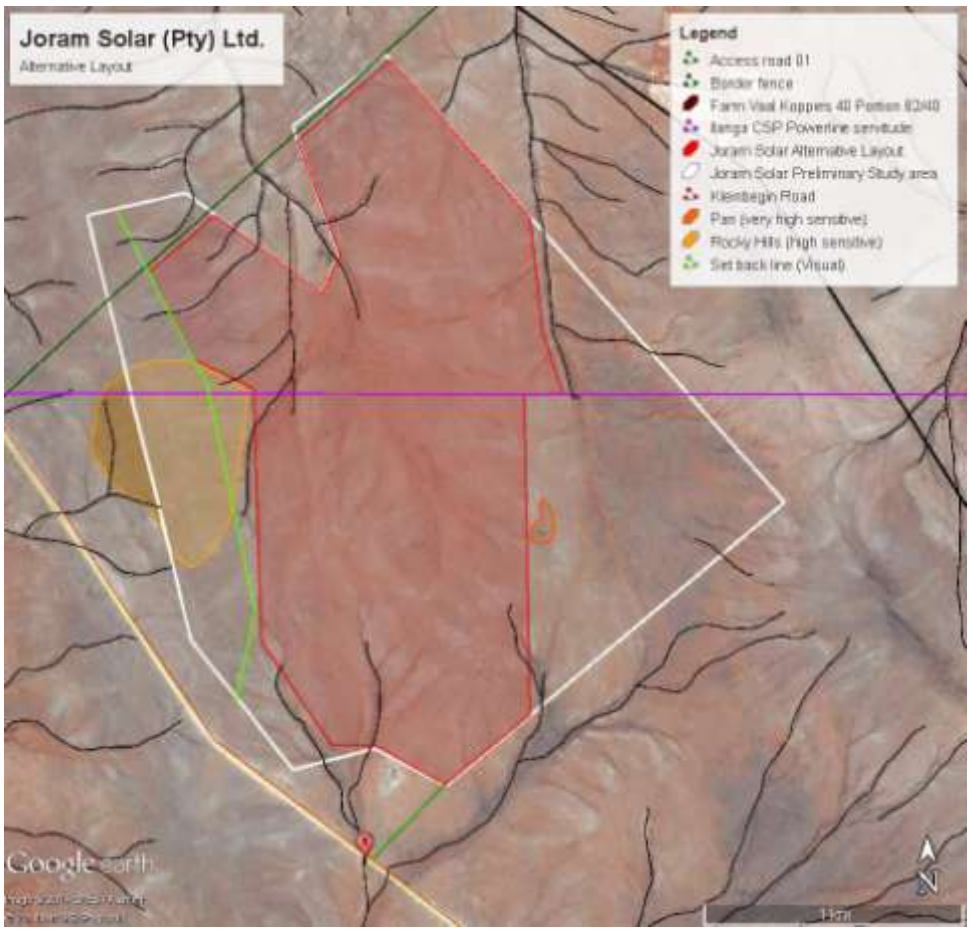

Figure 7: Layout Alternative 2 - Alternate Layout

4.1.5 Layout Alternative 3 - Preferred Layout

As part of the Environmental Impact assessment phase the specialist reports, sensitive areas have been included and mapped in order to evaluate layout alternatives and to determine the preferred layout for the Impact Assessment phase of the EIA. The possible drainage lines and sensitive areas have been assessed and confirmed by the specialist studies namely ecological, archaeology, agricultural and visual studies.

The initial layouts have been altered, so as to avoid sensitive areas and to reduce the environmental impact of the solar facility on the area.

Due to a power line servitude from another renewable solar development (Ilanga CSP Karoshoek) crossing the preliminary study site from east to west direction, the initial site layouts have been altered to incorporate this servitude. The proposed Ilanga power line servitude has already received an environmental authorisation

This preferred site layout covers an area of 220ha which excludes the identified highly sensitive areas.

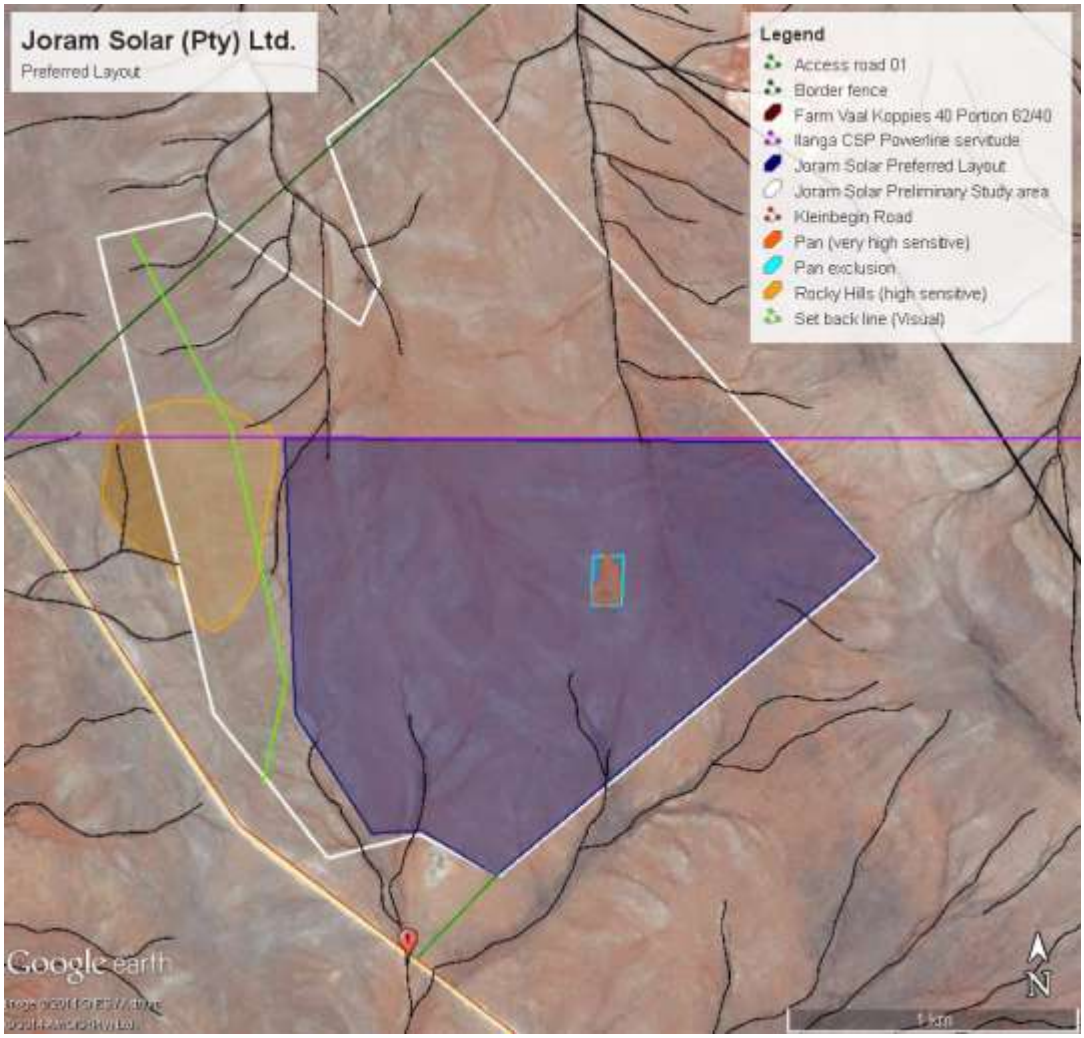

Figure 8: Layout Alternative 3 - Preferred Layout

4.1.5.1 Details of preferred layout

Within the preferred footprint, the figure below illustrates how the typical layout will look like and what components the facility will comprise of. Please refer to the Engineering report (Attached in Annexure D7) for a detailed list and discussion of all componants.

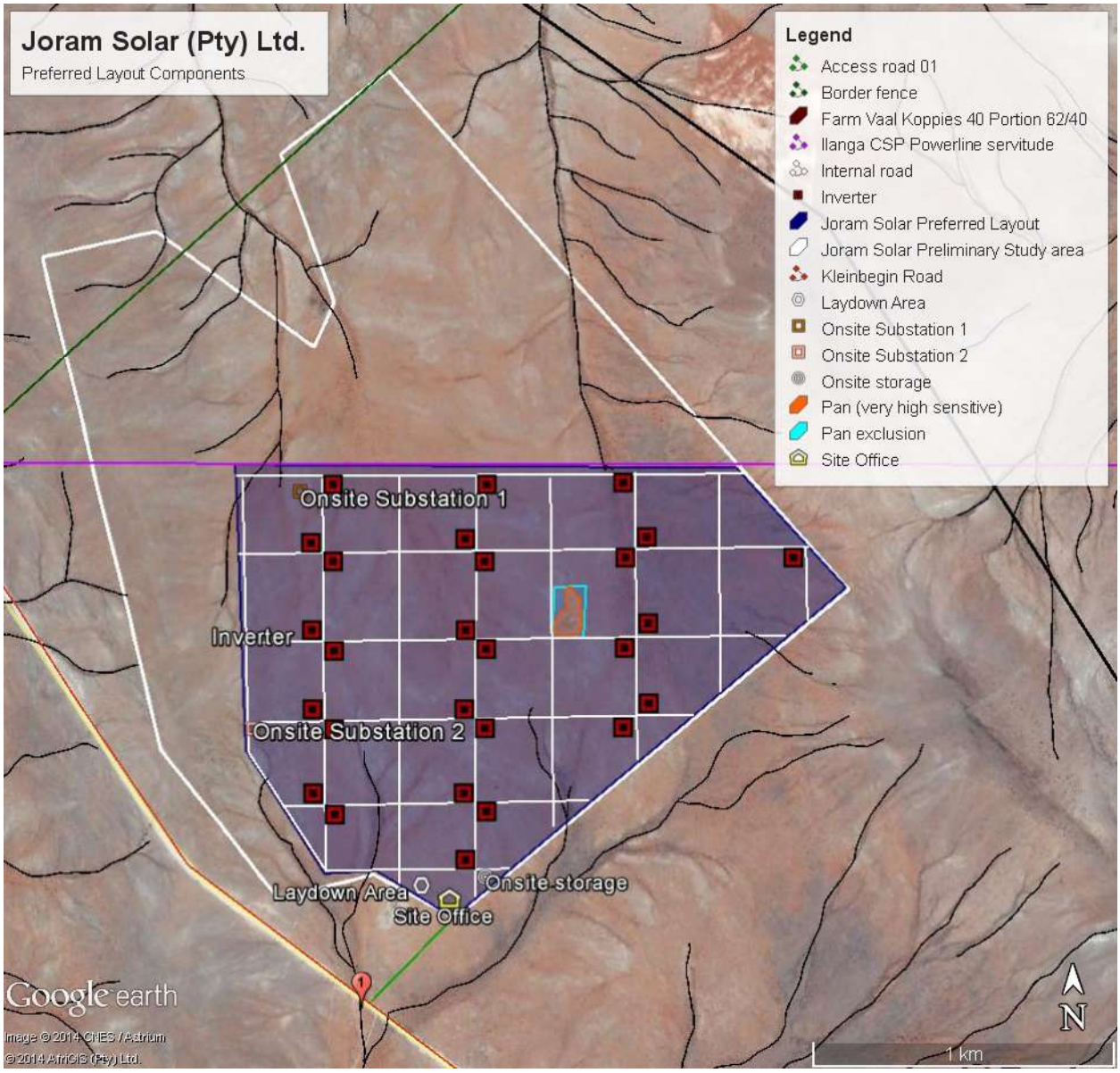

Figure 9: Joram Solar Preferred Layout including infrastructure and components

Components include solar modules, roads, workshop and admin office area, laydown area and an onsite substation. The exact position of these components will be determined in the final plant design if the project receives preferred bidder status. NOTE: Although the final detailed layout may change, it will be contained within the same footprint as considered and assessed in the environmental process.

4.2 ACCESS ROAD ALTERNATIVES

Different access route alternatives (Including the preferred access) are described within this section of the report.

4.2.1 Access Alternative 1

Access road alternative 1 has been investigated and provides access to the Preferred Layout (Layout Alternative 3) site from the Kleinbegin road at the existing farm entrance (point 1) parallel to the south boundary of the preliminary study site.

4.2.2 Access Alternative 2

Access road alternative 2 has been investigated and provides access from the Kleinbegin road at (point 2) to the proposed Layout Alternative 1 as considered in the scoping phase.

4.2.3 Access Alternative 3

Access road alternative 3 has been investigated and provides access from the Kleinbegin road at (point 3) to the proposed site alternative 1. This third alternative was also selected and planned to run parallel the original farm camp fence.

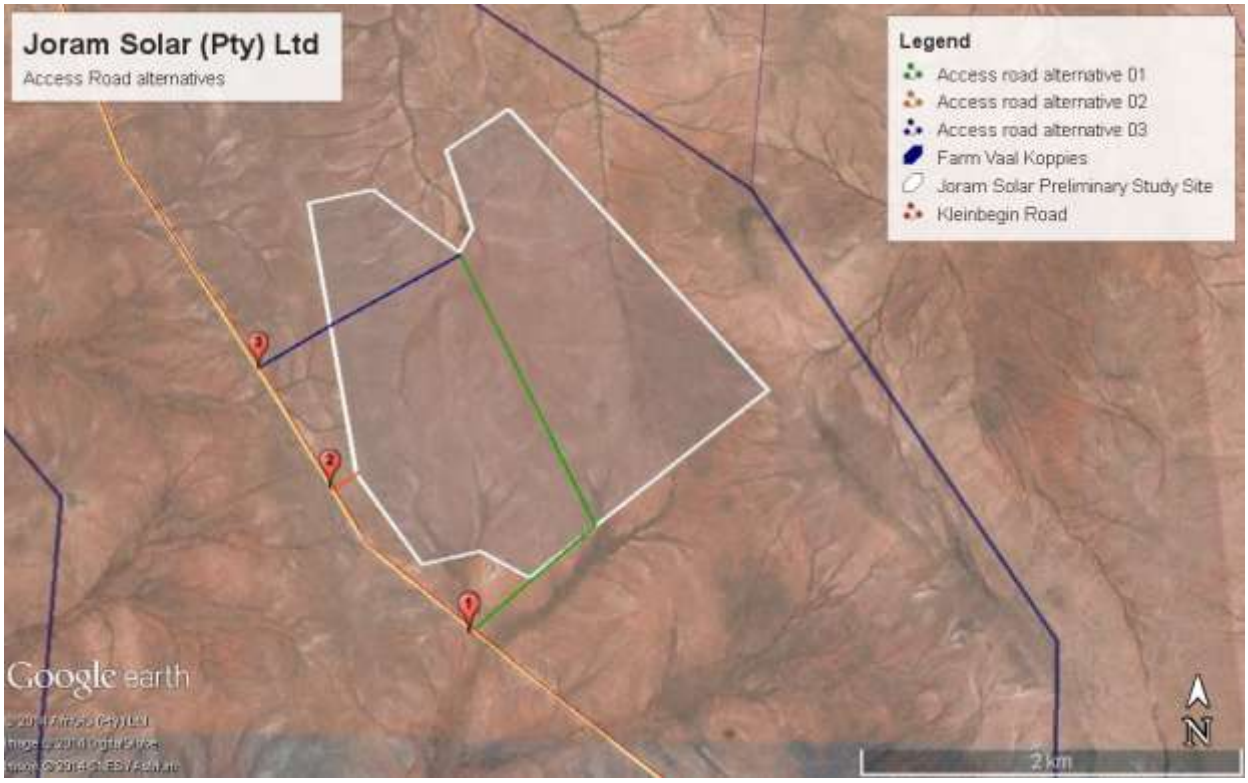

Figure 10: Alternative site access roads to Site Alternative 1 and 2

As per outcome of the transportation and traffic management plan, the preferred access point to the site is “Access road 1”(i.e.at the same point as the existing farm gate and track). The access roads to the property will be from the existing Kleinbegin road, 8km from the Kleinbegin / N10 intersection and 10km south east from Upington.

Upgrading of the existing farm access and access road 1 is the preferred option. The site access road should be upgraded to at least 5m width (preferable 6m with sufficient shoulders) and gravel wearing course layer.

During the environmental process, the access road alternatives and routes have been reviewed by “South African National Road Agency” (SANRAL). SANRAL is governed by various laws by which all national roads should be managed.

SANRAL's specific area of concern is at the intersection of the N10 and Kleinbegin road. Solek, the project engineers are engaging directly with SANRAL in this regard.

The preferred alternative from a biophysical and traffic management point of view is shown in the figure below.

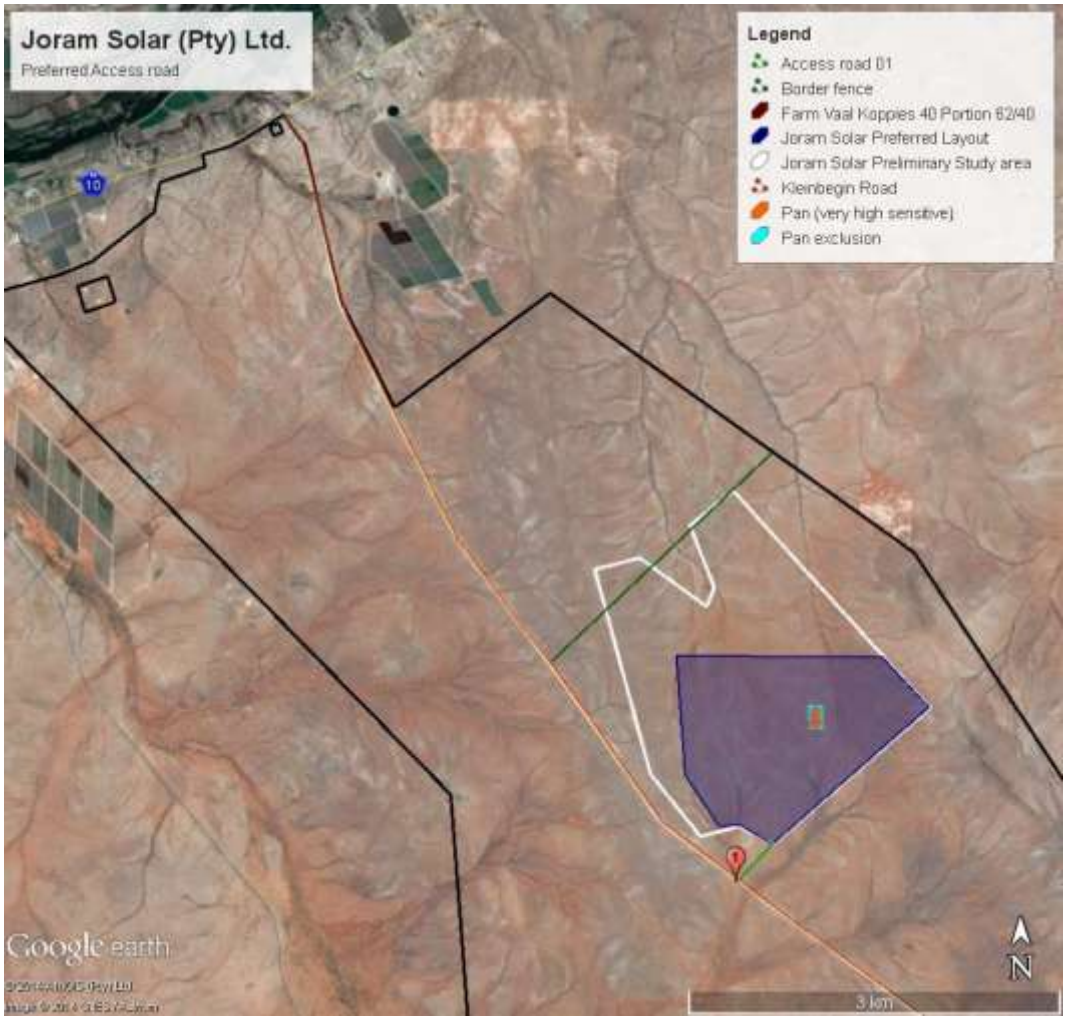

Figure 11: Preferred access road

4.3 GRID CONNECTION ALTERNATIVES

In the scoping phase several self-build and Loop in Loop out power line route alternatives were investigated. The distances of self-build power lines, upgrading of infrastructure (Keidebees Eskom substation) and servitude alternatives were all taken into account when determining the various grid connection alternatives.

During this environmental process the Ilanga Concentrated Solar Power (CSP) project received environmental authorisation. This Environmental Authorisation includes a Grid connection over the Joram Solar Property. The design and position of the Ilanga power line route has been finalised and as such, certain of the grid connections investigated during scoping phase are no longer viable.

Please note that the routes of power lines inside the study area have a number of options, but that the route options inside the study area could change during detailed design.

4.3.1 Loop-in Loop-out proposed Alternatives

The option to loop into the existing Gordonia Kleinbegin 132 kV line has been assessed as connection alternative from onsite substations 1, 2 and 3.

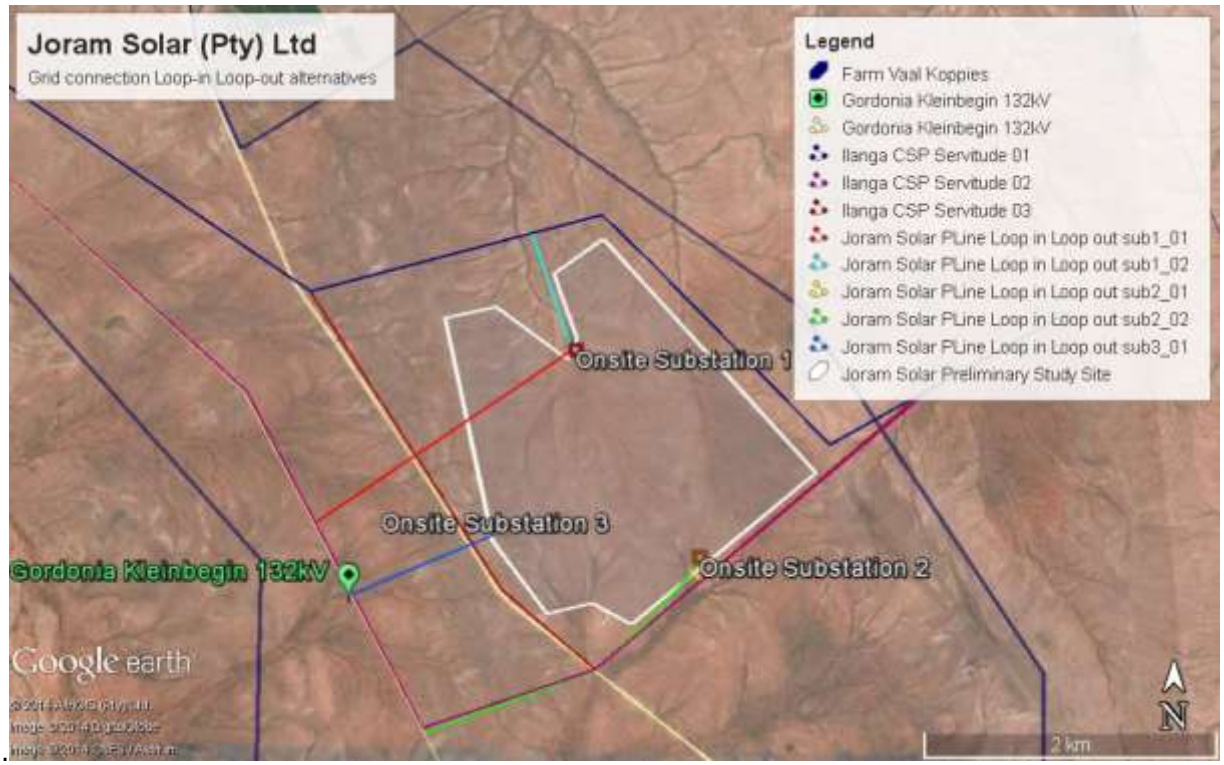

Figure 12: Power line Loop in Loop out alternatives

4.3.2 Self-build Alternatives

All the self-build power line alternatives as part of the scoping phase will follow their different routes up to location of the decommissioned Keidebees substation and will then run parallel the Gordonia Kleinbegin 132kV line connecting to Gordonia Eskom Substation.

The routes were all chosen along existing fences or power lines, in order to minimise the environmental impact. From a visual perspective, it has been determined that power line alternative 2 will not be acceptable. The environmental impact of the remaining alternatives are deemed to be similar.

The four self-build alternatives that have been assessed are illustrated in **Figure 13**.

4.3.3 Self-build Alternative 1

The proposed power line alternative option 1 "**Joram Solar PLine Selfbuild sub1_01**" runs along the east west border fence within the preliminary study site crossing the Kleinbegin road and runs north parallel the existing Gordonia Kleinbegin 132kV power line connecting to Gordonia Eskom Substation. The indicated self-build line connecting Keidebees will be investigated due to possible upgrading of infrastructure as part of Eskom planning specifically on the southern side of the Orange River.

4.3.4 Self-build Alternative 2

The proposed power line alternative option 2 "**Joram Solar PLine selfbuild sub1_02**" runs north to the proposed Ilanga CSP power line servitude 1 alternative and the follows this proposed line connecting to Gordonia Eskom Substation.

4.3.5 Self-build Alternative 3

The proposed power line alternative option 3 "**Joram Solar PLine Selfbuild sub1_03**" follows the same route of option 2, with the only difference of continuing up to the existing Gordonia Kleinbegin 132kV line and runs parallel this power line connecting to Gordonia Eskom Substation.

4.3.6 Self-build Alternative 4

The proposed power line alternative option 4 "**Joram Solar PLine Selfbuild sub3_01**" runs north from onsite substation 3 following the same route as self-build alternative 1 running parallel to the Gordonia Kleinbegin 132kV power line connecting to Gordonia Eskom Substation.

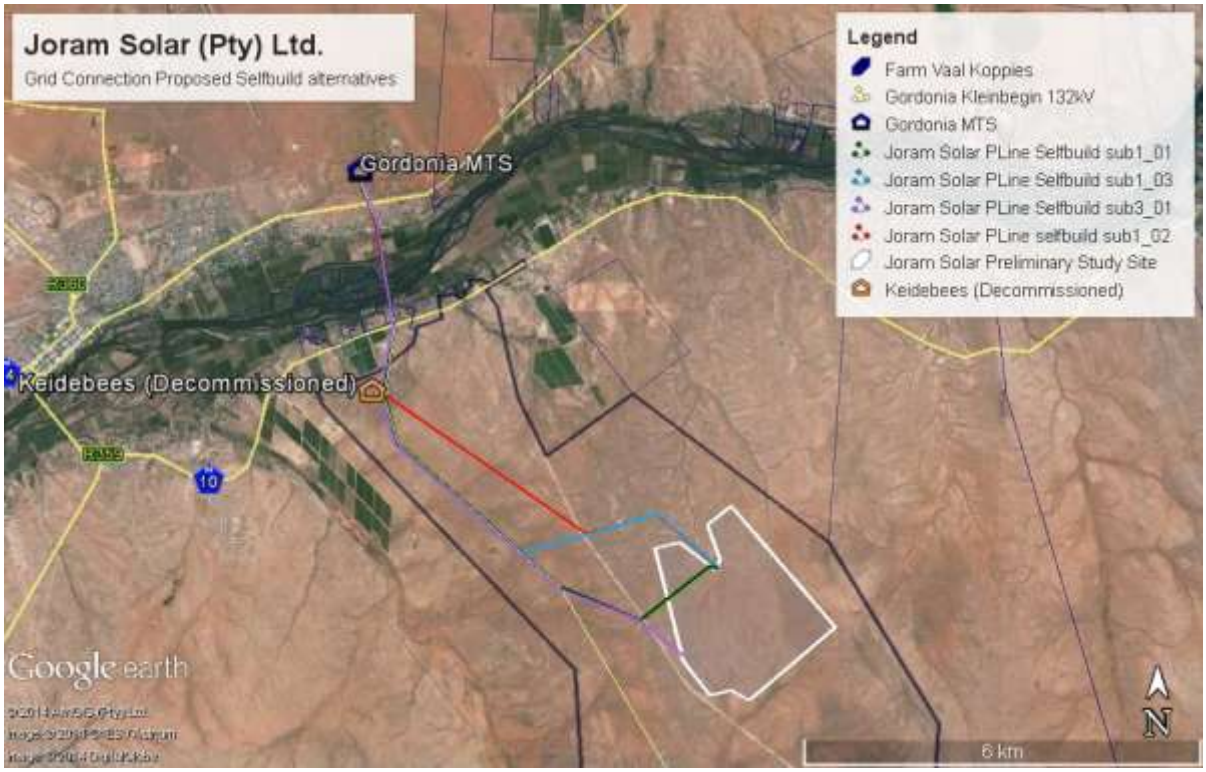

Figure 13: Grid Connection Self-build alternatives

The summarised grid connection alternatives and their distances from the onsite substation to the Gordonia Eskom substation or existing Gordonia Kleinbegin 132kV line is illustrated in Table 3 below.

Table 3: Grid connection alternative distances

Grid Connection Alternatives	**Distance (km)**
Loop in Loop out Alternatives	
Joram Solar PLine Loop in Loop out sub3_01	2.3

Grid Connection Alternatives	Distance (km)
Joram Solar PLine Loop in Loop out sub1_02	1
Joram Solar PLine Loop in Loop out sub2_01	0.2
Joram Solar PLine Loop in Loop out sub2_02	2.2
Joram Solar PLine Loop in Loop out sub3_01	1
Self-build Alternatives	
Joram Solar PLine Selfbuild sub1_01	10.8
Joram Solar PLine Selfbuild sub1_02	10.1
Joram Solar PLine Selfbuild sub1_03	10.6
Joram Solar PLine Selfbuild sub3_01	10.3

4.4 Preferred Grid Connection options

With regard to the selling of land north of the Preliminary study area as well as the finalization of the Ilanga CSP Power Line across the Joram Solar Preliminary study area, the preferred Layout and related grid connections have been altered. It should be noted that for the preferred grid connection options, the assessed routes from Gordonia substation to the Preliminary study site will be applicable.

The proposed substation positions have been changed due to the change of the Preferred Layout and the Ilanga Power line servitude route. The alternative self-build and Loop-in Loop out grid connections applicable to the new Preferred and Alternative facility layouts is illustrated in Figure 14.

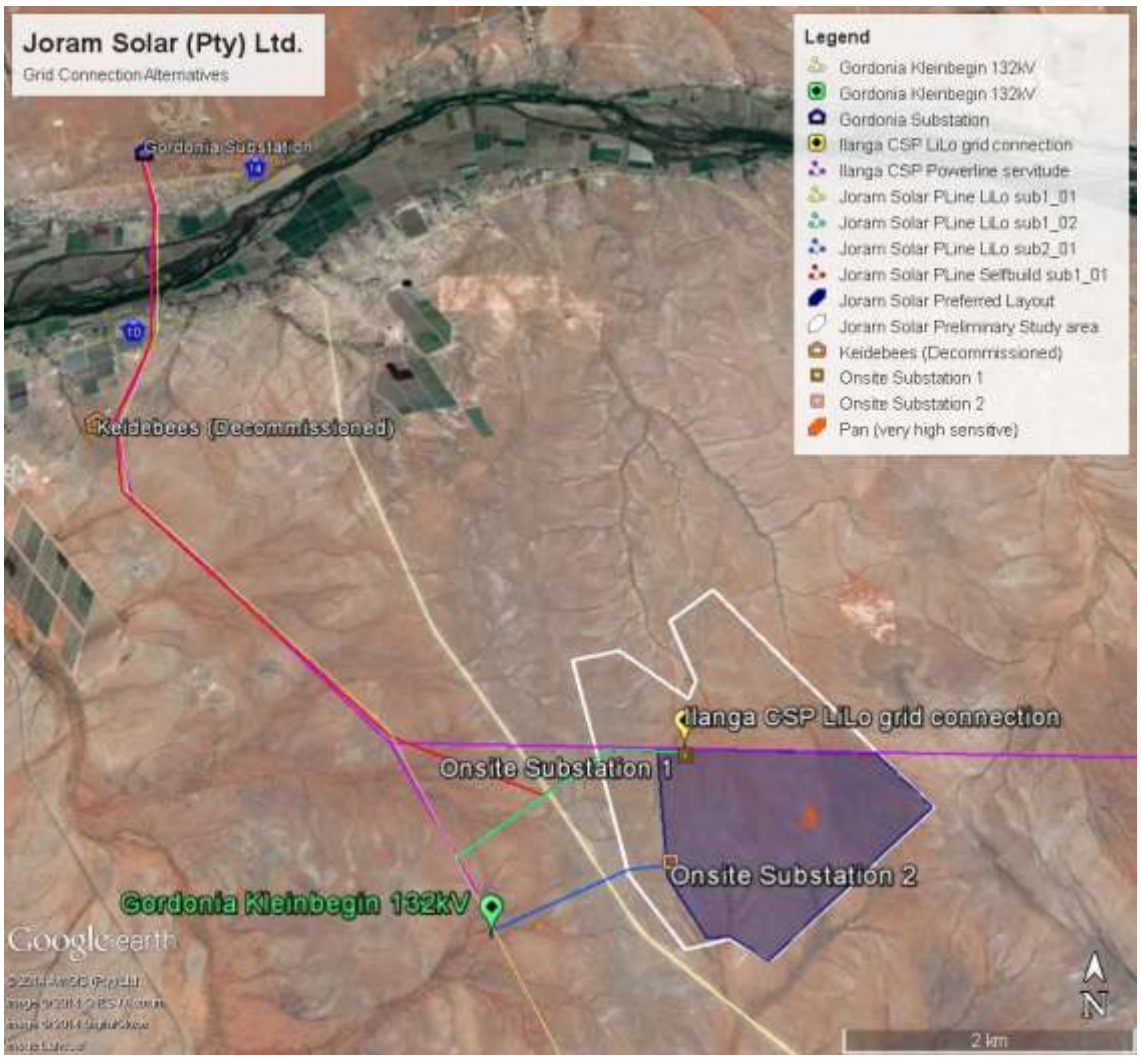

Figure 14: Applicable Grid Connection Alternatives

4.4.1 Preferred Loop-in Loop-out Grid Connection

The preferred Loop-in Loop-out grid connection will be from onsite substation 1 to the Ilanga CSP 132kV Power line.

4.4.2 Preferred Self-Build Grid Connection

The preferred Self build Grid connection will be from onsite substation 1 and will follow the route parallel of the Ilanga CSP Power line in a western direction up to the boundary of the preliminary study site where after following the assessed route along the Gordonia Kleinbegin 132kV line connecting to the Gordonia substation.

The preferred Grid connections options are illustrated in **Figure 15**.

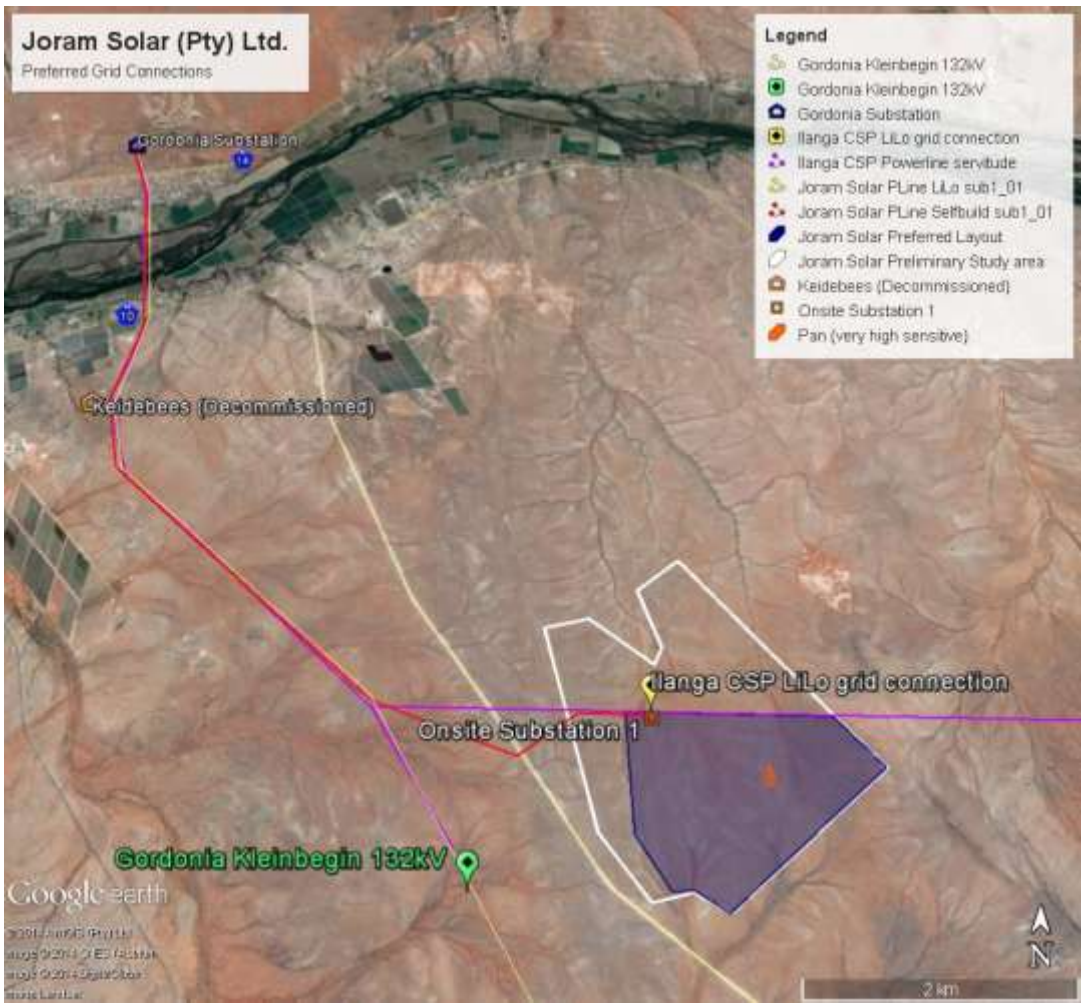

Figure 15: Preferred Grid Connection options

The specialist assessments and recommendations were taken into when deriving the preferred grid connection options (e.g. visual specialist recommendations of excluding self-build alternative 2). The pylons and access tracks under these grid connections may not be constructed within 32m of the edge of any watercourses.

Please refer to the table below for applicable distances for the preferred alternatives.

Table 4: Updated Grid connection alternatives

Grid Connection Alternatives	**Distance (km)**
Preferred Loop in Loop out Alternatives	
Joram Solar PLine LiLo sub1_01	0.1
Preferred Self-build Alternative	
Joram Solar PLine Selfbuild sub1_01	10.6

4.5 TECHNOLOGY ALTERNATIVES

The proposed development area will make use of Solar PV or Solar CPV technology. The option of constructing a Concentrated Solar Power (CSP) facility is not considered or assessed within this application.

Two technology alternatives for PV solar facilities have also been considered for this application. An overview of the two PV technologies as well as a summary of their advantages and disadvantages is discussed below.

