VOLUME 1: Part I

Kalahari Solar Power Project - Environmental and Social Impact Assessment Report

Group Five (Pty) Ltd

June 2011

DEA REF NO: 12/12/20/1994

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WSP

QUALITY MANAGEMENT

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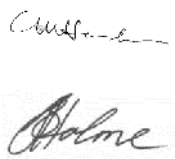
Signature				
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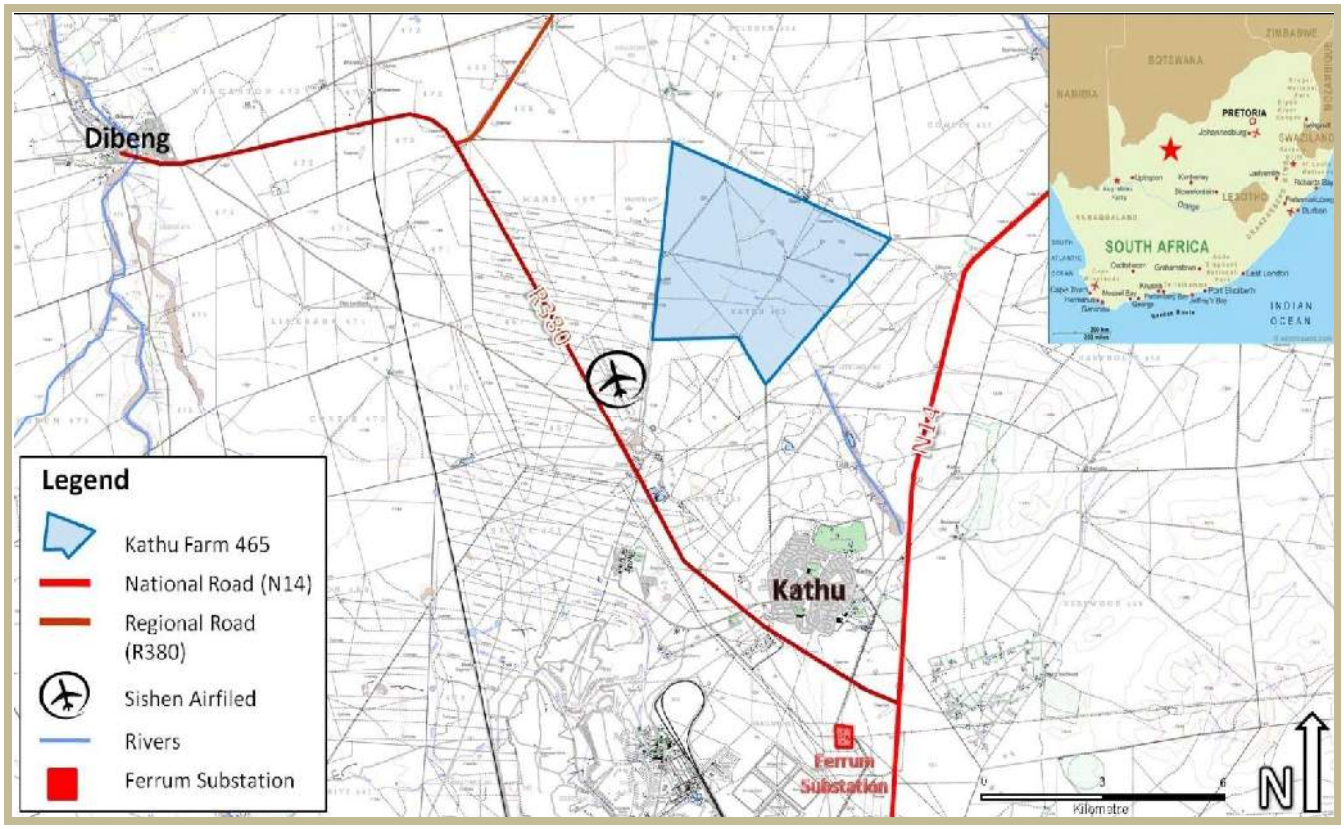
PROJECT BACKGROUND

Group Five (Pty) Ltd (Group Five) proposes to develop a solar power project in Kathu, in the Northern Cape. WSP Environment and Energy (WSP) were appointed by Group Five as the independent environmental assessment practitioner (EAP) on 2 June 2010 to undertake the environmental authorisation process.

The proposed Kalahari Solar Power project (KSP) triggers a number of listed activities according to Environmental Impact Assessment (EIA) Regulations GN R. 385, 386 and 387 of the National Environmental Management Act (No. 107 of 1998) and is therefore subject to an environmental authorisation procedure that includes a two-phase environmental and social impact assessment (ESIA) process, namely, scoping and impact assessment.

An application was submitted to the national Department of Environmental Affairs (DEA) on 19 July 2010 as the lead authority for environmental authorisation of energy sector projects which comply with the National Energy Response Plan (NERP) criteria. The reference number for the application is: 12/12/20/1994.



GOVERNANCE FRAMEWORK

The EIA Regulations (2006), in terms of the National Environmental Management Act (No. 107 of 1998), are applicable as the application form was submitted to the DEA prior to the promulgation of the new regulations that came into effect on 2 August 2010. The legal review undertaken for the proposed KSP project considers both the 2006 and the 2010 EIA Regulations to ensure best management practice. A legal review is an essential component of the ESIA and identifies the applicable legislation, including international, national and provincial legislation, local by-laws, policies and guidelines and relates them to the project specifics.

Due to the fact that the proposed project triggers activities listed under GNR. 387 a full scoping and ESIA process has been undertaken that includes an assessment of the potential environmental and social impacts associated with the proposed project. This process involved the following:

- Submission of an application form to the DEA (submitted on 19 July 2010);

- Compilation and submission of a Scoping Report (submitted on 29 November 2010), which included a plan of study for the ESIA;
- Stakeholder engagement (undertaken for the duration of the project); and
- A comprehensive ESIR and draft Environmental and Social Management Programme (ESMP) (this report).

The draft Environmental and Social Impact Report (ESIR) and ESMP will be submitted to the DEA and electronic copies will be submitted to other relevant authorities, including the Northern Cape Department of Environmental Affairs and Nature Conservation; Department of Energy; Department of Water Affairs; Department of Agriculture, Forestry and Fisheries; Wildlife and Environmental Society of South Africa; South African Heritage Resource Agency; Gamagara Local Municipality; Eskom; and the National Energy Regulator of South Africa for review, comment and authorisation.

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT AND MANAGEMENT PROGRAMME

A Scoping Report was submitted to the DEA on 29 November 2010 and this document is the ESIR and ESMP in support of the authorisation application for the proposed KSP project in Kathu, Northern Cape.

In line with the requirements of the NEMA EIA Regulations, this ESIR has provided:

- A motivation for the project;
- A detailed project description;
- A discussion on the assessment of all alternatives;
- A pre-development environment description utilising information and findings from specialist studies;
- A response to all issues raised by stakeholders and details of the continued stakeholder engagement process;
- An assessment of impacts on the biophysical and socio-economic environments;
- An environmental impact statement providing a summary of the impact assessment, a comparative assessment of the positive and negative findings and the environmental assessment practitioner (EAP) opinion on this project;
- Information on proposed management or mitigation measures that will be taken to address the environmental impacts that were identified in the impact assessment, including environmental impacts or objectives in respect of planning and design, pre-construction and construction activities and the operation or undertaking of the activities;
- A description of the aspects of the activity that are covered by the draft ESMP;
- An identification of the persons who will be responsible for the implementation of the mitigation measures; and
- Proposed mechanisms for monitoring compliance with the draft ESMP and reporting thereto.

In summary, the ESIR and ESMP have assessed both biophysical and socio-economic environments and identified appropriate management and mitigation measures. The biophysical impact assessment revealed that there are no environmental fatal flaws and no significant negative impacts associated with the proposed project should mitigation and management measures be implemented. In addition, it should be noted that the overall socio-economic impacts associated with the project are positive and include the creation of job opportunities and contributions to the local, regional and national economies.

WSP are of the opinion that should the identified mitigation and management measures be implemented, the proposed KSP project ought to proceed.

1 Introduction

Group Five (Pty) Ltd (Group Five) proposes to develop a solar power project in Kathu, in the Northern Cape (see Figure 1-1 for the locality plan). WSP Environment and Energy (WSP) were appointed by Group Five as the independent environmental assessment practitioner (EAP) on the 2 June 2010 to undertake the environmental authorisation process.

The proposed Kalahari Solar Power project (KSP) will trigger a number of listed activities according to Environmental Impact Assessment (EIA) Regulations GN R. 385, 386 and 387 of the National Environmental Management Act (No. 107 of 1998) and is therefore subject to an environmental authorisation procedure that includes a two-phase environmental impact assessment (EIA) process, namely, scoping and impact assessment.

An application was submitted to the national Department of Environmental Affairs (DEA) on the 19 July 2010 as the lead authority for environmental authorisation of energy sector projects which comply with the National Energy Response Plan (NERP) criteria (as detailed in **Section 2.1.4** of this report). The reference number for the application is: 12/12/20/1994.

This report documents the ESIA phase of the authorisation process and includes:

- A review of the relevant legislation, including: national energy policy; national, provincial and local environmental legislation and international lender policies and guidelines (**Section 2**);
- The approach and methodology utilized in the environmental authorisation process (**Section 3**);
- A description of the obligatory stakeholder engagement process and listing of issues of concern raised by stakeholders and identified by the technical project team (**Section 3.3**) – stakeholder concerns are a major input into the selection of subjects for specialist investigation (**Section 6**);
- A detailed discussion of site, technology and power line route alternatives (**Section 4**);
- A comprehensive project description, including all available details of project design (**Section 5**);
- A description of the key issues identified and summary findings of the associated specialist studies (**Section 6**);
- A description of the impact rating methodology and the detailed impact assessment (**Section 7**);
- The draft environmental management plan (EMP) (**Section 9**); and
- The impact statement, including recommendations (**Section 8**).

1.1 PROJECT BACKGROUND

South Africa's electricity demand started challenging Eskom's reserve margin during the winter of 2004 and more continuously from mid-2007. The sharp rise in demand required load shedding measures to be implemented during the first quarter of 2008. The global recession at the end of 2008 brought some relief to the continuous growth in energy demand but normalisation of the market has seen the energy gap continue to grow as early as the fourth quarter of 2010.

Government has responded to the Eskom crisis in various ways, with major policy shifts and strategic development in the energy sector over the past five years. While the policy and strategy development is not complete and is ongoing, key strategic developments have been the deregulation of generation capacity to allow independent power producers and the increasing profiling of renewable energy sources in the energy supply mix. Solar generation technologies are an obvious option to pursue in 'sunny South Africa'. Concentrated solar power (CSP) technology captures solar energy from large fields of solar mirrors/collectors and focuses it to heat boilers to drive steam turbines. Concentrated solar power plant sizes are now approaching 250MW, which are demonstrating improved electricity production costs due to the economies of scale. The life expectancy of a CSP plant is similar to that of any other power generation technology.

In the absence of suitable fossil fuel resources, concentrated solar power can provide distributed large scale, steady state power generation with low CO_2 emissions and relatively low water consumption. CSP projects are suited to semi-

desert regions where vast amounts of space are available for the required infrastructure. CSP requires clean blue skies with little cloud cover or water vapour. The Northern Cape region has the top solar resource in the country which ranks with some of the best solar statistics in the world.

Group Five has identified an opportunity to take advantage of government's strategic energy generation development programmes, notably the Renewable Energy Feed-in Tariff (REFIT) programme, to develop in three phases a 450MW CSP (approximately 3 x 150MW phases = 450MW) facility on a suitable site near Kathu. The KSP project has the capacity to deliver on all the main objectives and initiatives envisaged by the power sector. It would add sustainable renewable energy to the grid during operating hours and provide opportunities for private sector participation.

1.2 PROJECT MOTIVATION

In 2004, the South African Government introduced the Independent Power Producer (IPP) model which allows the private sector to develop and operate up to 30% of new generation across conventional generation mixes. The enabling regulatory environment that is needed for private sector engagement is only now starting to take shape and there may be the potential for bankable IPPs as early as March of 2011.

In 2008, the South African Government introduced a renewable energy subsidiary scheme. The South African REFIT Programme provided a guideline and viable opportunity for sponsors considering developing renewable energy projects. These guidelines included a tariff that offers attractive returns for the early/first entrants of a specified technology.

In 2010, the selection criteria guidelines for renewable energy were released by the National Energy Regulator of South Africa (NERSA). Intensive energy users, who have access to primary energy and/or who have access to an IPP developer with a power project, are considering generating power for their own use as captive off-takers. While power that is generated and consumed inside the fence has no need to feed into the grid, it is beneficial to have access to the grid to take up excess power from the captive power plant at a reasonable tariff. Smaller projects, such as the KSP Project, subject to grid access, can be implemented quicker and can help meet power conservation programme requirements when implemented.

The KSP project has the capacity to deliver on all the main objective and initiatives envisaged by the power sector. It would add energy to the grid during peak day periods. The project also has the potential to bring large scale power and stabilisation to the strategic part of the grid in the next 3 to 4 years. This is a significant contribution toward improving the reserve margin, therefore, reducing transmission losses and delaying the implementation of power conservation programmes and load shedding.

1.3 PROJECT LOCATION

The proposed site is located approximately 7km north-west of the town of Kathu on the farm Kathu 465, and lies within the Gamagara Local Municipality and the John Taolo Gaetsewe District Municipality, Northern Cape. The site is approximately 1,922ha in size and was previously used for small-scale cattle farming.

The farm is part of the land holdings of Sishen Iron Ore Company (Pty) Ltd and a Memorandum of Agreement which guarantees lease of the land to Group Five for the development of the KSP project is in place.

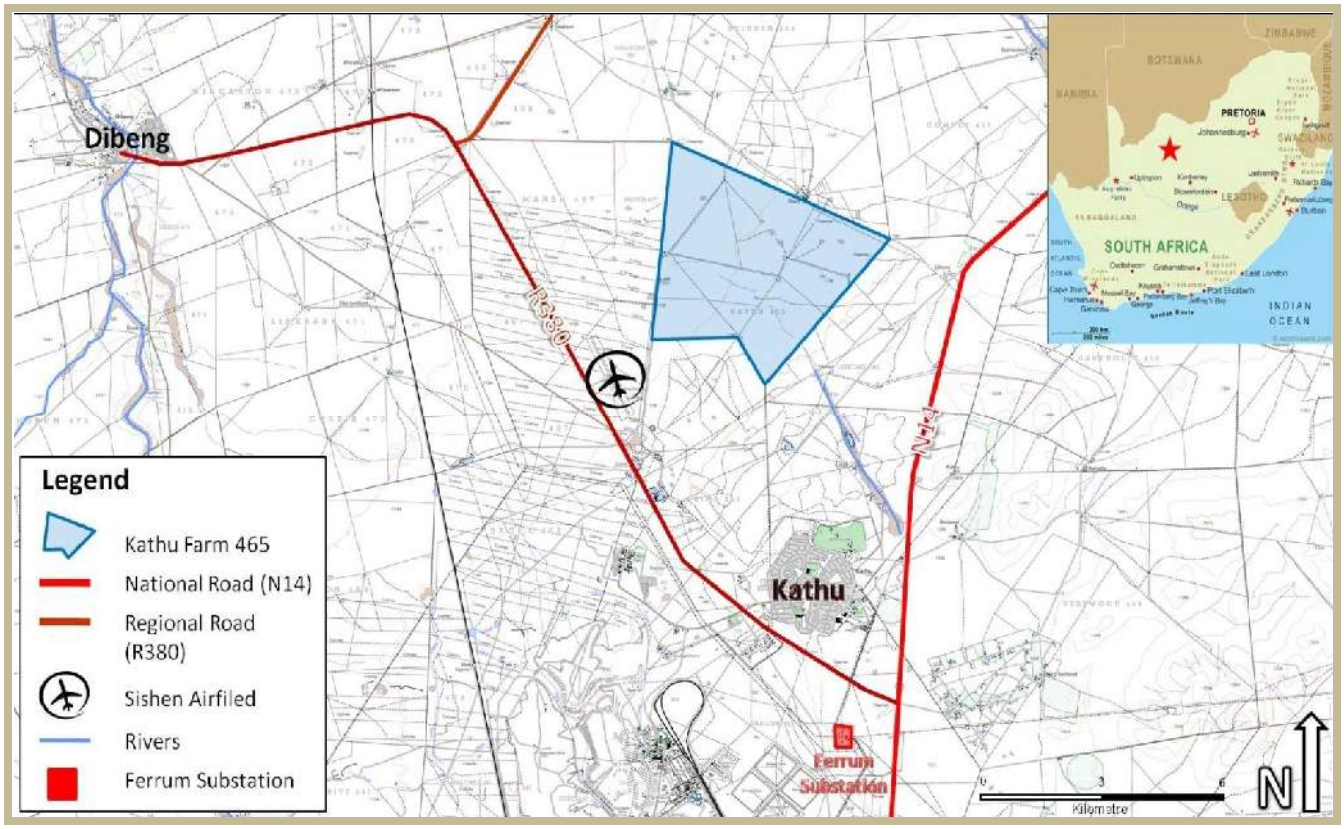


Figure 1-1: Site locality map (1:50 000 Topocadastral Map - 2722DB Dibeng Second Edition and 2723CA Kathu Second Edition, 2001)

The proposed KSP site is an irregularly shaped agricultural portion, consisting of flat grazing land subdivided by tracks and fences. The site boundaries are determined by cadastral boundaries in the west, south and east and a gravel road connecting the N14 with Sesheng in the north. The approximate area of Kathu 465 is 1,922ha and is currently zoned as Resort Zone 1 according to the town planning department. Refer to Figure 1-1 for the site location of Kathu Farm 465. Co-ordinates of the proposed site have been included in the satellite illustration in Figure 1-2.

The site is bordered by the Oupos farm on the north, the Uitkoms farm to the west, the Kalahari Golf & Jag development to the south and the Sishen airfield on the south west of the site. The Vaal-Gamagara Pipeline owned by Sedibeng Water, boarders the western border of the site and supplies potable water to Hotazel and Swartklip. A dirt road runs along the north of the property. Due to the fact that the dirt road will need to accommodate heavy load vehicles during the construction phase of the project, Group Five have indicated that the road to the north will be tarred, extending to the N14 highway. It has been proposed that the entrance to the site will be on the northern boundary.

Various pans have been identified on-site as well as non-perennial rivers running south east towards the Vlermuisleegte. A portion of the Kathu forest has also been identified on-site. According to the Department of Agriculture and Forestry, this forest is classified as category three species which has been taken into consideration. Although the identified Kathu forest will be protected during the lifespan of the project, a number of Camelthorn trees (not included in the forest) will need to be removed for site clearance. These trees will be identified and an application for removal will be applied for. No tree will be removed without authorisation from the Department of Agriculture and Forestry.

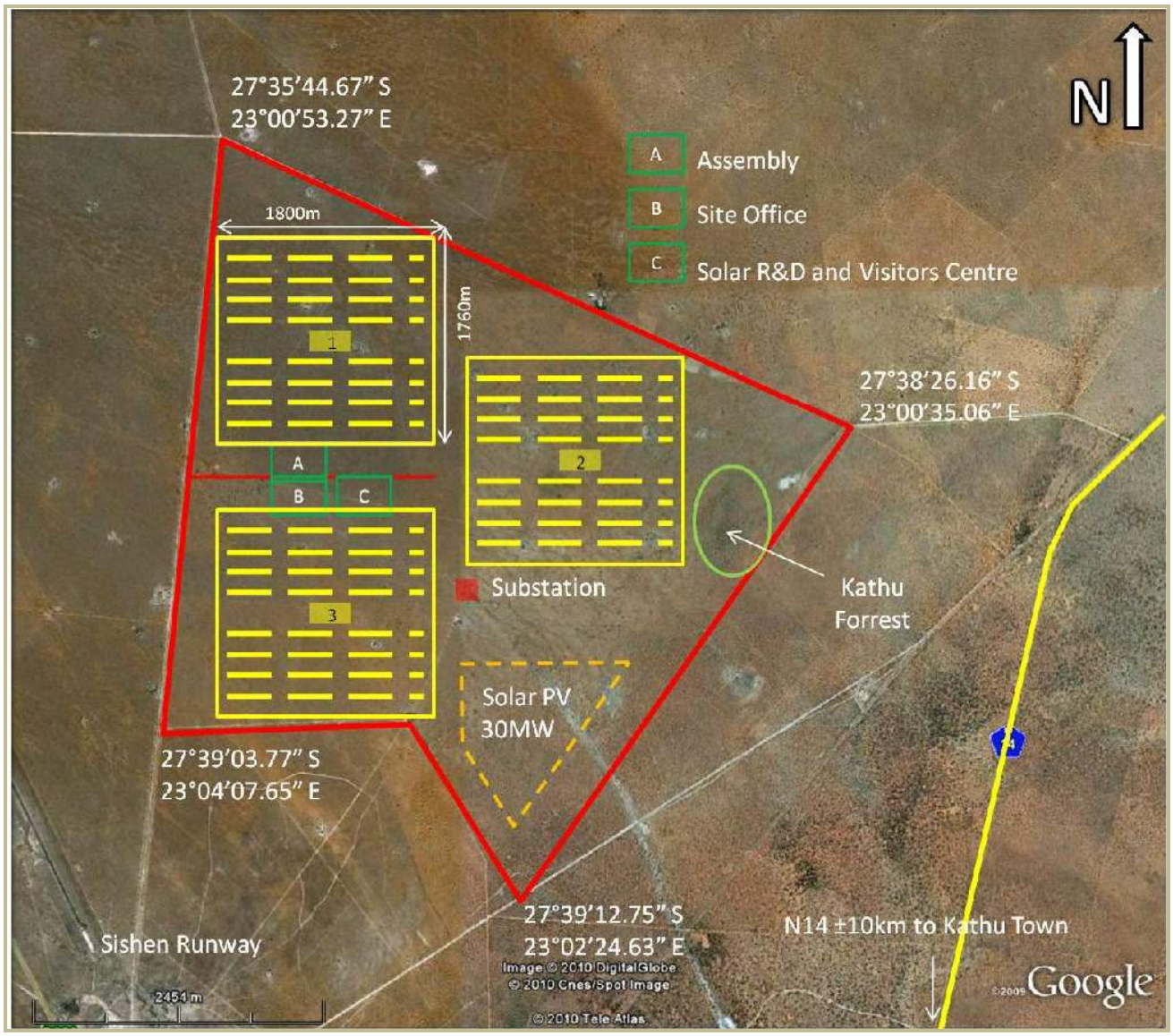


Figure 1-2: Satellite image of proposed project location (Google, 2011)

The site slopes gently to the west and south-east, with the highest area recording 1,216 metres above sea level on the north-eastern corner of the property. Figure 1-3 shows the general project layout and contours of the site. The originally proposed PV area to the south of the site has been removed from the project plan due to the potential impact on the Vlermuisleegte and Camelthorn trees.

1.4 OVERVIEW OF THE PROJECT

The KSP project will be one of the first large-scale solar power electricity generation projects in Southern Africa.

It will be developed in three phases, utilising the best available concentrated solar power technology, which is currently parabolic trough solar field and thermal generation. Each of the three phases will comprise a 75-150MW parabolic trough solar thermal power plant.

Each parabolic trough solar thermal power plant will consist of the following components:

- Solar field with parabolic trough collectors;
- Heat transfer fluid (HTF) system to transport the solar energy;
- Power block with steam turbine generator for the generation of electricity in a conventional Rankine cycle;

- Ancillary infrastructure:
  - Auxiliary system to drive and control the power plant electrical system;
  - Control systems.

The HTF system and the power block, including the steam cycle and cooling system, are located inside the solar field, as shown in the figure below. Several buildings related to process control are located within the power block area.

The collector has a linear parabolic shaped reflector that focuses the sun's direct beam radiation on the heat collection elements (HCE), located at the focus of the parabola. One HCE comprises a stainless steel tube with a highly absorptive, low emissivity coating which is encased in an outer glass tube evacuated to reduce thermal losses.

The collectors track the sun from east to west during the day to keep the sun's rays continuously focused on the receiver tube. The row of collectors has a hydraulic drive unit with sensors to determine appropriate collector orientation throughout the day and according to ambient conditions. The drive unit also reports operational status, alarms and diagnostics to the main solar field control room.

The HTF is heated to a high temperature (400°C) as it circulates through the receiver tube and returns to a series of heat exchangers in the power block where the fluid is used to generate high pressure superheated steam. The superheated steam is then fed to a conventional power block, consisting of a reheat steam turbine generator to produce electricity.

Group Five will also build a solar research and development centre on the site.

The construction of phase 1 and associated infrastructure will take approximately 24-30 months, with the construction of the succeeding phases proceeding in sequence immediately the previous phase is complete. The fully developed project will generate electricity for up to 25 years, but continuous refurbishment will almost certainly prolong its lifespan a long way beyond this.

Each phase's construction will require a total labour force of 500-600 persons, and 75 people will be permanently employed to operate each phase solar plant.

Alternatives considered in the development and design of the project, and details of the final project itself, are provided in **Sections 4** and **5**, respectively.

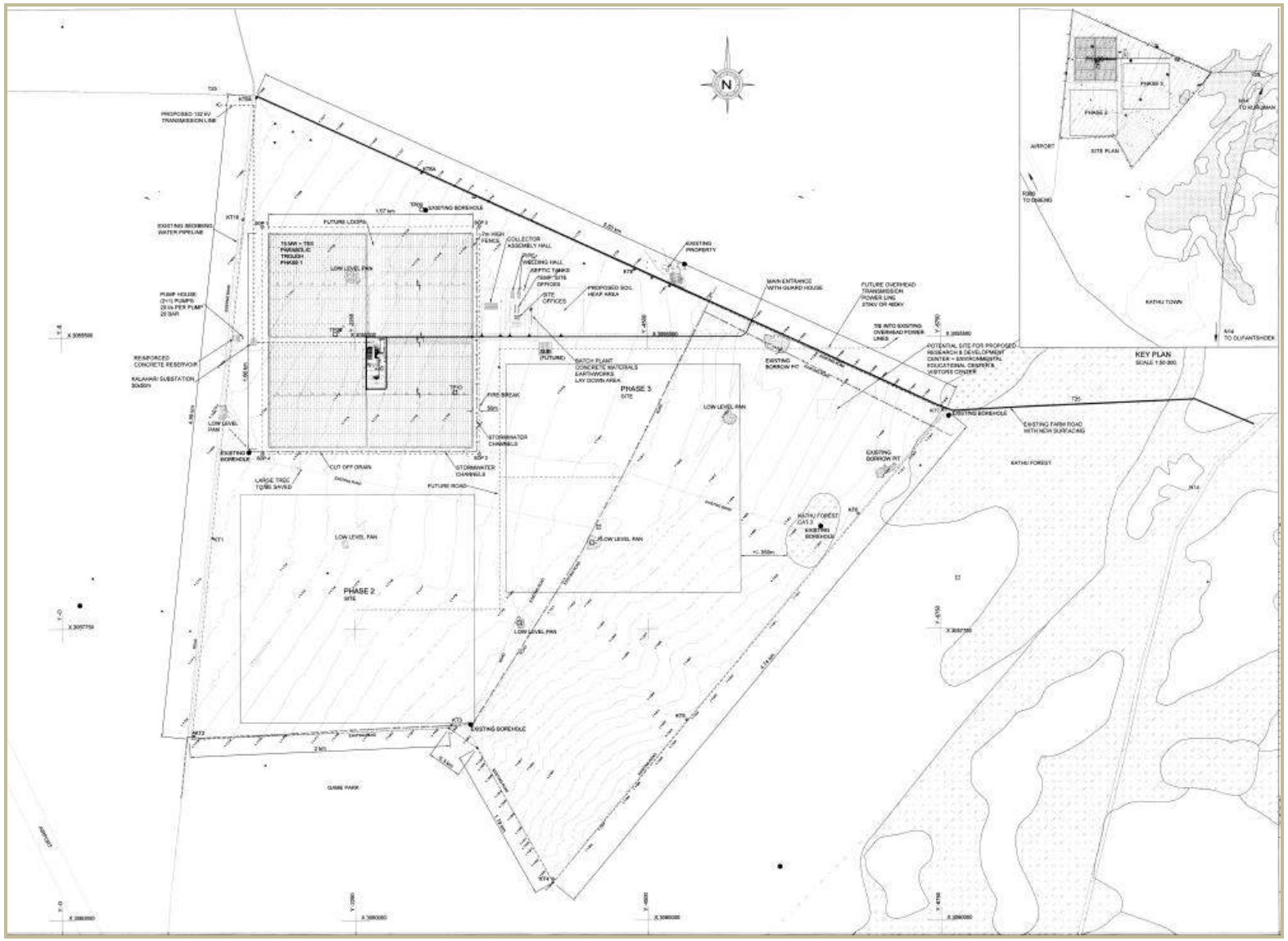


Figure 1-3: Layout plan indicating contours (Group Five, 2011)

1.5 DETAILS OF THE PROJECT PROPONENT

The applicant for the proposed KSP Project is Group Five (Pty) Ltd (Group Five). The relevant details are contained in Table 1-1:

Table 1-1: Project proponent details

Project Applicant	**Group Five (Pty) Ltd**
Company Registration/ Identity number for individuals:	1974/003166/07
Contact Person:	Chris Carnegie
Postal Address:	PO Box 5016 Rivonia 2128
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Fax:	011 513 7692
E-mail:	ccarnegie@groupfive.co.za

1.6 DETAILS OF THE ENVIRONMENTAL ASSESSMENT PRACTITIONER

WSP Environmental (Pty) Ltd (WSP) – details in Table 1-2 was appointed by Group Five as the independent environmental assessment practitioner (EAP) to facilitate the environmental authorisation process. 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 B**).

Table 1-2: Environmental assessment practitioner details

Environmental Assessment Practitioner:	**WSP Environment and Energy**	**WSP Environment and Energy**
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2 Governance Framework

The environmental impact assessment (EIA) Regulations (2006), in terms of the National Environmental Management Act (No. 107 of 1998), are applicable as the application form was submitted to the Department of Environmental Affairs (DEA) prior to the promulgation of the new regulations that came into effect on 2 August 2010. This legal review undertaken for the proposed KSP project will consider both the 2006 and the 2010 EIA Regulations (refer to **Appendix C**) to ensure best management practice. A legal review is an essential component of the ESIA and will identify the applicable legislation, including international, national and provincial legislation, local by-laws, policies and guidelines and relate them to the project specifics.

Worldwide over the past decade, renewable energy has progressed from a marginal energy source into the mainstream. As South Africa's demand for energy has exceeded supply, renewable energy in South Africa has increased rapidly. As well as being a favourable source of clean energy, it is important to realise the renewable energy technology and socio-economic potentials in the context of South Africa's development needs. Besides their favourable environmental contribution, the contribution to society (as employment and economic benefits) should be included.

The following statutes have been considered as relevant for the proposed project.

2.1 NATIONAL ENERGY POLICY

Due to the interdependent linkages between national energy policies and the development of this project, energy policy will be discussed in some detail in this section.

2.1.1 Renewable Energy Policy (DME, 2003b)

The White Paper on Renewable Energy supplements the White Paper on Energy Policy of the Republic of South Africa recognises that the medium and long-term potential of renewable energy is significant. South Africa relies heavily on coal to meet its energy needs due to its vast coal resources but recognises that the emissions of greenhouse gases from the use of fossil fuels such as coal and petroleum products has led to increasing concerns worldwide about global climate change. South Africa has an infinite renewable energy resource yield that can be sustainable alternatives to fossil fuels; so far these have remained largely untapped. It is the intention of the Government to make South Africa's due contribution to the global effort to mitigate greenhouse gas emissions.

Four key strategic areas are addressed in the White Paper to help Government meet its commitment to promoting renewable energy:

- Financial
- Legal
- Technology development
- Awareness raising, capacity building and education

The Department of Energy will take overall responsibility for renewable energy policy in South Africa. The Department will establish the appropriate enabling environment to ensure that activities undertaken by other stakeholders are co-ordinated, uniform and effective. According to Trollip and Marquard (2010), the implementation of the policy to date has been very low. A number of recent legislative, regulatory and planning process developments have advanced with the publication of the REFIT regulatory guidelines; although no substantial progress has been made in renewable energy implementation. Less than 10% of the targeted new renewable energy capacity has been achieved to date.

2.1.2 Integrated Energy Plan

A number of processes are underway that directly impact on renewable energy. An important process is the Integrated Energy Plan. At the end of 2003, the former Department of Minerals and Energy (DME) published an

Integrated Energy Plan (IEP; Energy Research Centre (ERC), 2006). This plan provided a framework for taking decisions on energy policy and for the development of different energy sources and energy technologies in the country (ERC, 2006). The ERC was contracted to undertake a computerised analysis of the plan based on energy reserves, energy demand, and consumption up to 2020, using different scenarios of the South African economy (ERC, 2006). These scenarios show future energy use from different energy sources, and evaluate the associated pollution, including emissions of greenhouse gases (ERC, 2006). The following is an overview of the goals of the Integrated Energy Plan (DME, 2003a):

- Energy supply will remain reliant on coal for at least the next two decades
- Diversify energy supply through increased use of natural gas and new and renewable energies
- Continue investigations into nuclear options as a future new energy source
- Promote the use of energy efficiency management and technologies
- Maximise load factors on electricity generation plant to lower levelised lifecycle costs
- Lessen reliance on imported liquid fuels by exploring and developing oil and gas deposits
- Increase existing oil refineries capacity when appropriate rather than greenfields development
- Continue with existing synfuel plants and supplement with natural gas as feedstock
- New electricity generation will remain coal based with potential for hydro, natural gas and nuclear capacity
- Ensure environmental considerations in energy supply, transformation and end use
- Promote universal access to clean and affordable energy, with emphasis on household energy supply being co-ordinated with provincial and local integrated development programmes
- Introduce policy, legislation and regulation for the promotion of renewable energy and energy efficiency measures and mandatory provision of energy data
- Undertake integrated energy planning on an ongoing basis

The Minister must review the IEP annually. The review plan must take into account plans relating to

- Transport, petroleum, water, housing, air quality, and greenhouse gas emissions;
- Sustainable development;
- Environmental , health, safety and socio-economic impacts; and
- Development requirements of the South African Development Community (SADC).

2.1.3 National Strategy for Sustainable Development (NSSD; Enviropaedia, 2007)

The NSSD has been developed to provide a framework to shift our development path to one of sustainable development that is appropriate and specific to the South African context. The NSSD is iterative and will be updated to address new priorities as they emerge. The 2006 Strategy looks forward 20 to 30 years, but will be updated regularly to ensure that the 20- to 30-year Vision and Action Plan remains hopeful, relevant and realistic.

The NSSD provides an integrated framework in which it views social, economic and ecosystem factors as embedded within each other, and is underpinned by systems of governance. As such, it identifies key areas for intervention based on an integrated analysis of trends in the four areas. Through this approach, the NSSD seeks to build on the definition of sustainable development set out in the NEMA by highlighting the importance of institutions and systems of governance in implementing the concept and in oversight activities.

The NSSD's response to the natural resources, economic, social and governance trends in South Africa is to, through a multi-stakeholder approach, highlight the priority areas for intervention and identify measures through which these can be addressed. The partnership model required to make the NSSD work means that various sectors and spheres use the NSSD as a guideline whereby they structure appropriate responses. The five integrated priority areas identified by South Africa's NSSD are:

- Sustaining our ecosystems and using resources sustainably;
- Investing in sustainable economic development and infrastructure;
- Creating sustainable communities;
- Enhancing systems for integrated planning and implementation; and
- Building capacity for sustainable development.

2.1.4 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. The key drivers for the plan came from the unplanned shortages that were occurring through the country. Two main intervention options were identified with various scenarios for growth and supply capacity: the Supply Intervention Plan and the Demand Intervention Plan.

The Supply Intervention Plan includes intervention, fast-tracking and seven-year forecasting of the capacity margin. The Demand Intervention Plan has defined three intervention timelines: immediate (6 months); medium term (18 months); and long term (more than 18 months). The immediate interventions are phased demand reductions, demand behavioural change programmes, and an intense consumer awareness campaign. The phase demand reduction includes system security recovery and/or load shedding, power rationing through fixed scheduled load shedding for less than four months, and power conservation programmes with quota allocations (<24 months). The demand behavioural change programme includes aggressive energy efficiency in Government and State-Owned enterprise buildings, restricting the sale of incandescent light bulbs, the introduction of national housing specifications (water heating and building standards), and solar water heating programmes. The intensive consumer awareness campaign includes proper load shedding communication as well as general energy savings.

Medium term demand-related interventions include residential time-of-use tariffs, residential cooking load to gas-power, traffic lights to solar power generation, public lighting, pro-poor cost reflective tariffs, and EIA fast-tracking

The long term demand interventions are incorporated into the Power Conservation Programme. This programme identifies the following goals: overall savings target; penalty and incentive schemes; trading scheme with built-in flexibility; estimated yields; and implementation timeframes.

The following are the proposed energy efficiency regulations for the NERP:

- Requirements for water heating in commercial and residential buildings;
- Prohibitions in respect of lighting;
- Prohibitions in respect of space heating, ventilation and cooling in commercial and residential buildings, to be completed no later than the year 2010; and
- Norms and Standards for reticulation services.

2.1.5 Climate Change Strategy (Rumsey and King, 2009)

As a signatory to the United Nations Framework Conference on Climate Change, South Africa is required to formulate a national response strategy outlining measures to mitigate climate change and actions to facilitate adequate adaptation to climate change.

Certain key principles that make up the national strategy include:

- Establishing the institutional capacity for effective climate change response;
- Ensuring that the strategy is consistent with national priorities, including poverty alleviation and economic development, and using local resources and expertise where possible;
- Linking climate change response to sustainable development;
- Promoting the use of donor funding to address vulnerability and adaptation issues;

- Promoting programmes that will build capacity, raise awareness, and educate the public on climate change;
- Integrating climate change response in government and with other stakeholders; and
- Promoting a sustainable energy programme.

A critical element of the national strategy is that, while the strategy proposes the reduction of greenhouse gases, climate change efforts must be consistent with poverty alleviation and economic development.

The objectives of the national strategy are as follows:

- To integrate climate change response across government departments;
- To implement a clean development mechanism programme;
- To adapt to the impacts of global warming;
- To mitigate South Africa's contribution to global climate change;
- To raise awareness through education;
- To introduce legislative provisions addressing climate change; and
- To promote renewable energy.

2.1.6 National Energy Regulator Act (No. 40 of 2004)

Part of this mandate focuses on facilitating investment in the electricity supply industry and promoting the use of diverse energy sources and energy efficiency. The Committee was informed that the Renewable Energy Paper of 2003 set forth a 10-year target for renewable energy aimed at achieving a 10 000 gigawatts hour (0.8Mtoe) renewable energy contribution to final energy consumption by 2013, to be produced mainly from biomass, wind, solar and small-scale hydro.

According to the draft National Integrated Resource Plan for Electricity 6,000 GWh of this target is expected from on-grid electricity generation. At the DME Renewable Energy Summit in March 2009, the then Energy Minister indicated that more ambitious targets 'for the period 2013 and 2018 could be set in the range of six to nine percent and nine to fifteen percent of the current capacity respectively' (DME 2009). This may result in a renewable energy target of 14.5 – 22 terawatt hours (TWh) for 2013 and 22 – 36TWh for 2018. (South Africa's Renewable Energy Policy Roadmaps, 2010).

2.1.7 National Energy Efficiency Strategy (2009)

The National Energy Efficiency Strategy was developed with the concept of sustainable development in mind. The strategy's vision includes, but is not limited to, encourage sustainable energy sector development and energy use through efficient practises thereby minimising the undesirable impacts of energy usage upon health and environment, and contributing towards secure and affordable energy. The strategy's goals include:

- Social sustainability, by improving health, job creation and alleviating energy poverty;
- Environmental sustainability, by reducing environmental pollution and minimising carbon dioxide emissions; and
- Economic sustainability, by improving industrial competitiveness, enhance energy security, and to reduce the necessity for additional power supply capacity.

2.2 NATIONAL LEGISLATION

2.2.1 The National Environmental Management Act (No. 107 of 1998)

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

The principles of the Act include:

- Environmental management must place people and their needs at the forefront of its concern;
- Development must be socially, environmentally and economically sustainable;
- Environmental management must be integrated, acknowledging that all elements of the environment are linked and interrelated;
- Environmental justice must be pursued;
- Equitable access to environmental resources to meet basic human needs and ensure human well-being must be pursued;
- Responsibility for environmental health and safety consequences of a project or activity exists throughout its life cycle;
- The participation of all interested and affected parties in environmental governance must be promoted;
- Decisions must take into account the interests, needs and values of all interested and affected parties;
- The social, economic and environmental impacts of activities, must be considered, assessed and evaluated, and decisions must be appropriate in the light of such consideration and assessment;
- Decisions must be made in an open and transparent manner, and access to information must be provided in accordance with the law;
- The environment is held in a public trust for the people, the beneficial use of environmental resources must serve the public interest and the environment must be protected as the people's common heritage;
- The cost of remedying pollution, environmental degradation and consequent adverse health effects must be paid for by the parties responsible for harming the environment; and
- Sensitive, vulnerable, highly dynamic or stressed ecosystems, such as coastal shores, estuaries, wetlands, and similar eco-systems require specific attention in management and planning procedures, specifically where they are subject to significant human resource usage and development pressure.

2.2.2 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.

The Act protects the health, well-being and the environment by providing reasonable measures for minimisation of consumption of a natural resource, minimising general waste, reducing, re-using, recycling and recovering waste, safely treating or disposing waste as a last resort, preventing pollution and ecological degradation, securing ecological sustainable development.

Table 2-1: Listed Activities according to GN R. 386 of the National Environmental Management Act (No. 107 of 1998)

GN R. 386 LIST OF ACTIVITIES AND COMPETENT AUTHORITIES IDENTIFIED IN TERMS OF SECTIONS 24 AND 24D OF THE NATIONAL ENVIRONMENTAL MANAGEMENT ACT (NO. 107 OF 1998)
Activity Description
1(k) The construction of facilities or infrastructure, including associated structures or infrastructure, for the bulk transportation of sewage and water, including storm water, in pipelines with – (i) an internal diameter of 0.36 metres or more; or (ii) a peak throughput of 120 litres per second or more.
7. The aboveground storage of a dangerous good, including petrol, diesel, liquid petroleum gas or paraffin, in containers with a combined capacity of more than 30 cubic metres but less than 1 000 cubic metres at any one location or site.
12. The transformation or removal of indigenous vegetation of 3 hectares or more or of any size where the transformation or removal would occur within a critically endangered or an endangered ecosystem listed in terms of section 52 of the National Environmental Management: Biodiversity Act (No. 10 of 2004).
13. The abstraction of groundwater at a volume where any general authorisation issues in terms of the National Water Act (No. 36 of 1998) will be exceeded.
15. The construction of a road that is wider than 4 metres or that has a reserve wider than 6 metres, excluding roads that fall within the ambit of another listed activity or which are access roads less than 30 metres long.
16. The transformation of undeveloped, vacant or derelict land to – (b) residential, mixed, retail, commercial, industrial or institutional use where such development does not constitute infill and where the total area to be transformed is bigger than 1 hectare.

Table 2-2: Listed Activities according to GN R. 387 of the National Environmental Management Act (No. 107 of 1998)

GN R. 387 LIST OF ACTIVITIES AND COMPETENT AUTHORITIES IDENTIFIED IN TERMS OF SECTIONS 24 AND 24D OF THE NATIONAL ENVIRONMENTAL MANAGEMENT ACT (NO. 107 OF 1998)
Activity Description
1. The construction of facilities or infrastructure, including associated structures or infrastructure, for - (a) the generation of electricity where - (i) the electricity output is 20 megawatts or more; or (ii) the elements of the facility cover a combined area in excess of 1 hectare. (c) the above ground storage of a dangerous good, including petrol, diesel, liquid petroleum gas or paraffin, in containers with a combined capacity of 1 000 cubic metres or more at any one location or site including the storage of one or more dangerous goods, in a tank farm. (e) any process or activity which requires a permit or license in terms of legislation governing the generation or release of emissions, pollution, effluent or waste and which is not identified in GN R. 386 of 2006, or included in the list of waste management activities published under section 19 of the National Environmental Management: Waste Management Act in which case the activity is regarded as excluded from this list. (I) the transmission and distribution of above ground electricity with a capacity of 120 kilovolts or more.
2. Any development activity, including associated structures and infrastructure, where the total area of the developed area is, or is intended to be, 20 hectares or more.
10. Any process or activity identified in terms of section 53(1) of the National Environmental Management: Biodiversity Act (No. 10 of 2004).

The Act also promotes economic and sustainable development, promotes and ensures effective delivery of waste services, remediating land where contamination is or could be present, and achieving integrated waste management. The relevance of the following listed activities will be assessed during the contractor accommodation site selection process. The potential requirements for sewage treatment or waste storage will need to be discussed in more detail with the Gamagara Local Municipality.

Table 2-3: Listed Activities according to GN R. 718 of the National Environmental Management: Waste Act (No. 59 of 2008)

GN R. 718 **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 *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*	**CATEGORY B** *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*
Storage and Transfer of Waste 1. The storage, including the temporary storage, of general waste at a facility that has the capacity to store in excess of 100m^3 of general waste at any one time, excluding the storage of waste in lagoons. 2. The storage including the temporary storage of hazardous waste at a facility that has the capacity to store in excess of 35m^3 of hazardous waste at any one time, excluding the storage of hazardous waste in lagoons.	**Recycling, Reuse and Recovery of Waste** 2. The reuse and recycling of hazardous waste
Treatment of Waste 11. The treatment of effluent, wastewater or sewage with an annual throughput capacity of more than 2,000m^3 but less than 15,000m^3.	**Treatment of Waste** 7. The treatment of effluent, wastewater or sewage with an annual throughput capacity of 150,000m^3 or more.
Construction, Expansion or Decommissioning of Facilities and Associated Structures and Infrastructure 18. The construction of facilities for activities listed in Category A of this schedule (not in isolation to associated activity). 19. The expansion of facilities or changes to existing facilities for any process or activity which requires an amendment of an existing permit or licence or new permit or licence in terms of legislation governing the release of pollution, effluent or waste.	**Construction of Facilities and Associated Structures and Infrastructure** 11. The construction of facilities for activities listed in Category B of this schedule (not in isolation to associated activities).

2.2.3 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.

And whereas minimisation of pollution through vigorous control, cleaner technologies and cleaner production practices is key to ensuring that air quality is improved, and whereas additional legislation is necessary to strengthen the Government's strategies for the protection of the environment and, more specifically, the enhancement of the quality of ambient air, in order to secure an environment that is not harmful to the health or well-being of people."

2.2.4 Listed Activities and Minimum Emission Standards

GN R. 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 air quality impact assessment that was undertaken as part of the ESIA phase has determined that an air emissions license is not required for the project.

2.2.5 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 preamble to the Act recognizes that the ultimate aim of water resource management is to achieve sustainable use of water for the benefit of all users and that the protection of the quality of water resources is necessary to ensure sustainability of the nation's water resources in the interests of all water users. The purpose of the Act is stated, in Section 2 as, *inter alia:*

- Promoting the efficient, sustainable and beneficial use of water in the public interest;
- Facilitating social and economic development;
- Protecting aquatic and associated ecosystems and their biological diversity;
- Reducing and preventing pollution and degradation of water resources; and
- Meeting international obligations.

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.

Part 5 of the NWA details the pollution of water resources following an emergency incident, such as an accident involving the spill of a harmful substance that finds, or may find its way, into a water resource. In terms of Section 30 of NEMA and Section 20 of the NWA, the responsibility for remedying the situation rests with the person responsible for the incident or the substance involved. If there is a failure to act, the relevant Catchment Management Agency may take the necessary steps for remediation and, recover the costs from the responsible person.

Table 2-4: Listed Activities according to the National Water Act (No. 36 of 1999)

NATIONAL WATER ACT (NO. 36 OF 1999) Licence if exceeds the thresholds set out under the particular use in the General Authorisations R 398 and 399 as amended.
Section 21: Water uses requiring licensing if exceed General Authorisations: (b) storing water; (e) engaging in a controlled activity identified as such in section 37 (1) (c) identifies a power generation activity which alters the flow regime of a water resource; (h) disposing in any manner of water which contains waste from, or which has been heated in, any industrial or power generation process; and (j) removing, discharging or disposing of water found underground if it is necessary for the efficient continuation of an activity or for the safety of people.

Water abstracted from the underlying aquifer for use in the KSP would not be considered a Schedule 1 water use and would therefore require the relevant water use licence from DWA. A water use licence application in terms of Section 21(a), "taking water from a resource", for the full Phase III water requirement of 265,000m^3/annum has been submitted to DWA for approval. The proposed project will only utilise groundwater for emergency augmentation of water supply to the KSP facility.

2.2.6 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, are subject to assessment by SAHRA. A cultural and heritage impact assessment was carried out during the ESIA phase, the detailed report is attached in **Appendix G**.

Table 2-5: Listed Activities according to the National Resources Heritage Act (No. 25 of 1999)

NATIONAL HERITAGE RESOURCES ACT (NO. 25 OF 1999)
A heritage site means a place declared to be a national heritage site by SAHRA or a place declared to be a provincial heritage site by a provincial heritage resources authority.
Section 48(2) requires a permit from a heritage resources authority to perform such actions at such time and subject to such terms, conditions and restrictions or directions as may be specified in the permit. This would include any development of the site, "development" means any physical intervention, excavation, or action, other than those caused by natural forces, which results in a change to the nature, appearance or physical nature of a place, or influence its stability and future well-being, including— (a) construction, alteration, demolition, removal or change of use of a place or a structure at a place; (b) carrying out any works on or over or under a place; (e) any change to the natural or existing condition or topography of land; and (f) any removal or destruction of trees, or removal of vegetation or topsoil
SAHRA has power to grade heritage sites. Grade III: = Other heritage resources worthy of conservation, under prescribed heritage resources assessment criteria, consistent with the criteria set out in section 3(3). A local authority is responsible for the identification and management of Grade III heritage resources and heritage resources which are deemed to fall within their competence in terms of this Act.

2.2.7 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. The Act establishes the South African National Biodiversity Institute (SANBI). NEM: BA creates a basic legal framework for the formation of a national biodiversity strategy and action plan and the identification of biodiversity hotspots and bio-regions which will then be given legal recognition. It imposes obligations on landowners (state or private) governing alien invasive species as well as regulates the introduction of genetically modified organisms. Furthermore, the Act serves to regulate bio-prospecting, making provision for communities to share the profits of any exploitation of natural materials involving indigenous knowledge.

- Threatened or Protected Species Regulations

The National Environmental Management: Biodiversity Act (No. 10 of 2004), (NEM: BA) was signed into law in mid-2004 and entered into effect on 1 September 2004. The Act provides for the consolidation of biodiversity legislation through establishing national norms and standards for the management of biodiversity across all sectors and by different management authorities.

Chapter 4, Part 2 of the Biodiversity Act provides for listing of species as threatened or protected. If a species is listed as threatened, it must be further classified as critically endangered, endangered or vulnerable. The Act defines these classes as follows:

Critically endangered species: any indigenous species facing an extremely high risk of extinction in the wild in the immediate future.

Endangered species: any indigenous species facing a high risk of extinction in the wild in the near future, although it is not a critically endangered species.

Vulnerable species: any indigenous species facing an extremely high risk of extinction in the wild in the medium-term future; although it is not a critically endangered species or an endangered species.

Protected species: any species which is of such high conservation value or national importance that it requires national protection". Species listed in this category will include, among others, species listed in terms of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES).

The Threatened and Protected Species Regulations (ToPS) were issued in terms of the NEM: BA on 23 February 2007 and came into effect in 2007.

ToPS lists a variety of species as critically endangered, endangered, vulnerable or protected. The purpose of the Regulations is, *inter alia*, to:

- regulate the permit system set out in the Biodiversity Act with regards to restricted activities involving specimens of listed threatened or protected species;
- provide for the registration of captive breeding operations, commercial exhibition facilities, game farms, nurseries, scientific institutions, sanctuaries and rehabilitation facilities and wildlife traders;
- provide for the regulation of the carrying out of a specific restricted activity, namely hunting;
- provide for the prohibition of specific restricted activities involving specific listed threatened or protected species; and
- provide for the protection of wild populations of listed threatened species.

The predominant species of concern with respect to the proposed project is the camelthorn tree (*Acacia erioloba*). This species is not listed within ToPS.

The specific restricted activities are regulated on listed species using permits by a special set of regulations published under the Act. Restricted activities regulated under the act are keeping, moving, having in possession, importing and exporting, and selling.

Species specific measures relating to ToPS are detailed in the specialist biodiversity assessments contained in **Appendix O, Attachment 2.**

- Biodiversity Offsetting in South Africa

Biodiversity offsets are not required by legislation in South Africa, however, the National Biodiversity Strategy and Action Plan (DEA, 2005) includes the commitment to develop a national policy framework to guide the implementation of biodiversity offsets as a part of its strategic objectives and outcomes. One of the significant gaps remaining to be addressed is the long-term management of offset areas. Presently there is no standard legal way of securing offset areas and ensuring their long-term management and maintenance (where required). A few options to secure offsets have been suggested by the Western Cape Offset Guidelines (Department of Environmental Affairs and Development Planning, 2007). In addition, presently no national offset guidelines exist. As a consequence, initiatives that have been implemented or initiated have had to create their own rules as they proceed. (Joanna Kuntonen-van't Riet, August 2007). It is envisioned that any offsets required for the project would be contained within the conditions set under the environmental authorisation.

