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# PROPOSED COMMERCIAL CONCENTRATED SOLAR POWER (CSP) FACILITY

## Draft Social and Environmental Impact Assessment (SEIA) Report

2012/09/07 Revised: 2012/09/07

# Quality Management

| Issue/revision | Issue 1 | Revision 1 | Revision 2 | Revision 3 |
|---|---|---|---|---|
| Remarks | Draft SEIA | | | |
| Date | August 2012 | | | |
| Prepared by | L. Prosch & C. Stevens | | | |
| Signature |  | | | |
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| Project number | 30085 | | | |
| Report number | | | | |
| File reference | | | | |

# PROPOSED COMMERCIAL CONCENTRATED SOLAR POWER (CSP) FACILITY

## Draft Social and Environmental Impact Assessment (SEIA) Report

2012/09/07

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# Executive Summary

In order for Sasol to remain competitive and grow sustainably, Sasol is investigating the use of alternative sources of energy, with solar power being identified as one of the most economically and environmentally sustainable technologies. Sasol New Energy Holdings (Pty) Ltd proposes to develop a Commercial Concentrated Solar Power facility near Upington, in the Northern Cape Province.

Solar energy is the most abundant energy source, and is a 'clean' energy source. The levels of solar irradiation in Southern Africa are comparable with countries such as Spain and the USA where solar power has been successfully implemented.

The proposed Sasol CSP Project involves activities in Government Notices 544, 545 and 546 of 2010, published in terms of the National Environmental Management Act (No. 107 of 1998), as amended (2010) (NEMA) as well as activities listed in Government Notice 718 published in terms of the National Environmental Waste Act (No. 59 of 2008) . Prior to commencement of any activities listed in these notices, an Environmental Authorisation (EA) from the National Department of Environmental Affairs (DEA) is required.

WSP Environmental (Pty) Ltd was appointed by Sasol New Energy Holdings (Pty) Ltd as the independent environmental assessment practitioner (EAP) on the 28 March 2012 to undertake the Scoping and Social and Environmental Impact Assessment (S&SEIA) process required in application for an Environmental Authorisation.

The SEIA for the proposed Sasol CSP Project is undertaken in accordance with the Environmental Impact Assessment Regulations (2010) as published in terms the National Environmental Management Act (No. 107 of 1998). The competent authority has been identified as the National Department of Environmental Affairs.

In order to ensure that a comprehensive assessment of the relevant bio-physical and socio-economic components was performed, the following specialist investigations were conducted:

- Desktop Hydrology and Geohydrology Assessment;
- Desktop Land Capability and Grazing Capacity Assessment;
- Specialist Avifaunal Assessment;
- Faunal Specialist Study;
- Specialist Vegetation Assessment;
- Heritage Impact Assessment;
- Social Impact Assessment,
- Traffic Impact Assessment;
- Air Quality Assessment, and
- Visual Impact Assessment.

In the assessment conducted by WSP and its specialist teams, no fatal flaws have been found to pertain to the Sasol CSP development and associated infrastructure for any of the bio-physical or socio-economic environmental aspects investigated. Impacts of high significance during the construction phase include:

- Dust emissions for land clearing and vehicle activity;
- Disturbance of topsoil (including potential contamination);
- Change in land use and capability;
- Surface water pollution, and
- The destruction and alteration of ecological systems.

The mitigation measures related to emissions and pollutions can be effectively mitigated through the implementation of the prescribed measures which reduce the impact significance. The change in land use and destruction and alteration of ecological systems will reduce slightly in significance through the implementation of mitigation measures though these impacts will only be mitigated effectively after the decommissioning of the project.

During the operational phase the impacts related to pollution and contamination is regarded as significant and can be managed effectively through the implementation of the mitigation measures. The impacts associated with visual disturbance and avifauna will reduce slightly in significance through the implementation of mitigation measures though these impacts will only be mitigated effectively after the decommissioning of the project.

All impacts associated with the project can be suitably mitigated or managed and positive impacts can be adequately enhanced. It is therefore WSP's recommendation that approval of Sasol CSP Project be granted to SNE. It is recommended that the authorisation should include the following conditions:

- All mitigation and management measures as outlined in the SEMP should be adhered to. Compliance with the SEMP will be regarded as a legal requirement.
- The SNE must appoint an Environmental Officer to oversee compliance with the SEMP. SNE will appoint an independent suitably qualified consultant to verify compliance with SEMP on an annual basis;
- A programme for continued improvement must be developed and implemented for all phases of the project. The programme must be a component of the Social and Environmental Management System, and
- A Health and Safety and Environmental Legal Register must be developed for the operational phase of the project to ensure legal compliance with all local, provincial and national health, safety and environmental legislation. The SNE will appoint an independent suitably qualified consultant to verify legal compliance on an annual basis.

The final draft Social and Environmental Impact Assessment (SEIA) and Social and Environmental Management Programme reports will be submitted to the DEA in Pretoria in September 2012 for review and decision-making.

In terms of the accelerated schedule for the SEIA process proposed for National Electricity Response Plan (NERP) projects, public review of the final draft SEIA and SEMP reports will occur simultaneously with the authority review of the document. The NERP schedule thus allows a total of 40 days from submission of the report to the issuing of a decision by DEA. The report will then be amended to incorporate DEA's and other stakeholders' comments.

# Acronyms

| Acronym | Description |
|---|---|
| **SNE** | Sasol New Energy Holdings |
| **CSP** | Concentrated Solar Power |
| **NEMA** | National Environmental Management Act (No. 107 of 1998), as amended (2010) |
| **DEA** | National Department of Environmental Affairs |
| **EA** | Environmental Authorisation |
| **WSP** | WSP Environmental (Pty) Ltd |
| **EAP** | Environmental Assessment Practitioner |
| **S&SEIA** | Scoping and Social and Environmental Impact Assessment |
| **SEIA** | Social and Environmental Impact Assessment |
| **IRP** | Integrated Resource Plan |
| **IPPs** | Independent Power Producers |
| **SEMP** | Social and Environmental Management Programme |
| **NERP** | National Electricity Response Plan |
| **EIS** | Environmental Impact Statement |
| **ToR** | Terms of Reference |
| **CPV** | Concentrated Photovoltaic |
| **ESI** | Environmental Screening Investigation |
| **KGLM** | Kai! Garib Local Municipality |
| **KHLM** | //Khara Hais Local Municipality |
| **GNR** | Government Notice regulation |
| **NWA** | National Water Act |
| **NEM:AQA** | National Environmental Management Air Quality Act (No. 39 of 2004) |
| **AEL** | Air Emissions License |
| **SAHRA** | South African Resources Agency |
| **IFC** | International Finance Corporation |
| **NEMWA** | National Environmental Management Waste Act (No 59 of 2008) |
| **BID** | Background Information Document |
| **I&APs** | Interested and Affected Parties |
| **DWA** | Department of Water Affairs |
| **ACC** | Air-cooled Condenser |
| **PM** | Particulate Matter |
| **TDS** | Total Dissolved Solids |

| Acronym | Description |
|---|---|
| **SAWS** | South African Weather Services |
| **AQIA** | Air Quality Impact Assessment |
| **CERC** | Cambridge Environmental Research Consultants |
| **EU** | European Union |
| **NAAQS** | National Ambient Air Quality Standards |
| **masl** | Metres above sea level |
| **EMF** | Environmental Management Framework |
| **IDP** | Integrated Development Plan |
| **AU** | Animal Unit |
| **ToPS** | Threatened or Protected Species |
| **NMDS** | Non-metric Multidimensional Scaling |
| **GPS** | Global Positioning System |
| **VIA** | Visual Impact Assessment |
| **IEMA** | Institute of Environmental Management and Assessments |
| **SIA** | Social Impact Assessment |

# Chemical Symbols

| Chemical Symbol | Description |
|---|---|
| **$CO_2$** | Carbon Dioxide |
| **$SO_2$** | Sulphur Dioxide |
| **$NO_2$** | Nitrogen Dioxide |

# 1 Introduction

## 1.1 Project Background

Sasol New Energy Holdings (Pty) Ltd (SNE) proposes to develop a Commercial Concentrated Solar Power (CSP) facility near Upington, in the Northern Cape Province (Figure 1), hereafter referred to as the Sasol CSP Project or Project Solis.

The proposed Sasol CSP Project involves activities in Government Notices 544, 545 and 546 of 2010, published in terms of the National Environmental Management Act (No. 107 of 1998), as amended (2010) (NEMA) as well as activities listed in Government Notice 718 published in terms of the National Environmental Waste Act (No. 59 of 2008) . Prior to commencement of any activities listed in these notices, an Environmental Authorisation (EA) from the National Department of Environmental Affairs (DEA) is required. The listed activities that will be undertaken during the construction and operation of the Sasol CSP Plant are included in Table 1, Table 2 and Table 3.

WSP Environmental (Pty) Ltd (WSP) was appointed by SNE as the independent environmental assessment practitioner (EAP) on the 28 March 2012 to undertake the Scoping and Social and Environmental Impact Assessment (S&SEIA) process required in application for an EA.

**Table 1: Listed Activities according to GN R. 544 of the National Environmental Management Act (No. 107 of 1998), as amended 2010**

| GN R. 544<br>LIST OF ACTIVITIES AND COMPETENT AUTHORITIES IDENTIFIED IN TERMS OF SECTIONS 24 AND 24D OF THE NATIONAL ENVIRONMENTAL MANAGEMENT ACT (NO. 107 OF 1998), AS AMENDED 2010. | | |
|---|---|---|
| **#** | **Activity Description** | **Applicability** |
| 10(i) | The construction of facilities or infrastructure for the transmission and distribution of electricity – outside urban areas or industrial complexes with a capacity of more than 33 but less than 275 kilovolts. | The proposed facility will be located on the Van Roois Vley farm, near Upington outside of an urban area.<br>Electricity transmission will be at a capacity of 132 kilovolts. |
| 11 | The construction of: (i) canals; (ii) channels; (iii) bridges; (iv) dams; (v) weirs; buildings exceeding 50 square metres in size; or (xi) infrastructure or structures covering 50 square metres or more where such construction occurs within a watercourse or within 32 metres of a watercourse, measured from the edge of a watercourse, excluding where such construction will occur behind the development setback line. | Three ephemeral streams are located on site. An assessment of the surface hydrology and features has been undertaken. Impacts and layout options are discussed in Sections 7 and 8.7. |
| 13 | The construction of facilities or infrastructure for the storage, or for the storage and handling of a dangerous good, where such storage occurs in containers with a combined capacity of 80 but not exceeding 500 cubic metres. | Storage of diesel will be required for use in the auxiliary boiler and for the maintenance/refuelling of vehicles on site storage capacity is estimated at 170 $m^3$. |
| 18(i) | 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 or more than | Three ephemeral streams are located on site. An assessment of the surface hydrology and features has been undertaken. Impacts and layout options are discussed in Sections 8 and 9.7. |

| | | |
|---|---|---|
| | 5 cubic metres from a watercourse. | |
| 22(ii) | The construction of a road, outside urban areas – Where no reserve exists where the road is wider than 8 metres. | The proposed facility will be located at the Van Roois Vley farm, near Upington outside of an urban area.<br>An access road will be developed for the site (outside of an existing road reserve). The road is 8m wide. |

**Table 2: Listed Activities according to GN R. 545 of the National Environmental Management Act (No. 107 of 1998), as amended 2010**

| GN R. 545<br>LIST OF ACTIVITIES AND COMPETENT AUTHORITIES IDENTIFIED IN TERMS OF SECTIONS 24 AND 24D OF THE NATIONAL ENVIRONMENTAL MANAGEMENT ACT (NO. 107 OF 1998), AS AMNEDED 2010. | | |
|---|---|---|
| # | **Activity Description** | **Applicability** |
| 1 | The construction of facilities or infrastructure for the generation of electricity where the electricity output is 20 megawatts or more. | The proposed CSP facility will have an electricity output of approximately 125MW. |
| 15 | Physical alteration of undeveloped vacant or derelict land for residential, retail, commercial, recreational, industrial or institutional use where the total area to be transformed is 20 hectares or more. | The proposed development will cover a footprint greater than 20 ha. |

Table 3 indicates waste activities applicable to the proposed development.

**Table 3: Listed Activities according to GN R. 718 of the National Environmental Management: Waste Act (No. 59 of 2008)**

| GN R. 718<br>NATIONAL ENVIRONMENTAL MANAGEMENT: WASTE ACT (NO. 59 OF 2OO8} LIST OF WASTE MANAGEMENT ACTIVITIES THAT HAVE, OR ARE LIKELY TO HAVE, A DETRIMENTAL EFFECT ON THE ENVIRONMENT | | |
|---|---|---|
| # | **Category A** | Applicability |
| *A person who wishes to commence , undertake or conduct an activity listed under this Category, must conduct a basic assessment process as stipulated in the environmental impact assessment regulations made under section 24(5) of the National Environmental Management Act, 1998 (Act No. 107 of 1998) as part of a waste management licence application* | | |
| 11. | Treatment of Waste<br>The treatment of effluent, wastewater or sewage with an annual throughput capacity of more than 2,000 $m^3$ but less than 15,000$m^3$. | An on-site sewage treatment plant with an estimated throughput capacity of approximately 2,000 $m^2$ will be established. A waste license will therefore be required. |
| 18. | Construction, Expansion or Decommissioning of Facilities and Associated Structures and Infrastructure<br>The construction of facilities for activities listed in Category A of this schedule (not in isolation | In application for Activities 11. |

| GN R. 718<br>NATIONAL ENVIRONMENTAL MANAGEMENT: WASTE ACT (NO. 59 OF 2OO8} LIST OF WASTE MANAGEMENT ACTIVITIES THAT HAVE, OR ARE LIKELY TO HAVE, A DETRIMENTAL EFFECT ON THE ENVIRONMENT | | |
|---|---|---|
| | to associated activity). | |
| # | **Category B** | Applicability |
| *A person who wishes to commence , undertake or conduct an activity listed under this Category, must conduct an environmental impact assessment process as stipulated in the environmental impact assessment regulations made under section 24(5) of the National Environmental Management Act, 1998 (Act No. 107 of 1998) as part of a waste management licence application* | | |
| 1. | Storage of Hazardous Waste<br>The storage including the temporary storage of hazardous waste in lagoons. | An evaporation pond is proposed for the handling of waste water from the water treatment and sewage treatment process selected. |
| 11. | Construction of Facilities and Associated Structures and Infrastructure<br>The construction of facilities for activities listed in Category B of this schedule (not in isolation to associated activities). | In application for Activities 1 and 7. |

## 1.2 Legislative Framework

### 1.2.1 The National Environmental Management Act (No. 107 of 1998), as amended (2010)

The Act provides for the right to an environment that is not harmful to the health and wellbeing of South African citizens; the equitable distribution of natural resources, sustainable development, environmental protection and the formulation of environmental management frameworks (Government Gazette, 1998).

As previously mentioned, an S&SEIA process is required to be undertaken in order to apply for EA.

### 1.2.2 National Environmental Management: Waste Act (No. 59 of 2008)

This Act serves to reform the law regulating waste management in order to protect the health and the environment. This is done by providing reasonable measures for the prevention of pollution and ecological degradation and for securing ecologically sustainable development while promoting justifiable economic and social development, to provide for national norms and standards for regulating the management of waste by all spheres of government, for specific waste management measures, and for matters incidental thereto.

As previously mentioned, of relevance to the project is GN: R718 (July 2009) which comprises a list of waste management activities that have, or are likely to have a detrimental effect on the environment – activities contained in this list require a waste management license that in turn require a Basic Assessment (BA) Process (Category A activities) or an S&SEIA Process (Category B activities).

### 1.2.3 National Water Act (No. 36 of 1999)

The National Water Act (NWA) provides for fundamental reformation of legislation relating to water resources and use. The Act presents strategies to facilitate sound management of water resources, provides for the

protection of water resources, and regulates use of water by means of Catchment Management Agencies, Water User Associations, Advisory Committees and International Water Management.

Section 21 of the Act lists water uses for which authorisation a Water Use Licence will be required. Water uses relating to the proposed development that may be triggered are included in Table 4.

**Table 4: Listed Activities according to the National Water Act (No. 36 of 1999)**

| | NATIONAL WATER ACT (NO. 36 OF 1999)<br>Section 21 Water Uses requiring a Water Use Licence, if the use exceeds the thresholds set out under the particular use in the General Authorisations published in terms of the Act. | |
|---|---|---|
| # | **Section 21** | **Applicability** |
| (a) | Taking water from a water resource | Abstraction from the Orange River may be required.<br>It is currently anticipated that municipal water (treated water) will be available. The municipality indicated that there is sufficient capacity available. A formal request still needs to be issued and signed off on.<br>In the event that the municipality is unable or unwilling to provide treated water to the facility, abstraction and piping from the Orange River is being considered in parallel. If required, an application for the abstraction and storage of water will be submitted to the Department of Water Affairs (DWA). |
| (c) | Impeding and diverting the flow of water in a watercourse | Abstraction from the Orange River may be required. In the event that municipal water supply will be used, a license for this activity will not be required.<br>Ephemeral water courses that occur on site will be avoided through changing the site layout. If any watercourses are impacted on a license will be required. |
| (e) | Engaging in a controlled activity identified as such in Section 31(1) or declared under Section 38(1) [37(1)(c): a power generation activity which alters the flow regime of a watercourse] | Abstraction from the Orange River may be required. In the event that municipal water supply will be used, a license for this activity will not be required. |
| (g) | Disposing of waste in a manner which may detrimentally impact on a watercourse | Treated water from the sewage treatment plant may be used for the purposes of irrigation. A license will be required for the activity. |
| (i) | Altering the bed, banks, course or characteristics of a watercourse | Abstraction from the Orange River may be required. In the event that municipal water supply will be used, a license for this activity will not be required.<br>Ephemeral water courses that occur on site will be avoided through changing the site layout. If any watercourses are impacted on a license will be required. |

### 1.2.4 National Environmental Management: Air Quality Act (No. 39 of 2004)

The NEMA Air Quality Act (NEM: AQA) states the following as its primary objective: “To reform the law regulating air quality in order to protect the environment by providing reasonable measures for the prevention of pollution and ecological degradation and for securing ecologically sustainable development while promoting

justifiable economic and social development; to provide for national norms and standards regulating air quality monitoring, management and control by all spheres of government, for specific air quality measures, and for matters incidental thereto.

Whereas the quality of ambient air in many areas of the Republic is not conducive to a healthy environment for the people living in those areas, let alone promoting their social and economic advancement, whereas the burden of health impacts associated with polluted ambient air falls most heavily on the poor, whereas air pollution carries a high social, economic and environmental cost that is seldom borne by the polluter, and whereas atmospheric emissions of ozone-depleting substances, greenhouse gases and other substances have deleterious effects on the environment both locally and globally, and whereas everyone has the constitutional right to an environment that is not harmful to their health or well-being, and whereas everyone has the constitutional right to have the environment protected, for the benefit of present and future generations, through reasonable legislative and other measures that:

- Prevent pollution and ecological degradation;
- Promote conservation; and
- Secure ecologically sustainable development and use of natural resources.

### 1.2.5 National Environmental Management: Air Quality Act (No. 39 of 2004) and Minimum Emission Standards

GNR 248 of the National Environmental Management: Air Quality Act (No. 39 of 2004) is a list of activities which result in atmospheric emissions, which have or may have a significant detrimental effect on the environment, including health, social conditions, economic conditions, ecological conditions or cultural heritage.

The following activities listed under GNR 248 are relevant to the proposed Commercial CSP facility, dependent on the boiler that will be used onsite, table.

**Table 5: Listed activities according to the National Environmental Management: Air Quality Act (No. 39 of 2004)**

| National Environmental Management: Air Quality Act (No. 39 of 2004) | |
|---|---|
| **Category 1** | **Applicability** |
| Subcategory 1.2: Liquid fuel combustion installations<br>Liquid fuels combustion installations used primarily for steam raising or electricity generation, except reciprocating engines.<br>All installations with design capacity equal to or greater the 50MW heat input per unit, based on the low calorific value of the fuel used | A 50MW (electrical) diesel auxiliary boiler will be present on site for plant daily start-up every day, which will use 50ppm sulphur diesel as fuel source. |

An Atmospheric Emission License (AEL) for the facility will therefore be required. An application for an AEL will be conducted.

### 1.2.6 National Heritage Resources Act (No. 25 of 1999)

The National Heritage Resources Act established the South African Heritage Resources Agency (SAHRA) in 1999. SAHRA is tasked with protecting heritage resources of national significance. Under Section 38 of this Act, all new developments with a site exceeding 5 000m² or the construction of a road, wall, power line, pipeline, canal or other similar form of linear development or barrier exceeding 300m in length, are subject to assessment by SAHRA. A Heritage Impact Assessment has been carried out by a heritage specialist.

### 1.2.7 National Environmental Management: Biodiversity Act (No. 10 of 2004)

In line with the Convention on Biological Diversity, the Act aims to legally provide for biodiversity conservation, sustainable use and equitable access and benefit sharing. It provides for the publishing of lists of threatened or protected ecosystems and species, as well as threatening activities. No threatened ecosystems or protected species were found on site. A permit application will not be required.

### 1.2.8 National Forests Act (No. 84 of 1998)

The objectives of the National Forests Act (No. 84 of 1998) are to promote the sustainable management and development of forests, provide special measures for the protection of certain forests and trees; promote the sustainable use of forests for environmental, economic, educational, recreational, cultural, health and spiritual purposes. The Act provides for the declaration of protected forests and protected species. No protected species were found on site. A permit application will not be required.

### 1.2.9 Aviation Act (No. 74 of 1962)

The Act requires that the Civil Aviation Authority is consulted, and consent requested, for structures exceeding 45m above ground level or 150 m above mean ground level (i.e. the lowest ground level within a 3km radius of the structure). This would apply for the CSP power tower and an Application for Approval of Obstacles will be submitted.

### 1.2.10 Fencing Act (No. 31 of 1963)

The aim of the Fencing Act (No. 31 of 1963) is to consolidate the laws relating to fences and the fencing of farms and other holdings. When a landowner erects a fence in a designated area, he / she may insist that the adjacent owner make a contribution towards the erection or maintenance costs. In areas where contributions are not mandatory / have not been published in the Government Gazette, a contribution can be claimed from the adjacent owner if the fence offers beneficial use for such a person. The Act also makes provision for a mechanism to deal with disputes between adjacent owners regarding a contribution towards erecting or repairing a fence.

**Table 6: Legal requirements according to the Fencing Act (No. 31 of 1963)**

| FENCING ACT (NO. 31 OF 1963) | |
|---|---|
| **Section 17** | **Applicability** |
| Requires that any person erecting a boundary fence may clean any bush along the line of the fence up to 1.5 metres on each side thereof and remove any tree standing in the immediate line of the fence. | A security fence will be erected around the boundary of the facility. |

### 1.2.11 National Veld and Forest Fires Act

The purpose of this Act is to prevent and combat veld, forest and mountain fires. The Act provides for a variety of institutions, methods and practices for achieving the purpose such as the formation of fire protection associations. It also places responsibility on landowners to develop and maintain firebreaks as well be sufficiently prepared to combat veld fires.

The site is however very arid and it is unlikely that sufficient biomass to carry a fire develops on a regular basis. However, should areas be fenced-off and not grazed for some time, a fire risk could potentially develop. Under the Act, the landowner could be held responsible for any damages to neighbours' property caused under such a situation

### 1.2.12 Northern Cape Nature Conservation Act

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 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;

The Act also lists protected fauna and flora under 3 schedules ranging from Endangered (Schedule 1), protected (schedule 2) to common (schedule 3). The majority of mammals, reptiles and amphibians are listed under Schedule 2, except for listed species which are under Schedule 1. A permit is required for any activities which involve species listed under schedule 1 or 2.

## 1.3 Applicable policies and Plans

Table 7 reflects applicable policies, plans and guidelines that have relevance to the propose project.

**Table 7: Applicable Policies and Plans**

| Policy / Plan | Applicability |
|---|---|
| Renewable Energy Policy (DME, 2003b) | ■ Recognises that the medium and long-term potential of renewable energy is significant<br>■ While South Africa is well endowed with renewable energy resources that can be sustainable alternatives to fossil fuels, so far these have remained largely untapped<br>■ It is the intention of the Government to make South Africa's due contribution to the global effort to mitigate greenhouse gas emissions |
| Integrated Energy Plan | ■ Diversify energy supply through increased use of natural gas and new and renewable energies<br>■ Maximise load factors on electricity generation plant to lower lifecycle costs<br>■ Ensure environmental considerations in energy supply, transformation and end use |
| National Strategy for Sustainable Development (NSSD; Enviropaedia, 2007) | ■ Enhancing systems for integrated planning and implementation<br>■ Sustaining our ecosystems and using resources sustainably<br>■ Building capacity for sustainable development<br>■ Investing in sustainable economic development and infrastructure |
| Climate Change Strategy (Rumsey and King, 2009) | ■ Establishing the institutional capacity for effective climate change response<br>■ Integrating climate change response in government and |

| Policy / Plan | Applicability |
|---|---|
| | with other stakeholders<br>■ Promoting the use of donor funding to address vulnerability and adaptation issues<br>■ Ensuring that the strategy is consistent with national priorities, including poverty alleviation and economic development, and using local resources and expertise where possible |
| National Electricity Response Plan (NERP; DME, 2008) | ■ The National Electricity Response Plan was drawn up for many reasons, one of them being the security of supply crisis of 2008<br>■ Demand related interventions include the supplementation of power generation with alternate or renewable energy sources such as gas and solar power generation. |

## 1.4 Applicable Guidelines

The following are the key applicable guidelines have been considered during the assessment process:

- DEA, 2010. Draft Companion to the EIA Regulations 2010. Drafted as Guideline 5 in terms of the Integrated Environmental Management Guideline series gives access to the content of the Regulations in layman's terms.
- DEA, 2010. Draft Guideline on Public Participation in the EIA Process. Drafted as Guideline 7 in terms of the Integrated Environmental Management Guideline series gives access to the content of the Regulations as it pertains to public participation in layman's terms, as well as providing guidance on the proper fulfilment of public participation processes.
- DEA, 2008. Guideline on Environmental Impact Assessments for Facilities to be Included in the Electricity Response Plan, Government Notice 162, Government Gazette 32970.This Guideline (published in GN 162 of 2010) provides a framework for the procedures to be used in response to S&SEIA applications for facilities to be included in the NERP. In particular it provides for shorter timeframes to be applied to the various regulatory steps of the process.

## 1.5 International Best Practice Standards

According to screening criteria used by various lending institutions, the extent, duration and potential social and environmental issues associated with the proposed Sasol CSP Project trigger the requirement for an SEIA to be undertaken. The content of the SEIA is determined by the identification of key issues and policy and legal approaches for addressing such issues. In the case of the proposed Sasol CSP Project, various policies and legal drivers, including those of international lending institutions and legislative requirements, have shaped the methodology adopted for the purposes of the SEIA and the specialist studies undertaken.

In order to promote responsible environmental stewardship and socially responsible development, the proposed Sasol CSP Project will, as far as practicable, incorporate the environmental and social policies of the International Finance Corporation (IFC). These policies provide a frame of reference for lending institutions to review of environmental and social risks of projects, particularly those undertaken in developing countries. Through the Equator Principles[1], the IFC's standards are now recognised as international best practice in project finance.

[1] Equator Principles are a voluntary set of guidelines for managing environmental and social issues in project finance lending. The signatories of the Equator Principles believe that adoption of and adherence to these principles offers significant benefits to the financiers, their customers and other stakeholders. These principles will foster the ability of financiers to document and manage their risk exposures to environmental and social matters associated with the projects they

The IFC screening process categorises projects into A, B or C in order to indicate relative degrees of environmental and social risk. Category A projects are those that are expected to have "adverse impacts that may be sensitive, irreversible and diverse", (OD 4.01) with attributes such as direct pollutant discharges large enough to cause:

- Degradation of air, water or soil;
- Large-scale physical disturbance of the site or surroundings;
- Extraction, consumption, or conversion of substantial amounts of forest and other natural resources, and
- Involuntary displacement of people and other significant social disturbances. These impacts may affect an area broader than the site or facilities subject to physical works.

Accordingly, large-scale projects such as the proposed Sasol CSP are categorised as Category A projects. The environmental assessment process for Category A projects examines the project's potential negative and positive environmental impacts and compares them with those of feasible alternatives (including the 'without project' scenario). As required for Category A projects a comprehensive SEIA approach is being undertaken for the Sasol CSP Project.

## 1.6 Need and Desirability

Recent economic growth and increased efficiency in distribution across the country has resulted in an increase in electricity demand, beyond what current infrastructure can support (Banks, 2006). Blackouts experienced periodically, particularly in winter, from 2004 onwards necessitated the development of implementation of a load shedding plan by Eskom during 2008. This was in spite of attempts to implement energy efficiency and demand side management plans to accommodate the sharp increase in demand.

In response to the deficit between electricity supply and demand, the Department of Energy compiled an Integrated Resource Plan (IRP2010), which is a long term electricity capacity plan that defines the need for new generation and transmission capacity for the country. The shortage of electricity, as well as the IRP, has subsequently opened opportunities for organisations in the electricity sector. There has been a growing need for the independent power producers (IPPs) to contribute generation capacity to the national grid.

The IRP2010 (a 20-year projection on electricity supply and demand) stated the objective that approximately 42% of electricity generated in South Africa is required to come from renewable resources.

Current electricity supply in South Africa is primarily from coal-fired power stations. Issues associated with the dependence on coal include 1) the fact that the resource is non-renewable, 2) consumption of coal for use in power generation reduces the availability of coal for other uses and 3) burning of coal is one of the major producers of carbon dioxide, which is commonly accepted as a contributor to climate change, deterioration in urban and rural air pollution and acid rain (Banks, 2006). These issues associated with the burning of coal as well as the rising prices for other fossil-fuels (such as oil), geopolitical developments and environmental concerns have led to growing demand for renewable energy sources. Several renewable energy technologies have the potential to contribute significantly to meeting future energy demand in South Africa, such as, solar thermal and photovoltaic energy generation; wind electricity generation; biomass conversion and hydropower wave power (Banks, 2006).

In order for Sasol to remain competitive and grow sustainably, Sasol is investigating the use of alternative sources of energy, with solar power being identified as one of the most economically and environmentally sustainable technologies for Sasol's implementation, through its subsidiary, SNE.

Solar energy is the most abundant energy source, and is a 'clean' energy source. The levels of solar irradiation in Southern Africa are comparable with countries such as Spain and the USA where solar power has been successfully implemented. While it is not currently cost competitive with conventional coal, the cost of solar energy project has been consistently decreasing. Further technology development of solar power will result in it being cost competitive will conventional coal produced power. Concentrated solar power can provide

finance, thereby allowing them to engage proactively with their stakeholders on environmental and social policy issues. The adopting institutions view these principles as a framework for developing individual, internal practices and policies, and are doing so voluntarily and independently.

distributed large-scale, steady-state power generation with low $CO_2$ emissions and substantially low water consumption.

The proposed solar power facility is well aligned with South Africa's Renewable Energy Policy and its objectives and will contribute to meeting the goals of the Department of Energy's Integrated Energy Plan (Section 1.3).

Sasol is an energy and chemicals company, and the mandate of SNE is to invest in alternate sources of energy. Sasol is a significant producer and consumer of electricity and SNE has chosen to focus on cleaner generation options such as gas-to-electricity and renewable electricity both for internal consumption as well as grid connected applications. Sasol's decision to develop the CSP Facility is a strategic decision based on the recognition that electricity provision is playing an increasingly important role in the sustainable future of Sasol's business.

SNE's role in the Sasol Group is to develop sustainable solutions for Sasol to prosper in a carbon- and water-constrained environment. SNE was created to focus on new technologies that can integrate lower carbon energy options to reduce our environmental footprint. SNE's approach is to leverage Sasol's key competitive advantage, which is developing and commercialising new technologies, and implementing and operating facilities based on these technologies at large scale.

## 1.7 Project Value

South Africa enjoys an abundance of solar energy, which is higher than in many countries that have already successfully implemented solar power projects. CSP was evaluated to be capable of reaching grid parity in the medium to long term. CSP benefits from economies of scale and is suited to utility scale applications.

The expected capital investment is between R 4 and R 5 billion. The project will create between 40 and 60 permanent jobs in the operations phase.

It is SNE's intention to employ local labour, in line with the IPP requirements. This is likely to have a positive impact on local communities and have downstream impacts on household income, education, and other social aspects.

With the implementation of specific skills training for local communities, SNE has the opportunity to develop local employee potential. These costs could be offset against the cost of relocating people from outside the region (i.e. higher labour costs, transport and relocation costs). In addition, it was highlighted that awareness training for the youth would assist in vocational guidance and the long-term development and skills base in the region.

Other benefits include the offsetting of $CO_2$, since solar energy is considered a clean energy, little greenhouse gases will be produced in comparison to conventional coal produced power.

The project will also create a number of construction related jobs and a fairly high number of jobs in the operational phase; this will aid the employment rate within the region. Alstom Power Systems initiated an assessment to determine the local economic development potential of the proposed Sasol CSP Project. Based on this assessment the following jobs will be created as a result of the project.

**Table 8: Jobs created by the Sasol CSP Project**

| Area | Local employment – Upington area | Provincial employment | National employment (South Africa) |
|---|---|---|---|
| **Construction Phase** | | | |
| Solar field subcontractors | 85 jobs: Solar field<br>20 jobs: Building assembly | 40 jobs: Solar field<br>15 jobs: Building assembly | 50 jobs: Solar field<br>15 jobs: Building assembly<br>25: Commissioning |
| Power block subcontractors | 50 jobs: Mechanical and electrical | 40 jobs: Mechanical and electrical | 85 jobs: Mechanical and Electrical |

| Area | Local employment – Upington area | Provincial employment | National employment (South Africa) |
|---|---|---|---|
| | 60 jobs: Civil | 50 jobs: Civil | 65 jobs: Civil<br>25: Commissioning |
| Engineering, procurement and construction contractor | 5 jobs: Administrative | 10 jobs | 40 jobs |
| **Total** | **220** | **155** | **515** |
| **Operational Phase** | | | |
| Operations and administration | 50 jobs | | 10 jobs |
| **Total** | **50** | | **10** |

## 1.8 Details of Applicant

The applicant for the proposed Commercial CSP facility is Sasol New Energy Holdings (Pty) Ltd (SNE). Details of the applicant are provided in Table 9.

**Table 9: Project applicant details**

| Project applicant: | Sasol New Energy Holdings (Pty) Ltd | | |
|---|---|---|---|
| **Contact person:** | Shane Pillay | | |
| **Physical address:** | The Mall Office, Cradock Avenue, Rosebank, 2196 | | |
| **Postal address:** | P.O Box 5486, Johannesburg, 2000 | | |
| **Postal code:** | 2196 | **Fax:** | 011 522 8618 |
| **Telephone:** | 011 344 2743 | **E-mail:** | shane.pillay@sasol.com |

## 1.9 Details of independent Environmental Assessment Practitioner

WSP was appointed by SNE as the independent environmental assessment practitioner (EAP) to facilitate the environmental authorisation process, Table 10. WSP is a leading international environmental consultancy with a broad range of expertise in the environmental industry. WSP is a subsidiary of WSP Group PLC, a global consultancy which is listed on the London Stock Exchange. WSP has successfully project managed a number of high profile environmental projects in South Africa over the past 20 years (refer to WSP's Capability Statement in (**Appendix 1**).

**Table 10: EAP details**

| EAP: | WSP Environmental (Pty) Ltd | | |
|---|---|---|---|
| **Contact person:** | Catherine Greengrass, Lizelle Prosch or Chevonne Stevens | | |
| **Physical address:** | WSP House Bryanston Place, 199 Bryanston Drive, Bryanston, Sandton, 2021 | | |
| **Postal address:** | PO Box 5384, Rivonia | | |
| **Postal code:** | 2196 | **Fax:** | 086 240 0693 |
| **Telephone:** | 011 361 1395 (Catherine) | **E-mail:** | Catherine.Greengrass@wspgroup.co.za |

| EAP: | WSP Environmental (Pty) Ltd | | |
|---|---|---|---|
| | 011 361 1392 (Lizelle)<br>011 300 6178 (Chevonne) | | Lizelle.Prosch@wspgroup.co.za<br>Chevonne.Stevens@wspgroup.co.za |

## 1.10 SEIA and SEMP Submission and Review

The final draft Social and Environmental Impact Assessment (SEIA) and Social and Environmental Management Programme reports will be submitted to the DEA in Pretoria in September 2012 for review and decision-making.

In terms of the accelerated schedule for the SEIA process proposed for National Electricity Response Plan (NERP) projects, public review of the final draft SEIA and SEMP reports will occur simultaneously with the authority review of the document. The NERP schedule thus allows a total of 40 days from submission of the report to the issuing of a decision by DEA. The report will then be amended to incorporate DEA's and other stakeholders' comments.

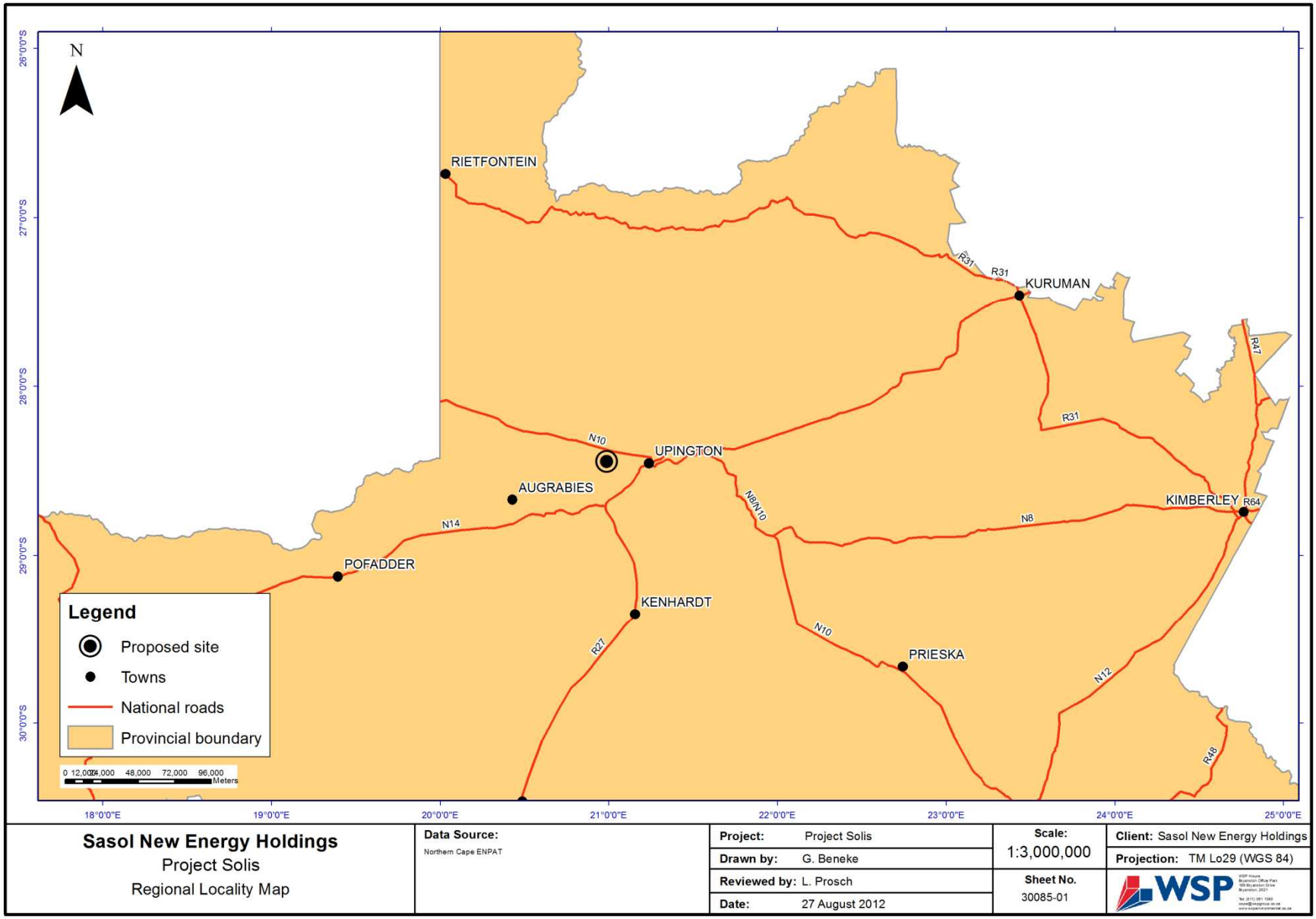



**Figure 1: Locality Map**

# 2 Methodology

Prior to the initiation of the SEIA Process, SNE conducted an Environmental Screening Investigation (ESI) to identify a site suitable for the Sasol CSP Project (further discussed in Section 3.7). The Scoping and SEIA is undertaken for the selected site and site alternatives are not considered or evaluated as part of the process.

The SEIA for the proposed Sasol CSP Project is undertaken in accordance with the Environmental Impact Assessment Regulations as published in terms of NEMA (2010). The competent authority has been identified as the National Department of Environmental Affairs (DEA).

An application form for an environmental authorisation was submitted to the DEA for NEMA listed activities. Acknowledgement of receipt and formal authorisation to proceed was received on 26 April 2012 and the approval of the Final Scoping Report and Plan of Study for Environmental Impact Assessment was received on 24 October 2012. The DEA reference number for the project is 14/12/16/3/3/2/335 (**Appendix 2**).

The Scoping Phase was initiated and included:

- The collection and collation of baseline information required for the application;
- The preparation of a draft SR including:
  - A description of the activity and alternatives;
  - A description of the property and location of the property;
  - A description of the environment (physical, biological, social, economic, cultural);
  - Identification of all applicable legislation and guidelines, and
  - A description of all the potential environmental issues and potential impacts.
- The Scoping Phase Stakeholder Consultation Process, included:
  - The identification of stakeholders (including key stakeholders such as adjacent and affected landowners, Government Departments and Non-Governmental Organizations (NGO))
  - Advertisement placement and written notification of stakeholders, including:
    - Written notification of identified stakeholders;
    - Posting of site notices, and
    - Placement of newspaper advertisements.
- A Stakeholder Meeting, and
- A recording of all issues, concerns and comments received.

During the Scoping Phase it was established that applications for the following additional authorisation will be required for the project:

- Waste Management Licence; and
- Atmospheric Emissions Licence.

The requirements for these authorisations are further discussed in Section 1.2.2 and 1.2.4 respectively.

At a post-application authorities meeting with the case officer for the DEA, Ms Masina Litsoane, it was confirmed that an Integrated SEIA Process will be applied for these authorisations. A Draft Integrated Application form has been prepared (**Appendix 3**) and will be submitted to the DEA with the Final SEIA Report.

During the Scoping Phase, feasible alternatives and potential environmental impacts were identified that would require further investigation during the SEIA Phase. The following methodology was adopted for the SEIA phase of the study, as outlined by the EIA Regulations:

- Specialist assessments detailing assumptions, uncertainties and gaps in knowledge;

- A description and comparative assessment of all alternatives identified during the Scoping Phase;
- An assessment of the significance of each impact and issue as well as an indication of the extent to which the issue could be addressed by the implementation of mitigation measures, namely:
  - Cumulative impacts;
  - The nature of the impact;
  - The extent and duration of the impact;
  - The probability of the impact occurring;
  - The degree to which the impact can be reversed;
  - The degree to which the impact may cause irreplaceable loss of resources, and
  - The degree to which the impact can be mitigated.
- A SEIA Phase Stakeholder Consultation Process;
- A recommendation drafted as to whether the Sasol CSP Project should or should not be authorised, and if the opinion is that it should be authorised, any conditions that should be made in respect of that authorisation;
- The development of an Environmental Impact Statement (EIS) which contains:
  - A summary of the key findings of the SEIA, and
  - A comparative assessment of the positive and negative implications of the proposed activity and identified alternatives.
- The compilation of an SEMP, and
- The compilation of a Decommissioning Programme which includes a rehabilitation and remediation plan.

## 2.1 Description of the Integrated SEIA Process

Section 24 (5) of NEMA provides for the Minster of Environmental Affairs to publish regulations describing the requirements for environmental authorisation processes for listed activities. Government Notice Regulation 543 of 2010 was published in terms of this and describes in detail the requirements for a S&SEIA process.

Section 24 L of the NEMA provides for instances where the carrying of out of a listed activity in terms of NEMA is also regulated in terms of another law or a specific environmental management Act (such as the NEMWA), that one integrated process can be followed for all authorisations required. Authorisations resulting from an integrated process will be combined in the form of an Integrated Environmental Authorisation. The Integrated Scoping and SEIA process has been indicated in Figure 2.

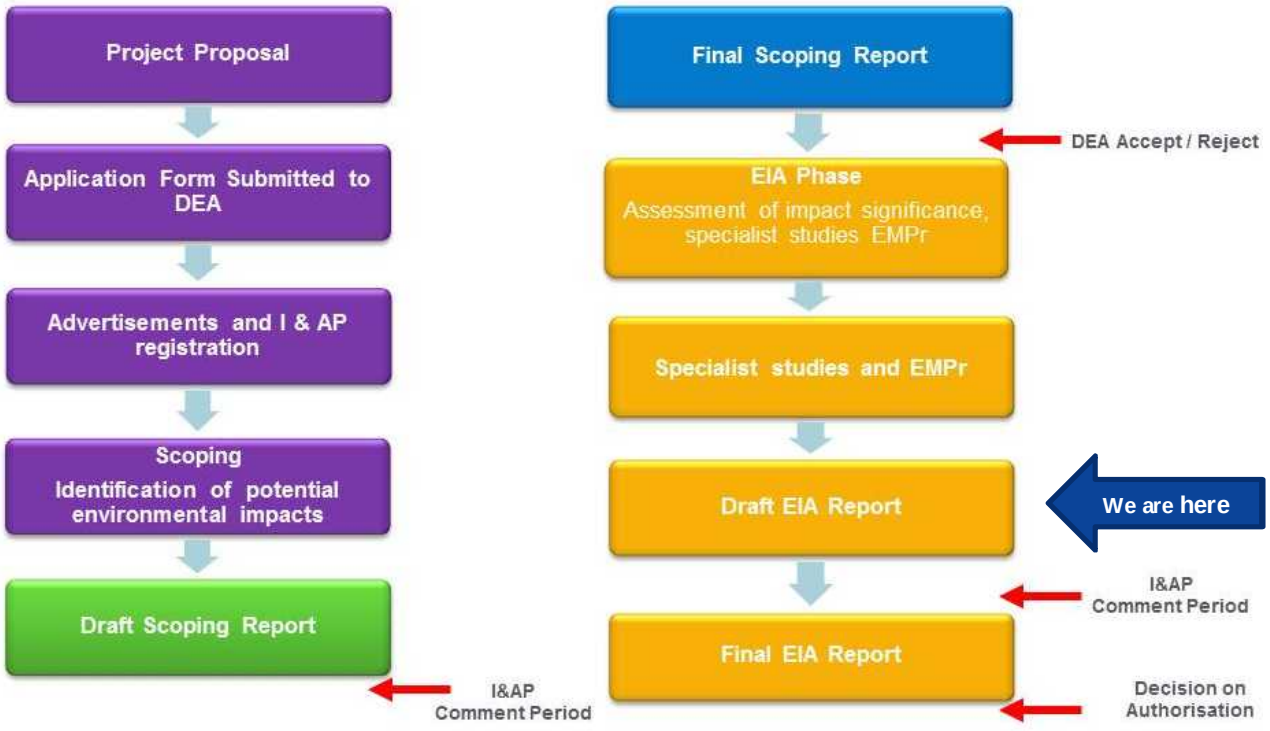



**Figure 2: Process flow chart for Integrated Scoping and SEIA**

# 3 The Scoping Phase (Completed)

The tasks undertaken and investigations conducted as part of the Scoping Phase as required in terms of the EIA Regulations (GNR 543 of 2010) are described below.

## 3.1 Application for Authorisation

An application form for an environmental authorisation was submitted to the DEA (the Competent Authority for energy projects) for NEMA listed activities. Acknowledgement of receipt and formal authorisation to proceed was received on 26 April 2012 and the approval of the Final Scoping Report and Plan of Study for Environmental Impact Assessment was received on 24 October 2012. The DEA reference number for the project is 14/12/16/3/3/2/335 (**Appendix 2**).

During the Scoping Phase it was established that applications for the following authorisation may also be required for this project:

- Waste Management Licence; and
- Atmospheric Emissions Licence.

At a post-application authorities meeting with the case officer for the DEA, Ms Masina Litsoane, it was confirmed that an Integrated SEIA Process will be followed in application for these authorisations. A Draft Integrated Application form has thus been prepared (**Appendix 3**) and will be submitted to the DEA with the Final SEIA Report

In addition to this, a Water Use Licence Application will also be required. Consultation with the DWA are being undertaken to determine the requirements for the application.

## 3.2 Site Investigations

Various site visits were conducted as part of the Scoping Phase in order to observe the receiving environment and identify potential issues or impacts of the propose development.

- 8 May 2012 - Initial WSP site visit;
- 21 May 2012 – Site visit with WSP, the Applicant (SNE) and various project specialists;
- 22 May 2012 – Site visit with WSP, the Applicant (SNE), the DEA, and members of the KGLM; and
- 23 May 2012 – Site visit WSP and project specialist.

## 3.3 Stakeholder Engagement Conducted

The NEMA EIA Regulations (Sections 54-57) require that an inclusive, transparent process of engagement – sharing of information, receipt of comments, expression of issues and concerns, and response and feedback regarding issues and concerns – be undertaken that allows participation by any and all persons and entities who may be affected by and/or have an interest in a proposed project. Procedures for informing stakeholders about a project and engaging their participation have become standard practice.

The following sections outline the tasks that have been undertaken as part of the stakeholder consultation process.

### 3.3.1 Compilation of Stakeholder Database

The identification and registration of stakeholders has been an on-going activity during the course of this study. Neighbouring farms, local communities and groupings, as well as authorities and state departments having jurisdiction in respect of any aspect of the activity were identified. WSP developed and maintained an electronic database for the duration of the project where stakeholder details were captured and automatically updated as and when information was received. Refer to **Appendix 4.1** for a copy of the database for this project.

### 3.3.2 Public Participation

#### 3.3.2.1 Site Notices

The NEMA EIA Regulations require that a site notice be fixed at a place conspicuous to the public at the boundary or on the fence of the site where the activity to which the application relates is to be undertaken and on any alternative sites. Nine site notices were placed at the following locations (refer to **Appendix 4.2** for a copy of the Site Notice placed and Site Photographs):

- KHLM in Upington (English and Afrikaans);
- KGLM in Keimoes (English and Afrikaans);
- //Khara Hais Public Library in Upington (English and Afrikaans);
- The boundary of the proposed site: Van Roois Vley (English and Afrikaans); and
- Piet Thole Hall, public meeting venue (Afrikaans);

The purpose of the site notices was to notify the public of the project and to invite the public and interested and / or affected parties to register as stakeholders for the project and to attend the public meeting. Five of the site notices were published in Afrikaans and the remaining four were published in English.

#### 3.3.2.2 Background Information Documents and Letters of Notification

According to the NEMA EIA Regulations, written notice must be given to the:

- Owner or person in control of that land if the applicant is not the owner;
- Occupiers of the site where the activity is to be undertaken;
- Owners and occupiers of land adjacent to the site where the activity is to be undertaken, including all alternate sites;
- Owners and occupiers of land within a 100m radius of the boundary of the project;
- Municipal ward councillor in which the site is situated;
- Municipality who has jurisdiction of the area;
- Any organ of state having jurisdiction in respect of any respect of the activity; and
- Any other party as required by the competent authority.

The purpose of the Background Information Document (BID) was to provide information on the proposed project, outlining the environmental process, notifying stakeholders of the date and venue of the public meeting and providing an opportunity for registration of other stakeholders. A copy of the BID is contained in **Appendix 4.3**. The BID's were distributed to all landowners and tenants that could be affected by the proposed project and in accordance with the above requirements.

Authorities and stakeholders were notified via Email and SMS.

#### 3.3.2.3 Advertisements

The NEMA EIA Regulations require that an advertisement be placed in either a local newspaper or a Government Gazette. Should the project have a potential impact that extends beyond the boundaries of the metropolitan or local municipality, the project should be advertised within at least one provincial or national newspaper. To ensure that the stakeholder consultation was comprehensive, an advertisement was placed in two local newspapers (The Kalahari Bulletin and The Northern Cape Express), and one national newspaper (The Star), thereby ensuring that a wider range of people were informed. Refer to **Appendix 4.4** for a copy of the newspaper advertisements.

The proposed facility project advertised through the press in the following local newspapers:

- The Kalahari Bulletin – 2 May 2012;
- Northern Cape Express – 3 May 2012; and
- The Star – 3 May 2012.

### 3.3.3 Public Meeting

A public meeting was held at the Piet Thole Hall on 22 May 2012 from 17h30 to 19h00. The aim of the meeting was to outline the details of the project and provide an opportunity for stakeholders to raise issues, concerns and queries related to the proposed project. The meeting also established a line of communication between the stakeholders and project team. In consultation with DEA and local authorities it was requested that during the next public participation round in the SEIA phase that two public meetings be held one in Upington as well as one in Keimoes. DEA agreed to this expansion.

WSP presented the proposed project and the environmental processes associated with the project in Afrikaans. The design details of the proposed project were also discussed during the meeting. The floor was then opened for discussion and for the attendees to raise questions, concerns and issues. All discussions, questions, concerns and issues were noted and included in the Issues Trail. A copy of the meeting minutes report is contained in **Appendix 4.5.**

All adjacent landowners were invited to individual meetings on 22 and 23 May. Meetings with individual landowners who were available were conducted and telephonic discussions with those who were not available were held whereby they were invited to send any comments or issues to WSP. Issue raised by adjacent landowners are recorded in **Appendix 4.6.**

### 3.3.4 Authorities Consultation

The first Authorities Meeting was held on 15 May 2012 with the DEA. The objectives of the meeting were to gain clarification on requirements set out in the acknowledgement letter received from DEA on 26 April 2012.

All the relevant issues, questions and concerns were noted, and a copy of the meeting minutes was distributed to the DEA (**Appendix 4.7**).

The second Authorities Meeting was held on 22 May 2012 at Piet Thole Hall in Upington with representatives from the following regulatory authorities:

- Masina Litsoane (Department of Environmental Affairs);
- Yolande de Jager (Kai! Garib Local Municipality); and
- Patrick Wells (Kai! Garib Local Municipality).

Project information, in the form of a presentation and potential environmental impacts, was presented to the authorities in order to ensure that they were adequately informed about the project. A site visit was undertaken in order to allow authorities to familiarise themselves with the site and the proposed project. All discussions, questions, concerns and issues were documented and included in the issues trail. A copy of the minutes is included in **Appendix 4.8**.

### 3.3.5 Public Review

The draft Scoping Report for the proposed facility was placed on public review between 13 June and 4 July 2012 at the following venues:

- Kai! Garib Local Municipality
- Kai! Garib Library
- //Khara Hais Local Municipality
- //Khara Hais Libraries (all three libraries in Upington)
- WSP Website: www.wspenvironmental.co.za

### 3.3.6 Issues Trail

An issues trail was developed that details the outcomes of all engagement and consultation with authorities and stakeholders. This issues trail was developed at the onset of the project and as such includes all comment and responses received (**Appendix 4.6**)

- During consultation with the surrounding landowners the following comments and concerns were raised:
  - Increases in stock theft due to influx of people during construction and operation phases.
  - Concerns were raised about the possibility of construction and/or operational staff being housed on site.
  - Increase risk of veld fires.
  - Scouring and soil erosion by rain water running off the heliostats.
  - Some landowners indicated their interest in linking into proposed infrastructure such as pipelines and substations.

These concerns were noted and conveyed to the applicant and responses will be included in the Issues Trail.

## 3.4 Potential Environmental Impacts - Identified during the Scoping Phase

The over-arching objective of the Scoping Phase is to identify record and describe the potential environmental issues associated with the proposed Sasol CSP Project. This enables the specialist studies to be clearly focused on aspects of significant concern. It also provides a framework for the assessment of the impacts that the proposed project will have on the environment, and of the impacts the environment will have on the proposed project.

Based on inputs from the project team, stakeholders, Interested and Affected Parties (I&APs) and specialists the environmental (biophysical, social and cultural) impacts in Table 11 have been identified as potentially associated with the proposed development and were investigated during the SEIA phase of the process.

**Table 11: Potential impacts associated with the proposed CSP facility**

| Environmental Aspect | Potential Impact | Proposed method of investigation |
|---|---|---|
| **Soil, Land Use and Land Capability** | Loss of agricultural capacity | Land Capability Assessment (Agriculture and soils) |
| | Loss of grazing capacity | |
| **Biodiversity** | Loss of terrestrial habitat | Botanical Impact Assessment, Faunal Impact Assessment, Avifaunal Impact assessment |
| | Loss of ephemeral habitat | |
| | Disturbance and displacement of fauna / avifaunal species | |
| | Faunal interaction with structures, servitudes and personnel | |
| | Impact on surrounding habitat and species | |
| | Increase in environmental degradation | |
| | Loss of Red data / protected floral species | |
| | Introduction / spread of alien species | |
| | Loss of species diversity | |
| **Surface and Groundwater** | Soil erosion from changes in surface water flow due to construction of infrastructure | Hydrological and Geohydrological Impact Assessment |
| | Soil erosion due to storm water runoff from heliostats | |
| | Impact on water users downstream of proposed abstraction point in the Orange River | |
| **Air Quality** | Particulate matter (dust) impacts during construction phase | Air Quality Impact Assessment |
| | Air quality impacts due to burning of diesel in auxiliary boiler | |
| **Visual** | Light reflection from heliostats into surrounding properties and traffic routes | Visual Impact Assessment |
| | Light reflection from heliostats into the sky (aviation safety) | |
| | Visual impact from viewpoints overlooking the proposed site | |
| | Visual impact of power tower structure | |

| Environmental Aspect | Potential Impact | Proposed method of investigation |
|---|---|---|
| **Noise** | Noise impact during construction | Noise Impact Investigation |
| | Noise from steam turbine | |
| **Traffic** | Construction vehicles using the existing road networks to access the proposed site | Traffic Impact Assessment |
| | Increase in the number of vehicles on the existing networks during operation | |
| **Culture and Heritage** | Loss of significant archaeological sites | Heritage Impact assessment (including Phase I archaeological investigations) |
| | Loss of significant cultural / heritage resources | |
| **Air Space** | Physical obstacle to aircraft | Consultation with the Civil Aviation Authority |
| **Socio-Economic** | Job creation | Social Impact Assessment |
| | Expansion of local skill | |
| | Small business opportunities | |
| | Economic development | |
| | Increased potential for stock theft | |
| | Visual disturbance | |
| | Security risks | |
| | Noise intrusion | |
| | Dust intrusion | |
| | Light intrusion | |
| | Increased potential for fires | |

## 3.5 Objectives and requirements of the Environmental Study

### 3.5.1 Scoping Phase

The primary function of the Scoping Phase of the environmental assessment process can be described as:

- The identification of the potential significant environmental and socio-economic impacts associated with a development activity;
- The identification of alternatives for consideration in the decision-making process, and
- To define the Terms of Reference (ToR) of the Plan of Study for SEIA for assessment.

The function of the Scoping Phase Stakeholder Consultation Process is the following:

- Informing the stakeholders and interested and affected parties of the development proposal;
- Identifying additional projects impacts based of the feedback obtained, and
- Identifying the concerns and values of the stakeholders.

### 3.5.2 Social and Environmental Impact Assessment and Social and Environmental Management Programme

#### 3.5.2.1 Social and Environmental Impact Assessment

SEIA is the systematic process to identify, predict and evaluate the environmental impacts of proposed development. The overarching purpose of the SEIA is to:

- Provide information for decision-making on the social and environmental consequences of proposed development project, and
- Promote environmentally sound and sustainable development through the identification of appropriate mitigation measures.

During this phase of the environmental assessment process the impacts identified during the Scoping Phase of the study are comprehensively quantified and appropriate mitigation measures identified to either reduce or avoid such potentially adverse impacts identified.

#### 3.5.2.2 Social and Environmental Management Programme

The SEMP is a tool used to ensure potentially adverse impacts transpiring during the construction, operation, decommissioning phase of the project life cycle are prevented, mitigated and/or managed. The SEMP translates recommended mitigation and monitoring measures into specific actions to be implemented by the project proponent and various other role players.

The following objectives of the SEMP are considered important:

- Ensuring compliance with the regulatory authority stipulations and guidelines;
- Verifying environmental performance through monitoring;
- Responding to changes in project implementation;
- Responding to unforeseen events, and
- Providing feedback for continual improvement in environmental performance.

The SEMP has been developed to adhere to the following requirements:

- The objectives of the SEMP are noticeably stated;
- A list of environmental characteristics and impacts associated with the proposed development activity are included;
- Measures to manage the impacts associated with the proposed development activity are identified;
- A comprehensive indication of the environmental responsibilities of respective role players (i.e. applicant, contractor, government departments, other) are included, and
- Emergency response procedures are highlighted.

## 3.6 Specialist Investigations

In order to ensure that a comprehensive assessment of the relevant bio-physical and socio-economic components was performed, the following specialist investigations were conducted:

- Desktop Hydrology and Geohydrology Assessment;
- Desktop Land Capability and Grazing Capacity Assessment;
- Specialist Avifaunal Assessment;
- Faunal Specialist Study;

- Specialist Vegetation Assessment;
- Heritage Impact Assessment;
- Social Impact Assessment,
- Traffic Impact Assessment;
- Air Quality Assessment, and
- Visual Impact Assessment.