4.5.1 PV alternative T1: concentrated photovoltaic solar facility (CPV)

CPV technology differs from conventional photovoltaic systems (PV) in that the CPV modules use different solar cells and include **lenses** which **focus light energy** in a more concentrated manner, hence harvesting more energy from the sun. The efficiency of the cells provides benefits relating to capacity per module and reduced spatial requirements and usage. CPV technology systems are much higher than conventional PV technology, with the system reaching a **maximum height** of approximately **10 m**. In some cases CPV installations can require a higher amount of water for cooling, unlike PV panels which only require water for cleaning purposes. However, there are **alternative dry cooling methods** that do not required additional water..

4.5.2 PV Alternative T2: Photovoltaic Solar facility (PV)

Photovoltaic solar power is **solar energy** that is converted into electricity using **photovoltaic solar cells**. The captured light moves along a circuit from positive-type semiconductors to negative-type semiconductors in order to create electric voltage. Semiconductors only conduct electricity when exposed to light, as opposed to conductors, which always conduct electricity, and insulators, which never conduct electricity.

Power is collected through a structure comprised of **many solar cells**, usually a solar power panel (also called a PV module). PV modules/solar panels can be combined into an “array” of panels in order to capture a greater amount of solar energy. PV solar panels can either be fixed (rows of tables) or they can be constructed on a single or double axis tracking system. Such a system will use sun sensors to follow the movements of the sun. With the double axis tracking system the sun can be tracked on more than one axis allowing the maximum radiation over the entire solar module.

The fixed tilt solar technology (table installations of rows) is the less expensive option but it has a much lower energy yield than the axis tracking system (free standing panel installation).

4.5.3 Summary of environmental advantages and disadvantages of CPV and PV technology

The following table depicts the different advantages and disadvantages correlated to PV and CPV technology.

Table 5: Technology comparison between PV and CPV technology.

	CPV	**PV**
Advantages	• Takes up less surface area therefore “footprint” is less, resulting in less impact on soil, agriculture and biodiversity. • More energy can be produced per module. • Because the modules are higher and spread out, the ground in between and under the modules are exposed to more sunlight,	• Lower visual impact (range between 2 m and 5 m in height). • Lower impact on birds due to lower height. • Lower impact on bats due to lower height. • Easier to erect PV technology. • Lower impact on heritage/ culture due to lower impact on

	allowing vegetation to grow back easier after construction.	landscape of visual impacts. • Easier to transport.
Disadvantages	• Higher visual impact, CPV systems can be up to 10 m high. • Higher impact on birds. • Higher impact on bats. • Requires skilled labour because more difficult to erect. • CPV systems utilises more water than conventional PV. • Higher cultural/ historic impact to the landscape. • Harder to transport – abnormal load.	• PV facilities of the same footprint of CPV facilities produce less power. • The tightly packed PV arrays allow little sunlight through, which can cause the vegetation to grow back slower.

The industry is changing very quickly in terms of PV technology types and associated costs. Constraining the project to a particular technology at this stage could be detrimental towards the viability of the project in the light of what will be realistic to construct in 2-3 years from now. This environmental process is thus considering both these technologies at potential options for implementation considering a maximum footprint and height.

4.5.4 Mounting and film alternatives

PV solar power technology has been identified as the preferred technology to generate electricity in this project. There are, however, several alternatives in terms of the specific solar PV technology to be used. These alternatives can be grouped in terms of mounting and film alternatives but should not trigger any major difference in the impact of the project as explained in this report.

Mounting alternatives

There are two major alternatives in terms of solar PV mounting, namely **fixed-tilt** and **tracker mounting technology**. The following figure depicts the two mounting alternatives.

Plate 1: Examples of various mounting alternatives (Solek, 2014)

When **fixed-tilt** solar mounting technology is considered, the solar PV modules are fixed to the ground and do not contain any moving parts. These modules are fixed at a specific north facing angle. This type of technology is **less expensive** than tracker technology, but it has a **lower energy yield** due to the limited exposure to sun radiation.

The preferred technology type is known as **horizontal tracker technology**. This technology is designed to follow the path of the sun across the sky. By using this technology, the modules are exposed to typically 25% more radiation than fixed systems. The design is extremely robust and contains only a few moving parts. It also has more or less the same footprint and infrastructure

requirements than that of fixed-tilt designs. The tracker requires approximately **1.8 to 2.3 hectares per megawatt**. The tracking design is based on a simple design and makes use of a well proven off-the-shelve technology that is readily available. If conventional PV modules are used, the maximum height of the trackers is typically less than 2 m, but as previously stated, the CPV trackers are much higher, reaching a maximum height of approximately 10 m. The panels will most probably be mounted on either a single axis or a dual axis tracking system, both of which have a similar impact.

It must be noted that the mounting technology is **unlikely to affect the significance of environmental impacts** and as such **all the mounting technologies** described above are under **consideration.**

Film Alternatives

There are a multitude of different film technologies available within the market. The best solution, according to research conducted, are either thin film (amorphous silicon or cadmium telluride) or -crystalline cells (mono- or poly-crystalline) depending on the space and irradiance of local conditions.

The **film technology will not affect the significance of environmental impacts** and as such all film alternatives are being considered in this environmental process.

4.6 THE NO-GO ALTERNATIVE

The Status Quo Alternative proposes that the Joram Solar Development not go ahead and that the area in proximity to the Gordonia substation remain undeveloped as it is currently. The land on which the proposed project is proposed is currently vacant. It is currently used for limited cattle grazing activities, however due to a combination of poor soil quality, water scarcity and extreme climatic conditions, it has no potential for irrigated crop cultivation. The area in question is also considered too small to generate noteworthy financial benefit from agricultural activities due to its low carrying capacity.

The solar-power generation potential of the Northern Cape area, particularly in proximity to the existing Eskom infrastructure is significant and will persist should the no-go option be taken.

The 'No-go/Status Quo' alternative will limit the potential associated with the land and the area as a whole for ensuring energy security locally, as well as the meeting of renewable energy targets on a provincial and national scale. Should the 'do-nothing' alternative be considered, the positive impacts associated with the solar facility (increased revenue for the farmer, local employment and generation of electricity from a renewable resource) will not be realised.

The no-go alternative is thus not considered a favourable option in light of the benefits associated with the proposed solar facility development, however it will be used as a baseline from which to determine the level and significance of potential impacts associated with the proposed solar development during the Impact Assessment phase of the on-going environmental process.

5 TECHNICAL CONSIDERATIONS

The following details were drawn from the **Engineering Report** (Solek, 2014), attached in **Annexure D4**.

5.1 OVERVIEW OF THE PROPOSED PROJECT

The proposed solar development aligns with the planned generation development by the Department of Energy, under the REIPPP program and the IRP 2010 plans.

The proposed facility is planned and designed for the generation of approximately 75 MW. The developed electricity of this project will be fed into the national electricity grid. The proposed development site covers an area of approximately 200 - 220 hectares, although an initial preliminary study site of 450ha has been considered). The area is located approximately 10 km from the existing Gordonia Substation and in close proximity to the existing Gordonia Kleinbegin 132 KV powerline.

5.2 SOLAR ENERGY AS A POWER GENERATION TECHNOLOGY

5.2.1 Basic understanding of solar PV plants

Photovoltaic (PV) panels convert the energy delivered by the sun to direct current (DC) electric energy. The array of panels is connected to an inverter by means of a network of cables. The DC power is inverted to alternating current (AC) power by a grid-tied inverter. The AC power can then be added to the national electricity network (grid). The voltage at which power is generated is stepped up to the required voltage and frequency of the national grid by using a transformer. The electricity is distributed from the on-site transformers via distribution lines to the nearest Eskom substation. From the Eskom substation the electricity is fed into the Eskom grid.

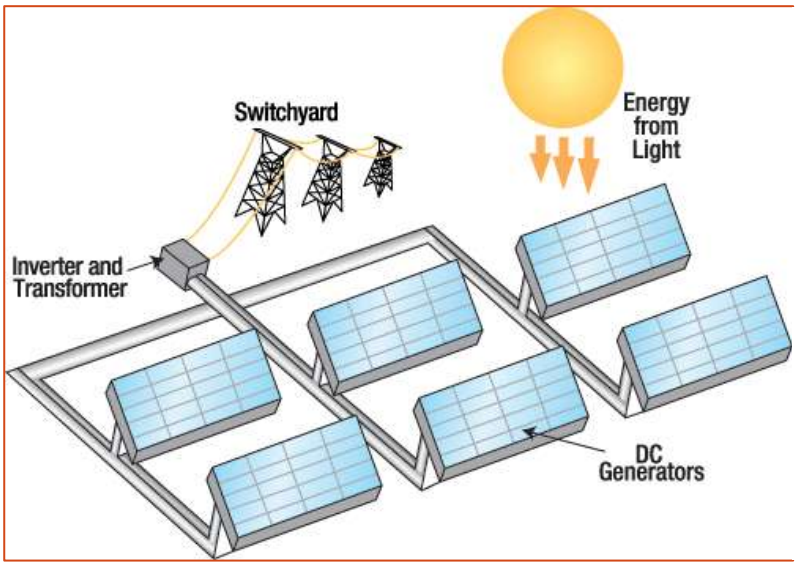

Figure 16: Schematic depiction of a photovoltaic energy generation facility (Solek, 2014)

The **infrastructure** of the facility includes the ground-mounted structures, **panels**, **cables**, **inverter rooms**, **access roads**, **auxiliary roads**, an **on-site substation**, and a **distribution line**.

The primary input of the system is sunlight, which is converted to electricity. In the case of sun tracker technology the facility may also utilise auxiliary electricity from the Eskom grid to power tracker motors in order to optimise the amount of sunlight on the solar PV infrastructure. In addition to auxiliary power being used for powering tracker motors, small amounts of auxiliary power would be used for on-site usage on items such as, but not limited to, security and site office energy requirements.

Installing either a fixed or dual tracking PV system (CPV modules or arrays of PV panels) is proposed. In a fixed system, the PV modules stay in one position, and do not follow the path of the sun. A tracking system is ground-mounted and follows the sun's path with the use of typically single or dual-axis technology in order to maximise the amount of direct sunlight on the Solar PV

modules. By following the sun, the tracked array rises quickly to full power and stays there on a clear sunny day, while the fixed array only maintains maximum power for a few hours in the middle of the day.

5.3 TECHNICAL DESCRIPTION OF THE PROPOSED SOLAR FACILITY

The proposed facility has a planned peak capacity of 75 MW_p. with an estimated footprint between 200 and 220ha. The initial study area of 450ha has been identified as the initial study site that will be investigated by the specialists as part of their baseline studies. The footprint of the study site is larger than what is physically required for the proposed development, so as to ensure ample development space are available after potential environmental sensitive areas are excluded, based on specialist studies and recommendations.

5.3.1 Site development components

The final design will consist of different components. A typical description of the components is listed below. For further details please refer to the Layout Report attached in **Appendix C** as well as the Technical Report attached in **Annexure D4**.

5.3.1.1 Position of solar facilities

The final exact position of the solar **PV** or **CPV** module layout will follow a **risk-averse approach** and be determined by the recommendations of the participating specialists in order to avoid all sensitive areas in the positioning of the facility. In addition, the final layout will be influenced by the final detail design of the project once a tender has been awarded (preferred bidder status has been awarded by the Department of Energy to the project). The footprint of the 75 MW will be located on a proposed site area of 200 - 220 ha, within a preliminarily investigated area of 450ha. The final footprint of the facility is expected to be closer to 200ha, effectively allowing land area to be excluded as sensitive area should this be required.

The following figure depicts a typical layout of PV modules for the two types of PV technology.

Plate 2: Showing typical examples of PV arrays (left) and CPV modules (right) (Solek, 2014)

5.3.1.2 Foundation footprint

The physical footprint of the PV/CPV modules on the ground is formed by a **network** of **vertical poles** (typically 100 mm in diameter), on which the modules are to be mounted (see examples below). The following figure depicts the typical foundation and substructures unto which the frames and PV modules are mounted.

Plate 3: Showing typical foundation structures for mounting of PV panels (Solek, 2014)

Different methods are used to mount the modules to the ground. The **exact mounting structure** choice will be influenced by the **pricing**, **geotechnical properties** and **technology** at the time of construction.

Some of the methods include basic **drilling** or **hammering** with specific tools. The physical process of **ramming** the anchors into the ground is done using special equipment (typically on tracks). In the case where **earth screws** or **rock anchors** would be more suitable, the rammed pole would be replaced by one of the former. Some of the ground covering in the medium sensitivity area will be cleared to do the frame installation accurately. Although the site is very flat, some **minor excavation** may be necessary in certain **medium sensitivity areas** (as defined by Todd, 2014). The modules can also be mounted to the ground in small **concrete foundation blocks**; usage of concrete foundation will be limited as far as possible (function of geology and other requirements). Removal of such foundations is possible upon de-commissioning of the project.

5.3.1.3 Module height

The PV panel arrays have an approximate height of 3.5 m, whereas the CPV modules have a height of 10m. A **maximum height** of **10 m** will be considered and assessed in the Environmental Impact Assessment Process. This will allow for flexibility to technology changes in the industry. The maximum height listed here is only a precautionary description due to foreseeable future changes in technology. This maximum height of 10 m will be considered by the visual specialist.

5.3.1.4 Solar Panel Area

The solar arrays are put together with strings of **solar modules** connected in series, which can be **fixed** or mounted onto **single** or **double** axis **tracking systems**. These frames are typically installed with the single tracking axis in an east-west direction to maximise the system's output. The standardised length of a solar array would typically be between **50m** and **200m** long. Where a tracker system is used, each of the modules is controlled individually and standardised systems are preferred for economic and practical reasons. The solar modules will be placed in such a way that it would have the least influence on the washes and avoiding the ecological boundaries set where practically possible.

5.3.1.5 Access road to site

An access road of approximately **6m wide** will be required for the facility. The access road alternatives are discussed in more detail under the section dealing with **consideration of alternatives** as well as in **Appendix C** and **Annexure D4** attached.

5.3.1.6 Internal roads indication width

Gravelled internal roads and un-surfaced access tracks are to be provided for. Such access tracks (typically < 6 m wide and limited to the construction site) will form part of the development footprint. Pathways (typically <6 m wide) between the PV/CPV module layout will typically also be provided for to make the cleaning and maintenance of the panels possible. Existing roads will be used as far as possible.

Plate 4: Showing typical example of internal access tracks (Solek, 2014)

5.3.1.7 Inverter Rooms

The DC cabling from the module strings will be connected to the inverters that will be housed within inverter rooms located at specific areas as per solar PV design layouts and cabling diagrams. The footprint of an inverter room will be approximately 56m² (4m x 14m) and height of 3m.

Plate 5: Typical example of inverter room (Solek, 2014)

5.3.1.8 On-site substations and transformers

The step-up substation and its associated infrastructure and internal roads should have a footprint of approximately 0.04 ha (20 m x 20 m). Note that the 0.04 ha is an estimate and included in the entire building footprint of typically < 1 ha.

Plate 6: Typical example of on-site substation (Solek, 2014)

5.3.1.9 Cable routes and trench dimensions

Shallow trenches for electric cables will be required to connect the PV/CPV modules to the on-site substation (such electric cables are planned along internal roads and/or along pathways between the PV/CPV modules).

Plate 7: Typical example of internal cable trenching (Solek, 2014)

5.3.1.10 Connection routes to the distribution/transmission network

Electricity will be transmitted from the **on-site step-up substation** via a **new overhead power line** to either the **existing 132kV** Gordonia Kleinbegin powerline or via an own-built line to the existing Gordonia Substation. A number of possible connection routes are investigated in this environmental process. The final preferred route will be subject to the negotiations with the neighbouring farmers and the recommendation of the participating specialists.

5.3.1.11 Security fence

A **perimeter security fence** will be constructed around the solar park with a guarded security point. The perimeter security fence is envisioned to include security cameras as well as related and **required infrastructure** (such as cabling, central monitoring etc). Note that energy supply towards this required security infrastructure is envisioned to be obtained from the auxiliary power supply.

5.3.1.12 Cut and fill areas

As far as possible, any **cut and fill** activity along the access roads will be **avoided**. The majority of the proposed access roads are currently being used by construction vehicles and should not need any alternation. Where alternations might be necessary, input from civil construction engineers will be sourced regarding the cut and fill aspects.

5.3.1.13 Borrow pits

As far as possible, the creation of **borrow pits** will also be **avoided.** The current **EIA application does not make provision for new borrow pits**. Should new borrow pits be required on the property, these will have to be licenced/authorised in terms of the Minerals and Petroleum Resources Development Act and the National Environmental Management Act. To avoid this process a licenced borrow pit in the area would rather be used.

5.3.1.14 Soil heaps

As far as possible, the creation of **permanent soil heaps** will be **avoided**. All topsoil removed for the purpose of digging foundations are to be separately stockpiled within the boundaries of the 220 ha development footprint, for later rehabilitation. It is unlikely that major soil heaps will be required for this construction site.

5.3.1.15 Auxiliary buildings (Laydown area)

The auxiliary buildings area will typically include:

- A workshop area
- A storeroom area
- A change and ablution room area
- An administrative and security building
- 10 x 10 kl water tanks

The **infrastructure** for the **auxiliary buildings** should occupy approximately **2 ha**. The **workshop** will be used for general maintenance of parts, etc. and will typically be **20m x 40m**. The **storeroom** will be used for the storage of small equipment and parts and will typically be **20m x 30m**. The change and **ablution facilities** will be very basic and will include toilets, basins and a change area. The administrative and security building will be used as an on-site office and will have a footprint of typically **10m x 10m**.

5.4 WATER RELATED ITEMS

The following section contains discussions pertaining to water, the volumes and seasonality of the project requirements, the sources available, the infrastructure pertaining to water usage, the legislative approvals required for water usage and the corresponding environmental impact risks thereof. Please refer to the Engineering report attached in **Annexure D4**.

1.1.1 Water requirements

The project requires about **8 litres** of water **per panel per annum** for the purposes of construction and maintenance (cleaning of the panels). The capacity of the panels that will be used will therefore determine how much water will be required for a 75 MW plant. If a 250 Watt panel is used, a 75 MW plant will consist of more or less 300 000 panels, which will roughly calculate to 6.6-8 kl of water required per day (**2400-2900 m^3/annum**). The 10 kl capacity tanks will be placed on site in order to store 100 000 litres of water at any given time, effectively providing a storage capacity of two to three days of cleaning water supply.

The water distribution system will distribute water from the ten 10 kl water tanks to a high pressure hose and on to the solar panels. The proposed activity is not a “water intensive activity” (as opposed to CSP technology). Only a limited amount of water is required in low rainfall periods to clean the modules once every quarter so that they can operate at maximum capacity. **No chemicals will be used to clean the panels, only water.**

Weather conditions, traffic and general dustiness at the site play a role in the exact amount of water required to clean the solar PV panels. At present it is assumed that each panel should be washed once every three months.

To further reduce the use of water at the solar facility, the **use of alternative panel cleaning methods is also being investigated**. The most feasible technology under consideration uses compressed air to blow off any debris from the panel's surface. At this stage the technology is being tested and needs refinement before it would be commercially viable. Other cleaning options are currently under development where rotating rubber-based waterless cleaning is used. Cleaning technologies are improving over time and it is expected that more innovative cleaning technology will be developed, further reducing or eliminating water requirements although these are not as yet fully commercially proven.

The development is expected to apply for a water use licence, from the Department of Water Affairs, as part of the development process. A water use licence is expected to be required for any water extraction (boreholes, rivers or channels) or for crossing river beds/washers. The requirements to apply for a water use licence are expected to be confirmed and directed by the appropriate specialists.

5.4.1 Water sources

There are a number of different water sources which can be further investigated to supply water for the project. The following section investigation these options.

5.4.1.1 Boreholes:

The preferred water sources are the existing boreholes on the proposed farm. One borehole has been identified on the farm situated near the proposed site. This borehole is seen as a possible water option for the facility. The small volumes of water required for washing the solar PV modules and for general operational purposes (maximum expected usage of 3'000 m^3/annum) are expected to be sourced from these boreholes. According to the farmer the boreholes are strong enough and the water they supply is drinking water quality.

A full pump-test is expected to be done after preferred-bidder status in order to confirm sufficient water supply potential from the borehole; this will further confirm water availability.

Depending on where on the final design the water tanks will be located, the water from the boreholes will probably be pumped to the water tanks through a pipeline. The pipe diameter will be approximately 50mm-150mm. The pipeline will be laid on the ground, or just below the ground by means of manual excavation. The water pipeline should not result in any additional environmental impacts outside of the main construction area.

Borehole pump tests and corresponding confirmation of water availability is expected to be conducted after preferred bidder status.

5.4.1.2 Khara Hais Garib municipality (alternative supply)

Permission to use water directly from the nearest town, Upington, will be sought from the Khara Hais Municipality. This water will also have to be transported by trucks to the proposed site. This will be seen as the last alternative as transport costs will be significantly higher compared to the other two options. The usage of municipal water can reduce the requirement of obtaining a water use licence from the Department of Water Affairs in terms of the extraction of water from resources such as groundwater or rivers.

5.4.1.3 Rainwater

As an additional measure, PVC rainwater tanks could also be placed alongside the on-site buildings to collect the rainwater runoff from the roof. These PVC tanks will then form part of the water storage tanks. If necessary, measures can also be put in place to capture the rainwater runoff from the PV modules.

5.4.2 Water buffer

Water storing infrastructure is to be provided as part of the auxiliary building footprint area. Storing capacity for two weeks are planned to be provided for. This will add up to ten x 10 kl water tanks. These tanks will be supplemented by rainwater capture from the auxiliary building.

5.4.3 Water-use permission

Solek Renewable Energy Engineers are in the Process of submitting the relevant Water Use Licence Applications (WULA) to the Department of Water Affairs.

5.5 EROSION AND STORM WATER CONTROL

Solek renewable Energy Engineers developed a stormwater management plan for the proposed Joram Solar Development from which the following is drawn. Please refer to Annexure D8 of the report for a full copy of the Stormwater Management Plan.

The scope of the stormwater management plan includes consideration of the following:

- Geology, climate and rainfall.
- Existing drainage lines and natural direction of water flow.
- Water usage, storage and water drainage.
- Determine catchment area at the proposed project facility.
- Calculate storm water coefficient.
- Water drainage designs to mitigate risk of erosion and support natural water flow direction.

5.5.1 Climate and rainfall

As confirmed by the agricultural specialist, the climate statistics for the Joram study site are as follows.

Table 6: Climate statistics at Joram site location

Rainfall	
Annual rainfall 0-200 mm	0-200mm
Summer rainfall <62.5 mm	>62.5mm
Winter rainfall <62.5 mm	<62.5 mm
Variation in rainfall 40 to 50%	10 – 50%
Temperature	

Mean maximum temperature	31 to 33^{0}C
Mean minimum temperature	Minus 2^{0}C
First frost expected	01 to 10 May
Last frost expected	11 to 20 September
Hours of sunshine	>80%
Evaporation	2200 2400 mm

The Mean Annual Precipitation (MAP) for the area at Upington is 163mm. Based on supplementary information received the following information is applicable to the stormwater management plan:

- Upington collects an average of 159 mm of rainfall per year, or 13.25 mm per month (should the rainfall be equally distributed over the year).
- The driest weather is in October when an average of 0 mm of rainfall (precipitation) occurs.
- The wettest weather is in February when an average of 36 mm of rainfall (precipitation) occurs.

The average rainfall figures for Upington region is illustrated in Table 7.

Table 7: Average monthly rainfall figures (Upington area)

	Jan.	Feb.	Mar.	Apr.	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.
Average Precipitation (mm)	24	36	35	26	10	4	2	4	0	1	17

The corresponding rainfall figure for Upington area as depicted in the table above is depicted in **Figure 17**.

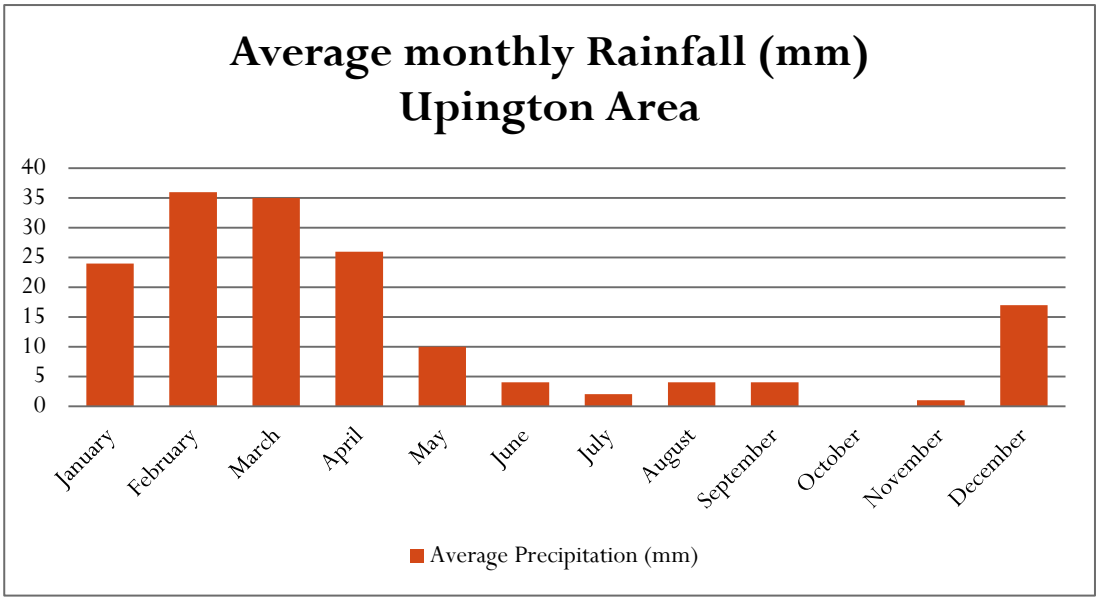

Figure 17: Average monthly rainfall within the Upington region.

Both the table and figure clearly depict the seasonality of the precipitation in the Upington region. Notably 93% of precipitation occurs within five months of the year (December and April) with an average of 31mm per month of precipitation during these five months (equally distributed over these months).

5.5.2 Existing Drainage and seasonal washes characteristics

Figure 18 below depicts the proposed Joram Solar site layout and further illustrates the drainage lines and seasonal washes direction of water flow in the area.

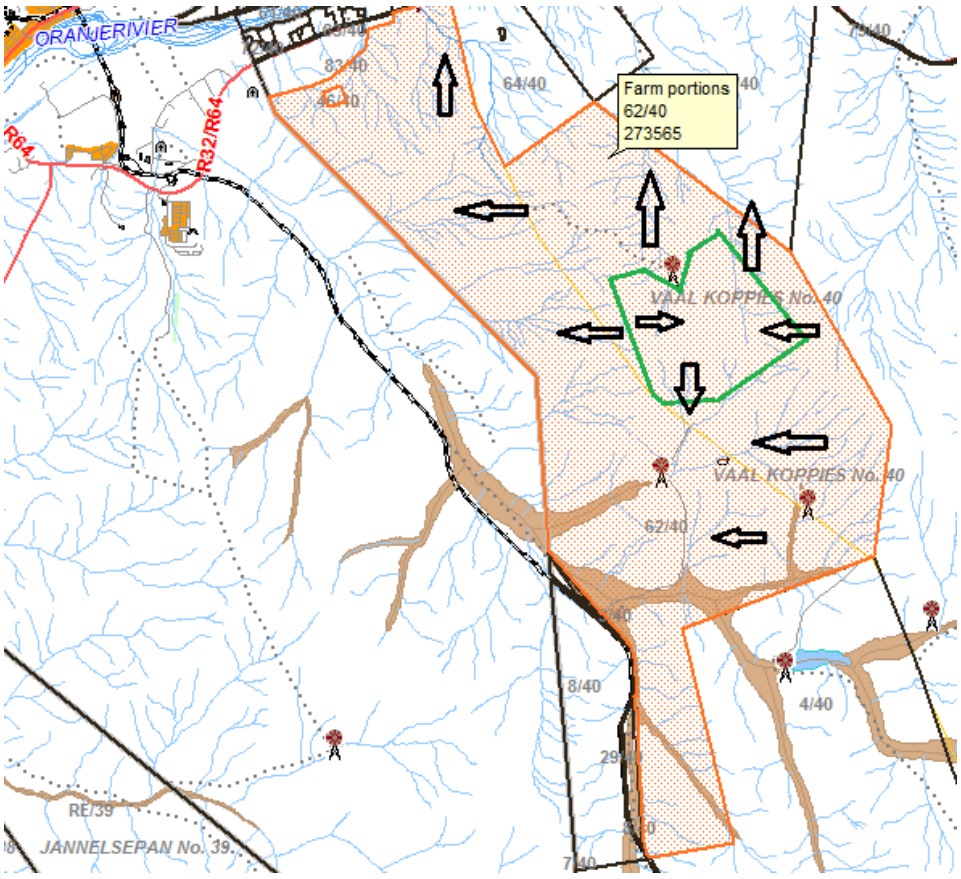

Figure 18: Water drainage characteristics of the Joram Solar Development

The appointed agricultural specialist describes the soil characteristics in terms of its water absorption and drainage characteristics within the agricultural study as follows:

- Freely drained, structure less soils may occur.
- Soils may have favourable physical properties.
- Soils may also have restricted depth, excessive drainage, high erode-ability and low natural fertility.

The soil characteristics together with the corresponding low amount of vegetation have a high erode-ability factor. The combination of low annual precipitation, flat gradients of the site and permeability of the soils are however factors which significantly reduces the associated erosion risk.

5.5.3 Drainage Patterns

The drainage patterns for the proposed PV facility layout as per topographical data are illustrated in **Figure 18**. The estimated catchment areas within the preliminary study site layout have been illustrated in **Figure 19**, as indicated below. The washes located within the named and identified catchment area is fed by the indicated catchment area.

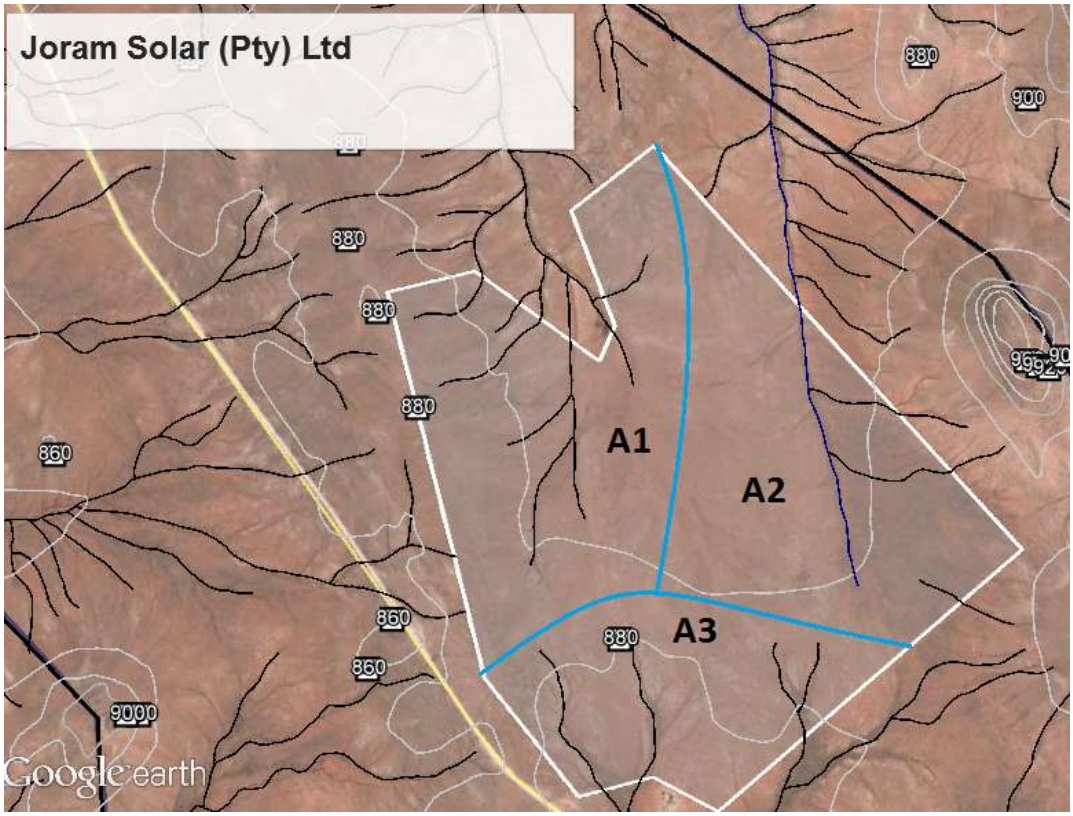

Figure 19: Catchment areas within the study area.

Each of the identified and in catchment areas is quantified in area within Table 8, as illustrated below.

Table 8: Water catchment area – size quantification

Catchment Area	Area (km²)	Area (ha)
A1	1.9	190
A2	1.7	170
A3	0.9	90

5.5.4 Drainage area and access roads

The access road to the proposed site will be from the Kleinbegin road, which is a district gravel road. Upgrading of the existing entrance (preferred site access road) to the site is recommended. Provision for drainage at the site access road from the Kleinbegin road will be done according to regulations and recommendations as described in the Transportation and traffic management plan.

Due to the fact that the site is situated adjacent to the existing district gravel road, no additional drainage provisions to that of upgrading the existing entrance, is expected to be required.

5.5.5 Storm water calculation

The rational method for calculating surface runoff is used within this storm water calculation portion of the report. The rational method makes use of three input parameters to derive the surface runoff rate. These input parameters include the drainage area (hectares), the runoff coefficient (factor of the storm intensity) and the rainfall intensity (mm/hour). The following formula portrays the relationship between these input parameters and the peak flow:

$$Q = (\frac{CIA}{3.6})$$

Where: $Q = peak\ flow\ \left(\frac{m3}{s}\right)$;

$C = run - off\ coefficient$;

$I = average\ rainfall\ intensity\ over\ catchment\ \left(\frac{mm}{hour}\right)$

$A = effective\ area\ of\ catchment\ (km2)$

In this section of the report this three input parameters will be discussed and derived in order to ultimately calculate the surface runoff rate.

5.5.6 Drainage area and runoff coefficient

As discussed in the previous section the proposed site footprint was divided into three areas according to the watershed of the area, portrayed in the catchment area (**Figure 19**). Each of these catchment areas feeds the washes within the identified area. The drainage areas for the three identified areas are summarised in the **Table 8**.

The runoff coefficient is a combination of the surface slope (C_s), Permeability (C_p) and Vegatation (C_v). The total runoff coefficient used by SANRAL within their developed Drainage Manual (Drainage Manual, 5th edition, SANRAL) is indicated in **Table 11** below.

Table 9: Recommended run-off factor values (SANRAL Drainage Manual, 5th edition)

Rural (C_1)					Urban (C_2)	
Component	Classification	Mean annual rainfall (mm)			Use	Factor
		< 600	600 - 900	> 900		
Surface slope (C_s)	Vleis and pans (<3%)	0,01	0,03	0,05	*Lawns*	
	Flat areas (3 to 10%)	0,06	0,08	0,11	- Sandy, flat (<2%)	0,05 - 0,10
	Hilly (10 to 30%)	0,12	0,16	0,20	- Sandy, steep (>7%)	0,15 – 0,20
	Steep areas (>30%)	0,22	0,26	0,30	- Heavy soil, flat (<2%)	0,13 – 0,17
					- Heavy soil, steep (>7%)	0,25 – 0,35
Permeability (C_p)	Very permeable	0,03	0,04	0,05	*Residential areas*	
	Permeable	0,06	0,08	0,10	- Houses	0,30 – 0,50
	Semi-permeable	0,12	0,16	0,20	- Flats	0,50 – 0,70
	Impermeable	0,21	0,26	0,30		
					Industry	
					- Light industry	0,50 – 0,80
Vegetation (C_v)	Thick bush and plantation	0,03	0,04	0,05	- Heavy industry	0,60 – 0,90
	Light bush and farm lands	0,07	0,11	0,15	*Business*	
					- City centre	0,70 – 0,95
	Grasslands	0,17	0,21	0,25	- Suburban	0,50 – 0,70
	No vegetation	0,26	0,28	0,30	- Streets	0,70 – 0,95
					- Maximum flood	1,00

There is however a difference between rainfall and run-off due to saturation of the ground. Depending on the slope and the permeability of the land an adjustment factor (Ft) needs to be incorporated. The return period influences the adjustment factor. Normally a 1:20 year return period is reduces the risk, but for the purpose of a higher damage risk mitigation a 1:50 year return period was used.

The adjustment factor used by SANRAL within their developed Drainage Manual (Drainage Manual, 5th edition, SANRAL) is indicated in **Table 10** below.

Table 10: Adjustment factor for the runoff coefficient

Return period (years)	2	5	10	20	50	100
Factor (Ft) for steep and impermeable catchments	0,75	0,80	0,85	0,90	0,95	1,00
Factor (Ft) for flat and permeable catchments	0,50	0,55	0,60	0,67	0,83	1,00

The rainfall in Upington area are well below the indicated 600mm/annum with a permeability of between very permeable (gravel, coarse sand type) and permeable (sandy, sandy loam). The total runoff coefficient therefore is derived according to the above SANRAL drainage guide as follow:

$$C1 = Ft\ (Cs + Cp + Cv)$$

$$C1 = 0.67\ (0.01 + 0.05 + 0.26)$$

$$C1 = 0.2144$$

The runoff coefficient can be calculated with a second method which is further explored in order to verify the derived value above (derived according to the SANRAL drainage manual). The second method derives the runoff coefficient by utilising the hydrological soil group classification and the slope of the land. According to R.E. Schulze et al (2012, “Mapping Hydrological Soil Groups over South Africa”) no detailed map of hydrological soil group classification existed prior to their work.

Prior to their developed hydrological soil group map of South Africa hydrological soil groups could only be derived by an “in-depth knowledge of South Africa’s agricultural based soil classifications or from fieldwork”.

Shulze et al 2012 derived a hydrological soil classification map enables users to readily identify hydrological soil types according to these maps. **Figure 20** depicts this SCS hydrological soil group map of South Africa, as developed by Shulze et al (2012).