2.2.8 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 for the benefit of all;
- Create the conditions necessary to restructure forestry in State 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;
- Promote community forestry; and
- Promote greater participation in all aspects of forestry and the forest products industry.

The Kathu forest is unique woodland of exceptionally large Camelthorn trees *(Acacia erioloba)* north of the town of Kathu in the Northern Cape Province. This woodland of about 4,000 ha is one of the only of its kind in the world. It was de-proclaimed as a State forest in 1956 to allow for the development of the town of Kathu. However, the Kathu forest was registered as a National Heritage Site in 1995 by the Department of Environmental Affairs and Tourism. The Kathu forest, which is partially located on farm Kathu 465, was also declared a protected woodland under Section 12(1) (C) of the National Forests Act (No. 84 of 1998) in the Government Gazette on the 10 July 2009. The legal requirements, listed below, associated with the disturbance of protected trees must be taken into consideration.

Table 2-6: Legal requirements according to the National Forests Act (No. 84 of 1998)

NATIONAL FORESTS ACT (NO. 84 OF 1998)
Section 7 states that no person may cut, disturb, damage or destroy any indigenous, living tree in a natural forest, except in terms of a license issued under Section 7(4) or Section 23; or an exemption from the provisions of this subsection published by the Minister in the Gazette.
Sections 12 – 16 deal with protected trees, with the Minister having the power to declare a particular tree, a group of trees, a particular woodland, or trees belonging to a certain species, to be a protected group of trees, woodland or species. In terms of Section 15, no person may cut, disturb, damage, destroy or remove any protected tree; or collect, remove, transport, export, purchase, sell, donate or in any other manner acquire or dispose of any protected tree, except under a licence granted by the Minister.

2.2.9 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 2-7: Legal requirements according to the Fencing Act (No. 31 of 1963)

FENCING ACT (NO. 31 OF 1963)
Section 17 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. However, this provision must be read in conjunction with the environmental legal provisions relevant to the protection of flora.

2.2.10 Hazardous Substances Act (No. 15 of 1973) and Regulations

The object of the Hazardous Substances Act (No. 15 of 1973) is to 'provide for the control of substances which may cause injury or ill health to or death of human beings by reason of their toxic, corrosive, irritant, strongly sensitising or flammable nature or the generation of pressure thereby in certain circumstances; for the control of electronic products; for the division of such substances or products into groups in relation to the degree of danger; for the prohibition and control of such substances.'

In terms of the Act, substances are divided into schedules, based on their relative degree of toxicity, and the Act provides for the control of importation, manufacture, sale, use, operation, application, modification, disposal and dumping of substances in each schedule.

2.3 PROVINCIAL LEGISLATION

2.3.1 Local Authorities: Standard Water Regulations (PN. 850 of 1953)

Table 2-8: Legal requirements according to the Local Authorities: Standard Water Regulations (PN. 850 of 1953)

LOCAL AUTHORITIES: STANDARD WATER REGULATIONS (PN. 850 OF 1953)
Application for Water Supply Part 111, Section 4 states that an application for the supply of water must be submitted to the local authority and that no water shall be supplied to any person unless a signed agreement is in place.
Waste, Misuse or Contamination of Water Part 111, Section 13 states that no person may waste, misuse or contaminate any water supplied by the local authority.

2.3.2 Standard Sanitary Regulations (PN. 564 of 1986)

Table 2-9: Legal requirements according to the Standard Sanitary Regulations (PN. 564 of 1986)

STANDARD SANITARY REGULATIONS (PN. 564 OF 1986)
Local Authority to Approve of Construction of Septic Tank Part 11, Section 1-3 states that an application for approval must be submitted to the local authority prior to construction of a septic tank. The application must include a block plan of where the tank, soakage drain, stoneware soil drain, manhole and inspection chamber is to be installed. No approval shall be granted unless the septic tank complies with the provisions of regulation P. 16 of the Schedule to the National Building Regulations and Building Standards Act (No. 103 of 1977).

2.4 MUNICIPAL BY-LAWS APPLICABLE TO THE PROJECT

2.4.1 Gamagara Municipality (Notice 74 of 2003) – Approved Zoning Scheme Land Development Procedures and Regulations

The whole of Kathu Farm 465 is currently zoned as Resort Zone I (refer to Figure 2-1) and is therefore restricted to use for holiday accommodation, a hotel, a restaurant or a place of entertainment. As there is currently no land use zone specified for solar power facilities in the existing approved zoning scheme Group Five will be required to apply for 'special' rezoning upon receipt of a positive record of decision from the DEA. The application will be published in a local municipality and the public will be given the opportunity to object the rezoning. Should no objections be raised the local municipality will take between 6 weeks to 3 months to process the application. Note that no construction may take place during this time period.

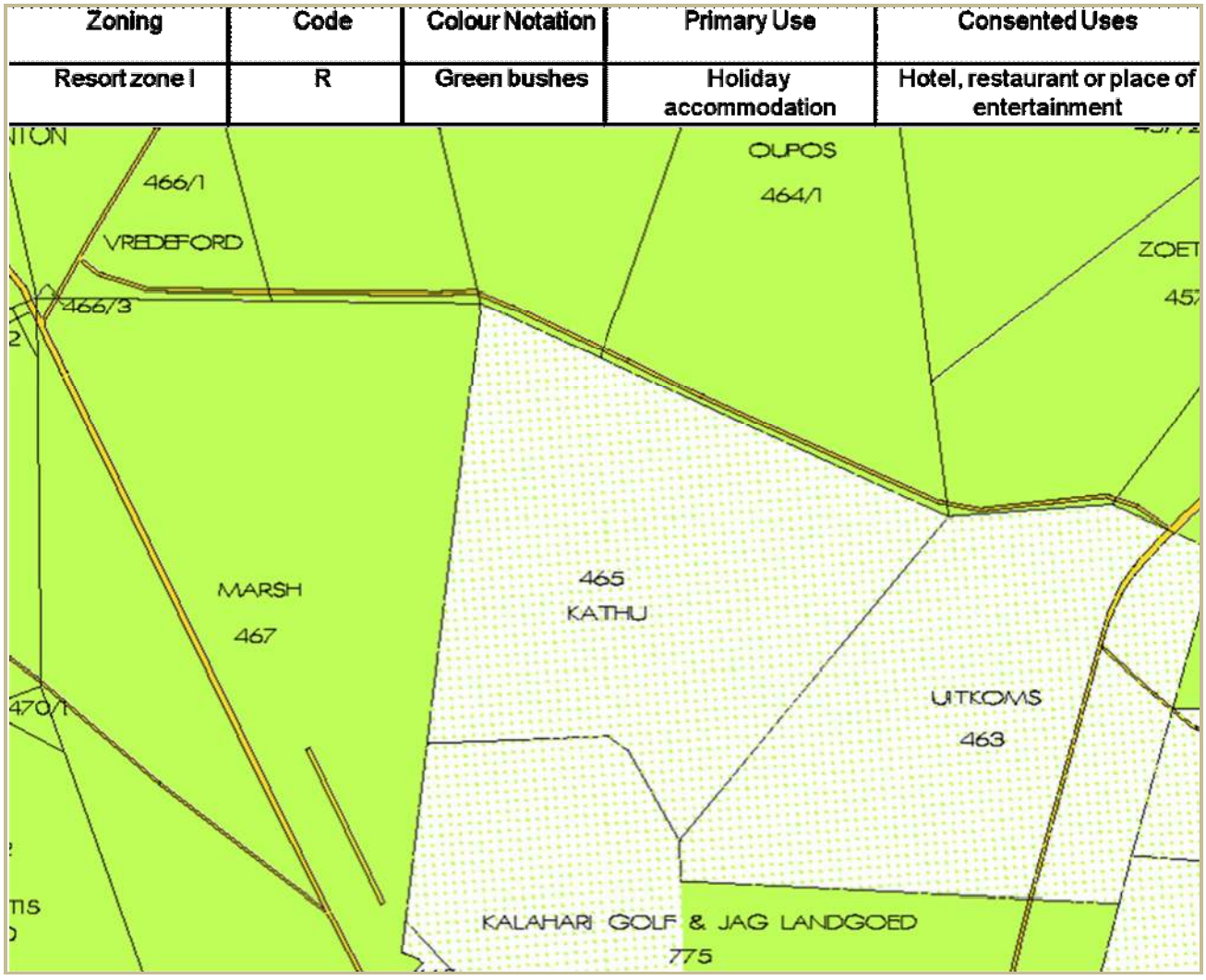


Figure 2-1: Land use zones (Gamagara Local Municipality, 2010)

Refer to **Appendix C** for a tabulated summary of the legal requirements, including a review of the NEMA EIA Regulations, 2010.

3 Approach and Methodology

3.1 ENVIRONMENTAL AUTHORISATION

In order for the project to commence, environmental authorisation through a full scoping and ESIA process is required, as the project triggers specific listed activities outlined in the NEMA, NEM:WA, NWA, and NEM:AQA. Group Five requested WSP to undertake the necessary environmental authorisation in accordance with national environmental legislation, but to ensure too that it would comply with international financial institutions' guidelines for social and environmental appraisal.

WSP undertook the required study according to the NEMA EIA Regulations of 2006 (GN R. 385, 386 and 387), because the process commenced before the revision of the EIA Regulations had been concluded. Nevertheless, to ensure a comprehensive and diligent approach, WSP took into consideration the amended NEMA EIA Regulations of 2010 (GN R. 543, 544, 545, and 546).

Refer to Figure 3-1 below for an illustration of the environmental authorisation process indicating specifically where the section can be located in NEMA EIA Regulations GN R. 385 of 2006.

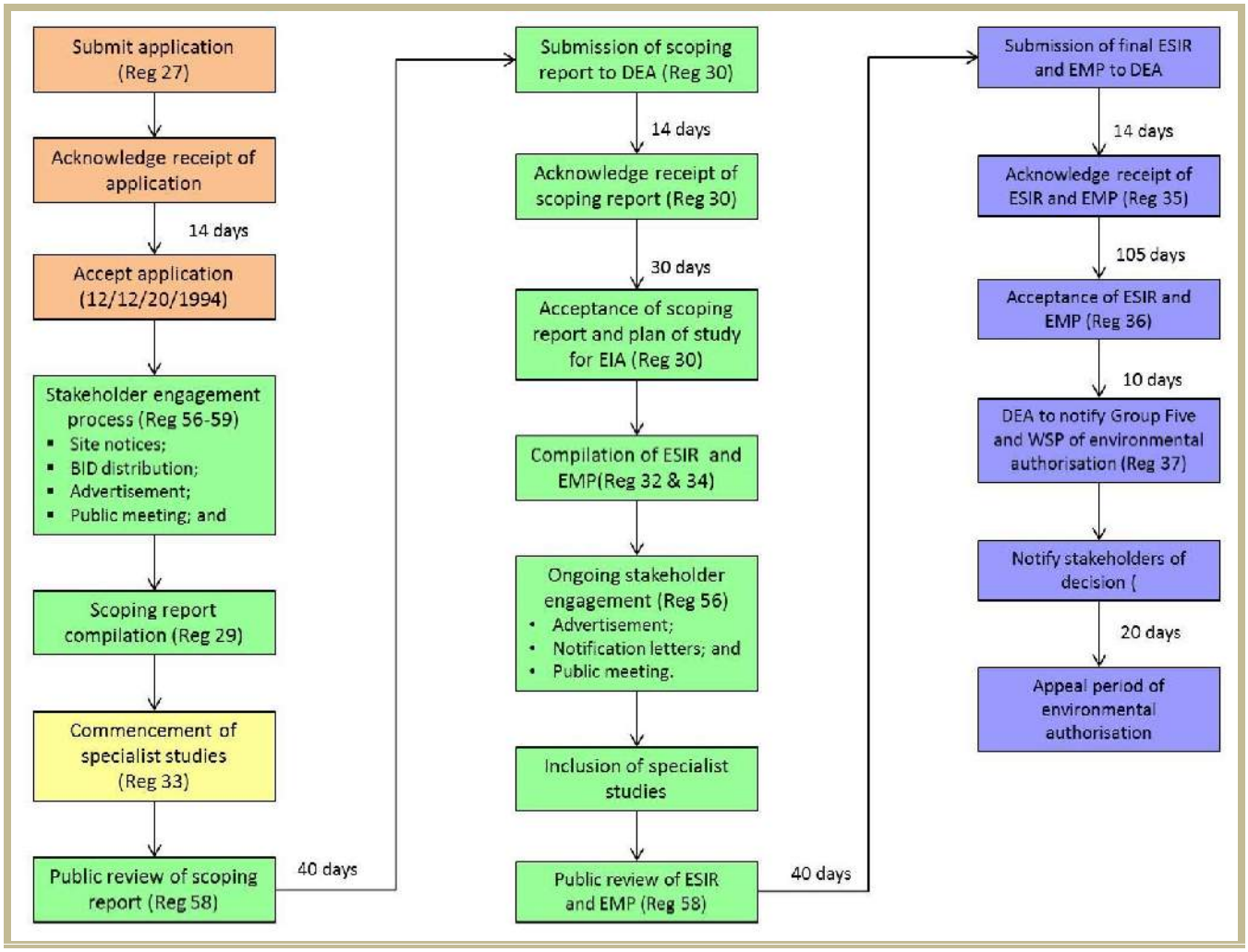


Figure 3-1: Simplified Illustration of the S&EIA Phase that was undertaken for the project

3.2 APPROACH TO THE ESIA

The scoping phase of the environmental authorisation process was completed in February 2011 (Refer to **Appendix A** for the letter of acknowledgment from the DEA concerning the final Scoping Report.).

This report details the environmental impact assessment (EIA) phase, and represents the environmental and social impact report (ESIR) and draft environmental and social management plan (Draft ESMP) for the proposed KSP project.

3.2.1 Objectives of the environmental and social impact assessment process

The objectives of the ESIR are to provide:

- An assessment of the environment likely to be affected by the proposed project;
- An assessment of the nature, extent, duration, probability and significance of the identified potential environmental, social and cultural impacts of the proposed project;
- A comparative assessment of the identified land use and development alternatives and their environmental, social and cultural impacts;
- Appropriate mitigation measures for each significant impact of the proposed project;
- Details of the stakeholder engagement process followed and an indication of how the issues raised have been addressed;
- Identification of knowledge gaps and reporting on the adequacy of predictive methods, underlying assumptions and uncertainties encountered in compiling the required information;
- A description of the arrangements for monitoring and management of environmental impacts; and
- Inclusion of technical and supporting information as appendices, if available.

3.2.2 Approach and methodology for the environmental and social impact assessment

The ESIR and draft ESMP have been developed in accordance with legal requirements along with the actions detailed in the plan of study for the ESIR.

The methodology applied for conducting the ESIA consisted of the following processes:

- The environmental Scoping Report was submitted to the DEA on 29 November 2010;
- All comments received from the DEA, (including relevant authorities) and stakeholders were addressed in this ESIR and the draft ESMP;
- The environments likely to be affected by the project were assessed without management measures in place including cumulative impacts;
- The identified potential environmental, social, cultural and cumulative impacts were identified and assessed with management measures in place;
- A draft ESMP was compiled detailing the proposed management commitments as described in the ESIR;
- The ESIR and the draft ESMP (combined report) will be submitted to DEA following a public review period of 40 days, from 13 April to 26 May 2011. Comments received from the public review period will be incorporated in the final ESIR and ESMP before being submitted to DEA;
- The stakeholders were informed of the availability of the draft report by means of personal communications, either by email, fax or telephonically;
- All comments received from the stakeholders will be addressed in the ESIR and the draft ESMP;

- This ESIR and draft ESMP were submitted to the DEA and other relevant government departments, including: the Northern Cape Provincial Department of Environment Affairs and Nature Conservation, the Department of Energy, the Department of Water Affairs, the Department of Agriculture, Forestry and Fisheries, Wildlife and Environmental Society of South Africa, South African Heritage Resource Agency, the Gamagara Local Municipality, Eskom and the National Energy Regulator of South Africa for consideration;
- An environmental authorisation may be issued by the DEA; and
- All stakeholders will be informed of the DEA's decision on the proposed KSP project.

3.2.3 Specialist studies

To ensure a comprehensive environmental authorisation process, specialist studies were undertaken for potential impacts associated with the proposed KSP project. The studies undertaken and the entity and consultant responsible for each are listed in Table 3-1:

Table 3-1: Specialist studies

Aspect	Organisation	Contact
Air quality	WSP Environment and Energy	Ewert Steyn 011 361 1394
Cultural heritage	Cultmatrix cc	Robert de Jong 012 323 8666
Biodiversity: zoology	McGregor Museum	Beryl Wilson 053 839 2700
Biodiversity: botany	Ecological Management Services	Natalie Birch 083 406 9730
Biodiversity: entomology	WSP Environment and Energy	Eden Wildy 011 361 1372
Socio-economic	Nomad Socio-Economic Management and Consulting	Greg Huggins 082 460 4247
Geohydrology and hydrology	WSP Environment and Energy	Greg Matthews 031 240 8866
Soil, land use and land capability	WSP Environment and Energy	Andrew Gemmell 031 240 8889
Traffic	WSP SA Civil and Structures	Desmund Hundermark 012 361 4141
Visual	Visual Resource Management Africa	Steve Snead 044-876 0020
Noise	WSP Environment and Energy	Lodewyk Jansen 011 361 1390
Health and Safety Management Plan**	WSP Risk Management	Martin Quinn 011 450 2290

Refer to **Section 6** for summaries of the findings of the above specialist studies. The full specialist reports are attached in **Volume 2, Appendices**.

3.2.4 Environmental impact rating

The environmental impact rating was undertaken according to the WSP impact assessment methodology and is detailed in **Section 7.1** of this report.

3.2.5 Draft environmental and social management plan

The draft ESMP was developed and provides the actions for the management of identified environmental impacts emanating from the proposed KSP project as well as an outline of the implementation programme to minimise and/or eliminate significant environmental impacts. The draft ESMP addresses the roles and responsibilities of environmental management personnel on-site and establishes a framework for environmental compliance and monitoring (refer to Table 9-1).

The draft ESMP includes the following for the construction, operational and closure phases for the proposed project:

- Details and expertise of the person who prepared the draft ESMP;
- Information on any proposed management or mitigation measures that will be taken to address the environmental impacts that have been identified in the ESIA. This will include environmental impacts or objectives in respect of planning and design, pre-construction and construction activities, operation or undertaking of the activities and rehabilitation of the environment and closure where relevant;
- A detailed description of the aspects of the activity that are covered by the draft ESMP;
- An identification of the persons who will be responsible for the implementation of the measures; and
- Proposed mechanisms for monitoring compliance with the draft ESMP and reporting thereof.

3.3 STAKEHOLDER ENGAGEMENT

In order to ensure compliance with the applicable national legislation, WSP undertook the stakeholder consultation process in a diligent manner utilising Chapter Six of the NEMA EIA Regulations, with specific reference to Sections 56 – 59. The NEMA requires that an inclusive, transparent process of stakeholder 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 Kalahari Solar power Project.

Procedures for informing stakeholders about the project and engaging their participation have become standard practice. In the case of this project, WSP undertook additional actions - a social scan and informal engagement meetings - to ensure that the largest portion of interested and/or affected persons were informed and kept up to date of the progress of the meeting.

A full stakeholder consultation process was undertaken from the onset of the scoping phase of the project to ensure that the widest range of stakeholders were adequately and effectively consulted, which continued into the ESIA phase of the project. The stakeholder consultation process was undertaken in English and Afrikaans. The following sections outline the required tasks that have been undertaken as part of the stakeholder consultation process.

3.3.1 Objectives of the stakeholder engagement process

All issues and concerns that were raised during the scoping and ESIA phases of the project have been included in this report. The objectives of the stakeholder engagement process were as follows:

- To ensure an open and transparent ESIA and consultation process;
- To identify and inform stakeholders of the Kalahari Solar Power Project and associated environmental authorisation process;

- Establish an ongoing line of communication between the stakeholder and the project team (Group Five and WSP);
- Provide an opportunity for stakeholders to raise all issues, concerns and questions and ensure that these are considered in the environmental authorisation process for the project;
- Ensure that stakeholders have an opportunity to make a meaningful contribution towards decision making by all commenting authorities as well as the lead authority; and
- Compile an issues trail of all issues, concerns and questions raised during the full stakeholder engagement process and other stakeholder consultation processes.

3.3.2 Stakeholder database

The identification and registration of stakeholders has been an ongoing activity during the course of this study. Neighbouring mines and farms as well as other stakeholders were identified. These stakeholders were, where possible, individually notified of the proposed construction and operation of the solar power plant. WSP also placed advertisements in two local newspapers (Kalahari Bulletin – 8 July 2010 and Kathu Gazette – 10 July 2010), calling for the registration of stakeholders, and inviting potential stakeholders to attend a public meeting.

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 P, Attachment 6** for a copy of the database for this project.

3.3.3 Stakeholder engagement: scoping phase

The stakeholder consultation process was conducted from the onset of the project and as part of the overall environmental consultation process. The scoping phase stakeholder engagement commenced during June 2010, with a public meeting being held on 20 July 2010 and authorities meeting with DEA on 16 July and 4 August 2010. The draft Scoping Report was placed on public review for a period of 40 days from 5 October – 5 November 2010 prior to being finalised and submitted to DEA for acceptance on 30 November 2010.

According to Section 56 of the NEMA EIA Regulations, WSP must give notice to all potential stakeholders of the project. The statutory requirements were followed in full, comprising:

- Site notices;
- Written notice and distribution of background information documents;
- Advertisements (attached in **Appendix P, Attachment 3**);
- Public meeting (20 July 2010);
- Authorities consultation; and
- Informal stakeholder consultation.

Full details of the scoping stakeholder engagement process are provided in the Scoping Report.

3.3.4 Public Review of KSP Scoping Report

The draft scoping report was placed on public review at appropriate locations in Kathu and on WSP's website from 5 October – 5 November 2010. Registered stakeholders were notified about the location and review period of the reports via facsimile and email.

In terms of the accelerated schedule for the ESIA process proposed for NERP projects, public review of the draft scoping report occurred 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 feedback by the DEA.

The final Scoping Report and Plan of Study for ESIA was finalised after public review and submitted to the DEA in Pretoria in November 2010. The Scoping Report was approved on 22 February 2011.

3.3.5 Issues Trail

The scoping phase issues trail details the outcomes of all engagement and consultation with authorities and stakeholders. This issues trail records the following, as listed below and is provided in **Appendix P, Attachment 5**:

- List of all issues raised;
- Record of who raised the issues;
- Record of where the issues were raised; and
- Response to the issues (given by the project team).

The main issues raised during the scoping phases of the project are outlined in Table 3-2:

Table 3-2: Issues identified during the Scoping Phase of the project

Issues
Water Issues
■ Sources of water supply to the project and the impacts thereof on other water sources and water users in the area; ■ Amount of water required during the construction and operational phases of the project; ■ Quality requirements of the water necessary for the operational phase.
Fauna, Flora and Heritage Issues
■ Impacts of the project on the Kathu forest / National Heritage Site and on Camelthorn trees on the property; ■ Impacts of the project on potential areas of archaeological significance.
Socio-economic and Safety Issues
■ Socio-economic benefits of the project; ■ Impacts on public infrastructure – housing, services, schools; ■ Impacts on social pathologies, such as crime, public health (infectious diseases); ■ Safety risks of the project; ■ Impacts associated with the potential spillage or leakage of heat transfer fluid.
Air, Noise, Visual and Traffic Issues
■ Impacts of project-generated noise; ■ Air quality impacts associated with the use of diesel for the fossil fuel hybrid firing system; ■ Dust impacts on neighbours; ■ Visual impacts of the project; ■ Impacts on the traffic in the area and location of the proposed access road.
Power Generation and Power line Route Issues
■ Effects of the project on energy supplies and tariffs in the area; ■ Whether the power produced will be fed into the national grid or purchased by captive off-takers; ■ The different technologies that have been considered as part of the project; ■ Type of power lines required and potential route alternatives.
Site Selection
■ Impacts on other land uses and land users; ■ The size of the site that will be impacted upon; ■ Whether any alternative sites were assessed as part of the site selection process.

3.3.6 Stakeholder Engagement: ESIA Phase

Stakeholder consultation continued into the ESIA phase of the environmental authorisation process. To ensure transparency of the stakeholder engagement process, additional stakeholders were welcome to register throughout the project. All comments received from commenting authorities were included in the Issues Trail and responded to accordingly. Furthermore, conditions contained in the approval of the Scoping Report from DEA were similarly included in the Issues Trail.

WSP undertook the ESIA stakeholder engagement process according to the NEMA EIA Regulations. A public feedback meeting was held on 18 April 2011 at the Namakwari Lodge from 18h00 – 20h00. The purpose of this meeting was to outline the specialist studies that had been undertaken and the findings of the studies, as well as information pertaining to the draft ESIR. The draft ESIR and ESMP went on public review for a period of 40 days from 13 April – 26 May 2011, two weeks prior to the public feedback meeting in order for stakeholders to have an opportunity to review the report before the feedback meeting.

The following was undertaken as part of the ESIA stakeholder engagement process for the project:

- Advertisements;
- Written notices;
- Public feedback meeting;
- Authorities consultation; and
- Informal stakeholder consultation.

Advertisements

Advertisement were published during the ESIA phase of the project, and contained information of the ESIR, specialist studies undertaken as well as the locations of the venues and dates for public review of the draft ESIR and ESMP. Furthermore, the public was invited to attend a public feedback session where components of the ESIR and ESMP will be discussed in an open forum. The advertisement was published in:

- Kalahari Bulletin – 14 April 2011; and
- Kathu Gazette – 16 April 2011.

Refer to **Appendix Q, Attachment 1** for a copy of the advertisement.

Written Notices

Written notices containing detailed progress information of the project, findings of the specialist studies undertaken as well as location of the draft ESIR and ESMP were submitted to stakeholders. Furthermore, the document invited stakeholders to attend a public feedback session on 18 April 2011. Authorities and stakeholders were notified in April 2011 via the following methods of contact:

- Email notification (13 April 2011);
- Facsimile notification (13 April 2011);
- SMS notification (13 April 2011); and
- Post (13 April 2011).

Refer to **Appendix Q, Attachment 2** for a copy of the BID.

Public Meeting

An ESIA public feedback meeting was held at the Namakwari Lodge on 18 April 2011 from 18h00 – 20h00. The meeting was held in order to update stakeholders on the progress of the project, outline specialist study findings, provide an opportunity for stakeholders to voice their comments regarding the draft ESIR and ESMP as well as the way forward with regards to the project construction and operation requirements. Please note that the draft ESIR and ESMP was placed on public review for a period of two weeks prior to the public meeting in order for stakeholders to review the report.

All questions, concerns and issues were minuted; a copy of the ESIA meeting minutes is contained in **Appendix Q, Attachment 3**.

Authorities Consultation

An ESIA authorities meeting was held with members of Group Five, WSP and the DEA on 4 March 2011 from 14h00 – 16h00 at the DEA offices in Pretoria. The purpose of the meeting was to outline the detail of the report, specialist studies and way forward with regards to the REFIT application.

An authorities' site visit was held on the Kathu Farm 465 on 19 April 2011. The aim of the meeting was to present the authorities with the draft ESIA / ESMP and to present the site to the authorities. Authorities were notified via email of the meeting on 9 March 2011. The following government departments were invited:

- Department of Environmental Affairs;
- Department of Water Affairs;
- Department of Energy;
- Department of Agriculture, Forestry and Fisheries;
- Northern Cape Department of Environmental Affairs and Nature Conservation; and
- Gamagara Municipality.

Refer to **Appendix Q, Attachment 4** for a copy of the authority meeting minutes for the site visit undertaken.

Informal Stakeholder Engagement

WSP continued the informal engagement process during the ESIA phase of the project. The aim of the meetings was to inform primary stakeholders of the progress of the project, specialist study findings as well as to answer any principal questions raised by the stakeholders. A meeting was held on 2 March 2011 to discuss and propose alternatives for housing arrangements for the project during construction and operation. All issues, comments and queries, along with responses from the project team are included in the Issues Trail. The following stakeholders were informally engaged during the ESIA phase:

Organisation / Name	Position / Interest in the Project	Place / Venue	Date
Stephanie and Willie Cornelissen	Member of the Water Users Association and Camelthorn Tree Association	Wright Farm	1 March 2011
Peens and Burger Family	Adjacent landowner	Oupos/Uitkoms Farm	1 March 2011
Tanya Aukamp, and Jimmy Walker	Kumba Communications Manager	Namakwari Lodge	2 March 2011
Lategang Botha	Gamagara Municipality		
Andre Nel	Lakutshona Housing Co.		

3.3.7 Public Review

The final Scoping Report and Plan of Study for ESIA was finalised after public review and submitted to the DEA in Pretoria in November 2010 for review and was approved on 22 February 2011.

In terms of the accelerated schedule for the EIA process proposed for NERP projects, public review of the draft ESIR and ESMP 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 feedback by the DEA. The report will then be edited by WSP to incorporate DEA's and other stakeholders' as well as the public's comments in order to finalise the ESIR and ESMP.

The draft ESIR and ESMP will be made available in hard copy and CD for public review at the following venues:

- Kathu Library;
- Namakwari Lodge; and

- The Security Office at the Sishen Mine entrance.

An electronic copy of the draft report was made available on WSP's website (www.wspenvironmental.co.za). Furthermore, primary stakeholders were submitted a draft copy of the report to review. The draft ESIR and ESMP was placed on public review from 13 April – 26 May 2011.

Please note that the reports were also submitted to the following government departments for comments during the public review period:

- Northern Cape Department of Environmental Affairs and Nature Conservation;
- Department of Energy;
- Department of Water Affairs;
- Department of Agriculture, Forestry and Fisheries;
- Wildlife and Environmental Society of South Africa;
- South African Heritage Resource Agency;
- Gamagara Local Municipality;
- Eskom; and
- National Energy Regulator of South Africa.

The ESIR and ESMP will be updated with the comments received and submitted to DEA for authorisation.

3.3.8 Issues Trail

Issues originating during the ESIA phase of the project were captures and responded to in the Issues Trail. The Issues Trail included the following:

- List of all issues raised;
- Record of who raised the issues;
- Record of where the issues were raised; and
- Response to the issues (given by the project team).

All meeting's issues and lists of all issues received by WSP via email, fax and post have been recorded in **Appendix Q, Attachment 5.**

The main issues raised during the ESIA phase of the project are outlined in Table 3-3.

Table 3-3: Issues identified during the ESIA Phase of the project

Issues
Water Issues
■ If the boreholes had been registered with the Department of Water Affairs; ■ Water Use License Application; ■ Stormwater management plan for the site; and ■ Water sourcing for the project.
Infrastructure Issues
■ Information on services required on the site, e.g. sewage, refuse removal, water and electricity supply and road access; ■ Details of future planning of the site and infrastructure after decommissioning including upgrading of technologies; and ■ Visual impact associated with the project.
Housing Issues
■ Details of housing and accommodation for labourers and senior management.
Biodiversity Issues
■ Protection of Kathu woodland; ■ Impacts of the agricultural potential of the site from the development; ■ Effects of the development on vegetation ecology with regards to lowland-highland interface in the area; and ■ Impacts of the development on avifauna and bats.
Construction Issues
■ Duration of construction phase; and ■ Impacts of noise and dust from construction phase.

The issues raised by affected parties and regulatory authorities are reflected in the scopes of work and findings of the specialist studies (**Section 6**) and in the impact assessment (**Section 7**) and management plan (**Section 9**).

4 Project Alternatives

4.1 NO-GO ALTERNATIVES

Without the implementation of solar power projects such as the KSP project, 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's and Kusile's being delayed from the original programme. Mining and industry, being the largest energy users, would likely suffer as a result, leading to a negative impact on the national economy.

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.

4.2 SITE ALTERNATIVES

4.2.1 Criteria for preferred site selection

- Solar resource

The best solar resources in South Africa range between 7-8kWh/m^2 per day as an annual average. A direct normal irradiation (DNI) satellite study was commissioned for the project as part of the Group Five Concept Study (1 June 2010). The DNI at the site was estimated at 7.6, higher than any CSP site in the world. An onsite DNI measuring station was erected at the site on 8 July 2010 and is currently measuring DNI, temperature, humidity, wind direction, wind speed and wind gust.

- Grid connection

Power plants require suitable grid connection to evacuate their power. Close proximity to the connection is ideal for keeping costs down in infrastructure and servitude fees. The Eskom Ferrum Substation at Sishen rated at about 250MW, is suitable for the KSP project. The voltages feeding into and out of the sub-station include 275kV, 132kV and 66kV. The project will connect to the 132kV electrical conductors (see **Section 4.5**).

- Aviation impact criteria

The Kathu area offered a number of sites for consideration (refer to Figure 4-1). The northern sites were preferred due to the distance from the dust generated by the mining activities in the south. Close proximity of the Sishen airfield required close collaboration with the South African Civil Aviation Authority (SACAA) on the site selection criteria. The Kathu Farm 465 was selected by SACAA as the best of the 3 sites under consideration from an aviation impact perspective, Provisional obstacle parameters were provided by the SACAA for the height of the structures that may be built on the site.

- Site topography

CSP technologies require a relatively flat surface. High resolution maps procured for the site indicate a 0.5% slope for the complete site. This is well within the recommended specifications of a 1-2% slope.

- Water supply

A sustainable water supply is a vital component for the feasibility of the KSP project. Operational water consumption is expected to be in the region of 80,000m^3 per annum per 150 MW phase.

The primary water supply will be from the Vaal-Gamagara pipeline that is regulated by Sedibeng Water. The project may utilise groundwater from the confined aquifer during emergency conditions and a water use license has been submitted in this regard (refer to **Section 6.8** for the summary findings of the water feasibility assessment).

- Meteorology

CSP plants are best suited in dry hot climates with little precipitation and cloud cover. High wind speeds are also not preferred, although wind shields are built into the perimeter fence to reduce wind entering the solar field. Meteorological data for the region was acquired from the South African Weather Bureau. The assessment of this data suggests a suitable climate for the project (*refer to* **Section 6.6** for more detailed information).

- Air quality and dust nuisance

A visual inspection of the site suggests that little of the dust from the nearby mining activities reaches the site. Ambient dust fallout monitoring, which assesses dust fallout at the site as a whole, has commenced and will continue throughout the construction phase of the project.

- Social context

The preferred site is undeveloped rural land located within the Sishen mine property boundary. There are no people living on the site and from surface inspection, no site contamination is evident.

There is one neighbouring resident close to the northern boundary of Kathu farm 465, namely the Peens/Burger family on the farm Oupos/Uitkoms. A baseline social impact assessment was undertaken as part of this report and is detailed in **Section 6.1**.

- Title deeds and future mining operations

The site falls within Sishen Mine's property and is subject to a mining right issued to Sishen Iron Ore Company (SIOC) by the Department of Mineral Resources. There are no planned mining activities that will marginalise or impact on the site. The site has recently been exempt from the Mine, Health and Safety Act (No. 29 of 1996).

- Housing and accommodation

Housing and recreation of management, engineers and labour is of key concern for the operation and construction of the project. The construction programme may peak at 600 people with a 70/30 split between labour and management during the first phase.

Planning for housing for the 600 or so construction employees has not been finalised. The number of accommodation units and types of units cannot be determined with finality until it is clear what percentage of the workforce can be sourced locally, and is therefore already housed. The principle has been established that housing will be developed within the urban precincts of Kathu and Sishen, so that it is sustainable in the longer term. Workers will be transported to site in buses. Group Five has agreed that no construction camp will be established at the project site, for reasons relating to potential social conflict with surrounding landowners, difficulties in supplying services and disposing of wastes.

A meeting was held in Kathu in February 2011 with senior members of the Gamagara Local Municipality's technical services staff and Sishen/Kumba's housing team. Both parties declared their willingness to assist Group Five and make approved plots or housing available where possible, or to come to a mutually beneficial agreement to build accommodation. It was also stated that the number of potential temporary residents could be accommodated with respect to the additional water, sewage and power services required. Several options for rental accommodation in existing facilities were suggested (refer to Figure 4-1). Construction accommodation is therefore likely to comprise a combination of some of the options listed below:

- Da Silva farmhouse: rental for management staff;
- Peens' lodge: potential rental for management staff, on adjacent Uitkoms Farm;
- Sishen: old Kuruman Road land;
- Kumba Kathu Extensions: purchase/lease of serviced plots;
- Municipal: Kathu Extension 3; and
- Private township developments e.g. RooiSand: purchase of serviced plots.

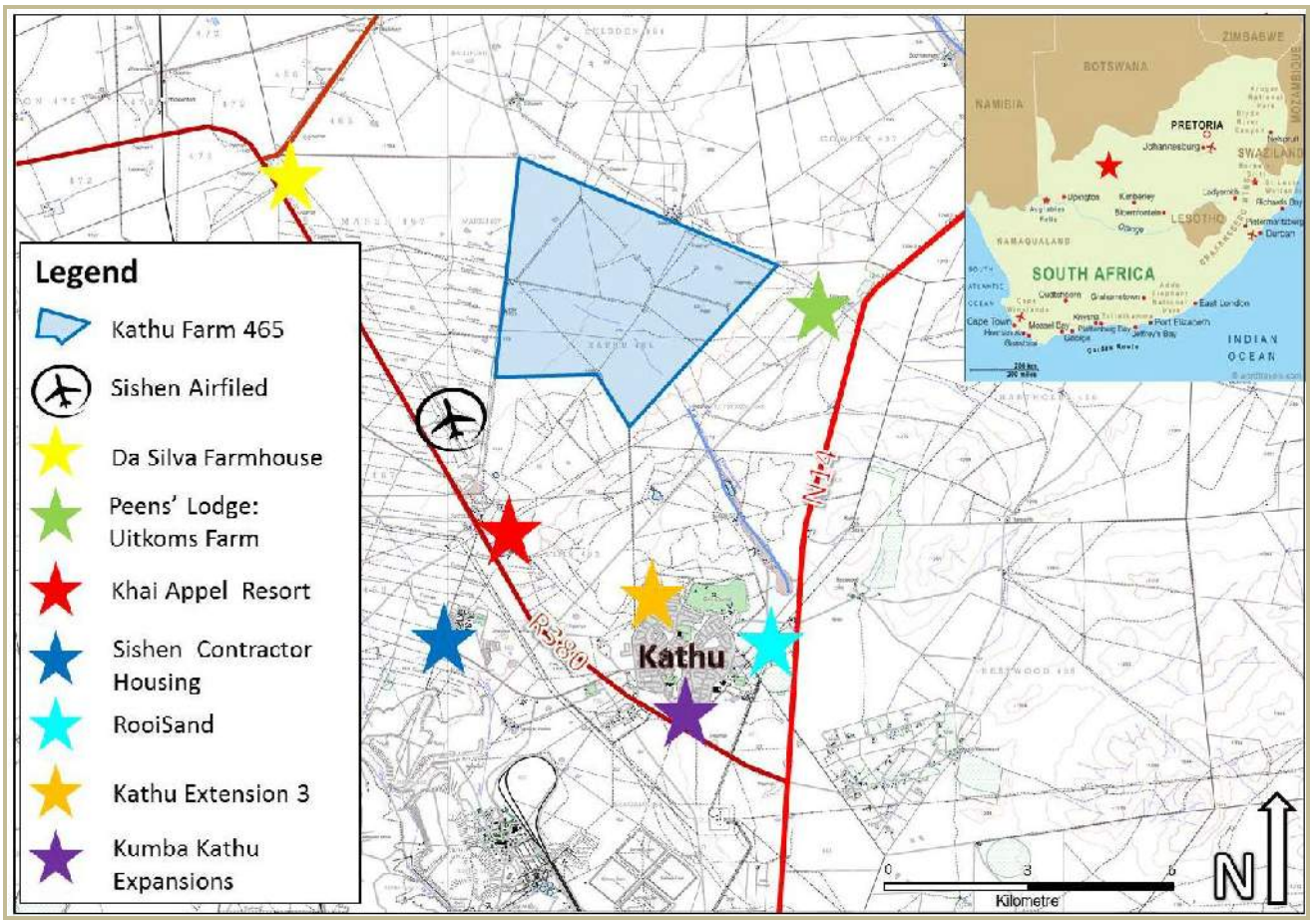


Figure 4-1: Housing alternatives

- Transport and logistics

The site is located close to the N14 and is accessible from a number of import and manufacturing portals, including Johannesburg, where most of the steel fabrication and galvanising will take place. The short distance (7km) of road from the N14 to the site will be core-sampled, reinforced and capped to ensure its suitability for heavy loads (*refer to* **Section 6.4** for a summary of the traffic impact assessment).

- Fossil fuel supply for co-firing

CSP plants require fossil fuel fired heat exchangers to keep the heat transfer fluid (HFT) and the power island warm during shutdown conditions. The HFT needs to be maintained above 12ºC. Fossil fuel will be used to warm up the system in the morning in order to get the plant running on solar energy a lot sooner, which raises the capacity factor of the plant. The REFIT programme allows for a 15% annual usage of fossil fuels to still quality as renewable energy (*refer to* **Section 5.4** for further information on the proposed co-firing system).

4.2.2 Evaluation of alternative sites

Three sites were considered when selecting the preferred site for the construction and operation of the solar power plants, shown in Figure 4-2.

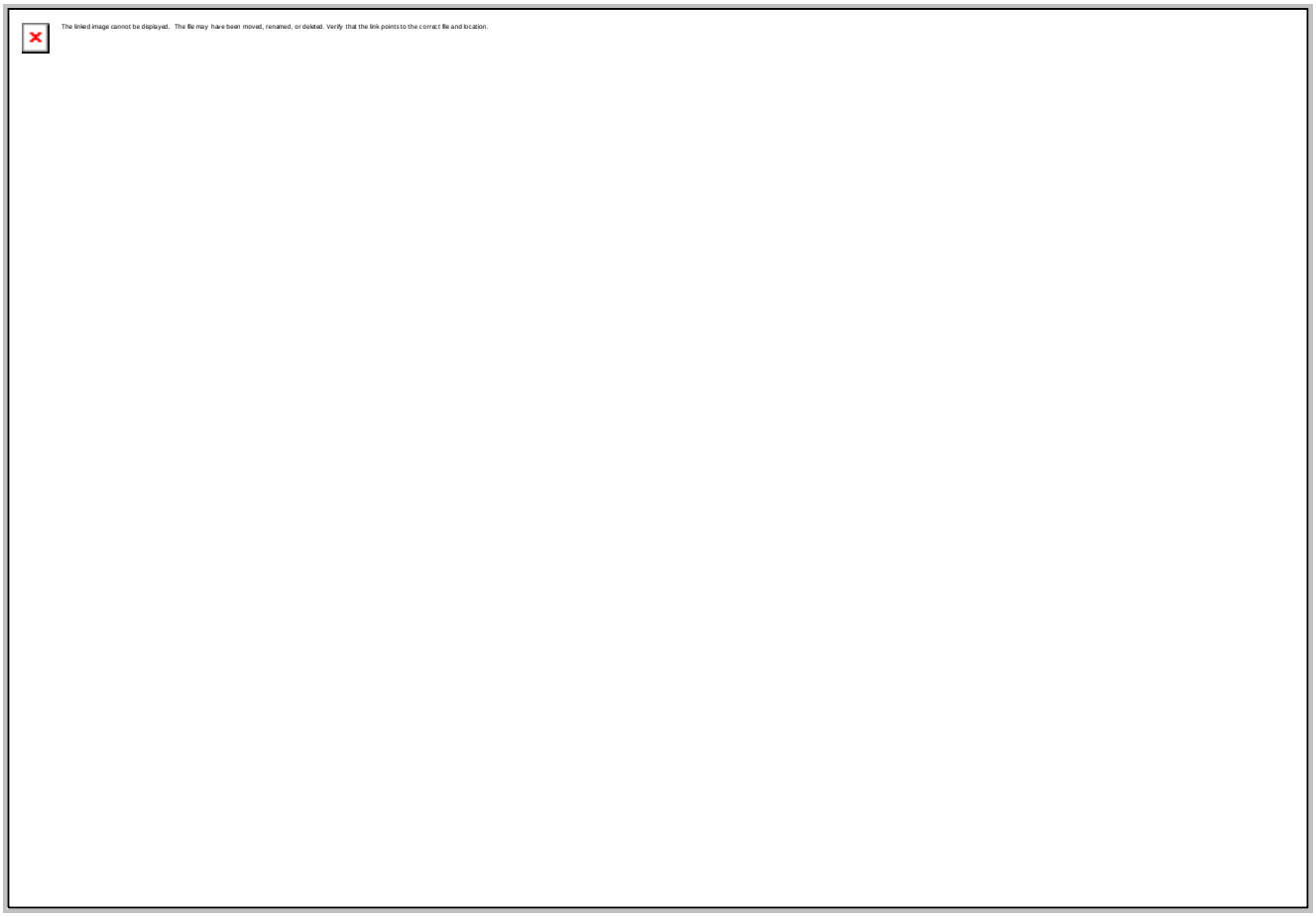


Figure 4-2: Site Alternatives (Group Five, 2010)

- **Site Option A** is situated to the west of the preferred site alternative and was considered unsuitable based on:
  - The existence of a number of power line servitudes traversing the site with voltages in excess of 11kV, 22kV and 33kV;
  - As the site is located within close proximity to the Sishen Airfield the Civil Aviation Authority would not allow the construction of structures of height, as required by the project, within the proposed area;
  - The site borders an area of potential cultural and heritage significance;
  - The land is currently zoned as agricultural and as such the development of a solar park would decrease land capability in the area; and
  - Visible air pollution on and around the site during the early mornings and late afternoons poses a risk that cleaning of the CSP mirrors would be required at a higher frequency, thus increasing the quantity of water required by the project
- **Site Option B** is situated to the east of Site Option A and to the west of the preferred site alternative and was considered unsuitable based on:
  - As with Site Option A, the site is located within close proximity to the Sishen Airfield and the Civil Aviation Authority would not allow the construction of structures of height, as required by the project, within the proposed area;
  - There is a higher number of neighbours in close proximity, thereby increasing the risk of noise and dust impact during construction; and
  - The land is currently zoned as agricultural and as such the development of a solar park would decrease land capability in the area.

- **Final Site Option** was selected as the preferred alternative based on its alignment with the selection criteria listed in **Section 4.2.1** above. In addition, the site was deemed the most feasible alternative based on:
  - Its close proximity to the Vaal-Gamagara Pipeline, which runs adjacent to the western boundary;
  - Its location in relation to the favourable general wind direction and the relation to Sishen Mine;
  - The land is considered to be non-arable comprising low potential grazing land; and
  - The site is zoned as Resort Zone 1 and the development of a solar park will therefore not decrease the land capability.

4.3 TECHNOLOGY ALTERNATIVES

A wide range of solar power technologies exist, and various technologies may be used to track the sun and focus light. Two types of CSP systems have been identified and are potentially viable for the project, these being the parabolic trough system and photovoltaic technology.

4.3.1 Parabolic trough (*preferred alternative*)

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. Sunlight is reflected by the mirror and concentrated onto an absorber tube (also known as the Dewar 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. Refer to Figure 4-3 to Figure 4-5**.** Each parabolic trough section will comprise four collectors per loop and 152 loops per phase, resulting in 608 collectors. There will be 116km of collector troughs per phase and they will be six to eight metres high.

The electricity generation process is illustrated in Figure 4-6. If thermal energy storage (TES) is not utilised, a hybrid, co-generation plant will be used to heat the HTF to operating temperature (12°C). The cool HTF runs through the tubes to absorb the concentrated light, causing the fluid temperature to rise to as much as 400°C. The heated fluid returns to a series of heat exchangers in the power block, from which the heat is transferred to generate high-pressure, superheated steam. The superheated steam drives the turbines to produce electricity. The spent steam from the turbines is condensed in a standard condenser and returned to the heat exchangers, via condensate and feed water pumps, to be transformed back into steam. Condenser cooling is provided by a dry cooling system which loses less water than other systems (e.g. mechanical wet cooling towers). Alternative cooling methods are investigated in **Section 4.4**.

After passing through the HTF side of the solar heat exchangers, the cooled HTF is re-circulated through the solar field. The process is very economical, and can produce overall efficiencies from collector to grid of approximately 15%, similar to that of photovoltaic cells. It is anticipated that 3,500 m^3 of HTF will be required per phase of the project.

One advantage of parabolic trough power plants is their potential for storing solar thermal energy to use during non-solar periods, and to dispatch electricity when it is needed most. As a result, thermal storage allows parabolic trough power plants to achieve higher annual capacity, from 25% without thermal storage up to 70% or more with storage.

The most proven technology to date is the two-tank indirect system. In this system, molten salt is stored in two tanks; one hot, the other cold. The thermal storage system is charged by taking hot HTF from the solar field and running it through heat exchangers, where cold molten-salt from the cold storage tank is run counter-currently, is heated then stored in the hot storage tank for later use. Later, when the energy in storage is required, the system operates in reverse to reheat the HTF, which generates steam to run the power plant. Existing commercial plants using the parabolic troughs are hybrid: fossil fuels are used mainly during night hours and are restricted to a maximum of 15% of electricity production, allowing the plant to qualify as a renewable energy source. The hybrid plants include cooling stations, condensers, accumulators and other components besides the solar collectors. Currently, parabolic trough technology is the most proven solar thermal electric technology.

Figure 4-3: Photograph of existing parabolic trough facility in Spain (Flagsol, 2010)

Figure 4-4: Photograph of existing parabolic trough infrastructure in Spain (Flagsol, 2010)

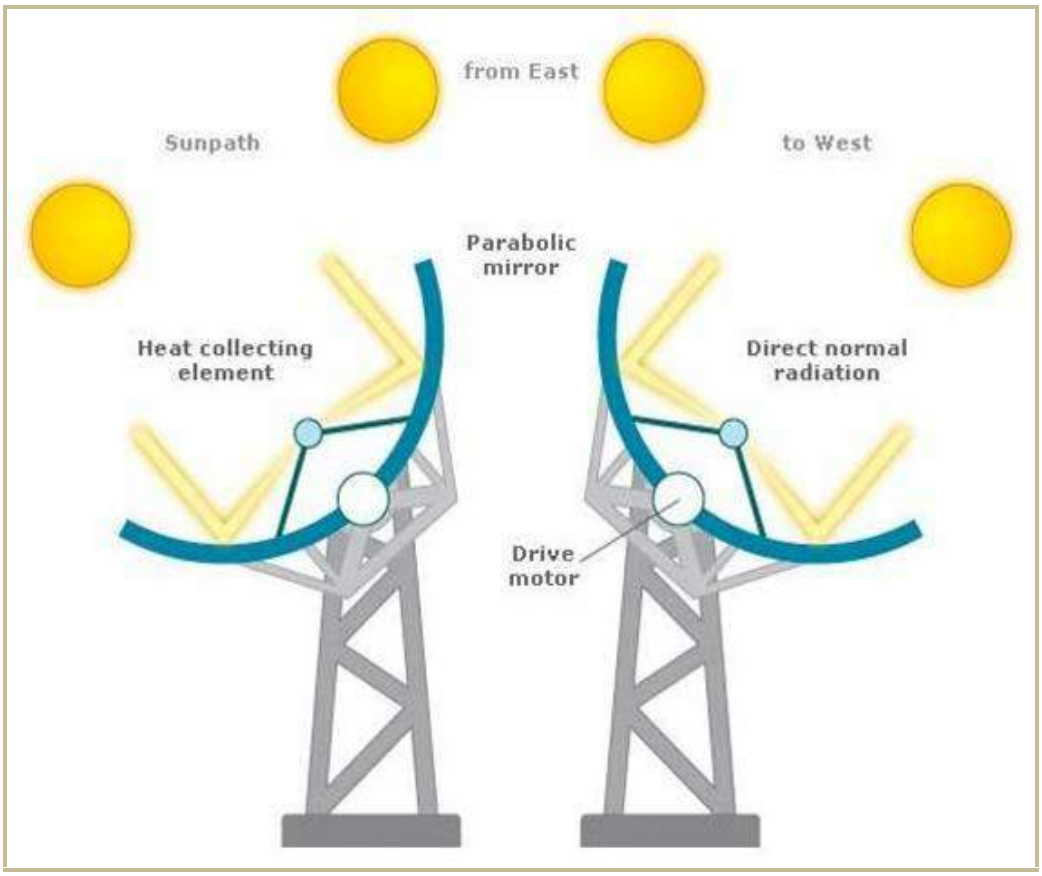


Figure 4-5: Parabolic trough electricity generation process (Glaskom.com, 2010)

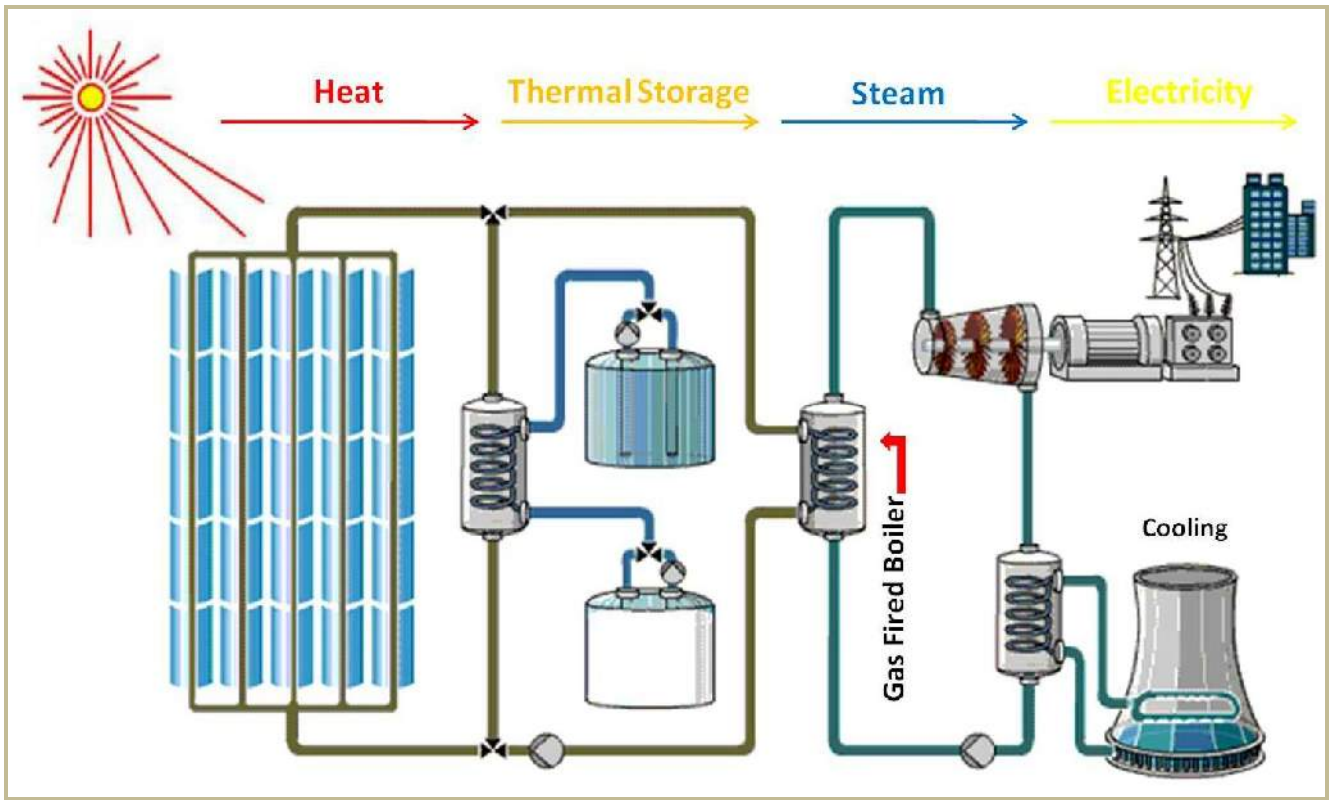


Figure 4-6: Parabolic trough process flow diagram (Group Five, 2010)

4.3.2 Photovoltaic

Photovoltaic (PV) arrays use semiconductor materials that directly generate electric power when exposed to light. PV cells are made from semiconductor material, usually silicon. The silicon is chemically treated so that the upper and lower layers are oppositely charged. Normally the electricity generated through the panels is stored in a battery or a bank of batteries. Because PV panels produce direct current (DC) and most appliances and equipment are designed to be powered by alternating current (AC), an inverter is used to convert the direct current from the PV panels or battery into alternating current.