## 3.7 Detailed Description of the Site Selection Process

Prior to the commencement of the S&SEIA process, a desktop site selection study using geographical information system (GIS) data was conducted by Stellenbosch University to identify suitable locations. This led to the identification of areas around Upington of which three farms were then shortlisted after inspections of conditions on the ground.

These three farms in the Northern Cape were then selected by SNE to undergo an environmental screening investigation (ESI) to determine their suitability for the establishment of a Commercial CSP Facility (**Appendix 5**). The farms, namely, Van Roois Vley, Droogehout and Areachap, are all located within the Siyanda District Municipality in the Northern Cape Province (Figure 3).

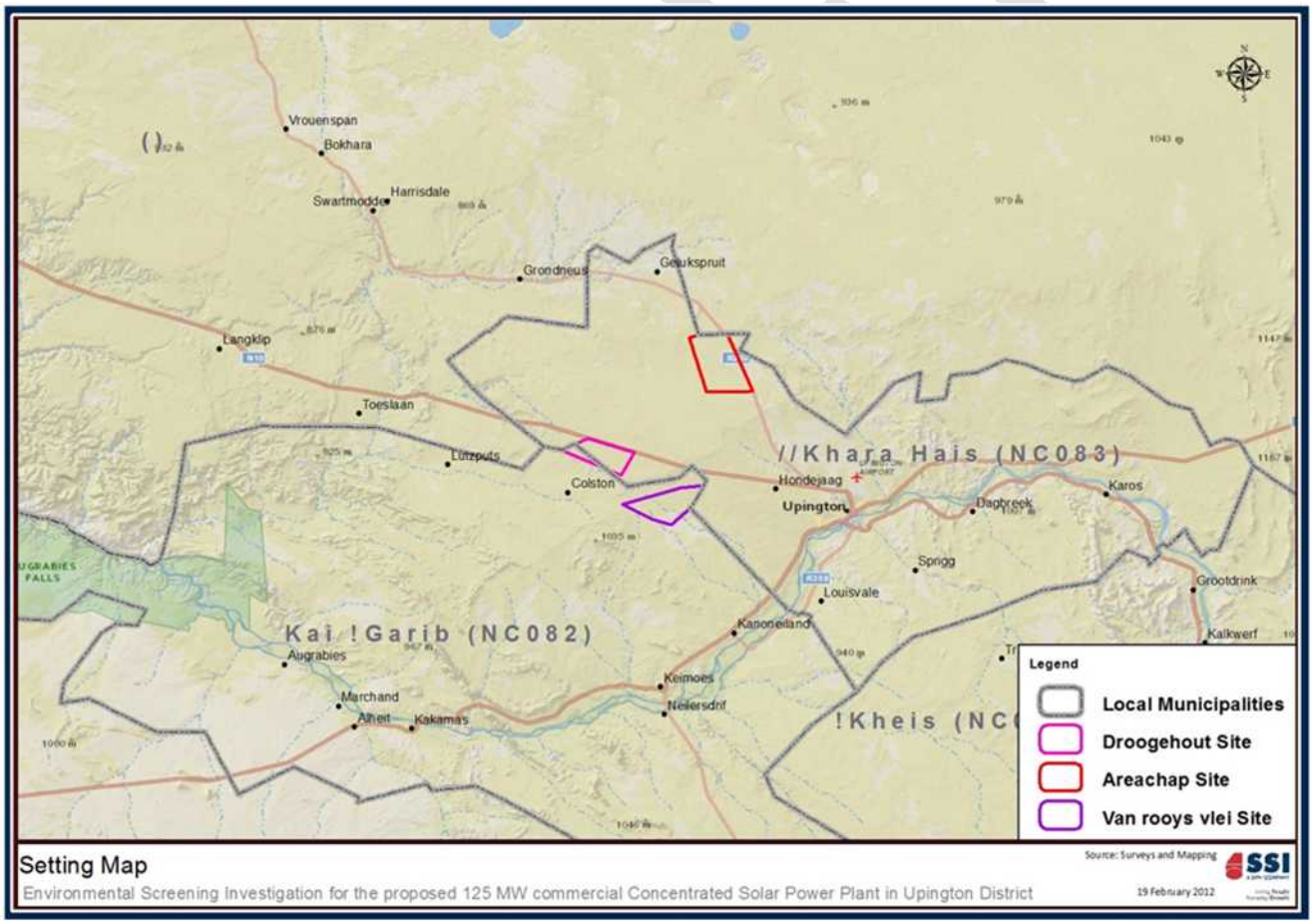



**Figure 3: Setting Map from ESI Report (SSI, 2012)**

The environmental screening comprised an assessment of the biophysical, social and enviro-legal criteria indicated in Figure 4.

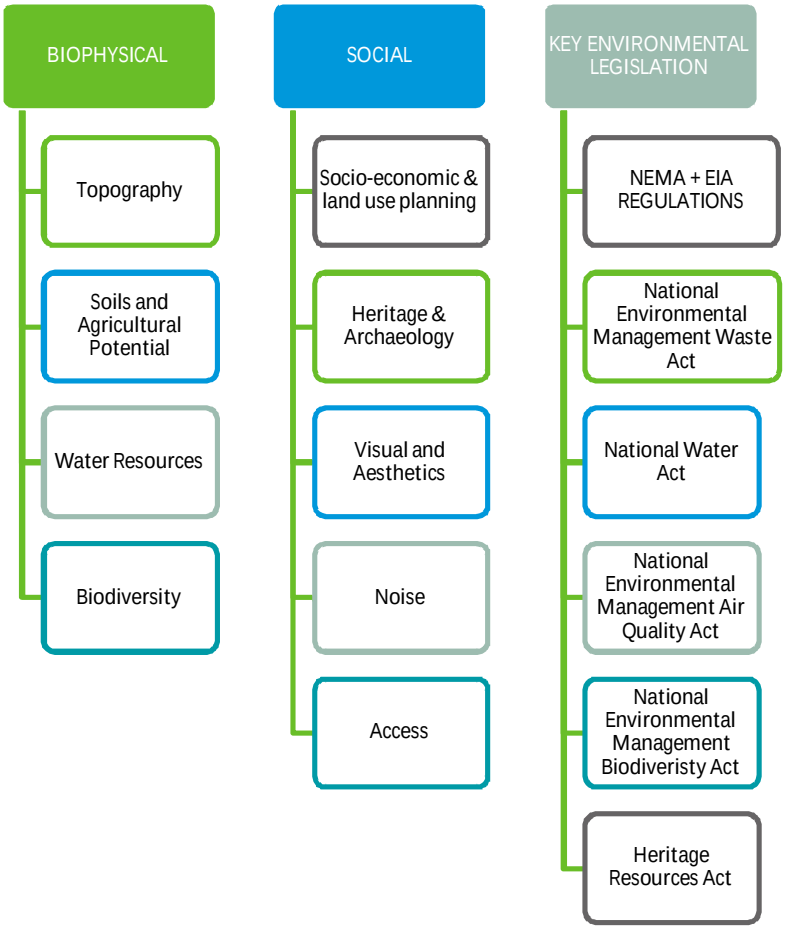



**Figure 4: ESI Assessment Criteria**

The ESI found that the Van Roois Vley farm is the least environmentally sensitive site and would be the preferred option from an environmental point of view for the development of the proposed Commercial CSP facility. The Droogehout farm would be the second preferred option. The least preferred site was the farm Areachap due to conflicting local planning objectives.

The farm on which the Commercial CSP facility is proposed to be located is Van Roois Vley. The farm boundary is indicated in Figure 6. Only a portion of the farm is proposed for the development of the Commercial CSP facility. The area indicated as the Proposed Solis Site is the area under investigation for Commercial CSP in this SEIA process, as well as for a proposed Concentrated Photovoltaic (CPV) facility, which is being assessed as part of a separate SEIA process.

## 3.8 Proposed CPV Facility (excluded from this SEIA process)

SNE is investigating the development of a CPV facility on the same land portion identified for the development as the CSP facility. The feasibility of the CPV facility and decision to continue is pending. The location of the proposed CPV facility in relation to the CSP facility is indicated in Figure 5.

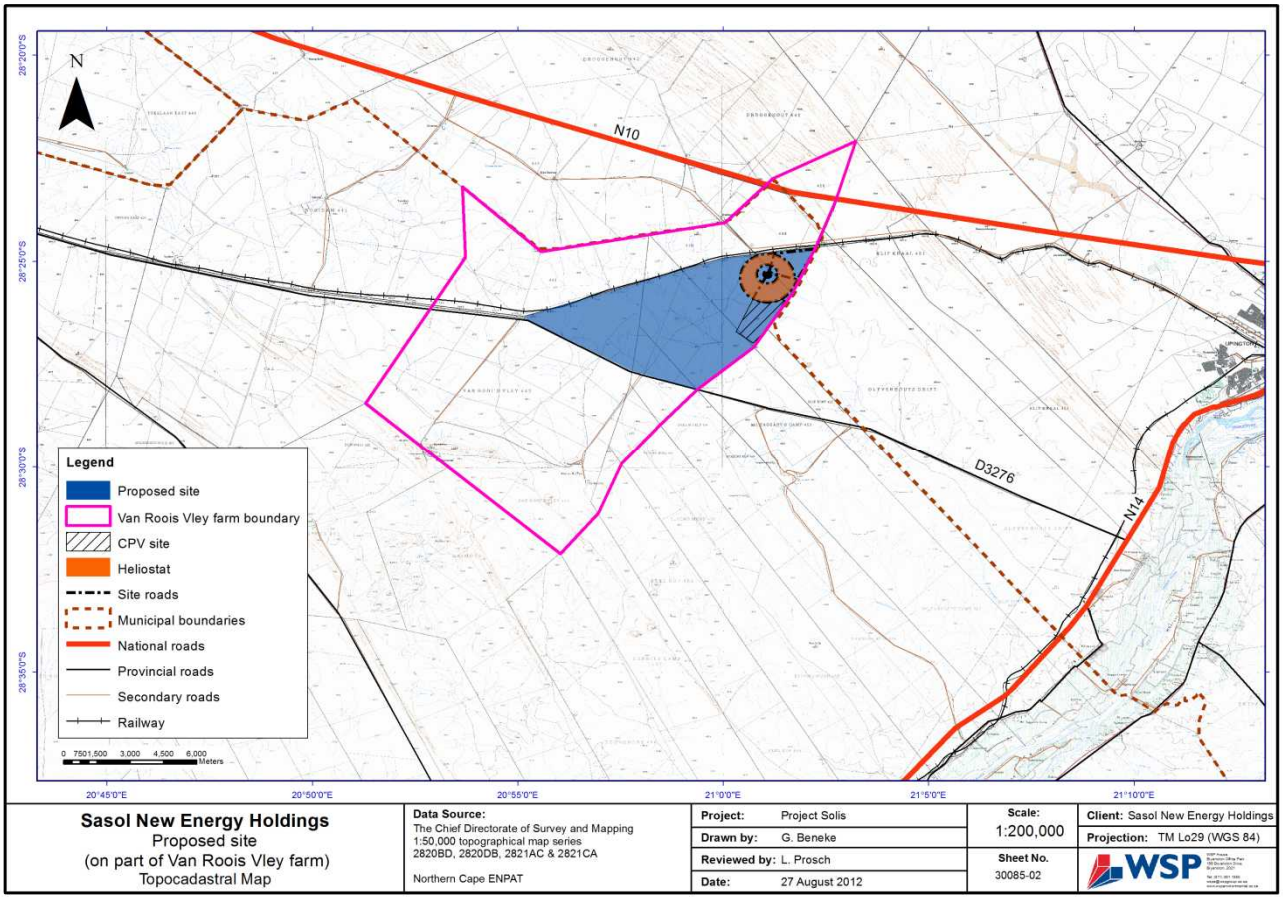



**Figure 5: Extent and locality of the CVP facility in relation to the CSP facility**

The impacts associated with the CPV facilities are not addressed this report and a separate assessment process will be undertaken for the required authorisations. It is recognised that the possible development of a CPV facility on the same farm portion as the CSP facility may result in broader impacts. The projects cannot be assessed in complete isolation and the combined development footprint was kept in mind during the SEIA process. All specialist investigation undertaken considered both the CSP and CPV facilities in order to ensure that cumulative impacts are adequately addressed.

# 4 Description of Proposed Development Site

The proposed project site is located approximately 25km west of the town of Upington and approximately 26km north the town of Keimoes and is located within the Kai! Garib Local Municipality (KGLM). The access road is located within the //Khara Hais Local Municipality (KHLM) (Figure 1 and Figure 6). The full details of the affected properties within Van Roois Vley are provided in Table 12 and indicated in Figure 6.

**Table 12: Details of properties within the proposed Solis site**

| Farm Name | Farm Number | Surveyor general code |
|---|---|---|
| **Van Roois Vley** | 443 | C02800000000044300000 |
| | 444 | C02800000000044400000 |
| | 445 | C02800000000044500000 |
| | 446 | C02800000000044600000 |

| Farm Name | Farm Number | Surveyor general code |
|---|---|---|
| | 447 | C02800000000044700000 |
| | 448 | C02800000000044800000 |
| | 449 | C02800000000044900000 |
| | 450 | C02800000000045000000 |

The existing access to the site is via the well-graded D3276 gravel road that runs east-west along the southern boundary of the site. The D3276 can be accessed via the N14, which connects Upington and Keimoes. A new access road is proposed, as indicated by the blue line on Figure 6, which will provide access to the site from the N10 tarred road that connects Upington with the Namibian border post Ariamsvlei. The proposed access will need to cross the railway line running between Upington and Ariamsvlei.

The Van Roois Vley farm and the surrounding farms have low agricultural potential (SSI, 2012).The current land use on the farm, and those directly adjacent to it, is the grazing of sheep and/or cattle, however grazing capacity is also considered to be low.

There are no households or homesteads located on the proposed Project Solis site. The only existing infrastructure on site includes gravel roads, grazing camp fences and wind pumps with associated reservoirs and piping.

Eskom recently obtained approval for the construction and operation of a CSP facility on the farm Olyvenhouts Drift. The farm Olyvenhouts is located to north east of the Van Roois Vley farm (refer to Figure 6).

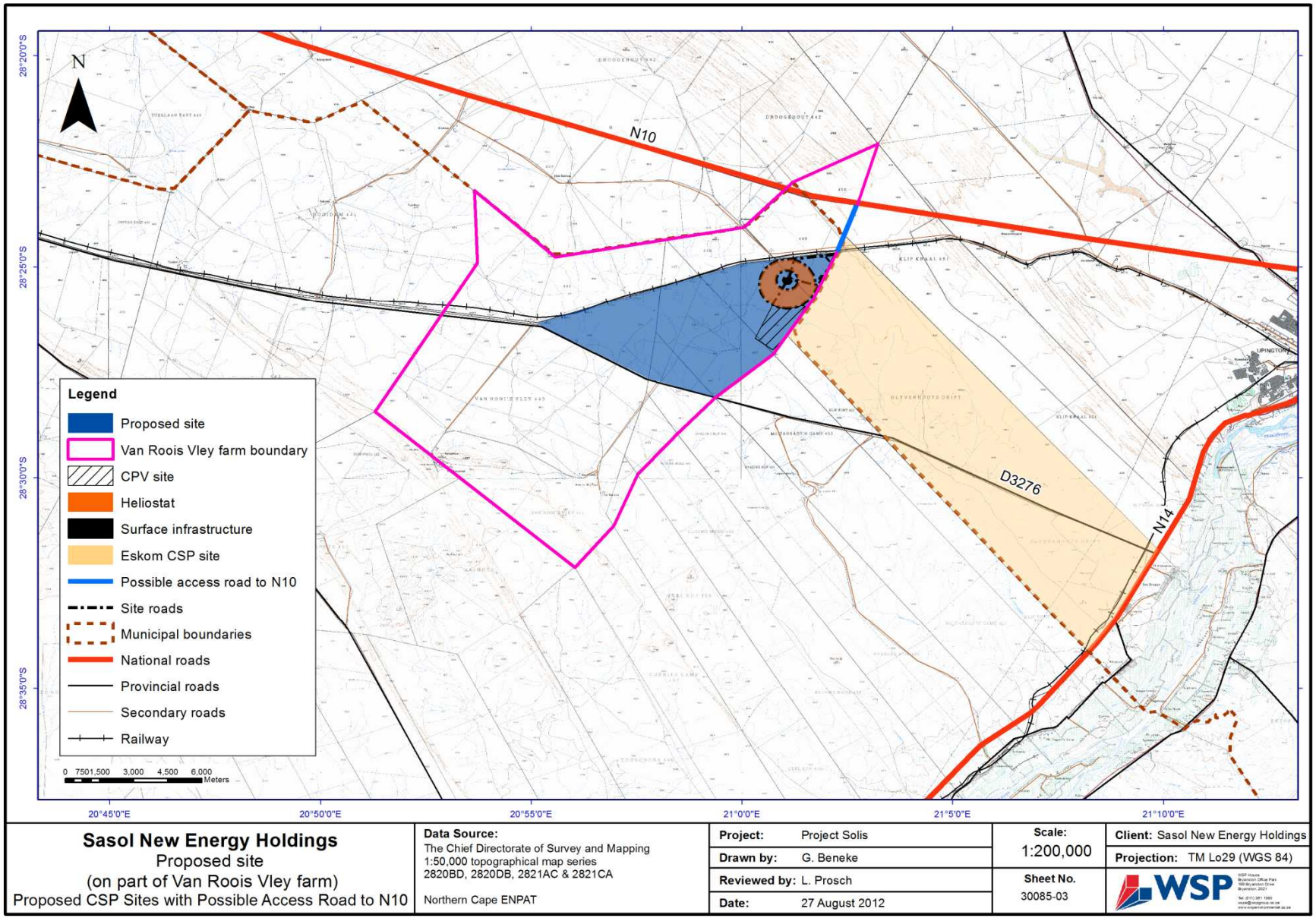



**Figure 6: Topocadastral Map Illustrating the Eskom Site and the Proposed Access Road**

# 5 Description of the Proposed Project

Solar power technology involves the use of energy from the sun to produce electricity. The sun's energy is used to heat a medium (usually water), which is then sent to turbines where electricity is produced and generated. This is referred to as solar-thermal power generation.

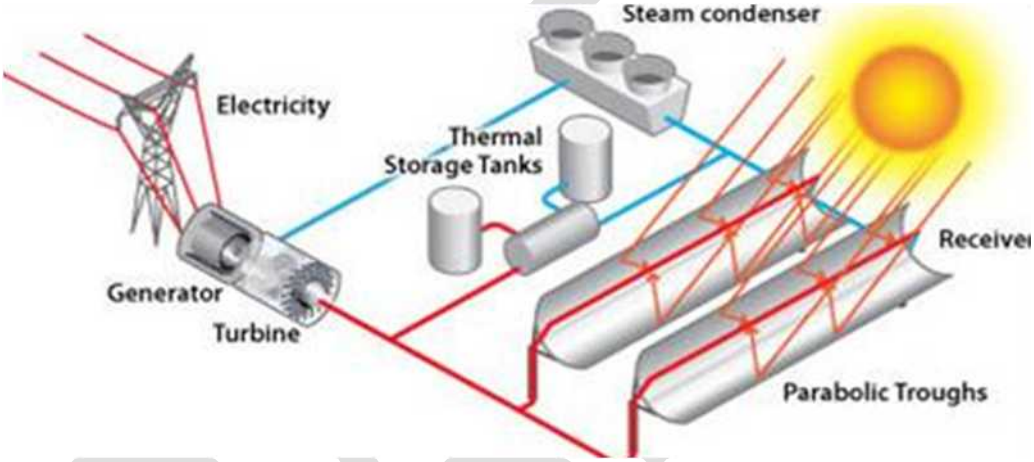
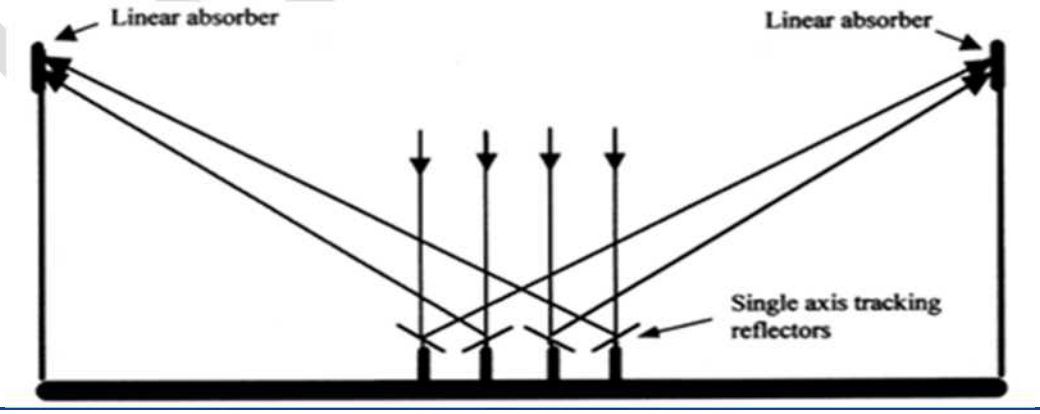
CSP tower has been identified as having the lowest cost for large-scale solar-thermal power production. This technology involves the use of mirrors (heliostats) to reflect sunlight to a focal point (power tower receiver), thereby concentrating the sun's heat in one place. There are three main types of CSP technologies that have been developed and successfully implemented in various places around the world, including: the parabolic trough system, the central linear Fresnel system and the central receiver (power tower receiver) system. A brief overview of the alternative technologies is provided in Table 13.

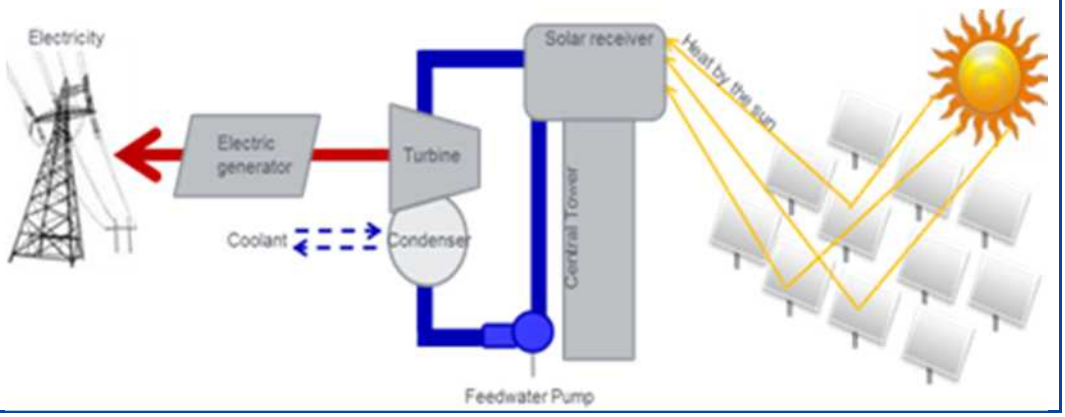
Sasol undertook a comparative analysis of the available technologies and selected the CSP technology for the following reasons:

- The cost curve for CSP tower technology displays a potential for significant reduction;
- The CSP technology is well suited to Sasol's engineering and operations experience;
- CSP has the potential to offer the highest local content and job creation, and
- The possibility of integrated thermal storage of CSP presents firm, flexible electrical production capacity to utilities and grid.

A detailed comparative analysis of the technologies was undertaken by SNE and a final decision with regard to the preferred technology was made. The impact assessment process was initiated based on this final decision and technology alternatives are not further discussed as part of the SEIA.

**Table 13: CSP Technologies**

| Technology Type | Brief Description |
|---|---|
| Parabolic Trough | A parabolic trough is a solar thermal energy collector consisting of a linear parabolic reflector, or mirror, which is usually coated with either silver or polished aluminium. The reflector concentrates the sun's rays onto a receiver positioned along the mirror's focal line.<br><br>Sunlight is reflected by the mirror and concentrated onto an absorber tube running the entire panel length at the focal point. The trough is optimally aligned on a north-south axis, and rotated to track the sun as it moves across the sky each day (NER, 2012).<br><br>  |
| Central Linear Fresnel | Linear Fresnel Reflectors use long, thin segments of mirrors to focus sunlight onto a fixed absorber located at a common focal point of the reflectors. These mirrors are capable of concentrating the sun's energy to approximately 30 times its normal intensity (Dey, 2004).<br><br>This concentrated energy is transferred through the absorber into the thermal fluid. The fluid then goes through a heat exchanger to produce steam and then to power a steam generator.<br><br>  |

| Technology Type | Brief Description |
|---|---|
| Prefered Technology<br><br>Concentrated Solar Power (CSP)Tower Facility | CSP Tower facilities (also known as 'central tower' power plants or 'heliostat' power plants) focus the sun's thermal energy with tracking mirrors (heliostats). A tower is placed in the centre of the heliostat field. The heliostats focus sunlight on the central receiver, on top of the tower. Within the receiver, the concentrated sunlight heats a solution to over 540°C. The heated solution then flows into a thermal storage tank, and/or to a steam turbine and electricity generator. The steam drives a standard turbine to generate electricity. This process is similar to a standard coal-fired power plant, except it is fuelled by solar energy. The advantage of this design above the parabolic trough design is the higher temperature achieved. Thermal energy at higher temperatures can be converted to electricity more efficiently.<br><br>  |

## 5.1 Overview of the Preferred Technology - CSP Tower Facility

As previously mentioned, the CSP Tower facility focus the sun's energy with heliostats with a tower is placed in the centre of the heliostat field. This technology is illustrated in Figure 7, Figure 8, and Figure 9.

**Figure 7: Heliostat facility (Bright Source, 2010)**

**Figure 8: Concentrated solar power technology (Abengoa Solar, 2010)**

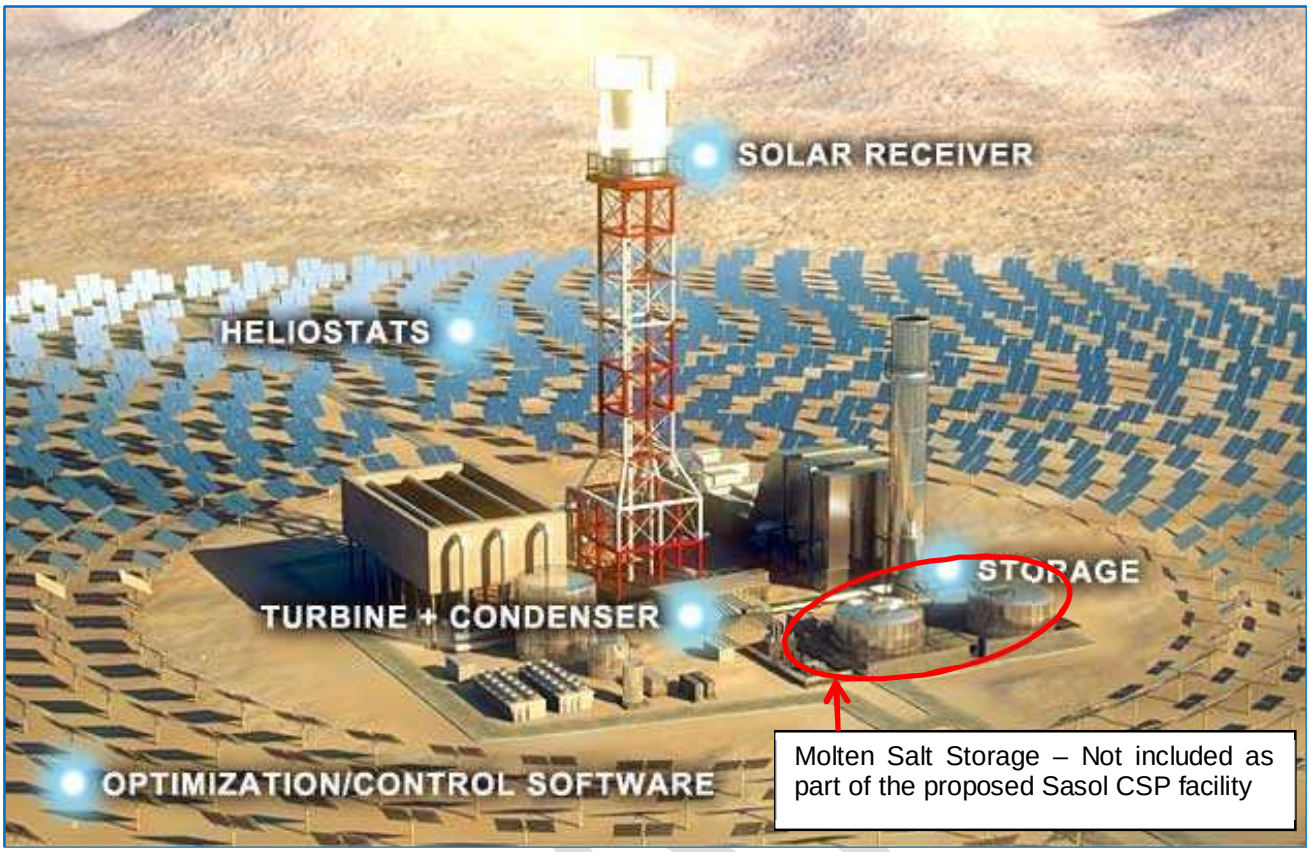



**Figure 9: CSP technology (Bright Source, 2012)**

## 5.2 Detailed Project Description for CSP tower facility

The proposed CSP facility will typically include the following development components:

- Solar field;
- Power block;
- Connection infrastructure (transmission/substations);
- Access and internal roads;
- Services and resource requirements; and
- Auxiliary infrastructure.

A conceptual layout for the proposed Sasol CSP facility has been provided in Figure 10. The components are described in the sections below.

### 5.2.1 Solar Field

The solar field refers to the area occupied by the heliostats. The following components typically apply to the solar field for the proposed CSP facility:

- Approximately 50,000 heliostats arranged in circular rows around the power block and focused up to the receiver on top of the tower facility in the power block (see Section 5.2.2). The heliostats will be spread across an area of approximately 700ha.

- Each heliostat is approximately 17m$^2$ and is made up of two mirrors of approximately 8.5m$^2$ each. Heliostats are raised approximately 0.5m off the ground. The exact height will vary slightly based on the topography of the ground on which the solar field is located.
- Each heliostat is mounted on a pylon linked to a computerised system (optimisation/control system) that will rotate the heliostat to track the sun as it moves through the sky. The tracking system can also be used to turn heliostats so that they do not focus the suns energy onto the tower, to control the amount of heat focused on the receiver or for heliostat/receiver maintenance purposes. When there is cloudy weather or storm events the heliostats can also be turned to the restore position where no sunlight is reflected. For these purposes, the heliostat tracking system can rotate in a north-south or east-west orientation.

Although the solar field is the largest component of the project in terms of footprint, the area beneath the heliostats will not be cleared of vegetation. Vegetation will be allowed to continue to grow beneath the heliostats but will be trimmed to a lower level to prevent obstruction of the panels if required.

### 5.2.2 Power Block

The power block will be situated in the centre of the solar field in order to allow maximum efficiency of the facility.

The following components typically apply to the power block:

- Power tower consisting of a concrete tower (± 170m high and ± 21m in diameter) and receiver located at the top of the concrete tower (± 30m high and ± 26m wide). The total height of the proposed tower will thus be ± 200m above normal ground level.
- The receiver structure absorbs the concentrated energy and heats water contained within a boiler to produce steam. Although technologies using various salt solutions are available, the solution for the proposed CSP facility will be water. Temperatures at the external surface of the receiver could reach approximately 600°C.
- Steam generated in the receiver is piped down the power tower to a turbine located adjacent to the power tower. The steam drives the turbine to produce electricity and is then converted back to water through an air-cooled condenser and returned to the receiver.
- An air-cooled condenser is commonly preferred over water-cooled condensers in arid environments like the Northern Cape as air cooling uses 90% less water than wet cooling.
- An auxiliary boiler that will provide heat for plant start-up in the mornings before the sun has risen to expedite the start-up and increase the capacity factor of the plant will be installed adjacent to the power tower. The capacity factor refers to the online operation of the plant as a percentage of the total day.
- Fuel required for the boiler will be diesel, which will be stored on site in two storage containers of 83m$^3$ each. The auxiliary boiler will only be run for about 1 hour each morning and consumption of diesel will thus be approximately 5m$^3$ per hour (approximately 1850 m$^3$ per year) for this purpose.

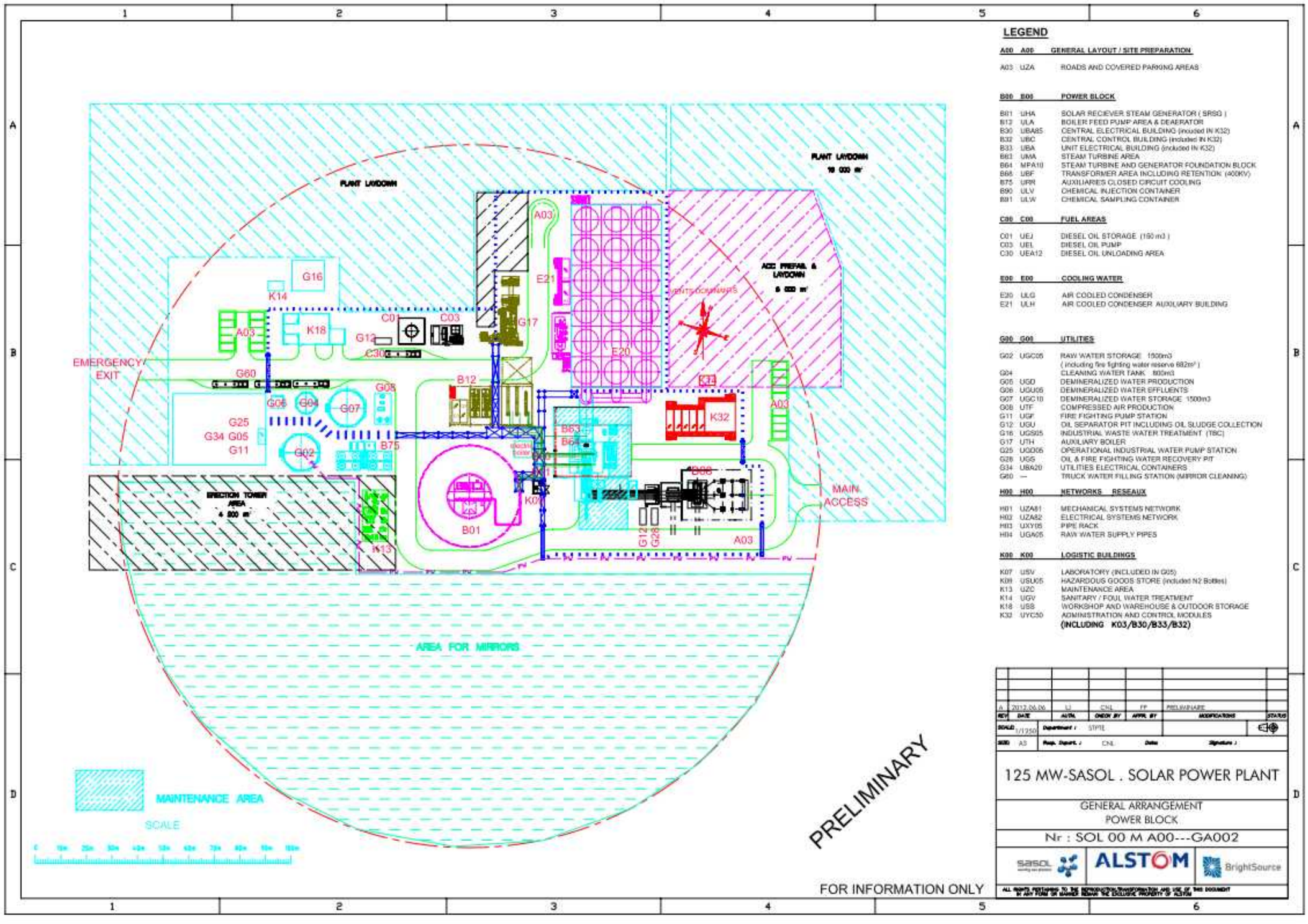



**Figure 10: Power Block Layout**

### 5.2.3 Connection Infrastructure (transmission/substations)

Infrastructure to connect to Eskom's transmission grid will be required. Currently, it is proposed that the facility will connect to an approved (but not yet built) substation on the site of Eskom's recently authorised CSP facility adjacent to the proposed Sasol CSP Project site (see Figure 11 "Possible Substation Locations"). The preferred substation is that which is labelled "C" in Figure 11.

Discussion to obtain consent for the connection and to confirm the final location of the substation is currently being undertaken. It is anticipated that the connection to the substation will be via an underground cable along the eastern boundary of the development site and via an above ground cable from the proposed site boundary to the proposed substation.

As part of the impact assessment process, specialist studies undertaken include the determination of baseline environmental conditions for the alignment of the underground cable. Impact identification and mitigation measures for the above ground transmission line (which will be constructed from the farm boundary to the substation) have been included Avifaunal and Visual Impact Assessments.

### 5.2.4 Access and Internal Roads

The proposed main plant access road is indicated in Figure 11. The proposed access road will cross the existing railway line running between Upington and Ariamsvlei A railway – road level crossing will be constructed. The main access road will be surfaced.

Internal road infrastructure will be constructed as a network of gravel roads; however, these will be kept to a minimum and will provide for a 5m circular gravel road around the power block, a 5m wide gravel external boundary road, a 5m wide gravel road between the solar field and the 'common area' and three roads between the property boundaries and the power block (transecting the solar field). The rows of heliostats will be placed approximately 3m apart, which will allow for access for the purposes of cleaning the heliostats. Cleaning will take place on a daily basis using high pressure water guns and scrubbers. It should be noted that while mirror cleaning will take place daily not all mirrors (55,000) will be cleaned on a daily basis due to the large quantity of mirrors, rather all mirrors will be cleaned within a 20 day cycle. Maintenance vehicles (approximately 7-9) will drive through the heliostat fields along the designated roads and spray water on each mirror. Each mirror will then be scrubbed automatically.

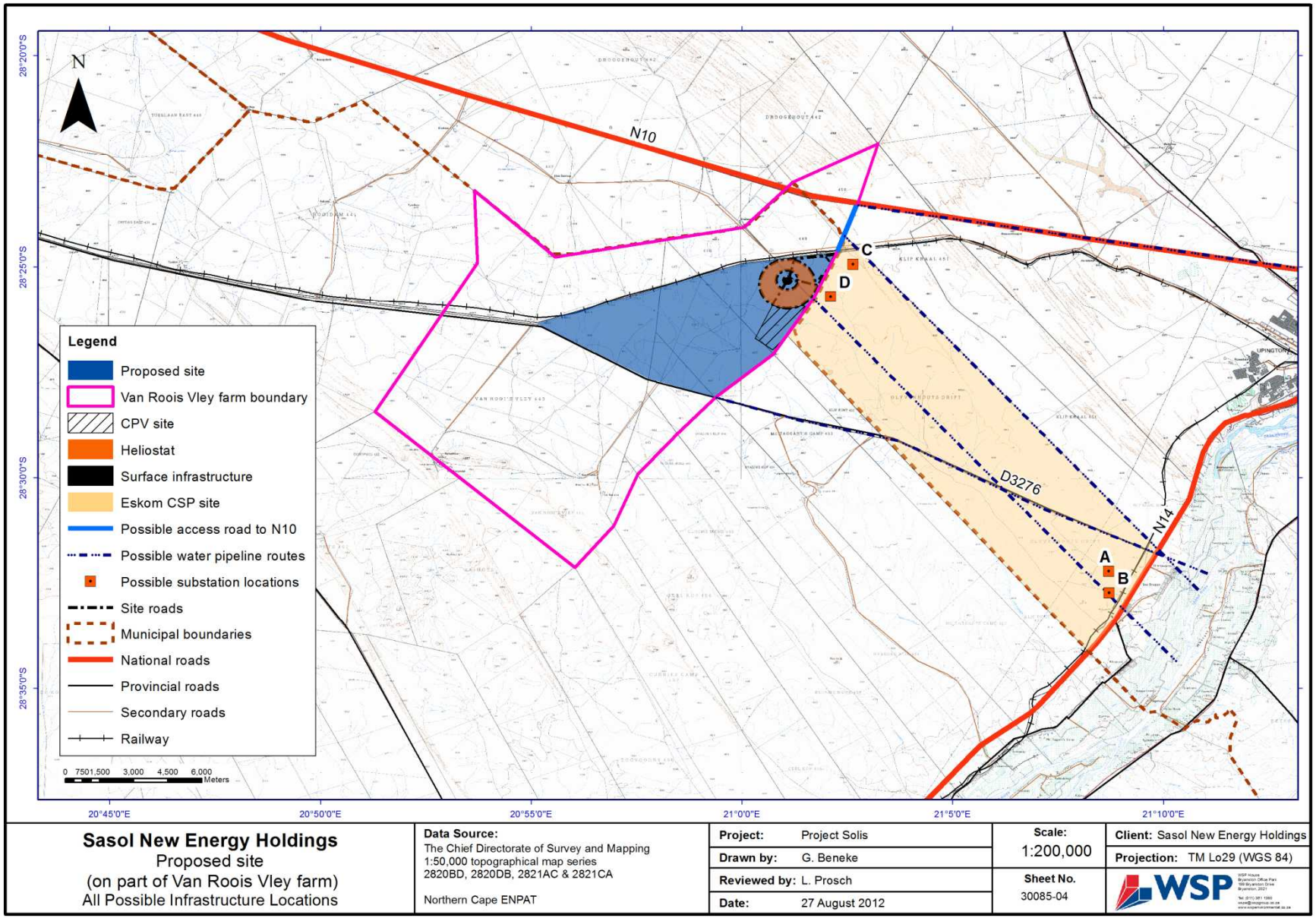



**Figure 11: Infrastructure Map**

## 5.2.5 Services and Resource Requirements

### 5.2.5.1 Water Supply and Treatment

The total amount of water required for the proposed facility will be 50,000m$^3$ per year (including water requirements for mirror cleaning, boiler feed water make-up, potable water, inter alia).

It is currently anticipated that municipal water (treated water) will be available. It is anticipated that municipal water will be obtained from the //Khara Hais local municipality. In discussion with the municipality it is understood that there is sufficient capacity available and an application for water use is therefore underway with the municipality however, no formal request has been made or signed off as yet.

In the event that the municipality is unable or unwilling to provide treated water to the facility, abstraction and piping from the Orange River is being considered. Proposed water pipeline routes are indicated in Figure 11 and, if required, an application for the abstraction and storage of water will be submitted to the Department of Water Affairs (DWA). The pipeline routes have not been assessed as part of this SEIA and if required a new application process will have to be initiated to obtain approval for the construction of a water pipeline from the Orange River to the Sasol CSP site.

The current water treatment flow scheme (municipality), as it stands, appears to be sufficient for potable water production.

Potable water for use in the administration building and workshop areas will be received from the Upington municipal water distribution system. An estimated 3,000m$^3$ supply will be required per annum. The potable water supply pumps draw water from the potable water system and supply water to all sanitary fixtures, kitchen sinks, laboratory and work sinks, emergency shower/eyewash units, and other users of wash down facilities as required.

Raw water for further treatment, service water supply and fire fighting received from municipal supply will be stored in two 800m$^3$ water tanks on site. Recovered blowdown water from the cooling tower is recycled back to the raw water tanks for treatment and reuse.

In order to produce water of sufficient quality to form boiler feed, Air Cooled Condenser washing and to use to clean the heliostats, the water must be taken through an AC filter for organic removal followed by anion/cation and mix bed ion exchange units for demineralisation.

Regeneration effluent and sludge waste will be generated as part of the treatment process. A clarification unit will be installed to treat the watery backwashes and sludges from the settling tank, filtration and AC filter units and any the overflow from the clarifier will be sent back to the reservoir.

Effluent waste from the clarifier, the underflow, regeneration effluents and spent carbon from the AC filter will be pumped to a lined evaporation pond and the solid waste collected and disposed of at a suitably licensed waste disposal site.

The service water pumps will draw water from the raw water tanks and supply water through service water header to various users (including HVAC, oil separator filling and washing services), and will have a minimum flow recirculation line discharging back to the tanks.

The raw water storage tanks capacity is designed to store sufficient water for 12 hours of normal operation. The raw water storage tank is also designed to maintain a reserve of fire fighting water. The fire fighting water reserve storage is designed in line with National Fire Protection Association requirements (2 hours).

The daily water balance for the site and the raw and demineralised water flow is represented in Figure 14 and Figure 13 respectively.

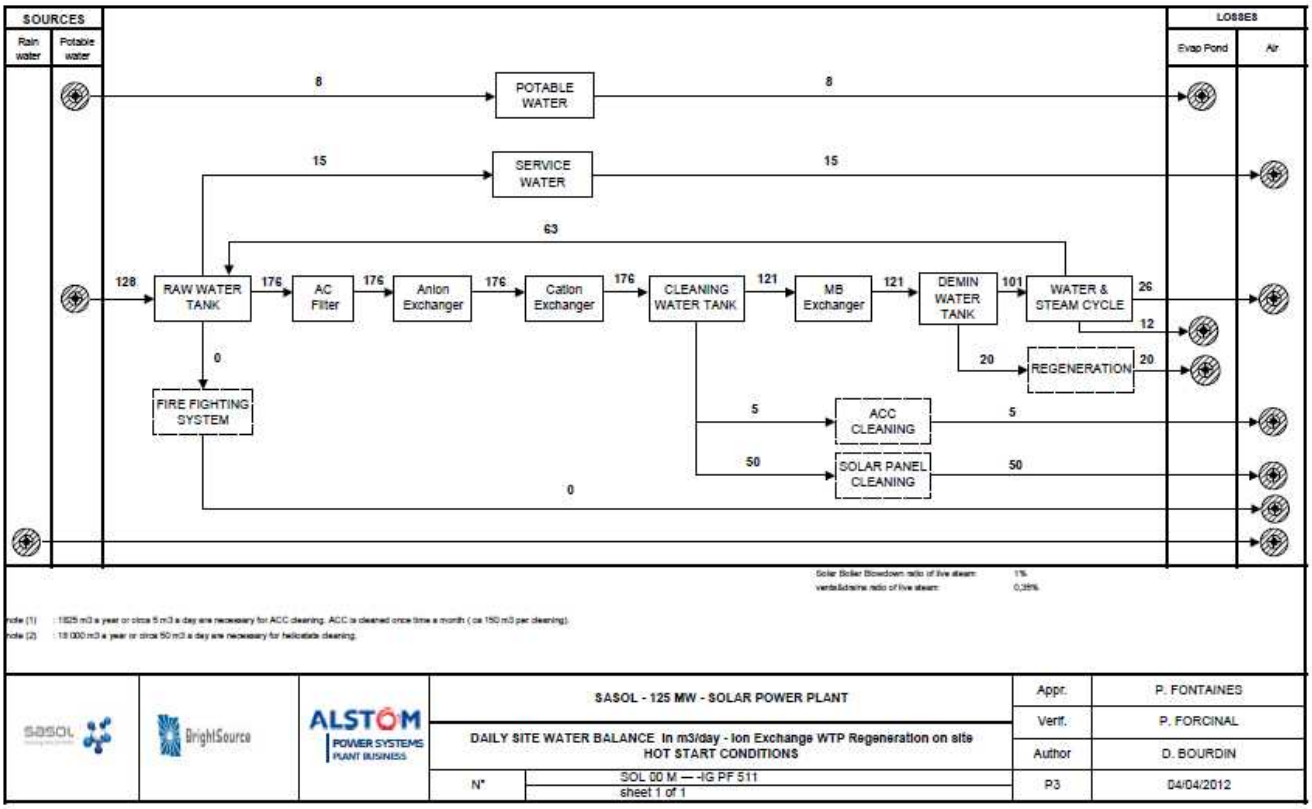



**Figure 12: Schematic diagram of Daily Site Water Balance**

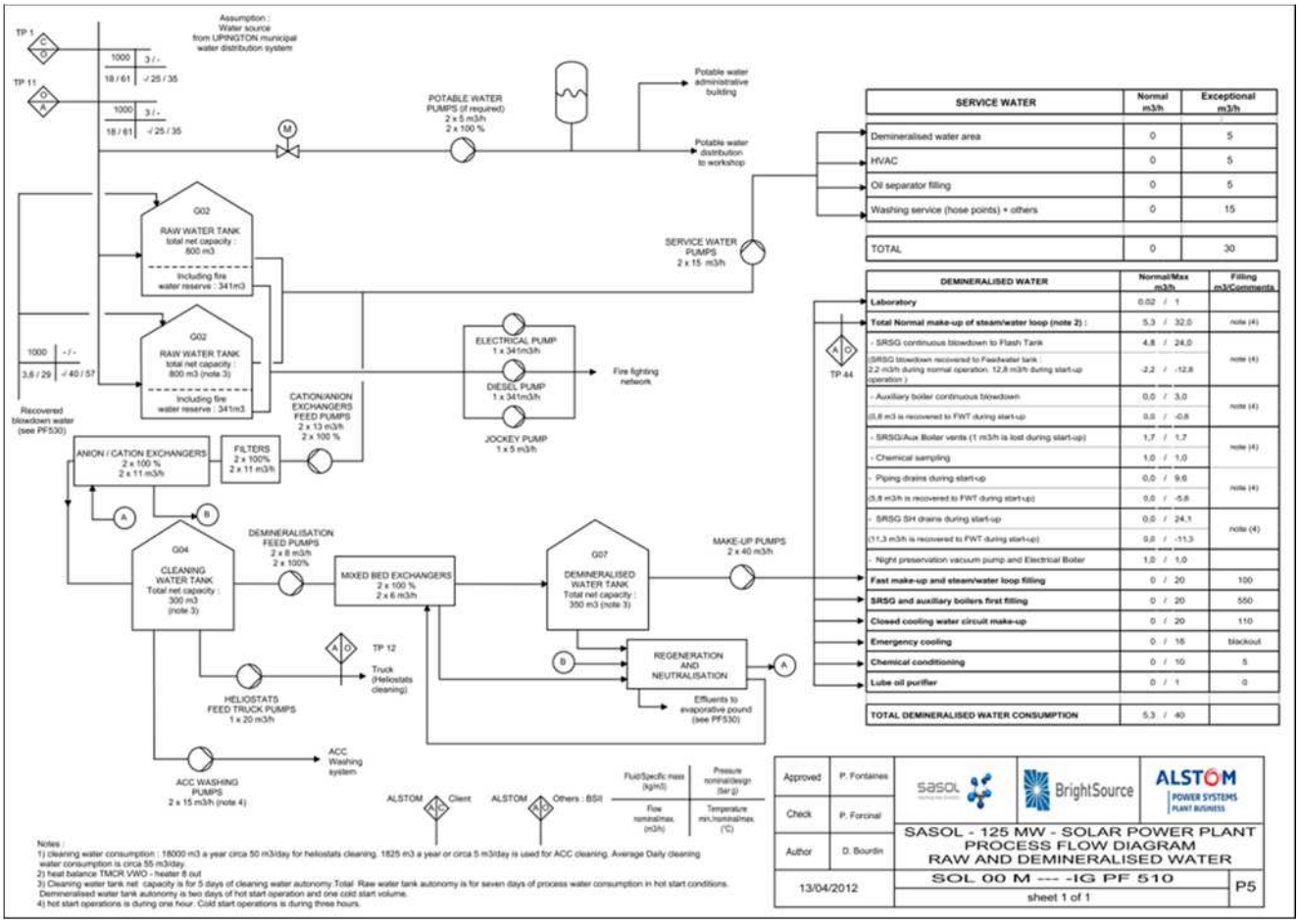



**Figure 13: Schematic diagram of Raw and Demineralised Water Flow**

### 5.2.5.2 Power Supply

An 11kV Eskom electricity supply will be required for night time operations. During the day time the auxiliary operations will draw power from the CSP facility directly.

### 5.2.5.3 Sewage System

A decentralized wastewater treatment systems will be constructed for the onsite treatment of waste water during the construction phase of the project. The system makes use of the activated sludge process.

In this process the waste is degraded biologically by micro-organisms. These micro-organisms form a floc referred to as activated sludge. The activated sludge is heavier than the water in the tank it will settle down in the settling compartment from where it can be separated from the water flow.

The installation is fitted with a surface aerator which creates a vertical circulation by intermittent aeration. This vertical circulation makes denitrification possible. The system itself automatically detects the amount of wastewater inflow and adjusts the oxygen input while the purification process continues.

The excess growth of sludge is periodically discharged to a sludge pit. Controlling the amount of sludge, ensures that the system keeps sludge in the aeration compartment stable and prevents the wastewater treatment tank becoming overgrown. To drain the excess sludge from the wastewater treatment tank, an excess sludge pit is necessary. The wastewater treatment tank is placed partly above ground making sure the effluent (excess sludge) can be drained to the lowest point.

The actual treatment process takes place in the wastewater treatment tank. To regulate the inflow of wastewater to the treatment tank, a buffer pump pit is used. This buffer pump pit prevents too much wastewater coming into the wastewater treatment tank.

The buffer pump pit and the excess sludge pit are installed underground. Excess sludge has to be removed from the sludge pit periodically.

The treatment process is illustrated in the schematic diagrams in Figure 14 and Figure 15.

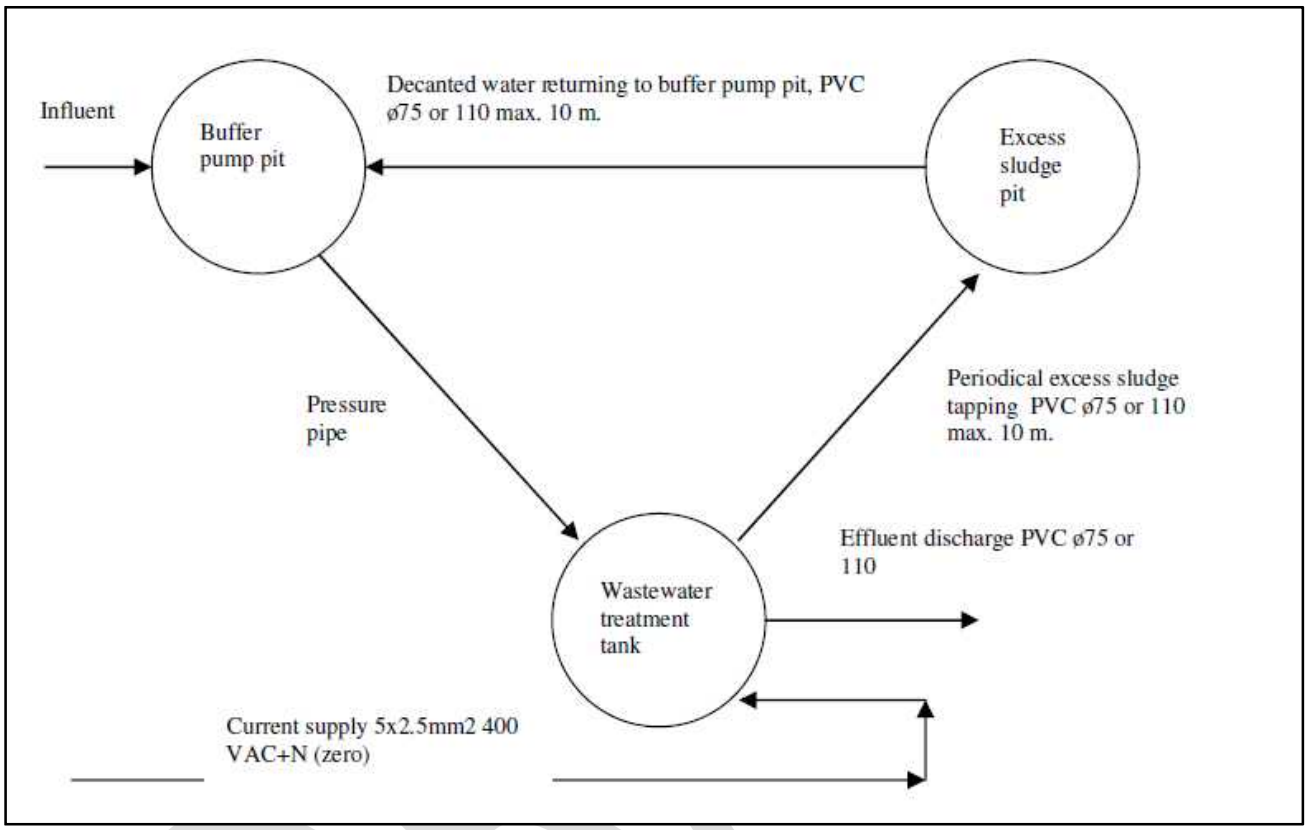



**Figure 14: Schematic diagram of the Sewage Treatment System - Plan (Afmitech)**

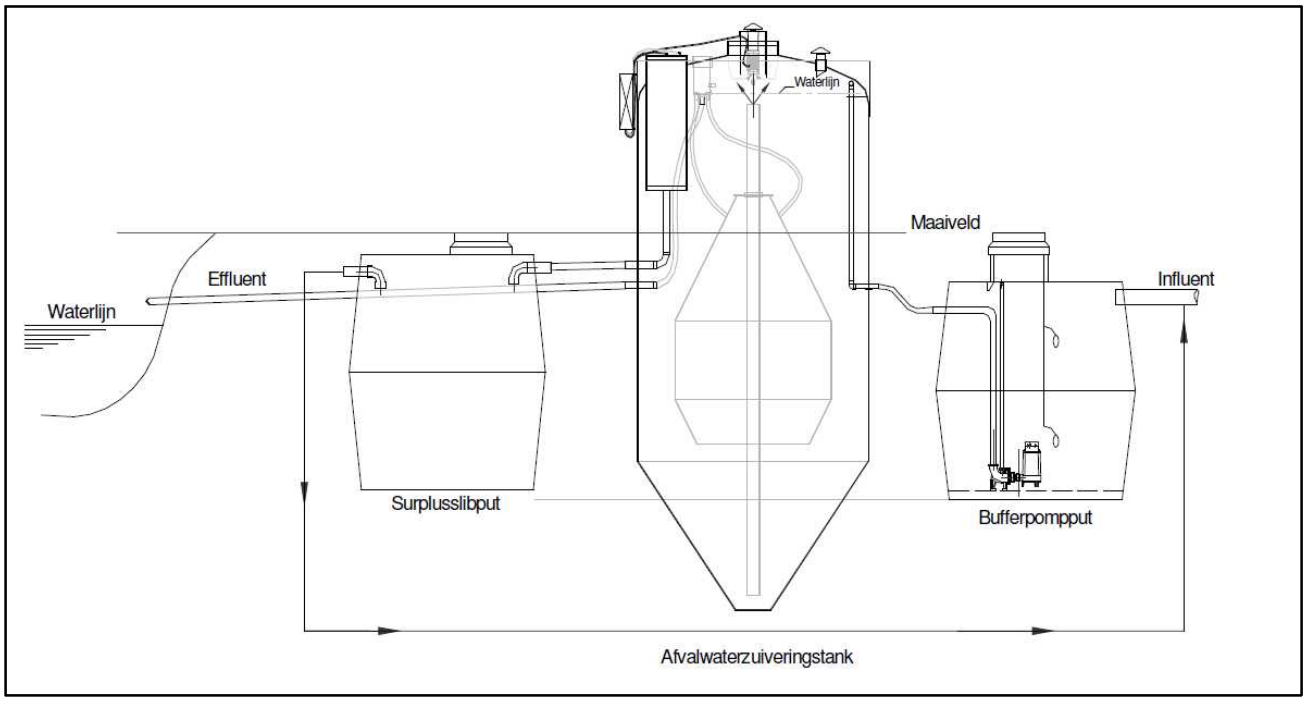



**Figure 15: Schematic diagram of the Sewage Treatment System – Section (Afmitech)**

### 5.2.6 Waste Management

The expected wastes that will be generated on site are indicated in Table 14. Where practically possible, waste will be recycled and otherwise disposed of at an appropriately license landfill. Waste storage areas will be allocated and appropriately designed to avoid the uncontrolled release of any materials and / effluents.

**Table 14: Waste Streams and Management**

| Waste Streams | Waste Generated | Management | Minimum Frequency of Removal | Estimated Quantity per Month ($m^3$) | Storage Area |
|---|---|---|---|---|---|
| **General Office Waste** | Paper | Recycling | Weekly | 1 | Office |
| | Packaging | Recycling and / or disposal at general landfill site (separation of recyclable and non-recyclable waste to be undertaken on site) | Weekly | 1 | Office |
| | Plastic | Recycling (separation of recyclable and non-recyclable waste to be undertaken on site) | Weekly | 0.5 | Office |
| **General Food Waste** | All food waste | Disposal at general landfill | Weekly | 1 | Kitchen area |
| **Hazardous Office Waste** | Fluorescent tubes | Disposal at hazardous landfill site | As required | <0.1 | Office |
| | Printed cartridges | Return to manufacturer and / or disposal at hazardous landfill site | As required | <0.1 | Office |
| | Batteries | Disposal at hazardous landfill site | As required (depending quantity) | <0.1 | Office |
| **General Site Waste** | Packaging | Recycling and / or disposal at general landfill | Monthly | 1 | General waste bin |

| Waste Streams | Waste Generated | Management | Minimum Frequency of Removal | Estimated Quantity per Month ($m^3$) | Storage Area |
|---|---|---|---|---|---|
| | | site (separation of recyclable and non-recyclable waste to be undertaken on site) | | | |
| **Hazardous Site Waste** | Used oils | Recycling and / or disposal at general landfill site (separation of recyclable and non-recyclable waste to be undertaken on site) | As required (depending quantity) | <0.5 | Fuel storage area |
| | Oily rags | Disposal at hazardous landfill site | As required (depending quantity) | <0.1 | Hazardous waste bin |
| | Used chemicals | Disposal at hazardous landfill site | As required (depending quantity) | <0.1 | Laboratory |
| | Used spill clean –up kit | Disposal at hazardous landfill site | As required (depending quantity) | <1 | Hazardous waste bin |
| **Other** | Water treatment solid waste | Discharge to evaporation pond. Solids to be disposed of at a hazardous waste landfill site | As required (depending quantity) | <5 | Evaporation pond |

### 5.2.7 Effluent Management

In addition to the waste inventory outlined in Section 5.2.6, a detailed effluent source list has been compiled describing the expected source, nature, characteristics, expected flow and destination of effluents that will be generated on the site. The source list is included in Table 15.