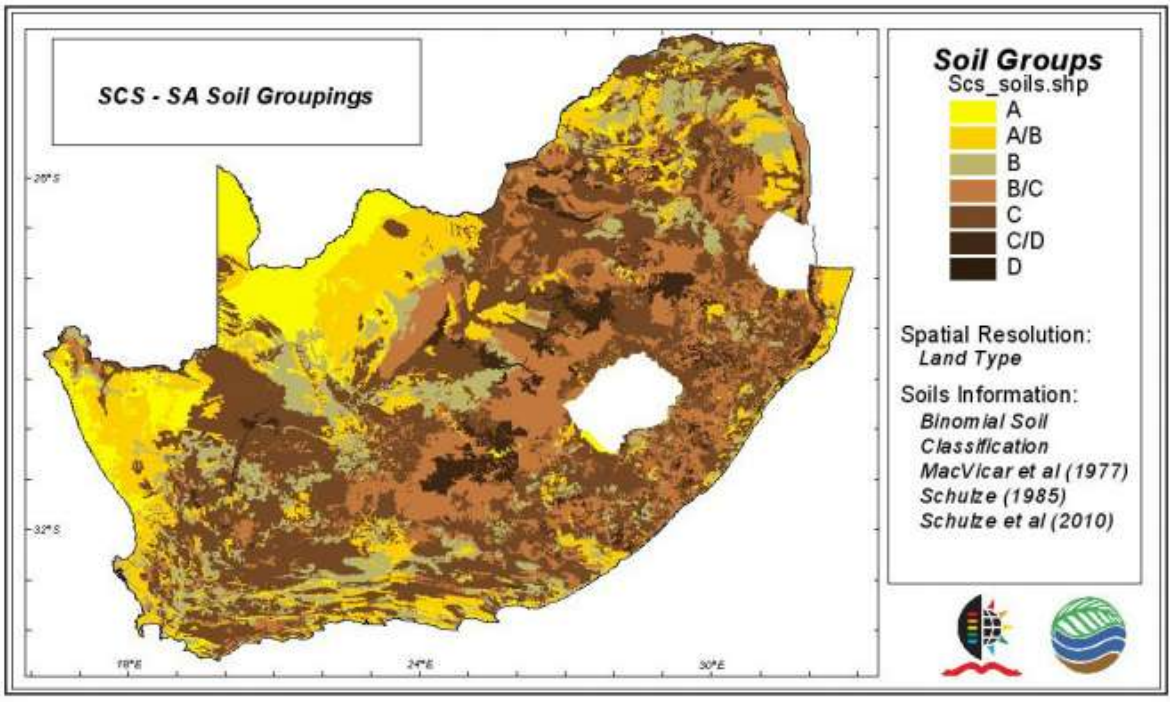

Figure 20: Hydrological SCS soil groups in South Africa (Schulze et al, 2012)

For the Upington area in which the proposed Joram Solar project is located Soil Group B is used. The runoff coefficient is derived according to standardised runoff coefficient values for the rational method and the corresponding hydrological soil group.

Table 11 below depicts the recommended runoff coefficient values to be used within the rational method of surface runoff calculations (Knox County Stormwater manual, Chapter 3, Volume 2, 2008).

Table 11: Recommended runoff coefficient values for the rational method (Knox County Stormwater Manual)

Land Use	Runoff Coefficient (C) by Hydrologic Soil Group and Ground Slope											
	A			B			C			D		
	<2%	2 - 6%	>6%	<2%	2 - 6%	>6%	<2%	2 - 6%	>6%	<2%	2 - 6%	>6%
Forest	0.08	0.11	0.14	0.10	0.14	0.18	0.12	0.16	0.20	0.15	0.20	0.25
Meadow	0.14	0.22	0.30	0.20	0.28	0.37	0.26	0.35	0.44	0.30	0.40	0.50
Pasture	0.15	0.25	0.37	0.23	0.34	0.45	0.30	0.42	0.52	0.37	0.50	0.62
Farmland	0.14	0.18	0.22	0.16	0.21	0.28	0.20	0.25	0.34	0.24	0.29	0.41

Table 12 below portrays a combination of the amount of washes, the length of these waterways (inside of the drainage area and site footprint) as well as slope indicators within the main waterways (average slope and maximum slope).

Table 12: Runoff coefficient per catchment area (slope of main waterway)

Catchment Area	Drainage Area (km²)	Area (ha)	Length of main waterway (m)	Average slope (S)	Maximum slope (S)	Runoff coefficient
A1	1.9	190	850m	1.3%	3.7%	0.21
A2	1.7	170	1200m	1.4%	3.8%	0.21
A3.1 (west)	0.9	90	390m (west)	1.4%	1.8%	0.16
A3.2 (east)			420 (east)	1.8%	3.9%	0.21

The derived runoff coefficient in the second method correlates well with the SANRAL derived value should a 1:20 return period be used. Due to the fact that a 1:50 return period was used the runoff coefficient is more conservative with a higher value.

5.5.7 Rainfall intensity

The rainfall intensity is related to the mean annual rainfall and the rainfall region. The SANRAL Drainage Manual states:

"to obtain the largest possible peak discharge for a given return period using the rational method, the storm rainfall should have a duration equal to the time required for the whole catchment to contribute to run-off, defined as the Time of Concentration, T_c"

On occurrence of "The time of concentration" therefore the full catchment area contributes to run-off and the rainfall intensity is at its peak. The time of concentration is used to determine the rainfall intensity.

5.5.8 Time of Concentration (T_c) calculation

The Time of concentration is defined by SANRAL Drainage Manual as the time required for runoff, as a result of rainfall with a uniform areal distribution, contributing to the peak discharge at the catchment outlet. Two types of time of concentrations is calculated for this solar energy facility site. The first being the "Time of concentration for overland flow" (T_{c1})and the second being "Time of concentration in a watercourse" (T_{c2}). The total time of concentration will be:

$$Tc = Tc1 + Tc2$$

Tc1 is time of concentration for overland flow:

$$Tc1 = 0.604\left(\frac{rL}{\frac{\sqrt{H}}{1000L}}\right)^{0.467}$$

Where:

H = height distance along flow path (m)

L= hydraulic length of flow path (km)

r = roughness coefficient (between 0.02 and 0.8) agricultural land (Joram = 0.3)

Tc2 is time of concentration for flow in defined watercourse:

$$Tc2 = \left(\frac{0.87.L^2}{1000.S}\right)^{0.385}$$

Where:

L = Length of waterway [km],

S = average slope.

For the 3 areas defined as A1, A2 and A3 in **Figure 19** the time of concentration calculations is depicted in **Table 13** below.

Table 13: Time of Concentration calculation

Area	H (m)	L (km)	r	Tc1 (min)	Tc2 (min)	Tc total (min)
A1	10	0.85	0.3	54	3	**57**
A2	11	1.2	0.3	67	4	**71**
A3.1 (west)	6	0.39	0.3	35	2	**37**
A3.2 (east)	4	0.42	0.3	40	1.5	**41.5**

5.5.9 Rainfall intensity calculation

According to SANRAL Drainage guide the rainfall intensity can be derived by dividing the point rainfall by the time of concentration. The point rainfall is obtained from Figure 21 below for each of the derived Tc values at a 50 year period.

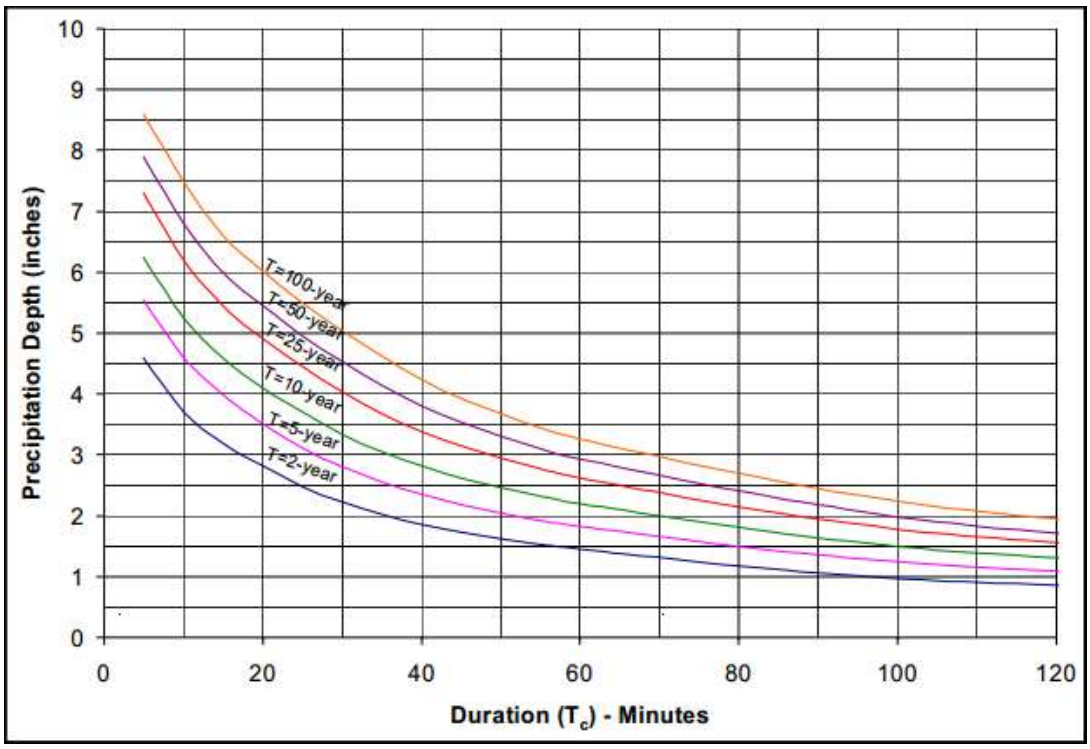

Figure 21: Rainfall intensity duration frequency (Knox County)

The rainfall intensity results as per calculation and graph discussed above is illustrated in Table 14 below. Note that the point of rainfall has been converted from inches to mm. In addition the rainfall intensity is calculated in mm/hour.

Table 14: Rainfall intensity calculation

Area	Time of Concentration (T_c (min))	Point Rainfall (mm)	Rainfall intensity (I = mm/h)
A1	57	76.2	80.2
A2	71	74.93	63.5
A3	78.5	63.5	48.8

5.5.10 Effective catchment area calculation

According to SANRAL Drainage Manual the effective catchment area is "*that part of the total catchment which would contribute to the peak flow. Pans or areas that are artificially cut off should consequently be excluded*".

Due to the fact that a pan is located within the study area, the specific catchment area contributing to the pan should not form part of the effective catchment area. The pan located on the study area is 1.8ha in size. The following table depicts the effective catchment area calculations.

Table 15: Effective catchment area calculation

Area	Total area (km^2)	Area to be excluded (km^2)	Effective catchment area (km^2)

A1	1.9	n/a	1.9
A2	1.7	Pan exclusion 0.018 km^2 Pan catchment 0.2 km^2 Total exclusion of 0.218 km^2	1.482
A3	0.9	n/a	0.9

5.5.11 Peak flow calculation

In Section 5.5.6 – Section 5.5.10 the various input parameters were calculated in order to derive the peak flow according to the rational method, depicted in the formulae below. In this section the surface runoff rate is calculated according to the calculations done in these previous sections.

$$Q = (\frac{CIA}{3.6})$$

Where: $Q = peak\ flow\ \left(\frac{m3}{s}\right)$;

$C = run - off\ coefficient$;

$I = average\ rainfall\ intensity\ over\ catchment\ \left(\frac{mm}{hour}\right)$

$A = effective\ area\ of\ catchment\ (km2)$

Table 16: Peak flow calculation

Area	Run-off coefficient C	Rainfall intensity I (mm/hour)	Effective area of catchment A (km^2)	Time of concentration (min)	Peak flow C (m^3/s)
A1	0.21	80.2	1.9	57	8.89
A2	0.21	63.5	1.482	71	5.49
A3.1	0.16	48.8	0.9	37	1.95
A3.2	0.21	48.8	0.9	41.5	2.56

Interference on the watercourses and their drainage patters should be kept as low as possible. Should these watercourses be crossed or impacted sufficient stormwater management measures should be in place in order to accommodate the peak flows and associated flow velocities.

5.5.12 Water runoff

The water runoff and the distribution thereof are largely dictated by the detail design of the solar panel arrays. The specific runoff parameters and considerations are discussed within this section of the report.

5.5.13 Flow and outlets

The topography has low slope throughout the area with a slope gradient average between 1.3% and 1.8% and a maximum slope of below 4% and an undulating shape. The little slope (<5%) and low annual rainfall implies a low expected water flow velocity. The following formula was used to derive the average flow velocity within the washes.

$$v = L/Tc$$

Where:

$v = average\ water\ flow\ velocity\ (\frac{m}{s})$

$Tc = Time\ of\ concentration\ (hours)$

$L = lenght\ of\ watercourse\ (km)$

#	**Derived water flow velocity**	**Area**
1	V_{A1} = 0.25 m/s	Catchment area 1 flow maximum flow velocity
2	V_{A2} = 0.28 m/s	Catchment area 2 flow maximum flow velocity
3	V_{A3} = 0.18 m/s	Catchment area 3 flow maximum flow velocity

Due to this slope gradient the flow of water will be expected to be less than 1.0 m/s taking into account the time of concentration (based on soil type, permeability of land, slope of land) and the length of the watercourse. The vegetation as well as the gradient which indicates flat grades and semi-permeable soils concludes in a low water runoff coefficient. Applicable measures will be implemented with regard to water outlets, although the expected flows are considered to be low.

Water runoff at the PV area will be dictated by the specific design, technology and facility layout. The layout of the proposed Joram Solar development will take slopes, seasonal washes and drainage lines into account in order to minimise the impact on the environment as well as natural flow of water.

5.5.14 Mitigation Measures and drainage design

5.5.14.1 Erosion and storm water control

The risk of water erosion is low because of the extremely low annual rainfall in the area. The ground condition in the Upington area is such that any surface water is very quickly absorbed into the soil. This avoids water build up on the surface and quickly reduces any water flow which might cause water erosion. As depicted above, the Time of Concentration is in all cases more than 50minutes, implying that a rain storm should occur for longer than 50minutes before the whole catchment area will contribute to runoff. Storms lasting for this length of period in Upington area have a low probability of occurring.

. The solar module surfaces are installed at a relatively large incline with gaps between modules. This does not allow significant water build up on the modules while also reducing the energy in falling droplets. Should a tracking technology be used this implies that droplets leaving the solar module surface would not drop onto the same ground areas all the time.

The construction area might cross over seasonal washes. To avoid erosion in these washes recognised building practices will be followed to keep the natural flow of water within its natural borders. It is in the interest of the solar operator to keep the area clean and free of erosion to avoid any damage to the equipment. The solar modules would be installed on frames, allowing for natural water flow underneath the structure.

Access roads and internal roads would also be designed and build using recognised erosion and storm water management systems. During the construction phase of the solar PV facility temporary solutions would be implemented to ensure that the environment is preserved in a sustainable way by avoiding erosion. The following figure shows a typical temporary solution that would be implemented during the construction phase, basically consisting of an inlet, channel and outlet. During outflow of the water energy is dissipated allowing any particles to sink to the ground which also avoids fast flowing water to sweep particles up from the ground avoiding erosion, by flowing though packed stones acting as a filter.

Figure 22: Installed concrete pipes and culverts

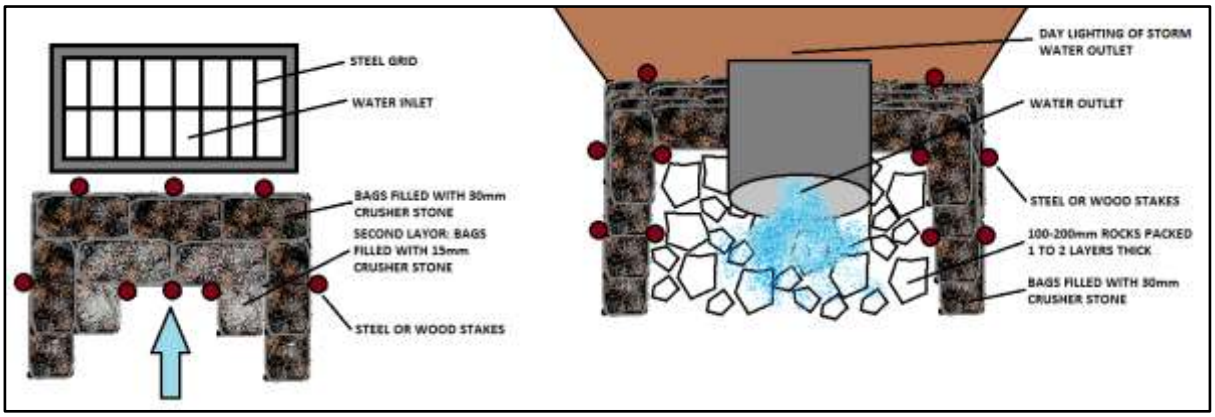

Figure 23: Temporary culvert inlet and outlet

More permanent solutions would be designed to keep storm water under control in a sustainable way. These structures would be built to be aesthetically pleasing by using fixtures such as stones packed in wire mesh to stay in a position or locking retaining walls at the inflow and outflow of the culverts also acting as scour protection. Depending on the situation which is influenced by the type of water control most probably being stream crossing (in this particular case it would be a dry water washes for most of the year) or a culvert for water runoff management, either portal culverts with bases or reinforced precast concrete pipes would be used as the channelling.

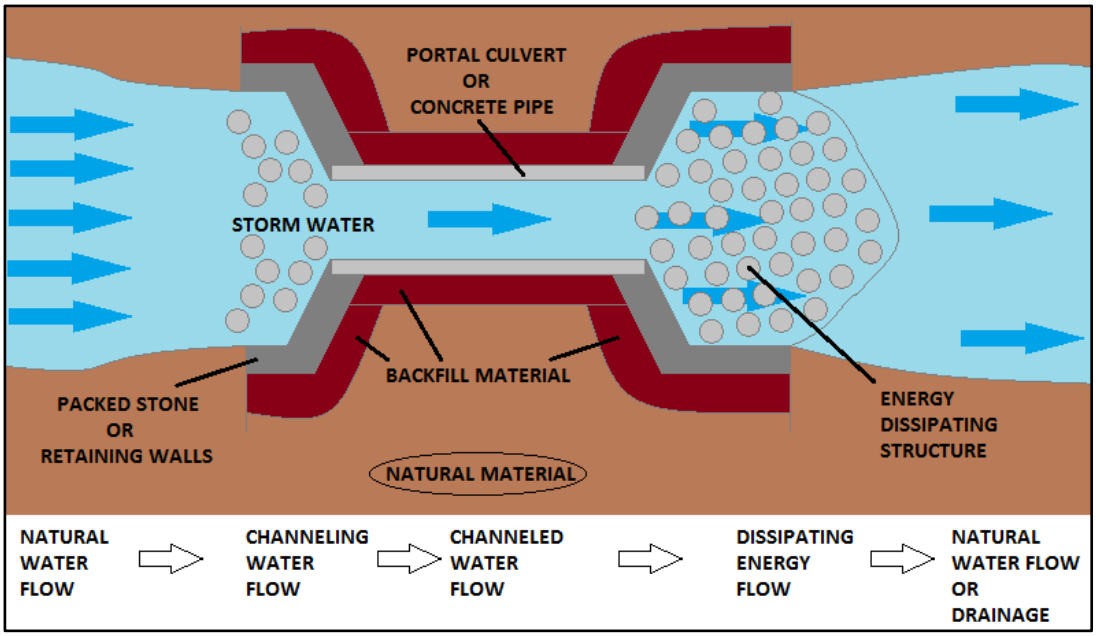

Figure 24: Storm water flow

An alternative to culverts considering drainage line crossings, Low-level River Crossings (LLRC) can be used. A LLRC is a structure that is designed in such a way to provide a bridge when water flow is low, while under high flow conditions water runs over the roadway, without causing damage. Two types of LLRC can be used depending of the particular situation. A “Causeway” contains openings underneath the surface, which allows passing water through where a “Drift” does not.

The same type of erosion control methods discussed with the culverts is taken into account when designing a LLRC. Because a LLRC is designed for water to flow over it, erosion protection is very important. Rock filled baskets, loosely packed rock or perforated bags filled with stone are some of the methods usually considered with LLRC.

All water courses will be avoided as far as possible. Should the crossing of such water courses occur, the standard best practices will be used to reduce potential erosion from occurring. Detailed designs for crossing of such water courses will be done as and when required. The water use licence application process will include application for potential crossings of water courses in terms of Section 21(i)&(c) of the national water act. This application process will only commence if the project is selected as a preferred bidder.

5.5.15 Conclusion in terms of Stormwater Management and Erosion control

The proposed Stormwater Management Plan to be included as part of the Environmental process has the objective to mitigate risks and take into account measures and recommendations for drainage and water flow elements at the Solar PV Facility including access roads and internal roads.

To minimise environmental impact the drainage elements will take the existing contours and seasonal washes into account. The layout of the proposed Joram Solar development will take slopes, seasonal washes and drainage lines into account in order to minimise the impact on the environment as well as natural flow of water.

This storm water management plan describes the typical associated flow volumes and rates and the proposed drainage elements to be considered in order to ensure effective stormwater

management for the proposed site. Should the best practice stormwater management principles be applied for the sensitive areas stormwater risks will be sufficiently reduced.

5.6 SERVICES REQUIRED

Due to the remote location of the proposed site, making use of municipal services is very difficult. It is therefore proposed to manage the Water and Electricity, Sewage and Waste Removal aspects independently.

5.6.1 Water

Water will be sourced from either the two boreholes close to the site, the Kai Garib municipality or other third party suppliers. Permission has been obtained from the farmer in the lease agreement, that the borehole water may be used. According to the farmer the water is drinking water quality. The water will be stored on site in standard 10kl water tanks. Due to the small amount of water needed, water can also be obtained for the Khara Hais municipality and transported to the site by standard water trucks, should the borehole water not be sufficient. All legislative requirements with regard to water provision will be followed.

5.6.2 Electricity

Electricity will be needed during the construction period as well as the operation period in the support offices, security systems etc. It is proposed to either use generators for electricity, or alternatively make use of a number of PV panels during the construction period. As part of the infrastructure installed, it is proposed to utilise on-site electricity reticulation from the on-site substation towards the required areas by utilising the accounted infrastructure. As an additional option it is proposed to make provision for the utilisation of an off-grid, on-site solar system for the required on-site electricity.

All these options are likely to have similar environmental impacts.

5.6.3 Waste effluent, emission and noise management

5.6.3.1 Solid waste management

During the construction phase an estimated amount of less than 5 m^3 non-hazardous solid construction waste are to be produced per month, for the expected 12-18 month construction period. An independent service provider will be used to safely store all construction waste, and remove it from the site on a scheduled (weekly or bi-weekly) basis. The construction waste, where applicable, will be disposed at a municipal landfill site that is appropriately licenced. As far as possible the waste hierarchy should be applied in order to reduce, re-use and recycle waste. The Environmental Management Programme will address solid waste management during construction.

During the operational phase after construction, the facility is not expected to produce any solid waste.

5.6.3.2 Liquid effluent (sewage)

The liquid effluent generated is expected to be minimal and limited to the ablution facilities. All workers will be transported to site on a daily basis should the workers not be housed on site. Chemical toilets will be provided during the construction phase. These chemical toilets will be

serviced and emptied on a weekly basis by a private independent contractor. The sewage will be transported to a nearby Waste Water Treatment Works for treatment.

The on-site permanent sewage solution for the operation period of the facility is expected to either utilise a combination of a septic tank or a conservancy tank, as determined by the local authority. Due to the locality of the farm, sewage cannot be disposed in a municipal sewage system.

5.6.3.3 Emissions into the atmosphere and noise generation

Very little emissions should be released into the atmosphere and no significant noise should be generated, except during the construction period with drilling and hammering. Due to the site location this should not pose any issue as no residential area is located nearby. Further mitigation measures in this regard will be included in the Environmental Management Programme.

5.7 TRAFFIC MANAGEMENT AND TRANSPORTATION

Solek renewable energy engineers compiled a traffic management and Transportation Plan for the proposed Joram Solar development from which the following is drawn. Please refer to Annexure D9 for a full copy of the Transportation and Traffic Management Plan.

The transport and traffic management plan considered the following key aspects.

- Determine access freight routes for delivery of material and resources
- Confirm required clearance for material delivery
- Confirm freight requirements
- Propose alternative routes for delivery of material and resources
- Normal and heavy vehicle freight legal limits
- Specific permits required for Abnormal Vehicles
- Maximum height clearance on roads.
- Propose traffic accommodation measures during construction and operation of proposed Solar Energy facility

5.7.1 Definitions and assumptions

As part of the study and specifically to the transportation of materials for constructing and operating of a Solar Energy Facility the following will assumed to be applicable:

- Imported or national manufactured materials being solar PV modules and substructure. The transportation will be from the preferred port or national manufacturer and supplier.
- Substructure (frames) foundations will be finalised with final facility design and will be dependent on the outcome of geotechnical studies.
- Material required for constructing and upgrading of roads and infrastructure are obtained locally from closest available commercial manufacturer or supplier.
- The largest potential load could be a single 80MVA transformer with a payload of approximately 70 ton.

- Freight will be transported predominantly on surfaced roads up to the N10 Kleinbegin road intersection.
- The access roads to the site will be from the Kleinbegin road, 8km from the Kleinbegin / N10 intersection and 10km south east from Upington. SANRAL to confirm whether mitigation measures are sufficient regarding road safety and requirements at the N10 / Kleinbegin road intersection.

5.7.2 Evaluation of Freight Transport

5.7.2.1 *General freight requirements - Legislation*

The general current limitations on road freight transport are:

- Axle load limitation of 7,7t on front axle, 9,0t on single rear axles.
- Axle unit limitations are 18t for dual axle unit and 24t for 3 axle unit.
- Bridge formula requirements to limit concentration of loads and to regulate load distribution on the vehicle.
- Gross vehicle mass of 56t. This means a typical payload of about 30t.
- Maximum vehicle length of 22m for an Interlink, 18,5m for horse and trailer and 13,5m for a single unit.
- Width limit of 2,6m.
- Height limit of 4,3m.

Abnormal permits are required for vehicles exceeding these limits.

5.7.2.2 *Freight for Solar Energy Facility*

- Solar modules (panels).
- Substructure and possible foundation which might be drill in screws (Frames for Solar modules).
- Building materials (concrete aggregates, cement and gravel).
- Construction equipment such as piling rigs and cranes.
- Inverter rooms (containerized) as per regulations and standard container specifications.
- Transformer and cables.

The following is anticipated:

- Depending on the technology (PV or CPV) the substructure foundation could be drill in screws or concrete foundation. The transportation of these materials will be conventional trucks which should adhere to legal limits.
- Solar Modules and substructure (frames) will probably be transported in containers using conventional heavy vehicles within the legal limits from nearest South African port. The number of loads will be a function of the capacity of the solar farm and the extent of the substructure.

- The Inverter rooms will be containerized units and will be transported with conventional trucks which should adhere to legal limits.
- Transformers will most probably be transported by abnormal vehicles from the nearest South African port or local South African manufacturer.

5.7.3 Traffic consideration

Taking into account freight and traffic volumes for a 75MW solar project as well as the planned timelines of construction which will be between 12 to 18 months the following will be applicable:

- Estimated 3000 to 4000 heavy vehicle trips per 12 months period
- Between 15 to 20 heavy vehicle trips per day over a period of 12 months

The impact of this on the general traffic would therefore be negligible as the additional peak hour traffic would be at most 2 trips

The current traffic volumes on N10 as received from SANRAL for the year 2013 at and at location Grootdrink, 57km from the N10 Kleinbegin intersection is illustrated in the table below:

Table 17: Traffic volumes on N10 between Upington and Groblershoop

N10 (Grootdrink)	**To Upington**	**To Groblershoop**	**Total**
Average daily Traffic (ADT)	532	432	963
Average daily Truck Traffic (ADTT)	109	87	196
Percentage of trucks	20.5	20.2	20.3
Truck split % (Short: Medium: Long)	49:13:38	45:14:41	48:13:39
Percentage of night traffic (20h00 – 06h00)	13.5	13	13.3

Therefor the ADT and a maximum hourly flow of about 60 vehicles/hour been calculated for this section of road. The average of 60 vehicles / hour is calculated as 87% of total vehicles during daytime (06h00 – 20h00).

It can therefore be stated that the construction traffic and the post construction traffic would have an impact of max 20% ((20*2 roundtrip)/196) of the average truck traffic and less than 5% on the total traffic volumes.

It should be noted that the specific route will be determined and that a distance of only 10 km on the N10 will probably been used between Upington and the Kleinbegin road.

5.7.4 Access Routes to Joram Solar Facility

5.7.4.1 Joram Solar Facility Location

With regard to the different route options from alternative ports to the Joram Solar Facility, the site entrance option 1 coordinate on the Kleinbegin road is:

Latitude:	28°30'34.26"S

Longitude	21°21'16.90"E

Figure 25 below illustrates Joram Solar Facility and site access position and road.

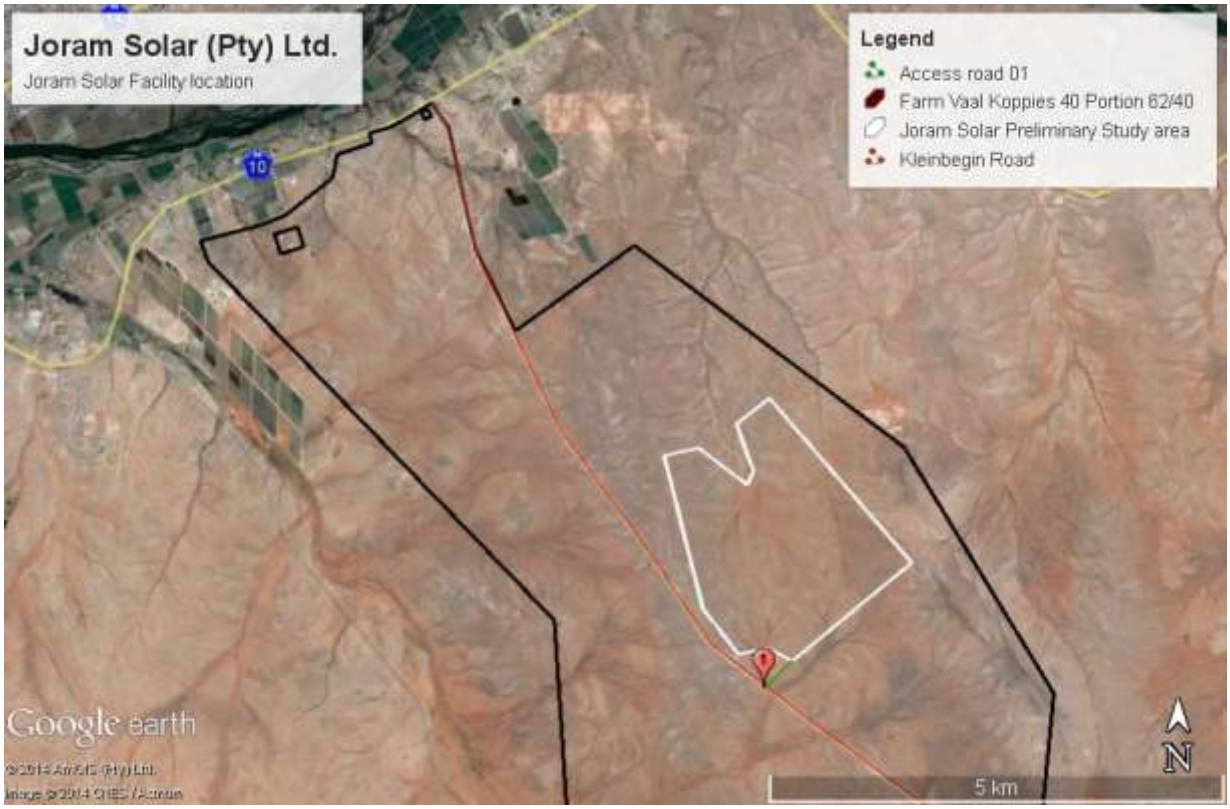

Figure 25: Joram Solar facility location and access road

5.7.4.2 Preferred Route

The route for transportation of imported material (Solar modules) equipment is either from Saldanha, Capetown or Port Elizabeth.

Saldanha is the preferred port with the shortest route as indicated in the figure below.

It should be noted that the Ports Authority also has preferences on freight import which should be respected.

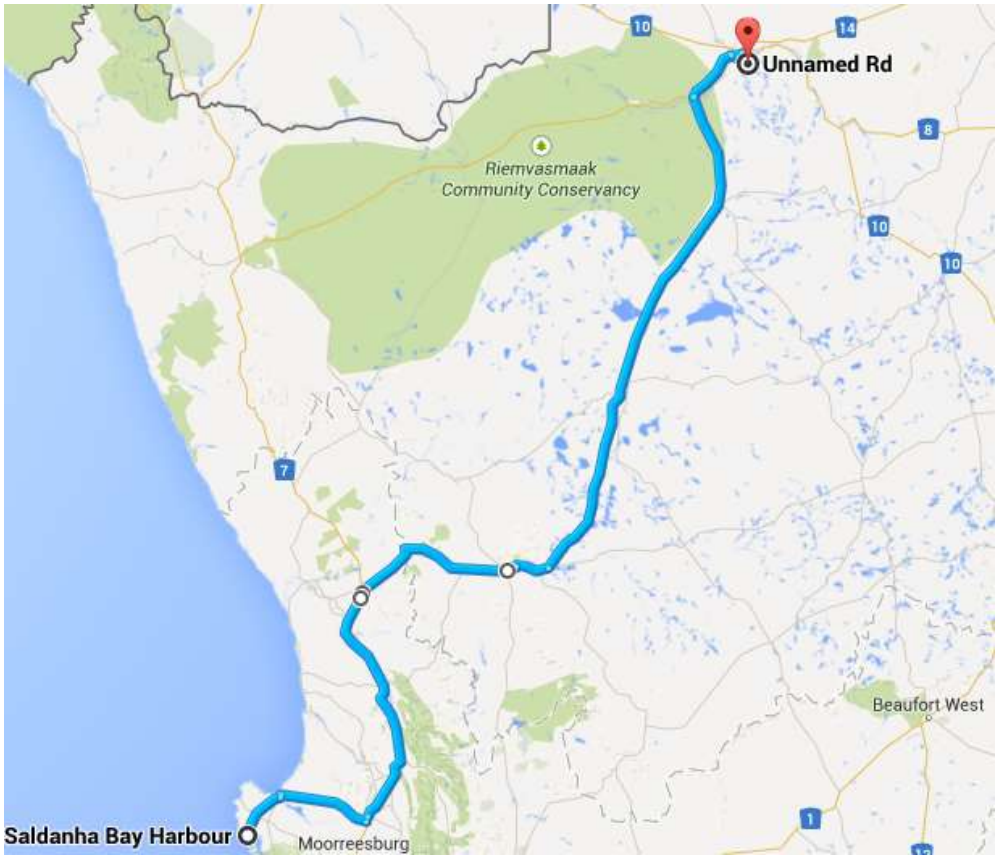

Figure 26: Saldanha Bay Harbour as Preferred port

The route (817 km) from the Saldana Port to the Joram Solar Facility site will be as follows:

Table 18: Preferred Route detail

From	To	Distance	Road	Road surface
Saldanha	Velddrif	33km	(Provincial) R27	Tar (surfaced 2 with tar shoulders
Velddrif	Piketberg	62km	R399 (Provincial)	Tar (surfaced 2 with gravel shoulders
Piketberg	Vanrhynsdorp	174km	N7 (National)	Tar (single carriage way. Two way road Currently upgrading in process.
Vanrhynsdorp	Calvinia	121km	R27 (National)	Tar (single carriage way. Two way road Recently upgraded.
Calvinia	Keimoes	366km	R27 (National)	Tar (single carriage way. Two way road. Gravel shoulder.
Keimoes	Upington	43	N14 (National)	Tar (single carriage way. Two way road.

From	To	Distance	Road	Road surface
				Gravel shoulder.
Upington	N10 / Kleinbegin intersection	10km	N10	Tar (single carriage way. Two way road. Gravel shoulder
Kleinbegin Road	Site	8km	Kleinbegin	Gravel road (7.5m wide)

5.7.4.3 Alternative Routes

Should the preferred route not be acceptable or engaged under periodic maintenance works, then the route via Springbok could be used as alternative. This route from Saldanha (a distance of 936km) is shown in the following figure and follows the National Road.

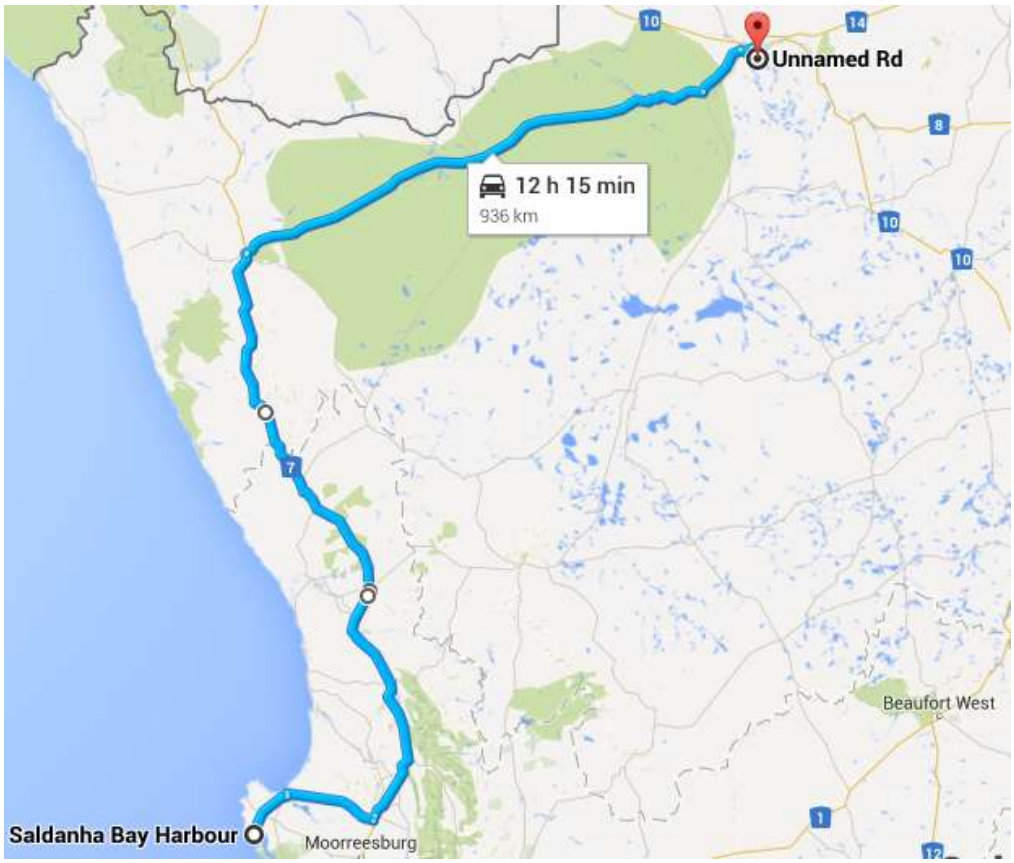

Figure 27: Alternative Route

The first Port alternative route from Cape Town Port also follows the national road and also follows the same route as the preferred route except from Cape Town via the N7 to Piketberg. This route will also an alternative in case of the Saldahna route is not available for any reason.

The second Port alternative route of Port Elizabeth is about 908km and the least preferred route but offers an alternative should Saldanha port not be available for any reason.

5.7.5 Routes from Local Suppliers

Routes from local manufacturers might include:

- Johannesburg and area, Gauteng
- Cape Town, Western Cape
- Durban, KwaZulu Natal

The routes to the site from these centres are predominantly on Provincial and National roads. The following figures shows the most probable routes.

There are no limitations on normal freight on these routes.

Material sources for road building and concrete works is available in Upington and all material will most likely be transported from Upington.