Modules should be properly orientated to collect maximum energy. The amount of tilt towards the sun depends on the latitude and what time of year most solar collection is required. Batteries are used mainly as a back-up system that stores energy collected during sunny days for use at night or during cloudy days. Figure 4-7 illustrates a photovoltaic plant.

Over the past 20 years, production costs have been dramatically reduced, increasing the viability of using this technology. Large solar PV arrays are being connected to electrical distribution networks to provide electrical energy without burning fossil fuels.

One of the concerns associated with the use of PV technology is the use of cadmium in cadmium telluride (CdTe) solar cells (CdTe is only used in a few types of PV panels). Cadmium in its metallic form is a toxic substance that has the tendency to accumulate in ecological food chains. The amount of cadmium used in thin-film PV modules is relatively small (5-10g/m²) and with proper emission control techniques in place, the cadmium emissions from module production is insignificant.

Note: 30MW of PV arrays were originally planned for the south eastern portion of the site, however, following the flora assessment undertaken by Beryl Wilson, the proposed PV site has been removed from the project plan as the south eastern portion of the proposed site contains a high number of *A. erioloba* trees (*refer to* **Section 6.9** for a summary of the flora impact assessment).

Figure 4-7: Photovoltaic technology at Nellis Air Force Base in the USA (USAF Photographic Archives, 2010)

4.4 COOLING METHODS

Historically, CSP plants have used evaporative water-cooling to reject heat produced in the steam cycle, but more recently the industry has been exploring ways to reduce its expensive H_2O dependency. The traditional wet cooling system can account for approximately 90% of a parabolic trough power plant's water consumption. Consequently, CSP plant owners face huge water bills, especially when precious supplies have to be piped in from distant sources.

Regions where CSP plants are most productive often have relatively little water and the lack of water is often a common denominator of CSP plants. Reducing water dependency in arid climates is critical. Air or dry cooling offers a viable alternative to traditional wet cooling and dramatically curbs water consumption because steam-cycle heat is rejected directly to the air without the need for water.

Although the water-saving potential of dry cooling is impressive, it does have its drawbacks. A dry-cooled plant, depending on its location, would provide 5% less electricity per annum than a wet-cooled plant. Location significantly influences the performance of dry-cooling technology. Cooler climates are more suited for dry cooling. In dry, hot desert areas, the loss of efficiency and capacity increase.

Table 4-1: Comparing three solar power cooling systems (Carter & Campbell, 2009; William, 2010)

Type	Advantage	Disadvantage
Wet Cooling	Lowest cost	High water consumption
	Low parasitic loads	Water treatment and blow-down disposal required
	Most efficient cooling, especially in arid climates	
Dry Cooling	Less water consumption	Higher capital costs
	Less water treatment required	Higher auxiliary operating power requirements
		Fan noise
		Lower plant performance, especially on hot days
		Poorer cooling at high dry-bulb temperature
Hybrid Cooling	Less water consumption	Complicated system involving wet and dry cooling
	Maintain good performance during hot weather	Same advantages of wet system, but to a lesser degree

4.4.1 Dry cooling (*preferred alternative*)

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.

- **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 4-8).

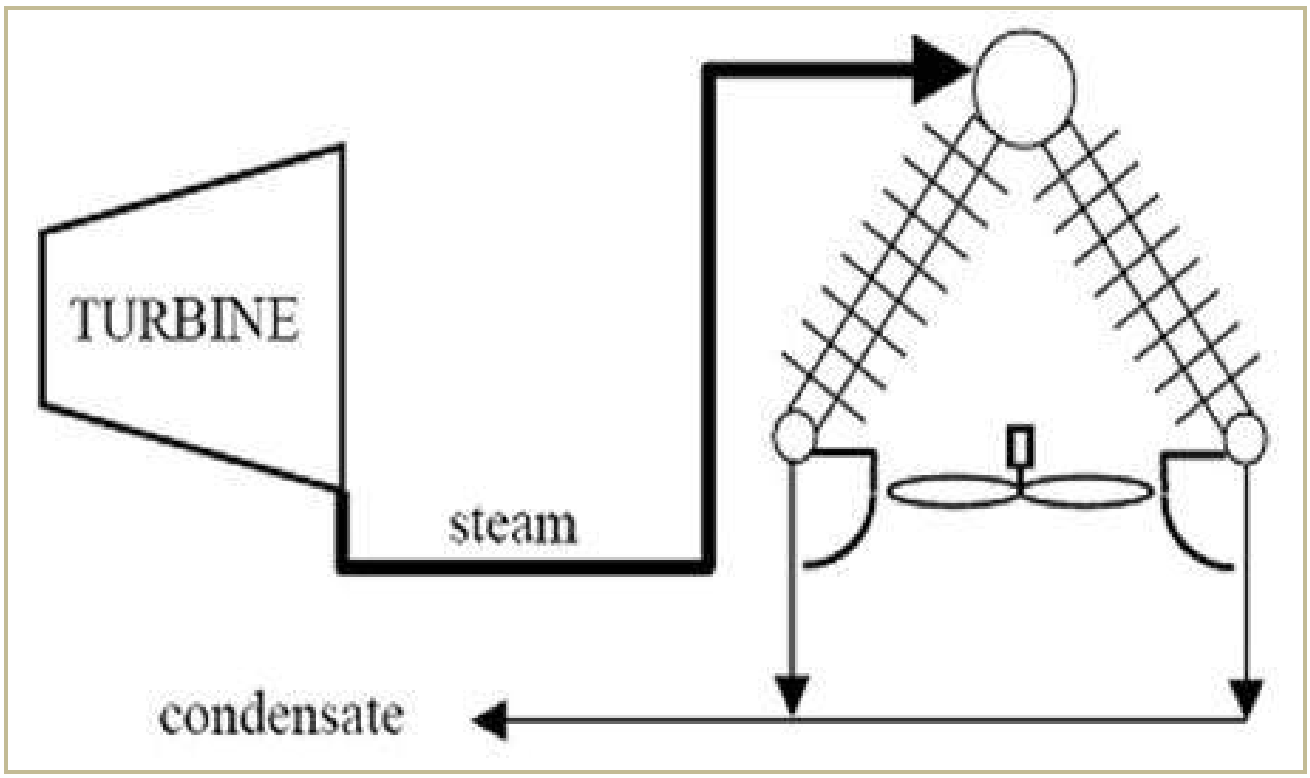


Figure 4-8: Direct dry cooling technology (U.S. Department of Energy, 2006)

- **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 4-9).

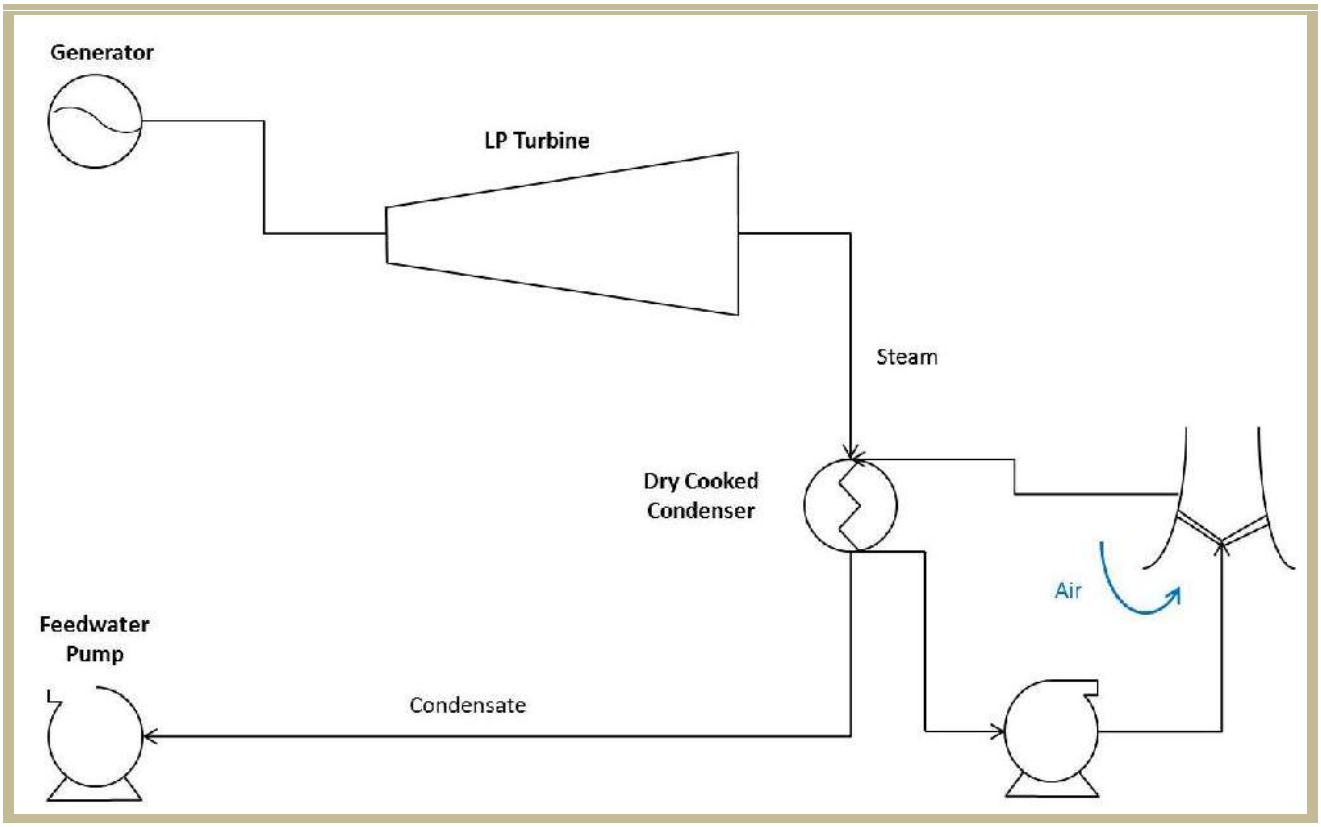


Figure 4-9: Indirect dry cooling technology (Kelly, 2006)

4.4.2 Wet cooling

- **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.

- **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 PM10 (particulates less than 10 microns in diameter), which is restricted by regulations. Figure 4-10 represents a diagram of wet cooling technology.

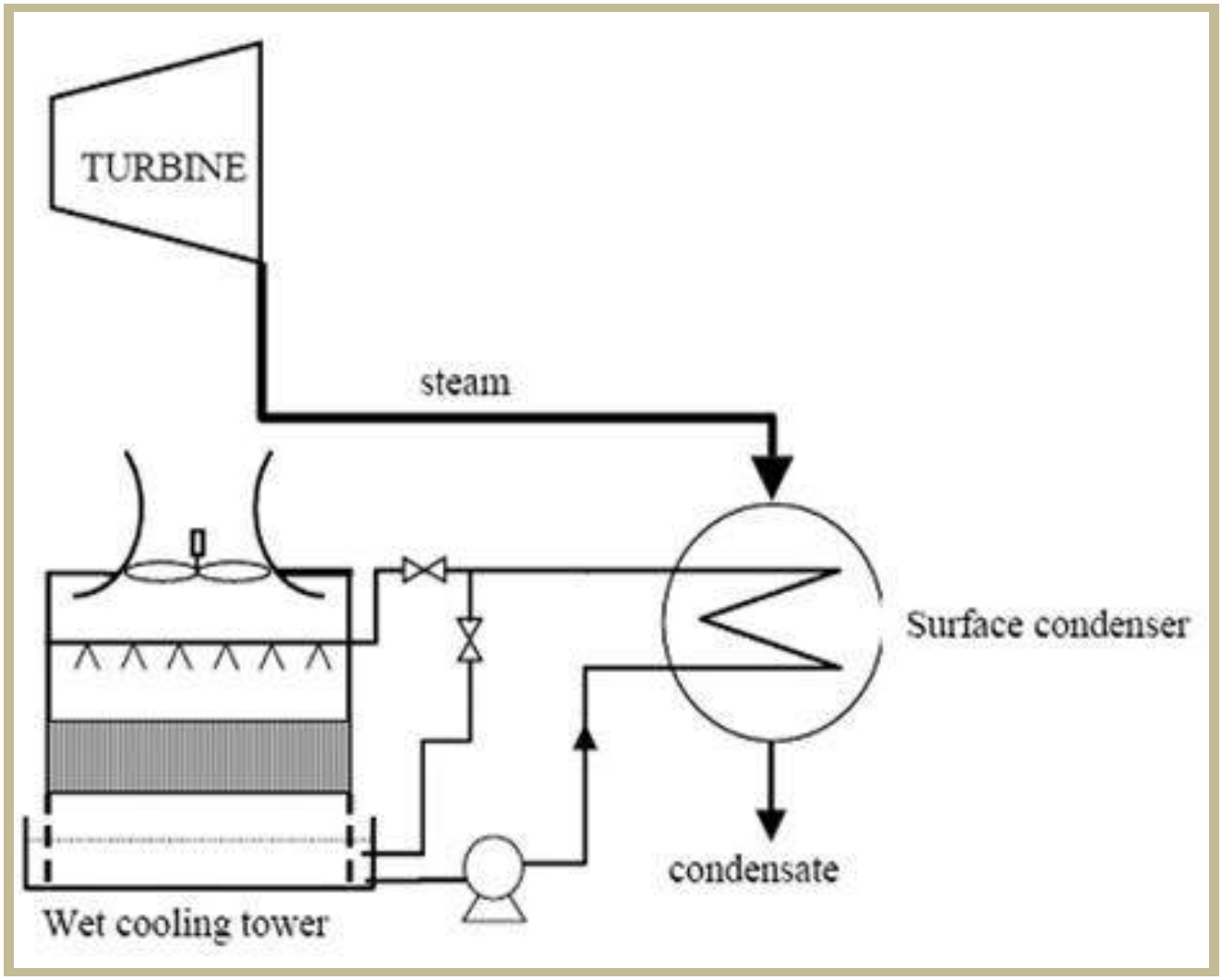


Figure 4-10: Flow diagram illustrating wet cooling technology (U.S. Department of Energy, 2006)

4.4.3 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 4-11).

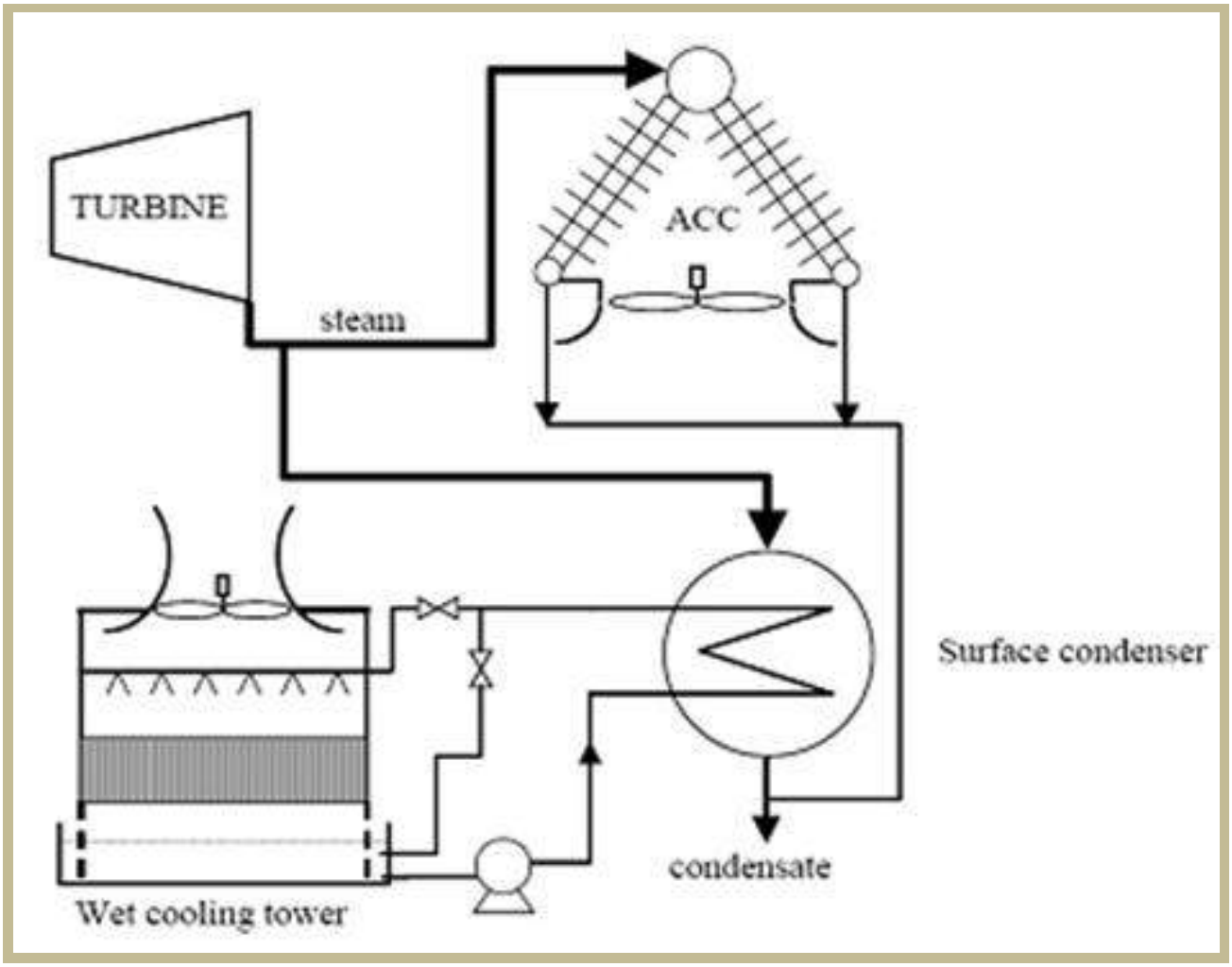


Figure 4-11: Hybrid wet/dry parallel cooling system (U.S. Department of Energy, 2006)

4.4.4 Thermal storage

Heat storage allows a solar plant to produce electricity at night and on overcast days. This allows the use of solar power for base load generation as well as peak power generation, with the potential of displacing both coal and natural gas fired power plants.

Heat is transferred to a thermal storage medium in an insulated reservoir during the day, and withdrawn for power generation at night. Thermal storage media include pressurized steam, concrete, a variety of phase change materials, and molten salts such as sodium and potassium nitrate.

- Molten salt storage

A variety of fluids have been tested to transport the sun's heat, including water, air, oil, and sodium, but molten salt was selected as best. It provides an efficient, low-cost medium in which to store thermal energy, its operating temperatures are compatible with today's high-pressure and high-temperature steam turbines, and it is non-flammable and non-toxic.

The molten salt is a mixture of 60 percent sodium nitrate and 40 percent potassium nitrate, commonly called saltpeter. The salt melts at 220°C and is kept liquid at 290°C in an insulated storage tank. The uniqueness of this solar system is in de-coupling the collection of solar energy from producing power, electricity can be generated in periods of inclement weather or even at night using the stored thermal energy in the hot salt tank. Normally tanks are well insulated and can store energy for up to a week (http://en.wikipedia.org/wiki/Solar_thermal_energy, 2011).

4.5 POWER LINE ROUTE ALTERNATIVES

Various servitudes for the power line route have been assessed as part of the pre-feasibility study for the KSP project. EON Engineering (Pty) Ltd has recently undertaken a servitude route assessment for the proposed 132kV power lines. Refer to Figure 4-12 for a pictorial representation of these routes.

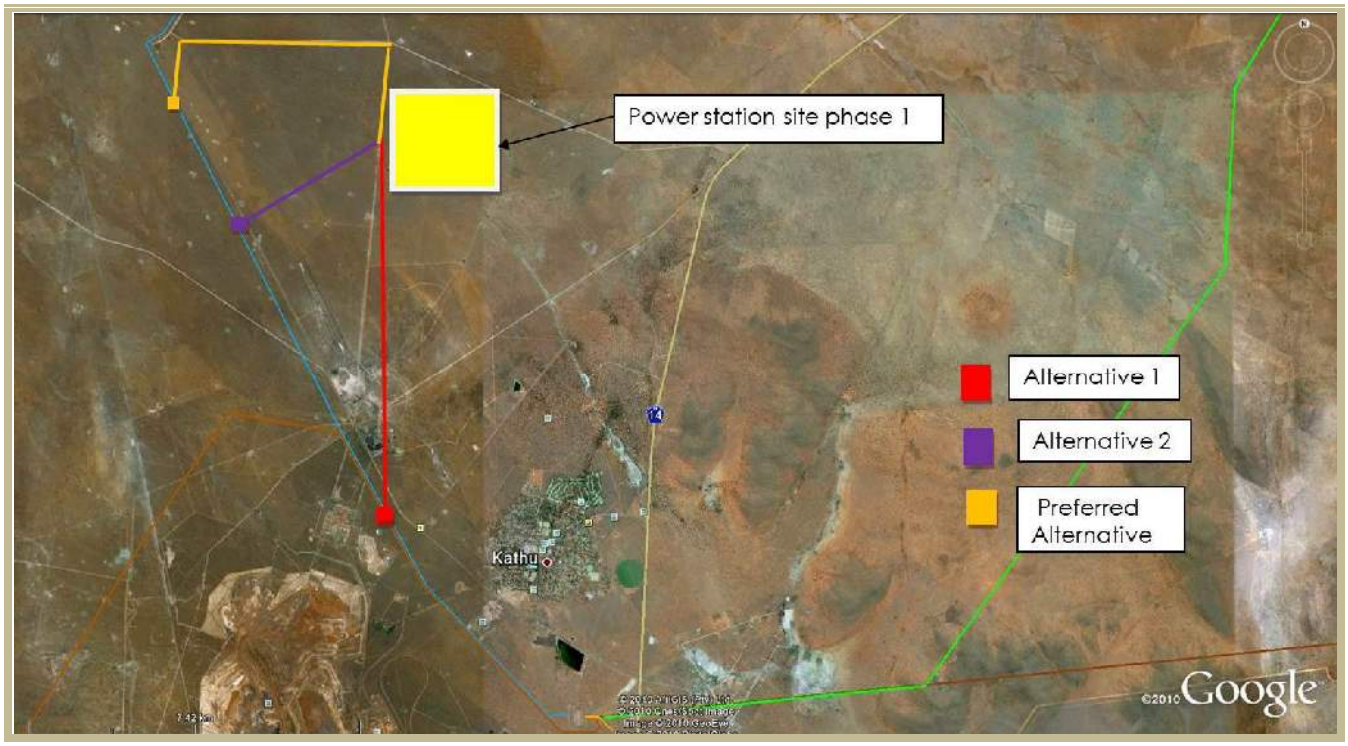


Figure 4-12: Power line route alternatives (Google, 2010)

4.5.1 Shortest and Most Direct Servitude Option (Alternative 1)

Initially, it was proposed that a 132kV power line would be developed from the south eastern section of the site, running towards the 132kV line around the bottom of the airport along the Kumba farm. This option was rejected as the proposed power line would need to pass through the property set aside for a game reserve, and would clash with planned land use in the area. Additional to this, the line would also be in close proximity to the approach routes of the airport. Refer to Figure 4-13 showing the allowable clearances for structures near airports.

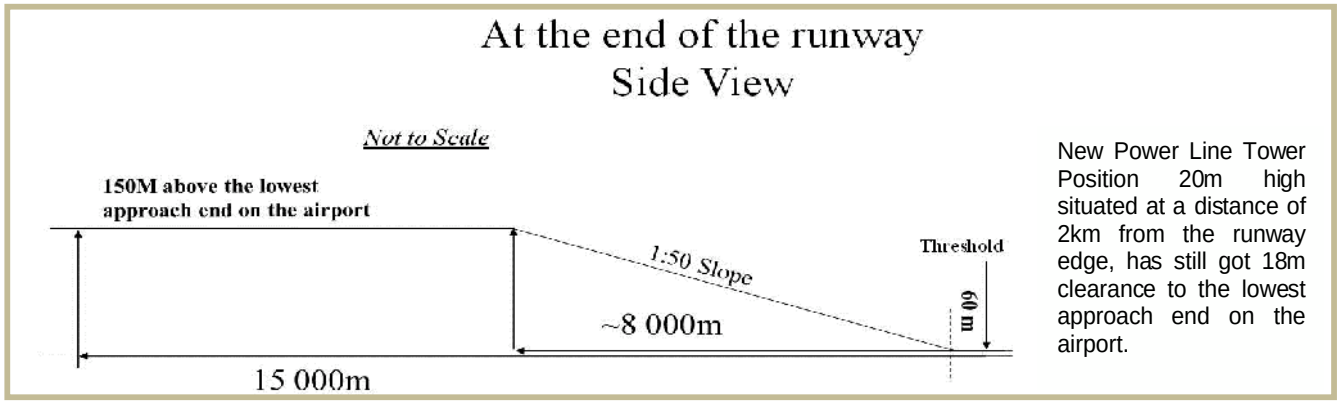


Figure 4-13: Airport limitations (EON, 2011)

4.5.2 Alternative Servitude Options (Alternative 2)

Alternate routes proposed by EON Engineering (Pty) Ltd included; the construction of a 132kV power line running directly east from the centre of the KSP site, across the top portion of the farm MARSH 467, with a straight line towards the future Eskom 132kV power line. This route was deemed unsuitable for several reasons: it would bisect some of the portions of the farms comprising the area MARSH 467 (refer to Figure 4-14), as it would cut across the centre of these farms in some cases, thereby causing possible complications in providing for maintenance access. This route could also impact on the Sishen airfield approach routes.

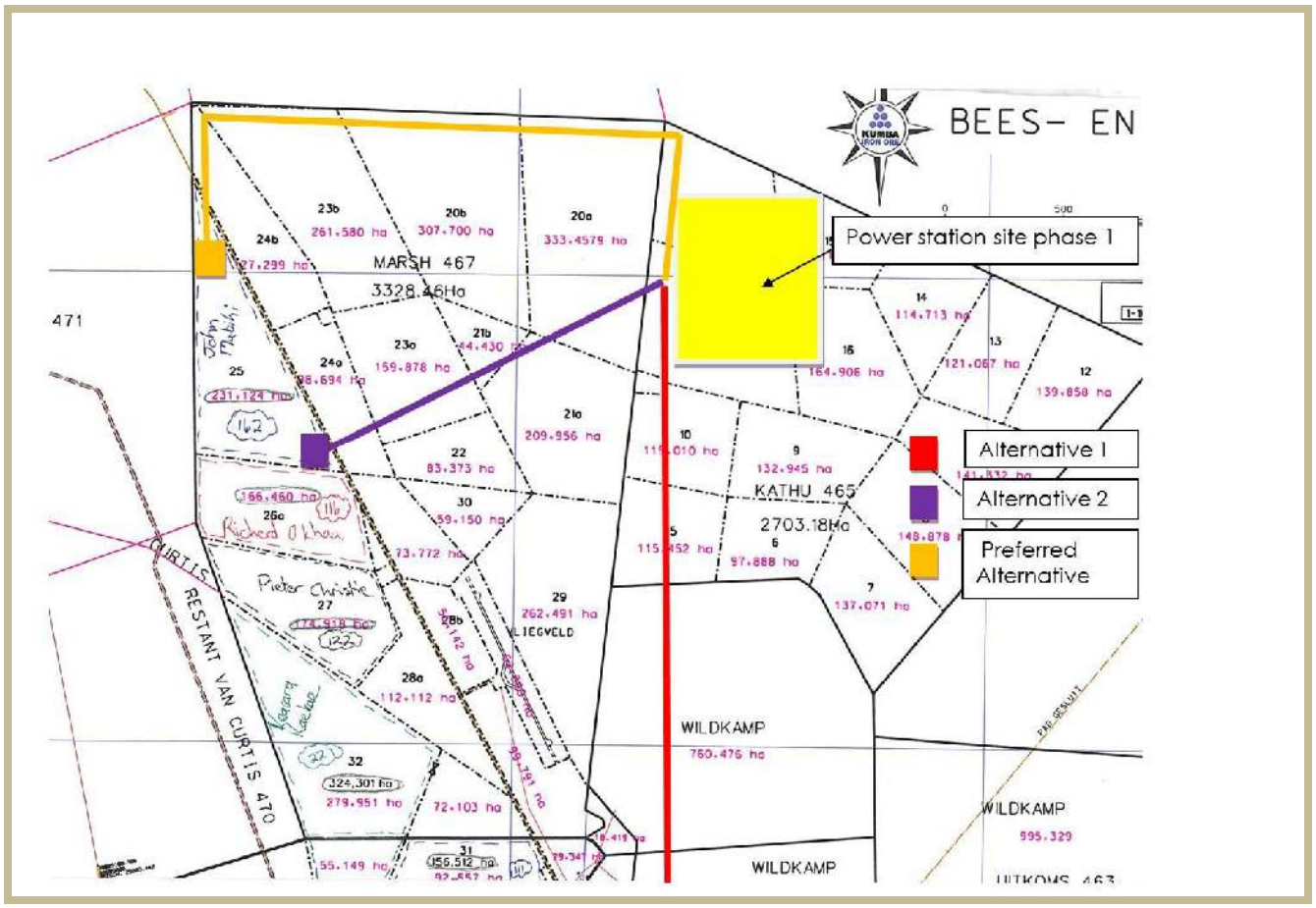


Figure 4-14: Proposed 132kV Power Line Routes and Position of Switching Station, with Property Information (EON, 2011)

4.5.3 Preferred Servitude Option

The preferred servitude option is to construct a 132kV power line that would exit the site at the north-west corner, run in a westerly direction along the northern border of the farm MARSH 467 until the property boundary with the farm of Mr Da Sylva is reached. From here the line will make a turn in a southerly direction towards the road, while keeping to the border of farm MARSH 467. The line route will cross the road (R380) and still within the borders of farm MARSH 467 intersect with the Eskom line. Refer to Figure 4-15. The connection substation is planned for the location where the proposed 132kV line and the Eskom line meets. Running the line close to the existing road provides easy access for maintenance and reduces potential impacts on the environment as new maintenance roads will not be required.

Figure 4-15: Locations of proposed substation, transmission line and switching stations (EON, 2011)

4.6 POWER LINE TYPES AND SERVITUDE INFORMATION

To reduce servitude space and reduce the environmental impact as well as cost, it is recommended to build these lines by means of a double circuit monopole type of construction see Figure 4-16 below. See also Figure 4-17 showing typical drawings of 132kV tower structures.

Figure 4-16: Monopole double circuit 132kV Line

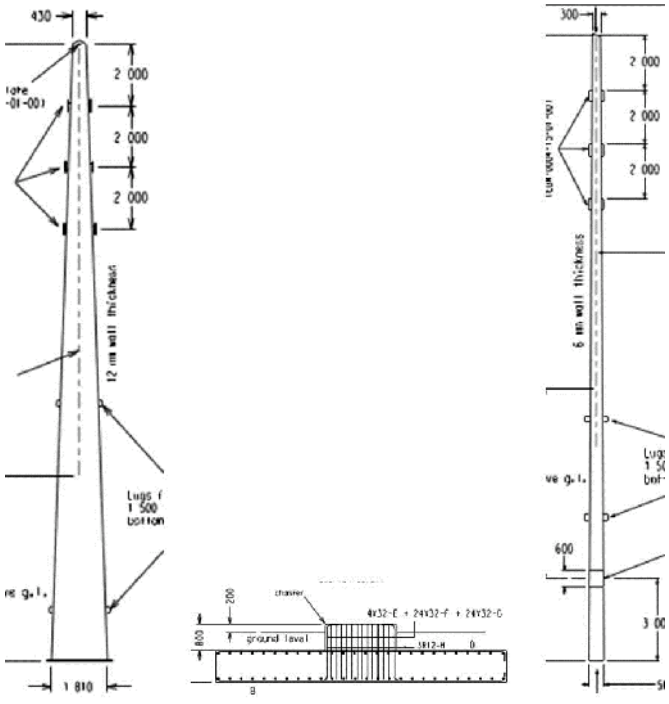


Figure 4-17: 132kV steel monopole double circuit tower examples- height approximately 20-25m (EON, 2011)

Some conditions of the power line servitude are:

- Servitude conditions are the same whether the power line runs through a rural area or an urban or built up area;
- Servitude width on a 132kV power line is 31m i.e. 15,5m either side of the centre line;
- No permanent buildings/structures or trees allowed in the servitude area;
- Services such as roads and pipelines etc. are allowed but a co-use agreement must be attained from Eskom for indemnity;
- The clearance above ground at 70 degrees Celsius is 6.3m but above roads it is 7,5m (in the design phase the power line is templated to a maximum of 70 degrees Celsius. If the temperature in the conductor reaches this limit the minimum clearance the conductor may be above ground as stated is 6.3m and above any proclaimed road it may not hang lower than 7.5m);
- No excavation or digging closer than 6m to any supporting mechanism is generally allowed; and
- No blasting closer than 500m to the centre of the power line is allowed.

4.7 GRID CONNECTION SUBSTATION

The grid connection substation according to the Eskom indicative quotation will be typically cover an area of 100m by 100m and will be located on the western side of the road (R380) connecting Kathu with Hotazel. The location of the substation is shown by the square in Figure 4-14**.** The substation will be of the outdoor air insulated type with high strung busbar structures, refer to Figure 4-18 below.

Figure 4-18: Typical outdoor high strung busbar substation (EON, 2011)

5 Project Description

5.1 OVERVIEW

The KSP project will be one of the first large-scale solar power electricity generation projects in Southern Africa.

It will be developed in three phases, utilising the best available concentrated solar power technology, which is currently parabolic trough solar field and thermal generation. Each of the three phases will comprise a 75-150MW parabolic trough solar thermal power plant.

Each parabolic trough solar thermal power plant will consist of the following components:

- Solar field with parabolic trough collectors;
- Heat transfer fluid (HTF) system to transport the solar energy;
- Power block with steam turbine generator for the generation of electricity in a conventional Rankine cycle;
- Ancillary infrastructure:
  - Auxiliary system to drive and control the power plant electrical system;
  - Control systems.

A general plant schematic is shown in Figure 5-1.

The HTF system and the power block, including the steam cycle and cooling system, are located inside the solar field. Several buildings related to process control are located within the power block area.

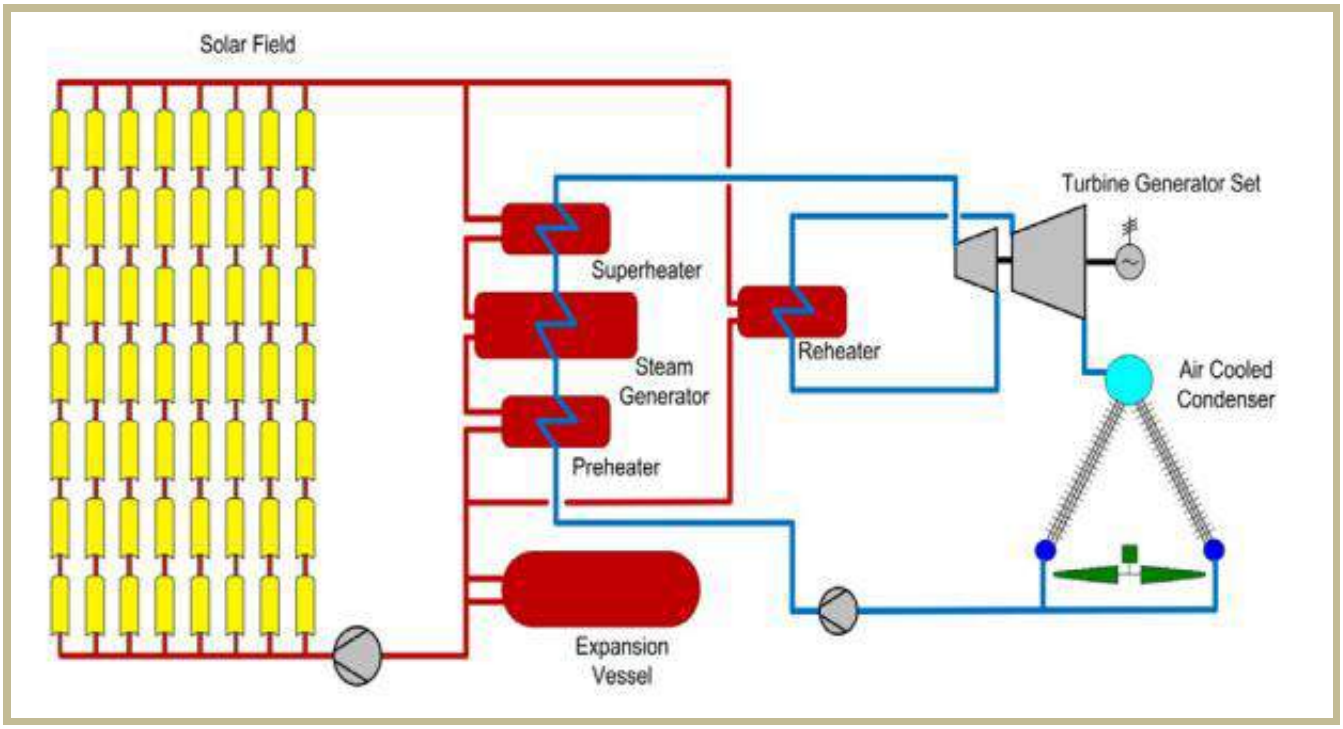


Figure 5-1: Schematic diagram of a parabolic trough solar power plant with dry cooling (Flagsol, 2011)

The collector has a linear parabolic shaped reflector that focuses the sun's direct beam radiation on the heat collection elements (HCE), located at the focus of the parabola. One HCE comprises a stainless steel tube with a highly absorptive, low emissivity coating which is encased in an outer glass tube evacuated to reduce thermal losses.

The collectors track the sun from east to west during the day to keep the sun's rays continuously focused on the receiver tube. The row of collectors has a hydraulic drive unit with sensors to determine appropriate collector orientation throughout the day and according to ambient conditions. The drive unit also reports operational status, alarms and diagnostics to the main solar field control room.

The HTF is heated to a high temperature (400°C) as it circulates through the receiver tube and returns to a series of heat exchangers in the power block where the fluid is used to generate high pressure superheated steam. The superheated steam is then fed to a conventional power block, consisting of a reheat steam turbine generator to produce electricity.

Group Five will also build a solar research and development centre on the site.

The construction of phase 1 and associated infrastructure will take approximately 24-30 months, with the construction of the succeeding phases proceeding in sequence immediately the previous phase is complete. The fully developed project will generate electricity for up to 25 years, but continuous refurbishment will almost certainly prolong its lifespan a long way beyond this.

Refer to Figure 1-3 for the site layout of the proposed solar power facility

Each phase's construction will require a total labour force of 500-600 persons, and 75 people will be permanently employed to operate each phase solar plant.

5.2 SOLAR FIELD

5.2.1 Solar collector terraces and field

Each phase of the parabolic trough field will occupy a rectangle of dimensions 1,86km x 1,68km, that is, 312ha in area. While the configuration and size of the solar fields is limited to rectangles due to the linear nature of the collector terraces, some dimensional variation can be designed to accommodate the necessity to minimize the number of Camelthorn trees to be removed. The project layout footprint has been designed to ensure the outlier of the Kathu forest on the property will not be removed or altered in any way (see Figure 1-3 for solar fields' layout)

The parabolic trough terrace areas will need to be completely cleared and levelled to ensure no ground variation and to reduce hazards associated with fires. Areas that are cleared for the parabolic troughs will be covered with crushed aggregate to reduce the amount of dust generated during operation.

5.2.2 HelioTrough® technology

The solar field of the project comprises collector loops of Flagsol's HelioTrough® collector technology. The HelioTrough® parabolic trough solar collector follows the successful development of the SKAL-ET solar collectors selected for the three 50MW Andasol plants in Spain and for the ISCC plant in Kuraymat in Egypt.

Each collector loop consists of a group of solar collector assemblies (SCA) which are supported on concrete cast-in-place footings and connected to the HTF system via piping headers. The SCA's are also provided with cabling for power distribution and communication. The collectors are controlled by a system of local controllers (LOCs) mounted on each SCA and a central field supervisor-controller (FSC) located in the central control building. Weather stations provide solar insolation and wind data required to control the plant and protect the solar field.

The parabolic trough collectors consist of a concentration system with parabolic geometry, equipped with a sun tracking mechanism that moves the parabolic reflector panels at any moment into the optimum incident solar radiation angle.

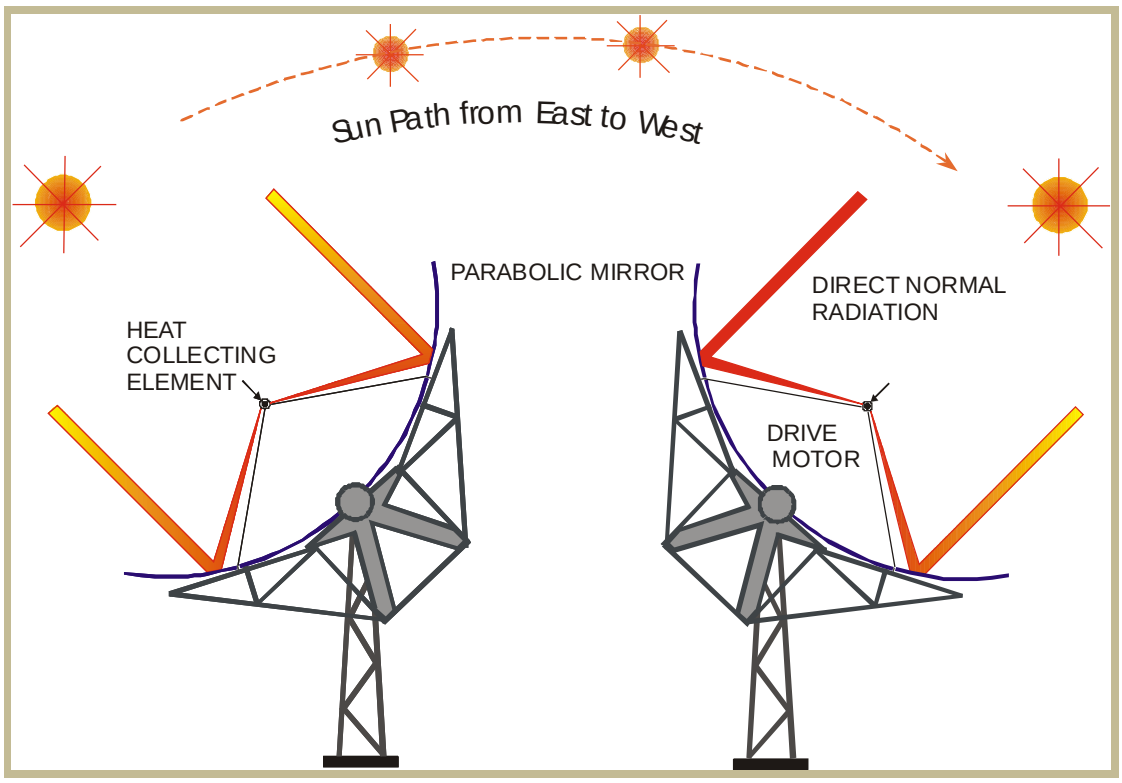


Figure 5-2: Working principle of a Parabolic Trough Collector (Flagsol, 2011)

Figure 5-2 above shows the functional principle and the tracking of the collectors: Tracking the sun from east to west, the collectors reflect and concentrate the direct solar radiation about eighty times on absorber tubes (HCE) located in the focal line of the reflecting surface. One HCE is comprised of a stainless steel tube with a highly absorptive, low emissivity coating which is encased in an outer glass tube evacuated to reduce thermal losses. The HTF circulates through the absorber tubes and is heated by the concentrated solar radiation up to a temperature of almost 400°C.

Figure 5-3: HelioTrough® Collectors installed at Kramer Junction (California /USA) (Flagsol, 2011)

Figure 5-3 and Figure 5-4 show a HelioTrough® collector loop during the construction phase at the Kramer Junction site in California /USA. In the following sections, a detailed description of the collector technology and the other solar field components is presented.

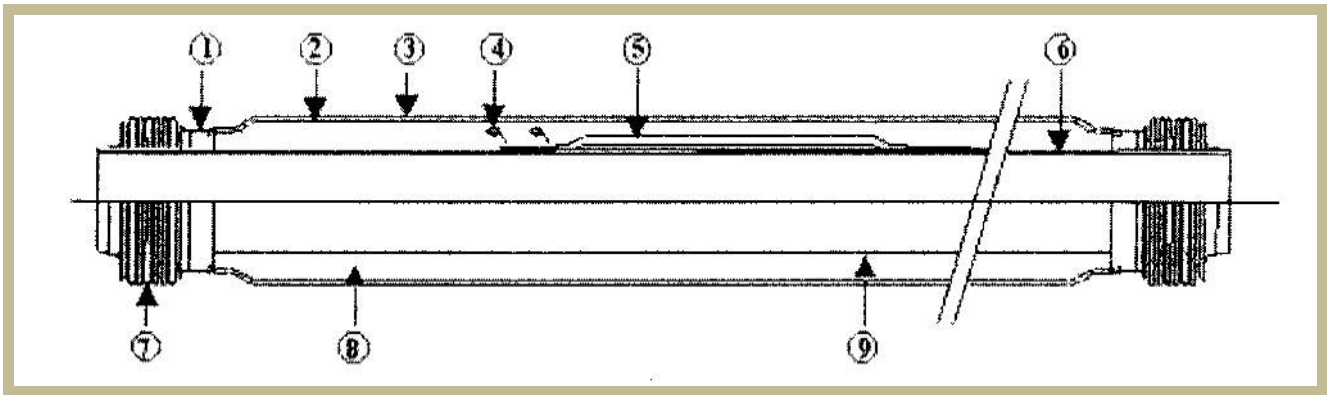
5.2.3 Solar collector element

The HelioTrough® technology consists of 10 basic segments, the so-called solar collector elements (SCEs). Each SCE consists of a torque tube that resists torsion and bending forces caused by strong wind and gravity. On the torque tube 24 pairs of cantilever arms are fixed to support the reflectors. On these arms 48 parabolic curved reflector panels are mounted, with six supports each. HCE absorber tubes are located in the focal line of the parabolic reflectors. Each HCE is 4.7m long and is supported by an HCE support that is fixed on the torque tube. At each end, the SCE is connected to the moment transfer assembly, sitting on the bearing housing, which is located on top of each intermediate pylon. The moment transfer assemblies thereby transfer the motion from the drive system to the entire SCA.

Figure 5-4: HelioTrough® SCE with main components during site erection (Flagsol, 2011)

Heat collecting element

The HCE is another key component of the parabolic trough collector. It converts the radiation concentrated by the reflector panels into heat.



1. Glass to metal connection	6. Stainless steel tube
2. Glass envelope	7. Expansion Compensating Bellows
3. Anti-reflective coating	8. Evacuated space
4. Vacuum indicators	9. Solar coating
5. Getters for vacuum stability	

Figure 5-5: Construction Principle of an HCE (Flagsol, 2011)

Figure 5-5 and Figure 5-6 illustrates the construction principle of a HCE: it consists of an inner stainless steel tube, an outer quartz tube and metallic bellows on both sides, which form the joint between the inner metallic tube and the outer quartz tube. The inner tube is covered by a selective coating to maximize the absorptivity of the concentrated radiation and minimize the re-radiation of the infrared radiation. The quartz tube on both ends is joined with the metallic bellows by a sophisticated glass-to-metal seal, resistant to operating temperatures and sealing the enclosed vacuum. On the other side, the metallic bellows are welded to the inner absorber tubes. The elasticity of these connecting bellows compensates the difference of the thermal expansion of the inner metallic tube and the outer

quartz tube during warming up and cooling down of the absorber tubes. The sensitive glass-to-metal seal is protected from damage due to overheating by solar radiation by a sleeve called Bellow Shield.

The energy of the concentrated radiation is converted into thermal energy at the absorber surface of this inner tube, which transfers the circulating HTF and heats it up to approximately 400°C. The outer quartz tube works as an additional barrier to the infrared re-radiation and reduces thermal losses like a greenhouse made of glass. It is covered by an anti-reflective coating that allows for about 96% of the incident concentrated radiation to pass through it and into the absorber tube.

Figure 5-6: Pre Assembly of HCE elements (Flagsol, 2011)

Parabolic mirror

The SCE collects solar radiation by concentrating the sun's rays onto a single focal line via reflector panels. The reflector panels are the optical key components to maximize the concentration, optical performance and durability of the HelioTrough® collector. The reflector panels receive the direct incident radiation and reflect it to the focal line to concentrate its energy on the absorber tubes. Each SCE has 24 inner and 24 outer reflector panels mounted, half of them on each side, totalling 48 reflectors per SCE. The 10 SCEs of a collector carry 480 reflector panels with a total aperture area of 1263m^2 per collector. Usually the reflectors utilized for the HelioTrough® collector have a glass thickness of 4mm. However, in order to reduce reflector breakage the outer edges and windward sides of the solar field can be covered by strong reflectors with a glass thickness of 5mm.

5.2.4 Solar collector assembly

Each SCA unit consists of 19m long SCEs. The parabolic reflector panels and the absorber tubes are mounted on these SCEs, which provide the necessary rigidity to keep the whole collector in focus under all operating conditions.

The 10 SCEs of a HelioTrough® collector assembly are mounted on 10 “middle“ pylons and one central drive pylon that moves all the SCAs while tracking the sun. Torque transfers transmit the movement of the central drive pylon to the whole collector. These torque transfers are fixed to the top bearing housings of each normal pylon.

Each HelioTrough® collector is an independent unit that concentrates and collects energy from solar radiation and has its own tracking unit and control and communication system. For this purpose, each collector is equipped with local measurement sensors, a hydraulic drive system and its own LOC, which allows it to track the sun independently of the instructions of the central computer, maintain the reflector panels focused on the absorber tubes and protect them from overheating (Figure 5-7).