**Table 15: Effluent source list**

| Source | Nature | Frequency | Flow | | | Destination |
|---|---|---|---|---|---|---|
| | | | $m^3/h$ | $m^3/d$ or volume | $m^3/y$ | |
| Transformer Area | | | | | | |
| Fire fighting water | Oily water | Accidental | 341 | 57 | - | Stormwater network |
| Rain water | Oily water | Occasional | - | 45 | 180 | |
| Transformer oil spillage in case of fire of leakage | Oil | Accidental | - | 50 | -- | Retention pit under transformer |
| Power block area | | | | | | |
| Turbine area – Fire fighting water | Oily water | Accidental | 341 | 57 | - | Oil separator |
| Rain water ST Area | Oily water | Occasional | - | 6 | 24 | Oil separator |
| ST lube oil area | Oil | Accidental | - | 15 | - | Oil separator |
| Rain water FWP oily area | Oily water | Occasional | - | 9 | 36 | Oil separator |
| FWP oil circuit spillage | Oil | Accidental | - | 2 | - | Oil separator |

| Source | Nature | Frequency | Flow | | | Destination |
|---|---|---|---|---|---|---|
| | | | $m^3/h$ | $m^3/d$ or volume | $m^3/y$ | |
| Steam water cycle circuit emptying | Process water | Occasional | - | 650 | - | Waste water network – evaporative pond or raw water tank |
| Turbine hall no-oily area floor washing | Dust water | Periodic | N/A | N/A | N/A | N/A |
| Steam turbine piping drains | Process water | Continuous during each start | 13 | 39 | - | Waste water network – evaporative pond, raw water tank or ACC condensate tank |
| Sampling discharge | Process water | Continuous | 1 | - | - | Waste water network – evaporative pond or raw water tank |
| CCW circuit emptying | Chemical | Occasional | - | 110 | - | Retention pit, removed by truck and disposed off-site |
| Steam generator (SRSG and Auxiliary Boiler) | | | | | | |
| SRSG are floor washing | Dust water | Periodic | N/A | N/A | N/A | N/A |
| SRSG blowdown drain | Process water | Periodic | 12 | 36 | - | Waste water network – evaporative pond or raw water tank |
| | Process water | Periodic | 3 | 36 | - | Waste water network – evaporative pond or raw water tank |
| Rain water SRSG and auxiliary boiler area | Fresh water | Occasional | N/A | N/A | N/A | Stormwater network |
| SRSG fire fighting water | Service water | Accidental | 341 | 57 | - | Stormwater network |
| Auxiliary boiler drain | Process water | Periodic | 3 | 9 | - | Waste water network – evaporative pond or raw water tank |
| Auxiliary boiler fire fighting water | Service water | Accidental | 341 | 57 | - | Stormwater network |
| Fuel oil area | | | | | | |
| Rain water | Only water | Occasional | - | 12 | 50 | Oil Separator |
| Fire fighting water | Fuel / oily water | Accidental | - | 20 | - | |
| Fuel oil storage tank leakage | Fuel / oil | Accidental | - | 165 | - | Retention pit (bund wall) around fuel oil tank<br>Disposal truck |
| Common area parking | | | | | | |
| Rain water | Oily | Occasional | - | 36 | 150 | Oil separator, to evaporation pond |
| Workshop and warehouse | | | | | | |
| Floor washing | Oily | Periodic | 10 | 10 | 520 | Oil Separator |
| Water production area | | | | | | |
| Demineralised water plant filter backwash | Dust water | Periodic | 33 | 11 | 3850 | Waste water network – evaporative pond |

| Source | Nature | Frequency | Flow | | | Destination |
|---|---|---|---|---|---|---|
| | | | $m^3/h$ | $m^3/d$ or volume | $m^3/y$ | |
| Demineralised water plant cation, anion and mixed bed regeneration plant | Chemical | Periodic | - | 20 | 7000 | Demineralisation water plant neutralisation – evaporation pond |
| Laboratory wash water | Chemical | Occasional | - | - | 1 | Water treatment neutralisation to evaporation pond |
| Laboratory waste product | Chemical | Occasional | - | - | - | Truck discharge |
| Battery room | Chemical | Occasional | - | 0,5 | - | Truck discharge |
| Raw water tank discharge | Fresh water | Occasional | - | 1600 | - | Waste water network – evaporative pond |
| Cleaning water tank water discharge | Treated water | Occasional | - | 300 | - | Waste water network – evaporative pond |
| Demineralised water tank water discharge | Demi water | Occasional | - | 350 | - | Waste water network – evaporative pond |
| Common - other | | | | | | |
| Rain from building roof | Fresh water | Occasional | - | 55 | - | Rain water network |
| Sanitary sewer | Sanitary | | - | 8 | 2920 | Evaporation pond or for irrigation |

### 5.2.8 Auxiliary Infrastructure

Auxiliary infrastructure includes:

- Cooling water (air cooled condenser and auxiliary buildings);
- Utilities:
  - Raw water storage;
  - Compressed air production;
  - Fire fighting pump station;
  - Oil separator pit and sludge collection;
  - Auxiliary boiler;
  - Operational industrial water pump station;
  - Oil and fire fighting water recovery pit;
  - Utilities electrical containers, and
  - Truck water filling station.
- Networks:
  - Mechanical system network;
  - Electrical system network, and
  - Raw water supply pipes.
- Logistics (laboratory, hazardous goods store, maintenance area, workshops, warehousing, general store and administration building).

### 5.2.9 Bulk Diesel and Lubricant Storage

A bulk diesel storage facility is required with a capacity of approximately 200m$^3$. This will ensure a stock for 5 day's consumption. The storage area is to be bunded in order to contain the tank capacity in case of a major spill. Storage tanks for new oils may be required next to the bulk diesel storage facility. The tanks, pumping equipment, metre, associated valves and hose connections are to be bunded collectively to contain spillage within the bunded area. The above ground storage tanks for petroleum product shall be in accordance with the requirements of the South African National Standards (SANS 10131).

### 5.2.10 Office Blocks

An administration office has been allowed for as part of the control room, which will accommodate management and administrative staff. The office complex will consist of offices, a conference room, a meeting room, ablutions and refreshment facilities.

### 5.2.11 Security Infrastructure

Security offices and facilities will be provided at the entrance gate and will serve as a security access control point. The project site will 3m high demarcation fence and will have a patrol zone, cleared of vegetation, approximately 3m wide, on the inside of the fence.

# 6 Development Phases

This following section provides an overview of the development phases of the proposed Sasol CSP Project. The development phases are typically discussed as the construction, operational and decommissioning phases.

## 6.1 Construction Phase

The construction phase will progress over a period of 3 years and will include the construction of various facilities. The construction activities will include:

- Site establishment (including the establishment on the construction camp and laydown areas);
- Civil works (including earthworks, excavations and foundations)
- Construction and erection of surface infrastructure;
- Commissioning, and
- Start-up and performance test runs.

The workforce present on site will vary based on the construction activities. During site establishment an estimated 200 workers will be on site. The number of workers will be at its maximum during the construction and erection of surface infrastructure. During this period 800 workers, working in two shifts will be on site. During the commissioning and test phase approximately 400 workers will be present on site. This number will reduce 100 towards the end of the overall construction phase.

## 6.2 Operational Phase

The operational phase will commence immediately upon completion of the construction. The lifetime of the facility has been designed for 20 years, although SNE will consider extending the life of the facility further. During this phase of the operational the main activities will comprise:

- Demineralised Water Production and Effluent Treatment;
- Sewage Treatment;
- Industrial waste and water treatment;
- Domestic and / or hazardous waste management;
- The washing of heliostats, and
- General site maintenance and management.

A workforce of approximately 60 people working two shifts is expected to be on site during this phase of the operation.

## 6.3 Decommissioning Phase

At decommissioning of the site it is anticipated that all surface infrastructure will be removed and that the site will be rehabilitated.

# 7 Alternatives

Alternatives identified during the Scoping phase of the project include:

- Alternative cooling technology (wet cooling versus dry cooling);

- Water treatment (ion exchange versus reverse osmosis), and
- Sewage disposal (on-site treatment alternatives).

The alternatives are investigated and assessed in terms of their expected impacts and the preferred alternative for each of the scenario identified.

## 7.1 Cooling Technology

There are three feasible alternative cooling technologies that could be used in the condenser required to convert steam back to water: dry-cooling, wet-cooling and hybrid-cooling. The technologies differ in their electricity production efficiencies with wet-cooling having a higher efficiency; however dry-cooling has lower water requirements. Using dry-cooling technologies as opposed to wet-cooling will reduce water consumption by over 90% (Turchi, Wagner and Kutscher, 2010).

### 7.1.1 Dry Cooling Alternatives

Dry cooling may be the most practical solution for curtailing CSP water demands. Also known as convective cooling, dry cooling circulates ambient air through a closed-loop system. There are two main types of dry cooling systems: a direct air cooling system, typically known as an air-cooled condenser (ACC), and an indirect air cooling system, also called a Heller system. Dry cooling reduces water consumption by about 90% over conventional wet cooling systems, since both evaporation and drift are eliminated. However, power loss can be over 17% during the hottest days and average about 5% annually (KSP Project, WSP).

#### 7.1.1.1 Direct dry-cooling

In a direct dry cooling system, steam is condensed directly by air in a heat exchanger and the condensate is pumped to the boiler in a closed loop. Mechanical fans induce air flow for the condensation process, rather than through the updraft induced by cooling towers, Figure 16.

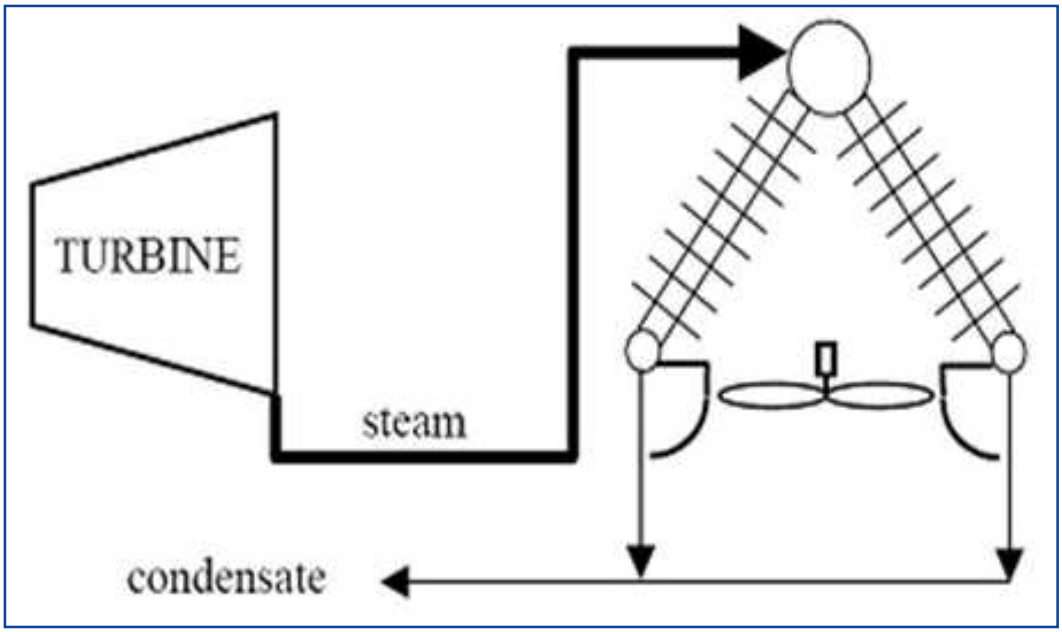



**Figure 16: Direct dry cooling technology (U.S. Department of Energy, 2006)**

#### 7.1.1.2 Indirect dry-cooling

An indirect dry-cooling system operates similarly to the wet-cooled system, the difference being that the system is closed and heat is dissipated via water-to-air heat exchangers, rather than evaporation of the cooling water. An advantage of indirect dry-cooling is that it consumes very little water as no water is lost via evaporation. The disadvantage is the construction cost of the cooling tower which is not necessary for direct dry-cooling. Comparing this design to a wet cooled plant, has the same advantages and disadvantages as the direct dry cooled design, Figure 17.

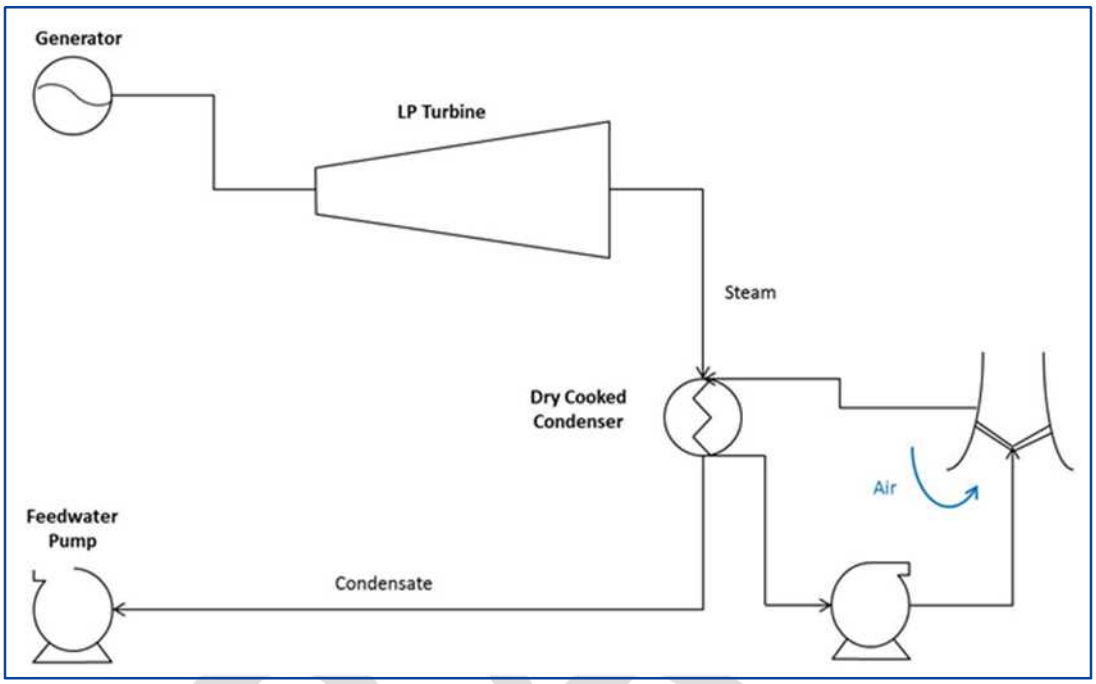



**Figure 17: Indirect dry cooling technology (Kelly, 2006)**

### 7.1.2 Wet-cooling

#### 7.1.2.1 Once-through water cooling

Once-through water cooling returns all of the withdrawn water to the source. Although it does not consume any water in the cooling process, it does increase the temperature and hence the evaporation rate from the body of water. This cooling method is limited in application and is not typically available for a solar power plant. It is also becoming more restricted in certain areas, because of the potential environmental consequences of returning water at an elevated temperature to the environment.

#### 7.1.2.2 Evaporative water cooling

The most common cooling method for new power plants is evaporative cooling. This is a financially economical and high performing power plant cooling technique. The waste heat energy dissipated from the power plant is rejected to the air via evaporation of the cooling water. Typically the evaporation takes place in a cooling tower. This method consumes a considerable amount of water.

The water treatment chemicals and minerals contained in the water being evaporated become concentrated over time, which requires a portion of the cooling water to be drained to remove particulates and salts. This discharge (called “blow-down”) is a potential source of environmental hazard due to the high concentrations of salts. Also some concern must be given to water with treatment chemicals which drift into the ambient air and can be considered a source of $PM_{10}$ (particulates less than 10 microns in diameter), which is restricted by regulations. Figure 18 represents a diagram of wet cooling technology.

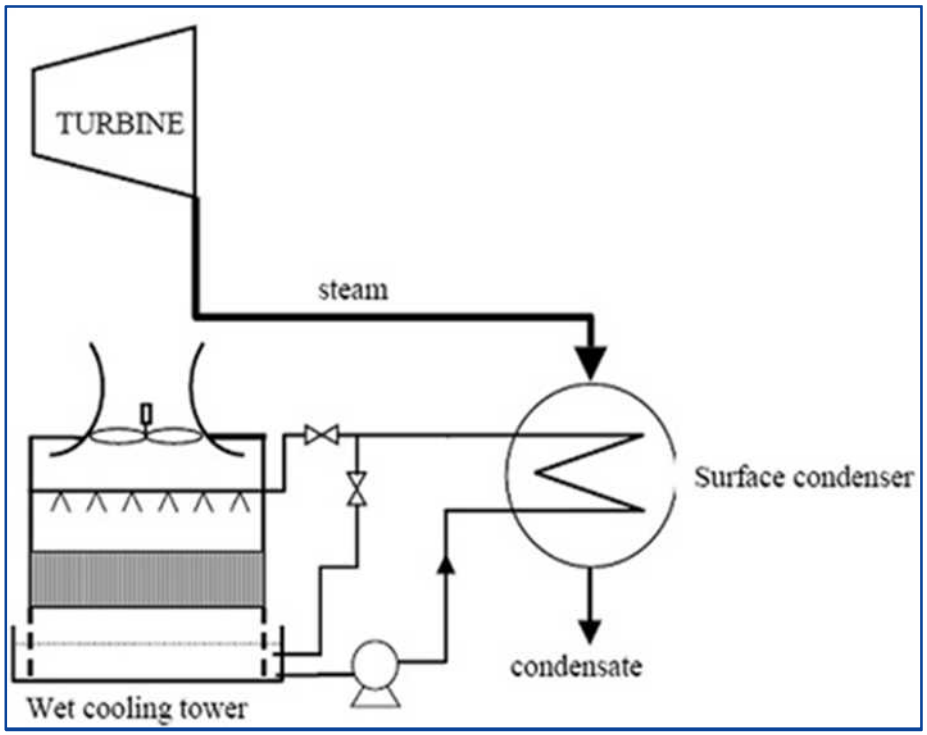



**Figure 18: Flow diagram illustrating wet cooling technology (U.S. Department of Energy, 2006)**

### 7.1.3 Hybrid-cooling

Another way in which water consumption can be cut at a lower cost than dry cooling is to employ a hybrid wet-dry system. The hybrid system maintains output near 100% even at high ambient temperatures, with annual water consumption about 10% that of a wet cooling tower. However this system involves higher capital costs as it requires both a conventional wet cooling tower and a dry cooling surface condenser (Figure 19).

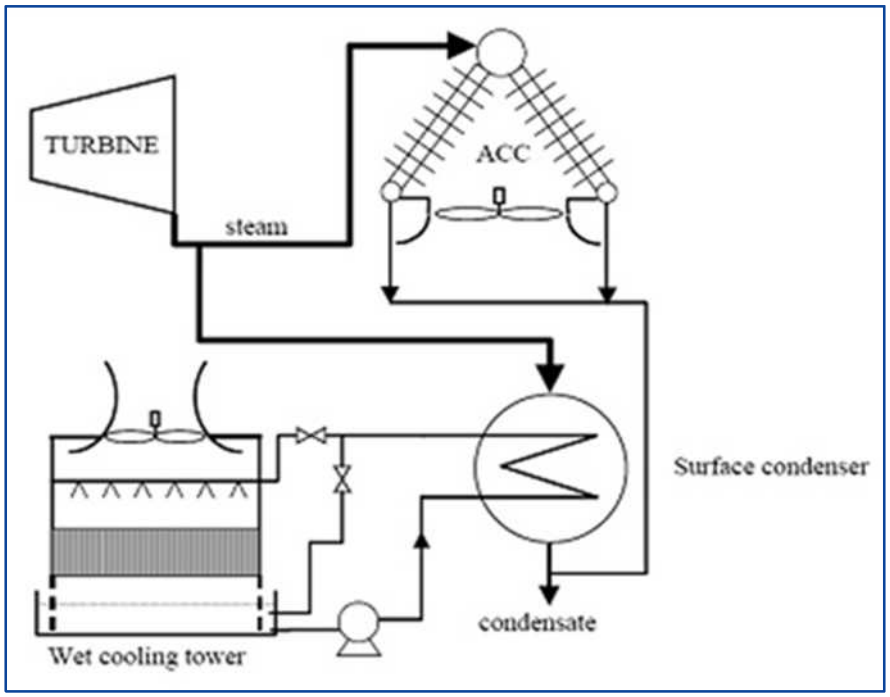



**Figure 19: Hybrid wet/dry parallel cooling system (U.S. Department of Energy, 2006)**

### 7.1.4 Cooling Technology: Preferred Alternative

The impacts identified with the cooling technology relates to:

- Water consumption (resource use);
- Noise (noise impacts as a result of the use of fans in dry cooling)
- Pollution potential (from blow down), and
- Capital cost.

Table 16 provides a comparative analysis of the technologies investigated.

**Table 16: Cooling Technology Comparative Analysis**

| General Type | Specific Type | Water Consumption | Noise Impacts | Pollution Potential | Capital Cost |
|---|---|---|---|---|---|
| **Wet Cooling** | Once-through water cooling | Low | Low | Medium - High | Low |
| | Evaporative wet cooling | High | Low | Medium - High | Low |
| **Dry Cooling** | Direct dry cooling | Low | Medium | Low - None | Low |
| | Indirect dry cooling | Low - None | Medium | Low - None | Medium |
| **Hybrid Cooling** | None | Medium - High | Medium | Medium | High |

*Note: The rating (high, medium and low) is not a rating against baseline conditions, but serves as a comparative analyses between technologies*

Dry cooling is preferred given the regional water supply constraints. Indirect dry-cooling has the lowest water demand of all the technologies. This does not offset the significant increase in cost when compared to direct dry cooling. Noise impacts resulting from the dry cooling technology are not regarded as significant given the location of the site.

Direct dry cooling has been identified as the preferred cooling technology alternative.

## 7.2 Water Supply

The proposed Sasol CSP facility is expected to use approximately 50,000m$^3$ of water per annum for activities such as mirror cleaning, boiler feed water make-up as well as potable water for domestic usage. Three alternative water supply options have been identified:

- Municipal water supply;
- Groundwater abstraction, and
- Abstraction from the Orange River.

### 7.2.1 Municipality

It would be preferable for the project to obtain municipal (treated) water from the //Khara Hais local municipality. In discussion with the municipality it is understood that there is sufficient capacity available and an application for water use is therefore underway with the municipality however, no formal request has been made or signed off as yet.

### 7.2.2 Groundwater Abstraction

The primary porosity in the region is low to very low due to high grade regional metamorphism which would have recrystallised existing sedimentary rocks, reducing both porosity and permeability. These formations include the staurolite schists of the Bietjiespoorts Group and aluminous gneisses of the Areachap Group. The only stratigraphy likely to support a primary aquifer includes shallow saturated residual and transported Quaternary red-brown Aeolian sands of the Gordonia Formation located in the northern portions of the property in which the proposed development will occur. Regional groundwater is predominantly controlled by secondary porosity of jointed and fractured bedrock and is the main source of water abstraction. The aquifer harvest potential is limited by the volume of effective storage due to low substrate permeability.

According to the Department of Water Affairs (DWA) 1:4 000 000 Groundwater Resources of the Republic of South Africa Map Series, the mean annual groundwater recharge for the region is 0-1mm/annum. The depth to groundwater is 30m-50m and the recommended drilling depth below groundwater level is 20m to 30m. The aquifer is classified as fractured, with fractures restricted principally to the zone directly below the groundwater level.

According to the aquifer classification of South Africa (WRC, 1999), the aquifer of the region is classified as poor aquifer source (i.e. low yielding). Aquifer vulnerability is regarded as low, hence maintains a low vulnerability to contaminant migration within the aquifer medium. The aquifer is therefore regarded as having low susceptibility to the effects of anthropogenic contamination. The probability of a successful borehole in the area of the site yielding more than 2l/second is less than 10%. The probability of drilling a successful borehole is less than 40%.

Based on the DWAF groundwater harvest potential mapping for South Africa the maximum volume of groundwater that may be abstracted annually per surface area of an aquifer system in the area to preserve a sustained abstraction is 2,500-4,000 $m^3/km^2$/year.

SNE made a strategic decision not to abstract groundwater for supply to the CSP facility as it was assumed that the region has a poor aquifer source. This initial assumption was confirmed by further specialist investigation. Groundwater abstraction was therefore excluded as a feasible alternative.

### 7.2.3 Abstraction from the Orange River

Water abstraction form the Orange River is regarded as a feasible alternative to municipal supply. A parallel process for an application for water abstraction from the Orange River is currently being undertaken. The preferred option for water supply is currently municipal supply.

### 7.2.4 Water Supply Alternatives – Preferred Alternative

Environmental impacts for the water supply alternatives relate to water treatment considerations and, in the case of water abstraction from the Orange River, hydrological (water flow) alterations which may affect the current ecological functioning of the river system.

Both alternatives are regarded as feasible. Pending the outcome of the current discussions with the municipality, a final decision with regard to the water supply alternative will be made.

## 7.3 Water Treatment

Water treatment alternatives can only be assessed after the water supply source has been confirmed. The two alternatives considered include:

- Ion exchange, and
- Reverse osmosis.

Consideration will predominantly be economical. Generally Ion Exchange is regarded as a more economically feasible alternative. High total dissolved solids (TDS) will increase the treatment cost associated with Ion

Exchange and depending on the water supply alternative, supply water quality will have to be assessed prior to the determination of the treatment alternative.

The Ion Exchange water treatment process has been applied at other Sasol facilities and the water quality resulting from the process has been proven to be adequate for the proposed application at the Sasol CSP facility.

Based on the current available information, the Ion Exchange water treatment process is regarded as the preferred alternative and should an alternative treatment process be considered for implementation, an amendment to an existing environmental authorisation will have to be applied for.

Chemicals that will be used as part of the Ion Exchange treatment process represent an environmental risk and the appropriate storage and waste disposal methods will have to be implemented.

## 7.4 Sewage Treatment Plant

The volumes of sewage waste water that will be generated on site are regarded as low. Onsite treatment options are investigated and three alternatives have been considered for the onsite treatment of sewage waste water that will be generated at the facility. These include:

- On-site treatment through septic tank system and leach field;
- On-site treatment through the activated sludge process, and
- Surface Lagoons.

### 7.4.1 Septic Tank and Leach Field

The anaerobic bacterial environment developed in the septic tank decomposes and mineralize the waste discharged into the tank. Periodic maintenance activities (e.g. removal of sedimentation and sludge via honey suckers) are required to remove the irreducible solids which fill the tank, reducing its efficiency. The septic tank system requires a drainfield which removes contaminants and impurities from the effluent discharged from the septic tank. Settled solids in the tank are anaerobically digested, reducing the volume of solids. The liquid component flows through into a second chamber, where further settlement takes place, with the resultant effluent then draining outlet into the leach field. Further effluent treatment is through the catabolising of organic materials by a microbial ecosystem.

Disadvantages of the septic tank and leach field treatment and disposal alternative include the generation of carbon dioxide and methane as a result of the fermentation process. The low redox potential created by the anaerobic conditions within the tank keeps phosphates soluble and mobilized and when discharged with the effluent may trigger prolific plant growth including algal blooms.

### 7.4.2 Activated Sludge Process

The process involves the oxygenation of waste water combined with the reduction of organic content thought the development of biological floc. The floc largely consist of filter feeding species including amoebae, spirotrichs, peritrichs, referred to as “protozoan flora” as well as saprotrophic bacteria. During treatment, nitrogenous matter (ammonium and nitrogen) is oxidised, phosphates removed and entrained gases (e.g. $CO_2$, ammonia and nitrogen) are driven off. The resultant floc settles in the tank and an effluent low in dissolved or suspended solids is produced. In poorly managed activated sludge systems, filamentous bacteria can develop which will produce a sludge that is difficult to settle and may result in the decanting of the sludge resulting in the contamination of the final effluent.

The activated sludge process is a self-maintaining system and is capable of removing more that 90% of suspended solids. Similar to the septic tank and leach field treatment system, $CO_2$ and methane are generated by the fermentation process. The process does allow for the biological removal of phosphorous.

#### 7.4.2.1 Hybrid Sewage Package Plants

Sewage treatment package plants utilise a hybrid treatment process involving the use of aerobic sludge (from the activated sludge process) to treat incoming sewage stream. Sewage undergoes an initial separation process where non-biodegradable products are removed before being oxygenated to produce floc. Bacteria (Protozoan flora and saprotrophic bacteria) are introduced and nitrification and phosphate removal occurs. Overflow effluent is sterilised using ozone and/ or ultra violet prior to being pumped for reuse in irrigation, blackwater (such as re-used in cisterns) or discharged.

### 7.4.3 Surface Lagoons

Sewage is pumped into a lined treatment pond provided with artificial aeration thereby encouraging biological oxidation of the sewage. The lagoon acts as a biologically assisted flocculator which converts soluble biodegradable organics of the sewage effluent to a biomass which settles as sludge. The settled sludge undergoes additional anaerobic stabilisation. Effluent can be removed from the surface with a relatively low COD.

On average, sludge within the lagoons has a residence time of between 1 – 10 days. As a result, the COD removed from the sludge is minor and therefore the effluent is unacceptable for discharge into receiving environments.

### 7.4.4 Sewage Treatment Plant – Preferred Alternative

The alternatives are not dissimilar in terms of the advantages and disadvantages. The activated sludge process is preferred for its inherent capability for the effective removal of phosphorous. It is recommended that a Hybrid Sewage Package Plant be constructed for the project.

## 7.5 Layout

Specialist studies did not reveal any sensitive features on the site that will be directly affected by the Sasol CSP facility and no layout alternatives were considered.

## 7.6 'No-go' Option

Without the development of the renewables industry, including solar and projects such as the Project Solis, Eskom's reserve margin will continue to deplete and drastic measures such as load-shedding may be required to stabilise energy demand. This energy gap could extend beyond 2014 in the event of Medupi and Kusile power stations being delayed. Mining and industry, being the largest energy users, would likely suffer as a result, leading to a negative impact on the national economy.

The Northern Cape is an area that has been deprived of economic development. If the project did not go ahead then the region would lose out on the economic stimulus that the CSP industry would bring and the associated multiplier effects.

Furthermore, South Africa's current dependence on coal as a fossil fuel based energy supply means that energy generation is the country's main contributor to $CO_2$ emissions, being responsible for 70% of the country's $CO_2$ emissions. $CO_2$ is the primary greenhouse gas that has been linked to climate change. With South Africa's commitment to reducing its $CO_2$ emissions by 34% by 2020 (Copenhagen Accord, 2010), coupled with the increasing demand for electricity, the 'no-go option' is not considered a viable alternative to this project.

The cost of renewable energy such as hydro, wind, and solar power has been steadily decreasing while coal and nuclear costs are escalating. Taking a long term view, renewable energy will provide South Africa with access to electricity that is cheaper and cleaner than coal and nuclear alternatives. By utilising Independent Power Producers to supply the power, the South African government will also save on capital investment required to build Eskom owned generation capacity.

# 8 Description of the Receiving Environment

Based on information gathering through desk top investigations, site visits and input from the various project specialists, the following description of the receiving environment was compiled.

## 8.1 Climate

Meteorological data was obtained from the South African Weather Service's (SAWS) Upington International Airport station (station number 317475A8). This station is located ±25km east of the proposed site and is considered representative of conditions at the Van Roois Vley farm. The data available extends back to 1991. WSP requested the latest three years of data (2009, 2010 and 2011). The meteorological parameters obtained include temperature, humidity, rainfall, cloud cover, wind speed and wind direction.

Daily, monthly and annual averages were calculated from the available data, and annual and seasonal wind roses were created. Wind roses are a useful tool for illustrating the prevailing meteorological conditions of an area, indicating wind speeds and a directional frequency distribution. In the following wind roses, the colour of the bar indicates the wind speed interval, while the length of the bar indicates the frequency of winds blowing from a certain direction (as a percentage).

The annual wind rose (Figure 20) indicates that winds are predominantly from the north (15% of the time) and south-south-west (11% of the time). Wind speeds are strongest from the north and reached speeds greater than 11.1 m.s-1.

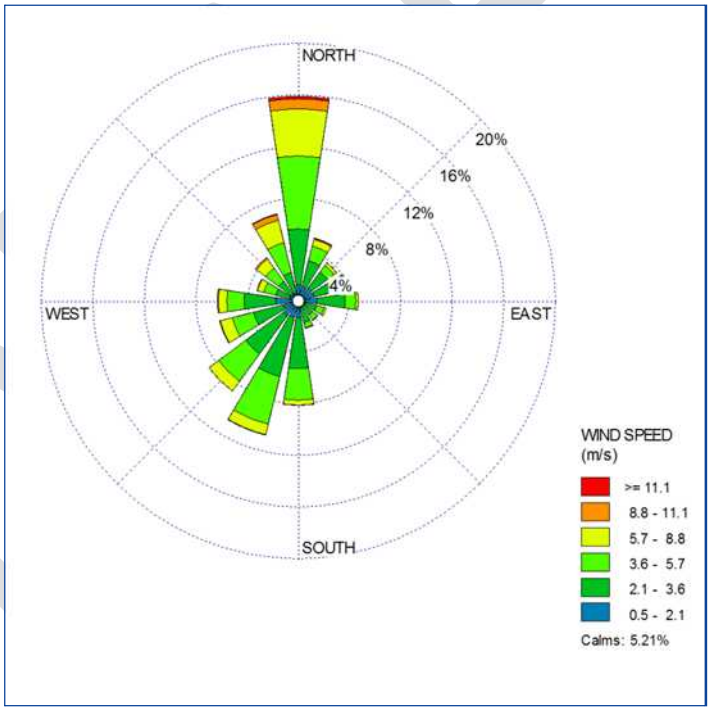
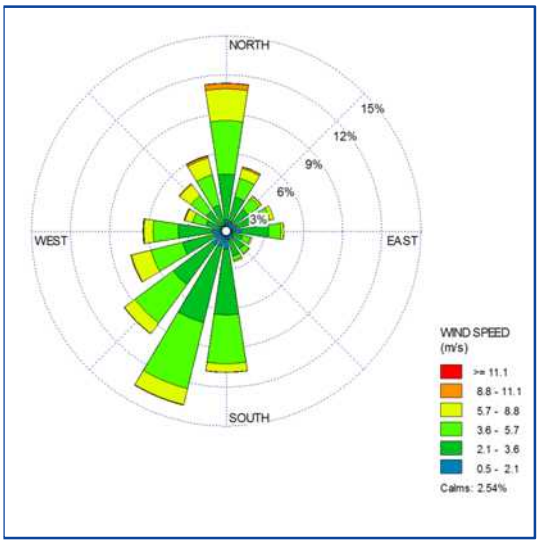


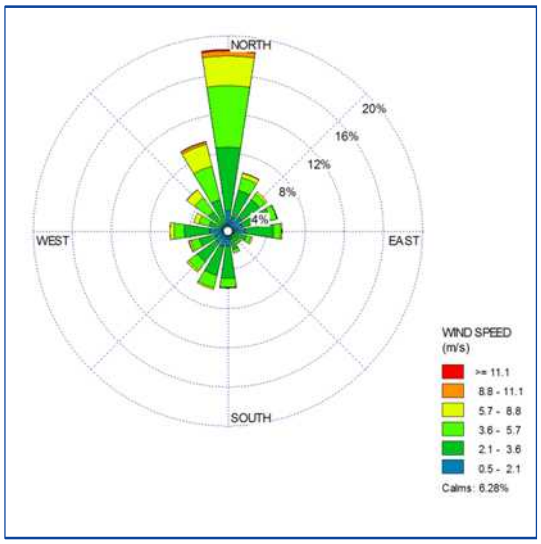

**Figure 20: Wind rose plot for the Upington International Airport from 2009 to 2011**

Seasonal variations in winds at the Upington International Airport are depicted in Figure 21. During summer (December to February), dominant wind directions are from the south-south-west and from the north. During autumn (March to May) and winter (June to August), there is a shift in dominant wind direction, with the northerly wind component strengthening and predominating. During these seasons the occurrence of calm conditions are at their greatest, characteristic of the high pressure system which is situated over the interior of South Africa at this time. Winds greater than 11 m.s-1 are experienced from the north. During spring, the frequency of winds from the north decreases but average speeds from this direction increase. The dominant wind directions during spring are from the south-west and south-south-west.

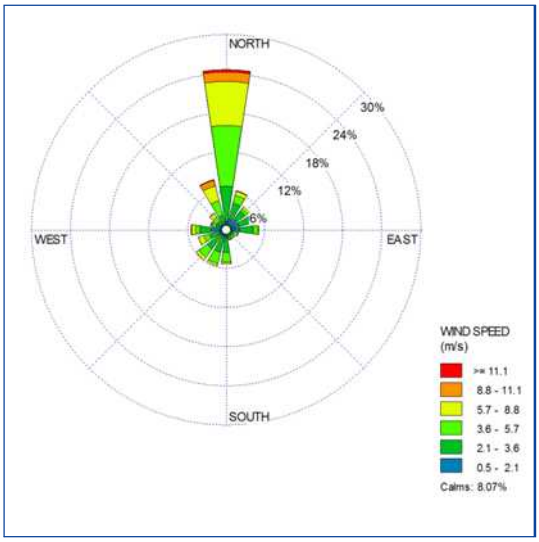
Diurnal variations in wind at Upington International Airport are depicted in Figure 22. From 00:00 to 06:00 northerly flow dominates with smaller south-westerly to south-south-westerly components. Winds are calm to moderate, with wind speeds of up to 11.1 m.s-1 experienced from the north. Similar conditions are experienced after sunrise (06:00 to 12:00) but with a clear strengthening of the northerly and north-north-westerly components, which indicate speeds greater than 11.1 m.s-1. After midday (12:00 to 18:00) winds blow between the northerly and southerly directions across the western half of the wind rose, reaching speeds over 11 m.s-1 from the north. By the evening (18:00 to 24:00) the wind frequency distribution is very similar to that described for 00:00 to 06:00..The dispersion of emissions will be lower overnight as a result of calmer wind speeds relative to the daylight hours. During winter the concentrations of pollutants experienced in the early morning hours may also be augmented by the formation of surface inversions that trap pollutants and prevent them from being dispersed into the atmosphere. After sunrise, convective mixing is initiated and pollutants are dispersed into the atmosphere.



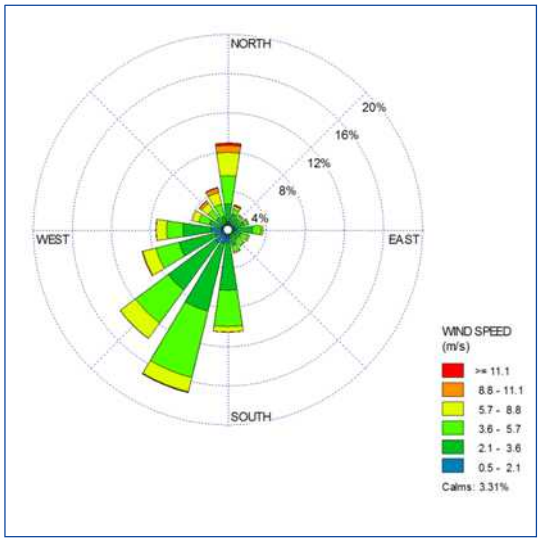

SUMMER (Dec to Feb)




AUTUMN (Mar to May)




WINTER (June to Aug)




SPRING (Sep to Nov)

**Figure 21: Seasonal wind rose plots for the Upington International Airport from 2009 to 2011**

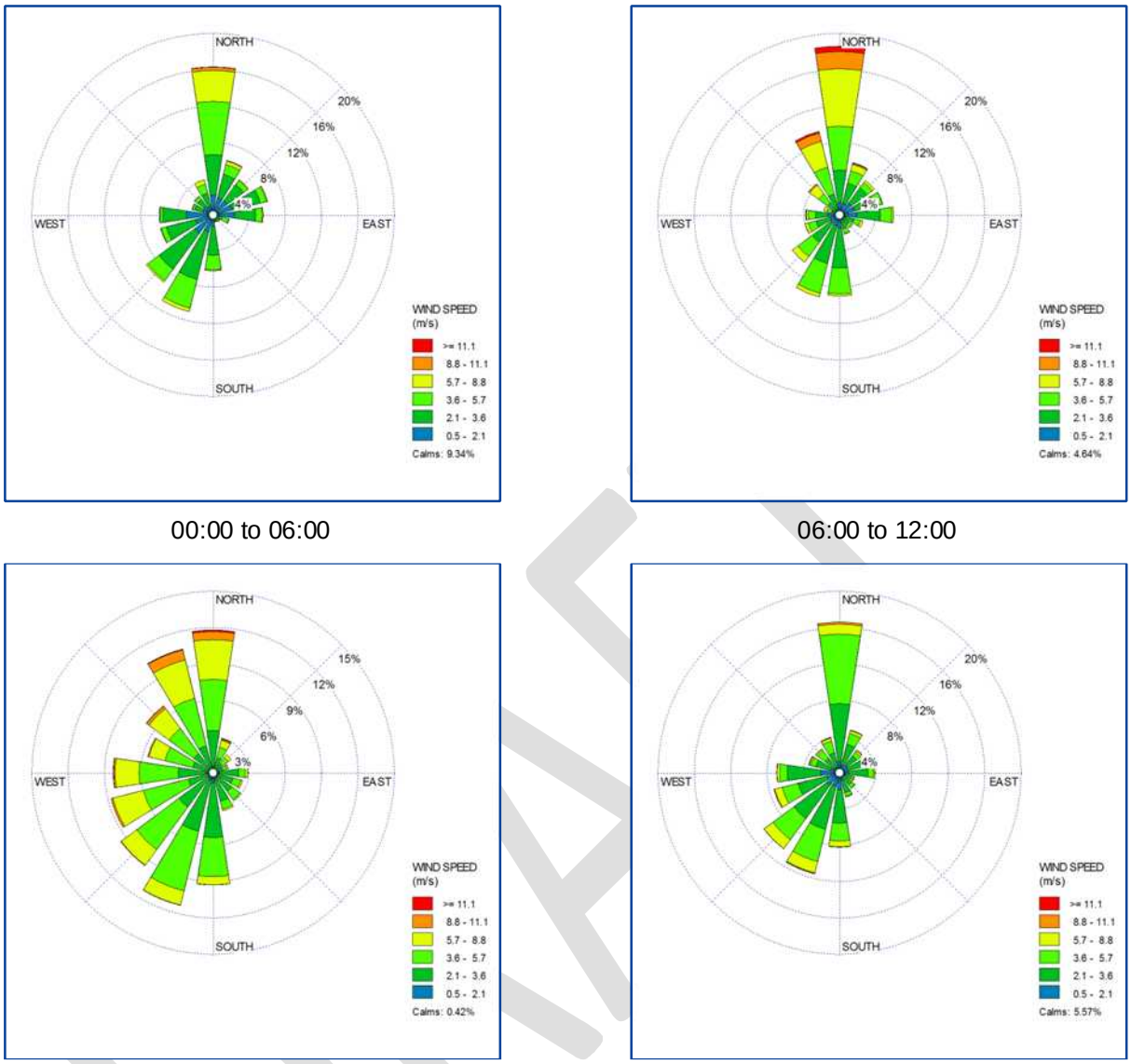



**Figure 22: Diurnal wind rose plots for the Upington International Airport for 2009 to 2011**

Figure 23 presents the average, minimum and maximum hourly temperatures at Upington International Airport as recorded over the 2009 to 2011 period. Maximum temperatures occur from November to February (with monthly maximum temperatures 39.9°C, 41.3°C, 39.97°C and 39.2°C respectively) while minimum temperatures are experienced during May to August (with minimum monthly temperature of 0.27°C, -1.90°C, -3.17°C and -1.20°C respectively). Average temperatures range considerably between the summer and winter months with a difference of up to 15°C between the highest summer month's average temperature and the lowest winter month's average temperature. The average summer temperature is 27.43°C while the average winter temperature is 13.31°C.

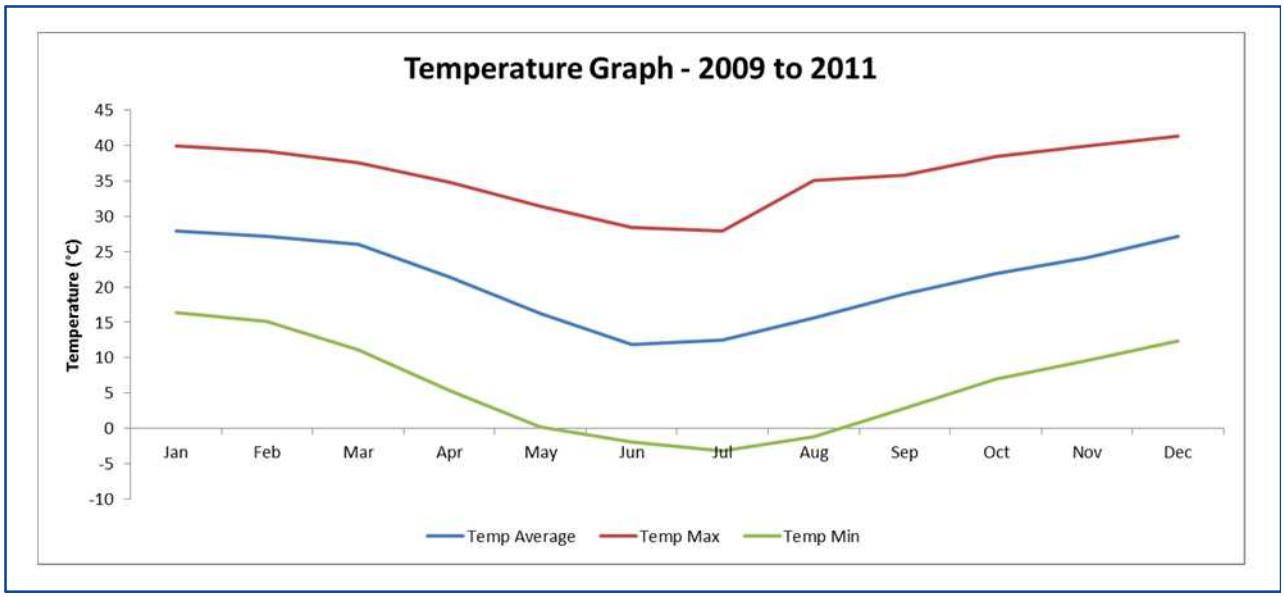



**Figure 23: Average, maximum and minimum temperatures at Upington International Airport**

Monthly rainfall figures at Upington International airport are plotted in Figure 24. Highest rainfall is experienced during late summer and early autumn (January to March). The lowest rainfall occurs during the winter and spring season (May to October). The annual rainfall for the site was 202.0 mm in 2009, 230.8 mm in 2010 and 479.4mm in 2011. Rainfall has the potential to remove pollutants from the air and limit dust generation thereby improving the air quality situation in high rainfall areas. During the winter and spring months at the CSP site there is likely to be an increase in particulate matter concentrations over the region due to increased erosion from dry surfaces and a decrease in rainfall washout from the atmosphere.

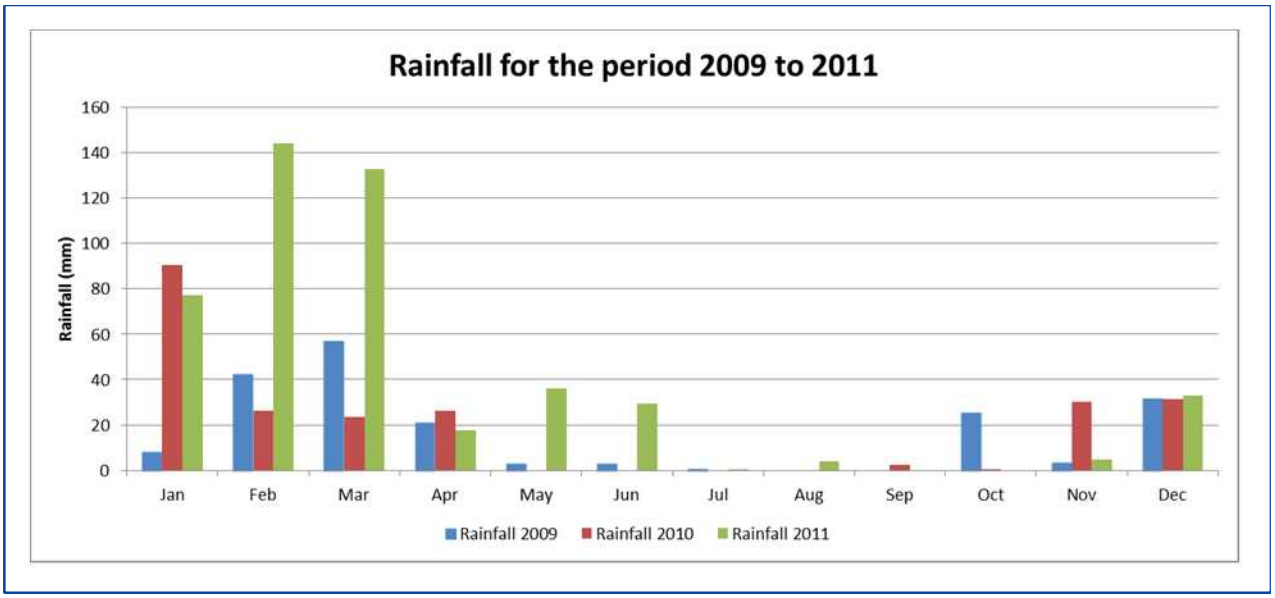



**Figure 24: Total monthly rainfall at Upington International Airport**

## 8.2 Air Quality

### 8.2.1 Introduction

WSP has an experienced air quality team and was appointed to conduct the air quality impact assessment (AQIA) and Atmospheric Emissions Licence (AEL) application for the client. For ease of analysis, the project was subdivided into two phases, namely the construction and operational phases. Dust emissions from the various activities associated with each project phase were assessed and recommendations are made on limiting the environmental impact of local dust emissions during this project. The Specialist Study is attached as **Appendix 6**.

### 8.2.2 Methodology (Modelling Approach)

#### 8.2.2.1 Model Selection

The latest version (v4.2) of the ADMS dispersion model was selected for this study (see **Appendix 6** for full study). Cambridge Environmental Research Consultants (CERC) have developed ADMS to offer a practical dispersion model that simulates a wide range of buoyant and passive releases to the atmosphere, whether individually or in combination. It is recognised as a leading dispersion model in the UK, European Union (EU), Asia, Australasia, the Middle East and South Africa, drawing on the latest plume dispersion mathematics and based on a solid GIS platform (ArcView 3.3 & ArcGIS 9.2). The software is currently endorsed by the Climate Research Group (operating from the University of the Witwatersrand, the University of KwaZulu-Natal & University of Cape Town) and used by most metro councils in South Africa. Output for criteria pollutants has been validated extensively against field data sets in the EU and the American Standard Test Methods. The model handles multiple point, line, area and volume sources to produce long- and short-term scenarios for comparison with measured values (in the case of an existing plant), guidelines, standards and objectives. The interface requires detailed geographic data, sequential meteorological data, efflux and emission parameters to produce optimal output; the preparation of which for this investigation is described in the following sections.

#### 8.2.2.2 Model Scenarios

The CSP project comprises two phases, each with characteristic processes and activities. Each phase is treated as a distinct air quality scenario.

**Scenario 1 – Construction Phase**

The main components of this phase that are likely to generate airborne pollutants are:

- Construction of roads;
- Vehicle movement;
- Earth clearing of construction camp and areas of construction;
- Transport of excavated topsoil from ground levelling; and
- Construction of the buildings located within the power block area.

**Scenario 2 – Operation phase**

The main components of this phase that are likely to generate airborne pollutants are:

- The start-up boiler;
- Vehicle movement on roads; and
- Wind erosion from open area sources.

The main roads at the site used by the majority of personnel will be paved by then end of the construction phase. Only the service roads between the heliostats and photovoltaic panels will be unpaved. The cleaning/washing trucks when travelling to clean the heliostats and photovoltaic panels will only use these. These unpaved roads and the open areas between the heliostats and panels will be subjected to wind erosion.

The start-up boiler will be situated north of the receiver tower and turbine. The start-up boiler will be unitised for one hour a day every day of the year (a total of 365 hours per year), to ensure that the system temperatures is at an adequate operational level.

Emissions from the above-mentioned sources are calculated using the US EPA AP-42 equations for wind erosion, fugitive emissions from unpaved roads, and uncontrolled emission rates from industrial diesel engines respectively.

#### 8.2.2.3 Emission Inventory

According to the US-EPA, an emission factor is a representative value that relates the quantity of a pollutant released to the atmosphere with an activity associated with the release of that pollutant. These factors usually are expressed as the mass of pollutant divided by a unit mass, volume, distance, or duration of the activity emitting the pollutant. Such factors facilitate conservative estimations of emissions from various sources of air pollution based on empirical data. In most cases, these factors are simply averages of all available data of acceptable quality, and are assumed representative of long-term averages for all facilities in the source category (i.e., a population average).

The US EPA AP-42 factors relevant to this study are listed below:

- Chapter 3 Section 4 – Large Stationary Diesel and All Stationary Dual-fuel Engines:

The emission factor equations for large stationary industrial engines are based on engines with a capacity of more than 6,000 horsepower. The emission factor relevant to this study is that for diesel fuel engines.

- Chapter 13 Section 2.2 – Unpaved Roads (dust from vehicles travelling on roads):

The force of wheels on a road surface causes pulverization of surface material. The particles are then lifted and dropped from the rolling wheels to be entailed by the turbulent wind generated by the passing vehicle. This dust can be dispersed over an area dependent on the meteorological conditions.

- Chapter 13 Section 2.3 – Heavy Construction Operations (Construction, Building and Roads)

Heavy construction is a source of dust emissions that may have substantial (albeit temporary) impact on local air quality. Building and road construction are two examples of construction activities with high emissions potential. Emissions are associated with land clearing, drilling and blasting, ground excavation, cut and fill operations (i.e., earth moving), and the actual construction itself. Dust emissions often vary substantially from day to day, depending on the level of activity, the specific operations, and the prevailing meteorological conditions. A large portion of the emissions results from equipment traffic over temporary roads at the construction site.

The emission factor used for the calculation of the emissions from the site is based on a generalised construction factor. This emission factor is commonly used for construction of buildings and roads and covers, blasting, drilling, earth moving and vehicle movement on the exposed surface areas. The construction of the CSP site will also contain some if not all of the activities around the site. The US EPA AP-42 Chapter 13 Section 2.3 – Heavy Construction Operations states that the emission factor overestimates the TSP levels and that a generally applicable PM10 emission factor cannot be calculated. In this assessment, we used the environmentally conservative TSP emission rate for construction over the 35 months, and calculated the PM10 emission rate from this. The PM10 emission rate was taken at 50% of the TSP emission rate and the PM2.5 emission rate was taken at 75% of the PM10. The emission rate was entered over a general area source as it was not clear where the construction would take place during the period and the assumption was made that on average 17ha of the land will be under construction at any time during that period. Together with the construction emission rate, an active wind erosion emission rate was calculated and added to establish a final construction phase emission rate.

## Emission Source Inventory

A comprehensive emissions inventory is imperative for accurate predictive dispersion modelling. The emission inventory consists of a detailed list of possible sources together with their physical dimensions and characteristics. The tables below are only a summary of the final emissions used in the model.

**Table 17: Emission Source Inventory for Scenario 1 – Construction Phase**

| Area Name | Total Area (ha) | Emission rate per pollutant (g/m$^2$/s) | | |
|---|---|---|---|---|
| | | TSP (>30µm) | $PM_{10}$ (<10µm) | $PM_{2.5}$ (<2.5µm) |
| **Heliostat field** | 394.41 | 5.660E-06 | 2.830E-06 | 2.123E-06 |
| **CPV field** | 205.9 | 5.660E-06 | 2.830E-06 | 2.123E-06 |

**Table 18: Emission Source Inventory for Scenario 2 – Operational Phase**

| Area Name | Total Area (ha) | Emission rate per pollutant (g/m$^2$/s) | | |
|---|---|---|---|---|
| | | TSP (>30µm) | $PM_{10}$ (<10µm) | $PM_{2.5}$ (<2.5µm) |
| **Heliostat field** | 394.41 | 3.071E-06 | 1.535E-06 | 1.151E-06 |
| **CPV field** | 205.9 | 4.935E-03 | 2.468E-03 | 1.851E-03 |

**Table 19: Emission Source Inventory for Scenario 2 – Operational phase Boiler operations**

| Pollutant | Uncontrolled Emission rate | Calculated compliant emission rates* |
|---|---|---|
| | g/s | g/s |
| **$SO_2$** | 68.35 | 10 |
| **$NO_2$** | 202.76 | 5 |
| **PM** | 5.91 | 1 |
| **CO** | 46.47 | --- |

* Calculated from the emission standards, Section 1.2 (GN 248, 2010), with flow rate from stack (20 m3/s)

**Table 20: Stack input parameters – Operational phase**

| | Height (m) | Inside Diameter (m) | Exit Temperature (°C) | Exit Gas Velocity (m/s) | Exit Gas Flow rate (m$^3$/s) |
|---|---|---|---|---|---|
| **Start-up Boiler** | 25 | 1.3 | 177 | 15 | 20 |

### 8.2.3 Assumptions and Limitations

Various assumptions were made during this assessment as listed below:

- Terrain: The terrain is viewed as flat as there are no significant terrain features that could influence the dispersion of pollutants over the region.
- Meteorological data: There were no onsite meteorological data available and data from the nearest SAWS station (Upington Airport, approximately 25km west east from the CSP site) was used as meteorological

input for this assessment. This station is considered representative of the meteorological conditions at the study site due to the flat terrain of the region.

- For model scenarios, the month considered most 'summerlike' (February 2011) had the highest average temperature and rainfall, while the month considered most 'winter like' (July 2011) had the lowest rainfall and temperatures over the three year data period.
- All particulate matter sources were assumed to have a release height of 0m above ground with a 0 m/s release velocity to imitate the passive release of dust that will only be generated from wind erosion.
- The construction period will last for 35 months, thus it was assumed that on average 17 ha per month will be under active construction.
- The average vehicle speed onsite is 40 km/h, with a mean vehicle weight of 2.4 tonnes. The surface silt content for the roads onsite are assumed at 7,5% (based on what data gathered during similar studies done by WSP); and
- It was assume that there would be nine vehicles cleaning the mirrors 7 days a week, eight hours a day.

### 8.2.4 Findings

For the purpose of this study, five scenarios were modelled, as listed below:

- **Scenario 1**: Modelled Particulate Matter (PM) emitted from the construction phase;
- **Scenario 2**: Modelled Particulate Matter (PM) emitted from the construction phase during most summerlike meteorology conditions;
- **Scenario 3**: Modelled Particulate Matter (PM) emitted from the construction phase during most winter like meteorological conditions;
- **Scenario 4**: Modelled Particulate Matter (PM) emitted from the operational phase;
- **Scenario 5**: Modelled Particulate Matter (PM) emitted from the operational phase during most summerlike meteorology conditions;
- **Scenario 6**: Modelled Particulate Matter (PM) emitted from the operational phase during most summerlike meteorology conditions;
- **Scenario 7**: Modelled uncontrolled emissions emitted from the start-up boiler.

Long-term scenarios were run to predict the annual average concentrations of criteria pollutants, as health risks are primarily based on long-term exposure to pollutants. In addition, the long-term run also collates and calculates statistics for worst-case short-term concentrations, to assess the potential exceedence of standards over intervals of 1-hour, 8-hours and 24-hours, as applicable for various criteria pollutants in the National Ambient Air Quality Standards (NAAQS). Results of the modelled scenarios are described and graphically displayed in isopleth maps and tabular formats below.

#### 8.2.4.1 Scenario 1 – Construction Phase

The model calculated $PM_{10}$ concentrations for the construction phase of the CSP project, generating annual average concentrations and daily maximum concentrations. The calculated daily concentrations are based on the worst case concentration at one grid point during the modelling period. These are thus the 100th percentile (or P100) values and can be compared with the 24 hour NAAQS.

Table 21 presents the results for both the long-term and short-term $PM_{10}$ concentrations for the two specified receptor points, while Figure 25 maps modelled annual average concentrations. Annual average $PM_{10}$ concentrations are low, with the receptor locations experiencing values below the lowest international annual standard (IFC at 20 µg/m$^3$). The maximum annual average concentration of 255.22 µg/m$^3$ occurred on the construction area source and should not be considered a realistic representation of conditions onsite. The highest daily $PM_{10}$ levels occur close to the development site and dissipate rapidly away from the site. The daily (P100) concentrations are well below the 24 hour NAAQS of 120 µg/m$^3$ as well as the lowest international

standard of 50 µg/m$^3$. The maximum daily concentration (P100) of 616.03 µg/m$^3$ occurs on the construction area source. No exceedences of the standard occur at the two receptors.