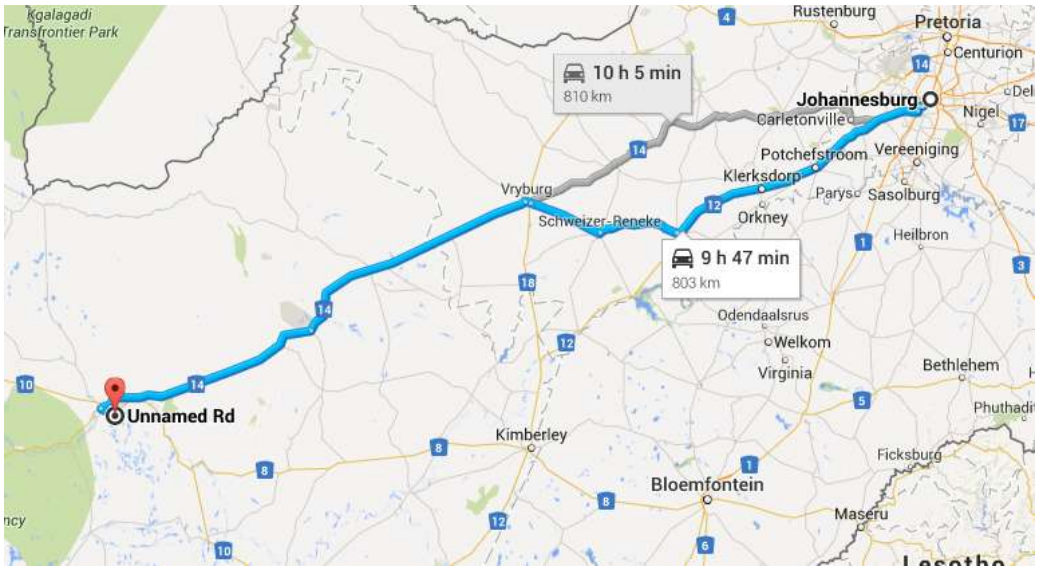

Figure 28: Alternative route from Gauteng for additional materials

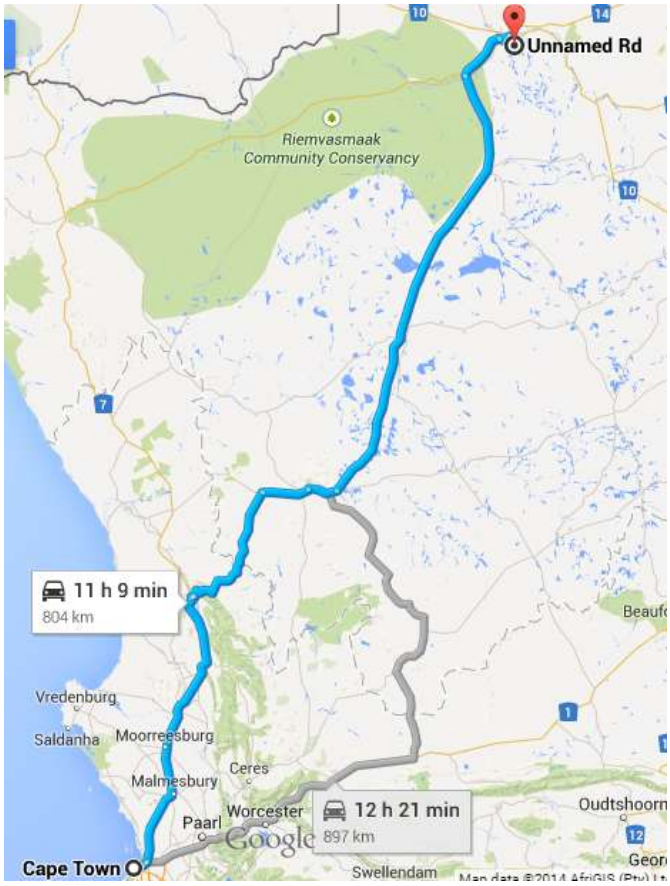

Figure 29: Alternative Route from Cape Town for additional materials

Figure 30: Alternative Route from Durban, KZN for additional Materials

5.7.6 Authority and Permit Requirements

The following is of importance in this regard:

- No toll fees required on the routes from the preferred port. On the routes from the other manufacturing centres certain portions of the national routes are tolled which will required toll fees.
- An Abnormal permit will be required for the transport of the transformer. The estimated permit value will be a function of the actual vehicle configuration but is estimated at R7000 - R9000 per trip.

5.7.7 Route Limitations of the Preferred Route from the Port

As per the preferred route from the Saldanha Port to the Solar Facility the general remark is that:

- No limitations on normal heavy vehicles.
- Permits required from the Provincial Authorities for abnormal loads such as the transformer.
- Vertical clearance of bridges in general 5,2m. However, should the transformer exceed 5,2m then the route will have to be confirmed or altered as required but the permit conditions will direct the load to an approved route.

It should also be noted that the N7 is currently undergoing upgrades and might be completed by the time the project receive preferred bidder status.

It should be noted that all the site entrance access routes will be from the Kleinbegin road to the proposed Joram Solar facility preliminary site. The Kleinbegin road is a gravel road with a width of 7.5m.

5.7.8 Alternative Site access roads (Site Entrance)

It should be noted that all the site entrance access routes will be from the Kleinbegin road to the proposed Joram Solar facility site. The Kleinbegin road is a gravel road with a width of 7.5m.

5.7.8.1 Alternative 1

Access road alternative 1 being investigated and provides access to the proposed site from the Kleinbegin road at the existing farm entrance (point 1) parallel to the south boundary of the preliminary study site.

5.7.8.2 Alternative 2

Access road alternative 2 being investigated and provide access from the Kleinbegin road at (point 2) to the proposed site as per environmental impact scoping phase.

5.7.8.3 Alternative 3

Access road alternative 3 being investigated and provide access from the Kleinbegin road at (point 3) to the proposed alternative site north boundary.

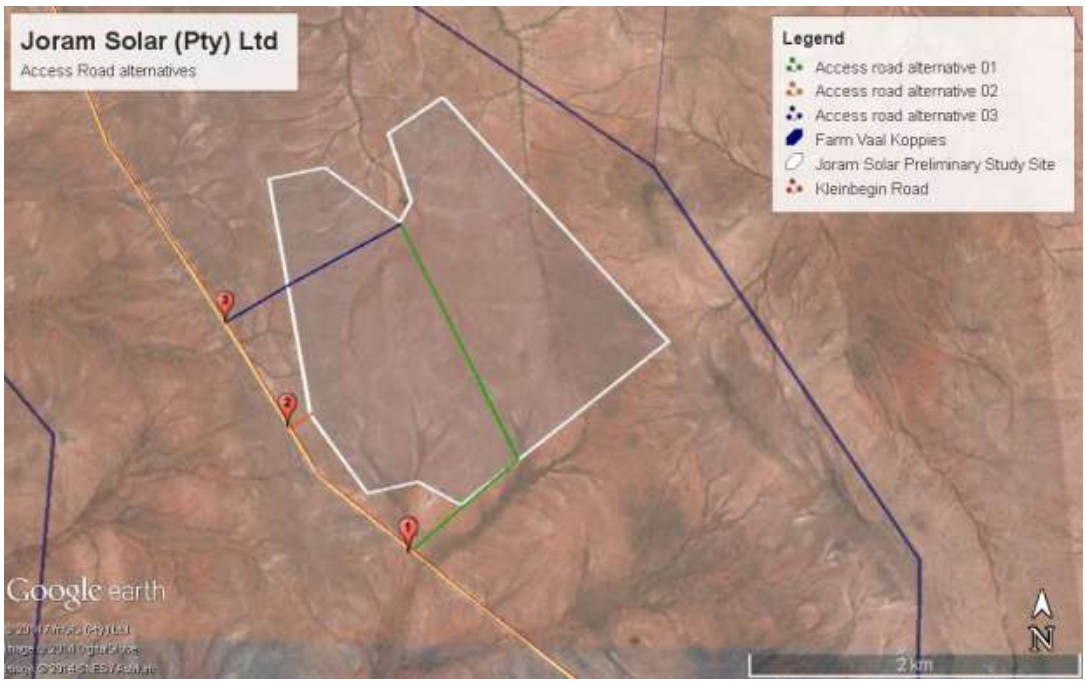

Figure 31: Alternative access roads from the Kleinbegin road to the Joram Solar Development

t. Access 1 has sufficient sight distances and should therefore be approved by local road authority as development access road to the proposed solar facility. This site access is also located at the current farm entrance thus minimising disturbance. The sight distance to the proposed preferred Access road 1 from the north and south is more than 500m.

As per SANRAL requirements the intersection at the N10 Kleinbegin road will require upgrades with regard to road signage due to sight distance and possible potential upgrading of the intersection to surfaced standards with turning lanes. This access upgrading at this intersection will be limited to the current road reserve and will not require further environmental authorisation as it will not trigger any activities listed in terms of the 2010 or 2014 regulations.

Shoulders are the usable areas immediately adjacent to the travelled way and are a critical element of the roadway cross-section. They provide:

- A recovery area for errant vehicles;
- A refuge for stopped or disabled vehicles;
- An area out of the travel lanes for emergency and maintenance vehicles; and
- Lateral support of the roadway structure.

The figure below indicated the N10 and Kleinbegin road intersection.

Figure 32: N10 / Kleinbegin intersection

5.7.9 Accommodation of Traffic during Construction

As per feedback from SANRAL, the intersection of the N10 and Kleinbegin may require upgrading and specific signage should be implemented during the construction phase due to the limited sight distance of 200m and 170m as illustrated in the figure below. As mentioned above, the proposed upgrades to the intersection will not require further environmental authorisation.

During upgrading of the access, traffic will have to be accommodated as per SADC Road Traffic Signs Manual requirements.

Figure 33: Site Distances at N10 / Kleinbegin road intersection

5.8 ESTABLISHMENT OF INTERNAL ACCESS ROADS ON THE FARM

Minor internal maintenance roads on the farm and proposed construction site are to be constructed. Where necessary, gravel may be used to service sections of the existing road on the farm itself. In order to form an access track surface some of the existing vegetation and level the exposed ground surface might need to be stripped off. The impact of this will be assessed by the participating specialists. These access tracks (typically 6 m wide or less) will form part of the development footprint. In order to allow enough space for the larger vehicles to turn easily a width of 6m will be proposed. The layout and alignment of these internal roads will be planned and influenced by the recommendations made by the botanical specialist, as well as the topographical survey. Pathways (typically less than 6 m wide) between the solar PV modules are to be provided for ease of maintenance and cleaning of the panels.

In addition, a fire break (buffer area) that can also serve as an internal road will be constructed around the perimeter edges of the entire proposed site. All gravel access roads constructed will be more or less 6 m wide.

5.9 SITE PREPARATION

Cleaning of the surface areas is necessary in order to construct the solar PV plant. This will include clearance of vegetation at the footprint of the solar PV modules, the digging of the on-site substation and workshop area foundations and the establishment of the internal access roads and lay-down areas. Where stripping of the topsoil is required, the soil is planned to either be stockpiled, backfilled and/or spread on site as part of the rehabilitation. The environmental management plan will provide specifications for this vegetation re-establishment.

To reduce the risk of open ground erosion, the site preparation will typically be undertaken in a systematic manner. Where any floral species of concern or sites of cultural/heritage value are involved, measures are to be put in place to attend to the preservation or restoration of these elements as recommended by the botanical specialist.


Plate 8: Typical example of site preparation activities (Solek, 2014)

5.10 ERECTING OF SOLAR PV MODULES

Once the site preparation has been done, and all necessary equipment has been transported to the site, the solar PV modules and structures are assembled on site. Each solar PV module consists of a number of cells, forming a single panel. Each module is capable of generating typically **200 W - 300 W** of DC electrical power. If conventional Solar PV technology is used, the solar PV modules are assembled in blocks of rows, forming a network of strings, across the solar PV array.

There is a separation distance between the rows of approximately 5 m. The exact amount of modules in each solar PV array is subject to the final facility design and will be finalised as part of the detailed design phase.

If CPV technology is to be used, the distance between the modules are carefully calculated to ensure the trackers have enough room to rotate and the shadows are taken into account. Foundation holes for the solar PV modules are to be mechanically quarried to a depth of approximately 400 - 800 mm. Driven piers and screws are recommended in order to minimise the environmental impact of the facility, but will be dependent on mechanical specifications.

If concrete foundations are used, foundation holes will be mechanically excavated to a depth of about 400 - 600 mm. The concrete foundation will be poured and be left for up to a week to cure.

Plate 9: Showing typical erection of Solar PV modules

5.11 CONSTRUCT ON-SITE SUBSTATION

An on-site **substation** will be necessary to enable the connection between the solar energy plant and the National Eskom electricity grid. The generated voltage is planned to be **stepped up** to **132 kV** by means of an **on-site substation** in order to be fed to the Eskom grid via a planned connection to the existing Gordonia substation. The on-site substation and its associated infrastructure and internal roads should have a footprint of approximately 0.04 ha (20mx20m).

The on-site substation is constructed in a few sequential steps. First a site is determined by the recommendations from the reports of the environmental specialists to avoid the most sensitive areas in the positioning of the substation (a geological study is expected to be conducted prior to the finalisation of the on-site substation and is expected to be taken into account for this purpose).

Once the site is approved, the site clearing and levelling is to be done, after which the access roads to the substation is constructed. Next the substation foundation is laid. Once the foundation is constructed, the assembly, erection and installation of all equipment, including the transformers, are to be completed.

The final step is the connection of the conductors to the equipment. The post-construction phase includes the rehabilitation of disturbed areas and protection of erosion sensitive areas. Below is typical on-site substation that connects to the existing Eskom substation.

Plate 10: Typical example of on-site substation (Solek, 2014)

5.12 ESTABLISHMENT OF ADDITIONAL INFRASTRUCTURE

To minimise the potential ecological impact a project of this scope, a decision was made to limit all activities and storage of equipment to one nominated area. A dedicated construction equipment camp and lay-down area are planned to be established (further referred to as the "laydown area"), which will then form part of the auxiliary building area.

The laydown area for the construction period will be approximately 2ha. This area will typically be used for the assembly of the solar PV modules and the generation placement/storage of construction equipment. A temporary facility is planned to be used to secure the storage of fuel for the on-site construction vehicles. The volume of fuel stored will be below the threshold defined in legislation and management of this storage area will be included in the Environmental Management Programme.

The auxiliary building area will typically consist of a workshop area; storeroom area; change and ablution room area; administrative and security building; 10 x 10'000 L water tanks.

5.13 CONNECT ON-SITE SUBSTATION TO POWER GRID

In order to evacuate the power generated by the proposed facility and feed it into the ESKOM grid, a distribution line would have to be constructed between the proposed on-site substation and the grid connection point, either the Gordonia Eskom substation or to an existing 132kV line (loop-in/loop-out).

A grid feasibility application will be submitted to ESKOM, in order to confirm the connection possibilities of this project.

The following figure depicts the different alternatives of connecting to the existing ESKOM grid. Two of the options which can be investigated for grid connection are either the first of a "loop-in/loop-out" into one of the existing 132 kV lines (currently running over the farm or the planned 132kV line of the Ilanga CSP project) and the second option is to build a new line directly to the Gordonia Eskom substation. The "loop-in/loop-out" option will be subject to the available capacity on the existing 132 kV line, which shall be further investigated and discussed with ESKOM as part of the cost estimate letter request.

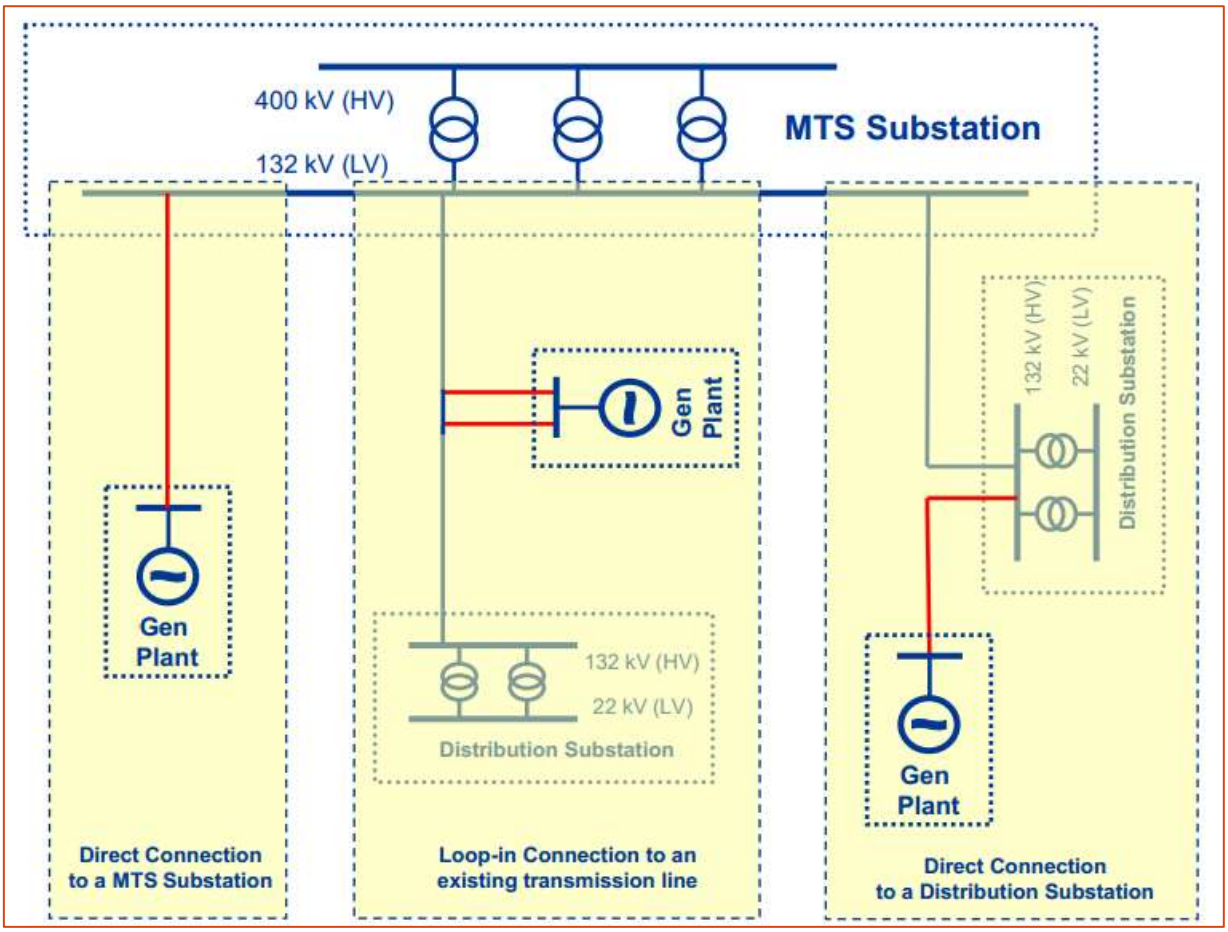

Figure 34: Showing examples of different connection options (Solek, 2014)

Application for the new line(s) is considered within this Environmental Process and also depicted, although a separate "Basic Assessment" (BA) may be initiated for the grid connection options.

As part of the environmental impact assessment and the engagement with ESKOM pertaining to a grid connection application, feedback from Eskom is expected to provide guidance towards the planned expansions, possible loop-in/loop-out options and the potential scenarios within the final Cost Estimate letter. Eskom's recommendations will be taken into account and used within the environmental impact assessment phase as far as possible.

6 ECONOMIC CONTEXT

The following economic context was provided by Solek Renewable Energy Engineers.

6.1 PROJECT COST OVERVIEW

Renewable energy projects, such as the proposed solar facility, require significant capital investment. Funds of equity and debt investors either from foreign or domestic sources are obtained. The cost requirements and potential revenue are discussed in this section, sketching a business case for the development of renewable energy projects within South Africa (specifically solar farms in the Northern Cape).

The project costs consist of two parts, capital cost and running cost. The capital cost pertains to all costs incurred for the establishment of a producing facility. The running cost relates to those costs incurred to ensure that the facility operates as it should throughout its expected lifetime.

Solar PV installations can operate for many years with little maintenance or intervention. Therefore after the initial capital outlay required for building the solar power plant, further financial investment is limited. Operating costs are also limited compared to other power generation technologies.

6.1.1 Project specific costs

The Joram Solar development detail costing has not been completed on the date of submitting this scoping report. The project is, however, based on the industry standard cost with capital expenditure that can amount to more or less R20-25M per megawatt installed capacity. The running cost of a solar PV facility is minimal related to the initial capital cost, contributing to the most significant cost of constructing and running a solar PV facility.

6.1.2 Revenue streams

The payback of the facility results mainly from electricity sales, intended under the current governmental subsidy, known as the "Renewable Energy Independent Power Producer Procurement Programme" (REIPP Procurement Programme).

The IPP procurement programme portrays fixed ceiling prices for bidders to tender against. The establishment of these ceiling prices is based on industry standard return on investments. The governmental study performed identified the feed-in tariff per technology related to the capital cost required per technology against its revenue potential, identifying the required subsidy per technology to be paid in order to create a lucrative investment and attract investors.

In short the subsidy offered by the governmental procurement programme (IPP procurement programme) enables the project to be financially viable by selling electricity at a subsidised price, while the costs of such a facility relates to the industry standard.

As part of the IPP procurement programme preferred bidders will enter into a power purchase agreement between the IPP generator and the Single Buyers Office/Department of Energy. National treasury provides surety, while NERSA regulates the IPP licences.

The bidding and tender procedure of the IPP procurement programme requires an approved EIA Environmental Authorisation/Record of Decision as a gate keeping criteria, where no project would be considered without the EIA Environmental Authorisation being given.

6.2 EMPLOYMENT AND SOCIAL UPLIFTMENT OPPORTUNITIES

The planned construction period is estimated to be between 14-18 months. During the construction activities an estimated 5 jobs will be created per MW of installed capacity. Therefore an estimated job creation of 375-450 employees are expected during the construction of the facility, mechanisms for ensuring that these employment opportunities are sourced from the Khara Hais Municipal Area will be included in the Environmental Management Programme.

7 PROJECT PROGRAMME AND TIMELINES

As mentioned previously the Joram solar development is intended to be lodged under the IPP procurement programme. The programme has definite and stringent timelines, which the project should meet:

Table 19: Proposed implementation schedule (Solek, 2014)

	Description	Timeline
1	Expected IPPPP submission date (5th round)	May 2015
2	Preferred bidders selected	October 2015
3	Finalisation of agreements	November 2015 – July 2016
4	Procurement of infrastructure	August 2016 – September 2016
5	Construction	October 2016 – March 2017
6	Commissioning	March 2017 – July 2017

The table above clearly depicts the dependence of the project on the IPP procurement programme's timelines. Any delay within the IPP procurement programme will have a corresponding effect on the timelines of the projects timelines.

Although no official public submission date for Round 5 has been communicated by the Department of Energy, there have been reports of an accelerated Round 5 timelines, with the submission date potentially brought forward to May/June 2015.

The impact of such an accelerated timeline could have a significant impact on Joram Solar due to the already limited time available to complete the EIA process. **NB: The Joram Solar Development intend submitting their bid during the 5th bidding window.**

8 SITE DESCRIPTION AND ATTRIBUTES

The following sections provide a description of the environmental and built environment context of the property, with particular focus on site location for the proposed Joram Solar Development.

8.1 LOCATION & BUILT ENVIRONMENT

The target property, remainder of portion 42 (portion of portion 9) of the farm 40 Vaal Koppies, is located in the ZF Mgcawu district of the Northern Cape Province, within the jurisdiction area of the Khara Hais Local Municipality. The property is approximately **4700ha** in size and is located approximately 14km east of Upington.

The proposed Joram Solar development site is situated **south** of the **N10 National Road**.

No buildings, ruins or any other structures were noted on or within the direct proximity of the proposed solar development site.

Additional information on regarding the built environment will be included in the Heritage impact assessment that will be included in the Draft EIR.

8.2 GEOLOGY & CLIMATE

The geology and climate of the proposed Joram Solar Development is detailed below.

8.2.1 Geology

The geology is that of the Bushmanland sequence. Sedimentary and Volcanic rocks of this sequence include schist, quartzite and amphibolites

8.2.2 Climate

The region is classified as an arid zone with desert climate. The following specific parameters are applicable:

Table 20: Rainfall and Temperature associated with Joram Solar (Lubbe, 2014)

Rainfall	
Annual rainfall	0-200 mm
Summer rainfall	<62.5 mm
Winter rainfall	<62.5 mm
Variation in rainfall	40 to 50%
Temperature	
Mean maximum temperature	31 to 33ºC
Mean minimum temperature	Minus 2ºC
First frost expected	01 to 10 May
Last frost expected	11 to 20 September
Hours of sunshine	>80%
Evaporation	2200 2400 mm

8.2.3 Soils

Soils in this region usually show the following characteristics:

- Soils have minimal development, are usually shallow, on hard or weathering rock, with or without intermittent diverse soils.
- Lime is generally present in part or most of the landscape.
- Red and yellow well-drained sandy soil with high base status may occur.
- Freely drained, structure less soils may occur.
- Soils may have favourable physical properties.
- Soils may also have restricted depth, excessive drainage, high erodability and low natural fertility.

8.2.4 Topography

The topography has low relief. The slope gradient is between 0 and 2% with an undulating shape. The visual specialist, VRMA will develop a slope analysis of the site which will be included in the Draft Environmental Impact Report.

8.3 BOTANICAL COMPOSITION OF THE SITE

Mr. Simon Todd, of Simon Todd Consulting, conducted an Faunal and Flora Impact Assessment of the proposed Solar development sites (see Annexure D1 for full Ecological Impact Assessment Report), from which the following is drawn with regard to the vegetative component of the site.

8.3.1 Broad-Scale Vegetation Patterns

According to the national vegetation map (Mucina & Rutherford 2006), the entire development site is restricted to the Kalahari Karroid Shrubland vegetation type, with Bushmanland Arid Grassland being the other major vegetation type present in the wider area. In terms of the conservation status of the various vegetation types of the area, only Lower Gariep Alluvial Vegetation is of concern and is listed as Endangered. This vegetation type is however associated with the alluvium along the Orange River and would not be impacted by the current development which is some distance from the river itself.

Kalahari Karroid Shrubland occurs in the Northern Cape Province, typically forming belts alternating with Gorgonia Duneveld on the plains north-west of Upington through Lutzputs and Noenieput to the Rietfontein/Mier area in the north. There are also other patches around Kakamas and north of Groblershoop. This vegetation type is associated with flat gravel plains and represents a transitional vegetation type between the karoo and northern floristic elements associated with sandy soils. Kalahari Karroid Shrubland is classified as Least Threatened and has been little impacted by transformation and more 99% of its original extent is still intact (Table 2), it is however Hardly Protected within formal conservation areas. Mucina & Rutherford (2006) list no vegetation-type endemic species for Kalahari Karroid Shrubland, suggesting that most species associated with this vegetation are relatively widespread species, which correlates with the transitional nature of the vegetation type.

Typical species include include shrubs such as *Rhigozum trichotomum*, *Leucosphaera bainesii*, *Hermannia spinosa*, *Monoechma genistifoilium*, *Salsola rabieana*, *Aptosimum albomarginatum*, *A.spinecens*, *Kleinia longiflora*, *Limeum argute-carinatum*, *Phyllanthus maderaspatensis*, grasses such as *Stipagrostis anomala*, *S.ciliata*, *S.uniplumis*, *S.hochstetteriana*, *S.uniplumis* and *Schmidtia kalihariensis*. Drainage lines in the area are dominated by woody species such as *Acacia mellifera*, *Boscia foetida*, *Phaeoptilum spinosum*, *Cadaba aphylla* and *Parkinsonia africana*, with an understorey of low shrubs and grasses such as *Zygophyllum rigidum*, *Monechma spartioides*, *Indigofera heterotricha*, *Fingerhutia africana* and *Cenchrus ciliaris*. Soils within the study area are generally shallow and areas of very shallow soils or exposed calcrete are common, with deeper soils present in depressions and along drainage lines. In general, the areas of deeper soils have a higher proportion of perennial bunchgrasses such as *Stripagrostis*. It is likely that despite the site being classified entirely as Kalahari Karroid Shrubland, that there are areas within the site which have greater affinity with Bushmanland Arid Grassland, such as the eastern corner of the site which has , more loamy soils than the rest of the site. There may also be some areas of exposed quartz along ridges or higher-lying ground and species of conservation concern are frequently located within such areas and may include species such as *Lithops* and *Adenium oleifolium*. Protected species frequently encountered in this area include *Hoodia gordonii* and *Boscia foetida* and *Boscia albitrunca*.

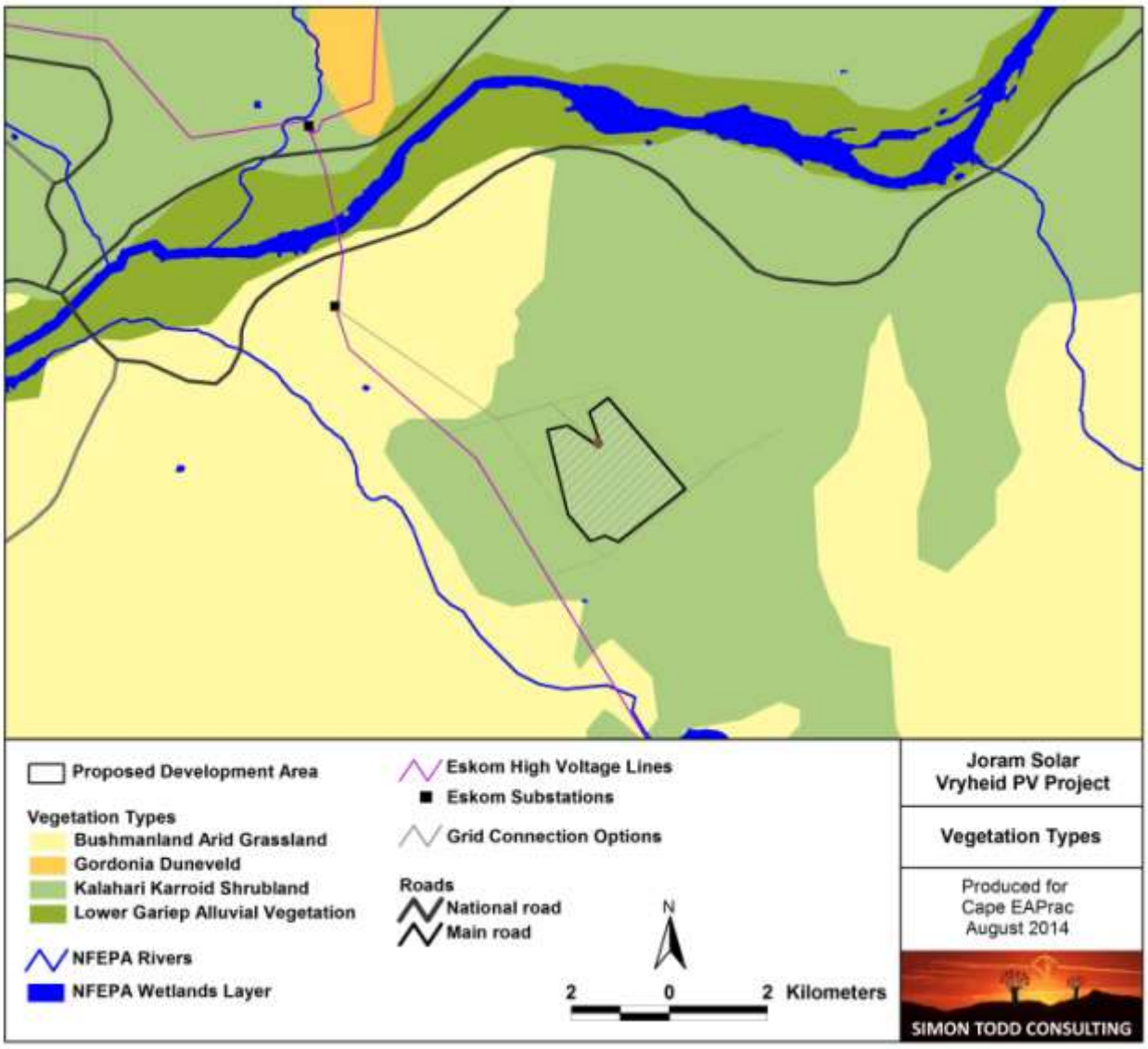

Figure 35: Broad-scale overview of the vegetation in and around the Joram Solar Project (Todd, 2014)

The vegetation map above is an extract of the national vegetation map as produced by Mucina & Rutherford (2006), and also includes rivers and wetlands delineated by the National Freshwater Ecosystem Priority Areas assessment (Nel et al. 2011).

The table below shows the vegetation types that occur within or near the site with their basic conservation statics and status according to the National List of Threatened Ecosystems (2011). Only Kalahari Karroid Shrubland occurs within the proposed development area.

Table 21: Vegetation types on or near Joram Solar (Todd, 2014)

Name	Extent km^2	Remaining	Conservation Target	Protected	Status
Kalahari Karroid Shrubland	**8284**	**99.2%**	**21%**	**0.1%**	**Least threatened**
Gordonia Duneveld	36772	99.8%	16%	14.2%	Least threatened
Lower Gariep Alluvial	752	50.3%	31%	5.8%	Endangered

Name	Extent km^2	Remaining	Conservation Target	Protected	Status
Vegetation					
Lower Gariep Broken Veld	4538	99.5%	21%	3.9%	Least threatened
Bushmanland Arid Grassland	45479	99.4%	21%	0.4%	Least threatened

Plate 11: The proposed Joram Solar study site as seen from the public road (Todd, 2014)

The photograph above was taken from near to the public road which runs along the southwest of the site. The facility would be located on the plains in the foreground and middle ground and does not reach the hills in the distance. The vegetation is dominated by grasses and shrubs, with *Rhigozum trichotomum* the dominant shrub and scattered *Acacia mellifera* visible along the drainage lines.

8.3.2 Listed and Protected Plant Species

According to the SANBI SIBIS database, 221 indigenous plant species have been recorded from the quarter degree squares 2821 AD, BC, CB and DA. This includes only 4 species of conservation concern, but those known from a somewhat wider area are listed below in Table 3 as the immediate area has not been well sampled and is not likely to be representative. It is not likely that many of these species are present at the site, or if they are, they would be localised within the site. There are also additional species which may be present which are either protected under the National Forests Act such as *Boscia albitrunca* or protected under the Northern Cape Nature Conservation Act of 2009, which includes *Boscia foetida*, all *Mesembryanthemaceae*, , all species within the *Euphorbiaceae*. *Oxalidaceae*, *Iridaceae*, all species within the genera *Nemesia* and *Jamesbrittenia*. It is not likely that many *Boscia albitrunca* would be affected by the development as this species is mostly restricted to larger drainage lines in the area and these do not occur within the site. *Boscia foetida* is however more common and may occur along the smaller drainage lines as well as in the open veld, and it is likely that at some of these will be present within the site. The number of affected individuals is however likely to be low and it is not likely that the development would generate a significant impact on this or any of the other listed and protected species.

Table 22: Listed species which may occur within the Joram Solar Development (Todd,2014)

Family	Species	IUCN Status	Likelihood
ASPHODELACEAE	*Aloe dichotoma*	VU	Low
MESEMBRYANTHEMACEAE	*Dinteranthus wilmotianus*	NT	Low
AMARYLLIDACEAE	*Crinum bulbispermum*	Declining	Low
FABACEAE	*Acacia erioloba*	Declining	Low
APOCYNACEAE	*Hoodia gordonii*	DDD	Moderate
GERANIACEAE	*Pelargonium reniforme subsp. reniforme*	DDD	Low
ASTERACEAE	*Gymnostephium ciliare*	DDT	Low
ASTERACEAE	*Senecio monticola*	DDT	Low

8.3.3 Critical Biodiversity Areas & Broad-Scale Processes

No fine-scale conservation planning has been conducted for the region and as a result, no Critical Biodiversity Areas have been defined for the study area. In terms of other broad-scale planning studies, the site does not fall within a National Protected Areas Expansion Strategy Focus Area (NPAES), indicating that the area has not been identified as an area of exceptional biodiversity or of significance for the long-term maintenance of broad-scale ecological processes and climate change buffering within the region. The development would however contribute to cumulative impacts in the area, which are becoming increasingly large given the concentration of renewable energy facilities in the area. Although there are currently no other developments in the immediate area, the Ilanga CSP project is located east of the site. The concentration of development within the area will increase the fragmentation of the landscape and potentially impact landscape connectivity.

8.4 FAUNAL COMPONENT OF THE SITE

The following input into the faunal component of the study site was provided by Mr Simon Todd. Please refer to **Annexure D1** for the full copy of the Fauna and Flora Impact Assessment Report.

8.4.1 Mammals

The site falls within the distribution range of 46 terrestrial mammals, indicating that the mammalian diversity at the site is of moderate potential. There do not appear to be any specialised faunal habitats within the site, which is relatively homogenous and it is only the drainage lines which are likely to be differentially utilised by mammals on account of their high cover and productivity. Overall, the site would not be not considered highly sensitive from a faunal perspective as similar habitat is widely available in the area.

Three listed terrestrial mammals may occur at the site, the Honey Badger *Mellivora capensis* (Endangered), Brown Hyaena *Hyaena brunnea* (Near Threatened) and Black-footed cat *Felis nigripes* (Vulnerable). Although the area is used for livestock production, human activity in the area is currently low and it is likely that all three listed species occur in the general area. As these species have a wide national distribution, the development would not create a significant extent of habitat loss for these species, a single individual of which has a home range far exceeding the extent of the current development.

The site lies within the distribution range of 6 bat species, indicating that the richness of bats at the site is probably quite low. Bat activity is probably focused along the Orange River, where there is ample food as well as an abundance of natural and artificial shelter. The lack of wetlands and large drainage lines away from the Orange River suggests that bat activity patterns within the site are likely to be low. There are also no pans within or near the site that would attract bats.

Overall there do not appear to be any highly significant issues regarding mammals and the development of the site. In general the major impact associated with the development of the site for mammals would be habitat loss and potentially some disruption of the broad-scale connectivity of the landscape.

8.4.2 Reptiles

According to the SARCA database, 39 reptile species are known from the area suggesting that the reptile diversity within the site is likely to be moderate to low. Species observed in the area include the Karoo Girdled Lizard *Karusasaurus polyzonus* which is usually associated with rocky outcrops, the Namaqua Mountain Gecko *Pachydactylus montanus* which shelters under rocks and the Spotted Sand Lizard *Pedioplanis lineoocellata* which is usually the most common reptile in the area.

Within the proposed development area, there are no large rocky outcrops or other specialised reptile habitats. As with mammals, the development is likely to result in local habitat loss for reptiles but as there are no listed or range-restricted reptiles that are likely to occur at the site the impacts are not likely to be of broader significance.

8.4.3 Amphibians

The site lies within the distribution range of 10 amphibian species. The only listed species which may occur at the site is the Giant Bullfrog *Pyxicephalus adspersus* which is listed as Near Threatened. There are no pans within the development area which would represent habitat for this species and so it is highly unlikely that the development would generate an impact of this species. There are no other natural perennial water sources at the site and amphibian abundance in the vicinity of the development area is likely to be low. As a result impacts on amphibians are likely to be local in extent and of low significance.