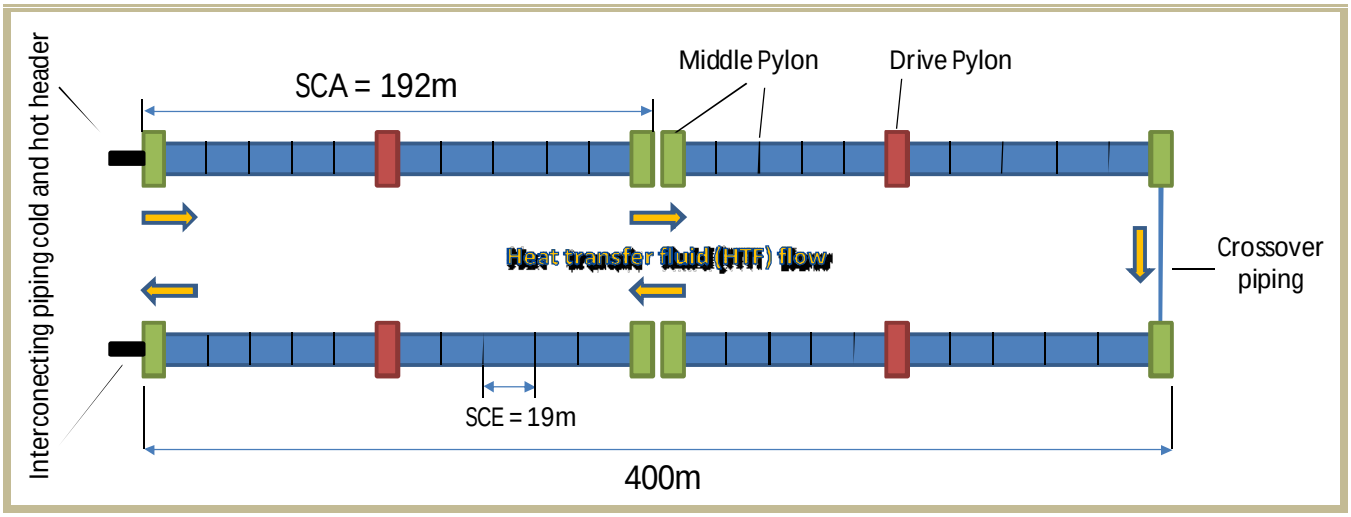


Figure 5-7: HelioTrough® collector arrangement (Flagsol, 2011)

Metal support structure

To achieve the required high accuracy and efficiency of the solar collector, the metal support structure has to be manufactured with very high precision. To protect the SCAs from wind forces, various parts of the construction have been strengthened. The SCA is designed so that the central axis of rotation is located about 4 m off the ground, in the centre of bearings attached to the top of the pylons. Each of the 191m long SCAs is mounted on 11 pylons (10 middle pylons and 1 drive pylon). All pylons are carefully levelled and aligned for maximum accuracy of position and securely bolted to the anchor bolts of the concrete base.

Two types of pylons are utilized:

- Middle pylons: Support SCE subunits only. At the end of a row, the final pylon is also a regular (“middle”) pylon; and
- Drive pylons: At the centre of each SCA, supporting the drive components, sensors and local controllers.

In order to adapt the support structure to different environmental conditions, e.g. locations with higher wind loads, the pylons must be partly reinforced.

Drive and tracking system

The SCA is able to track the sun from sunrise to sunset. Each collector rotates during its daily tracking of the sun around its rotation axis driven by two hydraulic cylinders which move two lever arms attached to the torque transfer.

Source of motion of the SCA is an electrical motor located in the drive pylon. The electrical motor is driving a hydraulic pump, which moves the lever arms in the desired position. The motor is enclosed in an outdoor housing and is designed to operate under the environmental conditions on site.

The whole set of SCA’s that form the solar field, operates as a unit under the control of the FSC, a central computer located in the control room of the plant. The FSC collects information from each loop of collectors, analyses and

represents them on the operator's screens. It receives instructions from the operator and issues global instructions to the field as a unit and modular instructions to the individual loops. It deploys the solar field during the day when weather and plant availability permit, and stows it at night and during high winds.

The tracking at each SCA is controlled by the LOC, which is mounted on the drive pylon. Signal and power lines lead from the LOC to the hydraulic unit and to sensors, which are used to provide input information to the LOC. The following three different sensors are mounted on each SCA for tracking control:

- Position sensor;
- Sun sensor; and
- Temperature sensor.

5.2.5 Solar collector loop

Figure 5-8 illustrates the arrangement of 4 collectors in one loop. One single SCA has a length of about 191m. Each HelioTrough® SCA unit consists of 10 sub modules with a length of about 19m, called SCE.

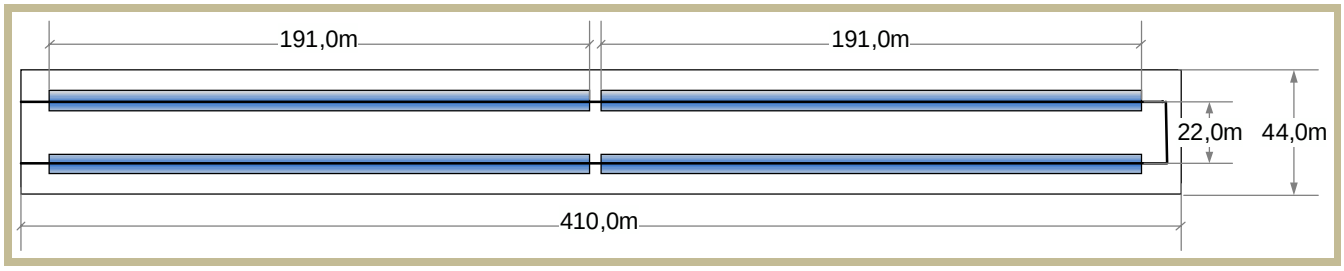


Figure 5-8: HelioTrough® collector loop arrangement (Flagsol, 2011)

Interconnection pipes

Each cold and hot end of the solar collecting loops is linked via interconnection pipes with the cold- and hot- header pipes respectively (see Figure 5-9 and Figure 5-10). In the interconnection pipes several adjusting - and safety valves are installed.

Figure 5-9: Interconnecting Piping (Flagsol, 2011)

Crossover pipes

A crossover pipe (COP) connects the ends of two SCA rows to form an SCA loop.

Figure 5-10: Crossover Pipe (Flagsol, 2011)

5.3 HEAT TRANSFER FLUID SYSTEM

5.3.1 Heat transfer system

The heat transport within the solar thermal power plant basically consists of separate, coupled cycles:

- HTF cycle; and
- Water steam cycle of combined cycle power block.

The HTF cycle transfers accumulated solar heat from a parabolic trough solar field via parallel trains of heat exchangers for driving the steam turbine generator.

The HTF cycle is driven by variable speed pumps. In operation the HTF temperature varies from approximately 400°C ("hot") leaving the solar field to approximately 300°C ("cold") leaving the heat exchangers.

In other words, the HTF system distributes cold HTF from the heat exchangers to the solar field with its collector loops, and collects hot HTF from the solar field and inputs the collected heat to the feed water/steam cycle for the steam generator system.

Due to the characteristics of HTF, several auxiliary systems are required to maintain the HTF loop. A system of reclamation and ullage vessels removes low boiler and high boiler distillates that develop over time in the HTF system.

To keep the HTF warm during the night HTF and avoid freezing, a circulation pump circulates HTF at night or during cool weather periods.

As the solar field begins tracking and the HTF heats up, its thermal expansion is accommodated in the expansion vessel(s). If thermal input to the HTF stops, the HTF begins to contract and the HTF level in the expansion vessel(s) falls.

The HTF system comprises of the following main components:

- HTF;
- Hot and cold HTF headers;
- Cycle pumps;
- Heat exchangers;
- Expansion system;
- Reclamation and ullage system; and
- HTF heater(s).

5.3.2 Chemistry of HTF

HTF is a eutectic mixture of about 73.5% diphenyl oxide and 26.5% biphenyl, with a density of 694kg/m^3 at 400°C and a specific heat of 2.6kJ/kg K. It freezes at 12°C and is flammable and toxic, so measures are required in the design and operation of the plant to mitigate freezing, fire and contamination risks. Over time HTF degrades into low and high boiling fractions, and these must be removed.

5.3.3 Hot and cold HTF headers

The header piping system is connecting the loops with the HTF system, located in within the solar field. The HTF headers cross the solar field into east and west direction. Each loop of SCAs is connected to the HTF headers via an interconnection pipe system.

HTF piping is made of carbon steel. Depending on diameter, temperature and pressure, pipe wall thicknesses may vary.

Piping and equipment include a high-quality and weather proof insulation.

5.3.4 HTF main pumps

The HTF main pumps push the HTF into the solar field system to obtain the required flow that is necessary to transfer the heat energy to the heat exchangers. The amount of main pumps is varying dependent on the size of the solar power plant.

The main pumps circulate the HTF through solar field, heat exchanger, and the expansion system. The HTF pumps are operated via variable frequency drives (VFD).

5.3.5 Circulation pump

To prevent the HTF in the solar field from freezing during cool weather or at night when the field is not operating a circulation pump circulates the HTF through the solar field. In case that the HTF temperature is still too low the HTF main pumps must be operated additionally. The electrical power of the HTF main pumps will be transferred to the HTF fluid either as static, kinetic and thermal energy. In case of extremely low ambient temperatures or long periods without solar thermal operation, the HTF heating system could be activated in order to provide enough freeze protection.

5.3.6 HTF – water/steam heat exchanger

HTF - water/steam heat exchangers are used to transfer heat from the HTF to the feed water and steam. Within each heat exchanger train the HTF stream is split between the steam generation train and re-heater. The steam generation train consists of a super heater, steam generator and preheater.

The solar steam generator system supplies steam to the steam turbine. Feed water flows to the solar preheater and then to the solar steam generator. The feed water level in the solar steam generator is maintained by the feed water pumps following the level and pressure control devices.

Saturated steam, generated in the solar steam generator, is superheated in the solar super heater. Afterwards the steam is fed to the main steam header.

After expanding in the high pressure turbine the steam passes through the cold reheat line to the solar re-heater and flows through the hot reheat line to the low pressure turbine.

The solar steam generator generates steam according to the heat transferred from the HTF. The HTF flow changes according to the solar direct radiation, but the HTF temperature at the solar steam generator system inlet is controlled at a constant temperature.

5.3.7 Expansion system

Thermal HTF expansion is accommodated in one or more expansion vessels –pressure tanks with a nitrogen blanketing. The expansion vessel(s) is elevated above the suction pipe of the HTF main pumps on a steel frame structure to provide net positive suction head to the HTF main pumps.

The expansion vessel(s) are located in a concrete containment pit. For safety reasons, the pit is sized to accommodate the full volume of HTF in the expansion vessel(s) when full. The concrete is coated with a sealer resistant to HTF absorption, while a sump pump drains the pit.

5.3.8 Leakage and accident control system

According to the experience gained in previous projects, the main sources of leakages are:

- The flanged pipe and mobile connections;
- Leakage of valves; and
- Collapse of major piping.

General protective measures built in to prevent spillages of HTF and accidents include:

- Plant will be equipped with fire fighting equipment according local SA codes and standards;
- Sectionalizing / isolating valves to block HTF liquid in case of pressure loss will be installed in the HTF piping system. This will reduce the size of each HTF containing section; and
- Piping will be provided with protective external insulation due to high temperature liquids.

The mitigation of the possible risks will be done via consideration in the design:

Leakage of flanges

- The number of flanged connections in the piping of the solar field and HTF system will be reduced to an absolute minimum with the aim of avoiding leakages of HTF. Welded connections will be inspected via X-ray tests in accordance with ASME B31.3 (severe cyclic conditions). Flanged connections in the SOF will not be foreseen; all the flange connections are within the HTF area;
- All flanged connections in the plant are equipped with high-class seals (raised face, spirometalic stainless steel / graphite or tongue and groove); and
- Major volumes within the HTF area will be arranged in a retention basin, suitable to withhold the volume of the respective section in order to avoid soil contamination caused by oil spill.

Leakage of valves

- High-class sealing systems complying with very strict leakage requirements have been considered for the majority of the rotating equipment (pumps, etc.);
- Valves and piping shall be “technically tight” and hermetically sealed according to the “German TA Luft”, VDI 2440 or comparable national codes;

– Bellow-seal globe valves will be used. Such globe valves are considered to be technically tight; and

– Vents and drains will be equipped with vents / drain valves and blind flanges.

Collapse of major piping

– The piping will be sufficiently designed to absorb the expansion/contraction of the piping in different operating conditions with a minimum amount of flexible pipes/connections. In order to proof sufficient flexibility of the piping, stress calculation for critical lines will be done during design of the plant;

– Sliding pipe supports for the HTF piping will be designed with special support plates (e.g. PTFE) to enable proper displacement of the pipe which will occur due to high temperature differences between warm and cold conditions. This mitigation will reduce the risk of a pipe system collapse of the supports and the pipes and

– A proper training program will be designed for the operation and maintenance staff, in order to minimize the risk of thermal shock in the HTF piping system due to wrong operation.

5.3.9 Reclamation and ullage system

The purpose of the ullage and reclamation system is to remove low and high boiling degradation products in the HTF cycle which form over time. It is expected that approximately two percent of the HTF has to be replaced in the reclamation and ullage system per annum.

5.3.10 HTF heaters

The HTF heaters are used to heat the HTF when insufficient thermal power is generated by the solar field. The heaters may be operated in parallel mode. In case of part load operation when no solar radiation is available, the solar field can be switched off and the HTF heat exchangers can be operated by the heaters only.

5.4 POWER BLOCK SYSTEM

5.4.1 Power block cycle

Steam turbine

The steam turbine is of a condensing type and consists of high and low-pressure sections. It receives high-pressure medium-temperature steam (e.g. 103bar and 383°C) from the heat exchanger trains. The steam leaving the high-pressure turbine is reheated in the re-heater before feeding the low-pressure turbine. Exhaust steam from the low-pressure turbine is directed to the direct air-cooled condenser. Extraction steam is used to heat and de-aerate the feed water supplied to the steam generators. The turbine/generator unit is installed on a floor-mounted concrete foundation and includes an axial connection to the ACC. Upstream of the re-heater system a water separator assembly removes any moisture in all operation modes. The HP and LP inlets are equipped with stop valves, control valves and steam strainers for turbine protection and steam admission control. The turbine parts working under high steam temperature conditions will be insulated with glass fibre mats filled with mineral wool (asbestos-free) or spray-type insulation. To prevent atmospheric air from entering the evacuated portions of the turbine casing, seal steam is conducted to the joints. This seal steam is controlled by control valves and fed by an auxiliary steam line. Air evacuation of the steam rooms is accomplished by use of air ejectors. The condensate in the condenser hot well is pumped by condensate pumps to the storage tank through the LP condensate heaters. The drains from the LP heaters cascade to the condenser. All the condensate heaters are fed by extraction steam from the LP sections of the turbine. The cycle makeup water will be supplied from the demineralized water storage tank to the condensate tank.

Auxiliary steam generator

For start-up, shutdown and emergency purposes, auxiliary steam is needed to feed the following systems:

- De-aerator for degassing of the incondensable contents of the feed water;
- Feed water tank for heating of the condensate;

- Gland steam system of the turbines to seal the labyrinths; and
- Motion steam for the vacuum ejectors to generate the vacuum of the condenser, the low-pressure and the high-pressure preheaters (preheaters before the start up).

As standard, the auxiliary steam generator is an autonomous boiler system with its own feed water tank, feed water pumps and fuel supply; the steam data are approximately 12 – 16bar pressure and a temperature of 220 – 230°C (superheated).

The assumed thermal power is approximately 7 – 15MWth.

The consumer systems described above will be fed during normal operation via bleeding steam of a turbine extraction, in case of low load or trip of the turbines via a pegging steam line from the live steam system, and in case of non-existent main-generated steam by means of the auxiliary boiler.

During standby operation (e.g. at night) the auxiliary steam keeps the condensate and feed water warm and also assures the sealing of the turbines and the vacuum in the main condenser.

To provide a quick supply of steam in cases of emergency, the unit will be in the standby mode.

De-aerator

To remove air and other dissolved gases from the feed water system a de-aerator is the intermediary device. The dissolubility of gases nearly goes to zero when the water reaches the pressure of the required boiling point. In the de-aerator, the condensed water flows over riddled trays, where its droplets are heated by a transversal steam current of a turbine extraction. Merging with the droplets, the steam condenses and the dissolved gases are blown out by a venting system and mostly cooled back via the incoming make-up water. The condensate flows directly into the feed water tank and the make-up water is heated by the exhaust gases. The condensate is stored in the feed water tank and fed to the feed water pumps by suction ports. The feed water tank is protected against overpressure by a pressure relief valve. Additionally, the feed water tank has a steam-heated injection pipe that provides direct warming of the feed water.

Feed water

The feed water, which is collected in the feed water tank, is transported toward the steam generators through the feed water heaters fed by extraction steam from the HP section of the turbine. Condensate from these heaters cascades to the de-aerator.

Steam and feed water piping & instrumentation

The feed water heating system comprises mainly the LP feed water heaters up to the feed water tank with the de-aerator and the HP feed heaters. All of the heaters and the de-aerator are supplied with steam from the turbine bleeds. Condensate pumps transfer the condensate from the turbine condenser hot well through the gland steam condenser, the air ejector steam condenser and the LP heaters into the de-aerator of the feed water tank. Boiler feed pumps take the feed water from the feed water tank and pump it through the HP feed water heaters to the boiler. In case of an emergency the feed water will be bypassed by means of the emergency bypass valves of the HP feed heaters and fed directly to the boiler, thus ensuring that the boiler is always supplied with sufficient feed water and the turbine is protected against overflow of the feed water caused by tube cracks in the heaters.

The steam condensates of the HP heaters will be cascaded through the HP feed water heater train and directed to the de-aerator during normal operation and to the atmospheric flash tank during start up. If the feed water level in the feed water tank is too high or in case of an emergency (such as a turbine trip), then the drains will feed directly into the condenser.

The steam condensates from the LP feed heaters will be cascaded through the LP feed water heater train and eventually fed to the turbine condenser or the drain flash box.

In order to maintain an uninterrupted steam flow to the de-aerator even when the extraction pressure is insufficient, a supplementary steam supply is taken from the live steam manifold.

The supply from the live steam manifold is also taken during start-up/shutdown operation in order to maintain the required minimum feed water temperature. The drain from the HP feed heaters and the return minimum flow and relief flow (where applicable) from the boiler feed water pumps are also returned to the feed water tank.

5.4.2 Plant services

Air cooling system

In case of limited access to a groundwater or other freshwater supply for environmental reasons, air has to be used for cooling purposes. However the power block still requires a limited amount for demineralized process water.

In comparison to conventional water cooling, the utilization of cooling air in air-cooled heat exchangers as condensers requires large-area fans which drive the cooling air flow through radiators that condense the steam to water. The direct air condensing concept using a mechanical draught is technically adequate and economical for nearly all sizes of steam turbine plants and is in widespread operation all over the world.

The steam turbine air cooled condenser will receive exhaust steam from the last stage of the turbine and condense it for reuse. The condenser will handle all the exhaust steam with the steam turbine at maximum load, providing a low back-pressure at the turbine outlet to maximize plant output and efficiency. It will also collect and condense, without any limitation, the steam expanded in the by-pass stations during by-pass operation.

The material of the condenser tubes will be carbon steel fitted with aluminium fins.

The condenser will be equipped with an evacuation system with redundant design (2 x 100%).

The condensate pipes will be installed with a slope to avoid air pockets trapping and to ensure pipe complete drainage. The condenser will have deflectors and a condensate collecting system in the by-pass system outlet area to prevent pipe wear and to collect and discharge any condensate resulting from possible leaks in the by-pass valves.

The air-cooled condenser will be constructed of single modules. Each module comprises one fan driven by one electric motor and a gear reduction box that will ventilate the air through the bundles of steel tubes fitted with aluminium fins.

The condensates will be collected into the condensate collecting tank located under the air-cooled condenser structure.

Raw water supply and water usage

Water is used for power cycle demineralized make – up and for mirror washing. For water consumption requirements refer to Table 6-11.

Water treatment system

The water must be treated by the reverse osmosis and electro-dialysis reversal process to achieve the required demineralized water quality. The water treatment system produces make-up water for the power cycle system and demineralized water for the washing of the solar panels.

Wastewater discharge system

Chemical storage and containment areas will be provided with drain plugs to allow operations to properly assess and neutralize chemical spills before discharge to the wastewater collection sump.

All potential power block oily wastes will be conveyed by gravity to an oil/water separator. The oil/water separator's discharge pumps will pump expansion from the oil/water separator to the recycle basin.

Rainwater and wash-down water from the solar panel field will percolate partly in the solar field.

The sanitary drainage system will consist of a system of manholes and gravity sewer lines draining sewage from all sanitary facilities to the plant's sanitary septic tank/tile field system.

Compressed air system

The compressed air system will be designed and constructed to supply filtered, dry and oil-free compressed air to both the plant service (utility) air system and the instrumentation air system. The instrument air system provides air to pneumatic control devices and valves. Compressed air will be delivered to the compressed air header and receivers via the air dryer in use. Each air compressor will have sufficient capacity to supply the maximum service air and instrument air required during normal-operation STG demand.

Nitrogen system

To prevent oxidation or combustion, nitrogen is used as blanketing for several vessels of the HTF system. To ensure a nitrogen supply, plans call for the rental of one or more liquid nitrogen storage tanks, including additional equipment for pressure regulation, vaporization and safety. The required nitrogen will be delivered by road in insulated cryogenic trucks.

Usually air is stored at about –190°C and at atmospheric pressure. Plans call for nitrogen storage tanks in the power block area that are large enough to make delivery by large tank trucks possible.

The nitrogen system includes a receiver, an evaporator, a pressure regulating control valve, the level and pressure instrumentation and all interconnecting piping.

5.4.3 Co-firing System

The main fossil fuel considered is natural gas (the following properties have been assumed: low heating value = 13.7kWh/kg, density = 0.781kg/m^3). The annual consumption (for the proposed 150MW thermal power plant) is estimated in 3193MWht, equivalent to a natural gas volume of 18,057,872Nm^3. This volume will be different should the properties of the available natural gas do not match to the ones above. The natural gas has to be stored in a proper vessel which is included in the natural gas plant. The size of such a vessel has to be according to the total nominal flow of natural gas, which can be estimated in 10,152Nm^3/h. This flow will feed the 4 heaters of 23.5MW each, which are planned to be installed in the plant for freeze protection of the HTF and additional heating.

- The natural gas consumption depends on its quality which has to be provided by local authorities; and
- These numbers are subject to variations should a different heating strategy be selected or updated meteorological data is provided and included in the performance model.

Diesel co-firing may be included as an option in the heaters. Whether it will be include it in each of the heaters or just in one of them depends on the availability of the fuels on site. The heater´s diesel consumption and its storage cannot be defined as long as the availability and properties of diesel is undefined.

5.5 HAZARDOUS SUBSTANCES STORAGE

The storage of dangerous goods comprises, besides the previously commented flammable natural gas, the storage of HTF before filling the HTF piping system. Due to the high freezing temperature of the HTF (around 12°C) the delivery and filling of the HTF into the piping system has to be done without storage. The HTF is delivered to the plant by trucks directly from the production centre. The delivery and filling temperature of the oil must be around 50°C and the heat tracing of the piping system has to be ready for operation in case the HTF temperature drops down during the filling.

During the lifespan of the plant, a certain amount of HTF degrades completely due to the high working temperatures and pressures. This intermittent flow shall be collected by an authorised agent for disposal.

There is no additional chemical generation expected beside the typical ones generated in the power block (process, septic and oily water).

5.6 SERVICES

5.6.1 Electricity Supply

The preferred servitude option is to construct a 132kV power line that would exit the site at the north-west corner, run in a westerly direction along the northern border of the farm MARSH 467 until the property boundary with the farm of Mr Da Sylva is reached. From here the line will make a turn in a southerly direction towards the road, while keeping to the border of farm MARSH 467. The line route will cross the road and still within the borders of farm MARSH 467 intersect with the Eskom line. The connection substation is planned for the location where the proposed 132kV line

and the Eskom line meet, as detailed in **Section 4.6**. A cost estimate letter for point of utility connection has been received by Eskom (*refer to* **Appendix D** for a copy of the letter).

5.6.2 Water Supply and Management

Water from Sedibeng Water is the best bankable option for long term water supply due to consistency of supply and regulated framework in which this resource is delivered. Alignment of the KSP project construction timeframes and Vaal-Gamagara pipeline upgrade needs to be rationalised.

Currently, studies are being undertaken by KV3 Engineers to upgrade the supply scheme. The project developers have registered as a key stakeholder in this forum in order to ensure that the project's water needs can be accounted for as part of the study.

Surety of water supply from Sedibeng Water is not guaranteed under current conditions and as a result, contingency water supplies would be considered to be a prudent strategy with an onsite closed water reservoir providing for emergency water backup should interruption of supply occur.

Gamagara Municipality has indicated that they are currently in no position to supply any water to the project; however this may change in the future. Sishen Mine will not be able to supply directly to the project, however water abstracted for dewatering purposes will in the long terms augment the water supplied by Sedibeng Water to the region.

Supplementary water supply is potentially available through groundwater abstraction. Published data, information from the Sishen Mine and Gamagara Municipality as well as confirmed quantitative data obtained during the pump testing indicates sufficient groundwater is available through both the unconfined and confined aquifer beneath the site to supply the requirements of all the phases of the proposed development.

Sishen Mine have indicated that their boreholes located adjacent to the site may be utilised by KSP as supply wells. If required, a formal agreement will need to be established with the mine regarding the utilisation of these wells for future water supply.

The use of the confined aquifer as an emergency source of water would be deemed feasible based on the pump test data alone. Two wells would provide a secure and consistent source of water whilst ensuring that neither well is stressed beyond sustainability. This potential resource has the advantage over the use of the shallow aquifer as the current demands on the system are less and results in less stress being placed on the ecological and agricultural requirements of the shallow unconfined minor aquifer.

5.6.3 Stormwater Management

To manage sheet flow into Phase 1 of the KSP project from outside its boundary, a bund wall and shallow channel will be constructed on the southern and eastern side of the solar field. The flow from each channel will then be discharged via an outlet structure and energy dissipater at the north eastern and south western corners of the Phase 1 site.

Phase 1 consists of approximately 300 individual terraces, on which the collectors will be built. Each terrace is 400m long by 12m wide and drains to either side with a slope of 3%. To effectively manage the stormwater for Phase 1, the solar field has been subdivided into 8 sections (refer to Figure 5-11).

An earth channel will be constructed parallel to each loop and will follow the natural slope of the site. The earth channel will capture all the drainage from the terrace and discharge the flow into a shallow secondary channel that runs perpendicular to the collectors at the bottom of each subarea, except for the 2 most northern west and east subareas. The flow from these two subareas will be discharged strait into the open veld via a small outlet structure and energy dissipater.

The secondary channels of the three lower subareas, located on the western side of the solar park will drain to the west and discharge beyond the wind shield fence via an outlet structure and energy dissipater, to ensure that the velocity remains low. The secondary channels of the three lower subareas on the eastern side also drain west, where they fuse into a single wide low level main channel running from south to north parallel to the power block. Low level precast concrete portal culverts will be used at each point where the main channel crosses a road. The main channel will then discharge beyond the wind shield fence, with an outlet structure and energy dissipater to ensure that no scouring of the indigenous vegetation will occur.

Refer to **Appendix E** for a copy of the draft stormwater management plan.

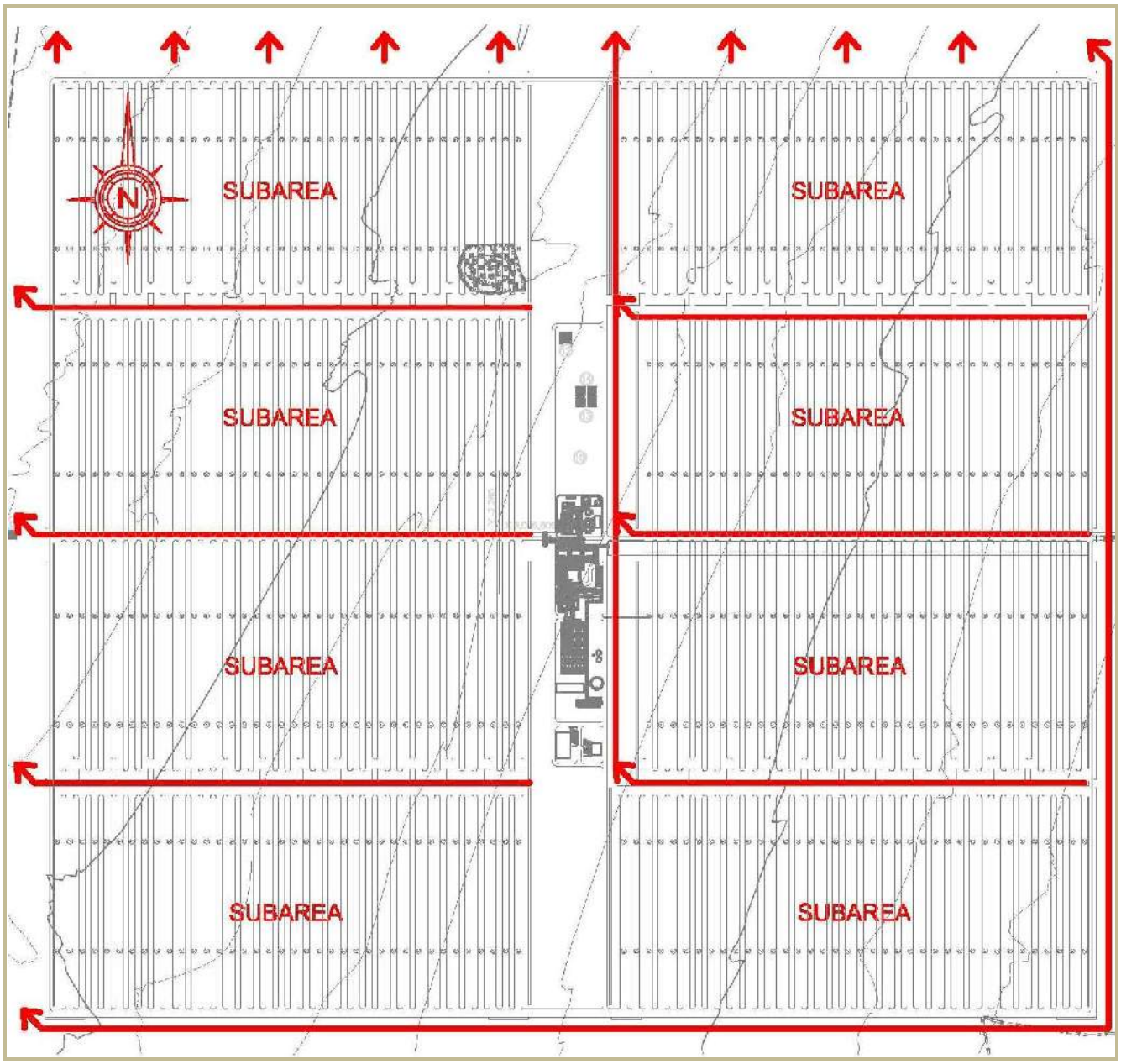


Figure 5-11: Phase 1 stormwater management subdivision (Group Five, 2011)

5.6.4 Maintenance

Maintenance program (first 6 years)

Solar field requirements are, of course, unique with respect to spare parts, maintenance tasks, and mirror washing. Solar field maintenance provides a contrast to conventional power plant maintenance — not necessarily in complexity but primarily due to the fact that the solar field consists of many units of a modular design distributed over a large area. The frequency of mirror washing is determined by a trade-off between the cost of water and labour compared to loss of performance due to the increasing soiling of the mirrors.

Maintenance activities consist of scheduled maintenance, unscheduled maintenance and general/major overhauls. In addition, major turbine overhauls are scheduled periodically (every 5-6 years for a turbine in cyclic operation).

Scheduled maintenance includes:

- Predictive and preventive maintenance steps;

- Solar field mirror washing; and
- Repair of minor equipment faults.

Mirror washing is accomplished with a special washing truck (s). At night, when the plant is not generating power, this unit is driven between mirror rows and directs a high-pressure spray at the mirror surfaces.

During the initial one to five years of plant operation, maintenance costs will revolve primarily around run scheduled maintenance. As the equipment will be new and construction quality control practices will be firmly in place, potential incidents of equipment failure will probably consist of unanticipated failures, primarily involving equipment (such as motors and valves) that is most affected by the nature of cyclic operations.

A standard preventive maintenance program will be in place to undertake the routine cleaning, inspection and lubrication of equipment as recommended by the various equipment suppliers on a daily, weekly, monthly, quarterly and yearly basis. The cost associated with preventive maintenance is a minor component of overall maintenance costs and typically involves lubricants, filters and other minor consumable items.

A core predictive maintenance program consisting of vibration analysis, tribology and thermography will forewarn staff regarding incipient failure mechanisms of major and critical pieces of equipment such as the HTF and feed water pumps.

The cost of the initial predictive maintenance program is relatively minor, but the reactive measures associated with such predictive warnings typically help to minimize the cost of equipment repair.

Minor plant inspection outages will take place on an annual basis and will have a relatively minor impact on material costs. During the course of these outages, costs are largely for labour and subcontract services associated with cleaning, inspection, and testing. Work completed during these outages is typically that which cannot be completed during regular periods of non-operation (such as at night), due to the time required to complete the activities. Such work includes the inspection of the plug and seats of main steam valves and generator protective relays, inspection and cleaning of main electrical breakers, and cleaning and tightening of main electrical bus connections. Steam generators, feed water heaters and heat exchangers require internal inspections of tube thickness and evidence of water treatment problems and other irregular steam conditions. Various pressure relief valves, most notably in high-pressure steam systems, also require periodic inspection and testing, which are typically done by outside technical services.

The major O&M tool is a Computerized Maintenance Management System (CMMS) starting initially with all maintenance plans, schedules and instructions on an aggregated level obtained from the plant documentation of the EPC- contractor. Upon start of the commercial operation a history server will be set up to record all maintenance activities. The system will provide all maintenance steps for the plant related to the plant history & condition and the underlying maintenance recommendations.

Flagsol can offer an additional CMMS feature called Solar Field Status & Maintenance Programme which records the status of a solar field, providing analysis on components, support the root- cause effect and finally provide a Solar Field Maintenance Management System.

The CMMS and its feature programme will decreases O&M cost significantly and ensure highest plant efficiency.

Expected availability

The plant is designed with redundant equipment for critical items, e.g. 4x33% main HTF pumps and the redundancy for all water pumps. Therefore in case of unplanned outages of important equipment a stand by equipment is predominantly available, which will lead to minimum plant outage.

Repairs and extensive overhauls (e.g. replacement of major valves) are planned for during the annual shutdown period.

The operation of the solar field can be maximized by planning solar field maintenance in such a way that it does not interfere with operating periods, e.g. by carrying out the maintenance at night or on collectors that are stowed for other reasons. It is expected to have approximately 99% of a CSP solar field ready for operation at any given time. A full outage of the solar field is very unlikely to occur.

Preventive actions – O & M

- Daily visual inspection of the SOF, paying special to the mobile parts (like the flex hoses);
- Surveillance system to detect the initiation of fires;
- Operation of the CMMS; and
- Mirror washing.

5.7 CONSTRUCTION PHASE

5.7.1 Site office

For the construction phase a site office, storage yards, topsoil stockpile areas, parking space, assembly warehouse, workshops and ablutions will be required (Figure 1-3).

The site office, storage yard, parking, ablutions and workshops are likely to be in the vicinity of the assembly warehouse, since this is central to the three phases of the project.

Note that this project entails rolling construction: once phase 1 is complete and starts operating, construction of phase 2 will commence, then Phase 3. So the cycle will be repeated over a similar period. To complete the project then, construction will last over some 6 years.

5.7.2 Assembly warehouse

As part of the site design, Group Five will need to construct an assembly warehouse where the imported mirrors and locally produced steel supporting infrastructure will be assembled. This building will occupy a floor space of some 5,400m^2 and will be built of corrugated iron cladding to some 15m high.

No metal cutting occurs in the building – all components arrive pre-sized or cast – but bolting and welding will take place.

5.7.3 Access and haul roads; construction traffic

Construction will generate an almost continuous flow of low-bed trucks arriving at site to deliver parabolic troughs and other components of the plant.

Workforce transport will be largely confined to morning and evening, but small vehicles moving to and from the site and within it will amount to some 40 passenger vehicles per day.

The plant required for earthworks will comprise: 2 x 30 ton excavators, 2 x loaders, 10 x 10 ton Bell dump trucks, 2 x graders, 2 x off Bomag 213 vibratory roller compactors, 2 x 20Kl water trucks, 3 x TLB excavators and 2 x off D6 bulldozers and these will be active for the levelling and preparation of the solar field for approximately one year.

The special vehicles that distribute the parabolic troughs to the solar field and install them will comprise 6 x tractors with long trailers for approximately 1 year.

5.8 EMPLOYMENT

Figure 5-12 below indicates the organogram for the construction of the first phase of the project. Construction will continue for 18-30 months with the number of employees peaking at about 600 people. This is broken down into approximately 50 management; 150 skilled; 100 semi-skilled and up to 300 unskilled employees.

Figure 5-13 below indicates the organogram for the operation and maintenance of the plant. The plant shall be operated in a three shifts leading to an overall number of employees of some 75 people, which will be trained during the commissioning and initial operation / start-up phase of the KSP plant.

5.9 RESEARCH AND DEVELOPMENT CENTRE

As part of Group Five's approach to sustainable community development in the Northern Cape, a solar research and development centre (R&D Centre) will be established as a contribution to local and national skills and knowledge development.

As the KSP site is considered one of the best, if not *the* best, site in the world for a concentrated solar power project, it is envisaged that international technology providers will utilise the R&D centre for ongoing research into the various technologies currently available and those under development.

The R&D Centre will include facilities for visitors, local communities, scholars and students to learn more about solar power technology. Local universities have expressed great interest in the proposed R&D centre as a means to developing national expertise in solar power generation, thereby contributing to South Africa's becoming a significant player in the international solar technology arena.

Initial, high level engagement with local investors who might have an interest in investing in the R&D Centre has been met with an overwhelmingly positive response, with ubiquitous recognition of the significant opportunity afforded the Northern Cape, South Africa and Africa as a whole.

5.10 HOUSING

Planning for housing for the 600 or so construction employees has not been finalised. The number of accommodation units and types of units cannot be determined with finality until it is clear what percentage of the workforce can be sourced locally, and is therefore already housed. The principle has been established that housing will be developed within the urban precincts of Kathu and Sishen, so that it is sustainable in the longer term. Workers will be transported to site in buses. Group Five has agreed that no construction camp will be established at the project site, for reasons relating to potential social conflict with surrounding landowners, difficulties in supplying services and disposing of wastes.

Several options for rental accommodation in existing facilities are currently under review. Construction accommodation is therefore likely to comprise a combination of some of the options listed below:

- Da Silva farmhouse: rental for management staff;
- Peens' lodge: potential rental for management staff, on adjacent Uitkoms Farm;
- Sishen: old Kuruman Road land;
- Kumba Kathu Extensions: purchase/lease of serviced plots;
- Municipal: Kathu Extension 3; and
- Private township developments e.g. RooiSand: purchase of serviced plots.

Refer to Figure 4-1.

5.11 SECURITY

The following on-site security measures have been proposed for the construction and operation phase:

- The entire site will be fenced off with diamond mesh, with 6ft barbed wire around the top.
- Access will be via the main gate and this will be controlled by a security guard with the standard - pre-arrange access, show ID, site safety induction with confirmation of ID, sign in and sign out process.
- Further to the security at the main gate there will another 4-5 security guards patrolling the area 24hrs a day.
- Security lighting will be provided across the entire site both during construction and operation.
- During construction and operation regular staff to site will have access via an electronic swipe in/swipe out management system.

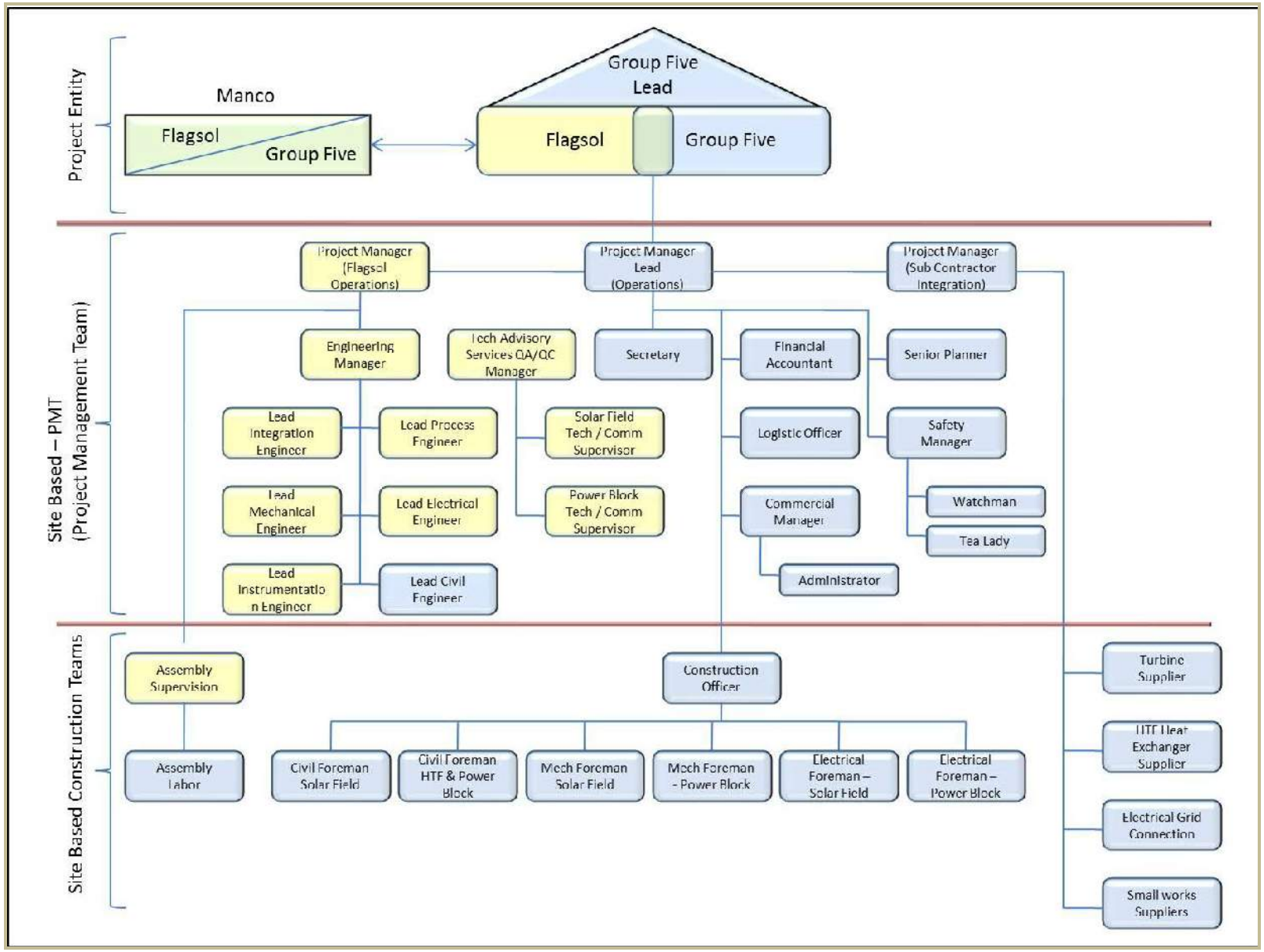


Figure 5-12: Construction phase organisational chart (Group Five, 2011)

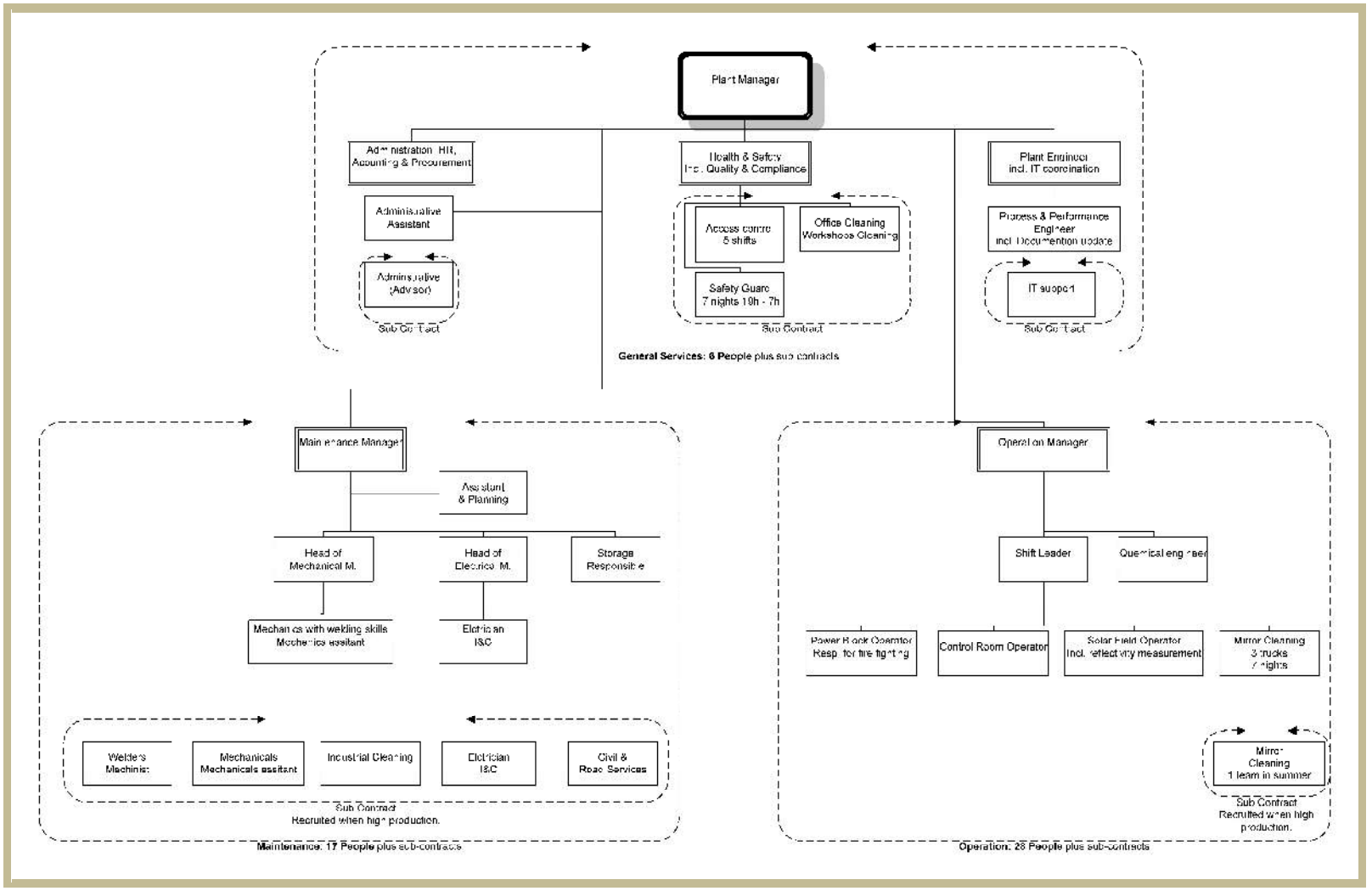


Figure 5-13: O&M organisational chart (Flagsol, 2011)

5.12 ECONOMICS

Preliminary monthly wage bill, projected annual local, regional, national and international spend figures have been calculated for phase 1 of the KSP project (refer to Table 5-1).

Table 5-1: Preliminary phase 1 (150 MW) spend

Activity	Predicted Spend
Monthly wage bill	R 50 million
Annual local spend	R 275 million
Annual regional spend	R 450 million
Annual national spend	R 1.6 billion
Annual international spend	R 500 million
Annual local taxes (VAT)	R 40 million
Annual national taxes (corporate)	R 40 million

5.13 DECOMMISSIONING

With sunlight, the fuel for the solar power generation project, being ever-present and freely available at the KSP site in the Northern Cape, the solar power generation project will continually have the components and technology refurbished throughout its operational life, in line with technology advancements and improvements available internationally. The operations and maintenance contract that will be put in place, will allow for these technology upgrades annually. The life of the plant will thus be continually extended from the planned 25 years, to 40 years and possibly beyond.

6 Key Issues: Summary of Specialist Investigations

Key issues identified during the scoping phase were investigated in further detail in specialist studies. This chapter provides a summary of the findings of the specialist studies, as they are major inputs to the impact assessment and management plans that complete the report.

All specialist reports are provided in full in the appendices contained in **Volume 2: Appendices** of this report set.

SOCIO-ECONOMIC ENVIRONMENT

Key socio-economic issues studied were:

- Overall social and economic impacts (Section **6.1**);
- Cultural and heritage resources (Section **6.2**);
- Noise (Section **6.3**)
- Traffic (Section **6.4**)
- Visual (Section **6.5**)

A specialist was also commissioned to develop a Workforce Health and Safety Plan and a Community Health and Safety Plan, which are specific requirements of the IFC's performance standards. These plans form appendices to the Draft Environmental and Social Management Plan (ESMP) - Part II (**Section 9**) of the ESIR documentation – since they did not investigate safety and health impacts as such.

6.1 SOCIO-ECONOMIC

6.1.1 Objectives

The objectives of the study were to:

- Generate an overview of the issues, claims and concerns that interested and affected parties might have with the proposed development, and against those captured in the scoping report;
- Determine and understand land use systems and practices of the people in and around the study area; and
- Investigate the potential socio-economic impacts of the project.

The project will be situated in Ward 3 of the Gamagara Local Municipality (GLM), which falls within the John Taolo Gaetsewe District Municipality, Northern Cape Province of South Africa (Figure 6-1).

The social impact assessment was undertaken in accordance with national guidelines and International Finance Corporation (IFC) standards as stipulated in IFC Performance Standard 1: Social and Environmental Assessment.

Quantitative data were gathered from Statistics South Africa (Census 2001, Community Survey, 2007 (brings demographic data down to a municipal level), Mid-year Population Estimates, 2009, and Quarterly Labour Force Survey, June 2009).

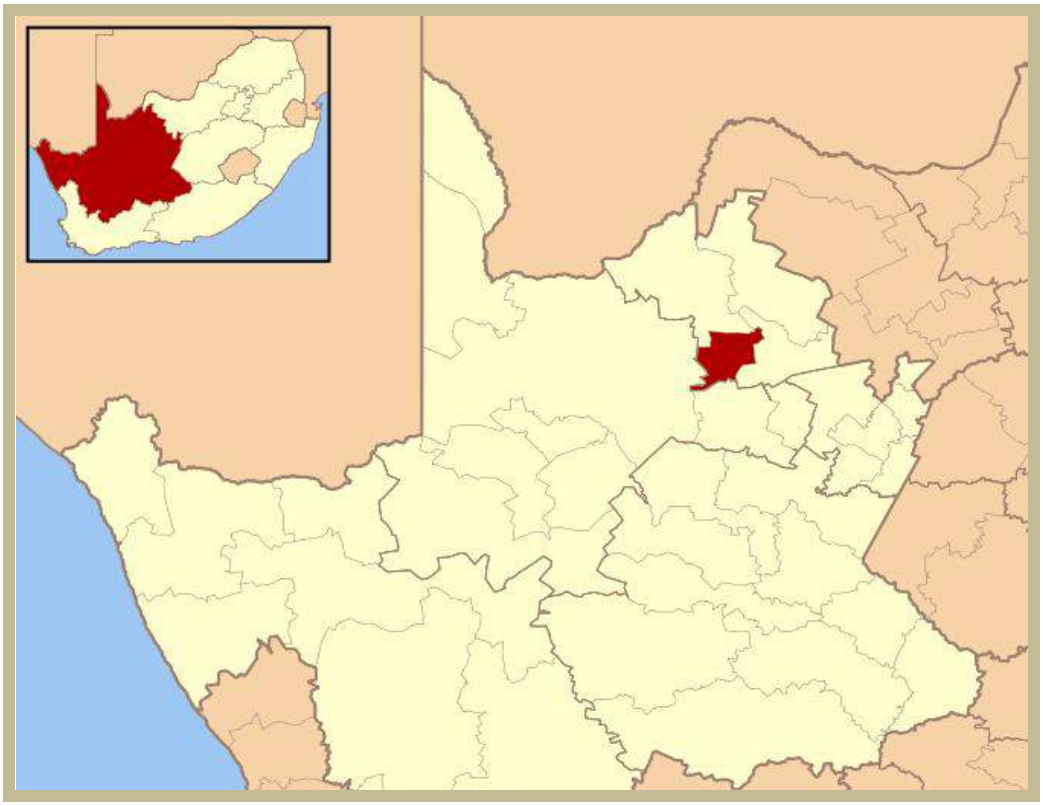


Figure 6-1: Northern Cape Province showing Gamagara Local Municipality

6.1.2 Baseline

Provincial context (area of indirect influence)

The Northern Cape occupies some 29,7% of the total land mass of South Africa, but its 1,15 million people in 2009 accounted for only 2,3% of the national population (Statistics South Africa 2009), the smallest provincial population in the country. In Statistics SA's Statistical Release P0302 it was stated that between 2006 and 2011, the Northern Cape will experience emigration of some 25,500 people.

The Northern Cape is also the smallest provincial contributor to the national economy, at 2.1% of GDP. Economic development is thus a provincial priority. Moreover, over the 2004-2008 period, the Northern Cape economy experienced average annual GDP growth of 2.7%, compared with 4% for the South African economy as a whole. The decline in mining at that time had dire consequences for employment, with the unemployment rate in the province climbing to 22.8% in 2008 from 19.7% in 2004. The unemployment rate is growing annually at a rate of 2.8%, outstripping the rate of employment creation by a factor of 2. The largest employer in the province is government, employing 21.2%, followed by agriculture at 20%. The Community Survey (Statistics SA, 2007) thus concluded that:

- The Northern Cape underperforms economically when contrasted with the rest of the country. This is largely a result of a lack of resources and the remote nature of the area. As such any development that attracts investment needs to be carefully considered;
- Climatic factors give the Northern Cape a strategic advantage when it comes to solar energy; and
- Mining is one of the biggest contributors to the Northern Cape's economy in terms of monetary value, but its 'boom-bust' nature means that investments in other industries need to be considered and developed;

With climatic conditions that are optimal for solar generation, this concentrated solar project and similar entities could exploit a key strategic advantage of the Northern Cape. The KSP project would create employment and would contribute to stabilising the provincial economy.