**Table 21: $PM_{10}$ Concentrations for the Construction phase**

| Receptor | Annual average Concentration (µg/m$^3$) | Highest daily Concentration (P100 - µg/m$^3$) | Annual NAAQS (µg/m$^3$) | 24 hour NAAQS (µg/m$^3$) |
|---|---|---|---|---|
| **Droëhout Farm House** | 5.649 | 48.904 | 50 | 120 |
| **Van Rooi Vley Farmhouse** | 2.341 | 24.482 | 50 | 120 |

Table 22 presents the results for both the long-term and short-term $PM_{2.5}$ concentrations for the two specified receptor points. Isopleth maps can be found in Appendix B of the Specialist Study (**Appendix 6**). The annual average concentrations are low, following the trend of the $PM_{10}$ plume from source, with concentrations at the receptor locations not exceeding the lowest international standard of 10 µg/m$^3$. The maximum annual average concentration (191.46 µg/m$^3$) occurs within the construction area source and should not be considered a realistic representation of conditions onsite. The highest PM2.5 levels occur close to the development site and dissipate rapidly away from the site. The daily (P100) concentrations also are well below the 24 hour NAAQS of 65 µg.m-3. The maximum daily concentration (P100) of 462.13 µg/m$^3$ occurs within the construction area source and once again should not be considered a realistic representation of conditions onsite. No exceedences occurred at the two receptor points.

**Table 22: $PM_{2.5}$ Concentrations for the Construction phase**

| Receptor | Annual Average $PM_{2.5}$ Concentration (µg/m$^3$) | Highest Daily $PM_{2.5}$ Concentration (P100 - µg/m$^3$) | NAAQS Annual $PM_{10}$ Standard (µg/m$^3$) | 24 hour NAAQS (µg/m$^3$) |
|---|---|---|---|---|
| **Droëhout Farm House** | 4.238 | 36.687 | 25 | 65 |
| **Van Rooi Vley Farmhouse** | 1.756 | 18.366 | 25 | 65 |

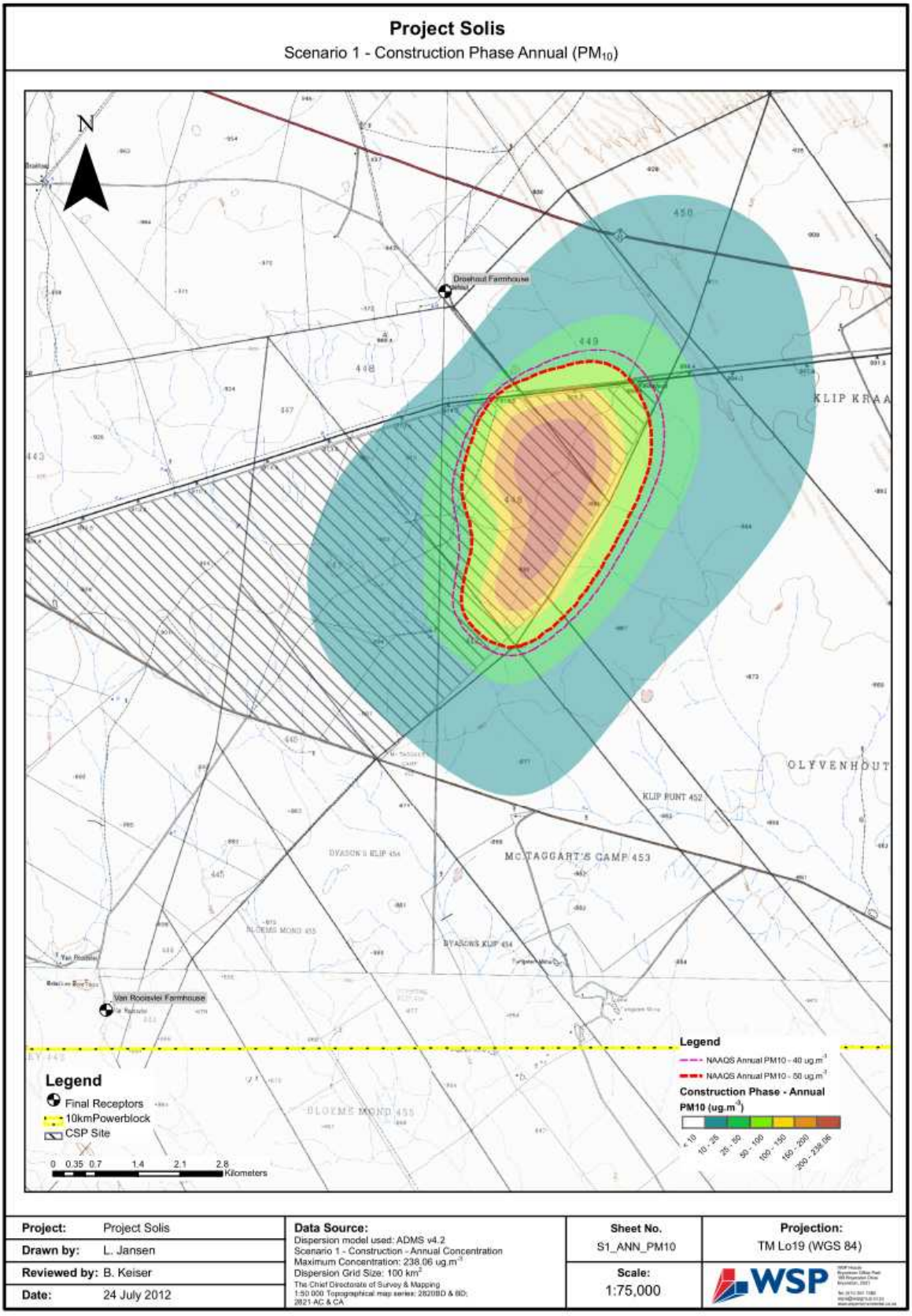



**Figure 25: PM10 emissions from the Construction phase of the project, indicating annual average concentrations**

### 8.2.4.2 Scenario 2 – Construction Phase Summer

Scenario 2 uses the meteorological data of February 2011 to represent summerlike conditions and models emissions from the construction phase of the proposed CSP project. .

Table 23 presents the annual average $PM_{10}$ concentrations for the two specified receptor points (see Appendix B of the Specialist Study for the isopleth maps). The maximum daily $PM_{10}$ concentration at the receptor points during the summer period was 46.50 µg/m$^3$ (Droëhout farmhouse), which is below national and international standards. The maximum summer daily concentration is less than the maximum daily concentration for the entire construction period (48.90 µg/m$^3$).

The table below presents modelled summer concentrations for $PM_{10}$ and $PM_{2.5}$.

**Table 23: Summer - PM10 concentrations at the two receptor points**

| | Receptor | Annual Average Concentration (µg/m$^3$) | Highest Daily (P100) Concentration (µg/m$^3$) | 24 Hour NAAQS (µg/m$^3$) |
|---|---|---|---|---|
| **PM10** | Droëhout Farm House | *11.80* | 46.50 | 120 |
| | Van Roois Vley Farmhouse | *3.65* | 16.00 | 120 |
| **PM2.5** | Droëhout Farm House | *8.87* | 34.90 | 65 |
| | Van Roois Vley Farmhouse | *2.74* | 12.00 | 65 |

The predominant wind direction blew from the north north-east and thus dust generated by the construction activities was dispersed more to the south of the site. The month of February 2011 also had an equal south-west wind component, and the plume consequently disperses towards the north-east of the site. It should also be noted that the area source is length wise from north to south thus increasing the volume of dust the wind could pick up flowing over the area source from the north to south.

### 8.2.4.3 Scenario 3 – Construction Phase Winter

Scenario 3 uses the meteorological data of July 2011 to represent winter conditions and models emissions from the construction phase for the proposed CSP project.

Table 24 presents annual average $PM_{10}$ concentrations for the two specified receptor points (see Appendix B of the Specialist Study for the isopleth maps). The maximum daily $PM_{10}$ concentration at the receptor points during the winter period is 51.20 µg.m-3 (Droëhout farmhouse), which is below the NAAQS of 120 µg.m-3 but exceeds an international standard (IFC at 50 µg.m-3). The maximum winter daily concentration is more than the maximum daily concentration for the full construction period (48.90 µg.m-3).

The table below presents expected winter concentrations for $PM_{10}$ and $PM_{2.5}$.

**Table 24: Winter - PM10 concentrations at the two receptor points**

| | Receptor | Annual Average Concentration (µg/m$^3$) | Highest Daily Concentration (P100- µg/m$^3$) | 24 hour NAAQS (µg/m$^3$) |
|---|---|---|---|---|
| **PM10** | Droëhout Farm House | *6.26* | 51.20 | 120 |
| | Van Roois Vley Farmhouse | *5.34* | 21.20 | 120 |
| **PM2.5** | Droëhout Farm House | *4.70* | 38.40 | 65 |
| | Van Roois Vley Farmhouse | *4.01* | 15.90 | 65 |

The predominant wind direction is from the north with a strong north-east component, thus the dust generated by the construction phase will disperse towards the south to south-west. The month of July 2011 also had a strong west-south-west component, and the plume disperses towards the east of the site.

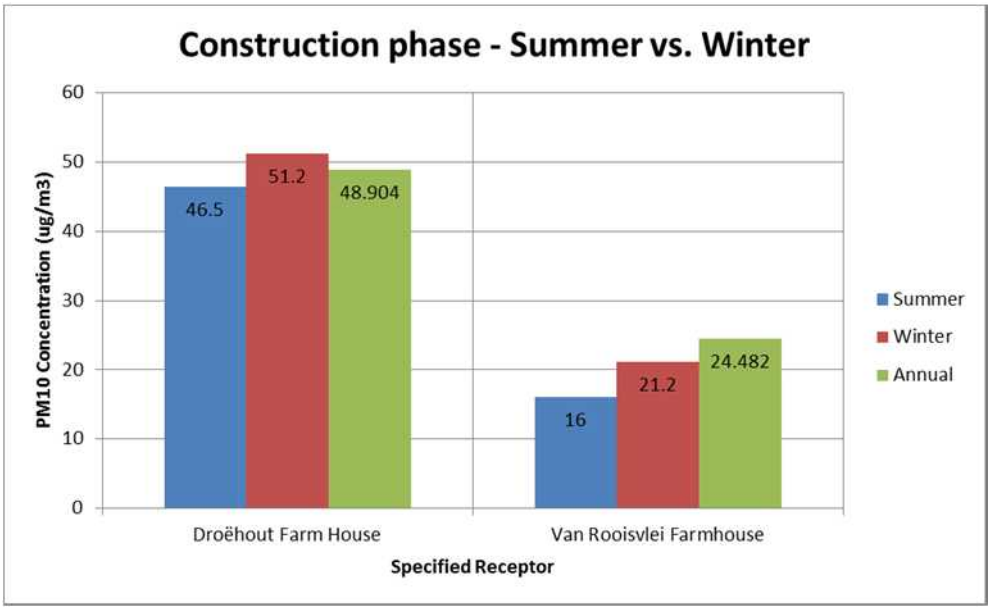



**Figure 26: Comparison of daily (P100) PM10 results for each season with the daily (P100) PM10 concentration for the entire year – Construction**

#### 8.2.4.4 Scenario 4 – Operational Phase

Scenario 4 provides annual and daily maximum particulate matter concentrations for the operational phase. It is assumed that only two vehicles will travel on unpaved roads for two days per week. The calculated daily concentrations are based on the worst case concentration at one grid point during the course of a year. These are thus the 100th percentile (or P100) values and can be compared with the 24 hour NAAQS.

Table 25 presents the results for both the long-term and short-term $PM_{10}$ concentrations for the two specified receptor points, while Figure 27 maps annual average concentrations. Annual average $PM_{10}$ concentrations are low, with the receptor locations experiencing values below the lowest international annual standard (IFC at 20 µg/m$^3$). The maximum annual average ($PM_{10}$) concentration of 138.89 µg/m$^3$ occurred on the heliostat field, south from the power block. The highest annual average PM10 levels occur close to the CSP site and dissipate rapidly away from the site. The daily (P100) concentrations are also well below the 24 hour NAAQS of 120 µg.m-3 as well as the lowest internationally standard (IFC at 50 µg/m$^3$). The maximum daily concentration (P100) of 334.37 µg/m$^3$ occurs in the heliostat field. No exceedences occurred at the two receptors.

**Table 25: $PM_{10}$ Concentrations for the operational phase**

| Receptor | Annual Average $PM_{10}$ Concentration (µg/m$^3$) | Highest Daily $PM_{10}$ Concentration (P100 - µg/m$^3$) | Annual NAAQS (µg/m$^3$) | 24 Hour NAAQS (µg/m$^3$) |
|---|---|---|---|---|
| **Droëhout Farm House** | 3.09 | 26.70 | 50 | 120 |
| **Van Roois Vley Farmhouse** | 1.29 | 13.40 | 50 | 120 |

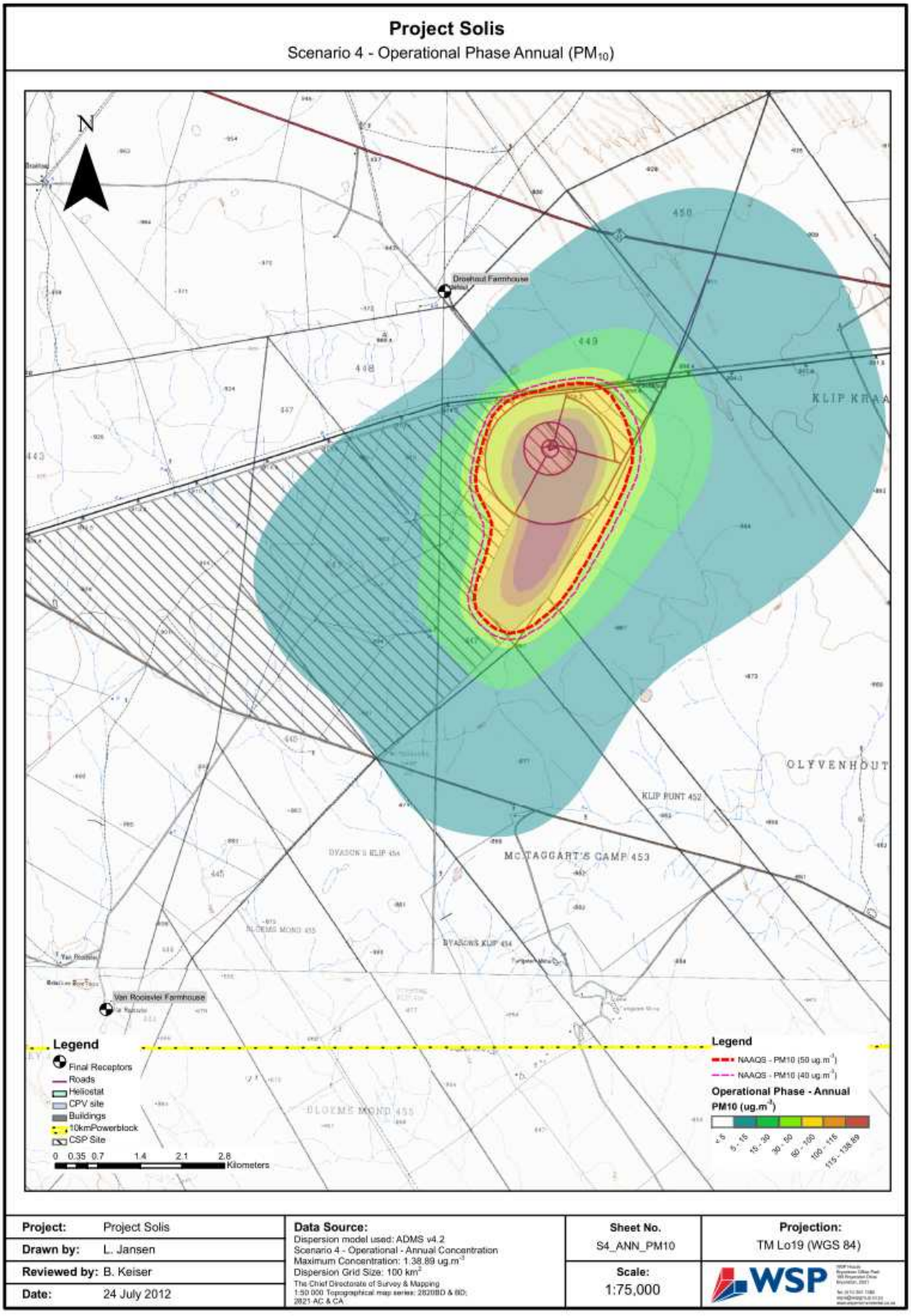



**Figure 27: $PM_{10}$ emissions from the Operational phase of the project, indicating annual average concentrations**

Table 26 presents the long-term and short-term $PM_{2.5}$ concentrations for the two specified receptor points. Isopleth maps can be found in Appendix B of the Specialist Study. Annual average concentrations are low, following the trend of the $PM_{10}$ plume with concentrations at the receptor locations not exceeding the lowest international standard (IFC at 10 µg/m$^3$). The maximum annual average concentration (104.15 µg/m$^3$) occurs in the heliostat field, south of the power block. The highest $PM_{2.5}$ levels occur at site and dissipate rapidly away from the site. Daily (P100) concentrations are also below the 24 hour NAAQS of 65 µg/m$^3$. The maximum daily concentration (P100) of 250.72 µg/m$^3$ occurs within the heliostat field. No exceedences occur at the two receptor points.

**Table 26: $PM_{2.5}$ Concentrations for the operational phase**

| Receptor | Annual Average Concentration (µg/m$^3$) | Highest Daily Concentration (P100 - µg/m$^3$) | Annual NAAQS (µg/m$^3$) | 24 Hour NAAQS (µg/m$^3$) |
|---|---|---|---|---|
| **Droëhout Farm House** | 2.32 | 20.00 | 25 | 65 |
| **Van Roois Vley Farmhouse** | 0.96 | 10.10 | 25 | 65 |

### 8.2.4.5 Scenario 5 – Operational Phase Summer

Scenario 5 uses the meteorological data of February 2011 to present summerlike conditions and models emissions from the operational phase. Table 27 presents the annual average $PM_{10}$ concentrations for the two specified receptor points (see Appendix B for the isopleth maps). The maximum daily $PM_{10}$ concentration at the receptor points during the summer period was 25.50 µg/m$^3$ (Droëhout farmhouse), which is still below the national and international standards. The maximum summer daily concentration is less than the daily maximum for the full operational period (26.70 µgm$^3$).

The table below present modelled summer concentrations for $PM_{10}$ and $PM_{2.5}$.

**Table 27: Summer - $PM_{10}$ concentrations at the two receptor points**

| | Receptor | Annual Average (µg.m$^3$) | Highest Daily Concentration (P100 - µg.m$^3$) | 24 Hour NAAQS (µg.m$^3$) |
|---|---|---|---|---|
| **PM10** | Droëhout Farm House | *6.46* | 25.50 | 120 |
| | Van Roois Vley Farmhouse | *2.00* | 8.77 | 120 |
| **PM2.5** | Droëhout Farm House | *4.84* | 19.10 | 65 |
| | Van Roois Vley Farmhouse | *1.50* | 6.58 | 65 |

The predominant wind direction blew from the north north-east and thus dust generated by the construction activities was dispersed more to the south of the site. The month of February 2011 also had an equal south west wind component, concluding that the plume would also disperse towards the north east of the site. It should also be noted, that the area source is length wise from north to south and thus increasing the volume of dust the wind could pick up flowing over the area source from the north to south.

### 8.2.4.6 Scenario 6 – Operational Phase Winter

Scenario 6 uses the meteorological data of July 2011 to present winter like conditions and models emissions from the operational phase. Table 28 presents the annual average $PM_{10}$ concentrations for the two specified receptor points (see Appendix B of the Specialist Study for the isopleth maps). The maximum daily $PM_{10}$ concentration at the receptor points during the summer period was 28.00 µg/m$^3$ (Droëhout farmhouse), which is below the national and international standards. The maximum daily winter concentration is higher than the daily average over the annual operational period (26.70 µg/m$^3$).

The table below present the typical summer concentrations for $PM_{10}$ and $PM_{2.5}$ to be expected.

**Table 28: Winter - $PM_{10}$ concentrations at the two receptor points**

| | Receptor | Annual Average Concentration ($\mu g.m^3$) | Highest Daily Concentration (P100 -$\mu g.m^3$) | 24 Hour NAAQS ($\mu g.m^3$) |
|---|---|---|---|---|
| **PM10** | Droëhout Farm House | *3.42* | 28.00 | 120 |
| | Van Roois Vley Farmhouse | *2.94* | 11.60 | 120 |
| **PM2.5** | Droëhout Farm House | *2.56* | 21.00 | 65 |
| | Van Roois Vley Farmhouse | *2.20* | 8.72 | 65 |

The predominant wind direction blew from the north, with a strong north-east component, thus the dust generated by the construction phase will disperse towards the south to south-west. The month of July 2011 also had a strong west south-west component and the plume also dispersed towards the east of the site.

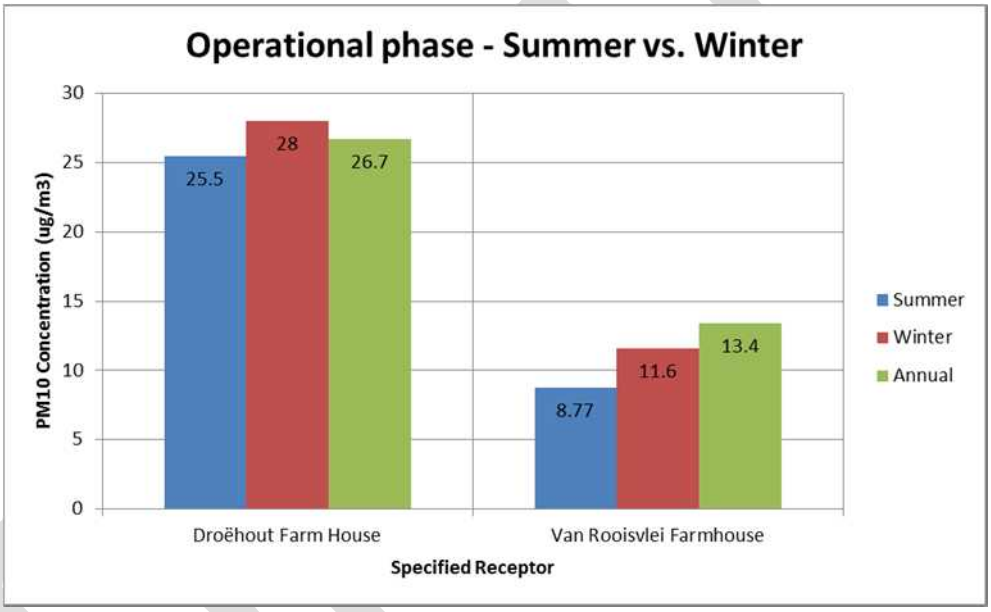



**Figure 28: Comparing the daily (P100) $PM_{10}$ results for each season with the daily (P100) $PM_{10}$ concentration over the entire year – Operational**

### 8.2.4.7 Scenario 7 – Start-up Boiler

The proposed boiler is an Actom JT with a heat input of 18,000 MJ/hr (50 MWe). The physical dimensions of the boiler and stack are listed in Appendix A of the Specialist Study. Abatement technology to ensure compliance with emission limits (GNR 248, 2010) is yet to be decided. The dispersion model was run for (i) uncontrolled emissions and (ii) controlled emissions of $SO_2$, $NO_2$ and PM10. The uncontrolled emissions were calculated from the US EPA AP-42 Chapter 3 Section 4 emission factors and the controlled emission rates were calculated from the standards specified in the Listed Activities (GNR 248, 2010) Category 1 Section 2.

The result from the dispersion model (See Appendix B of the Specialist Study and Table 29 below) indicate that controlled emissions are significantly lower than uncontrolled emissions and are compliant with the listed activities standards (GNR 248, 2010. The results of calculations of required abatement control efficiency for the uncontrolled emissions to be compliant are presented in Table 30.

**Table 29: Ambient concentration of $SO_2$, $NO_2$ and $PM_{10}$ emitted from the boiler – Controlled and Uncontrolled**

| Name | Controlled Emissions | | | Uncontrolled Emissions | | |
|---|---|---|---|---|---|---|
| | $SO_2$ | $NO_2$ | $PM_{10}$ | $SO_2$ | $NO_2$ | $PM_{10}$ |
| **Droëhout Farm house** | 0.57 | 0.28 | 0.05 | 3.87 | 11.48 | 0.27 |
| **Van Rooi Vley farm house** | 3.30 | 1.65 | 0.08 | 22.52 | 66.83 | 0.49 |

**Table 30: Calculated minimal control efficiency for boiler**

| Pollutant | Uncontrolled Emission Rate (g/s) | Controlled Emission Rate (g/s) | % Control Efficiency Required |
|---|---|---|---|
| **$SO_2$** | 68.35 | 10 | 85.37 |
| **$NO_2$** | 202.76 | 5 | 97.53 |
| **$PM_{10}$** | 5.91 | 1 | 83.09 |

## 8.3 Noise

Baseline noise levels are expected to be low and any increase in the ambient noise levels will result in noise impacts. The provisions of SANS 10103:2004 (Table 31) shall apply to all areas within audible distance of neighbouring occupants.

**Table 31: Noise Control Regulations**

| **Noise Control Regulations** | |
|---|---|
| *Noise Control Regulations promulgated in terms of the Environment Conservation Act 73 of 1989, Regulations 4 and 5* | |
| *SANS 10103:2004* | |
| The local authority may, if a noise emanating from a building, premises, vehicle, recreational vehicle or street is a disturbing noise or noise nuisance, or may in the opinion of the local authority concerned be a disturbing noise or noise nuisance, instruct in writing the person causing such noise or who is responsible therefore, or the owner or occupant of such building or premises from which or from where such noise emanates or may emanate, or all such persons, to discontinue or cause to be discontinued such noise, or to take steps to lower the lever of the noise to a level conforming to the requirements of these Regulations within the period stipulated in the instruction: Provided that the provisions of this paragraph shall not apply in respect of a disturbing noise or noise nuisance caused by rail vehicles or aircraft which are not used as recreational vehicles on a public road.<br>*"disturbing noise" means 'a noise level which exceeds the ambient sound level measured continuously at the same measuring point by 7 dBA or more;*<br>*"noise nuisance" means any sound which disturbs or impairs or may disturb or impair the convenience or peace of any person;* | |
| **SANS 10103:2004 - extract from Table 2: Acceptable rating levels for noise in districts** | |
| | *Equivalent continuous rating for noise (dBA) – outdoors* |

| Noise Control Regulations | | | |
|---|---|---|---|
| *Type of District* | | *Day-time (06h00-22h00)* | *Night-time (22h00-06h00)* |
| Residential Districts | | | |
| a) | Rural districts | 45 | 35 |
| b) | Suburban districts with road traffic | 50 | 40 |
| c) | Urban districts | 55 | 45 |
| Non Residential Districts | | | |
| a) | Urban districts with some workshops, with business premises, and with main roads | 60 | 50 |
| b) | Central business districts | 65 | 55 |
| c) | Industrial districts | 70 | 60 |

## 8.4 Geology and Soils

The geological description is based on a previous assessment conducted within the study area by SRK Consulting (Report on the Drilling Phase: Geotechnical Investigation for the Proposed Sasol Commercial CSP Project, Report Number 443957, May 2012). The typical geology comprises tertiary calcrete deposits towards the south-west of the property. The remainder of the property is dominated by Quaternary Kalahari Group Surficial deposits of red-brown aeolian (windblown) sands of the Gordonia Formation (Figure 31). Based on the preliminary plant layout, the development of the access road and plant will occur in the area dominated by the Gordonia Formation.

Based on the soil class mapping for the area (DAFF, 2012) the soils of the property are expected to comprise red, yellow and greyish excessively drained sandy soils. The exception is the northern extremities where shallow soils with minimal development are expected on the slopes of the plateau. The land type maps indicate that the site development (including access road and proposed plant) will be on soils dominated by Hutton soil forms of the Lowlands, Maitengwe, Mangano and Roodepoort Families. Soils are typically 300mm to 750mm deep, and comprise fine sands.

## 8.5 Topography

The proposed area is characteristic of a typical Kalahari landscape with flat to slightly undulating plains and is, generally, an area of little topographical relief. The elevation of the proposed site ranges from 946 metres above sea level (masl) to 881 masl, indicative of a relatively flat topography. Figure 29 illustrates the cross profile of the Van Roois Vley site as indicated from north to south and east to west. The north to south profile represented by the Y-axis has an average slope of -0.8 % with point ‘c’ noted to be 937 masl and point ‘d’ 885 masl. The west to east profile is represented by the X-axis has an average slope of 0.3%, with an altitude at point ‘a’ being 922 masl and ‘b’ of 894 masl.

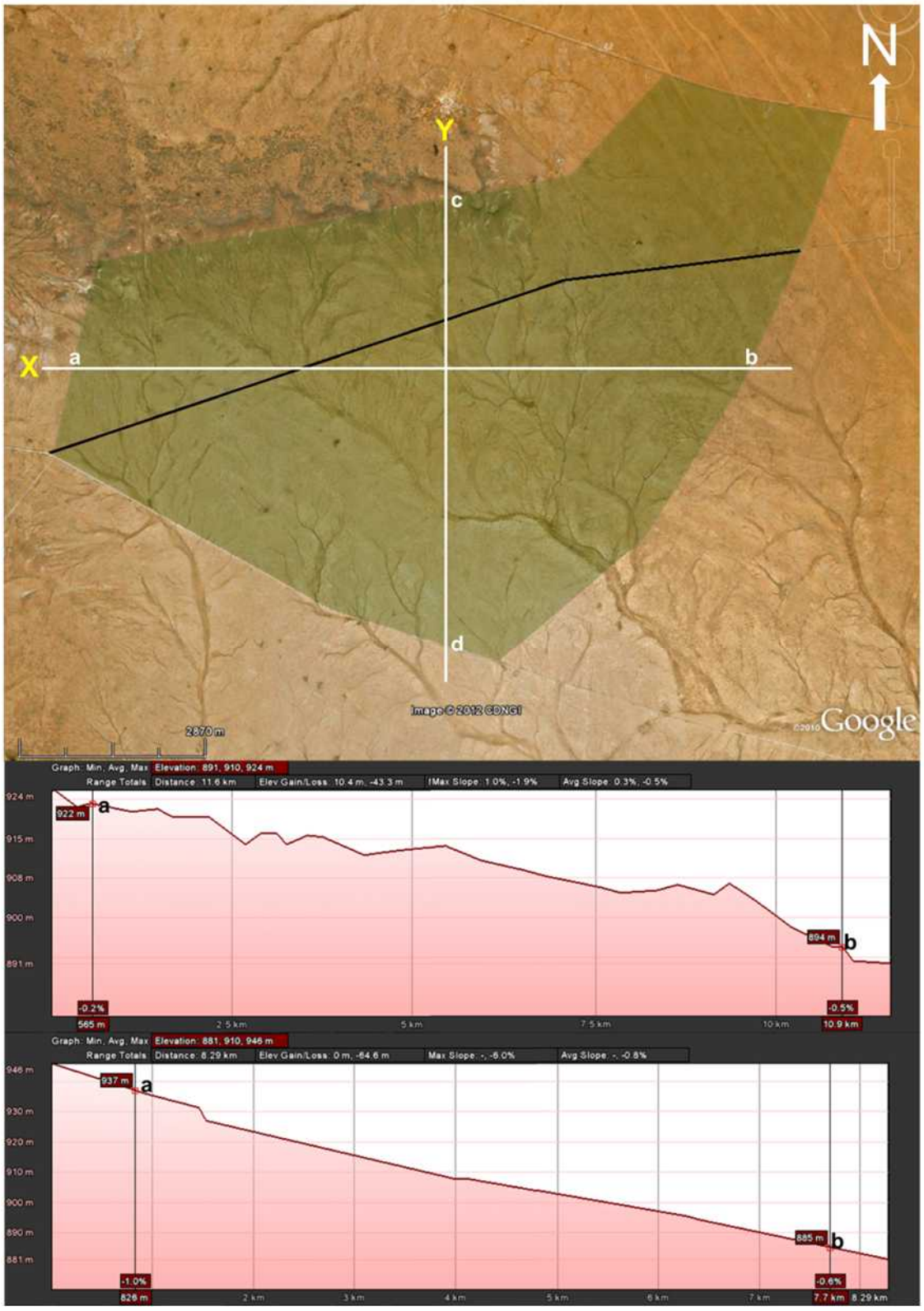



**Figure 29: Cross section of the Van Roois Vley site (Google earth, 2012)**

## 8.6 Land use and Land capability

According to the Siyanda District Municipality Environmental Management Framework (EMF) (2008) and the KGLM Integrated Development Plan (IDP) (2009), agriculture is the main economic sector within the municipality with the largest potential for economic growth. Farming in the area is characterised by grazing (cattle and sheep).

The current land use is predominately small-scale sheep farming. The agricultural potential of the site can be described as low and this is attributed to the low rainfall experienced in the area. The grazing potential of the area is also described as low as a result of the climatic conditions.

### 8.6.1 Introduction

As part of the specialist studies required, WSP carried out a desktop assessment of the baseline conditions influencing the land capability and grazing capacity. The Specialist Study is attached as **Appendix 7**.

### 8.6.2 Methodology

A desktop study was conducted to determine the land capability and grazing capacity of the proposed site. The land capability is described based on eight classes of soil capability, outlining the arable potential (ranging from very high to non-arable) and the grazing potential (ranging from moderate to low). The grazing potential is described based on the number of animals that can be sustained without deterioration of the natural resources (expressed in hectares per livestock unit). This is described based on the grazing potential mapped for the area in 2007.

Based on the desktop study, the land capability and grazing potential for the proposed site is described. Based on the grazing capacity determined for the study site, the potential economic cost for the loss of grazing land is estimated.

### 8.6.3 Assumptions and Limitations

The assessment has been limited to a desktop review. This is reliant on published data sources (aerial imagery, mapping and previous reporting) which have been assumed by WSP to be accurate.

### 8.6.4 Findings

#### 8.6.4.1 Land Capability

Land capability classes are interpretive groupings of land units with similar potentials and continuing limitations or hazards. Whilst social and economic variables are not specifically considered, consideration is given to:

- The risks of land damage from erosion and other causes; and,
- The difficulties in land-use owing to physical land characteristics, including climate.

There are eight land classes, donated by Roman numerals. Classes I to IV are suitable for arable land, Classes V to VII are suitable as grazing land, and Class VIII is not considered suitable for agriculture, with the use being limited to recreation, wildlife, water supply or aesthetic purposes.

Based on land capability mapping for the area (DAFF, 2012), the entire study site comprises a land capability of Class VII. This is representative of the land capability on a regional scale. Land in Class VII has very severe limitations that make it unsuitable to cultivation and restricts its use largely to grazing, woodland or wildlife.

Restrictions are more severe than those for Class VI because of one or more continuing limitations that cannot be corrected. Typical limitations include very steep slopes, erosion, shallow soil, stones, wet soils, salts or sodicity and unfavourable climate. Based on the desktop information available for the study site, the land

capability is likely to be limited by the sandy soils and low rainfall. As a result, based on the current regional land use the land use is considered best suited to grazing.

#### 8.6.4.2 Grazing Capacity

The grazing capacity is defined as the area of land required to maintain a single animal unit without causing deterioration in vegetation or soil condition (a decrease in basal cover, or a change in species composition or vigour of the veld plants). The area required for one animal unit varies considerably and is determined primarily by the veld type, the condition of the veld and topography. An Animal Unit (AU) is equivalent to a mammal of conventional quadruped shape which has a mass of 450kg (i.e.the size of an average steer).

The majority of the study area has a grazing capacity of between 31ha/AU and 40ha/AU(DAFF, 2012). The north-eastern extremity has a slightly improved grazing capacity of between 26ha/AU and 30ha/AU. This grazing capacity is representative of the regional capability.

## 8.7 Hydrology and Geohydrology

### 8.7.1 Introduction

As part of the specialist studies required, WSP carried out a desktop assessment to determine the baseline environmental conditions influencing the surface water and groundwater at the site. The assessment includes both the water quantity and quality. The Specialist Study is attached as **Appendix 8**.

### 8.7.2 Methodology

Available hydrological and geohydrological information pertinent to the area was sourced, reviewed and described. In particular this included any water quality data for the surface water and groundwater resources within the area. A hydrocensus of all groundwater wells within a 2km radius of the proposed development was conducted to determine borehole location, use, yield and water quality (if available).

Based on available project related information, a conceptual model of the surface water and groundwater resources was developed. This defined the relationships between the resource and associated users. These information sources were used to describe potential impacts of the site (both to surface water and groundwater) and to determine potential water supply options.

### 8.7.3 Assumptions and Limitations

The assessment was limited to a desktop review. This was reliant on various published data sources (aerial imagery, mapping and reporting) and supplied datasets (i.e. water quality data) which have been assumed by WSP to be accurate.

### 8.7.4 Findings

#### 8.7.4.1 Hydrology

The topography of the Van Roois Vley property is flat, with drainage towards the south and south-east, as seen in Figure 30. Site elevations range from 960m meters above sea level (masl) in the north, and 880m masl towards the south of the property. Slopes range between gradients of 0.5 and 1%.

Three watercourses drain the site. Due to the climate, these non-perennial watercourses are expected to only flow directly after heavy rainfall events. An ephemeral unnamed watercourse drains the western portion of the property, and does not contribute to any other watercourses. It is not expected to be impacted by the plant footprint or access road construction.

The Helbrandleegte and Helbrandkloofspruit originate from a plateau located on the northern boundary of the property (Figure 30).The Helbrandleegte drains the majority of the property including the central and north-eastern portions, and flows in a south-eastern direction. The Helbrandkloofspruit drains the southern portion of the site, confluences with the Helbrandleegte 18km south-east of the site, and contributes to the Orange River, 21km south-east of the site. Both of these watercourses are expected to be influenced by the development of the access road and plant.

Based on topographical mapping and aerial imagery two farm dams are located within the central portion of the property, associated with the Helbrandleegte. In addition, a quarry is located on the unnamed watercourse on the south-western boundary, and is expected to be temporarily filled with water after rainfall events. Ephemeral pans are located towards the north and south-west of the property associated with each of the three watercourses. Wind pumps associated with the Helbrandleegte drainage line are located to the north-west and south-east of the study area, and serve as an indication of groundwater abstraction. Various small water storage reservoirs are located to the west of the property in the vicinity of the railway line. None of these dams, pans and reservoirs is expected to be impacted by the plant development area.

The flow of the Gariep River into which the watercourses originating on site contribute varies between 50 and 1800$m^3$ per second, depending on the season. The flow of the river is controlled mainly by discharges from upstream dams such as the Bloemhof, Gariep and Van der Kloof dams. Various canals originating in the vicinity of Upington are used to supply irrigation water to farms on the river banks. Upington and all other settlements in the //Khara Hais municipality derive their raw water from the Gariep River either by direct withdrawal or from an irrigation canal (//Khara Hais SDF, 2009).

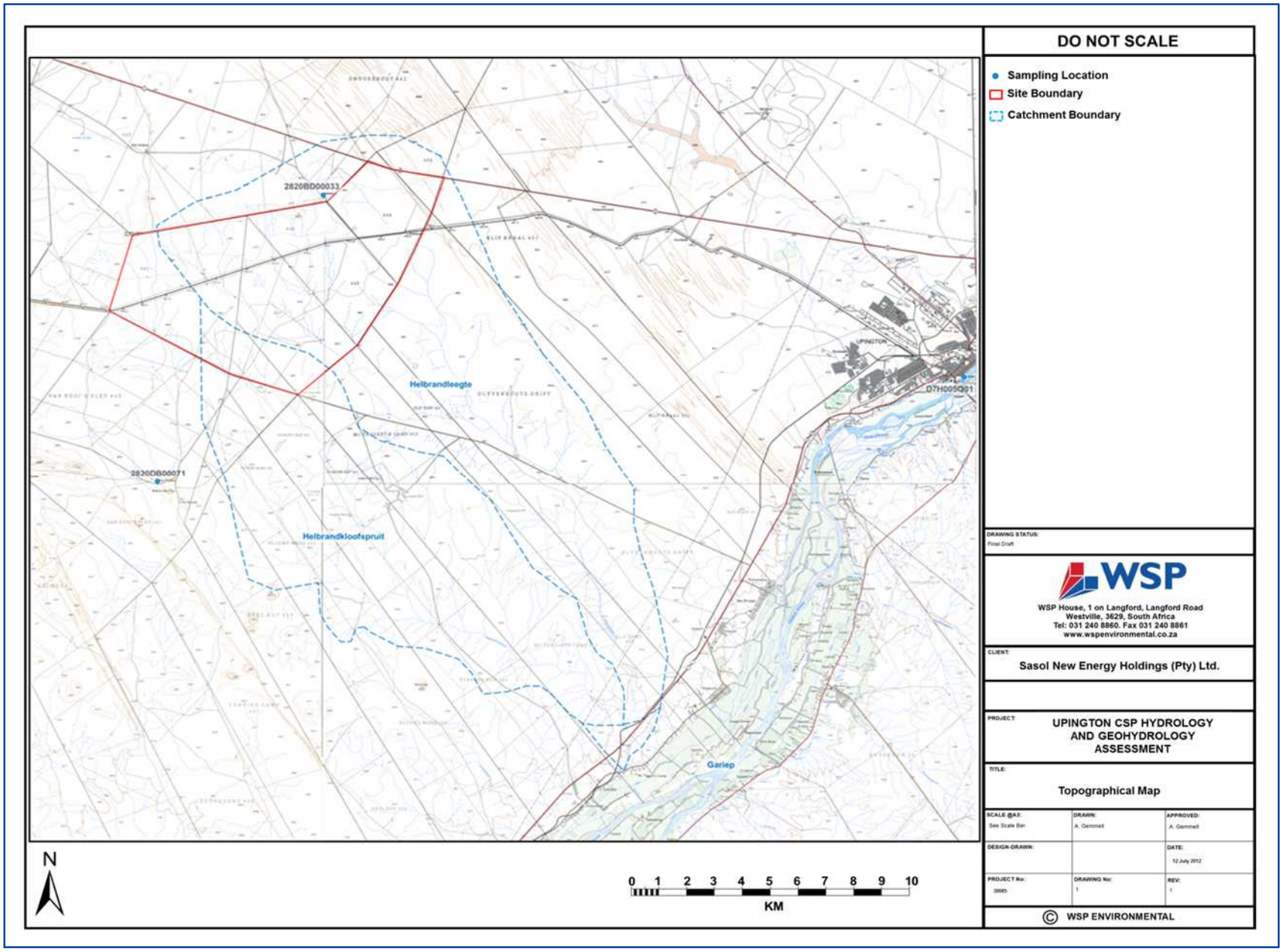



**Figure 30: Topographical map indicating river catchments and property boundary (after Chief Directorate, Surveys and Land Information)**

### 8.7.4.2 Geohydrology

The primary porosity in the region is regarded low to very low due to high grade regional metamorphism which would have recrystallised existing sedimentary rocks, reducing both porosity and permeability. Such formations include the staurolite schists of the Bietjiespoorts Group and aluminous gneisses of the Areachap Group. The only stratigraphy likely to support a primary aquifer includes shallow saturated residual and transported Quaternary red-brown Aeolian sands of the Gordonia Formation located in the northern portions of the property in which the proposed development will occur (Figure 31).Regional groundwater is controlled predominantly by secondary porosity of jointed and fractured bedrock and is the main source of water abstraction. Aquifer harvest potential is limited by the volume of effective storage due to low substrate permeability.

According to the Department of Water Affairs (DWA) 1:4,000,000 Groundwater Resources of the Republic of South Africa Map Series, the mean annual groundwater recharge for the region is 0-1mm/annum. The depth to groundwater is 30m-50m and the recommended drilling depth below groundwater level is 20m to 30m. The aquifer is classified as fractured, with fractures restricted principally to the zone directly below the groundwater level.

According to the aquifer classification of South Africa (WRC, 1999), the aquifer of the region is classified as poor aquifer source (i.e. low yielding). Aquifer vulnerability is regarded as low, hence maintains a low vulnerability to contaminant migration within the aquifer medium. The aquifer is therefore regarded as having low susceptibility to the effects of anthropogenic contamination.

The probability of a successful borehole in the area of the site yielding more than 2ℓ/second is less than 10%. The probability of drilling a successful borehole is less than 40%.

Based on the DWAF groundwater harvest potential mapping for South Africa the maximum volume of groundwater that may be abstracted annually per surface area of an aquifer system in the area to preserve a sustained abstraction is 2500-4000$m^3/km^2$/year.

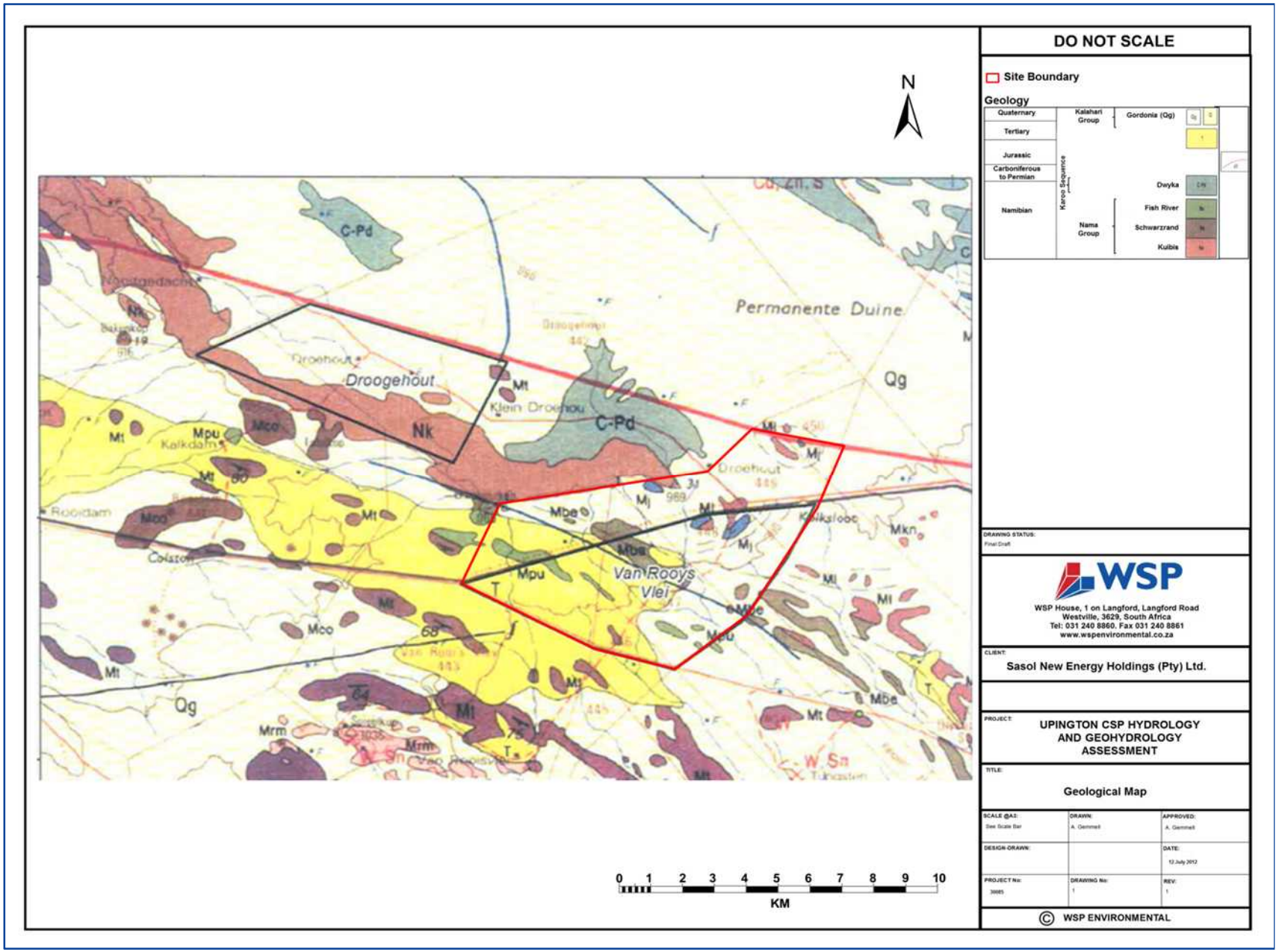



**Figure 31: Site Geology (after SRK, 2012)**

# 8.8 Flora

## 8.8.1 Introduction

WSP Environment & Energy have appointed Simon Todd Consulting to conduct the specialist botanical assessment for the proposed project. The Specialist Study is attached as **Appendix 9**.

## 8.8.2 Methodology

### 8.8.2.1 Site Visit

A site visit was undertaken on the 16 and 17th of July 2012. As part of the site survey a preliminary assessment of the different habitats, landscape units and vegetation features present within the site was made and mapped onto satellite imagery of the site. The vegetation was assessed at numerous locations and a preliminary species list for the site was developed. Potentially sensitive areas such as drainage lines, calcrete outcrops and quartz fields were investigated for the presence of rare, protected or otherwise important species.

### 8.8.2.2 Sensitivity Mapping and Assessment

A vegetation sensitivity map of the site was produced and includes delineating the different vegetation and habitat units and assigning sensitivity values to the units based on their ecological properties, values and the potential presence of species of conservation concern. The flora sensitivity of the different units identified in the mapping procedure was rated according to the following scale:

- **Low** – Units with a low sensitivity where there is likely to be a negligible impact on ecological processes and plant biodiversity. This category is reserved specifically for areas where the natural vegetation has already been transformed, usually for intensive agricultural purposes such as cropping. Most types of development can proceed within these areas with little ecological impact. There were however, no transformed areas within the site and hence no areas were mapped as being of Low Sensitivity.
- **Medium** – Areas of natural or previously transformed land where the impacts are likely to be largely local and the risk of secondary impact such as erosion low. Development within these areas can proceed with relatively little ecological impact provided that appropriate mitigation measures are taken.
- **High** – Areas of natural or transformed vegetation where a high impact is anticipated due to the high biodiversity value, sensitivity or important ecological role of the area. Development within these areas is highly undesirable and should only proceed with caution as it may not be possible to mitigate all impacts appropriately.
- **Very High** – Critical and unique habitats that serve as habitat for rare/endangered species or perform critical ecological roles. These areas are essentially no-go areas from a developmental perspective and should be avoided.

## 8.8.3 Assumptions and Limitations

The major potential limitation associated with the sampling approach is the narrow temporal window of sampling. Ideally, a site should be visited several times during different seasons to ensure that the full complements of plant species present are captured. However, this is rarely possible due to time and cost constraints and therefore, the representation of the species sampled at the time of the site visit should be critically evaluated.

Although the site visit took place outside of what is normally considered to be the ideal season, there had been substantial late summer and autumn rains in the area; with the result that the vegetation was is a good state for sampling. The grasses were not green but contained seed and were easily identified. In addition, most shrubs

were also in a state that they could be identified and the late rains had also stimulated a lot of annuals and geophytes with the result that there were also a lot of ephemerals present at the site. Therefore, a single visit was undertaken and the timing thereof is not considered to pose any significant limitations on the reliability of the data collected. It is possible that some rare or occasional species were not observed during the site visit, and so in order to overcome this limitation and the potential that species of conservation concern may occur in the area that were not observed, lists of species known to occur in the area were derived from the SANBI SIBIS database for a substantially larger area than the site. This represents a sufficiently conservative and cautious approach which takes account of the study limitations.

## 8.8.4 Findings

### 8.8.4.1 Broad-Scale Vegetation Patterns

According to the national vegetation map (Mucina& Rutherford 2006); there are three vegetation types within the vicinity of the site: Kalahari Karroid Shrubland, Gordonia Duneveld and Bushmanland Arid Grassland (Figure 32). Only Kalahari Karroid Shrubland lies within the development area. In terms of their conservation status, all three vegetation types are classified as Least Threatened and have been little impacted by transformation and more 99% of their original extent is still intact (Table 32). Both Kalahari Karroid Shrubland and Bushmanland Arid Grassland are Hardly Protected within formal conservation areas, while Gordonia Duneveld is Moderately Protected. The biogeographically important and endemic species known from these vegetation types tend to be widespread within the vegetation type itself and local-level impacts are not likely to be of significance for any of these vegetation types or species concerned.

**Table 32: Vegetation types that will be traversed by the different power line options and their basic conservation statics and status according to the National List of Threatened Ecosystems (2009).**

| 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 |
| **Bushmanland Arid Grassland** | 45479 | 99.4% | 21% | 0.4% | Least threatened |

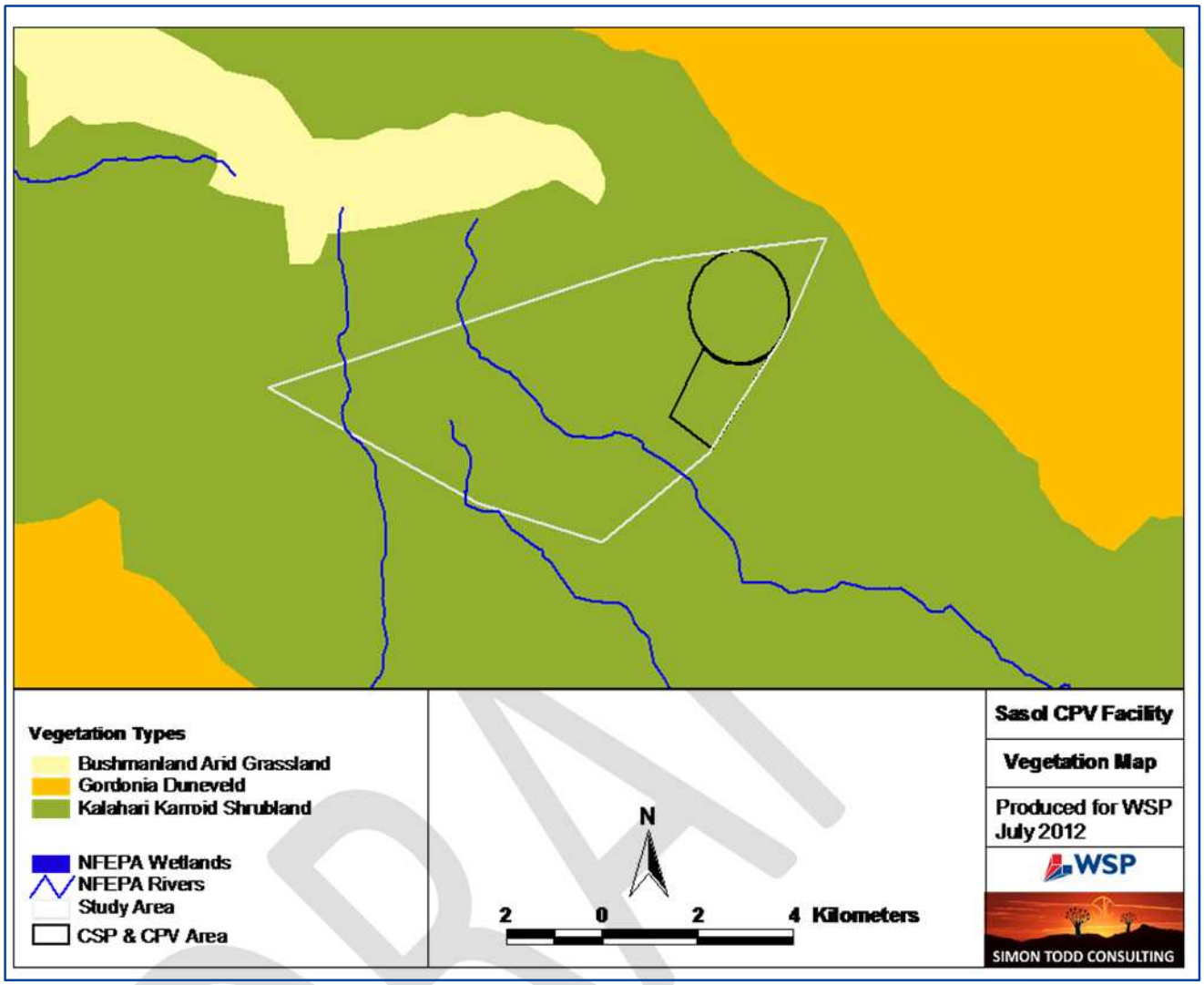



**Figure 32: The vegetation types within and around the Van Roois Vley site**

### 8.8.4.2 Fine-Scale Vegetation Patterns

A total of 127 plant species were recorded at the site. This is a relatively high total for the area and results largely from the fact that there had been good late summer and autumn rains in the area, rather than any property of the site itself.

The abundance of annuals, forbs and geophytes was regarded as high at the time of the site visit and significantly boosted the species richness recorded at the site. Such fluctuations are a natural element of arid areas where many plant species avoid harsh dry conditions by retreating under the soil as bulbs, corms or tubers or by remaining dormant as seed. The high total does however indicate that a high degree of confidence can be placed in the data collected and the species composition recorded at the site should be viewed as providing a reliable reflection of the species present in the area.

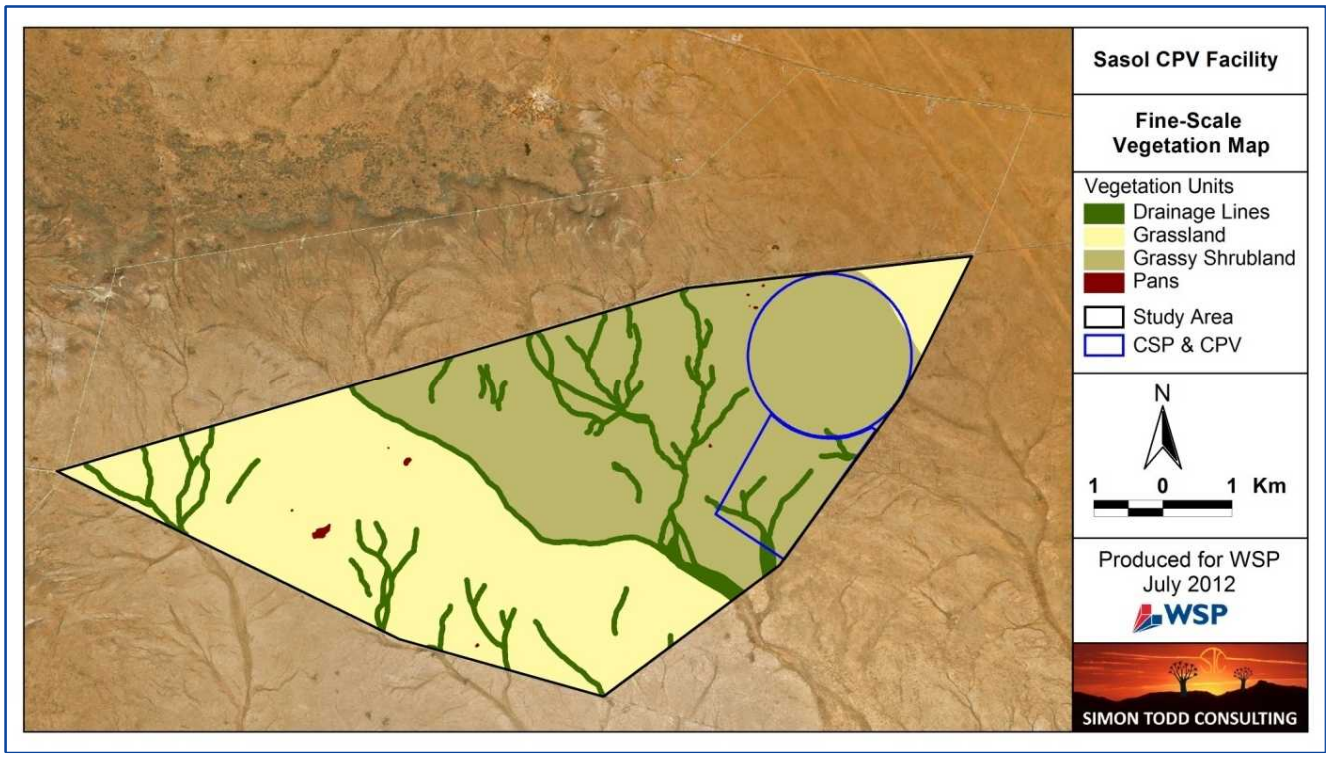



**Figure 33: Fine-scale vegetation map of the site, illustrating the distribution of the three plant communities identified and mapped during the site visit.**

The site was differentiated into three basic plant communities these are:

- Drainage Lines:
- Grassland, and
- Grassy Shrubland.

The Grassy Shrubland dominated the central part of the site and is comparable to the Kalahari Karroid Shrubland. The south-western part of the site was open grassland which can be equated to the Bushmanland Arid Grassland vegetation type. The north-eastern corner of the development area as well as that part of the site to the north of the railway line were also grassland, but of a type with affinity to Gordonia Duneveld and was associated with areas of deeper Kalahari sands.

The Drainage Lines represents the vegetation community associated with the drainage areas of the site. Each of these communities and their associated species and sensitivity is described in detail below.