8.4.4 Avifauna

According to the SABAP 1 and 2 data sets, 190 bird species are known from the broad area surrounding the site. This includes 7 IUCN listed species (Table 3), all of which except for the Black Stork are likely to occur at the site. All of the listed species are susceptible to some degree to either or both electrocution or collision from power-line infrastructure. Larger raptors are susceptible to both collision and electrocution, while storks and bustards are all vulnerable to collision with power lines. This is a significant source of impact for these species in the country. At worst, the grid connection for the development would be about 10 km long, a proportion of which would be located on the outskirts of Upington where the abundance of vulnerable species is likely to be low. Overall impacts on avifauna are not likely to be highly significant.

Table 23: Listed bird species known to occur in the vicinity of the proposed Joram Solar Project (Todd, 2014)

Species	Common Name	Status	Collision	Electrocution
Falco biarmicus	Lanner Falcon	NT	High	Moderate
Falco naumanni	Lesser Kestrel	VU	High	Moderate
Ciconia nigra	Black Stork	NT	High	
Falco peregrinus	Peregrine Falcon	NT	High	Moderate
Ardeotis kori	Kori Bustard	VU	High	
Neotis ludwigii	Ludwig's Bustard	VU	High	
Polemaetus bellicosus	Martial Eagle	VU	Moderate	High

9 PLANNING CONTEXT

A Planning specialist will be appointed in order to consider the planning implications of the proposed facility. The results of the findings of the planning specialist will be presented in the Draft EIR. The following key components will likely take place from a planning perspective.

- A **land use change application** for the rezoning of 220ha, from **Agricultural Zone I to Special Zone**, will be lodged at the Khara Hais Local Municipality, in accordance with the Northern Cape Planning and Development Act (Act 7 of 1998).
- If there are restrictive Title Deed conditions burdening the proposed development, an application for the removal thereof will be lodged at the Government of the Northern Cape Province, Department: Corporate Governance and Traditional Affairs, in accordance with the Removal of Title Deed Restriction Act (Act 84 of 1967).
- Parallel to the rezoning application, a **long term lease application will be lodged at the National Department of Agriculture**, in accordance with the Subdivision of Agricultural Land Act (Act 70 of 1970).
- Relevant planning documents, on all spheres of Government, will be evaluated before any land use change application is launched. These documents include, but are not limited to the following: **NSDP** (National Spatial Development Perspective); **PGDS NC** (Provincial Growth and Development Strategy), Northern Cape Province; **IDP** (Integrated Development Plan); **SDF** (Spatial Development Framework).

The planning specialist will furthermore engage with the following authorities as part of the planning process. Where relevant, these authorities will also be engaged with as part of the Environmental Process and will be given an opportunity to provide input and comment on this

- **Upington Municipality** for approval in terms of the relevant Zoning Scheme;
- **Northern Cape Department of Agriculture** as well as the **National Department of Agriculture, Forestry & Fisheries** (DAFF) for approval in terms of Act 70 of 70 (SALA) and Act 43 of 83(CARA);
- **District Roads Engineer** for comment on the land use application;
- **Department of Water Affairs** (DWA) for comment in terms of the National Water Act and the land use application;
- **Department of Mineral Resources** for approval in terms of Section 53 of Act 28 of 2002;

- **Department of Transport & Public Works** for comment on the land use application;
- **South African Heritage Resource** (SAHRA) Agency for comment on the land use application;
- **Civil Aviation Authority** for comment on the land use application;
- **Eskom** Northern Cape for comment on the land use application; and
- **Northern Cape Nature** Conservation for comment on the land use application.

10 AGRICULTURAL POTENTIAL OF THE STUDY SITE

Mr Christo Lubbe, an agricultural specialist, undertook an agricultural potential study of the proposed Joram Solar Development from which the following is drawn. A full copy of the agricultural potential study is attached in Appendix D, Annexure D2 of this report.

The objectives of Mr Lubbe's study were to consider the possibility of temporary and permanent impacts on agricultural production that may result from the construction and operation of the PV Power Plant.

The key findings of this study are summarised below.

10.1 STRUCTURES ON SITE

There are no building structures on site, except for a borehole pump and reservoir At the entrance on the South western corner a gravel borrow pit exists.

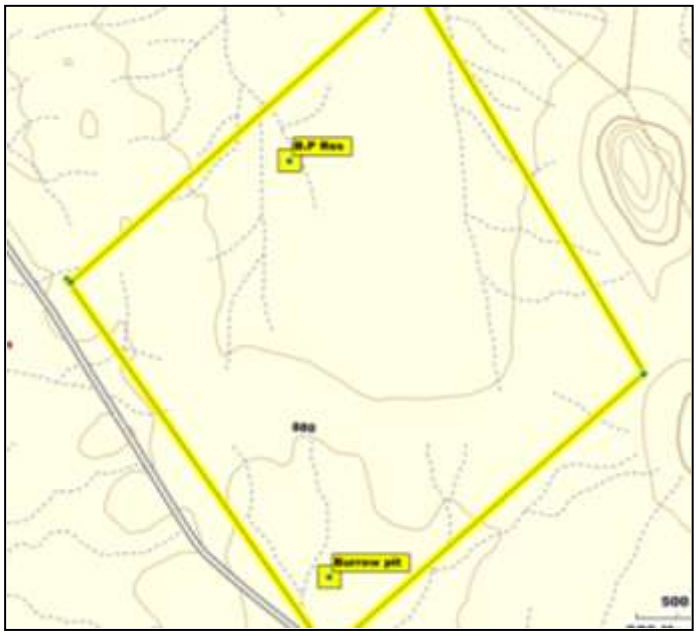

Figure 36: Showing existing structures on site (Lubbe, 2014)

10.2 SURROUNDING LAND USE

The site is surrounded by various stock farming activities.

10.3 PAST AND CURRENT AGRICULTURAL ACTIVITIES ON SITE

The site is currently utilised for extensive sheep farming. There is no evidence of past or current cultivation.

10.4 SOIL CLASSIFICATION

An augering survey was carried out by Mr Christo Lubbe, as indicated in the figure below. At each augering point, an observation record was completed.

The soil observation records were used to determine soil forms. These soil forms were then grouped in uniform utilization polygons, as illustrated.

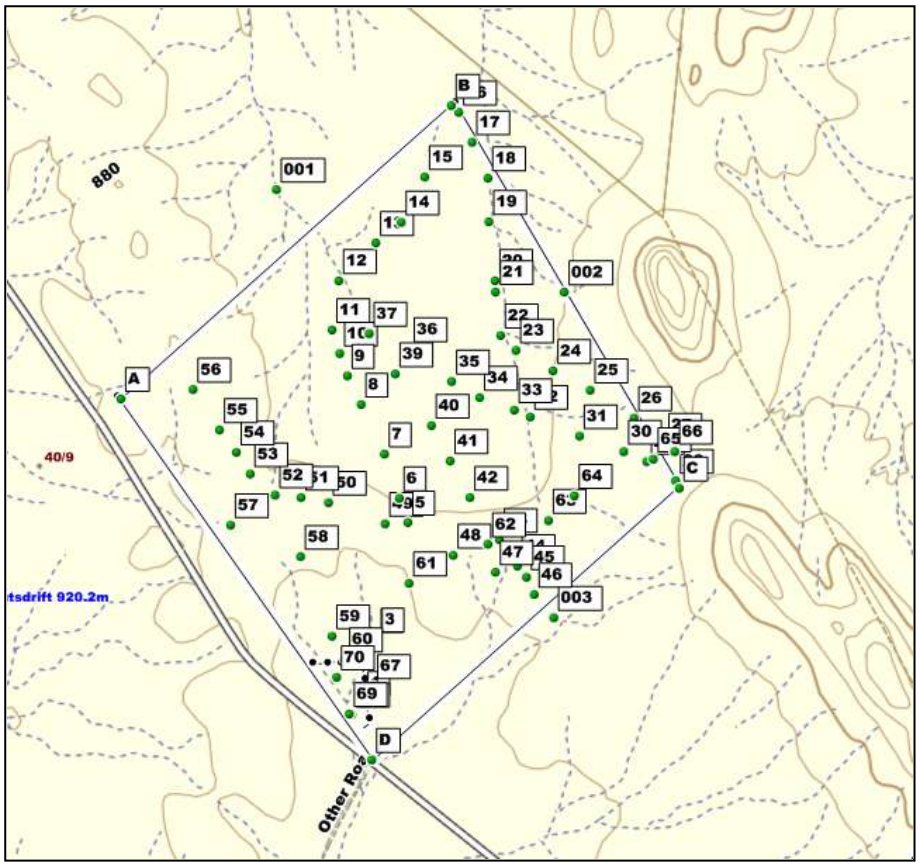

Figure 37: Showing soil augering points (Lubbe, 2014)

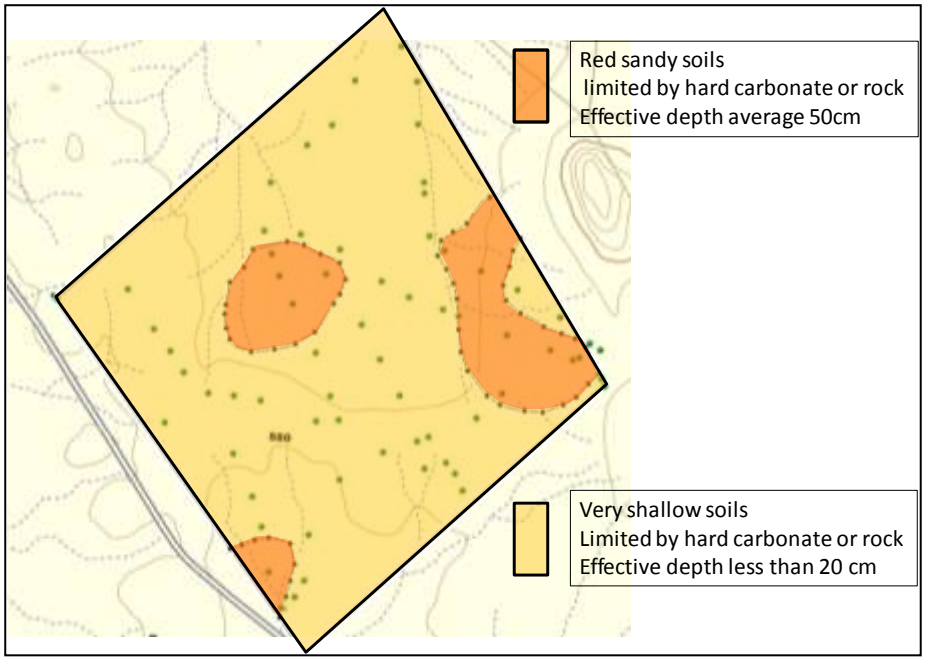

Figure 38: Soil Groups on the Joram Solar Study Site (Lubbe, 2014)

Figure 39: Soil Groups on the Joram Solar Study Site (Lubbe, 2014)

More than 80% of the soil on the site has an effective depth less than 20cm. The restriction is rock and hard carbonates sub surface layers. The top surface also is rough with a high level of surface rock. **Cultivation is not possible** because of these mechanical restrictions.

Some deep pockets of sandy soil with a depth up to 120cm occur and contribute to 18 % or 80 ha of the 450 ha unit.

10.5 VELD CONDITION ASSESSMENT

A veld condition assessment was done simultaneous with the soil survey, by visual acknowledgement and random sampling on 1m² grids. The outcome of the veld condition assessments is shown in the table below.

The photos in the plate below also show that the basal cover is low; consisting mainly of shrubs and poor grazing grasses. There is a moderate level of invasion of three thorn shrubs and *Acacia mellifera*.

Table 24: Outcome of veld condition assessment (Lubbe, 2014)

ASSESSMENT CATEGORY	FINDING	SCORE
PLANT COVER	Plant cover is very sparse with large bare areas	4
COMMON GRASSES	Mainly poor grazing grasses mixed with Karoo succulents	4
SURFACE CONDITION	Severe levels of top soil loss	1
BUSH ENCROACHMENT	Medium encroachment present Three thorn *Rhigozum and Black thorn Acacia mellifera*	3
SOIL TYPE	Sandy soil	2
TOTAL		**14**

Shrub veld with Three thorn and Black thorn invasion	Cover spars with mostly shrub vegetation and large bare and stony areas	Cover on soils deeper than 40 cm

Plate 12: Examples of veld conditions (Lubbe, 2014).

10.6 LAND CAPABILITY AND SUITABILITY FOR AGRICULTURE

The land surveyed falls in capability **class VI, generally not suited for cultivation**. Very severe limitations restrict land use to grazing, woodlands or wildlife - see tables below.

Table 25: Land Capability and Suitability Assessment for Crop Production (Lubbe, 2014)

Land capability class	Suitability Rating	Major Limitation to Crop Production	Area (ha)	% of Local Study Area
Class VI Cg and Hu	Very low	Low water holding capacity Shallow rooting zone	370	82

Land capability class	Suitability Rating	Major Limitation to Crop Production	Area (ha)	% of Local Study Area
<30 cm		Severe climate Severe erosion hazard		
Class IV Py >40cm	Low	Low water holding capacity Severe climate	80	18

Table 26: Land Capability and Suitability Assessment for Grazing (lubbe, 2014)

Area Description	Suitability Rating	Major Limitation to Grazing	Area (ha)	% of Local Study Area
Cattle /Sheep	Low	Very shallow rooting depth on carbonate hard setting, low clay content, low rainfall, with carrying capacity of 41-60 ha /LSU	450	100

10.7 WATER AVAILABILITY/PROVISION

Water is provided to livestock from a borehole pumped by windmill and stored in a reservoir and troughs.

10.8 SUMMARY OF FINDINGS

According to the agricultural specialist, the site is largely unsuitable for cultivation due to the following limiting factors:

- Low annual rainfall, high evaporation and extreme temperatures restrict dry land cultivation.
- The very shallow soil depth with its limited water holding capacity restricts root development
- The soils have carbonate-rich B-horizons. The use of Calcic soils is limited by climate (low rainfall and high evaporation), shallow soil depth, high pH, low plant available P and trace elements (especially Fe), toxic levels of extractable B and stoniness. All calcic soils are highly susceptible to water erosion.
- The very fine sand grade of top soil influences the stability and increases erodability potential.
- Low clay percentage results in low water holding capacity and low nutrient availability, resulting in low soil fertility.

The area could be utilised as grazing, but it should be noted that the grazing potential is very low.

Due to the low agricultural potential of the site, no additional studies are deemed necessary.

11 ECOLOGICAL SITE SENSITIVITY ANALYSIS

11.1 SITE SENSITIVITY ASSESSMENT

The Ecological Specialist, Mr Simon Todd undertook a site sensitivity analysis of the initial study site in order to inform the development of the preferred layout. Please refer to Annexure D1 for a full copy of the Ecological Impact Assessment Report.

The sensitivity map for the proposed development area of the Joram Vryheid PV Project site is illustrated below. The site is quite variable and a variety of different features are present, of which

the drainage lines, the pan and the rocky hill are identified as being of higher sensitivity. The impact of the development hinges largely on the extent to which these features can be respected by the development footprint. Although the current layout does not impinge on the hill and avoids most of the drainage lines as well as accommodating an exclusion zone around the pan, this may not be sufficient to reduce all impacts to a low level. **Although there is an exclusion zone around the pan, the pan would be an isolated remnant within the facility and as such would be ecologically isolated and would be likely to lose a significant proportion of its ecological functioning**. In addition, it is likely that there would changes in the runoff frequency or amount which would affect the period and extent of inundation of the pan. As the associated fauna have been selected over time based on these attributes, it is likely that development in the area would impact the faunal composition of the pan, which would be likely to be considered a negative impact. There is also the possibility that all the disturbance in the vicinity would increase the silt input into the pan which would change its' character and it is unlikely that it would be able to revert to its former condition naturally as the processes which currently maintain the pan would no longer be active. Therefore, although the pan is not likely to be lost which is preferable, it is considered likely that the development would result in the loss of a significant proportion of the ecological functioning of pan.

The drainage line to the north-east of the pan contains greater woody biomass than the other drainage lines at the site and includes a relatively large number of *Acacia erioloba*. As these are protected species, impact to these areas with higher densities of *Acacia erioloba* should be avoided as much as possible. With the implementation of some avoidance of the areas with highest density, it is likely that about **30 - 50 *Acacia erioloba* trees** would be impacted, which is not considered highly significant in the context of the large local population of this species in the area, which is clearly not in decline as is apparently the case in some areas. The remaining plains are relatively low sensitivity with few species or features of concern present. The only species of concern observed on the open plains was *Hoodia gordonii* which was observed as occasional scattered individuals across the plains.

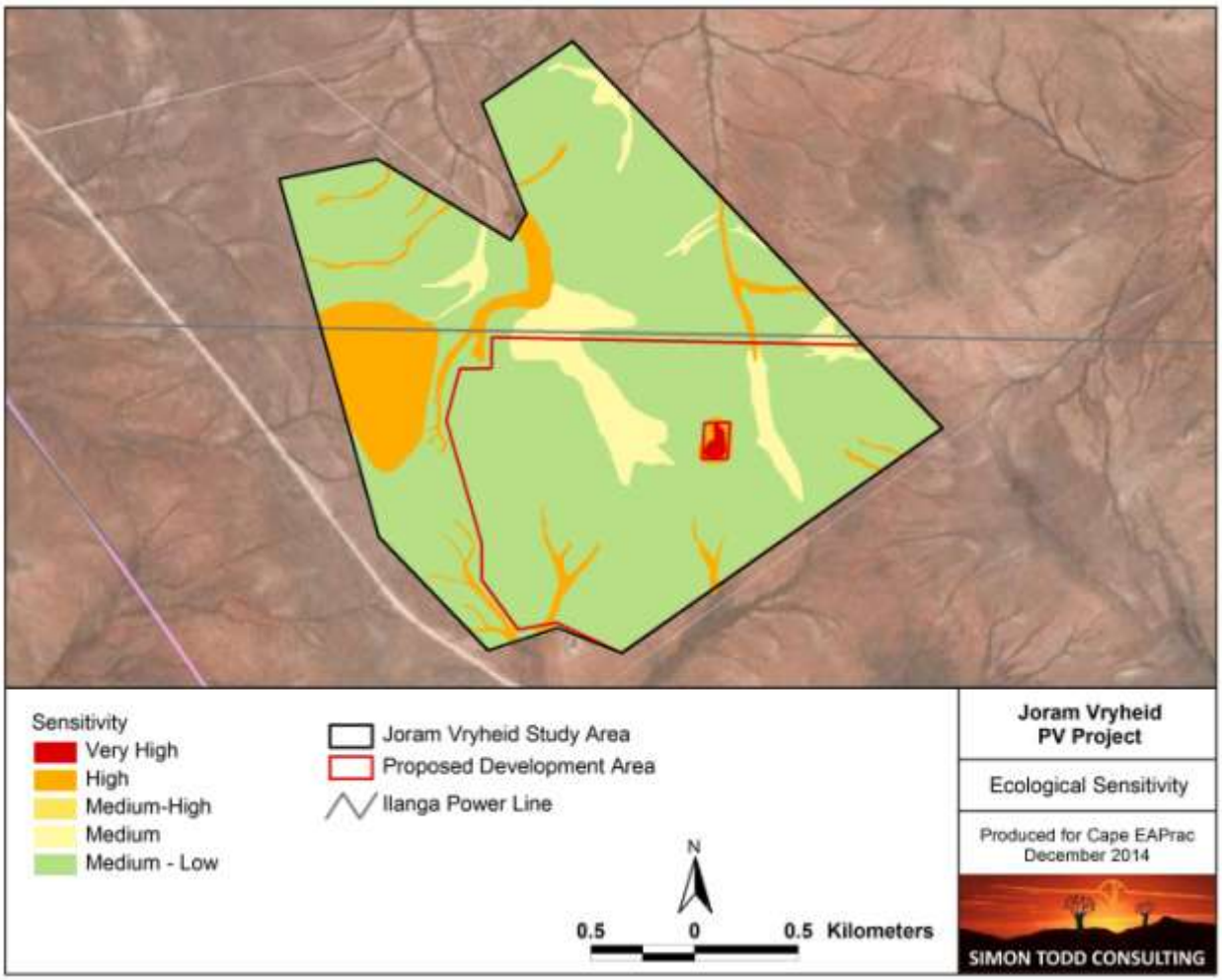

Figure 40: Ecological Sensitivity Map of the Joram Study site illustrating the proposed development area which includes an exclusion zone around the Pan

12 ASSESSMENT OF ECOLOGICAL IMPACTS

Mr Simon Todd undertook a detailed assessment of the potential impacts on the Fauna (including Avifauna and Flora of the site. Please refer to Annexure D1 for a full copy of the Ecological Impact Assessment Report.

12.1 IDENTIFICATION OF POTENTIAL IMPACTS AND DAMAGING ACTIVITIES

Potential ecological impacts resulting from the development of the Joram Vryheid Solar PV Project would stem from a variety of different activities and risk factors associated with the preconstruction, construction and operational phases of the project including the following:

12.1.1 Preconstruction Phase

- Human presence and uncontrolled access to the site may result in negative impacts on fauna and flora through poaching of fauna and uncontrolled collection of plants for traditional medicine or other purpose.
- Site clearing & exploration activities for site establishment would have a negative impact on biodiversity if this was not conducted in a sensitive manner.

12.1.2 Construction Phase

- Vegetation clearing for the PV arrays, access roads, site fencing etc could impact listed plant species as well as high-biodiversity plant communities. Vegetation clearing will also lead to habitat loss for fauna and potentially the loss of sensitive faunal species, habitats and ecosystems.
- Increased erosion risk would occur due to the loss of plant cover and soil disturbance created during the construction phase. This may impact downstream riparian and wetland habitats if a lot of silt enters the drainage systems.
- Presence and operation of construction machinery on site. This will create a physical impact as well as generate noise, pollution and other forms of disturbance at the site.
- Increased human presence can lead to poaching, illegal plant harvesting and other forms of disturbance such as fire.

12.1.3 Operational Phase

- The operation of the facility will generate noise and disturbance which may deter some fauna from the area.
- The areas inside the facility will requirement management and if this is not done appropriately, it could impact adjacent intact areas through impacts such as erosion, alien plant invasion and contamination from pollutants, herbicides or pesticides.
- Overhead power lines will pose a risk to avifauna susceptible to collisions and electrocution with power line infrastructure.

12.1.4 Cumulative Impacts

- The loss of unprotected vegetation types on a cumulative basis from the broad area may impact the countries' ability to meet its conservation targets.
- Transformation of intact habitat would contribute to the fragmentation of the landscape and would potentially disrupt the connectivity of the landscape for fauna and flora and impair their ability to respond to environmental fluctuations.

12.2 IMPACTS ASSESSED BY ECOLOGICAL SPECIALIST

The development will result in a variety of impacts, associated largely with the disturbance, loss and transformation of intact vegetation and faunal habitat to hard infrastructure such as roads, PV areas, operations buildings etc. The following impacts are identified as those most likely to be associated with the development and which are assessed for the different phases of the project as appropriate.

12.2.1 Impacts on vegetation and protected plant species

There are a number of listed and protected species present at the site and it is highly likely that some of these would be impacted by the development. Vegetation clearing during construction will lead to the loss of currently intact habitat within the development footprint and is an inevitable consequence of the development. As this impact is certain to occur it is assessed for the construction phase as this is when clearing will take place.

12.2.2 Soil erosion and associated degradation of ecosystems

The large amount of disturbance created during construction would potentially leave the site vulnerable to soil erosion. The site is gently sloping and disturbance leading to the loss of plant

cover over large parts of the site will certainly increase the risk of wind and water erosion at the site. In addition, the panels will generate a lot more runoff than the natural vegetation would and as a result the amount of runoff the site experiences is likely to increase. Soil erosion is therefore considered a likely impact and is assessed for the construction phase.

12.2.3 Impact on Ephemeral Pans

The development is likely to impact on the ephemeral pan at the site and even if it is suitably buffered and spared from development, it is likely to lose some ecological function and the long-term persistence of the pan within the facility is unlikely given the increased runoff and silt input that is likely to occur. In addition, the development will isolate the pan from the surrounding landscape, which may prevent some fauna which would have used the pan from accessing the site.

12.2.4 Direct Faunal Impacts

Increased levels of noise, pollution, disturbance and human presence during construction will be detrimental to fauna. Sensitive and shy fauna would move away from the area during the construction phase as a result of the noise and human activities present, while some slow-moving species would not be able to avoid the construction activities and might be killed. Some impact on fauna is highly likely to occur during construction as well as operation and this impact is therefore assessed for the construction phase and operational phase.

12.2.5 Alien Plant Invasion

The disturbance created during construction is highly likely to encourage the invasion of the disturbed areas by alien species. Although there are not a lot of alien species present within the undisturbed parts of the site, there were some aliens present in disturbed areas such as around watering points. This includes woody invaders such as *Prosopis glandulosa*. Such species will rapidly increase in abundance and expand into the disturbed areas if given the opportunity. This impact is deemed highly likely to occur and is assessed as a likely impact associated with the development.

12.2.6 Reduced ability to meet conservation obligations & targets

The loss of unprotected vegetation types on a cumulative basis from the broad area may impact the countries' ability to meet its conservation targets. The receiving vegetation types in the study area are classified as Least Threatened and are still more than 98% intact. As these are widespread vegetation types and there is no indication that there are any rare or restricted habitats within the development footprint, this is not considered to be a high risk associated with the current development when considered at the scale of the vegetation type. However, this impact is assessed on account of the high potential for cumulative impacts on more local habitat types which are not as widespread as the vegetation type itself.

12.2.7 Impact on broad-scale ecological processes

Transformation of intact habitat on a cumulative basis would contribute to the fragmentation of the landscape and would potentially disrupt the connectivity of the landscape for fauna and flora and impair their ability to respond to environmental fluctuations. Due to the large amount of development in the area, this is a likely cumulative impact of the development that is assessed.

12.3 ASSESSMENT AND SIGNIFICANCE OF IMPACTS ON FAUNA AND FLORA

12.3.1 Solar PV Development

The following assessed impacts are those for the solar facility itself, for the planning and construction and operational phases of the development

12.3.1.1 Planning & Construction Phase

Nature of impact	Spatial Extent	Duration	Intensity	Probability	Reversibility	Significance and Status		Confidence level
						Without Mitigation	With Mitigation	
Impacts on vegetation and listed or protected plant species resulting from construction activities	Local	Long-Term	High	Definite	Low	Medium-High Negative	Medium Negative	High
Mitigation/Management Actions • Preconstruction walk-through of the facility in order to locate species of conservation concern that can be translocated (such as *Hoodia*) as well as comply with the Northern Cape Nature Conservation Act and DENC/DAFF permit conditions. • Vegetation clearing to commence only after walk through has been conducted and necessary permits obtained. • Preconstruction environmental induction for all construction staff on site to ensure that basic environmental principles are adhered to. This includes awareness as to no littering, appropriate handling of pollution and chemical spills, avoiding fire hazards, minimizing wildlife interactions, remaining within demarcated construction areas etc. • Eco to provide supervision and oversight of vegetation clearing activities within sensitive areas such as near drainage areas. • Vegetation clearing to be kept to a minimum. No unnecessary vegetation to be cleared. • All construction vehicles should adhere to clearly defined and demarcated roads. No off-road driving to be allowed outside of the construction area. • Temporary lay-down areas should be located within previously transformed areas or areas that have been identified as being of low sensitivity. These areas should be rehabilitated after use. • The small ephemeral pan at the site should be delineated with construction tape and placed off-limit to all construction personnel.								
Direct Faunal Impacts During Construction	Local	Short-Term	Medium	High	High	Medium Negative	Medium-Low Negative	High
Mitigation/Management Actions • All personnel should undergo environmental induction with regards to fauna and in particular awareness about not harming or collecting species such as snakes, tortoises and owls which are often persecuted out of superstition. • Any fauna threatened by the construction activities should be removed to safety by the ECO or appropriately qualified environmental officer. • All construction vehicles should adhere to a low speed limit to avoid collisions with susceptible species such as snakes and tortoises. • All hazardous materials should be stored in the appropriate manner to prevent contamination of the site. Any accidental chemical, fuel and oil spills that occur at the site should be cleaned up in the appropriate manner as related to the nature of the spill. • If trenches need to be dug for water pipelines or electrical cabling, these should not be left open for extended periods of time as fauna may fall in and become trapped in them. Trenches which are standing open should have places where there are soil ramps allowing fauna to escape the trench.								
Soil Erosion Risk During Construction	Local	Medium-term	Medium-High	High	Low	Medium Negative	Low Negative	High
Mitigation/Management Actions • Dust suppression and erosion management should be an integrated component of the construction approach. • Disturbance near to drainage lines or the pan should be avoided and sensitive drainage areas near to the construction activities should demarcated as no-go areas.								

Nature of impact	Spatial Extent	Duration	Intensity	Probability	Reversibility	Significance and Status		Confidence level
						Without Mitigation	With Mitigation	
• Regular monitoring for erosion problems along the access roads and other cleared areas. • Erosion problems should be rectified on a regular basis. • Sediment traps may be necessary to prevent erosion and soil movement if there are topsoil or other waste heaps present during the wet season. • A low cover of vegetation should be left wherever possible within the construction footprint to bind the soil, prevent erosion and promote post-disturbance recovery of an indigenous ground cover.								

12.3.1.2 Operational Phase

Nature of impact	Spatial Extent	Duration	Intensity	Probability	Reversibility	Significance and Status		Confidence level
						Without Mitigation	With Mitigation	
Alien Plant Invasion Risk During Operation	Local	Long-term	Medium-High	High	Low	Medium Negative	Low Negative	High
Mitigation/Management Actions • Wherever excavation is necessary, topsoil should be set aside and replaced after construction to encourage natural regeneration of the local indigenous species. • The recovery of the indigenous grass layer should be encouraged through leaving some areas intact through the construction phase to create a seed source for adjacent cleared areas. • Due to the disturbance at the site as well as the increased runoff generated by the hard infrastructure, alien plant species are likely to be a long-term problem at the site and a long-term control plan will need to be implemented. Problem woody species such as *Prosopis* are already present and are likely to increase rapidly if not controlled. • Regular monitoring for alien plants within the development footprint as well as adjacent areas which receive runoff from the facility as there are also likely to be prone to invasion problems. • Regular alien clearing should be conducted using the best-practice methods for the species concerned. The use of herbicides should be avoided as far as possible.								
Soil Erosion Risk During Operation	Local	Long-term	Medium-High	High	Low	Medium Negative	Low Negative	High
Mitigation/Management Actions • All roads and other hardened surfaces should have runoff control features which redirect water flow and dissipate any energy in the water which may pose an erosion risk. • Regular monitoring for erosion after construction to ensure that no erosion problems have developed as result of the disturbance. • All erosion problems observed should be rectified as soon as possible, using the appropriate erosion control structures and revegetation techniques. • All cleared areas should be revegetated with indigenous perennial grasses from the local area. These can be cut when dry and placed on the cleared areas if natural recovery is slow.								
Faunal impacts during operation:	Local	Long-term	Medium	Moderate	High	Medium-Negative	Low-Negative	High
Mitigation/Management Actions • No unauthorized persons should be allowed onto the site. • Any potentially dangerous fauna such snakes or fauna threatened by the maintenance and operational activities should be removed to a safe location. • The collection, hunting or harvesting of any plants or animals at the site should be strictly forbidden. • If the site must be lit at night for security purposes, this should be done with downward-directed low-UV type lights (such as most								

LEDs), which do not attract insects.

- All hazardous materials should be stored in the appropriate manner to prevent contamination of the site. Any accidental chemical, fuel and oil spills that occur at the site should be cleaned up in the appropriate manner as related to the nature of the spill.
- All vehicles accessing the site should adhere to a low speed limit (30km/h max) to avoid collisions with susceptible species such as snakes and tortoises.
- If the facility is to be fenced, then no electrified strands should be placed within 30cm of the ground as come species such as tortoises are susceptible to electrocution from electric fences as they do not move away when electrocuted but rather adopt defensive behaviour and are killed by repeated shocks. Alternatively, the electrified strands should be placed on the inside of the fence and not the outside.

Impact on Ephemeral Pan	Local	Long-term	Medium	Moderate	Low	Medium-High Negative	Medium-Low Negative	Moderate

Mitigation/Management Actions

- The small catchment in the immediate vicinity of the pan should be delineated in the field prior to construction during the preconstruction walk-through of the facility, in order to determine the most appropriate set-back for this feature.
- The pan should be explicitly accommodated within the erosion and runoff management plans for the facility and it should not be used to receive and manage waste water or runoff at the site.
- The pan should be monitored during operation to ensure that it does not attract birds which are then negatively impacted by the panels or the power lines at the site.
- The pan should be fenced off from the facility, but with standard livestock-type fencing (not jackal-proof) that allows fauna to pass through.

Impact on Avifauna	Local	Long-term	Medium	Moderate	Low	Medium Negative	Medium-Low Negative	Low-Moderate

Mitigation/Management Actions

- Any avifaunal mortalities at the site should be recorded and the species affected and the cause of mortality established and recorded where possible.
- The impact of the pan on avifauna should be monitored during operation to ensure that it does not attract species which are negatively affected by the facility due to collision or other cause. Additional mitigation to reduce the attractiveness of the pan may be required if this proves to be a significant impact source.
- It is highly likely that some species will nest within the support frames of the panels, if the nests need to be removed for safety or other reasons, then this should be done after the breeding season and the favoured site blocked from further use if this is deemed important for valid operational reasons.

12.3.2 Power Line & Grid Connection

The following assessed impacts are those for the grid connection required to connect the facility to the Eskom grid, for the construction and operational phases of the development. No preconstruction-phase impacts are anticipated for the grid connection.

12.3.2.1 Construction Phase

Nature of impact	Spatial Extent	Duration	Intensity	Probability	Reversibility	Significance and Status		Confidence level
						Without Mitigation	With Mitigation	
Impacts on vegetation and listed or protected plant species resulting from construction activities	Local	Long-Term	Low	Probable	Moderate-High	Medium-Low Negative	Low Negative	High

Mitigation/Management Actions

- Preconstruction walk-through of the final power line route in order to identify any sensitive features which might be affected along the route, with minor adjustment of the route or pylon positions were necessary.

Nature of impact	Spatial Extent	Duration	Intensity	Probability	Reversibility	Significance and Status		Confidence level
						Without Mitigation	With Mitigation	
• No unauthorised site clearing or disturbance at the site without an ECO present or without the required permits from the provincial authorities.								

12.3.2.2 Operational Phase

Nature of impact	Spatial Extent	Duration	Intensity	Probability	Reversibility	Significance and Status		Confidence level
						Without Mitigation	Without Mitigation	
The operation and presence of the facility may lead to negative impacts on avifauna as a result of electrocution or collisions with the associated power transmission infrastructure.	Local	Long-Term	Low	Probable	Moderate	Medium Negative	Low Negative	Moderate
Mitigation/Management Actions • Ensure that all new lines are marked with bird flight diverters along their entire length, but particularly in areas where larger birds are likely to pass such as near drainage lines, dams or pans and hills. • All new power line infrastructure should be bird-friendly in configuration and adequately insulated (Lehman et al. 2007). • Any electrocution and collision events that occur should be recorded, including the species affected and the date. If repeated collisions occur within the same area, then further mitigation and avoidance measures will need to be implemented. Collisions should also be reported to the EWT-Eskom partnership (0860-111-535).								

12.3.3 Cumulative Impacts

The following are the cumulative impacts that are assessed as being a likely consequence of the development.

Nature of impact	Spatial Extent	Duration	Intensity	Probability	Reversibility	Significance and Status		Confidence level
						Without Mitigation	With Mitigation	
Reduced ability to meet conservation obligations & targets due to cumulative habitat loss	Regional	Long-Term	Low	Low	Moderate	Low Negative	Low Negative	Moderate-High
Mitigation/Management Actions • The development footprint should be kept to a minimum and natural vegetation should be encouraged to return to disturbed areas. • An open space management plan should be developed for the site, which should include management of biodiversity within the fenced area, as well as that in the adjacent rangeland.								
Impact on broad-scale ecological processes due to cumulative loss and fragmentation of habitat	Regional	Long-Term	Medium	Moderate	Low	Medium-Low Negative	Low Negative	Moderate-High
Mitigation/Management Actions • Minimise the development footprint as far as possible. • Avoid impact to potential corridors such as the riparian corridor associated with the Helbrandkloofspruit river as well as the smaller drainage lines within the facility itself. • The facility should be fenced off in a manner which allows fauna to pass by the facility within the property in a direction to and from the Orange River. In practical terms this means that the facility should be fenced-off to include only the developed areas and								

Nature of impact	Spatial Extent	Duration	Intensity	Probability	Reversibility	Significance and Status		Confidence level
						Without Mitigation	With Mitigation	
should include as little undeveloped ground or natural veld as possible.								

12.4 CONCLUSION AND RECOMMENDATIONS REGARDING IMPACT ON FAUNA AND FLORA

The site is quite variable in terms of the different habitats and features present, with the pan and the rocky hill being the most significant. There are also a number of drainage lines present which are considered sensitive. The intervening areas are considered less sensitive on account of the relatively low abundance of listed and protected species as well as the poor condition of the vegetation in general, which can be related to poor grazing management. A significant constraint on the development of the site is the Illanga power line which is proposed to traverse the site and which places pressure on the development to remain south the power line and impinge on the more sensitive parts of the site in order to achieve the desired extent and output.

The development of the site under the current development plan would result in the isolation and probably loss of ecological function of the small bedrock pan within the site. The development of the site would be highly likely to alter runoff or sediment yields at the site which affect the character and function of the pan. Buffering the pan and the small surrounding catchment would provide some protection from impact, but ultimately the isolation of the pan within the facility would be likely to prevent many fauna from using the pan and may also impinge on other associated ecological processes associated with the pan. **Although impact to the pan is considered undesirable, it is not considered to be a fatal flaw of the development** as while this is considered to be an important local feature, there are a fairly large number of such pans in the wider area and it is therefore not considered unique or irreplaceable and as such the impact on the pan would be considered to have largely local significance. **An additional concern associated with the pan would be the possibility that it would attract waterfowl and waders which might then be impacted by the facility due to collision with power lines or other similar impact**.

In terms of the likely ecological impacts associated with the development, impacts on vegetation and fauna during the construction phase are likely to be relatively high and are difficult to mitigate as little can be done to avoid the large amounts of disturbance associated with this phase of the development. This is however transient and disturbance levels during operation would be much lower. As the affected vegetation types are widespread and have been little impacted by transformation to date, the impact on vegetation is likely to be of locally high intensity, but is not considered to be of broader significance. Although there are some listed and protected species confirmed present within the site, their density is relatively low and their local populations are not likely to be compromised by the loss of the individuals within the development footprint. Similarly, while there are likely to be some listed fauna utilising the site, these are widespread species and the development would not be likely to generate a significant impact on the populations of these species. Cumulative impacts are a potential concern given the abundance of other renewable energy developments in the Upington area. However, there are relatively few facilities south of the Orange River and the current development would contribute to cumulative habitat loss and transformation in the area, but the contribution would be relatively small. Overall the development of the site is considered to have moderate overall potential impact because it is likely that some sensitive areas and the pan would be impinged on by the development and there are limited mitigation options to avoid or reduce these impacts.