KSP Kathu study area (area of direct influence)

The KSP study area has a low population density (fewer than 5 persons / km^2) with urban concentrations occurring at the town of Kathu and surrounds and, to a lesser degree, Dibeng. The Gamagara Local Municipality had a population of some 28,000 by 2007, according to the Community Survey 2007, the largest concentration of which is in Kathu. However, the 1,922ha farm on which the project will be developed is unoccupied, but immediately to the north, across the district road, lies the homestead of the Peens family. The Peens family and their resident workforce of approximately 26 persons will be the most sensitive human receptors of impacts emanating from the solar project. Five kilometres south (from the centre of the KSP property) is the farm of Sishen Iron Ore Company (Pty) Ltd, currently managed by Kasper van Vuuren (about 40 residents); 7km west of the site is a smallholding belonging to a consortium, the house being occupied by tenants at present. The other closest concentration of people is the non-resident staff of companies operating at the Kathu airport, some four kilometres south-west of the project site.

Approximately 7km to the south lies the town of Kathu, which was established in 1972 and developed to service the Sishen open pit iron ore mine south of it. Kathu is mushrooming due to the rapid expansion of mining operations in the area, and has reached a population of approximately 30,000 (Huggins, 2009). The rapid influx into the town has resulted in pressure on services, notably potable water supply and sewage treatment, and schools and hospitals/ clinics. Plans for augmentation and upgrading are being implemented and take account of a number of the planned developments, that is, increased capacity is being built into the upgrade plans. Refer to **Appendix F** for a copy of the Socio-economic Impact Study.

6.1.3 Impacts

Strategic development issues, applicable to all new projects in the vicinity of Kathu, raised by stakeholders in the area include:

- Kathu is a growing town but this is associated to the extensive mining activities and as such any development that acts in parallel to mining needs to be assessed for its potential positive contribution to the sustainability of the town;
- Tourism is mooted as one of the alternative growth strategies for Kathu however, this is currently due to access to the golf course or alternative estate developments and as a gateway to other parts of the Kalahari;
- The need for the project to contribute to the surrounding area via a social development plan;
- The degree to which goods and services will be procured locally so as to promote maximum local benefits;
- Ensure mechanisms are in place to promote employment opportunities in both the construction and operational phases; and
- Kathu has a relatively well educated and prosperous middle class who could regard the impacts associated with the proposed power plant as a threat with regard to visual impacts.

The following potential issues were identified pertaining to the construction and operational phases of the concentrated solar project:

- Job creation and social upliftment

This potential socio-economic impact was identified as positive due to a number of available job opportunities that will arise for the local workforce, both directly and indirectly. Consequently, this will result in an expansion of the local skills base, small business opportunities, economic development within the region and change in tourism and recreation patterns. Optimisation will be achieved through ensuring that contractors have a “locals first” policy.

- Social conflict and social pathologies

Given the high unemployment rate and levels of poverty within the region, the likelihood of migrating job seekers arriving in Kathu is high. Consequently, there may potentially be competition between local residents as well as between local residents outside of the district for employment opportunities. Therefore, this may pose a negative impact on the immediate social environment.

- Visual impact

Kathu has a relatively well educated and prosperous middle class who might regard the impacts associated with the proposed solar farm as having an unacceptable visual impact on the sense of place.

Visual impact is assessed in detail in **Section 6.5**.

- Health, Safety and Security

The project may generate light and dust pollution as well as noise intrusion and traffic congestion.

Impacts with an increased propensity to occur due to construction activities include:

- Traffic safety risks due to additional traffic loads on the local roads as a result of the construction and operational phases of the proposed estate may have a direct traffic and accessibility impact (assessed in **Section 6.4**);
- Security risks due to theft, poaching and increased criminality associated with an influx of non-local labour;
- Noise intrusion due to plant and vehicle activity and blasting (assessed in detail in **Section 6.3**);
- Particulate pollution from traffic, earthworks, drilling and blasting activities undertaken during the construction phase and on-site maintenance activities during the operations phase (assessed in detail in **Section 6.6**);
- Light reflection off the panels during the operations phase could affect aeroplanes approaching and departing from the nearby airport (this is assessed in **Section 6.5**); and
- Increase in communicable diseases due to an influx of construction workers, which may place pressure on local health service resources and exacerbate health problems.

- Tourism
  - The KSP project provides an opportunity for educational recreation as it is itself an interesting operation. Provided security concerns are borne in mind structured tour groups may visit the site.

Mitigation measures for the above impacts include *inter alia:*

- The Contractor should, in consultation with local HIV/AIDS organizations and government structures, design and implement a HIV/AIDS awareness and prevention campaign;
- The implementation of safety briefings and road signage as well as speed control measures;
- Limit construction activities with potential noise impacts to daytime (6:00 to 18:00 hours);
- Install low-impact lighting on the exterior of those components of the power plant and associated facilities where night-time lighting is essential.

Following the implementation of the provided mitigation measures, the impacts will be short term and minor, and affect only the immediate study area. The Peens family farm is the only directly impacted residential site, and it is screened from the solar farm by an existing thicket of large trees along the intervening road. These trees will to some extent screen the farm from the visual and reflection impacts, night-time lighting and noise.

Overall, subsequent to the recommended mitigation measures being implemented, socio-economic impacts should be positive, though the Peens farm residents will experience residual noise and traffic impacts for the six to eight-year duration of the phased construction process.

6.2 CULTURAL AND HERITAGE RESOURCES

6.2.1 Objectives and Methods

The objective of this study was to assess the significance of cultural/ heritage resources (built/ historic, archaeological and paleontological) on project-affected sites, as required by Sections 38(1) and 38(3) of the National Heritage Resources Act (NHRA; No. 25 of 1999), IFC Performance Standard 8: Cultural Heritage and the corresponding IFC Guidance Note and the World Bank's Environmental Assessment Sourcebook update on cultural heritage in

environmental assessment. The ultimate purpose of this work is to ensure that no sites of cultural or heritage significance on the site itself or in areas close to the proposed development would be compromised should development proceed. The full study report is contained in **Appendix G.**

A reconnaissance-level survey of the project site was conducted during the scoping phase in 2010, to establish the likelihood of heritage resources being present that would merit more detailed survey and research. The scoping phase heritage study concluded that further investigation was not merited (de Jong, 2010). However, the environmental authorities requested that relevant reports dealing with other projects in the same region and submitted to the South African Heritage Resources Agency (SAHRA) should be accessed and scrutinized for further information in order to obtain a better understanding of the archaeological and paleontological potential/ risk in the broader area, as encapsulated in reports that have been compiled over a number of years and in different seasons. This was done and the findings compiled into a second report (**Appendix G**).

The KSP transmission line/grid connection fell outside the scope of the heritage assessment scoping phase site survey, because the route was not established at that time. Although the now-established, preferred alignment along the T25 district road westwards is unlikely to contain significant heritage resources (on the basis of known distributions of heritage resources on other project sites, there is a lower risk of significant archaeological deposits on the farms west of farm Kathu 465), a field inspection of that alignment will have to be conducted before construction of the line proceeds. This will complete the KSP's compliance with the National Heritage Resources Act.

6.2.2 Baseline

The proposed area for development (farm Kathu 465) is located in a cultural landscape classified primarily as a combination of (degraded) historic farmland and an archaeological/paleontological landscape. Although the region is known for its Stone Age artefacts, this class of landscape is of comparatively low heritage sensitivity as it is able to absorb new developments without serious adverse effects on heritage resources. Nonetheless, heritage studies done over the past couple of years as part of the environmental appraisal processes for a number of proposed mining and urban development projects in the vicinity of Kathu have identified a range of significant heritage resources in the relevant properties. The closest of these is some 4km from the KSP site. The Kathu is a major site close to the development area, but it will not be impacted by the proposed development (**Appendix G**).

None of these significant resources is on the proposed site for the solar farm. From a historic/ built environment perspective, no features of heritage significance were identified and those recent features, associated with quarrying and farming that are present on the farm are typical of many others in the region. As regards archaeological resources, no finds or artefacts of significance were identified: isolated surface scatters of Stone Age artefacts, mainly around the rims of a number of small pans on the development site, were found. There was no evidence at all of the presence of paleontological resources: the entire area is underlain by Precambrian rocks that are not exposed, and these in turn are covered by Tertiary surface limestone. The Precambrian rocks are not known to contain any fossils. There is a slight, but unlikely, possibility of Tertiary fossils being present in the limestone deposits, but these will only be uncovered once construction (site clearance) begins.

6.2.3 Impacts

- Because no resources of significance have been found on site, no significant heritage-related impacts during the construction or operational phases are anticipated;
- Nevertheless, given the nature of heritage resource remains and survey methods, vigilance at the start of construction during site clearance must be exercised, so that if any heritage resource remains are uncovered, construction is halted until the remains can be inspected and investigated by a heritage resources specialist;
- No effects on religious and other intangible heritage assets and issues are anticipated;
- Given that the closest identified heritage resources are some 4km from the KSP site, the KSP project will not affect any of the heritage resources found in other studies on the sites of other contemplated projects in the vicinity of Kathu;

- Any negative visual impacts (related to glare and visual intrusion in the landscape) will be most visible for the north, but there are no known projects north of the proposed KSP project that could be affected visually. In addition, the Kathu forest will probably deflect any negative visual impacts as seen from the main view shed (the N14) since it is located between the KSP site and the N14 (visual impacts were themselves the subject of a specialist study, see **Section 5.6**); and
- No significant heritage-related impact on the Kathu forest. The proclamation (10 July 2009) in terms of which the forest was declared a protected woodland, erroneously refers to the forest as a "national heritage site"; this should have been "natural heritage site". The site is not on SAHRA's list of declared heritage sites.

6.2.4 Mitigation

Heritage management mechanisms that must be implemented are as follows:

- Should any hidden human remains (highly unlikely) be disturbed, exposed or uncovered during site clearing and excavations (e.g. foundation preparation), these should immediately be reported to the SAHRA, then to an archaeologist. Burial remains should not be disturbed or removed until inspected by an archaeologist;
- Site preparation activities must be monitored for the occurrence of any hidden archaeological material (Stone Age tools) and similar chance finds (such as historic middens and foundations) and if any are exposed, this should be reported to a heritage resources specialist so that an investigation and evaluation of the finds can be made. The small pans and the drainage line are potential places where such finds may occur; and
- It is unlikely that the proposed development will have an impact on paleontological heritage, but it is essential that if fossils are uncovered in the process of development activities, SAHRA must be notified, as well as a professional palaeontologist bought in to access the situation.

6.3 NOISE

6.3.1 Objectives

The noise assessment sought to establish whether the KSP project would have any significant impacts on the existing noise environment and, if so, to mitigate such impacts.

Noise measurements and modelling were undertaken in accordance with South African national standard (SANS) 10103:2008, and compared with the SANS noise guidelines and IFC Standard 4: Community Health, Safety and Security. Background noise levels were measured at seven points around the KSP site a daytime and a night-time measurement were done at each point, in each case comprising 10 minutes of continuous measurement using a Casella Cel 480 sound meter.

The full, detailed Noise Impact Assessment Report is provided in **Appendix H**.

6.3.2 Baseline

The ambient noise levels in the study area were expected to be moderate. The measured background noise levels (averaged over the seven measurement points) of (LA_{eq}) 56.7dB(A) daytime and 45.9dB(A) night-time in the vicinity of the KSP project site, exceed the applicable SANS land use - *suburban* background noise guidelines (50dB(A) – daytime and 40dB(A) – night-time). They are, however, considerably in excess of the SANS *rural* guideline of 45dB(A) for daytime and 35dB(A) for night-time. However, the noise levels at the individual points were very variable, with the more rural of the points displaying noise levels below the rural thresholds. The noise levels measured in the LA90 range are more relevant as it gives as they give an indication of the noise that will be experienced for 90% of the time. LA_{90} therefore indicate the typical constant noise the receptor will be exposed to. The average noise level (LA_{90}) for the daytime is 41.10 dB(A) below the SANS Rural guideline; and the night-time average is 42.20 dB(A) which exceed the night-time SANS Rural guideline.

The baseline noise levels were also above the IFC environmental noise guideline (55dB(A) – daytime and 45dB(A) – night-time) (*see* details in **Appendix H**).

Periodic high noise levels as a result of mining activities in the area may be experienced, due to blasting, vehicular and machinery activity and other unit processes related to mining operations. The only other significant source of environmental noise in the study area is vehicular traffic associated with the T25, R380 and N14 motor routes.

6.3.3 Impacts

The noise impact assessment modelled the following scenarios for the project assuming the full 4-phase development.

- Scenario 1: Construction phase (rolling, phase 1, 24-30 months; phases 2 and 3 following sequentially with the built phase then operating;
- Scenario 2: Operation of Solar field 1 and construction of Solar field 2;
- Scenario 3: Operation of Solar field 1 and 2 with construction of solar field 3;
- Scenario 4: Operation of all the solar fields and no construction
- Worst case scenario – including all the noise sources from the previous scenarios.

The site layout is not yet been finalised, while the noise modelling and investigation was done. It was also assumed that all the powerhouse equipment, including the steam turbines, would be enclosed in buildings, except for the condenser. The construction phase activities would take place during the daytime hours (06:00 to 22:00), with delivery vehicles night and day.

The modelled results (LA_{eq}) concluded that the KSP plant will not have a significant impact on the noise climate at all of the monitoring locations. The highest additional noise that will be generated by the plant occurs during the day, when the plant is the most active. The highest impact on the noise climate (LA_{eq} – range) was +0.31 dBA at receptor F and +0.83 dBA during the night. The increase on the LA_{eq} range is <1 dBA and will not have any significant impact on the noise climate.

It must also be noted that the LA_{90} monitored results from the monitoring locations did however align to the SANS Rural guidelines of 45 dBA (Daytime) and 35 dBA (Night-time), with the daytime LA_{90} logarithmic calculated average of 41.10 dBA being lower than the daytime average. The night-time logarithmic calculated average for the night-time LA_{90} is higher than the SANS night-time guideline of 35 dBA, exceeding it with +7.20 dBA (42.20 dBA). This again concludes that even that there is little to no activity in the region during the night, the nocturnal insects/animals do increase the noise climate due to their activities.

The modelled results (LA_{90}) do indicated that at receptor points F and G the impact of the noise generated by the KSP plant will be noticeable, and according to the SANS Categories of community/group response to an increase in noise difference (SANS 10103:2008) there would be wide spread complaints. These two locations are close to the access road that will be used to enter and exit the site, throughout the projects life time. The highest difference in increase of noise climate (LA_{90}) at the receptor points is at receptor F during the first and second scenario (+11.80 dBA). During the first two scenarios, there is more activity closer to the northern boundary than during any of the other scenarios also looking at receptor G the increase in noise level is constant throughout the scenarios (+1.09 dBA), indicating that the location will only be influenced by the road passing by the receptor. This is due to the noises emitted from the site have to travel over a great distance to most of the sensitive receptors and the distance travelled is the largest depending factor for the noise propagates rate.

Good practice to avoid high-intensity impulse sounds at night and attenuation on more constant sources will ensure that noise is not a significant impact from the proposed development. Should complaints arise during either the construction or any of the operational phases identified, measurements can be taken and compared with the background data provided in this study. Attenuation measures can then be implemented to reduce the impact and the noise levels retested to close out the issue.

The following maps illustrate the Baseline Conditions at Kathu in the Northern Cape. The figures are based on interpolating the noise levels between different points to create a map for the model. Thus the figures are only used for indicative purposes and for accurate results please refer to the tables in the report.

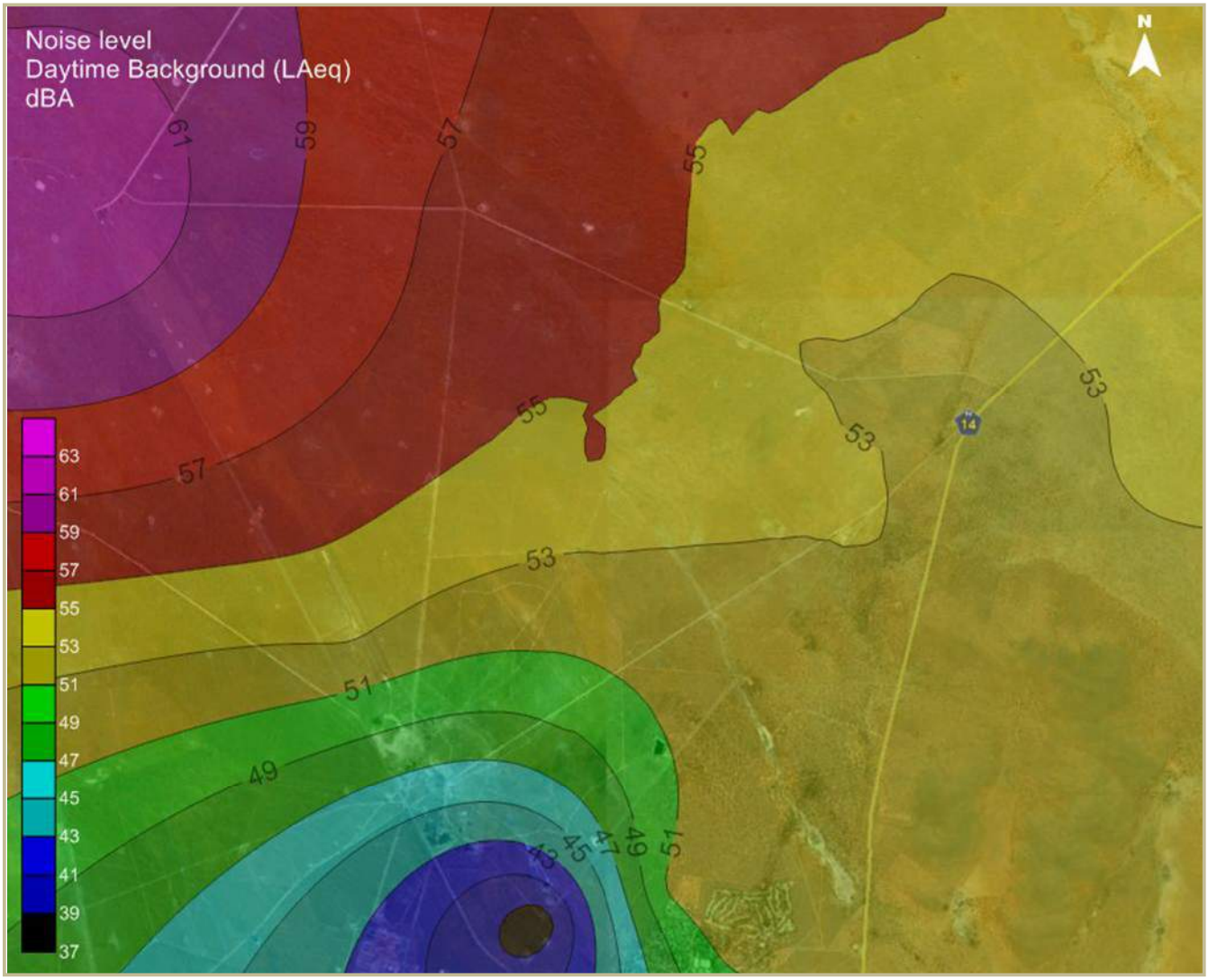


Figure 6-2: Interpolated surface representation of baseline daytime noise environment

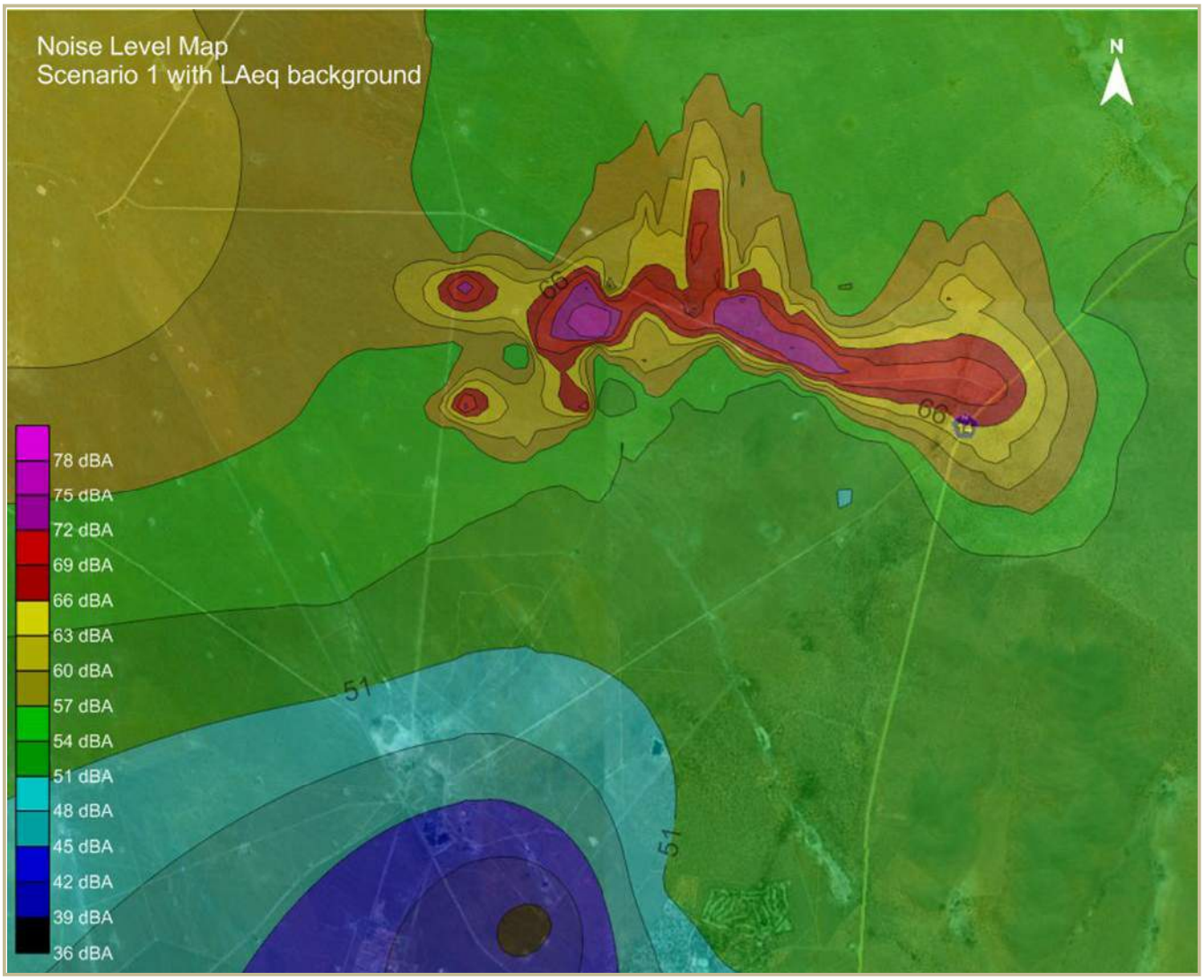


Figure 6-3: Scenario 1 - daytime modelled results

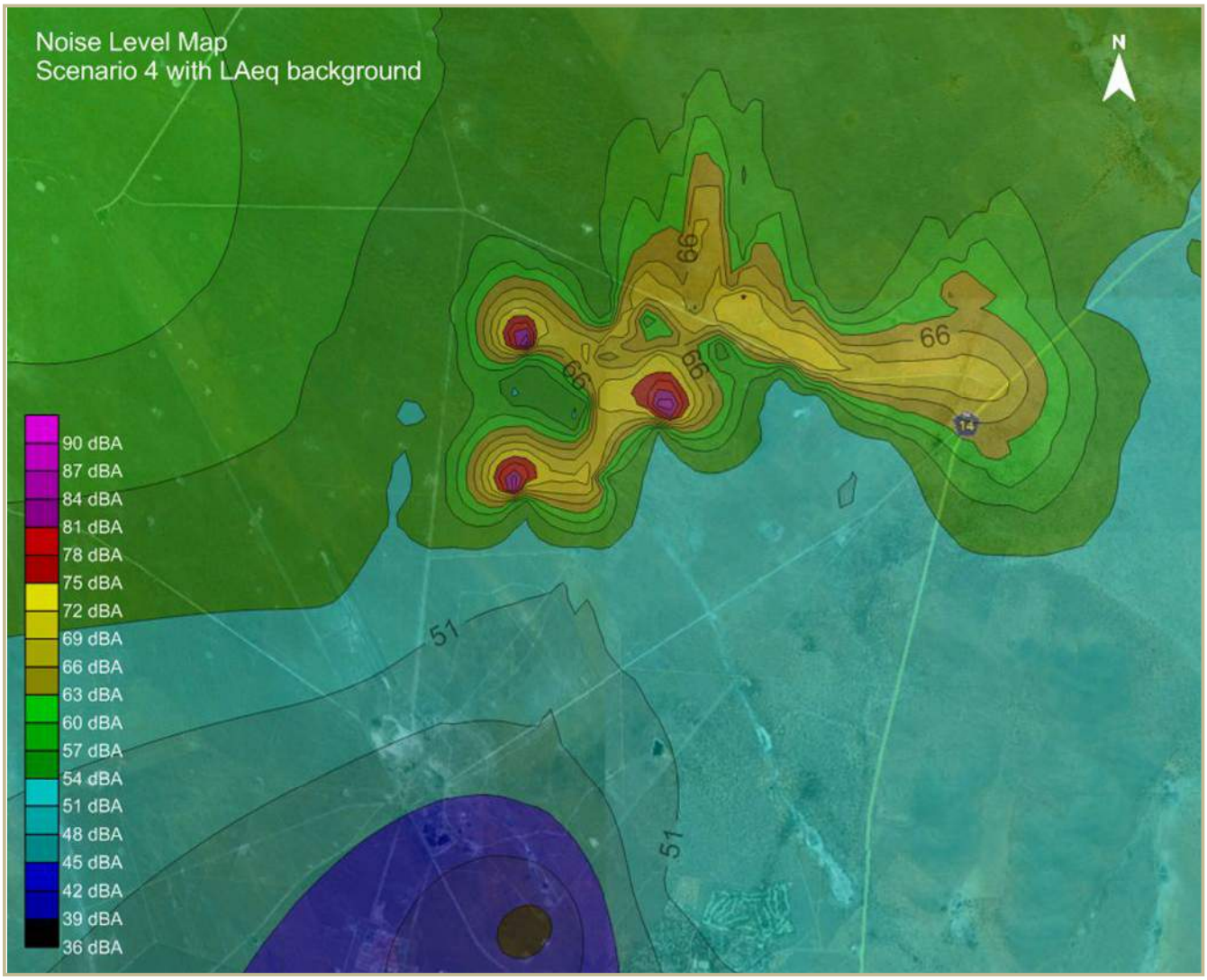


Figure 6-4: Scenario 4 – daytime modelled results

6.4 TRAFFIC

6.4.1 Objectives

The traffic study aimed to establish the impacts on traffic flows in the vicinity of the proposed KSP project.

The study modelled traffic generation due to the KSP development during its construction phase and thereafter during its operation. A site visit was undertaken on 25 and 26 January 2011 during which manual traffic counts were undertaken during the weekday morning and afternoon peak periods at two strategic locations, namely:

- Along the N14 near the site location; and
- Along the R380 near the site location.

Capacity analyses at the two strategic sites were undertaken to test the minimum geometric requirements for these intersections. For this purpose, the SIDRA traffic engineering software was used.

6.4.2 Baseline

There are three primary roads surrounding the proposed site, namely, the national route N14, R380 running north-west from Kathu and the gravel district road T25 that runs east-southeast past the northern boundary of the KSP property/ site. The site however, does not abut directly onto any paved road. Current access to the N14 and R380 is by means of existing gravel roads.

With reference to Figure 6-5, two access roads are suggested for the construction stage namely Road A (T25), which will connect to the N14 and Road B connecting to the R380. Road A and B are both existing gravel roads, A forming the northern site boundary and B being a private gravel road connecting to the R380, close to the Sishen Airfield. KSP proposes to tar the T25/ road A from the N14 junction to the north western boundary of the site (past the Peens' homestead) Road C is the continuation of the T25 to its junction with the R380, but it will not be tarred. The full Traffic Impact Assessment Report (**Appendix I)** provides data on existing traffic volumes for Kathu and environs.

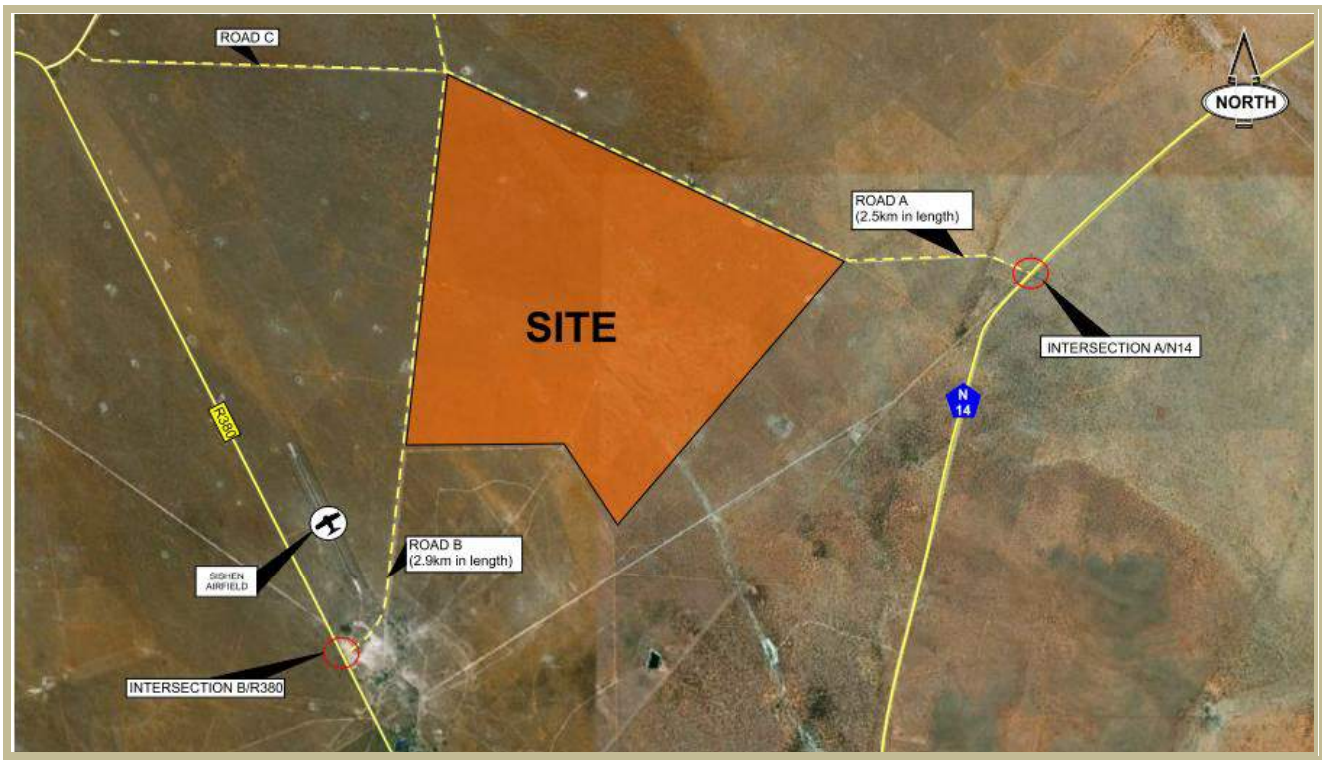


Figure 6-5: Proposed access roads and associated intersections

6.4.3 Impacts

Even though the construction phase will be temporary (approximately 30 months), the employment and consequent traffic generation of this phase will be significantly higher than that of the operational phase, due to vast differences in employment and contractor numbers. Consequently, it was decided to estimate the traffic generation of both phases. A summary is provided in Table 6-1.

Table 6-1: Estimated peak hour traffic generation summaries (vehicles per hour)

Estimated Peak Hour Traffic Generation (veh/hr)			
	AM peak hour (reverse flows for PM peak)		
	IN	**OUT**	**TOTAL**
Construction phase	42	27	69

Estimated Peak Hour Traffic Generation (veh/hr)			
Operational phase	56	4	60
Estimated Daily Traffic Generation (veh/day)			
	Daily (24hr) Traffic		
	IN	**OUT**	**TOTAL**
Construction phase	185	185	370
Operational phase	100	100	200

The estimated traffic generation is considered high, specifically the estimated morning and afternoon peak hour traffic generation. It is likely that a larger portion of the traffic would occur outside the one-hour peak.

Overall, it was concluded that the addition of the traffic associated with the project will have a minimal traffic impact on the surrounding area, since the increase in traffic volumes will be of a low order. There will be capacity available at both intersections, provided the minimum requirements are implemented as per the Traffic Impact Assessment Report. However, the increase in traffic along Road A past the Peens' will represent a significantly disturbing impact to them, even if the road is tarred. On the other hand, there are very few other residents in the rural areas surrounding the proposed development site who could be disturbed by the increase in traffic.

6.4.4 Mitigation

WSP SA Civil and Structural Engineers recommend the following to ensure the traffic impacts remain minimal:

- Road A (Figure 6-5) must be surfaced and be used during the construction phase. The road will primarily be used by heavy vehicles transporting the equipment to the site. Therefore, residents can use this road.
- Minimum local road widening in the vicinity of the two intersections (T25/N14 and Road C (T25)/R380) must be constructed at both of these intersections. As the operating speeds at both intersections are 100 to 120km/h, upgrades are considered necessary from a traffic and road safety perspective, especially in light of the heavy vehicles using the R380 and N14 to/from the site. Thus, safe turning and deceleration lanes are required.

Overall, the traffic engineering study indicates that the general traffic impact will be moderate, should all recommendations be implemented.

6.5 VISUAL LANDSCAPE

6.5.1 Objectives

The objectives of the study were to:

- Identify the landscape character of the site and surrounding areas;
- Identify the main potential receptors or key observation points (KOP); and
- Make recommendations with regards to the potential issues.

The visual impact assessment was undertaken in accordance to the Visual Resource Management system (developed by the Bureau of Land Management from the United States Department of Internal Affairs), Institute of Environmental Management and Assessments (IEMA) guidelines and the Western Cape Department of Environmental Affairs and Development Planning Visual and Aesthetic guidelines (South Africa). The VRM system was used to evaluate potential visual impacts associated with landscape modifications. Field verification was undertaken in February 2011 and a photographic study completed of the site and surrounding landscape.

6.5.2 Baseline

Grassland and shrubs dominate undulating plains with ridges in the distance, contributing to high visual quality of the landscape. Being a semi-arid region with low land capabilities, development is concentrated in pockets of transformed land accommodating human habitation and infrastructure.

There are large mining activities concentrated mainly in the mountain range to the south of Kathu, where mining primarily of iron-ore and manganese deposits occur. Iron-ore deposits are mined by means of open cast methods, leaving large environmental scars of which excavation pits and residue heaps are the most obvious. The Sishen Mine, with an open pit 11km long and 400m deep, is one of the world's largest open cast mines. Agriculture in the area is predominantly low intensive grazing.

A natural feature of the area is the Kathu forest which is approximately 4,000ha in extent. The Kathu forest comprises tall, mature specimens of Camelthorn trees (*Acacia erioloba)* which were a focal point for the development of Kathu 'the town under the trees'. The Kathu forest is under pressure from a developmental boom within the area predominantly focussing on upmarket residential developments and new and expanding mines, and for an ecosystem already regarded as 'critically endangered' (Anderson and Anderson, 2007), any development must take cognisance of the need to integrate effective conservation management with sustainable development.

Eight "broad-brush" landscape types were defined within the greater Kathu area and evaluated for visual appeal and receptor sensitivity:

- Non perennial rivers and pans;
- Mining context;
- Kathu Town;
- Sishen airfield and surrounding disturbed area;
- Low hills;
- Sishen golf course;
- Kathu forest heritage area; and
- Agricultural lands.

The most significant landscape was the Kathu forest (Figure 6-6) due to the site's being proclaimed as a heritage site and due to its large *Acacia erioloba* population. The least significant was the Sishen Mine landscape, which is a transformed, mining landscape.

Figure 6-6: View of the Kathu forest

6.5.3 Impacts

Six observation points surrounding the proposed development site were identified for potential visual impacts:

- Oupos farm (0.1km from the site);
- The N14 south-west bound, located 14km from site, show the large (4 – 6m high) trees along the road that form part of the Kathu forest extension;
- Sishen golf course/Kalahari golf estate (5km from site);
- Khai-apple resort (4.7km from site);
- R380 (3km from site); and
- Kathu residential (7km from site).

Two observation points were defined in terms of the VRM criteria as being key observation points (KOPs), namely Oupos farm (Figure 6-7) and the N14 (Kathu forest/ Kalahari Golf en Jag). Table 6-2 summarises the construction and operational phase impacts that may be experienced by the two KOPs.

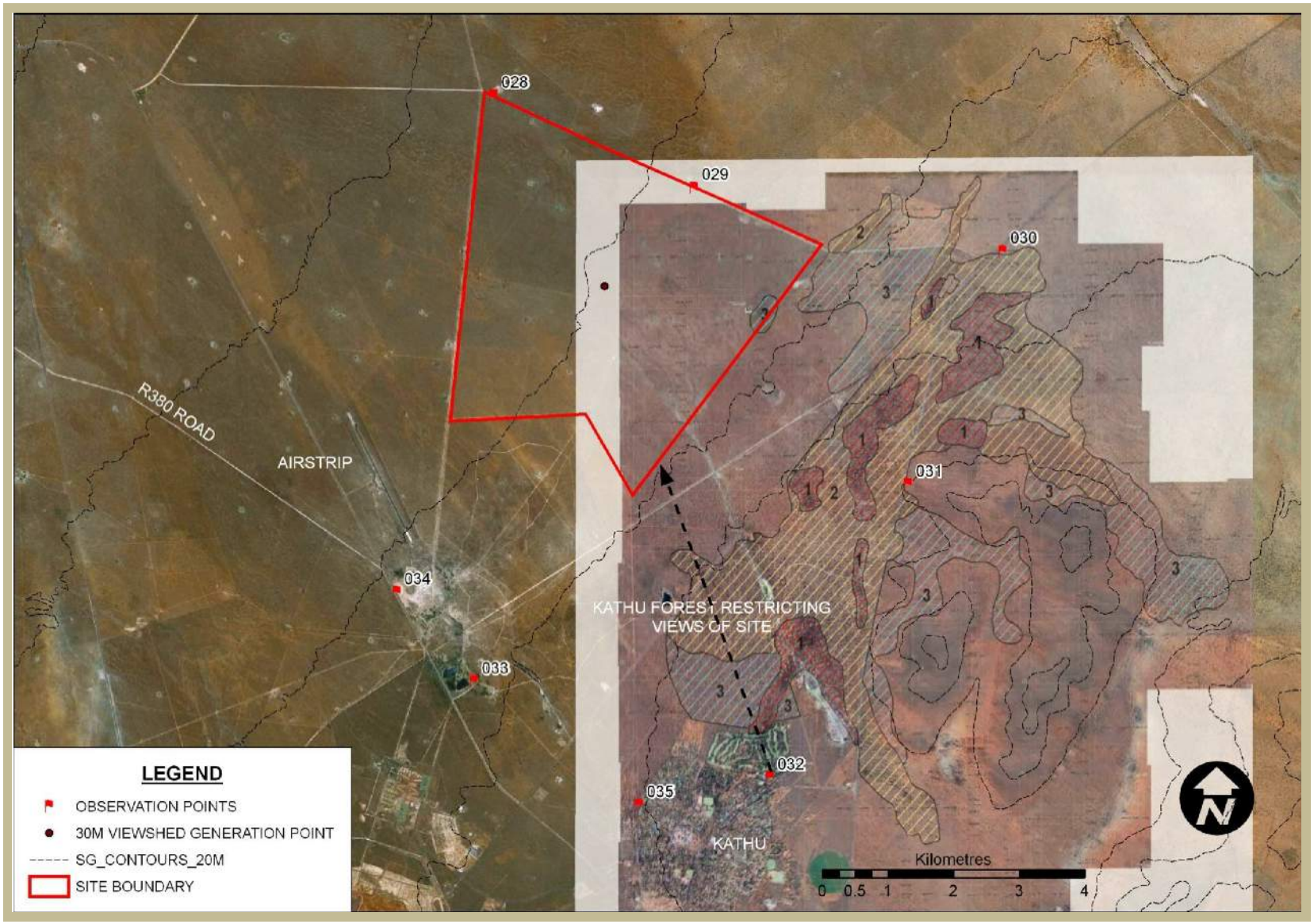


Figure 6-7: Key observation points and sensitive receptors in the area of the project site

Table 6-2: Summary of the potential construction and operational phase impacts experienced by the two KOPs

Construction phase	Operational phase
Site clearing and levelling	Views of parabolic troughs
Dust	Reflectivity
Vehicle movements	Chimney
Lights at night	Lights at night
Tarring of the road	Assembly warehouse
Construction of auxiliary infrastructure, assembly warehouse and chimney	Increased traffic

6.5.4 Mitigation

The following mitigation measures are recommended:

- Dust retardant measures to control wind-blown dust;
- Retain vegetation buffer around the site which allows existing vegetation to offer some visual screening; and
- Colour of dust fence to be mid-grey so as to absorb reflected light. The mid-grey colour of the large porous dust fence would blend with the natural predominantly grey colour of the sky. In conjunction with the proposed perimeter tree growth, the dust fence would also be further visually absorbed.

Should these mitigation measures be implemented, the impact significance would drop from moderate to low.

Refer to **Appendix J** for the detailed Visual Impact Assessment Report.

BIO-PHYSICAL ENVIRONMENT

Areas of concern in the biophysical environment investigated were:

- Air quality (Section **6.6**);
- Soils, land capability and land use (Section **6.7**);
- Water (hydrology and geohydrology) (Section **6.8**);
- Vegetation and floral biodiversity (Section **6.9**);
- Vertebrate fauna (Section **6.10**)
- Invertebrate fauna (Insects) (Section **6.11**)

6.6 AIR QUALITY

6.6.1 Objectives

The objective of the air quality impact assessment for this project was to investigate, in a conservative manner, expected emissions during both the construction and operational phases of the project. These probable emissions, based on anticipated quantities provided by Group Five for the unit processes during both the construction and operation phases were then inserted into an atmospheric dispersion model, a predictive mathematical tool, for assessment. These include particulate matter and dust impacts during construction as well as particulate matter and gaseous pollutant impacts including sulphur dioxide (SO_2) and nitrogen dioxide (NO_2). To account for the effect of

mitigation and dust suppression during the construction and operational phases, two scenarios were created. These were labelled Scenario A which represents the unmitigated scenario, and Scenario B which incorporates mitigation with an expected efficiency of 90%. The results of these scenarios were assessed against legislated Air Quality standards as found in the National Environmental Management: Air Quality Act, Act 39 of 2004 (NEM:AQA), and the South African Bureau of Standards' SANS 1929:2005 Ambient Air Quality – Limits for common pollutants.

6.6.2 Baseline

For the purposes of assessing baseline meteorological conditions and collating meteorological data required as input into the atmospheric model, meteorological data was sourced from the South African Weather Service's weather station located in Postmasburg (approximately 75km south of the site). Postmasburg has a warm to hot and dry climate. Average daily maximum temperatures range from 29.96˚C in December to 13.66˚C in June (Table 6-3). The Mean Annual Precipitation (MAP) is 250.3mm and most (88.65%) of the rainfall occurs in the summer from October to March with the highest rainfall in January and February (Table 6-3). Early summer rainfall is derived mainly from deep convective showers and thunderstorms with occasional hailstorms. Late summer rainfall is less severe with more widespread convective activity.

On average, during the course of a year Postmasburg experiences more rainfall at the beginning of the year (January to March) and then only again in the last 3 months of the year (88.65% is summer rainfall and 11.35% occurred during the winter months). Temperature follows the same trend as the rainfall of the region, with it being higher in the beginning and end of the year and low in the winter months. Thus the winters at Postmasburg are generally dry and cold with big variations between day and night temperatures, followed with wet and hot summer months.

Table 6-3: Summary of the temperature and rainfall at Postmasburg

Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Max Temp	28.40	26.65	24.60	21.69	16.80	13.66	14.95	19.85	22.33	26.08	28.36	29.96
Min Temp	20.05	17.73	16.15	11.13	4.25	-3.04	3.24	5.81	10.73	16.52	14.91	15.60
Avg. Temp	24.49	22.64	20.39	17.98	12.72	9.90	8.77	13.39	17.34	21.49	22.31	25.84
Rainfall	75.40	52.10	19.40	9.60	10.20	4.80	3.80	0.00	0.00	21.20	25.80	28.00

The most frequent wind speed that occurred at Postmasburg was between 1.5 - 3m/s from the direction north (360°). The average wind direction at Postmasburg is from the north (360°) with the wind direction that has the most wind speeds that were above 5.4m/s. Although the dominant wind direction is from the north, the wind direction that has the most potential for wind generated dust is from the west, with 25% of the annual wind that is >5.4m/s comes from this direction (Figure 6-8).

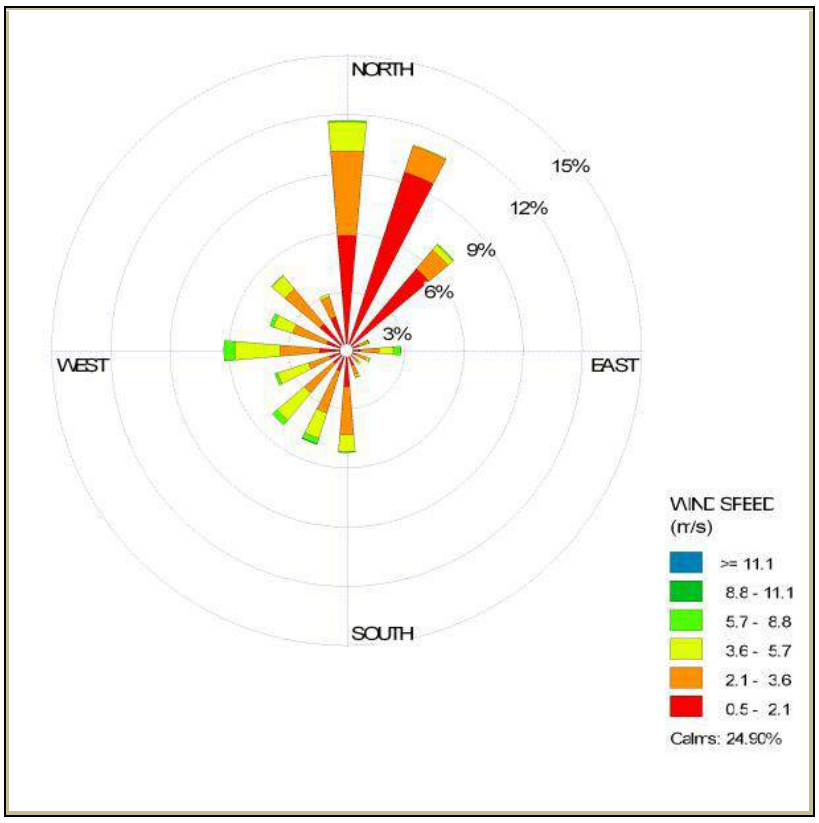


Figure 6-8: Wind-rose indicating the wind direction and wind speed for 2009 at Postmasburg

Baseline air quality data was sourced for the Kathu region. Data provided for the Sishen Mine, located just to the south of Kathu indicate that particulate matter (PM_{10}) concentrations have historically been in the moderate range, with values varying from the mid-twenty to mid-thirty µg/m^3. Recently there appears to have been an appreciable increase in the ambient concentration of particulate matter (PM_{10}), with concentrations of 52.00µg/m^3.and 90.6µg/m^3 being recorded in the last two years, see Table 6-4.

Table 6-4: Ambient respirable particulate matter (PM_{10}) monitoring data in µg/m^3 for Kathu (Sishen Mine, 2010)

Date	Kathu
Jan – Dec 2003	25.9
Jan – Dec 2004	33.6
Jan – Dec 2005	26.3
Jan – Dec 206	27.5
Jan – Dec 2007	38.4
Jan – Dec 2008	52.0
Jan – Dec 2009	90.6

Baseline dust deposition data for the areas of Sesheng (approximately 8km south of the site), Kathu and Wincanton (approximately 10km north west of the site), have recorded average values of 480 (mg/m^2/day), 504 (mg/m^2/day) and 628 (mg/m^2/day) respectively in the recent past. The average values recorded for Sesheng and Kathu are within the SANS 1929:2005 Ambient Air Quality – Limits for common pollutants' residential threshold value of 600mg/m^2/day, though the Wincanton value of 628mg/m^2/day is slightly in excess of this threshold value (see Table 6-5).

Table 6-5: Dust fallout monitoring data (mg/m^2/day) in the area surrounding the proposed site (Sishen Mine, 2010)

Date	Sesheng	Kathu	Wincanton
30-Jun-2009	117	198	189
25-Aug-2009	169	271	414
21-Sep-2009	450	262	371
19-Oct-2009	1119	1174	1211
16-Nov-2009	894	1080	1108
18-Dec-2009	597	897	1123
29-Mar-2010	413	98	281
24-May-2010	80	55	323
Average	480	504	628

6.6.3 Impacts

It should be noted that the emissions predicted in this study are considered to represent conservative, worst case estimates for impact assessment purposes. The model estimates will need to be validated through field monitoring, a process that has already been initiated, so as to validate emission estimates as well as demonstrate achievement of mitigation efficiencies.

Atmospheric Dispersion Modelling Results – Construction Phase

During the construction phase, the predicted particulate matter (PM10) concentrations range from 5.32 µg/m^3 to 69.67 µg/m^3 for the 24 hour averaging period and 0.35 µg/m^3 to 25.22 µg/m^3 for the annual average averaging period, Scenario A (unmitigated). This is well within the National Environmental Management: Air Quality Act, Act 39 of 2004 (NEM:AQA) standards for particulate matter (PM10) of 75 µg/m^3 and 50 µg/m^3 for the 24 hour and annual average periods respectively. For the construction phase, Scenario B (90% effective mitigation) predicted particulate matter (PM10) concentrations range from 0.57 µg/m^3 to 4.99 µg/m^3 for the 24 hour averaging period and 0.04 µg/m^3 to 1.62 µg/m^3 for the annual average averaging period. Similarly these are all well within the National Environmental Management: Air Quality Act, Act 39 of 2004 (NEM:AQA) standards.

The predicted dust fallout levels range from 66.92 mg/m^2/day to 4845.85 mg/m^2/day for the construction phase, Scenario A (unmitigated), and range from 10.53 mg/m^2/day to 762.77 mg/m^2/day for the construction phase, Scenario B (90% effective mitigation). For the construction phase Scenario A (unmitigated) the predicted dust fallout levels are in excess of the SANS 1929:2005 Alert standard of > 2400 mg/m^2/day indicating the requirement for dust mitigation measures. For the construction phase Scenario B (90% effective mitigation), the predicted dust fallout levels are within the SANS 1929:2005 Residential standard of < 600 mg/m^2/day for all identified discrete receptors, with the exception of the Andre Markgraaf Lodge (b), for which a value of 659.57 mg/m^2/day is predicted. This value is in excess of the SANS 1929:2005 Residential standard of <600mg/m^2/day.

Atmospheric Dispersion Modelling Results – Operational Phase: Vehicular Activity

During the operational phase, the predicted particulate matter (PM_{10}) concentrations range from 0.86µg/m^3 to 11.28µg/m^3 for the 24 hour averaging period and 0.06µg/m^3 to 4.08µg/m^3 for the annual average averaging period, Scenario A (unmitigated). This is well within the National Environmental Management: Air Quality Act, Act 39 of 2004 (NEM:AQA) standards for particulate matter (PM_{10}) of 75µg/m^3 and 50µg/m^3 for the 24 hour and annual average averaging periods respectively. For the construction phase, Scenario B (90% effective mitigation) predicted particulate matter (PM_{10}) concentrations range from 0.09µg/m^3 to 1.13µg/m^3 for the 24 hour averaging period and 0.01µg/m^3 to 0.41µg/m^3 for the annual average averaging period.

The predicted dust fallout levels range from 9.11mg/m^2/day to 659.57mg/m^2/day for the operational phase, Scenario A (unmitigated), and range from 0.91mg/m^2/day to 65.96mg/m^2/day for the operational phase, Scenario (90% effective mitigation). For the operational phase Scenario A (unmitigated) the predicted dust fallout levels are within the SANS 1929:2005 Residential standard of <600mg/m^2/day for all the identified discrete receptors with the exception of the Industrial standard of <1,200mg/m^2/day, for a single identified discrete receptors. For the construction phase Scenario B (90% effective mitigation), the predicted dust fallout levels are within the SANS 1929:2005 Residential standard of <600mg/m^2/day for all identified discrete receptors.