## Drainage Lines

The drainage lines in the upper parts of the site were generally quite narrow and confined. These were dominated by shrubs and small trees such as *Acacia mellifera*, *Cadaba aphylla*, *Rhigozum trichotomum* and *Lycium boscifolium*, with an understorey of shrubs and grasses such as *Monechma spartioides* and *Cenchrus ciliaris*. The larger drainage lines lower in the catchment were quite wide, up to 100m and did not have a clearly defined channel. The larger drainage lines contained trees such as *Boscia albitrunca*, *Boscia foetida*, and *Acacia erioloba*, shrubs such as *Lycium boscifolium*, *Cadaba aphylla* and *Rhigozum trichotomum* and various forbs and grasses such as *Monechma spartioides*, *Salsola tuberculata*, *Geigeria pectidea*, *Cenchrus ciliaris* and *Panicum lanipes*.

Due to their ecological role and the presence of protected species and species not found elsewhere in the landscape, the drainage lines are considered to be a sensitive plant community and are considered to be of High to Very High Sensitivity.

## Grassland

The areas of grassland in the western part of the site were very open with virtually no trees except along drainage lines. The vegetation was dominated by bushman grasses including *Stipagrostis ciliata*, *S. anomala*, *S. uniplumis* and *S. obtusa*. This was a very homogenous vegetation type and contained the lowest relative species richness of the vegetation types observed at the site. In the eastern corner of the site, the vegetation has also been classified as grassland, although the nature is slightly different from that described above. In this area, the vegetation consisted largely of *Stipagrostis* with scattered *Parkinsonia africana* and *Boscia foetida*. Annuals such as *Arctotis leiocarpa* and *Heliophila minima* were also abundant in disturbed areas within this community.

## Grassy Shrubland

The majority of the proposed development area falls within the grassy shrubland community type. This unit occurs on generally shallow soils, sometimes on exposed calcrete, gravel or quartz. The community is dominated by shrubs and grasses, the exact ratio of the two carrying with soil texture and depth. On deeper or more sandy soils the proportion of grasses increases, while in areas of very shallow soils or finer-texture, shrubs tended to be more dominant.

The shrub and grass dominated areas tended to form a mosaic across the site which was affected by topographic position, slope and the proximity to the other vegetation units. Dominant shrub species were *Monechma genistifolium*, *Aptosimum albomarginatum*, *Leucosphaera bainesii*, *Hermannia spinosa*, *Zygophyllum flexuosum* and *Salsola tuberculata*. Dominant grasses include: *Stipagrostis anomala*, *S. ciliata*, *S. uniplumis*, *Eragrostis lehmanniana*, *Enneapogon scaber*, *S.hochstetteriana*, *S.uniplumis* and *Schmidtia kalariensis*. Forbs were common at the time of sampling, particularly within disturbed areas. Common species includes *Manulea schaeferi*, *Heliophila minima*, *Senecio consanguineus*, *Senecio glutinarius*, *Arctotis leiocarpa*, *Amellustridactylus* subsp. *arenarius* and *Dimorphotheca polyptera*. Occasional trees occurred including *Boscia foetida* and *Acacia mellifera*.

There were some areas within this vegetation type that had been disturbed or overgrazed in the past and could be identified by the presence of *Rhigozum obovatum* as well as more disturbance-oriented grasses such as *Schmidtia kalahariensis* and *Stipagrostis uniplumis*. This is a widespread plant community type and is not considered to be highly sensitive.

## Listed Plant Species

A number of listed and protected species were observed within the study area.

| **National Legislation** | |
|---|---|
| *Hoodia gordonii* | *Acacia erioloba* |
| *Bosciaal bitrunca* | |
| **Northern Cape Nature Conservation Act of 2009** | |
| All species of *Mesembryanthemaceae (Lithopsbromfieldii)* | *Boscia foetida* |
| *Androcymbium helanthioides* | *All species of Euphorbiaceae* |
| *Oxalidaceae* | *Iridaceae* |
| All species within the genera *Nemesia* | All species within the genera *Jamesbrittenia* |
| **Actual Threat Status** | |
| *Hoodia gordonii (DDD)* | *Acacia erioloba (Declining)* |
| *Senecio glutinarius (DDT)* | *Crinum bulbispermum (Declining)* |

A permit from the provincial offices of DAFF is required for any activities which impact protected tree species, while a permit from Northern Cape Department of Environment and Nature Conservation is required for all species protected under the provincial legislation.

### 8.8.4.3 Critical Biodiversity Areas and Broad-Scale Processes

No fine-scale conservation planning has been done in the district and as a result, no Critical Biodiversity Areas have been defined. Although the development of the site itself is therefore not likely to generate any significant broad-scale impacts, there are a number of other developments planned for the area and so the potential for cumulative impacts is significant. These may impact fauna to a greater degree than flora, as there are no species which are known to be restricted to the area and the affected vegetation types are widespread and remain largely intact.

**Site Sensitivity Assessment**

The botanical sensitivity map produced for the site is depicted below in Figure 34. The drainage lines have been identified as being of higher sensitivity than the surrounding areas on account of the important ecological role these areas play as well as their vulnerability to disturbance. The minor drainage lines are however classified as being less sensitive than the downstream areas which have developed significant associated vegetation. There was little basis on which to differentiate the sensitivity of grassland areas from the grassy shrubland areas and hence these two community types have been classified as being equally sensitive. Overall, these areas are considered to be of moderate sensitivity and development within these areas is not likely to result in an overall loss of plant biodiversity at the landscape scale. There are no species which are likely to be restricted to the area and there are no species of conservation concern which are known or were observed to be particularly abundant within the affected area.

In terms of the sensitivity of the vegetation within the CSP area, there were no specific features of high sensitivity that could be identified within this area. There is a very small drainage line which projects very slightly into the CSP area, but this is the very head of the drainage line and development within this area is not likely to be ecologically significant.

There were a relatively large number of the protected tree *Boscia foetida* within this area. This species is not of conservation concern it is protected under provincial legislation and a permit for the removal of the affected individuals would be required. Although some other protected tree species were observed at the site, they were not observed within the CSP development area and it is therefore unlikely that they occur within the affected area. A single individual of the protected succulent *Hoodia gordonii* was observed near the northern edge of the CSP development area. Although this was the only individual observed at the site, which suggests that the abundance of Hoodia at the site is low, it is possible that there are other individuals at the site as the grass was long at the time of the site visit which may have obscured other plants. There were no pans or rocky outcrops within the CSP area.

In terms of the peripheral and support infrastructure for the development which includes buildings, access roads, an evaporation pond and underground and overhead cabling, there do not appear to be any major issues with regards to the siting of these components. The access road will be from the N10 to the north of the site, while the electrical connections will run to the south-eastern boundary of the site and then to the ESKOM substation less than a kilometre away. These areas are of low sensitivity and the only features of concern that are likely to be encountered are some protected tree species, largely I, which is not of high conservation concern. The final routes for these elements should be subject to a walk-through by an ecologist prior to construction and any sensitive features encountered can then be avoided through small route adjustments if necessary.

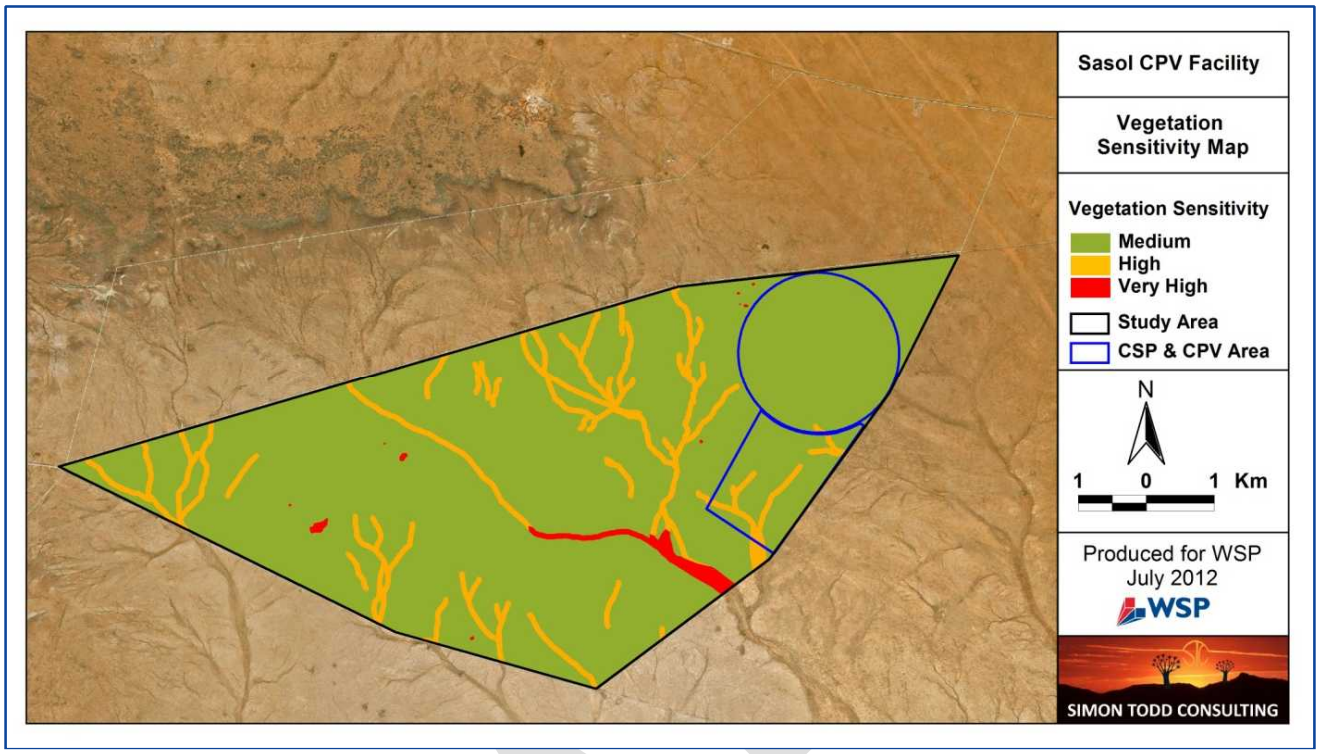



**Figure 34: Botanical Sensitivity map of the Van RooisVley site with the approximate location of the CSP and CPV facilities.**

## 8.9 Fauna

### 8.9.1 Introduction

Beryl Wilson, head of the Zoology Department at McGregor Museum, Kimberley was appointed to conduct a specialist study on the mammals, reptiles and amphibians, as well as selected arachnid species in the immediate area and surroundings. The Specialist Study is attached as **Appendix 10**.

### 8.9.2 Methodology

In order to specify and describe the specifics at the site, satellite imagery from Google Earth and 1:50,000 topo-cadastral maps and previous specialist reports were examined.

Only species of conservation importance deemed to be occurring on the site or immediate surroundings were discussed in detail. The purpose of listing Red Data species is to provide information on the potential occurrence of species of special conservation concern in the area that may be affected by the proposed facilities and related activities. Species appearing on these lists could then be assessed in terms of their habitat requirements and general ethology in order to determine whether any of them have a likelihood of being adversely impacted.

Lists of threatened animal species that have geographical range that includes the study area were obtained from museum databases and also from literature sources (listed in reference section). The likelihood of any of them occurring was evaluated on the basis of habitat preference, and habitats available at the proposed site. The three parameters used for each species were as follows:

- **Habitat requirements**: most Red Data animals have very specific habitat requirements and the presence/absence of these characteristics within the project locations area were assessed

- **Habitat status**: in the event that available habitat is considered suitable for these species, the status or ecological condition was assessed. Often, a high level of degradation of a specific habitat type will negate the potential presence of Red Data species
- **Habitat linkage**: movement between areas used for breeding and feeding purposes forms an essential part of the ecological existence of many species. The connectivity of the proposed project area to these surrounding habitats and adequacy of these linkages was assessed for the ecological functioning of the Red Data species within the project locations.

For all the threatened or conservation-worthy species that occur in the general geographical area of the site, a rating of the likelihood of it occurring on site is given as follows:

- **LOW**: no suitable habitats occur on site / habitats on site do not match habitat description for the species
- **MEDIUM**: habitats on site match general habitat description for species, but detailed microhabitat requirements are absent on the site or are unknown from the descriptions given in the literature or from the relevant authorities
- **HIGH**: habitats found on site match very strongly to the general and microhabitat description for the species.

#### 8.9.2.1 Project Location Sensitivity Analysis

The study site was evaluated in terms of the potential for containing habitat for animal species of conservation concern. Any habitat considered important for species of concern was considered to be sensitive whereas habitat not important for species of conservation concern was considered to be not sensitive.

**Table 33: Project location Sensitivity Analysis**

| SENSITIVITY LEVEL | DESCRIPTION |
|---|---|
| **LOWER SENSITIVITY** | Habitat with no breeding, inhabiting or foraging importance for animal species of conservation concern but adequate or suitable for species of Least Concern. |
| **MEDIUM SENSITIVITY** | Habitat with breeding, inhabiting or foraging importance for animal species of low conservation concern (Data Deficient, Near Threatened). |
| **HIGHER SENSITIVITY** | Habitat with breeding, inhabiting or foraging importance for animal species of high conservation concern (Critically Endangered, Endangered, Vulnerable or Protected). |

#### 8.9.2.2 Gap Analysis

An elementary gap analysis was undertaken to ascertain whether or not the site falls within an area deemed as having relevant criteria such as irreplaceability of target biodiversity components, minimum effective size and viability requirements, migration requirements, integrity, essential ecological processes and/or ecosystem services for any of the local or regional applicable faunal species.

### 8.9.3 Assumptions and Limitations

- The designation of Red Data species status reflects the viewpoint mainly from a South African perspective and this data should be viewed with caution because national and international lists vary considerably and are also reviewed on a regular basis.
- Red Data List species are, by their nature, usually very rare and difficult to locate. Compiling the list of applicable species that could potentially occur in an area is limited by a paucity of records that make it difficult to predict whether a species may occur in an area or not.
- The methodology used in this assessment is aimed at reducing the risks of omitting any species, as well as including others unexpectedly. However predictions based on experience of these and similar species

cannot be expected to hold true under all circumstances, particularly in the instance of highly mobile fauna such as larger mammals and bats.

- The Northern Cape region in general, in particular the area under study, has little long term, verifiable data available on species distribution on a micro-habitat level. Gap analysis data to identify gaps in conservation lands where significant plant and animal species and their habitat or important ecological features occur is limited, unanalysed or currently unpublished.
- This study was undertaken at a desktop level following a brief site visit in May 2012. This is considered adequate for assessing the major issues associated with the impacts of the current project activities and those envisaged for the immediate future on the relevant fauna in the area.

### 8.9.4 Findings

Typically, faunal species diversity in the region is relatively low as is expected in semi-desert areas. The nearby Orange River and rocky koppies are not expected to contribute significant to the diversity as most species have developed habitat-specific niches. The faunal components of the region are highly impoverished due to persecution, habitat transformation and poor grazing management.

Several conservation-worthy and/or common species are present in the area. These include Visagie's golden mole (*Chrysochloris visagie*,) which is Critically Endangered; Grant's rock mouse (*Aethomys granti*); Shortridge's rat (*Thallomys shortridgei*), and the Riverine rabbit (*Bunolagus monticularis*), which is Endangered. The common Red veld rat (*Aethomys chrysophilus*) was also incorrectly mentioned. Whilst these species do occur in the Nama-Karoo biome, they are restricted to other veld types, and not the Kalahari Karroid Shrubland which is present in this area. This veld type is only one of 15 types that make up the Nama-Karoo biome and species present in other veld types are not indicative of those present in this particular situation.

Taking into account the actual location and habitat in the area, and with reference to literature and available databases, the Van Roois Vley area and surrounds contains the following species breakdown as indicated in Table 34.

Since bats, larger mammals and reptiles are mobile, it was naturally assumed that there will be movement in and out of the immediate vicinity of all of the project locations and this was taken into account together with the location and vegetation. The preferred habitat and ethological (animal behaviour) requirements of each species of concern was also considered, with reference to literature and available databases. It should be noted that certain species are routinely under-reported, particularly those that are nocturnal, secretive, migratory, vagrants, subterranean or hard to identify (such as shrews, lacertids, amphisbaenids and arachnids).

With this in mind, the number of potential naturally-occurring species with similar habitat requirements as those in the project and surrounding areas was calculated, incorporating some species that have historical distributions in the region. Naturally, it is not guaranteed that these species will be present, but the possibility that these species remain in undisturbed or more suitable adjacent areas needs to be considered. From this group, the number of conservation-worthy species was then determined and discussed. It should be noted that only arachnids (spiders and scorpions) with protected statuses have been included for consideration.

**Table 34: Faunal (excluding avifauna) composition in the Van Roois Vley area and surrounds**

| FAUNAL GROUP | POTENTIAL NUMBER OF SPECIES IN THE GENERAL AREA | NUMBER OF SPECIES OF CONSERVATION CONCERN |
|---|---|---|
| **Mammals** | 49 | 11 |
| **Reptiles** | 47 | 2 |
| **Amphibians** | 9 | 1 |
| **Selected Arachnids** | ~ 17 | ~ 9 |
| **TOTAL** | *105 (+~ 17)* | 23 |

### 8.9.4.1 Species of Conservation Concern

There are a number of species of conservation concern that have geographical distributions that include the Van Roois Vley area. The following conservation categories are applicable (some of which may not be applicable to species included in this report):

- Critically Endangered (CE): when a species is facing an extremely high risk of extinction in the wild in the immediate future according to Threatened or Protected Species (ToPS) Schedule 2007
- Regionally Extinct (RE): when a species is no longer present in a specific area where it historically occurred, but may well be present elsewhere according to Red Data Books 1988, 2000, 2004 and 2004
- Endangered Species (EN): indigenous species facing a high risk of extinction in the wild in the near future according to ToPS Schedule 2007
- Vulnerable (VU): when a species is considered to be facing a high risk of extinction in the wild in the near future according to Red Data books 1988, 2000, 2004 and 2004, ToPS Schedule 2007
- Near Threatened (NT): when a species is close to qualifying for or is likely to qualify for a threatened category in the near future according to Red Data Books 1988, 2000, 2004 and 2004
- Data Deficient (DD): when there is inadequate information to make a direct or indirect assessment of the population status in the wild but for which there is local evidence that the population under discussion may be at risk according to Red Data Books 1988, 2000, 2004 and 2004
- Protected Species (PS): where the species is considered to have high conservation value or national importance according to ToPS Schedule 2007.
- Least Concern (LC): where the species is considered widespread and abundant and currently under no conservation threat according to Red Data Books 1988, 2000, 2004 and 2004.

It should also be noted that the IUCN Red List status (international) may differ from the SA Red Data Book status (national), i.e. a species may be Vulnerable internationally, but locally only considered Least Concern. Some species are also Protected by the ToPS schedule but may not be threatened in the wild (e.g. a common species may be protected to prevent trade in the animal or parts thereof). The status that is most relevant to this situation is the one discussed.

Based on habitat, ethological requirements and investigative evidence, there were 19 species and 2 groups of conservation concern that may be present on Van Roois Vley and in adjacent areas. The types of conservation statuses are summarised in Table 35. Figures in parenthesis are species that have a dual conservation status and for which this particular status is considered least important.

**Table 35: Summary of conservation statuses in the faunal groups found at Van Roois Vley and surrounding areas**

| FAUNAL GROUP | CE | EN | VU | NT | PS | DD | LC |
|---|---|---|---|---|---|---|---|
| **Mammals** | | | (2) | 6 | 3 (1) | 2 | 38 (2) |
| **Reptiles** | | | (2) | | 2 | | 45 |
| **Amphibians** | | | | 1 | (1) | | 8 |
| **Selected Arachnids** | | | | | 7 + ~ 4 | | 8 |
| **Total** | | | | 7 | 12 + ~ 4 | 2 | 99 |
| **Habitat Sensitivity** |  | | | | | | |



The species of conservation concern include:

- BushveldSengi (Data Deficient)
- Southern African Hedgehog (Near Threatened)
- Darling's Horseshoe Bat (Near Threatened)

- Dent's Horseshoe Bat (Near Threatened)
- Angolan Wing-gland Bat (Near Threatened regionally / globally Vulnerable)
- Bushveld Gerbil (Data Deficient)
- Cape Fox (Least Concern / Protected Species)
- Honey Badger (Ratel) (Near Threatened / Protected Species)
- Brown Hyaena (Near Threatened)
- African Wild Cat (Least Concern / Protected Species)
- Black-footed Cat (Least Concern / globally Vulnerable / Protected Species)
- Rock Monitor (globally Vulnerable/ Protected Species)
- Water Monitor (globally Vulnerable / Protected Species)
- Giant Bullfrog (Near Threatened / Protected Species)
- Rock Scorpion (Protected Species)
- Burrowing Scorpions – 3 species (Protected Species)
- Horned Baboon Spiders – 2 species (Protected Species)
- Starburst Baboon Spider (Protected Species)
- Common Baboon Spiders – unknown number of species (Protected Species)
- Lesser Baboon Spiders – unknown number of species (Protected Species)

Of these, only 6 (six) were considered to have high possibility of occurring on the site or making use of the habitats available on site either permanently, seasonally or transiently. .

Study area sensitivity analysis suggests that the site has a Low-Medium Sensitivity based on the Least Concerned, Data Deficient and Near Threatened species recorded in the area and veld type in general. The actual site forms only a very small section in the QDS and cannot be reasonably expected to hold all the recorded species.

All terrestrial species will be directly affected particularly those that are sedentary such as the Bushveld Gerbil and Bushveld Elephant-shrew, amphibian, reptile and all the arachnids including the Rock and Burrowing Scorpions. The main reason for this is the inability of these species to react in time to disturbance or the inability to relocate. As an example, female Baboon Spiders are long-lived individuals (up to 18 years) but only make one burrow in their life-time whilst they still have the digging apparatus as a young instar. This burrow is used for shelter and from which prey is ambushed. Some individuals may never range more than several centimetres from their burrow entrances in their entire lives. The loss of this burrow, and the inability to make a new one, results in the individual being vulnerable to predation and the elements.

It should be noted, however, that the Bushveld Gerbil and Bushveld Elephant-shrew are both data deficient species and that their conservation priority status is low. Neither is unique to this area or habitat. The Burrowing Scorpions and Baboon Spiders generally are only found in the deep, sandy soil pockets whilst Rock Scorpions are associated with rocky areas. Both the scorpions' and spiders' current Protected Species status is only due to concerns regarding the illegal pet trade industry rather than due to habitat loss or a general decline in population numbers.

Note was made of the potential presence of two Near Threatened species of bats. The Dent's Horseshoe Bat is an endemic breeding species that is widely but sparsely distributed throughout the arid western parts of southern Africa only. Darling's Horseshoe Bat is also widely distributed throughout southern and central Africa but absent from fynbos regions. The Angolan Wing-gland Bat is endemic restricted to the western areas of southern Africa. Horseshoe Bats are associated with caves and mine shafts, neither of which are in the immediate vicinity of the project, nor is the geological substrate suitable for the formation of the types of caves normally preferred by these species. Occasional reports of these two species utilising culverts has been recorded, but this would be isolated and rare incidents. The Angolan Wing-gland Bat is reported to use buildings for roosting. All three species are short-winged and are clutter foragers meaning that they forage for

insects in closed habitats within the vegetation canopy. This type of vegetation is not typically found at the site, but the bats are expected to present in and around the Orange River riparian vegetation. Since all bats are highly mobile, it is possible that occasional or transient bats will be reported in the area. In this regard, the safety of all bats is usually only considered with power projects that make use of wind turbine structures which create vacuum vortices into which bats are sucked, or in which significant portions of potential breeding or foraging sites were to be removed in the development of the project. Any other projects that are daylight associated are of little consequence given that bats are nocturnal species.

There are several ephemeral pans and river streams evident in the area which will hold or carry water in heavy rainfall seasons. These water features provide essential habitat links between other water bodies for migratory species for brief periods, particularly in semi-desert regions (Nash & Endfield, 2002).

They are also vital for the resident and sedentary amphibian species such as the Giant Bullfrogs that use them for breeding events. At the time of survey, all the pans and river streams were dry, but bullfrogs remain underground for significant periods of time and only emerge after periods of heavy rain to breed. Sub-regionally Giant Bullfrogs populations have declined by as much as 50% over the past century, largely as a result of urbanisation and industrial activities. This includes the disturbance of wetlands (loss or pollution), and accidental deaths on roads whilst dispersing from breeding sites, as well as being sought after for the native medicinal trade and as food. Whilst bullfrogs are fairly mobile during breeding periods when they travel long distances between suitable breeding sites, they are particularly vulnerable whilst hibernating underground. Since Giant Bullfrogs are a Near Threatened and a Protected Species any pans that are used in the area would be considered as medium sensitivity. This can only be investigated during the wet season during a breeding event.

## 8.10 Avifauna

### 8.10.1 Introduction

WSP Environment and Energy approached Agreenco Environmental Projects to assist in establishing the extant avifaunal population at the proposed CSP/CPV project site, and to assess the potential risk to avifauna as a result of the proposed CSP/CPV and associated infrastructure. The Specialist Study is attached as **Appendix 11**.

### 8.10.2 Methodology

The field methodology for assessing the impact of the proposed development on the extant avifaunal population involves establishing what the extant avifaunal population is, as this will have bearing on the species that will be displaced by construction activities and habitat destruction.

#### 8.10.2.1 Assessing the resident avifaunal population for Van Roois Vley

The winter bird community structure was assessed using conventional line transect methodology. This method consists of walking a fixed-length transect within a given time and recording all bird species seen or heard within a specified transect width. In order to calculate optimal transect length, the first five transects were each placed at 1km long, and a species-accumulation curve was derived for each. The data showed that after 450m, none of the transects revealed species new to the respective transects and the standardised length was therefore set at 500m. The time allowed for each 500m transect was 20 minutes, thus at a pace of 3 second per metre, allowing for a steady and deliberate pace, increasing the chances of detecting all birds within the transect. The transect width was set at 100m, 50m either side of the main line, as this was the distance at which smaller birds can no longer be readily identified by binoculars.

Counts were only conducted between 06h30 and 11h00 in the morning, and again between 16h00 and 18h00 in the afternoon, the periods of peak activity. Sampling took place on 21, 21, 23 and 24 May 2012.

Furthermore, wherever larger water bodies or good observation areas, such as dune crests or hill-tops, were encountered, extensive scanning with a field telescope was undertaken in an attempt to detect larger terrestrial

birds, water birds and raptors that may not otherwise have been detected during the line-transect methodology. Driving to and from the survey sites before and after sunrise was also undertaken in an attempt to locate any nocturnal birds, which would be absent from the diurnal survey schedule.

All data were analysed on a matrix basis, giving total and relative abundance per site and species, as well as species frequencies, species richness per site and reporting rates. Data were then further analysed using similarity matrices, hierarchical cluster analyses and non-metric multidimensional scaling to ascertain groupings in terms of species assemblages for community structure and composition. This would form the basis of the spatial risk rating, along with GIS maps of species richness and avifaunal community sensitivity in terms of red data species.

The data were then used to tabulate and rate avifaunal impact according to the risk matrix provided by WSP Environment and Energy.

## 8.10.3 Findings

### 8.10.3.1 Species records

Table 36 shows species recorded during the winter surveys for this study and whether the species reflected in the SABAP2 data for the pentad 2825_2100 (only one SABAP2 atlas card has been submitted for the whole zone, in July 2011, refer Figure 35). An illustration of the Van Roois Vley site relative to the SABAP2 pentads is shown in Figure 35.

Table 36 shows the total species list for all species recorded at Van Roois Vley, in both the current winter survey and the previous SABAP2 surveys. The table also indicates the national red data list status of each species.

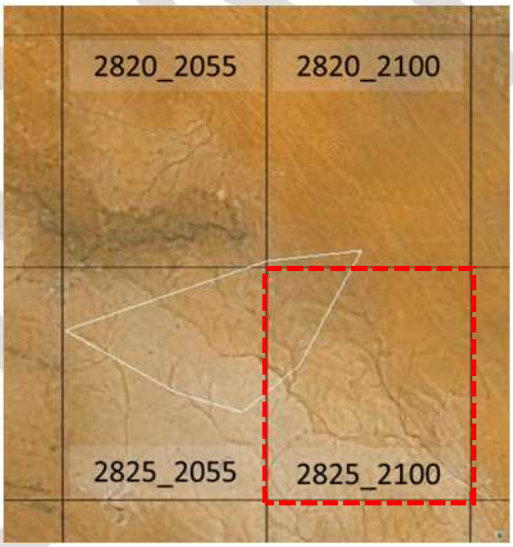



**Figure 35: Van Roois Vley site relative to the SABAP2 pentads**

**Table 36: List of species recorded during summer and winter surveys at Van Roois Vley, with SABAP2 cross-reference data for those species.**

| No | English Name | Genus | Species | Status | SABAP2 | Van Roois Vley |
|---|---|---|---|---|---|---|
| | | | | | *2825_2100* | *Winter 2012* |
| **1** | Acacia Pied Barbet | *Tricholaema* | *leucomelas* | Least concern | 1 | 1 |
| **2** | African Red-eyed Bulbul | *Pycnonotus* | *nigricans* | Least concern | | 1 |
| **3** | African pipit | *Anthus* | *cinnamomeus* | Least concern | 1 | |
| **4** | Ant-eating Chat | *Myrmecocichla* | *formicivora* | Least concern | | 1 |
| **5** | Black-chested Prinia | *Prinia* | *flavicans* | Least concern | 1 | 1 |
| **6** | Black-eared Sparrow-Lark | *Eremopterix* | *australis* | Least concern | | 1 |
| **7** | Blacksmith Lapwing | *Vanellus* | *armatus* | Least concern | 1 | 1 |
| **8** | Black-throated Canary | *Crithagra* | *atrogularis* | Least concern | | 1 |
| **9** | Black-winged stilt | *Himantopus* | *himantopus* | Least concern | 1 | |
| **10** | Bokmakierie | *Telophorus* | *zeylonus* | Least concern | 1 | 1 |
| **11** | Brubru | *Nilaeus* | *afer* | Least concern | | 1 |
| **12** | Cape Penduline Tit | *Anthoscopus* | *minutus* | Least concern | | 1 |
| **13** | Cape Sparrow | *Passer* | *melanurus* | Least concern | 1 | 1 |
| **14** | Cape wagtail | *Motacilla* | *capensis* | Least concern | 1 | |
| **15** | Cattle egret | *Bubulcus* | *ibis* | Least concern | 1 | |
| **16** | Chestnut-vented titbabbler | *Parisoma* | *subcaeruleum* | Least concern | 1 | 1 |
| **17** | Capped Wheatear | *Oenanthe* | *pileata* | Least concern | | 1 |
| **18** | Chat Flycatcher | *Bradornis* | *infuscatus* | Least concern | 1 | 1 |
| **19** | Common Fiscal | *Lanius* | *collaris* | Least concern | 1 | 1 |
| **20** | Common ostrich | *Struthio* | *camelus* | Least concern | 1 | |
| **21** | Desert Cisticola | *Cisticola* | *aridulus* | Least concern | 1 | 1 |
| **22** | Dusky Sunbird | *Cinnyris* | *fuscus* | Least concern | | 1 |
| **23** | Eastern Clapper Lark | *Mirafra* | *fasciolata* | Least concern | 1 | 1 |
| **24** | Egyptian Goose | *Alopochen* | *aegyptiaca* | Least concern | | 1 |
| **25** | Familiar chat | *Cercomela* | *familiaris* | Least concern | 1 | |
| **26** | Fawn-coloured Lark | *Calendulauda* | *africanoides* | Least concern | 1 | 1 |
| **27** | Greater Kestrel | *Falco* | *rupicoloides* | Least concern | 1 | 1 |
| **28** | House sparrow | *Passer* | *domesticus* | Least concern | 1 | |

| No | English Name | Genus | Species | Status | SABAP2 | Van Roois Vley |
|---|---|---|---|---|---|---|
| **29** | Kalahari scrub-robin | *Cercotrichas* | *paena* | Least concern | 1 | 1 |
| **30** | Karoo Korhaan | *Eupodotis* | *vigorsii* | Least concern | 1 | 1 |
| **31** | Karoo Scrub Robin | *Erythropygia* | *coryphaeus* | Least concern | | 1 |
| **32** | Kori Bustard | *Ardeotis* | *kori* | Vulnerable | | 1 |
| **33** | Lanner falcon | *Falco* | *biarmicus* | Near-threatened | 1 | |
| **34** | Lark-like Bunting | *Emberiza* | *impetuani* | Least concern | | 1 |
| **35** | Laughing Dove | *Stigmatopelia* | *senegalensis* | Least concern | | 1 |
| **36** | Layard's Tit-babbler | *Parisoma* | *layardi* | Least concern | | 1 |
| **37** | Little grebe | *Tachybaptus* | *ruficollis* | Least concern | 1 | |
| **38** | Longbilled crombec | *Sylvietta* | *rufescens* | Least concern | 1 | 1 |
| **39** | Ludwig's Bustard | *Neotis* | *ludwigii* | Vulnerable | | 1 |
| **40** | Namaqua dove | *Oena* | *capensis* | Least concern | 1 | |
| **41** | Mountain Wheatear | *Oenanthe* | *monticola* | Least concern | | 1 |
| **42** | Namaqua Sandgrouse | *Pterocles* | *namaqua* | Least concern | 1 | 1 |
| **43** | Northern Black Korhaan | *Afrotis* | *afraoides* | Least concern | 1 | 1 |
| **44** | Pale Chanting Goshawk | *Melierax* | *canorus* | Least concern | 1 | 1 |
| **45** | Pied Crow | *Corvus* | *albus* | Least concern | 1 | 1 |
| **46** | Pink-billed Lark | *Spizocorys* | *conirostris* | Least concern | | 1 |
| **47** | Pririt Batis | *Batis* | *pririt* | Least concern | | 1 |
| **48** | Pygmy Falcon | *Polihierax* | *semitorquatus* | Least concern | | 1 |
| **49** | Red-billed Quelea | *Quelea* | *quelea* | Least concern | 1 | 1 |
| **50** | Red-capped Lark | *Calandrella* | *cinerea* | Least concern | | 1 |
| **51** | Rock kestrel | *Falco* | *rupicollis* | Least concern | 1 | |
| **52** | Rufous-eared Warbler | *Malcorus* | *pectoralis* | Least concern | 1 | 1 |
| **53** | Sabota Lark | *Calendulauda* | *sabota* | Least concern | 1 | 1 |
| **54** | Scaly-feathered Finch | *Sporopipes* | *squamifrons* | Least concern | 1 | 1 |
| **55** | Stark's Lark | *Eremalauda* | *starki* | Least concern | | 1 |
| **56** | Secretarybird | *Saggitarius* | *serpentarius* | Near-threatened | 1 | |
| **57** | Sociable Weaver | *Philetairus* | *socius* | Least concern | 1 | 1 |
| **58** | South African Shelduck | *Tadorna* | *cana* | Least concern | 1 | 1 |
| **59** | Southern Masked Weaver | *Ploceus* | *velatus* | Least concern | 1 | 1 |

| No | English Name | Genus | Species | Status | SABAP2 | Van Roois Vley |
|---|---|---|---|---|---|---|
| **60** | Southern Red Bishop | *Euplectes* | *orix* | Least concern | 1 | 1 |
| **61** | Spike-heeled Lark | *Chersomanes* | *albofasciata* | Least concern | 1 | 1 |
| **62** | Steppe buzzard | *Buteo* | *vulpinus* | Least concern | 1 | |
| **63** | Tractrac chat | *Cercomela* | *tractrac* | Least concern | | 1 |
| **64** | White-backed mousebird | *Colius* | *colius* | Least concern | | 1 |
| **65** | White Stork | *Ciconia* | *ciconia* | Least concern | | 1 |
| **66** | Yellow Canary | *Crithagra* | *flaviventris* | Least concern | 1 | 1 |
| **67** | Yellow-bellied Eremomela | *Eremomela* | *icteropygialis* | Least concern | 1 | 1 |
| **TOTALS** | | | | | 43 | 54 |

A total of 54 species were recorded on site during this winter survey. 50 of these species were recorded during structured line-transect surveys and a further four (South African Shelduck, Pygmy falcon, Mountain wheatear, African red-eyed bulbul) were recorded incidentally whilst on site. Adding the 43 species that were recorded during the SABAP2 survey brings the total list to 67 species, although there was only an overlap of 30 species, thus 45%.

Although the Pentad 2825_2100 is larger than the Van Roois Vley site, which only partially falls within a small section of the pentad, the species lists should be expected to have higher overlap. Looking at the species present, it is evident that the SABAP2 list has more wetland-associated species, indicating that additional wetland habitats were surveyed within the wider pentad, or that conditions during the survey period in 2011 had higher levels of surface water. Furthermore, the 2012 winter survey data contain more of the cryptic and harder to identify species that did not make it onto the SABAP2 list where survey effort was far lower. Nevertheless, the area of the SABAP2 pentad that overlays the portion of the Van Roois Vley site that falls within it is particularly interesting in that it is the preferred location for the CSP/PV infrastructure.

Four species of conservation significance (using red data book protocol) were confirmed on site. These are Lanner falcon (near-threatened), Secretary bird (near-threatened), Kori bustard (vulnerable) and Ludwig's bustard (vulnerable).

#### 8.10.3.2 Winter 2012 surveys

The winter 2012 surveys, in the form of line transects as described in the methodology, were successfully completed. A total of 25 line transects were undertaken (see Figure 36 for a map of line transect localities and the habitat type-spread of surveys, as well as Table 37), recording a total of 50 species confirmed within the proposed CSP/CPV site boundaries. There was reasonably low variability between transects once sufficient data had been collected. Figure 37 shows the resultant species-area curve and indicates that after about 7 surveys, the rate of new species were recorded slowed down dramatically and stopped altogether after 22 line transects. This is confirmed by the relatively low average species richness of 11.72 species per survey.

**Table 37: Details of habitat types surveyed, with cross-reference of sample sites per habitat.**

| No. | Site | Habitat type |
|---|---|---|
| **1** | VRV1 | Grassland with karroid shrubs |
| **2** | VRV2 | Grassland with karroid shrubs and kalahari scrub |
| **3** | VRV3 | Grassland with karroid shrubs |

| No. | Site | Habitat type |
|---|---|---|
| **4** | VRV4 | Drainage line with grassland and woody species |
| **5** | VRV5 | Grassland with karroid shrubs, gravelly |
| **6** | VRV6 | Drainage line with grassland and woody species |
| **7** | VRV7 | Grassland with karroid shrubs, gravelly |
| **8** | VRV8 | Grassland with karroid shrubs |
| **9** | VRV9 | Grassland with karroid shrubs |
| **10** | VRV10 | Grassland with karroid shrubs |
| **11** | VRV11 | Grassland with karroid shrubs |
| **12** | VRV12 | Grassland with karroid shrubs |
| **13** | VRV13 | Grassland with karroid shrubs and kalahari scrub |
| **14** | VRV14 | Grassland with karroid shrubs |
| **15** | VRV15 | Drainage line with grassland and woody species |
| **16** | VRV16 | Grassland with karroid shrubs and kalahari scrub |
| **17** | VRV17 | Grassland with karroid shrubs |
| **18** | VRV18 | Grassland with karroid shrubs, gravelly |
| **19** | VRV19 | Grassland with karroid shrubs, gravelly |
| **20** | VRV20 | Grassland with karroid shrubs, gravelly |
| **21** | VRV21 | Grassland with karroid shrubs, gravelly |
| **22** | VRV22 | Drainage line with grassland and woody species |
| **23** | VRV23 | Grassland with karroid shrubs, gravelly |
| **24** | VRV24 | Grassland with karroid shrubs, gravelly |
| **25** | VRV25 | Grassland with karroid shrubs, gravelly |

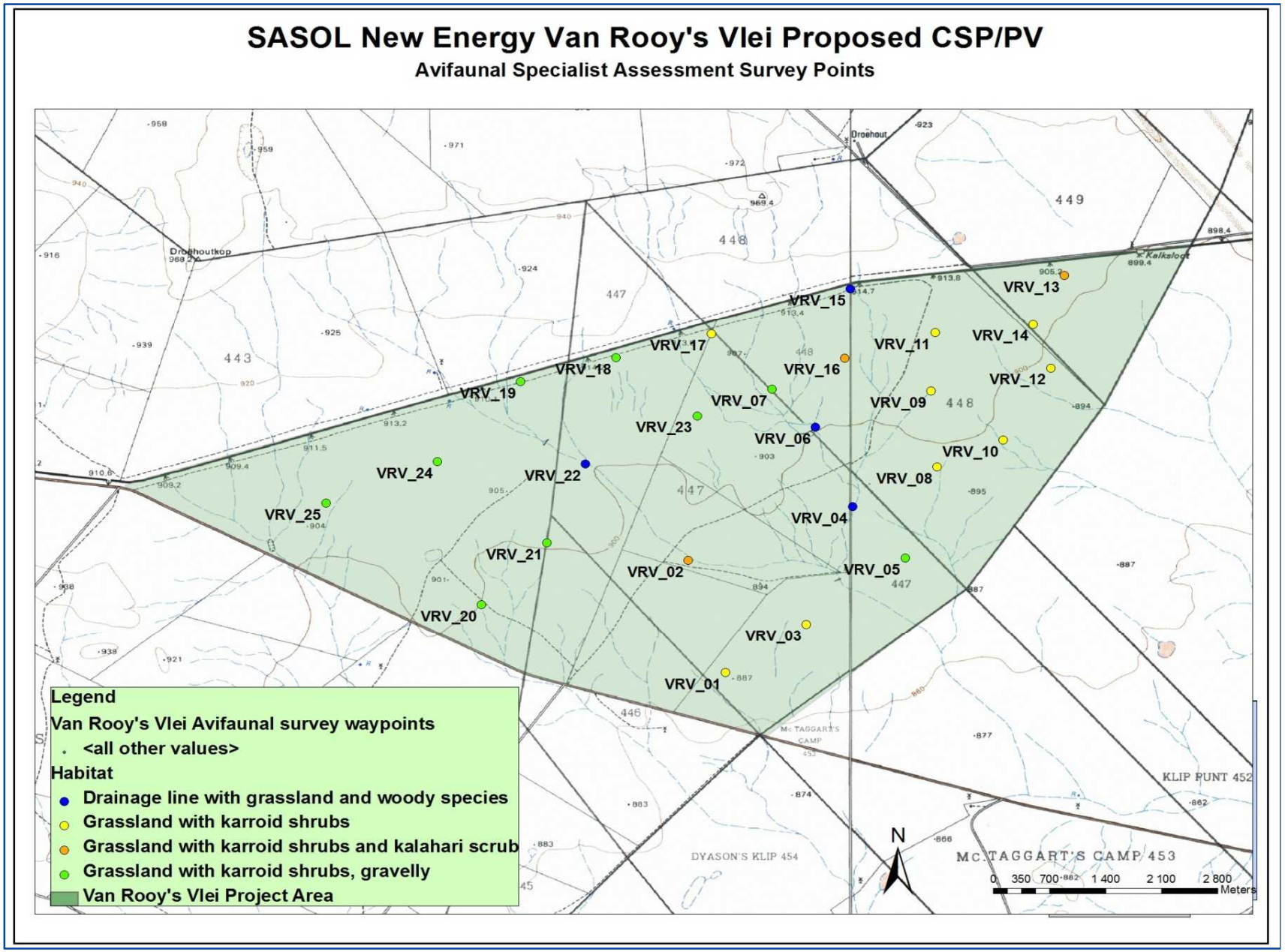



**Figure 36: Map of Van Rooi's Vley CSP/CPV site with boundaries and survey localities. The map also indicates habitat types surveyed**

**Table 38: Bray-Curtis similarity index for all point counts at Van Roois Vley for the winter surveys.**

| | VRV 1 | VRV 2 | VRV 3 | VRV 4 | VRV 5 | VRV 6 | VRV 7 | VRV 8 | VRV 9 | VRV 10 | VRV 11 | VRV 12 | VRV 13 | VRV 14 | VRV 15 | VRV 16 | VRV 17 | VRV 18 | VRV 19 | VRV 20 | VRV 21 | VRV 22 | VRV 23 | VRV 24 | VRV 25 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| VRV1 | | | | | | | | | | | | | | | | | | | | | | | | | |
| VRV2 | 51.1 | | | | | | | | | | | | | | | | | | | | | | | | |
| VRV3 | 49.9 | 36.5 | | | | | | | | | | | | | | | | | | | | | | | |
| VRV4 | 14.7 | 18.1 | 15.0 | | | | | | | | | | | | | | | | | | | | | | |
| VRV5 | 33.0 | 31.8 | 55.4 | 48.1 | | | | | | | | | | | | | | | | | | | | | |
| VRV6 | 13.1 | 19.0 | 35.5 | 37.4 | 42.9 | | | | | | | | | | | | | | | | | | | | |
| VRV7 | 49.1 | 37.0 | 29.8 | 27.2 | 47.7 | 31.1 | | | | | | | | | | | | | | | | | | | |
| VRV8 | 48.8 | 30.6 | 25.8 | 18.0 | 31.9 | 18.4 | 32.5 | | | | | | | | | | | | | | | | | | |
| VRV9 | 37.2 | 23.3 | 32.5 | 26.1 | 25.7 | 22.8 | 51.8 | 23.5 | | | | | | | | | | | | | | | | | |
| VRV10 | 35.3 | 30.0 | 20.9 | 17.8 | 20.1 | 9.2 | 29.2 | 26.4 | 32.3 | | | | | | | | | | | | | | | | |
| VRV11 | 38.1 | 39.2 | 37.2 | 24.2 | 29.0 | 18.9 | 51.5 | 30.8 | 49.7 | 32.3 | | | | | | | | | | | | | | | |
| VRV12 | 27.7 | 28.2 | 34.9 | 26.4 | 30.6 | 19.9 | 38.9 | 21.6 | 30.1 | 9.1 | 30.7 | | | | | | | | | | | | | | |
| VRV13 | 21.2 | 28.8 | 22.0 | 13.0 | 18.3 | 14.2 | 45.0 | 8.0 | 34.5 | 21.0 | 34.1 | 43.1 | | | | | | | | | | | | | |
| VRV14 | 25.0 | 31.2 | 18.6 | 19.6 | 19.9 | 14.4 | 33.5 | 39.1 | 44.0 | 45.4 | 35.2 | 20.7 | 19.5 | | | | | | | | | | | | |
| VRV15 | 42.6 | 41.2 | 28.1 | 19.7 | 23.8 | 16.2 | 40.1 | 16.4 | 28.1 | 25.4 | 31.7 | 41.0 | 43.7 | 19.3 | | | | | | | | | | | |
| VRV16 | 50.9 | 46.4 | 43.3 | 29.6 | 40.5 | 23.3 | 47.1 | 54.6 | 45.6 | 30.1 | 58.2 | 34.7 | 35.1 | 35.0 | 44.2 | | | | | | | | | | |
| VRV17 | 44.5 | 26.2 | 66.9 | 20.9 | 60.1 | 41.7 | 49.8 | 24.7 | 43.0 | 30.7 | 36.5 | 33.0 | 22.9 | 31.4 | 29.0 | 43.2 | | | | | | | | | |
| VRV18 | 33.0 | 23.5 | 30.6 | 28.5 | 34.3 | 21.5 | 59.4 | 31.7 | 45.4 | 27.4 | 48.6 | 46.6 | 43.1 | 25.7 | 38.2 | 50.0 | 39.2 | | | | | | | | |
| VRV19 | 18.5 | 20.3 | 13.8 | 19.6 | 18.2 | 21.6 | 40.4 | 41.9 | 39.3 | 37.0 | 41.7 | 8.6 | 9.8 | 46.0 | 8.0 | 42.9 | 26.4 | 34.2 | | | | | | | |
| VRV20 | 60.0 | 43.1 | 50.4 | 26.5 | 35.6 | 27.0 | 43.4 | 45.0 | 43.8 | 33.3 | 42.8 | 38.3 | 27.4 | 37.2 | 34.3 | 58.4 | 43.5 | 44.4 | 28.2 | | | | | | |
| VRV21 | 69.5 | 49.0 | 51.3 | 20.7 | 38.5 | 22.4 | 57.0 | 43.5 | 46.5 | 47.0 | 42.4 | 36.2 | 25.4 | 34.3 | 45.1 | 56.1 | 50.6 | 44.9 | 28.8 | 72.5 | | | | | |
| VRV22 | 29.7 | 40.1 | 26.7 | 28.6 | 33.9 | 39.1 | 40.4 | 33.4 | 28.3 | 18.4 | 36.6 | 24.5 | 22.6 | 32.8 | 23.4 | 39.5 | 27.1 | 31.4 | 28.6 | 46.8 | 45.0 | | | | |
| VRV23 | 50.8 | 46.1 | 48.7 | 38.1 | 42.2 | 38.9 | 52.1 | 46.4 | 48.5 | 32.1 | 53.3 | 48.9 | 27.1 | 36.7 | 34.5 | 55.9 | 48.2 | 45.3 | 34.7 | 64.8 | 55.8 | 51.3 | | | |
| VRV24 | 56.8 | 26.9 | 45.1 | 24.5 | 33.3 | 21.0 | 58.1 | 38.8 | 58.2 | 41.5 | 47.2 | 33.1 | 21.8 | 40.1 | 36.6 | 47.8 | 56.1 | 46.1 | 34.6 | 60.3 | 74.1 | 41.2 | 53.1 | | |
| VRV25 | 57.3 | 30.2 | 42.0 | 26.9 | 37.2 | 22.3 | 66.3 | 40.0 | 61.6 | 32.4 | 48.1 | 30.1 | 33.3 | 39.9 | 33.2 | 51.8 | 51.7 | 50.5 | 33.5 | 52.6 | 51.8 | 34.2 | 57.4 | 67.5 | |

Table 38 above shows the Bray-Curtis Similarity for species composition across the line transects. The lowest similarity score was 9.2, the highest similarity score was 69.5. This indicates that there are some observable differences between species assemblages at different areas on site. The similarity matrix was used to graphically present the data in the NMDS diagram in Figure 37 below.

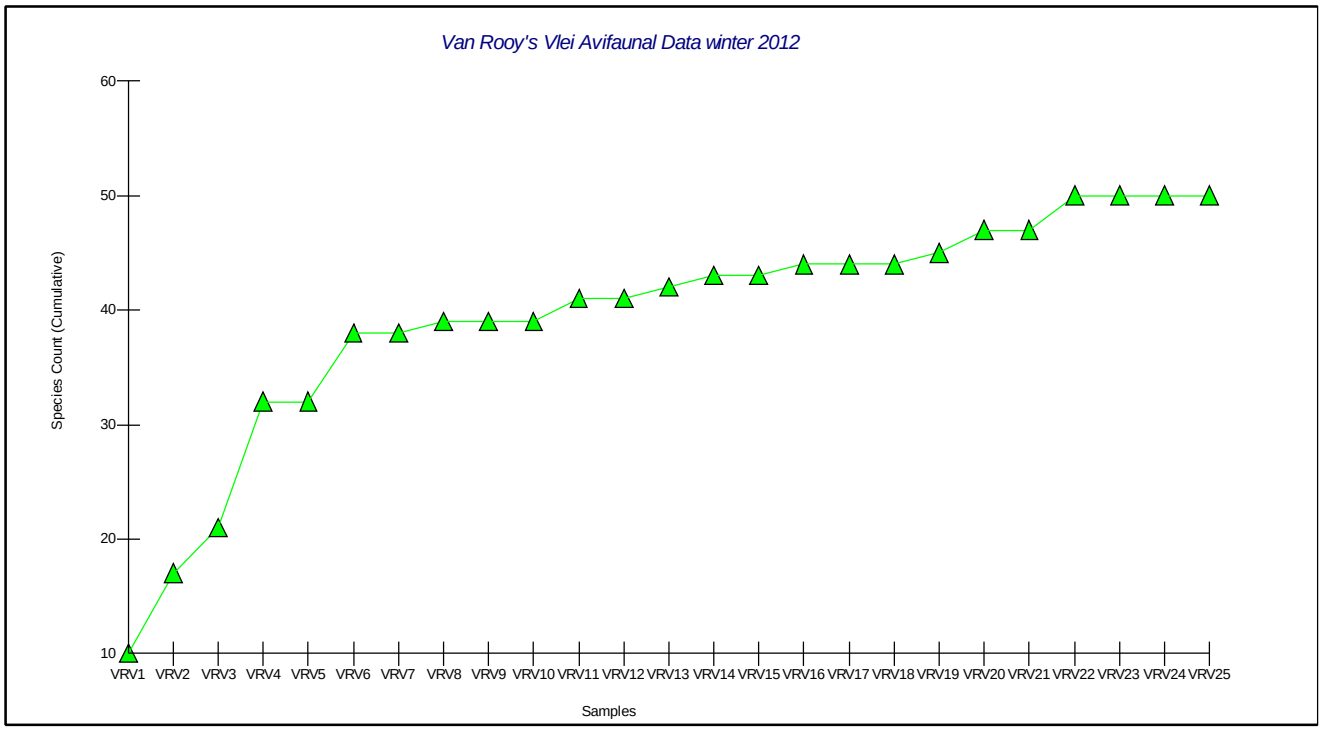



**Figure 37: Species-accumulation curve for the winter surveys showing evenness between survey sites**

Figure 38 shows the NMDS diagram for the avifaunal community, indicating the strength of similarity between line transects and habitats and based on bird species distributions and abundances. The diagram shows that there were differences between the four habitat types but that there was also overlap. Samples from the 'Grassland with Karroid shrubs, gravelly' habitat type clustered towards the centre of the diagram, indicating that they share characteristics with other habitat types. Apart from VRV6 and VRV19 they also had a very tight grouping, indicating high levels of similarity. The 'Grassland with Karroid shrubs and Kalahari scrub' habitat type had a similar tight grouping, although these clustered away from the centre of the diagram, indicating that they had some unique assemblage attributes. Looking at the data, it is evident that these sites had lower numbers of the more common species, as well as low bird numbers overall.

The 'Grassland with karroid shrubs' habitat type had a poor grouping and wider distribution, indicating that there were highly variable species assemblages, as well as variable numbers of birds present. The data confirms this, as large flocks of common species were recorded in some sites but were absent in others. The last habitat type 'Drainage line with grassland and woody species' mostly grouped away from centre and together at the bottom right of the diagram. A notable exception is VRV16. VRV4, VRV8 and VRV22 had species assemblages that were unique to this habitat type, as the woody component provided habitat variability otherwise absent on site. Species richness was high in these sites, far higher than the average for the whole area, and absolute numbers of birds were higher than other sites, resulting in very high diversity index values for both Shannon and Simpson's diversity. Species such as Acacia pied barbet, Brubru, Chestnut-vented titbabbler, Laughing dove, Pririt batis and Southern masked weaver, which were all very uncommon on site, were confined to this habitat type. VRV16 clustered separately and more closely with the 'Grassland with karroid shrubs and Kalahari scrub' due to higher overall bird numbers and higher number of common species. There was also better grassland quality (less overgrazed), resulting in better species diversity.

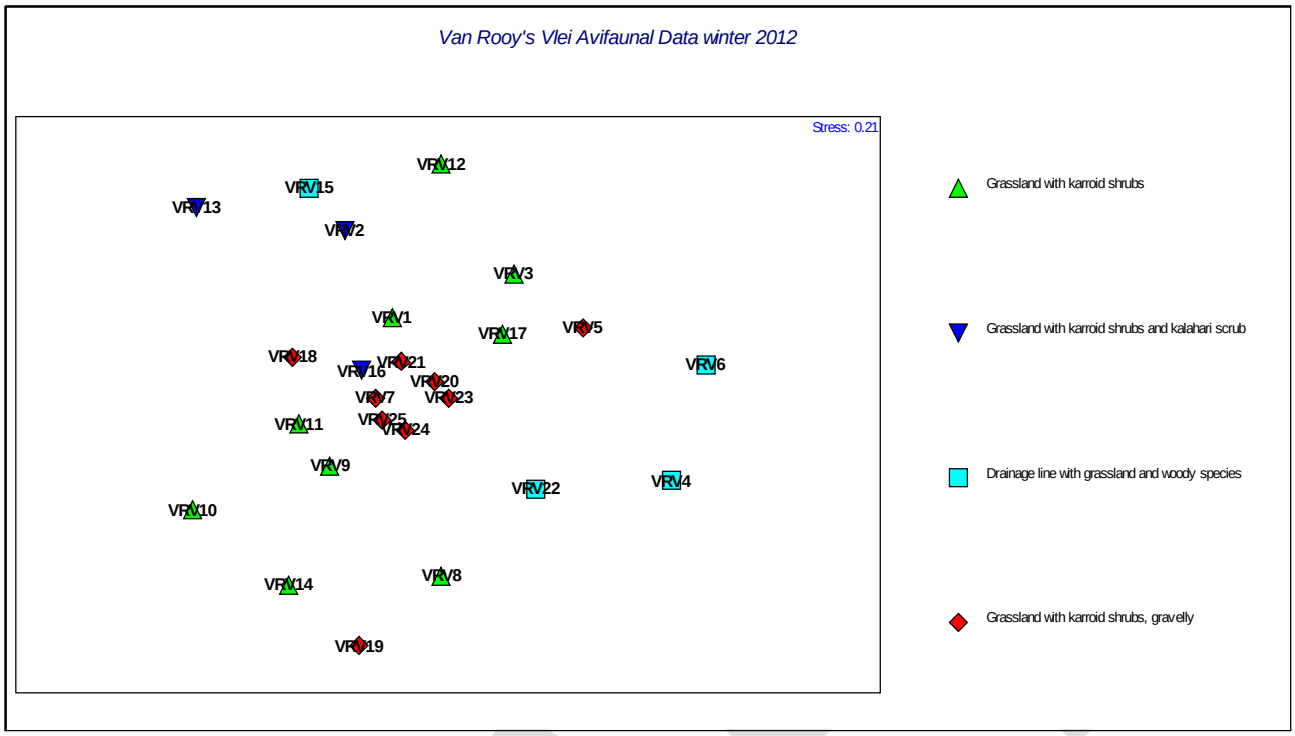



**Figure 38: Non-metric multidimensional scaling (NMDS) diagram of avifaunal assemblages for each sample site and displayed by habitat type.**

**Table 39: Diversity and richness indices for the 2012 winter survey at the Van Roois Vley CSP/CPV site.**

| Index→ | Species richness | No. individuals | Pielou's evenness | Shannon-Wiener diversity | Simpson's diversity |
|---|---|---|---|---|---|
| Site↓ | *S* | *N* | *J'* | *H'(loge)* | *1-Lambda'* |
| **VRV1** | 10 | 38 | 0.863 | 1.987 | 0.849 |
| **VRV2** | 13 | 36 | 0.950 | 2.437 | 0.925 |
| **VRV3** | 11 | 114 | 0.642 | 1.540 | 0.650 |
| **VRV4** | 15 | 216 | 0.501 | 1.356 | 0.631 |
| **VRV5** | 13 | 180 | 0.606 | 1.554 | 0.709 |
| **VRV6** | 23 | 238 | 0.645 | 2.024 | 0.799 |
| **VRV7** | 11 | 26 | 0.932 | 2.235 | 0.914 |
| **VRV8** | 12 | 26 | 0.952 | 2.365 | 0.932 |
| **VRV9** | 8 | 20 | 0.888 | 1.846 | 0.847 |
| **VRV10** | 9 | 15 | 0.932 | 2.049 | 0.914 |
| **VRV11** | 13 | 29 | 0.879 | 2.255 | 0.884 |
| **VRV12** | 5 | 38 | 0.460 | 0.741 | 0.367 |
| **VRV13** | 6 | 11 | 0.916 | 1.642 | 0.855 |
| **VRV14** | 9 | 21 | 0.837 | 1.839 | 0.810 |
| **VRV15** | 9 | 18 | 0.952 | 2.091 | 0.915 |

| Index→ | Species richness | No. individuals | Pielou's evenness | Shannon-Wiener diversity | Simpson's diversity |
|---|---|---|---|---|---|
| **VRV16** | 15 | 38 | 0.948 | 2.568 | 0.937 |
| **VRV17** | 9 | 158 | 0.428 | 0.941 | 0.379 |
| **VRV18** | 7 | 20 | 0.804 | 1.565 | 0.763 |
| **VRV19** | 10 | 17 | 0.947 | 2.181 | 0.926 |
| **VRV20** | 16 | 80 | 0.825 | 2.287 | 0.864 |
| **VRV21** | 13 | 48 | 0.924 | 2.370 | 0.911 |
| **VRV22** | 19 | 107 | 0.849 | 2.501 | 0.895 |
| **VRV23** | 14 | 81 | 0.761 | 2.009 | 0.779 |
| **VRV24** | 12 | 49 | 0.949 | 2.358 | 0.913 |
| **VRV25** | 11 | 38 | 0.854 | 2.047 | 0.858 |

Table 39 shows the number of individuals per transect, absolute species richness, Pielou's Evenness and two indices of species diversity (Shannon-Wiener index and Simpson's D) for the line transects.

Absolute species richness (Table 39) shows the total number of species recorded within any transect. The number varied greatly, with some transects having high species numbers (e.g. VRV6, VRV22) and others had low species numbers (e.g. VRV12, VRV13). Comparing the absolute species richness to the habitat map in Figure 36, there is a slight correlation that suggests that the drainage line habitats have higher species richness, perhaps due to more variable structure provided by the mixture of grasses, shrubs and smaller trees. There certainly were some species, i.e. White-backed mousebird, that were confined to this habitat type. The trend becomes more evident when viewed in the light of Figure 39, which shows the absolute species richness in relative terms. One can clearly see that the northern and north-eastern areas have fewer species than the central area (highest richness as a result of concentration of drainage line habitats) and the southern and south-western area (medium species richness as a result of better quality grassland and gravel plains habitat absent in the north and north-east).