13 ASSESSMENT OF HERITAGE RELATED IMPACTS

Mr Stefan De Kock undertook an integrated heritage assessment of the Proposed Joram Solar Facility. This integrated heritage assessment is included in **Annexure D3**.

The Integrated Heritage Study included the following additional specialist assessments in support of the Full Heritage Impact Assessment:

- Archaeological Impact Assessment – Dr Peter Nilssen – Appendix D4
- Paleontological Impact Assessment – Dr John Almond – Appendix D5
- Visual Impact Assessment – VRMA – Annexure D6

13.1 HISTORICAL BACKGROUND

Early travellers such as Wikar and Gordon travelled along the Orange River in the 1770's and described various communities living along the river (Penn 1995). By the mid-19th century the stretch of the Orange River to the west of Upington was settled by the Korana, a Khoekhoen group whose origins are still unclear (Strauss 1979). With increasing Trekboer encroachment from the south, the Korana became involved in a struggle to maintain an independent existence. The attempt by the Korana to resist resulted in two wars, that of 1868-9 and 1878-9.

Formally founded in 1884, the town of Upington was named after Sir Thomas Upington. Sir Thomas Upington (1844–1898), was born in Cork, Ireland, and was an administrator and politician of the Cape Colony. He was briefly Prime Minister of the Cape Colony, between 1884 and 1886, during a period of extreme turbulence in the Cape's history . However the town's origins date back to 1875, when a mission station was established and run by Reverend Schröder. The mission station now houses the town museum, known as the Kalahari Orange Museum.

The farm Vaal Koppies was first surveyed in 1883 and included a surface area of 20,586 morgen and 593 square roods (±17,696 ha). The original farm boundaries included the farms Vryheid, Gifkloof and Strausville.

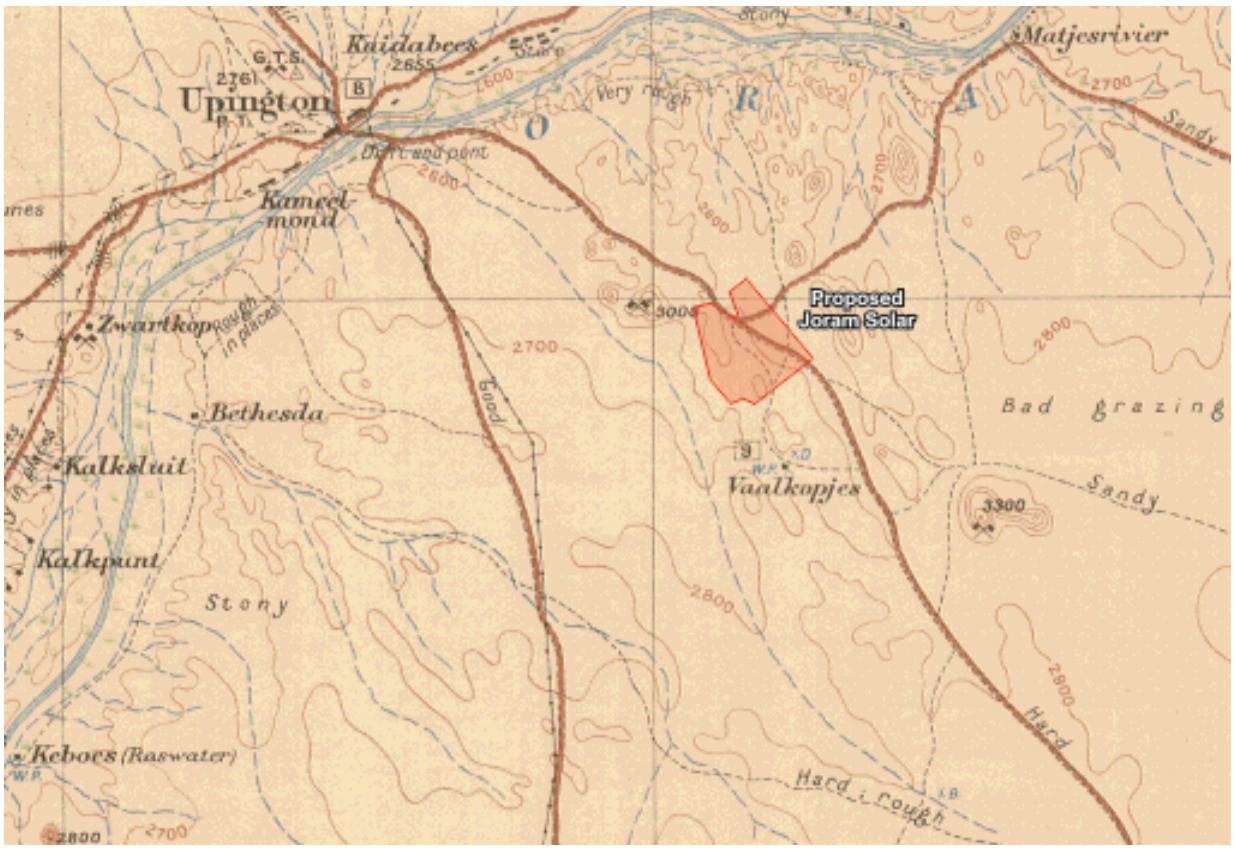

Figure 41: Approximate location of proposed development site transposed onto extract from early (1906-1914) mapping for the area southeast of Upington (Source: CDSM)

Early mapping (1906-1914) shows the location of an early farmstead at Vaalkopjes, south of the proposed development site boundary. Further structures recorded during the compilation of this mapping include a single well with wind pump, tank and trough as well as a small dam. Availability of water and grazing are described as fair during wet months and bad during dry months. The mapping furthermore highlights the alignment of several historic tracks through the area, which are no longer evident within the landscape.

Basic historic background research did not identify or highlight any significant historic or other heritage-related themes, which may be negatively impacted through the proposed development.

13.2 CULTURAL LANDSCAPE CONTEXT

The term “cultural landscape” refers to the imprint created on a natural landscape through human habitation and cultivation over an extended period of time. While the Cape has been inhabited for many hundreds of thousands of years (pre-colonial history) prior to Western settlement (colonial history), the nomadic lifestyles of early inhabitants are not always as evident within the landscape as the significant imprints made by humans during the last two – three hundred years and more. Unlike ancient landscapes in parts of the world where environmental conditions allowed more intensive cultivation over periods much longer than locally have allowed natural and cultural components of the landscape to become interwoven, landscape components Northern Cape have not yet developed in such a manner. The fact that natural and cultural landscape components in the region is therefore more distinguished means that the cultural landscape is likely to be very vulnerable to the cumulative impact of inappropriate large-scale development.

Ultimately, definition of a cultural landscape can be informed by the following elements, weighed through professional opinion, public values and statutory (legal) framework:

- Natural Landscape
- Public Memory
- Social History
- Historical Architecture
- Palaeontology
- Archaeology

The site may be described as forming part of a typical Kalahari landscape and defined by flat and wide open spaces overgrown by sparse, low-growing vegetation. From a Pre-Modern perspective, the site formed part of an area mostly used for small stock farming and so, modern man-made features noted on the site include single vehicle gravel tracks, a windmill with above surface concrete dam, feeding and watering troughs for cattle, cattle grazing, fencing, and a small quarry or borrow pit is situated immediately outside the south west corner of the 450 ha area. No structures or ruins were noted within the proposed site boundaries or its direct vicinity. From a cultural landscape perspective, the site is considered to be of no local cultural significance.

13.3 ARCHAEOLOGY

A copy of the Archaeological Impact Assessment (AIA), compiled by Dr. Peter Nilssen, is attached Annexure D4. Kindly refer to specialist's full report and findings.

"Previous archaeological studies in the area showed that the immediate surroundings do not contain significant archaeological sites. Although numerous Stone Age stone artefacts were recorded in the studied areas covered by this assessment, they occur as isolated finds or in very low density scatters that are temporally mixed, in derived and unstratified contexts and that lack organic remains and other cultural materials. No other tangible heritage resources were identified. Consequently, the archaeological record in the studied areas is considered to be of low significance, and therefore, it is recommended that no further archaeological studies are required prior to the development. Nevertheless, there are areas within the 450 ha study area that contain fewer stone artefacts, and it is suggested that the development activities associated with the solar facility be placed within these areas, as far as possible, in order to minimize the impact.

Overall, from an archaeological perspective there are no fatal flaws, and therefore, no objections to the authorization of the proposed development of the Joram Solar Facility and associated grid connection routes to the Gordonia Substation. Please refer to the figures below showing the Archaeological Findings in the Study Site and Grid Connection Route.

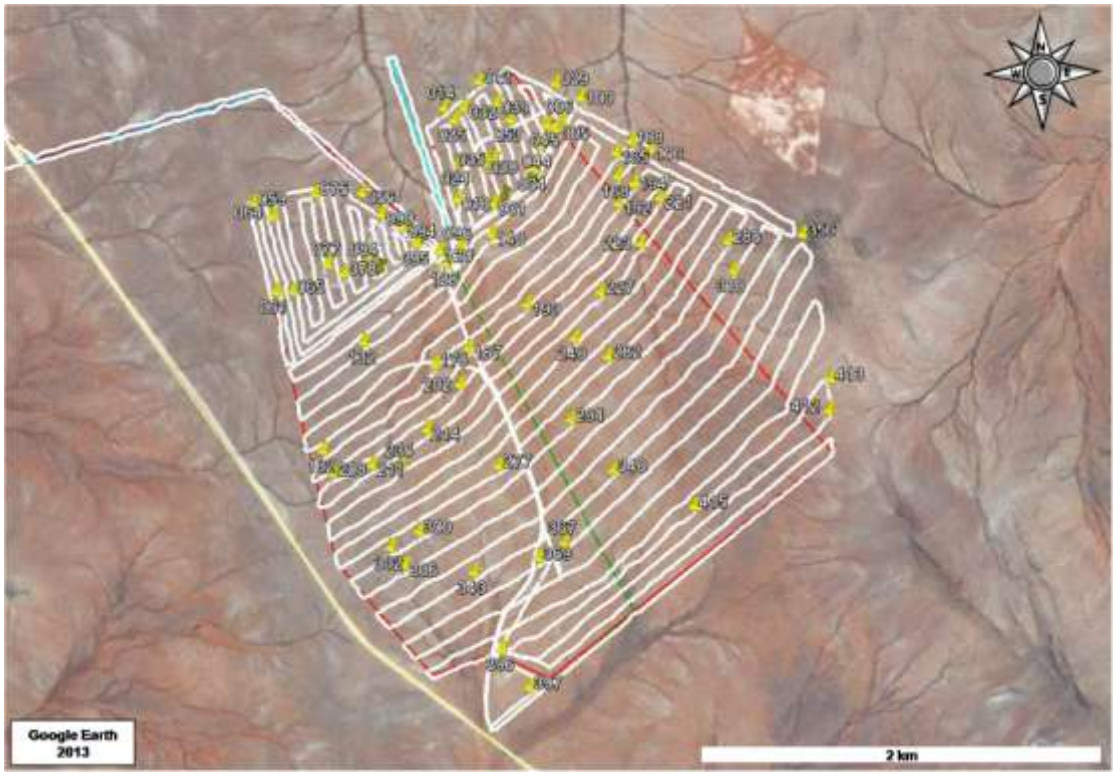

Figure 42: AIA Findings - archaeological occurrences recorded on and within proposed site boundaries (Nilssen, 2014)

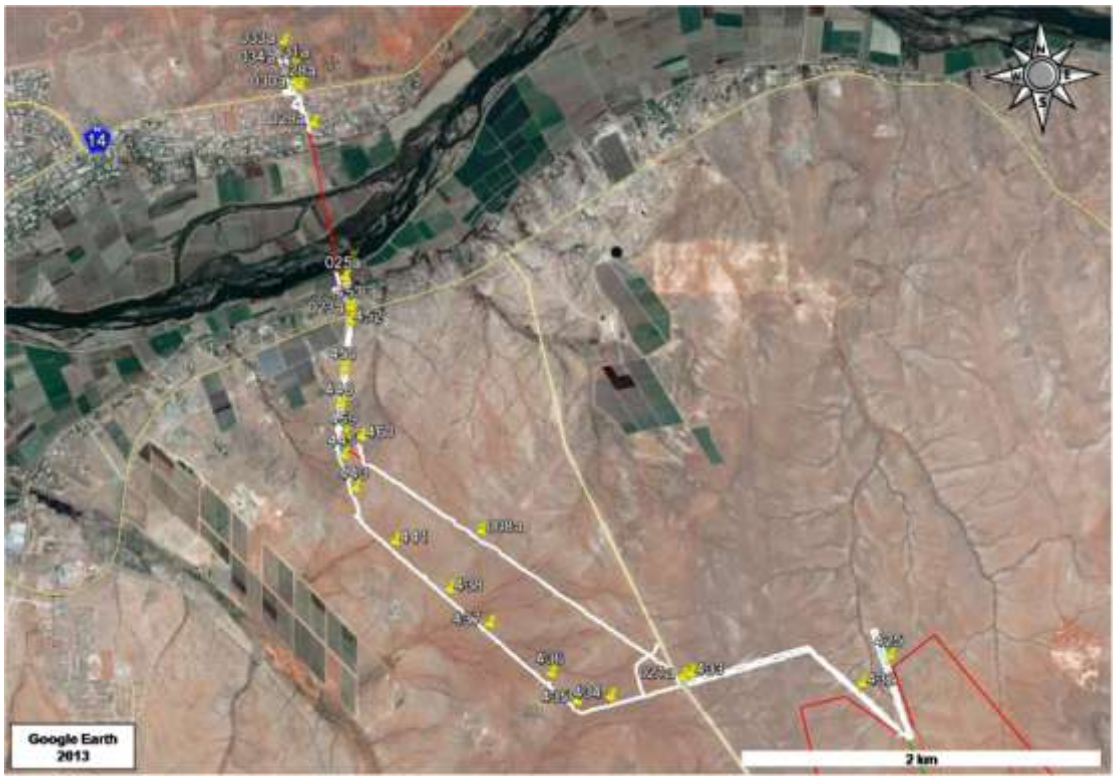

Figure 43: AIA Findings - archaeological occurrences recorded along possible grid connections (Nilssen, 2014)

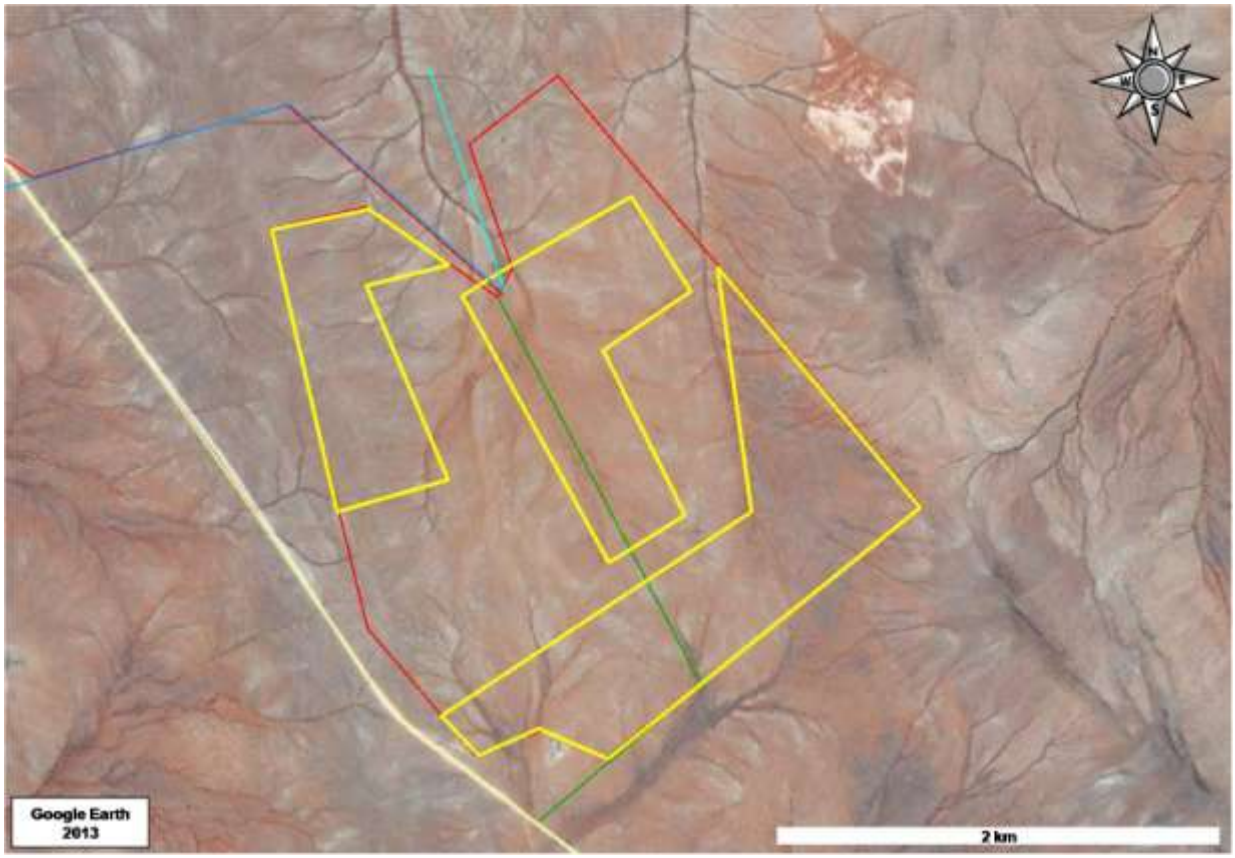

Figure 44:Yellow polygons demarcating areas that contain fewer Stone Age stone artefacts. While not a requirement, it is suggested that the solar facility footprint be placed within these polygons that have a collective extent of some 250 ha (Nilssen, 2014)

As can be seen, the preferred footprint has been positioned to the Southern extent of the study site and as such the majority of the development falls within these low occurrence zones.

13.3.1 Recommended Archaeological Mitigation Measures;

- Archaeological resources identified during this study do not require further recording/studies, and because they are considered to be of low heritage value and have been adequately recorded through this assessment, it is suggested that they can be disturbed or damaged without a permit from SAHRA;
- Certain areas within the larger 450 ha study area for the Joram Solar Facility contain very few artefacts and it is suggested that the development footprint be placed in these areas as far as possible, though this is not considered to be a requirement (see Figure 13).
- The development may benefit from having an on-site display of the Stone Age archaeological record in the area, though this will require negotiation with and permission from SAHRA.

13.3.2 Required Archaeological Mitigation Measures;

- In the event that excavations and earthmoving activities expose significant archaeological or heritage resources, such activities must stop and SAHRA must be notified immediately;
- If significant archaeological or heritage resources are exposed during construction activities, then they must be dealt with in accordance with the National Heritage Resources Act (No. 25 of 1999) and at the expense of the developer;

- In the event of exposing human remains during construction, the matter will fall into the domain of the South African Heritage Resources Agency (Mrs Colette Scheermeyer) and will require a professional archaeologist to undertake mitigation if needed. Such work will also be at the expense of the developer."

13.4 PALAEONTOLOGY

The findings and recommendations from a desktop palaeontological study (summarised below), compiled by Natura Viva (Dr. John Almond) conclude that no further related studies or mitigation would be required. Kindly refer to specialist's full report and recommendations (Annexure D5).

"The igneous and metamorphic Precambrian basement rocks underlying the Joram Solar Development study area at depth are entirely unfossiliferous. The overlying aeolian sands and stream gravels of the Kalahari Group mantling the older bedrocks are generally of low palaeontological sensitivity. Significant impacts on possible – but unmapped - older (Tertiary) fossiliferous river gravels along the southern banks of the Gariep are not considered likely.

It is concluded that the proposed Joram Solar Development near Upington, including the associated short transmission line, is unlikely to have significant impacts on local palaeontological heritage resources.

It is therefore recommended that, pending the discovery of significant new fossils remains before or during construction, exemption from further specialist palaeontological studies and mitigation be granted for the proposed Joram Solar Development on the farm Vaal Koppies 40 near Upington, Northern Cape.

13.4.1 Paleontological Reccomendations

Should any substantial fossil remains (e.g. mammalian bones and teeth) be encountered during excavation, however, these should be safeguarded, preferably in situ, and reported by the ECO to SAHRA, i.e. The South African Heritage Resources Authority, as soon as possible (Contact details: Mrs Colette Scheermeyer, P.O. Box 4637, Cape Town 8000. Tel: 021 462 4502. Email: cscheermeyer@sahra.org.za) so that appropriate action can be taken by a professional palaeontologist, at the developer's expense. Mitigation would normally involve the scientific recording and judicious sampling or collection of fossil material as well as associated geological data (e.g. stratigraphy, sedimentology, taphonomy) by a professional palaeontologist."

13.5 ECO-TOURISM

One of the goals of ecotourism is to offer tourists insight into the impact of human beings on the environment, and to foster a greater appreciation of our natural habitats and from an economic perspective, heritage resources may prove to be valuable resources when used in sustainable manner through eco-tourism. This may for example include investment in adaptive reuse of historic buildings so as to conserve and enhance the unique character and historic themes pertinent to this area. Heritage tourism can therefore serve as a driver for economic development, including infrastructure development and poverty alleviation through job creation. The broader region's rich archaeological, palaeontological, historical and natural heritage has the potential to provide unique tourism opportunities when developed and used in responsible and sustainable ways.

Given the location as well as pattern of existing land use within the proximity of the site and furthermore, the relative low density of heritage resources considered of cultural significance noted as part of this assessment, we do not consider that the proposed development would offer significant heritage-related eco-tourism opportunities associated with the development site.

13.6 HERITAGE INFORMANTS AND INDICATORS

According to the requirements of Section 38(3) of the NHRA, land use planning and EIA processes must be informed by and incorporate heritage informants and indicators (as done through the mapping and grading of relevant heritage resources in Section 8 of this report). It is the purpose of this Section to define heritage informants and indicators pertaining to the way in which heritage resources must be incorporated into the overall layout and design of the proposed development as read in conjunction with preceding Sections.

13.6.1 Cultural landscape issues

From a regional and natural landscape perspective, the proposed development site forms part of a highly-transformed landscape altered through mining activities as well as high concentration of proposals for development of several renewable energy (solar) facilities. While the proposal would relate to a landscape modification, we do not consider that it would alter any natural or cultural landscape of cultural significance.

13.6.2 Archaeology

All recommendations contained in AIA, as summarised in Section 8.2 of the HIA report shall be adhered to.

13.6.3 Palaeontology

It is recommended that no further palaeontological studies or mitigation be undertaken in respect of the proposed development site. Should substantial fossil remains be exposed during construction, however, the ECO should safeguard these, preferably in situ, and alert SAHRA as soon as possible so that appropriate action (e.g. recording, sampling or collection) can be taken by a professional palaeontologist.

13.7 SUMMARY OF HERITAGE RECOMMENDATION

Regarding the various heritage related assessments undertaken, the integrated heritage specialist recommended that:

1. The Integrated HIA fulfils the requirements of an Integrated Heritage Impact Assessment (HIA);
2. That the recommendations below be incorporated into the proposed development and that the Department of Environmental Affairs be informed accordingly:

- **AIA-1** Certain areas within the larger 450 ha study area for the Joram Solar Facility contain very few artefacts and it is suggested that the development footprint be placed in these areas as far as possible, though this is not considered to be a requirement
- **AIA-2** In the event that excavations and earthmoving activities expose significant archaeological or heritage resources, such activities must stop and SAHRA must be notified immediately
- **AIA-3** If significant archaeological or heritage resources are exposed during construction activities, then they must be dealt with in accordance with the National Heritage Resources Act (No. 25 of 1999) and at the expense of the developer
- **AIA-4** In the event of exposing human remains during construction, the matter will fall into the domain of the South African Heritage Resources Agency (Mrs Colette Scheermeyer)

and will require a professional archaeologist to undertake mitigation if needed. Such work will also be at the expense of the developer.

- **PIA-1** Should any substantial fossil remains (e.g. mammalian bones and teeth) be encountered during excavation, however, these should be safeguarded, preferably in situ, and reported by the ECO to SAHRA, i.e. The South African Heritage Resources Authority, as soon as possible (Contact details: Mrs Colette Scheermeyer, P.O. Box 4637, Cape Town 8000. Tel: 021 462 4502 (Email: cscheermeyer@sahra.org.za), so that appropriate action can be taken by a professional palaeontologist, at the developer's expense. Mitigation would normally involve the scientific recording and judicious sampling or collection of fossil material as well as associated geological data (e.g. stratigraphy, sedimentology, taphonomy) by a professional palaeontologist.

The EAP further recommends that these Heritage recommendations be incorporated into the conditions of approval for the Joram Solar Development.

14 ASSESSMENT OF VISUAL IMPACTS

Mr Stephen Stead of Visual Resource Management Africa (VRMA) undertook a Visual Impact Assessment of the proposed Joram Solar Facility from which the following is drawn. Please also refer to Annexure D6 for a full copy of the Visual Impact Assessment Report.

14.1 BASELINE ASSESSMENT

14.1.1 Project Visibility

The visible extent, or viewshed, is 'the outer boundary defining a view catchment area, usually along crests and ridgelines' *(Oberholzer, 2005).* This reflects the area, or extent, where a landscape modification of a specified height would probably be seen. In order to define the extent of the possible influence of the proposed project, a viewshed analysis is undertaken from the proposed sites at a specified height above ground level as indicated in the below table. The extent of the viewshed analysis was restricted to a defined distance that represents the approximate zone of visual influence (ZVI) of the proposed activities. The maps are informative only as visibility tends to diminish exponentially with distance, which is well recognised in visual analysis literature (*Hull, R.B. and Bishop, I.E., 1988)*.

Table 27: Proposed Project Heights Table

Project Phase	Proposed Activity	Approx. Height (m)	Approx. ZVI (km)
Construction and Operation	PV structures and Substation	10	12

A viewshed analysis was undertaken from the following locations:

- Proposed PV Site
    - North facing valley area
    - Southern south facing areas
    - Ridgeline area

The ZVI for the proposed PV site was extended to 12km as there is currently no precedent for built PV, no other industrial type structures in the area and no large vegetation. These factors lower the visual absorption capacity. Other proposed solar generation facilities in close proximity to the proposed Joram Solar are Illanga and Caroshoek CSP.

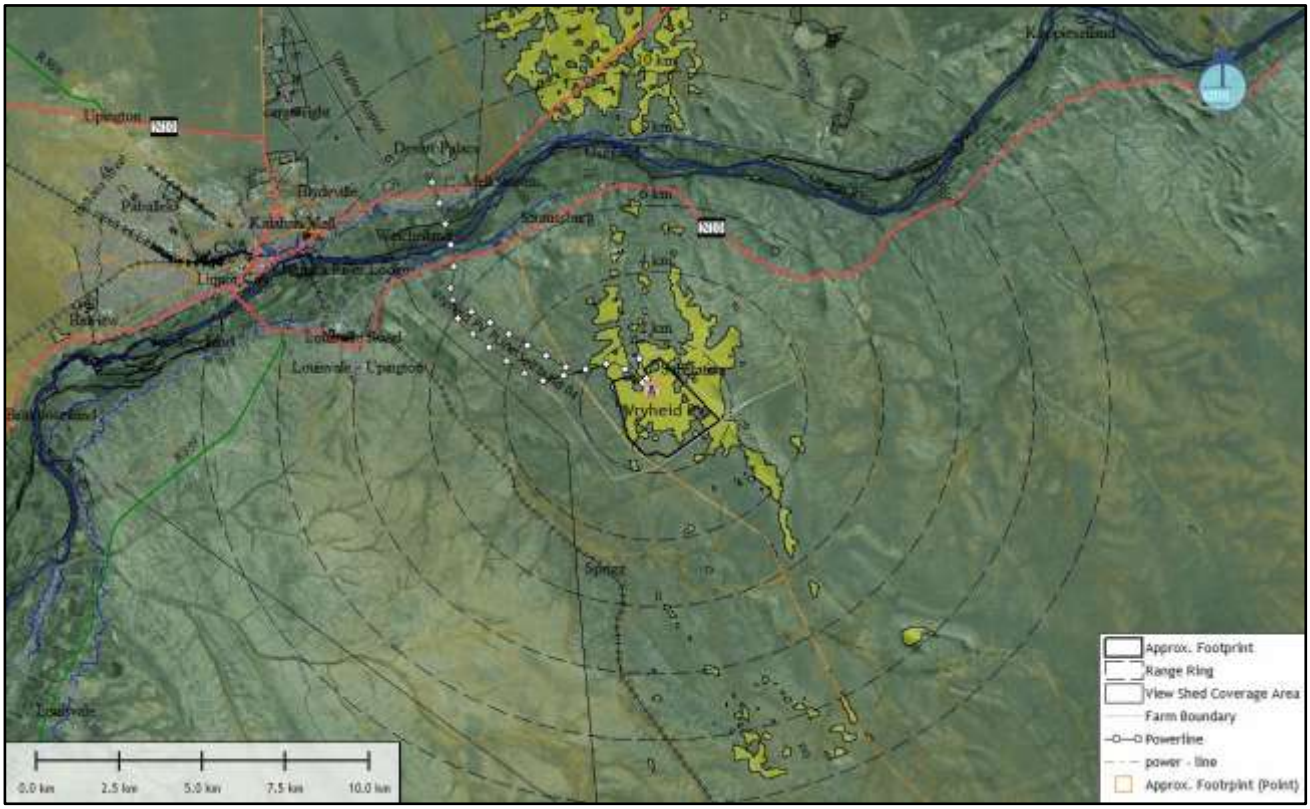

Figure 45: Viewshed from the valley area of the proposed site with a 10m offset overlay onto OS Satellite Image Map

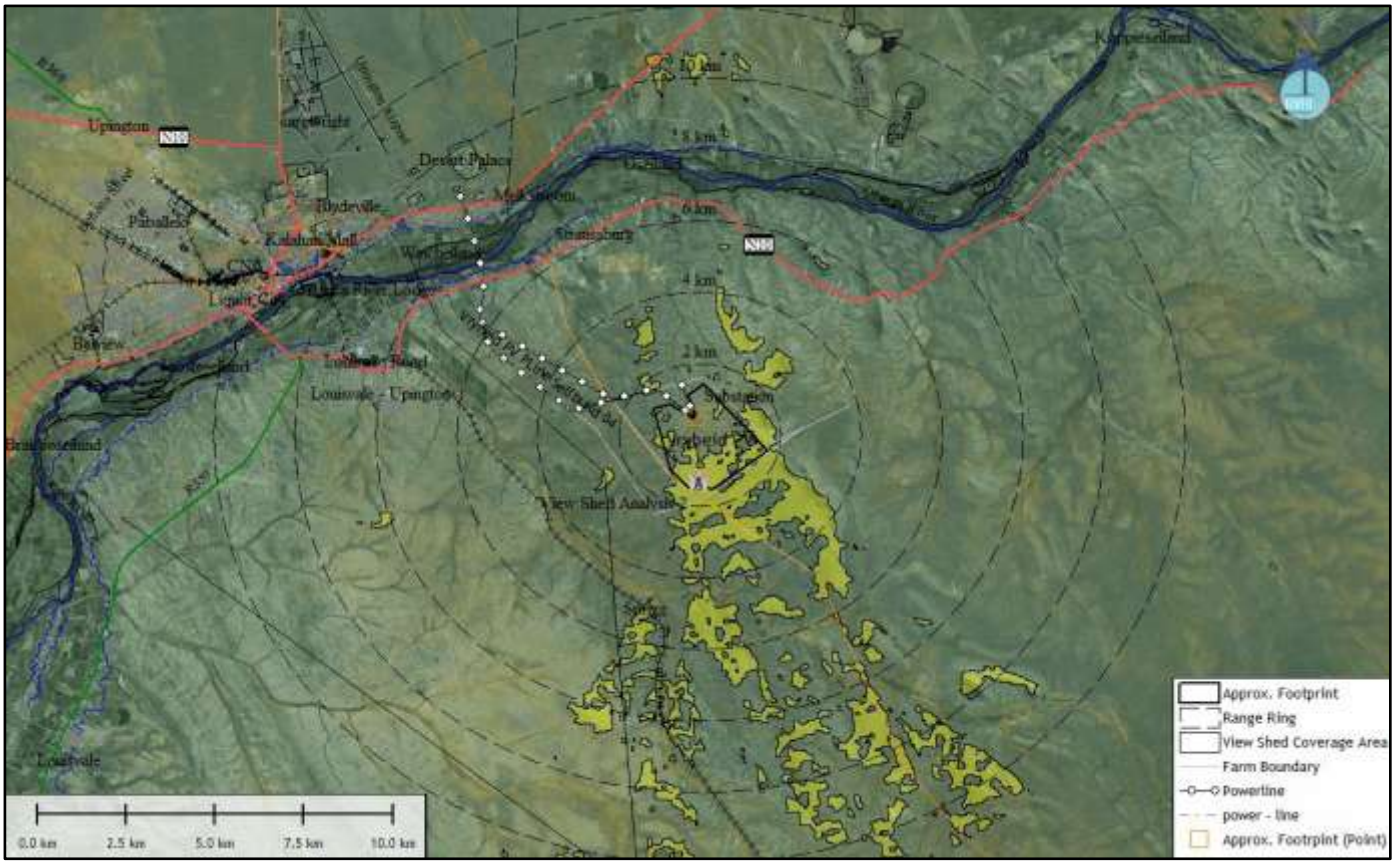

Figure 46: Viewshed from the southern area of the proposed site with a 10m offset overlay onto OS Satellite Image Map

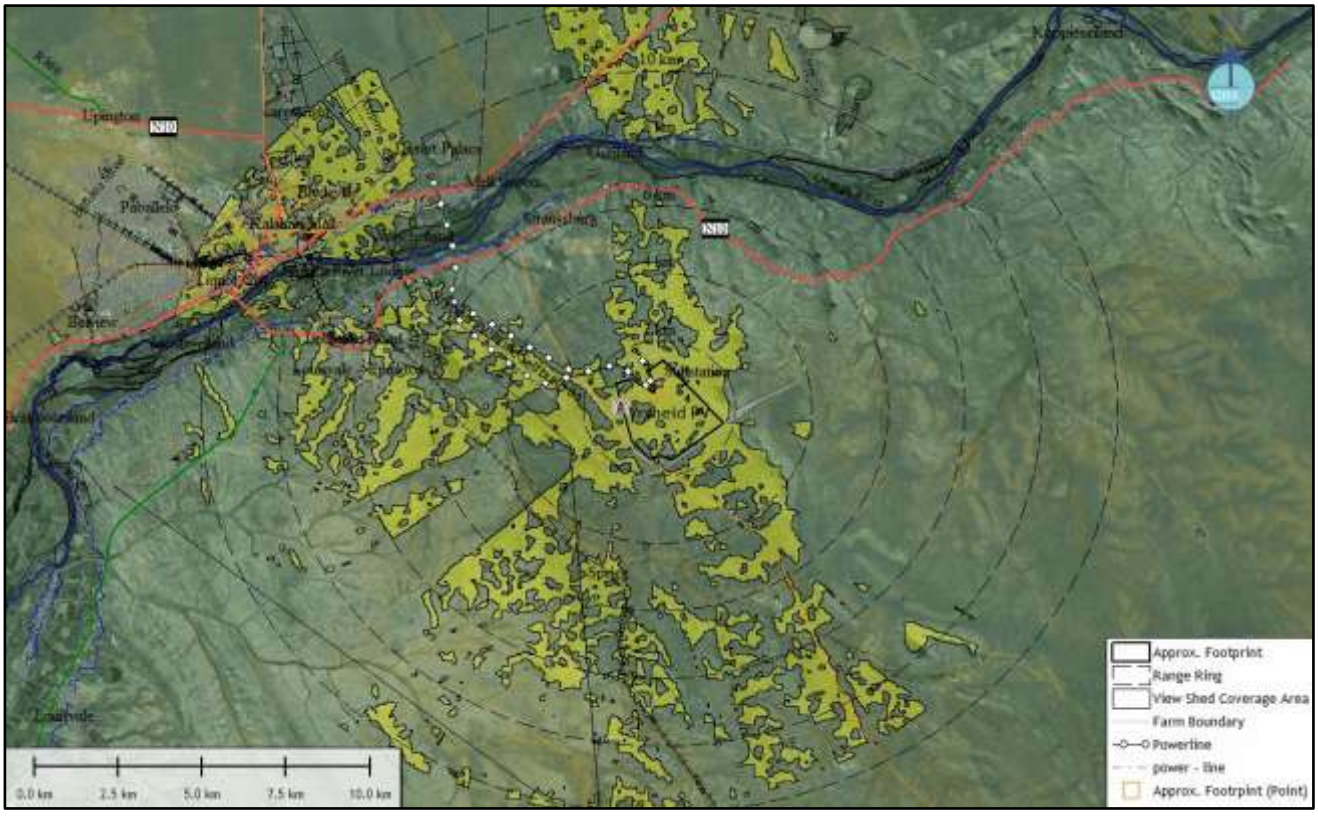

Figure 47: Viewshed from the ridgeline area of the proposed site with a 10m offset overlay onto OS Satellite Image Map

14.2 REGIONAL LANDSCAPE CHARACTER

Landscape character is defined by the U.K. Institute of Environmental Management and Assessment (IEMA) as the 'distinct and recognisable pattern of elements that occurs consistently in a particular type of landscape, and how this is perceived by people. It reflects particular combinations of geology, land form, soils, vegetation, land use and human settlement'. It creates the specific sense of place or essential character and 'spirit of the place' *(Spon Press, 2002).* The following landmarks were identified as significant in defining the surrounding area's characteristic landscape:

- Low hills to the east of the site which add value from to the region;
- Agri Tourism And Viniculture Cultural Landscape adjacent to the Orange River;
- Rural road (Kleinbegin) which runs south from the N10 national road, west of the proposed site;
- N10 national road;
- Orange River; and
- Upington Residential.