Atmospheric Dispersion Modelling Results – Operational Phase: Co-firing plant

In order to investigate air quality impacts as a result of emissions from the co-firing plants, a worst-case scenario was selected by assessing atmospheric dispersion modelling results based on the completion of the project, i.e. with three co-firing plants in operation. During the operational phase the predicted particulate matter (PM) concentrations for the third phase as a result of emissions from the co-firing plant range from 0.076 µg/m^3 to 0.257 µg/m^3 for the 24 hour averaging period and 0.003 µg/m^3 to 0.039 µg/m^3 for the annual average averaging period. This is well within the National Environmental Management: Air Quality Act, Act 39 of 2004 (NEM:AQA) standards for particulate matter (PM10) of 75 µg/m^3 and 50 µg/m^3 for the 24 hour and annual average averaging periods respectively.

The predicted sulphur dioxide (SO_2) concentrations for the operational phase, third phase as a result of emissions from the co-firing plant range from 5.358 µg/m^3 to 13.218 µg/m^3 for the 1 hour averaging period, 0.771 µg/m^3 to 2.721 µg/m^3 for the 24 hour averaging period and 0.039 µg/m^3 to 0.397 µg/m^3 for the annual average averaging period. This is well within the National Environmental Management: Air Quality Act, Act 39 of 2004 (NEM:AQA) standards for sulphur dioxide (SO_2) of 350 µg/m^3, 125 µg/m^3 and 50 µg/m^3 for the 1 hour, 24 hour and annual average averaging periods respectively.

The predicted nitrogen dioxide (NO_2) concentrations for the operational phase, third phase as a result of emissions from the co-firing plant range from 2.679 µg/m^3 to 6.610 µg/m^3 for the 1 hour averaging period and 0.019 µg/m^3 to 0.198 µg/m^3 for the annual average averaging period. This is well within the National Environmental Management: Air Quality Act, Act 39 of 2004 (NEM:AQA) standards for nitrogen dioxide (NO_2) of 200 µg/m^3 and 40 µg/m^3 for the 1 hour and annual average averaging periods respectively.

On the basis of the above findings, the potential emissions from the co-firing plants are not considered to be of any concern.

6.6.4 Proposed Mitigation measures

Recommendations on mitigation options for dust and particulates matter (PM_{10}) impacts from the project are provided below.

Table 6-6: Dust and particulate matter mitigation options

Emission source	Recommended control method(s)
Debris handling	Wind speed reduction Wet suppression [a]
Truck transport [b]	Wet suppression Paving Chemical stabilization [c]
Bulldozers	Wet suppression [d]
Pan scrapers	Wet suppression of travel routes
Cut/fill material handling	Wind speed reduction Wet suppression
Cut/fill haulage	Wet suppression Paving Chemical stabilization
General construction	Wind speed reduction Wet suppression Early paving of permanent roads

[a] Dust control plans should contain precautions against watering programs that confound track-out problems.

[b] Loads could be covered to avoid loss of material in transport, especially if material transported is off-site

[c] Chemical stabilization usually cost-effective for relatively long-term or semi-permanent unpaved roads

[d] Excavated materials may already be moist and not require additional wetting. Furthermore, most soils are associated with an 'optimum moisture' for compaction.

- Traffic Management

Vehicle movement along unpaved roads manifests a range of dust emission mechanisms. Firstly, as the vehicle's tyres move across the road surface the frictional forces result in the soil and rock particles breaking down into smaller sized particles (which are more readily entrained into the air compared with larger, heavier particles). Air turbulence from the moving tyres, the bulk of the vehicle itself and even the exhaust can result in entrainment of dust which would have otherwise remained on the ground surface.

The USEPA (2006c) suggests that vehicle restrictions are one of three categories of mitigation efforts that may be employed to reduce dust emission from unpaved roads. Its recommendations include reducing vehicle speed, reducing vehicle weights and limiting the amount of traffic using the roads. Of these, the latter two are not completely feasible for the Kalahari Solar Power project, as certain vehicles are required for construction activities. Vehicle speed on site can be managed by means of road signage and speed humps.

- Wet suppression

Following from traffic management is a symptomatic suppression technique; water cart usage. Dust emissions from unpaved roads are (amongst others) a factor of the moisture content of the road material. The drier the material, the more friable (and hence more susceptible to entrainment) it becomes. Water carts are typically road tanker trucks with special spray nozzles to release water onto the road surface, thus through regular application maintaining a suitable moisture content on the roads, in turn assisting in reducing the amount of dust emitted. The effectiveness of this

technique is influenced by how quickly the road surface dries after each application (the more applications required, the more vehicle trips).

From the above, the following recommendations can be made:

- Wherever possible, vehicle access to the site should be restricted or minimised.
- Vehicle speed should be managed and offenders should be penalized.
- The use of water carts to moisten road surfaces should be employed, ideally containing chemical binding agents and other dust suppressants. The frequency of these should be determined by the state of the roads, the prevailing weather and vehicle volume on site at the time.

Refer to **Appendix L** for the detailed Air Quality Impact Assessment Report.

6.7 SOIL, LAND USE AND LAND CAPABILITY

6.7.1 Objectives

The objective of the study was to determine the land capability of the development site.

The land capability information was obtained from the Agricultural Geo-Referenced Information System (2011). The land capability is determined based on soil capability and climate factors. The soil capability is defined according to 8 classes, whereby Classes I-IV are considered arable and Classes V-VIII are considered non-arable. The classes are defined by terrain/soil factors (flooding hazard and erosion hazard) and soil factors (soil depth, soil texture, internal drainage, mechanical limitations, and other soil properties). By applying a climatic factor, the land capability (Table 6-7) is determined from these soil capability classes. The methodology to determine land capability is set out in Schoeman *et al.* (2000).

Table 6-7: Land capability class description

Land Capability Class	Description
Class I	Prime arable land with a low risk of erosion
Class II	Good arable land but with a slight risk of erosion
Classes III	Arable land; however has increasing limitations due to an increasing erosion risk
Classes IV	Marginally arable land and has increasing limitations due to an increasing risk of erosion
Classes V	Restricted agricultural potential (suitable for grazing)
Class VI	Very restricted agricultural (suitable for grazing)
Class VII	Regarded as non-arable (suitable for grazing)
Class VIII	Regarded as being unsuitable for any form of agriculture

6.7.2 Baseline

Approximately 98% of the John Taolo Gaetsewe District Municipal area is used for agriculture. Of this, only 2% is suitable for crop cultivation, while the remainder accounting for livestock farming (cattle, sheep and goats). Game farming is becoming increasingly popular. The same pattern is observed in the Gamagara Local Municipality. Kathu is the only commercial node within the Municipality, originally planned and built as part of the mining activities at Sishen. Significant land-use surrounding the proposed development site is low intensive agriculture, the Kathu forest, Kathu national reserves and a golf course.

The agricultural potential of the area is low which is attributable to the soil potential and climatic conditions. Where climate permits, the study area may be suitable for grazing or forestry, but is not suitable for arable agriculture. As

rainfall is generally very low and evaporation is very high. Even high quality soils would be unsuitable for dry land agriculture.

The Strategic Environmental Assessment and Integrated Environmental Management Programme for the John Taolo Gaetsewe District Municipality (Kgalagadi District Municipality, 2005) highlights insufficient land availability for the following community needs:

- Low cost housing;
- Parks and recreational areas;
- Waste management; and
- Roads.

The proposed site, farm Kathu No. 465, has historically been utilised for low intensity grazing.

6.7.3 Impacts

The entire KSP site is classed as Class VIII and is thus considered non-arable, low potential grazing land. Low land capability is a result of the dry climate and shallow sandy soils which have a low water holding capacity and low fertility status (Figure 6-9).

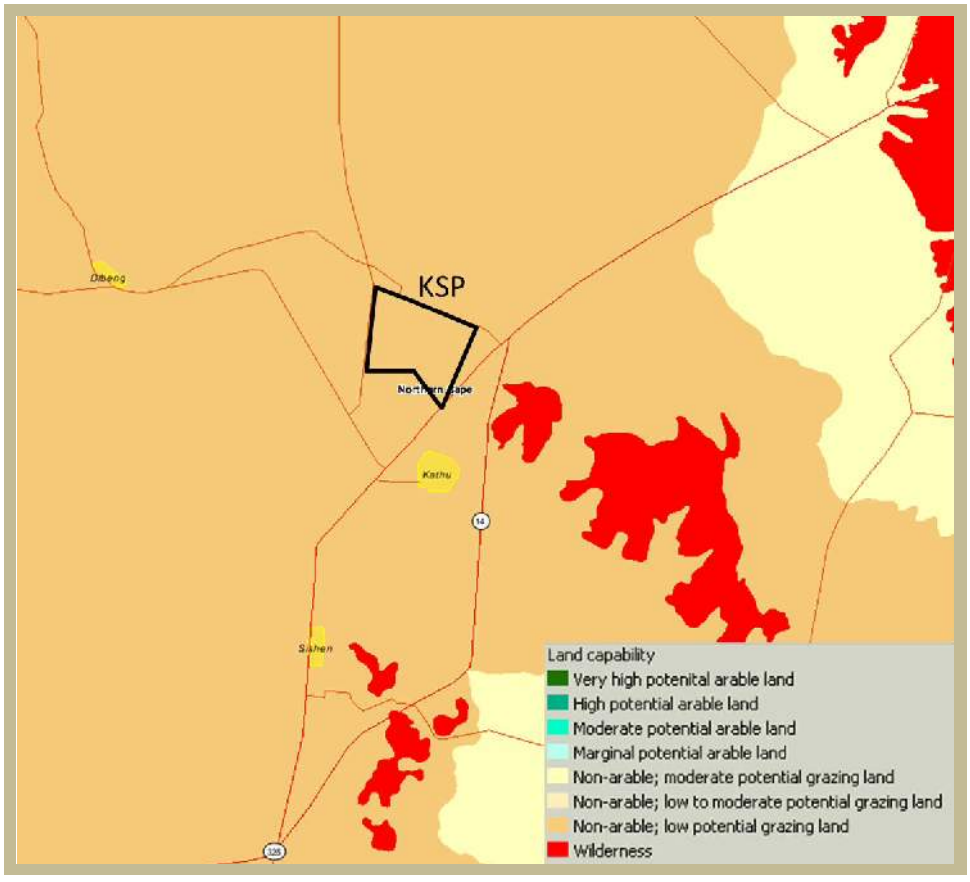


Figure 6-9: Land capability

Based on the low agricultural capability, the site is only suitable for grazing. The grazing capacity of the study area is between 16 and 25 hectares per large stock unit (LSU) (moderate in the South African context) which is not significantly different from the surrounding land on a regional scale (Figure 6-10).

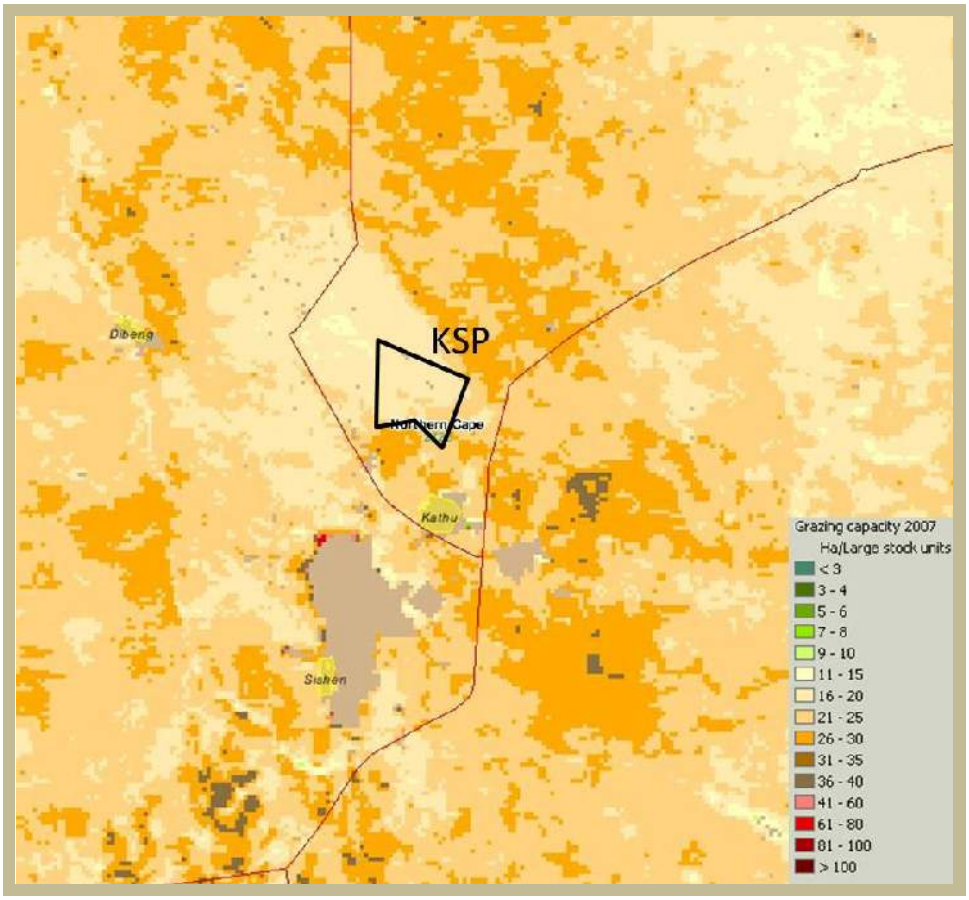


Figure 6-10: Grazing capacity (large stock units)

During the construction of the KSP, the development footprint area will cleared of vegetation. Through these activities, grazing capability will be lost. Nevertheless, the grazing capacity of the KSP site is not significantly different from the regional grazing capacity, thus impact is considered to be insignificant on a regional scale.

Refer to **Appendix M** for the detailed Soils, Land Use and Land Capability Report.

6.8 WATER (HYDROLOGY AND GEOHYDROLOGY)

6.8.1 Objectives

The hydrological and geohydrological study had a twofold objective:

- To establish a sustainable water supply for the KSP project;
- To determine the significance of impacts of the Project's water demand on local and regional water resources.

The following scope of work was conducted as part of the water assessment:

- A broad assessment and review of water potentially available via surface- and ground-water supply options using upper (worst case scenario) and lower water requirement thresholds for the relevant technology;
- Identification and pump testing of existing unconfined and confined aquifer boreholes to establish sustainable yield from the relevant aquifer;
- Preliminary hydrocensus based on available published data and information available from relevant stakeholders;
- Determination of the confined and unconfined aquifer characteristics and potential sustainable yields based on available desktop information and pump test results; and

– Identification of the need for a water use license.

Appendix N contains the detailed Water Feasibility Assessment Report.

6.8.2 Baseline

Hydrology

The KSP site is located in the Gamakara River catchment on the watershed between the D41J and D41K quaternary catchments. The Gamakara River drains into the Kuruman River approximately 60km to the north of the site (Figure 6-11). The Gamakara River is non-perennial in nature and the episodic nature of flow is evident in aerial imagery through the presence of centre pivot irrigation systems within the river channel in the town of Dibeng, west of the site.

Regional hydrological information for the area is summarised in Table 6-8. This information was sourced from the Surface Water Resources of South Africa 1990 (Midgley *et al.* (1994)) and includes catchment and climatic characteristics of the catchment areas

Table 6-8: Quaternary catchment information

Quaternary Catchment	Gross Area (km^2)	Net Area (km^2)	MAP (mm)	MAE (mm)	MAR (mm)	Net MAR (10^6m^3)
D41J	3 878	2 518	358	2 350	1.3	3.2
D41K	4 216	2 664	344	2 350	1.1	2.8

Figure 6-11: Site location and quaternary catchments

Rainfall

Based on the mean annual precipitation (MAP) for the region, the KSP site is located in semi-arid climate which is defined as an area that receives relatively low annual precipitation, usually between 250 to 500mm and the mean annual evaporation (MAE) largely exceeds precipitation. Furthermore quaternary catchments D41J and D41K are

endorhoeic in nature, i.e. closed drainage basins, indicating that the nett catchment area contributing to runoff is less than the gross catchment area.

The daily rainfall data for the period 1950 to 1993 from the Smythe Raingauge (SAWS Number 0356712W) was utilised for the hydrological assessment conducted to establish the feasibility of surface water utilisation for the purposes of the KSP project. The information was obtained from the Institute for Commercial Forestry Research (ICFR) and Bioresources Engineering and Environmental Hydrology (BEEH) database. The rain gauge information is given in Table 6-9.

Table 6-9: Rainfall stations information

Station Name and Number	SAWS Number	Record (Years)	Latitude	Longitude	MAP (mm)	Altitude (m)
Smythe	0356712 W	43	22°54'	27°52'	337	1329

Figure 6-12 shows the time series plot of the recorded monthly rainfall for the Smythe Raingauge (0356712W). The secondary axis shows the cumulative rainfall over the recorded period. The relatively constant slope of the cumulative rainfall graph is indicative of there being no major anomalies in the rainfall record and that it can be considered representative of rainfall conditions for the area.

Based on the daily rainfall record for the period, rainfall occurred on 8.3% of the days, i.e. 1,303 days out of 15,695 days, and the rainfall depth of the events ranged between 0.1 and 222.3mm. Table 6-10 indicates the daily rainfall distribution for the record, which displays the dominance of less frequent, short duration, high intensity rainfall events.

Table 6-10: Percentile distribution of daily rainfall for rain gauge 0356712W (1950 to 1993)

	Percentiles										
	90th	91th	92th	93th	94th	95th	96th	97th	98th	99th	Max
Daily rainfall (mm)	0.0	0.0	1.3	2.6	4.0	6.0	8.1	11.4	15.9	25.4	222.3

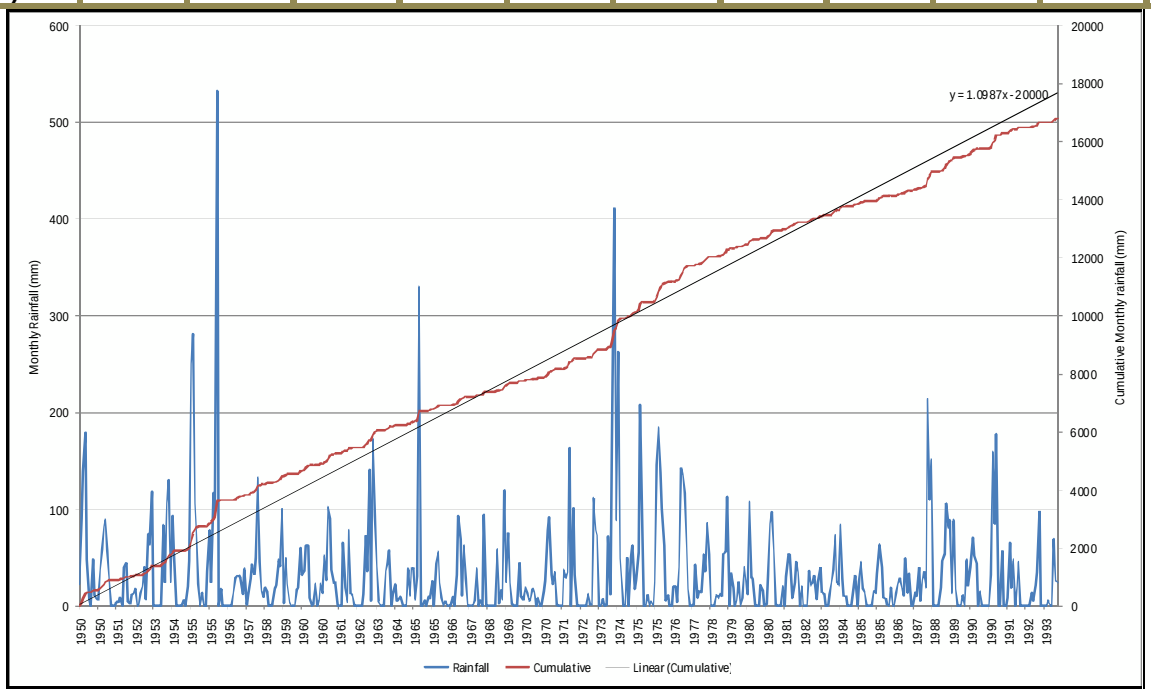


Figure 6-12: Smythe rain gauge (0356712W) - monthly and cumulative precipitation

Geohydrology

- Aquifer description

The Kgalagadi District Municipality in partnership with the Department of Water Affairs (DWA) has developed a series of plans (DWAF, 2005. Maps 1-18) that document various aspects of the regional geohydrology occurring in the

district. The plans have divided the region into groundwater management areas (GMA) which comprise several groundwater management units (GMU) in accordance with the compartmentalisation and characterisation of the underlying aquifers (Figure 6-13).

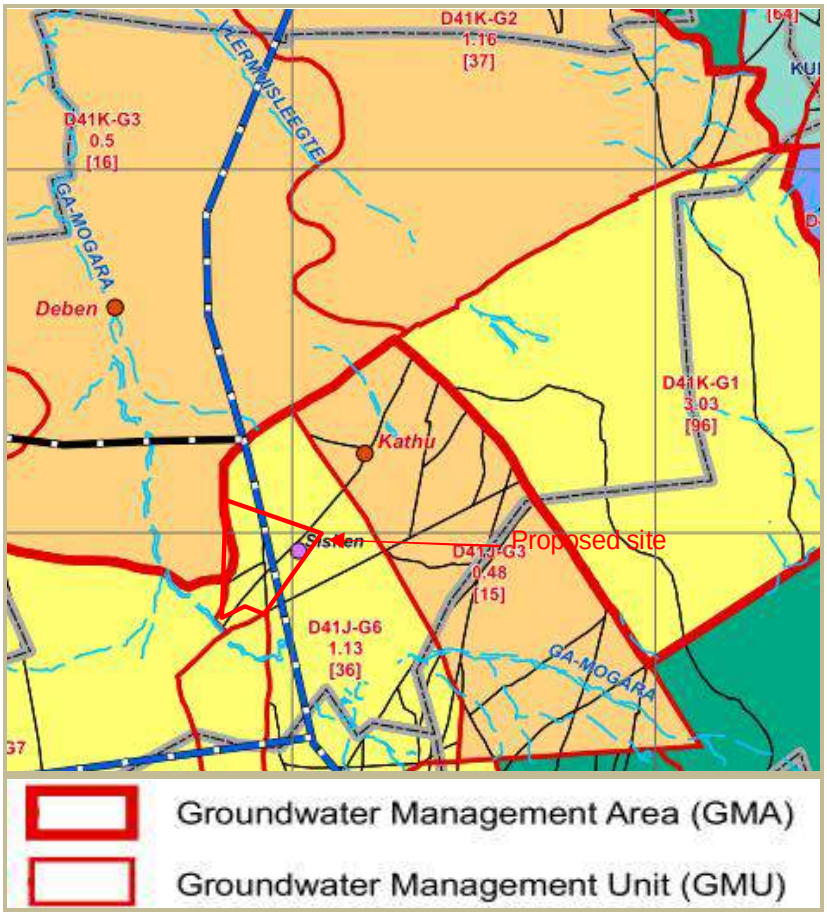


Figure 6-13: Distribution of groundwater management areas and groundwater management units in the study area (after DWAF Map 12, 2005)

The proposed KSP site falls within the D41K GMA and the D41K-G3 GMU known as the Gamagara. The high density of dyke intrusions to the south of the site effectively isolates the D41K GMA from the D41J GMA in which the Kathu Municipality and Sishen Mine are situated.

The contact zone created by the intrusion of the dolerite dyke beneath the site should typically form an area of high groundwater activity resulting in potentially good groundwater resources.

Two aquifers are present in the GMU: a shallow unconfined aquifer present within the Kalahari sediments, and a deeper confined aquifer within lavas (Figure 6-14). The thick clay layer provides a horizontal barrier separating the deeper confined aquifer from the shallow unconfined aquifer. The aquifers can be described as follows:

- *Unconfined aquifer*: The shallow unconfined aquifer in the region of the proposed site is the saturated Kalahari Group sediments and is an intergranular minor aquifer which contains the groundwater within the pore spaces between the grains of the sand. This aquifer has two limbs: the thicker, longer limb to the SSE, extending towards Kathu; and the second thinner limb to the SE extending towards Cassel (DWAF, 2005 Map 6). Groundwater occurrence within the unconfined aquifer is likely to be condition specific and variable across the site.
- *Confined aquifer*: The deep confined aquifer occurs in the inter-granular and fractured zones of the extrusive basaltic and andesitic lavas. The borehole yield class (median litres per second) is d2, which equates to an expected yield ranging between 0.1 to 0.5l/s for boreholes sunk in this area (DWAF, 2005 Map 6).

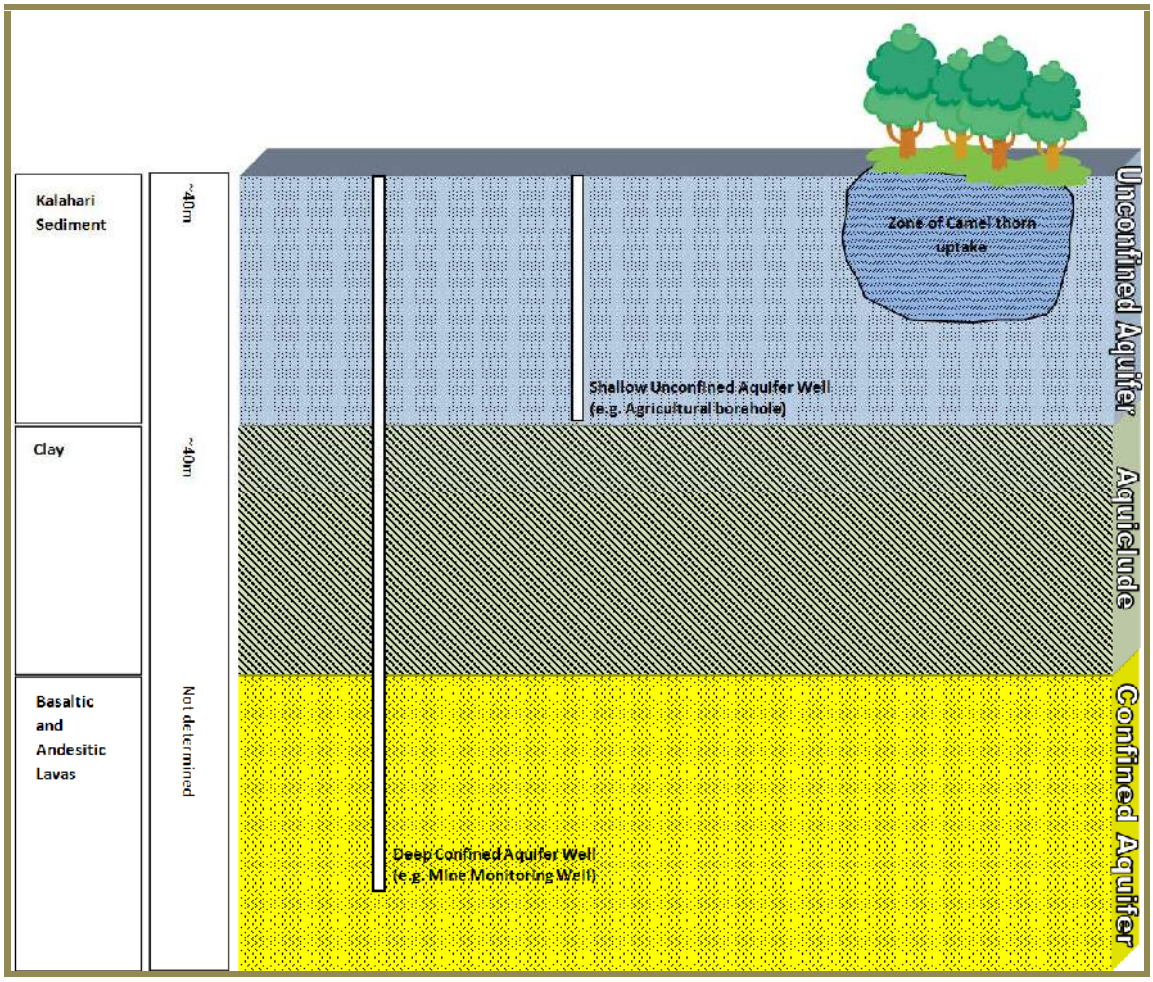


Figure 6-14: Schematic of the unconfined and confined aquifers beneath the proposed site

The vertical inflow is negligible for the GMU and is typical of a semi-arid region with sedimentary lithology. Contribution to recharge within the GMU is largely due to lateral inflow of adjacent groundwater management units, principally from Redsands GMU (D41K – G1) and the Langeberg GMU (D41K-G4) located to the east of the site (DWAF, 2005 Map 16). For the D41K-G3 GMU, recharge is described as 0.5% of the Mean Annual Precipitation (MAP) (DWAF Map 10, 2005).

The ecological groundwater reserve of the GMU ranges from <0.05 million m^3/annum to >2.50 million m^3/annum; the reserve of the GMU for the proposed site is 0.05 to 0.40 million m^3/annum (DWAF, 2005 Map 15).

The available water use for the GMU ranges from 1.215 to 1.822 million m^3/annum. Using the conservative limit of the ecological reserve, the available water use ranges from 0.815 to 1.422 million m^3/annum.

- Regional groundwater use

The National Groundwater Database shows up to 31 boreholes within 2 km of the site (Figure 6-15). The data pertaining to each of the boreholes is given in Appendix A of the detailed water feasibility report contained in **Appendix N**. However no quantitative use data are provided. It is likely these wells comprise water level observation wells used by the mine and wind powered agricultural wells used for stock watering. The Gamagara Local Municipality Strategic Environmental Assessment and Integrated Environmental Management Programmes, Phase 5 Report (June 2005) suggests that domestic water use derived from private abstraction wells is very low.

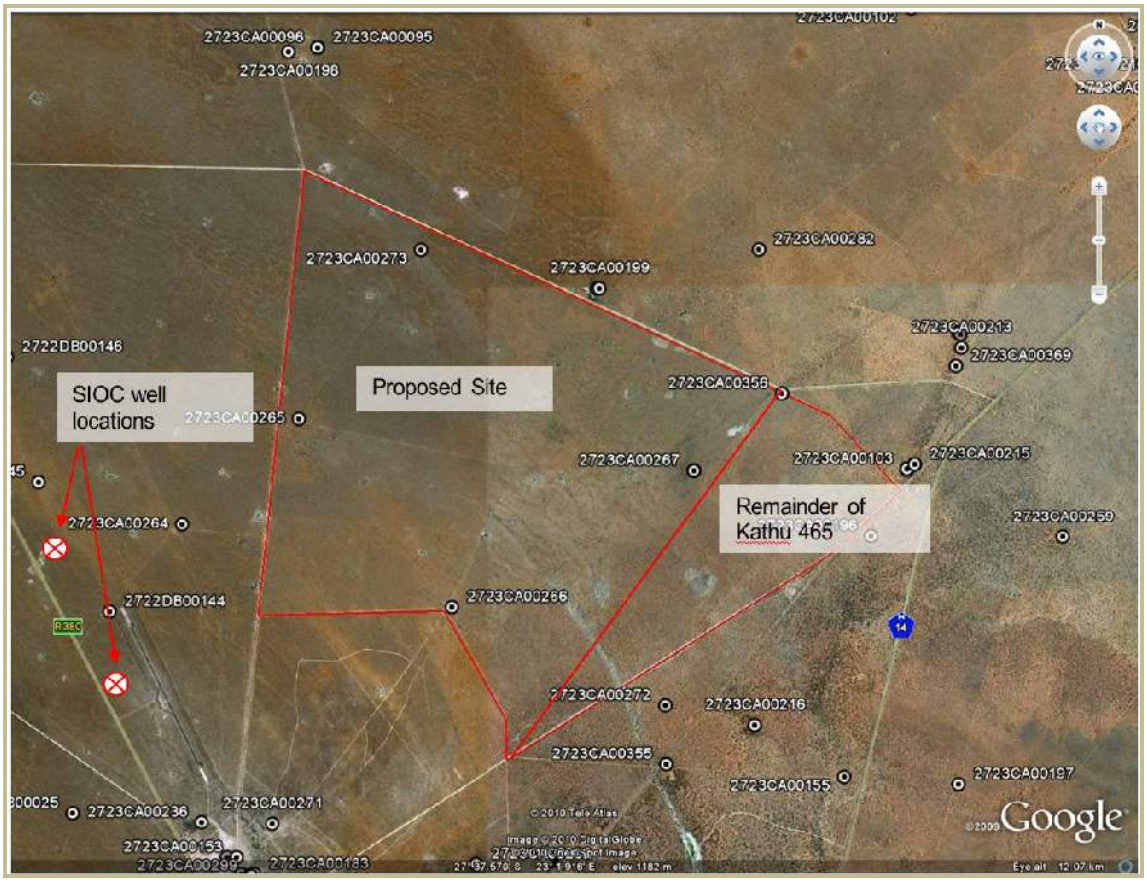


Figure 6-15: Localities of wells as per the NGDB within 2km of the site

Surrounding land users generally derive their water supply from windmill powered abstraction of groundwater from the unconfined aquifer at a depth ranging from between 30 and 50mbgl. These wells generally do not have metered abstraction volumes and yields are likely to be variable dependent on the aquifer characteristics of the intersected water bearing formation and the well construction. This however is changing with the Gamagara Municipality developing a groundwater abstraction well field, to the north and east of the town, in order to augment potable water supply to the town of Kathu.

6.8.3 Regional water supply

Sedibeng Water provides bulk water, sanitation and reticulation services to the North West, Eastern and Central Free State and Northern Cape. Approximately 13.3 million m^3 / annum. Raw water is currently sourced from the Vaal River and treated at Delportshoop water treatment plant. Water supply to the Vaal-Gamagara pipeline is further augmented by groundwater abstraction from Beeshoek. All bulk water supplies are provided via the Vaal-Gamagara pipeline which transfers water up to Black Rock located north of Kathu.

KV3 Engineers have been commissioned by Sedibeng Water to carry out a study for the reconciliation of the Vaal-Gamagara Scheme to determine the water requirements in the area and propose infrastructure upgrades required to fulfil future requirements. It is understood the existing Vaal-Gamagara pipeline is to be upgraded by 2015 in order to meet the water demand for the area.

According to Sedibeng Water, the current water demand for the area is 13.3 million m^3 / annum, with an expected increase in this demand to 45 million m^3 / annum by 2030. This equates to an increase of 70% in water demand between 2010 and 2030. The current water use licence for abstraction from the Vaal River is set at 13.6 million m^3 / annum. This would be augmented by water sourced from groundwater reserves to meet the 2030 demand.

The main water supply to the Kathu Municipality is sourced from both the Vaal-Gamagara pipeline and the Sishen Mine. Currently 19 600 m^3/annum is sourced from the pipeline. The mine supplies between 4.38 to 5.26 million m^3/annum to the town of which 1.75 million m^3/annum is suitable for domestic purposes.

6.8.4 Project water requirements

Approximately 85,000m^3 of water per year will be consumed by each 150MW phase of the proposed installation. Steam production and cleaning of the mirrors are the main areas of water use in the parabolic trough solar technology. The only other water use is likely to be limited to potable use and periodic wash-down of the power plants.

Expected water consumption for the entire operation of the KSP project is outlined in Table 6-11.

- Steam production

  Approximately 42,500m^3 per 150MW power plant/annum of makeup water is required. Water quality for use in steam generation is important and generally a clarifier and demineralisation pre-treatment plant is used. Excellent water quality is required in order to prevent scaling and fouling of pipes and associated infrastructure.

  A dominant pathway for water loss is through evaporation.

- Mirror cleaning

  Approximately 42,500m^3 per 150MW solar field/annum is required for cleaning of mirrors. Specific technology has been developed for the cleaning of parabolic troughs using a vehicle-mounted unit. The troughs are cleaned once every two weeks.

  Dominant pathway for water loss would be through evaporation and seepage into soils.

- Potable water use

  The operation and management of the first phase of the solar installation would potentially require 75 staff and each phase thereafter would require a further staff complement of approximately 60 personnel. Based on the Building Regulations for a site worker, the daily water consumption of 140 litres per staff member per day is expected. The first phase would therefore consume approximately 3,800m^3/annum with each subsequent phase consuming a further 3,100m^3/annum.

Table 6-11: Raw operational water consumption for Phases I - III

Phase	Cumulative make up water (m^3/annum)	Cumulative cleaning water (m^3/annum)	Cumulative potable water (m^3/annum)	Total (m^3/annum)
Phase I	42 500	42 500	3 800	88 800
Phase II	85 000	85 000	6 900	176 900
Phase III	127 500	127 500	10 000	265 000

6.8.5 Assessment of potential for water supply to the project

- *Surface water assessment*

A hydrological assessment was conducted to determine the potential for surface water to be used as a resource by the construction of dams or water retention facilities. Hydrological modelling of the surface water D41J and D41K catchments show that evaporation and ingress greatly exceeds run off for dry, intermediate and wet climatic conditions. Consequently, the potential for surface water exploitation is not considered feasible.

Based on the surface water assessment, the following can be inferred:

– The ratio between rainfall and evaporation is low indicating that runoff generation in the area can be expected to be low. This is confirmed by the observation of the central pivot irrigation system located within the main drainage channel in the vicinity (Dibeng) of the site indicating infrequent surface water flow.

– Due to the dominance of high intensity, short duration rainfall events, and the high erodibility of the soil in the region, a high suspended solids load is expected during rainfall events, resulting in water that would require treatment prior to use.

– Surface water is therefore not considered a viable water source alternative.

- *Geohydrological assessment*

A multi-step drawdown and a constant discharge and recovery test was conducted on five boreholes intercepting the shallow unconfined aquifer (30-50m below ground level) and four boreholes intercepting the deeper confined aquifer on and to the west of the site.

The pump testing results indicate that 307m^3/day (112,000m^3/annum) may be sustainably abstracted from the unconfined aquifer from the five existing boreholes and 414m^3/day for the confined aquifer (151,100m^3/annum) on a 8 to 12 hour abstraction cycle. These yields would be sufficient for the construction and operation of Phase I and portions of Phase II of the proposed KSP, however owing to the ecological sensitivity and human dependence on the unconfined aquifer it is proposed that the confined aquifer be primarily utilised as an alternate water source.

Supplementary water supply is potentially available through groundwater abstraction. Published data, information from the Sishen Mine and Gamagara Municipality as well as confirmed quantitative data obtained during the pump testing indicates sufficient groundwater is available through both the unconfined and confined aquifer beneath the site to supply the requirements of all the phases of the proposed development.

Sishen Mine have indicated that their boreholes located adjacent to the site may be utilised by the KSP project as supply wells. If required, a formal agreement will need to be established with the mine regarding the utilisation of these wells for future water supply.

The use of the confined aquifer as an emergency source of water would be deemed feasible based on the pump test data alone. Two wells would provide a secure and consistent source of water whilst ensuring that neither well is stressed beyond sustainability. This potential source has the advantage over the use of the shallow aquifer as the current demands on the system are less and results in less stress being placed on the ecological and agricultural requirements of the shallow unconfined minor aquifer.

In terms of suitability for industrial use, the water quality of both the unconfined and confined aquifer will require treatment prior to use in the KSP operations.

A water use licence application in terms of Section 21(a), “taking water from a resource”, for the full Phase III water requirement of 265,000m^3/annum has been submitted to DWA for approval. Further consultation with DWA and relevant stakeholders (i.e. Tshipeng Water Use Association) will be required.

- *Service providers*

A formal application was lodged with Sedibeng Water in January 2011 to gain commitment to water provision to the project. Sedibeng Water has indicated that water will be provided to the project prior to the upgrade of the pipeline. The supply cannot be assured and therefore onsite storage of at least 48 hours has been recommended by Sedibeng Water with consideration given to potential alternatives for water supply augmentation (i.e. groundwater). Gamagara Municipality has indicated that they are currently in no position to supply any water to the project; however this may change in the future. Refer to Appendix D and E of the of the detailed water feasibility report contained in **Appendix N** for a copy of the communication with the Gamagara Municipality and Sedibeng Water.

Water from Sedibeng Water is the most bankable option for long term water supply due to consistency of supply and regulated framework in which this resource is delivered. Alignment of the KSP project construction timeframes and Vaal-Gamagara pipeline upgrade needs to be rationalised.

Currently, studies are being undertaken by KV3 Engineers to upgrade the supply scheme. The project developers have formally registered as a key stakeholder in this forum in order to ensure that the project’s water needs can be accounted for as part of the study.

Surety of water supply from Sedibeng Water is not guaranteed under current conditions and as a result contingency water supplies would be considered to be a prudent strategy with an onsite closed water reservoir providing for emergency water backup should interruption of supply occur.

Gamagara Municipality has indicated that they are currently in no position to supply any water to the project; however this may change in the future. Sishen Mine will not be able to supply directly to the project however water abstracted for dewatering purposes will in the long term augment the water supplied by Sedibeng Water to the region.

6.8.6 Water quality

- Groundwater quality of the unconfined aquifer

The electrical conductivity of the groundwater in the shallow, unconfined aquifer in the vicinity of the proposed site lies in class 1 (70-150mS/m) (DWAF, 2005 Map 7). The chloride content for the proposed site is in class 1 (100–200mg/l) (DWAF, 2005 Map 8). The nitrate content for the proposed site is in class 2 (10-20mg/l) (DWAF, 2005 Map 9) and lies within a poor water quality zone (N>10 mg/l). However, water from the unconfined aquifer will not be used for the project.

Water samples obtained from the unconfined and confined aquifers when compared to DWAF Water Quality Guidelines for Industrial Use – Category 1 (i.e. power generation requirements) indicated that treatment would be required to improve the groundwater quality to an acceptable standard for use.

Analytical results obtained from Sedibeng Water for the Kathu Town off-take were insufficient to determine overall water quality of the potable water supply in terms of use in the KSP operations. It can be assumed that the water quality will be in line with domestic water quality standards and it is further recommended that a sampling programme be initiated to obtain an adequate data set to allow for appropriate screening.

6.8.7 Water use licensing

For groundwater use, the D41K GMA is considered by DWA as a close catchment and only Schedule 1 permissible water uses are permitted which include 10kl/day for domestic use or 20kl/day for small industrial use per property/activity.

As a result water abstracted from the underlying aquifer for use in the KSP would not be considered a Schedule 1 water use and would therefore require the relevant water use licence from DWA. A water use licence application in terms of Section 21(a), “taking water from a resource”, has been submitted to DWA for approval. The proposed project will only utilise groundwater for emergency augmentation of water supply to the KSP facility.

6.9 VEGETATION AND FLORAL BIODIVERSITY

6.9.1 Objectives

The vegetation survey was undertaken by Dr N Birch of Ecological Management Services, Kimberley. A qualitative and quantitative approach was undertaken for the vegetation assessment. Quantitative data were collected by undertaking vegetation sampling according to the Braun-Blanquet approach (Mueller-Dombois and Ellenberg 1974, Westhoff & van der Maarel 1978). Furthermore, a qualitative assessment was undertaken whereby the specialist undertook a site visit in November 2010.

6.9.2 Baseline

The proposed site comprises a mixed Camphor bush (*Tarchonanthus camphoratus),* Blackthorn *(Acacia mellifera),* A. *erioloba* woodland. *A. erioloba* dominates the deeper sands, while *T. camphoratus* and *A. mellifera* tend to be predominant in the remaining areas. Gypsum is prevalent at the site, suggesting that *T. camphoratus* may have been dominant due to a close association with sandy-gypsum soil types. *Acacia mellifera* is an encroaching species and has become dominant in many areas (Ward, 2005; Kraaij and Ward, 2006).

A. erioloba is considered a keystone species (Milton and Dean, 1995; Anderson and Anderson, 2001; Seymour and Milton, 2003; Anderson and Anderson, 2007) because they maintain many other species (Rohner and Ward, 1999; Munzbergova and Ward, 2002). These include shrubs such as Velvet raisin (*Grewia flava),* Buffalo thorn *(Ziziphus mucronata), T. camphoratus* and Puzzle-bush *(Ehretia rigida)* that grow under *A. erioloba*.

Plant species in the Kathu forest include protected species such as Karoo lily *(Ammocharis coranica), Nerine laticoma*, *Ruschia griquensis* and the endemics/near-endemics Sour karee (*Rhus tridactyla), Anthephora argentea* and Switch grass *(Panicum kalahariense)* (Anderson, 2009).

6.9.3 Impacts

The study area is very homogenous with little variable in terms of floristic composition and structure. Three broad vegetation type units (Figure 6-16) were distinguished namely:

- *Acacia mellifera-Tarchonanthus camphoratus-Enneapogon desvauxii* shrubveld;
- *Acacia erioloba-Acacia mellifera-Tarchonanthus camphoratus* open to dense bushveld/woodland; and
- Ephemeral pans.

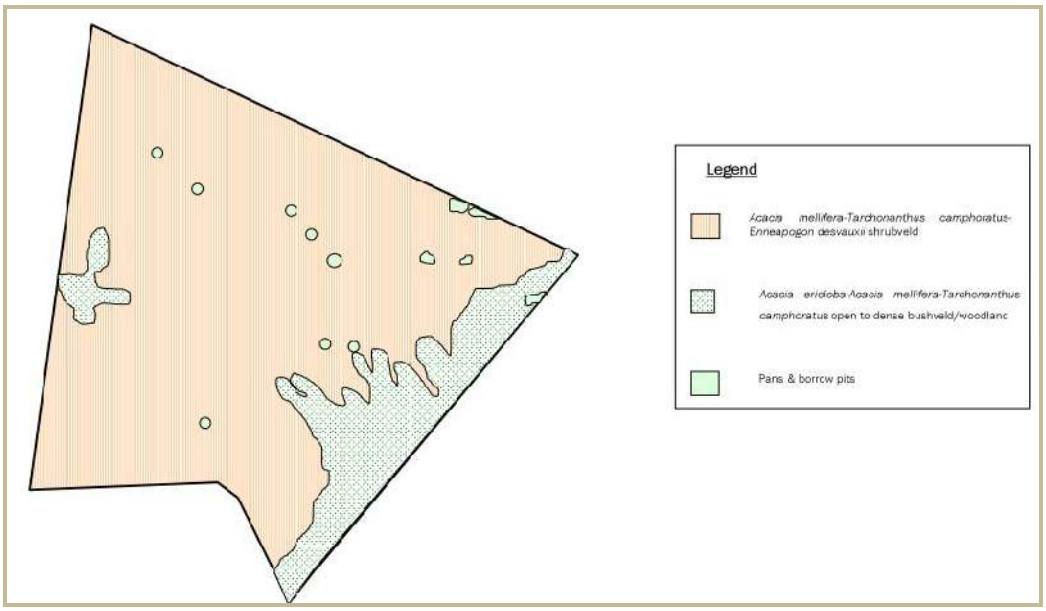


Figure 6-16: Vegetation distribution map of the study site

The primarily issue of concern is regarding the number of Camel thorn (*Acacia erioloba)* trees identified on site. This species has a higher conservation priory, as it is listed as declining. A high number of *A. erioloba* trees exist within the south eastern portion of the proposed site. The *A. erioloba* is considered to be a keystone species in the Kalahari because it facilitates the processes that maintain heterogeneity and species diversity, namely seed dispersal and site modification. It is a groundwater dependent species thus indicating the substantial underground water supply in an aquifer within the development site.

Furthermore, *A. erioloba* and Shepards tree *(Boscica albitrunca*) occurring in the area are protected in terms of the National Forests Act (No. 84 of 1998). In addition the *Asclepias burchellii*, a protected plant species in terms of the Northern Cape Nature Conservation Ordinance Schedule 4, was also identified on the property. Prior to removal of such species, a permit needs to be obtained from DAFF and DENC respectively.

In terms of the sensitivity of the development area as a whole, it does not fall into a bioregional conservation planning programme, although there are a few private game reserve in the area, none of which is recognised as a protected area. The only protected area is the unique and sensitive Kathu Forest (refer to Figure 6-17 for the site sensitive map). The structure of the *A. erioloba* savannah surrounding the Kathu forest is ecotonal in nature. Ecotones are essentially natural buffer zones. By depleting this natural buffer zone through the clearance of the vegetation unit for development, this will deplete the forests buffer zone which could result in edge effects on the forest and isolation of this unique area which could have a long term sustainability issue. Moderately sensitive sites include the pans, non-perennial river and the *Acacia erioloba-Acacia mellifera-Tarchonanthus camphoratus* open to dense bushveld/woodland.

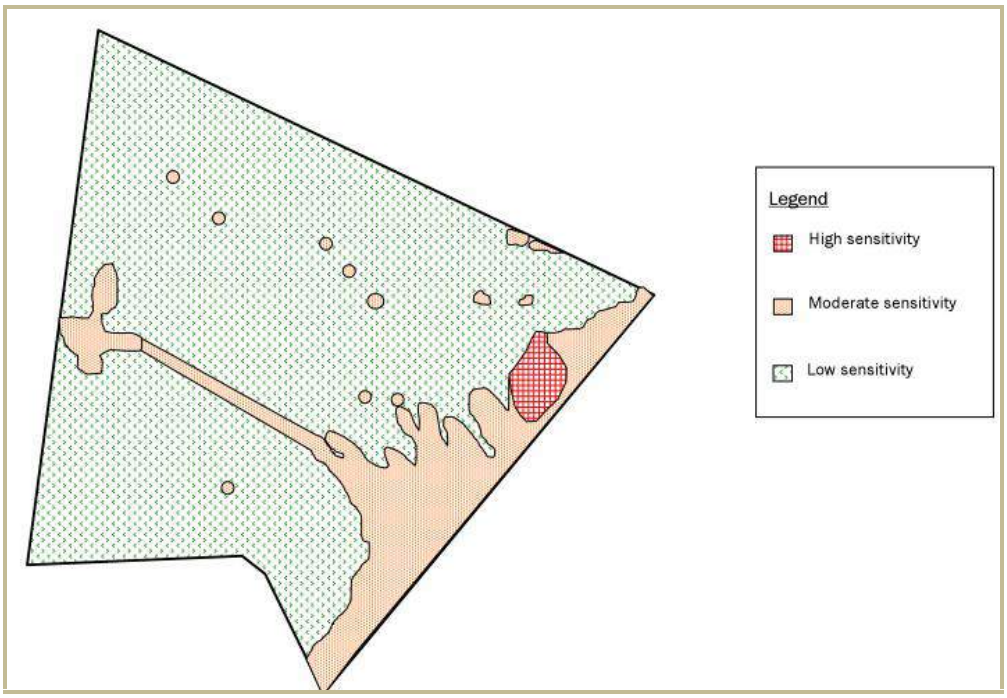


Figure 6-17: Site sensitive map

Potential impacts identified from the floral assessment were as follows:

- Loss of natural vegetation due to vegetation fragmentation and habitat disturbance in the landscape.
- Loss of Red data and/or protected floral species due to the removal of the two protected tree species namely, *A. erioloba and B. albitrunca* identified on site will not only result in a loss of the species richness in the area, but will have a further impact on the ecosystem functioning of the area and even may lead to a loss of biodiversity within the Northern Cape.

  Furthermore, should dewatering and the lowering of the water table occur, this could further affect the *A. erioloba* trees within the area. This species is slow growing and may only establish in wet years, suggesting it's more vulnerable to rapid declines due to groundwater extraction by pumping. The presence of the large amount of *A. erioloba* trees within and surrounding the study site is indicative of a substantial underground water supply in an aquifer. Pumping of groundwater, especially in a season without good rains, could lead to aquifer depletion which would result in a knock on effect being tree mortality as the trees are groundwater dependent. Consequently, the forest may collapse depending on the level of the groundwater depletion. Thus any groundwater abstraction within the area could have detrimental effects to the *A. erioloba* community within and surrounding the study site.

  B. albitrunca is a valuable source of shade in arid areas thus important for any animal seeking shelter or habitats in this harsh environment. Therefore, the removal of this species will result in
- As the spread of alien species prosper on any land under development, this will most certainly be the case with the proposed projects subsequently resulting in the disturbance of the landscape.

Mitigation measures proposed to ameliorate the identified impacts on the floral community include:

- Prior to the clearing of the protected flora species, the relevant permits must be obtained from the relevant authorities;
- No groundwater abstraction should be allowed for the project;
- A buffer zone of at least 300 m from the edge of the area delineated as Kathu forest within the study site must be provided;
- A comprehensive monitoring programme of the protected trees within the area must be undertaken;

- Protect trees to be left *in situ* within the planned site office area must be clearly marked and a small buffer zone of 3-4m surrounding these trees must be created;
- Clearing of the protected trees should be kept to a minimum;
- The planned structure proposed for the south eastern portion of the proposed site should be moved in order to ensure as little clearing of the *A. erioloba*; and
- Although a large number of *A. erioloba* trees will still be removed as per the shuffling of the infrastructure, it is proposed that a biodiversity off-set be undertaken by the project proponent in order to offset the residual impact to the biodiversity.

The November 2010 survey was subsequently complemented by a follow-up survey undertaken in February 2011, which recorded species that only emerge following the summer rainfall period. The February survey verified the findings of the initial survey with no new species of conservation importance recorded.

Refer to **Appendix O, Attachment 2** for the detailed Botanical Assessment Report.

6.10 VERTEBRATE FAUNA

6.10.1 Objectives

A faunal specialist study was undertaken by Beryl Wilson from the McGregor Museum in accordance to IFC Performance Standard 6: Biodiversity Conservation and Sustainable Natural Resource Management. The aim of the study was to evaluate the potential impacts on local fauna associated with the proposed project.

The study included the following scope of work by undertaking a desktop study and a site assessment:

- A description of the habitats (structure and condition);
- Species linked to each habitat (with emphasis on potential red listed and endangered species);
- Identification of impacts on species with particular focus on:
  - the loss of habitats;
  - the potential loss of rare and threatened species;
  - the loss of natural migration corridors; and
  - an assessment of cumulative impacts.