The numbers of birds per transect in Table 39 should be expected to vary greatly, as large, single-species flocks were encountered in some transects and were absent in others. Species occurring in flocks can be seen in Table 36 as Namaqua sandgrouse, Sociable weaver and Scaly-feathered finch. Most other species occurred singly, in pairs or in small groups (<5).

Species Evenness reflects how similar the sites were in terms of their total composition and abundance, thus how equal the avifaunal is in numerical terms. Table 39 also shows Pielou's Evenness, with a value of 0 indicating complete unevenness and a value of 1 indicating complete evenness. Values ranged between 0.43 and 0.95, indicating that there is some variability in the dataset and that birds are not entirely evenly distributed across the site in species composition species richness or relative abundances. Whilst this may sound logical, it is an important result, as it indicates the importance of extensive surveys that adequately cover the spatial variation present in the taxon. The species-accumulation curve in Figure 37 shows that all variation was adequately sampled in temporal space.

The maximum score for the Simpson's Diversity (D) is 1, therefore the nearer to 1 the higher the true diversity of each transect, accounting for the total number of species present, relative to their abundance. Form the Table we can see that true diversity was relatively high with most sites falling above 0.63 (exceptions are VRV12 and VRV17) with a mean of 0.81. VRV17 had very low numbers of birds of few species, apart from a single large flock of Sociable weaver, and VRV12 had very low number so of birds and species, apart from a single large flock of Namaqua sandgrouse.

The Shannon-Wiener (SW) diversity index also attempts to give a true index of diversity by relating the number of species present in relation to the total abundance of all species present. Essentially, it has the same intention as the Simpson Index but expresses the data differently and can be considered a more specialised index. The Shannon-Wiener Index values appear to reflect the situation on site better in this case, as sites with high

species richness and high number of species have ranked higher. For the dataset, the maximum SW index value has been calculated as 3.22, and the minimum value is, as always, 0. Table 4 shows that for most sites the true diversity was >2, thus better than 63%. The only sites lower than this were VRV1, VRV3, VRV4, VRV5, VRV9, VRV12, VRV13, VRV14, VRV17, VRV18. Figure 39 shows a graphic representation of the relative diversity according to the Shannon index and shows only two points with very high diversity, both in the central area and thus within the drainage line habitat type.

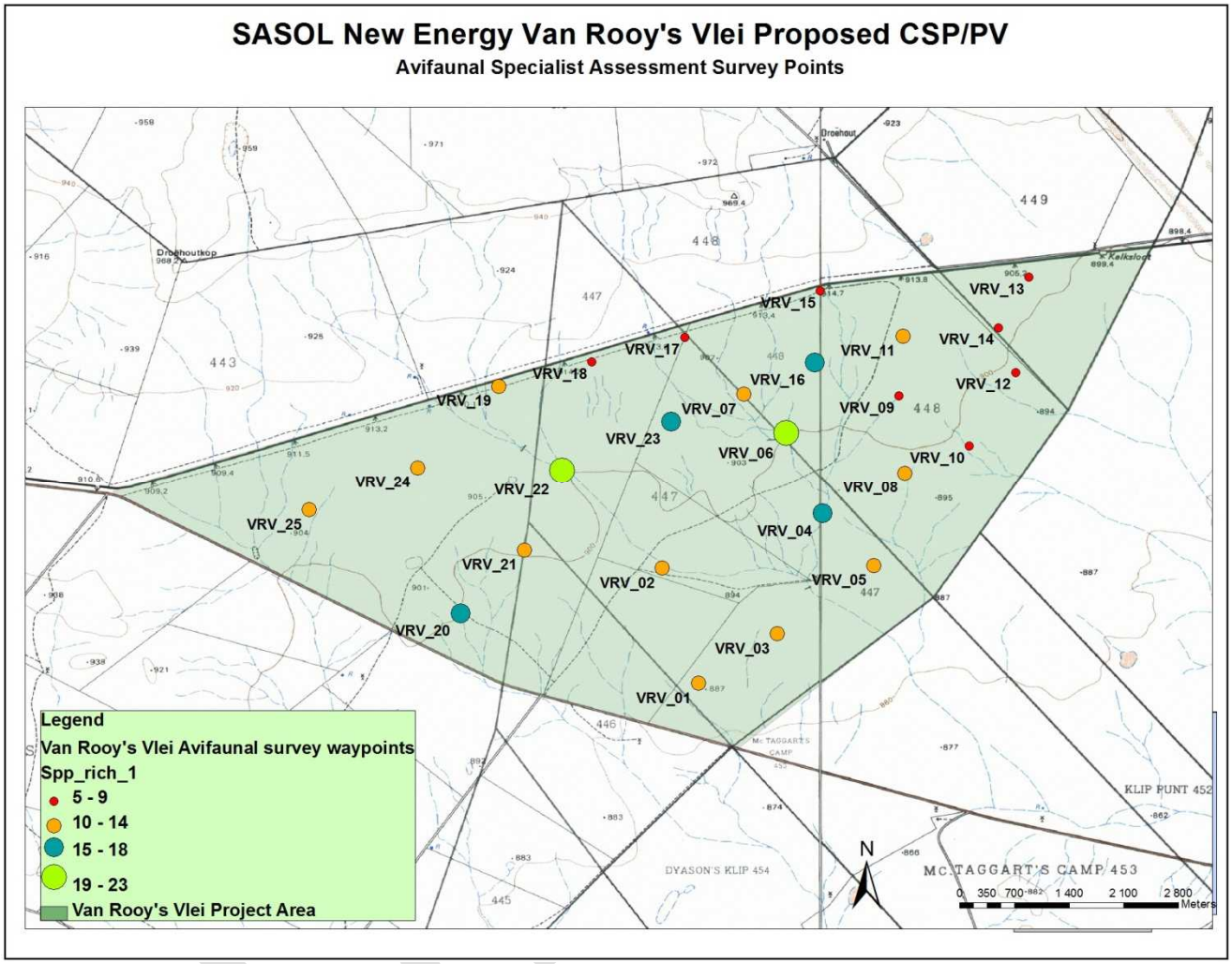



**Figure 39: Absolute avifaunal species richness for each of the sampling sites, expressed in the map as relative icon size and colour. Larger icons represent higher absolute diversity, similarly red=low, grading to green=high.**

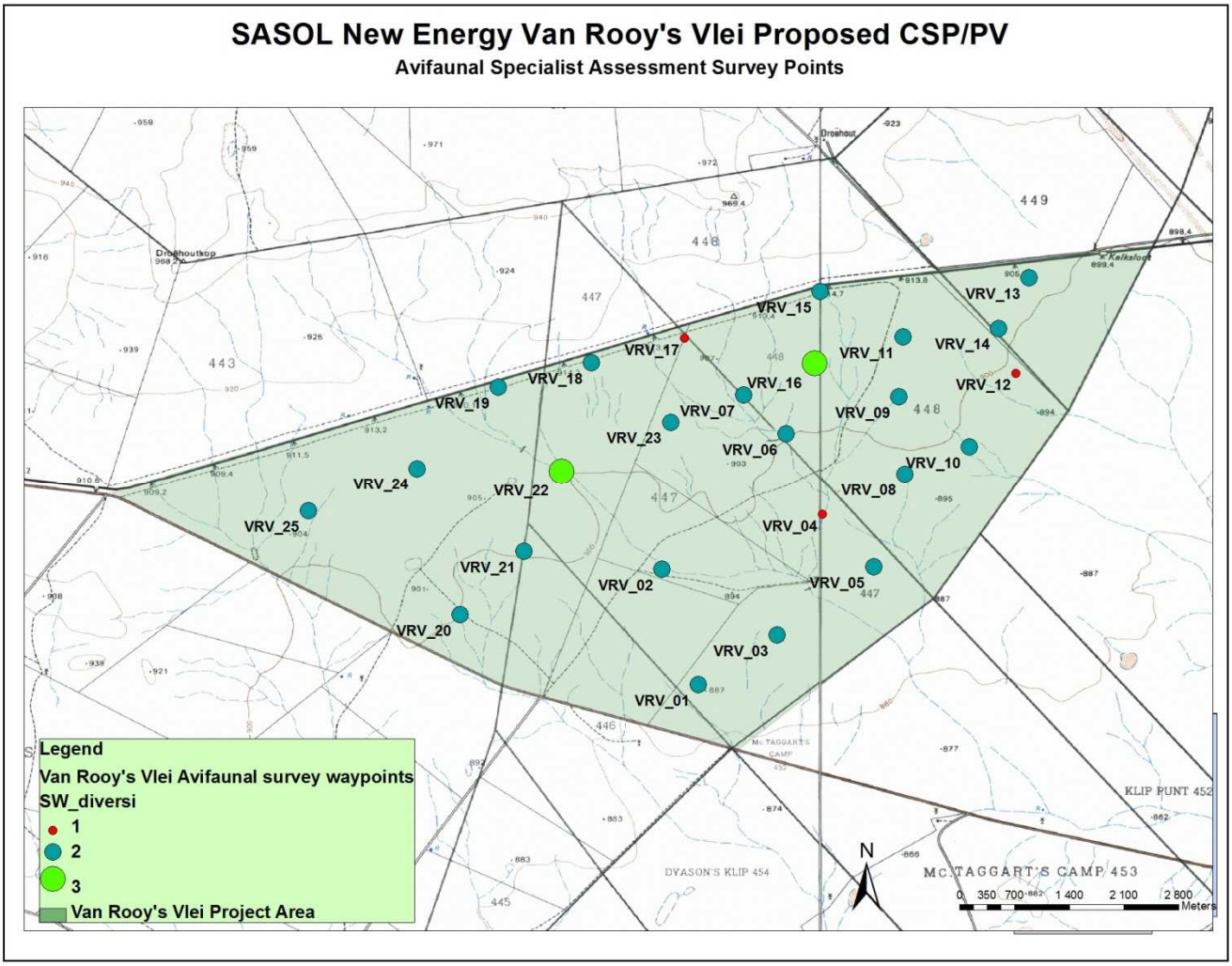



**Figure 40: Shannon-Wiener Index representation for avifaunal species diversity for each of the sampling sites, expressed in the map as relative icon size and colour. Larger icons represent higher absolute diversity, similarly red=low, grading to green=high.**

### 8.10.3.3 Red Data species

The IUCN uses 9 categories of conservation status to apply across taxa. These are summarised in Table 40.

There are other Red Data species that could possibly occur on site, even as vagrants and the likelihood of their occurrence must be assessed. The potential red data species for the Van Roois Vley site, along with probability estimates and notes are presented in Table 41.

**Table 40: IUCN red-list conservation criteria.**

| Category | Description |
|---|---|
| **Extinct** | A taxon is Extinct when there is no reasonable doubt that the last individual has died. A taxon is presumed Extinct when exhaustive surveys in known and/or expected habitat, at appropriate times (diurnal, seasonal, annual), and throughout its historic range have failed to record an individual. Surveys should be over a time frame appropriate to the taxon's life cycle and life form. |
| **Extinct In the Wild** | A taxon is extinct in the wild when it is known only to survive in cultivation, in captivity or as a naturalized population (or populations) well outside the past range. A taxon is presumed extinct in the wild when exhaustive surveys in known and/or expected habitat, at |

| Category | Description |
|---|---|
| | appropriate times (diurnal, seasonal, annual), and throughout its historic range have failed to record an individual. Surveys should be over a time frame appropriate to the taxon's life cycle and life form. |
| **Critically Endangered** | A taxon is critically endangered when the best available evidence indicates that it meets any of the criteria for critically endangered, and it is therefore considered to be facing an extremely high risk of extinction in the wild. |
| **Endangered** | A taxon is endangered when the best available evidence indicates that it meets any of the criteria for endangered, and it is therefore considered to be facing a very high risk of extinction in the wild. |
| **Vulnerable** | A taxon is vulnerable when the best available evidence indicates that it meets any of the criteria for vulnerable, and it is therefore considered to be facing a high risk of extinction in the wild. |
| **Near Threatened** | A taxon is near threatened when it has been evaluated against the criteria but does not qualify for critically endangered, endangered or vulnerable now, but is close to qualifying for or is likely to qualify for a threatened category in the near future. |
| **Least Concern** | A taxon is least concern when it has been evaluated against the criteria and does not qualify for critically endangered, endangered, vulnerable or near threatened. Widespread and abundant taxa are included in this category. |
| **Data Deficient** | A taxon is data deficient when there is inadequate information to make a direct, or indirect, assessment of its risk of extinction based on its distribution and/or population status. A taxon in this category may be well studied, and its biology well known, but appropriate data on abundance and/or distribution are lacking. Data deficient is therefore not a category of threat. Listing of taxa in this category indicates that more information is required and acknowledges the possibility that future research will show that threatened classification is appropriate. |
| **Not Evaluated** | A taxon is not evaluated when it is has not yet been evaluated against the criteria. |

**Table 41: Red Data species that could occur (by distribution) at the proposed Van Roois Vley CSP/CPV site.**

| Species | IUCN status | SA RDB status | Endemic species | Migrant species | Recorded SABAP2 | Recorded Winter 2012 | Likelihood of occurrence at Van Roois Vley |
|---|---|---|---|---|---|---|---|
| **Ludwig's bustard** | Endangered | Vulnerable | No | No | No | Yes | Confirmed |
| **Secretary bird** | Vulnerable | Near-threatened | No | No | Yes | No | Confirmed |
| **Martial eagle** | Near-threatened | Vulnerable | No | No | No | No | Moderate- very scarce in the area outside of protected areas |
| **Kori bustard** | Least concern | Vulnerable | No | No | No | Yes | Confirmed |
| **Tawny eagle** | Least concern | Vulnerable | No | No | No | No | Unlikely, except as vagrant - very scarce in the area outside of protected areas |

| Species | IUCN status | SA RDB status | Endemic species | Migrant species | Recorded SABAP2 | Recorded Winter 2012 | Likelihood of occurrence at Van Roois Vley |
|---|---|---|---|---|---|---|---|
| **Black stork** | Least concern | Near-threatened | No | No | No | No | Unlikely, except as vagrant |
| **Lanner falcon** | Least concern | Near-threatened | No | No | Yes | No | Confirmed |
| **Peregrine falcon** | Least concern | Near-threatened | No | No | No | No | Unlikely, except as vagrant |
| **Sclater's lark** | Least concern | Near-threatened | No | No | No | No | Possible as nomad-habitat suitable |

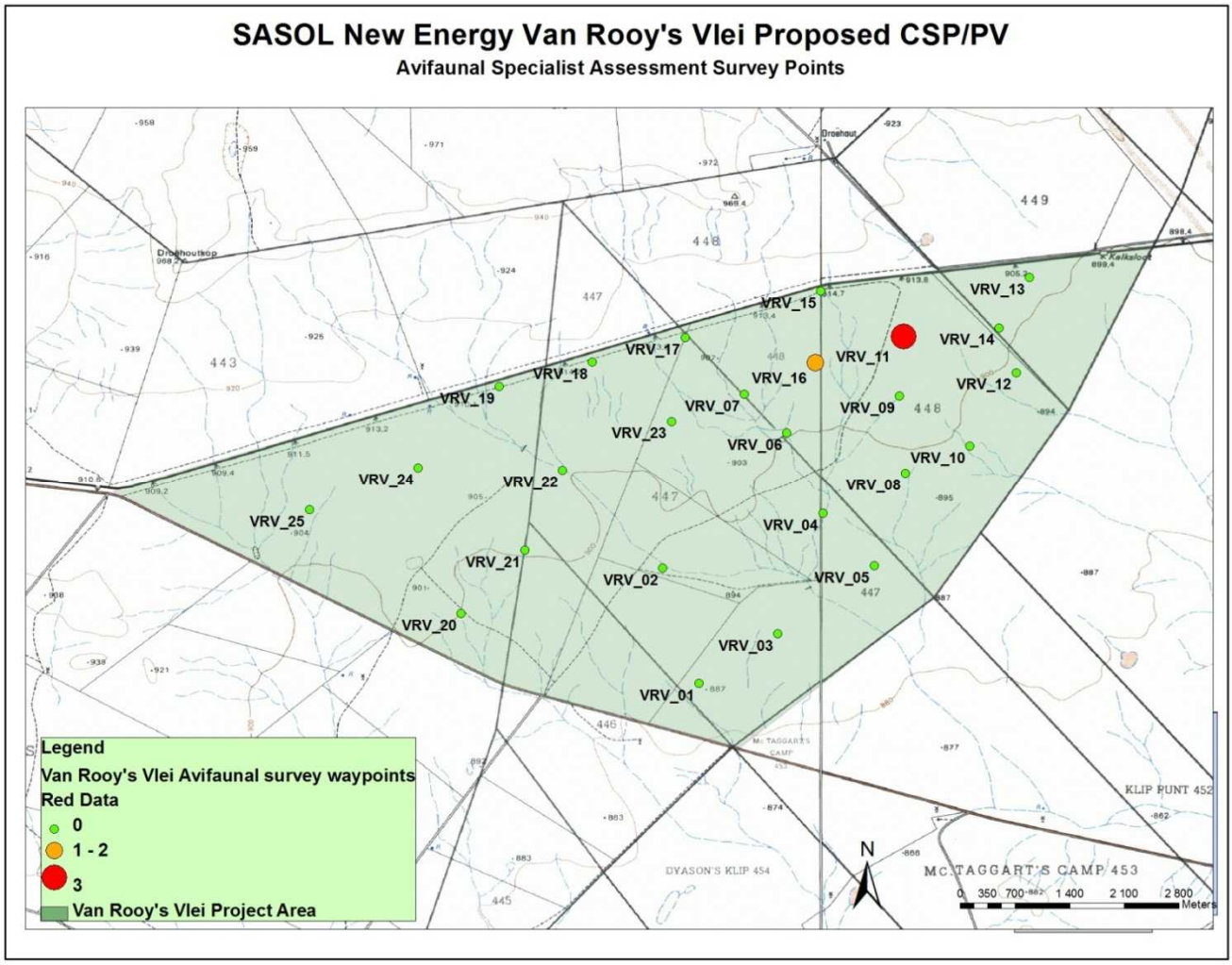



**Figure 41: Location of red data species recorded during Winter 2012 surveys at the Van Rooi's Vley site, indicated by icon size and colour. Larger icons represent increasing numbers of red data species and colour grading: green=none grading to red=many.**

Only 4 of the 9 potential Red Data species that could occur on site have been recorded. These are Ludwig's bustard (Vulnerable, Barnes 2000) and Kori bustard Vulnerable, Barnes 2000), which were recorded during winter 2012 surveys, and Secretarybird (Near-threatened, Barnes, 2000) and Lanner falcon (Near-threatened, Barnes, 2000), which were only recorded during the SABAP2 winter 2011 survey for pentad 2825_2100 (Figure

35). Figure 41 shows the locations of records of Red Data species, with VRV16 having held a pair of Ludwig's bustard and VRV11 having held a single Ludwig's bustard and a pair of Kori bustard. Both of these localities fall within the proposed footprint site for the proposed development but are wide ranging species. Both of these species were also recorded on neighbouring properties between the site and the N14 highway.

From Table 41 above, the following species that have been confirmed as occurring, or have a greater than 50% chance of expected occurrence that have restricted ranges, or are protected by virtue of red data status:

- Lanner falcon- this species was recorded in one of the pentads in which the site falls (2825_2100, Figure 1) and therefore has a very high likelihood of occurrence on site, although it was not observed during the winter 2012 surveys and will have a low degree of residency, particularly if breeding nearby. It does have fairly large home ranges and the study site may thus occur within the home range of a pair or be on the boundary of two or perhaps three pairs. It is a partial migrant, with dispersal of young birds into the Karoo regions in summer. It favours open country and has a national population estimate of 9000-18000 pairs (cited by Kenkins, 2005). Its IUCN and Red Data status is Near-threatened. The CSP/CPV development will have a low specific impact on this species, but the cumulative impact of sustained habitat loss at a regional scale is detrimental.
- Secretary bird- this species has been recorded for one of the pentads in which the site falls (2825_2100, Figure 1) and therefore has a very high likelihood of occurrence on site, although it was not observed during the winter 2012 surveys. It has been classified as Near-threatened (Barnes, 2000) and is thought to be undergoing substantial local population declines. Secretary birds are endemic to Sub-Saharan Africa and are non-migratory, though they may follow food sources as dictated by temporal availability and although they may be resident in a given area, they are certainly not sedentary. The Northern Cape population is very small, with an estimated 130 individuals in the nearby Kgalagadi Transfrontier Park (Dean and Simmons, 2005). Secretary birds prefer open grasslands, savannah and shrubland, which assist their foraging habits. They are sensitive to habitat degradation due to overgrazing, bush encroachment, disturbance, and loss of habitat to afforestation and crop cultivation. A significant threat is collision with telephone and power lines. Recent data has seen a constriction of its range and lower reporting rates, which is cause for concern. The proposed CSP/CPV development will impact on this species directly through habitat loss within its home range, as well as the cumulative impact of collisions with electricity transmission infrastructure.
- Kori bustard- this species was recorded on site (2 individuals) for the winter surveys and habitat is highly suitable. This species is listed as Vulnerable in South Africa due to declines in population numbers (Barnes, 2000). Throughout its range the species is locally nomadic, being sparse to locally common and unevenly distributed with the Northern Cape being a stronghold for this species in South Africa, although the regional strongholds are in Botswana and Namibia. South African population estimates are at 2000-5000, with a local example of 100-140 in the Kgalagadi Transfrontier National Park (Allan and Osborne, 2005). The main threats to current populations are habitat loss through overgrazing and conversion of grasslands, poisoning, deliberate snaring, hunting by feral dogs as well as collisions with power lines. Allan and Osborne (2005) cite a study in which 22 individuals were killed through collisions with power lines in a 5 month period along a 10km stretch in the Karoo. The electricity transmission infrastructure associated with the proposed CSP/CPV development is the greatest cumulative threat to this species, although habitat will be lost due to construction of infrastructure.
- Ludwig's bustard- this species is listed as Vulnerable (Barnes, 2000) as recent research has suggested that the population has undergone a very rapid population decline due to collisions with power lines, a trend which is set to continue into the future as successful mitigation measures are yet to be implemented. It is a near-endemic species and has a large range centred on the dry biomes of the Karoo and Namib in southern Africa, being found in the extreme south-west of Angola, western Namibia and in much of South Africa. The global population has been previously estimated at 56,000 to 81,000 individuals (Allan, 2005). The species is nomadic and undertakes partial seasonal migrations, with higher reporting rates during winter months in the Nama-Karoo biome (Allan, 2005) .Collision rates on high voltage transmission lines in the eastern Karoo, for example, have resulted in ca 270 carcasses recorded under 150km of power lines. Given that the extent of power lines in the Karoo is vast and expanding, with already over 250,000 km of lines in place, it is estimated that such collisions alone are already enough to cause a rapid decline in the population and may increase in the future (Taylor, 2010). This threat may be exacerbated as males are more prone to power line collisions than females, which may lead to a reduced effective population size. Further threats include entanglement in jackal-proofed fences, intentional snaring, and unintentional

fatalities in traps set for problem carnivores. The electricity transmission infrastructure associated with the proposed CSP/CPV development is the greatest cumulative threat to this species, although habitat will be lost due to construction of infrastructure.

- Martial eagle- this species is listed as Vulnerable in South Africa (Barnes, 2000) due to population decreases, most notably outside of protected areas. It inhabits open woodland, wooded savannah, bushy grassland, thorn bush and, in southern Africa, more open country and even sub desert, from sea level to 3,000 m but mainly below 1,500 m(Ferguson-Lees & Christie 2001). The availability of nests sites is often a limiting factor concerning this species. The combined population of the Western, Eastern and Northern Cape is estimated at only 100-150 individuals (<1 bird per 5000 km²) and the nearby Kgalagadi Transfrontier Park holds only 32 birds (Simmons, 2005). The species suffers from direct persecution (shooting and trapping) by farmers, indirect poisoning (these two threats by far the most important causes of losses), drowning in sheer-walled reservoirs, electrocution on power poles, and habitat alteration and degradation (BirdLife International Factsheet 2010). Poisoning is largely carried out by a few large-scale commercial farmers, but is also a problem in tribal small-stock farming communities. Reduction in natural prey may lead to an increase in predation on domestic animals which may in turn lead to increased persecution by farmers. A recent study cited by Simmons (2005) showed that in the Karoo, 1 Martial eagle is killed per 2km of 22 kV power line every 2.5 years. The electricity transmission infrastructure associated with the proposed CSP/CPV development is the greatest cumulative threat to this species, although habitat will be lost due to construction of infrastructure.
- Tawny eagle- This species was not recorded on site but has a wide range and is considered marginal for the Van Rooi's Vley area and is only likely to occur as a vagrant. It is uncommon outside of large protected areas and is recorded in the nearby Kgalagadi Transfrontier Park but is absent from the much nearer Augrabies National Park. It is listed as Vulnerable by Barnes (2000) but is not globally listed as a threatened species due to wide African distribution. Threats include persecution by farmers and poisoning. The proposed CSP/CPV development is unlikely to have an impact.
- Peregrine falcon- this species has a wide global distribution and is migratory but the Southern African population consists of the subspecies *Falco peregrinus minor* and is sedentary and territorial. It occurs in the nearby Orange River Gorge at Augrabies National Park and it is localised to the mountainous habitat there. It is considered Near-threatened in South Africa (Barnes, 2000) but is unlikely to occur on site except as a vagrant. It is threatened by collisions with fences and power lines, but the proposed development is unlikely to have any impact on this species.
- Black stork- like the previous species, it has a wide global distribution but in South Africa is considered Near-threatened (Barnes, 2000). It has been recorded in the nearby Augrabies National Park and is strongly associated with mountainous regions and is thus very unlikely to occur on site except as a vagrant. Fatalities due to collisions with overhead cables and power lines have been recorded, but the proposed development is unlikely to have an impact on this species.
- Sclater's lark is listed as Near-threatened (Barnes, 2000). This species is endemic to South Africa and Southern Namibia, its distribution being confined to the Nama-Karoo where it is concentrated in the Northern Cape slightly to the south and north of the study area. Although this species has been reported to move substantially it appears to move within in its core Bushmanland distribution. This species was not detected during the site visit but is notoriously nomadic responding to rainfall events and suitable habitat does exist, as there is a close association with the grass *Enneapogon desvauxii* which is present on site. Sclater's lark's preferred habitat is arid to semi-arid gravely and stony plains with scattered shrubs and grasses on shale soils, and sparse dwarf shrublands on clays. Apart from habitat destruction, this species is unlikely to be affected by the proposed CSP/CPV development and may benefit from water provision in the form of the evaporation pond.

## 8.11 Sites of Archaeological, Cultural and Heritage Significance

### 8.11.1 Introduction

Archaetnos cc was appointed by WSP Environment and Energy to conduct a cultural heritage study for the proposed Sasol CSP Project. The client indicated the area where the proposed development is to take place. The field survey was confined to this area. The Specialist Study is attached as **Appendix 12**.

### 8.11.2 Methodology

#### 8.11.2.1 Survey of literature

A survey of literature was undertaken in order to obtain background information regarding the area. Sources consulted in this regard are indicated in the references (see **Appendix 12**).

#### 8.11.2.2 Field survey

The survey was conducted according to generally accepted heritage impact assessment (HIA) practices and was aimed at locating all possible objects, sites and features of cultural significance in the area of proposed development. If required, the location of any site was determined by means of a Global Positioning System (GPS), while photographs were also taken where needed. The survey was undertaken by a physical survey via off-road vehicle and on foot.

#### 8.11.2.3 Oral histories

People from local communities are interviewed in order to obtain information relating to the surveyed area. It needs to be stated that this is not applicable under all circumstances. When applicable, the information is included in the text and referred to in the references (see **Appendix 12**).

#### 8.11.2.4 Documentation

All sites, objects features and structures identified were documented according to the general minimum standards accepted by the archaeological profession. Co-ordinates of individual localities were determined by means of the GPS. The information was added to the description in order to facilitate the identification of each locality.

#### 8.11.2.5 Evaluation of Heritage sites

The evaluation of heritage sites is done by giving a field rating of each (see Appendix C of the Specialist Study) using the following criteria:

- The unique nature of a site
- The integrity of the archaeological deposit
- The wider historic, archaeological and geographic context of the site
- The location of the site in relation to other similar sites or features
- The depth of the archaeological deposit (when it can be determined or is known)
- The preservation condition of the site
- Uniqueness of the site and
- Potential to answer present research questions.

### 8.11.3 Assumptions and Limitations

The following conditions and assumptions have a direct bearing on the survey and the resulting report:

- Cultural Resources are all non-physical and physical man-made occurrences, as well as natural occurrences associated with human activity (Appendix A of the Specialist Study). These include all sites, structure and artefacts of importance, either individually or in groups, in the history, architecture and archaeology of human (cultural) development. Graves and cemeteries are included in this.
- The significance of the sites, structures and artefacts is determined by means of their historical, social, aesthetic, technological and scientific value in relation to their uniqueness, condition of preservation and research potential. The various aspects are not mutually exclusive, and the evaluation of any site is done with reference to any number of these aspects.
- Cultural significance is site-specific and relates to the content and context of the site. Sites regarded as having low cultural significance have already been recorded in full and require no further mitigation. Sites with medium cultural significance may or may not require mitigation depending on other factors such as the significance of impact on the site. Sites with a high cultural significance require further mitigation (see Appendix C of the Specialist Study).
- The latitude and longitude of any archaeological or historical site or feature, is to be treated as sensitive information by the developer and should not be disclosed to members of the public.
- All recommendations are made with full cognizance of the relevant legislation.
- It has to be mentioned that it is almost impossible to locate all the cultural resources in a given area, as it will be very time consuming. Developers should however note that the report should make it clear how to handle any other finds that might occur. In this particular case the area was very large and the vegetation cover in certain sections reasonably dense, making archaeological visibility difficult.

### 8.11.4 Findings

#### 8.11.4.1 Historical Context

**Stone Age**

The Stone Age is the period in human history when lithic material was mainly used to produce tools (Coertze & Coertze 1996: 293). In South Africa the Stone Age can be divided in three periods. It is important to note that dates are relative and only provide a broad framework for interpretation. The division for the Stone Age according to Korsman & Meyer (1999: 93-94) is as follows:

- Early Stone Age: 2 million – 150 000 years ago
- Middle Stone Age: 150 000 – 30 000 years ago
- Late Stone Age: 40 000 years ago – 1850 - A.D.

This geographical area is not well-known as one containing many prehistoric sites. This may be a result of limited research done in the area. The SAHRA Database does not indicate any sites in the region. The closest sites of heritage significance include:

- The Doornlaagte Early Stone Age archaeological site close to Kimberley;
- The Wonderwerk Cave in the Kuruman Hills to the east;
- Tsantsabane, an ancient specularite working on the eastern side of Postmasburg,
- Doornfontein, specularite working north of Beeshoek, and
- A cluster of important Stone Age sites near Kathu.

Additional specularite workings with associated Ceramic Later Stone Age material and older Fauresmith sites (early Middle Stone Age) are known from Lylyfeld, Demaneng, Mashwening, King, Rust & Vrede, Paling, Gloucester and Mount Huxley (Morris 2005: 3).

The onset of the Middle Stone Age coincided with a widespread demand for coloured or glittering minerals that arose at the time. The intensive collection of such substances soon exhausted surface exposures and led to the quest being extended underground and thus the birth of the mining practice.

Specularite was commonly mined in the Postmasburg area. In 1968 AK Boshier, working in collaboration with P Beaumont, found a number of underground specularite mines on Paling (De Jong 2010: 35). Stone and Iron Age communities mined specularite associated with iron ores for cosmetic purposes at Blinkklipkop, Paling, Gloucester and other farms (De Jong 2010: 41; Snyman 2000: 3).

A number of Stone Age sites and scattered finds of Stone Age material were identified by Küsel et.al. (2009) and Archaetnos near the town of Hotazel and adjacent to the Gamagara River during 2011 (Archaetnos database). Many Middle and Late Stone Age tools have been found by Archaetnos during surveys in the Northern Cape. These sites are located close to Griekwastad, Hotazel. Postmasburg and Kenhardt (www.archaetnos.co.za). On the farm Konkooksies 91 in the Pofadder district, five sites with Middle and Late Stone Age tools were identified (Pelser 2011).

The mentioned Late Stone Age sites are associated with the San people. These people were hunters and gatherers which means that they would have moved around, leaving little trace of their existence. The Sasol CSP project site seems similar to that at the study area mentioned above, indicating that sites are likely to be found at Van Roois Vley.

Rock engraving (rock pecking) sites are known from Beeshoek and Bruce (Morris 2005: 3; Snyman 2000: 3). The latter are associated with the Late Stone Age.

Similar rock peckings were found on the farm Van Roois Vley, but these are on the portion of the farm to the west of the provincial road and these will not be affected by the development as it falls outside of the project area. On these rocks, found in a dry river bed, different animals and geometrical figures are depicted. It includes different depictions of giraffes, an aardvark and animals that could not be identified due to the state of preservation of the peckings (Figure 42, Figure 43 and Figure 44).

As a result of these findings it can be assumed that Stone Age people did settle in the area and utilise the resources. Numerous Middle and Late Stone Age features were identified during the survey.

**Figure 42: Rock pecking of an aardvark**

**Figure 43: Rock pecking showing a geometrical figure (perhaps a picture of a footprint).**

**Figure 44: Rock pecking of two giraffes.**

## Iron Age

The Iron Age is the name given to the period of human history when metal was mainly used to produce metal artefacts (Coertze & Coertze 1996: 346). In South Africa it can be divided in two separate phases according to Van der Ryst & Meyer (1999: 96-98), namely:

- Early Iron Age: 200 – 1000 A.D
- Late Iron Age: 1000 – 1850 A.D

Huffman (2007: xiii) however indicates that a Middle Iron Age should be included as follows:

- Early Iron Age 250: – 900 A.D
- Middle Iron Age 900: – 1300 A.D
- Late Iron Age 1300: – 1840 A.D

No Early or Middle Iron Age sites were identified in the area of study. Iron Age people occupied the central and eastern parts of southern Africa from about 200 A.D., but the San and Khoi remained in the western and southern parts (Inskeep 1978: 126; see also Huffman 2007).

During the Late Iron Age, people stayed in extensive stonewalled settlements, such as the Thlaping capital Dithakong, 40km north of Kuruman. Sotho-Tswana and Nguni societies, the descendants of the Late Iron Age mixed farming communities, found the region already sparsely inhabited by the Late Stone Age Khoisan groups, the so-called 'first people'. Most of them were eventually assimilated by Late Iron Age communities and only a few managed to survive, such as the Korana and Griqua. This period of contact is sometimes known as the Ceramic Late Stone Age and is represented by the Blinkklipkop specularite mine near Postmasburg and finds at the Kathu Pan (De Jong 2010: 36). According to Inskeep (1978: 135) Late Iron Age people made use the area close to the Orange River, albeit briefly, as a result of copper mining in the Northern Cape. No sites indicating Iron Age people were identified on site during the survey.

## Historical Age

The historical age started with the first recorded oral histories in the area, therefore the movement of literate (able to read and write) people into the area. This era may also be referred to as the Colonial era or the recent past. Due to factors such as population growth and a decrease in mortality rates, more people inhabited the country during the recent historical past. Cultural heritage resources from this era are common.

It is important to note that all cultural resources older than 60 years are potentially regarded significant and detailed studies are needed in order to verify significance. Factors to be considered include aesthetic, scientific, cultural and religious value of such resources. Sites include the many historical buildings and structures indicated on the SAHRA database in Kakamas, Kenhardt, Keimoes and Upington. These are associated with the early missionaries, travellers, first white farmers and establishment of towns during the 19th century.

Factors such as population expansion, increasing pressure on natural resources, the emergence of power blocs, attempts to control trade and influx by Griquas, Korana and white communities from the south-west resulted in a period of instability in Southern Africa that began in the late 18th century and effectively ended with the settlement of white farmers in the interior. This period, known as the difaqane or Mfecane, also affected the Northern Cape Province, although at a relatively late stage compared to the rest of Southern Africa. Here, the period of instability, beginning in the mid-1820s, and was triggered by the incursion of displaced refugees associated with the Tlokwa, Fokeng, Hlakwana and Phuting tribal groups (De Jong 2010: 36).

The difaqane coincided with the influx of the interior of South Africa by white traders, hunters, explorers and missionaries. The first traders in the Northern Cape were PJ Truter's and William Somerville's journey of 1801, which reached Dithakong at Kuruman. They were again followed by Cowan, Donovan, Burchell and Campbell and resulted in the establishment of a London Mission Society station near Kuruman in 1817 by James Read (De Jong 2010: 36). During the 1870's William Sanderson, John Ryan and John Ludwig passed through the area close to Postmasburg (Snyman 2000: 3).

The Great Trek of the Boers from the Cape in 1836 brought large numbers of Voortrekkers up to the borders of large regions known as Bechuanaland and Griqualand West, thereby coming into conflict with many Tswana groups and also the missionaries of the London Mission Society. The conflict between Boer and Tswana communities escalated in the 1860s and 1870s when the Korana and Griqua communities became involved and later the British government.

The conflict was mainly centred on land claims by various communities. For decades the western border of the Transvaal Boer republic was unknown. Only through arbitration (the Keate Arbitration), triggered by the discovery of gold at Tati (1866) and diamonds at Hopetown (1867) was part of the western border finally determined in 1871. Ten years later, the Pretoria Convention declared the entire western border, thereby finally excluding Bechuanaland and Griqualand West from Boer domination (De Jong 2010: 36).

The Gariep area was inhabited by the Nama, Bondelswarts, Afrikaners, Koranna and the Griqua. These people utilised the islands in the Orange (Gariep) River and due to their wars the Koranna chief, Klaas Lukas, appealed for the establishment of a mission station at Olyfenhoutsdrift. This led to the Reverend Christiaan Schröder establishing a mission station here in 1871. The buildings at the missionary were erected between 1873 and 1883. These buildings host the museum in the town of Upington (Kalahari-Oranje Museum brochure).

Conflict between the white farmers and the San and Koranna between 1869 and 1879 led to a visit by Sir Thomas Upington to investigate the situation. As a result a police force was stationed here. The Reverend Schröder refused them using the name Olyvenhoutsdrift and therefore the name Upington was used to refer to the police. In 1898 the two areas united under the name Upington (Kalahari-Oranje Museum brochure).

From the 1880's onwards colonial settlement was promoted in the area. Government-owned land was surveyed and divided into farms, which were transferred to farmers. Surveyors were given the task of surveying and naming some of the many farms in this region. These farms were allocated to prospective farmers, but permanent settlement only started in the late 1920s and the first farmsteads were possibly built during this period. The region remained sparsely populated until the advent of the 20th century (De Jong 2010: 36).

During the Rebellion of 1914 (some Afrikaner people against the Government's plan to invade German South-west Africa) a number of people camped on the farm Van Roois Vley. Here, under a camel thorn tree, General Manie Maritz announced his intentions to join the rebellion (Personal communication: A. Vlok). The tree and site (the Rebellion tree) is a declared Provincial Heritage site. It is situated on the farm Van Roois Vley, but on the portion not to be affected by the development (Figure 45 and Figure 54).

One of the rebels, Willem Hendrik Strauss died here. He was originally buried under one of the other trees at the camp site, but his body was exhumed and he was reburied at the Rebellion tree (Personal communication: A. Vlok). The headstone has fallen down and is broken, but it still is legible (Figure 46 and Figure 47).

**Figure 45: The Rebellion tree**


**Figure 46: Close-up view of the headstone.**

**Figure 47: Headstone of the grave of Willem Hendrik Strauss.**

### 8.11.4.2 Site 1

This is a recent historical site that was used for residential purposes. It contains a large refuse midden with indication of material dating back to at least the 1920's. This includes glass, porcelain and metal artefacts. Other features on site include a pile of bricks which seem much more recent (1960's) as well as artefacts scattered over an area of about 50m in diameter (Figure 48).

The permanent settlement of the farm is on the western side of the road. This could therefore only be a non-permanent settlement area, perhaps used by the first farmer before building a house or by some of the farm workers. The site is regarded as having a low cultural significance. It therefore is of a general significance and is given a rating of Grade C (IVC).

This report is seen as ample mitigation and it may therefore be demolished. However it is expected that there will not be a direct impact on the site.

**Figure 48: The refuse midden at site no. 1.**

### 8.11.4.3 Stone Age features (numbers 2-34)

A total number of 33 features dating to the Middle and Late Stone Age were identified. These vary between scatters of stones with only a few stone tools in between to others with a reasonable number of stone tools. It needs to be indicated that none of these had such a large number of stone tools to be called a site.

No Early Stone Age tools were identified. The tools identified all date to either the Middle or the Late Stone Age (Figure 49, Figure 50, Figure 51 and Figure 52). It mostly consists of waste flakes, cores, scrapers and broken points. Most of the tools were made from local volcanic material, but exceptions were notable in tools made from a caramel coloured and shiny volcanic material

**Figure 49: Middle Stone Age artefacts found in the surveyed area.**

**Figure 50: Middle and Late Stone Age artefacts from the surveyed area.**

**Figure 51: Late Stone Age artefacts from the Van Roois Vley. Note the shiny material of the one at the top**

**Figure 52: More Late Stone Age artefacts from the surveyed area. Again note the shiny material of the two artefacts on the top left.**

The Stone Age material is regarded as having a medium cultural significance. There are a reasonably large number of lithic tools in the area making it less unique, but since not much else from this period was recorded in the area it increases the importance. In all the features are of local significance and are given a rating of Grade IIIB (see Appendix C of the Specialist Study). It should be included in the heritage register and may be mitigated.

Some of the areas where the Stone Age artefacts have been found will not be impacted and others will. Some of the features seem to be reasonably close to each other and may therefore constitute a larger open air site. It is therefore recommended that a collection of surface material be made all over the farm before development may continue and that this be reported on to SAHRA. A permit from SAHRA would be required before collection can be done.

One site from the Historical Age and 33 Stone Age occurrences were identified. A nearby historical site (the Rebellion tree) and another Stone Age site (rock peckings) were also identified although outside of the area to be affected (Figure 53 and Figure 54).

The farmer, Mr. Ampie Vlok, who has resided on the farm for more than 40 years, indicated that he does not know of any graves or other historical and prehistorical features on the portion of the farm that was surveyed

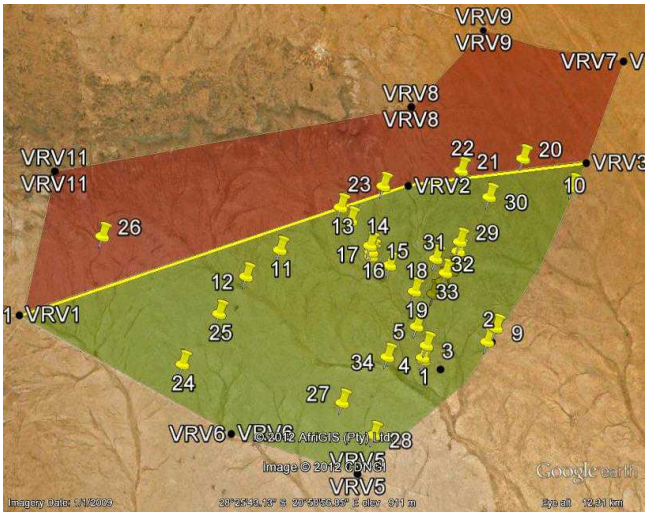



**Figure 53: Google image indicating the GPS points of the sites and features found in the surveyed area.**

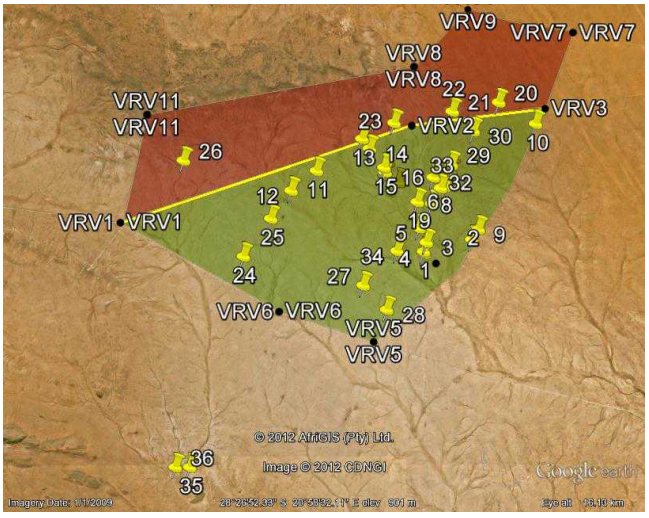



**Figure 54: Google image of the sites and features found during the survey in relation to the two sites identified on the other portion of Van Roois Vley. Number 35 is the Rebellion tree and number 36 the rock peckings.**

Key:

1 – Historical site

2 – 34 – Stone Age occurrences

VRV1 – 11 – Points on project boundary

## 8.12 Aesthetic Environment (visual)

The Van Roois Vley site and surrounding area is generally flat, with low hills and low valleys therefore contributing to high visual quality of the landscape. Being a semi-arid region with low land capabilities, development is concentrated along the Orange River. The Van Roois Vley site falls within the Nama Karoo biome (Mucina and Rutherford, 2006) with a Kalahari Karroid Shrubland vegetation type. Figure 55 illustrates the general landscape of the site. Potentially sensitive visual receptors include:

- National and Regional roads;
- Secondary and minor dirt roads;
- Railway lines; and
- Nearby towns (Upington).

**Figure 55: Typical landscape of Van Roois Vley site**

### 8.12.1 Introduction

VRM Africa was appointed by WSP Environmental to undertake a Visual Impact Assessment (VIA) for the proposed Sasol CSP Facility. The Specialist Study is attached as **Appendix 13**.

### 8.12.2 Methodology

The methodology used for the VIA is based on the United States Bureau of Land Management's (BLM) Visual Resource Management method in that the study involves the measurement of contrast in the form, line, texture and colour of the proposed landscape modification brought about by a project, against the same elements found in the existing natural landscape. The International Finance Corporation (IFC) prescribes eight performance standards (PS) on environmental and social sustainability, the first of which is to identify and evaluate environmental and social risks and impacts of a project, as well as to avoid, minimize or compensate for any such impacts. This is the essence of all impact assessment fields, including visual.

Even though a documented methodology is used, it is important to remember that a VIA differs from most other fields of impact assessment in that, besides the unavoidable subjective human element innate to the assessment practitioner, common to all fields, the assessment subject in VIA is in itself a result of human perception. The visual experience is not limited to the visual senses, but is a multisensory emotional involvement experienced by people when they perceive a specific scene, landmark, landscape, etc. However, objectivity and consistency is greatly increased by using standard assessment criteria such as that utilised.

This emotional enrichment that people experience is a non-material benefit that people obtain from cultural ecosystems services. This includes the following, amongst others:

- Inspiration: Ecosystems provide a rich source of inspiration for art, folklore, national symbols, architecture, and advertising;
- Aesthetic values: Many people find beauty or aesthetic value in various aspects of ecosystems, as reflected in the support for parks, scenic drives, and the selection of housing locations;
- Sense of place: Many people value the "sense of place" that is associated with recognized features of their environment, including aspects of the ecosystem;
- Cultural heritage values: Many societies place high value on the maintenance of either historically important landscapes ("cultural landscapes") or culturally significant species; and
- Recreation and ecotourism: People often choose where to spend their leisure time based in part on the characteristics of the natural or cultivated landscapes in a particular area.

One of the objectives of IFC Performance Standard 6 is to maintain the benefits from ecosystem services. Ecosystem services are organised into four types, with visual/aesthetic benefits falling into the category of cultural services, which are the nonmaterial benefits people obtain from ecosystems, as discussed above. The VIA method used aims to protect the integrity of the landscape character that a proposed project will impact on, in order to sustain visual resources for future benefit to, and utilisation by, people. This resonates with IFC Performance Standard 8 that recognises the importance of cultural heritage for current and future generations. Its objective is to protect cultural heritage from adverse impacts of project activities and promote equitable sharing of benefits gained from the use thereof.

The first step in the VIA process is determining the existing landscape context. A regional landscape survey is undertaken, which identifies defining landscape features that surround the site of a proposed development. These features, also referred to as visual issues, are assessed for their scenic quality/worth. Also assessed is to what degree people who make use of these locations (e.g. a nearby holiday resort), would be sensitive to change(s) in their views, brought about by a proposed project.

The landscape character of the proposed project site is then surveyed to identify areas of similar land use and landscape character. These areas are then evaluated in terms of scenic quality (landscape significance) and receptor sensitivity to landscape change (of the site) in order to define the visual objective for the project site. The overall objective is to maintain a landscape's integrity, but this can be achieved at varying levels. The areas identified on site are categorised into Classes by using a matrix from the BLM Visual Resource Management method, which is then represented in a visual sensitivity map.

Proximity to surrounding receptors is evaluated in terms of distance buffers (foreground up to 6km, background from 6 to 24km, and seldom seen due to no receptors) and viewshed maps are generated that indicate the overall areas where the project activities would be visible, and shows in which distance buffers receptors fall.

The proposed project activities are then finally assessed from the key observation points (KOP) around the site to see whether the visual objectives defined for the site, are met in terms of measuring the potential change to the site's form, line, colour and texture visual elements, as a result of the proposed project. Photo montages are

generated to represent the expected change in the views, as seen from each KOP and, if Class objectives are not met, to also show how proposed mitigation measures could improve the same views.

Using the impact assessment method provided by the environmental consultant, each project activity is assessed for its visual impact. This is based on the contrast rating which was undertaken from each of the surrounding receptors on whether the proposed activities meet the recommended visual objectives defined to protect the landscape character of the area. Recommendations are made and mitigations are provided.

### 8.12.3 Assumptions and Limitations

- Although every effort to maintain accuracy was undertaken, as a result of the Digital Elevation Model (DEM) being generated from satellite imagery and not being a true representation of the earth's surface, the viewshed mapping is approximate and may not represent an exact visibility incidence.
- The use of Google Earth Pro for mapping is licensed for use in this document.
- The information for the terrain used in the 3D computer model on which the visibility analysis is based on:
  - The ASTGTM_S2 3E014 and ASTGTM_S24E014 data set. ASTER GDEM is a product of METI and NASA (ASTER, Source: https://lpdaac.usgs.gov).
  - South African Provincial Survey General data.
- In the absence of specific provincial regulations for Visual Impact Assessment, reference has been made to the Western Cape Department of Environmental Affairs and Development Planning's *"Guideline for involving visual and aesthetic specialists in EIA processes"*.
- Determining visual resources is a subjective process where absolute terms are not achievable. Evaluating a landscape's visual quality is complex, as assessment of the visual landscape applies mainly qualitative standards. Therefore, subjectivity cannot be excluded in the assessment procedure (Lange 1994). The project deliverables, including electronic copies of reports, maps, data, shape files and photographs, are based on the author's professional knowledge, as well as available information. The study is based on assessment techniques and investigations that are limited by time and budgetary constraints applicable to the type and level of assessment undertaken. VRM Africa reserves the right to modify aspects of the project deliverables if, and when, new/additional information may become available from research or further work in the applicable field of practice, or pertaining to this study.

### 8.12.4 Findings

The Visual impact Assessment was undertaken through an analysis of the following aspects:

- Regional Scenic Quality: The inherent sensitivity of the landscape, which is usually determined by a combination of topography, land form, vegetation cover and settlement pattern
- Extent: Geographical area of influence
- Visual Exposure: Degree of exposure to receptors
- Site Visual Absorption Capacity: Potential of landscape to conceal
- Site Scenic Quality: The inherent sensitivity of the landscape, which is usually determined by a combination of topography, land form, vegetation cover and settlement pattern
- Visual Sensitivity of Receptors The level of visual impact considered acceptable is dependent on the type of receptors
- Visual Intrusion: Congruence of the project with the particular qualities of the area, or its 'sense of place'

The findings of the assessment is summarised below and represented from Table 42 to Table 49.

### 8.12.4.1 Regional Landscape Survey

The project is situated in the Southern Kalahari, which is an arid area of mainly flat plains, north-west and west of the Orange River. The proposed farm site is currently zoned for agriculture. The landscape is sparsely vegetated with predominantly Kalahari Karroid Shrubland, and to the north is Bushmanland arid grasslands. Key tourism features in the area include the Augrabies Falls National Park (60km south-west), the Kgalagadi Transfrontier Park (220km north) and the Orange River (20km south).

A broad brush regional landscape survey was undertaken, which identified core features in the surrounding area that define the landscape context and sets the scene for the VIA process to follow. During the field study, six significant landscapes issues were defined in the context of both the site and the surrounding areas. The significant surrounding landscape issues identified during the field survey that are associated with the proposed site are listed and mapped below:

- L1: Orange River valley
- L2: View corridors
- L3: Rocky hills to the south-west
- L4: Isolated farmsteads
- L5: Rock quarry
- L6: Railway line

**Table 42: Regional Scenic Quality Findings**

| **Regional Scenic Quality** | The inherent sensitivity of the landscape, which is usually determined by a combination of topography, land form, vegetation cover and settlement pattern<br>**High (H) : highly visible and potentially sensitive areas in the landscape.**<br>**Moderate (M) : moderately visible areas in the landscape.**<br>**Low (L) : minimally visible areas in the landscape.** |
|---|---|
| **Moderate to High** | Within the region surveyed, land form was mostly flat or slightly undulating, semi-arid region with two main vegetation types which lowers the scenic quality. The Orange River area, however, is more thickly vegetated and is associated with a vineyard cultural landscape and more interesting terrain. As a water feature, the Orange River is a core element in the landscape and the overall scenic quality for this area is high. The region is associated with tourism and as such, roads have view corridor status. The rock quarry, located approximately 4km to the north-west of the site, is the only regional limitation to scenic quality and has a two to four kilometre zone of visual influence which is noticeable to the N10 receptors. |

### 8.12.4.2 Potential Glare Impacts

In terms of understanding the glare impacts of the Sasol CSP project, reference has been made to the USA Ivanpah Solar Electric Commission Generating System Traffic and Transportation Study by Jason Ricks and James Jewell in the Final Staff Assessment and Draft Environmental Impact Statement (BLM California Energy 2009).

The following key findings were documented:

- The proposed project, particularly the solar receiver units atop the solar power towers, would generate conspicuously bright levels of glare;
- While not representing a hazard, it could represent a strong, visually dominant feature as seen from the viewpoints;
- It could strongly alter the character of views of from the valley floor, interfering with the public's ability to enjoy those views;
- Solar radiation and light reflected from proposed project heliostats could cause a significant human health and safety hazard to observers in vehicles on adjacent roadways or air traffic flying above the site, and

could cause a distraction of drivers that would lead to road hazards and to pilots of aircraft flying over the site.

The nearest receptor is located 3km away, with the freight railway line situated 1.2km from the tower. Therefore, the likelihood of reflected solar radiation impact is very low. However, the following mitigations were documented in the Ivanpah Assessment and should be reviewed for relevance in this project. These measures include:

- To ensure solar radiation and light from the heliostats does not impair the vision of motorists or pilots travelling near the site, and to ensure that the potential for exposure of observers does not cause a human health and safety hazard, the following is suggested:
  - Identify the heliostat movements and positions that could result in reflected solar radiation from heliostats being observed by receptors.
  - Propose a Heliostat Operating Plan that would avoid the potential for human health and safety hazards at locations of sensitive receptors, including the potential for momentary and continuous solar radiation exposure to occur in excess of the recommended levels.
  - Develop a monitoring plan to verify any operational impacts and, if impacts are found or reported, that they are investigated and appropriate mitigation proposed and implemented. The monitoring plan should log, investigate and respond to complaints regarding glare.
  - The monitoring plan should be updated on an annual basis for the first 5 years, and at 2-year intervals thereafter for the life of the project (BLM California Energy 2009).

#### 8.12.4.3 Potential Brightness Impacts

There are currently no regulations that are directly applicable to brightness from facilities such as solar plants. This level of brightness could be extreme and would be temporarily blinding when viewed directly. However, the following would mitigate this:

- Viewers of such glare would instinctively divert their eyes from the source;
- The duration of exposure may be very short because light would be reflected at a constant stationary angle and the viewer (motorist or pilot) would be travelling at a high speed; and
- Glare that is bright enough to temporarily impair vision and cause viewers to look away is a common occurrence from other objects in the built and natural environment (such as lakes, building windows, and reflective surfaces such as mirrors and windows on other roadway vehicles).' (BLM California Energy 2009).

#### 8.12.4.4 Project Visibility and Exposure

The CSP has a maximum height of 200m above ground level. The viewshed is large and covers all of the foreground / middle ground in the 6km range and beyond and starts to fragment after approximately 15km. The spread of the viewshed is mainly central and to the south-east, with fragmented views to the north-east and west. Potential receptors located in the viewshed are:

- N10 to the north of the property, which is the main route to Namibia.
- N14, which is a national road located approximately 15km to the south of the property and is routed between Keimoes and Upington.
- R360, which is the main route from Upington to the Kgalagadi Transfrontier National Park, and is located approximately 15km to the north-east of the property.
- District road routed adjacent the southern boundary of the property.
- Sections of Upington.
- Isolated farmsteads (proximate).
- Farming areas to the south of the Orange River, located approximately 15km to the south of the property.

The CSP base structures and mirrors have a height of 4m above ground level. The viewshed is more localised and covers sections of the foreground / middle ground within the 6km range, and some small areas in the background. The spread of the viewshed is mainly central and to the south-west, with fragmented views to the north-east and south. Potential receptors located in the viewshed are:

- A small area of the R360;
- A portion of the N10; and
- Surrounding isolated farmsteads in the foreground / middle ground.

Due to distance, and ground-based infrastructure, it is unlikely the proposed landscape modifications would generate and influence further than the six kilometre foreground / middle ground area and that it is highly unlikely that the N14, and the more formalised irrigated farming areas to the south-east (across the Orange River), would have views of these proposed project components.

**Table 43: Visibility and exposure findings**

| Extent | Geographical area of influence<br>**Site Related (S) :extending only as far as the activity**<br>**Local (L) :limited to immediate surroundings**<br>**Regional (R) :affecting a larger metropolitan or regional area**<br>**National (N) :affecting large parts of the country**<br>**International (I) :affecting areas across international boundaries** |
|---|---|
| Regional | The geographic area of influence of the CSP tower is widespread and would affect a regional area in relation to the flat surround terrain. The CSP buildings and mirrors will generate a moderate geographic extent for ground-based receptors, but will be higher for aircraft receptors due to potential glint. During construction, the water pipeline alternatives would have local exposure and would not be visible once construction and rehabilitation is completed. |

**Table 44: Visibility and exposure findings**

| Visual Exposure | Degree of exposure to receptors<br>**High (H) : Dominant or clearly noticeable (<2km)**<br>**Moderate (M) : Recognisable to the viewer (2 – 6km)**<br>**Low (L) : Minimally visible areas in the landscape (>6km)** |
|---|---|
| Moderate | The proposed CSP tower is located in a remote area with few receptors located within the foreground/middle ground area, and all receptors are located outside the 2kmkilometre, high exposure zone (except for the train driver who would be closer). The two residential receptors located within the foreground area will be subjected to moderate to high levels of exposure. The ground-based activities of the CSP would also have moderate levels of exposure, also due to the remoteness of their location. Pipeline Alternative 1 would have moderate to high levels of exposure during construction after which exposure would be nil. Alternative 4 would have higher levels of visual exposure to the N10 during construction. The pipeline Alternatives 2 & 3 would have moderate to low levels of exposure due to their remote locations. The overall exposure rating for the project is moderate to high. |

### 8.12.4.5 Project Site Landscape Survey

The landscape character of the proposed project site is surveyed to identify areas of similar land use and landscape character. These areas are then evaluated in terms of scenic quality (landscape significance) and receptor sensitivity to landscape change (of the site) in order to define the visual objective for the project site. The overall objective is to maintain a landscape's integrity, but this can be achieved at varying levels, called

VRM Classes, depending on various factors, including the visual absorption capacity of a site (i.e., how much of the project would be "absorbed" or "disappear", into the landscape). The areas identified on site are categorised into these Classes by using a matrix from the BLM Visual Resource Management method, which is then represented in a visual sensitivity map.