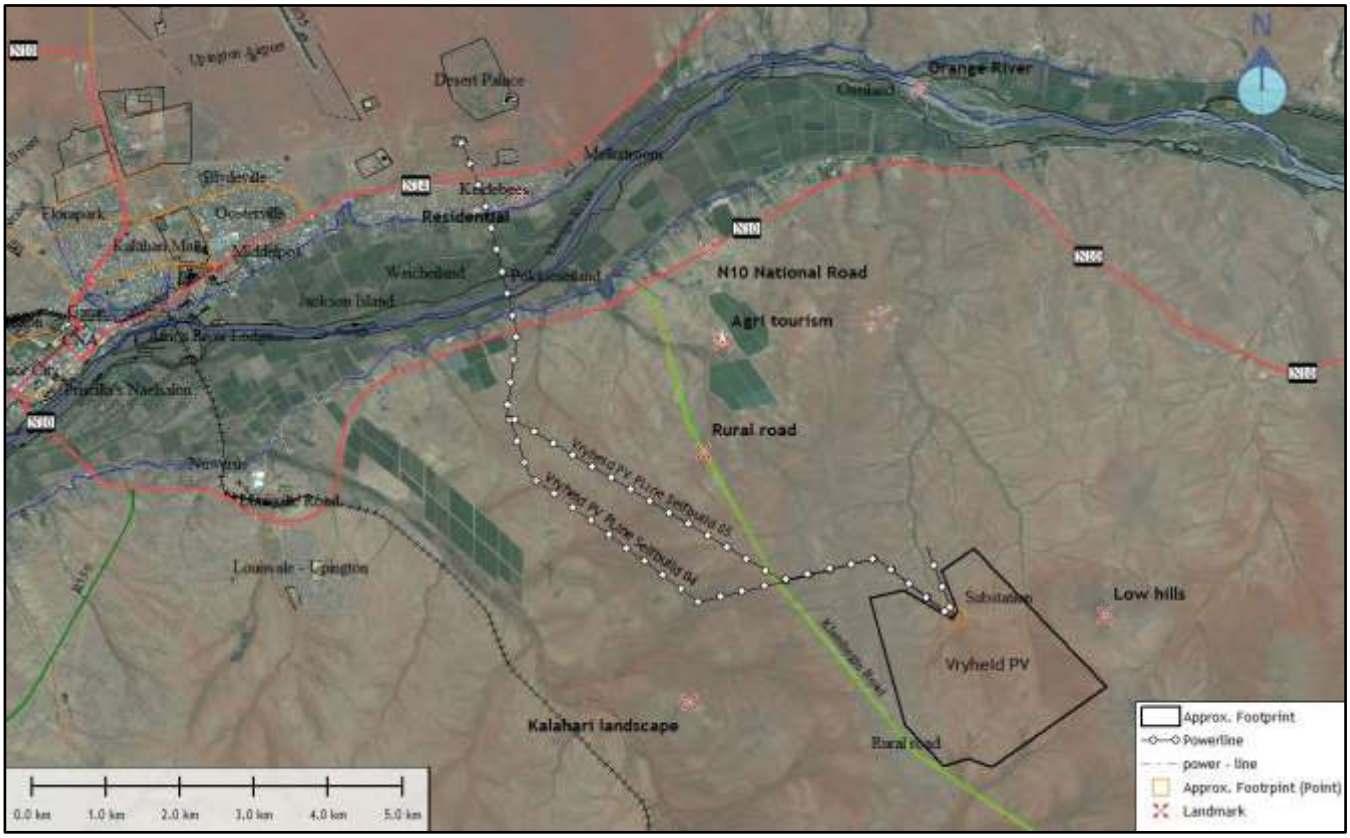

Figure 48: Landscape Context Photograph Points overlay onto Satellite Image

14.2.1 Low hills

Figure 49: Zoomed photograph taken east towards the low hills as seen from the proposed site

As depicted on all three of the PV site viewsheds, the low hills to the east of the site would have views of the proposed landscape modification. The low hills add landscape value by increasing undulation of the region. There are north-south aligned and rounded in form with limited man-made modifications. They significantly restrict the viewshed of the proposed PV site to the east.

Although having high exposure to the proposed project, there are no apparent tourist or residential receptors located in the vicinity (or directly using the visual resource) and it is likely that sensitivity to landscape change in the region would be low.

14.2.2 Agri-tourism

Figure 50: Photograph taken of the entrance to the Carpe Diem Raisons farm

As depicted in Figure 9, the only part on the proposed site which extends the potential visibility of the project to the north, is the ridgeline area to the west. It is unlikely that any views of the site

would be visible from the Carpe Diem Raisons farm. There are other similar types of agri-tourism initiatives taking place along the N10, but receptors making use of these tourist based activities would experience low exposure views (if at all).

14.2.3 Roads and infrastructure

Figure 51: Photograph taken of the N10 (bottom) and Klienbegin (top) roads

There are two roads which fall within the proposed PV and powerline viewshed, the rural road (Kleinbegin) and the N10 national road. The Kleinbegin road is routed south from the N10 national road to the west of the proposed site and acts as a low volume access for farms in the southern interior. The N10 national road links the town of Upington with Prieska in the south. This is an important tourist route and should be considered a tourist view corridor.

As depicted in the viewshed maps, it is unlikely that receptors using the N10 would have any view of the proposed PV site. As depicted in the powerline viewshed, the N10 receptors would have high exposure views of the powerline where it crosses over to the north. The proposed routing is aligned with an existing 132kv Eskom powerline which does increase the VAC levels, however the N10 should be considered as a KOP where landscape change should be moderated.

14.2.4 Orange River And Viniculture Landscape

Figure 52: Photograph taken of the Orange River obscured by trees as seen from the elevated northern Upington residential areas

The main landscape feature in the area is the Orange River valley. This landscape includes the river and residential and agricultural developments along the valley. The cultural landscapes of this area are primarily associated with agricultural activities and vineyards on the more fertile lands along the Orange River and they add value to the overall vista. The types of receptors making use of the Orange River visual resources are mostly related to agriculture, tourism and residential. It is likely that maintaining the existing sense of place would be important to these receptors. The area is also strongly associated with the 'vineyard' cultural landscape and hence attractive to landscape based tourism. Although it is unlikely that receptors would have views of the proposed PV site, the proposed powerline does cross the Orange River and the cultivated areas adjacent the river. Due to the cultural landscape significance, it is likely that receptor sensitivity to change in landscape character in these areas would be *moderate to high*.

14.2.5 Upington Residential

Figure 53: Photograph taken of the Upington residential areas

Located to the north of the Orange River on elevated ground, residential receptors look across the river towards the proposed site. As depicted on the viewshed maps, only the ridgeline areas of the proposed PV site would possibly be seen. The powerline is routed along an existing 132kv Eskom powerline corridor and residential receptors would have high exposure views of this. Due to the existing precedent, it is likely that receptor sensitivity would be moderated.

14.3 SITE LANDSCAPE CHARACTER

In terms of the Visual Resource Management methodology, landscape character is derived from a combination of scenic quality, receptor sensitivity to landscape change, and distance of the proposed landscape modification from key receptor points. The scenic quality is determined making use of the VRM scenic quality questionnaire (refer to addendum). In order to better understand the visual resources of the site, regional vegetation and terrain influences are described at a broad brush level.

14.3.1 Topography

Elevation profiles were generated making use of ASTER data Digital Elevation Model. The profiles across the study area reflect an undulating terrain with some shallow ridgelines located on the proposed site. The low and high points on the site are 841 m and 877 m respectively.

The west to east profile depicts a gradual increase in elevation with the proposed site contained between two high points which restrict the east-west visibility as depicted on the valley area viewshed map. Also apparent is the close proximity of the western boundary of the proposed site to the ridgeline which will generate skyline intrusion as seen from the lower lying western areas.

The north to south profile depicts undulating terrain with some moderately prominent sections which increase regional visibility. The south-western section of the site has the potential to generate skyline intrusion to the lower lying western areas.

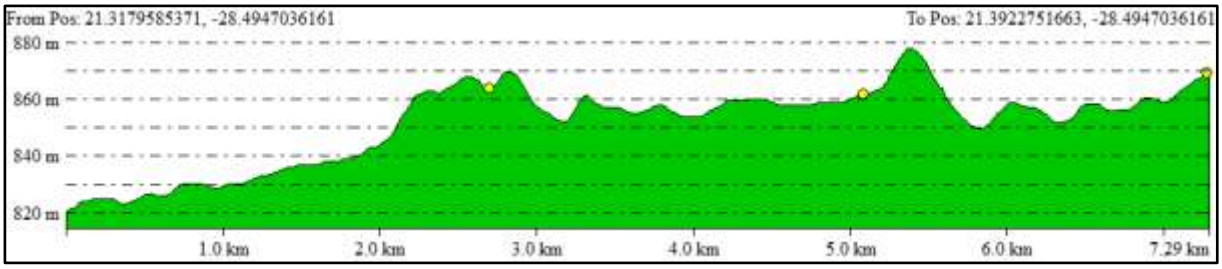

Figure 54: West to East profile with dots indicating the proposed project boundary

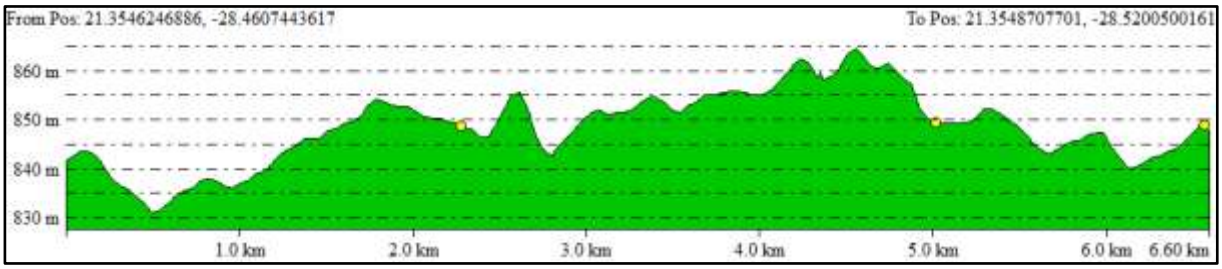

Figure 55: North to South profile with dots indicating the proposed project boundary

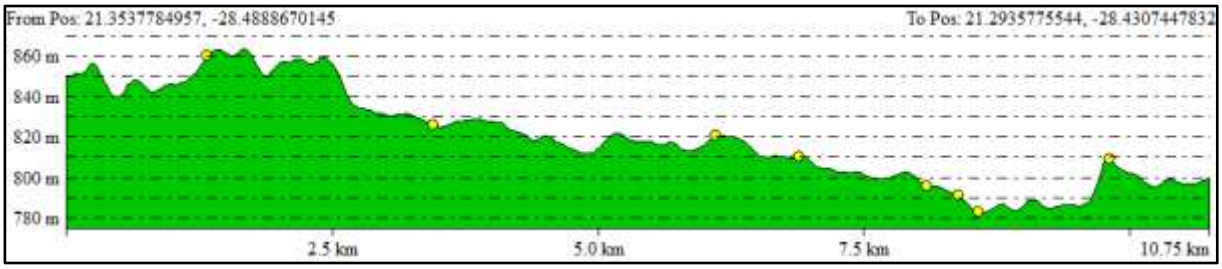

Figure 56: South to North along the proposed powerline routing

The profile along the proposed powerline routing starts at a higher elevation of 850mamsl, increases in elevation to a shallow ridgeline before it starts to drop down into the Orange River valley low point of approximately 780mamsl. Continuing to the north over flat floodplains, the route crosses a steep sided valley in the vicinity of the Upington residential areas before flattening towards the substation location. In the vicinity of the proposed site, there are moderately prominent ridgelines which have the potential to generate higher levels of visual contrast due to skyline intrusion.

14.3.2 Site Visual Resources

The VRM process requires that visual objectives are defined for each of the main physiographic rating units. The following broad brush Landscapes were identified and surveyed within the study area:

- Dry land agriculture south facing;
- Drainage lines;
- Dry land agriculture ridgeline;
- Dry land agriculture north facing;
- Kleinbegin Rural road;
- N10 National road; and

- Upington residential

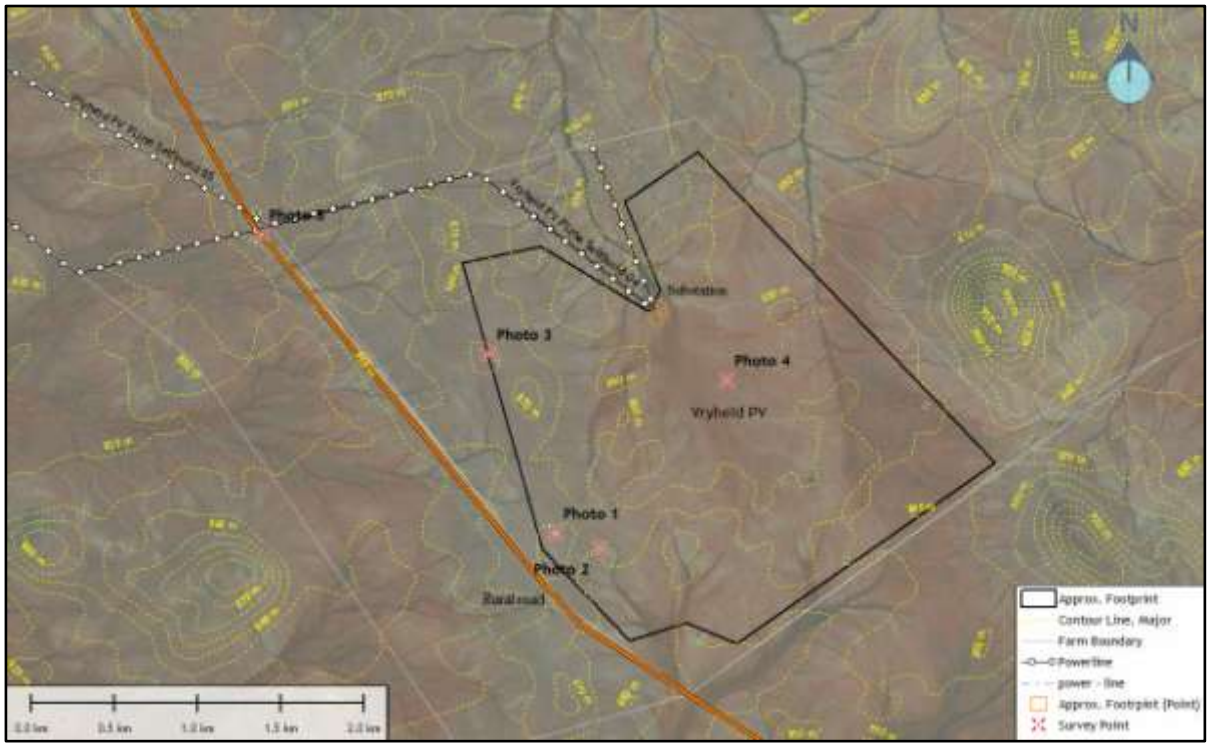

Figure 57: Southern landscape character survey points overlay onto OS satellite image map

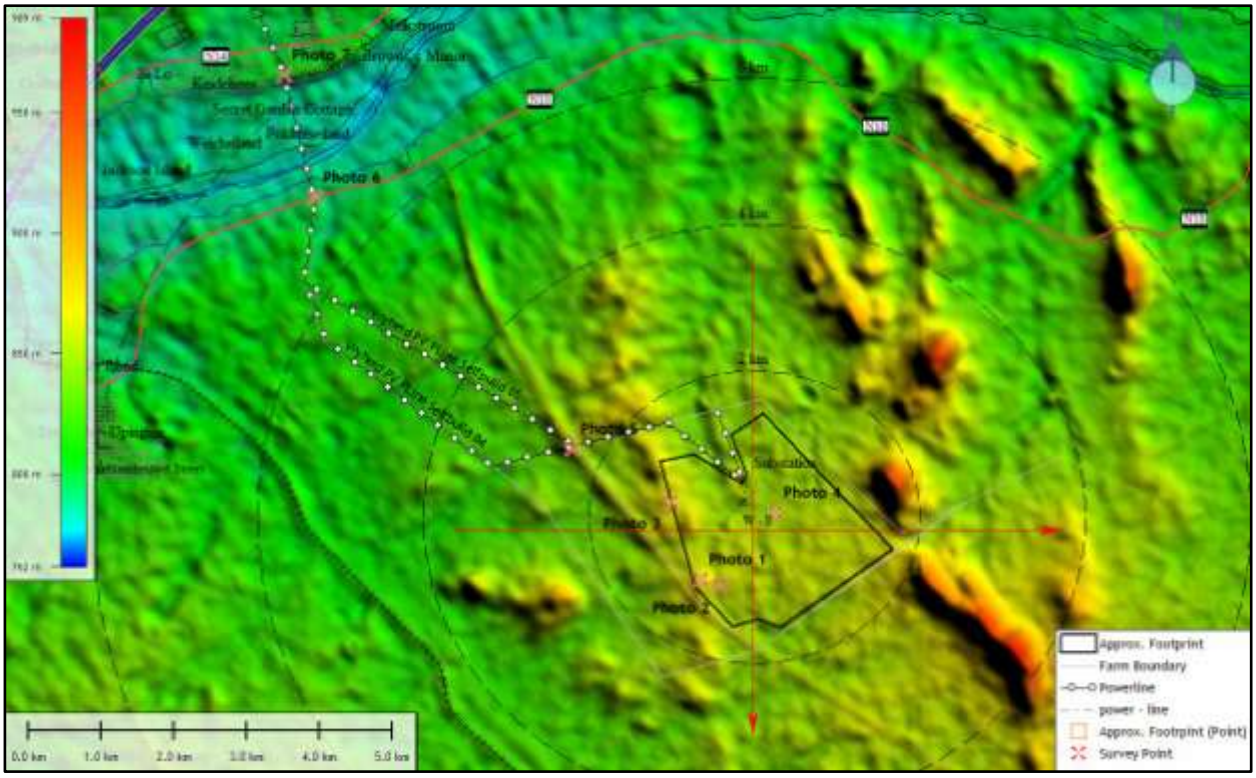

Figure 58: Regional elevation model and profile lines map

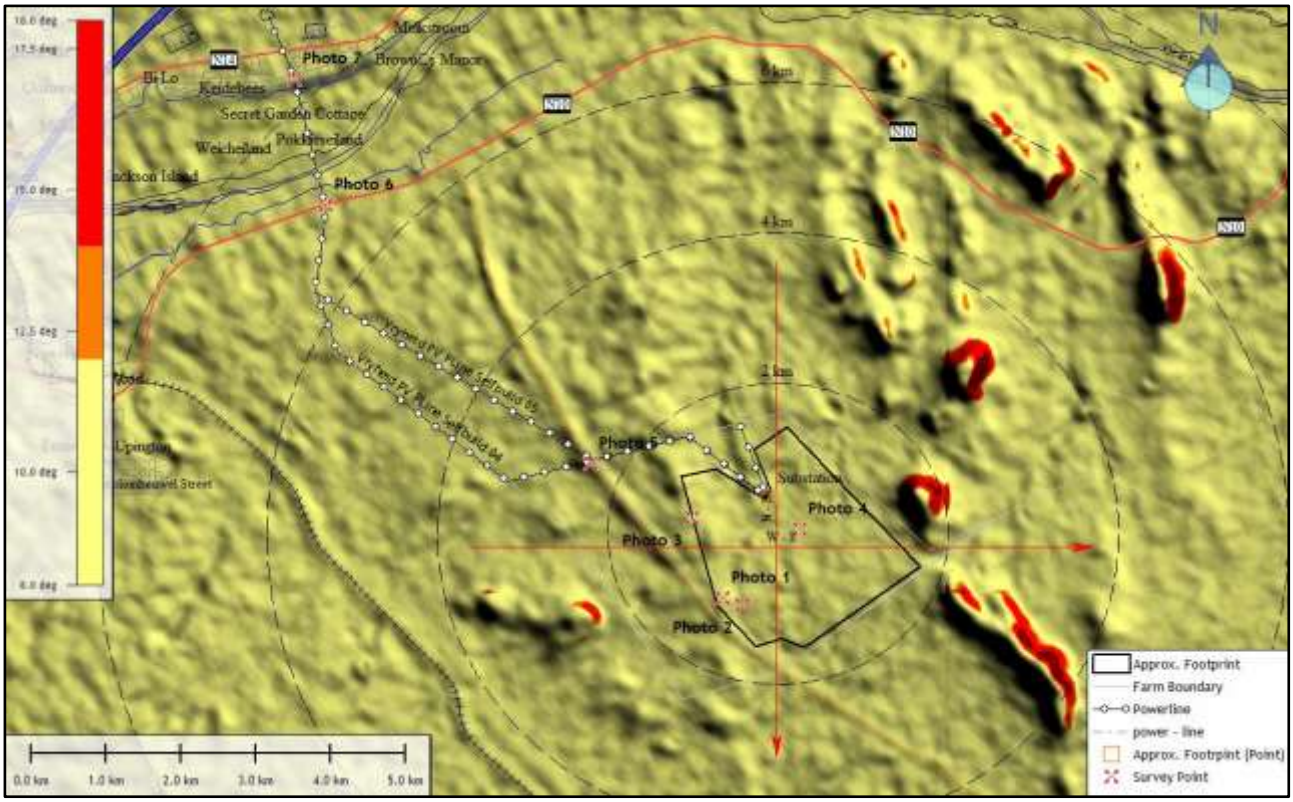

Figure 59: Broad brush slopes degrees map

Table 28: Landuse, Visual Absorption Capacity, Prominence and Receptors Exposure Table

Survey Points	Proposed Activity	Landuse	Viewshed	Exposure	VAC	ZVI
1	PV	Dry land agriculture south facing	High	Low	Low	FG/MG
2	PV	Drainage	Low	Low	Low	FG/MG
3	PV	Dry land agriculture ridgeline	High	Low	Low	FG/MG
4	PV and Substation	Dry land agriculture	Low	Low	Low	BG
Sum			**Medium**	**Low**	**Low**	**MG**

(Key: FG = Foreground, MG = Middleground, BG = Background)

Table 29: Scenic Quality Table

Survey Points	Landform	Vegetation	Water	Colour	Scarcity	Adjacent scenery	Cultural Modification	Total	Scenic Quality
1	2	2	1	3	1	3	0	12	B
2	2	3	3	3	3	3	0	17	B
3	2	2	1	3	1	3	0	12	B

4	1	1	1	2	1	3	-1	8	C
Sum.	**2**	**2**	**2**	**2**	**2**	**3**	**0**		**B**

(Key: A= scenic quality rating of ≥19; B = rating of 12 – 18, C= rating of ≤11)

Table 30: Receptor Sensitivity Table

Survey Points	Type user	Amount use	Public interest	Adjacent land users	Special zoning	Receptor sensitivity
1	Medium	Low	Low	High	Low	Medium
2	Medium	Low	Medium	High	Low	Medium
3	Medium	Low	Low	High	Low	Medium
4	Low	Low	Low	High	Low	Medium
Sum.	**Medium**	**Low**	**Medium to Low**	**High**	**Low**	**Medium**

14.4 RESULTS OF VISUAL BASELINE ASSESSMENT

14.4.1 Visibility

Due to the raised ground adjacent to the site and to the south of the site, the visibility of the northern flat area where the PV and Substation are proposed is well contained. The viewshed is mainly to the north which is strongly associated with the higher VAC levels of Upington and the surrounding intensive agricultural areas. The visibility of this area is defined as *Low*.

The southern raised ground area of the site, extends the site visibility to the south into the open rural landscape which has low VAC levels and where the change in landuse would be strongly experienced. The visibility of this area of the proposed site is defined as *Medium*.

Along the western boundary of the proposed site is an elevated ridgeline. Should the proposed PV structures be placed in this vicinity, the proposed project visibility would extent further to the north, west and south. The visibility of this area is defined as *High*.

14.4.2 Exposure and Distance

Given that the majority of receptors would be located in the northern areas away from the proposed PV site, exposure to residential receptors is rated *Low*.

14.4.3 Scenic Quality

Making use of the VRM Scenic Quality Rating Questionnaire, the overall scenic quality of the site was rated as B, which equates to *Moderate*. This is due to the low rolling landform which has few interesting features, little or no variety or contrast in vegetation and the absence of water. The colours from the vegetation offer some variety but are generally not a dominant scenic element. The higher ratings for the site are related to the adjacent scenery where the low hills and undulating, open rural landscape to the south increases the regional scenic quality. Although

interesting in its setting, it is fairly common within the region. Cultural modifications are limited to farm tracks and little or no visual variety to the area.

14.4.4 Receptor Sensitivity to Landscape Change

Making use of the VRM Scenic Quality Rating Questionnaire, the overall sensitivity of the surrounding receptors to landscape change was rated *Medium* for the proposed PV site, and *High* for the proposed Powerline. Due to the flat terrain which is well screened by the adjacent elevated land, most users would not see a portion of the site, reducing sensitivity. The southern and elevated ridgeline areas would extend the visibility to the south and possibly into the northern areas along the Orange River. Here the change in landscape modification would be more strongly experienced. Due to tourism interests, maintenance of visual quality to sustain adjacent landuse objectives would be higher.

14.5 VISUAL RESOURCE MANAGEMENT OBJECTIVES

The BLM has defined four Classes that represent the relative value of the visual resources of an area and are defined making use of the VRM Matrix below:

i. **Classes I and II** are the most valued

ii. **Class III** represent a moderate value

iii. **Class IV** is of least value

The Classes are not prescriptive and are utilised as a guideline to determine the carrying capacity of a visually preferred landscape which is utilised to assess the suitability of the landscape change associated with the proposed project. The Visual Inventory Classes are defined using the matrix below and with motivation, can be adjusted to Visual Resource Management Classes which take zoning and regional planning into consideration if applicable.

Table 31: VRM Class Summary Table

Survey Points	Proposed Activity	Landuse	ZVI	Scenic Quality	Receptor sensitivity	Visual Inventory	Visual Resource Management
1	PV	Dry land agriculture south facing	FG/MG	B	Medium	Class III	Class II
2	PV	Drainage	FG/MG	B	Medium	Class III	Class I
3	PV	Dry land agriculture ridgeline	FG/MG	B	Medium	Class III	Class I
4	PV and Substation	Dry land agriculture	BG	C	Medium	Class IV	Class IV
			FG	B	Medium		

(Key: FG = Foreground, MG = Middleground, BG = Background, MH = Medium High)

14.5.1 Class I

The drainage lines and the western elevated ridgeline identified on the proposed site should be suitability buffered and regarded as Class I (No-Go). The Class I objective is to preserve the existing character of the landscape, the level of change to the characteristic landscape should be very low, and must not attract attention. Class I is assigned when a specialist decision is made to maintain a natural landscape.

14.5.2 Class II

The landscapes identified as having a VRM Class II visual objective were the south facing areas to the south of the proposed site. Development of a PV plant on these areas would extend the industrial ZVI to the south into rural landscapes which currently exihibit higher levels of scenic quality. The visual objective is to retain the existing character the landscape. The level of change to the characteristic landscape should be low. Management activities may be seen, but should not attract attention of the casual observer and should repeat the basic elements of form, line, colour and texture found in the predominant natural features of the characteristic landscape.

14.5.3 Class III

The landscapes identified as having a VRM Class III visual objective were those associated with the proposed powerline. The presence of the existing Eskom powerline servitude along the northern section of the proposed route, increases the VAC levels, even though receptor sensitivities would be higher. The Class III objective is to partially retain the existing character of the landscape, where the level of change to the characteristic landscape should be moderate. Management activities may attract attention, but should not dominate the view of the casual observer, and changes should repeat the basic elements found in the predominant natural features of the characteristic landscape.

14.5.4 Class IV

The landscapes identified as having a VRM Class IV visual objective were those located on the flat terrain to the north of the proposed site. With little visibility and receptor sensitivity, this area is suited for landscape change without resulting in a significant change to the characteristic landscape. The Class IV objective is to provide for management activities which require major modifications of the existing character of the landscape. The level of change to the landscape can be high, and these management activities may dominate the view and be the major focus of the viewer's (s') attention.

14.6 KEY OBSERVATION POINTS

Key Observation Points (KOPs) are defined by the Bureau of Land Management as the people (receptors) located in strategic locations surrounding the property that make consistent use of the views associated with the site where the landscape modifications are proposed. These locations are important in terms of the VRM methodology which requires that the degree of contrast that the proposed landscape modifications will make to the existing landscape is measured from these most critical locations, or receptors, surrounding the property.

To define the KOPs, potential receptor locations are identified in the viewshed analysis, which are screened, based on the following criteria:

- Angle of observation
- Number of viewers
- Length of time the project is in view
- Relative project size
- Season of use
- Critical viewpoints, e.g. views from communities, road crossings
- Distance from property

Five locations were identified as having KOP status. The receptors at these points will have clear views of the proposed project which could result a change to local visual resources. These KOP's are:

- Rural Road North 1
- Rural Road North 2
- Rural Road South
- N10 National Road
- Upington Residential

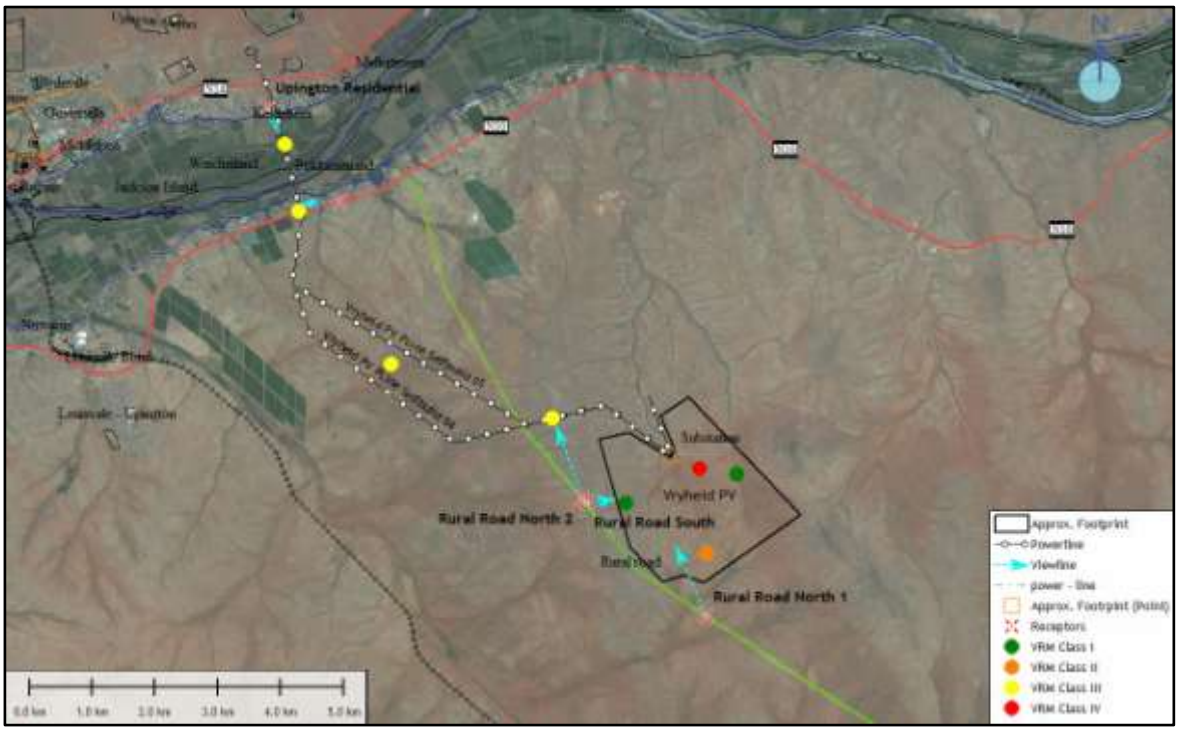

Figure 60: Key Observation Points overlaid onto VRM Classes and Proposed Development Footprint Map

14.7 ASSESSMENT AND SIGNIFICANCE OF VISUAL IMPACTS

14.7.1 Summary of Visual and Cumulative Impacts

Table 32: Landscape Character Environment Impacts Summary Table

Impact Activity	Phase	Mitigation	Nature	Extent	Duration	Severity	Probability	Significance without	Significance with mitigation	Mitigation	Mitigation Map Ref No.
PV Solar Facility	Cons.	W/Out	-ve	Local	Long	MH	HP	H		Retain southern, ridgeline and western facing slopes as No-Go areas (or until the area has become a de-facto PV Solar Facility hub. Lights at night management.	1
		With	-ve	Site	Long	MH	P		M		
	Ops.	W/Out	-ve	Local	Long	MH	HP	H		As above.	
		With	-ve	Site	Long	MH	P		M		
	Close	W/Out	-ve	Reg.	Perm	H	P	VH		Remove all structures and buildings. Rip compacted surfaces, rehabilitate and restore to indigenous, endemic vegetation.	
		With	-ve	Site	Short	L	P		L		
Access road	Cons.	W/Out	-ve	Local	Long	M	P	M		Erosion control, dust control with no dominant signage along the rural road.	
		With	-ve	Local	Long	L	P		L		
	Ops.	W/Out	-ve	Local	Long	M	P	M		Continued erosion and dust control.	
		With	-ve	Local	Long	L	P		L		
	Close	W/Out	-ve	Local	Long	M	P	M		Rip compacted surfaces, rehabilitate and restore to vegetation (unless the road can be incorporated into the subsequent landuse).	
		With	-ve	Site	Long	VL	P		VL		
Substation	Cons.	W/Out	-ve	Site	Long	M	P	M		NA	
		With	-ve	Site	Long	M	P		M		
	Ops.	W/Out	-ve	Site	Long	M	P	M		NA	
		With	-ve	Site	Long	M	P		M		
	Close	W/Out	-ve	Site	Perm	H	P	H		Rip compacted surfaces, rehabilitate and restore to vegetation (unless the road can be incorporated into the subsequent	
		With	-ve	Site	Short	VL	P		VL		

Impact Activity	Phase	Mitigation	Nature	Extent	Duration	Severity	Probability	Significance without	Significance with mitigation	Mitigation	Mitigation Map Ref No.
										landuse).	

(Key: -ve = Negative, Reg = Regional, Perm = Permanent, VL = Very Low, L = Low,

M = Medium, H = High, P = Probable, HP = Highly Probable)

Table 33: Cumulative Impacts Summary Table

Impact Activity	Phase	Mitigation	Nature	Extent	Duration	Severity	Probability	Significance without	Significance with mitigation	Mitigation	Mitigation Map Ref No.
Cumulative Effects	Cons.	W/Out	-ve	Reg.	Perm	H	P	H		Effective coordination at a municipal level to manage possible negative effects of landscape degradation.	
		With	+ve	Reg.	Perm	M	P		M		
	Ops.	W/Out	-ve	Reg.	Perm	H	P	H		As above.	
		With	+ve	Reg.	Perm	M	P		M		
	Close	W/Out	-ve	Reg.	Perm	H	P	H		As above.	
		With	+ve	Reg.	Perm	M	P		M		

(Key: +ve = Positive, -ve = Negative, Reg = Regional, Perm = Permanent,

VL = Very Low, L = Low, M = Medium, H = High, P = Probable, HP = Highly Probable)

14.7.2 Impacts Associated with Development Components

14.7.2.1.1 PV Solar Facility

Without mitigation the proposed PV facility has a strong potential to generate *Negative High* visual impacts due to skyline intrusion on the west ridgeline. The area to the south of the proposed site currently has higher scenic qualities that typify the Kalahari landscape of the Upington area. With mitigation the ridgeline and southern development areas which have strong drainage lines would

not be developed. This would significantly reduce skyline intrusions and the southern ZVI of the project. With mitigation the visual significance would be reduced to *Negative Moderate*. Once the project life is completed, all structures should be removed, the compact areas ripped and then rehabilitated and restored to indigenous, endemic vegetation. Lights at night have the potential to significantly increase the proposed project ZVI and light management is recommended (refer to generic light mitigations in the Appendix).

14.7.2.1.2 Access Road

Without mitigation the access road has the potential to generate *Negative Moderate* visual impacts due to dust and soil erosion. Mitigation would reduce the impact to *Negative Low*. Once the project life cycle is completed, the roads should be ripped and then rehabilitated and restored to indigenous, endemic vegetation (unless the road can be incorporated into a future land-usage).

14.7.2.1.3 Substation

Without and with mitigation the proposed substation has the potential to generate *Negative Moderate* visual impacts due to low prominence and limited visibility. Once the project life cycle is completed, the structure should be ripped and then rehabilitated and restored to indigenous, endemic vegetation (unless the substation can be incorporated into a future land-usage).

14.7.2.1.4 Cumulative Effects

Without mitigation the potential for regional landscape degradation from ad hoc planning of new PV solar projects could result in *Negative High* cumulative impacts as landscape resources in the area become degraded from sprawling PV. This effect has the potential to significantly detract from the current viticulture cultural landscape associated with the Orange River which is not recommended. Effective planning at a municipal level is required to coordinate the expansion of the proposed solar energy projects so as not to detract from existing visual resources. Cumulative significance could then be reduced to a *Moderate Positive* effect by adding an interesting visual experience to the landscape.

14.8 CONCLUSION

It is the recommendation of the Visual Impact Assessment that the proposed project, with mitigation, would not significantly detract from the current visual resources which has important receptors which should be recognised. A development setback on the western and southern boundaries was defined to ensure that skyline intrusion on the western raised ground and maintenance of the southern rural visual resources are not compromised.

15 ASSESSMENT OF POTENTIAL HYDROLOGICAL IMPACTS.

Condition 8 of the acceptance of Final Scoping Report advised that the EAP conduct a surface hydrological study as part of the EIAr. The Terms of reference for this study must include:

- Identification and sensitivity rating of all surface watercourses for the impact phase of the proposed development;
- Identification, assessment of all potential impacts to the watercourses and suggestion of mitigation measures; and
- Recommendations on the preferred placement of photovoltaic panels.

This assessment was compiled taking the following into account:

- Ecological Scoping Report compiled by Mr Simon Todd;

- Ecological Impact Assessment Report compiled by Mr Simon Todd;
- Stormwater Management Plan Compiled by Solek Renewable Energy Engineers.

15.1 IDENTIFICATION AND SENSITIVITY RATING OF SURFACE WATERCOURSES.

Todd, 2014 identified potential watercourses via a desktop study that formed part of the ecological scoping report. These watercourses were ground-truthed and mapped as part of the ecological impact assessment report.

Todd, 2014 categorised all hydrological features on site into 3 habitat categories, namely:

- Drainage Systems,
- Pans, and
- Plains wash

These are shown in the figure below.