6.10.2 Baseline

The proposed site is not within an environmentally sensitive area for animal species nor is it considered an important bird area of southern Africa. Nevertheless, many animal species depend on dominant tree species located in the area, such as the Acacia tree rat (*Thallomys nigricauda)* (Eccard *et al.,* 2006), certain skink species (Cooper and Whiting, 2000) and Martial Eagles (*Polematus bellicosus)* (Milton and Dean, 1995; Dean *et al.,* 1999; Anderson, 2009). Other bird species that have been recorded in the nearby Kathu forest include the rare yellow morph of the Green-winged Pytilia (*Pytilia melba*), the yellow morph of the Crimson-breasted Shrike (*Laniarius atrococcineus)*, Red-billed Spurfowl (*Francolinus adspersus*), Pied Babbler (*Turdoides bicolor*), Groundscraper Thrush (*Psophocichla litsitsirupa*) and Red-billed Buffalo Weaver (*Bubalornis niger*) (Liversidge, 2001).

One bird species which can be encountered in the John Taolo Gaetsewe District Municipal Area and its four municipalities is currently classified as indeterminate, seven as near threatened and nine as vulnerable in red data lists for birds. All raptor (birds of prey) species are categorised as protected wild animals.

Threatened and protected herpetofaunal species include the flap-necked chameleon (*Chamaeleo dilepis*), geometric tortoise (*Psammobates geometricus*) (Sishen Mine, Undated), and rock monitor (*Varanus albigularis*) (Kgalagadi District Municipality, 2005). The district municipality populations of rock monitor and leguaan (*Varanus*

exanthematicus) are increasingly threatened due the utilisation of these species in traditional healing and the perception that these species are problem animals in terms of livestock mortalities.

Snakes are also considered problem animals, probably more because of a lack of knowledge about this vertebrate group and the threats poisonous species hold for humans than in terms of damage to livestock (Kgalagadi District Municipality, 2005).

6.10.3 Impacts

A total of 56 mammal (14), 272 bird (21), 45 reptile (2), 11 amphibian (1) and an uncalculated number of arachnid (5) naturally-occur in the Kathu region and surrounds. The numbers in brackets specify the number of species that are of potential conservation significance that may occur in the general area. It was elucidated that larger mammals, bird and reptile species will not be directly impacted or influenced by the project due to their mobility.

The following eight species of concern were discussed extensively in the report due to their likely occurrence either transiently or permanently on site:

- Bushveld Elephant-shrew (*Elephantulus intufi*) (Data Deficient);
- Bushveld Gerbil (*Gerbilliscus leucogaster*) (Data Deficient);
- African Wild Cat (*Felis silvestris lybica*) (Protected Species);
- Martial Eagle (*Polemaetus bellicosus*) (Vulnerable);
- Rock Monitor (*Varanus albigularis*) (Vulnerable);
- African Bullfrog (*Pyxicephalus adspersus*) (Near Threatened); and
- Burrowing Scorpions – 2 species (Protected Species).

A note was made of the potential presence of two Near Threatened species of Horseshoe Bats, one of which is an endemic breeding species, but these are both associated with caves and mine tunnels, neither of which are in the immediate vicinity of the project. Furthermore, the safety of all bats need only be considered with power projects that make use of wind turbine structures which create vacuum vortices into which bats are sucked. Any other projects that are daylight associated are also of little consequence given that bats are nocturnal species.

Due to the required infrastructure for the KSP project, a total of 1,055 hectares of vegetation will be removed and the area resurfaced to mitigate dust and prevent fires. As a result, loss of terrestrial and ephemeral habitats and an increase in environmental degradation was identified as a significant impact on the local fauna as a result of the proposed project. These impacts may potentially result in a local extinction of small mammals, amphibians and arachnid species that are sedentary.

Further identified impacts namely impact on surrounding habitat & species, local & regional fragmentation/ isolation of habitat and faunal interactions with structures, servitudes & personnel were considered minimal.

Overall, the nearby Kathu forest and surrounding nature reserve is considered to be a sensitive habitat in terms of species diversity and as a potential biological diversity reservoir for the area as a whole. However, the investigated area in question is not unique in terms of species diversity and eco-status within the region as a whole. Development of this specific site will not have significant impact on the overall distribution, the survival or dynamics of the encountered fauna. Nevertheless, the cumulative effect of this project and the surrounding mining activities and related changes to the environment and associated microsystems is difficult to assess and quantify at this point, but is considered to be a significant and adverse impact to this site, as well as to the general area as a whole.

Management guidelines have been provided in the report with the aim to prevent the unnecessary habitat destruction, and the subsequent disturbance and displacement of fauna in the area, and the maintenance of suitable habitat and resources where possible. Both passive and active discouragement measures are suggested. Emphasis is placed on safety of conservation-worthy species regarding possible interactions with the various types of electrical infrastructures. Such mitigation and management measures include *inter alia* the following:

- Avoiding the removal of *Acacia* trees that have breeding raptors present until the conclusion of the breeding season at the end of November;

- Raptor-proofing all open reservoirs, dams or ponds to allow birds to drink and bathe, preventing drowning, and thus contributing to raptor conservation (Figure 6-18);

Figure 6-18: A ladder structure used to raptor-proof a reservoir

- Bird-unsafe electrical servitudes must be modified by Eskom to insulate dangerous live components, and to cut a gap in the earth wire – perch deterrents can also be installed to keep birds away from the dangerous areas on the structure (Figure 6-19).

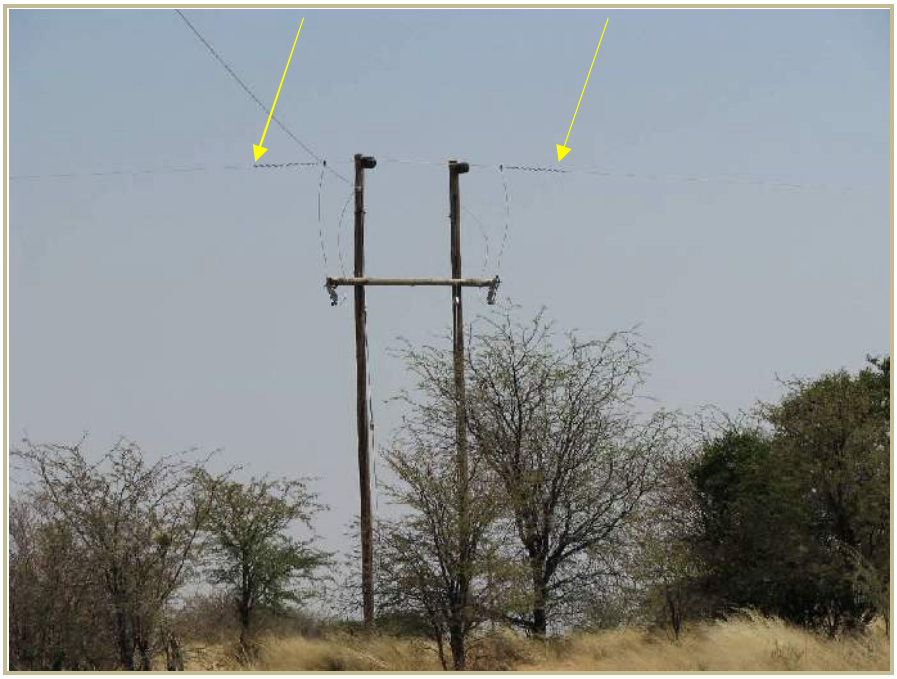


Figure 6-19: A power line with raptor-friendly measures in place

- Nesting by birds on the equipment must be discouraged, either by removing nests as they are built, or by supplying suitable alternative structures, and by avoiding infrastructure construction designs such as flat or trellised surfaces near key structures;
- Relocating slow-moving animals like Tortoises and Giant Bullfrogs, found during ground-breaking to nearby suitable, undisturbed areas;
- Relocating vulnerable species such as the Ground Pangolin or African Rock Python to suitable, off-site protected areas in the region such as Tswalu Nature Reserve.

Refer to **Appendix O, Attachment 1** for the detailed Zoological Assessment Report.

6.11 INVERTEBRATE FAUNA (INSECTS)

6.11.1 Objectives

The entomological survey was undertaken by WSPs in-house specialist Mr Eden Wildy in a three day period during November 2010. A qualitative and quantitative approach was undertaken for the vegetation assessment. Quantitative data was collected by undertaking insect sampling according to established sampling methods for epigaeic, arboreal and grassland associated insect fauna (Lovell *et al*., 2010). This data was qualified through analysis of species diversity, richness and evenness (Clark and Gorley, 2001) and complementarity (Colkwell and Coddington, 1994).

6.11.2 Baseline

Formal conservation status for invertebrate taxa identified as unique species of conservation importance has also been recommended (Kgalagadi, 2005). Insect species are categorised in three distinct groups:

- Weevils (Curculionidae) - including: *Episus cyathiformis*, *Gyllenhalia crinita*, *Microcerus latipennis*, *Hoplitotrachelus spiniger* and *Episus aculeatus*;
- Twisted-winged parasites (Strepsiptera) - including: *Elenchus spp*; and
- Tiger Beetle (Cicindelidae) - including: Ground-living Tiger Beetle (*Mantichora* spp.)

6.11.3 Impacts

Insect species diversity was low (Table 6-12) for this study suggesting significant degradation of the site by past land use practices.

Site vegetation is sensitive to disturbance due to various factors. The low rainfall, high temperatures and evaporation rate within the study area leads to a low production phytomass and hence slow nutrient cycle and low organic content of soils. Establishment of seedlings and eventually adult plants is slow because of a low survival rate in such harsh conditions. The impacts of overgrazing and poor land management practices of the past bear testimony to the sensitivity of the vegetation and the slow rate of recovery in the absence of proactive rehabilitation. Rosenzweig (1995) demonstrated that habitat variety influences species diversity and therefore the site, which displays extensive degradation, may therefore contribute significantly to low species diversity.

Another contributing factor may be the high altitude environment. The average altitude was approximately 1,200 metres above sea level, and it is documented that invertebrate species richness decreases with altitude within South Africa (Samways, 1989). Nevertheless, there is a paucity of data for insect distribution in the Northern Cape and the knowledge base for insect taxa in the Northern Cape region is considered data deficient (Le Roux, 2002; Picker, 2008).

Table 6-12: Insect species diversity

Sampling Station	Shannon's Diversity Index	Diversity Rating
Pan	1.227	Low
Big Tree	1.919	Low-Medium
Vlermisleegte	0.8208	Low
Camelthorns	1.792	Low

Sampling Station	Shannon's Diversity Index	Diversity Rating
Grassland	2.139	Low-Medium
Nature Reserve1	2.63	Medium

1 Outside of proposed development footprint

No insect species of conservation importance highlighted in the district municipality's SEA was recorded. The low species diversity recorded was also due to the predominance of generalist and opportunist species. For example, the ant assemblage had two species contributing over a half of the specimens within the assemblages. A decrease in diversity is often the result of a corresponding increase in the percentage dominance of a common species (Kempton, 1979; May, 1981).

Due to the dominance of generalist and opportunistic species within the proposed development footprint it is anticipated that there will be no substantial increase in the cumulative effect of land transformation in the local area. It is considered unlikely that the area constitutes critically important habitat or resources for any insect species of conservation concern and the loss of some of this habitat will not have a major impact on insect diversity overall as the species encountered all have significant distributional ranges beyond this site.

The survey does not account for seasonal variation, with only one field visit undertaken. Nevertheless, based on anecdotal evidence and available desktop data it is assumed that no significant biodiversity would be recorded due to season. Any increase in insect abundance would be expected to be an artefact of temporal population explosions of r-selected (opportunistic) species such as grasshoppers and pierid butterflies.

- Potential impacts:

The impacts of this project are considered, in terms of insect biodiversity, to be minimal. Species recorded during the survey tended to be common species and are not restricted in terms of habitat or distribution. This is reinforced by the two dominant species in the ant assemblage, *Pheidole* sp.1 and *Lepisiota* sp.1. *Pheidole* are examples of 'generalised myrmecinae' in the context of Andersen's ant functional groups (Lach *et al.*, 2010). Species within this functional group tend to be the most abundant ants in warm environments such as South African savannas and have a broad distribution in relation to environmental stress and disturbance with small colony sizes. Within the same paradigm, 'opportunist species' such as *Lepisiota* are unspecialised species with wide habitat distributions. They tend to predominate only at sites where stress or disturbance severely limits ant productivity and diversity (Lach *et al.*, 2010). The low species diversity has indicated by the two dominant ant species, the extensively degraded habitat and the overall low insect species richness recorded suggests that few, if any, rare species, protected species or red listed species will potentially be impacted by a development on this site.

The potential for increased fragmentation and isolation of *A. erioloba* and the removal of specimens of *G. flava* from the property may, however, affect the one species of potential conservation concern recorded on the property: the butterfly, Linda's Hairtail (*Anthene lindae*), although the presence of these trees in greater numbers and densities in the adjacent Khei appel Nature Reserve and Kathu forest suggests that the risk of a local extinction is not significant. The lack of hilltops, ridges or significant topographical variation on-site also suggests that reproductive success will not be compromised (Lawrence and Samways, 2002).

Negative impacts on the insect assemblage are localised and diffuse habitat destruction, habitat fragmentation, various forms of soil degradation and light pollution and the facilitated spread of opportunistic cosmopolitan insect populations. Many of these impacts are not amenable to mitigation. Site road networks and infrastructure should be kept to the minimum possible to prevent unnecessary habitat fragmentation. Sources of potential soil contamination need to be identified prior to construction activities and mitigated accordingly. Lighting at site should be minimal and if possible a long wavelength should be utilised (e.g. yellow) to reduce the number of insects attracted to the light source.

Refer to **Appendix O, Attachment 3** for the detailed Entomology Assessment Report.

7 ESIA Impact Assessment

7.1 RISK ASSESSMENT METHODOLOGY

The potential environmental impacts of the proposed KSP project were evaluated according to their severity, duration, extent and significance of the impact, and include the cumulative impact. The WSP Risk Assessment Methodology was used for the ranking of the impacts.

This system derives environmental significance on the basis of the consequence of the impact on the environment and the likelihood of the impact occurring. Consequence is calculated as the average of the sum of the ratings of severity, duration and extent of the environmental impact. Likelihood considers the frequency of the activity together with the probability of an environmental impact occurring. The following tables (Table 7-1 to Table 7-8) describe the process in detail:

- Consequence

Table 7-1: Assessment and rating of severity

Rating	Description
1	Negligible / non-harmful / minimal deterioration (0 – 20%)
2	Minor / potentially harmful / measurable deterioration (20 – 40%)
3	Moderate / harmful / moderate deterioration (40 – 60%)
4	Significant / very harmful / substantial deterioration (60 – 80%)
5	Irreversible / permanent / death (80 – 100%)

Table 7-2: Assessment and rating of duration

Rating	Description
1	Less than 1 month / quickly reversible
2	Less than 1 year / quickly reversible
3	More than 1 year / reversible over time
4	More than 10 years / reversible over time / life of project or facility
5	Beyond life of project of facility / permanent

Table 7-3: Assessment and rating of extent

Rating	Description
1	Within immediate area of activity
2	Surrounding area within project boundary
3	Beyond project boundary
4	Regional / provincial
5	National / international

Consequence is calculated as the average of the sum of the ratings of severity, duration and extent of the environmental impact.

Table 7-4: Determination of consequence

Determination of Consequence (C)	(Severity + Duration + Extent) / 3

- Likelihood

Table 7-5: Assessment and rating of frequency

Rating	Description
1	Less than once a year
2	Once in a year
3	Quarterly
4	Weekly
5	Daily

Table 7-6: Assessment and rating of probability

Rating	Description
1	Almost impossible
2	Unlikely
3	Probable
4	Highly likely
5	Definite

Likelihood considers the frequency of the activity together with the probability of the environmental impact associated with that activity occurring.

Table 7-7: Determination of likelihood

Determination of Likelihood (L) =	(Frequency + Probability) / 2

- Environmental Significance

Environmental significance is the product of the consequence and likelihood values.

Table 7-8: Determination of environmental significance

Environmental Significance (Impact) = C × L	Description
L (1 – 4.9)	Low environmental significance
LM (5 – 9.9)	Low to medium environmental significance
M (10 – 14.99)	Medium environmental significance
MH (15 – 19.9)	Medium to high environmental significance
H (20 – 25)	High environmental significance. Likely to be a fatal flaw.

7.2 KNOWLEDGE GAPS AND ADEQUACY OF PREDICTIVE METHODS

7.2.1 Knowledge Gaps

The environment that is likely to be affected by the KSP project was assessed and the ESIR and ESMP have covered all prevailing conditions of the environmental impacts identified, including cumulative impacts. It is believed that the environment is well understood. Hence, no knowledge gaps exist in terms of the current state of the environment, ESIR and ESMP.

7.2.2 Adequacy of Predictive Methods

Due to the nature of the environment, the local conditions of the area, as well as the professional expertise, it is believed that the predictive methods that have been proposed in the ESIR and ESMP are suitable and without limitations.

7.3 ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT

An ESIA has been undertaken for the proposed KSP project and has included both the potential biophysical and socio-economic impacts that may occur as a result of the development.

The ESIA methodology (and associated numeric ratings) as per the WSP Risk Assessment Methodology is provided in **Section 7.1** above, with the actual ratings that were undertaken included in Table 7-9 below. To ensure that there is a clear linkage between the ESIA tables in this section and the mitigation measures contained in the ESMP, unique reference numbers have been assigned for each impact description.

Table 7-9: Impact ratings table

BIOPHYSICAL AND SOCIO-ECONOMIC ENVIRONMENT																
				A	B	C	D	E	F	G	(D xG)	H	(D xG)	H	
Environment	**ESMP Ref No.**	**Impact Description**	**Phase**	**Severity**	**Duration**	**Extent**	**Consequence (A+B+C)/3**	**Frequency**	**Probability**	**Likelihood (E+F)/2**	**Environmental Significance (without mitigation)**	**Significance**	**Environmental Significance (with mitigation)**	**Significance**	**Cumulative Impact**
Soil, Land Use and Land Capability															
Soil, Land Use and Land Capability	**G**	The grazing capacity of the KSP site is not significantly different from the regional capacity, thus impact to the land capability is considered to be insignificant on a regional scale.	Construction	3.0	2.0	1.0	2.0	5.0	4.0	4.5	9.0	LM	9.0	LM	
Biodiversity															
Biodiversity	**D**	Loss of terrestrial habitat	Construction & Operation	4.0	4.0	2.0	3.3	5.0	4.0	4.5	**15.0**	**MH**	**15.0**	**MH**	
		Loss of ephemeral habitat	Construction & Operation	4.0	5.0	1.0	3.3	5.0	5.0	5.0	**16.7**	**MH**	**16.7**	**MH**	
		Local and regional fragmentation/isolation of habitat	Construction & Operation	2.0	4.0	2.0	2.7	5.0	2.0	3.5	9.3	LM	9.3	LM	X
		Disturbance and displacement of fauna species	Construction & Operation	2.0	3.0	2.0	2.3	5.0	4.0	4.5	**10.5**	**M**	**10.5**	**M**	X
		Faunal interaction with structures, servitudes and personnel	Construction & Operation	3.0	4.0	3.0	3.3	2.0	2.0	2.0	6.7	LM	6.7	LM	
		Impact on surrounding habitat and species	Construction & Operation	1.0	2.0	3.0	2.0	5.0	2.0	3.5	7.0	LM	7.0	LM	X
		Increase in environmental degradation	Construction & Operation	3.0	4.0	4.0	3.7	5.0	4.0	4.5	**16.5**	**MH**	**16.5**	**MH**	X
		Impacts on the Kathu Forest and camelthorn trees on the property	Construction & Operation	1.0	4.0	2.0	2.3	5.0	2.0	3.5	8.2	LM	8.2	LM	X

BIOPHYSICAL AND SOCIO-ECONOMIC ENVIRONMENT																	
				A	B	C	D	E	F	G	(D xG)	H	(D xG)	H	
Environment	**ESMP Ref No.**	**Impact Description**	**Phase**	**Severity**	**Duration**	**Extent**	**Consequence (A+B+C)/3**	**Frequency**	**Probability**	**Likelihood (E+F)/2**	**Environmental Significance (without mitigation)**	**Significance**	**Environmental Significance (with mitigation)**	**Significance**	**Cumulative Impact**
		Loss of natural vegetation	Construction	3.0	4.0	1.0	2.7	5.0	5.0	5.0	13.3	M			X
				2.0	3.0	1.0	2.0	5.0	5.0	5.0			10.0	M	X
		Loss of Red data / protected floral species	Construction	5.0	4.0	2.0	3.7	5.0	5.0	5.0	18.3	M H			X
				4.0	4.0	1.0	3.0	5.0	5.0	5.0			15.0	M H	X
		Introduction / spread of alien species	Construction & Operation	4.0	3.0	2.0	3.0	3.0	4.0	3.5	10.5	M			X
				4.0	2.0	1.0	2.3	3.0	3.0	3.0			7.0	LM	X
		Removal of vegetation within the site will result in a loss of habitat for insect taxa	Construction	4.0	5.0	2.0	3.7	5.0	5.0	5.0	18.3	M H			
				4.0	5.0	1.0	3.3	5.0	5.0	5.0			16.7	M H	
		Loss of insect species diversity	Construction & Operation	4.0	5.0	2.0	3.7	5.0	5.0	5.0	18.3	M H			X
				4.0	5.0	1.0	3.3	5.0	5.0	5.0			16.7	M H	X
		Fragmentation of the landscape will reduce the viability of local insect assemblages	Construction & Operation	3.0	4.0	2.0	3.0	3.0	5.0	4.0	12.0	M			X
				3.0	4.0	1.0	2.7	3.0	5.0	4.0			10.7	M	X

BIOPHYSICAL AND SOCIO-ECONOMIC ENVIRONMENT																	
				A	B	C	D	E	F	G	(D xG)	H	(D xG)	H	
Environment	**ESMP Ref No.**	**Impact Description**	**Phase**	**Severity**	**Duration**	**Extent**	**Consequence (A+B+C)/3**	**Frequency**	**Probability**	**Likelihood (E+F)/2**	**Environmental Significance (without mitigation)**	**Significance**	**Environmental Significance (with mitigation)**	**Significance**	**Cumulative Impact**
		Disturbance of the vegetation and soil could result in an increase in opportunistic/pest species	Construction & Operation	4.0	3.0	2.0	3.0	3.0	4.0	3.5	10.5	M			X
				4.0	2.0	1.0	2.3	3.0	3.0	3.0			7.0	LM	X
		Excavations and sources of potential soil contamination will destroy habitats for epigaeic insect taxa	Construction	4.0	3.0	2.0	3.0	4.0	5.0	4.5	13.5	M			
				4.0	2.0	1.0	2.3	4.0	5.0	4.5			10.5	M	
		Artificial light sources may attract large insect numbers from adjacent areas	Construction & Operation	4.0	5.0	2.0	3.7	5.0	5.0	5.0	18.3	MH			
				4.0	5.0	1.0	3.3	5.0	5.0	5.0			16.7	MH	
		Any on-site species of conservation importance may be prone to local extinction	Construction	5.0	4.0	3.0	4.0	5.0	5.0	5.0	20.0	H			
				5.0	4.0	3.0	4.0	5.0	3.0	4.0			16.0	MH	
Surface and Groundwater															
Surface and Groundwater	**L**	Rainfall in the area is considered nominal; however rainfall events are generally of high intensity and short duration. Erodibility of the surrounding soils is considered moderate owing to the intensity of regional rainfall, low vegetation cover and sandy nature of soils.	Construction	2.0	4.0	3.0	3.0	4.0	3.0	3.5	10.5	M			X
				1.0	3.0	2.0	2.0	3.0	3.0	3.0			6.0	LM	X
			Operation	3.0	3.0	3.0	3.0	3.0	3.0	3.0	9.0	LM			X
				2.0	3.0	2.0	2.3	3.0	3.0	3.0			7.0	LM	X

BIOPHYSICAL AND SOCIO-ECONOMIC ENVIRONMENT																
				A	B	C	D	E	F	G	(D xG)	H	(D xG)	H	
Environment	**ESMP Ref No.**	**Impact Description**	**Phase**	**Severity**	**Duration**	**Extent**	**Consequence (A+B+C)/3**	**Frequency**	**Probability**	**Likelihood (E+F)/2**	**Environmental Significance (without mitigation)**	**Significance**	**Environmental Significance (with mitigation)**	**Significance**	**Cumulative Impact**
		Abstraction of groundwater from the unconfined aquifer for water use, resulting in impacts to ecological and agricultural requirements.	Construction & Operation	3.0	3.0	3.0	3.0	2.0	3.0	2.5	7.5	LM	7.5	LM	X
		Abstraction of groundwater from the confined aquifer resulting in impacts to local and regional groundwater users.	Construction & Operation	2.0	3.0	2.0	2.3	1.0	2.0	1.5	3.5	L	3.5	L	X
Air Quality																
Air Quality	**C**	Particulate Matter Impacts during construction phase (unmitigated) average across all receptors	Construction phase	1.0	3.0	3.0	2.3	5.0	4.0	4.5	**10.5**	**M**			X
		Particulate Matter Impacts during construction phase (mitigated, 90% efficiency)	Construction phase	1.0	3.0	3.0	2.3	5.0	4.0	4.5			**10.5**	**M**	X
		Dust Fallout Impacts during construction phase (unmitigated) average across all receptors	Construction phase	4.0	3.0	3.0	3.3	5.0	4.0	4.5	**15.0**	**MH**			X
		Dust Fallout Impacts during construction phase (mitigated, 90% efficiency) average across all receptors	Construction phase	2.0	3.0	3.0	2.7	5.0	4.0	4.5			**12.0**	**M**	X
		Particulate Matter Impacts during operational phase as a result of vehicular activity (unmitigated) average across all receptors	Operational phase	1.0	4.0	3.0	2.7	5.0	4.0	4.5	**12.0**	**M**			X
		Particulate Matter Impacts during operational phase as a result of vehicular activity (mitigated, 90% efficiency) average across all receptors	Operational phase	1.0	4.0	3.0	2.7	5.0	4.0	4.5			**12.0**	**M**	X

BIOPHYSICAL AND SOCIO-ECONOMIC ENVIRONMENT																
				A	B	C	D	E	F	G	(D xG)	H	(D xG)	H	
Environment	**ESMP Ref No.**	**Impact Description**	**Phase**	**Severity**	**Duration**	**Extent**	**Consequence (A+B+C)/3**	**Frequency**	**Probability**	**Likelihood (E+F)/2**	**Environmental Significance (without mitigation)**	**Significance**	**Environmental Significance (with mitigation)**	**Significance**	**Cumulative Impact**
		Dust Fallout Impacts during operational phase as a result of vehicular activity (unmitigated) average across all receptors	Operational phase	2.0	4.0	3.0	3.0	5.0	4.0	4.5	**13.5**	M			X
		Dust Fallout Impacts during operational phase as a result of vehicular activity (mitigated, 90% efficiency) average across all receptors	Operational phase	1.0	4.0	3.0	2.7	5.0	4.0	4.5			**12.0**	M	X
		Air Quality Impacts during operational phase as a result of co-firing plant (unmitigated) average across all receptors	Operational phase	1.0	4.0	3.0	2.7	5.0	4.0	4.5	**12.0**	M			
Visual																
Visual	**K**	Impact of site clearing and levelling on Oupos Farm	Construction	4.0	3.0	3.0	3.3	5.0	4.0	4.5	**15.0**	MH			
				3.0	3.0	3.0	3.0	5.0	4.0	4.5			**13.5**	M	
		Dust impact on Oupos Farm	Construction	4.0	3.0	3.0	3.3	5.0	4.0	4.5	**15.0**	MH			
				3.0	3.0	3.0	3.0	5.0	4.0	4.5			**13.5**	M	
		Impact of vehicle movements on Oupos Farm	Construction	4.0	3.0	3.0	3.3	5.0	4.0	4.5	**15.0**	MH			
				3.0	3.0	3.0	3.0	5.0	4.0	4.5			**13.5**	M	
		Impact of lights at night on Oupos Farm	Construction	4.0	3.0	3.0	3.3	5.0	4.0	4.5	**15.0**	MH			

BIOPHYSICAL AND SOCIO-ECONOMIC ENVIRONMENT																	
				A	B	C	D	E	F	G	(D xG)	H	(D xG)	H	
Environment	**ESMP Ref No.**	**Impact Description**	**Phase**	**Severity**	**Duration**	**Extent**	**Consequence (A+B+C)/3**	**Frequency**	**Probability**	**Likelihood (E+F)/2**	**Environmental Significance (without mitigation)**	**Significance**	**Environmental Significance (with mitigation)**	**Significance**	**Cumulative Impact**
				3.0	3.0	3.0	3.0	5.0	4.0	4.5			**13.5**	M	
		Impact of the construction of auxiliary infrastructure, assembly warehouse and chimney on Oupos Farm	Construction	4.0	3.0	3.0	3.3	5.0	4.0	4.5	**15.0**	MH			
				3.0	3.0	3.0	3.0	5.0	4.0	4.5			**13.5**	M	
		Impact of tarring of the road on Oupos Farm	Construction	4.0	3.0	3.0	3.3	5.0	4.0	4.5	**15.0**	MH			
				3.0	3.0	3.0	3.0	5.0	4.0	4.5			**13.5**	M	
		Impact of the views of the parabolic troughs on Oupos Farm	Operation	3.0	3.0	3.0	3.0	5.0	4.0	4.5	**13.5**	M			
				2.0	3.0	3.0	2.7	5.0	2.0	3.5			9.3	LM	
		Impact of reflectivity on Oupos Farm	Operation	3.0	3.0	3.0	3.0	5.0	4.0	4.5	**13.5**	M			
				2.0	3.0	3.0	2.7	5.0	2.0	3.5			9.3	LM	
		Impact of the chimney on the Oupos Farm	Operation	3.0	3.0	3.0	3.0	5.0	4.0	4.5	**13.5**	M			
				2.0	3.0	3.0	2.7	5.0	2.0	3.5			9.3	LM	
		Impact of the assembly warehouse on the Oupos Farm	Operation	3.0	3.0	3.0	3.0	5.0	4.0	4.5	**13.5**	M			

BIOPHYSICAL AND SOCIO-ECONOMIC ENVIRONMENT																	
				A	B	C	D	E	F	G	(D xG)	H	(D xG)	H	
Environment	**ESMP Ref No.**	**Impact Description**	**Phase**	**Severity**	**Duration**	**Extent**	**Consequence (A+B+C)/3**	**Frequency**	**Probability**	**Likelihood (E+F)/2**	**Environmental Significance (without mitigation)**	**Significance**	**Environmental Significance (with mitigation)**	**Significance**	**Cumulative Impact**
				2.0	3.0	3.0	2.7	5.0	2.0	3.5			9.3	LM	
		Impact of increased traffic on Oupos Farm	Operation	3.0	3.0	3.0	3.0	5.0	4.0	4.5	**13.5**	M			
				2.0	3.0	3.0	2.7	5.0	2.0	3.5			9.3	LM	
		Impact of dust on the Kathu Forest	Construction	3.0	3.0	3.0	3.0	4.0	3.0	3.5	**10.5**	M			X
				2.0	3.0	3.0	2.7	4.0	2.0	3.0			8.0	LM	X
		Impact of increased vehicle movements on the roads on the Kathu Forest	Construction & Operation	2.0	3.0	3.0	2.7	4.0	3.0	3.5	9.3	LM			X
				1.0	3.0	3.0	2.3	4.0	2.0	3.0			7.0	LM	X
		Impact of lights at night (pool of light) on the Kathu Forest	Construction & Operation	2.0	3.0	3.0	2.7	4.0	3.0	3.5	9.3	LM			X
				2.0	3.0	3.0	2.7	4.0	2.0	3.0			8.0	LM	X
		Impact of possible partial views of structures / chimney on the Kathu Forest	Operation	2.0	3.0	3.0	2.7	4.0	3.0	3.5	9.3	LM			X
				1.0	3.0	3.0	2.3	3.0	2.0	2.5			5.8	LM	X
Noise															
Noise	**H**	Noise impact	Construction	1.0	2.0	2.0	1.7	5.0	5.0	5.0	8.3	LM			X

BIOPHYSICAL AND SOCIO-ECONOMIC ENVIRONMENT																	
				A	B	C	D	E	F	G	(D xG)	H	(D xG)	H	
Environment	**ESMP Ref No.**	**Impact Description**	**Phase**	**Severity**	**Duration**	**Extent**	**Consequence (A+B+C)/3**	**Frequency**	**Probability**	**Likelihood (E+F)/2**	**Environmental Significance (without mitigation)**	**Significance**	**Environmental Significance (with mitigation)**	**Significance**	**Cumulative Impact**
				1.0	2.0	2.0	1.7	5.0	5.0	5.0			8.3	LM	X
		Noise impact	Operation	1.0	4.0	1.0	2.0	5.0	4.0	4.5	9.0	LM			X
				1.0	4.0	1.0	2.0	5.0	4.0	4.5			9.0	LM	X
Socio-Economic																	
Socio-Economic	**I and J**	Job creation	Construction	2.0	3.0	3.0	2.7	5.0	4.0	4.5	**12.0**	**M+**			
				3.0	3.0	3.0	3.0	5.0	5.0	5.0			**15.0**	**MH+**	
		Expansion of local skill	Construction	2.0	3.0	3.0	2.7	5.0	4.0	4.5	**12.0**	**M+**			
				3.0	3.0	3.0	3.0	5.0	5.0	5.0			**15.0**	**MH+**	
		Small business opportunities	Construction	2.0	3.0	3.0	2.7	5.0	4.0	4.5	**12.0**	**M+**			
				3.0	3.0	3.0	3.0	5.0	5.0	5.0			**15.0**	**MH+**	
		Economic development	Construction	2.0	3.0	3.0	2.7	5.0	4.0	4.5	**12.0**	**M+**			
				3.0	3.0	3.0	3.0	5.0	5.0	5.0			**15.0**	**MH+**	
		Introduction of foreign workers	Construction	3.0	3.0	3.0	3.0	4.0	3.0	3.5	**10.5**	**M**			

BIOPHYSICAL AND SOCIO-ECONOMIC ENVIRONMENT																	
				A	B	C	D	E	F	G	(D xG)	H	(D xG)	H	
Environment	**ESMP Ref No.**	**Impact Description**	**Phase**	**Severity**	**Duration**	**Extent**	**Consequence (A+B+C)/3**	**Frequency**	**Probability**	**Likelihood (E+F)/2**	**Environmental Significance (without mitigation)**	**Significance**	**Environmental Significance (with mitigation)**	**Significance**	**Cumulative Impact**
				2.0	3.0	3.0	2.7	3.0	2.0	2.5			6.7	LM	
		Visual disturbance	Construction	2.0	3.0	3.0	2.7	5.0	5.0	5.0	13.3	M			X
				2.0	3.0	3.0	2.7	5.0	5.0	5.0			13.3	M	X
		Increase in communicable diseases	Construction	3.0	3.0	3.0	3.0	4.0	5.0	4.5	13.5	M			
				2.0	3.0	3.0	2.7	5.0	4.0	4.5			12.0	M	
		Traffic safety risks	Construction	2.0	3.0	3.0	2.7	4.0	4.0	4.0	10.7	M			X
				1.0	3.0	3.0	2.3	5.0	3.0	4.0			9.3	LM	X
		Security risks	Construction	2.0	3.0	3.0	2.7	4.0	4.0	4.0	10.7	M			X
				1.0	3.0	3.0	2.3	5.0	3.0	4.0			9.3	LM	X
		Noise intrusion	Construction	3.0	3.0	3.0	3.0	4.0	5.0	4.5	13.5	M			X
				2.0	3.0	3.0	2.7	5.0	4.0	4.5			12.0	M	X
		Dust intrusion	Construction	3.0	3.0	3.0	3.0	4.0	5.0	4.5	13.5	M			X

BIOPHYSICAL AND SOCIO-ECONOMIC ENVIRONMENT																	
				A	B	C	D	E	F	G	(D xG)	H	(D xG)	H	
Environment	**ESMP Ref No.**	**Impact Description**	**Phase**	**Severity**	**Duration**	**Extent**	**Consequence (A+B+C)/3**	**Frequency**	**Probability**	**Likelihood (E+F)/2**	**Environmental Significance (without mitigation)**	**Significance**	**Environmental Significance (with mitigation)**	**Significance**	**Cumulative Impact**
				1.0	3.0	3.0	2.3	5.0	4.0	4.5			10.5	M	X
		Light intrusion	Construction	2.0	3.0	3.0	2.7	4.0	5.0	4.5	12.0	M			
				1.0	3.0	3.0	2.3	5.0	4.0	4.5			10.5	M	
		Job creation	Operation	1.0	3.0	3.0	2.3	5.0	4.0	4.5	10.5	M+			
				2.0	3.0	3.0	2.7	5.0	5.0	5.0			13.3	M+	
		Expansion of local skill	Operation	1.0	3.0	3.0	2.3	5.0	4.0	4.5	10.5	M+			
				2.0	3.0	3.0	2.7	5.0	5.0	5.0			13.3	M+	
		Small business opportunities	Operation	1.0	4.0	3.0	2.7	5.0	4.0	4.5	12.0	M+			
				2.0	4.0	3.0	3.0	5.0	5.0	5.0			15.0	M H+	
		Economic development	Operation	1.0	4.0	4.0	3.0	5.0	4.0	4.5	13.5	M+			
				2.0	4.0	4.0	3.3	5.0	5.0	5.0			16.7	M H+	
		Changes in tourism and recreation	Operation	1.0	4.0	3.0	2.7	4.0	4.0	4.0	10.7	M+			

BIOPHYSICAL AND SOCIO-ECONOMIC ENVIRONMENT																	
				A	B	C	D	E	F	G	(D xG)	H	(D xG)	H	
Environment	**ESMP Ref No.**	**Impact Description**	**Phase**	**Severity**	**Duration**	**Extent**	**Consequence (A+B+C)/3**	**Frequency**	**Probability**	**Likelihood (E+F)/2**	**Environmental Significance (without mitigation)**	**Significance**	**Environmental Significance (with mitigation)**	**Significance**	**Cumulative Impact**
				2.0	4.0	3.0	3.0	4.0	3.0	3.5			10.5	M+	
		Introduction of foreign workers	Operation	2.0	3.0	4.0	3.0	4.0	3.0	3.5	10.5	M			
				1.0	3.0	3.0	2.3	4.0	2.0	3.0			7.0	LM	
		Visual disturbance	Operation	2.0	3.0	3.0	2.7	5.0	5.0	5.0	13.3	M			X
				2.0	3.0	3.0	2.7	5.0	5.0	5.0			13.3	M	X
		Traffic safety risks	Operation	2.0	4.0	3.0	3.0	4.0	4.0	4.0	12.0	M			X
				1.0	4.0	3.0	2.7	5.0	3.0	4.0			10.7	M	X
		Light intrusion	Operation	2.0	3.0	3.0	2.7	5.0	5.0	5.0	13.3	M			
				2.0	3.0	3.0	2.7	5.0	5.0	5.0			13.3	M	

8 Conclusion and Recommendations

This report provides a detailed and comprehensive description of the proposed project, stakeholder engagement process, environmental impacts and proposed management and mitigation measures associated with the development of the KSP project.

Three sites were considered when selecting the preferred site for the construction and operation of the KSP project. The final site option was selected as the preferred alternative based on its alignment with the selection criteria listed in **Section 4.2.1**. In addition, the site was deemed the most feasible alternative based on:

- Its close proximity to the Vaal-Gamagara Pipeline, which runs adjacent to the western boundary;
- Its location in relation to the favourable general wind direction in relation to Sishen Mine;
- The land is considered to be non-arable comprising low potential grazing land; and
- The site is zoned as Resort Zone 1 and the development of a solar park will therefore not decrease the land capability.

A full stakeholder consultation process was undertaken from the onset of the scoping phase of the project to ensure that the widest range of stakeholders were adequately and effectively consulted, which continued into the ESIA phase of the project. The stakeholder consultation process was undertaken in English and Afrikaans.

Some of the key issues and concerns raised during the project include:

- Sources of water supply to the project and the impacts thereof on other water sources and water users in the area;
- Amount of water required during the construction and operational phases of the project;
- Impacts of the project on the Kathu forest / National Heritage Site and on Camelthorn trees on the property;
- Socio-economic benefits of the project;
- Impacts on other land uses and land users;
- Impacts of project-generated noise;
- Dust impacts on neighbours;
- Visual impacts of the project;
- Impacts of the project on potential areas of archaeological significance;
- Impacts on public infrastructure – housing, services, schools; and
- Impacts associated with the potential spillage or leakage of heat transfer fluid.

In response to the issues and concerns listed above the following specialist studies were commissioned as part of the ESIA process and are detailed in **Section 3** of this report:

- Desktop soil, land use and land capability review;
- Biodiversity and ecological assessment;
- Hydrological and geohydrological assessment;
- Air quality assessment;
- Traffic impact assessment;
- Visual impact assessment;
- Noise assessment;
- Cultural heritage assessment;

- Socio-economic impact assessment; and
- Health, safety and community security planning.

Environmental Statement

In summary, the ESIR and ESMP have assessed both biophysical and socio-economic environments and identified appropriate management and mitigation measures. The biophysical impact assessment revealed that there are no environmental fatal flaws and no significant negative impacts associated with the proposed project should mitigation and management measures be implemented. In addition, it should be noted that the overall socio-economic impacts associated with the project are positive and include the creation of job opportunities and contributions to the local, regional and national economies.

The KSP project has the capacity to deliver on all the main objective and initiatives envisaged by the power sector. It would add energy to the grid during peak day periods. The project also has the potential to bring large scale power and stabilisation to the strategic part of the grid in the next 3 to 4 years. This is a significant contribution toward improving the reserve margin, therefore, reducing transmission losses and delaying the implementation of power conservation programmes and load shedding.

WSP are of the opinion that should the identified mitigation and management measures (identified in Table 9-1) be implemented, the proposed KSP project ought to proceed.

VOLUME 1: Part II

Kalahari Solar Power Project – DRAFT Environmental and Social Management Programme

Group Five (Pty) Ltd

June 2011

DEA REF NO: 12/12/20/1994

UNITED BY OUR DIFFERENCE

WSP

9 Draft Environmental and Social Management Programme

Responsibility for the ESMP will reside with Group Five, but there will be links with other functional clusters in areas such as workplace health and safety.

Table 9-1 addresses the dual objectives of the ESMP, namely to fully disclose the environmental and social commitments undertaken by Group Five, and to provide managers and staff with a clear framework for ESMP implementation. The ESMP is structured by major environmental components that are managed as programmes, e.g. air quality; water; biodiversity; socio-economic, then identifies the cross-linkages to other environmental aspects, the phase of the project in which the management action will be required, and the location of responsibility for implementation.

The management / mitigation table has the following characteristics:

- Mitigation and management measures are discussed in relation to aspects (for example the management of biodiversity). This groups related impacts and management / mitigation measures, and permits easy cross-reference to management programmes and plans;
- The programmes and plans under which management / mitigation will be undertaken are listed by aspect. The table presents a schedule for the implementation of management / mitigation activities, sub-divided by project phase; and
- The schedule shows, at a glance, the timing of the many actions required under the ESMP. It is particularly useful where management / mitigation measures extend across phases (as is frequently the case).

9.1 CHECKING AND CORRECTIVE ACTION

Checking, and if necessary implementing corrective action, form a component of the ESMP management cycle. They ensure that the:

- Required ESMP management activities are being implemented; and,
- Desired outcomes are being achieved.

As such this component includes four key activities. These are:

- Monitoring selected environmental and social quality variables as defined in the objectives and targets;
- Ongoing inspections of the operational controls and general state of the operations;
- Internal audits to assess the robustness of the ESMP or to focus on a particular performance issue; and
- External audits to provide independent verification of the efficacy of the ESMP.

Monitoring

The environmental variables that are to be monitored are described in the ESMP (Table 9-1). Monitoring results must be structured and presented for review on an ongoing basis so that if objectives and targets are not met, corrective action can be taken.

Inspections: construction phase

Owing to the transient nature of the construction phase, the greatest source of information is that obtained through ongoing visual inspection. At the same time, some potential impacts are difficult to monitor quantitatively, such as soil erosion and waste management. An ongoing, but pragmatic inspection regime will be developed that allows for potential transgressions to be identified proactively so that mitigation can be quickly and effectively implemented.

Internal and external audits

Where the monitoring data and the inspection reports highlight problems, an internal audit can be used to ascertain the source of the problem and to define actions to prevent its recurrence. The three key areas for audit are facilities (are they operating properly?), project procedures (are they properly designed and correctly implemented?) and finally, and perhaps most importantly Contractor's performance.

International lending institutions and commercial banks may have their own requirements for external and independent monitoring verification, as well as regular audits of the ESMP implementation.

Corrective action

There are several mechanisms for implementing corrective action, both during the construction and operational phases:

- Verbal instruction

Verbal instructions are likely to be the most frequently used form of corrective action and are given in response to minor transgressions that are evident during routine site inspections. Verbal instructions are also used to create further awareness amongst Contractors, as often the transgressions are a function of lack of awareness.

- Written instructions

Written instructions will be given following an audit. The written instructions will indicate the source or sources of the problems, and proposed solutions to those problems. The implementation of these solutions can also be assessed in a follow-up audit and further written instructions issued if required. All written instructions will be centrally logged to ensure that there is an auditable record of such instructions and how they were responded to.

- Contract notice

A contract notice is a more extreme form of written notice because it reflects the transgression as a potential breach of contract. If there is not an adequate response to a contract notice, then the next step can be to have the contractor removed from the site and the contract cancelled. Contracts will be drafted with this in mind.

Reporting

The findings of all of the above will be structured into instructive reporting that provides information to all required parties on ESMP compliance and performance, together with clearly defined corrective action where this is seen to be required. Both the monitoring and inspections are reported on continuously. Within the reporting structure, it is necessary to create a review function that continuously assesses the reporting and prescribes any necessary corrective action. Reporting will include the provision of information on the performance to external stakeholders and surrounding communities.

9.2 MANAGEMENT REVIEW

The final component of the ESMP management cycle is a formal management review that takes place at defined intervals, both during the construction and operational phases. The purpose of the management review is for senior project management to review the environmental management performance during the preceding period and to propose measures for improving that performance in the spirit of continuous improvement.

9.3 LIAISON

Throughout the project, ongoing liaison will be maintained with authorities and communities alike to ensure the following:

- Timeous advance warning of any project activities that may have some adverse impact on surrounding communities, e.g. vegetation clearing; and
- Ongoing feedback on the environmental performance of the project.

9.4 LINKS WITH ESIA

Impact identification numbers are consistent between the ESIR and ESMP, facilitating cross-referencing.

Table 9-1 of this document describes the management plans and programmes within which management and mitigation measures will be implemented. The rationale is to cluster related measures in a cohesive and systematic structure, ensuring clear roles and responsibilities, together with integrated and efficient implementation.