The following locations, which are associated with various proposed project activities, were surveyed during the field study to determine scenic quality, receptor sensitivity to landscape change and distance from nearest receptors:

- S1: CSP Tower and Mirrors
- S2: Railway line to the north of the CSP Tower and Mirrors site
- S3: Drainage Lines (no proposed activity)
- S4: N14 Vineyards/ Pipelines 1 & 3
- S5: N14 Vineyards/ Pipelines 2
- S6: N10/ Pipelines 4

**Table 45: Site Visual Absorption Capacity**

| Site Visual Absorption Capacity | Potential of landscape to conceal<br>**High (H) : effective screening**<br>**Moderate (M) : partial screening**<br>**Low (L) : little screening** |
|---|---|
| Low | Due to the flat landscape and the limited vegetation, the visual absorption capacity of the landscape where the CSP activity is proposed, is low. Although the site is adjacent to a railway line, contrast generated by this railway line and associated infrastructure, is limited in relation to the size and scale of the proposed project.<br><br>The area to the south, in the region of the N14, where pipeline alternatives are proposed, has higher VAC level due to the existing agricultural landscape character which has more infrastructure, structures and undulating topography, and can be rated moderate to high. |

**Table 46: Site Scenic Quality**

| Site Scenic Quality | The inherent sensitivity of the landscape, which is usually determined by a combination of topography, land form, vegetation cover and settlement pattern<br>**High (H) : highly visible and potentially sensitive areas in the landscape.**<br>**Moderate (M) : moderately visible areas in the landscape.**<br>**Low (L) : minimally visible areas in the landscape.** |
|---|---|
| Moderate | Based on the VRM methodology, the scenic quality of the area where the CSP is proposed is defined as Category B and as having moderate levels of landscape character. This is due to the predominantly flat land form which offers limited terrain variation, only one of two vegetation type and the limited presence of water. The colour contrast generated by the khaki coloured grasses, the red earth and the reddish background hills does add value to the scenic quality but the scenery is fairly common in the area and scarcity is low. Cultural modifications are mainly related to agricultural grassland farming which adds to the sense of place by the lack of development which creates a remote sense of place. The exception is the railway line which has lower levels of landscape character. |

**Table 47: Visual Sensitivity of Receptors**

| Visual Sensitivity of Receptors | The level of visual impact considered acceptable is dependent on the type of receptors<br>**High (H) :e.g. residential areas, nature reserves and scenic routes or trails**<br>**Moderate (M) :e.g. sporting or recreational areas, or places of work**<br>**Low (L) :e.g. industrial, mining or degraded areas** |
|---|---|
| Moderate | The types of users include two farm residential receptors, the N10 road users and the N14 road users. As the farming receptors would be used to the open vistas of the Kalahari plains, it is likely that they would be sensitive to landscape change. The N14 and N14 roads do carry tourist traffic who would also be more sensitive to landscape modification, with N10 users being less so due to exposure to views of the rock quarry to the north-west of the site as well as views of the railway line and background views of the town of Upington. As the area is not associated with formal conservation, it is unlikely that public interest is high. Other than road traffic, there are no tourist activities located within the foreground / middle ground distance zone with the nearest tourist activity being Spitzkoppe private nature reserve located approximately 20 kilometres to the north-east. There are no unique features associated with the site and the overall receptor sensitivity was defined as moderate. |

### 8.12.4.6 Sensitivity Mapping

Sensitivity levels are a measure of public concern for scenic quality. Evaluation of the suitability of a proposed landscape modification is undertaken by means of assessing the proposed modification against a predefined management objective assigned to each class. The USA Bureau of Land Affairs has defined four Classes that represent the relative value of the visual resources of an area:

i. Classes I and II are the most valued;

ii. Class III represent a moderate value; and

iii. Class IV is of least value.

Based on the survey points, a constraints map was generated for the site, which defined the preferred visual objective for proposed landscape modifications on the site. The following recommendations were made:

**Class I**

- No Class I areas were defined for the property.

**Class II**

- Class II visual objective, which allows for low levels of landscape modifications, was assigned to the river wash areas. It is recommended that main drainage lines are not utilised for development to ensure continued hydrological integrity, although this does not affect the CSP project.

**Class III**

- Class III visual objective was assigned to the agricultural fields on the site, as this type of landscape is fairly common in the area and receptor sensitivity would be low. However, the importance of the rural agricultural sense of place is also important as an element in the greater landscape and would need some moderation.
- The railway line sections of the site offer existing higher levels of visual contrast to proximate receptors, which do detract from the scenic quality but the overall landscape context is agricultural.

**Class IV**

- No Class IV areas were defined for the property.

### 8.12.4.7 Key Observation point Contrast Rating

The assessment of the Degree of Contrast (DoC) is a systematic process undertaken from KOPs surrounding the project site, and is used to evaluate the potential visual impacts associated with the proposed landscape modifications. KOPs are defined by the BLM 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. The degree of contrast generated by the proposed landscape modifications are measured against the existing landscape context in terms of the elements of form, line, colour and texture. Each alternative activity is then assessed in terms of whether it meets the objectives of the established class category, and whether mitigation is possible (USA Bureau of Land Management, 2004).

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

Eleven receptor locations were identified as KOPs. These locations are used to assess the suitability of the proposed landscape modifications and are indicated in Table 48.

**Table 48: Receptor locations**

| Map ID | Proposed Activity | Description | KOP |
|---|---|---|---|
| R1 | N10 north | Infrastructure / View corridor | Yes |
| R2 | N10 north | Infrastructure / View corridor | Yes |
| R3 | Farmstead1 | Agricultural | Yes |
| R4 | Farmstead2 | Agricultural | No |
| R5 | Spitzkop Nature Reserve | Tourism | Yes |
| R6 | N14 east | Infrastructure / View corridor | Yes |
| R7 | Klippunt | Residential | Yes |
| R8 | Gravel Road north | District road infrastructure | Yes |
| R9 | Upington west | Residential | No |
| R10 | Train and maintenance personnel | Infrastructure / View corridor | Yes |
| R11 | R360 east 2 | Infrastructure / View corridor | No |

**Table 49: Visual intrusion**

| Visual Intrusion | Congruence of the project with the particular qualities of the area, or its 'sense of place'<br>**High (H) : noticeable change**<br>**Moderate (M) : partially fits into the surroundings, but clearly noticeable**<br>**Low (L) : blends in well with the surroundings** |
|---|---|
| Moderate to High | Due to the size and scale of the proposed landscape modification, the Class III visual objective of moderate levels of landscape change required to maintain the existing agricultural landscape context would not be met for four of the eleven receptors. These receptors include the N10 northbound and southbound, the receptors making use of the district road to the south of the site and the two proximate farmstead receptors located within the foreground distance zone. It is possible to mitigate the proximate farmsteads using an 'abate at site' mitigation and planting of trees. This could cause further visual intrusion of the receptors as their views of the open veldt could be obscured. It is recommended that this option and the positioning of the screening trees be negotiated with I&AP's to determine their preference as this would be an effective method in retaining their residential sense of place. For all the other receptors which include the N14 scenic tourist route and Upington, the moderate Class III visual objectives would be met without mitigation and the proposed landscape modification would not result in a direct change to the landscape context. Due to the close proximity of the railway line to the site, it would be important to ensure that the intensity of light is measured as soon as the project is in operation to ensure that railway personnel were all informed of the potential glare risks and have the required personnel protection eye equipment should it be required. |

# 8.13 Traffic

## 8.13.1 Introduction

WSP SA Civil and Structural Engineers (Pty) Ltd were appointed to undertake a Traffic Access Study (**Appendix 14**) for the proposed Commercial Concentrated Solar Power (CSP) facility that is to be constructed in the Northern Cape.

## 8.13.2 Methodology

The assessment included a data collection phase whereby a traffic survey was undertaken and information was be gathered regarding existing and future roads and intersections. a site visit to observe current travel patterns and to gain an understanding of the area was undertaken. A meeting and correspondence with the local authority provided clarification on the scope of the traffic study and determined what current developments are taking place. Traffic counts were undertaken during relevant peak hours to determine the magnitude of traffic in the area and latent rights in the area were sourced.

## 8.13.3 Findings

### 8.13.3.1 Surrounding Road Networks

The following existing roads play a significant role within the study area:

**N10:** This is a Major Rural Arterial (Colto, 2010) which follows an east-west alignment directly to the north of the site. This road in the vicinity of the site is a single lane carriageway road (1 lane per direction). The proposed development will gain direct access onto the N10.

**R360:** This road is an arterial route which follows a north-south alignment to the east of the site. The road is several kilometres from the site and would really fall outside the study area of this traffic impact study. The intersection of the N10 and R360 is however the only significant intersection in proximity to the site and was therefore considered as part of this study. This road in the vicinity of the site is a single lane carriageway road (1 lane per direction).

### 8.13.3.2 Proposed Access

The site will be served by a single access from the N10. The same access will be used for the construction period and during operations. The approximate Google earth co-ordinates for the access position on the N10 are 28°23'23.63"S and 21° 1'43.82"E.

### 8.13.3.3 Existing Traffic Flows

A detailed traffic survey (traffic count) was carried out at the N10 and R360 intersection on the 17th May 2012. The surveys were conducted for 12 hours (06:00 – 18:00). The 12 hour traffic volumes are shown on Figure 56.

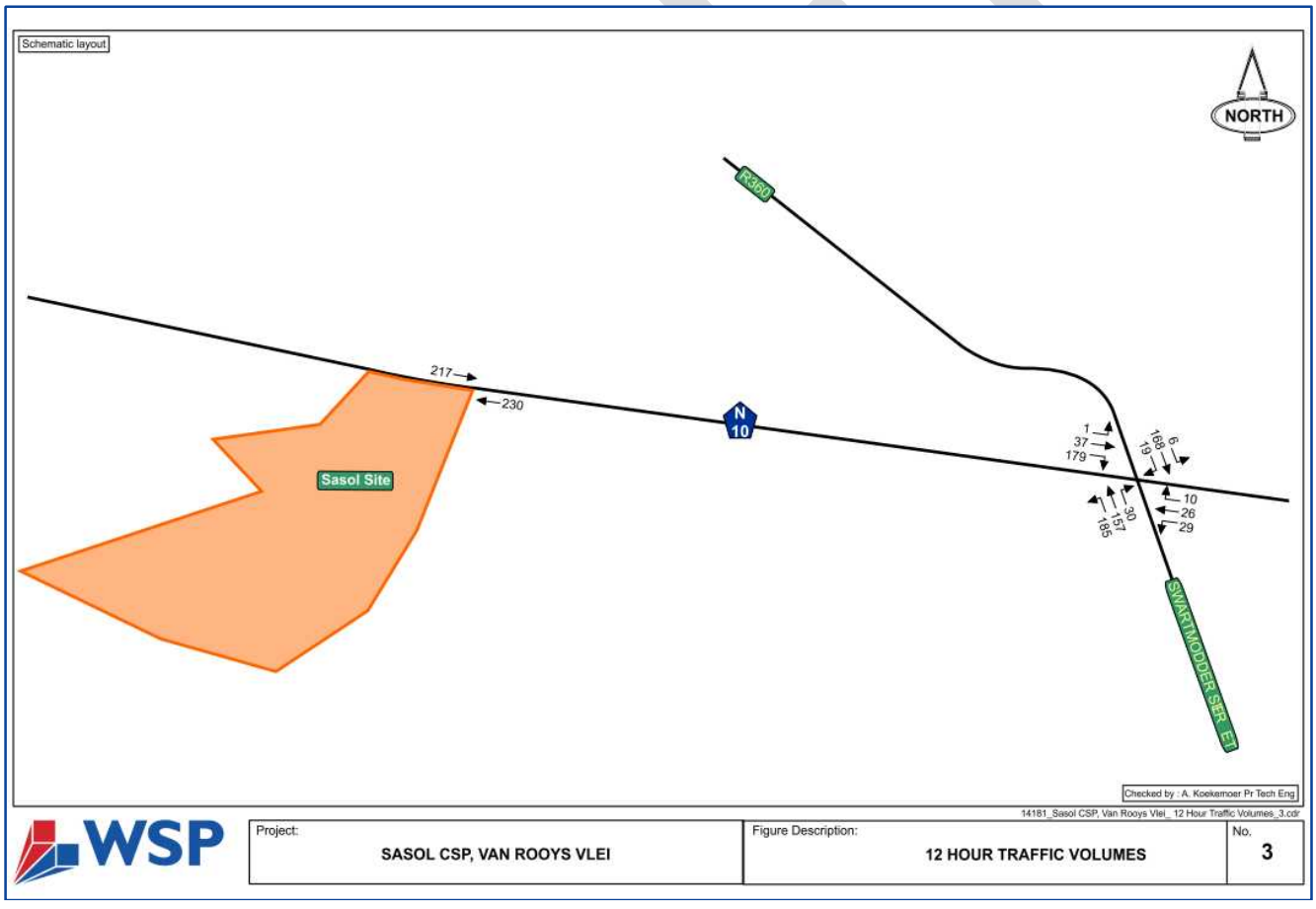



**Figure 56: 12 Hour traffic volumes**

From the traffic counts a common peak hour was determined (the busiest hour) for each counted period and was found to be:

- Morning peak 08:00 – 09:00

- Afternoon peak 15:00 – 16:00

#### 8.13.3.4 Traffic Generations – Construction Phase

It is estimated that the construction stage would generate employment opportunities for approximately 800 people during its highest peak. In determining the estimated traffic generations to / from the site, the following information and assumptions has been used (see Annexure A of specialist study):

- 80% of workers will be housed on site. These workers will live on site. They will be bussed to site on Monday mornings and bussed from site on Friday afternoons.
- 20% of workers will be based in Upington and surrounds and will enter the site in the mornings and leave the site in the afternoons.
- The highest inbound peak will thus occur on Monday mornings when most workers will arrive at site. The highest outbound peak will thus occur on Friday afternoons when most workers will leave site. This is the scenario (see Scenario 2 in Annexure A of the specialist study) that was considered for the construction stage.
- 90% of all workers were assumed to be using buses, the buses were assumed to have a 65 person capacity and 95% occupancy.
- 10% of all workers were assumed to be using cars, with 1.2 person occupancy assumed.

Based on the assumptions above and the calculations in Annexure A of the specialist study the estimated weekday AM and PM peak hour trips are summarised in Table 50.

**Table 50: Estimated Development Trips (Construction Stage)**

| Travel Mode | Estimated Vehicle Trips | | | | | |
|---|---|---|---|---|---|---|
| | **AM (vph)** | | | **PM (vph)** | | |
| | In | Out | Total | In | Out | Total |
| Buses | 12 | 12 | 24 | 12 | 12 | 24 |
| Light vehicles | 63 | 4 | 67 | 4 | 63 | 67 |
| TOTAL Trips | 75 | 16 | 91 | 16 | 75 | 91 |

These traffic volumes are still of a very low order of less than 100 vehicles per hour (i.e. total IN plus OUT).

#### 8.13.3.5 Traffic Generation – Operational Phase

Once the construction of the plant had been completed, the staff component required for the operational phase will be substantially less. The estimated staff for this stage will approximately 60 people who will be working in two shifts namely:

- 40% of operational staff will work during the day time.
- 60% of operational staff will work during the night time.

The staff compliment in the evenings will be higher since it is during this time when the solar mirrors are cleaned.

In determining the estimated traffic generations to / from the site, the following information and assumptions had been used (see Annexure A of specialist study):

- It was assumed that 100% of the night staff leaves in the morning peak and 100% of the day staff arrives during the morning peak.
- It was assumed that 100% of the day staff leaves in the afternoon peak and 100% of the night staff arrives during the afternoon peak.

- The above two assumptions are conservative but would represent a worst case scenario.
- 50% of the staff component will make use of buses with a capacity of 65 persons and a vehicle occupancy of 95%.
- 50% of the staff component was assumed to be using cars, with 1.2 person occupancy assumed.
- Limited visitors can be expected on a daily basis, however it was assumed that they would not arrive during the morning and afternoon peak hours.

Based on the assumptions above and the calculations in Annexure A of the specialist study the estimated weekday AM and PM peak hour trips are summarised in Table 51.

**Table 51: Estimated Development Trips (Operational Stage)**

| Travel Mode | Estimated Vehicle Trips | | | | | |
|---|---|---|---|---|---|---|
| | AM (vph) | | | PM (vph) | | |
| | In | Out | Total | In | Out | Total |
| Buses | 1 | 1 | 2 | 1 | 1 | 2 |
| Light vehicles | 15 | 10 | 25 | 10 | 15 | 25 |
| TOTAL Trips | 16 | 11 | 27 | 11 | 16 | 27 |

These traffic volumes are still of a very low order of less than 100 vehicles per hour (i.e. total IN plus OUT).

### 8.13.3.6 Trip Distribution and Assignment – Construction Phase

The trip distribution for the construction stage was based on the expected origins of trips destined to the development taking background traffic patterns into account. The development traffic is indicated on Figure 57.

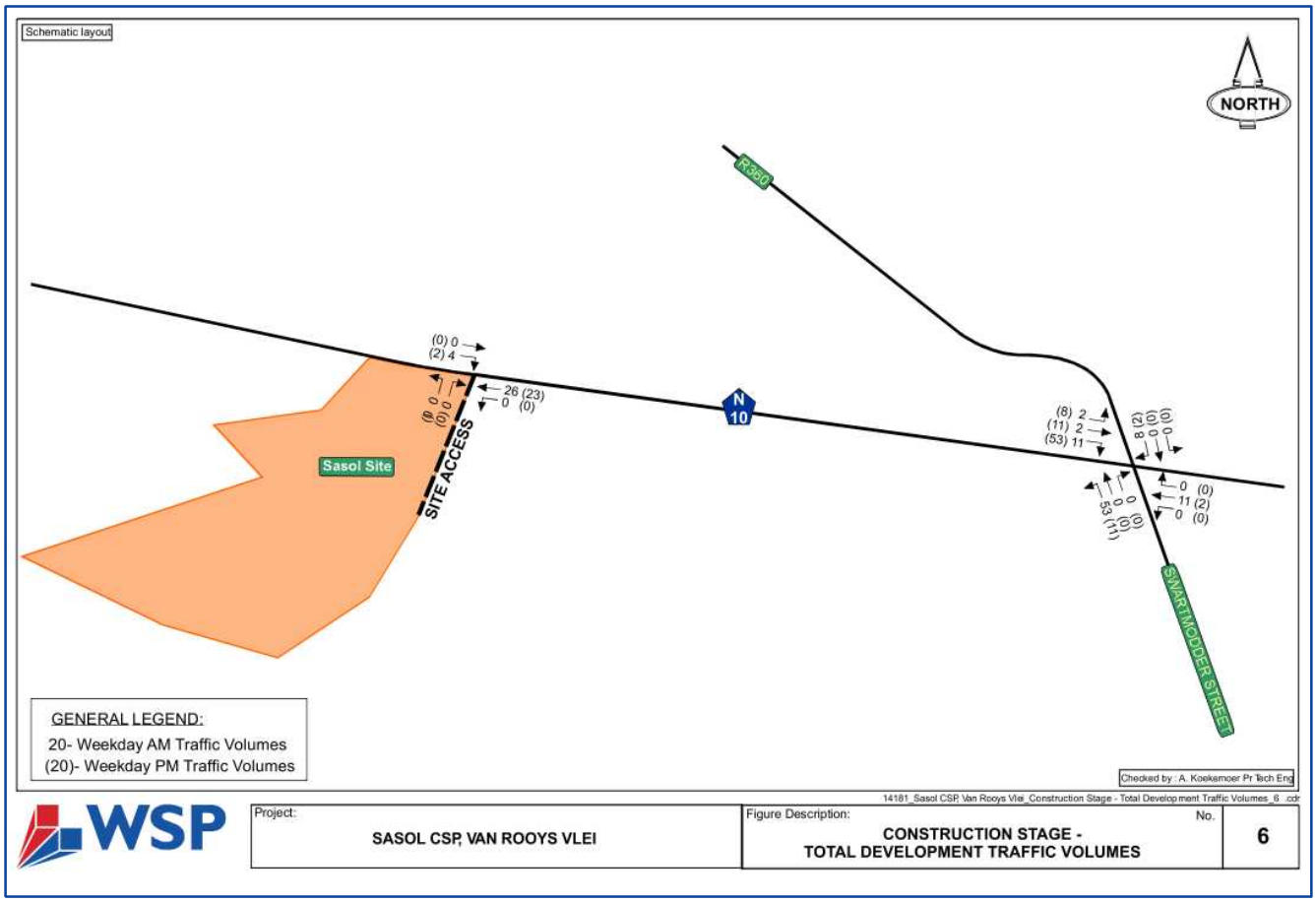



**Figure 57: Construction phase – total development traffic volumes**

### 8.13.3.7 Trip Distribution and Assignment – Operational Phase

The trip distribution for the operational stage was based on the expected origins of trips destined to the development taking background traffic patterns into account. The development traffic is indicated on Figure 58.

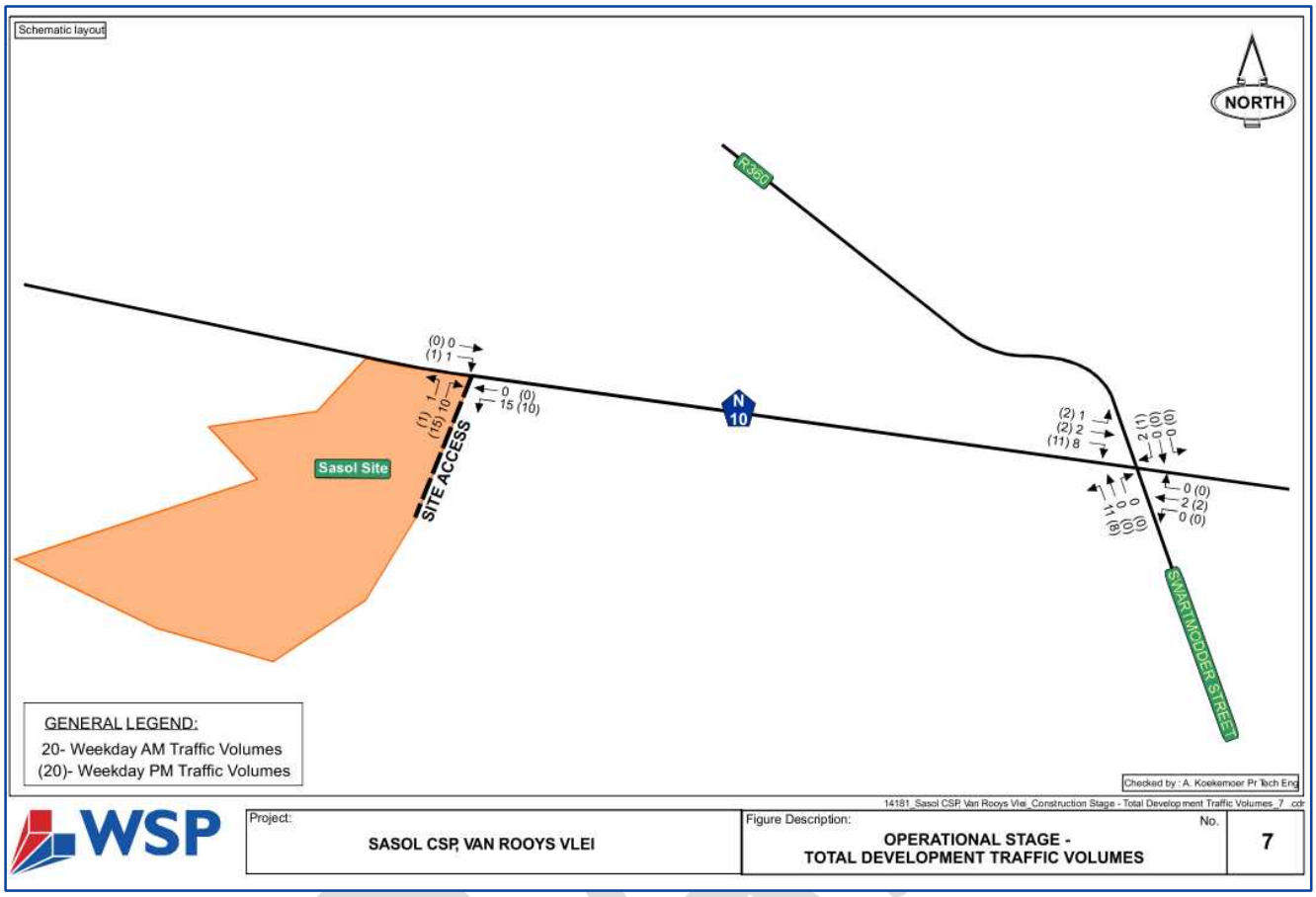



**Figure 58: Operational phase – total development traffic volumes**

## 8.14 Socio-economic Structure

### 8.14.1 Introduction

SNE is proposing to construct a solar power generation complex near Upington in the Northern Cape. WSP has been appointed by SNE to undertake a Social Impact Assessment (SIA) to determine the socio-economic impact of the proposed project. The Specialist Study is attached as **Appendix 15**.

### 8.14.2 Methodology

WSP have undertaken a SIA investigation in order to identify and assess the socio-economic impacts associated with the proposed project. A description of the SIA methodology is provided below.

#### 8.14.2.1 Development of a Social Profile

In order to develop a social profile of the project area, WSP undertook a desktop review of existing information on the Upington and Keimoes areas, and a site orientation visit was undertaken to verify desktop findings. The desktop review included consideration of the following documents:

- Siyanda District Municipality - Integrated Development Plan
- Kai! Garib Local Municipality - Local Integrated Development Plan
- //Khara Hais Local Municipality:

- Local Integrated Development Plan
- Spatial Development Framework

- The Arid Areas Programme Volume 1: District Socio-economic Profile and Development Plans (University of the Free State, Centre for Development Support)

In addition, the following data and information was reviewed to provide background information for the project area:

- Statistics South Africa Census 2001 data
- Statistics South Africa Community Survey, 2007
- Topographical Map (1:50 000) and aerial photography

An initial site visit was undertaken in order to establish the existing socio-economic landscape through ground-truthing and discussions with local authorities. Aspects observed included identification of local communities, spatial layout of communities and amenities, surrounding land uses. Meetings with local authorities provided insights into local socio-economic challenges, issues and priorities.

#### 8.14.2.2 Data Collection

Primary data collection was deemed necessary to contribute to the evaluation of the potential impacts of the proposed SSP. Primary data was collected through a process of interviews with key local stakeholders so as to determine the magnitude and extent of the socio-economic impact at a local level. The aim was to obtain data which will assist with the identification and description of the key socio-economic issues and impacts associated with the project.

WSP developed a range of formal, open-ended questionnaires which were implemented through an interview process with the representatives of local organisations, authorities, land owners and other key stakeholders. All interviews and discussions were documented and kept on record for assessment and identification of the key socio-economic issues. The following stakeholders were consulted with:

- Kai! Garib Local Municipality
  - Town Planner
  - IDP Manager
  - Ward Councillor – Ward 8
- //Khara Hais Local Municipality
  - Environmental Manager
  - Housing - Head of Department
- Siyanda District Municipality
  - Environmental Manager
- Surrounding farmers

#### 8.14.2.3 Data Analysis

The socio-economic issues were analysed from the information collected through the primary data collection and desktop phases. The issues would be considered in two streams. The first of these was the potential negative issues associated with the solar project and associated infrastructure. The second would be to look at the potential positive issues associated with the development.

In addition a sensitivity map showing those communities and/or resources that will be most affected by the proposed solar project, for example: - disadvantaged communities, potentially affected near-by towns, and the rating of the positive and negative impacts on these communities.

#### 8.14.2.4 Reporting and Recommendations

This SIA report provides a culmination of the above phases. The report includes an assessment of the key socio-economic impacts associated with the proposed project, as well as the "no development" alternative. The report makes recommendations for mitigation measures to be considered in the design and operation of the project. These recommendations are in line with the IFC requirements for social consultation, risk avoidance and management measures.

#### 8.14.2.5 Study Area

The SIA study area is defined as the area over which the proposed project is likely to have influence. This area is therefore limited to a 30km radius of the site, and encompasses the two key urban area, Upington and Keimoes, McTaggerscamp and other settlements discussed above, and the farms lands immediately surrounding the site. The SIA has not identified any socio-economic transboundary impacts, i.e. beyond the border of South African. Refer to Appendix B for a map of the study area.

### 8.14.3 Assumptions and Limitations

#### 8.14.3.1 Secondary Data

The demographic data used in the development of the socio-economic context of this study was sourced predominantly from Statistics South Africa data. This included: Census 2001 (this is the most comprehensive set of population data available for South Africa at a Ward level); Community Census 2007 (limited information available); and the 2011 mid-year population predictions. This information was considered sufficient to inform this study. Community-specific information was obtained from the local ward councillor.

#### 8.14.3.2 Primary Data

A limited number of municipal representatives were not available to partake in the study. Meetings were arranged with specific individuals; however they did not attend on the day. These individuals included ward councillors in charge of wards surrounding the site (the ward councillor for the site was consulted), and certain representatives of the two local municipalities. It should be noted, however, that key representatives were consulted during the SIA process (as above), and therefore the study is considered to be complete.

### 8.14.4 Findings

#### 8.14.4.1 Regional Context

The proposed project is located within the Kai! Garib LM, within the Siyanda District Municipality of the Northern Cape Province (Figure 59). The site is located approximately 20km north-west of the town of Upington, on the border of the Kai! Garib and //Khara Hais Local Municipalities.

The Northern Cape is one of South Africa's largest provinces (~30% of total land mass); however, it has the smallest population of 1,096,731 . The population density of the province is therefore low (~2 people per square kilometre).

On a geographical basis, the province shares borders with Namibia in the north and stretches as far as the Atlantic Ocean in the west. The Northern Cape also shares borders with the Western Cape to the south, the Eastern Cape to the southeast, and the Free State and the North West Province to the east. The largest centres in the Northern Cape are Kimberley and Upington. Kimberly was founded on the mining industry, but most mineshafts in Kimberley have been closed, thus the traditional economic base of the city has been eroded, and there is a need to look for alternative activities to sustain its local economy. Upington's (population ~47000) local economy is based on services, agriculture and agro-industry, and long-term sustainability is not a particular issue. It is, however, an issue in the northern areas of the province where mining has taken over from extensive agriculture.

The sparse, arid landscape is dominated by sheep and cattle rearing, and mining. The Orange River provides a source of fertile land and water within the northern region of the province. The areas immediately adjacent to Orange River are therefore characterised by a concentration of vineyards and other intensive agricultural activities, producing products such as export-quality table grapes, wine, dried and preserved fruit.

The Siyanda District Municipality is located towards the north of the province, with the Orange River running near the southern border of the municipality, through the town of Upington. The region has a fairly healthy tourism component, which supplements the local economy, and comprises agri-tourism, adventure tourism, as well as scenic and historical tourism.

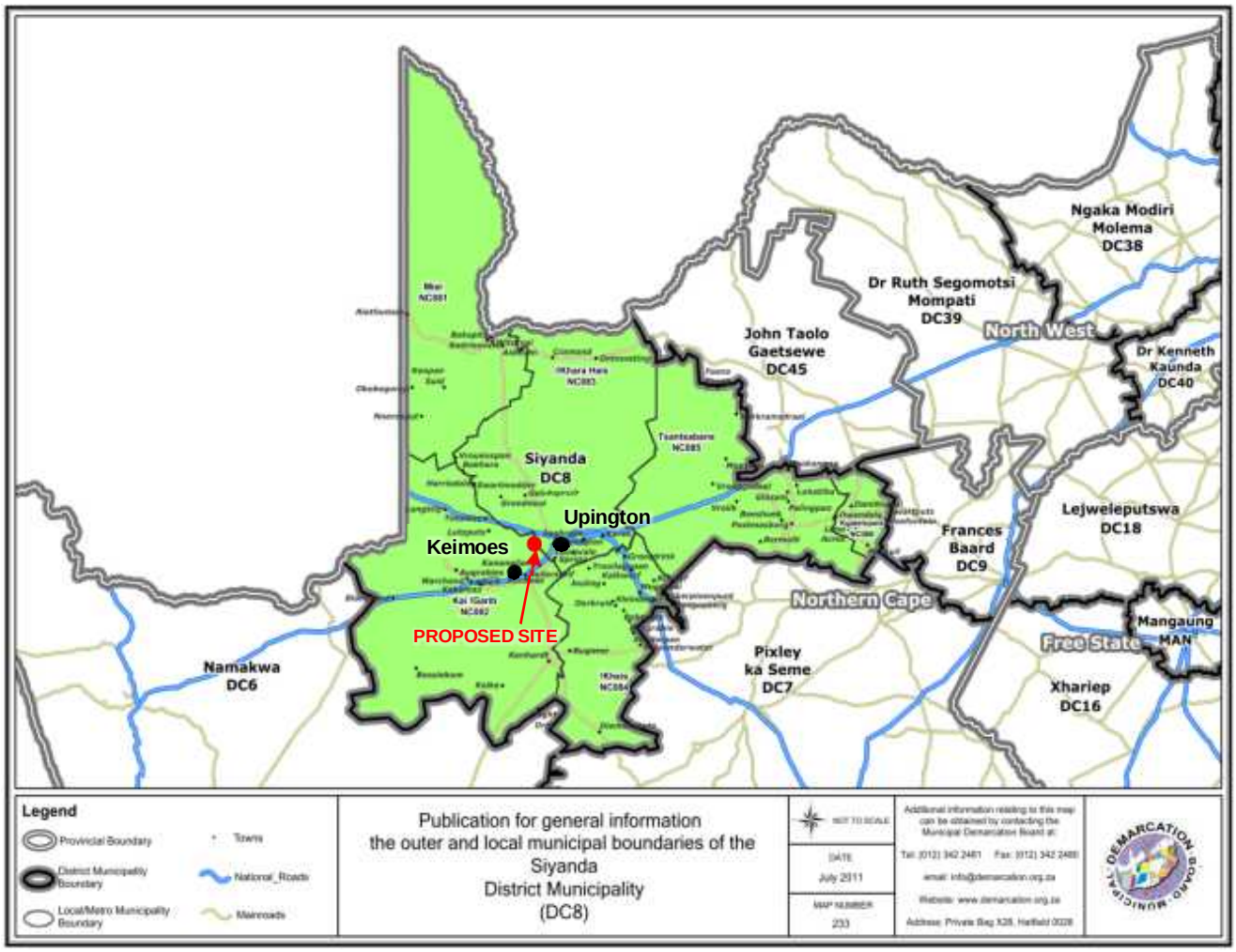



**Figure 59: Location of proposed SSP site within municipal boundaries (Municipal Demarcation Board, 2011)**

### 8.14.4.2 Local Context

The service levels within the //Khara Hais LM are relatively good, with the municipality providing the majority of households with waste removal, piped water and electricity[2]. This is likely to be due to the concentration of populations within urban areas (Upington) and the linear development corridor and farming areas associated with the Orange River. Education levels are characteristic of many South African municipalities, with 34% having some secondary schooling, 21% with high school qualifications, and 6% with tertiary education. Employment is low by comparison with the national levels, with 35% of the labour force being unemployed[3].

[2] Statistics South Africa (2001) Census Data

[3] Statistics South Africa (2001) Census Data

The main employment sectors are: agriculture; wholesale and retail trade; community; social and personal services; and private households[4].

The Kai! Garib LM has a relatively lower service provision rate, when compared with the //Khara Hais LM. There is marginally lower water, refuse removal and electricity provision. Many areas, such as the islands on the Orange River have no access to clean drinking water and areas like Blaauwskop and Bloukamp are provided water through water trucks[5].

This is likely to be a product of the local context, namely the predominantly rural nature of the area, dispersed population, and lack of a major urban centre. The education levels are also fairly low, with 14% having had no schooling, 10% with a grade 10, and only 2% with tertiary education. Employment levels are, however, higher than the //Khara Hais LM, with 82% of the labour force being employed (only 18% unemployment rate)[6]. The key economic sectors, in which the labour force is employed, are skilled agricultural sector (12%) and elementary occupations (63%)[7]. This is reflective of the low education levels and predominantly agricultural nature of the LM.

The site is located within Ward 8 of the Kai! Garib LM. The key urban areas in the LM are Keimoes (20km south west of the site) and Kakamas (50km southwest of the site). Ward 8 is comprised of six communities/areas namely: Eksteenskuil Eilande, Soverby, McTaggerscamp, Curriescamp, Blaauwsekop, and Kanoneiland. The Ward occupies the eastern corner of the LM, and is characterised by the semi-arid landscape, with the Orange River running through the centre of the Ward. The population is concentrated along the Orange River and on the islands in the river.

Upington and Keimoes are the closest urban areas to the site. There are a number of smaller rural communities in proximity to the site, including:

- Kalkstoot (17km south-west);
- Dysons Klip (20km south south-west); and
- Geelkop(20km south south-west).

The site is located in an area of extensive sheepand cattle farming, and has little connection to other features in the area, except for the national highway (N10) which runs near to the north-east border of the site. The N10 links Upington to Nakop on the Namibian border (approximately 100km north-west of the site). Key tourism features in the area include the Augrabies Falls National Park (60km south-west), the Kgalagadi Transfrontier Park (220km north and Upington and the Orange River (20km west and south respectively). The socio-economic impacts are therefore likely to be limited to the nearby towns, surrounding farmers and land owners, and users of the N10 highway.

#### 8.14.4.3 Site Context

The site is located on a farm, Van Roois Vley, located approximately 20km north-west of Upington, between the N10 Freeway to Namibia, and the N14 freeway to Keimoes. The land is currently not used by the owner, although sheep grazing has occurred on the site in the past. The site has been identified as low agricultural value[8], and is approximately 18km from the nearest community (MountianView , near Upington). The site is surrounded by similar agricultural land, used predominantly for extensive sheep, cattle and game farming. Figure 2 provides map of the site in context with the surrounding land use, communities and towns.

[4] Statistics South Africa (2001) Census Data. http://www.statssa.gov.za/publications/populationstats.asp

[5] Kai Garib LM IDP, 2012

[6] Statistics South Africa (2001) Census Data

[7] Statistics South Africa (2001) Census Data

[8] SSI Environmental (2012)

### 8.14.4.4 Surrounding Communities

#### Neighbouring Farmers

There are eleven land owners who are likely to be affected by the proposed project. WSP undertook a survey of these key stakeholders to determine the type of activities surrounding the site. An assets register of this community was not considered necessary, as the project is unlikely to directly affect the farm houses, vehicles, and equipment of these surrounding land owners and users. There is, however, the potential for the activities occurring on these farms to be impacted by the development. Table 52 provides an overview of the activities of land adjacent to the site. Appendix A provides an overview of the location of these farms in relation to the site.

**Table 52: Activities register for surrounding land uses**

| Farm | Extent (ha) | Years | Activity | No. Employees |
|---|---|---|---|---|
| Van RooisVley (Primary site) | 15781 | 41 | Livestock | 4 |
| Van Rooi'sVley (Adjacent) | 15500 | -* | Sheep | 4 |
| Colston | 4000 | 65 | Livestock | 3 |
| Rooisdam - west | 9000 | 38 | Livestock | 2 |
| Rooidam | 6000 | 8 | Livestock and game | 2 |
| Droogenhout 442/4 | 3000 | 11 | Livestock | -* |
| Droogenhout 442/5 | 2000 | -* | Droogenhout Crusher (surface mining) | 27 |
| Dysonsklip | 5500 | 20 | Sheep, cattle, game, vineyards | 50-60 |
| Geelkop | 4700 | 23 | Cattle | 12-65 |
| Rooipunt and Olyfenhout Farm | 11000 | -* | Cattle | -** |

**Information not available*

***No labourers required on this farm (brought on from another farm)*

#### McTaggerscamp Community

Discussions with the local Ward Councillor (Ward 8) revealed that one of the key communities that should benefit from the proposed project is the McTaggerscamp community. This is a rural community located approximately 20km south of the site. This community is unlikely to be directly affected by the project, however aspects have been identified that could benefit this community. Appendix B of the Specialist Study provides detailed statistics of the skills, education and other aspects of the McTaggerscamp community. Key aspects include:

- Education/Skills Development
  - Many residents have Grade 12 Education; little/no tertiary education
- Employment
  - High rate of unemployment; lack in skills and experience.
- Access to potable water
  - There is no formal water system in the community; the LM provides water by tankers.
- Access road to site
  - The current access road is highly degraded, and public transport (taxis) is not willing to drive to the community, therefore residents have to walk to the N14 (~2km) to get transport.

- Community clinic/healthcare facility
  - The closest clinic is located in Kalkstoot (6km away)

**Blocuso Community Trust**

There are currently two Community Trusts which have been set up within the LM. These communities are unique to other communities within the LM, as they have assistance of the South African government. There have been significant improvements in social services and general conditions within these communities as a result of the trusts which have been established, although may still be affected by certain socio-economic issues, such as unemployment and lack of education.

The Blocuso community is located within the Orange River "green belt" within Ward 8 of the LM, and consists of three farms, namely: Bloemsmond, Curriescamp and Soverby. These farms were forcibly sold to White farmers in the early 1900s, and the previous workers became farm labourers. Between 1914 and 1934, the Independent church of Gordonia assisted the community is buying back these farms, and in 2000 the community was assisted by the government to purchase the farms from the church. This community consists of 466 families, who make use of government funds to provide basic services.

#### 8.14.4.5 The Future Receiving Environment

The town of Upington is a small, but developing urban area, isolated from the major economic hubs within South Africa. According to the //Khara Hais IDP, future development plans for the town include the development of the central business district and the secondary commercial areas in and around Upington . The identification of the Northern Cape Solar Corridor (of which Upington is a part) as a key location for solar energy generation (in line with the IPPPP initiative), together with the existing business and service infrastructure at Upington and a key source of water (Orange River), is likely to result in large-scale change to the area.

A concentration of solar facilities within the Upington region could have a significant impact on the nature and size of the town of Upington, including industrial, business and related service growth. The growth of the solar sector in the Northern Cape, and the plans to develop Upington as a service and transport hub for the region , could result in the rapid expansion of the physical size of the town over the next 10 to 15 years. This in turn could push less advantaged communities away from the centre of the town. This sprawl is unlikely to be constrained, or significantly affect the surrounding land uses in the area, as there is sufficient land available for this level of growth

# 9 Environmental Impact Assessment

## 9.1 Impact Identification

### 9.1.1 Climate

The release of greenhouse gasses and other contaminants to the atmosphere is expected as a result of land based vehicle activities and the use of diesel generators during the construction and possibly the operational phases. The clearing of vegetation negatively affects carbon sequestration efficiency and increase emissions resulting from decomposition. These impacts are regarded as insignificant in terms of contribution. The risks are recognised as a cumulative impact.

## 9.1.2 Air Quality

### 9.1.2.1 Construction Phase

Due to the nature of construction sites with vehicles moving around onsite and surface areas exposed to wind, dust is a pollutant of focus. The results for the construction phase based on unmitigated emission values indicate that the ambient concentrations of particulate matter will remain below the NAAQS (GNR 1210, 2009).

Dust generated by the activities would not disperse far beyond the site boundaries. While the highest average daily concentration (P100) exceeds the NAAQS, it occurs at no distance greater than 800m from the site boundary. The concentrations at the two receptors identified in the study area are all well below the national standards and only at the Droëhout receptor is the highest daily average (P100) close to the IFC standards of 50µg/$m^3$.

### 9.1.2.2 Operational Phase

Other airborne pollutants will become relevant during the Operational Phase, including $SO_2$ and $NO_2$. The airborne pollutants emitted to the air during the operational phase will be dust from vehicle activity on gravel roads (cleaning vehicles) and emissions from the boiler. As the boiler will only be active for one hour per day, emissions will be limited. The results for the operational phase based on unmitigated emission values indicate that ambient concentrations of particulate matter will remain below the NAAQS (GNR 1210, 2009). The main contributor is vehicle movement on unpaved roads.

There will be minimal vehicle movement on site and most of the movement will occur on paved roads. The only expected vehicle movement on gravel roads will be between the heliostats and CPV panels by cleaning vehicles. The dispersion model calculated the emissions of two vehicles cleaning the heliostats for two days a week and this was added to the final emission rate from the site. The worst case daily average PM10 and PM2.5 concentrations are well below the national standards.

Seasonal variability (winter and summer) are compared. Winter concentrations were shown to be higher than summer concentrations due to meteorological conditions. Analysis of the dust fall out rate during the operational phase indicated that dust fallout will not occur more than 300m away from the site boundary. The dust fallout rates experienced at the two receptors are below 1 mg/m2/day.

Analysis of gaseous emissions from the start-up boiler indicated that the annual average and highest hourly average (P100) concentrations are all well below the National Ambient Air Quality Standards (GNR 1210, 2009). However, the $NO_2$ emission rate exceeds the limit set out in the Listed Activities (GNR 248, 2010). It is advised that the boiler be fitted with adequate abatement technology to ensure that the boiler stack emissions do not exceed the limits specified in the Listed Activities (GNR 248, 2010).

### 9.1.2.3 Decommissioning Phase

Air quality impact associated with the decommissioning phase of the project is expected to be similar in nature to the construction phase.

## 9.1.3 Noise

### 9.1.3.1 Construction Phase

During the construction phase, impacts concerning noise will involve the following increase vehicular flow. Noise levels are expected to be well within the acceptable limits.

### 9.1.3.2 Operational Phase

During the operational phase, impacts concerning noise will involve increased ambient noise levels due to:

- Dry cooling fan, and
- Vehicular movement (maintenance vehicles).

Noise levels are expected to be well within the acceptable limits.

#### 9.1.3.3 Decommissioning Phase

During the decommissioning phase, impacts concerning noise will involve the following increase vehicular flow. Noise levels are expected to be well within the acceptable limits.

### 9.1.4 Geology

Based on the Preliminary Geotechnical Survey undertaken by SRK Consulting (Report on the Drilling Phase: Geotechnical Investigation for the Proposed Sasol Commercial CSP Project, Report Number 443957, May 2012), the site is located in an area low seismicity. Due to recent seismic activity experienced in the Augrabies area it is recommended by SRK Consulting that a site specific seismic investigation be undertaken.

The above-mentioned report highlights founding requirements for the construction of surface infrastructure.

### 9.1.5 Soils

#### 9.1.5.1 Construction Phase

The removal of topsoil as part of land clearing activities for the development of surface infrastructure will result in the loss of topsoil which supports vegetation. Land clearing activities will result in increased soil erosion potential. The increase in impermeable surface, through the development of surface infrastructure, will result in increased stormwater flow volumes that will contribute to potential soil erosion.

Soil pollution due to potential hydrocarbon and hazardous materials spills, handled and storage on site may occur.

#### 9.1.5.2 Operational Phase

Soil pollution due to potential hydrocarbon spills, spills of potentially hazardous materials handled and stored on site may occur.

#### 9.1.5.3 Decommissioning Phase

In the absence of site rehabilitation, soil pollution impacts identified during the Operational Phase are expected to continue after the decommissioning of the site.

### 9.1.6 Topography

The proposed Sasol CSP Project will not result in any significant alteration of the topography of the area. Limited top and subsoil stockpiles will be placed during the construction phase of the project and will remain on site during the operational phase for re-use during rehabilitation after the decommissioning of the facility.

## 9.1.7 Land Use and Land Capability

### 9.1.7.1 Construction Phase

Impacts during the Construction Phase of the project relates to the transformation of land resulting from the removal of vegetation and soils as part of the construction activities. The transformation of land will result in the loss of grazing land (the current land use). Land transformation is limited to the surface infrastructure development footprint and the solar field. The estimated extent of the impact is approximately 20% of the total site area.

### 9.1.7.2 Operational Phase

The impacts associated with the loss of grazing land will increase in extent if the entire farm portion is fenced for security purposes in which instance viable untransformed grazing land will be become inaccessible. The indirect impact reduction is the reduction in sales to support the local economy.

### 9.1.7.3 Decommissioning Phase

At decommissioning surface infrastructure and services will be removed. The capability of the land to restore itself (in the absence of rehabilitation) is limited and the land capability is expected be low for an extended period of time after the decommissioning of the facility.

## 9.1.8 Hydrology

### 9.1.8.1 Construction Phase

Land clearing activities undertaken as part of the Construction Phase will result in the increased stormwater flow volumes resulting from the clearing of vegetation. Increased flow volumes will reduce infiltration and increase peak flows. These impacts will be specific to the receiving watercourses (the Helbrandleegte and Helbrandkloofspruit originating on the proposed development site).

Stormwater quality will deteriorate as a result of construction activities and increased turbidity and suspended solids are expected. Surface water quality impacts due to potential hydrocarbon spills, spills of potentially hazardous materials handled and stored on site can be expected. Inadequate waste water treatment and waste management activities may result in the biological contamination of surface water.

### 9.1.8.2 Operational Phase

The increase in impermeable surface (surface infrastructure) will, similar to the Construction Phase, result in increased stormwater flow volumes, reduced infiltration and increased peak flow. Increased flow rates increases the soil erosion potential which will impact on stormwater and surface water quality through turbidity and suspended solids. Surface water quality impacts due to potential hydrocarbon spills, spills of potentially hazardous materials handled and stored on site can be expected. Inadequate waste water treatment and waste management activities may result in the biological contamination of surface water.

### 9.1.8.3 Decommissioning Phase

In the absence of site rehabilitation, stormwater and surface water quality impacts identified during the Operational Phase are expected to continue after the decommissioning of the site.

## 9.1.9 Geohydrology

### 9.1.9.1 Construction Phase

Through the increase in impervious areas and resultant surface runoff during the construction of the project, the infiltration of water into the soil is expected to be reduced. This will lead to some reduction in the groundwater recharge. The limited extent of the impervious areas (i.e. roads, buildings, evaporation pond and stormwater infrastructure), and since the unchannelled runoff is expected to re-infiltrate into the sandy soils the impact is expected to be low.

Groundwater pollution is expected as a result of recharge by contaminated surface water.

### 9.1.9.2 Operational Phase

Refer to Section 9.1.9.1

Water supply to the facility will not be by means of groundwater abstraction and impacts related to aquifer dewatering are not applicable.

### 9.1.9.3 Decommissioning Phase

In the absence of site rehabilitation, groundwater quality impacts identified during the Construction and Operational Phases are expected to continue after the decommissioning of the site.

## 9.1.10 Biodiversity (Flora)

### 9.1.10.1 Construction Phase

Land clearing activities during the Construction Phase of the project will result in the loss of habitat. The vegetation type is not regarded as sensitive and the impact is regarded to have a low significance and no threatened species were identified on the project site.

The introduction of weeds and alien invasive species present a significant risk to habitat degradation beyond the footprint of the project.

Erosion resulting from increased stormwater flow rates may result in the loss of vegetation cover due to soil disturbances.

### 9.1.10.2 Operational Phase

Impacts during the Operational Phase of the project relate to the introduction of weeds and alien invasive plant species as well as the loss of vegetation due to soil erosion (refer to Section 9.1.10.1).

### 9.1.10.3 Decommissioning Phase

In the absence of site rehabilitation, impacts associated with the loss of habitat will continue beyond the Operational Phase of the project.

## 9.1.11 Biodiversity (Fauna)

### 9.1.11.1 Construction Phase

Areas larger than 10 hectares are considered to have significant environmental footprint impact, particularly with regard to changes in landforms, drainage patterns, dust generation and conversion of untransformed

areas. As a result of the proposed project, vegetation will be removed for infrastructure such as the power block and roads and a loss of habitat will occur. Vegetation will largely remain in the heliostat and CPV fields. The ephemeral pans and river streams provide essential habitat links between other water bodies for migratory species for brief periods, particularly in semi-desert regions. The CSP project may result in the loss of this habitat.

All terrestrial species will be directly affected particularly those that are sedentary such as the Bushveld Gerbil and Bushveld Elephant-shrew, amphibian, reptile and all the arachnids including the Rock and Burrowing Scorpions. The main reason for this is the inability of these species to react in time to disturbance or the inability to relocate.

Project activities, particularly more so in the construction than operational phases, will create noise, dust and general disturbances which will cause animals to move away from the immediate area. The species most likely affected will be the larger species and they will react by retreating to less disturbed neighbouring areas. As most small and some medium-sized mammal species as well as most reptile species construct refuges below-ground or on specific localized micro-habitats, their response to the envisaged activities is more likely to seek refuge in their burrows or nests rather than to escape, and they are thus at significant risk of being killed.

The establishment of a human presence or a project in an area increases the opportunity for interactions between fauna and the associated structures, servitudes and personnel. Road systems related to this project are not expected to be high traffic zones except in the construction phase of the project. Incidences of road mortalities as a result of vehicular traffic especially with respect to terrestrial and slow moving species are expected. With increased human presence and movement in an area there is usually an associated risk of poaching, and sometimes of the capture and trade of certain species.

Staff should be made aware of certain species of dangerous fauna that are present in the area. Common species include Black Spitting Cobras, Cape Cobras, Coral Shield Cobras, Puff Adders, Horned Adders and Thick-tailed Scorpions.

The presence of an evaporation pond in a semi-desert region may attract fauna which can cause accidental drowning.

The construction phase will result in excavations, pits, dumps, blasting, noise pollution and generation of dust. Dust emission can affect the greater area as it can cause a decline in the growth vitality, palatability and quality of food plants. Various forms of pollution and environmental degradation are associated with new facilities. These include air, noise, soil and water pollution which will a direct health impact on fauna.

Noise and vibrations from construction activity, operating machinery and passing vehicles in the construction phase will affect all species concerned to a lesser extent.

Local extinction of terrestrial sedentary species is anticipated as a result of land clearing activities. Conservation-worthy species most likely to be affected include the Angolan Wing-gland Bat, the Bushveld Gerbil, the Bushveld Elephant-shrew, the Giant Bullfrog and all the Baboon Spiders and Scorpions.

Although widely distributed, the hybridisation of African Wild Cats with domestic or feral cats is a possible impact of concern. It is becoming increasingly difficult to find populations of pure African Wild Cats and the Kalahari region is considered to hold some of the less contaminated populations of the species. Increase in the risk of the introduction of new strains of existing diseases as well as entirely new diseases and parasites to the local faunal populations are possible.

The presence of the Orange River to the south and the associated agricultural disturbances has both a positive and negative effect respectively on diversity in the region. The area supports a varying degree of faunal diversity, but which is particularly reduced in the degraded areas of the farm. The natural species richness, diversity, endemism is already extremely low, with perhaps the exception of Scorpions, and this is typical of a semi-desert area. The project is expected to have a contributing impact on the loss of species diversity resulting from habitat destruction.

#### 9.1.11.2 Operational Phase

No additional impact other to those identified in the Construction Phase is expected to occur during the Operational Phase of the project.

#### 9.1.11.3 Decommissioning Phase

In the absence of rehabilitation, impacts associated with the loss of habitat and ecosystem pollution is expected to continue.

### 9.1.12 Avifauna

#### 9.1.12.1 Construction Phase

- Land transformation activities will result in the destruction of foraging, roosting and nesting habitat. Although birds are unlikely to suffer direct mortality from these activities, displacement will occur. Success of colonising adjacent areas depends on habitat quality, population dynamics, vacant niches and non-reliance on specialist life-history traits. Generalist bird species will be less affected than the few more specialised species.
- Human and mechanical activities may result in the displacement or disturbance birds in the immediate vicinity of the construction site. Most wild birds are not habituated to persist commensally with such high levels of disturbance and are likely to vacate the wider site area or utilise it only during periods of low human and mechanical activity.
- Increased poaching of birds by persons on site may occur.
- The installation of electricity transmission infrastructure will extend beyond the immediate project area and will temporarily displace birds from the specific zones. This impact is temporary but extends beyond project site boundaries.

#### 9.1.12.2 Operational Phase

The heliostat field and PV array will cover a large surface area and as each heliostat is effectively a highly reflective mirror, it may result in:

- Confuse or disorient birds in flight and thus cause collisions;
- The reflective surface can be mistaken for water and attract birds, thus causing collisions with the heliostats or incineration in focal standby points;
- Reflect the image of a bird, with the consequence of attracting territorial birds that can ultimately injure or kill themselves. Studies have shown that 61% of all CSP-related avian mortalities are as a result of collisions with heliostats.

Daily operation of the focal standby points has been shown to have a significant impact on bird mortalities, especially aerial feeders such as swifts and swallows that can be incinerated by the superheated concentrated beam. Studies have shown that 19% of CSP-related bird mortalities result from incineration in focal standby points.

When in operation the central receiver becomes superheated and the risk exists that birds in the close vicinity will be incinerated. This is particularly relevant to aerial feeders and also species that have an affinity to roosting or nesting on tall buildings.

The existence and operation of the electricity transmission infrastructure, including pylons and power cables will attract birds as vantage points for hunting, safe sites for roosting or nesting (pylons). The risk of electrocution from and direct collision with cables is a real and proven hazard. However, the birds most at risk are large terrestrial game birds and larger raptors, neither of which is likely to occur on site with any frequency.

#### 9.1.12.3 Decommissioning Phase

In the absence of site rehabilitation, the impacts associated with the Decommissioning Phase of the development project relates to the loss of habitat.

## 9.1.13 Archaeology, Heritage and Cultural

### 9.1.13.1 Construction Phase

The recent historical site used for residential purposes is regarded as having a low cultural significance. The site will not be affected by the current site layout and no impacts are expected.

The Middle and Late Stone Age materials (stone tools) identified will be impacted on. The impact relates to the loss of heritage resources.

### 9.1.13.2 Operational Phase

No additional impacts are expected during the Operational Phase of the development project. This does not exclude the possibility of chance finds of heritage resources and / or graves.

### 9.1.13.3 Decommissioning Phase

No additional impacts are expected during the Decommissioning Phase of the development project.

## 9.1.14 Visual

### 9.1.14.1 Construction Phase

Project activities that will impact on the visual character of the area (visual resource) during the Construction Phase have been identified as:

- Land clearing: (facility footprint and infrastructure development such as the water pipeline and transmission line);
- Light pollution as a result of construction activities undertaken at night, and
- Visible dust pollution.

### 9.1.14.2 Operational Phase

Based on the contrast rating, which was undertaken from each of the surrounding receptors, an assessment was made on whether the proposed activities met the recommended visual objectives defined in order to protect the landscape character of the area. The following proposed activities were identified as resulting in visual impact:

- CSP Tower: Within the greater landscape, the visual impact of the tower during construction and operation will be moderate to high, with and without mitigation. The extent is widespread and will result in a landscape change in the area.
- Glow: A clearly noticeable triangular glowing shape is generated by the reflected light that will be visible from a widespread area.
- CSP mirrors and structures: Intense glint impacts during construction for ground-based receptors and long-term glint impacts on aircraft pilots and railway line staff.
- Lights at Night: Lights and night for security and aircraft warning would be required and, if not managed effectively, could significantly extend the zone of visual influence of the project.

#### 9.1.14.3 Decommissioning Phase

No significant visual impacts are expected after the decommissioning of the facility. During the dismantling, demolition and removal of infrastructure, impacts similar to those listed in the Construction Phase of the project is expected.

### 9.1.15 Traffic

#### 9.1.15.1 Construction Phase

During the construction phase of the project it is anticipated that there will be increased traffic, therefore the following impacts are envisioned:

- Increased traffic flow in the area, this will result in damage to road surfaces therefore possibly requiring additional maintenance it may also increase the potential for motor vehicle accidents; and
- The safety of the surrounding community may be impacted when crossing the roads that will have increased traffic.

#### 9.1.15.2 Operational Phase

The same impacts are anticipated for the operational phase of the project however, to a lesser extent because there will not be as many heavy vehicles accessing the site during the operational phase.

#### 9.1.15.3 Decommissioning Phase

No additional impacts other than those identified during the construction phase are expected.

### 9.1.16 Socio-economic

#### 9.1.16.1 Construction Phase

It has been indicated that a maximum of 800 jobs are likely to be created during parts of the construction phase of the solar facilities. This is likely to provide a limited number of job opportunities to the local communities, as there are limited skills available at the local level. Employment associated with the construction phase of the project is limited to a period of 24-36 months. The extent is likely to be predominantly at a national level. The opportunity for providing employment on a local and regional level is likely to have a positive impact on the local economy and socio-economic environment.

There are likely to be opportunities for local businesses to provide services and materials for the construction phase of the project. Currently industry and businesses in the Upington and Keimoes areas are limited to agricultural, light industry, small-scale construction and tourism related sectors. The increase in demand for new materials and services by the SSP may stimulate business and local economic development. The impact is limited to the medium-term (construction phase only), and has a regional influence, as locally sourced materials and services will be limited, but could impact the Northern Cape.

The construction phase is likely to lead to the influx of workers from outside the region. This could lead to social conflict over the resources and employment, and between those perceived as ‘local’ and ‘foreign’ communities and individuals. This in-migration may also have an impact on the local municipality and their ability to service additional people within the immediate areas. This impact is likely to be limited to the construction period, and local communities surrounding the site.

The influx of labour to an area such as Upington and surrounding communities could potentially have a negative impact on their general health status. The impact is likely to be significant in severity, as this may affect a portion of the population, but not all communities, and be limited to the construction phase. The

influence of the impact is likely to go beyond the boundary of the site (local communities. It is unlikely to have a regional impact.

Safety and security is a key potential impact of the proposed project for local stakeholders, especially the immediately surrounding landowners and farmers. In addition, local farmers have raised the issue that the influx of labourers from outside the area may result in an increase in petty crime, such as stock theft, and may be a threat to female residents. This is likely to only be for the duration of the construction phase, and only affect the area immediately surrounding the site.

In accordance with the noise, traffic and air quality specialist study reports, the proposed construction phase is likely to have a number of impacts on the area immediately surrounding the site, as well as on the neighbouring farms. Discussions held with neighbouring land owners indicated, that the majority of them are not particularly concerned. This is with the exception of one farmer whose house is located 2km north of the proposed site. This nuisance is limited to the construction phase, but is highly likely to occur.

#### 9.1.16.2 Operational Phase

The project will result in a fairly hight number of jobs during the operational phase. Jobs that are provided will a high level maintenance and on-going management. The management and maintenance jobs are likely to be sourced predominantly from outside the study area. There may be opportunities for local residents to be in low-skilled jobs, such as security and cleaning. These are likely to be long-term opportunities, and definitely will be required in order to operate the facility.

There is potential for the change in nature of the businesses, and economic development in the area to give rise to a change in nature of employment patterns in the area. The overall impact is therefore likely to be positive, as the local economy should adapt to absorb this change in sectors.

#### 9.1.16.3 Decommissioning Phase

Positive impacts resulting from skills development programmes and regional economic growth can be expected to continue after the decommissioning of the facility.