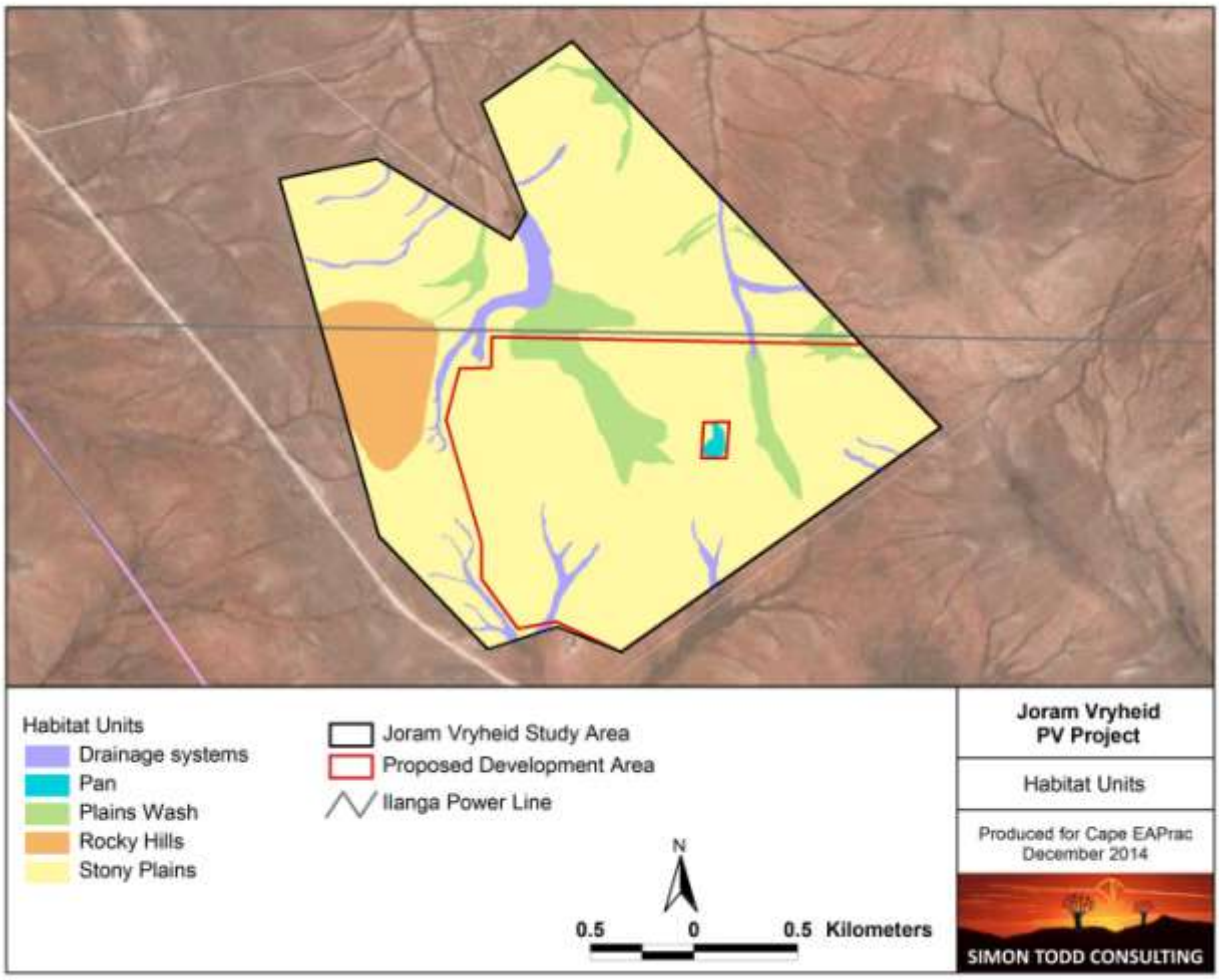

Figure 61: Hydrological features of the site as identified by the ecological specialist

15.1.1 Plains Wash

The lower-lying parts of the site have accumulated relatively deeper soils on account of water and wind transport and deposition of sand into these areas. Due to the deeper and more sandy nature of the soils, these areas are generally dominated by various species of *Stipagrostis*, which is typical of this substrate. Dominant and typical species include *Stipagrostis anomala*, *S.ciliata*, *S.uniplumis* and *Schmidtia kalariensis*. Occasional scattered shrubs and low trees are also present and usually consist of *Phaeoptilum spinosum*, *Rhigozum trichotomum* and *Boscia foetida*. A variety of other shrubs from the surrounding stony plains may also be present depending on the soil depth and texture. It is important to note that these areas are not drainage lines, as there is no clear drainage channel present and there are no species associated with mesic conditions present, but these are simply areas which occasionally receive runoff from adjacent more stony soils and when this does occur, the water usually infiltrates in-situ and does not drain further. As such, these areas are considered more sensitive than the surrounding plains, but are not considered ecologically equivalent to drainage lines and not considered highly sensitive areas.

Figure 62: Example of the plains wash habitat type, illustrating the deeper soils and greater prevalence of grasses.

15.1.2 Drainage Lines

There are a number of minor drainage lines which traverse the site. These are not very large and well developed, but carry water for brief periods following heavy rainfall events and usually consist of a variable width sandy bed which may be exposed or fairly well vegetated by tall shrubs and scattered trees such as *Rhigozum trichotomum*, *Acacia mellifera*, *Boscia foetida* and *Phaeoptilum spinosum*. Due to the ecological role that drainage lines play as well as their vulnerability to disturbance, these areas are considered sensitive and should be avoided as much as possible. Within the site, the density and abundance of protected species is concentrated along the drainage

lines with species such as *Boscia foetida*, and *Acacia erioloba* being found largely within or near this habitat type.

Figure 63:Example of a drainage line from within the Joram site,

These Drainage Lines which in the section pictured is fairly well vegetated largely by *Rhigozum trichotomum*, but with *Acacia mellifera*, *Boscia foetida* and *Phaeoptilum spinosum* also prevalent. The tree towards the right of the image is the woody alien Prosopis glandulosa, which was prevalent around the watering point located with the V along northern boundary of the study area.

15.1.3 Pan

There is a single bedrock pan present within the site. As the name suggests, it is located on bedrock which probably explains why it was not picked up by the NFEPA assessment which is largely very good at identifying pans within this area. There is a small catchment around the pan which provides water to the pan. Although it is located in a depression and one might expect it to become filled with sand over time, this does not occur due to animal activity which loosens any sediment around the pan and wind action which removes it from the area again. The pan had water in it at the time of the site visit and numerous species were observed to be utilising the pan including amphibians and a variety of temporary water organisms such as Daphnia and various cladocerans. The pan is fringed by *Acacia mellifera* and *Boscia foetida*. Due to the ecological role that such pans play and their relative scarcity in the landscape, they are considered highly sensitive and should be avoided. However, it is important to note that even if the pan is not developed and provided with a buffer, runoff patterns in the area are likely to impacted by the development and this may impact the ecological functioning of the pan as the associated fauna are closely allied to the pattern and frequency of inundation. Furthermore, some fauna may be unable to utilise the pan as under the preferred layout it is surrounded by PV panels. Recent studies have suggested that some types of PV facilities attract water birds which appear to mistake the panels

for water and the presence of a real water body within the facility may exacerbate this problem. However, the pan is only about 10m across and would be too small to attract species such as flamingos. Although there is no clear evidence at this point, the studies suggest that tracking arrays are more likely to attract water birds than static arrays as this phenomenon does not appear to have been reported from any of the operational static PV array facilities to date.

Figure 64: The small pan which was observed at the Joram site (Todd, 2015).

The pan is fringed largely by *Acacia mellifera* and *Phaeoptilum spinosum* and was observed to contain a variety of temporary water organisms typical of such pans.

15.2 ECOLOGICAL SENSITIVITY OF HYDROLOGICAL FEATURES

The Ecological specialist allocated the following sensitivities to the Hydrological Features.

- Pan – Very High
- Drainage Lines – High
- Plains Washes – Medium

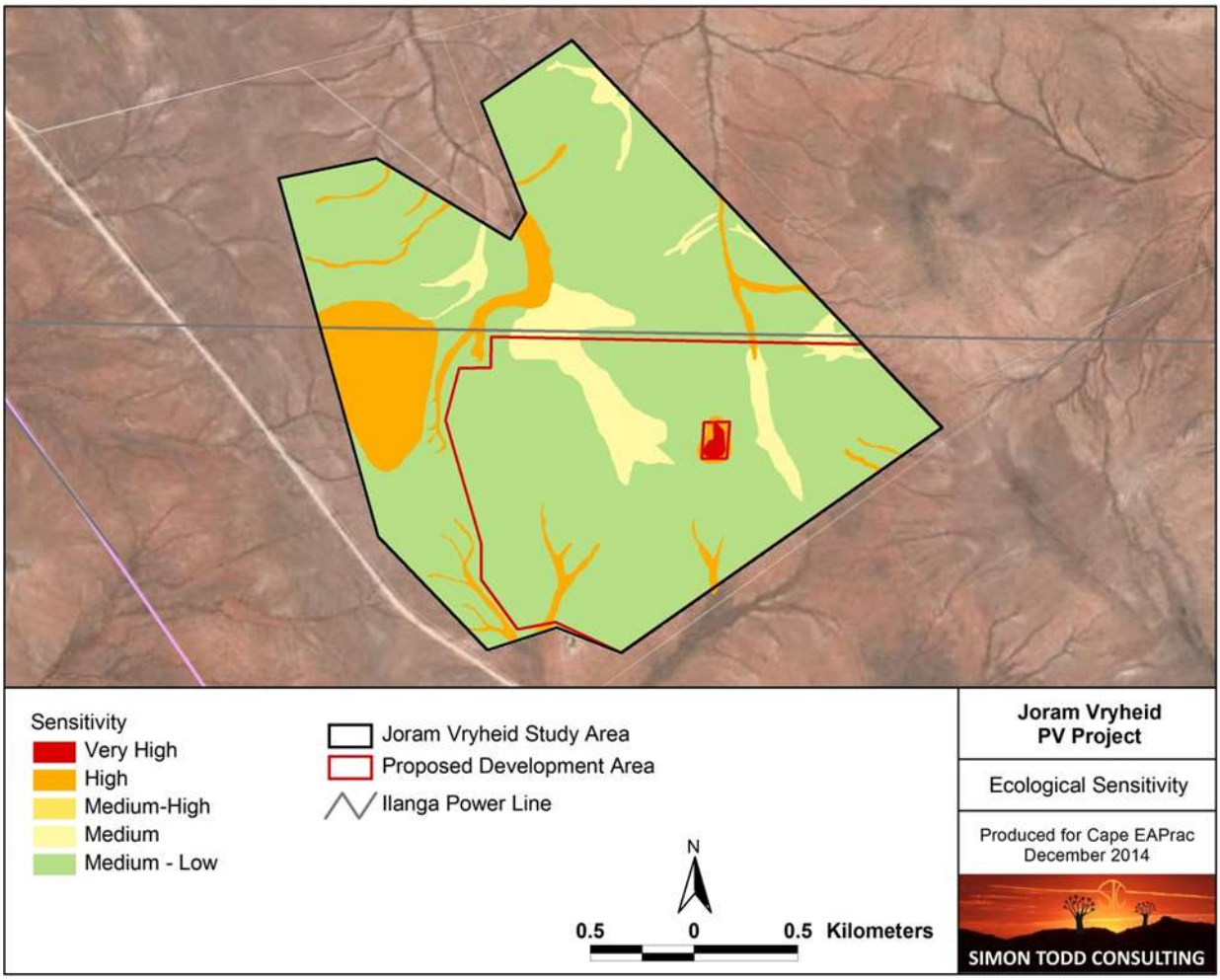

Figure 65: Ecological Sensitivity of Hydrological Features (Todd, 2015)

15.3 IDENTIFICATION, ASSESSMENT OF ALL POTENTIAL IMPACTS TO THE WATERCOURSES AND SUGGESTION OF MITIGATION MEASURES; AND

Based on the outcome of the Ecological Impact Assessment and Storm water management plan, the following potential hydrological impacts were identified.

- Impacts on drainage patterns.
- Erosion and siltation of the offsite drainage line.
- Loss of vegetation along plains washes

The table below includes an assessment of the potential impacts of the preferred alternative on onsite and nearby hydrological features.

Table 34: Ecological Impact on Hydrological Features.

Soil Erosion Risk During Construction	Local	Medium-term	Medium-High	High	Low	Medium Negative	Low Negative	High
Mitigation/Management Actions • Dust suppression and erosion management should be an integrated component of the construction approach. • Disturbance near to drainage lines or the pan should be avoided and sensitive drainage areas near to the construction activities								

should demarcated as no-go areas.
- Regular monitoring for erosion problems along the access roads and other cleared areas.
- Erosion problems should be rectified on a regular basis.
- Sediment traps may be necessary to prevent erosion and soil movement if there are topsoil or other waste heaps present during the wet season.
- A low cover of vegetation should be left wherever possible within the construction footprint to bind the soil, prevent erosion and promote post-disturbance recovery of an indigenous ground cover.

Impact on Ephemeral Pan	Local	Long-term	Medium	Moderate	Low	Medium-High Negative	Medium-Low Negative	Moderate

Mitigation/Management Actions

- The small catchment in the immediate vicinity of the pan should be delineated in the field prior to construction during the preconstruction walk-through of the facility, in order to determine the most appropriate set-back for this feature.
- The pan should be explicitly accommodated within the erosion and runoff management plans for the facility and it should not be used to receive and manage waste water or runoff at the site.
- The pan should be monitored during operation to ensure that it does not attract birds which are then negatively impacted by the panels or the power lines at the site.
- The pan should be fenced off from the facility, but with standard livestock-type fencing (not jackal-proof) that allows fauna to pass through.

15.4 RECOMMENDATIONS ON THE PREFERRED PLACEMENT OF PHOTOVOLTAIC PANELS

The preferred layout was specifically developed to exclude the sensitive hydrological features as identified by the ecological specialist. An avoidance approach was applied, whereby ecologically sensitive hydrological features were excluded from within the development layout.

The preferred layout included the following key exclusions in order to ensure that the impact on hydrological was kept to an absolute minimum.

- Main drainage lines were excluded completely from the proposed development footprint.
- The ephemeral was excluded from the preferred layout.
- A buffer area surrounding the ephemeral pan was excluded from the preferred development footprint.

In addition to these exclusions, it is recommended that the following conditions form part of the environmental authorisation:

- No stormwater may be discharged into the ephemeral plan
- A 20m wide corridor along the plains wash must link the ephemeral pan to the natural areas outside of the development footprint. This corridor and the pan should be fenced outside of the development footprint.

15.5 MANAGEMENT OF STORM WATER TO PROTECT HYDROLOGICAL RESOURCES.

The effective management of stormwater in the long term is of utmost importance to ensure that the hydrological resources on site remain functional from both an ecological and hydrological perspective. To this end, Solek Renewable Energy Engineers were appointed to develop a Stormwater Management Plan for the site.

The scope of the Stormwater Management Plan (SMP) includes inter alia:

- Determine catchment area for the project site.
- Estimate floods expected for the catchment.

- Confirm existing drainage pattern and streams.
- Propose drainage elements such as side drains, outlets and other mitigation measures to accommodate the flows.
- Prepare a conceptual drainage layout plan and strategy for the project site.

The stormwater management plan makes specific provision for following existing contours to minimise impacts on the existing drainage patterns. With the implementation of the stormwater management plan, the potential impact of the facility on existing drainage patterns is deemed to be low.

Please refer to appendix D8 that includes a full copy of the Stormwater Management Plan.

16 ASSESSMENT OF POTENTIAL HYDROGEOLOGICAL IMPACTS

The assessment of potential Hydrogeological impacts discussed below, took into account the following:

- DEA&DP guideline on involving hydrogeologists in EIA processes.
- Ecological Scoping Report compiled by Mr Simon Todd;
- Ecological Impact Assessment Report compiled by Mr Simon Todd;
- Stormwater Management Plan Compiled by Solek Renewable Engineers; and
- Layout and Engineering report compiled by Solek Renewable Energy Engineers.

According to the DEADP guideline the following triggers and key issues potentially require specialist input.

In order to determine whether hydrogeological specialist input to the EIA process is required it is suggested that:

1. The proponent and/or the EIA practitioner determines whether the proposed development falls within one of the following activity types:
    - Where effluent or chemicals with the potential to change groundwater quality is handled as part of the project, or discharged into the environment due to the project.
      The proposed activity (generation of electricity by means of PV) does not generate or use any chemicals or effluent that could potentially result in pollution of groundwater resources. Note – cleaning of PV panels will be done with clean water without the use of any cleaning chemicals.
    - The volume of groundwater in storage or entering groundwater storage is changed beyond what is allowed by the DWAF General Authorisations.
      The current proposal does not include the utilisation or storage of groundwater. Should the utilization or storage of groundwater be considered in the future a hydrological specialist will be required to provide input into the legally required application in terms of the National Water Act.
    - The groundwater flow regime is changed.
      The groundwater flow regime will not be changed as a result of the proposed activity.

Considering the above, it is concluded that the proposed PV facility will not likely have any impact on Hydrogeological resources and as such, further assessment is not deemed necessary.

17 SOCIO ECONOMIC CONTEXT OF THE KHARA HAIS MUNICIPAL AREA

Information displayed in this section, unless otherwise indicated, was obtained from the 2013/14 Integrated Development Plan (IDP) of the Khara Hais Municipality (Khara Hais IDP, 2013/14).

According to the Khara Hais Municipal IDP, there are approximately 23 245 households in the Municipal area. The 2011 census conducted by Stats-SA reported that the total population of Khara Hais is 93 494. The population of the Municipality has increased by 2.5% between 2002 and 2012. The IDP states that the increase in population figures from 78 393 in 2008 to 93 494 in 2011 is a result of an overall influx of people from other parts of South Africa and Africa. It is expected that with a further increase of 2.5% between 2012 and 2022, the population will be ±116 868. Currently the population constitute 49.3% male and 50.7% female.

According to the IDP 26.9% of the inhabitants are economically active and 14 486 households are subsidized by the services subsidy scheme. Approximately 23% of the labour force is unemployed and a large number of residents are dependent on government pensions, which mean that they earn less than R1 280 per month. This has a negative impact on payment of services.

The Khara Hais Spatial Development Framework (SDF) of 2009 indicates the racial composition of the Municipal area to be as follows:

- 66.3% Coloured;
- 19.2% Black;
- 14.4% White; and
- 0.1% Indian.

The potentially economically active population of Khara Hais comprises approximately 67% of the total population. The fastest growing economic sectors which can be exploited for future job creation in the Municipal area are:

- Agriculture;
- Electricity and Water; and
- Mining.

The table below shows the employment status of the potentially economically active population of Khara Hais:

Table 35: Employment statistics for the Khara Hais Municipal area (IDP)

Total Potential Economically Active Population (Ages 15-64)	**67 127**
Employed	45%
Unemployed	16%
Not working / other	39%
Total economically active population	**40 894**
Employed	75%
Unemployed	25%

The following service backlogs are indicated in the //Khara Hais IDP (2013/14):

- ±5% of households does not have services for sewerage and sanitation;
- 3% of households are not serviced for water; and
- 4% of households do not have waste removal

The housing statistics for Khara Hais are as follows:

Table 36: Housing statistics for Khara Hais Municipal Area

Number of Households	
Formal Structures	17 479 (72%)
Informal Structures	6 182 (35%)
Informal Back Yard	718 (3%)

According to the Khara Hais IDP (2013/14) there are no houses within the 14 Wards of the Municipal area that are not serviced for electricity.

Various solar development opportunities have been identified for the Khara Hais Municipal area, which the Municipality identified as Anchor economic activities. The Upington area is regarded to be one of the most ideal areas for solar energy generation and by utilising these opportunities the Municipality would be able to create substantial job opportunities for local communities.

18 ASSESSMENT OF POTENTIAL CUMULATIVE IMPACTS

When considering South Africa's irradiation distribution, the Northern Cape Province, and Upington in particular, is known to be one of the most preferred areas for the generation of solar energy in South Africa and even in the world. This can be ascribed to the advantageous sun radiation specifications and the flat planes which are not intensively used except for low scale grazing. The global irradiation in the specific area is between 2400 and 2600 kWh/m^2.

In order to consider the project cumulatively, the Environmental Impact Reporting phase of the Environmental Process will need to consider cumulative of the proposed facility in addition to the other projects that are proposed in the immediate area.

There are at least two known projects in the vicinity of the Joram Solar Development Site.

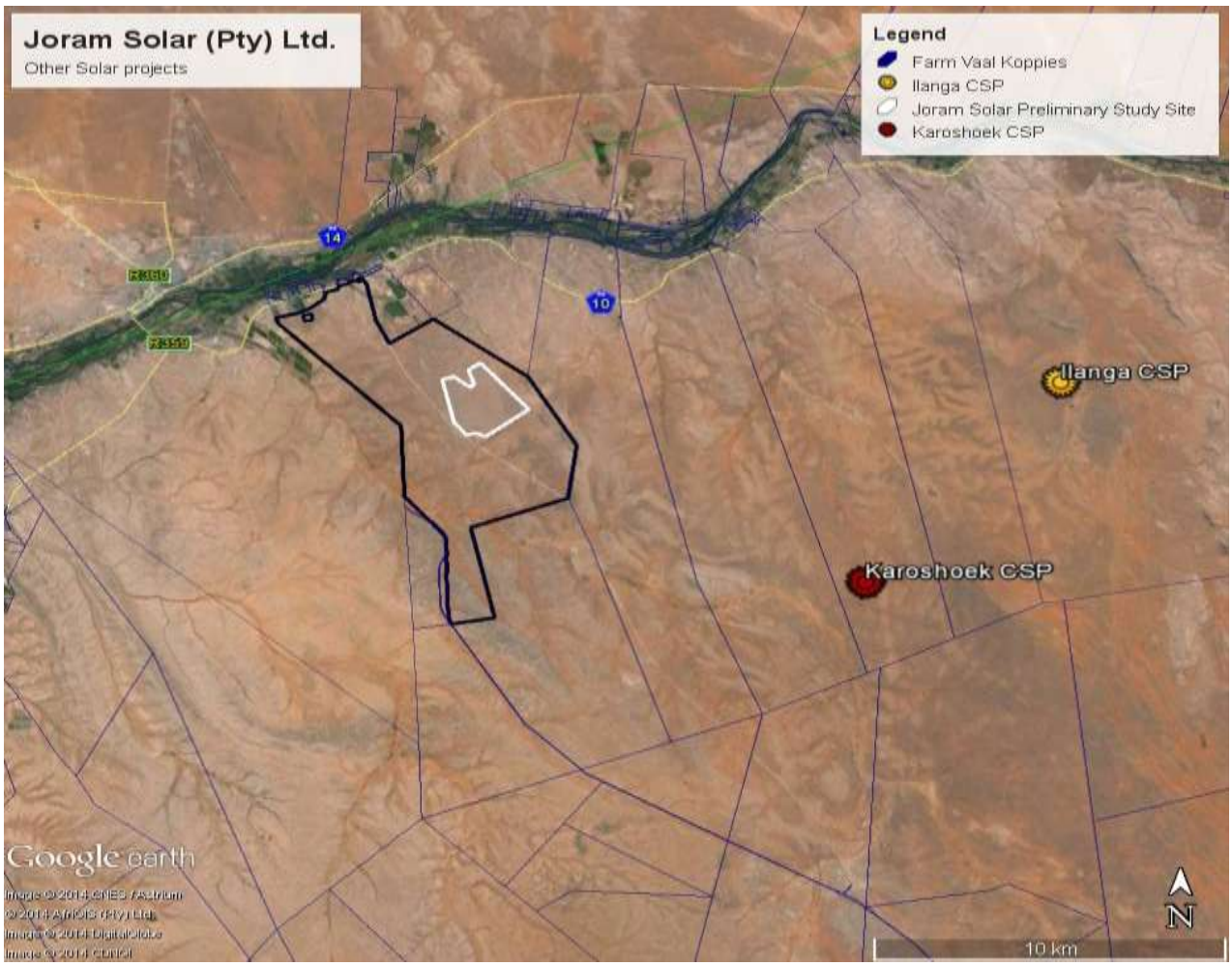

Figure 66: Showing other proposed solar generation facilities in close proximity to the proposed Joram Solar (Solek, 2014).

19 PUBLIC PARTICIPATION PROCESS TO DATE

As part of the public participation process the following steps were taken to ensure compliance with the legislation and to allow ample opportunity for members of the public and key stakeholders to be involved and participate in the environmental process. Please see **Appendix E** for evidence of this Public Participation process. The Public Participation Process has been undertaken according to the requirements of the new NEMA EIA regulations. The following requirements i.t.o the scoping process have been undertaken and complied with in terms of Regulation 56:

Table 37: Summary of Public Participation Process to date.

CHRONOLOGY OF EVENTS	
DATE	**ACTION**
03 June 2014	**Notifications** were sent to the Landowners for the proposed Joram Solar Facility as well as those where potential Grid Connections may be required..
4 July 2014	**Call for registration advert** placed in Die Gemsbok local newspaper.
28 July 2014	**Notifications** were sent to neighbouring landowners informing them of the development proposal and the environmental process. They were automatically registered as Interested

	and Affected Parties
28 July 2014	The **ZF Mgcawu District Municipality** and the **Khara Hais Local Municipality** (which have jurisdiction over the area) were notified and automatically registered as key stakeholders.
28 July 2014	**Organs of state** (including, Northern Cape Nature Conservation, Department of Agriculture, Forestry & Fisheries, Department of Minerals and Energy, Department of Water Affairs, SAHRA, Eskom, Civil Aviation Authority etc.), were notified and registered as key stakeholders.
10 June 2014	**Notice Boards** (English & Afrikaans) were placed on the boundary of the study site.
May 2014	A **Stakeholder Register** was opened and the details of all registered stakeholders entered for future correspondence.
27 August 2014	Hard copies of the Draft Scoping Report (DSR) have been placed at the Khara Hais Municipality offices (Upington) and the Upington Public Library (Mutual Street Upington), to inform the public of the proposal and EIA process, and invite them to review the document and provide comment (**28 August 2014 to 08 October 2014.**). The DSR has also been made available on the *Cape EAPrac* website: www.cape-eaprac.co.za/active
22 August 2014	Registered Stakeholders and I&APs were sent notifications informing that of the availability of the DSR for a review and comment period of 40-days, extending from **28 August 2014 to 08 October 2014.** Stakeholders were also provided with digital copies of the Draft Scoping Report on CD in order to facilitate efficient comment.
10 October 2014	Registered Stakeholders and I&APs were sent notifications informing that of the availability of the FSR for a review and comment period of 21-days, extending from **10 October 2014 to 30 October 2014.** Stakeholders were also provided with digital copies of the Final Scoping Report on CD in order to facilitate efficient comment.
10 October 2014	Final Scoping Report submitted to the Department of Environmental Affairs for consideration and decision making.
29 January 2014	Registered Stakeholders and I&APs were sent notifications informing that of the availability of the Draft EIR for a review and comment period of 30-days. Stakeholders were also provided with digital copies of the Final Scoping Report on CD in order to facilitate efficient comment.

Copies of all comments received during the initial registration period as well as those received on the Draft Scoping Report are included in **Appendix E** of this report. Comments received in response to the Draft Scoping Report have been included in this Final Scoping Report submitted Department of Environmental Affairs (DEA) for consideration.

19.1 PRE-APPLICATION NOTIFICATIONS

Prior to submission of the application to the Department of Environmental Affairs, notifications were submitted to potentially affected landowners. The following parties were notified as affected landowners.

Table 38: Affected landowners notified at the pre-application phase of the environmental process

Owner	Property
Newhaven Trust	Portion 62 of the farm Vaal Koppies
Eskom Holdings	Gordonia Substation

Owner	Property
ISF Trust	Portion 3 of farm 40
Alko Verhuurings	Erf 73 & Erf 19951
Gerrit David de Vries	Portion 52 of Farm 40
Joseph van der Merwe	Portion 7 of the Farm 555

19.2 SITE NOTICES

Site notices printed in English as well as Afrikaans were placed on the boundary of the Joram Solar Development Site.

Plate 13: Site notices placed on the boundary of the Joram Solar study site.

19.3 BACKGROUND INFORMATION DOCUMENT

With the initial stakeholder registrations background information documents (BID's) were made available to stakeholders. All key stakeholders were provided with hard copies of the BID along with the notification letters. BID's were also made available at the Upington Library and the Khara Hais municipality. The BID's were also made available on the Cape EAPrac Website.

19.4 REGISTRATION OF KEY STAKEHOLDERS

A number of key stakeholders were automatically registered and will be given an opportunity to comment on this Draft Scoping Report. Copies and proof of these notifications are included in **Appendix E**. A list of key stakeholders registered for this process included in the table below.

Table 39: Key Stakeholders automatically registered as part of the Environmental Process

Stakeholders Registered		
Neighbouring property owners	Department of Environmental Affairs and Nature Conservation	Department of Water Affairs
Khara Hais Municipality: Municipality.	SENTECH	Department of Science and Technology
Department of Mineral	South African National Roads	The Council for Scientific and

Stakeholders Registered		
Resources	Agency Limited	Industrial Research
South African Heritage Resources Agency	Department of Transport and Public Works	The South African Square Kilometre Array
Northern Cape Heritage Resources Authority	Department of Health	The South African Civil Aviation Authority
Department of Agriculture, Forestry and Fisheries	Department of Minerals and Energy	Department of Science and Technology
Provincial Department of Agriculture	Eskom	Department of Communications
Khara Hais Municipality Ward councillors	Neighbouring property owners	Khara Hais Municipality Planning Department.

19.5 PRELIMINARY COMMENTS RECEIVED.

Preliminary comments were received from the following stakeholders:

- Eskom – Provided requirerements for working in or near Eskom Servitudes.
- Khara Hais – Requesting to be registered

Copies of these comments as well as the responses thereto are included in **Appendix E** of this Report.

19.6 NOTIFICATION OF AVAILABILITY OF DRAFT SCOPING REPORT

Registered I&AP's were notified of the availability of the Draft Scoping Report for review and comment. The Draft Scoping Report was made available at the Upington Public Library as well as the Khara Hais municipality for review and comment. A digital copy of the report was also placed on the Cape EAPrac website. In order to facilitate effective comment, all State Departments and key stakeholders have been provided with digital copies of the report on CD.

19.7 COMMENTS ON DRAFT SCOPING REPORT.

During the comment period on the Draft Scoping Report, comments were received from:

- The Northern Cape department of Agriculture, Land Reform and Rural Development
- Department of Agriculture Forestry and Fisheries. And
- Square Kilometre Array (SKA)

Please refer to Annexure E3 for copies of these comments as well as the responses thereto.

19.8 ISSUES AND CONCERNS RAISED BY I&AP'S

During the scoping phase for the proposed RE Capital 11 Solar Development, no issues or concerns were raised by registered I&AP's nor from State Departments and Organs of State. Eskom provided management recommendations for working in or near Eskom servitudes and the Northern Cape Department of Agriculture, Land Reform and Rural Development provided legislative requirements in terms of the Conservation of Agricultural Resources Act.

The Department of Agriculture, Forestry and Fisheries made certain requests for confirmation on protected species numbers and location as well as fencing of the facility. The ecological specialist will provide these confirmations during the Impact assessment phase of the project.

19.9 NOTIFICATION OF AVAILABILITY OF FINAL SCOPING REPORT

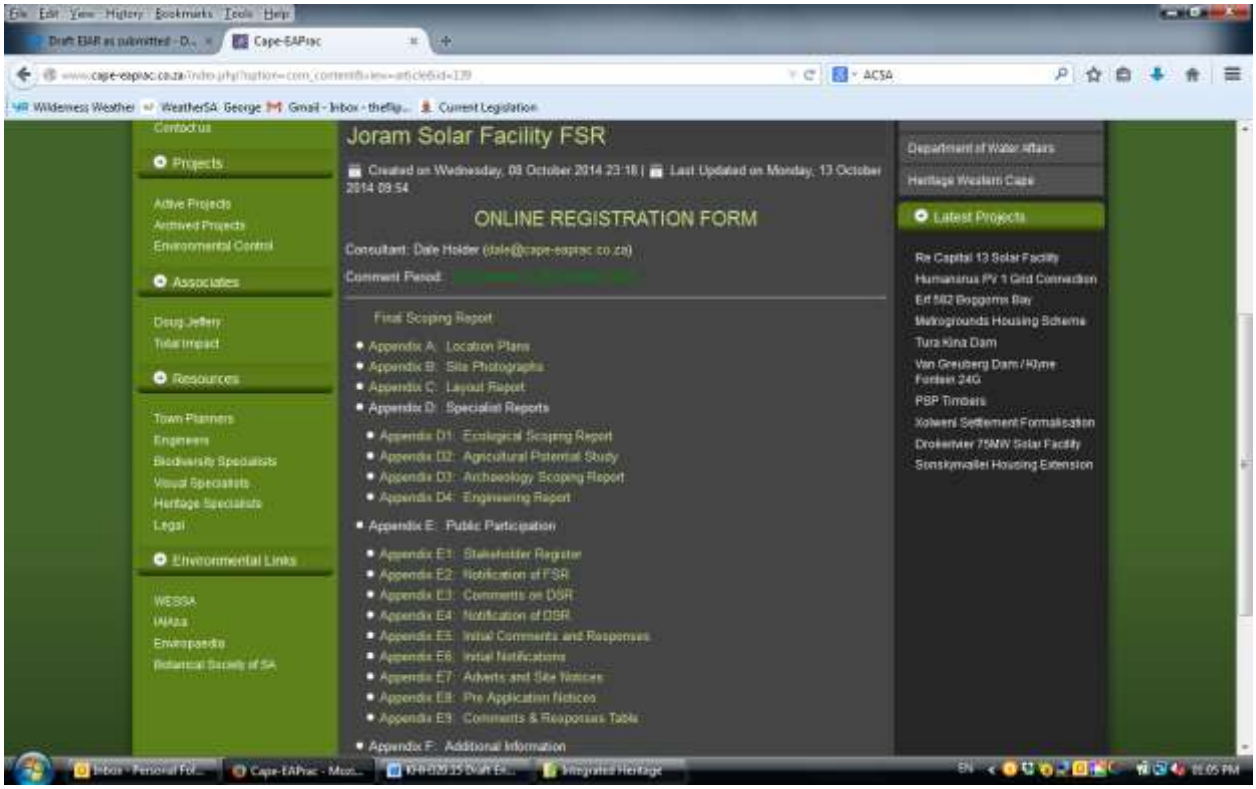

Plate 14: Showing Final Scoping Report as Available on the Cape EAPrac Website

19.10 NOTIFICATION OF AVAILABILITY OF DRAFT ENVIRONMENTAL IMPACT REPORT

Registered I&AP's were notified of the availability of the Draft Environmental Impact Assessment Report for review and comment. The Draft Scoping Report was made available at the Upington Public Library as well as the Khara Hais municipality for review and comment. A digital copy of the report was also placed on the Cape EAPrac website. In order to facilitate effective comment, all State Departments and key stakeholders have been provided with digital copies of the report on CD. Proof of these notifications will be included in the Final Environmental Impact Report.

20 ASSUMPTIONS & LIMITATIONS

This section provides a brief overview of *specific assumptions and limitations* having an impact on this environmental application process:

- It is assumed that the information on which this report is based (specialist studies and project information, as well as existing information) is **correct, factual and truthful.**
- The proposed development is **in line** with the statutory planning vision for the area (namely the local Spatial Development Plan), and thus it is assumed that issues such as the cumulative impact of development in terms of character of the area and its resources, have been taken into account during the strategic planning for the area.

- It is assumed that all the relevant **mitigation measures** and agreements specified in this report will be implemented in order to ensure minimal negative impacts and maximum environmental benefits.
- It is assumed that due consideration will be given to the **discrepancies in the digital mapping** (PV panel array layouts against possible constraints), caused by differing software programs, and that it is understood that the ultimate/final positioning of solar array will only be confirmed on-site with the relevant specialist/s.
- The Department of Water Affairs **may consider the submission of a water use application** necessary for allowing the use of water from the farm boreholes and possible the crossing of the on-site drainage lines by the infrastructure associated with the solar facility. The assumption is made that on review of this Draft Scoping Report the Department of Water Affairs will provide prompt confirmation and recommendations in this regard.
- It is assumed that Stakeholders and Interested and Affected Parties notified during the initial public participation process will submit all relevant **comments within the designated 40-days** review and comment period, so that these can included in the Final Scoping Report can be timeously submitted to the delegated Authority, the Department Environmental Affairs for consideration.

The assumptions and limitations of the various specialist studies are included in their respective reports attached in **Appendix D**.

21 REMAINING PROCESS TO BE FOLLOWED

The following process is to be followed for the remainder of the environmental process:

- The DEIR will be made available for public review and comment period of 30-days;
- All comments and inputs received during the comment & review period will be included with the Final EIR;
- The Final EIR will be submitted to the DEA for consideration and decision-making;
- The DEA's decision (Environmental Authorisation) on the FEIR will be communicated with all registered I&APs.

The competent Authority will be involved through continuous email and report **updates** on the process, in particular, when the **draft and final Environmental Impact Reports** have been completed. Should any unforeseen problems occur during the course of the impact assessment phase the competent authority will also be **contacted** for an **update and/or advice**.

22 CONCLUSION & RECOMMENDATIONS

This environmental impact assessment exercise is currently being undertaken to **present concept proposals** to the public and potential Interested & Affected Parties, to **identify environmental issues and concerns** raised as a result of the proposed development alternatives to date and to assess the impacts identified. The Joram Solar Development site has been assessed from Ecological (Fauna and Flora, Including avifauna), Agricultural Potential and Archaeological / Heritage / Palaeontological / Visual perspectives.

According to the specialist findings, the impacts associated with this development range between **Negligible to Medium / High** without mitigation. With mitigation potential impacts range between

Negligible to Medium / Low No fatal flaws have been identified and all the specialists are satisfied that the development may be authorised with conditions.

This Draft Environmental Impact Report (DEIR) summarises the process to date, reports on the findings of relevant baseline studies and provides the impact assessments associated with the activity.

Cape EAPrac is of the opinion that the information contained in this DEIR and the documentation attached hereto is sufficient to allow the general public and key stakeholders to apply their minds to the potential negative and/or positive impacts associated with the development, in respect of the activities applied for. We believe that the proposed Joram Solar Development will be sustainable in the long term and that the proposed development will be an asset to the Upington area, Northern Cape region and the broader South African society through supplementing the electricity supply for the National Eskom Grid.

The comment period for stakeholders is for a period of 30-days, extending from **Thursday 29th January to 02 March 2015**. All comments received, will be considered and addressed, and feedback will be provided to registered stakeholders.

All stakeholders are requested to review this Report and the associated appendices, and provide comment, or raise issues of concern, directly to *Cape EAPrac* and DEA within the specified 30-day comment period.

Comments must be submitted, in writing, to the following address no later than 02 March 2015

Cape Environmental Assessment Practitioners

Att: **Mr Dale Holder**

PO Box 2070, George, 6530

Fax: 044-874 0432 or Email: dale@cape-eaprac.co.za

23 ABBREVIATIONS

AIA	Archaeological Impact Assessment
BGIS LUDS	Biodiversity Geographic Information System Land Use Decision Support
CBA	Critical Biodiversity Area
CDSM	Chief Directorate Surveys and Mapping
CEMPr	Construction Environmental Management Programme
DEA	Department of Environmental Affairs
DEA&NC	Department of Environmental Affairs and Nature Conservation
DME	Department of Minerals and Energy
EAP	Environmental Impact Practitioner
EHS	Environmental, Health & Safety
EIA	Environmental Impact Assessment
EMPr	Environmental Management Programme
ESA	Ecological Support Area
GPS	Global Positioning System
GWh	Giga Watt hour
HIA	Heritage Impact Assessment
I&APs	Interested and Affected Parties
IDP	Integrated Development Plan
IFC	International Finance Corporation
IPP	Independent Power Producer
kV	Kilo Volt
LUDS	Land Use Decision Support
LUPO	Land Use Planning Ordinance
MW	Mega Watt
NEMA	National Environmental Management Act
NEMBA	National Environmental Management: Biodiversity Act
NERSA	National Energy Regulator of South Africa
NHRA	National Heritage Resources Act
NPAES	National Protected Area Expansion Strategy
NSBA	National Spatial Biodiversity Assessment

NWA	National Water Act
PM	Post Meridiem; "Afternoon"
PSDF	Provincial Spatial Development Framework
S.A.	South Africa
SACAA / CAA	South African Civil Aviation Authority
SAHRA	South African National Heritage Resources Agency
SANBI	South Africa National Biodiversity Institute
SANS	South Africa National Standards
SDF	Spatial Development Framework
TOPS	Threatened and Protected Species

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