Table 9-1: Environmental and social management programme

Mitigation and Management Measures	Environmental Aspect															Project Phase					Responsibility			
	Geology	Topography	Soil, Land Use and Land Capability	Biodiversity	Surface Water	Groundwater	Air Quality	Noise	Traffic	Visual	Cultural and Heritage	Waste Generation and Management	Incidents and Spillages	Health and Safety	Socio-Economic	Pre-Construction	Construction	Operation	Closure	Post-Closure/ Rehabilitation	Environmental Officer	Plant Manager	Contractor	Construction Officer
A: ADMINISTRATION																								
The overall responsibility of the environmental management and costs associated with the implementation of the ESMP lies with Group Five	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
Group Five is to ensure that all permanent and temporary employees, sub-contractors and contractors understand, are aware of the requirements and adhere to the ESMP														✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Group Five will appoint a staff member directly involved with the construction and operational activities as the Environmental Officer (EO)														✓	✓	✓	✓	✓			✓			
The EO will be responsible for ensuring continual implementation of the ESMP, monthly internal monitoring of activities to ensure compliance with the ESMP, ensure environmental awareness among all members of the workforce, implement preventative and corrective actions in accordance with the ESMP and outcomes of any environmental audits, and report all environmental incidents	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			

Mitigation and Management Measures	Environmental Aspect															Project Phase					Responsibility			
	Geology	Topography	Soil, Land Use and Land Capability	Biodiversity	Surface Water	Groundwater	Air Quality	Noise	Traffic	Visual	Cultural and Heritage	Waste Generation and Management	Incidents and Spillages	Health and Safety	Socio-Economic	Pre-Construction	Construction	Operation	Closure	Post-Closure/ Rehabilitation	Environmental Officer	Plant Manager	Contractor	Construction Officer
observed on-site in the environmental incidents register in accordance with the requirements of the ESMP and relevant environmental legislation																								
The EO will ensure that all compliant and non-compliant findings, as well as a list of all environmental incidents, are recorded and made available to the DEA and NCDEANC on request	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			
Observations and findings of non-compliance reported during internal and external audits and incidents reported in the environmental complaints register will be closed out by Group Five on approval of suitable rectification or mitigation measures	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
It is the Contractor's responsibility to monitor the performance of sub-contractors and construction workers to ensure that points relayed during the induction training are properly understood and being complied with. If necessary, the EO/translator should be called to explain aspects contained in the ESMP	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				✓		✓	

Mitigation and Management Measures	Environmental Aspect															Project Phase					Responsibility			
	Geology	Topography	Soil, Land Use and Land Capability	Biodiversity	Surface Water	Groundwater	Air Quality	Noise	Traffic	Visual	Cultural and Heritage	Waste Generation and Management	Incidents and Spillages	Health and Safety	Socio-Economic	Pre-Construction	Construction	Operation	Closure	Post-Closure/ Rehabilitation	Environmental Officer	Plant Manager	Contractor	Construction Officer
Main delivery and entrance routes will be clearly signposted and printed delivery maps will be made available to all employees, contractors and sub-contractors									✓	✓				✓	✓	✓	✓	✓			✓	✓		✓
Adequate parking for all employees, contractors and sub-contractors will be made available and should not impact negatively on neighbouring farmers									✓					✓	✓	✓	✓	✓			✓	✓		
All vehicles, machinery and equipment will be inspected monthly to ensure good working order							✓	✓					✓			✓	✓	✓	✓	✓	✓	✓		
It is the Plant Manager's responsibility to monitor the performance of employees to ensure that points relayed during the induction training are properly understood and being complied with. If necessary, the EO/translator should be called to explain aspects contained in the ESMP	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓			✓	✓		
B: AWARENESS AND TRAINING																								
Group Five are to ensure that the ESMP forms part of the formal site induction for all employees, contractors and sub-contractors, preferable in their native language. All contractors, sub-contractors and employees will	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓

Mitigation and Management Measures	Environmental Aspect															Project Phase					Responsibility			
	Geology	Topography	Soil, Land Use and Land Capability	Biodiversity	Surface Water	Groundwater	Air Quality	Noise	Traffic	Visual	Cultural and Heritage	Waste Generation and Management	Incidents and Spillages	Health and Safety	Socio-Economic	Pre-Construction	Construction	Operation	Closure	Post-Closure/ Rehabilitation	Environmental Officer	Plant Manager	Contractor	Construction Officer
acknowledge their understanding of the ESMP and environmental responsibilities by signing the induction attendance register																								
An environmental awareness programme will be implemented for all on-site personnel describing key environmental issues and potential impacts thereof													✓	✓	✓	✓	✓	✓			✓	✓		
Contractors, sub-contractors and labourers will be trained in health and safety policies, environmental awareness and emergency preparedness														✓	✓	✓	✓	✓			✓	✓	✓	✓
Sufficient training will be provided to all employees, contractors and sub-contractors to ensure that designated tasks are undertaken adequately													✓	✓	✓	✓	✓	✓			✓	✓	✓	✓
No employee, contractor or sub-contractor will be permitted to operate critical machinery, vehicles or equipment without undertaking necessary training by a competent individual														✓	✓	✓	✓	✓			✓	✓	✓	✓
In-service training, where applicable, will be provided to contractors and labourers														✓	✓	✓	✓	✓			✓	✓	✓	✓
Contractors are to hold toolbox talks														✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	

Mitigation and Management Measures	Environmental Aspect															Project Phase					Responsibility			
	Geology	Topography	Soil, Land Use and Land Capability	Biodiversity	Surface Water	Groundwater	Air Quality	Noise	Traffic	Visual	Cultural and Heritage	Waste Generation and Management	Incidents and Spillages	Health and Safety	Socio-Economic	Pre-Construction	Construction	Operation	Closure	Post-Closure/ Rehabilitation	Environmental Officer	Plant Manager	Contractor	Construction Officer
Employees will be trained to reduce littering along the haul routes				✓						✓		✓					✓	✓			✓	✓		
C: SOCIO-ECONOMIC MANAGEMENT PLAN																								
Group Five will establish a grievance mechanism that will specify procedures for lodging and registering complaints – by external parties and employees - and for responses to them including time limits for responding and addressing the complaint, and recording of same. The grievance mechanism will be applicable to all project phases and any areas of operation or impact.		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
The Peens farmstead residents, as close neighbours, will be visited prior to construction, introduced to the key role players such as Contractor and Client Representative, and given information about disruptive activities (such as the application of animal warning sirens, blasting sirens) and the grievance mechanism.							✓	✓	✓	✓			✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓
Group Five will ensure that a "locals first" policy is implemented									✓						✓	✓	✓	✓			✓	✓	✓	✓

Mitigation and Management Measures	Environmental Aspect															Project Phase					Responsibility			
	Geology	Topography	Soil, Land Use and Land Capability	Biodiversity	Surface Water	Groundwater	Air Quality	Noise	Traffic	Visual	Cultural and Heritage	Waste Generation and Management	Incidents and Spillages	Health and Safety	Socio-Economic	Pre-Construction	Construction	Operation	Closure	Post-Closure/ Rehabilitation	Environmental Officer	Plant Manager	Contractor	Construction Officer
Group Five will ensure that contractors have a “skills development" policy and that the policy is adequately implemented															✓	✓	✓	✓			✓	✓	✓	✓
Group Five will ensure that contractors having a local SMME policy and that the policy is adequately implemented															✓	✓	✓	✓			✓	✓	✓	✓
Group Five will ensure that contractors have a regional as well as local focus															✓	✓	✓	✓				✓	✓	✓
Local government will be consulted with regards to their resource allocation to ensure that local residents are not adversely impacted by the influx of contractors															✓	✓	✓	✓				✓	✓	✓
The construction site will be fenced off to prevent access														✓	✓	✓	✓	✓			✓	✓		
The Contractor will ensure that hazard warning signs, which should be graphic and in the vernacular, are erected on all boundary fences warning against entering the construction area														✓	✓	✓	✓				✓	✓		
Fencing will be inspected weekly and maintained properly until closure														✓	✓	✓	✓	✓	✓	✓	✓	✓		

Mitigation and Management Measures	Environmental Aspect															Project Phase					Responsibility			
	Geology	Topography	Soil, Land Use and Land Capability	Biodiversity	Surface Water	Groundwater	Air Quality	Noise	Traffic	Visual	Cultural and Heritage	Waste Generation and Management	Incidents and Spillages	Health and Safety	Socio-Economic	Pre-Construction	Construction	Operation	Closure	Post-Closure/ Rehabilitation	Environmental Officer	Plant Manager	Contractor	Construction Officer
Trespassing on neighbouring properties will be forbidden and measures to incorporate transgression into a disciplinary code will be taken and explained to the workforce														✓	✓	✓	✓	✓	✓		✓	✓	✓	✓
Public awareness programmes will be developed by the Contractor with the community to identify areas of particular risk and approaches to reduce risk. This will include awareness programmes at schools along roads leading to the site to advise children of the dangers of traffic as well as other frequent users									✓					✓	✓	✓	✓	✓			✓	✓	✓	
To ensure that local levels of HIV/AIDS are not exacerbated, the Contractor will brief employees on health risks. This should be included as an action within the Health & Safety Plan prepared by the Contractor														✓	✓	✓	✓	✓			✓	✓	✓	
The Contractor must, in consultation with local HIV/AIDS organizations and government structures, design and implement HIV/AIDS awareness and prevention campaign.														✓	✓	✓	✓	✓			✓	✓	✓	

Mitigation and Management Measures	Environmental Aspect															Project Phase					Responsibility			
	Geology	Topography	Soil, Land Use and Land Capability	Biodiversity	Surface Water	Groundwater	Air Quality	Noise	Traffic	Visual	Cultural and Heritage	Waste Generation and Management	Incidents and Spillages	Health and Safety	Socio-Economic	Pre-Construction	Construction	Operation	Closure	Post-Closure/ Rehabilitation	Environmental Officer	Plant Manager	Contractor	Construction Officer
The Contractor will make HIV/AIDS awareness and prevention program a condition of contract for all suppliers and sub-contractors														✓	✓	✓	✓	✓			✓	✓	✓	
The Contractor will provide free condoms to all workers. Condoms should be located in the bathrooms on the construction site														✓	✓	✓	✓	✓			✓	✓	✓	
The numbers of condoms made available will be calculated using the numbers of employees resident at each site as a basis														✓	✓	✓	✓	✓			✓	✓	✓	
A voluntary counselling and testing program will be introduced during the construction phase and continued during operations														✓	✓	✓	✓	✓			✓	✓	✓	✓
The Contractor will undertake a HIV/AIDS prevalence survey amongst all workers on a regular basis. It will involve a voluntary test available to 100% of the workforce. The results of the survey will help to determine the HIV/AIDS strategy. When and if statistically representative results are obtained then the results of the survey will be made available to management and workers at the same time. Results will be presented as														✓	✓	✓	✓	✓			✓	✓	✓	

Mitigation and Management Measures	Environmental Aspect														Project Phase					Responsibility			
	Geology	Topography	Soil, Land Use and Land Capability	Biodiversity	Surface Water	Groundwater	Air Quality	Noise	Traffic	Visual	Cultural and Heritage	Waste Generation and Management	Incidents and Spillages	Health and Safety	Socio-Economic	Pre-Construction	Construction	Operation	Closure	Post-Closure/ Rehabilitation	Environmental Officer	Plant Manager	Contractor	Construction Officer
statistical returns that ensure confidentiality																								
The use of labour intensive construction methods should be implemented where possible														✓	✓	✓	✓	✓					✓	
Principles of equality, BEE, gender =equality and non-discrimination will be implemented														✓	✓	✓	✓	✓					✓	
The contractor is to ensure that all staff on-site will be in possession of a South African identity document, or suitable valid work permit from the Department of Home Affairs															✓	✓	✓	✓					✓	
All contact with affected parties shall be courteous at all times, and the rights of the affected parties should be respected at all times															✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
No unnecessary interruptions other than those negotiated shall be permitted to any essential service. Should disruptions occur, the activity should be communicated to affected landowners and published in the Kathu Gazette. Damage to municipal and government infrastructure will not be tolerated and any damage will be rectified as soon as possible by the contractor. Records of													✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓

Mitigation and Management Measures	Environmental Aspect															Project Phase					Responsibility			
	Geology	Topography	Soil, Land Use and Land Capability	Biodiversity	Surface Water	Groundwater	Air Quality	Noise	Traffic	Visual	Cultural and Heritage	Waste Generation and Management	Incidents and Spillages	Health and Safety	Socio-Economic	Pre-Construction	Construction	Operation	Closure	Post-Closure/ Rehabilitation	Environmental Officer	Plant Manager	Contractor	Construction Officer
damage and remedial actions will be maintained																								
The construction period is to be kept to a minimum										✓				✓	✓		✓	✓			✓		✓	✓
It is advised that a Research and Development Centre be constructed for educational purposes. The centre will also continue researching technologies associated with solar power										✓					✓			✓			✓	✓	✓	
D: CULTURAL AND HERITAGE MANAGEMENT PLAN																								
The activities undertaken on the project site are to be compliant with the Cultural and Heritage Plan compiled for this project (refer to Appendix G)											✓						✓	✓	✓		✓	✓		
All archaeological findings will be managed as per the requirements of the National Heritage Resources Act (No 25 of 1999)											✓					✓	✓	✓	✓		✓	✓		✓
The necessity for reporting any uncovered archaeological artefact will be included in the site induction											✓					✓	✓	✓	✓		✓	✓		
Group Five will take reasonable precautions to prevent any person from removing or damaging any such article and will immediately, upon discovery thereof, inform the EO or Site Manager											✓					✓	✓	✓	✓		✓	✓		✓

Mitigation and Management Measures	Environmental Aspect															Project Phase					Responsibility			
	Geology	Topography	Soil, Land Use and Land Capability	Biodiversity	Surface Water	Groundwater	Air Quality	Noise	Traffic	Visual	Cultural and Heritage	Waste Generation and Management	Incidents and Spillages	Health and Safety	Socio-Economic	Pre-Construction	Construction	Operation	Closure	Post-Closure/ Rehabilitation	Environmental Officer	Plant Manager	Contractor	Construction Officer
of the discovery																								
If an artefact or site of archaeological importance is uncovered on-site, work in the vicinity will be stopped immediately											✓					✓	✓	✓	✓		✓	✓		✓
If a grave, midden or archaeological artefact is uncovered on site, or discovered before the commencement of work, then all work in the immediate vicinity of the graves / middens will be stopped and the EO informed of the discovery											✓					✓	✓	✓	✓		✓	✓		✓
The South African Heritage Resources Association (SAHRA) should be contacted and in the case of removal of archaeological artefacts and graves, as well as arrangements made for an undertaker to carry out exhumation and reburial											✓					✓	✓	✓	✓		✓	✓		
The SAHRA is to be contacted who will appoint an archaeological consultant											✓					✓	✓	✓	✓		✓	✓		
Work may only resume once clearance is given in writing by an archaeological consultant											✓					✓	✓	✓	✓		✓	✓		✓
E: NOISE MANAGEMENT PLAN																								

Mitigation and Management Measures	Environmental Aspect															Project Phase					Responsibility			
	Geology	Topography	Soil, Land Use and Land Capability	Biodiversity	Surface Water	Groundwater	Air Quality	Noise	Traffic	Visual	Cultural and Heritage	Waste Generation and Management	Incidents and Spillages	Health and Safety	Socio-Economic	Pre-Construction	Construction	Operation	Closure	Post-Closure/ Rehabilitation	Environmental Officer	Plant Manager	Contractor	Construction Officer
Construction activities should be limited to daylight hours in noise sensitive areas. Where construction activities are required after dark, notification is to be sent to affected landowners				✓				✓		✓				✓	✓	✓	✓	✓	✓		✓	✓		
Blasting activities are to be controlled to minimise noise, air blast and timing of explosives		✓					✓	✓		✓				✓		✓	✓				✓	✓		
Construction and operation activities will comply with the standard requirements of the Occupational Health and Safety Act (No. 85 of 1993)								✓						✓	✓	✓	✓	✓	✓		✓			
All equipment, machinery and vehicles are kept in good working order and inspected regularly to ensure integrity and reliability and prevent excessive noise. Vehicles, machinery and equipment generating excessive noise should be fitted with appropriate noise abatement measures							✓	✓					✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
All the necessary noise mitigation measures will be installed to minimise any noise pollution that might extend beyond the solar park								✓	✓					✓	✓	✓	✓	✓			✓	✓		

Mitigation and Management Measures	Environmental Aspect															Project Phase					Responsibility			
	Geology	Topography	Soil, Land Use and Land Capability	Biodiversity	Surface Water	Groundwater	Air Quality	Noise	Traffic	Visual	Cultural and Heritage	Waste Generation and Management	Incidents and Spillages	Health and Safety	Socio-Economic	Pre-Construction	Construction	Operation	Closure	Post-Closure/ Rehabilitation	Environmental Officer	Plant Manager	Contractor	Construction Officer
Staff working in areas of excessive noise (above 75dBa) should be provided hearing protection equipment (personal protective equipment)							✓	✓						✓	✓	✓	✓	✓			✓	✓		
Any complaints originating from noise issues from the public will be recorded and adequately closed out within 14 days. A complaints register will be available at the security office								✓					✓	✓	✓	✓	✓	✓	✓		✓	✓		
F: TRAFFIC MANAGEMENT PLAN																								
Group Five will ensure that all contracted logistics companies have professional driver training programmes in place									✓							✓	✓				✓	✓	✓	
Group Five will ensure that all contractors, sub-contractors etc on site implement driver training programmes, as Group Five will do for its own drivers for the construction and operational phases.									✓								✓	✓			✓	✓	✓	
Traffic calming and speed control measures will be instigated in consultation with the municipality									✓					✓	✓	✓	✓	✓			✓	✓		
Material delivery to site will be scheduled to avoid peak-hour traffic									✓					✓	✓	✓	✓	✓			✓	✓	✓	
All construction and maintenance vehicles travelling on public roads will									✓					✓	✓	✓	✓	✓	✓		✓	✓		

Mitigation and Management Measures	Environmental Aspect															Project Phase					Responsibility			
	Geology	Topography	Soil, Land Use and Land Capability	Biodiversity	Surface Water	Groundwater	Air Quality	Noise	Traffic	Visual	Cultural and Heritage	Waste Generation and Management	Incidents and Spillages	Health and Safety	Socio-Economic	Pre-Construction	Construction	Operation	Closure	Post-Closure/ Rehabilitation	Environmental Officer	Plant Manager	Contractor	Construction Officer
adhered to the relevant traffic laws and regulations																								
No deviation from approved access routes will be permitted									✓					✓	✓	✓	✓	✓	✓		✓	✓		
The T25 will be surfaced for use during the construction phase. The road will primarily be used by heavy vehicles transporting the equipment to the site									✓					✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Minimum local road widening in the vicinity of the two intersections (T25/N14 and T25/R380) will be constructed at both of these intersections									✓					✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
General road rules will be enforced and complied with at all times									✓					✓		✓	✓	✓	✓	✓	✓	✓		
During fuel delivery, the tanker driver and associated qualified staff are to be present at all times during product off-loading												✓	✓	✓	✓		✓	✓	✓		✓	✓		
An emergency stop will be installed should an accidental spillage occur												✓	✓	✓			✓	✓	✓		✓	✓		
G: VISUAL MANAGEMENT PLAN																								
Any additional external lighting of the facility will be limited										✓					✓	✓	✓	✓			✓	✓		

Mitigation and Management Measures	Environmental Aspect															Project Phase					Responsibility			
	Geology	Topography	Soil, Land Use and Land Capability	Biodiversity	Surface Water	Groundwater	Air Quality	Noise	Traffic	Visual	Cultural and Heritage	Waste Generation and Management	Incidents and Spillages	Health and Safety	Socio-Economic	Pre-Construction	Construction	Operation	Closure	Post-Closure/ Rehabilitation	Environmental Officer	Plant Manager	Contractor	Construction Officer
Lights will be positioned at such an angle that light is focused on the immediate site and not the surrounding area										✓					✓	✓	✓	✓			✓	✓		
Focused light sources will be used										✓					✓	✓	✓	✓			✓	✓		
The entire project site is to be maintained to ensure minimal aesthetic impact										✓				✓	✓		✓	✓	✓		✓	✓		
The colour of the 8m high dust fence will be mid-grey so as to absorb reflected light.										✓								✓			✓	✓		
H: HEALTH, SAFETY AND SECURITY MANAGEMENT PLAN (*see* also Appendix K)																								
A grievance mechanism will be put in place (*see* Socio-economic Management Plan) and all employees and project-affected parties will be made aware of its existence and the procedures contained therein.														✓	✓	✓	✓	✓						
All visitors to site will be inducted in site health and safety procedures														✓			✓	✓						
Blasting on-site will be done in accordance with relevant by-laws and SANS standards and according to relevant guidelines, including the Occupational Health and Safety Act (No. 15 of 1973) and the Explosives Act (No. 26 of 1956)								✓						✓	✓	✓	✓					✓		

Mitigation and Management Measures	Environmental Aspect															Project Phase					Responsibility			
	Geology	Topography	Soil, Land Use and Land Capability	Biodiversity	Surface Water	Groundwater	Air Quality	Noise	Traffic	Visual	Cultural and Heritage	Waste Generation and Management	Incidents and Spillages	Health and Safety	Socio-Economic	Pre-Construction	Construction	Operation	Closure	Post-Closure/ Rehabilitation	Environmental Officer	Plant Manager	Contractor	Construction Officer
Blasting notification signs will be indicated to passing traffic and at the entrance to the project site and all surrounding landowners will be notified prior to blasting activities								✓						✓	✓	✓	✓				✓	✓		
A siren will be sounded before blasting occurs								✓						✓	✓	✓	✓					✓		
Cover blasting will be considered to minimise fly rock			✓					✓						✓	✓	✓	✓					✓		
The Contractor will provide for security staff and ensure that the contracted security company supports local community policing forums								✓						✓	✓	✓	✓	✓			✓	✓	✓	
Access of all construction and material delivery vehicles will be controlled through one security entrance									✓					✓	✓	✓	✓	✓			✓	✓		✓
Areas for the storage of fuels and other flammable materials will comply with standard fire safety regulations and may require approval from the Municipal Fire Department														✓		✓	✓	✓				✓		
All storage tanks and associated infrastructure containing hydrocarbon, chemical and hazardous substances will be designed and installed in accordance with the relevant oil and petroleum industry standards, SANS codes or other													✓	✓		✓	✓	✓				✓		

Mitigation and Management Measures	Environmental Aspect															Project Phase					Responsibility			
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relevant requirements																								
Flammable fuel and gas will be kept separate from welding activities, assembly areas and loading bays														✓		✓	✓	✓				✓		
Adequate sanitary facilities and ablutions will be provided for construction staff, with a recommended maximum ratio of 15 workers to one ablution facility														✓	✓	✓	✓	✓				✓	✓	✓
Sufficient drinking water will be made available to all contractors, sub-contractors and on-site staff. The drinking water container will be strategically located and will be signposted as potable water														✓	✓	✓	✓	✓				✓	✓	✓
The site is to have 24 hour security									✓					✓	✓	✓	✓	✓	✓		✓	✓		✓
Unauthorised social activities are to be prohibited, which includes, but is not limited to, consumption of or illegal selling of goods, drug utilisation or selling and on-site prostitution									✓				✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓
All drivers will be in possession of a valid driver's license.									✓					✓	✓	✓	✓	✓	✓			✓		
Travel after dark will be avoided where possible									✓					✓	✓	✓	✓	✓			✓	✓		

Mitigation and Management Measures	Environmental Aspect															Project Phase					Responsibility			
	Geology	Topography	Soil, Land Use and Land Capability	Biodiversity	Surface Water	Groundwater	Air Quality	Noise	Traffic	Visual	Cultural and Heritage	Waste Generation and Management	Incidents and Spillages	Health and Safety	Socio-Economic	Pre-Construction	Construction	Operation	Closure	Post-Closure/ Rehabilitation	Environmental Officer	Plant Manager	Contractor	Construction Officer
Driving under the influence of alcohol is prohibited									✓					✓	✓	✓	✓	✓	✓		✓	✓		
Plant operators and all drivers will be subjected to driver safety training														✓				✓				✓		
No firearms are to be permitted on-site									✓					✓	✓	✓	✓	✓	✓		✓	✓		✓
No trespassing on surrounding property is permitted									✓	✓			✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓
Flammable materials are to be stored in a bunded and impervious area, well ventilated and adequately signed posted			✓	✓									✓	✓		✓	✓	✓	✓			✓		
Emergency Preparedness and Response Procedures will be provided should an incident or the spillage of hazardous chemicals occur													✓	✓		✓	✓	✓	✓			✓		
Fire prevention equipment will be available at all storage facilities and will be inspected regularly														✓		✓	✓	✓	✓			✓		
The eating areas should be maintained and cleaned to ensure sufficient hygiene and cleanliness														✓	✓	✓	✓	✓	✓			✓	✓	✓
Activities undertaken on-site are to be in accordance with the Occupational Health and Safety Plan, Community Security Plan as well as the Emergency Preparedness and Response Plan														✓	✓	✓	✓	✓	✓			✓		✓

Mitigation and Management Measures	Environmental Aspect														Project Phase					Responsibility			
	Geology	Topography	Soil, Land Use and Land Capability	Biodiversity	Surface Water	Groundwater	Air Quality	Noise	Traffic	Visual	Cultural and Heritage	Waste Generation and Management	Incidents and Spillages	Health and Safety	Socio-Economic	Pre-Construction	Construction	Operation	Closure	Post-Closure/ Rehabilitation	Environmental Officer	Plant Manager	Contractor	Construction Officer
Group Five and the appointed contractor will implement safety measures, work procedures and first aid measures as depicted in the Occupational Health and Safety Plan														✓	✓	✓	✓	✓	✓			✓	✓	✓
All work on-site will be compliant with the Occupational Health and Safety Act (No. 85 of 1993)														✓	✓	✓	✓	✓	✓			✓	✓	✓
A Safety Officer will be appointed by the contractor														✓	✓	✓	✓	✓	✓				✓	
Records of health and safety incidents, as well as mitigation measures will be maintained. Any health and safety incidents should be reported to the Safety Officer, EO or Site Manager as soon as possible													✓	✓	✓	✓	✓	✓	✓		✓	✓		
First aid facilities will be available on-site														✓	✓	✓	✓	✓	✓			✓		
A record of all drugs administered or precautions taken, as well as the date and time will be maintained														✓	✓	✓	✓	✓	✓			✓		
The location of the Kathu Clinic where more information and counselling is offered will be indicated														✓	✓	✓	✓	✓	✓			✓		
Personal protective equipment (PPE) will be made available to all contractors, sub-contractors and employees. A PPE register will be maintained for auditing														✓	✓	✓	✓	✓	✓			✓	✓	✓

Mitigation and Management Measures	Environmental Aspect															Project Phase					Responsibility			
	Geology	Topography	Soil, Land Use and Land Capability	Biodiversity	Surface Water	Groundwater	Air Quality	Noise	Traffic	Visual	Cultural and Heritage	Waste Generation and Management	Incidents and Spillages	Health and Safety	Socio-Economic	Pre-Construction	Construction	Operation	Closure	Post-Closure/ Rehabilitation	Environmental Officer	Plant Manager	Contractor	Construction Officer
purposes																								
SABS standards and specifications governing dangerous and high risk processes will be applied														✓	✓	✓	✓	✓	✓			✓	✓	✓
High risk areas, including but not limited to scaffolding, heights and open excavations will be demarcated and clearly marked and include, where relevant, adequate warning signs														✓		✓	✓	✓	✓			✓		
Emergency numbers for the police, fire department, clinic and relevant responsible staff will be made available in conspicuous locations														✓		✓	✓	✓	✓			✓		
All warning signs will be made available in English and applicable local languages														✓		✓	✓	✓	✓			✓		
Fire training and associated activities are to be included in the site induction														✓	✓	✓	✓	✓	✓			✓		
Smoking may only take place in demarcated areas														✓	✓	✓	✓	✓	✓			✓		
Welding and other sources of heating materials will be undertaken in a controlled environment, wherever possible and under the supervision of relevant personnel														✓	✓	✓	✓	✓	✓			✓		
All stakeholders identified in the ESIA will be notified of high risk activities (e.g.														✓	✓	✓	✓	✓	✓		✓	✓		

Mitigation and Management Measures	Environmental Aspect															Project Phase					Responsibility			
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blasting)																								
Fire fighting measures, such as fire extinguishers, will be located in strategic locations on-site and the workforce will be made aware of fire prevention and fire fighting measures														✓		✓	✓	✓	✓	✓		✓		
A fire management strategy will be compiled and made available													✓	✓		✓	✓	✓	✓	✓		✓		
I: AIR QUALITY MANAGEMENT PLAN																								
All activities on-site will comply with the requirements of the National Environmental Management: Air Quality Act (No. 39 of 2004)							✓	✓						✓		✓	✓	✓			✓	✓		✓
Where possible vegetation will be retained to reduce dust generation			✓	✓			✓									✓	✓	✓	✓		✓	✓		
Exposed soil surfaces should be rehabilitated as soon after completion of earthworks as possible		✓	✓	✓			✓									✓	✓	✓	✓		✓	✓		
Should topsoil stockpile/s become a source of windblown dust, they will be revegetated with indigenous grasses by hydroseeding. 75% cover is the germination and survival-after-six-months minimum to be met.		✓	✓	✓			✓							✓	✓	✓	✓	✓			✓	✓		✓

Mitigation and Management Measures	Environmental Aspect															Project Phase					Responsibility			
	Geology	Topography	Soil, Land Use and Land Capability	Biodiversity	Surface Water	Groundwater	Air Quality	Noise	Traffic	Visual	Cultural and Heritage	Waste Generation and Management	Incidents and Spillages	Health and Safety	Socio-Economic	Pre-Construction	Construction	Operation	Closure	Post-Closure/ Rehabilitation	Environmental Officer	Plant Manager	Contractor	Construction Officer
Wherever possible, vehicle access to the site should be restricted or minimised			✓	✓			✓	✓	✓							✓	✓	✓	✓		✓	✓		✓
Where excessive dust exists watering down of blasts prior to blasting should be undertaken							✓									✓	✓				✓	✓		
Blasting will be carried out in accordance with relevant legislation and using only the required amount of explosives. Blasting should occur on calm days to reduce the possibility of dust travel		✓	✓		✓		✓	✓						✓	✓	✓	✓				✓	✓		
The use of water carts to moisten road surfaces will be employed, ideally containing chemical binding agents and other dust suppressants. The frequency of these should be determined by the state of the roads, the prevailing weather and vehicle numbers on site at the time		✓	✓	✓	✓	✓	✓			✓				✓	✓	✓	✓	✓	✓	✓	✓	✓		✓
A speed limit of 40km/h will not be exceeded by vehicles on-site. Offenders will be penalised							✓		✓					✓	✓	✓	✓	✓	✓		✓	✓		✓
No burning of waste such as refuse (litter), plastic bags and cement bags will be permitted on the site							✓			✓		✓		✓		✓	✓	✓	✓	✓	✓	✓	✓	
Abluting anywhere other than in provided ablution facilities is not permitted			✓	✓	✓	✓	✓							✓		✓	✓	✓	✓	✓	✓	✓	✓	✓

Mitigation and Management Measures	Environmental Aspect															Project Phase					Responsibility			
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Any complaints originating from dust issues from the public will be recorded and adequately closed out within 14 days. A complaints register will be available at the security office, as per the grievance mechanism.							✓	✓	✓				✓	✓	✓	✓	✓	✓	✓		✓	✓		
J: LAND MANAGEMENT																								
Prior to the commencement of construction activities, the project site will be clearly demarcated with fencing. No construction activities are allowed outside of the demarcated footprint area										✓				✓	✓	✓					✓	✓		
The Contractor is to provide a method statement, including a construction site layout plan, before site clearance commences. The method statement will clearly indicate all material storage areas, offices and other site infrastructure, waste disposal/ storage areas etc., designed to minimize removal of vegetation and damage to surrounding areas.				✓	✓	✓						✓				✓	✓						✓	
Vegetation clearance will be undertaken in phases to ensure the minimum area of soil is exposed to potential erosion on the project site			✓	✓													✓	✓			✓	✓		

Mitigation and Management Measures	Environmental Aspect															Project Phase					Responsibility			
	Geology	Topography	Soil, Land Use and Land Capability	Biodiversity	Surface Water	Groundwater	Air Quality	Noise	Traffic	Visual	Cultural and Heritage	Waste Generation and Management	Incidents and Spillages	Health and Safety	Socio-Economic	Pre-Construction	Construction	Operation	Closure	Post-Closure/ Rehabilitation	Environmental Officer	Plant Manager	Contractor	Construction Officer
Should borrow-pits be required on-site, the relevant environmental authorisation will need to be obtained from Northern Cape Department of Mineral Resources	✓		✓													✓	✓				✓	✓	✓	
No soil is to be stripped from areas within the site that the contractor does not require for construction works			✓	✓												✓	✓				✓	✓		
Topsoil stripped to a depth of 300 mm where possible from construction areas will be stockpiled in a designated area, not exceeding a height of 2 m. The stockpile shall be located away from seepage zones, floodlines, water courses and other ecological sensitive areas (Kathu Forest)		✓	✓	✓	✓	✓				✓				✓	✓	✓	✓	✓			✓	✓		
Subsoil and overburden will be stockpiled separately in order to be returned for backfilling (where applicable) in the correct soil horizons		✓	✓	✓			✓									✓	✓				✓	✓		
Erosion control measures such as swales, sandbags, planting of vegetation, hydroseeding of topsoil and subsoil stockpiles and retention of vegetation, will be undertaken as necessary to prevent sediment transport into natural drainage lines and wetlands			✓	✓			✓			✓							✓	✓	✓	✓	✓	✓		

Mitigation and Management Measures	Environmental Aspect															Project Phase					Responsibility			
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Erosion control measures will be regularly maintained			✓														✓	✓			✓	✓		✓
All haul roads within the project site will be clearly defined									✓	✓				✓	✓	✓	✓	✓			✓	✓		
All disturbed areas should be rehabilitated as soon as possible in accordance with design specifications to reduce soil erosion			✓	✓													✓	✓	✓	✓	✓	✓		✓
Residual stockpiles are to be removed to spoil or spread on the site as directed by the EO		✓	✓														✓	✓	✓	✓	✓		✓	✓
Group Five is to ensure that all access routes are adequately maintained (potholes, erosion damage, corrugations, etc.)									✓					✓		✓	✓	✓	✓	✓	✓	✓		✓
The use of herbicides and pesticides and other related horticultural chemicals should be carefully controlled and only applied by personnel adequately certified to apply pesticides and herbicides			✓	✓	✓	✓										✓	✓	✓	✓	✓	✓	✓		
Fertilizers should not be used excessively and slow release fertilizers and organic products should be used in preference to highly soluble and inorganic fertilizers			✓	✓	✓	✓										✓	✓	✓	✓	✓	✓	✓		

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The use of herbicides and pesticides will be applied in compliance with the Fertilizers, Farm Feeds, Agricultural Remedies and Stock Remedies Act (No. 46 of 1947)			✓	✓	✓	✓							✓			✓	✓	✓	✓	✓	✓	✓		
Fires will only be allowed in facilities specially designed and constructed for this purpose within the project site. No open fires or uncontrolled fires will be permitted as outlined in The National Veld and Forest Fire Act (No. 101 of 1998)			✓	✓			✓							✓		✓	✓	✓	✓	✓	✓	✓		✓
K: INTEGRATED WATER AND WASTE MANAGEMENT PLAN																								
No construction may take place within the 1:100 year floodline or on slopes greater than 1:3		✓	✓		✓	✓										✓	✓				✓		✓	✓
A demarcated area will be designated for the cement batching plants and mixing of concrete in order to minimise soil contamination. The batching area is to be bunded/ surrounded by diversion drains to contain any runoff			✓	✓	✓	✓							✓			✓	✓				✓	✓	✓	✓
All excess cement and concrete mixes are to be contained on the construction site prior to disposal at a licensed landfill off-site												✓				✓	✓				✓	✓	✓	✓

Mitigation and Management Measures	Environmental Aspect															Project Phase					Responsibility			
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Cementaceous wash water is to be captured and settled out in settling tanks before removal of the sludge and proper disposal as above. Cementaceous waste water is not to be released into the environment.					✓	✓						✓				✓	✓				✓		✓	
New access roads within the site are to be constructed according to design and contract specifications. The access routes will have suitable stormwater management plans and erosion control measures			✓		✓	✓			✓					✓	✓	✓	✓	✓			✓	✓		
Wind screening and stormwater control systems should be implemented to reduce/prevent erosion from the project site			✓	✓	✓	✓	✓			✓						✓	✓	✓			✓		✓	✓
All stormwater mitigation measures will be undertaken according to the Stormwater Management Plan compiled by Group Five					✓											✓	✓	✓			✓	✓	✓	
A bund wall is to be constructed at the south eastern boundary of the site to effectively manage the two main catchments. The bund wall will direct sheet flow from short high intensity storms to the stream to ensure that the existing infrastructure on-site will remain					✓		✓	✓						✓		✓	✓	✓			✓	✓	✓	✓

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unaffected																								
Each solar field will be constructed on a terrace that is elevated above the natural ground level. An earth bund will be constructed parallel to each loop to capture the drainage and discharge to a shallow main channel that runs along the main road in the solar field			✓		✓		✓	✓						✓		✓	✓	✓			✓	✓	✓	✓
Construction rubble will be removed from site. Under no circumstances is rubble waste to be disposed of on-site		✓	✓									✓				✓	✓	✓			✓	✓		
Soil and water contamination from diesel spills, particularly at the storage tanks, will be prevented by ensuring these areas are adequately constructed on barrier foundations with the statutory bund walls (see below)			✓	✓	✓	✓							✓			✓	✓	✓	✓		✓	✓		✓
All chemicals and other hazardous materials are to be stored in designated and bunded areas, where the bunded area is impermeable and is impervious to the stored substance. The bunded area will contain 110% volume of the largest container stored			✓	✓	✓	✓						✓	✓	✓		✓	✓	✓	✓		✓	✓	✓	✓

Mitigation and Management Measures	Environmental Aspect															Project Phase					Responsibility			
	Geology	Topography	Soil, Land Use and Land Capability	Biodiversity	Surface Water	Groundwater	Air Quality	Noise	Traffic	Visual	Cultural and Heritage	Waste Generation and Management	Incidents and Spillages	Health and Safety	Socio-Economic	Pre-Construction	Construction	Operation	Closure	Post-Closure/ Rehabilitation	Environmental Officer	Plant Manager	Contractor	Construction Officer
All bunds should be designed with valves which should be locked when not in use and will be protected from vandalism and unauthorised use			✓	✓	✓	✓							✓	✓		✓	✓	✓	✓		✓	✓	✓	✓
All bunded areas are to be adequately signposted identifying the material, volume and appropriate SANS code. Furthermore, safety signs indicating "No Smoking" and "Danger" are to be placed in and around flammable storage areas													✓	✓		✓	✓	✓	✓		✓	✓	✓	✓
Monthly inspections of the integrity of all designated and bunded areas will be undertaken														✓		✓	✓	✓	✓		✓			
MSDS should be displayed for all chemicals and hazardous materials stored on site and will take cognisance of the storage, handling, transportation and disposal of chemicals and hazardous materials													✓	✓		✓	✓	✓	✓		✓	✓		
Any water that collects in bunds will not be allowed to stand. Should the water be contaminated, it is to be removed and treated prior to discharge, or disposed of as hazardous waste. Clean stormwater contain within the bunds may be reused in the KSP process			✓		✓								✓			✓	✓	✓	✓		✓	✓	✓	✓

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Used fuels, oils, paints, solvents, grease and heat transfer fluid should be stored in drums or other suitable containers in a bunded area. These should be labelled, sealed and disposed of at an appropriate disposal or recycling facility. Under no circumstances are the substances to be disposed of on-site or into the surrounding environment			✓	✓	✓	✓						✓	✓	✓		✓	✓	✓	✓		✓	✓	✓	✓
All waste fuel, oily and chemically impregnated rags will be stored in leak-proof containers including a lid and will be disposed of at an appropriate disposal facility												✓	✓			✓	✓	✓	✓		✓	✓	✓	✓
In the event of a major spillage or leak, the administrating authority will be contacted immediately and a licensed HazMet team be contacted to manage the spillage												✓	✓	✓		✓	✓	✓	✓		✓	✓	✓	✓
Demarcated areas for food preparation should be designated and provided with adequate washing, seating and general refuse receptacles which should be removed from the site weekly												✓		✓	✓	✓	✓	✓	✓		✓	✓	✓	

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All solid waste collection and sanitation will be managed effectively to avoid any potential surface and groundwater contamination					✓	✓						✓				✓	✓	✓	✓		✓	✓		
The use of water to clean spillages and leakages will be avoided where possible					✓	✓						✓	✓			✓	✓	✓	✓		✓	✓		
Spill response procedures are to include removal and disposal of potentially contaminated/contaminated water and any used absorbent materials					✓	✓						✓	✓			✓	✓	✓	✓		✓	✓		
An adequate number of waste receptacles will be available throughout the project site. The waste receptacles will be clearly marked and colour coded for the different waste streams being generated on-site. Furthermore, the receptacles should include a lid												✓				✓	✓	✓	✓		✓	✓		
Green waste receptacles will be made available for general domestic waste												✓				✓	✓	✓	✓		✓	✓		
Black receptacles will be made available for recyclable waste												✓				✓	✓	✓	✓		✓	✓		
Blue receptacles will be made available for industrial waste												✓				✓	✓	✓	✓		✓	✓		
Red receptacles will be made available for hazardous waste												✓				✓	✓	✓	✓		✓	✓		

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A central salvage yard should be established where waste streams will be taken to prior to removal off-site												✓				✓	✓	✓	✓		✓	✓		
The central waste salvage area should be hardstanding, demarcated and contain bunds to ensure no contaminated run-off impacts on the surrounding soil, surface and groundwater			✓		✓	✓						✓				✓	✓	✓	✓		✓	✓		
Sufficient skips should be available; green for domestic waste, black for recyclable waste, blue for industrial waste streams and red for hazardous waste. All skips are to be clearly marked and colour coded. Furthermore, all skips should include a lid												✓				✓	✓	✓	✓		✓	✓		
Should a spillage or leakage from a hazardous waste receptacle or skip occur, the area is to be cleaned immediately, to the approval of the EO												✓	✓			✓	✓	✓	✓		✓	✓	✓	✓
All waste is to be removed from site on a weekly basis. Record of waste removed will be retained on-site												✓		✓		✓	✓	✓	✓		✓	✓		
A housekeeping team should be appointed to regularly maintain the waste generated on the site												✓		✓	✓	✓	✓	✓	✓		✓	✓		

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Under no circumstances are different waste steams to be mixed												✓				✓	✓	✓	✓		✓	✓	✓	✓
Contractors, sub-contractors and labourers will be trained in waste management procedures												✓		✓	✓	✓	✓	✓	✓		✓	✓	✓	✓
All waste management and waste disposal activities are to be undertaken in accordance with the National Environmental Management: Waste Act (No. 59 of 2008)												✓				✓	✓	✓	✓		✓	✓	✓	✓
Littering by contractors, sub-contractors and employees is not permitted. The EO will monitor and inspect the project site, and where appropriate, manage the housekeeping team												✓				✓	✓	✓	✓		✓			
Groundwater abstraction is a critical issue in area, and water should be sourced from an alternative supply such as the Vaal-Gamagara Pipeline				✓	✓	✓										✓	✓	✓	✓	✓	✓	✓		✓
No vehicles, machinery and equipment may be maintained, serviced or washed on the construction site			✓	✓	✓	✓						✓	✓			✓	✓	✓	✓	✓	✓	✓	✓	✓

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Should vehicle, machinery or equipment spillages or leakages be observed on-site, drip trays are to be placed to ensure no soil contamination occurs. Should a spill or leak occur, the resultant spillage will be cleaned immediately			✓	✓	✓	✓						✓	✓			✓	✓	✓	✓	✓	✓	✓	✓	✓
Adequate spill kits should be placed in strategic locations throughout the project site			✓	✓	✓	✓						✓	✓	✓		✓	✓	✓	✓	✓	✓	✓		
Under no circumstances is contaminated land to be treated or remediated on-site without the required environmental authorisation (waste license)			✓		✓	✓						✓	✓	✓		✓	✓	✓	✓	✓	✓	✓		
The project site will be kept in an orderly state at all times. Littering is prohibited				✓						✓		✓			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Runoff from the construction site will not discharge into neighbours' properties or into any watercourse			✓		✓	✓									✓	✓	✓	✓	✓	✓	✓		✓	✓
The facilities will be serviced weekly and waste removed off-site to reduce the risk of surface and groundwater contamination			✓	✓	✓	✓								✓		✓	✓	✓	✓	✓	✓	✓		
Under no circumstances is the ablution waste to be disposed of on-site			✓	✓	✓	✓	✓					✓	✓	✓		✓	✓	✓	✓	✓	✓	✓		

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Should an ablution facility leak or spill, the resultant contaminated soil should be immediately cleaned up and disposed of as hazardous waste			✓	✓	✓	✓	✓					✓	✓	✓		✓	✓	✓	✓	✓	✓	✓		
Ablution facilities shall be within 100 m from places of work, but further than 100 m from any watercourse or borehole			✓	✓	✓	✓	✓				✓		✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	
No unauthorised groundwater abstraction may occur on site						✓										✓	✓	✓	✓	✓	✓	✓	✓	
Regular inspection of diesel storage facilities will be undertaken and a clean-up operation will be implemented in the event of an accidental spill			✓	✓	✓	✓											✓	✓			✓			
Soils that may be contaminated by leakages and spillages associated with construction and operational activities are to be removed as soon as possible to prevent further contamination of the soils or underlying groundwater. Contaminated soil will be treated as hazardous waste and disposed of at an appropriate disposal facility off-site			✓			✓						✓	✓				✓	✓			✓	✓	✓	✓
The new pipeline point that will connect to the existing Vaal-Gamagara Pipeline will be designed in such a way to ensure no loss of water			✓		✓								✓	✓			✓	✓					✓	

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The new pipeline should be placed as close to existing infrastructure as possible			✓	✓													✓	✓					✓	✓
Water pipelines on the site will be inspected for defects, cracks and leakages					✓								✓				✓	✓			✓		✓	✓
Should any water be discharged from the site, the water is to comply with national effluent standards. No contaminated water may be discharged from site				✓	✓							✓					✓	✓	✓		✓	✓		
Potentially contaminated water originating from site will be directed through an oil and water separator. Oil is to be removed from site by a licensed contractor					✓							✓	✓				✓	✓	✓		✓	✓		
A suitable recycling contractor (e.g. ROSE Foundation) will be employed to remove and recycle waste oil from the site												✓					✓	✓	✓		✓	✓	✓	✓
Should topsoil become contaminated, the soil will be removed to the full depth of the contamination and replaced with suitable topsoil which should at least be equal to Department of Agriculture approved topsoil specifications			✓									✓	✓				✓	✓	✓	✓	✓	✓	✓	✓

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Should any negative effects on the underlying groundwater be identified, the surrounding neighbours as well as the relevant authorities (DWA, DEA, NCDEANC, Gamagara Municipality) will be notified						✓							✓	✓	✓		✓	✓	✓	✓	✓	✓		
The boreholes on-site will be monitored for quality and quantity on a monthly basis and results supplied to DWA and the Gamagara Municipality. These results will be communicated to relevant stakeholders on a biannually basis						✓									✓		✓	✓	✓	✓	✓	✓		
Once construction has been completed, all excess material, infrastructure and containers are to be removed and the area rehabilitated. Should underlying soil be contaminated, the soil is to be removed and disposed of as hazardous waste off-site. Revegetation will be done in order to minimise dust generation			✓									✓						✓			✓	✓	✓	✓
L: BIODIVERSITY ACTION PLAN																								
Before construction/ site clearance begins, the entire site is to be searched for rare species, which, if found, will be removed to nearly undisturbed areas. Prior to construction, warning sirens/				✓												✓					✓	✓		✓

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noises can be made to scare away mobile animals such as birds (neighbours will be given written warning of siren use and the timing thereof will take account of social sensitivities).																								
Prior to the clearing of the protected floral species the relevant permits will be obtained from the relevant authorities				✓												✓					✓	✓		✓
Where bird nests with eggs are found, the area will be marked off with tape, and activity within that area prohibited until a biologist has issued an instruction for how to handle the matter.				✓												✓					✓	✓		✓
No Go areas are to be designated with tape and warning signs prohibiting access erected. Plant and vehicle operators will be instructed on where these No Go sites are, and what the penalties for transgression are.				✓												✓					✓	✓		✓
As far as is practically possible initial construction activities will be avoided during spring / summer as animals reproduce and disperse during this period				✓												✓	✓				✓	✓		✓

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Clearing of the protected trees will be kept to a minimum. A biodiversity offset will be considered by the project proponent in order to offset the residual impacts to the biodiversity				✓												✓	✓				✓	✓		
Employees will be educated to minimise accidental killings of animals during the pre-construction phase				✓												✓	✓				✓	✓		
The removal of trees that have breeding raptors present will be avoided until the conclusion of the breeding season at the end of November				✓												✓	✓				✓	✓		✓
The amount of soils removed from site will be kept to a minimum. Topsoil to a depth of 30 mm will be removed where possible and stockpiled in a designated area, not more than 2 m high and in a position where the stockpiles will not be compacted by moving vehicles and plant.		✓	✓	✓						✓						✓	✓				✓	✓	✓	✓
Culverts will be constructed, where necessary, to allow for water flow along drainage lines and suitable erosion barriers		✓	✓	✓	✓	✓				✓						✓	✓				✓	✓		✓

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All biodiversity not interfering with the pipeline and power line route as well as the footprint of the solar field will be left undisturbed				✓												✓	✓				✓	✓		
A buffer zone of at least 300 m from the edge of the area delineated as Kathu forest within the study site will be provided				✓												✓	✓	✓			✓	✓		✓
Protect trees to be left in situ within the planned site office area will be clearly marked (to prevent accidental uprooting, pruning etc.) and a small buffer zone 3-4 m surrounding these trees will be created				✓												✓	✓	✓			✓	✓		
A vegetation buffer will be retained around site to allow existing vegetation to offer some visual screening				✓				✓	✓	✓						✓	✓	✓			✓	✓		
Indigenous / endemic Camelthorn trees (*Acacia erioloba*) will be planted around the site (20 m) to reduce any visual impact on agricultural and agri-tourism landscapes				✓				✓	✓	✓						✓	✓	✓			✓			
The movement of any animals intending to flee the impacted area will not be obstructed. Abuse and hunting / chasing of animals by workers will not be allowed.		✓	✓	✓	✓	✓				✓						✓	✓	✓			✓	✓	✓	✓

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If necessary, the presence of flocking bird species and certain mammals like Savanna baboons and Small-spotted genets will be discouraged, by using standard anti-animal sound devices such as gas cannons etc.				✓												✓	✓	✓			✓	✓		
Clearing of the natural vegetation will be kept to a minimum by marking the limits of clearing with hazard tape. Where possible, corridors of natural vegetation will be retained within the development area	✓	✓	✓	✓						✓	✓					✓	✓	✓			✓	✓	✓	✓
A buffer zone of 30 m will be maintained between erected structures and any natural drainage line/ sensitive area		✓	✓	✓	✓	✓				✓						✓	✓	✓			✓	✓		✓
Stockpiles should be kept clear of weeds and alien vegetation			✓	✓												✓	✓	✓			✓	✓		
Protected or endangered species may occur along the proposed water pipeline and power line route. Special care should be taken not to damage or remove any such species unless absolutely necessary			✓	✓												✓	✓	✓			✓			
Open water pans on-site will be off limits from all on-site staff, including contractors and sub-contractors. No bathing, washing of clothes or				✓	✓									✓	✓	✓	✓	✓			✓	✓		✓

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abstraction of this water will be permitted																								
Collection of traditional medicinal plants will not be permitted. No area will be cleared of vegetation for camping purposes			✓	✓												✓	✓	✓			✓			
Slow-moving animals like Tortoises and Giant Bullfrogs, found during ground-breaking will be relocated to nearby suitable, undisturbed areas				✓												✓	✓	✓	✓		✓			
Vulnerable species such as the Ground pangolin or African rock python will be relocated to suitable, off-site protected areas in the region such as Tswalu Nature Reserve (permit and permission is required by Northern Cape Department of Environment and Nature Conservation).				✓												✓	✓	✓	✓		✓			
Nesting by birds on the solar power infrastructure will be discouraged, either by removing nests as they are built, or by supplying suitable alternative structures				✓												✓	✓	✓	✓		✓	✓		✓
The intentional killing of animals will be prohibited through on-site supervision and worksite rules				✓												✓	✓	✓	✓		✓	✓		

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Dangerous interactions between personnel and venomous fauna will be reduced through awareness courses, posters, and other forms of education				✓												✓	✓	✓	✓		✓			
The importation of unsterilised and unvaccinated domestic animals, in particular cats, on to site will be banned				✓												✓	✓	✓	✓		✓	✓		
A veld fire action policy will be established to prevent unnecessary loss of fauna and habitat in the event of a veld fire			✓	✓			✓									✓	✓	✓	✓		✓	✓		
In the event that animals are present that may pose a risk to the safety of people on-site, a suitable animal handler will be requested to remove the animal in an environmentally responsible manner. This specifically refers to snakes, scorpions and spiders				✓										✓		✓	✓	✓	✓		✓	✓		
Should a complaint be received relating to wildlife interaction, the EO will respond to the complaint within 24 hours. All complaints will be reported in a complaints register				✓									✓	✓		✓	✓	✓	✓		✓			

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Where necessary and feasible, landscaped culverts, to a depth of 300 mm, will be constructed to allow free movement for small mammals, reptiles and amphibians under roads or other barriers. These will be maintained throughout the operational phase				✓												✓	✓	✓	✓	✓	✓	✓		✓
Raptor-proofing of all open reservoirs, dams or ponds to allow birds to drink and bathe will be undertaken. This can be done by: - keeping the reservoir full; - covering the reservoir with shade cloth; and - placing a wooden plank, log, ladder or branch into the reservoir attached firmly to one side				✓												✓	✓	✓	✓	✓	✓	✓		✓
Photographs of the project site before, during construction, operation, rehabilitation and after closure should be taken and maintained on record															✓	✓	✓	✓	✓	✓	✓			
The integrity of the natural habitat around the solar park will be maintained, thereby providing the possibility for animals to flee the affected area and re-settle in the undisturbed areas around the site				✓												✓	✓	✓	✓	✓	✓	✓		✓

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Weeds, alien plants and invasive vegetation will be removed should ingress into the site occur. Category 1 (declared weeds) and Category 2 (declared invader plants with a value) according to the Conservation of Agricultural Resources Act (No. 43 of 1983) will be removed whenever possible			✓	✓												✓	✓	✓	✓	✓	✓	✓		
No marking or disfiguring of natural rocks, trees and vegetation is permitted. Marking may be done by stakes and tags			✓	✓						✓	✓					✓	✓	✓	✓	✓	✓	✓		✓
Newly constructed electrical features will have anti-collision devices in place and diverters currently in use by Eskom.				✓													✓	✓	✓	✓	✓	✓		✓
The area and associated ecosystems will be monitored (for signs of stress: measurements such as foliage cover, die-offs and shoot recruitment) on an ongoing basis for significant negative changes				✓													✓	✓	✓	✓	✓			
If an electrical boundary fence is constructed, this will be inspected regularly for accidental mortalities such as Tortoises				✓													✓	✓	✓	✓	✓			
Rubble, compost heaps, domestic chickens etc. are all tremendous				✓										✓			✓	✓	✓		✓	✓		

Mitigation and Management Measures	Environmental Aspect															Project Phase					Responsibility			
	Geology	Topography	Soil, Land Use and Land Capability	Biodiversity	Surface Water	Groundwater	Air Quality	Noise	Traffic	Visual	Cultural and Heritage	Waste Generation and Management	Incidents and Spillages	Health and Safety	Socio-Economic	Pre-Construction	Construction	Operation	Closure	Post-Closure/ Rehabilitation	Environmental Officer	Plant Manager	Contractor	Construction Officer
attractants to snakes and will be avoided																								
Control and eradication strategies associated with management of alien species, and a framework that can be used during the rehabilitation of biodiversity assets on the site will be drafted				✓													✓	✓	✓	✓	✓			
A comprehensive monitoring programme of the protected trees within the area will be undertaken				✓													✓	✓	✓	✓	✓			
Revegetation of disturbed areas should occur as soon as possible after construction has been completed			✓	✓			✓			✓							✓	✓	✓	✓	✓			
Only indigenous vegetation should be planted in the project site				✓						✓							✓	✓	✓	✓	✓			
All compacted areas should be ripped to a minimum depth of 300 mm to allow organic breakdown and promote vegetation establishment			✓	✓													✓	✓	✓	✓	✓	✓		
All high risk areas are to be assessed for underlying contamination prior to removal and rehabilitation			✓									✓	✓				✓	✓	✓	✓	✓	✓		
Topsoil should be used for rehabilitation purposes in order to facilitate regrowth of species that occur naturally in the			✓	✓													✓	✓	✓	✓	✓	✓		

Mitigation and Management Measures	Environmental Aspect															Project Phase					Responsibility			
	Geology	Topography	Soil, Land Use and Land Capability	Biodiversity	Surface Water	Groundwater	Air Quality	Noise	Traffic	Visual	Cultural and Heritage	Waste Generation and Management	Incidents and Spillages	Health and Safety	Socio-Economic	Pre-Construction	Construction	Operation	Closure	Post-Closure/ Rehabilitation	Environmental Officer	Plant Manager	Contractor	Construction Officer
area																								
Rehabilitated areas will be inspected on a monthly basis and maintained, if necessary			✓	✓													✓	✓	✓	✓	✓	✓		
All areas where temporary services and infrastructure have been installed/undertaken are to be rehabilitated to the satisfaction of Group Five, the EO and the Site Manager		✓	✓	✓							✓		✓				✓	✓	✓	✓	✓	✓		✓
A rehabilitation plan will be drafted that will provide best management guidelines for the restoration and rehabilitation of the remnant portions of biodiversity				✓													✓			✓	✓	✓		
Raptor-proof reservoir modifications will be maintained on a regular basis			✓	✓						✓								✓			✓	✓		
Weekly inspection of power lines for bird carcasses resulting from collisions and electrocutions will be undertaken. These incidents will be reported to Group Five so that the implementation and maintenance of devices can be carried out				✓														✓	✓	✓	✓			

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Appendix A Letter of Acknowledgement from the DEA

Appendix B WSP Environment and Energy Capability Statement

Appendix C Summary of National Legislation

Appendix D Eskom Cost Estimate Letter

Appendix E Draft Stormwater Management Plan

Appendix F Socio-economic Impact Report

Appendix G Cultural and Heritage Impact Report

Appendix H Noise Impact Report

Appendix I Traffic Impact Report

Appendix J Visual Impact Report

Appendix K Health and Safety Study/Plan

Appendix L Air Quality Impact Report

Appendix M Soil, Land Use and Land Capability Study

Appendix N Water Feasibility Study

Appendix O Biodiversity Impact Reports

Attachment 1: Zoology

Attachment 2: Botany

Attachment 3: Entomology

Appendix P Stakeholder Engagement Process: Scoping Phase

Attachment 1: Site Notice

Attachment 2: Background Information Document

Attachment 3: Advertisement

Attachment 4: Public Meeting Minutes

Attachment 5: Issues Trail (Scoping Phase)

Attachment 6: Stakeholder Database

Appendix Q Stakeholder Engagement Process: ESIA Phase

Attachment 1: Advertisement

Attachment 2: Background Information Document including Feedback Information

Attachment 3: Public Meeting Minutes

Attachment 4: Authorities Consultation Minutes

Attachment 5: Issues Trail (ESIA Phase)