## 9.2 Impact Evaluation

The evaluation of impacts is conducted in terms of the criteria detailed in Table 53 to Table 58. The various environmental impacts and benefits of this project are discussed in terms of impact status, extent, duration, probability, and intensity. Impact significant is regarded as the sum of the impact extent, duration, probability and intensity and a numerical rating system will be applied to evaluate impact significance; therefore an impact magnitude and significance rating is applied to rate each identified impact in terms of its overall magnitude and significance (Table 58).

In order to adequately assess and evaluate the impacts and benefits associated with the project it was necessary to develop a methodology that would scientifically achieve this and to reduce the subjectivity involved in making such evaluations. To enable informed decision-making it is necessary to assess all legal requirements and clearly defined criteria in order to accurately determine the significance of the predicted impact or benefit on the surrounding natural and social environment.

### 9.2.1 Impact Status

The nature or status of the impact is determined by the conditions of the environment prior to construction and operation. A discussion on the nature of the impact will include a description of what causes the effect, what will be affected and how it will be affected. The nature of the impact can be described as negative, positive or neutral.

**Table 53: Status of Impact**

| RATING | DESCRIPTION | QUANTITATIVE RATING |
|---|---|---|
| **Positive** | A benefit to the receiving environment. | **P** |
| **Neutral** | No cost or benefit to the receiving environment. | **-** |
| **Negative** | A cost to the receiving environment. | N |

### 9.2.2 Impact Extent

The extent of an impact is considered as to whether impacts are either limited in extent of if it affects a wide area or group of people. Impact extent can be site specific (within the boundaries of the development area), local, regional or national and/or international.

**Table 54: Extent of Impact**

| RATING | DESCRIPTION | QUANTITATIVE RATING |
|---|---|---|
| **Low** | Site Specific; Occurs within the site boundary. | 1 |
| **Medium** | Local; Extends beyond the site boundary; Affects the immediate surrounding environment (i.e. up to 5 km from the Project Site boundary). | 2 |
| **High** | Regional; Extends far beyond the site boundary; Widespread effect (i.e. 5 km and more from the Project Site boundary). | 3 |
| **Very High** | National and/or international; Extends far beyond the site boundary; Widespread effect. | 4 |

### 9.2.3 Impact Duration

The duration of the impact refers to the time scale of the impact or benefit.

**Table 55: Duration of Impact**

| RATING | DESCRIPTION | QUANTITATIVE RATING |
|---|---|---|
| **Low** | Short term; Quickly reversible; Less than the project lifespan; 0 – 5 years. | 1 |
| **Medium** | Medium term; Reversible over time; Approximate lifespan of the project; 5 – 17 years. | 2 |
| **High** | Long term; Permanent; Extends beyond the decommissioning phase; >17 years. | 3 |

### 9.2.4 Impact Probability

The probability of the impact describes the likelihood of the impact actually occurring

**Table 56: Probability of Impact**

| RATING | DESCRIPTION | QUANTITATIVE RATING |
|---|---|---|
| **Improbable** | Possibility of the impact materialising is negligible; Chance of occurrence <10%. | 1 |
| **Probable** | Possibility that the impact will materialise is likely; Chance of occurrence 10 – 49.9%. | 2 |
| **Highly Probable** | It is expected that the impact will occur; Chance of occurrence 50 – 90%. | 3 |
| **Definite** | Impact will occur regardless of any prevention measures; Chance of occurrence >90%. | 4 |

### 9.2.5 Impact Intensity

The intensity of the impact is determined to quantify the magnitude of the impacts and benefits associated with the proposed project.

**Table 57: Intensity of Impact**

| RATING | DESCRIPTION | QUANTITATIVE RATING |
|---|---|---|
| **Maximum Benefit** | Where natural, cultural and / or social functions or processes are positively affected resulting in the maximum possible and permanent benefit. | + 5 |
| **Significant Benefit** | Where natural, cultural and / or social functions or processes are altered to the extent that it will result in temporary but significant benefit. | + 4 |
| **Beneficial** | Where the affected environment is altered but natural, cultural and / or social functions or processes continue, albeit in a modified, beneficial way. | + 3 |
| **Minor Benefit** | Where the impact affects the environment in such a way that natural, cultural and / or social functions or processes are only marginally benefited. | + 2 |
| **Negligible Benefit** | Where the impact affects the environment in such a way that natural, cultural and / or social functions or processes are negligibly benefited. | + 1 |
| **Neutral** | Where the impact affects the environment in such a way that natural, cultural and / or social functions or processes are not affected. | 0 |
| **Negligible** | Where the impact affects the environment in such a way that natural, cultural and / or social functions or processes are negligibly affected | - 1 |
| **Minor** | Where the impact affects the environment in such a way that natural, cultural and / or social functions or processes are only marginally affected. | - 2 |
| **Average** | Where the affected environment is altered but natural, cultural and / or social functions or processes continue, albeit in a modified way. | - 3 |
| **Severe** | Where natural, cultural and / or social functions or processes are altered to the extent that it will temporarily cease. | - 4 |

| RATING | DESCRIPTION | QUANTITATIVE RATING |
|---|---|---|
| **Very Severe** | Where natural, cultural and / or social functions or processes are altered to the extent that it will permanently cease. | - 5 |

### 9.2.6 Impact Significance

The impact magnitude and significance rating is utilised to rate each identified impact in terms of its overall magnitude and significance.

**Table 58: Impact Magnitude and Significance Rating**

| IMPACT | RATING | DESCRIPTION | QUANTITATIVE RATING |
|---|---|---|---|
| **Positive** | High | Of the highest positive order possible within the bounds of impacts that could occur. | + 12 – 16 |
| | Medium | Impact is real, but not substantial in relation to other impacts that might take effect within the bounds of those that could occur. Other means of achieving this benefit are approximately equal in time, cost and effort. | + 6 – 11 |
| | Low | Impacts is of a low order and therefore likely to have a limited effect. Alternative means of achieving this benefit are likely to be easier, cheaper, more effective and less time-consuming. | + 1 – 5 |
| **No Impact** | No Impact | Zero impact. | 0 |
| **Negative** | Low | Impact is of a low order and therefore likely to have little real effect. In the case of adverse impacts, mitigation is either easily achieved or little will be required, or both. Social, cultural, and economic activities of communities can continue unchanged. | - 1 – 5 |
| | Medium | Impact is real, but not substantial in relation to other impacts that might take effect within the bounds of those that could occur. In the case of adverse impacts, mitigation is both feasible and fairly possible. Social cultural and economic activities of communities are changed but can be continued (albeit in a different form). Modification of the project design or alternative action may be required. | - 6 – 11 |
| | High | Of the highest order possible within the bounds of impacts that could occur. In the case of adverse impacts, there is no possible mitigation that could offset the impact, or mitigation is difficult, expensive, time-consuming or a combination of these. Social, cultural and economic activities of communities are disrupted to such an extent that these come to a halt. | - 12 - 16 |

Table 59, Table 60 and Table 61, summarises the impacts for each individual phase of the project, namely the construction, operational and decommissioning / closure phases. The table summarises the identified / expected impacts of a proposed activity during each project phase both before and after the proposed mitigations measures. A description of the terms used in the table is detailed below:

**Aspect:** Refers to the physical, biophysical or socio-economic environmental components as investigated in the SEIA.

**General Impact:** Refers to the broad-spectrum or category of the expected impact being pollution, degradation, loss; etc.

**Specific Impact:** Refers to the actual activity that will cause the expected impact.

The complete Social and Environmental Management Plan is attached as **Appendix 16**.

**Table 59: Construction Phase**

| Issue | General Impact | Specific Impact | Cause/Aspect | Status | Impact significance prior to mitigation | | | | | Mitigation Measures | Impact significance post to mitigation | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | E | D | P | I | S | | E | D | P | I | S |
| Climate | Contribution to climate change | Emission of carbon and other greenhouse gasses into the atmosphere | Construction operations (land clearing) | N | -4 | -1 | -4 | -1 | -10 | ■ Ensure vehicle exhaust systems function correctly.<br>■ Ensure energy reduction practices are developed & implemented. | -4 | -1 | -2 | -1 | -8 |
| | | | Land based vehicle activity | N | -4 | -1 | -4 | -1 | -10 | | -4 | -1 | -2 | -1 | -8 |
| | | | Use of backup diesel generators during construction | N | -4 | -1 | -4 | -1 | -10 | | -4 | -1 | -2 | -1 | -8 |
| Air Quality | Fugitive Dust and PM | Reduction in ambient air quality from fugitive dust emissions | Particulate Matter (PM) emitted from the construction phase | N | -2 | -1 | -3 | -3 | -9 | ■ Dust suppression<br>■ Re-vegetation of areas as soon as possible<br>■ Reduction of drop height as far as is practicable<br>■ Reduction of speed of vehicles to keep within the applicable speed limits | -1 | -1 | -2 | -1 | -5 |
| Noise | Noise Pollution | Increased ambient noise levels | Construction activities | N | -2 | -1 | -3 | -2 | -8 | ■ All machinery used during construction will be maintained in sound mechanical condition<br>■ Appropriate use of PPE | -2 | -1 | -2 | -1 | -6 |
| | | | Use of diesel generators | N | -2 | -1 | -4 | -3 | -10 | ■ On-site generators should be clad in suitable material or housed in structures that would reduce their noise impacts<br>■ Generators will be fitted with appropriate silencers.<br>■ Appropriate use of PPE | -1 | -1 | -4 | -1 | -7 |
| | | | Increase traffic flow (on-site) | N | -2 | -1 | -4 | -3 | -10 | ■ All vehicles will be fitted with appropriate sound suppression devices or silencers<br>■ Keep within the applicable speed limits | -2 | -1 | -4 | -2 | -9 |

| Issue | General Impact | Specific Impact | Cause/Aspect | Status | Impact significance prior to mitigation | | | | | Mitigation Measures | Impact significance post to mitigation | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | E | D | P | I | S | | E | D | P | I | S |
| Soils | Disturbance of topsoil | Soil disturbance, loss of nutrients, loss of topsoil cover, loss of in situ structure and physical / chemical properties | Clearing of vegetation for infrastructure development (roads, top structure, services) | N | -1 | -3 | -4 | -4 | -12 | ■ Strip and stockpile top- and subsoils appropriately<br>■ Commence rehabilitation of affected and completed areas<br>■ Application of soil handling and removal practices (including vegetative cover)<br>■ Application of soil emplacement and storage practices<br>■ Fertilisation and amendments<br>■ Re-use top- and subsoils during ongoing rehabilitation<br>■ Erosion control and treatment<br>■ Implementation of good housekeeping practices (vehicle maintenance and waste management)<br>■ Correct storage of dangerous goods, waste and other material which may cause contamination<br>■ Spill clean up | -1 | -2 | -1 | -1 | -5 |
| | | Soil contamination | Spillages (hydrocarbons, chemicals and waste) | N | -1 | -3 | -3 | -4 | -11 | | -1 | -1 | -2 | -1 | -5 |
| Land use and capability | Change of land capability | Land Capability will be reduced to construction site (industrial use) | Disruption of ecosystem due to the construction and development activities | N | -1 | -3 | -4 | -4 | -12 | ■ Effective soil handling and removal practices<br>■ Effective soil emplacement and storage practices<br>■ Fertilisation and amendments.<br>■ Soil amelioration<br>■ Limiting the footprint of the construction activities to a minimum | -1 | -3 | -3 | -2 | -9 |

| Issue | General Impact | Specific Impact | Cause/Aspect | Status | Impact significance prior to mitigation | | | | | Mitigation Measures | Impact significance post to mitigation | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | E | D | P | I | S | | E | D | P | I | S |
| | Change of land use | Loss of natural habitat (i.e. a change of land use from grazing to industrial) | Industrial operation and infrastructure | N | -1 | -3 | -4 | -4 | -12 | ■ Limiting the footprint of the construction activities<br>■ Strip and stockpile top- and subsoils appropriately<br>■ Commence rehabilitation of affected and completed areas where appropriate, as soon as practically possible | -1 | -3 | -3 | -2 | -9 |
| Hydrology / Surface Water | Impact on surface water quality | Increased TDS, possible erosion (wind and water) | Stripping of vegetation as part of construction<br>Instability of stockpiles (top and subsoil) | N | -2 | -1 | -3 | -4 | -10 | ■ Limit areas to be stripped for construction purposes<br>■ Minimise erosion<br>■ Slope stabilisation<br>■ DTM model and implementation of surface water management plan | -1 | -1 | -2 | -2 | -6 |
| | | Surface water contamination | Spillages (hydrocarbons, chemicals and waste) | N | -2 | -2 | -3 | -5 | -12 | ■ Erosion control and treatment<br>■ Implementation of good housekeeping practices (vehicle maintenance and waste management)<br>■ Correct storage of dangerous goods, waste and other material which may cause contamination<br>■ Spill clean up | -1 | -2 | -2 | -2 | -7 |
| Geohydrology | Pollution | Groundwater quality deterioration | Contamination of localised aquifer due to waste management activities and sewage effluent disposal | N | -4 | -3 | -1 | -3 | -11 | ■ Implement recommended waste management systems<br>■ Manage inorganic substances on surface to prevent groundwater impacts | -4 | -3 | -1 | -1 | -9 |
| Flora | Destruction of local ecological integrity, decimation of vegetation on | Potential loss / degradation of local vegetation / habitat | Land transformation though infrastructure development | N | -1 | -3 | -4 | -4 | -12 | ■ Minimise construction footprint:<br>• Use existing roads where | -1 | -2 | -4 | -2 | -9 |

| Issue | General Impact | Specific Impact | Cause/ Aspect | Status | Impact significance prior to mitigation | | | | | Mitigation Measures | Impact significance post to mitigation | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | E | D | P | I | S | | E | D | P | I | S |
| | site, peripheral impacts relating to human presence & industrial activities | Alteration of natural ecological processes / ecosystem functioning | Creation of atypical/ non-natural habitat, presence of humans for prolonged periods | N | -2 | -3 | -4 | -5 | -14 | possible<br>• Clear minimum vegetation<br>• Maximise site vegetation retention areas<br>■ Preservation of vegetation<br>■ Implementation of conservation practices (including the control of weeds and alien invasive species)<br>■ Fire prevention<br>■ Ongoing rehabilitation | -2 | -2 | -4 | -3 | -11 |
| | | Introduction of species not associated with the region | High traffic volume between site & other areas | N | -3 | -3 | -2 | -3 | -11 | | -2 | -2 | -1 | -1 | -6 |
| | | Changes in vegetation dynamics | Fires, water, vegetation transformation | N | -2 | -3 | -3 | -4 | -12 | | -2 | -3 | -2 | -3 | -10 |
| | | Impacts on sensitive environments (receiving water body / watercourses) | Direct/ indirect impacts, physical or cumulative, wood harvesting, plant collection | N | -2 | -3 | -1 | -4 | -10 | | -1 | -3 | -1 | -1 | -6 |
| Fauna | Destruction of local ecological integrity, decimation of faunal habitat on site, peripheral impacts relating to human presence & construction activities | Potential loss / degradation of local faunal habitat and/or communities | Land transformation though infrastructure development | N | -2 | -3 | -4 | -5 | -14 | ■ Minimise construction footprint:<br>• Use existing roads where possible<br>• Clear minimum vegetation<br>• Maximise site vegetation retention areas | -2 | -3 | -4 | -3 | -12 |
| | | Road deaths of animals on access roads | Reckless driving and night-time driving on feeder and access roads | N | -1 | -1 | -1 | -3 | -6 | ■ Keep within the applicable speed limits<br>■ Prohibit night driving, except in case of emergencies | -1 | -1 | -1 | -2 | -5 |
| | | Alteration of natural ecosystem functioning/ disruption of migration routes | Land transformation though infrastructure development | N | -2 | -3 | -3 | -3 | -11 | ■ Minimise construction footprint:<br>• Use existing roads where possible<br>• Clear minimum vegetation<br>• Maximise site vegetation retention areas | -2 | -3 | -3 | -2 | -10 |
| | | Increase in poaching, snaring and trapping of animals | Increase in human habitation at the site and lack of environmental awareness | N | -2 | -1 | -2 | -3 | -8 | ■ Awareness training and stipulated disciplinary action | -2 | -1 | -2 | -2 | -7 |

| Issue | General Impact | Specific Impact | Cause/Aspect | Status | Impact significance prior to mitigation | | | | | Mitigation Measures | Impact significance post to mitigation | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | E | D | P | I | S | | E | D | P | I | S |
| | | Hybridisation of African Wild Cats with domestic or feral cats | Increase in human habitation at the site and lack of environmental awareness | N | -2 | -3 | -2 | -3 | -10 | ■ Awareness training and stipulated disciplinary action<br>■ Prohibit the introduction of domestics cats | -2 | -1 | -1 | -2 | -6 |
| | | Impact of chemical compounds from construction on animals | Release of hazardous/ bio-accumulating chemicals into the environment | N | -2 | -3 | -2 | -2 | -9 | ■ Eliminate leaching of chemicals<br>■ Implementation of containment structures<br>■ Responsible transportation and storage of chemicals | -2 | -3 | -1 | -1 | -7 |
| | | Attraction of animals to artificial surface water (animal drowning and increased interaction with workers on site) | Sources of artificial surface water introduced | N | -1 | -1 | -2 | -3 | -7 | ■ Limit open water sources to those required only<br>■ Monitor animal access<br>■ If required, fence open water sources | -1 | -1 | -1 | -2 | -5 |
| | | Loss of natural faunal species to introduced faunal species | Killing of small mammals by domestic cats and dogs | N | -2 | -2 | -2 | -3 | -9 | ■ Prevent introduction of foreign species by prohibiting all pets | -2 | -2 | -1 | -1 | -6 |
| Avifauna | Destruction of habitat | Destruction of foraging, roosting and nesting habitat | Land clearing for construction of surface infrastructure | N | -1 | -3 | -4 | -3 | -11 | ■ Minimise construction footprint:<br>• Use existing roads where possible<br>• Clear minimum vegetation<br>• Maximise site vegetation retention areas<br>■ Undertaken land clearing activities during the non-breeding season (if possible) | -1 | -2 | -4 | -3 | -10 |
| | Impact on distribution patterns | Increased human activity and noise | Construction activities | N | -2 | -1 | -4 | -3 | -10 | ■ Limit movement of people and machinery to the footprint of the site<br>■ Persons on site to be limited to authorised workers only | -1 | -1 | -3 | -1 | -6 |
| | Loss of avifauna | Loss of individual avifauna resulting from increased poaching | Presence of persons on site during the construction phase of the project | N | -2 | -1 | -2 | -3 | -8 | ■ Awareness training and stipulated disciplinary action | -2 | -1 | -2 | -2 | -7 |

| Issue | General Impact | Specific Impact | Cause/Aspect | Status | Impact significance prior to mitigation | | | | | Mitigation Measures | Impact significance post to mitigation | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | E | D | P | I | S | | E | D | P | I | S |
| Archaeological | Loss of archaeological / heritage resources | Middle and Late Stone Age materials (stone tools) | Land clearing and transformation by construction of infrastructure | N | -1 | -3 | -4 | -2 | -10 | ■ Collection, cataloguing, recording and removal of materials prior to the initiation of construction | -1 | -3 | -4 | -1 | -9 |
| | | The destruction of archaeological / heritage resources and or graves | Chance finds during land clearing and construction activities | - | 0 | 0 | 0 | 0 | 0 | ■ Development of a procedure dealing with chance finds | 0 | 0 | 0 | 0 | 0 |
| Visual | Visual impact and change of "sense of place" | Visual disturbance and change in landscape character | Land clearing: (facility footprint and infrastructure development such as the water pipeline and transmission line) | N | -2 | -1 | -4 | -2 | -9 | ■ Minimise construction footprint:<br>• Use existing roads where possible<br>• Clear minimum vegetation<br>• Maximise site vegetation retention areas<br>■ Commence rehabilitation of affected and completed areas where appropriate, as soon as practically possible | -1 | -1 | -4 | -1 | -7 |
| | | Light pollution | Construction activities undertaken at night | N | -2 | -1 | -3 | -2 | -8 | ■ Directional lighting located closer to the point of construction (within safety requirements).<br>■ LED directional lighting on perimeter security fence. | -2 | -1 | -3 | -1 | -7 |
| | | Visible dust pollution | Dust emissions form construction activities | N | -2 | -1 | -3 | -2 | -8 | ■ Dust suppression<br>■ Re-vegetation of areas as soon as possible<br>■ Reduction of drop height as far as is practicable<br>■ Reduction of speed of vehicles to keep within the applicable speed limits | -2 | -1 | -2 | -1 | -6 |
| | | Glare | Mirror construction | N | -2 | -1 | -2 | -3 | -8 | ■ Construct glare fence around mirror construction area to contain ground-based glint impacts during installation | -1 | -1 | -1 | -3 | -6 |

| Issue | General Impact | Specific Impact | Cause/Aspect | Status | Impact significance prior to mitigation | | | | | Mitigation Measures | Impact significance post to mitigation | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | E | D | P | I | S | | E | D | P | I | S |
| Waste | Contamination of soil and groundwater<br><br>Landfill space<br><br>Health risks - exposure to hazardous wastes | Consumption of land space | Generation and disposal of general waste to landfill | N | -1 | -3 | -3 | -2 | -9 | ■ Re-use of wastes – avoidance of virgin material<br>■ Recycling of wastes off site | -1 | -3 | -2 | -1 | -7 |
| | | Contamination of soil & groundwater.<br>Consumption of land space | On-site land filling / burial of biodegradable wastes (permanent on-site disposal) | N | -2 | -3 | -3 | -4 | -12 | ■ On-site disposal of organic food wastes to be prohibited | -2 | -3 | -1 | -1 | -7 |
| | | Contamination of soil | Temporary storage of hazardous waste on unprotected ground – on site or off-site<br><br>Hazardous waste spills outside contained areas | N | -2 | -3 | -3 | -4 | -12 | ■ Storage of hazardous wastes in purpose built stores (impermeable floors, bunding etc.)<br>■ Labelling of containers | -1 | -3 | -1 | -1 | -6 |
| | | Contamination of groundwater | Disposal of hazardous wastes on general landfills | N | -2 | -3 | -3 | -3 | -11 | ■ Contactor control<br>■ Traceability (documentation) and reconciliation of waste disposed | -2 | -3 | -2 | -2 | -9 |
| | | Litter -aesthetic impacts<br>Litter - ingestion by animals | Waste not placed in designated waste bins / containers | N | -1 | -1 | -2 | -2 | -6 | ■ Provision of bins<br>■ Management and education of people | -1 | -1 | -1 | -1 | -4 |
| | | Odour – unpleasant and may attract pests and wildlife | Waste not disposed of timeously or kept in closed containers | N | -2 | -1 | -2 | -2 | -7 | ■ Frequent removal of waste | -1 | -1 | -1 | -2 | -5 |
| Traffic | Increased traffic | Traffic congestion | Increased light and heavy vehicles gaining access to the site during the construction phase | N | -2 | -1 | -2 | -2 | -7 | ■ Avoid heavy vehicle movement on public roads during peak traffic hours | -2 | -1 | -1 | -2 | -6 |
| | | Damage to surrounding road surfaces | | N | -2 | -3 | -1 | -3 | -9 | ■ If required, undertake in conjunction with the local municipality, road repairs | -2 | -1 | -1 | -3 | -7 |
| | | Potential increase in motor vehicle accidents and community safety | | N | -2 | -1 | -2 | -3 | -8 | ■ Adhere to speed limits<br>■ Ensure adequate training of drivers | -2 | -1 | -1 | -3 | -7 |

| Issue | General Impact | Specific Impact | Cause/Aspect | Status | Impact significance prior to mitigation | | | | | Mitigation Measures | Impact significance post to mitigation | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | E | D | P | I | S | | E | D | P | I | S |
| Social | Employment | Creation of construction phase specific employment opportunities | Development of the Sasol CSP Project | P | 2 | 1 | 4 | 2 | +9 | ■ Site-specific construction positive impacts on unskilled, semi-skilled, skilled labour. But, little likelihood of sustained high involvement of local labour across community members. No clear means of mitigation, even with sourcing labour from directly affected area | 2 | 1 | 4 | 3 | +10 |
| | Employment<br>(directly affected area) | Creation of employment opportunities not directly related to the CSP Project itself. | Development of the Sasol CSP Project | P | 2 | 1 | 4 | 2 | +9 | ■ Focus on short-term employment opportunities near communities, preceded by extensive community liaison to support employment across community members | 2 | 1 | 4 | 3 | +10 |
| | HIV&AIDS | Increased infection rates (surrounding communities) | Development / construction phase of the Sasol CSP Project resulting in influx of people (workers) | N | -2 | -3 | -2 | -5 | -12 | ■ Sasol interventions on site, as per HIV/AIDS plan of action instituted by Sasol, and as per the Wellness Policy. Need to include condom programming, information and attitudinal change, gender relations and power over sexual decision-making, life skills education, testing, ARVs, recreational activities<br>■ Conduct within the context of a broader wellness programme (if applicable) | -2 | -3 | -1 | -2 | -8 |
| | Gender | Gender Inequality / Discrimination | Development / construction phase of the Sasol CSP Project resulting in influx of people (workers) | N | -2 | -2 | -4 | -4 | -12 | ■ Open dialogue about male and female employment opportunities<br>■ Specific requests for females with experience to apply for construction jobs | 2 | 1 | 2 | 1 | +6 |

**Table 60: Operational Phase**

| Issue | General Impact | Specific Impact | Cause/Aspect | Status | Impact significance prior to mitigation | | | | | Mitigation Measures | Impact significance post to mitigation | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | E | D | P | I | S | | E | D | P | I | S |
| Climate | Climate change | Emission of carbon and other greenhouse gasses into the atmosphere | Land based vehicle activity | N | -4 | -2 | -4 | -1 | -11 | ■ Ensure vehicle exhaust systems function correctly | -4 | -2 | -1 | -2 | -9 |
| | | | Use of backup diesel generators during operations | N | -4 | -1 | -4 | -1 | -10 | ■ Ensure energy reduction practices are developed & implemented | -4 | -1 | -3 | -1 | -9 |
| | | Reduction of the emission of carbon and greenhouse gasses into the atmosphere | Nature of the project – solar power generation | P | 4 | 2 | 4 | 2 | +12 | ■ No mitigation | 4 | 2 | 4 | 2 | +12 |
| Air Quality | Fugitive Dust and PM | Reduction in ambient air quality from fugitive dust emissions | Particulate Matter (PM) emitted from the operational phase | N | -2 | -2 | -3 | -2 | -9 | ■ Dust suppression<br>■ Reduction of speed of vehicles to keep within the applicable speed limits | -2 | -2 | -2 | -1 | -7 |
| | Air pollution | Reduction in ambient air quality from $SO_2$ and $NO_2$ emissions | Uncontrolled start-up of boiler | N | -2 | -2 | -3 | -2 | -9 | ■ Boiler to be fitted with $NO_2$ abatement technology to comply with National Standards; | -2 | -2 | -3 | -1 | -8 |
| Noise | Noise Pollution | Increased ambient noise levels | Operational phase activities (traffic, cooling fans) | N | -2 | -2 | -3 | -2 | -9 | ■ All vehicles used will be maintained in sound mechanical condition<br>■ Keep within the applicable speed limits<br>■ Where practical, the engineering design has made provision for the installation of enclosures around source equipment | -2 | -2 | -2 | -1 | -7 |
| | | | Use of back-up diesel generators | N | -2 | -1 | -4 | -3 | -10 | ■ On-site generators should be clad in suitable material or housed in structures that would reduce their noise impacts<br>■ Generators will be fitted with appropriate silencers. | -1 | -1 | -4 | -1 | -7 |

| Issue | General Impact | Specific Impact | Cause/ Aspect | Status | Impact significance prior to mitigation | | | | | Mitigation Measures | Impact significance post to mitigation | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | E | D | P | I | S | | E | D | P | I | S |
| Soils | Disturbance of topsoil | Soil disturbance, loss of nutrients, loss of topsoil cover, loss of in situ structure and physical / chemical properties | Soil erosion | N | -1 | -2 | -4 | -5 | -12 | ■ Erosion control and treatment<br>■ Implementation of good housekeeping practices (vehicle maintenance and waste management) | -1 | -2 | -2 | -2 | -7 |
| | | Soil contamination | Spillages (hydrocarbons, chemicals and waste) | N | -1 | -3 | -3 | -4 | -11 | ■ Correct storage of dangerous goods, waste and other material which may cause contamination<br>■ Spill clean up | -1 | -2 | -2 | -1 | -6 |
| use and capability | Change of land use | Loss of natural habitat (i.e. a change of land use from grazing to industrial) | Industrial operation and infrastructure | N | -1 | -3 | -4 | -4 | -12 | ■ Limiting the footprint of the facility | -1 | -1 | -2 | -2 | -6 |
| Hydrology / Surface Water | Impact on surface water quality | Increased TDS, possible erosion (wind and water) | Increase in impermeable surface resulting in increased flow causing erosion | N | -2 | -2 | -4 | -3 | -11 | ■ Minimise erosion<br>■ DTM model and implementation of surface water management plan | -2 | -2 | -2 | -2 | -8 |
| | | Surface water contamination | Spillages (hydrocarbons, chemicals and waste) | N | -2 | -3 | -3 | -4 | -12 | ■ Implementation of good housekeeping practices (vehicle maintenance and waste management)<br>■ Correct storage of dangerous goods, waste and other material which may cause contamination<br>■ Spill clean up | -2 | -3 | -2 | -1 | -8 |
| Geohydrology | Pollution | Groundwater quality deterioration | Contamination of localised aquifer due to waste management activities and sewage effluent disposal | N | -4 | -3 | -1 | -3 | -11 | ■ Implement recommended waste management systems<br>■ Manage inorganic substances on surface to prevent groundwater impacts | -4 | -3 | -1 | -1 | -9 |
| Flora | Destruction of local ecological integrity, decimation of vegetation on site, peripheral impacts relating to human presence & industrial | Introduction of species not associated with the region | High traffic volume between site & other areas | N | -3 | -3 | -2 | -3 | -11 | ■ Preservation of vegetation<br>■ Implementation of conservation practices (including the control of weeds and alien invasive species) | -2 | -2 | -1 | -1 | -6 |
| | | Changes in vegetation dynamics | Fires, water, vegetation transformation | N | -2 | -3 | -3 | -4 | -12 | | -2 | -3 | -2 | -3 | -10 |

| Issue | General Impact | Specific Impact | Cause/ Aspect | Status | Impact significance prior to mitigation | | | | | Mitigation Measures | Impact significance post to mitigation | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | E | D | P | I | S | | E | D | P | I | S |
| | activities | Impacts on sensitive environments (receiving water body / watercourses) | Direct/ indirect impacts, physical or cumulative, wood harvesting, plant collection | N | -2 | -3 | -1 | -4 | -10 | ■ Fire prevention<br>■ Ongoing rehabilitation | -1 | -3 | -1 | -1 | -6 |
| Fauna | Destruction of local ecological integrity, decimation of faunal habitat on site, peripheral impacts relating to human presence & construction activities | Road deaths of animals on access roads | Reckless driving and night-time driving on feeder and access roads | N | -1 | -2 | -1 | -3 | -7 | ■ Keep within the applicable speed limits<br>■ Prohibit night driving, except in case of emergencies | -1 | -2 | -1 | -2 | -6 |
| | | Increase in poaching, snaring and trapping of animals | Increase in human habitation at the site and lack of environmental awareness | N | -2 | -2 | -3 | -2 | -9 | ■ Awareness training and stipulated disciplinary action | -2 | -2 | -1 | -1 | -6 |
| | | Hybridisation of African Wild Cats with domestic or feral cats | Increase in human habitation at the site and lack of environmental awareness | N | -2 | -3 | -2 | -3 | -10 | ■ Awareness training and stipulated disciplinary action<br>■ Prohibit the introduction of domestics cats | -2 | -1 | -1 | -2 | -6 |
| | | Impact of chemical compounds on animals | Release of hazardous/ bio-accumulating chemicals into the environment | N | -2 | -3 | -2 | -2 | -9 | ■ Eliminate leaching of chemicals<br>■ Implementation of containment structures<br>■ Responsible transportation and storage of chemicals | -2 | -3 | -1 | -1 | -7 |
| | | Attraction of animals to artificial surface water (animal drowning and increased interaction with workers on site) | Sources of artificial surface water introduced | N | -2 | -2 | -2 | -2 | -8 | ■ Limit open water sources to those required only<br>■ Monitor animal access<br>■ If required, fence open water sources | -1 | -2 | -1 | -1 | -5 |
| | | Loss of natural faunal species to introduced faunal species | Killing of small mammals by domestic cats and dogs | N | -2 | -2 | -2 | -3 | -9 | ■ Prevent introduction of foreign species by prohibiting all pets | -2 | -2 | -1 | -1 | -6 |
| Avifauna | Loss of Avifauna | Heliostat collisions and incineration in focal standby points, electrocution from and direct collision with transmission lines | Collision with heliostat mirrors, incinerated by the superheated concentrated beam and collision with overhead transmission lines | N | -3 | -2 | -3 | -4 | -12 | ■ Remove vegetation from heliostat field to limit foraging areas | -3 | -2 | -3 | -3 | -11 |

| Issue | General Impact | Specific Impact | Cause/Aspect | Status | Impact significance prior to mitigation | | | | | Mitigation Measures | Impact significance post to mitigation | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | E | D | P | I | S | | E | D | P | I | S |
| Archaeological | Loss of archaeological / heritage resources | The destruction of archaeological / heritage resources and or graves | Chance finds during land clearing and construction activities | - | 0 | 0 | 0 | 0 | 0 | ■ Development of a procedure dealing with chance finds | 0 | 0 | 0 | 0 | 0 |
| Visual | Visual impact and change of "sense of place" | Glow | Triangular glowing shape generated by the reflected light from the CSP Tower | N | -3 | -2 | -4 | -2 | -11 | ■ Monitoring of all luminance emissions to assess potential health impacts to proximate receptors | -3 | -2 | -4 | -2 | -11 |
| | | Light Pollution | Operations at night | N | -2 | -2 | -2 | -2 | -8 | ■ Directional lighting located closer to the point of use<br>■ Use directional LED-type lighting of a green hue | -2 | -2 | -2 | -1 | -7 |
| | | Visual Impact | CSP Tower and associated buildings and structures | N | -3 | -2 | -4 | -3 | -12 | ■ Abate at sight mitigation could be implemented by planting trees at the receptor (if required)<br>■ Colour mitigation for all building structures must be implemented to ensure that natural earth colours that relate to the surrounding landscape colour are utilised | -3 | -2 | -4 | -2 | -11 |
| | | Glint | | N | -3 | -2 | -4 | -3 | -12 | ■ Aircraft flight patterns in relation to the site need to be assessed<br>■ A mirror malfunction procedure must be implemented to ensure that malfunctioning mirrors automatically face downwards<br>■ Glint monitoring program to inform South Africa best practice norms and standards | -3 | -2 | -4 | -3 | -12 |
| Waste | Contamination of soil and groundwater | Consumption of land space | Generation and disposal of general waste to landfill | N | -1 | -3 | -3 | -2 | -9 | ■ Re-use of wastes – avoidance of virgin material<br>■ Recycling of wastes off site | -1 | -3 | -2 | -1 | -7 |

| Issue | General Impact | Specific Impact | Cause/Aspect | Status | Impact significance prior to mitigation | | | | | Mitigation Measures | Impact significance post to mitigation | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | E | D | P | I | S | | E | D | P | I | S |
| | Landfill space<br><br>Health risks - exposure to hazardous wastes | Contamination of soil & groundwater.<br><br>Consumption of land space | On-site land filling / burial of biodegradable wastes (permanent on-site disposal) | N | -2 | -3 | -3 | -4 | -12 | ■ On-site disposal of organic food wastes to be prohibited | -2 | -3 | -1 | -1 | -7 |
| | | Contamination of soil | Temporary storage of hazardous waste on unprotected ground – on site or off-site<br><br>Hazardous waste spills outside contained areas | N | -2 | -3 | -3 | -4 | -12 | ■ Storage of hazardous wastes in purpose built stores (impermeable floors, bunding etc.)<br>■ Labelling of containers | -1 | -3 | -1 | -1 | -6 |
| | | Contamination of groundwater | Disposal of hazardous wastes on general landfills | N | -2 | -3 | -3 | -3 | -11 | ■ Contactor control<br>■ Traceability (documentation) and reconciliation of waste disposed | -2 | -3 | -2 | -2 | -9 |
| | | Litter -aesthetic impacts<br><br>Litter - ingestion by animals | Waste not placed in designated waste bins / containers | N | -1 | -1 | -2 | -2 | -6 | ■ Provision of bins<br>■ Management and education of people | -1 | -1 | -1 | -1 | -4 |
| | | Odour – unpleasant and may attract pests and wildlife | Waste not disposed of timeously or kept in closed containers | N | -2 | -1 | -2 | -2 | -7 | ■ Frequent removal of waste | -1 | -1 | -1 | -2 | -5 |
| Traffic | Increased traffic | Traffic congestion | Increased light and heavy vehicles gaining access to the site during the operational phase | N | -2 | -2 | -2 | -2 | -8 | ■ Avoid heavy vehicle movement on public roads during peak traffic hours | -2 | -2 | -1 | -2 | -7 |
| | | Damage to surrounding road surfaces | | N | -2 | -3 | -1 | -3 | -9 | ■ If required, undertake in conjunction with the local municipality, road repairs | -2 | -2 | -1 | -3 | -8 |
| | | Potential increase in motor vehicle accidents and community safety | | N | -2 | -2 | -2 | -3 | -9 | ■ Adhere to speed limits<br>■ Ensure adequate training of drivers | -2 | -2 | -1 | -3 | -8 |

| Issue | General Impact | Specific Impact | Cause/Aspect | Status | Impact significance prior to mitigation | | | | | Mitigation Measures | Impact significance post to mitigation | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | E | D | P | I | S | | E | D | P | I | S |
| Social | Employment | Creation of construction phase specific employment opportunities | Development of the Sasol CSP Project | P | 2 | 1 | 4 | 2 | +9 | ■ Site-specific construction positive impacts on unskilled, semi-skilled, skilled labour. But, little likelihood of sustained high involvement of local labour across community members. No clear means of mitigation, even with sourcing labour from directly affected area | 2 | 1 | 4 | 3 | +10 |
| | Employment<br>(directly affected area) | Creation of employment opportunities not directly related to the CSP Project itself. | Development of the Sasol CSP Project | P | 2 | 1 | 4 | 2 | +9 | ■ Focus on short-term employment opportunities near communities, preceded by extensive community liaison to support employment across community members | 2 | 1 | 4 | 3 | +10 |
| | HIV&AIDS | Increased infection rates (surrounding communities) | Operational phase of the Sasol CSP Project resulting in influx of people (workers) | N | -2 | -3 | -2 | -5 | -12 | ■ Sasol interventions on site, as per HIV/AIDS plan of action instituted by Sasol, and as per the Wellness Policy. Need to include condom programming, information and attitudinal change, gender relations and power over sexual decision-making, life skills education, testing, ARVs, recreational activities<br>■ Conduct within the context of a broader wellness programme (if applicable) | -2 | -3 | -1 | -2 | -8 |
| | Gender | | Operational phase of the Sasol CSP Project resulting in influx of people (workers) | N | -2 | -2 | -4 | -4 | -12 | ■ Open dialogue about male and female employment opportunities<br>■ Specific requests for females with experience to apply for construction jobs | 2 | 1 | 2 | 1 | +6 |

**Table 61: Decommissioning Phase**

| Issue | General Impact | Specific Impact | Cause/Aspect | Status | Impact significance prior to mitigation | | | | | Mitigation Measures | Impact significance post to mitigation | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | E | D | P | I | S | | E | D | P | I | S |
| Climate | Contribution to climate change | Emission of carbon and other greenhouse gasses into the atmosphere | Land based vehicle activity | N | -4 | -1 | -4 | -1 | -10 | ■ Ensure vehicle exhaust systems function correctly. | -4 | -1 | -2 | -1 | -8 |
| Air Quality | Fugitive Dust and PM | Reduction in ambient air quality from fugitive dust emissions | Particulate Matter (PM) emitted from the demolition and dismantling of infrastructure | N | -2 | -1 | -3 | -3 | -9 | ■ Dust suppression<br>■ Re-vegetation of areas as soon as possible<br>■ Reduction of drop height as far as is practicable<br>■ Reduction of speed of vehicles to keep within the applicable speed limits | -1 | -1 | -2 | -1 | -5 |
| Noise | Noise Pollution | Increased ambient noise levels | Demolition and dismantling of infrastructure | N | -2 | -1 | -4 | -3 | -10 | ■ All machinery used during construction will be maintained in sound mechanical condition<br>■ Appropriate use of PPE | -2 | -1 | -3 | -2 | -8 |
| | | | Increase traffic flow (on-site) | N | -2 | -1 | -4 | -3 | -10 | ■ All vehicles will be fitted with appropriate sound suppression devices or silencers<br>■ Keep within the applicable speed limits | -2 | -1 | -4 | -2 | -9 |
| Soils | Disturbance of topsoil | Soil disturbance, loss of nutrients, loss of topsoil cover, loss of in situ structure and physical / chemical properties | Clearing of vegetation resulting from demolition and dismantling activities | N | -1 | -2 | -2 | -2 | -7 | ■ Commence rehabilitation of affected and completed areas<br>■ Application of soil emplacement and storage practices | -1 | -1 | -1 | -1 | -4 |

| Issue | General Impact | Specific Impact | Cause/Aspect | Status | Impact significance prior to mitigation | | | | | Mitigation Measures | Impact significance post to mitigation | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | E | D | P | I | S | | E | D | P | I | S |
| | | Soil contamination | Spillages (hydrocarbons, chemicals and waste) | N | -1 | -3 | -3 | -4 | -11 | ■ Fertilisation and amendments<br>■ Erosion control and treatment<br>■ Implementation of good housekeeping practices (vehicle maintenance and waste management)<br>■ Correct storage of dangerous goods, waste and other material which may cause contamination<br>■ Spill clean up | -1 | -1 | -2 | -1 | -5 |
| Land use and capability | Restoration of land capability | Land Capability will be restored to "grazing land" | Rehabilitation of the project site | P | 1 | 3 | 3 | 3 | +10 | ■ Commence rehabilitation of affected and completed areas where appropriate, as soon as practically possible | 1 | 3 | 3 | 3 | +10 |
| | Restoration of land use | Land use will be restored to "grazing land" | Rehabilitation of the project site | P | 1 | 3 | 3 | 3 | +10 | ■ Commence rehabilitation of affected and completed areas where appropriate, as soon as practically possible | 1 | 3 | 3 | 3 | +10 |
| Hydrology / Surface Water | Impact on surface water quality | Increased TDS, possible erosion (wind and water) | Clearing of vegetation resulting from demolition and dismantling activities | N | -2 | -1 | -4 | -3 | -10 | ■ Minimise and manage erosion | -1 | -1 | -2 | -2 | -6 |
| | | Surface water contamination | Spillages (hydrocarbons, chemicals and waste) | N | -2 | -2 | -3 | -5 | -12 | ■ Implementation of good housekeeping practices (vehicle maintenance and waste management)<br>■ Correct storage of dangerous goods, waste and other material which may cause contamination<br>■ Spill clean up | -1 | -2 | -2 | -2 | -7 |
| Geohydrology | Pollution | Groundwater quality deterioration | Contamination of localised aquifer due to waste management activities | N | -4 | -3 | -1 | -3 | -11 | ■ Implement recommended waste management systems<br>■ Manage inorganic substances on surface to prevent groundwater impacts | -4 | -3 | -1 | -1 | -9 |

| Issue | General Impact | Specific Impact | Cause/Aspect | Status | Impact significance prior to mitigation | | | | | Mitigation Measures | Impact significance post to mitigation | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | E | D | P | I | S | | E | D | P | I | S |
| Flora | Restoration of local ecological integrity | Limited restoration of local vegetation / habitat | Restoration of ecosystem habitat through rehabilitation activities | P | 2 | 3 | 4 | 3 | +12 | ■ Undertake re-vegetation through the use of indigenous species<br>■ Control and management of weeds and invasive alien plant species | 2 | 3 | 4 | 3 | +12 |
| | Impacts as identified for the construction phase: During the process of demolition and dismantling of the facility, impacts similar to those identified during the construction of the project may occur. Reference is made to the impact assessment section for the construction phase. Management and mitigation measures will similarly apply. | | | | | | | | | | | | | | |
| Fauna (including avifauna) | Restoration of local ecological integrity | Restoration of local faunal habitat and/or communities | Restoration of ecosystem habitat through rehabilitation activities | P | 2 | 3 | 4 | 3 | +12 | ■ Undertake re-vegetation through the use of indigenous species<br>■ Control and management of weeds and invasive alien plant species | 2 | 3 | 4 | 3 | +12 |
| | Impacts as identified for the construction phase: During the process of demolition and dismantling of the facility, impacts similar to those identified during the construction of the project may occur. Reference is made to the impact assessment section for the construction phase. Management and mitigation measures will similarly apply. | | | | | | | | | | | | | | |
| Archaeological | Loss of archaeological / heritage resources | The destruction of archaeological / heritage resources and or graves | Chance finds during demolition activities | N | 0 | 0 | 0 | 0 | 0 | ■ Development of a procedure dealing with chance finds | 0 | 0 | 0 | 0 | 0 |
| Visual | Visual impact and change of "sense of place" | Visual disturbance and change in landscape character | Demolition and dismantling | N | -2 | -1 | -4 | -2 | -9 | ■ Commence rehabilitation of affected and completed areas where appropriate, as soon as practically possible | -1 | -1 | -4 | -1 | -7 |
| | | Light pollution | Demolition and dismantling activities undertaken at night | N | -2 | -1 | -3 | -2 | -8 | ■ Directional lighting located closer to the point of use (within safety requirements).<br>■ LED directional lighting on perimeter security fence. | -2 | -1 | -3 | -1 | -7 |

| Issue | General Impact | Specific Impact | Cause/ Aspect | Status | Impact significance prior to mitigation | | | | | Mitigation Measures | Impact significance post to mitigation | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | E | D | P | I | S | | E | D | P | I | S |
| | | Visible dust pollution | Dust emissions form decommissioning activities | N | -2 | -1 | -3 | -2 | -8 | ■ Dust suppression<br>■ Re-vegetation of areas as soon as possible<br>■ Reduction of drop height as far as is practicable<br>■ Reduction of speed of vehicles to keep within the applicable speed limits | -2 | -1 | -2 | -1 | -6 |
| Waste | Contamination of soil and groundwater<br><br>Landfill space<br><br>Health risks - exposure to hazardous wastes | Consumption of land space | Generation and disposal of general waste to landfill | N | -1 | -3 | -3 | -2 | -9 | ■ Re-use of wastes – avoidance of virgin material<br>■ Recycling of wastes off site | -1 | -3 | -2 | -1 | -7 |
| | | Contamination of soil & groundwater.<br><br>Consumption of land space | On-site land filling / burial of biodegradable wastes (permanent on-site disposal) | N | -2 | -3 | -3 | -4 | -12 | ■ On-site disposal of organic food wastes to be prohibited | -2 | -3 | -1 | -1 | -7 |
| | | Contamination of soil | Temporary storage of hazardous waste on unprotected ground – on site or off-site<br><br>Hazardous waste spills outside contained areas | N | -2 | -3 | -3 | -4 | -12 | ■ Storage of hazardous wastes in purpose built stores (impermeable floors, bunding etc.)<br>■ Labelling of containers | -1 | -3 | -1 | -1 | -6 |
| | | Contamination of groundwater | Disposal of hazardous wastes on general landfills | N | -2 | -3 | -3 | -3 | -11 | ■ Contactor control<br>■ Traceability (documentation) and reconciliation of waste disposed | -2 | -3 | -2 | -2 | -9 |
| | | Litter -aesthetic impacts<br><br>Litter - ingestion by animals | Waste not placed in designated waste bins / containers | N | -1 | -1 | -2 | -2 | -6 | ■ Provision of bins<br>■ Management and education of people | -1 | -1 | -1 | -1 | -4 |
| | | Odour – unpleasant and may attract pests and wildlife | Waste not disposed of timeously or kept in closed containers | N | -2 | -1 | -2 | -2 | -7 | ■ Frequent removal of waste | -1 | -1 | -1 | -2 | -5 |

| Issue | General Impact | Specific Impact | Cause/Aspect | Status | Impact significance prior to mitigation | | | | | Mitigation Measures | Impact significance post to mitigation | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | E | D | P | I | S | | E | D | P | I | S |
| Traffic | Increased traffic | Traffic congestion | Increased light and heavy vehicles gaining access to the site during the construction phase | N | -2 | -1 | -2 | -2 | -7 | ■ Avoid heavy vehicle movement on public roads during peak traffic hours | -2 | -1 | -1 | -2 | -6 |
| | | Damage to surrounding road surfaces | | N | -2 | -3 | -1 | -3 | -9 | ■ If required, undertake in conjunction with the local municipality, road repairs | -2 | -1 | -1 | -3 | -7 |
| | | Potential increase in motor vehicle accidents and community safety | | N | -2 | -1 | -2 | -3 | -8 | ■ Adhere to speed limits<br>■ Ensure adequate training of drivers | -2 | -1 | -1 | -3 | -7 |
| Social | Employment | Creation of decommissioning phase specific employment opportunities | Decommissioning of the Sasol CSP Project | P | 2 | 1 | 4 | 2 | +9 | ■ Site-specific positive impacts on unskilled, semi-skilled, skilled labour. But, little likelihood of sustained high involvement of local labour across community members. No clear means of mitigation, even with sourcing labour from directly affected area | 2 | 1 | 4 | 3 | +10 |
| | HIV&AIDS | Increased infection rates (surrounding communities) | Decommissioning phase of the Sasol CSP Project resulting in influx of people (workers) | N | -2 | -3 | -2 | -5 | -12 | ■ Sasol interventions on site, as per HIV/AIDS plan of action instituted by Sasol, and as per the Wellness Policy. Need to include condom programming, information and attitudinal change, gender relations and power over sexual decision-making, life skills education, testing, ARVs, recreational activities<br>■ Conduct within the context of a broader wellness programme (if applicable) | -2 | -3 | -1 | -2 | -8 |
| | Gender | Discrimination | Decommissioning phase of the Sasol CSP Project resulting in influx of people (workers) | N | -2 | -2 | -4 | -4 | -12 | ■ Open dialogue about male and female employment opportunities<br>■ Specific requests for females with experience to apply for jobs | 2 | 1 | 2 | 1 | +6 |

# 10 Cumulative Impacts

The following cumulative impacts have been identified to potentially result from the proposed development. Cumulative impacts are regarded as the incremental and combined effects of human activity which pose a significant threat to the environment. Cumulative impacts accrue over time, from one or more sources, and can result in the degradation of valuable resources.

Cumulative impacts are discussed through considering of the Sasol CSP facility in conjunction with the Eskom CSP facility on the farm Olyvenhouts Drift (located to north east of the Van Roois Vley farm). Additionally, impacts that may be regarded to contribute to existing impacts are highlighted.

Table 62 below identification of the cumulative impacts as provides a description thereof.

**Table 62: Cumulative impacts**

| Aspect | Impacts | Mitigation | Cause | Detailed Description |
|---|---|---|---|---|
| **Climate** | Release of greenhouse gas emissions | ■ Ensure vehicle exhaust systems function correctly.<br>■ Ensure energy reduction practices are developed & implemented. | ■ Land based vehicle activity<br>■ The use diesel generators<br>■ Clearing of vegetation negatively affects carbon sequestration efficiency and increase emissions resulting from decomposition | The release of greenhouse gasses and other contaminants to the atmosphere is expected as a result of land based vehicle activities and the use of diesel generators during the construction and possibly the operational phases. The clearing of vegetation negatively affects carbon sequestration efficiency and increase emissions resulting from decomposition. These impacts are regarded as insignificant in terms of contribution. The risks are recognised as a cumulative impact. |
| **Air Quality** | Degradation of air quality | ■ Boiler to be fitted with $NO_2$ abatement technology to comply with National Standards. | ■ $NO_2$ and $SO_2$ emissions from the start-up boiler | Pollutants expected from the start up boiler during the Operational Phase, includes $SO_2$ and $NO_2$. As the boiler will only be active for one hour per day, emissions will be limited. |
| **Noise** | No cumulative impacts expected | N/A | N/A | N/A |
| **Geology** | No impacts are expected | N/A | N/A | N/A |
| **Soils** | Loss of natural resource (topsoil) | ■ Commence rehabilitation of affected and completed areas<br>■ Application of soil emplacement and storage practices<br>■ Fertilisation and amendments<br>■ Erosion control and treatment<br>■ Implementation of good housekeeping practices (vehicle maintenance and waste management)<br>■ Correct storage of dangerous goods, waste and other material which may cause contamination<br>■ Spill clean up | ■ Soil erosion<br>■ Soil contamination by chemicals and hydrocarbons | The loss of topsoil as a natural resource may be regarded as cumulative impact. Refer to the description of the impact as included in the land use and capability section of the report. |
| **Topography** | No impacts are expected | N/A | N/A | N/A |
| **Land Use and Capability** | Loss of land currently available for grazing | ■ Commence rehabilitation of affected and completed areas where appropriate, as soon | Land transformed for the use a CSP Generation Plant. | Eskom recently obtained approval for the construction and operation of a CSP facility on the farm Olyvenhouts Drift. The farm Olynhouts is located to north east of the |

| Aspect | Impacts | Mitigation | Cause | Detailed Description |
|---|---|---|---|---|
| | | as practically possible<br>■ Commence rehabilitation of affected and completed areas where appropriate, as soon as practically possible | | Van Roois Vley farm. In terms of cumulative impact, the two developments in close proximity will have an increased cumulative impact as it relates to land use and capability. The regional impact on land use and capability remains insignificant given the untransformed nature of the region. |
| **Hydrology** | Surface water pollution | ■ Implementation of good housekeeping practices (vehicle maintenance and waste management)<br>■ Correct storage of dangerous goods, waste and other material which may cause contamination<br>■ Spill clean up | ■ Soil erosion<br>■ Soil contamination by chemicals and hydrocarbons<br>■ Microbial contamination from waste streams generated on site (including effluent) | Surface water quality impacts will extend beyond the boundary of the site if not managed appropriately. The Helbrandleegte spruit drains the majority of the property including the central and north-eastern portions, and flows in a south-eastern direction. The Helbrandkloofspruit drains the southern portion of the site, confluences with the Helbrandleegte 18km south-east of the site, and contributes to the Gariep River (formally the Orange River), 21km south-east of the site. Both of these watercourses are expected to be influenced by the development of the access road and plant therefore potentially affecting the water quality of the Gariep River.<br><br>The potential cumulative impact may increase in significance as a result of the development of the Eskom CSP facility on the adjacent farm portion. |
| **Geohydrology** | Groundwater pollution | ■ Implement recommended waste management systems<br>■ Manage inorganic substances on surface to prevent groundwater impacts | Groundwater contamination from waste stream (including effluent) - sources include, treated effluent from the sewage treatment facility, evaporations ponds and leachate waste storage facilities. | Groundwater contamination is regarded as a cumulative impact. According to the aquifer classification of South Africa (WRC, 1999), the aquifer of the region is classified as poor aquifer source (i.e. low yielding). Aquifer vulnerability is regarded as low, hence maintains a low vulnerability to contaminant migration within the aquifer medium. The aquifer is therefore regarded as having low susceptibility to the effects of anthropogenic contamination. The risks associated with groundwater contamination are regarded as low.<br><br>The potential cumulative impact may increase in significance as a result of the development of the Eskom CSP facility on the adjacent farm portion. |
| **Biodiversity (Flora, Fauna and Avifauna)** | Loss of biodiversity and disruption of existing ecosystem functioning | ■ Preservation of vegetation<br>■ Implementation of conservation practices (including the control of weeds and alien invasive species) | ■ Land transformed for the use a CSP Generation Plant.<br>■ Anthropological activities (poaching, pollution) | The cumulative impacts relate to land transformation resulting in the loss of habitat. The habitat type is not regarded as threatened and not unique to either the Olynhouts or Van Roois Vley farms and the impacts on a regional scale is not expected to be significant. |

| Aspect | Impacts | Mitigation | Cause | Detailed Description |
|---|---|---|---|---|
| | | ■ Ongoing rehabilitation | | |
| **Archaeology** | Loss of archaeological and heritage resources | ■ Collection, cataloguing, recording and removal of materials prior to the initiation of construction | ■ Land transformed for the use a CSP Generation Plant. | The Middle and Late Stone Age materials (stone tools) identified will be impacted on. The impact relates to the loss of heritage resources. This impact is regarded as cumulative representing a possible loss of resources of cultural significance not limited to the directly affected community. |
| **Visual** | Visual disturbance and change of landscape character. | ■ Directional lighting located closer to the point of construction (within safety requirements).<br>■ LED directional lighting on perimeter security fence.<br>■ Construct glare fence around mirror construction area to contain ground-based glint impacts during installation.<br>■ Abate at sight mitigation could be implemented by planting trees at the receptor (if required).<br>■ Colour mitigation for all building structures must be implemented to ensure that natural earth colours that relate to the surrounding landscape colour are utilised<br>■ Aircraft flight patterns in relation to the site need to be assessed.<br>■ A mirror malfunction procedure must be implemented to ensure that malfunctioning mirrors. automatically face downwards<br>■ Glint monitoring program to inform South Africa best practice norms and standards. | ■ The construction and operation of the Sasol CSP Tower;<br>■ Glow: A clearly noticeable triangular glowing shape is generated by the reflected light that will be visible from a widespread area.<br>■ CSP mirrors and structures: Intense glint impacts during construction for ground-based receptors and long-term glint impacts on aircraft pilots and railway line staff.<br>■ Lights at Night: Lights and night for security and aircraft warning would be required and, if not managed effectively, could significantly extend the zone of visual influence of the project. | The cumulative impacts relate to visual disturbance and glare is regarded to impact the regional “sense of place”. The development of the ESKOM CSP facility may result in a significant change in the way receptors perceive the landscape. |
| **Traffic** | Increased traffic | ■ If required, undertake in conjunction with the local municipality, road repairs | ■ Traffic congestion<br>■ Damage to surrounding road surfaces | The increase in traffic flow will have an impact on regional and national roads in the area. |

| Aspect | Impacts | Mitigation | Cause | Detailed Description |
|---|---|---|---|---|
| | | ■ Adhere to speed limits<br>■ Ensure adequate training of drivers | ■ Potential increase in motor vehicle accidents and community safety | |
| **Socio-Economic** | Regional economic benefit<br><br>Negative impact on their general health status | ■ Focus on employment opportunities near communities, preceded by extensive community liaison to support employment. across community members.<br>■ Sasol interventions on site, as per HIV/AIDS plan of action instituted by Sasol, and as per the Wellness Policy. Need to include condom programming, information and attitudinal change, gender relations and power over sexual decision-making, life skills education, testing, ARVs, recreational activities<br>■ Conduct within the context of a broader wellness programme (if applicable). | | There is potential for the change in nature of the businesses, and economic development in the area to give rise to a change in nature of employment patterns in the area. The overall impact is therefore likely to be positive, as the local economy should adapt to absorb this change in sectors.<br><br>The influx of labour to an area such as Upington and surrounding communities could potentially have a negative impact on their general health status. The impact is likely to be significant in severity, as this may affect a portion of the population, but not all communities, and be limited to the construction phase. The influence of the impact is likely to go beyond the boundary of the site (local communities. It is unlikely to have a regional impact.<br><br>Both the positive and negative impacts on the socio-economic environment will be increase in significance as a result of the combined development proposal implemented by Sasol and Eskom |

# 11 Environmental Impact Statement

In the assessment conducted by WSP and its specialist teams, no fatal flaws have been found to pertain to the Sasol CSP development and associated infrastructure for any of the bio-physical or socio-economic environmental aspects investigated. Impacts of high significance during the construction phase include:

- Dust emissions for land clearing and vehicle activity;
- Disturbance of topsoil (including potential contamination);
- Change in land use and capability;
- Surface water pollution, and
- The destruction and alteration of ecological systems.

The mitigation measures related to emissions and pollutions can be effectively mitigated through the implementation of the prescribed measures which reduce the impact significance. The change in land use and destruction and alteration of ecological systems will reduce slightly in significance through the implementation of mitigation measures though these impacts will only be mitigated effectively after the decommissioning of the project.

During the operational phase the impacts related to pollution and contamination is regarded as significant and can be managed effectively through the implementation of the mitigation measures. The impacts associated with visual disturbance and avifauna will reduce slightly in significance through the implementation of mitigation measures though these impacts will only be mitigated effectively after the decommissioning of the project.

All impacts associated with the project can be suitably mitigated or managed and positive impacts can be adequately enhanced. It is therefore WSP's recommendation that approval of Sasol CSP Project be granted to SNE. It is recommended that the authorisation should include the following conditions:

- All mitigation and management measures as outlined in the SEMP should be adhered to. Compliance with the SEMP will be regarded as a legal requirement.
- The SNE must appoint an Environmental Officer to oversee compliance with the SEMP. SNE will appoint an independent suitably qualified consultant to verify compliance with SEMP on an annual basis;
- A programme for continued improvement must be developed and implemented for all phases of the project. The programme must be a component of the Social and Environmental Management System, and
- A Health and Safety and Environmental Legal Register must be developed for the operational phase of the project to ensure legal compliance with all local, provincial and national health, safety and environmental legislation. The SNE will appoint an independent suitably qualified consultant to verify legal compliance on an annual basis.

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# 13 Appendices

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